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Efficacy of Bio-Pesticides against Leaf Miner, *Liriomyza sp*. of Field Pea

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

On the effectiveness of biopesticides against *Liriomyza* spp., the pea leaf miner, field research was done. at an experimental field, Organic Research Farm Karguwan Ji, Department of Entomology, Institute of Agricultural Sciences, Bundelkhand University, Jhansi (Utter Pradesh) during *Rabi* Season of 2022-2023. Many biopesticides, such as castor oil, panchgavya, neem seed kernel extract (Crude extract), *verticillium lecanii* (2x108 cfu), neem oil, garlic bulb extract, and *Bacillus thuringiensis* (5% WP). Pea leaf miner *Liriomyza* Spp. was significantly different in the biopesticide-treated plant compared to the untreated control, according to the experimental data. Among them, the treatment of *Beauveria bassiana* (8.90 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 leaf miner *Liriomyza* spp.

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Keywords: Pea; pea leaf miner Liriomyza sp.; bio-pesticides.

1. INTRODUCTION

Global cultivation is underway for one of the major vegetable crops, the pea (*Pisum sativum* L.). It is native to Syria, Iraq, Iran, Turkey, Israel, Jordan, Ethiopia, Lebanon and has been cultivated in Europe for several thousand years [1]. Field peas are grown in 637.60 thousand hectares of land in India, yielding 5422 MT of production and a productivity of 10.04 tonnes per hectare. Field pea production in Uttar Pradesh totals 361 thousand hectares, with a yield of 1557 kg/ha and a production of 562 thousand MT. It covers an area of over 668 thousand hectares in the Bundelkhand Region, Jhansi district, Uttar Pradesh, with 929 MT of output and 1.39 tonne/ha of productivity (Ministry of Agriculture and farmer welfare, GOI, 2022).

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 winter season in plains and during summer season in hills [2]. The major Pea producing states are Uttar Pradesh, Punjab, Himachal Pradesh, Orissa, Karnataka and Haryana, etc. [3]. 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 [4]. 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 [4]. 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 (*Acyrthosiphon pisum*) and thrips (*Caliothrips indicus* Bagnall). These are serious insect pest and often cause substantial loss to the crop. Insect pest 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 [5]. The majorninsect pests attacking field pea are stemfly, *Ophiomyia phaseoli*; leaf miner, *Chromatomyia horticola*, thrips, *Caliothrips indicus;* pea pod borer, *Etiella zinckenella;* and gram pod borer, *Helicoverpa armigera*. A 10-15% reduction in the 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 per cent. Infestation of the *Etiella zinckenella* pest has been reported at up to 17.5 per cent.

2. MATERIALS AND METHODS

A Field study was carried out at the experimental field, Organic Research Farm Karguwan Ji, Department of Entomology, Institute of Agricultural Sciences, Department of Entomology, Bundelkhand University, Jhansi Utter Pradesh During the *Rabi* Season of 2022-2023. From November 2022 to March 2023, to determine the effectiveness of biopesticides against the pea leaf miner (*Liriomyza* sp.). Every week, the field pea plant was checked for *Liriomyza* sp. infestations. If found, various treatments were sprayed directly into the plant using a backpack sprayer fitted with a flat fan nozzle (total plot 27, spacing 30 cm x 10 cm, number of sprays 2). Neem oil (5% EC), castor oil (5% EC), *Bacillus thuringiensis* var. Kurstaki (5% WP), panchgavya, *verticillium lecanii* (2x108 cfu), neem seed kernel extract (Crude extract), and *Beauveria bassiana* were among the other biopesticides that were employed. the assessment of the larval population of *Etiella zinckenella*. The observations were made prior to spraying as well as three, seven, and fourteen days after. After being conveniently varied, the data from the various treatments were statistically examined.

3. RESULTS AND DISCUSSION

3.1 The Efficacy of Different Bio-Pesticide against Pea Leaf Miner, *Liriomyza* spp.

3.1.1 First spray

3.1.1.1 Number of damaged leaves (Day before spray)

The mean data of the results revealed that the number of damaged leaves per treatment ranged from 10.64 to 16.90 and there was no statically significant difference between the treatments (Table 1, Fig. 1).

Table 1. Effect of Bio-pesticides on Leaf miner, *Liriomyza spp*. (First spray)

Mean reduction of damage leaves/ Plant					
Treatment	**DBS**	**3 DAS**	**7 DAS**	**14 DAS**	**Overall Mean**
Bt var. kurstaki	14.92 (3.86)	12.18 (3.48)	11.65 (3.40)	13.17 (3.36)	12.33
Neem oil	11.40 (3.37)	9.47 (3.07)	9.27 (3.04)	8.50 (2.91)	9.08
NSKE	10.64 (3.25)	10.20 (3.18)	10.15 (3.17)	9.95 (3.13)	10.10
Castor Oil	15.91 (3.97)	15.40 (3.91)	14.76 (3.83)	14.37 (3.78)	14.84
Verticillium lecanii	14.38 (3.79)	14.15 (3.76)	14.86 (3.85)	16.30 (4.03)	15.10
Beauveria bassiana	14.09 (3.75)	12.29 (3.50)	10.46 (3.23)	11.72 (3.41)	11.49
Garlic bulb extract	12.31 (3.50)	11.92 (3.44)	13.30 (3.64)	15.23 (3.89)	13.48
Panchgavya	16.90 (4.11)	16.48 (4.05)	16.81 (4.09)	16.66 (4.07)	16.65
Water control	14.09 (3.74)	19.01 (4.36)	20.18 (4.48)	20.47 (4.45)	19.89
C.D.	**2.84**	**2.63**	**2.89**	**3.33**	**1.47**
SE(m)	**0.94**	**0.87**	**0.96**	**1.10**	**0.49**

Figures in the parentheses are transformed values √x+0.5 values
**DBS-Day Before Spray *DAS-Day After Spray*

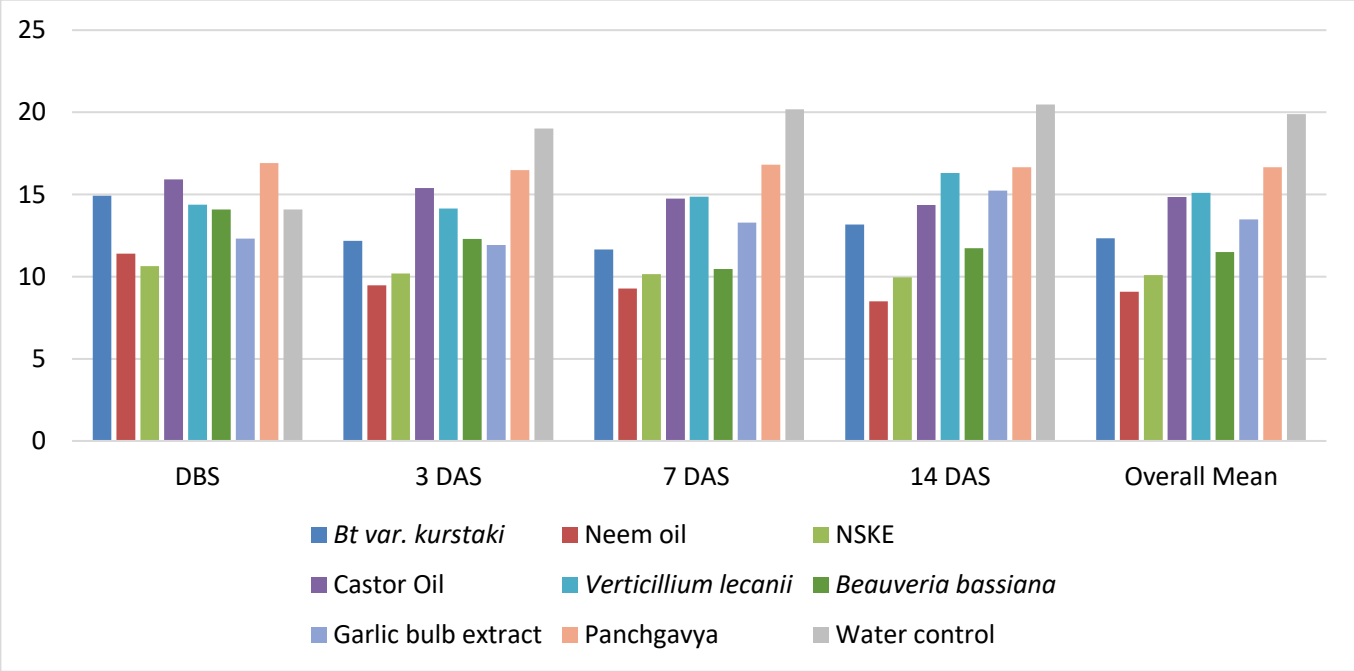

Fig. 1. Effect of Bio-Pesticides on Leaf miner, *Liriomyza spp*. (First spray)

Table 2. Effect of Bio-pesticides on Leaf miner, *Liriomyza spp*. (Second spray)

Mean reduction of damage leaves/ Plant					
Treatment	**DBS**	**3 DAS**	**7 DAS**	**14 DAS**	**Overall Mean**
Bt var. kurstaki	13.17 (3.62)	10.64 (3.26)	9.81 (3.13)	8.74 (2.95)	9.73
Neem oil	8.50 (2.91)	7.22 (2.68)	6.14 (2.47)	4.94 (2.22)	6.10
NSKE	9.95 (3.13)	8.78 (2.29)	7.81 (2.76)	6.64 (2.25)	7.74

Mean reduction of damage leaves/ Plant					
Treatment	**DBS**	**3 DAS**	**7 DAS**	**14 DAS**	**Overall Mean**
Castor oil	14.37 (3.78)	12.81 (3.57)	11.06 (3.31)	10.24 (3.19)	11.37
Verticillium lecanii	16.30 (4.03)	13.58 (3.68)	12.07 (3.47)	10.78 (3.28)	12.14
Bavaria bassiana	11.72 (3.41)	9.95 (3.14)	8.86 (2.96)	7.88 (2.79)	8.90
Garlic bulb extract	15.23 (3.89)	11.96 (3.45)	10.15 (3.18)	9.13 (3.01)	10.42
Panchgavya	16.66 (4.09)	14.76 (3.89)	12.61 (3.54)	11.28 (3.35)	12.88
Water control	20.47 (4.45)	21.10 (4.58)	21.67 (4.65)	21.91 (3.35)	21.56
C.D.	**3.33**	**2.76**	**2.72**	**2.35**	**1.08**
SE(m)	**1.10**	**0.91**	**0.90**	**0.78**	**0.36**

Figures in the parentheses are transformed values √x+0.5 values
**DBS-Day Before Spray *DAS-Day After Spray*

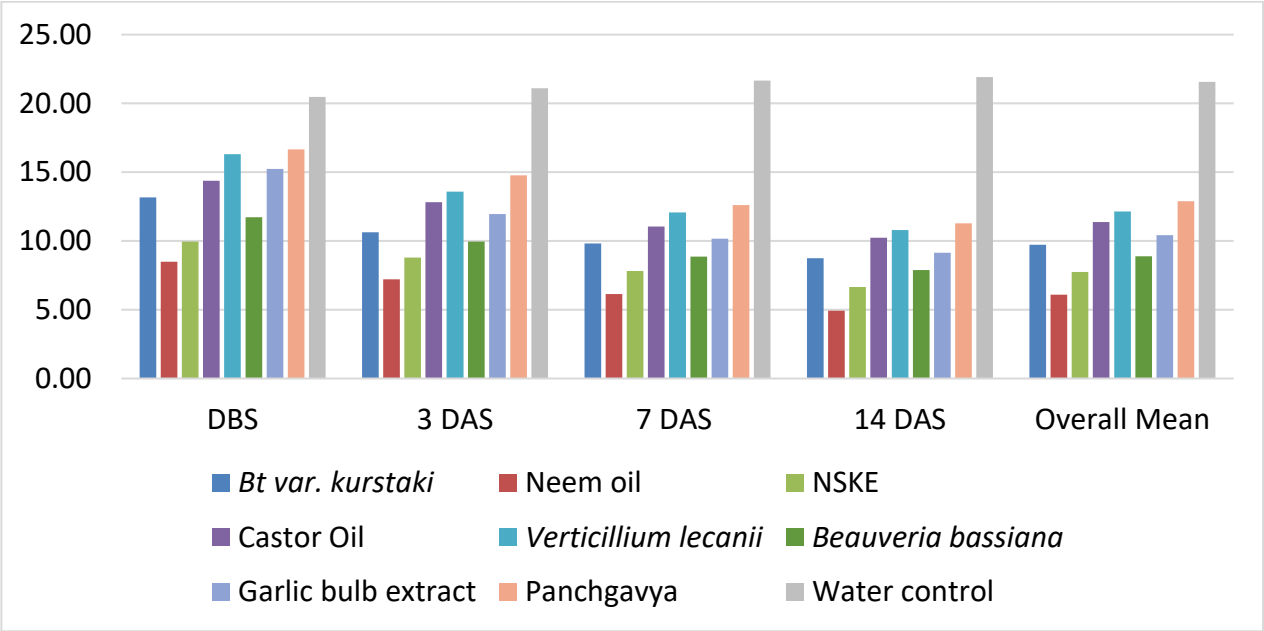

Fig. 2. Effect of Bio-Pesticides on Leaf miner, *Liriomyza spp*. (Second spray)

3.1.2 Three days after spray

All the treatments were found significantly more effective than the untreated control (19.01 damage leaves / 5 plants). A significantly less mean reduction number of damaged leaves (9.47 damaged leaves /5 plants) was observed in Neem oil than in the others, except NSKE (10.20 damaged leaves/5 plants) and Garlic bulb extract (11.92 damaged leaves / 5 plants).

3.1.3 Seven days after spray

All the treatments were found significantly more effective than the untreated control (20.18 damage / 5 leaves). Among the different treatment, neem oil (9.27 damage leaves / 5 plants) was significantly superior over all the treatments. Followed by NSKE (10.15 damaged leaves/plants) and *Beauveria bassiana* (10.46 damaged leaves /5 plants).

3.1.4 Fourteen days after first spray

All the treatment had found significantly less mean reduction number of damaged leaves than untreated control (20.47 damaged leaves/plants). Among the varied treatment Neem oil (8.50 damage leaves /5 plants) was significantly superior to the rest of the treatment except NSKE (9.95 damage leaves/plants) and *Beauveria bassiana* (11.72 damage leaves/plants).

3.2 Second Spray

3.2.1 Number of damaged leaves (Day before spray)

The mean data of the results revealed that the number of damaged leaves per treatment ranged from 8.50 to 20.47 and there was no statically significant difference between the treatments (Table 2, Fig. 2).

3.2.2 Three days after second spray

All the treatment had found significantly less mean reduction number of damaged leaves than untreated control (21.10 damaged leaves / 5 plants). It was seen that after two days of application among the varied bio-pesticides, the lowest number of damaged leaves was observed in the treatments of Neem oil (7.22 damaged leaves / 5 plants) and NSKE (8.78 damaged leaves / 5 plants), followed by *Bavaria bassiana* (9.95 damage leaves /5 plants) and *Bt.* Var. kurstaki (10.64 damaged leaves /5 plants) which was the next better treatment.

3.2.3 Seven days after second spray

All the treatment had found significantly less mean reduction number of damaged leaves than untreated control (21.67 damaged leaves / 5 plants). Among the different bio-pesticides treatment, the lowest number of damaged leaves was recorded in the treatment of Neem oil (6.14 damaged leaves / 5 plants) and NSKE (7.81 damaged leaves / 5 plants) followed by *Beauveria bassiana* (8.86 damaged leaves / 5 plants) and *Bt.* var. kurstaki (9.81 damage leaves / 5 plants).

3.2.4 Fourteen days after second spray

All the bio-pesticide treatment had found significantly a smaller number of damaged leaves than the untreated control (21.91 damaged leaves / 5 plants). Among the varied bio-pesticides treatment, the lowest damage of leaves was recorded in the treatment of Neem oil (4.99 damage leaves / 5 plants) followed by NSKE (6.64 damage leaves / 5 plants), *Beauveria bassiana* (7.88 damage leaves / 5 plants) and *Bt.* var. kurstaki (9.91 damage leaves / 5 plants).

3.2.5 Overall mean effect

All the bio-pesticide treatment was found statically significantly more effective than untreated control (21.56 damage leaves / 5 plants). Among the varied bio-pesticide treatment, Neem oil (6.10 damage leaves / 5 plants) and NSKE (7.74 damage leaves / 5 plants) had significantly the lowest number of damaged leaves. The similar findings of [6,7] Were most effective than other treatments. *Bavaria bassiana* (8.90 damaged leaves / 5 plants) [8,9] and *Bt* var. kurstaki (9.73 damaged leaves / 5 plants) [10,11,12] was the next better treatment. (Table 2, Fig. 2).

Based on the overall mean reduction of damaged leaves, leaf miner (*Liriomyza spp.*), *Beauveria bassiana* and *Bacillus thuringiensis* (7.88 and 8.74 leaves/5 plants) were found significantly superior treatments and overall mean reduction damage leaves of a leaf miner (*Liriomyza spp.*), *Beauveria bassiana* and *Bacillus thuringiensis* had a significantly lowest larval population (8.90 and 9.73 leaves/5 plants) were most effective than other treatments respectively.

4. CONCLUSION

The following suggestions and conclusions are put out in light of the investigation's findings and discussion. When it came to lowering the number

of pea pod borer larvae (*Etiella zinckenella* Treitschke), *Beauveria bassiana* outperformed the biopesticides by a large margin and increasing yield.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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