

Efficacy of bio-pesticides against leaf miner, *Liriomyza spp.* of field pea

Abstract

Field studies were conducted on the efficacy of bio-pesticides against pea leaf miner, *Liriomyza spp.* at an experimental field, Organic Research Farm Karguwan Ji, Department of Entomology, Institute of Agricultural Sciences, Bundelkhand University, Jhansi (Uttar Pradesh) during Rabi Season of 2022-2023. Different bio-pesticides viz: Neem oil, Garlic bulb extract, *Bacillus thuringiensis* (5% WP), Castor oil, Panchgavya, Neem Seed Kernel Extract (Crude extract), *Verticillium lecanii*(2x10⁸ cfu), *Beauveria bassiana*. Experimental results revealed that the plant treated with bio-pesticides registered a significant difference of pea leaf miner *Liriomyza Spp.* over the treatment of untreated control. 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.*

Keywords: Pea, pea leaf miner *Liriomyza spp.*, Bio-pesticides

Introduction

The pea (*Pisum sativum* L.), a significant vegetable crop, is cultivated all over the world. In India, it is mostly grown as a summer vegetable in the highlands and as a winter crop in the plains of north India. It is generally used as a fresh vegetable and in the form of canned, processed, or dehydrated foods. The field pea is a type of pea sometimes called *Pisum sativum* sub sp. *arvense* (L.), belonging to the family Leguminosae (Papilionaceae). It is native to India. It is highly nutritive, containing a high percentage of digestible protein, carbohydrates, vitamins, and minerals. The field pea is a cool-season crop. Over 30.37 million acres globally are used to grow it. In India, field pea is cultivated in a 637.60 thousand ha area with 5422 MT of production and 10.04 tonne per ha productivity. In Uttar Pradesh, the total area of field pea is 361 thousand ha, with 562 thousand MT of production and 1557 kg/ha of productivity. In Bundelkhand Region, Jhansi district of Uttar Pradesh, it occupies an area of about 668 thousand ha with 929

MT of production and 1.39 tonne /ha. productivity. (**Ministry of Agriculture and farmer welfare, GOI.2022**).

The major insect 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 percent. Infestation of the *Etiella Zinckenella* pest has been reported at up to 17.5 percent.

Material 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 Uttar 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* Spp.). The field pea plant was observed at weekly intervals for infestations of *Liriomyza* Spp., and thereupon 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 sprays 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*(2x10⁸ 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

The efficacy of different Bio-pesticide against pea leaf miner, *Liriomyza* spp.

First spray

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, Graph 1).

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).

Sevendays 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).

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).

Second spray

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, Graph 2).

Threedays 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.

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).

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).

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. Were most effective than other treatments. *Bavaria bassiana* (8.90 damaged leaves / 5 plants) and *Bt var. kurstaki* (9.73 damaged leaves / 5 plants) was the next better treatment. (Table- 3, fig.-1).

Conclusion

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

Acknowledgement

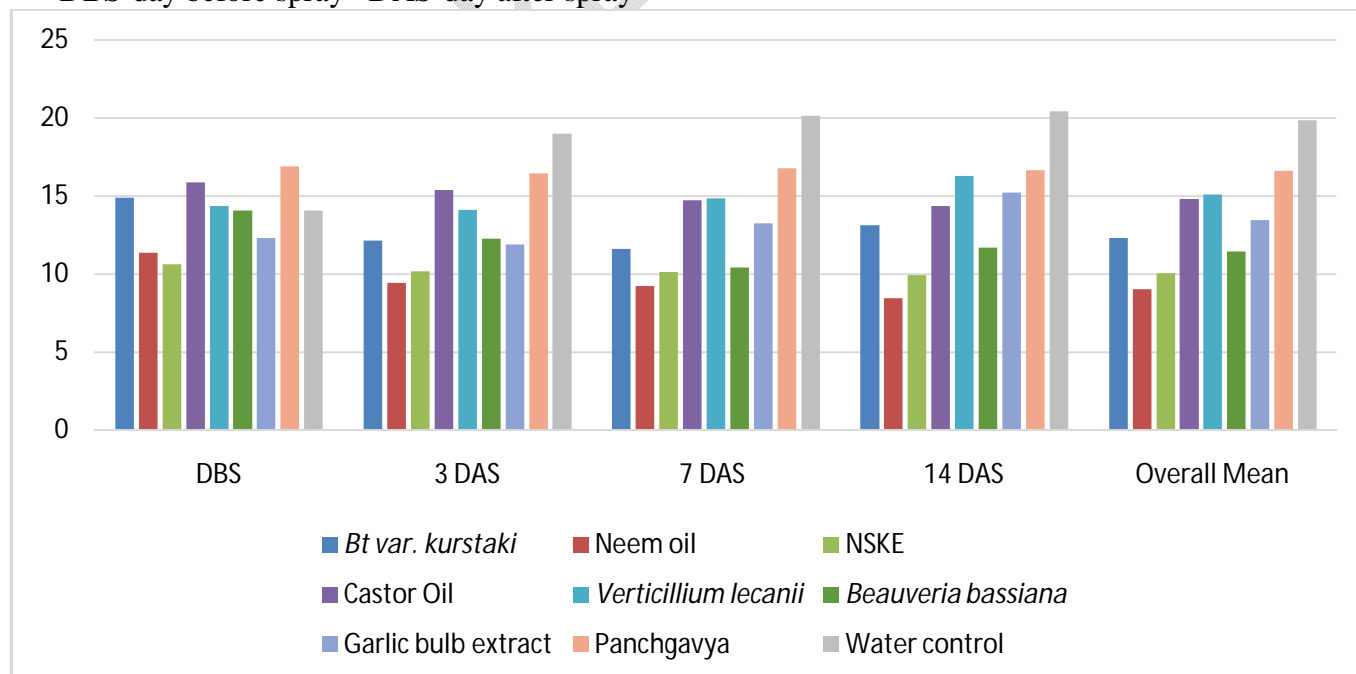
The authors are thankful to the Department of Entomology, Institute of Agricultural Science Bundelkhand University, Jhansi for providing the infrastructure and all necessary help to conduct this study.

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
<i>Bt var. kurstaki</i>	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
<i>Verticillium lecanii</i>	14.38 (3.79)	14.15 (3.76)	14.86 (3.85)	16.30 (4.03)	15.10
<i>Beauveria bassiana</i>	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 $\sqrt{x+0.5}$ values.

*DBS-day before spray *DAS-day after spray



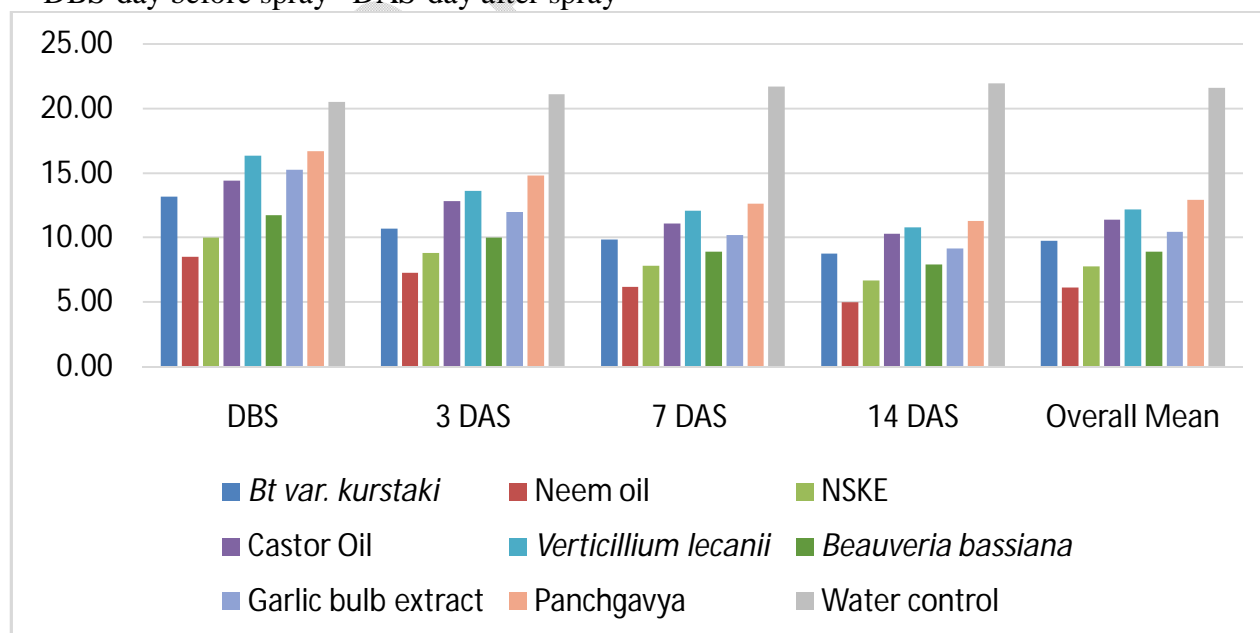
Graph: -1. Effect of Bio-Pesticides on Leaf miner, *Liriomyza spp.* (First spray)

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
<i>Bt var. kurstaki</i>	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
Castor oil	14.37 (3.78)	12.81 (3.57)	11.06 (3.31)	10.24 (3.19)	11.37
<i>Verticillium lecanii</i>	16.30 (4.03)	13.58 (3.68)	12.07 (3.47)	10.78 (3.28)	12.14
<i>Bavaria bassiana</i>	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 $\sqrt{x+0.5}$ values.

*DBS-day before spray *DAS-day after spray



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

Discussion

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.

References

1. Abhilasha CR 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* 2017; **5**(3): 690-696.
2. Ali *et. al.* (2012). Combine effect of relative resistance and chemical control against pea leaf miner (*Phytomyza horticola* goureau (Diptera: Agromyzidae)) in pea (*Pisum sativum* L) varieties. *Agriculture, Science and Engineering (ICASE2012)*, 263.
3. Bhadauria NS. (1998). Biology of pea pod borer (*Etiella zinckenella*) on pea and gram. *Agric. Sci. Dige.Karnal.***18**(4): 221-222.
4. Banshtu, T and Kaith, N. S. (2020). Field efficacy of insecticide, bio-pesticide and pheromone trap against pea pod borer in District Shimla. Vol. **8**, issue-8.
5. Choudhury *et. al.* (2021). Evaluation of Biological Approaches for Controlling Shoot and Fruit Borer (*Earias vitella* F.) of Okra Grown in Peri-Urban Area in Bangladesh. *Horticulturae*, **7** (1), 7.
6. Dabhi, M. V and Barad, A. H. (2018). Bio-efficacy of seed treatment insecticidal molecules against cucumber leaf miner, *Liriomyza trifolii* (Burgess). *Journal of Entomology and Zoology Studies*. Vol. **6**, issue- 8.
7. Gathage, J. W. (2018). Prospects of fungal endophytes in the control of *Liriomyza* leafminer flies(Diptera: Agromyzidae)incommon bean *Phaseolus vulgaris* Linnaeus (Fabales: Fabaceae) under field conditions (Doctoral dissertation, Jomo Kenyatta University of Agriculture and Technology).

8. Hoshino, *et. al.* (2018). Effect of pigeon pea intercropping or shading with leucaena plants on the occurrence of the coffee leaf miner and on its predation by wasps in organic coffee plantings. *Ciencia Rural*, **48** (3).
9. Keval, R., Vanajakshi, H. S., Verma, S and Kumar, A. (2019). Analysis of Various IPM Modules Against Pea Leaf Miner (*P. horticola* G.) Infesting Pea (*Pisum sativum* L.). *International Journal of Bio-resource and Stress Management*, **10** (1):060-063.
10. Kwon, M., Kim, J., & Maharjan, R. (2018). Effect of *Liriomyza huidobrensis* (Diptera: Agromyzidae) density on foliar leaf damage and yield loss in potato. *Applied entomology and zoology*, **53** (3): 411-418.
11. Lingbeek, *et. al.* (2021). Phenology, Development, and Parasitism of Allium Leaf miner (Diptera: Agromyzidae), a Recent Invasive Species in the United States. *Environmental Entomology*. Vol. **50**, issue- 4, Page. 878-887.
12. Mandal, T and Ghosh, S. K. (2021). Leaf Miner (*Phytomyza spp.*) Infestation on Som Plant (*Machilus bombycina* King) and Plant-based Formulation for their Sustainable Management. *Pakistan Journal of Zoology*. **53** (6): pp 1-6.
13. Mehta PK and Chandel RS. (1998). Reaction of pea varieties to leaf miner (*Chromatomyia horticola*) (Goureau). *Insect.Env.***3** (4): 118.
14. Mujahid, A., Khan, H. A., Sarwar, S., Mustafa, J., Khan, H., Qadir, S and Sajid, Z. (2020). Toxicity of Alone and Combine Application of Botanical Extracts against 2nd Instar Larvae of *Liriomyza trifolli* on Tomato, *Lycopersicum esculentum*. *Egyptian Academic Journal of Biological Sciences. A, Entomology*, **13**(4), 123-128.
15. Shantibala T and Singh TK. (2002). Efficacy of insecticides and biopesticides against the pea pod borer, *Lampides boeticus* infesting pea. *Ann. of Pl. Prot. Sci.***10** (2):370-372.
16. Sharma SK, Punum, Saini JP and kumarR. (2014). Management of pea leaf miner, *Chromatomyia horticola* (Goureau) by organic inputs in organically grown garden pea. *Current Biotica***8** (3): 288-293.
17. Thakur, A (2017). Efficacy of botanicals and their impact on natural enemies of pea leaf

miner (*Chromatomyia horticola* G.) under climatic conditions of mid-hills of Himachal Pradesh. *International Journal of Tropical Agriculture*, **35** (2), 297-302.

18. Wade, P. S., Wankhede, S. M and Rahate, S. S. (2020). Efficacy of different pesticides against major pests infesting tomato (*Solanum lycopersicum* L.). *Journal of Pharmacognosy and Phytochemistry*, **9** (4), 545-548.

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