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# Biocontrol based management of cotton bollworms in the Punjab

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**ABSTRACT**: **Two biocontrol based IPM modules, along with Punjab Agricultural University (PAU) spray schedules were evaluated for the management of cotton bollworms. IPM module II (3 sprays each for sucking pests and cotton bollworm + 8 releases of *Trichogramma chilonis* @ 1,50,000/ha/week + one release of *Chrysoperla carnea* @ 10,000/ha) was on par with PAU spray schedule in reducing the bollworm damage and increasing the yield. When *T. chilonis* (Bathinda strain) was integrated with insecticides it reduced the damage of bollworm by 70.3 percent and gave higher yield by 44.5 percent over insecticides alone.**

**KEY WORDS**: *Chrysoperla carnea*, Cotton bollworms, insecticides, IPM module, *Trichogramma chilonis*

Cotton crop in the Punjab is damaged by bollworm complex namely, *Earias* spp. *Helicoverpa armigera* (Hübner) and *Pectinophora gossypiella* (Saunders). Although large number of insecticides have been recommended for their control, their indiscriminate use has resulted in the destruction of natural enemy complex (Sekhon & Varma 1985; Singh *et al.*, 1997). Integration of different pest control components in which natural enemies play an important role, have proved effective, economical and ecologically sound (Gahukar, 1997). Tanweer and Nagaraja Rao (1997) reported that IPM approach comprising nine sprays of chemicals and five releases of bioagents and two sprays of plant products was more effective than chemical control (15 sprays) and farmer's practice (21-22 sprays). The local (Bathinda) strain of *Trichogramma chilonis* Ishii proved comparatively tolerant to insecticides (Singh, 2000). Therefore the present studies were undertaken to evaluate the IPM modules and integration of Bathinda strain *T. chilonis* with insecticides for the management of cotton bollworms.

## MATERIALS AND METHOD

The experiment for the evaluation of biocontrol based IPM modules was conducted at Regional Research Station (RRS), Bathinda for the three years during 1997 to 1999. The plot size was 0.4ha for each of the four treatments (Table 1). The experiment for the integration of *T. chilonis* (Bathinda strain) was conducted at farmer's field at village Khuban (Distt. Ferozepur). The plot size was 4.0 ha each for both the treatments. In both the plots, 8 insecticidal sprays were given; in one plot, 8 releases of *T. chilonis* were made (3 days after each spray) during August- October. For recording observations each plot was divided into four parts. The incidence of bollworms was recorded from 10

Table 1. Treatment details of biocontrol based IPM for the control of cotton pests

| Module | Component (s) |
|---|---|
| IPM module-I | 1. Need based applications (three) of insecticides against sucking pests<br>2. Sixteen releases of *Trichogramma chilonis* @ 1,50,000/ha/week during July to October<br>3. One release of *Chrysoperla carnea* @ 10,000/ha on the appearance of sucking pests<br>4. One spray of *Ha*NPV @ $1.5\times10^{12}$ POB/ha on the appearance of *H. armigera* |
| IPM module-II | 1. Need based applications (three) of insecticides against sucking pests<br>2. Eight releases of *T. chilonis* @ 1,50,000/ha/week during July-August<br>3. One release of *C. carnea* @ 10,000/ha on the appearance of sucking pests<br>4. Need based application of insecticides (three) against bollworms during September-October |
| PAUspray schedule | 1. Need based application of insecticides (three) against sucking pests<br>2. Need based application of insecticides (six) against bollworms |
| Control | 1. Need based application of insecticides (three) against sucking pests |

plants from each sub-plot at fortnightly interval and mean worked out. For egg parasitism, 25-50 eggs of *H. armigera* were collected from each plot 3-4 times during the season. These eggs were brought to the laboratory for recovery of the released parasitoid. The yield at RRS Bathinda was recorded on the sub- plot basis, while at farmer's field, on whole plot basis.

## RESULTS AND DISCUSSION

The percent bolls damaged in the IPM modules and PAU spray schedule was significantly lower than in control in all the years of study. The pooled data of three years (1997 to 1999) revealed that the lowest incidence of bollworms (28.6%) was recorded in IPM modules-II and it was at par with Punjab Agricultural University (PAU) spray schedule but was significantly better than IPM modules-I (Table 2). The parasitisation of the eggs of *H. armigera* was observed in IPM module-I during all the three years, while in IPM module-II and control, it was recorded in two years, whereas in PAU spray schedule it was found only during 1997. The mean parasitism was highest (10.2%) in IPM module-1 and it was low (0.3 to 3.9%) in other treatments (Table 2). The yield in all the years was significantly higher in IPM modules and PAU spray schedule as compared to control (Table 3). The pooled data of three years revealed that the highest yield (7.1q/ha) was obtained in PAU spray schedule and it was on par with IPM module-II, but was significantly higher than IPM module-I. The increase in yield over control was 91.9 per cent in PAU spray schedule and 78.4 per cent in IPM-II. However, the pure biocontrol alone (IPM module-I) increased the yield by 45.9 per cent.

When *T. chilonis* (Bathinda strain) was evaluated on large scale field trial, it recorded only 1.78 per cent boll damage as compared to 4.13 per cent in insecticidal sprays, which results in 70.3 per cent reduction over insecticides alone (Table 4). The incidence of bollworm in control plots was very high (41.30 %). The mean parasitism of eggs of *H. armigera* was higher (10.7%) in treatments of *T. chilonis* + insecticides as compared to insecticides alone (0.7 %). The yield in the plot where *T. chilonis* was integrated with insecticides was 7.76 q/ha as compared to 5.37 q/ha in insecticidal sprays, which was 44.5 per cent higher in *T. chilonis* + insecticides.

During 1997, IPM module-I proved better, however, on the basis of 3 years data, IPM module-

Table 2. Efficacy of biocontrol based IPM modules for the control of cotton bollworms in Punjab

| Treatment* | Mean per cent bolls damaged | | | | Mean parasitism of *H. armigera* (%) | | | |
|---|---|---|---|---|---|---|---|---|
| | 1997 | 1998 | 1999 | Mean | 1997 | 1998 | 1999 | Mean |
| IPM Module-I | 18.8 (24.40) | 39.0 (38.68) | 59.7 (50.51) | 39.2 (37.86) | 15.7 | 4.0 | 11.0 | 10.2 |
| IPM Module-II** | 13.2 (19.81) | 27.5 (31.64) | 45.2 (42.27) | 28.6 (31.24) | 1.7 | 0.0 | 2.1 | 1.3 |
| PAU spray schedule*** | 10.3 (17.23) | 37.0 (37.43) | 57.3 (49.23) | 34.9 (34.63) | 0.8 | 0.0 | 0.0 | 0.3 |
| Control | 33.5 (35.26) | 58.9 (50.16) | 78.7 (62.64) | 57.0 (49.32) | 9.4 | 0.0 | 2.4 | 3.9 |
| CD (P=0.05) | (4.96) | (5.87) | (6.24) | (5.72) | – | – | – | – |

* Three sprays were provided for the control of sucking pests in all the treatments.
** Three sprays were provided for the control of bollworms.
*** Six sprays were provided for the control of bollworms during 1997 & 1998 and three sprays during 1999.

Table 3. Efficacy of biocontrol based IPM modules for the control of cotton bollworms in Punjab

| Module | Yield (q/ha) | | | | Percent increase over control |
|---|---|---|---|---|---|
| | 1997 | 1998* | 1999** | Mean | |
| IPM module-I | 13.0 | 0.5 | 2.8 | 5.4 | 45.9 |
| IPM modules-II | 14.5 | 1.4 | 3.9 | 6.6 | 78.4 |
| PAU spray schedule | 16.9 | 1.0 | 3.5 | 7.1 | 91.9 |
| Control | 10.4 | 0.1 | 0.7 | 3.7 | – |
| CD (P=0.0.5) | 2.7 | 0.2 | 0.6 | 1.2 | – |

* The crop was damaged by heavy rains (300 mm) between September 17 and 24
** High incidence (more than 50 percent) of cotton leaf curl virus

Table 4. Evaluation and integration of *T. chilonis* (Bathinda strain) and insecticides for the control of cotton bollworms at Khuban during 1999

| Treatment | Boll damage (%) | Reduction in boll damage over insecticides (%) | Parasitisation of eggs of *H. armigera* (%) | Yield (q/ha) | Increase in yield over insecticides (%) |
|---|---|---|---|---|---|
| **T. chilonis* + insecticidal sprays (8) | 1.78 | 70.3 | 10.5 | 7.76 | 44.5 |
| Insecticidal spray (8) | 6.00 | – | 0.7 | 5.37 | – |
| Control | 41.30 | – | 0.0 | 0.87 | – |

* Eight releases of *T. chilonis* @ 1,50,000/ha during August-October (3 days after each spray)

II was on par with PAU spray schedule in reducing the bollworm damage and increasing the seed cotton yield. The increase in the cost of biocontrol agents was compensated by reduced number of sprays for the control of bollworms. The biocontrol alone (IPM module-I) was less effective. These results corroborates the findings of Gill *et al.* (1993) and Tanweer and Nagaraja Rao (1997), who reported that IPM approach was better for the control of cotton pests. However, Yadav *et al.* (1985) reported that inundative releases of *T. chilonis* proved effective for the control of *H. armigera* on tomato, potato and lucerne. Brar *et al.* (1992) advocated the use of *T. achaeae* for the control of bollworm complex. Dhandapani *et al.* (1992) observed that three releases of *T. chilonis* (1,00,000 per ha) and *Brinckochrysa scelestes* (50,000 per ha) could control *H. armigera* and *Bemisia tabaci* as effectively as insecticides. Mishra and Mandal (1995) reported that release of *T. chilonis* @ 1,50.000 adults/ha/week combined with *Ha*NPV (250 LE/ha) reduced the boll damage and increased the yield. Manjunath (1993) also recommended the use of sex pheromone traps, parasitoids (*Trichogramma* spp.), *C. carnea* and NPV for the control of *H. armigera* on cotton.

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