EVALUATIONS WITH BWACTS IN BRAZIL FOR BOLL WEEVIL POPULATION REDUCTIONS AT CROP TERMINATION

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Abstract

The boll weevil is a major pest of cotton in Brazil. The pest is not "indigenous" to Brazil but it has biologically adapted with high reproduction capabilities and the capacity to widely disperse and survive between crop cycles in the arid, semi-arid and tropical conditions of Brazil. During the last 15 years, the boll weevil has increased pest control costs and caused production losses to Brazilian growers. In order to produce cotton in the presence of this species (*Anthonomus grandis Boh.),* growers had to develop methods and adjust production practices with various Integrated Pest Management (IPM) control techniques.

With the objective to assess boll weevil control efficacy of pheromonal-based products, traps and Boll Weevil Attract and Control Tubes (BWACTs) were installed in historically weevil-infested fields. The test results demonstrated that where the BWACTs were installed at pre-planting, there were:

- 3X less weevil damaged squares in the fields,
- a reduction in the number of insecticide sprays for the control of the cotton pest complex and
- an increase in yield when compared to the "Conventional" IPM Program treatment.

"Collecting pans" placed under installed BWACTs and BWACTs coated with glue and/or cottonseed oil at stalk destruction, exhibited an average boll weevil attraction and kill of 1067.5 weevils per day. The BWACTs demonstrated that they are efficient for attracting and killing weevils at the end of the crop; this significantly reduced the population, lowered the potential for damage to the subsequent cotton crop and reduced the migration of weevils into "near-by and distant" refugios for surviving between crops. The use of the BWACT as a component in IPM programs provides significant advantages to a cotton production system.

Introduction

The cotton boll weevil was first detected in Brazil in 1983; during the next 17 years, it dispersed into the various cotton production regions, infesting about 70% of Brazil's cultivated areas. The weevil had a significant influence in removing more than a million cotton producers from the industry, principally small family farms with low levels of production technology; this resulted in Brazil becoming a cotton importer, instead of an exporter.

The weevil is considered an important pest that has a high reproduction potential, a large capacity for migration into cotton regions and the capability for multiple generations in a crop cycle (Bradley and Phillips, 1978). The physiological characteristics of the pest and the diversity of flowers (with pollen as a food source) in Brazil, permit high levels of weevils to survive between crops and these weevils damage production in the subsequent crop. The ecosystems in the regions of Brazil where cotton is cultivated have conditions that almost guarantee the survival of boll weevils. The weevil is a pest of major economic importance, because of its rapid reproduction and damage capacities; when adequate control methods are not employed, losses at high levels generally occur. In fields infested with weevils, Brazilian growers typically experience an increase of about 35% in control costs. Due to their availability and efficiency, insecticides are the principle tools for boll weevil control.

In recent years pheromonal-based products have been developed as promising tools in IPM programs for several pest species in agriculture. Boll weevil traps baited with "Grandlure" pheromone have been shown to be very efficient for attracting and detecting weevils during the early season and at the end of a crop cycle. In Nicaragua (McKibben, 1994), Brazil (Santos & Hofer, 1996), Paraguay and Colombia (Plato et al., 2000), pheromonal-based products have been validated as an IPM method for the suppression of boll weevil populations.

With the objective to assess the efficiency and agronomic practicality of utilizing "Grandlure" pheromone based products, BWACTs and boll weevil traps (USDA model) were installed at planting and at stalk destruction in cotton growing areas having fields with a history of boll weevils.

Materials and Methods

The BWACTs were installed in selected fields with a "prior" crop history of boll weevils. BWACTs are biodegradable paper fiber "tubes", 3 feet in length that have a lemon lime-green color coating containing a feeding stimulant (cottonseed oil) and malathion insecticide. In the top portion of the tube, a 3 X 3 inch square pheromone dispenser containing 60 mg of "synthetic" Grandlure is inserted. The BWACTs were installed twice per crop cycle, at planting and at stalk destruction. In the fields during the post harvest period, boll weevil traps were installed, baited each 2 weeks with 10 mg Grandlure dispensers and inspected weekly to determine the level of the boll weevil population.

At Planting Installations of BWACTs

During the cotton crop cycle of 1998/1999 (near Jataizinho, Parana), 32 BWACTs were installed 13 days before planting in the field perimeter near boll weevil ("between season") resting sites (refugios). The spacing between the BWACTs was about 45 yards; about 75% of the field perimeter of a 30-acre field had BWACTs between the field border and the refugios. The BWACT treatment was compared with a similar 30-acre field receiving only the Conventional IPM Program. Both treatments were separated by about 2 miles with fields of corn and soybeans. The cotton variety was Coodetec 401 and normal agronomic practices were implemented to ensure a good cotton crop. Damaged square counts were made weekly during 35 to 100 days "after emergence". The squares were collected in a "zigzag" pattern at 10 sites in the field, 10 squares per "site". Each "treatment" field was divided into 2 collection zones, the border and the center of the field. The "border zone" was a band about 15 yards wide and the "central zone" was inspected with about 50 yards between each "site". The data was analyzed for percent damage differences between treatments with "Student test" (Snedecor & Cochran, 1975). The pest complex that occurred in the treatments was compared at each inspection and each spray application.

End of Crop Cycle Installations of BWACTs

After harvest and stalk destruction of fields with a high boll weevil infestation (around IV Centenário, Paraná), BWACTs were installed (in June 1999) in groups of 4 on the borders of 2 fields adjacent to 3 bands of habitats (low quality, high quality brush and river bottom). In each habitat area, the BWACTs were coated with glue or with cottonseed oil or with "no" additive to facilitate the counting of attracted weevils. The BWACTs were installed with 20-inch pans under them to facilitate weevil counts of the "non-glued" BWACTs. BWACTs were installed at 75-yard intervals; weevil counts were made, twice per week for 4 weeks.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 2:1170-1173 (2001)
National Cotton Council, Memphis TN

Results and Discussion

At Planting Installations of BWACTs

During the "in-between" crop period, weevil traps baited with Grandlure demonstrated the presence of high weevil populations; from May to December, monthly captures were an average of 1557.57 in the conventional IPM field and 813.57 in the BWACT treatment fields (Figure 1). The "in-between" crop weevil captures indicate that in the absence of cotton plants, even with the low moisture and low temperature conditions of the state of Paraná, boll weevils have a high survival capacity and a large potential to infest the subsequent cotton crop. In the months between crops, the weevils are in an intermediate state of diapause with reduced metabolic processes; however, as necessary, weevils forage for "flower" pollen to augment their fat reserves that are required for survival between crops.

The punctured square data collected during plant inspections from days 35 to 100, exhibited that the BWACT treated field had better weevil control than the fields under the Conventional IPM program. The "damaged square" data was statistically analyzed and it demonstrated that there was a statistical advantage for "less damage" in the BWACT treatment (Table 1), where numerically there was about 3 times less damage than the Conventional IPM Program that only used insecticides for weevil control. Square counts on the borders illustrated more damage than in the field centers, especially in the BWACT fields (Figure 2).

Table 1. "Cumalative" Boll Weevil Damaged Squares in BWACT and Conventional IPM Fields from day 35 to day 100. 1998/99.

BWACT	10,892	a	CONV.	32,035	b
BWACT BORDER	15,357	a	CONV. BORDER	29,214	b
BWACT CENTER	6,428	a	CONV. CENTER	34,857	b
BWACT CENTER	6,428	a	BWACT BORDER	15,357	b
CONV. CENTER	34,857	a	CONV. BORDER	29,214	a

Data with the same letter are not significant as measured with the STUDENT Test $\sqrt{x+1}$ at the 5% level of probability.

Also, the data indicated that the BWACTs provided a barrier and "blocked" the movement of weevils from the refugios into the "centers" of the fields. The Conventional IPM fields required 3 more insecticide applications (deltametrin and betacyfluthrin) than the BWACT fields for weevil control. The results demonstrate that the BWACT provided for "less" weevil damage to fruiting bodies (Figure 3) and this resulted in a 7.7% yield increase (about 75 lbs. of lint per acre) over the Conventional IPM program.

End of Crop Cycle Installations of BWACTs

The counts of weevils attracted to the BWACTs illustrated that it was easier to count weevils on "glued" BWACTS (average of 1067.5) than when compared to BWACTs with cottonseed oil (767.5 average) and BWACTs with 20-inch pans (74.3 average). Also, the data illustrates a greater dispersal at the end of the crop cycle in the direction of "high quality" brush when compared to the "low quality" and the "riverbed" refugios (Figure 4.)

The "sticking" additives (glue and cottonseed oil) had a 14.36 X and a 10.33 X greater retention capacity of intoxicated weevils; this suggests a possible way to improve the measuring of weevil levels in BWACT fields (Figure 4). The "post harvest and stalk destruction" BWACT installation in the dispersal routes of the weevils affects the dispersal of the population and significantly reduces the survival between crops; as a consequence, this reduces the potential for damage in the subsequent crop. The BWACTs demonstrated that they are an efficient tool or system in IPM programs for the "attraction and kill" of weevils, even in areas with high weevil populations.

Ways to Use the BWACT

The BWACT can be used "before or at planting" and in "post harvest" with the objective to reduce weevil populations in a cotton production system. The BWACTs should be installed on the field perimeter, with a preference position "adjacent" to refugios. But in crops with cultivated areas of 12.5 acres or less, with a rectangular shape, the BWACTs may be installed before planting at a rate of 1 to 2 per 2.5 acres in the field interior. At stalk destruction or during preparation of the field for planting, BWACT installations should be made with proper timing and field placements to ensure an economic return from cotton in the presence of boll weevils.

Conclusions

The fields receiving the BWACTs had lower levels of boll weevil infestations and population growth than when compared with the Conventional IPM Program of only insecticides.

The BWACTs reduced the establishment of weevil infestations during cotton "fruiting" and consequently minimized the risk and losses that could have occurred.

The BWACTS installed in the post harvest period were efficient in the "attraction and kill" of boll weevils. The "sticking" additives (glue and cottonseed oil) on the BWACTs increased the retention of intoxicated weevils on the BWACT surfaces and provided more evidence regarding the size of the weevil populations of the infested fields.

The BWACT installation at "post harvest" destruction of cotton stalks reduced the migration of weevils into refugios for survival between crops. BWACTs should be installed in field perimeters adjacent to known, "between crop" resting sites/refugios.

In small fields (rectangular in shape), BWACTs can be installed in the center part of the fields before planting, at planting and post harvest.

As a "tool" for use in IPM programs, the BWACT permits for more selective insecticide use and provides for a reduction of insecticide applications during a crop cycle; this results in significant advantages for the cotton agro system.

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BWACT with "sticking additive"

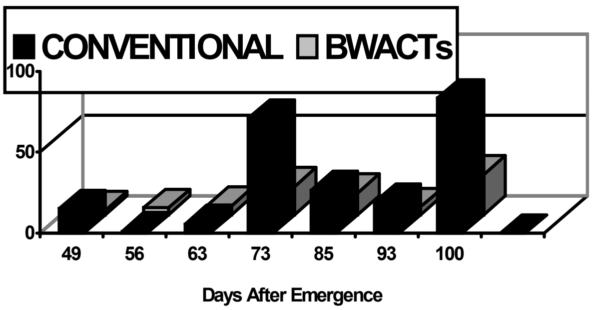

Figure 1. Average Trap Captures of Boll Weevils during the "Between Crop" months in fields near Jataizinho, Paraná. 1998.

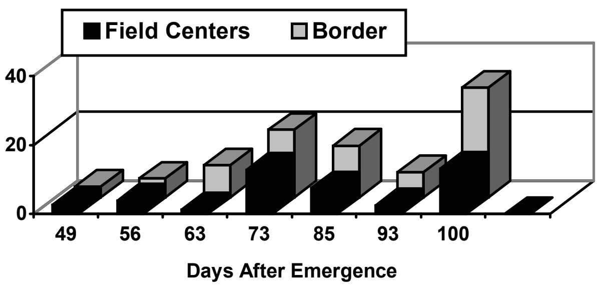

Figure 2. Percent Damaged Square Counts in Field Centers and Borders of BWACT Treatments with Coodetec 401. Jataizinho, Paraná. 1998/99.

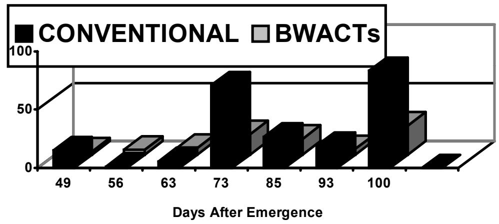

Figure 3. Percent Damaged Square Counts in BWACT and Conventional IPM Treatments with Coodetec 401. Jataizinho, Paraná. 1998/99.

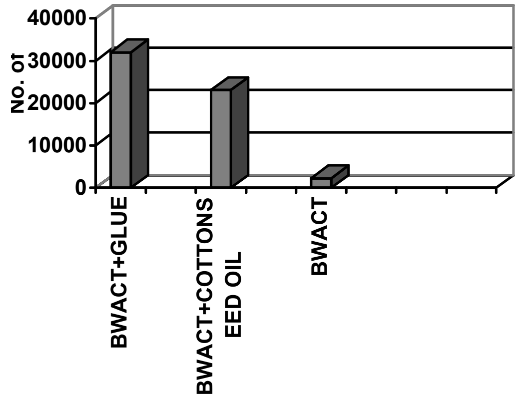

Figure 4. Cumulative Counts of Boll Weevils on BWACTs and in 20 inch pans at the base of BWACTs (29 days). IV Centenário, Paraná. August 1999.