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Field efficacy of insecticide, biopesticide and pheromone trap against pea pod borer in District Shimla

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Abstract

Pea is the second most important crop in apple growing regions of Himachal Pradesh after apple and growing legumes enriches the soil health because of their nitrogen fixing ability in soil. Pea pod borer is the serious pest of pea crop. The caterpillar not only defoliates the tender leaves but also makes holes in the pods and feed upon the developing grains. Therefore, the present studies on efficacy of some pesticides (insecticides+biopesticides) viz., Deltamethrin (Decis), Azadirachtin (Neem Gold), *Bacillus thuringiensis* var. *kurstaki* (Mahastra) and pheromone trap with Helilure capsule were carried out against the pea pod borer infesting pea and further their effect on the yield of the pea crop was also studied at farmer's field in Village Badiyara, PO Jangla, Tehsil Chirgaon Distt. Shimla, Himachal Pradesh during two consecutive years. The experiment comprised of five treatments viz., T₁- Pheromone trap with Helilure capsule + *Bacillus thuringiensis* var. *kurstaki* @2g/lt, T₂- *Bacillus thuringiensis* var. *kurstaki* @2g/lt, T₃- Azadirachtin @3ml/lt, T₄- Deltamethrin @1ml/lt and T₅- Control (water only) with three replications. The pheromone trap with Helilure capsule was installed in the pea field when the crop was 30-days old and the spray was given after the emergence of the pest and the data on pod borer population were recorded after 1, 3 and 5 days after the pesticide applications. The results of the study revealed that there was reduction in the larval population of the pod borer and the highest mortality was recorded in the treatment T₁ (1.36 larvae/ plant) with pheromone trap having Helilure capsule + *Bacillus thuringiensis* var. *kurstaki* @2g/lt followed by T₂ treatment (2.26 larvae/ plant) which was statistically at par with T₃ (2.30 larvae/ plant) and T₄ (2.40 larvae/ plant) while it was the lowest in T₅ treatment (5.83 larvae/ plant). Among the treated plots, significantly highest yield of pea crop was recorded in the T₁ treatment having 61q/ ha yield while the minimum yield of 49.5q/ ha was recorded in T₅ (Control) treatment. Hence, the use of biopesticides with Pheromone trap should be encouraged in future as it is not only eco-friendly but economical as well.

Keywords: Pea, pea pod borer, deltamethrin, azadirachtin, *Bacillus thuringiensis* var. *kurstaki*, pheromone trap

Introduction

Pea is the second most important crop in apple growing regions of Himachal Pradesh after apple and growing legumes enriches the soil health because of their nitrogen fixing ability in soil [1]. Green pods are used for vegetable purpose and dried peas are used as pulses. It is one of the most important vegetable crops in terms of higher returns, friendly environment and employment generation. In India, it is commercially cultivated in the states of Himachal Pradesh, Madhya Pradesh, Punjab, Maharashtra, Rajasthan, Haryana, Karnataka and Bihar. It is rich source of proteins, amino acids and sugars. Green peas straw is good source of nutritional fodder for livestock. In Himachal Pradesh, pea crop is being cultivated over 26256 ha with annual production of 329910.80 MT [1]. The major biotic factors inflicting huge economic losses are the insect pests and 10-15 per cent reduction in yield of pea crop has been reported due to insect-pest [9]. The major insect-pests attacking pea are stem fly, leaf miner, thrips etc [4]. Besides these, pea pod borer, *Helicoverpa armigera* is the serious pest of pea crop in Himachal Pradesh. The damage is done by larvae which not only defoliates the tender leaves but also makes holes in the pods and feed upon the developing grains [5]. Consequently the yield of the infested crop is much reduced [13]. Thus, causing economic losses to the farmers.

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The management of this noxious pest is primarily based on synthetic insecticides. Preference of insecticides is due to their easy availability and applicability but now a days biopesticides play an important role in pest management because they are inherently less harmful than conventional pesticides. Pheromone technology possesses enormous potential as one of the tools in Integrated Pest Management (IPM) [8]. Pheromone helps in monitoring insect pest population and also indirectly controls them either by male annihilation through mass trapping or by mating disruption [12]. Therefore, the present study was undertaken to evaluate the field efficacy of insecticide, biopesticide and pheromone trap against pea pod borer and further study their effect on the yield of the pea crop in district Shimla.

Material and Methods

The field experiments were carried out to study the efficacy of insecticides, biopesticides and pheromone trap namely Deltamethrin (Decis), *Bacillus thuringiensis var. kurstaki* (Mahastra), Azadirachtin (Neem Gold) and Pheromone trap with Helilure capsules of 2mg against pea pod borer infesting pea crop in Randomized Block Design with three replications at farmers' field in Village Badiyara, PO Jangla, Tehsil Chirgaon Distt. Shimla Himachal Pradesh during two consecutive years i.e. 2019 and 2020. Spacing of 30 cm between row to row and 10 cm between plant to plant were maintained. All agronomical practices were adopted to raise a good crop. Pre and post count of larvae were taken by spraying with the above mentioned treatments and the data on larval population were recorded on 1, 3 and 5 days after treatment. In first treatment, Pheromone traps were installed in the field with 2mg of pheromone blend of Helilure and were deployed at the height of 0.5m above the crop canopy for trapping the maximum number of the male moths. Spray of insecticides and biopesticides namely *Bacillus thuringiensis var. kurstaki* (2g/lit) was given in the first treatment in combination with Pheromone trap. Second treatment was *Bacillus thuringiensis var. kurstaki* (2g/lit) alone, third was Azadirachtin (3ml/lit) and fourth was Deltamethrin (1ml/lit) after the emergence of the pest. Control plots with only water spray were maintained simultaneously for comparison.

Percent reduction in the population of larvae were calculated by the given Henderson & Tilton's formula:

$$\text{Corrected (\%)} = \frac{100 \times [1 - n \text{ in } C_0 \text{ before treatment} \times n \text{ in } T \text{ after treatment}]}{n \text{ in } C_0 \text{ after treatment} \times n \text{ in } T \text{ before treatment}}$$

Where, n= Larval population, T= Treated, Co= Control
The effect of insecticides and biopesticides on the yield of pea was studied by the below given formula:

$$\text{Yield} = \text{kg/ha}$$

Results and Discussion

The data (Table 1) depicts that during the year 2019, treatment with all the chemicals and the use of *Bacillus thuringiensis var. kurstaki* with pheromone trap were significantly superior over the control wherein the larvae population increased from 5.00 (Precount) to 5.83 (1DAS) in the present study. Use of Pheromone trap with *Btk* proved to be the best treatment in managing the pest wherein the pest population was brought down significantly from 9.00

(Precount) to 1.36 (1DAS) followed by *Btk* which managed the pest population substantially from 8.00 (Precount) to 2.26 (1DAS). Whereas Azadirachtin and Deltamethrin treated pest population was brought down significantly from 7.23 (Precount) to 2.30 (1DAS) and from 7.33 (Precount) to 2.40 (1DAS) respectively. Similar trend was observed during the year 2020 where Pheromone trap with *Btk* proved to be the best treatment in managing the pest population wherein the pest population was brought down significantly from 8.76 to 1.26. This was followed by *Btk* which showed the drastic reduction in pest population from 7.73 to 2.16 and treatment of Azadirachtin and Deltamethrin brought the pest population significantly down from 7.50 to 2.20 and from 7.1 to 2.33, respectively. These three treatments of *Btk*, Azadirachtin and Deltamethrin were statistically non-significant and equally effective.

The present findings were in agreement with Rahul *et al.* [12] who also reported that pheromone traps are important tool for monitoring of *H. armigera* population on the pigeon pea crop followed by management practices for effective management of this insect-pest. Mukhopadhyay and Mukherjee [10] also reported the same that pheromone traps are helpful in monitoring and mass trapping of the pest population for legume pod borers. Golvankar *et al.* [5] reported that minimum number of larvae were recorded in the treatments with *Btk* followed by Azadirachtin which were significantly superior and were at par with each other.

The data (Table 2) reveals that the pest population was reduced drastically by 86.33 percent with the combination treatment of Pheromone trap and *Btk* (1DAS) during the year 2019 followed by *Btk* alone which reduced the pest population by 75.24 percent. Azadirachtin and Deltamethrin reduced the larval pest population to 72.72 and 71.04 percent respectively during the year 2019.

The data during the year 2020 also followed the same trend and Pheromone trap with *Btk* proved to be the best treatment in managing the pest population with 87.66 percent followed by *Btk* with 76.07 percent reduction in the larval pest population. Whereas

Azadirachtin and Deltamethrin reduced the larval pest population to 74.95 and 71.94 percent respectively during the year 2020. These findings were in agreement with Baruah and Chauhan [2] who reported that synthetic pyrethroids are effective against pod borers of pigeon pea when applied at their recommended doses. Similarly Bhushan and Nath [3] reported that the Neem Seed Kernel Extract (NSKE 5 percent) was most effective in reducing the larval population and pod damage.

From the table 3 it is clear that the use of Pheromone trap with *Btk* resulted in significantly higher crop yield i.e., 61q/ha and 62.12q/ha recorded for the years 2019 and 2020, respectively. The yield of pea crop ranged from 62-54q/ha with all other treatments except control where it was 49.5q/ha. The present findings are corroborative with the findings of Jadhav *et al.* [7] They reported that the IPM module having hand collection of larvae, alternate spray of NSKE 5 percent, *Btk* after 50 percent flowering recorded maximum yield of pea crop. The present findings also confirm the results of Golvankar *et al.* [5] who reported that *Btk* recorded highest yield followed by Azadirachtin and were at par with each other except water spray.

Gundannavar *et al.* [6] reported the superiority of biopesticides against pod borers in recording highest larval reduction and lowest pod and grain damage and increase profitability.

Table 1: Field efficacy of insecticides, biopesticides and pheromone trap against pea pod borer.

Treatment	Pre Count	Mean number of larvae per plant (days after spray) in 2019			Pre Count	Mean number of larvae per plant (days after spray) in 2020		
		1	3	5		1	3	5
Pheromone trap with Helilure capsule (1No.) + <i>Bacillus thuringiensis var. kurstaki</i> (2g/l)	9.00	1.36	1.26	1.10	8.76	1.26	1.22	1.05
<i>Bacillus thuringiensis var. kurstaki</i> (2g/l)	8.00	2.26	2.16	2.06	7.73	2.16	2.1	1.9
Azadirachtin (3ml/l)	7.23	2.30	2.33	2.23	7.50	2.20	2.23	2.16
Deltamethrin (1ml/l)	7.33	2.40	2.60	2.50	7.1	2.33	2.5	2.4
Control (Water only)	5.00	5.83	6.00	6.23	4.86	5.7	5.83	6.13
CD (p=0.05%)	NS	0.768	0.567	0.562	NS	0.554	0.455	0.462

Table 2: Percent reduction in the population of larvae of pea pod borer after the spray of insecticides and biopesticides.

Treatments	Percent reduction in population of larvae over control					
	*DAS 2019			*DAS 2020		
	1	3	5	1	3	5
Pheromone trap with Helilure capsule (1No.) + <i>Bacillus thuringiensis var. kurstaki</i> (2g/l)	86.33	88.03	90.00	87.66	88.32	90.49
<i>Bacillus thuringiensis var. kurstaki</i> (2g/l)	75.24	77.45	79.07	76.07	77.34	80.50
Azadirachtin (3ml/l)	72.72	73.11	75.22	74.95	75.15	77.14
Deltamethrin (1ml/l)	71.04	70.25	72.31	71.94	70.62	73.17

*DAS- Days after spray

Table 3: Yield of pea crop after the treatment of insecticides and biopesticides and pheromone trap.

Treatment	Yield q/ ha	
	2019	2020
Pheromone trap with Helilure capsule (1No.) + <i>Bacillus thuringiensis var. kurstaki</i> (2g/l)	61	62.12
<i>Bacillus thuringiensis var. kurstaki</i> (2g/l)	56	56.1
Azadirachtin (3ml/l)	54.4	55.3
Deltamethrin (1ml/l)	54	54.18
Control (Water only)	49.5	49.63

Conclusion

Results showed that the treatment of Pheromone trap with *Bacillus thuringiensis var. kurstaki* biopesticide was superior over all other treatments and significantly the highest yield of pea crop was also observed in this treatment. Hence, the use of Pheromone trap with *Bacillus thuringiensis var. kurstaki* biopesticide is not only economical, ecofriendly and sustainable but also their use renders the crop much safer for human consumption. Therefore now a days biopesticides can play an important role in pest management.

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