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MANAGEMENT CONSIDERATIONS FOR STINK BUGS - 2003

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Abstract

Because stink bugs continue to pose a challenge to current and future efforts concerning cotton insect management, we continued investigations into alternative monitoring strategies and management tactics for the pest complex. Pheromone trapping of stink bugs was again useful in following in-field populations of stink bugs, but the reduced availability and considerable expense of currently available lures and unavailability of lures for other important species continues to make potential pheromone trapping prohibitive. Research with treatment thresholds for stink bugs, based on monitoring internal feeding injury to bolls, supported treatment at the 10-20% injury to mid-sized (ca. 14-d-old) bolls. In laboratory bioassays concerning insecticide efficacy, methyl parathion (Methyl 4E) and dicrotophos (Bidrin 8), standard organophosphates used for control of bug pests, provided superior control (94-100% mortality) of field-collected fifth instars and adults of the green stink bug (GSB), *Acrosternum hilare* (Say) and the brown stink bug (BSB), *Euschistus servus* (Say), at 0.5 lb (AI)/A. Pyrethroid insecticides alone provided variable results (11-100% 24-hr mortality) due to considerable tolerance by BSB. Results from studies addressing simulated mechanical injury to bolls, terminals, and squares suggested that losses from bug feeding injury to young cotton and to small-to-medium-sized bolls could be significant under certain circumstances. In caging experiments, the ability of GSB to damage cotton bolls and reduce yield decreased as bolls aged, and yields from bolls that accumulated 583 HU at 27 d following anthesis were not significantly reduced.

Introduction

The status of stink bugs as a challenging pest group continues to escalate because of various factors related to reduced reliance on broad-spectrum foliar insecticides. Factors that allow stink bugs to thrive under our current and future production practices include the eradication of the boll weevil, *Anthonomus grandis* Boheman, availability of alternative chemistries for selective control of worm (Lepidoptera) pests, established use of transgenic *Bt* cotton and the recent registration of second-generation *Bt* varieties, enhanced in controlling worm pests. All of these advances offer significant reductions in broad-spectrum foliar insecticide usage, and stink bugs greatly benefit from the reduction of insecticides traditionally applied for major pest groups. "Coincidental" control of stink bugs has been eliminated. Stink bugs are now recognized as part of an important group of boll-feeding insects, and producers have had to shift to using "intentional" control for their management. Entomologists have been addressing this problem for several years now and have generated some useful information concerning management of stink bugs in cotton (Greene et al. 1999; Greene et al. 2001a,b; Willrich et al. 2002, 2003; Greene and Capps 2002, 2003).

Predominant phytophagous (plant-feeding) stink bugs in the Southeast and much of the Mid-South are similar and include the green stink bug, *Acrosternum hilare* (Say), the southern green stink bug, *Nezara viridula* (L.), and the brown stink bug, *Euschistus servus* (Say). Several other species are part of the plant-feeding stink bug complex but are of less importance. In 2003, we continued investigations, in laboratory bioassays, into the effects of several new chemistries with those of established materials on mortality of two important species, the green stink bug (GSB), *A. hilare*, and the brown stink bug (BSB), *E. servus*. Also, we continued work with pheromone trapping, development of boll-injury-based thresholds for stink bugs, and simulated mechanical injury to terminals, squares, and bolls. The ability of GSB to injure bolls of varying ages was addressed in cage experiments to investigate the duration of susceptibility to bug injury.

Materials and Methods

Insecticide Efficacy

Adults and nymphs of GSB and BSB were collected from soybeans with a sweep net and held overnight in an environmental chamber at 27°C, 60% RH, and a photoperiod of 14:10 (L:D) h. They were provided with water and green beans (Harris and Todd 1981), and the following day, adults and fifth instars of each species were placed singly in 30-ml plastic diet cups with a 3-4 cm section of green bean before topical assays.

Doses of each insecticide simulated the concentrations of field-use rates applied at a total volume of 10 gal per acre (Greene and Capps 2002, 2003). Mixtures using 1 ml or 1 g of material were made for the following insecticides and field-use rates: dicrotophos (Bidrin 8, Amvac, Los Angeles, CA, 0.25 and 0.50 lb [AI]/A), cyfluthrin/imidacloprid (Leverage 2.7, Bayer, Kansas City, MO, 0.079 lb [AI]/A), cyfluthrin (Baythroid 2, Bayer, 0.03 lb [AI]/A), spinosad (Tracer 4, Dow AgroSciences, Indianapolis, IN, 0.07 lb [AI]/A), *lamda*-cyhalothrin (Karate 2.08, Syngenta, Greensboro, NC, 0.025 and 0.03 lb [AI]/A), *zeta*-cypermethrin (Mustang Max 0.8, FMC, Philadelphia, PA, 0.02 lb [AI]/A), imidacloprid (Trimax 4, Bayer, 0.03125 and 0.0469 lb [AI]/A), oxamyl (Vydate 3.77, DuPont, Wilmington, DE, 0.25 and 0.33 lb [AI]/A), methyl parathion (Methyl 4E, Cheminova, Wayne, NJ, 0.25 and 0.5 lb [AI]/A), CS-AU-44-JO (Control Solutions, Pasadena, TX, 1 qt/acre), novaluron (Diamond 0.83, Crompton/Uniroyal, Middlebury, CT, 0.039 and 0.08 lb [AI]/A), thiamethoxam (Centric 40WG, Syngenta, 0.03125 and 0.05 lb [AI]/A), chlorpyrifos (Lorsban 4E, Dow AgroSciences, 0.5 lb [AI]/A), and GF-231 1.25 (Dow AgroSciences, 0.015 lb [AI]/A). To simulate practical efficacy in the field, 1 µl of each insecticide mixture was applied to the ventral abdominal segments of each insect. Each bug was returned to its respective diet cup following treatment. A bug was considered dead if in a supine position and no coordinated movement was observed after agitating its cup. Mortality was recorded 24, 48, 72, and 96 hr after treatment.

Pheromone Trapping

Traps (22), modified from Mizell and Tedders (1995) and Greene et al. (2001a), were placed in and around cotton fields near Rowher, AR, during 2003. Major components of the traps were corrugated plastic, plastic jars, rubber septa, and synthetic pheromone. Trap tops were made from plastic jars, and trap bases were made from sheets (4' x 8' safety yellow) of 10-mm corrugated plastic board. Lures were placed in the plastic jar top of each trap and consisted of a rubber septum (sleeve stopper, Fisher Scientific) treated with 40 µl of methyl 2,4-decadienoate, and replaced every 7 d. Traps were examined and emptied once per wk.

Boll Infestation Cage Experiment

Adults and late instars of GSB were collected from soybeans with sweep net procedures and held until used in the experiments using procedures described previously. On 18 July 2003, insect cages (each either 6 x 6 x 12 ft or 6 x 6 x 6 ft), constructed using 18 x 14 mesh screen and aluminum pipe frames, were placed over second-generation *Bt* cotton (DP468BIIRR) planted on 5 May near the Southeast Research and Extension Center in Monticello, AR. On 24 July and 5 August, esfenvalerate (Asana XL 0.66EC at 0.05 lb ai/a), dicrotophos (Bidrin 8EC at 0.5 lb ai/a), and spinosad (Tracer 4 at 0.09 lb ai/a) were applied to caged plants, using a compressed-air backpack sprayer that delivered 10 gal/a at 50 psi, to kill arthropods present. White blooms on enclosed cotton were tagged with fluorescent flagging tape every 2 or 3 d and dated. Small cages, designed to enclose a single boll, were constructed of 12 oz polystyrene foam cups, knee-high nylon hose, rubber bands, and wire ties (Greene et al. 1999). Bottoms of cups and toe-ends of nylon hose were removed, and cups were placed in the middle of the hose sleeves. The bottom end of a cup cage was placed over a boll to enclose it, and the sleeve was tied with a wire tie to the peduncle of the boll. An experiment was initiated by placing a single stink bug inside a cup with the boll, folding the other end of the sleeve over the top of the cup and securing it with a rubber band. Dead bugs were removed from cages and replaced daily.

We addressed the effect of boll age on stink bug feeding and yield loss by confining adults and late 5th instars of *A. hilare* singly with bolls aged 4, 8, 14, 18, 21, 27, and 32 d from white bloom using a completely randomized design. Paired bolls of corresponding age were caged without bugs as controls. After a 7-d exposure, bugs were removed from the cages. At maturity, cotton was manually harvested and weighed from each boll.

Boll-Injury Thresholds

Plots of DP424BIIRR and SG215B/RR at the Rohwer Branch of the Southeast Research and Extension Center in Desha County, AR (24 rows by 70 ft and 16 rows by 40 ft, respectively) and PM1218B/R at a producer's farm in Ashley County, AR (16 rows by 300 ft) were arranged in a RCBD with 6-7 treatments and 4 replications. Twenty-five bolls (50-75% full size, ca. 14 d from white bloom) were collected from each plot weekly and examined for internal symptoms of feeding by stink bugs. A boll was considered damaged if at least one internal growth (cell proliferation) or obvious staining of lint with associated feeding injury to seeds was observed. Dicrotophos (Bidrin 8, Amvac, Los Angeles, CA at 0.50 lb [AI]/A) was applied to all plots in a treatment at or exceeding the following levels of damaged bolls: 10, 20, and 30% and at a density of 1 bug per 6 ft of row. Additional treatments included a 15% level in Ashley County and an untreated control at both sites. Two or four rows from the center of each plot were harvested by machine.

Injury Simulation Studies

Plots of ST4892B/R at the Rohwer Branch of the Southeast Research and Extension Center in Desha County, AR (4 rows by 30 ft) were arranged in a RCBD with 6 treatments (boll punctures) and 4 treatments (terminal and square removals) and 4 replications. In a test to simulate the mechanical injury caused by pentatomid feeding, bolls (ca. 1-2 wk from anthesis) were punctured weekly with insect pins (38 x 0.55 mm) by inserting the pointed end into the boll in the middle of one lock through the carpel wall (ca. 0.25 in). Bolls from the center two rows were injured in each plot according to the treatment regime (no injury, 10, 20, 30, 50, and 100%). Bolls punctured were tagged with fluorescent flagging tape for identification. Prior to harvest, total bolls and injured (tagged) bolls were counted in each plot to determine actual percentages of simulated injury. Twenty feet of row were hand harvested from the center two rows of each plot.

In a test to simulate injury to terminal growth on young cotton, terminals were hand removed at the 6-7 true leaf stage on 17 June (near pin-head square) by aggressively pinching off terminal growth with thumb and index finger from plants at rates of 25, 50, and 100% in three treatments, with a fourth undamaged/untreated treatment for comparison. In a similar third test, pre-floral buds (squares) were removed weekly for 4 weeks from young cotton beginning at match-head square on 17 June. Squares were pinched off of plants in a like manner as terminals and at identical rates of 25, 50, and 100%, with an undamaged treatment for comparison. Two rows from the center of each plot, in both the terminal and square removal tests, were harvested by machine. All injury simulation studies were protected from natural populations of insect pests by weekly or semi-weekly applications of insecticides.

Data were processed using Agriculture Research Manager (ARM) (Gylling Data Management, Inc., Brookings, SD), and means were separated using Least Significant Difference (LSD) procedures following significant F tests using Analysis of Variance (ANOVA).

Results and Discussion

Insecticide Efficacy

The predominant species of stink bugs in cotton in Southeast Arkansas during 2003 were primarily the green stink bug (GSB), *Acrosternum hilare* (Say), and, to a lesser extent, the brown stink bug (BSB), *Euschistus servus* (Say). The southern green stink bug (SGSB), *Nezara viridula* (L.), was very common in soybeans but was not abundant in cotton until later in the season, therefore its numbers were not sufficient for statistical evaluation in laboratory efficacy trials.

Bidrin and methyl parathion provided excellent control (94-100%) of adults and nymphs of GSB and adults of BSB (Tables 1-3) at the 0.5 lb AI/A rate 24 hr after exposure. The 0.25 lb AI/A rates of both products provided good control (85-97%) of both species at 24 hr. The pyrethroid insecticides applied alone provided variable control (11-100%) of both species after 24 hr (Tables 1-3), but poorest control was demonstrated with BSB (11-78%). Vydate at 0.33 lb AI/A provided good control of both species. When pyrethroids were applied in combination with an organophosphate, a neonicotinoid, or an insect growth regulator (IGR), control (39-100%) was also variable, depending on the grouping. Centric plus Karate and CS-AU-44-JO provided good control of both species, but Karate plus the IGR did not provide acceptable control of BSB when applied topically. As expected, Tracer, a lep-specific material, offered little or no control of both species. Cumulative mortalities for several treatments fluctuated slightly and, in some cases, decreased over time because some bugs recorded as dead apparently recovered from initial “knockdown”. These results were consistent with those found previously (Greene and Herzog 2000, Greene et al. 2001a, Greene and Capps 2002, Greene and Capps 2003).

Pheromone Trapping

Over a 13-wk sampling period, 2,345 stink bugs were captured in 22 traps. Approximately 95% of those trapped were part of the brown stink bug complex, *Euschistus* spp. The majority were *E. servus*, with some *E. tristigmus*, *E. crenator*, and *E. ictericus*. Others included *Thyanta* sp., *A. hilare*, *N. viridula*, and *Oebalus pugnax*.

Weekly trap numbers (Figure 1) appeared to follow field populations. Capture in pheromone traps declined during July and increased during August and September. Highest trap numbers were obtained during mid and late September. Highest field populations were detected with shake sheet procedures during the middle of August and first week of September. The increase in numbers in August and September occurred after a trend for increasing trap capture began in early August. Similar results were observed previously (Greene et al. 2001a, Greene and Capps 2003).

Boll Infestation Cage Experiment

As bolls aged, damage and yield loss decreased (Figure 2). Significant yield loss did not occur with bolls aged 27 or 32 d from anthesis that had accumulated over 583 heat units (HU). In our earlier findings using a related species, the southern green stink bug, *Nezara viridula* (L.), results were almost identical where bolls aged 25 and 30 d that had accumulated 559 and 658 HU, respectively, did not incur yield loss (Greene et al. 2001a). In earlier tests with *N. viridula* (Greene and Herzog 2000), bolls aged 21 d with over 405 HU accumulated did not suffer significant yield reduction. These results were similar to even earlier findings where bolls aged 18 d with over 380 HU did not display significant symptoms of feeding damage

(Greene et al. 1999). Results were obtained from cotton under field cages that provided ca. 18% shade to enclosed plants and with field-collected/laboratory-held stink bugs confined to single bolls for an entire week. Considering the effects of shading and extended length of exposure to bug injury, bolls are likely safe from significant yield loss due to stink bugs when they attain an age of 21-25 d from anthesis (ca. 3 wk old) and/or an accumulation of 450-550 HU. Because bolls would likely increase in size and mature faster with full canopy exposure to photosynthetic energy and because of the artificially intimate and intense exposure to stink bugs in the enclosures, this should be a conservative estimate. Because bolls become resistant to bug feeding and damage as they age, we should be better able to decide when to terminate insecticide use for stink bugs based on these results.

Boll-Injury Thresholds

During 2003, three fields in southeast Arkansas were established for research addressing boll-injury thresholds for stink bugs. Data from two of the sites located at the Rohwer Experiment Station in Desha County, AR, with identical treatments were pooled for analysis (Figure 3). At those sites, 2.0-2.5 applications of dicrophos (Bidrin 8) at 0.5 lb (AI)/A at thresholds of 10 and 20% internal boll injury resulted in 260 and 212 lb, respectively, increases in lint yield when compared with untreated plots. In-field populations were not detected at the threshold of 1 bug per 6 row feet using a shake sheet. These data are similar to those summarized from earlier trials (Greene and Capps 2003). When yield increases and insecticide costs were calculated, the 10% level of treatment (followed closely by 20%) yielded the best net return. In these trials, significant populations of tarnished plant bug (TPB), *Lygus lineolaris*, were present for most of the fruiting period and, although treated 2-3 times with insecticide specifically for control of TPB, caused significant injury to small bolls. The benefits of treating earlier for stink bugs at the 10% level of injury undoubtedly resulted in reduced numbers of both TPB and stink bugs and increased returns. At a third site in Ashley County, AR, results were similar as plots protected 4 times with Bidrin at the 10 and 15% level produced about 100 lb more cotton than plots treated 3 times at the 20% level. Bolls and yields were significantly injured at 30 and 50% damage levels after 1 or 2 treatments with Bidrin. When populations of boll-feeding bugs were predominantly comprised of stink bugs, cotton with bolls protected at the 20% level of internal injury produced the highest yields and net return (Greene and Capps 2003). Under conditions of high TPB pressure, coupled with numbers of stink bugs, protection in the 10-20% range of boll injury apparently provided supplemental protection from TPB and resulted in highest yields and net returns. Recommendations in most states include some variation of a boll-injury threshold for stink bugs and other boll-feeding bugs. As a result of these continuing studies, alternative monitoring and management recommendations are available for stink bugs in cotton.

Injury Simulation Studies

Bolls punctured with insect pins, simulating mechanical feeding injury by stink bugs, at all levels resulted in significant damage and yield losses of up to 345 lb (Table 4). Yields from bolls punctured at all levels (10, 20, 30, 50, and 100% - actually 11.6, 22.2, 32.5, 48.8, and 95.5%, respectively) were statistically lower than those from undamaged plots. These results were inconsistent with those observed in identical work in 2002 when bolls from only the 50 and 100% levels of injury had significantly reduced yields. Yields from bolls injured at the 10, 20, and 30% level were not significantly reduced in 2002. This suggested that other factors (weather, variety, etc.) complicated the study, preventing our repetition of the results from year to year. However, these data do support results from the current boll-injury threshold research where protection at the lowest level (10%) provided the highest yields and returns. It remains our opinion that the most appropriate threshold for stink bug management in cotton is between 10 and 30% when sampling medium-sized bolls and using the damage criterion of at least one internal feeding injury per boll described previously (Greene et al. 1999, 2001a), understanding that populations of other boll feeders such as TPB can contribute significantly to boll injury and must be managed properly.

Yields were not significantly reduced when terminal growth was mechanically removed by hand at 25, 50, and 100% (Table 5). Plant height was significantly reduced at the 100% level. Yields were significantly reduced when pre-floral buds were mechanically removed by hand at 100% for the first four weeks of squaring (Table 6). These and previous results demonstrate that excessive terminal and square losses from insects, specifically the bug complex (stink bugs or plant bugs), in early-squaring cotton can result in significant loss of yield and canopy structure. It is widely known that plant bugs can and will injure squares and terminal growth, but observational work has questioned whether or not stink bugs are capable of injuring meristematic tissue and pre-floral buds as well. Although stink bugs are primarily fruit/seed feeders, their potential capacity, along with related species of plant bugs, to injure terminal growth and squares should caution growers when elevated populations are encountered in young cotton.

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Disclaimer

The mention of trade names in this report is for informational purposes only and does not imply an endorsement by the University of Arkansas Cooperative Extension Service.

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Table 1. Cumulative mortality of field-collected adults of the green stink bug, *Acrosternum hilare* (Say), over a 4-d interval following exposure to insecticides (1-µl to ventral abdominal segments) in laboratory bioassays (2003).

Treatment (lb [AI]/Acre)	Reps	$/Acre/ Application	% Cumulative Mortality			
			24 hr	48 hr	72 hr	96 hr
1. UTC	33	$0.00	12	30	36	48
2. Diamond 0.83 @ 0.08	33	N/A	12	24	27	45
3. Diamond 0.83 @ 0.039 + Karate 2.08 @ 0.025	33	N/A	91	91	97	97
4. Tracer 4 @ 0.07	33	$12.75	33	45	58	76
5. Prolex (GF-231) 1.25 @ 0.015	33	N/A	88	88	91	91
6. Karate 2.08 @ 0.03	33	$5.58	88	85	94	97
7. Mustang Max 0.8 @ 0.02	33	$4.71	100	97	97	97
8. Baythroid 2 @ 0.03	33	$4.93	79	85	91	91
9. Vydate 3.77 @ 0.25	33	$4.42	52	61	67	76
10. Vydate 3.77 @ 0.33	33	$5.84	85	94	97	97
11. Centric 40WG @ 0.05	33	$7.93	79	85	94	85
12. Bidrin 8 @ 0.25	33	$2.70	97	100	100	100
13. Bidrin 8 @ 0.5	33	$5.40	100	100	100	100
14. Methyl parathion 4 @ 0.25	33	$1.83	97	100	100	100
15. Methyl parathion 4 @ 0.5	33	$3.66	100	100	100	100
16. Leverage 2.7 @ 0.079	33	$11.06	100	100	100	91
17. Trimax 4 @ 0.0469	33	$7.58	82	88	91	94
18. Trimax 4 @ 0.03125 + Bidrin 8 @ 0.25	33	$7.75	97	97	100	100
19. Centric 40WG @ 0.03125 + Karate 2.08 @ 0.02	33	$8.68	94	100	100	100
20. CS-AU-44-JO @ 1 qt/acre	33	N/A	100	100	100	100
21. Lorsban 4 @ 0.5	33	$4.75	76	88	91	91

Table 2. Cumulative mortality of field-collected nymphs (5th instars) of the green stink bug, *Acrosternum hilare* (Say), over a 4-d interval following exposure to insecticides (1-µl to ventral abdominal segments) in laboratory bioassays (2003).

Treatment (lb [AI]/Acre)	Reps	$/Acre/ Application	% Cumulative Mortality			
			24 hr	48 hr	72 hr	96 hr
1. UTC	72	$0.00	25	40	47	57
2. Diamond 0.83 @ 0.08	72	N/A	25	51	57	69
3. Diamond 0.83 @ 0.039 + Karate 2.08 @ 0.025	72	N/A	93	94	96	96
4. Tracer 4 @ 0.07	72	$12.75	26	39	47	57
5. Prolex (GF-231) 1.25 @ 0.015	72	N/A	96	97	99	97
6. Karate 2.08 @ 0.03	72	$5.58	97	97	97	99
7. Mustang Max 0.8 @ 0.02	72	$4.71	96	96	96	97
8. Baythroid 2 @ 0.03	72	$4.93	89	92	93	93
9. Vydate 3.77 @ 0.25	72	$4.42	88	93	96	96
10. Vydate 3.77 @ 0.33	72	$5.84	94	96	96	99
11. Centric 40WG @ 0.05	72	$7.93	94	96	97	99
12. Bidrin 8 @ 0.25	72	$2.70	93	93	93	93
13. Bidrin 8 @ 0.5	72	$5.40	100	100	100	100
14. Methyl parathion 4 @ 0.25	72	$1.83	85	97	97	97
15. Methyl parathion 4 @ 0.5	72	$3.66	99	100	100	100
16. Leverage 2.7 @ 0.079	72	$11.06	100	100	100	100
17. Trimax 4 @ 0.0469	72	$7.58	90	88	90	93
18. Trimax 4 @ 0.03125 + Bidrin 8 @ 0.25	72	$7.75	100	100	100	100
19. Centric 40WG @ 0.03125 + Karate 2.08 @ 0.02	72	$8.68	100	100	100	100
20. CS-AU-44-JO @ 1 qt/acre	72	N/A	99	100	100	100
21. Lorsban 4 @ 0.5	72	$4.75	64	90	90	90

Table 3. Cumulative mortality of field-collected adults of the brown stink bug, *Euschitus servus* (Say), over a 4-d interval following exposure to insecticides (1-µl to ventral abdominal segments) in laboratory bioassays (2003).

Treatment (lb [AI]/Acre)	**Reps**	**$/Acre/ Application**	**% Cumulative Mortality**			
			24 hr	**48 hr**	**72 hr**	**96 hr**
1. UTC	18	$0.00	6	22	28	44
2. Diamond 0.83 @ 0.08	18	N/A	6	6	6	17
3. Diamond 0.83 @ 0.039 + Karate 2.08 @ 0.025	18	N/A	39	56	67	78
4. Tracer 4 @ 0.07	18	$12.75	11	22	39	50
5. Prolex (GF-231) 1.25 @ 0.015	18	N/A	11	17	28	28
6. Karate 2.08 @ 0.03	18	$5.58	39	50	72	78
7. Mustang Max 0.8 @ 0.02	18	$4.71	78	72	72	72
8. Baythroid 2 @ 0.03	18	$4.93	N/A	N/A	N/A	N/A
9. Vydate 3.77 @ 0.25	18	$4.42	78	78	78	78
10. Vydate 3.77 @ 0.33	18	$5.84	100	100	100	100
11. Centric 40WG @ 0.05	18	$7.93	39	44	50	61
12. Bidrin 8 @ 0.25	18	$2.70	94	94	94	94
13. Bidrin 8 @ 0.5	18	$5.40	100	100	100	100
14. Methyl parathion 4 @ 0.25	18	$1.83	89	89	89	89
15. Methyl parathion 4 @ 0.5	18	$3.66	94	100	100	100
16. Leverage 2.7 @ 0.079	18	$11.06	78	78	78	72
17. Trimax 4 @ 0.0469	18	$7.58	11	6	6	11
18. Trimax 4 @ 0.03125 + Bidrin 8 @ 0.25	18	$7.75	94	94	94	94
19. Centric 40WG @ 0.03125 + Karate 2.08 @ 0.02	18	$8.68	94	94	94	89
20. CS-AU-44-JO @ 1 qt/acre	18	N/A	89	89	94	94
21. Lorsban 4 @ 0.5	18	$4.75	11	33	56	72

Table 4. Average yield from simulated mechanical injury to cotton bolls with insect pins at intended treatments and (actual percentage injured) - 2003.

Treatment (actual %)	**Yield (Lint/A)**
1. 10% punctured (11.6%)	852 b
2. 20% punctured (22.2%)	840 b
3. 30% punctured (32.5%)	879 b
4. 50% punctured (48.8%)	866 b
5. 100% punctured (95.5%)	708 c
6. UTC	1053 a

Table 5. Average yield and plant height from simulated terminal injury to young cotton by hand removal of terminal growth (2003).

Treatment (actual %)	**Plant Height (in)**	**Yield (Lint/A)**
1. UTC	35.80 a	1748 a
2. 25% removed	34.38 a	1711 a
3. 50% removed	33.40 ab	1567 a
4. 100% removed	31.75 b	1659 a

Table 6. Average yield from simulated pre-floral bud injury to young cotton by hand removal of squares (2003).

Treatment (actual %)	Yield (Lint/A)
1. UTC	1726 a
2. 25% removed (4 wk)	1604 a
3. 50% removed (4 wk)	1658 a
4. 100% removed (4 wk)	1352 b

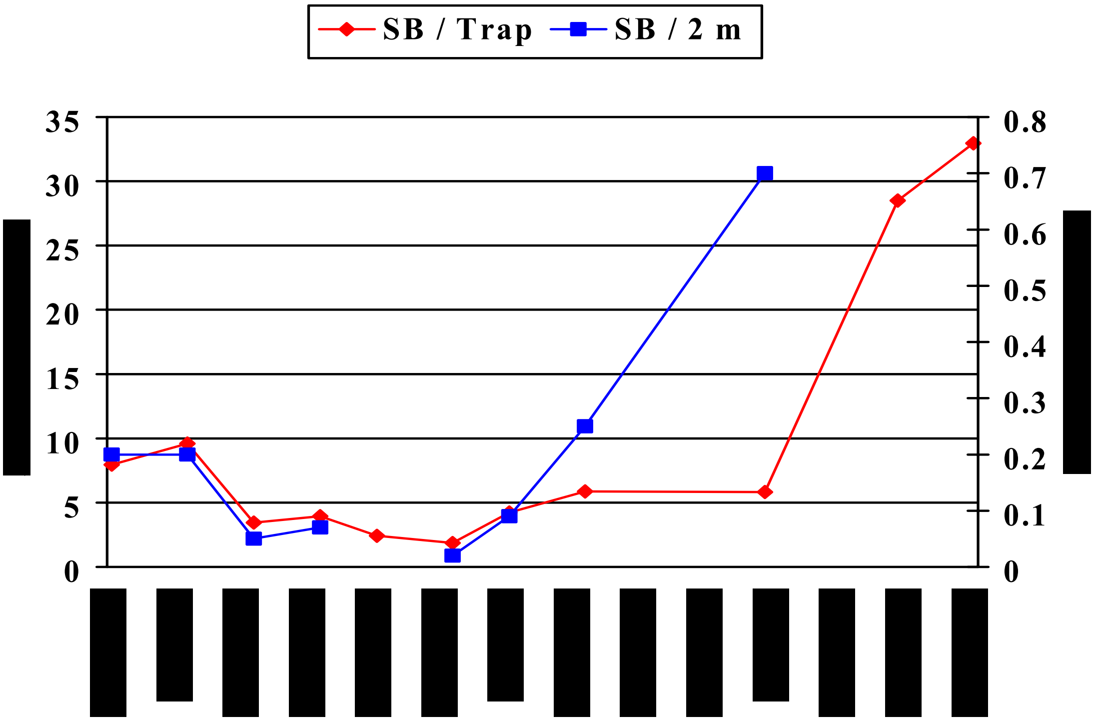

Figure 1. Weekly average number of stink bugs in pheromone-baited traps and shake sheet samples from cotton near Rohwer, AR (2003).

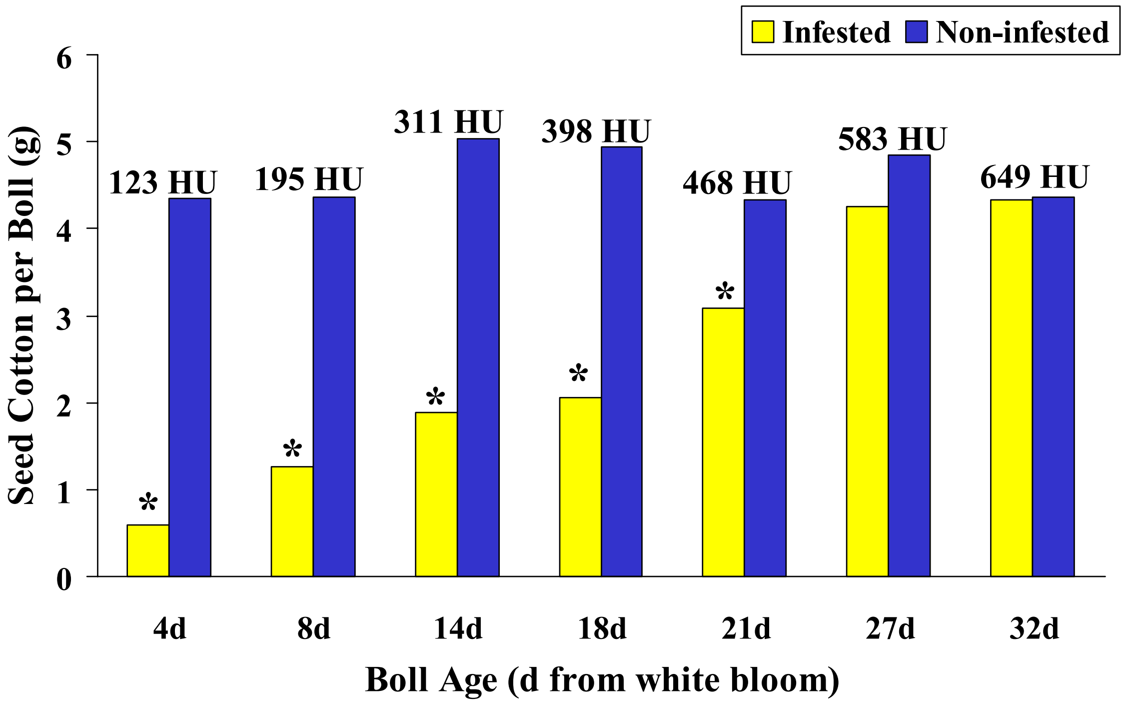

Figure 2. Yields following 1-wk exposure of bolls of varying ages to adults and late 5th instars of green stink bug, *Acrosternum hilare* (Say), from DP468BIIRR cotton in 2003. *Significant difference P < 0.05. HU, heat units (calculated by averaging daily temperature F°- 60 for each day).

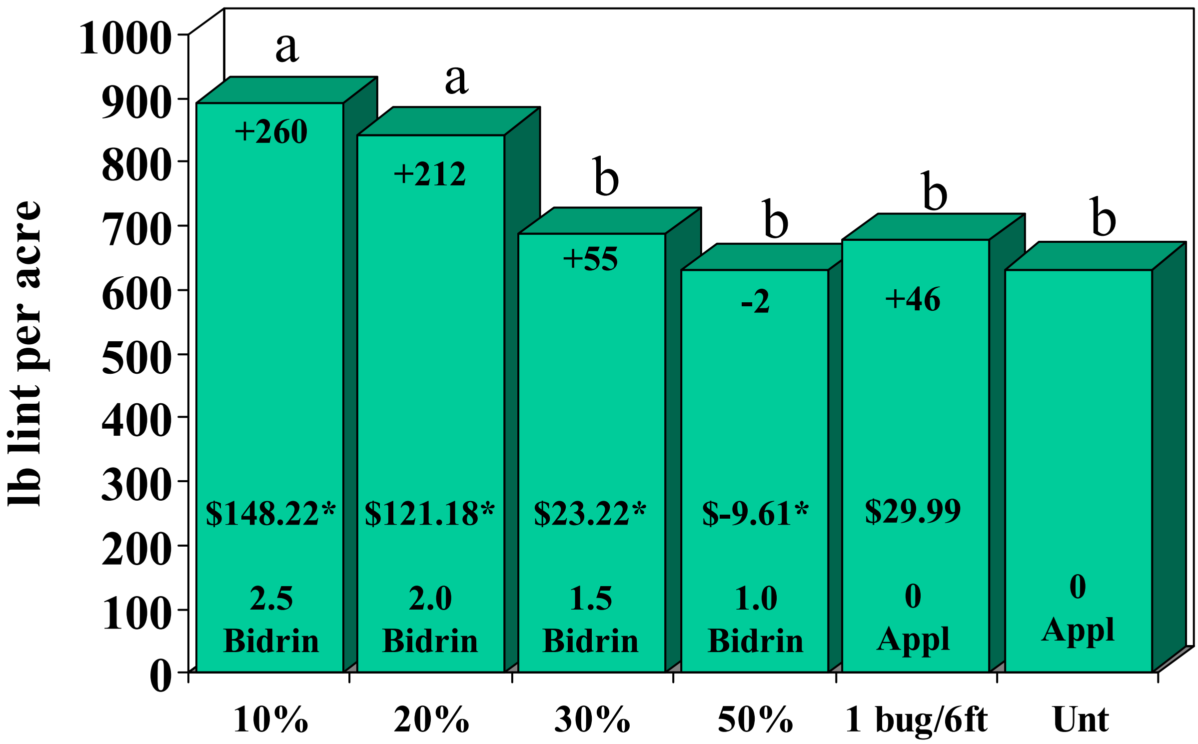

Figure 3. Two-site average (2003) lint yield following treatment with dicrotophos (Bidrin 8, avg.# of treatments per treatment) at various thresholds (percentage of internal boll injury or density) for stink bugs. *Net $ gain, calculated with yield gain at $0.65 per lb minus $8.31 per application ($5.31, insecticide plus $3.00, application costs). Treatment bars with a letter in common are not significantly different, P>0.05, LSD = 146.95.