YIELD LINT QUALITY AND YIELD COMPENSATION FROM SIMULATED BOLLWORM (HELICOVERA ZEA) INJURY IN A NEW MEXICO ACALA 1517 VARIETY

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Abstract

Cotton plants effectively compensate for late-season square losses primarily by retention of squares or bolls that would otherwise be shed but also by increasing boll size. The loss of 4 squares per plant, over 80% of 1/3 grown squares, at one point in time late-season, typically does not result in yield losses. Boll losses are more difficult to compensate. Field trials were conducted in 2003-2004 to evaluate the impact of extremely heavy injury, a loss of 4 squares or bolls per plant each week for two weeks. Square removal resulted in significant yield losses in 2004 with 23-26% yield losses, but no significant losses in 2005. Yield losses for boll removal were 49-57% in 2004 but 28-44% in 2005. These results were very similar to those in previously reported trials from 2002 and 2003. Lint quality was not significantly affected by 4 square or boll losses per plant and resulting compensation in higher nodes or positions. Mean length ranged from 1.19-1.20 inches across all treatments. Strength was similarly unaffected with means over 32 grams per tex. Micronaire did vary among treatments but was always in the premium range. Compensation in later positions did not reduce quality in Acala 1517-99. Length and strength were not significantly lower in 2nd or 3rd positions compared to 1st position bolls. Micronaire was variable but always in the premium range. Node had the most significant impact on quality. Micronaire decreased in late-season bolls. The 17th-24th node bolls had significantly lower micronaire (21-38) than the 6th-14th nodes (41-42). Discounted bolls represented 10% of total bolls. Strength and length were unaffected by node with the exception of the last few nodes which represented less than 0.5% of bolls.

Introduction

Management decisions regarding crop inputs are often difficult. Real and immediate costs for control must be weighed against estimates of yield losses and crop value. In New Mexico, bollworm is a late-season pest injuring the crop when the value of susceptible squares and bolls is relatively low. Good estimates of the value of the susceptible squares or bolls are essential to determine if insecticide applications are justified.

In New Mexico, mid-to-late August squares are typically produced on the 15-22nd nodes. From that point on, returns on insecticide inputs diminish rapidly. Some data on crop value for economic thresholds in cotton assume a worst-case scenario. Boll value is determined from undisturbed plants. The loss is assumed to be equal to the value of that lost boll. However, cotton has a known ability to compensate for insect injury to fruiting structures. Late-season squares are lower value and the late date may allow little time for compensation. Very late season, if squares are unavailable, bollworms will infest small bolls in which the plant has a higher investment. Although Bt varieties are available cost is an issue and there is demand for conventional varieties. These issues justified field tests to specifically address potential compensation for insect injury to late-season cotton.

Materials and Methods

In 2002-2007, field trials were conducted in Artesia and Las Cruces, New Mexico to evaluate compensation from heavy late-season bollworm injury. Manual removal of fruiting structures produces essentially the same crop response as damage by pests, so squares and bolls were removed manually (Brooke et. al. 1992). Treatments were designed to mimic extremely heavy bollworm injury by removing 4-8 susceptible bolls or squares at 1-2 time points per treatment in 2002-2003. Yield results for 2002 and 2003 were reported previously (Pierce et al. 2006, 2007). This report details yield results from the 2004 and 2005 field trials and lint quality data from 2002.

Small squares were removed August 1 and 15 in 2002. Small bolls were removed August 29 and September 12. COTMAN data was collected in control plots. Plots were three meters with six replicates in randomized blocks. Yields were determined by removing all plants from each plot. Seed cotton was hand-picked then sorted by node and position for each plot. Lint quality was determined for each node and position.

In 2004-2007, compensation trials were conducted with larger plots, 9 meters long in randomized blocks. Squares or bolls were removed once a week for two weeks, late-season. A total of eight squares or bolls were removed from each plant, twice as many as in the 2002-2003 trials. Yields were determined by handpicking all plots without regard to node or position. Seed cotton was ginned and quality determined from this pooled yield per plot.

Results

Square removal resulted in significant losses in 2004 with 23-26% yield loss, but no significant loss in 2005. (Figure 1) Injury from boll losses was, not surprisingly, more difficult to compensate with significant losses both years. Like square removal, boll removal also had a larger impact in 2004 than 2005. Yield losses for boll removal were 49-57% in 2004 and 28-44% in 2005. There were no significant differences between dates of injury for square or boll removal either year.

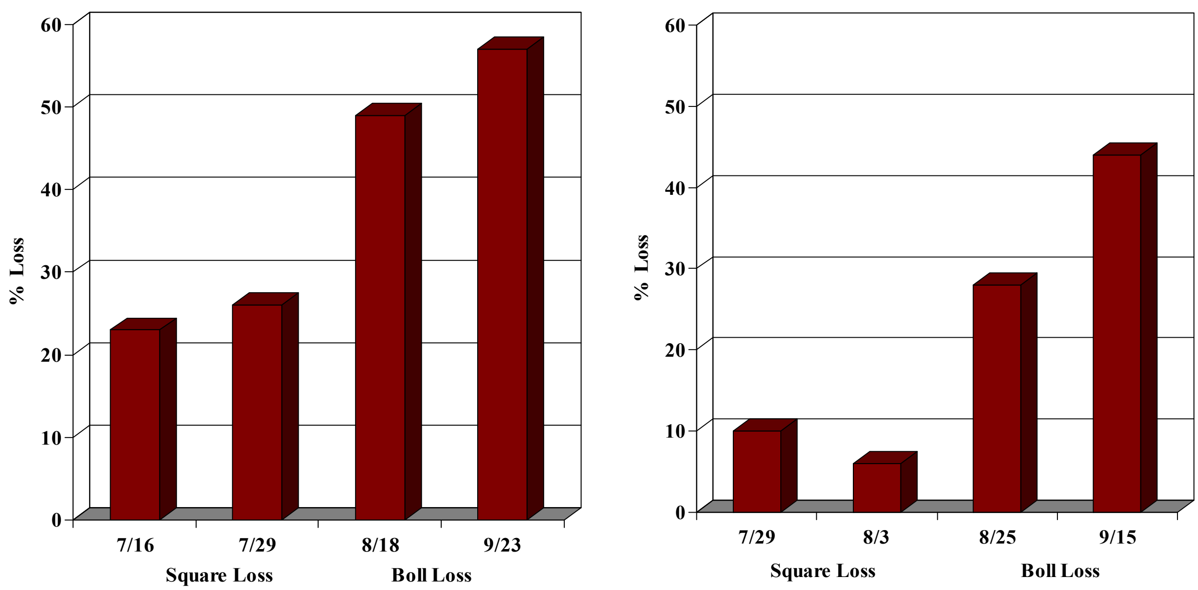

Figure 1. Mean yield reduction after removal of 8 squares or bolls per plant in Acala 1517-99

Impact on Lint Quality

Length and strength were not significantly affected by square or boll removal. Mean length across all treatments ranged from 1.19-1.20 inches or 38, 32nds. (Table 1) All treatments had very strong fiber with all means over 32 grams per tex. Micronaire did vary with treatments but was always in the premium range.

Table 1. Lint Quality after Square/Boll Removal from Acala1517-99.[1]

Treatment	# Squares/Bolls Removed	Micronaire	Length	Strength
Check	0	37 a	1.195 a	32.45 a
8/1	32	39 bc	1.200 a	32.45 a
8/15	32	41 c	1.192 a	32.73 a
8/29	32	38 ab	1.196 a	32.79 a
9/12	32	39 bc	1.198 a	32.74 a

[1]Means across rows followed by different letters are significantly different by Tukey's Comparison

Compensation by retaining or producing bolls in 2nd-4th positions did not reduce quality in this high quality upland variety (Figure 2). Boll position did impact micronaire, but in this variety micronaire averaged 37-40 which was always in the premium range. First position bolls were not significantly stronger than 2-4th position bolls. First position bolls were 33 grams per tex compared to 32 and 31 for 2nd -3rd and 4th position bolls respectively. Length was consistent across all positions (1.19-1.20 inches or 38 32nds), the only difference being greater variation in the fourth position.

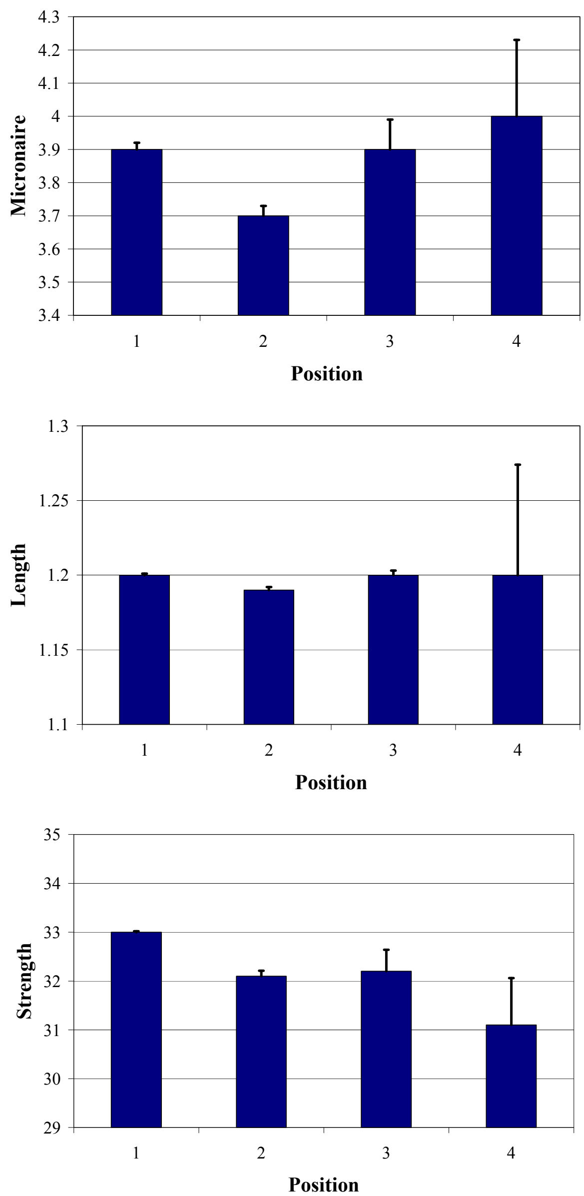

Figure 2. Impact of boll position on fiber quality

Plants may also compensate by producing or retaining squares or bolls in higher nodes (Figure 3). Compensation on later nodes did not affect length or strength in 1517-99 but could affect micronaire. Micronaire was significantly decreased in late-season bolls. The 17-24th node bolls had significantly lower micronaire (21-38) than the 6th-14th nodes (41-42). Bolls that produced in the discount range represented 10% of the total bolls.

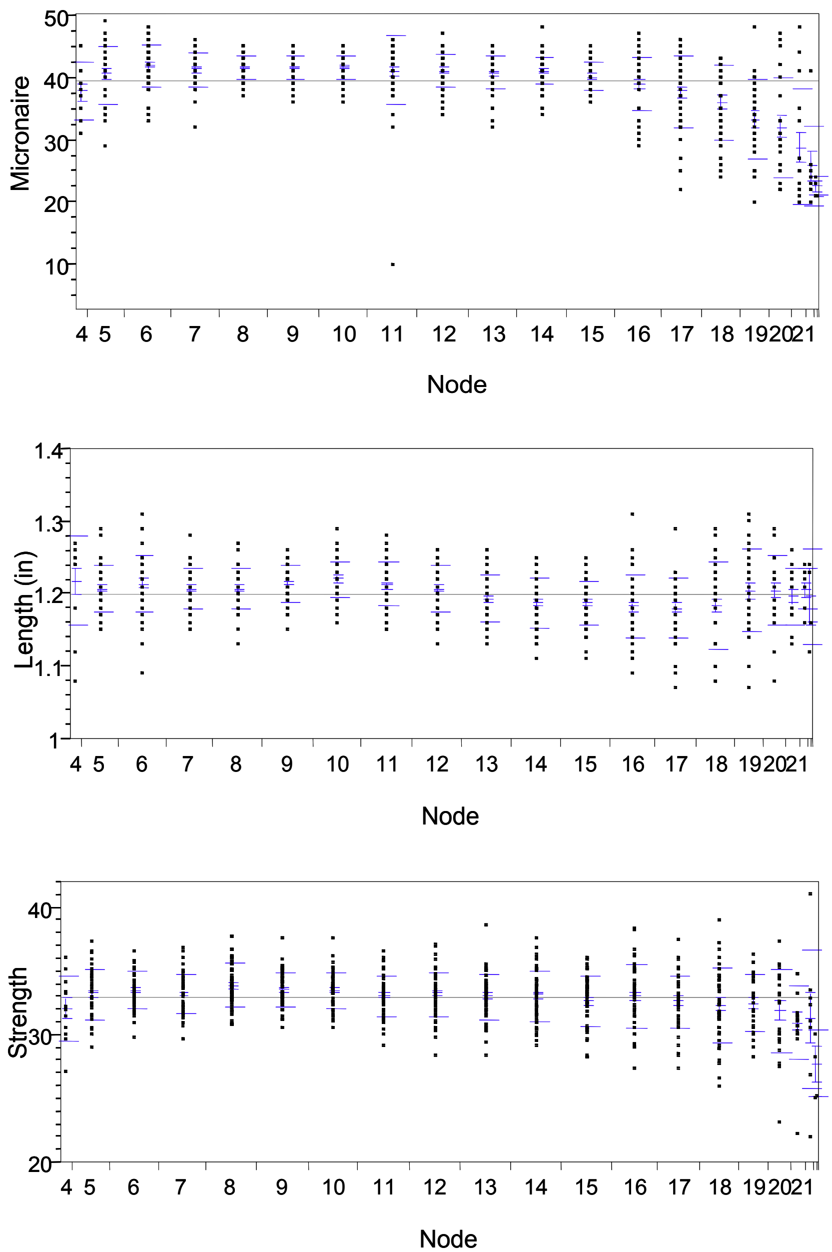

Figure 3. Impact of node on fiber quality

Strength was consistent with very strong fiber (31-34 grams per tex) in all but the last two nodes. Bolls on the 23rd and 24th nodes had discount range strength (25-27 grams per tex) but only represented 0.5% of the total bolls. Length was not significantly affected by node in 1517-99 with a range of 1.181-1.214 inches or 38-39 32nds.

Conclusion

As reported previously for 2002 and 2003 field trials, yield compensation was variable with the largest difference between square and boll removal. With square injury, the timing of late-season square removal late season appears to be less significant than the number of squares removed. Compensation was apparent with relatively high rates of injury, but persistent high levels of injury can prevent the plant from compensating sufficiently. Plants are more likely to compensate for square losses than boll losses in which the plant has invested more resources.

Injury imposed on the plants was extremely high, and unrealistic, over 80% loss of 1/3 grown squares for two consecutive weeks. Even this very high level of injury did not ensure significant yield losses. Data reported here and earlier indicate that short periods of very high square losses late-season are unlikely to cause significant losses in yield. Very high losses for two weeks might cause significant losses. Compensation for squares is primarily accomplished by greater retention of squares of bolls but can also be accomplished by producing heavier bolls. (Pierce et al. 2007)

Studies in other states have examined the effect of square loss on cotton yield with responses ranging from slight yield increases to dramatic decreases (Sadras 1995). In Louisiana, Holman (1996) indicated that up to 19% first-position square shed at first flower did not result in a yield loss. Square losses above 19% did produce a significant yield loss. In the San Joaquin Valley, Montez and Goodell (1994) found that light to moderate losses of early squares had higher yields than control plots. Very severe losses of squares resulted in some yield loss. Results of this study are consistent with results of these earlier studies.

Quality of Acala 1517 cotton varieties is unlikely to be significantly affected by square or boll losses from insects. Length and strength were not significantly reduced and were always in the premium range. Micronaire did vary by position but was always in the premium range. However, previous trials showed significant losses in strength and length in 2nd and 3rd position compared to 1st position bolls (Pierce et al. 2005). Compensation in those lower quality varieties might cause a significant loss in quality if losses were very high.

Acknowledgement

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