Limited Irrigation Research for the High Plains

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Background

Declining ground water and diminished surface water supplies during drought are not new problems for the High Plains, however, the drought across the inter-mountain west and Great Plains over the past six years has magnified the problem. Nebraska legislation to conjunctively manage groundwater and surface water will have an impact and change ground and surface water allocations. For most areas it simply means less water for producers which means greater production risk.

Declining groundwater levels in irrigated areas of the Great Plains have already required a shift to limited irrigation or a return to dryland crop production in some areas. The economic reality is that irrigation provides higher profitability and increased income stability than dryland farming. When faced with limited water, the dilemma for producers is whether to reduce irrigated acres and maintain full irrigation of less land by reverting land to dryland or grassland, or to irrigate all acres with less water.

Another alternative is to adapt irrigation management strategies, practice no-till and residue management and change cropping systems to produce lower water usage crops. UNL research suggests that applying limited water to an optimum number of acres provides more profit potential and has less impact on the local economy than reverting some land to dryland and fully irrigating less land (Schneekloth, et al, 2001).

Under limited irrigation, less water is applied than is required to meet full ET demand. As a result, the crop will be stressed. The goal is to manage cultural practices and irrigation timing such that the resulting water stress has less of a negative impact on grain yield. Previous Nebraska research on the concepts of moisture conservation from dryland, no-till ecofallow (Burnside et al., 1980) and the timing of limited irrigation (Garrity et al., 1982; Klocke, et al., 1989; Maurer et al., 1979) were combined in a project at North Platte, NE (Hergert et al, 1993; Schneekloth, et al., 1991). Over a 10-year period, this cropping-systems approach for stretching limited irrigation (6-inch application per crop) on a silt loam soil showed winter wheat yields were 99% of full irrigation, corn yields were 86% and soybeans were 88% of fully irrigated yields. This research did not include oilseed or pulse crops.

Supalla and Martin have developed a tool for managing limited water called ***Water Optimizer*** (http://real.unl.edu/h20). This tool enables producers faced with limited water to evaluate what crops to grow, how many acres to irrigate and how much water to apply during a single year, field by field basis. ***Water Optimizer*** is now limited to a relatively small set of crops. It includes data for Nebraska counties only and does not address all of the critical risk management questions associated with limited water. Specific enhancements include: 1) development of crop production function data sets for all major irrigated areas within Nebraska, Kansas and Colorado; 2) whole farm optimization (simultaneous considerations of multiple fields); 3) dynamic optimization (consideration of multi-year water supplies); 4) incorporation of additional crops (including, but not limited to, pulse crops and oil seed crops); and 5) incorporation of a routine for evaluating irrigation system improvements.

Objectives

1. Expand the geographic coverage of ***Water Optimizer*** to include all counties in Nebraska, Colorado and Kansas where there is a significant amount of irrigation.
2. Develop the capability to evaluate risk management alternatives on a whole farm basis.
3. Determining the optimum strategies for managing a multi-year water allocation.
4. Incorporate a routine for evaluating irrigation system improvements.
5. Develop improved irrigation response crop production functions (dryland to fully irrigated yields), with emphasis on oil seed and pulse crops grown in the semiarid High Plains.

Research Approach and Methodology

Task 1. Develop limited irrigation crop production functions for oilseed and pulse crops to provide data for enhancing ***Water Optimizer***. Land area at PREC and HPAL under linear move sprinkler irrigation systems plus a small pivot near Alliance will be used for the research. Irrigation allocations including dryland production (e.g., dryland 4, 8, 12 inches and irrigation to meet full ET) will be replicated four times. Larger blocks (40 feet x 80 feet) of a water level or irrigation treatment will be split into sub-plots with different oilseed or pulse crops.

Task 2. As additional production function data becomes available it will be incorporated into the ***Water Optimizer*** program. This will include additional crops, additional climatic information for existing crops, and additional information on how crops respond to water in different geographic areas.

Task 3. Expand ***Water Optimizer*** to include simultaneous consideration of multiple fields (whole farm case) and multiple time periods.

Task 4. Develop a routine for evaluating investments to improve irrigation efficiency and incorporate it in ***Water Optimizer***.

Task 5. Implementation of the whole farm, multi-year version of ***Water Optimizer*** will be beta-tested with a group of cooperating farmers and RMA and university specialists.

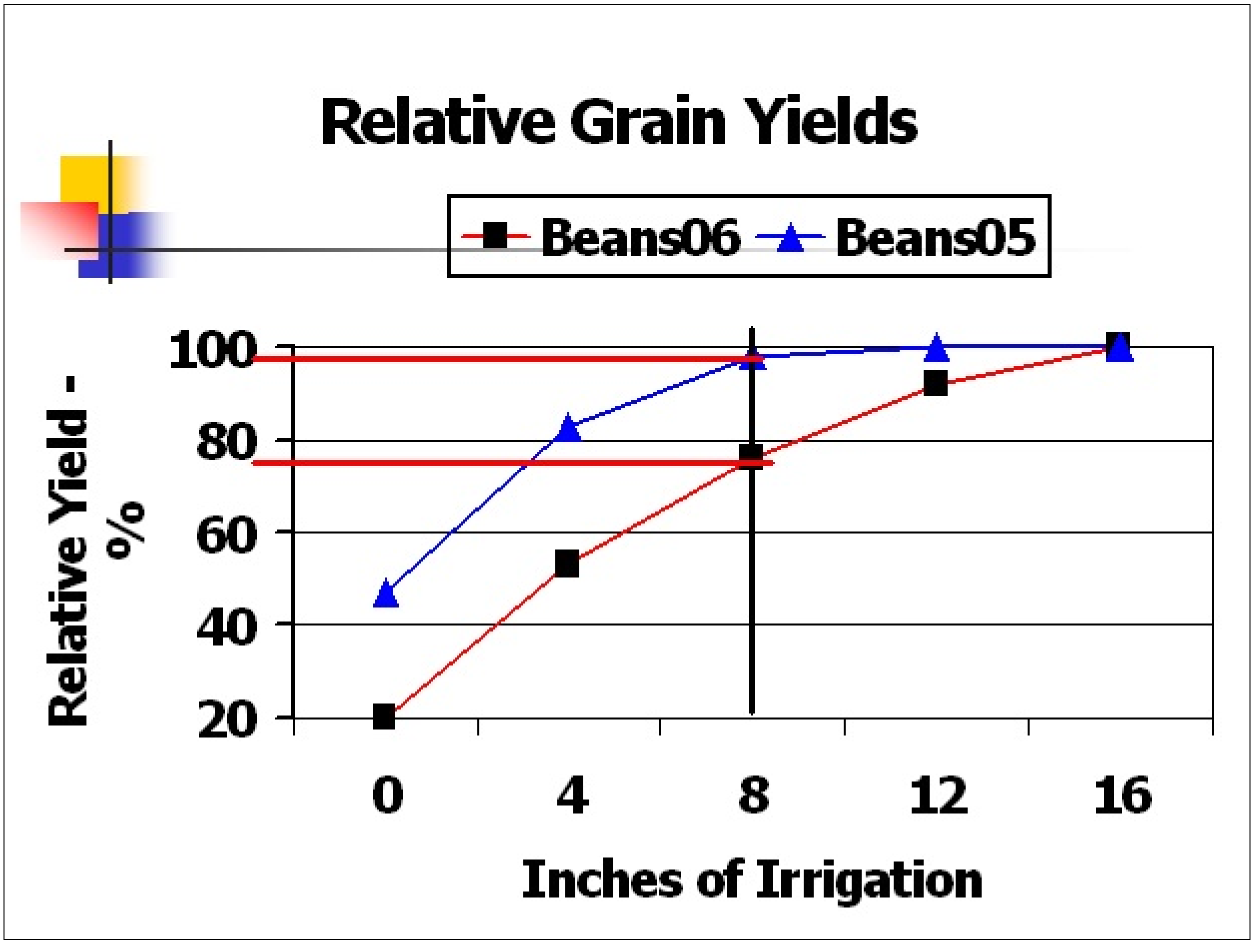
Project budget

$885,093 for 2006-2009

Benefits and results expected and transferability

The benefit of this project will be to maintain profitability and sustain farming enterprises with a limited irrigation supply. The goal is to develop a management tool within the ***Water Optimizer*** framework that can be used to make whole-farm crop planning decisions to mitigate risk under limited irrigation conditions.

The figure below shows a production function for dry beans from PHREC no-till limited irrigation research the past two years. To develop information for ***Water Optimizer*** and for other economic analysis, we must develop similar production functions over a number of years with a range of precipitation for oil seed crops. The two years 2005 and 2006 were an excellent contrast of a wet year(above normal precipitation) and a fairly dry year (below normal precipitation). For a given irrigation level, there can be major differences in productivity (e.g., 98% in 2005 versus 78% in 2006 for 8 inches of irrigation). The range of differences must be captured to determine economic implications of irrigation allocations.



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