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YIELD COMPENSATION FROM SIMULATED BOLLWORM LOSSES IN ACALA 1517-99

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Abstract

In 2002-2004 field trials were conducted in the Mesilla and Pecos Valleys of New Mexico to determine if cotton can compensate for heavy mid to late-season bollworm injury. Bollworm injury was simulated by manually removing 4-8 squares and small bolls from a locally adapted variety Acala 1517-99. Lint weights from plots with four squares removed once were similar to yields from uninjured plots. Plants compensated primarily by retaining more squares and bolls but sometimes also by producing more lint per lock. In 2003, control and square removal plots had 29-30 bolls/ft despite the removal of 10 squares or bolls/ft. The highest yield, 1620 lb lint/A, was from one of the injured plots. That cotton overcompensated with not only increased boll retention, but also more lint/boll. Mean lint weight/lock was 12% higher than from control plots. Boll removal was more difficult to compensate. Plots with bolls removed 8/29 had 1424 lb/A, and 27 bolls/ft both 10% less than undisturbed plants. Removal of bolls 9/12 resulted in no yield compensation with 30% fewer bolls and 30% less lint. In 2004, more persistent injury with eight squares removed did result in significant yield losses with 23-26% less lint than control plots. Removal of eight bolls over two weeks resulted in 49-57% less lint.

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. Most 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. These issues justified field tests to specifically address potential compensation for insect injury to late-season cotton.

Materials and Methods

In 2002-2005 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 (Brook et. al. 1992). Treatments were designed to mimic extremely heavy bollworm injury by removing four susceptible bolls or squares at one time point per treatment in 2002-2003. Small squares were removed August 1 and 15 in 2002. Small bolls were removed late August 29 and September 12. COTMAN data was collected in control plots. Plots were 10 feet 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 2004-2005 compensation trials were also conducted with larger plots, 30 feet 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 the 2002-2003 trials. Yields were determined by hand picking all plots without regard to node or position. Seed cotton was ginned and quality determined from this pooled yield per plot.

Results

In 2002, most injured cotton plants compensated for injury. The primary means of compensation was by retaining more squares and bolls, but sometimes also by producing more lint per boll. Higher boll retention is evidenced by a harvestable boll number greater than what would be expected when the number of removed squares or bolls are subtracted from the harvestable boll number in the undisturbed plot. In the 2002 test, both undisturbed and square removal plots had 29-30 bolls/ft, despite removal of 10 squares per foot (Table 1). Lint yields from square removal plots were similar to those from uninjured plots and ranged from 1476-1620 lb/A. The highest yield, 1620 lb/A, was from one of the treatment plots with squares removed 8/15, from the 17-21st nodes. In those same plots mean lint weight per lock and boll was 12% higher than uninjured plants. The difference in boll weight was particularly notable in very late bolls, nodes 19-22 where the injured plants' bolls had 20% more lint than control bolls. (Figure 1 and 2)

Table 1. Yield Compensation after Square/Boll Removal from Acala 1517-99.[1]

Square/Boll Removal Date	Reproductive organs lost/plant	Bolls/Row Ft	Lint Wt/Lock (grams)	# lb lint/Acre
Untreated	none	30.0a	0.42a	1580a
8/1	4 squares	29.0b	0.41a	1476ab
8/15	4 squares	30.1a	0.47b	1620a
8/29	4 bolls	27.4ab	0.43a	1424ab
9/12	4 bolls	21.0b	0.44a	1097b

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

Injury from loss of bolls is, not surprisingly, more difficult to compensate. Yield was somewhat compensated in plots with bolls removed 8/29. Lint yields were 9.9% lower than undisturbed plots. Those injured plots had 27 bolls/ft, only 10% fewer than undisturbed plots despite losing 4 bolls per plant. The final plant population was 2.45 plants/ft. Without compensation, injured plots would have produced 30-(4 x 2.45)=20.2 bolls/ft or 33% less than undisturbed plots. Plants with small bolls removed 9/12 had no yield compensation. These plots averaged only 1097 lb/A, 31% less lint than undisturbed plots. The number of bolls was also significantly fewer with 21 bolls /foot, 30% less than the 30 bolls per foot in undisturbed plots. This 21 bolls was consistent with the number, 20.2 predicted to be left at harvest, if plants did not compensate.

Overcompensation in one treatment was made possible by adding higher lint weight per lock, to the increased square or boll retention found in most 2002 injured plots. Mean lint weight per boll and per lock was 12% higher for plants with squares removed 8/15 compared to undisturbed plants (Table 1). Undisturbed and all other treated plots had approximately 0.5 g lint/lock in nodes 10-16, but less lint in earlier and later nodes. (Figure 1) Overcompensating plants had high lint weights per lock in all but the last two nodes, 21st and-22nd. (Figure 2)

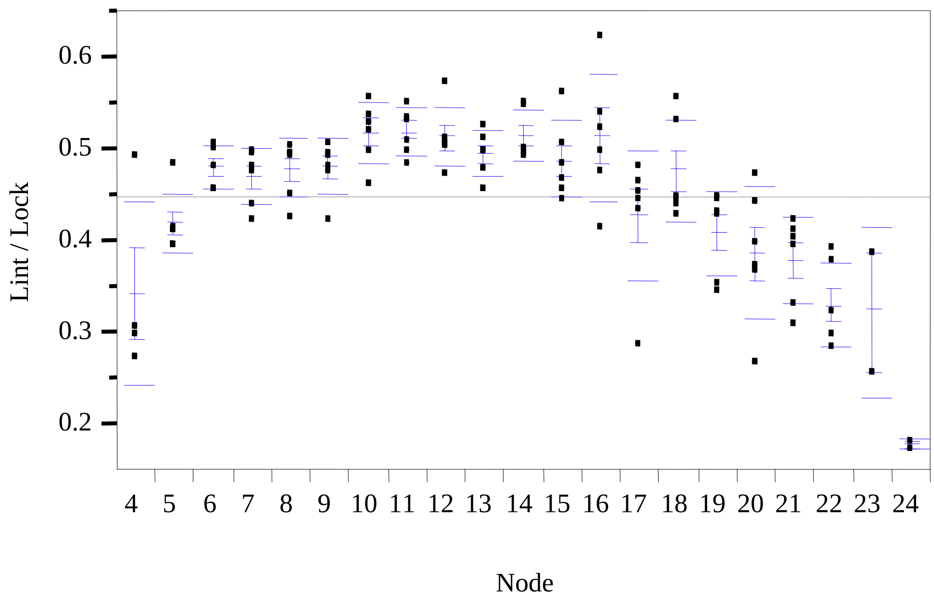

Figure 1. Lint weight per lock by node in undisturbed Acala 1517-99 compensation test in 2002.

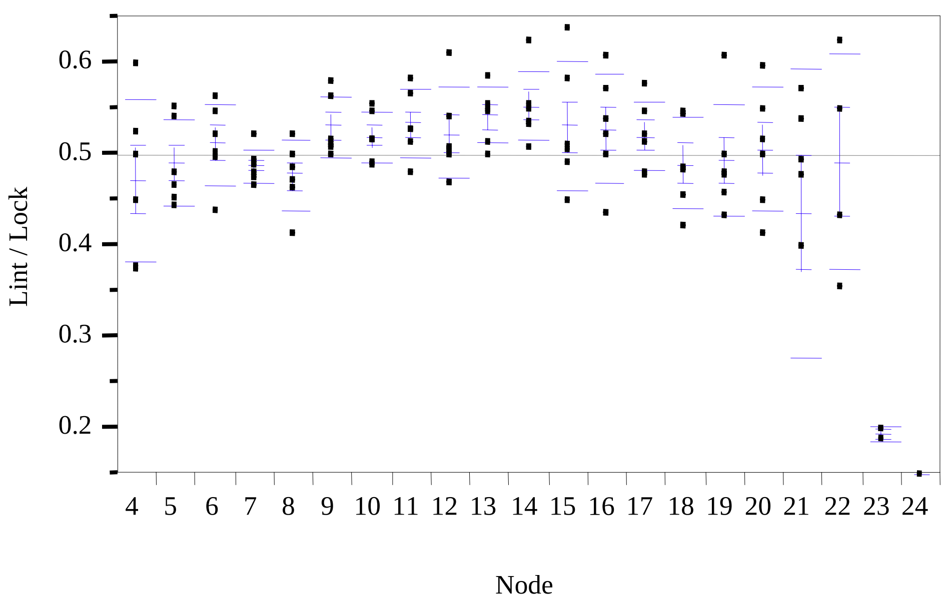

Figure 2. Lint weight per lock by node in plots with four squares removed 8/15/02 from Acala 1517-99.

The larger plot tests with more injury imposed had yield losses ranging from 23-57%. (Figure 3) Plots that had a total of eight squares removed /plant July 16-23 produced an average 1081 lb/Acre. Plants that had squares removed July 29-August 5 produced 1033 lb/Acre. These yields were significantly lower, 23% and 26% respectively than the undisturbed plots, which produced 1399 lb/Acre. Plots with bolls removed Aug 18- Sept 9, and Sept 23 produced 715lb/Acre and 596 lb/Acre respectively, 49% and 57% less than control plots.

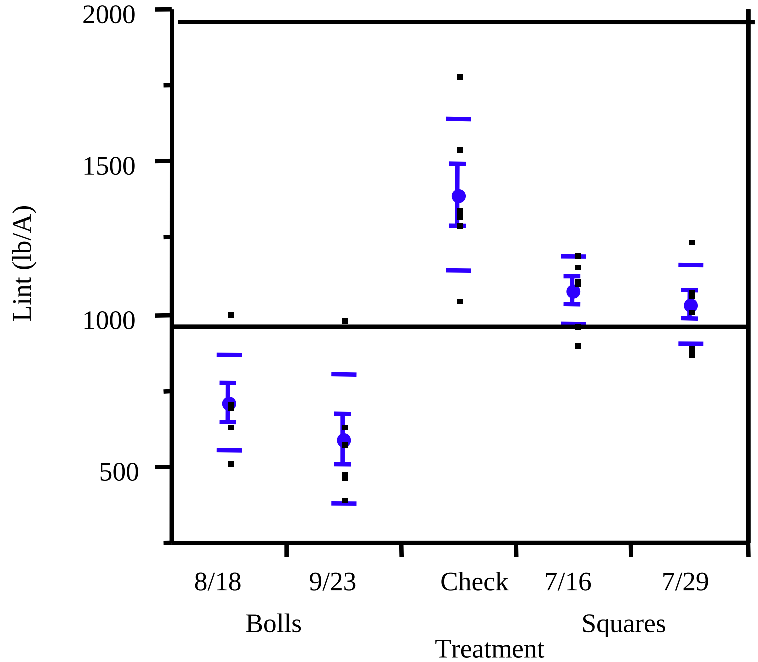

Figure 3. Lint (lb/A) of cotton with eight squares or bolls removed over two weeks in 2004.

Conclusion

Yield compensation was variable and dependent on intensity of injury, reproductive organ injured (square or boll) and time of injury. Compensation was primarily accomplished by greater retention of remaining squares or bolls. Some overcompensation was accomplished in one treatment by producing heavier bolls, with 12% more lint per lock. Late-season removal of four squares per plant did not have a significant impact on yield. Removal of four bolls per plant, very late-season, did produce high yield losses (30%), but similar injury two weeks earlier produced much less yield damage (10%). Greater injury, with removal of eight squares or bolls over two weeks resulted in much higher yield losses. Removal of eight squares/plant produced 23-26% yield losses. Similar boll injury resulted in 49-57% less lint compared to the check.

With square injury, the timing of 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.

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, Homan (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.

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