Report for 2003GA38B: Decreasing Irrigation Volumes While Maintaining Crop Yields

- Water Resources Research Institute Reports:
  - Perry, C., S. Pocknee, C. Kvien, and G. Vellidis, 2004. "Decreasing Irrigation Volumes While Maintaining Crop Yields." Georgia Water Resources Institute, Georgia Tech, Atlanta, GA., 5p.
- Conference Proceedings:
  - Perry, C. and S. Pocknee, 2003. Precision Pivot Irrigation Controls To Optimize Water Application. In Understanding & Addressing Conservation and Recycled Water Irrigation, the Proceedings of the 2003 Irrigation Association Meeting, San Diego, CA. pp. 86-92.
  - Perry, C., S. Pocknee, and O. Hansen, 2003. A variable rate pivot irrigation control system. In J. Stafford and A. Werner (eds), ECPA 2003, Proceedings of the Fourth European Conference on Precision Agriculture, pp. 539-544.
- Other Publications:
  - Perry, C., S. Pocknee, and K. Harrison, 2003. Optimizing Irrigation Water Application. The Precision Ag Guide, pp 10-11, insert in the July issues of The Peanut Grower and Cotton Farming trade magazines, July 2003.

Report Follows

DECREASING IRRIGATION VOLUMES WHILE MAINTAINING CROP YIELDS

Georgia Water Resources Institute
Final Report

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Background

VRI is an innovative technology that enables a center pivot irrigation (CP) system to match field variability with an appropriately variable irrigation application, differentially applying irrigation water to match the needs of individual management zones within a field. VRI technology can lead to substantial water conservation while optimizing application efficiency. Additionally, crop yield should increase because every field area receives the right amount of water. NESPAL and its commercial partner Farmscan have developed a VRI system that is now ready for commercial deployment. The system is currently installed on 6 CP systems (4 farmer-owned, 2 University-owned).

The NESPAL system, which retrofits on existing CP systems, integrates GPS positioning into a control system which cycles individual sprinklers or groups of sprinklers OFF and ON (seconds ON per minute) and varies travel speed to achieve desired rates within management zones. In doing so, the system also avoids off-target water applications onto roads, waterways and non-cropped areas, boggy spots, and overlapping pivot areas. The pivot covers the field at optimum speed, as variable speed control allows pivot to move quickly over boggy spots and waterways and will slow down over the sandy spots, rather than running them twice. Poorly drained spots are less boggy, aiding tillage and spraying operations.

Initial testing with these systems has shown the NESPAL VRI system to be robust and user-friendly. We have been contacted by numerous researchers, county agents, and producers from other regions that have various needs that a technology like VRI could help address.

Results

Application Maps

We developed and implemented irrigation application maps for the six installed VRI systems. Application maps for the 4 farmer-owned CP systems are shown in Figs. 1 - 4. For each of the six systems, the application map was unique as each field had site-specific variabilities to be addressed with VRI. For example, in Fig. 1, the Screven County pivot covers a field with a sandy area that does not hold much soil moisture as well as low, poorly-drained areas that become boggy during normal irrigation applications. The majority of the field (shown in dark green) requires “normal” amounts of irrigation.

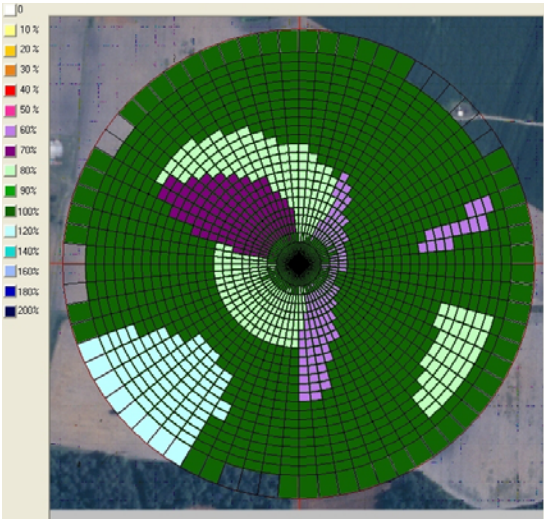

Figure 1. Application map for Screven County VRI pivot.

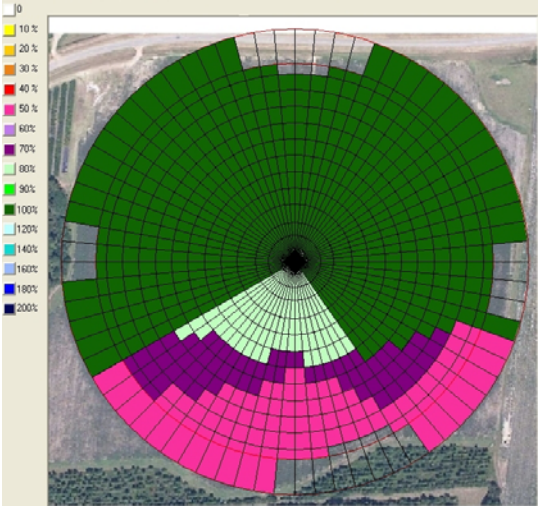

Figure 2. Application map for Colquitt County VRI pivot.

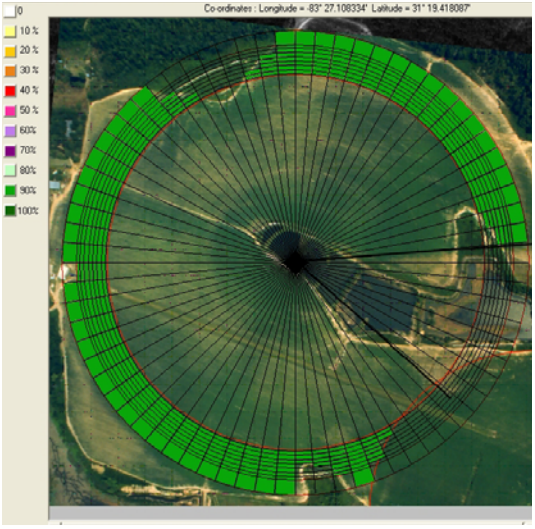

Figure 3. Application map for Cook County VRI pivot.

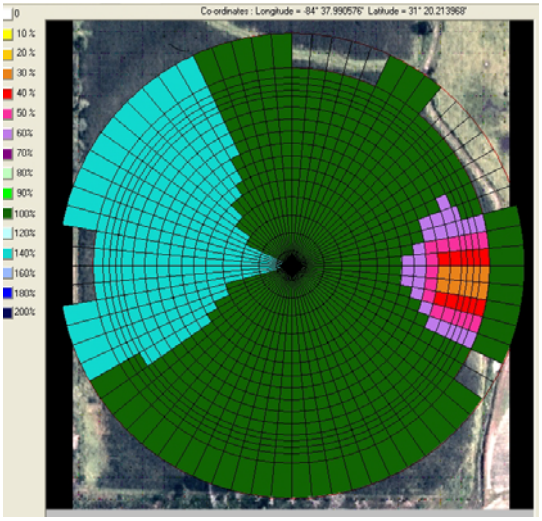

Figure 4. Application map for Baker County VRI pivot.

Water Savings

To determine the potential water savings from VRI for each system, calculations were made based on the application maps. For the following pivots, we calculated the percent water savings compared to “normal” application:

Baker Co. – 0%, Colquitt Co. - 36%, Cook Co. - 8%, Screven Co. – 7%.

To verify the water savings, flow tests were conducted on the Baker Co. and Colquitt Co. pivots. 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 (Fig. 5). Results are shown in Table 1. 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, the Colquitt Co. pivot used considerably less water in one pass. However, the Baker Co. pivot used slightly more 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.

Figure 5. Ultrasonic flow meter.

Yield Impacts

To evaluate the effect of variable-rate water application on crop yield, the Baker Co. field was divided into two halves (Fig. 6) with conventional application on the south half and variable application on the north half (ie. a split-map). We planned to have the grower irrigate using the split-map for the entire ’03 growing season and then harvest the peanuts and make a yield map to determine any effects of irrigation on yield. However, the field received more than average rainfall and the farmer only irrigated once.

We were able to harvest the field with a peanut combine equipped with a yield monitor. A yield map (Fig. 8) was created from the data collected during harvest.

Even though a split-map irrigation schedule was not followed (due to rainfall), the yield map does provide useful information. When compared to the 2002 corn yield map (Fig. 7) (which was representative of yield variation for several years prior), the ’03 yield map showed that, with ample soil moisture, areas with low yields (center left and upper left) can be brought up to yield levels comparable with the majority of the field that usually yields in the “high” category.

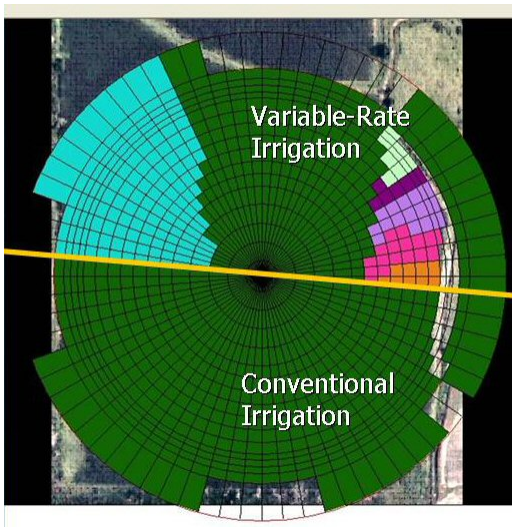

Figure 6. Split-map irrigation application map.

Table 1. Results of actual water use testing.

Pivot	Measured non-VRI water use (gallons)	Measured VRI water use (gallons)	Calculated VRI water use (gallons)	Percent Timer Setting	Time for one pass (hours)
Baker Co.	188,800	195,300	197,600	90%	4.4
Colquitt Co.	68,400	43,800	52,900	100%	4

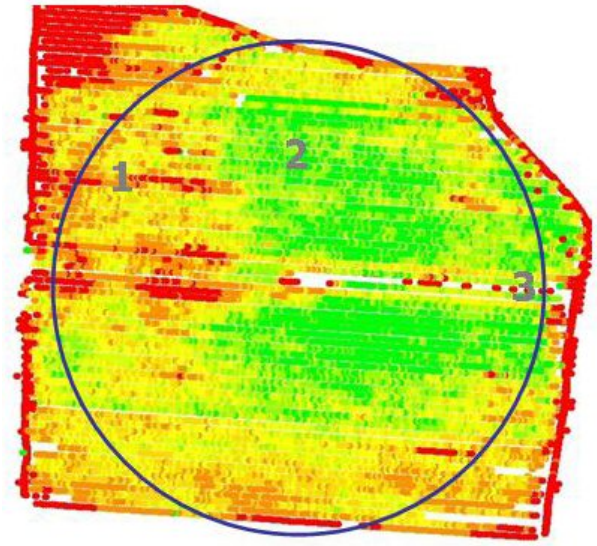

Figure 7. 2002 corn yield map. Circle indicates approx. pivot diameter. Red indicates low yield, yellow medium yield, green high yield.

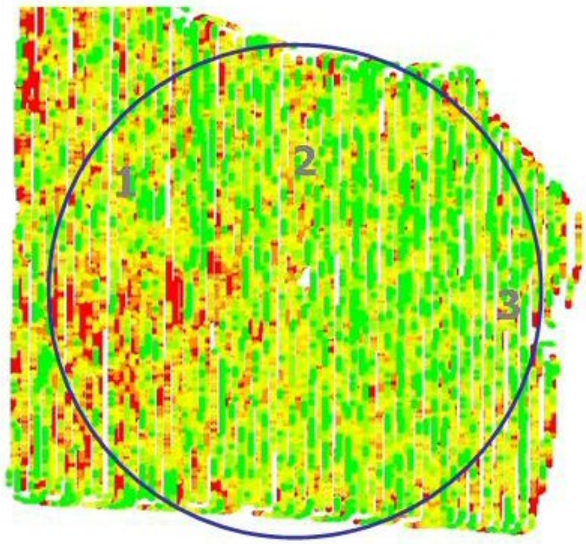

Figure 8. 2003 peanut yield map. Circle indicates approx. pivot diameter.

Web site

A web site was developed to give interested persons a better understanding of how variable-rate irrigation can benefit growers as well as rural communities. More information on this is available at http://www.nespal.org/irreff .

Publications/Presentations

Perry, C. and S. Pocknee. 2003. Precision Pivot Irrigation Controls To Optimize Water Application. In Understanding & Addressing Conservation and Recycled Water Irrigation, the Proceedings of the 2003 Irrigation Association Meeting, San Diego, CA. pp. 86-92.

Perry, C., S. Pocknee, and O. Hansen. 2003. A variable rate pivot irrigation control system. In J. Stafford and and A. Werner (eds), ECPA 2003, Proceedings of the Fourth European Conference on Precision Agriculture, pp. 539-544.

Perry, C., S. Pocknee, and K. Harrison. 2003. Optimizing Irrigation Water Application. The Precision Ag Guide, pp 10-11, July 2003. The Precision Ag Guide was an insert in the July issues of The Peanut Grower and Cotton Farming trade magazines.

Perry, C.D., S. Pocknee, O. Hansen, C. Kvien, G. Vellidis, and E. Hart. 2002. Development and testing of a variable-rate pivot irrigation control system. ASAE Paper No. 02-2290, ASAE, St. Joseph, MI.

Perry, C.D., and S. Pocknee. 2002.Variable-Rate Irrigation. The Peanut Grower Precision Ag. Guide, p.14, July 2002. The Peanut Grower is a peanut industry trade magazine.

Kvien, C., G. Vellidis, T. Wells, S. Pocknee, G. Rains, G. Hart, C. Perry, and D. Thomas. 2002. Precision management for improving crop quality in peanut and cotton. In Proceedings of the 6th International Conference on Prec. Agriculture, Minneapolis, MN. ASA-CSSA-SSSA. Pg. 567.

Perry, C.D., S. Pocknee, E. Hart, G. Vellidis, D. Thomas, N. Wells, and C. Kvien. 2002. Precision pivot irrigation. In Proceedings of the 6th International Conference on Prec. Agriculture, Minneapolis, MN. ASA-CSSA-SSSA. pp. 969-983.