IMPACTS OF WATER DEFICITS ON KEY ACALA LINT QUALITY PARAMETERS

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Abstract

Contrasting water management regimes were imposed on Acala Maxxa over a five-year period. High water stress and low stress treatments resulted in a wide range of yield impacts with the premature water terminations having the greatest impact on yield. Gin turnout information and fiber quality measurements including fiber micronaire length and strength are compared to crop yield. An average leaf water potential measurement was developed during the critical flower set period and compared to crop yield. A high correlation exists between average LWP and lint yields for the 1995 to 1997 data evaluations. Gin turnouts were improved as crop water stress increased and yields declined while no change in micronaire was observed. The most sensitive parameters to water stress measured were fiber length and fiber strength. Water management parameters that resulted in high lint yield also tend to produce the longest and strongest fibers both within and between years. Although fiber strength was improved with high yielding treatments, no explanation is offered for the lack of micronaire response.

Introduction

Federal legislation known as the CVPIA impacting irrigation water deliveries in California's San Joaquin Valley (SJV) was enacted in 1996. This legislation has resulted in reduced availability and increased cost of irrigation water throughout most cotton producing areas in the SJV where 98 percent of the states cotton is produced. Because more than 80 percent of seasonal crop water use comes from irrigation water, economics and availability of water supplies becomes increasingly important to California cotton producers.

Irrigation water availability has become more uncertain for growers elevating the possibility for acreage reduction and incorporating deficit irrigation strategies to maximize profits. The yield and profits of SJV cotton will become increasingly variable as the region oscillates between abundant water and drought years. Although several studies have documented impacts on yield to water deficits, Grimes etc. 69, Marani et. al 1971) very little information is available on the impact to marketable quality of deficit irrigated cotton in the SJV. The objective of this study is to evaluate the impact of deficit irrigation practices on several important cotton quality parameters.

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Materials and Methods

Experimental design and procedures are available in, Munk, 2000. In addition to the 1995 to 1997 data presented herein, data from previous irrigation experiments conducted at the University of California West Side Research and Extension Center, Five Points, is also included. For each of the irrigation treatments imposed, gin turnouts and fiber quality data were obtained for two of the four replicates. Subsamples of 5 to 7 pounds were obtained for gin turnout on the UC Shafter research gin with lint further subsampled and classified at the USDA classing facility in Visalia, Ca. All work presented is Acala Maxxa, California's industry standard since 1992.

Results and Discussion

Yield loss and micronaire reductions were reported by Kerby et. al. 1996, as premature defoliation influenced boll maturity and plant physiologic performance. Yield reduction and micronaire declined in a non-linear manner when premature defoliation proceeded prior to the crop achieving 4 nodes above cracked boll, Figures 1 and 2. Because reductions in photosynthate production similarly occur as crop water stress increases (Ackerson et. al., 1997), there is some expectation to find variations in how primary and secondary fiber cell wall components are deposited thereby impacting key cotton quality characteristics.

Munk, 2000 describes the close relationship between cumulative crop water stress and yield impact that occurs within each season, on Panache Clay loam soils. Crop yield can then be used as an indicator to evaluate the extent of crop water stress experienced at a specific site and season. Evaluating the 1995, 1996, and 1997 data collectively, there was poor correlation between micronaire and crop yield, Figures 3 and 4. Evaluating the data independently for each year, the relationship was also poor. Gin turnouts only increased with treatments experiencing very high crop stress and large yield reductions, figure 5.

There appeared to be a stronger relationship between fiber length and yield, Figure 6. The 1995 data however shows a poor correlation, which is thought to be due to the presence of high insect populations that dramatically reduced yields that year. Correlation coefficients of 0.50 and 0.55 were observed for the 1996 and 1997 data respectively. Combining the larger data set over many years showed an overall correlation of length to yield (R^2=0.61) that was improved as 1995 data was separated form the data Figure 7. Generally, the higher yields tended to have the longest fiber indicating both increased fiber length for unstressed cotton and an overall trend between years for increased length with yield that may or may not be explained by crop water stress impacts. This suggests that with regard to water management, external factors that create high yields are similar to those that allow favorable early boll development to occur.

Fiber strength also appears to have a close connection to water stress in the 1996 and 1997 evaluations, Figure 8. Correlation coefficients of 0.61 and 0.38 were obtained for the 1996 and 1997 season while an overall coefficient of 0.40 was observed for the three years of data combined, Figure 9. As with fiber length the closest relationship was experienced in 1996 with an overall trend for increased fiber strength with increased yield. Developmentally, fiber strength characteristics are largely achieved more than 20 days following anthesis as the secondary fiber wall is being deposited. It appears that water management influences both primary and secondary fiber wall development in cotton and is a related factor responsible for producing high yields in cotton.

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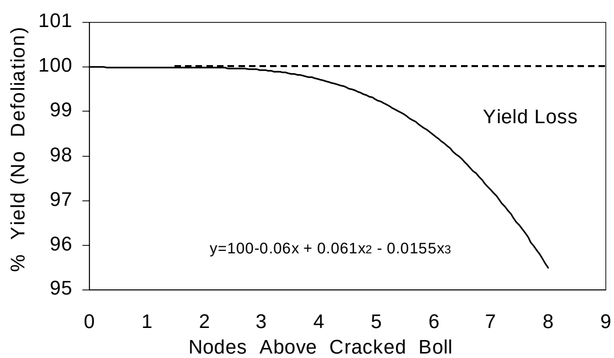

Figure 1. Yield as affected by premature defoliation prior to crop achieving four nodes above cracked boll.

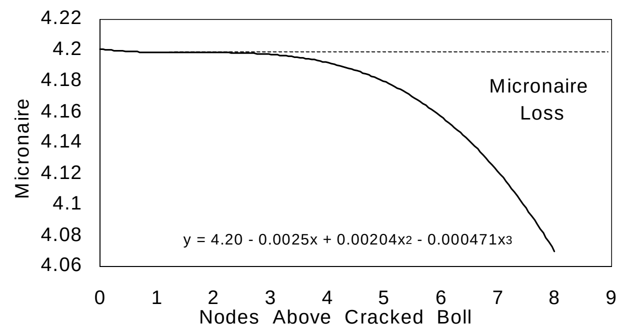

Figure 2. Micronaire as affected by premature defoliation prior to crop achieving four nodes above cracked boll.

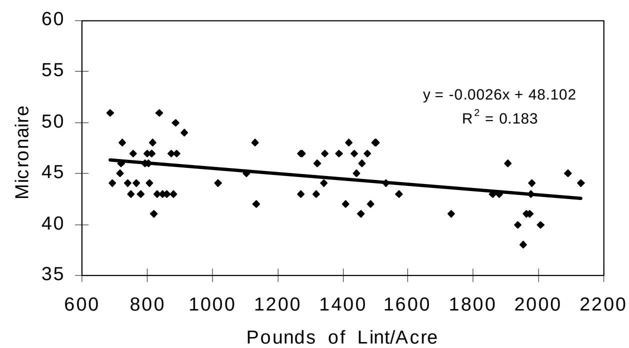

Figure 3. Correlation between micronaire and yield in 1995, 1996, and 1997 combined.

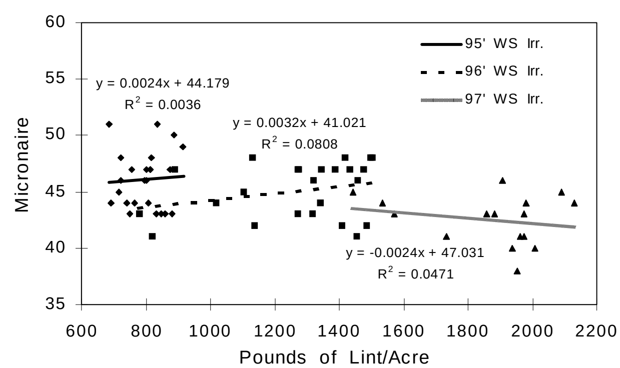

Figure 4. Correlation between micronaire and yield in 1995, 1996, and 1997.

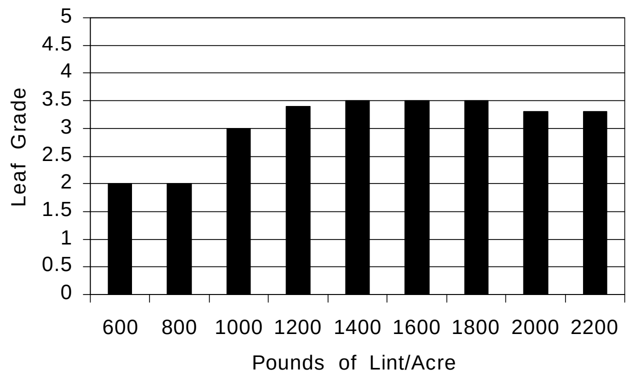

Figure 5. Leaf grade as affected by lint yield in 1995, 1996, and 1997.

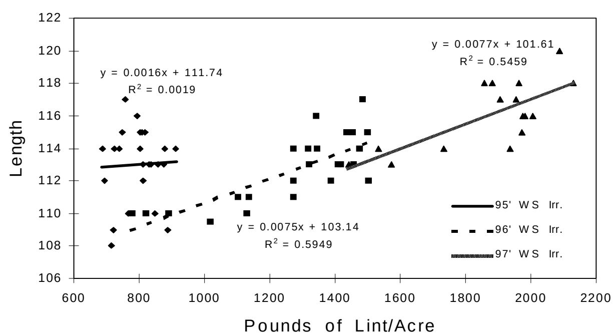

Figure 6. Correlation between fiber length and yield in 1995, 1996, and 1997.

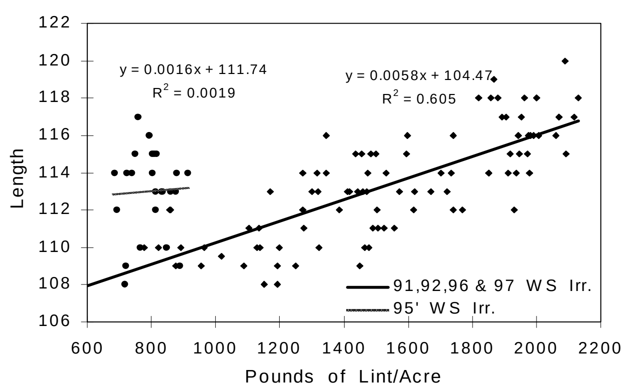

Figure 7. Correlation between fiber length and yield in 1991, 1992, 1996, and 1997 combined with 1995 separate.

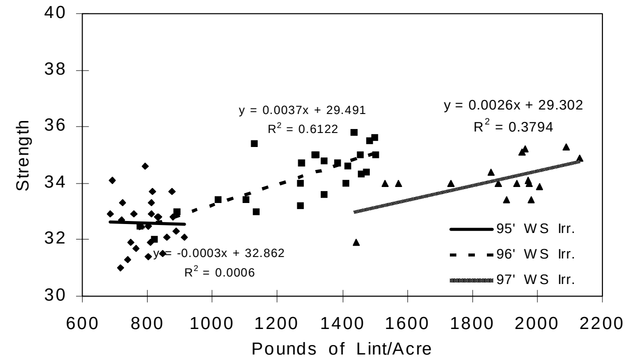

Figure 8. Correlation between fiber strength and yield in 1995, 1996, and 1997.

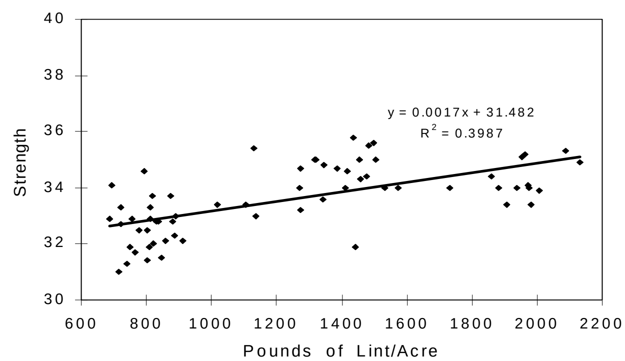

Figure 9. Correlation between fiber strength and yield in 1995, 1996, and 1997 combined.