ALTERNATIVE USES OF BWACT (BOLL WEEVIL ATTRACT AND CONTROL TUBE) IN COLOMBIA, BRAZIL AND PARAGUAY

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Abstract

The Boll Weevil Attract and Control Tube (BWACT, TMP or TMB) was evaluated by various research and extension workers in Colombia, Brazil and Paraguay during 1994-1996. Results from using BWACTs in IPM programs have shown high levels of boll weevil attraction and control, delayed initiation of weevil sprays, reduced number of weevil control sprays required to produce a crop, reduced crop damage, increased square retention in the #1 and #2 positions, increased cotton fiber production and greater operating profits from insecticide savings and fiber production.

The use of the BWACT to attract and kill "out of season" or "between crop" weevil populations is discussed as it pertains to Brazilian and Colombian IPM programs and to Paraguayan and Argentine boll weevil prevention and eradication programs. In semi-tropical/tropical countries, boll weevils remain active year round and this provides a unique opportunity for attract and control" tactics. Information is presented on control methods which occur when there are no cultivated host plants available for weevil reproduction.

The methods of deploying the BWACT in quarantine programs in Argentina and Bolivia are explained; the main quarantine objective is to prevent the boll weevil from becoming established in the cotton growing zones of Argentina and Bolivia.

Introduction

Since the introduction of the "Bait Stick" by the USDA, ARS, Boll Weevil Research Laboratory (BWRL) to the cotton industry at the 1991 Beltwide Cotton Conference (Smith et al., 1991), many research and extension workers in Latin America have followed and participated in the development of the technology and the commercial product, BWACT [known as the Tubo Mata Picudo (TMP) in the Spanish speaking countries and Tubo Mata Bicudo (TMB) in Brazil]. The first "Bait Stick" product prototypes were based on a four-foot long, wooden "broom handle" which had a pheromone "cap" and was treated with the "patented coating" containing an insecticide, color attractant, cotton seed oil as a feeding enticer and formulation inert ingredients. The "Bait Stick" results from county wide isolated tests in Tennessee (Smith et al., l992; McGovern et al., 1993), in Georgia (USDA, ARS, BWRL and APHIS unpublished data, 1993) and in Texas (Plato unpublished data, 1992) clearly demonstrated that the technology could be utilized to reduce boll weevil populations to "sub-economically" damaging and targeted eradication thresholds. With the licensing of the technology by the USDA, ARS to Plato Industries of Houston, Texas for commercial development and with expanded field testing in 1992/93, it became apparent that the "Bait Stick" had to be modified before mechanized production could occur and its performance improved, if it were to become a practical product for use in commercial IPM cotton insect control programs and in area wide boll weevil prevention, suppression and eradication programs. The modifications have been reported at previous Beltwide Conferences (McKibben et al., 1993; Plato and Plato, 1995) and the improvements with their resulting effectiveness in area wide tests (McKibben et al., 1994; Daxl et al., 1995; Parvin 1995), in county wide tests (McGovern et al., 1996) and in commercial IPM programs (Roberts and Bradley, 1996; Plato, 1996; Plato et al., 1996) have been reported in the 1995 and 1996 Beltwide Conferences.

Field test results from Mississippi State University, USDA, ARS and APHIS in the Southeast Boll Weevil Eradication Program were instrumental in convincing IASCAV of Argentina (their equivalent to the USDA) to deploy the BWACT on its borders with Paraguay and Brazil during 1994 - 1996 to prevent the entry of the boll weevil into their main cotton growing provinces. The IASCAV Boll Weevil Prevention Program is on-going and successful year to date; it has expanded to a "bi-national" program with Paraguay and its three southern departments (equivalent to states or provinces) bordering Argentina. The area wide results from Nicaragua (McKibben et al., 1994; Daxl et al., 1995) have been extremely beneficial in guiding Latin American cotton producers, consultants, research and extension workers in expanding the use of the BWACT as an IPM component and control system for boll weevils during "in season" and the "non-cotton-growing" months.

Horacio Villavicencio, Guatemalan cotton producer/crop consultant (Summary Test Report, 1996) reported that in 1994/1995 he was successful in reducing an "every year problem" of a large population of economically damaging weevils infesting an isolated cotton farm, Naranjo Finca, from a major problem to a "non problem" in his 1995/1996 crop. Villavicencio implemented an "out of season" program consisting of a thorough stalk destruction in May, 1995, traps to monitor and BWACTs (TMP/TMB) installed from stalk destruction until planting in October 1995. In the 1995/96 crop, he found only one boll weevil in his fields and did not have to make a single spray dedicated for just weevils; whereas, in the previous crop, it was a season long battle against the weevil.

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Discussion

This paper discusses some of the different ways which the BWACT (TMP/TMB) is being employed in Colombia, Brazil and Paraguay to control, as well as to prevent population establishment and provide suppression and/or eradication of the boll weevil. Crop consultants, research and extension workers in these three countries, as well as the countries of Mexico, Guatemala, Nicaragua, Venezuela, Bolivia and Argentina have collaborated with Plato Industries and its distributors to improve the technology, to define its practical applications under their semi-tropical/tropical growing conditions and to find ways to maximize results from the product usage/technology.

Colombia

Ing. Agr. Guillermo Alvarez (retired Technical Director of the Colombian Cotton Growers Association, FEDEALGODON) was the person most instrumental in developing the use of the BWACT (TMP/TMB) in Colombian cotton growing zones in the interior of the country (planting dates from February to April) and the coastal zones (planting dates from August to October). Consistent with the cotton growing environment from South Texas to Argentina, the Colombian cotton zones have distinct wet and dry seasons which never experience freezing temperatures; thus, boll weevils remain active year round. The boll weevil has been an economically damaging pest in the coastal zones for more than 30 years; however, due to several biological barriers, it only became a pest in the interior zones during the last ten years. Depending on the zone, 4 to 14 applications of insecticides are required to keep the boll weevil populations below economically damaging threshold levels. The first field test with the BWACT (TMP/TMB) was installed in 1993 and the first commercial use occurred in 1994. After three years and six crops, the BWACT use program has been "fine tuned" by Alvarez and PLATO's distributor, COLJAP, S.A., for use under local conditions and crop practices.

In each zone, boll weevil "out of crop season" habitats are well defined; thus, the BWACTs (TMP/TMB) are used as a "barrier line" between the cotton and the boll weevil refugios. The control approach is "preventative" and once "in season" populations reach damaging thresholds as determined by trap counts and square damage, conventional, IPM spray programs are implemented. BWACTs are installed:

- During the 15 days before planting up to 5 days after planting on 175 to 250 ft. centers;
- For a second installation, at the initiation of squaring on 90 to 125 ft. centers, between the first installation positions;
- About 21 days before stalk destruction on 200 ft. centers; and
- About 60 days after stalk destruction, on the borders of defined, "out ofseason" resting sites/refugios on 200 ft. centers.

The actual results from using the BWACTs (TMP/TMB) in Colombian IPM programs under two different production operations are reported in Tables 1 and 2. Hacienda Pajonales (Table 1) has an approximate 35 fields containing 3,500 acres of cotton production and CNI-Nataima (Table 2) is a regional experimental station with several fields. Approximately 80% of the fields in each operation were treated with the BWACTs (TMP/TMB) and 20% were left untreated. All fields were sprayed under local IPM criteria as damage thresholds occurred. The BWACT (TMP/TMB) performance was evaluated by Ing. Alvarez by comparing the fruit retention and yields collected. In both field tests, there were substantial positive differences attributed to incorporating the BWACT (TMP/TMB) into their IPM program; the yield increase varied from 26% to 47%. In addition, Alvarez like many other Latin American workers, conducted efficacy and attraction tests. He demonstrated the capacity of the BWACT (TMP/TMB) to attract and kill weevils by comparing 4 BWACTs (TMP/TMB) coated with insect "stick'em" to a trap line of 41 traps (Hardee model). In Table 3 the data from seven days of activity are recorded; the average capture per trap per day was 15 compared to 699 on the BWACTs (TMP/TMB) coated with "stick'em."

Brazil

The BWACT (TMP/TMB) was introduced to Brazilian research and extension workers in 1993 by Plato Industries and its distributor AgrEvo do Brasil. Since that initial introduction, more than 50 laboratory and field tests have been conducted by Brazilian workers, i.e. Eng. Walter Jorge Dos Santos, Enga. Zuleide Alves Ramiro, Eng. Verino Ramos da Cruz, Eng. Antonio Carlos Busoli, Eng. Paulo DeGrande, Eng. Raimundo Braga, etc. In this paper, certain representative results and conclusions are presented.

The general utilization trend for the BWACT in Brazil is to use it as an integral part of their IPM cotton insect control programs. Brazilians have learned to keep their weevil populations to manageable levels by aggressive IPM programs which require from 4 to 8 insecticide applications per crop to keep the weevil below economically damaging levels. The boll weevil is a relatively new pest in Brazil. It entered the country in 1983 and proceeded to spread to nearly all cotton zones. During the last 10 years, it has contributed (among certain other factors) to the cotton acreage decreasing by more than 85% from about 9,000,000 acres to less than 1,500,000. Boll weevils are more severe in the states of Sao Paulo and Paraná than in other states. In these states, the BWACTs are being used as border treatments adjacent to refugios to protect fields from weevils moving into newly planted cotton and at the end of the season to kill weevils leaving the fields for "resting sites/refugios" to pass the "out of season" cycle.

The BWACTs (TMP/TMB) are installed between 10 days before planting until 7 days after planting on 150 ft. centers; at about 35 days after the first installation, a second installation is placed at the 75 ft. position between the 150 ft. centers. At the end of the season at stalk destruction, BWACTs are installed on 150 ft. centers adjacent to the "out of season" resting sites/refugios. The "end of crop" objective is to reduce the population that will be the "seed source" for damaging the next crop. An example of the results of BWACT (TMP/TMB) use in the early season program is illustrated in Table 4. In this test, Verino et al. evaluated the product from square damage, weevil emergence and yield perspectives; the results reveal a yield increase of 21% which is consistent with many other tests in Latin America and the USA.

Walter Jorge Dos Santos, a leader in IPM, (Santos, 1996) has concluded after three years of field testing that the BWACT (TMP/TMB) product can make valuable contributions to IPM programs in Brazil. His conclusions are summarized as follows:

- The BWACT (TMP/TMB) is an acceptable technology for use in IPM programs, especially due to its selective control of only adult boll weevils.
- The BWACT (TMP/TMB) has the advantage of controlling "out of season" (over wintering) adults before they can infest the next crop. In difficult climatic situations, the BWACT will satisfactorily substitute as a trap crop.
- The BWACTs (TMP/TMB) installed in the perimeter of cotton field borders, approximately 10 days before planting, can reduce insecticide costs, delay the occurrence of economically damaging weevil infestations and delay weevil sprays until late season (90 to 110 DAP).
- The BWACTs (TMP/TMB) will reduce next crop surviving weevil" populations, when installed at stalk destruction; thus, BWACTs can reduce future costs and future crop damage.
- The BWACT (TMP/TMB) attracts and kills weevils efficiently for a period of 30 to 40 days under Brazilian field conditions.

Paraguay

The boll weevil entered Paraguayan cotton in 1993 and as in most other countries, it has been instrumental in reducing cotton acreage and causing severe economic damages. The acreage in Paraguay has been reduced in the last four years by about 60%, from an approximate 875,000 acres to 350,000 acres. This has created serious social problems because cotton was typically a "cash crop" for 200,000 small, "campesino" producers who averaged 4 acres per farm and normally produced a crop which required only one insecticide spray for aphids/thrips and one for cotton leafworms. Thus, there are about 200,000 small producers who do not have the "know how" or resources to combat a problem like the boll weevil. The cotton industrialists have not organized to combat the weevil and to provide the much needed assistance to the small growers. In only four years the weevil has spread to more than 90% of the cotton acreage. However, on the positive side there is a high degree of natural boll weevil parasitism which according to local consultants (Gallo, 1995) can rapidly reach 90% by mid season and often delay damage and weevil build up until late season. This is a very favorable phenomenon for enhancing control and eradication programs based on pheromone "attract and control" systems.

The boll weevil devastation in Mercosur has not escaped world attention. In an effort to more broadly educate research and extension workers in Brazil, Paraguay and Argentina, an integrated cotton boll weevil management project was established by the International Cotton Advisory Committee in 1994; additionally, a Bi-National (Paraguay and Argentina) Program to Control the Boll Weevil was formalized in December 1996. In this paper, the use of the BWACT (TMP/TMB) in the Bi-National Program is discussed. The Paraguayan Ministry of Agriculture and Livestock (MAG, primarily represented by Vice Minister G. Lopez, Ing. J. Rhodas, Inga. G. Gomez and Ing. V. Gomez) and the Argentine Institute of Vegetable Health and Quality (IASCAV, primarily represented by Lic. A. Bermejo, Ing. E. Cosenzo, Inga. G. Pardo and Ing. O. Manezzi) are the government entities which are implementing the Bi-National Boll Weevil Control Program.

There are multiple program objectives, the primary ones appear to be:

- To prevent the boll weevil from becoming established in 2,500,000 acres of Argentine cotton.
- To establish the southern tier of Paraguayan Departments (states or provinces) which contain about 50,000 acres of cotton land, as fully operative "buffer zones".
- To eradicate boll weevil outbreaks which occur in Argentina, as well as those populations which have become established in the buffer zone.
- To develop the skill, confidence and methodologies for pushing the boll weevil back to the border of Brazil.

The BWACTs (TMP/TMB) are being employed in the Bi-National Program as outlined in the following:

- In all fields in the buffer zone, the BWACTs are to be installed at the end of the "1st picking", again at stalk destruction and at about 15 days before planting of the subsequent crop. Fields are to be sprayed once at the stalk destruction and during the next crop whenever an infestation is detected by traps and/or damaged squares.
- BWACTs are used in conjunction with sprays to eliminate all detectable infestations in the buffer

zones of Paraguay and the border provinces of Argentina.

- In smaller fields, less than 10 acres, the BWACTs are installed in a 6 X 6 ft. cleared spot in the center of each 2.0 to 2.5 acres.
- In larger fields, the BWACTs are installed on the field perimeter at 125 to 250 ft. centers.
- In quarantine programs, BWACTs are deployed at a rate of 1 to 5 at each gin yard, seed warehouse, truck inspection station, province border crossing and country border crossing.
- During the boll weevil migration months of May to August, BWACTs will be installed on alternating 300 ft. centers along 200 kilometers of the Argentine/Paraguay border road in the Province of Corrientes.

Additionally, a similar program as outlined above is being implemented by the Bolivian Cotton Producers Association (ADEPA) under the technical direction of Ing. Daniel Duran. Boll weevils have been found on the Brazil/Bolivia border, but as of today the weevils have not crossed an approximate 400 mile zone (which is free of cultivated cotton) into the 75,000 acres of cotton near Santa Cruz. In some states of Bolivia, there is an added complexity factor of perennial cotton which is cultivated for home consumption/cottage industry purposes. In such instances, the Bolivian plan is to provide a BWACT at the homeowner level each 60 days; the objective is to attract and kill "hitch hiker" and/or migrating weevils which escape their quarantine program into these local communities. This approach is socially more acceptable than the destruction of home owner cotton trees/plants.

Summary

Research and extension workers in Colombia, Brazil and Paraguay have developed alternative methods of use for the BWACT (TMP/TMB) under their semi-tropical and tropical cotton production zones. The major difference from use in the USA is the deployment of the product at stalk destruction and between crop seasons. The BWACT (TMP/TMB) product improvements relating to malathion as the toxicant of choice, pheromone dispenser modifications, increased pheromone content, duration of insecticide residual control, refinement of field placement, spacing, timing and criteria to measure performance have contributed to good research, extension service, crop consultant and cotton producer results.

IPM programs have illustrated that by incorporating the BWACT in cotton insect control programs, generally one or more of the following benefits can be expected:

- Up to a 95% reduction of an "out of season", surviving boll weevil population;
- As much as 6 weeks delay in the initiation of early and mid season weevil insecticide sprays;
- As many as 9 less weevil insecticide applications during a crop;
- Up to 60% reduction in seasonal square damage from boll weevils;
- As much as 45% increase in retained fruit in the #1 and #2 fruiting positions;
- From 50 to 175 pounds per acre lint increase;
- Operating profit increases of $50 to $115 per acre from insecticide savings and increased yield; and
- Up to a 97% reduction of an "end of season" or "out of season" boll weevil population.

Results from the 1994 to 1996 Argentina boll weevil prevention/control/eradication program have provided evidence that the incorporation of BWACTs in the Paraguay/Argentine Program will substantially contribute to the prevention of infestations and the eradication of the boll weevil "out breaks" in an environmentally acceptable, economical and effective manner.

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Table 1: Average square retention in positions #1 and #2 and seed cotton production in BWACT and conventionally treated fields. Hacienda Pajonales, Colombia

Treatment	Position #1	Position #2	Lbs. Production
BWACT	9.4	6.2	2,668
Conventional	6.9	3.6	1,814
% Difference	36%	72%	47%

Alvarez, 1995

Table 2: Average square retention in positions #1 and #2 and seed cotton production in BWACT and conventionally treated fields. CNI-Nataima, Espinal, Colombia.

Treatment	Position #1	Position #2	Lbs. Production
BWACT	6.4	3.2	1,160
Conventional	4.1	1.8	919
% Difference	56%	78%	26%

Alvarez, 1995

Table 3: Effectiveness of BWACT compared to the Boll Weevil Trap in attraction and kill of weevils. Cerete, Sinu, Colombia.

Treatment	# of Units	Daily Kill/Unit	7 Day Kill
BWACT	4	699	19,575
BW Traps	41	15	4,235

Alvarez, 1995

Table 4: Comparison of square damage, weevil emergence from damaged squares and seed cotton yield from BWACT and conventional treated fields. Porto Ferreina, Sao Paulo, Brazil.

Treatment	Damaged Sqs. @ 66 DAE	Weevil Emerg. @ 66 DAE	Lbs. Production
BWACT	1,531	3	3,120
Conventional	2,284	42	2,576
Difference	62%	13 X	21%

Verino Bersoli and Antonini, 1995