MISSISSIPPI SOYBEAN PROMOTION BOARD
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Project Title: Practical Application of Sensor-based Irrigation Scheduling Method in Soybean

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Objectives: 1) develop practical application method of soil moisture sensors for irrigation scheduling on soybean; 2) compare the sensor-based irrigation scheduling method with Arkansas Irrigation Scheduler.

Progress: **Objective 1.**

Experimental plots were established in a 20-acre field under coverage of a variable rate irrigation system. Soybean (HBK LL 4805) was planted Apr. 24. Soil water content sensors (EC5, Decagon Devices, Inc., Pullman, WA) were installed in 6 locations in the field. The sensors were installed at 3 underground depths (6, 12, and 24 in.). To install the sensors, a hole was drilled at the center of the crop row using a soil auger. The sensors were inserted horizontally into the soil at the designated depths. One data logger (EM50R or EM50G, Decagon Devices, Inc., Pullman, WA) was used to collect soil moisture data from 3 sensors at each location. Data loggers were set up to continuously make one measurement of soil water content every minute and calculate the hourly average of the measurements. Readings of the soil water content from the logger were wirelessly transmitted online for download. A bendable antenna mount was developed and used to place the antenna above the plant canopy for wireless data transmission while not interfering with the operation of field equipment (Fig. 1).

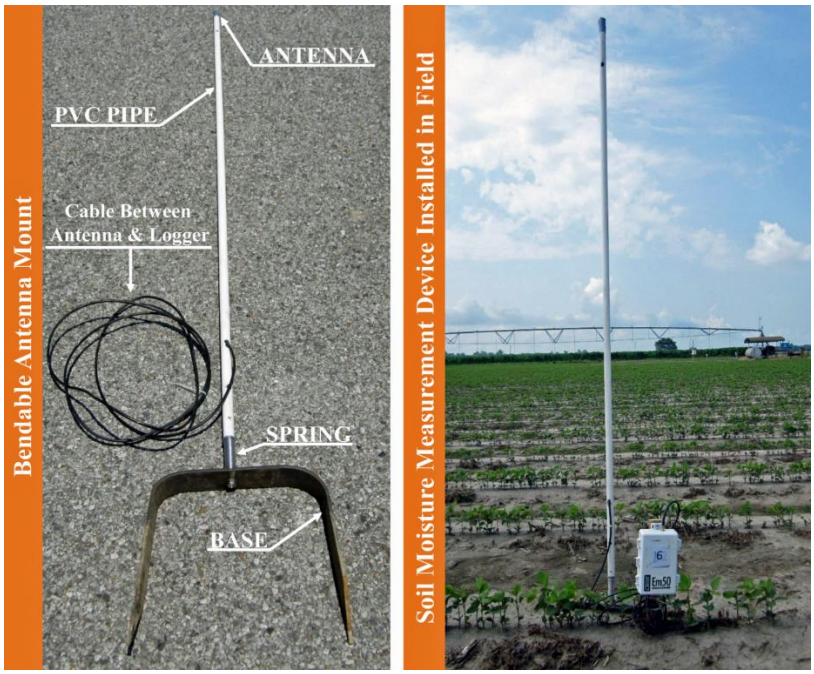

Fig. 1. Bendable antenna mount (left) and soil moisture sensing device with a bendable antenna mount installed in a soybean field for irrigation scheduling (right).

There were a couple of sensors which didn't perform properly during the season. They were repaired or replaced as needed. Weeds and insects in the field were managed with common practices in the region. Soybean was harvested on Sept 29, 2016. Twenty-six crop samples were taken for yield across the field. All plants in a 2-m-long row section were manually harvested to make one yield sample. Yield data were also obtained from a yield monitor.
The data loggers were removed from the field after the growing season. The soil moisture sensors remained in the soil, but were protected from field operation and wildlife damage during winter and spring with plastic end caps.
New soil moisture sensors (GS1, Decagon Devices, Inc., Pullman, WA) were purchased for next season. Soil moisture sensor data across locations in the field were compared to investigate the effect of variable rate irrigation and soil texture on soil water content during the growing season.
Soybean yield was estimated using hand-harvested plant samples. The yield was 4120 kg/ha in irrigated plots and 3526 kg/ha in rainfed plots. Irrigation increased yield by 17%.
Soil water content data collected during the season were filed for further analyses with data collected in the 2017 and 2018 seasons.

Progress: Objective 2.

Soil water content measured using the sensors was used for irrigation scheduling. Soil water content measurements at the three depths were interpreted using a weighted average method to reflect the importance of soil water in different depths across the plant root zone. A weight was assigned to each sensor measurement based on the sensor depth as 0.45, 0.35, and 0.2 for the sensor depth of 6, 12, and

24 inches, respectively. The weighted average of the soil water content (SWC) was used for irrigation scheduling. Soil water content measured by the sensors in the field at 48 hours after the soil was saturated was used as the sensor-measured field capacity (FC). Irrigation was triggered when the plant available water (PAW) dropped close to 50%.
PAW is defined as follows:

$$PAW = \frac{(Sensor - measured\ SWC) - (SWC\ at\ wilting\ point)}{FC - (SWC\ at\ wilting\ point)}$$

During the season, three irrigation events were scheduled on June 23, June 29, and July 19, respectively. In each irrigation event, 0.75 in. of water was applied to plots with 100% irrigation rate assignment. Weather data were collected from a weather station near the soybean field, and the irrigation data (including time and amount of irrigation water applied) were collected. These data are the necessary inputs for the Arkansas Irrigation Scheduler (AIS). To compare AIS with soil moisture sensor-based irrigation scheduling, a Bio-Science Aid was hired to work on these data. However, due to the federal hiring freeze, the Bio-Science Aid position had to be terminated. So, the processing of data could not be completed as planned. We will continue the data processing in 2017.