Soybean Irrigation Initiative Timing Using Evapotranspiration and Soil Moisture Sensor Cues

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Introduction: Soybean (Glycine max) is an important cash crop across the Midsouth. About 3.3 million acres of soybeans were planted in Arkansas in 2014 with an average yield of 48 bushels per acre, or 3228 kg/ha. 65% of the soybean acreage in Arkansas is irrigated. With proper application timing, irrigation can increase yield. Groundwater is the primary source for irrigation water for Arkansas row crops; however, aquifers are being used at an unsustainable rate.

Problem Statement: Expanded use of irrigation management tools is needed to improve irrigation management efficiency. Current recommendations have not been validated in northeast Arkansas.

Objectives: 1) Develop irrigation initiative timing cues from weather station data & field-specific soil moisture measurements in sandy soils. 2) Use plant maturity measures and ET to cue irrigation initiation. 3) Quantify crop and insect pest response to irrigation.

Material & Methods: The research site was a commercial farm located in Mississippi County, Arkansas. A 40 acre furrow irrigated field was used with a coarse sand/sandy loam soil type. The field was designed as an irrigation initiation timing study, with an early, recommended, and late start, and a controlled rainfall. The experiment was arranged in a randomized complete block with 4 replications in 2014 and 3 replications in 2015. An ET gauge, soil moisture sensors of varying depths and locations in relation to soil textural zone, and a weather station was installed to determine timing and effectiveness of irrigation events.

Treatments: 1) Early Start (ET Deficit = 3 cm) 2) Recommended Start (ET Deficit = 6.1 cm) 3) Late Start (ET Deficit = 7.6 cm) 4) Rainfed

Current Cooperative Extension recommendations for irrigation scheduling in soybean using an atometer (Henry et al., 2014); recommended irrigation timing for a furrow irrigated sandy loam soil is highlighted.

Results: Weather data was collected throughout the season using a weather station 1 km from the study site. Also, the crop was monitored for growth and pest response on a weekly basis. As expected, growth was greater in earlier initiated irrigation treatments. Alternatively, there was no pest response to irrigation treatments. Yield was determined using catch weights from load cells on the producers’ grain cart, obtained yield monitor data, and 1 m grab samples taken from the field 2 days before machine harvest.

An atometer (left) was installed to complement weather station data. The producer punched 15/16” holes in the poly-pipe in each row for furrow irrigation (middle). A Veris 3150 dual depth (Veris Technologies; Salina, KS) soil surveyor was used to map EC of the study site (right).

Soil EC map (top 90 cm) for the field site. Red signifies sand blows, green signifies sandy loam.

Increased lodging was associated with treatments that received more irrigation; significant differences in main stem and branch stem lengths were detected in these treatments.

Conclusions: Water is “a resource that must be better priced” (Dyson, 1999). The 2014 Arkansas water plan indicates that 10.2 billion m³ will be needed for irrigation in 2050, while only 2.2 billion m³ of groundwater will be available. More efficient use of irrigation water must become priority. This study showed that a reduced number of irrigation is possible on the front end with no yield difference and that a possible yield penalty exists for over-watering. The use of ET gauge/soil moisture sensors can help accomplish this; however, more work is needed on different soils.

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