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BOLL REMOVAL STUDIES AND FIELD SURVEYS TO IMPROVE MANAGEMENT OF BUG SPECIES IN VIRGINIA COTTON

D. Ames Herbert, Jr. and Sean Malone
Department of Entomology
Tidewater Agric. Res. and Ext. Ctr.
Virginia Tech
Suffolk, VA

Abstract

Experiments were undertaken in three seasons (2001-2003) in Virginia cotton to evaluate the response to loss of 10 to 14-day old bolls via mechanical removal. Four levels of boll removal (0, 5, 15 and 20%) were imposed on three dates beginning 14 days after first flower and repeated two times, each five days after the last. Results showed no significant differences in lint yields among the boll removal levels or removal dates, in either 2002 or 2003 studies. In 2001, there was a statistically significant reduction at the 20 percent removal rate at the second removal date. The same trend occurred at the third removal date; however, the difference was not significant. In addition, in an effort to document the severity of bug species (stink bugs and plant bugs), a 2-year survey was conducted of 40 randomly selected grower fields for presence of bug species and plant damage. Field surveys showed that plant bug, *Lygus lineolaris,* was the predominant pest during the weeks between square formation and early boll development. Plant bug populations and levels of damage to bolls were considerably higher in 2003 compared with 2002. Plant bug was present in 80 and 95% of the fields in 2002 and 2003, respectively. In 2002, only 7 percent of the fields surveyed reached or exceeded the 10 percent boll damage threshold compared with 30 percent in 2003. Results showed that although not strongly related (R^2 = 0.4437), retention rate (percent) decreased as number of plant bugs increased (Y = -0.8504x + 80.678). Sweep net, shake cloth, and dirty bloom samples were variable and did not relate well to levels of boll damage. Percent square retention and boll damage assessments seem to be the best indicators of the need to spray, with the other information, i.e., insects and dirty blooms are present, serving to alert scouts of the need to do more intensive square or boll sampling.

Introduction

As with other eastern US cotton growing states, compared with past years, Virginia cotton is at greater risk to infestations by bug species (plant bugs and stink bugs). With the increase in use of varieties with the Bollgard gene (estimated at almost 80 percent in 2003), growers are altering their bollworm management practices, e.g., reducing the number of pyrethroid sprays, and delaying the first spray, compared to earlier years when the majority of the acreage was planted to conventional varieties. These reductions in insecticide usage increase the risk of bug species surviving in, and damaging cotton. As a result, studies have been undertaken to determine the ability of cotton in Virginia to compensate from losses of the fruiting structures that are attacked by bug species, e.g., squares and young bolls. Square damage by plant bug species during the period between first square and early bloom is reported to have the greatest impact on cotton yield (Tugwell et al. 1976; O'Leary 1998; Godfrey et al. 1998). However, research in the mid to late 1990's in Virginia showed that mechanical removal of first position squares had little impact on lint yield. In 1996 in a series of small-plot field experiments, there was no significant difference in lint yield when 0, 2, 4 or 6 first position squares were removed from each plant (1128a, 1303a, 1371a, 1207a lb lint/acre, respectively, P=0.05). In a similar experiment in 1998, there was no significant difference in yield among first position square removal levels of 0, 12-15, 20-25, and 30-40 percent (1509a, 1544a, 1615a, 1553a lb lint/acre, respectively, P=0.05). Although not simulating insect feeding and damage, and not simulating losses to insects over an extended period of time, these data did show that cotton in Virginia was capable of compensating from high levels of square loss. Experiments presented here were undertaken to evaluate the response to loss of bolls via mechanical removal, with the premise that boll loss would have a greater impact as less time would be available for compensation. In addition, in an effort to document the severity of bug infestations in Virginia, a 2-year (2002 and 2003) survey of presence of bug species and the amount of plant damage caused was conducted in randomly selected growers' fields. Findings of both boll removal studies and field surveys are presented here.

Materials and Methods

Mechanical Boll Removal Studies

Three field experiments (one in 2001, one in 2002, and one in 2003) were conducted to evaluate the impact on yield of different levels of mechanical boll removal. Experiments were conducted at the Virginia Tech Tidewater Agricultural Research and Extension Center research farm located in southeastern-most Virginia. All fields are in a 3-year corn/peanut/cotton rotation. Tillage was rip-strip into a herbicide-killed winter wheat cover crop stubble. Plots were planted the first week in May, and harvested in mid-October. In each, a series of small plots (4 rows on 36-inch centers x 40 ft long) was established in a randomized complete block design with four replicates, with treatments being four levels of boll removal (0, 5, 15, and 20

percent). Only the center two rows of each plot were subjected to boll removal procedures and harvested. Ten to 14-day old bolls were removed to pattern the bolls most preferred by bug species. In order to locate 10 to 14-day old bolls, at first bloom, representative white blooms in rows adjacent to treatment rows were marked with colored tags (color 1) hung from their petioles. This was repeated in four days on new white blooms using a different color tag (color 2). Then, 10 days after the second tagging, bolls at the color 2 sites were 10 days old, and bolls at the color 1 sites were 14 days old. These 10 to 14-day old bolls were pulled and used as 'guides' for determining which bolls to remove from treatment rows. The total number of 10 to 14-day old bolls in each of the center two rows of each plot was determined by visual inspection. Then, 0, 5, 15 or 20 percent of that total was removed. This procedure was repeated two times, each five days after the last. This constituted a 12-treatment test (0, 5, 15, and 20 percent boll removal rates x three successive removal dates, at 5-day intervals beginning at first bloom). Yield was determined by harvesting cotton in the two treatment rows (80 row-ft/plot) using a commercial 2-row John Deere picker. Sub-samples were ginned to determine the lint:seed ratio. Means were compared using standard ANOVA and means separation procedures, P=0.05.

Field Surveys

In 2002 and 2003, 40 commercial cotton fields randomly selected across the four major cotton producing counties (Southampton, Suffolk, Isle of Wight, and Greensville) were sampled for bug species and damage. Fields were sampled weekly from pinhead square to when growers initiated bollworm spray programs (early August). Each week, fields were sampled for insects using a series of 10, 25-sweep samples using a 15-inch diameter sweep net, and 10, 6-row-foot samples using a 3-foot shake cloth. Representative samples of insects were collected and returned to the laboratory for identification. After bloom, two sets of 50 randomly selected blooms were inspected for signs of insect feeding (dirty blooms). After bolls were set, two sets of 50 randomly selected quarter-sized bolls were returned to the laboratory and inspected for any signs of internal injury, including inner wall calluses, stained lint or seed. In early September, each field was visited a final time to determine fruit retention rate on 50 randomly selected plants by counting the number of missing fruit on the first two positions of nodes 6-10.

Results

Mechanical Boll Removal Studies

In 2001, lint yields ranged from 980 to 1150 lb/acre; in 2002, from 710 to 878 lb/acre; and in 2003, from 753 to 906 lb/acre. There were no significant differences in lint yields among the boll removal levels or removal dates, in either 2002 or 2003 studies (Figures 2 and 3). In 2001, there was a statistically significant reduction at the 20 percent removal rate at the second removal date (Figure 1). The same trend occurred at the third removal date; however, the difference was not significant.

Field Surveys

Results from 2002 indicated that plant bugs (almost exclusively *Lygus lineolaris*) were present in 80 percent of the fields, and at threshold in 4 percent (current threshold = 8 per 100 sweeps) (Table 1). Stink bugs (predominantly green stink bug, *Acrosternum hilare*) were much less common and present in only 38 percent of the fields, and at threshold in 4 percent (current threshold = 1 per 6 row-feet). Eighty-eight percent of the fields had dirty blooms, and 21 percent reached threshold (current threshold = 15 percent dirty bloom). Thirty-two percent had internal boll damage, and of those, 7 percent were at threshold (current threshold = 10 percent damaged bolls).

Results from 2003 indicated that plant bugs were present in 95 percent of the fields, and at threshold in 25 percent (current threshold = 8 per 100 sweeps) (Table 1). Stink bugs were much less common and present in only 28 percent of the fields, and were never at threshold. Ninety-three percent of the fields had dirty blooms, and 20 percent reached threshold (current threshold = 15 percent dirty bloom). Ninety-eight percent had internal boll damage, and of those, 30 percent were at threshold (current threshold = 10 percent damaged bolls).

Discussion

Results of the 3-year mechanical boll removal project showed that cotton in Virginia is capable of sustaining relatively high levels of loss of 10 to 14-day old bolls without affecting lint yield. Even 15 to 20 percent loss had no impact in two of the three years. The reduction due to 20 percent loss in 2001 does show that exceptions do occur. Up to 15 percent loss never caused a lint reduction. Currently Virginia Cooperative Extension recommends allowing up to 10 percent boll damage from bug species before making an insecticide treatment. That '10 percent' encompasses all types of damage ranging from severe (e.g., rotted, aborted bolls) to minor, a lot of which does not have a large impact on final lint yield (e.g., single internal boll wall callus). The results of these boll removal studies indicate that boll damage thresholds may be increased to at least 15 percent without jeopardizing yields. Further studies that include yield assessments are needed before true thresholds can be developed.

Field surveys showed that in 2002, and even more so in 2003, *Lygus lineolaris* was the predominant bug species pest during the weeks between square formation and early boll development. Although stink bugs were present, they appeared to play a minor roll compared to plant bugs. Plant bug populations and levels of damage to bolls were considerably higher in 2003 compared with 2002. In 2002, only 7 percent of the fields surveyed reached or exceeded the 10 percent boll damage threshold

compared with 30 percent in 2003. That plant bug populations varied so much in the two survey years suggests that control decisions will have to be made year-by-year and field-by-field based on good sampling procedures. Although numeric, survey data suggested that the sweep net, shake cloth and dirty bloom samples are not good procedures for determining the need for protective sprays. Both sweep net and shake cloth samples tended to underestimate the potential for boll damage. Regression procedures were used to evaluate the relationship between the highest number of plant bugs netted during the survey period for each of the 40 fields, and percent boll retention. Results showed that with the exception of Suffolk, there was a trend of retention rate decreasing as number of plant bugs increased (Figure 4). Over all 40 fields, the relationship was described by the equation Y = -0.8504x + 80.678 (Figure 5). The variability in this data is indicative of the difficulty in sampling adult plant bugs due to several factors including differences in sampler skill, time of day samples were taken, degree of moisture on cotton plants, and the erratic flight behavior of adult plant bugs. Dirty bloom ratings tended to overestimate boll damage in 2002 and underestimate it in 2003, again indicating a level of variability that could lead to poor treatment decisions. Percent square retention and boll damage assessments seem to be the best indicators of the need to spray, with the other information, i.e., insects and dirty blooms are present, serving to alert scouts of the need to do more intensive square or boll sampling. These data are being used to refine management recommendations for bug species in Virginia cotton.

References

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Table 1. Percent of fields surveyed (40 per year) with bug species and damage to blooms and 10 to 14-day old bolls.

	Plant bugs		Stink bugs		Dirty blooms		Damaged bolls	
Year	% present	% threshold (8/100 sweeps)	% present	% threshold (1/6 row feet)	% present	% threshold (15%)	% present	% threshold (10%)
2002	80	4	38	4	88	21	32	7
2003	95	25	28	0	93	20	98	30

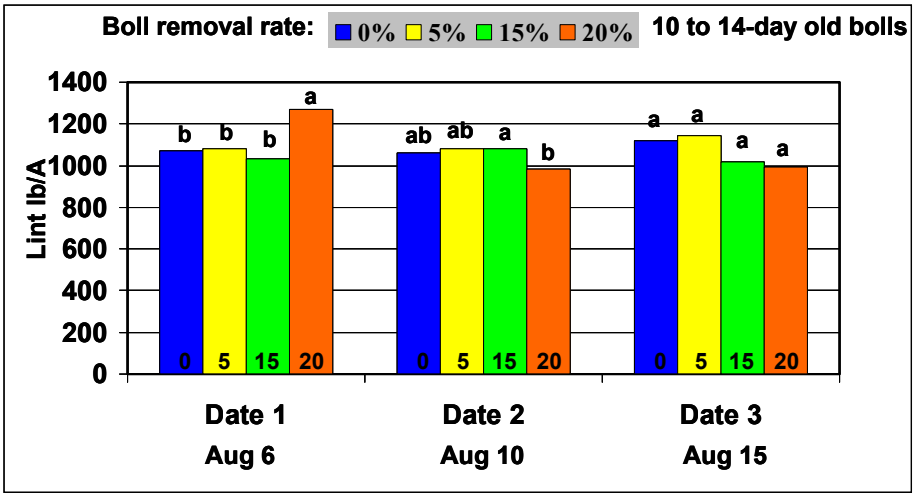

Figure 1. Lint yields after mechanical removal of 10-14 day old bolls, 2001.

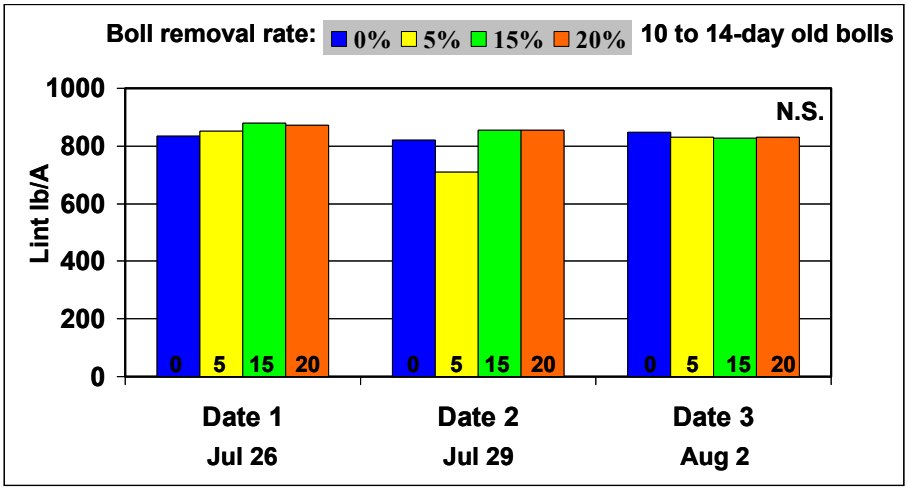

Figure 2. Lint yields after mechanical removal of 10-14 day old bolls, 2002.

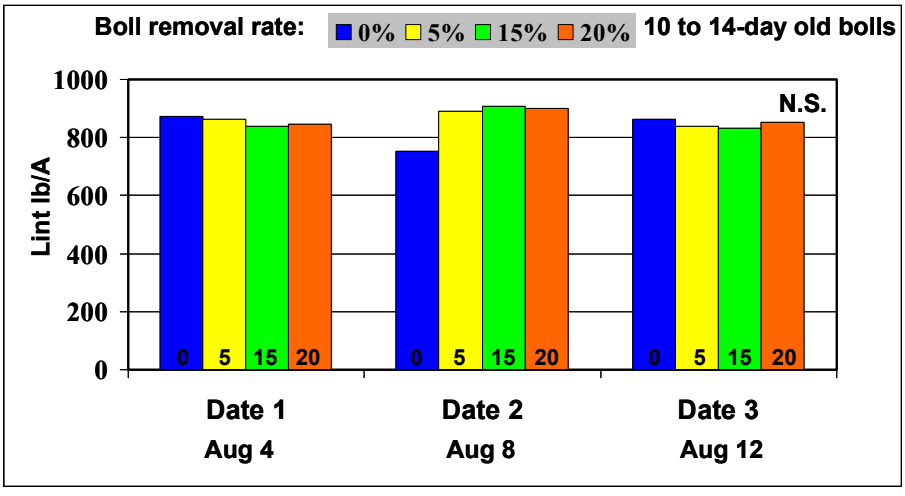

Figure 3. Lint yields after mechanical removal of 10-14 day old bolls, 2003.

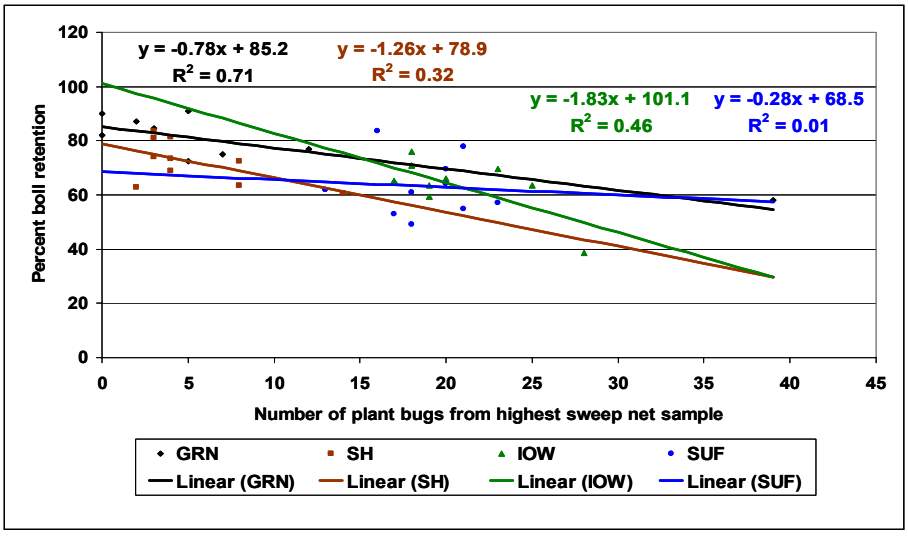

Figure 4. Relationship between highest number of plant bugs netted and percent boll retention for 10 fields sampled per county in Suffolk, Greensville, Southampton, and Isle of Wight Counties, Virginia, 2003.

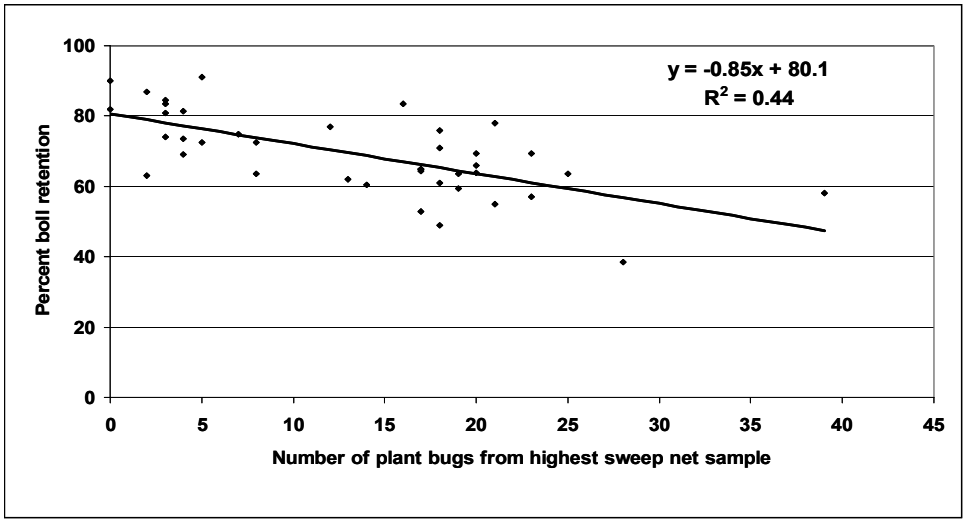

Figure 5. Relationship between highest number of plant bugs netted and percent boll retention for 40 fields sampled in Suffolk, Greensville, Southampton, and Isle of Wight Counties, Virginia, 2003.