IMPACT OF PRE-BLOOM SQUARE LOSS ON YIELD IN LATE PLANTED COTTON IN THE TEXAS HIGH PLAINS

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Abstract

It is not uncommon for the High Plains cotton crop to be late planted due to environmental conditions. There has been research demonstrating the extraordinary capability of cotton to compensate for pre-bloom square loss. However, when cotton is planted late in a shortened season, the ability of the cotton to compensate is questionable. There were four treatments which consisted in manual square removal on pre-bloom cotton. There were no significant differences in yield or five of six HVI lint quality factors. The impact of early-season square loss was evident in its impact on fruit location and on fiber maturity. There appeared to be a trend demonstrating that loan values suffer with increasing early-season square loss. There is evidence that cotton will compensate for early-season square loss. However, stress factors that lower the boll carrying capacity may give the illusion of compensation when in fact it may not have occurred. Capping boll carrying capacity was evident by the trend towards higher micronaire where natural square retention was lower; this suggest that bolls that may have produced immature fiber were shed and compensated bolls tended to be more immature.

Introduction

It is not uncommon for as much as 30% of the High Plains cotton crop to be late planted due to environmental conditions such as lack of precipitation or hail damage. In recent years there has been much research conducted demonstrating the extraordinary capability of cotton to compensate for pre-bloom square loss due to square feeding insects such as cotton fleahopper and Lygus with little or no impact yield. However, when cotton is planted late or cold late-season temperatures result in a shortened season, the ability of the cotton to compensate is questionable. Additionally, the lint quality of compensated fruit may be poor.

The objective of this research is:

1. To determine the impact of pre-bloom square loss on the yield of late-planted cotton.
2. If compensation occurs, to determine where compensation occurs on the plant.
3. To determine the impact of pre-bloom square loss on lint quality of late-planted cotton.

Materials and Methods

This test was conducted at Glover Farm of the Texas AgriLife Research and Extension Center in Lubbock, TX. Cotton, 'Phytogen 375 WRF' was planted on June 1, 2009 on 40-inch rows and was irrigated as needed using furrow run irrigation. Plots were 1-row wide × 14-feet long. The test was a randomized complete block design with 4 replicates. Plots were evenly thinned to 35 plants per plot (32,670 plants per acre) on July 12, 2009. All abnormally small or deformed plants were removed leaving a uniform plant population.

Treatments consisted of 0, 30, 50 and 100% manual square removal on pre-bloom cotton. On July 12, 2009, all of the squares in each plot were counted and numbered. The numbered squares from each plot were then randomized and based on the percentage to be removed; squares were randomly selected for removal. Square slated for removal were removed using fine forceps on July 13, 2009. At that time the plants were approximately 18 days into squaring and at approximately 13-14 nodes.

At harvest on October 30, 10 consecutive plants from each plot were plant mapped, and the entire plot was hand harvested. Samples were ginned at Texas AgriLife Ginning Facility in Lubbock. Lint samples were submitted to the

International Textile Center at Texas Tech University for HVI analysis, and USDA Commodity Credit Corporation (CCC) Loan values were determined for each treatment by plot. All count data were analyzed using PROC GLM and the means were separated using an F protected LSD ($P \leq 0.05$). Relationships were determined by using linear regression models, and distribution data were analyzed with PROC FREQ and differences in distribution relative to the 0% square removal treatment was determined using Chi-square tests ($P \leq 0.05$).

Results and Discussion

We could not detect any differences in yield (Figure 1A) or any lint qualitative factors (micronaire, staple length, uniformity, elongation and color) with the exception of lint strength (Figure 1B). The reason for the lack of differences in yield are not certain, but may include yield compensation, stress induced limited fruit carrying capacity or a combination of these factors. This test did suffer water stress the last week of June due to delayed irrigation. Regardless of the reason for a lack of yield differences among treatments, the impact of early-season square loss was evident in its impact on fruit location and on fiber maturity.

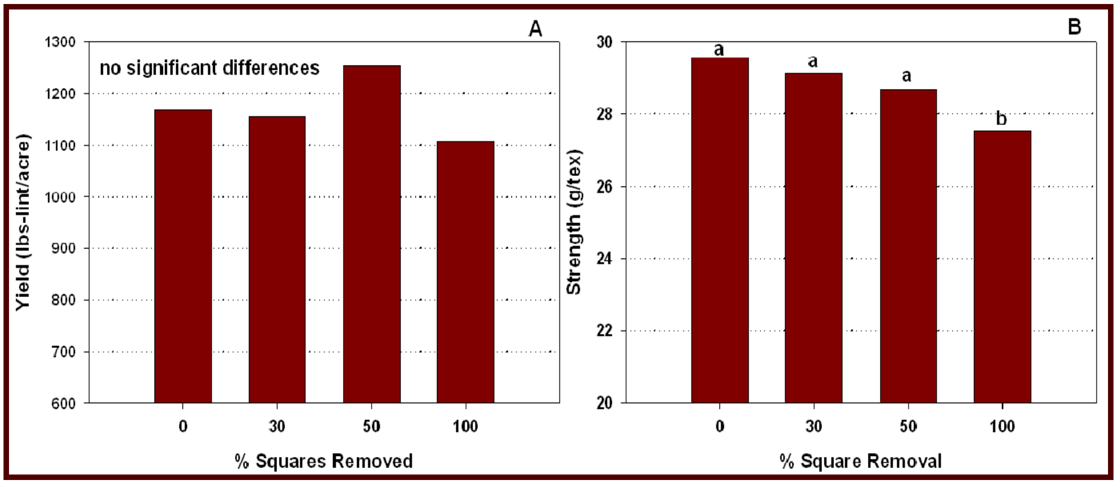

Figure 1. (A) Yield and (B) fiber strength of cotton subjected to 0, 30, 50 or 100% square removal at 13 node stage. Bars capped with the same letter are not significantly different based on GLM and a *F* protected (LSD, $P < 0.05$).

At harvest, plants that had no squares removed had significantly more 1st position bolls than plants where 100% of the squares were removed (Figure 2A). Similarly, the frequency of boll distribution (1st, 2nd and 3rd positions) was different between 0 and 100% square removal (Figure 2B). Neither 30 nor 50% square removal treatments differed from the 0% removal treatment.

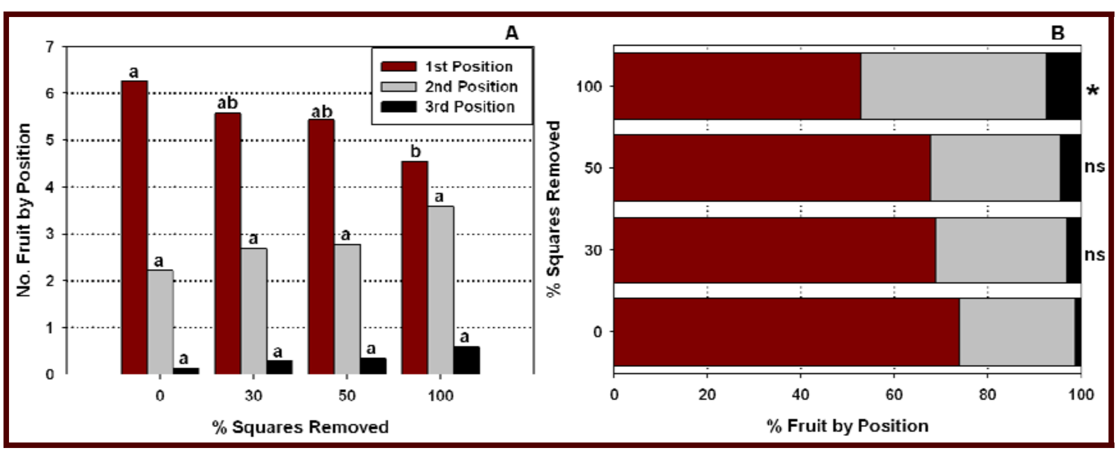

Figure 2. (A) Number of bolls per plant subjected to 0, 30, 50 or 100% square removal at 13 node stage. Same colored bars capped with the same letter are not significantly different based on GLM and

a *F* protected (LSD, $P < 0.05$). (B) Distribution frequency of bolls, * denotes significant difference from the 0% square removal base on PROC FREQ and Chi-square tests ($P \leq 0.05$).

There were also differences in boll distribution vertically within the plant canopy. When looking at the number of fruit at nodes 13 and lower, there were significantly more bolls where there were no squares removed relative to the other treatments (Figure 3A). Although the 30 and 50% square removal treatments did not differ from each other, both had significantly more bolls at nodes 13 or lower relative to the 100% removal treatment. There were no differences among treatments in the total number of bolls per plant, suggesting either compensation in the addition of upper canopy bolls in the 30, 50 and 100% square removal treatments, or all treatments reaching a stress induced boll carrying capacity. The 100% square removal treatment was the only treatment where the vertical distribution of bolls (nodes ≤ 13 vs. nodes ≥ 14) differed from the 0% square removal treatment (Figure 3B). These data suggest that boll distribution is affected somewhere between 50 and 100% square loss on cotton in the 18th day of squaring, and that the greatest difference occurs based on vertical distribution rather than horizontal (within a branch fruit position).

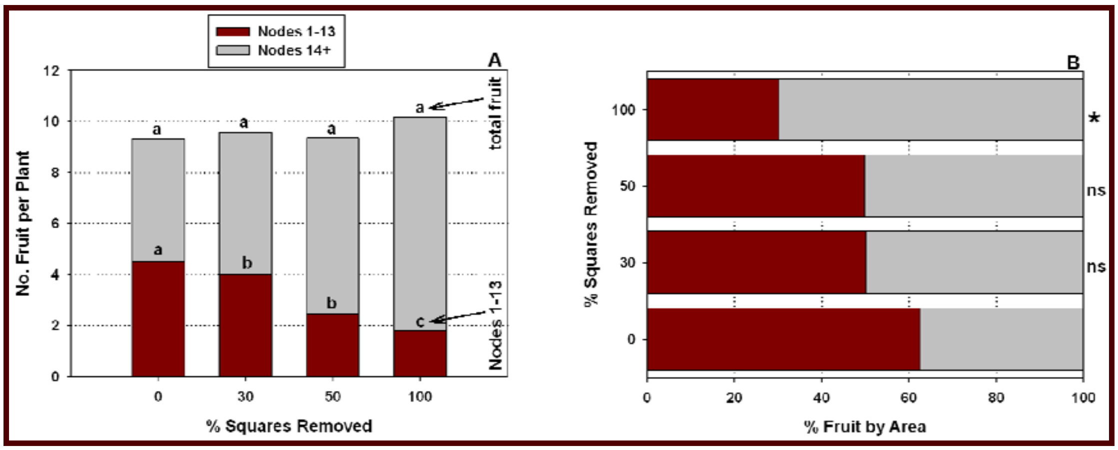

Figure 3. (A) Number of bolls per plant subjected to 0, 30, 50 or 100% square removal at 13 node stage. Same colored bars capped with the same letter are not significantly different based on GLM and a *F* protected (LSD, $P < 0.05$). (B) Distribution frequency of bolls, * denotes significant difference from the 0% square removal base on PROC FREQ and Chi-square tests ($P \leq 0.05$).

Because the frequency of bolls in the 100% square removal treatment were higher on the plant and further out on individual fruiting branches, we would expect this treatment to suffer boll maturity problems regardless of yield; yet we did not detect differences among treatments in micronaire. However some linear trends were observed. Micronaire appears to decline in relation to increased square removal, although more data points are required to strengthen the model (Figure 4A). In support of this data, fruit retention based on individual plots demonstrates that micronaire declines with higher fruit retention (Figure 4B). This data supports the premise that stress was limiting boll load and essentially equating yield and boll density across treatments. Plots that shed the most upper fruit (low quality), regardless of treatment, trended towards the highest micronaire.

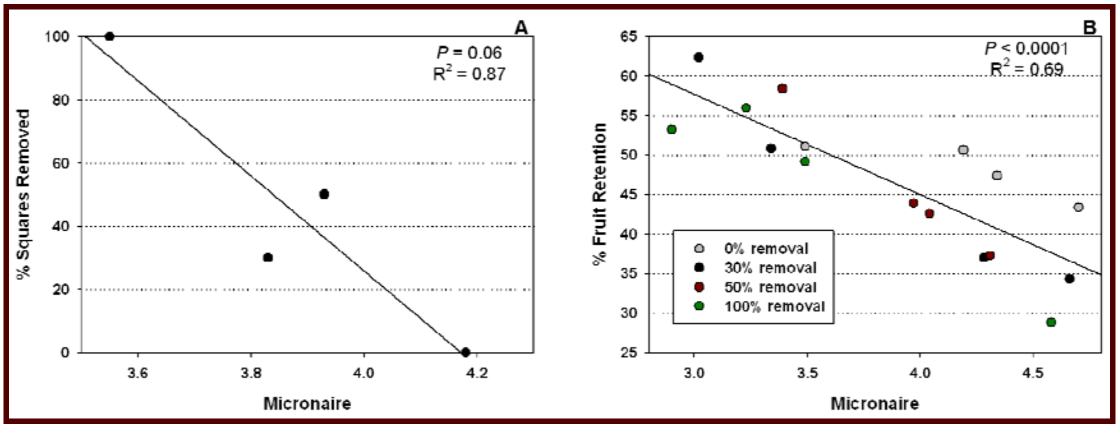

Figure 4. (A) Simple linear relationship between fiber micronaire and percentage of squares removed. (B) Simple linear relationship between fiber micronaire and percentage fruit retention.

Another measure of boll maturity is fiber strength. As previously noted, the 100% square removal treatment had weaker fiber than the other treatments (Figure 1B). There was a strong correlation between the % of squares removed and strength (Figure 5). Fiber strength declined as a higher percentage of squares were removed. This data suggest that some compensation was taking place and that the compensated bolls were immature and suffered in fiber strength.

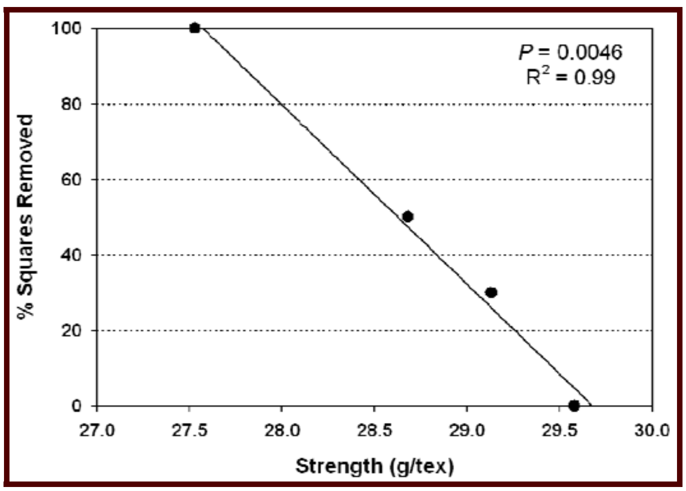

Figure 5. Simple linear relationship between fiber strength and percentage of squares removed.

A similar relationship was noted for loan value. Although the 100% square removal treatment was the only treatment that differed from the 0% square removal, having a lower loan value (Figure 6A). There appeared to be a trend demonstrating that loan values suffer with increasing early-season square loss, but more data points are needed to strengthen the model (Figure 6B).

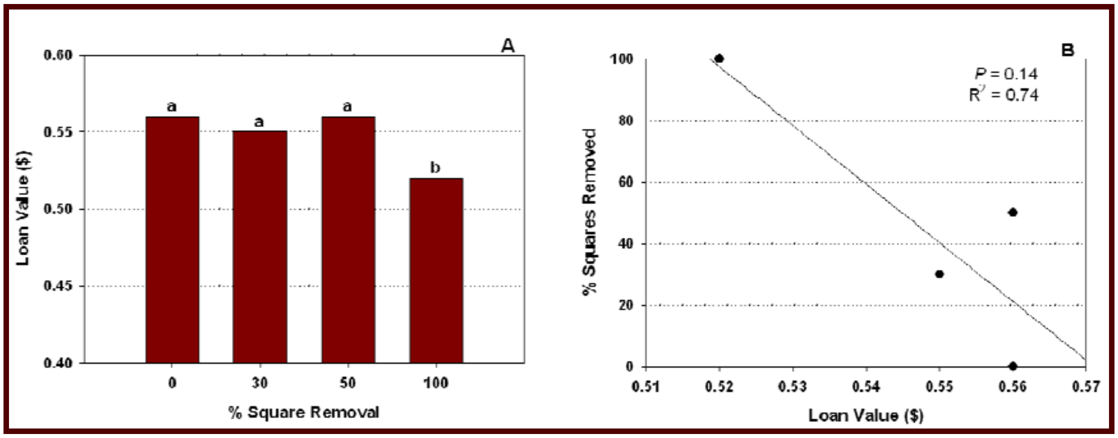

Figure 6. (A) Loan value of cotton subjected to 0, 30, 50 or 100% square removal at 13 node stage. Bars capped with the same letter are not significantly different based on GLM and a *F* protected (LSD, $P < 0.05$). (B) Simple linear relationship between loan value and percentage of squares removed.

Conclusions

In conclusion, there is evidence that cotton will compensate for early-season square loss. However, stress factors that lower the boll carrying capacity of a crop may give the illusion of compensation when in fact it may not have occurred. In this test we saw evidence of both compensation and water stress related boll carrying capacity limitation. Compensated bolls tended to be more immature as evident primarily in reduced fiber strength and a trend towards lower micronaire. Capping boll carrying capacity in this test was evident by the trend towards higher micronaire where natural square retention was lower; this suggest that bolls that may have produced immature fiber were shed.

Acknowledgements

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