

ON-FARM EVALUATION OF WIRELESS SOIL MOISTURE SENSORS FOR IRRIGATION MANAGEMENT

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Abstract

As irrigation becomes more popular across the cotton belt farmers are looking for more sophisticated methods of irrigation scheduling. Tests were conducted throughout one growing season in southeast North Carolina on a commercial cotton farm to determine the reliability of wireless soil moisture sensors under pivot irrigation. These Decagon systems were installed in early June just after the cotton plants emerged and a consistent stand could be identified. Two sites were chosen and a system of 1 data logger, 3 volumetric soil moisture sensors, as well as 2 matric potential sensors occupied each site. These sites were visited weekly for data collection as well as plant measurements, and occasional soil samples. The data was revised and compared to known amounts of water from irrigation events or rainfall. Soil samples that were taken were sent off to the North Carolina Dept. of Agriculture for nutrient testing as well as soil type analysis. Volumetric water content data from the decagon systems was analyzed and differences in soil moisture directly correlated with differences in soil type at the two sites. Because of soil variability in the southeast two or more systems will be required per pivot to determine the most accurate times an irrigation event is needed. This study will continue in more depth in the coming year with a goal to reduce the number of systems required to determine, more accurately, when irrigating is necessary for maximum yield during the growing season.

Introduction

Cotton producers are constantly looking for ways to increase their yields while decreasing inputs. With fuel prices increasing, the operation of a center pivot is not cheap; therefore accurate and timely irrigation scheduling is a must. Many companies have come forward to accomplish this task in the most producer friendly way possible. The systems used in this experiment were made by Decagon Devices, a company out of Pullman Washington. This company like many others are mainly focused on research but are becoming more involved in commercial farming applications of their systems.

Producers are constantly faced with difficult decisions throughout the growing season. The use of residual herbicides, as well as fertilizer incorporation have made influences on the timing of irrigation during the first 30-50 DAP (Days After Planting). With the use of soil moisture sensors the producer is faced with one less questionable decision, because the data is there to prove whether the pivots should or should not be turned on.

Materials and Methods

Two Decagon soil moisture systems were put in place under a single pivot irrigation system on a commercial cotton farm for evaluation as well as effectiveness. The two sites were chosen using aerial photos of the field which made evident change in soil type as well as land topography. These photos were then brought into Arc Map where latitude and longitude of the desired site locations could be obtained. Sites 1 and 2 were sites where management decisions regarding irrigation scheduling would possibly be made. Site 1 had a sandy soil type while site two was a more organic, heavier soil. The installation process began by going to the desired areas using a gps, and looking for a good constant stand of cotton that may represent the majority of the field. Each site consisted of a Decagon data logger, one plastic rain gauge, three Decagon EC5 volumetric soil moisture sensors, as well as two Decagon matric potential sensors. The rain gage was put in place to regulate the amount of water that was being applied due to an irrigation event or rainfall. A single hole was augured directly in the planted row down to 24 inches. The first EC5 soil moisture sensor was inserted vertically using a notched piece of 1/4 inch PVC pipe. The sensor was then covered by 12 inches of the same soil removed from the hole. The next EC5 soil moisture sensor was installed, with one of the matric potential sensors the same depth. These sensors were then covered by 6 inches of the removed soil and the last EC5 moisture sensors as well as the last matric potential sensor were installed. Both sites were set up the same way, with an EC5 soil moisture sensor at 24, 12, and 6 inches and matric potential sensors at 6 and 12 inches only. The soil was kept as natural and undisturbed as possibly to insure accurate data. The Decagon data loggers were mounted onto a piece of angle iron in the row to avoid field traffic. The sites were visited weekly to recover the

data and monitor rainfall/irrigation events. Soil samples were taken periodically throughout the experiment for nutrient tests as well as to manually measure volumetric water content. The data from the Decagon data loggers was analyzed and compared to the manually calculated water content using Microsoft Excel.

Results and Discussion

Viewing the data from the matric potential sensors it becomes obvious that this data may not be valuable to the research. The data suggested that these sensors were strongly affected by soil temperature. Decagon actually discontinued the manufacturing of this sensor shortly after it was installed for this experiment; therefore, we focused solely on the volumetric soil moisture sensor data.

The soil moisture varied at each site, which was expected due to differences in soil type. Figure 1. depicts a comparison of each site over a span of 17 days and two obvious watering events. These two events happened to be rainfall events explaining the coinciding peaks in data. Here it is obvious the differences in the soil moisture at 6 and 12 inches. Site 1, the sandy soil held more moisture in the 12 inch area while Site 2, the heavier organic soil, held more water in the top 6 inches. This data suggests it may be difficult to rely on one system alone to schedule irrigation events.

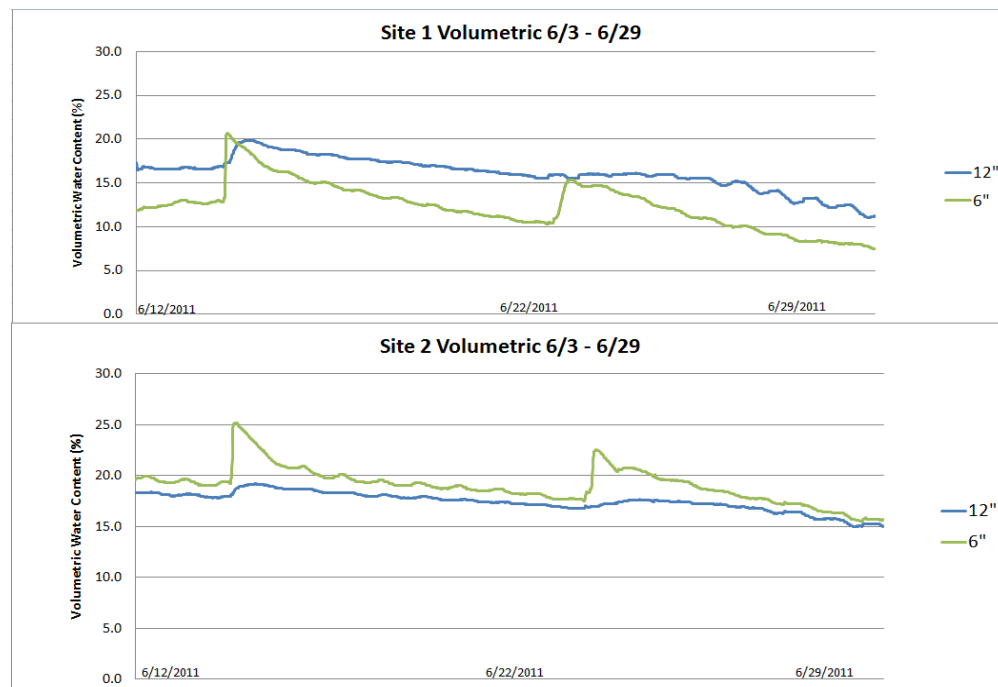


Figure 1. Site Comparisons.

The soil samples that were taken to measure volumetric water content were sealed and carried to the lab for measurement. The volumetric water content that was manually measured was then compared to the data downloaded from the sites. The accuracy of the volumetric soil moisture sensors are shown in Figure 2. It is made obvious the amount of volumetric soil moisture increases with depth however the differences in the sensor reading and the sample measurement are greater than desired. These extreme differences may be the result of human error during the drying and weighing process or calibration of the sensors.

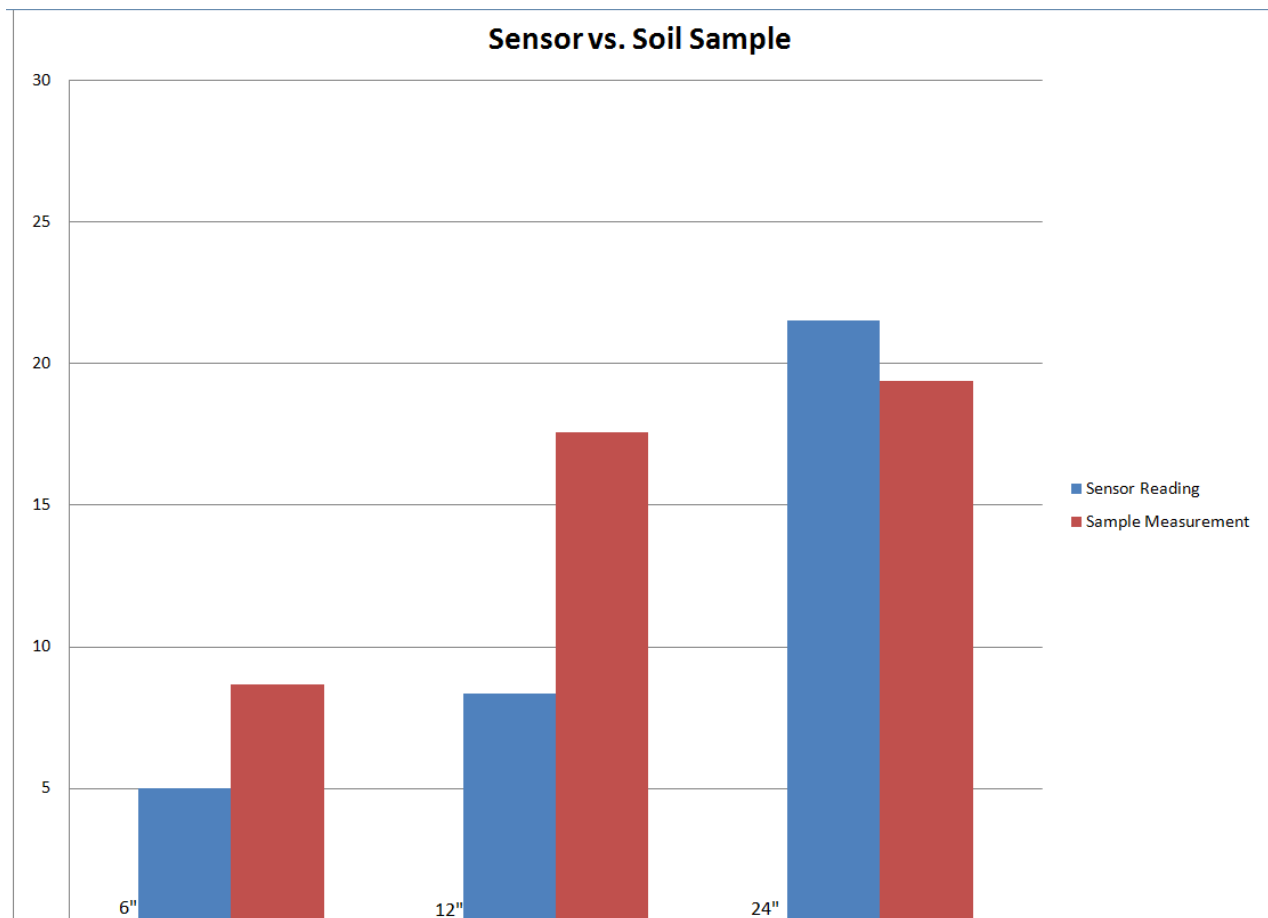


Figure 2. Sensor vs. Soil Sample

The plant available water (PAW) was calculated using the data from the 6 inch moisture sensor from each site during the same time period the previous comparison (Figure 3.) was. Here it is obvious that the PAW at the sandy location, Site 1, decreased more rapidly than the PAW at Site 2. This data suggests that it may be difficult to base the irrigation scheduling on one system because in different soil types water that is available to the plant is lost at different rates.

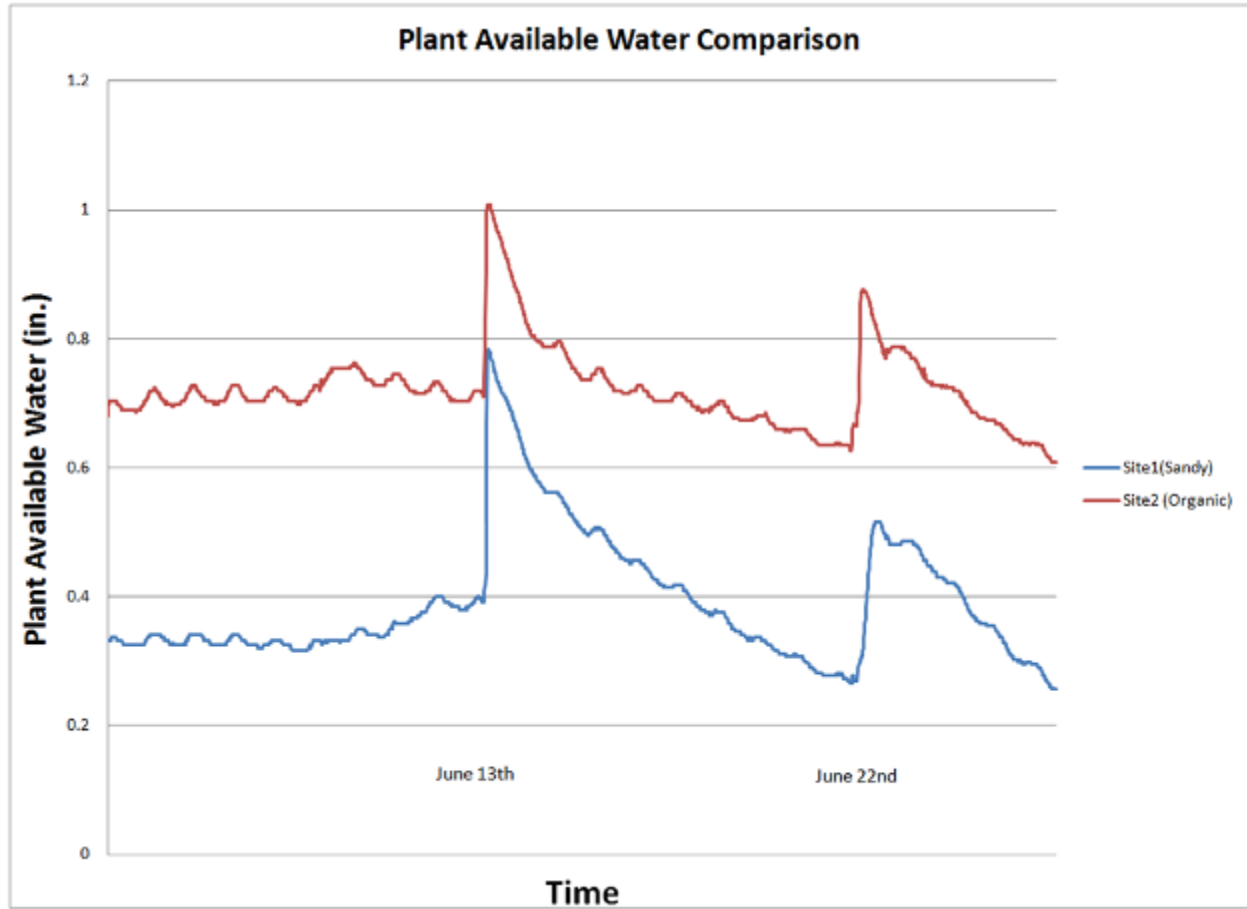


Figure 3. Plant Available Water Comparison

Conclusion

As irrigation systems are put on more and more farms, these producers will be searching for ways to help maximize their yields, and schedule irrigation events. Soil moisture systems are becoming more producer friendly and have the potential to be extremely helpful. Each of the systems used in our research survived being hit by machinery proving their toughness and adaptability to commercial farm use. It is definite that it will take a few irrigation/rainfall events to allow the systems to calibrate and adjust to the environment in which they are placed. At this point in the research it is not yet definite if one system per pivot will be able to accurately trigger an irrigation event.