



Texas Precision Agriculture

The Texas A&M University System – Agriculture Program

Annual Reports - 2000

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Agencies: Texas Agricultural Experiment Station and Texas Agricultural
Extension Service

Primary Research Location: Halfway/Helms

Project Title: Equipment Development for Site-Specific Irrigation and Chemigation

Project Objectives:

1. Modify a center pivot irrigation system to provide variable quantities of water in a pre-programmed manner as the system circles a field.
2. Begin development of a delivery system for the spot application of foliar agricultural chemicals along the length of a pivot.

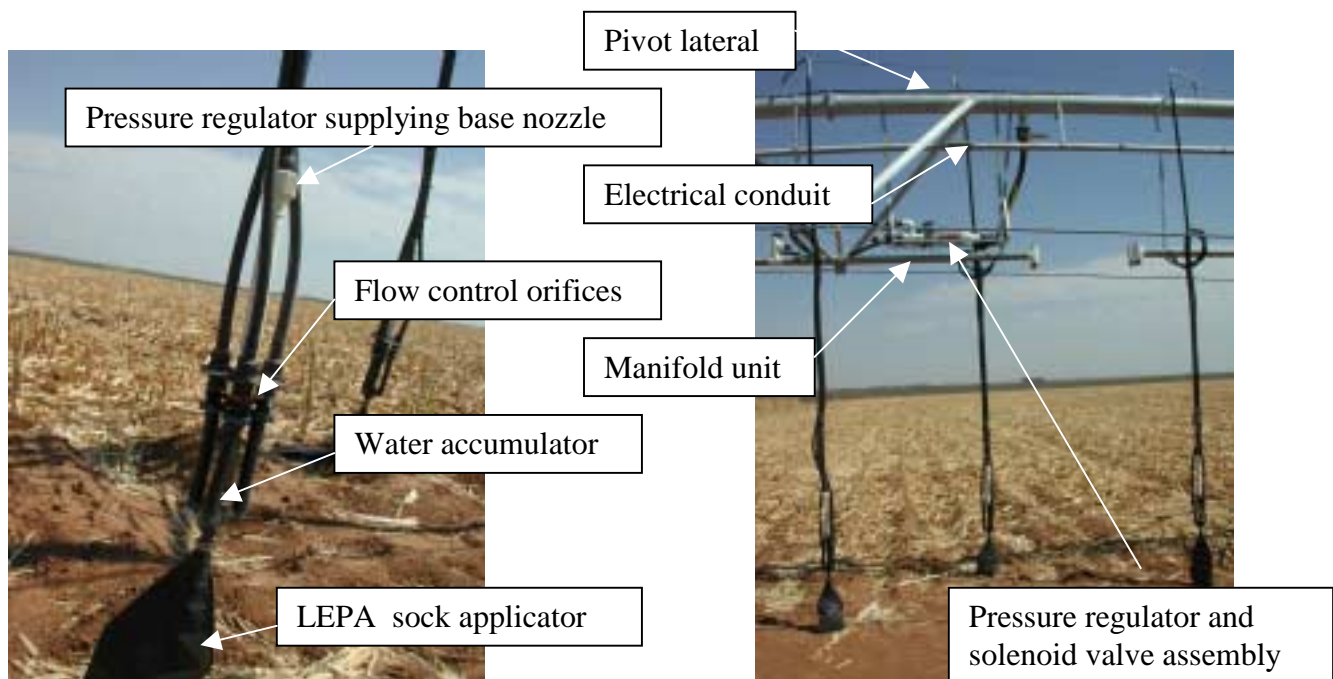
Reporting Period: September 1999 to December 2000.

A. Summary of Progress: (specific objectives listed above)

Progress has been made on the first of the two objectives. Original implementation plans called for the modification of four spans of a center pivot located at Halfway. However, access to a larger pivot and more land area at the Helms site resulted in moving this project to the larger pivot at Helms. A standard commercial center pivot (Lindsey Manufacturing, Lindsey, NE) 1360 feet in length was delivered in March 2000.

Water Distribution System. Prior to the delivery of the pivot several variable rate (VR) irrigation components were constructed and evaluated. A VR manifold unit was suspended from a single span center pivot at Halfway to evaluate options for construction and hydraulic performance. Based on this evaluation, brackets and braces for the support of final manifold units and electrical conduit were fabricated and galvanized. A modified LEPA applicator was also developed to accommodate water flows from the three manifolds of each manifold unit. Ninety-six LEPA applicators were constructed to equip three spans of the Helms pivot for VR irrigation.

The system design required water to be supplied from the mainline pivot lateral through pressure regulators and solenoid valves to each of three manifolds comprising the manifold unit. There are three manifold units per 160-ft pivot span. Hoses are used to direct water from the manifolds to the modified LEPA applicator. Initial nozzle sizes for each applicator provide flow rates of 2x, 3x, and 4x which, in various combinations, will provide 6 discrete irrigation amounts ranging from 40 to 140% of a base irrigation rate. Manifold units, hoses, and LEPA applicators have been installed on Spans 6, 7, and 8 of the Helms pivot. Pressure regulator and valve assemblies have been constructed and are currently being installed.

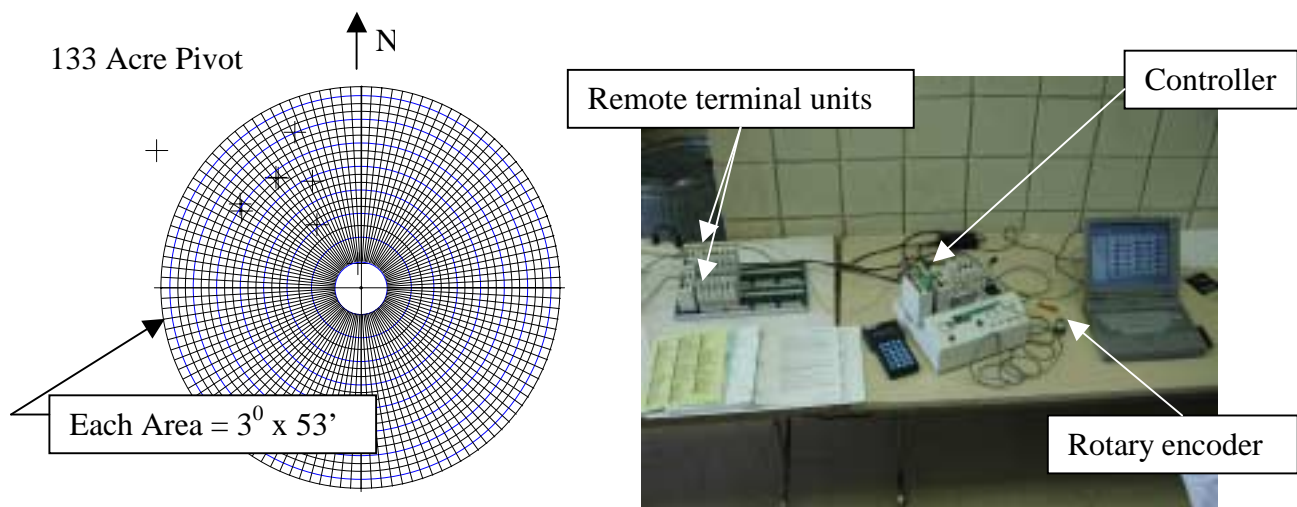


Figures 1 and 2. Elements of a variable-rate LEPA irrigation system being constructed on the Helms pivot at the Halfway/Helms research site.

Water Supply Equipment. Irrigation wells and pipelines are typically designed for constant flow at relatively low pressures. VR irrigation can cause drastic changes in flows and pressures within that water delivery system due to valves being turned on and off at various preplanned locations in the field. To address this problem, a pressure regulating system (Cycle Stop model CSV3R, Lubbock, TX) and an interactive pivot safety system were installed on one well supplying water to the VR Pivot. This system provides a means to reduce pressure in pipelines and the pivot as total irrigation volume is reduced. In initial tests, this system provided constant outlet pressures (+/- 2 psi) over flow rates ranging from 30 to 350 gpm. A booster pump at the pivot was installed to increase pivot pressure if required. Variable speed controls for this pump will be installed subject to need. An additional water well with pressure regulation will be available prior to the 2001 crop season.

Control System. The solenoid valves of each manifold unit are to be activated relative to field location, thereby controlling irrigation quantities at specific sites. A SNAP-LCSX-PLUS industrial controller (Opto 22, Temecula, CA), two remote terminal

units (SNAP-B3000), software, and related accessories were purchased for this purpose. The control system was programmed to provide four control signals to each manifold unit (3 signals for the 3 water manifold solenoids and an additional signal for a future chemigation actuator). Programming further allowed changes in solenoid status every 3° around the 360° perimeter of the pivot. Therefore, the largest control area under this VR pivot will be less than 0.1 acre (53' manifold unit length x $71'$ of a three degree arc) resulting in over 2000 water/chemical control areas under this 133 acre pivot. A standard incremental encoder (Dynapar™ Series E15) was purchased to provide an input signal to the controller to determine pivot location. A Microsoft Excel™ program was written to create coded map files from irrigation application maps. Changing an application sequence in the field will require developing a map file and transferring this code directly with a laptop computer or by telephone modem to the controller in the field. Installation of the control system and wiring on the pivot is scheduled for January 2001. Preliminary testing and evaluation of the system should occur in February and March 2001.



Figures 3 and 4. Schematic of the irrigation control areas and control system components of the variable-rate pivot being constructed at Halfway/Helms.

B. Education/technology transfer:

Bordovsky attended a 3-day irrigation control system workshop sponsored by Eldar-Shany in Fresno, CA.

Invited presentations which contained elements of VR application research conducted within this project:

- Bordovsky, J. P. 1999. Irrigation system efficiency. High Plains Association of Crop Consultants. Lubbock, TX.
- Bordovsky, J.P. 2000. New research developments. Irrigation in Cotton Production: Fundamentals, Management Strategies and New Developments, Marriott River Center, San Antonio, TX.
- Bordovsky, J.P. 2000. Irrigation research on the Texas High Plains. Texas Agricultural Industries Association. Lubbock, TX.

Bordovsky, J.P. 2000. New research developments. Irrigation Update for the High Plains. Texas Agricultural Irrigation Association. Amarillo, TX.

C. Milestones achieved:

- March 2000 Helms center pivot was delivered. Support brackets for variable-rate items were installed as the pivot was being constructed.
- August 2000 Installed and evaluated flow control valve on well.
- Sept. 2000 Finished development of preliminary software for the control of variable-rate irrigator.
- Oct. 2000 Finished field construction of manifold units on outer three spans of Helms pivot.
- Dec. 2000 Final cotton harvest completed in a 9-acre area used to evaluate a position sensitive, multiple rate spray applicator for perennial weed control (1997-99 funding period.)

D. Publications: (complete references)

Bordovsky, J.P. and J.W. Keeling. 2000. Perennial weed management with a position sensitive, multiple-rate spray applicator. Proceedings 2000 Beltwide Cotton Conferences, San Antonio, TX 399-404.

E. Precision agriculture proposals:

Archer, T.L., R. Lascano, K. Bronson, and E. Segarra. (J. Bordovsky – collaborator). 1999. Optimizing plant productivity using integrated crop management in a precision agriculture system. NRI. Not funded.

Rush, C.M. and J.P. Bordovsky. 1999. Development of a variable rate irrigation-chemigation system for center pivots. ARP/ATP. Not funded.

Archer, T.A., L.T. Wilson, R. Lascano, B. Payne, E. Segarra, J. Bordovsky, and W. Xu. 2000. Optimizing plant productivity using site-specific crop management. USDA – NRI. Not funded.

F. Precision Agriculture meetings attended/papers (posters) presented:

Meetings Attended.

National Irrigation Symposium. Nov. 2000. Session - Precision Irrigation for Site-Specific Management. Phoenix, AZ.

Papers Presented.

Beltwide Cotton Conferences. Jan. 2000. Perennial weed management with a position sensitive, multiple-rate spray applicator. San Antonio, TX.

G. Other developments:

Negative Impacts.

The decision to use the larger pivot at Helms instead of the pivot at Halfway for this project slowed the construction and evaluation of this system. The construction

was further slowed by continuous pivot use (watering crops) during a summer with little rainfall.

Positive Impacts.

The decision to use the pivot at Helms instead of the one at Halfway will, over time, provide up to 130 acres (versus 30 acres) to evaluate site-specific irrigation and chemigation. The construction of an additional water well at Helms should further increase the utility of this pivot as a research tool.

The use of water well pressure regulating equipment to control pivot pressures as flow rates change is less complicated and less expensive (initial cost) than the variable speed motor drives that were initially proposed.

The Opto 22 industrial control equipment offers much greater flexibility for irrigation control and data gathering (remote sensor input) than the programmable logic controllers that were initially proposed.