EVALUATIONS OF FACTITIOUS TRAP CROPS FOR USE IN EARLY AND LATE SEASON BOLL WEEVIL SUPPRESSION PROGRAMS

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Abstract

Grandlure point sources located in prebloom soybean and whorl stage corn plots caused host-seeking boll weevils to immigrate into the plots and converge on the soybean and corn plants near the lures. Grandlure baits also significantly increased populations of boll weevils in nonsquaring and squaring regrowth cotton. The results of these experiments indicated a potential for using grandlure in combination with green crops other than early-planted cotton to form effective factitious crop systems for concentrating host-seeking boll weevils in early and late season.

Introduction

Considerable research has demonstrated that early planted, early fruiting cotton used as a trap crop can be an effective practice to increase efficiencies of insecticide applications used to suppress early season populations by concentrating overwintered boll weevils, *Anthonomus grandis grandis* Boheman, (Isley, 1950; Weaver, 1982; Moore and Watson, 1988; Chiles and Chiles, 1990). Other research has shown that the efficacy of cotton trap crops for concentrating early season weevils can be significantly enhanced by the addition of grandlure (Bottrell, 1972; Scott et al., 1974; Rummel et al., 1976; Burris et al., 1984; Teague and Tugwell, 1996,1997). Bottrell and Rummel (1976) demonstrated that grandlure could also be used to concentrate boll weevils entering natural overwintering habitats.

The objectives of the research reported here were:

1. Determine if selected green crops other than early-planted cotton can be used in combination with various treatments of grandlure pheromone to develop a factitious trap crop system that will effectively concentrate boll weevils in early and late season.
2. Determine distribution patterns of immigrant boll weevils in the selected factitious trap crops relative to placement location of grandlure pheromone point sources.

Materials and Methods

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Crops evaluated with various combinations of grandlure pheromone treatments as boll weevil factitious trap crops included commercial prebloom soybeans in the spring, and fall-planted whorl stage corn, nonsquaring regrowth cotton, and squaring regrowth cotton in the fall. The experiments were conducted in Burleson County, TX, during the spring and fall of 1998 in a cotton production area where populations of overwintered boll weevils are historically known to be relatively high. Different treatments of 10-mg dispensers of grandlure (Hercon Environmental Co., Emigsville, PA) were used in the experiments. The relative number of boll weevils in the experimental plots were determined by whole plot sampling with either a tractor mounted pneumatic sampler (TMS) (Beerwinkle et. al., 1997a) or a hand carried pneumatic sampler (KISS) (Beerwinkle et. al., 1997b). Earlier research had shown that the sampling efficiencies of both devices for collecting boll weevils in cotton varied with the phenological development stage of the cotton plants, but that the results obtained with both devices closely tracked the field population trends in cotton through first bloom (Raulston et al., 1997; Beerwinkle et al., 1998).

Preblooom Soybeans

Nine plots (15 rows wide by 52 ft. long) were established in a commercial soybean field on April 30, 1998. The soybean plants were on 40-in. rows and in the prebloom stage of development (»7 in. tall). Plot treatments were pheromone only, pheromone plus a spray application of a food source (concentrated sugar solution at a rate of 13.5 gal./acre), and an untreated check with three replications. Pheromone treatments were single 10-mg grandlure dispensers attached to marker flags placed in the center of each treatment plot at a height of about 15 inches above ground level. Flags without pheromone dispensers were placed in check plots. Whole plots were sampled for the presence of boll weevils four times (5-hr, 1-d, 4-d, and 7-d post-treatment) with the TMS and the KISS. The TMS was used to sample the entire 52 ft. length of odd numbered rows in each plot, and the KISS was used to sample the even numbered rows of each plot in discrete 13 ft. increments.

Fall-Planted Whorl Stage Corn

Two plots (9 rows x 200 ft.) were established in fall-planted whorl stage corn on September 30, 1998, and each 200-ft. row in each plot was sampled for boll weevils with the TMS. After the pretreatment sampling, nineteen 10-mg grandlure dispensers attached to marker flags were placed along the center row (10-ft spacing) of one plot, and marker flags without pheromone (blanks) were placed along the center row of the other (check) plot. Each row in each plot was sampled with the TMS on three consecutive post-treatment days. Then, the positions of the pheromone lures and blanks in the two plots were reversed. Subsequently, after three days, the plots were again sampled with the TMS. The occurrence of a period of persistent rain prevented additional sampling.

Nonsquaring Regrowth Cotton
Eight plots (9 rows x 100 ft) were established in a defoliated, recently harvested cotton field in which the cotton had begun to regrow but had not begun to form squares. The plots were separated by fifty rows in the cotton field. A boll weevil diapause control treatment of ULV Malathion (14 oz/acre) was applied to the field on October 14. On October 15, marker flags with10-mg grandlure dispensers were placed with 10-ft spacing on the center rows in the four treatment plots, and blank flags with similar spacing were placed on the center rows in the four check plots. An extended period of persistent rain prevented sampling the treated plots until October 26 when each row in each plot was sampled with the TMS on two consecutive days before the cotton was plowed under.

Squaring Regrowth Cotton
Four plots (8 rows x 200 ft) were established in two blocks of squaring regrowth cotton with two plots in each block. Each row in each plot was sampled with the TMS on September 29 to establish the pretreatment distribution of weevils in each plot. Then marker flags with single10-mg grandlure dispensers were placed at 10-ft spacing on the fourth row of one plot in each block. Blank flags were placed with similar spacing on the fourth rows of the other plots. Each row in each plot was sampled with the TMS on four separate days during a six-day period beginning on September 30. The occurrence of a rainy period prevented additional sampling.

In both of the experiments in regrowth cotton, boll weevils were separated from plant debris collected with the TMS by using Berlese funnel separators in the laboratory. Data from all experiments were statistically analyzed where appropriate using ANOVA with mean separations using the LSD procedure ($P < 0.05$).

Results and Discussion

Prebloom Soybeans
Overwintered boll weevils readily responded to the pheromone lures placed in the soybean plots, and the attracted weevils congregated on the plants in the treated plots (Fig. 1). Substantial numbers of weevils were captured in all of the pheromone treated plots during each of the four sampling trials conducted over a 7-d period with the first sampling conducted on April 30, only about 5-h after the pheromone lures were placed in the plots. The boll weevils collected during sampling were not replaced in the plots. The temporal pattern of average boll weevil captures in both sets of pheromone baited soybean plots over the 7-d period were very similar to the pattern of daily captures in standard weevil pheromone traps in the area (KRB, unpublished data). This indicated that weevil populations detected in the soybean plots were transient in nature and that they were affected by the same environmental factors that affected the pheromone trap captures. There were no significant differences between the mean number of boll weevils captured in the pheromone-only and the pheromone+sugar treated plots in any of the four sampling trials (LSD test, $P < 0.05$). This indicated that the presence of the sugar food source had little or no effect on the attractiveness and retention of the boll weevils.

Boll weevils immigrating into the soybean plots in response to the single pheromone point sources tended to congregate on plants in close proximity to the pheromone lures. Boll weevil numbers collected from plants around the pheromone source approximated skewed normal distributions across rows (Fig. 2) and along rows (Fig. 3) with skewness of the distributions apparently caused by the effects of prevailing winds on the weevil responses to the pheromone point sources. Most of the total number of boll weevils (≈ 85 %) collected from the pheromone treated plots were collected from the center two 13-ft row sections along four rows including the adjacent row upwind of the pheromone, the row with the pheromone, and the two adjacent rows downwind of the pheromone. These results indicated that the weevils attracted by the point source pheromone lures tended to clump on the soybean plants near the lure (within 0 to »7 ft).

Fall-Planted Whorl Stage Corn
The experimental plots of fall-planted whorl stage corn were adjacent to a block of maturing cotton heavily infested with boll weevils. No boll weevils were captured in the corn plots during the pretreatment sampling with the TMS on September 29. Substantial numbers of weevils were collected, without replacement, from the corn plants in the pheromone-baited plot during sampling on three consecutive days after pheromone placement in the first sample set, and on the third day following the reversal of treatments in the plots in the second set (Fig. 4). The sampling results in the corn were similar to that observed in the spring-season soybean experiments in that the temporal pattern of boll weevil captures in the pheromone-baited corn plots indicated that the resident populations were transient in nature and that the population densities were greatly influenced by uncontrolled environmental factors. The distribution pattern of boll weevil captures across rows resembled a symmetric normal distribution with a higher than normal central tendency (Fig. 5). This distribution indicates that the boll weevils immigrating into the corn in response to the line of pheromone point sources on the center row tended to congregate on the plants in close proximity to the pheromone sources in a manner similar to that observed in the soybean factitious crop experiments. Greater than 90 % of the total number of boll weevils collected in the corn plots were captured on five rows including the center row and the two rows on either side of the center row (a lateral distance of ± 7 ft from the line of pheromone sources).

Nonsquaring Regrowth Cotton
The factitious crop experiments in nonsquaring regrowth cotton were conducted in late season after stalks in nearby

cotton fields had been destroyed. The experiment was hampered by the occurrence of persistent rain for several days after the lures were placed. However, substantially (9 to 13 X) more boll weevils were captured in the pheromone-baited plots than were captured in the check plots on the tenth and eleventh days after treatment (Fig, 6), indicating a potential for using grandlure treatments in nonsquaring regrowth cotton to concentrate weevils. The distribution pattern of boll weevil captures across rows in nonsquaring regrowth cotton approximated a normal distribution that was slightly skewed, apparently due to the prevailing wind (Fig. 7). The distribution was somewhat flatter with less central tendency than that previously observed in the distributions in the soybean and corn plots. Apparently, the presence of the natural host plants reduced the boll weevils' tendency to clump near to the pheromone sources. Still, more than 75 % of the total number of weevils collected in the two sampling trials were captured on the five center rows of the plots within a lateral distance of about ± 7 ft from the line of pheromone sources.

Squaring Regrowth Cotton

The experimental plots in squaring regrowth cotton were located in a research area between two adjacent blocks of maturing cotton. The maturing cotton had received no insecticidal treatment for controlling boll weevils. The plants in the plots were about 18 inches tall, in full leaf, and heavily squaring. Pretreatment boll weevil populations in the plots were high on Sept. 29 and not significantly different among plots (Fig. 8). In post-treatment sampling without replacement, significantly (2 to 3 X) more weevils were captured in the pheromone-baited plots than were captured in the check plots on four different days in a 6-d period after pheromone placement, indicating a high response to the lures. The variations in the temporal patterns of boll weevil captures over the 6-d period were similar in the treated and check plots, indicating that the resident populations in both areas were transient to some degree and that the population densities in both areas were influenced by uncontrolled environmental factors. The distribution pattern of boll weevils captures across rows of squaring regrowth cotton in the pheromone-baited plots approximated a normal distribution that was highly skewed, again apparently due to the prevailing wind; whereas, the distribution in the check plots was more random (Fig. 9). The distribution pattern for the pheromone-baited plots was considerably flatter with less central tendency than were those obtained for the soybean and corn plots (Figs. 2, 5), and somewhat flatter than was that obtained for the nonfruiting regrowth cotton plots (Fig. 7). Apparently, the presence of abundant food and oviposition sites in the squaring regrowth cotton plots further reduced the tendencies of attracted boll weevils to clump at the pheromone sources. Even though the boll weevil population levels were excessive in the current research area in comparison to those which might be expected in commercial cotton production areas, these results indicate a potential for using grandlure treatments to enhance the concentration of migrating weevils into selected areas of squaring regrowth cotton in the fall.

Summary

The results indicated good potential for using grandlure in combination with green crops other than early-planted squaring cotton to form effective factitious trap crops for attracting and concentrating host-seeking boll weevils in early and late season. However, the distribution patterns and movement behavior of immigrant boll weevils appeared to be different for the different crops evaluated. The distributions of boll weevils that were attracted by grandlure point sources into soybeans and corn, plants that did not provide sources of food or oviposition sites, were more highly clumped in plants close to the lures than were the weevils attracted into the nonsquaring and squaring regrowth cotton. The boll weevils in the soybeans and corn also appeared to be more highly transient than those in the regrowth cotton. These factors would need to be considered in the development of an effective toxicant-grandlure-factitious crop system for suppressing early and late boll weevil populations.

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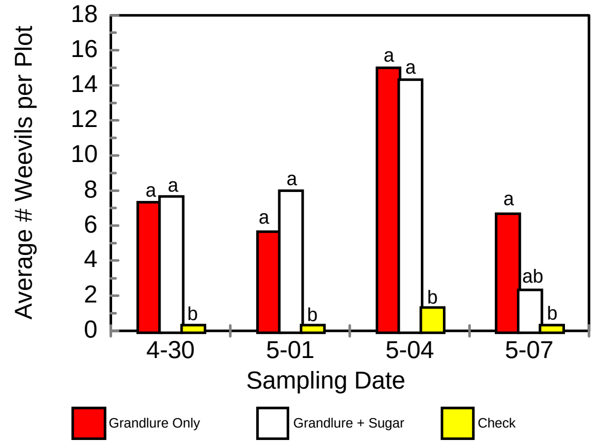

Figure 1. Temporal patterns of boll weevil captures in prebloom soybean plots (15 rows x 52 ft = 0.06 acre) baited with single pheromone lures compared to check plots without lures.

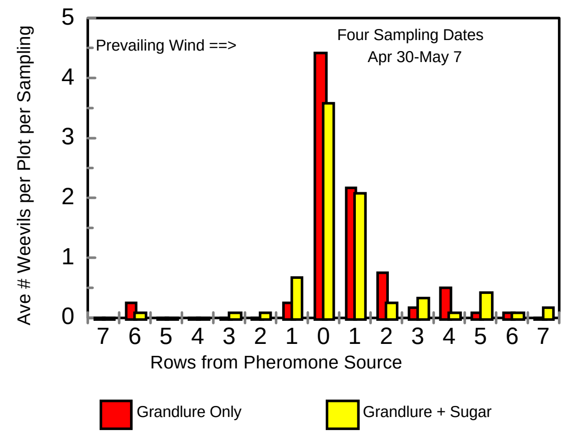

Figure 2. Distribution patterns of boll weevil captures across rows of prebloom soybeans in plots with a single pheromone lure located at the center of the center row.

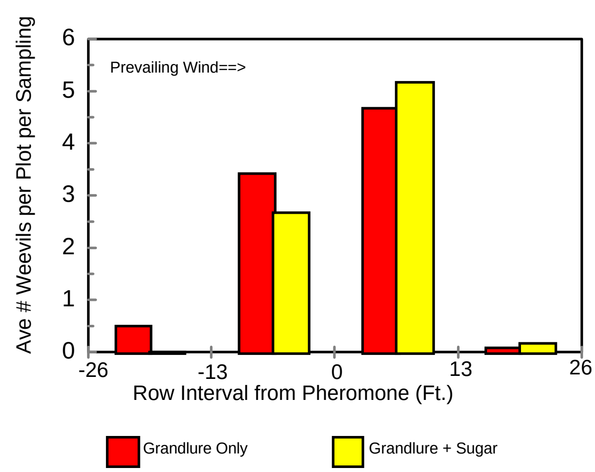

Figure 3. Distribution patterns of boll weevil captures along the rows of prebloom soybeans in plots with a single pheromone lure located at the center.

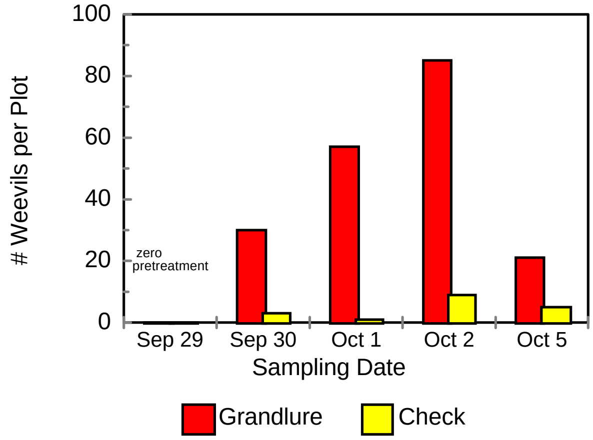

Figure 4. Temporal pattern of boll weevil captures in a whorl stage corn plot (9 rows x 200 ft = 0.14 acre) with pheromone lures spaced at 10-ft intervals on the center row compared to a check plot without lures.

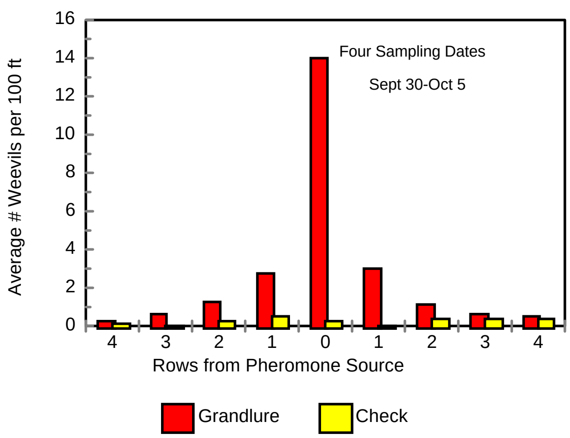

Figure 5. Distribution pattern of boll weevil captures across rows of a fall-planted whorl-stage corn plot with pheromone lures spaced at 10-ft intervals on the center row compared to a check plot without lures.

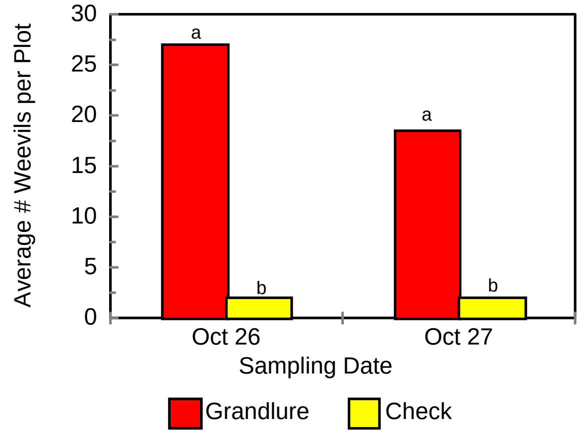

Figure 6. Immigrant boll weevil captures in nonsquaring regrowth cotton plots (9 rows x 100 ft = 0.07 acre) with pheromone lures placed on October 15 at 10-ft intervals along center rows compared to check plots without lures.

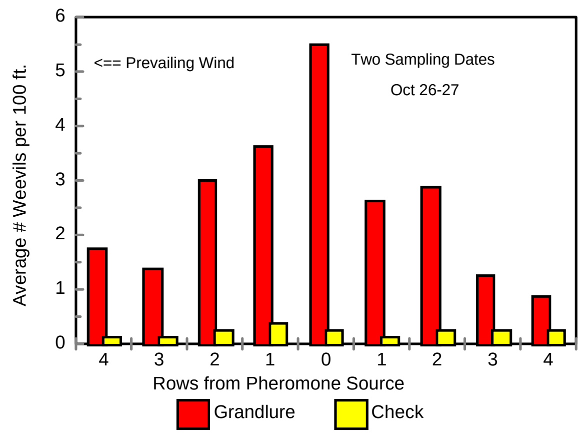

Figure 7. D istribution pattern of boll weevil captures across ro ws of nonsquaring regrowth cotton plots with pheromone lures spaced at 10-ft intervals on center rows compared to check plots without lures.

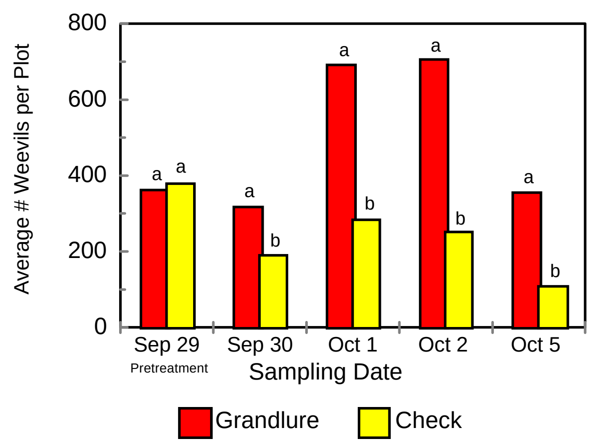

Figure 8. Temporal pattern of boll weevil captures in squaring regrowth cotton plots (8 rows x 200 ft = 0.12 acre) with pheromone lures spaced at 10-ft intervals on the fourth row compared to check plots without lures.

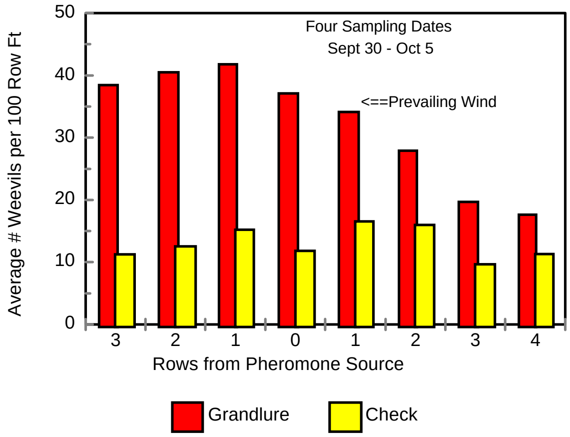

Figure 9. Distribution pattern of boll weevil caprtures across rows of squaring regrowth cotton plots with pheromone lures spaced at 10-ft intervals along the fourth row compared to check plots without lures.