EFFICACY AND TOTAL RELEASE INTERVAL OF MATING DISRUPTION PHEROMONE ON THE CONTROL OF PINK BOLLWORM - *PECTINOPHORA GOSSYPIELLA*- IN COTTON UNDER FIELD CONDITIONS IN BRAZIL

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Abstract

This experiment was developed in order to evaluation the efficiency of pheromone to control the pink bollworm and the total time of its release in cotton field. The experiment was installed in field conditions, in Chapadão do Sul/SP/Brazil, from January to April, 1998. The treatments consisted of 2 areas, being one of 30ha, where it was applied the pheromone and another of 10ha that was chosen as control area and did not receive pheromone. In the treated area, the laboratory synthesized sex pheromone (PB-Rope) was used thought of dispensers that allowed the slow and gradual release of the active substance. A total of 250 dispenser per hectare were evenly hand distributed in the area. The dispensers were wrapped around the plants. Both areas (treated area and untreated area) were monitored by delta trap. For evaluation of the boll damage, the treatment area was divided into 4 sub-areas. Twenty five green bolls were collected at random from each sub-area at 48 and 65 days after pheromone treatment. Bolls were cracked open by hand, and number of the bolls with symptoms of pink bollworm attacks was recorded. For evaluation of the productivity four areas were demarcated in each treatment, where all fibers and seeds harvested were weighted. Release rate of pheromone from dispenser was evaluated through of the weigh of the dispensers. Were marked and weighed in analytic scale, 20 dispensers contend the pheromone, being placed 10 dispensers under the cotton plants in treated area and other 10 dispensers in an open area. To every 15 days the dispensers were retired and weighed in analytic scale and soon after put back in the field in the same places. The results showed that only one application of mating disrupt pheromone, used in a dosage of 250 dispenser/ha, reached 80% of control for pink bollworm. The release period of pheromone from dispenser, after the application, was 120 days.

Introduction

Pink bollworm, *Pectinophora gossypiella* (Saunders, 1844), is one of the most important economic pest of cotton occurring throughout most of the tropical and subtropical regions of the world (Ingram,1994). In the U.S.A. it is considered one of the most damaging cotton pest in Arizona and southern California. In Brazil the pink bollworm is important in all the areas where the cotton is cultivated. Heavy insecticide use often promotes resurgence of secondary pest species such as *Heliothis virescens, Helicoverpa zea* and *Bucculatrix thurberiella* in the U.S.A. and *Spodoptera frugiperda, Heliothis virescens* and *Alabama argillacea* in Brazil.

Pink bollworm larvae feed on flower buds, flowers and seeds. Damage to developing seeds, and the termination of growth results in boll rotting, premature or partial boll opening, reduction of staple length, strength, and increase trash content in the lint. According to Schuwartz (1983) estimated yield losses in the U.S.A. due to pink bollworm range from 9% when chemically controlled to 61% when uncontrolled, although 100% crop loss can occur in one condition of heavy infestation. Pink bollworm spend the winter as diapausing larvae, then pupate and emerge as adults in spring and early summer (Bariola & Henneberry, 1980). Even in Brazil where the winter is not so rigorous, pink bollworm spend this period as diapausing larvae. After emergence, moths disperse widely over large areas primarily from the previous years cotton field, to find susceptible cotton or wild plants (Flint & Merkle, 1981)

Insects use specific chemicals (pheromone) as a means of communication. One of the most important is a sex pheromone which is closely related to their reproductive activities. Generally, female insects secrete a sex pheromone or scent which is specific to their species to lure males of the same species. Male insects trail the females by following the scent to the source and mate. When the field is covered with synthetic Sex pheromones, the mating communication is confused.

Unlike convention insecticides used on pest control, pheromones do not rely on any toxic properties for their action against the target pest. They are not hazardous to beneficial insects or other non target organisms. They decompose readily to carbon dioxide and water in the soil and leave no residues.

Considerable research emphasis has been placed on the development of pest control techniques based on disruption of the premating communication between males and females of *P. gossypiella* (McLaughlin et al. 1972). To enable these control techniques to be intelligently applied, much more information must be gathered in the field regarding the influence on mating behavior of a number of environmental variables, such as crop type, density, elevation, air movement, and moonlight.

In Brazil, Brooks et al. (1981) verified the validity of the technique of the mating disruption of the pink bollworm. Researches on the simultaneous control of *P. gossypiella* and

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Helicoverpa zea with the pheromone use were conducted by Buzoli and Pazini (1984). Also Papa et al. (1984) and Habib et al. (1984) showed the advantages of the use of sex pheromone for the control of the pink bollworm, and for the employment in the programs of insects pest management in cotton.

Gossyplure, (Z)-7(Z,E)-11-hexadecadien-1-ol, acetate, a Sex attractant for *P. gossypiella* males (Hummel *et al.*,1973), is commercially used to disrupt mating in the U.S.A., Egypt and Greece. In theory male moths fail to locate and mate with females, thus protecting susceptible bolls from infestation (Gouge *et al.*,1997). The present experimental field trial evaluated the efficiency of pheromone to control the pink bollworm and the total time of its release in cotton.

Materials and Methods

The experiment was installed in field conditions, in Chapadão do Sul/MS/Brazil, from January to April, 1998. The treatments consisted of 2 areas, distanced one of the other in 300m, being one of 30ha, where it was applied the pheromone and another of 10ha that was chosen as control area and did not receive pheromone. In the treated area, the laboratory synthesized sex pheromone (PB-Rope L) was used. The pheromone qualitative and quantitative chemical composition was the mixture of the substances (Z,Z)-7,11-hexadecadienyl acetate (46.7%); (Z,E)-7,11-hexadecadienyl acetate (44.1%) and inert material (9.2%), that was formulated through a wire of 20 cm of length, involved by high density polyethylene (dispenser) that allowed the slow and gradual release of the active substance. A total of 250 dispenser per hectare were evenly hand distributed in the area (one dispenser for one plant, every $40m^2$). The dispensers were wrapped around the plants, 25 cm from the ground. The pheromone was applied only once, 42 days after planting took place. Both areas (treated area and untreated area) were monitored by delta trap contains pheromone baits. The treatment area received traps in the center of the area and in the border of the area. Traps were examined every 3 days and number of males moths caught recorded.

For evaluation of the boll damage, the treatment area was divided into 4 sub-areas. 25 green bolls were collected at random from each sub-area at 48 and 65 days after pheromone treatment. Bolls were cracked open by hand, and number of the bolls with symptoms of pink bollworm attacks was recorded.

For evaluation of the productivity 4 areas of $40m^2$ were demarcated in each treatment with a total of $160m^2$ where all fibers and seeds harvested were weighted.

Release rate of pheromone from dispenser was evaluated through of the weigh of the dispensers. In the day of the application of the pheromone were marked and weighed in analytic scale, 20 dispensers contend the pheromone, recently unpacked, being placed 10 dispensers under the cotton plants in treated area and other 10 dispensers in an open area (without any crop) distant 120m of the treated area. To every 15 days the dispensers were retired and weighed in analytic scale and soon after put back in the field in the same places.

Analysis of variance was used to test for significance and difference among treatment means. Tukey test was used to partition means into significant ranges when a significant *F* value was determined by analysis of variance. 5% level of probability was used in all statistical tests.

Discussion

The monitoring of the population of moths using traps with pheromone (Table 1) indicated that in the area treated with pheromone and in the control area, the number of adults captured until 25 days after the application of pheromone was zero thus indicating that the areas did not have any fertilized females. After the application of pheromone in the treated area, the capture *P. gossypiella* moths in the center and in the borders of the treated area remained zero until 100 days after the application of pheromone. After that, the center of the area treated with pheromone showed a low number of captured moths, until 120 days after treatment, when the average was 4 moths per trap per night while in the borders of the area treated with pheromone the capture of *P.gossypiella* adults was higher than in the center of the treated area, with an average of 13 moths/trap/night. In the control area, the capture of moths reached an average of 27/moths/trap/night thus indicating that until this time (120 days after the application of pheromone) the pheromone was still being released in the area.

Table 2 show the results of the evaluations of damages in bolls by the pink bollworm. The center and the borders of the treated area showed results significantly different from the ones in the control area, specially in the center of the treated area that showed an efficiency in the control of *P.gossypiella* higher than 84%. The damages in the bolls in the borders of the treated area were not different from the center of the treated area but numerically the efficiency in the control of the border was lower, reaching an average of 76%.

Table 3 shows the results of productivity. Though no significant differences had occurred in the treatment, it was shown that the borders and the center of the area treated with pheromone presented higher productivity if compared to the control area.

The Table 4 shows the result of release rate from pheromone dispenser. It was observed that until 30 days after the application of the pheromone were not significant differences

in the amount of pheromone release from dispensers placed in the treated area and untreated area. At 60 and 90 days after the application the rate of release of the pheromone were significantly smaller in the treated area (covered by the culture of the cotton), when compared with the rate of release of the pheromone from dispensers placed in open area. In this time, the covered area for the cotton was shaded, protecting the dispensers contends the pheromone of the excessive temperature, consequently the amount of pheromone released was smaller, comparatively to the dispenser that stayed in open area.

Disclaimer

Mention of a trade name, or specific equipment does not constitute a guarantee or warranty by the USDA or Brazilian government and not imply its approval to the exclusion of other products that may suitable.

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Table 1. Mean male moths capture per trap/night in each treatment. Jan. - abr.-1998. Chapadão do Sul/MS-Brazil.

Days after pheromone treatment	5	25	50	75	100	120
Border (treated area)	0a	0a	0a	0.9a	3a	13a
Center (treated area)	0a	0a	0a	0.2a	0.4a	6b
Untreated area	0a	0.7a	6b	14b	20b	27c

Table 2. Number of boll infestation by pink bollworm and percentage of efficiency (%E) at 48 and 65 days after pheromone treatment. Chapadão do Sul/MS/Brazil, 1998.

	48 days		65 days	
Treatments	Number boll	%E	Number boll	%E
Border (treated area)	6 b	68	7 b	70
Center (treated area)	3 b	84	4 b	82
Untreated area	19 a	--	23 a	--

Table 3. Productivity. Yield per treatment (160m^2).

Treatment	Kg per treatment	Increment percentage
Border (treated area)	39.22 a	105.4
Center (treated area)	41.10 a	110.5
Untreated area	37.22 a	100.0

Table 4. Release rate from pheromone dispenser. Average weight of dispensers (g) placed under cotton plants and in open area (without crop).

	Days in the field					
Treatments	0	30	60	90	120	150
Under the cotton plant	0.99a	0.96a	0.94a	0.92a	0.89a	0.89a
Open area	0.99a	0.94a	0.91b	0.90b	0.90a	0.90a