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Evaluation of management practices against bollworms in cotton

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Abstract
The present study was conducted at Chaudhary Charan Singh Haryana University, Hisar, in experimental area of Department of Entomology during the *Kharif* season of 2016-17. The main aim of the study was to reduce the maximum use of pesticides because these pesticides induce pest resurgence, environmental pollution and toxic residue in food. Efforts were being made to encourage those pest management practices which are eco-friendly for everyone. It was found that spotted bollworm minimum boll damage (10.09 percent damage/ 50 boll/ plot) was in treatment T_2 (Spinosad alone) followed by T3 (Spinosad alternated with Nimbecidine) i.e. 10.13%, T_1 (Nimbecidine) i.e. 10.14, T_6 (Intercrop alternated with *Trichogramma* release and nimbecidine) i.e. 12.24%, T_4 (*Trichogramma* release) i.e. 13.33%, T_5 (Intercrop) i.e. 14.81% and maximum was found in untreated check i.e. 15.62%. All the treatments were significantly different as compared to T_7 except treatment T_5. Treatments T_1, T_2 and T_3 were found statistically at par from each other while significantly different from T_4, T_5 and T_6. Similarly T_4 and T_5 were statistically at par with each other. In case of pink bollworm, T_2 (10.53 percent/50 bolls/plot) was found as the most effective practice as compared to untreated check. However T_1 (11.87 percent/50 bolls/plot) and T_3 (11.47 percent/50 bolls/plot) were found statistically at par with T_2. T_4 (15.60 percent/50 bolls/plot), T_5 (17.33 percent/50 bolls/plot) and T_6 (16.53 percent/50 bolls/plot) were found statistically at par with each other. Among all treatments chemical was best followed by botanical, botanical + chemical, intercrop + *trichogramma* + botanical, biological control and alone intercrop.

Keywords: Spotted bollworm, pink bollworm and different management practices

1. Introduction
Cotton, *Gossypium* spp. is one of the commercially important fibre crop in the world grown as an annual crop in both tropical and warm temperate regions [1] But this crop is affected by bollworms *viz.*, spotted bollworm (*Earias vittella* Fabricius) and (*Earias insulana* Boisdual), American bollworm (*Helicoverpa armigera* Hubner) and pink bollworm (*Pectinophora gossypiella* Saunders) which causes yield reduction in almost all cotton growing areas of Haryana [2]. It was reported that *Trichogramma achaeae* and *T. chilonis* parasitized the eggs of *Earias* spp. and *H. armigera* on cotton and okra and the average parasitism of *Earias* spp. on cotton and okra was 23.44 and 14.87 percent and that of *H. armigera* 51.16 and 4.84 percent, respectively [3]. Neem in combination with one spray of synthetic pyrethroid gave significant control of bollworms as it resulted in minimum incidence of bollworms (10.8%) [4]. It was reported that spraying of crop with alternate applications of a neem formulation significantly reduced the incidence of bollworms in cotton [5]. Intercropping of cotton with sesame was found to increase parasitization of *H. armigera* eggs on cotton by about 32 percent [6]. There is increasing awareness about the ill effects of pesticide, particularly in terms of pest resurgence, environmental pollution and toxic residue in food; efforts are being made to encourage those pest management practices which are ecofriendly. The objective of the study was to evaluation of management practices against bollworms in cotton.

2. Materials and Methods
Cotton variety HD-432 was sown in 14th of May in the experimental area of Department of Entomology, CCS Haryana Agricultural University, Hisar during 2016-2017. There were seven treatments and three replications in each treatment and the experiment was laid out in randomized block design. Spraying of spinosad and nimbecidine were initiated as soon as the bollworms incidence reached economic threshold (i.e. at 5% incidence in fruiting bodies). *Trichogramma chilonis* adults were released as soon as eggs of bollworms appeared on cotton plants. Observations on bollworms incidence were recorded at 20 days intervals starting from 15th of July.

Table 1: Experimental details

T_1	Nimbecidine (0.03% Azadirachtin) @ 1 liter/acre in 200 litres of water
T_2	Spinosad 45 SC @ 75 ml/acre in 200 litres of water
T_3	Spinosad 45 SC @ 75 ml/ acre in 200 litres of water alternated with Nimbecidine (0.03% Azadirachtin) @ 1 liter/acre in 200 litres of water
T_4	Release of *Trichogramma chilonis* Ishii adults @ 60000 parasitoids/acre at 7 days intervals
T_5	Sesame will be sown as intercrop in cotton in the ratio of 1:1
T_6	Intercropping (cotton + sesame) in 1:1 ratio + Release of *Trichogramma chilonis* adults @ 60000 parasitoids/acre alternated with Nimbecidine (0.03% Azadirachtin) @ 1 liter/acre in 200 litres of water.
T_7	Control

2.1 Observation Record

To record incidence of bollworms in fruiting bodies of cotton, 50 fruiting bodies (intact as well as damage) from each plot were examined randomly for bollworms damage at 20 days interval starting from 45 days after sowing. To record pink bollworm incidence 50 fruiting bodies per plot were plucked at 90, 110 and 140 days after sowing. To record incidence of bollworms in opened bolls at harvest time, 50 opened bolls per plot were plucked randomly and were collected in polyethylene bags. Lint and seed of the bolls were examined carefully for bollworms damage and for diapausing larvae of pink bollworm in double seed.

2.2 Statistical analysis

The data were subjected to suitable ANOVA Techniques and the critical difference (CD) was worked out at 5% level of significance.

3. Results and Discussion

The results showed that incidence of bollworms in plots started from late July and continued to increase reaching its peak during last of September (i.e. 26.10%) and incidence gradually declined afterwards (Table 2). Minimum boll damage (10.09 percent damage/ 50 boll/ plot)) was observed in treatment T_2 followed by T_3 (10.13%), T_1 (10.14), T_6 (12.24%), T_4 (13.33%), T_5 (14.81%) and maximum was found in untreated check (15.62%). All the treatments were significantly different as compared to T_7 except treatment T_5. Treatments T_1, T_2 and T_3 were found statistically at par from each other while significantly different from T_4, T_5 and T_6. Similarly T_4 and T_5 were statistically at par with each other.

Table 2: Effect of different management practices on spotted bollworm throughout the period.

Treatments	No. of sprays	% Green fruiting bodies damaged by spotted bollworms on different dates							
		8-Jul	28-Jul	16-Aug	5-Sep	24-Sep	12-Oct	29-Oct	Mean
T_1	9	0.00	1.33	6.00	7.33	23.00	18.00	15.33	10.14
T_2	8	0.00	0.00	6.67	6.67	22.67	16.67	17.99	10.09
T_3	8	0.00	0.67	4.00	7.33	22.33	18.67	18.00	10.13
T_4	16	0.00	0.00	10.00	11.33	26.67	24.67	20.67	13.33
T_5	-	0.00	0.67	11.33	12.00	31.00	26.67	22.00	14.81
T_6	12	0.00	0.00	5.33	7.33	25.67	26.00	21.33	12.24
T_7	-	0.00	1.33	12.00	14.00	31.33	27.33	23.33	15.62
Mean		0.00	0.57	7.90	9.43	26.10	22.57	19.81	
CD (P=0.05)		N/A	N/A	2.86	4.32	0.21	3.12	3.34	2.02

It is concluded from the table that among all the treatments, T2 was found best to minimize the damage by spotted bollworms followed by T_3, T_1, T_6, T_4 and T_5. Similar observations were made by [7] studied the effect of IPM (including seed treatment, *Trichigramma* release, use of botanicals, ovicides and later stage use of chemical), chemical only and Recommended package of practices schedule (RPP) and found that less locule damage was in chemical plot (10.30%), medium in IPM plot (34.82%) and maximum was in RPP plot (47.73). Three sprays each for bollworms + 8 releases of *T. chilonis* at the rate of 1.5 lakh per hectare weekly + one release of Chrysoperla carnea at the rate of 10,000 per hectare was found on a par with alone chemical control [8]. Dissimilar findings was found in the field performance of T. chilonis against Earias spp. under sowing time and observed that *T. Chilonis* parasitized eggs of *Earias* spp. which resulted in 50 percent reduction in bollworm damage [9]. Intercropping of cotton with cowpea, soyabean, sesame etc. has been reported to encourage the population of natural enemies. Intercropping of cotton with sesame was found to increase parasitization of *H. armigera* eggs on cotton by about 32 percent [6].

Table 3: Effect of different management practices on Pink bollworm in green bolls and opened bolls.

Treatments	Number of sprays	Green bolls % damage			Opened boll % damage		Mean
		90 DAS	110 DAS	140 DAS	12 -Oct	3-Nov	
T_1	4	0.00	2.00	10.67	11.33	31.33	11.87
T_2	3	0.00	0.00	8.67	10.67	29.33	10.53
T_3	3	0.00	0.67	8.00	12.67	32.67	11.47
T_4	5	0.00	1.33	8.67	18.67	42.00	15.60
T_5	-	0.67	1.33	12.00	22.00	44.00	17.33
T_6	4	0.00	0.00	9.33	18.67	42.00	16.53
T_7	-	0.00	2.67	13.33	24.67	51.33	18.93
Mean		0.10	1.14	10.10	16.95	38.95	
CD (P=0.05)		N/A	N/A	3.00	3.79	5.42	4.69

The results showed that incidence of bollworms in plots started from 90 days after sowing and continued to increase reaching its peak in early November (Table 3). It was revealed that all the treatments decreased the population of Pink boll worm. T_2 (10.53 percent/50 bolls/plot) was found as the most effective practice as compared to untreated check. However T_1 (11.87 percent/50 bolls/plot) and T_3 (11.47 percent/50 bolls/plot) were found statistically at par with T_2. T4 (15.60 percent/50 bolls/plot), T_5 (17.33 percent/50 bolls/plot) and T_6 (16.53 percent/50 bolls/plot) were found statistically at par with each other. Similar observations were made by [10] reported that minimum pink bollworm damage was found in T_4 treatment (All chemical inscticidese) i.e. 10.50%, followed by T_2 treatment (Seed treatment + *Trichogramma* + Endosulfan + HaNPV) 11.10%, T_3 treatment (Seed treatment + *Trichogramma* + Neem + HaNPV) 15.60%, T_1 treatment (Seed treatment + *Trichogramma* + Neem) 15.80% and maximum was found in T_5 treatment (Control) 27.80. They also reported yield which was maximum of T_4 treatment (612.97 kg/ha) and lowest was of T_5 treatment (242.99 kg/ha). The neem in combination with one spray of synthetic chemical gave significant control of bollworms as it resulted in minimum incidence of bollworms (10.8%) and maximum yield of the seed cotton. It is also reported that no build up of whitefly population in neem treated plots [5].

4. Conclusion

From the present study it is concluded that among all treatments, chemical is the best which was followed by botanical, botanical + chemical, intercrop + *trichogramma* + botanical, biological control.

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