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STATUS ON THE USE OF "ATTRACT & CONTROL" TECHNOLOGY IN BOLL WEEVIL CONTROL, PREVENTION, SUPPRESSION & ERADICATION PROGRAMS IN LATIN AMERICA DURING CROP CYCLE 2005/2006

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Abstract

The use of an "attract & control" product, based on the USDA – ARS invention of the "bait stick" technology, 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 14 years in Central America and for about 10 years in Brazil. In national cotton programs, it has been sporadically deployed for 10 years in Paraguay (in program acres varying from 500,000 to 850,000 acres) and in Colombia for 7 years (annually in about 100,000 program acres). For 11 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 875,000 program acres) and in Bolivia, a similar program is to commence its second year of implementation in about 20,000 acres.

The TMB/TMP usage in the national and/or regional, area-wide programs and in IPM programs in Argentina, Bolivia, Brazil, Central America, Colombia and Paraguay has been demonstrated as a viable alternative, preventive approach for managing the boll weevil. Where used correctly, as a complement to good production practices, the boll weevil has been removed from the production scheme, populations have been reduced by 95+%, seed cotton yields have been increased by more than 350 lbs. per acre and the requirements for massive insecticide usage for boll weevil control have been substantially reduced. When used according to Plato Industries' recommendations, the TMB/TMP, as an additive to IPM programs, 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 to $12".

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, an EPA Experimental Use Permit was obtained and in December 1993, the 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 a "non restricted use" registration was the potential for the 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 the occurrence of reproduction and further dispersal. The PNPEPA program has been economical and effective in preventing weevils from reaching, infesting, establishing, damaging and dispersing throughout the main production areas of Argentina. This program consists of 1) strategically placed boll weevil traps for monitoring migrating weevils, 2) TMPs for

killing weevils before they reach 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 to 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 semi-tropical to tropical environments and the operational differences between the Latin American and the USA programs. Between the two programs, 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 population studies conducted by Gutierrez and his analysis for the FAO (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, they would appear to be less expensive and 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 postulated 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 7 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 TMB/TMP in Latin American programs that have made multiple year installations, 2 to 3 years of consecutive use 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, Central America, Colombia, 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, TMBs/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, TMBs/TMPs should be installed at the 100 to 125 feet spacing, between those at the 200 to 250 feet positions. This program should continue after stalk destruction, with TMBs/TMPs remaining around the field for at least 3 weeks to attract and kill weevils emerging from the crop residue, containing squares and bolls, on the soil surface.
- After stalk destruction, on large farms with "well defined" weevil refugios, a few traps should be installed adjacent to the refugios, and if weevil captures occur, a barrier line of TMBs/TMPs (one per 200 feet) should be installed along the side of, or around, any adjacent refugios capturing weevils. The barrier program should continue so long as there are captures in the traps.
- At planting of the next crop, TMBs/TMPs should be installed (as a minimum on the "up-wind sides" and adjacent refugio 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.
- 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 a barrier line of TMBs/TMPs (one per 200 feet) should be installed along the side of or around fields. The barrier program should continue with additional, fresh installations on the "down wind" perimeters, each 50 to 60 days, as long as there are captures in the traps.
- With small producers, in small fields of 1 to 5 acres, at planting of the next crop, TMBs/TMPs should be installed (on the "up-wind sides" and adjacent refugio sides) as soon as fields are planted at an equivalent use rate of 1 per 2.5 acres, or 1 per field, if less than 2.5 acres.
- In large or small 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 TMB/TMP installations or weevil insecticide applications should be made (unless punctured square data "trigger" an application), 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,

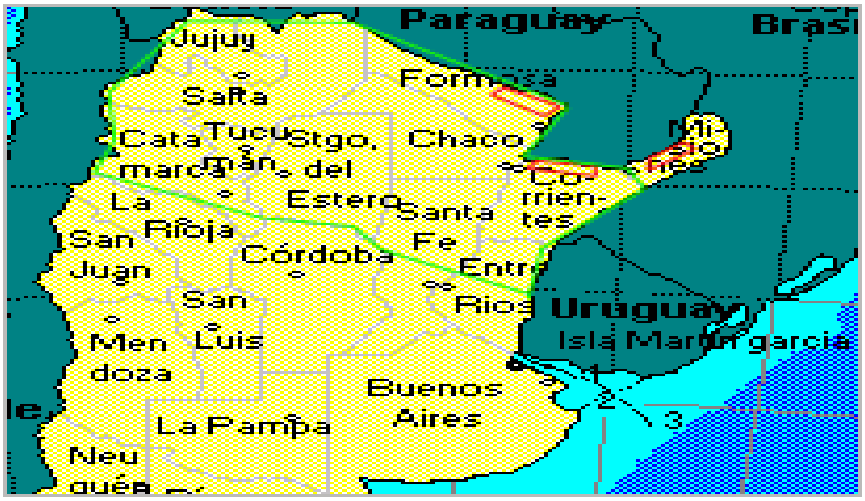
according to recommendations), the TMPs have been instrumental in reducing boll weevil populations to very low levels and this has permitted crops to be produced without economic damage from weevils. This has been accomplished by installations of TMPs in most fields of infested zones at planting, at stalk destruction and in some situations, installations along the side of, or around, "well defined" refugios.

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 longer stakes for tube re-enforcement in heavy rain conditions) and packaging (better pheromone packages and individually packaged TMBs/TMPs).

Argentina

SENASA, the equivalent of the USDA in Argentina, 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, a program of complete stalk destruction. 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 the 2003/2004 crop, 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 2004, newly emerged weevils were captured in fields in the northern part of the Chaco Province, the major cotton producing province in Argentina.

For 10+ years, migrations have been successfully halted with traps and TMPs, and infestations have been eliminated with insecticide applications and TMP installations. However, with the captures of weevils in the Chaco, SENASA and the cotton industry are concerned and the PNPEPA will intensify, as originally designed.



Bolivia

The Bolivian Ministry of Agriculture, thru its department of plant protection, SENASAG, started a national program in late 2004 to reactivate cotton production. To accomplish this goal, several programs needed to be put in place and one of the programs was to ensure that the boll weevil is eliminated from the production scheme. Thus, a National Boll Weevil Program was implemented in concert with the cotton producers' association (ADEPA) in about 20,000 acres of the 2004/2005 crop. Boll weevil traps were installed around fields and when captures occurred, TMPs were installed to eliminate the reproduction of the population in the adjacent fields.

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 questions on "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 the 2005/2006 crop, the FMC Agricultural Products Company commenced a reactivation program for use of the TMB in Brazil. It is being recommended and used by crop consultants and cotton producers at planting and at the end of crop in the states of Paraná, Sao Paulo, Minas Gerais, Mato Grosso do Sul, Mato Grosso and of the Nordest. However, in the states of Goias and Bahia, due to another program for weevils, the TMB is used only in the between crop cycles. For several years, it has been demonstrated that the typical results are a 90+% population reduction during the first year of a TMB program with "at planting and end of crop" installations.

Central America (Costa Rica and El Salvador)

In the country of Costa Rica there are about 2500 acres of winter nursery production of cottonseed for most seed companies in the USA. The TMP is in its second year of use and the results have been very good. Economic damage from weevils has been almost eliminated with the implementation of the installation program at planting (1 TMP / 80 meters and 30 days later, another in between the first at the 40 meter position) and at crop termination (1 at defoliation / 80 meters and 30 days later, another in between the first at the 40 meter position). This program provides about 90 days of pheromone liberation for the attraction and control of weevils in the early part of the crop and again at the termination of the crop.

In El Salvador, the Ministry of Agriculture and the cotton growers association, COPAL, have a program to reactivate the production of cotton in El Salvador. In the 1960's, El Salvador had about 250,000 acres of cotton production, but for many different reasons, the boll weevil being a major factor, production declined to practically zero by year 2000. The new national plan is to develop about 50,000 acres of production for supplying the local textile industry.

As with any new program, there have been start up problems, but the Ministry and COPAL, in concert with the country of Israel, have put together a good technical approach to the program and it is expected to be successful. TMPs are used, and are to be used, in a manner similar to that of Costa Rica, i.e. at planting (1 TMP / 80 meters and 30 days later, another in between the first at the 40 meter position) and at crop termination (1 at defoliation / 80 meters and 30 days later, another in between the first at the 40 meter position). With this program, the approximate 90 days of pheromone liberation for the attraction and control of weevils in the early part of the crop delays weevil establishment in the crop and contributes to the elimination of economic damage. The installation at the termination of the crop will reduce the surviving population to low levels and make the weevil more manageable in the subsequent crop. It is the intention to continue the TMP program year after year and to position the producers with a cotton production program that is without economic damage from weevils.

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 in about 100,000 acres. The Program employs 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 of the two production zones, the coastal and the interior zone.

The results of the National Program have been excellent, even though there has not been complete compliance by some of the producers. As an effort to overcome the lack of compliance, ICA (Instituto Colombiano Agropecuario, the equivalent of the USDA) established official field tests in the 2002/2003 and 2003/2004 crops to demonstrate that the National Boll Weevil Control Program is a practicable way to eliminate economic damage and to "take the boll weevil out of the production scheme" (Villarreal, et al. 2005).

Damaged square data, cotton yields and economic return results were excellent and are illustrated in the following Figures 1 - 4; these test results are consistent with results obtained during the last 12 years in other

tests and are a good example of the benefits of incorporating the TMP in IPM and regional programs. The test design was in randomized blocks, with 4 repetitions for each Treatment and with a separation of about 500 feet (150 meters) between the Treatments and each of the respective reps. The different Treatments in each of the Figures 1 – 4 were:

-- T1: Installation of 1 TMP / 2.5 acres (1/hectare) at stalk destruction and again at planting of the subsequent crop.

-- T2: Installation of 1 TMP / 2.5 acres (1/hectare) at stalk destruction, again at the flowering of adjacent "corn" crops and again at planting of the subsequent crop.

-- T3: Installation of 2 TMPs / 2.5 acres (2/hectare, 1 @ 80 meters and again at 40 meters) at stalk destruction and again at planting of the subsequent crop.

-- T4: "Check", no TMPs were installed.

In Figure 1, the average weekly damaged square data, during the period of 40 to 90 days after planting for each Treatment, are reported during the 2 years:

Figure 1. Average weekly damaged square data during two years from ICA TMP test, Cerete, Colombia. Source: Instituto Colombiano Agropecuario "ICA"- 2005.

Average damaged squares – feeding & oviposition sites from 40 to 90 days after planting.

Treatment	Feeding Damage 2002-2003	Oviposition Damage 2002-2003	Feeding Damage 2003-2004	Oviposition Damage 2003-2004
T1	5.09	7.35	1.58	5.99
T2	3.91	11.67	2.49	9.65
T3	0.91	10.17	0.66	11.08
T4	12.57	17.25	27.33	24.99

T1: 1 TMP at stalk destruction and again at planting of the subsequent crop.

T2: 1 TMP at stalk destruction, 1 at flowering of adjacent corn crops and 1 again at planting of the subsequent crop.

T3: 2 TMPs at stalk destruction and 2 TMPs again at planting of the subsequent crop.

T4: "Check" – 0 TMPs

Damaged square data does not always tell the whole story, but it illustrates a lot and provides a good alert as to when to make curative applications of insecticides for weevils. Treatment T4, without a TMP program, had 3 to 4 times as many damaged squares as did the Treatments with the TMPs.

Figure 2. Average yield data during two years from ICA TMP test, Cerete, Colombia. Source: Instituto Colombiano Agropecuario "ICA"- 2005

Average seed cotton yield (lbs / acre and kgs / hectare) in each Treatment.

Treatments	Seed Cotton Yield per acre / per hectare	
	2002-2003	2003-2004
T1	2398.8 lbs / 2676.7 kgs	2717.5 lbs / 3032.3 kgs
T2	2326.0 lbs / 2595.5 kgs	2807.7 lbs / 3133.0 kgs
T3	2643.1 lbs / 2949.3 kgs	2864.6 lbs / 3196.5 kgs
T4	2198.1 lbs / 2452.7 kgs	2346.2 lbs / 2618.0 kgs

T1: 1 TMP at stalk destruction and again at planting of the subsequent crop.
T2: 1 TMP at stalk destruction, 1 at flowering of adjacent corn crops and 1 again at planting of the subsequent crop.
T3: 2 TMPs at stalk destruction and 2 TMPs again at planting of the subsequent crop.
T4: "Check" – 0 TMPs

The increased yields from the use of the TMP in each of the Treatments in Figure 2 are very clear and where the TMP was used, there was an increase from 287 to 482 pounds per acre (320 to 538 kilograms per hectare) of seed cotton, an average of 355 pounds per acre (396 kilograms per hectare). This increase is consistent with the historical use of the TMP in programs.

Figure 3. Economic analysis of TMP programs during 2002-3 of the two year ICA TMP test, Cerete, Colombia. Source: Instituto Colombiano Agropecuario "ICA"- 2005.

Economic returns from each TMP program in 2002-3

Treatment	Dosage of TMPs	Treatment Cost US $	Net Returns per Hectare		
			Seed Cotton Yield in kilograms	Kilogram increase in Seed Cotton	$ Increase
T1	2	20	2676.7	+224.0	127.86
T2	3	30	2595.5	+142.8	81.60
T3	4	40	2949.3	+496.6	283.77
T4	0	0	2452.7		

Price of Seed Cotton in March 2004 - US $571.43 / metric ton Price of each TMP - US $10 / unit

T1: 1 TMP at stalk destruction and again at planting of the subsequent crop.
T2: 1 TMP at stalk destruction, 1 at flowering of adjacent corn crops and 1 again at planting of the subsequent crop.
T3: 2 TMPs at stalk destruction and 2 TMPs again at planting of the subsequent crop.
T4: "Check" – 0 TMPs

Figure 4. Economic analysis of TMP programs during 2003-4 of the two year ICA TMP test, Cerete, Colombia. Source: Instituto Colombiano Agropecuario "ICA"- 2005.

Economic returns from each TMP program in 2003-4

Treatment	Dosage of TMPs	Treatment Cost US $	Net Returns per Hectare		
			Seed Cotton Yield in Kilograms	Kilogram increase in Seed Cotton	$ Increase
T1	2	20	3032.3	+414.3	236.74
T2	3	30	3133.0	+515.0	294.29
T3	4	40	3196.0	+578.0	330.29
T4	0	0	2618.0		

Price of Seed Cotton in March 2004 - US $571.43 / metric ton Price of each TMP - US $10 / unit

T1: 1 TMP at stalk destruction and again at planting of the subsequent crop.
T2: 1 TMP at stalk destruction, 1 at flowering of adjacent corn crops and 1 again at planting of the subsequent crop.
T3: 2 TMPs at stalk destruction and 2 TMPs again at planting of the subsequent crop.
T4: "Check" – 0 TMPs

The economic returns from either year are impressive and clearly demonstrate that the inclusion of the TMP's preventive approach for eliminating the boll weevil from the cotton production scheme provides a good return on the cost of the TMP program. The most beneficial Treatment was T3 in which the TMPs were installed for extended time periods at the beginning and the end of the crop cycle; the economic return was $284 to $330 per hectare more than the "Check" without TMPs.

In the interior cotton production zone of Colombia, one of the most progressive cotton producing operations is a farm named Pajonales. This farm has been a leader in IPM programs for cotton pests and has been a consistent user of the TMP. In Figure 5, there is a table on the historical use of the TMP.

Figure 5. Results from an Integrated Pest Management Program for Boll Weevils in Pajonales Company, Tolima, Colombia. Source: Tulio Jaramillo, Jefe técnico producción de Algodón, Compañía PAJONALES S.A.; Luz Ángela Mendoza I.A. MSc., Investigador programa MIP. C. I. Nataima

Number of insecticide applications for boll weevil control in Pajoales.

Year	Area (Ha)	# Applications	Observations
1999	306	7.90	Without TMPs
2000	419	1.82	With TMPs
2001	686	1.70	With TMPs
2002	518	0.81	With TMPs
2003	512	2.42	With TMPs
2004	710	0.72	With TMP

Note: With the use of the TMPs in the preventive control of weevils, Pajonales has increased yields to an average production of 4300 kgs / ha (3855 lbs / ac) of seed cotton, the highest in Colombia and 2300 kgs more that the average

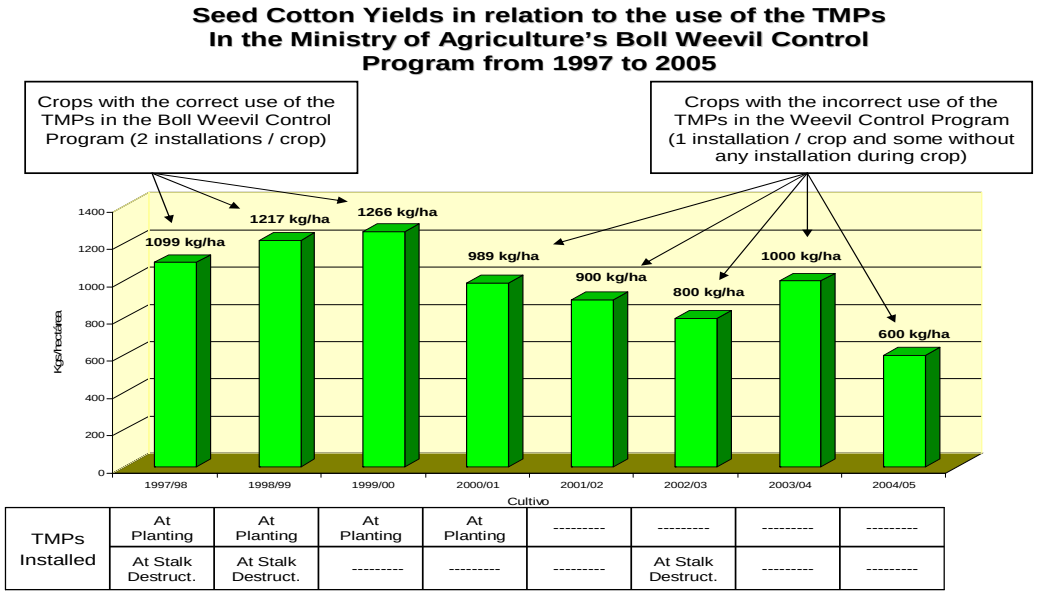
Paraguay

In 1997, a 5-year National Plan to Reactivate Cotton was launched in about 350,000 acres; 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 at crop termination by Brazilian, Colombian and USA 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 observed in boll weevil traps and no sprays were required during the crop cycle for the boll weevil control.

During the 5 years of the National Program, boll weevil captures in traps declined more than 94% when the National Program was implemented correctly.

However, the failure to fully implement the weevil program in 2000/2001 thru 2004/2005 resulted in an average seed cotton loss of about 400 kilograms per hectare (350 pounds per acre) and there is expected to be a greater loss in the 2005/2006 crop, due to the absence of the National Boll Weevil Program. An example of the "good and the bad" years may be observed in the following Figure 6.



Fuente: Ministerio de Agricultura del Paraguay y GEO – Grupo de Estudios de Opinión.

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

- The boll weevil will continue to cause serious economic damage.
- Beneficial insect populations will continue to 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 remain at low levels.
- Income potential to the family farms from cotton production will be cut by at least 50% and the potential cotton exports of the country will be reduced by 50% or more.
- Cotton will become more unprofitable, due to low yields and increased costs due to the weevil control.
- The planted area will probably be drastically reduced.
- The lack of cotton production will create more serious social problems for the country.

Conclusions

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, Costa Rica, El Salvador 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 the alternative of no TMBs/TMPs or a conventional, "wash day, weekly or bi-weekly" spray programs.

In Latin America, the availability of labor for TMB/TMP installations, the year round boll weevil activity and the approximate 90 days of weevil "attraction and kill" with the TMB/TMP programs makes the technology very suitable for use in their production schemes and Programs. Whereas, the use of the Product in USA programs has been limited for many different reasons, but primarily due to the lack of labor for installations and the "operational design" of programs (with limited labor and extensive aerial applications).

Historical and current data illustrate that the weevil has to be "taken out" of the production scheme in boll weevil infested regions, in order to have a successful National Cotton Production Program. In Latin America, concentrated planting dates and TMB/TMP installations at planting and subsequently during "complete" stalk destruction programs 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 weevil control programs, the TMB/TMP has greatly contributed to the elimination of economic damage from boll weevils at an approximate cost of $8.80 per acre ($22.00 per ha) per crop cycle and resulted in an average "cost to benefit" ratio of $1:$12, i. e. for each $1 in cost there have been resulting benefits of $12.

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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