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UPDATE ON THE "ATTRACT & CONTROL" TECHNOLOGY IN BOLL WEEVIL PREVENTION, SUPPRESSION & ERADICATION PROGRAMS IN LATIN AMERICA DURING CROP CYCLES 2003/2004 & 2004/2005

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Abstract

The use of the "Attract & Control" technology (based on the Bait Stick) in boll weevil control, prevention, suppression and eradication programs maintains an important role in Argentina, Bolivia, Brazil, Colombia, Costa Rica, El Salvador and Paraguay. The "Bait Stick" (known as the BWACT® in the USA, the Tubo Mata Bicudo or TMB® in Brazil and the Tubo Mata Picudo or TMP® in Spanish speaking Latin America) has been successfully used in IPM Programs for more than 12 years in Central America and for about 8 years in Brazil. In National Cotton Programs, it has been deployed for 9 years by Paraguay (annually in program acres varying from 500,000 to 850,000 acres) and by Colombia for 5 years (annually in about 100,000 program acres). For 10 years, the country of Argentina has successfully used pheromone traps and TMPs as part of their National Program to detect, eradicate and prevent the establishment of boll weevils in their major cotton zones (currently in about 750,000 program acres). In Bolivia, the National Program is reactivating and TMPs are being installed to eliminate weevils that have become established during the last 2 crop cycles, when the Program was inactive. The "Bait Stick" or TMB/TMP results from the national and IPM programs in Central and South Central America have been outstanding. Where used correctly, as a complement to local production programs, the boll weevil has been removed from the production scheme, populations have been reduced by 95+%, crop damage has been reduced to less than 2%, seed cotton yields have been increased an average of 350 lbs. per acre and the requirements for massive insecticide usage for boll weevil control have been substantially reduced. When used year after year, as an additive to programs, the TMB/TMP has greatly contributed to the elimination of economic damage from boll weevils at an approximate per acre cost of $8.80 per crop cycle and resulted in an average "cost to benefit" ratio of $1:$12, i. e. for each $1 in cost there has been a resulting $12 in benefits". TMB/TMP product improvements and results from the aforementioned programs are presented herein.

Introduction

During 1990, the USDA-ARS Boll Weevil Research Lab introduced the "Bait Stick" to the cotton industry (Smith et al., 1991) as an alternative, new approach for the control of cotton boll weevils, an approach that was "preventive" and predicted to result in the reduction of damaging weevil populations and production costs.

The "Bait Stick" technology was patented by the USDA in 1990 and licensed to Plato Industries in January 1992; during the same time frame, product development efforts were initiated under a Cooperative Research and Development Agreement with the USDA's Boll Weevil Research Lab. Through collaborative work, EPA Experimental Use Permits were obtained and in December 1993, the US EPA granted the "Bait Stick" the first "low risk-low use" insecticide registration in the USA. A key factor in the EPA's decision for granting the registration was the potential use for this technology in the US Boll Weevil Eradication Programs (BWEPs). The "Bait Stick" was introduced commercially in the USA as the Boll Weevil Attract & Control Tube (BWACT), in Brazil as the Tubo Mata Bicudo (TMB) and in Spanish speaking Latin America as the Tubo Mata Picudo (TMP). A comprehensive history of the commercial development of the technology, with an extensive bibliography, was presented in the 2001 NCC's Beltwide Cotton Conference (Plato et al., 2001).

The technology created strong interest in Latin America, as it offered a new approach for solving a serious economic barrier (the boll weevil) to profitable cotton production. In Nicaragua (1993) and Argentina (1994), national programs using the TMPs were designed and implemented against the boll weevil. The Argentine program (PNPEPA) was much larger and more complex; it had to prevent the invasion of weevils from Brazil and Paraguay and to eradicate those that did reach the cotton zones, before reproduction and dispersal. The program has been economical and effective in preventing weevils from reaching, infesting, establishing, damaging and dispersing into its main production areas. This program consists of 1) strategically placed boll weevil traps for monitoring migrating weevils, 2) TMPs for killing weevils before they reached cotton producing fields, and 3) applications of insecticides and installations of TMPs to eliminate outbreaks detected in cotton fields. In Nicaragua, the program was based on installations of TMPs at planting (1 per 1.75 acres) and at stalk destruction (1 per 1.75 acres) on 100% of the acreage; during 1993-1995, the program was very successful in eliminating large populations of weevils (McKibben et al., 1994) and in reducing the requirement

for massive insecticide applications to prevent weevil economic damage (Daxl et al., 1995). The Argentine and Nicaraguan programs led to expanded interest in using the TMB/TMP in other Latin American countries.

Discussion and Program Results

The '"Bait Stick" technology is more widely used in Latin American programs than in the USA BWEPs for many different reasons, but primarily due to the biology of the boll weevil in tropical environments and operational differences between the Latin American and the USA programs. Between the two, there are substantial differences in boll weevil habitats, weevil activity between crops, alternate hosts, farming operations, climates, availability of farm labor, availability of aerial and ground application equipment, flexibility in program operations and availability of financial resources.

According to studies conducted by Gutierrez (personal communication, 2000), "pheromone based technologies for boll weevil suppression would appear to be extremely promising for large areas of South America. At current prices, it would appear to be less expensive and it would reduce, if not eliminate the negative human and environmental health effects, and hence, be more sustainable" than conventional insecticide programs. In his studies, he postulates that 30% of a boll weevil population (within 200 yards of a TMB/TMP) are attracted each day and removed from that environmental area. Thus, with the effective TMB/TMP "killing life" of 6 to 8 weeks, each TMB/TMP has the potential to eliminate an "existing 30,000 per acre weevil population" during 4 weeks and still have a continued "killing activity" for at least 3 more weeks, to "take-out" migrating weevils that move into a TMB/TMP zone from areas outside the 200 yard zone. This is one of the important reasons for the success of the Latin American programs that have made multiple year (2 to 3 years consecutively) TMB/TMP installations at planting and at stalk destruction.

The recommended use of the BWACT/TMB/TMP in IPM and in area wide control, suppression, eradication and prevention programs, based on several years of field experience and results from Argentina, Bolivia, Brazil, Colombia, Nicaragua, Paraguay and the USA, are outlined in the following; each country program has certain variations, but the general use recommendations for Latin America are:

- At the end of a crop cycle, when weevil dispersal commences (weekly trap counts measuring 4+ per trap) or at crop defoliation, TMB/TMPs are installed at one per 200 to 250 feet on all sides of the field perimeters to attract and kill emerging/migrating weevils that occur between sprays; 30 days after this installation or at crop destruction, TMB/TMPs should be installed at the 100 to 125 feet spacing, between those at 200 to 250 feet. This program should continue after stalk destruction, with TMB/TMPs remaining around the field at least until 3 weeks after stalk destruction to attract and kill any weevils emerging from the residual squares and bolls of the crop.
- After stalk destruction, on large farms with "well defined" weevil refuges, a few traps should be installed adjacent to the refuges, and if weevil captures occur, a barrier line of TMB/TMPs (one per 200 feet) should be installed along the side of, or around, any adjacent refuges capturing weevils. The barrier program should continue so long as there are captures in the traps.
- After stalk destruction, on small family farm fields (normally 1 to 5 ac.), 1 to 2 traps should be installed on "down wind" field borders, and if weevil captures occur, a barrier line of TMB/TMPs (one per 200 feet) should be installed along the side of, or around, any fields capturing weevils. The barrier program should continue with replacements each 45 to 50 days, as long as there are captures in the traps.
- At planting of the next crop, TMB/TMPs should be installed (on the "up-wind sides" and adjacent refuge sides) as soon as fields are planted (one per 200 to 250 feet and again 30 days later, in between the first installations, at the 100 to 125 feet positions), around all fields.
- With small producers, in small fields of 1 to 5 acres, at planting of the next crop, TMB/TMPs should be installed (on the "up-wind sides" and adjacent refuge sides) as soon as fields are planted at an equivalent use rate of one per field, a minimum of 1 per 2.5 acres.
- In planted fields, two to three weeks before the "pin-head square" stage, an adequate number of traps should be installed to determine if 1, 2, 3 or if any, "pin-head" sprays would be required. Subsequent to this, no further weevil insecticide applications (unless punctured square data "trigger" an application) or TMB/TMP installations should be made until weevil dispersal occurs at the end of the crop.

These general recommendations for Latin America are applicable for a BWEP, an area-wide "Suppression Program" or for an IPM program. In Brazilian, Colombian and Paraguayan Programs (when used repeatedly, according to recommendations), the TMPs have been instrumental in reducing boll weevil populations to very low levels and this has permitted the crop to be produced without economic damage from weevils. This has

been accomplished by installations of TMPs in all fields of infested zones at planting, at stalk destruction and in some situations, installations along the side of, or around "well defined" refuges.

As a result of Plato Industries participating in the aforementioned programs, significant improvements were made in TMB/TMP use methodology, product quality (stronger control tubes, longer residual control, better pheromone liberation and better stakes for installations) and packaging (better pheromone packages and individually packaged TMBs/TMPs).

Argentina

The equivalent of the USDA in Argentina, SENASA, has a National Program for the Prevention and Eradication of the Boll Weevil (PNPEPA). It started in 1994 and is based upon strategically placed boll weevil traps for monitoring migrating weevils, TMPs for killing weevils before they reach cotton producing fields, applications of insecticides and TMPs to eliminate outbreaks detected in producing cotton fields and at crop termination, programs of complete stalk destruction, with TMP installations. The success of the National Program is measured by weevil captures in boll weevil traps that are placed in the main cotton producing provinces and by the elimination of infestations that periodically occur in about 200 acres of cotton in the provinces of Corrientes and Formosa, adjacent to Paraguay. Until recently there were no weevils captured in any provinces, except for migratory weevils from Paraguay that reached the northeast provinces of Formosa, Corrientes and Misiones; however, in the off seasons of 2002/2003 and 2003/2004, a few weevils were captured in the northern part of the Chaco Province, the major cotton producing province in Argentina.

While migrations have been successfully halted for 10 years with traps and TMPs, and infestations have been eliminated with insecticide applications and TMP installations, SENASA and the cotton industry are very concerned. They plan to continue and intensify the program as originally designed.

Bolivia

The Bolivian Ministry of Agriculture, through its department of plant protection, SENASAG, started a program in late 2004 to reactivate cotton production. To accomplish this goal, several programs need to be put in place and one of the programs is to ensure that the boll weevil is eliminated from the production scheme. Thus, a National Program similar to that of Paraguay is being implemented in concert with the cotton producers' association (ADEPA) in about 35,000 acres.

Brazil

EMBRAPA's National Cotton Research Center (CNPA) has completed 3 years of replicated field tests with the TMB in the state of Paraíba. Their tests were designed to answer the questions regarding how to best use the TMB in the Northeast of Brazil. The tests were well designed, provided good statistical information and defined "how to best use" the TMB in the northeast of Brazil. The tests have demonstrated that the only practical, economical and environmentally acceptable solution for the boll weevil problem in the Northeast of Brazil is the area-wide destruction of cotton stalks and installations of TMBs (1 per 2.5 acres) at the end of the crop cycle and TMB installations (1 per 2.5 acres) at planting.

In other cotton production zones of Brazil, typical results of 90+% population reductions from first year TMB programs with "at planting and end of crop" installations have been demonstrated for several years and efforts are underway with one of the major cotton input supplier companies, FMC, for the use of the TMB to be reactivated in 2005 in the major, mechanized cotton producing states of Brazil.

Colombia

In May 2000, Conalgodon (the National Cotton Production Association) launched, as part of its National Cotton Reactivation Program, a National Plan for the Control of the Cotton Boll Weevil. Good progress and results are being obtained from the Program. The objective is to increase cotton production from about 100,000 acres to 500,000; however, to accomplish this, among other factors, the boll weevil must be taken out of the production scheme. The Reactivation Program contemplates that the National Plan for the Control of the Cotton Boll Weevil will solve the problem by implementing a program of boll weevil traps for monitoring, 2 TMPs per 2.5 acres (one at stalk destruction and again at planting), 100% stalk destruction and concentrated crop plantings in each production zone.

The results of the National Program have been excellent in the interior of the country and in certain parts of the coastal production zones, even though there has not been 100% compliance by some of the producers. As an effort to overcome this problem, isolated field tests were been established in the 2003/2004 and 2004/2005 crops to demonstrate that the National Program is a practicable way to "take the boll weevil out of the production scheme" and thus, eliminate it as an economically damaging pest. The results are excellent and will be published in the next Beltwide Cotton Conference.

Paraguay

In 1997, a 5-year National Plan to Reactivate Cotton was launched; it was based on a "pilot project" that had been conducted in 1995 and 1996 in two production zones of about 100,000 acres. The National Plan was designed to eliminate economic damage from the boll weevil (by using TMPs at planting and at stalk destruction), improve soils through crop rotation and fertilizers, improve seed quality, control insecticide quality, provide crop financing, provide technical services and expand R&D activities for crop production. This program was, and its continuation is, strategically important to Paraguay because cotton has been and remains to be the number one "cash" crop for about 120,000 small, family farms, each averaging 2 to 5 acres of cotton. The "scheme of cotton production" employs and involves about 1.5 million people, a third of the country's population.

In March 2000, the National Program was surveyed by USA, Brazilian and Colombian delegations with a focus on the boll weevil aspects; their reports to the Ministry of Agriculture (MAG) were positive and supportive for program continuation. Their data illustrated that during the third year of the Program, there was no economic damage from boll weevils to the crop, only 1 weevil was captured in traps and no sprays were required for the boll weevil control. During the 5 years, boll weevil captures in traps declined more than 94% with the correct implementation of the National Program.

During the last three crops, an NGO (Non Governmental Organization) in Paraguay has studied the declining conditions of cotton production and reported the impact of the boll weevil damage to cotton production (GEO, 2003). In Figure 1, the impact of weevil damage on a national level, during the last 6 years, is illustrated as the average kilograms of seed cotton production per hectare. According to the NGO, the production statistics are official and from the Bureau of Statistics of MAG.

The failure to fully implement the weevil program in 2000/2001 through 2002/2003 resulted in an average seed cotton loss of 370 kilograms per hectare or 326 pounds per acre. Unfortunately, this occurred again in the 2003/2004 crop, with an approximate loss of 400 kilograms per hectare (350 pounds per acre) and there is expected to be a greater loss in the 2004/2005 crop.

In Figure 2, there is a comparison of the average % square damage from weevils in a zone that had complete installations of the TMPs, as compared to the average square damage of the other production zones in the NGO study. The data demonstrate a 95+% reduction in damage, when the TMP Program is implemented correctly.

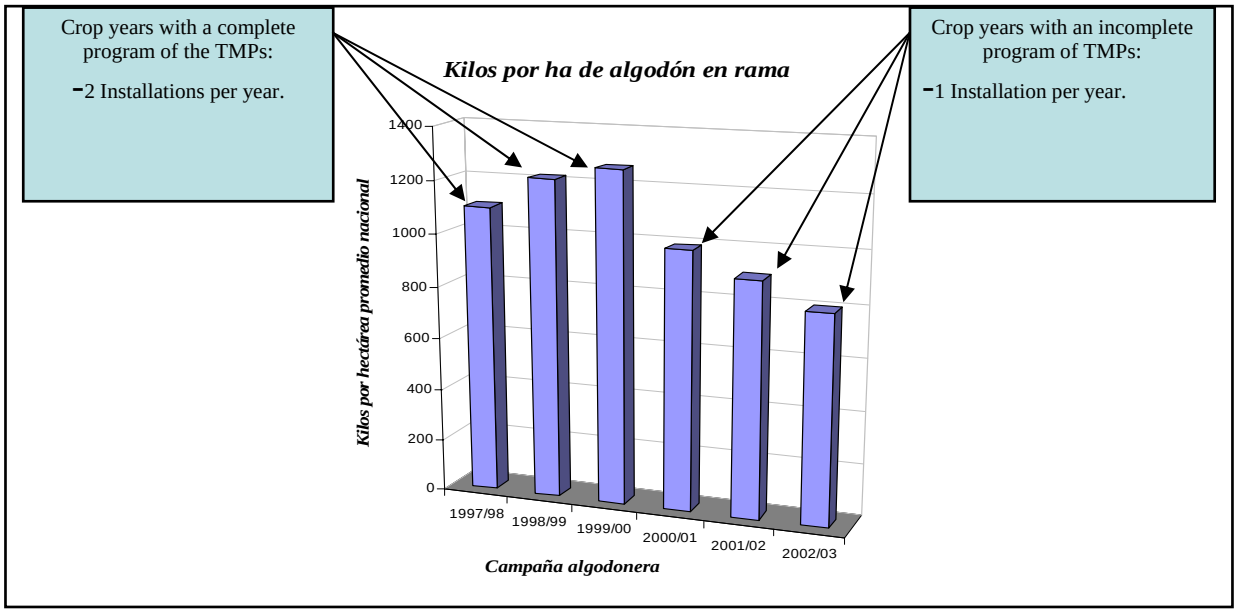

Figure 1. Average Seed Cotton Production 1997 – 2003

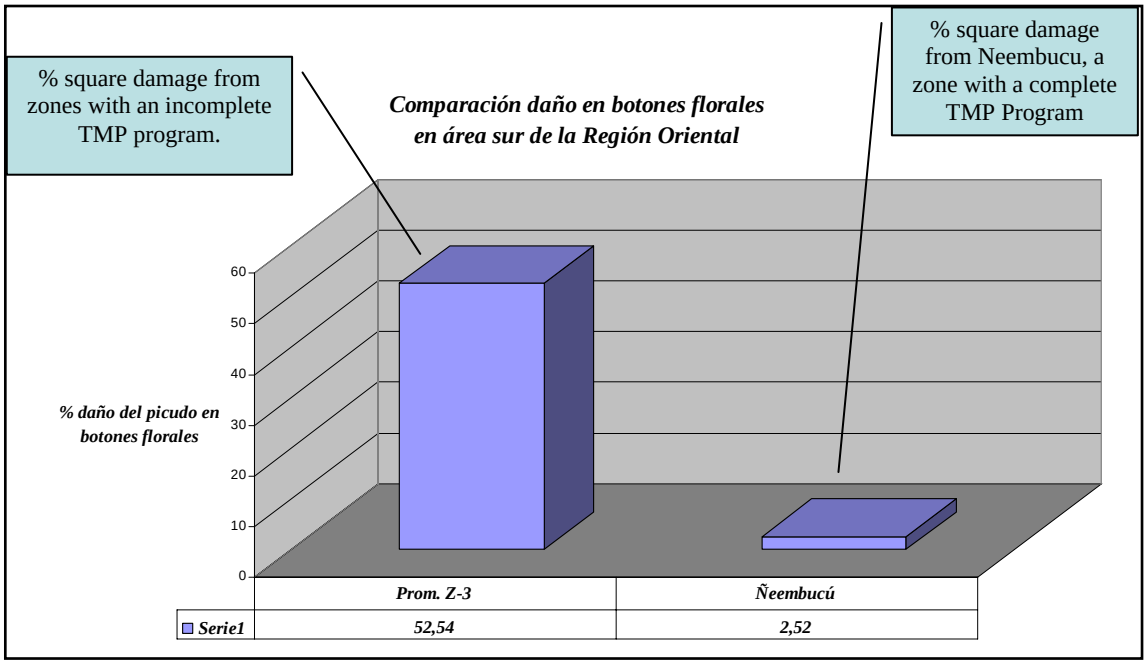

Figure 2. Average percentage square damage during 2002/2003

The data from the Paraguay Program clearly illustrate the need for 100% compliance and for TMP installations at planting and at stalk destruction. Otherwise, the following will continue to be repeated:

- The boll weevil will cause more serious economic damage.
- Beneficial insect populations will be decimated by 6 to 8 applications of insecticides (for weevils), applied through knapsack sprayers by “campesino” producers who have very little knowledge about the correct use of such products.
- Yields will drop.
- Cotton will become less profitable (for various reasons, including increased costs due to the weevil).
- The planted area will probably be reduced.

- The lack of cotton production will create more serious social problems, such as has occurred in other countries of Central and South America.

Conclusion

In Latin America and the USA, the use of the "Bait Stick" technology in boll weevil control, prevention, suppression and eradication programs has been validated various times; it has made good progress and played an important role in an approximate 2 million acres of area-wide programs in Argentina, Bolivia, Brazil, Colombia and Paraguay. The development and use history of the TMB/TMP in area wide programs clearly illustrate that the product and its related technology of "attraction and control" provide an ideal, complementary "tool" (product) for incorporation into area wide programs. In addition, the inclusion of the TMB/TMP in true "IPM - Integrated Pest Management" programs has been repeatedly demonstrated during several years, in more than 150 field tests, to be synergistic and much better than either alone or the alternative of conventional spray programs (wash day, weekly or bi-weekly).

In Latin America, the availability of labor for TMB/TMP installations, the year round boll weevil activity and the 49 + days of weevil "attraction and kill" by the TMBs/TMPs makes the technology very suitable for use in their production schemes and Programs. Whereas, BWACT use in USA programs has been limited for many different reasons, but primarily due to labor for installations and the "operational design" of programs (with limited labor).

Historical and current data illustrate that in order to have a successful National Cotton Production Program in a boll weevil infested region, the weevil has to be "taken out" of the production scheme. In Latin America, mandatory concentrated plantings and TMB/TMP installations at planting and subsequently during a "complete" stalk destruction program have been very economical, effective and environmentally friendly tactics to use for eliminating economic damage from the weevil. When used according to recommendations and as an additive to programs, the TMB/TMP has greatly contributed to the elimination of economic damage from boll weevils at an approximate per acre cost of $8.80 per crop cycle and resulted in an average "cost to benefit" ratio of $1: $12, i. e. for each $1 in cost there has been a resulting $12 in benefits".

In boll weevil infested regions and countries where the technology is not used, it is primarily due to political, competitive and/or operational factors, not for technical and economic reasons.

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