Integration of Fertigation and Soil Moisture Control for Automation of Subsurface Drip Irrigation System

A proposal to TAES/TWRI

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Project Need

Irrigated vegetable crops are economically important in south Texas. Considering the U.S., Texas ranks 3rd in production of watermelon ($268 million economic impact), 4th in onions ($200 million), 3rd in cantaloupe ($80 million), 3rd in chili peppers ($44 million) and 4th in spinach ($36 million). However, increased regulations restricting water use, competition for underground water with large urban areas coupled with extreme temperatures and drought conditions has placed a large strain on the aquifers and on the livelihood of farming communities in south Texas. Currently growers are allowed to pump only 24 inches/acre or 2-acre feet of irrigation water per year. We expect that water pumping restrictions will become a stronger reality for vegetable producers within the next 10 years. Since 1998, there has been an increased interest in the application of subsurface drip irrigation (SDI), an increase in the use of center pivot irrigation systems, and a decline in the low-efficient furrow irrigation systems. The benefits of SDI to conserve water, improve plant nutrition, reduce disease stress, and reduce leaching of contaminants are well documented. The benefits of SDI can be further emphasized with the use of monitoring tools that can provide precise control of irrigation and fertilization, and to facilitate decision during crop production.

The overall goal of this project is to develop efficient water conservation to enhance quality of vegetable crops while saving water in the Edwards Aquifer region. Our approach is to implement deficit irrigation (less than 100% ETc) in combination with selected genotypes that have shown drought tolerance in the Wintergarden. The requested funds will be used for the purchase of a base precision irrigation monitoring system that incorporates volumetric soil sensors, water meter, transmitter and receiver connected to a PC computer. This system will be an excellent addition to enhance ongoing efforts in irrigation and crop management projects. This system will be linked to a fertigation control system (Fertijet, in kind donation by Netafim, USA) which has the capacity for automatic fertilization and acid injection adjustment based on electrical conductivity and pH sensors.

Description of the Project

This project consists of three phases. During phase I, we plan to establish the permanent SDI system with 12 zones, each containing 12 rows. It will incorporate a filtration system, pressure regulators, air/vacuum relief valves, pressure gauges, automatic valves, main lines, sub-mains, laterals, connectors,

and line end-caps. Phase two will involve the installation of the moisture monitoring system, that includes 24 volumetric soil moisture sensors with, 12 flow lateral water meters, radio transmitter and receiver. Phase three will be linking the fertigation control system in the Fertijet with the computer controller used for irrigation management. This system will allow the application of two fertilizer sources, a N based type and another with a balanced N-P-K-S fertilizer blend. In addition, a third source will be used as an acid fertilizer to control the pre-set EC and pH rates (e.g. EC 1.2 dS/m and 6.5 pH).

The new SDI system will be used for irrigation studies (e.g. scheduling, irrigation rates) in combination with salinity and fertility levels on economically important vegetable crops in the Wintergarden region. Those include onion and spinach in the fall season and watermelon and peppers in the spring season. In onion and spinach crops we intend to evaluate deficit irrigation effects on quality, chemical components of flavor, yield and water use efficiency on selected genotypes identified for their drought tolerance. In specialty peppers, we will continue evaluating the genetic variation of habaneros, poblanos and jalapenos under deficit irrigation. In watermelon, we will evaluate diploid (seeded) and triploid (seedless) yellow, orange and red flesh cultivars at 100% and 50% ETc. Yield, soluble solid content, firmness, rind thickness and fruit size will be measured at harvest by standard methods. Fruit carotenoids will be measured by HPLC.

Potential limitations of the studies include uncontrollable excess rainfall during critical periods of plant development (e.g. reproductive and maturity). Studies will be arranged in a single or two factor experiments using a complete randomized block and split-plot design, respectively, with four or six replications each. Growth, yield, physical and chemical components will be subjected to analysis of variance. Significant interactions will be partitioned for the specific parameter and means separated by LSD.

Expected Outcomes

This project would enhance our understanding of how drip fertigation strategies affect growth, development, and final product quality. We expect to develop water-crop SDI irrigation strategies for high cash value crops with the ultimate goal to save at least 25% or more water and to increase profitability to producers. Along with industry collaborators we will present information at the regional and state meetings. An annual field demonstration and newsprint will disseminate results. Support for the applicability of this research and demonstrations will be provided by Ag Equipment, Netafim, T-Systems, Constanzo Farm, San Antonio Water Systems (SAWS) and EAA.

Budget

The requested funding will be used to purchase components for the installations of phase two of the project, including software for the wireless crop monitoring system (IrriWise) and for the communication between the controller, sensors and computer. Partial salary (25%) for a Research Assistant is provided by SAWS. Drip tape and components will be provided by Ag Equipment (Uvalde, TX-quote AAAQ1157) and Netafim (e-mail quote). Support for growing transplants is also provided by SouthCross Nursery (Mission, TX). Lab and field equipment for water conservation studies are already in place at the TAES Uvalde Center.