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STATUS OF THE "ATTRACT & CONTROL" TECHNOLOGY IN BOLL WEEVIL PREVENTION, SUPPRESSION & ERADICATION PROGRAMS IN LATIN AMERICA DURING CROP CYCLES 2001/2002 & 2002/2003

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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 continues to make good progress and is being positioned to play a more important role in 1.9 million acres of area-wide programs in Argentina, Brazil, Colombia 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 by Paraguay for 7 years (in about 500,000 ac.) and by Colombia for 3 years (in about 100,000 ac.) in their National Cotton Programs. In state programs in Northeast Brazil (Alagoas, Ceará, Paraíba, Pernambuco and Rio Grande do Norte, currently about 250,000 ac.), the TMB is being deployed as a strategic component to reactivate family farm cotton production and expand "colored cotton" production; while in the central states of Goias and Mata Grosso, the TMB is being evaluated as an effective, economical and environmentally friendly product to stop the exploding weevil populations in about 475,000 acres. For 8 years, the country of Argentina (in about 600,000 ac.) has successfully used pheromone traps and TMPs as part of their program to detect, eradicate and prevent the establishment of boll weevils in their major cotton zones. The Argentines (SENASA) have a strong desire to collaborate on similar programs with Brazil in the States of Parana and Sao Paulo (about 150,000 ac.) and with Paraguay in its departments (same as states) of Neembucu, Misiones and Itapua (about 100,000 ac.); SENASA wants to move the "line of defense against the boll weevil" further away from their cotton growing zones.

The "Bait Stick" or TMB/TMP results from the national and state area-wide programs in Argentina, Brazil, Colombia and Paraguay have been outstanding. Where used correctly, boll weevil populations have been reduced by 95+%, seed cotton yields have been increased an average of 350 lbs. per acre and insecticide usage for boll weevil control has been reduced from an average of 7 per crop to less than 1. As a result, the incidence of mammalian poisoning, outbreaks of secondary pests and damage to beneficial insect populations have practically been eliminated. When used according to recommendations, the TMB/TMP programs have eliminated the 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".

Results from the aforementioned programs are presented herein.

Index terms: *Anthonomus grandis*, boll weevil eradication, BWACT, Grandlure.

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 would result in the reduction of damaging weevil populations and insecticide costs.

The "Bait Stick" Technology was licensed to Plato Industries Inc. 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 to profitable cotton production, the boll weevil. In Nicaragua (1993) and Argentina (1994), national programs using the TMPs were implemented against the boll weevil. The Argentines developed a program to prevent the boll weevil from establishing in its main production areas (at that time about 1,875,000 ac.). This program consisted of strategically placed boll weevil traps for monitoring migrating weevils, TMPs for killing weevils before they reached cotton producing fields and ap-

plications of insecticides and installations of TMPs to eliminate outbreaks detected in producing cotton fields. In Nicaragua, the program was based on installations of TMPs at planting (1/manzana or 1/1.75 ac.) and at stalk destruction (1/mz.) on 100% of the acreage; during 1993-1995, the program was very successful in eliminating large populations of weevils (McKibben et al., 1994) and reducing insecticide applications to prevent weevil damage from an average of 18 to less than 2 per crop cycle (Daxl et al.,1995). The Argentine and Nicaraguan programs led to expanded TMB/TMP use in other Latin American countries.

Discussion and Program Results

Many cotton specialists question why the '"Bait Stick" Technology is more widely used in Latin American programs than in the USA BWEPs. The answers can be found in boll weevil behavioural, environmental and operational differences between Latin America and the USA; 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 and removed from that environmental area each day. Thus, with an effective, "killing life" of 6 to 7 weeks, each TMB/TMP has the potential to eliminate an "existing 30,000 per acre weevil population" during 4 weeks and still have activity for another 3 weeks, to "take-out" migrating weevils that move into a TMB/TMP zone. This is one of the important reasons for the success of the Latin American programs that have TMB/TMP installations at planting and at stalk destruction.

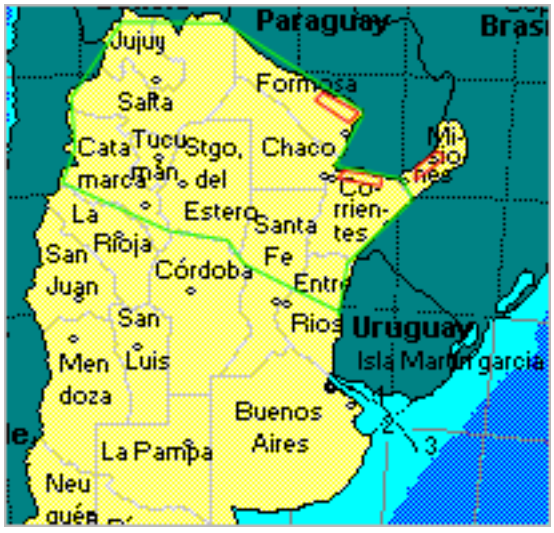
The recommended use of the BWACT/TMB/TMP in IPM and in area wide control, suppression, eradication and prevention programs, based on several years of field experience and results from Argentina, Bolivia, Brazil, Colombia, Nicaragua, Paraguay and the USA, are outlined in the following; each country program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

- At the end of a crop cycle, when weevil dispersal commences (weekly trap counts jumping to 4+ per trap), BWACTs are installed at one per 200 feet on all sides of the field perimeters to attract and kill emerging/migrating weevils that occur between sprays; the BWACTs should be replaced, if necessary, each 45 to 50 days. This program should continue through stalk destruction, with BWACTs remaining around the field 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 refugios, a few traps should be installed adjacent to the refugios and if weevil captures occur, a barrier line of BWACTs (one per 200 feet) should be installed along side of, or around, any adjacent refugios 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 2 to 5 ac.), 1 to 2 traps should be installed on "down wind" field borders and if weevil captures occur, a barrier line of BWACTs (one per 200 feet) should be installed along side of, or around, any fields capturing weevils. The barrier program should continue with replacements each 45 days, so long as there are captures in the traps.
- At planting of the next crop, BWACTs should be installed (on the "up-wind sides" and adjacent refugio sides) as soon as fields are planted (one per 200 feet and again 30 days later, in between the first installations, at the 100 feet positions), around all fields that were treated at the end of the last crop and/or around all fields that were in cotton, treated but are rotated out of cotton for this crop cycle.
- 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 BWACT installations should be made until weevil dispersal occurs at the end of the crop.

These general recommendations are applicable for a BWEP, an area-wide "Suppression Program" or for an IPM program. In the Brazil, Colombian and Paraguayan Programs (when used 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 alongside of "well defined" refugios.

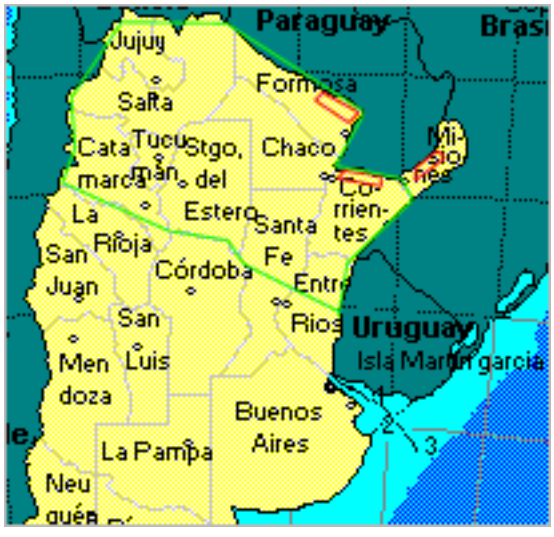
Argentina

Cotton production, the textile industry and the country in general have experienced severe political, climatic and economic problems during the last three years; cotton plantings have decreased from 2,500,000 acres to less than 500,000 and this has made it very difficult for the responsible federal and provincial agricultural authorities to maintain the country free of boll weevils.



The SENASA Boll Weevil Prevention and Eradication Program is based upon strategically placed boll weevil traps for monitoring migrating weevils, TMPs for killing weevils before they reach cotton producing fields and applications of insecticides and TMPs to eliminate outbreaks detected in producing cotton fields. The success of the National Program is measured by weevil captures from about 20,000 boll weevil traps that are placed in the 12 cotton producing provinces and by the elimination of infestations that periodically occur in about 200 acres of cotton in the province of Formosa, adjacent to Paraguay. With the exception of one boll weevil captured in December 1998 in the northwest province of Salta, adjacent to Bolivia and two weevils in the northern part of the Chaco Province, all captures have been in the northeast provinces of Formosa, Corrientes and Misiones

While migrations have been successfully halted with traps and TMPs and infestations eliminated with insecticide applications and TMP installations for 8 years, SENASA is working to move the "line of defense" against the weevils farther north of its 12 cotton producing provinces into the bordering departments (states) of Paraguay (Neembucu, Misiones and Itapua, about 100,000 ac.) and Brazil (Parana and Sao Paulo, about 150,000 ac.).



The apparent intent is to broaden an existing bi-national agreement (between Argentina and Paraguay) into a tri-national agreement that includes Brazil and to implement the SENASA "boll weevil" prevention and eradication program in the aforementioned zones.

Brazil

Due to the national and state governmental elections and depressed cotton prices in 2001/2002, the five programs to reactivate cotton in the northeast states of Alagoas, Ceará, Paraíba, Pernambuco and Rio Grande Do Norte were not fully implemented and the introduction of colored cotton was limited. The Ceará program was partially conducted on about 50,000 acres with good results and their long-term goal remains to eliminate economic damage from weevils and to increase cotton production from 75,000 acres in 2002 to 500,000 in 2005. Cotton production in Northeast Brazil is typically small grower, 2 to 5 acres per farm, low tech and low inputs. In this region, the boll weevil has been widely established for about 15 years and it was the main reason for cotton acreage in the Northeast to decrease from 7.5 million acres of mostly "perennial" cotton to less than 125,000 acres of conventional cotton in 1999.

There is a consensus among the leading cotton specialists that the only practical, economical and environmentally acceptable solution for the boll weevil problem is the area-wide destruction of cotton stalks and installations of TMBs (1 per ha.) at the end of the crop cycle and TMB installations (1 per ha.) at planting.

EMBRAPA's National Cotton Research Center (CNPA) is continuing its replicated field tests with the TMB in the state of Paraíba; their tests are designed to answer the questions on "how to best use the TMB in the Northeast of Brazil?" The tests are well designed and have provided good statistical information in support to the various state programs. Results of these tests will be reported at the next National Brazilian Cotton Congress in September 2003.

Typical results with 90+% population reductions from first year TMB programs with "at planting and end of crop" installations are expressed in Figure 1 and Figure 2.

The average weevil captures (Oct. 2001 – Oct. 2002) in 14 traps (Plato Model) were compared to captures in two previous crops (Jan. 2000 – Oct. 2001). TMBs were installed in 10-23/11-24-01 & 3-13/4-11& 5-24/7-4-02 at 80:40 meter spacing, respectively.

The production zone of Itumbiara has very high weevil populations and during the 2001/2002 crop, the following farms received an average of 10 applications, just for weevils. The owner, Dr. Paulo Shimohira is one of the best cotton producers in Goias and is the president of the cotton growers association, AGOPA.

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. Colombia continues to have many internal security problems and this deters advancement of the National Cotton Program. Additionally, as with most other countries, there is a significant segment of the plant protection industry opposed to changing boll weevil control methodologies and they have successfully delayed the full implementation of the TMP Program.

While the Boll Weevil Control Program is mandatory by law for anyone growing cotton and tied to crop financing, there are problems in enforcement. The objective is to increase cotton production from about 100,000 acres to 500,000 during the next 3 to 4 crop cycles. The Reactivation Program contemplates that the National Plan will solve the boll weevil problem by implementing a program of boll weevil traps for monitoring, 2 TMPs per hectare (at stalk destruction and at planting), 100% stalk destruction and concentrated crop plantings in each production zone. However, until Colombia sorts out its internal problems, progress will continue to be painfully slow.

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 two production zones of about 100,000 acres for 2 years. 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 is strategically important to Paraguay, as cotton is their 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.

The National Program has been audited by USA, Brazilian and Colombian delegations with a focus on the boll weevil aspects; their reports (Internal Reports to MAG, Paraguay, 2000) were positive and supportive for program continuation. Their data illustrated no economic damage to the crop, only 1 weevil capture in traps and no sprays required for the boll weevil.

The performance of the TMPs has been measured primarily through a "trapping" program of up to 1200 traps in the major production zones; this type of trap and other data as illustrated are similar to the approach used by the US BWEPs to measure their program success. The zones and boll weevil captures are illustrated in figure 3.

In Figure 4, key data from 3 years of TMP installations are presented as a comparison of trap captures to a 3-year average, prior to TMP installations and a comparison of the average number of insecticide applications required to produce each crop during 1997-2000.

It should be mentioned that the National Program for Boll Weevil Control was not implemented at stalk destruction in May/June 2000 and this resulted in larger weevil captures in June-October 2000 and an increased use of weevil insecticides in the 2000/2001 crop. The failure to implement the program completely in 2001/2002 resulted an average seed cotton lose of 400 kgs. and 4 applications of insecticides for weevil; this is expected to be case again in the 2002/2003 crop. The data clearly illustrate the need for 100% compliance and for TMP installations at planting and at stalk destruction. Otherwise, the following will be repeated:

- The boll weevil will cause more serious economic damage.
- Beneficial insect populations will be decimated by 6 to 8 applications of toxic insecticides (for weevils), applied through knapsack sprayers by "campesino" producers who have only very little knowledge about the correct use of such products.
- Yields will drop.
- Cotton will be unprofitable (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, as have occurred in other countries of Central and South America.

It would seem that with the success of the Paraguayan Program and other programs as described in the foregoing, there would be a greater consensus on the use of the "Attract and Control " technologies in IPM and area wide programs. But "real world" being "real world", the elimination of 6 applications of insecticides in 750,000 acres represents a loss of about $30,000,000 in insecticide sales and there are a lot of commercial interests to stop the use of the TMPs, regain the insecticide sales in Paraguay and stop the other Latin American programs from deploying the TMBs/TMPs.

Conclusion

Since its beginning in Nicaragua in 1993, the use of the "Bait Stick" technology in boll weevil control, prevention, suppression and eradication has continued to make good progress and play an important role in 1.9 million acres of area-wide programs in Argentina, Brazil, Colombia and Paraguay. The development and use history of the TMB/TMP in IPM and area wide programs clearly illustrates that the product and its related technology of "attraction and control" provide an alternative to conventional spray programs (wash day, weekly or bi-weekly) and "IPM - Integrated Pesticide Management" programs. The TMB/TMP has been demonstrated during several years, in more than 150 field tests, to be an ideal "tool" (product) for integration into true "IPM -Integrated Pest Management" programs.

In Latin America, the availability of labor for TMB/TMP installations, the year round boll weevil activity and the 42 + days of weevil "attraction and control" by the TMBs/TMPs makes the technology very suitable for use in IPM and area-wide 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 to have successful National Cotton Production Program in a weevil infested region, the weevil has to be "taken out" of the production scheme. In Latin America, forced concentrated plantings and TMB/TMP installations at planting and during a "complete" stalk destruction have been the most economical, effective and environmentally friendly tactics to employ for "taking the weevil" out of the production scheme. Where used according to recommendations, the TMB/TMP programs have eliminated the economic damage from boll weevils at an approximate per acre cost of $8.80 per crop cycle and resulted in an average cost benefit ratio of $1:$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 economical reasons.

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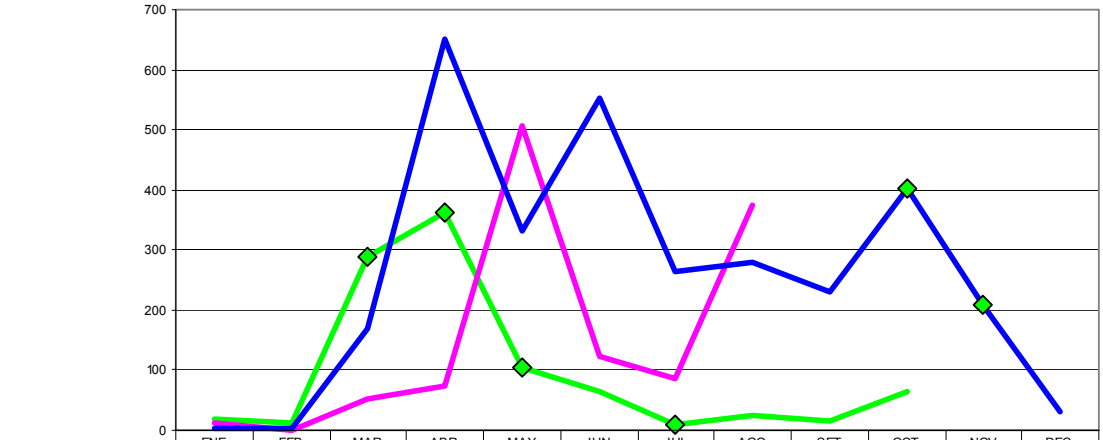
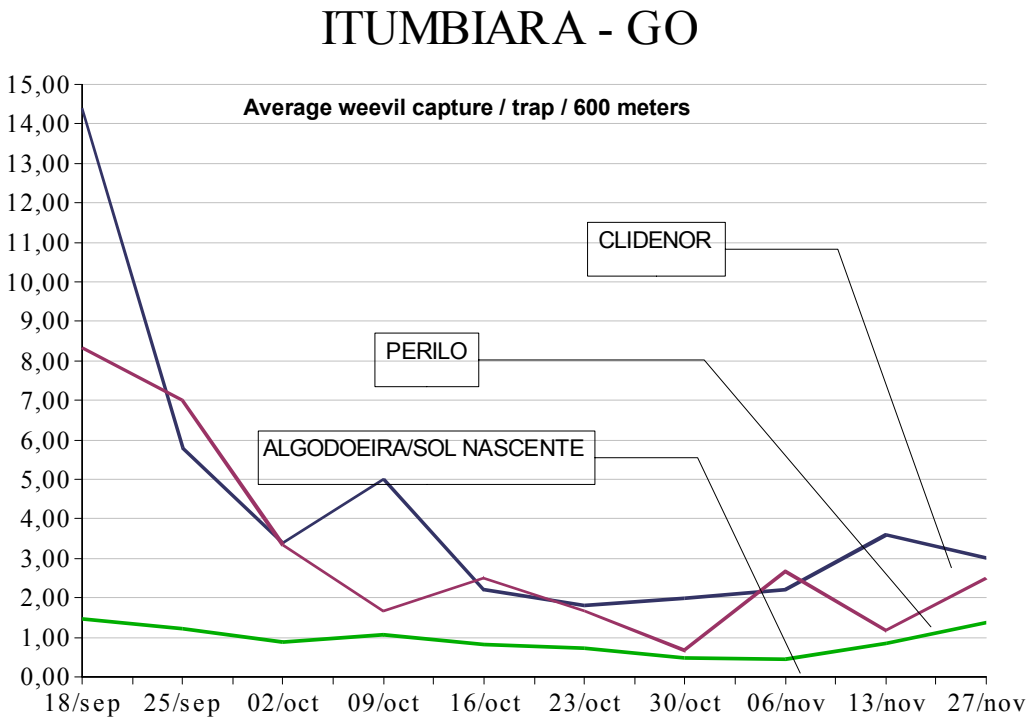


	ENE	FEB	MAR	ABR	MAY	JUN	JUL	AGO	SET	OCT	NOV	DEC
Palotina ano 2002	17.8	12.2	287.1	361.8	104.6	64	9.8	24.6	15.6	63.07		
Palotina ano 2000	13.5	1.2	53.4	74	507.1	123	86.8	373.8				
Palotina ano2001	1.6	3.2	168.3	652	331.7	553.8	264.8	279.4	230.9	403	208	32.2

Figure 1. Eeffect of TMB "at planting & end of crop" installations on a historical high weevil population in a 65 hectare, isolated cottonseed production farm. Palotina, Parana.

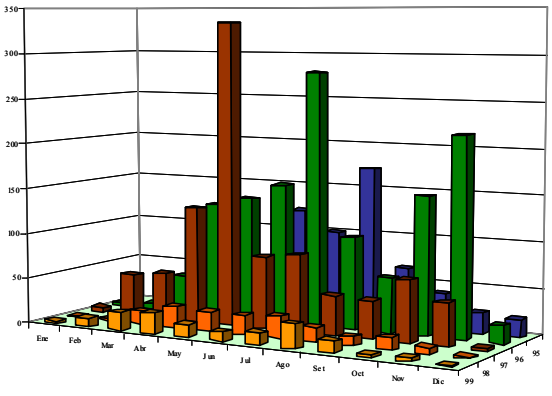


CLIDENOR (18 ha.): at end of crop, 1 TMB / 5 ha. installed [5-30-02]; at planting [11-18-02] no installation of TMBs.

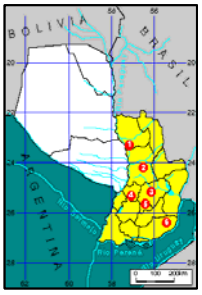
PERILO (76 ha.): at end of crop, 1TMB/1ha/in 2 installations [80:40 meters, 5-30-02 & 6-13-02]; at planting[11-8-02] TMBs installed at 60 meter spacing along side refugios.

ALGODOEIRA/SOL N.(200 ha): at the end of crop, 1TMB/1ha/in 3 installations, 1st. at 80 meters [5- 30-02], 2nd. at 40 meters [6-13-02] & 3rd. at 80 meters [8-17-02]; at planting [11-16-02] 1st. installation, 1TMB at 60 meters; 2nd TMB to be installed?

Figure 2.



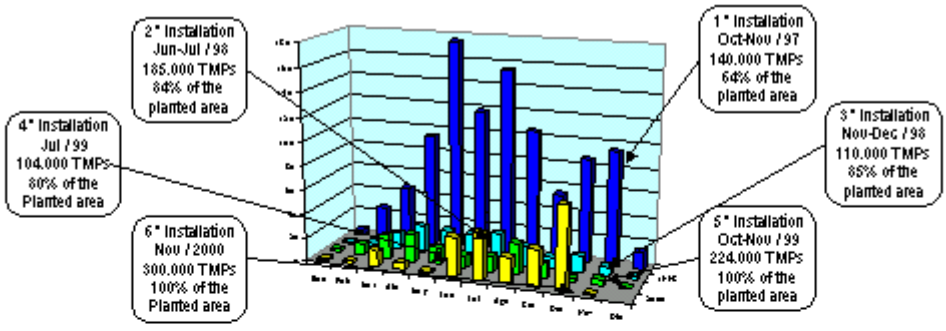
RED DE MONITOREO



- Total: 1200 trampas de feromona
- Localidades: Concepción, Chore, Caaguazú, Caacupé, Natalicio Talavera y T. R. Pereira
- Superficie monitoreada: aprox. 200.000 has.

FUENTE: : Datos suministrados por la Red de Monitoreo del INSTITUTO AGRONOMICO NACIONAL de la DIRECCION DE INVESTIGACIÓN AGRICOLA del MINISTERIO DE AGRICULTURA Y GANADERIA DEL PARAGUAY – Actualizados a Diciembre de 1999.

Figure 3.



Monthly Average Trap Captures	Ene	Feb	Mar	Abr	May	Jun	Jul	Ago	Set	Oct	Nov	Dic
2000	1,48	2,6	13,3	5,9	2,2	33,1	39,8	21,7	30,9	69,8	1,2	
1999	2,8	9,7	19,8	22,5	14,4	10,5	12,9	26,8	12,8	2,8	4,2	1,1
1998	1,6	2,9	14,4	23,3	21,3	21	24	18,4	9,9	13,5	6,9	1,6
Prom. 1998/99/00	4,5	22,05	49,95	94,11	125,28	118,3	154,51	101,68	55,21	89,21	95,21	14,08

Number of Insecticide Applications for Boll Weevil Control					
Before the Use of the TMP		**After the Use of the TMP**			
1995/96 Crop:	1996/97 Crop:	1997/98 Crop:	1998/99 Crop:	1999/00 Crop:	2000/01 Crop:
6 Applications	8 Applications	3 Applications	0,8 Applications	0,1 Applications	1-2 Applications

Source: Data provided by the Instituto Agronómico Nacional, Dirección de Estadística y Censos and Dirección de Extensión Agraria of the Ministerio de Agricultura y Ganadería of Paraguay – December 2000.

Figure 4. Key data from 3 ½ years of TMP use in the national cotton program of Paraguay for the prevention of economic boll weevil damage.