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OPTIMIZING IRRIGATION WATER APPLICATIONS

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Abstract

Site-specific agriculture typically involves dividing a single field into smaller management zones based on variations in soil type and other management factors. Equipment to vary inputs such as fertilizers and insecticides are becoming commercially available; however, systems for site-specific application of irrigation water are still lacking. Additionally, knowing how to adjust water applications within the field would be a challenge even if a variable rate irrigation system were used. This poster addresses both issues. First, a variable rate pivot has been developed and tested on six systems in Georgia. Next, an affordable, wireless soil moisture sensor array was developed that could automatically control the amount of water delivered to different sections of the field. Combined, these two systems have the potential prevent yield loss and reduce water usage.

Variable-Rate Irrigation

Agricultural water use is a major portion of total water consumed in many critical cotton-producing regions of Georgia. Georgia has nearly 10,000 center pivot systems, watering over 1.1 million acres. Many fields irrigated by these systems have highly variable soils as well as non-cropped areas. Current pivot irrigation systems are not capable of varying the water application rate to meet the needs of plants on different soil types nor capable of stopping application in non-cropped inclusions. This limitation results in over-applying or under-applying irrigation water. The NESPAL Precision Ag Team has developed Variable-Rate Irrigation (VRI), a prototype method for differentially applying irrigation water to match the precise needs of individual sub-field zones. Recognizing that water is the major yield determiner in nearly all agricultural settings, the original interest lay in varying application rates from a precision crop production viewpoint. However, it was quickly apparent that a method for varying irrigation across a field could also lead to substantial water savings. This system easily retrofits onto existing center pivot irrigation systems. NESPAL has partnered with an Australian company, Farmscan, to develop a user-friendly and reliable/robust VRI control system. The VRI system varies application rates by cycling sprinklers on and off and by varying the pivot travel speed. Desktop PC software is used to define static application maps which are loaded into the VRI controller. The VRI system uses GPS to determine position/angle of the pivot mainline. Application rates along the mainline can be varied between 0% and 200% of "normal" application. A prototype version of the system has been installed on 6 center pivot systems in Georgia.

Wireless Sensor System

The focus of this project was to fully develop and field test a wireless soil moisture sensor array that would allow an irrigation system to respond to real-time plant water needs. The prototype sensor array uses off-the-shelf components and consists of a Watermark® soil moisture sensor; a micro-controller which converts the sensor information to digital data; a RFID tag which is a low-cost wireless device that attaches to the micro-controller and periodically transmits the data; and an interrogator which polls the tags. The microcontroller also allows us to attach a temperature sensor to the system so that we could simultaneously and remotely measure soil moisture and soil temperature throughout the field. During 2003 field-testing, the soil moisture sensor array was extensively evaluated and proved to be robust and reliable. Sensor arrays were installed in two fields and collected data throughout the season. The arrays were able to accurately track soil moisture conditions at several locations within each field. We were also able to determine that the sensor array's range was approximately 600 ft under dense canopy conditions (cotton). In a peanut field, the effective range is at least 2700 ft. We also developed the ability to read soil temperature and soil moisture simultaneously although the soil temperature component has not been field tested.