Use of Pheromones for Pink Bollworm (*Pectinophora gossypiella*, Saunders) Mating Disruption in Israel

A. Niv
The Cotton Production and Marketing Board, Israel,
P.O.Box 384, Herzlia B. Israel.

ABSTRACT

Pink bollworm (Pectinophora gossypiella) is one of the major cotton pests of Israel. Until ten years ago the pest appeared mainly in one region, the Beit-Shean valley, but it has spread all over Israel. The number of spray applications against this pest ranges between 1 and 9, mainly organo-phosphates and pyrethroids. Applications start early in the season, disrupting the delicate balance that exists between natural enemies and pests. The result is severe outbreaks of other pest. In the mid-1980s, the Sandoz pheromone product "No Mate" was used for mating disruption. P.B. Rope technology evolved in the Beit Shean valley during the 1990's. The average number of insecticide sprays declined from 9 to 5. Insecticide applications only commenced in the middle of the season following delayed pink bollworm occurrence and the decline in population intensity. This affected other pest populations. Since 1991 the use of P.B. Ropes and P.B. Rings (AGRISENSE) has increased and during the 1998 season, approximately half the cotton fields are treated with P.B. Ropes. The recommendation in Israel is to administer pheromone Ropes and rings early in the season, prior to appearance of pin-head squares. The initial dosage used to be 500 units (50 mg) per hectare but has been reduced to 250 (40 mg) units per hectare. The application of the pheromones is manual and time consuming. Researchers in Israel are working on a mechanical application method. Pheromones are active for about 2-3 months. Termination of efficacy is difficult to determine. At present, despite difficulties, the American method of pink bollworm oviposition monitoring is under observation.

Introduction

Pheromones are widely used in Israel, including pheromone use for monitoring purposes. In the late seventies and early eighties pheromones experiments were undertaken for mass-trapping of pink bollworm, *Pectinophora gossypiella* (Saunders) and cotton leaf worm, *Spodoptera littoralis* (Boisd.). Growers started using pheromones later for mating disruption. Some controlled release formulations were examined, and although the main formulation in current use Israel is P.B. Ropes, other formulations are still under investigation. Pheromones for mating disruption of spiny bollworm, *Earias insulana* (Boisd.) and American bollworm, *Helicoverpa armigera* (Hübner) were tested but are not in commercial use at present.

Pink bollworm is one of the major cotton pests of Israel. Until ten years ago, it appeared mainly in the Beit-Shean valley but it has spread all over Israel. The number of spray applications against this pest ranges between one and nine, mainly with organo-phosphates and pyrethroids. Applications start early in the season and disrupt the delicate balance existing between natural enemies and pests. The result is severe other pest outbreaks. However, the situation has changed probably because pheromones for pink bollworm mating disruption are used widely in Israel, and their use is increasing every year.

As in Arizona, the tendency in Israel is towards an integrated approach to area-wide pink bollworm management, although the growers there use different means (Antilla *et al.*, 1996). In Israel, the pheromones are applied despite the possibility of attacks by spiny bollworm, the control of which is based on application of organo-phosphates and pyrethroids, the same pesticides used to control of pink bollworm. After some years of using mating disruption pheromones in the Beit Shean valley spiny bollworm became a minor pest. *Earias insulana* and E. *vitella* are major pests in Pakistan and growers seek a solution for both species. Experiments on mating disruption of both these pests are underway (Campion *et al.*, 1989).

Pink bollworm in Israel

Pink bollworm is one of the major cotton pests of Israel. There are two main reasons pink bollworm prefers Pima cultivars that were traditionally cultivated in the Beit-Shean valley. The pest accompanied these cultivars when their cultivation developed elsewhere in Israel. Whitefly, *Bemisia tabaci* is an additional major pest in Israel. Traditional chemical control of whitefly with organo-phosphates and pyrethroids inadvertently depressed pink bollworm populations. The transition whitefly control to insect growth regulators (IGRs) enabled pink bollworm population development.

History of pink bollworm mating disruption in Israel

Pheromone testing for pink bollworm control commenced in the early 1980s. Since 1985, synthetic pink bollworm sex pheromone was applied by air in the form of hollow fibers filled with pheromone dissolved in hexane and mixed with an adhesive. Appropriate aerial application equipment was utilized to employ this mixture. The pheromone called "No Mate," was produced by Sandoz. The experiments began on 160 hectares in 1985 and expanded to 2,000 hectares in 1988.The number of treatments applied to each field was between one and eight. The conclusions after four years of testing were:

1. Mating disruption is efficient only when the pest population is low.
2. It is important to start the pheromone applications early in the growing season.
3. The success of the treatment is correlated with a small number of adults emerging from hibernation at spring.
4. Cotton growers should apply the "No Mate" every 3 weeks or immediately after they found adult moths in pheromone baited traps, which were placed in each field.
5. Where mating disruption succeeded: a. other pests appeared later then usual; b. a delay of three to five weeks in the first pesticide applications was achieved; c. there was no, or less, damage from pink bollworm; d. pest control expenses were the same as in the years before the pheromone applications (Or and Fishler, 1988).

In 1989, the first experiments were conducted with P.B. Ropes, macro-capsules and micro-capsules on small areas with iny were examined on small areas, therefore no conclusions could be gained. Although the P.B. Ropes were planted late in June, no males were caught in pheromone baited traps. The infestation of bolls rose rapidly, mainly because the fields were small and fertilized females migrated from other fields. From the first experiments it was concluded that 500 (80 mg) P.B. Ropes per hectare were adequate for mating disruption (Or *et al.*, 1989).

In 1990, many combinations of P.B. Ropes were examined on 500 hectares of cotton. The best combination was spraying "No Mate" early, followed by P.B. Ropes (Hutchison *et al.*, 1988). This option was examined because the plants are too small for P.B. Ropes to be tied on them early in the season. If "No Mate" is sprayed first, there is approximately 3 weeks of mating disruption, allowing enough time to apply the P.B. Ropes. The first application of pesticides against pink or spiny bollworm utilizing the same pesticides, was in mid July or later. The number of pesticide applications against pink bollworm was lower in the fields where P.B. Ropes were applied (Figure 1). Since then all the cotton fields in the Beit-Shean valley have been treated with P.B. Ropes and later this technology has spread to other regions of Israel.

The consequences of pink bollworm mating disruption are that the number of sprays against pink bollworm declined, the necessity for spray applications against other pests apart from American bollworm are postponed to mid-July, or later and the population and intensity of other pests has changed. For example, the delay or lack in use of monocrotophos caused a delay in the outbreak of whitefly and cotton leafworm while the spiny bollworm infestation is less severe.

Commercial products in use

P.B. Ropes manufactured by hin tsu, Japan. Each Rope contains 80 mg of the two components of female sex pheromone in a ratio of 1:1. From 1995, the dose has been increased to 160 mg of the same components.

'Selibate' pink bollworm- rings manufactured by Agrisense, U.K. Each ring contains 257 mg of the two components of female sex pheromone in a ratio of 1:1.

In 1998, only B.P. Ropes were used as growers terminated the use of 'No Mate' because of difficulties in application.

The use of P.B. Ropes and rings for pink bollworm mating disruption developed rapidly from 1991 and by 1998, covered about half of the cotton fields of Israel (Figure 2).

Recommendations for use of P.B. Ropes

1. Apply early in the season. The application should be complete before the appearance of pin-head squares.
2. Apply 25 Ropes, each containing 160 mg pheromone comprising a final dosage of 40 gram/hectare.
3. Pheromone baited traps should be placed in the fields at one trap per 5 hectares. Traps should be monitored daily.
4. Cotton bolls should be examined weekly for egg and larvae infestation.

Problems in use of P.B. Ropes

The rate of evaporation from the P.B. Ropes is almost constant for 120 days (Kehat, 1996). Nevertheless pink bollworm population density increases gradually and chance encounters between males and females become more likely. In effect, mating disruption becomes gradually ineffective.

The population monitoring system in Israel is based upon pheromone baited traps. The threshold for intervention has been determined at eight males per trap per night before boll opening and 12 males per trap per night later on. As the air in mating disruption fields

is still permeated with pheromone, pheromone baited traps placed in these fields give misleading information. Despite the absence of males caught in pheromone baited traps, infected bolls become abundant, making it difficult to determine chemical threshold intervention using this method.

At present an American method of monitoring pink bollworm oviposition is under observation to determine the termination of mating disruption efficacy. At high pest densities pink bollworm eggs are readily discovered but at low infestation rates, difficulties arise and larval infestation can be detected prior to the detection of eggs. Problems also arise in determining what action to take when the typical rosette bloom pink bollworm infestation is detected in fields treated with P.B. Ropes

A problem is faced when rosettes – typical bloom infestation - are found in fields treated with P.B. Ropes with the onset of bloom. It is not yet clear how to react in these circumstances.

The application of pheromones is manual and time consuming. Researchers in Israel are working on a mechanized dispersal method. A prototype has given promising results.

It seems that dosage may be reduced dramatically with no ill effects on control. This could save up to 30% in cost. The efficacy and cost effectiveness of a second mid-season application is under examination.

The necessity for pesticide applications after the termination of mating disruption is an open question. Experiments in 1997 showed that pesticide applications in Pima were essential but not in upland cultivars.

Acknowledgements

We acknowledge the contributions of I.Teich, S. Neumark, C. Chen, Z. Klein, Y. Hameiri, R. Or and G. Fishler, pioneers of pink bollworm mating disruption in the Beit-Shean valley.

References

Antilla, L., M. Whitlow, R.T. Staten, O.El Lissy and F. Myers. (1996): An integrated approach to areawide pink bollworm management in Arizona. In: Proc. Beltwide Cotton Conference. P. Dugger and D.A Richter (Ed). Pp. 1083-1085.

Campion, D.G., B.R. Critchley and L.J. McVeigh. (1989): Mating Disruption. In: Insect Pheromones In Plant Protection A.R. Justum and R.F.S.Gordon (Ed). John Wiley and Sons LTD. Pp. 106-109.

Hutchison, W.D., C.A. Beasley, T.J. Henneberry and J.M. Martin. (1988): Sampling pink bollworm (Lepidoptera: Gelechiidae) eggs: Potential for improved timing and reduced use of insecticides. J. Econ. Entomol.81(2):673-678.

Kehat, M. *et al.* (1996). Efficacy of pheromones for pink bollworm mating disruption. 1996 report. (in Hebrew).

Or, R. and G. Fishler. (1988): Pink bollworm mating disruption in the Beit Shean valley- A four year report. In: Proceeding of Field Experiments in Beit Shean, (In Hebrew).

Or, R., S. Malka, G. Fishler, Y. Hameiry and Y. Brener. (1989): Control of pink bollworm in the Beit Shean valley. In: Proceeding of field experiments in Israel. Pp. 96-101(In Hebrew).

Figure 1. Average number of sprays against PBW in some of the Beit Shean locations, comparing fields with, and without P.B. Ropes.

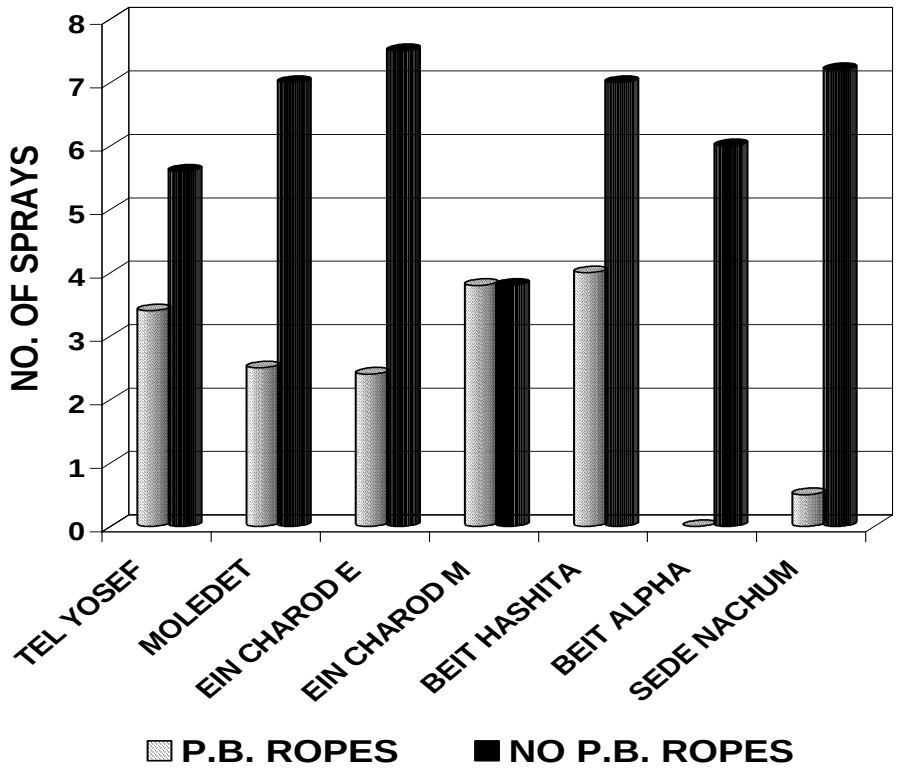

Figure 2. Use of P.B. Ropes and rings for pink bollworm mating disruption in Israel.