2009-2010 USGS/ NIWR Water Resources-related Research Funding Proposal

1. Title of Proposal

Regulated Deficit Irrigation Application and Cotton Production in SW Texas

2. Focus Category

Agriculture; Irrigation; Water use

3. Keywords

Regulated deficit irrigation, water stress, irrigation scheduling, water supply/ demand

4. Duration

One year: March 1, 2009 – February 28, 2010.

5. Federal Funds Requested

$5,000.00

6. Non-Federal (matching) Funds Pledged

$11,097.00, from Dept. Soil and Crop Sciences, TAMU

7. Principal Investigator (graduate student)

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9. Congressional District(s) Where Project Will Occur

Texas 23 Congressional District. (Uvalde County.)

10. Abstract (200 words limit)

Water demand is increasing in South Texas due to the population increase. As the water resources are limited in this area, making a good plan for urban / agricultural water use is crucial. Regulated deficit irrigation (RDI) can be one of the measures to save water without affecting the crop yield.

According to the previous study, approximately 25% of the water used in irrigation can be saved by maintaining the same yield. In this project, a further developed RDI experiment (using cotton as an example crop) was designed and planned to be repeated for at least two years in order to find the maximum water saving potential, and build a model of irrigation and crop yield. Five 'fixed' ratio regimes and two 'dynamic' ratio regimes are applied in the experiment. Their water use efficiency data will be collected in selected growth stages for comparison purpose as well. An irrigation-yield relationship curve or equation can be derived from the collected data as the objective of this study. This result is expected to be very helpful for the decision making on water issues as it may save more water for urban consumption and other purposes.

11. Statement of Critical Regional Water Problems

In South Texas, esp. San Antonio and nearby towns, a rapid population increase brings in a higher demand of urban water supply for daily consumption. Meanwhile, the crop production should be maintained. A detailed research on the agricultural water saving potential needs to be done to support the water distribution policy to maximize the benefit for this area.

12. Nature, Scope, and Objectives of the Research

Regulated deficit irrigation (RDI) is one important measure for saving water and maintaining crop yield. Some studies were done in the last decades in North China (Zhang et al., 1998b; Zhang et al., 1999; Kang et al., 2000), Australia (French and Schultz, 1984), West Germany (Ehlers, 1989) and North Syria (Zhang et al., 1998a). In these studies, several different irrigation regimes were conducted, and the water use efficiency/ transpiration efficiency of both dry matter of shoot and grain yield were discussed in details. However, these results cannot be used directly in South Texas, as the climatic and hydrologic conditions are different. What is more, the irrigation regimes used in literature are relatively simple, only controlling the irrigation frequency without considering much about the irrigated water amount.

RDI is applied according to the actual ET measured directly through lysimeters or some other

methods (e.g. eddy covariance), given in %ET. For instance, if the actual ET is 20mm, 50% irrigation will be 10mm. The most recent research at Agrilife Research and Extension Center (Uvalde) showed that 75% irrigation would be sufficient for maintaining the same yield, compared with full irrigation (100%ET), based on three irrigation treatments (100%, 75%, and 50%). In this project, the experiment is further developed by applying five 'fixed' treatments (100%, 80%, 70%, 60% and 50%) in order to find out the maximum water saving potential (i.e. the threshold). What is more, two 'dynamic' treatments (70%D and 50%D) are tested for an attempt of irrigation scheduling optimization. In dynamic treatments, irrigation is applied based on the plant growth stages. In case of 70%D, in some stages irrigation may only be applied 50%, and other stages may be 90-100%; but the total irrigation in the whole growing season will be kept 70% of total ET. This type of irrigation is expected to be better than the 'fixed' irrigation scheme (always irrigate 70%ET in this case), thus may further improve the water saving potential.

This project is mainly based on field experiment. For data analysis, beside common statistic techniques such as non-linear regression and ANOVA, spatial analysis, time series analysis, and even micrometeorology/ soil physics analyses methods will be involved to try to build a comprehensive irrigation-yield model.

The objectives:

1) Build models of: (a) grain-yield vs. % irrigation; and (b) fresh shoot/ dry biomass vs. % irrigation in small watershed scale. Analyze potentially how much water can be saved in 'fixed' irrigation schemes.
2) Give suggestions on optimizing crop irrigation schedule (to minimize irrigation water use while keeping the same crop yield) by comparing different dynamic irrigation treatments.

13. Results Expected from this Project

Build a small watershed-scale irrigation-yield prediction model for cotton, and generalize it for other crop, which can be used for future application/ research.

Publish 1-2 academic papers on peer reviewed journals and/ or national/ international conferences in this field.