Irrigation Management Improvements for San Joaquin Valley Pima Cotton Systems

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Pima cotton, Gossypium barbedense*, has different water use patterns than Upland cotton plantings,* Gossypium hirsutum*, previously used for irrigation studies. This research narrowly defines water scheduling practices and points out opportunities for improving water use efficiency leading to higher productivity per unit of water applied for Pima cotton.*

While Pima cotton, *Gossypium barbedense*, was first grown in California in the 1920's, it wasn't until 1991 that large-scale acreage was approved for planting following changes in the one-variety law established by the San Joaquin Valley Quality Cotton Control Board. Since that time, market conditions favoring very high quality lint have led to Pima cotton acreage increases to 273,000 acres with Upland, *Gossypium hirsutum*, cotton plantings steadily declining to 256,000 acres in 2006. Combined irrigation water applications for these two crops are estimated at over 1.5 million acre feet statewide, and options to reduce applied irrigation water without adversely impacting crop productivity are needed.

When compared to the common upland varieties grown throughout the US cotton belt, Pima cotton's more indeterminate growth habit led growers and researchers to suspect that its water use characteristics were different from those of the more traditional plant types and began to document changes in crop water use. Our work in this study is aimed at developing additional crop water use information for Pima cotton, validate the water stress guidelines that have been proposed for the crop, increase irrigation management extension outreach activities, and document the value of deficit irrigation practices as a method for improving water use efficiency.

One key element that separates irrigation management of cotton from that of other crops is cotton's ability to sustain modest water deficits without sacrificing large yield or quality losses. While peak productivity comes from meeting the full water requirement of the crop, it is common that the amount of water applied greatly surpasses the amount of water required by the crop. These inefficiencies in applied water combined with improper timing of irrigation events, results in low water use efficiency.

Cotton efficiently takes up water from the root zone and transports it to the leaves for evapotranspiration (ET). Upon soil drying between irrigation events, cotton leaves and

A grower and project cooperator interested in conserving water on-farm, Jeff Yribarren is seen here with Pima cotton.

the root system begin to recognize water stress events and the consumption of water is reduced without creating sudden and dramatic changes in water stress as is the case for many other agricultural crops. This unique feature allows water stress to accumulate over a longer period without great impacts on crop quality or productivity. By monitoring crop water status in addition to soil water status, we are developing soil and plant based water management approaches that result in improved timing of irrigation events. Working to better control the frequency and duration of stress periods between irrigations, we can limit premature irrigation scheduling resulting in fewer irrigation events, and minimize yield loss when water becomes very expensive or is unavailable.

Field trials were conducted on west side Fresno County farms and at the West Side Research and Extension Center (WSREC) near Five Points, CA. During the 2005 production season, we conducted our studies on three farm sites; in 2006 we are evaluating one grower site and one WSREC site.

Our 2005 season irrigation studies used a wide range of applied irrigation volumes which enabled us to evaluate water deficit treatments that ranged from low water stress treatments that maximized yields to moderate stress treatments that significantly impacted crop productivity. The timing, duration and magnitude of water stress as measured by the pressure chamber was confirmed to be a very useful tool in scheduling irrigation events and determining when crop water stresses are significant enough to impact yield. While minor yield reductions may have occurred when imposing early and mid-season crop stress, we found that late season water scheduling played a major role in determining the magnitude of yield loss in pima cotton. This is contrary to many of the studies in Upland cotton that have shown that modifying late season irrigation cutoff dates typically plays a more subdued role in reducing yield and crop quality. The reasons for this difference might be explained by the characteristics of fruit production for this crop. Pima cotton requires a fruit set period of more than 45 days whereas Upland cotton types set fruit in 30 days. This, combined with the fact that a larger percentage of bolls are set late in the fruiting cycle, appears to change the crop's sensitivity to late season plant stress events.

This continuing work challenges the Pima cotton grower to manage irrigation water more carefully and to take advantage of opportunities earlier in the season to stretch irrigation events and conserve water. These findings will assist growers, irrigation districts and irrigation managers with the tools they need to increase water use efficiency in Pima cotton production systems. The experimental results and extension activities more narrowly define water scheduling practices and point out opportunities for improving water use efficiency leading to higher productivity per unit of water applied.

Collaborative Efforts

This project is part of a larger activity to improve irrigation management in cotton and elevate our understanding of crop water use in Pima cotton as compared with Upland cotton types. At the early stages of this activity we consulted with and gained support from the Westlands Water District and the United States Bureau of Reclamation. We acknowledge each agency for their financial and administrative support and would like to especially thank Gerald Robb with Westlands Water District and Tracy Slavin from the Bureau for their interest, ideas and support of water relations research in Pima cotton. We also acknowledge the efforts and invaluable support of UCCE Statewide Cotton Specialist Bob Hutmacher and UCCE Biometeorology Specialist Rick Snyder.

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