Improving Irrigation Management Through Soybean Root Growth

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Abstract

Variable rate irrigation (VRI) systems in soybean (*Glycine Max*) have been shown to increase yield with proper prescriptions. Objectives are to determine how irrigation affects soybean root development and evaluate performance of soybean cultivars under different irrigation regimes. Yield was responsive to irrigation and a significant difference in yield was seen between 0.0cm and 2.9cm of irrigation.

Impact of irrigation levels (0.0cm, 0.9cm, 1.9cm, 2.9cm, 3.8cm) on soybean roots were observed through minirhizotron systems. Traditionally root analysis has been a destructive process that consisted of manually taking rooting measurements after uprooting the growing plant. Rhizotron systems have been used as a non-destructive alternative for research and prove effective for collecting root data, but their limitations exist in both expense and the intensive labor that must be undertaken to create a working system. Minirhizotron systems may reduce costs over the course of a few years and can be used to effectively monitor root growth of the same plant throughout the growing season.

Introduction

Evaluating the impact of variable rate irrigation can be assessed through several facets, one of which is monitoring the development of the crop's root system. Minirhizotrons allow for the study of developing roots, in situ, without causing harm to the crop being analyzed. Roots are monitored through pictures taken by a camera throughout the growing season. This research project included two primary objectives: 1) determine the interrelationship of soybean root and soil parameters as it relates to yield; and 2) assess the effect of irrigation on soybean root development.

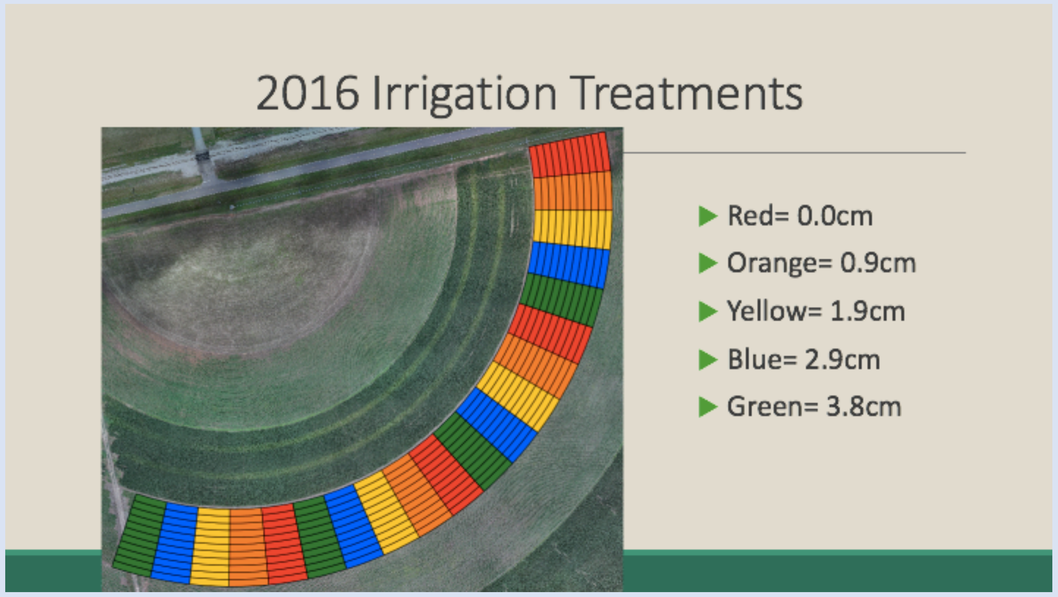

Figure 1. 2016 Irrigation treatments in pivot field at Auburn's E.V. Smith research station.

Materials and Methods

Variable Rate Irrigation (VRI)

Treatments were applied through a Valley 7000 series center pivot. Each cultivar contained two replicates of 0.0cm, 0.9cm, 1.9cm, 2.9 cm, and 3.8cm irrigation treatments. A schematic of the pivot field with applied irrigation treatments can be seen in Figure 1.

Minirhizotrons and Root Analysis

Twenty sites were developed within a 100-acre field at Auburn's EV Smith research station in Tallassee, Alabama. Camera tubes were created using acrylic tubes and rubber end caps as seen in Figure 2.Tubes were then installed along a single row of soybeans in the field at each of the determined twenty sites.

Yield

A total of eight cultivars were assessed in 2016. Cultivar selection was based upon availability. Soybean cultivars were planted in a strip-tilled 100-acre pivot field in Tallassee, AL on May 17, 2016 and harvested on October 19, 2016.

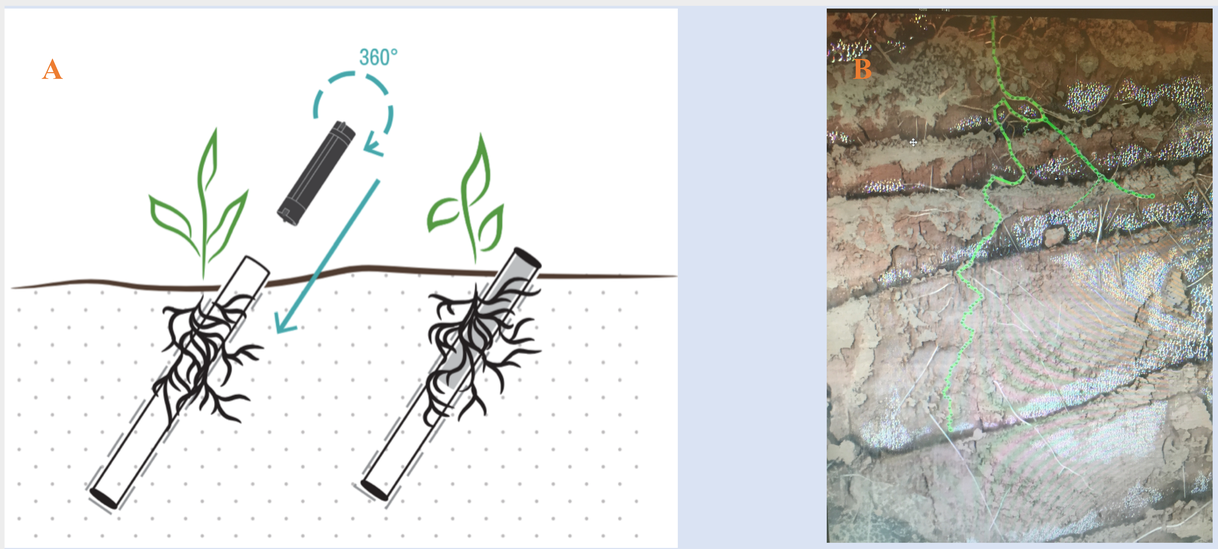

Figure 2. Minirhizotron Tube Installation (www.cidbioscience.com) (A); Tracing a soybean root system with Rootsnap (B).

Results

- Yield increased with increasing irrigation amounts. Optimum yield was achieved at 2.9cm treatment.
- All cultivars increased yield through increasing irrigation and Pioneer 52T50 R outperformed all other cultivars.
- Soybean root diameter increased with increasing irrigation amounts.
- Stressed plants had more, but smaller roots.

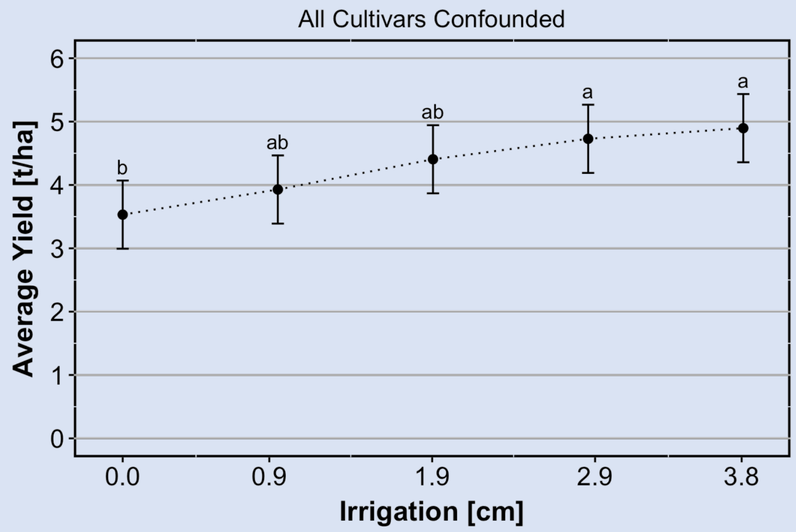

Figure 3. Irrigation effect on 2016 soybean yield in t/ha.

Table 1. Cultivar yield ranking in response to irrigation treatments.

	Irrigation [cm]				
Rank	0.0	0.9	1.9	2.9	3.8
1	Pioneer 52T50 R	Pioneer 52T50 R	Pioneer 52T50 R	Pioneer 52T50 R	Pioneer 52T50 R
2	Asgrow 5533 R	Asgrow 5533 R	Asgrow 5533 R	Asgrow 5533 R	Pioneer 54T94 R
3	Pioneer 56T12 S	Pioneer 56T12 S	Pioneer 56T12 S	Pioneer 56T12 S	Pioneer 56T29 R2
4	Pioneer 95Y70 R	Pioneer 55T81 R	Pioneer 55T81 R	Pioneer 54T94 R	Asgrow 5533 R
5	Asgrow 5831 R	Pioneer 95Y70 R	Pioneer 56T29 R2	Pioneer 56T29 R2	Pioneer 56T12 S
6	Pioneer 56T29 R2	Pioneer 54T94 R	Pioneer 54T94 R	Pioneer 55T81 R	Pioneer 55T81 R
7	Pioneer 54T94 R	Asgrow 5831 R	Pioneer 95Y70 R	Pioneer 95Y70 R	Pioneer 95Y70 R
8	Pioneer 55T81 R	Pioneer 56T29 R2	Asgrow 5831 R	Asgrow 5831 R	Asgrow 5831 R

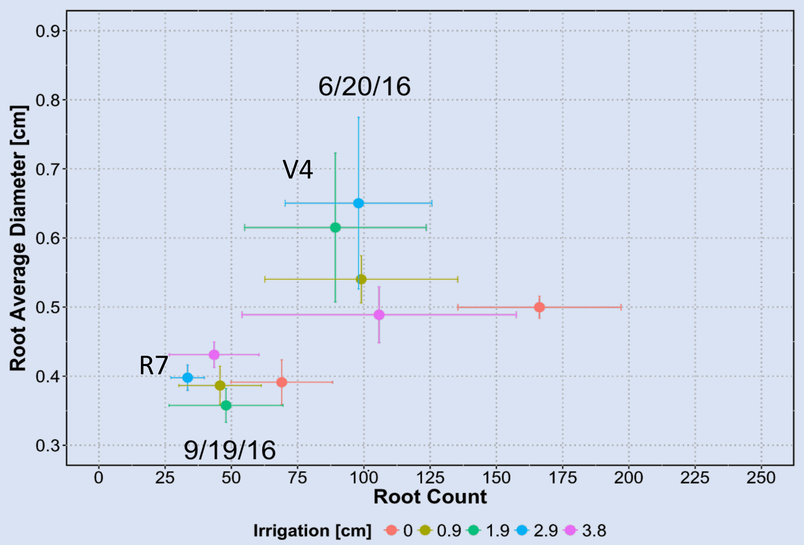

Figure 4. Average root diameter (cm) plotted against root count for irrigation treatments.

Summary

- *Glycine Max* was impacted by varying treatments of irrigation throughout the growing season.
- Stressed plants produced more, but smaller roots.
- Stressed plants resulted in lower yields.
- Yield increased with increasing irrigation treatments

Acknowledgments

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