ECONOMIC THRESHOLD FOR THE COTTON BOLL WEEVIL (*ANTHONOMUS GRANDIS* BOHEMAN) CONTROL

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Keywords: insect pest control, economic threshold level, boll weevil, *Gossypium hirsutum*, yield loss

Summary

In a field experiment study was carried out in Paraíba State, Brazil, to determine the economic threshold for *Anthonomus grandis* Boheman control, under irrigation conditions. This insect pest has caused high yield losses in upland and perennial cotton since its invasion in 1983. The effects of boll weevil damage on cotton agronomic characteristics, fibre quality and yield losses are discussed.

INTRODUCTION

The boll weevil is the most important insect pest of cotton in Brazil and may cause serious damage and consequently high economic losses. The indiscriminate manner and incorrect use of insecticides may lead to extremely negative consequences, affecting humans directly and indirectly through of agricultural ecosystem. On the other hand, the use of insecticides in integrated pest management is an indispensable technique for most crops (Almeida *et al.,* 1997).

Since this exotic insect pest was found in Brazil, in 1983, substantial cotton yield losses took place. The use of insecticides provided temporary solutions, however, undesirable side effects, such as the destruction of natural enemies and adverse effects on the environment and human health, led to the development of improved control methods as part of the integrated pest management (IPM).

In Brazil, in the dry season, many researches use the economic threshold of 10% of damaged squares for cotton boll weevil control (Ramalho & Jesus, 1986; Cruz *et al.*, 1988; Ramalho & Jesus, 1989; Santos, 1989; Bleicher *et al.*, 1990; Almeida & Silva, 1999). However, under irrigation conditions no studies were published in which the economic threshold was determined.

This study aims to determine the best insect damage level to initiate the control of *A. grandis* in irrigated cotton and the effects on agronomic traits, fibre quality and yield losses due to damages caused by boll weevil.

MATERIAL AND METHODS

This work was carried out in Paraíba State, Brazil, under irrigation conditions, during the 97/98 harvest, aiming to determine the most appropriate *A. grandis* population level to start chemical control measures in upland cotton crop. The cotton CNPA 7H cultivar was used in this study. The experimental plots measured 87m^2. Randomised Complete Block design was used to data analysis, with 6 treatments and 5 replications. The treatments were: 1 – EC = Economic threshold level of 0% (systematic control); 2 - EC of 5%; 3– EC of 10%; 4 - EC = of 15%; 5 – EC of 20%; and 6 – EC of 25%.

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The samples were collected with intervals of five days, after the development of the first squares until the first boll opening. Fifty squares (5mm diameter) were sampled per plot. Squares were collected from the upper middle part of each plant. A total of 250 squares were sampled. Using these data it was possible to determine the percentage of damaged squares per treatment (squares with oviposition and/or feeding punctures).

Endosulfan CE 350 (700 g.a.i/ha) was applied when the economic threshold established for each treatment was reached. The other cotton insect pests did not reach their economic threshold levels to need control according to the recommendations (Almeida & Silva, 1999). The insecticides were applied using a knapsack sprayer.

Technical recommendations for cultural practices were followed as closely as possible for the trial (Beltrão *et al.*, 1993). The following traits were measured: lint percentage, boll opening weight (g), 100 seeds weight (g), seed germination (%), vigour (cm), plant height (cm), stem diameter (cm), micronaire (mμ/in), fibre strength (gf/tex), fibre length (mm), uniformity (%), elongation (EL), reflectance (rd), yellow fibre index (+b), seed cotton yield (kg/ha), yield losses (%), application number of insecticides and mean percentage of attacked squares/treatment between 30-60, 60-90 and 30-90 days after germination. The yield losses were calculated according to Bertles (1950). The data were submitted to analysis of variance and the mean data compared by Tukey test ($P \leq 0.05$).

RESULTS AND DISCUSSION

On the whole, no difference was found in lint percentage, seed cotton yield, 100 seeds weight, seed germination, vigour, plant height and stem diameter, suggesting that the damage caused by the different boll weevil population levels did not affect these variables (Table 1). Almeida *et al.* (1997) detected a correlation between percentage of squares damaged and plant height.

Among the fibre characteristics studied only the micronaire showed differences between treatments (Table 2) and at the 10% threshold the micronaire was the highest.

For the seed cotton yield, the 10% of squares with punctures threshold for initiating chemical control allowed for the best yield (3,241.14 kg/ha). However, differences were only significant with the control. Probably the increase of seed cotton yield in this treatment may be attributed to the high boll number produced, although this trait has not been evaluated. Moser *et al.*(1999) assume that the boll number per ha is the largest contributor to Pima cotton yield.

The yield losses reached the highest values in the control treatment (32.48%) and at the treatment 5% level (22.14%). However, using the higher thresholds of 15, 20 and 25% did not result in a yield loss of more than 9,67%. Probably the yield losses did not increase due to low percentage of *A. grandis* damage (4.69%) during the 30 first days after the development of the squares. This could guarantee part of the cotton yield until the beginning of the boll opening, that is, during the critical period of boll weevil attack. Using 10% of damaged squares as economic threshold and different insecticides as treatment, Almeida *et al.* (1997) found yield losses ranged from 24.31 to 73% under high population pressure of boll weevil.

Problems with morphological changes in cotton leaves, increase of the vegetative bunches numbers, later fruit maturity and cotton yield reduction have been attributed to some insecticides (McLlrath, 1950; Fowler, 1956; Roark *et al*, 1963; Bradley & Corbin, 1974). This suggest that the yield loss of seed cotton by the excessive use of insecticides in the control treatment is caused by phytotoxic effects of the insecticides, because no differences were found in the percentage of squares that were attacked (Table 3).

Studies carried out to evaluate the effectiveness of different formulations of deltamethrin and cypermethrin against *A. grandis* demonstrate that all treatments were effective in maintaining infestation levels at around the threshold of 10% of infested squares, up to 8 days after the 3rd application. At a high density this insect pest could be reduced by 3 insecticide applications at 3-day intervals (Bleicher *et al.*, 1990). Ramalho & Jesus (1989) verified that three sprays of carbaryl, at 4-day intervals, reduced the infestation of squares to below the 10% threshold for 8 days after the last spray. This trial showed that if high infestation has take place between 60-90 days after planting, an efficient control of the insect population was not feasible. The average percentage of attacked squares in this period ranged from 46.20 to 56.87%. The efficient control was not feasible because the low number of squares present attracted by the newly emerged boll weevils, resulting in high permanent number of weevils per squares.

To maximise the cotton yield under irrigation conditions the economic threshold level for *A. grandis* control is of 10% of squares with damage.

Table 1*. Means[1] of the lint percentage, boll opening weight (g), 100 seeds weight (g), seed germination percentage, vigour (cm), plant height (cm) e stem diameter (cm). Paraíba State, Brazil in 1997*

Treatment	lint %	boll opening weight	100 seeds weight	Seed germination	Vigour (cm)	Height plant	Stem diameter
EC= 0%	37.74 a	7.62 a	14.20 a	96.00 a	9.52 a	105.26 a	11.39 a
EC= 5%	37.28 a	7.98 a	14.22 a	96.40 a	10.03 a	116.78 a	11.80 a
EC= 10%	38.20 a	7.48 a	13.96 a	92.40 a	11.50 a	94.89 a	10.66 a
EC= 15%	39.06 a	7.36 a	13.90 a	95.20 a	8.82 a	99.00 a	10.06 a
EC= 20%	37.02 a	8.24 a	14.40 a	95.60 a	9.19 a	109.23 a	11.39 a
EC= 25%	37.38 a	7.80 a	14.26 a	92.80 a	10.37 a	107.82 a	11.52 a
CV(%)	4.69	7.81	4.73	4.84	20.16	15.57	9.25

[1]Means followed with the same letter are not significantly different by Tukey test (P≤0.05).
CV - Coefficient of variability

Table 2*. Means[1] of the micronaire (mµ/in), fibre strength (gf/tex), fibre length (mm), fibre uniformity (%), fibre elongation (EL), reflectance (rd) and yellow fibre index (+b). Paraíba State, Brazil in 1997*

Tratamento	Micronare	Fibre strength	Fibre length	Fibre uniformity	Fibre elongation	Reflectance	Yellow fibre index
EC= 0%	4.80 ab	20.70 a	29.02 a	48.76 a	6.08 a	61.26 a	10.40 a
EC= 5%	4.74 ab	19.82 a	29.28 a	49.02 a	6.10 a	61.32 a	10.32 a
EC= 10%	4.94 a	20.68 a	29.62 a	48.96 a	5.64 a	62.06 a	10.06 a
EC= 15%	4.44 b	20.76 a	30.04 a	47.78 a	5.96 a	60.40 a	9.86 a
EC= 20%	4.58 ab	21.18 a	30.52 a	48.66 a	6.22 a	61.76 a	10.12 a
EC= 25%	4.58 ab	19.82 a	29.98 a	48.90 a	6.20 a	61.16 a	10.26 a
CV(%)	4.80	5.51	3.61	3.03	8.25	2.75	3.90

[1]Means followed with the same letter are not significantly different by Tukey test (P≤0.05).
CV - Coefficient of variability

Table 3. Means[1] of the seed cotton yield (kg/ha), yield losses (%), application number of insecticides and percentage of attacked squares per period. Paraíba State, Brazil in 1997

Treatment	Seed cotton yield	Yield losses	Applications number	Percentage of squares attacked/period 30/60	60/90	30/90
EC= 0%	2,189.29 b	32.48	13	1.43	46.20	22.09
EC= 5%	2,504.91 ab	22.14	08	3.71	47.67	24.00
EC= 10%	3,242.41 a	-	07	4.69	56.87	28.49
EC= 15%	3,021.87 ab	6.08	06	2.40	51.93	25.26
EC= 20%	3,116.52 ab	3.88	06	4.51	52.60	26.71
EC= 25%	2,929.02 ab	9.67	06	4.06	56.67	28.11
CV (%) =	17.39	-	-	-	-	-

[1] Means followed with the same letter are not significantly different by Tukey test ($P \leq 0.05$).
CV - Coefficient of variability

ACKNOWLEDGEMENTS

I would like to thank José Rodrigues, Ivonaldo Targino and Arnaldo R. de Alencar for technical assistance and Richard Stouthamer for reading and commenting on the manuscript.

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