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ECOLOGICAL BASES FOR AN I.P.M. PROGRAMME FOR THE COTTON BOLL WEEVIL (Anthonomus grandis Boh.) IN SÃO PAULO STATE, BRAZIL.

M.E.M. HABIB[1] et I. PIEROZZI Jr.[2]

[1]I.B.-UNICAMP - P.B. 6109 13.081-970 Campinas, SP, Brazil
[2] NMA-EMBRAPA - P.B. 491 13.001-970 Campinas, SP, Brazil

SUMARY:
Since the boll weevil, Anthonomus grandis Boh., was detected in cotton fields in São Paulo State, Brazil, in 1983, many ecological aspects have been studied aiming the establishment of some Integrated Pest Manegement (I.P.M.) strategies for its control. Also, many ecological and behavioural differences were detected in comparison to other cotton agroecosystems, principally in the U.S.A. This situation allowed to recommend an I.P.M programme based on vegetable traps, crop weekly monitoring, destruction of cotton plant stalks as soon as cotton was harvested and utilization of aggregating pheromone and seletive chemical insecticides.

Key-words: Boll weevil, Anthonomus grandis, cotton, I.P.M strategies, population ecology.

RESUME:
BASES ECOLOGIQUES POUR UN PROGRAMME DE LUTTE INTEGREE CONTRE L'ANTHONOME (Anthonomus grandis Boh.) DANS L'ETAT DE SAO PAULO, AU BRESIL.
Après la détection d'Antonomus grandis Boh. dans les cultures de coton de l'Etat de Sao Paulo (Brésil), en 1983, plusieurs aspects de son écologie ont été étudiés pour envisager l'établissement de stratégies de lutte intégrée. Plusieurs différences écologiques et comportementales ont été observées par rapport à d'autres régions cotonnières, principalement aux Etats Unis. Cette situation a permis de recommander un programme de lutte intégrée avec utilisation de plantes pièges, surveillance de la culture toutes les semaines, élimination des résidus de culture immédiatement après la récolte et utilisation de phéromones d'aggrégation et d'insecticides chimiques sélectifs.

Mots clés: Coton, Anthonomus grandis, lutte intégrée, écologie des populations.

INTRODUCTION

The cotton boll weevil, Anthonomus grandis Boh., was detected in São Paulo State, Brazil, in 1983 (HABIB & FERNANDES, 1983) and now is considered as a key pest in this country (PIEROZZI Jr., 1989). The crop losses and the increased costs of production caused by this insect pest, and the concomitant load of insecticides in the environment, are enormous (LESSER et al., 1988). FALCON et al. (1986) and FRISBIE et al. (1989) have provided recent reviews of the literature on this pest in the Americas. The development of an I.P.M. programme which preserve intact the natural enemies that help to supress the key pests is one of the aims of the present study. To reach this objective, many ecological investigations were undertaken. The holistic concept of ecosystem, which has become a dominant theme in Environmental Biology, has also revealed its importance in Modern Agronomy and the interaction of different components of an agroecosystem and the existence of self-regulatory mechanisms are two of the major rules of this vision (METCALF & LUCKMANN, 1982).

The aim of the present communication is to describe the boll weevil population behaviour under field conditions in São Paulo State. Also, how such a behaviour is different when compared with that of the same species in the U.S.A. humid cotton belt. Accordingly, some I.P.M. strategies were developed by the present authors, and their feasibility and effectiveness are being evaluated in the present study.

MATERIAL AND METHODS

During five consecutive years, including growing seasons and between-season periods, the present study was realized in some cotton fields, in São Paulo State, Brazil, between 22° 35' and 23°05' of latitude S and between 46° 55' e 47° 35' of longitude WGr.

Weekly sampling procedures during the cotton seasons and monthly ones during the between-seasons were adopted to evaluated the boll weevil population fluctuation (details can be found in PIEROZZI Jr., 1985 and 1989). During the growing seasons free adults were monitored, while squares and bolls were examined (feeding and oviposition punctures).

Traps baited with the pheromone grandlure were utilized to monitor the size of the boll weevil populations during the between-season periods.

The investigations were conducted in two distinct situations: farms commonly treated by chemical insecticides (conventional crops) and fields subjected to I.P.M. measures (I.P.M. experimental fields).

RESULTS AND DISCUSSION

The cotton plant phenology and the population behaviour of A. grandis, observed during the present study, can be examined through Figure 1.

In all cases, the infestation during the early season begins by the invasion of a very little number of adults, attacking the firstly formed squares. The weevil showed a greater preference for squares relative to bolls. Never the between-season periods showed to be able to support or to sustain significant population densities of A. grandis.

Moreover, during October and November the number of adults captured by pheromone traps is drastically reduced, reaching zero (Figure 2).

Figure 3 summarizes the ecological complex of A. grandis within the regional physical and biological field conditions in São Paulo State during the growing season as well as the between-season period.

Climatic conditions, availability of food and reproduction sites (squares and bolls), control methods and natural mortality agents are the most important factors affecting the population dynamics of the boll weevil during the growing season. During winter, only the natural mortality factors and the availability of secundary host-plants represent the more significant elements responsible for the survival of this insect pest.

This curculionid, which was detected in the U.S.A. in the last decade of the 19th century, is still the first important key pest of cotton. Diapause is a very efficient natural survival mechanism which make this insect pest capable for overwintering in the U.S.A. (BRAZZEL & NEWSON, 1959). The basic requisits to induce its diapause are an average temperature less than 10 °C for adult stage, exposition of the immature forms to photophases shorter than 11 hours and changement in the adult diet (squares to bolls) at the end of the growing season. Due to this situation, the North American I.P.M. programmes include the use of traps baited with pheromone grandlure to monitor the size and extent of the boll weevil population; aggregation

Figure 1: Phenological aspects of the cotton plant and population behaviour of Anthonomus grandis Boh., in São Paulo State, Brazil, during the year.
Aspects phenologiques de la plante du coton et comportement de la population d'Anthonomus grandis Boh., dans l'Etat de São Paulo, Brésil, pendant l'année.

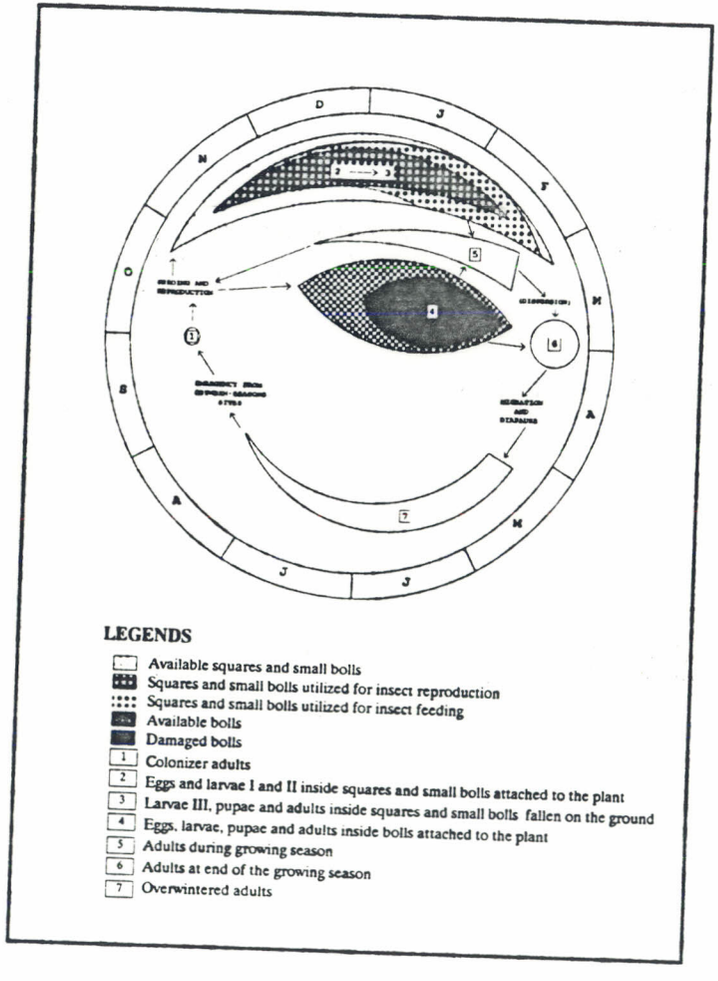


Figure 2: Capture of Anthonomus grandis Boh. adults by traps, in São Paulo State, Brazil.
Capture d'adultes d'Anthonomus grandis Boh., par pièges dans l'Etat de São Paulo, Brésil.

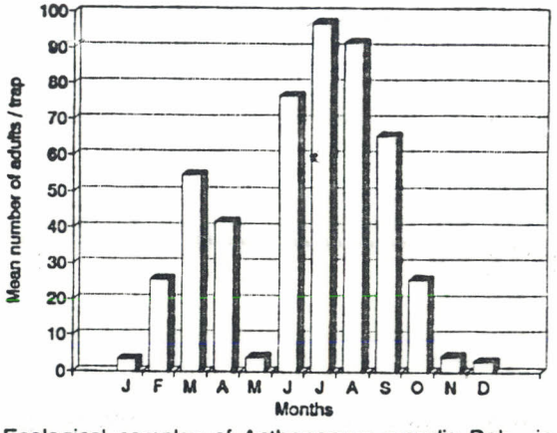
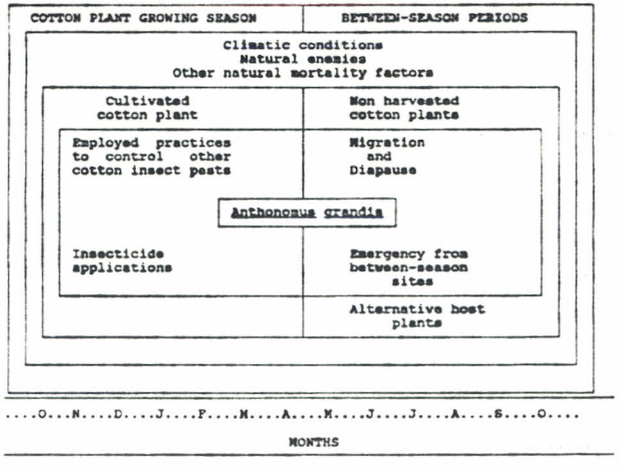


Figure 3: Ecological complex of Anthonomus grandis Boh., in São Paulo State, Brazil.
L'ensemble ecologique d'Anthonomus grandis Boh., dans l'Etat de São Paulo, Brésil.



pheromone; selective chemical insecticides; defoliation or desiccation of cotton plants to hasten harvest operation; destruction of cotton plant stalks as soon as cotton is harvested and diapause control by chemical insecticides, all as effective means to reduce the population densities of this insect pest.

The ecology of A. grandis was shown to be completely different under São Paulo State conditions (PIEROZZI Jr., 1985 and 1989; PIEROZZI & HABIB, 1992). For this new habitat, in addition to the great availability of food (mainly polens) during winter, the average of temperature is always superior to 15 °C and the photoperiod is longer than 11 hours. For these reasons, the induction of diapause is very difficult to happen. Moreover, predators like ants, spiders, birds and lizards are very active during winter, consuming the major part of the boll weevil populations.

Therefore, the potentiality to reach the new growing season depends directly upon the availability of secundary host plants to sustain the boll weevil reproduction and development during winter.

Due to these differences, our I.P.M. programme for cotton crops in São Paulo State includes the following four measures:

1. Vegetable traps formed by cotton plants cultivated a month before, occupying the boundary rows of the farm and corresponding to 5-10% of the total area. By the appearance of the first squares, these rows received applications of endossulfan with 5 days of interval (ten applications in average);

2. Weekly monitoring by direct examination of squares and bolls among the inner area (90-95% of the total), responsible for the commercial production of cotton. Application of endossulfan when the infestation among squares and/or bolls reaches 3-5%;

3. Destruction of cotton plant stalks as soon as cotton was harvested, keeping only some small plots (100 m^2 each) as vegetable traps during the end of the season to atract the boll weevil adults and to kill them by chemical insecticides;

4. Atract by aggregation pheromone and kill by chemical insecticides in small areas (100 m^2 each) during winter, near refuge localities. The timming of this procedure depends upon the presence of adults which can be indicated by traps baited with grandlure;

These measures resulted in a very efficient control of the boll weevil and in the same time permitted a good protection of the beneficial species allover the year.

Obviously, these results and coments describe only the specific situation of São Paulo State, and cannot be generalized for other Brazilian cotton regions.

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