Managing Heat Stress In Potato Production

Project Overview

This project focuses on characterizing and mitigating the effects of heat stress on potato crops, specifically within the environment of Southern Alberta. The initial findings presented in this report are based on a single year of study and are considered preliminary.

Background and Context of Potato Heat Stress

Understanding how high temperatures impact potato (Solanum tuberosum L.) is crucial, as the thermal optimum for growth varies depending on the plant's developmental stage. Elevated temperatures do not seem to negatively impact carbon fixation and assimilation itself; rather, heat stress fundamentally affects carbon partitioning within the plant. High temperatures alter plant development timing, accelerate the aging of mature leaves, stimulate the growth of new tissues, and ultimately favor vine growth while reducing the flow of carbon allocated to the developing tubers.

The specific thermal optimums for potatoes highlight the sensitivity of the plant to heat during critical phases as shown in the table below:

Table 1: Potato thermal optimums. Modified from Singh et al,. 2020.

Growth Stages	Ideal temperature in Celsius	Effect of high temperature
Sprouting	16	Increased
Early vigor	20-25	Enhance early plant growth
Shoot growth	32	Increase vegetative plant growth
Stolon formation	25	Enhanced stolon initiation
Tuber formation	15-22	Reduce tuber induction and initiation
Tuber bulking	14-22	Reduce dry matter partitioning and tuber filing, increase secondary tuber formation
Tuber yield	20-24	Reduce tuber yield, size and quality,

Ultimately, the ideal temperature for overall tuber yield is 20°C to 24°C, and exceeding this range tends to reduce tuber size, quality, and total yield.

Given these distinct optimal temperature ranges, managing heat stress may need to be tailored differently depending on the desired end use of the potato, such as for fresh market, seed, or processing into French fries or chips.

This is a summary prepared by the PGA from a provided interim report from Dr. Jonathan Nielson's work at AAFC. Final project results will be posted once completed.

Project Objectives and Methodology

The primary purpose of the current study is to characterize precisely how much stress results in negative outcomes for potatoes grown in Southern Alberta. A second major focus is to determine methods by which this stress can potentially be lessened.

To simulate the necessary heat stress conditions, the researchers utilized low greenhouse tunnels placed over the plants. The application of the tunnels began after plant emergence and continued at weekly intervals until late August. Each heat stress treatment period lasted for one week.

Two sets of plants were treated with biostimulant products prior to receiving the heat stress treatment. The biostimulants used in the study included algae extract and glycine betaine solution.

Preliminary Results and Key Observations

The preliminary results yielded three main observations:

1. The use of the greenhouse tunnels was effective in stimulating a heat stress response in the plants.

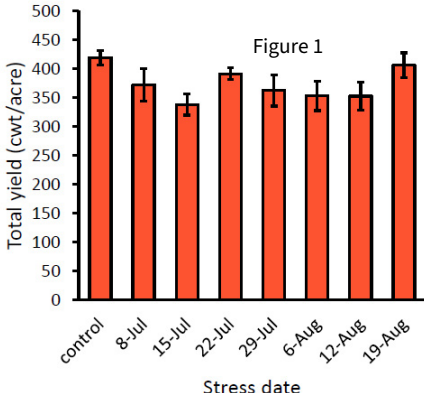
2. The timing of the heat stress significantly modulated the observed effects, although the resulting patterns were mixed.

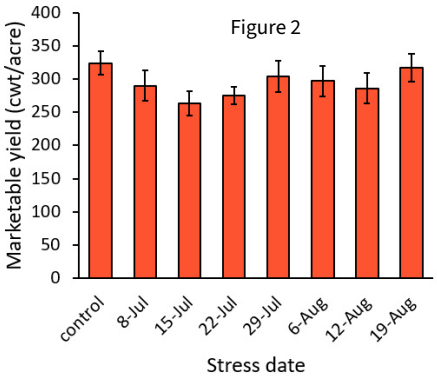
3. The application of the biostimulant products also modulated the effects of heat stress, though, again, the patterns were mixed.

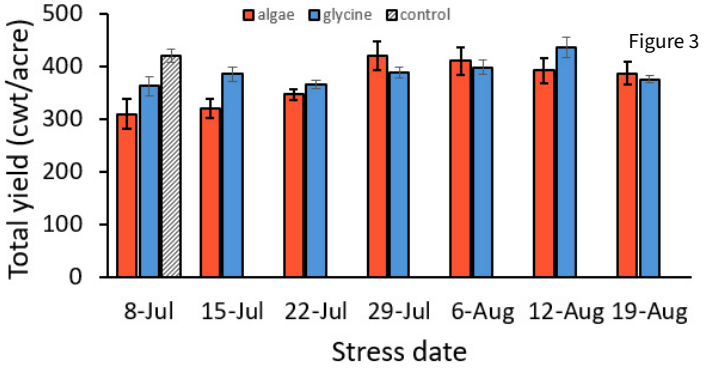
Impacts on Yield and Tuber Characteristics

Overall, the project observed a general negative effect of heat stress on both total and marketable yields (Figure 1).

However, when looking at the quality of the harvest, while the absolute total and marketable yield figures tended to be lower in heat-stressed plants, the proportion of the total yield that was considered marketable was often unaffected, or even higher later in the growing season (Figure 2). Figure 3 shows the effects of the application of the biosimulants products at different time periods.







These single-year results confirm that heat stress can be characterized in Southern Alberta using the greenhouse tunnel methodology and demonstrate that biostimulants have the potential to modulate certain yield characteristics, although the final determination of their efficacy requires further investigation due to the mixed nature of the current preliminary findings.

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