

Title: Increasing the Water Use Efficiency in Vegetable Production Systems in the Lower Rio Grande Valley through Improved Irrigation Scheduling Techniques

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Amount of Funding Requested: \$5,216.00

Duration: 03/1/04 - 3/01/05

Project Need, Description and Expected Outcomes:

More than 95% of the water for urban and agricultural use in the Lower Rio Grande Valley (LRGV) comes from the Rio Grande River. In recent years, this vital resource has come under tremendous pressure partly due to reduced flows as a result of the drought currently affecting most of Texas, and also to dramatic increases in human population along the River. These trends pose a serious threat to agricultural sustainability which depends on water for irrigation. The LRGV is one of the most important vegetable producing areas in the United States, with substantial social and economic contributions to the local, national economies (1). Approximately 50% or 65,000 acres of the vegetable production in Texas is located in the LRGV and nearly all of it is irrigated. One approach to conserve water and ensure agricultural sustainability is to increase water use efficiency in agricultural production systems through improved technology and irrigation scheduling. An increasing number of farmers in the LRGV now use drip irrigation to efficiently deliver water directly to plant roots where it is needed. (2,3). This system virtually eliminates water losses to evaporation, deep drainage and runoff, saving anywhere from 20 to 40% of the water required for irrigation. However, irrigation scheduling in vegetable production systems in the Valley is still based on empirical assessments such as plant symptoms or feel and appearance of soil. Such approaches can cause drought stress during periods between irrigations and anoxia due to excessive irrigation. Furthermore, the irrigation requirements for major vegetable crops grown in the Valley have not been established. Several methods for determining crop water requirements and scheduling irrigation have been developed, but due to their site-specific nature, these methods are not widely applicable in the LRGV. Frequent, light irrigations designed to maintain a moist root zone, and targeted to critical growth stages, could reduce irrigation requirements and sustain profitable vegetable production in the face of a less abundant and increasingly costly water supply.

We have initiated long-term experiments as part of the TWRI-Rio Grande Basin Initiative (RGBI) Program aimed at improving on-farm irrigation management in vegetable production systems in the LRGV. The said project is a collaborative effort with Soil Scientists (Bob Wiedenfeld (PhD) and Irrigation Specialists (Juan Anciso, PhD). Current research under the TWRI-RGBI umbrella is evaluating: 1) soil moisture depletion and weather-based approaches for scheduling irrigation; 2) how irrigation frequency influences soil moisture and root distribution as well as total water required to produce key vegetable crops in the Valley, and 3) the effects of irrigation frequency on crop/farm water use efficiency. We are using low-cost tools that farmers can readily afford in conjunction with research-grade instrumentation to

monitor soil moisture, weather and crop physiological status as the basis for scheduling irrigation.

Equipment Needs and Justification:

The requested funds will enable us to establish semi-permanent irrigation study plots for addressing the short- and long-term goals of this project. We currently have a portable gas exchange system (CIRAS-2, PP Systems, MA) which is capable of simultaneously measuring leaf level crop water use, carbon assimilation, and water use efficiency. A Scholander-type pressure chamber (PMS Instruments, Corvallis, Ore.) is available for measuring leaf water potentials. A watermark soil moisture meter and a limited number of soil moisture sensors are available. A dedicated station at the research plots would greatly improve the quality of the data collected. We currently have one data logger (CR21X Campbell, Scientific, Logan, Utah) with 8-differential-input channel capacity. This data logger can only be deployed in one location, which makes it difficult to collect data from a fully replicated trial. We have currently retrofitted this data logger with a limited number of sensors to collect soil moisture data; the data acquisition capability of this logger is inadequate to meet the research objectives.

The requested funds will support the purchase of micro weather stations, data loggers, environmental sensors, field irrigation plumbing supplies, flow meters, and controllers (Table 1). These instruments will allow us to simultaneously monitor/record/analyze several soil/plant/atmosphere parameters at several locations within a replicated experiment. This is critical for the stated objectives since the spatial variability that is inherent in soil, water, or atmospheric studies will be characterized.

Expected Outcomes:

In addition to the more immediate benefits of determining crop water requirements for vegetable production in the LRGV, the benefits (water savings) of altering the irrigation frequency will be demonstrated together with the physiological mechanisms responsible for increased crop water use efficiency. Data generated from this study will also be used in developing models for accurate irrigation scheduling using a combination of crop, weather, soil and cultural management variables. Efforts will be made to expand the weather station network for adequate coverage of the vegetable production areas in the LRGV so that irrigation scheduling can be based on actual local weather conditions rather than average weather. Long-term studies based on the results of this project will focus on reducing evapotranspiration by use of cover crops, organic mulch use, conservation tillage and increasing soil organic matter content. In addition to peer-reviewed publications, fact sheets and other popular publications will be prepared to communicate research findings to farmers.

Literature Cited:

- (1) Texas Agricultural Statistics Service. (2003). Crop Reports: Vegetables. (www.nass.usda.gov/tx/).
- (2) Dainello, F.J. 1996. Rainfall Capture and Drip Irrigation. Vegetable Production and Marketing News – Texas Agricultural Extension Service Bulletin Vol. 6(6):2-3.
- (3) Miller, T.D. 2000. Opportunities for Drought Mitigation in Texas Agriculture. Texas Agricultural Extension Service Publication SCS-2000-22. 4pp.

Table 1: List of equipment, manufacturers and approximate costs.

Instrument	Model	Manufacturer	Unit Price	Quantity	Extension
Soil moisture sensors	Watermark (6450WD20)	Spectrum Technologies, Inc, Plainfield IL	56	12	\$672.00
Portable data Loggers	WatchDog 400 (3685)	Spectrum	284	4	\$1,136.00
Weather sensors	3684PAR	Onset, Pocasset, MA	135	4	\$540.00
Totalizing water meters	DLJ200 2"	WaterMeters.com	260	4	\$1,040.00
Totalizing water meters	DLJ75 ¾"	WaterMeters.com	69	12	\$828.00
Other Items					
Permanent pipes/ tubing flow valves					\$1,000
				Total	<u>\$5,216.00</u>

**TAES/TWRI
Water Resources Research
Project Budget Form**

Expenditure Description	Amount Requested	Other Sources	Total
Staffing Requirements:			
1)		14,616	14,616
2)			
Fringe Benefits		1,206	1,206
Total Staff Costs		15,822	15,822
Travel:		700	700
Supplies and Materials:	5,216.00	2,800	8,016
Capital Equipment (purchases over \$5,000)		0	0
Printing and Publications			
Other Direct Costs (describe in detail)			
Total Project Costs	<u>5,216.00</u>	19,322	24,538