PGA RESEARCH ARCHIVE

# EQUIPMENT EVALUATION

POTATO GROWERS OF ALBERTA

# TABLE OF CONTENTS

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: Timing of Power Hilling for Russet Burbank in Southern Alberta.

Objectives:
1. To determine how many weeks after planting potatoes can be power hilled before root pruning and yield loss occur; and
2. To compare conventional hilling to power hilling with respect to yield and grade of potatoes.

## 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 May, 2004. A yearly report will be provided to the PGA by December 31, 2004.

## BASIS OF PAYMENT

The sponsor of the project, the PGA, will provide $4,000 upon finalization of this memorandum to AAFRD, to cover the following estimated yearly costs:

Casual Manpower (on an as need basis): $4,000

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

RECEIVED FEB 1 4 2005

**Project Report**

# Timing of Power Hilling for Russet Burbank in Southern Alberta

## 2nd Year

Prepared for:

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

Prepared by:

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January 17, 2005

Background

Potato acreage has expanded in southern Alberta and many growers have expanded operations without a proportional increase in equipment or manpower. In recent years, many growers have implemented power hilling as part of their spring planting routine, rather than hilling with conventional hilling equipment. Alberta's spring weather is unpredictable at best, and in some years, moisture has prevented growers from planting and hilling potatoes during an optimal window of time. Although damage from late hilling is anticipated, there is little information regarding the impact this damage has on yield or quality of processing potatoes. When plants have emerged and power hilling is no longer deemed safe, some growers may rely on conventional hillers.

Traditionally, commercially grown potatoes are hilled in the production cycle between emergence and canopy close (Carling and Walworth 1990, Geisel 2003). Geisel (2003) maintains that hilling is the only necessary tillage operation in the production of potatoes on the Canadian Prairies. Hilling improves drainage, minimizes tuber greening, minimizes frost damage, aids in weed control and facilitates harvesting (Carling and Walwoth 1990, Vangessel and Renner 1990, Renner 1992, Geisel 2003). Cultivation may benefit potatoes by aerating and improving the soil structure, but it may be detrimental to potato growth if soil structure is damaged, potato roots are pruned, or foliage is damaged (Carling and Walworth 1990, Renner 1992, Schaupmeyer 1992, Secor 1993).

Rotary hoes, discs, mouldboards, or power hillers equipped with a metal mould are commonly used to hill potatoes (Geisel 2003). Conventional hilling is typically conducted when plants are approximately 30 cm tall because there is little risk of covering the foliage (Carling and Walworth 1990, Vangesel and Renner 1990, Renner 1992). Vines of larger plants may, however, sustain greater damage from hilling than smaller plants, and the possibility of damaging roots and stolons increases as the plants increase in size (Carling and Walworth 1990, Rowe and Secor 1993). Geisel (2003) recommends that post-emergent hilling with conventional equipment be completed before the plants are 20 cm in height to avoid damage to roots and foliage and power hilling should be completed prior to emergence to avoid covering the plants.

The purpose of this project was to determine optimal timing of power hilling for Russet Burbank potatoes in southern Alberta and to compare not hilling with conventional and power hilling at various intervals for up to ten weeks after planting. Potatoes were graded for total yield, marketable yield, deformities, internal defects, specific gravity and fry colour.

Objectives

1. To determine how many weeks after planting potatoes can be power hilled before root pruning and yield loss occur; and
2. To compare conventional hilling to power hilling with respect to yield and grade of potatoes.

Materials and Methods

The study was conducted in replicated plots at CDCS in Brooks, AB. The plots were irrigated and managed following the guidelines for the Western Canadian Potato Breeding Program. Russet Burbank seed (E3) of the same seed lot was used for this trial. Seed was cut (approximately 2½ to 3 oz. seed pieces), suberized, treated with Maxim™ seed piece treatment (500 g/100 kg seed) and planted 12" apart in 25' rows spaced 36" apart. Potatoes were planted approximately 5 to 5½" deep using a two-row wheel planter on May 4, 2004. Each treatment was replicated four times. Each treatment was 4 rows wide, but only the two center rows were harvested (see plot plan).

Potatoes were hilled with a power hiller or a disc hiller according to the treatment list below:

Treatments:

1. Control – no hilling (for comparison only)
2. Power hilling 1 week after planting (immediately after planting)
3. Power hilling 3½ weeks after planting (ground crack)
4. Power hilling 4 weeks after planting (emergence)
5. Power hilling 6½ weeks after planting (stolon hooking)
6. Power hilling 7½ weeks after planting (buds forming; plants 5 to 12" tall)
7. omitted
8. Disc hilling 4 weeks after planting (emergence)
9. Disc hilling 6½ weeks after planting (stolon hooking)
10. Disc hilling 7½ weeks after planting (buds forming; plants 5 to 12" tall)
11. omitted
12. Disc hilling 9½ weeks after planting (row close)

Potatoes were planted approximately 5 to 5½" deep using a two-row wheel planter on May 20, 2004. Each treatment was 4 rows wide, and the center two rows were harvested (see plot plan attached). Wireless temperature loggers were attached to the first seed piece in two replicates of each treatment. These data loggers were recovered just prior to harvest and daily maximum and minimum temperature data from each device were collected. The plots were irrigated to maintain soil moisture close to 70%. Eptam (2.0 L/ac) was applied pre-planting (April 15) 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 1). Insecticides were applied July 15 (Sevin, 0.5 L/ac) and July 30 (Admire, 80 ml/ac) to control Colorado Potato Beetles.

**Table 1:** Foliar fungicides applied to the potato crop 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 |

All treatments were harvested mechanically September 29 and 30. Tubers were weighed to obtain yield estimates and graded to remove small and deformed tubers. Marketable tubers (1⅞ to 3½" 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. 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 sample of marketable tubers was submitted to the Food Science lab at CDCS for fry quality analysis. Eight tubers were used to process fries, and 5 fry strips from each potato were used to assess fry color. Fry color was rated on a scale of 1 to 7 where 1 = very dark and 7 = very light.

Data were statistically analyzed using GLM and Duncan's Multiple Range Test ($p \leq 0.05$; SAS).

Results and Discussion

The trial was planted quite early, but cool, wet weather immediately after planting delayed treatments. Hilling treatments were planned at weekly intervals for comparison, however, the stage of growth and development of the potato plants is more informative than the time elapsed after planting. Environmental conditions affected the stage of growth and development, and plants emerged later than expected in 2004. The growth stages of potatoes were noted for each treatment (Table 2).

**Table 2:** Stages of potato growth and development at the time hilling was conducted for each treatment in 2003.

| *Treatment(s)* | *Weeks After Planting* | *Stage of Potato Growth and Development* |
|---|---|---|
| 1 | No Hilling | N/A |
| 2 | 1 | Planted |
| 3 | 3½ | Ground crack; Growth Stage I |
| 4, 7 | 4 | Emergence; Growth Stage II |
| 5, 8 | 6½ | Stolon hooking; Growth Stage II |
| 6, 9 | 7½ | 5 to 12" Plants; Buds forming; Growth Stage III |
| 10 | 9½ | Row close; Growth Stage III |

Soil temperatures ranged from 4.25°C to 28.25°C during the early part of the growing season when hilling treatments were taking place (see Appendix Figures A1 and A2). In general, climate had a greater impact on soil temperatures in potato hills than the method or timing of hilling. Carling and Walworth (1990) reported that large changes in soil temperature in potato hills were related to weather changes rather than to hilling treatment or irrigation. Timing of hilling, and method of hilling had less impact on minimum soil temperatures in the spring than on maximum soil temperatures. Maximum soil temperatures differed by as much as 4°C between treatments. Power hilling immediately after planting appeared to prevent the hills from warming up as much as the control treatments. The cooler temperatures in these hills may have delayed emergence and may account for lower yields relative to the check and to hilling at ground crack or emergence. In general, power hilling treatments had lower maximum soil temperatures and higher minimum soil temperatures in the spring compared to disc hilled treatments. This environmental buffering or insulation effect was less noticeable as the season progressed. Carling and Walworth (1990) also noted that variation in soil temperature was much less during the later part of the season, due perhaps to the shading produced by closure of the canopy. Environmental buffering was also observed in the fall (see Appendix Figures A3 and A4). Minimum temperatures were higher and maximum temperatures were lower for power hilled treatments in September compared to not hilling or to disc hilled treatments. This soil temperature buffering effect may be even more noticeable in years with greater temperature extremes. Overall, 2003 was cooler with more precipitation than 2004, especially in August.

In 2004, hilling at ground crack (3½ weeks after planting) resulted in the highest total yield, however, none of the hilling treatments resulted in statistically significant improvements in gross yield (Figure 1) compared to the control. In contrast, most hilled treatments in 2003 resulted in greater total yield than the control (not hilled). Carling and Walworth (1990) reported that all four hilled treatments in their study yielded significantly more than the treatment that was not hilled. In 2004, we experienced more regular rainfall than usual, and fewer excessively hot days. The difference in environmental conditions may explain why not hilling gave good results in 2004, but not in 2003 or other studies.

Power hilling at ground crack (3½ weeks after planting) resulted in significantly greater total yield than power hilling immediately after planting. Power hilling early in 2004, may have delayed plant emergence enough to impact yield. Hilling with a power hiller any time after stolon hooking had taken place resulted in significant yield reductions compared to not hilling. Presumably, this yield reduction is a consequence of root pruning and damage to the vegetative portions of the plant.

Hilling with a disc hiller 3½ to 7½ weeks after planting resulted in gross yield similar to the control, but disc hilling at row close (9½ weeks after planting) resulted in a significant reduction in gross yield relative to the control (Figure 1). This hilling event corresponded to stage III (tuber initiation). Few studies have looked at the effects of the timing of hilling on potato yield and quality, and none have addressed timing of power hilling. Many of the papers dealing with timing of hilling are focused on hilling as a means of weed control, and few time frames are included. Vangessel and Renner (1990) and Renner (1992) used early hilling (ground crack) and conventional hilling (plants 12" tall) time frames in their study of weed interference in potato. In their studies, no difference in yield or marketable yield could be attributed to the time of hilling. However, in the absence of other methods of weed control, the timing of hilling impacted weed biomass, type of weed species present and yield (Renner 1992). Rajalahti et al. (1999) used a cultivator type hiller 3 weeks after planting (late ground cracking), 4 weeks after planting (1 week after 50% potato emergence) and 5 weeks after planting (2 weeks after 50% potato emergence). Their study reported significantly greater yield in plots hilled 3 weeks after planting than those hilled 4 and 5 weeks after planting and in those hilled 4 weeks after planting compared to those hilled 5 weeks after planting, but there were no significant differences in marketable yield between timings.

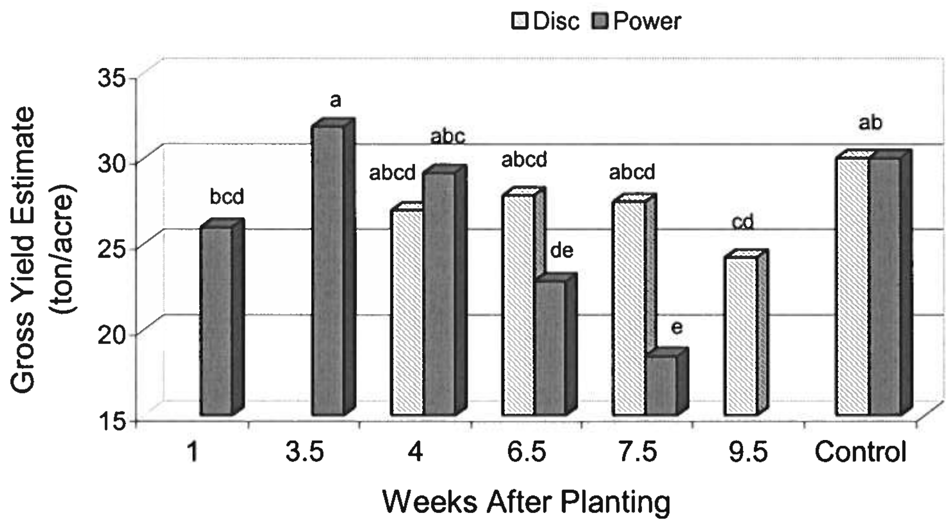


**Figure 1:** Gross yield estimates (ton/acre) of Russet Burbank potatoes from plants hilled with a disc hiller or a power hiller at intervals ranging from immediately after planting to 9.5 weeks after planting. Bars with the same letter are not significantly different at the $p \leq 0.05$ level.

Harvested tubers were graded according to the Guidelines for the Western Canadian Potato Breeding Program. Potatoes with a diameter of less than 1⅞" were categorized as small tubers, tubers between 1⅞" and 3½" were classed as marketable and potatoes greater than 3½" in diameter were classed as oversized. Tubers with secondary growth, growth cracks and other deformities were reported as deformed. Results of grading from the trial are shown in Table 3. None of the hilled treatments resulted in significantly different yields of undersized potatoes than the control, however there was a trend toward fewer smalls the later the plants were power hilled.

The greatest marketable yield was observed when Russet Burbank potatoes were power hilled at ground crack (3½ weeks after planting). Although not significantly different from the control, yield of marketable potatoes from plants power hilled at ground crack were significantly better than those from plants power hilled immediately after planting (1 week after planting). Power hilling after stolon hooking reduced marketable yield compared to the control. Yield of marketable tubers from disc hilled treatments were not significantly different from the control, except for treatments disc hilled at row close, which were lower. Carling and Walworth hilled with a spider hiller when plants were 4 to 6" high (early treatment) or when plants were 12" high (late treatment), and reported no significant difference in total or marketable yield as a result of these treatments. Their treatments roughly correspond to our disc hilled treatments 6½ and 7½ weeks after planting. Rajalahti et al. (1999) observed significant differences in total yields between treatments, however, no differences in marketable yield between timings of hilling events. Not hilling (control) and hilling too late resulted in more oversized and deformed tubers than other treatments, although few significant differences were observed.

**Table 3:** Yield estimates (ton/acre) by size category of Russet Burbank potatoes from plants power hilled or disc hilled at various times from immediately after planting to 9.5 weeks after planting. Values in columns with the same letter are not significantly different at the p ≤0.05 level..

| *Trt.* | *Weeks After Planting* | *Small (<1⅞")* | *Marketable (1⅞-3½")* | *Oversize (>3½")* | *Deformed* |
|---|---|---|---|---|---|
| 1 | Not Hilled | 3.94 ab | 24.14 ab | 0.85 ab | 1.07 b |
| | Power Hilled | | | | |
| 2 | 1 | 5.47 a | 20.00 bc | 0.13 b | 0.36 bcd |
| 3 | 3½ | 5.83 a | 24.99 a | 0.37 ab | 0.67 bcd |
| 4 | 4 | 4.09 ab | 23.96 ab | 0.89 a | 0.20 d |
| 5 | 6½ | 3.10 b | 18.66 c | 0.42 ab | 0.62 bcd |
| 6 | 7½ | 3.34 b | 13.69 d | 0.45 ab | 0.98 bc |
| | Disc Hilled | | | | |
| 8 | 4 | 4.45 ab | 21.59 abc | 0.60 ab | 0.31 cd |
| 9 | 6½ | 5.08 ab | 21.00 abc | 0.51 ab | 0.53 bcd |
| 10 | 7½ | 5.87 a | 20.82 abc | 0.22 ab | 0.54 bcd |
| 12 | 9½ | 4.07 ab | 18.01 c | 0.35 ab | 1.74 a |

Specific gravity data is shown in Table 4. Potatoes hilled with a power hiller after tuber formation began, or with a disc hiller at row close had lower specific gravity than those from other treatments, although few of the differences were statistically significant. The highest specific gravities were observed in the samples from treatments hilled at emergence (4 weeks after planting). No reported information was found linking specific gravity to method or timing of hilling.

**Table 4:** Specific gravity of tubers harvested from plants hilled 0 to 9.5 weeks after planting. Specific gravity was measured using the weight in air over weight in water method. Data in the table followed by the same letter are not significantly different at the p ≤0.05 level.

| *Type of Hilling* | *Weeks After Planting* | | | | | |
|---|---|---|---|---|---|---|
| | *1* | *3.5* | *4* | *6.5* | *7.5* | *9.5* |
| Power | 1.095 abc | 1.087 abc | 1.099 ab | 1.086 bc | 1.081 c | |
| Disc | | | 1.101 a | 1.092 abc | 1.098 ab | 1.087 abc |
| None | 1.090 abc | | | | | |

Fry quality data is presented in Table 5. The lightest fry colors were observed from samples of potatoes disc hilled at stolon hooking and bud formation, although there were no unacceptable fry scores from the 2004 harvest. No reported information was found linking fry color to method or timing of hilling.

**Table 5:** Fry color data for tubers harvested from plants hilled 0 to 9.5 weeks after planting. Fry color was rated on a scale of 1 to 7 where 1 = very dark (U.S.D.A. 4 rating) and 7 = very light (U.S.D.A. 000 rating). Data in the table followed by the same letter are not significantly different at the $p \leq 0.05$ level.

| *Type of Hilling* | *Weeks After Planting* | | | | | |
|---|---|---|---|---|---|---|
| | *1* | *3.5* | *4* | *6.5* | *7.5* | *9.5* |
| Power | 4.00 abc | 3.50 bc | 4.00 abc | 3.25 c | 4.25 ab | |
| Disc | | | 3.75 abc | 4.25 ab | 4.50 a | 3.75 abc |
| None | 4.00 abc | | | | | |

Tuber uniformity data is presented in Table 6. The greatest uniformity of tuber size was observed when Russet Burbank potatoes were power hilled at emergence. Tuber uniformity from this treatment was significantly better than the control and all other treatments. Poor timing of power hilling decreased the uniformity of tuber size. Carling and Walworth (1990) reported that tuber size was influenced by some hilling treatments, though not necessarily in a negative way.

**Table 6:** Uniformity of size for tubers harvested from plants hilled 0 to 9.5 weeks after planting. Uniformity was rated on a scale of 1 to 5 where 1 = very variable and 5 = very uniform. Data in the table followed by the same letter are not significantly different at the $p \leq 0.05$ level.

| *Type of Hilling* | *Weeks After Planting* | | | | | |
|---|---|---|---|---|---|---|
| | *1* | *3.5* | *4* | *6.5* | *7.5* | *9.5* |
| Power | 2.63 bcd | 2.63 bcd | 3.80 a | 2.50 bcd | 3.13 b | |
| Disc | | | 2.88 bc | 2.63 bcd | 2.25 cde | 1.75 e |
| None | 2.13 de | | | | | |

Summary

Power hilling at ground crack (3½ weeks after planting) resulted in the highest gross yield, the highest marketable yield and good specific gravity and fry color relative to other treatments. Gross yield and marketable yield were reduced when potatoes were power hilled after tuber initiation (6½ and 7½ weeks after planting). The optimum time to hill with a power hiller appears to be before plant emergence, although power hilling up to stolon hooking still resulted in acceptable marketable yields. Power hilling immediately after planting appeared to delay emergence and reduce yield, possibly because soil temperatures remain cool longer. Late hilling caused a reduction in total yield, however late power hilling was more detrimental to marketable yield than late disc hilling. If power hilling has not been completed by the time plants are 2 to 5" tall, disc hilling may be better than power hilling.

Power hilling at emergence resulted in the highest specific gravity, however few significant differences in specific gravity were observed between treatments. The best fry quality was observed for treatments hilled at emergence. Fry colors were very good for all treatments, regardless of timing or method of hilling.

The greatest uniformity of tuber size was observed when Russet Burbank potatoes were power hilled at emergence. Poor timing of power hilling decreased the uniformity of tuber size.

In 2004, power hilling Russet Burbank potatoes at ground crack or at emergence resulted in the best combination of marketable yield, good fry color, and uniform tuber size. A third year of the trial is planned for 2005.

<u>References</u>


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## Appendix

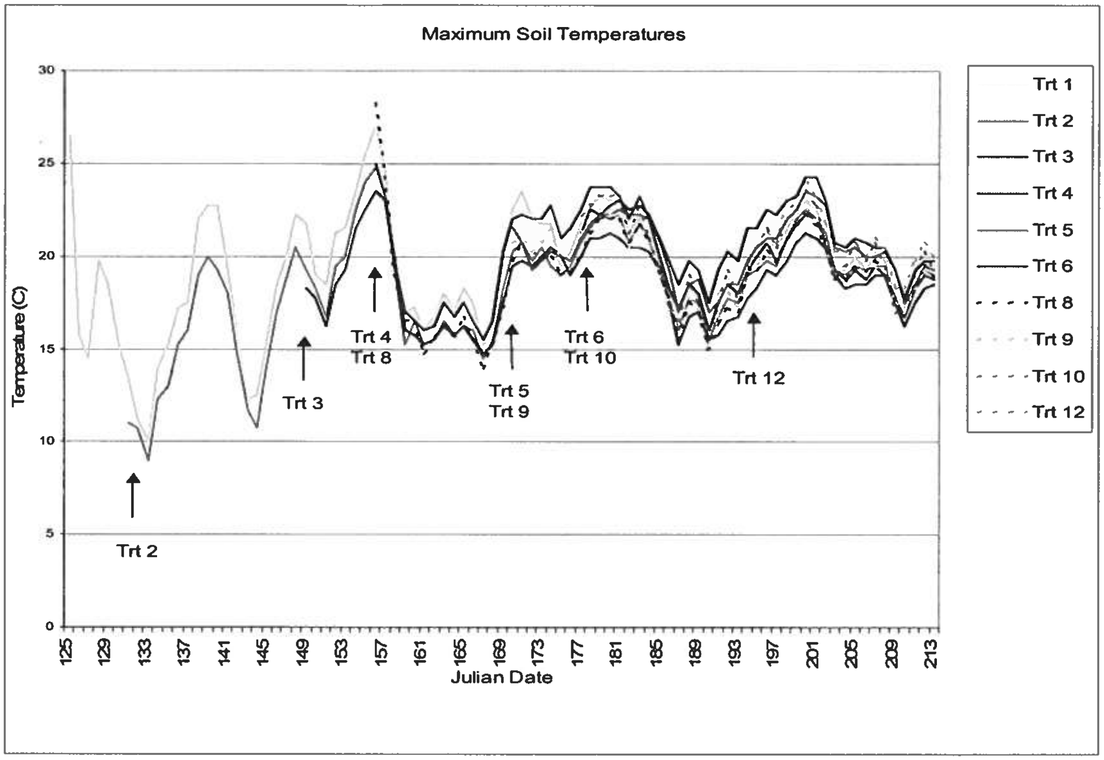


Figure A1: Maximum soil temperatures recorded in potato hills formed at different times using two types of hilling equipment (May, June and July 2004).

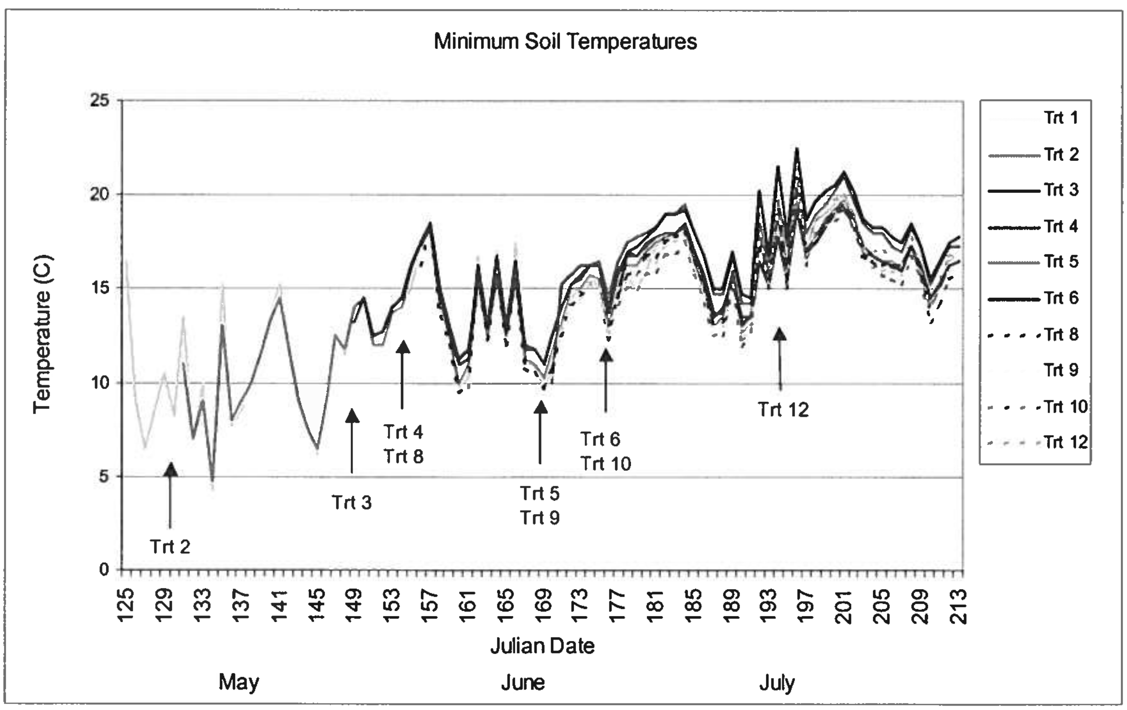


Figure A2: Minimum soil temperatures recorded in potato hills formed at different times using two types of hilling equipment (May, June and July 2004).

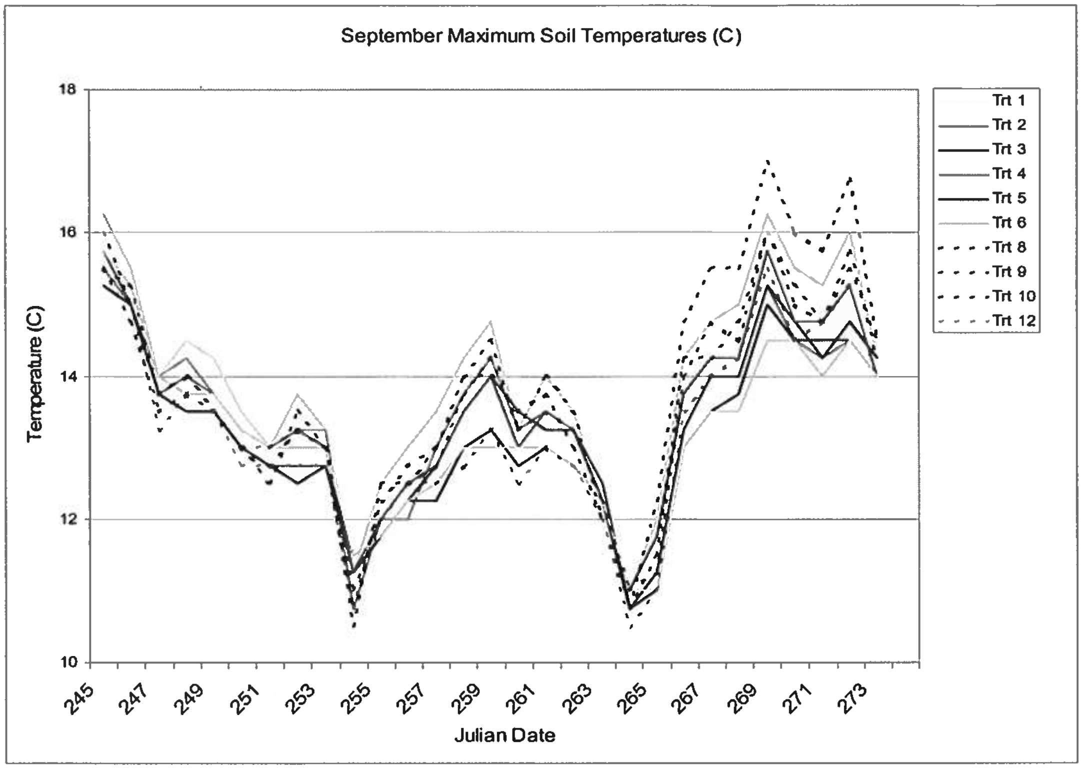


Figure A3: Maximum soil temperatures recorded in potato hills formed at different times using two types of hilling equipment (September 2004).

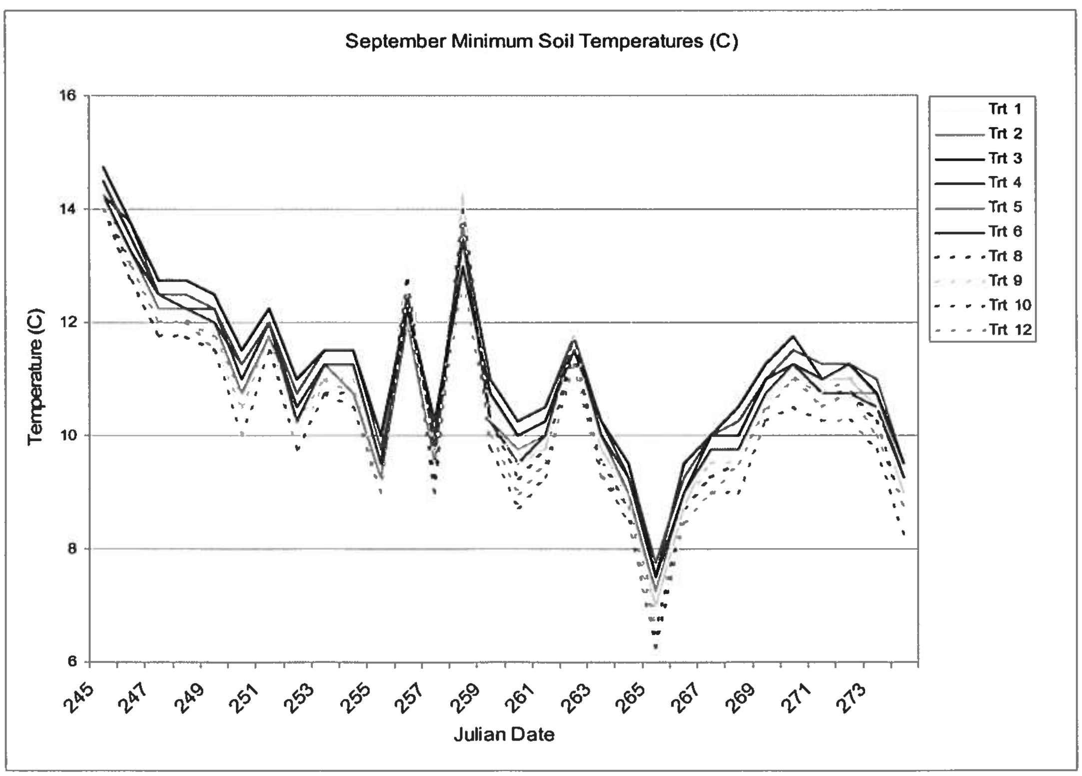


Figure A4: Minimum soil temperatures recorded in potato hills formed at different times using two types of hilling equipment (September 2004).

## Plot Plan

### Power Hilling Trial - 2004

Russet Burbank

N ←

7.5m · 3m between ranges · 12m · 63m

| | Row | Plot | TRT | Plot | TRT | Plot | TRT | Plot | TRT | Plot | TRT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| START | 1 | Guard | | Guard | | Guard | | Guard | | Guard | |
| | 2 | 1001 | 2 | 2001 | 2 | 3001 | 2 | 4001 | 2 | 5001 | 2 |
| | 3 | 1002 | 2 | 2002 | 2 | 3002 | 2 | 4002 | 2 | 5002 | 2 |
| | 4 | Guard | | Guard | | Guard | | Guard | | Guard | |
| | 5 | Guard | | Guard | | Guard | | Guard | | Guard | |
| | 6 | 1003 | 10 | 2003 | 10 | 3003 | 10 | 4003 | 10 | 5003 | 10 |
| | 7 | 1004 | 10 | 2004 | 10 | 3004 | 10 | 4004 | 10 | 5004 | 10 |
| | 8 | Guard | | Guard | | Guard | | Guard | | Guard | |
| | 9 | Guard | | Guard | | Guard | | Guard | | Guard | |
| | 10 | 1005 | 11 | 2005 | 11 | 3005 | 11 | 4005 | 11 | 5005 | 11 |
| | 11 | 1006 | 11 | 2006 | 11 | 3006 | 11 | 4006 | 11 | 5006 | 11 |
| | 12 | Guard | | Guard | | Guard | | Guard | | Guard | |
| START | 13 | Guard | | Guard | | Guard | | Guard | | Guard | |
| | 14 | 1007 | 3 | 2007 | 3 | 3007 | 3 | 4007 | 3 | 5007 | 3 |
| | 15 | 1008 | 3 | 2008 | 3 | 3008 | 3 | 4008 | 3 | 5008 | 3 |
| | 16 | Guard | | Guard | | Guard | | Guard | | Guard | |
| | 17 | Guard | | Guard | | Guard | | Guard | | Guard | |
| | 18 | 1009 | 9 | 2009 | 9 | 3009 | 9 | 4009 | 9 | 5009 | 9 |
| | 19 | 1010 | 9 | 2010 | 9 | 3010 | 9 | 4010 | 9 | 5010 | 9 |
| | 20 | Guard | | Guard | | Guard | | Guard | | Guard | |
| | 21 | Guard | | Guard | | Guard | | Guard | | Guard | |
| | 22 | 1011 | 4 | 2011 | 4 | 3011 | 4 | 4011 | 4 | 5011 | 4 |
| | 23 | 1012 | 4 | 2012 | 4 | 3012 | 4 | 4012 | 4 | 5012 | 4 |
| | 24 | Guard | | Guard | | Guard | | Guard | | Guard | |
| START | 25 | Guard | | Guard | | Guard | | Guard | | Guard | |
| | 26 | 1013 | 8 | 2013 | 8 | 3013 | 8 | 4013 | 8 | 5013 | 8 |
| | 27 | 1014 | 8 | 2014 | 8 | 3014 | 8 | 4014 | 8 | 5014 | 8 |
| | 28 | Guard | | Guard | | Guard | | Guard | | Guard | |
| | 29 | Guard | | Guard | | Guard | | Guard | | Guard | |
| | 30 | 1015 | 5 | 2015 | 5 | 3015 | 5 | 4015 | 5 | 5015 | 5 |
| | 31 | 1016 | 5 | 2016 | 5 | 3016 | 5 | 4016 | 5 | 5016 | 5 |
| | 32 | Guard | | Guard | | Guard | | Guard | | Guard | |
| | 33 | Guard | | Guard | | Guard | | Guard | | Guard | |
| | 34 | 1017 | 7 | 2017 | 7 | 3017 | 7 | 4017 | 7 | 5017 | 7 |
| | 35 | 1018 | 7 | 2018 | 7 | 3018 | 7 | 4018 | 7 | 5018 | 7 |
| | 36 | Guard | | Guard | | Guard | | Guard | | Guard | |
| START | 37 | Guard | | Guard | | Guard | | Guard | | Guard | |
| | 38 | 1019 | 6 | 2019 | 6 | 3019 | 6 | 4019 | 6 | 5019 | 6 |
| | 38 | 1020 | 6 | 2020 | 6 | 3020 | 6 | 4020 | 6 | 5020 | 6 |
| | 39 | Guard | | Guard | | Guard | | Guard | | Guard | |
| | 40 | Guard | | Guard | | Guard | | Guard | | Guard | |
| | 40 | 1021 | 12 | 2021 | 12 | 3021 | 12 | 4021 | 12 | 5021 | 12 |
| | 41 | 1022 | 12 | 2022 | 12 | 3022 | 12 | 4022 | 12 | 5022 | 12 |
| | 42 | Guard | | Guard | | Guard | | Guard | | Guard | |
| | 42 | Guard | | Guard | | Guard | | Guard | | Guard | |
| | 43 | 1023 | 1 | 2023 | 1 | 3023 | 1 | 4023 | 1 | 5023 | 1 |
| | 44 | 1024 | 1 | 2024 | 1 | 3024 | 1 | 4024 | 1 | 5024 | 1 |
| | 44 | Guard | | Guard | | Guard | | Guard | | Guard | |

| Date | TRT | Treatment | Date | TRT | Treatment |
|---|---|---|---|---|---|
| 4-May | 1 | No Hilling | n/a | 7 | PH |
| 10-May | 2 | PH 1 wk after planting | 4-Jun | 8 | CH Emergence |
| 28-May | 3 | PH 3.5 wks after planting/ground crack | 18-Jun | 9 | CH Stolon hooking |
| 4-Jun | 4 | PH Emergence | 25-Jun | 10 | CH Buds forming/plants 5-12" |
| 18-Jun | 5 | PH Stolon hooking | n/a | 11 | CH |
| 25-Jun | 6 | PH Buds forming/plants 5-12" | 14-Jul | 12 | CH Row Close/tubers loonie sized/plants 2 |

**Evaluation of the Spudnik Bed Planter for Chipping Potatoes in Southern Alberta – 2010**

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

## Background

There have been a number of recent reports identifying the benefit of planting potatoes in wider beds for moisture conservation (Harms and Konschuh, 2010; Steele et al., 2006; Mundy et al., 1999). Moisture conservation is important, primarily when potato production relies on supplemental irrigation to provide sufficient soil water for growth and bulking of the tubers, however, the main interest of producers regarding bed planting of potatoes is for uniform size, regular shape, increased production per unit area and better economic return.

Bed planting of potatoes is fairly new to North America but is widely practiced in Europe as the production method of choice. Plant densities within the beds can be varied depending on the equipment used. Standen-Pearson Corporation out of England sells planters that will seed 3 to 9 rows in a bed with variable seed spacing from 13 cm to 45 cm.

The primary advantages identified, for bed planted potatoes in Europe, are the increase in yield, consistent size, less greening, protection from frost damage and regular shape compared to conventionally spaced and planted potatoes in the standard "hill – furrow" system.

Growers in Idaho have been experimenting with bed planting over the last few years using a planter developed by Spudnik (Baum, 2010). Responding to the interest expressed by a few growers and a processor, Growers Supply secured one of the Spudnik bed planters and brought it in to Canada for a limited trial in 2010.

The purpose of the evaluation was to assess yield, tuber uniformity, water use efficiency and economic returns between bed planted potatoes and conventionally planted potatoes.

## The Spudnik Bed Planter

The Spudnik bed planter used was designed to seed 7 rows of potatoes in a 98" bed (Figure 1). The configuration used in 2010 was to block the center row of the seeder and plant 6 rows in a 98" wide bed (Figure 2). With conventional hill seeding, 4 rows would be planted within the same width.


Figure 1. Spudnik bed planter.

Figure 2. Bed planted section of field after emergence. Soil water monitoring site shown in upper, left part of picture

## Methods

The Spudnik bed planter was used on a portion of 3 commercial potato fields in southern Alberta in 2010 and at Alberta Agriculture and Rural Development's Irrigation Demonstration Facility in Lethbridge (CACDI). Growers Supply staff assisted with the set up of the bed planter at all sites, Western Tractor supplied a John Deere 8345RT with wide spaced tracks to ensure the power equipment straddled the beds.

Soil water monitoring sites were set up in each field, one in the bed planted area of the field and one in the standard hill/furrow section of the field. Instrumentation at the sites consisted of an access tube to take weekly soil water readings and a collection rain gauge to monitor irrigations and rainfall amounts.

Tuber samples were obtained from three of the sites immediately prior to the main harvest by AARD staff. Four samples (3m) were dug from rows in the conventionally planted area and compared with four samples of 3m x ½ bed section within the bed planted area.

Samples were evaluated for total yield, marketable yield, tuber deformities, specific gravity and internal defects and are presented in ton/acre.

A basic analysis was performed to evaluate the economic benefit or penalty of bed planted potatoes in 2010.

## Results

Consistent with previous findings (Harms and Konshuh, 2010), soil water content in the bed planted areas of the field retained about 10% more moisture (week to week) compared to the standard shaped hill.

Different varieties were grown and different plant density strategies were used by growers to test the bed-planting concept. In two of the three fields sampled, yield from the bed-planted area of the field was greater than that from the conventional hill planted area. Both total and marketable yield were significantly greater in Field B. Specific gravity was unaffected by bed-planting in this study (Table 1).

Assuming a basic contract price for marketable potatoes, gross economic returns in the commercial fields were 34% greater from beds than from hills once the seed costs were deducted (Figure 3). To our knowledge, other costs (fertility, pesticides, irrigation, manpower, etc.) incurred were the same for hilled or bed-planted regions of each field.

Table 1. Comparison of yield and size profile and specific gravity of samples from conventional and bed-planted areas of each field.

| Field | Treatment | Total Yield (ton/ac) | Yield (ton/ac) Smalls (<$1^7/_8$ in) | Yield (ton/ac) Marketable ($1^7/_8$-$3^1/_2$ in ) | Yield (ton/ac) Large (>$3^1/_2$ in) | Specific Gravity |
|---|---|---|---|---|---|---|
| A | Hills | 28.1a | 1.8a | 17.8a | 8.3 | 1.084 |
| A | Beds | 33.5a | 3.1a | 23.0a | 7.4 | 1.088 |
| B | Hills | 29.8b | 5.1b | 23.4b | 1.2 | 1.085 |
| B | Beds | 42.2a | 8.6a | 31.5a | 1.9 | 1.086 |
| C | Hills | 30.6a | 4.0b | 26.3a | 0.0 | 1.104 |
| C | Beds | 31.7a | 5.9a | 25.6a | 0.2 | 1.106 |

Note: Yield comparisons presented were analyzed using the paired t-test between hills and beds for each field independently. For example, Field A was analyzed independent of Field B and Field C.

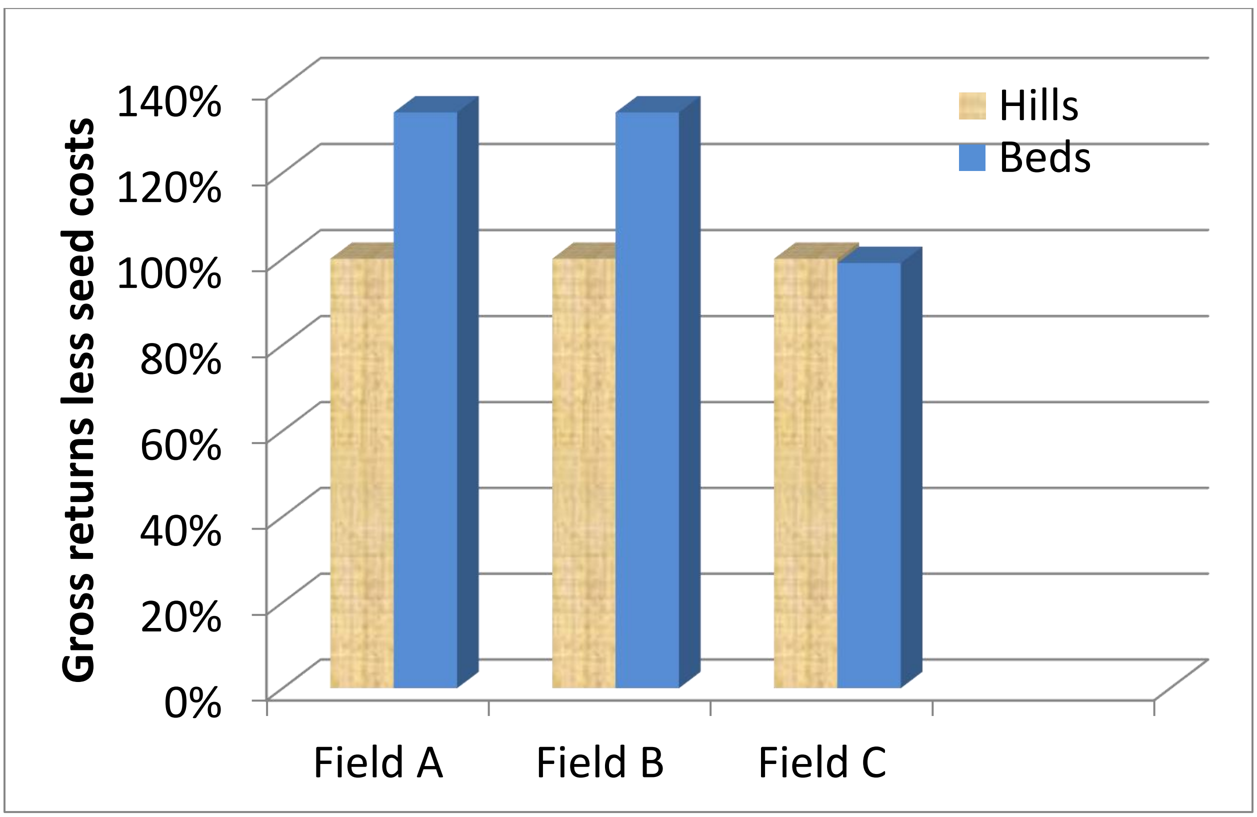


Figure 3. Economic returns from hill planted and bed-planted areas of potato fields as a percentage of conventional hill planted areas. For comparison, a basic contract of $10/cwt for marketable yield (2 to 3.5") was used. Seed was estimated at $340/cwt. All other costs were assumed to be equal.

## Conclusions

This was a first year evaluation on new equipment. It was identified that it may be necessary to prepare fields differently in fall when using a bed planter compared to fall preparation when using the conventional hill planting equipment. The growers expressed interest in the Spudnik planter but each had suggestions for modifications. As well, there were concerns with the final construction of the bed (relying solely on the drag bar to form the bed).

Planting in a wide bed definitely has a fit for irrigated potato production in southern Alberta. However, to get a complete picture or thorough evaluation of the technique, it would be advantageous to try other bed configurations such as the Quad planted bed (Figure 4) which has 4 off-set rows in a 72" (1.8m) wide bed. The manufacturers of the Quad planter advertise an 82% increase in plant growing area compared to standard hill planted potatoes (Figure 5).

As well, it would be worthwhile to try a selection of the common potato varieties to evaluate the possibilities and/or potential problems with bed planted potatoes.

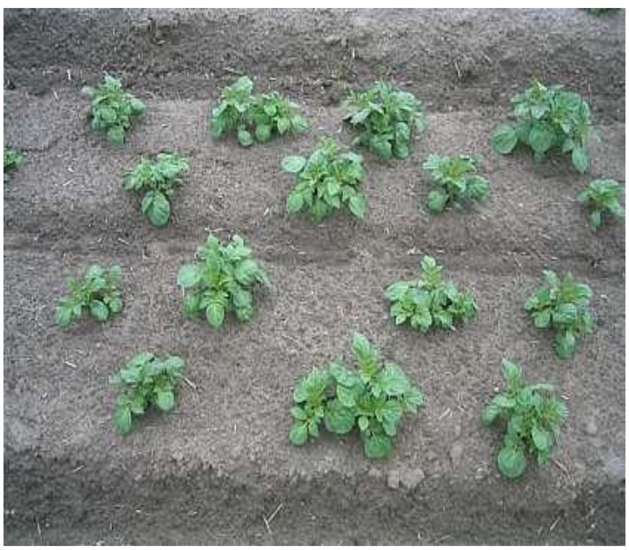

Figure 4. Four row bed using Standen Quad bed planter.

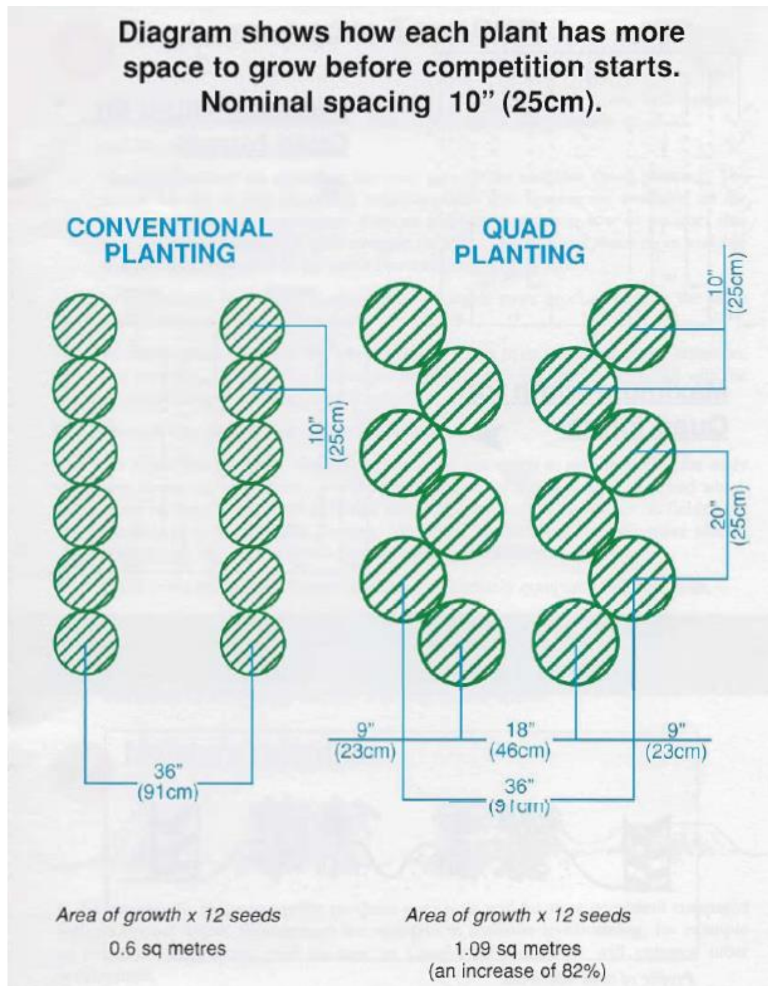


Figure 5. Increases in plant area.

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## Acknowledgements

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Contact Information

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# Evaluation of the Spudnik Bed Planter for Chipping Potatoes in Southern Alberta - 2010

**Ted Harms[1] Michele Konshuh[2]**

1. AAFRD, Irrigation Branch, Brooks AB 2. AAFRD, Industry Development, Brooks AB.

## Key Findings

Consistent with previous findings, soil water content in the bed planted areas of the field retained about 10% more moisture (week to week) compared to the standard hill-furrow section of the standard shaped hill.

Marketable yields

Economics

## Background

There have been a number of recent reports identifying the benefit of planting potatoes in wider beds for moisture conservation. Moisture conservation is important, primarily when potato production relies on supplemental irrigation to provide sufficient soil water for growth and bulking of the tubers, the main interest of producers regarding bed planting of potatoes is for uniform size, regular shape, increased production per unit area and better economic return.

Bed planting of potatoes is fairly new to North America but is widely practiced in Europe as the production method of choice. Plant densities within the beds can be varied depending on the equipment used. Standen-Pearson Corporation out of England sells planters that will seed 3 to 9 rows in a bed with variable seed spacing from 13 cm to 45 cm.

The primary advantages identified, for bed planted potatoes, are the increase in yield, consistent size, less greening, protection from frost damage and regular shape compared to conventionally spaced and planted hill – furrow system.

Growers in Idaho have been experimenting with bed planting over the last few years using a planter developed by Spudnik. Responding to the interest expressed by a few growers and a processor, Growers Supply secured one of the Spudnik bed planters and brought it in to Canada for a limited trial in 2010.

## The Spudnik Bed Planter

The Spudnik bed planter used was designed to seed 7 rows of potatoes in a 98” bed (Figure 1). The configuration used in 2010 was to block the center row of the seeder and plant 6 rows in a 98” wide bed (Figure 2). With conventional hill seeding, 4 rows would be planted within the same width.

## Methods

The Spudnik bed planter was used on a portion of 3 grower fields in southern Alberta in 2010 and at Alberta Agriculture and Rural Development’s Irrigation Demonstration Facility in Lethbridge (CACDI). Growers Supply staff assisted with the set up of the bed planter at all sites, Green Power supplied a John Deere ???? with the wide spaced tracks to ensure the power equipment straddled the beds.

Samples were obtained from two grower fields and at CACDI in Lethbridge immediately prior to the main harvest by AARD staff. A 10 ft. section from 4 rows were sampled in the conventionally planted area and a ?????? was sampled from the bed planted area.

Samples were evaluated for total yield, marketable yield, tuber deformities, specific gravity and internal defects.

A basic analysis was performed to evaluate the economic benefit or penalty of bed planted potatoes in 2010.

Figure 1. Spudnik bed planter

Figure 2. Bed planted section of field after emergence. Soil water monitoring site shown in upper, left part of picture.

## Results

## Yield and Quality

## Future Considerations

The growers expressed interest in the Spudnik planter but they had suggestions for modifications . As well, there were concerns with the final construction of the bed (relying solely on the drag bar to form the bed).

Planting in a wide bed definitely has a fit for irrigated potato production in southern Alberta. However, to get a complete picture or thorough evaluation of the technique, it would be advantages to try other bed configurations such as the Quad planted bed (Figure 3) which has 4 off-set rows in a 72” (1.8m) wide bed.

As well, it would be worthwhile to try a selection of the common potato varieties to evaluate the possibilities and/or potential problems with bed planted potatoes.

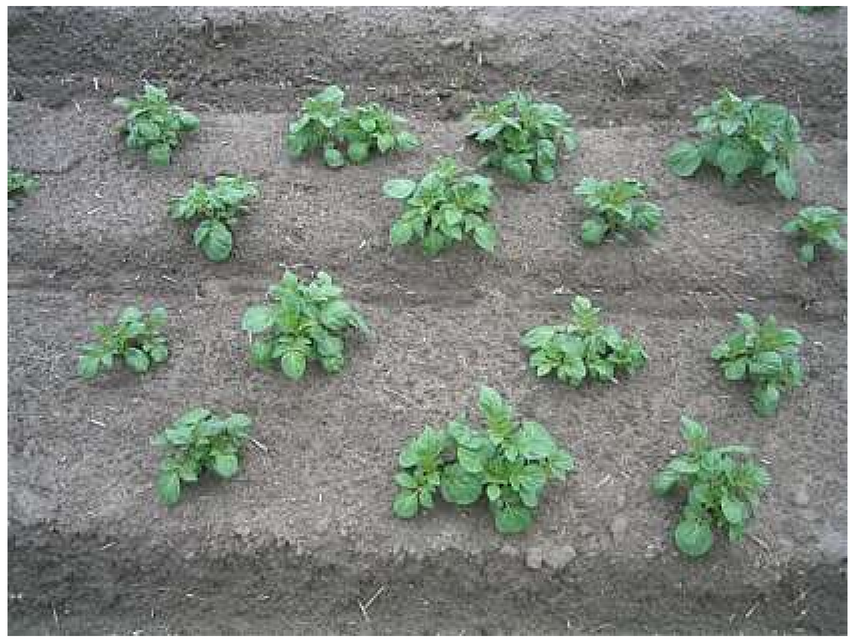

Figure 3. Four row bed using Standen Quad bed planter

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**Government of Alberta**

Agriculture and Rural Development
Irrigation and Farm Water Branch
Food and Bio-Industrial Crops Branch

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**Ted Harms and Michele Konschuh**

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

## Key Findings

- Consistent with previous findings, soil water content in the bed planted areas of the field retained about 10% more moisture (week to week) compared to the standard shaped hill.
- Different varieties were grown and different plant density strategies were used by growers to test the bed-planting concept. In two of the three fields sampled, yield from the bed-planted area of the field was greater than that from the conventional hill planted area. Both total and marketable yield were significantly greater in Field B. Specific gravity was unaffected by bed-planting in this study.
- Assuming a basic contract price for marketable potatoes, gross economic returns in the commercial fields were 34% greater from beds than from hills once the seed costs were deducted. To our knowledge, other costs (fertility, pesticides, irrigation, manpower, etc.) incurred were the same for hilled or bed-planted regions of each field.
- Additional research may be required to determine the best fit for this type of technology.

## Background

There have been a number of recent reports identifying the benefit of planting potatoes in wider beds for moisture conservation. Moisture conservation is important, primarily when potato production relies on supplemental irrigation to provide sufficient soil water for growth and bulking of the tubers. The main interest of producers regarding bed planting of potatoes is for uniform size, regular shape, increased production per unit area and better economic return.

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A basic analysis was performed to evaluate the economic benefit or penalty of bed planted potatoes in 2010.

## Results

Table 1. Comparison of yield and size profile and specific gravity of samples from conventional and bed-planted areas of each field.

| Field | Treatment | Total Yield (ton/ac) | Small Yield (ton/ac) | Mkt. Yield (ton/ac) | Large Yield (ton/ac) | SG |
|---|---|---|---|---|---|---|
| A | Hills | 28.1 a | 1.8 a | 17.8 a | 8.3 a | 1.084 a |
| A | Beds | 33.5 a | 3.1 a | 23.0 a | 7.4 a | 1.088 a |
| B | Hills | 29.8 b | 5.1 b | 23.4 a | 1.2 a | 1.085 a |
| B | Beds | 42.2 a | 8.6 a | 31.5 b | 1.9 a | 1.086 a |
| C | Hills | 30.6 a | 4.0 b | 26.3 a | 0.0 a | 1.104 a |
| C | Beds | 31.7 a | 5.9 a | 25.6 a | 0.2 a | 1.106 a |

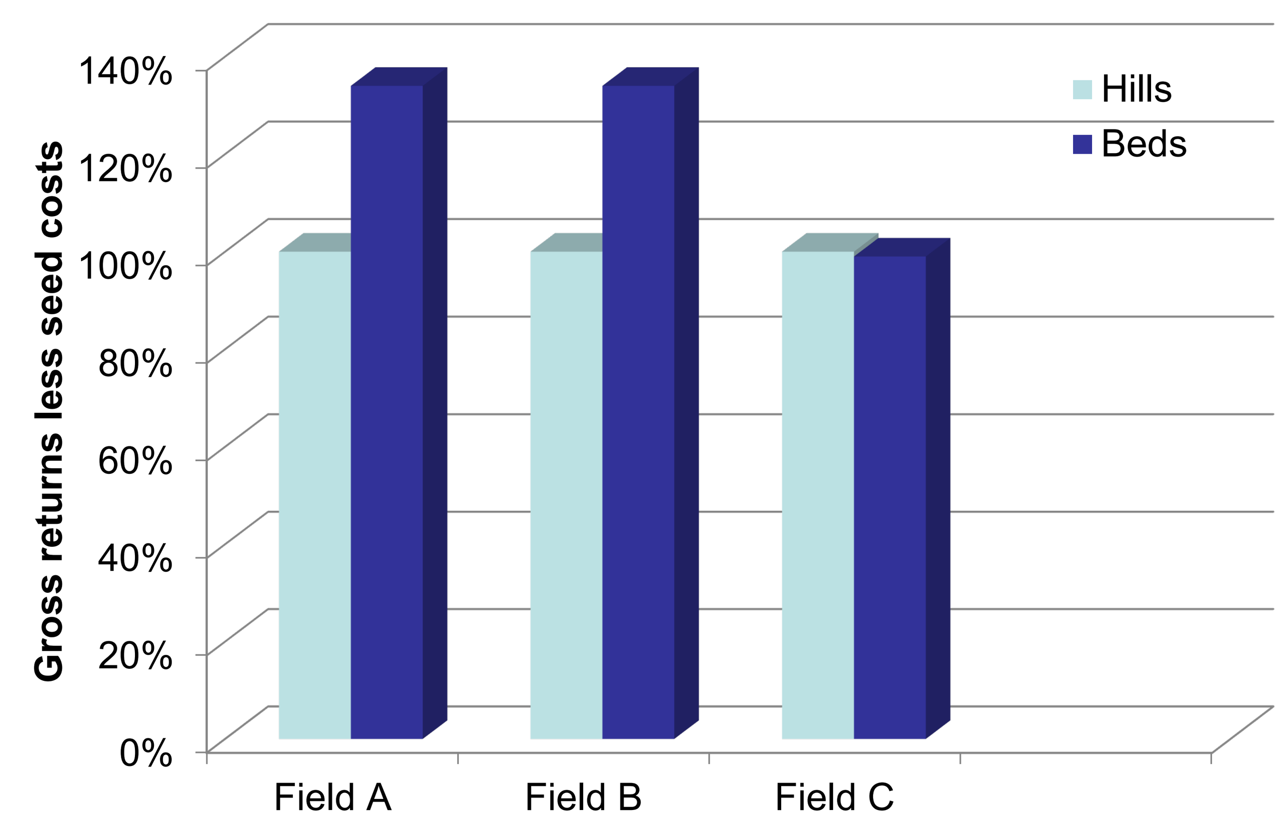


Figure 3. Economic returns from hill planted and bed-planted areas of potato fields as a percentage of conventional hill planted areas. For comparison, a basic contract of $10/cwt for marketable yield (2 to 3.5") was used. Seed was estimated at $340/cwt. All other costs were assumed to be equal.

## Future Considerations

The growers expressed interest in the Spudnik planter but they had suggestions for modifications . As well, there were concerns with the final construction of the bed (relying solely on the drag bar to form the bed).

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