# Management of pink bollworm through eco-friendly pheromone "Sirene PBW" in cotton

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## ABSTRACT

*The environmental awareness and integration of ecology with fashion have created much interest in recent years. The identification of sex pheromones for the major insect pests of cotton and advances in the development of delivery systems provide very unusual opportunities. The most common approaches being considered are mating disruption and destruction of males with the use of attracticides, in which an insecticide is combined with a pheromone, appear quite promising for insect suppression. Pink bollworm is consistently becoming abundant during the later part of the season – this indicating its likelihood to become as a pest in Karnataka. Measures to combat this pest cannot depend upon insecticides alone, but rather on an integrated approach involving pheromones to provide a sustainable control system. Sirene PBW, a pheromone based pest control product for pink bollworm, which is a combination of a small amount of a pyrethroid insecticide with the pheromone, was evaluated at different dosages for its mating disruption effects in comparison with insecticide treated fields during 1997-98 and 1998-99. Data collected during these seasons seasons revealed that the treated block recorded 7.91% green boll infestation compared to 17.35% in the untreated block. Furthermore, there was a reduction in locule damage to the extent of 52.31%, with a 19.12% increase in seed cotton yield.*


## Introduction

Cotton (*Gossypium* spp.), a "friendly fiber", is one of the most important commercial crops that are cultivated all over the world. India ranks first in the world with regard to area, (9.0 m.ha) and fourth in production (2.65 Mt) of cotton (Mayee *et al.*, 2002). Despite the large area under cultivation, the productivity is very low (306 kg/ha) as compared to the world average of 600 kg/ha of lint. The key factors for instability and low yields are mainly heavy insect pest attacks and disease incidence, which cause more than 50 percent damage in India compared to 24.50 percent in the rest of the world. Approximately 130 species of insect pests have been reported to damage the cotton crop (Agarwal *et al.*, 1984). Among these, bollworms have been reducing the productivity as they damage the economic parts of the plant. The pink bollworm (PBW) (*Pectinophora gossypiella* Saunders) is a major pest of cotton. The PBW larvae burrow through lint, penetrating deeply into the immature seeds and consume them. When one seed is destroyed, the larva tunnels through the developing lint to another seed until the locule is destroyed. The affected bolls subsequently rot and are shed, while those that are retained on plants open prematurely resulting in stained, immature fiber (Agarwal *et al.*, 1984). Ginning percentage, oil content and seed germination are badly affected (Bindra and Bhatani, 1976; Shivasabranian, 1991).

Efforts to reduce the damages caused by this pest have been in progress over several decades. Several workers have evaluated from time to time a variety of pesticides to control this pest. However, as the early instar enters the bolls, the period of exposure to insecticide is very short. Hence, chemical insecticides are not able to control these pests satisfactorily; moreover, pesticide usage on cotton has been both extensive and intensive. In addition, regular and continuous use of diversified insecticides resulted in many problems such as pest resurgence, secondary pest out breaks, upsetting of the natural balance and development of resistance in insects to insecticides and causing health hazards (Mehratra, 1989). These associated problems forced producers to follow integrated pest management practices comprising all suitable control strategies in close association with environment.

As a possible means to reduce the pesticide load in the environment, the use of certain behavior modifying chemicals have been considered. These behavior modifying chemicals are potentially a viable alternatives or supplements to the use of conventional insecticides. They are considered as powerful pest management tools and are to be intelligently integrated with other tools of pest management. A large class of such behavior modifying chemicals consists of insect sex pheromones. A novel approach in the use of pheromones is the attracticide approach (Quareshi and Ahmed, 1987). A series of trials with gossyplure have been used to attract pink bollworm males to an insecticide-treated area with a resultant of fatality to these males. This could reduce insecticide requirement, especially as the pheromone acts as a synergist for the insecticide because the male moths become agitated and thereby more susceptible to the lethal effects of the insecticide.

## Experimental procedure

Sirene PBW, a behavior modifying bio-chemical, containing gossyplure and cypermethrin, was used for this investigation. The experiments were carried out during 1997-98 and 1998-1999 at the Agricultural Research Station, Dharwad Farm, Dharwad (Karnataka, India) which is located at an altitude of 678 m, latitude 15.7° N., longitude 76.0° E. The investigation comprised of two treatments *viz.*,

$T_1$: Application of Sirene PBW twice + RPP (recommended plant protection schedule)

$T_2$: RPP alone.

Each treatment consisted of one acre with plots 200 m apart. The popular interspecific hybrid cotton

DCH-32 a susceptible genotype was used in the investigation. After all preparatory tillage, cotton seeds were planted with a spacing of 90 cm x 60 cm in the first week of June 1997 for the 1997-98 season and second week of June 1998 for the 1998-99 season. Standard agronomic practices were followed for raising a healthy crop as per package of practices for zone 8 (Anonymous, 1996) of Karnataka.

In the first treatment ($T_1$) Sirene PBW was applied twice as droplets on the foliage on every alternate plant at the rate of one droplet with the help of a Sirene gun. The application of Sirene PBW was commenced once the PBW moth trap catches exceeded six moths per trap per night and the second application was done 30 days later.

A blanket spray of dimethoate 30 EC @ 1.7 ml/liter was applied to protect the crop from the sucking pest complex at 25 and 40 days after sowing. Similarly, to protect the crop from bollworms (*Earias vittella* and *Helicoverpa armigera*), sprays recommended for bollworm management were initiated on 55 days after sowing and continued at 10 day intervals until bollworm moth (*Heliothis*) activity ceased.

### Observations

Pheromone traps baited with gossyplure were used for trapping the PBW male moths. Two traps were installed in each cotton block at a distance of 30 m apart. The traps were fixed to bamboo poles, maintaining heights above the crop canopy. Trap lures were changed at 20 day intervals to maintain trap efficiency. Trap catches were recorded in the morning of each day where after traps were emptied. The moth counts from the two traps were averaged. Reduction in trap catches was computed according to the following formula (Grant, (1978):

$$\%\ Reducion\ in\ moth\ cases = \frac{X\delta\ moths\ caught\ in\ checks\ /\ night - X\delta\ moths\ caught\ in\ treated\ /\ night}{X\delta\ moths\ caught\ in\ checks\ /\ night}\ x\ 100$$

Observations on the incidence of pink bollworm in green bolls were made at fortnightly intervals. For this purpose, 50 cotton bolls of three weeks age were sampled randomly from each block and observed for green boll infestation and number of larvae per 50 bolls. At the time of harvest, approximately 50 opened bolls were sampled randomly from each block. Percentage of all locule damage due to pink bollworm was determined. At each harvesting time, three sample plots of 6 m x 6 m randomly were selected from each block. A total of five pickings were made during the season. Harvested kapas was weighted separately. Yield data was expressed as q/ha.

## Results and Discussion

### Number of moths

The maximum number of 9.55 adult male moths per trap/night was trapped in the recommended plant protection schedule block as compared to 3.90 moths in Sirene PBW pheromone treated block (Table 1). This is mainly because the Sirene PBW pheromone is a blended mixture of Sirene, a six attractant (male moths) and cypermethrin insecticide, which is a good adulticide.

### Number of PBW larvae

Over the two seasons data revealed that lowest number of PBW larvae (8.37/50 bolls) was recorded in the Sirene PBW applied block compared to the 18.75-larvae/50 bolls in the recommended plant protection schedule. There was a 52.83 percent reduction in the incidence of PBW larvae in Sirene PBW treated compared to the recommended plant protection schedule where there was no specific PBW management (Table 1).

### Percent boll damage

Increased attraction and mortality of male moths, in the treated block with Sirene PBW resulted in a lower percentage boll damage (7.91%) by PBW larvae compared to the 17.35% in the recommended plant protection schedule trial. Where the Sirene specific treatment for PBW management was done, the reduction in boll damage was 52.31 percent. The percentage bollworm infestation in locules in the Sirene PBW applied block was 7.06 percent, which was lower when compared to the recommended plant protection schedule block (13.96 percent) (Table 1).

### Seed cotton yield

The highest seed cotton yield of 21.11 q/ha was obtained in the Sirene PBW pheromone treated plot compared to the 17.06 q/ha in the recommended plant schedule. The application of Sirene PBW in addition to the RPP increased the yield by 19.12 percent compared to the recommended plant schedule (Table 1).

The results of the present investigations are in accordance with findings of Beasley and Henneberry (1984) who observed lower PBW in fields treated with Nomate-PBW + permethrin on immature bolls than in the fields treated with "Nomate-PBW" alone. The same opinion was also expressed by Korat (1991) who found that the addition of Sirene PBW to insecticides resulted in the significant reduction of PBW incidence to an extent of 28.24 and 29.61 percent in green bolls. Sangareddy (1994) also found that the formulation called "Check mate" was more effective than pheromone and insecticide applications as separate treatments in checking the incidence of PBW.

Bheemanna *et al.* (2000), reported the lowest number of PBW larvae (29 larvae/500 plants), minimum incidence of PBW (3.75%) on bolls, highest seed cotton yield (19.27 q/ha). Male moths trapped in Sirene

PBW pheromone treated block were also the lowest (three moths). Uttamswamy (1998) also reported similar results. Since the incidence of PBW has become quite alarming in South India in recent years, there is an urgent need of good control measures for this pest. As the stages of this insect are not amenable to insecticide application, the dependence on pheromone-based exploitation is quite evident world-wide (Bajikar and Sarode 1986; Chamberlain *et al.,* 1992; Charles and Brook, 1978; Mafra and Habib 1996; Haynes and Baker 1986). Under this situation Sirene PBW appeared to be more reliable.

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***Table 1.*** *Efficacy of Sirene PBW pheromone against* Pectinophora gossypiella *in cotton.*

| Parameters | 1997-1998 | | | 1998-1999 | | | Mean (Pooled) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Sirene application | RPP* | % Reduction/ increase | Sirene application | RPP | % Reduction/ increase | Sirene application | RPP | % Reduction/ increase |
| Number of moths/trap/night | 3.83 | 9.88 | 53.66 | 3.97 | 9.23 | 56.98 | 3.90 | 9.55 | 55.32 |
| Number of larvae/50 bolls | 8.61 | 18.17 | 47.73 | 8.13 | 19.33 | 57.94 | 8.37 | 18.75 | 52.83 |
| Green boll damage /50 bolls | 8.00 | 17.80 | 50.93 | 7.83 | 16.91 | 53.69 | 7.91 | 17.35 | 52.31 |
| Locule damage (%) | 7.15 | 14.60 | 51.02 | 6.98 | 13.33 | 47.63 | 7.06 | 13.96 | 49.32 |
| Seed cotton yield (q/ha) | 21.53 | 16.89 | 21.53 | 20.69 | 17.23 | 16.72 | 21.11 | 17.06 | 19.12 |

* RPP – Recommended package of practice