



Irrigation Management Improvements for San Joaquin Valley Pima Cotton Systems

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Pima cotton, Gossypium barbedense, has different water use patterns than traditionally grown Upland cotton plantings, Gossypium hirsutum, previously used for irrigation studies. This research develops deficit irrigation strategies and points out opportunities for improving water use efficiency leading to higher productivity per unit of water applied.

The 2007 growing season was the first season on record to find California growers producing more Pima cotton, *Gossypium barbedense*, than its traditional Upland counterpart, *Gossypium hirsutum*. Though Pima cotton was first grown experimentally in California during the 1920's, it was not 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 extra-long staple (ELS) Pima cotton have led to Pima cotton acreage increasing to 270,000 acres with Upland plantings declining to 170,000 acres in 2007. Combined irrigation water applications for these two crops are estimated at over 1.3 million acre feet statewide, and options to reduce applied irrigation water without adversely impacting crop productivity are needed.

Pima cotton's indeterminate growth habit has led growers and researchers to suspect that its water use characteristics were different from those of more traditional plant types and work began to document changes in crop water use. The work conducted in this study is aimed at developing additional crop water use information for Pima cotton, validating the water stress guidelines that have been proposed for the crop, increasing irrigation management extension outreach activities, and documenting the value and potential for 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.

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 focused our activities at the WSREC site. Our 2006 season irrigation studies incorporated a range of applied irrigation volumes in three irrigation treatments which enabled us to evaluate water deficit treatments as well as low water stress irrigation treatments that would optimize yield. Preirrigation activities in late February allowed an application of about 12 inches of water which largely went to refilling the soil water profile that was deficient of water due to the previous crop. Additional in-season irrigations of approximately 6 inches each were applied to the field including two, three and four post-plant irrigations that represented the range of water stress conditions desired.

The 2006 cotton growing season was characterized by good planting conditions

that were accompanied by optimal plant stands; the slight delays in early season plant growth caused by cooler than average spring conditions did not have much impact on yield expectations though first flower date was delayed several days beyond the long-term average. The most significant event during the season came during the month of August when mid and late August daily temperatures typically exceeded 110 degrees, leaving the flowering cotton's pollen susceptible to heat stress events. This is widely thought to have played an important role in reducing yields below the 5 year average.

The timing, duration and magnitude of water stress, as measured by the pressure chamber,



Pressure chamber

was found to be a very useful tool in scheduling irrigation events and determining when crop water stresses are significant enough to impact yield. Cumulative leaf water potential readings confirmed that the

timing of the two in-season irrigation events assisted in minimizing crop losses from excessive water stress. Determining the appropriateness of the deficit irrigation treatment timing was also confirmed by the yield results obtained.

For each of the three cotton types evaluated in this study, Pima, Upland and the interspecific Pima-Upland hybrid, water deficit treatments performed exceedingly well when compared to the irrigation treatment that followed UCCE irrigation management guidelines. Surprisingly, a larger impact to productivity was observed between the widely grown plant types tested in this study. The Pima cotton exhibited high productivity relative to the Upland and interspecific hybrid. While numeric yield

reductions were observed in the deficit irrigation treatments, there were no significant impacts on crop yield when comparing the guideline treatments with the deficit irrigation treatment. Lower yield was only observed in the excessive irrigation treatment compared to the guideline treatment. 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. Deficit irrigation practices in cotton can be developed as a method 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 would like to thank Kevin Collins of Borba Farms and Tom Fairless of Fairless Farms for their time and resources while conducting field activity on their farms. We also acknowledge the invaluable support of UC Biometeorology Specialist Rick Snyder.

Publications

Munk, Daniel, Jonathan Wroble and Robert Hutmacher. Crop Responses to Water Deficits in High Yielding Pima and Acala Cotton. 2007 Beltwide Cotton Production Conferences. ncc.confex.com/ncc

Munk, Daniel and Jonathan Wroble Contrasting Fruit Retention Characteristics of High Yielding Pima and Acala Cotton. 2007 Beltwide Cotton Production Conferences. ncc.confex.com/ncc

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