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YIELD RESPONSE AND COMPENSATION AFTER BOLLWORM LOSSES IN NEW MEXICO

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Abstract

Field trials were conducted in Artesia and Las Cruces, New Mexico to determine crop value by node and position and to determine if cotton can compensate for mid to late season losses of squares or bolls from bollworm. The influence of node was similar to that reported elsewhere with highest yields in the lower middle of the plant and from first position bolls. Nodes 8-18 generally produced over 90% of the total yield. The last three nodes added very little to final yields, typically less than 1%. Higher yields were due to more boll retention at those nodes with 95% of the higher yield due to more bolls rather than heavier bolls. For example, node 10 had five times more bolls compared to node 20. Boll size had a much smaller impact with node 10 bolls 25% larger than those at node 20.

Fiber quality was similar across node with the exception of the last few nodes where there was deterioration of length and strength. First position bolls had significantly longer and stronger fibers than second or third position bolls in NuCotn 33 B and HS 26. In Acala 1517-95, fiber from first position bolls was only significantly longer and stronger than fiber from third position bolls.

Compensation testing indicated that square losses could result in some compensation by diverting resources to bolls. One late season square loss treatment had 12% larger bolls than the control. That increase was due to the bolls having significantly more lint per lock rather than more locks per boll suggesting that the plant diverted energy from the lost squares to small bolls.

Introduction

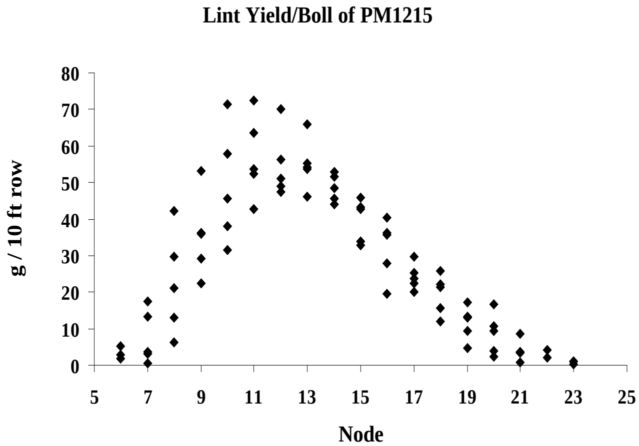
Management decisions regarding crop inputs are often difficult. Real and immediate costs for insect control must be weighed against somewhat nebulous estimates of yield losses or crop value. In New Mexico, cotton bollworm is not an early-season pest. Growers generally make insecticide applications for bollworm in August when the value of developing squares may be questionable. Field trials were initiated to determine the relative value of bolls produced mid to late-season in New Mexico. Follow-up tests were then conducted to determine if cotton could compensate for mid to late-season losses of squares and bolls.

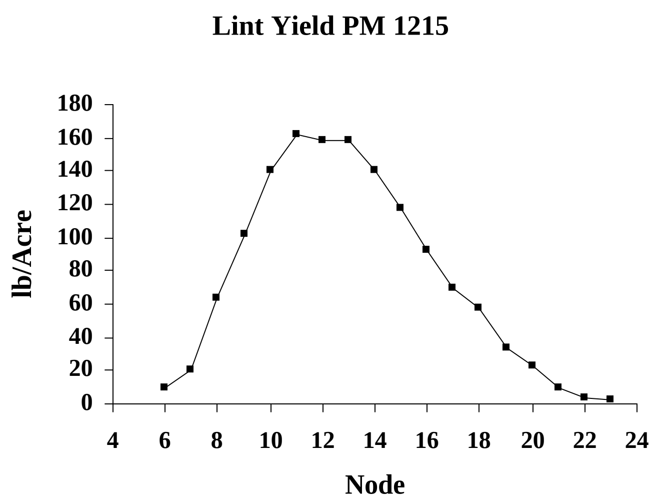
From 1998-2001 multiple varieties were planted in Artesia and Las Cruces, New Mexico under conventional conditions with 4-6 replications. Varieties included NuCotn 33 B, PM 1215, Acala 1517-95 and HS 26. Subplots 10 ft long were hand picked with yield for each node and position sorted. Seed cotton for each node x position was weighed. The number of bolls and locks for each sample was recorded, then each sample was ginned. The lint cotton and seed for each node x position was then weighed and the lint quality was determined at Cotton Incorporated labs.

Compensation tests were initiated in 2002 and designed to mimic heavy, late-season losses from bollworm. 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). One variety, Acala 1517-99, was used in all trials and maintained under conventional practices for the area. Plots were arranged in a randomized block with 6 replicates for four injury treatments and a control. Squares or bolls were removed one time with the treatments being different dates of removal. On average 6-8 squares were removed. In early and mid August all available 1/3 grown squares were removed. In late August and mid September all susceptible bolls were removed. Plants from 10 row ft subplots were removed from the field and the cotton was hand picked, separated and ginned by node and position as described for previous tests.

Results

Trends for production of cotton were similar across years and varieties when production by node and position were evaluated. Results were similar to those reported elsewhere, with the highest yields in the lower middle of the plant, typically nodes 9-14. Nodes 8-18 generally produced over 90% of the total yield. The last three nodes added very little to final yields, typically 1% or less (Figure 1).





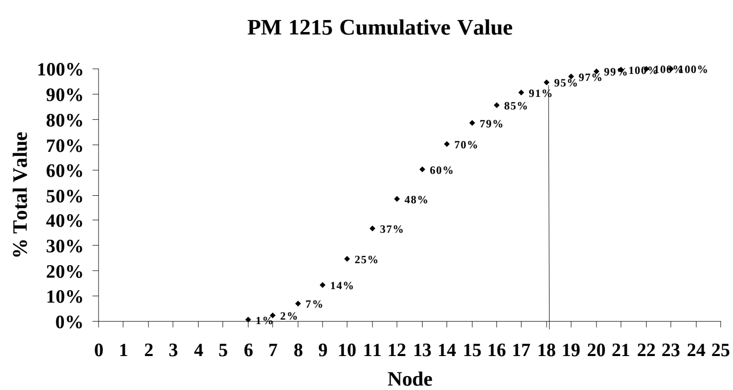
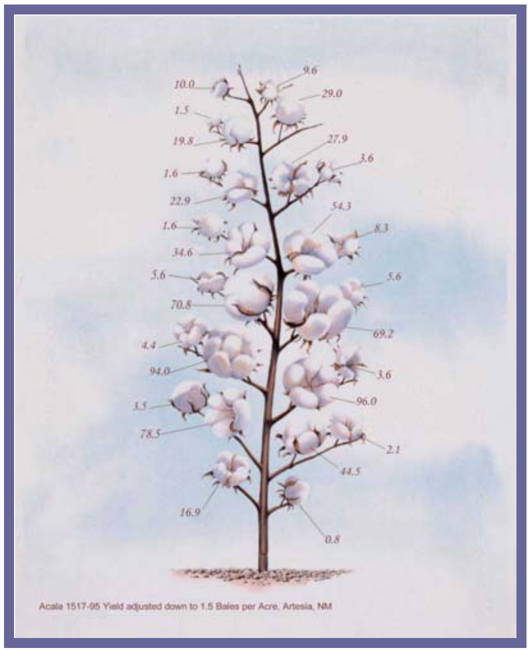


Figure 1. Influence of boll location on yield using first position bolls with PM 1215. Artesia, NM.



This data is similar to previous reports in indicating that there is not a high value in very late-season squares. Mid-August in New Mexico squares would typically be produced on the 15-20th nodes. From that point on, returns on insecticide inputs diminish very rapidly. Additionally, this data assumes a worst-case scenario for yield losses. Cotton has a known ability to compensate for insect injury to fruiting structures. Late-season it would presumably be more difficult to compensate but still possible. On the other hand, losses to bolls must also be considered. When squares are unavailable, late-season bollworms may injure small bolls in which the plant has a higher investment. These questions prompted additional field tests to determine if cotton in New Mexico could compensate for late-season losses of squares or bolls.

Quality was similar across node, with the exception of the last few nodes where there was some deterioration of length and strength. Boll position did affect quality. First position bolls had significantly longer and stronger fibers than second and third position bolls in NuCotn 33 B and HS 26. The higher quality Acalaa 1517-95 variety only had significant losses in strength or length in the less common third position bolls. Those shorter staple varieties lost approximately $0.03/lb in second compared to first position bolls (Table 1)

Table 1. Fiber Strength and Length by boll position in three varieties planted in Artesia, NM[1].

	Strength Boll Position			Length (32's/inch) Boll Position		
Variety	1	2	3	1	2	3
A 1517-95	30.3a	29.0sb	27.5b	36.5a	36.2a	35.2b
NuCOTN 33 B	26.9a	24.6b	22.8b	34.9a	33.9b	32.0c
HS 26	27.9a	26.5b		33.3a	32.3b	

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

Highest yields were in undisturbed and in the earliest square removal plots, but no yields were significantly different. (Table 2) Untreated plots had 26 bolls/ft compared to 18-22 bolls/ft in the treated plot, but again the differences were not significant. There may have been some yield compensation in at least one treated plot. The plot that had squares removed on August 15 were 12% larger than those from all other plots, with 1.8 grams of lint per boll, compared to 1.6 grams/ boll. This increase was due to an increase in lint per lock rather than an increase in the number of locks, which were similar across all plots. The amount of lint/lock was also significantly higher for the August 15 treatment, with 0.46 g/lock compared to 0.41-0.44 for all other treatments. On August 15, squares were removed from nodes 15-20. Plant mapping indicated 50% of plants had the last fruiting position on node 20 on that date.

Table 2. Yield Compensation after Square or Boll Removal from Acala 1517-99. Artesia, NM.[1]

Square/Boll Removal Date	Bolls/ Row Ft	Lint Wt/Boll (grams)	Lint Wt/Lock (grams)	# Locks/ Boll	# Bales/ Acre
Untreated	25.9a	1.6a	0.44a	3.79a	1.9a
8/1	21.5a	1.6a	0.43a	3.73a	1.8a
8/15	19.0a	1.8b	0.46b	3.74a	1.6a
8/26	21.9a	1.6a	0.42a	3.76a	1.7a
9/12	18.5a	1.6a	0.41a	3.66a	1.5a

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

Scatter plots of node by yield illustrate the tremendous impact of boll number on yield. (Figure 2) Node 10, for example, produced 5 times as many bolls as node 20 with 2.0 and 0.4 bolls/ft respectively. Lint weight per boll on the other hand was only 25% higher on node 10 compared to bolls on node 20 with 2.0 vs. 1.5 g lint respectively. Lint to seed ratio was quite similar across nodes until node 18, when more energy was apparently allocated to seed production.

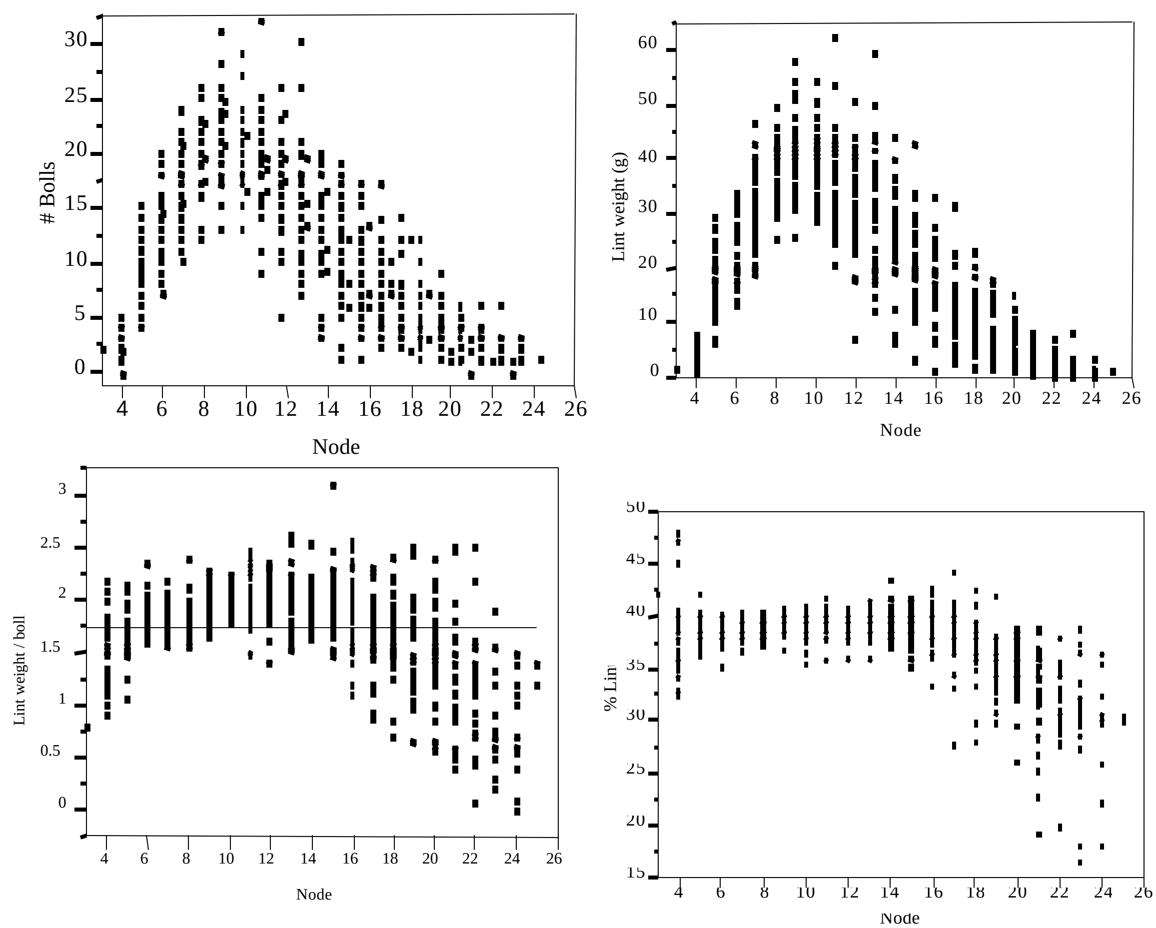


Figure 2. Impact of node on first position bolls number, lint weight and lint to seed ratio.

The data we have analyzed to date suggests that insecticide treatments to protect squares may not be profitable mid-season, and is unlikely to be profitable late-season. This is due, in part, to a low projected value due primarily to having relatively few bolls retained late-season. Additionally, this data suggests that the crop can redirect energy for lint production that would have been directed toward those bolls into other bolls that it has retained. Protection of bolls is a different issue. Yield losses from bollworm late-season are most likely a result of boll losses rather than square losses, and while those losses are infrequent they can be severe. Very late-season injury to bolls in 1998 resulted in up to 40% yield losses (Pierce et. al. 2001). In the data presented, late-season boll injury did not show significantly lower yield, but the trend in number of bolls and total lint was lower and we will continue to test this area with larger plot sizes.

Acknowledgements

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