Direct Impacts of Heat Stress on Illinois Soybeans

Jessica O'Connor,[1] Charles Burroughs,[2] and Lisa Ainsworth[2,3]
Moraine Valley Community College Palos Hills, IL
Department of Plant Biology, College of Science, University of Illinois at Urbana-Champaign[2]
USDA ARS, Department of Plant Biology, College of Science, University of Illinois at Urbana-Champaign[3]

PRECS Phenotypic Plasticity Research Experience for Community College Students

Introduction/Background

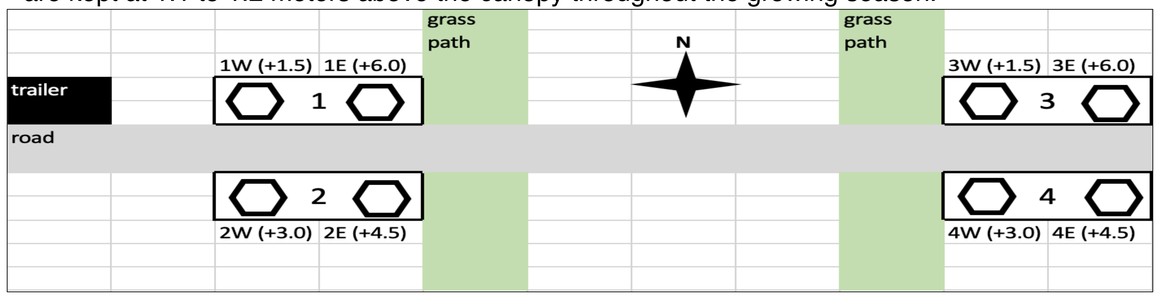
Rising global temperatures are challenging agricultural productivity and can affect soybean yield through many physiological and metabolic processes. Recent regression analyses indicate that **soybean yield is depressed in warmer years.**[1] Our research aims to help us understand which processes are affected by heat stress, such as photosynthesis, plant development, leaf area index and yield.

The Experiment

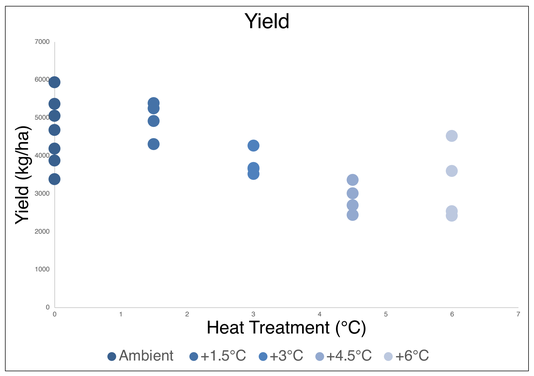
Our experiment consists of **two different varieties of commercial Illinois soybeans**. These cultivars will be continually heated throughout the growing season, allowing us to compare the physiological characteristics of the soybeans in the heated arrays, to those growing in ambient conditions. We will collect data on **photosynthesis**, **plant development**, and **leaf area index**, as well as **yield**. Collecting this data will allow us to understand how heat stress directly impacts photosynthesis, plant development, reproductive development, and yield. Using our results, we can predict how heat stress will impact soybean varieties across the United States.

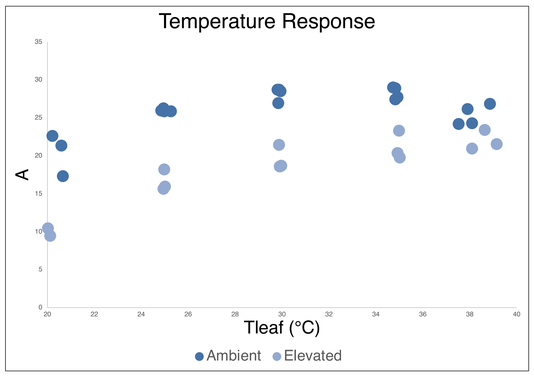
The Setup

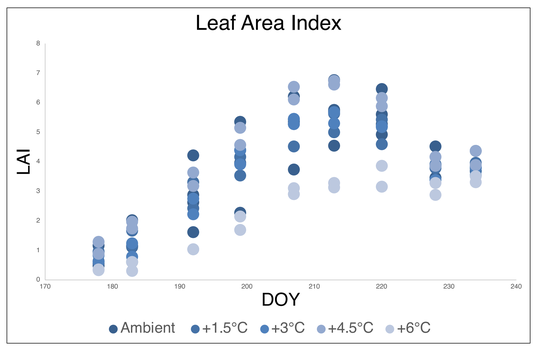
Our project consists of four elevated temperature controlled rings heated at temperatures of **+1.5°C, +3.0°C, +4.5°C and +6.0°C**, above ambient conditions. Ambient temperature plots are monitored by infrared canopy censors that continuously record the temperature in open air field conditions. There are two replicates of each heat treatment, for a total of 8 treatments. The lamps are kept at 1.1 to 1.2 meters above the canopy throughout the growing season.

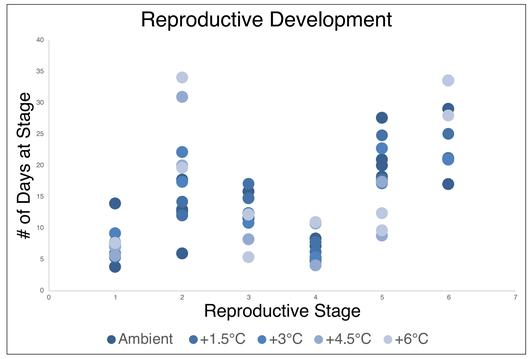


2018 Data









Reproductive Data, Leaf Area Index, Temperature Response Curves and Yield were all collected during the 2018 growing season.

Conclusions/Results

Yield: As heat treatments increase, the overall yield (kg/ha) decreases. **The plants were stressed enough to display a decrease in yield.**

Temperature Response: As Tleaf (°C) increases, photosynthetic carbon assimilation (A) increases for both ambient and elevated treatments. Elevated plants show lower overall A than the ambient plots. This suggests that **elevated temperatures decrease A, which is also shown to decrease yield**.[2]

Leaf Area Index: Plants grown under ambient conditions have greater LAI than plants grown under elevated temperatures. **Elevated temperatures decrease LAI.**

Reproductive Development: Elevated temperatures have fluctuating impacts on the reproductive development**. At +6 °C, full bloom (R2) is delayed and at ambient, beginning seed (R5) is delayed.**

References

1. Lobell, D.; Gourdji, S. *Influence of Climate Change on Global Crop Productivity.* **2012,** *160,* 1686-1697.
2. Yamori, W.; Hikosaki, K. *Temperature Response of Photosynthesis in C3 Plants.* **2013,** *119,* 101-117.

Acknowledgments

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