Project Narrative

Name of the Project: **Limited Irrigation for Biotic and Abiotic Stress Management: A Precision Farming Approach to Water Conservation**

Is This a New Project or Request for Continuation?: New

Geographic Area of the Project: Southwest Texas

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Amount of Funding Requested: 15,000

Project Need, Description and Expected Outcomes

The economic stability of Texas border regions is largely dependent on vegetables and agronomic crops irrigated from underground aquifers. However, increased regulations restricting water use, competition for water with large urban areas coupled with extreme temperatures and drought conditions has placed a large risk on the aquifers and on the livelihood of the farming communities. To overcome these limitations **it is necessary to use efficient water conservation strategies**. Since 1998, there has been an increase in the use of center pivot irrigation systems, and a decline in the low-efficiency furrow systems. Rainfall patterns during winter and spring also can reduce early season irrigation expenses, enhance soil moisture and increase profitable yields, particularly if minimum or no tillage is used. Reducing tillage can maintain crop residue, increase water infiltration from rainfall and overhead irrigation, and decrease soil evaporation losses.

Precision Agriculturetechnology usingremote sensing instrumentation,new drought tolerant varieties and a new understanding of agricultural productivity can allow crop production with limited water availability. Such technology opens new opportunities when implemented with variable rate application of chemicals through center pivots and water saving measurements achieved through conservation tillage practices. If remote sensing technologies, such as infrared thermometers (IRT) and infrared cameras (IRC) can be used to differentiate between abiotic and biotic stresses, such as drought and insect, variable rate application could be linked with global positioning system (GPS) and used to apply irrigation only to areas under stress.

The goal of this research is to develop a limited irrigation schedule to save water resources, maximize production efficiency, and improve yield and product quality of economically important row and vegetable crops for southwest Texas. The specific objectives to be accomplished are: 1) Identify limited irrigation thresholds for each crop grown under conventional and no tillage farming practices, 2) Evaluate the accuracy of infrared thermometers and infrared cameras to optimize limited irrigation scheduling in the presence of drought, disease and/or insect stresses.

Field studies will be conducted at the TAMU - TAES Uvalde. Irrigation will be supplied by a center pivot system equipped with LEPA nozzles. The land under the center pivot will be farmed in a to planting in order to implement non-limiting fertilizer rates. The center pivot circle will be divided in 4 wedges approximately 12 acres each. Each wedge will have a different crop throughout the fall-winter season and spring-summer season (spinach, wheat and sorghum in the fall followed by corn, cotton, sorghum and peppers in the summer). Each wedge is already subdivided in two tillage treatments (no-tillage and conventional tillage).

Objective 1. Limited irrigation thresholds under conventional and no tillage.

Two farming systems will be evaluated, one conventional tillage (CT) and one no-tillage (NT). The CT system will consist of normal tillage practices for the region which includes chiseling, moldboard plowing if necessary, disking, bedding, banded herbicides at planting and cultivation for weed control, shredding after harvest and disking. For the NT system crops will be planted in the residue from the previous year crop. Three irrigation regimes (100%, 75%, and 50%ET) will be implemented to evaluate plant response to stress under CT and NT systems. Weed control will be provided by herbicides applied by broadcast and hooded sprayers. Insect and disease control will be done using a precision chemical applicator provided by Valmont (Accu-Pulse). This system allows for chemical cost savings by spraying only targeted areas instead of the entire field. We expect to geo-reference areas under disease or insect stress using the IRTs or IRC and apply pesticides only to the target areas. In addition, we will monitor plant growth and physiological responses as affected by irrigation rates and tillage practices.

Objective 2. Accuracy of infrared measurements (IRT and IRC) to optimize irrigation scheduling.

One method of remotely sensing biological stresses in plants is through the use of precision infrared thermometers (IRT). IRTs are used to detect the difference in surface temperatures of plants rather than reflectance or energy units. Three irrigation regimes will be used (described in objective 1). Multiple IRTs are directly attached to the center pivot to record real-time plant stress conditions while the pivot is moving. In addition every other week we will fly a helicopter-mounted infrared camera above the pivot. The resolution of this camera is such that small differences in temperature between biotic and abiotic stress can be detected.

Specific Issues Addressed

The goal of this research is to save water resources, maximize production efficiency, and improve yield and product quality of some of the most important crops in the Texas agricultural economy. From this research we expect that conservation tillage in conjunction with limited irrigation and remote sensing to monitor plant stress would cut crop production costs significantly. Therefore, studies addressing crop production with limited water availability and irrigation management techniques will provide the basis for economical viability for the agricultural-based Edwards aquifer dependent communities west of San Antonio. Results from this study would also benefit growers in the other Texas areas where similar water restrictions are imposed by the high cost of pumping water from the aquifer and by its depletion.

Collaboration

Technology transfer to growers is a major focus of this research. Experiment Station (Drs Piccinni and Leskovar) and Extension scientists (Dr. Troxclair and Mr. Stichler) along with industry collaborators will present information at the local, state, regional and national meetings. Field demonstration, news print and refereed publications will disseminate results. A mechanism of communication for the improved irrigation and farming strategies will be provided by the local agriculture and water clientele teams (ACT), a group composed of key row and vegetable crop growers and consultants. Support for the applicability of the technology will be provided by agribusiness related to center pivot (Zimmatic), drip technology (Tand EAA. This research will extend educational training for two current graduate students, Libbie Johnson, M.S. student in the Horticulture Sciences Dept., and Nyland Falkenberg, M.S. student in the Soil and Crop Sciences Dept.