Bol. San. Veg. Plagas, 31: 509-515, 2005

Behavioural control of the cotton boll weevil, *Anthonomus grandis* (Coleoptera: Curculionidae), in Northeast Brazil

J. E. MIRANDA, C. A. D. DA SILVA

The boll weevil, *Anthonomus grandis*, is the most important pest of cotton farms in Northeast Brazil and could cause significant losses to the production. The Boll Weevil Attract and Control Tube (BWACT) have been used by the producers as tactic of behavioural control. Because of their located and specific control, this method is considered an appropriate tool to the concepts of Integrated Pest Management (IPM), working as an alternative to the chemical control. This study sought to evaluate the use of such devices in the control of the boll weevil in cotton farms in Northeast Brazil. In comparative experiments among conventional management (where the use of the chemical control prevails), IPM, and their interactions with the use of BWACT, smaller number of applications of insecticides was verified for the control of the insect in areas where it was allied IPM plus BWACT. The device was efficient on the control of the boll weevil when installed at the planting time and reduced remaining populations of the insect after the stalk destruction. The adoption of IPM plus BWACT resulted in larger liquid incomes than the non adoption of IPM and the non use of the device.

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Key words: Insecta, IPM, pheromone.

INTRODUCTION

In the Paraíba State, Northeast Brazil, cotton farms are located in two different agro ecological regions (*Agreste* and *Seridó* regions) (Figure 1). The *Agreste* region constitutes a singular area due to the natural conditions and the traditional form of small farm organization. *Seridó* region is a depression area that includes Rio Grande do Norte and Paraíba States. Those two regions, although present different agro ecological characteristics, are traditional cotton areas. In spite of accentuated reduction in the area and production of cotton through the last 10 years in the Northeast Brazil, both herbaceous (*Gossypium hirsutum* L. r. *latifolium* Hutch.) and arboreal cotton (*G. hirsutum* L. r. *marie gallant* Hutch.) still represents an important source of income (MOREIRA *et al.*, 1979; 1997). Among the responsible factors for the accentuated fall in the area and production stand out management mistakes, low agricultural inputs and the low technological level used by the cotton farmers (DUQUE, 1973; BELTRÃO, 1996).

The attack of pests to the cotton plants is one of the major problems of the crop. The control of these pests has been done through the application of broad spectrum insecticides, whose economical investment most of the time burdens or even makes unfeasible the production, since almost producers explore areas up to 12 acres using familiar labor. Among the pests of the crop stands out the boll weevil, *Anthonomus grandis*, which

can cause significant losses in the production when the control is not efficient (RAMALHO *et al.*, 1993; SILVA & ALMEIDA, 1998). For control of the boll weevil, chemical insecticides are frequently used. However, the collateral effects resultants of their constant use are known. Among them, the principal harmful effects are caused to the environment, affecting live organisms and causing biological unbalances and favoring the resistance of target-pests, turning the treatment, in many cases, ineffective and uneconomical (MELO & AZEVEDO, 2000). In this way, the Integrated Pest Management (IPM) is notably important to the sustainability of the cotton ecosystem of the Northeast Brazil.

In any program of IPM, it is always tried to reduce the number of spraying with chemical insecticides, taking maximum advantage of other alternative methods of control. The reduction of pest populations through behavioural control stands out as an option capable to minimize the damages that those pests have been causing to the cotton crop, without bringing damage to the environment. To reach this purpose, the Boll Weevil Attract and Control Tube (BWACT) is a device of located and specific control of the pest, considered as an appropriate technology to the concepts of IPM (SANTOS, 1996).

The BWACT is an attract and control device that is installed in the field perimeters for the specific control of the boll weevil; it is a system that incorporates the use of grandlure pheromone and a coating containing an insecticide and a feeding stimulant on a biodegradable, one meter tall, tubular kill station (PLATO *et al.*, 2001). The sexual pheromone glandlure is a mixture of chemical substances emitted by males of boll weevils. BWACT was registered in the U.S.A. in 1992 and have been used as an alternative of control of the insect.

In a research to test the insecticide malathion, VILLAVASO *et al.* (1993) verified that BWACT with malathion presented larger control efficiency (48,6%) than BWACT without the insecticide, proving the effect of the product in the control of the insect.

VILLAVASO *et al.* (1993) and SPURGEON *et al.* (1998) agree that BWACT devices have four times larger power than traps to attrac-

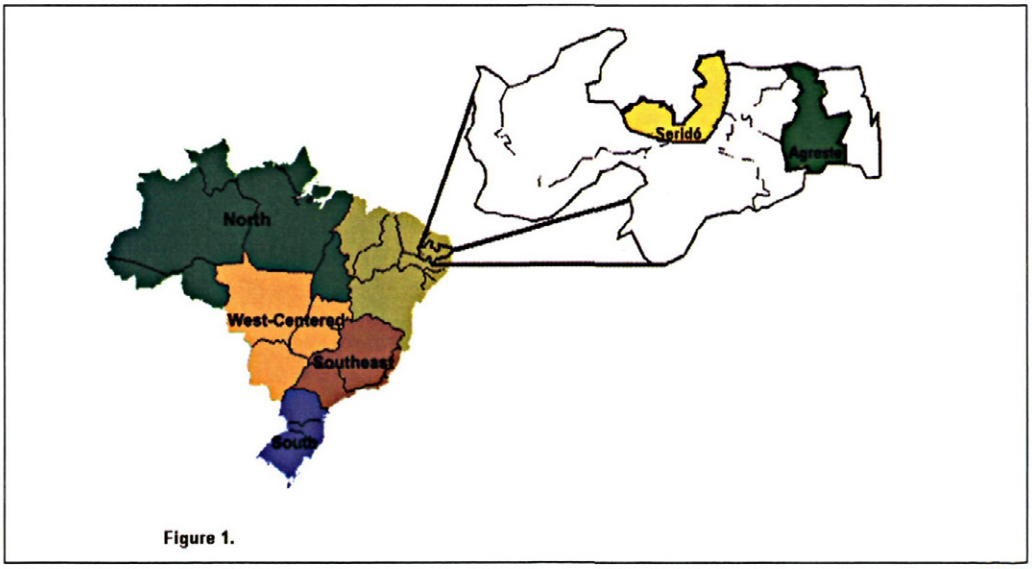

Figure 1. *Seridó* and *Agreste* regions, areas located in the Northeast Brazil.

Figure 2. Boll Weevil Attract and Control Tube installed in the experimental area of cotton crop.

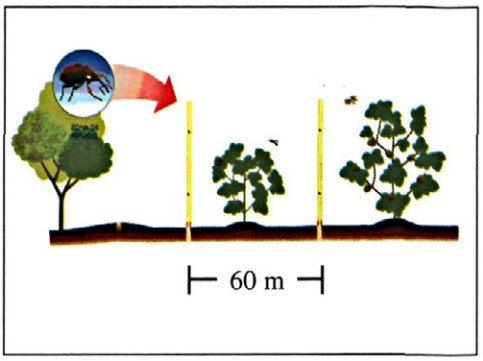

Figure 3. Schematic representation of BWACT devices installed around the cotton area.

tion and capture. This occurs probably due to the largest available amount of attractant in that device.

In Argentina, a national plan of control of the boll weevil has been executed with views to contain the migration of the insects from Paraguayan areas to the Northeast area of that country, through monitoring traps, BWACT devices and destruction of cultural remains (PLATO *et al.*, 2001).

In Colombia, a monitoring system in the cotton areas has been executed using BWACT devices as instruments of control of the insect and traps to the monitoring of the populations (GONZÁLEZ *et al.*, 2003). According to the authors, the traps allow the opportune decision of control when the populations of boll weevils increase, besides act as indicators of the efficiency of the plan of insect control.

The area of cotton production in Paraguay was reduced from 1,400,000 acres to about 280,000 acres between 1991 and 1997 due to the migration of the boll weevils to that country, the increase of the production cost and the incorrect use of chemical control. Starting from 1997, a national plan of cotton reactivation was implemented, being used traps, BWACT devices and destruction of cultural remains, and began to revert the picture of decline of the crop, and in 2000/2001 the cotton area was already expanded to 780,000 acres (PLATO *et al.*, 2001).

This research had as objective to determine the efficiency of the BWACT in the control of the boll weevil, *Anthonomus grandis*, in cotton crops of the Northeast Brazil.

MATERIAL AND METHODS

The research was accomplished in areas traditionally infested by the boll weevil, at four municipal districts of the Paraíba State, Brazil. In each site, four areas of farmers were used, measuring about 4 acres.

BWACT devices were installed in areas measuring approximately 4 acres, in the side of the predominant wind direction and close to the refuge sites of the pest, in the periphery of each area, at the cotton planting time. Thirty days after the installation, other BWACT devices were installed, between the first ones (Figure 2).

The treatments were the following ones: conventional control (without BWACT); conventional control plus BWACT; IPM control (without BWACT) and IPM control plus BWACT. The experimental design was arranged in randomized blocks, with 4 treatments and 4 replicates, being each block represented by a municipal district.

The evaluations were made at intervals of seven days, being taken 50 plants in each area, through zigzag walking on the crop area. The samplings to search the boll weevil individuals started after floral initiation until

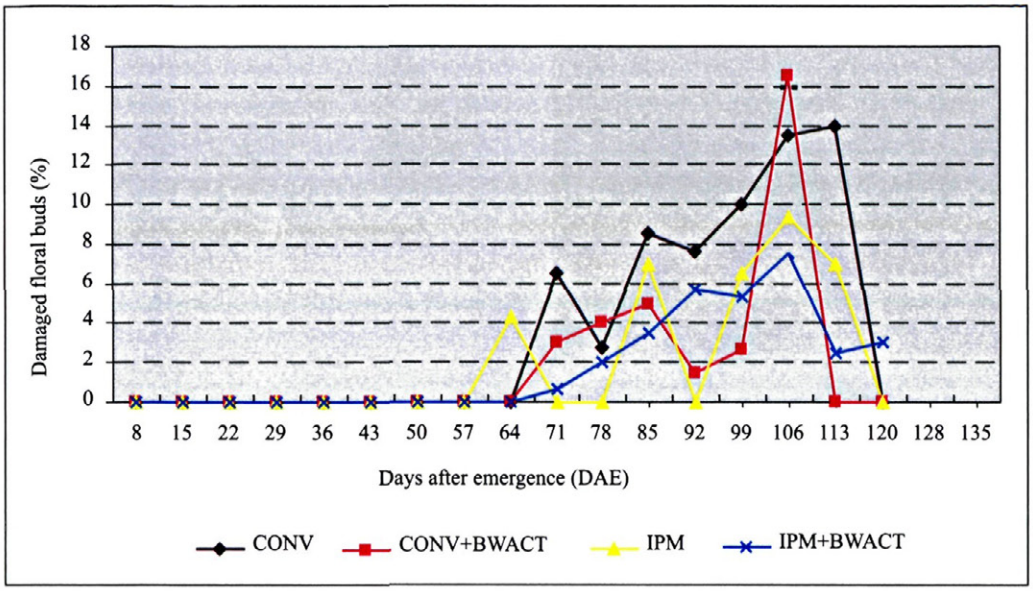

Figure 4. Incidence of floral buttons damaged by boll weevil in the semi-arid area of Paraíba State, Brazil. 2003.

the emergence of the first boll in the crop.

At the end of the crop season, 2 BWACT devices were installed at each area, at intervals of 60 m each one, on the side of the exit of the wind, close to refuge sites (Figure 3), and other BWACT devices were placed between the first ones, at the stalk destruction time.

The rates of damaged floral bolls and the productions were calculated and compared by Duncan's test at 5% probability.

RESULTS AND DISCUSSION

The largest flower bud damages occurred in conventional and conventional plus BWACT treatments, comparing to the IPM and IPM plus BWACT treatments. The largest percentage of damaged flower buds was observed in the conventional (without BWACT) treatment, while the smallest percentage of damaged flower buds was observed in the IPM plus BWACT treatment (Table 1). The conventional treatments (with and without BWACT) were 1.7 and 1.9 times more damaged in relation to the IPM treatments, respectively. BWACT treatments were, respectively, 8.9 and 19.0% less damaged compared to the no BWACT treatments.

The first damaged flower buds were observed at 57 days after the emergence (DAE) (Figure 4). The largest picks of damaged flower buds were observed from 106 to 113 DAE.

The insecticide spraying number accomplished in the four treatments varied from 3.25 (IPM and IPM plus BWACT) to 4.7 (conventional with and without BWACT).

Table 1. **Damaged flower buds in areas with and without BWACT in the *Agreste* region of Paraíba State, Brazil. 2003.**

Treatment	Damaged flower buds (%)
Conventional	6.68 a[1]
Conventional + BWACT	6.06 ab
IPM	5.07 bc
IPM + BWACT	4.62 c

[1] Averages transformed in arc sen $\sqrt{x+1}$

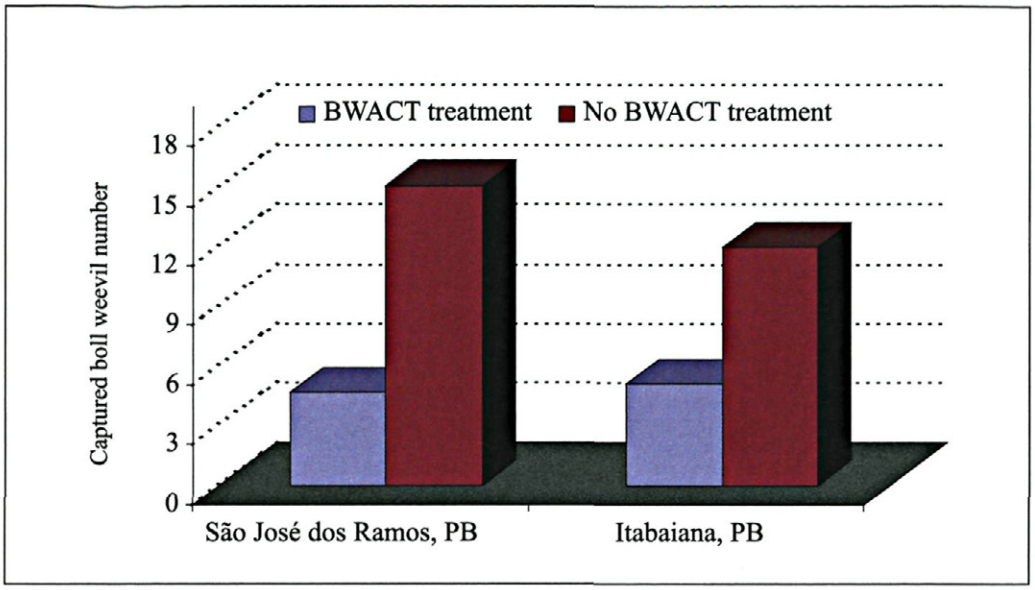

Figure 5. Comparison of the total number adults of boll weevil captured in traps in cotton areas with and without BWACT devices, at São José of Ramos and Itabaiana, PB, Brazil. 2003.

The largest liquid incomes were obtained in the treatments IPM plus BWACT and conventional plus BWACT, while the smallest liquid income was obtained in the conventional treatment (Table 2).

These results agree with researches developed by McKibben & Villavaso (1991), who affirmed that in the beginning of the cotton harvest, BWACT was as efficient as insecticide sprayings to reduce the population of the boll weevil. McGovern et al. (1996) recommend the use of BWACT in control programs where the population level is low and in areas of moderate size (equal or smaller than 50 acres).

In relation to the efficiency of the BWACT after stalk destruction, at São José dos Ramos district, the total number of adults of boll weevil attracted and captured by traps in cotton areas with and without BWACT devices were, respectively, 5.6 and 16.5 individuals, i.e., treatment without BWACT devices attracted 2.9 times more boll weevil individuals than BWACT treatment (Figure 5).

At Itabaiana city, the total number of adults of boll weevil attracted and captured

Table 2. **Spraying number, control costs, cotton production, gross and liquid income in cotton farms located in the semi-arid area of Paraíba State, Brazil. 2003.**

Treatment	Spraying number	Control costs (US$/ac) [1,2]	Cotton production (@/ac) [3]	Gross income (US$/ac)	Liquid income (US$/ac)
Conv	4.67	22.82	35.75 b	240.51	217.68
Conv+BWACT	3.50	25.21	44.38 ab	298.52	273.31
IPM	3.25	15.89	40.58 ab	272.95	257.06
IPM+BWACT	3.25	23.99	45.51 a	306.15	282.15

[1]Including the insecticide and BWACT device costs; [2]US$1.00 = R$0.37 (prices at Nov, 2003); [3] Averages followed by the same letters did not differed by the Duncan test ($p<0.05$).

by traps in cotton areas with and without BWACT devices were 6.4 and 13.1 individuals, respectively, i.e., no BWACT treatment captured 2 times more boll weevils than BWACT treatment, attesting the efficiency of the BWACT devices on the reduction of the populations of boll weevil after stalk destruction.

CONCLUSIONS

The BWACT device was efficient in the control of the boll weevil, *Anthonomus grandis*, when installed at the planting time of the cotton crop, in cotton farms in the Northeast Brazil;

The BWACT device was efficient to reduce remaining populations of boll weevil after stalk destruction, in post-harvests programs;

Areas where it was adopted the use of IPM or IPM plus BWACT presented smaller percentages of damaged flower buds than areas without BWACT device;

Smaller number of insecticides spraying for the control of boll weevil was observed in areas of IPM plus BWACT management;

The adoption of IPM plus BWACT devices resulted in larger liquid incomes than the non adoption of IPM and/or the non use of the BWACT device in cotton areas from Northeast Brazil.

RESUMEN

MIRANDA J. E. , C. A. D. DA SILVA. 2005. Control etológico del picudo del algodonero, *Anthonomus grandis* (Coleoptera: Curculionidae), en el Nordeste de Brasil. *Bol. San. Veg. Plagas*, **31**: 509-515.

El picudo del algodonero, *Anthonomus grandis*, es la plaga más importante de la zona algodonera de Nordeste de Brasil y puede causar pérdidas significantes a la producción. El tubo mata picudo (TMP) se ha usado por los productores como táctica de control etológico. Debido a su acción localizada y específica, este método es considerado una herramienta apropiada a los conceptos de Manejo Integrado de Plagas (MIP), funcionando como una alternativa al control químico. Este estudio buscó evaluar el uso de tales dispositivos en el control del picudo del algodonero en el cultivo de algodón en Nordeste de Brasil. En los experimentos comparativos entre el control convencional (donde el uso del control químico prevalece), MIP, y sus interacciones con el uso de TMP, el número más pequeño de aplicaciones de insecticidas se verificó para el control del insecto en áreas dónde MIP fue aliado a TMP. El dispositivo fue eficaz en el control del insecto cuando instalado en la siembra y las poblaciones restantes fueran reducidas después de la destrucción de los residuos de cosecha. La adopción de MIP más TMP resultó en rendimientos económicos líquidos más grandes que la no adopción del MIP y la no adopción del dispositivo.

Palabras clave: Insectos, MIP, feromona.

REFERENCIAS

BELTRÃO, N.E. de M. 1996. *Breve diagnóstico do algodão no Brasil e no Nordeste brasileiro.* Campina Grande: EMBRAPA Algodão, 25p. (EMBRAPA Algodão, Comunicado Técnico, 43).

DUQUE, G. 1973. *O Nordeste e as lavouras xerófilas.* Fortaleza: Banco do Nordeste do Brasil, 238p.

GONZÁLEZ, V.L. VILLAREAL, N.V.; ROJANO, E.A.; BLANCO, M. 2003. Resultados de la red de monitoreo del picudo del algodonero (*Anthonomus grandis Boh.)* en zonas algodoneras colombianas, año 2002. *Revista Asiava*, **60**: 10-12.

MCGOVERN, W.L.; VILLAVASO, E.J.; MCKIBBEN, G.H. 1996. Final evaluation of 1994 boll weevil bait stick test in Noxubee County, MS. *Proceedings of the Beltwide Cotton Conferences.* National Cotton Council, Memphis, TN.

MCKIBBEN, G.H.; VILLAVASO, E.J. 1991. Field research results on the boll weevil bait stick. *Proceedings of the Beltwide Cotton Conferences.* National Cotton Council, Memphis, TN.

MELO, I.S. de; AZEVEDO, J.L. de. 2000. *Controle biológico.* Jaguariúna: EMBRAPA Meio Ambiente, 388p.

MOREIRA, J. de A. N.; FREIRE, E.C.; SANTOS, R.F.; BARREIRO NETO, M. 1979. *Algodoeiro mocó: uma lavoura ameaçada de extinção.* Campina Grande: EMBRAPA Algodão, 20p. (EMBRAPA Algodão, Documentos, 36).

MOREIRA, J. de A. N.; BELTRÃO, N.E. de M.; FREIRE, E.C.; NOVAES FILHO, M de B.; SANTOS, R.F.; AMORIM NETO, M. da S. 1997. *Decadência do algodoeiro mocó e medidas para o seu soerguimento no Nordeste brasileiro.* Campina Grande: EMBRAPA Algodão, 20p. (EMBRAPA Algodão, Documentos, 43).

PLATO, T.A.; PLATO, J.C.; PLATO, J.S.; PLATO, S.E. 2001. Results of the BWACT in boll weevil control, prevention, suppression and eradication programs in the Americas. *Proceedings of the Beltwide Cotton Conferences.* National Cotton Council, Mendes, TN.

RAMALHO, F.S.; GONZAGA, J.V.; SILVA, J.R.B. 1993. Métodos para determinação das causas de mortalidade natural do bicudo do algodoeiro. *Pesquisa Agropecuária Brasileira*, **28**: 877-887.

SANTOS, W.J. Avaliação do uso de feromônio sexual em dispositivos para atração, captura e controle do bicudo, *Anthonomus grandis*, Boh., 1843, na cultura do algodoeiro. 1996. In: Integrated Pest Management of the Cotton Boll Weevil in Argentina, Brazil and Paraguay. *Workshop Proceedings*, pp.184-194.

SILVA, C.A.D.; ALMEIDA, R.P. de. 1998. *Manejo integrado de pragas do algodoeiro no Brasil.* Campina Grande: EMBRAPA Algodão, 65p. (EMBRAPA Algodão, Circular Técnica, 27).

SPURGEON, S.D.; RAUSLTON, J.R.;CANTU, R.V.; COPPEDGE, J.R. 1998. Competitive interactions and relative attractancy of boll weevil pheromone traps and bait sticks. *Tektran.* Available in <http://www.nal.usda.gov/ttic/tektran/data/000008/82/0000088236.html>. Access at 07/05/2003.

VILLAVASO, E.J.; MCKIBBEN, G.H.; SMITH, J.W. 1993.Comparing boll weevil bait sticks to pheromone traps. *Proceedings of the Beltwide Cotton Conferences.* National Cotton Council, Memphis, TN.

(Recepción: 4 agosto 2005)
(Aceptación: 11 noviembre 2005)