PGA RESEARCH ARCHIVE

VARIETY DEVELOPMENT & EVALUATION

POTATO GROWERS OF ALBERTA

Est. 1966

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Alberta
AGRICULTURE, FOOD AND
RURAL DEVELOPMENT

Crop Diversification Centre
South

S.S. #4
Brooks, Alberta
Canada T1R 1E6

Telephone 403/362-1300
Fax 403/362-1306

July 21, 2003

Potato Growers of Alberta
6008 – 46th Avenue
Taber, AB T1G 2B1

Attention: Vern Warkentin, Executive Director

Re: MOU for "Effect of MH60 for size control in a Chipping Variety" project

Dear Vern;

Thank you for your e-mail advising me that the PGA is willing to fund our project entitled "Effect of MH60 for Size Control in a Chipping Variety" in 2003. As a formality, we like to set up a Memorandum of Understanding (MOU) with each cooperator for externally funded projects. Please review the enclosed MOU. If the terms of the MOU are acceptable, please sign both copies and return an original to me. If you would prefer to propose alternate terms, please contact me at 403-362-1314 and we can discuss the terms further. An invoice will be issued under separate cover. Thank you.

Sincerely,

Michele Konschuh, Ph.D.
Potato Research Agronomist

RECEIVED JUL 2 3 2003

Project
New: **X** Renewal:

MEMORANDUM OF UNDERSTANDING

Between: Potato Growers of Alberta
(hereafter referred to as "PGA")

and

Alberta Agriculture, Food & Rural Development
(hereafter referred to as "AAFRD")

Project Title: Effect of MH60 for Size Control in a Chipping Variety

Objectives:
1. To determine the effect of MH60 applications on Norvalley potatoes in southern Alberta; and
2. To establish the correct stage of tuber development for MH60 application to attain an optimal size profile.

STATEMENT OF WORK

Alberta Agriculture, Food & Rural Development is willing to undertake this study for the PGA, who hereby agrees to contribute toward the costs of researching the information required as described in the research proposal.

PERIOD OF WORK

The research project will commence in July, 2003. A progress report will be provided to the PGA by December 31, 2003, and a full report will be sent when all of the storage data has been analyzed.

BASIS OF PAYMENT

The sponsor of the project, the PGA, will provide $5,375 upon finalization of this memorandum to AAFRD, to cover the following estimated yearly costs:

Casual Manpower (on an as need basis):	$4,685
Materials and Supplies	$100
GST and Overhead	$590

The Budget can be adjusted and used at the discretion of the project manager.

Payment of research project expenditures will be made from funds made available to AAFRD up to the maximum amount of funds received from the sponsor.

If requested, AAFRD will provide a record of revenue and expenditure upon project completion or depletion of funds. Any remaining funds after completion or termination of the project can be used for research at the discretion of the project manager.

RESPONSIBILITY OF PROJECT MANAGER

The project manager for this study is Dr. Michele Konschuh. She will provide all reports to AAFRD and the sponsor.

The project manager will authorize expenses and submit them to the appropriate AAFRD department for processing payment.

The project manager is not eligible for any manpower funds herself.

AMENDMENTS OR TERMINATION

This Memorandum of Understanding may be amended by mutual consent of the parties as evidenced by an exchange of letters.

Either AAFRD or the PGA may terminate this Memorandum of Understanding by providing two weeks notice in writing to the other party.

NOTICES AND REPRESENTATIVES

Notices for all purposes of or incidental to this Memorandum of Understanding shall be effectively given if delivered personally, or sent by registered or certified mail to the representatives of the parties designated as follows:

Potato Growers of Alberta

Mr. Vern Warkentin
Executive Director
Potato Growers of Alberta
6008 – 46th Avenue
Taber, AB T1G 2B1

Alberta Agriculture, Food & Rural Development:

Dr. Christine Murray
Branch Head, CDCS
Crop Diversification Centre South
S.S. #4
Brooks, AB T1R 1E6

Information generated from the project may be used by the Department of Agriculture, Food & Rural Development and the PGA.

The sponsor, the PGA, relinquishes ownership of any materials, supplies and assets purchased with project funds to the AAFRD which assigns control to the project manager's departmental division.

The parties affirm their acceptance of the terms of this Memorandum of Understanding by signing below.

Copies bearing original signatures of this Memorandum will be kept by each party.

Dr. Michele Konschuh, Project Manager

Date July 21, 2003

I agree that the project manager named above may supervise this project.

Christine Murray

Dr. Christine Murray, Branch Head, CDCS

Date July 21/03

Mr. Vern Warkentin, Executive Director
Potato Growers of Alberta

Date July 23/03

Alberta
AGRICULTURE, FOOD AND
RURAL DEVELOPMENT

Crop Diversification Centre
South

S.S. #4
Brooks, Alberta
Canada T1R 1E6

Telephone 403/362-1300
Fax 403/362-1306

June 18, 2003

Potato Growers of Alberta
6008 – 46th Avenue
Taber, AB T1G 2B1

Attention: Board of Directors

Re: Application for Funding
"Effect of MH60 for Size Control in a Chipping Variety"

Dear Board Members:

I attended a meeting June 12 hosted by Tony Mrak (UAP) where Keith Lockhart of Crompton Corp. (formerly Uniroyal) spoke about the usefulness of MH60 for size control in potatoes. Crompton has already commissioned a trial with Alberta Agriculture to study the effect of MH60 on Russet Burbank size profiles. At the meeting, it became apparent that growers with chipping varieties are also very interested in this product. Lawrie Wilson of Frito Lay has agreed to perform quality assessments if we conduct a trial on a chipping variety through the PGA. Norvalley was suggested as it is grown by Frito Lay and Old Dutch growers. Crompton has agreed to provide product for the study.

Enclosed are 10 copies of the funding application for our project entitled "Effect of MH60 for Size Control in a Chipping Variety". The trial will be conducted in a commercial field of Norvalley potatoes in the Taber or Vauxhall area. We are requesting a contribution of $5,375 from the PGA for 2003. A second year of data would also be required. Please contact me if you have any questions (403-362-1314).

Thank you for your consideration. I look forward to hearing from you.

Sincerely,

Michele Konschuh, Ph.D.
Potato Research Agronomist

approved!
July 15/03

Project Proposal

Effect of MH60 for Size Control in a Chipping Variety

Prepared for:

Board of Directors
Potato Growers of Alberta
6008 – 46th Avenue
Taber, AB T1G 2B1

Prepared by:

Michele Konschuh and Simone Dalpé
Alberta Agriculture, Food and Rural Development
Crop Diversification Centre South
SS #4
Brooks, AB T1R 1E6

June 16, 2003

I. BACKGROUND

A significant quantity of chipping potatoes are grown in southern Alberta, but little research has been conducted locally on these varieties. Tubers of many of these varieties can reach undesirable sizes before the crop reaches physiological maturity. The potato chip industry favors uniform tuber size and growers are docked for oversize tubers.

The use of maleic hydrazide as a foliar applied sprout inhibitor has been well documented. Weis et al. (1980) studied maleic hydrazide applied to Russet Burbank potatoes in Wisconsin and reported that maleic hydrazide was an effective sprout inhibitor on tubers from treatment dates in July and August. Weis et al. (1980) also reported an increase in yield of U.S. #1 tubers and a reduction in malformed tubers. Yada et al. (1991) applied MH60SG on Kennebec and Norchip potatoes in Ontario and reported that foliar applied MH had no apparent effect on yield, was effective in suppressing sprout growth, and had no effect on sugar content of potatoes newly harvested or after 6 months of storage. They also reported that no consistent difference was found between the color of chips made from potatoes from untreated and MH-treated plants. Crompton Corporation is advocating the use of maleic hydrazide (MH60) for controlling tuber size. This product is expected to allow smaller tubers to bulk up while preventing larger tubers from becoming too large.

The purpose of the proposed research is to compare MH60 applications at several stages of tuber development to determine if the product can effectively alter the size profile of a chipping variety of potatoes grown in southern Alberta. Total yield, grade, specific gravity, % defects and chip color will be assessed with the help of a commercial processor. Tubers will be stored after harvest and periodically assessed for sprout control as well.

References:

Schaupmeyer, C. A. 1992. Potato Production Guide for Commercial Producers. Alberta Agriculture Agdex 258/20-8. pp. 20-21.

Weis, G. G., J. A. Schoenemann and M. D. Groskopp. 1980. Influence of time of application of maleic hydrazide on the yield and quality of Russet Burbank potatoes.Am. Potato J. 57: 197-204.

Yada, R. Y., R. H. Coffin, M. K. Keenan, M. Fitts, C. Dufault and G. C. C. Tai. 1991. The effect of maleic hydrazide (potassium salt) on potato yield, sugar content and chip color of Kennebec and Norchip cultivars. Am. Potato J. 68: 705-709.

II. PROJECT OBJECTIVES

- **To determine the effect of MH60 applications on Norvalley potatoes in southern Alberta.** Total yield, yield profile, specific gravity, %hollow heart, and internal defects will be assessed.

- **To establish the correct stage of tuber development for MH60 application to attain an optimal size profile.** MH60 will be applied at three developmental stages and compared with no MH60 application. Size profiles will be compared for each treatment.

III. WORK PLAN

A crop of Norvalley potatoes will be planted and managed commercially in southern Alberta. Approximately 1 acre will be used for each treatment (6 rows x length of the field). Treatments will be applied when tubers have sized to 1 to 1.5" (treatment #2), 2" (treatment #3) and two weeks before regular top-killing (treatment #4). We will harvest five samples from each treatment area, each measuring 50' x 2 rows. Total yield will be estimated based on these digs. Samples of tubers will be provided to Frito-Lay in Taber for lab analysis and grading. Tubers will also be graded at Brooks and stored for 8 months. Shrinkage and sprout control will be assessed.

Treatments will be applied as follows:

1. Check; no MH60
2. MH60 applied when tubers are 1 to 1.5" in diameter
3. MH60 applied when tubers are 2" in diameter
4. MH60 applied two weeks before desiccating

The trial should be conducted for two to three consecutive years to allow for differences in environmental conditions between years.

IV. TIME-FRAME AND REPORTING

July:	MH60 application to Treatment #2
August:	MH60 application to Treatment #3 MH60 application to Treatment #4
September:	Harvest Grading
October to May:	Storage assessments
June:	Data analysis Report writing

Interim progress will be reported verbally or by e-mail as requested. Michele Konschuh, Ph. D. (Potato Research Agronomist) will act as Project Leader.

V. BUDGET

Description	*Unit Cost*	*Total Cost*
Field familiarization & staking treatment areas (2 people x 1 day)	125	250
Monitoring stage of tuber development (3 visits x 0.5 day x 1 person)	125	185
Materials & supplies (stakes, bags, tags)		100
Treatment #2 (1 to 1.5" tubers):		
Tuber samples, applying MH60 (2 people x 0.5 day)	125	125
Treatment #3 (2" tubers):		
Tuber samples, applying MH60 (2 people x 0.5 day)	125	125
Treatment #4 (14 days before desiccating):		
Tuber samples, applying MH60 (2 people x 0.5 day)	125	125
Travel (9 field visits, 150 km round trip @0.35, lunches)		1,500
Harvest (4 people x 2 days)	125	1,000
Grading (4 people x 2 days)	125	1,000
Sprout checks (4 assessments x 1 person x 0.5 day)	125	250
Shrinkage (1 person x 1 day)	125	125
Data analysis and report writing (incl.)		
Overhead and GST (5% OH + 7% GST)		590
Total		$5,375

Note: The budget does not include compensation for time committed to the project by crop scouts, processors, cooperators, or professional AAFRD staff.

An invoice will be mailed out for the total cost of the project once a memorandum of understanding has been signed by both parties.

Contact Information:

Michele Konschuh
Potato Research Agronomist
AAFRD, Crop Diversification Centre South
S.S. #4
Brooks, AB T1R 1E6
Ph. 403-362-1314; Fax 403-362-1306

Lawrie Wilson

Frito Lay Canada
5904 – 52 Avenue
Taber, AB T1G 1X3
Ph. 403-223-3574 ; Fax 403-223-9401

Effect of Royal MH60 for Size Control in Chipping Potatoes – 2nd Year

Michele Konschuh and Simone Dalpé
Alberta Agriculture, Food and Rural Development, Crop Diversification Centre South, S.S. #4, Brooks, AB T1R 1E6

Alberta Agriculture Food and Rural Development
Crop Diversification Division

POTATO GROWERS OF ALBERTA

Background

Royal MH60 is a plant growth regulator. When applied to healthy growing plants, the active ingredient, maleic hydrazide, is absorbed by the plant and will affect plant growth by stopping cell division, but not cell expansion. Through such action, Royal MH controls sprout development in potatoes. In addition to sprout control, Royal MH can help reduce storage losses and improve potato quality through a number of additional effects on the potato. Royal MH may improve grade, reduce the number of late season set potatoes, reduce volunteers and reduce shrinkage. Both the extent and number of these benefits obtained will depend on several factors such as variety and local growing conditions.

Anecdotal information from North Dakota indicates that MH60 may allow potatoes to reach physiological maturity (higher specific gravity) without producing an excess of oversize tubers.


August 5, 2004

Project Plan and Treatments

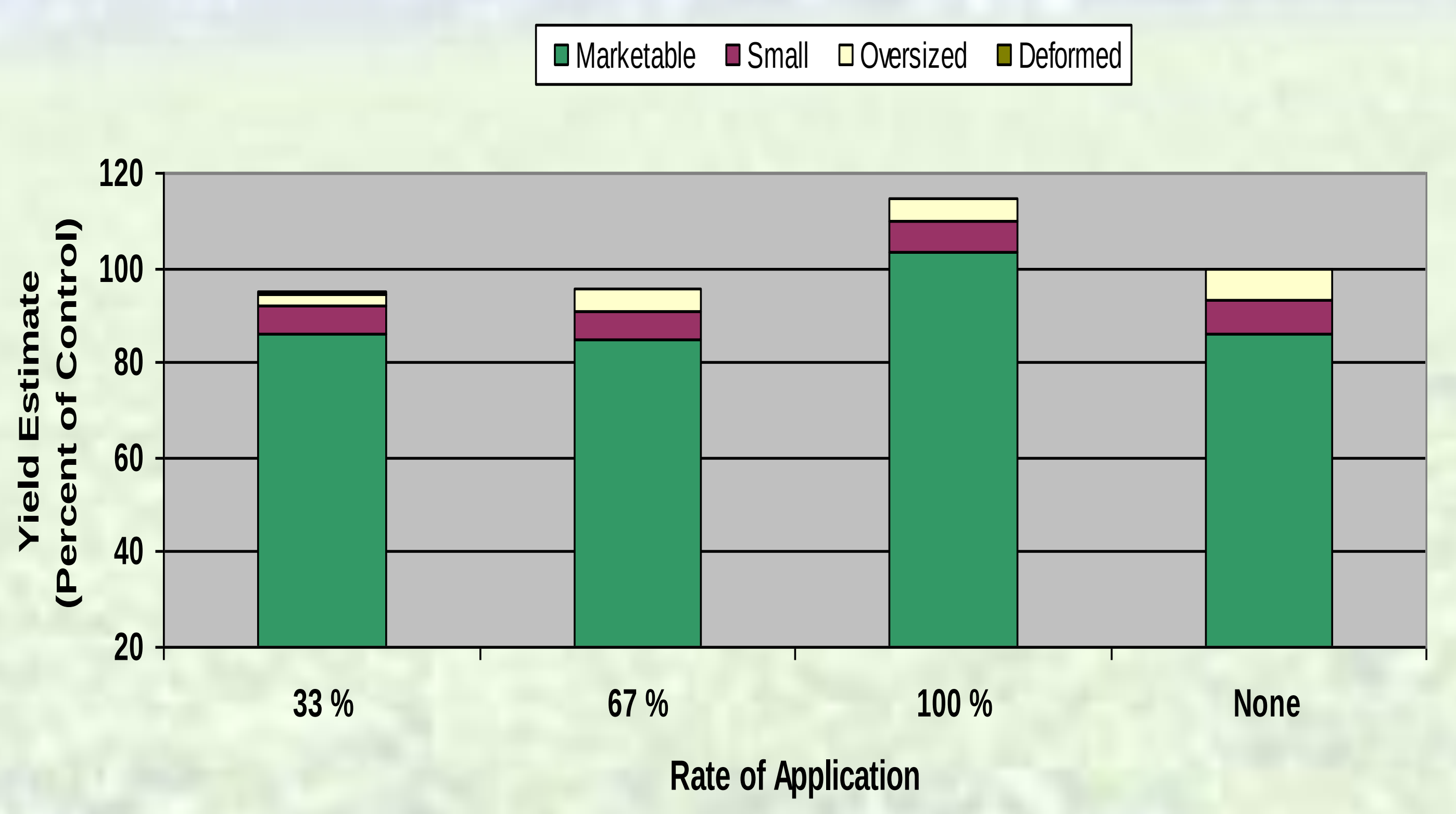
The study was conducted in a commercial field of chipping potatoes (Frito Lay variety9) in the Rolling Hills area. Royal MH60SG® (maleic hydrazide) was applied to 6 row strips at different rates two weeks before desiccation. The smallest tubers that were expected to size up measured 1.5 to 2" in diameter. Tuber yield, grade and quality were assessed for each treatment. Commercial grade and quality assessments will be conducted by FritoLay. Storage samples will be assessed for shrinkage and sprout control after 4 and 8 months.

- •Control – no Royal MH60SG®
- •33 % – Royal MH60SG® (1.88 kg/ha) applied two weeks before desiccation; August 5, 2004
- •67 % – Royal MH60SG® (3.78 kg/ha) applied two weeks before desiccation; August 5, 2004
- •100 % – Royal MH60SG® (5.65 kg/ha) applied two weeks before desiccation; August 5, 2004

Purpose

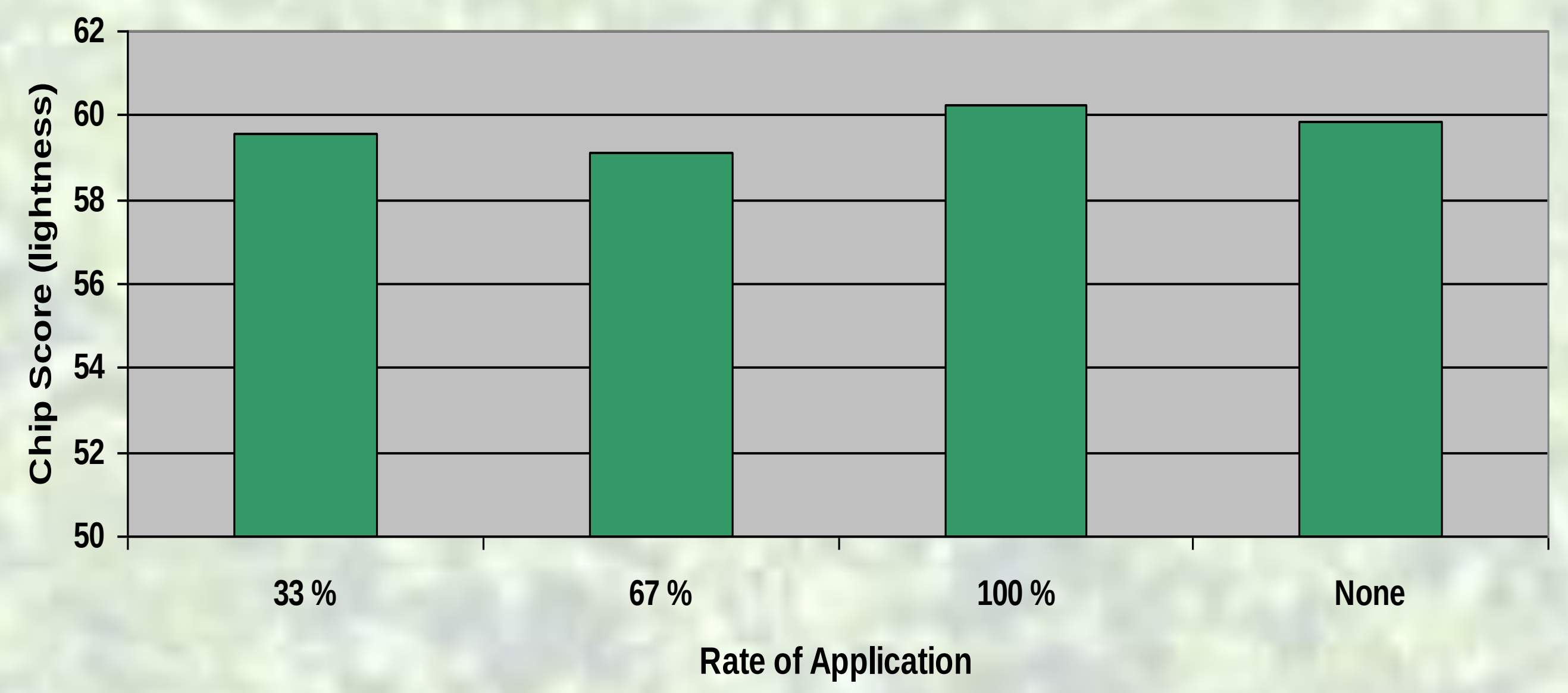
- To compare several rates of MH60 application to determine if the product can effectively alter the size profile and quality of Chipping potatoes grown in southern Alberta; and
- To determine whether lower than recommended rates of MH60 result in any beneficial effects.

Yield and Profile



- Application of the full rate of MH60 two weeks before top-kill increased gross yield and marketable yield.
- Marketable yield from the other application rates were similar to the control.

Chip Score



- The best chip score resulted from a full MH60 application, 2 weeks prior to top-kill (smallest tubers were 2" in diameter).

Acknowledgements

This project was supported through funding by the Potato Growers of Alberta and Alberta Agriculture, Food and Rural Development, and in-kind contributions by Kanegawa Farms Ltd., AMPDF, Frito Lay and Crompton Co.

Specific Gravity

Rate MH60 Applied	Specific Gravity
33%	1.0808
67%	1.0818
100%	1.0806
None	1.0816

- Specific gravity was not greatly affected by the MH60 application rate.


September 1, 2004

Observations

- Timing of Royal MH60 application on potatoes is critical for size control in tubers (2003 results). The best results obtained in 2003 indicated that MH60 should be applied when the smallest tubers likely to size up reach 2" in diameter or two weeks prior to desiccation. In 2004, the crop reached these stages at the same time, so rates of application were examined instead of timing.
- Cut rates of MH60 applied two weeks prior to desiccation did not affect total or marketable yield of FL1879 potatoes..
- Application of the registered rate (100 %) of MH60 two weeks prior to desiccation increased both total and marketable yield of tubers.
- Neither specific gravity nor chip scores were affected by application of MH60 two weeks before desiccation, regardless of rate of application.
- The effect of MH60 application on stored potato quality (sprouts and chip scores) will be determined this winter.

Note

This poster is based on preliminary data from the 2004 field season. The data has not yet been statistically analyzed. Commercial data was not available at the time of printing. Storage data (shrinkage and sprout inhibition) will be collected through the winter months. A full report will be available through the PGA by spring. Data from at least two years will be evaluated before any general recommendations will be made.

Background

One of the key areas of research that the Alberta potato industry identified in industry-wide priority setting meetings in 2003 and 2004 is breeding for new potato varieties. This was reiterated in National industry consultation meetings held in 2011. For about 40 years now, Agriculture and Agri-Food Canada managed a potato breeding program in Western Canada focused on breeding and selecting varieties that would perform well under our environmental conditions. Alberta Agriculture facilitated the process by conducting regional trials, disease resistance trials, agronomic trials, culinary and storage trials with promising new varieties. In recent years, reductions in government staff and budgets put pressure on the support provided by both levels of government. The nature of potato breeding and selection has shifted. Industry participants are exploring varieties for different end-uses, such as gourmet and functional food uses. The potato breeding programs in Canada were consolidated into a National program in 2004 and there is now one National Potato Breeder based in New Brunswick. By necessity, less emphasis is directed at varieties best suited for Western Canada. Varieties from breeding programs in Europe and the United States are often being assessed by industry stakeholders.

Regional trials of potato varieties in Western Canada were funded in part by industry money collected through the Western Canadian Potato Breeding Consortium. This system was unique to Western Canada and served established industry stakeholders well. Newcomers to the industry were not easily able to participate. Even established stakeholders questioned whether they received sufficient value for the fees. The shift to an accelerated release mechanism moved the responsibility for the evaluations to industry and provides broader access to stakeholders initially. However, the window for evaluation of varieties is much narrower than in the Consortium and less data is available for decision makers.

Over the last 15 years, Alberta Agriculture and Rural Development staff worked with individual stakeholders in the potato industry to provide agronomic evaluations of potato varieties from various breeding programs. Public varieties are still widely grown, but not always as good a fit as private varieties for the same end use. Growing environments vary significantly among potato production regions in Canada. Alberta data is essential when selecting varieties appropriate for our climate, our customers and industry stakeholders.

Many breeding programs target disease resistance, nitrogen use efficiency and excellent storage potential in addition to increased yield. The challenge is often that impartial comparisons of the material with standards varieties are not available. Each stakeholder would have the responsibility to obtain seed, sign agreements, engage researchers, or evaluate varieties independently. Many are not equipped to conduct small-scale evaluations well and seed is not available for larger-scale evaluations. Breeder's seed also has higher tolerances for virus loads and producers evaluating this material on farm put the remainder of the crop at risk.

In Alberta, potato industry stakeholders are looking for replacement varieties that use less nitrogen, less water, less pesticide, yet yield superior processing or culinary quality and tonnage. Varieties from breeding programs in Canada, Europe and the United States are often being assessed. Many breeding programs target disease resistance, nitrogen use efficiency and excellent storage potential in addition to increased yield. Tuber yield potential and nutritional requirements are impacted by variety characteristics and by environmental characteristics such as the length of the growing season (Westerman, 1993). As noted by Love et al. (2003), the full potential of a new variety may not be realized until proper management is implemented. There is increasing pressure on potato producers to utilize best management practices to reduce the environmental footprint for potatoes. The costs of such shifts in production practices will be borne primarily by producers.

An ideal French fry variety would have earlier maturity than Russet Burbank, be relatively tolerant of environmental fluctuations, have few defects, yield well and have specific gravity in the desired range (1.086 to 1.092). Good fry color out of the field is an asset, and good fry color out of storage is also very desirable. An ideal chipping variety would produce a good yield of medium sized tubers, be relatively tolerant of environmental fluctuations, have few defects, and have high specific gravity in the desired range (above 1.086). Chipping tubers with a good skin set, good maturity at harvest and low concentration of reducing sugars is also very desirable. Varieties that store well at cooler temperatures are an asset. Ideal fresh market varieties would produce a good yield of creamer or medium sized tubers, be relatively tolerant of environmental fluctuations, have few defects, and have an attractive appearance. Fresh market tubers with a good skin set that store well are very desirable.

The purpose of this project was to pool resources to evaluate potential varieties from a range of sources, using a cooperative approach. This trial was established to collect local agronomic data on varieties from breeding programs in Canada, the U.S. and elsewhere. Including agronomy in the evaluations allowed us to provide growers with additional relevant information when they consider producing new varieties. Often, there are economies of scale realized when varieties are evaluated collectively rather than individually. ARD was well positioned to provide regional data in an impartial setting. The varieties were planted in replicated plots at the Alberta Irrigation Technology Centre (AITC) in Lethbridge, AB and in demonstration plots at the Crop Diversification Centre South (CDCN) in Brooks, AB in 2014.

Project Overview

Potato variety evaluation trials were conducted at the Alberta Irrigation Technology Centre (AITC) in Lethbridge to provide data from an irrigated site in Alberta. Standard varieties were included to represent early French fry, full-season French fry, early chipper, full-season chipper, fresh market red, fresh market yellow classes. Sufficient potatoes were planted to provide replicated data from AITC and to host a demonstration field day at CDCS in 2014.

Material for these trials was provided by AAFC Potato Breeding Program and by industry stakeholders either through the AAFC Accelerated Release Program or by sourcing varieties from European, U.S. or other breeding programs. All import requirements were the responsibility of the stakeholder requesting evaluation.

At AITC, we set up a nitrogen response trial with moderate and reduced levels of nitrogen fertility. Stakeholders indicated whether or not they required fertility information and provided sufficient seed (in-kind) and funds to include these evaluations. Some accommodations were made to ensure that all client sponsors found value in the data provided.

The leveraged funding from industry also provided resources for the regional evaluation of AAFC material prior to release to industry. Without funding from this project, there would not have been an opportunity to observe the breeding program cultivars in Alberta in 2014.

Variety trials were set up as randomized complete blocks. Guard rows were planted to minimize edge effects. Four replicate rows (6m) were harvested. The agronomic trials were set up as split plot designs with nitrogen level as the main plot and varieties as sub plots.

Data collected included emergence data, stand count, total yield, grade by size category relevant to end-use, specific gravity, internal defects, external deformities, and culinary evaluations. Samples were returned to stakeholders for bruise testing, storage assessments or acrylamide testing by the stakeholders. Local production data supports adoption of new potato varieties that will enhance the competitiveness of our potato industry.

A field day was hosted at CDCS in August to allow stakeholders to evaluate the response of cultivars to irrigated growing conditions in Alberta. There is no substitution for first-hand observation of potato varieties in the field.

Objectives:

A. To evaluate potential new varieties for processing (fry and chip), creamer and other markets;
B. To provide the potato industry an opportunity to assess varieties grown under local conditions;
C. To compare varieties from European, Tri-State and National breeding programs (AAFC) under Alberta conditions; and
D. To develop agronomic information on nitrogen response to support potato growers interested in producing new varieties.
E. To evaluate the cooperative approach to variety development and develop a model that takes the industry beyond the current project.

Project Team Members

Alberta Agriculture and Rural Development, Crop Diversification Centre South, Brooks, AB

- Dr. Michele Konschuh, Potato Research Scientist – Project Lead
- Seasonal Technologists

Agriculture and Agri-Food Canada, Potato Research Centre, Fredericton, NB

- Dr. Benoit Bizimungu, Plant Breeder
- Technologists

Executive Summary

In 2014, the first year of the trial, funding from 9 industry stakeholders plus the Potato Growers of Alberta (PGA) was leveraged to conduct replicated potato variety trials in southern Alberta. The trial was conducted under pivot irrigation at the Alberta Irrigation Technology Centre in Lethbridge, AB. More than 100 potato varieties were evaluated in 2014. Data collected was adjusted where possible to ensure that clients were provided with information useful for their organizations. A limited amount of agronomic data was also provided at the request of client sponsors.

Data collected included emergence data, stand count, total yield, grade by size category relevant to end-use, specific gravity, internal defects, external deformities, and culinary evaluations. Samples were returned to stakeholders for bruise testing, storage assessments or acrylamide testing by the stakeholders. Local production data supports adoption of new potato varieties that will enhance the competitiveness of our potato industry.

A few potato cultivars submitted by clients were intended for the French fry market. French fry varieties must yield well and have good fry characteristics. Specific gravity of the potatoes is an indirect measure of fry colour. In lieu of submitting additional cultivars, one client elected to evaluate several nitrogen fertilizer strategies for two varieties.

Eight chipping potato varieties were included in 2014. Old Dutch Foods, as well as seed growers and variety development firms provided chippers for evaluation. Chipping potatoes are graded by size rather than weight. As with French fry cultivars, good fry colour is essential and specific gravity is a good indirect measure of chip colour. Typically, chipping potatoes required less N than French fry cultivars and a comparison at a lower rate of N was requested for seven of the chipping entries. Chip colour scores were provided for varieties evaluated as chippers.

Fresh market potatoes were included in the 2014 trial as well. Although the fresh market sector of Alberta’s potato industry is the smallest segment, there is a lot of growth potential even if we simply replace imported potatoes with locally produced ones. Sixteen fresh market cultivars and 2 checks were evaluated in 2014. Five entries were evaluated on a moderate rate of N, 5 entries were evaluated at a lower rate of N and 6 entries were evaluated at both rates to determine whether or not the varieties respond well to reduced N. Culinary data was provided as requested. For table potatoes, potatoes were evaluated as baked and boiled to determine the best fit for marketing purposes.

A special category of fresh market potatoes is the creamer potato market, made popular by the Alberta based Little Potato Company. Creamer potatoes are not smaller versions of other fresh market varieties; the varieties are selected for high tuber set and small tuber size intentionally to satisfy this market. These potatoes are prepared with the skin on and may be served with limited additional preparation. As such, skin set and tuber appearance are critical. Flavour is also very important for this class of potatoes. Forty creamer cultivars were included in the trail in 2014 and spacing was adjusted to reflect the special nature of this type of crop.

Agriculture and Agri-Food Canada (AAFC) has been involved in potato breeding for over 40 years. The National Potato Variety program includes selections that might be suitable for the French fry, chipping, or table market, including the creamer category. Industry participants are encouraged to view selections after one or two years of regional testing and to “pick up” the varieties for further testing. Without regional testing in Alberta and knowledge of how the cultivars perform in our growing environment, industry stakeholders would be hard-pressed to make selections. AAFC supplied test material for replicated trials and included entries suitable for all industry sectors. In 2014, 11 chipping cultivars, 13 French fry cultivars and 13 fresh market cultivars were evaluated along with relevant check material from eastern and western sources at AITC.

A field day was hosted at CDCS in August to allow stakeholders to evaluate the response of cultivars to irrigated growing conditions in Alberta. There is no substitution for first-hand observation of potato varieties in the field.

Customer specific reports were generated and provided. Client confidentiality was respected by coding entries prior to releasing reports more widely.

Lutein in Yellow-Fleshed Potatoes

Michele Konschuh[1], Qin Chen[4], Tricia McAllister[2], Simone Dalpé[1], Tina Lewis[2] and Norm Janssen[3]
Alberta Agriculture, Food and Rural Development, Crop Diversification Centre South[1], S.S. #4, Brooks, AB T1R 1E6;
AAFRD, Crop Diversification Centre North[2]; AAFRD, Agri-Food Investment;
Agricuture and Agri-Food Canada, Lethbridge Research Centre[4]

Alberta Agriculture Food and Rural Development
Crop Diversification Division

Background

- Carotenoid pigments, such as lutein produce the flesh color in yellow-fleshed potatoes.
- Carotenoids are known to protect against a variety of chronic diseases including cardiovascular disease and certain cancers.
- Dietary lutein intakes of 3 to 6 mg per day have been connected with reduced risk of age-related macular degeneration (AMD) and cataract formation (leading causes of blindness as people age).
- We must provide good reasons for people to include potatoes as part of a healthy diet.

Objectives

1. To determine concentrations of total carotenoids and lutein and zeaxanthin in yellow-fleshed potato varieties grown in Alberta;
2. To determine whether growing location (Brooks vs Edmonton) has an impact on carotenoid content in potato tubers;
3. To determine the stability of carotenoids, especially lutein and zeaxanthin, during storage of potato tubers; and during cooking or processing of potatoes.

Project Plan and Treatments

- Grew 20 yellow-fleshed potato varieties and two checks (Yukon Gold and Russet Burbank) at CDCN (rain fed) and CDCS (irrigated) in 2004.
- Composite samples were used to measure the yellow flesh color and total carotenoid, lutein and zeaxanthin levels.
- To provide information on carotenoid stability with respect to storage and processing or cooking:
  - 5 promising processing varieties and 5 promising fresh market varieties were stored for 4 months.
  - Lutein and total carotenoids were measured before and after processing or boiling.

Flesh Color and Carotenoid Content

Table 3: Flesh color intensity (chroma) and concentration of carotenoids (lutein, zeaxanthin = Zea, and total carotenoids; µg per g FW) in yellow-fleshed potato tubers grown at two locations in Alberta.

	CDCS (Brooks)				CDCN (Edmonton)			
Variety	**Chroma**	**Lutein**	**Zea**	**Total**	**Chrom**	**Lutein**	**Zea**	**Total**
Russet Burbank	30.3	13.5	0.0	30.0	31.3	9.3	.0.	21.0
Innovator	41.9	22.7	1.4	90.0	43.6	23.5	1.5	85.0
Baby Boomer	42.3	17.6	0.6	69.0	44.6	25.3	1.2	86.0
Amandine	42.6	9.9	0.0	35.0	44.7	24.0	2.3	78.0
Provento	43.1	13.9	0.0	78.0	45.6	20.2	0.0	115.0
Cherie (red)	43.2	27.2	0.9	109.0	42.9	31.0	1.8	133.0
Adora	43.5	17.7	1.5	83.0	44.0	18.5	1.7	71.0
Velox	44.8	13.9	0.0	77.0	46.2	12.7	0.0	54.0
Sante	45.0	27.2	2.2	120.0	47.4	36.2	2.1	142.0
Agat	45.5	23.5	0.0	95.0	46.2	29.0	1.5	93.0
Red Scarlett	45.5	17.6	0.0	74.0	47.2	16.3	0.0	60.0
Yukon Gold	46.6	12.6	0.4	65.0	46.0	10.6	2.0	59.0
Fabula	46.8	17.0	1.3	93.0	48.0	23.9	2.4	115.0
Cecile (red)	47.5	40.6	0.0	195.0	49.5	32.4	1.0	128.0
Sinora	47.6	28.2	0.9	111.0	50.2	17.3	0.0	54.0
Penta	47.6	27.5	0.8	116.0	47.8	26.3	1.5	93.0
Mozart red)	48.0	18.6	0.0	62.0	48.6	31.3	1.0	96.0
Rosara (red)	48.2	21.7	0.6	146.0	51.2	24.8	2.2	125.0
Piccolo	50.2	23.6	1.0	110.0	53.3	21.5	1.4	102.0
Satina	50.7	54.0	3.3	227.0	51.0	50.8	4.2	110.0
Victoria	51.1	22.5	0.9	124.0	49.6	21.9	2.1	110.0
Island Sunshine	53.6	45.0	1.2	240.0	53.0	34.3	0.5	133.0

Stability of Lutein

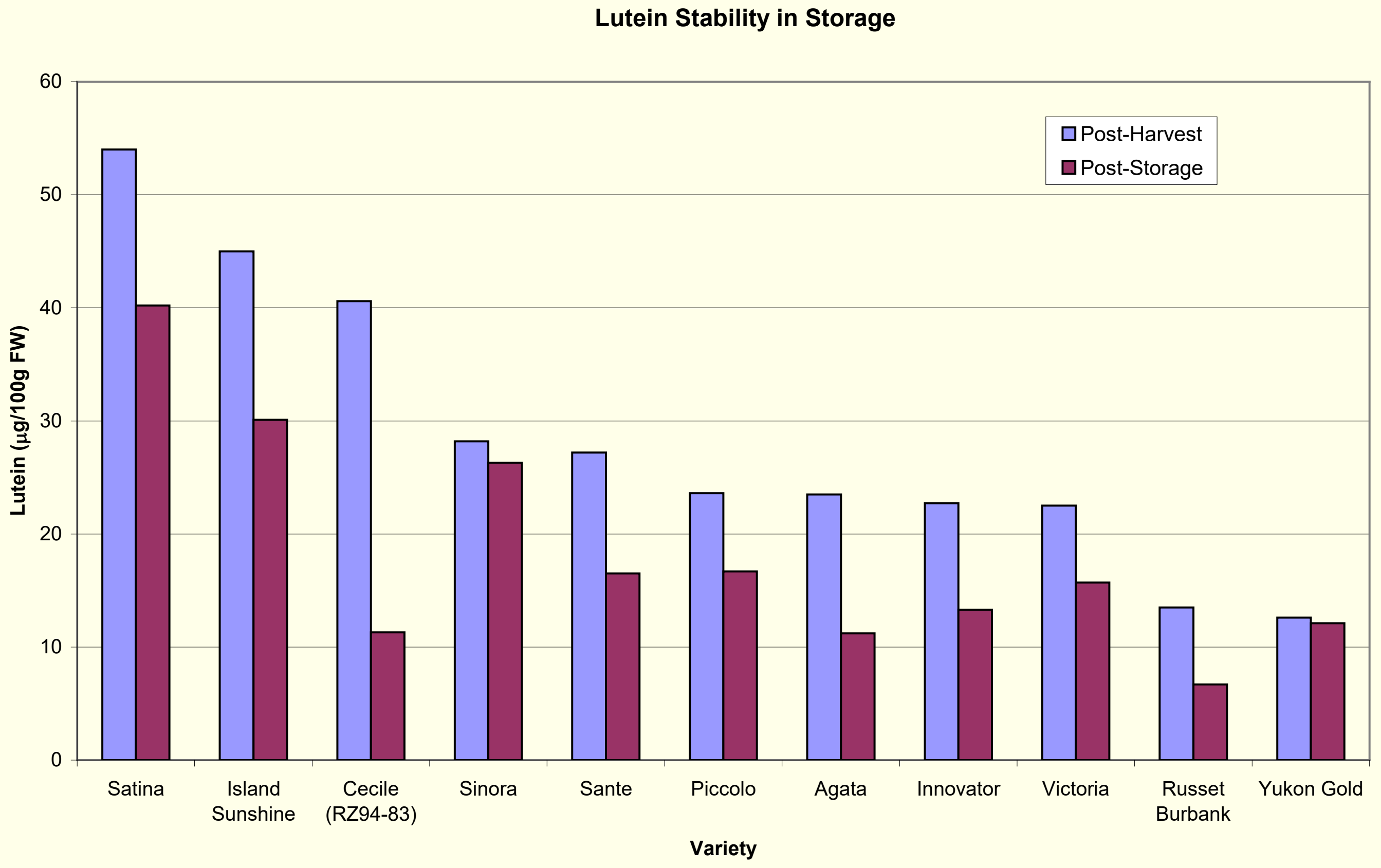


Figure 1: Concentration (µg / g FW) of lutein extracted from yellow-fleshed potatoes at harvest (post-harvest), and after four months storage (post-storage).

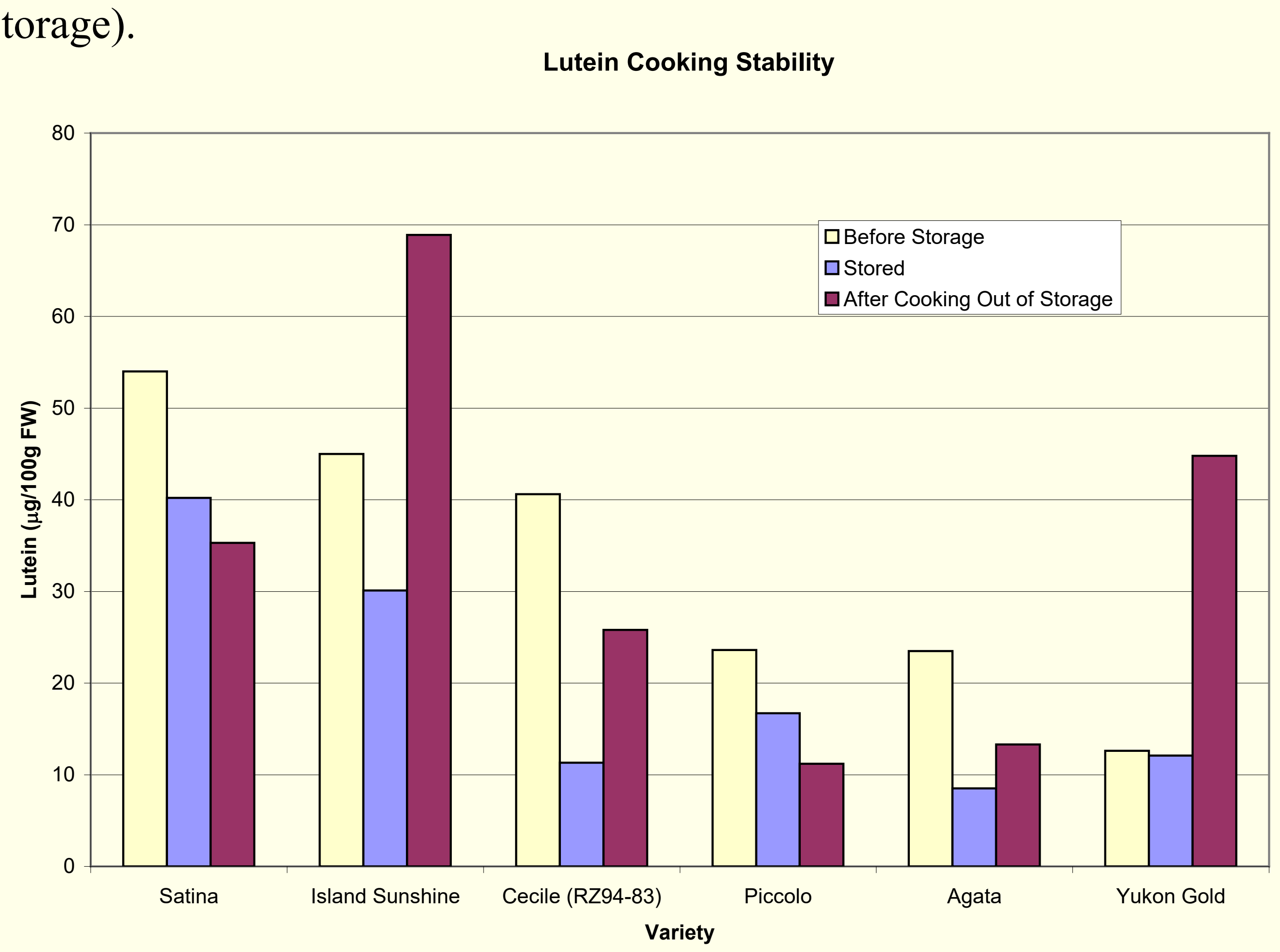


Figure 2: Concentration (µg / g FW) of lutein extracted from yellow-fleshed potatoes at harvest (before storage), after four months storage (stored), and after cooking out of storage.

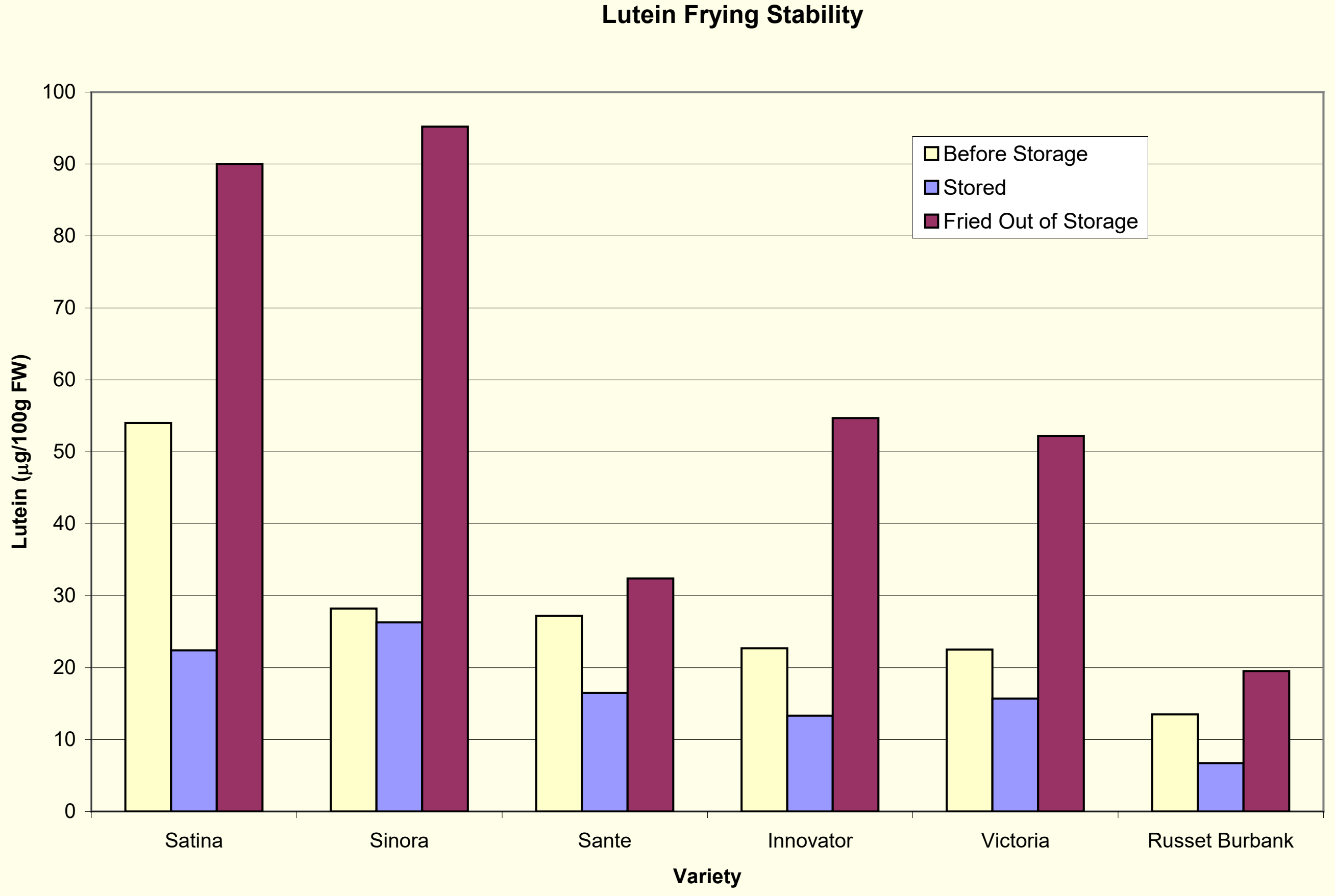
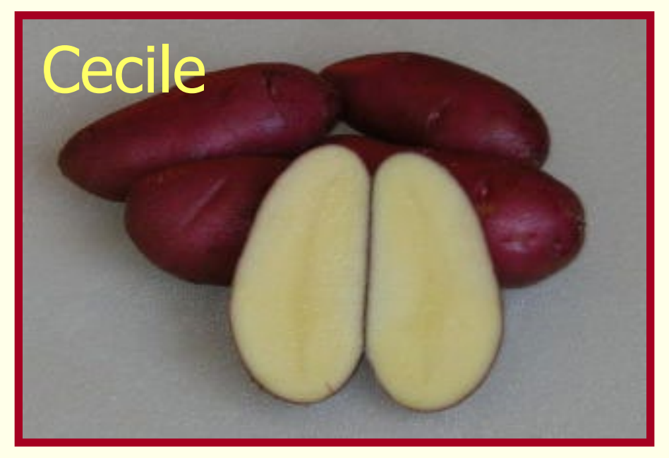


Figure 3: Concentration (µg / g FW) of lutein extracted from yellow-fleshed potatoes at harvest (before storage), after four months storage (stored), and after frying out of storage.

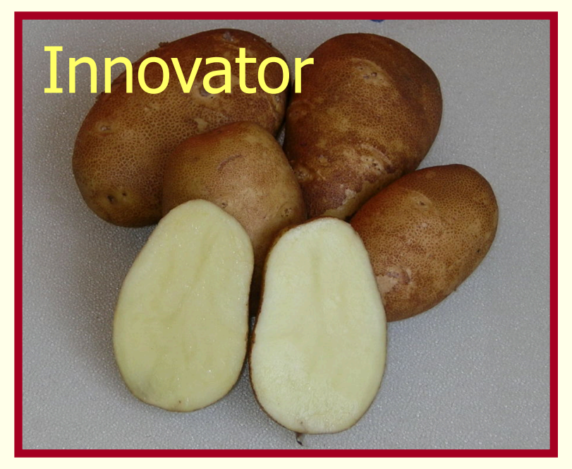
Fresh Market Varieties



Observations

- Total carotenoid concentration in yellow-fleshed potatoes ranged from 35 to 240 µg/100 g FW (1 mg = 1000 µg).
- In most varieties, lutein made up to one third of the total carotenoid content. Zeaxanthin concentration was negligible in the varieties studied.
- Lutein concentration ranged from 9.5 (check) to over 50 µg/100 g FW (Satina).
- Carotenoid stability in storage differed by variety, but in all cases, less lutein was recovered from stored tubers than from freshly harvested tubers.
- More lutein was recovered from three of the five varieties after cooking.
- The quantity of lutein extracted from fried samples was much greater than from stored potatoes.
- Two additional years of funding will enable us to determine the effect of growing location (Edmonton, Lacombe, Brooks) and time of harvest on lutein concentration in 10 varieties.

Potential Processing Varieties



Conclusions

- Lutein concentration is correlated with variety, but can be influenced by growing location, storage and cooking or frying.
- A seven ounce potato may contribute between 20 and 50% of the lutein in a supplemented multi-vitamin.

Acknowledgements

- Funding for the project was provided by Alberta Agriculture, Food and Rural Development (NIF), Potato Growers of Alberta, Maple Leaf Potatoes, McCain Foods Ltd., Lamb-Weston, HZPC Americas, Parkland Seed Potatoes Ltd., and Solanum International .
- Special thanks to Darcy Driedger and Marivic Hansen for carotenoid analyses.

Project
New: Renewal: **X**

MEMORANDUM OF UNDERSTANDING

Between:

Potato Growers of Alberta
(hereafter referred to as "PGA")

and

Alberta Agriculture, Food & Rural Development
(hereafter referred to as "AAFRD")

Project Title: Effect of MH60 for Size Control in a Chipping Variety

Objectives:

1. To determine the effect of MH60 applications on chipping potatoes in southern Alberta; and
2. To establish the correct stage of tuber development for MH60 application to attain an optimal size profile.

STATEMENT OF WORK

Alberta Agriculture, Food & Rural Development is willing to undertake this study for the PGA, who hereby agrees to contribute toward the costs of researching the information required as described in the research proposal.

PERIOD OF WORK

The research project will commence in July, 2004. A progress report will be provided to the PGA by December 31, 2004, and a full report will be sent when all of the storage data has been analyzed.

BASIS OF PAYMENT

The sponsor of the project, the PGA, will provide $5,375 upon finalization of this memorandum to AAFRD, to cover the following estimated yearly costs:

Casual Manpower (on an as need basis):	$4,685
Materials and Supplies	$100
GST and Overhead	$590

The Budget can be adjusted and used at the discretion of the project manager.

Payment of research project expenditures will be made from funds made available to AAFRD up to the maximum amount of funds received from the sponsor.

If requested, AAFRD will provide a record of revenue and expenditure upon project completion or depletion of funds. Any remaining funds after completion or termination of the project can be used for research at the discretion of the project manager.

RESPONSIBILITY OF PROJECT MANAGER

The project manager for this study is Dr. Michele Konschuh. She will provide all reports to AAFRD and the sponsor.

The project manager will authorize expenses and submit them to the appropriate AAFRD department for processing payment.

The project manager is not eligible for any manpower funds herself.

AMENDMENTS OR TERMINATION

This Memorandum of Understanding may be amended by mutual consent of the parties as evidenced by an exchange of letters.

Either AAFRD or the PGA may terminate this Memorandum of Understanding by providing two weeks notice in writing to the other party.

NOTICES AND REPRESENTATIVES

Notices for all purposes of or incidental to this Memorandum of Understanding shall be effectively given if delivered personally, or sent by registered or certified mail to the representatives of the parties designated as follows:

Potato Growers of Alberta

Mr. Vern Warkentin
Executive Director
Potato Growers of Alberta
6008 – 46th Avenue
Taber, AB T1G 2B1

Alberta Agriculture, Food & Rural Development:

Dr. Christine Murray
Branch Head, CDCS
Crop Diversification Centre South
S.S. #4
Brooks, AB T1R 1E6

Information generated from the project may be used by the Department of Agriculture, Food & Rural Development and the PGA.

The sponsor, the PGA, relinquishes ownership of any materials, supplies and assets purchased with project funds to the AAFRD which assigns control to the project manager's departmental division.

The parties affirm their acceptance of the terms of this Memorandum of Understanding by signing below.

Copies bearing original signatures of this Memorandum will be kept by each party.

Dr. Michele Konschuh, Project Manager

April 13/04
Date

I agree that the project manager named above may supervise this project.

Christine Murray
Dr. Christine Murray, Branch Head, CDCS

April 13/04
Date

Mr. Vern Warkentin, Executive Director
Potato Growers of Alberta

April 16/04
Date

Alberta
AGRICULTURE, FOOD AND
RURAL DEVELOPMENT

Crop Diversification Centre
South

S.S. #4
Brooks, Alberta
Canada T1R 1E6

Telephone 403/362-1300
Fax 403/362-1306

January 15, 2004

RECEIVED JAN 1 6 2004

Potato Growers of Alberta
6008 – 46th Avenue
Taber, AB T1G 2B1

Attention: Board of Directors

Re: Application for Funding
"Effect of MH60 for Size Control in a Chipping Variety"

Dear Board Members:

I am writing this letter in lieu of a full funding application for the second year of our project. In 2003, the Board approved our application for funding for the project entitled "Effect of MH60 for Size Control in a Chipping Variety". The trial was conducted in a commercial field of Norvalley potatoes near Taber. Some interesting data was generated and a progress report will be submitted to the PGA once the storage data has been analyzed. I hope to present a summary of our 2003 findings at a PGA breakfast in the near future. We would like to conduct the trial for a second year to ensure that the observations we made are generally applicable and not simply the result of a particular year. We may shift the application dates somewhat based on the 2003 findings. We are requesting a contribution of $5,375 from the PGA for 2004. Please contact me if you need any clarification (403-362-1314).

Thank you for your consideration. I look forward to hearing from you.

Sincerely,

Michele Konschuh, Ph.D.
Potato Research Agronomist

POTATO GROWERS OF ALBERTA

Taber, April 16 2004.

Michele Konschuh
Potato Research Agronomist
Alberta Agriculture, Food and Rural Development
Crop Diversification Centre South
Brooks

Re: "Assessment of carotenoid content of yellow-fleshed varieties grown in Alberta to determine potential nutritional benefits"

Dear Michele

We are pleased to advise that the Board of the Potato Growers of Alberta has approved your application in the amount of, $2,000.00, and the funds are available to meet the timelines specified in your application.
When requesting the funds for the project, please provide an invoice that specifies the amount, GST and to whom payable.
We appreciate your commitment and dedication to the potato industry.

Yours truly,

Alfonso Parra
Technical Director

Assessment of carotenoid content of yellow-fleshed potato varieties grown in Alberta to determine potential nutritional benefits

Researcher: Michelle Konschuh (AAFRD Brooks)
Term: One year
Objectives:

- To determine concentrations of total carotenoids and lutein in yellow-fleshed potato varieties grown in Alberta.
- To determine whether growing locations (Brooks vs. Edmonton) has an impact on total carotenoid content in potato tubers.
- To determine the stability of carotenoids, especially lutein and zeaxanthin, during storage of potato tubers with significant concentration of carotenoids.
- To determine the stability of carotenoids, especially lutein and zeaxanthin, during cooking or processing of varieties with significant concentration of carotenoids.

Costs: Total$21.790.oo PGA$2.000.oo

Comments:

- Project does not fit PGA priorities, but it could be included as a Value added for potatoes.
- The project has a relevant value for yellow flesh potato markets.

Proposal Application Form

AAFRD-IDS - New Initiatives Fund (NIF)

Confine information to the space provided.

Project Title: The title should be brief and descriptive (Max. 15 words

Assessment of carotenoid content of yellow-fleshed potato varieties grown in Alberta to determine potential nutritional benefits.

Project Abstract: Briefly provide a summary of the proposed project

This project involves growing yellow-fleshed potato varieties in two locations in Alberta and analyzing them for flesh color intensity, total carotenoid content and concentrations of lutein and zeaxanthin. Promising lines will also be assessed after storage and cooking or processing to determine the stability of carotenoid compounds in potato tubers. Lutein and zeaxanthin are two carotenoid compounds associated with reduced incidence of age-related macular degeneration and cataract formation. Potato varieties with significant concentrations of

Submitter Information: Project Manager

Name: Michele Konschuh	**Title: Potato Research Agronomist**
Branch: Crop Diversification Centre South	**Division: Crop Diversification Division**
Sector: Industry Development Sector	**Tel: 403-362-1314**
E-Mail: Michele.Konschuh@gov.ab.ca	

Baseline Project Information:

Project Start Date: (month/year) 04/04	**Project Length:** (months) 11

Project Budget: Bring amounts forward from attached budget worksheet

Manpower	$18,000
Contract Services	$4,500
Equipment Rental	$
Other Costs	$1,400
Contingency	$2,390
Total Project Costs	**$26,290**
Less: Total Amount (Cash Only) Requested from Other Sources	**$4,500**
Amount Requested from AAFRD-IDS	$21,790
Total Amount of In-Kind Contributions	**$400**

Branch Head Section: To be completed by Project Manager's Branch Head

Name of Branch Head: Christine Murray

Comments: Briefly provide any comments regarding the proposed project.

I support this project. It is aligned with the Functional Foods/Natural Health Products key initiative; it is preliminary work for a new opportunity for the Alberta crop. The team assembled has the necessary knowledge and skills to conduct the required research. An important aspect of the research is the analysis of the potatoes for the content of the carotenoids, which is proposed to be in conjunction with the Food Processing Centre Group at Brooks. It is of great benefit to be able to use or develop in-house analysis techniques for this purpose, as it is cost efficient compared to paying for technique development at other labs.
It also increases the information that can be used in the future when working with external partners.

Project Goals and Objectives:

1. Introduction: Briefly describe the overall purpose/goal/final outcome of the proposed project.

- Yukon Gold, a yellow-fleshed potato cultivar developed by Canadian potato breeders (Johnston & Rowberry 1981) has found a niche in North America and has opened the door to acceptance of yellow-fleshed potatoes by consumers. The impetus to develop new, improved yellow-fleshed cultivars has now expanded beyond the goal of simply developing novelty types for specialty markets (Lu et al. 2001). The yellow color of the potato flesh is imparted by carotenoids and Lu et al. (2001) reported that both individual and total carotenoid contents were positively correlated to yellow-flesh intensity in potato tubers. Carotenoids may protect against a variety of chronic diseases including cardiovascular disease (Gaziano et al. 1995) and certain cancers (Colditz et al. 1985). Perhaps the clearest link between specific carotenoids and a health outcome is that for lutein and zeaxanthin with age-related macular degeneration (AMD), the leading cause of visual impairment and blindness in the U.S (Snodderly 1995). Lutein and zeaxanthin are two carotenoids that circulate in human blood plasma and are concentrated in the macula region of the eye. Consumption of foods rich in lutein and zeaxanthin is inversely related to AMD (Seddon et al. 1994) and short-term feeding of foods rich in lutein and zeaxanthin can substantially increase pigment density in the eyes of human subjects (Hammond et al. 1997). Conversely, people with macular degeneration have been found to have lower levels of zeaxanthin and lutein than people without which supports the premise that these antioxidants provide some protection (Bliss 2003). Recent feeding studies have also shown that although spinach is rich in carotenoids, other foods may contain a more bio-available source of the compounds (Bliss 2003).
- As of 2000, there was no dietary reference intake for lutein in the U.S. (Food and Nutrition Board / Institute of Medicine). It is widely believed, however, that health benefits would accrue as a result of increasing lutein consumption in the U.S. from the estimated average intake of 1.3 mg/day (Chug-Ahuja et al. 1993). Studies at the University of Florida looking at the effect of dietary lutein supplements of 2.4 mg/day showed an increase in serum lutein concentration and an increase in macular pigment density. Total carotenoid content in white-fleshed potato varieties ranges from15 to 185 μg/100 g fresh weight, while yellow fleshed varieties can exceed 500 μg/100g fresh weight of lutein and up to 1.4 mg/100 g fresh weight of total carotenoids (Lu et al. 2001). A typical baked potato serving is approximately 200g; so yellow-fleshed potatoes could supply a significant percentage of dietary lutein.

2. Key Objectives/Deliverables: In point form, indicate the main objectives of the project.

☐ To determine concentrations of total carotenoids and lutein and zeaxanthin in yellow-fleshed potato varieties grown in Alberta.
☐ To determine whether growing location (Brooks versus Edmonton) has an impact on total carotenoid content in potato tubers.
☐ To determine the stability of carotenoids, especially lutein and zeaxanthin, during storage of potato tubers with significant concentrations of carotenoids.
☐ To determine the stability of carotenoids, especially lutein and zeaxanthin, during cooking or processing of varieties with significant concentrations of carotenoids.

3. Impact on Alberta's Agriculture/Food Industry: Describe the potential impact the project will have on the growth of the industry. Also, provide an indication of the scope of the industry potentially impacted by the project (i.e. small or large segment of the industry impacted).

The project is preliminary in nature. If the project determines that yellow-fleshed potato varieties grown in Alberta are significant sources of dietary carotenoids, additional study could attempt to link health claims to yellow-fleshed potato products. This would impact the table, processing and seed sectors of the potato industry. Table potato packers may be able to use the information as a marketing tool. Processors could use the information to develop and market healthier snack food. Seed growers would be positioned to supply seed potato for both table and processing markets.

Overall, the scope of the industry potentially impacted by the trial is small, however, this project opens up an avenue for the industry to be proactive when it comes to market responsiveness, diversity and industry competitiveness. There has been a significant amount of bad press associated with potatoes as a result of the popularity of the Atkins diet, the prevalence of Type II diabetes in our population, and the current focus on glycemic indexing. Potatoes are good sources of other nutrients, and highlighting other attributes would be a more effective strategy than refuting claims in the popular press.

4. Benefits to Industry Development Sector: Briefly describe the potential benefits to the Industry Development Sector. Refers to individual growth (intellectual capacity & leadership) and organizational capacity.

This project represents a deviation from the type of projects normally conducted in the Potato Research Agronomy program. The area of nutritional content and functional foods is of key concern to Albertans and the potato industry has identified functional foods, consumer attitudes and healthy fast foods using potatoes as research priorities. The project would provide me with an opportunity for academic growth in branching into a new area of research. The project represents forward thinking on the part of Industry Development Sector and shows our understanding and support of concerns facing the potato industry in the province. Also, the project involves cooperating with private companies, testing facilities and the federal government. The project will allow me to hone my project management skills including organization and communication skills.

5. Uniqueness: The uniqueness of a project is related to the number of others with a similar objective that have been done or are currently underway in Alberta, Canada and North America.

Brown et al. (1993) published a study looking at carotenoid content in orange-fleshed potato varieties. A 2001 report published by USDA researchers makes the link between lutein in potatoes and eye health. Their study assessed two registered varieties and eleven diploid clones for carotenoid content and composition and indicated that tuber flesh color could be used as an indicator of carotenoid content for breeding and selection purposes. A 2002 report concluded that carotenoids and carotenoid esters are quantitatively significant compounds in potatoes. A 2003 article on USDA research noted that although some vegetables, such as spinach, are very high in lutein, other food sources may represent significant sources due to greater availability of the lutein. Clinical trials are underway at the University of Alberta comparing two Alberta potato varieties with respect to glycaemic index. No Albertan or Canadian projects on lutein in potatoes came to light.

Project Strategy

AAFRD-IDS - New Initiatives Fund (NIF)

Describe the project strategy, including objectives/outcomes, deliverables, milestones/dates and individuals responsible.

Summary of Project Strategy

Our strategy is to grow approximately 20 registered or nearly registered varieties of yellow-fleshed potatoes in replicated trials at two locations in Alberta, an irrigated site in Brooks and a dry land site in Edmonton. Yield, size profiles, and specific gravity will be determined for all samples. Composite samples will be analyzed for total carotenoid concentration, and lutein and zeaxanthin concentrations using HPLC. Yellow flesh color will be assessed using a Hunter Colorimeter. Approximately five promising varieties will be analyzed again after storage and cooking or processing to determine how stable the carotenoid compounds are in potato tissue and how suitable the varieties are for various market applications.

Objective/Outcome	Deliverables	Milestones/Dates	Responsible
1. Source of potatoes for analysis	Will grow sufficient potatoes in a replicated trial to provide tissue for analysis after harvest, storage and processing. Two locations.	Potatoes harvested by October 2004	Michele Konschuh & Simone Dalpé, Tricia McAllister & Tina Lewis
2. Carotenoid analyses of potato varieties after harvest	Potatoes will be sent to testing facility for analysis Data from commercial testing facility	Potatoes sent to testing facility by November 2004 Data expected by December 2004	Simone Dalpé and Tina Lewis
3. Promising varieties selected for storage and processing analyses	Data from carotenoid analyses and field data will be used to select several promising varieties to continue working with	Identification of at least five promising varieties by January 2005	Michele Konschuh, Qin Chen, Tricia McAllister, Norm Janssen
4. Measurements of yellow flesh color intensity	Hunter colorimeter determinations of yellow flesh color for all varieties	Quantitative data by February 2005	Simone Dalpé
5. Carotenoid analyses of promising varieties after storage and cooking or processing	Stored potatoes will be analyzed then cooked or processed to determine carotenoid stability. Potato tissue sent to testing facility for analysis	Potatoes sent January 2005 Data expected February 2005	Simone Dalpé
6. Trial report	Summary of the work conducted in the study will be compiled into a trial report.	Trial Report by April 2005	Michele Konschuh, Qin Chen, Tricia McAllister

Project Team

AAFRD-IDS – New Initiatives Fund (NIF)

Identify individuals (internal/external) that will be contributing directly to the project.

Name	**Division/Institution***	**Person Years Required**	**Role/Responsibility**
Project Manager Michele Konschuh	Crop Diversification / CDCS	0.1	Project coordination, oversee production of potatoes for sampling at CDCS
Qin Chen	AAFC Lethbridge Research Centre	0.05	Assist with selection of promising varieties
Tricia McAllister	Crop Diversification / CDCN	0.1	Oversee production of potatoes for sampling at CDCN
Simone Dalpé	Crop Diversification/ CDCS	0.1	Plant and manage potato production, grade potatoes, arrange for samples to be sent to testing facility, arrange for storage and processing of
Tina Lewis	Crop Diversification / CDCN	0.1	Plant and manage potato production, grade potatoes, arrange for samples to be sent to testing facility, arrange for storage and processing of
Norm Janssen	Agri-Food Investment Division / Production Investment	0.05	Provide perspective on potential commercialization opportunities

* For individuals from outside of AAFRD, indicate proper business name and address.

Budget Worksheet

AAFRD-IDS – New Initiatives Fund (NIF)

State the amount being requested in each category. Only indicate amounts where cash will be expended. Account for *In-kind Contributions* in item "E" of the worksheet (see page 5).

A. Manpower

	Name/Title	Address	Person Years Required	Salary/Wage Amount Requested
Professional				
Technical	HPLC Technologist	CDCS Brooks, AB	0.2	8,000
Graduate Student				
Other (Specify) Casual Labour	Field Assistant	CDCS Brooks, AB	0.2	5,000
Other (Specify) Casual Labour	Field Assistant	CDCN Edmonton, AB	0.2	5,000
		TOTAL A		**$18,000**

Note: Employees of public institutions are not eligible for wages, honoraria, or other compensation from project funds. Include in-kind contributions of such employees on project team worksheet.

B. Contract Services (amounts for contracts other than manpower identified above)

Name	Description of Contract Services	Rate	Total Cost
FPDC	Facility fees for HPLC analysis of carotenoid content of potato tissue (60 samples) - not including manpower	$150/day 2 samples/day estimated	$4,500
			$
			$
		TOTAL B	**$4,500**

C. Equipment Rental

Name	Description of Equipment	Rate	Total Cost
			$

			$
			$
		TOTAL B	**$**

D. Other Costs

i. Travel (includes travel and accommodation costs)

a. Project Travel

Traveller's Name	
Destination(s)	
Number of Trips	
Mode of Travel	
Purpose	
Cost (Line 1)	**$**

ii. Materials/Supplies (if you have more than six items, please attach a list)

Description of Items to be Purchased	Quantity	$ Per Unit	Cost
Bags, stakes, tags for plot work	2 sites	200/site	400
Seed potato	20 varieties	50	1,000
		Sub-Total (Line 2)	**$1,400**

iii. Computer Cost (relates to purchase of software; purchase of hardware not eligible for funding)

	$
	$
Sub-Total (Line 3)	**$**

iv. Miscellaneous Costs

	$
Sub-Total (Line4)	**$**

TOTAL C (Line 1 + 2 +3+4)	**$1,400**

E. Contingency (include 10% of the total budget for unexpected costs)

TOTAL E	**$2,390**

TOTAL PROJECT COST (A+B+C+D+E)	$26,290

E. Other Funding Sources (Support applied for, granted, or promised for this project from sources other than AAFRD-IDS New Initiatives Fund)

In-Kind Contributions (i.e. use of facilities, materials/supplies and services provided)		
Name (No Abbreviations) **& Description of Contribution**	**Confirmed (Y/N)**	**Amount**
Name: Parkland Seed Potatoes **Address: Box 5581, Lacombe, AB** **Description: Will provide seed potato of up to eight yellow-fleshed varieties for inclusion in the study**	N	$400
Name: **Address:** **Description:**		$
Name: **Address** **Description:**		$
Name: **Address:** **Description:**		$
Name: **Address:** **Description:**		
Total In-Kind Contributions		$400

Cash Contributions		
Name of Organization*	**Confirmed (Y/N)**	**Amount**
Potato Growers of Alberta	N	**$2,000**
Maple Leaf Potatoes	N	**$1,000**
McCain Foods Ltd.	N	**$1,000**
Lamb-Weston	N	
Little Potato Company	N	**$500**
Total Amount (Cash Only) Requested from Other Sources (A+B+C+D+E)		$4,500

* For organizations from outside of AAFRD, indicate proper business name and address.

AEROPONIC SEED POTATO PRODUCTION – PIP200 EVALUATION (2012-2014)

MICHELE KONSCHUH
AGRICULTURE AND RURAL DEVELOPMENT

Alberta Agriculture and Rural Development

ALBERTA SEED POTATOES

- Alberta is the largest seed exporter in Canada
- Early generation seed begins with disease-free tissue culture plantlets
- Certified mini-tubers are produced in greenhouses
- These tubers are multiplied for several generations in the field prior to being sold to produce commercial crops
- **Costs of mini-tuber production have been increasing and yield has not**
- **Competitors were selling mini-tubers at prices dangerously close to our COP**

PROJECT

- After a literature search and consultations with seed growers, a proposal was developed to address productivity from a number of angles
- The research committee favored an evaluation of a novel aeroponic system, the Vital Farms PIP100
- Eventually, we were able to bring a modified version, the PIP200, to our facility for evaluation
- Three rounds of production were planned
- Field comparisons between aeroponic and conventional mini-tubers were included in the project

VITAL FARMS PIP200

PIP200 CONTROL SYSTEM

STOCK TANKS

TISSUE CULTURED PLANTLETS

TRANSPLANTS READY FOR SYSTEM

NEWLY PLANTED

APPROXIMATELY 2 WEEKS AFTER TRANSPLANTING

ROOT DEVELOPMENT

TUBER COMPARTMENT

INVISIBLE POTATO HILL

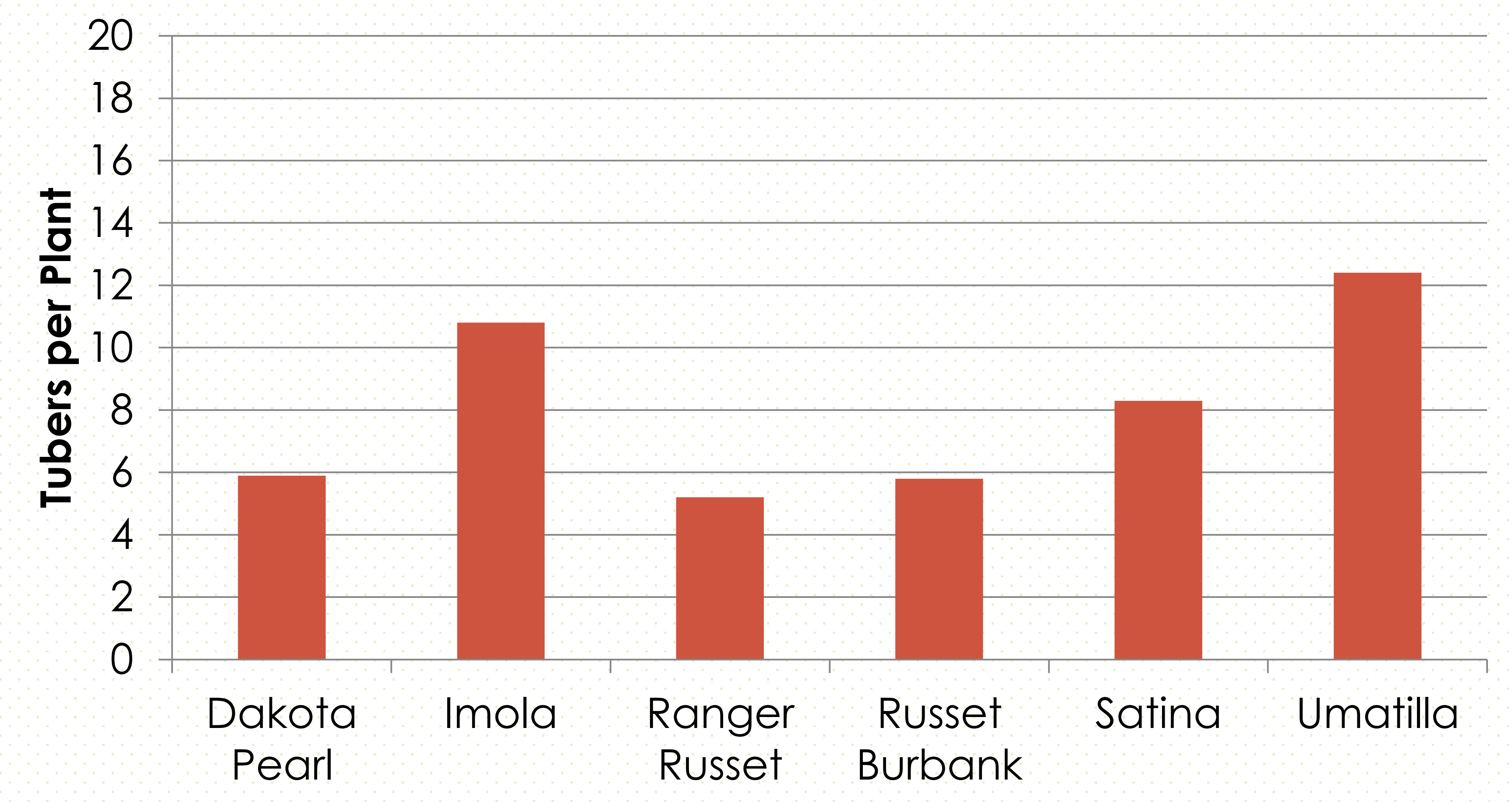
TUBER DEVELOPMENT

APPROXIMATELY 8 WEEKS AFTER TRANSPLANTING

TUBER PRODUCTION POTENTIAL

ROOTS

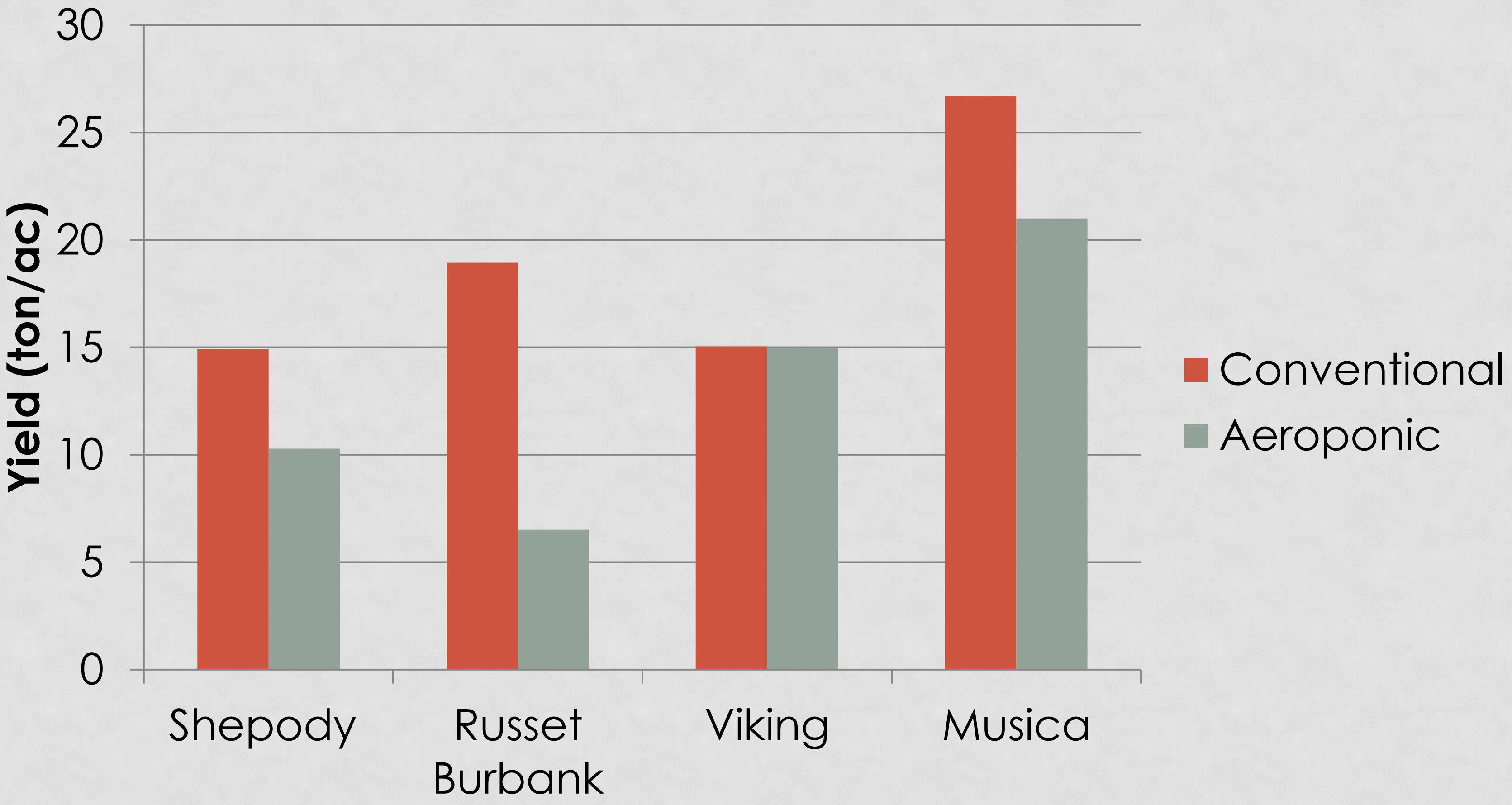
MINI-TUBERS PER PLANT
WINTER 2012



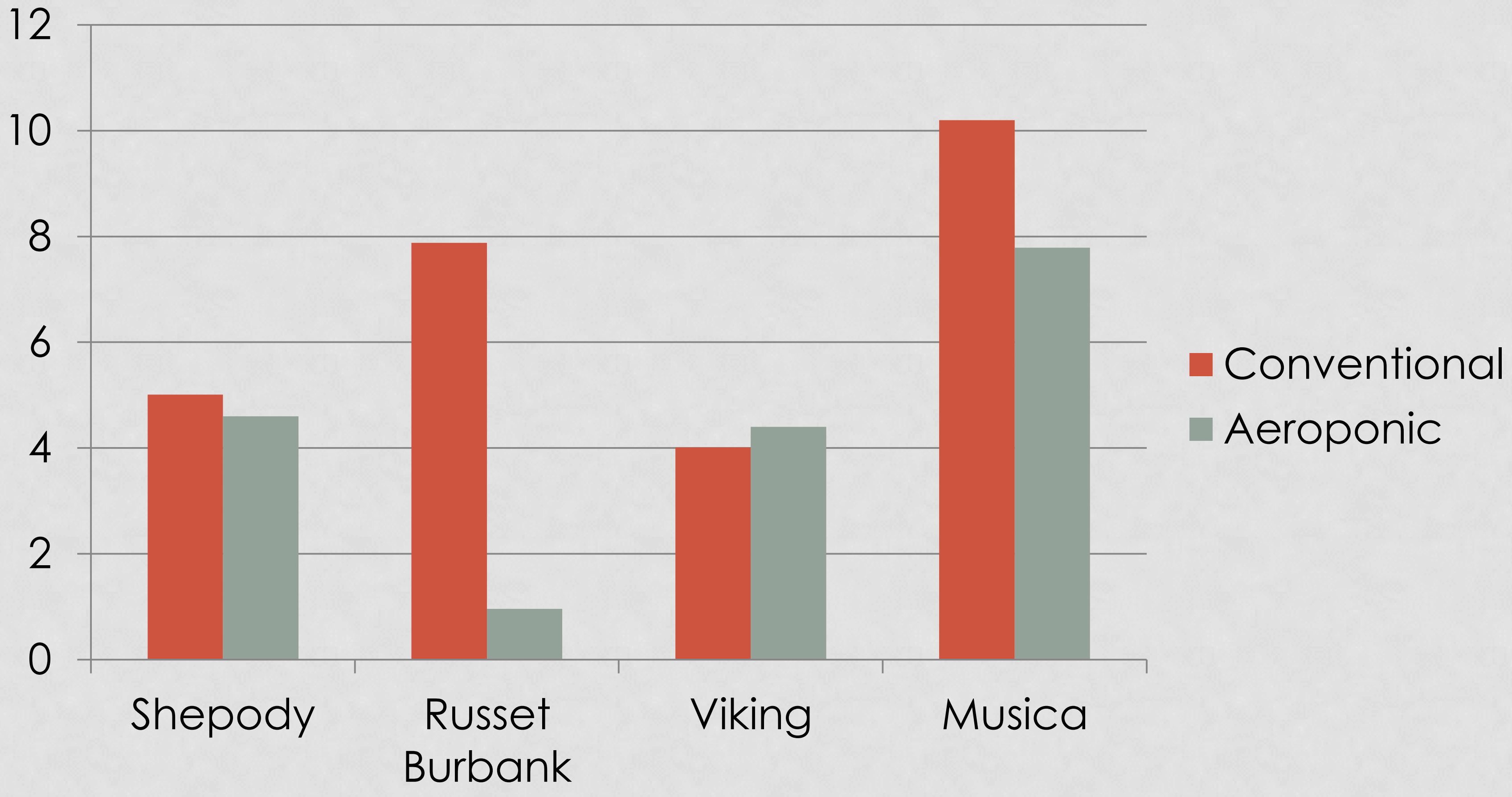
FIELD EVALUATION 2013

FIELD EVALUATION
2013

FIELD EVALUATION – WINTER CROP



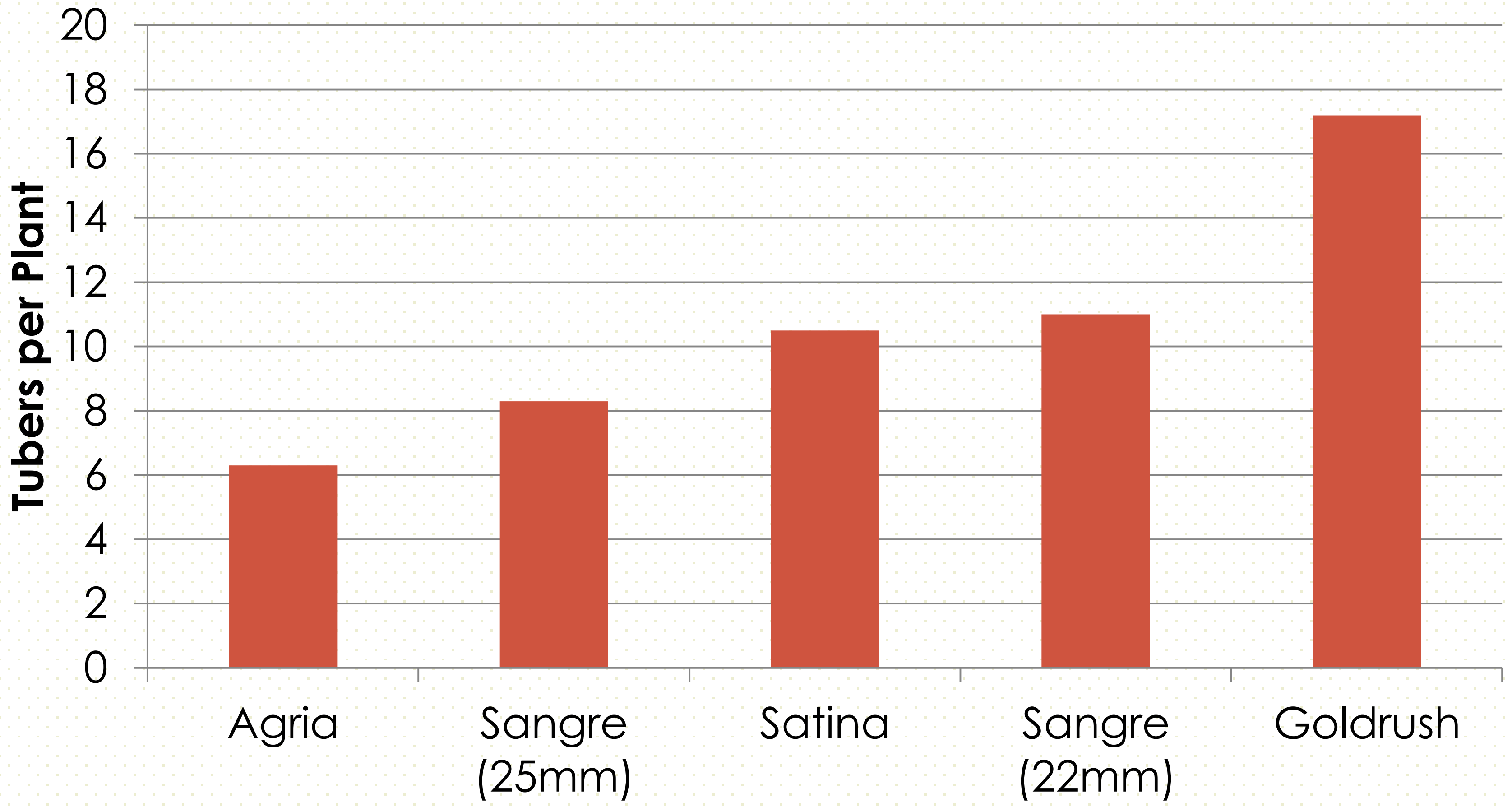
TUBER SET – WINTER CROP



SPRING CROP

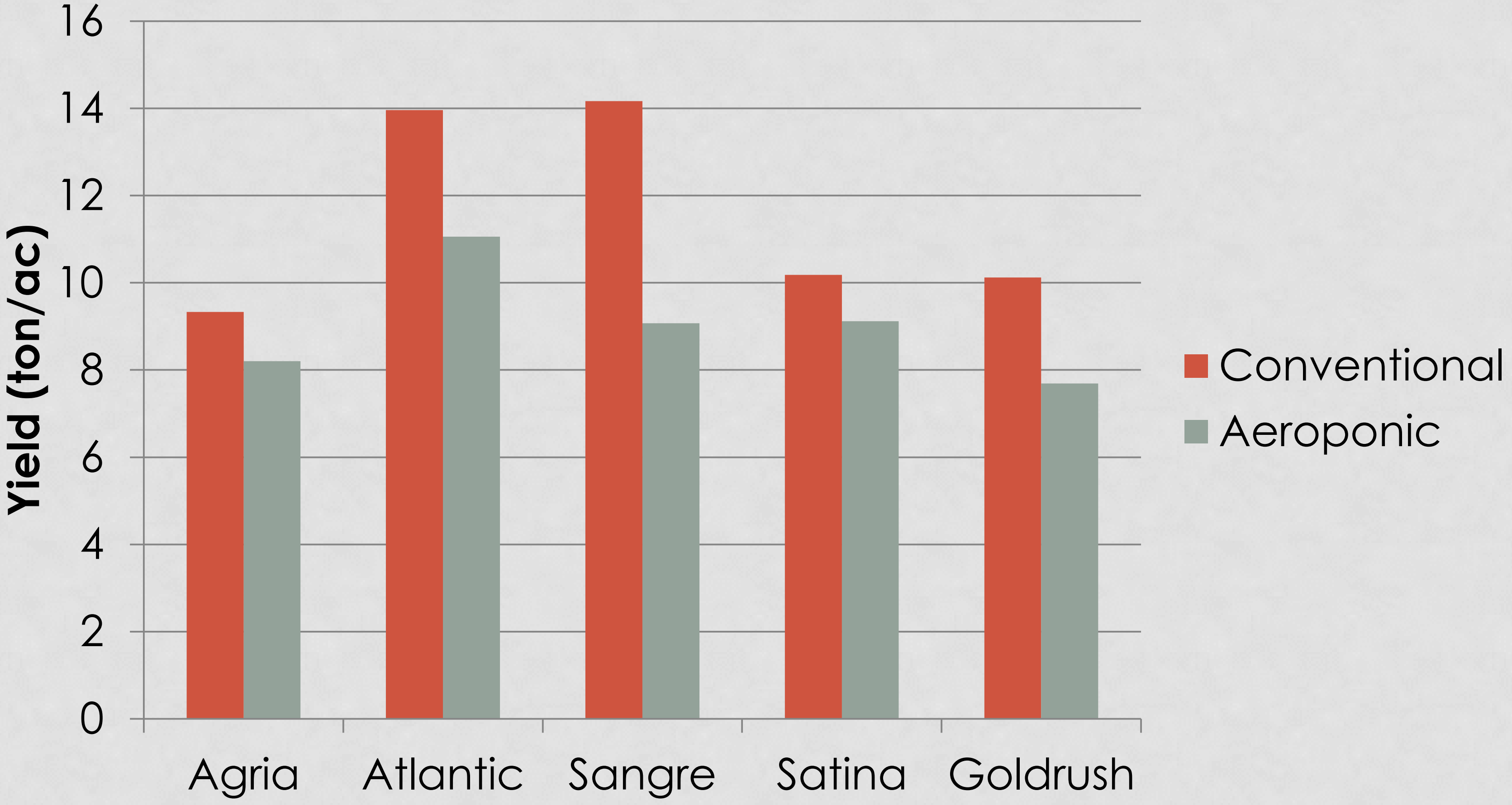
TUBER PRODUCTION POTENTIAL

MINI-TUBERS PER PLANT
SPRING CROP 2013

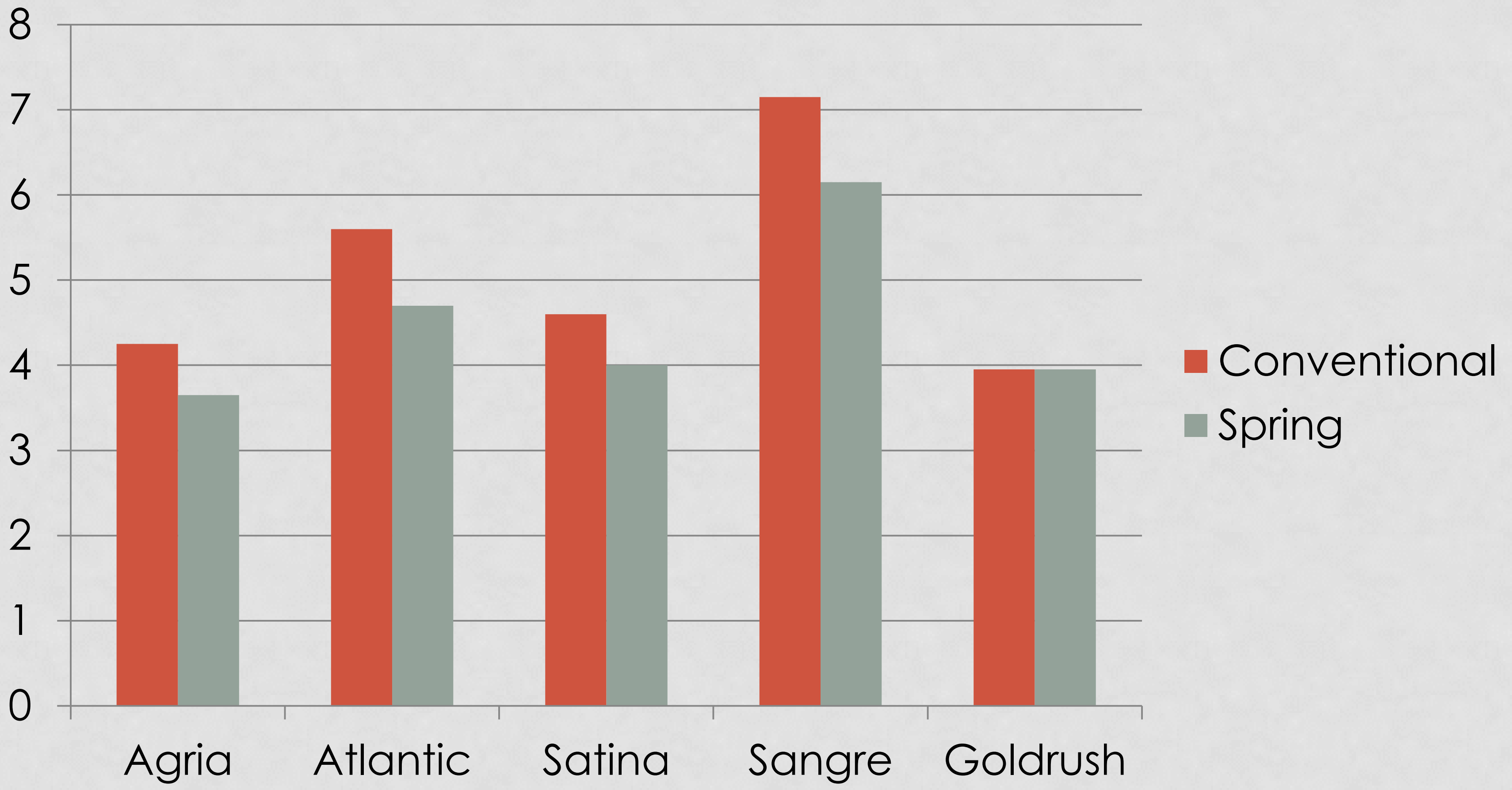


FIELD EVALUATION
2014

FIELD EVALUATION – SPRING CROP



TUBER SET – SPRING CROP

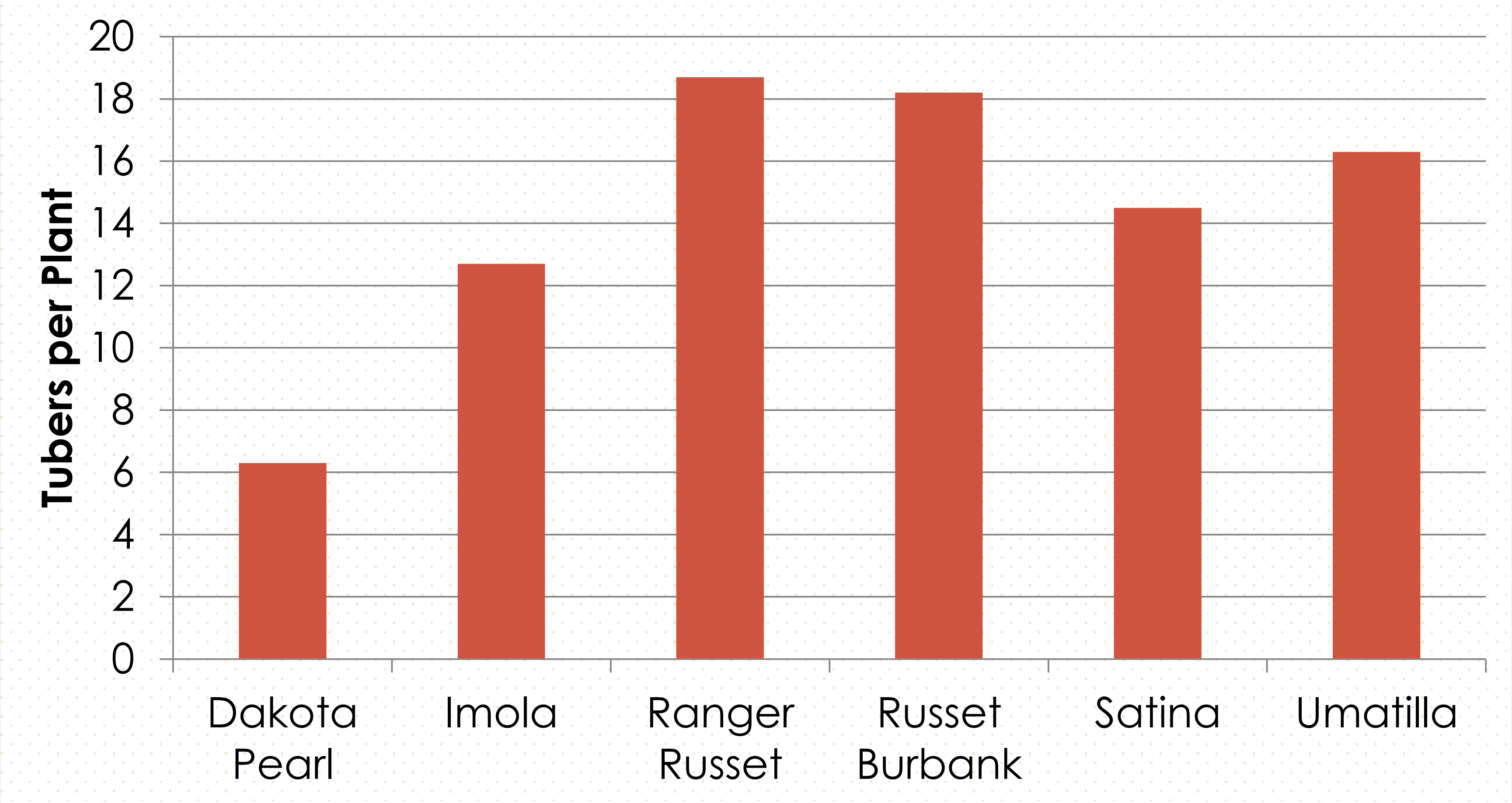


SUMMER CROP

18.10.2013

TUBER PRODUCTION POTENTIAL

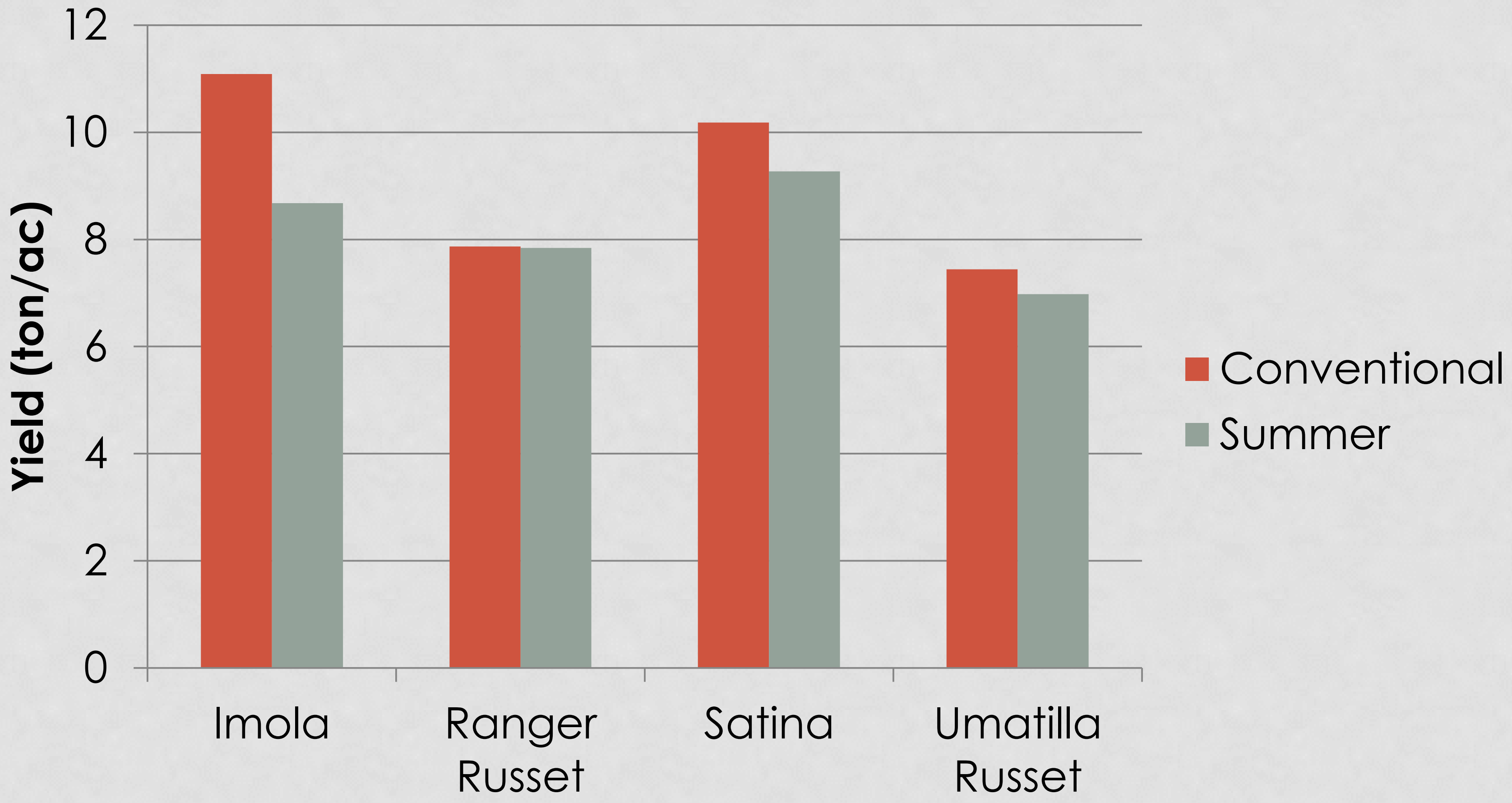
MINI-TUBERS PER PLANT
SUMMER CROP



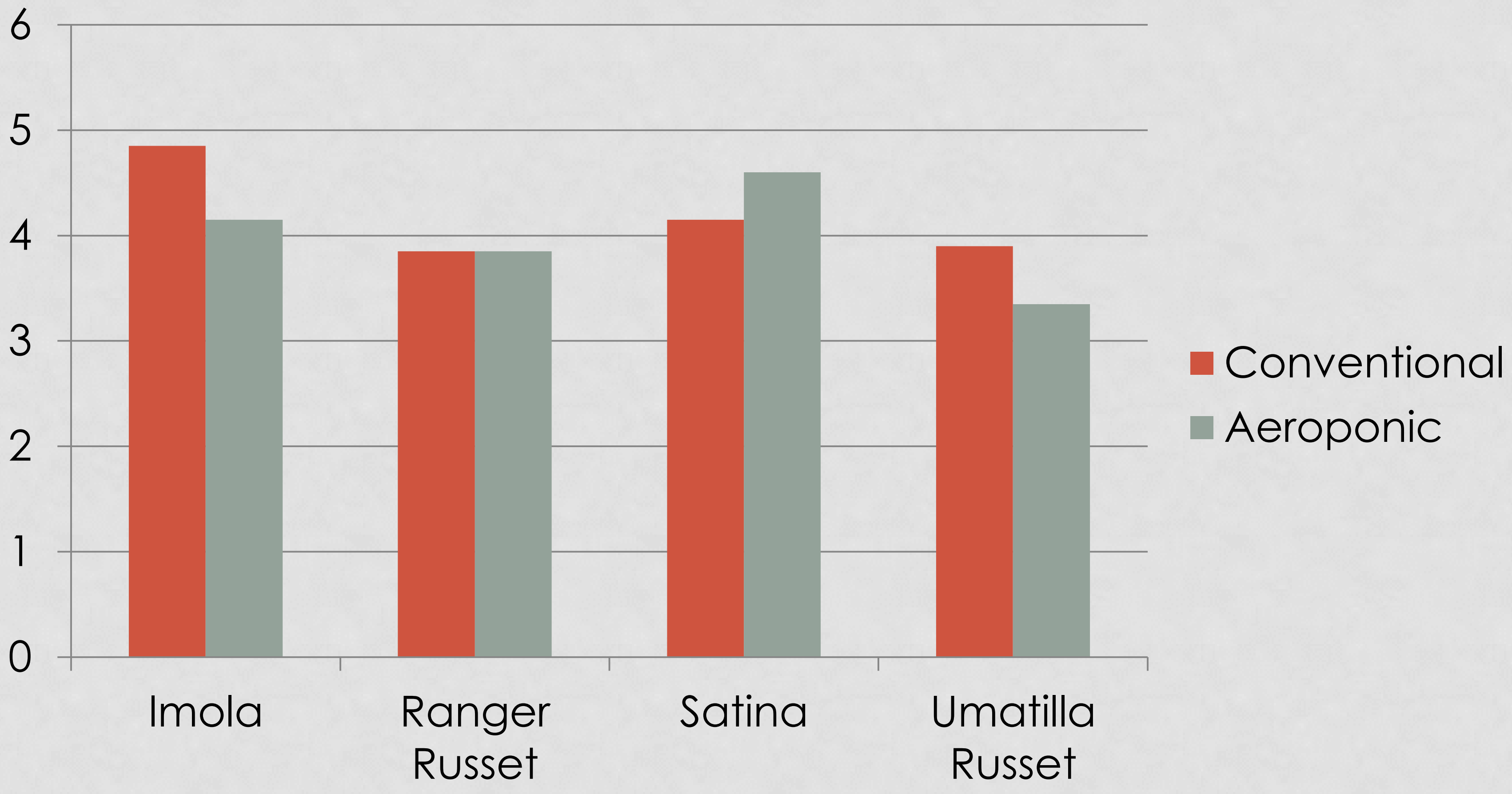
FIELD EVALUATION
2014

FIELD EVALUATION

FIELD EVALUATION – SUMMER CROP



TUBER SET – SUMMER CROP



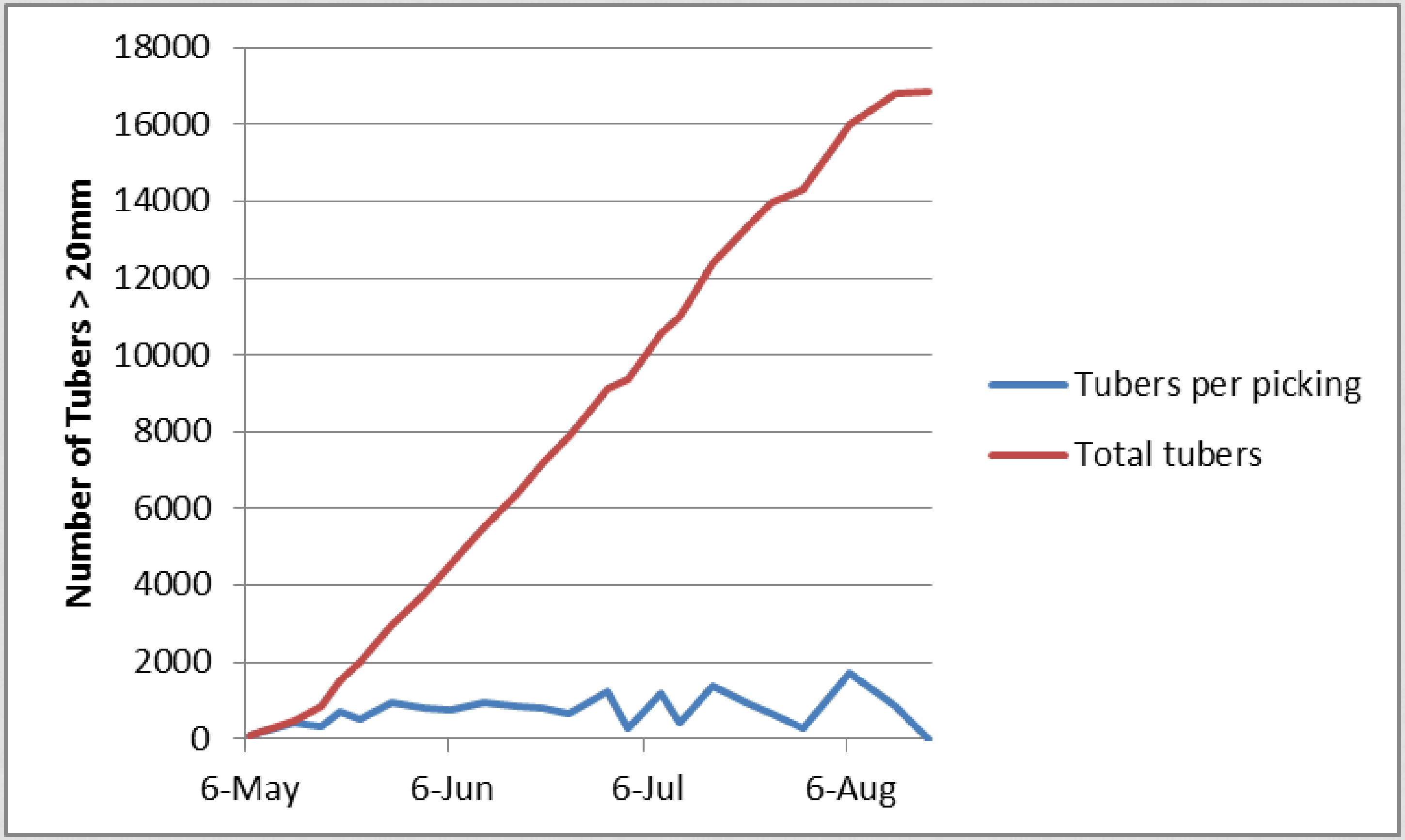
BONUS ROUND 2014

SINGLE VARIETY – RUSSET BURBANK

18.06.2014

VITAL FARMS PIP200

BONUS ROUND
(RUSSET BURBANK)



ECONOMIC EVALUATION

- Compared variable costs for similar sized facility
- Conventional (included plantlets, fertilizers, disinfectants, potting mix, plastic, other materials and manpower)
- If 2 to 3 tubers per plant; COP = $0.71 to $0.43/tuber
- Aeroponic (included plantlets, fertilizers, disinfectants, felt, plastic, rock wool, nozzles, other materials and manpower)
- If 15 to 20 tubers per plant; COP = $0.35 to $0.27/tuber

SUMMARY

- We have grown four rounds of seed potato in the PIP200, including over 17 different potato varieties
- Each crop cycle has yielded better results than the previous round
- There is still more to learn to optimize the production for specific varieties
- We haven’t yet realized the full potential of the system, but in the fourth cycle, we reached a level of tuber production that I believe is economically feasible
- The PIP150 is a more cost-effective option for growers
- Vital Farms is also working with a greenhouse manufacturer on integrating the system with a greenhouse frame

THANK YOU

- Funding for the project was provided by ACIDF, PGA and Ag & Food Council; in-kind contributions were provided by Alberta seed growers
- This has been one of the most interesting projects I have had the opportunity to work on
- In my opinion, our role as Government of Alberta is to mitigate risks to producers
- I am willing to share what I have learned
- The report will be available on the PGA website
- Northbright has incorporated many suggestions in design modifications

- Michele Konschuh 403-362-0689 (cell)

ACIDF

PGA
POTATO GROWERS OF ALBERTA

Agriculture & Food Council
The Catalyst

Assessment of carotenoid content of yellow-fleshed potato varieties grown in Alberta to determine potential nutritional benefits

Final Report

Project #: 2004-008

Alberta
AGRICULTURE, FOOD AND
RURAL DEVELOPMENT

Assessment of carotenoid content of yellow-fleshed potato varieties grown in Alberta to determine potential nutritional benefits

New Initiatives Fund – 2004/2005
June 30, 2005

Dr. Michele Konschuh
Tricia McAllister
Simone Dalpé
Tina Lewis
Dr. Darcy Driedger
Norm Janssen
AAFRD

Dr. Qin Chen
Agriculture and Agri-Food Canada, Lethbridge

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Tables and Figures

Abstract

Twenty yellow-fleshed potato varieties were grown alongside two check varieties at two Alberta locations; a dry-land site near Edmonton and an irrigated site near Brooks. Tuber flesh color (chroma) was measured after harvest and ranged from 30 in the Russet Burbank check (off-white flesh) to over 50 in several yellow-fleshed varieties. There was very high correlation between locations with respect to tuber flesh color, indicating that flesh color is a variety specific trait not easily influenced by growing location. Total carotenoids, lutein and zeaxanthin were extracted from tubers after harvest, and again after 4 months storage at 8°C for some varieties. Total carotenoid content ranged from 35 to 240 µg per 100 g FW and was positively correlated with tuber flesh color. Lutein concentrations in the same variety were correlated but not consistent between growing locations. Environmental conditions experienced at each site were quite different and it was not clear whether the differences observed were a result of latitude, soil type, environmental conditions or simply tuber size and maturity. Lutein accounted for approximately ⅓ of the total carotenoid content in many varieties and ranged from 9.3 µg per 100 g FW in the Russet Burbank check to over 50 µg per 100 g FW in the deep yellow-fleshed variety, Satina. Zeaxanthin was present in low concentrations and did not contribute significantly to total carotenoid content in the varieties studied.

Five fresh market varieties (Agata, Cecile, Island Sunshine, Piccolo and Satina) were selected for storage and cooking stability analyses. Another five potential processing varieties (Innovator, Sante, Satina, Sinora and Victoria) were selected for storage and frying stability analyses. Less lutein was extracted from stored potatoes than from freshly harvested potatoes, but the decrease in lutein concentration depended on the potato variety. More lutein was recovered from cooked potato than from stored potato for three of the fresh market varieties. Similarly, the concentration of lutein extracted from fried samples was much higher than from stored samples for all of the processing varieties studied. A reduction in moisture content only accounted for a portion of the increase observed. Although the reason for greater lutein concentrations after cooking and frying was not determined, we have put forward some possible explanations.

Introduction

Yukon Gold, a yellow-fleshed potato cultivar developed by Canadian potato breeders (Johnston & Rowberry 1981) has found a niche in North America and has opened the door to acceptance of yellow-fleshed potatoes by consumers. The impetus to develop new, improved yellow-fleshed cultivars has now expanded beyond the goal of simply developing novelty types for specialty markets (Lu et al. 2001). The yellow color of the potato flesh is imparted by carotenoids and Lu et al. (2001) reported that both individual and total carotenoid contents were positively correlated to yellow-flesh intensity in potato tubers. Carotenoids may protect against a variety of chronic diseases including cardiovascular disease (Gaziano et al. 1995) and certain cancers (Colditz et al. 1985). Perhaps the clearest link between specific carotenoids and a health outcome is that for lutein and zeaxanthin with age-related macular degeneration (AMD), the leading cause of visual impairment and blindness in the U.S (Snodderly 1995). Lutein and zeaxanthin are two carotenoids that circulate in human blood plasma and are concentrated in the macula region of the eye. Consumption of foods rich in lutein and zeaxanthin is inversely related to AMD (Seddon et al. 1994) and short-term feeding of foods rich in lutein and zeaxanthin can substantially increase pigment density in the eyes of human subjects (Hammond et al. 1997). Conversely, people with macular degeneration have been found to have lower levels of zeaxanthin and lutein than people without, which supports the premise that these antioxidants provide some protection (Bliss 2003). Recent feeding studies have also shown that although spinach is rich in carotenoids, other foods may contain a more bio-available source of the compounds (Bliss 2003).

As of 2000, there was no dietary reference intake for lutein in the U.S. (Food and Nutrition Board / Institute of Medicine). It is widely believed, however, that health benefits would accrue as a result of increasing lutein consumption in the U.S. from the estimated average intake of 1.3 mg/day (Chug-Ahuja et al. 1993). Studies at the University of Florida looking at the effect of dietary lutein supplements of 2.4 mg/day showed an increase in serum lutein concentration and an increase in macular pigment density. Total carotenoid content in white-fleshed potato varieties ranges from 15 to 185 µg/100 g fresh weight, while yellow fleshed varieties can exceed 500 µg/100g fresh weight of lutein and up to 1.4 mg/100 g fresh weight of total carotenoids (Lu et al. 2001). A typical baked potato serving weighs approximately 170 g; so yellow-fleshed potatoes could supply a significant percentage of dietary lutein.

This trial involved screening several registered or near-registered yellow-fleshed potato varieties for flesh color, total carotenoid content and concentrations of lutein and zeaxanthin to determine whether any of the varieties would supply a good source of dietary lutein. Further we wanted to establish the stability of carotenoids, especially lutein, during storage and processing for some of the most promising lines. Identification of yellow-fleshed varieties with significant carotenoid concentrations would allow the potato industry in Alberta to market products, fresh and processed, as functional foods to health-conscious consumers.

Objectives

- To determine concentrations of total carotenoids and lutein and zeaxanthin in yellow-fleshed potato varieties grown in Alberta.
- To determine whether growing location (Brooks versus Edmonton) has an impact on total carotenoid content in yellow-fleshed potato tubers.
- To determine the stability of carotenoids, especially lutein and zeaxanthin, during storage of potato tubers with significant concentrations of carotenoids.
- To determine the stability of carotenoids, especially lutein and zeaxanthin, during cooking or processing of varieties with significant concentrations of carotenoids.

Methods

The trial was conducted in replicated plots at the Crop Diversification Centre South (CDCS) in Brooks, AB, and the Crop Diversification Centre North (CDCN) in Edmonton, AB. Twenty different yellow-fleshed varieties were included in the trial (Table 1). Two check varieties were also included as known comparisons. Three companies agreed to provide seed for the trial, and each company was asked for input in variety selection. Early generation seed (E2 or E3) of each variety was used for this trial. Seed was cut, if necessary, to ensure seed pieces of no more than 70 to 85 g, suberized, and planted 30 cm apart in 6 m rows spaced 90 cm apart. Each variety was grown in a randomized complete block design with four replicates (see plot plan).

Table 1: Yellow-fleshed potato varieties included in the lutein screening trial.

Variety	***Seed Supplied By***
Agata	Solanum International
Adora	HZPC Americas
Amandine	Solanum International
Baby Boomer	Solanum International
Cherie	Solanum International
Fabula	HZPC Americas
Innovator	HZPC Americas
Island Sunshine	Parkland Seed Potatoes
Mozart	HZPC Americas
Piccolo	Solanum International
Provento	Parkland Seed Potatoes
Red Scarlet	HZPC Americas
Rosara	Solanum International
Russet Burbank	Check
Cecile (RZ94-83)	HZPC Americas
Sante	Parkland Seed Potatoes
Satina	Solanum International
Sinora	Parkland Seed Potatoes
Velox	Solanum International
Victoria	HZPC Americas
Yukon Gold	Check

At CDCS the plots were managed following the guidelines for the Western Canadian Potato Breeding Program. Potatoes were planted approximately 12 to 14 cm deep using a two-row wheel planter on May 19, 2004 at CDCS. The plots were hilled prior to emergence and were irrigated at CDCS to maintain soil moisture close to 70%. Eptam (2.0 L/ac) was applied pre-planting (April 15), Lorox (1.8 L/ac) was applied pre-emergent (June 8) and Prism (24 g/ac) was applied post-emergent (June 23) to control weeds. Foliar fungicides were applied approximately every 2 weeks during the growing season to prevent early blight and late blight from developing (Table 2). Insecticides were applied July 15 (Sevin, 0.5 L/ac) and July 30 (Admire, 80 mL/ac) to control Colorado Potato Beetles. Reglone (1 L/ac) was applied August 27 to desiccate the plots. All treatments at CDCS were harvested mechanically September 9 and 10.

Table 2: Foliar fungicides applied to the potato crop at CDCS to prevent early blight and late blight development.

Date of Application	*Fungicide*	*Rate*
June 22	Quadris	0.250 L/ac
July 8	Dithane DG Rainshield	0.60 kg/ac
July 16	Ridomil Gold/Bravo	8.83 L/10 ac
July 30	Bravo 500	0.75 L/ac
August 12	Dithane DG Rainshield	0.60 kg/ac
August 27	Quadris	0.250 L/ac

At CDCN, plots were managed as dry-land plots following the guidelines for the Western Canadian Potato Breeding Program. Potatoes were planted approximately 12 to 14 cm deep using a two-row wheel planter on May 17, 2004. Plots were hilled May 25, prior to emergence, but difficult conditions at hilling resulted in some dragging and damaged tubers. Lorox (1.8 L/ac) was applied pre-emergent and plots were hand weeded in early July to control weeds. Foliar fungicide (Bravo, 1 L/ac) was applied approximately every 2 weeks during the growing season to prevent early blight and late blight from developing (4 applications). No insecticides were required. Reglone (1.4 L/ac) was applied August 31 to desiccate the plots. Harvest was delayed by early snowfall September 8 and 9 in the Edmonton area. All treatments at CDCN were harvested September 16.

Tubers were weighed to obtain yield estimates and graded into small, medium, large and deformed categories. Medium tubers (48 to 88 mm in diameter) were weighed to obtain estimates of marketable yield. Yield estimates have been presented in ton/acre although small plot trials do not always accurately reflect commercial yield potential (Appendix). A sample of 25 marketable tubers was washed and used to determine specific gravity by the weight-in-air over weight-in-water method. Each of these tubers was then cut longitudinally to assess brown center, hollow heart and other internal defects. Also, a composite sample of marketable tubers of each variety from each location was submitted to the Food Science lab at CDCS for measurement of flesh color (chroma) and analysis of total carotenoids, lutein and zeaxanthin. Samples of each variety were stored at 8°C for analysis of carotenoid stability in storage and lutein concentration after cooking or processing.

Field data were statistically analyzed using GLM and Duncan's Multiple Range Test ($p \leq 0.05$; SAS). Lab analyses were based on composite samples, so no statistics were applied.

Once initial assessments were complete, five varieties were selected (high lutein content, good yield and grade, and low to moderate specific gravity; see Appendix) for fresh market varieties. These potatoes were peeled, diced and either frozen or cooked then frozen. Another five varieties were selected (high lutein content, good yield and grade, and high specific gravity; see Appendix) for potential processing varieties. Eight tubers were used to cut fries, half of the fry strips from each potato were frozen, the other half were processed into fries, then frozen. These samples were analyzed for total carotenoids, lutein and zeaxanthin. The samples frozen before cooking/frying were compared to the post-harvest samples to determine stability of carotenoids during storage. The samples frozen after cooking/frying were compared to the before cooking/frying samples to show stability of carotenoids during cooking and processing.

Flesh color was measured using a HunterLab ColorQuest color measurement instrument. Tubers were prepared for color analysis by dicing into 1 cm cubes and using approximately 250 mL for color measurement. Measurements were made in triplicate. Chroma was measured using the CIELCh color scale, D65 illuminant and a 10° observer angle. Chroma is a measure of color intensity. Previous unpublished work in our lab indicated that chroma is the best indicator of yellowness in white and yellow-fleshed potatoes.

The composite sample provided for carotenoid analysis was diced and frozen (approximately 1 cm cubes). Carotenoid analysis was based on the method of Lu et al. (2001). Carotenoids were extracted from a 100 g sub-sample with 100 mL tetrahydrofuran containing 0.05% butylated hydroxytoluene, 2 g sodium carbonate and 3 g Celite 545 as a filter aid. The mixture was blended for 1 minute and vacuum filtered through Whatman 1 filter paper. The filter cake and paper were extracted a second time with fresh extraction solvent and the filtrates combined. Most of the yellow color was removed from the potatoes during the first extraction. The combined filtrate was evaporated on a rotary evaporator to remove the tetrahydrofuran. The concentrated extract was transferred quantitatively with a small amount of methanol to a separatory funnel containing 50 mL saturated aqueous sodium chloride. The aqueous solution was extracted repeatedly with methylene chloride until all the yellow color was removed. Generally, two extractions were sufficient. The methylene chloride extract was dried over anhydrous sodium sulfate. The extract was then evaporated to dryness. The residue was re-dissolved in mobile phase containing beta-apo-8'-carotenal as an internal standard to a final volume of 25 mL (fried samples were diluted to 50 mL). The extract was filtered though a 0.45 µm filter into an HPLC vial.

Analysis of carotenoids was performed on an Agilent 1100 liquid chromatography system using a Phenomenex Synergi Hydro RP column (4.6 x 250 mm) and diode-array detection at 450 nm. The mobile phase consisted of 70% acetonitrile, 15% methanol, 15% methylene chloride, 0.05% butylated hydroxytoluene and 0.01% N,N-diisopropylethylamine. Elution was isocratic at 0.8 mL/min. Linearity and retention times were verified with lutein and zeaxanthin standards. Carotenoid concentrations were calculated relative to the internal standard concentration.

Results

Composite samples of marketable potatoes from each location were used to determine the concentration of lutein and zeaxanthin per 100 g fresh weight of tuber. These samples were also used to determine flesh color intensity (chroma) and total carotenoid concentration from each potato variety at each location. The data for CDCS and CDCN are reported in Table 3.

Table 3: Flesh color intensity (chroma) and concentration of carotenoids (lutein, zeaxanthin = Zea, and total carotenoids; mcg per g FW) in yellow-fleshed potato tubers grown at two locations in Alberta.

	CDCS (Brooks)				CDCN (Edmonton)			
Variety	**Chroma**	**Lutein**	**Zea**	**Total**	**Chroma**	**Lutein**	**Zea**	**Total**
Russet Burbank	30.3	13.5	0.0	30.0	31.5	9.3	0.0	21.0
Innovator	41.9	22.7	1.4	90.0	43.6	23.5	1.5	85.0
Baby Boomer	42.3	17.6	0.6	69.0	44.6	25.3	1.2	86.0
Amandine	42.6	9.9	0.0	35.0	44.7	24.0	2.3	78.0
Provento	43.1	13.9	0.0	78.0	45.6	20.2	0.0	115.0
Cherie (red)	43.2	27.2	0.9	109.0	42.9	31.0	1.8	133.0
Adora	43.5	17.7	1.5	83.0	44.0	18.5	1.7	71.0
Velox	44.8	13.9	0.0	77.0	46.2	12.7	0.0	54.0
Sante	45.0	27.2	2.2	120.0	47.4	36.2	2.1	142.0
Agat	45.5	23.5	0.0	95.0	46.2	29.0	1.5	93.0
Red Scarlett	45.5	17.6	0.0	74.0	47.2	16.3	0.0	60.0
Yukon Gold	46.6	12.6	0.4	65.0	46.0	10.6	2.0	59.0
Fabula	46.8	17.0	1.3	93.0	48.0	23.9	2.4	115.0
Cecile (red)	47.5	40.6	0.0	195.0	49.5	32.4	1.0	128.0
Sinora	47.6	28.2	0.9	111.0	50.2	17.3	0.0	54.0
Penta	47.6	27.5	0.8	116.0	47.8	26.3	1.5	93.0
Mozart red)	48.0	18.6	0.0	62.0	48.6	31.3	1.0	96.0
Rosara (red)	48.2	21.7	0.6	146.0	51.2	24.8	2.2	125.0
Piccolo	50.2	23.6	1.0	110.0	53.3	21.5	1.4	102.0
Satina	50.7	54.0	3.3	227.0	51.0	50.8	4.2	110.0
Victoria	51.1	22.5	0.9	124.0	49.6	21.9	2.1	110.0
Island Sunshine	53.6	45.0	1.2	240.0	53.0	34.3	0.5	133.0

Chroma is the measurement of color most closely aligned with our perception of color intensity. The chroma of tuber flesh ranged from 30 in the Russet Burbank check (considered off-white) to over 50 in several of the yellow-fleshed varieties (the higher the number, the more yellow the appearance of the flesh). Yellow flesh color is a heritable trait (Lu et al. 2001) and is characteristic of a particular variety. Although there was very good correlation between chroma values from samples obtained at the two locations (r^2 = 0.925), the values from CDCS and CDCN were not identical. Growing conditions and size at the time of harvest may influence the chroma values for each variety as well.

In the literature, it is noted that individual and total carotenoid content are positively correlated with flesh color. We found that flesh color was more closely correlated with total carotenoids (r^2 = 0.46) than with lutein (r^2= 0.30), and even then, the correlation was positive but not all that strong. The correlations were stronger for samples from CDCS than from CDCN and may relate to tuber maturity. Certainly, carotenoids other than lutein and zeaxanthin contribute to yellow flesh color and compounds other than carotenoids may also influence the chroma of potato tubers.

Total carotenoid concentration in yellow-fleshed potatoes ranged from 35 to 240 µg / 100 g FW. Lutein, zeaxanthin, and several other carotenoids have been reported to be present in yellow-fleshed tubers (Brown et al. 1993, Lu et al. 2001, Brethaupt and Bamedi 2002). Lutein and zeaxanthin specifically, have been linked to improved eye health in clinical studies (Bruno and Medeiros 2000, Moeller et al. 2000, Krinsky et al. 2003). Lutein was present in appreciable amounts in all of the varieties examined, even the non-yellow check, Russet Burbank. However, zeaxanthin was present in very low quantities and did not contribute significantly to the total carotenoid concentration in the tubers. In most varieties, lutein made up to ⅓ of the total carotenoid content. It was beyond the scope of this trial to identify other carotenoid compounds present in the potato tubers. Lutein concentration ranged from 9.3 µg / 100 g FW in the Russet Burbank check to over 50 µg / 100 g FW in the variety Satina. Again, there was a strong correlation ($r^2 = 0.925$) in lutein concentration between locations, but the numbers were not identical. There may be an influence of growing location (environment, latitude, soil type, etc.) or the size and maturity of the tubers harvested on lutein concentration, but variety seemed to be the greatest influencing factor. Total carotenoid concentration was correlated between CDCN and CDCS samples, but the correlation for total carotenoid ($r^2 = 0.57$) was not as strong as that for lutein ($r^2 = 0.62$). This suggests that compounds other than lutein may be more variable from one location to another.

Based on the lutein data (Table 3), yield data, tuber shape and specific gravity data (Appendix); five varieties were selected to move forward as potential fits for fresh market. Varieties with high lutein, moderate to low specific gravity, high yields of marketable or small potatoes, and pleasant tuber shapes were selected for fresh market interest. These varieties, Agata, Cecile, Island Sunshine, Piccolo, and Satina, were compared to Yukon Gold, a well-known yellow-fleshed variety sold in the fresh market, for storage and cooking data collection.

Based on the lutein data (Table 3), yield, tuber shape and specific gravity data (Appendix); five varieties were selected to move forward as potential fits for the processing industry. Varieties with high lutein, oblong to oval tuber shape, good marketable yield and high specific gravity were selected for processing interest. These varietie, Innovator, Sante, Satina, Sinora, and Victoria, were compared with Russet Burbank, a widely used French fry processing variety, for storage and frying data collection.

Lutein, zeaxanthin and total carotenoids were determined again after approximately four months in storage. Carotenoid stability varied with variety, and in all cases, less total carotenoid and less lutein were recovered from tubers after storage. Differences may be related to the physiology of specific varieties (including size and maturity at harvest) or may relate to variability in dormancy and shrinkage in storage. The storage lutein data for the fresh market and processing varieties are shown in Figure 1.

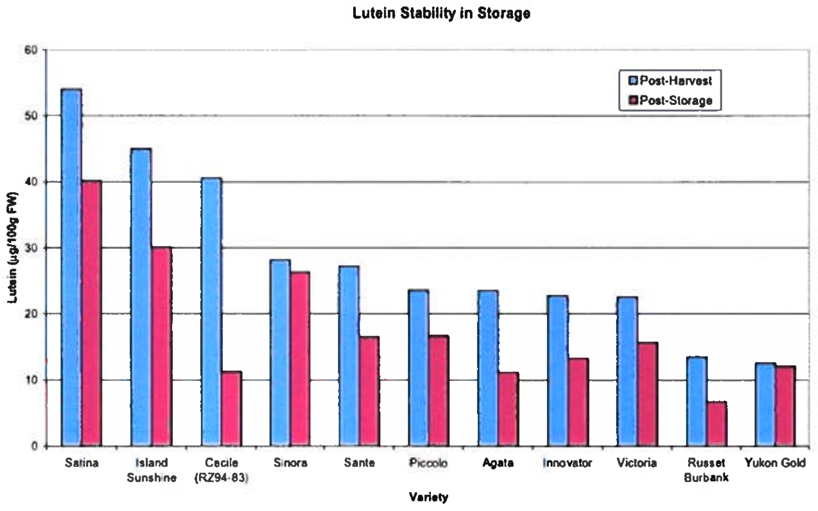

Figure 1: Concentration (µg / g FW) of lutein extracted from yellow-fleshed potatoes at harvest (post-harvest), and after four months storage (post-storage).

Total carotenoids, lutein and zeaxanthin were extracted from samples that had been cooked out of storage (Figure 2). These potatoes were diced, boiled, frozen and used for carotenoid extraction. As noted, less lutein was recovered from stored potatoes than from freshly harvested potatoes. After cooking, lutein recovery differed with variety (Figure 2). In Satina and Piccolo, less lutein was recovered after cooking than before. In Island Sunshine, Cecile, Yukon Gold and Agata, more lutein was recovered after cooking than before. This trend was observed for total carotenoids as well regardless of whether concentration was expressed in terms of fresh weight or dry weight of tuber tissue, so the differences cannot be explained on the basis on moisture content alone.

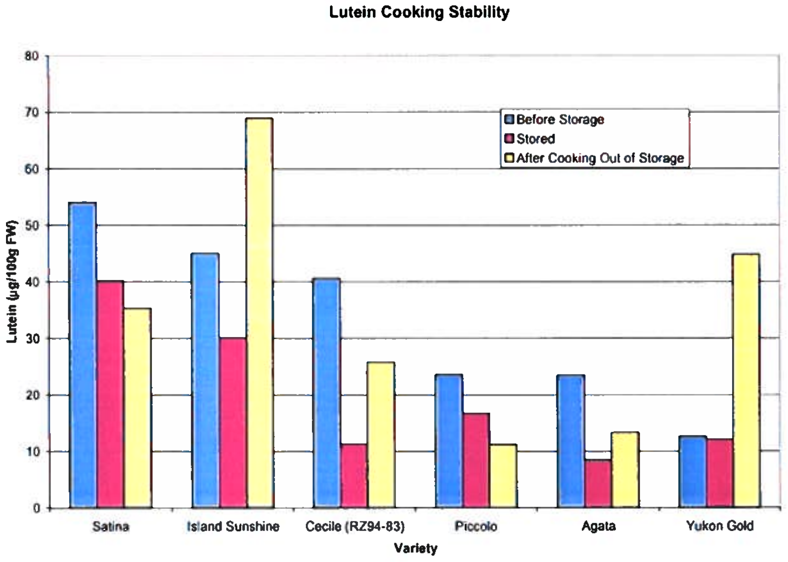

Figure 2: Concentration (µg / g FW) of lutein extracted from yellow-fleshed potatoes at harvest (before storage), after four months storage (stored), and after cooking out of storage.

Total carotenoids, lutein, and zeaxanthin were also extracted from samples that had been fried out of storage (Figure 3). These potatoes were sliced into fry strips, blanched, frozen, fried and used for lutein extraction. As already noted, less lutein was recovered from tubers after storage than after harvest. However, the quantity of lutein extracted from fried samples was much higher than from stored samples for all varieties fried. This trend was also observed for total carotenoid concentrations. This can in part, be accounted for because of changes in moisture content as a result of frying, but was true of all varieties expect for Sante, even when expressed in terms of dry weight of tuber tissue.

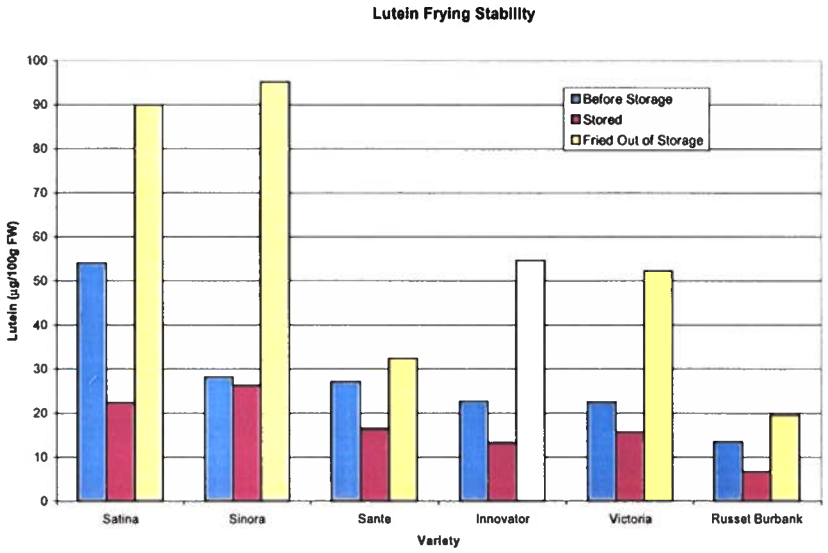

Figure 3: Concentration (µg / g FW) of lutein extracted from yellow-fleshed potatoes at harvest (before storage), after four months storage (stored), and after frying out of storage.

The greater recovery of lutein after cooking or frying may be explained by a number of possible rationales:

1. Because lutein is lipophillic (soluble in solvents, not water), heating as a result of cooking or frying and cell disruption may increase the quantity of lutein extracted by the same method; or
2. Some other carotenoid compounds (for example lutein epoxides and lutein esters) may be converted to lutein during the cooking or frying process; or
3. The reduction in water concentration in the tissues as a result of cooking and frying may result in less interference during the extraction process and allow for greater extraction efficiency.

It was, however, not within the scope of this project to determine which explanation best fits the data.

Conclusions

Total carotenoid content in the yellow-fleshed potatoes studied ranged from 35 to 240 µg per 100 g FW and can be influenced by the growing location, storage and cooking or frying. The concentration of lutein in yellow-fleshed potatoes depended on the variety, among other factors, and ranged from 9.3 µg per 100 g FW to over 50 µg per 100 g FW in the varieties studied. Lutein concentrations in raw potatoes were higher after harvest than after storage for all varieties studied, but lutein concentrations were still significant after 4 months at 8°C. Lutein recovery after cooking or frying was greater than recovery from raw stored potatoes for most varieties studied. When boiled or fried, an average size yellow-fleshed potato can contribute five times the dietary lutein, and eight times the total carotenoid content found in more common potato varieties.

Presentation to Industry

Preliminary data was presented in a Power Point slide show at a breakfast meeting of the Potato Growers of Alberta in Taber, Alberta February 22, 2005. A second presentation of data is being arranged for a Potato Growers of Alberta area meeting in Edmonton August 18, 2005 and a poster version of the results will be prepared for the Potato Growers of Alberta Annual Meeting in November. A copy of this report will be provided to all of our industry sponsors a once it is approved.

Industry Reaction

The reaction from industry so far has been positive. Potato production has remained static in Alberta while acres of potatoes are being reduced in other growing areas. This project is being perceived as an effort to add value to fresh potato sales, and to provide a marketing angle to processors and packers alike. The data from the NIF project allowed us to move forward with the concept. We applied to Ag & Food Council this spring for funds to allow us to explore the impact of growing location and time of harvest on several varieties for two additional years. We have industry funds from several interested parties as well. The information generated in the NIF project and the two-year Ag & Food Council project will give us a firm base of scientific information from which to initiate a marketing study. It is not clear how industry intends to use the information to advantage. A collective effort between industry competitors is unlikely. Individual industry members may capitalize on this information in different ways.

Summary

The color of yellow-fleshed potatoes is imparted by carotenoids. Carotenoids are anti-oxidant compounds that may protect against a variety of chronic diseases and certain cancers. Lutein and zeaxanthin are two specific carotenoid compound associated with a reduced incidence of age-related macular degeneration and cataract formation. This project involved screening twenty yellow-fleshed potato varieties grown in two Alberta locations, and analyzing them for tuber flesh color intensity, total carotenoid content and concentrations of lutein and zeaxanthin. Total carotenoid content ranged from 35 to 240 µg per 100 g FW and was positively correlated with tuber flesh color intensity. Lutein accounted for approximately ⅓ of the total carotenoid content in many varieties and ranged from 9.3 µg per 100 g FW in the Russet Burbank (off-white) check to over 50 µg per 100 g FW in the variety Satina (deep-yellow). Zeaxanthin was present in low concentrations and did not contribute significantly to the total carotenoid content in the varieties studied.

Five promising fresh market varieties (Agata, Cecile, Island Sunshine, Piccolo and Satina) were selected for storage and cooking analyses. Five varieties (Innovator, Sante, Satina, Sinora and Victoria) were selected as promising processing varieties for storage and frying stability analyses. Less lutein was extracted from stored potatoes than from freshly harvested potatoes, but the decrease in lutein concentration depended on the potato variety. More lutein was recovered from cooked potato than from stored potato for three of the fresh market varieties. Similarly, the concentration of lutein extracted from fried samples was much higher than from stored samples for all of the processing varieties studied. A reduction in moisture content only accounted for a portion of the increase in lutein concentration observed. Although the reason for greater lutein concentrations after cooking and frying was not determined, we have put forward some possible explanations. Potato varieties with significant concentrations of lutein and zeaxanthin may be marketed in the future as functional foods.

Sponsors

AAFRD New Initiatives Fund

Potato Growers of Alberta

Con Agra Limited (Lamb-Weston)

Maple Leaf Potatoes

McCain Foods Ltd.

Solanum International

HZPC Americas Corp.

Parkland Seed Potatoes

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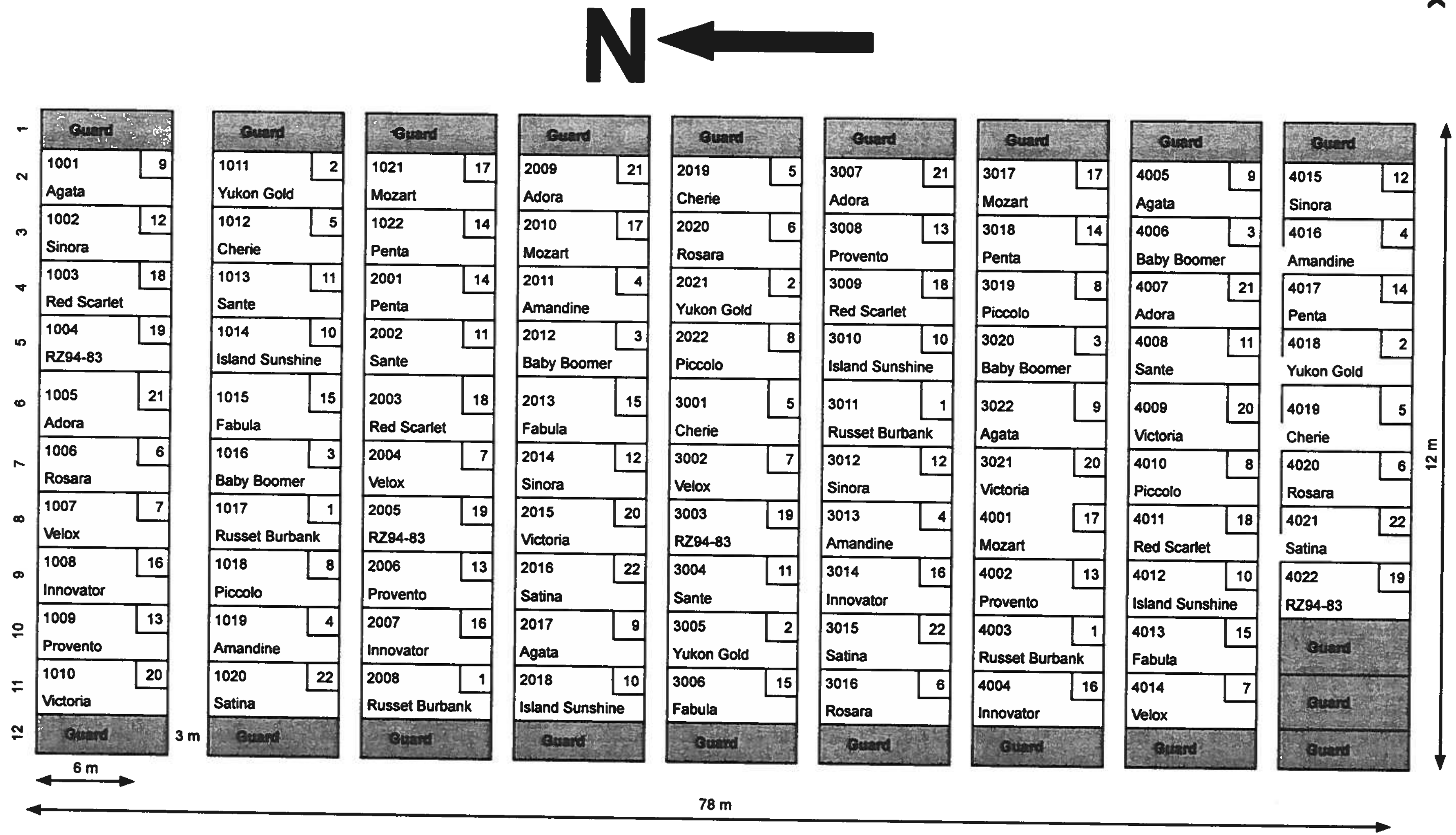
Appendix

Figure A1: Plot plan for lutein screening trial 2004

Lutein Screening Trial 2004 - Field 71
22 cultivars x 4 reps
6 metre rows, 20 hills/plot row, 30 cm plant spacing



1	Guard	Guard	Guard	Guard	Guard	Guard	Guard	Guard	Guard
2	1001 Agata 9	1011 Yukon Gold 2	1021 Mozart 17	2009 Adora 21	2019 Cherie 5	3007 Adora 21	3017 Mozart 17	4005 Agata 9	4015 Sinora 12
3	1002 Sinora 12	1012 Cherie 5	1022 Penta 14	2010 Mozart 17	2020 Rosara 6	3008 Provento 13	3018 Penta 14	4006 Baby Boomer 3	4016 Amandine 4
4	1003 Red Scarlet 18	1013 Sante 11	2001 Penta 14	2011 Amandine 4	2021 Yukon Gold 2	3009 Red Scarlet 18	3019 Piccolo 8	4007 Adora 21	4017 Penta 14
5	1004 RZ94-83 19	1014 Island Sunshine 10	2002 Sante 11	2012 Baby Boomer 3	2022 Piccolo 8	3010 Island Sunshine 10	3020 Baby Boomer 3	4008 Sante 11	4018 Yukon Gold 2
6	1005 Adora 21	1015 Fabula 15	2003 Red Scarlet 18	2013 Fabula 15	3001 Cherie 5	3011 Russet Burbank 1	3022 Agata 9	4009 Victoria 20	4019 Cherie 5
7	1006 Rosara 6	1016 Baby Boomer 3	2004 Velox 7	2014 Sinora 12	3002 Velox 7	3012 Sinora 12	3021 Victoria 20	4010 Piccolo 8	4020 Rosara 6
8	1007 Velox 7	1017 Russet Burbank 1	2005 RZ94-83 19	2015 Victoria 20	3003 RZ94-83 19	3013 Amandine 4	4001 Mozart 17	4011 Red Scarlet 18	4021 Satina 22
9	1008 Innovator 16	1018 Piccolo 8	2006 Provento 13	2016 Satina 22	3004 Sante 11	3014 Innovator 16	4002 Provento 13	4012 Island Sunshine 10	4022 RZ94-83 19
10	1009 Provento 13	1019 Amandine 4	2007 Innovator 16	2017 Agata 9	3005 Yukon Gold 2	3015 Satina 22	4003 Russet Burbank 1	4013 Fabula 15	Guard
11	1010 Victoria 20	1020 Satina 22	2008 Russet Burbank 1	2018 Island Sunshine 10	3006 Fabula 15	3016 Rosara 6	4004 Innovator 16	4014 Velox 7	Guard
12	Guard	Guard	Guard	Guard	Guard	Guard	Guard	Guard	Guard

Table A1: Description, characteristics and resistance or susceptibilities of yellow-fleshed potato varieties and check varieties used in the trial

	Description					Characteristics			Resistance or Susceptibilities													
Cultivar	**Maturity**	**Skin Color**	**Flesh Color**	**Tuber Shape**	**Eyes**	**Yield Potential**	**Storage**	**Utilization**	**Comon Scab**	**Hollow Heart**	**Blackleg**	**Fusarium**	**Rhizoctonia**	**Late Blight**	**PVA**	**PVS**	**PVX**	**PVY**	**PLRV**	**Wart**	**Nematodes**	**Metribuzin**
Adora	early	light yellow	pale yellow	oblong	shallow/medium	high		boil, bake	MR		MS	R					R	MR	MR		R(G)	
Agata	early	smooth, yellow	yellow	oval/long	shallow	high	very good, short dormancy	boil, bake	MR		MR	MR		MR					MR	HR	R(A)	R
Amandine	early	pale yellow	pale yellow	long	very shallow	high			R					R				S	S			
Baby Boomer	mid-season	yellow	yellow	round	medium	high	good	bake, wedges	R					S								
Cecile		deep red	bright yellow	oval/long	shallow			boil, bake														
Cherie	early	red	pale yellow	oval/long	very shallow	high	good	boil, bake	MR					MS								
Fabula	mid-season	yellow	pale yellow	oval	shallow	very high		boil, bake	MR					R	HR		R	R	HR	HR		
Innovator	early	reddish brown	cream	oval/long	shallow	high	good, can recondition	boil, bake, fry	MR					R		MR	MR	MR		HR		S
Island Sunshine	very late	buff, flaky	yellow	round	deep	high	very good, long dormancy	boil, bake	MR			MR		HR(1)				S	S			
Mozart																						
Penta	mid-season	yellow / red eyebrows	yellow	round	shallow/medium	high	good, good dormancy	boil, bake	MR		MS		MR	MR	R		R	S	MR	S	R(A)	
Piccolo	medium early	yellow	yellow	oval/long	shallow	high	good dormancy	boil, bake	R					S								
Provento	mid-season	yellow	yellow	round/oval	shallow	very high		boil, bake	MR		MR	MS		MR	HR		HR	R	R	HR	S	MR
Red Scarlett	early	red	pale yellow	oval	shallow	high		boil, bake	MR					MS				MR	MR	HR		
Rosara	first early	red	yellow	oval/long	shallow	high	medium	boil, bake	R	R	R		MR	R								
Russet Burbank	very late	russet, netted	white	long	shallow	high	good	boil, bake, fry	R		HR	R						HS				
Sante	mid-season	buff	light yellow	oblong	shallow	very high	good	boil, bake, fry	MR		MS	MR		HR	HR		HR	HR	HR	HR	HR	S
Satina	medium early	yellow	deep yellow	oval	shallow/medium	very high	good	boil, bake		HR	MR		HR	MR						R		
Sinora	early	yellow	light yellow	round/oval	shallow/medium	high	good	fries, chips	MS					MR			R	R	MR			
Velox	first early	yellow	light yellow	oval/long	very shallow	high	medium	boil, bake, fry	MR	MR	HR		MR	MR						MR		
Victoria	mid-season	yellow	yellow	oval/long	shallow	high	good	boil, bake, fry	S					MR			MR	R	R	HR		

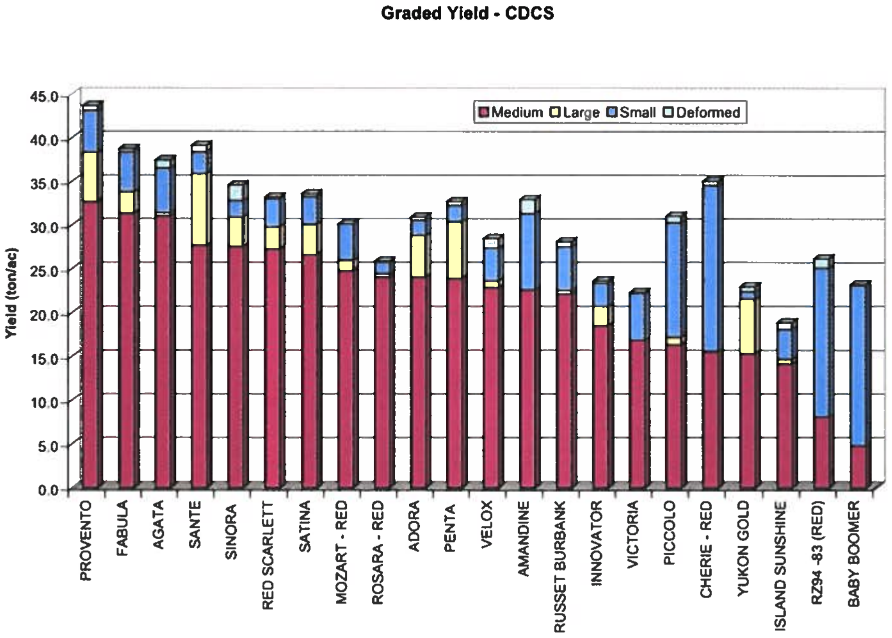


Figure A2: Estimated yield and grade (ton/ac) of each variety of yellow-fleshed potatoes grown at CDCS in Brooks.

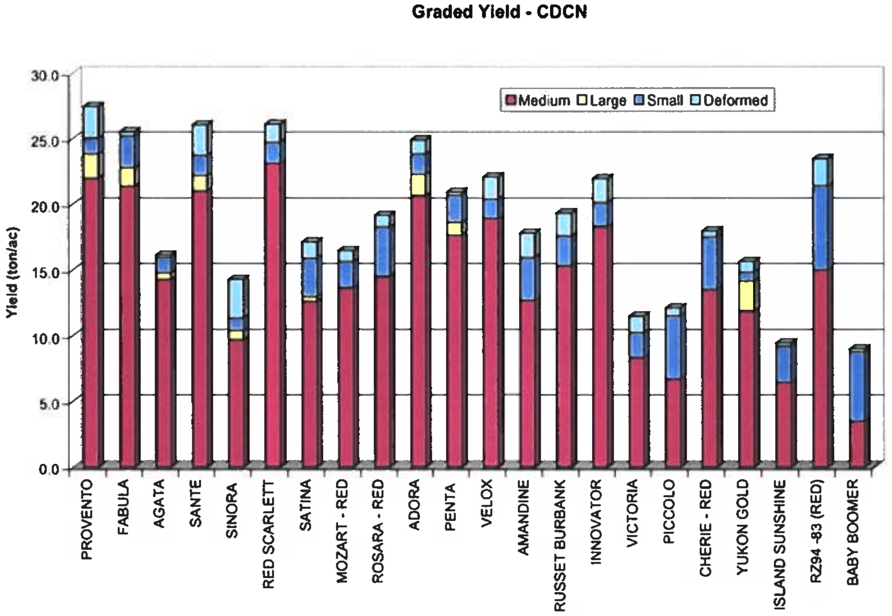


Figure A3: Estimated yield and grade (ton/acre) of each variety of yellow-fleshed potatoes grown at CDCN in Edmonton.

Table A2: Specific gravity of yellow-fleshed potato varieties grown at CDCS (Brooks) and CDCN (Edmonton).

Variety	***CDCS***	***CDCN***
Agata	1.065	1.031
Adora	1.072	1.048
Amandine	1.072	1.041
Baby Boomer	1.097	1.051
Cherie	1.078	1.058
Fabula	1.066	1.044
Innovator	1.081	1.060
Island Sunshine	1.091	1.040
Mozart	1.076	1.048
Piccolo	1.081	1.047
Provento	1.078	1.052
Red Scarlet	1.070	1.045
Rosara	1.077	1.048
Russet Burbank	1.091	1.063
Cecile (RZ94-83)	1.078	1.048
Sante	1.082	1.057
Satina	1.081	1.046
Sinora	1.084	1.043
Velox	1.084	1.059
Victoria	1.078	1.046
Yukon Gold	1.089	1.058

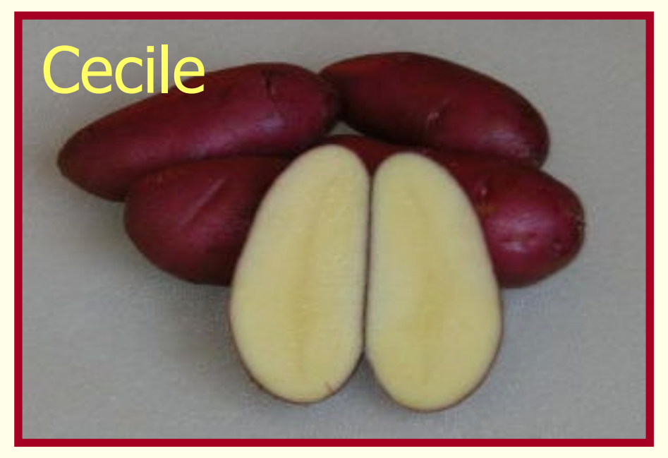
Lutein in Yellow-Fleshed Potatoes – 2005 Lab Data Update

Michele Konschuh[1], Tricia McAllister[2], Simone Dalpé[1], Tina Lewis[2] and Darcy Driedger[3]
Alberta Agriculture, Food and Rural Development
Crop Diversification Centre South[1], 301 Horticultural Station Road East, Brooks, AB T1R 1E6;
Crop Diversification Centre North[2]; Food Processing Development Centre[3]

Abstract

The color of yellow-fleshed potatoes is imparted by carotenoids. Carotenoids are anti-oxidant compounds that may protect against a variety of chronic diseases and certain cancers. Lutein is a specific carotenoid compound associated with a reduced incidence of age-related macular degeneration and cataract formation. This project involved growing ten yellow-fleshed potato varieties in three Alberta locations, harvesting at three different times and analyzing them for tuber flesh color intensity, total carotenoid content and lutein concentration. Total carotenoid content ranged from 17 to 250 µg per 100 g FW and was positively correlated with tuber flesh color intensity, especially when tubers were harvested at 100 days after planting. Lutein accounted for approximately 25% of the total carotenoid content in many varieties and ranged from 3.2 µg per 100 g FW in one variety (Sinora) to over 50 µg per 100 g FW in the variety Satina. Lutein concentration was determined most by variety, but varied with time of harvest and between locations. Satina and Victoria had consistently higher concentrations of lutein than most of the varieties studied. An average serving of Satina potatoes would provide approximately 100 µg of dietary lutein. Potato varieties with significant concentrations of lutein may be marketed in the future as functional foods.

Fresh Market Varieties



Objectives

1. To determine lutein concentration in up to 10 potato varieties grown at three locations in Alberta;
2. To determine what effect growing location and time of harvest have on lutein concentration in each variety;
3. To determine the amount of lutein contributed in an average potato serving for use in marketing strategies.

Acknowledgements

•Funding for the project was provided by Ag & Food Council, Potato Growers of Alberta, Alberta Food and Rural Development, Lamb-Weston, HZPC Americas, Parkland Seed Potatoes Ltd., Solanum International, Edmonton Potato Growers and The Little Potato Company .

•Special thanks to Marivic Hansen and Cindy Dykstra for flesh color and carotenoid analyses.

Lutein Content

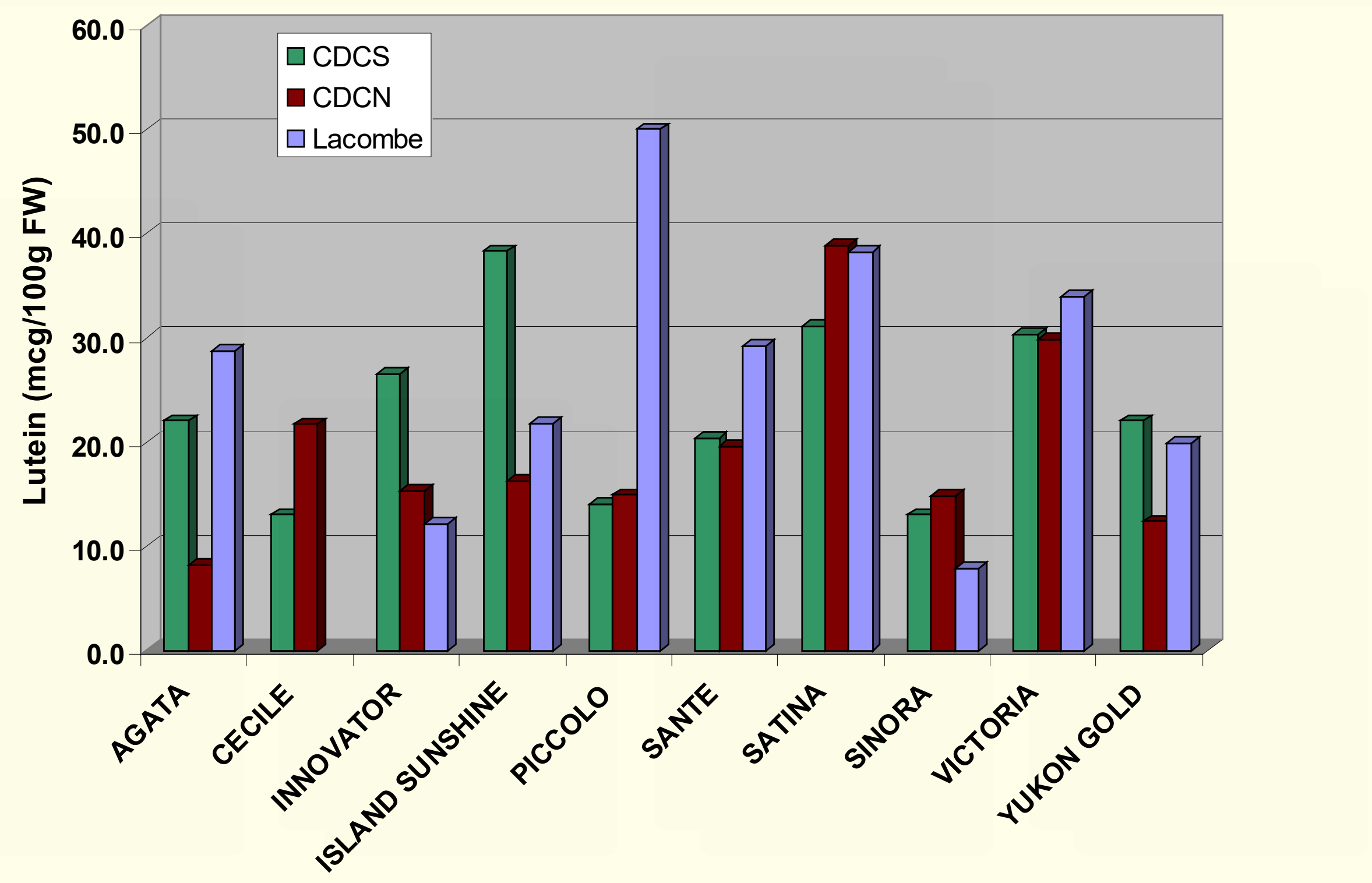


Figure 1: Concentration (µg / 100g FW) of lutein extracted from yellow-fleshed potatoes harvested at 80 days after planting (DAP) at CDCS in Brooks, AB, CDCN in Edmonton, AB, and in a commercial field in Lacombe.

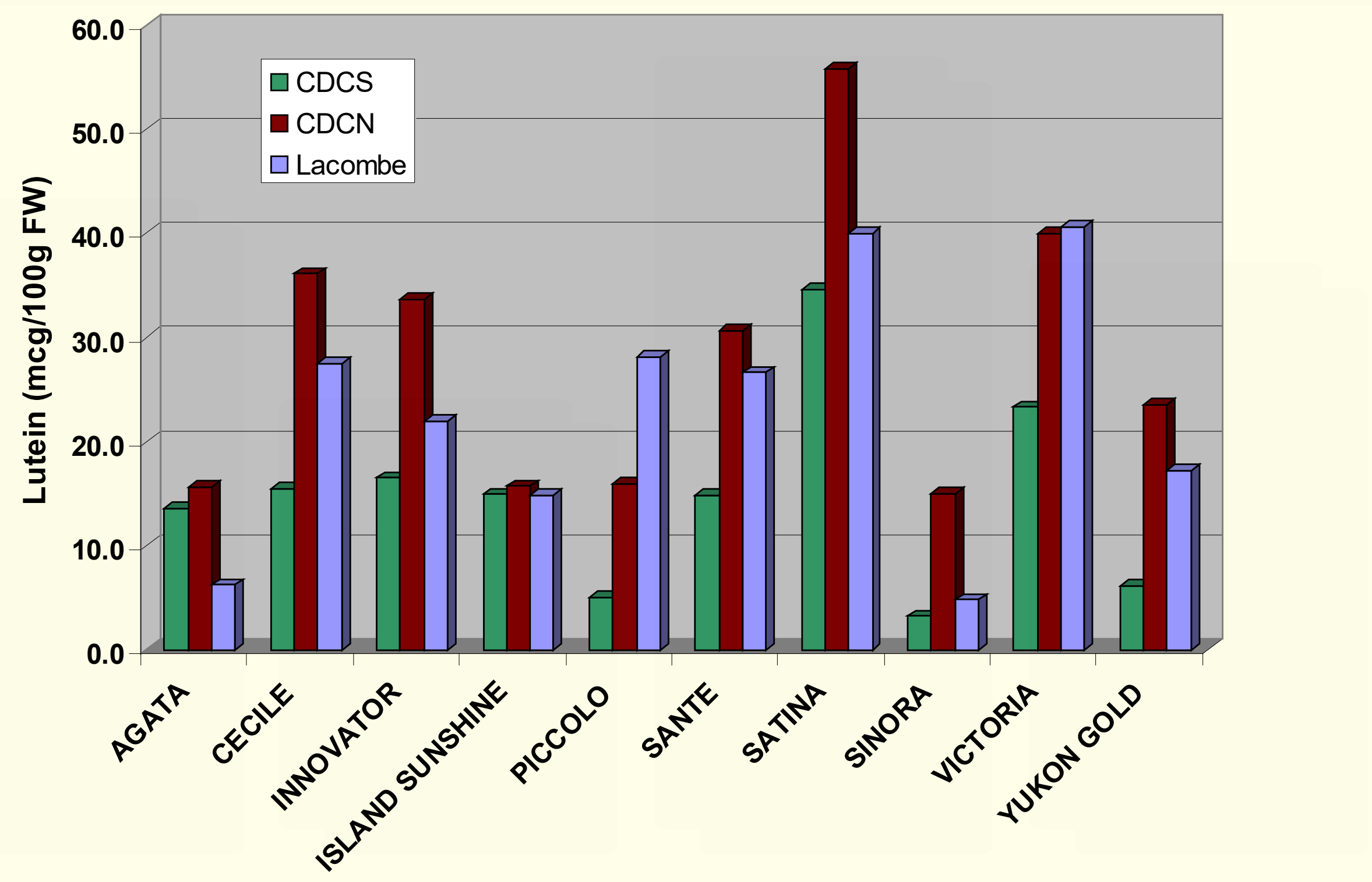


Figure 2: Concentration (µg / 100g FW) of lutein extracted from yellow-fleshed potatoes harvested at 100 days after planting (DAP) at CDCS in Brooks, AB, CDCN in Edmonton, AB, and in a commercial field in Lacombe.

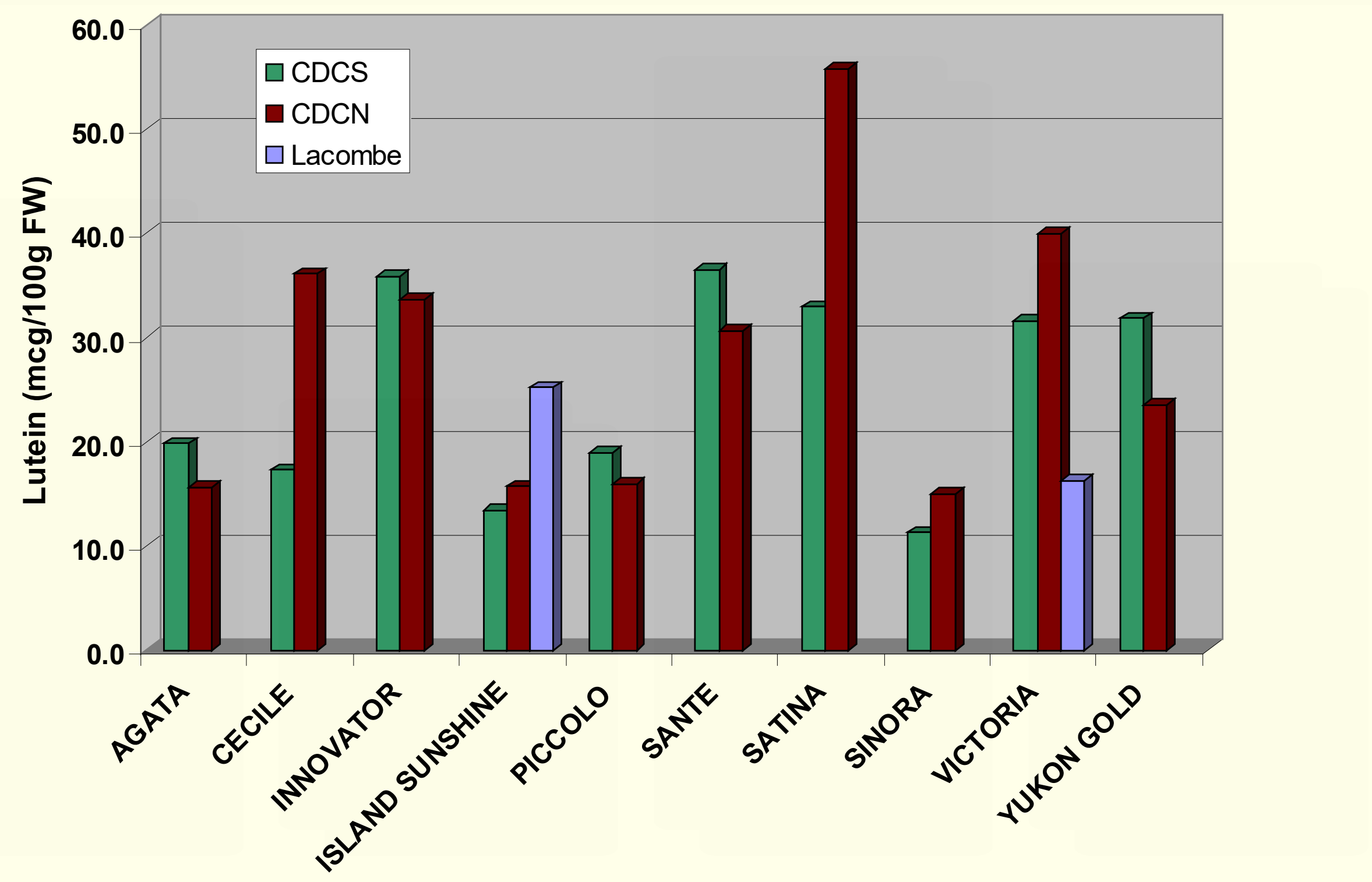


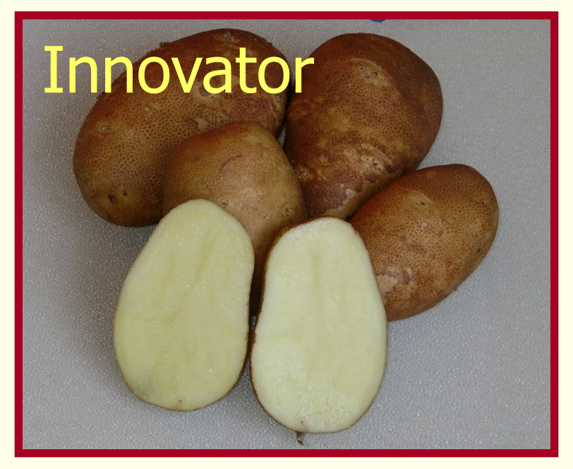
Figure 3: Concentration (µg / 100g FW) of lutein extracted from yellow-fleshed potatoes harvested at 130 days after planting (DAP) at CDCS in Brooks, AB, CDCN in Edmonton, AB, and in a commercial field in Lacombe.

Carotenoid Content

Table 4: Total carotenoid concentration of yellow-fleshed potato tubers grown at three locations in Alberta, harvested approximately 80 days after planting (DAP), 100 DAP and 130 DAP.

	CDCS (Brooks)			CDCN (Edmonton)			Lacombe	
Variety	80 DAP	100 DAP	130 DAP	80 DAP	100 DAP	130 DAP	80 DAP	100 DAP
Agata	97.9	69.1	79.1	38.6	63.6	40.4	158.0	34.9
Cecile	81.4	84.7	89.6	151.8	218.3	137.0		160.0
Innovator	130.2	94.9	139.2	78.8	156.4	58.6	58.9	103.5
Island Sunshine	196.2	77.9	64.3	102.8	86.7	58.2	132.6	90.9
Piccolo	84.7	34.4	107.6	112.3	116.2	85.2	283.3	126.3
Sante	112.3	108.2	157.8	128.6	202.3	100.9	179.7	163.0
Satina	160.9	192.5	140.1	186.1	257.4	173.9	187.2	192.4
Sinora	64.7	17.1	53.1	65.9	78.7	46.1	47.4	23.1
Victoria	186.1	179.7	177.3	202.8	242.5	136.8	220.6	240.9
Yukon Gold	113.7	38.3	124.3	69.1	136.8	80.1	116.8	95.9

Potential Processing Varieties



Conclusions

•Total carotenoid content in the yellow-fleshed potatoes studied ranged from 17 to 250 µg per 100 g FW and was influenced by variety, the growing location, and the time of harvest.
•The concentration of lutein in yellow-fleshed potatoes depended on the variety, the growing location and time of harvest, and ranged from 3.2 µg per 100 g FW to over 50 µg per 100 g FW in the varieties studied.
•Lutein accounted for approximately 25 % of the total carotenoid concentration depending on the time of harvest.
•Although lutein concentration can be influenced by growing location and time of harvest, chroma, total carotenoid and lutein are determined most through genetics.
•Satina and Victoria had consistently higher lutein than other varieties in 2005.

EXECUTIVE SUMMARY

(Advancing Canadian Agriculture and Agri-Food Program [ACAAF]
Progress Report March 2006)

The color of yellow-fleshed potatoes is imparted by carotenoids. Carotenoids are anti-oxidant compounds that may protect against a variety of chronic diseases and certain cancers. Lutein is a specific carotenoid compound associated with a reduced incidence of age-related macular degeneration and cataract formation. This project involved growing ten yellow-fleshed potato varieties in three Alberta locations, harvesting at three different times and analyzing them for tuber flesh color intensity, total carotenoid content and lutein concentration. Total carotenoid content ranged from 17 to 250 μg per 100 g FW and was positively correlated with tuber flesh color intensity, especially when tubers were harvested at 100 days after planting. Lutein accounted for approximately 25% of the total carotenoid content in many varieties and ranged from 3.2 μg per 100 g FW in one variety (Sinora) check to over 50 μg per 100 g FW in the variety Satina. Lutein concentration was determined most by variety, but varied with time of harvest and between locations. Satina and Victoria had consistently higher concentrations of lutein than most of the varieties studied. An average serving of Satina potatoes would provide approximately 100 μg of dietary lutein. Potato varieties with significant concentrations of lutein may be marketed in the future as functional foods.

Market Opportunity Assessment for Lutein in Potatoes in Alberta

Prepared for:

Dr. Michele Konschuh
and
Functional Foods/Natural Health Products Theme
Alberta Agriculture, Food and Rural Development

Prepared by:
Dean Dyck, P. Ag.
Financial Business Analyst
Market Opportunities and Innovation Division

November 2006

Table of Contents

A. Disclaimer and Acknowledgements

The information contained within this report contains summaries of several papers, studies, opinions and research sources pertaining to opportunities for lutein in potatoes. The author wishes to thank the following people for their assistance in the preparation of this report:

- Dr. Michele Konschuh, Potato Research Scientist, Alberta Agriculture, Food and Rural Development
- Patricia McAllister, Seed Potato Specialist, Alberta Agriculture, Food and Rural Development
- Shirzad Chunara, Health Claims Research Assistant, Alberta Agriculture, Food and Rural Development
- Darcy Driedger, Program Manager, Alberta Agriculture, Food and Rural Development
- Alfonso Parra, Technical Director, Potato Growers of Alberta

B. Definition or description of new idea/product/concept

Lutein (LOO-teen) is one of over 600 known naturally occurring carotenoids. Found in green leafy vegetables such as spinach and kale, lutein is employed by organisms as an antioxidant and for blue light absorption.

Lutein was found to be present in a concentrated area of the macula, a small area of the retina responsible for central vision. The hypothesis for the natural concentration is that lutein helps protect from oxidative stress and high-energy light. Various research studies have shown that a direct relationship exists between lutein intake and pigmentation in the eye. Several studies also show that an increase in lutein concentration in the macular region of the retina decreases the risk for eye diseases such as Age-related Macular Degeneration (AMD).

Lutein is a natural part of human diet when fruits and vegetables are consumed. For individuals lacking sufficient lutein intake, fortification via vitamin tablets or lutein-fortified foods is available. As recently as 1996, lutein has been incorporated into dietary supplements. While no recommended daily allowance currently exists for lutein as for other nutrients, positive effects have been seen at supplemented levels of 6 mg/day. The only definitive side effect of excess lutein consumption is the same observed for β-carotene overdose, namely bronzing of the skin (carotenodermia). The normal levels of lutein found in a daily vitamin are 0.25mg.

C. Executive Summary

Trends

- ➢ The baby boomer demographic will continue to shape the market by adopting healthier eating habits. Add to this the younger busy family shoppers, who have strong concerns and interests as well as higher household income. Thus, **the link between nutrition and health/wellness, although not completely understood by consumers, will continue to influence the market.**

- Trends indicate that nutrition continues to be an important factor for the majority of Canadians when making food choices. Since many of the purchase decisions are made while shopping, having readily accessible food and nutrition information at the point of purchase would assist consumers in making choices.
- Potato consumption is declining in Canada, noticeably in the fresh and frozen sectors. However, chips and processed potato sectors are increasing as consumers look for "spontaneous" purchases.

Strengths

- Yellow fleshed potato varieties can be competitively grown in Alberta with high lutein content.
- The target markets – the "baby boomer" generation – are likely to purchase a product with health benefits.

Weaknesses

- Consumers may not be entirely aware of the benefits of lutein.
- Lack of profitability at the farm gate may hinder production and therefore marketing of yellow fleshed varieties. In particular, storage losses and high grade outs hinder profitability in the short and long run.

Opportunities

	Time Frame	**Impact**	**Likelihood**	**Strategies**
Market the benefits of yellow fleshed potato varieties to "baby boomers" who eat more potatoes and are concerned with health issues such as AMD.	1 – 2 years	High		A media campaign that is designed to address "maintaining health", specifically the benefits of lutein and AMD; have more promotional materials available.
Promote the benefits of the yellow fleshed varieties.	1 – 2 years	High		Effective merchandising ideas and point of purchase (POP) displays, promotional plans and customer support.
Determine the level of interest and significant factors in consumers decision to purchase potatoes.	1 – 2 years	High		Commission consumer point of sale (POS) surveys on purchase decisions on yellow fleshed

				varieties such as attributes, willingness to pay, etc.

Threats

	Impact	Likelihood	Strategies
Yellow fleshed potatoes must compete with white and red potatoes, pasta and white rice for market share.			Have uniformity in labeling; effective product placement in grocery stores; and product consistency in texture and quality.
Many consumers are not sure what "healthy" really means.			Have effective marketing campaigns targeting the benefits of lutein and potatoes.
Farm gate profitability may hinder supply in the short run.			Address grade outs to increase yields and income at farm gate.

Critical Issues and Risks

1. *Industry actions*

Labeling, product placement and product consistency are critical to the success of this project. All industry players must work together to achieve these goals.

2. *Consumer education*

Nutrition is not ranked high on the scale of "first to mind" in purchasing potatoes. An assertive education process highlighting the benefits of yellow fleshed potatoes would need to be undertaken.

3. *Farm gate profitability*

If yellow fleshed varieties cannot be grown at a profit, growers will not switch to these varieties. Thus, the ability to supply potential market demand will be compromised. As this market is relatively small and there may be only one or two small to medium sized fresh market wholesalers, there may be only a few growers that will enter into yellow fleshed potato production. In other words, the market may sort this problem out.

D. Key Market Drivers

Global Market and Industry Trends

Lutein is classified as a carotenoid and competes with other carotenoids. A 2005 study by BCC, Inc. concluded that lutein has been the big marketing success in recent years. Until the end of the 1990s, lutein was mainly used to color egg yolks and partly for broiler skin. After 2000, a new application developed in supplements when it was demonstrated that lutein could help to reduce age-related macular degeneration disease. A new outlet in supplements was created and pushed lutein's market value up to $139 million in 2004, compared to $64 million in 1999. It is anticipated that strong growth will continue, and thus, lutein's market will grow at an average annual growth rate (AAGR) of 6.1% through the forecast period.

Global Carotenoid Market by Product Type, through 2009
($ Millions)

Product	**2004**	**2009**	**AAGR% 2004-2009**	**Percent of Total, 2004**	**Percent of Total, 2009**
Astaxanthin	234.0	257	1.9	26.4	25.1
Beta-carotene	242.0	253	0.9	27.3	24.7
Lutein	139.0	187	6.1	15.7	18.3
Canthaxanthin	148.0	156	1.1	16.7	15.2
Others*	123.9	170	6.5	14.0	16.6
Total	886.9	1,023	2.9	100.0	100.0

*Includes Lycopene, Annatto, Zeaxanthin, Apo-carotenal and Apo-carotenal-ester.
Source: BCC, Inc.

Potato Production

Total potato production in Alberta increased rapidly until 2003 and has decreased since that time. While designated seed potato acres have remained relatively constant, table potato acreage continues to drop due to lack of profitability. However, there is room for growth since table potato acreage has averaged over 4,000 acres prior to 2003.

Alberta Potato Acreage
1998 – 2006

Designation	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Processed	12800	24616	32563	34877	37296	40960	38077	38508	36633
Seed	10250	10886	12037	12595	14644	13690	11062	10531	11878
Table	5100	4698	4331	3883	3241	4125	3508	2567	1575
Total	28150	40200	48931	51355	55181	58775	52647	51606	50086

Source: Potato Growers of Alberta

Alberta Potato Acreage
1998 – 2006
Percent of Total Acres

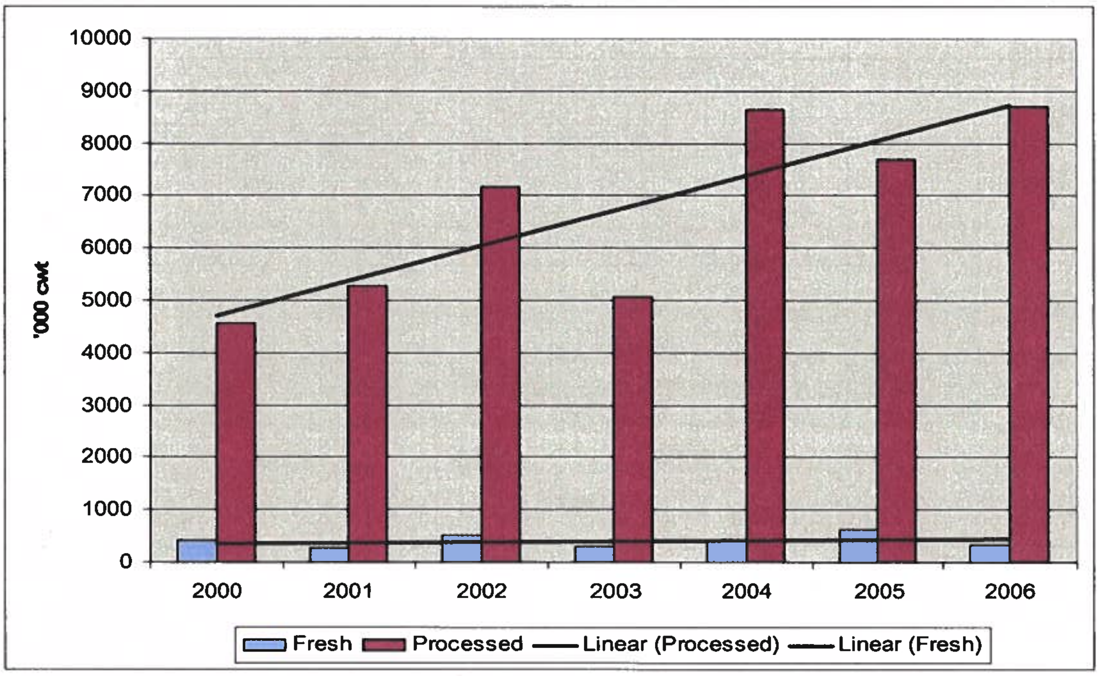
Designation	1998	1999	2000	2001	2002	2003	2004	2005	2006
Processed	45%	61%	67%	68%	68%	70%	72%	75%	73%
Seed	36%	27%	25%	25%	27%	23%	21%	20%	24%
Table	18%	12%	9%	8%	6%	7%	7%	5%	3%

Source: Potato Growers of Alberta

Utilization

Intended uses of both fresh and processed potatoes in Alberta have seen fluctuations over the years. As with the acreage, it is apparent that the trend is toward more processed potatoes, while the fresh potato market has stayed remarkably constant.

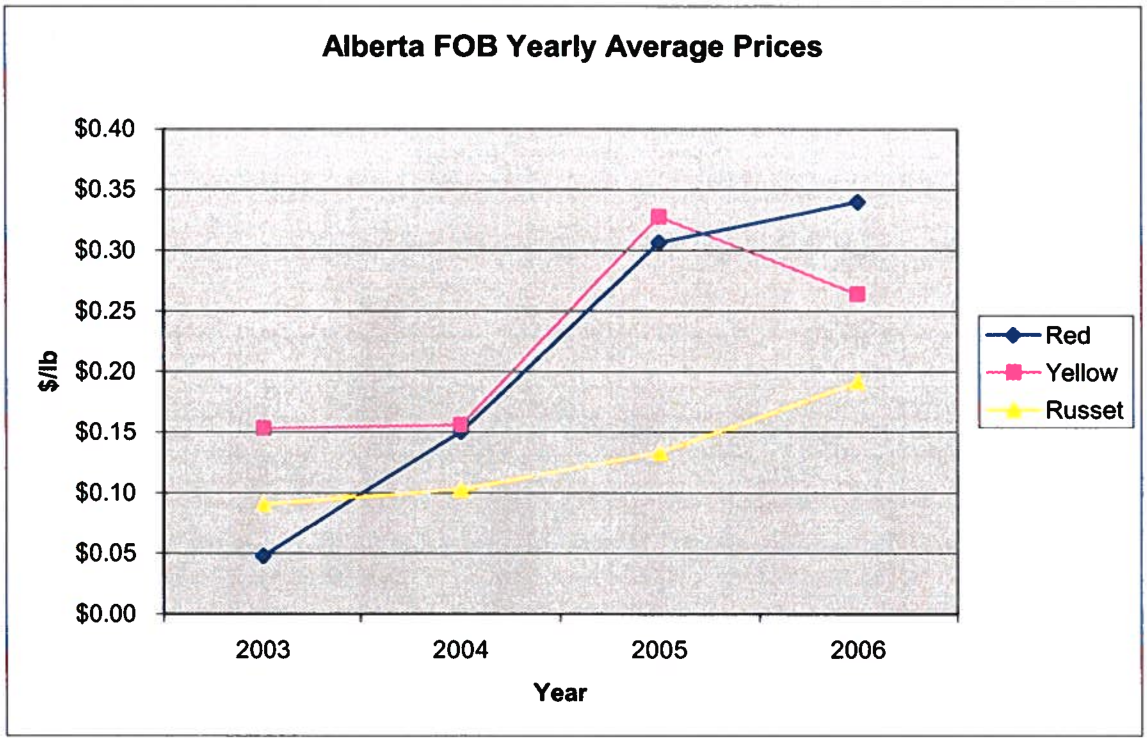
Intended Utilization of Potatoes, Alberta
Fresh and Processed



Pricing

The following chart shows the wholesale (packer) FOB potato prices in Alberta. These prices do not reflect the prices received at the farm gate. However, some general observations can be made. Red and yellow varieties, which are exclusively fresh market, have seen substantial price increases since 2003. This can be attributed to a number of factors:

- An increase in demand as these varieties are seen as a "healthier" alternative by consumers. Russet potatoes have shown price increases to a lesser extent.
- Production restrictions in the United States through the United Fresh Produce Association.
- Competition from other parts of North America that produce the Russet Burbank variety for the processing market.
- A decrease in the volume of fresh market russet potatoes. The Russet Norkotah is grown exclusively for table production but are less palatable than many other varieties when consumed as a baked potato, especially after being held in cold storage for long periods. Along with the current low-carb diet fad, Russet Norkotah's out-of-storage quality issues may be contributing to the slow decline in overall fresh potato consumption.



Source: InfoHort, Agriculture and Agri-Food Canada

E. Consumer Analysis and Opportunities

What Do Consumers Really Want?

Consumers choose foods at the grocery store for a variety of reasons. Many studies indicate that the top five most important factors that consumers consider when buying food products are as follows, in order of significance:

1. Freshness/Quality
2. Price
3. Nutrition
4. Taste

5. Brand

Other factors include sale/promotion/coupons, convenience, food safety and functional properties.

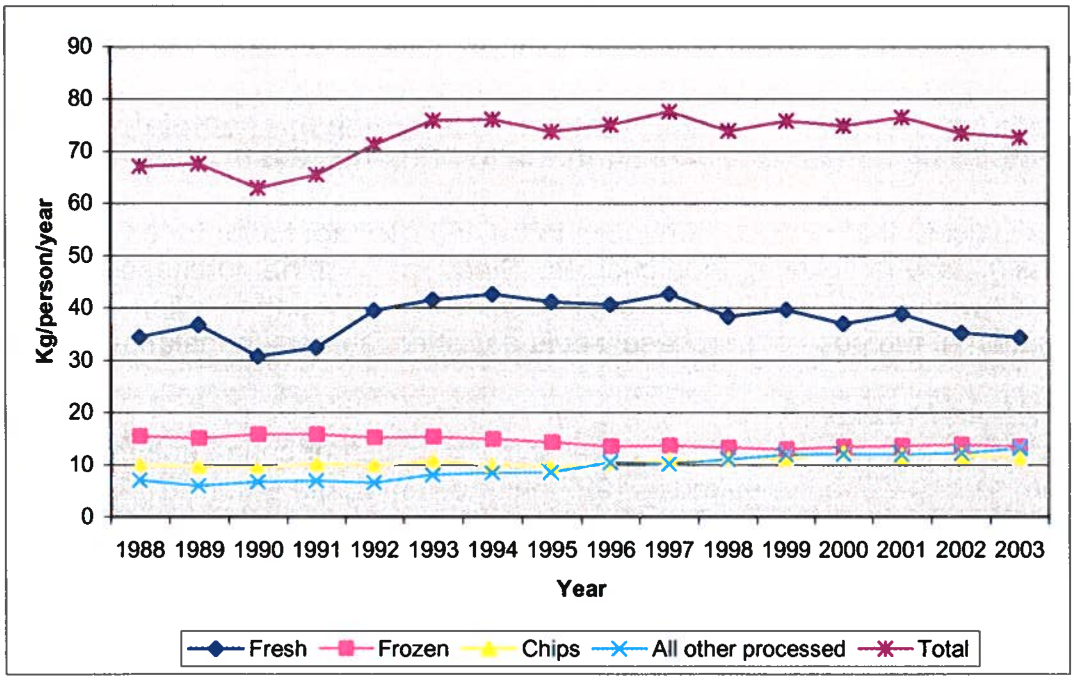
The baby boomer demographic will continue to shape the market by adopting healthier eating habits. Add to this the younger busy family shoppers, who have strong concerns and interests as well as higher household income. Thus, **the link between nutrition and health/wellness, although not completely understood by consumers, will continue to influence the market.**

Trends indicate that nutrition continues to be an important factor for the majority of Canadians when making food choices. Since many of the purchase decisions are made while shopping, having readily accessible food and nutrition information at the point of purchase would assist consumers in making choices.

What About Potatoes?

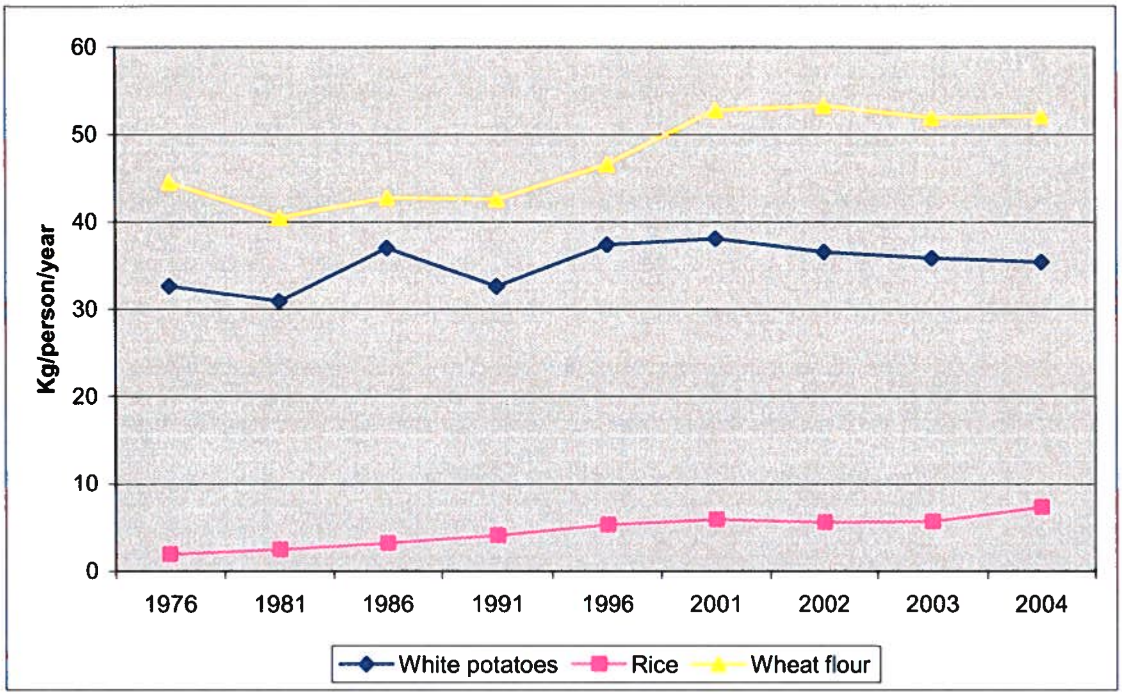
According to a paper completed by Statistics Canada, per capita potato consumption in Canada peaked in 1997 and has stabilized around 74 kg per person since that time. Specifically, consumption of fresh potatoes has been showing a gradual decline, as has consumption of frozen potato products. However, consumption of other processed potato products, such as pressed potato chips and dehydrated product, is increasing.

Canadian Per Capita Consumption of Potatoes and Potato Products
In Fresh Equivalent or Farm Weight
Per Annum



In addition, potatoes have lost market share to its direct starch substitutes – rice and pasta – since 2001.

Food Consumed, By Commodity
Potatoes and Substitutes



This can be attributed to a number of factors:

- Increased consumer demand for greater varieties and more convenience in all products;
- Little consumer recognition of potato varieties and uses;
- More health conscious consumers concerned about the carbohydrates in potatoes;
- Potatoes are a "planned purchase" to go with a prepared meal (typically one of the four protein groups). Consumers who buy "spontaneously" will not purchase potatoes.

A recent study completed by Compas Inc. for the Ontario Potato Board of 1002 Canadians identified some key findings in potato consumption.

1. Canadians under age 55 years are less likely to eat potatoes often than are those over age 55
    - Respondents over age 55 consumed potatoes 2.4 times in the three days preceding the survey.
    - Canadians under 55 years of age consumed potatoes 1.8 times a week. This group also tends to consume pasta and rice more frequently than do older Canadians.
2. Taste versus nutrition
    - Most respondents (42%) said they eat potatoes more often than other foods because of the taste.
    - Only 10% of respondents said they eat potatoes more often than other foods for health reasons.
3. Timing
    - 75% of respondents said they eat potatoes at least two to three times a week.
    - Only 3% reported eating potatoes once or twice a year.
4. In what form do Canadians like to eat their potatoes?
    - Boiled (28%), mashed (25%), baked (25%), fried (11%) and potato chips (5%)
5. The regions where Canadians consume potatoes at least two to three times per week:
    - Atlantic Canada – 87%
    - Quebec – 78%
    - Western Canada – 74%
    - Ontario – 70%

Factors Influencing Purchase of Potatoes

Given the factors above, what does this mean for the future potential of marketing yellow fleshed potatoes for lutein qualities?

1. Demand

Unfortunately, overall fresh potato consumption is falling as younger families with higher household income purchase less fresh potatoes. Two main drivers are

Yellow potatoes	74,781	1,394,448

Median values of consumption

White potatoes	$ 11,346,340
Red potatoes	$ 4,491,260
Yellow potatoes	$ 680,053

Over the ten year time period, the yellow potato market will average a significant increase in demand of $680,000. This translates into an increase of $346,000 over current market size or an average annual growth rate (AAGR) of 7.1%. It is important to note that the growth targets are quite aggressive for the yellow fleshed varieties and it is assumed that they will take market share from red and white varieties.

Given these assumptions, a market of this size could possibly attract one or two smaller wholesalers. These wholesalers would probably be existing companies who have the facilities to add fresh yellow potatoes in their product line. They would also have the facilities to handle yellow potatoes and a direct line to the retailer.

F. Competitive Advantage

Production

In 2004, Dr. Michele Konschuh of Alberta Agriculture, Food and Rural Development undertook a research study of twenty yellow fleshed varieties in the province. This study demonstrated that a number of these varieties can be grown successfully in Alberta with high lutein content.

Specific results:

- Of the twenty different varieties grown in Alberta, total carotenoid concentration in yellow-fleshed potatoes ranged from 35 to 240 mcg/100 g FW.
- In most varieties, lutein made up to 1/3 of the total carotenoid content.
- Zeaxanthin concentration was negligible in the varieties.
- Lutein concentration ranged from 9.5 (check) to over 50 mcg/100 g FW (Satina).
- A number of varieties have processing potential: Innovator, Sante, Satina, Sinora , and Victoria
- Five varieties have potential to market as fresh: Agata, Island Sunshine, Piccolo, RZ94-83 (Cecile), and Satina.
- Lutein concentration is correlated with variety, but can be influenced by growing location, storage and cooking or frying.
- A seven ounce potato may contribute between 20 and 50% of the lutein in a supplemented multivitamin.

Profitability

There are two critical production decision rules for owner/operators of farms. The first is the "rule for the short run": production should continue if projected revenue would at least cover variable costs. That is, gross margin must be positive. The second rule is the "rule for the long run": production should continue if all costs could be covered. In other words, return to management must be positive.

Another useful rule is Net Present Value. Net present value (NPV) is a standard method for evaluating competing long-term projects in capital budgeting. It measures the excess or shortfall of cash flows, in present value (PV) terms, once financing charges are met. All projects with a positive NPV should be undertaken.

Using a ten year simulation technique, we can estimate average gross margin and return to management over the time period as well as the net present value. Prices and yields will be input as distributions. The discount rate for NPV is assumed at 7%, a relatively conservative figure.

Assumptions

	Minimum	Maximum	Most likely
Selling price in year 1 ($/tonne)	$60.00	$130.00	$110.00
Yield (tonne/acre)	10	19	17
Storage loss (on-farm)	5%	15%	10%
Grade out at packer	15%	30%	20%

The table below indicates that both gross margin, return to management and net present value are negative over the ten year time period using the given assumptions.

Simulation Outputs

	Per Acre
Net Present Value	($20,776)
Gross Margin	($543)
Return to Management	($2,243)

A useful risk analysis tool is the "breakeven analysis". This analysis provides the producer with a yield and price that would be needed so that gross margin or return to management is zero. The following tables show the breakeven price and yields for yellow skinned potatoes with the given production costs.

Break Even Selling Price

	Per tonne
Cash costs	$90.03
Economic costs	$190.03

Break Even Yield

	Tonnes per acre
Cash costs	13.91
Economic costs	29.37

Analysis

Profitability presents a significant barrier to increasing the supply of yellow fleshed potatoes. The high break even prices and yields to cover economic costs (which include land rent, water rates, and interest) are a major concern. With current prices at least $30/tonne below the break even, the incentive for growers to plant yellow potatoes is negligible both in the short and long term.

There are two main reasons:

- High production costs, which typically come in between $2,500 to $3,000 per acre for irrigated potatoes; and
- A "double hit" for producers that typically lose 10% from storage losses at the farm gate and a further 20% at the packer for grade out.

Addressing these two major risks is paramount in the success of this project. Growers who have minimal debt on both their major capital items – land, machinery and buildings – are more apt to plant the yellow fleshed varieties. Locating and contracting with these growers will be essential. Reducing or eliminating the grade out percentage would take away the "double hit" that producers experience in selling their product and reducing their income.

G. Legal and Regulatory Issues

Health Claims – U.S.

Carotenoids, specifically lutein and zeaxanthin, have FDA approval pending because of epidemiologic data. A recent decision by the FDA rejected the qualified health claim petition for Xangold® Lutein Esters and age-related macular degeneration and cataract formation. In their decision, the comments were supportive of a qualified health claim regarding lutein and certain eye diseases, but considered the subject of the petitioner's proposed claim too restrictive. Most commented that the available evidence for a relationship between lutein and eye diseases involved the unesterified, "free" form of lutein, not the esterified form. The thirteen comments indicated that the subject of any authorized claim should be lutein and/or lutein-containing foods instead of lutein esters.

Health Claims - Canada

In Canada, product labels can only make a content claim (i.e.) x mg of lutein per serving. There can be no mention of the "benefits" of lutein such as AMD on the label.

H. Conclusion

Marketing yellow fleshed potato varieties for the fresh market does have potential in Alberta. The size of the market indicates that one or possibly two small to medium size wholesalers can add these varieties to their existing product line. A direct link to the grocer and an aggressive marketing campaign highlighting the health benefits may achieve growth targets. Targeting the "baby boomers" should be a first step as they are the likely demographic to purchase these potatoes.

Grower profitability may be a limiting factor as prices are below cost of production and growers will not switch if there is no evidence of short or long term profitability.

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WERA027: Potato Variety Development *Western Association of Agricultural Experimental Directors* http://www.nimss.umd.edu/homepages/home.cfm?trackID=7117

Wikipedia, http://en.wikipedia.org/wiki/Lutein#note_11a

Lutein content of yellow-fleshed potatoes grown in Alberta

Functional Foods are defined as foods that contain health-promoting compounds beyond calories, minerals and nutrients. A class of compounds called carotenoids imparts the color of yellow-fleshed potatoes. Carotenoids are anti-oxidant compounds that may protect against a variety of chronic diseases and certain cancers. Lutein is a specific carotenoid compound associated with a reduced incidence of age-related macular degeneration and cataract formation. Research initiated in 2004 by AAFRD scientist, Dr. Michele Konschuh, is aimed at making a functional food claim for yellow-fleshed potato varieties as a way of promoting potatoes to consumers. Twenty potato varieties were grown at CDCN (Edmonton) and CDCS (Brooks) and screened for lutein and zeaxanthin, another carotenoid compound. Potatoes were stored, boiled or fried, and assessed for lutein once again. Results from the first year of the study confirmed that lutein is present in yellow-fleshed potatoes grown in Alberta, even after storage, and that lutein is not destroyed during the boiling or frying process. Additional work was needed to establish the quantity of lutein available in a serving of Alberta-grown yellow-fleshed potatoes.

Ag & Food Council agreed to augment industry funding to further study lutein in yellow-fleshed potatoes in 2005 and 2006. The current project involves growing ten yellow-fleshed potato varieties in three Alberta locations, harvesting at three different times and analyzing them for tuber flesh color intensity, total carotenoid content and lutein concentration. Armed with this information, we envision that partners from the potato industry will use the information to promote potatoes to health conscious consumers and retailers. While yellow-fleshed potatoes may not be the richest source of lutein, the knowledge that potatoes contain another health promoting compound may encourage potato consumption or provide good reasons to continue including potatoes in a balanced diet.

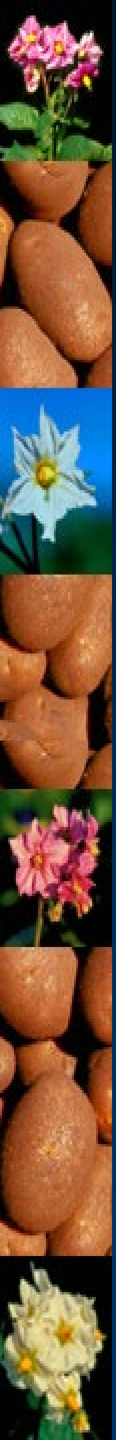
Results are now available from the 2005-growing season. Total carotenoid content ranged from 17 to 250 mcg per 100 g FW and was positively correlated with tuber flesh color intensity, especially when tubers were harvested 100 days after planting. Lutein accounted for approximately 25% of the total carotenoid content in many varieties and ranged from 3.2 mcg per 100 g FW in one variety (Sinora) to over 50 mcg per 100 g FW in the variety Satina. Lutein concentration was influenced most by variety, but varied with time of harvest and between locations. Satina and Victoria had consistently higher concentrations of lutein than most of the varieties studied. An average serving of Satina potatoes would provide approximately 100 mcg of dietary lutein. The trial will be repeated in 2006 to provide additional data to support a functional food claim. Potato varieties with significant concentrations of lutein may be marketed in the future as functional foods.

The Potato Growers of Alberta, ConAgra Foods, HZPC Americas, Parkland Seed Potatoes, Solanum International, Edmonton Potato Growers and The Little Potato Company provided the industry funding for the 2005-2006 research project.

Lutein – What is it?

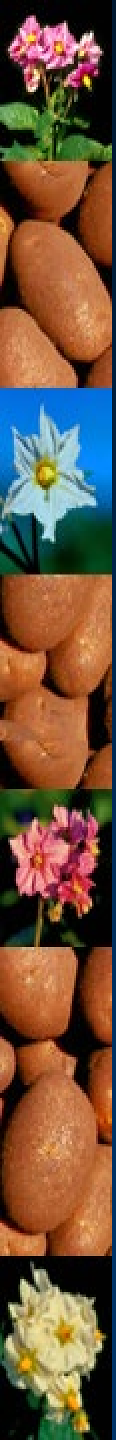
Why are we talking about it at a potato meeting?

Michele Konschuh, Tricia McAllister, Simone Dalpé, Tina Lewis and Darcy Driedger



Background

- Lutein is a carotenoid compound associated with a reduced incidence of age-related macular degeneration (AMD) and cataract formation (leading causes of blindness as people age).
- Carotenoids are anti-oxidant compounds that may also protect against a variety of chronic diseases including cardiovascular disease and certain cancers.
- The color of yellow-fleshed potatoes is imparted by carotenoids.

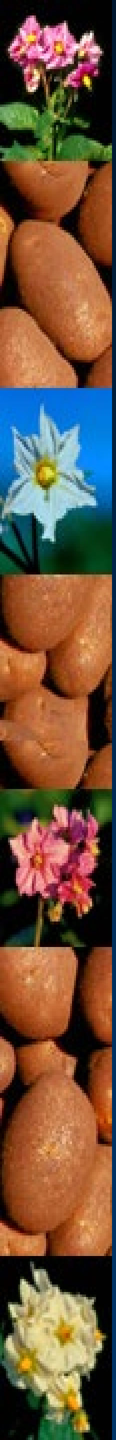


A Little More Background

- Dietary lutein intakes of 3 to 6 mg (1 mg = 1000 mcg) have been correlated with reduced risk of AMD and cataract formation.
- Lutein supplements in multi-vitamin pills range from 250 to 600 mcg/pill.
- We want to provide good reasons for people to include **potatoes** as part of a healthy diet.

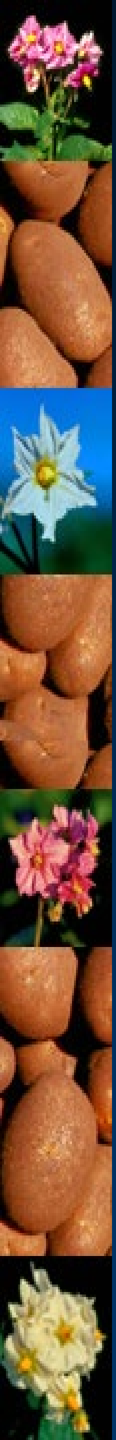
Preliminary Work (2004)

- Discussed concept with stakeholders.
- Proposals to AF and PGA for preliminary project.
- Requested variety recommendations and seed from stakeholders.
- Trial was conducted at CDCN (Edmonton) and CDCS (Brooks).
- FPDC Lab analyzed flesh color, and concentrations of lutein, zeaxanthin and total carotenoids.



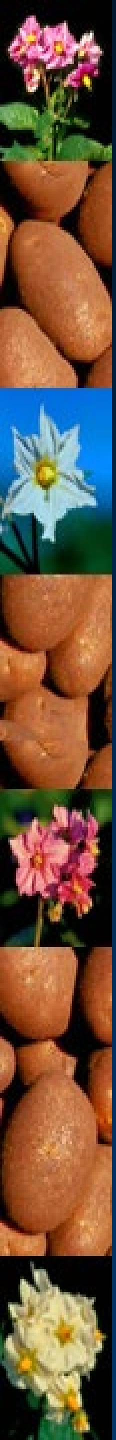
Sound Concept

- Total carotenoid concentration in yellow-fleshed potatoes ranged from 35 to 240 mcg/100 g FW.
- In most varieties, lutein made up to 1/3 of the total carotenoid content.
- Zeaxanthin concentration was negligible in the varieties we studied.
- Selected 5 fresh market and 5 processing varieties from 20.
- Determined stability of carotenoid compounds in storage and after cooking and frying.

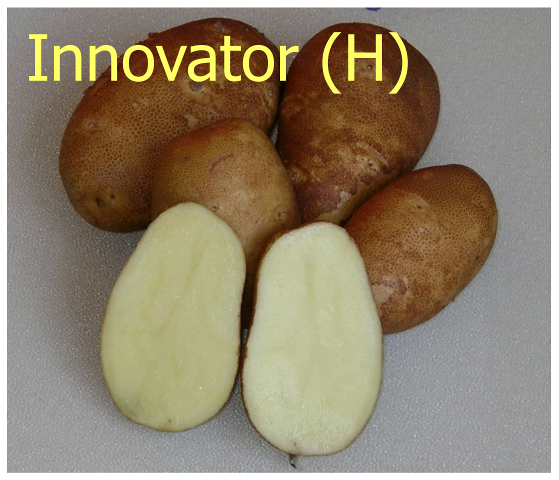


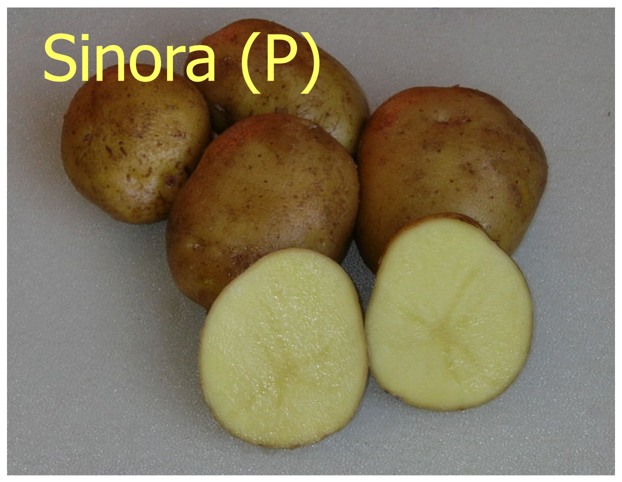
Lutein (mcg/100g FW)

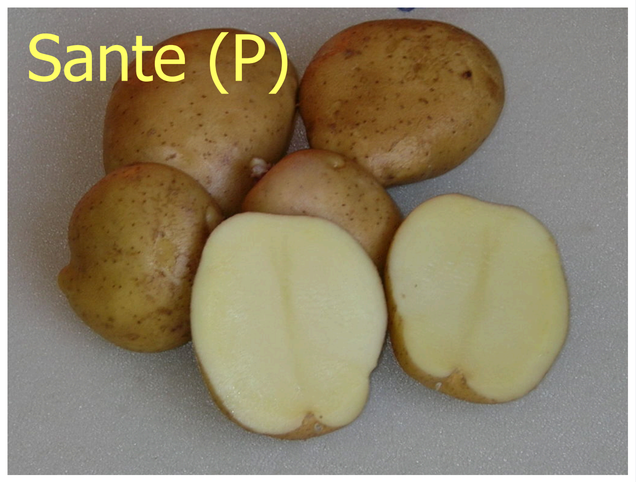
Variety (2004):	**CDCN**	**CDCS**
Agata	29.0	23.5
Cecile	32.4	40.6
Innovator	23.5	22.7
Island Sunshine	34.3	45.0
Piccolo	21.5	23.6
Sante	36.2	27.2
Satina	54.0	50.8
Sinora	17.3	28.2
Victoria	21.9	22.5
Yukon Gold	10.6	12.6
Russet Burbank	9.3	13.5

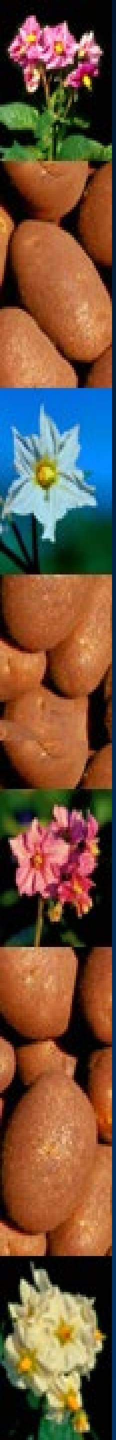


Processing Varieties

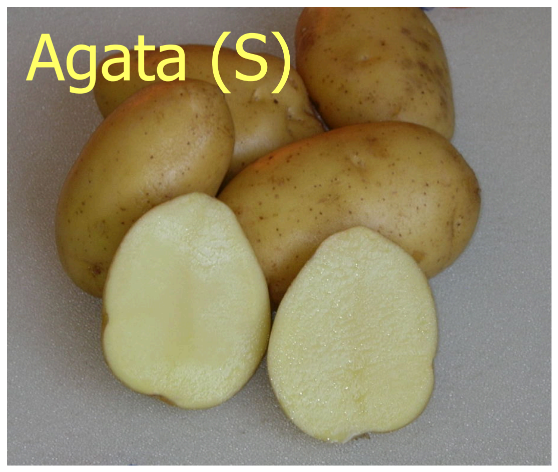






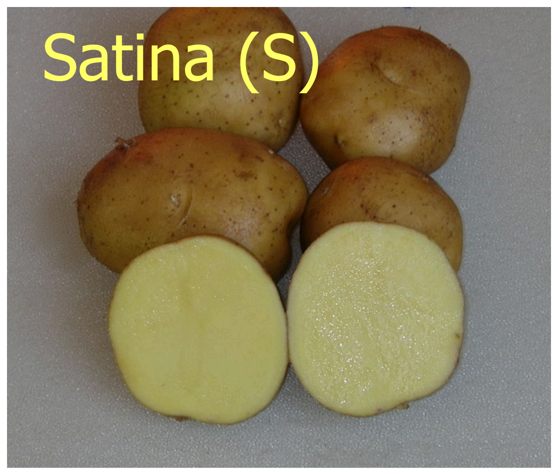


Fresh Market Varieties

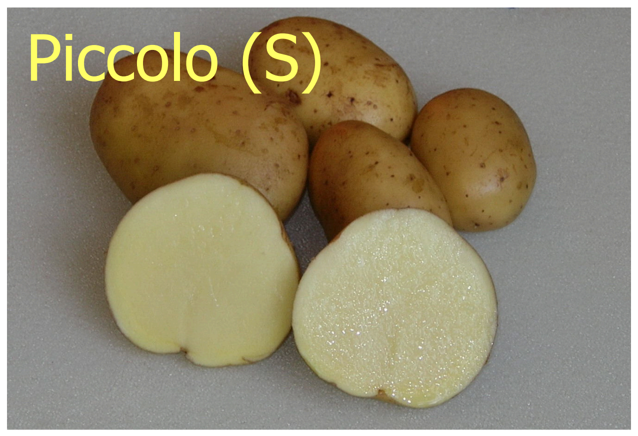


Agata (S)

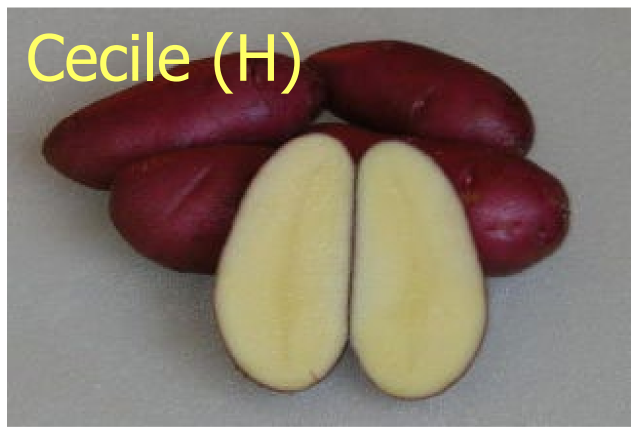
Island Sunshine (P)



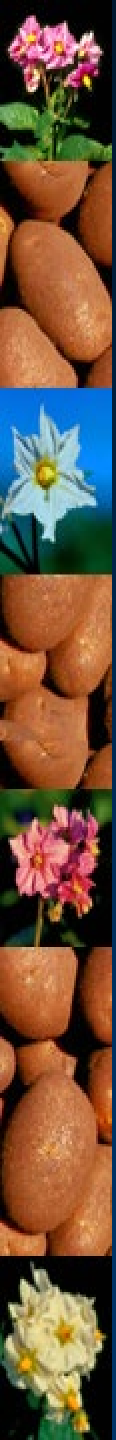
Satina (S)



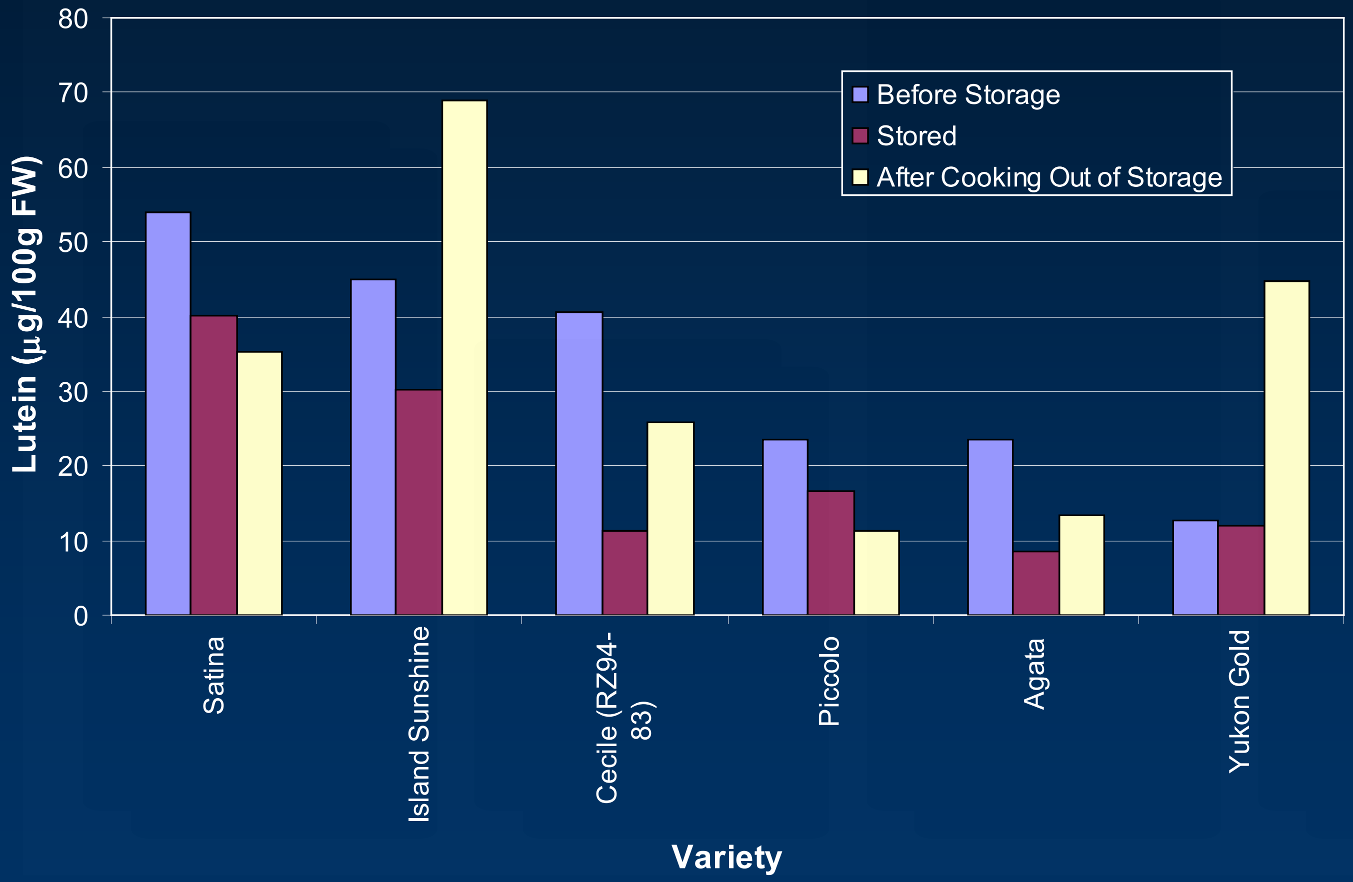
Piccolo (S)

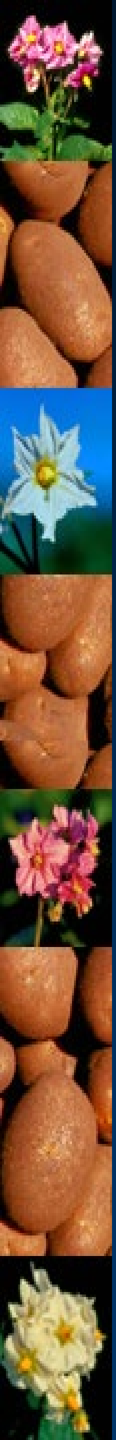


Cecile (H)

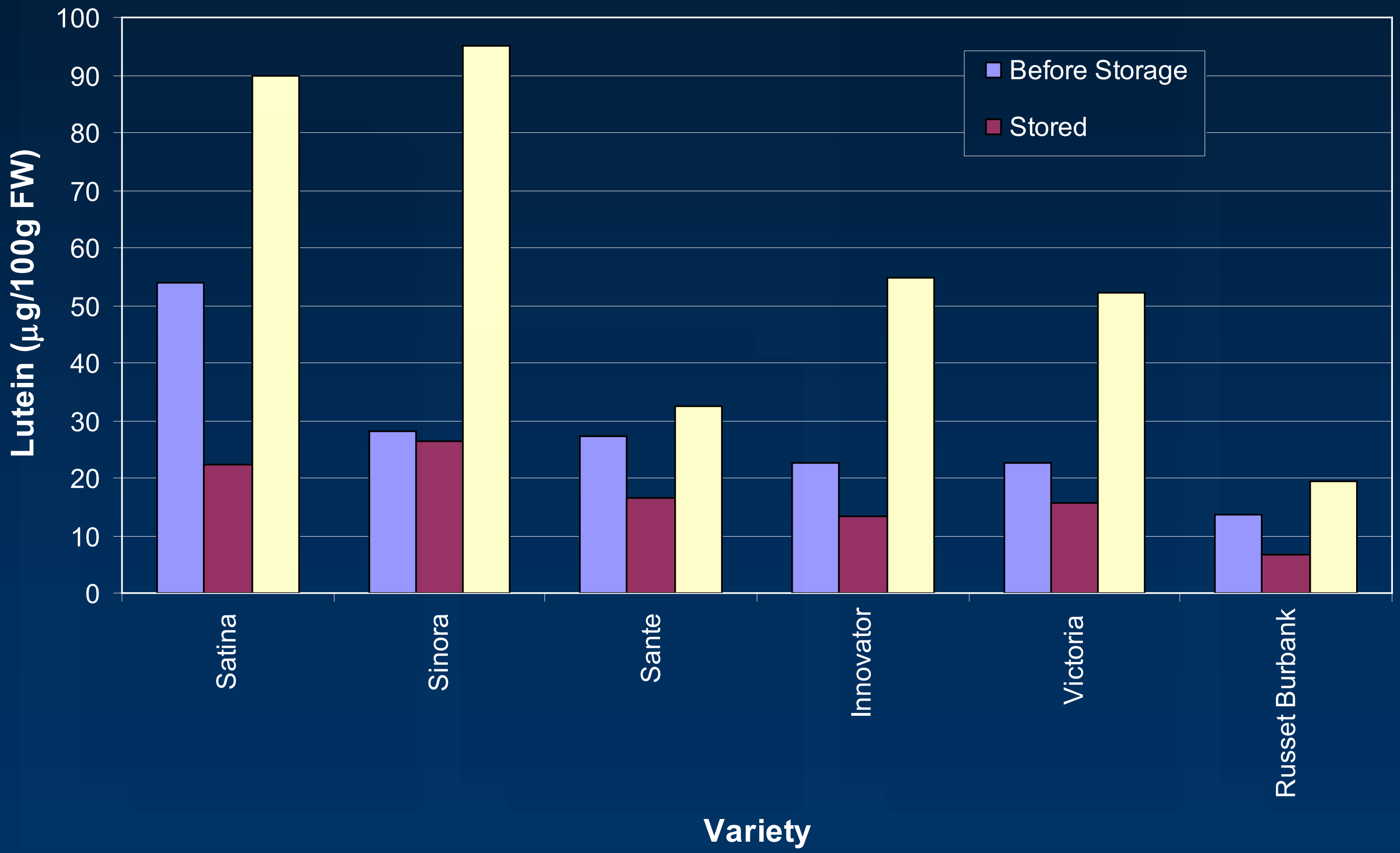


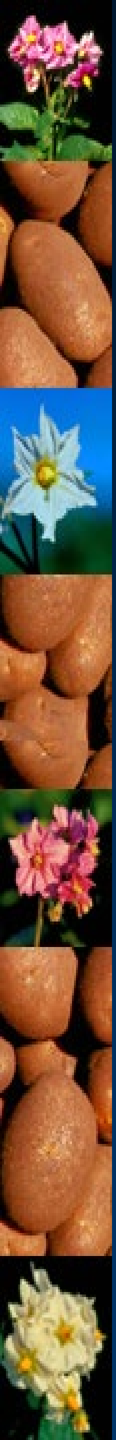
Lutein Cooking Stability





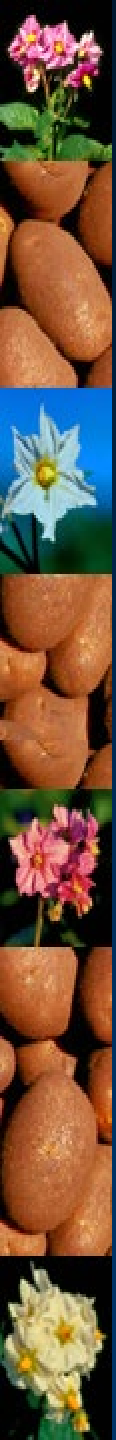
Lutein Frying Stability





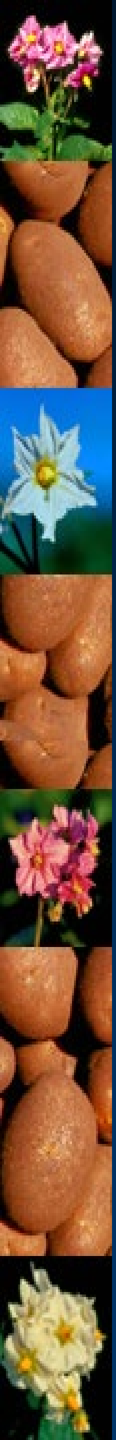
Stability of Lutein

- Lutein concentration up to 60 mcg/100 g FW.
- Carotenoid stability in storage differed by variety, but in all cases, some lutein was lost during storage.
- More lutein was recovered from 3 of 5 varieties after cooking.
- The quantity of lutein extracted from fried samples was much greater than from stored potatoes.



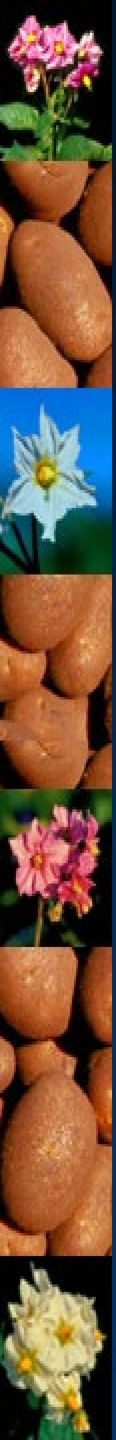
So What?

- Results from the 2004 study provided information that would allow us to include “contains lutein” on packaging.
- We needed to establish the quantity of lutein in an average serving (consistency, reproducibility) for use in marketing strategies.
- Ag & Food Council and others provided financial assistance for field trials in 2005 - 2006.



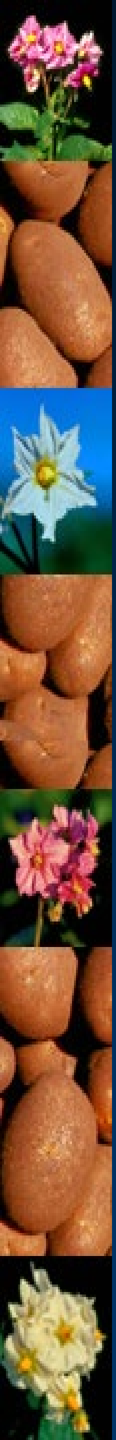
2005 - 2006

- This project involved growing 10 potato varieties in three locations in Alberta;
- Harvested at three different times;
- Analyzed for flesh color and concentration of lutein and total carotenoids.



Lutein (mcg/100 g FW)

2005	CDCS (Brooks)			CDCN (Edmonton)			Lacombe		
Variety	**80 DAP**	**100 DAP**	**130 DAP**	**80 DAP**	**100 DAP**	**130 DAP**	**80 DAP**	**100 DAP**	**130 DAP**
Agata	22.0	13.6	19.8	8.2	15.6	10.0	28.7	6.2	-
Cecile	13.0	15.5	17.3	21.7	36.1	27.9		27.5	-
Innovator	26.5	16.5	35.8	15.3	33.6	15.3	12.2	21.9	-
Island Sunshine	38.3	14.9	13.4	16.2	15.7	13.4	21.8	14.8	25.5
Piccolo	14.0	5.0	18.9	14.9	15.9	17.3	50.0	28.1	-
Sante	20.4	14.8	36.5	19.6	30.6	22.8	29.2	26.6	-
Satina	31.1	34.6	32.9	38.8	55.7	40.7	38.2	40.0	-
Sinora	13.0	3.2	11.3	14.8	15.0	9.7	7.9	4.8	-
Victoria	30.3	23.3	31.6	29.8	39.9	25.4	34.0	40.6	16.2
Yukon Gold	22.0	6.1	31.8	12.4	23.5	21.7	19.9	17.2	-



Lutein (mcg/100 g FW)

2006	CDCS (Brooks)			CDCN (Edmonton)			Lacombe		
Variety	**85 DAP**	**95 DAP**	**120 DAP**	**85 DAP**	**95 DAP**	**120 DAP**	**85 DAP**	**95 DAP**	**120 DAP**
Agata	40.2	13.6	19.8	29.0	15.6	10.0	13.6	18.5	16.0
Agria	52.7	15.5	17.3	53.7	36.1	27.9	39.0	86.6	39.3
Cecile	42.3	16.5	35.8	20.4	33.6	15.3	4.8	50.5	34.8
Innovator	9.8	14.9	13.4	27.0	15.7	13.4	22.7	36.8	23.2
Island Sunshine	81.2	5.0	18.9	46.6	15.9	17.3	15.5	47.9	35.0
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Victoria	35.9	23.3	31.6	20.3	39.9	25.4	26.4	54.2	15.1
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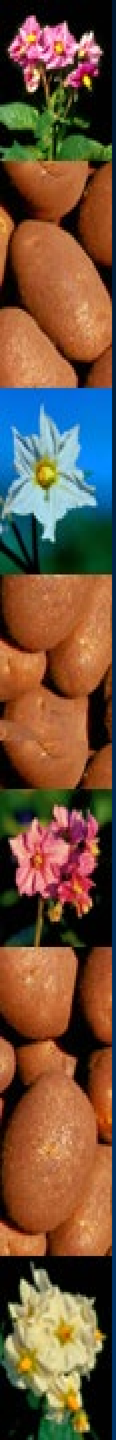
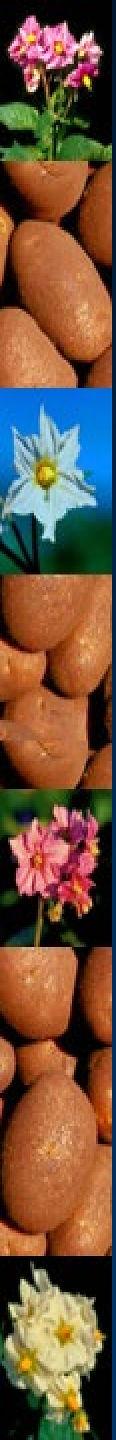


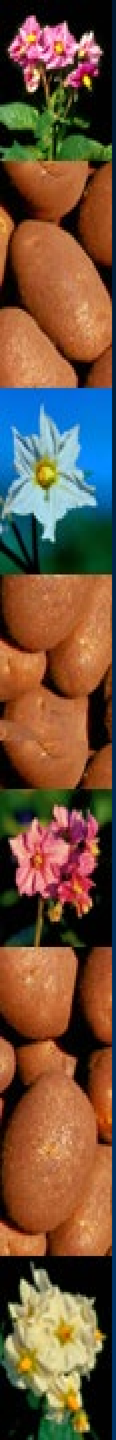
2005 - 2006 Results

- Lutein concentration is variety dependent, and is influenced by growing location, environmental conditions and time of harvest.
- Lutein concentrations varied from 3.2 mcg to over 80 mcg per 100g FW.
- Agria, Satina, Island Sunshine and Victoria consistently showed higher concentrations of lutein than other varieties.
- A 7 oz. potato may contribute between 20 and 50% of the lutein in a supplemented multivitamin.



What Next?

- Business Development people completed a Market Opportunity Assessment.
- Stakeholders have been invited to access AF funds to pursue a marketing opportunity.
- Need to screen additional varieties for greater lutein concentration.
- Develop variety specific agronomic information.
- Conduct storage studies to improve stability of lutein in stored potatoes.
- Additional research must be led by industry.



Acknowledgements

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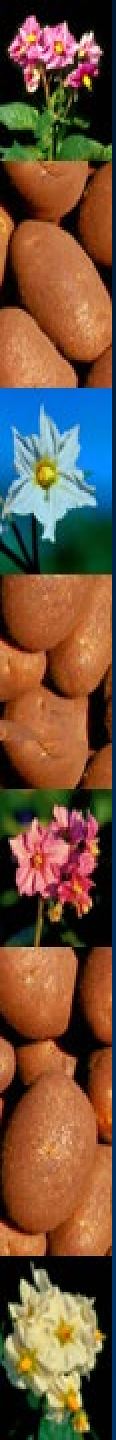
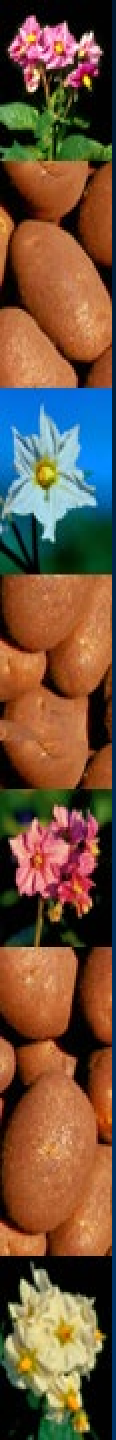


Dr. Michele Konschuh

Alberta Agriculture and Food
Crop Diversification Centre South
301 Horticultural Station Road East
Brooks, Alberta T1R 1E6
403-362-1314 phone
403-362-1306 fax
michele.konschuh@gov.ab.ca



Lutein Content of Yellow-Fleshed Potatoes Grown in Alberta

Michele Konschuh, Tricia McAllister,
and Darcy Driedger

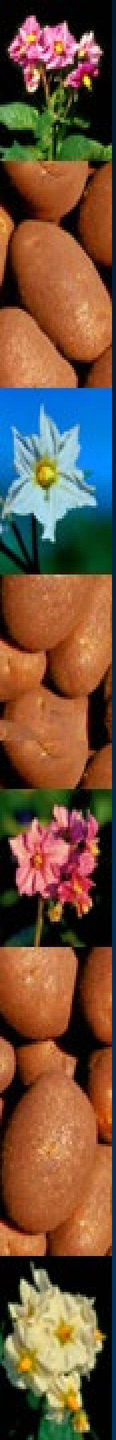
Potato Research Program, Crop Diversification Centre South

Background

- Lutein is a carotenoid compound associated with a reduced incidence of age-related macular degeneration (AMD) and cataract formation (leading causes of blindness as people age).
- Carotenoids are anti-oxidant compounds that may also protect against a variety of chronic diseases including cardiovascular disease and certain cancers.
- The color of yellow-fleshed potatoes is imparted by carotenoids.

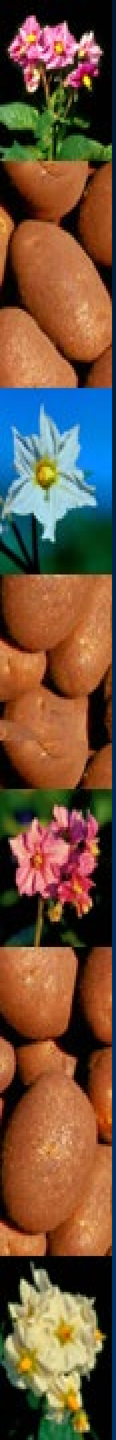
A Little More Background

- Dietary lutein intakes of 3 to 6 mg (1 mg = 1000 mcg) have been correlated with reduced risk of AMD and cataract formation.
- Lutein supplements in multi-vitamin pills range from 250 to 600 mcg/pill.
- We want to provide good reasons for people to include **potatoes** as part of a healthy diet.



Preliminary Work (2004)

- Discussed concept with stakeholders.
- Proposals to AF and PGA for preliminary project.
- Requested variety recommendations and seed from stakeholders.
- Trial was conducted at CDCN (Edmonton) and CDCS (Brooks).
- FPDC Lab analyzed flesh color, and concentrations of lutein, zeaxanthin and total carotenoids.

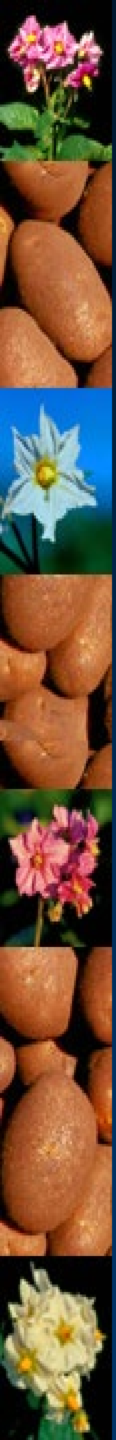


Sound Concept

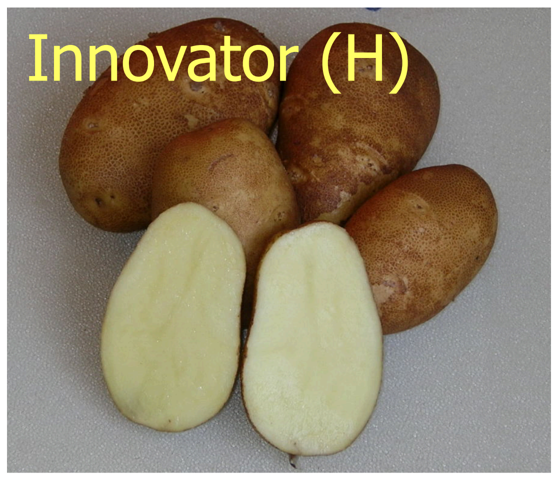
- Total carotenoid concentration in yellow-fleshed potatoes ranged from 35 to 240 mcg/100 g FW.
- In most varieties, lutein made up to 1/3 of the total carotenoid content.
- Zeaxanthin concentration was negligible in the varieties we studied.
- Selected 5 fresh market and 5 processing varieties from 20.
- Determined stability of carotenoid compounds in storage and after cooking and frying.

Lutein (mcg/100g FW)

Variety (2004):	**CDCN**	**CDCS**
Agata	29.0	23.5
Cecile	32.4	40.6
Innovator	23.5	22.7
Island Sunshine	34.3	45.0
Piccolo	21.5	23.6
Sante	36.2	27.2
Satina	54.0	50.8
Sinora	17.3	28.2
Victoria	21.9	22.5
Yukon Gold	10.6	12.6
Russet Burbank	9.3	13.5



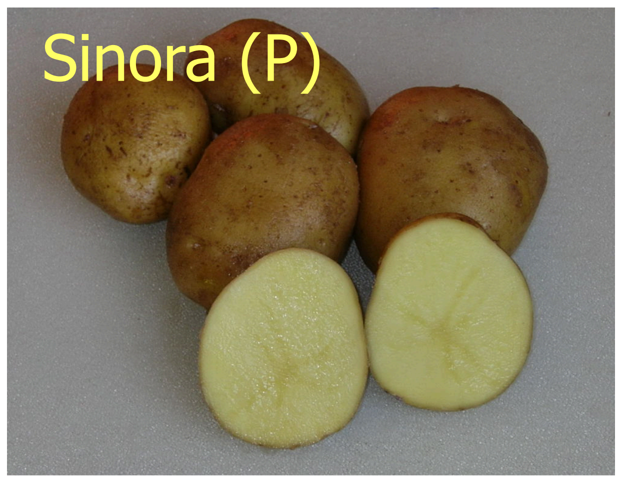
Processing Varieties



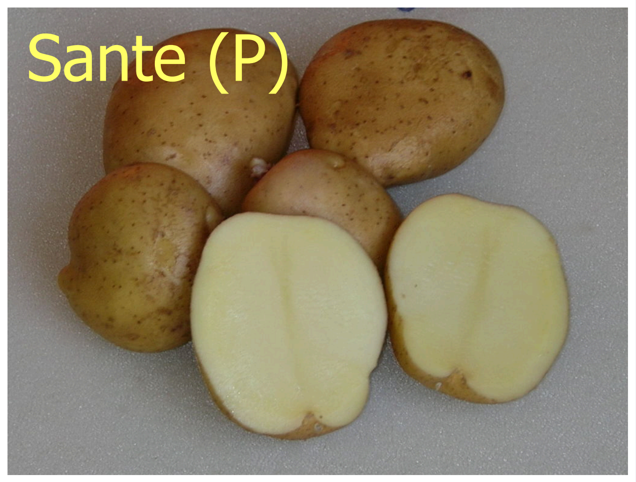
Innovator (H)

Satina (S)

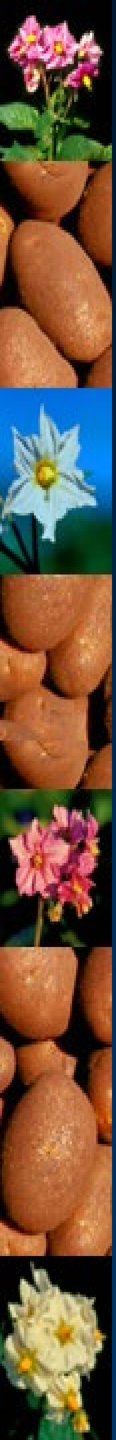
Victoria (H)



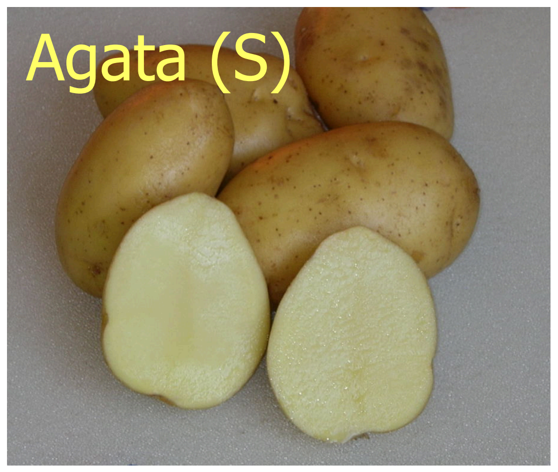
Sinora (P)



Sante (P)

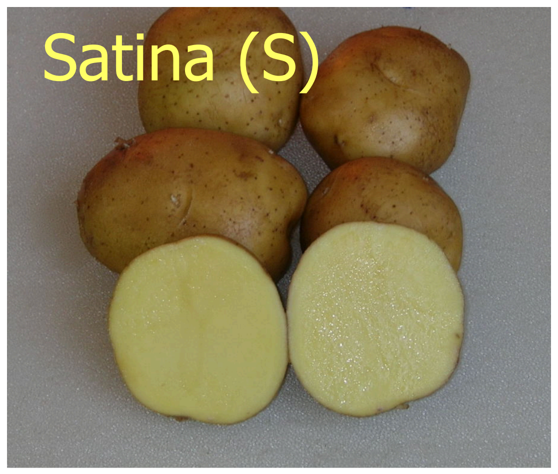


Fresh Market Varieties

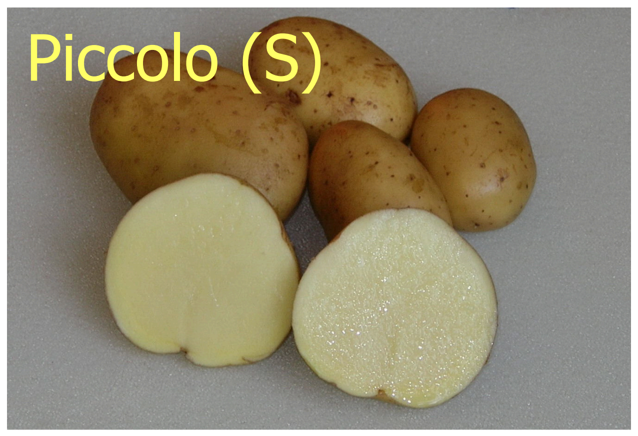


Agata (S)

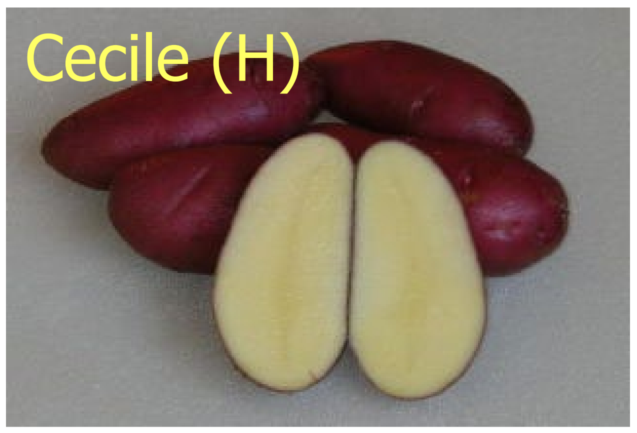
Island Sunshine (P)



Satina (S)

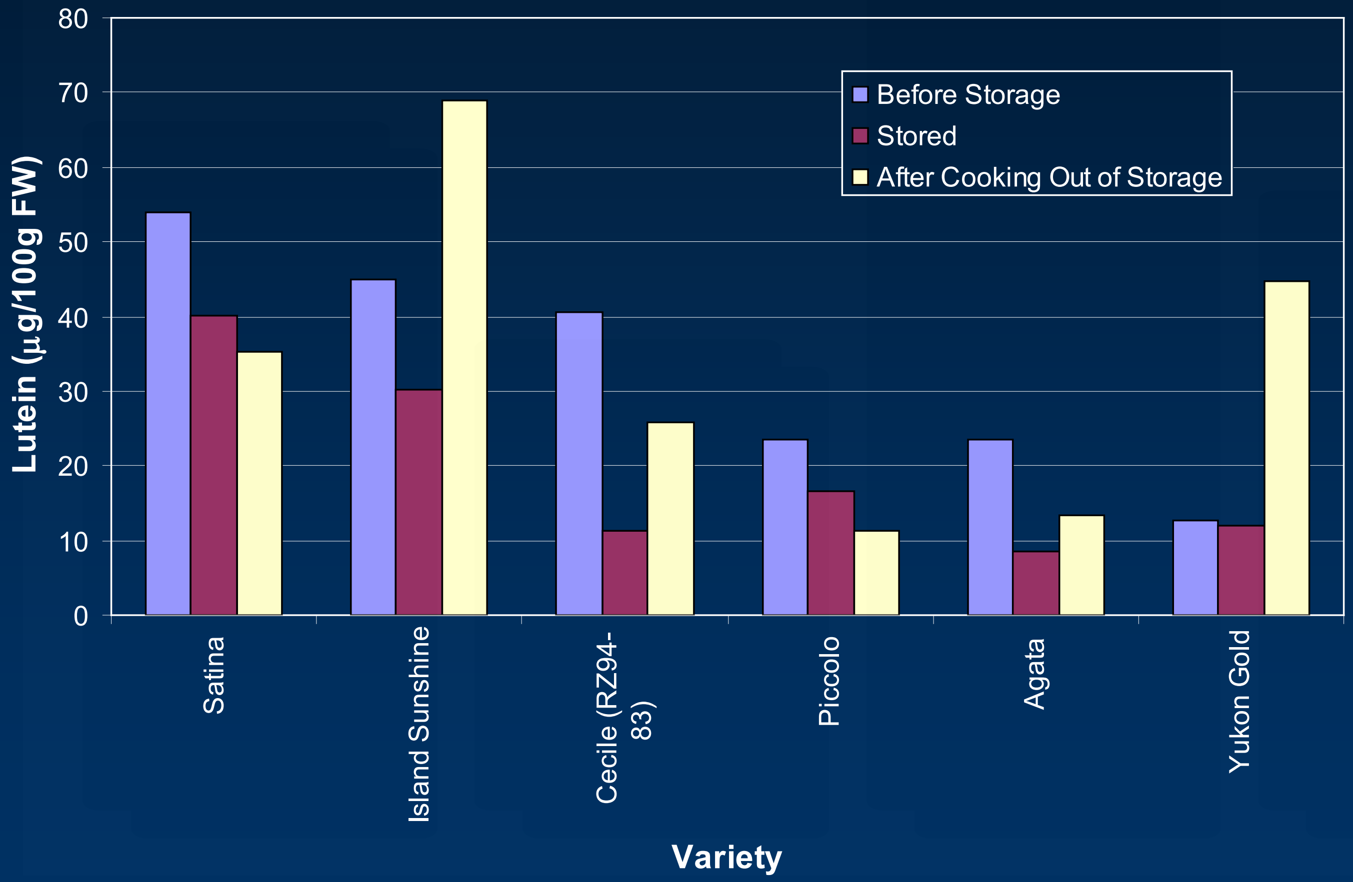


Piccolo (S)



Cecile (H)

Lutein Cooking Stability



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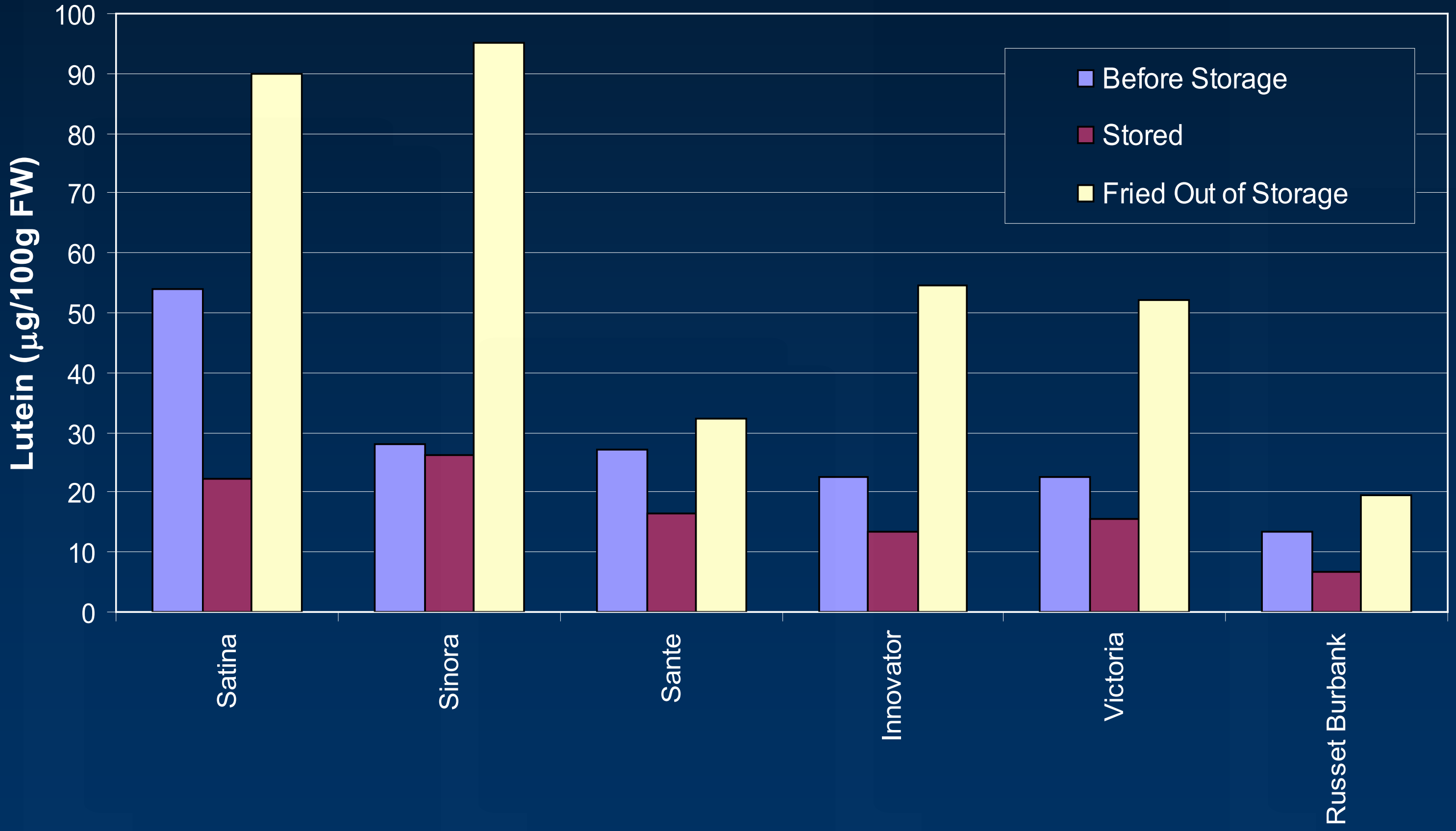
Lutein Frying Stability



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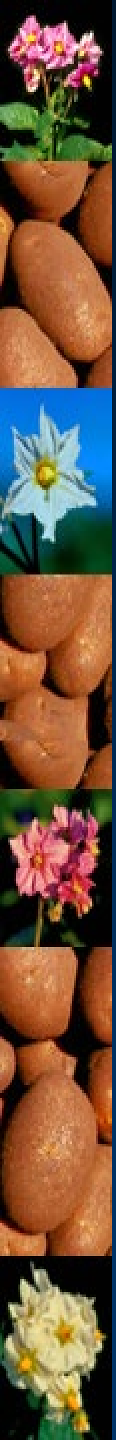
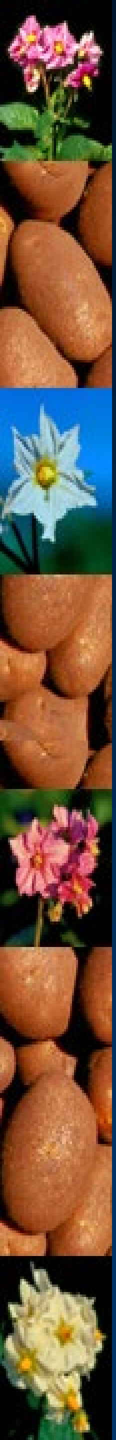


Stability of Lutein

- Lutein concentration up to 60 mcg/100 g FW.
- Carotenoid stability in storage differed by variety, but in all cases, some lutein was lost during storage.
- More lutein was recovered from 3 of 5 varieties after cooking.
- The quantity of lutein extracted from fried samples was much greater than from stored potatoes.

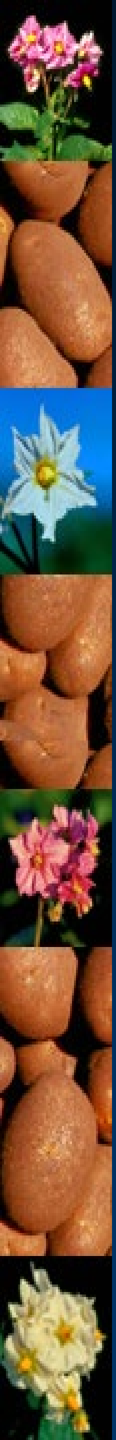
So What?

- Results from the 2004 study provided information that would allow us to include “contains lutein” on packaging.
- We needed to establish the quantity of lutein in an average serving (consistency, reproducibility) for use in marketing strategies.
- Ag & Food Council and others provided financial assistance for field trials in 2005 - 2006.



2005 - 2006

- This project involved growing 10 potato varieties in three locations in Alberta;
- Harvested at three different times;
- Analyzed for flesh color and concentration of lutein and total carotenoids.



Lutein (mcg/100 g FW)

2005	CDCS (Brooks)			CDCN (Edmonton)			Lacombe		
Variety	**80 DAP**	**100 DAP**	**130 DAP**	**80 DAP**	**100 DAP**	**130 DAP**	**80 DAP**	**100 DAP**	**130 DAP**
Agata	22.0	13.6	19.8	8.2	15.6	10.0	28.7	6.2	-
Cecile	13.0	15.5	17.3	21.7	36.1	27.9		27.5	-
Innovator	26.5	16.5	35.8	15.3	33.6	15.3	12.2	21.9	-
Island Sunshine	38.3	14.9	13.4	16.2	15.7	13.4	21.8	14.8	25.5
Piccolo	14.0	5.0	18.9	14.9	15.9	17.3	50.0	28.1	-
Sante	20.4	14.8	36.5	19.6	30.6	22.8	29.2	26.6	-
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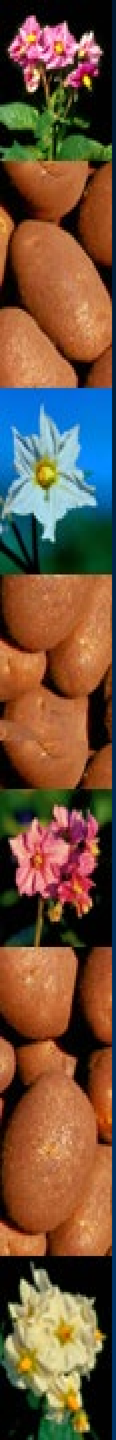

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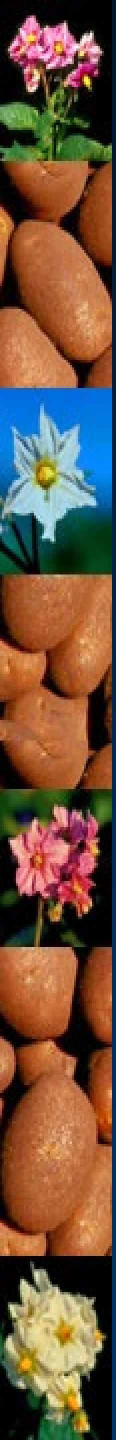

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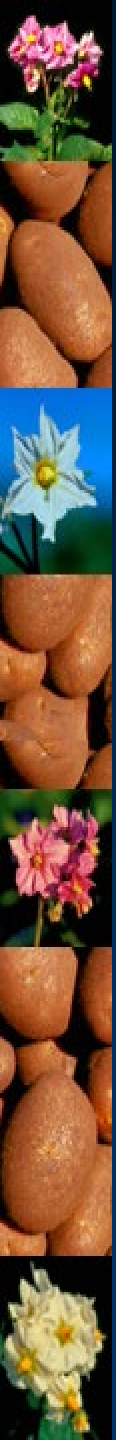

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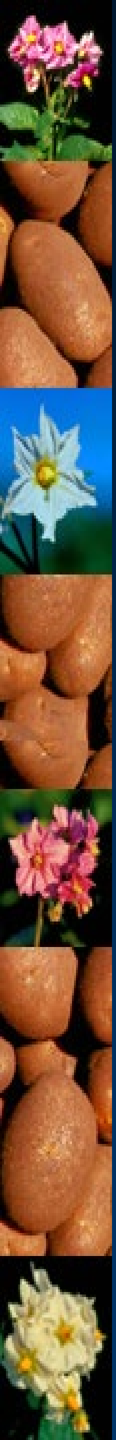

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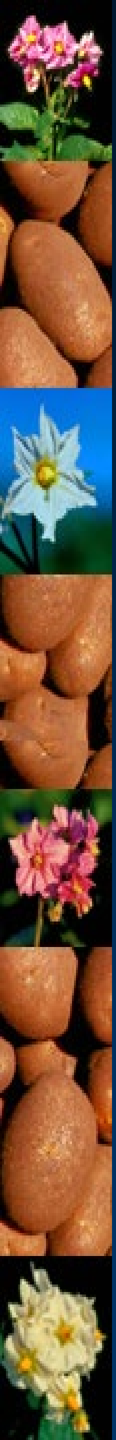

Dr. Michele Konschuh

Alberta Agriculture and Rural Development
Crop Diversification Centre South
301 Horticultural Station Road East
Brooks, Alberta T1R 1E6
403-362-1314 phone
403-362-1306 fax
michele.konschuh@gov.ab.ca

Date Received
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Full Research Project Final Report

- This report must be a stand-alone report, *i.e.*, must be complete in and of itself. Scientific articles or other publications cannot be substituted for the report.
- One electronic copy and one signed original copy are to be forwarded to the lead funding agency on or before the due date as per the investment agreement.
- A detailed, signed statement of expenses incurred during the entire funding period of the project must be submitted along with this report.
- For any questions regarding the preparation and submission of this report, please contact the representative of the funding agency.

Section A: Project overview

1. Project number: 2011F046R
2. Project title: Improving greenhouse mini-tuber production
3. Research team leader: Michele Konschuh
4. Research team leader's organisation: Alberta Agriculture and Rural Development
5. Project start date: 2012/03/01
6. Project completion date: 2015/01/31
7. Project final report date: 2015/01/23

Section B: Non-technical summary (max 1 page)

This project involved evaluating the Vital Farms Potato Incubator (PIP200), an aeroponic (media-free) seed potato production system designed to optimize the yield and quality of seed potato mini-tubers. It is assumed that producers using the conventional approach for the past 20 years or so may have already reached the potential of the traditional greenhouse production system and a change in production approach may be required to remain competitive. There are a number of advantages to producing nuclear seed potatoes in such a system over conventional approaches. A number of constraints have also been identified. Over the 2 ½ -year span of the trial, 17 different varieties were evaluated in the system over four cropping cycles. The mean yield of nuclear seed potatoes produced in the first cycle of evaluation of the aeroponic system was 3.8 tubers per plantlet and improved to almost 19 tubers per plantlet by the third round, depending on the variety. A bonus round was facilitated by a seed grower and we had the opportunity to evaluate the system with a single potato variety for the fourth cycle. In the fourth round of production, 16 marketable Russet Burbank tubers were produced per plant and another 6000 tubers (5 per plant) were harvested that hadn't yet reached marketable size. A partial economic assessment was conducted. An economically feasible level of production is attainable based on the observations made during this project; however the full potential of the PIP-200 system has not been witnessed yet. An estimated 15 to 20 tubers per plantlet reduces the variable costs of production sufficiently to allow for a capital investment in an aeroponic system. Little information is available for producing North American varieties in such a system and more research may be required to optimize production with this system or a modified model (PIP-150) before this method of production is widely adopted by seed potato producers in Alberta or other parts of North America. Much was learned throughout the evaluation and this may direct future research on the topic.

Section C: Project details

1. Project team (max ½ page)

Michele Konschuh acted as the project lead and was the key research and technical person throughout the project. Michele assisted with assembly and installation of the PIP-200, prepared fertilizer solutions, transplanted plant material, adjusted settings as required and harvested potatoes. Seasonal staff were employed to assist with harvesting tubers, cleaning the equipment before each reset and with the field evaluation of each crop.

Nick Savidov was initially included as a resource person for the project, but was unable to participate fully as a result of a reassignment within the department and a change in work location. Some aeroponics expertise was accessible via the supplier and additional expertise was developed during the project.

2. Background (max 1 page)

Seed potato production in Canada uses a limited generation system, which means that seed passing inspection must advance to a lower class with each generation of production. Nuclear seed (highest generation) must be produced from disease-free parent stock in a protected environment (a growth room, greenhouse or screen-house; Kirkham, 2003). In Alberta, the nuclear generation is typically produced from plantlets propagated through tissue culture and transplanted into a greenhouse for mini-tuber production. Although tissue-culture propagation allows rapid multiplication of seed stocks, it is labour intensive and costly. Costs of growing media, labour, utilities and other inputs have been steadily increasing, but customers are reluctant to pay higher prices for mini-tubers.

One of the key issues facing the high generation segment of the seed potato industry in Alberta is that of rising costs of production. In particular, greenhouse production costs have been steadily rising and no local research has been conducted in the area of mini-tuber production for many years. A literature review revealed that some advances have been made in production systems in other parts of the world. If other production areas are using alternate production techniques, Alberta mini-tuber producers may be at risk if they cannot improve cost of production efficiencies.

Alternative production approaches need to be evaluated to determine if they will work with locally relevant varieties under the conditions prevalent in our growing region. In 2011, the Research Committee of the Potato Growers of Alberta (PGA) indicated a desire to support the evaluation of a commercial aeroponic system that had been developed. The manufacturers of this technology were willing to work with us to facilitate an evaluation of the technology in Alberta.

The project involved evaluating the Vital Farms Potato Incubator (PIP200), an aeroponic seed potato production system designed to optimize the yield and quality of seed potato mini-tubers. In addition we planned to determine the effect of light, potato variety and nutrient solution on the yield of mini-tubers within the context of the system.

3. Objectives and deliverables (max 1 page)

The project involved evaluating the Potato Incubator (PIP200), an aeroponic seed potato production system designed to optimize the yield and quality of seed potato mini-tubers. Further, we intended to determine the effect of light, potato variety and nutrient solution on the yield of mini-tubers within the context of the system. The specific objectives were:

- To evaluate the ‘Potato Incubator™’ (PIP200) for production of mini-tubers of Alberta potato varieties;
- To compare yield of seed potato grown on different nutrient solutions;
- To evaluate the effect of pre-treating tissue culture plantlets with a shorter (12 h) photoperiod on the yield and size of mini-tubers produced; and
- To evaluate the costs of production (COP) for nuclear tubers using an aeroponic system.

The product supplied included only one zone for irrigation and fertilizer. As such, only one nutrient solution could be evaluated at any given time. Plant material was supplied by growers as an in-kind contribution. There was no opportunity to pre-treat plantlets with different photoperiods with 6 to 8 suppliers and independent delivery dates. In lieu of nutrient evaluation and photoperiod adjustments, we evaluated different varieties, and the effect of harvesting tubers at different target diameters. There was also some exploration of planting methods in one round of production.

4. Research design and methodology (max 4 pages)

The evaluation was conducted in collaboration with Dr. Michele Konschuh (Alberta Agriculture and Rural Development) in the Greenhouse Research and Production Complex at the Crop Diversification Centre South in Brooks, Alberta.

The project start was delayed until relevant contracts were signed by Alberta Agriculture and Rural Development and NorthBright Technologies Inc., and the system was manufactured and shipped to Alberta. A research bay was reserved for the project in the Brooks Greenhouse Research and Production Complex. Existing benches and irrigation lines were removed and stored to ensure there was adequate space for installation of the Vital Farms PIP-200. The Potato Incubator (PIP-200) arrived in Brooks in August, 2012. The installation required a frame to be assembled in the greenhouse research bay. The frame was assembled in 1-2 days. The rest of the installation proved to be much more time-consuming than expected and training could not begin until the installation was complete. Staff from the supplier, NorthBright Technologies, were on-hand to assist with installation. It took approximately two weeks of turning wrenches, running rivet guns, plumbing and installing plastic “root bags” that house the roots and return flow to the system to partially complete the installation. The installation was modified to accommodate supply tanks within the greenhouse bay. A total of 17 hanging gutters were installed, each with room for 71 plantlets. The system accommodated approximately 1200 potato plants in a 60 m^2 space. A short training video was presented by way of training. Plantlets could not be transplanted to the system while the supplier was on site because the installation was incomplete. There was an additional delay due to breakage of one UV glass for the sanitation system. A representative from the supplier repaired the UV system, ensured that the system was operational, and programmed initial settings. Some training was provided with respect to the computerized controls. Installation was completed in October 2012.

Round 1

Varieties were selected by 7 seed growers as shown in the Appendix (Table A-1), but many producer labs shut down during the summer and fall, so an alternate provider was arranged. Plantlets for the first round of evaluation were supplied by Tina Lewis of Alberta Agriculture and Rural Development. Timing of the first round was not ideal, but did allow us to begin the learning process and work some kinks out. In the first round, 14 different varieties of seed potato plantlets were planted into 17 gutters. Three varieties (Sangre, Russet Burbank and Shepody) were planted in side by side gutters. Primarily, we were able to evaluate variety responses to the system. With the duplicated varieties we evaluated the effect of harvesting two sizes of tubers (Shepody), the effect of insufficient humidity during plantlet establishment (Sangre) and the effect of delayed transfer to the system (Russet Burbank).

Plantlets were transplanted into rock wool blocks in October and transferred into the PIP-200 between October 31 and November 14, 2012. Harvesting of tubers began November 25 for the earliest varieties and continued at 4 to 7 day intervals until February 14, 2013. Plant survival was noted. The industry standard for nuclear tubers in Alberta is a 20mm minimum diameter. Anecdotal information from other growing regions and some Alberta seed growers indicates that smaller tubers will also produce a crop, but vigor may be affected. Tuber number, total yield and yield of seed potato tubers over 20mm was documented for each variety at each harvest event. When the crop was removed from the greenhouse, tubers remaining on the plant were graded into four size categories (< 10mm, 10 – 20mm, 20 – 30mm and > 30mm).

During the first round of production, Dr. Konschuh (Alberta Agriculture and Rural Development) worked with the staff of the Canadian Food Inspection Agency to ensure that seed produced in the PIP-200 was certified. A Quality Control Manual was developed by Dr.

Konschuh for the facility and will be shared with interested growers to facilitate adoption of this new seed potato production system.

Field Evaluation 2013

A seed source comparison was conducted in small plots at the Crop Diversification Centre South in Brooks, AB. A sample of tubers from the first round of evaluation were planted in the spring of 2013 along with conventionally produced tubers to determine whether or not there are differences in field vigor. Conventional tubers were provided by grower sponsors. The rest of the mini-tubers produced in the first round were provided to grower sponsors for individual on-farm evaluations.

Fertility (190 lbs/ac N) was achieved through a combination of soil fertility (124 lbs/ac N; 361 lbs/ac P, 1930 lbs/ac K) and broadcast fertilizer (165 lbs/ac of 30-0-0 and 100 lbs/ac of 11-52-0) incorporated prior to planting. Varieties from each source (aeroponic and conventional) were planted in four replicate rows in a randomized complete block design. Each block was planted adjacent to guard rows to reduce any edge effects.

Eptam 8E (2.2 L/ac) and Sencor 75DF (150 g/ac) were applied pre-plant (May 6, 2013) to control weeds. Conventional nuclear tubers were provided by each participant, but size of tubers was determined by the supplier. Whole seed was used for all cultivars. The nuclear tubers were planted approximately 8.5 to 11 cm deep using a two-row tuber unit planter June 6, 2013. In-row spacing was 25 cm spacing in 5 m rows spaced 90 cm apart.

The potatoes were hilled July 4 with a power hiller. The plots were irrigated to maintain soil moisture close to 70%. Foliar fungicides were applied several times during the growing season to prevent early and late blight from developing (Table 1). Insecticide was applied July 10 (Matador 120 EC, 40 mL/ac) to control Colorado potato beetle.

Table 1: Foliar fungicides applied to the 2013 potato crop to prevent early and late blight development.

Date of Application	*Fungicide*	*Rate*
July 10	Quadris	202 mL/ac
July 20	Bravo 500	0.64 L/ac
Aug 15	Ridomil Gold Bravo	883 mL/ac

Emergence data was taken every two days following hilling. The Julian date when 50% of the plants had emerged was recorded and full emergence (100%) was recorded as the date when all plants expected to emerge had emerged. Stand was recorded once full emergence had been reached.

Reglone (1.4 L/ac) was applied September 11 to encourage skin set and facilitate mechanical harvest. Stem counts were taken following desiccation, just prior to harvest. The mean number of stems per plant was calculated by dividing the stand by the total number of stems in each row. The mean number of tubers per stem was calculated by dividing the total number of tubers from each row by the number of stems per row. Tubers were harvested September 23 & 24 with a one-row Checci harvester for yield and grade data.

Aeroponic tubers were stored for variable lengths of time depending on when they were harvested. Conventional tubers were harvested in the fall and stored through the winter.

Round 2

In the second round of evaluation, plantlets of 10 different varieties were provided by 6 seed producers (Appendix, Table A-2). Plantlets were transplanted into rock wool blocks in late March and early April and transferred into the PIP-200 between April 10 and 14, 2013. Some varieties (Russet Burbank, Shepody, and Sangre) were provided by more than one producer and this allowed for the evaluation of different planting methods using the same varieties. One gutter each of Russet Burbank and Shepody was planted using small baskets to suspend the rock wool in the root bags. One gutter of each was planted using toothpicks to suspend the rock wool plug half-way into the root bag. And one gutter of each was planted using the felt to separate the tubers from the root bag, but the felt was cut to allow better penetration access of roots to the nutrient mist. One gutter of Sangre was used to harvest at a target size of 22mm and the adjacent gutter of Sangre was harvested at a target diameter of 25mm to determine the effect of harvest size on total yield and number of tubers. Harvesting of tubers began May 2 for the earliest varieties and continued at 4 to 7 day intervals until July 16, 2013.

Round 3

In the third round of evaluation, plantlets of 6 different varieties were supplied by 4 producers (Appendix, Table A-3). Two producers were unable to obtain seed potato plantlets as seasonal labs had shut down before orders were placed. Plantlets were transplanted into rock wool blocks in early August and transferred into the PIP-200 between August 12 and 19, 2013. Only 11 of the 17 gutters were planted in the third round. Inadvertently, this allowed for the evaluation of planting density within the greenhouse bay and some replication within varieties.

In the third round, strategies learned in the first two rounds of evaluation were employed from the outset. Biological thrip control was introduced as soon as plants had been transplanted. Fungicides were applied at regular intervals throughout the growth cycle to prevent early and late blight. Irrigation scheduling was adjusted to enhance root establishment and was adjusted as the plants grew. However, with only one irrigation zone, it was still not possible to control irrigation independently for each variety. A compromise was necessary.

EC was monitored and the fertilizer solution was partially refreshed every two weeks or so. Harvesting began September 19 for the earliest variety and continued once every 6 to 7 days until December 16. Harvesting was less frequent in this round to reduce stress on the plants.

Field Evaluation 2014

A sample of tubers from the second and third rounds of evaluation were planted in the spring of 2014 along with conventionally produced tubers to determine whether or not there were differences in field vigor. Conventional tubers were provided by grower sponsors and were not limited to 20mm diameter tubers. The rest of the mini-tubers produced in each production cycle were provided to grower sponsors for independent on-farm evaluations.

Fertility (157 lbs/ac N) was achieved through a combination of soil fertility (57 lbs/ac N; 113 lbs/ac P, 1650 lbs/ac K) and broadcast fertilizer (294 lbs/ac of 34-17-0) incorporated prior to planting. Varieties from each source (aeroponic and conventional) were planted in four replicate rows in a randomized complete block design. Each block was planted adjacent to guard rows to reduce any edge effects.

Eptam 8E (2.2 L/ac) and Sencor 75DF (150 g/ac) were applied pre-plant (May 12, 2014) to control weeds. Conventional nuclear tubers were provided by each participant, but size of tubers was determined by the supplier. Whole seed was used for all cultivars. The nuclear tubers were planted approximately 10 to 13 cm deep using a two-row tuber unit planter May 21, 2014. In-row spacing was 25 cm spacing in 5 m rows spaced 90 cm apart.

The potatoes were hilled July 4 with a power hiller. The plots were irrigated to maintain soil moisture close to 70%. Foliar fungicides were applied several times during the growing season to prevent early and late blight from developing (Table 1). Insecticide was applied July 24 (Matador 120 EC, 40 mL/ac) to control Colorado potato beetle.

Table 1: Foliar fungicides applied to the 2014 potato crop to prevent early and late blight development.

Date of Application	***Fungicide***	***Rate***
July 10	Dithane	0.91 kg/ac
July 24	Bravo 500	0.64 L/ac
Aug 13	Dithane	0.91 kg/ac

Emergence data was taken every two days following hilling. The Julian date when 50% of the plants had emerged was recorded and full emergence (100%) was recorded as the date when all plants expected to emerge had emerged. Stand was recorded once full emergence had been reached.

Reglone (1.4 L/ac) was applied August 29 to encourage skin set and facilitate mechanical harvest. Stem counts were taken following desiccation, just prior to harvest. The mean number of stems per plant was calculated by dividing the stand by the total number of stems in each row. The mean number of tubers per stem was calculated by dividing the total number of tubers from each row by the number of stems per row. Tubers were harvested September 15 & 16 with a one-row Grimme harvester for yield and grade data.

Aeroponic tubers were stored for variable lengths of time depending on when they were harvested. Conventional tubers were harvested in the fall and stored through the winter.

An economic assessment was planned to allow producers to determine whether the additional production of tubers justifies the costs of the system, supplies and greenhouse requirements.

Bonus Round

Seed growers expressed curiosity about whether the yield per plant would be improved when a single variety or similar varieties were grown in the single zone system as proposed. One seed grower arranged to sponsor an additional round of production to allow us to address the issue. Russet Burbank plantlets were provided for a bonus round of production in the spring of 2014. NorthBright ensured that any necessary repairs and adjustments were made to the system prior to planting the bonus round. Plantlets were received March 31, 2014 and were transplanted into rockwool plugs April 3 to 6th. The plantlets were introduced to the PIP200 April 14 to 16th. Strategies learned in the previous rounds were applied. Irrigation settings were adjusted based on crop responses. Nutrient solution was partially replenished every two weeks to limit salt build-up. A high volume fan was introduced to improve air circulation within the bay. Preventative maintenance reduced the number of alarm events to once every three weeks or so.

None of the alarm events interrupted the irrigation system. Tubers at least 20mm in diameter were harvested every 4 to 7 days between May 13 and August 19, 2014.

5. Results, discussion and conclusions (max 8 pages)

Round 1

In the first round of evaluation, varieties differed in their response to the system (Table 1). Plantlet survival was less than ideal for several varieties. There was only one zone supplied with the PIP-200, so all varieties were irrigated on the same schedule. A comparison of nutrient regimes was not possible with a one-zone system. The irrigation settings initially programmed by the Vital Farms staff were not suitable for the varieties and the environmental conditions in our greenhouse. Plants grew well for the first month or so, but seemed to hit a wall. Root establishment was poor in the first round and plants showed signs of nutrient deficiencies and drought after one month even when irrigation was increased. Misting the tuber area relieved drought symptoms. Some varieties also developed symptoms of edema, typically a sign that the plants cannot get rid of excess moisture.

An average of 70% of the plants survived for the full length of the first round. It was determined that this may be related to the type of fabric supplied to separate the root chamber from the tuber chamber as well as to not optimizing the irrigation schedule for each variety. The fabric supplied to separate the tuber area from the root bag was heavier than specified. Different fabric was ordered for the second round. Insufficient information was provided in the manual regarding irrigation settings and plant nutrition targets.

Exposing Sangre plantlets to low humidity prior to planting into the system appeared to affect the final productivity of the plants. Approximately 30% fewer tubers of marketable size were harvested from plantlets exposed to sub-lethal low humidity.

Harvesting larger Shepody tubers (25mm diameter rather than 20mm diameter) resulted in an approximately 40% reduction in final tuber count. As mini-tubers are sold by count rather than by weight, this is a significant finding. Additional work may be required to establish relevant pricing for different size classes of mini-tubers.

Delaying planting by one week into the PIP-200 had no significant effect on the final number or yield of tubers harvested (Russet Burbank).

The mean yield of marketable tubers was 3.9 per plant (surviving) in the first round. Although this is comparable to or better than current mini-tuber production levels in conventional potting mix, a yield of 10 to 30 tubers per plant was expected. Total yield of 3 to 10 tubers per plants was observed, but plants did not survive long enough for all tubers set to reach marketable size. Modifications to the fabric and the irrigation schedule were made for the second round of evaluation.

Table 1: Yield of seed potatoes from varieties planted in the PIP-200 (October 2012 to February 2013).

Variety	***Plantlet survival***	***Total Number***	***Total Yld (g)***	***Mkt Number***	***Number per Plant***
Agata	45%	216	941	109	6.8
Agria	87%	328	2390	242	5.3
Atlantic	58%	187	1157	135	4.6
Dakota Pearl	35%	147	544	59	5.9
Imola	46%	356	2159	212	10.8
Musica	56%	404	2692	268	10.1
Ranger Russet	90%	331	2230	171	5.2
Russet Burbank (Oct 24)	99%	403	2500	241	5.8
Russet Burbank (Oct 30)	100%	396	2320	244	5.6
Sangre (humid)	82%	634	3299	333	10.9
Sangre (dry)	97%	416	1995	192	6.0
Satina	89%	525	2647	263	8.3
Shepody (20mm)	86%	560	3469	379	9.2
Shepody (30mm)	68%	422	2639	241	8.8
Stampede Russet	79%	240	2290	135	4.3
Umatilla Russet	73%	331	2465	188	6.4
Viking	54%	172	991	117	4.5

Field Evaluation 2013

The 2013 field evaluation of aeroponic and conventional nuclear seed potatoes resulted in some differences that were likely a result of dormancy and tuber size rather than seed source (Table A-4). The number of plants in each row (stand) was affected by seed source for 4 varieties, Imola, Ranger Russet, Satina and Shepody. There was no significant difference in total yield (ton/ac) for any varieties except Ranger Russet. There were no significant differences in the number of tubers produced per plant for varieties other than Russet Burbank. Russet Burbank has a long natural dormancy and the tubers produced in the first round of the aeroponic system had not been in storage long enough for the tubers to overcome this dormancy in time to produce a reasonable crop. Production of the two seed crops in a similar time frame would allow us to eliminate the length of time in storage (and dormancy) as a factor.

Round 2

In the second round of production, varieties again differed in their response to the system. Initial plantlet survival was much better in the second round and root establishment was much improved, but insect pressure, environmental conditions (shade cloth, air movement, and temperature settings) and fertility challenges affected results in the second round (Table 2).

Changing the fabric and the initial irrigation schedule for the second round improved rooting and access to the fertilizer solution. An average of 83% of the plants survived for the full length of the second round. Using hydroponic baskets or suspending the rock wool plugs in the mist chamber was evaluated along with thinner felt with cuts below each rock wool plug. Rooting was acceptable in all cases and there was no clear advantage to utilizing the more complicated planting methods for root establishment.

Table 2: Yield of seed potatoes from varieties planted in the PIP-200 (April 2013 to July 2013).

Variety	*Plantlet survival*	*Total Number*	*Total Yld (g)*	*Mkt Number*	*Mkt Number per Plant*
Agria	100%	447	3834	308	4.3
Atlantic	58%	606	4798	426	6.3
Goldrush	35%	431	2523	306	12.2
Innovator	93%	425	2679	311	4.7
Ivory Russet	83%	599	5451	420	7.1
Russet Burbank (Basket)	93%	587	4854	418	6.3
Russet Burbank (Toothpick)	96%	421	3834	295	4.3
Russet Burbank (Cut felt)	96%	406	3113	307	4.5
Russet Burbank (South)	97%	759	5978	534	7.7
Sangre (22mm)	73%	574	3313	386	7.4
Sangre (25mm)	82%	483	3366	313	5.4
Satina	86%	642	4732	451	7.4
Shepody (Toothpick)	79%	519	4200	311	5.6
Shepody (Basket)	90%	567	4413	345	5.4
Shepody (Cut felt)	85%	593	4037	359	6.0
Stampede Russet	87%	371	2732	279	4.5
Stampede Russet (2)	70%	507	3321	323	6.5

Harvesting larger tubers (25 mm diameter rather than 22 mm diameter) from a round variety (Sangre) resulted in an approximately 30% reduction in marketable tuber count. The total weight of tubers produced per plant was similar, but fewer tubers were produced when the tubers were larger at harvest. As mini-tubers are sold by count rather than by weight, this is a significant finding. Additional work may be required to establish relevant pricing for different size classes of mini-tubers.

The mean yield of marketable tubers was 6.3 per plant (surviving) in the second round. Although this is a good yield compared to current mini-tuber production levels (1 to 5) in conventional potting mix, the yield still fell far short of the 10 to 30 tubers per plant projected. The total number of tubers per plant ranged from 6 to 17, but challenges with settings did not allow all tubers to reach marketable size before the crop was pulled. Modifications to the greenhouse settings and the irrigation schedule were made for the third round of evaluation.

Round 3

By the third round of evaluation, the system itself had developed a few issues. The supplier was unable to address the issues in a timely fashion as most technical expertise and replacement parts were in Europe. As a result, the tuber misting pump was used to replace a damaged pump for irrigating the roots and the tuber misting system could not be used during this round. One glass tube in the UV disinfection system was damaged during the cleaning procedure and a replacement was not available. Two out of three of the UV tubes were functioning for this round, but the system was not full and the disinfection was deemed adequate. In mid-October, the computer reported a fault with the EC sensor equipment. Replacing one and then both sensors did not correct the fault. Recalibrating the sensors did not correct the fault. To address the deficiency, the fertilizer was added manually to the mixing tank and EC was monitored manually each day. pH continued to be monitored and adjusted automatically. The manual adjustment of the EC, rather than frequent automated monitoring, may have contributed to early senescence of the crop, although this may also be expected as a result of the shorter days and lower light intensities at this time of year.

Plant survival was higher (87%) in the third round (Table 3), although not as high as desired. Fungal and insect pests were better controlled in this round. Root growth was impressive early on, but roots browned and struggled later in the cycle. The yield of tubers ranged from 6 to 13 tubers per surviving plant in the third round, with a mean of 10.4. Although this is a good yield compared to current mini-tuber production levels (1 to 5) in conventional potting mix, and the best yield from the system so far, the yield still fell in the low end of the 10 to 30 tubers per plant range suggested by the supplier.

It became apparent during this evaluation that more production information is required to reach the full potential of the PIP-200 aeroponic seed potato production system. The current manual indicates that adjustments to the irrigation schedule and EC settings may be required depending on the time of year, the nutritional requirements of the crop and the stage of growth. There is, however, no indication as to when these adjustments should be made or what to base the decision to adjust settings on. Some literature information is now becoming available based on other aeroponic system in other settings (Chang et al., 2011, Chang et al., 2012 and Mateus-Rodriguez et al. 2013). I believe that guidelines are required with respect to greenhouse settings, troubleshooting with the system and management of the crop. Likely, we have not reached the full potential of the PIP-200, by the end of our evaluation period.

Table 3: Yield of seed potatoes from varieties planted in the PIP-200 (August 2013 to December 2013).

Variety	*Plantlet survival*	*Total Number*	*Total Yld (g)*	*Mkt Number*	*Mkt Number per Plant*
Dakota Pearl	82%	584	3207.7	364	7.5
Imola	94%	850	7780.0	690	10.6
Ranger Russet	87%	1160	8660.9	797	12.9
Ranger Russet 2	85%	874	6105.4	608	10.1
Russet Burbank 1	93%	1201	8017.0	903	13.7
Russet Burbank 2	75%	818	5245.9	586	11.1
Satina	86%	883	6520.5	692	11.3
Umatilla 1	87%	806	5518.1	575	9.3
Umatilla 2	87%	633	4082.4	431	7.0
Umatilla 3	96%	693	4354.5	455	6.7
Umatilla 4	89%	1027	6459.6	685	10.9

Field Evaluation 2014

The 2014 field evaluation of aeroponic and conventional nuclear seed potatoes resulted in some differences that were likely a result of tuber size rather than seed source (Table A-5). Conventional seed of Russet Burbank, Sangre and Sheody was supplied as E1 seed rather than nuclear seed, so a fair comparison with these varieties was not possible. Many of the seed pieces supplied by seed growers exceeded the 20mm diameter that was used to harvest aeroponic seed potatoes. The number of plants in each row (stand) was not significantly different for any varieties except Stampede Russet, regardless of the season in which the aeroponic tubers were grown. Stampede Russet tubers did not store as well as many other varieties and may require higher humidity or different storage conditions to ensure sprouting in the spring. There was no significant difference in total yield (ton/ac) for most varieties. There were significant differences between conventional seed of Russet Burbank, Sangre and Shepody, but the conventional material supplied was not nuclear class. Conventional Stampede Russet seed out-yielded aeroponic seed and may be related to the poor condition of the aeroponic seed coming out of storage. There were no significant differences in the number of tubers produced per plant for any of the varieties studied. Likely aeroponic and conventional seed of similar size would result in similar yield and number of tubers.

One observation by an astute seed grower was that varieties with longer natural dormancy could be produced in the earlier crop cycle if two aeroponic crops were grown per year. Varieties with shorter dormancy could be grown in the later crop cycle. By selecting the crop cycle to address the inherent dormancy of each variety, all varieties should store until spring and sprout as required when planted in the field.

Bonus Round

Plant survival was higher (89%) in the bonus round, although not as high as desired. Fungal and insect pests were well controlled in this round. Root growth was impressive early on, and good root development was a strong indication of plant survival and potential yield. The yield of marketable tubers was 15.7 per surviving plant in the third round, and the yield of all tubers was 19.6 per plant introduced. The crop was removed from the system in late August because the lease had expired, but many of the plants were still actively producing tubers and smaller tubers harvested would likely have sized up given more time. Tuber production was quite linear (Appendix Figure A-1).

Advantages of Aeroponic Production using the PIP200

Evaluation of the PIP-200 gave our industry a novel insight into the potential of using an aeroponic production system to produce a greater number of tubers per plant. There are some clear advantages to using a system like the PIP-200:

- The number of plants required to produce seed for the next generation should be reduced.
- Tubers are harvested at an ergonomic height.
- Hill depth can be adjusted to increase the number of tubers produced.
- Tubers are harvested at a marketable size.
- Continuous harvest allows the labour costs to be distributed more evenly throughout the cycle.
- Tubers are harvested free of potting mix and are clean and attractive.
- Water and fertilizer are recirculated and the amount of each required is less in this system than in a comparable sized greenhouse using potting mix.
- No potting mix is required, so costs and disposal of potting mix are also not an issue.

- With supplemental heat and light, it is possible to produce 2 crops of nuclear potatoes per year. A third crop is possible, but logistically more challenging because of dormancy issues and lapsed certification of the stock plants.

Drawbacks of Aeroponic Production using the PIP200

There are some drawbacks to the current configuration of the PIP-200. These drawbacks have been brought to the attention of the supplier and a number of them have been addressed through design modifications and the introduction of the PIP-150, a blend of the best features of the prototype and the PIP-200:

- There is insufficient information yet available to assist growers with choosing irrigation schedules and EC settings.
- The current configuration would allow one variety or a group of similar varieties to be grown in each cycle, but it does not have the flexibility to grow multiple varieties with different agronomic profiles. Additional zones are required.
- The adjustable hill depth is a nice feature, but the adjustments were time consuming, awkward, and risked plant damage. No information was available to direct these adjustments.
- The provision for adjusting the angle of access to the lower gutter did not add sufficient value to justify the additional expense and weight of the actuators installed. The addition of this feature allowed root material and occasionally stolons to become wedged into mechanical parts and made the PIP-200 difficult to clean.
- Replacement parts and technical assistance was too far away. A ready supply of replacements parts may need to be supplied with the equipment or stocked nearby. A trouble-shooting guide in the manual would also enable producers to address minor concerns without delay. Operating the system without the benefit of all the features it was designed with can limit the productivity of the crop and requires much more frequent monitoring.
- A preventative maintenance schedule and the installation of some pre-filters would circumvent many of the alarm events that were experienced. A service or maintenance contract may also be a valuable investment.

Challenges of Aeroponic Production in General

There are some challenges inherent with an aeroponic production approach that are independent of the PIP-200 system:

- Tubers are harvested at different times and need to be stored. Storage temperatures cannot be ramped down as gradually for each harvest unless multiple storages are available.
- Storing tubers from cycles until the following spring may provide challenges for shorter dormancy varieties.
- There were concerns raised that not all tubers will perform equally well as the physiological ages will differ. This may also be true of conventionally produced tubers as not all of the tubers harvested in either system were set at the same time.

Many of these challenges can be addressed with additional research. If producers in Alberta or other parts of Canada are interested in adopting aeroponic technology for nuclear seed production, some targeted research should provide enough information to overcome the constraints identified.

Economic Evaluation

It is difficult to conduct a full economic comparison between conventional and aeroponic seed potato production. The project was conducted in a modern research greenhouse with many features and amenities that were not required for the project. Utilities (heat, electricity and water) are covered by Alberta Infrastructure and there are no provisions to itemize the costs for a portion of the facility. Producers who produce nuclear seed potato already own greenhouses, and it is difficult to determine whether the greenhouses they own would suffice for aeroponic production or whether a capital investment would be required. If one cycle of aeroponic was produced annually, likely no additional heat or lighting would be required. Less water and fertilizer would be used. No potting mix would be necessary. Additional costs would be incurred for plastic, nozzles and other consumable or wear items used in the PIP-200 system. Also, if two aeroponic cycles were produced, some supplemental heat and lighting would be required for the shoulder seasons (early spring and late fall). In a conventional system, a much larger number of plantlets are required in the beds. For this comparison, I calculated expenses for a 60m^2 facility, however, in both systems, an economy of scale would be likely in a larger facility. I estimated that producers plan potato plantlets approximately 8cm apart in 15cm deep beds. I estimated that 6 beds (2m x 4m) would fit in a 60m^2 greenhouse and allow for walkways for planting, watering, inspection and harvesting of the crops. The aeroponic system is housed in a research greenhouse bay that measures approximately 6.8m x 8.8m or roughly 60 m^2.

The estimated variable costs of production for producing the seed potatoes in the PIP-200 aeroponic system are itemized in Table 4. The estimated variable costs for producing seed potatoes in a conventional bed-planted greenhouse are itemized in Table 5. Approximately 1200 plantlets were planted in the aeroponic system. If 10 tubers per plant were produced in each cycle, the nuclear tubers would cost $0.54 per tuber in variable costs alone. If the potential yield of 15 to 20 tubers per plantlet was realized, the variable cost per tuber would decrease dramatically to $0.35 and $0.27. In the conventional system, a yield of 3 tubers per plantlet would cost $0.47 per tuber. A yield of 2 tubers per plant would cost $0.71 per tuber in variable costs. These costs do not include amortized costs of the greenhouses, the aeroponic equipment, storage facilities or expenses common to both operations, such as storage utility costs and facility inspection charges. As with all production systems, the economics is heavily affected by yield of the system.

Yield of nuclear tubers in other aeroponic systems differs by variety and ranged from 2 to 15 marketable tubers per plantlet in one recent publication (Chang et al. 2011) to as high as 71 tubers per plantlet in another (Mateus-Rodriguez et al. 2012). These and other authors identify that yield is dependent on variety, environmental settings and nutrients supplied to the plants. Costs per tuber reported in South America range from $0.07 to $0.25 per tuber depending on the production system (Mateus-Rodriguez et al. 2013), but labour and some of the other costs are lower in other countries and it is difficult to compare directly with our estimates.

Table 4: Variable costs for the production of seed potatoes using the PIP-200 aeroponic system.

Item	**Unit Cost**	**Total Cost**	**Cost/cycle**
Potato plantlets	0.60	1448.40	724.20
Fertilizers	100	100	50
Disinfectants	100	100	50
Wecult discs	0.50	1200	600
Plastic	80	960	480
Felt	300	300	150
Rock wool plugs	160	480	240
Nozzles	0.60	600	300
Manpower (per day)	170	7480	3740
Other materials	100	200	100
Total		**12868.40**	**6434.20**

Table 5: Variable costs for the production of seed using a conventional potting mix bed approach in a greenhouse.

Item	**Unit Cost**	**Total Cost**	**Cost/cycle**
Potato plantlets	0.60	4500	4500
Fertilizers	100	200	200
Disinfectants	100	100	100
Potting mix	14	1800	1800
Plastic	80	160	160
Other materials	100	100	100
Manpower (per day)	170	3740	3740
Total		**10,600**	**10,600**

The PIP-200 system provided was adapted to a research bay in a research greenhouse complex and cost approximately $160,000 including delivery, installation and training. The system has the capacity to operate additional gutters, so a modest additional cost would be required to expand the system. At a moderate rate of production, the aeroponic system would not confer an advantage to producers with conventional facilities. The variable costs per tuber in each system are similar, and the capital investment cannot be justified at this level of production. If we assume we have the yields achieved in the Bonus Round, the cost per tuber decreases dramatically. At 20 tubers per plantlet, the variable cost decreases to less than half of the current variable cost of production per tuber. This level of production is attainable with some experience operating the system.

Assuming a selling price of $0.90 per nuclear tuber and 2 tubers per plant, a conventional producer would generate $13,520 in gross revenues in one cycle in a 60m^2 facility. After variable costs, that leaves $2,900 toward fixed costs and profit. Assuming the same selling price per tuber, the aeroponic system, producing 16 tubers per plantlet in a 60m2 facility would generate $34,762 in gross returns with two production cycles per year. After variable costs, that leaves $21,894 toward fixed costs and profit.

Clearly, the productivity of the system is of utmost importance in both systems to generate a return on investment. It is assumed that producers using the conventional approach for the past 20 years or so have already reached the potential of the current production system. The full potential of the PIP-200 system has not been witnessed yet. Additional work with this system or the PIP-150 may move us past the tipping point.

6. Literature cited

Provide complete reference information for all literature cited throughout the report.

Chang, D.C., I.C. Cho, J-T. Suh, S.J. Kim and Y.B. Lee. 2011. Growth and yield response of three aeroponcially grown potato cultivars (*Solanum tuberosum* L.) to different electrical conductivities of nutrient solution. Am. J. Potato Res. 88:450-458.

Chang, D.C., C.S. Park, S.Y. Kim and Y.B. Lee. 2012. Growth and tuberization of hydroponically grown potatoes. 2012. Potato Research. 55:69-81.

Mateus-Rodriguez, J.R., S. de Haan, I. Barker, C. Chuquillanqui, and A. Rodriguez-Delfin. 2012. Response of three potato cultivars grown in a novel aeroponics system for min-tuber seed production. Acta Hort. 947:361-367.

Mateus-Rodriguez, J., S. de Haan, J.L. Andrade-Piedra, L. Maldonado, G. Hareau, I. Barker, C. Chuquillanqui, V. Otazu, R. Frisancho, C. Bastos, A.S. Pereira, C.A. Medeiros, F. Motesdeoca, and J. Benitez. 2013. Technical and economic analysis of aeroponics and other systems for potato mini-tuber production in Latin America. Am. J. Potato Res. 90:357-368.

7. Benefits to the industry (max 1 page; respond to sections *a)* and *b)* separately)

a) Describe the impact of the project results on Alberta's agriculture and food industry (results achieved and potential short-term, medium-term and long-term outcomes).

This project was initiated to provide information to early generation seed potato producers regarding the costs of production for one pre-commercial aeroponic seed potato production system, the Vital Farms PIP-200. Seven seed potato producers participated directly in the project by providing plantlets for each evaluation cycle. Seed potato tubers in excess of those required for field assessments were provided to producers for independent evaluation. There has been great interest in the project from the potato industry and the greenhouse industry as this is the first pre-commercial system of its kind in North America. The reaction by most has been positive, although producers are aware that the system is less forgiving than their current production approach. As a result, many are cautiously optimistic about eventual modifications to their production systems. Many individuals toured the system throughout the 16 months it has been in operation at the Centre. At the time this report was prepared, though, one Alberta seed producer had already purchased a PIP-200 system and has produced two seed potato crops. This report and subsequent results of the field evaluations will be shared with the Potato Growers of Alberta and producers to assist with decision making.

b) Quantify the potential economic impact of the project results (*e.g.*, cost-benefit analysis, potential size of market, improvement in efficiency, etc.).

The Vital Farms PIP-200 is a commercial aeroponic system designed to enhance production of nuclear class seed potatoes. While aeroponic seed potato production is somewhat more widely used in China, Korea, some South American countries and other regions, this type of production is fairly new to North America and this project is the first to provide information in a North American context. Little is known about the challenges facing producers who choose to adopt this new approach. The best fit for this system may well be to fast-track production of new varieties, or to produce seed of specific varieties with production issues in the current production system. Because the system only replaces one year in a seven year flush through approach to seed potato production, a small number of producers could supply all of the nuclear tubers required to satisfy our current markets. If costs of production can be further reduced, adoption of this technology may allow Alberta seed producers to pursue new markets.

The system is more expensive and complicated than the conventional bed-planting approach to nuclear seed potato production. It is my opinion that the two systems represent opposite ends of a continuum. There are many options that fall between conventional greenhouse production and aeroponics with a commercial system. At this time, widespread adoption in North America is unlikely. There are some considerations that the supplier may need to address to improve the likelihood of producers choosing this system over developing an intermediate approach. The development of the PIP-150 model may reduce costs and address some of the drawbacks identified here. Additional research may improve the production figures sufficiently to make this a natural choice for other producers as well. As this was the only system of this kind available for evaluation, it may spur on additional research to improve the return on investment for nuclear seed potato producers.

8. Contribution to training of highly qualified personnel (max ½ page)

There was only one highly qualified person involved directly in the project. Participation in the trial allowed for the development of some aeroponic expertise by this individual.

9. Knowledge transfer/technology transfer/commercialisation (max 1 page)

a) Scientific publications (*e.g.,* scientific journals); attach copies of any publications as an appendix to this final report

None to date.

b) Industry-oriented publications (*e.g.,* agribusiness trade press, popular press, etc.) attach copies of any publications as an appendix to this final report

Hein, T. 2014. Alberta’s Aeroponic Potato Project; Evaluating new seed potato production technology. In: Potatoes in Canada, Spring 2014, pp. 10 - 12.

Konschuh, M. 2014. $900 Million Potato Industry Thriving. The Profile, International Agriculture Committee of the Calgary Stampede, 22: p. 30.

Zienkiewicz, M. 2014. A new way to grow. In: SpudSmart, Fall 2014, pp. 6 - 10.

Zienkiewicz, M. 2014. The final frontier: Research in space brings home real benefits to agriculture and the seed industry. Explore the possibilities. Seed Germination, September 2014, pp. 30 – 33.

c) Scientific presentations (*e.g.*, posters, talks, seminars, workshops, etc.)

Konschuh, M.N. 2014. Aeroponic Seed Potato Production – PIP200 Evaluation (2013). Presentation at Potato Association of America Annual General Meeting, Spokane, WA, July 28 – 31, 2014.

d) Industry-oriented presentations (*e.g.*, posters, talks, seminars, workshops, etc.)

M.N. Konschuh and N. Savidov. 2012. Aeroponic Seed Potato Production – PIP200 Evaluation (2012). Annual Meeting of the Potato Growers of Alberta, Red Deer, AB, November 13 – 16. Poster

M.N. Konschuh. 2012. Potatoes in the Mist: Evaluating the PIP200. Grower Open House, CDCS, Brooks, AB, December 10, 2012.

M.N. Konschuh and N. Savidov. 2013. Aeroponic Seed Potato Production – PIP200 Evaluation (2013). Annual Meeting of the Potato Growers of Alberta, Calgary, AB, November 19 – 21. Poster

Konschuh, M.N. 2014. Aeroponic Seed Potato Production – PIP200 Evaluation (2012-2014). Presentation at Potato Growers of Alberta Annual General Meeting, Red Deer, AB, November 18.

e) Media activities (*e.g.*, radio, television, internet, etc.)

Beecher, J. 2012. Aeroponics for potatoes. In: Brooks Bulletin. September 19, 2012.

Dumont, M. 2012. CDC South scientist uses aeroponics in seed potato process. In: Brooks and County Chronicle. September 23, 2012. p. A4.

Brown, R. 2012. CDC South opens doors for look at potato incubator. In: Brooks Bulletin. December 11, 2012. p. B1.

Dumont, M. 2014. Aeroponic research proves boon to potato seed industry. In: Brooks and County Chronicle. January 22, 2014.

f) Any commercialisation activities or patents

These are being pursued by the supplier.

N.B.: Any publications and/or presentations should acknowledge the contribution of each of the funders of the project.

Section D: Project resources

1. **Statement of revenues and expenditures:**
   a) **In a separate document certified by the organisation's accountant or other senior executive officer, provide a detailed listing of all cash revenues to the project and expenditures of project cash funds.** Revenues should be identified by funder, if applicable. Expenditures should be classified into the following categories: personnel; travel; capital assets; supplies; communication, dissemination and linkage; and overhead (if applicable).
   b) **Provide a justification of project expenditures and discuss any major variance (*i.e.*, ± 10%) from the budget approved by the funder(s).**

   Note that we were not charged to lease space in the Brooks Research and Production Greenhouse Complex, so $15,000 of the requested funds were not required.

2. **Resources:**

Provide a list of all external cash and in-kind resources which were contributed to the project.

Total resources contributed to the project		
Source	**Amount**	**Percentage of total project cost**
Agriculture Funding Consortium	44,789	21.0%
Other government sources: Cash	0	0%
Other government sources: In-kind	56,581	26.0%
Industry: Cash	103,512	48%
Industry: In-kind	10,950	5%
Total Project Cost	**215,832**	**100%**

External resources (additional rows may be added if necessary)		
Government sources		
Name (only approved abbreviations please)	Amount cash	Amount in-kind
Agriculture and Rural Development	0	56,581
Industry sources		
Name (only approved abbreviations please)	Amount cash	Amount in-kind
Potato Growers of Alberta	45,000	See below
Potato Growers of Alberta via CAAP	54,762	0
Chedzoy Farms	0	1,135
Hoogland Farms	0	3,400
Haenni Farms	0	1,510
Sandhills Seed Potato	0	945

Solanum International	0	375
Meyer Seed Potato Farms	3750	3,585

Section E: Research Team Signatures and Employers' Approval

The team leader and an authorised representative from his/her organisation of employment MUST sign this form.

Research team members and an authorised representative from their organisation(s) of employment MUST also sign this form.

By signing as representatives of the research team leader's employing organisation and/or the research team member's(s') employing organisation(s), the undersigned hereby acknowledge submission of the information contained in this final report to the funder(s).

Team Leader's Organisation

Team Leader	
Name: **Michele Konschuh**	**Title/Organisation:** **Research Scientist** **Alberta Agriculture and Rural Development**
Signature:	**Date:** **January 23, 2015**
Team Leader's Employer's Approval	
Name: **Darcy Driedger**	**Title/Organisation:** **Branch Director** **Food and Bio-Industrial Crops Branch**
Signature:	**Date:**

Research Team Members (add more lines as needed)

1. Team Member	
Name: **Nick Savidov**	**Title/Organisation:** **Senior Research Scientist** **Alberta Agriculture and Rural Development**
Signature:	**Date:**
Team Member's Employer's Approval	
Name: **Hong Qi**	**Title/Organisation:** **Director** **Bio-Industrial Opportunities Branch**
Signature:	**Date:**

2. Team Member	
Name:	**Title/Organisation:**
Signature:	**Date:**
Team Member's Employer's Approval	
Name:	**Title/Organisation:**
Signature:	**Date:**

Section F: Suggested reviewers for the final report

Provide the names and contact information of four potential reviewers for this final report. The suggested reviewers should not be current collaborators. The Agriculture Funding Consortium reserves the right to choose other reviewers. Under *Section 34* of the *Freedom of Information and Protection Act (FOIP)* reviewers must be aware that their information is being collected and used for the purpose of the external review.

Reviewer #1
Name: Becky Hughes
Position: Head, Northern Horticultural Research/SPUD Unit
Institution: New Liskeard Agricultural Research Station, University of Guelph
Address: P.O. Box 6007, 340 Armstrong St., New Liskeard, ON P0J 1P0
Phone Number: 705-647-8525 ext. 222
Fax Number: 705-647-9315
Email Address: bhughes@uguelph.ca

Reviewer #2
Name: Helen Tai
Position: Research Scientist
Institution: Agriculture and Agri-Food Canada
Address: 850 Lincoln Road, P.O. Box 20280, Fredericton, NB E3B 4Z7
Phone Number: 506-460-4519
Fax Number: 506-460-4377
Email Address: helen.tai@agr.gc.ca

Reviewer #3
Name: Peter Van der Zaag
Position:
Institution: Sunrise Potato Storage Ltd.
Address: 5546 County Road 15, R.#. #3, Alliston, ON L9R 1V3
Phone Number: 705-435-1028
Fax Number: 705-435-2626
Email Address: peter@sunrisepotato.com

Reviewer #4
Name: Sachid Madan
Position: Director
Institution: Technico Technologies Inc.
Address: 12 Airport Road, Hoyt, NB E5L 2K5
Phone Number: 506-687-4272
Fax Number: 506-687-4218
Email Address: sachid.madan@technituber.com.au

Appendix

Table A-1: Seed potato varieties included in the first round of evaluation (October 2012 to February 2013).

Variety	***Seed Selected By***
Agata	Solanum International
Agria	Chedzoy Farms
Atlantic	Chedzoy Farms
Dakota Pearl	Hoogland Farms
Imola	Hoogland Farms
Musica	Solanum International
Ranger Russet	Hoogland Farms
Russet Burbank (Oct 24)	Sandhills Seed Potato
Russet Burbank (Oct 30)	Meyer Seed Potato Farms
Sangre (humid)	Meyer Seed Potato Farms
Sangre (dry)	Haenni Farms
Satina	Hoogland Farms
Shepody (20mm)	Meyer Seed Potatoes
Shepody (30mm)	Haennis Farms
Stampede Russet	Sandhills Seed Potatoes
Umatilla Russet	Hoogland Farms
Viking	Hoogland Farms

Table A-2: Seed potato varieties included in the second round of evaluation (April 2013 to July 2013).

Variety	***Seed Supplied By***
Agria	Chedzoy Farms
Atlantic	Chedzoy Farms
Goldrush	Hoogland Farms
Innovator	Haenni Farms
Ivory Russet	Hoogland Farms
Russet Burbank (Basket)	Hoogland Farms
Russet Burbank (Toothpick)	Hoogland Farms
Russet Burbank (Cut felt)	Sandhills Seed Potato
Russet Burbank (South)	Meyer Seed Potato Farms
Sangre (22mm)	Meyer Seed Potato Farms
Sangre (25mm)	Hoogland Farms
Satina	Haenni Farms
Shepody (Toothpick)	Meyer Seed Potatoes
Shepody (Basket)	Hoogland Farms
Shepody (Cut felt)	Sandhills Seed Potatoes
Stampede Russet	Sandhills Seed Potatoes
Stampede Russet (2)	Haenni Farms

Table A-3: Seed potato varieties included in the third round of evaluation (August 2013 to December 2013).

Variety	*Seed Supplied By*
Dakota Pearl	Haenni Farms
Imola	Hoogland Farms
Ranger Russet	Hoogland Farms
Ranger Russet	Hoogland Farms
Russet Burbank (Oct 24)	Haenni Farms
Russet Burbank (Oct 30)	Haenni Farms
Satina	Hoogland Farms
Umatilla Russet	Chedzoy Farms
Umatilla Russet	Chedzoy Farms
Umatilla Russet	Hoogland Farms
Umatilla Russet	Hoogland Farms

Table A-4: 2013 Field evaluation of Winter 2012/2013 (A) aeroponic crop compared to conventional (C) seed tubers produced in greenhouses.

Variety	*Source*	*Stand*	*Total Yld (ton/ac)*	*Tubers per Plant*
Agata	A	17.5 bcd	13.7 ab	6.44 b-f
Agata	C	19.8 ab	21.4 ab	8.4 ab
Imola	A	**14.8 e**	9.2 b	5.3 def
Imola	C	**19.5 ab**	14.5 ab	6.5 b-f
Musica	A	20.0 a	21.0 ab	7.8 a-d
Musica	C	20.0 a	26.7 ab	10.2 a
Ranger Russet	A	**15.8 de**	**7.4 b**	4.9 ef
Ranger Russet	C	**19.3 abc**	**32.7 a**	6.6 b-f
Russet Burbank	A	18.8 abc	6.5 b	**1.0 g**
Russet Burbank	C	20.0 a	18.9 ab	**7.9 a-d**
Sangre	A	17.3 b-e	8.5 b	5.5 c-f
Sangre	C	19.8 ab	15.5 ab	8.1 abc
Satina	A	**16.8 cde**	15.0 ab	6.8 b-e
Satina	C	**19.8 ab**	17.1 ab	8.2 ab
Shepody	A	**17.3 b-e**	10.3 ab	5.6 ef
Shepody	C	**20.0 a**	14.9 ab	5.0 ef
Viking	A	17.3 b-e	15.0 ab	4.4 ef
Viking	C	18.3 a-d	15.0 ab	4.0 f

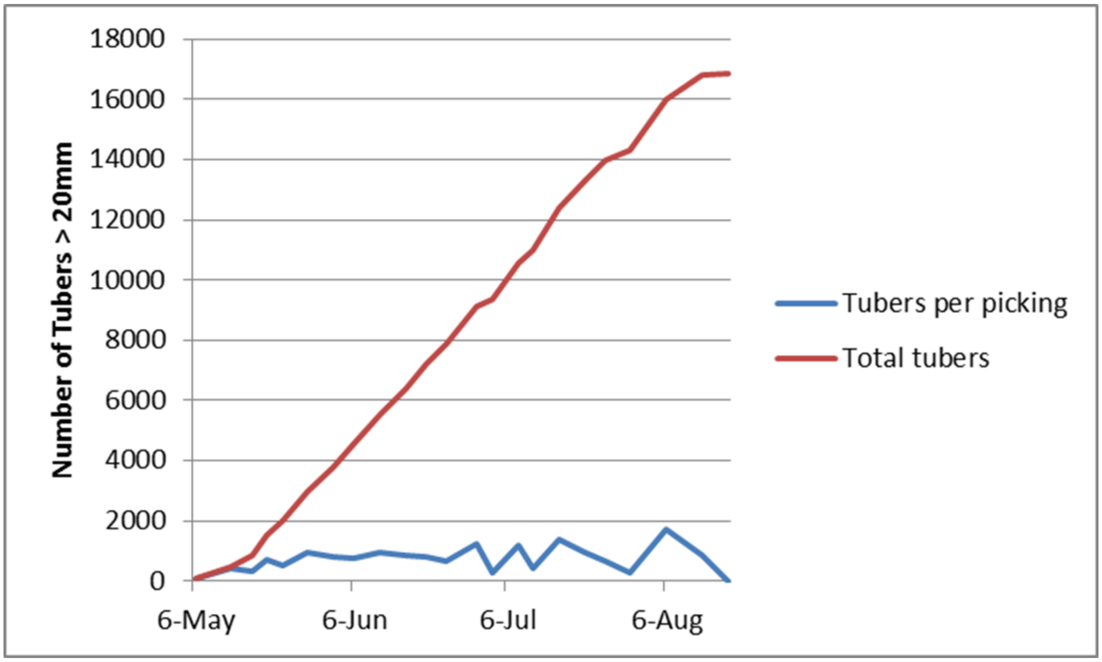


Figure A-1: Seed potato yield from an aeroponic Russet Burbank crop grown in the PIP-200 in 2014. 1200 plants were grown in a 60m^2 facility over 3.5 months.

Table A-5: 2014 Field evaluation of Spring (A2) and Summer (A3) 2013 aeroponic crop compared to conventional (C) seed tubers produced in greenhouses.

Variety	***Source***	***Stand***	***Total Yld (ton/ac)***	***Tubers per Plant***
Agria	A2	18.5 a	9.8 c-f	4.0 ab
Agria	C	20.0 a	11.2 cde	4.3 ab
Atlantic	A2	20.0 a	13.3 bc	4.7 ab
Atlantic	C	19.8 a	16.8 ab	5.6 ab
Goldrush	A2	16.8 a	9.2 c-f	4.5 ab
Goldrush	C	20.0 a	12.1 cd	4.0 ab
Imola	A3	19.0 a	10.3 c-f	4.2 ab
Imola	C	20.0 a	13.3 bc	5.0 ab
Innovator	A2	18.5 a	1.9 gi	1.4 b
Innovator	C	19.5 a	2.5 g	0.9 b
Ivory Russet	A2	16.5 a	6.5 f	2.6 b
Ivory Russet	C	19.3 a	7.1 ef	2.2 b
Ranger Russet	A3	20.0 a	9.4 c-f	3.9 ab
Ranger Russet	C	20.0 a	9.4 c-f	3.8 ab
Russet Burbank	A2	20.0 a	**8.8 def**	3.0 b
Russet Burbank	A3	19.8 a	**7.8 ef**	2.8 b
Russet Burbank	C	20.0 a	**18.7 a**	7.0 ab
Sangre	A2	19.0 a	**10.9 cde**	6.4 ab
Sangre	C	20.0 a	**17.0 ab**	7.1 ab
Satina	A2	18.5 a	11.1 cde	4.0 ab
Satina	A3	20.0 a	10.9 cde	4.8 ab
Satina	C	19.0 a	12.2 cd	12.8 a
Shepody	A2	17.8 a	**7.0 ef**	3.1 b
Shepody	C	20.0 a	**17.0 ab**	4.7 ab
Stampede Russet	A3	**4.0 b**	**2.2 g**	2.5 b
Stampede Russet	C	**17.5 a**	**7.6 ef**	4.0 ab
Umatilla	A3	20.0 a	8.4 def	3.4 b
Umatilla	C	20.0 a	8.9 c-f	3.9 ab

Aeroponic Seed Potato Production – PIP200 Evaluation (2013)

Michele Konschuh

Alberta Agriculture and Rural Development, 301 Horticultural Station Road East, Brooks, AB, T1R 1E6

Agriculture and Rural Development

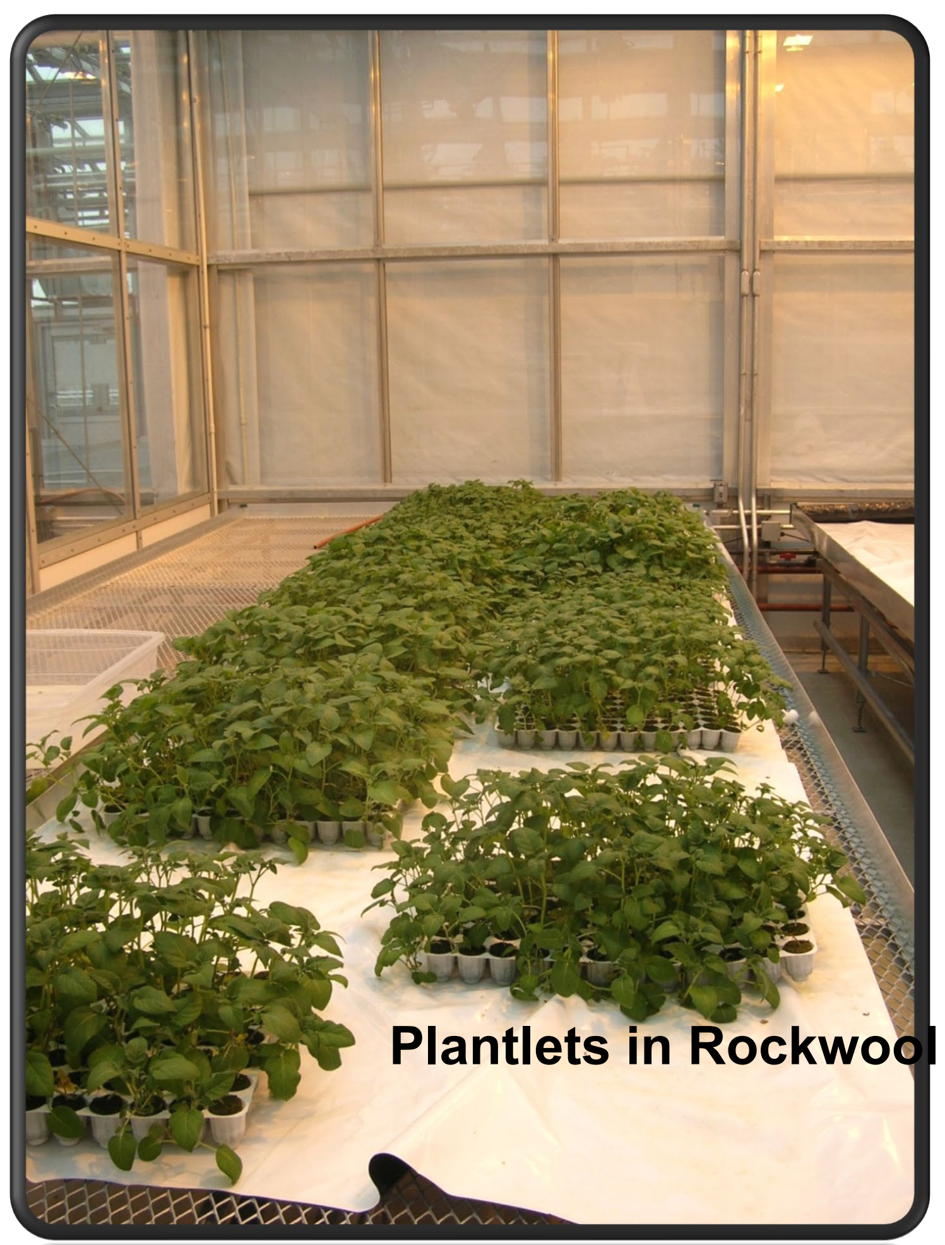
Food and Bio-Industrial
Crops Branch

Purpose

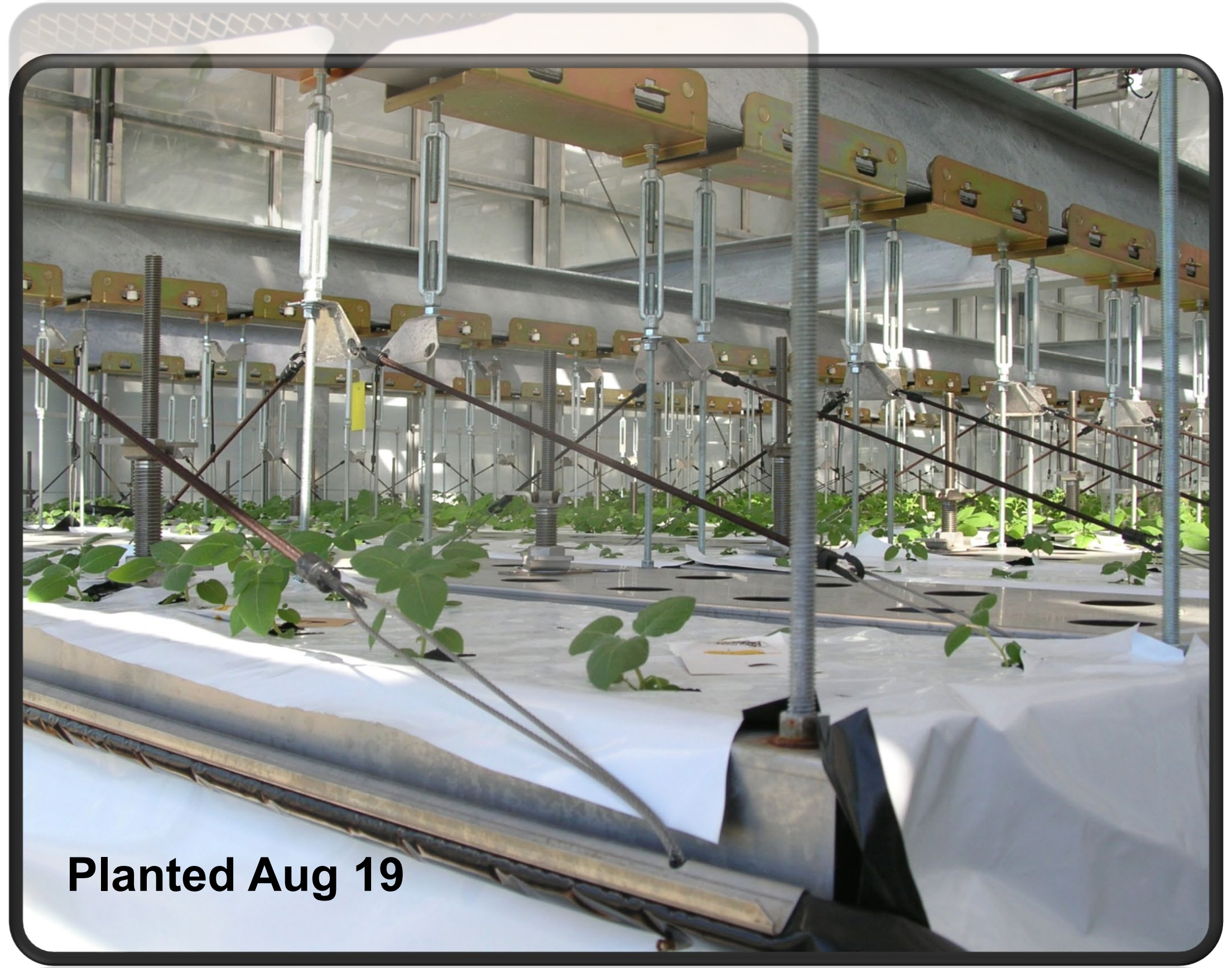
- The purpose of this study is to evaluate the 'Potato Incubator™' an aeroponic production system designed to optimize the yield and quality of seed potato mini-tubers.
- The effect of potato variety, tuber size at harvest and nutrient solution on the yield of mini-tubers will also be determined within the context of this system.

Objectives

1. To evaluate the 'Potato Incubator™' for production of mini-tubers of Alberta potato varieties;
2. To compare yield of seed potato harvested at different size cut-offs;
3. To evaluate the costs of production (COP) for nuclear tubers using and aeroponic system; and
4. To verify that the subsequent yield potential of mini-tubers produced in the Potato Incubator™ is equal or superior to that of mini-tubers produced in potting mix.

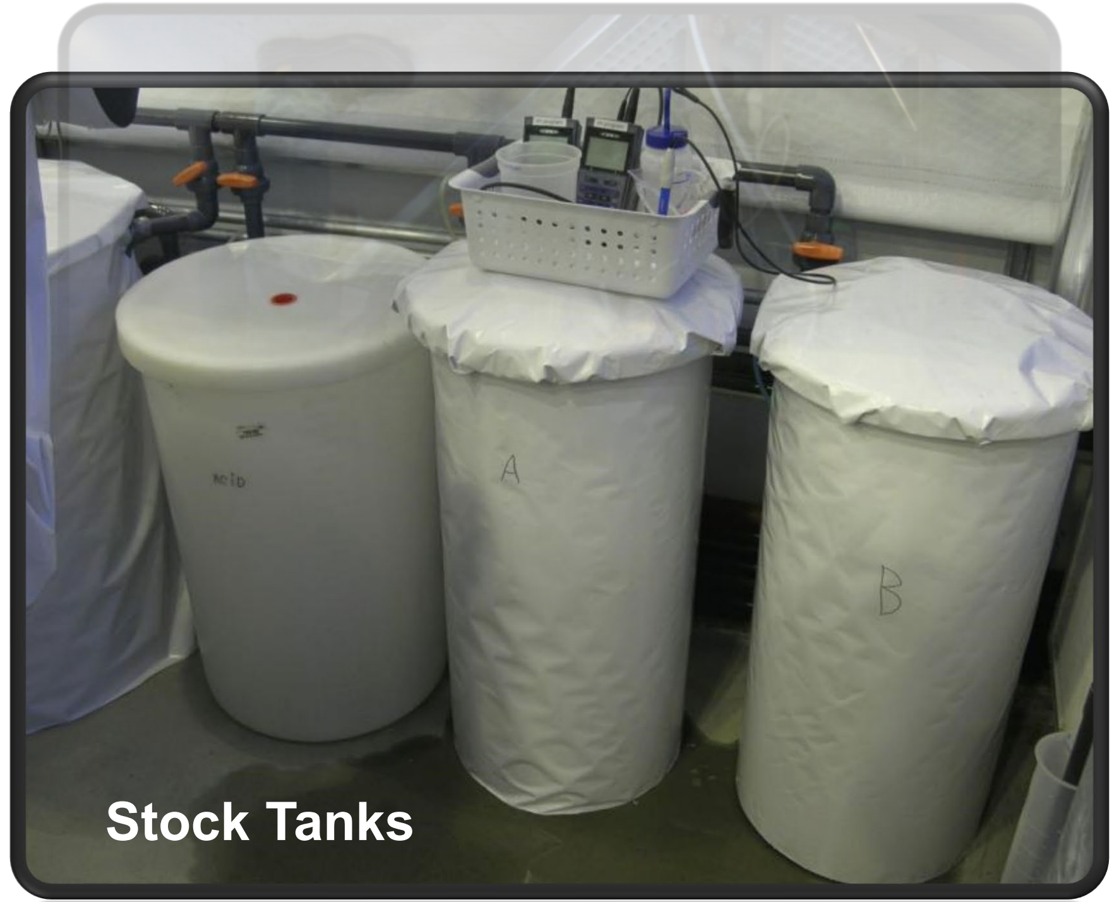


Plantlets in Rockwool



Planted Aug 19

Control System



Stock Tanks

Tubers Forming Oct 4

Roots Developing

Round 3 – September 20

Status and Results to Date

- Incubator assembled and installed by end of September, 2012.
- **First crop:** October 2012 to January 2013. Harvested 3 to 10 tubers per plant (mean 6.8).
- Planted at CDCS spring 2013 adjacent to conventional nuclear tubers.
- **Second crop:** April 2013 to July 2013. Harvested 6 to 17 tubers per plant (mean 9.5).
- **Third crop:** August 2013 to December 2013. Still harvesting. Best crop yet.
- **Field evaluations** of second and third crop planned for summer of 2014.
- Variety differences apparent.

Field Evaluation Aug 22

Acknowledgements

This project was supported financially by Alberta Crop Industry Development Fund Ltd., Alberta Agriculture and Rural Development, Agriculture and Agri-Food Canada, and the Potato Growers of Alberta and through in-kind contributions from seed potato growers.

Prepared for the Potato Growers of Alberta AGM, November 19 - 21, 2013, Calgary, AB

Agriculture & Food Council
The Catalyst

Canadian Agricultural Adaptation Program (CAAP)

Project Reporting Form

The following information is to assist you with CAAP reporting requirements. If you have any questions regarding any of the sections or bullets below contact your CAAP Project Officer.

- As per the Contract Agreement, ***Interim reports*** require sign-off by the project manager and ***Final financial reports*** must be signed off by an external accountant and by two executive officers/directors of the applicant, for the full report. See also the Financial Tracking template.
- Each and every Interim Report and the Final Performance Report shall be supported by documents, including invoices, statements, and receipts as the Council may require.
- Changes to estimated project costs, movement between cost elements, project timelines, and partner revenues often occur. CAAP pre-approval is required for material changes that affect initial project objectives, budget and/or extension of the project's term. Please contact your Project Officer as soon as you become aware of any changes.
- CAAP funding must be acknowledged on all press releases, public announcements and promotional materials related to the project/activity, and with consent of Council. Logos are available from our office at (855) 469-3714 or by email at caap-pcaa@agfoodcouncil.com. Copies of all such materials must be provided to CAAP prior to release to ensure that proper acknowledgement has been expressed.

Project Title	Improving greenhouse mini-tuber production		
Legal Organization	Potato Growers of Alberta		
Contact Person	Terence Hochstein	**Contact E-mail**	Terence@albertapotatoes.ca
Contact Phone Number	403-223-2262	**Project #**	AB1170

Project Start Date	April 2012	**Project End Date**	December 2013
Report Due Date	December 2013	**Reporting Period included in report**	September 2013 to December 2013
Funds requested for this period		$30,000	

Project Summary/Objectives	The project involves evaluating the Potato Incubator (PIP200), an aeroponic seed potato production system designed to optimize the yield and quality of seed potato mini-tubers. Further, we intend to determine the effect of light, potato variety and nutrient solution on the yield of mini-tubers within the context of the system. The specific objectives are: • To evaluate the 'Potato Incubator™' for production of mini-tubers of Alberta potato varieties; • To compare yield of seed potato grown on different nutrient solutions; • To evaluate the effect of pre-treating tissue culture plantlets with a shorter (12 h) photoperiod on the yield and size of mini-tubers produced; and • To evaluate the costs of production (COP) for nuclear tubers using an aeroponic system.

Progress To-Date

In the third round of evaluation, plantlets of 6 different varieties were supplied by 4 producers (Table 3). Two producers were unable to obtain seed potato plantlets as labs had shut down for the season before orders were placed. Plantlets were transplanted into rock wool blocks in early August and transferred into the PIP-200 between August 12 and 19, 2013. Only 11 of the 17 gutters were planted in the third round. Inadvertently, this allowed for the evaluation of planting density within the greenhouse bay and some replication within varieties.

In the third round, strategies learned in the first two rounds of evaluation were employed from the outset. Biological thrip control was introduced as soon as plants had been transplanted. Fungicides were applied at regular intervals throughout the growth cycle. Irrigation scheduling was adjusted to enhance root establishment and was adjusted as the plants grew. However, with only one irrigation zone, it was not possible to control irrigation independently for each variety. A compromise was necessary. EC was monitored and the fertilizer solution was partially refreshed every two weeks or so. Harvesting began September 19 for the earliest variety and continued once every 6 to 7 days until December 16. Harvesting was less frequent in this round to reduce stress on the plants.

Table 3: Seed potato varieties included in the third round of evaluation (August 2013 to December 2013).

Variety	***Seed Supplied By***
Dakota Pearl	Haenni Farms
Imola	Hoogland Farms
Ranger Russet	Hoogland Farms
Ranger Russet	Hoogland Farms
Russet Burbank (Oct 24)	Haenni Farms
Russet Burbank (Oct 30)	Haenni Farms
Satina	Hoogland Farms
Umatilla Russet	Chedzoy Farms
Umatilla Russet	Chedzoy Farms
Umatilla Russet	Hoogland Farms
Umatilla Russet	Hoogland Farms

An economic assessment was planned to allow producers to determine whether the additional production of tubers justifies the costs of the system, supplies and greenhouse requirements.

By the third round of evaluation, the system itself had developed a few issues. The supplier was unable to address the issues in a timely fashion as most technical expertise and replacement parts are in Europe. As a result, the tuber misting pump was used to replace a damaged pump for irrigating the roots and the tuber misting system could not be used during this round. One glass tube in the UV disinfection system was damaged during the cleaning procedure and a replacement was not provided. Two out of three of the UV tubers were functioning for this round, but the system was not full and the disinfection was deemed adequate. In mid-October, the computer reported a fault with the EC sensor equipment. Replacing one and then both sensors did not correct the fault. Recalibrating the sensors did not correct the fault. To address the deficiency, the fertilizer was added manually to the mixing tank and EC was monitored manually each day. pH continued to be monitored and adjusted automatically. The manual adjustment of the EC, rather than frequent automated monitoring, may have contributed to early senescence of the crop, although this may also be expected as a result of the shorter days and lower light intensities at this time of year.

Table 6: Yield of seed potatoes from varieties planted in the PIP-200 (August 2013 to December 2013).

Variety	*Plantlet survival*	*Total Number**	*Total Yld (g)*	*Mkt Number*	*Number per Plant*
Dakota Pearl	82%	364	3207.7	364	6.3
Imola	94%	850	7780	690	12.7
Ranger Russet	87%	1160	8660.9	797	18.7
Ranger Russet 2	85%	874	6105.4	608	14.6
Russet Burbank 1	93%	1201	8017	903	18.2
Russet Burbank 2	75%	818	5245.9	586	15.4
Satina	86%	883	6520.5	692	14.5
Umatilla 1	87%	806	5518.1	575	13.0
Umatilla 2	87%	633	4082.4	431	10.2
Umatilla 3	96%	693	4354.5	455	10.2
Umatilla 4	89%	1027	6459.6	685	16.3

***Total number only includes tubers harvested as of December 16. Final tuber harvest will include tubers of all size categories and will increase the total number of tubers.**

Plant survival was higher (87%) in the third round, although not as high as desired. Fungal and insect pests were better controlled in this round. Root growth was impressive early on, but roots browned and struggled later in the cycle. The yield of tubers ranged from 6 to 18 tubers per surviving plant in the third round, with a mean of 13.6. Although this is a good yield compared to current mini-tuber production levels (1 to 5) in conventional potting mix, and the best yield from the system so far, the yield still fell in the low end of the 10 to 30 tubers per plant suggested by the supplier.

It became apparent during this evaluation that more production information is required to reach the full potential of the PIP-200 aeroponic seed potato production system. The current manual indicates that adjustments to the irrigation schedule and EC settings may be required depending on the time of year, the nutritional requirements of the crop and the stage of growth. There is, however, no indication as to when these adjustments should be made or what to base the decision to adjust settings on. Some literature information is now becoming available based on other aeroponic system in other settings (Chang et al., 2011, Chang et al., 2012 and Mateus-Rodriguez et al. 2013). I believe that guidelines are required with respect to greenhouse settings, troubleshooting with the system and management of the crop. Likely, in the 16 months of evaluation to date, we have not reached the full potential of the PIP-200.

Evaluation of the PIP-200 gave our industry a novel insight into the potential of using an aeroponic production system to produce a greater number of tubers per plant. There are some clear advantages to using a system like the PIP-200:

- The number of plants required to produce seed for the next generation should be reduced.
- Tubers are harvested at an ergonomic height.
- Hill depth can be adjusted to increase the number of tubers produced.
- Tubers are harvested at a marketable size.
- Continuous harvest allows the labour costs to be distributed more evenly throughout the cycle.
- Water and fertilizer is recirculated and the amount required is less in this system than in a comparable sized greenhouse using potting mix.
- Tubers are harvested free of potting mix and are clean and attractive.
- No potting mix is required, so costs and disposal of potting mix are also not an issue.
- With supplemental heat and light, it is possible to produce 2 crops of nuclear potatoes per year. A third crop is possible, but logistically more challenging because of dormancy issues and lapsed certification of the stock plants.

There are some drawbacks to the current configuration of the PIP-200. These drawbacks have been brought to the attention of the supplier and a number of them have been addressed through design modifications and the introduction of the PIP-150, a blend of the best features of the prototype and the PIP-200:

- There is insufficient information yet available to assist growers with choosing irrigation schedules and EC settings.
- The current configuration would allow one variety or a group of similar varieties to be grown in each cycle, but it does not have the flexibility to grow multiple varieties with different agronomic profiles.
- The adjustable hill depth is a nice feature, but the adjustments were time consuming and awkward. No information is available to direct these adjustments.
- The provision for adjusting the angle of access to the lower gutter did not add sufficient value to justify the additional expense and weight of the actuators installed. The addition of this feature allowed root material and occasionally stolons to become wedged into mechanical parts and made the PIP-200 difficult to clean.
- Replacement parts and technical assistance was too far away. A ready supply of replacements parts may need to be supplied with the equipment or stocked nearby. A trouble-shooting guide in the manual would also enable producers to address minor concerns without delay. Operating the system without the benefit of all the features it was designed with can limit the productivity of the crop and requires much more frequent monitoring.
- A preventative maintenance schedule and the installation of some pre-

filters would circumvent many of the alarm events that were experienced.

There are some challenges inherent with an aeroponic production approach that are independent of the PIP-200 system:

- Tubers are harvested at different times and need to be stored. Storage temperatures cannot be ramped down as gradually for each harvest unless multiple storages are available.
- Storing tubers from cycles until the following spring may provide challenges for shorter dormancy varieties.
- There were concerns raised that not all tubers will perform equally well as the physiological ages will differ. This may also be true of conventionally produced tubers as not all of the tubers harvested in either system were set at the same time.

Many of these challenges can be addressed with additional research. If producers in Alberta or other parts of Canada are interested in adopting aeroponic technology for nuclear seed production, some targeted research should provide enough information to overcome the constraints identified.

Gross economic evaluation:

It is difficult to conduct a full economic comparison between conventional and aeroponic seed potato production. The project was conducted in a modern research greenhouse with many features and amenities that were not required for the project. Utilities (heat, electricity and water) are covered by Alberta Infrastructure and there are no provisions to itemize the costs for a portion of the facility. Producers who produce nuclear seed potato already own greenhouses, and it is difficult to determine whether the greenhouses they own would suffice for aeroponic production or whether a capital investment would be required. If one cycle of aeroponic was produced annually, likely no additional heat or lighting would be required. Less water and fertilizer would be used. No potting mix would be necessary. Additional costs would be incurred for plastic, nozzles and other consumable or wear items used in the PIP-200 system. Also, if two aeroponic cycles were produced, some supplemental heat and lighting would be required for the shoulder seasons (early spring and late fall). In a conventional system, a much larger number of plantlets are required in the beds. For this comparison, I estimated that producers are planting potato plantlets approximately 8cm apart in 15cm deep beds. I estimated that 6 beds (2m x 4m) would fit in a 60m^2 greenhouse and allow for walkways for planting, watering, inspection and harvesting of the crops. The aeroponic system is housed in a research greenhouse bay that measures approximately 6.8m x 8.8m or roughly 60 m^2. Of course, in both systems, an economy of scale may be likely in a larger facility.

The estimated variable costs of production for producing the seed potatoes in the PIP-200 aeroponic system are itemized in Table 7. The estimated variable costs for producing seed potatoes in a conventional bed-planted greenhouse are itemized in Table 8. Approximately 1200 plantlets were planted in the aeroponic system. If 10 tubers per plant were produced in each cycle, the nuclear tubers would cost $0.54 per tuber in variable costs alone. If the potential yield of 15 to 20 tubers per plantlet was realized, the variable cost per tuber would decrease dramatically to $0.35 and $0.27. In the conventional system, a yield of 3 tubers per plantlet would cost $0.47 per tuber. A yield of 2 tubers per plant would cost $0.71 per tuber in variable costs. These costs do not include amortized costs of the greenhouses, the aeroponic equipment, storage facilities or expenses common to both operations, such as storage utility costs and facility inspection charges.

Yield of nuclear tubers in other aeroponic systems differs by variety and ranged from 2 to 15 marketable tubers per plantlet in one recent publication (Chang et al. 2011) to as high as 71 tubers per plantlet in another (Mateus-Rodriguez et al. 2012). These and other authors identify that yield is dependent on variety, environmental settings and nutrients supplied to the plants. Costs per tuber reported in South America range from $0.07 to $0.25 per tuber depending on the production system (Mateus-Rodriguez et al. 2013), but labour and some of the other costs are lower in other countries and it is difficult to compare directly with our estimates.

Table 7: Variable costs for the production of seed potatoes using the PIP-200 aeroponic system.

Item	**Unit Cost**	**Total Cost**	**Cost/cycle**
Potato plantlets	0.60	1448.40	724.20
Fertilizers	100	100	50
Disinfectants	100	100	50
Wecult discs	0.50	1200	600
Plastic	80	960	480
Felt	300	300	150
Rock wool plugs	160	480	240
Nozzles	0.60	600	300
Manpower (per day)	170	7480	3740
Other materials	100	200	100
Total		**12868.40**	**6434.20**

Table 8: Variable costs for the production of seed using a conventional potting mix bed approach in a greenhouse.

Item	**Unit Cost**	**Total Cost**	**Cost/cycle**
Potato plantlets	0.60	4500	4500
Fertilizers	100	200	200
Disinfectants	100	100	100
Potting mix	14	1800	1800
Plastic	80	160	160
Other materials	100	100	100
Manpower (per day)	170	3740	3740
Total		**10,600**	**10,600**

The PIP-200 system provided was adapted to a research bay in a research greenhouse complex and cost approximately $160,000 including delivery, installation and training. The system has the capacity to operate additional gutters, so a modest additional cost would be required to expand the system. At the current rate of production, the aeroponic system would not confer an advantage to producers with conventional facilities. The variable costs per tuber in each system are similar, and the capital investment cannot be justified at this level of production. If some additional work is conducted and we approach the target yields reported by the supplier, the cost per tuber decreases dramatically. At 20 tubers per plantlet, the variable cost decreases to about half of the current variable cost of production per tuber. This level of production seems attainable with some experience operating the system.

Assuming a selling price of $0.90 per nuclear tuber, a conventional producer would generate $20,250 in gross revenues in one cycle in a 60m^2 facility. After variable costs, that leaves $9,650 toward fixed costs and profit. Assuming the same price per tuber, a more optimized aeroponic system, producing 20 tubers per plantlet in a 60m2 facility would generate $43,200 in gross returns with two production cycles per year. After variable costs, that leaves $30,330 toward fixed costs and profit.

Clearly, the productivity of the system is of utmost importance in both systems to generate a return on investment. It is assumed that producers using the conventional approach for the past 20 years or so have already reached the potential of the current production system. The full potential of the PIP-200 system has not been witnessed yet. Additional work with this system or the PIP-150 may move us past the tipping point.

Chang, D.C., I.C. Cho, J-T. Suh, S.J. Kim and Y.B. Lee. 2011. Growth and yield response of three aeroponcially grown potato cultivars (*Solanum tuberosum* L.) to different electrical conductivities of nutrient solution. Am. J. Potato Res. 88:450-458.

Chang, D.C., C.S. Park, S.Y. Kim and Y.B. Lee. 2012. Growth and tuberization of hydroponically grown potatoes. 2012. Potato Research. 55:69-81.

Mateus-Rodriguez, J.R., S. de Haan, I. Barker, C. Chuquillanqui, and A. Rodriguez-Delfin. 2012. Response of three potato cultivars grown in a novel aeroponics system for min-tuber seed production. Acta Hort. 947:361-367.

Mateus-Rodriguez, J., S. de Haan, J.L. Andrade-Piedra, L. Maldonado, G. Hareau, I. Barker, C. Chuquillanqui, V. Otazu, R. Frisancho, C. Bastos, A.S. Pereira, C.A. Medeiros, F. Motesdeoca, and J. Benitez. 2013. Technical and economic analysis of aeroponics and other systems for potato mini-tuber production in Latin America. Am. J. Potato Res. 90:357-368.

Technology Transfer Activities To-Date

A poster was presented at the PGA annual general meeting in Calgary in November.

An open house was hosted in December 2012. Growers attending a field day in August 2013 were also toured through the system. Another open house was not conducted in October 2013 as there was no new information to share with growers who had already seen the system. Individual requests were accommodated.

Research Plan for Upcoming Years/Next Steps

The third round of evaluation is complete. Additional product development work appears to be required before any firm recommendations can be made.

Field evaluation of the second and third round of tubers harvested from the system will take place in 2014 at CDCS.

The proposed timelines for the remainder of the year are:

Activities (Describe each activity and any sub-activities)	**Anticipated Activity Start Date**	**Anticipated Activity Completion Date**	**Deliverables/Outputs** (For each activity listed, show what will be produced)	**Who is undertaking the activities**
Data analyses and report writing	November 2013	February 2014	Final report for project; industry presentations	Alberta Agriculture and PGA
Feedback for manufacturer	Ongoing	July 2014	Trouble shooting guide	Alberta Agriculture and Vital Farms

Short-Term Outcomes (As indicated in original application)	X	Improved knowledge of potential innovative products, processes, technologies		Improved knowledge of solutions/strategies analyzed/tested to address issues/opportunities

Actual Short – Term Outcomes (if applicable):

- Improved knowledge of aeroponic seed potato production
- Some practical information has been generated and will form part of a trouble-shooting guide for producers.
- Made a number of suggestions to streamline set up and planting in the system

Long-Term Outcomes	X	Reduced production or processing costs
		Improved product quality
	X	Improved market share
	X	Preserving market share
		Other:
Actual Progress towards Long-Term Outcomes: (if applicable)		

Any significant changes, challenges?

The system is more expensive and complicated than the conventional bed-planting approach to nuclear seed potato production. At this time, widespread adoption in North America is unlikely. There are some considerations that the supplier may need to address to improve the likelihood of producers choosing this system over developing one of their own. The development of the PIP-150 model may reduce costs and address some of the drawbacks identified here. At the time this report was prepared, though, one Alberta seed producer has already purchased a PIP-200 system and produced his first crop. Additional research may improve the

	production figures sufficiently to make this a natural choice for other producers as well. As this was the only system of this kind available for evaluation, it may spur additional research on to improve return on investment for nuclear seed potato producers.

Agriculture and Agri-Food Canada
Agriculture et Agroalimentaire Canada

Canada

Alberta Crop Industry Development Fund Ltd.

June 26, 2013

Cindy Sulderitsch
Finance Coordinator
Food & Bio-Industrial Crops Branch
Agriculture & Rural Development
307 J.G. O'Donoghue Building
7000 113 Street
Edmonton AB. T6H 5T6

Michele Konschuh
Agriculture and Rural Development
Crop Development Centre South
301 Horticultural Station Road East
Brooks, AB. T1R 1E6

Terence Hochstein
Executive Director
Potato Growers of Alberta
6008-46 Avenue
Taber, AB. T1G 2B1

PAID

RE: Year 3 payment for proposal 2011F047R "*Potato Variety Development in Alberta*"

Michele, thank you for your interim report and the financials. The results of the due diligence has enable ACIDF to ACIDF's cheque #5024 payable to **Government of Alberta** for $10,000.00 to Cindy.

Terence, with this letter ACIDF as lead funder, is asking the Potato Growers of Alberta at their earliest convenience, to release their year ~~2 payment of $10,000.00~~ as per the schedule below. Please make the cheque payable to the following and send it to Cindy. 3RD YEAR PAYMENT OF $5000

as per Susan Crump.

Government of Alberta
Alberta Agriculture and Rural Development
Food Crops Branch
Crop Diversification Centre South
301 Horticultural Station Road East
Brooks, AB. T1R 1E6

#5116

Subject to the Agreement, the maximum possible amount granted for the Activity will be $74,000.00 divided between the funding agencies:

ACIDF Total: $59,000
Year 1 (2011): $ 19,000
Year 2 (2012): $ 20,000
Year 3 (2013): $ 10,000
Holdback: $ 10,000

PGA Total: $15,000
Year 1 (2011): $ 5,000
Year 2 (2012): $ 5,000
Year 3 (2013): $ 5,000 ←

A Holdback of $ 10,000.00 will be paid to ARD upon accepted receipt of Final Performance Report and detailed final budget due fifty (50) days before the end date of the Activity, or January 20 2014.

This grant, according to a ruling from the regional GST authority, does not contain a GST component. In simple terms, you don't have to submit GST when you collect the grant.

If you have any questions or concerns please contact our office.

Sincerely,

Bonnie Spragg
Chairperson, ACIDF Ltd

Alberta Crop Industry Development Fund Ltd.
5030 50 St, Agriculture Bldg.
LACOMBE, AB T4L 1W8
(403) 782-8034
FAX (403) 782-5514
e-mail: info@acidf.ca
web: www.acidf.ca

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8. Project Overview *(max. 2 pages)*

a) Background

Over the last 10 years, Alberta Agriculture and Rural Development staff worked with individual stakeholders in the potato industry to provide agronomic evaluations of potato varieties from various breeding programs. Public varieties are still widely grown, but not always as good a fit as private varieties for the same end use. The growing environments vary significantly among potato production regions in Canada. Alberta data is essential when selecting varieties appropriate for our climate, our customers and industry stakeholders. Also, there is increasing pressure on potato producers to utilize best management practices to reduce the environmental footprint for potatoes. The costs of such shifts in production practices will be borne primarily by producers. Industry stakeholders are looking for replacement varieties that use less nitrogen, less water, less pesticide, yet yield superior processing or culinary quality and tonnage.

The purpose of this research project is to pool resources and evaluate potential varieties, from a range of sources, using a cooperative approach. Including agronomy in the evaluations allows us to provide growers with additional relevant information when they weigh options of producing new varieties. Often, there are economies of scale realized when varieties are evaluated collectively rather than individually. ARD is well positioned to provide regional data in an impartial setting.

b) Objectives of the Project

Objectives:

A. To evaluate potential new varieties for processing (fry and chip), gourmet and other markets;
B. To provide the potato industry an opportunity to assess varieties grown under local conditions;
C. To compare varieties from European, Tri-State and National breeding programs (AAFC) under Alberta conditions; and
D. To develop agronomic information on plant density and nitrogen requirements to support potato growers interested in producing new varieties.
E. To evaluate the cooperative approach to variety development and develop a model that takes the industry beyond the current project.

c) Key Results Expected

Each stakeholder will receive information about varieties of interest relative to standard varieties in each class. Typically, we provide emergence, stand, vigour, and maturity data as well as yield by size category, specific gravity, defects and deformities, and culinary evaluations. For additional fees, stakeholders can enter varieties into trials looking at plant density levels and a reduced level of nitrogen. Local production data will support adoption of new potato varieties that will enhance the competitiveness of our potato industry.

A field day will be hosted each year at both locations to allow stakeholders to evaluate the response of cultivars to rain-fed and irrigated growing conditions. There is no substitution for first hand observation of potato varieties in the field.

As part of the proposed trial, we will work with stakeholders to develop a variety development mechanism for Alberta that takes us beyond the current project approach. The project is, in essence, a transition strategy to move the industry from a federal breeding program approach to a broader, more inclusive evaluation system.

9. *Progress to Date* *(max. 2 pages)*

a) Provide a concise report of the results achieved to date. It should contain a summary of the data collected and any preliminary conclusions made. The report should clearly state whether the results expected under the action plan for the proceeding year have been achieved. If they have not been achieved, please provide explain. Please also include all changes/modifications that have been made to the original plans and provide clear explanation for the changes.

The second year of the project was a good one. Industry participation increased and results were collected as planned. Reporting has been delayed as a result of staffing changes at ARD.

This year, thirteen potato industry stakeholders submitted a total of 55 varieties to be evaluated in the Potato Variety Development trail at Brooks. The test entries included 16 French fry varieties, 13 chipping varieties, 17 fresh market varieties and 9 gourmet varieties; 40 grown at a full rate of N, 34 grown at a reduced rate of N, and 13 grown with little or no supplemental N (some varieties were entered in more than one category).

Two replicates of 70 Agriculture and Agri-Food Canada (AAFC) cultivars were grown as well. These cultivars included 15 French fry, 13 chipping and 42 fresh market clones including some cultivars with novel traits such as low glycemic index, functional food and high antioxidant compounds.

A field day was held in conjunction with the Potato Growers of Alberta Summer Meeting at the Crop Diversification Centre North in Edmonton in early August. Demonstration rows of 56 AAFC cultivars were dug for industry stakeholders to evaluate first hand.

A field day was also hosted at the Crop Diversification Centre South in Brooks August 24. We had excellent weather and a good turn-out for the field day. Participants had an opportunity to visit the trial plots in the field and demo rows were dug of each AAFC and each private variety in the trial.

Potatoes were harvested in the fall and graded into size categories relevant for each intended end-use. Post-harvest culinary evaluations were conducted by the Food Science lab as requested by the clients. Some varieties were collected by clients after grading to be placed into long-term storage for chip and fry colour evaluations by industry.

Raw data was provided to AAFC to assist with decisions about which cultivars to include in the 2012 Accelerated Release Program. Raw data was provided to Little Potato Company to facilitate decision making for 2013.

Data for all private entries will be analyzed and several reports will be compiled. Each client will be provided with a report summarizing the findings for their entries relative to standard varieties. A full report will also be compiled and entries will be coded so that each sponsor can be provided with a full data set of all entries. Data from the AAFC plots will also be provided to each sponsor along with a link to the Accelerated Release web site for possible uptake by industry. (www.agr.gc.ca/potato-cultivars) These reports will be forwarded to you for your reference.

Industry participants were been invited to provide feedback on the first year of the trial and how the trial can be improved to provide additional value. Some changes were made to the trial in the second year to accommodate industry suggestions. We anticipated getting lists of entries and seed potato from sponsors much sooner in the second and third years of the trial as all paperwork is in place and people now know what to expect. Getting finalized lists of entries and seed for test varieties proved to be slow in the second year of the trial, similar to the first year. Reduced N treatments increased in the second year. Some participants required also special plant density, early desiccation, and different grading guidelines. This added significantly to the manpower requirements. A surcharge for these specific requests will be considered for the third year of the trial.

Feedback from participants in the second year of the trial has been constructive.

Some changes within the industry may affect utilization of the trials in the third year. Likely only a demonstration will be grown in Edmonton due to some changes in availability of technical support there. Prairie Gold Potatoes purchased the packing house and dehydration facility from Agristar Inc. and Cavendish Farms purchased Maple Leaf Potatoes. These companies will be approached to participate.

10. Research and Action Plans for Upcoming years *(max. 1 page)*

Specify by calendar year

2013 Work Plan:
April/May: Seed prep
Planting
May/June: Hilling
Irrigation pipe
Emergence data
June: 2012 data analyses, report writing
Stakeholder meeting
July: Weeding, fungicide, insecticide as required
In-season data collection (time to flowering, vigor)
August: Weeding, fungicide, insecticide as required
Maturity data
Field Day at CDCN
Harvest of early-season varieties
Field Day at CDCS
September: Desiccation of full-season varieties
Harvest full-season varieties
October: Grading
Post-harvest evaluations (culinary)
November: Data analyses, report writing

January: Final Report

11. Technology Transfer Plan *(max. 1 page)*

a) Please indicate all completed and future activities relating to the Technology Transfer Plan for this project.

The potato industry will have access to the project information in many ways. Growers and industry members were invited to see the varieties at field days in Edmonton (Crop Diversification Centre North) and Brooks (Crop Diversification Centre South) in August 2012. In Brooks, guests were invited to tour the evaluation plots and compare the unique performances of each variety in the field under local conditions.

Dr. Konschuh spoke at the North Area Meeting of the Potato Growers of Alberta about the trial and opportunities for potato industry stakeholders to participate. A poster was prepared for the Annual General Meeting of the Potato Growers of Alberta held in Calgary in November. Data will be collected, analyzed and presented in multiple reports to industry. Each sponsor will be provided with a client-specific report. Information will be available on the internet (PVMI website and PGA website) for easy access for growers. Implementation will be optimized during the three years of the project by direct feedback from industry and may be measured by the increase in uptake of local superior varieties.

12. Anticipated Research Budget by Year

Please complete budget for all years of the project, including the actuals for previous years of funding. Please also provide justification and details for each component of the budget (personnel, travel, capital assets, CDL and overhead)

Year	Source	Type	Personnel	Travel	Capital Assets	Supplies	CDL*	Overhead	Total/year
1 (2011-2012)	ACIDF	Cash	11,500	800	0	6,700	0	0	19,000
	Gov't	Cash	0	0	0	0	0	0	0
		In-kind	42250	0	0	0	0	0	42,250
	Industry	Cash	21,360	0	0	0	2,640	0	24,000
		In-kind	0	0	0	2,400	0	0	2,400
Total Year 1			75,110	800	0	9,100	2,640	0	87,650
Carry Over for year 1			0	0	0	0	0	0	0
2 (2012-2013)	ACIDF	Cash	12,500	56	0	7,444	0	0	20,000
	Gov't	Cash	1,843	0	0	643		0	2,486
		In-kind	42,250	0	0	0	0	0	42,250
	Industry	Cash	21,300	0	0	781	119	0	22,200
		In-kind	0	0	0	2,200	0	0	2,200
Total Year 2			78,893	56	0	11,068	119	0	89,136
Carry Over for year 2			(1,843)	744	0	(1,968)	2,581	0	(486)
3 (2013-2014)	ACIDF	Cash	12,500	800	0	6,700	0	0	20,000
	Gov't	Cash	0	0	0	0	0	0	0
		In-kind	42,250	0	0	0	0	0	0
	Industry	Cash	21,300	0	0	0	2,700	0	24,000
		In-kind	0	0	0	2,400	0	0	2,400
Total Year 3			**76,050**	**800**	**0**	**9,100**	**2,700**	**0**	**88,650**
4 (enter year)	ACIDF	Cash							
	Gov't	Cash							
		In-kind							
	Industry	Cash							
		In-kind							
Total Year 4									
5 (enter year)	ACIDF	Cash							
	Gov't	Cash							
		In-kind							
	Industry	Cash							
		In-kind							
Total Year 5									
Grand Total			227,210	2,400	0	27,300	8,040	0	264,950

*Communication, Dissemination, and Linkage

Details and Justification *(please provide complete details and justification for the budget for each of the following components:*

	Amount Requested for calendar year (2013)	Details and Justification
Personnel	33,800	Seasonal manpower required to plant, manage, harvest and grade potato trial
Travel	800	Travel to assist with field day in Edmonton
Capital Assets	0	
CDL	2,400	Attend conference to present results; networking with industry sponsors
Overhead	0	

13. *Funding Contribution*

Estimated Total Funds Requested for the Entire Duration of the Project		
Source	**Amount**	**Percentage of Total Project Cost**
ACIDF	59,000	27.3
Other Government sources: Cash	0	0
Other Government sources: In-kind	127,500	47.8
Industry: Cash	60,000	27.2
Industry: In-kind	7,500	2.7
Total Project Cost	264,950	100

Sources of Funding Contributions

Government Sources			
Name (no abbreviations please)	*Amount Cash*	*Amount In-Kind*	*Confirmed (Y/N)*
Alberta Agriculture Food and Rural Development		*90,750*	*N*
Agriculture and Agri-Food Canada		*36,000*	*Y*

Industry Sources			
Name (no abbreviations please)	*Amount Cash*	*Amount In-Kind*	*Confirmed (Y/N)*
Potato Growers of Alberta	*15,000*	*0*	*Y*
Potato Variety Management Institute	*3,000*	*450*	*Y*
Edmonton Potato Growers	*3,000*	*450*	*Y*
Solanum International	*3,000*	*450*	*Y*
Parkland Seed Potatoes	*3,000*	*450*	*Y*
Rockyview Seed Ltd.	*1,500*	*250*	*N*
Lamb Weston (ConAgra)	*3,000*	*450*	*N*
McCain Foods Ltd.	*3,000*	*450*	*Y*
Maple Leaf Potatoes	*6,000*	*750*	*Y*

Tuberosum Technologies	*3,000*	*450*	*N*
Agristar Inc.	*3,000*	*450*	*N*
Old Dutch Foods	*4,500*	*600*	*Y*
Alberta Seed Producers Inc.	*3,000*	*450*	*Y*

Part C
Regulatory Issues

1. Environmental Assessment

Do you anticipate the project will have an impact on the environment? (Y/N) **No**
If yes, has it been screened by Canadian Environmental Assessment Act? (Y/N, result?)
Has it been screened by Alberta Environment Act? (Y/N, result?)
Have other actions been taken? (Y/N, result?)

2. Biotechnology Related Projects

Does this proposal involve biotechnology research? (Y/N) **No**
If yes, state any potential adverse impact the project results may have on:
X food safety and human health:
X environmental sustainability:

Does the research include transfer of DNA between unrelated organisms? (Y/N) **No**
If yes, state the common name of the source of the genetic material:
State the Latin name:

3. Certificates/Permits

	Applied For	Attached	Not Required
Animal Care Certificates			X
Human Health Certificates			X
Transgenic Crop Permits			X

Part D
Personal Data Sheet

Please complete a Personal Data Sheet for the Team Leader AND any NEW Research Team Member (existing Team Members DO NOT need to complete a new form)
(Duplicate this sheet as required)

The personal information being collected is subject to the provisions of the Freedom of Information and Protection of Privacy Act.

Name:
Dr/Mr/Ms/Mrs. Last Konschuh First Michele

Position / Organization / Dept.:
Potato Research Scientist / Alberta Agriculture and Rural Development / Food & Bio-Industrial Crops Branch

Address: # 301 Horticultural Station Rd. E. — Street /Box
Brooks — City
AB — Prov.
T1R 1E6 — Postal Code

E-mail:
michele.konschuh@gov.ab.ca

Phone: 403-362-1314

Fax: 403-362-1306

Past experience relevant to project: (Point form, concise.)

- As a Potato Research Scientist for Alberta Agriculture and Rural Development, conducted regional trials for the Agriculture and Agri-Food Potato Breeding Program for the past 11 years (2000 – 2011)
- Conduct variety development trials for industry clients as requested (Lamb Weston, Solanum International, Rockyview Seed Ltd., Parkland Seed Potatoes, Maple Leaf Potatoes, Old Dutch Foods, and Edmonton Potato Growers)
- Earth Renew OM Plus Product Evaluation (2007-2008)
- Application of polymer-coated urea (ESN) in potato production in southern Alberta (2007-2010)
- Use of green manure crops to reduce soil-borne pests and diseases of potato crops in Alberta (2006-2010)
- Lutein content of yellow-fleshed potatoes grown in Alberta (2004-2006)

Degrees / Certificates / Diplomas: **Institution:**

Institution	Field Specialization	Degree/Diploma	Year
U of Calgary	Developmental Plant Physiology	Ph. D.	1995
U of Calgary	Biological Sciences – Botany	B.Sc.	1989

Publications and Patents:

# of Refereed papers: 9

Relevant Patents obtained: None

Conference proceedings: 10

Other relevant citations:

Other evidence of productivity during past 6 years: (Point form, concise)

Harms, T.E. and **M.N. Konschuh**. 2010. Water savings in irrigated potato production by varying hill-furrow or bed-furrow configurations. Agricultural Water Management. http://dx.doi.org/10.1016/j.agwat.2010.04.007

Bizimungu, B., D.R. Lynch, D.G. Holm, L.M. Kawchuk, **M. Konschuh**, C. Shaupmeyer, J. Wahab, D. Waterer, D. Driedger, H. Wolfe, P. McAllister, R. Howard, H.W. Platt and Q. Chen. 2009. Alta-Crown – A new russet potato cultivar suitable for early French fry processing and fresh market uses. Submitted to Amer. J. Potato Res.

Bizimungu, B, DR Lynch, LM Kawchuk, Q Chen, **MN Konschuh**, C Shaupmeyer, J Wahab, D Waterer, H Wolfe, P McAllister, R Howard and HW Platt. 2007. Northstar: A high-yielding, white cold-storage chipping potato cultivar with attractive oval tubers resistant to late blight. Amer. J. Potato Res. 84: 437-445.

JT Calpas, **MN Konschuh**, CC Toews & JP Tewari. 2006. Relationships among isolates of Botrytis cinerea collected from greenhouses and field locations in Alberta, based on RAPD analysis. Can. J. Plant Path. 28: 109-124.

Signature:

Date:

Research Team Signatures and Employers Approval Form

Note: An authorized representative from the Research Team Leader's organization of employment must sign this form. Any NEW Research Team Members must also sign this form and an authorized representative from their organization of employment must also sign this form.

By signing as representatives of the applicant(s)' employing organization, the undersigned hereby verify acceptance of the terms and conditions specified in the Agriculture Research Funding Program Guidelines. They further agree to allow the applicant to devote time to the project and use the facilities of the organization to conduct the proposed research.

The personal information being collected is subject to the provisions of the Freedom of Information and Protection of Privacy Act. If you have any questions about the collection, contact ACIDF 403-782-8034 e-mail info@acidf.ca

Team Leader's Organization

Please print or type name on the first line and sign in blue ink

Team Leader

Name: **Michele Konschuh**	**Title/Organization:** **Potato Research Scientist / Alberta Agriculture and Rural Development**
Signature:	**Date:**

Team Leader (Employer Approval)

Name: **James Jones**	**Title/Organization:** **Head, Food and Bio-Industrial Crops Branch / Alberta Agriculture and Rural Development**
Signature:	**Date:**

NEW Research Team Members' Organizations

1. Research Team Member's Name:	
Title:	**Organization:**
Signature:	**Date:**

Research Team Member's (Employer Approval)	
Name:	**Title/Organization:**
Signature:	**Date:**

2. Research Team Member's Name:	
Title:	**Organization:**
Signature:	**Date:**

Research Team Member's (Employer Approval)	
Name:	**Title/Organization:**
Signature:	**Date:**

Statement of Expenditures and Proposed Expenditures
Project: 2011F047R 'Potato Variety Development in Alberta'

Year	Source	Type	Personnel	Travel	Capital Assets	Supplies	CDL*	Overhead	Total/year
1 2011 /2012	ACIDF	Cash	11,500	800	0	6,700	0	0	19,000
		Spent	11,500	1,559		8,510			21,569
	Gov't	Cash	0	0	0	0	0	0	0
		Spent	42,250						42,250
		In-kind	42,250	0	0	0	0	0	42,250
	Industry	Cash*	18,360	0	0	0	1,640	0	20,000
		Spent	26,322			2,400	1,669		30,391
		In-kind	0	0	0	2,400	0	0	2,400
Total Year 1			72,110	800	0	9,100	1,640	0	83,650
Spent			**80,072**	1,559	0	10,910	1,669	0	94,210
2 2012/ 2013	ACIDF	Cash	12,500	800	0	6,700	0	0	20,000
		Spent	12,500	56		7,444			20,000
	Gov't	Cash	0	0	0	0	0	0	0
		Spent	1,843			643			2,486
		In-kind	42,250	0	0	0	0	0	42,250
	Industry	Cash	21,300	0	0	0	2,700	0	22,200
		Spent	21,300			781	119		22,200
		In-kind	0	0	0	2,200	0	0	2,200
Total Year 2			76,050	800	0	9,100	2,700	0	86,650
Spent			**77,893**	56	0	11,068	119	0	89,136
3 2013/ 2014	ACIDF	Cash	12,500	800	0	6,700	0	0	20,000
		Spent							
	Gov't	Cash	0	0	0	0	0	0	0
		Spent							
		In-kind	42,250	0	0	0	0	0	0
	Industry	Cash	21,300	0	0	0	2,700	0	24,000
		Spent							
		In-kind	0	0	0	2,400	0	0	2,400
Total Year 3			**76,050**	**800**	**0**	**9,100**	**2,700**	**0**	**88,650**
4 (enter year)	ACIDF	Cash							
		Spent							
	Gov't	Cash							
		Spent							
		In-kind							
	Industry	Cash							
		In-kind							
Total Year 4									
Grand Total			227,210	2,400	0	27,300	8,040	0	264,950

I hereby certify that the project costs incurred have been fully paid and the above statement of expenditure is correct.

Project Manager's Signature　　　　Date

Financial Signing Authority　　　　Date

receivership, or enjoys the benefit of any statute relating to bankrupt or insolvent debtors, or makes an assignment for the benefit of creditors;

2) an order is made or resolution passed for the winding up of the Applicant,

3) the Applicant is dissolved;

4) if, in the reasonable opinion of the Funders, the Applicant :

    a) ceases to operate;
    b) submits false or misleading information to the Funders;
    c) does not commence the Activity as set forth in the Application;
    d) does not actively work on the Activity, or;
    e) has failed to meet or satisfy any obligation under the terms of this Agreement.

B. Notwithstanding any provision to the contrary in this Agreement the Funders may, without cause, terminate this Agreement upon providing ninety (90) days notice to the Applicant.

C. If an Event of Default occurs prior to completion or termination of the Activity the Funders may give written notice of such default to the Applicant ("Notice of Default") and will be entitled to suspend any further payments to the Applicant following receipt of the Notice of Default by the Applicant while such Event of Default exists. If the Event of Default has not been remedied to the satisfaction of the Funders within ten (10) days following receipt of the Notice of Default by the Applicant, the Funders may exercise any or all of the following remedies:

1) terminate the further participation of the Funders in the Activity and any obligations of the Funders to make further payments of the Investment to the Applicant, such termination being without prejudice to or limitation of any other right or remedy of the Funders against the Applicant arising as a result of the Event of Default,

2) require the Applicant to forthwith repay to the Funders all or any portion of the Investment monies paid to the Applicant that, in the opinion of the Funders, has not been used for the purpose of carrying out the Activity. Any such monies not so repaid within forty-five (45) days of receipt of notice of such requirement by the Applicant will be subject to an interest charge calculated at the rate of 5% per annum beginning forty-five (45) days from the date of notice until repaid.

3) direct the Applicant, to forthwith provide the Funders with any and all reports as may be required pursuant to the terms of this Agreement.

D. Upon termination, and provided that the Applicant has fully complied with the provisions of this Agreement, the Funders will pay to the Applicant the monies determined at the sole discretion of the Funders as being payable to the Applicant based on the work completed prior to the date of termination.

E. If during the term of this Agreement the Applicant determines that the Activity should not be continued, then the Applicant shall consult with the Funders and may request that this Agreement be terminated. Upon such consultation the Funders may terminate this Agreement either unconditionally or upon such terms and conditions, not inconsistent with this Agreement, as the Funders and the Applicant agree.

11. Intellectual Property Rights

A. Subject to Section 11 A. 1) all Intellectual Property developed by personnel of the Applicant or the personnel of a Collaborating Institution shall be vested in the Applicant or the Collaborating Institution as the case may be unless the intellectual property policies, terms of employment or collective agreement of or binding on that Applicant or Collaborating Institution do not permit such vesting in which event title shall be vested in the Creator. In either event all Intellectual Property will be subject to the following provisions:

1) Where the intellectual property policies, terms of employment or collective agreement of or binding on that Applicant or Collaborating Institution require the vesting of title to the Intellectual Property in the Creator, the Creator shall either assign those rights to the Applicant or Collaborating Institution as the case may be or enter into an agreement with the Applicant or Collaborating Institution as the case may be to be bound by the terms and conditions of this Agreement with respect to such Intellectual Property which assignment or agreement will allow the Applicant to comply with its obligations herein.

2) If the Applicant is, in addition to receiving the Investment from the Funders, receiving funding from industry contributors for the Activity, the Applicant shall not, without the consent of the Funders, grant to any such industry participant:

   a) any rights in relation to the Intellectual Property that would interfere with the rights of the Funders or the obligations of the Applicant under this Agreement,

   b) any rights to obtain ownership of or royalties from the Intellectual Property,

   c) any right to use the Intellectual Property for which the Funders sponsor the cost of statutory protection.

   The Applicant may grant an industry contributor a personal right to use Intellectual Property other than that referred to in c) immediately preceding for such purposes as the industry contributor deems fits.

3) The Applicant will use reasonable efforts to ensure, or where the Creator continues to be the owner thereof will cause the Creator to use reasonable efforts to ensure, that any Intellectual Property generated through the

Activity is used to the benefit of Alberta and Albertans. Efforts to commercialize Intellectual Property should be first directed to appropriate Alberta businesses or organizations with suitable expertise.

4) The Applicant agrees to use substantially all of the revenue generated from the Intellectual Property developed in the course of carrying out the Activity for agriculture and agri-food research and commercialization, where possible benefiting Alberta after deducting, without duplication:

   a) royalties, fees, costs and charges to Creators pursuant to contracts, collective agreements or terms of employment binding on the Creators and the Applicant or Collaborating Institution,

   b) royalties, fees, costs and charges to Creators pursuant to policies of the Applicant or Collaborating Institution not incorporated into the contracts, collective agreements or terms of employment referred to in a) immediately preceding; provided the same are policies that were formally approved or adopted by the governing board of such entity, are of general application to the Applicant or Collaborating Institution and were in place prior to the date of execution of this Agreement or are amendments to or substitutions for any such existing policy, are of the same general application and were approved or adopted by such governing board following the date of execution of this Agreement in which event the allowed deduction shall not exceed that which would have been allowed pursuant to the initial policy,

   c) royalties, fees, costs and charges to other funders or sponsors of the Activity pursuant to contracts or agreements in existence at the date of execution of this Agreement and with respect to which the Applicant provided notice and details of to the Funders prior to the date of execution of this Agreement,

   d) direct and reasonable out of pocket costs for protecting, maintaining, defending the Intellectual Property and for granting, performing or enforcing any assignment or licensing of the Intellectual Property,

   e) amounts payable pursuant to policies of the Applicant or Collaborating Institution to support the general research or technology transfer activities of the Applicant or Collaborating Institution that are not supported by or reimbursed by any deductions made pursuant to the provisions of any earlier provision of this Section 11 A. 5), provided such policies are of general application to the Applicant or Collaborating Institution and were in place prior to the date of execution of this Agreement or are amendments to or substitutions for any such existing policy, are of the same general application and were approved or adopted following the date of execution of this Agreement in which event the allowed deduction shall not exceed that which would have been allowed pursuant to the initial policy.

5) The Applicant will advise the Funders of all research results through a regular reporting system, no less than twice each year and identify, to the extent possible, any Intellectual Property included in the research results that is capable of being statutorily protected and advise whether the Applicant will at its cost fund the seeking of such statutory protection. If the Applicant is not funding the seeking of such statutory protection, the Funders will have a right for a period of 90 days following receipt of any such report from the Applicant to elect, by notice to the Applicant, to fund the seeking of statutory protection for such Intellectual Property by, and in the name of, the Applicant.

6) If the Applicant has not actively pursued commercialization of any Intellectual Property within 3 years from the date that the Intellectual Property is protected by patent, plant breeders' rights, trademark, license or otherwise, the Applicant shall at the request of the Funders grant to the Funders an irrevocable, royalty free, non-exclusive, world wide, perpetual license to sublicense the Intellectual Property with 1/3 of the balance of revenue received by the Funders, after deduction of costs of the Funders in the nature of those referred to in Section 11. A. 4) d), payable to the Applicant. In such circumstances the Applicant and not the Funders shall be responsible for any continuing payments required pursuant to the provisions of Section 11 A. 4) other than d). Subject to the foregoing provisions of this Section such license shall be on terms and conditions as the Funders and the Applicant, each acting in good faith, agree.

12. Publication or Disclosure of Intellectual Property.

A. The research results of the Activity shall be considered confidential information of the Applicant and each of the Applicant and the Funders shall maintain the same in confidence until disclosure, publication or release is otherwise permitted in accordance with this Agreement.

B. The Applicant may at the expiration of the 90 day period referred to in Section 11 A. 5) disclose, publish or release research communicated to the Funders pursuant to that Section:

1) that are not capable of statutory protection;

2) that are capable of statutory protection but are identified in the report to the Funders pursuant to Section 11 A. 5) as research results for which the Applicant is not seeking statutory protection, unless the Funders within that 90 day period give notice to the Applicant that the Funders will fund the seeking of statutory protection for such Intellectual Property by, and in the name of, the Applicant. If the Funders give notice as provided in the foregoing sentence the Applicant will delay such disclosure, publication or release of those research results for a further 90 day period.

C. In the event a graduate student of the Applicant works on the Activity and that student completes a thesis or education report relating to the Activity, the student will own the copyright in that thesis or report. Notwithstanding anything otherwise contained in this Agreement delay in publication or defence of a thesis or education report will only be permitted in accordance with applicable policies of the Applicant.

13. Confidentiality

A. Subject to legislation applicable to the Applicant, the Applicant agrees not to disclose any confidential information about the affairs of the Funders, their operations, boards and committees, clients, or employees which it acquires in the undertaking of Activity.

14. Capital Items

A. Capital items purchased with the Investment become the property of the Applicant unless otherwise specified in Schedule "A".

15. Acknowledgment and Communications

A. Contributions from the Funders to the Activity shall be acknowledged by the Applicant on all signs, publications, announcements and press releases of the Applicant dealing with the Activity or any part thereof. Each Funding Agency should be named unless that Funding Agency directs otherwise. Contributions of the Applicant to the Activity shall be acknowledged by the Funders on all signs, publications, announcements and press release of the Funders dealing with the Activity.

B. Any and all public announcement in relation to the Activity or of any projects, products, or projects funded pursuant to this Agreement, where a ceremony is indicated and appropriate under the circumstances, shall be carried out in accordance with the reasonable requirements of each of the Applicant and the Funders.

C. The Funders may disseminate and publish research results communicated to it pursuant to Section 11 A. 5) following the earlier of disclosure, publication or release of the same by the Applicant or the expiration of twelve (12) months following completion of the Activity.

16. Applicant Responsibility for Employees

A. Neither the Applicant nor any persons employed by the Applicant or retained as contractors and performing work on the Activity are or shall be considered at any time to be employees of the funding agencies or entitled to any of the rights and benefits of employees of the funding agencies.

B. The Applicant shall ensure that appropriate employment withholdings are made for all of its employees according to any and all applicable laws and that the Applicant is in compliance with any and all laws, rules, orders and assessments howsoever arising which relate to its operations.

C. In no way whatsoever shall any provision of this Agreement be construed or interpreted so as to make the Funders responsible or liable in any way whatsoever for the Applicant, its employees, agents or independent contractors.

D. The Applicant shall cause its employees, agents, and independent contractors participating in the Activity to observe and be bound by each applicable restriction and obligation imposed upon the Applicant pursuant to this Agreement.

17. Indemnity

A. Except as provided in Section 17 B., the Applicant shall be liable for and shall indemnify and save harmless the Funders or any individual Funder from any and all costs, damages, actions, suits claims or other proceedings arising directly or indirectly from any willful act or negligence in the performance or non-performance of the Agreement, or the Activity, by the Applicant, its employees, agents, or its third party contractors.

B. The Applicant shall not be liable for any direct, consequential or other damage suffered by the Funders or others resulting from the development or use of the Intellectual Property or any invention, technology or product produced in the course of or using the research results. The Applicant does not warrant that the Intellectual Property or any part thereof or any aspect of the same will be capable of receiving statutory protection.

18. Addresses and Notice

A. Any notices herein provided for or permitted to be given by the Funders to the Applicant or vice versa shall be sufficiently given if mailed, posted prepaid, addressed to, as the case may be,

1) To the Funders' Representative on behalf of the Funders as follows:

Alberta Crop Industry Development Fund Ltd.
Agriculture Building
5030-50 St
Lacombe AB T4L 1W8
Attention: Project Manager

Phone: (403) 782-8034
Fax: (403) 782-5514
(e-mail: info@acidf.ca)

B. To the Applicant:

1) For All Matters:

Dr. M. Konschuh
Agriculture and Rural Development
Crop Diversification Centre South
301 Horticulture Station Road East
Brooks, AB T1R 1E6

Phone: (403)362-1314
Fax: (403)362-1306

C. Funding provided by the Funders shall be made payable to the respective applicant organization at:

1) For AF:

Minister of Finance, Alberta
In care of
Agriculture and Rural Development
Crop Diversification Centre South
301 Horticulture Station Road East
Brooks, AB T1R 1E6

D. Any notice which is delivered shall be deemed to have been received on the date of delivery. Any notice which is mailed shall be deemed to have been received seventy-two (72) hours after the date it is posted.

E. If normal mail service is interrupted by strike, slow down, force majeure or any other cause after the notice has been sent, the notice sent by such impaired means of communication will not be deemed to be received until it has actually been received.

F. The party sending a notice shall at all times attempt to utilize another service which has not been impaired or should personally deliver the notice in order to ensure prompt receipt thereof.

G. Any of the parties to this Agreement may change its address for the purposes of this Agreement by providing written notice of a new address to the other party.

19. Successors and Assigns

A. This Agreement shall enure to the benefit of the parties, their successors and approved assigns. The Applicant shall not assign or transfer all or any part of this Agreement without the express written consent of the Funders, which may not be unreasonably and arbitrarily withheld.

B. As described in their respective organizational structures, all rights, assets and monies owed to individual funding agencies transfer to that agency's surviving institution or institutions on dissolution of that agency.

20. Complete Agreement

A. This Agreement and attached schedules constitute the complete Agreement between the parties hereto. The provisions of this Agreement are not subject to or affected by the provisions of any other Agreement, representation, warranty, term, condition precedent, be they express or implied, not set out in this Agreement.

B. The Applicant shall in its conduct of the Activity fully conform to and comply with the published Program Guidelines of the Funders pursuant to which the Application for Investment was submitted to, and approved by, the Funders, to the extent the same are consistent with, the terms of this Agreement.

21. Amendments

A. This Agreement may be amended by the parties by mutual consent. Any amendment to this Agreement must be in writing signed by all parties before that amendment is deemed to take effect.

22. Survival

A. The parties acknowledge that the provisions of this Agreement shall survive payment of the Investment and shall not be merged therein or therewith.

B. The covenants, indemnity, representations and warranties made by any party in or pursuant to this Agreement shall survive payment of the Investment, termination of this Agreement, or completion of the Activity, as the case may be, and shall continue in full force and effect, until satisfied by the terms of this Agreement.

23. General Provisions and Interpretation

A. This Agreement shall be interpreted and governed by the laws in force in the Province of Alberta or which may be enacted or amended from time to time.

B. In this Agreement the singular includes the plural and one gender includes all genders and neuter and vice versa unless the context otherwise requires.

C. The headings in this Agreement are only for convenience of reference and do not form part of or affect the interpretation of this Agreement.

D. Time shall always be considered of the essence in this Agreement.

E. The Applicant agrees that any legal proceedings which exist or which may exist in the future as against the Funders shall be filed, brought forward, and carried on before the courts of the Province of Alberta.

F. No member of the House of Commons or any Provincial Legislature shall be admitted to participate in any share or part of this Agreement or any benefit arising there from. No former public office holder who is not in compliance with the post employment provisions of the Conflict of Interest and Post Employee Cost for Public Office Holders shall derive a benefit from this Agreement.

G. The Applicant shall ensure that the intent of any applicable federal and provincial environmental assessment and review procedures are followed in relation to the Activity.

H. The provisions of this Agreement relating to information shall be subject to the Canada Access to Information Act and Privacy Act and the Alberta Freedom of Information Protection of Privacy Act.

I. If any term, covenant or condition of this Agreement or the application thereof to any party or circumstance shall be invalid or unenforceable to any extent the remainder of this Agreement or application of such term, covenant or condition to a party or circumstance other than those to which it was held invalid or unenforceable shall not be affected thereby and each remaining term, covenant or condition of this Agreement shall be valid and shall be enforceable to the fullest extent permitted by law.

J. No remedy conferred upon a party pursuant to this Agreement is intended to be exclusive of any other remedy available to it. Each remedy shall be cumulative and shall be in addition to every other remedy now or hereafter existing by law, in equity, or by statute.

K. No consent or waiver expressed or implied by a party to or of any breach or default by any other party in the performance of its obligations pursuant to this Agreement shall be deemed or construed to be a consent or waiver to or of any other breach or default in the performance of the obligations of the Applicant. Failure on the part of a party to complain of any act or failure to act of another party or to declare that other party in default, irrespective of how long such failure continues, shall not constitute a waiver of rights under this Agreement.

24. Acceptance of Agreement

It is hereby acknowledged by the parties to this Agreement that they have reviewed this Agreement in its entirety and all terms and conditions contained herein are fully understood and acceptable to them.

The parties have therefore executed this Agreement, each by its duly authorized representative, on the respective dates shown below.

Date: 06/06/2011

ALBERTA CROP INDUSTRY DEVELOPMENT FUND LTD.

Name of authorized officer

board member

Office Held

Date: May 24/11

POTATO GROWERS OF ALBERTA

EDZO KOK

Name of authorized officer

EXEC. DIRECTOR

Office Held

Date: May 6/11

AGRICULTURE AND RURAL DEVELOPMENT

Jason Krips

Name of authorized officer

ADM, Alberta Ag + Rural Development

Office Held

I have read this Agreement and agree to comply with all obligations and requirements as outlined in this Agreement.

Dr. M. Konschuh, **Principle Investigator**

SCHEDULE "A" - PAYMENT SCHEDULE & TERMS

A. Words in this Schedule shall have the same definitions as provided in the agreement to which this Schedule is attached as Schedule "A" (the "Agreement").

B. The Activity shall begin on **April 1, 2011** and end on **November 31, 2013.**

C. Subject to the Agreement, the maximum possible amount granted for the Activity will be **$ 74,000.00** divided between the funding agencies:

1)	ACIDF	Total: $59,000	Year 1 (2011): $ 19,000
			Year 2 (2012): $ 20,000
			Year 3 (2013): $ 10,000
			Holdback: $ 10,000
2)	PGA	Total: $15,000	Year 1 (2011): $ 5,000
			Year 2 (2012): $ 5,000
			Year 3 (2013): $ 5,000

D. Payable to the Applicant in the following installments:

1) **$24,000.00** upon execution of agreement.

2) Interim payments following interim reports and updated budgets as accepted by the Funders on or before the following dates:

   April 15, 2012: $ 25,000
   April 15, 2013: $ 15,000

3) A Holdback of $ 10,000.00 will be paid to ARD upon accepted receipt of Final Performance Report and detailed final budget due fifty (50) days before the end date of the Activity, or January 20 2014.

4) Unused funds from the investment or grant made under this Agreement, including any deductions for overhead or expenses based on the unused portion, must be returned to the Funders within ninety (90) days of the submission of the final report for the Activity.

E. Initial and Interim Reports and Payments:

1) The initial installment as described herein will be made in accordance with the terms, conditions, and requirements of the Agreement.
2) The subsequent installments will be dependent on:

a) The Applicant's request accompanied by the Activity report or milestone;

b) Receipt of an accounting, prepared and certified to be accurate by the Applicant's accountant or other senior executive officer, of revenue and in kind contributions and expenditures (including Investment share) for the previous Investment installment, if any;

c) Compliance with this Schedule and the Agreement.

F. Reporting Requirements

1) Final Report

A final report is required for each terminated or completed research project. The final report must be submitted a minimum of six weeks prior to the project end date indicated in Schedule A (part B) above. If the final report cannot be submitted six weeks prior to the end date, an end date extension must be requested from the Funders. The request letter must state the reason(s) for the delay. The final report for the Activity must encompass the following:

a) an abstract of not more than 500 words, written in plain language and outlining the major findings, conclusions and benefits of the Activity.

b) shall be in presentation format and supplied in both electronic and printed form. The printed copies shall be bound and presented in a method appropriate to the project and agreed to by the Funders in advance. The Applicant will supply a minimum of two (2) finished copies for each Funding Agency.

c) shall detail the following:

- Scientific/technical text which outlines the project's background and expected results; describes the research design, and analytical methods and materials; presents the short term, intermediate and long term results and benefits; draws conclusions and describes the implications for Alberta's agriculture and food industry and/or the advancement of the agricultural sciences,
- targets achieved compared to those contemplated,
- all the "Resources" used in the Activity, including a listing of all expenditures of the Investment certified by the Applicant's accountant or other senior executive officer, and a list of non-Investment fund sources, including non-cash in-kind contributions, and their use in the Activity. The financial report will be separate from the project technical report.
- a full reporting of all scientific and agribusiness industry publications, conferences and symposia, and an outline of the proposed research program anticipated to be undertaken in the subsequent year.
- the acknowledgment of the contribution of each of the Funders in publications and communication activities.

- a brief, non-technical final report may also be requested for designated projects. This report should outline specific applications of the research results for producers and/or extension personnel.

2. Interim Reports

   An interim report shall occur mid-point between the initial and final payment or at each anniversary date for multi-year Activities, and will provide the Funders with a summary of the information dissemination activities conducted during the previous period, as well as an abbreviated progress report of work conducted since the latest annual review.

   The interim reports will also provide the Funders with all press releases related to the project, and any changes to the Activity, which may be deemed material in nature.

3. Promotional Article

   Upon completion of the project, the Applicant agrees to provide Funders with a brief article suitable for publication on the project, its impact and its value to Alberta's industry. The article becomes the property of the Funders for promotion of their respective agencies, publication in their newsletters and releases to public media.

SCHEDULE "B" – FULL APPLICATION AND REVISED BUDGET AS APPROVED

Inserted as PDF document.

Proposal Number 2011F047R

Name Potato Variety Development in Alberta

Abstract

The proposed research project will attempt to provide a transition strategy from the Western Canadian Potato Breeding Commsortium approach to a braoder, more inclusive approach to benefit the greatest number of stakehodlers. Replicated cultivar evaluation trials will be conducted at two research stations each year to provide local data on potential potato varieties in the breeding pipeline. A field day will be planned at each location to allow industry stakeholders an opportunity to see first hand how the varieties compare to standard varieties in each class. A plant density and a nitrogen fertility component will be included for additional fees if there is sufficient interest from participants. The planting density component of the project will involve spacing plantlets at different in-row distances to determine whether the variety responds favorably to adjustments in plant density. The fertility component of the project will involve growing the varieties on 2 levels of nitrogen fertility to determine whether nitrogen rates can be reduced for newer cultivars. Field days will be hosted to allow participants and other industry stakeholders the opportunity to observe potato varieties first-hand. The project capitalizes on an economy of scale in evaluating a wide range of cultivars with potential for production in Alberta. Data relevant to trial sponsors and collaborators will be collected each year and shared with all sponsors.

Keywords potato varieties, new releases, accelerated release, potato agronomy

Team Leader Name: Michele Konschuh

Team Leader Organization: Alberta Agriculture and Rural Development

Project Duration (Yrs) 3

Project Start Date 04/01/2011

Project End Date 11/30/2013

Stand-Alone Project Yes

Background

Breeding for new potato varieties was identified in industry-wide priority setting meetings in 2003 and 2004 by the potato inustry. For about 40 years now, Agriculture and Agri-Food Canada managed a potato breeding program in Western Canada focused on breeding and selecting varieties that would perform well under our environmental conditions. The potato breeding programs in Canada were consolidated into a National program in 2004 and there is now one National Potato Breeder. By necessity, less emphasis is directed at varieties best suited for Western Canada. The nature of potato breeding and selection has also shifted. Industry participants are exploring varieties for different end-uses, such as gourmet and functional food uses. Varieties from breeding programs in Europe and the United States are often being assessed.

Alberta Agriculture facilitated the regional evaluiation process by conducting regional trials, disease resistance trials, agronomic trials, culinary and storage trials with promising new varieties. This system was unique to Western Canada and served established industry stakeholders well. Over the last 10 years, Alberta Agriculture and Rural Development staff worked individually with stakeholders in the potato industry to provide agronomic evaluations of potato varieties from various breeding programs. Public varieties are still widely grown, but not always as good a fit as private varieties for the same end use. The growing environments vary significantly among potato production regions in Canada. Alberta data is essential when selecting varieties appropriate for our climate, our customers and industry stakeholders. Also, there is increasing pressure on potato producers to utilize best management practices to reduce the environmental footprint for potatoes. The costs of such shifts in production practices will be borne primarily by producers. Industry stakeholders are looking for replacement varieties that use less nitrogen, less water, less pesticide, yet yield superior processing or culinary quality and tonnage.

The purpose of the proposed research project is to pool resources and evaluate potential varieties, from a range of sources, using a cooperative approach. Including agronomy in the evaluations allows us to provide growers with additional relevant information when they weigh options of producing new varieties. Often, there are economies of scale realized when varieties are evaluated collectively rather than individually. ARD is well positioned to provide regional data in an impartial setting and mitigate risks to individual stakeholders.This proposal does not replace the Consortium as it is focused on Alberta. In addition, we intend to evaluate any material, regardless of the breeding origin, that might be well suited to our climate and end-uses. Support has been requested from many stakeholders, and we anticipate some flux in support between members depending on the year of the study.

Objectives and Deliverables

Objectives:

A. To evaluate potential new varieties for processing (fry and chip), gourmet and other markets;
B. To provide the potato industry an opportunity to assess varieties grown under local conditions;
C. To compare varieties from European, Tri-State and National breeding programs (AAFC) under Alberta conditions; and
D. To develop agronomic information on plant density and nitrogen requirements to support potato growers interested in producing new varieties.
E. To evaluate the cooperative approach to variety development and develop a model to take the industry beyond the current project.

Deliverables

Each stakeholder will receive information about varieties of interest relative to standard varieties in each class. Information generated will failicitate decision making, and stakeholders will need to pursue commercialization opportunties independent of the trial. Typically, we provide emergence, stand, vigour, and maturity data as well as yield by size category, specific gravity, defects and deformities, and culinary evaluations. For additional fees, stakeholders can enter varieties into agronomic trials looking at three plant density levels and a reduced level of nitrogen. Local production data will support adoption of new potato varieties that will enhance the competitiveness of our potato industry.

A field day will be hosted each year at both locations to allow stakeholders to evaluate the response of cultivars to rain-fed and irrigated growing conditions. There is no substitution for first hand observation of potato varieties in the field.

As part of the proposed trial, we will work with stakeholders to develop a variety development mechanism for Alberta that takes us beyond the current project approach. The project is, in essence, a transition strategy to move the industry from a federal breeding program approach to a broader, more inclusive evaluation system.

Project Design and Methodology

Variety evaluation trials will be set up at the Crop Diversification Centre North (CDCN) in Edmonton and the Crop Diversification Centre South (CDCS) in Brooks to provide data from rain-fed and irrigated production systems respectively. Standard varieties will be included to represent early French fry, full-season French fry, early chipper, full-season chipper, fresh market red, fresh market white and fresh market yellow classes. Two harvest dates are proposed, one in early to mid-August and one in mid September. Sufficient potatoes will be planted to provide replicated data as well as a demonstration for a field day at both locations.

Material for these trials will be provided by stakeholders either through the Accelerated Release Program or by sourcing varieties from European, U.S. or other breeding programs. All import requirements will be the responsibility of the stakeholder requesting evaluation.

At CDCS, we will set up a nitrogen response trial with standard and reduced levels of nitrogen fertility. Stakeholders will indicate whether or not they require fertility information and must provide sufficient seed and funds to include these evaluations.

At CDCS, we also plan to evaluate the response of potato varieties to plant density changes. Potatoes will be planted at three in-row spacings (20, 25 and 30 cm proposed) to determine the response. Stakeholders must provide sufficient seed and funds to include these evaluations.

Variety trials will be set up as randomized complete blocks for each harvest date. Guard rows will be planted to minimize edge effects. Four replicate rows (6m) will be harvested and an additional row will be planted to allow for in-season sampling and demonstration.

The Agronomic trials will be set up as split plot designs. For the nitrogen response trials, nitrogen level will be the main plots and varieties will be the sub plots. For in-row spacing evaluations, each block of potatoes will be planted at the same density, but varieties will be randomized within each block and blocks of plant density will be randomized within the trial.

Data collected may include emergence data, stand count, time to flowering, yield, grade by size category relevant to end-use, specific gravity, internal defects, external deformities, and culinary evaluations. Samples will be retained for bruise testing, storage assessments or acrylamide testing at the stakeholders expense.

Proposed Varieties to evaluate and rationale:
- AAFC Accelerated release material - various rationales
- Alpine Russet – Excellent cold sweetening resistance producing reduced acrylamide levels, very long storage capability, high % No 1s, lower N requirement
- Yukon Gem – Superior disease resistance, higher yields than it's direct competitor Yukon Gold, increased scab resistance, good organic choice, excellent chip processing qualities
- Highland Russet – Accepted by McDonalds for breakfast patty, superior culinary qualities for fresh and processing
- A0008-1TE – Early dual purpose with high yields and % No 1s
- Classic Russet – Possible replacement for Norkotahs, early yields, high No 1s, culinary qualities both fresh and processing
- And Others….

Annual Work Plan:
April/May: Seed prep
Planting

May/June: Hilling
Irrigation pipe
Emergence data

July: Weeding, fungicide, insecticide as required
In-season data collection (time to flowering, vigor)

August: Weeding, fungicide, insecticide as required
Maturity data
Field Day at CDCN
Harvest of early-season varieties
Field Day at CDCS

September: Desiccation of full-season varieties
Harvest full-season varieties

October: Grading
Post-harvest evaluations (culinary)

November: Data analyses, report writing
Stakeholder meeting

Contributions to Alberta's Agriculture and Agri-Food Knowledge

Practical knowledge about new potato varieties will be the main contribution of this work. What differentiates this work is the cooperative approach proposed to maximize information to industry with limited resources.

The project is not expected to generate any specific intellectual property through the work. The plant material will have come from various existing breeding programs and plant breeder's rights will have already been applied for by the owner.

While potato producers have a vested interest in producing new varieties of potato, the entire value chain is often involved in the decision to adopt a new variety. A cooperative approach ensures that considerations of many stakeholders are taken into account as varieties are evaluated. The decision to commercialize a variety, though, may be undertaken by a small segment of the industry.

We will be providing information critical to the decision making process for the potato industry to remain competitive. Our team involves people with expertise in the areas of plant breeding, variety development, marketing, agronomy and food science. This collaborative approach brings broad expertise to the project and allows the stakeholders to benefit more widely than from an independent evaluation of the varieties.

The novel, unique or innovative aspect of the project is that we will attempt to engage competitors in a cooperative project to benefit the greatest number of stakeholders in the potato industry. The project utilizes the limited government resources available and leverages that for the greatest good. Potato varieties from other programs will be evaluated to see their suitability and usefulness to the Canadian market. This information is currently lacking due to the recent lack of a western regional research and breeding program.

Benefits to Alberta's Agriculture and Agri-Food Industry

With increasing pressure to enhance competitiveness, potato growers, packers and processors require varieties that produce good yield, and more importantly, lower costs of production. Replacement varieties with improved nutrient use efficiency, improved disease resistance, fewer defects, better storage potential or other desirable traits would reduce the cost of production and these efficiencies will ensure that our potato industry remains competitive.

A number of clients have expressed interest in evaluating new varieties to see whether or not they are well-adapted to our growing region. Information on how varieties perform relative to standard varieties is important for decision making as well as for marketing new varieties. In fact, this type of information was a fundamental part of the former Western Canadian Potato Breeding Consortium.

The key benefit of this project is that individual stakeholders in the potato industry will realize an economy of scale when evaluating potato varieties and basic agronomy information in a cooperative way. In the last 10 years, Alberta Agriculture and Rural Development staff have worked with many potato industry stakeholders independently to assess varieties relative to standard varieties. Each trial involves standards from each class of potatoes and guard rows. Often the results were made available to specific customers, but access by others was limited. Independent evaluations represent a financial burden for seed growers, small companies or large companies producing potatoes in a unique environment. The current approach will provide information to many stakeholders in the value chain and should move the industry forward on a more united front.

The project is seen as a transition strategy from the Western Canadian Potato Breeding Program to a broader, more inclusive model for evaluating and ultimately introducing new varieties. If stakeholders perceive value in the new approach, we anticipate that they will be prepared to provide ongoing funding in support of this approach in the future.

Knowledge Transfer Plan

The industry will have access to this information in many ways. To start with growers and industry members will be invited to see the evaluation plots and compare on the ground the unique performances of each variety in the field under local conditions. Data will be collected analysed and presented in several formats to industry including posters, papers and talks. Information will be available on the internet (PVMI website and PGA website) for easy access for growers. Implementation will be optimized during the three years of the project by direct feedback from industry and may be measured by the increase in uptake of local superior varieties.

Project Team Qualifications

Dr. Michele Konschuh is a Research Scientist with ARD at CDC South, Brooks. She has extensive experience in potato agronomy and recently assumed responsibility for managing Alberta's seed potato repository at CDC North, Edmonton. She works closely with all facets of the potato industry and liaises with her counterparts across in Canada in activities related to research and extension support for the potato industry. Michele has over 10 years of experience with the potato industry and has been involved in the evaluation of varieties for various segments of the industry. She will lead the project and provide agronomy advice, spearhead external fund-raising activities, assist with field trials, and participate in technology transfer activities with the potato industry aimed at encouraging the adoption of potato varieties with improved production profiles.

Dr. Benoit Bizimungu recently assumed the leadership of the National Potato Breeding and Genetic Enhancement program with Agriculture and Agri-Food Canada, following the consolidation of eastern and western potato breeding projects. He is also leading a team of scientists working on the development of a low glycemic index and high fibre potato, as part of the Biopotato (ABIP) network. Benoit is very familiar with the needs of the Alberta potato industry from his former role as lead of the Western Canadian Potato Breeding Consortium.

Dr. Jeanne Debons is the Executive Director of the Potato Variety Management Institute (PVMI) in Oregon. PVMI has succeeded in bridging the gap between potato breeding programs and industry adoption in the Pacific Northwest by providing a mechanism to manage and release varieties and to channel royalties collected into developing agronomic information and marketing materials. Jeanne's interpersonal skills and calm competence have played a large part in the success of PVMI. Jeanne has relevant expertise in addressing the gap between superior breeding material and industry adoption and she is willing to lend this expertise to Alberta on this project.

Deb Hart is the Seed-Coordinator for the Potato Growers of Alberta. Deb worked with the Saskatchewan Seed Potato Growers Association prior to that. Deb is well respected in the seed potato industry in western Canada and is aware of the limitations of our current approach to variety development. Deb has excellent interpersonal skills and will help to plan and coordinate the field days to allow industry to experience the potato varieties first-hand.

Dr. Darcy Driedger is a Food Scientist with Alberta Agriculture and Rural Development. Darcy has been involved with the Western Canadian Potato Breeding Program for approximately 10 years. Darcy is familiar with the parameters used by the potato industry to evaluate new varieties and has project experience with many of the industry stakeholders. Darcy and his staff have the expertise to evaluate potato varieties for specific end-uses and will provide meaningful information for stakeholders.

Ability to Complete

Alberta Agriculture and Rural Development has the land base, plot scale equipment, grading and storage facilities required to conduct this work at both the Crop Diversification Centre North (CDCN) and the Crop Diversification Centre South (CDCS). There is adequate technical support to oversee all aspects of the work described provided that sufficient seasonal labour is available.

CDCS is an irrigated crop research station. Using this location will allow us to manage the trials and obtain meaningful data on the response of potato varieties to plant density and nitrogen levels. CDCN is a rain fed station situated near the main seed potato production area of the province. Providing information on the performance of varieties under conditions at CDCN gives seed growers and some fresh market growers valuable information for their operations. Both centres have facilities suited to hosting industry field days and demonstrations.

The Food Science lab at CDCS is well equipped to conduct boil and bake analyses for fresh market varieties and they are set up for French fry and chip evaluation as well. The lab has equipment necessary for dicing, drying and extracting components from the potato tissue as well.

Budget Commentary

Variety Development was identified as a research priority by the Potato Growers of Alberta (PGA). Specifically, they identified a need for a database of variety production profiles and a breeding program that recognizes and addresses differences between production areas. A key element to the success of a project like this is having access to varieties for evaluation. We have the cooperation of the variety providers for our trial and we would not be able to proceed without that.

The contributions identified by the PGA and other industry stakeholders are unconfirmed contributions. Industry contributions are anticipated to take the form of a per-variety charge for evaluation and fertility and spacing trials and in-kind contributions of seed potatoes. Potential contributors include Lamb Weston, McCain Foods, Maple Leaf Potatoes, Old Dutch, Little Potato Company, Edmonton Potato Growers, Parkland Seed Potatoes, Rockyview Elite Tubers and others. The full proposal will be submitted to the PGA Research Committee concurrently to confirm their contribution and it will be circulated among other stakeholders to attract and confirm additional funding.

Letters of support have been requested and will be provided directly to ACIDF.

Anticipated Budget By Year

Year 1

Source	Type	Personnel	Travel	Capital Assets	Supplies	CDL*	Overhead	Total/Year
Funding Consortium	Cash	$11,500.00	$800.00	$0.00	$6,700.00	$0.00	$0.00	$19,000.00
Gov't	Cash	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Gov't	In-Kind	$42,250.00	$0.00	$0.00	$0.00	$0.00	$0.00	$42,250.00
Industry	Cash	$21,360.00	$0.00	$0.00	$0.00	$2,640.00	$0.00	$24,000.00
Industry	In-Kind	$0.00	$0.00	$0.00	$2,400.00	$0.00	$0.00	$2,400.00
	Total:	$75,110.00	$800.00	$0.00	$9,100.00	$2,640.00	$0.00	$87,650.00

*Communication, Dissemination, and Linkage

Year 2

Source	Type	Personnel	Travel	Capital Assets	Supplies	CDL*	Overhead	Total/Year
Funding Consortium	Cash	$12,500.00	$800.00	$0.00	$6,700.00	$0.00	$0.00	$20,000.00
Gov't	Cash	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Gov't	In-Kind	$42,250.00	$0.00	$0.00	$0.00	$0.00	$0.00	$42,250.00
Industry	Cash	$21,300.00	$0.00	$0.00	$0.00	$2,700.00	$0.00	$24,000.00
Industry	In-Kind	$0.00	$0.00	$0.00	$2,400.00	$0.00	$0.00	$2,400.00
	Total:	$76,050.00	$800.00	$0.00	$9,100.00	$2,700.00	$0.00	$88,650.00

*Communication, Dissemination, and Linkage

Year 3

Source	Type	Personnel	Travel	Capital Assets	Supplies	CDL*	Overhead	Total/Year
Funding Consortium	Cash	$12,500.00	$800.00	$0.00	$6,700.00	$0.00	$0.00	$20,000.00
Gov't	Cash	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Gov't	In-Kind	$42,250.00	$0.00	$0.00	$0.00	$0.00	$0.00	$42,250.00
Industry	Cash	$21,300.00	$0.00	$0.00	$0.00	$2,700.00	$0.00	$24,000.00
Industry	In-Kind	$0.00	$0.00	$0.00	$2,400.00	$0.00	$0.00	$2,400.00
	Total:	$76,050.00	$800.00	$0.00	$9,100.00	$2,700.00	$0.00	$88,650.00

*Communication, Dissemination, and Linkage

Budget Grand Total

Personnel	Travel	Capital Assets	Supplies	CDL*	Overhead	Grand Total
$227,210.00	$2,400.00	$0.00	$27,300.00	$8,040.00	$0.00	$264,950.00

*Communication, Dissemination, and Linkage

LOI Funding Request

Funding Consortium	Gov't Cash	Gov't In-kind	Industry Cash	Industry In-kind	Total Project Cost
$60,000.00	$0.00	$127,500.00	$60,000.00	$7,500.00	$255,000.00

Total Amount Requested from Members of the FC

Year	Amt Requested From FC
Year 1	$19,000.00
Year 2	$20,000.00
Year 3	$20,000.00
Year 4	$0.00
Year 5	$0.00
Total Amount Requested From FC:	$59,000.00

Funding Contribution and Sources

Source	Amount	Percentage of Total
Funding Consortium Cash	$59,000.00	22.27%
Gov't Cash	$0.00	0%
Gov't In-Kind	$126,750.00	47.84%
Industry Cash	$72,000.00	27.17%
Industry In-Kind	$7,200.00	2.72%
Total Project Cost:	$264,950.00	100%

Government Sources

Name	Amount Cash	Amount In-Kind	Confirmed
Alberta Agriculture and Rural Development	$0.00	$90,750.00	Yes
Agriculture and Agri-Food Canada	$0.00	$36,000.00	Yes

Industry Sources

Name	Amount Cash	Amount In-Kind	Confirmed
Potato Variety Management Institute	$3,000.00	$450.00	No
McCain Foods Canada	$6,000.00	$750.00	No
Rockyview Seed Potatoes	$6,000.00	$750.00	No
Potato Growers of Alberta	$15,000.00	$0.00	No
Little Potato Company	$6,000.00	$750.00	No
Parkland Seed Potatoes	$6,000.00	$750.00	No
Edmonton Potato Growers	$3,000.00	$450.00	No
Agristar Inc.	$3,000.00	$450.00	No
Lamb Weston / ConAgra	$6,000.00	$750.00	No
Old Dutch	$6,000.00	$750.00	No
Alberta Seed Potatoes Inc.	$3,000.00	$450.00	Yes
Solanum International	$3,000.00	$450.00	No
Maple Leaf Potatoes	$6,000.00	$750.00	Yes

Approvals and Permits

Approval/Permit	Status
Animal Care Approval	N/A
Canadian Environmental Assessment Act	N/A
Other	N/A
Human Ethics Approval	N/A
Transgenic Crop Permit	N/A
Alberta Environment Act	N/A

Suggested Reviewers

Name	Susan Smith
Position	Industry Specialist - Field Vegetables and Organics
Institution	B.C. Ministry of Agriculture and Lands
Address	
Country	Canada
Phone Number	604-556-3087
Fax Number	
Email Address	Susan.L.Smith@gov.bc.ca

Name	Eugenia Banks
Position	Potato Specialist
Institution	OMAFRA
Address	
Country	Canada
Phone Number	519-826-3678
Fax Number	
Email Address	eugenia.banks@ontario.ca

Name	Doug Waterer
Position	Associate Professor
Institution	University of Saskatechewan
Address	
Country	Canada
Phone Number	306-966-5860
Fax Number	306-966-5015
Email Address	doug.waterer@usask.ca

Project Team Leader

Dr. Michele Konschuh
CDCS Alberta Agriculture and Rural Development Potato Research Scientist
301 Horticultural Station Road East Brooks
Alberta T1R 1E6
403-362-1314 403-362-1306
michele.konschuh@gov.ab.ca

Project Team Members

Darcy Driedger	Agriculture and Rural Development
Deb Hart	Potato Growers of Alberta
Jeanne Debons	Potato Variety Management Institute
Benoit Bizimungu	Agriculture

and Agri-
Food
Canada

Detailed Info:

Dr. Darcy Driedger
Food Processing Development Centre Agriculture and Rural Development Program Manager, Food Science and Technology
301 Horticultural Station Road E Brooks
AB T1R 1E6
403-362-1339 403-362-1326
darcy.driedger@gov.ab.ca

Degrees Certificates/Diplomas:

Ph.D. (Food Science and Technology), University of Alberta, 2000
M.Sc. (Foods and Nutrition), University of Manitoba, 1990
B.S.A. (Food Science), University of Manitoba, 1987

Publications and Patents:

Thomas, J.E., Bandura, M. Lee, E.L., Driedger, D. and Acharya, S. 2010. Biochemical monitoring in fenugreek to develop functional food and medicinal plant variants. New Biotechnol. (in press)

Iablokov, V., Sydora, B.C., Foshaug, R., Meddings, J., Driedger, D., Churchill, T. and Fedorak, R.N. 2010. Naturally occurring glycoalkaloids in potatoes aggravate intestinal inflammation in two mouse models of inflammatory bowel disease. Dig. Dis. Sci. 55:3078-3085.

Meng, X., Threinen, D., Hansen, M. and Driedger, D. 2010 Effects of extrusion conditions on system parameters and physical properties of a chickpea flour-based snack. Food Res. Int. 43:650-658.

Bandara, M., Lee, E.L., Driedger, D., Acharya, S. and Thomas, J.E. 2009. Genotype x environment effect on galactomannan content and seed yield of fenugreek (Trigonella foenum-graecum L.). Acta Hort. (submitted)

Bandara, M., Savidov, N. and Driedger, D. 2009. The impact of selected abiotic stresses on glucoraphanin content in field pepperweed (Lepidium campestre L.). Acta Hort. (ISHS) 841:323-327.

Bandara, M., Savidov, N. and Driedger, D. 2008. Evaluation of field pepperweed (Lepidium campestre L.) as a source for glucoraphanin production. Acta Hort. 765:165-172.
Bandara, M., Scharff, F. and Driedger, D. 2008. Root yield and inulin quality of chicory (Cichorium intybus L.) produced in southern Alberta. International Crop Science Congress, April 2008, Jeju. Korea.

Bizimungu, B, Lynch, D.R., Holm, D.G., Kawchuk, L.M., Konschuh, M., Wahab, J., Waterer, D., Driedger, D., McAllister, P., Howard, R. and Platt, H.W.2008.

Other Evidence of Productivity:

Manage the Food Science and Technology program at the Crop Diversification Centre South. Product and technology development projects with industry clients result in about 6 new products on the market annually. Sales resulting from these projects exceed $1 M.

2004-2010, Lead the establishment of an extrusion research facility at CDCS Brooks with permanent scientific and technical staff.

Deb Hart
Potato Growers of Alberta Seed Coordinator
17507 Fort Road NW Edmonton
AB T5Y 6H3
780-418-5-2305 780-422-6096
deb.hart@albertapotatoes.ca

Dr. Jeanne Debons
Potato Variety Management Institute Executive Director
60380 Chickasaw Way Bend
OR 97702-9724
541-318-1485 541-318-7561
jeannedebons@msn.com

Degrees Certificates/Diplomas:

Ph.D. 1986 Botany and Plant Pathology Oregon State University

M.Sc. 1980 Forest Pathology State University of New York

B.Sc. 1979 Forest Biology State University of New York

Publications and Patents:

Presentations at regional meetings. including PGA annual meeting. on the role of PVMI in the future of the potato industry in the US and Canada.

Other Evidence of Productivity:

Executive Director of PVMI. Potato VAriety ManagementInstitute since creation in 2006. Was granted $250 USDA Samll Business Development Grants to initiate and then further develop PVMI. Achieved a USDA ARS CREES Grant in 2008 to create an online system for MTA management and tracking.

PVMI has collected enough maney via licenses and royalty collection that $100K has been sent to research & breeding programs. Waiting on another $100-150K to be sent at the end of this year.

Fully updated and active website www.pvmi.org

Helped organize the Potato Association of America meetings in Corvallis, OR in Augusut 2010.

Dr. Benoit Bizimungu
Potato Research Centre Agriculture and Agri-Food Canada National Potato Breeder and Gene Resources Curator
850 Lincoln Road, P.O. Box 20280 Fredericton
NB E3B 4Z7
506-452-4880 506-452-3316
benoit.bizimungu@agr.gc.ca

Degrees Certificates/Diplomas:

Ph.D. 1995 Plant Breeding & Genetics University of Laval

M.Sc. 1987 Plant Breeding & Genetics University of Laval

B.Sc. 1984 General Agriculture National University of Rawanda

Publications and Patents:

10 refereed publications, 7 patents (plant breeders rights). 22 proceedings. technical reports, etc. in the last 5 years

Other Evidence of Productivity:

released 6 potato varieties. currently hold 7 grants. 3 grants completed

Attached File(s) 785_CV.doc
Michele_Konschuh_CV.doc

Comments No comments to load for this proposal.

SCHEDULE "C" – COLLABORATING INSTITUTIONS

Potato Research Centre, Agriculture and Agri-Food Canada
Potato Variety Management Institute

Proposal Number 2011F047R

Name Potato Variety Development in Alberta

Abstract

The proposed research project will attempt to provide a transition strategy from the Western Canadian Potato Breeding Comnsortium approach to a braoder, more inclusive approach to benefit the greatest number of stakehodlers. Replicated cultivar evaluation trials will be conducted at two research stations each year to provide local data on potential potato varieties in the breeding pipeline. A field day will be planned at each location to allow industry stakeholders an opportunity to see first hand how the varieties compare to standard varieties in each class. A plant density and a nitrogen fertility component will be included for additional fees if there is sufficient interest from participants. The planting density component of the project will involve spacing plantlets at different in-row distances to determine whether the variety responds favorably to adjustments in plant density. The fertility component of the project will involve growing the varieties on 2 levels of nitrogen fertility to determine whether nitrogen rates can be reduced for newer cultivars. Field days will be hosted to allow participants and other industry stakeholders the opportunity to observe potato varieties first-hand. The project capitalizes on an economy of scale in evaluating a wide range of cultivars with potential for production in Alberta. Data relevant to trial sponsors and collaborators will be collected each year and shared with all sponsors.

Keywords potato varieties, new releases, accelerated release, potato agronomy

Team Leader Name: Michele Konschuh

Team Leader Organization: Alberta Agriculture and Rural Development

Project Duration (Yrs) 3

Project Start Date 04/01/2011

Project End Date 11/30/2013

Stand-Alone Project Yes

Background

Breeding for new potato varieties was identified in industry-wide priority setting meetings in 2003 and 2004 by the potato inustry. For about 40 years now, Agriculture and Agri-Food Canada managed a potato breeding program in Western Canada focused on breeding and selecting varieties that would perform well under our environmental conditions. The potato breeding programs in Canada were consolidated into a National program in 2004 and there is now one National Potato Breeder. By necessity, less emphasis is directed at varieties best suited for Western Canada. The nature of potato breeding and selection has also shifted. Industry participants are exploring varieties for different end-uses, such as gourmet and functional food uses. Varieties from breeding programs in Europe and the United States are often being assessed.

Alberta Agriculture facilitated the regional evaluiation process by conducting regional trials, disease resistance trials, agronomic trials, culinary and storage trials with promising new varieties. This system was unique to Western Canada and served established industry stakeholders well. Over the last 10 years, Alberta Agriculture and Rural Development staff worked individually with stakeholders in the potato industry to provide agronomic evaluations of potato varieties from various breeding programs. Public varieties are still widely grown, but not always as good a fit as private varieties for the same end use. The growing environments vary significantly among potato production regions in Canada. Alberta data is essential when selecting varieties appropriate for our climate, our customers and industry stakeholders. Also, there is increasing pressure on potato producers to utilize best management practices to reduce the environmental footprint for potatoes. The costs of such shifts in production practices will be borne primarily by producers. Industry stakeholders are looking for replacement varieties that use less nitrogen, less water, less pesticide, yet yield superior processing or culinary quality and tonnage.

The purpose of the proposed research project is to pool resources and evaluate potential varieties, from a range of sources, using a cooperative approach. Including agronomy in the evaluations allows us to provide growers with additional relevant information when they weigh options of producing new varieties. Often, there are economies of scale realized when varieties are evaluated collectively rather than individually. ARD is well positioned to provide regional data in an impartial setting and mitigate risks to individual stakeholders.This proposal does not replace the Consortium as it is focused on Alberta. In addition, we intend to evaluate any material, regardless of the breeding origin, that might be well suited to our climate and end-uses. Support has been requested from many stakeholders, and we anticipate some flux in support between members depending on the year of the study.

Objectives and Deliverables

Objectives:
A. To evaluate potential new varieties for processing (fry and chip), gourmet and other markets;
B. To provide the potato industry an opportunity to assess varieties grown under local conditions;
C. To compare varieties from European, Tri-State and National breeding programs (AAFC) under Alberta conditions; and
D. To develop agronomic information on plant density and nitrogen requirements to support potato growers interested in producing new varieties.
E. To evaluate the cooperative approach to variety development and develop a model to take the industry beyond the current project.

Deliverables

Each stakeholder will receive information about varieties of interest relative to standard varieties in each class. Information generated will failicitate decision making, and stakeholders will need to pursue commercialization opportunties independent of the trial. Typically, we provide emergence, stand, vigour, and maturity data as well as yield by size category, specific gravity, defects and deformities, and culinary evaluations. For additional fees, stakeholders can enter varieties into agronomic trials looking at three plant density levels and a reduced level of nitrogen. Local production data will support adoption of new potato varieties that will enhance the competitiveness of our potato industry.

A field day will be hosted each year at both locations to allow stakeholders to evaluate the response of cultivars to rain-fed and irrigated growing conditions. There is no substitution for first hand observation of potato varieties in the field.

As part of the proposed trial, we will work with stakeholders to develop a variety development mechanism for Alberta that takes us beyond the current project approach. The project is, in essence, a transition strategy to move the industry from a federal breeding program approach to a broader, more inclusive evaluation system.

Project Design and Methodology

Variety evaluation trials will be set up at the Crop Diversification Centre North (CDCN) in Edmonton and the Crop Diversification Centre South (CDCS) in Brooks to provide data from rain-fed and irrigated production systems respectively. Standard varieties will be included to represent early French fry, full-season French fry, early chipper, full-season chipper, fresh market red, fresh market white and fresh market yellow classes. Two harvest dates are proposed, one in early to mid-August and one in mid September. Sufficient potatoes will be planted to provide replicated data as well as a demonstration for a field day at both locations.

Material for these trials will be provided by stakeholders either through the Accelerated Release Program or by sourcing varieties from European, U.S. or other breeding programs. All import requirements will be the responsibility of the stakeholder requesting evaluation.

At CDCS, we will set up a nitrogen response trial with standard and reduced levels of nitrogen fertility. Stakeholders will indicate whether or not they require fertility information and must provide sufficient seed and funds to include these evaluations.

At CDCS, we also plan to evaluate the response of potato varieties to plant density changes. Potatoes will be planted at three in-row spacings (20, 25 and 30 cm proposed) to determine the response. Stakeholders must provide sufficient seed and funds to include these evaluations.

Variety trials will be set up as randomized complete blocks for each harvest date. Guard rows will be planted to minimize edge effects. Four replicate rows (6m) will be harvested and an additional row will be planted to allow for in-season sampling and demonstration.

The Agronomic trials will be set up as split plot designs. For the nitrogen response trials, nitrogen level will be the main plots and varieties will be the sub plots. For in-row spacing evaluations, each block of potatoes will be planted at the same density, but varieties will be randomized within each block and blocks of plant density will be randomized within the trial.

Data collected may include emergence data, stand count, time to flowering, yield, grade by size category relevant to end-use, specific gravity, internal defects, external deformities, and culinary evaluations. Samples will be retained for bruise testing, storage assessments or acrylamide testing at the stakeholders expense.

Proposed Varieties to evaluate and rationale:
- AAFC Accelerated release material - various rationales
- Alpine Russet – Excellent cold sweetening resistance producing reduced acrylamide levels, very long storage capability, high % No 1s, lower N requirement
- Yukon Gem – Superior disease resistance, higher yields than it's direct competitor Yukon Gold, increased scab resistance, good organic choice, excellent chip processing qualities
- Highland Russet – Accepted by McDonalds for breakfast patty, superior culinary qualities for fresh and processing
- A0008-1TE – Early dual purpose with high yields and % No 1s
- Classic Russet – Possible replacement for Norkotahs, early yields, high No 1s, culinary qualities both fresh and processing
- And Others....

Annual Work Plan:
April/May: Seed prep
Planting

May/June: Hilling
Irrigation pipe
Emergence data

July: Weeding, fungicide, insecticide as required
In-season data collection (time to flowering, vigor)

August: Weeding, fungicide, insecticide as required
Maturity data
Field Day at CDCN
Harvest of early-season varieties
Field Day at CDCS

September: Desiccation of full-season varieties
Harvest full-season varieties

October: Grading
Post-harvest evaluations (culinary)

November: Data analyses, report writing
Stakeholder meeting

Contributions to Alberta's Agriculture and Agri-Food Knowledge

Practical knowledge about new potato varieties will be the main contribution of this work. What differentiates this work is the cooperative approach proposed to maximize information to industry with limited resources.

The project is not expected to generate any specific intellectual property through the work. The plant material will have come from various existing breeding programs and plant breeder's rights will have already been applied for by the owner.

While potato producers have a vested interest in producing new varieties of potato, the entire value chain is often involved in the decision to adopt a new variety. A cooperative approach ensures that considerations of many stakeholders are taken into account as varieties are evaluated. The decision to commercialize a variety, though, may be undertaken by a small segment of the industry.

We will be providing information critical to the decision making process for the potato industry to remain competitive. Our team involves people with expertise in the areas of plant breeding, variety development, marketing, agronomy and food science. This collaborative approach brings broad expertise to the project and allows the stakeholders to benefit more widely than from an independent evaluation of the varieties.

The novel, unique or innovative aspect of the project is that we will attempt to engage competitors in a cooperative project to benefit the greatest number of stakeholders in the potato industry. The project utilizes the limited government resources available and leverages that for the greatest good. Potato varieties from other programs will be evaluated to see their suitability and usefulness to the Canadian market. This information is currently lacking due to the recent lack of a western regional research and breeding program.

Benefits to Alberta's Agriculture and Agri-Food Industry

With increasing pressure to enhance competitiveness, potato growers, packers and processors require varieties that produce good yield, and more importantly, lower costs of production. Replacement varieties with improved nutrient use efficiency, improved disease resistance, fewer defects, better storage potential or other desirable traits would reduce the cost of production and these efficiencies will ensure that our potato industry remains competitive.

A number of clients have expressed interest in evaluating new varieties to see whether or not they are well-adapted to our growing region. Information on how varieties perform relative to standard varieties is important for decision making as well as for marketing new varieties. In fact, this type of information was a fundamental part of the former Western Canadian Potato Breeding Consortium.

The key benefit of this project is that individual stakeholders in the potato industry will realize an economy of scale when evaluating potato varieties and basic agronomy information in a cooperative way. In the last 10 years, Alberta Agriculture and Rural Development staff have worked with many potato industry stakeholders independently to assess varieties relative to standard varieties. Each trial involves standards from each class of potatoes and guard rows. Often the results were made available to specific customers, but access by others was limited. Independent evaluations represent a financial burden for seed growers, small companies or large companies producing potatoes in a unique environment. The current approach will provide information to many stakeholders in the value chain and should move the industry forward on a more united front.

The project is seen as a transition strategy from the Western Canadian Potato Breeding Program to a broader, more inclusive model for evaluating and ultimately introducing new varieties. If stakeholders perceive value in the new approach, we anticipate that they will be prepared to provide ongoing funding in support of this approach in the future.

Knowledge Transfer Plan

The industry will have access to this information in many ways. To start with growers and industry members will be invited to see the evaluation plots and compare on the ground the unique performances of each variety in the field under local conditions. Data will be collected analysed and presented in several formats to industry including posters, papers and talks. Information will be available on the internet (PVMI website and PGA website) for easy access for growers. Implementation will be optimized during the three years of the project by direct feedback from industry and may be measured by the increase in uptake of local superior varieties.

Project Team Qualifications

Dr. Michele Konschuh is a Research Scientist with ARD at CDC South, Brooks. She has extensive experience in potato agronomy and recently assumed responsibility for managing Alberta's seed potato repository at CDC North, Edmonton. She works closely with all facets of the potato industry and liaises with her counterparts across in Canada in activities related to research and extension support for the potato industry. Michele has over 10 years of experience with the potato industry and has been involved in the evaluation of varieties for various segments of the industry. She will lead the project and provide agronomy advice, spearhead external fund-raising activities, assist with field trials, and participate in technology transfer activities with the potato industry aimed at encouraging the adoption of potato varieties with improved production profiles.

Dr. Benoit Bizimungu recently assumed the leadership of the National Potato Breeding and Genetic Enhancement program with Agriculture and Agri-Food Canada, following the consolidation of eastern and western potato breeding projects. He is also leading a team of scientists working on the development of a low glycemic index and high fibre potato, as part of the Biopotato (ABIP) network. Benoit is very familiar with the needs of the Alberta potato industry from his former role as lead of the Western Canadian Potato Breeding Consortium.

Dr. Jeanne Debons is the Executive Director of the Potato Variety Management Institute (PVMI) in Oregon. PVMI has succeeded in bridging the gap between potato breeding programs and industry adoption in the Pacific Northwest by providing a mechanism to manage and release varieties and to channel royalties collected into developing agronomic information and marketing materials. Jeanne's interpersonal skills and calm competence have played a large part in the success of PVMI. Jeanne has relevant expertise in addressing the gap between superior breeding material and industry adoption and she is willing to lend this expertise to Alberta on this project.

Deb Hart is the Seed-Coordinator for the Potato Growers of Alberta. Deb worked with the Saskatchewan Seed Potato Growers Association prior to that. Deb is well respected in the seed potato industry in western Canada and is aware of the limitations of our current approach to variety development. Deb has excellent interpersonal skills and will help to plan and coordinate the field days to allow industry to experience the potato varieties first-hand.

Dr. Darcy Driedger is a Food Scientist with Alberta Agriculture and Rural Development. Darcy has been involved with the Western Canadian Potato Breeding Program for approximately 10 years. Darcy is familiar with the parameters used by the potato industry to evaluate new varieties and has project experience with many of the industry stakeholders. Darcy and his staff have the expertise to evaluate potato varieties for specific end-uses and will provide meaningful information for stakeholders.

Ability to Complete

Alberta Agriculture and Rural Development has the land base, plot scale equipment, grading and storage facilities required to conduct this work at both the Crop Diversification Centre North (CDCN) and the Crop Diversification Centre South (CDCS). There is adequate technical support to oversee all aspects of the work described provided that sufficient seasonal labour is available.

CDCS is an irrigated crop research station. Using this location will allow us to manage the trials and obtain meaningful data on the response of potato varieties to plant density and nitrogen levels. CDCN is a rain fed station situated near the main seed potato production area of the province. Providing information on the performance of varieties under conditions at CDCN gives seed growers and some fresh market growers valuable information for their operations. Both centres have facilities suited to hosting industry field days and demonstrations.

The Food Science lab at CDCS is well equipped to conduct boil and bake analyses for fresh market varieties and they are set up for French fry and chip evaluation as well. The lab has equipment necessary for dicing, drying and extracting components from the potato tissue as well.

Budget Commentary

Variety Development was identified as a research priority by the Potato Growers of Alberta (PGA). Specifically, they identified a need for a database of variety production profiles and a breeding program that recognizes and addresses differences between production areas. A key element to the success of a project like this is having access to varieties for evaluation. We have the cooperation of the variety providers for our trial and we would not be able to proceed without that.

The contributions identified by the PGA and other industry stakeholders are unconfirmed contributions. Industry contributions are anticipated to take the form of a per-variety charge for evaluation and fertility and spacing trials and in-kind contributions of seed potatoes. Potential contributors include Lamb Weston, McCain Foods, Maple Leaf Potatoes, Old Dutch, Little Potato Company, Edmonton Potato Growers, Parkland Seed Potatoes, Rockyview Elite Tubers and others. The full proposal will be submitted to the PGA Research Committee concurrently to confirm their contribution and it will be circulated among other stakeholders to attract and confirm additional funding.

Letters of support have been requested and will be provided directly to ACIDF.

Anticipated Budget By Year

Year 1

Source	Type	Personnel	Travel	Capital Assets	Supplies	CDL*	Overhead	Total/Year
Funding Consortium	Cash	$11,500.00	$800.00	$0.00	$6,700.00	$0.00	$0.00	$19,000.00
Gov't	Cash	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Gov't	In-Kind	$42,250.00	$0.00	$0.00	$0.00	$0.00	$0.00	$42,250.00
Industry	Cash	$21,360.00	$0.00	$0.00	$0.00	$2,640.00	$0.00	$24,000.00
Industry	In-Kind	$0.00	$0.00	$0.00	$2,400.00	$0.00	$0.00	$2,400.00
	Total:	$75,110.00	$800.00	$0.00	$9,100.00	$2,640.00	$0.00	$87,650.00
*Communication, Dissemination, and Linkage								

Year 2

Source	Type	Personnel	Travel	Capital Assets	Supplies	CDL*	Overhead	Total/Year
Funding Consortium	Cash	$12,500.00	$800.00	$0.00	$6,700.00	$0.00	$0.00	$20,000.00
Gov't	Cash	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Gov't	In-Kind	$42,250.00	$0.00	$0.00	$0.00	$0.00	$0.00	$42,250.00
Industry	Cash	$21,300.00	$0.00	$0.00	$0.00	$2,700.00	$0.00	$24,000.00
Industry	In-Kind	$0.00	$0.00	$0.00	$2,400.00	$0.00	$0.00	$2,400.00
	Total:	$76,050.00	$800.00	$0.00	$9,100.00	$2,700.00	$0.00	$88,650.00
*Communication, Dissemination, and Linkage								

Year 3

Source	Type	Personnel	Travel	Capital Assets	Supplies	CDL*	Overhead	Total/Year
Funding Consortium	Cash	$12,500.00	$800.00	$0.00	$6,700.00	$0.00	$0.00	$20,000.00
Gov't	Cash	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Gov't	In-Kind	$42,250.00	$0.00	$0.00	$0.00	$0.00	$0.00	$42,250.00
Industry	Cash	$21,300.00	$0.00	$0.00	$0.00	$2,700.00	$0.00	$24,000.00
Industry	In-Kind	$0.00	$0.00	$0.00	$2,400.00	$0.00	$0.00	$2,400.00
	Total:	$76,050.00	$800.00	$0.00	$9,100.00	$2,700.00	$0.00	$88,650.00
*Communication, Dissemination, and Linkage								

Budget Grand Total

Personnel	Travel	Capital Assets	Supplies	CDL*	Overhead	Grand Total
$227,210.00	$2,400.00	$0.00	$27,300.00	$8,040.00	$0.00	$264,950.00

*Communication, Dissemination, and Linkage

LOI Funding Request

Funding Consortium	Gov't Cash	Gov't In-kind	Industry Cash	Industry In-kind	Total Project Cost
$60,000.00	$0.00	$127,500.00	$60,000.00	$7,500.00	$255,000.00

Total Amount Requested from Members of the FC

Year	Amt Requested From FC
Year 1	$19,000.00
Year 2	$20,000.00
Year 3	$20,000.00
Year 4	$0.00
Year 5	$0.00
Total Amount Requested From FC:	$59,000.00

Funding Contribution and Sources

Source	Amount	Percentage of Total
Funding Consortium Cash	$59,000.00	22.27%
Gov't Cash	$0.00	0%
Gov't In-Kind	$126,750.00	47.84%
Industry Cash	$72,000.00	27.17%
Industry In-Kind	$7,200.00	2.72%
Total Project Cost:	$264,950.00	100%

Government Sources

Name	Amount Cash	Amount In-Kind	Confirmed
Alberta Agriculture and Rural Development	$0.00	$90,750.00	Yes
Agriculture and Agri-Food Canada	$0.00	$36,000.00	Yes

Industry Sources

Name	Amount Cash	Amount In-Kind	Confirmed
Potato Variety Management Institute	$3,000.00	$450.00	No
McCain Foods Canada	$6,000.00	$750.00	No
Rockyview Seed Potatoes	$6,000.00	$750.00	No
Potato Growers of Alberta	$15,000.00	$0.00	No
Little Potato Company	$6,000.00	$750.00	No
Parkland Seed Potatoes	$6,000.00	$750.00	No
Edmonton Potato Growers	$3,000.00	$450.00	No
Agristar Inc.	$3,000.00	$450.00	No
Lamb Weston / ConAgra	$6,000.00	$750.00	No
Old Dutch	$6,000.00	$750.00	No
Alberta Seed Potatoes Inc.	$3,000.00	$450.00	Yes
Solanum International	$3,000.00	$450.00	No
Maple Leaf Potatoes	$6,000.00	$750.00	Yes

Approvals and Permits

Approval/Permit	Status
Animal Care Approval	N/A
Canadian Environmental Assessment Act	N/A
Other	N/A
Human Ethics Approval	N/A
Transgenic Crop Permit	N/A
Alberta Environment Act	N/A

Suggested Reviewers

Name	Susan Smith
Position	Industry Specialist - Field Vegetables and Organics
Institution	B.C. Ministry of Agriculture and Lands
Address	
Country	Canada
Phone Number	604-556-3087
Fax Number	
Email Address	Susan.L.Smith@gov.bc.ca

Name	Eugenia Banks
Position	Potato Specialist
Institution	OMAFRA
Address	
Country	Canada
Phone Number	519-826-3678
Fax Number	
Email Address	eugenia.banks@ontario.ca

Name	Doug Waterer
Position	Associate Professor
Institution	University of Saskatechewan
Address	
Country	Canada
Phone Number	306-966-5860
Fax Number	306-966-5015
Email Address	doug.waterer@usask.ca

Project Team Leader

Dr. Michele Konschuh
CDCS Alberta Agriculture and Rural Development Potato Research Scientist
301 Horticultural Station Road East Brooks
Alberta T1R 1E6
403-362-1314 403-362-1306
michele.konschuh@gov.ab.ca

Project Team Members

Darcy Driedger	Agriculture and Rural Development
Deb Hart	Potato Growers of Alberta
Jeanne Debons	Potato Variety Management Institute
Benoit Bizimungu	Agriculture

and Agri-
Food
Canada

Detailed Info:

Dr. Darcy Driedger
Food Processing Development Centre Agriculture and Rural Development Program Manager, Food Science and Technology
301 Horticultural Station Road E Brooks
AB T1R 1E6
403-362-1339 403-362-1326
darcy.driedger@gov.ab.ca

Degrees Certificates/Diplomas:

Ph.D. (Food Science and Technology), University of Alberta, 2000
M.Sc. (Foods and Nutrition), University of Manitoba, 1990
B.S.A. (Food Science), University of Manitoba, 1987

Publications and Patents:

Thomas, J.E., Bandura, M. Lee, E.L., Driedger, D. and Acharya, S. 2010. Biochemical monitoring in fenugreek to develop functional food and medicinal plant variants. New Biotechnol. (in press)

Iablokov, V., Sydora, B.C., Foshaug, R., Meddings, J., Driedger, D., Churchill, T. and Fedorak, R.N. 2010. Naturally occurring glycoalkaloids in potatoes aggravate intestinal inflammation in two mouse models of inflammatory bowel disease. Dig. Dis. Sci. 55:3078-3085.

Meng, X., Threinen, D., Hansen, M. and Driedger, D. 2010 Effects of extrusion conditions on system parameters and physical properties of a chickpea flour-based snack. Food Res. Int. 43:650-658.

Bandara, M., Lee, E.L., Driedger, D., Acharya, S. and Thomas, J.E. 2009. Genotype x environment effect on galactomannan content and seed yield of fenugreek (Trigonella foenum-graecum L.). Acta Hort. (submitted)

Bandara, M., Savidov, N. and Driedger, D. 2009. The impact of selected abiotic stresses on glucoraphanin content in field pepperweed (Lepidium campestre L.). Acta Hort. (ISHS) 841:323-327.

Bandara, M., Savidov, N. and Driedger, D. 2008. Evaluation of field pepperweed (Lepidium campestre L.) as a source for glucoraphanin production. Acta Hort. 765:165-172.
Bandara, M., Scharff, F. and Driedger, D. 2008. Root yield and inulin quality of chicory (Cichorium intybus L.) produced in southern Alberta. International Crop Science Congress, April 2008, Jeju. Korea.

Bizimungu, B, Lynch, D.R., Holm, D.G., Kawchuk, L.M., Konschuh, M., Wahab, J., Waterer, D., Driedger, D., McAllister, P., Howard, R. and Platt, H.W.2008.

Other Evidence of Productivity:

Manage the Food Science and Technology program at the Crop Diversification Centre South. Product and technology development projects with industry clients result in about 6 new products on the market annually. Sales resulting from these projects exceed $1 M.

2004-2010, Lead the establishment of an extrusion research facility at CDCS Brooks with permanent scientific and technical staff.

Deb Hart
Potato Growers of Alberta Seed Coordinator
17507 Fort Road NW Edmonton
AB T5Y 6H3
780-418-5-2305 780-422-6096
deb.hart@albertapotatoes.ca

Dr. Jeanne Debons
Potato Variety Management Institute Executive Director
60380 Chickasaw Way Bend
OR 97702-9724
541-318-1485 541-318-7561
jeannedebons@msn.com

Degrees Certificates/Diplomas:

Ph.D. 1986 Botany and Plant Pathology Oregon State University

M.Sc. 1980 Forest Pathology State University of New York

B.Sc. 1979 Forest Biology State University of New York

Publications and Patents:

Presentations at regional meetings, including PGA annual meeting, on the role of PVMI in the future of the potato industry in the US and Canada.

Other Evidence of Productivity:

Executive Director of PVMI, Potato VAriety ManagementInstitute since creation in 2006. Was granted $250 USDA Samll Business Development Grants to initiate and then further develop PVMI. Achieved a USDA ARS CREES Grant in 2008 to create an online system for MTA management and tracking.

PVMI has collected enough maney via licenses and royalty collection that $100K has been sent to research & breeding programs. Waiting on another $100-150K to be sent at the end of this year.

Fully updated and active website www.pvmi.org

Helped organize the Potato Association of America meetings in Corvallis, OR in Augusut 2010.

Dr. Benoit Bizimungu
Potato Research Centre Agriculture and Agri-Food Canada National Potato Breeder and Gene Resources Curator
850 Lincoln Road, P.O. Box 20280 Fredericton
NB E3B 4Z7
506-452-4880 506-452-3316
benoit.bizimungu@agr.gc.ca

Degrees Certificates/Diplomas:

Ph.D. 1995 Plant Breeding & Genetics University of Laval

M.Sc. 1987 Plant Breeding & Genetics University of Laval

B.Sc. 1984 General Agriculture National University of Rawanda

Publications and Patents:

10 refereed publications, 7 patents (plant breeders rights), 22 proceedings, technical reports, etc. in the last 5 years

Other Evidence of Productivity:

released 6 potato varieties, currently hold 7 grants, 3 grants completed

Attached File(s)	785_CV.doc Michele_Konschuh_CV.doc
Comments	No comments to load for this proposal.

PGA
POTATO GROWERS OF ALBERTA

International Year of the
POTATO
2008
HIDDEN
TREASURE

Oct 17, 2008

Dr. Michele Konschuh
Alberta Agriculture, Food & Rural Development
301 – Horticultural Station Rd. E.
Brooks, AB T1R 1E6

Re: Effects of Green Manures on Verticillium Wilt, Rhizoctonia Solani, Scab, Root-Lesion Nematode, Soil Fertility and Yield of Potatoes

Dear Michele:

We are pleased to advise that after review of the Interim Project Report the Board of Directors of The Potato Growers of Alberta has approved continuing funding for your research project. This project was discussed at the Oct 15th, 2008 board meeting.

For the 2008 season the amount of $20,000 plus GST is available to meet the timelines specified in your application. Funds will be submitted shortly as we have already received and invoice for this year's funding amount.

We appreciate your commitment and dedication to the potato industry.

Yours truly,

Edzo Kok
Executive Director

/jb

6008 - 46 Avenue, Taber, AB T1G 2B1 • Office 403.223.2262 • Fax 403.223.2268
pga@albertapotatoes.ca • www.albertapotatoes.ca

Potato Variety Development in Alberta Project 2011F047R (2011-2013)

FINAL REPORT

Prepared for the
Alberta Crop Industry Development Fund
5030 – 50 Street
Agriculture Building
Lacombe, AB T4L 1W8

By

Michele Konschuh[1], Darcy Driedger[1], Benoit Bizimungu[2], Jeanne Debons[3] and Deb Hart[4]
[1] Alberta Agriculture and Rural Development, Crop Diversification Centre South, 301 Horticultural Station Road East, Brooks, AB T1R 1E6
[2] Agriculture and Agri-Food Canada, Potato Research Centre, 850 Lincoln Road, P.O. Box 20280, Fredericton, NB
[3] Potato Variety Management Institute,
[4] Potato Growers of Alberta, Crop Diversification Centre North, 17507 Fort Road NW, Edmonton, AB

November 17, 2014

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Executive Summary

This project was initially developed to pilot potato variety evaluation work as a cooperative effort between breeding programs, variety development companies, processors, packers and producers. The trials were conducted at two provincial research centres, the Crop Diversification Centre South (CDCS) and the Crop Diversification Centre North (CDCN) in 2011. Internal restructuring limited the involvement of CDCN in 2012 and 2013 to demonstration plots. Interested parties supplied seed of test material and efforts were made to ensure that we could gather some agronomic data in the trial. Although optimizing N fertility for so many varieties was not practical, growing on 2 levels of N gave an indication as to the potential N-response of some of these newer cultivars. There are economies of scale involved in the cooperative approach to variety trials, but compromises were made to accommodate the majority of participants.

Participants were asked for Letters of Support, and the extent of participation each year of the trial was flexible. In the first year of the trial, funding from 13 industry stakeholders plus the Potato Growers of Alberta (PGA) was leveraged. In 2012, we attracted one additional participant. Some changes within the potato industry in Alberta reduced participation in 2013 to 8 cooperators, plus the PGA, however, the level of funding from several participants increased. Over the three year project, industry support was very good.

Each year of the trial, there were potato cultivars intended for the French fry market. French fry varieties must yield well and have good fry characteristics. Specific gravity of the potatoes is an indirect measure of fry colour. In 2011, 11 French fry cultivars were compared to 1 check variety. In 2012, 10 French fry cultivars were evaluated relative to 2 check varieties. Only 1 French fry cultivar was evaluated in 2013. Two levels of N were provided to the French fry cultivars in each year of the trial as agronomic data is often limited for new varieties. McCain Foods, Lamb Weston, and Maple Leaf Potatoes all participated in 2011 and 2012. Maple Leaf Potatoes was acquired by Cavendish Farms in 2012, but Cavendish did not participate in 2013.

Chipping potatoes were included in each year of the trial as well. Old Dutch Foods, as well as seed growers and variety development firms provided chippers for evaluation. Chipping potatoes are graded by size rather than weight. As with French fry cultivars, good fry colour is essential and specific gravity is a good indirect measure of chip colour. In 2011 and 2013, 9 chipping cultivars were compared to 2 check varieties. In 2012, 8 chipping cultivars were evaluated relative to 3 check varieties. Typically, chipping potatoes required less N than French fry cultivars and a moderate or low rate of N was requested for specific entries.

Fresh market potatoes were included in the trial each year as well. Although the fresh market sector of Alberta's potato industry is the smallest segment, there is a lot of growth potential even if we simply replace imported potatoes with locally produced ones. To accommodate cooperator preferences, the fresh market potatoes were graded either by weight or size categories as requested in 2011. Thirteen cultivars were evaluated by size along with 3 check varieties and 9 cultivars were evaluated by weight along with 2 check varieties. In 2012 and 2013, all clients were satisfied with grading by size. Fifteen fresh market cultivars and 4 checks were evaluated in 2012 and 11 fresh market cultivars and 2 checks were included in 2013. Culinary data was provided as requested. For table potatoes, potatoes were evaluated as baked and boiled to determine the best fit for marketing purposes.

A special category of fresh market potatoes is the creamer potato market, made popular by the Alberta based Little Potato Company. Creamer potatoes are not smaller versions of other fresh market varieties; the varieties are selected for high tuber set and small tuber size intentionally to satisfy this market. These potatoes are prepared with the skin on and may be served with limited additional preparation. As such, skin set and tuber appearance are critical. Flavour is also very important for this class of potatoes. Nine creamer cultivars were included in the trail in 2012 at 2 levels of N, and 31 creamer cultivars were included in 2013. The Little Potato Company participated in the trail in 2012 and 2013. Creamer potato entries were provided by other participants as well.

To ensure year-round supply of raw product for processors and packers, potato varieties must be stored for up to 11 months per year. Although this trial did not include a storage evaluation component, potatoes were offered to participants after harvest and grading to allow independent storage evaluation in commercially relevant facilities.

Agriculture and Agri-Food Canada (AAFC) has been involved in potato breeding for over 40 years. The National Potato Variety program includes selections that might be suitable for the French fry, chipping, or table market, including the creamer category. Industry participants are encouraged to view selections after one or two years of regional testing and to “pick up” the varieties for further testing. Without regional testing in Alberta and knowledge of how the cultivars perform in our growing environment, industry stakeholders would be hard-pressed to make selections. AAFC supplied test material for replicated trials at CDCS and demonstration trials at CDCN in each year of the trial and included entries suitable for all industry sectors. In 2011, 10 chipping cultivars, 7 French fry cultivars and 28 fresh market cultivars were evaluated along with relevant check material from eastern and western sources at CDCS and CDCN. In 2012, 9 chipping cultivars, 10 French fry cultivars and 36 fresh market cultivars were evaluated along with relevant check material at CDCS and CDCN. In 2013, 7 chipping cultivars, 7 French fry cultivars, and 18 fresh market cultivars were evaluated at CDCS along with relevant check varieties. A demonstration at CDCN included 70 cultivars in 2013.

One of the most interesting things we noted about the three-year trial, is that there were examples of AAFC material included in 2011 that was picked up by industry in 2012 and 2013. Some of the industry entries in all three years of the trial originated from the federal program and within the space of three years, seed supplies are being established and commercial production is anticipated. These releases have been identified throughout the report with a maple leaf. This type of flow-through and the engagement of all links in the value chain is the kind of positive outcome we hoped to achieve.

The potato industry in Alberta now has a model for how cooperative variety testing can work for them. The equipment, knowledge, and facilities are specialized and it is unlikely that an applied research association could easily step into this role. With a suitable location, specialized facilities and equipment, such as those at provincial research stations (CDCS, CDCN, etc.), an experienced coordinator with a competent technical staff could conduct these evaluations with industry funding in the future.

The framework of this trial formed the basis for an application to the Growing Forward 2 Science Cluster for potato variety evaluation work. Alberta will receive funding for an additional 4 years from this source. Eight stakeholders plus the Potato Growers of Alberta provided letters of support for the new project.

Project Overview

Potato variety evaluation trials were conducted at the Crop Diversification Centre North (CDCN) in Edmonton and the Crop Diversification Centre South (CDCS) in Brooks to provide data from rain-fed and irrigated production systems respectively. Standard varieties were included to represent early French fry, full-season French fry, early chipper, full-season chipper, fresh market red, fresh market white and fresh market yellow classes. Sufficient potatoes were planted to provide replicated data from CDCS and to host a demonstration field day at both locations each year.

Material for these trials was provided by industry stakeholders either through the AAFC Accelerated Release Program or by sourcing varieties from European, U.S. or other breeding programs. All import requirements were the responsibility of the stakeholder requesting evaluation.

At CDCS, we set up a nitrogen response trial with standard and reduced levels of nitrogen fertility. Stakeholders indicated whether or not they required fertility information and provided sufficient seed and funds to include these evaluations. At CDCS, we also planned to evaluate the response of potato varieties to plant density changes, but few clients requested this information.

Variety trials were set up as randomized complete blocks. Guard rows were planted to minimize edge effects. Four replicate rows (6m) will be harvested and an additional row was planted to allow for in-season sampling and demonstration. The agronomic trials were set up as split plot designs with nitrogen level as the main plot and varieties as sub plots.

Data collected included emergence data, stand count, total yield, grade by size category relevant to end-use, specific gravity, internal defects, external deformities, and culinary evaluations. Samples were retained for bruise testing, storage assessments or acrylamide testing by the stakeholders. Local production data supports adoption of new potato varieties that will enhance the competitiveness of our potato industry.

The leveraged funding from industry also provided resources for the regional evaluation of AAFC material prior to release to industry. Without funding from this project, there may not have been any opportunity to observe the breeding program cultivars in Alberta over the past three years.

A field day was hosted each year at both locations to allow stakeholders to evaluate the response of cultivars to rain-fed and irrigated growing conditions. There is no substitution for first-hand observation of potato varieties in the field.

As part of the proposed trial, we will work with stakeholders to develop a variety development mechanism for Alberta that takes us beyond the current project approach. The project is, in essence, a transition strategy to move the industry from a federal breeding program approach to a broader, more inclusive evaluation system.

Objectives:

A. To evaluate potential new varieties for processing (fry and chip), creamer and other markets;
B. To provide the potato industry an opportunity to assess varieties grown under local conditions;
C. To compare varieties from European, Tri-State and National breeding programs (AAFC) under Alberta conditions; and
D. To develop agronomic information on nitrogen response to support potato growers interested in producing new varieties.
E. To evaluate the cooperative approach to variety development and develop a model that takes the industry beyond the current project.

Project Team Members

Alberta Agriculture and Rural Development, Crop Diversification Centre South, Brooks, AB
- Dr. Michele Konschuh, Potato Research Scientist – Project Lead
- Dr. Darcy Driedger, Food Scientist
- Simone Dalpé, Potato Technologist (2011 only)
- Tina Lewis, Seed Potato Technologist
- Seasonal Technologists

Agriculture and Agri-Food Canada, Potato Research Centre, Fredericton, NB
- Dr. Benoit Bizimungu, Plant Breeder
- Technologists

Potato Variety Management Institute, Bend, OR
- Dr. Jeanne Debons, Executive director

Potato Growers of Alberta, Crop Diversification Centre North, Edmonton, AB
- Deb Hart, Seed Coordinator

Background

One of the key areas of research that the Alberta potato industry identified in industry-wide priority setting meetings in 2003 and 2004 is breeding for new potato varieties. This was reiterated in National industry consultation meetings held in 2011. For about 40 years now, Agriculture and Agri-Food Canada managed a potato breeding program in Western Canada focused on breeding and selecting varieties that would perform well under our environmental conditions. Alberta Agriculture facilitated the process by conducting regional trials, disease resistance trials, agronomic trials, culinary and storage trials with promising new varieties. In recent years, reductions in government staff and budgets put pressure on the support provided by both levels of government. The nature of potato breeding and selection has shifted. Industry participants are exploring varieties for different end-uses, such as gourmet and functional food uses. The potato breeding programs in Canada were consolidated into a National program in 2004 and there is now one National Potato Breeder based in New Brunswick. By necessity, less emphasis is directed at varieties best suited for Western Canada. Varieties from breeding programs in Europe and the United States are often being assessed by industry stakeholders.

Regional trials of potato varieties in Western Canada were funded in part by industry money collected through the Western Canadian Potato Breeding Consortium. This system was unique to Western Canada and served established industry stakeholders well. Newcomers to the industry were not easily able to participate. Even established stakeholders questioned whether they received sufficient value for the fees. The shift to an accelerated release mechanism moved the responsibility for the evaluations to industry and provides broader access to stakeholders initially. However, the window for evaluation of varieties is much narrower than in the Consortium and less data is available for decision makers.

Over the last 10 years, Alberta Agriculture and Rural Development staff worked with individual stakeholders in the potato industry to provide agronomic evaluations of potato varieties from various breeding programs. Public varieties are still widely grown, but not always as good a fit as private varieties for the same end use. Growing environments vary significantly among potato production regions in Canada. Alberta data is essential when selecting varieties appropriate for our climate, our customers and industry stakeholders.

Many breeding programs target disease resistance, nitrogen use efficiency and excellent storage potential in addition to increased yield. The challenge is often that impartial comparisons of the material with standards varieties are not available. Each stakeholder would have the responsibility to obtain seed, sign agreements, engage researchers, or evaluate varieties independently. Many are not equipped to conduct small-scale evaluations well and seed is not available for larger-scale evaluations. Breeder’s seed also has higher tolerances for virus loads and producers evaluating this material on farm put the remainder of the crop at risk.

This project did not replace the Western Potato Consortium as it focused on Alberta. In addition, we evaluated any material, regardless of the breeding origin, that might be well suited to our climate and end-uses. Support was requested from many stakeholders, and there was some flux in support between members depending on the year of the study.

In Alberta, potato industry stakeholders are looking for replacement varieties that use less nitrogen, less water, less pesticide, yet yield superior processing or culinary quality and tonnage. Varieties from breeding programs in Canada, Europe and the United States are often being assessed. Many breeding programs target disease resistance, nitrogen use efficiency and excellent storage potential in addition to increased yield. Tuber yield potential and nutritional requirements are impacted by variety characteristics and by environmental characteristics such as the length of the growing season (Westerman, 1993). As noted by Love et al. (2003), the full potential of a new variety may not be realized until proper management is implemented. There is increasing pressure on potato producers to utilize best management practices to reduce the environmental footprint for potatoes. The costs of such shifts in production practices will be borne primarily by producers.

An ideal French fry variety would have earlier maturity than Russet Burbank, be relatively tolerant of environmental fluctuations, have few defects, yield well and have specific gravity in the desired range (1.086 to 1.092). Good fry color out of the field is an asset, and good fry color out of storage is also very desirable. An ideal chipping variety would produce a good yield of medium sized tubers, be relatively tolerant of environmental fluctuations, have few defects, and have high specific gravity in the desired range (above 1.086). Chipping tubers with a good skin set, good maturity at harvest and low concentration of reducing sugars is also very desirable. Varieties that store well at cooler temperatures are an asset. Ideal fresh market varieties would produce a good yield of creamer or medium sized tubers, be relatively tolerant of environmental fluctuations, have few defects, and have an attractive appearance. Fresh market tubers with a good skin set that store well are very desirable.

The purpose of this project was to pool resources to evaluate potential varieties from a range of sources, using a cooperative approach. This trial was established to collect local agronomic data on varieties from breeding programs in Canada, the U.S. and elsewhere. Including agronomy in the evaluations allowed us to provide growers with additional relevant information when they consider producing new varieties. Often, there are economies of scale realized when varieties are evaluated collectively rather than individually. ARD was well positioned to provide regional data in an impartial setting. The varieties were planted in replicated plots at the Crop Diversification Centre South (CDCS) in Brooks, AB in 2011, 2012 and 2013 and in demonstration plots at the Crop Diversification Centre North (CDCN) in Edmonton, AB in 2011, 2012 and 2013.

AAFC National Potato Variety Evaluation

2011

Materials and Methods

The AAFC cultivar evaluation was conducted in small plots at the Crop Diversification Centre South in Brooks, AB. Fertility for the full nitrogen rate was achieved through a combination of soil fertility (105 lbs./ac N; 214 lbs./ac P, 720 lbs./ac K), and broadcast fertilizer (350 lbs./ac of 34-17-0) incorporated at hilling. Cultivars were planted in two replicate rows in a randomized complete block design along with standard varieties. Each block was planted adjacent to guard rows to reduce any edge effects.

Eptam 8E (2.2 L/ac) and Sencor 75DF (150 g/ac) were applied pre-plant (May 13) to control weeds. Seed of standard cultivars and seed of test cultivars was provided by AAFC. Potatoes were planted May 18, 2011 approximately 12 to 14 cm deep using a two-row tuber unit planter. Seed was planted at 30 cm spacing in 6 m rows spaced 90 cm apart. Seed was (70 to 85 g) and suberized prior to planting.

The potatoes were hilled June 8 with a power hiller. The plots were irrigated to maintain soil moisture close to 70%. Foliar fungicides were applied several times during the growing season to prevent early and late blight from developing (Table 1). Insecticide was applied July 17 (Decis 5 EC, 50 mL/ac) to control Colorado potato beetle.

Table 1: Foliar fungicides applied to the potato crop to prevent early and late blight development.

Date of Application	***Fungicide***	***Rate***
July 18	Bravo 500	0.64 L/ac
Aug 2	Bravo 500	0.64 L/ac
Aug 23	Dithane DG Rainshield	0.91 kg/ac

Figure 1: NPVT trial at CDCS in Brooks, AB August 18, 2011.

Reglone (1.4 L/ac) was applied September 6 and re-applied (1.0 L/ac) September 12 to facilitate mechanical harvest. Tubers were harvested September 19 with a one-row Grimme harvester for yield and grade data.

Tubers were stored at 10˚C until graded. Tubers were graded into size categories (less than 48mm, 48 – 88mm, and over 88mm). A sample of twenty-five tubers (48 – 88mm) from each replicate was used to determine specific gravity using the weight in air over weight in water method. These tubers were cut longitudinally to assess internal defects. Sub-samples of each cultivar were stored at 10˚C until other (culinary, bruise tests, cold storage) analyses could be performed. Post-harvest analyses were conducted by AAFC and data may be available from the breeder.

For comparison purposes, cultivar data has been grouped by intended end-use category.

The cultivars included in the replicated trials at CDCS, plus other novel cultivars for specialty markets, were grown at CDCN in demo plots. Field days were conducted at both locations. Data was only collected from the CDCS plots for this report.

Results – Chipping Cultivars

Sample hills of each cultivar were dug for a field day August 24, 2011. Photos of the chipping cultivars are shown in Figure 2.

Figure 2. AAFC chipping cultivars at the CDCS field day August 24, 2011: a) Atlantic E., b) Atlantic W., c) CV96044-3, d) F06014, e) F07013, f) F07022, g) F07025 not shown, h) F07027, i) F07031, j) F07032, k) F07033, l) Snowden E., m) Snowden W., and n) V1351-3.

Yield data (total yield; ton/ac) and specific gravities of each of the chipping cultivars are shown in Table 2.

Table 2: Estimated total yield (ton/acre) and specific gravity for each chipping cultivar grown at CDCS in Brooks, AB (approximately 225 lbs./ac nitrogen). Data shown is the mean of two replicates.

2011 Chippers	Yield (ton/ac)	SG
Atlantic East	34.9	1.093
Atlantic West	32.3	1.092
CV96044-3	23.2	1.082
F06014	29.9	1.090
F07013	27.1	1.083
F07022	26.1	1.092
F07025	25.5	1.096
F07027	34.6	1.082
F07031	32.5	1.090
F07032	23.6	1.086
F07033	28.6	1.089
V1351-3	27.2	1.092
Snowden East	29.0	1.089
Snowden West	30.5	1.089

The mean percentage of total tuber number in each size category is shown in Table 3. It is important to note that harvesting with small plot equipment and manual labour recovers all potatoes over 19 mm in diameter. This tended to increase the yield of small potatoes relative to a commercial situation where more of these tubers may be left behind in the field.

Table 3: Percentage of total tuber number in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed) for each chipping cultivar grown at approximately 225 lbs./ac. Data shown is the mean of two replicates.

2011	No. of <48mm	No. of 48 to 88mm	No. of > 88mm	No. of deformed
Atlantic East	11.6	74.1	13.6	0.8
Atlantic West	14.4	73.4	10.0	2.1
CV96044-3	40.8	57.5	1.4	0.4
F06014	21.5	75.4	2.9	0.2
F07013	12.5	78.9	8.5	0.0
F07022	41.7	58.3	0.0	0.0
F07025	14.4	80.8	4.7	0.0
F07027	17.6	64.8	16.3	1.3
F07031	16.7	66.3	16.5	0.5
F07032	36.2	63.6	0.2	0.0
F07033	24.6	74.1	1.3	0.0
V1351-3	20.0	71.9	8.1	0.0
Snowden East	15.4	81.0	2.6	0.2
Snowden West	9.7	83.0	7.0	0.3

The yield of tubers (estimated ton/ac) of each chipping cultivar is shown by size category in Table 4.

Table 4: Estimated yield (ton/ac) in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed tubers) for each chipping cultivar grown at approximately 225 lbs./ac. Data shown is the mean of two replicates.

2011	Yield of <48mm (ton/ac)	Yield of 48 to 88mm (ton/ac)	Yield of > 88mm (ton/ac)	Yield of deformed (ton/ac)
Atlantic East	1.8	23.7	9.1	0.4
Atlantic West	1.9	22.7	6.8	0.9
CV96044-3	4.4	17.7	1.1	0.1
F06014	3.0	24.4	2.3	0.2
F07013	1.8	21.3	4.1	0.0
F07022	6.2	19.9	0.0	0.0
F07025	1.9	21.1	2.6	0.0
F07027	2.5	20.6	11.2	0.3
F07031	1.8	20.7	9.9	0.2
F07032	4.4	19.1	0.2	0.0
F07033	3.1	24.3	1.1	0.0
V1351-3	1.4	21.5	4.2	0.1
Snowden East	2.6	20.7	5.8	0.0
Snowden West	2.7	25.8	2.0	0.1

Tuber samples used to measure specific gravity were evaluated for hollow heart, other internal defects and scab. There were very few internal defects observed in the tubers examined. Hollow heart was noted in a few tubers of the Atlantic, CV96044-3, F07025, F07031, F07032, F07033, and one tuber of Snowden and F07013. F07025, F07031, and Snowden had a few tubers with internal necrosis. Subsamples of F06014, F07022, F07027, and V1351-3 were free of any internal defects.

Common scab lesions were noted on a few tubers of CV96044-3, F07013, F07022, F07025, F07027, F07032 and Snowden.

Results– French Fry Cultivars

Sample hills of each cultivar were dug for a field day August 24, 2011. Photos of the French fry cultivars are shown in Figure 3.

Figure 3. AAFC French fry cultivars at the CDCS field day August 24, 2011: a) Shepody E., b) Shepody W., c) F07002, d) F07005, e) F07006, f) F07007, g) F07008, h) F07010, i) Ranger Russet, j) Russet Burbank E., and k) Russet Burbank W.,

Yield data (total yield; ton/ac) and specific gravities of each of the French fry cultivars are shown in Table 5.

Table 5: Estimated total yield (ton/acre) and specific gravity for each French fry cultivar grown at CDCS in Brooks, AB (approximately 225 lbs./ac nitrogen). Data shown is the mean of two replicates.

2011 French Fry	Yield (ton/ac)	SG
Shepody East	31.4	1.077
Shepody West	29.0	1.079
F07002	25.4	1.089
F07005	27.3	1.089
F07006	22.3	1.092
F07007	25.3	1.084
F07008	21.9	1.085
F07010	25.1	1.072
FV13830	28.7	1.076
Ranger Russet	26.1	1.087
Russet Burbank East	28.3	1.082
Russet Burbank West	27.2	1.083

The mean percentage of total tuber number in each size category is shown in Table 6. It is important to note that harvesting with small plot equipment and manual labour recovers all potatoes over 19 mm in diameter. This tended to increase the yield of small potatoes relative to a commercial situation where more of these tubers may be left behind in the field.

Table 6: Percentage of total tuber number in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed) for each French fry cultivar grown at approximately 225 lbs./ac. Data shown is the mean of two replicates.

2011	No. of <48mm	No. of 48 to 88mm	No. of > 88mm	No. of deformed
Shepody E	22.9	70.6	4.4	2.2
Shepody W	24.7	68.7	1.1	5.4
F07002	19.1	74.1	4.0	2.8
F07005	28.3	68.8	1.6	1.3
F07006	24.4	66.7	6.7	2.4
F07007	48.6	49.9	0.0	1.5
F07008	48.6	50.1	0.0	1.3
F07010	19.3	77.0	2.7	0.9
FV13830	14.3	85.7	0.0	0.0
Ranger Russet	34.0	63.2	1.0	1.7
Russet Burbank E	41.3	56.8	0.2	2.2
Russet Burbank W	31.3	64.4	1.0	5.4

The yield of tubers (estimated ton/ac) of each chipping cultivar is shown by size category in Table 7.

Table 7: Estimated yield (ton/ac) in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed tubers) for each French fry cultivar grown at approximately 225 lbs./ac. Data shown is the mean of two replicates.

2011	Yield of <48mm (ton/ac)	Yield of 48 to 88mm (ton/ac)	Yield of > 88mm (ton/ac)	Yield of deformed (ton/ac)
Shepody E	1.8	24.4	4.2	1.1
Shepody W	2.2	22.8	0.9	3.0
F07002	1.9	20.2	2.4	1.0
F07005	2.9	22.4	1.5	0.5
F07006	1.9	16.0	4.4	0.5
F07007	6.4	18.1	0.0	0.8
F07008	5.6	15.9	0.0	0.5
F07010	1.9	21.3	1.7	0.3
FV13830	2.3	26.2	0.3	0.0
Ranger Russet	4.5	19.9	0.8	1.0
Russet Burbank E	6.1	21.2	0.3	0.8
Russet Burbank W	3.9	21.0	1.0	1.3

Tuber samples used to measure specific gravity were evaluated for hollow heart, other internal defects and scab. There were very few internal defects observed in the tubers examined. Hollow heart was noted in one or two tubers of the F07006 and F07008. Shepody E had one tuber with internal necrosis. Subsamples of F07002, F07005, F07007, F07010, FV13830, Shepody W, Russet Burbank E and Russet Burbank W were free of any internal defects.

Common scab lesions were noted on one tuber in each subsample of F07002, F07005, F07006, F07008, F07010 and Shepody E.

Results – Fresh Market Cultivars

Sample hills of each cultivar were dug for a field day August 24, 2011. Photos of the yellow fresh market cultivars are shown in Figure 4.

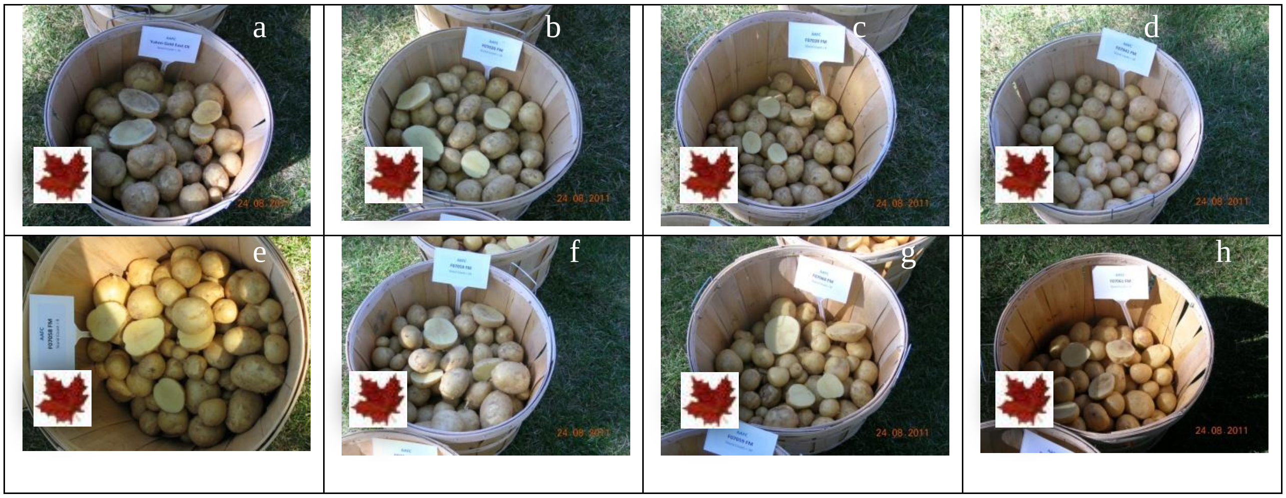

Figure 4. AAFC yellow fresh market cultivars at the CDCS field day August 24, 2011: a) Yukon Gold, b) F07020, c) F07039, d) F07041, e) F07058, f) F07059, g) F07060, and h) F07061.

Photos of the red-skinned fresh market cultivars are shown in Figure 5.

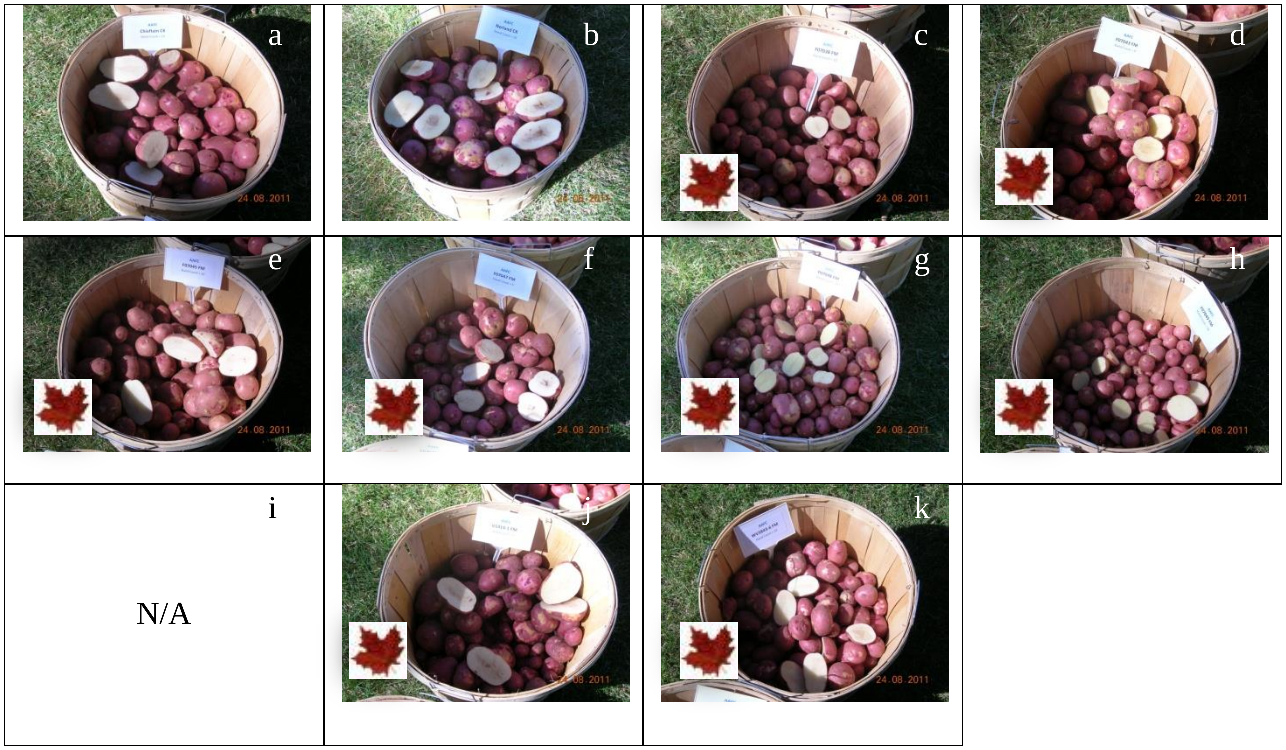

Figure 5. AAFC red-skinned fresh market cultivars at the CDCS field day August 24, 2011: a) Chieftain, b) Norland, c), F07038, d) F07043, e) F07045, f) F07047, g) F07048, h) F07049, i) F07063 not shown, j) V1414-1, and k) WV5843-6.

Photos of the white fresh market cultivars are shown in Figure 6.

Figure 6. AAFC white fresh market cultivars at the CDCS field day August 24, 2011: a) Kennebec, b) CV96044-3, c) F06027, d) F06037, e) F07040 not shown, f) F07071, g) V1255-3, h) and i) WV3252-1.

Photos of the novelty fresh market cultivars are shown in Figure 7.

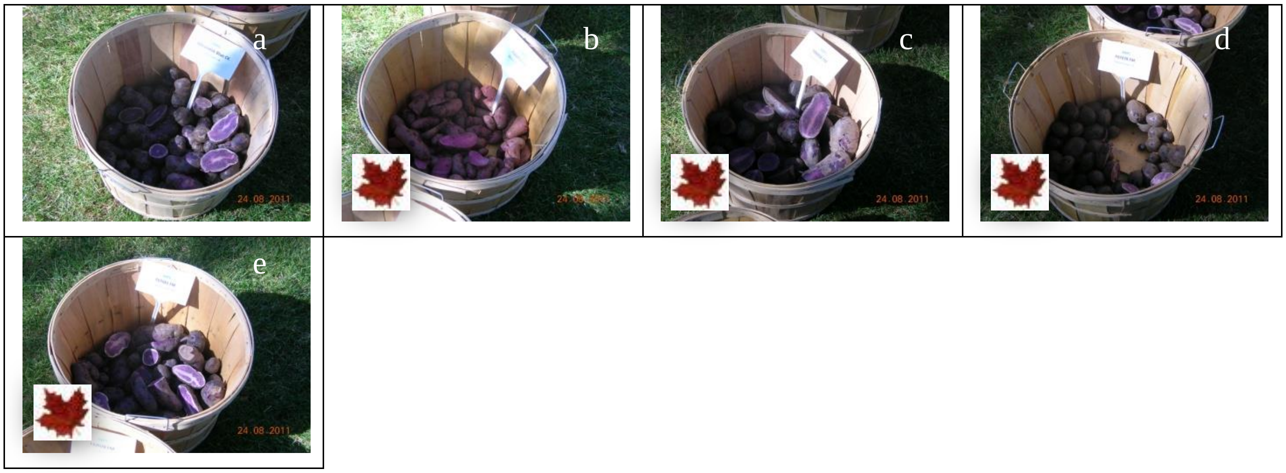

Figure 7. AAFC novelty fresh market cultivars at the CDCS field day August 24, 2011: a) Adirondak Blue, b) F06053, c) F06058, d) F07078, and e) F07081.

Yield data (total yield; ton/ac) and specific gravities of each of the fresh market cultivars are shown in Table 8.

Table 8: Estimated total yield (ton/acre) and specific gravity for each fresh market cultivar grown at CDCS in Brooks, AB (approximately 225 lbs./ac nitrogen). Data shown is the mean of two replicates.

2011 Fresh market	End Use†	Yield (ton/ac)	SG
Yellow			
Yukon Gold	FM	30.0	1.086
F07020	FM	28.5	1.089
F07039	FM/CR	28.4	1.076
F07041	FM	24.0	1.079
F07042	FM/CR	33.9	1.083
F07058	FM/CR	28.3	1.083
F07059	FM	29.0	1.080
F07060	FM	26.2	1.080
F07061	FM/CH	31.7	1.074
Red-skinned			
Chieftain	FM	31.8	1.077
Norland	FM	32.3	1.070
F07038	FM/CR	18.3	1.083
F07043	FM	29.0	1.084
F07045	FM	30.7	1.074
F07047	FM	28.0	1.085
F07048	FM/CR	25.4	1.080
F07049	FM/CR	22.1	1.081
F07063	FM	24.0	1.085
V1414-1	FM	28.3	1.071
WV5843-6	FM	30.9	1.063
White			
Kennebec	FM	31.9	1.081
CV96044-3	CH/FM/CR/GI	See Chipper data	
F06027	FM/FF	28.5	1.088
F06037	FM	35.3	1.085
F07040	FM/CR	16.8	1.077
F07071	FF/FM	32.5	1.102
V1255-3	FM/GI	27.4	1.079
WV3252-1	FM/CR/CH/GI	19.0	1.105
Novelty			
Adirondak Blue	FM/AO	24.4	1.080
F06053	FM/AO/FFN	19.0	1.071
F06058	FM/AO	33.4	1.070
F07078	FF/FM/AO	28.8	1.075
F07081	FM/FF/CH/AO	23.6	1.082

† AO = antioxidant, CH = chipper, CR = creamer, FF = French fry, FFN = functional food nutraceutical, FM = fresh market, GI = glycemic index, ST = starch

The mean percentage of total tuber number in each size category is shown in Table 9. It is important to note that harvesting with small plot equipment and manual labour recovers all potatoes over 19 mm in diameter. This tended to increase the yield of small potatoes relative to a commercial situation where more of these tubers may be left behind in the field.

Table 9: Percentage of total tuber number in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed) for each fresh market cultivar grown at approximately 225 lbs./ac. Data shown is the mean of two replicates.

2011	No. of <48mm	No. of 48 to 88mm	No. of > 88mm	No. of deformed
Yellow				
Yukon Gold	10.8	71.0	17.2	1.0
F07020	16.6	82.3	1.1	0.0
F07039	44.3	55.7	0.0	0.0
F07041	35.1	64.3	0.4	0.2
F07042	27.6	71.7	0.0	0.7
F07058	23.5	70.5	6.0	0.0
F07059	23.7	70.4	4.8	1.1
F07060	26.3	67.8	4.6	1.3
F07061	26.1	68.4	4.1	1.4
Red-skinned				
Chieftain	24.4	71.2	4.4	0.0
Norland	17.3	69.3	12.8	1.2
F07038	36.7	63.3	0.0	0.0
F07043	22.1	73.1	4.0	0.7
F07045	18.2	80.1	1.0	0.2
F07047	30.0	69.4	0.6	0.0
F07048	55.6	44.3	0.0	0.1
F07049	78.2	21.8	0.0	0.0
F07063	25.8	73.2	0.6	0.5
V1414-1	28.1	65.4	5.9	0.5
WV5843-6	39.8	59.7	0.0	0.5
White				
Kennebec	23.5	68.8	5.1	2.6
CV96044-3	See data for chipping varieties			
F06027	34.4	65.6	0.0	0.0
F06037	21.5	75.2	3.0	0.3
F07040	75.9	23.6	0.0	0.5
F07071	17.3	79.6	2.9	0.3
V1255-3	28.4	69.1	0.9	1.5
WV3252-1	40.5	59.0	0.5	0.0
Novelty				
Adirondak Blue	61.2	38.6	0.0	0.2
F06053	83.8	14.2	0.0	2.0
F06058	21.2	67.3	2.5	9.0
F07078	33.4	64.9	0.0	1.7
F07081	26.9	72.2	0.5	0.4

The yield of tubers (estimated ton/ac) of each fresh market cultivar is shown by size category in Table 10.

Table 10: Estimated yield (ton/ac) in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed tubers) for each fresh market cultivar grown at approximately 225 lbs./ac. Data shown is the mean of two replicates.

2011	Yield of <48mm (ton/ac)	Yield of 48 to 88mm (ton/ac)	Yield of > 88mm (ton/ac)	Yield of deformed (ton/ac)
Yellow	1.8	24.4	4.2	1.1
Yukon Gold	1.2	18.7	9.7	0.5
F07020	2.2	25.5	0.8	0.0
F07039	7.1	21.3	0.0	0.0
F07041	3.9	19.8	0.3	0.1
F07042	4.2	29.2	0.0	0.4
F07058	2.6	21.7	4.0	0.0
F07059	2.0	22.6	4.2	0.2
F07060	2.7	20.3	3.0	0.3
F07061	3.3	24.5	3.3	0.6
Red-skinned				
Chieftain	2.6	25.6	3.7	0.0
Norland	1.6	22.6	7.8	0.5
F07038	3.9	14.4	0.0	0.0
F07043	2.0	13.6	3.2	0.3
F07045	2.4	27.5	1.4	0.2
F07047	4.2	23.3	0.5	0.0
F07048	9.0	16.4	0.0	0.1
F07049	14.0	8.1	0.0	0.0
F07063	2.9	20.6	0.4	0.2
V1414-1	3.4	21.1	3.1	0.7
WV5843-6	6.3	24.3	0.0	0.4
White				
Kennebec	3.1	24.1	3.8	0.8
CV96044-3	See data for chipping varieties			
F06027	4.2	24.3	0.0	0.0
F06037	2.5	30.0	2.6	0.2
F07040	10.8	5.9	0.0	0.2
F07071	2.0	27.9	2.5	0.1
V1255-3	3.4	23.1	0.6	0.4
WV3252-1	4.5	14.2	03	0.0
Novelty				
Adirondak Blue	10.1	14.2	0.0	0.1
F06053	13.6	4.9	0.0	0.5
F06058	2.5	23.4	2.3	5.3
F07078	4.6	23.2	0.0	1.0
F07081	2.4	20.8	0.4	0.0

Tuber samples used to measure specific gravity were evaluated for hollow heart, other internal defects and scab. There were very few internal defects observed in the tubers examined. Hollow heart was noted in several tubers of Yukon Gold and F07047. F07059, F07060, F07063 and Norland subsamples each had one tuber with internal necrosis. Subsamples of all of the other varieties were free of any internal defects.

Common scab lesions (1%) were noted in at least one subsample of F06027, F07039, F07040, F07042, F07048, F07059, F07060, F07078, F07081, Norland, V1255-3, V1414-1, WV3252-1, and Yukon Gold.

2012

Materials and Methods

The variety evaluation was conducted in small plots at the Crop Diversification Centre South in Brooks, AB. Fertility (225 lbs./ac) was achieved through a combination of soil fertility (60 lbs./ac N; 187 lbs./ac P, 810 lbs./ac K), broadcast fertilizer (176 lbs./ac of 34-0-0 and 100 lbs./ac of 11-52-0) incorporated prior to planting and broadcast fertilizer (280 lbs./ac 34-0-0) incorporated at hilling. Varieties were planted in four replicate rows in a randomized complete block design along with standard varieties (Andover, Atlantic, Snowden, Russet Burbank, Ranger Russet, Shepody, Adirondak Blue, Chieftain, Kennebec, Norland, Sangre and Yukon Gold). Each block was planted adjacent to guard rows to reduce any edge effects.

Eptam 8E (2.2 L/ac) and Sencor 75DF (150 g/ac) were applied pre-plant (May 10) to control weeds. Seed was cut (70 to 85 g) if necessary and suberized prior to planting. Potatoes were planted May 18, 2012 approximately 5 to 5½"deep using a two-row tuber unit planter. Seed was planted at 30cm spacing in 6m rows spaced 90cm apart.

The potatoes were hilled June 4 with a disc hiller. The plots were irrigated to maintain soil moisture close to 70%. Foliar fungicides were applied several times during the growing season to prevent early and late blight from developing (Table 1). Insecticide was applied July 17 (Matador 120 EC, 40 mL/ac) and August 15 (Decis, 50 mL/ac) to control Colorado potato beetle.

Table 11: Foliar fungicides applied to the potato crop in 2012 to prevent early and late blight development.

Date of Application	*Fungicide*	*Rate*
June 29	Bravo 500	0.64 L/ac
July 27	Ridomil Gold Bravo	883 mL/ac
Aug 15	Bravo 500	0.64 L/ac

Figure 8: NPVT trial at CDCS in Brooks, AB July 20, 2012.

Reglone (1.4 L/ac) was applied August 28 to facilitate mechanical harvest. Tubers were harvested September 11 - 13 with a one-row Grimme harvester for yield and grade data.

Tubers were stored at 8˚C until graded. Tubers were graded into size categories (less than 48mm, 48 – 88mm, and over 88mm). A sample of twenty-five tubers (48 – 88mm) from each replicate was used to determine specific gravity using the weight in air over weight in water method. These tubers were cut longitudinally to assess internal defects. Sub-samples of each cultivar were stored at 10˚C until other (culinary, bruise tests, cold storage) analyses could be performed. Post-harvest analyses were conducted by AAFC and data may be available from the breeder.

Results shown are the means of two replicates. For comparison purposes, cultivar data has been grouped by intended end-use category.

The cultivars included in the replicated trials at CDCS, plus other novel cultivars for specialty markets, were grown at CDCN in demo plots. Field days were conducted at both locations. Data was only collected from the CDCS plots for this report.

Results – Chipping Cultivars

Sample hills of each cultivar were dug for a field day August 22, 2012. Photos of the chipping cultivars are shown in Figure 9.

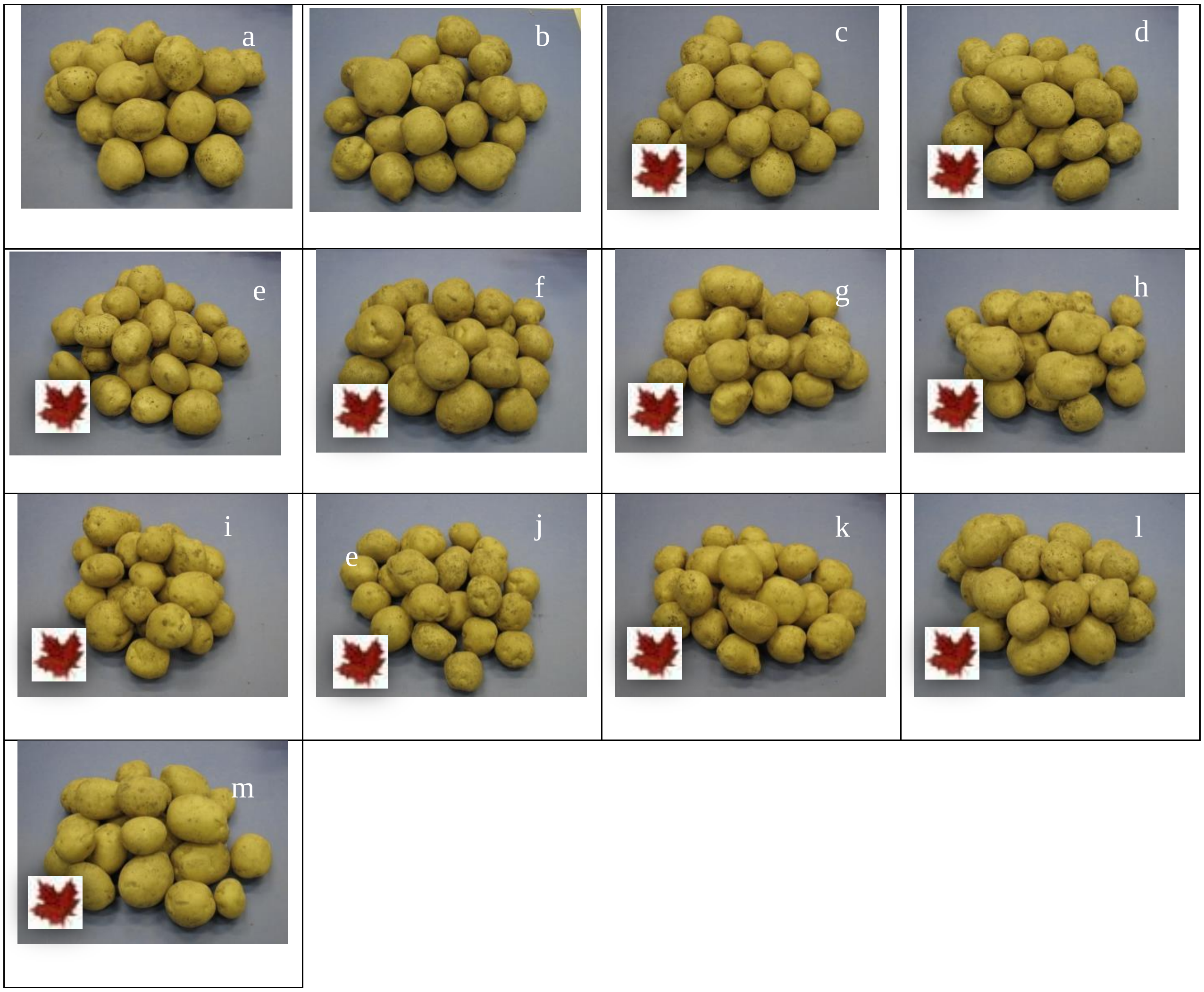

Figure 9: AAFC **chipping** cultivars grown at the CDCS in 2012: a) Andover., b) Atlantic W., c) CV97065-1, d) F07026, e) F08011, f) F08021, g) F08022, h) F08809, i) Snowden E., j) Snowden W., k) V05217-1, l) V1687-2 and m) WV4479-1.

Yield data (total yield; ton/ac) and specific gravities of each of the chipping cultivars are shown in Table 12.

Table 12: Estimated total yield (ton/acre) and specific gravity for each chipping cultivar grown at CDCS in Brooks, AB (approximately 225 lbs./ac nitrogen). Data shown is the mean of two replicates.

2012 Chipping	Yield (ton/ac)	SG
Andover	21.0	1.072
Atlantic West	27.9	1.085
CV97065-1	23.6	1.073
F07026	19.3	1.083
F08011	28.5	1.075
F08021	22.3	1.072
F08022*	3.6	1.063
F08809*	3.8	1.070
Snowden East	23.2	1.076
Snowden West	26.3	1.078
V05217-1	26.5	1.069
V1687-2	28.3	1.064
WV4479-1	26.8	1.068

* Plants affected by herbicide.

The mean percentage of total tuber number in each size category is shown in Table 13. It is important to note that harvesting with small plot equipment and manual labour recovers all potatoes over 19 mm in diameter. This tended to increase the yield of small potatoes relative to a commercial situation where more of these tubers may be left behind in the field.

Table 13: Percentage of total tuber number in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed) for each chipping cultivar grown at approximately 225 lbs./ac. Data shown is the mean of two replicates.

2012	No. of <48mm	No. of 48 to 88mm	No. of > 88mm	No. of deformed
Andover	28.3	69.8	0.8	1.1
Atlantic West	25.8	65.9	6.4	1.9
CV97065-1	26.0	73.0	0.1	0.0
F07026	38.5	61.3	0.0	0.2
F08011	43.1	53.2	2.0	1.6
F08021	23.4	72.8	3.9	0.0
F08022*	44.6	52.1	3.4	0.0
F08809*	52.8	47.2	0.0	0.0
Snowden East	40.4	58.5	0.9	0.2
Snowden West	32.7	66.2	1.1	0.0
V05217-1	37.5	59.3	1.5	1.7
V1687-2	28.5	70.3	1.0	0.2
WV4479-1	38.1	59.0	2.3	0.6

* Plants affected by herbicide.

The yield of tubers (estimated ton/ac) of each chipping cultivar is shown by size category in Table 14.

Table 14: Estimated yield (ton/ac) in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed tubers) for each chipping cultivar grown at approximately 225 lbs./ac. Data shown is the mean of two replicates.

2012	Yield of <48mm (ton/ac)	Yield of 48 to 88mm (ton/ac)	Yield of > 88mm (ton/ac)	Yield of deformed (ton/ac)
Andover	2.4	17.6	0.6	0.3
Atlantic West	2.1	20.1	4.9	0.6
CV97065-1	2.6	20.1	0.8	0.0
F07026	4.3	14.7	0.0	0.1
F08011	5.4	20.1	2.2	0.7
F08021	1.8	18.2	2.3	0.0
F08022*	0.7	2.5	0.4	5.7
F08809*	1.0	2.8	0.0	0.0
Snowden East	4.2	18.0	0.8	0.1
Snowden West	4.1	21.1	0.9	0.0
V05217-1	4.2	20.1	1.3	0.8
V1687-2	2.8	24.3	0.9	0.4
WV4479-1	4.2	20.5	1.9	0.1

* Plants affected by herbicide.

Tuber samples used to measure specific gravity were evaluated for hollow heart, other internal defects and scab. There were very few internal defects observed in the tubers examined. Hollow heart and/or brown center were noted in a couple of Atlantic tubers. Some tubers from most samples exhibited stem-end discoloration and this may be an indication that plants were not fully mature prior to desiccation. Common scab lesions were not noted for any cultivars.

Results– French Fry Cultivars

Sample hills of each cultivar were dug for a field day August 22, 2012. Photos of the French fry cultivars are shown in Figure 10.

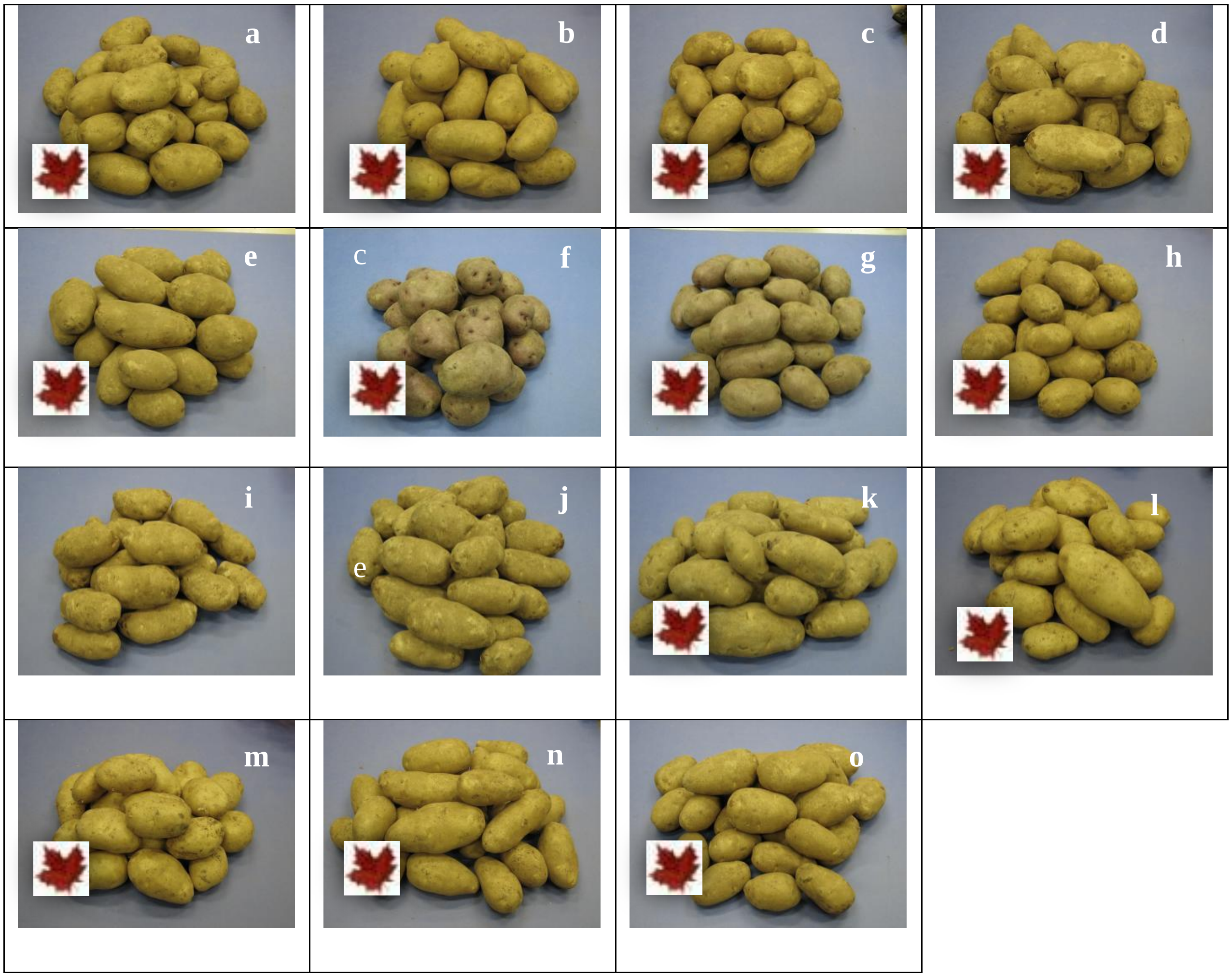

Figure 10: AAFC **French fry** cultivars grown at the CDCS in 2012: a) CV96022-3, b) F07001, c) V07002 d) F07007, e) F08001, f) F08003, g) F08099, h) FV15223-09, i) Russet Burbank E, j) Russet Burbank W, k). Ranger Russet/Amisk, l).Shepody E, m) Shepody W, n) WV3667-1, and o) WV4993-1

Yield data (total yield; ton/ac) and specific gravities of each of the French fry cultivars are shown in Table 15.

Table 15: Estimated total yield (ton/acre) and specific gravity for each French fry cultivar grown at CDCS in Brooks, AB (approximately 225 lbs./ac nitrogen). Data shown is the mean of two replicates.

2012 French Fry	Yield (ton/ac)	SG
CV96022-3	25.0	1.099
F07001	29.5	1.089
F07002	19.7	1.091
F07007	25.4	1.089
F08001	21.1	1.092
F08003	26.0	1.073
F08099	26.2	1.080
FV15223-09	26.8	1.094
R. Burbank East	25.3	1.090
R. Burbank West	29.5	1.087
Ranger R/Amisk	29.7	1.098
Shepody East	17.4	1.081
Shepody West	22.0	1.089
WV3667-1	23.9	1.101
WV4993-1	25.2	1.091

The mean percentage of total tuber number in each size category is shown in Table 16. It is important to note that harvesting with small plot equipment and manual labour recovers all potatoes over 19 mm in diameter. This tended to increase the yield of small potatoes relative to a commercial situation where more of these tubers may be left behind in the field.

Table 16: Percentage of total tuber number in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed) for each French fry cultivar grown at approximately 225 lbs./ac. Data shown is the mean of two replicates.

2012	No. of <48mm	No. of 48 to 88mm	No. of > 88mm	No. of deformed
CV96022-3	32.4	66.1	0.2	0.9
F07001	30.6	68.7	0.0	1.1
F07002	29.1	61.4	4.9	5.3
F07007	40.6	56.4	0.3	4.5
F08001	37.0	63.0	0.0	0.0
F08003	23.4	73.0	1.9	2.2
F08099	78.0	21.8	0.0	1.3
FV15223-09	28.1	70.4	0.7	1.1
R. Burbank East	57.2	41.1	0.0	4.0
R. Burbank West	71.1	27.1	0.0	5.9
Ranger R/Amisk	43.5	55.7	0.0	1.4
Shepody East	46.3	45.3	2.0	10.4
Shepody West	34.8	62.6	0.8	2.7
WV3667-1	48.5	51.5	0.0	0.0
WV4993-1	41.7	55.3	1.7	2.2

The yield of tubers (estimated ton/ac) of each chipping cultivar is shown by size category in Table 17.

Table 17: Estimated yield (ton/ac) in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed tubers) for each French fry cultivar grown at approximately 225 lbs./ac. Data shown is the mean of two replicates.

2012	Yield of <48mm (ton/ac)	Yield of 48 to 88mm (ton/ac)	Yield of > 88mm (ton/ac)	Yield of deformed (ton/ac)
CV96022-3	4.0	20.4	0.3	0.2
F07001	4.6	24.1	0.0	0.6
F07002	1.5	14.4	2.9	0.9
F07007	4.3	19.4	0.3	1.3
F08001	3.5	17.6	0.0	0.0
F08003	1.9	21.8	1.3	1.0
F08099	9.8	15.8	0.0	0.5
FV15223-09	2.7	23.0	0.6	0.4
R. Burbank East	8.4	15.2	0.0	1.7
West	7.3	19.1	0.0	2.9
Ranger R/Amisk	5.7	23.2	0.0	0.7
Shepody East	4.4	9.9	2.3	0.6
Shepody West	2.8	17.7	0.5	1.0
WV3667-1	6.1	17.6	0.0	0.0
WV4993-1	4.7	18.6	1.2	0.5

Tuber samples used to measure specific gravity were evaluated for hollow heart, other internal defects and scab. There were very few internal defects observed in the tubers examined. Hollow heart was noted in several tubers of WV3667-1. Some tubers from most samples exhibited stem-end discoloration and this may be an indication that plants were not fully mature prior to desiccation. Internal pigmentation was noted for some F08001 tubers.

Common scab lesions were not noted tubers in these subsamples

Results – Fresh Market Cultivars

Sample hills of each cultivar were dug for a field day August 22, 2012. Photos of the yellow fresh market cultivars are shown in Figure 11.

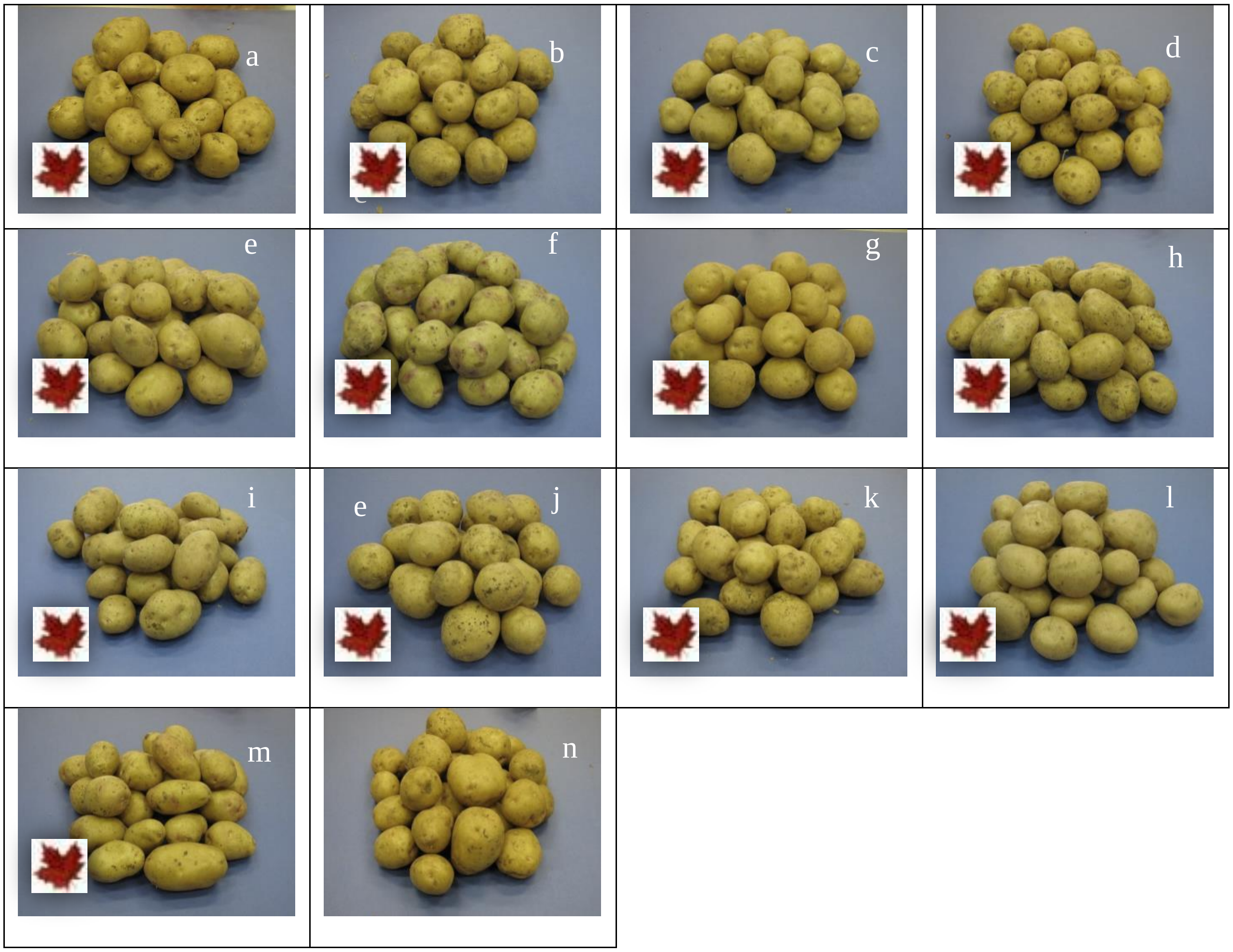

Figure 11: AAFC **yellow fresh market** cultivars at the CDCS field day August 22, 2012: a) CV05122-1, b) F06049, c) F07020, d) F7039, e) F7041, f) F7042, g) F07061, h) F08031, i) F08040, j) F08047, k) F08048, l) F08050, m) F08086, and n) Yukon Gold.

Photos of the red-skinned fresh market cultivars are shown in Figure 12.

Figure 12: AAFC red-skinned fresh market cultivars at the CDCS field day August 22, 2012: a) CV99161-5, b) CV99256-2, c) F06051, d) F07038, e) F07043, f) F08037, g) F08039, h) F08051, i) F08052, j) F08053, k) F05084, l) F08055, m) F08056, n) F08061, o) F08075, p) F08087, q) Chieftain, r) Norland, and s) Sangre.

Photos of the white fresh market cultivars are shown in Figure 13.

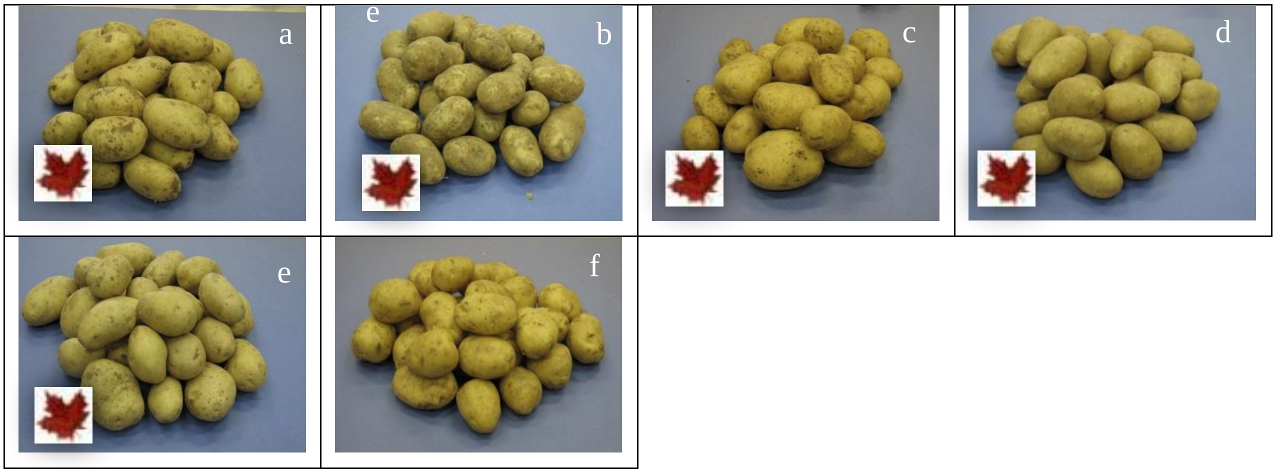

Figure 13: AAFC white fresh market cultivars at the CDCS field day August 22, 2012: a) F08008 and b) F08028, c) F08033, d) F08069, e) V115-3, and f) Kennebec.

Photos of the purple or blue cultivars are shown in Figure 14.

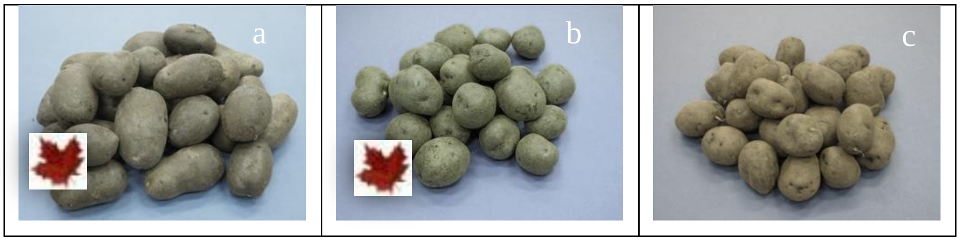

Figure 14: AAFC purple fresh market cultivars at the CDCS field day August 22, 2012: a) F06058, b) F08101 and b) Adirondak Blue.

Yield data (total yield; ton/ac) and specific gravities of each of the fresh market cultivars are shown in Table 18.

Table 18: Estimated total yield (ton/acre) and specific gravity for each fresh market FM) cultivar grown at CDCS in Brooks, AB (approximately 225 lbs./ac nitrogen). Data shown is the mean of two replicates.

2012 Fresh Market	End Use	Yield (ton/ac)	SG
Yellow			
CV05122-1	FM	29.7	1.087
F06049	FM	23.4	1.092
F07020	FM	22.7	1.089
F07039	FM	22.7	1.075
F07041	FM	24.3	1.086
F07042	FM	16.4	1.080
F07061	FM	29.9	1.076
F08031	FM	36.3	1.077
F08040	FM	30.1	1.084
F08047	FM	26.0	1.097
F08048	FM	23.6	1.082
F08050	FM	32.0	1.086
F08086	FM	28.1	1.085
Yukon Gold	FM	26.6	1.083
Red-skinned			
CV99161-5	FM	23.7	1.081
CV99256-2	FM	24.6	1.086
F06051	FM	19.1	1.078
F07038	FM	22.6	1.084
F07043	FM	30.2	1.086
F08037	FM	26.3	1.092
F08039	FM	36.3	1.082
F08051	FM	26.7	1.079
F08052	FM	12.7	1.083
F08053	FM	28.7	1.079
F08054	FM	22.1	1.076
F08055	FM	26.2	1.086
F08056	FM	26.6	1.076
F08061	FM	20.9	1.073
F08075	FM	27.0	1.081
F08087	FM	29.2	1.076
Chieftain	FM	34.0	1.081
Norland	FM	30.7	1.071
Sangre	FM	29.3	1.080
White/Russet			
F08008	FM	27.5	1.087
F08028	FM	25.7	1.088
F08033	FM	30.8	1.090
F08069	FM	26.3	1.096
V115-3	FM	26.6	1.081
Kennebec	FM	28.5	1.079
Anti-Oxidant			
F06058	FM/AO	24.0	1.067
F08101	FM/AO	29.0	1.084
Adirondak Blue	FM/AO	18.3	1.078

The mean percentage of total tuber number in each size category is shown in Table 19. It is important to note that harvesting with small plot equipment and manual labour recovers all potatoes over 19 mm in diameter. This tended to increase the yield of small potatoes relative to a commercial situation where more of these tubers may be left behind in the field.

Table 19: Percentage of total tuber number in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed) for each fresh market cultivar grown at approximately 225 lbs./ac. Data shown is the mean of two replicates.

2012	No. of <48mm	No. of 48 to 88mm	No. of > 88mm	No. of deformed
Yellow				
CV05122-1	16.5	76.8	6.4	0.2
F06049	36.4	61.8	0.9	0.8
F07020	39.4	60.0	0.7	0.0
F07039	61.3	38.2	0.0	0.5
F07041	38.8	60.3	0.4	0.5
F07042	67.8	29.1	0.2	2.9
F07061	32.9	63.3	1.9	2.0
F08031	20.3	77.3	2.0	0.4
F08040	42.8	56.3	0.0	0.9
F08047	41.7	56.8	0.8	0.8
F08048	33.4	65.2	1.2	0.2
F08050	35.5	61.6	2.1	0.9
F08086	56.1	43.0	0.0	0.9
Yukon Gold	19.2	74.3	5.6	1.0
Red-skinned				
CV99161-5	38.4	60.9	0.0	0.7
CV99256-2	43.9	55.4	0.2	0.6
F06051	74.7	24.5	0.4	0.4
F07038	54.6	45.4	0.0	0.0
F07043	24.7	74.0	0.8	0.6
F08037	54.7	45.3	0.0	0.0
F08039	26.9	67.7	5.0	0.4
F08051	45.7	53.3	0.2	0.9
F08052	56.5	43.5	0.0	0.0
F08053	45.1	53.4	1.4	0.2
F08054	47.5	52.3	0.2	0.0
F08055	41.3	57.0	1.6	0.0
F08056	45.2	50.5	3.5	0.8
F08061	41.5	50.2	6.2	2.2
F08075	30.1	64.3	5.1	0.5
F08087	22.2	75.1	2.2	0.5
Chieftain	20.1	77.9	1.3	0.7
Norland	26.7	69.2	3.4	0.7
Sangre	29.2	66.2	4.3	0.2
White/Russet				
F08008	39.7	58.8	0.3	1.2
F08028	44.0	55.6	0.3	0.0
F08033	25.8	70.7	2.3	1.2
F08069	46.6	52.3	0.2	0.8
V115-3	39.9	58.9	1.2	0.0
Kennebec	29.3	64.9	3.6	2.2
Anti-Oxidant				
F06058	45.4	50.1	2.2	2.4
F08101	46.9	53.1	0.0	0.0
Adirondak Blue	44.8	53.5	0.6	1.1

The yield of tubers (estimated ton/ac) of each fresh market cultivar is shown by size category in Table 20.

Table 20: Estimated yield (ton/ac) in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed tubers) for each fresh market cultivar grown at approximately 225 lbs./ac. Data shown is the mean of two replicates.

2012	Yield of <48mm (ton/ac)	Yield of 48 to 88mm (ton/ac)	Yield of > 88mm (ton/ac)	Yield of deformed (ton/ac)
Yellow				
CV05122-1	2.8	22.4	4.3	0.1
F06049	3.5	18.9	0.7	0.3
F07020	4.3	17.5	0.6	0.0
F07039	9.0	13.1	0.0	0.2
F07041	4.1	19.5	0.4	0.2
F07042	5.5	9.5	0.2	1.1
F07061	3.5	23.2	2.0	0.8
F08031	2.4	31.4	2.0	0.3
F08040	6.3	22.9	0.0	0.7
F08047	4.9	20.0	0.7	0.3
F08048	3.2	19.1	1.0	0.1
F08050	4.9	24.5	2.1	0.4
F08086	8.6	18.6	0.0	0.6
Yukon Gold	1.3	21.5	3.5	0.2
Red-skinned				
CV99161-5	5.3	18.1	0.0	0.3
CV99256-2	5.4	18.7	0.2	0.2
F06051	8.3	7.8	0.5	0.3
F07038	7.3	13.7	0.0	0.0
F07043	3.0	26.0	0.7	0.2
F08037	8.8	17.1	0.0	0.0
F08039	3.1	27.3	5.2	0.2
F08051	6.1	19.8	0.2	0.3
F08052	3.3	9.5	0.0	0.0
F08053	6.2	20.4	1.5	0.1
F08054	5.7	16.1	0.1	0.0
F08055	4.8	19.8	1.5	0.0
F08056	4.7	18.2	3.2	0.3
F08061	2.9	13.3	4.0	0.6
F08075	2.8	20.0	4.0	0.1
F08087	2.0	25.9	1.8	0.2
Chieftain	2.5	29.8	1.1	0.2
Norland	3.9	24.4	1.7	0.3
Sangre	2.6	23.0	3.5	0.0
White/Russet				
F08008	5.3	21.1	0.2	0.7
F08028	7.1	17.6	0.7	0.0
F08033	3.0	25.3	2.0	0.4
F08069	6.5	18.7	0.2	0.6
V115-3	5.6	19.5	1.3	0.0
Kennebec	2.7	22.1	2.6	0.9
Anti-Oxidant				
F06058	5.0	16.4	1.7	0.8
F08101	7.1	21.3	0.0	0.0
Adirondak Blue	4.2	13.2	0.4	0.4

Tuber samples used to measure specific gravity were evaluated for hollow heart, other internal defects and scab. There were few internal defects observed in the tubers examined. Hollow heart was noted in one tuber of CV99256-2, Adirondak Blue and Kennebec. Brown centre was noted in one or more tubers of F06058, F07038, F07039, F07041, F08047, F08048, F08052, F08053 and F08056. Adirondak Blue and F08101 exhibited some purple pigmentation. Some tubers from most samples exhibited some stem-end discoloration and this may be an indication that plants were not fully mature prior to desiccation.

Rhizoctonia scurf (1 to 5%) was noted on most tubers. No seed piece treatments were applied in this trial.

2013

Materials and Methods

The variety evaluation was conducted in small plots at the Crop Diversification Centre South in Brooks, AB. Fertility (235 lbs./ac) was achieved through a combination of soil fertility (124 lbs./ac N; 361 lbs./ac P, 1930 lbs./ac K), broadcast fertilizer (165 lbs./ac of 34-0-0 and 100 lbs./ac of 11-52-0) incorporated prior to planting and broadcast fertilizer (132 lbs./ac 34-0-0) incorporated at hilling. Varieties were planted in four replicate rows in a randomized complete block design along with standard varieties (Atlantic, Snowden, Russet Burbank, Ranger Russet, Shepody, Norland, Sangre and Yukon Gold). Each block was planted adjacent to guard rows to reduce any edge effects.

Eptam 8E (2.2 L/ac) and Sencor 75DF (150 g/ac) were applied pre-plant (May 6) to control weeds. Seed of standard cultivars was provided by Edmonton Potato Growers and seed of test cultivars was provided by each participant. Seed was cut (70 to 85 g) if necessary and suberized prior to planting. Potatoes were planted May 14, 2013 approximately 5 to 5½"deep using a two-row tuber unit planter. Seed was planted at 30cm spacing in 6m rows spaced 90cm apart.

The potatoes were hilled June 5 with a disc hiller. The plots were irrigated to maintain soil moisture close to 70%. Foliar fungicides were applied several times during the growing season to prevent early and late blight from developing (Table 21). Insecticide was applied July 10 (Matador 120 EC, 40 mL/ac) to control Colorado potato beetle.

Table 21: Foliar fungicides applied to the potato crop in 2013 to prevent early and late blight development.

Date of Application	*Fungicide*	*Rate*
July 10	Quadris	202 mL/ac
July 20	Bravo 500	0.64 L/ac
Aug 15	Ridomil Gold Bravo	883 mL/ac

Figure 15: NPVT trial at CDCS in Brooks, AB July 30, 2013.

Reglone (1.4 L/ac) was applied September 4 to facilitate mechanical harvest. Tubers were harvested September 12 - 13 with a one-row Grimme harvester for yield and grade data.

Tubers were stored at 8˚C until graded. Tubers were graded into size categories (less than 48mm, 48 – 88mm, and over 88mm). A sample of twenty-five tubers (48 – 88mm) from each replicate was used to determine specific gravity using the weight in air over weight in water method. These tubers were cut longitudinally to assess internal defects. Sub-samples of each cultivar were stored at 10˚C until other (culinary, bruise tests, cold storage) analyses could be performed. Post-harvest analyses were conducted by AAFC and data may be available from the breeder.

Results shown are the means of two replicates. For comparison purposes, cultivar data has been grouped by intended end-use category.

The cultivars included in the replicated trials at CDCS, plus other novel cultivars for specialty markets, were grown at CDCN in demo plots. Field days were conducted at both locations. Data was only collected from the CDCS plots for this report.

Results – Chipping Cultivars

Sample hills of each cultivar were dug for a field day August 22, 2013. Photos of the chipping cultivars are shown in Figure 16.

Figure 16. AAFC chipping cultivars at the CDCS field day August 22, 2013: a) Atlantic E., b) Atlantic W., c) F07026, d) F09020, e) F09026, f) FV12246-6, g) FV15079-10, h) FV15559-79, i) Snowden E., j) Snowden W., and k) V05073-2.

Yield data (total yield; ton/ac) and specific gravities of each of the chipping cultivars are shown in Table 22.

Table 22: Estimated total yield (ton/acre) and specific gravity for each chipping cultivar grown at CDCS in Brooks, AB (approximately 235 lbs./ac nitrogen). Data shown is the mean of two replicates.

	Yield (ton/ac)	SG
Atlantic East	28.4	1.096
Atlantic West	31.1	1.106
F07026	20.5	1.095
F09020	36.2	1.099
F09026	19.0	1.087
FV12246-6	36.5	1.100
FV15079-10	25.6	1.080
FV15559-79	23.8	1.088
Snowden East	28.9	1.094
Snowden West	26.0	1.102
V05073-2	21.0	1.093

The mean percentage of total tuber number in each size category is shown in Table 23. It is important to note that harvesting with small plot equipment and manual labour recovers all potatoes over 19 mm in diameter. This tended to increase the yield of small potatoes relative to a commercial situation where more of these tubers may be left behind in the field.

Table 23: Percentage of total tuber number in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed) for each chipping cultivar grown at approximately 235 lbs./ac. Data shown is the mean of two replicates.

	No. of <48mm	No. of 48 to 88mm	No. of > 88mm	No. of deformed
Atlantic East	25.0%	59.0%	11.0%	5.0%
Atlantic West	18.0	77.0	5.0	0.0
F07026	39.0	60.0	1.0	0.0
F09020	19.5	69.5	9.0	1.5
F09026	36.0	64.0	0.0	0.0
FV12246-6	26.5	66.0	3.5	5.0
FV15079-10	29.0	67.0	4.0	0.0
FV15559-79	36.0	64.0	0.0	0.0
Snowden East	23.0	74.0	3.0	0.0
Snowden West	26.0	71.0	3.0	0.0
V05073-2	43.0	57.0	0.5	0.0

The yield of tubers (estimated ton/ac) of each chipping cultivar is shown by size category in Table 24.

Table 24: Estimated yield (ton/ac) in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed tubers) for each chipping cultivar grown at approximately 235 lbs./ac. Data shown is the mean of two replicates.

	Yield of <48mm (ton/ac)	Yield of 48 to 88mm (ton/ac)	Yield of > 88mm (ton/ac)	Yield of deformed (ton/ac)
Atlantic East	1.8	17.4	7.3	1.9
Atlantic West	1.5	26.2	3.4	0.1
F07026	4.2	15.7	0.7	0.0
F09020	2.1	25.5	7.3	1.4
F09026	3.6	15.4	0.0	0.0
FV12246-6	3.5	26.2	4.0	2.8
FV15079-10	2.8	19.6	3.23	0.0
FV15559-79	4.4	19.1	0.3	0.0
Snowden East	2.5	23.8	2.5	0.0
Snowden West	2.9	20.7	2.3	0.0
V05073-2	4.7	15.9	0.4	0.0

Tuber samples used to measure specific gravity were evaluated for hollow heart, other internal defects and scab. There were very few internal defects observed in the tubers examined. Hollow heart and/or brown center were noted in a few tubers of the Atlantic, Snowden, F09026, and V05073-2. Some tubers from each sample exhibited stem-end discoloration and this may be an indication that plants were not fully mature prior to desiccation.

Common scab lesions were only noted on a few tubers of F07026.

Results– French Fry Cultivars

Sample hills of each cultivar were dug for a field day August 22, 2013. Photos of the French fry cultivars are shown in Figure 17.

Figure 17. AAFC French fry cultivars at the CDCS field day August 22, 2013: a) CV00031-3., b) CV04218-1., c) F07001, d) F09001, e) F09003, f) F09005, g) Russet Burbank E, h) Russet Burbank W, i) Ranger Russet/Amisk, j) Shepody E, k) Shepody W, and l) WV9120-2

Yield data (total yield; ton/ac) and specific gravities of each of the French fry cultivars are shown in Table 25.

Table 25: Estimated total yield (ton/acre) and specific gravity for each French fry cultivar grown at CDCS in Brooks, AB (approximately 235 lbs./ac nitrogen). Data shown is the mean of two replicates.

	Yield (ton/ac)	SG
CV00031-3	21.2	1.083
CV04218-1	24.8	1.070
F07001	30.4	1.080
F09001	30.4	1.091
F09003	27.8	1.078
F09005	24.1	1.078
R. Burbank East	34.8	1.089
R. Burbank West	29.9	1.087
Ranger R/Amisk	31.5	1.092
Shepody East	28.4	1.075
Shepody West	27.2	1.084
WV9120-2	26.5	1.089

The mean percentage of total tuber number in each size category is shown in Table 26. It is important to note that harvesting with small plot equipment and manual labour recovers all potatoes over 19 mm in diameter. This tended to increase the yield of small potatoes relative to a commercial situation where more of these tubers may be left behind in the field.

Table 26: Percentage of total tuber number in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed) for each French fry cultivar grown at approximately 235 lbs./ac. Data shown is the mean of two replicates.

	No. of <48mm	No. of 48 to 88mm	No. of > 88mm	No. of deformed
CV00031-3	26.2%	71.3%	1.2%	1.4%
CV04218-1	30.9	63.8	2.0	3.4
F07001	24.8	69.1	0.0	6.2
F09001	30.8	66.3	1.5	1.4
F09003	20.0	76.7	1.5	1.8
F09005	38.0	61.7	0.0	0.3
R. Burbank East	32.5	64.5	0.0	2.9
West	34.8	55.1	1.3	8.8
Ranger R/Amisk	34.9	64.4	0.2	0.5
Shepody East	22.6	59.0	7.9	10.4
Shepody West	24.8	65.7	4.5	5.1
WV9120-2	42.5	57.1	0.2	0.2

The yield of tubers (estimated ton/ac) of each chipping cultivar is shown by size category in Table 27.

Table 27: Estimated yield (ton/ac) in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed tubers) for each French fry cultivar grown at approximately 235 lbs./ac. Data shown is the mean of two replicates.

	Yield of <48mm (ton/ac)	Yield of 48 to 88mm (ton/ac)	Yield of > 88mm (ton/ac)	Yield of deformed (ton/ac)
CV00031-3	2.1	17.8	0.8	0.5
CV04218-1	2.8	19.2	1.6	1.2
F07001	2.7	25.5	0.0	2.2
F09001	3.6	25.0	1.3	0.5
F09003	2.0	24.0	1.3	0.5
F09005	5.0	19.0	0.0	0.1
East	5.2	28.5	0.0	1.1
West	3.7	19.6	1.1	5.5
Ranger R/Amisk	4.9	26.0	0.3	0.3
Shepody East	2.1	17.0	5.2	4.1
Shepody West	2.0	19.2	3.1	2.9
WV9120-2	5.5	20.7	0.3	0.0

Tuber samples used to measure specific gravity were evaluated for hollow heart, other internal defects and scab. There were very few internal defects observed in the tubers examined. Hollow heart was noted in several tubers of F07001, Russet Burbank, Shepody and WV9120-2. Some tubers from each sample exhibited stem-end discoloration and this may be an indication that plants were not fully mature prior to desiccation.

Common scab lesions were only noted on one tuber in each subsample of F09001 and several tubers in the Shepody W subsample.

Results – Fresh Market Cultivars

Sample hills of each cultivar were dug for a field day August 22, 2013. Photos of the yellow fresh market cultivars are shown in Figure 18.

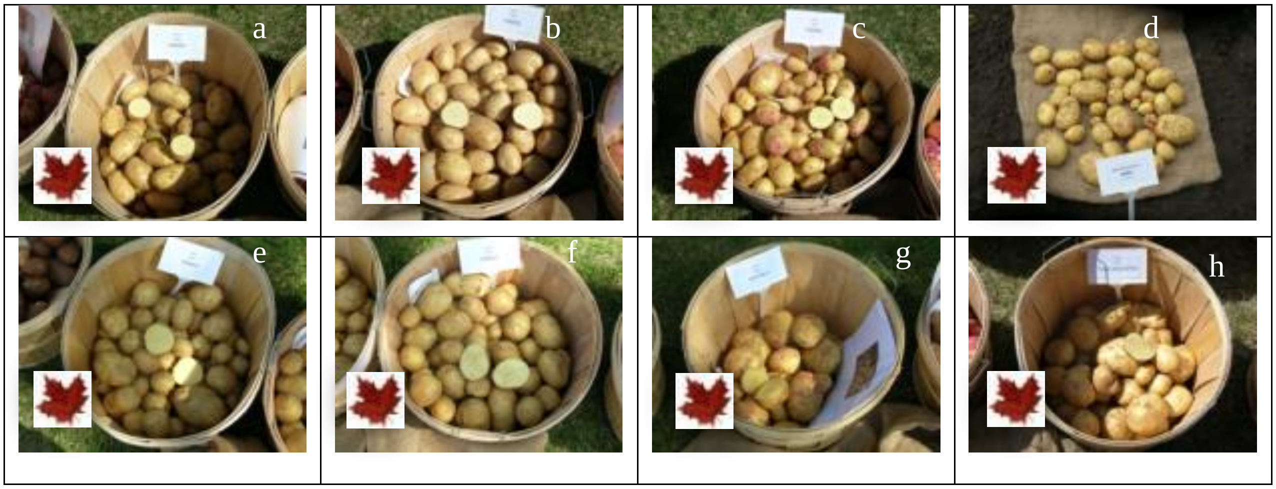

Figure 18. AAFC yellow fresh market cultivars at the CDCS field day August 22, 2013: a) F08003, b) F08050, c) F08086, d) F09053, e) F09054, f) F09065, g) V07148-2, and h) Yukon Gold.

Photos of the red-skinned fresh market cultivars are shown in Figure 19.

Figure 19. AAFC red-skinned fresh market cultivars at the CDCS field day August 22, 2013: a) CV05239-1, b) CV07366-2, c) CV97050-3, d) F08037, e) F08039, f) F08051, g) F08053, h) F08055, i) F09038, j) Norland, and k) Sangre.

Photos of the white fresh market cultivars are shown in Figure 20.

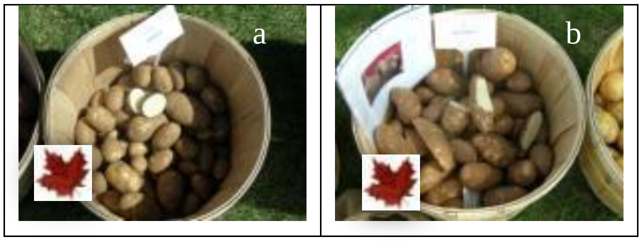

Figure 20. AAFC white fresh market cultivars at the CDCS field day August 22, 2013: a) F09030 and b) WV7868-1.

Yield data (total yield; ton/ac) and specific gravities of each of the fresh market cultivars are shown in Table 28.

Table 28: Estimated total yield (ton/acre) and specific gravity for each fresh market FM) cultivar grown at CDCS in Brooks, AB (approximately 235 lbs./ac nitrogen). Data shown is the mean of two replicates.

	End Use	Yield (ton/ac)	SG
Yellow			
F08003	FM	26.6	1.097
F08050	FM	33.7	1.088
F08086	FM	33.0	1.093
F09053	FM	18.3	1.082
F09054	FM	20.2	1.091
F09065	FM	32.1	1.087
V07148-2	FM	29.0	1.075
Yukon Gold	FM	27.2	1.091
Red-skinned			
CV05239-1	FM	34.7	1.076
CV07366-2	FM	31.1	1.081
CV97050-3	FM	28.1	1.084
F08037	FM	24.4	1.094
F08039	FM	37.4	1.089
F08051	FM	29.3	1.084
F08053	FM	34.7	1.081
F08055	FM	32.4	1.086
F09038	FM	34.5	1.084
Norland	FM	31.7	1.069
Sangre	FM	28.5	1.084
White			
F09030	FM	27.1	1.089
WV7868-1	FM	24.8	1.077

The mean percentage of total tuber number in each size category is shown in Table 29. It is important to note that harvesting with small plot equipment and manual labour recovers all potatoes over 19 mm in diameter. This tended to increase the yield of small potatoes relative to a commercial situation where more of these tubers may be left behind in the field.

Table 29: Percentage of total tuber number in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed) for each fresh market cultivar grown at approximately 235 lbs./ac. Data shown is the mean of two replicates.

	No. of <48mm	No. of 48 to 88mm	No. of > 88mm	No. of deformed
Yellow				
F08003	29.2	70.4	0.0	0.4
F08050	23.5	72.8	2.6	1.1
F08086	50.1	49.8	0.2	0.0
F09053	21.0	56.3	19.9	2.3
F09054	19.7	75.6	4.0	0.8
F09065	21.2	77.7	1.0	0.0
V07148-2	32.1	64.2	3.4	0.2
Yukon Gold	12.0	83.3	4.7	0.0
Red-skinned				
CV05239-1	23.2	71.6	4.3	0.9
CV07366-2	20.8	75.8	2.0	1.4
CV97050-3	23.8	57.9	5.4	12.9
F08037	39.2	60.8	0.0	0.0
F08039	20.1	76.0	3.4	0.5
F08051	32.9	65.6	1.5	0.0
F08053	26.1	67.4	6.3	0.2
F08055	13.7	80.6	5.3	0.4
F09038	20.3	76.8	2.3	0.6
Norland	18.4	74.8	4.2	2.6
Sangre	27.6	69.2	3.2	0.0
White				
F09030	44.2	55.3	0.4	0.2
WV7868-1	36.4	55.3	1.3	7.0

The yield of tubers (estimated ton/ac) of each fresh market cultivar is shown by size category in Table 30.

Table 30: Estimated yield (ton/ac) in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed tubers) for each fresh market cultivar grown at approximately 235 lbs./ac. Data shown is the mean of two replicates.

	Yield of <48mm (ton/ac)	Yield of 48 to 88mm (ton/ac)	Yield of > 88mm (ton/ac)	Yield of deformed (ton/ac)
Yellow				
F08003	4.3	22.1	0.2	0.0
F08050	3.0	27.6	2.7	0.4
F08086	9.0	23.8	0.2	0.0
F09053	0.9	10.1	6.4	0.8
F09054	1.2	16.9	2.0	0.2
F09065	2.4	28.8	1.0	0.0
V07148-2	3.8	21.8	3.2	0.2
Yukon Gold	0.9	22.6	3.7	0.0
Red-skinned				
CV05239-1	3.0	27.7	3.7	0.4
CV07366-2	2.6	26.3	1.7	0.5
CV97050-3	1.7	19.0	3.6	3.7
F08037	5.3	19.2	0.0	0.0
F08039	2.8	30.7	3.6	0.3
F08051	3.8	24.1	1.4	0.0
F08053	2.9	26.1	5.7	0.1
F08055	1.5	26.6	4.2	0.1
F09038	2.5	29.5	2.1	0.3
Norland	1.7	25.4	3.3	1.4
Sangre	2.9	22.6	31	0.0
White				
F09030	6.8	19.8	0.4	0.1
WV7868-1	3.4	17.0	1.4	2.6

Tuber samples used to measure specific gravity were evaluated for hollow heart, other internal defects and scab. There were very few internal defects observed in the tubers examined. Hollow heart or brown center was noted in a few tubers of CV05239-1, F08050, F08053, F08055, F09053, F09065, Norland, and WV7868-1. F08053 exhibited some purple pigmentation and internal necrosis. Some tubers from each sample exhibited stem-end discoloration and this may be an indication that plants were not fully mature prior to desiccation.

Common scab lesions (1%) were noted in at least one subsample of F08053, F09030, F09038, and F09065.

Conclusions

Each year of the trial included a number of cultivars with potential in southern Alberta. In 2011, Atlantic and Snowden were included in the trial as standard varieties to compare to chipping cultivars. Russet Burbank and Shepody were included in the trial as standard varieties to compare French fry cultivars with. Yukon Gold, Chieftain, Norland, Kennebec and Adirondak Blue were included in the trial as standard varieties to compare with fresh market cultivars.

In 2012, Andover, Atlantic and Snowden were included in the trial as standard varieties to compare to chipping cultivars. Russet Burbank, Ranger Russet (Amisk) and Shepody were included in the trial as standard varieties to compare French fry cultivars with. Yukon Gold, Kennebec, Adirondak Blue, Chieftain, Norland, and Sangre were included in the trial as standard varieties to compare with fresh market cultivars.

In 2013, Atlantic and Snowden were included in the trial as standard varieties to compare to chipping cultivars. Russet Burbank and Shepody were included in the trial as standard varieties to compare French fry cultivars with. Yukon Gold, Norland, and Sangre were included in the trial as standard varieties to compare with fresh market cultivars.

The trial was designed to provide regional data for a wide range of potato cultivars. All cultivars were planted at the same in-row spacing, the N rate was approximately 225 lbs./ac to 235 lbs/ac, and harvest was scheduled for full-season varieties. Addressing the agronomic needs, such as plant density, fertility requirements, and harvest timing for each variety may well result in improvements to yield and size profiles when compared to the results in this trial.

French Fry Variety Evaluation

2011

Materials and Methods

The variety evaluation was conducted in small plots at the Crop Diversification Centre South in Brooks, AB. Fertility for the full nitrogen rate was achieved through a combination of soil fertility (105 lbs./ac N; 214 lbs./ac P, 720 lbs./ac K), and broadcast fertilizer (350 lbs./ac of 34-17-0) incorporated at hilling. Fertility for the low nitrogen rate was achieved through a combination of soil fertility and broadcast fertilizer (100 lbs./ac of 11-52-0) incorporated at hilling. Varieties were planted in four replicate rows in a randomized split block design (with fertility as the main block) along with a standard variety (Russet Burbank). Each block was planted adjacent to guard rows to reduce any edge effects.

Eptam 8E (2.2 L/ac) and Sencor 75DF (150 g/ac) were applied pre-plant (May 13) to control weeds. Seed of standard cultivars was provided by BPS Ltd. and seed of test cultivars was provided by each participant. Most varieties were planted May 30, 2011 approximately 5 to 5½"deep using a two-row tuber unit planter. Mini-tubers were received late and were hand planted June 6. Seed was planted at 30cm spacing in 6m rows spaced 90cm apart. Seed was planted as single drop with the exception of some of the larger varieties. Cut seed (70 to 85 g) was suberized prior to planting.

The potatoes were hilled June 8 with a power hiller. The plots were irrigated to maintain soil moisture close to 70%. Foliar fungicides were applied several times during the growing season to prevent early and late blight from developing (Table 31). Insecticide was applied July 17 (Decis 5 EC, 50 mL/ac) to control Colorado potato beetle.

Table 31: Foliar fungicides applied to the potato crop to prevent early and late blight development.

Date of Application	*Fungicide*	*Rate*
July 18	Bravo 500	0.64 L/ac
Aug 2	Bravo 500	0.64 L/ac
Aug 23	Dithane DG Rainshield	0.91 kg/ac

Figure 21: Variety evaluation trial at CDCS in Brooks, AB July 22, 2011.

Reglone (1.4 L/ac) was applied September 6 and re-applied (1.0 L/ac) September 12 to facilitate mechanical harvest. Tubers were harvested September 21 – 26 with a one-row Grimme harvester for yield and grade data.

Tubers were stored at 10˚C until graded. Tubers were graded into weight categories (less than 4 oz., 4 – 6 oz., 6 – 10 oz., over 10 oz. and deformed). A sample of twenty-five tubers (over 6 oz.) from each replicate was used to determine specific gravity using the weight in air over weight in water method. The length and diameter of each tuber in the specific gravity sample was recorded and the tubers were cut longitudinally to assess internal defects. A composite sample of 8 tubers (2 per rep) was stored at 8˚C until culinary analyses could be performed. Samples were evaluated for French fry scores Dec. 1.

The data presented here have been statistically analyzed using ANOVA and Tukey's Multiple Comparison Test; (SPSS; $p \leq 0.05$). Statistical summaries are available upon request.

Results and Discussion

Sample hills of each variety were dug for a field day August 24, 2011. Photos of these varieties are shown in Figure 22.

Figure 22. French fry varieties at the CDCS field day August 24, 2011: a) Alpine Russet, b) Blazer Russet, c) Coaldale 1, d) Coaldale 2, e) Coaldale 3, f) Coaldale 4, g) Coaldale 5, h) Owyhee Russet, i) Russet Burbank.

Yield data (total yield and marketable yield; ton/ac), mean marketable tuber weight (oz.) and specific gravities of each of the varieties are shown in Table 32.

The highest total yield was observed with Coaldale 3 on regular N, and total yield of Coaldale 5, LW 002, LW 003 and Russet Burbank were not statistically less than Coaldale 3. Only one variety, Blazer Russet was evaluated on low N. Total yield of Blazer Russet was significantly less on low N than on regular N in this trial. Likely the difference in N level was too great and more work may be required to identify an optimal rate of N for this variety. The highest mean marketable tuber weight was observed with Coaldale 1 although it was not statistically different from Coaldale 4 or Russet Burbank. The smallest mean tuber size was observed with Owyhee Russet and Alpine Russet as expected. Both of these varieties were grown from mini-tubers that were planted later than the main crop. These varieties will need to be assessed again using regular seed potatoes planted at the same time as the comparison varieties.

Table 32: Estimated total yield and marketable yield (ton/acre), mean weight of marketable tubers, tuber length to width (L/W) ratio and specific gravity for each variety grown at full nitrogen (approximately 225 lbs./ac) and low nitrogen (approximately 115 lbs./ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

2011 French Fry	Yield (ton/ac)	Yield over 4 oz. (ton/ac)	Mean Tuber weight (oz.)	Tuber L/W ratio	SG
Regular Fertility					
Alpine Russet	19.0 c	12.5 c	6.0 c	-	1.080 b
Blazer Russet	23.4 b	20.3 ab	8.6 b	1.69 bc	1.077 b
Coaldale 1	20.0 c	17.6 b	10.8 a	1.72 bc	1.080 b
Coaldale 2	19.1 c	16.0 b	7.8 bc	1.91 a	1.085 ab
Coaldale 3	30.6 a	25.0 a	8.6 b	1.70 bc	1.076 b
Coaldale 4	20.5 c	18.6 a	10.0 ab	1.63 c	1.090 ab
Coaldale 5	27.4 ab	19.7 ab	6.4 bc	1.63 c	1.076 b
LW 001*	18.6 c	13.9 bc	6.9 bc	1.38 de	1.095 a
LW 002*	23.7 ab	19.3 ab	7.4 bc	1.63 cd	1.082 b
LW 003*	30.2 ab	21.3 ab	7.8 bc	1.37 e	1.086 ab
Owyhee Russet	18.6 c	9.2 c	5.5 c	-	1.082 b
Russet Burbank*	25.4 abc	22.4 ab	8.7 ab	1.90 ab	1.087 ab
Low Fertility					
Blazer Russet	18.6†	15.5†	8.1		1.075

* Seed of the check variety was cut and treated before delivery. Planting delays resulted in poor emergence and low stand count of the check variety. Data from two replicates at an alternate site was used for comparison purposes. No comparison check data was available for the low N plots.

†Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.

The mean length to width ratio of tubers in the SG sample is shown in Table 32. Coaldale 2 had the highest ratio and was not statistically different from Russet Burbank. A ratio near 1.0 indicates a round potato and a ratio of 2.0 indicates that the tubers are twice as long as they are wide. Blazer Russet, Coaldale 1 and Coaldale 3 were not statistically different from Russet Burbank. LW 001 and LW 003 were more oval than long in shape.

LW 001 had the highest specific gravity on regular N, but this was not statistically different from Coaldale 4, Russet Burbank, LW 003 and Coaldale 2. The lowest specific gravity was observed with Coaldale 5 and Coaldale 3, and these were not statistically lower than Blazer Russet, Alpine Russet, Coaldale 1, Coaldale 2, Coaldale 3, Coaldale 4, Coaldale 5, LW 002, LW 003, Russet Burbank, and Owyhee Russet at regular N. The specific gravity of Blazer Russet on low N plots was not statistically different from that on regular N.

The trial was designed to provide regional data for a wide range of potato cultivars. The N rate in the low N plots was over 100 lbs./ac lower than the regular rate. A rate of N that is intermediate may give better results than either full or low N. Addressing the agronomic needs of each variety may well result in improvements to yield and size profiles when compared to the results in this trial.

The mean percentage of total tuber number in each weight category is shown in Table 33. It is important to note that harvesting with small plot equipment and manual labour recovers all potatoes over 19mm in diameter. This tended to increase the yield of small potatoes relative to a commercial situation where more of these tubers may be left behind in the field.

Table 33: Percentage of total tuber number in each weight category (< 4oz., 4 to 6 oz., 6 to 10 oz. > 10 oz., and deformed) for each variety grown at full nitrogen (approximately 225 lbs./ac) and low nitrogen (approximately 115 lbs./ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

2011	< 4oz.	4 to 6 oz.	6 to 10 oz.	> 10 oz.	Deformed
Regular N					
Alpine Russet	54.0 ab	28.6 a	14.8 bc	1.92 c	0.65
Blazer Russet	28.4 c	19.9 ab	29.5 ab	21.1 ab	0.92
Coaldale 1	28.4 c	15.0 b	22.7 ab	32.3 ab	1.57
Coaldale 2	30.2 c	24.1 ab	32.3 a	13.0 bc	0.37
Coaldale 3	27.0 c	20.4 ab	30.6 ab	19.1 b	2.93
Coaldale 4	22.1 c	15.7 b	27.0 ab	33.4 a	1.77
Coaldale 5	47.9 b	26.1 ab	21.5 b	3.9 c	0.55
LW 001*	41.3 bc	25.8 ab	24.4 abc	6.6 bc	1.99
LW 002*	34.1 bc	24.5 ab	31.2 ab	9.1 bc	1.11
LW 003*	50.7 ab	18.1 ab	18.4 bc	10.9 bc	1.90
Owyhee Russet	66.7 a	23.6 ab	8.7 c	1.5 c	0.20
Russet Burbank*	23.7 c	22.8 ab	28.7 ab	23.1 ab	1.74
Low N					
Blazer Russet	25.5	22.3	32.8	17.3	2.00

†Data between the regular and low N plots was statistically different at the p ≤ 0.05 level.

As a result of a late planting date and planting mini-tubers, Owyhee Russet and Alpine Russet produced the greatest percentage of potatoes in the small (< 4 oz.) category, although not statistically different from LW 003. Coaldale 2 produced the greatest percentage of tubers in the 6 to 10 oz. category and LW 002, Coaldale 3, Blazer Russet, Russet Burbank, Coaldale 4, LW 001, and Coaldale 1 were not statistically different. Coaldale 4 yielded the greatest percentage of tubers over 10 oz. and Coaldale 1, Russet Burbank and Blazer Russet were not statistically different. There were no statistically significant differences in the deformed size category.

The yield of tubers (estimated ton/ac) of each variety is shown by size category in Table 34. Coaldale 3 gave the greatest yield of 6 to 10 oz. potatoes but was not statistically different from LW 002, Coaldale 5, LW 003, Russet Burbank, and Blazer Russet. Coaldale 1 and Coaldale 4 resulted in the greatest yield of large (> 10 oz.) potatoes, although this was not statistically greater than most other varieties because of variability within the data set. There were no statistically significant differences in the deformed size categories from regular N plots.

Table 34: Estimated yield (ton/ac) in each weight category (< 4oz., 4 to 6 oz., 6 to 10 oz. > 10 oz., and deformed) for each variety grown at full nitrogen (approximately 225 lbs./ac) and low nitrogen (approximately 115 lbs./ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

2011	< 4oz.	4 to 6 oz.	6 to 10 oz.	> 10 oz.	Deformed
Regular N					
Alpine Russet	6.0 a	6.5 b	4.9 bc	1.1 ab	0.3
Blazer Russet	2.3 ab	3.4 c	7.6 ab	9.3 ab	0.4
Coaldale 1	1.6 b	1.8 c	4.2 bc	11.5 a	0.4
Coaldale 2	2.8 ab	3.6 bc	7.2 b	5.2 ab	0.1
Coaldale 3	3.0 ab	4.2 bc	10.1 a	10.7 ab	2.0
Coaldale 4	1.2 b	1.9 c	5.3 bc	11.5 a	0.5
Coaldale 5	6.9 ab	7.7 a	9.3 ab	2.7 ab	0.4
LW 001*	3.5 ab	4.4 bc	6.5 b	3.0 ab	0.7
LW 002*	3.4 ab	4.9 bc	9.5 ab	4.9 ab	0.5
LW 003*	6.8 a	5.1 bc	8.1 ab	8.2 ab	1.3
Owyhee Russet	9.2 a	5.5 bc	3.1 c	0.5 b	0.1
Russet Burbank*	1.7 ab	4.0 bc	7.7 ab	10.6 ab	0.8
Low N					
Blazer Russet	1.8†	2.6	6.6	6.3	0.6

†Data between the regular and low N plots was statistically different at the p ≤ 0.05 level.

Fry scores are presented in Table 35. The Coaldale varieties and the LW varieties were evaluated by the sponsor and data is not available for this report. All of the varieties evaluated had lighter fry colour than Russet Burbank. All of the varieties except Alpine Russet had a mealy texture, suitable for French fries. The Alpine Russet sample may not have been fully mature given the late planting date. Colour uniformity was more variable for Russet Burbank than for the other varieties evaluated. Blazer Russet grown on low N had a darker fry score than when grown on regular N.

Table 35: Fry scores: Fry Colour was assessed visually by comparison with a USDA fry colour chart (000 to 4; the lower the score, the better the fry colour). Data shown is the result of one composite sample run in duplicate.

2011

Regular N	Fry Colour	Internal Texture[1]	Colour Uniformity[2]
Alpine Russet	USDA 0	3	3
Blazer Russet	USDA 0	4	3
Owyhee Russet	USDA 0	4	3
Russet Burbank*	USDA 2	4	2
Low N			
Blazer Russet	USDA 1	4	2

[1] Internal texture: 1 (wet) - 4 (mealy)

[2] Color uniformity: 1 (very variable) - 5 (very uniform)

Tuber samples used to measure specific gravity were evaluated for hollow heart, brown centre, stem-end discoloration, other types of internal necrosis and scab. There were no internal defects noted for Alpine Russet, Coaldale 2, Coaldale 3, Coaldale 4, Coaldale 5, LW 001, LW 002 or Owyhee Russet. One rep of Blazer Russet had several tubers with hollow heart. Hollow heart was noted in a few tubers of Coaldale 1. LW 003 showed stem end discoloration in two tubers, possibly related to tuber maturity. Russet Burbank samples had a few tubers in each rep with hollow heart, brown centre or stem end discoloration.

2012

Materials and Methods

The variety evaluation was conducted in small plots at the Crop Diversification Centre South in Brooks, AB. Fertility for the full nitrogen rate (248 lbs/ac) was achieved through a combination of soil fertility (82 lbs./ac N; 192 lbs./ac P, 760 lbs./ac K), broadcast fertilizer (176 lbs./ac of 34-0-0 and 100 lbs./ac of 11-52-0) incorporated prior to planting and broadcast fertilizer (280 lbs./ac 34-0-0) incorporated at hilling. Fertility for the reduced nitrogen rate (150 lbs./ac) was achieved through a combination of soil fertility and broadcast fertilizer (176 lbs./ac of 34-0-0 and 100 lbs./ac of 11-52-0) incorporated prior to planting. Varieties were planted in four replicate rows in a randomized split block design (with fertility as the main block) along with standard varieties (Russet Burbank, Ranger Russet, and Shepody). Each block was planted adjacent to guard rows to reduce any edge effects.

Eptam 8E (2.2 L/ac) and Sencor 75DF (150 g/ac) were applied pre-plant (May 10) to control weeds. Seed of standard cultivars was provided by Edmonton Potato Growers and seed of test cultivars was provided by each participant. Most varieties were planted May 23, 2012 approximately 5 to 5½"deep using a two-row tuber unit planter. Seed was planted at 30cm spacing in 6m rows spaced 90cm apart. Seed was cut (70 to 85 g) and suberized prior to planting.

The potatoes were hilled June 4 with a power hiller. The plots were irrigated to maintain soil moisture close to 70%. Foliar fungicides were applied several times during the growing season to prevent early and late blight from developing (Table 36). Insecticide was applied July 17 (Matador 120 EC, 40 mL/ac) and August 15 (Decis 5 EC, 50 mL/ac) to control Colorado potato beetle.

Table 36: Foliar fungicides applied to the potato crop to prevent early and late blight development.

Date of Application	*Fungicide*	*Rate*
June 29	Bravo 500	0.64 L/ac
July 27	Ridomil Gold Bravo	883 mL/ac
Aug 15	Bravo 500	0.64 L/ac

Figure 23: Variety evaluation trial at CDCS in Brooks, AB July 20, 2012.

Reglone (1.4 L/ac) was applied September 13 to facilitate mechanical harvest. Tubers were harvested September 18-25 with a one-row Grimme harvester for yield and grade data.

Tubers were stored at 8˚C until graded. Tubers were graded into weight categories (less than 4 oz., 4 – 6 oz., 6 – 10 oz., over 10 oz. and deformed). A sample of twenty-five tubers (over 6 oz.) from each replicate was used to determine specific gravity using the weight in air over weight in water method. The length and diameter of each tuber in the specific gravity sample was recorded and the tubers were cut longitudinally to assess internal defects. Sub-samples were provided to customers for storage evaluation as requested.

The data presented here have been statistically analyzed using ANOVA and Tukey’s Multiple Comparison Test; (SPSS; $p \leq 0.05$). Statistical summaries are available upon request.

Results and Discussion

Sample hills of each variety were dug for a field day August 22, 2012. Photos of some of the varieties are shown in Figure 24.

Figure 24. French fry varieties at the CDCS field day August 22, 012: a) Russet Burbank, b) Ranger Russet, c) Owyhee Russet (not shown) d) Coaldale 1, e) Coaldale 3 and f) Coaldale 6.

Yield data (total yield and marketable yield; ton/ac), mean marketable tuber weight (oz.) and specific gravities of each of the varieties are shown in Table 37. The highest total yield was observed with Owyhee Russet on regular N, and total yield of other varieties was not statistically different. Clearwater Russet was an exception, but yield was impacted by herbicide carryover in the seed and the yield in this trail is likely not a reflection of the potential for this variety in southern Alberta. Owyhee Russet also produced the greatest total yield on reduced N plots, and total yield of the other varieties in the trial was not statistically different. Owyhee Russet produced the greatest marketable yield at both levels of N. Marketable yield of Owyhee Russet was significantly different than marketable yield of Coaldale 6 and Coaldale 7, but not other varieties. Marketable yield of Owyhee Russet was not statistically different from that of the check varieties at the reduced rate of N. The highest mean marketable tuber weight was observed with Blazer Russet and Owyhee Russet although not statistically different from other varieties. For varieties grown at a reduced rate of N, Blazer Russet produced the largest mean marketable tuber size, but was not statistically different from the check varieties.

Table 37: Estimated total yield and marketable yield (ton/acre), mean weight of marketable tubers, tuber length to width (L/W) ratio and specific gravity for each variety grown at full nitrogen (approximately 248 lbs./ac) and reduced nitrogen (approximately 150 lbs./ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

2012 French Fry	Yield (ton/ac)	Yield over 4 oz. (ton/ac)	Mean Tuber weight (oz.)	SG
Regular N Fertility				
Russet Burbank	32.4 a	22.5 ab	7.7 ab	1.086 ab
Ranger Russet	27.5 ab	21.0 ab†	7.8 ab	1.095 b
Alpine Russet	27.2 ab†	22.7 ab†	8.2 ab	1.089 ab†
Blazer Russet	30.3 ab	27.9 a	10.4 a	1.080 b
Owyhee Russet	39.4 ab	28.1 a†	10.1 a†	1.093 a†
Clearwater Russet*	11.2 c	7.3 c	6.2 b	1.092 ab
Coaldale 1	23.9 ab	21.5 ab	8.5 ab	1.090 ab
Coaldale 3	22.3 abc	20.7 ab	8.7 ab	1.094 a
Coaldale 6	21.2 abc	15.2 bc	8.2 ab	1.085 ab
Coaldale 7	19.2 abc	13.7 bc	8.2 ab	1.085 ab
Coaldale 8	23.7 ab	20.8 ab	9.6 a	1.086 ab
LW008	29.0 ab	21.2 ab	7.2 ab	1.085 ab
Reduced N				
Russet Burbank	22.3 ab	13.7 ab	6.3 a	1.088 ab
Ranger Russet	20.8 ab	13.9 ab†	7.0 a	1.096 ab
Alpine Russet	21.0 ab†	15.3 ab†	6.5 a	1.103 a†
Blazer Russet	23.1 a	19.0 a	8.4 a	1.085 b
Owyhee Russet	27.2 a	21.3 a†	7.6 a†	1.099 ab†
Clearwater Russet*	11.22 b	5.4 b	6.4 a	1.099 ab
LW008	24.5 a	15.1 ab	7.3 a	1.086 b

*Seed lot was affected by herbicide carryover.

†Data between the regular and low N plots was statistically different at the p ≤ 0.05 level.

All of the varieties evaluated at the regular rate of N fell in a desirable range for specific gravity, between 1.085 and 1.095 except for Blazer Russet which measured 1.080. On reduced N, the specific gravity of all varieties tended to be higher than on regular N. The highest specific gravity was measured for Alpine Russet samples at 1.103. Blazer Russet and LW008 fell in the desirable range, but the specific gravity of all other varieties was higher than desirable at this level of N.

For the varieties evaluated in this trial, the reduced rate of N resulted in significantly lower total and marketable yield for Alpine Russet and significantly lower marketable yield for Ranger Russet and Owyhee Russet compared to the full rate of N. The reduced rate of N also resulted in significantly smaller mean tuber size for Owyhee Russet. Specific gravity was significantly higher in Alpine Russet and Owyhee Russet grown on reduced N compared to full N.

The trial was designed to provide regional data for a wide range of potato cultivars. The N rate in the reduced N plots was approximately 100 lbs./ac lower than the regular rate. A rate of N that is intermediate may give better results than either full or reduced N, but this data may provide insight as to the response of each variety to different levels of N. Addressing the agronomic needs of each variety may well result in improvements to yield and size profiles when compared to the results in this trial.

The mean percentage of total tuber number in each weight category is shown in Table 38. It is important to note that harvesting with small plot equipment and manual labour recovers all potatoes over 19mm in diameter. This tended to increase the yield of small potatoes relative to a commercial situation where more of these tubers may be left behind in the field.

Coaldale 1 produced the greatest percentage of tubers over 4 oz. when grown on regular N, but not statistically different from Coaldale 8, Coaldale 3, LW008, Russet Burbank, Ranger Russet, Blazer Russet or Owyhee Russet. The greatest deformities were observed for Coaldale 6, Coaldale 7, Blazer Russet, Russet Burbank and Ranger Russet, while Coaldale 3 exhibited the lowest percentage of deformities.

Although no significant differences were noted in the yield of marketable tubers of each variety between the full and reduced rate of N, there were shifts within size categories. The percentage of small tubers increased significantly when Owyhee Russet was grown on reduced N compared to the full rate of N. There was a decrease in the percentage of 4 to 6 oz. tubers for LW008 and in 6 to 10 oz. tubers for Ranger Russet and Alpine Russet when these varieties were grown at a reduced rate of N. Reducing the N rate resulted in a significantly lower percentage of tubers over 10 oz. for Russet Burbank, Blazer Russet and Owyhee Russet.

Table 38: Percentage of total tuber number in each weight category (< 4oz., 4 to 6 oz., 6 to 10 oz. > 10 oz., and deformed) for each variety grown at full nitrogen (approximately 248 lbs./ac) and reduced nitrogen (approximately 150 lbs./ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

2012	< 4oz.	4 to 6 oz.	6 to 10 oz.	> 10 oz.	Deformed	> 4 oz.
Regular N						
Russet Burbank	17.7 bc	21.2 ab	31.0 a	21.8 ab†	8.3 ab	73.9 a-d
Ranger Russet	18.0 bc	18.7 ab	34.5 a†	23.9 ab	5.0 ab	77.0 a-d
Alpine Russet	15.3 bc	18.7 ab	30.2 a†	33.2 ab	2.6 b	82.1 abc
Blazer Russet	8.1 c	19.4 ab	26.8 a	39.3 a†	6.5 ab	85.4 ab
Owyhee Russet	8.2 c†	16.0 ab	30.4 a	40.5 a†	4.9 b	86.9 a
Clearwater Russet*	37.4 a	28.6 a	21.8 a	12.1 b	0.0 b	62.6 d
Coaldale 1	10.1 c	15.1 ab	35.4 a	37.9 a	1.5 b	88.5 a
Coaldale 3	16.8 bc	19.3 ab	35.3 a	27.9 ab	0.7 b	82.5 abc
Coaldale 6	12.7 bc	11.8 b	25.5 a	29.7 ab	20.4 a	67.0 cd
Coaldale 7	19.4 bc	17.5 ab	26.9 a	25.5 ab	10.7 ab	69.9 bcd
Coaldale 8	9.2 c	13.9 ab	34.5 a	39.8 a	2.6 b	88.2 a
LW008	23.6 b	21.2 ab†	31.7 a	20.0 ab	3.5 b	72.9 a-d
Reduced N						
Russet Burbank	34.6 ab	24.7 a	22.5 a	9.2 b†	9.0 ab	56.4 ab
Ranger Russet	28.3 ab	22.8 a	28.7 a†	14.7 ab	5.4 abc	66.2 ab
Alpine Russet	24.0 b	24.2 a	25.1 a†	22.6 ab	4.1 abc	71.9 ab
Blazer Russet	14.8 b	17.8 a	27.6 a	29.0 a†	10.7 a	74.5 ab
Owyhee Russet	18.2 b†	21.0 a	33.0 a	24.7 ab†	3.1 bc	78.7 a
Clearwater Russet*	52.2 a	24.2 a	16.4 a	6.7 b	0.6 c	47.2 b
LW008	32.8 ab	19.6 a†	22.8 a	18.6 ab	6.1 abc	61.0 ab

†Data between the regular and low N plots was statistically different at the p ≤ 0.05 level.

The yield of tubers (estimated ton/ac) of each variety is shown by size category in Table 39. Owyhee Russet gave the greatest yield of 6 to 10 oz. potatoes at both levels of N, but was not statistically different from the other varieties. On full N, Owyhee Russet also gave the greatest yield over 10 oz. which was only significantly different from Coaldale 7 and Clearwater Russet. On reduced N, Blazer Russet produced the greatest yield of tubers over 10 oz.

Yields of tubers over 10 oz. for Russet Burbank and Blazer Russet were significantly affected by the level of N, while yield in other categories was not significantly affected. Yield of 6 to 10 oz. tubers of Ranger Russet and Alpine Russet were significantly affected by the rate of N. A significantly lower yield of 4 to 6 oz. tubers was produced by LW008 grown at the reduced rate of N and a significantly greater yield of tubers less than 4 oz. was produced when Owhyee Russet was grown at the reduced rate of N.

Table 39: Estimated yield (ton/ac) in each weight category (< 4oz., 4 to 6 oz., 6 to 10 oz. > 10 oz., and deformed) for each variety grown at full nitrogen (approximately 248 lbs./ac) and reduced nitrogen (approximately 150 lbs./ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

2012	< 4oz.	4 to 6 oz.	6 to 10 oz.	> 10 oz.	Deformed
Regular N					
Russet Burbank	5.3 ab	6.4	9.5 a	6.7 abcd†	2.5 ab
Ranger Russet	4.8 abc	5.1	9.3 a†	6.7 abcd	1.4 ab
Alpine Russet	4.1 abc	5.0	8.3 ab†	9.3 abc	0.8 b
Blazer Russet	2.5 c	6.8	8.4 ab	12.6 ab†	2.0 ab
Owyhee Russet	2.6 bc†	5.0	9.9 a	13.2 a	1.8 ab
Clearwater Russet*	4.0 abc	3.2	2.6 b	1.5 d	0.0 b
Coaldale 1	2.4 c	3.7	8.6 ab	9.2 abc	0.4 b
Coaldale 3	4.2 abc	4.9	8.9 a	6.9 abcd	0.2 b
Coaldale 6	2.8 bc	2.6	5.9 ab	6.6 abcd	4.4 a
Coaldale 7	3.6 bc	3.5	5.9 ab	5.0 cd	1.9 ab
Coaldale 8	2.2 c	3.5	8.3 ab	9.0 abc	0.6 b
LW008	6.6 a	6.0†	9.2 a	6.0 abcd	1.0 b
Reduced N					
Russet Burbank	6.0 ab	5.5	6.0 ab	2.3 ab†	1.5 ab
Ranger Russet	5.6 ab	4.5	6.0 ab†	3.3 ab	1.1 ab
Alpine Russet	4.8 b	5.1	5.3 ab†	4.9 ab	0.8 b
Blazer Russet	3.5 b	4.3	7.2 ab	7.5 a	2.8 a
Owyhee Russet	4.7 b†	5.5	9.1 a	6.7 a†	0.9 b
Clearwater Russet*	5.7 ab	2.7	1.9 a	0.8 b	0.1 b
LW008	7.7 a	4.6†	5.7 ab	4.7 ab	1.5 ab

†Data between the regular and low N plots was statistically different at the p ≤ 0.05 level.

Fry scores are presented in Table 40. The Coaldale varieties and the LW varieties were evaluated by the sponsor and data is not available for this report. Fries made from LW008 grown at both levels of N were lighter than those made from Russet Burbank. At the full N rate, Ranger Russet, Blazer Russet and Owyhee Russet were slightly darker than Russet Burbank fries. On reduced N, Owyhee Russet fried as well as Russet Burbank and all other varieties fried lighter. All varieties tested had a mealy texture suitable for French fries. The most uniform fry colour was observed for Alpine Russet and LW008 when grown on reduced N.

Table 40: Fry scores: Fry Colour was assessed visually by comparison with a USDA fry colour chart (000 to 4; the lower the score, the better the fry colour). Data shown is the result of one composite sample run in duplicate.

2012			
Regular N	Fry Colour	Internal Texture[1]	Colour Uniformity[2]
Russet Burbank	USDA 0	4	2
Ranger Russet	USDA 1	4	2
Alpine Russet	USDA 0	4	3
Blazer Russet	USDA 1	4	2
Owyhee Russet	USDA 2	4	2
Clearwater Russet	USDA 0	4	3
LW008	USDA 00	4	3
Reduced N			
Russet Burbank	USDA 1	4	2
Ranger Russet	USDA 0	4	3
Alpine Russet	USDA 00	4	5
Blazer Russet	USDA 0	4	3
Owyhee Russet	USDA 1	4	3
Clearwater Russet	USDA 0	4	3
LW008	USDA 00	4	5

[1] Internal texture: 1 (wet) - 4 (mealy)
[2] Color uniformity: 1 (very variable) - 5 (very uniform)

Tuber samples used to measure specific gravity were evaluated for hollow heart, brown centre, stem-end discoloration, other types of internal necrosis and scab. There were very few internal defects noted for the French fry varieties evaluated. Stem end discoloration was noted in several samples, possibly related to tuber maturity.

2013

Materials and Methods

The variety evaluation was conducted in small plots at the Crop Diversification Centre South in Brooks, AB. Fertility for the full nitrogen rate (235 lbs/ac) was achieved through a combination of soil fertility (124 lbs./ac N; 361 lbs./ac P, 1930 lbs./ac K), broadcast fertilizer (165 lbs./ac of 34-0-0 and 100 lbs./ac of 11-52-0) incorporated prior to planting and broadcast fertilizer (132 lbs./ac 34-0-0) incorporated at hilling. Fertility for the reduced nitrogen rate (190 lbs./ac) was achieved through a combination of soil fertility and broadcast fertilizer (165 lbs./ac of 34-0-0 and 100 lbs./ac of 11-52-0) incorporated prior to planting. Varieties were planted in four replicate rows in a randomized split block design (with fertility as the main block) along with standard varieties (Russet Burbank and Shepody). Each block was planted adjacent to guard rows to reduce any edge effects.

Eptam 8E (2.2 L/ac) and Sencor 75DF (150 g/ac) were applied pre-plant (May 6) to control weeds. Seed of standard cultivars was provided by Edmonton Potato Growers and seed of test cultivars was provided by each participant. Seed was cut (70 to 85 g) and suberized prior to planting. Potatoes were planted May 23, 2013 approximately 5 to 5½"deep using a two-row tuber unit planter. Seed was planted at 30cm spacing in 6m rows spaced 90cm apart.

The potatoes were hilled June 17 with a power hiller. The plots were irrigated to maintain soil moisture close to 70%. Foliar fungicides were applied several times during the growing season to prevent early and late blight from developing (Table 41). Insecticide was applied July 10 (Matador 120 EC, 40 mL/ac) to control Colorado potato beetle.

Table 41: Foliar fungicides applied to the potato crop to prevent early and late blight development.

Date of Application	***Fungicide***	***Rate***
July 10	Quadris	202 mL/ac
July 20	Bravo 500	0.64 L/ac
Aug 15	Ridomil Gold Bravo	883 mL/ac

Figure 25: Variety evaluation trial at CDCS in Brooks, AB July 30, 2013.

Reglone (1.4 L/ac) was applied September 11 to facilitate mechanical harvest. Tubers were harvested September 23-24 with a one-row Grimme harvester for yield and grade data.

Tubers were stored at 8˚C until graded. Tubers were graded into weight categories (less than 4 oz., 4 – 6 oz., 6 – 10 oz., over 10 oz. and deformed). A sample of twenty-five tubers (over 6 oz.) from each replicate was used to determine specific gravity using the weight in air over weight in water method. The length and diameter of each tuber in the specific gravity sample was recorded and the tubers were cut longitudinally to assess internal defects. Sub-samples were provided to customers for storage evaluation as requested.

The data presented here have been statistically analyzed using ANOVA and Tukey's Multiple Comparison Test; (SPSS; $p \leq 0.05$). Statistical summaries are available upon request.

Results and Discussion

Sample hills of each variety were dug for a field day August 22, 2013. Photos of these varieties are shown in Figure 25.

Figure 25. French fry varieties at the CDCS field day August 22, 2013: a) Russet Burbank, b) LW 004, and c) Shepody.

Yield data (total yield and marketable yield; ton/ac), mean marketable tuber weight (oz.) and specific gravities of each of the varieties are shown in Table 42. The highest total yield was observed for Russet Burbank on regular N, although total yield of LW 004 and Shepody were not statistically less than Russet Burbank at either level of N. The greatest marketable yield and mean tuber weight was observed for Shepody on reduced N, but Shepody is not normally harvested in late September.

No significant differences in total yield or yield of individual size categories were noted for the varieties when the results of Regular N and Reduced N plots were compared. However, Shepody on reduced N plots had significantly greater mean tuber weight than when grown on regular N and Russet Burbank grown on regular N had significantly greater marketable yield than Russet Burbank grown on reduced N.

Table 42: Estimated total yield and marketable yield (ton/acre), mean weight of marketable tubers, tuber length to width (L/W) ratio and specific gravity for each variety grown at full nitrogen (approximately 240 lbs./ac) and reduced nitrogen (approximately 190 lbs./ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

2013 French Fry	Yield (ton/ac)	Yield over 4 oz. (ton/ac)	Mean Tuber weight (oz.)	SG
Regular N Fertility				
Russet Burbank	33.62 a	29.65 a†	9.02 a	1.081 a
LW 004	29.32 a	28.31 a	9.18 a	1.085 a
Shepody	29.41 a	28.25 a	9.27 a†	1.082 a
Reduced N				
Russet Burbank	31.73 a	26.71 b†	9.06 b	1.082 a
LW 004	27.36 a	26.55 b	9.17 b	1.082 a
Shepody	31.67 a	31.14 a	11.10 a†	1.082 a

†Data between the regular and reduced N plots was statistically different at the p ≤ 0.05 level.

There were no significant differences in specific gravity for any of the varieties at either level of N.

The mean percentage of total tuber yield in each weight category is shown in Table 43. It is important to note that harvesting with small plot equipment and manual labour recovers all potatoes over 19mm in diameter. This tended to increase the yield of small potatoes relative to a commercial situation where more of these tubers may be left behind in the field.

Table 43: Percentage of total tuber yield in each weight category (< 4oz., 4 to 6 oz., 6 to 10 oz. > 10 oz., and deformed) for each variety grown at full nitrogen (approximately 240 lbs./ac) and reduced nitrogen (approximately 190 lbs./ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

2013	< 4oz.	4 to 6 oz.	6 to 10 oz.	> 10 oz.	Deformed
Regular N					
Russet Burbank	9.0 a	13.75 a	27.25 a	42.0 ab	8.0 a
LW 004	8.75 a	16.25 a	37.75 a	36.0 b	1.3 b
Shepody	5.75 a	11.25 a†	31.25 a	49.75 a†	2.0 b
Reduced N					
Russet Burbank	11.25 a	14.25 a	25.5 a	34.5 c	14.5 a
LW 004	5.25 b	12.0 ab	33.75 a	46.8 b	1.5 b
Shepody	6.0 ab	7.0 b†	25.0 a	60.0 a†	1.3 b

†Data between the regular and reduced N plots was statistically different at the p ≤ 0.05 level.

There were no significant differences in the percentage of tubers in the under 4 oz., the 4 to 6 oz. or the 6 to 10 oz. categories when the varieties were grown on 240 lbs./ac N. At this level of N, Shepody produced a significantly higher percentage of tubers over 10 oz. relative to LW 004. At 190 lbs./ac N, Russet Burbank produced a significantly higher percentage of tubers under 4 oz. and 4 to 6 oz. and correspondingly lower percentage of tubers over 10 oz. than the other two varieties. LW 004 was not statistically different from Shepody except that Shepody produced a greater percentage of tubers over 10 oz. at the 190 lb./ac rate. Russet Burbank produced a significantly higher percentage of deformed tubers than Shepody or LW 004 at both rates of N. The size distribution for Shepody changed significantly with N rate. When grown at a moderate rate of N, Shepody tends to produce a higher percentage of larger tubers. This type of shift was not statistically significant for Russet Burbank or LW 004.

The yield of tubers (estimated ton/ac) of each variety is shown by size category in Table 44. There were few statistical differences between varieties in specific size categories when grown at 240 lbs./ac N. Shepody produced significantly less undersized potatoes than the other two varieties and Russet Burbank produced significantly more deformed tubers. In the 190 lb./ac N plots, the size profile of Russet Burbank shifted toward smaller tubers, while the size profile of Shepody shifted toward larger tubers. LW 004 produced significantly fewer undersized and deformed tubers than Russet Burbank. There were no significant differences in any specific size category resulting from different levels of N.

Table 44: Estimated yield (ton/ac) in each weight category (< 4oz., 4 to 6 oz., 6 to 10 oz. > 10 oz., and deformed) for each variety grown at full nitrogen (approximately 240 lbs./ac) and reduced nitrogen (approximately 190 lbs./ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the $p < 0.05$ level.

2013	< 4oz.	4 to 6 oz.	6 to 10 oz.	> 10 oz.	Deformed
Regular N					
Russet Burbank	2.87 a	4.41 a	8.79 a	13.58 a	2.73 a
LW 004	2.54 a	4.62 a	10.76 a	10.38 a	0.39 b
Shepody	1.62 b	3.23 a	9.01 a	14.39 a	0.54 b
Reduced N					
Russet Burbank	3.39 a	4.33 b	7.87 a	11.12 b	4.89 a
LW 004	1.50 b	3.26 ab	9.11 a	12.68 b	0.43 b
Shepody	1.88 b	2.20 a	7.93 a	19.13 a	0.48 b

†Data between the regular and reduced N plots was statistically different at the $p \leq 0.05$ level.

Fry scores are presented in Table 45.

Table 45: Fry scores. Fry Colour was assessed visually by comparison with a USDA fry colour chart (000 to 4; the lower the score, the better the fry colour). Data shown is the result of one composite sample run in duplicate.

2013			
Regular N	Fry Colour	Internal Texture[1]	Colour Uniformity[2]
Russet Burbank	1	3.0	4.0
Ivory Russet	0	4.0	4.0
Shepody	1	3.0	3.0
Reduced N			
Russet Burbank	1	3.0	3.0
Ivory Russet	0	4.0	3.0
Shepody	2	4.0	3.0

[1] Internal texture: 1 (wet) - 4 (mealy)
[2] Color uniformity: 1 (very variable) - 5 (very uniform)

Tuber samples used to measure specific gravity were evaluated for hollow heart, brown centre, stem-end discoloration, other types of internal necrosis and scab. There were few internal defects noted for LW 004 or russet Burbank grown on 240 lbs./ac N. Shepody tubers had some incidence of stem end discoloration at this level of N. At the lower level of N, very few internal defects were noted in any of the varieties.

Conclusions

Each year of the trial included a number of French fry potato varieties with potential in southern Alberta. In 2011, Russet Burbank was included in the trial as a check variety, but seed piece decay affected the stand and yield. The use of mini-tubers for some of the varieties did not allow for a fair comparison of those varieties with the check and additional work with these varieties would be beneficial. In 2012, Russet Burbank, Ranger Russet and Shepody were included in the trial as check varieties. In 2013, Russet Burbank and Shepody were included in the trial as check varieties. Yield of several new varieties compared well with Russet Burbank. The specific gravities of most of the varieties fell within a desirable range.

The trial was designed to provide regional data for new potato cultivars and to give some idea of the nitrogen rate required to produce yields comparable to standard varieties. In 2011, the N rate in the low N plots was over 100 lbs./ac lower than the regular rate and may have been too low. A rate of N that is intermediate may give better results than either full or low N. In 2013, marketable yield of Russet Burbank (over 4 oz.) was greater on the higher fertility treatment. Mean tuber size for Shepody was greater on the reduced fertility treatment. Addressing the agronomic needs of each variety may well result in improvements to yield and size profiles when compared to the results in this trial.

Chipping Variety Evaluation

2011

Materials and Methods
The variety evaluation was conducted in small plots at the Crop Diversification Centre South in Brooks, AB. Fertility for the full nitrogen rate was achieved through a combination of soil fertility (105 lbs./ac N; 214 lbs./ac P, 720 lbs./ac K), and broadcast fertilizer (350 lbs./ac of 34-17-0) incorporated at hilling. Fertility for the low nitrogen rate was achieved through a combination of soil fertility and broadcast fertilizer (100 lbs./ac of 11-52-0) incorporated at hilling. Varieties were planted in four replicate rows in a randomized split block design (with fertility as the main block) along with two standard varieties (Atlantic and Lady Claire). Each block was planted adjacent to guard rows to reduce any edge effects.

Eptam 8E (2.2 L/ac) and Sencor 75DF (150 g/ac) were applied pre-plant (May 13) to control weeds. Seed of standard cultivars was provided by Old Dutch Foods and seed of test cultivars was provided each participant. Potatoes were planted May 30, 2011 approximately 5 to 5½"deep using a two-row tuber unit planter. Seed was planted at 30cm spacing in 6m rows spaced 90cm apart. Seed was planted as single drop with the exception of some of the larger varieties. Cut seed (70 to 85 g) was suberized prior to planting.

The potatoes were hilled June 8 with a power hiller. The plots were irrigated to maintain soil moisture close to 70%. Foliar fungicides were applied several times during the growing season to prevent early and late blight from developing (Table 46). Insecticide was applied July 17 (Decis 5 EC, 50 mL/ac) to control Colorado potato beetle.

Table 46: Foliar fungicides applied to the potato crop to prevent early and late blight development.

Date of Application	*Fungicide*	*Rate*
July 18	Bravo 500	0.64 L/ac
Aug 2	Bravo 500	0.64 L/ac
Aug 23	Dithane DG Rainshield	0.91 kg/ac

Figure 26: Variety evaluation trial at CDCS in Brooks, AB July 22, 2011.

Samples were taken from one replicate row of each variety to determine sugar concentrations prior to harvest. The yield and grade of these samples were recorded and added back to harvest data. Reglone (1.4 L/ac) was applied September 6 and re-applied (1.0 L/ac) September 12 to facilitate mechanical harvest. Tubers were harvested September 21 – 26 with a one-row Grimme harvester for yield and grade data.

Tubers were stored at 10˚C until graded. Tubers were graded into size categories (less than 48mm, 48 – 88mm, and over 88mm). A sample of twenty-five tubers (48 – 88mm) from each replicate was used to determine specific gravity using the weight in air over weight in water method. These tubers were cut longitudinally to assess internal defects. Two composite samples of 8 tubers each (2 per rep) were stored at 15˚C until culinary analyses could be performed. Sugar concentrations were measured November 23 – 25 and samples were evaluated for chip color Nov 29.

The data presented here have been statistically analyzed using ANOVA and Tukey's Multiple Comparison Test; (SPSS; $p \leq 0.05$). Statistical summaries are available upon request.

Results and Discussion

Sample hills of each variety were dug for a field day August 24, 2011. Photos of these varieties are shown in Figure 20.

Figure 27. Chipping varieties at the CDCS field day August 24, 2011: a) Atlantic, b) PLP 001, c) ODF 001, d) Sentinel, e) RV 001, f) ODF 002, g) Lady Claire, h) Lady Valora, i) ODF 004, j) EPG 001, and k) ODF 003.

Yield data (total yield; ton/ac) and specific gravities of each of the releases are shown in Table 47. The highest total yield was observed with EPG 001 on regular N, and Lady Claire, Lady Valora, ODF 001, ODF 002 and Sentinel were not statistically less than EPG 001. The highest total yield on low N was observed with Lady Valora and Atlantic, Lady Claire, ODF 001, ODF

002, ODF 003, ODF 004 and Sentinel were not statistically different. For all varieties except Atlantic, total yield was higher in the regular N plots than in the low N plots.

Table 47: Estimated total yield (ton/acre) and specific gravity for each variety grown at full nitrogen (approximately 225 lbs./ac) and low nitrogen (approximately 115 lbs./ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the $p < 0.05$ level.

2011 Chippers	Yield (ton/ac)	SG
Regular Fertility		
Atlantic	19.65 c	1.089 ab
EPG 001	34.40 a	1.079 b
Lady Claire	32.56 ab	1.088 ab
PLP 001	24.61 bc	1.098 ab
Lady Valora	26.64 abc	1.092 ab
ODF 001	26.02 abc	1.081 b
ODF 002	27.73 abc	1.100 a
ODF 003	23.24 c	1.090 ab
ODF 004	23.78 bc	1.080 b
RV 001	22.41 c	1.099 ab
Sentinel	27.92 abc	1.080 b
Low Fertility		
Atlantic	20.26 pq	1.091 pq
Lady Claire	22.08 p	1.094 p
PLP 001	17.40 q	1.096 p
Lady Valora	24.71 p	1.095 p
ODF 001	18.39 pq	1.082 r
ODF 002	23.40 pq	1.098 p
ODF 003	21.13 pq	1.093 pq
ODF 004	21.62 p	1.083 qr
RV 001	17.23 q	1.102 p
Sentinel	22.10 pq	1.083 r

ODF 002 had the highest specific gravity on regular N, but this was not statistically different from RV 001, PLP 001, Lady Valora, ODF 003, Atlantic and Lady Claire. The lowest specific gravity was observed with EPG 001, ODF 004 and Sentinel at regular N. The specific gravities of chipping varieties tended to be lower on regular N plots than low N plots, as expected.

The trial was designed to provide regional data for a wide range of potato cultivars. The N rate in the low N plots was over 100 lbs./ac lower than the regular rate. A rate of N that is intermediate may give better results than either full or low N. Addressing the agronomic needs of each variety may well result in improvements to yield and size profiles when compared to the results in this trial.

The mean percentage of total tuber number in each size category is shown in Table 48. It is important to note that harvesting with small plot equipment and manual labour recovers all potatoes over 19mm in diameter. This tended to increase the yield of small potatoes relative to a commercial situation where more of these tubers may be left behind in the field.

In the regular N plots, PLP 001 produced the greatest percentage of potatoes in the small (<48mm) category, although not statistically different from Lady Claire, Lady Valora, ODF 001, ODF 002, ODF 003, ODF 004 and RV 001. Sentinel produced the greatest percentage of tubers in the medium (48-88mm) category and Atlantic, EPG 001, ODF 001, ODF 002, ODF 003 and ODF 004 were not statistically different. There were no statistically significant differences in the large (> 88mm) or deformed size categories.

In the low N plots, PLP 001 produced a significantly greater percentage of small tubers (< 48mm) than other varieties, while Atlantic, ODF 001, ODF 003 and Sentinel produced a significantly lower percentage of small tubers. Sentinel produced the greatest percentage of medium tubers (48 – 88mm) and Atlantic, ODF 001 and ODF 003 were not statistically different. There were no statistically significant differences in the large (> 88mm) or deformed size categories from the low N plots. Fewer large tubers were observed from the low N plots than from the regular N plots.

Table 48: Percentage of total tuber number in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed) for each variety grown at full nitrogen (approximately 225 lbs./ac) and low nitrogen (approximately 115 lbs./ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

2011	No. of <48mm	No. of 48 to 88mm	No. of > 88mm	No. of deformed
Regular N				
Atlantic	16.7 b	71.9 abc	10.8	1.5
EPG 001	14.6 b	75.6 ab	9.8	0
Lady Claire	37.6 ab	61.9 bc	0.1	1.1
PLP 001	62.3 a	37.1 d	0	1.1
Lady Valora	40.9 ab	58.9 c	0	0.8
ODF 001	24.1 ab	73.1 abc	2.7	0.7
ODF 002	32.7 ab	67.1 abc	0.1	0.3
ODF 003	20.8 ab	75.8 a	3.4	0.2
ODF 004	31.2 ab	67.9 abc	0.8	0.4
RV 001	47.2 ab	51.9 cd	0	2.2
Sentinel	13.6 bc	80.6 a	5.8	0
Low N				
Atlantic	19.3 r	79.6 p	1.1	0.6
Lady Claire	44.2 q	55.7 q	0.1	0.7
PLP 001	66.1 p	33.9 r	0	0.5
Lady Valora	46.5 q	53.5 q	0	0.2
ODF 001	18.4 r	81.0 p	0.6	0.2
ODF 002	37.6 q	62.4 q	0	0.3
ODF 003	21.7 r	77.1 p	1.2	0.2
ODF 004	39.0 q	60.4 q	0.6	0.1
RV 001	48.7 q	51.3 q	0	0.2
Sentinel	15.7 r	81.0 p	3.4	0.2

The yield of tubers (estimated ton/ac) of each variety is shown by size category in Table 49. In the regular N plots, PLP 001 produced significantly greater yield of small (< 48mm) potatoes while Atlantic, EPG 001, ODF 001, ODF 003, ODF 004 and Sentinel produced the lowest yield of smalls. EPG 001 gave the greatest yield of medium (48 – 88mm) potatoes but was not statistically different from Lady Claire, Lady Valora, ODF 001, ODF 002, ODF 003, ODF 004 and Sentinel. EPG 001 also resulted in the greatest yield of large (> 88mm) potatoes, which was statistically different from varieties that produced no large potatoes (PLP 001, Lady Valora, and RV 001. There were no statistically significant differences in the deformed size categories from regular N plots.

In the low N plots, PLP 001 produced the greatest yield of small (< 48mm) potatoes, but not statistically more than Lady Claire, Lady Valora and RV 001. The greatest yield of medium (48 – 88mm) potatoes was observed with Sentinel but Atlantic, Lady Claire, Lady Valora, ODF 001, ODF 002, ODF 003 and ODF 004 were not statistically different. For all varieties except Atlantic, yield of medium (48 – 88mm) tubers was higher in the regular N plots than in the low N plots.

Table 49: Estimated yield (ton/ac) in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed tubers) for each variety grown at full nitrogen (approximately 225 lbs./ac) and low nitrogen (approximately 115 lbs./ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the $p < 0.05$ level.

2011	Yield of <48mm (ton/ac)	Yield of 48 to 88mm (ton/ac)	Yield of > 88mm (ton/ac)	Yield of deformed (ton/ac)
Regular N				
Atlantic	1.07 d	13.60 c	5.74 ab	0.29
EPG 001	1.74 d	25.88 a	8.18 a	0.03
Lady Claire	7.04 b	24.46 a	0.08 ab	1.21
PLP 001	9.83 a	14.05 c	0 b	0.89
Lady Valora	6.13 bc	20.17 abc	0 b	0.41
ODF 001	2.43 d	21.45 abc	2.21 ab	0.38
ODF 002	5.10 bc	22.39 ab	0.10 ab	0.23
ODF 003	2.03 d	19.11 abc	2.53 ab	0.03
ODF 004	3.64 cd	19.29 abc	0.84 ab	0.20
RV 001	6.17 bc	15.03 bc	0 b	1.46
Sentinel	1.55 d	22.87 ab	4.24 ab	0
Low N				
Atlantic	1.95 r	17.53 p	0.73	0.23
Lady Claire	5.92 pq	15.69 pqr	0.16	0.41
PLP 001	8.06 p	9.13 r	0	0.25
Lady Valora	6.55 pq	17.32 p	0	1.01
ODF 001	1.47 r	16.57 pq	0.35	0.08
ODF 002	5.11 q	18.16 p	0	0.15
ODF 003	2.20 r	18.31 p	0.70	0.05
ODF 004	4.43 qr	16.77 pq	0.46	0.05
RV 001	6.36 pq	10.37 qr	2.08	0.60
Sentinel	1.36 r	18.96 p	0	0.08

A comparison of medium potatoes (48 – 88mm) for each variety from regular and low fertility plots is shown in Figure 28.

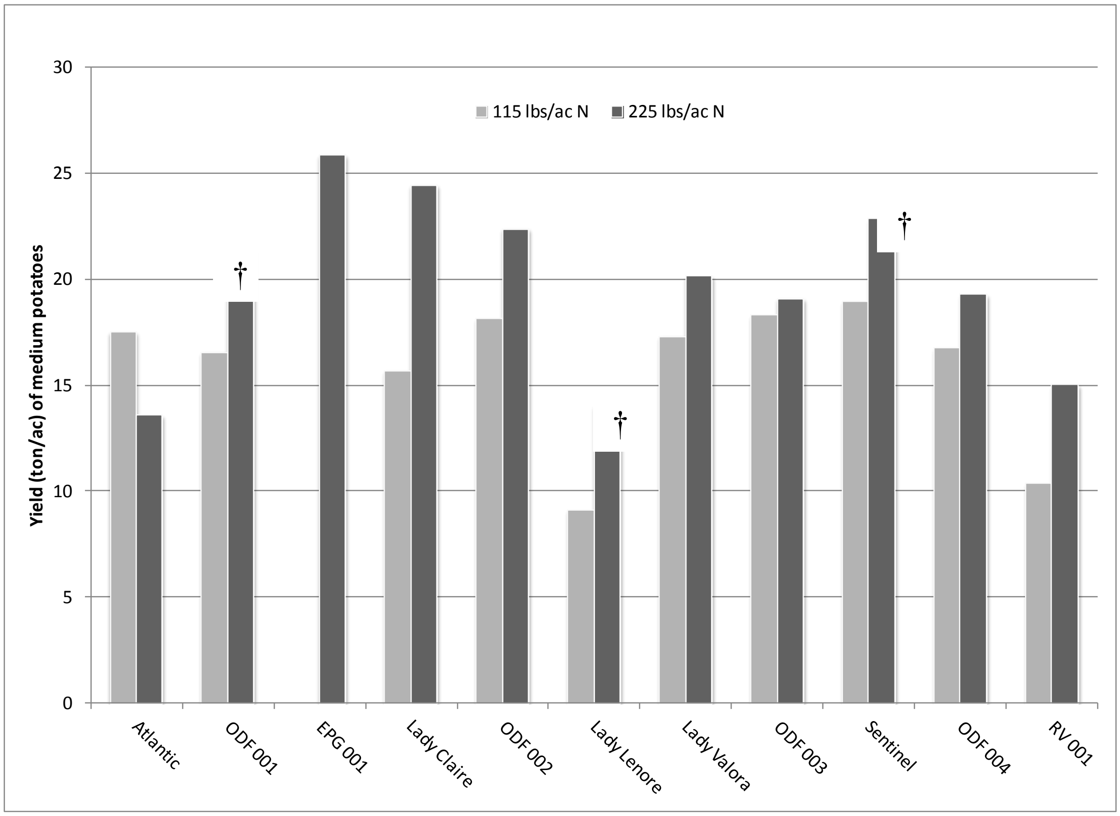

Figure 28: Yield of potatoes (48 – 88mm) produced on low (115 lbs./ac) and regular (225 lbs./ac) N. For each variety, columns marked with † are statistically different ($p \leq 0.05$).

Chip colour scores of composite samples are presented in Table 50. All of the samples except Atlantic grown at 225 lbs./ac N gave good chip scores. RV 001 and Lady Claire grown in the regular N plots gave the lightest chip scores.

Table 50: Chip colour scores from subsamples of each variety grown at full nitrogen (approximately 225 lbs./ac) and low nitrogen (approximately 115 lbs./ac). Data shown is the mean of duplicate analyses of a composite sample evaluated on a Hunter Colorimeter (L is a lightness score; higher numbers are lighter).

2011	L		L
Regular N		Low N	
Atlantic	56.57	Atlantic	61.47
EPG 001	62.69		
Lady Claire	68.81	Lady Claire	67.65
PLP 001	65.05	PLP 001	67.96
Lady Valora	64.16	Lady Valora	61.93
RV 001	71.89	RV 001	66.74
Sentinel	60.17	Sentinel	61.62

Tuber samples used to measure specific gravity were evaluated for hollow heart, brown centre, stem-end discoloration, other types of internal necrosis and scab. There were very few internal defects observed in the tubers examined. Hollow heart was noted in a few tubers of the Atlantic, EPG 001, ODF 002, and ODF 003. Subsamples of ODF 001, Lady Claire, Lady Valora, and RV 001 were free of any internal defects.

Approximately 16% of PLP 001 tubers showed common scab lesions of up to 8% tuber coverage.

2012

Materials and Methods

The variety evaluation was conducted in small plots at the Crop Diversification Centre South in Brooks, AB. Fertility for the full nitrogen rate (248 lbs/ac) was achieved through a combination of soil fertility (82 lbs./ac N; 192 lbs./ac P, 760 lbs./ac K), broadcast fertilizer (176 lbs./ac of 34-0-0 and 100 lbs./ac of 11-52-0) incorporated prior to planting and broadcast fertilizer (279 lbs./ac 34-0-0) incorporated at hilling. Fertility for the medium nitrogen rate (150 lbs./ac) was achieved through a combination of soil fertility and broadcast fertilizer (176 lbs./ac of 34-0-0 and 100 lbs./ac of 11-52-0) incorporated prior to planting. Fertility for the low nitrogen rate (90 lbs./ac) was achieved through a combination of soil fertility and broadcast fertilizer (100 lbs./ac of 11-52-0) incorporated prior to planting. Varieties were planted in four replicate rows in a randomized split block design (with fertility as the main block) along with standard varieties (Atlantic, Niska and PLP 001). Each block was planted adjacent to guard rows to reduce any edge effects.

Eptam 8E (2.2 L/ac) and Sencor 75DF (150 g/ac) were applied pre-plant (May 10) to control weeds. Seed of standard cultivars was provided by Edmonton Potato Growers and seed of test cultivars was provided by each participant. Most varieties were planted May 23, 2012 approximately 5 to 5½"deep using a two-row tuber unit planter. Seed was planted at 30cm spacing in 6m rows spaced 90cm apart. Seed was cut (70 to 85 g) and suberized prior to planting.

The potatoes were hilled June 4 with a power hiller. The plots were irrigated to maintain soil moisture close to 70%. Foliar fungicides were applied several times during the growing season to prevent early and late blight from developing (Table 51). Insecticide was applied July 17 (Matador 120 EC, 40 mL/ac) and August 15 (Decis 5 EC, 50 mL/ac) to control Colorado potato beetle.

Table 51: Foliar fungicides applied to the potato crop to prevent early and late blight development.

Date of Application	***Fungicide***	***Rate***
June 29	Bravo 500	0.64 L/ac
July 27	Ridomil Gold Bravo	883 mL/ac
Aug 15	Bravo 500	0.64 L/ac

Figure 29: Variety evaluation trial at CDCS in Brooks, AB July 20, 2012.

Reglone (1.4 L/ac) was applied September 13 to facilitate mechanical harvest. Tubers were harvested September 18-25 with a one-row Grimme harvester for yield and grade data.

Tubers were stored at 10˚C until graded. Tubers were graded into size categories (less than 48mm, 48 – 88mm, and over 88mm). A sample of twenty-five tubers (48 – 88mm) from each replicate was used to determine specific gravity using the weight in air over weight in water method. These tubers were cut longitudinally to assess internal defects. A composite sample of 8 tubers (2 per rep) was stored at 10˚C until culinary analyses were performed. Samples were evaluated for chip color using a Hunter Colorimeter December 17, 2012.

The data presented here have been statistically analyzed using ANOVA and Tukey's Multiple Comparison Test; (SPSS; $p \leq 0.05$). Statistical summaries are available upon request. Comparisons for specific cultivars at two rates of N were analyzed using t-tests on a cultivar-by-cultivar basis (Excel; $p \leq 0.05$).

Results and Discussion
Sample hills of each variety were dug for a field day August 22, 2013. Photos of these varieties are shown in Figure 30.

Figure 30. Chipping varieties at the CDCS field day August 22, 2012: a) Atlantic, b) Niska, c) Lady Claire, d) ODF 003, e) EPG 005, f) EPG 006, g) PLP 001, h) ODF 005, i) RV 002, j) RV 003 and l) RV 004.

Yield data (total yield; ton/ac) and specific gravities of each of the cultivars are shown in Table 52. At the regular rate of N (248 lbs./ac), RV 002 produced the highest total yield, but significantly more than EPG 005 and EPG 006 which were planted late. At a moderate rate of N (150 lbs./ac), the highest yield was observed with ODF 005, but was not statistically different from most other cultivars. For each cultivar, a t-test was applied to determine whether total yield was significantly affected by the rate of N in the plots. Although there was a trend toward lower yield on reduced N plots, no statistically significant differences were identified for total yield.

Table 52: Estimated total yield (ton/acre) and specific gravity for each variety grown at full nitrogen (approximately 248 lbs./ac), moderate nitrogen (approximately 150 lbs./ac) and low N (100 lbs./ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

2012 Chippers	Yield (ton/ac)	SG
Regular N		
Atlantic	29.5 ab	1.113 a
Lady Claire	20.5 c	1.128 a
PLP 001	30.8 a	1.118 a
Niska	30.2 a	1.102 a
RV 002	32.5 a	1.106 a
RV 003	29.7 ab	1.111 a
RV 004	27.0 abc	1.117 a
ODF 003	21.7 bc	1.117 a
EPG 005	9.5 d	1.109 a
EPG 006	11.2 d	1.108 a†
Moderate N		
Atlantic	22.6 ab	1.115 a
Lady Claire	20.3 ab	1.111 abc
PLP 001	26.3 a	1.114 ab
Niska	25.1 ab	1.096 cd
RV 002	26.7 a	1.098 bcd
ODF 005	29.2 a	1.099 abcd
RV 003	22.1 ab	1.107 abc
RV 004	24.1 ab	1.102 abcd
ODF 003	18.3 ab	1.100 abcd
EPG 005	7.9 b	1.090 d
EPG 006	7.9 b	1.094 cd†
Low N		
Atlantic	16.8	1.109
ODF 005	20.0	1.091

† Data between the regular and moderate N plots was statistically different at the p ≤ 0.05 level.

Potatoes selected as chipping cultivars, typically have specific gravities above 1.080 in Alberta and all of the entries in this trial were well above this level of solids. Specific gravity measurements for these cultivars seemed abnormally high and may reflect a technical error. The numbers may be somewhat useful in relative terms, but should not be relied on as absolute values. The chipping scores (Table 56) will provide a better indication of suitability for chipping.

The trial was designed to provide regional data for a wide range of potato cultivars. The N rate in the moderate N plots was approximately 100 lbs./ac lower than the regular rate. The rate of N may have been too different to establish the best rate for each cultivar. An intermediate rate may have resulted in greater yield than either of the rates tested.

The mean percentage of total tuber number in each size category is shown in Table 53. It is important to note that harvesting with small plot equipment and manual labour recovers all potatoes over 19mm in diameter. This tended to increase the yield of small potatoes relative to a commercial situation where more of these tubers may be left behind in the field.

In the regular N plots, RV 004 produced the greatest percentage of marketable tubers and was not statistically different from Atlantic, Niska, RV 002, or ODF 003. In the moderate N plots, ODF 003 produced the greatest percentage of potatoes in the marketable category (48 – 88mm) and was not statistically different from Atlantic, Lady Claire, Niska, RV 002, ODF 005, RV 004 or EPG 006. Atlantic and ODF 005 both produced a high percentage of marketable tubers on low N. As expected, there was a shift in size profile when tubers were grown on different rates of N. For Atlantic, there were significantly more small and significantly fewer large tubers on moderate than on regular N. RV 004 produced significantly more small and significantly fewer marketable tubers on moderate N.

Table 53: Percentage of total tuber number in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed) for each variety grown at full nitrogen (approximately 248 lbs./ac), moderate nitrogen (approximately 150 lbs./ac) and low nitrogen (100 lbs./ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

2012	% <48mm	% 48 to 88mm	% > 88mm	% deformed
Regular N				
Atlantic	17.8 c†	73.4 a	6.4 a†	2.4 a
Lady Claire	49.1 a	49.6 b	0.1 c†	1.1 a
PLP 001	48.2 b	50.1 b	0.1 c	1.7 a
Niska	20.7 c	69.9 a	6.1 a	3.3 a
RV 002	31.8 c	66.3 a	0.6 bc	1.3 a
RV 003	53.9 b	44.3 b	0.0 c	1.9 a
RV 004	21.6 c†	74.1 a†	0.7 bc	3.6 a
ODF 003	23.7 c	70.4 a	5.0 ab	0.8 a
EPG 005	72.5 a	25.2 c	0.0 c	2.3 a
EPG 006	51.0 b	46.4 b	0.9 bc	1.7 a
Moderate N				
Atlantic	32.6 cd†	64.8 ab	2.2 a†	0.5 a
Lady Claire	49.9 abcd	48.9 abc	0.6 a†	0.7 a
PLP 001	61.4 abc	37.7 bcd	0.2 a	0.7 a
Niska	32.7 cd	62.5 ab	2.4 a	2.4 a
RV 002	44.1 bcd	55.6 abc	0.1 a	0.2 a
ODF 005	46.7 bcd	49.2 abc	3.3 a	0.7 a
RV 003	68.4 ab	31.1 cd	0.0 a	0.5 a
RV 004	31.8 cd†	63.6 ab†	0.3 a	4.3 a
ODF 003	28.8 d	66.7 a	3.6 a	0.9 a
EPG 005	78.1 a	20.1 d	0.0 a	1.8 a
EPG 006	47.3 bcd	50.0 abc	0.5 a	2.2 a
Low N				
Atlantic	25.2	70.0	4.0	0.8
ODF 005	33.3	64.5	1.9	0.3

† Data between the regular and moderate N plots was statistically different at the p ≤ 0.05 level.

The yield of tubers (estimated ton/ac) of each variety is shown by size category in Table 54. At the regular rate of N (248 lbs./ac), RV 002 produced the greatest yield of marketable tubers, although not statistically different from Atlantic, PLP 001, Niska, RV 003 and RV 004. On moderate N plots, RV 002 produced the greatest yield of marketable (48 – 88mm) tubers and only EPG 006 and EPG 005 were statistically different.

In general, moderate N resulted in lower marketable yield than regular N. For Atlantic and RV 004, significantly greater yield of small tubers were produced on moderate N plots than on regular N plots and correspondingly fewer large and marketable tubers were produced.

Table 54: Estimated yield (ton/ac) in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed tubers) for each variety grown at full nitrogen (approximately 248 lbs./ac), moderate nitrogen (approximately 150 lbs./ac) and low nitrogen (100 lbs./ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

2012	Yield of <48mm (ton/ac)	Yield of 48 to 88mm (ton/ac)	Yield of > 88mm (ton/ac)	Yield of deformed (ton/ac)
Regular N				
Atlantic	1.5 f†	21.7 abc	4.9 a†	1.3 a
Lady Claire	5.7 bc	14.2 cd	0.2 d	0.4 a
PLP 001	7.8 ab	21.7 abc	0.1 d	1.2 a
Niska	2.0 ef	22.6 ab	4.4 ab	1.2 a
RV 002	4.4 cd	26.1 a	1.4 bcd	0.6 a
RV 003	10.2 a	18.2 abc	0.0 d	1.4 a
RV 004	2.1 def†	22.6 ab†	0.6 cd	1.7 a
ODF 003	1.9 f	16.0 bc	3.5 abc	0.4 a
EPG 005	4.4 cde	4.6 e	0.0 d	0.5 a
EPG 006	2.8 def	7.7 de†	0.4 cd	0.3 a
Moderate N				
Atlantic	2.8 cd†	18.0 a	1.7 a†	0.1 a
Lady Claire	5.6 bc	13.9 abc	0.5 a	0.3 a
PLP 001	10.0 a	15.6 ab	0.2 a	0.5 a
Niska	3.0 bcd	18.8 a	2.3 a	1.1 a
RV 002	6.3 b	20.1 a	0.1 a	0.2 a
ODF 005	4.4 bcd	14.6 abc	2.5 a	0.1 a
RV 003	10.9 a	10.9 abc	0.0 a	0.2 a
RV 004	3.4 bcd†	18.4 a†	0.2 a	2.1 a
ODF 003	2.0 d	14.0 abc	2.0 a	0.2 a
EPG 005	4.4 bcd	3.4 c	0.0 a	0.1 a
EPG 006	2.7 cd	4.8 bc†	0.1 a	0.3 a
Low N				
Atlantic	2.0	15.2	2.6	0.3
ODF 005	2.5	13.3	1.0	0.1

† Data between the regular and moderate N plots was statistically different at the $p \leq 0.05$ level.

A comparison of medium potatoes (48 – 88mm) for each variety from regular, moderate and low N plots is shown in Figure 31.

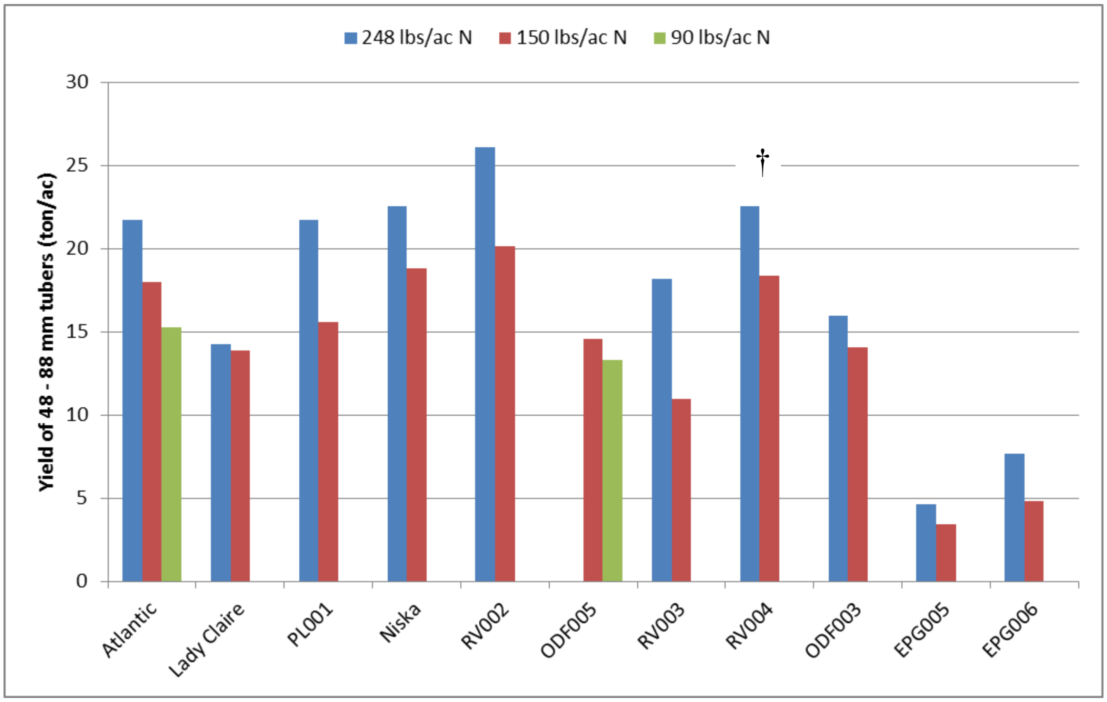

Figure 31: Yield (ton/ac) of potatoes (48 – 88mm) produced on regular (248 lbs./ac) N, and moderate (150 lbs./ac) N and low (90 lbs./ac) N plots. For each variety, yield columns marked with † are statistically different ($p \leq 0.05$).

Medium tubers were assessed subjectively for Uniformity of Size and Overall Appearance. Scores are presented in Table 55. RV 002 and RV 003 were rated as most uniformly sized from regular N plots. On moderate N, RV 003, EPG 006 and EPG 005 were most uniformly sized.

When comparing individual cultivars, N level appeared to affect scores for Uniformity of Size and Overall Appearance indicating the importance of agronomic data for the production of high quality chipping potatoes.

Table 55: Subjective tuber assessments. Uniformity of Size was subjectively assessed on each replicate by the same individual during the grading process. Overall Appearance was based on uniformity of size and uniformity of shape, skin colour, deformities and eye depth. Data shown is the mean of 4 replicates.

2012	Uniformity of Size[1]	Overall Appearance[2]
Regular N		
Atlantic	3.2	3
Lady Claire	2.8	3
PLP 001	3.4	3.4
Niska	1.6	2.2
RV 002	4	3
RV 003	4	3.6
RV 004	2.6	2.6
ODF 003	3.3	2.8
EPG 005	3.6	3.6
EPG 006	2.8	3.4
Moderate N		
Atlantic	3.3	2.8
Lady Claire	3.0	2.8
PLP 001	3.5	3.8
Niska	3.8	3.0
RV 002	3.5	3.5
ODF 005	2.8	2.8
RV 003	4.0	4.0
RV 004	2.8	2.8
ODF 003	2.8	3.0
EPG 005	4.0	3.8
EPG 006	4.0	3.8
Low N		
Atlantic	4.0	3.8
ODF 005	3.0	2.8

[1] Uniformity of Size: 1 (very variable) - 5 (very uniform)
[2] Overall Appearance: 1 (very poor) - 5 (outstanding)

Tuber samples used to measure specific gravity were evaluated for hollow heart, brown centre, stem-end discoloration, other types of internal necrosis and scab. Very few internal defects were noted for the chipping cultivars evaluated in 2012. Many of the samples had some level of stem-end discoloration. ODF 005 seemed somewhat susceptible to purple pigmentation developing within tubers when grown at the moderate rate of N, but no pigmentation was noted from low N samples.

Chip colour scores of composite samples are presented in Table 56. All of the samples, except EPG 005, gave good chip scores at all levels of N tested. A higher L-value indicates a lighter chip. The lightest chips were produced from Niska grown on both regular N and moderate N. EPG 005 produced chips below a desirable lightness score of 60 and this may be related to maturity issues. These results are from composite samples from one year of testing and additional testing may be required to determine optimal agronomic conditions for chip quality.

Table 56: Chip colour scores from subsamples of each variety grown at full nitrogen (approximately 248 lbs./ac), moderate nitrogen (approximately 150 lbs./ac) and low (approximately 100 lbs./ac) nitrogen. Data shown is the mean of duplicate analyses of a composite sample evaluated on a Hunter Colorimeter (L is a lightness score; higher numbers are lighter).

2012	L		L
Regular N		*Moderate N*	
Atlantic	68.7	Atlantic	64.6
Lady Claire	65.6	Lady Claire	64.0
PLP 001	63.7	PLP 001	64.2
Niska	70.4	Niska	70.5
RV 002	67.9	RV 002	61.1
		ODF 005	67.0
RV 003	69.3	RV 003	64.6
RV 004	64.9	RV 004	68.2
ODF 003	66.4	ODF 003	68.3
EPG 005	51.8	EPG 005	49.8
EPG 006	66.7	EPG 006	66.1
Low N		*Low N*	
Atlantic	68.3	ODF 005	66.8

2013

Materials and Methods

The variety evaluation was conducted in small plots at the Crop Diversification Centre South in Brooks, AB. Fertility for the full nitrogen rate (235 lbs/ac) was achieved through a combination of soil fertility (124 lbs./ac N; 361 lbs./ac P, 1930 lbs./ac K), broadcast fertilizer (165 lbs./ac of 34-0-0 and 100 lbs./ac of 11-52-0) incorporated prior to planting and broadcast fertilizer (132 lbs./ac 34-0-0) incorporated at hilling. Fertility for the reduced nitrogen rate (190 lbs./ac) was achieved through a combination of soil fertility and broadcast fertilizer (165 lbs./ac of 34-0-0 and 100 lbs./ac of 11-52-0) incorporated prior to planting. Varieties were planted in four replicate rows in a randomized split block design (with fertility as the main block) along with standard varieties (Atlantic and PLP 001). Each block was planted adjacent to guard rows to reduce any edge effects.

Eptam 8E (2.2 L/ac) and Sencor 75DF (150 g/ac) were applied pre-plant (May 6) to control weeds. Seed of standard cultivars was provided by Edmonton Potato Growers and seed of test cultivars was provided by each participant. Seed was cut (70 to 85 g) and suberized prior to planting. Potatoes were planted May 23, 2013 approximately 5 to 5½"deep using a two-row tuber unit planter. Seed was planted at 30cm spacing in 6m rows spaced 90cm apart.

The potatoes were hilled June 17 with a power hiller. The plots were irrigated to maintain soil moisture close to 70%. Foliar fungicides were applied several times during the growing season to prevent early and late blight from developing (Table 57). Insecticide was applied July 10 (Matador 120 EC, 40 mL/ac) to control Colorado potato beetle.

Table 57: Foliar fungicides applied to the potato crop to prevent early and late blight development.

Date of Application	*Fungicide*	*Rate*
July 10	Quadris	202 mL/ac
July 20	Bravo 500	0.64 L/ac
Aug 15	Ridomil Gold Bravo	883 mL/ac

Figure 32: Variety evaluation trial at CDCS in Brooks, AB July 30, 2013.

Reglone (1.4 L/ac) was applied September 11 to facilitate mechanical harvest. Tubers were harvested September 23-24 with a one-row Grimme harvester for yield and grade data.

Tubers were stored at 10˚C until graded. Tubers were graded into size categories (less than 48mm, 48 – 88mm, and over 88mm). A sample of twenty-five tubers (48 – 88mm) from each replicate was used to determine specific gravity using the weight in air over weight in water method. These tubers were cut longitudinally to assess internal defects. A composite sample of 8 tubers (2 per rep) was stored at 10C until culinary analyses were performed. Samples were evaluated for chip color using a Hunter Colorimeter December 17, 2013.

The data presented here have been statistically analyzed using ANOVA and Tukey’s Multiple Comparison Test; (SPSS; $p \leq 0.05$). Statistical summaries are available upon request. Comparisons for specific cultivars at two rates of N were analyzed using t-tests on a cultivar-by-cultivar basis (Excel; $p \leq 0.05$).

Results and Discussion

Sample hills of each variety were dug for a field day August 22, 2013. Photos of these varieties are shown in Figure 33.

Figure 33. Chipping varieties at the CDCS field day August 22, 2013: a) Atlantic, b) PLP 001, c) EPG013, d) EPG014, e) ODF003, f) ODF006, g) Photo not available of ODF007, h) RV002, i) RV003, j) RV004 and k) RV007.

Yield data (total yield; ton/ac) and specific gravities of each of the cultivars are shown in Table 58. At the regular rate of N (235 lbs./ac), RV 007 yielded significantly more than all other cultivars. Yield of EPG 013 was lowest and was not statistically different from EPG 006. Total yield of most cultivars was not significantly different from that of Atlantic. At a moderate rate of N (190 lbs./ac), the highest yield was observed with RV 007 and RV 003 and RV 004 were not statistically different. EPG 013 was the lowest yielding cultivar at this level of N. For each cultivar, a t-test was applied to determine whether total yield was significantly affected by the rate of N in the plots. No statistically significant differences were identified for total yield.

Table 58: Estimated total yield (ton/acre) and specific gravity for each variety grown at full nitrogen (approximately 235 lbs./ac) and moderate nitrogen (approximately 190 lbs./ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the $p < 0.05$ level.

2013 Chippers	Yield (ton/ac)	SG
Regular N		
Atlantic	32.6 b	1.098 ab
PLP 001	32.4 b	1.088 bcd†
RV 002	33.5 b	1.088 bcd
EPG 013	22.4 c	1.096 ab†
EPG 014		
RV 003	32.1 b	1.096 cd
RV 007	45.1 a	1.102 abc
RV 004	33.2 b	1.093 abc
ODF 003	32.8 b	1.084 cd†
EPG 006	28.8 bc	1.078 d
Moderate N		
Atlantic	34.4 bc	1.093 ab
PLP 001	30.5 bc	1.098 a†
RV 002	32.5 bc	1.082 cd
EPG 013	21.7 d	1.077 d†
EPG 014	31.3 bc	1.084 bcd
RV 003	37.0 ab	1.093 abc
RV 007	43.0 a	1.092 abc
RV 004	36.5 ab	1.089 bc
ODF 003	35.8 b	1.093 abc†
EPG 006	28.2 c	1.084 bcd

† Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.

Specific gravity of the chipping cultivars in this trial ranged from 1.078 for EPG 013 to 1.102 for RV 007 from the regular N plots and from 1.077 for EPG 013 to 1.098 for PLP 001 grown on moderate N plots (Table 2). Potatoes selected as chipping cultivars, typically have specific gravities above 1.080 in Alberta and the majority of entries in this trial were well above this level of solids. Nitrogen level had a significant effect on specific gravity of three cultivars, PLP 001, EPG 013 and ODF 003. Growing potatoes at higher levels of N usually results in a decrease in tuber specific gravity and this was the case for ODF 003 and PLP 001 in this trial.

The trial was designed to provide regional data for a wide range of potato cultivars. The N rate in the moderate N plots was approximately 45 lbs./ac lower than the regular rate. The N rates may not have been sufficiently different to impact yield and specific gravity of all cultivars tested. Addressing the agronomic needs of each cultivar may well result in improvements to yield and size profiles when compared to the results in this trial.

The mean percentage of total tuber number in each size category is shown in Table 59. It is important to note that harvesting with small plot equipment and manual labour recovers all potatoes over 19mm in diameter. This tended to increase the yield of small potatoes relative to a commercial situation where more of these tubers may be left behind in the field.

In both the regular N and moderate N plots, PLP 001 produced the greatest percentage of potatoes in the small (<48mm) category and RV 004 produced the lowest. The majority of tubers from each cultivar fell into the medium-size (48 – 88mm) category at harvest. Atlantic produced a significantly greater percentage of large (> 88mm) tubers than other cultivars at both levels of N, indicating that the September harvest data was too late for optimal sizing of this cultivar. Few significant differences in size profiles were observed for individual cultivars as a result of N level. A significantly lower percentage of large EPG 013 tubers were produced at the regular level of N compared to the moderate rate, and significantly greater percentage of small RV 007 tubers were produced at this level.

Table 59: Percentage of total tuber number in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed) for each variety grown at full nitrogen (approximately 235 lbs./ac) and moderate nitrogen (approximately 190 lbs./ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

2013	No. of <48mm	No. of 48 to 88mm	No. of > 88mm	No. of deformed
Regular N				
Atlantic	15.8 c	63.3 ab	19.0 a	1.8 ab
PLP 001	49.0 a	49.5 b	7.5 c	0.5 b
RV 002	23.3 c	75.3 a	1.8 bc	0.0 b
EPG 013	38.3 b	60.8 ab	0.5 c†	0.5 b
EPG 014				
RV 003	37.5 b	61.8 ab	0.00 d	1.0 b
RV 007	21.3 c†	68.5 a	9.3 b	0.5 b
RV 004	13.8 c	73.8 a	8.3 bc	4.0 a
ODF 003	19.0 c	73.8 a	7.3 bc	0.0 b
EPG 006	22.8 c	74.3 a	2.0 bc	1.0 b
Moderate N				
Atlantic	18.5 cd	55.8 b	23.5 a	2.3 a
PLP 001	45.5 a	53.8 b	0.8 b	0.3 a
RV 002	25.3 abc	71.5 ab	3.0 b	0.3 a
EPG 013	29.0 bc	62.3 ab	8.3 b†	0.8 a
EPG 014	34.3 ab	63.0 ab	2.3 b	0.5 a
RV 003	36.3 ab	62.0 ab	0.5 b	1.0 a
RV 007	15.8 d†	73.5 ab	10.5 b	0.3 a
RV 004	13.3 d	77.5 a	8.0 b	2.0 a
ODF 003	17.8 cd	71.3 ab	11.0 b	0.0 a
EPG 006	20.5 cd	76.0 a	3.0 b	0.8 a

† Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.

The yield of tubers (estimated ton/ac) of each variety is shown by size category in Table 60. At the regular rate of N (235 lbs./ac), PLP 001 and RV 003 yielded significantly more small potatoes than other cultivars. RV 004 and Atlantic produced the lowest yield of smalls, although not statistically different from ODF 003 and EPG 006. In the 48 – 88mm category, RV 007 produced the greatest yield and RV 002, ODF 003 and RV 003 were not statistically different. Atlantic produced the lowest yield in the marketable size category and correspondingly, the highest yield of oversized tubers (> 88mm), likely as a result of harvesting later than ideal for this early maturing variety. Based on the yield data in the oversized category, RV 007 may also be an early cultivar.

On moderate N plots, PLP 001 and RV 003 yielded significantly more small potatoes than other cultivars. Again, RV 007 produced the greatest yield of marketable (48 – 88mm) tubers and RV 002, RV 003, RV 004 and ODF 003 were not statistically different. Yield of large (> 88mm) Atlantic tubers was not statistically different from yield of large RV 007, RV 004 and ODF 003. An earlier harvest may have shifted some of this production into the marketable size category.

N level had a significant impact on the yield of marketable Atlantic and RV 004 tubers, where a greater yield of marketable tubers was harvested from the moderate N plots than from regular N plots. For EPG 013, significantly greater yield of large tubers were produced on moderate N plots than on regular N plots. PLP 001 and RV 007 both produced greater yields of small tubers in regular N plots than when grown in moderate N plots.

Table 60: Estimated yield (ton/ac) in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed tubers) for each variety grown at full nitrogen (approximately 235 lbs./ac) and moderate nitrogen (approximately 190 lbs./ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

2013	Yield of <48mm (ton/ac)	Yield of 48 to 88mm (ton/ac)	Yield of > 88mm (ton/ac)	Yield of deformed (ton/ac)
Regular N				
Atlantic	1.2 d	17.8 d†	12.5 a	1.1 ab
PLP 001	7.7 a†	12.2 bcd	0.7 c	0.8 ab
RV 002	3.1 bc	28.7 ab	1.7 c	0.1 b
EPG 013	3.4 b	18.2 cd	0.5 c†	0.3 ab
EPG 014				
RV 003	6.5 a	24.9 ab	0.3 c	0.4 ab
RV 007	2.7 bc†	31.2 a	10.4 ab	0.8 ab
RV 004	1.2 d	24.1 bcd†	5.8 bc	2.2 a
ODF 003	1.9 cd	26.0 ab	4.9 bc	0.0 b
EPG 006	2.4 bcd	24.5 bc	1.6 c	0.3 ab
Moderate N				
Atlantic	1.1 c	21.0 c†	11.7 a	0.6 a
PLP 001	6.4 a†	23.2 bc	0.7 d	0.2 a
RV 002	2.2 c	27.4 abc	2.6 cd	0.2 a
EPG 013	2.4 c	15.1 d	4.0 bcd†	0.2 a
EPG 014	4.4 b	24.4 bc	2.1 cd	0.3 a
RV 003	6.5 a	29.1 ab	0.7 d	0.6 a
RV 007	2.0 c†	31.2 a	9.7 a	0.2 a
RV 004	1.4 c	27.8 ab†	6.7 abc	0.7 a
ODF 003	1.7 c	26.3 abc	7.9 ab	0.0 a
EPG 006	1.9 c	23.7 bc	2.1 cd	0.5 a

† Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.

A comparison of medium potatoes (48 – 88mm) for each variety from regular and moderate N plots is shown in Figure 34.

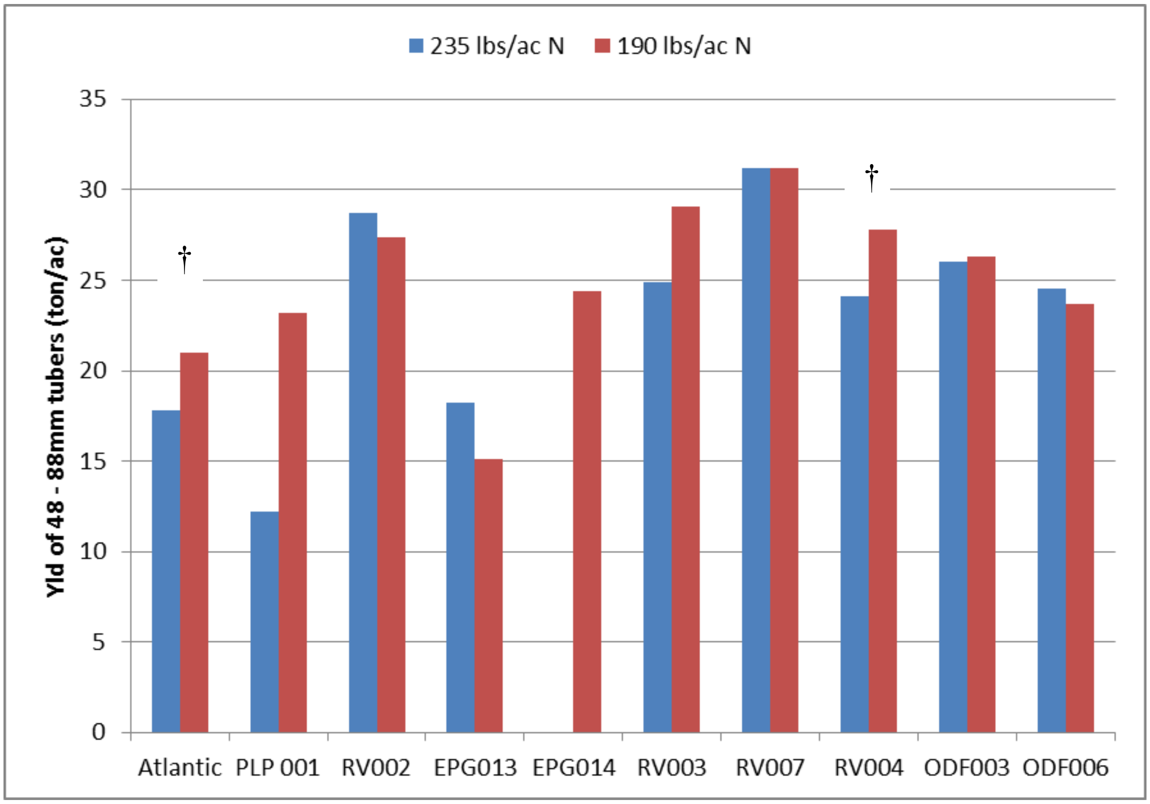

Figure 34: Yield (yon/ac) of potatoes (48 – 88mm) produced on regular (235 lbs./ac) N and moderate (190 lbs./ac) N plots. For each variety, yield columns marked with † are statistically different ($p \leq 0.05$).

Medium tubers were assessed subjectively for Uniformity of Size and Overall Appearance. Scores are presented in Table 61. At the regular rate of N, EPG 006 tubers appeared most uniform, but only EPG 013 scored significantly lower on this assessment. ODF 003 and Atlantic scored highest for Overall Appearance and scores for RV 002, RV 003, RV 004 and EPG 006 tubers were not statistically different.

On moderate N, no significant differences were observed between cultivars for Uniformity of Size. RV 002 and RV 003 scored highest for Overall Appearance and only EPG 006 scored significantly lower.

When comparing the Overall Appearance of individual cultivars, N level significantly affected scores for Atlantic, PLP 001, RV 002, EPG 013, and EPG 006, indicating the importance of agronomic data for the production of high quality chipping potatoes.

Table 61: Subjective tuber assessments: Uniformity of Size was subjectively assessed on each replicate by the same individual during the grading process. Overall Appearance was based on uniformity of size and uniformity of shape, skin colour, deformities and eye depth. Data shown is the mean of 4 replicates.

2013	Uniformity of Size[1]	Overall Appearance[2]
Regular N		
Atlantic	3.75 a	4.00 a†
PLP 001	3.50 a	2.25 c†
RV 002	3.00 a	3.25 ab†
EPG 013	2.00 b	2.25 c†
EPG 014		
RV 003	3.50 a	3.50 ab
RV 007	3.25 a	2.75 bc
RV 004	3.25 a	3.50 ab
ODF 003	3.75 a	4.00 a
EPG 006	4.00 a	3.75 ab†
Moderate N		
Atlantic	2.75 a	3.00 ab†
PLP 001	3.50 a	3.25 ab†
RV 002	4.00 a	4.00 a†
EPG 013	4.00 a	3.75 a†
EPG 014	3.00 a	3.25 ab
RV 003	3.75 a	4.00 a
RV 007	3.25 a	3.50 a
RV 004	2.75 a	3.25 ab
ODF 003	3.50 a	3.50 a
EPG 006	3.00 a	2.25 b†

[1] Uniformity of Size: 1 (very variable) – 5 (very uniform)
[2] Overall Appearance: 1 (very poor) – 5 (outstanding)
† Data between the regular and low N plots was statistically different at the p ≤ 0.05 level.

Tuber samples used to measure specific gravity were evaluated for hollow heart, brown centre, stem-end discoloration, other types of internal necrosis and scab. EPG 013 tubers had approximately 5% hollow heart when grown in regular N plots and 4% hollow hear when grown on moderate N. Atlantic tubers had approximately 3% hollow hear on the regular N plots. ODF 003 tubers had 8% hollow hear when grown on moderate N. Many of the samples had some level of stem-end discoloration. RV 007, RV 004, and PLP 001 had some level of stem-end discoloration at both levels of N and ODF 003, EPG 013, EPG 014 and EPG 006 when grown in moderate N plots. EPG 013 seemed somewhat susceptible to purple pigmentation developing within tubers and this may be a concern for chip production.

Chip colour scores of composite samples are presented in Table 62. All of the samples gave good chip scores. A higher L-value indicates a lighter chip. The lightest chips were produced from PLP 001 and RV 004 grown on regular N and from ODF 003 grown on moderate N. Atlantic produced chips just below a desirable lightness score of 60 when grown on regular N. All of the cultivars, except RV 002, produced chips with scores higher than 60 when grown on moderate N.

Reducing the N applied to the crop resulted in significantly lighter chip scores for Atlantic, RV 007 and ODF 003. PLP 001, RV 003, RV 004 and EPG 006 produced lighter chips when grown on regular N plots compared to the moderate rate of N. These are composite samples from one year of testing and additional testing may be required to determine optimal agronomic conditions for chip quality.

Table 62: Chip colour scores from subsamples of each variety grown at full nitrogen (approximately 235 lbs./ac) and moderate nitrogen (approximately 190 lbs./ac). Data shown is the mean of duplicate analyses of a composite sample evaluated on a Hunter Colorimeter (L is a lightness score; higher numbers are lighter).

2013	L		L
Regular N		*Moderate N*	
Atlantic	57.9	Atlantic	64.4
PLP 001	70.6	PLP 001	65.9
RV 002	60.2	RV 002	57.6
EPG 013		EPG 013	64.7
EPG 014		EPG 014	65.4
RV 003	66.5	RV 003	60.8
RV 007	58.2	RV 007	63.1
RV 004	68.8	RV 004	63.6
ODF 003	66.0	ODF 003	70.3
EPG 006	67.9	EPG 006	62.7

† Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.

Conclusions

The 2011 variety trial included a number of chipping potato varieties with potential in southern Alberta. Atlantic and Lady Claire were included in the trial as check varieties. Yield of many of the releases compared well with familiar standard varieties. For all varieties except Atlantic, total yield was higher in the regular N plots (225 lbs./ac) than in the low N plots (115 lbs./ac). The specific gravities of chipping varieties tended to be lower on regular N plots than low N plots, as expected. Fewer large tubers were observed from the low N plots than from the regular N plots. All of the samples except Atlantic grown at 225 lbs./ac N gave good chip scores. There were very few internal defects observed in the tubers examined. Scab was prevalent on one variety.

The 2012 variety trial included eight chipping potato cultivars with potential in southern Alberta. Atlantic, Lady Claire and Niska were included in the trial as check varieties. Seven of the cultivars were included in plots fertilized with a regular rate of N (248 lbs./ac), and eight were grown in plots fertilized with a moderate rate of N (150 lbs./ac) to determine the extent to which N may influence yield, size profile and chipping quality. One cultivar and one check were grown at a low (100 lbs./ac) rate of N. Nitrogen, at the rates tested, had no significant impact on total yield or specific gravity. However, there was a nitrogen response to size profile and yield of specific size categories for some cultivars. RV 002 produced the highest marketable yield at regular and moderate levels of N, but did not out-yield the check varieties. ODF 005 responded well to the low level of N relative to the moderate rate. RV 002 and RV 004 performed very well in the trials and chip color was good for all but one cultivar tested at all levels of N. It was difficult to assess EPG 005 and EPG 006 as seed was delayed and planting dates were late for these cultivars in 2012.

The 2013 variety trial included nine chipping potato cultivars with potential in southern Alberta. Atlantic and PLP 001 were included in the trial as check varieties. Eight of the cultivars were included in plots fertilized with a regular rate of N (235 lbs./ac) as well as in plots fertilized with a moderate rate of N (190 lbs./ac) to determine the extent to which N may influence yield, size profile and chipping quality. Nitrogen, at the two rates tested, had no significant impact on total yield or specific gravity. However, there was a nitrogen response to size profile for some cultivars. RV 007 produced the highest marketable yield at both levels of N and out-yielded both check varieties. RV 004 and Atlantic both responded well to the moderate level of N relative to the regular rate. RV 003, ODF 003, RV 002 and RV 004 all performed well in the trials and chip color was good for all cultivars tested at one or both levels of N. It was difficult to assess EPG 014 fully as a limited quality of seed was available for the 2013 season.

The trial was designed to provide regional data for a wide range of potato cultivars. In 2011, the N rate in the low N plots was over 100 lbs./ac lower than the regular rate. A rate of N that is intermediate may give better results than either full or low N. Addressing the agronomic needs of each variety may well result in improvements to yield and size profiles when compared to the results in this trial.

Fresh Market Variety Evaluation

2011

Materials and Methods

The majority of variety evaluations were conducted in small plots at the Crop Diversification Centre South in Brooks, AB. Fertility for the full nitrogen rate was achieved through a combination of soil fertility (105 lbs./ac N; 214 lbs./ac P, 720 lbs./ac K), and broadcast fertilizer (350 lbs./ac of 34-17-0) incorporated at hilling. Fertility for the low nitrogen rate was achieved through a combination of soil fertility and broadcast fertilizer (100 lbs./ac of 11-52-0) incorporated at hilling. Varieties were planted in four replicate rows in a randomized split block design (with fertility as the main block) along with three standard varieties (Norland, Dark Red Norland, and Yukon Gold). Each block was planted adjacent to guard rows to reduce any edge effects.

Eptam 8E (2.2 L/ac) and Sencor 75DF (150 g/ac) were applied pre-plant (May 13) to control weeds. Seed of standard cultivars was provided by Alberta Seed Producers Inc. (ASPI), Edmonton Potato Growers (EPG) and BPS Ltd. and seed of test cultivars was provided by each participant. Potatoes were planted May 30, 2011 approximately 12 to 14 cm deep using a two-row tuber unit planter. Seed was planted at 30 cm spacing in 6 m rows spaced 90 cm apart. Seed was planted as single drop with the exception of some of the larger varieties. Cut seed (70 to 85 g) was suberized prior to planting.

The potatoes were hilled June 8 with a power hiller. The plots were irrigated to maintain soil moisture close to 70%. Foliar fungicides were applied several times during the growing season to prevent early and late blight from developing (Table 63). Insecticide was applied July 17 (Decis 5 EC, 50 mL/ac) to control Colorado potato beetle.

Table 63: Foliar fungicides applied to the potato crop at CDCS to prevent early and late blight development.

Date of Application	*Fungicide*	*Rate*
July 18	Bravo 500	0.64 L/ac
Aug 2	Bravo 500	0.64 L/ac
Aug 23	Dithane DG Rainshield	0.91 kg/ac

Figure 35: Variety evaluation trial at CDCS in Brooks, AB July 22, 2011.

Reglone (1.4 L/ac) was applied September 6 and re-applied (1.0 L/ac) September 12 to facilitate mechanical harvest. Tubers were harvested September 21 – 26 with a one-row Grimme harvester for yield and grade data.

Two varieties and one check were planted in replicate rain-fed plots at CDCN in Edmonton, AB. Fertility for the CDCN (approximately 180 lbs./ac N) site was achieved through a combination of soil fertility (93 lbs./ac N; 120 lbs./ac P, 653 lbs./ac K), and broadcast fertilizer (170 lbs./ac of 46-0-0 and 120 lbs./ac 0-50-17) incorporated prior to planting. Varieties were planted in four replicate rows in a randomized complete block design along with one standard variety (Yukon Gold). Each block was planted adjacent to guard rows to reduce any edge effects.

Tubers were stored at 10˚C until graded. Some clients preferred size data for fresh market cultivars. For these cultivars, tubers were graded into size categories (less than 48mm, 48 – 88mm, and over 88mm). Varieties were evaluated for several other quality parameters during the grading process including uniformity of shape, uniformity of size, eye depth, and overall appearance following the guidelines for the former Western Canadian Potato Breeding Program. Uniformity of shape and uniformity of size were estimated using a scale of 1 to 5 where 1 is most variable and 5 is most uniform. Eye depth was estimated using a scale of 1 to 5 where 1 is deep and 5 is very shallow. Overall appearance was rated on a scale of 1 to 5 where 1 is very poor and 5 is outstanding.

Some clients preferred to have fresh market cultivars graded into weight categories. For these clients, tubers were graded into weight categories (less than 4 oz., 4 to 6 oz., 6 to 10 oz., and over 10 oz.). Varieties were evaluated for several other quality parameters during the grading process including uniformity of shape, uniformity of size and eye depth following the guidelines for the former Western Canadian Potato Breeding Program. Uniformity of shape and uniformity of size were estimated using a scale of 1 to 5 where 1 is most variable and 5 is most uniform. Eye depth was estimated using a scale of 1 to 5 where 1 is deep and 5 is very shallow.

A sample of twenty-five tubers (48 – 88mm or 4 to 10 oz.) from each replicate was used to determine specific gravity using the weight in air over weight in water method. These tubers were cut longitudinally to assess internal defects. A composite sample of 8 tubers (2 per rep) was stored at 8˚C until culinary analyses could be performed. Samples were evaluated for baking and boiling December 1 - 15.

The data presented here have been statistically analyzed using ANOVA and Tukey's Multiple Comparison Test; (SPSS; $p \leq 0.05$). Statistical summaries are available upon request.

Results and Discussion – Graded into Size Categories

Sample hills of each variety were dug for a field day at CDCS August 24, 2011. Photos of these varieties are shown in Figure 36.

Figure 36. Fresh market varieties at the CDCS field day August 24, 2011: a) ASPI 002, b) ASPI 001, c) DR Norland, d) EPG 002, e) EPG 003, f) EPG 004, g) Norland, h) Solanum 001, i) Solanum 002, j) Solanum 003, k) Solanum 004, l) Tuberosum 001, m) Tuberosum 002, n) Tuberosum 003, o) Tuberosum 004, and p) Yukon Gold.

Yield data (total yield; ton/ac) and specific gravities of each of the releases are shown in Table 64. The highest total yield at CDCS was observed with Solanum 001 on regular N, and total yield of ASPI 002, Dark Red Norland, and Tuberosum 001 were not statistically less than that of Solanum 001. At CDCN, ASPI 002 yielded significantly better than ASPI 001 or Yukon Gold.

The highest total yield on low N was observed with Tuberosum 001 and total yield of Tuberosum 002, Tuberosum 003, Tuberosum 004 and Yukon Gold were not statistically different. Yields of Norland, Tuberosum 001, Tuberosum 003 and Tuberosum 004 were significantly greater from the regular fertility plots than from the low fertility plots at CDCS indicating that the low fertility rate was sub-optimal for yield. The trial was designed to provide regional data for a wide range of potato cultivars. The N rate in the low N plots was over 100 lbs./ac lower than the regular rate at CDCS. A rate of N that is intermediate may give better results than either full or low N. Further addressing the agronomic needs of each variety may well result in improvements to yield and size profiles when compared to the results in this trial.

Yukon Gold had the highest specific gravity of the fresh market selections grown at CDCS, statistically greater than Solanum 001 and Tuberosum 002. The specific gravity of Yukon Gold was also significantly higher in the low fertility plots than that of Norland, Tuberosum 001, Tuberosum 002, and Tuberosum 004. When comparing the specific gravity of tubers grown at both fertility levels, only the specific gravity of Tuberosum 001 was significantly higher when grown on low fertility than in regular fertility plots. At CDCN, the specific gravity of Yukon Gold was higher than for ASPI 002 but not significantly different from ASPI 001.

Table 64: Estimated total yield (ton/acre) and specific gravity for each variety grown at full nitrogen (approximately 225 lbs./ac at CDCS and 180 lbs./ac at CDCN) and low nitrogen (approximately 115 lbs./ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

CDCS – 2011 Fresh Market by Size	Yield (ton/ac)	SG
Regular N		
ASPI 001	24.5 cde	1.079 a
ASPI 002	36.2 ab	1.069 ab
DR Norland	31.6 abc	1.064 ab
EPG 002	25.6 cde	1.076 ab
EPG 003	26.6 cde	1.068 ab
EPG 004	22.5 de	1.074 ab
Norland	22.2 e	1.066 ab
Solanum 001	39.8 a	1.055 b
Solanum 002	23.8 cde	1.068 ab
Solanum 003	30.6 bcde	1.074 ab
Solanum 004	28.2 bcde	1.067 ab
Tuberosum 001	31.2 abcd	1.065 ab
Tuberosum 002	24.3 cde	1.060 b
Tuberosum 003	26.2 cde	1.071 ab
Tuberosum 004	24.2 cde	1.071 ab
Yukon Gold	25.3 cde	1.082 a
Low N		
Norland	15.2 q†	1.066 r
Tuberosum 001	22.8 p†	1.071 qr†
Tuberosum 002	17.9 pq	1.066 r
Tuberosum 003	18.4 pq†	1.076 pq
Tuberosum 004	20.6 p†	1.071 qr
Yukon Gold	21.5 p	1.081 p
CDCN	Yield (ton/ac)	SG
Regular N		
ASPI 001	12.9 z	1.090 xy
ASPI 002	22.2 x	1.085 y
Yukon Gold	16.4 y	1.096 x

† indicates significant differences between regular fertility and low fertility plots using a two-tailed t-test.

The mean percentage of total tuber number in each size category is shown in Table 65. It is important to note that harvesting with small plot equipment and manual labour recovers all potatoes over 19mm in diameter. This tended to increase the yield of small potatoes relative to a commercial situation where more of these tubers may be left behind in the field.

In the regular N plots, Solanum 002 produced the greatest percentage of potatoes in the small (<48mm) category, although only statistically different from Yukon Gold. Conversely, Yukon Gold produced the greatest percentage of tubers in the medium (48-88mm) category, only statistically different from Solanum 002. There were no statistically significant differences in the percentage of tuber number in the large (> 88mm) or deformed size categories.

In the low N plots, Tuberosum 003 produced a significantly greater percentage of small tubers (< 48mm) than other varieties, while Yukon Gold, Tuberosum 004, Tuberosum 001 and Norland, a significantly lower percentage of small tubers. Tuberosum 004 produced the greatest percentage of medium tubers (48 – 88mm) and Tuberosum 003 produced the lowest percentage of medium tubers. Yukon Gold produced the highest percentage of large tubers (> 88mm), while Tuberosum 002 and Tuberosum 003 produced none. Tuberosum 004 yielded a significantly lower percentage of small and large potatoes and significantly greater percentage of medium potatoes when grown in low fertility plots compared to regular fertility plots. There were no statistically significant differences in the deformed size categories from the low N plots. A significantly lower percentage of large tubers were observed with Norland, Tuberosum 003 and Tuberosum 004 from the low N plots than from the regular N plots.

At CDCN, there were no statistical differences between varieties in the percentage of tubers in the small or medium size classes. Yukon Gold produced a significantly greater percentage of large and deformed tubers than the ASPI varieties.

Table 65: Percentage of total tuber number in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed) for each variety grown at full nitrogen (approximately 225 lbs./ac at CDCS and 180 lbs./ac at CDCN) and low nitrogen (approximately 115 lbs./ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

CDCS - 2011	< 48mm	48 to 88mm	> 88mm	Deformed
Regular N				
ASPI 001	27.3 ab	71.7 ab	0.7	0.3
ASPI 002	21.3 ab	74.2 ab	1.9	2.6
DR Norland	22.0 ab	70.7 ab	6.4	0.9
EPG 002	44.8 ab	55.2 ab	0.0	0.0
EPG 003	22.2 ab	72.1 ab	5.6	0.2
EPG 004	51.9 ab	48.0 ab	0.0	0.1
Norland	26.1 ab	66.1 ab	6.3	1.5
Solanum 001	30.4 ab	66.4 ab	2.7	0.5
Solanum 002	65.3 a	34.5 b	0.0	0.1
Solanum 003	30.6 ab	63.9 ab	0.3	5.3
Solanum 004	35.2 ab	64.3 ab	0.2	0.3
Tuberosum 001	21.8 ab	74.7 ab	3.3	0.1
Tuberosum 002	44.7 ab	54.9 ab	0.1	0.3
Tuberosum 003	39.3 ab	53.7 ab	6.8	0.2
Tuberosum 004	35.4 ab	59.4 ab	6.1	0.0
Yukon Gold	19.9 b	75.5 a	4.3	0.3
Low N				
Norland	24.0 r	74.5 p	1.3 pq†	0.2
Tuberosum 001	21.5 r	77.5 p	0.9 pq	0.3
Tuberosum 002	48.0 q	52.0 q	0.0 q	0.1
Tuberosum 003	75.7 p	24.3 r	0.0 q†	0.1
Tuberosum 004	17.7 r†	78.0 p†	4.1 pq†	0.2
Yukon Gold	19.5 r	69.5 p	9.2 p	1.7
CDCN	< 48mm	48 to 88mm	> 88mm	Deformed
Regular N				
ASPI 001	24.0	75.7	0.3 y	0.3 y
ASPI 002	21.0	75.8	0.8 y	2.5 y
Yukon Gold	16.0	76.5	2.0 x	6.3 x

† indicates significant differences between regular fertility and low fertility plots using a two-tailed t-test.

The yield of tubers (estimated ton/ac) of each variety is shown by size category in Table 66. In the regular N plots, Solanum 002 produced the greatest yield of small (< 48mm) potatoes, only significantly different from Yukon Gold and EPG 003. Solanum 001 and ASPI 002 gave the greatest yield of medium (48 – 88mm) potatoes but were not statistically different from Dark Red Norland, Solanum 003, Solanum 004 and Tuberosum 001. There were no statistically significant differences in the large (> 88mm) or deformed size categories from regular N plots.

In the low N plots, Tuberosum 003 produced the greatest yield of small (< 48mm) potatoes, but not statistically more than Tuberosum 001 or Tuberosum 002. The greatest yield of medium (48 – 88mm) potatoes was observed with Tuberosum 001 and Tuberosum 004 and Yukon Gold were not statistically different. For Tuberosum 001, Tuberosum 003 and Yukon Gold, yield of medium (48 – 88mm) tubers was significantly higher in the regular N plots than in the low N plots.

At CDCN, Yukon Gold yielded significantly less small potatoes than the ASPI varieties. ASPI 002 produced a significantly greater yield of medium potatoes. ASPI 001 produced the lowest yield of large and deformed tubers, although not statistically different from ASPI 002.

Table 66: Estimated yield (ton/ac) in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed tubers) for each variety grown at full nitrogen (approximately 225 lbs./ac at CDCS and 180 lbs./ac at CDCN) and low nitrogen (approximately 115 lbs./ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

CDCS - 2011	Yield of <48mm (ton/ac)	Yield of 48 to 88mm (ton/ac)	Yield of > 88mm (ton/ac)	Yield of deformed (ton/ac)
Regular N				
ASPI 001	2.7 ab	21.2 bc	0.5	0.1
ASPI 002	2.0 ab	30.5 a	2.0	1.6
DR Norland	2.1 ab	24.2 abc	4.9	0.4
EPG 002	6.7 ab	18.8 bcd	0.0	0.0
EPG 003	1.9 b	21.2 bc	3.6	0.0
EPG 004	6.9 ab	15.6 cd	0.0	0.0
Norland	2.0 ab	16.0 cd	3.9	0.4
Solanum 001	5.8 ab	30.7 a	3.0	0.4
Solanum 002	12.1 a	11.7 d	0.0	0.1
Solanum 003	4.6 ab	23.7 abc	0.3	2.0
Solanum 004	5.4 ab	22.5 abc	0.2	0.1
Tuberosum 001	2.1 ab	26.4 ab	2.6	0.1
Tuberosum 002	5.9 ab	18.1 bcd	0.2	0.4
Tuberosum 003	5.9 ab	16.1 cd	4.0	0.1
Tuberosum 004	4.6 ab	16.4 cd	3.3	0.0
Yukon Gold	1.8 b	20.3 bcd	3.1	0.1
Low N				
Norland	1.6 pq	13.0 qr	0.6 pq†	0.0
Tuberosum 001	2.1 pq	20.0 p†	0.6 pq	0.1
Tuberosum 002	5.3 pq	12.6 qr	0.0 q	0.0
Tuberosum 003	11.1 p	7.2 r†	0.0 q	0.0
Tuberosum 004	1.2 q	17.4 pq	2.0 pq	0.0
Yukon Gold	1.1 q	15.4 pq†	4.5 p	0.5
CDCN	< 48mm	48 to 88mm	> 88mm	Deformed
Regular N				
ASPI 001	1.2 x	11.5 y	0.1 y	0.1 y
ASPI 002	1.4 x	19.4 x	0.6 xy	1.1 xy
Yukon Gold	0.6 y	14.0 y	0.8 x	1.0 x

† indicates significant differences between regular fertility and low fertility plots using a two-tailed t-test.

A comparison of medium potatoes (48 – 88mm) for each variety from regular and low fertility plots is shown in Figure 37.

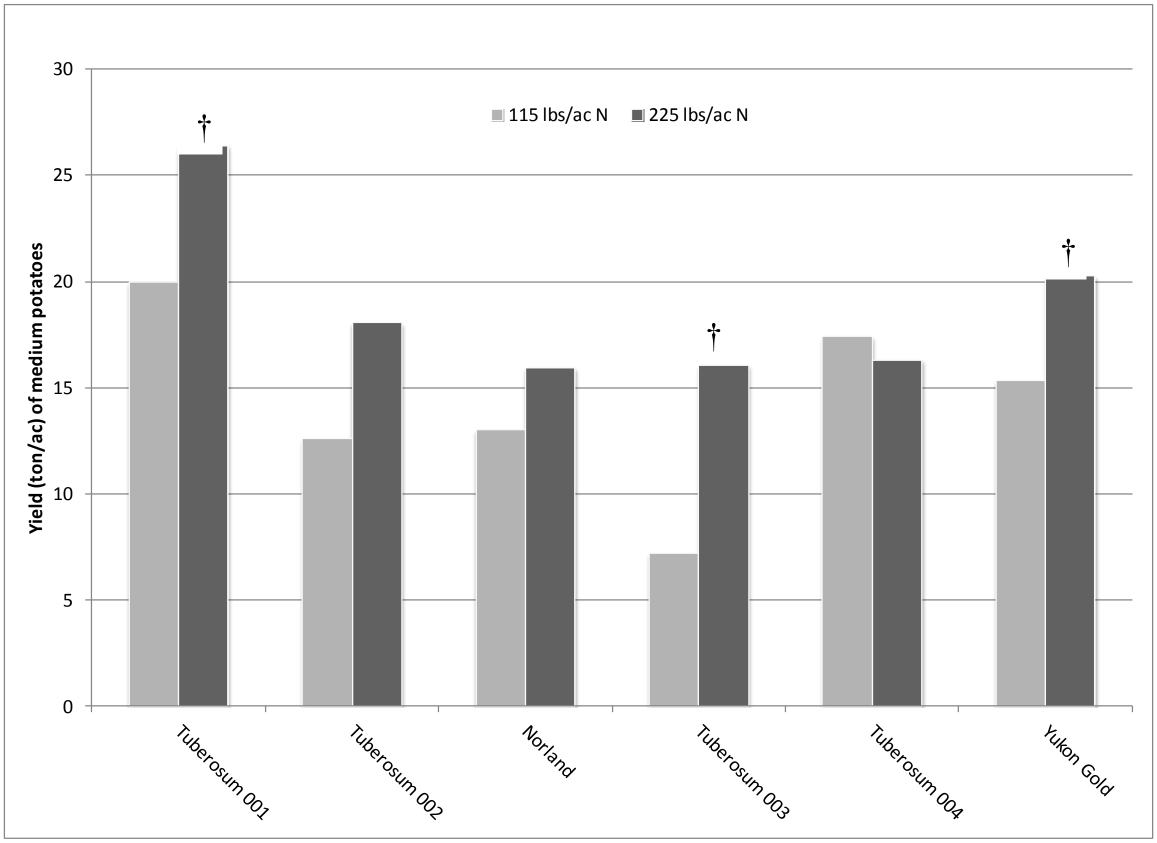

Figure 37: Yield of potatoes (48 – 88mm) produced on low (115 lbs./ac) and regular (225 lbs./ac) N at CDCS. For each variety, columns marked with † are statistically different ($p \leq 0.05$).

Varieties were evaluated for several other quality parameters during the grading process including uniformity of shape, uniformity of size, eye depth, and overall appearance. The results of these subjective assessments are presented in Table 67. There were no significant differences between varieties grown at CDCS in terms of uniformity, eye depth or overall appearance. At CDCN, ASPI 001 exhibited greater uniformity of shape than Yukon Gold and the eyes were significantly shallower on ASPI 001 tubers than those of Yukon Gold.

Table 67: Uniformity of shape, uniformity of size, eye depth, and overall appearance of each variety grown at full nitrogen (approximately 225 lbs./ac at CDCS and 180 lbs./ac at CDCN) and low nitrogen (approximately 115 lbs./ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

CDCS - 2011	Uniformity of Shape	Uniformity of Size	Eye Depth	Overall Appearance
Regular N				
ASPI 001	3.8	3.5	3.3	3.5
ASPI 002	3.0	3.0	3.0	3.0
DR Norland	3.0	3.0	3.0	3.0
EPG 002	3.8	3.8	3.5	3.5
EPG 003	2.8	3.0	3.0	3.0
EPG 004	2.8	3.0	3.8	3.0
Norland	3.0	3.0	3.0	3.0
Solanum 001	3.0	3.0	3.0	3.0
Solanum 002	2.8	3.3	3.0	3.0
Solanum 003	3.0	3.0	3.0	3.0
Solanum 004	3.0	3.0	3.3	3.3
Tuberosum 001	2.3	2.5	3.0	2.8
Tuberosum 002	3.0	3.3	3.0	3.0
Tuberosum 003	3.0	2.8	3.0	3.0
Tuberosum 004	3.0	2.8	3.0	3.0
Yukon Gold	3.0	3.0	3.3	3.0
Low N				
Norland	3.0	3.0	3.0	3.0
Tuberosum 001	3.0	3.0	3.0	3.0
Tuberosum 002	3.3	3.3	3.0	3.0
Tuberosum 003	3.0	3.0	3.3	3.0
Tuberosum 004	3.0	3.0	3.0	3.0
Yukon Gold	3.0	3.0	3.0	3.0
CDCN	Uniformity of Shape	Uniformity of Size	Eye Depth	Overall Appearance
Regular N				
ASPI 001	3.8 a	2.3	4.0 a	3.3
ASPI 002	3.3 ab	2.3	3.8 ab	3.3
Yukon Gold	2.5 b	2.0	2.8 b	2.3

† indicates significant differences between regular fertility and low fertility plots using a two-tailed t-test.

Tuber samples used to measure specific gravity were evaluated for hollow heart (HH), brown centre (BC), stem-end discoloration (SED), other types of internal necrosis and scab. Subsamples of ASPI 002, EPG 002, Norland, Tuberosum 003, and Tuberosum 004 were free of any internal defects. There were very few internal defects observed in the other varieties examined, except for Yukon Gold where stem-end discoloration was common and hollow heart and vascular discoloration were observed in at least one tuber of each subsample. Solanum 001 and Solanum 002 had brown centre in one tuber of one subsample. EPG 003 and Solanum 003 showed some evidence of hollow heart and/or brown centre and several subsamples had anthocyanin present in the tubers (PP), usually a variety characteristic. ASPI 002, Dark Red Norland, Solanum 004, and Tuberosum 002 had some stem-end discoloration and Tuberosum 001 had some vascular discoloration (VD), possibly a result of immaturity at the time desiccant was applied. EPG 004 had one subsample with evidence of hollow heart and was the only variety with common scab lesions present on one tuber.

Varieties were evaluated in the Food Science lab at CDCS for culinary quality. Data from the boil and bake evaluations is presented in Table 68.

Table 68: Culinary evaluations of each variety grown at full nitrogen (approximately 225 lbs./ac at CDCS and 180 lbs./ac at CDCN) and low nitrogen (approximately 115 lbs./ac). Data shown is the mean of duplicate analyses of a composite sample.

Boiled Potatoes

CDCS - 2011	Flesh color	Waxiness†	Sloughing	After Cooking Discoloration
Regular N				
ASPI 001	yellow	3	moderate	none
ASPI 002	off-white	3	little or no	none
DR Norland	off-white	3	moderate	moderate
EPG 002	yellow	3	little or no	none
EPG 003	off-white	3	little or no	none
EPG 004	yellow	2	moderate	moderate
Norland	yellow	2	little or no	none
Solanum 001	yellow	2	little or no	none
Solanum 002	deep yellow	3	little or no	none
Solanum 003	deep yellow	4	little or no	none
Solanum 004	deep yellow	3	little or no	none
Tuberosum 001	deep yellow	3	little or no	none
Tuberosum 002	yellow	3	little or no	none
Tuberosum 003	yellow	3	little or no	none
Tuberosum 004	off-white	2	little or no	none
Yukon Gold	deep yellow	4	moderate	none
Low N				
Norland	off-white	3	little or no	none
Tuberosum 001	yellow	3	little or no	none
Tuberosum 002	off-white	2	little or no	none
Tuberosum 003	n/a	n/a	n/a	n/a
Tuberosum 004	yellow	2	little or no	none
Yukon Gold	deep yellow	4	severe	none

CDCN	Flesh color	Waxiness	Sloughing	After Cooking Discoloration
Regular N				
ASPI 001	off-white	3	little or no	none
ASPI 002	off-white	2	little or no	none
Yukon Gold	deep yellow	4	little or no	none

† Waxiness: 1 = very waxy (very clean cuts); 2 = waxy (clean cuts with some residue); 3 = slightly waxy (more mealy than waxy); 4 = not waxy (fluffy/mealy)

Table 68 continued.

Baked Potatoes

CDCS - 2011	Flesh color	Texture*	After Cooking Discoloration
Regular N			
ASPI 001	off-white	3	none
ASPI 002	off-white	2	none
DR Norland	yellow	1	none
EPG 002	yellow	3	none
EPG 003	off-white	3	none
EPG 004	yellow	2	none
Norland	yellow	3	none
Solanum 001	off-white	2	none
Solanum 002	deep yellow	2	none
Solanum 003	deep yellow	3	none
Solanum 004	deep yellow	2	none
Tuberosum 001	deep yellow	4	none
Tuberosum 002	yellow	2	none
Tuberosum 003	yellow	3	none
Tuberosum 004	deep yellow	3	none
Yukon Gold	deep yellow	3	none
Low N			
Norland	yellow	3	none
Tuberosum 001	deep yellow	4	none
Tuberosum 002	yellow	2	none
Tuberosum 003	yellow	3	none
Tuberosum 004	deep yellow	4	none
Yukon Gold	deep yellow	3	none
CDCN	Flesh color	Texture	After Cooking Discoloration
Regular N			
ASPI 001	off-white	3	none
ASPI 002	off-white	3	none
Yukon Gold	yellow	4	none

* Texture: 1 = wet; 2 = slightly wet; 3 = slightly mealy; 4 = mealy

Results and Discussion – Graded into Weight Categories

Sample hills of each variety were dug for a field day at CDCS August 24, 2011. Photos of these varieties are shown in Figure 38.

Figure 38. Fresh market varieties at the CDCS field day August 24, 2011: a) A99326-1PY*, b) Amarosa, c) Norland, d) Red Sunset*, e) Terra Rosa, f) Alpine Russet*, g) Blazer Russet, h) Owyhee Russet*, i) Tebina Russet, j) Yukon Gem*, and k) Yukon Gold. Varieties marked with an asterisk were planted as mini-tubers approximately 1 week after the other varieties.

Yield data (total yield; ton/ac) and specific gravities of each of the releases are shown in Table 69. The highest total yield of these fresh market varieties was observed with Tebina Russet and total yield of Yukon Gold was not statistically different.

The highest total yield on low N was observed with Tebina Russet and total yields of Yukon Gold and Blazer Russet were not statistically different. Yields of Norland were significantly greater from the regular N plots than from the low N plots at CDCS indicating that the low N rate was sub-optimal for yield. The trial was designed to provide regional data for a wide range of potato cultivars. The N rate in the low N plots was over 100 lbs./ac lower than the regular rate at CDCS. A rate of N that is intermediate may give better results than either full or low N. Further addressing the agronomic needs of each variety may well result in improvements to yield and size profiles when compared to the results in this trial.

Terra Rosa had the highest specific gravity of these fresh market selections grown at CDCS, and Yukon Gold was not statistically different. Noland and Red Sunset had the lowest specific gravity on regular N. The specific gravity of Yukon Gold and Tebina Russet were the highest in the low fertility plots and were statistically higher than that of Norland. There were no significant differences in specific gravity of varieties grown on regular N compared to the low N plots.

Table 69: Estimated total yield (ton/acre) and specific gravity for each variety grown at full nitrogen (approximately 225 lbs./ac at CDCS and 180 lbs./ac at CDCN) and low nitrogen (approximately 115 lbs./ac). Varieties marked with an asterisk were planted as mini-tubers later than other varieties. Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the $p < 0.05$ level.

CDCS – 2011 Fresh Market by Weight	Yield (ton/ac)	SG
Regular N		
A99326-1PY*	20.6 bc	1.072 e
Amarosa	16.3 c	1.073 de
Norland	22.2 bc	1.066 f
Red Sunset*	16.5 bc	1.062 f
Terra Rosa	21.2 bc	1.087 a
Alpine Russet*	19.0 bc	1.080 bc
Blazer Russet	19.7 bc	1.077 bcde
Owyhee Russet*	17.5 bc	1.083 ab
Tebina Russet	31.0 a	1.079 bcd
Yukon Gem*	20.5 bc	1.076 c
Yukon Gold	25.3 ab	1.082 abc
Low N		
Norland	15.2 q†	1.066 q
Blazer Russet	18.6 pq	1.075 p
Tebina Russet	30.1 p	1.081 p
Yukon Gold	21.7 pq	1.081 p

† indicates significant differences between regular fertility and low fertility plots using a two-tailed t-test.

* Varieties marked with an asterisk were planted as mini-tubers approximately 1 week after the other varieties.

The mean percentage of total tuber number in each size category is shown in Table 70. It is important to note that harvesting with small plot equipment and manual labour recovers all potatoes over 19mm in diameter. This tended to increase the yield of small potatoes relative to a commercial situation where more of these tubers may be left behind in the field.

In the regular N plots, Amarosa produced the highest percentage of potatoes in the small (< 4 oz.) category, statistically greater than all other varieties. Conversely, Amarosa produced the lowest percentage of tubers in the 4 to 6 oz. category. Yukon Gold yielded the greatest percentage of tubers in the 6 to 10 oz. range and Blazer Russet and Norland were not statistically different. Blazer Russet yielded the greatest percentage of tubers over 10 oz., although only statistically different from Amarosa which did not produce any tubers over 10 oz. There were no statistically significant differences in the percentage of tuber number in the deformed size category.

In the low N plots, Tebina Russet produced a significantly greater percentage of small tubers (< 48mm) than other varieties. There were no significant differences in the percentage of tubers in the 4 to 6 oz. category for varieties grown on low N. Blazer Russet produced a significantly higher percentage of 6 to 10 oz. tubers than Tebina Russet when grown on low N. Yukon Gold produced a significantly higher percentage of tubers over 10 oz. than Tebina Russet in the low N plots. There were no statistically significant differences in the percentage of tuber number in the deformed size category. There were no significant differences in the percentage of tubers in each size category when varieties grown on regular N were compared to the low N plots.

Table 70: Percentage of total tuber number in each size category (< 4 oz., 4 to 6 oz., 6 to 10 oz., > 10 oz. and deformed) for each variety grown at full nitrogen (approximately 225 lbs./ac) and low nitrogen (approximately 115 lbs./ac). Varieties marked with an asterisk were planted as mini-tubers later than other varieties. Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the $p < 0.05$ level.

CDCS – 2011	< 4 oz.	4 to 6 oz.	6 to 10 oz.	> 10 oz.	Deformed
Regular N					
A99326-1PY*	71.0 b	18.4 a	8.8 def	1.4 ab	0.4
Amarosa	92.0 a	7.3 b	0.7 f	0.0 b	0.0
Norland	32.8 d	20.7 a	24.8 ab	26.2 a	1.5
Red Sunset*	63.6 bc	18.8 a	14.0 cde	3.2 ab	0.5
Terra Rosa	51.8 c	19.8 a	20.8 bc	7.2 ab	0.8
Alpine Russet*	54.0 c	28.6 a	14.8 cde	2.0 ab	0.7
Blazer Russet	29.6 d	18.7 a	30.2 a	26.4 a	1.0
Owyhee Russet*	68.2 b	23.1 a	7.8 ef	0.6 ab	0.2
Tebina Russet	50.7 c	25.0 a	19.1 bc	4.5 ab	0.9
Yukon Gem*	52.5 c	26.1 a	17.6 bc	3.6 ab	0.3
Yukon Gold	30.8 d	20.9 a	31.8 a	19.1 a	0.6
Low N					
Norland	35.7 q	24.7	28.1 pq	12.6 pq	0.6
Blazer Russet	25.4 qr	22.3	32.9 p	21.1 pq	2.1
Tebina Russet	52.6 p	29.7	15.5 q	1.8 q	0.5
Yukon Gold	19.7 r	21.7	31.3 pq	34.8 p	1.8

† indicates significant differences between regular fertility and low fertility plots using a two-tailed t-test.

* Varieties marked with an asterisk were planted as mini-tubers approximately 1 week after the other varieties.

The yield of tubers (estimated ton/ac) of each variety is shown by size category in Table 71. In the regular N plots, Amarosa produced significantly greater yield of tubers under 4 oz. and tubers 4 to 6 oz. than all other varieties. Tebina Russet produced the greatest yield of 6 to 10 oz. tubers but was not statistically different from Yukon Gold, Blazer Russet, Terra Rosa and Norland. Norland produced the highest yield of tubers over 10 oz. although only statistically greater than

Amarosa with no tubers in this category. There were no statistically significant differences in the deformed size category from regular N plots.

In the low N plots, Tebina Russet produced the greatest yield of tubers under 4 oz. and 4 to 6 oz. Yukon Gold produced a significantly higher yield of tubers over 10 oz. than Tebina Russet or Norland. There were no statistically significant differences between varieties when yields of 6 to 10 oz. and deformed tubers were evaluated. Yukon Gold produced significantly lower yields of tubers under 4 oz. and 6 to 10 oz. when grown in low N plots than in regular N plots. Norland produced a significantly lower yield of tubers over 10 oz. when grown on low N compared to regular N.

Table 71: Estimated yield (ton/ac) in each size category (< 4 oz., 4 to 6 oz., 6 to 10 oz., > 10 oz. and deformed) for each variety grown at full nitrogen (approximately 225 lbs./ac) and low nitrogen (approximately 115 lbs./ac). Varieties marked with an asterisk were planted as mini-tubers later than other varieties. Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

CDCS - 2011	Yield of < 4 oz. (ton/ac)	Yield of 4 to 6 oz. (ton/ac)	Yield of 6 - 10 oz. (ton/ac)	Yield of > 10 oz. (ton/ac)	Yield of deformed (ton/ac)
Regular N					
A99326-1PY*	9.9 b	5.6 bcd	3.8 de	0.9 ab	0.2
Amarosa	13.4 a	13.4 a	0.3 f	0.0 b	0.0
Norland	2.4 e	3.2 de	6.2 abcde	9.5 a	0.4
Red Sunset*	5.9 cd	5.9 bcd	4.0 cde	1.6 ab	0.1
Terra Rosa	5.2 de	4.4 bcde	7.3 abc	3.6 ab	0.4
Alpine Russet*	6.0 cd	6.8 b	5.4 cde	1.1 ab	0.3
Blazer Russet	2.1 e	2.3 e	6.5 abcd	7.4 a	0.3
Owyhee Russet*	9.2 bc	5.1 bcde	2.6 ef	0.4 ab	0.1
Tebina Russet	8.8 bc	3.8 cde	9.5 a	3.4 ab	0.6
Yukon Gem*	6.2 cd	6.0 bc	5.9 bcde	1.8 ab	0.3
Yukon Gold	2.8 e	3.9 cde	9.3 ab	8.4 a	0.3
Low N					
Norland	2.3 q	3.1 q	5.5	3.7 qr†	0.1
Blazer Russet	1.9 q	2.6 q	6.6	6.3 pq	0.6
Tebina Russet	9.5 p	10.5 p	7.9	1.3 r	0.3
Yukon Gold	1.4 q†	3.0 q	6.6†	9.6 p	0.4

† indicates significant differences between regular fertility and low fertility plots using a two-tailed t-test.

* Varieties marked with an asterisk were planted as mini-tubers approximately 1 week after the other varieties.

Varieties were evaluated for several other quality parameters during the grading process including uniformity of shape, uniformity of size and eye depth. The results of these subjective assessments are presented in Table 72. There were no significant differences between varieties grown at CDCS in terms of uniformity or eye depth.

Table 72: Uniformity of shape, uniformity of size, and eye depth ratings for each variety grown at full nitrogen (approximately 225 lbs./ac at CDCS). Varieties marked with an asterisk were planted as mini-tubers later than other varieties. Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

CDCS - 2011	Uniformity of Shape	Uniformity of Size	Eye Depth
Regular N			
A99326-1PY*	3.0	3.3	3.0
Amarosa	3.0	3.0	3.0
Norland	3.0	3.0	3.0
Red Sunset*	3.0	3.0	3.0
Terra Rosa	3.0	3.0	3.0
Alpine Russet*	3.0	3.0	3.0
Owyhee Russet*	3.3	3.3	4.0
Tebina Russet	2.0	2.7	3.0
Yukon Gem*	3.0	3.0	3.3
Yukon Gold	3.0	3.0	3.3

† indicates significant differences between regular fertility and low fertility plots using a two-tailed t-test.

* Varieties marked with an asterisk were planted as mini-tubers approximately 1 week after the other varieties.

Tuber samples used to measure specific gravity were evaluated for hollow heart (HH), brown centre (BC), stem-end discoloration (SED), other types of internal necrosis and scab. Subsamples of Amarosa, Alpine Russet, Norland, Owyhee Russet, Red Sunset, and Tebina Russet were free of any internal defects. There were very few internal defects observed in the other varieties examined, except for Yukon Gold where stem-end discoloration was common and hollow heart and vascular discoloration were observed in at least one tuber of each subsample. Yukon Gem had brown centre in one tuber of two subsamples. Blazer Russet showed some evidence of hollow heart. A99326-1PY had anthocyanin present in the tubers (PP) of several subsamples, usually a variety characteristic. Terra Rosa had some stem-end discoloration and vascular discoloration (VD), possibly a result of immaturity at the time desiccant was applied. Yukon Gold was the only variety with common scab lesions present on one tuber.

Varieties were evaluated in the Food Science lab at CDCS for culinary quality. Data from the boil and bake evaluations is presented in Table 73.

Table 73: Culinary evaluations of each fresh market variety grown at full nitrogen (approximately 225 lbs./ac) at CDCS. Data shown is the mean of duplicate analyses of a composite sample.

Boiled Potatoes

CDCS - 2011	Flesh color	Waxiness†	Sloughing	After Cooking Discoloration
Regular N				
A99326-1PY*	deep yellow	3	none	none
Amarosa	purple	3	none	none
Norland	off-white	2	none	none
Red Sunset*	yellow	3	none	none
Terra Rosa	light purple	3	none	moderate
Alpine Russet*	off-white	3	none	none
Owyhee Russet*	off-white	4	none	none
Tebina Russet	yellow	3	none	none
Yukon Gem*	deep yellow	3	none	moderate
Yukon Gold	deep yellow	4	moderate	none

Baked Potatoes

CDCS	Flesh color	Texture*	After Cooking Discoloration
Regular N			
A99326-1PY*	deep yellow	3	none
Amarosa	deep purple	3	none
Norland	yellow	3	none
Red Sunset*	off-white	2	none
Terra Rosa	light purple	3	none
Alpine Russet*	off-white	3	none
Owyhee Russet*	deep yellow	4	none
Tebina Russet	yellow	3	none
Yukon Gem*	deep yellow	4	none
Yukon Gold	deep yellow	3	none

† Waxiness: 1 = very waxy (very clean cuts); 2 = waxy (clean cuts with some residue); 3 = slightly waxy (more mealy than waxy); 4 = not waxy (fluffy/mealy)

* Varieties marked with an asterisk were planted as mini-tubers approximately 1 week after the other varieties.

†† Texture: 1 = wet; 2 = slightly wet; 3 = slightly mealy; 4 = mealy

2012

Materials and Methods

The variety evaluation was conducted in small plots at the Crop Diversification Centre South in Brooks, AB. Fertility for the full nitrogen rate (248 lbs/ac) was achieved through a combination of soil fertility (82 lbs./ac N; 192 lbs./ac P, 760 lbs./ac K), broadcast fertilizer (176 lbs./ac of 34-0-0 and 100 lbs./ac of 11-52-0) incorporated prior to planting and broadcast fertilizer (279 lbs./ac 34-0-0) incorporated at hilling. Fertility for the medium nitrogen rate (150 lbs./ac) was achieved through a combination of soil fertility and broadcast fertilizer (176 lbs./ac of 34-0-0 and 100 lbs./ac of 11-52-0) incorporated prior to planting. Fertility for the low nitrogen rate (90 lbs./ac) was achieved through a combination of soil fertility and broadcast fertilizer (100 lbs./ac of 11-52-0) incorporated prior to planting. Varieties were planted in four replicate rows in a randomized split block design (with fertility as the main block) along with standard varieties (Norland, Russet Norkotah, and Yukon Gold). Each block was planted adjacent to guard rows to reduce any edge effects.

Eptam 8E (2.2 L/ac) and Sencor 75DF (150 g/ac) were applied pre-plant (May 10) to control weeds. Seed of standard cultivars was provided by Edmonton Potato Growers and seed of test cultivars was provided by each participant. Most varieties were planted May 23, 2012 approximately 5 to 5½"deep using a two-row tuber unit planter. Seed was planted at 30cm spacing in 6m rows spaced 90cm apart. Seed was cut (70 to 85 g) and suberized prior to planting.

The potatoes were hilled June 4 with a power hiller. The plots were irrigated to maintain soil moisture close to 70%. Foliar fungicides were applied several times during the growing season to prevent early and late blight from developing (Table 74). Insecticide was applied July 17 (Matador 120 EC, 40 mL/ac) and August 15 (Decis 5 EC, 50 mL/ac) to control Colorado potato beetle.

Table 74: Foliar fungicides applied to the potato crop to prevent early and late blight development.

Date of Application	***Fungicide***	***Rate***
June 29	Bravo 500	0.64 L/ac
July 27	Ridomil Gold Bravo	883 mL/ac
Aug 15	Bravo 500	0.64 L/ac

Figure 39: Variety evaluation trial at CDCS in Brooks, AB July 20, 2012.

Reglone (1.4 L/ac) was applied September 13 to facilitate mechanical harvest. Tubers were harvested September 18-25 with a one-row Grimme harvester for yield and grade data.

Tubers were stored at 8˚C until graded. Tubers were graded into size categories (less than 48mm, 48 – 88mm, and over 88mm). A sample of twenty-five tubers (48 – 88mm) from each replicate was used to determine specific gravity using the weight in air over weight in water method. These tubers were cut longitudinally to assess internal defects. A composite sample of 8 tubers (2 per rep) was stored at 8˚C until culinary analyses were performed. Samples were evaluated for suitability for boiling and baking November 23, 2012.

The data presented here have been statistically analyzed using ANOVA and Tukey's Multiple Comparison Test; (SPSS; $p \leq 0.05$). Statistical summaries are available upon request. Comparisons for specific cultivars at two rates of N were analyzed using t-tests on a cultivar-by-cultivar basis (Excel; $p \leq 0.05$).

Results and Discussion

Sample hills of each variety were dug for a field day August 22, 2012. Photos of these varieties are shown in Figure 40.

Figure 40. Fresh Market varieties at the CDCS field day August 22, 2012 (cultivars marked with an asterisk are from archives): a) EPG 007, b) PLP 005, c) Markies, d) Norkotah, e) Norland, f) Roko*, g) Sangre*, h) Yukon Gold, i) Amarosa, j) ASPI 003, k) ASPI 002*, l) SI 002, m) SI 003, n) SI 004, o) SI 001*, p) Red Sunset*, q) Terra Rosa, r) ASPI 001, and s) Yukon Gem

Yield data (total yield; ton/ac) and specific gravities of each of the fresh market cultivars are shown in Table 75. The highest total yield on regular N plots at CDCS was observed with SI 001. SI 001 yielded significantly more than all other fresh market cultivars at this level of N.

The highest total yield on moderate N at CDCS was observed with Norland. Total yield of CV99044-3 was statistically lower than that of Norland at 150 lbs./ac N.

Specific gravity of tubers grown on 248 lbs./ac ranged from 1.067 for SI 001 to 1.099 for Terra Rosa. There were no statistical differences in specific gravity between fresh market cultivars at this level of N. Specific gravity of tubers grown on 150 lbs./ac ranged from 1.071 for Norland to 1.102 for EPG 007 and CV99044-3. As expected, specific gravity of Amarosa on 100 lbs./ac plots was significantly higher than when grown on 248 lbs./ac N.

The trial was designed to provide regional data for a wide range of potato cultivars. Amarosa, CV99044-3, Markies, Russet Norkotah, Norland, Roko, Sangre, and Yukon Gold were grown on two rates of N. There were significant differences in total yield and/or specific gravity for Amarosa, CV99044-3, Roko and Yukon Gold as a result of different levels of N. Further addressing the agronomic needs of each cultivar may well result in improvements to yield and size profiles when compared to the results in this trial.

Table 75: Estimated total yield (ton/acre) and specific gravity for each variety grown at full nitrogen (approximately 248 lbs./ac), moderate nitrogen (approximately 150 lbs./ac) and low nitrogen (100 lbs./ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

2012 Fresh Market	Yield (ton/ac)	SG
Regular N		
Amarosa	17.0 f†	1.080 a†
ASPI 003	25.6 b-f	1.080 a
PLP 005	27.5 b-e†	1.091 a
ASPI 002	23.6 c-f	1.098 a
SI 002	26.8 b-f	1.077 a
SI 003	34.6 b	1.084 a
SI 004	27.9 bcd	1.073 a
Markies	23.4 c-f	1.086 a
Russet Norkotah	27.9 bcd	1.087 a
Norland	29.7 bcd	1.078 a
SI 001	46.5 a	1.067 a
Red Sunset	17.5 ef	1.073 a
Roko	29.3 bcd†	1.092 a
Sangre	23.7 c-f	1.087 a
Terra Rosa	22.1 def	1.099 a
ASPI 001	32.6 bc	1.088 a
Yukon Gem	34.8 b	1.078 a
Yukon Gold	28.4 bcd†	1.092 a
Moderate N		
EPG 007	25.8 ab	1.102 a
PLP 005	13.0 b†	1.102 a
Markies	18.3 ab	1.086 b
Russet Norkotah	24.0 ab	1.086 b
Norland	28.4 a	1.071 c
Roko	21.9 ab†	1.091 ab
Sangre	19.3 ab	1.083 bc
Yukon Gold	17.3 ab†	1.088 b
Low N		
Amarosa	4.13 b†	1.095 a†
Norland	23.32 a	1.083 b

† Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.

The mean percentage of total tuber number in each size category is shown in Table 76. It is important to note that harvesting with small plot equipment and manual labour recovers all potatoes over 19mm in diameter. This tended to increase the yield of small potatoes relative to a commercial situation where more of these tubers may be left behind in the field.

The percentage of tuber count in each size category for fresh market cultivars is represented in Table 3. In the 248 lb./ac N plots, Amarosa, SI 002, SI 004, Markies and Terra Rosa produced a greater percentage of small tubers (< 48 mm) than medium tubers (48 – 88mm). CV99044-3 has similar percentages of small and medium tubers, and the remainder of cultivars produced more medium than small tubers. Yukon Gold, Yukon Gem, Sangre and Red Sunset had a significantly higher percentage of oversized tubers than other cultivars which may be an indication that these cultivars are early maturing and an earlier harvest date may be more appropriate. Yukon Gold had a significantly higher percentage of deformed tubers than all other cultivars, except ASPI 001 and may be related to growing past an optimal harvest date.

In moderate N plots, Amarosa, SI 002, SI 004, Markies and Terra Rosa produced a greater percentage of small tubers (< 48 mm) than medium tubers (48 – 88mm). Russet Norkotah and Roko produced similar percentage of small and medium tubers at this level of N. A small percentage of oversized tubers were produced by cultivars at this level of N in the trial. All of the tested cultivars, except Sangre and Russet Norkotah produced a smaller percentage of deformed tubers than Yukon Gold. Size distribution of Amarosa and Norland on 100 lbs./ac N plots was similar to the size profiles of these cultivars at other levels of N.

Significant differences in percentages of specific size categories were observed for CV99044-3, Norland, Russet Norkotah and Yukon Gold grown at different rates of N.

Table 76: Percentage of total tuber number in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed) for each variety grown at full nitrogen (approximately 248 lbs./ac), moderate nitrogen (approximately 150 lbs./ac) and low nitrogen (100 lbs./ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the $p < 0.05$ level.

2012	No. of <48mm	No. of 48 to 88mm	No. of > 88mm	No. of deformed
Regular N				
Amarosa	99.0 a	0.4 d	0.3 bc	0.2 b
ASPI 003	25.5 ef	69.2 a	3.0 bc	2.3 b
PLP 005	48.6 bcd†	49.4 abc†	0.6 bc	1.4 b
ASPI 002	35.9 de	61.5 ab	0.0 c	2.6 b
SI 002	63.8 b	33.8 bc	0.0 c	2.4 b
SI 003	34.4 def	60.5 abc	1.0 bc	4.1 b
SI 004	57.0 bc	41.7 abc	0.2 c	1.1 b
Markies	64.1 b	31.1 cd	0.1 c	4.6 b
Russet Norkotah	35.4 c-f	57.0 abc	2.1 bc†	5.4 b
Norland	23.6 ef	66.5 a†	2.7 bc	2.1 b
SI 001	36.7 c-f	57.5 abc	2.0 bc	3.8 b
Red Sunset	37.9 cde	56.9 abc	3.7 abc	1.6 b
Roko	47.8 bcd	50.0 abc	0.0 c	2.3 b
Sangre	30.9 def	62.7 abc	3.6 abc	2.8 b
Terra Rosa	63.2 b	34.4 bc	0.0 c	2.4 b
ASPI 001	29.2 ef	63.3 ab	1.8 bc	5.7 ab
Yukon Gem	31.9 def	60.8 abc	4.7 ab	2.6 b
Yukon Gold	15.1 f†	64.6 ab	7.8 a†	12.5 a
Moderate N				
EPG 007	33.2 cd	64.0 ab	1.3 abc	1.4 bc
PLP 005	61.0 ab†	38.6 de†	0.0 c	0.6 c
Markies	68.9 a	27.7 e	0.0 c	3.4 bc
Russet Norkotah	47.0 bc	46.5 cd	0.6 bc†	5.9 ab
Norland	24.1 d	71.6 a†	2.9 ab	1.4 bc
Roko	53.6 ab	43.8 cd	0.0 c	2.6 bc
Sangre	35.2 cd	57.8 abc	2.7 ab	4.2 abc
Yukon Gold	35.3 cd†	53.0 bcd	3.3 a†	8.4 a
Low N				
Amarosa	100.0 a	0.0 b	0.0 b	0.0 b
Norland	27.4 b	67.5 a	1.3 a	3.9 a

† Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.

The yield of tubers (estimated ton/ac) of each variety is shown by size category in Table 77. In the regular N plots, Amarosa yielded significantly more potatoes less than 48 mm than most cultivars, but was not significantly different from SI 002, SI 004 or Terra Rosa. Marketable yield ranged from 0.2 ton/ac of Amarosa to 32.7 ton/ac of SI 001. SI 001 yielded significantly more marketable tubers than Yukon Gold or Norland (checks) in this trial, but was not statistically different from Russet Norkotah, SI 003, Yukon Gem or ASPI 001.

At the moderate rate of N, Markies produced a significantly greater yield of small tubers compared to two check varieties, Yukon Gold and Norland. Yield of marketable tubers (48 – 88mm) ranged from 7.7 ton/ac for CV99044-3 to 22.6 ton/ac for Norland.

N level had a significant impact on the yield of small Amarosa tubers, where a greater yield of small tubers was harvested from the regular N plots than from the moderate N plots. Significantly higher yield of marketable CV99044-3 tubers were produced on 248 lbs./ac N than 150 lbs./ac N plots. On 150 lbs./ac plots, significantly lower yield of oversized Russet Norkotah and Yukon Gold tubers were produced compared to the higher rate of N. No significant impact of N level was observed for yield of deformed tubers.

Table 77: Estimated yield (ton/ac) in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed tubers) for each variety grown at full nitrogen (approximately 248 lbs./ac), moderate nitrogen (approximately 150 lbs./ac) and low nitrogen (100 lbs./ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

2012	Yield of <48mm (ton/ac)	Yield of 48 to 88mm (ton/ac)	Yield of > 88mm (ton/ac)	Yield of deformed (ton/ac)
Regular N				
Amarosa	16.7 a†	0.2 f	0.0 a	0.1 a
ASPI 003	2.4 c	20.2 b-e	2.2 a	0.8 a
PLP 005	7.1 bc	19.2 b-e†	8.7 a	12.0 a
ASPI 002				
SI 002	11.5 ab	14.2 b-e	0.0 a	1.1 a
SI 003	4.7 bc	26.4 ab	1.3 a	2.2 a
SI 004	9.2 abc	17.8 b-e	0.4 a	0.6 a
Markies	7.7 bc	13.3 cde	0.1 a	2.2 a
Russet Norkotah	3.5 bc	20.4 a-e	2.3 a†	1.7 a
Norland	6.4 bc	20.0 b-e	2.4 a	9.5 a
SI 001	7.3 bc	32.7 a	3.2 a	3.4 a
Red Sunset	2.5 c	12.6 def	1.9 a	0.5 a
Roko	7.4 bc	19.3 b-e	0.0 a	2.6 a
Sangre	2.7 c	17.2 b-e	2.8 a	1.1 a
Terra Rosa	9.8 abc	11.6 ef	0.0 a	0.8 a
ASPI 001	2.4 c	25.6 abc	2.3 a	2.3 a
Yukon Gem	4.0 bc	24.7 a-d	4.8 a	1.3 a
Yukon Gold	4.5 bc†	13.0 de	6.4 a†	4.4 a
Moderate N				
EPG 007	3.5 abc	20.6 a	1.083 abc	0.6 ab
PLP 005	5.1 abc	7.7 b†	0.00 c	0.2 b
Markies	7.9 a	8.7 b	0.00 c	1.7 ab
Russet Norkotah	5.3 abc	15.6 ab	0.7 bc†	2.4 a
Norland	2.6 bc	22.6 a	2.7 a	0.5 ab
Roko	7.3 ab	13.7 ab	0.00 c	0.9 ab
Sangre	2.5 c	13.9 ab	1.7 abc	1.2 ab
Yukon Gold	2.3 c	10.8 b	2.1 ab†	2.2 ab
Low N				
Amarosa	4.1 a†	0.0 b	0.0 b	0.0 b
Norland	2.4 b	18.3 a	1.0 a	1.6 a

† Data between the regular and low N plots was statistically different at the p ≤ 0.05 level.

A comparison of medium potatoes (48 – 88mm) for the three cultivars grown on regular and moderate N plots is shown in Figure 41.

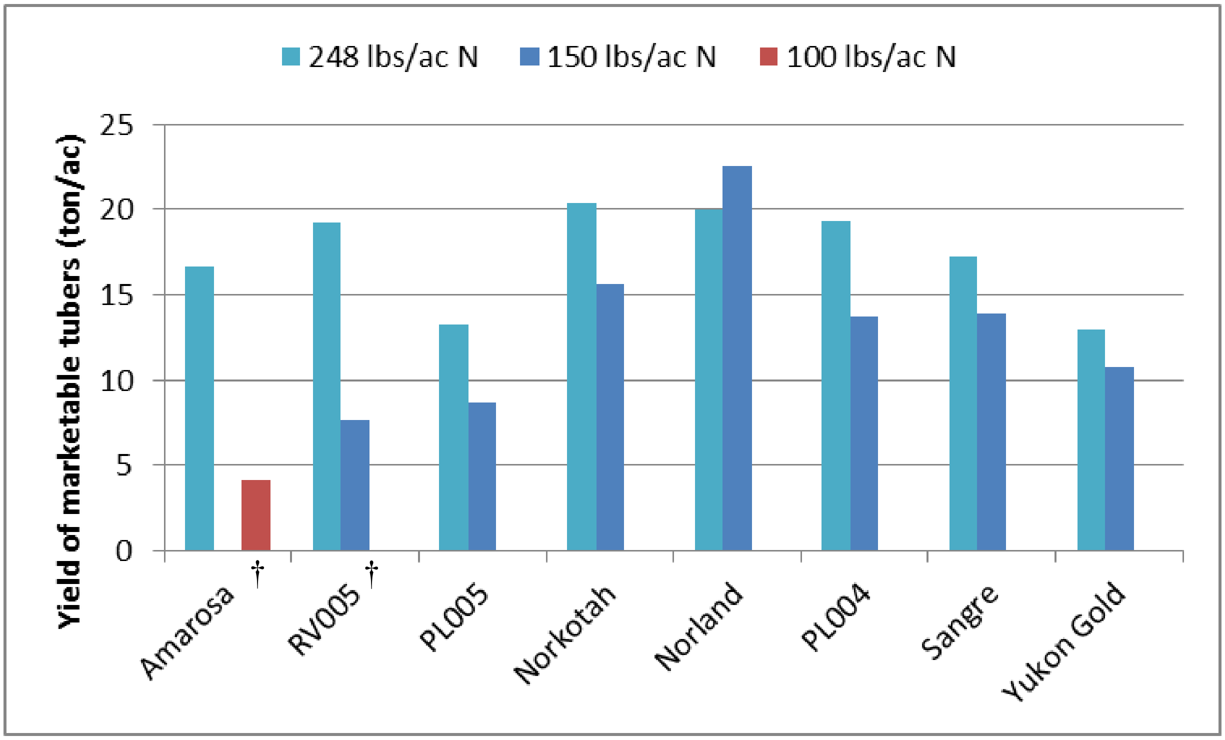

Figure 41: Yield (yon/ac) of marketable potatoes (< 48 mm for Amarosa and 48 – 88mm for others) produced on regular (248 lbs./ac) N, moderate (150 lbs./ac) N and low (100 lbs./ac) N plots. Each variety marked with † are statistically different ($p \leq 0.05$).

Tubers were assessed subjectively for Uniformity of Size and Overall Appearance. Scores are presented in Table 78. At the regular rate of N, no significant differences in Uniformity of Shape were observed. Amarosa scored highest for Uniformity of Size, but was only significantly different from Red Sunset, Yukon Gem and ASPI 001. For Overall Appearance, SI 001 scored significantly higher than Yukon Gold, Red Sunset, Roko and Terra Rosa. At the moderate rate of N, EPG 007 and Russet Norkotah scored highest for Uniformity of Shape and were significantly different from Roko. There were no significant differences in Uniformity of Size or Overall Appearance at this level of N.

Table 78: Subjective tuber assessments. Uniformity of Size was subjectively assessed on each replicate by the same individual during the grading process. Overall Appearance was based on uniformity of size and uniformity of shape, skin colour, deformities and eye depth. Data shown is the mean of 4 replicates.

2012	Uniformity of Shape[1]	Uniformity of Size[2]	Overall Appearance[3]
Regular N			
Amarosa	4.0 a	4.0 a	3.8 ab
ASPI 003	2.5 a	2.3 ab	2.8 ab
PLP 005	3.5 a	3.5 ab	3.5 ab
ASPI 002			
SI 002	3.3 a	3.3 ab	3.3 ab
SI 003	3.5 a	2.8 ab	3.3 ab
SI 004	3.5 a	3.3 ab	3.3 ab
Markies	2.8 a	2.5 ab	3.0 ab
Russet Norkotah	4.0 a	3.3 ab	3.0 ab
Norland	3.0 a	2.4 ab	3.0 ab
SI 001	4.3 a	3.5 ab	4.3 a
Red Sunset	2.5 a	2.0 b	2.5 b
Roko	2.5 a	2.3 ab	2.5 b
Sangre	3.0 a	2.5 ab	3.0 ab
Terra Rosa	2.5 a	2.5 ab	2.5 b
ASPI 001	3.0 a	2.0 b	2.8 ab
Yukon Gem	3.0 a	2.0 b	3.0 ab
Yukon Gold	2.8 a	2.5 ab	2.5 b
Moderate N			
EPG 007	3.8 a	3.3 a	3.8 a
PLP 005	3.3 ab	3.7 a	3.3 a
Markies	3.0 ab	3.0 a	3.5 a
Russet Norkotah	3.8 a	3.0 a	3.3 a
Norland	3.2 ab	2.8 a	3.2 a
Roko	2.0 b	2.8 a	2.5 a
Sangre	2.8 ab	2.3 a	3.0 a
Yukon Gold	2.8 ab	2.3 a	3.5 a
Low N			
Amarosa	4.0	4.0	3.0
Norland	3.0	3.0	3.0

[1] Uniformity of Shape: 1 (very variable) - 5 (very uniform)

[2] Uniformity of Size: 1 (very variable) - 5 (very uniform)

[3] Overall Appearance: 1 (very poor) - 5 (outstanding)

† Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.

Tuber samples used to measure specific gravity were also evaluated for hollow heart, brown center, stem-end discoloration, other types of internal necrosis and scab. There were few internal defects noted for most cultivars grown at 248 lbs./ac N. Roko and SI 003 have a tendency toward internal pigmentation. Several varieties showed low levels of stem end discoloration, possibly as a result of vine maturity at the time of top-killing.

There were few internal defects noted for the varieties grown at 150 lbs./ac N or 100 lbs./ac N. Several varieties had a small percentage of tubers with stem end discoloration, possibly as a result of vine maturity at the time of top-killing. Very few other internal defects were noted.

Cultivars were evaluated in the Food Science lab at CDCS for culinary quality. Data from the boil and bake evaluations are presented in Table 79A and B. After cooking darkening was not noted for any of the varieties after boiling or baking. When grown at 248 lbs./ac N, ASPI 002 and Yukon Gold displayed severe sloughing in the boiled potato evaluations, while Amarosa, ASPI 003, SI 002, Norland, SI 001, Red Sunset, Roko and Terra Rosa had none. Of the cultivars evaluated, Amarosa, SI 004, SI 001 and Red Sunset were the waxiest and ASPI 002, Russet Norkotah, Terra Rosa, ASPI 001 and Yukon Gold the mealiest after boiling. When baked, SI 002, SI 004, Russet Norkotah and Red Sunset were rated as slightly wet textured while Yukon Gold was mealiest.

When grown at 150 lbs./ac N, only Russet Norkotah displayed severe sloughing in the boiled potato evaluations. Norland and Sangre were rated as waxy after boiling, while Russet Norkotah and Yukon Gold were rated as fluffy/mealy. Most cultivars were rated as slightly wet after baking, while Russet Norkotah was rated as slightly mealy.

Table 79: A) Culinary evaluations of each fresh market variety grown on full nitrogen (approximately 248 lbs./ac), moderate nitrogen (approximately 150 lbs./ac) and low nitrogen (100 lbs./ac). Data shown is the mean of duplicate analyses of a composite sample.

Boiled Potatoes

2012	Waxiness†	Sloughing£	After Cooking* Discoloration
Regular N			
Amarosa	2	3	3
ASPI 003	3	3	3
ASPI 002	4	1	3
SI 002	3	3	3
SI 003	3	2	3
SI 004	2	2	3
Russet Norkotah	4	2	3
Norland	3	3	3
SI 001	2	3	3
Red Sunset	2	3	3
Roko	3	3	3
Sangre	3	2	3
Terra Rosa	4	3	3
ASPI 001	4	2	3
Yukon Gem	3	2	3
Yukon Gold	4	1	3
Moderate N			
Markies	3	3	3
Russet Norkotah	4	1	3
Norland	2	2	3
Roko	3	3	3
Sangre	2	3	3
Yukon Gold	4	2	3
Low N			
Amarosa	2	3	3
Norland	2	3	3

† Waxiness: 1 = very waxy (very clean cuts); 2 = waxy (clean cuts with some residue); 3 = slightly waxy (more mealy than waxy); 4 = not waxy (fluffy/mealy); £Sloughing: 1 = severe; 2 = moderate; 3 = none; *After-cooking Discoloration: 1 = severe; 2 = moderate; 3 = none.

Table 79. B) Culinary evaluations of each fresh market variety grown on full nitrogen (approximately 248 lbs./ac), moderate nitrogen (approximately 150 lbs./ac) and low nitrogen (100 lbs./ac). Data shown is the mean of duplicate analyses of a composite sample.

Baked Potatoes

2012	Flesh color	Texture*	After Cooking Discoloration*
Regular N			
Amarosa	Red	3	3
ASPI 003	White	3	3
ASPI 002	White		
SI 002	Yellow	2	3
SI 003	Yellow	3	3
SI 004	Yellow	2	3
Russet Norkotah	White	2	3
Norland	White	3	3
SI 001	Off-white	3	3
Red Sunset	White	2	3
Roko	White	3	3
Sangre	White	3	3
Terra Rosa	Red	3	3
ASPI 001	White	3	3
Yukon Gem	Yellow	3	3
Yukon Gold	Yellow	4	3
Moderate N			
Markies	Yellow	2	3
Russet Norkotah	White	3	3
Norland	White	2	3
Roko	White	2	3
Sangre	White	2	3
Yukon Gold	Yellow	2	3
Low N			
Amarosa	Red	2	3
Norland	White	2	3

*** Texture: 1 = wet; 2 = slightly wet; 3 = slightly mealy; 4 = mealy; *After-cooking Discoloration: 1 = severe; 2 = moderate; 3 = none.**

2013

Materials and Methods

The variety evaluation was conducted in small plots at the Crop Diversification Centre South in Brooks, AB. Fertility for the full nitrogen rate (235 lbs/ac) was achieved through a combination of soil fertility (124 lbs./ac N; 361 lbs./ac P, 1930 lbs./ac K), broadcast fertilizer (165 lbs./ac of 34-0-0 and 100 lbs./ac of 11-52-0) incorporated prior to planting and broadcast fertilizer (132 lbs./ac 34-0-0) incorporated at hilling. Fertility for the reduced nitrogen rate (190 lbs./ac) was achieved through a combination of soil fertility and broadcast fertilizer (165 lbs./ac of 34-0-0 and 100 lbs./ac of 11-52-0) incorporated prior to planting. Varieties were planted in four replicate rows in a randomized split block design (with fertility as the main block) along with standard varieties (Norland and Yukon Gold). Each block was planted adjacent to guard rows to reduce any edge effects.

Eptam 8E (2.2 L/ac) and Sencor 75DF (150 g/ac) were applied pre-plant (May 6) to control weeds. Seed of standard cultivars was provided by Edmonton Potato Growers and seed of test cultivars was provided by each participant. Seed was cut (70 to 85 g), if necessary, and suberized prior to planting. Potatoes were planted May 23, 2013 approximately 5 to 5½"deep using a two-row tuber unit planter. Seed was planted at 30cm spacing in 6m rows spaced 90cm apart.

The potatoes were hilled June 17 with a power hiller. The plots were irrigated to maintain soil moisture close to 70%. Foliar fungicides were applied several times during the growing season to prevent early and late blight from developing (Table 80). Insecticide was applied July 10 (Matador 120 EC, 40 mL/ac) to control Colorado potato beetle.

Table 80: Foliar fungicides applied in 2013 to the potato crop to prevent early and late blight development.

Date of Application	***Fungicide***	***Rate***
July 10	Quadris	202 mL/ac
July 20	Bravo 500	0.64 L/ac
Aug 15	Ridomil Gold Bravo	883 mL/ac

Figure 42: Variety evaluation trial at CDCS in Brooks, AB July 30, 2013.

Reglone (1.4 L/ac) was applied September 11 to facilitate mechanical harvest. Tubers were harvested September 23-24 with a one-row Grimme harvester for yield and grade data.

Tubers were stored at 8˚C until graded. Tubers were graded into size categories (less than 48mm, 48 – 88mm, over 88mm and deformed). A sample of twenty-five tubers (48 – 88mm) from each replicate was used to determine specific gravity using the weight in air over weight in water method. These tubers were cut longitudinally to assess internal defects.

The data presented here have been statistically analyzed using ANOVA and Tukey's Multiple Comparison Test; (SPSS; $p \leq 0.05$). Statistical summaries are available upon request. Comparisons for specific cultivars at two rates of N were analyzed using t-tests on a cultivar-by-cultivar basis (Excel; $p \leq 0.05$).

Results and Discussion

Sample hills of each variety were dug for a field day August 22, 2013. Photos of these varieties are shown in Figure 43.

Figure 43. Fresh Market varieties at the CDCS field day August 22, 2013: a) Yukon Gold, b) SI004, c) SI002, d) RV006, e) SI001, f) TT003, g) Almera, h) PLP 005, i) Penta, j) Norland, k) SI003, l) TT005 and m) Roko.

Yield data (total yield; ton/ac) and specific gravities of each of the fresh market cultivars are shown in Table 81. The highest total yield on regular N plots at CDCS was observed with SI001. SI001 yielded significantly more than all other fresh market cultivars at this level of N. Both SI002 and RV006 yielded significantly more than Yukon Gold (yellow-fleshed check). SI004 and SI003 both yielded less than their respective check varieties, however, it should be noted that seed piece decay was evident at planting for both of these cultivars. This may have resulted from holding seed until all other trial entries were provided and is not an indication of the true potential of the cultivars.

The highest total yield on moderate N at CDCS was observed with Almera. Total yield of Roko, Norland, Penta, TT003 and RV006 were not statistically different from one another, but less than that of Almera. Total yield of PLP 005 was significantly greater than total yield of Yukon Gold (check).

Specific gravity of tubers grown on 235 lbs./ac ranged from 1.060 for SI001 to 1.078 for SI002, Yukon Gold and SI003. These values are consistent with specific gravity typical of other fresh market cultivars.

Specific gravity of tubers grown on 190 lbs./ac ranged from 1.064 for Almera to 1.088 for Roko. The specific gravities of Almera, RV006 and TT003 were significantly lower than that of Yukon Gold (check), but not statistically different from Norland. The specific gravities of PLP 005, Penta, Roko and TT005 were not statistically different from that of Yukon Gold (check) under these conditions.

The trial was designed to provide regional data for a wide range of potato cultivars. Norland, Yukon Gold and RV006 were grown at both rates on N. There was no significant difference in total yield or specific gravity for these varieties as a result of different levels of N. The N rate in the moderate N plots was approximately 45 lbs./ac lower than the regular rate. The N rates may not have been sufficiently different to impact yield and specific gravity of all cultivars tested. Further addressing the agronomic needs of each cultivar may well result in improvements to yield and size profiles when compared to the results in this trial.

Table 81: Estimated total yield (ton/acre) and specific gravity for each variety grown at full nitrogen (approximately 235 lbs./ac) and moderate nitrogen (approximately 190 lbs./ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

2013 Fresh Market	Yield (ton/ac)	SG
Regular N		
SI004	21.0 c	1.063 bc
SI002	30.4 b	1.078 a
RV006	30.5 b	1.069 b
Yukon Gold	20.0 c	1.078 a
SI001	45.1 a	1.060 c
SI003	16.8 c	1.078 a
Norland	32.4 b	1.070 b
Moderate N		
TT003	34.41 bc	1.069 cd
Almera	46.72 a	1.064 d
PLP 005	26.53 c	1.078 bc
RV006	34.06 bc	1.069 cd
Penta	31.99 bc	1.081 ab
Yukon Gold	19.55 d	1.080 ab
Norland	33.42 bc	1.069 cd
TT005	22.15 d	1.074 bcd
Roko	38.53 b	1.088 a

† Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.

The mean percentage of total tuber number in each size category is shown in Table 82. It is important to note that harvesting with small plot equipment and manual labour recovers all potatoes over 19mm in diameter. This tended to increase the yield of small potatoes relative to a commercial situation where more of these tubers may be left behind in the field.

The percentage of tuber count in each size category for fresh market cultivars is represented in Table 3. In the 235 lb./ac N plots, the majority of tubers for each variety fell into the marketable category (48 – 88mm). Norland, Yukon Gold and SI001 had a significantly higher percentage of oversized tubers than other cultivars which may be an indication that these cultivars are early maturing and an earlier harvest data may be more appropriate. SI003 had a significantly higher percentage of deformed tubers than the other cultivars and may be related to the seed condition at planting.

In moderate N plots, Almera yielded a significantly lower percentage of small (< 48mm) tubers than most of the other varieties tested, but not statistically less than Yukon Gold, Norland or TT003. Both PLP 005 and TT005 produced a significantly higher percentage of small tubers than other cultivars. In the marketable category (48 – 88mm), Roko produced the highest percentage of marketable tubers and the percentage of marketable tubers produced by Almera, TT003, Penta, RV006, Yukon Gold and Norland were not statistically different. The percentage of marketable tubers from TT005 was significantly lower than Roko and several other varieties, but not significantly lower than Yukon Gold, Norland or PLP 005. A small percentage of oversized tubers were produced by many cultivars in the trial. Norland, Yukon Gold and Almera produced the highest percentage of oversized tubers likely because these are early maturing varieties and the trial was harvested in September. TT003, PLP 005, RV006, and Penta produced a smaller percentage of oversized tubers than Yukon Gold (check). TT005 and Roko produced a significantly smaller percentage of oversized tubers than Norland. All of the tested cultivars produced a smaller percentage of deformed tubers than Yukon Gold, but the percentage of deformed tubers for these cultivars was not statistically different than that of Norland.

No significant differences in size profile were observed for Norland, Yukon Gold and RV006 grown at different rates of N.

Table 82: Percentage of total tuber number in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed) for each variety grown at full nitrogen (approximately 235 lbs./ac) and moderate nitrogen (approximately 190 lbs./ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the $p < 0.05$ level.

2013	No. of <48mm	No. of 48 to 88mm	No. of > 88mm	No. of deformed
Regular N				
SI004	40.5 a	57.5 ab	1.3 d	0.5 b
SI002	43.5 a	56.0 ab	0.0 d	0.5 b
RV006	30.0 abc	66.8 a	2.5 cd	1.3 b
Yukon Gold	24.0 bc	60.5 ab	11.3 abc	4.5 b
SI001	20.8 c	64.0 a	15.5 a	0.0 b
SI003	37.3 ab	48.5 b	4.5 bcd	9.8 a
Norland	25.5 ab	58.8 ab	12.3 ab	3.5 b
Moderate N				
TT003	20.3 cde	71.0 ab	6.5 bc	2.5 b
Almera	13.3 e	75.3 ab	10.8 ab	0.8 b
PLP 005	41.5 ab	57.3 bc	1.3 c	0.3 b
RV006	32.0 bc	65.3 ab	2.0 c	0.8 b
Penta	28.5 cd	67.0 ab	2.8 c	1.3 b
Yukon Gold	18.0 de	61.8 abc	14.5 a	6.5 a
Norland	18.5 de	61.3 abc	17.8 a	3.0 ab
TT005	51.5 a	47.3 c	0.3 c	1.0 b
Roko	19.0 de	76.3 a	3.0 c	2.0 b

† Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.

The yield of tubers (estimated ton/ac) of each variety is shown by size category in Table 83. In the regular N plots, SI002 yielded significantly more potatoes under 48 mm than other cultivars. Marketable yield ranged from 9.9 ton/ac of SI003 to 27.5 ton/ac of SI001. SI001, RV006, SI002 and SI004 all yielded significantly more marketable than Yukon Gold (check) in this trial. Norland yielded significantly more marketable tubers than SI003. SI003 yielded more deformed tubers than the other test cultivars, but was not significantly different from either check in this category.

At the moderate rate of N, Penta, PLP 005, RV006 and TT005 produced a significantly greater yield of small tubers compared to both check varieties, Yukon Gold and Norland. Yield of marketable tubers (48 – 88mm) ranged from 11.26 ton/ac for Yukon Gold to 33.86 ton/ac for Almera. Marketable yield of Almera and Roko were statistically greater than that of both check varieties. Marketable yield of TT005 was significantly lower than many of the cultivars tested, but was not statistically different from either check. The greatest yield of oversized tubers was observed for early varieties, Norland, Almera and Yukon Gold, likely resulting from the timing of harvest for the trial. TT005 and Roko produced statistically lower yields of oversized tubers relative to Norland. The yield of oversized TT003, Almera, PLP 005, RV006 and Penta tubers were not statistically different from that of Yukon Gold. There were no statistical differences in the yield of deformed tubers produced by the varieties in this trial.

N level had a significant impact on the yield of small Yukon Gold tubers, where a greater yield of small tubers was harvested from the regular N plots than from the moderate N plots. No significant impact of N level was observed for yield by size category of RV006 or Norland.

Table 83: Estimated yield (ton/ac) in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed tubers) for each variety grown at full nitrogen (approximately 235 lbs./ac) and moderate nitrogen (approximately 190 lbs./ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

2013	Yield of <48mm (ton/ac)	Yield of 48 to 88mm (ton/ac)	Yield of > 88mm (ton/ac)	Yield of deformed (ton/ac)
Regular N				
SI004	3.9 b	15.8 cd	1.1 c	0.2 b
SI002	6.6 a	23.6 ab	0.2 c	0.3 b
RV006	3.9 b	24.2 ab	1.9 bc	0.5 b
Yukon Gold	1.2 c†	12.4 d	5.1 bc	1.4 ab
SI001	2.4 bc	27.5 a	15.1 a	0.2 b
SI003	2.1 bc	9.9 d	2.5 bc	2.3 a
Norland	2.0 bc	20.1 bc	8.5 b	1.7 ab
Moderate N				
TT003	1.85 cde	26.43 ab	5.35 b	0.78 a
Almera	1.62 de	33.86 a	10.85 a	0.36 a
PLP 005	4.94 ab	20.67 bc	1.21 b	0.12 a
RV006	4.27 ab	27.41 ab	2.00 b	0.37 a
Penta	3.51 bc	25.41 ab	2.50 b	0.57 a
Yukon Gold	0.61 e†	11.26 d	6.16 ab	1.52 a
Norland	1.34 de	19.36 bcd	11.20 a	1.52 a
TT005	5.61 a	15.69 cd	0.46 b	0.39 a
Roko	2.54 cd	31.58 a	2.94 b	1.47 a
EPG 006	1.9 c	23.7 bc	2.1 cd	0.5 a

† Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.

A comparison of medium potatoes (48 – 88mm) for the three cultivars grown on regular and moderate N plots is shown in Figure 44.

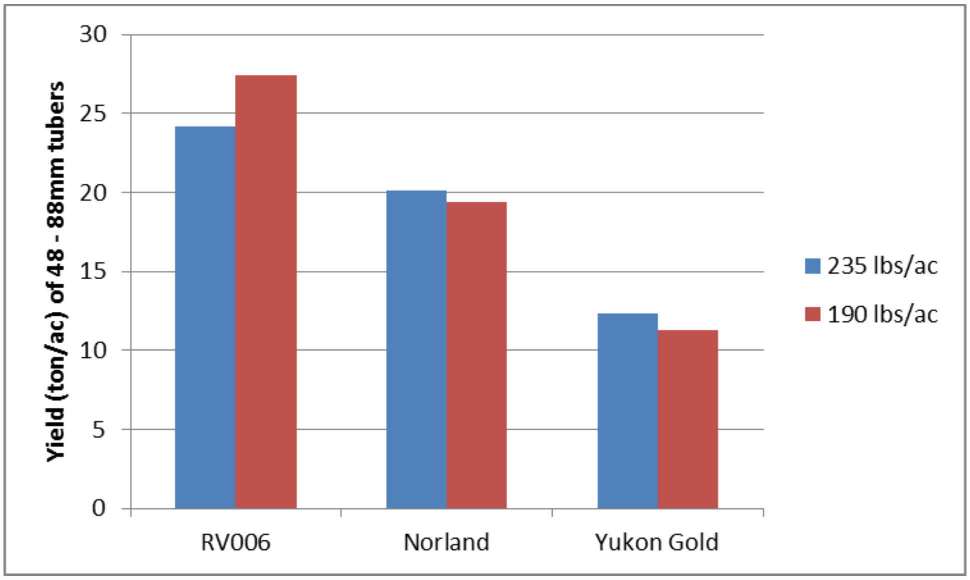

Figure 44: Yield (ton/ac) of potatoes (48 – 88mm) produced on regular (235 lbs./ac) N and moderate (190 lbs./ac) N plots. For each variety, yield columns marked with † are statistically different ($p \leq 0.05$).

Tubers were assessed subjectively for Uniformity of Size and Overall Appearance. Scores are presented in Table 84. At the regular rate of N, SI002 scored significantly better for uniformity of size than Yukon Gold. At the moderate rate of N, the two check varieties scored lower for Uniformity of Size and Overall Appearance than the other cultivars tested. Penta, PLP 005 and TT005 were scored as the most uniform of the cultivars evaluated. PLP 005, RV006, Penta and TT005 scored highest in terms of Overall Appearance at this level of N.

Table 84: Subjective tuber assessments: Uniformity of Size was subjectively assessed on each replicate by the same individual during the grading process. Overall Appearance was based on uniformity of size and uniformity of shape, skin colour, deformities and eye depth. Data shown is the mean of 4 replicates.

2013	Uniformity of Size[1]	Overall Appearance[2]
Regular N		
SI004	3.3 ab	3.8 a
SI002	3.5 a	3.0 ab
RV006	2.8 ab	3.8 a
Yukon Gold	2.0 b	2.8 ab
SI001	2.8 ab	3.8 a
SI003	2.5 ab	2.3 b
Norland	2.3 ab	2.5 ab
Moderate N		
TT003	3.00	3.00
Almera	2.75	3.00
PLP 005	3.75	4.00
RV006	3.25	3.75
Penta	3.75	3.75
Yukon Gold	2.00	2.00
Norland	2.25	2.00
TT005	3.50	3.50
Roko	3.00	3.00

[1] Uniformity of Size: 1 (very variable) - 5 (very uniform)

[2] Overall Appearance: 1 (very poor) - 5 (outstanding)

† Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.

Tuber samples used to measure specific gravity were also evaluated for hollow heart, brown centre, stem-end discoloration, other types of internal necrosis and scab. There were few internal defects noted for SI004, SI002, RV006, and SI001 grown at 235 lbs./ac N. Approximately 9% of SI003, 5% of Yukon Gold and 2% of the Norland tubers in the SG sample had hollow heart. Approximately 30% of the SI003 tubers had some level of pigmentation in the tubers flesh. Several varieties showed low levels of stem end discoloration, possibly as a result of vine maturity at the time of top-killing.

There were few internal defects noted for most of the varieties grown at 190 lbs./ac N. Approximately 8% of Yukon Gold tubers in the SG sample had hollow heart. Several varieties (Yukon Gold, Penta, Almera, Roko, PLP 005 and TT005) showed stem end discoloration, possibly as a result of vine maturity at the time of top-killing. Very few other internal defects were noted.

Cultivars were evaluated in the Food Science lab at CDCS for culinary quality. Data from the boil and bake evaluations are presented in Table 85A and B. After cooking darkening was not noted for any of the varieties after boiling or baking. When grown at 235 lbs./ac N, Yukon Gold displayed severe sloughing in the boiled potato evaluations, while RV006 and SI001 had none. Of the cultivars evaluated, SI001 was the waxiest and Yukon Gold the mealiest after boiling and baking.

When grown at 190 lbs./ac N, none of the cultivars displayed severe sloughing in the boiled potato evaluations. Norland, Almera, PLP 005 and RV006 were rated as waxy after boiling, while TT003, TT005 and Roko were only slightly wet. Yukon Gold and Penta were rated as mealier after boiling. Most cultivars were rated as slightly mealy after baking, while Penta, PLP 005 and Almera were rated as slightly wet. RV006 was rated as mealy after baking.

Table 85: A) Culinary evaluations of each fresh market variety grown at a regular rate of nitrogen (235 lbs./ac) at CDCS). Data shown is the mean of duplicate analyses of a composite sample.

Boiled Potatoes

CDCS - 2013	Flesh color	Waxiness†	Sloughing	After Cooking Discoloration
Regular N				
SI004	Yellow	3	Moderate	None
SI002	Yellow	2	Moderate	None
RV006	Yellow	3	None	None
Yukon Gold	Yellow	4	Severe	None
SI001	Off-white	1	None	None
SI003	Yellow	2	Moderate	None
Norland	White	1	None	None
Moderate N				
TT003	Yellow	2	Moderate	None
Almera	Yellow	1	None	None
PLP 005	Off-white	1	Moderate	None
RV006	Deep Yellow	1	None	None
Penta	Yellow	4	Moderate	None
Yukon Gold	Yellow	3	Moderate	None
Norland	White	1	None	None
TT005	White	2	Moderate	None
Roko	Off-white	2	Moderate	None

† Waxiness: 1 = very waxy (very clean cuts); 2 = waxy (clean cuts with some residue); 3 = slightly waxy (more mealy than waxy); 4 = not waxy (fluffy/mealy)

Table 85. B) Culinary evaluations of each fresh market variety grown at a moderate rate of nitrogen (190 lbs./ac) at CDCS). Data shown is the mean of duplicate analyses of a composite sample.

Baked Potatoes			
CDCS - 2013	Flesh color	Texture*	After Cooking Discoloration
Regular N			
SI004	Deep Yellow	1	None
SI002	Deep Yellow	1	None
RV006	Deep Yellow	2	None
Yukon Gold	Yellow	3	None
SI001	Yellow	1	None
SI003	Deep Yellow	4	None
Norland	Off-white	2	None
Moderate N			
TT003	Yellow	3	None
Almera	Deep Yellow	2	None
PLP 005	Off-white	2	None
RV006	Deep Yellow	4	None
Penta	Deep Yellow	2	None
Yukon Gold	Yellow	3	None
Norland	Off-white	3	None
TT005	Off-white	3	None
Roko	Yellow	3	None

* Texture: 1 = wet; 2 = slightly wet; 3 = slightly mealy; 4 = mealy

Conclusions

The 2011 variety trial included a number of fresh market potato varieties with potential in Alberta. Norland and Yukon Gold were included in the trial as check varieties for varieties graded into weight categories. Yield of tubers produced from mini-tubers was disappointing and sizes tended to be smaller than for other varieties. A russet skinned standard was not included in the first year of the trial. Some of the novel varieties included yielded well. It is difficult to draw conclusions from such a range of varieties and intended uses. It may be necessary to evaluate some of these varieties again with appropriate standards and conventional seed.

For varieties graded into size categories, Norland, Dark Red Norland and Yukon Gold were included in the trial as check varieties. Yield of many of the test varieties compared well with familiar standard varieties. ASPI 002 is an impressive oblong white potato. ASPI 001 is a uniform, attractive oblong russet skinned variety. Several of the red-skinned varieties are attractive with yields comparable to the red standards. Solanum 001 is a high-yielding yellow-fleshed variety. Solanum 002 and Tuberosum 003 may have potential as creamer varieties. For all varieties except Tuberosum 003, there was a trend toward higher total yield in the regular N plots (225 lbs./ac) than in the low N plots (115 lbs./ac). Fewer large tubers were observed from the low N plots than from the regular N plots. There were very few internal defects observed in most of the tubers examined. Scab was only observed on one EPG variety.

For all varieties, there was a trend toward higher total yield in the regular N plots (225 lbs./ac) than in the low N plots (115 lbs./ac). Fewer large tubers were observed from the low N plots than from the regular N plots. There were very few internal defects observed in most of the tubers examined. The trial was designed to provide regional data for a wide range of potato cultivars. The N rate in the low N plots was over 100 lbs./ac lower than the regular rate. A rate of N that is intermediate may give better results than either full or low N. Addressing the agronomic needs of each variety may well result in improvements to yield and size profiles when compared to the results in this trial.

Results from the CDCN location indicated that higher fertility and irrigation typically resulted in greater yield. Addressing the agronomic needs of each variety may well result in improvements to yield and size profiles when compared to the results in this trial.

The 2012 variety trial included five fresh market cultivars with potential in Alberta and several check varieties, Norland, Russet Norkotah, and Yukon Gold. SI 001, ASPI 001, Yukon Gem and SI 003 were impressive in the 2012 evaluations for high total and marketable yield, good overall appearance and good boiling characteristics. SI 002, Amarosa, SI 004 and Markies yielded well in both the small potato and marketable potato categories indicating the potential usefulness in dual purpose (gourmet and table) markets.

The 2013 variety trial included five fresh market cultivars with potential in Alberta and two check varieties, Norland and Yukon Gold. SI001 and Almera were impressive in the 2013 evaluations for high total and marketable yield, good overall appearance and good boiling characteristics. SI002 yielded well in both the small potato and marketable potato categories indicating its potential usefulness in dual purpose (gourmet and table) markets. RV006, Penta and TT003 look like excellent potential replacements for Yukon Gold in the yellow fleshed market. Roko yielded very well and scored better than Norland for Uniformity of Size and Overall Appearance. TT005 and PLP 005 appear to be suited to a smaller potato market or a dual purpose potato with good yield of small and marketable sizes and good scores for Uniformity of Size and Overall Appearance. It was difficult to assess SI003 and SI004 fairly in this trial because seed quality at planting was questionable.

The trial was designed to provide regional data for a wide range of potato cultivars. Addressing the agronomic needs of each specific cultivar may well result in improvements to yield and size profiles when compared to the results in this year of the trial.

Creamer Variety Evaluation

2012

Materials and Methods
The variety evaluation was conducted in small plots at the Crop Diversification Centre South in Brooks, AB. Fertility for the medium nitrogen rate of 145 lbs/ac N was achieved through a combination of soil fertility (74 lbs./ac N; 192 lbs./ac P, 760 lbs./ac K), broadcast fertilizer (175 lbs./ac of 34-0-0) incorporated prior to planting and broadcast fertilizer (100 lbs./ac of 11-52-0) incorporated at hilling. Fertility for the reduced nitrogen rate of 85 lbs./ac was achieved through a combination of soil fertility and broadcast fertilizer (100 lbs./ac of 11-52-0) incorporated prior to planting. Varieties were planted in four replicate rows in a randomized split block design (with fertility as the main block). Each block was planted adjacent to guard rows to reduce any edge effects.

Eptam 8E (2.2 L/ac) and Sencor 75DF (150 g/ac) were applied pre-plant (May 10) to control weeds. Seed of test cultivars was provided by each participant. Most varieties were planted May 23, 2012 approximately 5 to 5½"deep using a two-row tuber unit planter. Whole seed was planted at 15 cm spacing in 6 m rows spaced 90 cm apart.

The potatoes were hilled June 4 with a power hiller. The plots were irrigated to maintain soil moisture close to 70%. Foliar fungicides were applied several times during the growing season to prevent early and late blight from developing (Table 86). Insecticide was applied July 17 (Matador 120 EC, 40 mL/ac) and August 15 (Decis 5 EC, 50 mL/ac) to control Colorado potato beetle.

Table 86: Foliar fungicides applied to the 2012 potato crop to prevent early and late blight development.

Date of Application	*Fungicide*	*Rate*
June 29	Bravo 500	0.64 L/ac
July 27	Ridomil Gold / Bravo	883 mL/ac
Aug 15	Bravo 500	0.64 L/ac

Figure 45: Variety evaluation trial at CDCS in Brooks, AB July 27, 2012.

Reglone (1.4 L/ac) was applied August 3 and re-applied (1.0 L/ac) August 12 to encourage skin set and facilitate mechanical harvest. Tubers were harvested September 4 & 5 with a one-row Checci harvester for yield and grade data.

Tubers were stored at 8˚C until graded. Tubers were graded into size categories (less than 25 mm, 25-41 mm, > 41 mm, and deformed). A 5 kg sample of (tubers 25-41 mm) from each replicate was used to determine specific gravity using the weight in air over weight in water method.

The data presented here have been statistically analyzed using ANOVA and Tukey's Multiple Comparison Test; (SPSS; $p \leq 0.05$). Statistical summaries are available upon request.

Results and Discussion

Sample hills of each variety were dug for a field day at CDCS August 22, 2012. Photos of these varieties are shown in Figure 46.

Figure 46. Creamer varieties at the CDCS July 27, 2012: a) TT 011, b) TT 006, c) TT 007, d) LPC 012, e) LPC 010, f) LPC 013, g) TT 009, h) TT 008, i) LPC 014.

Yield data (total yield; ton/ac) and specific gravities of each of the releases are shown in Table 87. The highest total yield on medium N at CDCS was observed with LPC 012, and total yield of TT 011, TT 009 and TT 008 were not statistically less than that of LPC 012.

The highest total yield on low N was observed with LPC 012 and total yield of TT 011, TT 009, and TT 008 were not statistically different. Total yield of TT 011 was significantly greater from the medium fertility plots than from the low fertility plots at CDCS indicating that the low fertility rate was sub-optimal for yield. Total yield of other varieties was not significantly different between the two fertility levels. The trial was designed to provide regional data for a wide range of potato cultivars. The N rate in the low N plots was approximately 60 lbs./ac lower than the medium rate at CDCS. A rate of N that is intermediate may give better results than either full or low N. Further addressing the agronomic needs of each variety may well result in improvements to yield and size profiles when compared to the results in this trial.

Specific gravity of tubers ranged from 1.054 for TT 011 to 1.074 for LPC 013 (low N). Differences between varieties were fairly consistent at each level of N. Only LPC 013 showed a significant response to N, with the SG at medium N significantly higher than that at low N.

Table 87: Estimated total yield (ton/acre) and specific gravity for each variety grown on medium nitrogen (approximately 145 lbs./ac) and low nitrogen (approximately 85 lbs./ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

CDCS - 2012	Yield (ton/ac)	SG
Medium N		
TT 011	17.72 a †	1.054 d
TT 006	11.24 bc	1.070 ab
TT 007	12.22 bc	1.057 d
LPC 012	18.62 a	1.064 bcd
LPC 010	8.45 c	1.069 abc
LPC 013	11.19 bc	1.074 a †
TT 009	15.35 ab	1.057 d
TT 008	15.16 ab	1.059 cd
LPC 014	7.12 c	1.070 ab
Low N		
TT 011	15.19 a †	1.054 c
TT 006	9.33 cde	1.068 a
TT 007	10.84 bcd	1.054 c
LPC 012	15.63 a	1.061 abc
LPC 010	8.68 de	1.063 ab
LPC 013	9.94 cde	1.066 a †
TT 009	14.13 ab	1.058 bc
TT 008	13.47 abc	1.063 ab
LPC 014	6.40 e	1.065 ab

† indicates significant differences between regular fertility and low fertility plots using a two-tailed t-test.

The mean percentage of total tuber number in each size category is shown in Table 88. It is important to note that harvesting with small plot equipment and manual labour recovers all potatoes over 19mm in diameter. This tended to increase the yield (and percentage) of small potatoes relative to a commercial situation where more of these tubers may be left behind in the field.

In the medium N plots, TT 006 produced a significantly higher number of potatoes in the small (< 25 mm) category than other varieties. In the 25 to 41 mm category, TT 006 produced more tubers than TT 011, TT 007 and LPC 014. TT 006 produced the fewest tubers over 41 mm, while TT 011, TT 007 and TT 009 produced the most. No significant differences were observed in the deformed category.

In the low N plots, TT 006 and TT 008 produced more tubers under 25 mm than other varieties, while TT 011 and LPC 010 produced the fewest small tubers. TT 008, LPC 013, TT 009, and

TT 006 produced the greatest number of tubers 25 to 41 mm and TT 011, LPC 010 and LPC 014 produced the fewest. TT 011, TT 007 and TT 009 produced the greatest number of tubers over 41 mm and TT 006 produced the fewest. There were no statistically significant differences in the deformed size categories from the low N plots. A significantly greater number of tubers over 41 mm was observed with LPC 013 from the medium N plots than from the low N plots.

Table 88: Percentage of total tuber number in each size category (< 25mm, 25 to 41mm, > 41mm, and deformed) for each variety grown on medium nitrogen (approximately 145 lbs./ac) and low nitrogen (approximately 85 lbs./ac). Data shown is the mean of four replicates. Data was analyzed as tuber number per acre. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

CDCS - 2012	< 25mm	25 to 41mm	> 41mm	Deformed
Medium N				
TT 011	8.4 b	45.7 c	35.4 a	10.5
TT 006	31.3 a	63.1 a	4.4 d	1.2
TT 007	8.4 b	53.9 bc	31.1 ab	6.6
LPC 012	13.6 b	64.0 abc	19.6 abc	2.9
LPC 010	10.6 b	66.7 abc	19.6 bcd	3.1
LPC 013	15.0 b	66.3 abc	18.0 abc†	0.7
TT 009	9.4 b	61.3 abc	27.1 a	2.2
TT 008	16.3 b	69.1 ab	13.8 abcd	0.7
LPC 014	12.7 b	64.7 bc	18.0 cd	4.7
Low N				
TT 011	6.8 c	52.5 d	38.5 ab	2.2
TT 006	25.2 a	68.8 ab	4.0 d	2.0
TT 007	10.1 bc	61.0 cd	25.8 abc	3.4
LPC 012	14.4 bc	65.8 bcd	17.1 bcd	2.7
LPC 010	7.5 c	59.5 d	30.1 abc	2.9
LPC 013	14.0 bc	71.6 abc	12.2 cd†	2.2
TT 009	9.7 bc	66.2 abc	22.9 a	1.1
TT 008	15.7 ab	71.1 a	11.3 cd	1.9
LPC 014	22.6 bc	63.2 d	11.9 d	2.3

† indicates significant differences between regular fertility and low fertility plots using a two-tailed t-test.

The yield of tubers (estimated ton/ac) of each variety is shown by size category in Table 89. In the medium N plots, TT 006 produced significantly the greatest yield of small (< 25 mm) potatoes compared to all varieties except TT 008. TT 008 produced the greatest yield of 25 to 41 mm tubers, and yields of TT 006, LPC 012, and TT 009 were not significantly lower in this category. The greatest yield of tubers > 41 mm was observed with TT 011, TT 007, and TT 009 on medium N. The smallest yield of tubers > 41 mm was observed with TT 006, LPC 014, LPC 010, LPC 013 and TT 008. The greatest yield of misshapen tubers was observed with TT 011 on medium N, and significantly fewer deformed tubers were observed for TT 006, LPC 013 and TT 008.

In the low N plots, there were no statistical differences in yield of tubers in the < 25 mm or deformed categories. LPC 012 produced the greatest yield of potatoes 25 to 41 mm in diameter, but not statistically more than TT 008, TT 009, LPC 013, TT 006 or TT 011. The smallest yield of tubers > 41 mm was observed with TT 006, LPC 014, LPC 013, TT 008, LPC 010 and TT 007 on low N plots.

Few significant differences were observed between yields in specific size categories for varieties grown on medium and low N plots. The medium rate of N significantly increased the yield of small (< 25 mm) tubers for LPC 014, and tubers over 41 mm for LPC 013. The trial was designed to provide regional data for a wide range of potato cultivars. The N rate in the low N plots was approximately 60 lbs./ac lower than the medium rate at CDCS. A rate of N that is intermediate may give better results than either full or low N. Further addressing the agronomic needs of each variety may well result in improvements to yield and size profiles when compared to the results in this year of the trial.

Table 89: Estimated yield (ton/ac) in each size category (< 25mm, 25 to 41mm, > 41mm, and deformed tubers) for each variety grown on medium nitrogen (approximately 145 lbs./ac) and low nitrogen (approximately 85 lbs./ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

CDCS - 2012	Yield of <25mm (ton/ac)	Yield of 25 to 41mm (ton/ac)	Yield of > 41mm (ton/ac)	Yield of deformed (ton/ac)
Medium N				
TT 011	0.29 b	5.35 cde	9.88 a	1.70 a
TT 006	1.24 a	8.52 abc	2.35 d	0.13 b
TT 007	0.25 b	4.72 de	6.41 abc	0.71 ab
LPC 012	0.59 b	9.93 ab	7.37 ab	0.54 ab
LPC 010	0.26 b	4.85 de	2.90 cd	0.26 ab
LPC 013	0.47 b	6.59 bcde	3.80 bcd †	0.14 b
TT 009	0.34 b	8.03 abcd	6.28 abc	0.45 ab
TT 008	0.69 ab	10.42 a	3.99 bcd	0.14 b
LPC 014	0.24 b †	3.80 e	2.68 cd	0.42 ab
Low N				
TT 011	0.21	5.23 bcd	9.00 a	0.32
TT 006	1.05	6.64 abc	1.32 c	0.26
TT 007	0.29	5.02 bcd	4.41 bc	0.46
LPC 012	0.59	8.87 a	5.57 b	0.39
LPC 010	0.18	3.89 d	4.28 bc	0.35
LPC 013	0.43	7.07 ab	2.23 c †	0.26
TT 009	1.61	7.42 ab	5.58 b	0.25
TT 008	0.65	8.64 a	3.28 bc	0.34
LPC 014	0.26 †	3.99 cd	1.89 c	0.19

† indicates significant differences between regular fertility and low fertility plots using a two-tailed t-test.

A comparison of medium potatoes (25 – 41 mm) for each variety from medium and low fertility plots is shown in Figure 47. Although some trends were evident, none of the yields in this size category were significantly different between N levels at the $p \leq 0.05$ level.

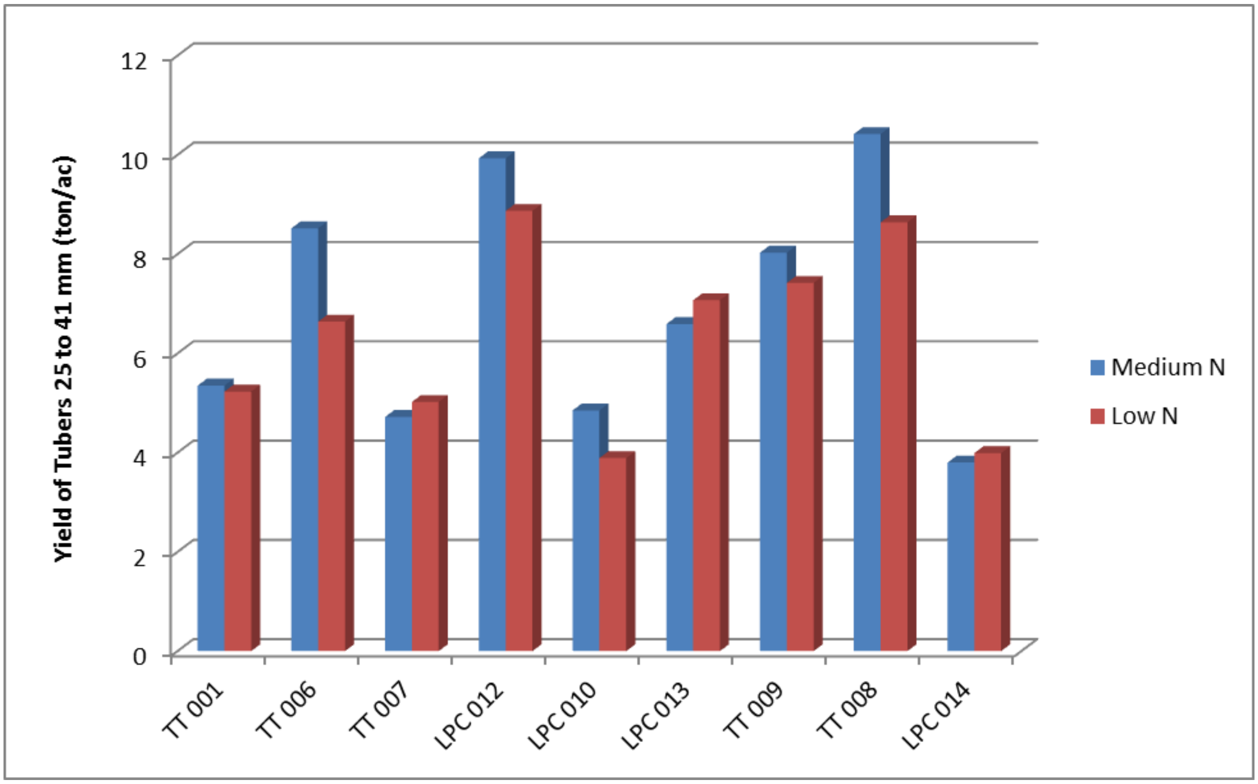

Figure 47: Yield of potatoes (25 – 41mm) produced on low (85 lbs./ac) and medium (145 lbs./ac) N at CDCS. None of the yields in this size category were significantly different between N levels at the $p \leq 0.05$ level.

2013

Materials and Methods

The variety evaluation was conducted in small plots at the Crop Diversification Centre South in Brooks, AB. Fertility for the low nitrogen rate of 135 lbs/ac N was achieved through a combination of soil fertility (124 lbs./ac N; 361 lbs./ac P, 1930 lbs./ac K) and broadcast fertilizer (100 lbs./ac of 11-52-0) incorporated prior to planting. Varieties were planted in four replicate rows in a randomized complete block design. Each block was planted adjacent to guard rows to reduce any edge effects. A fifth replicate of each variety was planted for in-season sampling and was not included in the yield calculations.

Eptam 8E (2.2 L/ac) and Sencor 75DF (150 g/ac) were applied pre-plant (May 6) to control weeds. Seed of test cultivars was provided by each participant. Whole seed was used for most cultivars, but when necessary seed was cut (70 to 85 g) and suberized prior to planting. The gourmet varieties were planted approximately 5 to 5½"deep using a two-row tuber unit planter June 7, 2013. In-row spacing was 15 cm spacing in 5 m rows spaced 90 cm apart.

The potatoes were hilled July 4 with a power hiller. The plots were irrigated to maintain soil moisture close to 70%. Foliar fungicides were applied several times during the growing season to prevent early and late blight from developing (Table 90). Insecticide was applied July 10 (Matador 120 EC, 40 mL/ac) to control Colorado potato beetle.

Table 90: Foliar fungicides applied to the 2013 potato crop to prevent early and late blight development.

Date of Application	*Fungicide*	*Rate*
July 10	Quadris	202 mL/ac
July 20	Bravo 500	0.64 L/ac
Aug 15	Ridomil Gold Bravo	883 mL/ac

Figure 48: LPC evaluation trial at CDCS in Brooks, AB July 30, 2012.

Emergence data was taken every two days following hilling. The Julian date when 50% of the plants had emerged was recorded and full emergence (100%) was recorded as the date when all plants expected to emerge had emerged. Stand was recorded once full emergence had been reached.

Reglone (1.4 L/ac) was applied September 11 to encourage skin set and facilitate mechanical harvest. Stem counts were taken following desiccation, just prior to harvest. The mean number of stems per plant was calculated by dividing the stand by the total number of stems in each row. The mean number of tubers per stem was calculated by dividing the total number of tubers from each row by the number of stems per row. Tubers were harvested September 23 & 24 with a one-row Checci harvester for yield and grade data.

Tubers were stored at 8˚C until graded. Tubers were graded into size categories (less than 25 mm, 25-41 mm, > 41 mm, and deformed). A 5 kg sample of (tubers 25-41 mm) from each replicate was used to determine specific gravity using the weight in air over weight in water method.

The data presented here have been statistically analyzed using ANOVA and Tukey's Multiple Comparison Test; (SPSS; $p \leq 0.05$). Statistical summaries are available upon request.

Sub-samples of tubers from the 25 – 41mm category were made available to the client for culinary evaluation. The results of the culinary evaluation will be provided independently of this report.

Results and Discussion

Sample hills of each cultivar were dug July 30, 2013 for an initial assessment of tuber set, yield potential and relative maturity. Photos of these potatoes are shown in Appendix B.

In season data is presented in Table 91. Approximately 19 days after planting, 50% of many of the plants in each row were visible (data not shown). Full emergence was reached between 23 and 32 days after planting. There was no significant difference in emergence dates from any of the cultivars planted. The mean number of stems per plant, tubers per stem and tubers per plant (tuber set) are shown in Table 2 as well. There were significant differences in each of these categories. For ease of comparison, cultivars have been grouped into categories by skin-color but were analyzed as a complete data set.

The mean number of tubers per plant ranged from as low as 8.7 for LPC 014 to as many as 46.9 for TT-10-014/2010-12. It is my understanding that a target of 15 or more tubers per plant is desirable for the production of gourmet potato varieties (Joel Vander Schaaf, personal communication). If tuber set is too high, however, many tubers may not reach a marketable size prior to harvest in Alberta's short growing season. Most of the cultivars included in the trial exceeded tuber sets of 15. Exceptions include the splash cultivars, LPC 013 and G12, the yellow cultivars G16, G7, and TT 009, red-skinned cultivars TT 007, LPC 012, G1, TT-09-060/2010-02 and TT-10-106/2011-07 and the purple-skinned cultivars LPC 014, G13, LPC 010, and TT-09-200-2010-04. As tuber set is only an indication, marketable yield will be a better indicator than tuber set alone for the potential of these cultivars as gourmet varieties.

Table 91: Field data and tuber set information for each variety grown at 135 lbs./ac N at CDCS. Data shown is the mean of three or four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

CDCS	Full Emergence DAP	Stems per Plant	Tubers per Stem	Tubers per Plant
Moderate N				
G12	27.3	3.5 cd	2.9 def	9.9 gh
LPC 013	31.8	3.5 cd	2.6 def	10.8 gh
425/09-06	31.0	8.0 a	3.3 def	26.3 b-f
G16	23.5	3.3 cd	6.6 a-e	14.1 fgh
G14	27.3	5.3 abcd	2.9 def	15.6 e-h
TT 006	24.8	5.7 abcd	3.0 def	17.1 d-h
G6	26.0	4.2 bcd	3.7 def	15.4 e-h
G7	28.5	4.3 bcd	3.0 def	12.5 gh
TT 009	27.3	5.3 abcd	3.9 def	14.7 fgh
G11	25.5	6.8 ab	2.4 ef	16.1 e-h
TT-08-024/2010-06	29.0	3.3 cd	6.5 a-e	21.2 b-g
TT-08-024/2010-07	27.7	4.4 bcd	1.8 b-f	19.8 c-h
TT-08-024/2010-12	27.7	5.2 abcd	6.1 a-f	32.2 b
TT-10-014/2010-06	27.7	3.9 bcd	7.3 a-d	27.1 b-e
TT-10-014/2010-12	27.7	4.9 abcd	10.0 a	46.9 a
TT 007	28.5	2.9 d	4.4 b-f	12.4 gh
LPC 012	27.7	5.2 abcd	2.9 def	14.7 fgh
G15	27.3	3.7 bcd	3.3 def	15.6 e-h
G1	27.3	4.8 bcd	2.8 def	13.4 gh
TT-08-006/2010-05	27.3	3.8 bcd	4.1 c-f	15.6 e-h
TT-09-060/2010-02	27.7	4.1 bcd	3.0 def	12.2 gh
TT-10-106/2011-07	29.3	4.1 bcd	3.6 def	12.2 gh
TT-10-106/2011-09	29.3	3.9 bcd	5.9 a-f	20.7 b-h
TT-10-125/2011-03	27.7	3.6 cd	9.1 ab	30.5 bc
TT-10-125/2011-05	27.7	3.2 cd	8.7 abc	27.9 bcd
G13	29.5	3.6 cd	3.2 def	10.8 gh
LPC 010	29.8	3.7 bcd	3.1 def	11.3 gh
LPC 014	27.7	5.7 abcd	1.6 f	8.7 h
TT-09-200/2010-01	29.3	6.3 abc	2.3 ef	16.4 d-h
TT-09-200/2010-04	29.0	5.7 abcd	2.2 ef	11.7 gh
TT-10-106/2011-04	27.7	5.0 abcd	3.3 def	16.2 d-h

Yield data (total yield; ton/ac) and specific gravities of each of the gourmet cultivars are shown in Table 92. Total yield estimates ranged from 7.0 ton/ac to 29.9 ton/ac. In order for producers to achieve a realistic return on investment growing gourmet potatoes, yield must be above a threshold. Of the bicolour potatoes, G12 yielded significantly more than LPC 013. Many of the yellow-skinned cultivars yielded well and were not significantly different from total yield of TT 006. TT 009, G6, G7, TT-08-024/2010-12, G16, 425/09-06, G14 and TT-10-014/2010-12 were among the best yielding yellow-skinned cultivars. Of these, G6 and TT 009 yielded significantly more than TT 006. TT 007, LPC 012, G15, G1, TT-08-006/2010-05, TT-09-060/2010-02 and TT-10-106/2011-09 were among the best yielding red-skinned cultivars, but none yielded significantly more than TT 007. Yields of purple-skinned cultivars were lower than yields of most other cultivars, with the exception of LPC 010, a yellow-fleshed cultivar. It is not clear whether yields are lower as a consequence of a shorter breeding and selection history, or if the production of anthocyanins in the tuber flesh is a significant sink for photosynthate with a corresponding impact on yield. Among the purple-skinned, purple-fleshed cultivars, the best yield was observed with TT-10-106/2011-04 although total yield was not statistically different from other purple-skinned entries. Further addressing the specific agronomic needs of each variety may well result in improvements to yield and size profiles when compared with the results in this trial.

Specific gravity of tubers ranged from 1.066 for TT 007 to 1.097 for 425/09-06 (Table 3). The texture of ‘new’ potatoes often associated with gourmet size is consistent with specific gravity values of 1.06 to 1.08. Varieties with specific gravities above 1.085 often rival those of French fry varieties with a dry or mealy texture and may be less suitable for the gourmet market.

Potatoes were sized into categories and the estimated number of tubers per acre in each size category is represented in Table 93. There were statistically significant differences in all size categories. For the bicolour potatoes, G12 produced significantly more tubers per acre in the > 41mm category than LPC 013, perhaps an indication of earlier maturity. Among the yellow-skinned potatoes, TT-10-014/2010-12 and TT-08-024/2010-12 produced significantly more 25 – 41mm tubers per acre than TT 006 and other yellow-skinned cultivars. None of the other tested lines produced significantly fewer tubers in this category than TT 006. G7 and TT 009 produced significantly more tubers in the > 41mm category than TT 006 and other cultivars, indicating that an earlier harvest of these potatoes may be required. TT-08-006/2010-05, TT-10-106/2011-09, TT-10-125/2011-03 and TT-10-125/2011-05 all produced significantly more tubers in the 25 – 41mm category than TT 007. Blushing Bell, however, produced the greatest number of tubes in the > 41mm category indicating that an earlier harvest of this cultivar may be preferred. The number of tubers over 41mm from G15 was not statistically different from that of TT 007 and G1, TT-09-060/2010-02 and TT-10-106/2011-09 also had a large number of tubers in the larger category. Both TT-10-106/2011-04 and TT-09-200/2010-01 produced high numbers of 25 – 41mm tubers per acre, however, there were no purple-skinned cultivars that produced significantly different numbers of tubers per acre in this size category than LPC 014. LPC 010 produced significantly more > 41mm tubers than LPC 014 and TT-09-200/2010-01 produced significantly fewer.

Table 92: Estimated total yield (ton/acre) and specific gravity for each variety grown at 135 lbs./ac N at CDCS. Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the $p < 0.05$ level.

CDCS	Yield (ton/ac)	SG
Moderate N		
G12	23.1 a-g	1.075 abc
LPC 013	8.38 hi	1.088 abc
425/09-06	20.2 a-g	1.097 a
G16	28.0 abc	1.070 bc
G14	19.3 a-h	1.082 abc
TT 006	17.8 c-i	1.080 abc
G6	29.9 a	1.067 c
G7	29.2 abc	1.081 abc
TT 009	29.8 a	1.080 abc
G11	13.6 f-i	1.084 abc
TT-08-024/2010-06	18.8 a-h	1.087 abc
TT-08-024/2010-07	15.8 e-i	1.083 abc
TT-08-024/2010-12	19.8 a-h	1.089 abc
TT-10-014/2010-06	18.3 b-i	1.096 a
TT-10-014/2010-12	20.8 a-g	1.080 abc
TT 007	27.0 a-d	1.066 c
LPC 012	29.3 ab	1.083 abc
G15	20.5 a-g	1.080 abc
G1	24.1 a-f	1.075 abc
TT-08-006/2010-05	21.1 a-g	1.080 abc
TT-09-060/2010-02	19.6 a-h	1.079 abc
TT-10-106/2011-07	7.0 i	1.082 abc
TT-10-106/2011-09	19.2 a-h	1.084 abc
TT-10-125/2011-03	13.3 f-i	1.079 abc
TT-10-125/2011-05	17.8 c-i	1.088 abc
G13	14.5 f-i	1.074 abc
LPC 010	26.9 a-e	1.084 abc
LPC 014	15.5 f-i	1.075 abc
TT-09-200/2010-01	12.0 ghi	1.073 abc
TT-09-200/2010-04	12.6 f-i	1.082 abc
TT-10-106/2011-04	16.5 d-i	1.095 ab

Table 93: Number of tubers per acre (x 1000) in each size category (< 25mm, 25 to 41mm, > 41mm, and deformed) for each variety grown at 135 lbs./ac N at CDCS. Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the $p < 0.05$ level.

CDCS	< 25mm	25 to 41mm	> 41mm	Deformed
Moderate N				
G12	18.9 hi	76.0 lm	169.3 b-g	0.9 b
LPC 013	32.3 hi	141.2 i-m	64.5 h-m	0.9 b
425/09-06	206.8 cd	398.4 cd	61.5 i-m	3.0 b
G16	47.2 hi	222.6 e-m	101.2 f-l	8.3 ab
G14	46.8 hi	201.7 f-m	171.8 efg	1.6 b
TT 006	52.4 hi	250.7 d-k	147.9 f-i	10.6 ab
G6	34.4 hi	183.0 f-m	195.8 def	2.7 b
G7	18.4 hi	99.6 klm	201.5 a-d	1.1 b
TT 009	28.8 hi	211.3 e-m	286.6 cde	0.6 b
G11	178.5 c-g	232.3 e-l	4.7 l	18.0 a
TT-08-024/2010-06	98.3 d-i	309.1 c-h	146.0 g-j	2.7 b
TT-08-024/2010-07	135.5 c-h	262.3 d-k	105.2 ijk	4.2 b
TT-08-024/2010-12	220.6 cd	566.6 ab	73.4 kl	6.9 ab
TT-10-014/2010-06	238.0 c	371.1 cde	117.5 jkl	5.1 b
TT-10-014/2010-12	593.3 a	643.0 a	25.8 l	2.1 b
TT 007	8.3 i	66.5 m	242.2 a	3.1 b
LPC 012	59.1 ghi	181.7 f-m	148.7 fgh	6.0 b
G15	24.3 hi	97.6 klm	204.4 a-d	0.9 b
G1	20.9 hi	129.7 j-m	204.2 bcd	1.8 b
TT-08-006/2010-05	76.4 f-i	301.1 c-i	36.4 kl	7.6 ab
TT-09-060/2010-02	22.5 hi	114.5 klm	180.5 bcd	3.9 b
TT-10-106/2011-07	113.3 c-i	153.2 h-m	43.8 jkl	4.2 b
TT-10-106/2011-09	72.2 f-i	290.2 d-j	180.8 f-i	0.6 b
TT-10-125/2011-03	462.9 b	319.6 c-f	28.5 l	11.4 ab
TT-10-125/2011-05	194.0 c-f	458.1 bc	90.5 jkl	2.4 b
G13	54.6 ghi	183.5 f-m	37.2 jkl	10.1 ab
LPC 010	4.9 i	72.2 lm	210.9 ab	11.0 ab
LPC 014	15.0 hi	106.4 klm	111.8 def	1.8 b
TT-09-200/2010-01	81.2 e-i	209.9 e-m	88.7 h-k	1.8 b
TT-09-200/2010-04	35.1 hi	155.9 f-m	113.3 f-i	0.0 b
TT-10-106/2011-04	38.7 hi	229.6 e-m	167.0 fgh	2.1 b

The mean percentage of total tuber number in each size category is shown in Table 94. It is important to note that harvesting with small plot equipment and manual labour recovers all potatoes over 15mm in diameter. This tended to increase the yield (and percentage) of small potatoes relative to a commercial situation where more of these tubers may be left behind in the field. The percentage of tubers in each category gives an indication of which cultivars require the full season to reach their potential and which may be earlier maturing. Approximately half of the trial entries reached marketable sizes well before the harvest date. Grouping cultivars into early and medium-maturing groups may prove a more effective tool for variety evaluation and selection in future.

Table 94: Percentage of total tuber number in each size category (< 25mm, 25 to 41mm, > 41mm, and deformed) for each variety grown at 135 lbs./ac N at CDCS. Data shown is the mean of four replicates.

CDCS	< 25mm	25 to 41mm	> 41mm	Deformed
Moderate N				
G12	7.1	28.6	64.0	0.3
LPC 013	7.4	59.1	27.1	0.4
425/09-06	30.8	59.6	9.2	0.4
G16	12.4	58.4	27.2	2.1
G14	11.0	48.2	40.6	0.4
TT 006	10.7	54.1	3.3	2.2
G6	5.6	43.4	48.0	0.6
G7	1.8	30.9	63.1	0.4
TT 009	5.5	40.1	54.7	0.1
G11	41.4	53.4	1.1	4.2
TT-08-024/2010-06	17.2	56.0	26.3	0.5
TT-08-024/2010-07	27.4	50.8	21.1	0.7
TT-08-024/2010-12	24.7	66.0	8.5	0.8
TT-10-014/2010-06	32.4	50.3	16.6	0.6
TT-10-014/2010-12	47.0	51.0	1.9	0.2
TT 007	2.6	20.9	75.6	1.0
LPC 012	8.0	45.9	37.6	1.5
G15	7.4	29.7	62.6	0.3
G1	6.0	36.7	56.9	0.5
TT-08-006/2010-05	17.8	71.9	8.5	1.9
TT-09-060/2010-02	3.9	35.3	56.6	1.2
TT-10-106/2011-07	35.8	49.0	13.9	1.3
TT-10-106/2011-09	13.3	53.5	33.1	0.1
TT-10-125/2011-03	56.1	38.9	3.5	1.4
TT-10-125/2011-05	26.3	61.3	12.0	0.3
G13	19.0	64.8	13.3	3.6
LPC 010	13.6	24.3	70.4	3.6
LPC 014	6.3	45.0	48.0	0.8
TT-09-200/2010-01	21.3	54.7	23.6	0.5
TT-09-200/2010-04	11.7	52.2	36.2	0.0
TT-10-106/2011-04	8.9	52.4	38.2	0.5

The estimated yield of tubers in each category is represented in Table 95. In general, a good yield of tubers in the 25 – 41mm category would be the focus of cultivar evaluation, but, in this trial, a good yield of tubers over 41mm may also indicate that an earlier harvest may result in an increased yield of 25 to 41 mm tubers. Several yellow-skinned cultivars had good yields of 25 to 41mm tubers. TT-10-014/2010-12, TT-08-024/2010-12, 425/09-06 and G16 yielded well and were not significantly different from TT 006. Yields of tubers > 41mm of G6, G7, TT 009, TT-09-060/2010-02 and G16 indicated that an earlier harvest may have been beneficial. For the red-skinned cultivars, G1 and TT-10-125/2011-05 showed promise with yields of 25 – 41mm tubers not significantly different from LPC 012 and TT 006. Higher yields of TT 007, LPC 012, G15, G1 and TT-10-106/2011-09 in the > 41mm category indicate that these cultivars may have been harvested too late. None of the purple-skinned cultivars stood out with good yields in the 25 – 41mm category and none were significantly different from LPC 014. Yields of TT-10-106/2011-04 and TT-09-200/2010-04 were reasonably good and not significantly different from that of LPC 014. LPC 010 yielded significantly more deformed tubers than most other cultivars regardless of skin colour, possibly as a result of harvesting past an optimal harvest date. G11 and G16 had yields of deformed tubers that were not statistically different from that of LPC 010 or any other cultivars. Optimizing harvest dates from each variety would allow a better evaluation of the yield potential within a desirable size range.

Table 95: Estimated yield (ton/ac) in each size category (< 25mm, 25 to 41mm, > 41mm, and deformed tubers) for each variety grown at 135 lbs./ac N at CDCS. Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

CDCS	Yield of <25mm (ton/ac)	Yield of 25 to 41mm (ton/ac)	Yield of > 41mm (ton/ac)	Yield of deformed (ton/ac)
Moderate N				
G12	0.19 hi	2.5 ef	20.2 a-d	0.18 b
LPC 013	0.30 hi	3.7 ef	4.4 j-m	0.05 b
425/09-06	2.33 c	12.6 a-d	4.7 i-m	0.66 b
G16	0.67 f-i	12.2 a-d	14.0 b-h	1.05 ab
G14	0.35 hi	6.1 b-f	12.7 d-j	0.11 b
TT 006	0.45 g-i	7.8 a-f	9.1 f-m	0.45 b
G6	0.36 hi	7.1 a-f	22.2 abc	0.26 b
G7	0.20 hi	4.7 def	24.2 a	0.15 b
TT 009	0.23 hi	6.6 b-f	22.9 ab	0.05 b
G11	2.39 c	9.7 a-f	0.5 m	0.98 ab
TT-08-024/2010-06	0.80 e-i	8.7 a-f	9.3 f-m	0.13 b
TT-08-024/2010-07	1.14 d-h	6.9 a-f	7.6 g-m	0.23 b
TT-08-024/2010-12	1.75 cde	13.7 abc	4.2 j-m	0.28 b
TT-10-014/2010-06	1.84 cd	9.3 a-f	7.0 g-m	0.20 b
TT-10-014/2010-12	4.72 a	14.4 ab	1.6 lm	0.05 b
TT 007	0.08 i	2.3 f	24.4 a	0.29 b
LPC 012	0.77 f-i	9.3 a-f	18.3 a-e	0.86 b
G1	0.20 hi	10.4 a-f	13.3 c-i	0.18 b
G15	0.20 hi	3.1 ef	17.2 a-f	0.05 b
TT-08-006/2010-05	1.35 d-g	15.1 a	4.2 j-m	0.50 b
TT-09-060/2010-02	0.17 hi	3.4 ef	15.6 a-g	0.47 b
TT-10-106/2011-07	0.83 e-i	3.6 ef	2.3 klm	0.23 b
TT-10-106/2011-09	0.61 f-i	7.6 a-f	10.9 e-k	0.03 b
TT-10-125/2011-03	3.45 b	7.8 a-f	1.7 lm	0.33 b
TT-10-125/2011-05	1.46 c-f	10.8 a-e	5.4 h-m	0.10 b
G13	0.70 f-i	9.0 a-f	3.9 j-m	0.85 b
LPC 010	0.05 i	2.4 f	22.5 ab	2.02 a
LPC 014	0.17 hi	3.5 ef	11.6 d-j	0.17 b
TT-09-200/2010-01	0.64 f-i	5.4 c-f	5.8 h-m	0.13 b
TT-09-200/2010-04	0.35 hi	4.2 def	8.0 g-m	0.00 b
TT-10-106/2011-04	0.33 hi	6.0 b-f	10.0 e-l	0.10 b

Conclusions

The 2012 variety trial included nine gourmet potato varieties with potential in Alberta. TT 008, TT 009 and TT 006 have desirable profiles for the yellow gourmet potato market. LPC 013 has an excellent size profile for the gourmet category and has a novel appearance. This variety seemed less prone to defects, and a reduced rate of N resulted in fewer oversized tubers. The blue potato varieties in this trial were unimpressive in appearance and yield and differences observed were not statistically significant. Fingerling varieties, such as TT 011 and LPC 012, likely need to be harvested earlier to maximize gourmet sizes and limit oversize potatoes.

The 2013 variety trial included thirty-one gourmet potato varieties with potential in Alberta. The splash-skinned cultivar, G12 out-yielded LPC 013 and has an attractive and interesting appearance. A number of yellow-skinned cultivars showed promise and rivaled TT 006 in yield, size profile and appearance. Several additional yellow-skinned cultivars had impressive yields of tubers in the >41mm category and may need to be harvested earlier for a meaningful evaluation. Red-skinned TT-08-006/2010-05 showed promise as a fingerling and several other red-skinned varieties, such as G15, G1, and TT09-060/2010-02 may need a closer look and an earlier harvest date. One purple-skinned cultivar, TT-10-106/2011-04, showed promise in appearance, size profile and yield relative to other purple-skinned cultivars.

The trial was designed to provide regional data for a wide range of potato cultivars. A N response curve for each variety is not realistic based on two levels of N, but these results should provide an indication of whether additional N will result in a shift in size categories that is desirable. In 2012, the N rate in the low N plots was 60 lbs./ac lower than the regular rate. In 2013, the N rate of 135 lbs./ac was a moderate rate of N relative to processing cultivars, but possibly higher than required for some of the gourmet potato cultivars. Addressing the agronomic needs of each variety may well result in improvements to yield and size profiles when compared to the results in this year of the trial.

Overall Results

Over the three years of the Alberta Potato Variety Evaluation trial, Alberta data was provided for 132 cultivars from the AAFC National Potato Breeding Program. The cultivars comprised 26 chipping clones, 24 French fry or dual purpose clones, and 82 fresh market clones including clones with anti-oxidant properties, low glycaemic index and other novel attributes.

The French fry industry supplied 22 French fry cultivars for evaluation over three years, the chipping industry evaluated 26 cultivars, 39 cultivars were evaluated for stakeholders pursuing the fresh market segment, and 40 creamer potato cultivars were evaluated along with relevant check varieties. Many of the entries were grown at two different levels of N to provide preliminary agronomic data for stakeholders. As requested, some harvest dates were adjusted to accommodate clients. Some in-row spacing changes were made for specific categories of potatoes. After harvest and grading each year, potatoes were provided to cooperators to allow them to conduct bruising, storage and culinary evaluations independently.

Conclusions

The potato variety evaluation trial was well supported by the Alberta potato industry. Almost all of the key stakeholders participated in one or more years of the trial and many participated in every year of the trial. There has been interest expressed in continuing this type of variety evaluation work to ensure impartial information is available to decision makers throughout the value-chain.

One of the most interesting things we noted about the three-year trial is that there were examples of AAFC material included in 2011 that was picked up by industry in 2012 and 2013. Some of the industry entries in all three years of the trial originated from the federal program and within the space of three years, seed supplies are being established and commercial production of the new releases is anticipated. These cultivars have been identified throughout the report with a maple leaf. This type of flow-through and the engagement of all links in the value chain is the kind of positive outcome we hoped to achieve.

With a suitable land base and equipment and facilities required for potato production and evaluation, a knowledgeable coordinator and a skilled technical staff could routinely evaluate cultivars on behalf of industry stakeholders. The Alberta potato industry members have demonstrated a willingness to cooperate and provide funding to ensure access to relevant data continues in Alberta.

The framework of this trial formed the basis for an application to the Growing Forward 2 Science Cluster for potato variety evaluation work. The project has received funding for an additional 4 years from this source. Eight stakeholders plus the Potato Growers of Alberta provided letters of support for the new project.

References

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Presentations

The potato industry will have access to the project information in many ways. Growers and industry members were invited to see the varieties at field days in Edmonton (Crop Diversification Centre North) and Brooks (Crop Diversification Centre South) in August 2011, August 2012 and August 2013. Dr. Konschuh spoke at the North Area Meeting of the Potato Growers of Alberta about the trial and opportunities for potato industry stakeholders to participate in 2011 and 2012. In Brooks, guests were invited to tour the evaluation plots and compare the unique performances of each variety in the field under local conditions.

Data was collected, analyzed and presented in multiple reports to industry stakeholders each year of the trial. Each sponsor was provided with a client-specific report for each year of participation. Information will be available on the internet (ARD website, PVMI website and PGA website) for easy access for growers.

Some modifications were made to the trial each year at the request of participants. Where possible, excess production was made available to partners for storage and culinary evaluations.

Posters were presented at the Annual General Meeting of the Potato Growers of Alberta in 2011, 2012 and 2013.

Acknowledgements

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McCain Produce Canada (2011, 2012)
Old Dutch Foods (2011, 2012, 2013)
Parkland Seed Potatoes (2011, 2012, 2013)
PVMI (Potato Variety Management Institute) (2011, 2012)
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Activity 18.v10 – Potato 17.v10 Canadian Potato Variety Evaluation Program – Alberta 2014

2014 REPORT


14.07.2014

Prepared for the
Potato Growers of Alberta
6008 – 46th Avenue
Taber, AB T1G 2B1

By

Michele Konschuh
Alberta Agriculture and Rural Development, Crop Diversification Centre South, 301 Horticultural Station Road East, Brooks, AB T1R 1E6

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Executive Summary

In 2014, the first year of the trial, funding from 9 industry stakeholders plus the Potato Growers of Alberta (PGA) was leveraged to conduct replicated potato variety trials in southern Alberta. The trial was conducted under pivot irrigation at the Alberta Irrigation Technology Centre in Lethbridge, AB. More than 100 potato varieties were evaluated in 2014. Data collected was adjusted where possible to ensure that clients were provided with information useful for their organizations. A limited amount of agronomic data was also provided at the request of client sponsors.

Data collected included emergence data, stand count, total yield, grade by size category relevant to end-use, specific gravity, internal defects, external deformities, and culinary evaluations. Samples were returned to stakeholders for bruise testing, storage assessments or acrylamide testing by the stakeholders. Local production data supports adoption of new potato varieties that will enhance the competitiveness of our potato industry.

A few potato cultivars submitted by clients were intended for the French fry market. French fry varieties must yield well and have good fry characteristics. Specific gravity of the potatoes is an indirect measure of fry colour. In lieu of submitting additional cultivars, one client elected to evaluate several nitrogen fertilizer strategies for two varieties.

Eight chipping potato varieties were included in 2014. Old Dutch Foods, as well as seed growers and variety development firms provided chippers for evaluation. Chipping potatoes are graded by size rather than weight. As with French fry cultivars, good fry colour is essential and specific gravity is a good indirect measure of chip colour. Typically, chipping potatoes required less N than French fry cultivars and a comparison at a lower rate of N was requested for seven of the chipping entries. Chip colour scores were provided for varieties evaluated as chippers.

Fresh market potatoes were included in the 2014 trial as well. Although the fresh market sector of Alberta’s potato industry is the smallest segment, there is a lot of growth potential even if we simply replace imported potatoes with locally produced ones. Sixteen fresh market cultivars and 2 checks were evaluated in 2014. Five entries were evaluated on a moderate rate of N, 5 entries were evaluated at a lower rate of N and 6 entries were evaluated at both rates to determine whether or not the varieties respond well to reduced N. Culinary data was provided as requested. For table potatoes, potatoes were evaluated as baked and boiled to determine the best fit for marketing purposes.

A special category of fresh market potatoes is the creamer potato market, made popular by the Alberta based Little Potato Company. Creamer potatoes are not smaller versions of other fresh market varieties; the varieties are selected for high tuber set and small tuber size intentionally to satisfy this market. These potatoes are prepared with the skin on and may be served with limited additional preparation. As such, skin set and tuber appearance are critical. Flavour is also very important for this class of potatoes. Forty creamer cultivars were included in the trail in 2014 and spacing was adjusted to reflect the special nature of this type of crop.

Agriculture and Agri-Food Canada (AAFC) has been involved in potato breeding for over 40 years. The National Potato Variety program includes selections that might be suitable for the French fry, chipping, or table market, including the creamer category. Industry participants are encouraged to view selections after one or two years of regional testing and to “pick up” the varieties for further testing. Without regional testing in Alberta and knowledge of how the cultivars perform in our growing environment, industry stakeholders would be hard-pressed to make selections. AAFC supplied test material for replicated trials and included entries suitable for all industry sectors. In 2014, 11 chipping cultivars, 13 French fry cultivars and 13 fresh market cultivars were evaluated along with relevant check material from eastern and western sources at AITC.

A field day was hosted at CDCS in August to allow stakeholders to evaluate the response of cultivars to irrigated growing conditions in Alberta. There is no substitution for first-hand observation of potato varieties in the field.

Customer specific reports were generated and provided. Client confidentiality was respected by coding entries prior to releasing reports more widely.

Project Overview

Potato variety evaluation trials were conducted at the Alberta Irrigation Technology Centre (AITC) in Lethbridge to provide data from an irrigated site in Alberta. Standard varieties were included to represent early French fry, full-season French fry, early chipper, full-season chipper, fresh market red, fresh market yellow classes. Sufficient potatoes were planted to provide replicated data from AITC and to host a demonstration field day at CDCS in 2014.

Material for these trials was provided by AAFC Potato Breeding Program and by industry stakeholders either through the AAFC Accelerated Release Program or by sourcing varieties from European, U.S. or other breeding programs. All import requirements were the responsibility of the stakeholder requesting evaluation.

At AITC, we set up a nitrogen response trial with moderate and reduced levels of nitrogen fertility. Stakeholders indicated whether or not they required fertility information and provided sufficient seed (in-kind) and funds to include these evaluations. Some accommodations were made to ensure that all client sponsors found value in the data provided.

The leveraged funding from industry also provided resources for the regional evaluation of AAFC material prior to release to industry. Without funding from this project, there would not have been an opportunity to observe the breeding program cultivars in Alberta in 2014.

Variety trials were set up as randomized complete blocks. Guard rows were planted to minimize edge effects. Four replicate rows (6m) were harvested. The agronomic trials were set up as split plot designs with nitrogen level as the main plot and varieties as sub plots.

Data collected included emergence data, stand count, total yield, grade by size category relevant to end-use, specific gravity, internal defects, external deformities, and culinary evaluations. Samples were returned to stakeholders for bruise testing, storage assessments or acrylamide testing by the stakeholders. Local production data supports adoption of new potato varieties that will enhance the competitiveness of our potato industry.

A field day was hosted at CDCS in August to allow stakeholders to evaluate the response of cultivars to irrigated growing conditions in Alberta. There is no substitution for first-hand observation of potato varieties in the field.

Objectives:

A. To evaluate potential new varieties for processing (fry and chip), creamer and other markets;
B. To provide the potato industry an opportunity to assess varieties grown under local conditions;
C. To compare varieties from European, Tri-State and National breeding programs (AAFC) under Alberta conditions; and
D. To develop agronomic information on nitrogen response to support potato growers interested in producing new varieties.
E. To evaluate the cooperative approach to variety development and develop a model that takes the industry beyond the current project.

Project Team Members

Alberta Agriculture and Rural Development, Crop Diversification Centre South, Brooks, AB

- Dr. Michele Konschuh, Potato Research Scientist – Project Lead
- Seasonal Technologists

Agriculture and Agri-Food Canada, Potato Research Centre, Fredericton, NB

- Dr. Benoit Bizimungu, Plant Breeder
- Technologists

Background

One of the key areas of research that the Alberta potato industry identified in industry-wide priority setting meetings in 2003 and 2004 is breeding for new potato varieties. This was reiterated in National industry consultation meetings held in 2011. For about 40 years now, Agriculture and Agri-Food Canada managed a potato breeding program in Western Canada focused on breeding and selecting varieties that would perform well under our environmental conditions. Alberta Agriculture facilitated the process by conducting regional trials, disease resistance trials, agronomic trials, culinary and storage trials with promising new varieties. In recent years, reductions in government staff and budgets put pressure on the support provided by both levels of government. The nature of potato breeding and selection has shifted. Industry participants are exploring varieties for different end-uses, such as gourmet and functional food uses. The potato breeding programs in Canada were consolidated into a National program in 2004 and there is now one National Potato Breeder based in New Brunswick. By necessity, less emphasis is directed at varieties best suited for Western Canada. Varieties from breeding programs in Europe and the United States are often being assessed by industry stakeholders.

Regional trials of potato varieties in Western Canada were funded in part by industry money collected through the Western Canadian Potato Breeding Consortium. This system was unique to Western Canada and served established industry stakeholders well. Newcomers to the industry were not easily able to participate. Even established stakeholders questioned whether they received sufficient value for the fees. The shift to an accelerated release mechanism moved the responsibility for the evaluations to industry and provides broader access to stakeholders initially. However, the window for evaluation of varieties is much narrower than in the Consortium and less data is available for decision makers.

Over the last 15 years, Alberta Agriculture and Rural Development staff worked with individual stakeholders in the potato industry to provide agronomic evaluations of potato varieties from various breeding programs. Public varieties are still widely grown, but not always as good a fit as private varieties for the same end use. Growing environments vary significantly among potato production regions in Canada. Alberta data is essential when selecting varieties appropriate for our climate, our customers and industry stakeholders.

Many breeding programs target disease resistance, nitrogen use efficiency and excellent storage potential in addition to increased yield. The challenge is often that impartial comparisons of the material with standards varieties are not available. Each stakeholder would have the responsibility to obtain seed, sign agreements, engage researchers, or evaluate varieties independently. Many are not equipped to conduct small-scale evaluations well and seed is not available for larger-scale evaluations. Breeder's seed also has higher tolerances for virus loads and producers evaluating this material on farm put the remainder of the crop at risk.

In Alberta, potato industry stakeholders are looking for replacement varieties that use less nitrogen, less water, less pesticide, yet yield superior processing or culinary quality and tonnage. Varieties from breeding programs in Canada, Europe and the United States are often being assessed. Many breeding programs target disease resistance, nitrogen use efficiency and excellent storage potential in addition to increased yield. Tuber yield potential and nutritional requirements are impacted by variety characteristics and by environmental characteristics such as the length of the growing season (Westerman, 1993). As noted by Love et al. (2003), the full potential of a new variety may not be realized until proper management is implemented. There is increasing pressure on potato producers to utilize best management practices to reduce the environmental footprint for potatoes. The costs of such shifts in production practices will be borne primarily by producers.

An ideal French fry variety would have earlier maturity than Russet Burbank, be relatively tolerant of environmental fluctuations, have few defects, yield well and have specific gravity in the desired range (1.086 to 1.092). Good fry color out of the field is an asset, and good fry color out of storage is also very desirable. An ideal chipping variety would produce a good yield of medium sized tubers, be relatively tolerant of environmental fluctuations, have few defects, and have high specific gravity in the desired range (above 1.086). Chipping tubers with a good skin set, good maturity at harvest and low concentration of reducing sugars is also very desirable. Varieties that store well at cooler temperatures are an asset. Ideal fresh market varieties would produce a good yield of creamer or medium sized tubers, be relatively tolerant of environmental fluctuations, have few defects, and have an attractive appearance. Fresh market tubers with a good skin set that store well are very desirable.

The purpose of this project was to pool resources to evaluate potential varieties from a range of sources, using a cooperative approach. This trial was established to collect local agronomic data on varieties from breeding programs in Canada, the U.S. and elsewhere. Including agronomy in the evaluations allowed us to provide growers with additional relevant information when they consider producing new varieties. Often, there are economies of scale realized when varieties are evaluated collectively rather than individually. ARD was well positioned to provide regional data in an impartial setting. The varieties were planted in replicated plots at the Alberta Irrigation Technology Centre (AITC) in Lethbridge, AB and in demonstration plots at the Crop Diversification Centre South (CDCN) in Brooks, AB in 2014.

AAFC National Potato Variety Evaluation

2014

Materials and Methods

The variety evaluation was conducted in small plots at the Alberta Irrigation Technology Centre in Letbridge, AB. Fertility (227 lbs/ac) was achieved through a combination of soil fertility (57 lbs/ac N; 23 lbs/ac P) and broadcast fertilizer (92 lbs/ac of 46-0-0, 162 lbs/ac of 11-52-0, 212 lbs/ac of 0-0-60 and 240 lbs/ac of 20.5-0-0-24) incorporated prior to planting. Varieties were planted in four replicate rows in a randomized complete block design along with standard varieties (Norland, Yukon Gold, Snowden, Atlantic, Russet Burbank and Shepody). Each block was planted adjacent to guard rows to reduce any edge effects (see plot plan, Appendix A1).

Roundup (1 L/ac) was sprayed prior to planting (May 21) to reduce weed pressure. Seed of standard cultivars was provided by Edmonton Potato Growers and seed of test cultivars was provided by each participant. Potatoes were planted June 5, 2014 approximately 5 to 5½"deep using a two-row tuber unit planter. Seed was planted at 30cm spacing in 6m rows spaced 90cm apart.

The potatoes were hilled June 27 with a power hiller. Sencor 75DF (100 g/ac) and Centurion (76 mL/ac) were applied prior to emergence (June 3) to control weeds. The plots were irrigated to maintain soil moisture close to 70%. Foliar fungicides were applied several times during the growing season to prevent early and late blight from developing (Table 1).

Table 1: Foliar fungicides applied to the potato crop in 2014 to prevent early and late blight development.

Date of Application	*Fungicide*	*Rate*
16 July	Bravo	1 L/ac
26 July	Dithane	900 g/ac
5 Aug	Bravo	1 L/ac
12 Aug	Dithane	900 g/ac
19 Aug	Dithane	900 g/ac
27 Aug	Bravo	1 L/ac
2 Sept	Bravo	1 L/ac
8 Sept	Bravo	1 L/ac

Reglone was applied (1.0 L/ac) September 15 and again September 19. Potatoes were harvested September 24 and 25 using a 1-row Grimme harvester.

Tubers were stored at 8˚C until graded. Tubers were graded into size categories (less than 48mm, 48 – 88mm, over 88mm and deformed). A sample of twenty-five tubers (48 – 88mm) from each replicate was used to determine specific gravity using the weight in air over weight in water method. These tubers were cut longitudinally to assess internal defects. Sub-samples of 48-88mm tubers were provided to Lethbridge Research Centre staff for culinary and post-harvest evaluations.

The data presented here have been statistically analyzed using ANOVA and Tukey's Multiple Comparison Test; (SPSS; $p \leq 0.05$). Statistical summaries are available upon request.

Results – Chipping Cultivars

Sample hills of each cultivar were dug for a field day August 27, 2014. Photos of the chipping cultivars are shown in Figure 2.

Figure 2. AAFC chipping cultivars at the CDCS field day August 27, 2014: a) Atlantic E., b) Atlantic W., c) F10031, d) F10034, e) F10035, f) F10037, g) FV15559-80, h) FV15568-30, i) GBB1-100, j) V05219-1, k) V07078-1, l) V08053-1, m) FV15720-18, n) Snowden E., and o) Snowden W..

Yield data (total yield; ton/ac) and specific gravities of each of the chipping cultivars are shown in Table 2. Yield ranged from 14.0 for Snowden E to 19.6 ton/ac for V05219-1. Specific gravity ranged from 1.079 for V07078-1 and V08053-1 to 1.099 for GBB1-100.

Table 2: Estimated total yield (ton/acre) and specific gravity for each chipping cultivar grown at AITC in Letbridge, AB (approximately 227 lbs/ac nitrogen). Data shown is the mean of two replicates.

	Yield (ton/ac)	SG
Atlantic East	16.6	1.098
Atlantic West	19.0	1.089
F10031	18.0	1.088
F10034	15.4	1.095
F10035	17.9	1.095
F10037	17.2	1.097
FV15559-80	14.5	1.085
FV15568-30	11.5	1.089
GBB1-100	19.2	1.099
V05219-1	19.6	1.084
V07078-1	18.3	1.079
V08053-1	17.3	1.079
FV15720-18	15.3	1.086
Snowden East	14.0	1.091
Snowden West	14.5	1.098

The mean percentage of total tuber number in each size category is shown in Table 3.

Table 3: Percentage of total tuber number in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed) for each chipping cultivar grown at approximately 227 lbs/ac. Data shown is the mean of two replicates.

	No. of <48mm	No. of 48 to 88mm	No. of > 88mm	No. of deformed
Atlantic East	11	79	10	0
Atlantic West	8	82	10	0
F10031	39	61	0	0
F10034	26	74	0	0
F10035	26	74	0	0
F10037	14	85	0	2
FV15559-80	18	81	2	0
FV15568-30	33	67	0	0
GBB1-100	15	82	2	0
V05219-1	34	64	1	1
V07078-1	19	76	3	2
V08053-1	34	66	0	1
FV15720-18	12	81	5	2
Snowden East	26	72	0	2
Snowden West	33	66	1	0

The yield of tubers (estimated ton/ac) of each chipping cultivar is shown by size category in Table 4. Marketable yield ranged from 9.7 ton/acre for FV15568-30 to 16.7 ton/ac for GBB1-100.

Table 4: Estimated yield (ton/ac) in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed tubers) for each chipping cultivar grown at approximately 227 lbs/ac. Data shown is the mean of two replicates.

	Yield of <48mm (ton/ac)	Yield of 48 to 88mm (ton/ac)	Yield of > 88mm (ton/ac)	Yield of deformed (ton/ac)
Atlantic East	0.6	12.9	3.0	0.1
Atlantic West	0.5	15.0	3.5	0
F10031	4.1	13.8	0.0	0.1
F10034	1.9	13.3	0.1	0.0
F10035	2.6	15.2	0.0	0.1
F10037	3.1	13.6	0.0	0.4
FV15559-80	1.1	12.7	0.7	0.0
FV15568-30	1.7	9.7	0.2	0.0
GBB1-100	1.3	16.7	1.2	0.0
V05219-1	3.2	15.6	0.6	0.3
V07078-1	1.2	14.9	1.7	0.5
V08053-1	3.0	14.0	0.0	0.4
FV15720-18	2.7	12.5	0.0	0.1
Snowden East	1.6	11.1	0.6	0.7

Snowden West	2.7	11.6	0.2	0.0

Tuber samples used to measure specific gravity were evaluated for hollow heart, other internal defects and scab. There were very few internal defects observed in the tubers examined. Hollow heart was noted in at least one tuber of the Atlantic, F10031, F10034, F10037, FV15720-18 and V05219-1. Some tubers from each sample exhibited stem-end discoloration and this may be an indication that plants were not fully mature prior to desiccation. Common scab lesions were not noted on any of the tubers evaluated.

Results– French Fry Cultivars

Sample hills of each cultivar were dug for a field day August 27, 2014. Photos of the French fry cultivars are shown in Figure 3.

Figure 3. AAFC French fry cultivars at the CDCS field day August 27, 2014: a) F10001., b) F10003., c) F10008, d) F10012, e) F10016, f) F10017, g) CV03155-2, h) CV03366-1, i) CV04144-1, j) CV05022-2, k) CV07180-1, l) FV15680-03, m) V1408-1, n) Russet Burbank E, o) Russet Burbank W, p).Shepody E, and q) Shepody W.

Yield data (total yield; ton/ac) and specific gravities of each of the French fry cultivars are shown in Table 5.

Table 5: Estimated total yield (ton/acre) and specific gravity for each French fry cultivar grown at AITC in Lethbridge, AB (approximately 227 lbs/ac nitrogen). Data shown is the mean of two replicates.

	Yield (ton/ac)	SG
F10001	22.4	1.081
F10003	21.8	1.096
F10008	19.0	1.098
F10012	17.9	1.085
F10016	17.2	1.087
F10017	19.7	1.088
CV03155-2	16.2	1.077
CV03366-1	17.0	1.096
CV04144-1	19.4	1.086
CV05022-1	18.7	1.077
CV07180-1	16.4	1.082
FV15680-03	15.9	1.092
V1408-1	17.4	1.080
R.Burbank East	19.0	1.082
R.Burbank West	23.1	1.078
Shepody East	19.3	1.079
Shepody West	18.7	1.086

The mean percentage of total tuber number in each size category is shown in Table 6.

Table 6: Percentage of total tuber number in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed) for each French fry cultivar grown at approximately 227 lbs/ac. Data shown is the mean of two replicates.

	No. of <48mm	No. of 48 to 88mm	No. of > 88mm	No. of deformed
F10001	20	75	0	4
F10003	19	78	1	2
F10008	24	76	0	0
F10012	40	60	0	0
F10016	32	58	9	1
F10017	32	68	0	0
CV03155-2	18	82	0	0
CV03366-1	54	46	0	0
CV04144-1	32	66	0	2
CV05022-1	41	59	0	0
CV07180-1	33	65	1	2
FV15680-03	40	57	0	3
V1408-1	15	84	0	1
R.Burbank East	55	43	0	2
R.Burbank West	37	60	0	3
Shepody East	21	73	2	3
Shepody West	25	72	0	3

The yield of tubers (estimated ton/ac) of each chipping cultivar is shown by size category in Table 7.

Table 7: Estimated yield (ton/ac) in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed tubers) for each French fry cultivar grown at approximately 227 lbs/ac. Data shown is the mean of two replicates.

	Yield of <48mm (ton/ac)	Yield of 48 to 88mm (ton/ac)	Yield of > 88mm (ton/ac)	Yield of deformed (ton/ac)
F10001	1.7	18.9	0.2	1.5
F10003	1.4	19.4	0.5	0.5
F10008	1.9	16.8	0.2	0.2
F10012	4.6	13.3	0.0	0.0
F10016	0.3	13.0	3.7	0.2
F10017	3.2	16.3	0.0	0.2
CV03155-2	1.2	14.9	0.0	0.1
CV03366-1	6.4	10.4	0.0	0.2
CV04144-1	3.0	15.6	0.0	0.9
CV05022-1	1.8	16.8	0.1	0.0
CV07180-1	2.2	13.3	0.5	0.5
FV15680-03	3.4	11.6	0.0	0.9
V1408-1	1.1	16.1	0.0	0.3
R.Burbank East	6.8	11.3	0.0	0.9
R.Burbank West	5.1	17.0	0.0	1.0
Shepody East	2.2	14.4	1.1	1.4
Shepody West	2.1	15.8	0.2	0.6

Tuber samples used to measure specific gravity were evaluated for hollow heart, other internal defects and scab. There were very few internal defects observed in the tubers examined. Hollow heart was noted in several tubers of F10001, F10003, F10008, CV04144-1, CV07180-1, Russet Burbank and Shepody. Some tubers from each sample exhibited stem-end discoloration and this may be an indication that plants were not fully mature prior to desiccation. Common scab lesions were not noted on any tuber in the evaluation.

Results – Fresh Market Cultivars

Sample hills of each cultivar were dug for a field day August 27, 2014. Photos of the yellow fresh market cultivars are shown in Figure 4.

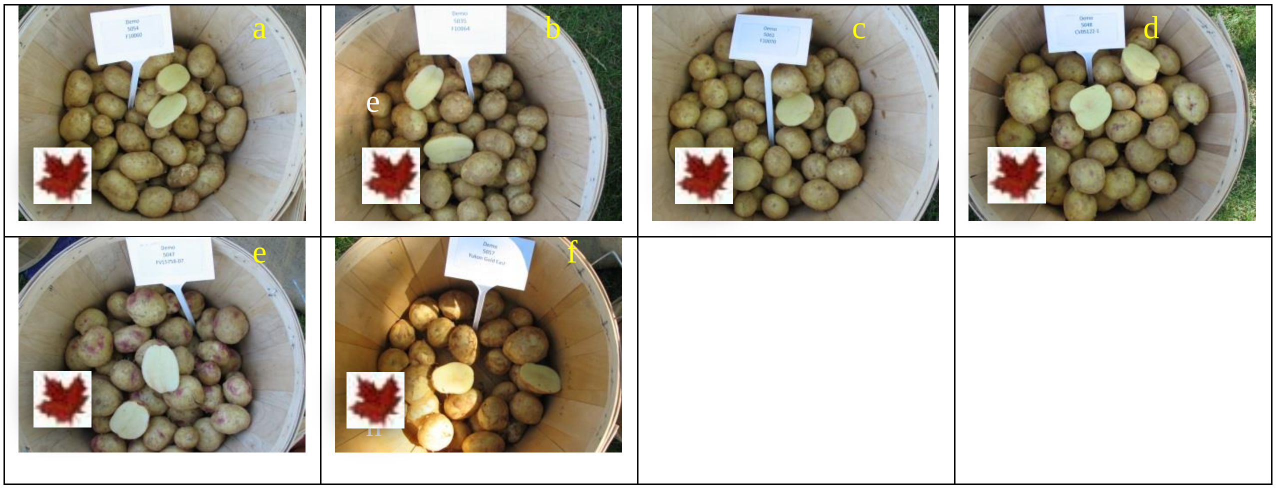


Figure 4. AAFC yellow/white fresh market cultivars at the CDCS field day August 27, 2014: a) F10060, b) F10064, c) F10070, d) CV05122-1, e) FV15758-07, and f) Yukon Gold.

Photos of the purple/red-skinned fresh market cultivars are shown in Figure 5.

Figure 5. AAFC purple/red-skinned fresh market cultivars at the CDCS field day August 27, 2014: a) F10066, b) F10075, c) F10077, d) V07047-2, e) V07116-1, f) V07148-2, and g) Norland.

Yield data (total yield; ton/ac) and specific gravities of each of the fresh market cultivars are shown in Table 8.

Table 8: Estimated total yield (ton/acre) and specific gravity for each fresh market FM) cultivar grown at AITC, Lethbridge, AB (approximately 227 lbs/ac nitrogen). Data shown is the mean of two replicates.

	End Use	Yield (ton/ac)	SG
Yellow			
F10060	FM	19.4	1.077
F10064	FM	19.7	1.081
F10070	FM	20.2	1.093
CV05122-1	FM	22.9	1.076
FV15758-07	FM	15.9	1.086
Yukon Gold	FM	17.0	1.088
Red-skinned			
F10066	FM	18.6	1.087
F10075	FM/CR/WR	17.5	1.082
F10077	FM/CR/WR	18.3	1.084
V0747-2	FM	21.9	1.066
V07116-1	FM	23.1	1.074
V07148-2	FM	21.7	1.070
Norland	FM	19.2	1.071

The mean percentage of total tuber number in each size category is shown in Table 9.

Table 9: Percentage of total tuber number in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed) for each fresh market cultivar grown at approximately 235 lbs/ac. Data shown is the mean of two replicates.

	No. of <48mm	No. of 48 to 88mm	No. of > 88mm	No. of deformed
Yellow				
F10060	44	56	0	0
F10064	25	75	0	0
F10070	26	74	0	0
CV05122-1	10	80	10	0
FV15758-07	12	81	5	2
Yukon Gold	10	84	4	1
Red-skinned				
F10066	29	71	0	0
F10075	23	77	0	0
F10077	40	60	0	0
V0747-2	24	66	0	10
V07116-1	19	79	2	1
V07148-2	17	81	2	0
Norland	15	83	0	1

The yield of tubers (estimated ton/ac) of each fresh market cultivar is shown by size category in Table 10.

Table 10: Estimated yield (ton/ac) in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed tubers) for each fresh market cultivar grown at approximately 227 lbs/ac. Data shown is the mean of two replicates.

	Yield of <48mm (ton/ac)	Yield of 48 to 88mm (ton/ac)	Yield of > 88mm (ton/ac)	Yield of deformed (ton/ac)
Yellow				
F10060	5.0	14.4	0.0	0.1
F10064	2.1	17.6	0.0	0.0
F10070	3.0	18.2	0.0	0.0
CV05122-1	0.6	17.9	4.3	0.0
FV15758-07	0.7	16.0	2.1	0.8
Yukon Gold	0.5	14.5	1.6	0.4
Red-skinned				
F10066	2.7	15.9	0.0	0.0
F10075	1.6	15.5	0.4	0.0
F10077	3.7	14.6	0.0	0.1
V0747-2	2.7	16.1	0.0	3.1
V07116-1	1.5	20.5	1.0	0.1
V07148-2	1.2	19.4	1.0	0.0
Norland	0.9	17.9	0.2	0.1

Tuber samples used to measure specific gravity were evaluated for hollow heart, other internal defects and scab. There were very few internal defects observed in the tubers examined. Hollow heart or brown center was noted in at least one tuber of F10075, FV15758-07, and Yukon Gold. F10077 exhibited some purple pigmentation. Some tubers from each sample exhibited stem-end discoloration and this may be related to vine maturity at the time of desiccation. Common scab lesions were not noted on any tubers in the evaluation.

Conclusions

The 2014 variety trial included a number of cultivars with potential in southern Alberta. Atlantic and Snowden were included in the trial as standard varieties to compare to 11 chipping cultivars. Russet Burbank and Shepody were included in the trial as standard varieties to compare 13 French fry cultivars with. Yukon Gold and Norland were included in the trial as standard varieties to compare with 11 fresh market cultivars.

The trial was designed to provide regional data for a wide range of potato cultivars. All cultivars were planted at the same in-row spacing, the N rate was approximately 227 lbs/ac, and harvest was scheduled for full-season varieties. Addressing the agronomic needs, such as plant density, fertility requirements, and harvest timing for each variety may well result in improvements to yield and size profiles when compared to the results in this trial.

French Fry Variety Evaluation

2014

Materials and Methods

The study was conducted in a split plot arrangement at the Alberta Irrigation Technology Centre in Lethbridge, AB. The main plots were based on nitrogen rates (see Table 11). Pre-plant N was applied as urea (44-0-0) or ESN (46-0-0) using a Conserva-Pak machine. Top-dressed N was applied as either urea or ESN manually just prior to hilling with a power hiller. Fertigation events were simulated by applying ammonium nitrate fertilizer and irrigating immediately afterward. Approximately 50 lbs/ac P was supplied to all treatments (11-52-0). Varieties were planted in the centre rows of 4 m blocks to ensure there were no edge effects for fertilizer treatments (see plot plan, Appendix A). Fertigation was simulated by applying ammonium nitrate immediately prior to an irrigation event.

Table 11: Fertilizer treatments (lbs/ac) applied to potato varieties in the 2014 trial.

				Simulated Fertigation		
Variety	**Treat ment**	**Pre-plant N (urea)**	**Top-dressed N**	**July 22**	**Aug 8**	**Aug 21**
LW 08	1	115	135 Urea	0	0	0
LW 08	2	115	135 ESN	0	0	0
LW 08	3	150	100 ESN	0	0	0
LW 08	4	100	50 ESN	25	25	25
LW 04	3	150	100 ESN	0	0	0
LW 04	4	100	50 ESN	25	25	25
LW 04	5	150	0	25	25	25
LW 04	6	75/75 ESN	0	25	25	25

Treatment 1: Urea Split (45:55)
Treatment 2: Urea/ESN Split (45:55)
Treatment 3: Urea/ESN Split (60:40)
Treatment 4: Urea/ESN Split + fertigation
Treatment 5: Urea high + fertigation
Treatment 6: Urea/ESN + fertigation

Roundup (1 L/ac) was sprayed prior to planting (May 21) to reduce weed pressure. Seed of each cultivar was provided by Lamb Weston. Seed was received in early May and was cut (2 ½ to 3 oz) and suberized prior to planting.

Potatoes were planted May 23, 2014 approximately 5 to 5½"deep using a two-row wheel planter. Seed was planted at 12"spacing in 20' rows spaced 36" apart. Each treatment was replicated four times. Sencor 75DF (100 g/ac) and Centurion (76 mL/ac) were applied prior to emergence (June

3) to control weeds. The plots were irrigated to maintain soil moisture close to 70%. Foliar fungicides were applied several times during the growing season to prevent early and late blight from developing (Table 1).

Reglone was applied (1.0 L/ac) September 15 and potatoes were harvested September 19 using a 1-row Grimme harvester.

Tubers were stored at 46°F until graded. Tubers were graded into size categories (less than 4 oz, 4 to 6 oz, 6 to 10 oz and over 10 oz). A sample of twenty-five tubers (4 to 10 oz) from each replicate was used to determine specific gravity using the weight in air over weight in water method. These tubers were cut longitudinally to assess internal defects. The remainder of the 6 to 10 oz tubers were placed in storage at 46°F until transferred to a commercial storage facility for periodic evaluation by Lamb Weston. The trial should be conducted for at least one additional year to allow for differences in environmental conditions between years.

The data presented here have been statistically analyzed using ANOVA and LSD Multiple Range Test; ($p \leq 0.05$). Statistical summaries are available upon request.

Results and Discussion

Both varieties were harvested in mid-September and results for each variety grown with different nitrogen treatments were compared with one another.

Yield estimates were obtained by digging single rows from each replicate. It is important to note that both varieties were harvested September 19 to tease out differences, although more time bulking would be required to reach optimal yields.

Significant differences in yields of marketable and small tubers were observed between nitrogen treatments with LW 08 (Table 12). The total yield of the varieties were lower than expected, likely because of a cool spring, late planting and early harvest. The 2014 season in Lethbridge started with a cool, wet spring, and ended with fewer P days (830.5) through the season than is recommended for potato.

Optimal fertilizer rate and timing are affected by the length of the growing season and the maturity of the cultivar grown (Stark and Westerman, 2003). Management recommendations for seed, fertility, irrigation and storage are developed for new varieties and allow the varieties to be adopted in the growing region where the recommendations were developed. Alberta has a shorter growing season and longer day-lengths than many other potato growing areas and local recommendations for specific varieties may be needed.

The yield of LW 08 grown on all nitrogen strategies was affected by the shorter growing season. Of the strategies applied in 2014, the split urea treatment (Trt#1) and the fertigation approach (Trt#4) provided significantly greater marketable yields and significantly lower yields of small tubers. If the crop had been permitted to bulk up, these differences may have been even more evident. These strategies both involved providing less urea pre-plant, but urea worked as well or better than ESN for top-dressing. Fertigation was useful, especially if any of the spring applied

N was vulnerable to leaching. For this variety, though, fertigation did not appear to be required. Additional work may be required to determine whether even less upfront N provide better size profiles.

Very few deformed tubers were observed with this variety, regardless of the N treatments. Specific gravity was not significantly affect by the nitrogen application strategies used in the study.

Table 12: Yield (ton/ac) by size category and specific gravity of **LW 08** potatoes grown with different nitrogen application strategies. The percentage by weight of key categories is indicated in brackets. Categories marked with an asterisk contain data that are statistically significant at the $p < 0.05$ level. Data followed by the same letter in each section of the table are not significantly different at the $p < 0.05$ level.

Split Urea 45:55	Urea/ESN Split 45:55	Urea/ESN Split 60:40	Urea/ESN split plus 3 fert
Total Yield (ton/ac)			
13.71	13.91	12.13	14.53
Yield of Marketable Tubers (ton/ac)*			
9.56 a (70%)	8.21 ab (61%)	6.30 b (52%)	9.49 a (65%)
Yield of Tubers < 4 oz. (ton/ac)*			
4.15 b (30%)	5.63 a (38%)	5.63 a (46%)	4.73 ab (32%)
Yield of Tubers 4 to 6 oz. (ton/ac)			
4.39 (32%)	5.23 (38%)	3.81 (32%)	5.20 (36%)
Yield of Tubers 6 to 10 oz. (ton/ac)			
4.70 (34%)	2.71 (21%)	2.13 (17%)	3.57 (24%)
Yield of Tubers > 10 oz. (ton/ac)			
0.36 (3%)	0.27 (2%)	0.36 (3%)	0.72 (5%)
Yield of Deformed Tubers (ton/ac)			
0.00	0.07	0.21	0.31
Specific Gravity			
1.085	1.087	1.087	1.086

No significant differences in total yield or yields of size categories between nitrogen treatments with LW 04 (Table 13). The total yield of the varieties were lower than expected, likely because of a cool spring, late planting and early harvest. The 2014 season in Lethbridge started with a cool, wet spring, and ended with fewer P days (830.5) through the season than is recommended for potato.

Optimal fertilizer rate and timing are affected by the length of the growing season and the maturity of the cultivar grown (Stark and Westerman, 2003). Management recommendations for seed, fertility, irrigation and storage are developed for new varieties and allow the varieties to be adopted in the growing region where the recommendations were developed. Alberta has a shorter growing season and longer day-lengths than many other potato growing areas and local recommendations for specific varieties may be needed.

The yield of LW 04 grown on all nitrogen strategies was affected by the shorter growing season. Of the strategies applied in 2014, the treatments including ESN and fertigation (Trt#4 and Trt#6) provided greater total and marketable yields. These strategies both involved providing less urea pre-plant. In 2014, applying ESN pre-plant with the urea or top-dressed at hilling gave similar results for total and marketable yield, but pre-plant ESN appeared to favor larger tuber size compared to the top-dressed ESN. Fertigation may be useful when less nitrogen is applied as urea pre-plant. Some of the spring applied urea may have been vulnerable to leaching as a large amount of rainfall was received prior to top-dressing and hilling. If the crop had been permitted to bulk up, these differences may have become significant.

Tuber deformities may have been affected by nitrogen strategies, but no significant differences were noted. Specific gravity was significantly affected by the nitrogen application strategies used in the study. Both treatments where ESN was applied as a top-dressing prior to hilling (Trt#3 and Trt#4) resulted in significantly higher specific gravity in the tubers.

Table 13: Yield (ton/ac) by size category and specific gravity of LW 04 potatoes grown with different nitrogen application strategies. The percentage by weight of key categories is indicated in brackets. Categories marked with an asterisk contain data that are statistically significant at the $p < 0.05$ level. Data followed by the same letter in each section of the table are not significantly different at the $p < 0.05$ level.

Urea/ESN Split 60:40	Urea/ESN split + 3 fert	Urea pre-plant + 3 fert	Urea/ESN pre-plant + 3 fert
Total Yield (ton/ac)			
11.11	12.67	10.91	12.36
Yield of Marketable Tubers (ton/ac)			
8.75 (79%)	10.56 (83%)	8.31 (76%)	9.79 (80%)
Yield of Tubers < 4 oz. (ton/ac)			
2.20 (20%)	2.07 (16%)	2.46 (22%)	2.06 (17%)
Yield of Tubers 4 to 6 oz. (ton/ac)			
3.05 (27%)	4.01 (31%)	3.01 (28%)	3.75 (30%)
Yield of Tubers 6 to 10 oz. (ton/ac)			
4.49 (40%)	5.57 (44%)	3.95 (36%)	4.62 (37%)
Yield of Tubers > 10 oz. (ton/ac)			
1.21 (11%)	0.98 (8%)	1.35 (12%)	1.42 (12%)
Yield of Deformed Tubers (ton/ac)			
0.16 (2%)	0.05 (0.5%)	0.14 (1%)	0.51 (4%)
Specific Gravity*			
1.085 a	1.086 a	1.082 b	1.082 b

Tuber samples used to measure specific gravity were also evaluated for hollow heart, stem-end discoloration and other types of defects. Very few internal defects were noticed in any treatments. LW 08 tubers were more prone to hollow heart (4% in some treatments) than LW 04 tubers. Hollow heart is usually most severe under conditions that favor rapid growth, such as a cool dry period followed by a warm wet period (Hiller and Thornton, 1993).

Conclusions

The trial conducted in 2014 were designed to develop some recommendations for producers in southern Alberta regarding N fertilization strategies for new processing varieties. Studies from the Pacific Northwest provided general guidelines on the ratio of N products required to produce a quality processing crop. Questions remained about the effect of different timing of in-season fertilizer applications on yield, quality and specific gravity.

The 2014 season in Lethbridge started with a cool, wet spring, and ended with fewer P days (830.5) through the season than is recommended for potato, but the results provide some insights with respect to N fertilization strategies for each variety. The levels of N fertility used in this study were not dissimilar enough to pick up many differences in the yield or quality response of the tubers. In this study, the timing of the N applications was evaluated.

There were some significant differences in marketable yield between N treatments for LW 08. Of the strategies applied in 2014, the split urea treatment (Trt#1) and the fertigation approach (Trt#4) provided significantly greater marketable yields and significantly lower yields of small tubers than the other treatments. For this variety, fertigation did not appear to be required. Additional work may be required to determine whether even less upfront N provides better size profiles. There were no significant differences in specific gravity.

LW 04 seemed somewhat insensitive to N application timing in this study, although applications of ESN at hilling appeared to favor higher specific gravity than when N was applied pre-plant followed by fertigation.

Chipping Variety Evaluation

2014

Materials and Methods

The variety evaluation was conducted in small plots at the Alberta Irrigation Technology Centre in Letbridge, AB. Fertility for the low N rate (193 lbs/ac) was achieved through a combination of soil fertility (57 lbs/ac N; 23 lbs/ac P) and broadcast fertilizer (74 lbs/ac of 46-0-0, 130 lbs/ac of 11-52-0, 164 lbs/ac of 0-0-60 and 190 lbs/ac of 20.5-0-0-24) incorporated prior to planting. Fertility for the moderate N rate (227 lbs/ac) was achieved through a combination of soil fertility (57 lbs/ac N; 23 lbs/ac P) and broadcast fertilizer (92 lbs/ac of 46-0-0, 162 lbs/ac of 11-52-0, 212 lbs/ac of 0-0-60 and 240 lbs/ac of 20.5-0-0-24) incorporated prior to planting. Varieties were planted in four replicate rows in a randomized complete block design along with standard varieties (Atlantic and Glacier). Each block was planted adjacent to guard rows to reduce any edge effects (see plot plan, Appendix A).

Roundup (1 L/ac) was sprayed prior to planting (May 21) to reduce weed pressure. Seed of Atlantic was provided by Edmonton Potato Growers, seed of Glacier was provided by Rockyview Seed Potatoes and seed of test cultivars was provided by each Sponsor. Potatoes were planted June 4 and 5, 2014 approximately 5 to 5½"deep using a two-row tuber unit planter. Seed was planted at 30cm spacing in 6m rows spaced 90cm apart.

The potatoes were hilled June 27 with a power hiller. Sencor 75DF (100 g/ac) and Centurion (76 mL/ac) were applied prior to emergence (June 3) to control weeds. The plots were irrigated to maintain soil moisture close to 70%. Foliar fungicides were applied several times during the growing season to prevent early and late blight from developing (Table 1).

Reglone was applied (1.0 L/ac) September 15 and again September 19. Potatoes were harvested September 22, 23 and 25 using a 1-row Grimme harvester.

Tubers were stored at 10˚C until graded. Tubers were graded into size categories (less than 48mm, 48 – 88mm, and over 88mm). A sample of twenty-five tubers (48 – 88mm) from each replicate was used to determine specific gravity using the weight in air over weight in water method. These tubers were cut longitudinally to assess internal defects. A composite sample of 8 tubers (2 per rep) was stored at 10C until culinary analyses were performed. The compressor on our storage facility failed in the fall. A temporary system was put in place to hold temperatures. When the compressor was repaired, temperatures lower than the desired set point were achieved and fry colour was negatively affected. Samples were evaluated for chip color using a Hunter Colorimeter December 1, 2014.

The data presented here have been statistically analyzed using ANOVA and Tukey's Multiple Comparison Test; (SPSS; $p \leq 0.05$). Statistical summaries are available upon request. Comparisons for specific cultivars at two rates of N were analyzed using t-tests on a cultivar-by-cultivar basis (Excel; $p \leq 0.05$).

Results and Discussion

Sample hills of each variety were dug for a field day August 24, 2014. Photos of these varieties are shown in Figure 6.

Figure 6. Chipping varieties at the CDCS field day August 24, 2014: a) Glacier, b) Atlantic, c) AR2014-02, d) AR2014-03, e) EPG015, f) EPG016, g) EPG018, h) ODF003, i) RV 003, and j) RV 007.

Yield data (total yield; ton/ac) and specific gravities of each of the cultivars are shown in Table 14. At the moderate rate of N (227 lbs/ac), total yield of EPG018 was the highest, however it was only significantly greater than that of Glacier. Glacier appeared to have issues with emergence and plant survival. Yield of Glacier in 2014 was not typical of this variety. Total yield of all test entries were not significantly different from Atlantic. At the lower rate of N (193 lbs/ac) RV 007 produced the greatest total yield, but none of the test entries were significantly different from Atlantic. In t-test comparisons, the level of N only significantly affected total yield of EPG016.

Table 14: Estimated **total yield** (ton/acre) and **specific gravity** for each variety grown at moderate nitrogen (approximately 227 lbs/ac) and low nitrogen (approximately 193 lbs/ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

	Yield (ton/ac)	SG
Moderate N		
Atlantic	14.7 abc	1.098 a†
Glacier	5.9 d	1.088 a-e
AR2014-02	14.0 bcd	1.093 abc
AR2014-03	12.9 bcd	1.083 b-f
EPG015	15.2 abc	1.076 e-h
EPG016	14.4 bcd†	1.083 b-f
EPG018	17.6 abc	1.093 abc
RV 003	16.8 abc	1.093 abc
RV 007	17.1 abc	1.093 abc
ODF003	16.0 abc	1.094 ab
Low N		
Atlantic	10.2 de	1.085 abc†
Glacier	6.9 e	1.088 a
AR2014-02		
AR2014-03	13.7 cde	1.075 b-e
EPG015	12.9 cde	1.076 b-e
EPG016	10.3 de†	1.074 cde
EPG018	15.7 b-e	1.085 abc
RV 003	18.7 a-d	1.089 a
RV 007	19.1 a-d	1.092 a
ODF003	14.9 cde	1.091 a

† Data between the regular and low N plots was statistically different at the p ≤ 0.05 level.

Specific gravity of the chipping cultivars in this trial ranged from 1.076 for EPG015 to 1.098 for Atlantic from the moderate N plots and from 1.074 for EPG016 to 1.092 for ODF003 grown on lower N plots (Table 2). Potatoes selected as chipping cultivars, typically have specific gravities above 1.080 in Alberta and the majority of entries in this trial were well above this level of solids. Nitrogen level had a significant effect on specific gravity of Atlantic. Atlantic grown on lower N had significantly lower specific gravity that when grown on moderate N, which runs contrary to most trends.

The trial was designed to provide regional data for a wide range of potato cultivars. The N rate in the lower N plots was approximately 35 lbs/ac lower than the moderate rate. The N rates may not have been sufficiently different to impact yield and specific gravity of all cultivars tested. Addressing the agronomic needs of each cultivar may well result in improvements to yield and size profiles when compared to the results in this trial.

The mean percentage of total tuber number in each size category is shown in Table 15. Atlantic, Glacier and AR2014-02 produced a higher percentage of large tubers in the trial and that may be an indicator that these varieties are earlier maturing varieties. The greatest percentage of marketable tubers (48-88mm) was observed with Atlantic and RV 007 on moderate N and was not significantly different from AR2014-02, AR2014-03, RV 003 and ODF003. EPG015, EPG016, EPG018 and RV 003 had a significantly higher percentage of tubers under 48mm than Atlantic when grown on moderate N. For varieties grown on moderate N, only a small percentage of tubers were deformed. On low N, RV 007 and ODF003 produced the greatest percentage of 48-88mm tubers, and were not significantly different from RV 003, EPG018, AR2014-03, Glacier and Atlantic. EPG015 produced a significantly higher percentage of tubers less than 48 mm than Atlantic, AR2014-03, RV 007 and ODF003. Atlantic had significantly more oversized tubers at the low rate of N, but is considered an early maturing variety. EPG015 had a significantly larger percentage of deformed tubers when grown on low N, but seed of this variety appeared to be affected by herbicide carryover. Nitrogen level had a significant impact on the percentage of 48-88mm tubers for RV 003 and on the percentage of deformed Atlantic tubers.

Table 15: Percentage of total tuber number in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed) for each variety grown at moderate nitrogen (approximately 227 lbs/ac) and low nitrogen (approximately 193 lbs/ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

	No. of <48mm	No. of 48 to 88mm	No. of > 88mm	No. of deformed
Moderate N				
Atlantic	19.3 f	71.9 a-d	8.7 a	0.0 e†
Glacier	35.1 b-f	59.0 b-h	5.5 abc	0.4 e
AR2014-02	30.9 def	63.9 a-g	4.6 abc	0.7 e
AR2014-03	32.3 c-f	67.1 a-f	0.4 c	0.1 e
EPG015	55.2 ab	44.2 gh	0.0 c	0.6 e
EPG016	40.3 a-e	59.3 b-h	0.2 c	0.2 e
EPG018	43.1 a-e	56.7 b-h	0.0 c	0.2 e
RV 003	46.8 a-d	53.2 d-h†	0.0 c	0.0 e
RV 007	27.8 def	70.1 a-d	1.9 bc	0.2 e
ODF003	31.8 b-f	66.2 a-f	1.4 bc	0.6 e
Low N				
Atlantic	18.3 def	68.3 abc	10.2 ab	3.2 ab†
Glacier	35.3 a-d	61.9 a-d	2.5 c	0.2 b
AR2014-02				
AR2014-03	28.0 b-f	71.4 abc	0.6 c	0.0 b
EPG015	52.6 a	41.9 e	0.2 c	5.3 a
EPG016	38.8 abc	55.7 cde	0.9 c	4.5 ab
EPG018	38.0 abc	61.9 a-d	0.1 c	0.0 b
RV 003	35.6 a-d	63.8 a-d†	0.0 c	0.7 b
RV 007	20.1 c-f	76.6 ab	2.4 c	0.9 b
ODF003	26.3 b-f	70.9 abc	2.1 c	0.7 b

† Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.

The yield of tubers (estimated ton/ac) of each variety is shown by size category in Table 16. At the moderate rate of N (227 lbs/ac), yield of 48-88mm RV 007 was significantly higher than that of Glacier, but was not significantly different from other cultivars. RV 003, EPG015 and EPG018 yielded significantly more small tubers (< 48mm) than Atlantic, Glacier and AR2014-02. EPG015 yielded significantly more tubers under 48mm than AR2014-03, EPG016, RV 007 and ODF003. Atlantic produced significantly more tubers over 88mm than AR2014-03, EPG015, EPG016, EPG018 and RV 003. At the moderate rate of N, there was no significant difference in yield of deformed tubers between cultivars.

On lower N plots, RV 007 produced the greatest yield of marketable tubers, significantly more than Glacier and EPG016. EPG015 and RV 003 produced a greater yield of small tubers than

Atlantic and Glacier. EPG015 produced significantly more deformed tubers on low N than Glacier, AR2014-03, EPG016 and ODF003.

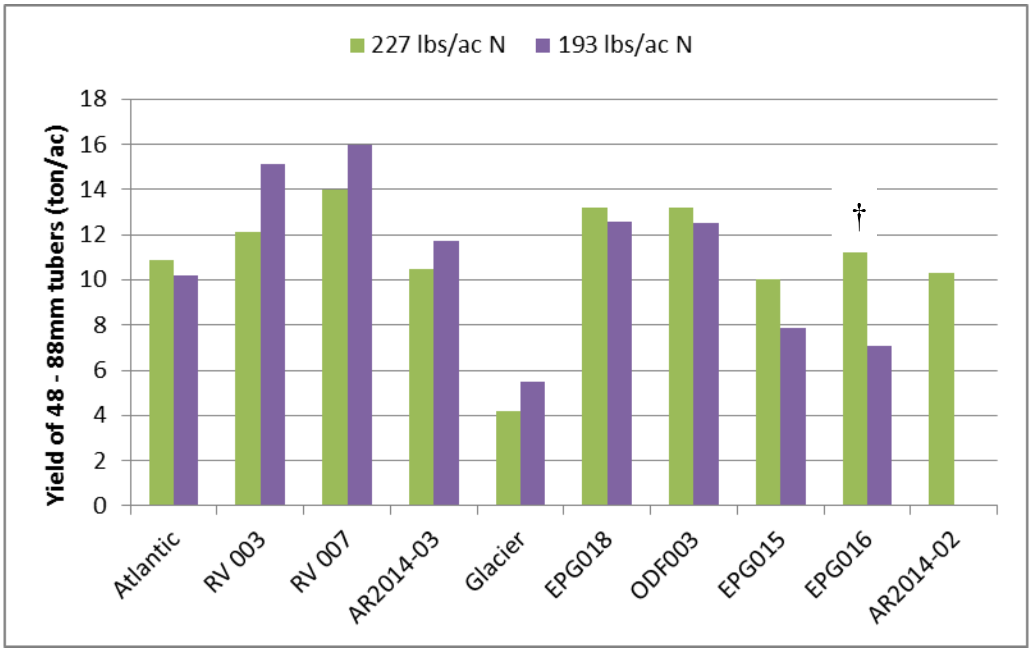
N level had a significant impact on the yield of small tubers for RV 003 and yield of marketable tubers for EPG016. Reduced N shifted the size profile of RV 003 toward the marketable category. Moderate N resulted in significantly greater yields of EPG016 than lower N.

Table 16: Estimated **yield** (ton/ac) in each **size category** (< 48mm, 48 to 88mm, > 88mm, and deformed tubers) for each variety grown at moderate nitrogen (approximately 227 lbs/ac) and low nitrogen (approximately 193 lbs/ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

	Yield of <48mm (ton/ac)	Yield of 48 to 88mm (ton/ac)	Yield of > 88mm (ton/ac)	Yield of deformed (ton/ac)
Moderate N				
Atlantic	0.8 h	10.9 bc	3.0 ab	0.0 d
Glacier	0.7 h	4.2 c	1.0 bc	0.1 d
AR2014-02	1.8 c-h	10.3 bc	1.7 abc	0.2 d
AR2014-03	2.1 d-h	10.5 bc	0.2 c	0.1 d
EPG015	5.1 ab	10.0 bc	0.0 c	0.1 d
EPG016	3.0 c-g	11.2 bc†	0.1 c	0.0 d
EPG018	4.4 a-d	13.2 ab	0.0 c	0.1 d
RV 003	4.6 abc†	12.1 bc	0.0 c	0.0 d
RV 007	2.0 c-h	14.0 ab	1.1 bc	0.0 d
ODF003	2.1 c-h	13.2 ab	0.7 bc	0.1 d
Low N				
Atlantic	0.5 e	10.2 c-f	2.4 bc	0.5 ab
Glacier	0.9 de	5.5 f	0.4 bc	0.1 b
AR2014-02				
AR2014-03	1.7 b-e	11.7 c-f	0.3 bc	0.0 b
EPG015	3.8 ab	7.9 def	0.1 bc	1.2 a
EPG016	2.0 b-e	7.1 ef†	0.2 bc	0.9 ab
EPG018	3.1 a-d	12.6 c-f	0.1 bc	0.0 b
RV 003	3.5 abc†	15.1 a-e	0.0 c	0.2 ab
RV 007	1.5 b-e	16.0 a-d	1.4 abc	0.2 ab
ODF003	1.6 b-e	12.5 c-f	0.6 bc	0.2 b

† Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.

A comparison of medium potatoes (48 – 88mm) for each variety from regular and moderate N plots is shown in Figure 7.



† Data between the regular and low N plots was statistically different at the p ≤ 0.05 level.

Figure 7: Yield (ton/ac) of potatoes (48 – 88mm) produced on moderate (227 lbs/ac) N and low (193 lbs/ac) N plots. For each variety, yield columns marked with † are statistically different (p ≤ 0.05).

Medium tubers were assessed subjectively for Uniformity of Size and Overall Appearance. Scores are presented in Table 17. There were no significant differences between varieties either for uniformity of size or overall appearance at either rate of N.

Table 17: Subjective tuber assessments: **Uniformity of Size** was subjectively assessed on each replicate by the same individual during the grading process. **Overall Appearance** was based on uniformity of size and uniformity of shape, skin colour, deformities and eye depth. Data shown is the mean of 4 replicates.

	Uniformity of Size[1]	Overall Appearance[2]
Moderate N		
Atlantic	3.3 a	3.7 a
Glacier	3.0 a	3.3 a
AR2014-02	3.0 a	3.3 a
AR2014-03	4.0 a	4.0 a
EPG015	4.0 a	3.8 a
EPG016	4.0 a	4.0 a
EPG018	4.3 a	4.0 a
RV 003	3.5 a	3.8 a
RV 007	4.0 a	4.0 a
ODF003	3.8 a	3.8 a
Low N	3.7 a	
Atlantic	3.5 a	3.0 a
Glacier	3.3 a	3.3 a
AR2014-02		
AR2014-03	4.0 a	4.0 a
EPG015	3.8 a	3.8 a
EPG016	4.0 a	3.3 a
EPG018	4.0 a	4.0 a
RV 003	3.5 a	3.8 a
RV 007	4.3 a	4.3 a
ODF003	4.3 a	4.0 a

[1] Uniformity of Size: 1 (very variable) - 5 (very uniform)
[2] Overall Appearance: 1 (very poor) - 5 (outstanding)

Tuber samples used to measure specific gravity were evaluated for hollow heart, brown centre, stem-end discoloration, other types of internal necrosis and scab. At the moderate rate of N, approximately 10% of AR2014-02 tubers and 7% of Atlantic tubers had hollow heart. At the lower rate of N, 16% of Atlantic tubers exhibited hollow heart. Occasional tubers with hollow heart were found with ODF003 and EPG015 at both levels of N and RV 007 at the lower rate of N. Many of the samples had some level of stem-end discoloration and this may be related to vine maturity at the time of desiccation.

Chip colour scores of composite samples are presented in Table 18. All of the samples gave better chip scores than Atlantic, but none were great. The compressor on our storage facility failed in the fall. A temporary system was put in place to hold temperatures. When the compressor was repaired, temperatures lower than the desired set point were achieved and fry colour was negatively affected. A higher L-value indicates a lighter chip. The lightest chips were produced from ODF003, Glacier, EPG016 and RV 003. ODF003 and EPG016 from the moderate N plots and RV 003 from the lower N plots produced good chip scores in spite of the cooler temperatures in storage.

Reducing the N applied to the crop resulted in lighter chip scores for Atlantic, Glacier, AR2014-03, and RV 003. These are composite samples from one year of testing and additional testing may be required to determine optimal agronomic conditions for chip quality.

Table 18: Chip colour scores from subsamples of each variety grown at moderate nitrogen (approximately 227 lbs/ac) and low nitrogen (approximately 193 lbs/ac). Data shown is the mean of duplicate analyses of a composite sample evaluated on a Hunter Colorimeter (L is a lightness score; higher numbers are lighter).

	L		L
Moderate N		*Low N*	
Atlantic	42.7	Atlantic	46.4
Glacier	53.5	Glacier	56.0
AR2014-02	49.4	AR2014-02	
AR2014-03	47.4	AR2014-03	49.2
EPG015	47.9	EPG015	34.9
EPG016	57.7	EPG016	
EPG018	44.5	EPG018	45.0
RV 003	53.4	RV 003	57.9
RV 007	49.5	RV 007	49.0
ODF003	58.7	ODF003	56.4

† Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.

Conclusions

The 2014 variety trial included eight chipping potato cultivars with potential in southern Alberta. Atlantic and Glacier were included in the trial as check varieties. All of the cultivars were included in plots fertilized with a moderate rate of N (227 lbs/ac) and seven were included in plots fertilized with a lower rate of N (193 lbs/ac) to determine the extent to which N may influence yield, size profile and chipping quality. Nitrogen, at the two rates tested, affected total yield and specific gravity for a couple of varieties. Also, there was a nitrogen response to size profile for some cultivars. RV 007 yielded well at both levels of N but was not significantly different from either check variety. RV 003 responded well to the lower level of N relative to the moderate rate. RV 007, AR2014-03 and EPG018 performed well in the trials. Chip color was not well evaluated because of an equipment failure during storage.

The trial was designed to provide regional data for a wide range of potato cultivars. Addressing the agronomic needs of each variety may well result in improvements to yield and size profiles when compared to the results in this trial.

Fresh Market Variety Evaluation

2014 – Lower N

Materials and Methods

The variety evaluation was conducted in small plots at the Alberta Irrigation Technology Centre in Letbridge, AB. Fertility (193 lbs/ac) was achieved through a combination of soil fertility (57 lbs/ac N; 23 lbs/ac P) and broadcast fertilizer (74 lbs/ac of 46-0-0, 130 lbs/ac of 11-52-0, 164 lbs/ac of 0-0-60 and 190 lbs/ac of 20.5-0-0-24) incorporated prior to planting. Varieties were planted in four replicate rows in a randomized complete block design along with standard varieties (Norland and Yukon Gold). Each block was planted adjacent to guard rows to reduce any edge effects (see plot plan, Appendix A).

Roundup (1 L/ac) was sprayed prior to planting (May 21) to reduce weed pressure. Seed of standard cultivars was provided by Edmonton Potato Growers and seed of test cultivars was provided by each participant. Potatoes were planted June 4, 2014 approximately 5 to 5½"deep using a two-row tuber unit planter. Seed was planted at 30cm spacing in 6m rows spaced 90cm apart.

The potatoes were hilled June 27 with a power hiller. The plots were irrigated to maintain soil moisture close to 70%. Sencor 75DF (100 g/ac) and Centurion (76 mL/ac) were applied prior to emergence (June 3) to control weeds. The plots were irrigated to maintain soil moisture close to 70%. Foliar fungicides were applied several times during the growing season to prevent early and late blight from developing (Table 1).

Reglone was applied (1.0 L/ac) September 15 and again September 19. Potatoes were harvested September 25 using a 1-row Grimme harvester.

Tubers were stored at 8˚C until graded. Tubers were graded into size categories (less than 48mm, 48 – 88mm, over 88mm and deformed). A sample of twenty-five tubers (48 – 88mm) from each replicate was used to determine specific gravity using the weight in air over weight in water method. These tubers were cut longitudinally to assess internal defects. Sub-samples of 48-88mm tubers were provided to the Food Processing Development Centre at Brooks for culinary evaluations.

The data presented here have been statistically analyzed using ANOVA and Tukey's Multiple Comparison Test; (SPSS; $p \leq 0.05$). Statistical summaries are available upon request.

Results and Discussion

Sample hills of each variety were dug for a field day at CDCS August 24, 2014. Photos of these varieties are shown in Figure 8.

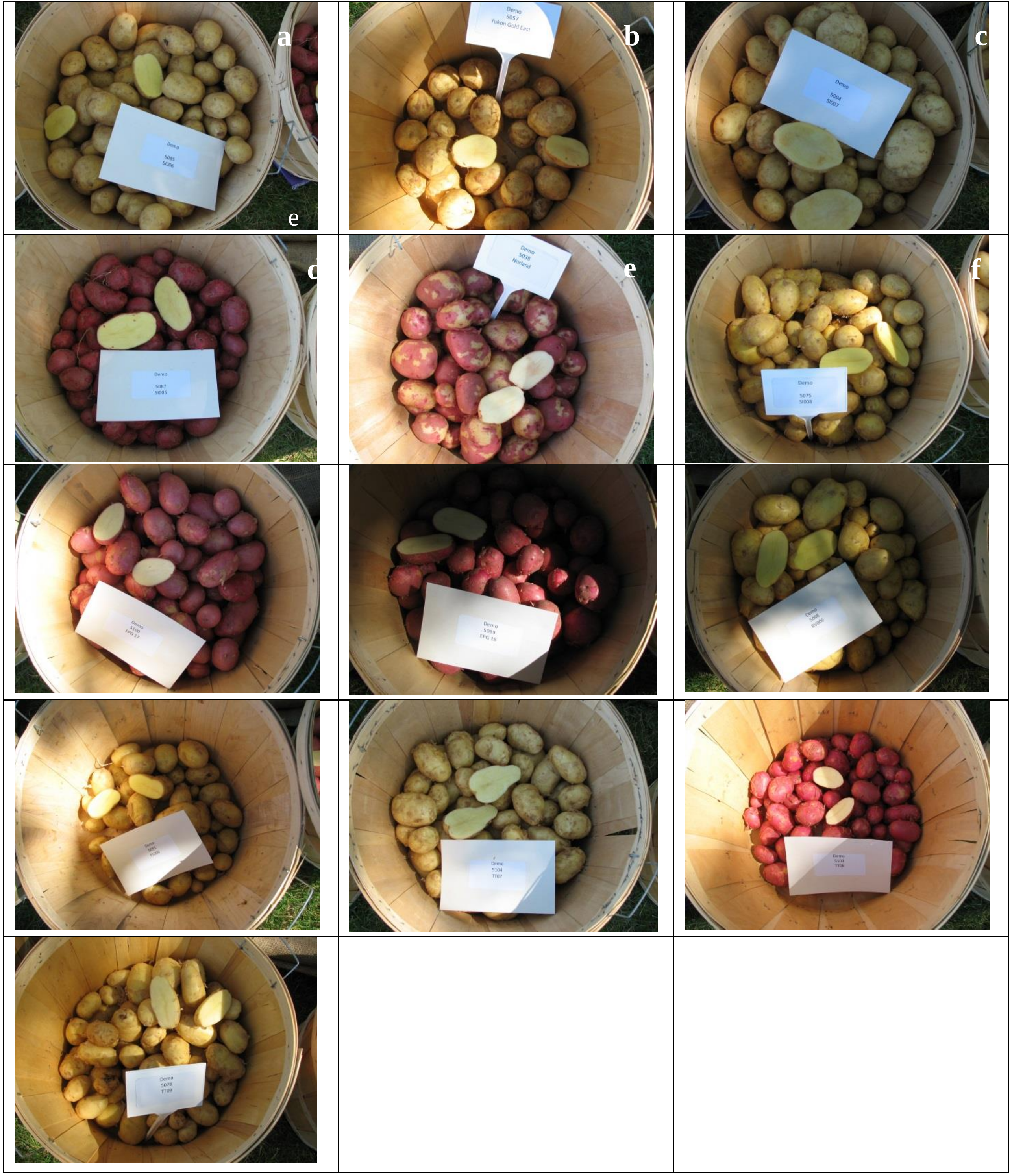


Figure 8. Fresh Market varieties at CDCS field day August 24, 2014: a) SI 006, b) Yukon Gold, c) SI 007, d) SI 005, e) Norland, f) SI 008, g) EPG017, h) EPG018, i) RV 006, j) PL 006, k) TT007, l) TT008, and m) TT009.

Yield data (total yield; ton/ac) and specific gravities of each of the fresh market cultivars are shown in Table 19. The highest total yield at AITC was observed with SI 007. SI 007, SI 006, and TT07 yielded significantly more than most other fresh market cultivars in the evaluation, although not statistically higher than Norland. SI 007 and SI 006 yielded more than Yukon Gold, but SI 008 was not statistically different from either check variety.

Further addressing the agronomic needs of each variety may well result in improvements to yield and size profiles when compared to the results in this trial.

Specific gravity of tubers ranged from 1.058 for SI 007 to 1.087 for SI 005. The specific gravity of SI 005 and EPG018 exceeded that of Yukon Gold and may make these varieties less suitable for salad potatoes.

Table 19: Estimated total yield (ton/acre) and specific gravity for each fresh market variety grown on approximately 193 lbs/ac nitrogen. Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

AITC	Yield (ton/ac)	SG
Low N		
SI 005	17.4 a-d	1.087 ab
SI 006	25.0 ab	1.068 ef
SI 007	25.1 a	1.058 f
Norland	20.9 abc	1.069 def
SI 008	17.0 a-d	1.072 de
Yukon Gold	12.5 cde	1.082 bcd
EPG017	19.2 a-d	1.074 cde
EPG018	15.7 b-e	1.085 abc
RV006	15.3 cde	1.071 de
PL006	9.8 de	1.074 cde
TT007	24.8 ab	1.065ef
TT008	10.2 de	1.070 def
TT009	12.6 cde	1.070 def

The mean percentage of total tuber number in each size category is shown in Table 20. The majority of tubers for each variety fell into the marketable category (48 – 88mm). SI 005, SI 008, EPG017, EPG018, PL006, TT008 and TT009 also had a large percentage of tubers in the small size category. SI 007 and Yukon Gold had a significantly higher percentage of tubers in the oversized category which may be an indication that these cultivars are early maturing and an earlier harvest data may be more appropriate. None of the varieties had a large percentage of deformed tubers. SI 006 and SI 008 had significantly more deformed than many of the other varieties, but were not significantly different from the standards, Norland and Yukon Gold.

Table 20: Percentage of total tuber number in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed) for each fresh market variety grown on full nitrogen (approximately 193 lbs/ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

AITC	< 48mm	48 to 88mm	> 88mm	Deformed
Low N				
SI 005	51.5 a	47.8 de	0.0 c	0.8 b
SI 006	26.3 b-f	71.8 abc	0.4 c	1.5 ab
SI 007	20.4 c-f	66.3 a-d	13.1 a	0.2 b
Norland	14.4 f	78.4 ab	5.2 bc	2.0 ab
SI 008	39.7 ab	58.4 b-e	0.5 c	1.3 ab
Yukon Gold	16.0 ef	74.3 abc	8.5 ab	1.3 ab
EPG017	31.7 b-f	68.1 abc	0.2 c	0.0 b
EPG018	38.0 abc	61.9 a-d	0.1 c	0.0 b
RV006	24.5 b-f	75.1 abc	0.0 c	0.5 b
PL006	34.1 a-e	65.9 a-d	0.0 c	0.0 b
TT007	15.5 ef	81.0 a	2.9 c	0.6 b
TT008	52.0 a	46.5 de	1.3 c	0.2 b
TT009	37.5 abc	61.0 a-d	1.2 c	0.3 b

The yield of tubers (estimated ton/ac) of each variety is shown by size category in Table 21. SI 005 yielded significantly more potatoes less than 48 mm than either check variety, but was not statistically different from SI 006, SI 008, EPF017, or EPG 018. Marketable yield ranged from 7.0 ton/ac of TT008 to 21.6 ton/ac of TT007. SI 006 and TT007 yielded significantly more marketable than Yukon Gold (check) in this trial, but were not statistically different from Norland. SI 007 yield significantly more oversized tubers than all other varieties, again possibly a reflection of an early maturing variety.

Table 21: Estimated yield (ton/ac) in each size category (< 48mm, 48 to 88mm, > 41mm, and deformed tubers) for each fresh market variety grown on full nitrogen (approximately 193 lbs/ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the $p < 0.05$ level.

AITC	Yield of <48mm (ton/ac)	Yield of 48 to 88mm (ton/ac)	Yield of > 88mm (ton/ac)	Yield of deformed (ton/ac)
Low N				
SI 005	5.1 a	12.0 c-f	0.0 c	0.3 ab
SI 006	2.8 a-e	21.1 ab	0.4 c	0.7 ab
SI 007	1.2 cde	16.1 a-d	7.8 a	0.0 b
Norland	0.6 de	17.4 abc	2.3 bc	0.6 ab
SI 008	3.1 a-d	13.2 b-f	0.3 bc	0.4 ab
Yukon Gold	0.5 e	9.0 c-f	2.8 b	0.2 ab
EPG017	3.1 a-d	16.0 a-d	0.1 bc	0.0 b
EPG018	3.1 a-d	12.6 c-f	0.1 c	0.0 b
RV006	1.6 b-e	13.7 a-f	0.0 c	0.1 b
PL006	1.4 b-e	8.1 def	0.0 c	0.0 b
TT007	1.1 cde	21.6 a	2.0 bc	0.2 b
TT008	2.8 b-e	7.0 ef	0.4 bc	0.1 b
TT009	2.4 b-e	9.8 c-f	0.4 bc	0.0 b

Tubers were assessed subjectively for Uniformity of Size and Overall Appearance. Scores are presented in Table 22. SI 005, SI 008 and EPG018 scored very high for both uniformity of size and overall appearance. EPG017, TT009 and SI 006 scored high for overall appearance.

Table 22: Subjective tuber assessments: Uniformity of Size was subjectively assessed on each replicate by the same individual during the grading process. Overall Appearance was based on uniformity of size and uniformity of shape, skin colour, deformities and eye depth. Data shown is the mean of 4 replicates.

	Uniformity of Size[1]	Overall Appearance[2]
LowN		
SI 005	4.00	4.75
SI 006	3.25	4.00
SI 007	3.33	3.00
Norland	3.00	3.50
SI 008	3.75	4.00
Yukon Gold	3.25	3.33
EPG017	3.50	4.50
EPG018	4.00	4.00
RV006	3.50	3.75
PL006	3.50	4.25
TT007	3.50	3.00
TT008	3.50	3.75
TT009	3.50	4.25

[1] Uniformity of Size: 1 (very variable) - 5 (very uniform)
[2] Overall Appearance: 1 (very poor) - 5 (outstanding)

Tuber samples used to measure specific gravity were also evaluated for hollow heart, brown centre, stem-end discoloration, other types of internal necrosis and scab. There were few internal defects noted for tubers in this trial. Some internal pigmentation was noted for SI 005. Approximately 5% of Yukon Gold tubers had hollow heart. Some stem-end discoloration was evident in many of the samples, possibly as a result of vine maturity at the time of top-killing.

Varieties were evaluated in the Food Science lab at CDCS for culinary quality. Data from the boil and bake evaluations are presented in Table 23. EPG 018 was evaluated as a chipper rather than as a fresh market variety. After cooking darkening was not noted for any of the varieties after boiling or baking. None of the varieties displayed significant sloughing in the boiled potato evaluations. All of the cultivars evaluated scored mid-way between waxy and mealy, with none at the waxy end or the mealy end of the score sheet.

Table 23: Culinary evaluations of each fresh market variety grown at low nitrogen (193 lbs/ac) at CDCS). Data shown is the mean of duplicate analyses of a composite sample.

Boiled Potatoes

AITC	Flesh color	Waxiness†	Sloughing	After Cooking Discoloration
Low N				
SI 005	Deep yellow	2	Little or none	None
SI 006	Deep yellow	2	Little or none	None
SI 007	Yellow	2	Little or none	None
Norland	Off-white	2	Little or none	None
SI 008	Deep yellow	3	Little or none	None
Yukon Gold	Yellow	3	Little or none	None
EPG017	Off-white	3	Little or none	None
EPG018				
RV006	Deep yellow	2	Little or none	None
PL006	Deep yellow	3	Little or none	None
TT007	Yellow	3	Little or none	None
TT008	Off-white	2	Little or none	None
TT009	Yellow	3	Little or none	None

† Waxiness: 1 = very waxy (very clean cuts); 2 = waxy (clean cuts with some residue); 3 = slightly waxy (more mealy than waxy); 4 = not waxy (fluffy/mealy)

Table 23 continued.

Baked Potatoes

AITC	Flesh color	Texture*	After Cooking Discoloration
Low N			
SI 005	Deep Yellow	2	None
SI 006	Deep Yellow	2	None
SI 007	Off-white	2	None
Norland	Off-white	2	None
SI 008	Deep Yellow	3	None
Yukon Gold	Yellow	3	None
EPG017	Off-white	3	None
EPG018			
RV006	Deep Yellow	2	None
PL006	Deep Yellow	3	None
TT007	Yellow	3	None
TT008	Off-white	2	None
TT009	Yellow	3	None

*** Texture: 1 = wet; 2 = slightly wet; 3 = slightly mealy; 4 = mealy**

Conclusions

The 2014 variety trial included eleven fresh market cultivars and two check varieties, Norland and Yukon Gold grown at 193 lbs/ac N. SI 006, TT007 and SI 007 yielded well in the 2014 evaluations for high total and marketable yield, with good boiling characteristics. SI 005 and EPG017 scored highest for overall appearance. Several varieties yielded well in both the small potato and marketable potato categories indicating their potential usefulness in dual purpose (gourmet and table) markets.

The trial was designed to provide regional data for a wide range of potato cultivars. Addressing the agronomic needs of each variety may well result in improvements to yield and size profiles when compared to the results in this year of the trial.

2014 – Moderate N

Materials and Methods

The variety evaluation was conducted in small plots at the Alberta Irrigation Technology Centre in Letbridge, AB. Fertility (227 lbs/ac) was achieved through a combination of soil fertility (57 lbs/ac N; 23 lbs/ac P) and broadcast fertilizer (92 lbs/ac of 46-0-0, 162 lbs/ac of 11-52-0, 212 lbs/ac of 0-0-60 and 240 lbs/ac of 20.5-0-0-24) incorporated prior to planting. Varieties were planted in four replicate rows in a randomized complete block design along with standard varieties (Norland and Yukon Gold). Each block was planted adjacent to guard rows to reduce any edge effects (see plot plan, Appendix A).

Roundup (1 L/ac) was sprayed prior to planting (May 21) to reduce weed pressure. Seed of standard cultivars was provided by Edmonton Potato Growers and seed of test cultivars was provided by each participant. Potatoes were planted June 5, 2014 approximately 5 to 5½"deep using a two-row tuber unit planter. Seed was planted at 30cm spacing in 6m rows spaced 90cm apart.

The potatoes were hilled June 27 with a power hiller. Sencor 75DF (100 g/ac) and Centurion (76 mL/ac) were applied prior to emergence (June 3) to control weeds. The plots were irrigated to maintain soil moisture close to 70%. Foliar fungicides were applied several times during the growing season to prevent early and late blight from developing (Table 1).

Reglone was applied (1.0 L/ac) September 15 and again September 19. Potatoes were harvested September 25 using a 1-row Grimme harvester.

Tubers were stored at 8˚C until graded. Tubers were graded into size categories (less than 48mm, 48 – 88mm, over 88mm and deformed). A sample of twenty-five tubers (48 – 88mm) from each replicate was used to determine specific gravity using the weight in air over weight in water method. These tubers were cut longitudinally to assess internal defects. Sub-samples of 48-88mm tubers were provided to the Food Processing Development Centre at Brooks for culinary evaluations.

Chipping tubers were stored at 10˚C until graded. Tubers were graded into size categories (less than 48mm, 48 – 88mm, and over 88mm). A sample of twenty-five tubers (48 – 88mm) from each replicate was used to determine specific gravity using the weight in air over weight in water method. These tubers were cut longitudinally to assess internal defects. A composite sample of 8 tubers (2 per rep) was stored at 10˚C until culinary analyses were performed. The compressor on our storage facility failed in the fall. A temporary system was put in place to hold temperatures. When the compressor was repaired, temperatures lower than the desired set point were achieved and fry colour was negatively affected. Samples were evaluated for chip color using a Hunter Colorimeter December 1, 2014.

French fry tubers were stored at 8˚C until graded. Tubers were graded into size categories (less than 48mm, 48 – 88mm, and over 88mm). A sample of twenty-five tubers (48 – 88mm) from each replicate was used to determine specific gravity using the weight in air over weight in water method. The tubers in the specific gravity sample were cut longitudinally to assess internal defects. A composite sample of 8 tubers (2 per rep) was stored at 8˚C until culinary analyses were performed. Sub-samples of 48-88mm tubers were provided to the Food Processing Development Centre at Brooks for culinary evaluations.

The data presented here have been statistically analyzed using ANOVA and Tukey's Multiple Comparison Test; (SPSS; $p \leq 0.05$). Statistical summaries are available upon request.

Results and Discussion – Fresh Market

Sample hills of each variety were dug for a field day at CDCS August 24, 2014. Photos of these varieties are shown in Figure 9.

Figure 9. Fresh Market varieties at CDCS field day August 24, 2014: a) AR2014-04, b) AR1024-05, c) AR2014-06, d) AR2014-11, e) Norland, f) EPG017, g) EPG018, h) TT 008, i) PL 006, j) TT 007, k) TT 009, and l) Yukon Gold.

Yield data (total yield; ton/ac) and specific gravities of each of the fresh market cultivars are shown in Table 24. The highest total yield at this level of N at AITC was observed with TT 007. TT 007 yielded significantly more than Yukon Gold and some fresh market cultivars in the evaluation, although not statistically higher than Norland, AR2014-01, AR2014 -04, AR2014-05, AR2014-06, AR2014-11, EPG 017, and EPG 018.

Further addressing the agronomic needs of each variety may well result in improvements to yield and size profiles when compared to the results in this trial.

Specific gravity of tubers ranged from 1.068 for TT 009 to 1.093 for EPG 018. The specific gravity of AR2014-01 and EPG 018 exceeded that of Yukon Gold and may make these varieties less suitable for salad potatoes.

Table 24: Estimated total yield (ton/acre) and specific gravity for each fresh market variety grown on approximately 227 lbs/ac nitrogen. Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the $p < 0.05$ level.

AITC	Yield (ton/ac)	SG
Moderate N		
AR2014-01	18.15 abc	1.091 a-d
AR2014-04	20.97 ab	1.071 fgh
AR2014-05	16.07 abc	1.075 fgh
AR2014-06	17.26 abc	1.078 e-h
AR2014-11	16.31 abc	1.080 d-h
Norland	19.88 abc	1.075 fgh
EPG 017	19.40 abc	1.074 fgh
EPG 018	17.63 abc	1.093 abc
TT 007	23.38 a	1.070 gh
TT 008	11.69 cd	1.077 e-h
TT 009	14.21 bcd	1.068 h
PL 006	12.60 bcd	1.078 e-h
Yukon Gold	14.35 bcd	1.088 a-e

The mean percentage of total tuber number in each size category is shown in Table 25. The majority of tubers for each variety fell into the marketable category (48 – 88mm). PL 006, TT 008, EPG017, and EPG018 also had a large percentage of tubers in the small size category. AR2014-04, AR2014-06 and Yukon Gold had a significantly higher percentage of tubers in the oversized category which may be an indication that these cultivars are early maturing and an earlier harvest data may be more appropriate. AR2014-06 had a significantly higher percentage of deformed tubers than the others, but the variety may have been harvested too late for optimal yields.

Table 25: Percentage of total tuber number in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed) for each fresh market variety grown on full nitrogen (approximately 193 lbs/ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the $p < 0.05$ level.

AITC	< 48mm	48 to 88mm	> 88mm	Deformed
Moderate N				
AR2014-01	32.8 c-f	64.7 a-f	1.3 c	1.3 cde
AR2014-04	24.2 ef	67.5 a-e	7.6 a	0.7 de
AR2014-05	33.0 c-f	66.0 a-f	0.3 c	0.7 de
AR2014-06	17.9 f	67.2 a-f	5.6 abc	9.4 a
AR2014-11	34.2 c-f	65.0 a-f	0.5 c	0.3 e
Norland	16.5 f	76.5 ab	3.9 abc	3.1 bcd
EPG 017	36.2 a-f	63.7 a-g	0.1 c	0.0 e
EPG 018	43.1 a-e	56.7 b-h	0.0 c	0.2 e
TT 007	16.3 f	79.8 a	2.0 bc	2.0 b-e
TT 008	52.5 abc	47.1 fgh	0.3 c	0.2 e
TT 009	36.6 a-f	62.3 a-h	0.3 c	0.8 de
PL 006	55.8 a	44.0 h	0.0 c	0.2 e
Yukon Gold	18.3 f	73.8 abc	6.5 ab	1.3 cde

The yield of tubers (estimated ton/ac) of each variety is shown by size category in Table 26. PL 006, EPG 017 and EPG 018 yielded significantly more potatoes under 48 mm than either check variety, but were not statistically different from many other varieties. Marketable yield ranged from 8.3 ton/ac of PL 006 to 20.6 ton/ac of TT07. TT07 yielded significantly more marketable tubers than Yukon Gold (check) in this trial, but was not statistically different from Norland. AR2014-04 yield significantly more oversized tubers than many other varieties, again possibly a reflection of an early maturing variety.

Table 26: Estimated yield (ton/ac) in each size category (< 48mm, 48 to 88mm, > 41mm, and deformed tubers) for each fresh market variety grown on full nitrogen (approximately 193 lbs/ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

AITC	Yield of <48mm (ton/ac)	Yield of 48 to 88mm (ton/ac)	Yield of > 88mm (ton/ac)	Yield of deformed (ton/ac)
Moderate N				
AR2014-01	2.5 d-h	14.6 ab	0.8 bc	0.3 d
AR2014-04	1.5 fgh	15.4 ab	3.9 a	0.2 d
AR2014-05	2.4 d-h	13.3 ab	0.2 c	0.2 d
AR2014-06	1.0 gh	12.0 bc	2.2 abc	2.0 a
AR2014-11	2.5 d-h	13.5 ab	0.3 c	0.1 d
Norland	0.9 gh	16.2 ab	1.9 abc	1.0 bc
EPG 017	3.6 a-f	15.8 ab	0.1 c	0.0 d
EPG 018	4.4 a-d	13.2 ab	0.0 c	0.1 d
TT 007	1.0 gh	20.6 a	1.2 bc	0.6 cd
TT 008	3.2 b-f	8.4 bc	0.1 c	0.0 d
TT 009	2.5 d-h	11.5 bc	0.1 c	0.1 d
PL 006	3.8 a-e	8.3 bc	0.4 c	0.0 d
Yukon Gold	0.7 h	11.2 bc	2.2 abc	0.2 d

Tubers were assessed subjectively for Uniformity of Size and Overall Appearance. Scores are presented in Table 27. AR2014-05 and EPG018 scored very high for both uniformity of size and overall appearance. EPG017, TT 008 and PL 006 scored high for overall appearance.

Table 27: Subjective tuber assessments: Uniformity of Size was subjectively assessed on each replicate by the same individual during the grading process. Overall Appearance was based on uniformity of size and uniformity of shape, skin colour, deformities and eye depth. Data shown is the mean of 4 replicates.

	Uniformity of Size[1]	Overall Appearance[2]
Moderate N		
AR2014-01	3.25	3.50
AR2014-04	3.25	3.25
AR2014-05	4.00	4.00
AR2014-06	4.00	3.25
AR2014-11	4.00	3.75
Norland	3.67	3.67
EPG 017	3.75	4.00
EPG 018	4.00	4.25
TT 007	4.00	3.50
TT 008	3.75	4.00
TT 009	3.50	3.50
PL 006	3.75	4.50
Yukon Gold	3.75	3.75

[1] Uniformity of Size: 1 (very variable) - 5 (very uniform)
[2] Overall Appearance: 1 (very poor) - 5 (outstanding)

Tuber samples used to measure specific gravity were also evaluated for hollow heart, brown centre, stem-end discoloration, other types of internal necrosis and scab. There were few internal defects noted for tubers in this trial. Some internal pigmentation was noted for EPG017 and AR2014-05. Approximately 4% of Yukon Gold and 2% of AR2014-02 tubers had hollow heart. Some stem-end discoloration was evident in many of the samples, possibly as a result of vine maturity at the time of top-killing.

Varieties were evaluated in the Food Science lab at CDCS for culinary quality. Data from the boil and bake evaluations are presented in Table 28. AR2014-01 was evaluated as a French fry potatoes and EPG 018 was evaluated as a chipper rather than as a fresh market variety. After cooking darkening was only noted for EPG017 after boiling. AR2014-11 and Yukon Gold displayed moderate sloughing in the boiled potato evaluations. AR2014-04 scored as the waxiest potato and AR2014-11 scored as a mealy potato. All of the other cultivars evaluated scored mid-way between waxy and mealy.

Table 28: Culinary evaluations of each fresh market variety grown at low nitrogen (193 lbs/ac) at CDCS). Data shown is the mean of duplicate analyses of a composite sample.

Boiled Potatoes

AITC	Flesh color	Waxiness†	Sloughing	After Cooking Discoloration
Moderate N				
AR2014-01				
AR2014-04	Yellow	1	None	None
AR2014-05	Yellow	3	None	None
AR2014-06	Off-white	2	None	Moderate
AR2014-11	Yellow	4	Moderate	None
Norland	Off-white	2	None	None
EPG 017	Off-white	2	None	Moderate
EPG 018				
TT 007	Off-white	3	None	None
TT 008	Off-white	3	None	None
TT 009	Yellow	2	None	None
PL 006	Deep Yellow	3	None	None
Yukon Gold	Deep Yellow	3	Moderate	None

† Waxiness: 1 = very waxy (very clean cuts); 2 = waxy (clean cuts with some residue); 3 = slightly waxy (more mealy than waxy); 4 = not waxy (fluffy/mealy)

Table 28 continued.

Baked Potatoes

AITC	Flesh color	Texture*	After Cooking Discoloration
Moderate N			
AR2014-01			
AR2014-04	Yellow	2	None
AR2014-05	Yellow	3	None
AR2014-06	Off-white	2	None
AR2014-11	Yellow	3	None
Norland	Off-white	3	None
EPG 017	Off-white	3	None
EPG 018			
TT 007	Yellow	3	None
TT 008	Off-white	3	None
TT 009	Yellow	2	None
PL 006	Deep Yellow	3	None
Yukon Gold	Deep Yellow	4	None

*** Texture: 1 = wet; 2 = slightly wet; 3 = slightly mealy; 4 = mealy**

AR2014-01 was evaluated as a French fry potatoes and EPG 018 was evaluated as a chipper rather than as a fresh market variety. After cooking darkening was not noted for any varieties after baking. Yukon Gold scored as a mealy potato after baking, but all of the other cultivars evaluated scored mid-way between waxy and mealy after baking.

2014 – N Response

Materials and Methods
The variety evaluation was conducted in small plots at the Alberta Irrigation Technology Centre in Letbridge, AB. Fertility for the low N rate (193 lbs/ac) was achieved through a combination of soil fertility (57 lbs/ac N; 23 lbs/ac P) and broadcast fertilizer (74 lbs/ac of 46-0-0, 130 lbs/ac of 11-52-0, 164 lbs/ac of 0-0-60 and 190 lbs/ac of 20.5-0-0-24) incorporated prior to planting. Fertility for the moderate N rate (227 lbs/ac) was achieved through a combination of soil fertility (57 lbs/ac N; 23 lbs/ac P) and broadcast fertilizer (92 lbs/ac of 46-0-0, 162 lbs/ac of 11-52-0, 212 lbs/ac of 0-0-60 and 240 lbs/ac of 20.5-0-0-24) incorporated prior to planting. Varieties were planted in four replicate rows in a randomized complete block design along with standard varieties (Norland and Yukon Gold). Each block was planted adjacent to guard rows to reduce any edge effects (see plot plan, Appendix A).

Roundup (1 L/ac) was sprayed prior to planting (May 21) to reduce weed pressure. Seed of standard cultivars was provided by Edmonton Potato Growers and seed of test cultivars was provided by each participant. Potatoes were planted June 4 and 5, 2014 approximately 5 to 5½"deep using a two-row tuber unit planter. Seed was planted at 30cm spacing in 6m rows spaced 90cm apart.

The potatoes were hilled June 27 with a power hiller. Sencor 75DF (100 g/ac) and Centurion (76 mL/ac) were applied prior to emergence (June 3) to control weeds. The plots were irrigated to maintain soil moisture close to 70%. Foliar fungicides were applied several times during the growing season to prevent early and late blight from developing (Table 1).

Reglone was applied (1.0 L/ac) September 15 and again September 19. Potatoes were harvested September 22, 23 and 25 using a 1-row Grimme harvester.

Tubers were stored at 8˚C until graded. Tubers were graded into size categories (less than 48mm, 48 – 88mm, over 88mm and deformed). A sample of twenty-five tubers (48 – 88mm) from each replicate was used to determine specific gravity using the weight in air over weight in water method. These tubers were cut longitudinally to assess internal defects. Sub-samples of 48-88mm tubers were provided to the Food Processing Development Centre at Brooks for culinary evaluations.

The data presented here have been statistically analyzed using ANOVA and Tukey's Multiple Comparison Test; (SPSS; $p \leq 0.05$). Statistical summaries are available upon request.

Results and Discussion

Sample hills of each variety were dug for a field day at CDCS August 24, 2014. Photos of these varieties are shown in Figure 10.

Figure 10. Fresh Market varieties at CDCS field day August 24, 2014: a) Norland, b) EPG017, c) EPG018, d) PL 006, e) TT 007, f) TT 008, g) TT 009 and h) Yukon Gold.

Yield data (total yield; ton/ac) and specific gravities of each of the fresh market cultivars are shown in Table 29. The highest total yield at this level of N at AITC was observed with TT 007. TT 007 yielded significantly more than Yukon Gold and some fresh market cultivars in the evaluation, although not statistically higher than Norland, EPG 017, and EPG 018.

Further addressing the agronomic needs of each variety may well result in improvements to yield and size profiles when compared to the results in this trial.

Specific gravity of tubers ranged from 1.068 for TT 009 to 1.093 for EPG 018. The specific gravity of EPG 018 exceeded that of Yukon Gold and may make this variety less suitable for salad potatoes.

Table 29: Estimated **total yield** (ton/acre) and **specific gravity** for each fresh market variety grown on Low N (193 lbs/ac) and Moderate N (227 lbs/ac) nitrogen. Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the $p < 0.05$ level.

AITC	Yield (ton/ac)	SG
Low N		
Norland	20.9 abc†	1.069 def†
EPG017	19.2 a-d	1.074 cde
EPG018	15.7 b-e	1.085 abc†
PL 006	9.8 de	1.074 cde
TT 007	24.8 ab	1.065ef†
TT 008	10.2 de	1.070 def
TT 009	12.6 cde†	1.070 def
Yukon Gold	12.5 cde	1.082 bcd
Moderate N		
Norland	19.88 abc†	1.075 fgh†
EPG017	19.40 abc	1.074 fgh
EPG018	17.63 abc	1.093 abc†
PL 006	12.60 bcd	1.078 e-h
TT 007	23.38 a	1.070 gh†
TT 008	11.69 cd	1.077 e-h
TT 009	14.21 bcd†	1.068 h
Yukon Gold	14.35 bcd	1.088 a-e

† Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.

The mean percentage of total tuber number in each size category is shown in Table 30. The majority of tubers for each variety fell into the marketable category (48 – 88mm). PL 006, TT 008, EPG017, and EPG018 also had a large percentage of tubers in the small size category. Yukon Gold had a significantly higher percentage of tubers in the oversized category which is related to being an early maturing cultivar and an earlier harvest data may have been more appropriate.

Table 30: Percentage of total tuber number in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed) for each fresh market variety grown on Low N (193 lbs/ac) and Moderate N (227 lbs/ac) nitrogen. Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

AITC	< 48mm	48 to 88mm	> 88mm	Deformed
Low N				
Norland	14.4 f	78.4 ab	5.2 bc	2.0 ab
EPG017	31.7 b-f	68.1 abc	0.2 c	0.0 b
EPG018	38.0 abc	61.9 a-d	0.1 c	0.0 b
PL 006	34.1 a-e	65.9 a-d	0.0 c	0.0 b
TT 007	15.5 ef	81.0 a	2.9 c	0.6 b
TT 008	52.0 a	46.5 de	1.3 c	0.2 b
TT 009	37.5 abc	61.0 a-d	1.2 c	0.3 b
Yukon Gold	16.0 ef	74.3 abc	8.5 ab	1.3 ab
Moderate N				
Norland	16.5 f	76.5 ab	3.9 abc	3.1 bcd
EPG 017	36.2 a-f	63.7 a-g	0.1 c	0.0 e
EPG 018	43.1 a-e	56.7 b-h	0.0 c	0.2 e
PL 006	55.8 a	44.0 h	0.0 c	0.2 e
TT 007	16.3 f	79.8 a	2.0 bc	2.0 b-e
TT 008	52.5 abc	47.1 fgh	0.3 c	0.2 e
TT 009	36.6 a-f	62.3 a-h	0.3 c	0.8 de
Yukon Gold	18.3 f	73.8 abc	6.5 ab	1.3 cde

The yield of tubers (estimated ton/ac) of each variety is shown by size category in Table 31. PL 006, EPG 017 and EPG 018 yielded significantly more potatoes under 48 mm than either check variety, but were not statistically different from many other varieties. Marketable yield ranged from 8.3 ton/ac of PL 006 to 20.6 ton/ac of TT 007. TT 007 yielded significantly more marketable tubers than Yukon Gold (check) in this trial, but was not statistically different from Norland.

Table 31: Estimated **yield** (ton/ac) in each **size category** (< 48mm, 48 to 88mm, > 41mm, and deformed tubers) each fresh market variety grown on Low N (193 lbs/ac) and Moderate N (227 lbs/ac) nitrogen. Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

AITC	Yield of <48mm (ton/ac)	Yield of 48 to 88mm (ton/ac)	Yield of > 88mm (ton/ac)	Yield of deformed (ton/ac)
Low N				
Norland	0.6 de†	17.4 abc†	2.3 bc	0.6 ab
EPG017	3.1 a-d	16.0 a-d	0.1 bc	0.0 b
EPG018	3.1 a-d	12.6 c-f	0.1 c	0.0 b
PL 006	1.4 b-e†	8.1 def	0.0 c	0.0 b
TT 007	1.1 cde	21.6 a	2.0 bc	0.2 b
TT 008	2.8 b-e	7.0 ef†	0.4 bc	0.1 b
TT 009	2.4 b-e	9.8 c-f†	0.4 bc	0.0 b
Yukon Gold	0.5 e†	9.0 c-f	2.8 b	0.2 ab
Moderate N				
Norland	0.9 gh†	16.2 ab†	1.9 abc	1.0 bc
EPG 017	3.6 a-f	15.8 ab	0.1 c	0.0 d
EPG 018	4.4 a-d	13.2 ab	0.0 c	0.1 d
PL 006	3.8 a-e†	8.3 bc	0.4 c	0.0 d
TT 007	1.0 gh	20.6 a	1.2 bc	0.6 cd
TT 008	3.2 b-f	8.4 bc†	0.1 c	0.0 d
TT 009	2.5 d-h	11.5 bc†	0.1 c	0.1 d
Yukon Gold	0.7 h†	11.2 bc	2.2 abc	0.2 d

† Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.

Tubers were assessed subjectively for Uniformity of Size and Overall Appearance. Scores are presented in Table 32. AR2014-05 and EPG018 scored very high for both uniformity of size and overall appearance. EPG017, TT 008 and PL 006 scored high for overall appearance.

Table 32: Subjective tuber assessments: **Uniformity of Size** was subjectively assessed on each replicate by the same individual during the grading process. **Overall Appearance** was based on uniformity of size and uniformity of shape, skin colour, deformities and eye depth. Data shown is the mean of 4 replicates.

	Uniformity of Size[1]	Overall Appearance[2]
LowN		
Norland	3.00	3.50
EPG017	3.50	4.50
EPG018	4.00	4.00
PL 006	3.50	4.25
TT 007	3.50	3.00
TT 008	3.50	3.75
TT 009	3.50	4.25
Yukon Gold	3.25	3.33
Moderate N		
Norland	3.67	3.67
EPG 017	3.75	4.00
EPG 018	4.00	4.25
PL 006	3.75	4.50
TT 007	4.00	3.50
TT 008	3.75	4.00
TT 009	3.50	3.50
Yukon Gold	3.75	3.75

[1] Uniformity of Size: 1 (very variable) - 5 (very uniform)

[2] Overall Appearance: 1 (very poor) - 5 (outstanding)

Tuber samples used to measure specific gravity were also evaluated for hollow heart, brown center, stem-end discoloration, other types of internal necrosis and scab. There were few internal defects noted for tubers in this trial. Some internal pigmentation was noted for EPG017. Approximately 4% of Yukon Gold had hollow heart. Some stem-end discoloration was evident in many of the samples, possibly as a result of vine maturity at the time of top-killing.

Varieties were evaluated in the Food Science lab at CDCS for culinary quality. Data from the boil and bake evaluations are presented in Table 33. EPG 018 was evaluated as a chipper rather than as a fresh market variety. After cooking darkening was only noted for EPG017 after boiling. Yukon Gold displayed moderate sloughing in the boiled potato evaluations. All of the cultivars evaluated scored mid-way between waxy and mealy.

Table 33: Culinary evaluations of each fresh market variety grown on Low N (193 lbs/ac) and Moderate N (227 lbs/ac) nitrogen. Data shown is the mean of duplicate analyses of a composite sample.

Boiled Potatoes

AITC	Flesh color	Waxiness†	Sloughing	After Cooking Discoloration
Low N				
Norland	Off-white	2	Little or none	None
EPG017	Off-white	3	Little or none	None
EPG018				
PL 006	Deep yellow	3	Little or none	None
TT 007	Yellow	3	Little or none	None
TT 008	Off-white	2	Little or none	None
TT 009	Yellow	3	Little or none	None
Yukon Gold	Yellow	3	Little or none	None
Moderate N				
Norland	Off-white	2	None	None
EPG 017	Off-white	2	None	Moderate
EPG 018				
PL 006	Deep Yellow	3	None	None
TT 007	Off-white	3	None	None
TT 008	Off-white	3	None	None
TT 009	Yellow	2	None	None
Yukon Gold	Deep Yellow	3	Moderate	None

† Waxiness: 1 = very waxy (very clean cuts); 2 = waxy (clean cuts with some residue); 3 = slightly waxy (more mealy than waxy); 4 = not waxy (fluffy/mealy)

Table 33 continued.

Baked Potatoes

AITC	Flesh color	Texture*	After Cooking Discoloration
Low N			
Norland	Off-white	2	None
EPG017	Off-white	3	None
EPG018			
PL 006	Deep Yellow	3	None
TT 007	Yellow	3	None
TT 008	Off-white	2	None
TT 009	Yellow	3	None
Yukon Gold	Yellow	3	None
Moderate N			
Norland	Off-white	3	None
EPG 017	Off-white	3	None
EPG 018			
PL 006	Deep Yellow	3	None
TT 007	Yellow	3	None
TT 008	Off-white	3	None
TT 009	Yellow	2	None
Yukon Gold	Deep Yellow	4	None

*** Texture: 1 = wet; 2 = slightly wet; 3 = slightly mealy; 4 = mealy**

After cooking darkening was not noted for any varieties after baking. Yukon Gold scored as a mealy potato after baking, but all of the other cultivars evaluated scored mid-way between waxy and mealy after baking.

Conclusions

The 2014 variety trial included eleven fresh market cultivars and two check varieties, Norland and Yukon Gold grown at 227 lbs/ac N. TT 007 yielded well in the 2014 evaluations for high total and marketable yield, with a large percentage of tubers in the marketable category. PL 006, EPG018, EPG017, and TT 008 scored highest for overall appearance. Several varieties yielded well in both the small potato and marketable potato categories indicating their potential usefulness in dual purpose (gourmet and table) markets.

Norland produced significantly greater yield of marketable tubers at the lower N rate than on moderate N. TT08 and TT09 produced significantly greater yield of marketable tubers at the moderate N rate compared to the lower rate of N.

The trial was designed to provide regional data for a wide range of potato cultivars. Addressing the agronomic needs of each variety may well result in improvements to yield and size profiles when compared to the results in this year of the trial.

Creamer Variety Evaluation

2014

Materials and Methods

The variety evaluation was conducted in small plots at the Alberta Irrigation Technology Centre in Letbridge, AB. Fertility (193 lbs/ac) was achieved through a combination of soil fertility (57 lbs/ac N; 23 lbs/ac P) and broadcast fertilizer (74 lbs/ac of 46-0-0, 130 lbs/ac of 11-52-0, 164 lbs/ac of 0-0-60 and 190 lbs/ac of 20.5-0-0-24) incorporated prior to planting. Varieties were planted in skin colour blocks. Each colour block included four replicate rows in a randomized complete block design along with standard varieties. Each block was planted adjacent to guard rows to reduce any edge effects (see plot plan, Appendix A).

Roundup (1 L/ac) was sprayed prior to planting (May 21) to reduce weed pressure. Seed of standard cultivars was provided by Edmonton Potato Growers and seed of test cultivars was provided by each participant. Potatoes were planted June 12, 2014 approximately 10 to 12cm deep using a two-row tuber unit planter. Seed was planted at 15cm spacing in 5m rows spaced 90cm apart.

The potatoes were hilled June 27 with a power hiller. Sencor 75DF (100 g/ac) and Centurion (76 mL/ac) were applied prior to emergence (June 3) to control weeds. The plots were irrigated to maintain soil moisture close to 70%. Foliar fungicides were applied several times during the growing season to prevent early and late blight from developing (Table 1).

Reglone was applied (1.0 L/ac) September 15 and again September 19. Potatoes were harvested October 6-9, 2015 using a 1-row Checci harvester.

Tubers were stored at 8˚C until graded. Tubers were graded into size categories (less than 25mm, 25 – 41mm, over 41mm and deformed). A 4 kg sample of tubers (25 – 41mm) from each replicate was used to determine specific gravity using the weight in air over weight in water method.

The data presented here have been statistically analyzed using ANOVA and Tukey’s Multiple Comparison Test; (SPSS; $p \leq 0.05$). Statistical summaries are available upon request. Sub-samples of tubers from the 25 – 41mm category were made available to the sponsor for culinary evaluation. The results of the culinary evaluation are independent of this report.

Results and Discussion

Sample hills of each cultivar were dug September 2, 2014 from a demonstration trial at CDCS in Brooks, AB for an initial assessment of tuber set, yield potential and relative maturity. Photos of these potatoes are shown in Appendix B.

In season data is presented in Table 34. Approximately 22 days after planting, 50% of many of the plants in each row were visible (data not shown). Full emergence was reached between 22 and 40 days after planting. There was no significant difference in emergence dates from any of the cultivars planted. The mean number of stems per plant, tubers per stem and tubers per plant (tuber set) are shown in Table 34 as well. There were significant differences in each of these categories. For ease of comparison, cultivars have been grouped into categories and analyzed by skin-color.

The mean number of tubers per plant ranged from as low as 8.0 for L14-39 to as many as 44.7 for L14-6. It is my understanding that a target of 15 or more tubers per plant is desirable for the production of gourmet potato varieties (Joel Vander Schaaf, personal communication). If tuber set is too high, however, many tubers may not reach a marketable size prior to harvest in Alberta's short growing season. Most of the cultivars included in the trial exceeded tuber sets of 15. As tuber set is only an indication, marketable yield will be a better indicator than tuber set alone for the potential of these cultivars as gourmet varieties.

Yield data (total yield; ton/ac) and specific gravities of each of the gourmet cultivars are shown in Table 3. Total yield estimates ranged from 5.5 ton/ac to 16.2 ton/ac. In order for producers to achieve a realistic return on investment growing gourmet potatoes, yield must be above a threshold. There were no significant differences in total yield estimates between cultivars, possibly because of field variability. Further addressing the specific agronomic needs of each variety may well result in improvements to yield and size profiles when compared with the results in this trial.

Table 34: Field data and tuber set information for each variety grown at 135 lbs/ac N at CDCS. Data shown is the mean of three or four replicates. Data for each skin colour block followed by the same letter in each column of the table are not significantly different at the $p < 0.05$ level.

CDCS	Full Emergence DAP	Stems per Plant	Tubers per Stem	Tubers per Plant
Moderate N				
L14-1	28.5 a	4.0 a	2.7 d	11.1 f
L14-2	37.3 a	4.6 a	6.6 a-d	27.1 b-e
L14-3	32.8 a	4.3 a	5.2 bcd	22.2 def
L14-4	33.8 a	6.7 a	7.0 a-d	44.0 a
L14-5	40.0 a	3.9 a	11.7 a	38.7 ab
L14-6	37.0 a	4.6 a	10.0 ab	44.7 a
L14-7	29.8 a	7.3 a	3.7 cd	26.0 b-e
L14-8	33.8 a	5.8 a	4.8 bcd	26.7 b-e
L14-9	35.5 a	5.2 a	4.8 bcd	23.9 cde
L14-10	39.3 a	4.4 a	3.2 d	14.3 ef
L14-11	37.5 a	4.8 a	5.9 a-d	28.1 bcd
L14-12	38.8 a	5.0 a	6.6 a-d	32.1 a-d
L14-13	35.5 a	3.9 a	7.4 a-d	26.1 b-e
L14-14	39.3 a	5.7 a	7.1 a-d	36.8 abc
L14-15	33.5 a	4.9 a	9.7 abc	44.6 a
L14-16	39.8 a	5.9 a	4.0 bcd	22.6 def
L14-17	22.8 a	3.0 a	3.7 b	10.6 de
L14-18	28.3 a	3.2 a	2.7 b	8.7 e
L14-19	26.3 a	4.7 a	7.2 a	33.5 a
L14-20	22.0 a	3.8 a	5.1 ab	19.0 c
L14-22	22.8 a	3.3 a	4.1 ab	12.8 de
L14-23	22.0 a	2.7 a	5.4 ab	23.8 b
L14-24	26.0 a	3.9 a	3.8 b	14.9 d
L14-25	24.5 a	4.0 a	3.2 b	12.7 de
L14-26	22.0 a	4.7 a	2.0 b	9.6 e
L14-28	33.5 a	4.1 a	2.6 a	13.7 a
L14-29	38.0 a	6.6 a	2.8 a	14.1 a
L14-30	31.0 a	3.8 a	2.5 a	12.8 a
L14-31	30.0 a	5.3 a	3.5 a	18.0 a
L14-32	25.3 a	3.0 a	2.7 a	8.2 a
L14-33	36.0 a	4.7 a	3.7 a	14.1 bc
L14-34	40.7 a	2.3 a	4.3 a	9.4 c

L14-35	37.0 a	5.1 a	2.9 a	13.0 bc
L14-36	37.5 a	3.3 a	3.8 a	11.7 c
L14-37	41.0 a	4.2 a	6.5 a	24.2 ab
L14-38	41.3 a	5.5 a	3.0 a	16.2 abc
L14-39	37.5 a	2.8 a	2.9 a	8.0 c
L14-40	40.7 a	3.7 a	4.9 a	18.5 abc
L14-41	40.0 a	5.7 a	3.7 a	19.5 abc
L14-42	33.3 a	3.6 a	8.1 a	26.8 a

Specific gravity of tubers ranged from 1.074 for L14-25 to 1.110 for 425/09-06 (Table 35). The texture of ‘new’ potatoes often associated with gourmet size is consistent with specific gravity values of 1.06 to 1.08. Varieties with specific gravities above 1.085 often rival those of French fry varieties with a dry or mealy texture and may be less suitable for the gourmet market.

- Within the yellow-skinned category, L14-1, L14-5, L14-8 had the lowest specific gravities and were significantly lower than both check varieties. The specific gravity of L14-16, L14-3, L14-4, and L14-14 were significantly higher than both check varieties.
- Within the red-skinned category, the specific gravity of several cultivars, L14-19, L14-22, and L14-23, was significantly higher than for L14-25. None of the cultivars tested had specific gravities significantly lower than L14-25.
- There were no significant differences in specific gravity measurements for the purple-skinned cultivars.
- There were no significant differences in specific gravity measurements for the specialty cultivars.

Table 35: Estimated total yield (ton/acre) and specific gravity for each variety grown at 135 lbs/ac N at CDCS. Data shown is the mean of four replicates. Data within each colour block followed by the same letter in each column of the table are not significantly different at the $p < 0.05$ level.

CDCS	Yield (ton/ac)	SG
Moderate N		
L14-1	14.6 a	1.083 g
L14-2	11.6 a	1.100 bcd
L14-3	10.4 a	1.102 bc
L14-4	13.2 a	1.103 ab
L14-5	12.8 a	1.083 g
L14-6	13.6 a	1.095 c-f
L14-7	8.9 a	1.098 b-e
L14-8	9.3 a	1.083 g
L14-9	12.4 a	1.094 def
L14-10	10.0 a	1.091 f
L14-11	13.7 a	1.092 ef
L14-12	8.7 a	1.093 ef
L14-13	13.1 a	1.098 b-e
L14-14	13.6 a	1.105 ab
L14-15	13.0 a	1.099 b-e
L14-16	12.3 a	1.110 a
L14-17	16.2 a	1.085 ab
L14-18	12.1 a	1.079 ab
L14-19	13.6 a	1.093 a
L14-20	15.2 a	1.088 ab
L14-22	14.7 a	1.093 a
L14-23	11.4 a	1.090 a
L14-24	7.3 a	1.080 ab
L14-25	13.5 a	1.074 b
L14-26	9.2 a	1.081 ab
L14-28	14.1 a	1.091 a
L14-29	11.1 a	1.092 a
L14-30	12.7 a	1.088 a
L14-31	16.2 a	1.097 a
L14-32	13.9 a	1.091 a

L14-33	11.5 a	1.090 a
L14-34	6.6 a	1.093 a
L14-35	4.9 a	1.083 a
L14-36	12.3 a	1.086 a
L14-37	7.2 a	1.093 a
L14-38	7.4 a	1.082 a
L14-39	10.6 a	1.097 a
L14-40	8.5 a	1.089 a
L14-41	5.5 a	1.099 a
L14-42	7.2 a	1.088 a

Potatoes were sized into categories and the estimated number of tubers per acre in each size category is represented in Table 36. There were statistically significant differences in some size categories for each skin colour category.

- For the yellow-skinned potatoes, yield of 25 to 41mm tubers per acre ranged from 194,000 per acre to over 430,000 per acre. Several test cultivars produced significantly more tubers per acre than L14-10, but not were significantly different from L14-9. L14-10 produced significantly more tubers per acre in the > 41mm category, indicating that an earlier harvest may have been necessary for this variety. Tow cultivars, L14-15 and L14-4, produced significantly more tubers per acre in the < 25mm category than L14-9.
- In the red-skinned category, several cultivars produced significantly more 25 to 41mm tubers than either check. These include L14-19, L14-20, L14-23 and L14-24. Two of these cultivars also produced significantly more < 25mm tubers than L14-25 and L14-26.
- All of the purple-skinned cultivars tested produced more tubers per acre than L14-32. One cultivar, L14-29 produced over 260,000 tubers < 25mm per acre; significantly more than all of the other entries in this category.
- For the < 25mm and 25 to 41mm size classes, there were no significant differences between cultivars in the specialty category. Three cultivars, L14-33, L14-34, and L14-36, produced significantly fewer tubers per acre in the > 41mm size class than L14-39.

Table 36: Number of tubers per acre (x 1000) in each size category (< 25mm, 25 to 41mm, > 41mm, and deformed) for each variety grown at 135 lbs/ac N at CDCS. Data shown is the mean of four replicates. Data within each coolur block followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

CDCS	< 25mm	25 to 41mm	> 41mm	Deformed
Moderate N				
L14-1	29.2 e	194.0 c	75.1 b	1.8 a
L14-2	116.6 cde	438.0 a	29.0 cd	1.6 a
L14-3	185.5 de	381.3 abc	31.0 cd	2.2 a
L14-4	609.1 ab	416.2 ab	5.4 d	8.1 a
L14-5	457.1 bcd	251.4 abc	3.1 d	5.6 a
L14-6	492.6 bc	331.1 abc	2.0 d	4.3 a
L14-7	232.9 cde	424.0 ab	8.8 cd	4.2 a
L14-8	256.5 cde	405.8 abc	44.1 c	1.1 a
L14-9	216.1 cde	366.7 abc	25.9 cd	3.1 a
L14-10	42.3 e	207.5 c	105.2 a	0.4 a
L14-11	202.4 de	456.2 a	28.3 cd	2.9 a
L14-12	275.4 cde	305.6 abc	36.0 cd	2.0 a
L14-13	272.3 cde	374.4 abc	30.1 cd	0.2 a
L14-14	295.4 cde	268.5 abc	18.2 cd	2.0 a
L14-15	778.6 a	386.1 abc	0.7 d	0.9 a
L14-16	232.3 cde	278.8 abc	14.4 cd	2.0 a
L14-17	22.9 c	100.7 d	136.0 a	0.0 b
L14-18	13.5 c	100.0 d	98.5 ab	.9 ab
L14-19	327.6 a	456.9 a	17.5 b	0.9 ab
L14-20	80.3 bc	310.3 b	120.5 a	2.7 a
L14-22	43.8 bc	180.1 cd	111.3 a	0.2 b
L14-23	102.3 b	368.7 ab	57.3 ab	0.9 ab
L14-24	92.4 bc	284.6 bc	15.5 b	1.3 ab
L14-25	24.7 c	148.2 d	135.1 a	0.2 b
L14-26	14.6 c	93.9 d	150.0 a	0.9 ab
L14-28	34.4 bc	216.5 a	117.6 a	0.0 b
L14-29	261.7 a	256.8 a	1.3 b	5.6 a
L14-30	54.4 bc	215.8 a	73.5 a	0.7 b
L14-31	79.4 b	309.8 a	90.2 a	0.9 b
L14-32	4.0 c	88.8 b	125.2 a	2.9 ab

L14-33	157.1 a	141.2 a	5.7 b	1.5 abc
L14-34	55.5 a	44.4 a	9.6 b	0.6 bc
L14-35	91.7 a	167.3a	22.0 ab	1.3 bc
L14-36	50.3 a	152.4 a	7.9 b	7.6 a
L14-37	140.3 a	241.5 a	22.5 ab	2.2 abc
L14-38	53.1 a	283.6 a	23.1 ab	6.9 ab
L14-39	16.6 a	74.6 a	58.5 a	0.9 bc
L14-40	121.1 a	151.4 a	24.3 ab	2.4 abc
L14-41	38.4 a	139.4 a	35.1 ab	0.3 c
L14-42	194.3 a	192.5 a	17.3 ab	2.2 abc

The mean percentage of total tuber number in each size category is shown in Table 37. It is important to note that harvesting with small plot equipment and manual labour recovers all potatoes over 15mm in diameter. This tended to increase the yield (and percentage) of small potatoes relative to a commercial situation where more of these tubers may be left behind in the field. The percentage of tubers in each category gives an indication of which cultivars require the full season to reach their potential and which may be earlier maturing cultivars.

There were no significant differences in the percentage of tubers in each size class for the yellow-skinned, red-skinned or specialty entries. In the purple-skinned category, two cultivars produced a significantly higher percentage of tubers in the 25 to 41mm class than L14-32, L14-30 and L14-31.

Table 37: Percentage of total tuber number in each size category (< 25mm, 25 to 41mm, > 41mm, and deformed) for each variety grown at 135 lbs/ac N at CDCS. Data shown is the mean of four replicates.

CDCS	< 25mm	25 to 41mm	> 41mm	Deformed
Moderate N				
L14-1	34.5 a	59.8 a	5.4 a	0.3 a
L14-2	26.1 a	57.3 a	15.9 a	0.7 a
L14-3	31.2 a	46.6 a	22.2 a	0.1 a
L14-4	52.1 a	45.2 a	2.5 a	0.3 a
L14-5	28.6 a	61.7 a	9.5 a	0.3 a
L14-6	20.7 a	64.9 a	14.2 a	0.3 a
L14-7	49.8 a	47.9 a	2.1 a	0.3 a
L14-8	40.1 a	45.8 a	14.3 a	0.5 a
L14-9	35.5 a	56.5 a	7.5 a	0.7 a
L14-10	30.1 a	59.5 a	9.8 a	0.7 a
L14-11	19.6 a	54.9 a	25.2 a	0.4 a
L14-12	44.3 a	51.3 a	3.9 a	0.5 a
L14-13	56.9 a	42.1 a	0.9 a	0.1 a
L14-14	48.4 a	48.6 a	1.9 a	1.1 a
L14-15	33.8 a	60.7 a	5.2 a	0.3 a
L14-16	40.6 a	55.9 a	2.9 a	0.6 a
L14-17	19.1 a	57.8 a	22.8 a	0.3 a
L14-18	5.0 a	29.3 a	40.6 a	0.1 a
L14-19	9.1 a	47.6 a	18.1 a	0.2 a
L14-20	5.4 a	42.0 a	52.3 a	0.4 a
L14-22	14.4a	49.2 a	36.0 a	0.5 a
L14-23	16.7 a	62.0 a	21.2 a	0.1 a
L14-24	5.6 a	25.9 a	18.5 a	0.0 a
L14-25	24.7a	47.5 a	27.6 a	0.2 a
L14-26	17.7 a	47.9 a	9.2 a	0.2 a
L14-28	9.5 b	57.8 ab	32.8 ab	0.0 a
L14-29	49.5 a	49.0 ab	0.2 c	1.0 a
L14-30	16.0 b	63.3 a	20.8 bc	0.2 a
L14-31	16.3 b	64.5 a	19.0 bc	0.3 a
L14-32	5.8 b	44.8 b	48.5 a	1.0 a

L14-33	25.0 a	63.1 a	10.6 a	1.3 a
L14-34	23.9 a	69.8 a	4.6 a	1.8 a
L14-35	34.8 a	41.0 a	23.0 a	1.2 a
L14-36	26.3 a	68.1 a	4.5 a	1.1 a
L14-37	41.1 a	42.2 a	16.4a	0.3 a
L14-38	56.0 a	35.1 a	4.4 a	4.5 a
L14-39	36.9 a	59.2 a	3.1 a	0.9 a
L14-40	11.5 a	48.2 a	6.4 a	0.6 a
L14-41	11.8 a	39.7 a	14.0a	1.1 a
L14-42	25.3 a	59.7 a	14.8 a	0.3 a

The estimated yield of tubers in each category is represented in Table 38. In general, a good yield of tubers in the 25 – 41mm category would be the focus of cultivar evaluation, but, in this trial, a good yield of tubers over 41mm may also indicate that an earlier harvest may result in an increased yield of 25 to 41 mm tubers.

- The yields of tubers from yellow-skinned cultivars were not significantly different from the check varieties.
- There were no significant yield differences in the red-skinned category.
- Three entries, L14-29, L14-30 and L14-31, yielded significantly more tubers in the 25 to 41mm size class than L14-32.
- There were no significant yield differences in the specialty category.

Table 38: Estimated yield (ton/ac) in each size category (< 25mm, 25 to 41mm, > 41mm, and deformed tubers) for each variety grown at 135 lbs/ac N at CDCS. Data shown is the mean of four replicates. Data within each colour block followed by the same letter in each column of the table are not significantly different at the $p < 0.05$ level.

CDCS	Yield of <25mm (ton/ac)	Yield of 25 to 41mm (ton/ac)	Yield of > 41mm (ton/ac)	Yield of deformed (ton/ac)
Moderate N				
L14-1	1.7 ab	10.5 a	2.2 a	0.2 a
L14-2	1.1 ab	7.2 a	3.1 a	0.2 a
L14-3	1.3 ab	4.6 a	4.5 a	0.0 a
L14-4	3.0 ab	8.9 a	1.2 a	0.1 a
L14-5	1.5 ab	7.5 a	3.7 a	0.1 a
L14-6	1.0 b	8.8 a	3.7 a	0.1 a
L14-7	2.1 ab	6.1 a	0.6 a	0.1 a
L14-8	1.4 ab	5.0 a	2.9 a	0.0 a
L14-9	1.7 ab	8.4 a	2.2 a	0.1 a
L14-10	1.2 ab	6.9 a	1.9 a	0.0 a
L14-11	0.9 b	7.1 a	5.6 a	0.1 a
L14-12	1.7 ab	5.9 a	1.1 a	0.1 a
L14-13	4.2 a	8.5 a	0.4 a	0.1 a
L14-14	2.9 ab	9.6 a	0.9 a	0.2 a
L14-15	1.6 ab	9.4 a	1.9 a	0.1 a
L14-16	2.1 ab	8.9 a	1.2 a	0.1 a
L14-17	1.0 a	8.8 a	6.3 a	0.1 a
L14-18	0.1 a	2.5 a	9.4 a	0.0 a
L14-19	0.4 a	6.4 a	6.9 a	0.0 a
L14-20	0.2 a	4.5 a	10.4 a	0.0 a
L14-22	0.5 a	5.1 a	9.0 a	0.1 a
L14-23	0.5 a	5.6 a	5.2 a	0.1 a
L14-24	0.2 a	3.2 a	3.9 a	0.0 a
L14-25	1.1 a	5.9 a	6.5 a	0.0 a
L14-26	0.8 a	6.4 a	2.0 a	0.1 a
L14-28	0.3 b	5.8 c	7.9 a	0.0 a
L14-29	2.7 a	8.1 ab	0.1 b	0.2 a
L14-30	0.5 b	6.7 b	5.5 a	0.0 a
L14-31	0.7 b	9.2 a	6.2 a	0.1 a
L14-32	0.2 b	4.0 c	9.5 a	0.3 a

L14-33	1.3 a	7.6 a	2.3 a	0.2 a
L14-34	0.5 a	4.7 a	1.2 a	0.2 a
L14-35	0.5 a	2.8 a	1.6 a	0.1 a
L14-36	1.0 a	9.4 a	1.6 a	0.3 a
L14-37	1.8 a	4.1 a	1.3 a	0.1 a
L14-38	1.6 a	4.8 a	0.9 a	0.2 a
L14-39	1.9 a	7.2 a	1.3 a	0.1 a
L14-40	0.4 a	5.9 a	2.0 a	0.2 a
L14-41	0.2 a	2.5 a	2.7 a	0.1 a
L14-42	0.5 a	4.3 a	2.3 a	0.0 a

Conclusions

The 2014 variety trial included forty gourmet potato lines with potential in Alberta. A number of yellow-skinned cultivars showed promise and were comparable to L14-9 in yield, size profile and appearance. Several red-skinned entries also showed promise, but culinary evaluations may play a greater role than yield for these cultivars. Several purple-skinned cultivars showed promise in appearance, size profile and yield relative to L14-32. In the specialty category, the novel appearances will likely weigh more than the yield and class of potatoes in determining which cultivars move forward.

The trial was designed to provide regional data for a wide range of potato cultivars. The N rate of 193 lbs/ac is a moderate rate of N relative to processing cultivars, but possibly higher than required for some of the gourmet potato cultivars. Addressing the agronomic needs of each variety may well result in improvements to yield and size profiles when compared to the results in this year of the trial.

Overall Results

In 2014, data was provided for over 100 cultivars or varieties supplied by various client sponsors and an additional 25 standard varieties were also included. Of the 37 cultivars from the AAFC National Potato Breeding Program, the cultivars comprised 13 chipping clones, 11 French fry or dual purpose clones, and 13 fresh market clones.

The French fry industry supplied 2 French fry cultivars for evaluation in 2014 and requested data related to N fertilizer strategies. The chipping industry evaluated 7 cultivars. In the fresh market segment, 15 cultivars were evaluated for stakeholders pursuing the fresh market segment, and 40 creamer potato cultivars were evaluated along with relevant check varieties. Many of the entries were grown at two different levels of N to provide preliminary agronomic data for stakeholders. Some in-row spacing changes were made for specific categories of potatoes. After harvest and grading each year, potatoes were available to cooperators to allow them to conduct bruising, storage and culinary evaluations independently.

Conclusions

The potato variety evaluation trial was well supported by the Alberta potato industry. Ten key stakeholders participated in the trial in 2014. There has been interest expressed in adding clients and varieties in future years of the trial. It is important that this type of variety evaluation work continues to ensure impartial information is available to decision makers throughout the value-chain.

Recommendations

- Varieties should be grown in southern Alberta for at least 3 years to evaluate them fully.
- To establish better estimates of yield potential and size profile for the varieties, each variety should be grown under optimal agronomic conditions (fertility, plant density, etc.).

References

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Westermann, D.T. 1993. Fertility management. In: Potato Health Management (R.C. Rowe, ed.). APS Press, St. Paul, MN. pp: 77-86.

Presentations

The potato industry will have access to the project information in many ways. Growers and industry members were invited to see the varieties at a field day in Brooks (Crop Diversification Centre South) in August 2014. Dr. Konschuh prepared a poster for the Annual Meeting of the Potato Growers of Alberta about the trial. In Brooks, guests were invited to compare the unique performances of each variety in the field under local conditions. No field day was hosted at the Alberta Irrigation Technology Centre in Lethbridge, but several client sponsors toured the site throughout the season.

Data was collected, analyzed and presented in multiple reports to industry stakeholders in 2014. Each sponsor was provided with a client-specific report for each year of participation. Information will be available on the internet (ARD website, AAFC website and PGA website) for access by interested parties.

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Project Report

AAFC National Potato Variety Trial Results from CDCS, Brooks, AB

2015

Prepared for:
Funding agencies and industry sponsors

Prepared by:

Michele Konschuh[1] and Benoit Bizimungu[2]
[1]Alberta Agriculture and Forestry
Crop Diversification Centre South
301 Horticultural Station Road East
Brooks, AB T1R 1E6

[2]Agriculture and Agri-Food Canada
Potato Research Centre
850 Lincoln Road P.O. Box 20280
Fredericton, NB E3B 4Z7

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Introduction

In Alberta, potato industry stakeholders are looking for replacement varieties that use less nitrogen, less water, less pesticide, yet yield superior processing or culinary quality and tonnage. Varieties from breeding programs in Canada, Europe and the United States are often being assessed. Many breeding programs target disease resistance, nitrogen use efficiency and excellent storage potential in addition to increased yield. Tuber yield potential and nutritional requirements are impacted by variety characteristics and by environmental characteristics such as the length of the growing season (Westermann, 1993). As noted by Love et. al (2003), the full potential of a new variety may not be realized until proper management is implemented. There is increasing pressure on potato producers to utilize best management practices to reduce the environmental footprint for potatoes. The costs of such shifts in production practices will be borne primarily by producers.

An ideal French fry variety would have earlier maturity than Russet Burbank, be relatively tolerant of environmental fluctuations, have few defects, yield well and have specific gravity in the desired range (1.086 to 1.092). Good fry color out of the field is an asset, and good fry color out of storage is also very desirable. An ideal chipping variety would produce a good yield of medium sized tubers, be relatively tolerant of environmental fluctuations, have few defects, and have high specific gravity in the desired range (above 1.086). Tubers with a good skin set, good maturity at harvest and low concentration of reducing sugars is also very desirable. Varieties that store well at cooler temperatures are an asset. Ideal fresh market varieties would produce a good yield of creamer or medium sized tubers, be relatively tolerant of environmental fluctuations, have few defects, and have an attractive appearance. Tubers with a good skin set that store well are very desirable.

The purpose of this project was to pool resources to evaluate potential varieties from a range of sources, using a cooperative approach. This trial was established to collect local agronomic data on varieties from breeding programs in Canada, the U.S. and elsewhere. The varieties were planted in replicated plots at the Crop Diversification in Brooks, AB and were provided with 209 lbs/ac N. Alberta data is essential when selecting varieties appropriate for our climate, our customers and industry stakeholders.

Objectives

A. To evaluate new cultivars for French fry processing;
B. To evaluate new cultivars for chip processing;
C. To evaluate new cultivars for fresh consumption; and
D. To evaluate cultivars from AAFC's National Potato Breeding Program under Alberta conditions.

Materials and Methods

The variety evaluation was conducted in small plots at the Crop Diversification Centre in Brooks, AB. Eptam (2.2 L/ac) and Sencor 75DF (150 g/ac) were applied pre-plant (May 4) to control weeds. Fertility (209 lbs/ac) was achieved through a combination of soil fertility (39 lbs/ac N; 342 lbs/ac P) and broadcast fertilizer (217 lbs/ac of 46-0-0 and 90 lbs/ac of 11-52-0) incorporated prior to planting and top-dressing prior to hilling. Varieties were planted in four replicate rows in a randomized complete block design along with standard varieties (Norland, Chieftain, Yukon Gold, Snowden, Atlantic, Russet Burbank and Shepody). Each block was planted adjacent to guard rows to reduce any edge effects (see plot plan, Appendix 1).

Potatoes were planted May 20, 2015 approximately 5 to 5½" deep using a two-row wheel planter. Additional nitrogen was applied as a top-dressing (130 lbs/ac of 46-0-0) at hilling (June 9), for a total of 209 lbs/ac N. The plots were irrigated to maintain soil moisture in treatments between 65 and 80%. Foliar fungicides were applied several times during the growing season to prevent early and late blight from developing (Table 2). Insecticide was applied July 30 (Matador, 14 mL/ac) to control Colorado potato beetle.

Table 2: Foliar fungicides applied to the potato crop to prevent early and late blight development.

Date of Application	Fungicide	Rate
6 July	Bravo	0.64 L/ac
30 July	Dithane	900 g/ac
19 Aug	Bravo	0.64 L/ac

Figure 1: Variety evaluation trial at CDCS in Brooks, AB July 27, 2015.

Reglone was applied (1.0 L/ac) September 4 and again September 11. Potatoes were harvested September 21 and 23 using a 1-row Grimme harvester.

Tubers were stored at 8˚C until graded. Tubers were graded into size categories (less than 48mm, 48 – 88mm, over 88mm and deformed). A sample of twenty-five tubers (48 – 88mm) from each replicate was used to determine specific gravity using the weight in air over weight in water method. These tubers were cut longitudinally to assess internal defects. Sub-samples of 48-88mm tubers were provided to Lethbridge Research Centre staff for culinary and post-harvest evaluations.

The data presented here have not been statistically analyzed. Data reported are the mean of two replicate rows.

Results – Chipping Cultivars

Sample hills of each cultivar were dug for a field day August 27, 2015. Photos of the chipping cultivars are shown in Figure 2.

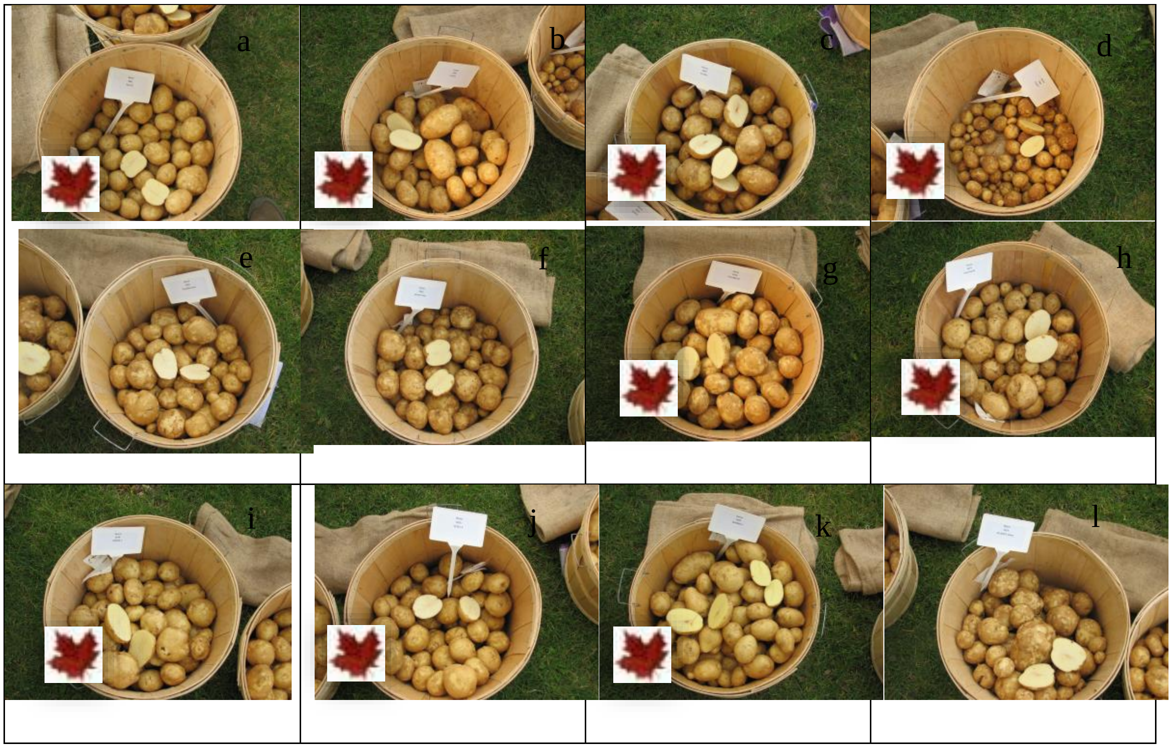

Figure 2. AAFC chipping cultivars at the CDCS field day August 27, 2015: a) F11011, b) F11012, c) F11013, d) F11017, e) Snowden East, f) Atlantic East, g) FV15568-30, h) FV15732-09, i) V08053-1, j) V1351-3, k) WV9890-2, l) Atlantic W.

Yield data (total yield; ton/ac) and specific gravities of each of the chipping cultivars are shown in Table 2. Yield ranged from 17.1 for F11017 to 29.3 ton/ac for Atlantic West. Specific gravity ranged from 1.068 for V08053-1 to 1.086 for Atlantic East.

Table 2: Estimated total yield (ton/acre) and specific gravity for each chipping cultivar grown at CDCS in Brooks, AB (approximately 209 lbs/ac nitrogen). Data shown is the mean of two replicates.

	Yield (ton/ac)	SG
Atlantic East	26.7	1.086
Atlantic West	29.3	1.081
F11011	24.3	1.085
F11012	26.2	1.082
F11013	24.4	1.076
F11017	17.1	1.078
FV15568-30	18.2	1.076
FV15732-09	27.7	1.083
V08053-1	27.3	1.068
V1351-3	24.4	1.075
WV9890-2	26.7	1.081
Snowden East	23.6	1.082

The mean percentage of total tuber number in each size category is shown in Table 3.

Table 3: Percentage of total tuber number in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed) for each chipping cultivar grown at approximately 209 lbs/ac. Data shown is the mean of two replicates.

	No. of <48mm	No. of 48 to 88mm	No. of > 88mm	No. of deformed
Atlantic East	14	69	18	0
Atlantic West	12	65	21	2
F11011	15	78	7	0
F11012	17	75	7	1
F11013	16	80	3	1
F11017	27	71	1	1
FV15568-30	13	79	7	0
FV15732-09	10	79	10	1
V08053-1	17	71	11	1
V1351-3	7	85	8	1
WV9890-2	38	60	0	2
Snowden East	19	71	9	0

The yield of tubers (estimated ton/ac) of each chipping cultivar is shown by size category in Table 4. Marketable yield ranged from 14.1 ton/acre for FV15568-30 to 21.3 ton/ac for F11012 and FV15732-09.

Table 4: Estimated yield (ton/ac) in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed tubers) for each chipping cultivar grown at approximately 209 lbs/ac. Data shown is the mean of two replicates.

	Yield of <48mm (ton/ac)	Yield of 48 to 88mm (ton/ac)	Yield of > 88mm (ton/ac)	Yield of deformed (ton/ac)
Atlantic East	0.7	16.3	9.7	0.0
Atlantic West	0.5	15.6	12.2	0.9
F11011	1.1	19.5	3.7	0.0
F11012	1.1	21.3	3.6	0.1
F11013	1.1	21.0	1.9	0.4
F11017	1.9	14.5	0.5	0.3
FV15568-30	0.7	14.1	3.4	0.1
FV15732-09	0.7	21.3	5.7	0.1
V08053-1	1.3	19.2	6.3	0.5
V1351-3	0.5	20.2	3.6	0.1
WV9890-2	4.1	21.0	0.4	1.2
Snowden East	1.3	17.3	4.9	0.1

Tuber samples used to measure specific gravity were evaluated for hollow heart, other internal defects and scab. There were very few internal defects observed in the tubers examined. Hollow heart or brown center was noted in at least one tuber of each Atlantic sample. Some tubers from each sample exhibited stem-end discoloration and this may be an indication that wilt organisms were present. Common scab lesions were noted on over 60% of the FV15568-30 tubers, 20% of FV15732-09 tubers and 36% of the V08053-1 tubers evaluated.

Results– French Fry Cultivars

Sample hills of each cultivar were dug for a field day August 27, 2015. Photos of the French fry cultivars are shown in Figure 3.

Figure 3. AAFC French fry cultivars at the CDCS field day August 27, 2015: a) F10008., b) F11009., c) F11001, d) F11004, e) F11005, f) F11006, g) F11007, h) CV08015-2, i) CV08032-1, j) CV08099-1, k) CV08104-5, l) CV08247-1, m) FV15223-09, n) V05060-2, o) V07087-1 (photo not available), p) Russet Burbank E, q) Russet Burbank W, r).Shepody E, and s) Shepody W.

Yield data (total yield; ton/ac) and specific gravities of each of the French fry cultivars are shown in Table 5. Total yield ranged from 19.5 ton/ac for CV08032-1 to 33.0 ton/ac for F11007. Specific gravity ranged from 1.060 for CV08015-2 to 1.083 for F10008 and CV08099-1.

Table 5: Estimated total yield (ton/acre) and specific gravity for each French fry cultivar grown at CDCS in Brooks, AB (approximately 209 lbs/ac nitrogen). Data shown is the mean of two replicates.

	Yield (ton/ac)	SG
F10008	26.2	1.083
F11009	29.9	1.071
F11001	28.8	1.072
F11004	31.3	1.071
F11005	27.3	1.071
F11006	30.3	1.073
F11007	33.0	1.066
CV08015-2	24.7	1.060
CV08032-1	19.5	1.070
CV08099-1	22.4	1.083
CV08104-5	30.6	1.077
CV08247-1	24.0	1.082
FV15223-09	24.3	1.077
V05060-2	21.4	1.075
V07087-1	20.3	1.073
R.Burbank East	27.7	1.068
R.Burbank West	27.2	1.068
Shepody East	30.3	1.072
Shepody West	32.1	1.067

The mean percentage of total tuber number in each size category is shown in Table 6.

Table 6: Percentage of total tuber number in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed) for each French fry cultivar grown at approximately 209 lbs/ac. Data shown is the mean of two replicates.

	No. of <48mm	No. of 48 to 88mm	No. of > 88mm	No. of deformed
F10008	23	74	2	1
F11009	19	78	2	0
F11001	30	66	1	4
F11004	32	65	1	1
F11005	30	66	3	1
F11006	15	66	18	2
F11007	13	73	13	2
CV08015-2	23	74	1	2
CV08032-1	30	68	1	1
CV08099-1	30	65	3	2
CV08104-5	19	61	18	3
CV08247-1	26	73	0	1
FV15223-09	18	70	11	1
V05060-2	20	78	0	2
V07087-1	30	52	1	17
R.Burbank East	26	67	1	7
R.Burbank West	19	71	1	9
Shepody East	18	65	12	5
Shepody West	16	74	6	4

The yield of tubers (estimated ton/ac) of each chipping cultivar is shown by size category in Table 7. Yield of 48 – 88mm tubers tanged from 16.3 ton/ac of CV08032-1 to 25.7 ton/ac of F11004.

Table 7: Estimated yield (ton/ac) in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed tubers) for each French fry cultivar grown at approximately 209 lbs/ac. Data shown is the mean of two replicates.

	Yield of <48mm (ton/ac)	Yield of 48 to 88mm (ton/ac)	Yield of > 88mm (ton/ac)	Yield of deformed (ton/ac)
F10008	1.3	22.2	2.0	0.7
F11009	2.2	25.1	1.9	0.3
F11001	2.8	23.6	0.9	1.5
F11004	3.3	25.7	1.5	0.7
F11005	3.4	21.5	5.5	0.8
F11006	0.5	17.8	11.5	0.7
F11007	0.7	22.0	9.6	0.7
CV08015-2	1.5	21.5	0.5	1.2

CV08032-1	2.1	16.3	0.9	0.3
CV08099-1	1.9	17.6	2.0	0.8
CV08104-5	1.4	24.6	3.2	1.4
CV08247-1	2.1	21.8	0.0	0.1
FV15223-09	0.5	18.1	5.6	0.1
V05060-2	1.4	19.4	0.0	0.6
V07087-1	1.9	12.6	0.6	5.2
R.Burbank East	2.6	22.2	0.6	2.3
R.Burbank West	1.2	21.1	0.9	4.0
Shepody East	1.1	19.1	7.9	2.2
Shepody West	1.2	24.2	4.6	2.1

Tuber samples used to measure specific gravity were evaluated for hollow heart, other internal defects and scab. There were very few internal defects observed in the tubers examined. Brown center was noted in one tuber of F11007, and several tubers of F10008 and Russet Burbank. Some tubers from each sample exhibited stem-end discoloration and this may be indicate the presence of wilt organisms. Common scab lesions were only noted on one tuber of CV08104-5 and Russet Burbank and two tubers of FV15223-09.

Results – Fresh Market Cultivars

Sample hills of each cultivar were dug for a field day August 27, 2015. Photos of the yellow/white fresh market cultivars are shown in Figure 4.

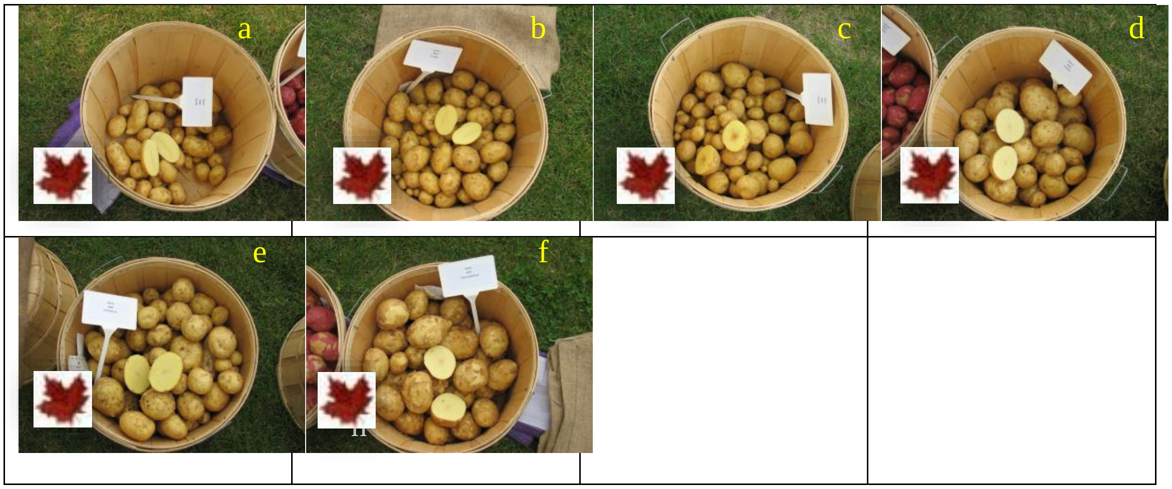

Figure 4. AAFC yellow/white fresh market cultivars at the CDCS field day August 27, 2015: a) F11021, b) F11036, c) F11037, d) F11044, e) FV15915-03, and f) Yukon Gold.

Photos of the purple/red-skinned fresh market cultivars are shown in Figure 5.

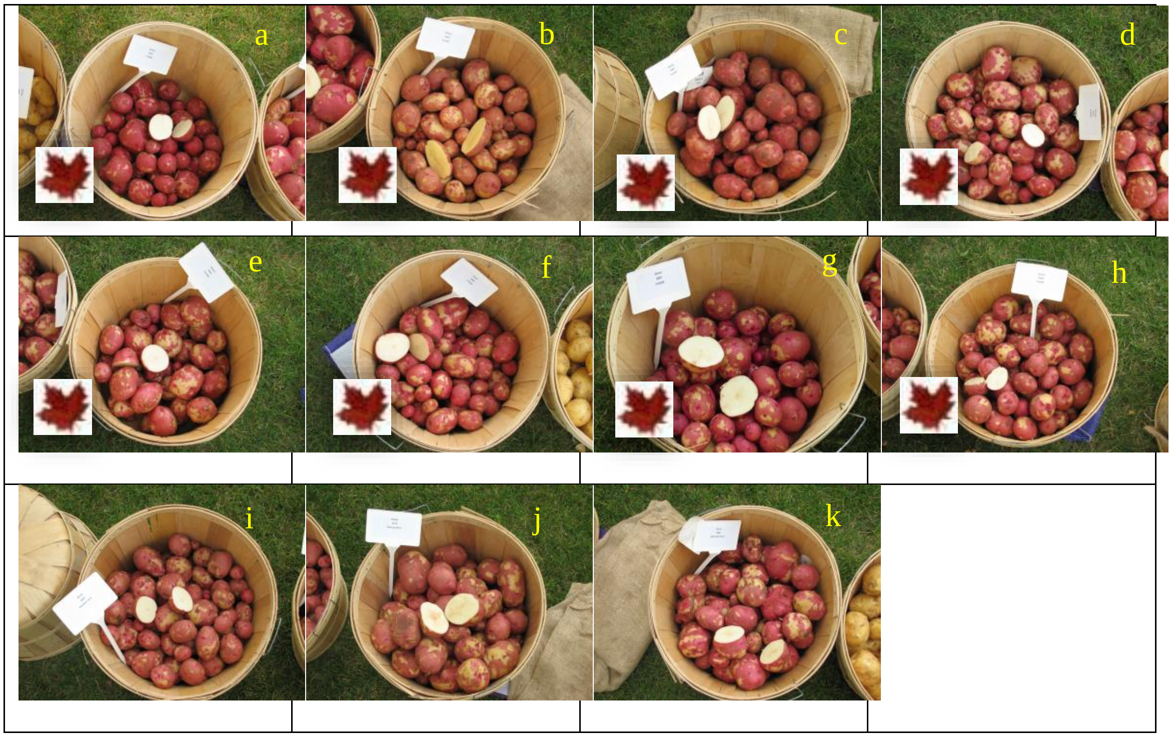

Figure 5. AAFC purple/red-skinned fresh market cultivars at the CDCS field day August 27, 2015: a) F11023, b) F11025, c) F11031, d) F11041, e) F11042, f) F11043, g) F11046, h) F11047, i) Chieftain, j) Norland E and k) Norland W.

Yield data (total yield; ton/ac) and specific gravities of each of the fresh market cultivars are shown in Table 8.

Table 8: Estimated total yield (ton/acre) and specific gravity for each fresh market FM) cultivar grown at CDCS in Brooks, AB (approximately 209 lbs/ac nitrogen). Data shown is the mean of two replicates.

	End Use	Yield (ton/ac)	SG
Yellow/white			
F11021	FM	24.4	1.061
F11036	FM	29.2	1.079
F11037	FM	29.4	1.077
F11044	FM	24.5	1.069
FV15915-03	FM	28.6	1.071
Yukon Gold East	FM CK	23.1	1.081
Red-skinned			
F11023	FM	27.4	1.063
F11025	FM	28.8	1.075
F11031	FM	31.3	1.074
F11041	FM	32.6	1.067
F11042	FM	29.5	1.062
F11043	FM	26.7	1.057
F11046	FM	29.1	1.074
F11047	FM	29.0	1.076
Chieftain	FM CK	35.7	1.064
Norland East	FM CK	29.4	1.065
Norland West	FM CK	27.2	1.064

The mean percentage of total tuber number in each size category is shown in Table 9.

Table 9: Percentage of total tuber number in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed) for each fresh market cultivar grown at approximately 235 lbs/ac. Data shown is the mean of two replicates.

	No. of <48mm	No. of 48 to 88mm	No. of > 88mm	No. of deformed
Yellow				
F11021	27	70	2	2
F11036	31	68	1	0
F11037	33	64	2	2
F11044	10	64	25	1
FV15915-03	34	65	1	0
Yukon Gold East	12	64	24	0
Red-skinned				
F11023	20	76	4	0
F11025	25	69	5	1
F11031	16	72	12	1
F11041	13	60	27	0
F11042	12	70	17	1
F11043	16	72	12	1
F11046	34	63	2	0
F11047	20	77	4	0
Chieftain	15	71	14	1
Norland East	11	71	18	0
Norland West	12	64	21	2

The yield of tubers (estimated ton/ac) of each fresh market cultivar is shown by size category in Table 10.

Table 10: Estimated yield (ton/ac) in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed tubers) for each fresh market cultivar grown at approximately 227 lbs/ac. Data shown is the mean of two replicates.

	Yield of <48mm (ton/ac)	Yield of 48 to 88mm (ton/ac)	Yield of > 88mm (ton/ac)	Yield of deformed (ton/ac)
Yellow				
F11021	1.5	15.2	1.1	0.5
F11036	3.5	27.0	1.1	0.0
F11037	2.5	22.0	1.6	0.9
F11044	0.4	13.6	11.9	0.3
FV15915-03	4.5	23.4	0.7	0.0
Yukon Gold East	0.4	12.3	10.3	0.0
Red-skinned				
F11023	1.8	23.4	2.8	0.0
F11025	1.9	21.6	3.6	0.3
F11031	0.9	21.6	8.2	0.3
F11041	0.7	14.6	16.4	0.0
F11042	0.6	20.6	10.9	0.6
F11043	0.8	18.7	6.6	0.2
F11046	3.2	20.7	2.3	0.0
F11047	1.6	25.0	2.8	0.0
Chieftain	1.2	24.7	9.4	0.4
Norland East	0.6	19.0	9.7	0.4
Norland West	0.6	15.5	10.5	0.6

Tuber samples used to measure specific gravity were evaluated for hollow heart, other internal defects and scab. There were very few internal defects observed in the tubers examined. Hollow heart or brown center was noted in at least one tuber of Chieftain, F11023, F110205, F11031, F11037 and several tubers of F11042. F10077 exhibited some purple pigmentation. Some tubers from each sample exhibited stem-end discoloration and this may indicate the presence of a wilt organism. Common scab lesions were only noted on one Norland tuber.

Conclusions

The 2015 variety trial included a number of cultivars with potential in southern Alberta. Atlantic and Snowden were included in the trial as standard varieties to compare to 9 chipping cultivars. Russet Burbank and Shepody were included in the trial as standard varieties to compare 15 French fry cultivars with. Yukon Gold, Chieftain and Norland were included in the trial as standard varieties to compare with 14 fresh market cultivars.

The trial was designed to provide regional data for a wide range of potato cultivars. All cultivars were planted at the same in-row spacing, the N rate was approximately 209 lbs/ac, and harvest was scheduled for full-season varieties. Addressing the agronomic needs, such as plant density, fertility requirements, and harvest timing for each variety may well result in improvements to yield and size profiles when compared to the results in this trial.

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ConAgra Foods, Lamb Weston Division
Edmonton Potato Growers
Little Potato Company
Old Dutch Foods
Parkland Seed Potatoes
Prairie Gold Produce
Solanum International Inc.
Tuberosum Technologies Inc.

Contact Information:
Michele Konschuh, Ph.D.
Potato Research Scientist
Alberta Agriculture and Forestry, CDCS
301 Horticultural Station Road East
Brooks, AB T1R 1E6
403-362-1314 phone
403-362-1306 fax
Michele.Konschuh@gov.ab.ca

and

Benoit Bizimungu, Ph.D.
Potato Breeder
Agriculture and Agri-Food Canada
Potato Research Centre
850 Lincoln Road P.O. Box 20280
Fredericton, NB E3B 4Z7
506-452-4880
506-452-3316
Benoit.Bizimungu@AGR.GC.CA

Appendix A Plot Plan

Planted May 20, 2015

AAFC - 2015 - Brooks

20 Seed pieces per row

N →

12 x 98 = 1176 m2

1	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**
2	1001 F11017	1011 Chieftain East	1021 Guard	1031 ATLANTIC West	1041 F10008	2001 F11006	2011 F11011	2021 F11004	2031 F10008	2041 Guard
3	1002 V05060-2	1012 Snowden East	1022 F11005	1032 CV08032-1	1042 V07087-1	2002 V08053-1	2012 CV08247-1	2022 F11031	2032 F11017	2042 F11041
4	1003 CV08104-5	1013 Russet Burbank East	1023 FV15915-03	1033 NORLAND West	1043 F11037	2003 FV15732-09	2013 F11047	2023 CV08099-1	2033 V07087-1	2043 F11009
5	1004 FV15568-30	1014 F11013	1024 Shepody East	1034 Atlantic East	1044 F11041	2004 WV9890-2	2014 NORLAND West	2024 Norland East	2034 F11046	2044 F11023
6	1005 CV08099-1	1015 V1351-3	1025 CV08015-2	1035 SHEPODY West	1045 Yukon Gold East	2005 F11007	2015 CV08015-2	2025 CV08104-5	2035 F11037	2045 Snowden East
7	1006 CV08247-1	1016 F11036	1026 F11044	1036 F11046	1046 F11023	2006 FV15223-09	2016 V1351-3	2026 F11005	2036 Atlantic East	2046 F11021
8	1007 FV15223-09	1017 F11012	1027 F11047	1037 FV15732-09	1047 F11009	2007 FV15915-03	2017 Yukon Gold East	2027 F11025	2037 SHEPODY West	2047 F11043
9	1008 F11011	1018 F11004	1028 F11021	1038 F11043	1048 F11025	2008 Shepody East	2018 F11042	2028 ATLANTIC West	2038 F11001	2048 F11012
10	1009 F11001	1019 F11006	1029 F11031	1039 F11007	1049 WV9890-2	2009 CV08032-1	2019 FV15568-30	2029 V05060-2	2039 F11036	2049 Chieftain East
11	1010 F11042	1020 RUSSET BURBANK Wes	1030 V08053-1	1040 Norland East	Guard	2010 Russet Burbank East	2020 F11013	2030 RUSSET BURBANK We	2040 F11044	Guard
12	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**

3 m

14m

6 m

98m

Project Report

AAFC National Potato Variety Trial Results from CDCS, Brooks, AB
2016

Prepared for:
Funding agencies and industry sponsors

Prepared by:

Michele Konschuh[1] and Benoit Bizimungu[2]
[1]Alberta Agriculture and Forestry
Crop Diversification Centre South
301 Horticultural Station Road East
Brooks, AB T1R 1E6

[2]Agriculture and Agri-Food Canada
Potato Research Centre
850 Lincoln Road P.O. Box 20280
Fredericton, NB E3B 4Z7

March 21, 2017

Canadian Horticultural Council | Conseil canadien de l'horticulture

Growing Forward 2

Introduction

In Alberta, potato industry stakeholders are looking for replacement varieties that use less nitrogen, less water, less pesticide, yet yield superior processing or culinary quality and tonnage. Varieties from breeding programs in Canada, Europe and the United States are often being assessed. Many breeding programs target disease resistance, nitrogen use efficiency and excellent storage potential in addition to increased yield. Tuber yield potential and nutritional requirements are impacted by variety characteristics and by environmental characteristics such as the length of the growing season (Westermann, 1993). As noted by Love et. al (2003), the full potential of a new variety may not be realized until proper management is implemented. There is increasing pressure on potato producers to utilize best management practices to reduce the environmental footprint for potatoes. The costs of such shifts in production practices will be borne primarily by producers.

An ideal French fry variety would have earlier maturity than Russet Burbank, be relatively tolerant of environmental fluctuations, have few defects, yield well and have specific gravity in the desired range (1.086 to 1.092). Good fry color out of the field is an asset, and good fry color out of storage is also very desirable. An ideal chipping variety would produce a good yield of medium sized tubers, be relatively tolerant of environmental fluctuations, have few defects, and have high specific gravity in the desired range (above 1.086). Tubers with a good skin set, good maturity at harvest and low concentration of reducing sugars is also very desirable. Varieties that store well at cooler temperatures are an asset. Ideal fresh market varieties would produce a good yield of creamer or medium sized tubers, be relatively tolerant of environmental fluctuations, have few defects, and have an attractive appearance. Tubers with a good skin set that store well are very desirable.

The purpose of this project was to pool resources to evaluate potential varieties from a range of sources, using a cooperative approach. This trial was established to collect local agronomic data on varieties from breeding programs in Canada, the U.S. and elsewhere. The varieties were planted in replicated plots at the Crop Diversification in Brooks, AB and were provided with 228 lbs/ac N. Alberta data is essential when selecting varieties appropriate for our climate, our customers and industry stakeholders.

Objectives

A. To evaluate new cultivars for French fry processing;
B. To evaluate new cultivars for chip processing;
C. To evaluate new cultivars for fresh consumption; and
D. To evaluate cultivars from AAFC's National Potato Breeding Program under Alberta conditions.

Materials and Methods

The variety evaluation was conducted in small plots at the Crop Diversification Centre South in Brooks, AB. Fertility for the AAFC plots (228 lbs/ac) was achieved through a combination of soil fertility (128 lbs/ac N; 499 lbs/ac P) and broadcast fertilizer (90 lbs/ac of 11-52-0) incorporated prior to planting. AAFC plots received an additional top-dressing (205 lbs/ac of 44-0-0) at hilling, for a total of 228 lbs/ac N. Entries were planted in duplicate rows in a randomized complete block design along with standard varieties. Each block was planted adjacent to guard rows to reduce any edge effects (see plot plan, Appendix A).

Sencor 75DF (150 g/ac) and Eptam 8E (1.8 L/ac) were applied prior to planting (May 4) to control weeds. Seed of standard cultivars and test cultivars was provided by AAFC. Potatoes were planted May 19 approximately 12 to 15cm deep using a two-row tuber unit planter. Seed was planted at 30cm spacing in 6m rows spaced 90cm apart. Plots were hilled June 3 with a power hiller. The plots were irrigated to maintain soil moisture close to 70%. Foliar fungicides were applied several times during the growing season to prevent early and late blight from developing (Table 1). Insecticide (Matador 120EC; 40 mL/ac) was applied July 27 to control Colorado Potato Beetle.

Table 1: Foliar fungicides applied to the potato crop in 2016 to prevent early and late blight development.

Date of Application	*Fungicide*	*Rate*
28 June	Bravo	0.64 L/ac
27 July	Ridomil Gold/Bravo	0.83L/ac
5 Aug	Bravo	0.64 L/ac
20 Aug	Dithane DG	0.91 kg/ac

Figure 1: Variety evaluation trial at CDCS in Brooks, AB August 5, 2016.

Reglone was applied (1.0 L/ac) August 23, 2016. Potatoes were harvested September 7 and 8 using a 1-row Grimme harvester.

Tubers were stored at 8˚C until graded. Tubers were graded into size categories (less than 48mm, 48 – 88mm, over 88mm and deformed). A sample of twenty-five tubers (48 – 88mm) from each replicate was used to determine specific gravity using the weight in air over weight in water method. These tubers were cut longitudinally to assess internal defects. Sub-samples of 48-88mm tubers were provided to Lethbridge Research Centre staff for culinary and post-harvest evaluations.

The data presented here have not been statistically analyzed. Data reported are the mean of two replicate rows.

Results – Chipping Cultivars

Sample hills of each cultivar were dug for a field day August 16, 2016. Photos of the chipping cultivars are shown in Figure 2.

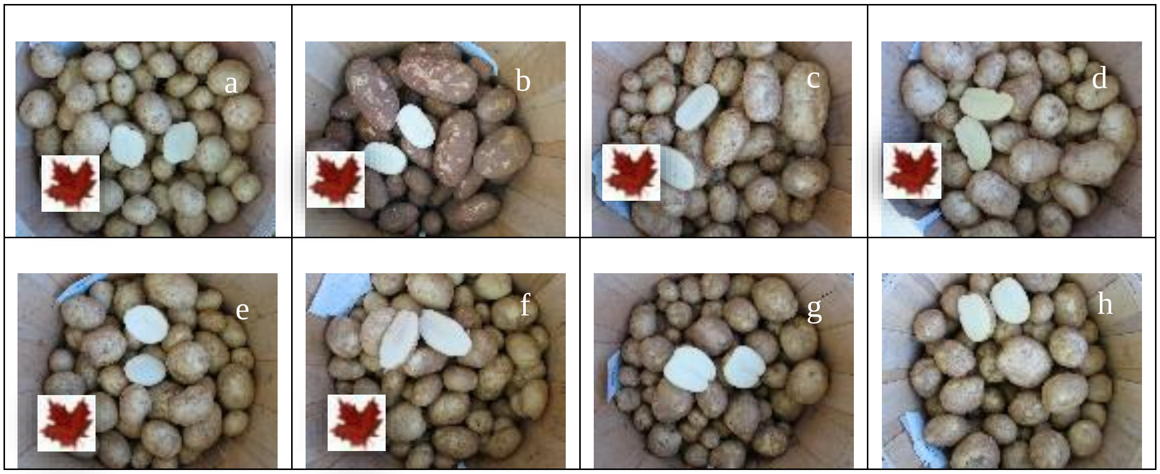

Figure 2. AAFC chipping cultivars at the CDCS field day August 16, 2016: a) F11011, b) F12002, c) F12012, d) F12015, e) F12016, f) F12017, g) Snowden East, and h) Atlantic East.

Yield data (total yield; ton/ac) and specific gravities of each of the chipping cultivars are shown in Table 2. Yield ranged from 24.4 for F12016 to 30.8 ton/ac for Atlantic East. Specific gravity ranged from 1.081 for F12002, F12015 and F12016 to 1.101 for Atlantic East.

Table 2: Estimated total yield (ton/acre) and specific gravity for each chipping cultivar grown at CDCS in Brooks, AB (approximately 228 lbs/ac nitrogen). Data shown is the mean of two replicates.

	Yield (ton/ac)	SG
Atlantic East	30.8	1.101
F11011	27.1	1.084
F12002	28.7	1.081
F12012	31.4	1.094
F12015	32.8	1.081
F12016	24.4	1.081
F12017	30.7	1.098
Snowden East	29.9	1.092

The mean percentage of total tuber number in each size category is shown in Table 3.

Table 3: Percentage of total tuber number in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed) for each chipping cultivar grown at approximately 228 lbs/ac. Data shown is the mean of two replicates.

	No. of <48mm	No. of 48 to 88mm	No. of > 88mm	No. of deformed
Atlantic East				
F11011				
F12002				
F12012				
F12015				
F12016				
F12017				
Snowden East				

The yield of tubers (estimated ton/ac) of each chipping cultivar is shown by size category in Table 4. Marketable yield ranged from 12.5 ton/acre for F12017 to 25.8 ton/ac for F12016.

Table 4: Estimated yield (ton/ac) in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed tubers) for each chipping cultivar grown at approximately 228 lbs/ac. Data shown is the mean of two replicates.

	Yield of <48mm (ton/ac)	Yield of 48 to 88mm (ton/ac)	Yield of > 88mm (ton/ac)	Yield of deformed (ton/ac)
Atlantic East	3.1	24.5	3.1	0.1
F11011	5.9	21.3	0.0	0.0
F12002	5.1	23.5	0.0	0.1
F12012	5.1	25.1	0.0	1.2
F12015	4.4	24.0	1.5	0.3
F12016	4.0	25.8	0.1	0.3
F12017	9.5	12.5	0.0	0.0
Snowden East	3.5	23.1	1.7	0.0

Tuber samples used to measure specific gravity were evaluated for hollow heart, other internal defects and scab. There were very few internal defects observed in the tubers examined. Hollow heart or brown center was noted in one tuber of Atlantic. Some tubers from each sample exhibited stem-end discoloration and this may be an indication that wilt organisms were present. Common scab and black scurf lesions were not present on the subsamples examined.

Results– French Fry Cultivars

Sample hills of each cultivar were dug for a field day August 27, 2015. Photos of the French fry cultivars are shown in Figure 3.

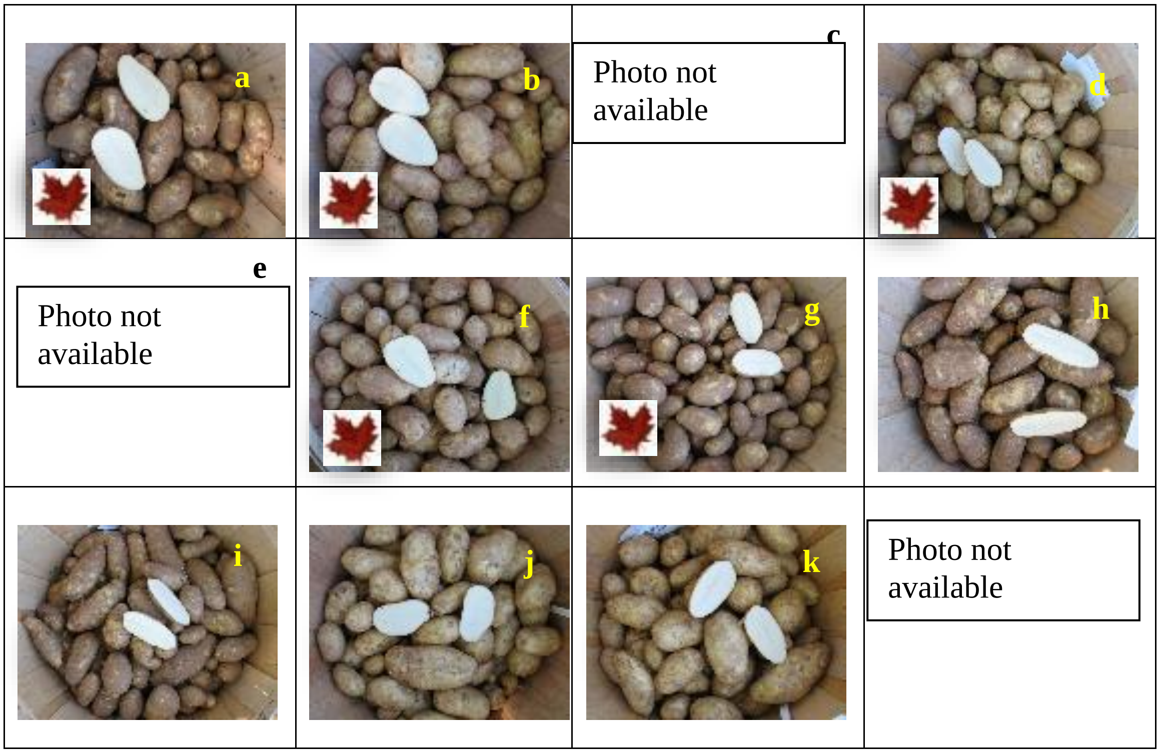

Figure 3. AAFC French fry cultivars at the CDCS field day August 16, 2016: a) F12004., b) F12008., c) F11001, d) F12011, e) CV01236-3, f) CV08104-5, g) WV10075rus-1, h) Russet Burbank E, i) Russet Burbank W, j).Shepody E, and k) Shepody W.

Yield data (total yield; ton/ac) and specific gravities of each of the French fry cultivars are shown in Table 5. Total yield ranged from 25.4 ton/ac for F12004 to 39.7 ton/ac for Shepody West. Specific gravity ranged from 1.072 for F12008 to 1.085 for F12011.

Table 5: Estimated total yield (ton/acre) and specific gravity for each French fry cultivar grown at CDCS in Brooks, AB (approximately 228 lbs/ac nitrogen). Data shown is the mean of two replicates.

	Yield (ton/ac)	SG
F12004	25.4	1.078
F12008	38.3	1.072
F12011	33.9	1.085
CV01236-3	33.9	1.078
CV08104-5	33.3	1.084
WV10075rus-1	29.6	1.085
R.Burbank East	27.6	1.077
R.Burbank West	33.8	1.078
Shepody East	31.3	1.075
Shepody West	39.7	1.077

The mean percentage of total tuber number in each size category is shown in Table 6.

Table 6: Percentage of total tuber number in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed) for each French fry cultivar grown at approximately 228 lbs/ac. Data shown is the mean of two replicates.

	No. of <48mm	No. of 48 to 88mm	No. of > 88mm	No. of deformed
F12004	47	53	0	0
F12008	40	58	1	1
F12011	38	62	0	0
CV01236-3	51	48	0	1
CV08104-5	41	55	0	4
WV10075rus-1	86	12	0	1
R.Burbank East	46	40	0	13
R.Burbank West	50	45	0	5
Shepody East	34	62	2	2
Shepody West	26	67	3	4

The yield of tubers (estimated ton/ac) of each French fry cultivar is shown by size category in Table 7. Yield of 48 – 88mm tubers ranged from 7.1 ton/ac of WV10075rus-1 to 31.6 ton/ac of Shepody West.

Table 7: Estimated yield (ton/ac) in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed tubers) for each French fry cultivar grown at approximately 228 lbs/ac. Data shown is the mean of two replicates.

	Yield of <48mm (ton/ac)	Yield of 48 to 88mm (ton/ac)	Yield of > 88mm (ton/ac)	Yield of deformed (ton/ac)
F12004	5.8	19.3	0.3	0.0
F12008	6.2	30.0	2.1	0.3
F12011	4.9	27.4	1.0	0.6
CV01236-3	9.5	24.0	0.0	0.4
CV08104-5	5.3	26.6	0.0	1.5
WV10075rus-1	21.8	7.1	0.0	0.6
R.Burbank East	5.1	16.4	0.6	5.5
R.Burbank West	8.4	22.1	0.6	2.7
Shepody East	3.9	24.4	1.9	1.1
Shepody West	3.0	31.6	3.2	1.9

Tuber samples used to measure specific gravity were evaluated for hollow heart, other internal defects and scab. There were very few internal defects observed in the tubers examined. Hollow heart was noted in one tuber of WV10075rus-1 and one Russet Burbank tuber. Some tubers from each sample exhibited stem-end discoloration and this may be indicate the presence of wilt organisms. Black scurf was only noted on individual tubers of F12011 and Russet Burbank.

Results – Fresh Market Cultivars

Sample hills of each cultivar were dug for a field day August 16, 2016. Photos of the yellow/white fresh market cultivars are shown in Figure 4.

Figure 4. AAFC yellow/white fresh market cultivars at the CDCS field day August 16, 2016: a) F12043, b) F12051, c) F12059, d)FV15920-01, e) WV10532-1, f) Yukon Gold East; and g) Yukon Gold West.

Photos of the purple/red-skinned fresh market cultivars are shown in Figure 5.

Figure 5. AAFC purple/red-skinned fresh market cultivars at the CDCS field day August 16, 2016: a) F12041, b) F12044, c) F12049, d) F12057, e) F12060, f) F12061, g) F12077, h) F12094, i) WV5888-2, j Chieftain, and k) Norland E.

Yield data (total yield; ton/ac) and specific gravities of each of the fresh market cultivars are shown in Table 8. Total yield ranged from 23.6 ton/ac for F12094 to 45.4 ton/ac for FV15920-01. Specific gravity ranged from 1.067 for F12094 and WV5888-2 to 1.085 for Yukon Gold.

Table 8: Estimated total yield (ton/acre) and specific gravity for each fresh market FM) cultivar grown at CDCS in Brooks, AB (approximately 228 lbs/ac nitrogen). Data shown is the mean of two replicates.

	End Use	Yield (ton/ac)	SG
Yellow/white			
F12043	FM	29.1	1.076
F12051	FM	32.6	1.078
F12059	FM	39.4	1.080
FV15920-01	FM	45.4	1.078
WV10532-1	FM	38.0	1.083
Yukon Gold East	FM check	27.4	1.085
Yukon Gold West	FM check	28.2	1.082
Red-skinned			
F12041	FM	33.9	1.081
F12044	FM	42.3	1.083
F12049	FM	36.4	1.081
F12057	FM	39.6	1.081
F12060	FM	22.2	1.075
F12061	FM	33.9	1.076
F12077	FM	34.6	1.084
F12094	FM/AO/Fingerling	23.6	1.067
WV5888-2	FM/CR	38.4	1.067
Chieftain	FM check	40.3	1.073
Norland East	FM check	33.5	1.064

The mean percentage of total tuber number in each size category is shown in Table 9.

Table 9: Percentage of total tuber number in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed) for each fresh market cultivar grown at approximately 228 lbs/ac. Data shown is the mean of two replicates.

	No. of <48mm	No. of 48 to 88mm	No. of > 88mm	No. of deformed
Yellow				
F12043	38	61	1	0
F12051	29	65	6	0
F12059	34	65	1	0
F12044	20	73	7	0
FV15920-01	38	60	1	0
WV10532-1	32	68	0	0
Yukon Gold East	21	72	4	3
Yukon Gold West	49	39	2	11
Red-skinned				
F12041	27	69	4	1
F12044	20	73	7	0
F12049	37	61	1	1
F12057	46	53	1	0
F12060	24	69	4	3
F12061	33	66	1	0
F12077	36	64	0	0
F12094	89	10	0	1
WV5888-2	46	53	1	1
Chieftain	20	73	6	1
Norland East	24	71	3	1

The yield of tubers (estimated ton/ac) of each fresh market cultivar is shown by size category in Table 10.

Table 10: Estimated yield (ton/ac) in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed tubers) for each fresh market cultivar grown at approximately 228 lbs/ac. Data shown is the mean of two replicates.

	Yield of <48mm (ton/ac)	Yield of 48 to 88mm (ton/ac)	Yield of > 88mm (ton/ac)	Yield of deformed (ton/ac)
Yellow				
F12043	3.8	24.0	1.1	0.1
F12051	2.8	24.3	5.4	0.0
F12044	1.7	33.3	4.6	2.6
F12059	5.4	32.9	0.9	0.3
FV15920-01	6.4	35.8	2.8	0.5
WV10532-1	21.8	7.1	0.0	0.6
Yukon Gold East	1.2	22.2	2.9	1.0
Yukon Gold West	4.6	17.1	2.5	4.0
Red-skinned				
F12041	2.9	27.1	3.7	0.3
F12044	1.7	33.3	4.5	2.6
F12049	4.7	30.0	1.6	0.2
F12057	6.3	31.9	1.0	0.4
F12060	2.0	17.4	2.1	0.8
F12061	4.4	28.6	0.8	0.2
F12077	5.6	28.9	0	0.1
F12094	17.5	5.6	0.0	0.5
WV5888-2	8.4	28.5	0.8	0.6
Chieftain	3.2	31.1	5.7	0.4
Norland East	2.4	28.0	2.6	1.1

Tuber samples used to measure specific gravity were evaluated for hollow heart, other internal defects and scab. There were very few internal defects observed in the tubers examined. Some tubers from each sample exhibited stem-end discoloration and this may indicate the presence of a wilt organism. Common scab lesions were only noted on one WV5888-2 tuber and eight tubers of Yukon Gold.

Conclusions

The 2016 variety trial included a number of cultivars with potential in southern Alberta. Atlantic and Snowden were included in the trial as standard varieties to compare to 6 chipping cultivars. Russet Burbank and Shepody were included in the trial as standard varieties to compare 6 French fry cultivars with. Yukon Gold, Chieftain and Norland were included in the trial as standard varieties to compare with 15 fresh market cultivars.

The trial was designed to provide regional data for a wide range of potato cultivars. All cultivars were planted at the same in-row spacing, the N rate was approximately 228 lbs/ac, and harvest was scheduled for full-season varieties. Addressing the agronomic needs, such as plant density, fertility requirements, and harvest timing for each variety may well result in improvements to yield and size profiles when compared to the results in this trial.

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ConAgra Foods, Lamb Weston Division
Edmonton Potato Growers
Little Potato Company
Old Dutch Foods
New Zealand Institute of Plants and Food Research
Parkland Seed Potatoes
Prairie Gold Produce
Rockyview Seed Potatoes
Solanum International Inc.
Tuberosum Technologies Inc.

Contact Information:
Michele Konschuh, Ph.D.
Potato Research Scientist
Alberta Agriculture and Forestry, CDCS
301 Horticultural Station Road East
Brooks, AB T1R 1E6
403-362-1314 phone
403-362-1306 fax
Michele.Konschuh@gov.ab.ca

and

Benoit Bizimungu, Ph.D.
Potato Breeder
Agriculture and Agri-Food Canada
Potato Research Centre
850 Lincoln Road P.O. Box 20280
Fredericton, NB E3B 4Z7
506-452-4880
506-452-3316
Benoit.Bizimungu@AGR.GC.CA

AAFC - 2016 - Brooks

N →

20 Seed pieces per row

Planted May 9

12 x 74 = 888 m2

Guard = Norland

12	**Guard**		**Guard**	**Guard**	**Guard**	**Guard**		**Guard**		**Guard**	**Guard**
11	1001 Chieftain East		1011 F12011	1021 CV08104-5	1031 Norland East	2001 F12012		2011 F12057		2021 F12059	2031 F12049
10	1002 F12059		1012 Snowden East	1022 F12051	1032 Yukon Gold West	2002 F12044		2012 F12094		2022 F12017	2032 F12041
9	1003 F12044		1013 Atlantic East	1023 F11011	1033 WV10532-1	2003 F12051		2013 CV01236-3		2023 F12002	2033 Yukon Gold Eas
8	1004 F12043		1014 R.Burbank East	1024 F12002	1034 F12041	2004 Atlantic East		2014 Yukon Gold West		2024 F12011	2034 F12060
7	1005 Sshepody West		1015 Shepody East	1025 F12057	1035 Yukon Gold East	2005 CV08104-5		2015 F12043		2025 F12015	2035 Chieftain East
6	1006 F12004		1016 F12008	1026 F12015	1036 F12061	2006 Shepody West		2016 F12008		2026 Norland East	2036 WV10532-1
5	1007 FV15920-01		1017 CV01236-3	1027 F12094	Guard	2007 Snowden East		2017 F12004		2027 F12061	Guard
4	1008 F12017		1018 WV10075rus-1	1028 F12016	Guard	2008 Shepody East		2018 FV15920-01		2028 F11011	Guard
3	1009 F12060		1019 F12012	1029 WV5888-2	Guard	2009 WV10075rus-1		2019 R.Burbank East		2029 WV5888-2	Guard
2	1010 F12049		1020 R.Burbank West	1030 F12077	Guard	2010 R.Burbank West		2020 F12016		2030 F12077	Guard
1	**Guard**	3 m	**Guard**	**Guard**	**Guard**	**Guard**	**10m**	**Guard**	**3m**	**Guard**	**Guard**
	6 m							6m			

Project Report

Alberta Potato Variety Development 2016
CDCS, Brooks, AB

N Response
Chipping Potatoes

Prepared for:
Old Dutch Foods

Prepared by:

Michele Konschuh
Alberta Agriculture and Forestry
Crop Diversification Centre South
301 Horticultural Station Road East
Brooks, AB T1R 1E6

November 24, 2016

Introduction

In Alberta, potato industry stakeholders are looking for replacement varieties that use less nitrogen, less water, less pesticide, yet yield superior processing or culinary quality and tonnage. An ideal chipping variety would produce a good yield of medium sized tubers, be relatively tolerant of environmental fluctuations, have few defects, and have high specific gravity in the desired range (above 1.085). Tubers with a good skin set, good maturity at harvest and low concentration of reducing sugars are also very desirable. Varieties that store well at cooler temperatures are an asset. Varieties from breeding programs in Canada, Europe and the United States are often being assessed. Many breeding programs target disease resistance, nitrogen use efficiency and excellent storage potential in addition to increased yield. Tuber yield potential and nutritional requirements are impacted by variety characteristics and by environmental characteristics such as the length of the growing season (Westerman, 1993). As noted by Love et al. (2003), the full potential of a new variety may not be realized until proper management is implemented. There is increasing pressure on potato producers to utilize best management practices to reduce the environmental footprint for potatoes. The costs of such shifts in production practices will be borne primarily by producers.

The purpose of this project was to pool resources to evaluate potential varieties from a range of sources, using a cooperative approach. This trial was established to collect local agronomic data on varieties from breeding programs in Canada, the U.S. and elsewhere. The varieties were planted in replicated plots at the Crop Diversification Centre in Brooks, AB and were provided with 168 lbs/ac N and, if requested, 138 lbs/ac N. Alberta data is essential when selecting varieties appropriate for our climate, our customers and industry stakeholders.

Objectives

A. To evaluate potential new varieties for chip processing;
B. To provide the potato industry an opportunity to assess varieties grown under local conditions;
C. To compare varieties from several breeding programs (including AAFC) under Alberta conditions; and
D. To determine the response of new chipping varieties to nitrogen fertilizer rates.

Materials and Methods

The variety evaluation was conducted in small plots at the Crop Diversification Centre South in Brooks, AB. Fertility for the low N plots (138 lbs/ac) was achieved through a combination of soil fertility (128 lbs/ac N; 499 lbs/ac P) and broadcast fertilizer (90 lbs/ac of 11-52-0) incorporated prior to planting; and moderate N plots received an additional top-dressing (65 lbs/ac of 46-0-0) at hilling, for a total of 168 lbs/ac N. Within each level of fertility, varieties were planted in four replicate rows in a randomized complete block design along with standard varieties (Atlantic, AC Vigor and Monticello). Each block was planted adjacent to guard rows to reduce any edge effects (see plot plan, Appendix A).

Sencor 75DF (150 g/ac) and Eptam 8E (1.8 L/ac) were applied prior to planting (May 4) to control weeds. Seed of standard cultivars was provided by Edmonton Potato Growers and Rockyview Seed Potatoes and seed of test cultivars was provided by each participant. Potatoes were planted May 12, 2016 (low N) and May 16, 2016 (moderate N) approximately 5 to 5½"deep using a two-row tuber unit planter. Seed was planted at 30cm spacing in 6m rows spaced 90cm apart. The plots were irrigated to maintain soil moisture close to 70%. Foliar fungicides were applied several times during the growing season to prevent early and late blight from developing (Table 1).

Table 1: Foliar fungicides applied to the potato crop in 2016 to prevent early and late blight development.

Date of Application	Fungicide	Rate
28 June	Bravo	0.64 L/ac
27 July	Ridomil Gold/Bravo	0.83L/ac
5 Aug	Bravo	0.64 L/ac
20 Aug	Dithane DG	0.91 kg/ac

Figure 1: Variety evaluation trial at CDCS in Brooks, AB Aug 05, 2016.

Reglone was applied (1.0 L/ac) September 7. The Low N plots were harvested September 22 to 27, 2016 and Moderate N plots were harvested September 27 to 29 using a 1-row Grimme harvester.

Chipping tubers were stored at 14˚C until graded. Tubers were graded into size categories (less than 48mm, 48 – 88mm, and over 88mm). A sample of twenty-five tubers (48 – 88mm) from each replicate was used to determine specific gravity using the weight in air over weight in water method. These tubers were cut longitudinally to assess internal defects. A composite sample of 8 tubers (2 per rep) was stored at 10˚C until culinary analyses were performed. Samples were evaluated for chip color using a Hunter Colorimeter in November 2016.

Marketable potatoes were made available to cooperators for additional storage evaluations, but data will not be provided here.

The data presented here have been statistically analyzed using ANOVA and Tukey's Multiple Comparison Test; (SPSS; $p \leq 0.05$). Statistical summaries are available upon request. T-tests were used to compare results for each variety at different levels of N.

Results and Discussion – Chippers

Sample hills of each variety were dug for a field day at CDCS August 16, 2016. Photos of these varieties are shown in Figure 2.

Figure 2. Chipping varieties at CDCS field day August 16, 2016: a) AC Vigor, b) Atlantic, c) EPG018, d) EPG013, e) ODF008, f) ASPI011, g) ODF007, h) EPG015, and i) Monticello.

Yield data (total yield; ton/ac) and specific gravities of each of the chipping cultivars are shown in Table 2. When grown on moderate nitrogen (168 lbs/ac), total yield ranged from 21 ton/ac for ODF008 to over 30 ton/ac for EPG018 and ODF007. The yield of ODF008 was significantly lower than yield of EPG018 and ODF007, but was not statistically different from Atlantic or other cultivars in the trial. When grown on low N (138 lbs/ac), ODF008 yielded significantly less than several other cultivars. Yield ranged from 21.7 ton/ac for ODF008 to over 30 ton/ac for AC Vigor, EPG018 and ODF007. AC Vigor and Monticello yielded significantly more on low N (138 lbs/ac) compared to the moderate rate of N (168 lbs/ac) indicating that nitrogen fertilizer in excess of 140 lbs/ac may not provide any economic benefit for these two cultivars. On moderate N, specific gravity of tubers ranged from 1.082 for ASPI011 to 1.101 for Monticello, but there were no significant differences between cultivars. Specific gravities ranged from 1.081 for ASPI011 to 1.094 for Monticello when grown on lower N, but there were no significant differences between cultivars at this level of N either. In 2016, none of the cultivars showed a significant difference in specific gravity (SG) in response to the rate of N applied during the growing season.

Further addressing the agronomic needs of each variety may well result in improvements to yield and size profiles when compared to the results in this trial.

Table 2: Estimated total yield (ton/acre) and specific gravity for each chipping variety grown on approximately 168 lbs/ac nitrogen (Moderate N) and 138 lbs/ac nitrogen (Low N). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

CDCS	Yield (ton/ac)	SG
Moderate N		
AC Vigor	25.4 abǂ	1.084 a
Atlantic	29.7 ab	1.099a
EPG018	33.1 a	1.091a
EPG013	27.0 ab	1.084 a
ODF008	21.0 b	1.084 a
ASPI011	25.8 ab	1.082 a
ODF007	31.6 a	1.095 a
EPG015	28.9 ab	1.095 a
Monticello	27.0 abǂ	1.101 a
Low N		
AC Vigor	33.4 abǂ	1.087 a
Atlantic		
EPG018	34.0 a	1.090 a
EPG013	29.3 abc	1.086 a
ODF008	21.7 d	1.082 a
ASPI011	26.4 cd	1.081 a
ODF007	30.2 abc	1.092 a
EPG015	27.0 bcd	1.090 a
Monticello	29.0 abcǂ	1.094 a

ǂ Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.

The mean percentage of total tuber number in each size category is shown in Table 3. The majority of tubers for each variety fell into the marketable category (48 – 88mm) for all cultivars except ASPI011 whether grown on moderate or low N. ASPI011 produced a significantly higher percentage of tubers in the small size category compared to other cultivars when grown on low N. EPG018 had a higher percentage of tubers in the oversized category at the moderate rate of N, and EPG018 and Monticello produced a significantly higher percentage of tubers over 88mm when grown on moderate N. EPG013 produced a significantly higher percentage of tubers over 88mm when grown on moderate N compared to the lower N rate. There were no significant differences in the percentage of deformed tubers between cultivars at either rate of N.

Table 3: Percentage of total tuber number in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed) for each chipping variety grown on moderate nitrogen (approximately 168 lbs/ac) and 138 lbs/ac nitrogen (Low N). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the $p < 0.05$ level.

CDCS	< 48mm	48 to 88mm	> 88mm	Deformed
Moderate N				
AC Vigor	40.5 a	53.5 a	4.8 ab	1.8 a
Atlantic	48.8 a	45.2 a	5.3 ab	1.0 a
EPG018	31.3 a	59.3 a	8.5 ab	0.5 a
EPG013	34.8 a	56.8 a	4.8 abǂ	3.5 a
ODF008	40.0 a	58.8 a	1.3 b	0.0 a
ASPI011	51.8 a	44.5 a	0.5 b	3.0 a
ODF007	33.5 a	62.8 a	2.3 b	1.3 a
EPG015	37.5 a	55.3 a	5.5 ab	1.8 a
Monticello	33.5 a	54.5 a	10.5 a	1.3 a
Low N				
AC Vigor	37.3 b	60.3 a	1.8 c	0.5 a
EPG018	25.0 c	65.0 a	8.8 a	1.0 a
EPG013	30.5 bc	67.8 a	1.8 cǂ	0.5 a
ODF008	35.5 bc	63.3 a	0.8 c	0.3 a
ASPI011	76.0 a	22.8 b	0.3 c	1.0 a
ODF007	29.5 bc	67.5 a	1.5 c	1.5 a
EPG015	34.5 bc	62.3 a	2.5 bc	0.8 a
Monticello	28.0 bc	65.8 a	5.5 b	0.8 a

ǂ Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.

The yield of tubers (estimated ton/ac) of each variety is shown by size category in Table 4. When grown at a moderate rate of N, ASPI011 yielded significantly more tubers under 48mm than other cultivars and significantly less tubers of marketable size than ODF007. EPG018 yielded more tubers over 88mm than ODF008 and ASPI011. There were no significant differences in yield of deformed tubers from the cultivars in the trial. When grown on lower rates of N, ASPI011 produced significantly greater yields of tubers under 48mm than other cultivars and significantly lower yields of tubers in the marketable size category than AC Vigor, EPG018, EPG013, ODF007, EPG015 and Monticello. Yield of large tubers of EPG018 was significantly greater than the yield of large tubers from all other cultivars at this rate of N. Marketable yield of AC Vigor, EPG013, and Monticello was greater when these cultivars were grown on low N compared to moderate N, and yield of tubers over 88mm were concurrently reduced for EPG013 and Monticello at the lower rate of N.

Table 4: Estimated yield (ton/ac) in each size category (< 48mm, 48 to 88mm, > 41mm, and deformed tubers) for each chipping variety grown on moderate nitrogen (approximately 168 lbs/ac) and at a lower rate of N (138 lbs/ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

CDCS	Yield of <48mm (ton/ac)	Yield of 48 to 88mm (ton/ac)	Yield of > 88mm (ton/ac)	Yield of deformed (ton/ac)
Moderate N				
AC Vigor	3.5 b	16.7 abǂ	4.2 ab	1.1 a
Atlantic	2.2 b	21.2 ab	5.6 ab	0.6 a
EPG018	2.7 b	21.9 ab	8.3 a	0.2 a
EPG013	3.1 b	18.8 abǂ	3.9 abǂ	1.2 a
ODF008	3.2 b	16.7 ab	1.1 b	0.0 a
ASPI011	9.9 a	14.0 b	0.6 b	1.2 a
ODF007	3.5 b	25.0 a	2.6 ab	0.6 a
EPG015	4.0 b	19.4 ab	4.8 abǂ	0.7 a
Monticello	2.5 b	17.6 abǂ	6.3 ab	0.5 a
Low N				
AC Vigor	5.2 b	25.7 aǂ	2.2 bc	0.2 a
EPG018	2.5 c	24.0 a	7.2 a	0.3 a
EPG013	3.4 c	24.1 aǂ	1.5 bcǂ	0.2 a
ODF008	3.4 c	17.6 bc	0.6 c	0.1 a
ASPI011	13.7 a	12.1 c	0.5 c	0.2 a
ODF007	3.2 c	24.8 a	1.5 bc	0.8 a
EPG015	3.6 c	21.1 ab	2.1 bcǂ	0.2 a
Monticello	2.5 c	22.6 abǂ	3.8 b	0.3 a

ǂ Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.

Tubers were assessed subjectively for Uniformity of Size and Overall Appearance. Scores are presented in Table 5. At a moderate rate of N, there were no significant differences in Uniformity of Size between cultivars. At a low rate of N, ASPI011 was scored as significantly less uniform with respect to size compared to other cultivars. EPG018 scored significantly higher for overall appearance than Monticello when grown at the moderate rate of N, although not statistically different from other cultivars. At a lower rate of N, no statistical differences were observed between cultivars for overall appearance. In 2016, AC Vigor was scored higher for overall appearance when grown on moderate N than when grown on low N.

Table 5: Subjective tuber assessments: Uniformity of Size was subjectively assessed on each replicate by the same individual during the grading process. Overall Appearance was based on uniformity of size and uniformity of shape, skin colour, deformities and eye depth. Data shown is the mean of 4 replicates.

	Uniformity of Size[1]	Overall Appearance[2]
Moderate N		
AC Vigor	4.0 a	4.0 abǂ
Atlantic	3.3 a	4.0 ab
EPG018	4.0 a	4.5 a
EPG013	3.5 a	3.5 ab
ODF008	3.3 a	3.8 ab
ASPI011	3.8 a	3.5 ab
ODF007	3.8 a	3.8 ab
EPG015	3.8 a	4.0 ab
Monticello	3.8 a	3.0 b
Low N		
AC Vigor	3.0 a	3.8 aǂ
Atlantic		
EPG018	2.8 a	3.0 a
EPG013	3.0 a	3.0 a
ODF008	2.8 a	3.3 a
ASPI011	1.5 b	3.0 a
ODF007	3.0 a	2.3 a
EPG015	2.3 ab	2.8 a
Monticello	3.0 a	2.3 a

[1] Uniformity of Size: 1 (very variable) - 5 (very uniform)

[2] Overall Appearance: 1 (very poor) - 5 (outstanding)

ǂ Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.

Tuber samples used to measure specific gravity were evaluated for hollow heart, brown center, stem-end discoloration, other types of internal necrosis and scab. At the moderate rate of N, very few tubers exhibited hollow heart or brown center. Many of the samples had some level of stem-end discoloration or vascular discoloration but these were not tested for wilt organisms. Some level of black scurf was noted for most cultivars, but no seed treatment was used in the trial. Common scab was noted on isolated tubers from a number of samples.

Chip colour scores of composite samples are presented in Table 6. All of the samples gave excellent chip scores in 2016. A higher L-value indicates a lighter chip. At the moderate rate of N, the lightest chips were produced from EPG013 and EPG015. At the low rate of N, the lightest chips were produced from AC Vigor. AC VIGOR, EPG018, and ODF008 had higher chip scores when grown on moderate N, while EPG013, ASPI011, ODF007, EPG015 and Monticello scored lighter when grown on low N. These are composite samples from one year of testing and additional testing may be required to determine optimal agronomic conditions for chip quality.

Table 6: Chip colour scores from subsamples of each variety grown at moderate nitrogen (approximately 168 lbs/ac) and at a lower rate of N (138 lbs/ac). Data shown is the mean of duplicate analyses of a composite sample evaluated on a Hunter Colorimeter (L is a lightness score; higher numbers are lighter).

	L (Moderate N)	L (Low N)
AC Vigor	69.7	70.2
Atlantic	65.3	
EPG018	66.9	68.7
EPG013	72.0	69.5
ODF008	65.0	67.3
ASPI011	67.4	66.4
ODF007	66.4	61.8
EPG015	70.0	69.3
Monticello	67.2	65.0

Conclusions

The 2016 variety trial included 9 chipping potato cultivars with potential in southern Alberta. Atlantic was included in the trial as a check variety for low N and AC Vigor and Monticello were included as check varieties at both rates of N. AC Vigor, EPG013 and ODF007 yielded well at both levels of N and gave a high percentage of tubers in the marketable size category. Chip color in 2016 was excellent for all cultivars tested. Chip colour out of storage may determine which cultivars have potential for the southern Alberta industry.

The trial was designed to provide regional data for a wide range of potato cultivars. Addressing the agronomic needs of each variety may well result in improvements to yield and size profiles when compared to the results in this year of the trial.

Recommendations

- Varieties should be grown in southern Alberta for at least 3 years and these results need to be compiled to ensure a reasonable evaluation.
- To establish better estimates of yield potential and size profile for the varieties, each variety should be grown under optimal agronomic conditions (fertility, plant density, etc.).

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ConAgra Foods, Lamb Weston Division
Edmonton Potato Growers
Little Potato Company
Old Dutch Foods
New Zealand Institute of Plants and Food Research
Parkland Seed Potatoes
Prairie Gold Produce
Rockyview Seed Potatoes
Solanum International Inc.
Tuberosum Technologies Inc.

Contact Information:

Michele Konschuh, Ph.D.
Potato Research Scientist
Alberta Agriculture and Forestry, CDCS
301 Horticultural Station Road East
Brooks, AB T1R 1E6

403-362-1314 phone
403-362-1306 fax

Michele.Konschuh@gov.ab.ca

Appendix A Plot Plan

Low N Variety Trial 2016 - Full Season (

20 Seed pieces per row

24 X 85 = 2040 m2

Planted May 11

→ **N**

Guard = Russet Burbank

24	**Guard**		**Guard**	**Guard**	**Guard**	**Guard**		**Guard**		**Guard**		**Guard**		**Guard**
23	1001 EPG015		1011 Red Snapper	1021 Yukon Gold	2001 Norland	2011 ASPI010		2021 NZ16-1		5001 ODF007		1031 SM08-83-01R		2031 Rosa Gold
22	1002 Bridget		1012 Guard	1022 EPG018	2002 AC Vigor	2012 Kennebec		2022 ASPI011		5002 Monticello		1032 RV010		2032 Anouk
21	1003 Gourmandine		1013 ASPI010	1023 AC Hamer	2003 EPG015	2013 NZ16-2		2023 Bridget		5003 AC Vigor		1033 AC Hamer		2033 Athlete
20	1004 ODF008		1014 EPG013	1024 Rosa Gold	2004 Roko	2014 Krone		2024 Bridget		5004 ODF008		1034 Athlete		2034 Gourmandine
19	1005 ASPI011		1015 Basin Russet	1025 NZ16-1	2005 RV011	2015 Red Snapper		2025 Birgit		5005 ASPI011		1035 PR07-55-1		2035 AC Hamer
18	1006 Blazer Russet		1016 Russet Burbank	1026 ODF007	2006 EPG018	2016 RV009		2026 Russet Burbank		5006 EPG013		1036 Gourmandine		2036 SM08-83-01R
17	1007 Birgit		1017 Monticello	1027 Roko	2007 EPG013	2017 AC Hamer		2027 ODF007		5007 EPG015		1037 Rosa Gold		2037 RV010
16	1008 RV009		1018 RV011	1028 Kennebec	2008 Guard	2018 Yukon Gold		2028 Monticello		5008 ASPI010		1038 Red Snapper		2038 PR07-55-1
15	1009 AC Vigor		1019 NZ16-2		2009 Gourmandine	2019 Rosa Gold				5009 Guard		1039 Anouk		2039 Red Snapper
14	1010 Krone		1020 Norland		2010 Blazer Russet	2020 ODF008				5010 Atlantic				
13	**Guard**	3 m	**Guard**	**Guard**	**Guard**	**Guard**		**Guard**	3m	**Guard**	5m	**Guard**	**3m**	**Guard**
	6m							6m		6m		5m		5m

12	**Guard**		**Guard**	**Guard**	**Guard**	**Guard**		**Guard**		**Guard**		**Guard**		**Guard**
11	3001 AC Hamer		3011 Norland	3021 Rosa Gold	4001 ASPI011	4011 Krone		4021 ASPI010		5011 EPG018		3031 RV010		4031 Athlete
10	3002 Red Snapper		3012 NZ16-2	3022 Krone	4002 ODF007	4012 RV011		4022 EPG013				3032 SM08-83-01R		4032 Red Snapper
9	3003 Basin Russet		3013 Russet Burbank	3023 NZ16-1	4003 Guard	4013 EPG018		4023 Yukon Gold				3033 Gourmandine		4033 PR07-55-1
8	3004 ODF007		3014 ODF008	3024 EPG015	4004 Gourmandine	4014 Birgit		4024 Kennebec				3034 Rosa Gold		4034 Anouk
7	3005 Yukon Gold		3015 RV009	3025 RV011	4005 NZ16-1	4015 Monticello		4025 Rosa Gold				3035 PR07-55-1		4035 Gourmandine
6	3006 ASPI010		3016 Blazer Russet	3026 EPG013	4006 AC Vigor	4016 Norland		4026 RV009				3036 Red Snapper		4036 SM08-83-01R
5	3007 Bridget		3017 EPG018	3027 Monticello	4007 Basin Russet	4017 AC Hamer		4027 EPG015				3037 Anouk		4037 AC Hamer
4	3008 Gourmandine		3018 Roko	3028 Birgit	4008 ODF008	4018 Russet Burbank		4028 Red Snapper				3038 Athlete		4038 RV010
3	3009 Guard		3019 Kennebec		4009 NZ16-2	4019 Blazer Russet						3039 AC Hamer		4039 Rosa Gold
2	3010 ASPI011		3020 AC Vigor		4010 Roko	4020 Bridget								
1	**Guard**	3 m	**Guard**	**Guard**	**Guard**	**Guard**	**10 m**	**Guard**	3m	**Guard**		**Guard**		**Guard**
	6m													

Variety Medium N Brooks - 2016 - Ful

20 Seed pieces per row

Planted May 16

⟶ **N**

24 x 85m = 2040m2

	12" spacing											ODF Extra
24	**Guard**		**Guard**	**Guard**	**Guard**	**Guard**		**Guard**		**Guard**	**Guard**	
23	1001 ASPI010		1011 ASPI011	1021 EPG015	1031 Barcelona	2001 ASPI010		2011 TT16-5		2021 TT16-3	2031 TT16-9	5001 AC Vigor
22	1002 TT16-4		1012 TT16-9	1022 Norland	1032 TT16-1	2002 TT16-4		2012 PGP03		2022 ASPI012	2032 TT16-10	5002 EPG018
21	1003 Birgit		1013 EPG017	1023 Yukon Gold	1033 ODF007	2003 Birgit		2013 ASPI011		2023 Blazer Russet	2033 ASPI013	5003 EPG013
20	1004 PGP03		1014 Russet Burbank	1024 TT16-3	1034 California RB	2004 ODF008		2014 ODF007		2024 Kennebec	2034 EPG013	5004 ODF008
19	1005 TT16-8		1015 EPG018	1025 Blazer Russet	1035 EPG016	2005 EPG017		2015 TT16-8		2025 Norland	2035 RV009	5005 Burbank
18	1006 Monticello		1016 RV010	1026 Kennebec	1036 RV009	2006 EPG015		2016 Yukon Gold		2026 TT16-7	2036 AC Vigor	5006 ASPI011
17	1007 ASPI013		1017 ASPI008	1027 TT16-2	1037 ASPI012	2007 Monticello		2017 EPG016		2027 ASPI014	2037 Russet Burbank	5007 ODF007
16	1008 TT16-5		1018 Atlantic	1028 AC Vigor	1038 ODF008	2008 Queen Anne		2018 EPG018		2028 RV011	2038 RV010	5008 EPG015
15	1009 ASPI014		1019 RV011	1029 EPG013	1039 TT16-6	2009 Atlantic		2019 ASPI008		2029 California RB	2039 TT16-1	5009 Atlantic
14	1010 TT16-7		1020 TT16-10	1030 Queen Anne		2010 Barcelona		2020 TT16-6		2030 TT16-2		5010 Monticello
13	**Guard**	3 m	**Guard**	**Guard**	**Guard**	**Guard**	**10m**	**Guard**		**Guard**	**Guard**	
	6m											
12	**Guard**		**Guard**	**Guard**	**Guard**	**Guard**		**Guard**		**Guard**	**Guard**	
11	3001 RV010		3011 Russet Burbank	3021 Yukon Gold	3031 Queen Anne	4001 EPG013		4011 TT16-8		4021 TT16-2	4031 TT16-5	5011 California RB
10	3002 Birgit		3012 TT16-9	3022 Norland	3032 Monticello	4002 ASPI012		4012 TT16-10		4022 RV009	4032 AC Vigor	
9	3003 ASPI010		3013 TT16-2	3023 TT16-8	3033 EPG015	4003 Queen Anne		4013 California RB		4023 TT16-6	4033 Barcelona	
8	3004 Blazer Russet		3014 TT16-5	3024 ASPI008	3034 Kennebec	4004 ASPI013		4014 TT16-9		4024 ODF008	4034 TT16-4	
5	3007 ASPI014		3017 TT16-6	3027 TT16-1	3037 PGP03	4007 Kennebec		4017 ASPI010		4027 ODF007	4037 ASPI008	
6	3006 ASPI011		3016 TT16-7	3026 EPG013	3036 Barcelona	4006 Norland		4016 RV010		4026 Atlantic	4036 Birgit	
7	3005 EPG018		3015 Atlantic	3025 ASPI012	3035 RV009	4005 Yukon Gold		4015 TT16-7		4025 EPG016	4035 Monticello	
4	3008 AC Vigor		3018 TT16-3	3028 TT16-4	3038 California RB	4008 EPG018		4018 PGP03		4028 TT16-3	4038 EPG017	
3	3009 TT16-10		3019 EPG016	3029 ODF008	3039 ASPI013	4009 TT16-1		4019 Russet Burbank		4029 ASPI011	4039 ASPI014	
2	3010 Russet Burbank		3020 ODF007	3030 RV011		4010 Blazer Russet		4020 RV011		4030 EPG015		
1	**Guard**	3 m	**Guard**	**Guard**	**Guard**	**Guard**		**Guard**	8m	**Guard**	**Guard**	
	6m											

Project Report

Alberta Potato Variety Development 2016
CDCS, Brooks, AB

Creamer Potatoes

Prepared for:
Various Sponsors

Prepared by:

Michele Konschuh
Alberta Agriculture and Forestry
Crop Diversification Centre South
301 Horticultural Station Road East
Brooks, AB T1R 1E6

February 21, 2017

Introduction

In Alberta, potato industry stakeholders are looking for replacement varieties that use less nitrogen, less water, less pesticide, yet yield superior processing or culinary quality and tonnage. An ideal gourmet potato variety would produce a good yield of small sized tubers, be relatively tolerant of environmental fluctuations, have few defects, and have an attractive appearance. Blemish-free tubers with a good skin set that store well are very desirable. Varieties from breeding programs in Canada, Europe and the United States are often being assessed. Many breeding programs target disease resistance, nitrogen use efficiency and excellent storage potential in addition to increased yield. Tuber yield potential and nutritional requirements are impacted by variety characteristics and by environmental characteristics such as the length of the growing season (Westerman, 1993). As noted by Love et al. (2003), the full potential of a new variety may not be realized until proper management is implemented. There is increasing pressure on potato producers to utilize best management practices to reduce the environmental footprint for potatoes. The costs of such shifts in production practices will be borne primarily by producers.

The purpose of this project was to pool resources to evaluate potential varieties from a range of sources, using a cooperative approach. This trial was established to collect local agronomic data on varieties from breeding programs in Canada, the U.S. and elsewhere. The varieties were planted in replicated plots at the Crop Diversification Centre in Brooks, AB and were provided with 168 lbs/ac N and, if requested, 138 lbs/ac N. Alberta data is essential when selecting varieties appropriate for our climate, our customers and industry stakeholders.

Objectives

A. To evaluate potential new varieties for the creamer market;
B. To provide the potato industry an opportunity to assess varieties grown under local conditions;
C. To compare varieties from several breeding programs (including AAFC) under Alberta conditions; and
D. To determine the response of new creamer varieties to nitrogen fertilizer rates.

Materials and Methods

The variety evaluation was conducted in small plots at the Crop Diversification Centre South in Brooks, AB. Fertility for the low N plots (138 lbs/ac) was achieved through a combination of soil fertility (128 lbs/ac N; 499 lbs/ac P) and broadcast fertilizer (90 lbs/ac of 11-52-0) incorporated prior to planting. Moderate N plots received an additional top-dressing (65 lbs/ac of 46-0-0) at hilling, for a total of 168 lbs/ac N. Within each level of fertility, varieties were planted in four replicate rows in a randomized complete block design. Each block was planted adjacent to guard rows to reduce any edge effects (see plot plan, Appendix A).

Sencor 75DF (150 g/ac) and Eptam 8E (1.8 L/ac) were applied prior to planting (May 4) to control weeds. Seed of test cultivars was provided by each participant. Potatoes were planted May 10 (Low N Early) May 12, 2016 (Low N Main) and May 16, 2016 (Moderate N Main) approximately 12 to 15cm deep using a two-row tuber unit planter. Seed was planted at 15cm spacing in 5m rows spaced 90cm apart. The plots were irrigated to maintain soil moisture close to 70%. Foliar fungicides were applied several times during the growing season to prevent early and late blight from developing (Table 1).

Table 1: Foliar fungicides applied to the potato crop in 2016 to prevent early and late blight development.

Date of Application	*Fungicide*	*Rate*
28 June	Bravo	0.64 L/ac
27 July	Ridomil Gold/Bravo	0.83L/ac
5 Aug	Bravo	0.64 L/ac
20 Aug	Dithane DG	0.91 kg/ac

Figure 1: Variety evaluation trial at CDCS in Brooks, AB Aug 05, 2016.

Reglone was applied (1.0 L/ac) July 29 to the early harvest Low N plots. Sample digs August 4 confirmed that tubers of several cultivars exceeded the creamer size. Several cultivars were hand topped prior to desiccation to restrict sizing and increase skin set. AC Hamer, Anouk, Athlete, and Rosa Gold in the main harvest plots were topped by hand August 4 and 5. Reglone (1.0 L/ac) was applied September 6 to desiccate the main harvest plots. The Low N early plots were harvested August 18, 2016; the Low N Main plots were harvested September 22 to 27, 2016 and moderate N plots were harvested September 27 to 29 using a 1-row Grimme harvester.

Creamer sized tubers were stored at 8˚C until graded. Tubers were graded into size categories (less than 25mm, 25 to 41mm, over 41mm and deformed). A sample of twenty-five tubers (25 to 41mm) from each replicate was used to determine specific gravity using the weight in air over weight in water method. These tubers were cut longitudinally to assess internal defects. A composite sample of 32 tubers (8 per rep) was stored at 8˚C until culinary analyses were performed. Samples were evaluated for bake and boil by the Food Science and Technology Centre, Brooks, in December 2016.

The data presented here have been statistically analyzed using ANOVA and Tukey's Multiple Comparison Test; (SPSS; $p \leq 0.05$). Statistical summaries are available upon request. T-tests were used to compare results for varieties grown at different levels of N.

Results and Discussion – Fresh Market

Sample hills of each creamer variety were dug for a field day at CDCS August 16, 2016. Photos of these varieties are shown in Figure 2.

Figure 2. Fresh market creamer sized varieties at CDCS field day August 16, 2016: a) Bellanita, b) RV010, c) Yellow Star, d) AC Hamer, e) Anouk, f) Athlete, g) Gourmandine, h) PR07-55-1, i) Red Snapper, j) Rosa Gold, and k) SM08-83-01R.

Yield data (total yield; ton/ac) and specific gravities of each of the creamer-style cultivars are shown in Table 2. Three cultivars were planted with little additional nitrogen and were harvested in August (Low N Early harvest). Of these early maturing cultivars, Yellow Star produced significantly greater total yield than the other cultivars, an indication that this cultivar is an efficient nitrogen utilizer. Specific gravity of Yellow Star was significantly higher than the other two cultivars in these plots.

Another nine cultivars were planted in low N plots (138 lbs/ac) and were harvested in September (Low N – main harvest). Total yield ranged from 22.4 ton/ac for PR07-55-1 to 47.3 ton/ac for Gourmandine (Table 2). Specific gravities ranged from 1.061 for Anouk to 1.078 for Gourmandine and SM08-83-01R.

Only one creamer style cultivar was planted in the moderate N plots and harvested early. Total yield of RV010 was significantly greater when grown on moderate N than on low N when harvested early (Table 2). RV010 grown on low N and harvested in September yielded significantly more than when harvested in August. Although the greatest total yield of RV010 was observed on moderate N in the September harvest, the yield was not significantly greater than moderate N early harvest or low N, main harvest.

Further addressing the agronomic needs of each variety may well result in improvements to yield and size profiles when compared to the results in this trial.

Table 2: Estimated total yield (ton/acre) and specific gravity for each creamer potato variety grown on approximately 168 lbs/ac nitrogen (Moderate N) and 138 lbs/ac nitrogen (Low N). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the $p < 0.05$ level.

CDCS	Yield (ton/ac)	SG
Low N – early harvest		
Bellanita	28.0 b	1.064 b
RV010	28.3 b¥ǂ	1.066 b
Yellow Star	33.9 a	1.071 a
Low N – main harvest		
AC Hamer	24.7 c	1.070 bc
Anouk	27.4 c	1.061 c
Athlete	23.3 c	1.073 bc
Gourmandine	47.3 a	1.078 ab
RV010	39.7 b¥	1.077 b
PR07-55-1	22.4 c	1.063 c
Red Snapper	36.4 b	1.090 a
Rosa Gold	27.6 c	1.063 c
SM08-83-01R	39.2 b	1.078 b
Moderate N – early harvest		
RV010	31.4ǂ	1.068
Moderate N – main harvest		
RV010	37.7	1.071

ǂ Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.

¥ Data between the early and main harvest plots was statistically different at the $p \leq 0.05$ level.

The mean percentage of total tuber number in each size category for creamer-style cultivars is shown in Table 3. The three cultivars grown on low N and harvested in August produced very different size profiles. Bellanita produced a significantly higher percentage of small (< 25mm) tubers and creamer-sized (25 to 41mm) tubers than RV010 or Yellow Star. Almost 50% of the RV010 tubers were over 41 mm in diameter indicating that an earlier harvest may be required to capitalize on the creamer market. Over 75% of the Yellow Star tubers were greater than 41 mm in diameter suggesting that this cultivar may be better suited for the regular fresh market.

Of the nine creamer-style cultivars grown on low N for the full season, Athlete and Red Snapper yielded the highest percentage of creamer sized tubers (Table 3). Many of the varieties yielded more than 50% of the tubers over 41 mm indicating that desiccation or harvest dates may need to be adjusted for optimal yield of creamer sized potatoes. RV010 tubers grown on moderate N for the full season were graded as regular sized fresh market cultivars, so the creamer size distribution data is not available.

The level of N fertilization did not significantly affect the percentage of tubers in each size class for RV010. A later harvest date did result in a significantly greater percentage of tubers over 41 mm (Table 3). Timing of desiccation and harvest will likely need to be optimized for each creamer-style cultivar to ensure the best return on investment.

Table 3: Percentage of total tuber number in each size category (< 25mm, 25-41mm, > 41mm and deformed) for each creamer potato variety grown on moderate nitrogen (approximately 168 lbs/ac) and 138 lbs/ac nitrogen (Low N). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

CDCS	< 25 mm	25– 41mm	> 41mm	Deformed
Low N – early harvest				
Bellanita	25.5 a	63.0 a	9.3 c	1.3 a
RV010	11.5 b¥	38.8 b	49.0 b¥	1.3 a
Yellow Star	3.3 c	20.3 c	75.3 a	2.0 a
Low N – main harvest				
AC Hamer	1.5 b	27.8 cd	68.3 a	2.3 ab
Anouk	3.3 ab	32.8 cd	63.0 ab	1.0 b
Athlete	3.5 ab	48.0 a	47.5 cd	1.0 b
Gourmandine	3.3 ab	22.3 d	71.0 a	3.0 ab
RV010	4.8 ab¥	36.3 bc	56.0 bc¥	3.0 ab
PR07-55-1	2.8 ab	45.3 ab	51.0 cd	0.8 b
Red Snapper	5.5 ab	48.8 a	43.8 d	2.0 ab
Rosa Gold	7.8 a	26.0 cd	64.5 ab	1.8 ab
SM08-83-01R	5.3 ab	26.8 cd	63.0 ab	4.8 a
Moderate N – early harvest				
RV010	13.0	38.0	47.0	1.0
Moderate N – main harvest				
RV010				

ǂ Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.
¥ Data between the early and main harvest plots was statistically different at the $p \leq 0.05$ level.

The yield of tubers (estimated ton/ac) of each creamer-style variety is shown by size category in Table 4. There were significant differences in yield by size category between the three cultivars grown in the Low N plots and harvested in August. Bellanita yielded significantly more tubers 25 to 41mm in diameter than RV010 or Yellow Star. Yellow Star yielded significantly more tubers over 41mm than the other cultivars.

For varieties grown on low N and harvested in September, Red Snapper yielded significantly more creamer-sized tubers than the other cultivars. In this trial, the yield of tubers over 41mm indicates that an earlier desiccation or harvest date may be required for many of these cultivars.

RV010 was grown at two levels of N and harvested at two different times. The later harvest resulted in significantly greater yield of tubers in the > 41mm category, while higher N fertility did not significantly affect the tuber yield in each size category.

Table 4: Estimated yield (ton/ac) in each size category (< 25mm, 25-41mm, > 41mm, and deformed) for each creamer potato variety grown on moderate nitrogen (approximately 168 lbs/ac) and at a lower rate of N (138 lbs/ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the $p < 0.05$ level.

CDCS	< 25 mm	25– 41mm	> 41mm	Deformed
Low N – early harvest				
Bellanita	1.8 a	18.8 a	6.6 c	0.7 a
RV010	0.4 b	6.4 b	20.0 b¥	0.5 a
Yellow Star	0.1 b	2.7 c	30.7 a	0.5 a
Low N – main harvest				
AC Hamer	0.0 b	2.7 c	21.3 cd	0.7 abc
Anouk	0.1 b	3.8 c	23.1 c	0.4 abc
Athlete	0.1 b	7.6 b	15.3 d	0.3 bc
Gourmandine	0.1 b	3.9 c	41.0 a	2.3 a
RV010	0.2 ab	6.3 b	31.2 b¥	2.0 abc
PR07-55-1	0.1 b	6.4 b	15.8 d	0.1 c
Red Snapper	0.3 a	11.3 a	24.0 c	0.8 abc
Rosa Gold	0.1 ab	2.7 c	24.1 c	0.6 abc
SM08-83-01R	0.2 ab	3.8 c	33.1 b	2.1 ab
Moderate N – early harvest				
RV010	0.5	7.6	22.4	0.9
Moderate N – main harvest				
RV010				

ǂ Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.

¥ Data between the early and main harvest plots was statistically different at the $p \leq 0.05$ level.

Tuber samples used to measure specific gravity were evaluated for hollow heart, brown center, stem-end discoloration, other types of internal necrosis, scab and black scurf. For creamer-style cultivars grown on low N and harvested in August, very few tubers exhibited internal defects. Approximately 4% of Bellanita tubers showed some brown centre. Stem-end discoloration was visible in approximately 10% of RV010 tubers. This may be related to the rate of vine kill, N status in the crop at the time of desiccation or the presence of wilt organisms. Tubers were not tested for wilt organisms. For tubers grown on low N and harvested in September, approximately 5% of Gourmandine tubers and occasional tubers of AC Hamer, Red Snapper and Rosa Gold displayed brown center. Gourmandine and SM08-83-01R seemed to display more stem-end discoloration and vascular discoloration than other cultivars, but tubers were not tested for wilt organisms. PR07-55-1 tubers showed cracking on the skin surface. No seed treatment was used in the trial so occasional tubers showed black scurf.

Tuber set parameters are presented in Table 5. The number of tubers per plant is often an indication of the potential for creamer potato production. Bellanita produced the highest number of tubers per plant on low N in the early harvest, but RV010 was not significantly lower. For cultivars planted on low N and harvested in

September, RV010 and Red Snapper set significantly more tubers per plant than other cultivars. A similar set for RV010 grown in all four plots indicates that tuber set for this cultivar is not affected by N fertility or time of harvest.

Table 5: Tuber set parameters for each creamer potato variety: Data shown is the mean of 4 replicates.

	Tubers per stem	Tubers per plant
Low N – early harvest		
Bellanita	4.2 a	23.0 a
RV010	3.2 b	19.9 a
Yellow Star	2.7 b	13.9 b
Low N – main harvest		
AC Hamer	2.6 d	10.2 c
Anouk	4.5 a	14.6 b
Athlete	2.3 de	12.6 bc
Gourmandine	3.5 b	13.0 bc
RV010	2.9 bcd	19.2 a
PR07-55-1	2.4 de	14.8 b
Red Snapper	2.9 cd	18.3 a
Rosa Gold	3.5 bc	12.0 bc
SM08-83-01R	1.8 e	13.7 b
Moderate N – early harvest		
RV010	3.2	20.7
Moderate N – main harvest		
RV010	3.1	20.1

† Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.

Culinary evaluations were conducted on all cultivars in the trial. Results for the creamer-style cultivars are presented in Table 6. Results of the culinary evaluation of red-skinned cultivars are presented in Table 6. Flesh colour and texture differences were noted after boiling and baking. Moderate sloughing was observed for RV010 and Red Snapper grown on low N and harvested in September. Severe after cooking discolouration was noted for AC Hamer and PR07-55-1 after baking, but not after boiling.

Table 6: Culinary evaluations of each creamer potato variety grown on moderate nitrogen (approx. 168lbs/ac) and low nitrogen (approx. 138lbs/ac) at CDCS. Data shown is the mean of duplicate analyses of a composite sample.

Boiled Potatoes

CDCS	Flesh color	Waxiness†	Sloughing	After Cooking Discoloration*
Low N – early harvest				
Bellanita	Deep yellow	3	3	3
RV010	Yellow	3	3	3
Yellow Star	Yellow	3	3	3
Low N – main harvest				
AC Hamer	Off-white	2	3	3
Anouk	Yellow	3	3	3
Athlete	Yellow	3	3	3
Gourmandine	Yellow	3	3	3
RV010	Yellow	3	2	3
PR07-55-1	White	3	3	3
Red Snapper	Yellow	4	2	3
Rosa Gold	Deep yellow	2	3	3
SM08-83-01R	Yellow	2	3	3
Moderate N – early harvest				
RV010	Deep yellow	3	3	3
Moderate N – main harvest				
RV010	Deep yellow	2	3	3

† Waxiness: 1 = very waxy (very clean cuts); 2 = waxy (clean cuts with some residue); 3 = slightly waxy (more mealy than waxy); 4 = not waxy (fluffy/mealy)

* After Cooking discoloration and sloughing: 1 = severe; 2 = moderate; 3 = none

Baked Potatoes

CDCS	Flesh color	Texture‡	After Cooking Discoloration*
Low N – early harvest			
Bellanita	Deep yellow	3	3
RV010	Deep yellow	3	3
Yellow Star	Deep yellow	3	3
Low N – main harvest			
AC Hamer	White	3	1
Anouk	Yellow	3	3
Athlete	Deep yellow	3	3
Gourmandine	Deep yellow	4	3
RV010	Deep yellow	3	3
PR07-55-1	White	3	1
Red Snapper	Yellow	4	3
Rosa Gold	Deep yellow	2	3
SM08-83-01R	Deep yellow	3	3
Moderate N – early harvest			
RV010	Deep yellow	3	3
Moderate N – main harvest			
RV010	Deep yellow	3	2

‡ Texture: 1 = wet; 2 = slightly wet; 3 = slightly mealy; 4 = mealy

Conclusions

The 2016 variety trial included 11 cultivars being evaluated for the creamer-sized market in southern Alberta. There was no check variety included in the trial as this market is still developing. Although yield of creamer-sized potatoes was good for some cultivars, such as Bellanita and Red Snapper, the high yield of tubers over 41mm indicates that desiccation and harvest dates may need to be optimized for each cultivar in order to increase the yield of desired sizes. Many cultivars had different culinary attributes that will need to be considered when developing a marketing approach. Few cultivars in the trial had issues with sloughing, after-cooking darkening or internal defects.

RV010 was the only cultivar grown in early and full-season plots at both levels of N fertilizer. For that variety, the length of time in the field had a greater impact than fertilizer for most parameters evaluated.

The trial was designed to provide regional data for a wide range of potato cultivars. Addressing the agronomic needs of each variety may well result in improvements to yield and size profiles when compared to the results in this year of the trial.

Recommendations

- Varieties should be grown in southern Alberta for at least 3 years and these results need to be compiled to ensure a reasonable evaluation.
- To establish better estimates of yield potential and size profile for the varieties, each variety should be grown under optimal agronomic conditions (fertility, plant density, etc.).

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Alberta Seed Producers Inc.
ConAgra Foods, Lamb Weston Division
Edmonton Potato Growers
Little Potato Company
Old Dutch Foods
New Zealand Institute of Plants and Food Research
Parkland Seed Potatoes
Prairie Gold Produce
Rockyview Seed Potatoes
Solanum International Inc.
Tuberosum Technologies Inc.

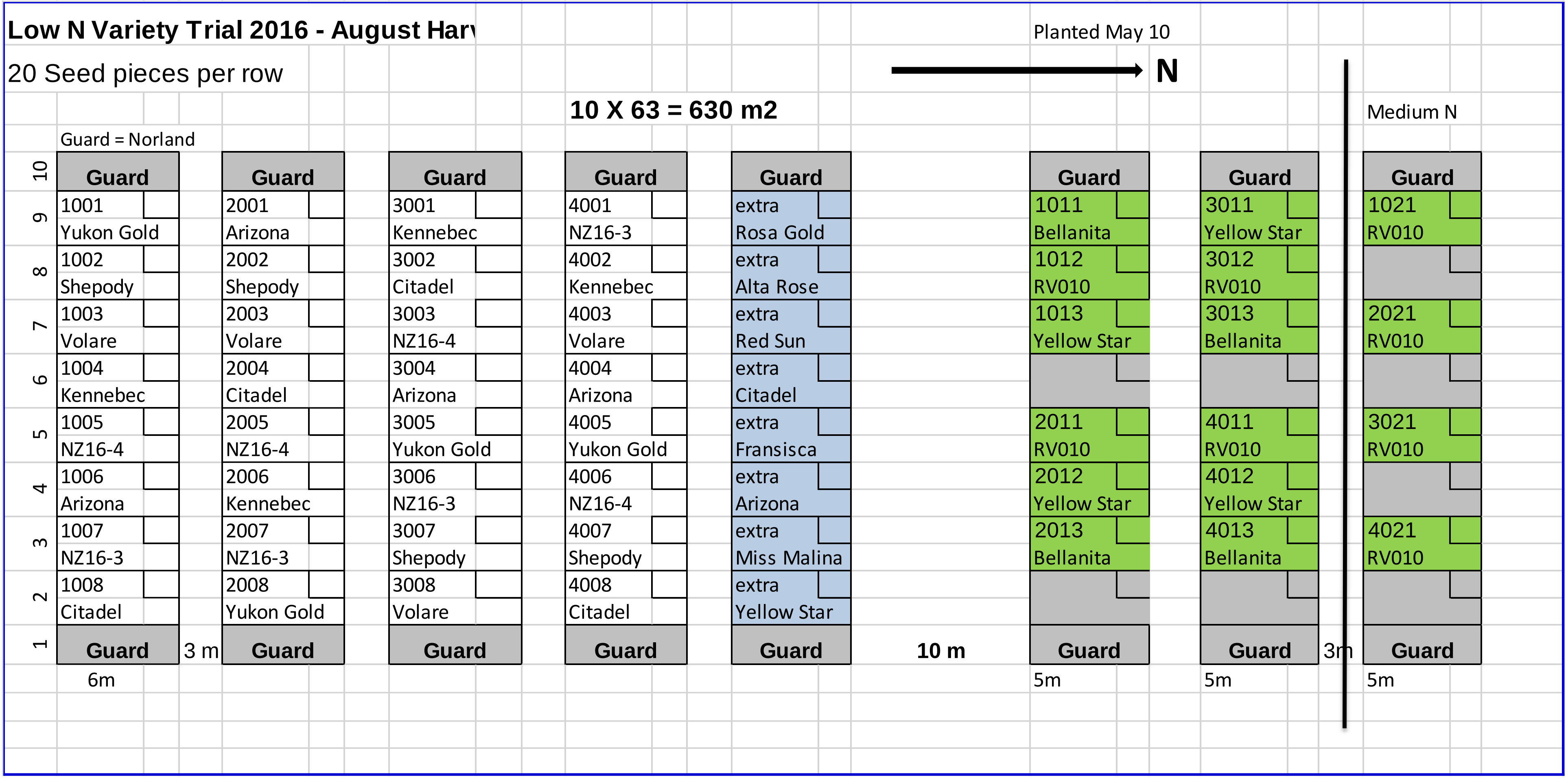
Contact Information:

Michele Konschuh, Ph.D.
Potato Research Scientist
Alberta Agriculture and Forestry, CDCS
301 Horticultural Station Road East
Brooks, AB T1R 1E6

403-362-1314 phone
403-362-1306 fax

Michele.Konschuh@gov.ab.ca

Appendix A Plot Plan



Low N Variety Trial 2016 - August Harv

20 Seed pieces per row

Planted May 10

N

10 X 63 = 630 m2

Medium N

Guard = Norland

10	**Guard**		**Guard**	**Guard**	**Guard**	**Guard**		**Guard**	**Guard**		**Guard**
9	1001 Yukon Gold		2001 Arizona	3001 Kennebec	4001 NZ16-3	extra Rosa Gold		1011 Bellanita	3011 Yellow Star		1021 RV010
8	1002 Shepody		2002 Shepody	3002 Citadel	4002 Kennebec	extra Alta Rose		1012 RV010	3012 RV010		
7	1003 Volare		2003 Volare	3003 NZ16-4	4003 Volare	extra Red Sun		1013 Yellow Star	3013 Bellanita		2021 RV010
6	1004 Kennebec		2004 Citadel	3004 Arizona	4004 Arizona	extra Citadel					
5	1005 NZ16-4		2005 NZ16-4	3005 Yukon Gold	4005 Yukon Gold	extra Fransisca		2011 RV010	4011 RV010		3021 RV010
4	1006 Arizona		2006 Kennebec	3006 NZ16-3	4006 NZ16-3	extra Arizona		2012 Yellow Star	4012 Yellow Star		
3	1007 NZ16-3		2007 NZ16-3	3007 Shepody	4007 Shepody	extra Miss Malina		2013 Bellanita	4013 Bellanita		4021 RV010
2	1008 Citadel		2008 Yukon Gold	3008 Volare	4008 Citadel	extra Yellow Star					
1	**Guard**	3 m	**Guard**	**Guard**	**Guard**	**Guard**	**10 m**	**Guard**	**Guard**	3m	**Guard**
	6m							5m	5m		5m

Low N Variety Trial 2016 - Full Season (

20 Seed pieces per row

Planted May 11

→ N

24 X 85 = 2040 m2

Guard = Russet Burbank

24	**Guard**		**Guard**	**Guard**	**Guard**	**Guard**		**Guard**		**Guard**		**Guard**		**Guard**
23	1001 EPG015		1011 Red Snapper	1021 Yukon Gold	2001 Norland	2011 ASPI010		2021 NZ16-1		5001 ODF007		1031 SM08-83-01R		2031 Rosa Gold
22	1002 Bridget		1012 Guard	1022 EPG018	2002 AC Vigor	2012 Kennebec		2022 ASPI011		5002 Monticello		1032 RV010		2032 Anouk
21	1003 Gourmandine		1013 ASPI010	1023 AC Hamer	2003 EPG015	2013 NZ16-2		2023 Bridget		5003 AC Vigor		1033 AC Hamer		2033 Athlete
20	1004 ODF008		1014 EPG013	1024 Rosa Gold	2004 Roko	2014 Krone		2024 Bridget		5004 ODF008		1034 Athlete		2034 Gourmandine
19	1005 ASPI011		1015 Basin Russet	1025 NZ16-1	2005 RV011	2015 Red Snapper		2025 Birgit		5005 ASPI011		1035 PR07-55-1		2035 AC Hamer
18	1006 Blazer Russet		1016 Russet Burbank	1026 ODF007	2006 EPG018	2016 RV009		2026 Russet Burbank		5006 EPG013		1036 Gourmandine		2036 SM08-83-01R
17	1007 Birgit		1017 Monticello	1027 Roko	2007 EPG013	2017 AC Hamer		2027 ODF007		5007 EPG015		1037 Rosa Gold		2037 RV010
16	1008 RV009		1018 RV011	1028 Kennebec	2008 Guard	2018 Yukon Gold		2028 Monticello		5008 ASPI010		1038 Red Snapper		2038 PR07-55-1
15	1009 AC Vigor		1019 NZ16-2		2009 Gourmandine	2019 Rosa Gold				5009 Guard		1039 Anouk		2039 Red Snapper
14	1010 Krone		1020 Norland		2010 Blazer Russet	2020 ODF008				5010 Atlantic				
13	**Guard**	3 m	**Guard**	**Guard**	**Guard**	**Guard**		**Guard**	3m	**Guard**	5m	**Guard**	**3m**	**Guard**
	6m							6m		6m		5m		5m

12	**Guard**		**Guard**	**Guard**	**Guard**	**Guard**		**Guard**		**Guard**		**Guard**		**Guard**
11	3001 AC Hamer		3011 Norland	3021 Rosa Gold	4001 ASPI011	4011 Krone		4021 ASPI010		5011 EPG018		3031 RV010		4031 Athlete
10	3002 Red Snapper		3012 NZ16-2	3022 Krone	4002 ODF007	4012 RV011		4022 EPG013				3032 SM08-83-01R		4032 Red Snapper
9	3003 Basin Russet		3013 Russet Burbank	3023 NZ16-1	4003 Guard	4013 EPG018		4023 Yukon Gold				3033 Gourmandine		4033 PR07-55-1
8	3004 ODF007		3014 ODF008	3024 EPG015	4004 Gourmandine	4014 Birgit		4024 Kennebec				3034 Rosa Gold		4034 Anouk
7	3005 Yukon Gold		3015 RV009	3025 RV011	4005 NZ16-1	4015 Monticello		4025 Rosa Gold				3035 PR07-55-1		4035 Gourmandine
6	3006 ASPI010		3016 Blazer Russet	3026 EPG013	4006 AC Vigor	4016 Norland		4026 RV009				3036 Red Snapper		4036 SM08-83-01R
5	3007 Bridget		3017 EPG018	3027 Monticello	4007 Basin Russet	4017 AC Hamer		4027 EPG015				3037 Anouk		4037 AC Hamer
4	3008 Gourmandine		3018 Roko	3028 Birgit	4008 ODF008	4018 Russet Burbank		4028 Red Snapper				3038 Athlete		4038 RV010
3	3009 Guard		3019 Kennebec		4009 NZ16-2	4019 Blazer Russet						3039 AC Hamer		4039 Rosa Gold
2	3010 ASPI011		3020 AC Vigor		4010 Roko	4020 Bridget								
1	**Guard**	3 m	**Guard**	**Guard**	**Guard**	**Guard**	**10 m**	**Guard**	3m	**Guard**		**Guard**		**Guard**
	6m													

Variety Medium N Brooks - 2016 - Ful

20 Seed pieces per row

Planted May 16

→ **N**

24 x 85m = 2040m2

12" spacing

									ODF Extra
24	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	
23	1001 ASPI010	1011 ASPI011	1021 EPG015	1031 Barcelona	2001 ASPI010	2011 TT16-5	2021 TT16-3	2031 TT16-9	5001 AC Vigor
22	1002 TT16-4	1012 TT16-9	1022 Norland	1032 TT16-1	2002 TT16-4	2012 PGP03	2022 ASPI012	2032 TT16-10	5002 EPG018
21	1003 Birgit	1013 EPG017	1023 Yukon Gold	1033 ODF007	2003 Birgit	2013 ASPI011	2023 Blazer Russet	2033 ASPI013	5003 EPG013
20	1004 PGP03	1014 Russet Burbank	1024 TT16-3	1034 California RB	2004 ODF008	2014 ODF007	2024 Kennebec	2034 EPG013	5004 ODF008
19	1005 TT16-8	1015 EPG018	1025 Blazer Russet	1035 EPG016	2005 EPG017	2015 TT16-8	2025 Norland	2035 RV009	5005 Burbank
18	1006 Monticello	1016 RV010	1026 Kennebec	1036 RV009	2006 EPG015	2016 Yukon Gold	2026 TT16-7	2036 AC Vigor	5006 ASPI011
17	1007 ASPI013	1017 ASPI008	1027 TT16-2	1037 ASPI012	2007 Monticello	2017 EPG016	2027 ASPI014	2037 Russet Burbank	5007 ODF007
16	1008 TT16-5	1018 Atlantic	1028 AC Vigor	1038 ODF008	2008 Queen Anne	2018 EPG018	2028 RV011	2038 RV010	5008 EPG015
15	1009 ASPI014	1019 RV011	1029 EPG013	1039 TT16-6	2009 Atlantic	2019 ASPI008	2029 California RB	2039 TT16-1	5009 Atlantic
14	1010 TT16-7	1020 TT16-10	1030 Queen Anne		2010 Barcelona	2020 TT16-6	2030 TT16-2		5010 Monticello
13	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	

3 m

10m

6m

12	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	
11	3001 RV010	3011 Russet Burbank	3021 Yukon Gold	3031 Queen Anne	4001 EPG013	4011 TT16-8	4021 TT16-2	4031 TT16-5	5011 California RB
10	3002 Birgit	3012 TT16-9	3022 Norland	3032 Monticello	4002 ASPI012	4012 TT16-10	4022 RV009	4032 AC Vigor	
9	3003 ASPI010	3013 TT16-2	3023 TT16-8	3033 EPG015	4003 Queen Anne	4013 California RB	4023 TT16-6	4033 Barcelona	
8	3004 Blazer Russet	3014 TT16-5	3024 ASPI008	3034 Kennebec	4004 ASPI013	4014 TT16-9	4024 ODF008	4034 TT16-4	
5	3007 ASPI014	3017 TT16-6	3027 TT16-1	3037 PGP03	4007 Kennebec	4017 ASPI010	4027 ODF007	4037 ASPI008	
6	3006 ASPI011	3016 TT16-7	3026 EPG013	3036 Barcelona	4006 Norland	4016 RV010	4026 Atlantic	4036 Birgit	
7	3005 EPG018	3015 Atlantic	3025 ASPI012	3035 RV009	4005 Yukon Gold	4015 TT16-7	4025 EPG016	4035 Monticello	
4	3008 AC Vigor	3018 TT16-3	3028 TT16-4	3038 California RB	4008 EPG018	4018 PGP03	4028 TT16-3	4038 EPG017	
3	3009 TT16-10	3019 EPG016	3029 ODF008	3039 ASPI013	4009 TT16-1	4019 Russet Burbank	4029 ASPI011	4039 ASPI014	
2	3010 Russet Burbank	3020 ODF007	3030 RV011		4010 Blazer Russet	4020 RV011	4030 EPG015		
1	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	

3 m

8m

6m

Project Report

Alberta Potato Variety Development 2016
CDCS, Brooks, AB

French Fry Potatoes

Prepared for:
Various Sponsors

Prepared by:

Michele Konschuh
Alberta Agriculture and Forestry
Crop Diversification Centre South
301 Horticultural Station Road East
Brooks, AB T1R 1E6

January 26, 2017

Introduction

In Alberta, potato industry stakeholders are looking for replacement varieties that use less nitrogen, less water, less pesticide, yet yield superior processing or culinary quality and tonnage. An ideal French fry variety would have earlier maturity than Russet Burbank, be relatively tolerant of environmental fluctuations, have few defects, yield well and have specific gravity in the desired range (1.086 to 1.092). Good fry color out of the field is an asset, and good fry color out of storage is also very desirable. Varieties from breeding programs in Canada, Europe and the United States are often being assessed. Many breeding programs target disease resistance, nitrogen use efficiency and excellent storage potential in addition to increased yield. Tuber yield potential and nutritional requirements are impacted by variety characteristics and by environmental characteristics such as the length of the growing season (Westerman, 1993). As noted by Love et al. (2003), the full potential of a new variety may not be realized until proper management is implemented. There is increasing pressure on potato producers to utilize best management practices to reduce the environmental footprint for potatoes. The costs of such shifts in production practices will be borne primarily by producers.

The purpose of this project was to pool resources to evaluate potential varieties from a range of sources, using a cooperative approach. This trial was established to collect local agronomic data on varieties from breeding programs in Canada, the U.S. and elsewhere. The varieties were planted in replicated plots at the Crop Diversification Centre in Brooks, AB and were provided with 168 lbs/ac N and, if requested, 138 lbs/ac N. Alberta data is essential when selecting varieties appropriate for our climate, our customers and industry stakeholders.

Objectives

A. To evaluate potential new varieties for French fry processing;
B. To provide the potato industry an opportunity to assess varieties grown under local conditions;
C. To compare varieties from several breeding programs (including AAFC) under Alberta conditions; and
D. To determine the response of new French fry varieties to nitrogen fertilizer rates.

Materials and Methods

The variety evaluation was conducted in small plots at the Crop Diversification Centre South in Brooks, AB. Fertility for the low N plots (138 lbs/ac) was achieved through a combination of soil fertility (128 lbs/ac N; 499 lbs/ac P) and broadcast fertilizer (90 lbs/ac of 11-52-0) incorporated prior to planting. Moderate N plots received an additional top-dressing (65 lbs/ac of 46-0-0) at hilling, for a total of 168 lbs/ac N. Within each level of fertility, varieties were planted in four replicate rows in a randomized complete block design along with standard varieties (Atlantic, AC Vigor and Monticello). Each block was planted adjacent to guard rows to reduce any edge effects (see plot plan, Appendix A).

Sencor 75DF (150 g/ac) and Eptam 8E (1.8 L/ac) were applied prior to planting (May 4) to control weeds. Seed of standard cultivars was provided by Edmonton Potato Growers and Rockyview Seed Potatoes and seed of test cultivars was provided by each participant. Potatoes were planted May 10 (Low N Early) May 12, 2016 (Low N Main) and May 16, 2016 (Moderate N Main) approximately 12 to 15cm deep using a two-row tuber unit planter. Seed was planted at 30cm spacing in 6m rows spaced 90cm apart. The plots were irrigated to maintain soil moisture close to 70%. Foliar fungicides were applied several times during the growing season to prevent early and late blight from developing (Table 1).

Table 1: Foliar fungicides applied to the potato crop in 2016 to prevent early and late blight development.

Date of Application	*Fungicide*	*Rate*
28 June	Bravo	0.64 L/ac
27 July	Ridomil Gold/Bravo	0.83L/ac
5 Aug	Bravo	0.64 L/ac
20 Aug	Dithane DG	0.91 kg/ac

Figure 1: Variety evaluation trial at CDCS in Brooks, AB Aug 05, 2016.

Reglone was applied (1.0 L/ac) July 29 to the Early harvest Low N plots and September 6 for main harvest plots. The Low N early plots were harvested August 18, 2016; the Low N Main plots were harvested September 22 to 27, 2016 and Moderate N plots were harvested September 27 to 29 using a 1-row Grimme harvester.

French fry tubers were stored at 8˚C until graded. Tubers were graded into size categories (less than 113g, 113 to 170g, 170 to 284g, over 284g and deformed). A sample of twenty-five tubers (113 to 284g) from each replicate was used to determine specific gravity using the weight in air over weight in water method. These tubers were cut longitudinally to assess internal defects. A composite sample of 8 tubers (2 per rep) was stored at 8˚C until culinary analyses were performed. Samples were evaluated for fry colour using a USDA colour chart in November 2016.

The data presented here have been statistically analyzed using ANOVA and Tukey's Multiple Comparison Test; (SPSS; $p \leq 0.05$). Statistical summaries are available upon request. T-tests were used to compare results for varieties grown at different levels of N.

Results and Discussion – French fries

Sample hills of each variety were dug for a field day at CDCS August 16, 2016. Photos of these varieties are shown in Figure 2.

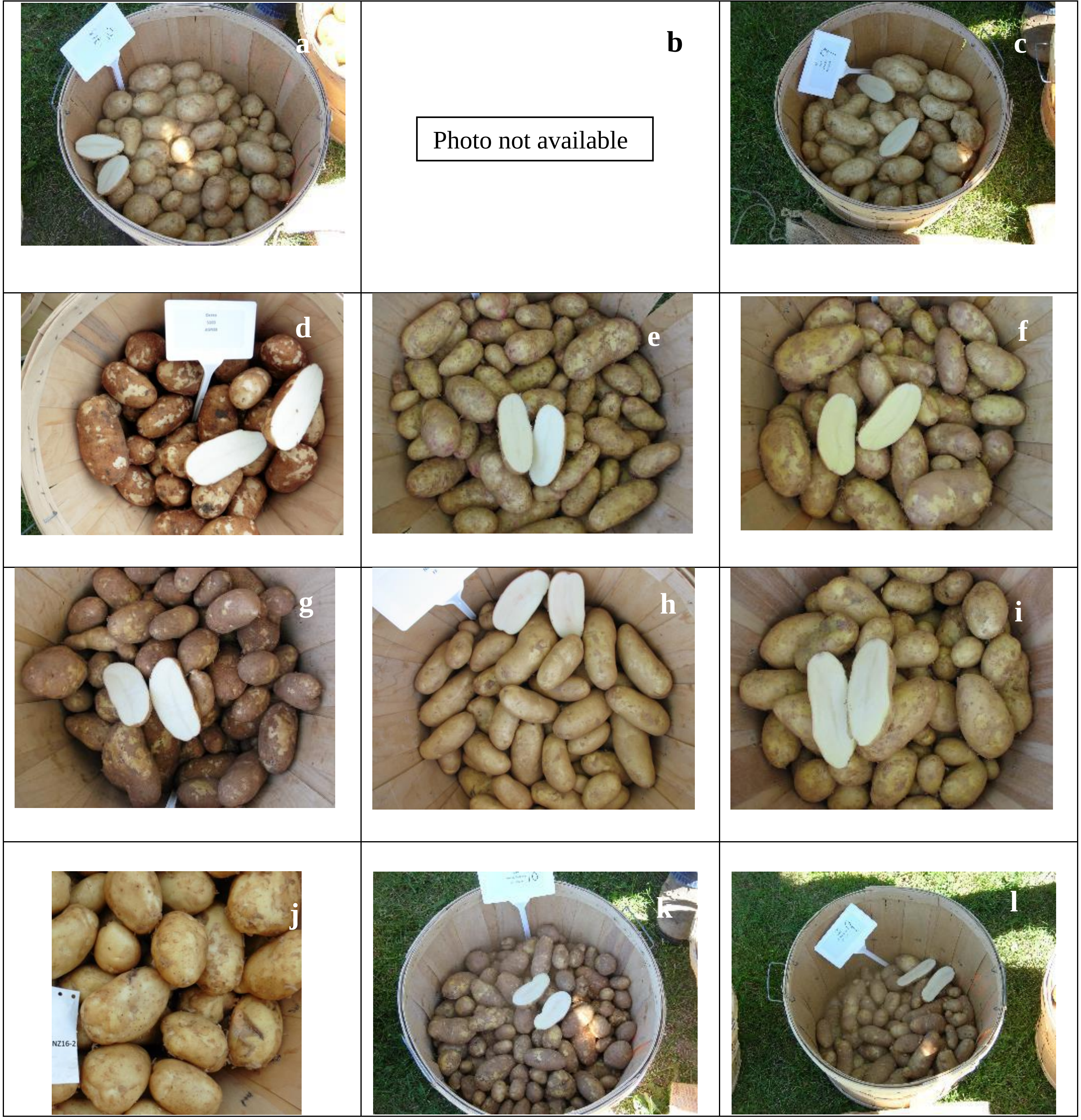


Figure 2. French fry varieties at CDCS field day August 16, 2016: a) NZ16-3, b) NZ16-4, c) Shepody, d) ASPI08, e) ASPI10, f) Basin Russet, g) Blazer Russet, h) NZ16-1, i) Bridget, j) NZ16-2, k) Russet Burbank, and l) California Russet Burbank.

Yield data (total yield and marketable yield; ton/ac), mean tubers size (oz.) and specific gravities of each of the French fry cultivars are shown in Table 2. Three cultivars were planted with little additional nitrogen and were harvested in August (Low N Early harvest). Of these early maturing cultivars, Shepody produced significantly greater yield, both total and marketable, than the other two cultivars. NZ16-3 produced tubers with a significantly smaller mean tuber size than NZ16-4 or Shepody. Specific gravities of NZ16-3 and Shepody were statistically higher than specific gravity of NZ16-4.

Another seven cultivars were planted in low N plots (138 lbs/ac) and were harvested in September (Low N – main harvest). Total yield ranged from 29.7 to 35.8 ton/ac, but there were no significant differences between cultivars for total yield (Table 2). Marketable yield of ASPI10, NZ16-1, Bridget and NZ16-2 were statistically greater than that of Russet Burbank. Nitrogen recommendations for Russet Burbank are typically much higher, so these results are not surprising. NZ16-2 produced tubers with a significantly greater mean tuber size than Russet Burbank, but not statistically greater than mean tuber size of Basin Russet or NZ16-1. Specific gravities ranged from 1.077 (slightly below the optimal range) for NZ16-2 to 1.097 (Above the optimal range) for NZ16-1. Specific gravities of ASPI10 and NZ16-1 were statistically greater than Russet Burbank.

Four cultivars were grown on a moderate level of N (168 lbs/ac) and harvested in September (Moderate N – main harvest). At this level of N, the total yield of Russet Burbank tubers was significantly more than ASPI08 and California Russet Burbank (Table 2). It should be noted that California Russet Burbank entered the trial as nuclear tubers so yield expectations were not the same as for other cultivars. Total yield of ASPI10 was not statistically different from that of Russet Burbank or ASPI08. Marketable yield of ASPI08, ASPI10 were not statistically different from marketable yield of Russet Burbank at this level of N. There were no statistical differenced in mean tuber size between cultivars grown at this level of N. Specific gravity of ASPI08 was significantly lower than that of Russet Burbank, while the specific gravity of ASPI10 was significantly higher than that of the other cultivars.

Two of the cultivars were grown at two levels of N. There were no statistical differences in total yield, marketable yield, mean tuber size or specific gravity between Russet Burbank grown at 138 lbs/ac N or 168 lbs/ac N. For ASPI10, though, a lower rate of N resulted in significantly higher marketable yield and significantly lower mean tuber yield than observed when grown in the presence of a moderate rate of N (Table 2).

Further addressing the agronomic needs of each variety may well result in improvements to yield and size profiles when compared to the results in this trial.

Table 2: Estimated total yield (ton/acre), marketable yield (ton/ac), mean tuber size (oz.) and specific gravity for each French fry variety grown on approximately 168 lbs/ac nitrogen (Moderate N) and 138 lbs/ac nitrogen (Low N). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the $p < 0.05$ level.

CDCS	Yield (ton/ac)	Marketable Yield	Mean Tuber Size	SG
Low N – early harvest				
NZ16-3	18.8 b	12.0 c	5.6 b	1.079 a
NZ16-4	22.0 b	20.3 b	6.6 a	1.066 b
Shepody	27.8 a	26.5 a	6.9 a	1.075 a
Low N – main harvest				
ASPI10	34.7 a	29.4 aǂ	7.7 dǂ	1.096 ab
Basin Russet	31.3 a	26.6 abc	9.7 ab	1.083 cd
Blazer Russet	29.7 a	22.7 bc	8.3 cd	1.078 d
NZ16-1	33.0 a	29.7 a	9.6 abc	1.097 a
Bridget	35.8 a	27.9 ab	7.4 d	1.089 bc
NZ16-2	31.7 a	28.5 ab	10.2 a	1.077 d
Russet Burbank	33.4 a	21.6 c	8.5 bcd	1.084 cd
Moderate N – main harvest				
ASPI08	26.4 bc	18.5 ab	6.9 a	1.080 c
ASPI10	31.7 ab	24.8 aǂ	8.2 aǂ	1.100 a
California Russet Burbank	22.9 c	15.0 b	8.0 a	1.084 bc
Russet Burbank	35.2 a	22.9 a	6.7 a	1.089 b

ǂ Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.

The mean percentage of total tuber number in each size category is shown in Table 3. For cultivars harvested from low N plots in August, NZ16-3 produced a significantly higher percentage of small tubers (< 4 oz) and a significantly lower percentage of tubers in the 6 to 10 oz. range compared to NZ16-4 and Shepody. NZ16-3 may require a longer growing season or even lower level of N to shift the size profile.

For varieties grown on low N (138 lbs/ac) and harvested in September, Basin Russet, NZ16-2 and NZ16-1 produced a significantly higher percentage of large tubers (> 10 oz) compared to the standard and other entries (Table 3). ASPI10, Blazer Russet, and Bridget produced size profiles similar to that of Russet Burbank with a smaller percentage of deformed tubers.

On moderate N, ASPI10 produced a significantly greater percentage of tubers in the 6 to 10 oz range compared to other cultivars and a significantly lower percentage of deformed tubers (Table 3).

There were no significant differences in the percentage of tubers in each size category for Russet Burbank grown on low N compared to moderate N (Table 3). Nitrogen had a greater impact on the size distribution for ASPI10. ASPI10 grown on moderate N produced significantly higher percentage of small tubers and significantly lower percentage of tubers in the over 10 oz. category than when grown on low N. These results suggest that ASPI10 may have better nitrogen use efficiency than Russet Burbank and may be suitable for low input production.

Table 3: Percentage of total tuber number in each size category (< 4 oz, 4 to 6 oz, 6 to 10 oz, > 10 oz, and deformed) for each French fry variety grown on moderate nitrogen (approximately 168 lbs/ac) and 138 lbs/ac nitrogen (Low N). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the $p < 0.05$ level.

CDCS	< 4 oz	4 to 6 oz	6 to 10 oz	> 10 oz	Deformed
Low N – early harvest					
NZ16-3	47.6 a	30.6 a	18.4 b	2.9 b	0.5 a
NZ16-4	23.5 b	25.2 a	41.0 a	9.8 ab	0.5 a
Shepody	20.7 b	24.0 a	39.6 a	14.9 a	0.8 a
Low N – main harvest					
ASPI10	14.1 bǂ	19.5 ab	37.3 a	28.0 bǂ	1.1 b
Basin Russet	7.9 c	9.1 c	30.1 ab	46.1 a	6.8 b
Blazer Russet	17.6 ab	15.4 bc	28.4 ab	32.8 b	5.9 b
NZ16-1	7.6 c	10.9 c	28.1 ab	50.9 a	2.4 b
Bridget	21.2 a	23.0 a	30.6 ab	24.5 b	0.8 b
NZ16-2	8.4 c	10.8 c	24.3 b	54.9 a	1.6 b
Russet Burbank	17.6 ab	12.6 c	23.0 b	28.9 b	17.8 a
Moderate N – main harvest					
ASPI08	20.4 a	17.5 ab	23.9 b	28.6 a	9.6 ab
ASPI10	19.8 aǂ	22.1 a	39.1 a	16.9 aǂ	2.0 b
California Russet Burbank	13.3 a	12.1 b	23.6 b	30.0 a	22.1 a
Russet Burbank	15.9 a	14.7 b	24.4 b	25.9 a	19.1 a

ǂ Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.

The yield of tubers (estimated ton/ac) of each variety is shown by size category in Table 4. The size profile of Shepody was not statistically different from that of NZ16-4 grown on low N. NZ16-3 had a significantly greater yield of tubers under 4 oz and a significantly lower yield of tubers in the 6 to 10 and over 10 oz. categories than NZ16-4 or Shepody.

For varieties grown on low N and harvested in September, ASPI10 yielded significantly more tubers in the 6 to 10 oz category than Russet Burbank Table 4). Basin Russet, NZ16-1 and NZ16-2 yielded significantly more tubers over 10 oz. than Russet Burbank, which may suggest that an earlier harvest is feasible for these varieties.

At the moderate level of N, ASPI10 yielded significantly more 6 to 10 oz. tubers than Russet Burbank, while other cultivars were not statistically different from Russet Burbank (Table 4).

There were no significant differences in the yield of tubers in each size category for Russet Burbank grown on low N compared to moderate N (Table 3). Nitrogen had a greater impact on the size distribution for ASPI10. A significantly greater yield of tubers over 10 oz. was observed when ASPI10 was grown on low N compared to moderate N. These results suggest that ASPI10 may have better nitrogen use efficiency than Russet Burbank and may be suitable for low input production.

Table 4: Estimated yield (ton/ac) in each size category (< 4 oz, 4 to 6 oz, 6 to 10 oz, > 10 oz, and deformed) for each French fry variety grown on moderate nitrogen (approximately 168 lbs/ac) and at a lower rate of N (138 lbs/ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the $p < 0.05$ level.

CDCS	< 4 oz	4 to 6 oz	6 to 10 oz	> 10 oz	Deformed
Low N – early harvest					
NZ16-3	8.9 a	5.8 a	3.8 b	0.6 b	0.1 a
NZ16-4	5.2 b	5.5 a	9.0 a	2.2 ab	0.1 a
Shepody	5.7 b	6.7 a	11.0 a	4.2 a	0.2 a
Low N – main harvest					
ASPI10	4.9 b	6.8 ab	13.0 a	9.6 bǂ	0.4 b
Basin Russet	2.5 c	2.9 c	9.4 ab	14.4 a	2.2 b
Blazer Russet	5.2 b	4.5 bc	8.4 b	9.8 b	1.8 b
NZ16-1	2.5 c	3.6 c	9.2 ab	16.8 a	0.8 b
Bridget	7.6 a	8.3 a	10.9 ab	8.7 b	0.3 b
NZ16-2	2.7 c	3.4 c	7.8 b	17.3 a	0.5 b
Russet Burbank	5.9 ab	4.2 c	7.7 b	9.6 b	5.9 a
Moderate N – main harvest					
ASPI08	5.3 a	4.5 b	6.3 b	7.6 a	2.5 bc
ASPI10	6.3 a	7.0 a	12.4 a	5.4 aǂ	0.6 c
California Russet Burbank	3.0 b	2.7 c	5.4 b	6.9 a	5.0 ab
Russet Burbank	5.6 a	5.1 b	8.6 b	9.1 a	6.8 a

ǂ Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.

Tuber samples used to measure specific gravity were evaluated for hollow heart, brown center, stem-end discoloration, other types of internal necrosis, scab and black scurf. At the low rate of N, very few tubers exhibited hollow heart or brown center. Some of the samples, NZ16-2, Bridget and Blazer Russet in particular, had some level of stem-end discoloration or vascular discoloration but tubers were not tested for wilt organisms. Some level of black scurf was noted for a few potatoes from each cultivar, but no seed treatment was used in the trial. Common scab was noted on isolated tubers from one replicate of Blazer Russet. At the moderate rate of N, brown center was observed in approximately 9% of tubers. All of the samples had some level of stem-end discoloration or vascular discoloration but tubers were not tested for wilt organisms. A low level of black scurf was noted on a few potatoes from each cultivar, but no seed treatment was used in the trial.

French fry colour scores of composite samples are presented in Table 5. All of the samples gave excellent French fry scores in 2016, with many scoring 0's or 00's on the USDA color chart. A higher overall score indicates better French fry quality, taking into account the fry colour compared to a USDA color chart, texture and colour uniformity. Overall, the highest score was observed for ASPI10 grown on moderate N. In the early harvested samples, NZ16-4 had the best overall score (Table 5). Basin Russet and Russet Burbank scored highest among the cultivars grown on low N and harvested in September. For the moderate N samples, ASPI08 and AR2015 scored better than Russet Burbank.

Table 5: Fry colour scores from subsamples of each variety grown at moderate nitrogen (approximately 168 lbs/ac) and at a lower rate of N (138 lbs/ac). Fry Colour was assessed visually by comparison with a USDA fry colour chart and converted to a scale of 1 to 7 (000 = 7 and 4 = 1; the higher the number, the better the fry colour). Data shown is the result of one composite sample run in duplicate.

CDCS	External Colour[1]	Internal Texture[2]	Colour Uniformity[3]	Total Score
Low N – early harvest				
NZ16-3	4	3	3	10
NZ16-4	6	3	4	13
Shepody	3	3	3	9
Low N – main harvest				
ASPI10	6	3	3	12
Basin Russet	6	4	3	14
Blazer Russet	4	4	3	11
NZ16-1	5	4	3	12
Bridget	6	2	3	11
NZ16-2	6	3	3	12
Russet Burbank	5	4	4	13
Moderate N – main harvest				
ASPI08	5	4	4	13
ASPI10	**6**	**4**	**5**	**15**
California Russet Burbank	4	3	3	10
Russet Burbank	4	4	3	11

[1] External Colour was assessed visually and compared with a USDA Color Chart (000 to 4; the lower the score, the better the fry colour); these scores were converted to a scale of 1 to 7 where higher scores are lighter fries.

[2] Internal texture: 1 (wet) - 4 (mealy)

[3] Color uniformity: 1 (very variable) - 5 (very uniform)

Conclusions

The 2016 variety trial included 12 French fry potato cultivars with potential in southern Alberta. Shepody was included in the trial as a check variety for early harvested cultivars grown on low N and Russet Burbank was included as a full-season standard at both rates of N. Shepody performed best as an early cultivar in this trial, possibly because different levels of N are required for NZ16-3 and NZ16-4. Fry color of all of the early harvested material was very good in spite of specific gravity scores lower than the desired range.

At a low level of N and a full-season, few differences were observed between cultivars for total yield, however most cultivars produced higher yields of marketable tubers than Russet Burbank at this level of N. When tubers were graded into size categories, differences in size profiles became evident. Preferences for yield in specific size categories vary between processors, and several of the cultivars in the 2016 study look promising and may be more efficient at utilizing nitrogen than Russet Burbank. Fry colour was impressive for most of these varieties as well, especially Basin Russet.

Russet Burbank performed well when grown at a moderate level of N and harvested in September, and ASPI10 produced comparable yields. Fry colour for ASPI10 was superior to Russet Burbank at this level of N. ASPI10 responded positively to a lower level of N and may be more a more efficient user of nitrogen than Russet Burbank.

The trial was designed to provide regional data for a wide range of potato cultivars. Addressing the agronomic needs of each variety may well result in improvements to yield and size profiles when compared to the results in this year of the trial.

Recommendations

- Varieties should be grown in southern Alberta for at least 3 years and these results need to be compiled to ensure a reasonable evaluation.
- To establish better estimates of yield potential and size profile for the varieties, each variety should be grown under optimal agronomic conditions (fertility, plant density, etc.).

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Alberta Seed Producers Inc.
ConAgra Foods, Lamb Weston Division
Edmonton Potato Growers
Little Potato Company
Old Dutch Foods
New Zealand Institute of Plants and Food Research
Parkland Seed Potatoes
Prairie Gold Produce
Rockyview Seed Potatoes
Solanum International Inc.
Tuberosum Technologies Inc.

Contact Information:

Michele Konschuh, Ph.D.
Potato Research Scientist
Alberta Agriculture and Forestry, CDCS
301 Horticultural Station Road East
Brooks, AB T1R 1E6

403-362-1314 phone
403-362-1306 fax

Michele.Konschuh@gov.ab.ca

Appendix A Plot Plan

Low N Variety Trial 2016 - Full Season (

20 Seed pieces per row

24 X 85 = 2040 m2

Planted May 11

→ **N**

Guard = Russet Burbank

24	**Guard**		**Guard**	**Guard**	**Guard**	**Guard**		**Guard**		**Guard**		**Guard**		**Guard**
23	1001 EPG015		1011 Red Snapper	1021 Yukon Gold	2001 Norland	2011 ASPI010		2021 NZ16-1		5001 ODF007		1031 SM08-83-01R		2031 Rosa Gold
22	1002 Bridget		1012 Guard	1022 EPG018	2002 AC Vigor	2012 Kennebec		2022 ASPI011		5002 Monticello		1032 RV010		2032 Anouk
21	1003 Gourmandine		1013 ASPI010	1023 AC Hamer	2003 EPG015	2013 NZ16-2		2023 Bridget		5003 AC Vigor		1033 AC Hamer		2033 Athlete
20	1004 ODF008		1014 EPG013	1024 Rosa Gold	2004 Roko	2014 Krone		2024 Bridget		5004 ODF008		1034 Athlete		2034 Gourmandine
19	1005 ASPI011		1015 Basin Russet	1025 NZ16-1	2005 RV011	2015 Red Snapper		2025 Birgit		5005 ASPI011		1035 PR07-55-1		2035 AC Hamer
18	1006 Blazer Russet		1016 Russet Burbank	1026 ODF007	2006 EPG018	2016 RV009		2026 Russet Burbank		5006 EPG013		1036 Gourmandine		2036 SM08-83-01R
17	1007 Birgit		1017 Monticello	1027 Roko	2007 EPG013	2017 AC Hamer		2027 ODF007		5007 EPG015		1037 Rosa Gold		2037 RV010
16	1008 RV009		1018 RV011	1028 Kennebec	2008 Guard	2018 Yukon Gold		2028 Monticello		5008 ASPI010		1038 Red Snapper		2038 PR07-55-1
15	1009 AC Vigor		1019 NZ16-2		2009 Gourmandine	2019 Rosa Gold				5009 Guard		1039 Anouk		2039 Red Snapper
14	1010 Krone		1020 Norland		2010 Blazer Russet	2020 ODF008				5010 Atlantic				
13	**Guard**	3 m	**Guard**	**Guard**	**Guard**	**Guard**		**Guard**	3m	**Guard**	5m	**Guard**	3m	**Guard**
	6m							6m		6m		5m		5m
12	**Guard**		**Guard**	**Guard**	**Guard**	**Guard**		**Guard**		**Guard**		**Guard**		**Guard**
11	3001 AC Hamer		3011 Norland	3021 Rosa Gold	4001 ASPI011	4011 Krone		4021 ASPI010		5011 EPG018		3031 RV010		4031 Athlete
10	3002 Red Snapper		3012 NZ16-2	3022 Krone	4002 ODF007	4012 RV011		4022 EPG013				3032 SM08-83-01R		4032 Red Snapper
9	3003 Basin Russet		3013 Russet Burbank	3023 NZ16-1	4003 Guard	4013 EPG018		4023 Yukon Gold				3033 Gourmandine		4033 PR07-55-1
8	3004 ODF007		3014 ODF008	3024 EPG015	4004 Gourmandine	4014 Birgit		4024 Kennebec				3034 Rosa Gold		4034 Anouk
7	3005 Yukon Gold		3015 RV009	3025 RV011	4005 NZ16-1	4015 Monticello		4025 Rosa Gold				3035 PR07-55-1		4035 Gourmandine
6	3006 ASPI010		3016 Blazer Russet	3026 EPG013	4006 AC Vigor	4016 Norland		4026 RV009				3036 Red Snapper		4036 SM08-83-01R
5	3007 Bridget		3017 EPG018	3027 Monticello	4007 Basin Russet	4017 AC Hamer		4027 EPG015				3037 Anouk		4037 AC Hamer
4	3008 Gourmandine		3018 Roko	3028 Birgit	4008 ODF008	4018 Russet Burbank		4028 Red Snapper				3038 Athlete		4038 RV010
3	3009 Guard		3019 Kennebec		4009 NZ16-2	4019 Blazer Russet						3039 AC Hamer		4039 Rosa Gold
2	3010 ASPI011		3020 AC Vigor		4010 Roko	4020 Bridget								
1	**Guard**	3 m	**Guard**	**Guard**	**Guard**	**Guard**	**10 m**	**Guard**	3m	**Guard**		**Guard**		**Guard**
	6m													

Variety Medium N Brooks - 2016 - Ful

Planted May 16

20 Seed pieces per row

→ N

24 x 85m = 2040m2

	12" spacing											ODF Extra
24	**Guard**		**Guard**	**Guard**	**Guard**	**Guard**		**Guard**		**Guard**	**Guard**	
23	1001 ASPI010		1011 ASPI011	1021 EPG015	1031 Barcelona	2001 ASPI010		2011 TT16-5		2021 TT16-3	2031 TT16-9	5001 AC Vigor
22	1002 TT16-4		1012 TT16-9	1022 Norland	1032 TT16-1	2002 TT16-4		2012 PGP03		2022 ASPI012	2032 TT16-10	5002 EPG018
21	1003 Birgit		1013 EPG017	1023 Yukon Gold	1033 ODF007	2003 Birgit		2013 ASPI011		2023 Blazer Russet	2033 ASPI013	5003 EPG013
20	1004 PGP03		1014 Russet Burbank	1024 TT16-3	1034 California RB	2004 ODF008		2014 ODF007		2024 Kennebec	2034 EPG013	5004 ODF008
19	1005 TT16-8		1015 EPG018	1025 Blazer Russet	1035 EPG016	2005 EPG017		2015 TT16-8		2025 Norland	2035 RV009	5005 Burbank
18	1006 Monticello		1016 RV010	1026 Kennebec	1036 RV009	2006 EPG015		2016 Yukon Gold		2026 TT16-7	2036 AC Vigor	5006 ASPI011
17	1007 ASPI013		1017 ASPI008	1027 TT16-2	1037 ASPI012	2007 Monticello		2017 EPG016		2027 ASPI014	2037 Russet Burbank	5007 ODF007
16	1008 TT16-5		1018 Atlantic	1028 AC Vigor	1038 ODF008	2008 Queen Anne		2018 EPG018		2028 RV011	2038 RV010	5008 EPG015
15	1009 ASPI014		1019 RV011	1029 EPG013	1039 TT16-6	2009 Atlantic		2019 ASPI008		2029 California RB	2039 TT16-1	5009 Atlantic
14	1010 TT16-7		1020 TT16-10	1030 Queen Anne		2010 Barcelona		2020 TT16-6		2030 TT16-2		5010 Monticello
13	**Guard**	3 m	**Guard**	**Guard**	**Guard**	**Guard**	**10m**	**Guard**		**Guard**	**Guard**	
	6m											

12	**Guard**		**Guard**	**Guard**	**Guard**	**Guard**		**Guard**		**Guard**	**Guard**	
11	3001 RV010		3011 Russet Burbank	3021 Yukon Gold	3031 Queen Anne	4001 EPG013		4011 TT16-8		4021 TT16-2	4031 TT16-5	5011 California RB
10	3002 Birgit		3012 TT16-9	3022 Norland	3032 Monticello	4002 ASPI012		4012 TT16-10		4022 RV009	4032 AC Vigor	
9	3003 ASPI010		3013 TT16-2	3023 TT16-8	3033 EPG015	4003 Queen Anne		4013 California RB		4023 TT16-6	4033 Barcelona	
8	3004 Blazer Russet		3014 TT16-5	3024 ASPI008	3034 Kennebec	4004 ASPI013		4014 TT16-9		4024 ODF008	4034 TT16-4	
5	3007 ASPI014		3017 TT16-6	3027 TT16-1	3037 PGP03	4007 Kennebec		4017 ASPI010		4027 ODF007	4037 ASPI008	
6	3006 ASPI011		3016 TT16-7	3026 EPG013	3036 Barcelona	4006 Norland		4016 RV010		4026 Atlantic	4036 Birgit	
7	3005 EPG018		3015 Atlantic	3025 ASPI012	3035 RV009	4005 Yukon Gold		4015 TT16-7		4025 EPG016	4035 Monticello	
4	3008 AC Vigor		3018 TT16-3	3028 TT16-4	3038 California RB	4008 EPG018		4018 PGP03		4028 TT16-3	4038 EPG017	
3	3009 TT16-10		3019 EPG016	3029 ODF008	3039 ASPI013	4009 TT16-1		4019 Russet Burbank		4029 ASPI011	4039 ASPI014	
2	3010 Russet Burbank		3020 ODF007	3030 RV011		4010 Blazer Russet		4020 RV011		4030 EPG015		
1	**Guard**	3 m	**Guard**	**Guard**	**Guard**	**Guard**		**Guard**	8m	**Guard**	**Guard**	
	6m											

Project Report

Alberta Potato Variety Development 2016
CDCS, Brooks, AB

Fresh Market Potatoes

Prepared for:
Various Sponsors

Prepared by:

Michele Konschuh
Alberta Agriculture and Forestry
Crop Diversification Centre South
301 Horticultural Station Road East
Brooks, AB   T1R 1E6

February 8, 2017

Introduction

In Alberta, potato industry stakeholders are looking for replacement varieties that use less nitrogen, less water, less pesticide, yet yield superior processing or culinary quality and tonnage. An ideal fresh market variety would produce a good yield of medium sized tubers, be relatively tolerant of environmental fluctuations, have few defects, and have an attractive appearance. Tubers with a good skin set that store well are very desirable. Varieties from breeding programs in Canada, Europe and the United States are often being assessed. Many breeding programs target disease resistance, nitrogen use efficiency and excellent storage potential in addition to increased yield. Tuber yield potential and nutritional requirements are impacted by variety characteristics and by environmental characteristics such as the length of the growing season (Westerman, 1993). As noted by Love et al. (2003), the full potential of a new variety may not be realized until proper management is implemented. There is increasing pressure on potato producers to utilize best management practices to reduce the environmental footprint for potatoes. The costs of such shifts in production practices will be borne primarily by producers.

The purpose of this project was to pool resources to evaluate potential varieties from a range of sources, using a cooperative approach. This trial was established to collect local agronomic data on varieties from breeding programs in Canada, the U.S. and elsewhere. The varieties were planted in replicated plots at the Crop Diversification Centre in Brooks, AB and were provided with 168 lbs/ac N and, if requested, 138 lbs/ac N. Alberta data is essential when selecting varieties appropriate for our climate, our customers and industry stakeholders.

Objectives

A. To evaluate potential new varieties for fresh market processing;
B. To provide the potato industry an opportunity to assess varieties grown under local conditions;
C. To compare varieties from several breeding programs (including AAFC) under Alberta conditions; and
D. To determine the response of new fresh market varieties to nitrogen fertilizer rates.

Materials and Methods

The variety evaluation was conducted in small plots at the Crop Diversification Centre South in Brooks, AB. Fertility for the low N plots (138 lbs/ac) was achieved through a combination of soil fertility (128 lbs/ac N; 499 lbs/ac P) and broadcast fertilizer (90 lbs/ac of 11-52-0) incorporated prior to planting. Moderate N plots received an additional top-dressing (65 lbs/ac of 46-0-0) at hilling, for a total of 168 lbs/ac N. Within each level of fertility, varieties were planted in four replicate rows in a randomized complete block design along with standard varieties (Atlantic, AC Vigor and Monticello). Each block was planted adjacent to guard rows to reduce any edge effects (see plot plan, Appendix A).

Sencor 75DF (150 g/ac) and Eptam 8E (1.8 L/ac) were applied prior to planting (May 4) to control weeds. Seed of standard cultivars was provided by Edmonton Potato Growers and Rockyview Seed Potatoes and seed of test cultivars was provided by each participant. Potatoes were planted May 10 (Low N Early) May 12, 2016 (Low N Main) and May 16, 2016 (Moderate N Main) approximately 12 to 15cm deep using a two-row tuber unit planter. Seed was planted at 30cm spacing in 6m rows spaced 90cm apart. The plots were irrigated to maintain soil moisture close to 70%. Foliar fungicides were applied several times during the growing season to prevent early and late blight from developing (Table 1).

Table 1: Foliar fungicides applied to the potato crop in 2016 to prevent early and late blight development.

Date of Application	*Fungicide*	*Rate*
28 June	Bravo	0.64 L/ac
27 July	Ridomil Gold/Bravo	0.83L/ac
5 Aug	Bravo	0.64 L/ac
20 Aug	Dithane DG	0.91 kg/ac

Figure 1: Variety evaluation trial at CDCS in Brooks, AB Aug 05, 2016.

Reglone was applied (1.0 L/ac) July 29 to the early harvest Low N plots and September 6 for main harvest plots. The Low N early plots were harvested August 18, 2016; the Low N Main plots were harvested September 22 to 27, 2016 and moderate N plots were harvested September 27 to 29 using a 1-row Grimme harvester.

Fresh market tubers were stored at 8˚C until graded. Tubers were graded into size categories (less than 48mm, 48 to 88mm, over 88mm and deformed). A sample of twenty-five tubers (48 to 88mm) from each replicate was used to determine specific gravity using the weight in air over weight in water method. These tubers were cut longitudinally to assess internal defects. A composite sample of 16 tubers (4 per rep) was stored at 8˚C until culinary analyses were performed. Samples were evaluated for bake and boil by the Food Science and Technology Centre, Brooks, in November 2016.

The data presented here have been statistically analyzed using ANOVA and Tukey's Multiple Comparison Test; (SPSS; $p \leq 0.05$). Statistical summaries are available upon request. T-tests were used to compare results for varieties grown at different levels of N.

Results and Discussion – Fresh Market

Sample hills of each yellow or white variety were dug for a field day at CDCS August 16, 2016. Photos of these varieties are shown in Figure 2.

		
		
		
		

Figure 2. Fresh market yellow or white varieties at CDCS field day August 16, 2016: a) Arizona, b) AC Hamer, c) ASPI 12, d) Barcelona, e) Blazer Russet, f) Citadel, g) Gourmandine, h) Kennebec, i) Krone, j) PGP03, k) RV009, l) RV010, m) Queen Anne, n) RV011, o) TT16-1, p) TT16-2, q) TT16-3, r) TT16-4, s) TT16-5, t) TT16-6, u) TT16-7, v) Volare, and w) Yukon Gold.

Sample hills of each red-skinned variety were dug for a field day at CDCS August 16, 2016. Photos of these varieties are shown in Figure 3.

Figure 3. Fresh market red-skinned varieties at CDCS field day August 16, 2016: a) ASPI 13, b) ASPI 14, c) EPG016, d) EPG017, e) Birgit, f) Norland, g) Red Snapper, h) Roko, i) Rosa Gold, j) TT16-8, k) TT16-9, and l) TT16-10.

Yield data (total yield; ton/ac) and specific gravities of each of the yellow and white fresh market cultivars are shown in Table 2. Five cultivars were planted with little additional nitrogen and were harvested in August (Low N Early harvest). Of these early maturing cultivars, Volare produced significantly greater total yield than the other cultivars, an indication that this cultivar is an efficient nitrogen utilizer. There were statistical differences in specific gravity between cutlivars with Volare and Arizona on the low end and Yukon Gold on the upper end.

Another seven cultivars were planted in low N plots (138 lbs/ac) and were harvested in September (Low N – main harvest). Total yield ranged from 27.8ton/ac for AC Hamer to 39.9 for Krone (Table 2). Specific gravities ranged from 1.076 for RV011 to 1.088 for RV009 and Yukon Gold.

Seventeen cultivars were grown on a moderate level of N (168 lbs/ac) and harvested in September (Moderate N – main harvest). At this level of N, the total yield ranged from 24.8 ton/ac for Yukon Gold to 45.9 ton/ac for Barcelona, although total yield is not always a good predictor of good marketable yield. Specific gravity of ASPI08 was significantly lower than that of Russet Burbank, while the specific gravity of ASPI10 was these cultivars ranged from 1.070 for Queen Anne to 1.094 for TT16-4.

Kennebec and Yukon Gold were grown at two levels of N and harvested at two different times. Kennebec and Yukon Gold both yielded better when grown at low N full season than when harvested early. Specific gravity of Yukon Gold was higher when harvested later, but the SG of Kennebec was not statistically different between harvest dates. Yukon Gold yielded better when grown full season on low N than when grown on moderate N for full season. Yield of Kennebec was not statistically different between the two levels of N, so 138 lbs/ac N was sufficient. RV011 and RV009 were also grown at two levels of N. Neither of these cultivars benefited from the additional N, so 138 lbs/ac N seemed sufficient for these cultivars as well (Table 2).

Further addressing the agronomic needs of each variety may well result in improvements to yield and size profiles when compared to the results in this trial.

Table 2: Estimated total yield (ton/acre) and specific gravity for each yellow or white fresh market variety grown on approximately 168 lbs/ac nitrogen (Moderate N) and 138 lbs/ac nitrogen (Low N). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

CDCS	Yield (ton/ac)	SG
Low N – early harvest		
Arizona	37.7 b	1.053 c
Citadel	21.2 d	1.064 b
Kennebec	26.6 c¥	1.072 a
Volare	50.3 a	1.051 c
Yukon Gold	24.8 cd¥	1.078 a¥
Low N – main harvest		
AC Hamer	27.8 c	1.083 abc
Gourmandine	39.8 ab	1.079 bc
Kennebec	36.9 ab¥	1.079 bc
Krone	39.9 ab	1.079 bc
RV009	40.5 a	1.088 a
RV011	36.1 ab	1.076 c
Yukon Gold	28.3 c¥ǂ	1.088 a¥
Moderate N – main harvest		
ASPI 12	25.6 ef	1.088 a-d
Barcelona	45.9 a	1.071 g-k
Blazer Russet	29.5 c-f	1.084 a-f
Kennebec	32.2 b-f	1.082 b-g
PGP03	28.4 def	1.077 d-i
RV009	36.0 bcd	1.089 a-c
RV010	37.7 bc	1.071 g-k
Queen Anne	37.1 bc	1.070 h-k
RV011	35.3 bcd	1.073 g-k
TT16-1	38.7 b	1.0788 c-h
TT16-2	34.8 bcd	1.079 c-h
TT16-3	37.5 bc	1.086 a-e
TT16-4	35.4 bcd	1.094 a
TT16-5	33.4 b-e	1.079 c-h
TT16-6	37.1 bc	1.071 g-k
TT16-7	33.1 b-e	1.079 c-h
Yukon Gold	24.8 eǂ	1.088 ab

ǂ Data between the regular and low N plots was statistically different at the p ≤ 0.05 level.
¥ Data between the early and main harvest plots was statistically different at the p ≤ 0.05 level.

Yield data (total yield; ton/ac) and specific gravities of each of the red-skinned fresh market cultivars are shown in Table 3. Five cultivars were planted in low N plots (138 lbs/ac) and were harvested in September (Low N – main harvest). Total yield ranged from 28.0 ton/ac for Red Snapper to 40.7 for Birgit (Table 3). Specific gravities ranged from 1.065 for Norland to 1.091 for Red Snapper and Roko.

Nine cultivars were grown on a moderate level of N (168 lbs/ac) and harvested in September (Moderate N – main harvest). At this level of N, the total yield ranged from 28.1 ton/ac for EPG017 to 39.2 ton/ac for TT16-9. Specific gravities ranged from 1.061 for EPG016 to 1.092 for TT16-10.

Norland and Birgit were grown at both levels of N. Yield of these two cultivars was not statistically different between the different levels of N. Specific gravity of Birgit was significantly higher when grown on low N compared to the moderate level of N. The specific gravity of Norland tubers was unaffected by the level of N.

Table 3: Estimated total yield (ton/acre) and specific gravity for each red-skinned fresh market variety grown on approximately 168 lbs/ac nitrogen (Moderate N) and 138 lbs/ac nitrogen (Low N). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the $p < 0.05$ level.

CDCS	Yield (ton/ac)	SG
Low N – main harvest		
Birgit	40.7 a	1.085 abǂ
Norland	35.2 ab	1.065 d
Red Snapper	28.0 c	1.091 a
Roko	40.0 ab	1.091 a
Rosa Gold	33.4 bc	1.090 a
Moderate N – main harvest		
ASPI 13	28.5 b	1.075 e-i
ASPI 14	31.9 b	1.069 h-k
EPG016	31.5 b	1.061 k
EPG017	28.1 b	1.073 f-j
Birgit	37.2 ab	1.080 c-hǂ
Norland	31.4 b	1.066 ijk
TT16-8	34.6 b	1.063 jk
TT16-9	39.2 ab	1.079 c-h
TT16-10 (purple)	32.7 b	1.092 ab

ǂ Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.

The mean percentage of total tuber number in each size category for yellow and white cultivars is shown in Table 4. The five cultivars grown on low N and harvested in August, produced mostly small (<48mm) and marketable (48 to 88mm) tubers as expected. The percentage of Arizona and Volare tubers in various size categories were not statistically different from Yukon Gold. Citadel produced a significantly lower percentage of tubers 48 to 88 mm than Arizona and Yukon Gold, and a significantly higher percentage of tubers under 48mm than Arizona, Volare and Yukon Gold. Yukon Gold and Kennebec produced a significantly higher percentage of deformed tubers than the other cultivars grown in these plots.

Of the seven yellow and white cultivars grown on low N for the full season, RV011, RV009 (Table 4), Gourmandine and Krone produced a greater percentage of tubers under 48mm in diameter than Yukon Gold. Kennebec and Yukon Gold produced a significantly higher percentage of tubers over 88mm than other cultivars from the low N full season plots and significantly higher percentage of Jumbo (> 88mm) than the early harvested plots at the same level of N..

At a moderate level of N, most of the cultivars produced similar percentage by weight size categories (Table 4). One exception was that ASPI 12 produced a significantly higher percentage of tubers under 48mm than Yukon Gold, although neither were statistically different from other cultivars in the plots.

Kennebec, RV009, RV011 and Yukon Gold were grown at low and moderate N for the full season. The only statistical difference observed for these cultivars was that RV009 produced a significantly higher percentage of tubers over 88mm when grown at a moderate level of N than at the lower level of N (Table 4).

Table 4: Percentage of total tuber number in each size category (< 48mm, 48-88mm, > 88mm and deformed) for each fresh market yellow or white variety grown on moderate nitrogen (approximately 168 lbs/ac) and 138 lbs/ac nitrogen (Low N). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

CDCS	< 48 mm	48 – 88mm	> 88mm	Deformed
Low N – early harvest				
Arizona	34.0 bc	65.0ab	0.5 b	0.5 b
Citadel	49.0 a	50.8 c	0.0 b	0.2 b
Kennebec	41.5 ab	54.5 bc	0.5 b¥	3.3 a
Volare	24.0 c	72.0 a	3.5 a	0.3 b
Yukon Gold	30.3 bc	66.8 ab	1.2 b¥	2.3 a
Low N – main harvest				
AC Hamer	46.5 c-f	51.8 ab	0.5 b	1.0 bc
Gourmandine	53.5 cd	45.3 abc	0.5 b	7.5 c
Kennebec	33.3 f	53.3 abǂ	9.0 a¥	4.5 aǂ
Krone	49.8 cde	48.3 ab	0.3 b	1.8 bc
RV009	60.0 bc	40.0 bc	0.0 bǂ	0.3 c
RV011	68.8 bǂ	31.0 cǂ	0.0 b	0.0 c
Yukon Gold	32.0 f	59.0 a	7.3 a¥	2.0 bc
Moderate N – main harvest				
ASPI 12	60.5 a	36.8 a	0.5 c	2.3 a
Barcelona	31.3 ab	59.5 a	4.8 abc	4.3 a
Blazer Russet	47.3 ab	44.8 a	1.5 c	5.3 a
Kennebec	41.5 ab	45.8 aǂ	6.0 abc	6.8 aǂ
PGP03	47.5 ab	45.5 a	2.8 c	4.5 a
RV009	50.0 ab	47.3 a	0.8 cǂ	2.3 a
RV010	58.0 ab	39.0 a	0.8 c	2.3 a
Queen Anne	54.8 ab	43.0 a	0.3 c	2.0 a
RV011	51.3 abǂ	48.0 aǂ	0.0 c	0.5 a
TT16-1	38.5 ab	53.8 a	3.3 abc	1.3 a
TT16-2	34.8 ab	56.8 a	1.8 c	6.8 a
TT16-3	47.5 ab	48.5 a	2.0 c	2.0 a
TT16-4	34.0 ab	57.5 a	3.8 bc	4.5 a
TT16-5	45.0 ab	48.0 a	3.3 c	3.3 a
TT16-6	37.3 ab	46.0 a	11.3 ab	5.0 a
TT16-7	37.8 ab	43.8 a	12.3 a	5.5 a
Yukon Gold	29.3 b	57.0 a	7.8 abc	6.3 a

ǂ Data between the regular and low N plots was statistically different at the p ≤ 0.05 level.

¥ Data between the early and main harvest plots was statistically different at the p ≤ 0.05 level.

The mean percentage of total tuber number in each size category for red-skinned cultivars is shown in Table5. Red Snapper produced a significantly higher percentage of small (<48mm) tubers, an indication that it may be suitable for the creamer potato market.

At the moderate level of N, there were some statistical difference in the percentage of tubers over 88mm, but the percentage of tubers in other categories was not statistically different (Table 5).

Birgit and Norland were grown at both levels of N. There were no significant differences in the percentage of tubers in each size category as a result of the different N fertility for either variety (Table 5).

Table 5: Percentage of total tuber number in each size category (< 48mm, 48-88mm, > 88mm and deformed) for each fresh market red-skinned variety grown on moderate nitrogen (approximately 168 lbs/ac) and 138 lbs/ac nitrogen (Low N). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

CDCS	< 48 mm	49 – 88mm	> 88mm	Deformed
Low N – main harvest				
Birgit	44.8 def	52.8 ab	2.0 b	0.5 c
Norland	33.3 f	55.6 ab	8.3 a	3.0 ab
Red Snapper	92.0 a	7.8 d	0.0 b	0.3 c
Roko	37.0 ef	60.5 a	0.8 b	1.5 bc
Rosa Gold	44.5 def	53.8 ab	1.5 b	0.3 c
Moderate N – main harvest				
ASPI 13	44.5 ab	51.8 a	1.5 c	2.0 a
ASPI 14	37.0 ab	55.8 a	3.8 bc	3.8 a
EPG016	34.3 ab	55.5 a	7.0 abc	3.3 a
EPG017	53.3 ab	42.0 a	1.8 c	2.8 a
Birgit	35.5 ab	57.5 a	4.3 bc	2.8 a
Norland	37.0 ab	50.8 a	6.0 abc	6.3 a
TT16-8	41.8 ab	49.0 a	4.3 bc	5.0 a
TT16-9	33.3 ab	63.3 a	2.5 c	1.0 a
TT16-10 (purple)	31.5 ab	64.8 a	1.5 c	2.3 a

ǂ Data between the regular and low N plots was statistically different at the p ≤ 0.05 level.

The yield of tubers (estimated ton/ac) of each yellow or white variety is shown by size category in Table 6. There were significant differences in yield by size category between the five cultivars grown in the Low N plots and harvested in August. Citadel yielded significantly more tubers under 48mm in diameter than other cultivars in these plots. Volare yielded significantly more tubers 48 to 88mm and over 88mm than the other cultivars.

For varieties grown on low N and harvested in September, a significantly greater yield of tubers under 48mm for cultivars such as RV009 and RV011, suggest that these may be suitable for marketing in more than one size category. Yield of tubers 48 to 88mm ranged from 20 ton/ac for Yukon Gold to 28 ton/ac for Gourmandine (Table 6). Yield of marketable Gourmandine was significantly greater than that of Yukon Gold, AC Hamer and RV011, but not significantly different from the other cultivars. Kennebec produced significantly greater yield of tubers over 88mm than other cultivars in these plots and significantly greater yield compared to the early harvested Kennebec. Yukon Gold grown at low N did not yield significantly more from the September harvest than from the August harvest supporting our knowledge of it as an early cultivar.

Seventeen yellow or white cultivars were grown on moderate N and harvested in September. Yield of tubers under 48mm ranged from 1.3 ton/ac for Yukon Gold to 17.6 ton/ac of RV010 (Table 6). Cultivars such as RV010, Snajava and TT16-2 may be marketed in more than one size category. Yield of tubers 48 to 88mm ranged from 16.0 ton/ac for Yukon Gold to 31.3 ton/ac for Barcelona. TT16-6 yielded significantly more Jumbo (> 88mm) tubers than the other cultivars, followed by TT16-7, TT16-1 and Barcelona indicating that an earlier harvest of these cutlviars may be desirable.

Kennebec, RV009, RV011 and Yukon Gold were grown at both levels of N for main harvest. Kennebec and Yukon Gold yielded significantly more tubers 48 to 88mm when grown at the low N level than when grown on moderate N plots (Table 6). There were significantly more deformed Kennebec tubers produced in the moderate N plots than the low N plots. RV009 and RV011 produced significantly higher yields of tubers under 48mm when grown on low N compare to moderate N, but yield of 48 to 88mm tubers was not significantly affected by the N level.

Table 6: Estimated yield (ton/ac) in each size category (< 4 oz, 4 to 6 oz, 6 to 10 oz, > 10 oz, and deformed) for each fresh market yellow or white variety grown on moderate nitrogen (approximately 168 lbs/ac) and at a lower rate of N (138 lbs/ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the $p < 0.05$ level.

CDCS	< 48 mm	48 – 88mm	> 88mm	Deformed
Low N – early harvest				
Arizona	5.2 b	31.3 b	0.8 b	0.3 b
Citadel	7.6 a	13.5 d	0.0 b	0.1 b
Kennebec	4.2 bc	20.6 c	0.6 b¥	1.2 a
Volare	3.2 bc	42.2 a	4.8 a	0.2 b
Yukon Gold	2.1 c	21.1 c	0.7 b	0.9 a
Low N – main harvest				
AC Hamer	6.4 d	20.3 d	0.6 cd	0.5 a
Gourmandine	10.6 c	28.0 abc	0.7 cd	0.5 a
Kennebec	3.2 e	22.2 cdǂ	9.7 a¥	1.9 aǂ
Krone	10.7 c	27.4 abc	0.6 cd	1.2 a
RV009	15.4 bǂ	24.6 bcd	0.2 d	0.2 a
RV011	15.1 bǂ	20.9 d	0.1 d	0.0 a
Yukon Gold	2.2 e	20.0 dǂ	4.0 bc	2.2 a
Moderate N – main harvest				
ASPI 12	7.0 b-e	16.9 de	0.6 g	1.1 ab
Barcelona	3.2 de	31.3 a	8.8 bc	2.5 ab
Blazer Russet	4.8 b-e	21.5 b-e	1.3 fg	1.9 ab
Kennebec	3.5 cde	17.7 cdeǂ	7.6 c-f	3.3 abǂ
PGP03	7.2 b-e	19.0 cde	1.3 fg	1.0 ab
RV009	8.9 bcdǂ	25.2 a-e	0.7 g	1.2 ab
RV010	17.6 a	18.6 cde	0.4 g	1.1 ab
Queen Anne	8.3 bcd	27.1 abc	0.4 g	1.3 ab
RV011	10.8 bǂ	23.9 a-e	0.3 g	0.3 b
TT16-1	3.9 cde	26.0 a-d	8.1 bcd	0.7 ab
TT16-2	10.4 bc	19.1 cde	1.5 fg	3.8 a
TT16-3	3.8 cde	29.3 ab	3.1 d-g	1.3 ab
TT16-4	3.9 cde	23.4 a-e	5.6 b-g	2.5 ab
TT16-5	5.3 b-e	22.9 a-e	3.4 d-g	1.7 ab
TT16-6	2.7 de	17.7 cde	14.8 a	1.8 ab
TT16-7	3.2 de	17.6 cde	10.2 b	2.1 ab
Yukon Gold	1.3 e	16.0 eǂ	4.5 c-g	3.0 ab

ǂ Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.

¥ Data between the early and main harvest plots was statistically different at the $p \leq 0.05$ level.

Rds-skinned potatoes were grown on low N, moderate N or both and harvested in September. Yield results by size category are shown in Table 7. On low N, Red Snapper produced a significantly higher yield of tubers under 48mm than other cultivars and significantly lower yield of tubers 48 to 88mm in diameter. Marketable yield of other cultivars were not significantly different from one another at this level of N. Norland yielded significantly more Jumbo tubers than other cultivars supporting our knowledge of Norland as an early cultivar.

On moderate N, there were no significant differences in yield of tubers under 48mm, or 48 to 88mm in diameter (Table 7). Marketable tubers ranged from 19.4 ton/ac for EPG017 to 29.7 ton/ac for TT16-9. EPG016 produced the highest yield of Jumbo tubers, suggesting that an earlier harvest may have been desirable.

Birgit and Norland were grown at both level of N. On low N, Birgit produced a significantly greater yield of tubers under 48mm than when grown on moderate N (Table 7). Norland produced significantly more deformed tubers on moderate N than on low N, but there was no significant impact of N fertility on the yield in other size categories.

Table 7: Estimated yield (ton/ac) in each size category (< 4 oz, 4 to 6 oz, 6 to 10 oz, > 10 oz, and deformed) for each fresh market red-skinned variety grown on moderate nitrogen (approximately 168 lbs/ac) and at a lower rate of N (138 lbs/ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the $p < 0.05$ level.

CDCS	< 48 mm	48 – 88mm	> 88mm	Deformed
Low N – main harvest				
Birgit	7.5 dǂ	30.0 ab	2.8 cd	0.3 a
Norland	2.6 e	25.6 a-d	6.0 b	0.9 aǂ
Red Snapper	22.9 a	4.9 e	0.0 d	0.2 a
Roko	6.6 d	31.5 a	1.0 cd	0.9 a
Rosa Gold	6.5 d	25.0 a-d	1.7 cd	0.2 a
Moderate N – main harvest				
ASPI 13	4.6 b-e	20.5 b-e	2.5 efg	1.1 ab
ASPI 14	3.5 cde	23.3 a-e	3.6 d-g	0.9 ab
EPG016	3.0 de	21.5 b-e	6.2 b-f	1.5 ab
EPG017	6.3 b-e	19.4 cde	1.0 fg	0.8 ab
Birgit	5.1 b-eǂ	26.9 abc	4.2 c-g	1.4 ab
Norland	2.5 de	21.3 b-e	4.9 c-g	2.8 abǂ
TT16-8	5.0 b-e	23.9 a-e	3.0 efg	2.8 ab
TT16-9	4.3 b-e	29.7 ab	4.7 c-g	0.5 ab
TT16-10 (purple)	3.6 cde	27.3 abc	0.6 g	1.2 ab

Tuber samples used to measure specific gravity were evaluated for hollow heart, brown center, stem-end discoloration, other types of internal necrosis, scab and black scurf. For yellow and white cultivars grown on low N and harvested in August, very few tubers exhibited internal defects. One Yukon Gold tuber exhibited brown centre. Some tubers in each sample had a low level of stem-end discoloration or vascular discoloration, but tubers were not tested for wilt organisms. For tubers grown on low N and harvested in September, approximately 6% of Gourmandine tubers displayed brown centre. Gourmandine, Krone and Yukon Gold seemed to display more stem-end discoloration and vascular discoloration than other cultivars, but tubers were not tested for wilt organisms. At the moderate rate of N, brown center was observed in approximately 7% of TT16-2 tubers, 2% of TT16-6 tubers, 2% of Yukon Gold tubers and isolated tubers of Barcelona, PGP03, and TT16-4. Many of the samples had some level of stem-end discoloration or vascular discoloration but tubers were not tested for wilt organisms. TT16-10 and TT16-3 were more affected by vascular discoloration than other cultivars. A low level of black scurf was noted on a few potatoes from each cultivar, however no seed treatment was used in the trial.

For red-skinned cultivars grown on low N there was some level of stem-end discoloration or vascular discoloration in most cultivars, but TT16-8 and TT16-10 seemed more affected than others. At the moderate rate of N, Roko and Rosa Gold seemed to display more vascular discoloration than other red-skinned cultivars.

Subjective assessments of yellow and white tubers are shown in Table 8. For the early harvested trial on low N, Kennebec and Yukon Gold demonstrated significantly greater uniformity of size than Volare. Kennebec scored significantly higher than other cultivars for overall appearance at this level of N. There were no significant differences for these parameters when cultivars were grown on low N and harvested in September. There was no significant difference in the uniformity of tuber size when grown on moderate N. TT16-7 scored the lowest for overall appearance in these plots and RV011 scored the highest. Overall appearance of ASPI 12, Blazer Russet, PGP03, RV009, RV010, Queen Anne and TT16-1 were not significantly different from RV011 for overall appearance.

Table 8: Subjective tuber assessments for each fresh market yellow or white variety: Uniformity of Size was subjectively assessed on each replicate by the same individual during the grading process. Overall Appearance was based on uniformity of size and uniformity of shape, skin colour, deformities and eye depth. Data shown is the mean of 4 replicates.

	Uniformity of Size[1]	Overall Appearance[2]
Low N – early harvest		
Arizona	3.25 b	4.25 ab
Citadel	3.5 ab	3.25 b
Kennebec	4.25 a	4.75 a
Volare	3.0 b	3.75 ab
Yukon Gold	4.25 a	3.75 ab
Low N – main harvest		
AC Hamer	3.25 a	4.25 ab
Gourmandine	4.0 a	4.5 ab
Kennebec	3.5 a	3.5 ab
Krone	4.25 a	4.25 ab
RV009	4.5 a	4.75 ab
RV011	3.75 a	4.0 ab
Yukon Gold	3.5 a	4.0 ab
Moderate N – main harvest		
ASPI 12	3.25 a	3.5 a-d
Barcelona	2.75 a	2.75 bcd
Blazer Russet	3.5 a	4.0 ab
Kennebec	2.75 a	2.25 cd
PGP03	3.75 a	3.5 a-d
RV009	3.5 a	4.0 ab
RV010	3.25 a	4.0 ab
Queen Anne	3.75 a	4.0 ab
RV011	4.0 a	4.5 a
TT16-1	3.0 a	3.25 a-d
TT16-2	2.75 a	2.5 bcd
TT16-3	2.75 a	2.75 bcd
TT16-4	3.25 a	2.5 bcd
TT16-5	2.25 a	2.5 bcd
TT16-6	2.75 a	2.75 bcd
TT16-7	2.25 a	2.0 d
Yukon Gold	2.25 a	2.25 cd

[1] Uniformity of Size: 1 (very variable) - 5 (very uniform)

[2] Overall Appearance: 1 (very poor) - 5 (outstanding)

† Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.

Subjective assessments of red-skinned cultivars are shown in Table 9. At the low rate of N, there was no significant difference between cultivars for uniformity of size. Red Snapper was rated significantly higher for overall appearance than Birgit. At the moderate rate of N. there was no significant difference between cultivars in either uniformity of size or overall appearance. The level of N did not significantly affect subjective scores for Birgit or Norland.

Table 9: Subjective tuber assessments for each fresh market red-skinned variety: Uniformity of Size was subjectively assessed on each replicate by the same individual during the grading process. Overall Appearance was based on uniformity of size and uniformity of shape, skin colour, deformities and eye depth. Data shown is the mean of 4 replicates.

	Uniformity of Size[1]	Overall Appearance[2]
Low N – main harvest		
Birgit	3.5 a	3.25 b
Norland	4.75 a	4.75 ab
Red Snapper	3.5 a	5.0 a
Roko	3.75 a	3.75 ab
Rosa Gold	3.75 a	4.5 ab
Moderate N – main harvest		
ASPI 13	3.25 a	3.75 a-c
ASPI 14	2.75 a	3.00 a-d
EPG016	3.0 a	3.0 a-d
EPG017	4.0 a	3.75 a-c
Birgit	2.75 a	3.25 a-d
Norland	3.0 a	2.75 bcd
TT16-8	2.5 a	3.25 a-d
TT16-9	3.75 a	4.0 ab
TT16-10 (purple)	3.0 a	3.0 a-d

[1] Uniformity of Size: 1 (very variable) - 5 (very uniform)

[2] Overall Appearance: 1 (very poor) - 5 (outstanding)

† Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.

Culinary evaluations were conducted on all cultivars in the trial. Results for the yellow and white cultivars are presented in Table 10. There was variation in flesh colour and tuber texture noted after boiling and baking samples. Moderate sloughing was observed after boiling Yukon Gold, RV009, Kennebec and RV011 grown on low N. Moderate sloughing was observed after boiling samples of TT16-4 and TT16-6 from the moderate N plots. Moderate after cooking discolouration was noted only for RV010 grown on moderate N.

Table 10: Culinary evaluations of each yellow or white fresh market variety grown on moderate nitrogen (approximately 168lbs/ac) and low nitrogen (approximately 138lbs/ac) at CDCS. Data shown is the mean of duplicate analyses of a composite sample.

Boiled Potatoes

CDCS	Flesh color	Waxiness†	Sloughing	After Cooking Discoloration*
Low N – early harvest				
Arizona	Off white	2	3	3
Citadel	Yellow	3	3	3
Kennebec	Off white	2	3	3
Volare	Off white	1	3	3
Yukon Gold	Yellow	3	2	3
Low N – main harvest				
AC Hamer	Off white	3	3	3
Gourmandine	Yellow	3	2	3
Kennebec	Off white	4	2	3
Krone	Yellow	2	3	3
RV009	Yellow	4	2	3
RV011	Deep yellow	3	2	3
Yukon Gold	Yellow	4	2	3
Moderate N – main harvest				
ASPI 12	Yellow	3	3	3
Barcelona	Yellow	2	3	3
Blazer Russet	Off white	4	3	3
Kennebec	Off white	3	3	3
PGP03	Yellow	3	3	3
RV009	Yellow	2	3	3
RV010	Deep yellow	2	3	3
Queen Anne	Deep yellow	2	3	3
RV011	Deep yellow	2	3	3
TT16-1	Yellow	3	3	3
TT16-2	Off white	3	3	3
TT16-3	Yellow	4	3	3
TT16-4	Yellow	3	2	3
TT16-5	Yellow	3	3	3
TT16-6	Off white	4	2	3
TT16-7	Off white	3	3	3
Yukon Gold	Yellow	4	2	3

† Waxiness: 1 = very waxy (very clean cuts); 2 = waxy (clean cuts with some residue); 3 = slightly waxy (more mealy than waxy); 4 = not waxy (fluffy/mealy)

* After Cooking discoloration and sloughing: 1 = severe; 2 = moderate; 3 = none

Table 10 continued.

Baked Potatoes

CDCS	Flesh color	Texture*	After Cooking Discolorationǂ
Low N – early harvest			
Arizona	Yellow	1	3
Citadel	Yellow	2	3
Kennebec	Off white	2	3
Volare	Off white	1	3
Yukon Gold	Yellow	2	3
Low N – main harvest			
AC Hamer	Off white	3	3
Gourmandine	Deep yellow	3	3
Kennebec	Off white	3	3
Krone	Deep yellow	3	3
RV009	Deep yellow	3	3
RV011	Deep yellow	2	3
Yukon Gold	Yellow	3	3
Moderate N – main harvest			
ASPI 12	Yellow	2	3
Barcelona	Yellow	3	3
Blazer Russet	Off white	3	3
Kennebec	Off white	2	3
PGP03	Deep yellow	2	3
RV009	Deep yellow	3	3
RV010	Deep yellow	3	2
Queen Anne	Deep yellow	3	3
RV011	Deep yellow	3	3
TT16-1	Yellow	3	3
TT16-2	Yellow	3	3
TT16-3	Yellow	3	3
TT16-4	Yellow	2	3
TT16-5	Yellow	2	3
TT16-6	Off white	2	3
TT16-7	Yellow	2	3
Yukon Gold	Yellow	4	3

* Texture: 1 = wet; 2 = slightly wet; 3 = slightly mealy; 4 = mealy

ǂ After Cooking discoloration: 1 = severe; 2 = moderate; 3 = none

Results of the culinary evaluation of red-skinned cultivars are presented in Table 11. Flesh colour and texture differences were noted after boiling and baking. Moderate sloughing was observed for Birgit and Red Snapper grown on low N and for ASPI 13 grown on moderate N. No after cooking discolouration was noted for any of the red-skinned cultivars in the trial after boiling or baking.

Table 11: Culinary evaluations of each yellow or white fresh market variety grown on moderate nitrogen (approximately 168lbs/ac) and low nitrogen (approximately 138lbs/ac) at CDCS. Data shown is the mean of duplicate analyses of a composite sample.

Boiled Potatoes

CDCS	Flesh color	Waxiness†	Sloughing	After Cooking Discoloration*
Low N – main harvest				
Birgit	Deep yellow	3	2	3
Norland	Off white	2	3	3
Red Snapper	Yellow	4	2	3
Roko	Off white	2	3	3
Rosa Gold	Yellow	2	3	3
Moderate N – main harvest				
ASPI 13	Yellow	3	2	3
ASPI 14	Off white	3	3	3
EPG016	Off white	2	3	3
EPG017	White	2	3	3
Birgit	Deep yellow	3	3	3
Norland	Off white	2	3	3
TT16-8	Yellow	1	3	3
TT16-9	Yellow	3	3	3
TT16-10 (purple)	Purple	2	3	3

† Waxiness: 1 = very waxy (very clean cuts); 2 = waxy (clean cuts with some residue); 3 = slightly waxy (more mealy than waxy); 4 = not waxy (fluffy/mealy)

* After Cooking discoloration and sloughing: 1 = severe; 2 = moderate; 3 = none

Table 11 continued.

Baked Potatoes

CDCS	Flesh color	Texture*	After Cooking Discoloration‡
Low N – main harvest			
Birgit	Deep yellow	2	3
Norland	Off white	2	3
Red Snapper	Yellow	3	3
Roko	Off white	3	3
Rosa Gold	Deep yellow	2	3
Moderate N – main harvest			
ASPI 13	Yellow	3	3
ASPI 14	Off white	3	3
EPG016	Off white	2	3
EPG017	Yellow	3	3
Birgit	Deep yellow	3	3
Norland	Off white	2	3
TT16-8	Yellow	1	3
TT16-9	Yellow	3	3
TT16-10 (purple)	Purple	2	3

* Texture: 1 = wet; 2 = slightly wet; 3 = slightly mealy; 4 = mealy

‡ After Cooking discoloration: 1 = severe; 2 = moderate; 3 = none

Conclusions

The 2016 variety trial included 23 yellow or white potato cultivars and 12 red-skinned potato cultivars with fresh market potential in southern Alberta. Kennebec and Yukon Gold were included in the trial as check varieties for early harvested cultivars grown on low N and full-season standards at both rates of N. For early harvested cultivars on low N, Volare and Arizona performed well. In the full season plots grown on low N Gourmandine and Krone out-yielded Yukon Gold, but were not statistically different than Kennebec. Barcelona, TT16-3, TT16-1 and Queen Anne yielded significantly more than Yukon Gold when grown on moderate N, and Barcelona and TT16-3 also yielded significantly more than Kennebec. Kennebec, Arizona, RV009, and RV011 scored well for overall appearance. Many cultivars had different culinary attributes that will need to be considered when developing a marketing approach. Few cultivars in the trial had issues with sloughing, after-cooking darkening or internal defects.

Some cultivars were grown at more than one level of N. RV009, RV011, Kennebec and Yukon Gold tended to perform better when grown at 138 lbs/ac rather than 168 lbs/ac indicating that these varieties are efficient at utilizing N.

Norland was included in the trial at both levels of N as a check. In the low N plots, Red Snapper yielded significantly more small tubers than other cultivars and may be well suited for a creamer market. Roko and Birgit yielded well on low N, but were not statistically better than Norland. Yield of most of the cultivars in the moderate N plots was not significantly different from that of Norland. Red Snapper scored very well for overall appearance when grown on low N. Many of the red-skinned cultivars had different culinary attributes that will need to be considered when developing a marketing approach. Few cultivars in the trial had issues with sloughing, after-cooking darkening or internal defects.

Birgit and Norland were grown at both levels of N. Birgit yielded better on low N than on moderate N, especially for tubers under 48mm in diameter.

The trial was designed to provide regional data for a wide range of potato cultivars. Addressing the agronomic needs of each variety may well result in improvements to yield and size profiles when compared to the results in this year of the trial.

Recommendations

- Varieties should be grown in southern Alberta for at least 3 years and these results need to be compiled to ensure a reasonable evaluation.
- To establish better estimates of yield potential and size profile for the varieties, each variety should be grown under optimal agronomic conditions (fertility, plant density, etc.).

References

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Alberta Seed Producers Inc.
ConAgra Foods, Lamb Weston Division
Edmonton Potato Growers
Little Potato Company
Old Dutch Foods
New Zealand Institute of Plants and Food Research
Parkland Seed Potatoes
Prairie Gold Produce
Rockyview Seed Potatoes
Solanum International Inc.
Tuberosum Technologies Inc.

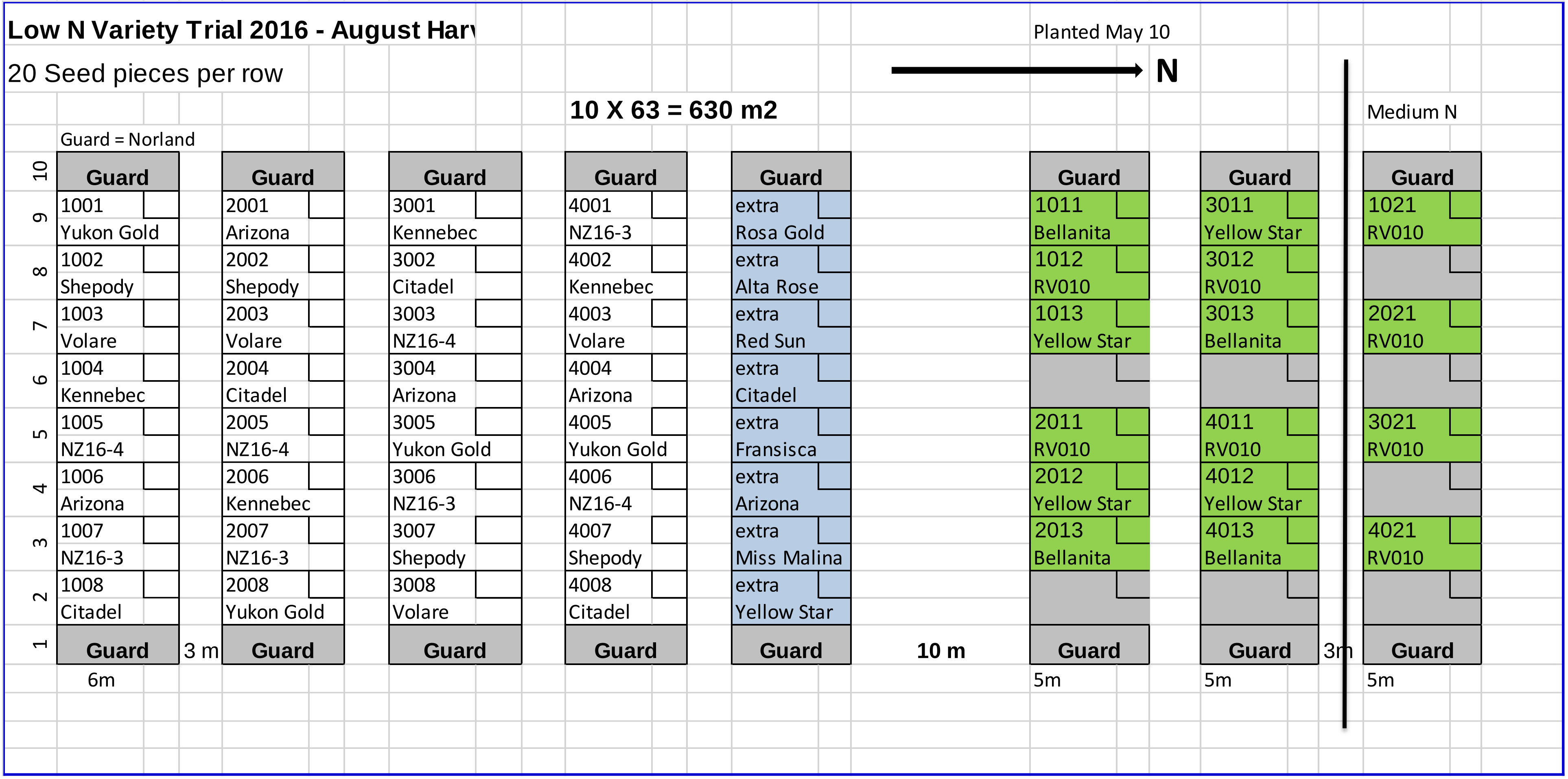
Contact Information:

Michele Konschuh, Ph.D.
Potato Research Scientist
Alberta Agriculture and Forestry, CDCS
301 Horticultural Station Road East
Brooks, AB T1R 1E6

403-362-1314 phone
403-362-1306 fax

Michele.Konschuh@gov.ab.ca

Appendix A Plot Plan



Low N Variety Trial 2016 - August Harv

20 Seed pieces per row

Planted May 10

N

10 X 63 = 630 m2

Medium N

Guard = Norland

10	**Guard**		**Guard**	**Guard**	**Guard**	**Guard**		**Guard**	**Guard**		**Guard**
9	1001 Yukon Gold		2001 Arizona	3001 Kennebec	4001 NZ16-3	extra Rosa Gold		1011 Bellanita	3011 Yellow Star		1021 RV010
8	1002 Shepody		2002 Shepody	3002 Citadel	4002 Kennebec	extra Alta Rose		1012 RV010	3012 RV010		
7	1003 Volare		2003 Volare	3003 NZ16-4	4003 Volare	extra Red Sun		1013 Yellow Star	3013 Bellanita		2021 RV010
6	1004 Kennebec		2004 Citadel	3004 Arizona	4004 Arizona	extra Citadel					
5	1005 NZ16-4		2005 NZ16-4	3005 Yukon Gold	4005 Yukon Gold	extra Fransisca		2011 RV010	4011 RV010		3021 RV010
4	1006 Arizona		2006 Kennebec	3006 NZ16-3	4006 NZ16-4	extra Arizona		2012 Yellow Star	4012 Yellow Star		
3	1007 NZ16-3		2007 NZ16-3	3007 Shepody	4007 Shepody	extra Miss Malina		2013 Bellanita	4013 Bellanita		4021 RV010
2	1008 Citadel		2008 Yukon Gold	3008 Volare	4008 Citadel	extra Yellow Star					
1	**Guard**	3 m	**Guard**	**Guard**	**Guard**	**Guard**	**10 m**	**Guard**	**Guard**	3m	**Guard**
	6m							5m	5m		5m

Low N Variety Trial 2016 - Full Season (

20 Seed pieces per row

24 X 85 = 2040 m2

Planted May 11

→ **N**

Guard = Russet Burbank

24	**Guard**		**Guard**	**Guard**	**Guard**	**Guard**		**Guard**		**Guard**		**Guard**		**Guard**
23	1001 EPG015		1011 Red Snapper	1021 Yukon Gold	2001 Norland	2011 ASPI010		2021 NZ16-1		5001 ODF007		1031 SM08-83-01R		2031 Rosa Gold
22	1002 Bridget		1012 Guard	1022 EPG018	2002 AC Vigor	2012 Kennebec		2022 ASPI011		5002 Monticello		1032 RV010		2032 Anouk
21	1003 Gourmandine		1013 ASPI010	1023 AC Hamer	2003 EPG015	2013 NZ16-2		2023 Bridget		5003 AC Vigor		1033 AC Hamer		2033 Athlete
20	1004 ODF008		1014 EPG013	1024 Rosa Gold	2004 Roko	2014 Krone		2024 Bridget		5004 ODF008		1034 Athlete		2034 Gourmandine
19	1005 ASPI011		1015 Basin Russet	1025 NZ16-1	2005 RV011	2015 Red Snapper		2025 Birgit		5005 ASPI011		1035 PR07-55-1		2035 AC Hamer
18	1006 Blazer Russet		1016 Russet Burbank	1026 ODF007	2006 EPG018	2016 RV009		2026 Russet Burbank		5006 EPG013		1036 Gourmandine		2036 SM08-83-01R
17	1007 Birgit		1017 Monticello	1027 Roko	2007 EPG013	2017 AC Hamer		2027 ODF007		5007 EPG015		1037 Rosa Gold		2037 RV010
16	1008 RV009		1018 RV011	1028 Kennebec	2008 Guard	2018 Yukon Gold		2028 Monticello		5008 ASPI010		1038 Red Snapper		2038 PR07-55-1
15	1009 AC Vigor		1019 NZ16-2		2009 Gourmandine	2019 Rosa Gold				5009 Guard		1039 Anouk		2039 Red Snapper
14	1010 Krone		1020 Norland		2010 Blazer Russet	2020 ODF008				5010 Atlantic				
13	**Guard**	3 m	**Guard**	**Guard**	**Guard**	**Guard**		**Guard**	3m	**Guard**	5m	**Guard**	**3m**	**Guard**
	6m							6m		6m		5m		5m

12	**Guard**		**Guard**	**Guard**	**Guard**	**Guard**		**Guard**		**Guard**		**Guard**		**Guard**
11	3001 AC Hamer		3011 Norland	3021 Rosa Gold	4001 ASPI011	4011 Krone		4021 ASPI010		5011 EPG018		3031 RV010		4031 Athlete
10	3002 Red Snapper		3012 NZ16-2	3022 Krone	4002 ODF007	4012 RV011		4022 EPG013				3032 SM08-83-01R		4032 Red Snapper
9	3003 Basin Russet		3013 Russet Burbank	3023 NZ16-1	4003 Guard	4013 EPG018		4023 Yukon Gold				3033 Gourmandine		4033 PR07-55-1
8	3004 ODF007		3014 ODF008	3024 EPG015	4004 Gourmandine	4014 Birgit		4024 Kennebec				3034 Rosa Gold		4034 Anouk
7	3005 Yukon Gold		3015 RV009	3025 RV011	4005 NZ16-1	4015 Monticello		4025 Rosa Gold				3035 PR07-55-1		4035 Gourmandine
6	3006 ASPI010		3016 Blazer Russet	3026 EPG013	4006 AC Vigor	4016 Norland		4026 RV009				3036 Red Snapper		4036 SM08-83-01R
5	3007 Bridget		3017 EPG018	3027 Monticello	4007 Basin Russet	4017 AC Hamer		4027 EPG015				3037 Anouk		4037 AC Hamer
4	3008 Gourmandine		3018 Roko	3028 Birgit	4008 ODF008	4018 Russet Burbank		4028 Red Snapper				3038 Athlete		4038 RV010
3	3009 Guard		3019 Kennebec		4009 NZ16-2	4019 Blazer Russet						3039 AC Hamer		4039 Rosa Gold
2	3010 ASPI011		3020 AC Vigor		4010 Roko	4020 Bridget								
1	**Guard**	3 m	**Guard**	**Guard**	**Guard**	**Guard**	**10 m**	**Guard**	3m	**Guard**		**Guard**		**Guard**
	6m													

Variety Medium N Brooks - 2016 - Ful

Planted May 16

20 Seed pieces per row

→ **N**

24 x 85m = 2040m2

	12" spacing											ODF Extra
24	**Guard**		**Guard**	**Guard**	**Guard**	**Guard**		**Guard**		**Guard**	**Guard**	
23	1001 ASPI010		1011 ASPI011	1021 EPG015	1031 Barcelona	2001 ASPI010		2011 TT16-5		2021 TT16-3	2031 TT16-9	5001 AC Vigor
22	1002 TT16-4		1012 TT16-9	1022 Norland	1032 TT16-1	2002 TT16-4		2012 PGP03		2022 ASPI012	2032 TT16-10	5002 EPG018
21	1003 Birgit		1013 EPG017	1023 Yukon Gold	1033 ODF007	2003 Birgit		2013 ASPI011		2023 Blazer Russet	2033 ASPI013	5003 EPG013
20	1004 PGP03		1014 Russet Burbank	1024 TT16-3	1034 California RB	2004 ODF008		2014 ODF007		2024 Kennebec	2034 EPG013	5004 ODF008
19	1005 TT16-8		1015 EPG018	1025 Blazer Russet	1035 EPG016	2005 EPG017		2015 TT16-8		2025 Norland	2035 RV009	5005 Burbank
18	1006 Monticello		1016 RV010	1026 Kennebec	1036 RV009	2006 EPG015		2016 Yukon Gold		2026 TT16-7	2036 AC Vigor	5006 ASPI011
17	1007 ASPI013		1017 ASPI008	1027 TT16-2	1037 ASPI012	2007 Monticello		2017 EPG016		2027 ASPI014	2037 Russet Burbank	5007 ODF007
16	1008 TT16-5		1018 Atlantic	1028 AC Vigor	1038 ODF008	2008 Queen Anne		2018 EPG018		2028 RV011	2038 RV010	5008 EPG015
15	1009 ASPI014		1019 RV011	1029 EPG013	1039 TT16-6	2009 Atlantic		2019 ASPI008		2029 California RB	2039 TT16-1	5009 Atlantic
14	1010 TT16-7		1020 TT16-10	1030 Queen Anne		2010 Barcelona		2020 TT16-6		2030 TT16-2		5010 Monticello
13	**Guard**	3 m	**Guard**	**Guard**	**Guard**	**Guard**	**10m**	**Guard**		**Guard**	**Guard**	
	6m											
12	**Guard**		**Guard**	**Guard**	**Guard**	**Guard**		**Guard**		**Guard**	**Guard**	
11	3001 RV010		3011 Russet Burbank	3021 Yukon Gold	3031 Queen Anne	4001 EPG013		4011 TT16-8		4021 TT16-2	4031 TT16-5	5011 California RB
10	3002 Birgit		3012 TT16-9	3022 Norland	3032 Monticello	4002 ASPI012		4012 TT16-10		4022 RV009	4032 AC Vigor	
9	3003 ASPI010		3013 TT16-2	3023 TT16-8	3033 EPG015	4003 Queen Anne		4013 California RB		4023 TT16-6	4033 Barcelona	
8	3004 Blazer Russet		3014 TT16-5	3024 ASPI008	3034 Kennebec	4004 ASPI013		4014 TT16-9		4024 ODF008	4034 TT16-4	
5	3007 ASPI014		3017 TT16-6	3027 TT16-1	3037 PGP03	4007 Kennebec		4017 ASPI010		4027 ODF007	4037 ASPI008	
6	3006 ASPI011		3016 TT16-7	3026 EPG013	3036 Barcelona	4006 Norland		4016 RV010		4026 Atlantic	4036 Birgit	
7	3005 EPG018		3015 Atlantic	3025 ASPI012	3035 RV009	4005 Yukon Gold		4015 TT16-7		4025 EPG016	4035 Monticello	
4	3008 AC Vigor		3018 TT16-3	3028 TT16-4	3038 California RB	4008 EPG018		4018 PGP03		4028 TT16-3	4038 EPG017	
3	3009 TT16-10		3019 EPG016	3029 ODF008	3039 ASPI013	4009 TT16-1		4019 Russet Burbank		4029 ASPI011	4039 ASPI014	
2	3010 Russet Burbank		3020 ODF007	3030 RV011		4010 Blazer Russet		4020 RV011		4030 EPG015		
1	**Guard**	3 m	**Guard**	**Guard**	**Guard**	**Guard**		**Guard**	8m	**Guard**	**Guard**	
	6m											

Project Report

AAFC National Potato Variety Trial Results from CDCS, Brooks, AB
2017

Prepared for:
Funding agencies and industry sponsors

Prepared by:

Michele Konschuh[1] and Benoit Bizimungu[2]
[1]Alberta Agriculture and Forestry
Crop Diversification Centre South
301 Horticultural Station Road East
Brooks, AB T1R 1E6

[2]Agriculture and Agri-Food Canada
Potato Research Centre
850 Lincoln Road P.O. Box 20280
Fredericton, NB E3B 4Z7

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Canadian Horticultural Council | Conseil canadien de l'horticulture
Growing Forward 2

Introduction

In Alberta, potato industry stakeholders are looking for replacement varieties that use less nitrogen, less water, less pesticide, yet yield superior processing or culinary quality and tonnage. Varieties from breeding programs in Canada, Europe and the United States are often being assessed. Many breeding programs target disease resistance, nitrogen use efficiency and excellent storage potential in addition to increased yield. Tuber yield potential and nutritional requirements are impacted by variety characteristics and by environmental characteristics such as the length of the growing season (Westermann, 1993). As noted by Love et. al (2003), the full potential of a new variety may not be realized until proper management is implemented. There is increasing pressure on potato producers to utilize best management practices to reduce the environmental footprint for potatoes. The costs of such shifts in production practices will be borne primarily by producers.

An ideal French fry variety would have earlier maturity than Russet Burbank, be relatively tolerant of environmental fluctuations, have few defects, yield well and have specific gravity in the desired range (1.086 to 1.092). Good fry color out of the field is an asset, and good fry color out of storage is also very desirable. An ideal chipping variety would produce a good yield of medium sized tubers, be relatively tolerant of environmental fluctuations, have few defects, and have high specific gravity in the desired range (above 1.086). Tubers with a good skin set, good maturity at harvest and low concentration of reducing sugars is also very desirable. Varieties that store well at cooler temperatures are an asset. Ideal fresh market varieties would produce a good yield of creamer or medium sized tubers, be relatively tolerant of environmental fluctuations, have few defects, and have an attractive appearance. Tubers with a good skin set that store well are very desirable.

The purpose of this project was to pool resources to evaluate potential varieties from a range of sources, using a cooperative approach. This trial was established to collect local agronomic data on varieties from breeding programs in Canada, the U.S. and elsewhere. The varieties were planted in replicated plots at the Crop Diversification in Brooks, AB and were provided with 209 lbs/ac N. Alberta data is essential when selecting varieties appropriate for our climate, our customers and industry stakeholders.

Objectives

A. To evaluate new cultivars for French fry processing;
B. To evaluate new cultivars for chip processing;
C. To evaluate new cultivars for fresh consumption; and
D. To evaluate cultivars from AAFC’s National Potato Breeding Program under Alberta conditions.

Materials and Methods

The variety evaluation was conducted in small plots at the Crop Diversification Centre South in Brooks, AB. Fertility for the AAFC plots (209 lbs/ac) was achieved through a combination of soil fertility (83 lbs/ac N; 253 lbs/ac P) and broadcast fertilizer (86 lbs/ac of 11-52-0) incorporated May 4 prior to planting. AAFC plots received an additional top-dressing (254 lbs/ac of 46-0-0) at hilling (June 8), for a total of 209 lbs/ac N. Entries were planted in duplicate rows in a randomized complete block design along with standard varieties. Each block was planted adjacent to guard rows to reduce any edge effects (see plot plan, Appendix A).

Eptam 8E (1.8 L/ac) was applied prior to planting (May 4) to control weeds. Seed of standard cultivars and test cultivars was provided by AAFC. Potatoes were planted May 16 approximately 12 to 15cm deep using a two-row tuber unit planter. Seed was planted at 30cm spacing in 6m rows spaced 90cm apart. Plots were hilled June 3 with a power hiller. The plots were irrigated to maintain soil moisture close to 70%. Foliar fungicides were applied twice during the growing season to prevent early and late blight from developing (Table 1). Insecticide (Coragen; 151mL/ac) was applied July 25 to control Colorado Potato Beetle.

Table 1: Foliar fungicides applied to the potato crop in 2017 to prevent early and late blight development.

Date of Application	*Fungicide*	*Rate*
7 July	Ridomil Gold/Bravo	0.83L/ac
25 July	Quadris	324mL/ac

Figure 1: Variety evaluation trial at CDCS in Brooks, AB July 8, 2017.

Reglone was applied (1.0 L/ac) August 25, 2017. Potatoes were harvested September 6 and 7 using a 1-row Grimme harvester.

Fresh market and French fry tubers were stored at 8˚C until graded. Chipping tubers were stored at 14.5°C until graded. Tubers were graded into size categories (less than 48mm, 48 – 88mm, over 88mm and deformed). A sample of twenty-five tubers (48 – 88mm) from each replicate was used to determine specific gravity using the weight in air over weight in water method. These tubers were cut longitudinally to assess internal defects. Sub-samples of 48-88mm tubers were provided to Lethbridge Research Centre staff for culinary and post-harvest evaluations.

The data presented here have not been statistically analyzed. Data reported are the mean of two replicate rows.

Results – Chipping Cultivars

Sample hills of each cultivar were dug for a field day August 24, 2017. Photos of the chipping cultivars are shown in Figure 2.

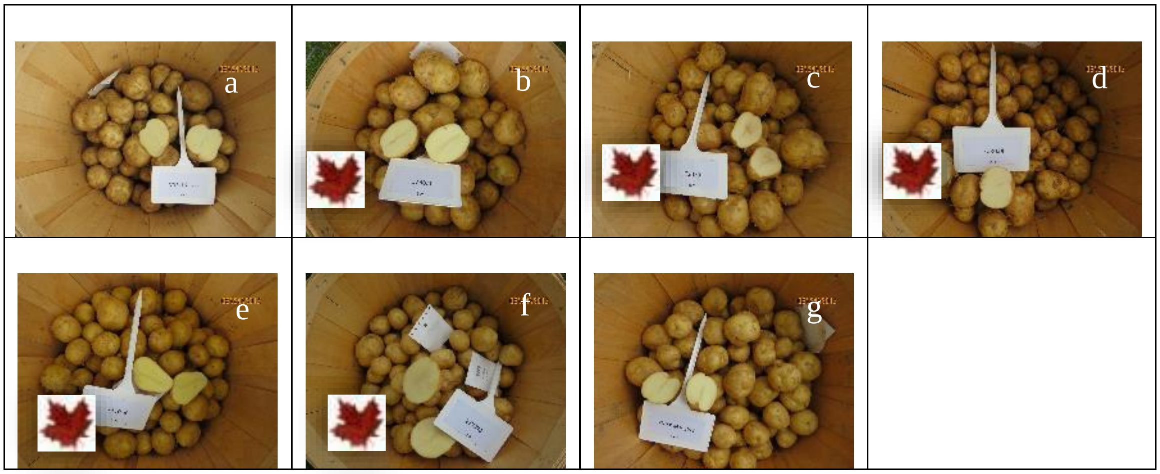

Figure 2. AAFC chipping cultivars at the CDCS field day August 24, 2017: a) Atlantic E, b) F13026, c) F13033, d) F13034, e) F13036, f) F13039, and g) Snowden East.

Yield data (total yield; ton/ac) and specific gravities of each of the chipping cultivars are shown in Table 2. Yield ranged from 18.4 for F13036 to 31.6 ton/ac for F13034. Specific gravity ranged from 1.082 for F13026 to 1.100 for Atlantic East.

Table 2: Estimated total yield (ton/acre) and specific gravity for each chipping cultivar grown at CDCS in Brooks, AB (approximately 209 lbs/ac nitrogen). Data shown is the mean of two replicates.

	Yield (ton/ac)	SG
Atlantic East	26.1	1.100
F13026	28.7	1.082
F13033	18.5	1.087
F13034	31.6	1.090
F13036	18.4	1.084
F13039	25.5	1.087
Snowden East	24.4	1.093

The mean percentage of total tuber number in each size category is shown in Table 3.

Table 3: Percentage of total tuber number in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed) for each chipping cultivar grown at approximately 209 lbs/ac. Data shown is the mean of two replicates.

	No. of <48mm	No. of 48 to 88mm	No. of > 88mm	No. of deformed
Atlantic East	27	66	6	1
F13026	18	77	4	1
F13033	34	65	1	0
F13034	34	63	3	1
F13036	41	58	0	1
F13039	31	66	2	1
Snowden East	33	66	1	0

The yield of tubers (estimated ton/ac) of each chipping cultivar is shown by size category in Table 4. Marketable yield ranged from 15.0 ton/acre for F13033 to 24.6 ton/ac for F13034.

Table 4: Estimated yield (ton/ac) in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed tubers) for each chipping cultivar grown at approximately 209 lbs/ac. Data shown is the mean of two replicates.

	Yield of <48mm (ton/ac)	Yield of 48 to 88mm (ton/ac)	Yield of > 88mm (ton/ac)	Yield of deformed (ton/ac)
Atlantic East	2.2	18.1	5.6	0.2
F13026	3.2	23.2	3.5	0.3
F13033	2.8	15.0	0.7	0.0
F13034	4.0	24.6	2.8	0.3
F13036	3.5	14.6	0.1	0.1
F13039	3.1	20.5	1.5	0.5
Snowden East	3.4	20.2	0.7	0.0

Tuber samples used to measure specific gravity were evaluated for hollow heart, other internal defects and scab. There were very few internal defects observed in the tubers examined. Hollow heart or brown center was noted in a few tubers. Several tubers has black scurf lesions, but few had common scab lesions.

Results– French Fry Cultivars

Sample hills of each cultivar were dug for a field day August 24, 2017. Photos of the French fry cultivars are shown in Figure 3.

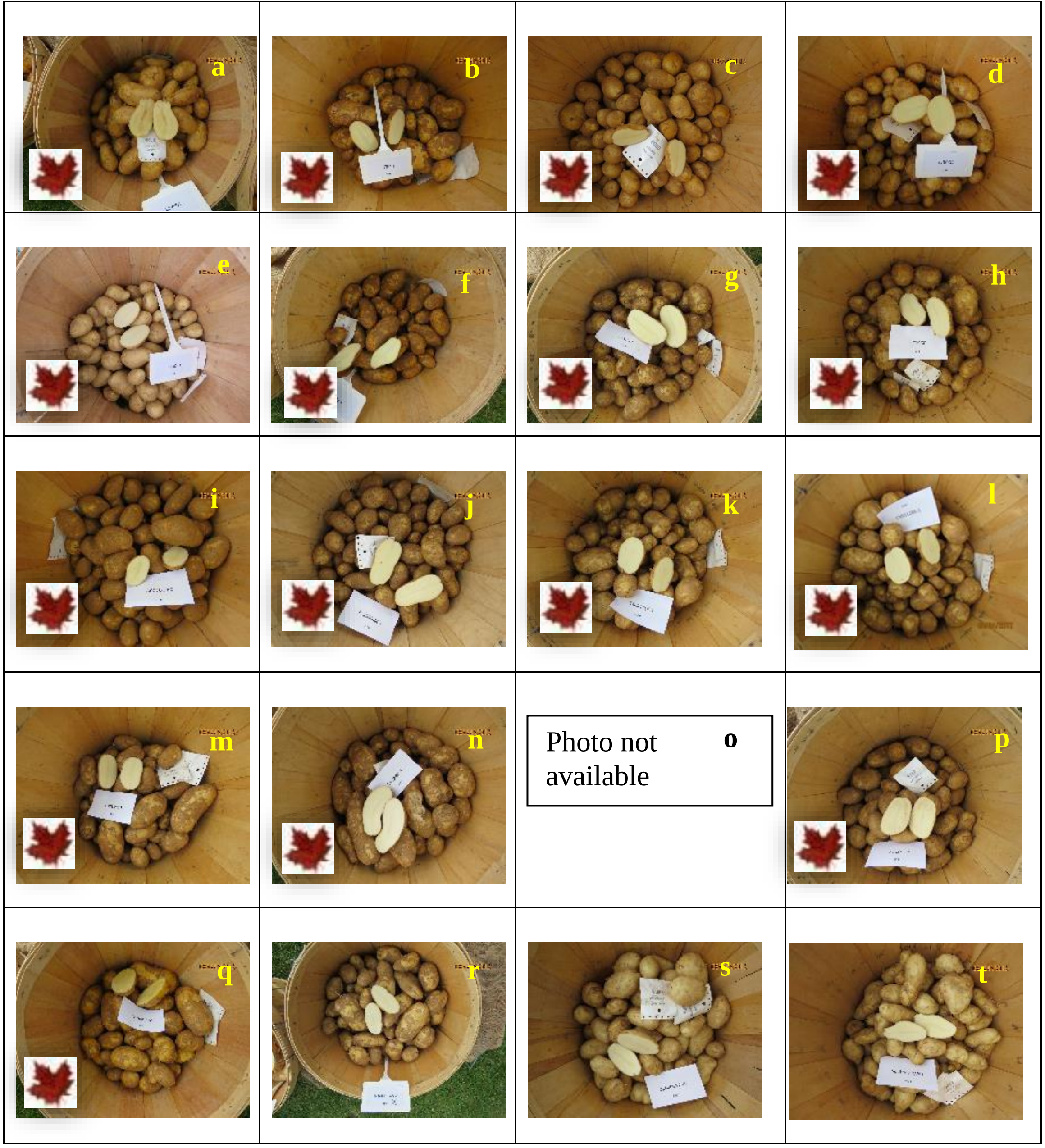

Figure 3. AAFC French fry cultivars at the CDCS field day August 24, 2017: a) F13004., b) F13007, c) F13008, d) F13009, e) F13010, f) F13014, g) F13015, h) F13020, i) CV011010-1, j) CV011188-1, k) CV011286-1, l) CV011295-1, m) CV03366-1, n) CV08087-2, o) CV10045-2, p) CV10121-1, q) FV16028-03, r) Russet Burbank, s) Shepody E, and t) Shepody W.

Yield data (total yield; ton/ac) and specific gravities of each of the French fry cultivars are shown in Table 5. Total yield ranged from 19.2 ton/ac for CV10121-1 to 31.6 ton/ac for Shepody West. Specific gravity ranged from 1.072 for CV08087-2 to 1.099 for F13009.

Table 5: Estimated total yield (ton/acre) and specific gravity for each French fry cultivar grown at CDCS in Brooks, AB (approximately 209 lbs/ac nitrogen). Data shown is the mean of two replicates.

	Yield (ton/ac)	SG
F13004	28.2	1.091
F13007	26.8	1.079
F13008	24.2	1.095
F13009	29.0	1.099
F13010	28.4	1.078
F13014	24.9	1.090
F13015	27.3	1.088
F13020	21.7	1.086
CV011010-1	22.8	1.080
CV011188-1	24.3	1.095
CV011286-1	25.8	1.078
CV011295-1	25.7	1.077
CV03366-1	21.4	1.089
CV08087-2	23.2	1.072
CV08253-1	26.2	1.078
CV10045-2	24.1	1.076
CV10121-1	19.2	1.089
FV16028-03	23.1	1.082
R.Burbank East	25.0	1.089
R.Burbank West	29.0	1.080
Shepody East	25.6	1.084
Shepody West	31.6	1.085

The mean percentage of total tuber number in each size category is shown in Table 6.

Table 6: Percentage of total tuber number in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed) for each French fry cultivar grown at approximately 209 lbs/ac. Data shown is the mean of two replicates.

	No. of <48mm	No. of 48 to 88mm	No. of > 88mm	No. of deformed
F13004	34	61	0	5
F13007	26	72	1	1
F13008	42	57	0	2
F13009	41	57	0	1
F13010	30	68	0	2
F13014	21	79	0	0
F13015	29	70	0	1
F13020	35	64	0	1
CV011010-1	33	67	0	1
CV11188-1	46	49	0	5
CV011295-1	19	77	0	3
CV03366-1	53	45	0	2
CV08087-2	26	64	3	6
CV08253-1	36	59	1	4
CV10045-2	28	63	0	9
CV10121-1	42	56	0	2
FV16028-03	26	67	0	7
R.Burbank East	37	59	0	5
R.Burbank West	33	53	0	14
Shepody East	38	47	1	15
Shepody West	28	69	0	3

The yield of tubers (estimated ton/ac) of each French fry cultivar is shown by size category in Table 7. Yield of 48 – 88mm tubers ranged from 14.7 ton/ac of CV03366-1 to 26.2 ton/ac of Shepody West.

Table 7: Estimated yield (ton/ac) in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed tubers) for each French fry cultivar grown at approximately 209 lbs/ac. Data shown is the mean of two replicates.

	Yield of <48mm (ton/ac)	Yield of 48 to 88mm (ton/ac)	Yield of > 88mm (ton/ac)	Yield of deformed (ton/ac)
F13004	3.5	21.4	0.4	3.0
F13007	2.2	23.0	1.4	0.1
F13008	4.7	18.7	0.0	0.8
F13009	6.2	22.4	0.0	0.4
F13010	2.9	24.8	0.0	0.7
F13014	2.0	22.9	0.0	0.0
F13015	3.5	23.2	0.0	0.6
F13020	2.9	18.4	0.0	0.4
CV011010-1	3.4	18.9	0.0	0.4
CV01188-1	5.6	17.0	0.0	3.4
CV011286-1	3.7	21.8	0.0	0.3
CV011295-1	1.6	22.6	0.0	0.5
CV03366-1	6.0	14.7	0.0	0.7
CV08087-2	1.4	17.6	2.4	1.8
CV10045-2	1.9	18.0	0.0	4.2
CV10121-1	4.0	14.8	0.0	0.4
FV16028-03	1.5	19.2	0.1	2.3
R.Burbank East	3.4	19.2	0.0	2.4
R.Burbank West	3.0	20.8	0.0	5.1
Shepody East	3.8	15.4	0.7	5.7
Shepody West	2.9	26.2	0.2	2.2

Tuber samples used to measure specific gravity were evaluated for hollow heart, other internal defects and scab. There were very few internal defects observed in the tubers examined. Hollow heart was noted in one tuber of WV10075rus-1 and one Russet Burbank tuber. Some tubers from each sample exhibited stem-end discoloration and this may be indicate the presence of wilt organisms. Black scurf was only noted on individual tubers of F12011 and Russet Burbank.

Results – Fresh Market Cultivars

Sample hills of each cultivar were dug for a field day August 24, 2017. Photos of the yellow/white fresh market cultivars are shown in Figure 4.

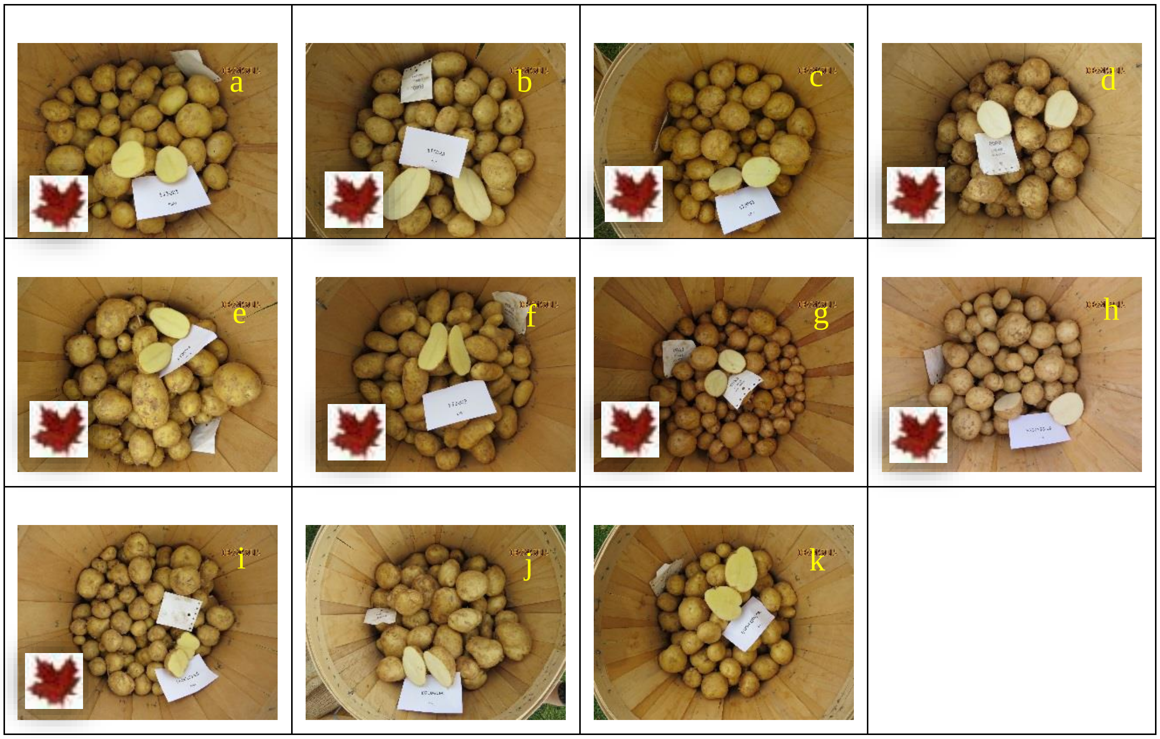

Figure 4. AAFC yellow/white fresh market cultivars at the CDCS field day August 24, 2017: a) F12051, b) F12059, c) F13047, d) F13058, e) F13063, f) F13065, g) F13072, h) FV16210-18, i) FV16213-02, j) Kennebec, and k) Yukon Gold East.

Photos of the purple/red-skinned fresh market cultivars are shown in Figure 5.

Figure 5. AAFC purple/red-skinned fresh market cultivars at the CDCS field day August 24, 2017: a) F12057, b) F12062, c) F12077, d) F13049, e) F13050, f) F13051, g) F13053, h) F13054, i) F13060, j Chieftain East, and k) Norland E.

Yield data (total yield; ton/ac) and specific gravities of each of the fresh market cultivars are shown in Table 8. Total yield ranged from 21.2 ton/ac for F13072 to 35.4 ton/ac for Norland E. Specific gravity ranged from 1.068 for Norland to 1.091 for F13047.

Table 8: Estimated total yield (ton/acre) and specific gravity for each fresh market FM) cultivar grown at CDCS in Brooks, AB (approximately 209 lbs/ac nitrogen). Data shown is the mean of two replicates.

	End Use	Yield (ton/ac)	SG
Yellow/White-skinned			
F12051	FM	29.5	1.082
F12059	FM	26.7	1.084
F13047	FM	29.2	1.091
F13058	FM	33.3	1.079
F13063	FM	22.4	1.082
F13065	FM	26.5	1.090
F13072	FM	21.2	1.084
FV16210-18	FM	23.6	1.078
FV16213-02	FM	24.7	1.083
Kennebec	FM CK	28.9	1.083
Yukon Gold East	FM CK	23.0	1.088
Red/Purple-skinned			
F12057	FM	26.2	1.080
F12062	FM	21.4	1.071
F12077	FM	33.0	1.083
F13049	FM	24.5	1.089
F13050	FM	27.6	1.082
F13051	FM	29.9	1.080
F13053	FM	29.2	1.087
F13054	FM	31.0	1.084
F13060	FM	30.1	1.085
Chieftain East	FM	28.9	1.076
Norland East	FM	34.5	1.068

The mean percentage of total tuber number in each size category is shown in Table 9.

Table 9: Percentage of total tuber number in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed) for each fresh market cultivar grown at approximately 209 lbs/ac. Data shown is the mean of two replicates.

	No. of <48mm	No. of 48 to 88mm	No. of > 88mm	No. of deformed
Yellow/White-skinned				
F12051	29	66	5	0
F12059	24	75	1	0
F13047	39	61	0	1
F13058	31	68	1	1
F13063	36	55	2	7
F13065	55	42	0	3
F13072	68	31	0	1
FV16210-18	39	59	1	1
FV16213-02	40	59	0	1
Kennebec	22	65	7	3
Yukon Gold East	21	75	4	0
Red/Purple-skinned				
F12057	57	41	0	1
F12062	48	49	0	3
F12077	30	70	0	0
F13049	51	49	0	0
F13050	54	45	0	0
F13051	35	64	1	0
F13053	30	67	2	1
F13054	18	81	1	1
F13060	36	58	4	2
Chieftain East	23	74	2	1
Norland East	25	70	4	1

The yield of tubers (estimated ton/ac) of each fresh market cultivar is shown by size category in Table 10.

Table 10: Estimated yield (ton/ac) in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed tubers) for each fresh market cultivar grown at approximately 209 lbs/ac. Data shown is the mean of two replicates.

	Yield of <48mm (ton/ac)	Yield of 48 to 88mm (ton/ac)	Yield of > 88mm (ton/ac)	Yield of deformed (ton/ac)
Yellow/White-skinned				
F12051	2.3	22.8	4.4	0.1
F12059	2.5	22.9	1.1	0.1
F13047	5.0	23.7	0.0	0.5
F13058	3.6	28.1	1.4	0.2
F13063	2.4	16.8	1.3	1.9
F13065	7.7	17.9	0.0	0.9
F13072	9.1	11.8	0.0	0.3
FV16210-18	3.7	18.8	0.9	0.3
FV16213-02	4.0	20.2	0.2	0.4
Kennebec	1.3	19.5	6.4	1.7
Yukon Gold East	1.2	19.8	1.9	0.0
Red/Purple-skinned				
F12057	7.4	17.6	0.5	0.6
F12062	5.4	15.0	0.2	0.9
F12077	4.2	28.6	0.1	0.1
F13049	6.2	18.2	0.0	0.1
F13050	7.1	19.8	0.6	0.0
F13051	3.7	25.2	1.0	0.0
F13053	3.1	24.4	1.5	0.2
F13054	1.8	23.4	0.6	0.3
F13060	1.8	23.1	3.2	1.9
Chieftain East	2.2	24.7	1.2	0.8
Norland East	2.5	27.4	4.1	0.5

Tuber samples used to measure specific gravity were evaluated for hollow heart, other internal defects and scab. There were very few internal defects observed in the tubers examined. Black scurf was noted on many entries, and affected around 50% of the tubers in samples of F13060, FV16210-18 and FV16213-02.

Conclusions

The 2017 variety trial included a number of cultivars with potential in southern Alberta. Atlantic and Snowden were included in the trial as standard varieties to compare to 5 chipping cultivars. Russet Burbank and Shepody were included in the trial as standard varieties to compare 18 French fry cultivars with. Yukon Gold, Chieftain, Kennebec and Norland were included in the trial as standard varieties to compare with 18 fresh market cultivars.

The trial was designed to provide regional data for a wide range of potato cultivars. All cultivars were planted at the same in-row spacing, the N rate was approximately 209 lbs/ac, and harvest was scheduled for full-season varieties. Addressing the agronomic needs, such as plant density, fertility requirements, and harvest timing for each variety may well result in improvements to yield and size profiles when compared to the results in this trial.

References

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Westermann, D.T. 1993. Fertility management. In: Potato Health Management (R.C. Rowe, ed.). APS Press, St. Paul, MN. pp: 77-86.

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Alberta Seed Producers Inc.
ConAgra Foods, Lamb Weston Division
Edmonton Potato Growers
Little Potato Company
McCain Foods
Old Dutch Foods
Parkland Seed Potatoes
Prairie Gold Produce
Rockyview Seed Potatoes
Solanum International Inc.
Tuberosum Technologies Inc.

Contact Information:
Michele Konschuh, Ph.D.
Potato Research Scientist
Alberta Agriculture and Forestry, CDCS
301 Horticultural Station Road East
Brooks, AB T1R 1E6
403-362-1314 phone
403-362-1306 fax
Michele.Konschuh@gov.ab.ca

and

Benoit Bizimungu, Ph.D.
Potato Breeder
Agriculture and Agri-Food Canada
Potato Research Centre
850 Lincoln Road P.O. Box 20280
Fredericton, NB E3B 4Z7
506-452-4880
506-452-3316
Benoit.Bizimungu@AGR.GC.CA

Appendix A Plot Plan

AAFC - 2017 - Brooks

20 Seed pieces per row

N

Planted: May 16, 2017

12 x 105 = 1260 m2

Guard = Norland

12	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**
11	1001 CV03366-1	1011 CV08087-2	1021 F13008	1031 FV16213-02	1041 Shepody East	1051 F13033	2001 Yukon Gold East	2011 F13033	2021 F13054	2031 F12059	2041 F13063
10	1002 F13058	1012 F13047	1022 CV011286-1	1032 FV16210-18	1042 CV011010-1	Norland	2002 F13020	2012 FV16028-03	2022 F13036	2032 F13050	2042 F13009
9	1003 CV10045-2	1013 Kennebec	1023 F13004	1033 CV10121-1	1043 F13063	Norland	2003 F13072	2013 F13047	2023 F13015	2033 F13039	2043 FV16213-02
8	1004 F13039	1014 F13010	1024 Shepody West	1034 F13072	1044 R.Burbank East	Norland	2004 CV10045-2	2014 F13010	2024 F13058	2034 F13004	2044 Shepody East
7	1005 F13014	1015 F13007	1025 F13009	1035 F13015	1045 CV011295-1	Norland	2005 Chieftain East	2015 Snowden East	2025 F13007	2035 F13008	2045 F13034
6	1006 R.Burbank West	1016 F12077	1026 F13034	1036 CV08253-1	1046 Chieftain East	Norland	2006 FV16210-18	2016 F13065	2026 F12062	2036 Atlantic East	2046 F13049
5	1007 F13054	1017 F12051	1027 Norland East	1037 Atlantic East	1047 CV011188-1	Norland	2007 F12077	2017 CV011286-1	2027 F12057	2037 F13060	2047 Shepody West
4	1008 FV16028-03	1018 F13065	1028 F13060	1038 F13036	1048 F12059	Norland	2008 R.Burbank West	2018 CV011295-1	2028 F13053	2038 F13014	2048 R.Burbank Eas
3	1009 Yukon Gold East	1019 F13050	1029 F13051	1039 F12057	1049 F13049	Norland	2009 F13051	2019 CV08253-1	2029 CV011188-1	2039 **CV08087-2**	2049 **F13026**
2	1010 F13020	1020 Snowden East	1030 F13053	1040 F13026	1050 F12062	2051 CV03366-1	2010 CV10121-1	2020 F12051	2030 CV011010-1	2040 Norland East	2050 Kennebec
1	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**

3 m

3m

3m

6 m

15m

6m

105m

AgriInnovation Program Stream B

2017-18 Annual Performance Report

For projects or activities that started late, it is expected that answers may be brief for some questions and not applicable or premature for other questions. Indicate "Not applicable" if the question is not relevant at this time.

Name of Recipient: Alberta Agriculture and Forestry	
Project Title:	
Project Number: AIP-	Period Covered by Report: 2016-04-01 to 2017-03-31
Activity #: 18 Name of Activity: Potato 17	Principal Investigator:

1. Performance Measures. See Annex A for an explanation of each measure.

Innovation Items	Results Achieved	Provide a description (2-3 paragraphs) for each item produced and describe its importance to the target group or sector. Explain any variance between results achieved and targets. Use plain language.
# of Intellectual property items flowing from the project		
# of new/improved products		
# of new/improved processes or systems		
# of new/improved practices		
# of new varieties		Reported in key highlights for each area.
# of new/improved genetic materials		
# of new/ improved gene sequences		
# of improved knowledge		Information provided to growers and industry members to aid in the decision making process of whether to grow a new variety for a new market, to replace a currently grown variety with a new line that will provide improved production or nutritional benefits. Development of production advice that will help growers improve economic and environmental sustainability when growing a new variety.

Information Items	Results Achieved	Provide the complete citation for each item. Please see Annex A for examples.

# of peer reviewed publications		
# of information items	AB	Activity 18.v10 –Potato 17.v10 Canadian Potato Variety Evaluation Program – Alberta 2017 prepared by Michele Konschuh, Alberta Agriculture and Rural Development, Crop Diversification Centre South, 301 Horticultural Station Road East, Brooks, AB T1R 1E6. Sixteen sponsor-specific reports distributed to variety contributors.
# of media reports		Not recorded.
# of information events	AB	Field Days, August 18, 2017 and August 24, 2017, Crop Diversification Centre South, 301 Horticultural Station Road East, Brooks, AB; Mini-poster update presented to the Potato Growers of Alberta Annual General Meeting held November 14-16, 2017 in Red Deer by Michele Konschuh.
		Provide the # of attendees
# of individuals attending information events	AB	**Field day – 12; Field day - 30; Infographic for PGA meeting - 2017**
		Provide the # of attendees who intended to adopt new information or technology
# of individuals attending information event who intend to adopt new innovation		Not able to measure
		Provide the name, degree completed and date of completion
# of persons who completed a M.Sc. or Ph.D. during project		

2. Executive Summary

The Executive summary contains two parts: Key highlights of activities and scientific results and Success story. Information may be used for internal and external communication purposes. Write for a general audience using plain language. Do not include sensitive or confidential information.

Key Highlights - This section describes the key activities and final scientific results of an activity/ project in such a way that readers can rapidly become acquainted with a large body of material without having to read it all. Include a brief statement of the problem(s), background information, concise analysis and main conclusions. Suggested length – maximum 1 page.

Alberta

In 2017, 137 varieties were evaluated for agronomic and culinary purposes. Varieties were provided by private industry and the AAFC national breeding program. AAFC evaluated 18 French fry, 5 chipping and 18 fresh market clones. Industry evaluated 38 creamer varieties, 8 chipping varieties, 18 French fry varieties, and 35 fresh market varieties. 17 entries were evaluated in alternate N plots to generate some agronomic information to support production of new varieties. Data collected included emergence data, stand count, total yield, yield by size category relevant to end-use, specific gravity, internal defects, external deformities, and culinary evaluations. Some samples were returned to stakeholders for bruise testing, storage assessments or acrylamide testing by the stakeholders. Local production data supports adoption of new potato varieties that will enhance the competitiveness of our potato industry.

Success Story - A success story presents a significant result or an important milestone achieved. It is intended to showcases achievements in applied research. Focus on research results, successful technology transfer, potential for pre-commercialization, and/or potential impact. A Success Story is not a progress report for each activity (suggested length 2 – 3 paragraphs).

3. Objectives/Outcomes (technical language is acceptable for this section)

Provide a brief summary that includes introduction, objectives, approach/methodology, deliverables/outputs, results and discussion, and any Ph.D or Master students recruited to work on the project.

Objective: There are three main types of trials being conducted under this project: 1) To help in the acceptance of new Canadian bred and foreign varieties, many that may be protected under Plant Breeders Rights, and sold in the domestic and/or export market. 2) To develop management protocols for newly released varieties being introduced into local areas. Information gained will help growers to produce these new varieties in the most productive and efficient manner possible to maximize both economic and environmental sustainability. Some of the parameters that may be looked at include variable fertilizer rates and spacing. 3) Nutrient Quality evaluation of new varieties and experimental lines.

Methodology: speicifcs varied slightly by location but randomized replicated plot design was used for field production. National grading standards were utilized to determine marketable yield, and standardized methods were used where specific gravity was measured. Various protocols were used to determine culinary quality in those trials where this was measured.

Outcome: Varieties will be grown under local growing conditions in participating provinces. Data from trials will be summarized and analysed and a report will be prepared. Promising new varieties or more efficient production methods could be adopted.

Results: Full reports provided to project collaborators. Results of project also shared via field days, grower and industry winter meetings, trade publications and peer reviewed journals. Information provided may be used by growers to determine potential new varieties they wish to evaluate on their own farm. As well results may be used by local variety agents to increase the commercial acreage of the varieties that they have the rights to by demonstrating the value a particular variety may have to a grower – either by satisfying a need in a niche market or improved production. Management profile trials provide growers with information that may help them produce specific varieties in a more economically and environmentally sustainable manner.

4. Issues

- Describe any challenges or concerns faced during the project. How were they overcome or how do you plan to overcome?
- Describe any potential changes to the work plan and the budget. How were or how will they be managed?

No variance to report. Trial planted, grown and harvested following commercial production practices common in local area. All data collected on time and as required.
Plan: no major changes planned – some issues to address re: financial reporting, approval of claims and dispersal of government funding to private contractors in a timely manner.

5. Lessons Learned:

Describe the key lessons learned gained as a result of executing the project (e.g., a more efficient approach to performing a specific task for activity / project).

The trial varieties change each year as clones/varieties are eliminated that didn't perform well and that new lines are introduced for evaluation trials and new varieties are chosen for management profile trials and nutritional analysis.
Those areas that had limited technology transfer of results via field days or presentations plan to expand these efforts in 2016.
In general, all the project collaborators are well positioned and have the necessary infrastructure and manpower in place to collaborate with breeders and the industry in potato adaptation trials.

6. Future Related Opportunities:

Describe the next steps for the innovation items produced by the activity/project. Is additional research required? Is there potential for commercialization or adoption?

In 2017, 3 of the entries for private industry sponsors were in the 2015 trial as AAFC selections, 6 had been evaluated by AAFC in 2016, and 8 were picked up from 2017 AAFC evaluations They were picked up for further industry evaluation through the Accelerated Release program of AAFC. Participants in the trial are not obligated to inform me if varieties are adopted and it takes years for significant acreage to develop from nuclear seed once a variety is introduced. The timelines for commercialization after selecting a variety put it largely outside the scope of the trial.

Annex A

Innovation Items	
Performance Measures	**Description**
# of Intellectual property items flowing from the project	These include: declaration of invention, patent application, patents, trademarks, copyrights, trade secrets, signed license agreements, and royalties generated. This does not include IP for plant varieties; those should be reported under "# of new varieties" below.
# of new/improved products	New products could include: a new commercial product, bacterial strain, cartographic product, cell culture, analysis certificate, computer software, database, enzyme, equipment/instrument, fertilizer, hormone, methodology, model, monoclonal antibody, pest control product, polyclonal antibody, standard reference-chemical, standard reference-biological, standard reference-plant, etc.
# of new/improved processes or systems	This is the set of operations performed by equipment in which variables are monitored or controlled to produce an output. A combination of inter-related components or processes is arranged to perform a specific function and generate a given outcome.
# of new/improved practices	This is for a research that generated new knowledge that can be applied directly on the ground by the sector. This is mostly for new agronomic practices but can also cover new practices by processors.
# of new varieties	This includes registered varieties, cultivars, or breeds. This includes invention disclosure, protection and license for new plant varieties. For each new variety, please provide the registration number and the variety name.
# of new/improved genetic materials	This could include genetic map and gene probes. Include new varieties, cultivars or breeds in category "New varieties."
# of new/ improved gene sequences	The discovery of order of bases of a DNA [segment] making up a gene.
# of improved knowledge	This category is for reporting results following completion of the final year of the activity, or results against an activity's improved knowledge target. It is intended for results that do not fit in any of the above categories.
Information Items	
Performance Measures	**Description**
# of peer reviewed publications	These are published items such as: research papers published in scientific journals, books, book chapters, review articles, conference proceedings, research notes, or other that receive peer-review. Items that are not yet published (ex. manuscripts in development or review) should not be reported. For each reported item, please provide the following: author(s), year of publication, article title, title of journal, volume (issue), and page number(s). If the item is a book or a book chapter, add name of publisher. If the item is an article for conference proceedings, add title of published proceedings, location, and year/month/day.
# of information items	Information items include: posters, abstracts, pieces in publications such as trade journals, articles in industry magazines or press, industrial reports (confidential or not), technical bulletins, brochures, guides, flyers, newsletters, other technical transfer publications. If an item is published in a medium whose audience is the general public, it should be reported in the # of media reports category below. For each reported item, please provide the following: author(s), article title, title of magazine/trade publication etc., page number(s), type of information item such as poster or abstract or guide etc., and year/month/day.

# of media reports	Examples include articles or interviews about project results in media such as newspaper, tv, radio, and internet (announcements about project funding are excluded). (These are items prepared by a third party, usually with input by the project). If an item is published in an industry journal, newspaper, or magazine, it should be reported in the # of information items category above. For each reported item, please provide the following: author(s), article title, name of interviewee(s), source of reports (TV or radio interview etc.), and year/month/day.
# of information events	These are events such as a scientific meeting, symposium, conference, industry meeting, or field day where a project participant has been invited to present a talk or presentation directly related to the activity. For each reported item, please provide the following: name of presenter, title of presentation, name of the event, location, and year/month/day.
# of individuals attending information events	Please provide the number of attendees per event.
# of individuals attending information event who intend to adopt new innovation	Please provide the number of attendees intending to adopt the new innovation per event.
# of persons who completed a MSc or PhD during project	Only students who completed their MSc or PhD in the last year should be included in this category. For each reported graduate, please provide the following: the name of the student, degree completed and date of completion.

AgriInnovation Program Stream B

2016-17 Annual Performance Report

For projects or activities that started in 2015-2016, it is expected that answers may be brief for some questions and not applicable or premature for other questions. Indicate "Not applicable" if the question is not relevant at this time.

Name of Recipient:	
Project Title: **CHC Cluster 2**	
Project Number: AIP-	Period Covered by Report: 2015-04-01 to 2016-03-31
Activity #: **18** Name of Activity: **Potato 17**	Principal Investigator: Mary Kay Sonier

1. Performance Measures.

See Annex A for an explanation of each measure.

Innovation Items	Results Achieved	Provide a description (2-3 paragraphs) for each item produced and describe its importance to the target group or sector. Explain any variance between results achieved and targets. Use plain language.
# of Intellectual property items flowing from the project	n/a	
# of new/improved products	n/a	
# of new/improved processes or systems	n/a	
# of new/improved practices	n/a	
# of new varieties		Reported in key highlights for each area.
# of new/improved genetic materials	n/a	
# of new/ improved gene sequences	n/a	
# of improved knowledge		Information provided to growers and industry members to aid in the decision making process of whether to grow a new variety for a new market, to replace a currently grown variety with a new line that will provide improved production or nutritional benefits. Development of production advice that will help growers improve economic and environmental sustainability when growing a new variety.

Information Items	Results Achieved	Provide the complete citation for each item
# of peer reviewed publications	ON	

# of information items	BC	Summary report is published in the proceedings for the LMHIA meeting. A report is sent via email or fax to all BC potato growers by ES Crop Consult Ltd.
	AB	Activity 18.v10 –Potato 17.v10 Canadian Potato Variety Evaluation Program – Alberta 2016 prepared by Michele Konschuh, Alberta Agriculture and Rural Development, Crop Diversification Centre South, 301 Horticultural Station Road East, Brooks, AB T1R 1E6. Twelve sponsor-specific reports distributed to variety contributors.
	MB	**FINAL REPORT:** Canadian Horticulture Council Canadian Agri-Science Cluster For Horticulture 2, Activity 18 Potato 17 **Project title:** Evaluation and Adaptation of French fry potato varieties for Manitoba. **Project leader:** Darin Gibson, Gaia Consulting Ltd. **Collaborators:** Stephen Paget, J. R. Simplot Company, Alan Christison, McCain Foods. The report was published in a bound printed publication and distributed at the Keystone Potato Producers Association spring meeting.
	ON	J. A. Sullivan and V. Currie. *2014. Ontario Cooperative Potato Variety Trials 2013*. Report to Ontario Potato Board Annual General Meeting. Dec 3, 2014. Cambridge ON. **Activity code and title: Potato – 17.v10: Canadian Potato Variety Evaluation Program,** Name of Researchers: Dr. Rickey Y. Yada, Dr. Reena Grittle Pinhero, Dept. of Food Science, University of Guelph, Ontario. **4. ON – Nutrient Quality Evaluation of Processing and Table Stock Potatoes**
	QC	**Potato Variety Evaluation in Quebec** prepared by **PROGEST 2001 INC.,** . 6833 Marie-Victorin, Sainte-Croix, Québec, G0S 2H0, André Gagnon *Research Coordinator, M.Sc.,* Sophie Massie *Project Manager, agr., M.Sc.* Report provided to all trial collaborators and suppliers of clones and varieties.
	PEI	Potato Cultivar Evaluation Trial Report – 2014, January 23, 2015, Collaborators: David Main, Agriculture and Agri-Food Canada, Mary Kay Sonier, PEI Potato Board Report distributed to all collaborators and article summarizing trial results published in trade magazine *Prince Edward Island Potato News*.
# of media reports		Not recorded.
		Provide the name of the event and the participant, and the title of the presentation
# of information events	BC	Presentation at ES Crop Consult Potato AGM – made by Heather Meberg, ES Crop Consult Ltd. Presentation on trials made at grower short course at LMHIA Ag Show, January 2015, H. Meberg, ES Crop Consult Inc.
	AB	Field Days, August 16, 2016 and August 26, 2017, Crop Diversification Centre South, 301 Horticultural Station Road East, Brooks, AB; Mini-poster update presented at the Potato Growers of Alberta Annual General Meeting held November 14-16, 2016 by Michele Konschuh.

	MB ON PEI	Preliminary Results were presented to the Manitoba Potato Research Committee Results Meeting in December and then to the entire grower base at their spring meeting in March. *Tour of New Varieties for the Ontario Market*- Vanessa Currie, Potato Research Field Day. August 13, 2014. Elora, ON *New* Shelburne Potato Day. September 12, 2014. Shelburne Ontario. Vanessa Currie and Reena Pinhero attended and highlighted trial results with growers. Ontario Potato Board District 1 Annual Meeting, October 27, 2014. Leamington Ontario. Vanessa Currie discussed collaborative opportunities and research highlights with growers. Ontario Potato Board District 2 Annual Meeting, November 10, 2014, Grand Bend, Ontario. Vanessa Currie discussed collaborative opportunities and research highlights with growers. *Potato Varieties for the Ontario Market* Agricultural Adaptation Council Annual General Meeting. Dec 11, 2014. Guelph ON. Ontario Potato Conference. March 5, 2015. Guelph ON. Vanessa Currie and Reena Pinhero attended and highlighted research with growers. Variety Trial Field Day, August 29, 2015, AAFC Harrington Research Farm, PEI.
		Provide the # of attendees
# of individuals attending information events	BC AB MB ON QC PEI	**125** **Field day – 12; Field day - 30; Presentation at PGA meeting - 200** **3 sponsors** **Research Station field day – 45, On-farm field day – 200** **0** **35**
		Provide the # of attendees who intended to adopt new information or technology
# of individuals attending information event who intend to adopt new innovation		Not able to measure
		Provide the name and the degree completed
# of persons who completed a M.Sc. or Ph.D. during project	n/a	

2. Executive Summary

The Executive summary contains two parts: Key highlights of activities and scientific results and Success story. Information may be used for internal and external communication purposes. Write for a general audience using plain language. Do not include sensitive or confidential information.

Key Highlights - This section describes the key activities and final scientific results of an activity/ project in such a way that readers can rapidly become acquainted with a large body of material without having to read it all. Include a brief statement of the problem(s), background information, concise analysis and main conclusions. Suggested length – maximum 1 page.

British Columbia

The BC Potato Variety Trial project demonstrates new varieties that may be of interest to our local growers. The 2014 variety trial included 52 varieties in the replicated trial. Five standards, 11 numbered varieties and 36 new to BC varieties were included in the agronomic portion of this trial for evaluation under BC growing conditions. There were three replicated plots and a demonstration plot for each variety. The goal of the project is to identify new potato varieties that will work in the BC marketplace and under local growing conditions that growers will be able to grow and market profitably.

Alberta

In 2016, 136 varieties were evaluated for agronomic and culinary purposes. Varieties were provided by private industry and the AAFC national breeding program. Data collected included emergence data, stand count, total yield, yield by size category relevant to end-use, specific gravity, internal defects, external deformities, and culinary evaluations. Some samples were returned to stakeholders for bruise testing, storage assessments or acrylamide testing by the stakeholders. Local production data supports adoption of new potato varieties that will enhance the competitiveness of our potato industry.

Manitoba

Three potato adaptation trials were conducted at an irrigated site near Carman, Manitoba in 2014 in order to study the effect of nitrogen levels and plant spacing on the tuber yield, size profile and quality. Blazer Russet, Classic Russet and Bannock Russet were included in this research.

Objectives:

- To test potato varieties to determine their potential as replacement varieties for those presently grown in Manitoba for French fry processing.
- To determine yield, grade and quality response of three potato varieties to three levels of N fertility and three in-row seed spacings.
- To evaluate the interaction between variety, seed piece spacing and N fertility.
- To develop management strategies for these varieties under Manitoba conditions.

Conclusions:

- Statistically significant differences were detected for total yield. Higher N rate and tighter spacing produced higher yield.
- No treatment differences were found for average tuber size.
- Incidence of hollow heart was not influenced by N rate or spacing.
- Very low specific gravity and high tissue NO_3 levels suggest immaturity.
- No treatment differences were found for any French fry parameters.
- Spacing effects could be exaggerated, as seed rot effectively made average spacing longer.
- No interaction (N x Spacing) effects were detected.

Ontario

Ontario Cooperative Potato Variety Trials 2014 – replicated plots are grown at the university of Guelph and on-farm demonstration plots are grown by potato industry co-operators: H.J. Vanderzaag Farms, Alliston and Dave Vanderzaag Farms, Shelburne. Seed from seven USA states, and six Canadian provinces and three European Seed companies of their promising new cultivars were provided and in addition the Ontario Seed Potato Growers' Association re-entered two new accelerated release lines. Ninety-seven lines, including standards, were included in the trials.

Nutrient Quality Evaluation of Processing and Table Stock Potatoes - The overall objective of the experiments were to select chipping potato varieties and elite clones from the potato breeding programs for chipping quality attributes such as color, glucose, sucrose, higher nutritional quality such as high antioxidant potential and low asparagine content after storage in a commercial storage facility at 12°C as well as select varieties suitable for low temperature storage at 5°C. Twenty varieties including 15 elite clones, two colored potatoes and three existing commercial varieties were grown in a replicated field trial at the Elora Research Station. In addition, two existing commercial varieties Beacon Chipper and Waneta (NY138) were also grown in Beeton and Alliston, respectively, to study the effect of location.

Highest mean specific gravity was registered for W5015-12, Tundra, W2717-5, W8641-4 and W8822-3 while lowest values were obtained for F06058 followed by F06053. Highest chip scores were obtained for Beacon Chipper, W8603-1, Snowden, Waneta, W6822-3, W6822-3, W5955-1, Tundra and W8587-4 whereas chip scores for F06058 and F06053 were the lowest. Glucose and sucrose contents varied significantly between varieties and the highest values were obtained for F06058 and F06053. Among the top ten varieties with lowest glucose contents recorded consistently over the study period were Tundra, Waneta, W2715-5, W8867-5, W2438-3Y, W8848-3 and W6822-3. Also Tundra, Nicolette, W2438-3Y and W5955-1 had significantly lower sucrose contents for most of the storage periods during the study period. Total phenolic contents and antioxidant activities of potato dry matter and chips were significantly higher for F06058 and F06053. Varieties with the highest total phenolic contents and antioxidant activities besides F06058 and F06053 were Beacon Chipper, Waneta, W2438-3Y, Nicolette, W8615-5, and Tundra. Similarly, chips with the highest total phenolic content and antioxidant activities during most of the storage periods were derived from varieties F06058, F06053W2438-3Y, Nicolette, W8615-5, W8641-4, Beacon Chipper and Waneta. The asparagine content of potatoes did not differ significantly among varieties, only W8641-4 showed lower asparagine contents during storage periods studied. The low temperature storage study did not show any promising varieties suitable for storage at low temperature of 5°C.

Quebec

OBJECTIVES

- Gather information on the agronomic performance of new potato genotypes
- Collect information on external and internal tuber quality of new potato genotypes
- Collect information on cooking quality of new potato genotypes

The trial included potato clones from the Accelerate Release Program (AR) from Fredericton and Lethbridge research station of Agriculture and Agri-Food Canada (AAFC). Clones from the NE1231 program (Eastern Potato Variety Development Projects) were also evaluated. Clones from Cornell University, Michigan University, Wisconsin-Madison University and Progest 2001 respective breeding program were also integrated to the trials. Known varieties, chosen for their special characteristics, were used as controls: Andover, Chieftain, Goldrush, Snowden and Superior. A total of 66 genotypes were used in this trial.

Prince Edward Island

Collaborators – PEI Potato Board and AAFC Crop & Livestock Research Centre – Charlottetown – experimental and recently released cultivars were evaluated for production under PEI environmental conditions. Plotswere grow in a randomized replicate d plot design and evaluated for emergance, yield in different size categories, specific gravity and visual defects. Fresh Market: (1) Yellow-fleshed – Seven out of the ten entries had marketable yields significantly greater than the standard cultivar Yukon Gold. 70% of the entries had total yields greater than the 2014 PEI average yield of 32.5 t/ha; (2) Red-skinned - Two out of the four entries equalled the standard cultivar Norland in marketable yield. All four had total yields greater than the 2014 PEI average; (3) Round-whites – Only one out of the five entries statistically outperformed the standard cultivar Superior in marketable yield. All five had total yields higher than the 2014 PEI average; (4) Russet-skinned - Two out of the six entries had marketable yields greater than the standard cultivar Goldrush. All six had total yields greater than the 2014 PEI average. Chip: Neither entry could equal the standard cultivar Atlantic in marketable yield. All three had total yields greater than the 2014 PEI average. Russet Burbank Clones: Two of the five clones outperformed the PEI standard clone in marketable yield. All clones had total yields above the 2014 PEI average.

Success Story - A success story presents a significant result or an important milestone achieved. It is intended to showcases achievements in applied research. Focus on research results, successful technology transfer, potential for pre-commercialization, and/or potential impact. A Success Story is not a progress report for each activity (suggested length 2 – 3 paragraphs).

Not recorded.

3. Objectives/Outcomes (technical language is acceptable for this section)

Provide a brief summary that includes introduction, objectives, approach/methodology, deliverables/outputs, results and discussion, and any Ph.D or Master students recruited to work on the project.

Objective: There are three main types of trials being conducted under this project: 1) To help in the acceptance of new Canadian bred and foreign varieties, many that may be protected under Plant Breeders Rights, and sold in the domestic and/or export market. 2) To develop management protocols for newly released varieties being introduced into local areas. Information gained will help growers to produce these new varieties in the most productive and efficient manner possible to maximize both economic and environmental sustainability. Some of the parameters that may be looked at include variable fertilizer rates and spacing. 3) Nutrient Quality evaluation of new varieties and experimental lines.
Methodology: speicifcs varied slightly by location but randomized replicated plot design was used for field production. National grading standards were utilized to determine marketable yield, and standardized methods were used where specific gravity was measured. Various protocols were used to determine culinary quality in those trials where this was measured.
Outcome: Varieties will be grown under local growing conditions in participating provinces. Data from trials will be summarized and analysed and a report will be prepared. Promising new varieties or more efficient production methods could be adopted.
Results: Full reports provided to project collaborators. Results of project also shared via field days, grower and industry winter meetings, trade publications and peer reviewed journals. Information provided may be used by growers to determine potential new varieties they wish to evaluate on their own farm. As well results may be used by local variety agents to increase the commercial acreage of the varieties that they have the rights to by demonstrating the value a particular variety may have to a grower – either by satisfying a need in a niche market or improved production. Management profile trials provide growers with information that may help them produce specific varieties in a more economically and environmentally sustainable manner.

4. Issues

- Describe any challenges or concerns faced during the project. How were they overcome or how do you plan to overcome?
- Describe any potential changes to the work plan and the budget. How were or how will they be managed?

No variance to report. Trial planted, grown and harvested following commercial production practices common in local area. All data collected on time and as required.
Plan: no major changes planned – some issues to address re: financial reporting, approval of claims and dispersal of government funding to private contractors in a timely manner.

5. Lessons Learned:

Describe the key lessons learned gained as a result of executing the project (e.g., a more efficient approach to performing a specific task for activity / project).

The trial varieties change each year as clones/varieties are eliminated that didn't perform well and that new lines are introduced for evaluation trials and new varieties are chosen for management profile trials and nutritional analysis.
Those areas that had limited technology transfer of results via field days or presentations plan to expand these efforts in 2016.
In general, all the project collaborators are well positioned and have the necessary infrastructure and manpower in place to collaborate with breeders and the industry in potato adaptation trials.

6. Future Related Opportunities:

Describe the next steps for the innovation items produced by the activity/project. Is additional research required? Is there potential for commercialization or adoption?

A step should be introduced to track the adoption of new varieties and acreage grown of new varieties that are being adopted by industry.
In 2016, 3 of the entries for private industry sponsors were in the 2015 trial as AAFC selections and 7 had been evaluated by AAFC in 2014. They were picked up for further industry evaluation through the Accelerated Release program of AAFC. Thirteen varieties that were evaluated in the project in 2016 were showcased for fresh market producers at storage workshops in Alberta in early 2017. Participants in the trial are not obligated to inform me if varieties are adopted and it takes years for significant acreage to develop from nuclear seed once a variety is introduced. The timelines for commercialization after selecting a variety put it largely outside the scope of the trial.

Annex A

Innovation Items	
Performance Measures	**Description**
# of Intellectual property items flowing from the project	These include; declaration of invention, patent application, patents, trademarks, copyrights, trade secrets, signed license agreements, and royalties generated. This does not include IP for plant varieties.
# of new/improved products	New products could include: a new commercial product, bacterial strain, cartographic product, cell culture, analysis certificate, computer software, database, enzyme, equipment/instrument, fertilizer, hormone, methodology, model, monoclonal antibody, pest control product, polyclonal antibody, standard reference-chemical, standard reference-biological, standard reference-plant, etc.
# of new/improved processes or systems	This is the set of operations performed by equipment in which variables are monitored or controlled to produce an output. A combination of inter-related components or processes is arranged to perform a specific function and generate a given outcome.
# of new/improved practices	This is for a research that generated new knowledge that can be applied directly on the ground by the sector. This is mostly for new agronomic practices but can also cover new practices by processors.
# of new varieties	This includes varieties, cultivars, or breeds. This includes invention disclosure, protection and license for new plant varieties.
# of new/improved genetic materials	This could include genetic map and gene probes. Include new varieties, cultivars or breeds in category “New varieties.”
# of new/ improved gene sequences	The discovery of order of bases of a DNA [segment] making up a gene.
# of improved knowledge	This category is for results that do not fit in any previous categories, and is normally used at the end of a research. For example, the innovation from a project aimed at defining the composition and properties of sugars in maple syrup would fit under improved knowledge.
Information Items	
Performance Measures	**Description**
# of peer reviewed publications	These are items such as research papers published in scientific journals, books, book chapters, review articles, conference proceedings, research notes, or other that receive peer-review.
# of information items	These types of items include non-peer-reviewed scientific publications (posters, abstracts), and publications such as trade journal publications, popularizing articles in magazines, press articles, industrial reports (confidential or not), technical bulletins, posters, brochures, guides, flyers, newsletters, other technical transfer publications (media items are not included here – see next).
# of media reports	Examples include articles or interviews about project results in media such as newspaper, tv, radio, and internet (announcements about project funding are excluded). (These are items prepared by a third party, usually with input by the project).
# of information events	These are events such as a scientific meeting, symposium, conference, industry meeting, or field day where a project participant has been invited to present a talk or presentation. Provide the name of the event and a reference to the talk or presentation.
# of individuals attending information events	
# of individuals attending information event who intend to adopt new innovation	
# of persons who completed a MSc or PhD during project	

Project Report

Alberta Potato Variety Development 2017
CDCS, Brooks, AB

N Response
Chipping Potatoes

Prepared for:
Old Dutch Foods

Prepared by:

Michele Konschuh
Alberta Agriculture and Forestry
Crop Diversification Centre South
301 Horticultural Station Road East
Brooks, AB T1R 1E6

April 17, 2018

Introduction

In Alberta, potato industry stakeholders are looking for replacement varieties that use less nitrogen, less water, less pesticide, yet yield superior processing or culinary quality and tonnage. An ideal chipping variety would produce a good yield of medium sized tubers, be relatively tolerant of environmental fluctuations, have few defects, and have high specific gravity in the desired range (above 1.085). Tubers with a good skin set, good maturity at harvest and low concentration of reducing sugars are also very desirable. Varieties that store well at cooler temperatures are an asset. Varieties from breeding programs in Canada, Europe and the United States are often being assessed. Many breeding programs target disease resistance, nitrogen use efficiency and excellent storage potential in addition to increased yield. Tuber yield potential and nutritional requirements are impacted by variety characteristics and by environmental characteristics such as the length of the growing season (Westerman, 1993). As noted by Love et al. (2003), the full potential of a new variety may not be realized until proper management is implemented. There is increasing pressure on potato producers to utilize best management practices to reduce the environmental footprint for potatoes. The costs of such shifts in production practices will be borne primarily by producers.

The purpose of this project was to pool resources to evaluate potential varieties from a range of sources, using a cooperative approach. This trial was established to collect local agronomic data on varieties from breeding programs in Canada, the U.S. and elsewhere. The varieties were planted in replicated plots at the Crop Diversification Centre in Brooks, AB and were provided with 180 lbs/ac N and, if requested, 100 lbs/ac N. Alberta data is essential when selecting varieties appropriate for our climate, our customers and industry stakeholders.

Objectives

A. To evaluate potential new varieties for chip processing;
B. To provide the potato industry an opportunity to assess varieties grown under local conditions;
C. To compare varieties from several breeding programs (including AAFC) under Alberta conditions; and
D. To determine the response of new chipping varieties to nitrogen fertilizer rates.

Materials and Methods

The variety evaluation was conducted in small plots at the Crop Diversification Centre South in Brooks, AB. Fertility for the low N plots (100 lbs/ac) was achieved through a combination of soil fertility (83 lbs/ac N; 253 lbs/ac P) and broadcast fertilizer (90 lbs/ac of 11-52-0) incorporated prior to planting. Low N plots received an additional top-dressing (15 lbs/ac of 46-0-0) at hilling, for a total of 100 lbs/ac N. Moderate N plots received an additional top-dressing (189 lbs/ac of 46-0-0) at hilling, for a total of 180 lbs/ac N. Within each level of nitrogen, varieties were planted in four replicate rows in a randomized complete block design along with standard varieties (Atlantic, AC Vigor and Monticello). Each block was planted adjacent to guard rows to reduce any edge effects (see plot plans, Appendix A).

Eptam 8E (1.8 L/ac) was applied prior to planting (May 4) to control weeds. Seed of standard cultivars was provided by Edmonton Potato Growers and seed of test cultivars was provided by each participant. Potatoes were planted May 30, 2017 (Low N Main) and May 29, 2017 (Moderate N Main) approximately 12 to 15cm deep using a two-row tuber unit planter. Seed was planted at 30cm spacing in 6m rows spaced 90cm apart. The plots were irrigated to maintain soil moisture close to 70%. Foliar fungicides were applied twice during the growing season to prevent early and late blight from developing (Table 1).

Table 1: Foliar fungicides applied to the potato crop in 2017 to prevent early and late blight development.

Date of Application	*Fungicide*	*Rate*
7 July	Ridomil Gold/Bravo	0.83L/ac
25 July	Quadris	324mL/ac

Figure 1: Variety evaluation trial at CDCS in Brooks, AB June 26, 2017.

Reglone was applied (1.0 L/ac) September 1 to the Low N and Medium N plots. The Low N plots were harvested September 14 to 15, 2017 and Moderate N plots were harvested September 12 to 13 using a 1-row Grimme harvester.

Chipping tubers were stored at 14.5˚C until graded. Tubers were graded into size categories (less than 48mm, 48 – 88mm, and over 88mm). A sample of twenty-five tubers (48 – 88mm) from each replicate was used to determine specific gravity using the weight in air over weight in water method. These tubers were cut longitudinally to assess internal defects. A composite sample of 8 tubers (2 per rep) was stored at 10˚C until culinary analyses were performed. Samples were evaluated for chip color using a Hunter Colorimeter in October 2017.

Marketable potatoes were made available to cooperators for additional storage evaluations, but data will not be provided here.

The data presented here have been statistically analyzed using ANOVA and Tukey's Multiple Comparison Test; (SPSS; $p \leq 0.05$). Statistical summaries are available upon request. T-tests were used to compare results for each variety at different levels of N.

Results and Discussion – Chippers

Sample hills of each variety were dug for a field day at CDCS August 24, 2017. Photos of these varieties are shown in Figure 2.

Figure 2. Chipping varieties at CDCS field day August 24, 2017: a) AC Hamer, b) AC Vigor, c) ODF007, d) ASPI17-5, e) Atlantic, f) Destiny, g) ODF009, and h) Monticello.

Yield data (total yield; ton/ac) and specific gravities of each of the chipping cultivars are shown in Table 2. When grown on moderate nitrogen (180 lbs/ac), total yield ranged from 22.4 ton/ac for ODF009 to over 30 ton/ac for AC Vigor and ASPI17-5. The yields of Destiny and ODF009 were significantly lower than yield of ASPI17-5, Atlantic and AC Vigor, but were not statistically different from Monticello or other cultivars in the trial. When grown on low N (100 lbs/ac), yield ranged from 24.1 ton/ac for Destiny and ODF009 to over 30 ton/ac for ODF007, but none of the yields were statistically different at this level of N. ASPI17-5 yielded significantly more on medium N (180 lbs/ac) compared to the low rate of N (100 lbs/ac) indicating that nitrogen fertilizer is required to optimize yield. On moderate N, specific gravity of tubers ranged from 1.088 for AC Hamer and AC Vigor to 1.107 for ODF009. Specific gravities ranged from 1.093 for ASPI17-5 to 1.109 for ODF009 when grown on lower N. All specific gravity measurements were above the threshold for light chip color, in fact, many were perhaps too high. In 2017, the specific gravity of four entries were significantly reduced when grown on the moderate rate of N, AC Hamer, ODF007, Atlantic, and Destiny.

Further addressing the agronomic needs of each variety may well result in improvements to yield and size profiles when compared to the results in this trial.

Table 2: Estimated total yield (ton/acre) and specific gravity for each chipping variety grown on approximately 180 lbs/ac nitrogen (Moderate N) and 100 lbs/ac nitrogen (Low N). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the $p < 0.05$ level.

CDCS	Yield (ton/ac)	SG
Moderate N		
AC Hamer	26.6 abc	1.088 cǂ
AC Vigor	30.3 ab	1.088 c
ODF007	27.9 abc	1.097 bǂ
ASPI17-5	32.0 aǂ	1.087 c
Atlantic	28.9 ab	1.097 bǂ
Destiny	22.6 c	1.101 abǂ
ODF009	22.4 c	1.107 a
Monticello	24.7 bc	1.103 ab
Low N		
AC Hamer	24.4 a	1.105 aǂ
AC Vigor	26.7 a	1.097 bc
ODF007	30.2 a	1.103 abǂ
ASPI17-5	25.4 aǂ	1.093 c
Atlantic	26.9 a	1.106 aǂ
Destiny	24.1 a	1.108 aǂ
ODF009	24.1 a	1.109 a
Monticello	26.7 a	1.108 a

ǂ Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.

The mean percentage of total tuber number in each size category is shown in Table 3. The majority of tubers for each variety fell into the marketable category (48 – 88mm) for all cultivars except Destiny whether grown on moderate or low N. AC Hamer and Destiny produced a significantly higher percentage of tubers in the small size category and a significantly lower percentage of medium sized tubers compared to the standard cultivars when grown on moderate N. When grown on moderate N, AC Hamer, Destiny and ASPI17-5 produced a significantly higher percentage of small tubers than the standard entries. All of the entries produced significantly lower percentages of oversized tubers than Atlantic grown on low N. ASPI17-5 was the only variety with a significant shift in the percentage of tubers in each size category as a response to N fertility, with a shift toward larger tuber size in response to moderate N.

Table 3: Percentage of total tuber number in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed) for each chipping variety grown on moderate nitrogen (approximately 180 lbs/ac) and 100 lbs/ac nitrogen (Low N). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the $p < 0.05$ level.

CDCS	< 48mm	48 to 88mm	> 88mm	Deformed
Moderate N				
AC Hamer	44.8 b	54.5 c	0.3 b	0.5 a
AC Vigor	26.3 c	71.0 ab	1.8 b	0.5 a
ODF007	28.8 c	69.8 ab	0.5 b	1.3 a
ASPI17-5	31.0 cǂ	66.3 abcǂ	2.3 abǂ	0.5 a
Atlantic	14.8 d	78.0 a	6.3 a	0.8 a
Destiny	59.3 a	40.3 d	0.0 b	0.8 a
ODF009	35.0 bc	63.5 bc	1.3 b	0.0 a
Monticello	28.8 c	68.3 ab	3.0 ab	0.0 a
Low N				
AC Hamer	42.3 a	57.3 bc	0.2b	0.3 b
AC Vigor	26.8 b	72.3 a	0.5 b	0.0 b
ODF007	25.8 b	71.5 ab	1.5 b	1.0 b
ASPI17-5	41.5 aǂ	52.3 cǂ	0.0 bǂ	6.3 a
Atlantic	19.8 b	71.3 ab	7.3 a	2.0 ab
Destiny	49.3 a	49.5 c	0.0 b	1.3 b
ODF009	28.8 b	69.3 ab	0.3 b	1.0 b
Monticello	27.0 b	70.5 ab	2.0 b	0.5 b

ǂ Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.

The yield of tubers (estimated ton/ac) of each variety is shown by size category in Table 4. Yield of medium sized tubers ranged from 14.7 ton/ac for Destiny to 26.2 ton/ac for ASPI17-5 on the moderate N plots. Yield of medium potatoes ranged from 18.1 ton/ac for ASPI17-5 to 25.7 ton/ac for ODF007 when grown on low N plots. When grown at a moderate rate of N, Destiny yielded significantly higher yield of tubers under 48mm than other cultivars and significantly lower yield of tubers of marketable size than other entries. Atlantic yielded more tubers over 88mm than other varieties at both levels of N. There were no significant differences in yield of deformed tubers from the moderate N plots, but on low N, ASPI17-5 produced significantly more deformed tubers than other cultivars. When grown on moderate rates of N, ASPI17-5 produced significantly greater yields of tubers 48 to 88mm and over 88mm than when grown on low N.

Table 4: Estimated yield (ton/ac) in each size category (< 48mm, 48 to 88mm, > 41mm, and deformed tubers) for each chipping variety grown on moderate nitrogen (approximately 180 lbs/ac) and at a lower rate of N (100 lbs/ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the $p < 0.05$ level.

CDCS	Yield of <48mm (ton/ac)	Yield of 48 to 88mm (ton/ac)	Yield of > 88mm (ton/ac)	Yield of deformed (ton/ac)
Moderate N				
AC Hamer	4.9 b	21.4 ab	0.2 b	0.1 a
AC Vigor	2.9 c	25.3 a	1.6 b	0.5 a
ODF007	3.4 c	23.6 a	0.5 b	0.4 a
ASPI17-5	3.4 c	26.2 aǂ	2.2 abǂ	0.3 a
Atlantic	1.4 d	22.0 ab	4.9 a	0.5 a
Destiny	7.6 a	14.7 c	0.0 b	0.3 a
ODF009	3.4 c	17.8 bc	1.2 b	0.0 a
Monticello	2.5 cd	20.5 ab	1.8 b	0.0 a
Low N				
AC Hamer	5.0 ab	19.0 a	0.2 b	0.2 b
AC Vigor	2.7 cd	23.1 a	0.7 b	0.2 b
ODF007	2.6 cd	25.7 a	1.6 b	0.3 b
ASPI17-5	4.5 abc	18.1 aǂ	0.0 bǂ	2.8 a
Atlantic	1.5 d	20.1 a	4.9 a	0.3 b
Destiny	5.8 a	17.9 a	0.0 b	0.4 b
ODF009	3.2 bcd	20.2 a	0.4 b	0.3 b
Monticello	2.8 cd	22.0 a	1.8 b	0.1 b

ǂ Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.

Tubers were assessed subjectively for Uniformity of Size and Overall Appearance. Scores are presented in Table 5. There were no significant differences in Uniformity of Size between cultivars grown at either rate of N. At a moderate rate of N, Destiny was scored significantly lower in overall appearance compared to other cultivars. At a lower rate of N, Atlantic scored lowest for overall appearance. AC Hamer, AC Vigor and Monticello scored significantly better than Atlantic for overall appearance. In 2017, there were no significant differences in overall appearance scores by cultivars between low and moderate N.

Table 5: Subjective tuber assessments: Uniformity of Size was subjectively assessed on each replicate by the same individual during the grading process. Overall Appearance was based on uniformity of size and uniformity of shape, skin colour, deformities and eye depth. Data shown is the mean of 4 replicates.

	Uniformity of Size[1]	Overall Appearance[2]
Moderate N		
AC Hamer	3.8 a	3.8 a
AC Vigor	3.5 a	3.5 a
ODF007	3.8 a	3.5 a
ASPI17-5	3.5 a	3.3 a
Atlantic	2.3 a	2.5 ab
Destiny	2.5 a	1.8 b
ODF009	3.0 a	3.3 a
Monticello	3.0 a	3.3 a
Low N		
AC Hamer	3.3 a	3.3 ab
AC Vigor	3.3 a	3.5 a
ODF007	3.0 a	2.8 abc
ASPI17-5		
Atlantic	2.0 a	2.0 c
Destiny	2.8 a	2.3 bc
ODF009	3.3 a	3.0 abc
Monticello	3.0 a	3.3 ab

[1] Uniformity of Size: 1 (very variable) - 5 (very uniform)

[2] Overall Appearance: 1 (very poor) - 5 (outstanding)

ǂ Data between the regular and low N plots was statistically different at the p ≤ 0.05 level.

Tuber samples used to measure specific gravity were evaluated for hollow heart, brown center, stem-end discoloration, other types of internal necrosis and scab. At the moderate rate of N, very few tubers exhibited hollow heart or brown center. Many of the samples had some level of stem-end discoloration or vascular discoloration but these were not tested for wilt organisms. Some level of black scurf was noted on several entries, especially AC Hamer, but no seed treatment was used in the trial. Common scab was noted on isolated tubers from a number of samples, including ODF007, ASPI17-5, and Monticello. At the low rate of N, very few tubers exhibited hollow heart or brown centre. A few tubers showed some stem-end discoloration or vascular discolouration. Internal necrosis was evident in a small percentage of ODF007, Atlantic, and Monticello. Black scurf was noted on AC Hamer, AC Vigor, Atlantic, and Destiny, but no seed treatment was used in the trail. Scab was present at low levels on AC Vigor, Atlantic, Destiny and Monticello. Two cultivars in the low N trial, ODF009 and Atlantic, showed signs of white knot, which is often present in tubers with exceptionally high dry matter.

Chip colour scores of composite samples are presented in Table 6. All of the samples gave excellent chip scores in 2017. A higher L-value indicates a lighter chip. At the moderate rate of N, the lightest chips were produced from ASPI17-5 and AC Hamer. At the low rate of N, the lightest chips were produced from AC Vigor, AC Hamer and Destiny. AC Hamer, AC Vigor, Destiny, ODF009 and Monticello had lighter chips when grown with low N, while Atlantic and ODF007 produced lighter chips from the moderate N plots. These are composite samples from one year of testing and additional testing may be required to determine optimal agronomic conditions for chip quality.

Table 6: Chip colour scores from subsamples of each variety grown at moderate nitrogen (approximately 180 lbs/ac) and at a lower rate of N (100 lbs/ac). Data shown is the mean of duplicate analyses of a composite sample evaluated on a Hunter Colorimeter (L is a lightness score; higher numbers are lighter).

	L (Moderate N)	L (Low N)
AC Hamer	69.9	72.3
AC Vigor	67.4	72.3
ODF007	65.2	57.2
ASPI17-5	69.0	n/a
Atlantic	68.8	64.0
Destiny	68.1	72.6
ODF009	65.4	69.3
Monticello	63.6	68.0

Conclusions

The 2017 variety trial included 5 chipping potato cultivars with potential in southern Alberta. Atlantic, AC Vigor and Monticello were included in the trial as check varieties at both rates of N.

Total yield of Destiny and ODF009 was significantly lower than that of Atlantic when provided with moderate rates of N, but differences in total yield were not significant on the low N plots. Specific gravity was significantly higher for ODF007, Destiny, AC Hamer and ODF009 grown on low N compared to moderate N.

Yield of marketable sized tubers was greatest for ASPI17-5, although only significantly higher than Destiny and Kibbbitz on moderate N. This variety also responded positively to additional N.

All samples gave excellent chip colour. On Moderate N plots, the lightest chips were observed for ASPI17-5 and AC Hamer. On low N plots, AC Hamer, AC Vigor and Destiny had the highest chip scores.

The trial was designed to provide regional data for a wide range of potato cultivars. Addressing the agronomic needs of each variety may well result in improvements to yield and size profiles when compared to the results in this year of the trial.

Recommendations

- Varieties should be grown in southern Alberta for at least 3 years and these results need to be compiled to ensure a reasonable evaluation.
- To establish better estimates of yield potential and size profile for the varieties, each variety should be grown under optimal agronomic conditions (fertility, plant density, etc.).

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- Alberta Seed Producers Inc.
- ConAgra Foods, Lamb Weston Division
- Edmonton Potato Growers
- Little Potato Company
- Old Dutch Foods
- McCain Foods
- Parkland Seed Potatoes
- Prairie Gold Produce
- Rockyview Seed Potatoes
- Solanum International Inc.
- Tuberosum Technologies Inc.

Contact Information:

Michele Konschuh, Ph.D.
Potato Research Scientist
Alberta Agriculture and Forestry, CDCS
301 Horticultural Station Road East
Brooks, AB T1R 1E6

403-362-1314 phone
403-362-1306 fax

Michele.Konschuh@gov.ab.ca

Appendix A Plot Plan

Low N Variety Trial 2017 - September harvest

20 Seed pieces per row

N

24 X 66 = 1584 m2

Guard = Russet Burban

24	**Guard**		**Guard**	**Guard**	**Guard**	**Guard**	**Guard**		**Guard**		**Guard**	
23	1001 PGP17-2		1011 TT17-3	1021 TT17-2	1031 Monticello	2001 TT17-10	2011 ODF009		2021 RV013		2031 Yukon Gold	
22	1002 TT17-5		1012 EPG17-3	1022 TT17-7	1032 Shepody	2002 TT17-7	2012 TT17-1		2022 EPG17-2		2032 PGP17-2	
21	1003 PGP17-4		1013 RV008	1023 AC Hamer	1033 EPG17-2	2003 AC Hamer	2013 Destiny		2023 PGP17-3		2033 Norland	
20	1004 TT17-9		1014 ODF007	1024 Blazer Russet	1034 RV013	2004 RV008	2014 Kennebec		2024 EPG17-3		2034 TT17-9	
19	1005 TT17-10		1015 RV014	1025 TT17-4	1035 PGP17-3	2005 PGP17-4	2015 ODF010		2025 TT17-4		2035 Monticello	
18	1006 AC Vigor		1016 Kennebec	1026 Destiny	1036 RV010	2006 RV011	2016 AC Vigor		2026 Shepody		2036 ODF007	
17	1007 Norland		1017 ODF009	1027 TT17-6	1037 Yukon Gold	2007 Lollipop	2017 Blazer Russet		2027 ASPI010		2037 TT17-6	
16	1008 RV011		1018 ASPI010	1028 RV009	5001 ODF007	2008 ASPI17-2	2018 TT17-2		2028 TT17-5		5004 AC Hamer	
15	1009 TT17-8		1019 ODF010	1029 Atlantic	5002 ODF009	2009 Atlantic	2019 TT17-3		2029 RV009		5005 Destiny	
14	1010 ASPI17-2		1020 TT17-1	1030 Lollipop	5003 ODF010	2010 TT17-8	2020 RV014		2030 RV010		5006 AC Vigor	
13	**Guard**	3 m	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**		**Guard**		**Guard**	
	6m										6m	

12	**Guard**		**Guard**	**Guard**	**Guard**	**Guard**	**Guard**		**Guard**		**Guard**	
11	3001 AC Vigor		3011 Destiny	3021 TT17-2	3031 PGP17-2	4001 ASPI010	4011 TT17-9		4021 PGP17-2		4031 TT17-6	
10	3002 AC Hamer		3012 Shepody	3022 ASPI010	3032 TT17-4	4002 TT17-1	4012 Monticello		4022 Kennebec		4032 TT17-10	
9	3003 TT17-6		3013 PGP17-3	3023 ASPI17-2	3033 Norland	4003 Norland	4013 TT17-5		4023 Shepody		4033 PGP17-4	
8	3004 Atlantic		3014 RV014	3024 ODF009	3034 Yukon Gold	4004 TT17-4	4014 TT17-3		4024 TT17-2		4034 EPG17-2	
7	3005 ODF007		3015 TT17-8	3025 Lollipop	3035 TT17-9	4005 RV011	4015 PGP17-3		4025 ODF007		4035 ODF009	
6	3006 Kennebec		3016 EPG17-3	3026 Monticello	3036 RV010	4006 ASPI17-2	4016 TT17-7		4026 EPG17-3		4036 Yukon Gold	
5	3007 TT17-3		3017 EPG17-2	3027 TT17-10	3037 RV008	4007 AC Vigor	4017 RV014		4027 ODF010		4037 Lollipop	
4	3008 RV011		3018 RV009	3028 TT17-5	5007 Atlantic	4008 Destiny	4018 Atlantic		4028 RV009			
3	3009 Blazer Russet		3019 PGP17-4	3029 TT17-7	5008 Monticello	4009 TT17-8	4019 RV013		4029 AC Hamer			
2	3010 RV013		3020 ODF010	3030 TT17-1		4010 RV010	4020 Blazer Russet		4030 RV008			
1	**Guard**	3 m	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**3m**	**Guard**	**3m**	**Guard**	3m
	6m											

Variety Medium N Brooks - 2017 - Ful

20 Seed pieces per row

N ↓

24 x 88m = 2112m2

	12" spacing										
24	**Guard**		**Guard**	**Guard**	**Guard**	**Guard**		**Guard**		**Guard**	**Guard**
23	3001 Destiny		3011 EPG17-4	3021 Russet Burbank Calif	3031 Bonnata	3041 ODF007		4001 Yukon Gold	4011 LW17-1	4021 EPG17-1	4031 EPG17-4
22	3002 Excellency		3012 Monticello	3022 Atlantic	3032 ASPI17-9			4002 ASPI17-5	4012 ODF010	4022 Norland	4032 ODF007
21	3003 PGP17-1		3013 Blazer Russet	3023 ASPI17-4	3033 Red Apple			4003 AC Vigor	4013 Russet Burbank	4023 Shepody	4033 Destiny
20	3004 Kennebec		3014 ASPI17-2	3024 Basin Russet	3034 LW17-1			4004 Russet Burbank Cali	4014 ASPI010	4024 ASPI17-2	4034 ASPI17-7
19	3005 AC Hamer		3015 ASPI17-1	3025 Rosa Gold	3035 ASPI17-7			4005 Kennebec	4015 Cerata	4025 Bridget	4035 LW17-2
18	3006 Bridget		3016 ASPI17-8	3026 ASPI010	3036 LW17-2			4006 ASPI17-9	4016 Atlantic	4026 RV012	4036 AC Hamer
17	3007 RV012		3017 Yukon Gold	3027 ASPI17-5	3037 EPG17-1			4007 ASPI17-1	4017 ASPI17-4	4027 ASPI17-8	4037 AC Hamer
16	3008 Norland		3018 ODF010	3028 EPG17-3	3038 Russet Burbank			4008 ODF009	4018 PGP17-1	4028 Red Apple	4038 Bonnata
15	3009 EPG17-2		3019 AC Vigor	3029 Shepody	3039 Cerata			4009 Blazer Russet	4019 EPG17-3	4029 Basin Russet	4039 Excellency
14	3010 EPG17-5		3020 AC Hamer	3030 ODF009	3040 ASPI17-2	4041 Monticello		4010 EPG17-2	4020 Rosa Gold	4030 EPG17-5	4040 ASPI17-2
13	**Guard**	3 m	**Guard**	**Guard**	**Guard**	**Guard**		**Guard**		**Guard**	**Guard**
	6m										
	12" spacing										
	Guard = Russet Burbank										
12	**Guard**		**Guard**	**Guard**	**Guard**	**Guard**		**Guard**		**Guard**	**Guard**
11	1001 ASPI17-2		1011 ODF009	1021 Destiny	1031 EPG17-2	1041 AC Hamer		2001 ASPI17-2	2011 ODF007	2021 LW17-1	2031 ASPI17-7
10	1002 ASPI17-2		1012 Basin Russet	1022 Rosa Gold	1032 Bonnata	5001 ODF007		2002 ASPI17-5	2012 Destiny	2022 ASPI17-9	2032 EPG17-4
9	1003 ASPI17-8		1013 Bridget	1023 Yukon Gold	1033 ASPI17-4	5002 ODF009		2003 Basin Russet	2013 EPG17-5	2023 Rosa Gold	2033 EPG17-1
8	1004 Kennebec		1014 RV012	1024 EPG17-5	1034 Russet Burbank	5003 Monticello		2004 Bridget	2014 AC Vigor	2024 AC Hamer	2034 ODF009
7	1005 Shepody		1015 ODF010	1025 Norland	1035 ASPI17-5	5004 ODF010		2005 ASPI010	2015 Atlantic	2025 EPG17-3	2035 EPG17-2
6	1006 ASPI17-1		1016 AC Vigor	1026 LW17-1	1036 EPG17-4	5005 Atlantic		2006 Excellency	2016 PGP17-1	2026 RV012	2036 AC Hamer
5	1007 ASPI17-9		1017 LW17-2	1027 AC Hamer	1037 Russet Burbank Califo	5006 AC Hamer		2007 ASPI17-4	2017 Red Apple	2027 LW17-2	2037 ASPI17-1
4	1008 EPG17-1		1018 PGP17-1	1028 Atlantic	1038 ASPI010	5007 Destiny		2008 Bonnata	2018 Shepody	2028 ASPI17-8	2038 Kennebec
3	1009 Monticello		1019 Excellency	1029 ODF007	1039 Red Apple	5008 AC Vigor		2009 Russet Burbank	2019 Russet Burbank Cali	2029 Cerata	2039 Yukon Gold
2	1010 EPG17-3		1020 Blazer Russet	1030 ASPI17-7	1040 Cerata	2041 ODF010		2010 ASPI17-2	2020 Norland	2030 Blazer Russet	2040 Monticello
1	**Guard**	3 m	**Guard**	**Guard**	**Guard**	**Guard**	13m	**Guard**	**Guard**	**Guard**	**Guard**
	6m										

Project Report

Alberta Potato Variety Development 2017
CDCS, Brooks, AB

Creamer Potatoes

Prepared for:
Various Sponsors

Prepared by:

Michele Konschuh
Alberta Agriculture and Forestry
Crop Diversification Centre South
301 Horticultural Station Road East
Brooks, AB T1R 1E6

April 11, 2018

Introduction

In Alberta, potato industry stakeholders are looking for replacement varieties that use less nitrogen, less water, less pesticide, yet yield superior processing or culinary quality and tonnage. An ideal gourmet potato variety would produce a good yield of small sized tubers, be relatively tolerant of environmental fluctuations, have few defects, and have an attractive appearance. Blemish-free tubers with a good skin set that store well are very desirable. Varieties from breeding programs in Canada, Europe and the United States are often being assessed. Many breeding programs target disease resistance, nitrogen use efficiency and excellent storage potential in addition to increased yield. Tuber yield potential and nutritional requirements are impacted by variety characteristics and by environmental characteristics such as the length of the growing season (Westerman, 1993). As noted by Love et al. (2003), the full potential of a new variety may not be realized until proper management is implemented. There is increasing pressure on potato producers to utilize best management practices to reduce the environmental footprint for potatoes. The costs of such shifts in production practices will be borne primarily by producers.

The purpose of this project was to pool resources to evaluate potential varieties from a range of sources, using a cooperative approach. This trial was established to collect local agronomic data on varieties from breeding programs in Canada, the U.S. and elsewhere. The varieties were planted in replicated plots at the Crop Diversification Centre in Brooks, AB and were provided with 180 lbs/ac N and, if requested, 100 lbs/ac N. Alberta data is essential when selecting varieties appropriate for our climate, our customers and industry stakeholders.

Objectives

A. To evaluate potential new varieties for the creamer market;
B. To provide the potato industry an opportunity to assess varieties grown under local conditions;
C. To compare varieties from several breeding programs (including AAFC) under Alberta conditions; and
D. To determine the response of new creamer varieties to nitrogen fertilizer rates.

Materials and Methods

The variety evaluation was conducted in small plots at the Crop Diversification Centre South in Brooks, AB. Fertility for the low N plots (100 lbs/ac) was achieved through a combination of soil fertility (83 lbs/ac N; 253 lbs/ac P) and broadcast fertilizer (90 lbs/ac of 11-52-0) incorporated prior to planting. Low N plots received an additional top-dressing (15 lbs/ac of 46-0-0) at hilling, for a total of 100 lbs/ac N. Moderate N plots received an additional top-dressing (189 lbs/ac of 46-0-0) at hilling, for a total of 180 lbs/ac N. Within each level of nitrogen, varieties were planted in four replicate rows in a randomized complete block design along with standard varieties (Atlantic, AC Vigor and Monticello). Each block was planted adjacent to guard rows to reduce any edge effects (see plot plans, Appendix A).

Eptam 8E (1.8 L/ac) was applied prior to planting (May 4) to control weeds. Seed of standard cultivars was provided by Edmonton Potato Growers and seed of test cultivars was provided by each participant. Potatoes were planted May 18 (Early plots), May30, 2017 (Low N Main) and May 29, 2017 (Moderate N Main) approximately 12 to 15cm deep using a two-row tuber unit planter. Seed was planted at 30cm spacing in 6m rows spaced 90cm apart. The plots were irrigated to maintain soil moisture close to 70%. Foliar fungicides were applied twice during the growing season to prevent early and late blight from developing (Table 1).

Table 1: Foliar fungicides applied to the potato crop in 2017 to prevent early and late blight development.

Date of Application	*Fungicide*	*Rate*
7 July	Ridomil Gold/Bravo	0.83L/ac
25 July	Quadris	324mL/ac

Figure 1: Variety evaluation trial at CDCS in Brooks, AB July 14, 2017.

Early plots were harvested green August 14, 2017. Reglone (1.0 L/ac) was applied September 1 to desiccate the main harvest plots. The Low N early plots were harvested August 18, 2016; the Low N Main plots were harvested September 19 to 20, 2017 using a 1-row Grimme harvester.

Creamer sized tubers were stored at 8˚C until graded. Tubers were graded into size categories (less than 25mm, 25 to 41mm, over 41mm and deformed). A sample of twenty-five tubers (25 to 41mm) from each replicate was used to determine specific gravity using the weight in air over weight in water method. These tubers were cut longitudinally to assess internal defects. A composite sample of 32 tubers (8 per rep) was stored at 8˚C until culinary analyses were performed. Samples were evaluated for bake and boil by the Food Science and Technology Centre, Brooks, in January 2018.

The data presented here have been statistically analyzed using ANOVA and Tukey's Multiple Comparison Test; (SPSS; $p \leq 0.05$). Statistical summaries are available upon request. T-tests were used to compare results for varieties grown at different levels of N.

Results and Discussion – Fresh Market

Sample hills of each creamer variety were dug for a field day at CDCS August 24, 2017. Photos of these varieties are shown in Figure 2.

Figure 2. Fresh market creamer sized varieties at CDCS field day August 24, 2017: a) Anouk, b) RV010, c) Rosa Gold, d) Yellow Star, and e) Lollipop.

Yield data (total yield; ton/ac) and specific gravities of each of the creamer-style cultivars are shown in Table 2. Four cultivars were planted with little additional nitrogen and were harvested in August (Low N Early harvest). Of these early maturing cultivars, Yellow Star produced significantly greater total yield than the other cultivars, an indication that this cultivar is an efficient nitrogen utilizer. Specific gravity of Yellow Star was significantly higher than Rosa Gold, but not statistically different from the other two cultivars in these plots.

Another two cultivars were planted in low N plots (100 lbs/ac) and were harvested in September (Low N – main harvest). Total yield was higher for RV010 than for Lollipop. RV010 was grown in early and full season plots. Total yield was significantly higher from full season plots.

Further addressing the agronomic needs of each variety may well result in improvements to yield and size profiles when compared to the results in this trial.

Table 2: Estimated total yield (ton/acre) and specific gravity for each creamer potato variety grown on approximately 100 lbs/ac nitrogen (Low N). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

CDCS	Yield (ton/ac)	SG
Low N – early harvest		
Anouk	13.4 ab	1.068 bc
RV010	10.9 ab¥	1.077 a
Rosa Gold	7.7 b	1.065 c
Yellow Star	17.1 a	1.073 ab
Low N – main harvest		
Lollipop	15.5 b	n/a
RV010	26.7 a¥	n/a

¥ Data between the early and main harvest plots was statistically different at the p ≤ 0.05 level.

The mean percentage of total tuber number in each size category for creamer-style cultivars is shown in Table 3. Some differences in size distribution was noted for the creamer entries in 2017. Rosa Gold produced a higher percentage of tubers over 41mm and lower percentage of creamer-sized (25 to 41mm) tubers than RV010 or Anouk.

Size distribution for the two creamer-style cultivars grown on low N for the full season were similar (Table 3). Both of the varieties yielded around 50% of tubers over 41 mm indicating that desiccation or harvest dates may need to be adjusted for optimal yield of creamer sized potatoes. There was a difference in size distribution for RV010 grown full season compared to RV010 harvested early, with a significantly lower percentage of tubers under 25mm and a significantly higher percentage of tubers over 41mm from full season plots.

Table 3: Percentage of total tuber number in each size category (< 25mm, 25-41mm, > 41mm and deformed) for each creamer potato variety grown on 100lbs/ac nitrogen (Low N). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

CDCS	< 25 mm	25– 41mm	> 41mm	Deformed
Low N – early harvest				
Anouk	32.5 a	51.5 a	15.5 b	0.3 a
RV010	35.8 a¥	52.8 a	11.3 b¥	0.0 a
Rosa Gold	18.3 a	36.3 b	43.8 a	1.8 a
Yellow Star	12.5 a	45.5 ab	42.3 a	0.0 a
Low N – main harvest				
Lollipop	3.6 a	41.2 a	55.1 a	0.3 b
RV010	8.0 a¥	41.9 a	49.4 a¥	3.0 a

¥ Data between the early and main harvest plots was statistically different at the p ≤ 0.05 level.

The yield of tubers (estimated ton/ac) of each creamer-style variety is shown by size category in Table 4. There were significant differences in yield by size category between the four cultivars grown in the early harvest plots. Anouk yielded significantly more tubers 25 to 41mm in diameter than RV010, Rosa Gold or Yellow Star. Yellow Star yielded significantly more tubers over 41mm than Anouk and RV010.

For varieties grown on low N and harvested in September, RV010 yielded significantly more tubers over 41mm than Lollipop. RV010 was harvested at two different times. The later harvest resulted in significantly greater yield of tubers in the > 41mm category.

Table 4: Estimated yield (ton/ac) in each size category (< 25mm, 25-41mm, > 41mm, and deformed) for each creamer potato variety grown on a lower rate of N (100 lbs/ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the $p < 0.05$ level.

CDCS	< 25 mm	25– 41mm	> 41mm	Deformed
Low N – early harvest				
Anouk	1.20 ab	7.8 a	4.3 b	0.1 a
RV010	1.3 a	6.1 b	3.5 b	0.1 a
Rosa Gold	0.3 c	1.3 c	6.0 ab	0.1 a
Yellow Star	0.4 bc	5.2 b	11.5 a¥	0.0 a
Low N – main harvest				
Lollipop	0.1 a	3.9 a	11.4 b	0.0 b
RV010	0.3 a	6.7 a	19.5 a¥	0.2 a

¥ Data between the early and main harvest plots was statistically different at the $p \leq 0.05$ level.

Tuber samples used to measure specific gravity were evaluated for hollow heart, brown center, stem-end discoloration, other types of internal necrosis, scab and black scurf. For creamer-style cultivars, very few tubers exhibited internal defects.

Tuber set parameters are presented in Table 5. The number of tubers per plant is often an indication of the potential for creamer potato production. RV010 and Anouk produced the highest number of tubers per plant on low N in the early harvest, but Yellow Star was not significantly lower. For cultivars planted on low N and harvested in September, RV010 set significantly more tubers per plant than Lollipop. A similar set for RV010 grown in early and full season plots indicates that tuber set for this cultivar is not affected by length of the growing season.

Table 5: Tuber set parameters for each creamer potato variety: Data shown is the mean of 4 replicates.

	Tubers per stem	Tubers per plant
Low N – early harvest		
Anouk	n/a	17.1 a
RV010	n/a	17.5 a
Rosa Gold	n/a	6.9 b
Yellow Star	n/a	14.6 a
Low N – main harvest		
Lollipop	1.8 b	9.8 b
RV010	2.8 a	16.0 a

† Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.

Culinary evaluations were conducted on all cultivars in the trial. Results for the creamer-style cultivars are presented in Table 6. Texture differences were noted after boiling and baking. None of the entries showed evidence of sloughing. Moderate after cooking discolouration was noted for Rosa Gold on early harvested plots after boiling.

Table 6: Culinary evaluations of each creamer potato variety grown on low nitrogen (approx. 100lbs/ac) at CDCS. Data shown is the mean of duplicate analyses of a composite sample.

Boiled Potatoes

CDCS	Flesh color	Waxiness†	Sloughing	After Cooking Discoloration*
Low N – early harvest				
Anouk	Yellow	2	3	3
RV010	Deep Yellow	2	3	3
Rosa Gold	Deep Yellow	2	3	2
Yellow Star	Deep Yellow	2	3	3
Lollipop	Of-white	2	3	3
RV010	Deep Yellow	3	3	3

† Waxiness: 1 = very waxy (very clean cuts); 2 = waxy (clean cuts with some residue); 3 = slightly waxy (more mealy than waxy); 4 = not waxy (fluffy/mealy)

* After Cooking discoloration and sloughing: 1 = severe; 2 = moderate; 3 = none

Baked Potatoes

CDCS	Flesh color	Textureǂ	After Cooking Discoloration*
Low N – early harvest			
Anouk	Deep yellow	2	3
RV010	Deep Yellow	2	3
Rosa Gold	Deep Yellow	2	3
Yellow Star	Deep Yellow	2	3
Low N – main harvest			
Lollipop	Off-white	2	3
RV010	Deep Yellow	3	3

ǂ Texture: 1 = wet; 2 = slightly wet; 3 = slightly mealy; 4 = mealy

Conclusions

The 2017 variety trial included 5 cultivars being evaluated for the creamer-sized market in southern Alberta. There was no check variety included in the trial as this market is still developing. Yield of creamer-sized potatoes was modest for most cultivars, and yield of tubers over 41mm indicates that desiccation and harvest dates may need to be optimized for each cultivar in order to increase the yield of desired sizes. Many cultivars had different culinary attributes that will need to be considered when developing a marketing approach. No cultivars in the trial had issues with sloughing or internal defects, and only one showed moderate after-cooking darkening.

RV010 was the only cultivar grown in early and full-season plots. For that variety, the length of time in the field had an impact on total yield and yield of specific size categories, but not on tubers per plant or culinary parameters evaluated.

The trial was designed to provide regional data for a wide range of potato cultivars. Addressing the agronomic needs of each variety may well result in improvements to yield and size profiles when compared to the results in this year of the trial.

Recommendations

- Varieties should be grown in southern Alberta for at least 3 years and these results need to be compiled to ensure a reasonable evaluation.
- To establish better estimates of yield potential and size profile for the varieties, each variety should be grown under optimal agronomic conditions (fertility, plant density, etc.).

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Alberta Seed Producers Inc.
ConAgra Foods, Lamb Weston Division
Edmonton Potato Growers
Little Potato Company
Old Dutch Foods
McCain Foods
Parkland Seed Potatoes
Prairie Gold Produce
Rockyview Seed Potatoes
Solanum International Inc.
Tuberosum Technologies Inc.

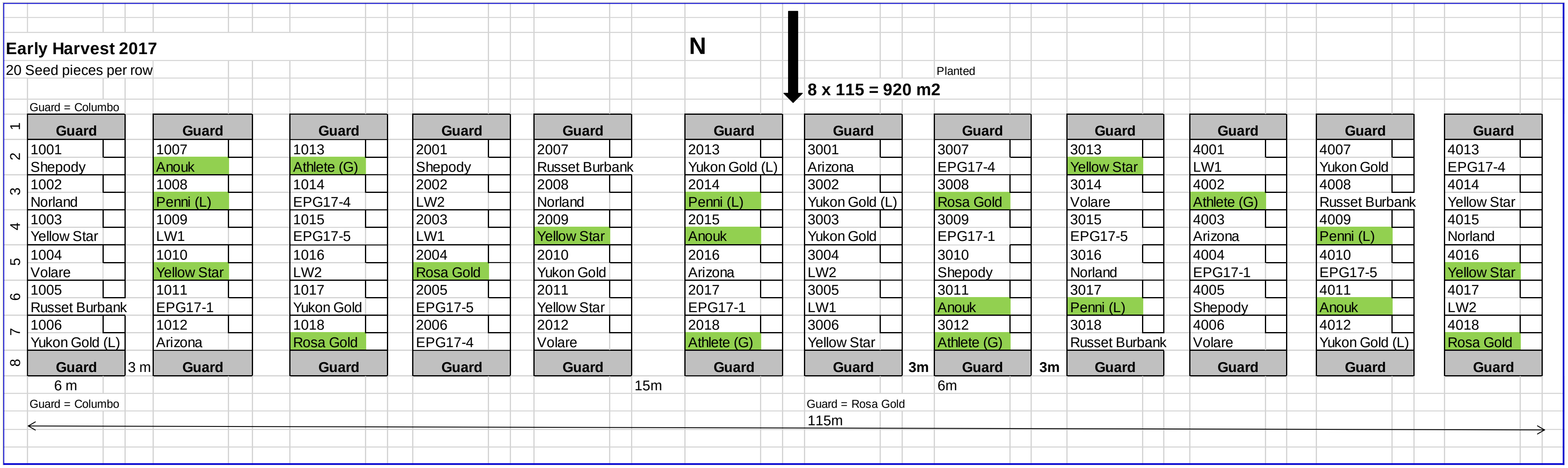
Contact Information:

Michele Konschuh, Ph.D.
Potato Research Scientist
Alberta Agriculture and Forestry, CDCS
301 Horticultural Station Road East
Brooks, AB T1R 1E6

403-362-1314 phone
403-362-1306 fax

Michele.Konschuh@gov.ab.ca

Appendix A Plot Plan



Early Harvest 2017

20 Seed pieces per row

N

Planted

8 x 115 = 920 m2

Guard = Columbo

1	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**
2	1001 Shepody	1007 Anouk	1013 Athlete (G)	2001 Shepody	2007 Russet Burbank	2013 Yukon Gold (L)	3001 Arizona	3007 EPG17-4	3013 Yellow Star	4001 LW1	4007 Yukon Gold	4013 EPG17-4
3	1002 Norland	1008 Penni (L)	1014 EPG17-4	2002 LW2	2008 Norland	2014 Penni (L)	3002 Yukon Gold (L)	3008 Rosa Gold	3014 Volare	4002 Athlete (G)	4008 Russet Burbank	4014 Yellow Star
4	1003 Yellow Star	1009 LW1	1015 EPG17-5	2003 LW1	2009 Yellow Star	2015 Anouk	3003 Yukon Gold	3009 EPG17-1	3015 EPG17-5	4003 Arizona	4009 Penni (L)	4015 Norland
5	1004 Volare	1010 Yellow Star	1016 LW2	2004 Rosa Gold	2010 Yukon Gold	2016 Arizona	3004 LW2	3010 Shepody	3016 Norland	4004 EPG17-1	4010 EPG17-5	4016 Yellow Star
6	1005 Russet Burbank	1011 EPG17-1	1017 Yukon Gold	2005 EPG17-5	2011 Yellow Star	2017 EPG17-1	3005 LW1	3011 Anouk	3017 Penni (L)	4005 Shepody	4011 Anouk	4017 LW2
7	1006 Yukon Gold (L)	1012 Arizona	1018 Rosa Gold	2006 EPG17-4	2012 Volare	2018 Athlete (G)	3006 Yellow Star	3012 Athlete (G)	3018 Russet Burbank	4006 Volare	4012 Yukon Gold (L)	4018 Rosa Gold
8	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**

3 m

3m

3m

6 m

15m

6m

Guard = Columbo

Guard = Rosa Gold

115m

Low N Variety Trial 2017 - September harvest

20 Seed pieces per row

24 X 66 = 1584 m2

N

Guard = Russet Burban

24	**Guard**		**Guard**	**Guard**	**Guard**	**Guard**	**Guard**		**Guard**		**Guard**	
23	1001 PGP17-2		1011 TT17-3	1021 TT17-2	1031 Monticello	2001 TT17-10	2011 ODF009		2021 RV013		2031 Yukon Gold	
22	1002 TT17-5		1012 EPG17-3	1022 TT17-7	1032 Shepody	2002 TT17-7	2012 TT17-1		2022 EPG17-2		2032 PGP17-2	
21	1003 PGP17-4		1013 RV008	1023 AC Hamer	1033 EPG17-2	2003 AC Hamer	2013 Destiny		2023 PGP17-3		2033 Norland	
20	1004 TT17-9		1014 ODF007	1024 Blazer Russet	1034 RV013	2004 RV008	2014 Kennebec		2024 EPG17-3		2034 TT17-9	
19	1005 TT17-10		1015 RV014	1025 TT17-4	1035 PGP17-3	2005 PGP17-4	2015 ODF010		2025 TT17-4		2035 Monticello	
18	1006 AC Vigor		1016 Kennebec	1026 Destiny	1036 RV010	2006 RV011	2016 AC Vigor		2026 Shepody		2036 ODF007	
17	1007 Norland		1017 ODF009	1027 TT17-6	1037 Yukon Gold	2007 Lollipop	2017 Blazer Russet		2027 ASPI010		2037 TT17-6	
16	1008 RV011		1018 ASPI010	1028 RV009	5001 ODF007	2008 ASPI17-2	2018 TT17-2		2028 TT17-5		5004 AC Hamer	
15	1009 TT17-8		1019 ODF010	1029 Atlantic	5002 ODF009	2009 Atlantic	2019 TT17-3		2029 RV009		5005 Destiny	
14	1010 ASPI17-2		1020 TT17-1	1030 Lollipop	5003 ODF010	2010 TT17-8	2020 RV014		2030 RV010		5006 AC Vigor	
13	**Guard**	3 m	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**		**Guard**		**Guard**	
	6m										6m	
12	**Guard**		**Guard**	**Guard**	**Guard**	**Guard**	**Guard**		**Guard**		**Guard**	
11	3001 AC Vigor		3011 Destiny	3021 TT17-2	3031 PGP17-2	4001 ASPI010	4011 TT17-9		4021 PGP17-2		4031 TT17-6	
10	3002 AC Hamer		3012 Shepody	3022 ASPI010	3032 TT17-4	4002 TT17-1	4012 Monticello		4022 Kennebec		4032 TT17-10	
9	3003 TT17-6		3013 PGP17-3	3023 ASPI17-2	3033 Norland	4003 Norland	4013 TT17-5		4023 Shepody		4033 PGP17-4	
8	3004 Atlantic		3014 RV014	3024 ODF009	3034 Yukon Gold	4004 TT17-4	4014 TT17-3		4024 TT17-2		4034 EPG17-2	
7	3005 ODF007		3015 TT17-8	3025 Lollipop	3035 TT17-9	4005 RV011	4015 PGP17-3		4025 ODF007		4035 ODF009	
6	3006 Kennebec		3016 EPG17-3	3026 Monticello	3036 RV010	4006 ASPI17-2	4016 TT17-7		4026 EPG17-3		4036 Yukon Gold	
5	3007 TT17-3		3017 EPG17-2	3027 TT17-10	3037 RV008	4007 AC Vigor	4017 RV014		4027 ODF010		4037 Lollipop	
4	3008 RV011		3018 RV009	3028 TT17-5	5007 Atlantic	4008 Destiny	4018 Atlantic		4028 RV009			
3	3009 Blazer Russet		3019 PGP17-4	3029 TT17-7	5008 Monticello	4009 TT17-8	4019 RV013		4029 AC Hamer			
2	3010 RV013		3020 ODF010	3030 TT17-1		4010 RV010	4020 Blazer Russet		4030 RV008			
1	**Guard**	3 m	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**3m**	**Guard**	**3m**	**Guard**	3m
	6m											

Project Report

Alberta Potato Variety Development 2017
CDCS, Brooks, AB

French Fry Potatoes

Prepared for:
Various Sponsors

Prepared by:

Michele Konschuh
Alberta Agriculture and Forestry
Crop Diversification Centre South
301 Horticultural Station Road East
Brooks, AB   T1R 1E6

November 6, 2017

Introduction

In Alberta, potato industry stakeholders are looking for replacement varieties that use less nitrogen, less water, less pesticide, yet yield superior processing or culinary quality and tonnage. An ideal French fry variety would have earlier maturity than Russet Burbank, be relatively tolerant of environmental fluctuations, have few defects, yield well and have specific gravity in the desired range (1.086 to 1.092). Good fry color out of the field is an asset, and good fry color out of storage is also very desirable. Varieties from breeding programs in Canada, Europe and the United States are often being assessed. Many breeding programs target disease resistance, nitrogen use efficiency and excellent storage potential in addition to increased yield. Tuber yield potential and nutritional requirements are impacted by variety characteristics and by environmental characteristics such as the length of the growing season (Westerman, 1993). As noted by Love et al. (2003), the full potential of a new variety may not be realized until proper management is implemented. There is increasing pressure on potato producers to utilize best management practices to reduce the environmental footprint for potatoes. The costs of such shifts in production practices will be borne primarily by producers.

The purpose of this project was to pool resources to evaluate potential varieties from a range of sources, using a cooperative approach. This trial was established to collect local agronomic data on varieties from breeding programs in Canada, the U.S. and elsewhere. The varieties were planted in replicated plots at the Crop Diversification Centre in Brooks, AB and were provided with 180 lbs/ac N (Medium N rate), 1609 lbs/ac (Early Harvest) and, if requested, 100 lbs/ac N (Low N rate). Alberta data is essential when selecting varieties appropriate for our climate, our customers and industry stakeholders.

Objectives

A. To evaluate potential new varieties for French fry processing;
B. To provide the potato industry an opportunity to assess varieties grown under local conditions;
C. To compare varieties from several breeding programs (including AAFC) under Alberta conditions; and
D. To determine the response of new French fry varieties to nitrogen fertilizer rates.

Materials and Methods

The variety evaluation was conducted in small plots at the Crop Diversification Centre South in Brooks, AB. Fertility for the Early Harvest plots (160 lbs/ac) was achieved through a combination of soil fertility (83 lbs/ac N; 253 lbs/ac P) and broadcast fertilizer (90 lbs/ac of 11-52-0) incorporated prior to planting. EarlyHarvest plots received an additional top-dressing (145 lbs/ac of 46-0-0) at hilling, for a total of 160 lbs/ac N. Fertility for the low N plots (100 lbs/ac) was achieved through a combination of soil fertility (83 lbs/ac N; 253 lbs/ac P) and broadcast fertilizer (90 lbs/ac of 11-52-0) incorporated prior to planting. Low N plots received an additional top-dressing (15 lbs/ac of 46-0-0) at hilling, for a total of 100 lbs/ac N. Moderate N plots received an additional top-dressing (189 lbs/ac of 46-0-0) at hilling, for a total of 180 lbs/ac N. Within each harvest or level of fertility, varieties were planted in four replicate rows in a randomized complete block design along with standard varieties (Russet Burbank and/or Shepody). Each block was planted adjacent to guard rows to reduce any edge effects (see plot plans, Appendix A).

Eptam 8E (1.8 L/ac) was applied prior to planting (May 4) to control weeds. Seed of standard cultivars was provided by Edmonton Potato Growers and seed of test cultivars was provided by each participant. Potatoes were planted May 18 (Early Harvest) May 30, 2017 (Low N Main) and May 29, 2017 (Moderate N Main) approximately 12 to 15cm deep using a two-row tuber unit planter. Seed was planted at 30cm spacing in 6m rows spaced 90cm apart. The plots were irrigated to maintain soil moisture close to 70%. Foliar fungicides were applied twice during the growing season to prevent early and late blight from developing (Table 1).

Table 1: Foliar fungicides applied to the potato crop in 2017 to prevent early and late blight development.

Date of Application	*Fungicide*	*Rate*
7 July	Ridomil Gold/Bravo	0.83L/ac
25 July	Quadris	324mL/ac

Figure 1: Variety evaluation trial at CDCS in Brooks, AB June 26, 2017.

The Early Harvest plots were harvested green. Reglone was applied (1.0 L/ac) September 1 to the Low N and Medium N plots. The Early Harvest plots were harvested August 14, 2017. The Low N plots were harvested September 14 to 15, 2017 and Moderate N plots were harvested September 12 to 13 using a 1-row Grimme harvester.

French fry tubers were stored at 8˚C until graded. Tubers were graded into size categories (less than 113g, 113 to 170g, 170 to 284g, over 284g and deformed). A sample of twenty-five tubers (113 to 284g) from each replicate was used to determine specific gravity using the weight in air over weight in water method. These tubers were cut longitudinally to assess internal defects. A composite sample of 8 tubers (2 per rep) was stored at 8˚C until culinary analyses were performed. Samples were evaluated for fry colour using a USDA colour chart in November 2017.

The data presented here have been statistically analyzed using ANOVA and Tukey’s Multiple Comparison Test; (SPSS; $p \leq 0.05$). Statistical summaries are available upon request. T-tests were used to compare results for varieties grown at different levels of N.

Results and Discussion – French fries

Sample hills of each variety were dug for a field day at CDCS August 24, 2017. Photos of these varieties are shown in Figure 2.

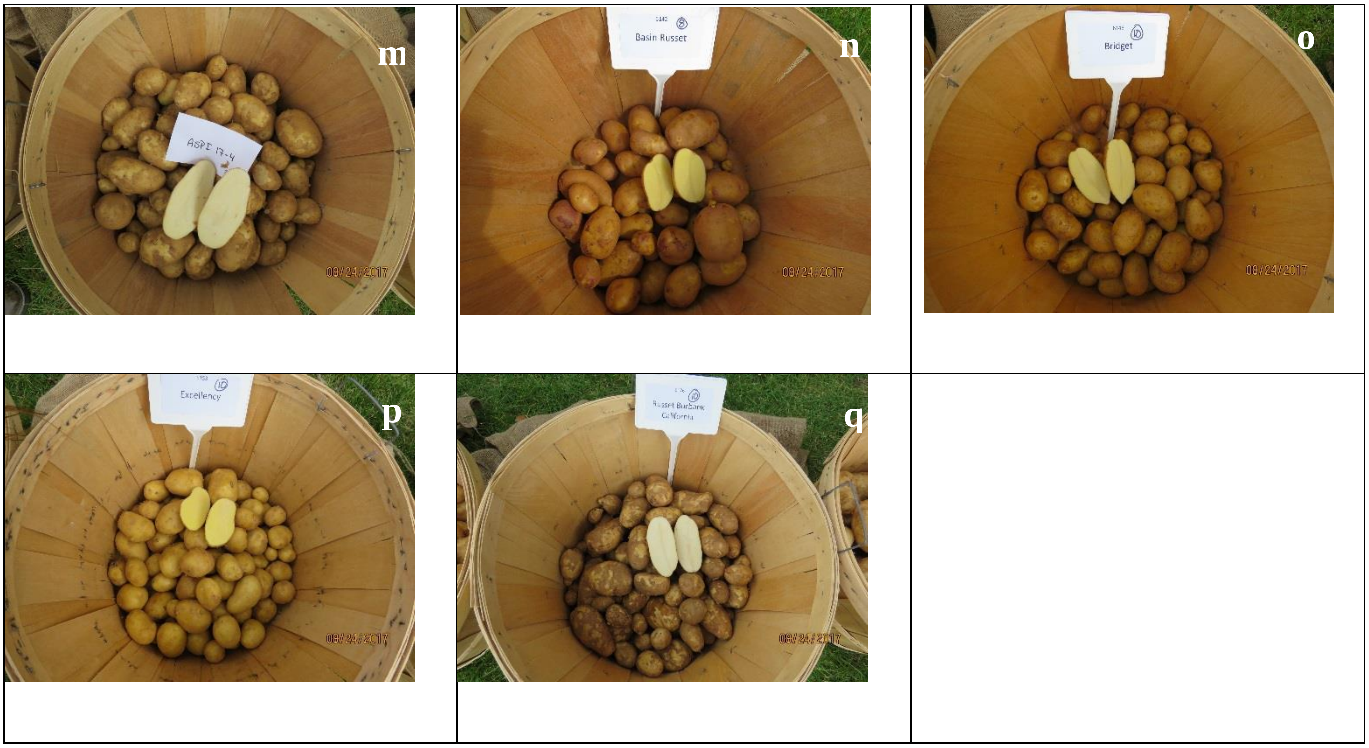


Figure 2. French fry varieties at CDCS field day August 24, 2017: a) LW17-1, b) LW17-2, c) Russet Burbank, d) Shepody, e) ASPI010, f) EPG17-2, g) EPG17-3, h) ASPI17-2, i) Blazer Russet, j) Kennebec, k) ASPI17-1, l) ASPI17-3, m) ASPI17-4, n) Basin Russet, o) Bridget, p) Excellency, q) California Russet Burbank.

Yield data (total yield and marketable yield; ton/ac), mean tubers size (oz.) and specific gravities of each of the French fry cultivars are shown in Table 2. Two cultivars and two standard varieties were planted with a moderate rate of nitrogen and were harvested in August (Early Harvest). There were no significant differences in total yield between cultivars. Marketable yield of LW17-1 was not significantly different from that of Shepody or Russet Burbank in these plots. Mean tuber size of both trial cultivars was significantly lower than that of Shepody in these plots, but specific gravity was higher than either standard. LW17-2 appeared to require additional N or a longer season to reach its potential.

Another six cultivars and two standards were planted in low N plots (100 lbs/ac) and were harvested in September (Low N – main harvest). Total yield ranged from 14.3 for ASPI17-2 to 38.3 ton/ac for EPG17-3. The total yield of EPG17-3 was significantly higher than the check varieties and other cultivars (Table 2). Marketable yield of EPG17-3 was significantly higher than that of Shepody, but was not statistically different from that of Kennebec. Marketable yield of EPG17-2 was second highest, but not significantly different from the check varieties. Kennebec produced tubers with the greatest mean tuber size. Mean tuber size of EPG17-2, EPG17-3, and Blazer Russet were not statistically different from Shepody. Specific gravities ranged from 1.084 for EPG17-3 to 1.098 EPG17-2. Specific gravities of most of the entries were suitable for French fry production.

Fourteen cultivars and three standards were grown on a moderate level of N (180 lbs/ac) and harvested in September (Moderate N – main harvest). At this level of N, total yield ranged from 17.3 ton/ac for ASPI17-2 to 39.4 ton/ac of EPG17-3. Although there were some significant differences, most of the cultivars overlap with the standards. The total yield of EPG17-3 and ASPI17-1 was significantly greater than both standards in these plots. Marketable yield ranged from 14.0 ton/ac (ASPI010) to 33.9 ton/ac for EPG17-3. The marketable yield of EPG17-3 was significantly greater than yield of the standards, but was not statistically different from EPG17-2, ASPI17-1, Bridget, Excellency or Kennebec (Table 2). Mean tuber size ranged from 5.6 oz (ASPI010) to 10.7 oz for Kennebec, and most cultivars were not significantly different from the standards, Shepody and Russet Burbank. Specific gravity ranged from 1.079 for ASPI17-1 to 1.099 for LW17-2. Specific gravity of ASPI010, ASPI17-4, LW17-1, and LW17-2 were significantly higher than the standard varieties.

Total yield, marketable yield, mean tuber size and specific gravity of LW17-1 were all significantly affected by harvest date (Table 2). For LW17-2, the mean tuber weight was not significantly different between the August and September harvest dates, but total yield, marketable yield and specific gravity were higher at the September harvest.

Seven of the cultivars were grown at two levels of N. There were no statistical differences in total yield, marketable yield, mean tuber size or specific gravity for cultivars grown at 100 and 180 lbs/ac N in 2017. Specific gravity was significantly lower for ASPI17-2 grown on moderate N compared to low N. The specific gravity for other entries was not affected (Table 2).

Further addressing the agronomic needs of each variety may well result in improvements to yield and size profiles when compared to the results in this trial.

Table 2: Estimated total yield (ton/acre), marketable yield (ton/ac), mean tuber size (oz.) and specific gravity for each French fry variety grown on approximately 100 lbs/ac nitrogen (Low N), 180 lbs/ac nitrogen (Moderate N) and 150 lbs/ac nitrogen (Early Harvest). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

CDCS	Yield (ton/ac)	Marketable Yield	Mean Tuber Size	SG
Early harvest				
LW17-1	12.9 a¥	5.1 a¥	5.0 b¥	1.080 a¥
LW17-2	11.4 a¥	1.1 b¥	5.0 b	1.079 a¥
Russet Burbank	13.6 a¥	5.7 a¥	5.7 ab¥	1.065 b¥
Shepody	11.2 a¥	4.9 a¥	5.8 a¥	1.067 b¥
Low N – main harvest				
ASPI010	25.8 bc	17.2 bc	6.4 c	1.097 ab
EPG17-2	30.3 b	26.0 ab	7.1 bc	1.098 a
EPG17-3	38.3 a	31.0 a	7.9 abc	1.084 b
ASPI17-2	14.3 d	13.4 c	7.9 abc	1.090 abǂ
Blazer Russet	23.6 bc	20.3 bc	8.9 ab	1.091 ab
Kennebec	27.5 bc	22.7 abc	9.6 a	1.087 ab
Shepody	20.3 cd	16.3 bc	8.6 ab	1.096 ab
Moderate N – main harvest				
ASPI010	27.2 b-e	14.0 d	5.6 g	1.098 ab
EPG17-2	30.1 b-e	24.9 abc	7.6 c-f	1.094 a-d
EPG17-3	39.4 a	33.9 a	8.9 abc	1.084efg
ASPI17-1	32.5 a-c	26.9 ab	8.3 bcd	1.079 g
ASPI17-2	17.3 f	15.3 cd	8.6 bcd	1.086 efgǂ
ASPI17-3	28.3 b-e	21.8 bcd	8.6 bcd	1.086 efg
ASPI17-4	30.7 a-e	20.0 bcd	6.2 efg	1.097 ab
Basin Russet	23.7 def	18.6 bcd	8.4 bcd	1.092 b-e
Blazer Russet	21.3 ef	18.0 bcd	8.7 bcd	1.086 efg
Bridget	34.3 abc	26.9 ab	7.0 c-g	1.089 c-f
Excellency	34.0 ab	24.9 abc	7.1 c-g	1.086 efg
Kennebec	30.7 a-e	25.7 abc	10.7 a	1.084 efg
LW17-1	25.6 c-f¥	21.7 bcd¥	7.4 c-g¥	1.096 abc¥
LW17-2	29.7 b-e¥	18.2 bcd¥	5.8 fg	1.099 a¥
California Russet Burbank	22.7 ef	14.3 d	6.7 d-g	1.084 efg
Russet Burbank	28.2 b-e¥	20.3 bcd¥	8.0 b-e¥	1.088 def¥
Shepody	25.3 c-f¥	20.7 bcd¥	9.9 ab¥	1.082 fg¥

ǂ Data between the moderate and low N plots was statistically different at the p ≤ 0.05 level.

¥ Data between the Early Harvest and Main Harvest was statistically different at the p ≤ 0.05 level.

The mean percentage of total tuber number in each size category is shown in Table 3. For cultivars harvested from Early Harvest plots in August, LW17-2 produced a significantly higher percentage of small tubers (< 4 oz) and a significantly lower percentage of tubers in the 4 to 6 oz. range compared to LW17-1 and the standards. LW17-2 may require a longer growing season to shift the size profile. LW17-1 and LW17-2 produced a significantly lower percentage of tubers in the 6 to 10 oz. category than either standard as well as a lower percentage of deformed tubers.

For varieties grown on low N (100 lbs/ac) and harvested in September, there were some differences in the percentage of tubers in each size category. In particular, ASPI010 had a significantly higher percentage of small tubers then the standards and ASPI17-2 produced a significantly greater percentage of tubers in the 6 to

10 oz. category compared to most other entries (Table 3). EPG17-2, EPG17-3, Blazer Russet, and Kennebec produced size profiles quite similar to those of the standards with a lower percentage of deformed tubers.

The size profiles of entries grown on moderate N (180 lbs/ac) differed between entries and some differed significantly from the standards. Most of the entries had a smaller percentage of deformed tubers than the standards. ASPI010 produced significantly higher percentages of small tubers (Table 3).

A comparison of LW17-1 and LW17-2 harvested in August versus September indicated a significant shift in size profile toward larger tubers, as expected.

Surprisingly, there were few significant differences in the percentage of tubers in each size category for potatoes grown on low N compared to moderate N (Table 3). Nitrogen had a greater impact on the size distribution for ASPI010. ASPI010 grown on moderate N produced significantly higher percentage of small tubers and significantly lower percentage of tubers in the over 10 oz. category than when grown on low N. These results suggest that ASPI10 may have better nitrogen use efficiency than Russet Burbank and may be suitable for low input production.

Table 3: Percentage of total tuber number in each size category (< 4 oz, 4 to 6 oz, 6 to 10 oz, > 10 oz, and deformed) for each French fry variety grown on approximately 100 lbs/ac nitrogen (Low N), 180 lbs/ac nitrogen (Moderate N) and 160 lbs/ac nitrogen (Early Harvest). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the $p < 0.05$ level.

CDCS	< 4 oz	4 to 6 oz	6 to 10 oz	> 10 oz	Deformed
Early harvest					
LW17-1	60.8 b¥	29.9 a	8.2 b¥	0.4 a¥	0.7 b
LW17-2	91.0 a¥	6.9 b¥	1.7 b¥	0.0 a¥	0.4 b
Russet Burbank	47.9 b¥	21.4 a¥	17.5 a¥	2.7 a¥	10.5 a
Shepody	49.0 b¥	21.7 a¥	17.8 a¥	3.6 a¥	7.9 a
Low N – main harvest					
ASPI010	33.7 aǂ	30.8 a	27.8 b	7.3 dǂ	0.4 b
EPG17-2	13.4 bc	20.5 ab	41.9 ab	23.1 bcd	1.1 b
EPG17-3	13.6 bc	18.2 ab	34.2 ab	28.5 a-d	5.5 ab
ASPI17-2	5.5 cǂ	19.2 b	49.4 a	25.2 a-d	0.7 b
Blazer Russet	11.9 bc	14.4 b	31.0 b	39.6 ab	3.1 ab
Kennebec	11.3 bc	10.5 b	24.8 b	47.2 a	6.2 ab
Shepody	14.8 bc	13.9 b	30.4 b	36.3 abc	4.7 ab
Moderate N – main harvest					
ASPI010	47.9 aǂ	31.4 ab	18.4 de	1.6 gǂ	0.8 d
EPG17-2	16.2 ef	21.1 cde	36.6 abc	24.7 a-f	1.3 d
EPG17-3	11.9 f	13.3 ef	32.6 abc	39.6 ab	2.5 bcd
ASPI17-1	16.5 cf	14.5 def	30.2 a-d	37.8 abc	1.0 d
ASPI17-2	10.3 fǂ	15.9 c-f	35.5 abc	37.3 abc	1.1 d
ASPI17-3	16.2 ef	14.9 def	27.9 a-e	33.4 a-d	7.5 bcd
ASPI17-4	34.3 bc	32.8 a	23.2 cde	8.9 efg	0.8 d
Basin Russet	11.4 f	15.6 c-f	29.5 a-e	33.7 a-d	9.8 ab
Blazer Russet	12.9 f	15.6 c-f	28.9 a-e	40.2 ab	2.5 bcd
Bridget	21.2 def	25.0 a-d	33.2 abc	20.0 b-g	0.5 d
Excellency	28.7 bcd	26.2 a-e	27.8 a-e	15.5 c-g	1.9 cd
Kennebec	12.1 f	8.4 f	16.9 e	47.6 a	2.0 cd
LW17-1	13.6 ef¥	23.3 a-e	39.1 a¥	22.1 b-g¥	1.2 d
LW17-2	38.0 ab¥	32.3 a¥	23.9 b-e¥	4.6 fg¥	11.3 a
California Russet Burbank	25.6 bcd	24.0 a-e	27.6 a-e	11.4 d-g	12.6 a
Russet Burbank	15.9 ef¥	15.3 c-f¥	27.2 a-e¥	29.0 a-e¥	12.6 a
Shepody	9.0 f¥	9.0 f¥	26.7 a-e¥	45.8 a¥	9.5 abc

ǂ Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.\ ¥ Data between the Early Harvest and Main Harvest was statistically different at the $p \leq 0.05$ level.

The yield of tubers (estimated ton/ac) of each variety is shown by size category in Table 4. The size profile of LW17-1 was not statistically different from that of Russet Burbank and Shepody in most of the size categories. LW17-2 had a significantly greater yield of tubers under 4 oz. and a significantly lower yield of tubers in the 6 to 10 category than LW17-1 or the standards and may not be well suited to an early harvest.

For varieties grown on low N and harvested in September, EPG17-2 and EPG17-3 yielded significantly more tubers in the 4 to 6 oz. and 6 to 10 oz. categories than Russet Burbank and Shepody (Table 4). Blazer Russet and Kennebec produced tuber size profiles similar to those of Russet Burbank and Shepody.

At the moderate level of N, there were some significant differences within size categories. ASPI010 yielded significantly more tubers in the smaller size categories. EPG17-3 yielded significantly more tubers in the 6 to 10 oz. category compared to the standards. EPG17-3 was not significantly different from EPG17-2, ASPI17-1, Bridget, Excellency and LW17-1 (Table 4). Several entries yielded size profiles similar to that of Russet Burbank. These include ASPI17-3, Basin Russet, Blazer Russet, Bridget, Kennebec, and LW17-1.

There were significant differences in the yield of tubers in most size categories for LW17-1 when comparing early harvest to September harvest. LW17-2 resulted in greater yield of tubers in all size categories except the under 4 oz. category in the full season plots. Both varieties benefited significantly from additional time in the field. Likely, more agronomic work is required with each of these to determine the best combination of fertility and growing season length.

Several entries were grown at low N (100 lbs/ac) and at a moderate rate of N (180 lbs/ac). ASPI010 yielded significantly more undersized tubers and a significantly lower yield of tubers over 10 oz. when provided with additional N. This variety may be an efficient user of nitrogen. Shepody produced a significantly lower yield of undersized tubers in response to the moderate rate of N. Fe other differences were observed for the entries in the study (Table 4).

Table 4: Estimated yield (ton/ac) in each size category (< 4 oz, 4 to 6 oz, 6 to 10 oz, > 10 oz, and deformed) for each French fry variety grown on approximately 100 lbs/ac nitrogen (Low N), 180 lbs/ac nitrogen (Moderate N) and 160 lbs/ac nitrogen (Early Harvest). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the $p < 0.05$ level.

CDCS	< 4 oz	4 to 6 oz	6 to 10 oz	> 10 oz	Deformed
Early harvest					
LW17-1	7.7 b¥	3.9 a	1.1 bc¥	0.1 a¥	0.1 b
LW17-2	10.2 a	0.9 b¥	0.2 c¥	0.0 a¥	0.1 b
Russet Burbank	6.4 b¥	2.9 a¥	2.4 a¥	0.4 a¥	1.5 a¥
Shepody	5.4 b¥	2.5 ab	2.0 ab¥	0.4 a¥	0.9 a
Low N – main harvest					
ASPI010	8.5 aǂ	7.9 a	7.3 b	2.0 cǂ	0.1 a
EPG17-2	4.0 bc	6.2 a	12.7 a	7.2 abc	0.3 a
EPG17-3	5.0 b	6.9 a	13.1 a	11.0 a	2.2 a
ASPI17-2	0.8 dǂ	2.8 b	6.9 b	3.8 bc	0.1 a
Blazer Russet	2.7 c	3.3 b	7.4 b	9.5 ab	0.7 a
Kennebec	3.1 bc	2.8 b	6.8 b	13.1 a	1.7 a
Shepody	3.0 cǂ	2.7 b	5.8 b	7.8 abc	1.0 a
Moderate N – main harvest					
ASPI010	12.9 aǂ	8.6 ab	5.0 e	0.4 eǂ	0.2 c
EPG17-2	4.8 b-e	6.1 ab	10.9 abc	7.8 cde	0.4 bc
EPG17-3	4.5 b-e	5.1 c-f	12.9 a	16.0 ab	1.0 bc
ASPI17-1	5.3 bcd	4.6 c-f	9.8 a-d	12.5 abc	0.3 bc
ASPI17-2	1.8 eǂ	2.5 ef	6.2 de	6.6 cde	0.2 c
ASPI17-3	4.5 b-e	4.1 c-f	7.9 b-e	9.7 a-d	2.0 abc
ASPI17-4	10.4 a	10.1 a	7.2 b-e	2.8 de	0.2 c
Basin Russet	2.6 cde	3.7 c-f	7.1 b-e	7.8 cde	2.5 abc
Blazer Russet	2.7 cde	3.3 c-f	6.1 de	8.6 b-e	0.6 bc
Bridget	7.2 b	8.6 ab	11.4 ab	6.9 cde	0.2 c
Excellency	10.4 a	9.4 a	10.0 a-d	5.5 cde	0.7 bc
Kennebec	3.6 cde	3.1 def	6.1 de	16.5 a	1.4 bc
LW17-1	3.4 cde¥	5.9 bcd	10.1 a-d¥	5.7 cde¥	0.5 bc
LW17-2	11.2 a	9.6 a¥	7.2 b-e¥	1.4 de¥	0.4 bc
California Russet Burbank	5.7 bc	5.5 cde	6.2 de	2.6 de	2.6 ab
Russet Burbank	4.4 b-e¥	4.2 c-f¥	7.6 b-e¥	8.5 b-e¥	3.6 a¥
Shepody	2.3 de¥ǂ	2.3 f	6.7 cde¥	11.6 abc¥	2.4 abc

ǂ Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.

¥ Data between the Early Harvest and Main Harvest was statistically different at the $p \leq 0.05$ level.

Tuber samples used to measure specific gravity were evaluated for hollow heart, brown center, stem-end discoloration, other types of internal necrosis, scab and black scurf. Very few internal defects were observed in French fry varieties in 2017. Some stem-end discoloration was observed, but none of the tubers were tested for wilt organisms. EPG17-2 and Kennebec had some common scab lesions. All of the varieties had at least one tuber affected by black scurf, but no fungicide seed treatments were used in the trial.

French fry colour scores of composite samples are presented in Table 5. Some impressive fry scores were observed in the 2017 samples. LW17-2 produced light fries even when harvested early. From the low N plots, ASPI010 produced the lightest fries. On moderate N, ASPI010, EPG17-2, EPG17-3, ASPI17-3, Basin Russet, Bridget, Excellency, LW17-1, LW17-2 and California Russet Burbank produced light fries. Some of these also had good overall ratings taking texture and colour uniformity into consideration as well.

Table 5: Fry colour scores from subsamples of each variety grown on approximately 100 lbs/ac nitrogen (Low N), 180 lbs/ac nitrogen (Moderate N) and 150 lbs/ac nitrogen (Early Harvest). Fry Colour was assessed visually by comparison with a USDA fry colour chart and converted to a scale of 1 to 7 (000 = 7 and 4 = 1; the higher the number, the better the fry colour). Data shown is the result of one composite sample run in duplicate.

CDCS	External Colour[1]	Internal Texture[2]	Colour Uniformity[3]	Total Score
Early harvest				
LW17-1	4	4	3	11
LW17-2	**5**	**4**	**4**	**13**
Russet Burbank	3	2	2	7
Shepody	3	3	2	8
Low N – main harvest				
ASPI010	**5**	**4**	**5**	**13**
EPG17-2	4	4	3	11
EPG17-3	5	3	3	11
ASPI17-2	4	4	4	12
Blazer Russet	4	4	2	10
Kennebec	4	3	3	10
Shepody	4	3	3	10
Moderate N – main harvest				
ASPI010	**5**	**3**	**5**	**13**
EPG17-2	**5**	**4**	**4**	**13**
EPG17-3	5	4	2	11
ASPI17-1	3	3	1	7
ASPI17-2	4	4	3	11
ASPI17-3	5	2	3	10
ASPI17-4	4	3	2	9
Basin Russet	**5**	**3**	**5**	**13**
Blazer Russet	4	4	3	11
Bridget	**5**	**3**	**4**	**12**
Excellency	5	3	3	11
Kennebec	4	4	3	11
LW17-1	**5**	**4**	**4**	**13**
LW17-2	**5**	**4**	**4**	**13**
California Russet Burbank	**5**	**3**	**4**	**12**
Russet Burbank	4	4	3	11
Shepody	4	4	3	11

[1] External Colour was assessed visually and compared with a USDA Color Chart (000 to 4; the lower the score, the better the fry colour); these scores were converted to a scale of 1 to 7 where higher scores are lighter fries.

[2] Internal texture: 1 (wet) - 4 (mealy)

[3] Color uniformity: 1 (very variable) - 5 (very uniform)

Conclusions

The 2017 variety trial included 14 French fry potato cultivars with potential in southern Alberta. Shepody was included in the trial as a check variety for early harvested cultivars, Shepody and Kennebec were included as standards for the low N plots, and Shepody, Kennebec and Russet Burbank were included as a full-season standard at the moderate rate of N.

Excellent yield and size distribution was observed with many f the varieties in the trial. The greatest total and marketable yield were observed with EPG17-3. Almost all of the varieties produced tubers with specific gravities in the desired range (1.085 to 1.095). Some of the varieties gave impressive fry scores. In particular, LW17-1, LW17-2, ASPI010, EPG17-2, Basin Russet, Blazer Russet and California Russet Burbank produced light fry colour.

The trial was designed to provide regional data for a wide range of potato cultivars. Addressing the agronomic needs of each variety may well result in improvements to yield and size profiles when compared to the results in this year of the trial.

Recommendations

- Varieties should be grown in southern Alberta for at least 3 years and these results need to be compiled to ensure a reasonable evaluation.
- To establish better estimates of yield potential and size profile for the varieties, each variety should be grown under optimal agronomic conditions (fertility, plant density, etc.).

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ConAgra Foods, Lamb Weston Division
Edmonton Potato Growers
Little Potato Company
Old Dutch Foods
McCain Foods
Parkland Seed Potatoes
Prairie Gold Produce
Rockyview Seed Potatoes
Solanum International Inc.
Tuberosum Technologies Inc.

Contact Information:

Michele Konschuh, Ph.D.
Potato Research Scientist
Alberta Agriculture and Forestry, CDCS
301 Horticultural Station Road East
Brooks, AB T1R 1E6

403-362-1314 phone
403-362-1306 fax

Michele.Konschuh@gov.ab.ca

Appendix A Plot Plans

Early Harvest 2017

20 Seed pieces per row

N

Planted

8 x 115 = 920 m2

Guard = Columbo

1	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**
2	1001 Shepody	1007 Anouk	1013 Athlete (G)	2001 Shepody	2007 Russet Burbank	2013 Yukon Gold (L)	3001 Arizona	3007 EPG17-4	3013 Yellow Star	4001 LW1	4007 Yukon Gold	4013 EPG17-4
3	1002 Norland	1008 Penni (L)	1014 EPG17-4	2002 LW2	2008 Norland	2014 Penni (L)	3002 Yukon Gold (L)	3008 Rosa Gold	3014 Volare	4002 Athlete (G)	4008 Russet Burbank	4014 Yellow Star
4	1003 Yellow Star	1009 LW1	1015 EPG17-5	2003 LW1	2009 Yellow Star	2015 Anouk	3003 Yukon Gold	3009 EPG17-1	3015 EPG17-5	4003 Arizona	4009 Penni (L)	4015 Norland
5	1004 Volare	1010 Yellow Star	1016 LW2	2004 Rosa Gold	2010 Yukon Gold	2016 Arizona	3004 LW2	3010 Shepody	3016 Norland	4004 EPG17-1	4010 EPG17-5	4016 Yellow Star
6	1005 Russet Burbank	1011 EPG17-1	1017 Yukon Gold	2005 EPG17-5	2011 Yellow Star	2017 EPG17-1	3005 LW1	3011 Anouk	3017 Penni (L)	4005 Shepody	4011 Anouk	4017 LW2
7	1006 Yukon Gold (L)	1012 Arizona	1018 Rosa Gold	2006 EPG17-4	2012 Volare	2018 Athlete (G)	3006 Yellow Star	3012 Athlete (G)	3018 Russet Burbank	4006 Volare	4012 Yukon Gold (L)	4018 Rosa Gold
8	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**

3 m

3m

3m

6 m

15m

6m

Guard = Columbo

Guard = Rosa Gold

115m

Low N Variety Trial 2017 - September harvest

20 Seed pieces per row

24 X 66 = 1584 m2

N

Guard = Russet Burban

24	**Guard**		**Guard**	**Guard**	**Guard**	**Guard**	**Guard**		**Guard**		**Guard**	
23	1001 PGP17-2		1011 TT17-3	1021 TT17-2	1031 Monticello	2001 TT17-10	2011 ODF009		2021 RV013		2031 Yukon Gold	
22	1002 TT17-5		1012 EPG17-3	1022 TT17-7	1032 Shepody	2002 TT17-7	2012 TT17-1		2022 EPG17-2		2032 PGP17-2	
21	1003 PGP17-4		1013 RV008	1023 AC Hamer	1033 EPG17-2	2003 AC Hamer	2013 Destiny		2023 PGP17-3		2033 Norland	
20	1004 TT17-9		1014 ODF007	1024 Blazer Russet	1034 RV013	2004 RV008	2014 Kennebec		2024 EPG17-3		2034 TT17-9	
19	1005 TT17-10		1015 RV014	1025 TT17-4	1035 PGP17-3	2005 PGP17-4	2015 ODF010		2025 TT17-4		2035 Monticello	
18	1006 AC Vigor		1016 Kennebec	1026 Destiny	1036 RV010	2006 RV011	2016 AC Vigor		2026 Shepody		2036 ODF007	
17	1007 Norland		1017 ODF009	1027 TT17-6	1037 Yukon Gold	2007 Lollipop	2017 Blazer Russet		2027 ASPI010		2037 TT17-6	
16	1008 RV011		1018 ASPI010	1028 RV009	5001 ODF007	2008 ASPI17-2	2018 TT17-2		2028 TT17-5		5004 AC Hamer	
15	1009 TT17-8		1019 ODF010	1029 Atlantic	5002 ODF009	2009 Atlantic	2019 TT17-3		2029 RV009		5005 Destiny	
14	1010 ASPI17-2		1020 TT17-1	1030 Lollipop	5003 ODF010	2010 TT17-8	2020 RV014		2030 RV010		5006 AC Vigor	
13	**Guard**	3 m	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**		**Guard**		**Guard**	
	6m										6m	
12	**Guard**		**Guard**	**Guard**	**Guard**	**Guard**	**Guard**		**Guard**		**Guard**	
11	3001 AC Vigor		3011 Destiny	3021 TT17-2	3031 PGP17-2	4001 ASPI010	4011 TT17-9		4021 PGP17-2		4031 TT17-6	
10	3002 AC Hamer		3012 Shepody	3022 ASPI010	3032 TT17-4	4002 TT17-1	4012 Monticello		4022 Kennebec		4032 TT17-10	
9	3003 TT17-6		3013 PGP17-3	3023 ASPI17-2	3033 Norland	4003 Norland	4013 TT17-5		4023 Shepody		4033 PGP17-4	
8	3004 Atlantic		3014 RV014	3024 ODF009	3034 Yukon Gold	4004 TT17-4	4014 TT17-3		4024 TT17-2		4034 EPG17-2	
7	3005 ODF007		3015 TT17-8	3025 Lollipop	3035 TT17-9	4005 RV011	4015 PGP17-3		4025 ODF007		4035 ODF009	
6	3006 Kennebec		3016 EPG17-3	3026 Monticello	3036 RV010	4006 ASPI17-2	4016 TT17-7		4026 EPG17-3		4036 Yukon Gold	
5	3007 TT17-3		3017 EPG17-2	3027 TT17-10	3037 RV008	4007 AC Vigor	4017 RV014		4027 ODF010		4037 Lollipop	
4	3008 RV011		3018 RV009	3028 TT17-5	5007 Atlantic	4008 Destiny	4018 Atlantic		4028 RV009			
3	3009 Blazer Russet		3019 PGP17-4	3029 TT17-7	5008 Monticello	4009 TT17-8	4019 RV013		4029 AC Hamer			
2	3010 RV013		3020 ODF010	3030 TT17-1		4010 RV010	4020 Blazer Russet		4030 RV008			
1	**Guard**	3 m	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**3m**	**Guard**	**3m**	**Guard**	3m
	6m											

Variety Medium N Brooks - 2017 - Ful

20 Seed pieces per row

24 x 88m = 2112m2

N ↓

	12" spacing										
24	**Guard**		**Guard**	**Guard**	**Guard**	**Guard**		**Guard**		**Guard**	**Guard**
23	3001 Destiny		3011 EPG17-4	3021 Russet Burbank Calif	3031 Bonnata	3041 ODF007		4001 Yukon Gold	4011 LW17-1	4021 EPG17-1	4031 EPG17-4
22	3002 Excellency		3012 Monticello	3022 Atlantic	3032 ASPI17-9			4002 ASPI17-5	4012 ODF010	4022 Norland	4032 ODF007
21	3003 PGP17-1		3013 Blazer Russet	3023 ASPI17-4	3033 Red Apple			4003 AC Vigor	4013 Russet Burbank	4023 Shepody	4033 Destiny
20	3004 Kennebec		3014 ASPI17-2	3024 Basin Russet	3034 LW17-1			4004 Russet Burbank Cali	4014 ASPI010	4024 ASPI17-2	4034 ASPI17-7
19	3005 AC Hamer		3015 ASPI17-1	3025 Rosa Gold	3035 ASPI17-7			4005 Kennebec	4015 Cerata	4025 Bridget	4035 LW17-2
18	3006 Bridget		3016 ASPI17-8	3026 ASPI010	3036 LW17-2			4006 ASPI17-9	4016 Atlantic	4026 RV012	4036 AC Hamer
17	3007 RV012		3017 Yukon Gold	3027 ASPI17-5	3037 EPG17-1			4007 ASPI17-1	4017 ASPI17-4	4027 ASPI17-8	4037 AC Hamer
16	3008 Norland		3018 ODF010	3028 EPG17-3	3038 Russet Burbank			4008 ODF009	4018 PGP17-1	4028 Red Apple	4038 Bonnata
15	3009 EPG17-2		3019 AC Vigor	3029 Shepody	3039 Cerata			4009 Blazer Russet	4019 EPG17-3	4029 Basin Russet	4039 Excellency
14	3010 EPG17-5		3020 AC Hamer	3030 ODF009	3040 ASPI17-2	4041 Monticello		4010 EPG17-2	4020 Rosa Gold	4030 EPG17-5	4040 ASPI17-2
13	**Guard**	3 m	**Guard**	**Guard**	**Guard**	**Guard**		**Guard**		**Guard**	**Guard**
	6m										
	12" spacing										
	Guard = Russet Burbank										
12	**Guard**		**Guard**	**Guard**	**Guard**	**Guard**		**Guard**		**Guard**	**Guard**
11	1001 ASPI17-2		1011 ODF009	1021 Destiny	1031 EPG17-2	1041 AC Hamer		2001 ASPI17-2	2011 ODF007	2021 LW17-1	2031 ASPI17-7
10	1002 ASPI17-2		1012 Basin Russet	1022 Rosa Gold	1032 Bonnata	5001 ODF007		2002 ASPI17-5	2012 Destiny	2022 ASPI17-9	2032 EPG17-4
9	1003 ASPI17-8		1013 Bridget	1023 Yukon Gold	1033 ASPI17-4	5002 ODF009		2003 Basin Russet	2013 EPG17-5	2023 Rosa Gold	2033 EPG17-1
8	1004 Kennebec		1014 RV012	1024 EPG17-5	1034 Russet Burbank	5003 Monticello		2004 Bridget	2014 AC Vigor	2024 AC Hamer	2034 ODF009
7	1005 Shepody		1015 ODF010	1025 Norland	1035 ASPI17-5	5004 ODF010		2005 ASPI010	2015 Atlantic	2025 EPG17-3	2035 EPG17-2
6	1006 ASPI17-1		1016 AC Vigor	1026 LW17-1	1036 EPG17-4	5005 Atlantic		2006 Excellency	2016 PGP17-1	2026 RV012	2036 AC Hamer
5	1007 ASPI17-9		1017 LW17-2	1027 AC Hamer	1037 Russet Burbank Calif	5006 AC Hamer		2007 ASPI17-4	2017 Red Apple	2027 LW17-2	2037 ASPI17-1
4	1008 EPG17-1		1018 PGP17-1	1028 Atlantic	1038 ASPI010	5007 Destiny		2008 Bonnata	2018 Shepody	2028 ASPI17-8	2038 Kennebec
3	1009 Monticello		1019 Excellency	1029 ODF007	1039 Red Apple	5008 AC Vigor		2009 Russet Burbank	2019 Russet Burbank Cali	2029 Cerata	2039 Yukon Gold
2	1010 EPG17-3		1020 Blazer Russet	1030 ASPI17-7	1040 Cerata	2041 ODF010		2010 ASPI17-2	2020 Norland	2030 Blazer Russet	2040 Monticello
1	**Guard**	3 m	**Guard**	**Guard**	**Guard**	**Guard**	13m	**Guard**	**Guard**	**Guard**	**Guard**
	6m										

Project Report

Alberta Potato Variety Development 2017
CDCS, Brooks, AB

Fresh Market Potatoes

Prepared for:
Various Sponsors

Prepared by:

Michele Konschuh
Alberta Agriculture and Forestry
Crop Diversification Centre South
301 Horticultural Station Road East
Brooks, AB T1R 1E6

April 10, 2018

Introduction

In Alberta, potato industry stakeholders are looking for replacement varieties that use less nitrogen, less water, less pesticide, yet yield superior processing or culinary quality and tonnage. An ideal fresh market variety would produce a good yield of medium sized tubers, be relatively tolerant of environmental fluctuations, have few defects, and have an attractive appearance. Tubers with a good skin set that store well are very desirable. Varieties from breeding programs in Canada, Europe and the United States are often being assessed. Many breeding programs target disease resistance, nitrogen use efficiency and excellent storage potential in addition to increased yield. Tuber yield potential and nutritional requirements are impacted by variety characteristics and by environmental characteristics such as the length of the growing season (Westerman, 1993). As noted by Love et al. (2003), the full potential of a new variety may not be realized until proper management is implemented. There is increasing pressure on potato producers to utilize best management practices to reduce the environmental footprint for potatoes. The costs of such shifts in production practices will be borne primarily by producers.

The purpose of this project was to pool resources to evaluate potential varieties from a range of sources, using a cooperative approach. This trial was established to collect local agronomic data on varieties from breeding programs in Canada, the U.S. and elsewhere. The varieties were planted in replicated plots at the Crop Diversification Centre in Brooks, AB and were provided with 180 lbs/ac N and, if requested, 100 lbs/ac N. Alberta data is essential when selecting varieties appropriate for our climate, our customers and industry stakeholders.

Objectives

A. To evaluate potential new varieties for fresh market processing;
B. To provide the potato industry an opportunity to assess varieties grown under local conditions;
C. To compare varieties from several breeding programs (including AAFC) under Alberta conditions; and
D. To determine the response of new fresh market varieties to nitrogen fertilizer rates.

Materials and Methods

The variety evaluation was conducted in small plots at the Crop Diversification Centre South in Brooks, AB. Fertility for the low N plots (100 lbs/ac) was achieved through a combination of soil fertility (83 lbs/ac N; 253 lbs/ac P) and broadcast fertilizer (90 lbs/ac of 11-52-0) incorporated prior to planting. Low N plots received an additional top-dressing (15 lbs/ac of 46-0-0) at hilling, for a total of 100 lbs/ac N. Moderate N plots received an additional top-dressing (189 lbs/ac of 46-0-0) at hilling, for a total of 180 lbs/ac N. Within each level of nitrogen, varieties were planted in four replicate rows in a randomized complete block design along with standard varieties (Atlantic, AC Vigor and Monticello). Each block was planted adjacent to guard rows to reduce any edge effects (see plot plans, Appendix A).

Eptam 8E (1.8 L/ac) was applied prior to planting (May 4) to control weeds. Seed of standard cultivars was provided by Edmonton Potato Growers and seed of test cultivars was provided by each participant. Potatoes were planted May 30, 2017 (Low N Main) and May 29, 2017 (Moderate N Main) approximately 12 to 15cm deep using a two-row tuber unit planter. Seed was planted at 30cm spacing in 6m rows spaced 90cm apart. The plots were irrigated to maintain soil moisture close to 70%. Foliar fungicides were applied twice during the growing season to prevent early and late blight from developing (Table 1).

Table 1: Foliar fungicides applied to the potato crop in 2017 to prevent early and late blight development.

Date of Application	*Fungicide*	*Rate*
7 July	Ridomil Gold/Bravo	0.83L/ac
25 July	Quadris	324mL/ac

Figure 1: Variety evaluation trial at CDCS in Brooks, AB July 14, 2017.

Reglone was applied (1.0 L/ac) September 1 to the Low N and Medium N plots. The Low N plots were harvested September 14 to 15, 2017 and Moderate N plots were harvested September 12 to 13 using a 1-row Grimme harvester.

Fresh market tubers were stored at 8˚C until graded. Tubers were graded into size categories (less than 48mm, 48 to 88mm, over 88mm and deformed). A sample of twenty-five tubers (48 to 88mm) from each replicate was used to determine specific gravity using the weight in air over weight in water method. These tubers were cut longitudinally to assess internal defects. A composite sample of 16 tubers (4 per rep) was stored at 8˚C until culinary analyses were performed. Samples were evaluated for bake and boil by the Food Science and Technology Centre, Brooks, in November 2017.

The data presented here have been statistically analyzed using ANOVA and Tukey's Multiple Comparison Test; (SPSS; $p \leq 0.05$). Statistical summaries are available upon request. T-tests were used to compare results for varieties grown at different levels of N.

Results and Discussion – Fresh Market

Sample hills of each yellow or white variety were dug for a field day at CDCS August 24, 2017. Photos of these varieties are shown in Figure 2.

Figure 2. Fresh market yellow or white varieties at CDCS field day August 24, 2017: a) TT17-2, b) AC Hamer, c) PGP17-1, d) Bonnata, e) TT17-3, f) PGP17-4, g) PGP17-3, h) RV009, i) TT17-1, j) RV011, k) TT17-4, l) TT17-5, m) Volare, n) Yellow Star, and o) Yukon Gold.

Sample hills of each red-skinned variety were dug for a field day at CDCS August 24, 2017. Photos of these varieties are shown in Figure 3.

Figure 3. Fresh market red-skinned varieties at CDCS field day August 24, 2017: a) EPG17-1, b) EPG17-4, c) EPG17-5, d) RV012, e) ASPI17-7, f) ASPI17-8, g) ASPI17-9, h) RV008, i) Cerata, j) PGP17-2, k) TT17-7, l) Norland, m) TT17-6, n) Red Apple, o) Rosa Gold, p) TT17-8, q) TT17-10, and r) TT17-9.

Yield data (total yield; ton/ac) and specific gravities of each of the yellow and white fresh market cultivars are shown in Table 2. Four cultivars were planted with little additional nitrogen and were harvested in August (Low N Early harvest). There were no statistical differences in total yield between cultivars in the early harvest. Specific gravity ranged between 1.061 for Volare and 1.089 for Yukon Gold.

Another ten cultivars were planted in low N plots (100 lbs/ac) and were harvested in September (Low N – main harvest). Total yield ranged from 16.4ton/ac for TT17-3 to 30.8 for PGP17-3 (Table 2). Specific gravities ranged from 1.078 for PGP17-4 to 1.123 for TT17-3.

Four cultivars were grown on a moderate level of N (180 lbs/ac) and harvested in September (Moderate N – main harvest). At this level of N, the total yield ranged from 22.8 ton/ac for Yukon Gold to 37.2 ton/ac for PGP17-1, although total yield is not always a good predictor of good marketable yield. Specific gravity of PGP17-1 was significantly lower than that of Yukon Gold, and other cultivars grown at moderate levels of N.

Yukon Gold was grown at two levels of N and harvested at two different times. Yukon Gold yielded better when grown at full season than when harvested early. Specific gravity of Yukon Gold was higher when harvested later. N level did not significantly affect yield or SG of Yukon Gold harvested in August or September in 2017 (Table 2).

Further addressing the agronomic needs of each variety may well result in improvements to yield and size profiles when compared to the results in this trial.

Table 2: Estimated total yield (ton/acre) and specific gravity for each **yellow or white** fresh market variety grown on approximately 180bs/ac nitrogen (Moderate N) and 100 lbs/ac nitrogen (Early and Low N). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

CDCS	Yield (ton/ac)	SG
Early harvest		
Arizona	10.7 a	1.069 c
Volare	18.8 a	1.061 d
Yellow Star	16.7 a	1.082 b
Yukon Gold (Mod N)	12.8 a¥	1.089 a
Yukon Gold (Low N)	11.6 a¥	1.088 ab¥
Low N – main harvest		
TT17-2	23.2 b-e	1.089 bcd
TT17-3	16.4 e	1.123 a
PGP17-4	26.2 a-d	1.078 de
PGP17-3	30.8 ab	1.096 b
RV009	25.3 a-e	1.096 b
TT17-1	22.1 b-e	1.081 de
RV011	28.3 abc	1.086 b-e
TT17-4	21.4 b-e	1.087 b-e
TT17-5	29.9 abc	1.087 b-e
Yukon Gold	22.9 b¥	1.095 bc¥
Moderate N – main harvest		
AC Hamer	25.0 bc	1.094 b
PGP17-1	37.2 a	1.079 fg
Bonnata	31.8 abc	1.090 bcd¥
Yukon Gold	22.8 bc¥	1.092 bc

ǂ Data between the regular and low N plots was statistically different at the p ≤ 0.05 level.

¥ Data between the early and main harvest plots was statistically different at the p ≤ 0.05 level.

Four cultivars were grown on low N (100 lbs/ac) and harvested in August (Early – Low N). There were no significant differences in total yield between these cultivars. Specific gravity of EPG17-5 was significantly higher than that of other cultivars harvest in August.

Yield data (total yield; ton/ac) and specific gravities of each of the red-skinned fresh market cultivars are shown in Table 3. Ten cultivars were planted in low N plots (100 lbs/ac) and were harvested in September (Low N – main harvest). Total yield ranged from 18.0 ton/ac for TT17-6 to 29.9 for Norland (Table 3). Specific gravities ranged from 1.076 for TT17-8 to 1.094 for TT17-7 and AR207-04.

Eleven cultivars were grown on a moderate level of N (180 lbs/ac) and harvested in September (Moderate N – main harvest). At this level of N, the total yield ranged from 24.6 ton/ac for EPG17-4 to 32.8 ton/ac for Norland. Specific gravities ranged from 1.071 for Norland to 1.108 for ASPI17-5.

Norland was grown at both levels of N and in Early and Late harvested trials. Yield of Norland was statistically higher when harvested in September rather than August. Specific gravity of Norland was higher in the later harvested material than when harvested in August. Total yield of Norland harvested in September was not statistically affected by N level, but SG was significantly higher when grown on low N compared to the moderate level of N (Table 3).

Table 3: Estimated total yield (ton/acre) and specific gravity for each **red-skinned** fresh market variety grown on approximately 180 lbs/ac nitrogen (Moderate N) and 100 lbs/ac nitrogen (Early and Low N). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the $p < 0.05$ level.

CDCS	Yield (ton/ac)	SG
Early harvest		
EPG17-1	14.5 a	1.073 c
EPG17-4	12.5 a	1.071 c
EPG17-5	14.7 a	1.086 ab
Norland	18.0 a¥	1.073 c¥
Low N – main harvest		
ASPI17-7	26.3 a-d	1.094 bc
ASPI17-8	24.4 a-d	1.089 bcd
RV008	28.5 bca	1.082 de
PGP17-2	33.5 a	1.078 de
TT17-7	22.1 b-e	1.094 bc
Norland	29.9 abc¥	1.084 cdeǂ¥
TT17-6	18.0 de	1.086 b-e
TT17-8	20.6 cde	1.076 e
TT17-10	23.6 b-e	1.089 bcd
TT17-9	27.7 abc	1.085 b-e
Moderate N – main harvest		
EPG17-1	32.0 abc	1.075 gh
EPG17-4	24.6 bc	1.073 gh
EPG17-5	25.3 bc	1.086 c-f
ASPI17-5	31.6 abc	1.108 a
RV012	28.2 abc	1.088 b-e
ASPI17-7	31.0 abc	1.088 b-e
ASPI17-8	27.7 abc	1.084 def
ASPI17-9	29.2 abc	1.087 b-e
Cerata	28.8 abc	1.080 efg
Norland	32.8 ab	1.071 hǂ
Red Apple	28.8 abc	1.085 c-f

ǂ Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.

¥ Data between the early and main harvest plots was statistically different at the $p \leq 0.05$ level.

The mean percentage of total tuber number in each size category for yellow and white cultivars is shown in Table 4. Of the four cultivars grown on low N and harvested in August, produced mostly small (<48mm) and marketable (48 to 88mm) tubers as expected. The percentage of Arizona and Volare tubers in various size categories were not statistically different from Yukon Gold. Yellow Star produced a significantly lower percentage of tubers 48 to 88 mm than Arizona and Yukon Gold, and a significantly higher percentage of tubers under 48mm than Arizona, Volare and Yukon Gold. Arizona and Volare produced a significantly higher percentage of jumbo (> 88mm) tubers than the other cultivars grown in these plots.

Of the ten yellow and white cultivars grown on low N for the full season, RV011 and PGP17-4 produced a greater percentage of tubers under 48mm in diameter than Yukon Gold (Table 4). TT17-5 and Yukon Gold produced a significantly higher percentage of tubers over 88mm than other cultivars from the low N full season plots.

At a moderate level of N, most of the cultivars produced a higher percentage of small tubers than Yukon Gold and a lower percentage of marketable and jumbo tubers (Table 4).

Yukon Gold was grown at low and moderate N for the early and the full season plots. The only statistical difference observed for these cultivars was that Yukon Gold produced a significantly higher percentage of tubers under 48mm when grown at a lower N and a correspondingly higher percentage of 48 to 88 mm tubers at the moderate level of N (Table 4).

Table 4: Percentage of total tuber number in each size category (< 48mm, 48-88mm, > 88mm and deformed) for each fresh market yellow or white variety grown on moderate nitrogen (approximately 180 lbs/ac) and 100 lbs/ac nitrogen (Early and Low N). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the $p < 0.05$ level.

CDCS	< 48 mm	48 – 88mm	> 88mm	Deformed
Early harvest				
Arizona	42.5 b	54.8 a	2.8 a	0.0 a
Volare	37.5 b	60.8 a	1.5 a	0.0 a
Yellow Star	75.8 a	24.3 b	0.0 b	0.3 a
Yukon Gold (Mod N)	46.3 b¥	53.8 a	0.3 b¥	0.0 a¥
Yukon Gold (Low N)	43.7 b¥	55.8 a	0.3 b¥	0.3 a¥
Low N – main harvest				
TT17-2	33.3 b-f	65.8 ab	0.5 b	0.3 ab
TT17-3	39.5 bcd	57.3 ab	0.0 b	3.3 ab
PGP17-4	45.0 bc	51.8 b	0.0 b	3.0 ab
PGP17-3	40.8 bcd	57.3 ab	0.8 b	1.5 ab
RV009	37.8 bcd	62.3 ab	0.0 b	0.0 b
TT17-1	37.0 b-e	59.5 ab	1.0 b	2.5 ab
RV011	46.5 bc	53.0 b	0.0 b	0.5 ab
TT17-4	34.0 b-f	64.5 ab	2.5 b	1.3 ab
TT17-5	19.8 ef	68.5 ab	9.0 a	2.5 ab
Yukon Gold	22.8 defǂ¥	62.0 abǂ	10.8 a¥	4.5 a¥
Moderate N – main harvest				
AC Hamer	50.0 b	47.5 e	1.0 c	1.5 ab
PGP17-1	41.2 bcd	58.0 b-e	0.0 c	0.5 ab
Bonnata	35.0 b-f	64.3 a-d	0.5 c	0.5 ab
Yukon Gold	14.5 gǂ¥	74.8 aǂ	8.8 a¥	2.3 ab¥

ǂ Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.

¥ Data between the early and main harvest plots was statistically different at the $p \leq 0.05$ level.

The mean percentage of total tuber number in each size category for red-skinned cultivars is shown in Table5. EPG17-5 produced a significantly higher percentage of potatoes under 48mm in the early harvested plots indicating the potential for creamer potato production.

On low N, the majority of cultivars tested produced over 50% of the tubers in the middle-size category (48 to 88), but TT17-7 yielded a significantly higher percentage of small tubers.

At the moderate level of N, there were statistical differences in the percentage of tubers in each size category, (Table 5). Red Apple produced a significantly higher percentage of small potatoes than any other cultivar. EPG17-1, EPG17-4, Cerata and Norland produced a greater percentage of medium-sized tubers and Norland produced the highest percentage of jumbo (> 88mm) tubers on moderate N.

EPG17-1, EPG17-4, EPG17-5, and Norland were harvested in early and full-season plots. The length of growing season significantly affected the percentage of EPG17-1 tubers in the medium, jumbo and deformed categories. A greater percentage of tubers in the larger categories were harvested from the full-season plots. For EPG17-4, significantly fewer tubers were small in the full-season plots and significantly more tubers were jumbo in the full-season when compared to the early harvested plots. EPG17-5 produced significantly fewer small tubers and significantly more medium sized tubers when grown full season than when harvested early.

ASPI17-7, ASPI17-8, and Norland were grown full-season at both levels of N. There were no significant differences in the percentage of ASPI17-7 tubers in each size category as a result of the different N fertility, ASPI17-8 produced a higher percentage of small tubers on moderate N than on low N, and Norland produced a significantly greater percentage of jumbo tubers on moderate N than low N (Table 5).

Table 5: Percentage of total tuber number in each size category (< 48mm, 48-88mm, > 88mm and deformed) for each fresh market red-skinned variety grown on moderate nitrogen (approximately 180 lbs/ac) and 100 lbs/ac nitrogen (Early and Low N). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

CDCS	< 48 mm	49 – 88mm	> 88mm	Deformed
Early harvest				
EPG17-1	55.0 b	44.5 a¥	0.3 b¥	0.3 a¥
EPG17-4	40.5 b¥	58.5 a	0.0 b¥	1.3 a
EPG17-5	81.8 a¥	18.3 b¥	0.0 b	0.0 a
Norland	46.5 b¥	53.5 a¥	0.0 b¥	0.0 a¥
Low N – main harvest				
ASPI17-7	35.5 b-f	62.8 ab	1.0 b	0.5 ab
ASPI17-8	35.0 b-f	62.0 ab	1.3 b	1.8 ab
RV008	30.5 b-f	66.8 ab	1.0 b	1.3 ab
PGP17-2	28.3 c-f	69.6 ab	1.3 b	1.0 ab
TT17-7	79.0 a	19.8 c	0.0 b	0.8 ab
Norland	19.3 f	75.3 a	3.3 bǂ	2.3 abǂ
TT17-6	38.3 bcd	58.8 ab	1.0 b	2.0 ab
TT17-8	42.3 bc	55.8 b	0.3 b	2.3 ab
TT17-10	47.5 b	52.5 b	0.0 b	0.0 b
TT17-9	45.2 bc	53.3 b	0.3 b	1.3 ab
Moderate N – main harvest				
EPG17-1	25.3 efg	71.3 ab¥	2.8 bc¥	0.8 ab¥
EPG17-4	26.0 efg¥	68.3 abc	5.3 b¥	0.8 ab
EPG17-5	48.3 bc¥	50.7 de¥	0.3 c	0.3 ab
ASPI17-5	33.5 c-f	65.0 a-d	1.0 c	0.5 ab
RV012	42.3 bcd	57.3 b-e	0.3 c	0.0 b
ASPI17-7	36.8 b-e	61.5 a-e	1.0 c	0.8 ab
ASPI17-8	46.8 bc	52.8 c-e	0.5 c	0.0 b
ASPI17-9	39.0 b-e	59.8 a-e	0.5 c	0.0 b
Cerata	27.3 d-g	71.3 ab	1.5 c	0.3 ab
Norland	20.8 fg¥	70.0 ab¥	9.3 aǂ¥	0.3 abǂ¥
Red Apple	68.0 a	29.3 f	0.0 c	2.8 a
Rosa Gold	42.0 bcd	57.0 b-e	0.5 c	0.5 ab

ǂ Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.

¥ Data between the early and main harvest plots was statistically different at the $p \leq 0.05$ level.

The yield of tubers (estimated ton/ac) of each yellow or white variety is shown by size category in Table 6. There were significant differences in yield by size category between the four cultivars grown in the Low N plots and harvested in August. Yellow Star yielded significantly more tubers under 48mm in diameter than other cultivars in these plots.

For varieties grown on low N and harvested in September, a significantly greater yield of tubers under 48mm for cultivars such as PGP17-4 and RV011, suggest that these may be suitable for marketing in more than one size category. Yield of tubers 48 to 88mm ranged from 12.6 ton/ac for TT17-7 to 24.2 ton/ac for PGP17-3 (Table 6). Yield of marketable PGP17-3 was significantly greater than that of Yukon Gold, but not significantly different from the other cultivars. TT17-5 and Yukon Gold produced significantly greater yield of tubers over 88mm than other cultivars in these plots.

Four yellow or white cultivars were grown on moderate N and harvested in September. Yield of tubers under 48mm ranged from 0.9 ton/ac for Yukon Gold to 6.7 ton/ac of PGP17-1 (Table 6). Yield of 48 – 88mm tubers ranged from 1536 ton/ac of Yukon Gold to 30.1 ton/ac of PGP17-1.

Yukon Gold was grown in early and full season plots at both levels of N. Yukon Gold yielded significantly more tubers in all categories when grown full season compared to early harvest (Table 6). Yield of Yukon Gold tubers seemed unaffected by the level of N within a particular harvest window.

Table 6: Estimated yield (ton/ac) in each size category (< 4 oz, 4 to 6 oz, 6 to 10 oz, > 10 oz, and deformed) for each fresh market yellow or white variety grown on moderate nitrogen (approximately 180 lbs/ac) and at a lower rate of N (100 lbs/ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the p < 0.05 level.

CDCS	< 48 mm	48 – 88mm	> 88mm	Deformed
Early harvest				
Arizona	1.5 c	7.7 ab	1.4 a	0.0 a
Volare	3.0 bc	14.9 a	1.0 a	0.0 a
Yellow Star	9.3 a	7.4 ab	0.0 a	0.0 a
Yukon Gold (Mod N)	2.7 bc	10.0 ab	0.1 a	0.0 a
Yukon Gold (Low N)	2.4 c¥	9.1 ab¥	0.1 a¥	0.1 a
Low N – main harvest				
TT17-2	3.3 e-h	19.2 bcd	0.5 b	0.1 a
TT17-3	3.1 e-h	12.6 de	0.1 b	0.6 a
PGP17-4	6.2 bc	18.6 bcd	0.2 b	1.3 a
PGP17-3	5.3 b-e	24.2 ab	0.8 b	0.5 a
RV009	5.1 b-f	20.2 bcd	0.0 b	0.1 a
TT17-1	2.5 gh	17.6 bcd	1.3 b	0.7 a
RV011	6.9 b	20.9 a-d	0.1 b	0.4 a
TT17-4	2.7 fgh	18.1 bcd	0.2 b	0.4 a
TT17-5	1.4 h	20.4 bcd	7.5 a	0.6 a
Yukon Gold	1.2 h¥	14.3 cde¥	6.2 a¥	1.1 a
Moderate N – main harvest				
AC Hamer	5.1 bc	18.2 bcd	1.2 de	0.5 b
PGP17-1	6.7 b	30.1 a	0.2 e	0.3 b
Bonnata	4.5 bcd	26.5 ab	0.5 e	0.2 b
Yukon Gold	0.9 e	15.6 de	4.9 ab	0.5 b

ǂ Data between the regular and low N plots was statistically different at the p ≤ 0.05 level.

¥ Data between the early and main harvest plots was statistically different at the p ≤ 0.05 level.

EPG17-1, EPG17-4, EPG17-5 and Norland were grown in early harvest plots as well as full season plots. EPG17-1 and Norland yielded significantly better in all size categories on full season plots than on early harvested plots (Table 7). For EPG17-4 and EPG17-5 yield of middle-sized tubers was greater in full season plots.

Red-skinned potatoes were grown on low N, moderate N or both and harvested in September. Yield results by size category are shown in Table 7. On low N, TT17-7 produced a significantly higher yield of tubers under 48mm than other cultivars and significantly lower yield of tubers 48 to 88mm in diameter. Marketable yield of other cultivars were not significantly different from one another at this level of N.

On moderate N, Red Apple yielded significantly higher yield of tubers under 48mm. Norland yielded significantly greater yield of jumbo tubers (Table 7). Marketable tubers ranged from 15.6 ton/ac for Red Apple-15 to 27.0 ton/ac for ASPI17-5.

ASPI17-7, ASPI17-8 and Norland were grown at both level of N. Norland yielded more jumbo tubers on moderate N than on low N. ASPI17-8 yielded more small tubers when grown at moderate N than low N (Table 7).

Table 7: Estimated yield (ton/ac) in each size category (< 4 oz, 4 to 6 oz, 6 to 10 oz, > 10 oz, and deformed) for each fresh market red-skinned variety grown on moderate nitrogen (approximately 180 lbs/ac) and at a lower rate of N (100 lbs/ac). Data shown is the mean of four replicates. Data followed by the same letter in each column of the table are not significantly different at the $p < 0.05$ level.

CDCS	< 48 mm	48 – 88mm	> 88mm	Deformed
Early harvest				
EPG17-1	4.3 b¥	9.9 ab¥	0.2 a¥	0.1 a
EPG17-4	2.2 c	10.2 ab¥	0.0 a¥	0.1 a
EPG17-5	9.2 a	5.4 b¥	0.0 a¥	0.0 a
Norland	4.4 b¥	13.6 ab¥	0.0 a¥	0.0 a¥
Low N – main harvest				
ASPI17-7	3.6 d-h	21.6 abc	1.0 b	0.1 a
ASPI17-8	3.4 d-hǂ	19.8 bcd	1.0 b	0.2 a
RV008	2.8 fgh	23.9 ab	1.2 b	0.6 a
PGP17-2	3.2 e-h	28.7 a	1.2 b	0.3 a
TT17-7	13.9 a	8.0 e	0.0 b	0.1 a
Norland	1.5 h¥	24.9 ab¥	2.6 b¥ǂ	0.8 a¥
TT17-6	2.9 fgh	14.0 cde	0.6 b	0.5 a
TT17-8	4.0 c-g	15.5 cde	0.3 b	0.8 a
TT17-10	5.8 bcd	17.8 bcd	0.0 b	0.0 a
TT17-9	5.7 bcd	21.0 abc	0.4 b	0.6 a
Moderate N – main harvest				
EPG17-1	2.7 cde¥	25.9 abc¥	2.8 cd¥	0.5 b
EPG17-4	1.8 cde	19.3 bcd¥	3.3 bc¥	0.2 b
EPG17-5	6.3 b	18.5 bcd¥	0.3 e¥	0.2 b
ASPI17-5	3.6 b-e	27.0 ab	0.9 de	0.1 b
RV012	4.4 bcd	23.6 a-d	0.2 e	0.0 b
ASPI17-7	4.2 b-e	25.4 abc	1.2 de	0.2 b
ASPI17-8	6.3 bǂ	21.0 a-d	0.5 e	0.0 b
ASPI17-9	4.1 b-e	24.5 a-d	0.6 e	0.0 b
Cerata	2.4 cde	24.9 a-d	1.4 cde	0.1 b
Norland	1.5 de	24.7 a-d	6.6 aǂ	0.1 b
Red Apple	11.6 a	15.6 d	0.1 e	1.5 a
Rosa Gold	3.8 b-e	17.0 cd	0.5 e	0.2 b

Tuber samples used to measure specific gravity were evaluated for hollow heart, brown center, stem-end discoloration, other types of internal necrosis, scab and black scurf. For cultivars grown on low N and harvested in August, very few tubers exhibited internal defects. For tubers grown on low N and harvested in September, a few tubers exhibited stem-end discoloration and vascular discoloration, but tubers were not tested for wilt organisms. At the moderate rate of N, many of the samples had some level of stem-end discoloration or vascular discoloration but tubers were not tested for wilt organisms. Black scurf was noted on several cultivars, such as Yukon Gold, PGP17-4 and Bonnata, however no seed treatment was used in the trial.

Red Apple had some anthocyanin pigment in the flesh of some tubers. PGP17-2 broke dormancy in December and would need sprout inhibition to store longer. At the low and the moderate rate of N, many of the samples had some level of stem-end discoloration or vascular discoloration but tubers were not tested for wilt organisms. Black scurf was noted on a number of red-skinned tubers, such as EPG17-4, EPG17-1, EPG17-5, ASPI17-7, ASPI17-8 and Norland, however, no seed treatment was used in the trial.

Subjective assessments of yellow and white tubers are shown in Table 8. For the early harvested trial on low N, there were no significant differences in uniformity of size or overall appearance. RV011, PGP17-3 and RV009 scored significantly better than Yukon Gold for uniformity of size and overall appearance when grown on low N. Bonnata scored higher than Yukon Gold for uniformity of size and Bonnata and PGP17-1 scored higher than Yukon Gold for overall appearance when grown on moderate N.

Table 8: Subjective tuber assessments for each fresh market yellow or white variety: Uniformity of Size was subjectively assessed on each replicate by the same individual during the grading process. Overall Appearance was based on uniformity of size and uniformity of shape, skin colour, deformities and eye depth. Data shown is the mean of 4 replicates.

	Uniformity of Size[1]	Overall Appearance[2]
Early harvest		
Arizona	2.00 a	4.3 a
Volare	2.00 a	3.5 ab
Yellow Star	2.00 a	3.8 ab
Yukon Gold (Mod N)	2.00 a	3.0 ab
Yukon Gold (Low N)	2.00 a	4.3 a¥
Low N – main harvest		
TT17-2	3.50 ab	3.75 ab
TT17-3	2.25 b	2.25 d
PGP17-4	3.00 ab	3.25 a-d
PGP17-3	3.75 a	3.50 abc
RV009	4.00 a	3.75 ab
TT17-1	2.75 ab	3.00 a-d
RV011	3.75 a	4.00 a
TT17-4	2.75 ab	2.50 cd
TT17-5	2.75 ab	2.75 bcd
Yukon Gold	2.25 b	2.25 d¥
Moderate N – main harvest		
AC Hamer	3.00 abc	3.00 ab
PGP17-1	3.25 abc	4.00 a
Bonnata	3.75 ab	3.75 a
Yukon Gold	2.0 c	2.25 b

[1] Uniformity of Size: 1 (very variable) - 5 (very uniform)

[2] Overall Appearance: 1 (very poor) - 5 (outstanding)

† Data between the regular and low N plots was statistically different at the $p \leq 0.05$ level.

Subjective assessments of red-skinned cultivars are shown in Table 9. In the early harvest plots, there were no significant differences between cultivars for uniformity of size or overall appearance. At the low rate of N, there was no significant difference between cultivars for uniformity of size. TT17-10 rated highest for overall appearance. At the moderate rate of N. EPG17-5 rated higher than Norland for uniformity of size and EPG17-5 and Red Apple were rated highest for overall appearance.

Table 9: Subjective tuber assessments for each fresh market red-skinned variety: Uniformity of Size was subjectively assessed on each replicate by the same individual during the grading process. Overall Appearance was based on uniformity of size and uniformity of shape, skin colour, deformities and eye depth. Data shown is the mean of 4 replicates.

	Uniformity of Size[1]	Overall Appearance[2]
Early harvest		
EPG17-1	4.00 a	3.0 ab
EPG17-4	4.00 a	3.5 ab
EPG17-5	4.00 a	3.8 ab
Norland	4.00 a	2.3 b¥
Low N – main harvest		
ASPI17-7	3.00 ab	3.00 a-d
ASPI17-8	3.25 ab	3.00 a-d
RV008	3.00 ab	3.25 a-d
PGP17-2	3.00 ab	3.00 a-d
TT17-7	3.00 ab	3.25 a-d
Norland	3.00 ab	3.00 a-d¥
TT17-6	3.00 ab	3.25 a-d
TT17-8	3.50 ab	2.75 bcd
TT17-10	4.00 a	4.00 a
TT17-9	3.25 ab	3.50 abc
Moderate N – main harvest		
EPG17-1	3.25 abc	3.25 ab
EPG17-4	3.00 abc	3.50 a
EPG17-5	4.33 a	4.00 a
ASPI17-5	3.25 abc	3.75 a
RV012	3.67 ab	3.33 ab
ASPI17-7	3.00 abc	3.25 ab
ASPI17-8	3.00 abc	3.00 ab
ASPI17-9	3.50 abc	2.75 ab
Cerata	3.50 abc	3.25 ab
Norland	2.50 bc	3.00 ab
Red Apple	3.50 abc	4.00 a
Rosa Gold	3.00 abc	2.75 ab

[1] Uniformity of Size: 1 (very variable) - 5 (very uniform)

[2] Overall Appearance: 1 (very poor) - 5 (outstanding)

† Data between the regular and low N plots was statistically different at the p ≤ 0.05 level.

Culinary evaluations were conducted on all cultivars in the trial. Results for the yellow and white cultivars are presented in Table 10. There was variation in flesh colour and tuber texture noted after boiling and baking samples. Moderate sloughing was observed after boiling Yukon Gold grown on moderate N and for PGP17-3, and TT17-5 grown on low N. Yukon Gold TT17-3 grown on low N exhibited severe sloughing. No after cooking discoloration was observed for any of the cultivars in the trial..

Table 10: Culinary evaluations of each yellow or white fresh market variety grown on moderate nitrogen (approximately 180lbs/ac) and low nitrogen (approximately 100lbs/ac) at CDCS. Data shown is the mean of duplicate analyses of a composite sample.

Boiled Potatoes

CDCS	Flesh color	Waxiness†	Sloughing	After Cooking Discoloration*
Early harvest				
Arizona	Yellow	1	3	3
Volare	White	1	3	3
Yellow Star	Yellow	2	3	3
Yukon Gold (Mod N)	Yellow	4	2	3
Yukon Gold (Low N)	Yellow	4	3	3
Low N – main harvest				
TT17-2	Yellow	2	3	3
TT17-3	Yellow	4	1	3
PGP17-4	Yellow	2	3	3
PGP17-3	Yellow	4	2	3
RV009	Deep Yellow	3	3	3
TT17-1	Deep Yellow	2	3	3
RV011	Deep Yellow	3	3	3
TT17-4	Deep Yellow	2	3	3
TT17-5	Off-white	4	2	3
Yukon Gold	Yellow	4	1	3
Moderate N – main harvest				
AC Hamer	Off-white	3	3	3
PGP17-1	Deep Yellow	1	3	3
Bonnata	Yellow	2	3	3
Yukon Gold	Yellow	4	2	3

† Waxiness: 1 = very waxy (very clean cuts); 2 = waxy (clean cuts with some residue); 3 = slightly waxy (more mealy than waxy); 4 = not waxy (fluffy/mealy)

* After Cooking discoloration and sloughing: 1 = severe; 2 = moderate; 3 = none

Table 10 continued.

Baked Potatoes			
CDCS	Flesh color	Texture*	After Cooking Discolorationǂ
Early harvest			
Arizona	Yellow	2	3
Volare	Yellow	1	3
Yellow Star	Yellow	3	3
Yukon Gold (Mod N)	Yellow	3	3
Yukon Gold (Low N)	Yellow	3	3
Low N – main harvest			
TT17-2	Yellow	1	3
TT17-3	Yellow	3	3
PGP17-4	Deep Yellow	2	3
PGP17-3	Yellow	3	3
RV009	Deep Yellow	3	3
TT17-1	Deep Yellow	2	3
RV011	Deep Yellow	2	3
TT17-4	Yellow	2	3
TT17-5	Off-white	2	3
Yukon Gold	Yellow	3	3
Moderate N – main harvest			
AC Hamer	Off-white	3	3
PGP17-1	Deep Yellow	2	3
Bonnata	Yellow	2	3
Yukon Gold	Yellow	3	3

* Texture: 1 = wet; 2 = slightly wet; 3 = slightly mealy; 4 = mealy

ǂ After Cooking discoloration: 1 = severe; 2 = moderate; 3 = none

Results of the culinary evaluation of red-skinned cultivars are presented in Table 11. Flesh colour and texture differences were noted after boiling and baking. Moderate sloughing was observed for ASPI17-7, TT17-7 and TT-11-012/2012-01 grown on low N. No after cooking discolouration was noted for any of the red-skinned cultivars in the trial after boiling or baking.

Table 11: Culinary evaluations of each yellow or white fresh market variety grown on moderate nitrogen (approximately 180lbs/ac) and low nitrogen (approximately 100lbs/ac) at CDCS. Data shown is the mean of duplicate analyses of a composite sample.

Boiled Potatoes				
CDCS	Flesh color	Waxiness†	Sloughing	After Cooking Discoloration*
Early harvest				
EPG17-1	Off-white	3	3	3
EPG17-4	Off-white	1	3	3
EPG17-5	Off-white	2	3	3
Norland	Off-white	2	3	3
Low N – main harvest				
ASPI17-7	Off-white	4	2	3
ASPI17-8	Off-white	3	3	3
RV008	Deep Yellow	3	3	3
PGP17-2	Off-white	2	3	3
TT17-7	Yellow	4	2	3
Norland	Off-white	2	3	3
TT17-6	Off-white	2	3	3
TT17-8	Yellow	2	3	3
TT17-10	Yellow	3	2	3
TT17-9	White	1	3	3
Moderate N – main harvest				
EPG17-1	Off-white	3	3	3
EPG17-4	Off-white	1	3	3
EPG17-5	Off-white	2	3	3
ASPI17-5	Yellow	4	3	3
RV012	Off-white	4	3	3
ASPI17-7	Off-white	4	3	3
ASPI17-8	Off-white	2	3	3
ASPI17-9	Off-white	3	3	3
Cerata	Off-white	3	3	3
Norland	Off-white	2	3	3
Red Apple	Yellow	2	3	3

† Waxiness: 1 = very waxy (very clean cuts); 2 = waxy (clean cuts with some residue); 3 = slightly waxy (more mealy than waxy); 4 = not waxy (fluffy/mealy)

* After Cooking discoloration and sloughing: 1 = severe; 2 = moderate; 3 = none

Table 11 continued.

Baked Potatoes			
CDCS	Flesh color	Texture*	After Cooking Discolorationǂ
Early harvest			
EPG17-1	Off-white	3	3
EPG17-4	Off-white	2	3
EPG17-5	Off-white	2	3
Norland	Off-white	1	3
Low N – main harvest			
ASPI17-7	Off-white	1	3
ASPI17-8	Off-white	2	3
RV008	Deep Yellow	2	3
PGP17-2	White	2	3
TT17-7	Yellow	2	3
Norland	Off-white	1	3
TT17-6	Off-white	2	3
TT17-8	Deep Yellow	2	3
TT17-10	Off-white	2	3
TT17-9	Off-white	2	3
Moderate N – main harvest			
EPG17-1	Yellow	*3*	3
EPG17-4	Off-white	*2*	3
EPG17-5	Yellow	*2*	3
ASPI17-5	Yellow	3	3
RV012	Off-white	3	3
ASPI17-7	Off-white	3	3
ASPI17-8	Off-white	2	3
ASPI17-9	Off-white	3	3
Cerata	Off-white	2	3
Norland	Off-white	2	3
Red Apple	Yellow	2	3

* Texture: 1 = wet; 2 = slightly wet; 3 = slightly mealy; 4 = mealy

ǂ After Cooking discoloration: 1 = severe; 2 = moderate; 3 = none

Conclusions

The 2017 variety trial included 16 yellow or white potato cultivars and 18 red-skinned potato cultivars with fresh market potential in southern Alberta. Yukon Gold was included in the trial as a check variety for early harvested cultivars grown on low N and full-season standards at both rates of N. For early harvested cultivars on low N, Yellow Star produced the highest yield of creamer sized potatoes. Volare produced the greatest yield of medium sized tubers from early harvested plots. In the full season plots grown on low N, PGP17-3 produced the greatest yield of medium sized tubers. At the moderate rate of N, PGP17-1 yielded very well compared to other white and yellow entries. Arizona, Yukon Gold (early on low N), RV011, and PGP17-1 scored very well for overall appearance. Many cultivars had different culinary attributes that will need to be considered when developing a marketing approach. A few cultivars in the trial had issues with sloughing and internal defects, but none showed after-cooking darkening.

Yukon Gold was grown at more than one level of N. Although the level of N affected the percentage of tubers in small and medium categories, yield was not significantly affected by N level in 2017.

Norland was included in the trial at both levels of N as a check in the early harvested trial. In the early harvested plots, EPG17-5 produced the greatest yield of creamer sized red potatoes. In the low N full season plots, PGP17-2 produced the greatest yield of medium sized red tubers, but not statistically more than Norland. ASPI17-5 yielded the greatest of the red cultivars at the moderate rate of N, however, none of the red entries yielded significantly more than Norland. TT17-10, EPG17-5, and Red Apple scored very well for overall appearance. Many of the red-skinned cultivars had different culinary attributes that will need to be considered when developing a marketing approach. A few cultivars in the trial had issues with sloughing and internal defects but none showed after-cooking darkening.

Norland was grown at both levels of N. Only the yield of jumbo tubers was significantly affected by the N level.

The trial was designed to provide regional data for a wide range of potato cultivars. Addressing the agronomic needs of each variety may well result in improvements to yield and size profiles when compared to the results in this year of the trial.

Recommendations

- Varieties should be grown in southern Alberta for at least 3 years and these results need to be compiled to ensure a reasonable evaluation.
- To establish better estimates of yield potential and size profile for the varieties, each variety should be grown under optimal agronomic conditions (fertility, plant density, etc.).

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Little Potato Company
Old Dutch Foods
McCain Foods
Parkland Seed Potatoes
Prairie Gold Produce
Rockyview Seed Potatoes
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Tuberosum Technologies Inc.

Contact Information:

Michele Konschuh, Ph.D.
Potato Research Scientist
Alberta Agriculture and Forestry, CDCS
301 Horticultural Station Road East
Brooks, AB T1R 1E6

403-362-1314 phone
403-362-1306 fax

Michele.Konschuh@gov.ab.ca

Appendix A   Plot Plan

Early Harvest 2017

20 Seed pieces per row

N

Planted

8 x 115 = 920 m2

Guard = Columbo

1	**Guard**		**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**		**Guard**		**Guard**	**Guard**	**Guard**	**Guard**
2	1001 Shepody		1007 Anouk	1013 Athlete (G)	2001 Shepody	2007 Russet Burbank	2013 Yukon Gold (L)	3001 Arizona		3007 EPG17-4		3013 Yellow Star	4001 LW1	4007 Yukon Gold	4013 EPG17-4
3	1002 Norland		1008 Penni (L)	1014 EPG17-4	2002 LW2	2008 Norland	2014 Penni (L)	3002 Yukon Gold (L)		3008 Rosa Gold		3014 Volare	4002 Athlete (G)	4008 Russet Burbank	4014 Yellow Star
4	1003 Yellow Star		1009 LW1	1015 EPG17-5	2003 LW1	2009 Yellow Star	2015 Anouk	3003 Yukon Gold		3009 EPG17-1		3015 EPG17-5	4003 Arizona	4009 Penni (L)	4015 Norland
5	1004 Volare		1010 Yellow Star	1016 LW2	2004 Rosa Gold	2010 Yukon Gold	2016 Arizona	3004 LW2		3010 Shepody		3016 Norland	4004 EPG17-1	4010 EPG17-5	4016 Yellow Star
6	1005 Russet Burbank		1011 EPG17-1	1017 Yukon Gold	2005 EPG17-5	2011 Yellow Star	2017 EPG17-1	3005 LW1		3011 Anouk		3017 Penni (L)	4005 Shepody	4011 Anouk	4017 LW2
7	1006 Yukon Gold (L)		1012 Arizona	1018 Rosa Gold	2006 EPG17-4	2012 Volare	2018 Athlete (G)	3006 Yellow Star		3012 Athlete (G)		3018 Russet Burbank	4006 Volare	4012 Yukon Gold (L)	4018 Rosa Gold
8	**Guard**	3 m	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**3m**	**Guard**	**3m**	**Guard**	**Guard**	**Guard**	**Guard**
	6 m					15m				6m					

Guard = Columbo

Guard = Rosa Gold

115m

Low N Variety Trial 2017 - September harvest

20 Seed pieces per row

24 X 66 = 1584 m2

N

Guard = Russet Burban

24	**Guard**		**Guard**	**Guard**	**Guard**	**Guard**	**Guard**		**Guard**		**Guard**	
23	1001 PGP17-2		1011 TT17-3	1021 TT17-2	1031 Monticello	2001 TT17-10	2011 ODF009		2021 RV013		2031 Yukon Gold	
22	1002 TT17-5		1012 EPG17-3	1022 TT17-7	1032 Shepody	2002 TT17-7	2012 TT17-1		2022 EPG17-2		2032 PGP17-2	
21	1003 PGP17-4		1013 RV008	1023 AC Hamer	1033 EPG17-2	2003 AC Hamer	2013 Destiny		2023 PGP17-3		2033 Norland	
20	1004 TT17-9		1014 ODF007	1024 Blazer Russet	1034 RV013	2004 RV008	2014 Kennebec		2024 EPG17-3		2034 TT17-9	
19	1005 TT17-10		1015 RV014	1025 TT17-4	1035 PGP17-3	2005 PGP17-4	2015 ODF010		2025 TT17-4		2035 Monticello	
18	1006 AC Vigor		1016 Kennebec	1026 Destiny	1036 RV010	2006 RV011	2016 AC Vigor		2026 Shepody		2036 ODF007	
17	1007 Norland		1017 ODF009	1027 TT17-6	1037 Yukon Gold	2007 Lollipop	2017 Blazer Russet		2027 ASPI010		2037 TT17-6	
16	1008 RV011		1018 ASPI010	1028 RV009	5001 ODF007	2008 ASPI17-2	2018 TT17-2		2028 TT17-5		5004 AC Hamer	
15	1009 TT17-8		1019 ODF010	1029 Atlantic	5002 ODF009	2009 Atlantic	2019 TT17-3		2029 RV009		5005 Destiny	
14	1010 ASPI17-2		1020 TT17-1	1030 Lollipop	5003 ODF010	2010 TT17-8	2020 RV014		2030 RV010		5006 AC Vigor	
13	**Guard**	3 m	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**		**Guard**		**Guard**	
	6m										6m	

12	**Guard**		**Guard**	**Guard**	**Guard**	**Guard**	**Guard**		**Guard**		**Guard**	
11	3001 AC Vigor		3011 Destiny	3021 TT17-2	3031 PGP17-2	4001 ASPI010	4011 TT17-9		4021 PGP17-2		4031 TT17-6	
10	3002 AC Hamer		3012 Shepody	3022 ASPI010	3032 TT17-4	4002 TT17-1	4012 Monticello		4022 Kennebec		4032 TT17-10	
9	3003 TT17-6		3013 PGP17-3	3023 ASPI17-2	3033 Norland	4003 Norland	4013 TT17-5		4023 Shepody		4033 PGP17-4	
8	3004 Atlantic		3014 RV014	3024 ODF009	3034 Yukon Gold	4004 TT17-4	4014 TT17-3		4024 TT17-2		4034 EPG17-2	
7	3005 ODF007		3015 TT17-8	3025 Lollipop	3035 TT17-9	4005 RV011	4015 PGP17-3		4025 ODF007		4035 ODF009	
6	3006 Kennebec		3016 EPG17-3	3026 Monticello	3036 RV010	4006 ASPI17-2	4016 TT17-7		4026 EPG17-3		4036 Yukon Gold	
5	3007 TT17-3		3017 EPG17-2	3027 TT17-10	3037 RV008	4007 AC Vigor	4017 RV014		4027 ODF010		4037 Lollipop	
4	3008 RV011		3018 RV009	3028 TT17-5	5007 Atlantic	4008 Destiny	4018 Atlantic		4028 RV009			
3	3009 Blazer Russet		3019 PGP17-4	3029 TT17-7	5008 Monticello	4009 TT17-8	4019 RV013		4029 AC Hamer			
2	3010 RV013		3020 ODF010	3030 TT17-1		4010 RV010	4020 Blazer Russet		4030 RV008			
1	**Guard**	3 m	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**3m**	**Guard**	**3m**	**Guard**	3m
	6m											

Variety Medium N Brooks - 2017 - Ful

20 Seed pieces per row

N

24 x 88m = 2112m2

12" spacing

24	Guard		Guard	Guard	Guard	Guard		Guard		Guard	Guard
23	3001		3011	3021	3031	3041		4001	4011	4021	4031
	Destiny		EPG17-4	Russet Burbank Calif	Bonnata	ODF007		Yukon Gold	LW17-1	EPG17-1	EPG17-4
22	3002		3012	3022	3032			4002	4012	4022	4032
	Excellency		Monticello	Atlantic	ASPI17-9			ASPI17-5	ODF010	Norland	ODF007
21	3003		3013	3023	3033			4003	4013	4023	4033
	PGP17-1		Blazer Russet	ASPI17-4	Red Apple			AC Vigor	Russet Burbank	Shepody	Destiny
20	3004		3014	3024	3034			4004	4014	4024	4034
	Kennebec		ASPI17-2	Basin Russet	LW17-1			Russet Burbank Cali	ASPI010	ASPI17-2	ASPI17-7
19	3005		3015	3025	3035			4005	4015	4025	4035
	AC Hamer		ASPI17-1	Rosa Gold	ASPI17-7			Kennebec	Cerata	Bridget	LW17-2
18	3006		3016	3026	3036			4006	4016	4026	4036
	Bridget		ASPI17-8	ASPI010	LW17-2			ASPI17-9	Atlantic	RV012	AC Hamer
17	3007		3017	3027	3037			4007	4017	4027	4037
	RV012		Yukon Gold	ASPI17-5	EPG17-1			ASPI17-1	ASPI17-4	ASPI17-8	AC Hamer
16	3008		3018	3028	3038			4008	4018	4028	4038
	Norland		ODF010	EPG17-3	Russet Burbank			ODF009	PGP17-1	Red Apple	Bonnata
15	3009		3019	3029	3039			4009	4019	4029	4039
	EPG17-2		AC Vigor	Shepody	Cerata			Blazer Russet	EPG17-3	Basin Russet	Excellency
14	3010		3020	3030	3040	4041		4010	4020	4030	4040
	EPG17-5		AC Hamer	ODF009	ASPI17-2	Monticello		EPG17-2	Rosa Gold	EPG17-5	ASPI17-2
13	Guard	3 m	Guard	Guard	Guard	Guard		Guard		Guard	Guard

6m

12" spacing

Guard = Russet Burbank

12	Guard		Guard	Guard	Guard	Guard		Guard		Guard	Guard
11	1001		1011	1021	1031	1041		2001	2011	2021	2031
	ASPI17-2		ODF009	Destiny	EPG17-2	AC Hamer		ASPI17-2	ODF007	LW17-1	ASPI17-7
10	1002		1012	1022	1032	5001		2002	2012	2022	2032
	ASPI17-2		Basin Russet	Rosa Gold	Bonnata	ODF007		ASPI17-5	Destiny	ASPI17-9	EPG17-4
9	1003		1013	1023	1033	5002		2003	2013	2023	2033
	ASPI17-8		Bridget	Yukon Gold	ASPI17-4	ODF009		Basin Russet	EPG17-5	Rosa Gold	EPG17-1
8	1004		1014	1024	1034	5003		2004	2014	2024	2034
	Kennebec		RV012	EPG17-5	Russet Burbank	Monticello		Bridget	AC Vigor	AC Hamer	ODF009
7	1005		1015	1025	1035	5004		2005	2015	2025	2035
	Shepody		ODF010	Norland	ASPI17-5	ODF010		ASPI010	Atlantic	EPG17-3	EPG17-2
6	1006		1016	1026	1036	5005		2006	2016	2026	2036
	ASPI17-1		AC Vigor	LW17-1	EPG17-4	Atlantic		Excellency	PGP17-1	RV012	AC Hamer
5	1007		1017	1027	1037	5006		2007	2017	2027	2037
	ASPI17-9		LW17-2	AC Hamer	Russet Burbank Calif	AC Hamer		ASPI17-4	Red Apple	LW17-2	ASPI17-1
4	1008		1018	1028	1038	5007		2008	2018	2028	2038
	EPG17-1		PGP17-1	Atlantic	ASPI010	Destiny		Bonnata	Shepody	ASPI17-8	Kennebec
3	1009		1019	1029	1039	5008		2009	2019	2029	2039
	Monticello		Excellency	ODF007	Red Apple	AC Vigor		Russet Burbank	Russet Burbank Cali	Cerata	Yukon Gold
2	1010		1020	1030	1040	2041		2010	2020	2030	2040
	EPG17-3		Blazer Russet	ASPI17-7	Cerata	ODF010		ASPI17-2	Norland	Blazer Russet	Monticello
1	Guard	3 m	Guard	Guard	Guard	Guard	13m	Guard	Guard	Guard	Guard

6m

Project Report

AAFC National Potato Variety Trial Results from CDCS, Brooks, AB
2018

Prepared for:
Funding agencies and industry sponsors

Prepared by:

Michele Konschuh[1] and Virginia Dickison[2]
[1]Alberta Agriculture and Forestry
Crop Diversification Centre South
301 Horticultural Station Road East
Brooks, AB T1R 1E6

[2]Agriculture and Agri-Food Canada
Potato Research Centre
850 Lincoln Road P.O. Box 20280
Fredericton, NB E3B 4Z7

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Canadian Horticultural Council | Conseil canadien de l'horticulture
Growing Forward 2

Introduction

In Alberta, potato industry stakeholders are looking for replacement varieties that use less nitrogen, less water, less pesticide, yet yield superior processing or culinary quality and tonnage. Varieties from breeding programs in Canada, Europe and the United States are often being assessed. Many breeding programs target disease resistance, nitrogen use efficiency and excellent storage potential in addition to increased yield. Tuber yield potential and nutritional requirements are impacted by variety characteristics and by environmental characteristics such as the length of the growing season (Westermann, 1993). As noted by Love et. al (2003), the full potential of a new variety may not be realized until proper management is implemented. There is increasing pressure on potato producers to utilize best management practices to reduce the environmental footprint for potatoes. The costs of such shifts in production practices will be borne primarily by producers.

An ideal French fry variety would have earlier maturity than Russet Burbank, be relatively tolerant of environmental fluctuations, have few defects, yield well and have specific gravity in the desired range (1.086 to 1.092). Good fry color out of the field is an asset, and good fry color out of storage is also very desirable. An ideal chipping variety would produce a good yield of medium sized tubers, be relatively tolerant of environmental fluctuations, have few defects, and have high specific gravity in the desired range (above 1.086). Tubers with a good skin set, good maturity at harvest and low concentration of reducing sugars is also very desirable. Varieties that store well at cooler temperatures are an asset. Ideal fresh market varieties would produce a good yield of creamer or medium sized tubers, be relatively tolerant of environmental fluctuations, have few defects, and have an attractive appearance. Tubers with a good skin set that store well are very desirable.

The purpose of this project was to pool resources to evaluate potential varieties from a range of sources, using a cooperative approach. This trial was established to collect local agronomic data on varieties from breeding programs in Canada, the U.S. and elsewhere. The varieties were planted in replicated plots at the Crop Diversification in Brooks, AB and were provided with 200 lbs/ac N. Alberta data is essential when selecting varieties appropriate for our climate, our customers and industry stakeholders.

Objectives

A. To evaluate new cultivars for French fry processing;
B. To evaluate new cultivars for chip processing;
C. To evaluate new cultivars for fresh consumption; and
D. To evaluate cultivars from AAFC’s National Potato Breeding Program under Alberta conditions.

Materials and Methods

The variety evaluation was conducted in small plots at the Crop Diversification Centre South in Brooks, AB. Fertility for the AAFC plots (200 lbs/ac) was achieved through a combination of soil fertility (40 lbs/ac N; 26 lbs/ac P) and broadcast fertilizer (90 lbs/ac of 11-52-0) incorporated May 8 prior to planting. AAFC plots received an additional top-dressing (326 lbs/ac of 46-0-0) at hilling (June 7), for a total of 200 lbs/ac N. Entries were planted in duplicate rows in a randomized complete block design along with standard varieties. Each block was planted adjacent to guard rows to reduce any edge effects (see plot plan, Appendix A).

Eptam 8E (1.8 L/ac) and Sencor (150g/ac) were applied prior to planting (May 7) to control weeds. Seed of standard cultivars and test cultivars was provided by AAFC. Potatoes were planted May 17 approximately 12 to 15cm deep using a two-row tuber unit planter. Seed was planted at 30cm spacing in 6m rows spaced 90cm apart. Plots were hilled June 7 with a power hiller. The plots were irrigated to maintain soil moisture close to 70%. Foliar fungicides were applied twice during the growing season to prevent early and late blight from developing (Table 1).

Table 1: Foliar fungicides applied to the potato crop in 2017 to prevent early and late blight development.

Date of Application	*Fungicide*	*Rate*
11 July	Ridomil Gold/Bravo	0.83L/ac
30 July	Quadris	324mL/ac

Figure 1: Variety evaluation trial at CDCS in Brooks, AB July 27, 2018.

Reglone was applied (1.0 L/ac) August 23, 2018. Potatoes were harvested September 5 and 6 using a 1-row Grimme harvester.

Fresh market and French fry tubers were stored at 8˚C until graded. Chipping tubers were stored at 14.5°C until graded. Chipping and Fresh Market tubers were graded into size categories (less than 48mm, 48 – 88mm, over 88mm and deformed). French Fries were graded by weight into categories (< 113g, 113 to 170g, 170 to 284g, 284 to 396g, > 396g and deformed). A sample of twenty tubers (48 – 88mm or 113 to 396g) from each replicate was used to determine specific gravity using the weight in air over weight in water method. These tubers were cut longitudinally to assess internal defects. Sub-samples of marketable tubers were provided to Lethbridge Research Centre staff for culinary and post-harvest evaluations.

The data presented here have not been statistically analyzed. Data reported are the mean of two replicate rows.

Results – Chipping Cultivars

Sample hills of each cultivar were dug for a field day August 14, 2018. Photos of the chipping cultivars are shown in Figure 2.

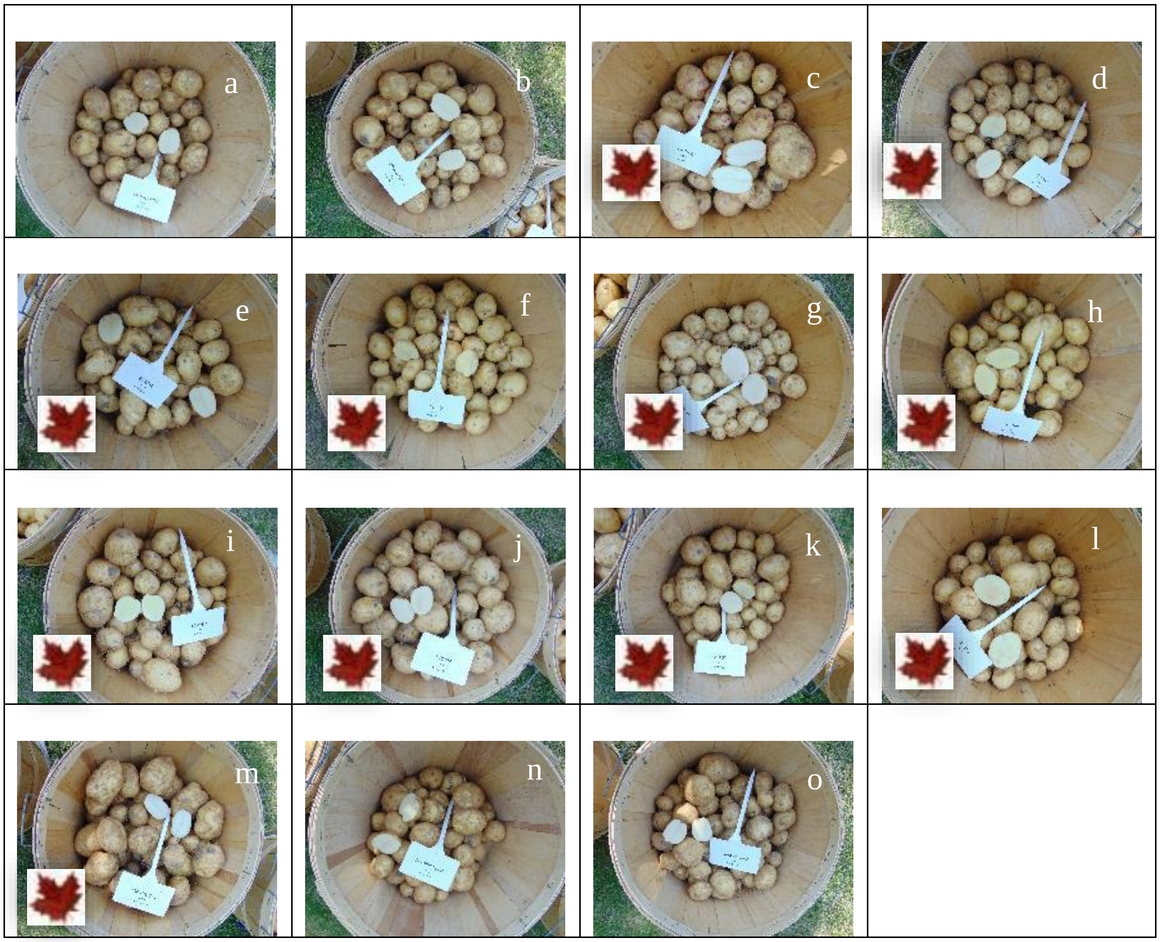

Figure 2. AAFC chipping cultivars at the CDCS field day August 14, 2018: a) Atlantic E, b) Atlantic West, c) F14025, d) F14026, e) F14028, f) F14030, g) F14031, h) F14032, i) F14034, j) F14035, k) F14036, l) F14037, m) WV10655-1, n) Snowden East, and o) Snowden West.

Yield data (total yield; ton/ac) and specific gravities of each of the chipping cultivars are shown in Table 2. Yield ranged from 24.2 for F14030 to 37.2 ton/ac for F14036. Specific gravity ranged from 1.083 for WV10655-1 to 1.109 for Atlantic East.

Table 2: Estimated total yield (ton/acre) and specific gravity for each chipping cultivar grown at CDCS in Brooks, AB (approximately 200 lbs/ac nitrogen). Data shown is the mean of two replicates.

	Yield (ton/ac)	SG
Atlantic East	32.0	1.109
Atlantic West	36.1	1.107
F14025	27.6	1.096
F14026	34.7	1.088
F14028	31.8	1.093
F14030	24.2	1.106
F14031	34.7	1.101
F14032	33.9	1.092
F14034	32.7	1.099
F14035	24.6	1.100
F14036	37.2	1.100
F14037	31.2	1.106
WV10655-1	29.0	1.083
Snowden East	27.2	1.105
Snowden West	28.7	1.104

The mean percentage of total tuber number in each size category is shown in Table 3.

Table 3: Percentage of total tuber number in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed) for each chipping cultivar grown at approximately 200 lbs/ac. Data shown is the mean of two replicates.

	No. of <48mm	No. of 48 to 88mm	No. of > 88mm	No. of deformed
Atlantic East	7	82	10	0
Atlantic West	11	81	8	0
F14025	10	67	22	0
F14026	18	79	3	0
F14028	17	77	5	1
F14030	37	62	0	1
F14031	20	78	2	0
F14032	13	81	6	0
F14034	17	72	10	2
F14035	16	80	4	0
F14036	13	79	8	0
F14037	19	76	5	0
WV10655-1	29	47	21	7
Snowden East	11	81	7	0
Snowden West	11	84	4	0

The yield of tubers (estimated ton/ac) of each chipping cultivar is shown by size category in Table 4. Marketable yield ranged from 13.1 ton/acre for WV10655-1 to 29.6 ton/ac for F14036.

Table 4: Estimated yield (ton/ac) in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed tubers) for each chipping cultivar grown at approximately 200 lbs/ac. Data shown is the mean of two replicates.

	Yield of <48mm (ton/ac)	Yield of 48 to 88mm (ton/ac)	Yield of > 88mm (ton/ac)	Yield of deformed (ton/ac)
Atlantic East	0.6	24.5	6.9	0.1
Atlantic West	0.9	29.0	6.1	0.2
F14025	0.5	15.2	11.7	0.1
F14026	1.9	28.2	3.6	0.0
F14028	1.0	26.8	3.8	0.2
F14030	3.8	19.4	0.4	0.7
F14031	2.3	31.3	0.7	0.3
F14032	1.1	28.6	4.3	0.0
F14034	1.2	23.1	7.1	1.3
F14035	1.3	20.8	2.2	0.3
F14036	1.1	29.6	6.6	0.0
F14037	1.8	25.6	3.7	0.0
WV10655-1	1.6	13.1	13.7	0.6
Snowden East	0.9	22.5	3.8	0.0
Snowden West	1.1	24.8	2.5	0.2

Tuber samples used to measure specific gravity were evaluated for hollow heart, other internal defects and scab. There were very few internal defects observed in the tubers examined. Hollow heart or brown center was noted in a few tubers. F14037 had internal necrotic lesions in almost half of the tubers. Snowden and WV10655-1 seemed somewhat susceptible to black scurf. No common scab lesions were noted.

Results– French Fry Cultivars

Sample hills of each cultivar were dug for a field day August 14, 2018. Photos of the French fry cultivars are shown in Figure 3.

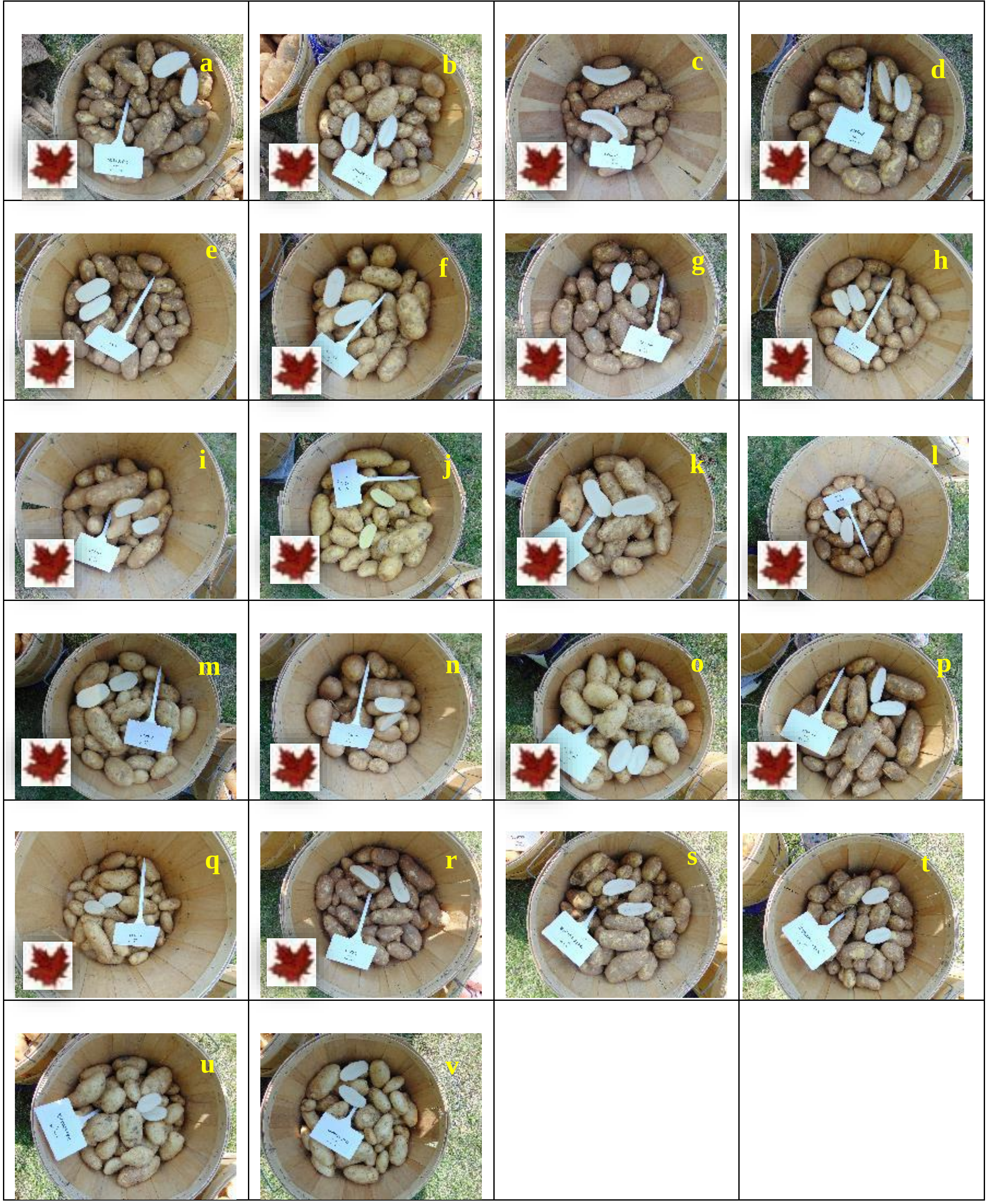

Figure 3. AAFC French fry cultivars at the CDCS field day August 14, 2018: a) CV011010-2, b) CV011238-1, c) CV08212-1, d) F14002, e) F14003, f) F14005, g) F14008, h) F14010, i) F14011, j) F14015, k) F14016, l) F14017, m) F14018, n) F14020, o) F14021, p) F14022, q) F14023, r) F14057, s) Russet Burbank E, t) Russet Burbank W, u) Shepody E, and v) Shepody W.

Yield data (total yield; ton/ac) and specific gravities of each of the French fry cultivars are shown in Table 5. Total yield ranged from 31.2 ton/ac for F14057 to 47.7 ton/ac for F14021. Marketable yield ranged from 24.7 ton/ac for CV08212-1 to 44.4 ton/ac for F14021. Specific gravity ranged from 1.079 for F14003 to 1.117 for F14023.

Table 5: Estimated total yield and marketable yield (ton/acre) and specific gravity for each French fry cultivar grown at CDCS in Brooks, AB (approximately 200 lbs/ac nitrogen). Data shown is the mean of two replicates.

	Total Yield (ton/ac)	Mkt Yield (ton/ac)	SG
CV011010-2	46.9	40.9	1.085
CV011238-1	40.3	37.0	1.094
CV08212-1	30.9	24.7	1.095
F14002	40.4	37.8	1.094
F14003	33.0	29.5	1.079
F14005	39.2	35.5	1.089
F14008	31.9	29.9	1.086
F14010	37.4	32.8	1.088
F14011	39.0	35.7	1.088
F14015	41.6	39.6	1.094
F14016	39.4	33.9	1.105
F14017	32.5	29.1	1.091
F14018	37.6	33.9	1.090
F14020	34.6	31.0	1.082
F14021	47.7	44.4	1.089
F14022	36.6	33.7	1.091
F14023	33.5	28.9	1.117
F14057	31.2	28.9	1.106
R.Burbank East	44.2	39.1	1.096
R.Burbank West	36.9	31.5	1.088
Shepody East	37.2	32.2	1.088
Shepody West	40.6	35.7	1.092

The mean percentage of total tuber number in each size category is shown in Table 6.

Table 6: Percentage of total tuber number in each size category (< 113g, 113 to 170g, 170 to 284g, 284 to 396g and > 396g, and deformed tubers) for each French fry cultivar grown at approximately 200 lbs/ac. Data shown is the mean of two replicates.

	% of <113g	% of 113-170g	% of 170-284g	% of 284-396g	% of >396g	% deformed
CV011010-2	8	10	26	26	26	5
CV011238-1	8	16	37	25	14	0
CV08212-1	13	12	21	19	28	7
F14002	6	11	33	29	20	0
F14003	10	22	46	15	6	1
F14005	5	6	20	28	37	4
F14008	6	9	34	25	26	1
F14010	7	13	25	22	27	6
F14011	7	9	22	28	32	2
F14015	5	8	22	27	37	0
F14016	7	7	20	30	30	7
F14017	10	14	36	25	15	0
F14018	7	14	35	27	14	2
F14020	7	8	20	24	37	3
F14021	7	8	27	31	27	0
F14022	8	11	32	28	22	0
F14023	14	15	27	24	21	0
F14057	7	17	41	17	18	1
R.Burbank East	9	13	27	25	24	2
R.Burbank West	10	14	40	18	14	4
Shepody East	6	10	20	23	34	7
Shepody West	10	15	31	19	23	3

The yield of tubers (estimated ton/ac) of each French fry cultivar is shown by size category in Table 7. Yield of 170 to 284g tubers ranged from 6.3 ton/ac of CV08212-1 to 15.3 ton/ac of F14003. Yield of 284 to 396g tubers ranged from 5.1 for F14003 to 14.8 for F14021

Table 7: Estimated yield (ton/ac) in each size category (< 113g, 113 to 170g, 170 to 284g, 284 to 396g and > 396g, and deformed tubers) for each French fry cultivar grown at approximately 209 lbs/ac. Data shown is the mean of two replicates.

	% of <113g	% of 113-170g	% of 170-284g	% of 284-396g	% of >396g	% deformed
CV011010-2	3.6	4.5	12.1	12.1	12.2	2.4
CV011238-1	3.4	6.0	14.9	10.5	5.7	0.0
CV08212-1	4.0	3.6	6.3	6.1	8.7	2.2
F14002	2.6	4.5	13.3	11.6	8.3	0.0
F14003	3.4	7.2	15.3	5.1	1.9	0.2
F14005	2.0	2.7	8.0	10.8	14.1	1.7
F14008	1.8	2.8	10.7	8.1	8.2	0.3
F14010	2.5	5.0	9.4	8.3	10.1	2.1
F14011	2.7	3.6	8.8	10.8	12.6	0.6
F14015	2.0	3.5	9.3	11.4	15.4	0.0
F14016	2.8	2.7	7.7	11.7	11.8	2.7
F14017	3.3	4.4	11.8	8.2	4.7	0.0
F14018	2.8	5.1	13.1	10.4	5.3	0.9
F14020	2.3	2.9	6.9	8.1	13.1	1.2
F14021	3.2	3.8	12.7	14.8	13.1	0.0
F14022	2.9	4.1	11.4	9.9	8.3	0.0
F14023	4.5	5.1	8.8	8.0	7.0	0.0
F14057	2.1	5.4	12.8	5.2	5.6	0.2
R.Burbank East	4.0	5.8	11.9	10.8	10.5	1.1
R.Burbank West	3.8	5.2	14.7	6.5	5.0	1.6
Shepody East	2.2	4.0	7.3	8.6	12.5	2.8
Shepody West	3.9	6.2	12.5	7.9	9.2	1.1

Tuber samples used to measure specific gravity were evaluated for hollow heart, other internal defects and scab. There were very few internal defects observed in the tubers examined. Hollow heart was noted in approximately 25% of CV08212-1 and F14057 tubers and a couple of Russet Burbank tubers. Black scurf was not noted on any tubers but several tubers of F14005 had common scab lesions.

Results – Fresh Market Cultivars

Sample hills of each cultivar were dug for a field day August 14, 2018. Photos of the yellow/white fresh market cultivars are shown in Figure 4.

Figure 4. AAFC yellow/white fresh market cultivars at the CDCS field day August 24, 2017: a) F14057, b) F14067, c) F14068, d) F14126, e) F14128, f) F14132, g) Kennebec, and h) Yukon Gold East.

Photos of the purple/red-skinned fresh market cultivars are shown in **Figure 5**.

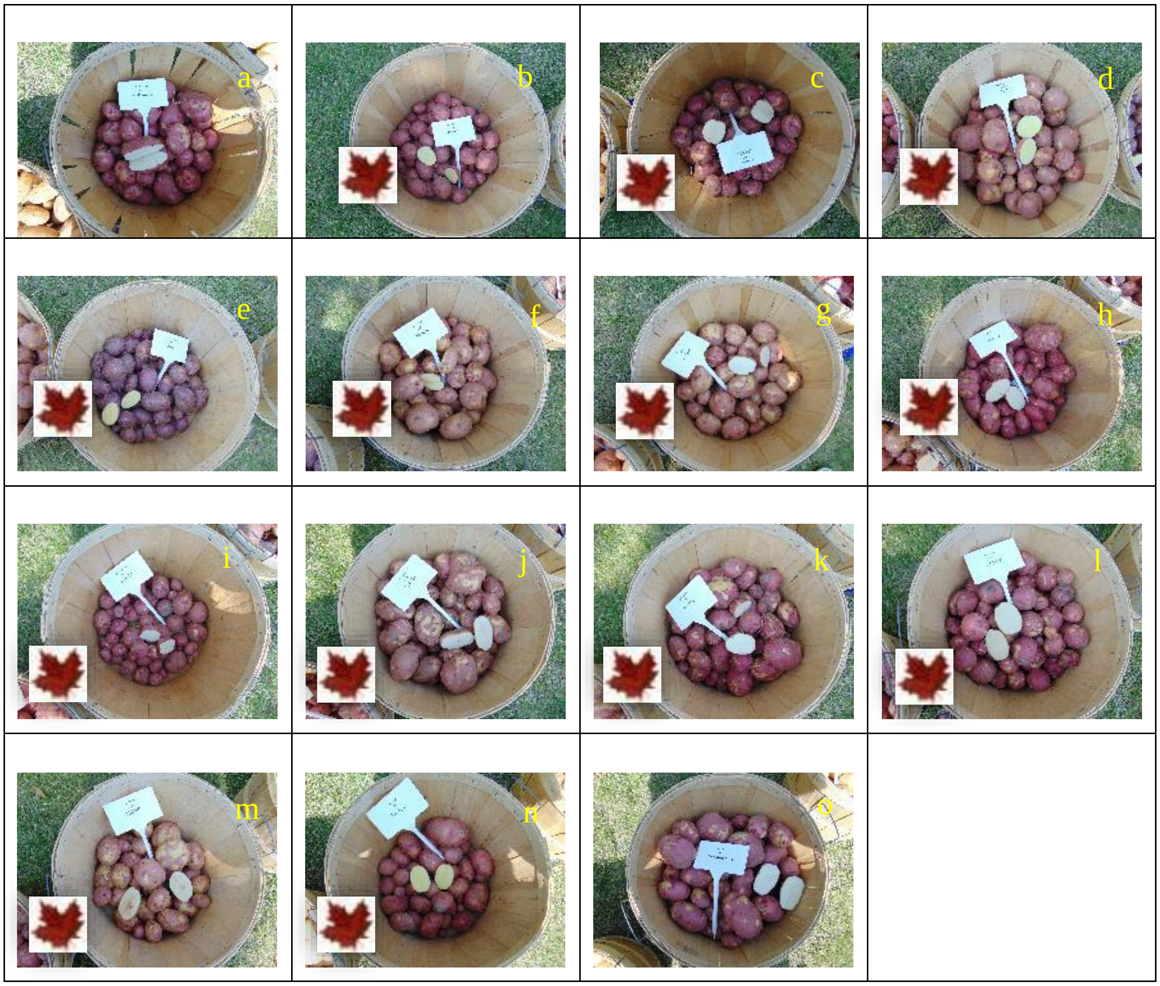

Figure 5. AAFC purple/red-skinned fresh market cultivars at the CDCS field day August 14, 2018: a) Chieftain E, b) F14052, c) F14071, d) F14075, e) F14085, f) F14090, g) F14096, h) F14100, i) F14112, j) F14114, k) F14118, l) F14119, m) F14120, n) F14134, o) Norland E.

Yield data (total yield; ton/ac) and specific gravities of each of the fresh market cultivars are shown in Table 8. Total yield ranged from 23.0 ton/ac for F14067 to 40.9 ton/ac for F14118. Specific gravity ranged from 1.076 for F14119 to 1.106 for F14057.

Table 8: Estimated total yield (ton/acre) and specific gravity for each fresh market FM) cultivar grown at CDCS in Brooks, AB (approximately 200 lbs/ac nitrogen). Data shown is the mean of two replicates.

	End Use	Yield (ton/ac)	SG
Yellow/White-skinned			
F14057	FM/FF	31.4	1.106
F14067	FM	23.0	1.093
F14068	FM	35.2	1.089
F14126	FM	30.8	1.071
F14128	FM	42.5	1.076
F14132	FM	30.3	1.095
Kennebec	FM CK	39.7	1.087
Yukon Gold East	FM CK	30.9	1.095
Red/Purple-skinned			
F14052	FM	24.3	1.096
F14071	FM	29.5	1.099
F14075	FM	30.8	1.079
F14085	FM	24.0	1.094
F14090	FM	32.9	1.095
F14096	FM	30.0	1.085
F14100	FM	32.1	1.087
F14112	FM	24.5	1.091
F14114	FM	37.8	1.089
F14118	FM	40.9	1.081
F14119	FM	33.4	1.076
F14120	FM	31.6	1.084
F14134	FM	31.7	1.084
Chieftain East	FM	36.0	1.081
Norland East	FM	36.8	1.080

The mean percentage of total tuber number in each size category is shown in Table 9.

Table 9: Percentage of total tuber number in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed) for each fresh market cultivar grown at approximately 200 lbs/ac. Data shown is the mean of two replicates.

	No. of <48mm	No. of 48 to 88mm	No. of > 88mm	No. of deformed
Yellow/White-skinned				
F14057	20	80	0	0
F14067	35	65	0	0
F14068	12	85	3	0
F14126	22	76	1	0
F14128	14	73	11	1
F14132	15	84	1	0
Kennebec	11	69	19	2
Yukon Gold East	10	69	20	0
Red/Purple-skinned				
F14052	39	61	0	0
F14071	16	82	1	1
F14075	11	70	19	0
F14085	26	74	0	0
F14090	11	70	18	1
F14096	16	67	18	0
F14100	13	82	4	1
F14112	35	65	0	0
F14114	21	70	8	1
F14118	14	74	13	0
F14119	11	79	9	1
F14120	6	55	34	5
F14134	23	71	5	2
Chieftain East	8	85	6	0
Norland East	15	74	11	0

The yield of tubers (estimated ton/ac) of each fresh market cultivar is shown by size category in Table 10.

Table 10: Estimated yield (ton/ac) in each size category (< 48mm, 48 to 88mm, > 88mm, and deformed tubers) for each fresh market cultivar grown at approximately 209 lbs/ac. Data shown is the mean of two replicates.

	Yield of <48mm (ton/ac)	Yield of 48 to 88mm (ton/ac)	Yield of > 88mm (ton/ac)	Yield of deformed (ton/ac)
Yellow/White-skinned				
F14057	2.4	28.7	0.0	0.2
F14067	3.1	19.7	0.2	0.0
F14068	1.1	31.4	2.7	0.0
F14126	2.2	27.5	1.1	0.0
F14128	1.3	29.3	11.0	0.9
F14132	1.4	27.7	1.2	0.0
Kennebec	0.7	23.8	14.3	1.0
Yukon Gold East	0.5	18.0	12.2	0.2
Red/Purple-skinned				
F14052	3.9	20.4	0.0	0.0
F14071	1.9	26.8	0.6	0.2
F14075	0.7	18.5	11.5	0.1
F14085	2.3	21.6	0.2	0.0
F14090	0.8	21.4	10.4	0.3
F14096	1.0	18.2	10.8	0.0
F14100	1.2	27.8	2.9	0.2
F14112	3.9	19.6	0.9	0.0
F14114	1.8	28.4	7.2	0.4
F14118	1.0	26.9	13.0	0.0
F14119	0.9	25.4	6.3	0.7
F14120	0.3	12.8	16.8	1.6
F14134	2.0	24.8	4.0	0.9
Chieftain East	0.7	30.0	5.2	0.1
Norland East	1.2	25.9	9.5	0.2

Tuber samples used to measure specific gravity were evaluated for hollow heart, other internal defects and scab. Approximately 25% of F14057 tubers displayed hollow heart while brown center and hollow heart were only observed in individual tubers of other lines. F14071 and F14120 tubers were affected by internal necrotic lesions, over 50% for F14071 and 25% for F14120. Black scurf was mostly absent, F14085 seemed susceptible to common scab.

Conclusions

The 2018 variety trial included a number of cultivars with potential in southern Alberta. Atlantic and Snowden were included in the trial as standard varieties to compare to 11 chipping cultivars. Russet Burbank and Shepody were included in the trial as standard varieties to compare 18 French fry cultivars with. Yukon Gold, Chieftain, Kennebec and Norland were included in the trial as standard varieties to compare with 18 fresh market cultivars.

The trial was designed to provide regional data for a wide range of potato cultivars. All cultivars were planted at the same in-row spacing, the N rate was approximately 200 lbs/ac, and harvest was scheduled for full-season varieties. Addressing the agronomic needs, such as plant density, fertility requirements, and harvest timing for each variety may well result in improvements to yield and size profiles when compared to the results in this trial.

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Alberta Seed Producers Inc.
ConAgra Foods, Lamb Weston Division
Edmonton Potato Growers
Old Dutch Foods
Parkland Seed Potatoes
Rockyview Seed Potatoes

Contact Information:
Michele Konschuh, Ph.D.
Potato Research Scientist
Alberta Agriculture and Forestry, CDCS
301 Horticultural Station Road East
Brooks, AB   T1R 1E6
403-362-1314 phone
403-362-1306 fax
Michele.Konschuh@gov.ab.ca

and

Benoit Bizimungu, Ph.D.
Potato Breeder
Agriculture and Agri-Food Canada
Potato Research Centre
850 Lincoln Road P.O. Box 20280
Fredericton, NB   E3B 4Z7
506-452-4880
506-452-3316
Benoit.Bizimungu@AGR.GC.CA

Appendix A Plot Plan

AAFC - 2018 - Brooks

20 Seed pieces per row

N

12 x 105 = 1260 m2

Planted: 17-May

Guard = Norland

12	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**
11	1001 🟪 F14026	1011 🟪 F14034	1021 🟪 WV10655-1	1031 🟪 F14037	1041 🟪 F14032	1051 🟪 F14028	2001 🟪 F14030	2011 🟪 F14028	2021 🟪 Snowden West	2031 🟪 F14032	2041 🟪 Atlantic West	2051 🟪 Atlantic East
10	1002 🟪 F14025	1012 🟪 F14031	1022 🟪 F14036	1032 🟪 Atlantic West	1042 🟪 Atlantic East	1052 🟪 F14030	2002 🟪 F14031	2012 🟪 F14036	2022 🟪 WV10655-1	2032 🟪 F14034	2042 🟪 F14026	2052 🟪 Snowden East
9	1003 🟪 F14035	1013 🟪 Snowden West	1023 🟪 Snowden East	1033 🟥 F14023	1043 🟥 F14002	1053 🟥 F14011	2003 🟪 F14025	2013 🟪 F14035	2023 🟪 F14037	2033 🟥 F14021	2043 🟥 Shepody West	2053 🟥 F14005
8	1004 🟥 CV011238-1	1014 🟥 F14020	1024 🟥 F14003	1034 🟥 Shepody East	1044 🟥 F14018	1054 🟥 F14005	2004 🟥 F14022	2014 🟥 F14008	2024 🟥 F14003	2034 🟥 Shepody East	2044 🟥 F14015	2054 🟥 F14002
7	1005 🟥 F14016	1015 🟥 R.Burbank West	1025 🟥 F14008	1035 🟥 F14015	1045 🟥 R.Burbank East	1055 🟥 F14022	2005 🟥 F14016	2015 🟥 F14018	2025 🟥 R.Burbank West	2035 🟥 F14011	2045 🟥 F14020	2055 🟥 R.Burbank Eas
6	1006 🟥 F14017	1016 🟥 Shepody West	1026 🟥 CV011010-2	1036 🟥 F14010	1046 🟥 F14021	1056 🟥 CV08212-1	2006 🟥 F14023	2016 🟥 CV011238-1	2026 🟥 CV011010-2	2036 🟥 F14010	2046 🟥 CV08212-1	2056 🟥 F14017
5	1007 🟦 F14067	1017 🟦 F14112	1027 🟦 F14100	1037 🟦 F14068	1047 🟦 Norland East	1057 🟦 F14132	2007 🟦 Kennebec	2017 🟦 F14085	2027 🟦 F14067	2037 🟦 Norland East	2047 🟦 F14118	2057 🟦 F14068
4	1008 🟦 F14096	1018 🟦 F14085	1028 🟦 F14118	1038 🟦 F14090	1048 🟦 F14119	1058 🟦 F14071	2008 🟦 Chieftain East	2018 🟦 F14112	2028 🟦 F14057	2038 🟦 F14119	2048 🟦 F14134	2058 🟦 F14114
3	1009 🟦 Chieftain East	1019 🟦 F14128	1029 🟦 F14052	1039 🟦 Kennebec	1049 🟦 F14057	1059 🟦 F14075	2009 🟦 F14120	2019 🟦 F14052	2029 🟦 F14128	2039 🟦 F14071	2049 🟦 F14100	2059 🟦 Yukon Gold East
2	1010 🟦 F14114	1020 🟦 F14126	1030 🟦 Yukon Gold East	1040 🟦 F14120	1050 🟦 F14134	Norland	2010 🟦 F14090	2020 🟦 F14075	2030 🟦 F14132	2040 🟦 F14096	2050 🟦 F14126	Norland
1	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**	**Guard**

3 m

3m

3m

6 m

6m

105m

Project Report

AAFC National Potato Variety Trial Results from CDCS, Brooks, AB

2020

Prepared for:
Funding agencies and industry sponsors

Prepared by:

Michele Konschuh[1] and Erica Fava[2]
[1]University of Lethbridge
Lethbridge, AB

[2]Agriculture and Agri-Food Canada
Potato Research Centre
850 Lincoln Road P.O. Box 20280
Fredericton, NB E3B 4Z7

Fall, 2020

Introduction

In Alberta, potato industry stakeholders are looking for replacement varieties that use less nitrogen, less water, less pesticide, yet yield superior processing or culinary quality and tonnage. Varieties from breeding programs in Canada, Europe and the United States are often being assessed. Many breeding programs target disease resistance, nitrogen use efficiency and excellent storage potential in addition to increased yield. Tuber yield potential and nutritional requirements are impacted by variety characteristics and by environmental characteristics such as the length of the growing season (Westermann, 1993). As noted by Love et. al (2003), the full potential of a new variety may not be realized until proper management is implemented. There is increasing pressure on potato producers to utilize best management practices to reduce the environmental footprint for potatoes. The costs of such shifts in production practices will be borne primarily by producers.

An ideal French fry variety would have earlier maturity than Russet Burbank, be relatively tolerant of environmental fluctuations, have few defects, yield well and have specific gravity in the desired range (1.086 to 1.092). Good fry color out of the field is an asset, and good fry color out of storage is also very desirable. An ideal chipping variety would produce a good yield of medium sized tubers, be relatively tolerant of environmental fluctuations, have few defects, and have high specific gravity in the desired range (above 1.086). Tubers with a good skin set, good maturity at harvest and low concentration of reducing sugars is also very desirable. Varieties that store well at cooler temperatures are an asset. Ideal fresh market varieties would produce a good yield of creamer or medium sized tubers, be relatively tolerant of environmental fluctuations, have few defects, and have an attractive appearance. Tubers with a good skin set that store well are very desirable.

The purpose of this project was to pool resources to evaluate potential varieties from a range of sources, using a cooperative approach. This trial was established to collect local agronomic data on varieties from breeding programs in Canada, the U.S. and elsewhere. The varieties were planted in replicated plots at the Crop Diversification in Brooks, AB and were provided with 182 kg/ha N. Alberta data is essential when selecting varieties appropriate for our climate, our customers and industry stakeholders.

Objectives

A. To evaluate new cultivars for French fry processing;
B. To evaluate new cultivars for chip processing;
C. To evaluate new cultivars for fresh consumption; and
D. To evaluate cultivars from AAFC’s National Potato Breeding Program under Alberta conditions.

Materials and Methods

The variety evaluation was conducted in small plots at the Crop Diversification Centre South in Brooks, AB. Fertility for the AAFC plots (182 kg/ha) was achieved through a combination of soil fertility (112 lbs/ac N; 347 lbs/ac P) and broadcast fertilizer (96 kg/ha of 11-52-0 and 130 kg/ha 46-0-0) incorporated May 13 prior to planting. Entries were planted in duplicate rows in a randomized complete block design along with standard varieties. Each block was planted adjacent to guard rows to reduce any edge effects (see plot plan, Appendix A).

Eptam 8E (1.8 L/ac) and Sencor (150g/ac) were applied prior to planting (May 13) to control weeds. Seed of standard cultivars and test cultivars was provided by AAFC. Potatoes were planted May 28 approximately 12 to 15cm deep using a two-row tuber unit planter. Seed of French fry varieties was planted at 30cm spacing in 6m rows spaced 90cm apart. Seed of Chip and Fresh Market varieties were planted at 20cm spacing in 6m rows. Plots were hilled June 11 with a power hiller. Lorox (0.91 L/ac) was applied prior to emergence of the potatoes to assist with weed suppression. The plots were irrigated to maintain soil moisture close to 70%. Foliar fungicides were applied four times during the growing season to prevent early and late blight from developing (Table 1).

Table 1: Foliar fungicides applied to the potato crop in 2020 to prevent early and late blight development.

Date of Application	*Fungicide*	*Rate*
8 July	Ridomil Gold and Bravo	0.64L/ac
31 July	Quadris	324mL/ac
19 Aug	Dithane	0.91 L/ac
26 Aug	Dithane	0.91 L/ac

Figure 1: Variety evaluation trial at CDCS in Brooks, AB July 15, 2020.

Reglone was applied (1.0 L/ac) September 18, 2020. Potatoes were harvested September 24 using a 1-row Grimme harvester.

Fresh market and French fry tubers were stored at 8˚C until graded. Chipping tubers were stored at 14.5°C until graded. Chipping and Fresh Market tubers were graded into size categories (less than 1.5”, 1.5 to 2.25”, 2.25: to 3.5”, 3.5 to 4.5”, over 4.5” and deformed). French Fries were graded by weight into categories (< 2”, < 2” and 170g, 170 to 284g, 284 to 340g, > 340g and deformed). A sample of twenty tubers (1.5 to 3.5” or 170 to 340g) from each replicate was used to determine specific gravity using the weight in air over weight in water method. These tubers were cut longitudinally to assess internal defects. Sub-samples of marketable tubers were provided to Lethbridge Research Centre staff for culinary and post-harvest evaluations.

The data presented here have not been statistically analyzed. Data reported are the mean of two replicate rows.

Results – Chipping Cultivars

Sample hills of each cultivar were dug for a virtual field day August 21, 2020. Photos of the chipping cultivars are shown in Figure 2.

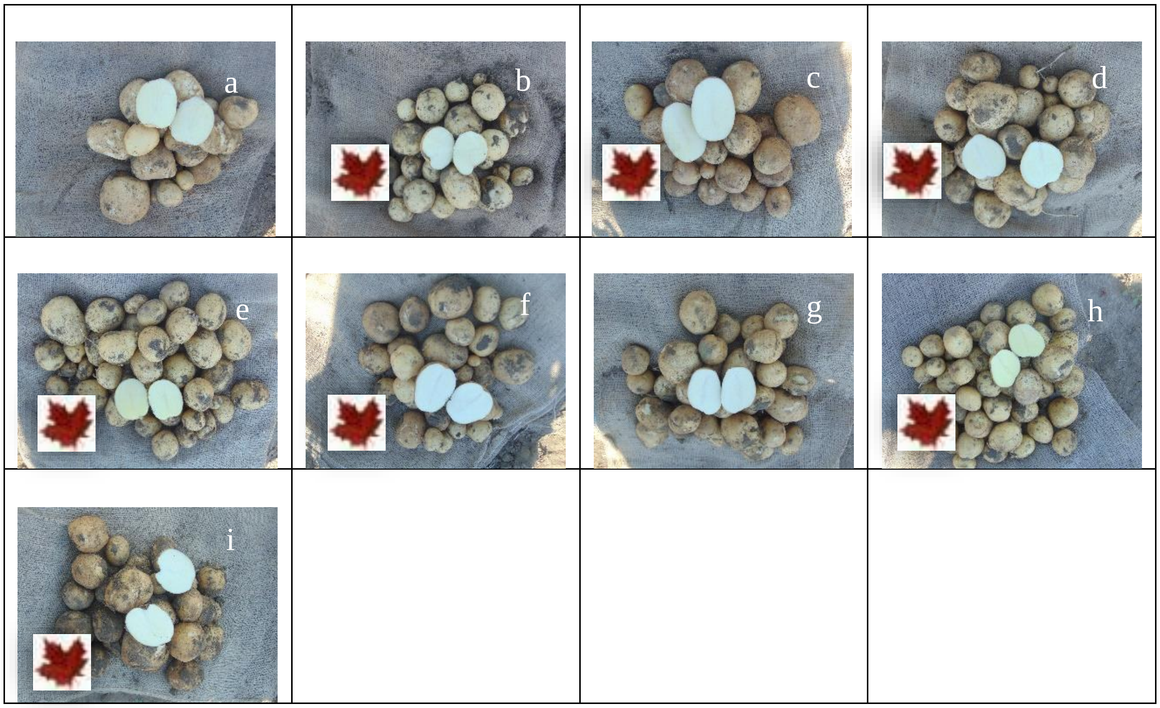

Figure 2. AAFC chipping cultivars at the CDCS field day August 21, 2020: a) Atlantic, b) CV10028-1, c) F150985-04, d) F150992-06, e) FV16324-08, f) FV16475-16, g) Snowden, h) Vigor, and i) WV10655-1.

Yield data (total yield; ton/ac) and specific gravities of each of the chipping cultivars are shown in Table 2. Yield ranged from 13.7 for F1150985.04 to 22.7 ton/ac for WV10655-1. Specific gravity ranged from 1.094 for FV16324.08 to 1.109 for Atlantic and F150985.04.

Table 2: Estimated total yield (ton/acre) and specific gravity for each chipping cultivar grown at CDCS in Brooks, AB (approximately 182 kg/ha nitrogen). Data shown is the mean of two replicates.

	Yield (ton/ac)	SG
ATLANTIC	18.07	1.109
CV10028-1	15.49	1.105
F150985-04	13.74	1.109
F150992-06	20.49	1.102
FV16324-08	12.85	1.094
FV16475-16	20.97	1.095
SNOWDEN	18.30	1.105
VIGOR	19.77	1.097
WV10655-1	22.72	1.097

The mean percentage of total tuber number in each size category is shown in Table 3.

Table 3: Percentage of total tuber number in each size category (< 1.5”, 1.5 to 2.25”, 2.25 to 3.5”, 3.5 to 4.5”, > 4.5, and deformed) for each chipping cultivar grown at approximately 182 kg/ha N. Data shown is the mean of two replicates.

	No. of < 1.5”	No. of 1.5 to 2.25”	No. of 2.25 to 3.5”	No. of 3.5 to 4.5”	No. of > 4.5”	No of Def.
ATLANTIC	12%	37%	48%	2%	0%	1%
CV10028-1	16%	36%	35%	0%	0%	13%
F150985-04	12%	70%	18%	0%	0%	1%
F150992-06	9%	45%	44%	2%	0%	0%
FV16324-08	17%	54%	28%	0%	0%	1%
FV16475-16	9%	32%	57%	2%	0%	0%
SNOWDEN	10%	51%	39%	0%	0%	1%
VIGOR	8%	60%	31%	0%	0%	1%
WV10655-1	8%	32%	57%	3%	0%	0%

The yield of tubers (estimated ton/ac) of each chipping cultivar is shown by size category in Table 4. Yield of tubers 1.5” to 3.5” in diameter ranged from 11.9 ton/acre for FV16324.08 to 20.4 ton/ac for WV10655-1.

Table 4: Estimated yield (ton/ac) in each size category (< 1.5", 1.5 to 2.25", 2.25 to 3.5", 3.5 to 4.5", > 4.5, and deformed) for each chipping cultivar grown at approximately 182 kg/ha N. Data shown is the mean of two replicates.

	Yield of < 1.5" (ton/ac)	Yield of 1.5 to 2.25" (ton/ac)	Yield of 2.25 to 3.5" (ton/ac)	Yield of 3.5 to 4.5" (ton/ac)	Yield of > 4.5" (ton/ac)	Yield of deformed (ton/ac)
ATLANTIC	0.4	3.8	12.5	1.3	0.0	0.1
CV10028-1	0.6	3.7	8.6	0.0	0.0	2.6
F150985-04	0.6	8.6	4.6	0.0	0.0	0.1
F150992-06	0.3	4.5	14.3	1.4	0.0	0.0
FV16324-08	0.6	5.3	6.6	0.0	0.0	0.4
FV16475-16	0.4	3.3	16.3	0.9	0.0	0.1
SNOWDEN	0.5	6.6	11.2	0.0	0.0	0.0
VIGOR	0.4	8.7	10.4	0.0	0.0	0.3
WV10655-1	0.3	3.5	16.9	2.1	0.0	0.0

Tuber samples used to measure specific gravity were evaluated for hollow heart, other internal defects and scab. There were very few internal defects observed in the tubers examined. No hollow heart was noted in 2020 samples. Brown center was noted only in a few tubers. F14037 had internal necrotic lesions in almost half of the tubers. FV16324-08, CV10028-1 and AC Vigor had some black scurf. Tubers were not protected by seed treatments in the trial. No common scab lesions were noted. FV16324-08 seemed to have very short inherent dormancy.

Results– French Fry Cultivars

Sample hills of each cultivar were dug for a virtual field day August 21, 2020. Photos of the French fry cultivars are shown in Figure 3.

Figure 3. AAFC French fry cultivars at the CDCS field day August 21, 2020: a) CV12202-2, b) CV12267-1, c) CV13010-4, d) CV13010-5, e) F15019, f) Ranger Russet, g) Russet Burbank, h) Shepody, i) VF140855-03, j) VF140855-05, k) VF140855-07, l) VF140855-11, m) VF150081-01, n) VF150083-02, o) VF150086-02, and p) VF150091-01.

Yield data (total yield; ton/ac) and specific gravities of each of the French fry cultivars are shown in Table 5. Total yield ranged from 15.7 ton/ac for VF140855-05 to 24.8 ton/ac for VF150091.01. Marketable yield ranged from 10.0 ton/ac for CV13010-4 to

22.3 ton/ac for VF140855-11. Specific gravity ranged from 1.091 for CV13010-5 to 1.114 for VF140855-07.

Table 5: Estimated total yield and marketable yield (ton/acre) and specific gravity for each French fry cultivar grown at CDCS in Brooks, AB (approximately 182 kg/ha nitrogen). Data shown is the mean of two replicates.

	Total Yield (ton/ac)	Mkt Yield (ton/ac)	SG
CV12202-2	17.7	14.0	1.092
CV12267-1	19.4	17.8	1.108
CV13010-4	21.5	10.0	1.094
CV13010-5	19.7	13.1	1.091
F15019	16.0	11.8	1.098
RANGER RUSSET	21.4	18.2	1.099
RUSSET BURBANK	24.0	20.7	1.096
SHEPODY	21.3	18.6	1.096
VF140855-03	20.8	18.2	1.107
VF140855-05	15.7	14.1	1.101
VF140855-07	23.7	21.3	1.114
VF140855-11	24.5	22.3	1.095
VF150081-01	19.8	17.4	1.098
VF150083-02	19.4	15.8	1.109
VF150086-02	21.7	17.6	1.107
VF150091-01	24.8	21.8	1.105

The mean percentage of total tuber number in each size category is shown in Table 6.

Table 6: Percentage of total tuber number in each size category (< 2.0", > 2.0" and > 170g, 170 to 284g, 284 to 340g and > 340g, and deformed tubers) for each French fry cultivar grown at approximately 182 kg/ha. Data shown is the mean of two replicates.

	# of <2.0"	# of > 2.0; > 170g	# of 170-284g	# of 284-340g	# of >340g	# deformed
CV12202-2	42%	26%	24%	4%	3%	0%
CV12267-1	24%	20%	37%	9%	10%	0%
CV13010-4	68%	21%	9%	1%	0%	1%
CV13010-5	57%	19%	20%	2%	1%	0%
F15019	55%	21%	19%	5%	1%	0%
RANGER RUSSET	32%	16%	35%	8%	7%	2%
RUSSET BURBANK	30%	37%	22%	3%	7%	1%
SHEPODY	23%	17%	33%	7%	15%	5%
VF140855-03	28%	24%	34%	7%	7%	1%
VF140855-05	17%	12%	32%	15%	21%	3%
VF140855-07	24%	24%	31%	9%	7%	1%
VF140855-11	27%	24%	35%	8%	12%	0%
VF150081-01	33%	32%	29%	6%	6%	0%
VF150083-02	38%	32%	23%	4%	3%	1%
VF150086-02	41%	18%	26%	5%	9%	1%
VF150091-01	23%	15%	36%	13%	16%	1%

The yield of tubers (estimated ton/ac) of each French fry cultivar is shown by size category in Table 7. Yield of 170 to 284g tubers ranged from 4.0 ton/ac of CV13010-4 to 9.9 ton/ac of VF140855-07. Yield of 284 to 396g tubers ranged from 0.4 for CV13010-4 to 4.7 for VF150091-01.

Table 7: Estimated yield (ton/ac) in each size category (< 113g, 113 to 170g, 170 to 284g, 284 to 396g and > 396g, and deformed tubers) for each French fry cultivar grown at approximately 182 kg/ha. Data shown is the mean of two replicates.

	Yld of <113g	Yld of 113-170g	Yld of 170-284g	Yld of 284-396g	Yld of >396g	Yld def
CV12202-2	3.4	4.3	6.4	1.7	1.7	0.3
CV12267-1	1.7	2.8	8.0	2.6	4.4	0.0
CV13010-4	11.1	5.5	4.0	0.4	0.2	0.4
CV13010-5	6.4	4.3	6.9	1.3	0.7	0.2
F15019	4.2	3.8	5.4	2.2	0.6	0.0
RANGER RUSSET	2.5	2.8	9.1	2.8	3.6	0.6
RUSSET BURBANK	2.9	7.0	7.1	1.4	5.2	0.4
SHEPODY	1.5	2.4	7.4	2.2	6.6	1.2
VF140855-03	2.3	3.8	8.5	2.3	3.6	0.3
VF140855-05	0.8	1.1	4.3	2.8	5.9	0.8
VF140855-07	2.1	4.1	9.9	3.7	3.6	0.3
VF140855-11	2.2	4.3	8.0	3.0	7.0	0.0
VF150081-01	2.4	5.2	6.7	2.4	3.0	0.0
VF150083-02	3.4	5.8	6.9	1.6	1.4	0.2
VF150086-02	3.8	3.3	7.1	1.8	5.4	0.3
VF150091-01	2.0	2.4	9.3	4.7	5.5	1.1

Tuber samples used to measure specific gravity were evaluated for hollow heart, other internal defects and scab. There were very few internal defects observed in the tubers examined. Hollow heart was only noted in s few tubers of CV12202-2. Common scab was not noted on any tubers and black scurf was present on some tubers of VF140855011 and CV12202-2.

Results – Fresh Market Cultivars

Sample hills of each cultivar were dug for a field day August 21, 2020. Photos of the yellow/white fresh market cultivars are shown in Figure 4.

Figure 4. AAFC yellow/white fresh market cultivars at the CDCS field day August 21, 2020: a) F150128-01, b) F150130.04, c) F150919-03, and b) Yukon Gold.

Photos of the purple/red-skinned fresh market cultivars are shown in **Figure 5**.

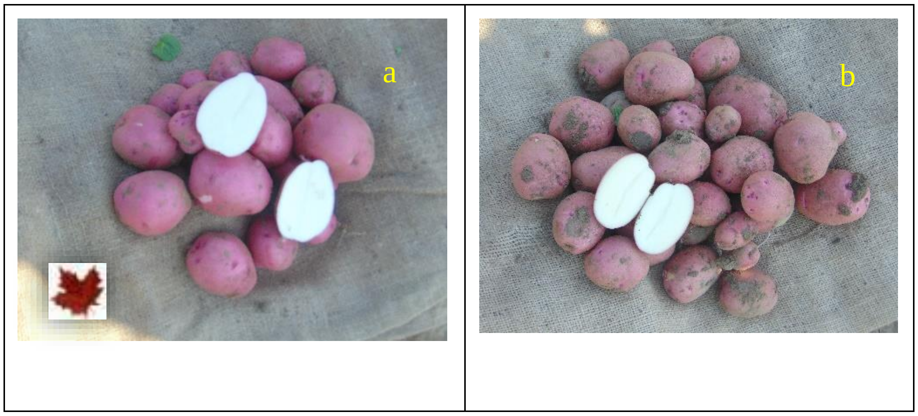

Figure 5. AAFC purple/red-skinned fresh market cultivars at the CDCS field day August 21, 2020: a) FV16004-7 and b) Norland.

Yield data (total yield; ton/ac) and specific gravities of each of the fresh market cultivars are shown in Table 8. Total yield ranged from 14.2 ton/ac for F150128-1 to 23.1 ton/ac for F150919-03. Specific gravity ranged from 1.081 for FV16004-7 and Norland to 1.101 for Yukon Gold.

Table 8: Estimated total yield (ton/acre) and specific gravity for each fresh market FM cultivar grown at CDCS in Brooks, AB (approximately 182 kg/ha nitrogen). Data shown is the mean of two replicates.

	End Use	Yield (ton/ac)	SG
Yellow/White-skinned			
F150128-01	FM	14.2	1.098
F150130-04	FM	16.8	1.096
F150919-03	FM	23.1	1.085
Yukon Gold	FM	21.1	1.101
Red/Purple-skinned			
FV16004-7	FM	19.7	1.081
Norland	FM	20.2	1.081

The mean percentage of total tuber number in each size category is shown in Table 9.

Table 9: Percentage of total tuber number in each size category (< 1.5”, 1.5 to 2.25”, 2.25 to 3.5”, 3.5 to 4.5”, > 4.5, and deformed) for each fresh market cultivar grown at approximately 182 kg/ha. Data shown is the mean of two replicates.

	No. of <1.5”	No. of 1.5 to 2.25”	No. of 2.25 to 3.5”	No. of 3.5 to 4.5”	No. of > 4.5”	No. of deformed
Yellow/White-skinned						
F150128-01	15%	61%	23%	0%	0%	1%
F150130-04	12%	47%	37%	1%	0%	3%
F150919-03	19%	46%	27%	0%	0%	8%
Yukon Gold	9%	26%	63%	1%	0%	1%
FV16004-7	9%	42%	48%	0%	1%	0%
Norland	8%	45%	47%	0%	0%	0%

The yield of tubers (estimated ton/ac) of each fresh market cultivar is shown by size category in Table 10. Yield of tuber between 1.5 and 3.5” in diameter ranged from 13.5 for F150128-1 to 20.1 for Yukon Gold. FV16004-7 was similar in size distribution to Norland.

Table 10: Estimated yield (Yld; ton/ac) in each size category (< 1.5", 1.5 to 2.25", 2.25 to 3.5", 3.5 to 4.5", > 4.5, and deformed) for each fresh market cultivar grown at approximately 182 kg/ha. Data shown is the mean of two replicates.

	Yld of <1.5" (ton/ac)	Yld of 1.5 to 2.25" (ton/ac)	Yld of 2.25 to 3.5" (ton/ac)	Yld of 3.5 to 4.5" (ton/ac)	Yield of > 4.5" (ton/ac)	Yld of def (ton/ac)
Yellow/White-skinned						
F150128-01	0.5	7.2	6.3	0.0	0.0	0.2
F150130-04	0.4	4.8	10.0	0.7	0.0	0.8
F150919-03	1.1	6.9	11.2	0.3	0.0	3.6
Yukon Gold	0.2	2.5	17.6	0.6	0.0	0.2
FV16004-7	0.3	4.8	13.8	0.6	0.0	0.2
Norland	0.3	5.7	14.2	0.0	0.0	0.0

Tuber samples used to measure specific gravity were evaluated for hollow heart, other internal defects and scab. No hollow heart was observed in 2020 samples. Black scurf was present at a low percentage on all samples except F150919-03. No common scab was observed in 2020 samples.

Conclusions

The 2020 variety trial included a number of cultivars with potential in southern Alberta. Atlantic, AC Vigor and Snowden were included in the trial as standard varieties to compare to 6 chipping cultivars. Russet Burbank and Shepody were included in the trial as standard varieties to compare to 14 French fry cultivars. Yukon Gold and Norland were included in the trial as standard varieties to compare with 4 fresh market cultivars.

The trial was designed to provide regional data for a wide range of potato cultivars. All cultivars were planted at the same in-row spacing, the N rate was approximately 182 kg/ha, and harvest was scheduled for full-season varieties. Addressing the agronomic needs, such as plant density, fertility requirements, and harvest timing for each variety may well result in improvements to yield and size profiles when compared to the results in this trial.

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Alberta Seed Producers Inc.
ConAgra Foods, Lamb Weston Division
Edmonton Potato Growers
Old Dutch Foods
Parkland Seed Potatoes
Rockyview Seed Potatoes
Tuberosum Technologies

Contact Information:
Michele Konschuh, Ph.D.
Irrigated Crop Scientist
University of Lethbridge
403-634-4940 phone
m.konschuh@uleth.ca

and

Erica Fava.
Industry Trial Coordinator and Liaison
Agriculture and Agri-Food Canada
Potato Research Centre
850 Lincoln Road P.O. Box 20280
Fredericton, NB E3B 4Z7
506-451-5198

Appendix A Plot Plan

AAFC - 2020 - Brooks **N**

24 Seed pieces per row Planted:

10" spacing 28-May **12 x 30 = 360 m2**

Guard = Atlantic

12	**Guard**			**Guard**			**Guard**			**Guard**	
11	1021	🟨		2021	🟨		1031	🟦		2031	🟦
	VIGOR			F150985-04			NORLAND			F150130-04	
10	1022	🟨		2022	🟨		1032	🟦		2032	🟦
	FV16475-16			FV16324-08			F150128-01			FV16004-7	
9	1023	🟨		2023	🟨		1033	🟦		2033	🟦
	FV16324-08			SNOWDEN			FV16004-7			YUKON GOLD	
8	1024	🟨		2024	🟨		1034	🟦		2034	🟦
	SNOWDEN			ATLANTIC			F150919-03			F150919-03	
7	1025	🟨		2025	🟨		1035	🟦		2035	🟦
	CV10028-1			F150992-06			YUKON GOLD			F150128-01	
6	1026	🟨		2026	🟨		1036	🟦		2036	🟦
	F150992-06			FV16475-16			F150130-04			NORLAND	
5	1027	🟨		2027	🟨		1037	🟦		2037	🟦
	ATLANTIC			WV10655-1			0			0	
4	1028	🟨		2028	🟨		1038	🟦		2038	🟦
	WV10655-1			VIGOR			0			0	
3	1029	🟨		2029	🟨		1039	🟦		2039	🟦
	F150985-04			CV10028-1			0			0	
2	1030	🟨		2030	🟨		1040	🟦		2040	🟦
	0			0							
1	**Guard**		3 m	**Guard**		**3m**	**Guard**		**3m**	**Guard**	
	6 m			6m			6m			6 m	
				Chippers			Fresh Market				

AAFC - 2020 - Brooks

N

20 Seed pieces per row

Planted: 28-May

12 " spacing

12 x 37 = 444 m2

Guard = Atlantic

12	**Guard**		**Guard**	**Guard**		**Guard**
11	1001 VF150081-01		1011 VF140855-03	2001 VF150091-01		2011 CV13010-5
10	1002 SHEPODY		1012 VF140855-07	2002 VF140855-07		2012 VF140855-05
9	1003 F15019		1013 RANGER RUSSET	2003 VF150081-01		2013 RANGER RUSSET
8	1004 CV12267-1		1014 VF150091-01	2004 CV12202-2		2014 F15019
7	1005 VF140855-11		1015 VF150083-02	2005 SHEPODY		2015 VF140855-11
6	1006 RUSSET BURBANK		1016 CV13010-4	2006 VF140855-03		2016 VF150083-02
5	1007 CV12202-2			2007 CV12267-1		0
4	1008 VF140855-05			2008 CV13010-4		0
3	1009 VF150086-02			2009 VF150086-02		0
2	1010 CV13010-5			2010 RUSSET BURBANK		
1	**Guard**	3 m	**Guard**	**Guard**	**3m**	**Guard**
	7 m					7 m

French Fries

AAFC POTATO FIELD DAY - ALBERTA

Virtual Field Tour

August 21, 2020

CDCS, Brooks, AB

CHIPPING POTATOES

Three-hill dig

Atlantic

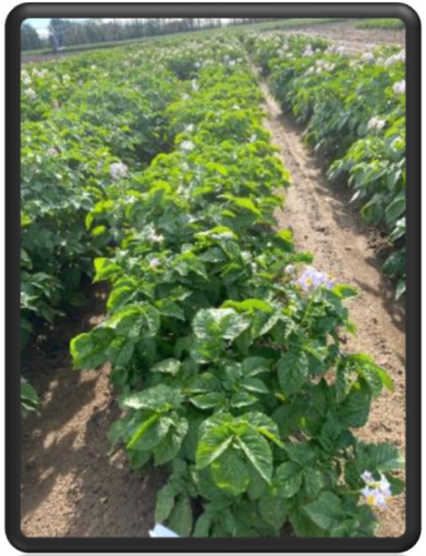
July 17, 2020

August 21, 2020

August 21, 2020

Sept 16	Mkt Yld (ton/ac)	SG	Chip Score
Atlantic	**16.3**	**1.109**	**62.6**
Snowden	17.8	1.105	63.8
Vigor	19.1	1.097	63.8

CV10028-1



July 17, 2020

Aug 21, 2020

August 21, 2020

Sept 16	Mkt Yld (ton/ac)	SG	Chip Score
Atlantic	16.3	1.109	62.6
CV10028-1	**12.3**	**1.101**	**62.3**
Snowden	17.8	1.105	63.8
Vigor	19.1	1.097	63.8

F150985-04

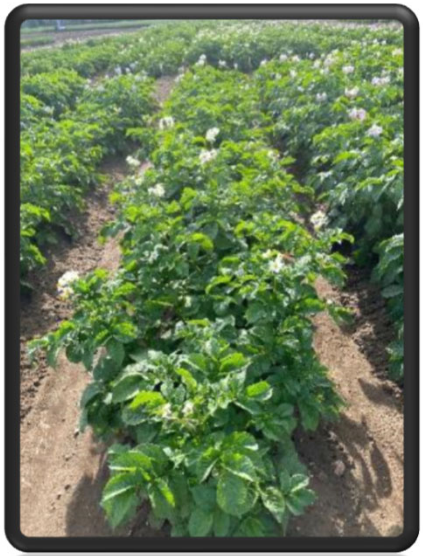
July 17, 2020

August 21, 2020

August 21, 2020

Sept 16	Mkt Yld (ton/ac)	SG	Chip Score
Atlantic	16.3	1.109	62.6
F150985-04	**13.1**	**1.109**	**63.3**
Snowden	17.8	1.105	63.8
Vigor	19.1	1.097	63.8

F150992-06



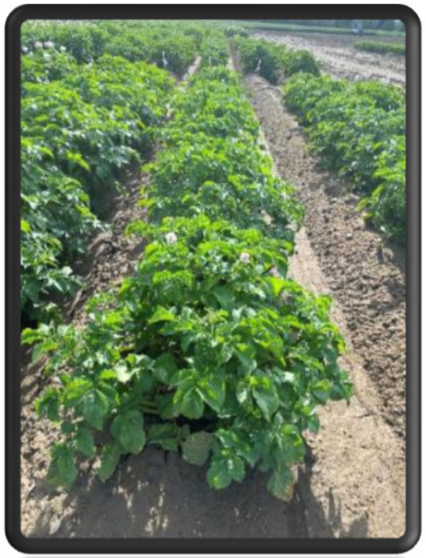
July 17, 2020

Aug 21, 2020

August 21, 2020

Sept 16	Mkt Yld (ton/ac)	SG	Chip Score
Atlantic	16.3	1.109	62.6
F150992-06	**18.8**	**1.102**	**53.5**
Snowden	17.8	1.105	63.8
Vigor	19.1	1.097	63.8

FV16324-08



July 17, 2020

Aug 21, 2020

August 21, 2020

Sept 16	Mkt Yld (ton/ac)	SG	Chip Score
Atlantic	16.3	1.109	62.6
FV16324-08	**11.9**	**1.094**	**55.7**
Snowden	17.8	1.105	63.8
Vigor	19.1	1.097	63.8

FV16475-16

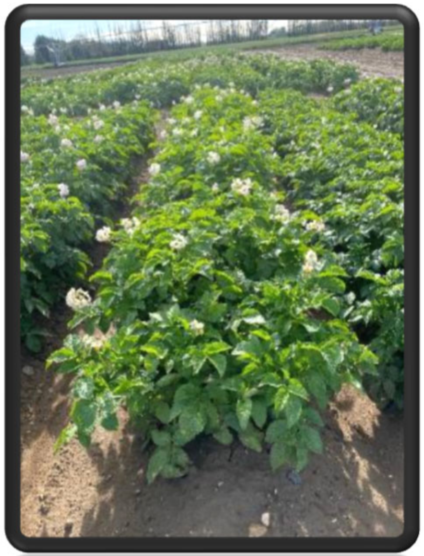
July 17, 2020

Aug 21, 2020

August 21, 2020

Sept 16	Mkt Yld (ton/ac)	SG	Chip Score
Atlantic	16.3	1.109	62.6
FV16475-16	**19.6**	**1.095**	**59.2**
Snowden	17.8	1.105	63.8
Vigor	19.1	1.097	63.8

WV10655-1



July 17, 2020

Aug 21, 2020

August 21, 2020

Sept 16	Mkt Yld (ton/ac)	SG	Chip Score
Atlantic	16.34	1.109	62.6
WV10655-1	**20.34**	**1.097**	**58.9**
Snowden	17.78	1.105	63.8
Vigor	19.07	1.097	63.8

Snowden

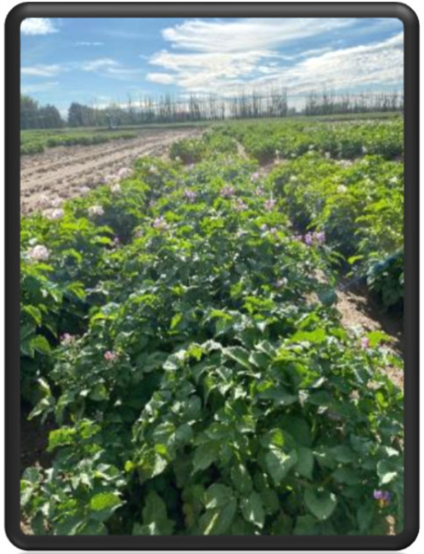
July 17, 2020

Aug 21, 2020

August 21, 2020

Sept 16	Mkt Yld (ton/ac)	SG	Chip Score
Atlantic	16.3	1.109	62.6
Snowden	**17.8**	**1.105**	**63.8**
Vigor	19.1	1.097	63.8

Vigor



July 17, 2020

Aug 21, 2020

August 21, 2020

Sept 16	Mkt Yld (ton/ac)	SG	Chip Score
Atlantic	16.3	1.109	62.6
Snowden	17.8	1.105	63.8
Vigor	**19.1**	**1.097**	**63.8**

FRENCH FRY POTATOES

Three hill dig

CV12202-2

July 15, 2020

Aug 21, 2020

August 21, 2020

Sept 16	Mkt Yld (ton/ac)	SG	USDA Color
Ranger Russet	18.2	1.099	2
Russet Burbank	20.7	1.096	2
CV12202-2	**14.0**	**1.092**	**2**
Shepody	18.6	1.096	3

CV12267-1

July 15, 2020

Aug 21, 2020

August 21, 2020

Sept 16	**Mkt Yld (ton/ac)**	**SG**	**USDA Color**
Ranger Russet	18.2	1.099	2
Russet Burbank	20.7	1.096	2
CV12267-1	**17.8**	**1.108**	**0**
Shepody	18.6	1.096	3

CV13010-4

July 15, 2020

Aug 21, 2020

August 21, 2020

Sept 16	Mkt Yld (ton/ac)	SG	USDA Color
Ranger Russet	18.2	1.099	2
Russet Burbank	20.7	1.096	2
CV13010-4	**10.0**	**1.094**	**1**
Shepody	18.6	1.096	3

CV13010-5

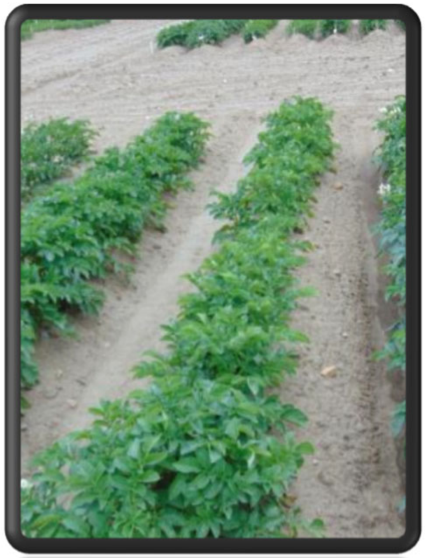
July 15, 2020

Aug 21, 2020

August 21, 2020

Sept 16	Mkt Yld (ton/ac)	SG	USDA Color
Ranger Russet	18.2	1.099	2
Russet Burbank	20.7	1.096	2
CV13010-5	**13.1**	**1.091**	**1**
Shepody	18.6	1.096	3

F15019



July 15, 2020

Aug 21, 2020

August 21, 2020

Sept 16	Mkt Yld (ton/ac)	SG	USDA Color
Ranger Russet	18.2	1.099	2
Russet Burbank	20.7	1.096	2
F15019	**11.8**	**1.098**	**4**
Shepody	18.6	1.096	3

VF140855-03

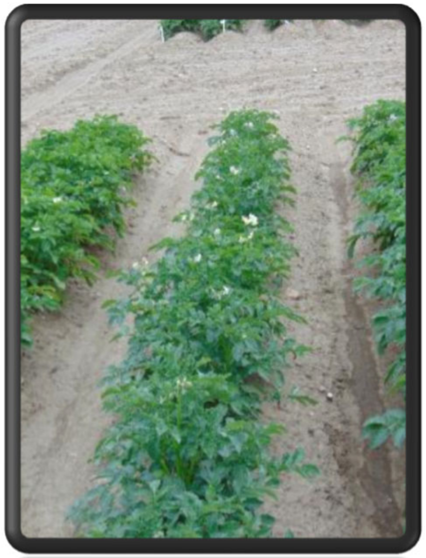
July 15, 2020

Aug 21, 2020

August 21, 2020

Sept 16	Mkt Yld (ton/ac)	SG	USDA Color
Ranger Russet	18.2	1.099	2
Russet Burbank	20.7	1.096	2
VF140855-03	**18.2**	**1.107**	**0**
Shepody	18.6	1.096	3

VF140855-05



July 15, 2020

Aug 21, 2020

August 21, 2020

Sept 16	Mkt Yld (ton/ac)	SG	USDA Color
Ranger Russet	18.2	1.099	2
Russet Burbank	20.7	1.096	2
VF140855-05	**14.1**	**1.101**	**1**
Shepody	18.6	1.096	3

VF140855-07

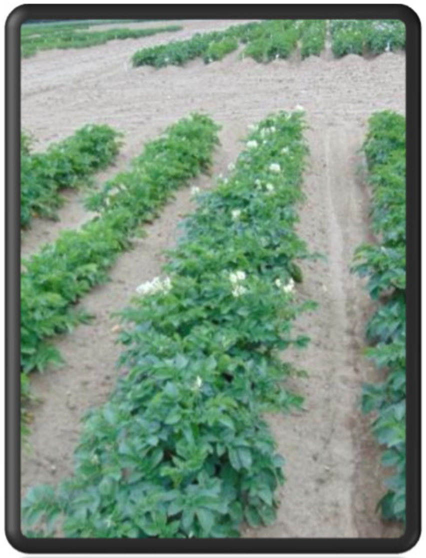
July 15, 2020

Aug 21, 2020

August 21, 2020

Sept 16	Mkt Yld (ton/ac)	SG	USDA Color
Ranger Russet	18.2	1.099	2
Russet Burbank	20.7	1.096	2
VF140855-07	**21.3**	**1.114**	**2**
Shepody	18.60	1.096	3

VF140855-11



July 15, 2020

Aug 21, 2020

August 21, 2020

Sept 16	**Mkt Yld (ton/ac)**	**SG**	**USDA Color**
Ranger Russet	18.2	1.099	2
Russet Burbank	20.7	1.096	2
VF140855-11	**22.3**	**1.095**	**1**
Shepody	18.6	1.096	3

VF150081-01

July 15, 2020

Aug 21, 2020

August 21, 2020

Sept 16	Mkt Yld (ton/ac)	SG	USDA Color
Ranger Russet	18.2	1.099	2
Russet Burbank	20.7	1.096	2
VF150081-01	**17.4**	**1.098**	**1**
Shepody	18.6	1.096	3

VF150083-02

July 15, 2020

Aug 21, 2020

August 21, 2020

Sept 16	Mkt Yld (ton/ac)	SG	USDA Color
Ranger Russet	18.2	1.099	2
Russet Burbank	20.7	1.096	2
VF150083-02	**15.8**	**1.109**	**1**
Shepody	18.6	1.096	3

VF150086-02

July 15, 2020

Aug 21, 2020

Aug 21, 2020

Sept 16	Mkt Yld (ton/ac)	SG	USDA Color
Ranger Russet	18.2	1.099	2
Russet Burbank	20.7	1.096	2
VF150086-02	**17.6**	**1.107**	**1**
Shepody	18.6	1.096	3

VF150091-01

July 15, 2020

Aug 21, 2020

August 21, 2020

Sept 16	Mkt Yld (ton/ac)	SG	USDA Color
Ranger Russet	18.2	1.099	2
Russet Burbank	20.7	1.096	2
VF150091-01	**21.8**	**1.105**	**2**
Shepody	18.6	1.096	3

Ranger Russet

July 15, 2020

Aug 21, 2020

August 21, 2020

Sept 16	Mkt Yld (ton/ac)	SG	USDA Color
Ranger Russet	18.2	1.099	2
Russet Burbank	20.7	1.096	2
			2
Shepody	18.6	1.096	3

Russet Burbank

July 15, 2020

Aug 21, 2020

August 21, 2020

Sept 16	Mkt Yld (ton/ac)	SG	USDA Color
Ranger Russet	18.2	1.099	2
Russet Burbank	**20.7**	**1.096**	2
			2
Shepody	18.6	1.096	3

Shepody

July 15, 2020

Aug 21, 2020

August 21, 2020

Sept 16	Mkt Yld (ton/ac)	SG	USDA Color
Ranger Russet	18.2	1.099	2
Russet Burbank	20.7	1.096	2
			2
Shepody	**18.6**	**1.096**	3

FRESH MARKET POTATOES – YELLOW AND WHITE

Three hill dig

F150128-01

July 18, 2020

Aug 21, 2020

August 21, 2020

Sept 16	Mkt Yld (ton/ac)	SG
F150128-01	**13.5**	**1.098**
Yukon Gold E	20.1	1.101

F150130-04

July 18, 2020

Aug 21, 2020

August 21, 2020

Sept 16	Mkt Yld (ton/ac)	SG
F150130-04	**14.8**	**1.096**
Yukon Gold E	20.1	1.101

F150919-03

July 18, 2020

Aug 21, 2020

August 21, 2020

Sept 16	Mkt Yld (ton/ac)	SG
F150919-03	**18.1**	**1.085**
Yukon Gold E	20.1	1.101

Yukon Gold

July 18, 2020

Aug 21, 2020

August 21, 2020

Sept 16	Mkt Yld (ton/ac)	SG
Yukon Gold	**20.1**	**1.101**

FRESH MARKET POTATOES – RED

Three hill dig

FV16004-7

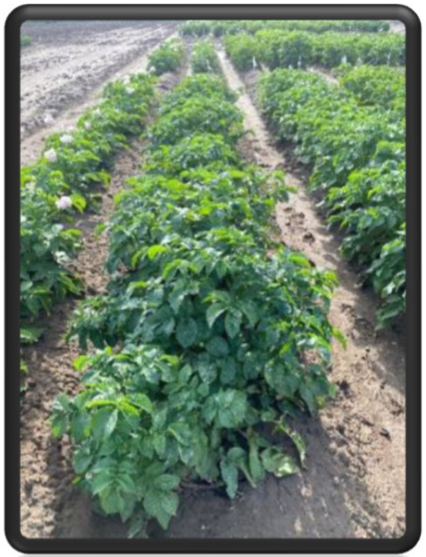
July 18, 2020

Aug 21, 2020

August 21, 2020

Sept 16	Mkt Yld (ton/ac)	SG
FV16004-7	**18.6**	**1.081**
Norland E	19.9	1.081

Norland



July 18, 2020

Aug 21, 2020

August 21, 2020

Sept 16	Mkt Yld (ton/ac)	SG
Norland	**19.9**	**1.081**