DOCUMENTING WATER SAVINGS FROM VARIABLE-RATE IRRIGATION CONTROL

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Introduction

Agricultural water use is a major portion of total water consumed in many critical regions of Georgia. Georgia has over 9500 center pivot systems, watering about 1.1 million acres . Many fields irrigated by these systems have highly variable soils as well as non-cropped areas. Current 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. In addition, five years of drought and a lawsuit over Georgia water use by Florida and Alabama have prompted a renewed interest in water conservation methods by the general public, which is becoming increasingly insistent that agriculture do its part to conserve water.

The NESPAL Precision Ag Team has developed Variable-Rate Irrigation (VR), 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 authors' original interest lay in varying application rates from a precision crop production viewpoint. However, it readily became apparent that a method for varying irrigation across a field could also lead to substantial water savings.

Objectives

The objective of this study was to determine actual water savings encountered on a center pivot when using VRI.

Materials and Methods

The VRI control system has since been installed on four farmer-owned CP systems in Georgia (Table 1). To determine actual water use (and potential water savings), a test was conducted on two of these CP systems (1 and 2). An application control map was developed for each system which was used to estimate water use for one complete pass of the irrigation system. The two systems were operated with VRI engaged for one complete pass (circle) while actual water use was being monitored by a Polysonic DCT-7088 ultrasonic flow meter mounted on the mainline. The water used while irrigating without VRI engaged was determined by measuring the normal flow rate with the Polysonic meter and then multiplying that rate by the time the CP would normally take to complete one pass.

Table 1. Farmer-owned center pivot systems with VRI controls installed.

Pivot	Towers	Mainline Length (ft)	End Gun	Total Acres	Flow Rate (gpm)	Pressure (psi)	Sprinkler Type	Control Zones
1	3	569	Yes	32	275	25	Spray on drop	13
2	3	609	Yes	37	750	55	Impact	16
3	5	995	Yes	88	1000	43	Spray on top	23
4	7	1408	Yes	162	1200	40	Impact	8*

* Only the last span, overhang, and end gun were controlled by VRI system.

Results and Discussion

Results from the actual water use studies with the two farmer-owned CP systems are shown in Table 2. The two pivots were operated at higher than normal travel speeds to reduce the time personnel had to remain on site during the testing. With VRI controls, pivot 1 used considerably less water in one pass. However, pivot 2 used approximately the same amount of water under VRI controls. This is common with many precision agriculture tools. Each field is a unique situation that has its own variability to be addressed.

Table 2. Results of actual water use testing.

Pivot	Measured non-VRI water use	Measured VRI water use	Percent Timer Setting	Time for one pass
1	68,400 gal	43,800 gal	100 %	4 hours
2	188,800 gal	195,300 gal	90 %	4.4 hours

The installed VRI systems will be tested further for circumferential variations, reliability and usability. The authors plan to continue to document actual water savings and crop yields realized from use of VRI controls. New sensors that could interface with the VRI controller and provide real-time soil water information will also be investigated.

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