

## Original Research Article

### **Evaluation of some biopesticides against pod borer in garden pea (*Pisum sativum* L.) under natural conditions of Prayagraj (U.P.)**

#### **ABSTRACT**

---

A field trial was conducted at the Central Research Farm, Department of Entomology SHUATS, Allahabad during the *Rabi* season. Eight treatments were evaluated against Pod borer, *Helicoverpa armigera* i.e., Neem oil 2% @ 2ml/lit, Spinosad 45% SC @ 0.2ml/lit, NSKE 5% @ 5ml/lit, *Bacillus thuringiensis* 4% WSP @ ml/lit, NSKE+*HaNPV*+*Bt* @ 1ml/lit, Emamectin Benzoate 5% SG @ 2ml/lit, *Beauveria bassiana* @ 2ml/lit and Untreated control in RBD with three replications. Results revealed that among the different treatments Emamectin benzoate 5% SG (10.57%) was found to be the most effective treatment in the reduction of *H. armigera* followed by Spinosad 45% SC (15.21%), NSKE+*HaNPV*+*Bt* (9.03%), *Beauveria bassiana* 1.5% SG (13.98%), NSKE 5% (16.41%), *Bacillus thuringiensis* 4% WSP (12.00%) and Neem oil 2% (17.32%) was found to be least effective against this pest. Among all the treatments, the cost-benefit ratio has been analyzed, in which the highest was Emamectin benzoate 5% SG (1:4.25) and marketable yield (19.20 q/ha) followed by Spinosad 45% SC (1:3.43 and 16.40 q/ha), and NSKE+*HaNPV*+*Bt* (1:3.00 and 14.60 q/ha), *Beauveria bassiana* 1.5% SG (1:2.80 and 13.25 q/ha), NSKE 5% (1:2.69 and 12.45 q/ha), *Bacillus thuringiensis* 4% WSP (1:2.55 and 11.80 q/ha) and the lowest was Neem oil 2% (1:2.48 and 11.20 q/ha) have been recorded.

**Keywords:** benefit cost ratio, evaluation, garden pea, *H. armigera*, pod borer.

#### **INTRODUCTION**

Garden pea (*Pisum sativum* L. var. hortense) belongs to the family Leguminosae (Fabaceae) is also called sweet pea is a choice vegetable grown for its fresh shelled green seeds rich in protein (7.2%), vitamins and minerals. Garden pea originated in the region comprising Central Asia, Mediterranean countries and Ethiopia. It is native to Syria, Iraq, Iran, Turkey, Israel, Jordan, Ethiopia, Lebanon and has been cultivated in Europe for several thousand years (Mohan *et al.*, 2013)<sup>[30]</sup>.

In terms of productivity, India stands as the second largest producer of green peas next to China and ranks ten among the vegetable crops. The annual global production of green pea and dry pea seeds is approximately 14.5 million tons and 22 million tons, respectively **(Kumari and Chandra 2021)<sup>[24]</sup>**.

In India, it is grown in an area of 0.42 million ha with the production of 4.01 million metric tonnes and productivity is 9.5 t/ha. Garden pea is a cool season crop mainly grown during the winter season on plains and during the summer season on hills **(Mohan et al., 2013)<sup>[30]</sup>**. The major Pea-producing states are Uttar Pradesh, Punjab, Himachal Pradesh, Orissa, Karnataka and Haryana, etc. **(Senapati et al., 2019)<sup>[34]</sup>**.

Uttar Pradesh is the leading state in the area (1.8 lakh ha) and production (18.8 lakh tonnes) followed by Madhya Pradesh (22.8 thousand ha; 5.34 lakh tonnes). Jammu and Kashmir is the leading state in productivity (20.8 t/ha) followed by Jharkhand **(Mohan et al., 2013)<sup>[30]</sup>**. The nutritional value of dry pea seed is similar to other grain legumes and contains 18-30 % protein, 35-50% starch and 4-7 % fiber **(Ibrahim et al., 2020)<sup>[16]</sup>**.

The crop is known to suffer from a number of insect pests like pod borers (*Etiella zinckenella* Tr. and *Helicoverpa armigera* Hub.), pea stem fly (*Melanagromyza phaseoli* Tyron), pea leaf miner (*Chromatomyia horticola* Goureau), aphid (*Acyrtosiphon pisum*) and thrips (*Caliothrips indicus* Bagnall). These are serious insect pests and often cause substantial loss to the crop. Insect pests in western Uttar Pradesh, in addition to other insect pests, the pod

borers *Etiella zinckenella* (Treitschke) and *Helicoverpa armigera* (Hübner) are most serious insect pest of vegetable pea appearing during the flowering and pod stage which seriously damages the crop and is considered to be a major limiting factor for the production of vegetable pea (Vaibhav *et al.*, 2018)<sup>[41]</sup>.

### Materials and Methods

The experiment was conducted during Rabi 2021 at Central Research Farm, the Sam Higginbottom University of Agriculture, Technology and Sciences, Naini, Prayagraj, U.P, to evaluate the efficacy of Some Biopesticides viz., Neem oil 2%(T<sub>1</sub>), Spinosad 45% SC (T<sub>2</sub>), NSKE 5% (T<sub>3</sub>), *Bacillus thuringiensis* (T<sub>4</sub>), NSKE+HaNPV+Bt (T<sub>5</sub>), Emamectin benzoate5%SG (T<sub>6</sub>), *Beauveria bassiana*(T<sub>7</sub>) and untreated Control (T<sub>0</sub>) in RBD with three replications at a spacing of 45cm x 30cm. The experimental field was monitored for incidence of garden pea pod borer at the weekly interval to observe ETL levels of insects. Spraying was done by using a Hand compression sprayer. pod damage analysis was recorded by randomly picking 5 plants per plot from each treatment a day prior to insecticide application and seven, fourteen days after each treatment

#### Cost-benefit ratio of treatments:

Gross returns will be calculated by multiplying the total yield with the market price of the produce. The cost of cultivation and cost of treatments will be deducted from the gross returns, to find out the returns and cost benefit of ratio by following formula,

$$B.C.R = \frac{\text{Gross Returns}}{\text{Total Cost of Protection}}$$

### RESULTS AND DISCUSSION

In the experiments, eight different treatments, consisting application of were tested to compare the efficacy against *Helicoverpa armigera* and their influences on the yield of a garden pea. The results obtained are discussed in the light of available relevant literature in this chapter as before.

Overall mean analysis of 7<sup>th</sup> and 14<sup>th</sup> days after 1st insecticidal application indicated that all the insecticidal treatments were significantly effective in highly reduced pod damage percentage of *H. armigera* as compared to untreated plots. Emamectin benzoate 5% SG (14.16%) was found significantly superior among all the treatments. Spinosad 45% SC (17.06%) is the next best treatment for reducing the population of pod borers. It is followed by *NSKE+HaNPV+Bt* (13.27%), *Beauveria bassiana* 1.5% SG (16.72%) and NSKE 5% (17.79%), *Bacillus thuringiensis* 4% WSP (14.98%) followed by Neem oil 2% (18.18%) which is less effective against pod borer.

The data on percent pod damage of *Helicoverpa armigera* on the second spray revealed that all the treatments were significantly superior to control. Among all treatments, Emamectin benzoate 5% SG (9.03%) was found significantly superior among all the treatments which are in line with the similar findings of **Akhtar et al. (2022)**<sup>[3]</sup> with (10.4% and 11.9%) and **Upadhyay et al. (2020)**<sup>[40]</sup> with (7.33%) and **Dadas et al. (2019)**<sup>[11]</sup> with (8.33%). Spinosad 45% SC (10.57%) is the next best treatment for reducing the population of pod borer which is in line with the similar findings of **Dadas et al. (2019)**<sup>[11]</sup> with (7.33%), **Agale et al. (2019)**<sup>[2]</sup> with pooled mean percent (6.82%), **Mihretie et al. (2020)**<sup>[28]</sup> with (11.39%), **Akhtar et al. (2022)**<sup>[3]</sup> with (7.8%). It is followed by

*NSKE+HaNPV+Bt* (12.00%) which is in line with the similar finding of **Byrappa et al. (2012)**<sup>[7]</sup> with (15.96%), *Beauveria bassiana* 1.5% SG (13.98%) which is in line with the similar finding of **Singh et al. (2016)**<sup>[38]</sup> and **Khorasiya et al. (2018)**<sup>[21]</sup> with (9.8%), and NSKE 5% (16.41%), *Bacillus thuringiensis* 4% WSP (12.00%) which is in line with the similar finding of **Khorasiya et al. (2018)**<sup>[21]</sup> and **Meena et al. (2018)**<sup>[27]</sup> with (13.17% and 10.50%) followed by Neem oil 2% (17.32%) which is in line with the similar finding of **Abhilasha and Shekarappa (2017)**<sup>[1]</sup> and **Mishra et al. (2014)**<sup>[29]</sup> with (25.68%) which is less effective against pod borer.

The yields among the treatments were found to be significant. The highest yield was recorded in Emamectin benzoate 5% SG (19.20 q/ha) which is in line with the similar findings of **Kumar and Kumar (2022)**<sup>[25]</sup> with (1966 kg/ha), **Santhosh and Kumar (2022)**<sup>[33]</sup> with (19.72q/ha) and **Chaukikar et al. (2017)**<sup>[9]</sup> with (1810kg/ha) followed by Spinosad 45% SC (16.40q/ha) which is in line with the similar findings of **Mihretie et al. (2020)**<sup>[28]</sup> with (16.68q/ha), **Mishra et al. (2014)**<sup>[29]</sup> with (17.53q/ha) and **Upadhyay et al. (2020)**<sup>[40]</sup> with (15.55q/ha), *NSKE+HaNPV+Bt* (14.60q/ha) which is in line with the similar finding of **Byrappa et al. (2012)**<sup>[7]</sup> with (10.01q/ha), *Beauveria bassiana* 1.5% SG (13.25 q/ha) which is in line with the similar finding of **Khorasiya et al. (2018)**<sup>[21]</sup> with (12.33q/ha), NSKE 5% (12.45 q/ha) which is in line with the similar finding of **Meena et al. (2018)**<sup>[27]</sup> with (12.22q/ha) and **Hossain et al. (2010)**<sup>[15]</sup> with (11.46q/ha), *Bacillus thuringiensis* 4% WSP (11.80 q/ha) with similar findings of **Khorasiya et al. (2018)**<sup>[21]</sup> with (11.17q/ha), **Meena et al. (2018)**<sup>[27]</sup> with (11.23q/ha) and **Singh et al. (2016)**<sup>[38]</sup> with (11.4q/ha) and Neem oil 2% (11.20 q/ha) with similar findings of **Santhosh and Kumar (2022)**<sup>[33]</sup> with (13.61q/ha) as compared to control plot (8.2q/ha).

When cost benefit ratio was worked out, interesting result was achieved. Among the treatments studied, the best and most economical treatment was Emamectin benzoate 5% SG (1:4.25) with the similar finding of **Kumar and Kumar (2022)**<sup>[25]</sup> with (1:4.5) followed by Spinosad 45% SC (1:3.43) with the similar findings of **Kumar and Kumar (2022)**<sup>[25]</sup> with (1:1:4.0) and **Abhilasha and Shekarappa (2017)**<sup>[1]</sup> with (1:3.91), *NSKE+HaNPV+Bt* (1:3.00) with the similar finding of **Byrappa et al. (2012)**<sup>[7]</sup> with (1:2.27), *Beauveria bassiana* 1.5% SG (1:2.80) with the similar finding of **Singh et al. (2016)**<sup>[38]</sup>, NSKE 5% (1:2.69) with the similar findings of **Abhilasha and Shekarappa (2017)**<sup>[1]</sup> with (1:2.89) and

**Hossain et al. (2010)**<sup>[15]</sup>, *Bacillus thuringiensis* 4% WSP (1:2.55) with similar findings of **Khorasiya et al. (2018)**<sup>[21]</sup> with (1:2.83) and **Meena et al. (2018)**<sup>[27]</sup> with (1:2.29) and Neem oil 2% (1:2.48) with the similar findings of **Abhilasha and Shekarappa (2017)**<sup>[1]</sup> with (2.73) and **Santhosh and Kumar (2022)**<sup>[33]</sup> with (1:2.41) as compared to Control (1:1.90).

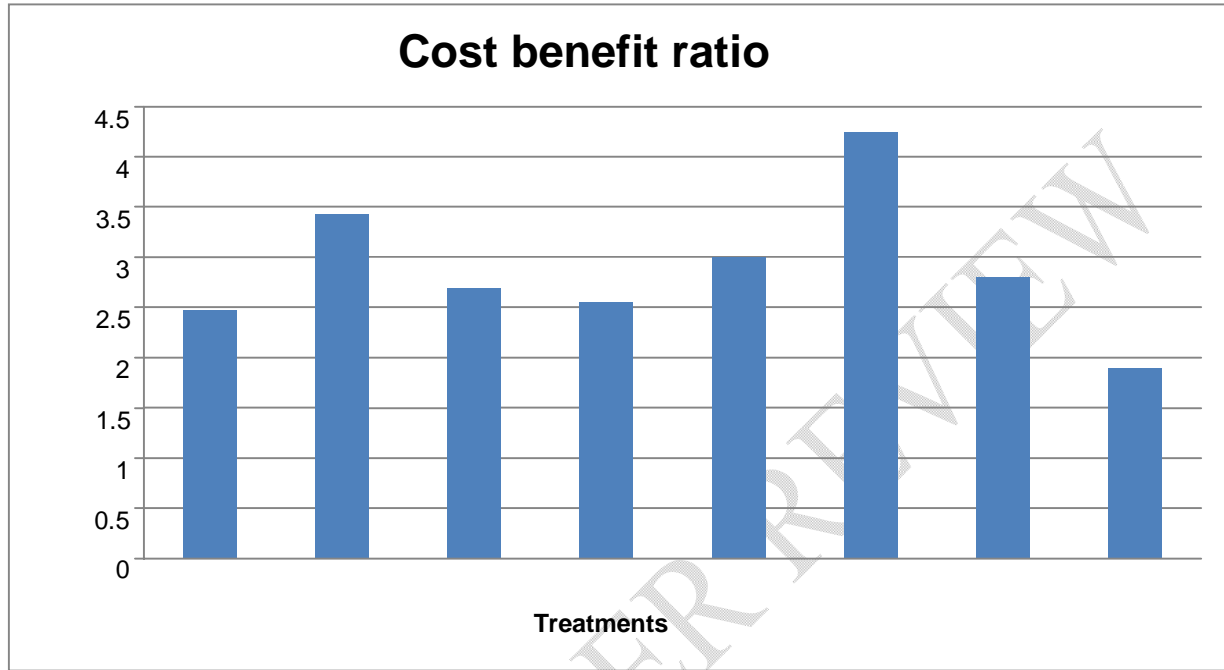
UNDER PEER REVIEW

**Table 1 : List of treatments and pod damage percentage**

S.No.	Treatments	Pod damage percentage								Yield (q/ha)	C:B Ratio	
		First spray				Second spray						
		1DBS	7DAS	14DAS	Mean	1DBS	7DAS	14DAS	Mean			Overall Mean
T <sub>1</sub>	Neem oil 2%	24.04	13.31	17.18	18.18	17.18	15.02	19.76	17.32	17.18	11.20	1:2.48
T <sub>2</sub>	Spinosad 45% SC	24.17	7.14	11.54	14.16	11.54	8.27	12.27	10.57	11.54	16.40	1:3.43
T <sub>3</sub>	NSKE 5%	24.19	11.41	15.76	17.06	15.75	13.03	17.04	15.21	15.75	12.45	1:2.69
T <sub>4</sub>	<i>Bacillus thuringiensis</i>	24.21	12.40	16.33	17.79	16.33	14.22	18.25	16.41	16.33	11.80	1:2.55
T <sub>5</sub>	NSKE+HaNPV+Bt	24.07	8.54	12.32	14.98	12.32	9.57	14.09	12.00	12.32	14.60	1:3.00
T <sub>6</sub>	Emamectin benzoate 5% SG	24.33	6.21	9.21	13.27	9.21	7.38	10.45	9.03	9.21	19.20	1:4.25
T <sub>7</sub>	<i>Beauveria bassiana</i> 1.5% SG	24.88	10.63	15.75	16.72	15.76	11.01	16.25	13.98	15.76	13.25	1:2.80
T <sub>0</sub>	Control	24.26	27.95	29.25	27.07	29.25	27.95	28.99	28.64	29.25	8.2	1:1.90
	F-Test	NS	S	S	S	S	S	S	S	S		
	S. Ed. (±)	_____	1.65	1.55	2.37	1.55	1.54	1.52	0.49	1.55		
	C.D. (P = 0.05)	_____	3.5	3.3	5.09	3.3	3.31	3.27	1.05	3.3		

**Table 2. Economics of Cultivation**

S.No.	Treatments	Yield of q/ha	Cost of yield / ₹/q	Total cost of yield (₹)	Common cost (₹)	Treatment cost(₹)	Net return(₹)	Total cost (₹)	C:B ratio
1	Neem oil 2%	11.20	5620	62944	24205	1160	37579	25365	<b>1:2.48</b>
2	Spinosad 45% SC	16.40	5620	92168	24205	2640	65323	26845	<b>1:3.43</b>
3	NSKE 5%	12.45	5620	69969	24205	1800	43964	26005	<b>1:2.69</b>
4	<i>Bacillus thuringiensis</i> 4% WSP	11.80	5620	66316	24205	1700	40411	25905	<b>1:2.55</b>
5	NSKE- <i>HaNPV-Bt</i> 5%-250LE-1L	14.60	5620	82052	24205	3100	54747	27305	<b>1:3.00</b>
6	Emamectin benzoate5%SG	19.20	5620	107904	24205	1130	82569	25335	<b>1:4.25</b>
7	<i>Beauveria bassiana</i> 1.5% SG	13.25	5620	74465	24205	2100	48160	26305	<b>1:2.80</b>
8	Control	8.2	5620	46084	24205	0	22279	24205	<b>1:1.90</b>



**Fig1. Cost-benefit ratio of different treatments**

### **Conclusion**

The present study was conducted on the evaluation of insecticides during *rabi* season 2021-22 on garden pea pod borer, *H. armigera* percent pod damage revealed that, Emamectin benzoate 5% SG (10.57%) was found to be the most effective treatment in the reduction of *H. armigera* followed by Spinosad 45% SC (15.21%), NSKE+HaNPV+Bt (9.03%), *Beauveria bassiana* 1.5% SG (13.98%), NSKE 5% (16.41%), *Bacillus thuringiensis* 4% WSP (12.00%) and Neem oil 2% (17.32%). Among all the treatments, the cost-benefit ratio has been analyzed, in which the highest was Emamectin benzoate 5% SG (1:4.25) and marketable yield

(19.20 q/ha) followed by Spinosad 45% SC (1:3.43 and 16.40 q/ha), and NSKE+HaNPV+Bt (1:3.00 and 14.60 q/ha), *Beauveria bassiana* 1.5% SG (1:2.80 and 13.25q/ha), NSKE 5% (1:2.69 and 12.45 q/ha), *Bacillus thuringiensis* 4% WSP (1:2.55 and 11.80 q/ha) and the lowest was Neem oil 2% (1:2.48 and 11.20 q/ha) have been recorded.

## REFERENCES

**Abhilasha, C.R. and Shekharappa. (2017).** Efficacy of bio and synthetic pesticides against Thrips *Scirtothrips dorsalis* (Hood) and Leaf miner *Liriomyza* spp. on Peas, *Pisum Sativum* (L.). *Journal of Entomology and Zoology Studies*, **5**(3): 690-696.

**Agale, S.V., Gupta, R. Rangarao, G. V. and Wani, S. P. (2019).** Efficacy of Some Biopesticides against *Helicoverpa Armigera* (Hubner) in Pigeonpea under Natural Condition. *Legume Research*, 0250-5371

**Akhtar, M., Mahmood, M. T., Khalid, M. J., Amin, A., Zafar, M. N., Aziz, A., Rasool, I. and Qadeer, Z. (2022).** Efficacy of some new chemistry insecticides against the chickpea pod borer (*Helicoverpa armigera*) [Hubner], *Plant Cell Biotechnology and Molecular Biology*, **23**(9&10):1-6.

**Babariya, P. M., Kabaria, B. B., Patel, V. N. and Joshi, M. D. (2010).** Chemical control of gram pod borer, *Helicoverpa armigera* Hubner infesting pigeonpea. *Legume Research-An International Journal*, **33**(3): 224-226.

**Babu, C. S. J. and Mallikarjun. (2012).** Evaluation of different insecticides and bio-pesticides for control of pigeonpea pod borer (*Helicoverpa armigera* Hubner). *International Journal of Plant Protection*, **5**(2) : 272-274.

**Bhushan, S., Singh, R. P. and Shanker R. (2011).** Bio-efficacy of neem and Bt against pod borer, *Helicoverpa armigera* in chickpea, *Journal of Biopesticides*, **4** (1): 87 – 89.

**Byrappa, A. M., Kumar, N.G., Divya, M. 2012.** Impact of biopesticides application on pod borer complex in organically grown field bean ecosystem. *Journal of Biopesticides*, **5** (2): 148.

**Chavan, P., Sonawane, C. J., Deshmukh, G. P. and Mhase, L. B. (2017).** Bio-Efficacy of Emamectin Benzoate 5 WG against Pod Borer, *Helicoverpa armigera* in Chickpea. *Trends in Biosciences*, **10**(33) :7089-7090.

**Chaukikar, K., Bhowmik A. K., Das, S. B., Marabi, R. S. and Singh, V. (2017).** Tomerbio-efficacy of Emamectin benzoate against *Helicoverpa armigera* (Hubner) and its Natural Enemies on chickpea (*Cicer arietinum*) Crop, *International Journal of Bio- resource and Stress Management*, **8**(5): 716-720.

**Chitralekha., Yadav, G. S. and Verma, T. (2018).** Efficacy of insecticides against *Helicoverpa armigera* on chickpea, *Journal of Entomology and Zoology Studies*, **6**(3): 1058-1061.

**Dadas, S. M., Gosalwad, S. S. and Patil, S. K. (2019).** Efficacy of different newer insecticides against pigeon pea pod borers, *Journal of Entomology and Zoology Studies*, **7**(5): 784- 791.

**Dinesh, K., Singh, R. B., Kavita, K. and Choudhary, R. S. (2017).** Relative efficacy of newer insecticides and biopesticides against *Helicoverpa armigera* (hub.) in chickpea, *Journal of Entomology and Zoology Studies*, **5**(3): 455-462.

**Gautam, M. P., Chandra, U., Singh S. N., Yadav S. K. and Giri S. K. (2018).** Studies on Efficacy of Botanicals against *Helicoverpa armigera* (Hubner) on Chickpea (*Cicer arietinum* L.), *International Journal Current Microbial Applied Sciences*. **1**(7): 612-618.

**Gomez, K. A. and Gomez, A. A. (1976).** Statistical procedures for agricultural research with emphasis on rice. *International Rice Research Institute*, **13**:303.