▶ Using Commercially Available Wireless Soil Moisture Systems On-Farm In Cotton

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Cotton Incorporated funded an irrigation demonstration project in 2011 in Mississippi to access the usability of commercially available wireless soil moisture systems. A producer was selected that was concerned about the declining aquifer in the area and was interested in using the data from soil moisture systems to make irrigation decisions that could help him save water. He was also interested in seeing how well the wireless communications systems worked for some of his remote fields.

Two different types of soil moisture sensors were selected for the project. A Decagon EC-5 soil water content sensor, which measures capacitance and is correlated with volumetric water content and an Irrometer / Watermark 200SS soil water potential sensor which measures resistance and is correlated to the negative pressure that the plant has to put on the soil to remove water.

Being 45 miles away from the project site and considering the traffic in a cotton field we did not want these soil moisture systems to become an obstruction in the field where they could get damaged or had to be temporarily removed from the path of the equipment, so we selected the manufacturer's associated dataloggers and wireless equipment to minimize their footprint in the field. The Decagon sensors were instrumented with an EM50G cellular datalogger. It was placed in the drill within the canopy and below the height of the tool bar of cultivation and spray equipment so the only thing above the canopy was a bicycle flag denoting where the unit was in the field. The Irrometer/Watermark sensors were instrumented with an Irrometer 950T radio transmitter that was also placed in the drill within the canopy but was modified such that the antenna was mounted above the canopy on a bicycle flag using an extension cable which was flexible enough to not be damaged.

The sensors were placed at depths of 8, 16, & 24 inches in the drill. The Decagon system was set to collect data every 2 hours and to send data 4 times a day by cellular transmission to the Decagon server where data would be stored. The data would then be available for download on-line from this server to each participant's computer where it could be charted and summarized with Decagon's Data Trac software. The Irrometer system came pre-programmed to radio data from each site to a central receiver whenever changes occurred in the data. This central receiver would store the data on site then send the data to the Irrometer server using a cellular gateway where the data was put in tabular and graphical form and could be accessed on-line by all participants.

This year both Irrometer and Decagon offered an option to monitor a reduced set of the data collected from a tablet or smart phone. The producer utilized this option on his I-Pad and we tested it out on an Android tablet and phone with success.

In general, these wireless communication systems worked well but needed some attention from time to time. Failure to transmit data occurred when there were issues with poor cellular signal strength, mechanical damage to the antenna or cabling, moisture in the enclosure, and poor battery/sensor connections. With proper installation and handling these issues can be minimized.

This project was located at a different group of fields each year. The producer was asked to initiate irrigations in each of the three to four irrigation sets approximately a week apart if no rainfall occurred, starting the first set at the time he felt was proper. Once initiated, he was to determine the timing of subsequent irrigations for each set. Soil sensor data was monitored throughout each growing season. The Decagon units were placed half-way down the furrow irrigated row in similar soils in each of three or four irrigation sets. The Irrometer units were placed a few rows over from the Decagon units ¼, ½, and ¾ down the row. The producer became more comfortable using this data to schedule irrigations each year.

The data from the Irrometer units that were placed at three locations down the row surprised the producer that he was not getting the lower end of the field watered as well as he thought. Basically he was stopping the irrigation shortly after the water had reached the end of the field, not giving these silt loam to loam soils which have low infiltration rates, enough time to wet the sensor at the 8 inch depth. We discussed surge flow as an option to improving his irrigation uniformity down the row, by surging to get the water across the field faster, then using shorter soak cycles to allow more time for water infiltration while reducing runoff.

Over the three years of this project, the results were similar. The later initiations resulted in the highest yield samples collected with less total water applied. The sensor data indicated that the plant had removed more water at the time of initiation at the 24-inch depth of the later initiations than the earlier initiations. Thus, the rooting depth of these soils was definitely 24+ inches during the years of this project. Proper irrigation scheduling to maximize yield with the least amount of water makes use of what water the soil can provide throughout the active rooting zone.

The producer monitored the sensor data regularly throughout all three seasons, and was pleased with the easy access to the data and the results that the later initiations could save him an irrigation, time, and energy in most cases on these soils without reducing yields.