COMPENSATION FROM SYSTEMATIC SQUARE REMOVAL BY VIRGINIA COTTON

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Abstract

In Virginia, with its northern location and relatively short growing season, a dogma exists that cotton does not have time to compensate from insect damage to reproductive structures and all must be protected in order to achieve maximum yields. This attitude sets the stage for multiple insecticide treatments if any insect damage to fruit is found. With the recent appearance of early-season bollworm/budworm and *Lygus* spp. infestations and associated square damage and loss, producers may react by making additional insecticide treatments. However, new research has shown that cotton can recover from substantial levels of early-season square damage and still make yields equal to undamaged cotton. Removing 0, 2, 4 or 6 first position squares per plant to 'simulate' feeding by early-season bollworm/budworm infestations caused the number of first position bolls to decrease as more squares were removed, but number of second position bolls increased. Lint yields at harvest were not significantly different among the square removal treatments with 1128a, 1303a, 1371a and 1207a lb lint/acre for 0, 2, 4 and 6 squares removed, respectively. Similarly, in another experiment, removing 0, 12-15, 20-25, or 30-40% of first position squares in late-June to early-July resulted in no significant difference in total number of bolls at harvest, individual boll weight, percentage lint, or lint yields (1509a, 1544a, 1615a, and 1553a lb lint/acre, respectively). These results show that cotton in Virginia, even at this northern location, can compensate for square loss by adding new squares in time to result in excellent yields.

Introduction

In recent years, cotton has gained prominence as a rapidly expanding crop that is well suited for production in eastern Virginia. Acreage expanded from almost none in the early 1980's to an average of almost 100,000 acres each year from 1995 to1998. Farm gate value exceeded $64,000,000 in each of the past three years, and this income is welcome to many producers compromised by recent downward trends in grain, soybean and peanut prices. Minimizing production costs will be critical to maintaining cotton as a competitive crop alternative. Insect control is a major cost in many cotton producing areas. It has been a priority to determine which insect pests pose an actual threat to cotton yield in Virginia, and to evaluate and develop economic control strategies. Previous work has shown that both early-season seedling damage by the cotton thrips complex and boll feeding by the bollworm/budworm complex can result in significant yield losses if they are not managed with insecticides (Herbert, 1996, 1997, 1998; Herbert et al., 1997). Current 'best management' recommendations include early-season insecticide treatments to minimize thrips injury (usually an in-furrow application at planting time, plus an additional foliar band, as-needed, at the first-true-leaf stage), and a two-spray system for minimizing bollworm/budworm damage initiated at the onset of egg thresholds. This program and total number of insecticide treatments compares well in terms of cost with insect management programs in most states. One key to success is not applying insecticide treatments during the period between the first-true-leaf thrips sprays (typically mid- to late-May) and the onset of bollworm/budworm sprays (typically late-July to early-August). This insecticide-free period allows beneficial populations to develop, which are important in regulating other pest species as well as low-level bollworm infestations. Allowing this insecticide-free period has only been possible because few insect pests have been present during that time. However, in the last two years, presence of early-season bollworm/budworm, and most recently, *Lygus* spp. have been reported. An estimated 1 to 2% of fields have suffered some level of square damage and loss. Square damage by plant bugs 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). Virginia cotton, with its northern location and relatively short growing season, may be at even greater risk to yield reductions from early season square damage. Most feel that because of the northern location, cotton does not have time to compensate from insect damage to reproductive structures and all must be protected in order to achieve maximum yields. The work reported here was undertaken to evaluate the impact of square loss and the compensation ability of cotton grown in Virginia.

Materials and Methods

Two field experiments (I and II) were conducted, I in 1996 and II in1998, both at the Virginia Tech Tidewater Agricultural Research and Extension Center, Suffolk, VA. 'DPL 51' cotton was planted in 36 inch-wide rows, using conventional full tillage, and managed according to recommended practices for Virginia (Maitland, 1998). In experiment I, at the first-true-leaf stage, 24 small plots comprised of single 4-foot sections of row, were randomly located within the field. Plants in each plot were thinned to two plants per row foot, 8 plants per plot. Plots were established to accommodate six replicates of four treatments. Treatments were randomly assigned to plots.

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Treatments consisted of mechanically removing first position squares beginning when plants had developed squares up to the eleventh sympodium. No squares were removed from treatment 1, which served as the untreated control. In treatments 2, 3, and 4, first position squares were removed from sympodia 11 and 10. In treatments 3 and 4, two additional first position squares were removed from sympodia 9 and 8, four days after the first square removal. In treatment 4, two additional first position squares were removed from sympodia 7 and 6, four days after the second square removal. At harvest, number of first and second position bolls was recorded and lint yields were determined by hand picking all harvestable bolls from the 8 plants in each plot.

In experiment II, 16 small plots comprised of two adjacent 5-foot sections of row were randomly located within the field and marked with plastic flags. Plots were established to accommodate four replicates of four treatments. Treatments consisted of mechanical removal of different percentages of first position squares. Twice during the season, 24 June (2 weeks after pinhead square) and 9 July (26 days after pinhead square), the number of first position squares was determined by counting the total number in each plot (all plants in 2, 5-foot sections of row). On 24 June, 0, 12, 20 or 30% of first position squares were removed, based on random selection, from treatments 1, 2, 3 or 4, respectively. On 9 July, after determining the total number per plot, an additional 0, 15, 25 or 40% of first position squares were removed from treatments 1, 2, 3 or 4, respectively. At harvest, total number of bolls, average individual boll weight, percentage lint and lint yields were measured on all plants in each plot. Data were analyzed using analysis of variance procedures and appropriate means separation tests.

Results and Discussion

Experiment I

Mechanical removal of first position squares had a dramatic effect on number of first position bolls at harvest. First position boll number decreased significantly from 56.2 bolls per 8 plants with 0 squares removed per plant to 43.0 per 8 plants with 2 squares removed per plant (Figure 1). Similarly, boll number was significantly reduced from 43.0 to 31.3 per 8 plants when square removal increased from 2 to 4 squares per plant. There was no significant reduction in boll number when square removal was increased from 4 to 6 per plant. Removal of first position squares had the opposite effect on number of second position bolls at harvest, as boll number increased with the increase in number of squares removed. Number of second position bolls significantly increased from 15.3 to 39.3 per 8 plants when square removal increased from 0 to 2 per plant (Figure 2). Number of second position bolls also increased significantly from 39.3 to 50.8 per 8 plants when square removal increased from 2 to 4 per plant. There was no significant increase in boll number when number of squares removed increased from 4 to 6 per plant. Although there were numerical differences, lint yields were not significantly affected by any first position square removal levels, with 1128a, 1303a, 1371a and 1207a lb lint/acre for the 0, 2, 4 and 6 square removal levels, respectively (Figure 3). The 0 square removal control had the lowest yield numerically compared with all other square removal levels, and the 4 squares removed per plant treatment had the highest numerical yield.

Experiment II

Total number of bolls in 5 row feet at harvest was not significantly affected by any of the square removal levels (Figure 4). Number ranged from 87.7 in the undamaged control to 98.8 in the 20-25% removal level. Boll weight at harvest was also not affected by square removal, with average individual boll weights of 5.4, 4.9, 5.1 and 5.3 g at the 0, 12-15, 20-25 and 30-40% square removal rates, respectively (Figure 5). Percent lint was not affected with a range of 39.8 in the undamaged control to 40.6 in both the 20-25% and 30-40% square removal levels (Figure 6). More importantly, lint yields were not significantly different among treatments with 1509a, 1544a, 1615a and 1553a lb lint/acre with the 0, 12-15, 20-25 and 30-40% square removal levels, respectively (Figure 7).

Summary

Although somewhat preliminary, as cotton yields can vary tremendously from year to year and from location to location, these results indicated that cotton in Virginia can compensate for loss of first position squares by adding new squares in time to result in excellent yields. Even though the two tests presented here were conducted in different years and used different de-squaring levels and techniques, this overall trend was consistent. The data also indicated that the primary way cotton seems to compensate for early season loss of first position squares is by adding second position squares and bolls, or perhaps putting more energy into them, which resulted in yields equal to, or higher than, yields in undamaged cotton. These findings go against the dogma for Virginia cotton, that in this northern location, all fruit should be protected from insect damage to achieve maximum yield potential. Although it is at a reduced level compared with many states, Virginia cotton does suffer from some early season damage by the bollworm complex and more recently, *Lygus* spp. Further studies are planned to evaluate natural square shed in relation to additional loses by insect feeding. Until they are completed, this work will be used to encourage producers to refrain from overreacting to small amounts of early season square loss.

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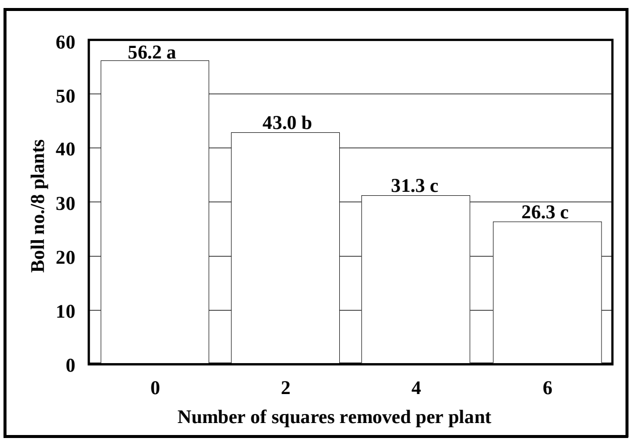

Figure 1. Total number of first position bolls at harvest after mechanical removal of first position squares. Tidewater AREC, Suffolk, VA, 1996.

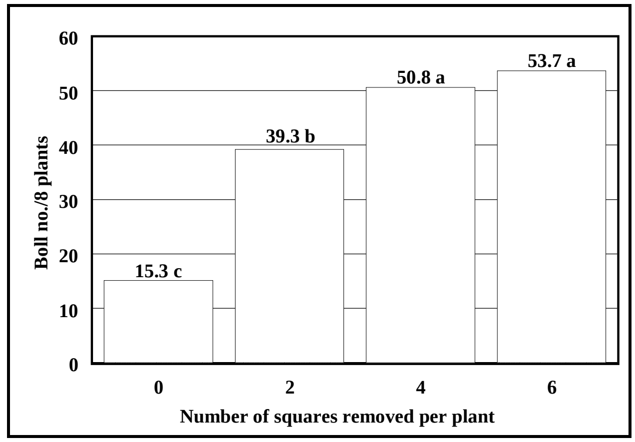

Figure 2. Total number of second position bolls at harvest after mechanical removal of first position squares. Tidewater AREC, Suffolk, VA, 1996.

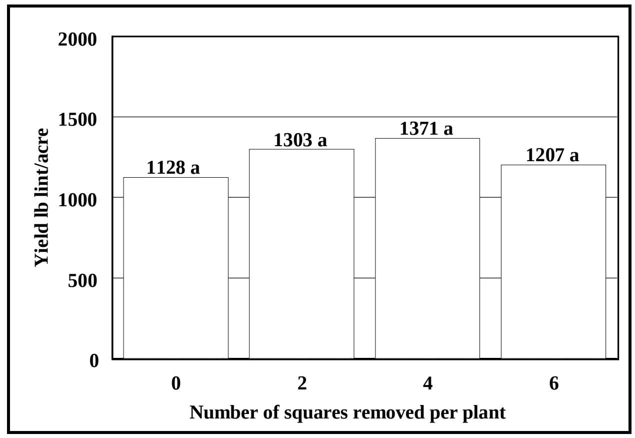

Figure 3. Lint yields after mechanical removal of first position squares. Tidewater AREC, Suffolk, VA, 1996.

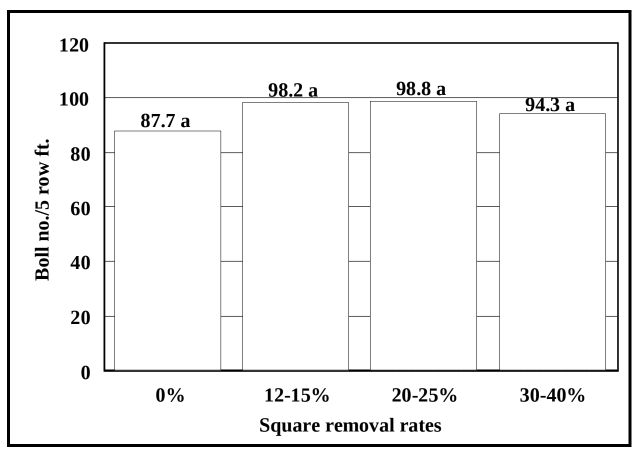

Figure 4. Effect of mechanical removal of first position squares on total boll number at harvest. First position squares randomly removed on Jun 24 (2 weeks after pinhead square) and Jul 9 (26 days after pinhead square). Tidewater AREC, Suffolk, VA, 1998.

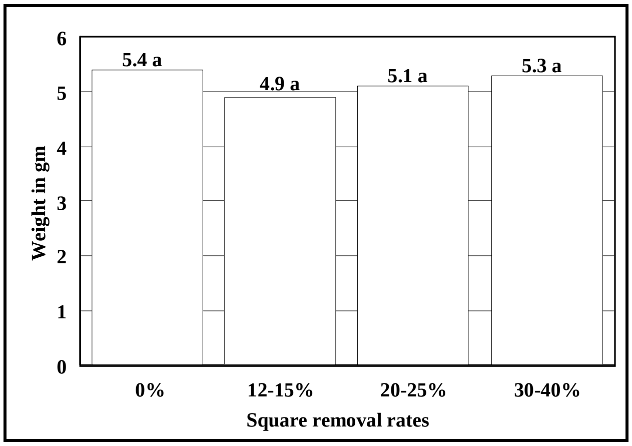

Figure 5. Effect of mechanical removal of first position squares on individual boll weight at harvest. First position squares randomly removed on Jun 24 (2 weeks after pinhead square) and Jul 9 (26 days after pinhead square). Tidewater AREC, Suffolk, VA, 1998.

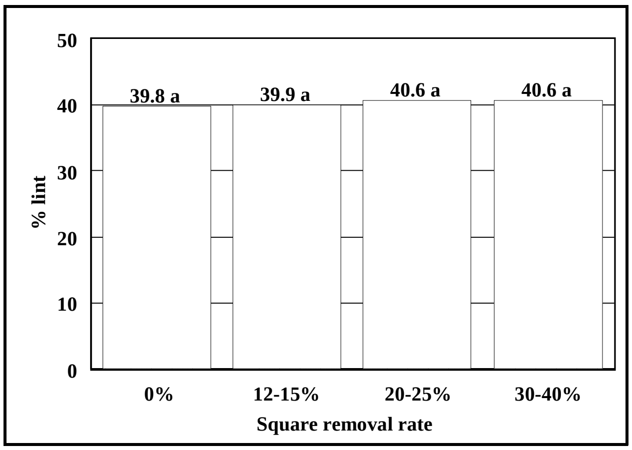

Figure 6. Effect of mechanical removal of first position squares on lint content at harvest. First position squares randomly removed on Jun 24 (2 weeks after pinhead square) and Jul 9 (26 days after pinhead square). Tidewater AREC, Suffolk, VA, 1998.

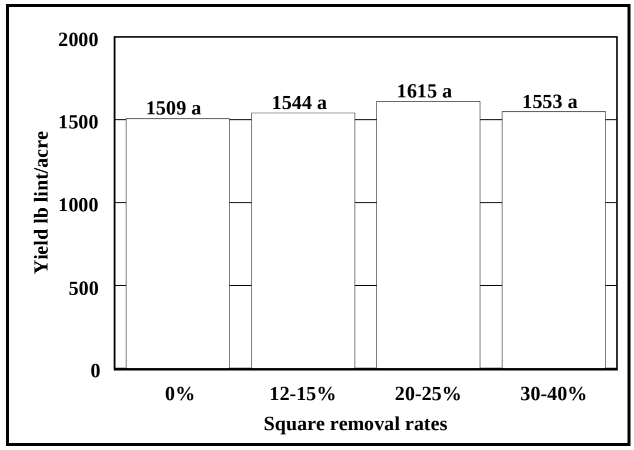

Figure 7. Effect of mechanical removal of first position squares on lint yield at harvest. First position squares randomly removed on Jun 24 (2 weeks after pinhead square) and Jul 9 (26 days after pinhead square). Tidewater AREC, Suffolk, VA, 1998.