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Efficacy of bio-pesticides against pea pod borer, *Etiella zinckenella* (Treitschke)

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Abstract
Field studies were conducted on the efficacy of bio-pesticides against pea pod borer, *Etiella zinckenella* (Treitschke) at experimental field, Organic Research farm Karguwan Ji, Department of Entomology, Institute of Agricultural Sciences, Bundelkhand University, Jhansi (Utter Pradesh) during *Rabi* Season of 2021-2022. Different bio-pesticides viz: Neem oil, Garlic bulb extract, *Bacillus thuringiensis* (5% WP), Castor oil, Panchgavya, Neem Seed Kernel Extract (Crude extract), *Verticillium lecanii* ($2x10^8$ cfu), *Beauveria bassiana*. Experimental results revealed that the plant treated with bio-pesticides registered a significant difference of pea pod borer *Etiella zinckenella* (Treitschke) over the treatment of untreated control. Among them, the treatment of *Beauveria bassiana* (5.71 larvae/5 plant) was found in significantly more effective against the pest as compared to other bio-pesticides *Bacillus thuringiensis*, NSKE, Neem oil, and *Verticillium lecanii* were found moderately effective and proved significantly superior over Castor oil, Panchgavya and Garlic bulb extract proved significantly less effective among the bio-pesticides evaluated against pea pod borer *Etiella zinckenella*.

Keywords: Pea, pea pod borer *Etiella zinckenella*, bio-pesticides

Introduction
Pea (*Pisum sativum* L.) is an important vegetable crop grown throughout the world. In India, it is mainly grown as winter vegetable in the plains of North India and as summer vegetable in the hills areas. It is generally used as fresh vegetable and in the form of canned, processed or dehydrated. The field pea is a type of pea sometimes called *Pisum sativum* sub sp. *arvense* (L.) belonging the family Leguminosae (Papilonaceae). It is native of India. It is highly nutritive, containing high percentage of digestible protein, carbohydrate, vitamins and very rich in minerals. The field pea is a cool-season crop. It is grown on over 25 million acres worldwide. In India, field pea is cultivated in 540.00 thousand ha area with 5422 MT production and 10.04 ton/ha productivity. In Utter Pradesh, the total area of field pea is 221 thousand ha with 2511.38 thousand MT production and 11.36 ton/ha productivity in Bundelkhand Region, Jhansi district of Utter Pradesh it occupies an area of about 28.52 thousand hac area with 337.28 MT production and 11.82 ton/ha productivity. (Anonymous, 2020) [1].
The major insect-pests attacking field pea are stemfly, *Ophiomyia phaseoli*, leaf miner, *Chromatomyia horticola*, thrips *Caliothrips indicus* and pea pod borer, *Etiella zinckenella* and gram pod borer, *Helicoverpa armigera*. There 10-15% reduction in yield of field pea was reported due to insect pest. the pod damage by pod borer, *E. zinckenella* in field pea ranged from 1.0 to 4.10 percent. Infestation of *Etiella Zinckenella* pest has been reported up to 17.5 percent.

Material and Methods
A Field study carried at the experimental field, organic research farm Karguwan Ji, Institute of Agricultural Sciences, Department of Entomology, Bundelkhand University, Jhansi Utter Pradesh During *Rabi* Season of 2021-2022. To know the efficacy of bio-pesticides against pea pod borer (*Etiella zinckenella* Treitschke) from November 2021 to March 2022. The field pea plant were observed at weekly intervals for the infestations of *Etiella zinckenella* and there upon different products were applied directly as sprays on the plant by using a knapsack sprayer with a flat fan nozzle (Total plot 27, spacing- 30cm x 10cm, Number of spray-2). Various bio-pesticides used were Neem oil (5% EC), Garlic bulb extract, *Bacillus thuringiensis* var. Kurstaki (5% WP), Castor oil (5% EC), Panchgavya, Neem Seed Kernel

Extract (Crude extract), *Verticillium lecanii* ($2x10^8$ cfu), *Beauveria bassiana.* Was evaluated based on the number of *Etiella zinckenella* larvae. The observations were recorded before spraying and 3, 7 and 14 days after spray. The data obtained from various treatments were subjected to convenient variation and statistically analyzed.

Result and Discussion

Efficacy of bio-pesticides against pea pod borer (*Etiella zinckenella* Treitschke)

First Spray

Pre-treatment observations

Non-significant differences were observed among all the different treatments as the pea borer population ranged between 12.95 to 10.19 larvae/ 5 plants. (Table 1 and Fig. 1)

3 days after first spray

All the treatments were found significantly effective than untreated control (13.60 larvae/ 5 plants). The significantly lower population (8.05 larvae/ 5 plants) was observed in *Beauveria bassiana* than the other treatments, except *Bacillus thuringiensis* (9.00 larvae/ 5 plants) and *Verticillium lecanii* (11.15 larvae/ 5 plants).

7 days after first spray

All the treatments were found significantly effective than untreated control (13.85 larvae/ 5 plants). Among the different treatments, *Beauveria bassiana* (7.74 larvae/ 5 plants) were significantly superior over all the treatments. Followed by *Bacillus thuringiensis* (8.76 larvae/5 plants) and NSKE (9.21 larvae/ 5 plants).

14 days after first spray

All the treatments had found significantly lower larval population than untreated control (14.39 larvae/ 5 plants). Among the different treatments, *Beauveria bassiana* (7.53 larvae/ 5 plants) was significantly superior than rest of the treatments except *Bacillus thuringiensis* and NSKE (8.12 and 8.71 larvae/ 5 plants).

Second spray

3 days after second spray

All the treatments had found significantly lower larval population than untreated control (14.54 larvae/ 5 plants). It was seen that after 3 days of application Among the different bio-pesticides, lowest larval population was observed in the treatments of *Beauveria bassiana* (7.09 larvae/ 5 plants) and *Bacillus thuringiensis* (7.86 larvae/ 5 plants), followed by NSKE and Neem oil (8.26 and 9.37 larvae/ 5 plants) which was the next better treatment.

7 days after second spray

All the treatments had found significantly low larval population than untreated control (14.64 larvae/ 5 plants). Among the different bio-pesticides treatments, lowest larval population was recorded in the treatments of *Beauveria bassiana* (5.43 larvae/ 5 plants) followed by *Bacillus thuringiensis* (6.46 larvae/ 5 plants), NSKE and Neem oil (7.07 and 7.83 larvae/ 5 plants).

14 days after second spray

All the bio-pesticides treatments had found significantly lower larval population than untreated control (14.78 larvae/ 5 plants). Among the different bio-pesticides treatments, lowest larval population was recorded in the treatments of *Beauveria bassiana* (4.61 larvae/ 5 plants) followed by *Bacillus thuringiensis* (5.53 larvae/ 5 plants), NSKE and Neem oil (6.14 and 7.02 larvae/ 5 plants).

Overall mean effect

All the bio-pesticides treatments were found significantly effective than untreated control (14.66 larvae/5 plants). Among the different bio-pesticides treatments, *Beauveria bassiana* and *Bacillus thuringiensis* had significantly lowest larval population (5.71 and 6.62 larvae/ 5 plants) were most effective than other treatments. NSKE and Neem oil (8.90 and 9.73 larvae/5 plants) was the next better treatment. (Table 2 and fig.2).

Table 1: Efficacy of different treatments against pea pod borer *Etiella zinckenella* during 1st spray (No. of larvae/ 5 plants)

Treatment	Before Spray	3 DAS	7 DAS	14 DAS	Overall Mean
T_1 Neem oil	11.56	10.85	9.82	10.14	10.27
T_2 Garlic Extract	12.63	12.21	12.02	12.90	12.38
T_3 *Bacillus thuringiensis*	10.86	9.00	8.76	8.12	8.63
T_4 Castor Oil	12.17	11.54	11.12	12.15	11.60
T_5 Panchagavya	11.66	12.10	11.99	12.33	12.14
T_6 NSKE	10.82	9.44	9.21	8.71	9.12
T_7 *Verticillium Lecanii*	12.78	11.15	10.82	11.83	11.27
T_8 *Beauveria bassiana*	10.19	8.05	7.74	7.53	7.77
T_9 Water Spray (Control)	12.95	13.60	13.85	14.39	13.95
C.D.	N/A	1.94	1.78	1.57	1.76
S.E(m)	N/A	0.64	0.58	0.52	0.58

Figures in the parentheses are transformed values √x+0.5 value, *DBS-day before spraying *DAS-day after spraying

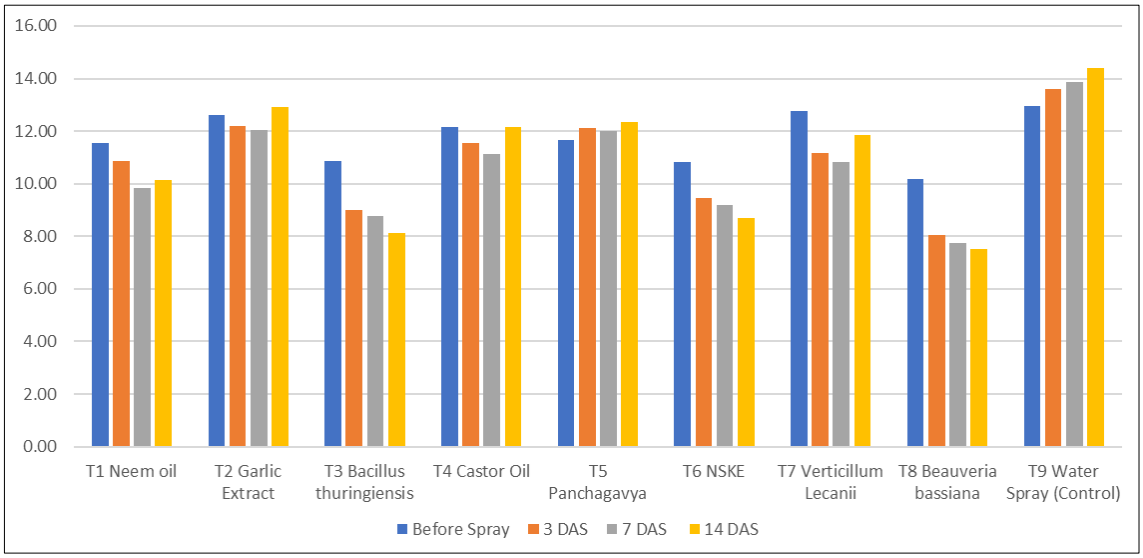

Fig 1: Efficacy of different treatments against pea pod borer *Etiella zinckenella* during 1st spray (No. of larvae/ 5 plants)

Table 2: Efficacy of different treatments against pea pod borer *Etiella zinckenella* during 2nd spray (No. of larvae/ 5 plants)

Treatment	Before Spray	3 DAS	7 DAS	14 DAS	Overall Mean
T_1 Neem oil	10.14	9.37	7.83	7.02	8.08
T_2 Garlic Extract	12.90	11.48	10.37	9.76	10.53
T_3 *Bacillus thuringiensis*	8.12	7.86	6.46	5.53	6.62
T_4 Castor Oil	12.15	10.32	9.37	8.28	9.33
T_5 Panchagavya	12.33	10.99	9.91	9.14	10.01
T_6 NSKE	8.71	8.26	7.07	6.14	7.16
T_7 *Verticillum Lecanii*	11.83	10.05	8.36	7.98	8.80
T_8 *Beauveria bassiana*	7.53	7.09	5.43	4.61	5.71
T_9 Water Spray (Control)	14.39	14.54	14.64	14.78	14.66
C.D.	1.57	1.31	1.38	1.02	1.23
S.E(m)	0.52	0.43	0.45	0.33	0.40

Figures in the parentheses are transformed values √x+0.5 value, *DBS-day before spraying *DAS-day after spraying

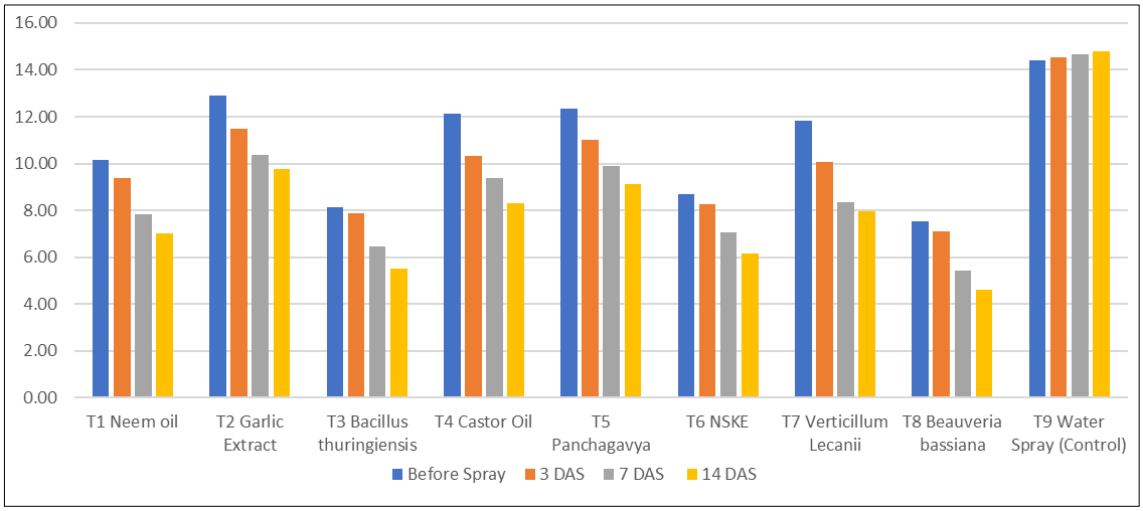

Fig 2: Efficacy of different treatments against pea pod borer *Etiella zinckenella* during 2nd spray (No. of larvae/ 5 plants)

Conclusion

On the basis of result and discussion of the present investigation the following recommendations conclusions are proposed. *Beauveria bassiana* proved significantly superior overall the bio-pesticides in reducing the pea pod borer (*Etiella zinckenella* Treitschke) larval population, providing significantly higher yield.

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