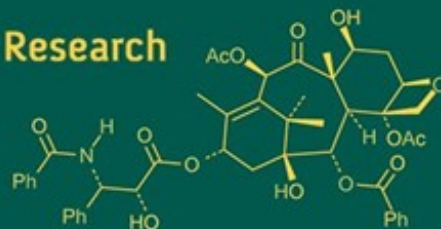
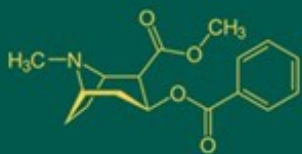


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Pallavi Bhagat

Raj Mohini Devi College of
Agriculture and Research
Station, Ambikapur,
Chhattisgarh, India

PK Bhagat

Raj Mohini Devi College of
Agriculture and Research
Station, Ambikapur,
Chhattisgarh, India

KL Painkra

Raj Mohini Devi College of
Agriculture and Research
Station, Ambikapur,
Chhattisgarh, India

Sachin Kumar Jaiswal

Raj Mohini Devi College of
Agriculture and Research
Station, Ambikapur,
Chhattisgarh, India

GP Painkra

College of Agriculture and
Research Station,
Shankargarh, Balrampur,
Chhattisgarh, India

Evaluation of biorational insecticides for the management of aphid, *Lipaphis erysimi* (Kalt.) on mustard

Pallavi Bhagat¹, PK Bhagat², KL Painkra³, Sachin Kumar Jaiswal⁴, GP Painkra⁵

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ABSTRACT

The present study was carried out during the Rabi season of 2024–25 at the Research-cum-Instructional Farm, Raj Mohini Devi College of Agriculture and Research Station, Ambikapur, Chhattisgarh, to assess the effectiveness of different biorational insecticides against mustard aphid, *Lipaphis erysimi* (Kalt.). All the treatments were effective in reducing the aphid population in comparison with the untreated control. Acetamiprid 20% SP recorded the lowest mean aphid population (17.28 aphids/5 plants), whereas among the biorational insecticides, *Beauveria bassiana* was most effective (19.39 aphids/5 plants), followed by Azadirachtin (20.52 aphids/5 plants) and *Metarhizium anisopliae* (21.08 aphids/5 plants). The highest aphid population was observed in the untreated control (36.77 aphids/5 plants). Similarly, Acetamiprid produced the highest seed yield (10.27 q/ha), net return (Rs. 36,408/ha) and ICBR (1:4.4). Among the biorational treatments, *B. bassiana* recorded 9.98 q/ha seed yield, with a net return of Rs. 34,618/ha and an ICBR of 1:3.7, compared with 6.02 q/ha seed yield in the untreated control. Based on aphid suppression, seed yield and economic returns, *B. bassiana* was found to be a promising biorational treatment for managing mustard aphid under the conditions of the present study.

Keywords: Mustard, *Lipaphis erysimi*, Aphid, Biorational insecticides, *Beauveria bassiana*, Acetamiprid, Yield

Introduction

Mustard (*Brassica juncea* L.) is one of the major oilseed crops cultivated extensively in India. Among the various insect pests associated with mustard, the mustard aphid, *Lipaphis erysimi* (Kalt.), is considered an important pest causing considerable damage to the crop. Both nymphs and adults feed by sucking sap from the plant, which adversely affects plant growth and flowering. The occurrence and multiplication of mustard aphid are also influenced by prevailing weather conditions, particularly temperature and relative humidity. Although chemical insecticides are commonly used for aphid management, their repeated application may lead to environmental and other associated problems. In this context, biorational insecticides, including microbial agents and botanical products, have gained importance as alternative pest management options. Microbial agents such as *Beauveria bassiana* and *Verticillium lecanii*, along with neem-based botanicals, have shown potential in suppressing aphid populations. Botanicals and microbial insecticides have also been reported as useful components of eco-friendly pest management in mustard. Hence, the present investigation was undertaken to evaluate the efficacy of selected biorational insecticides against mustard aphid, *L. erysimi* (Kalt.), under field conditions.

Material and Methods

The field experiment was carried out during the Rabi season of 2024–25 at the Research-cum-Instructional Farm, Raj Mohini Devi College of Agriculture and Research Station, Ambikapur, Chhattisgarh. The experiment was conducted in a Randomized Block Design (RBD) consisting of seven treatments, each replicated three times. The treatments included *Bacillus thuringiensis* @ 10 ml/L, *Beauveria bassiana* @ 10 ml/L, *Metarhizium anisopliae* @ 10 ml/L, *Verticillium lecanii* @ 10 ml/L, Azadirachtin 0.03% EC @ 5 ml/L, Acetamiprid 20% SP @ 2 g/L and an untreated control. These treatments were evaluated for their effectiveness against mustard aphid, *Lipaphis erysimi* (Kalt.). The required quantity of each treatment was applied with the help of a knapsack sprayer during the morning hours. Aphid observations were recorded from the upper 5 cm portion of the central twig of five randomly selected plants from each plot. The aphid population was recorded one day before spraying and subsequently at 3, 7 and 10 days after each spray.

Corresponding Author:
PK Bhagat

Raj Mohini Devi College of
Agriculture and Research
Station, Ambikapur,
Chhattisgarh, India

The increase in yield over control for each treatment was computed using the following formula:

$$\% \text{ increase in yield over untreated control} = \frac{\text{Yield in treatment} - \text{Yield in control}}{\text{Yield in untreated control}} \times 100$$

Cost benefit ratio, net return per rupees invested, was calculated by using the following formula.

$$\text{Cost benefit ratio} = \frac{\text{Net return (Rs. /ha)}}{\text{Cost of treatment (Rs. /ha)}}$$

Table 1. Treatment Details

S. No.	Treatments	Formulation	Dose (ml or g/l)
T ₁	<i>Bacillus thuringiensis</i>	(1×10 ⁹ CFU/ml min.)	10 ml.
T ₂	<i>Beauveria bassiana</i>	(1×10 ⁸ CFU/ml min.)	10 ml.
T ₃	<i>Metarhizium anisopliae</i>	(1×10 ⁸ CFU/ml min.)	10 ml.
T ₄	<i>Verticillium lecanii</i>	1×10 ⁸ CFUs/ml.min.	10 ml.
T ₅	<i>Azadirachtin indica</i>	0.03%EC	5 ml.
T ₆	Acetamiprid	20%SP	2g.
T ₇	Control (Untreated)	-	-

Results and Discussion

Effect of biorational insecticides on mustard aphid population

The response of mustard aphid, *Lipaphis erysimi* (Kalt.), to different biorational insecticides following the first and second applications is presented in Table 1.

Following the first spray, aphid numbers showed a gradual decline up to 7 days after treatment in most of the treated plots. At 10 days after spraying, Acetamiprid 20% SP (T₆) resulted in the minimum aphid population (18.50 aphids/5 plants), followed by *Beauveria bassiana* (T₂) with 21.37 aphids/5 plants and *Metarhizium anisopliae* (T₃) with 24.02 aphids/5 plants. In contrast, the maximum aphid population was observed in the untreated control (36.02 aphids/5 plants). The mean population after the first spray was lowest with Acetamiprid (21.73 aphids/5 plants), followed by *B. bassiana* (22.89 aphids/5 plants), whereas the untreated control showed the highest mean population (33.86 aphids/5 plants).

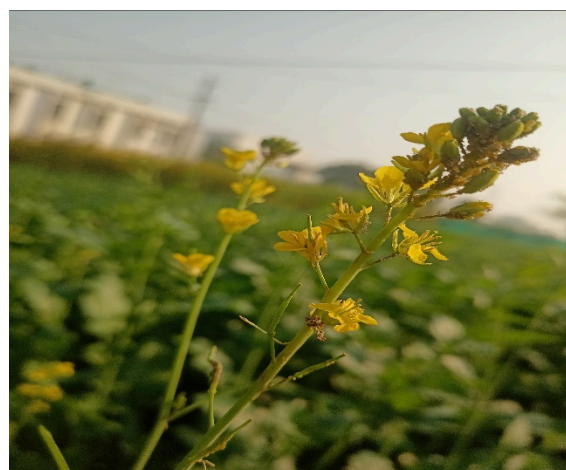
A further decline in aphid population was recorded in all treated plots after the second spray. At 10 days after the second application, Acetamiprid (T₆) recorded the lowest aphid population of 8.93 aphids/5 plants. Among the biorational treatments, *Azadirachtin indica* (T₅) recorded 12.17 aphids/5 plants, followed by *B. bassiana* (T₂) with 12.64 aphids/5 plants and *M. anisopliae* (T₃) with 13.45 aphids/5 plants. The untreated control continued to record the highest aphid population (41.35 aphids/5 plants).

Considering the pooled mean of observations from both sprays, Acetamiprid (T₆) recorded the lowest aphid population (17.28 aphids/5 plants). Among the biorational insecticides, *B. bassiana* (T₂) showed comparatively better performance, with a mean population of 19.39 aphids/5 plants, followed by *Azadirachtin indica* (20.52), *M. anisopliae* (21.08), *V. lecanii* (21.54) and *B. thuringiensis* (22.53 aphids/5 plants). The untreated control recorded the highest overall aphid population (36.77 aphids/5 plants).

The present results are supported by the findings of Shinde *et al.* (2021) [1], who reported that *Beauveria bassiana*, *Verticillium lecanii* and azadirachtin were effective biorational options for the management of mustard aphid, *Lipaphis erysimi* (Kalt.), and could be used as eco-friendly and cost-effective alternatives for aphid management.



Adult of aphid

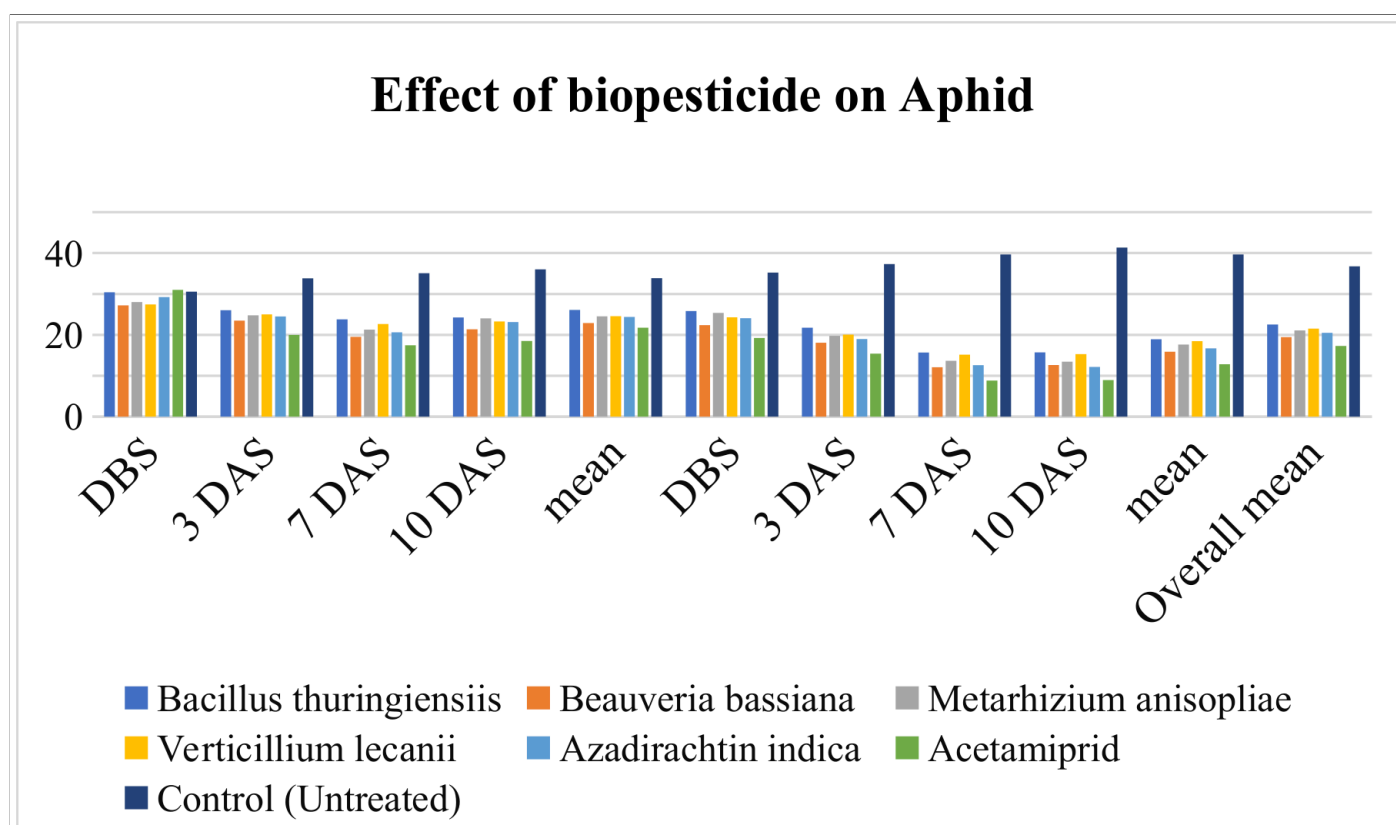


Nymph of aphid

Table 2. Effect of biorational pesticides on the population of aphids after first and Second spraying.

Tr. No	Treatments	Average population of aphids Aphid 5 cm. central twig/5 plant										Overall mean
		After 1 st Spray					After 2 nd Spray					
		DBS	3 DAS	7 DAS	10 DAS	Mean	DBS	3 DAS	7 DAS	10 DAS	Mean	
T ₁	<i>Bacillus thuringiensis</i> (10 ⁹ CFU/ml)	30.42 (5.52)	26.03 (5.10)	23.77 (4.88)	24.25 (4.92)	26.12 (5.11)	25.80 (5.08)	21.74 (4.66)	15.68 (3.96)	15.72 (3.96)	18.93 (4.35)	22.53 (4.75)
T ₂	<i>Beauveria bassiana</i> (10 ⁸ CFU/ml)	27.18 (5.21)	23.47 (4.84)	19.53 (4.42)	21.37 (4.62)	22.89 (4.78)	22.38 (4.73)	18.08 (4.24)	12.06 (3.55)	12.64 (3.55)	15.89 (3.99)	19.39 (4.40)
T ₃	<i>Metarhizium anisopliae</i> (10 ⁸ CFU/ml)	28.02 (5.29)	24.77 (4.98)	21.28 (4.61)	24.02 (4.90)	24.52 (4.95)	25.37 (5.04)	19.76 (4.45)	13.63 (3.69)	13.45 (3.67)	17.64 (4.20)	21.08 (4.59)
T ₄	<i>Verticillium lecanii</i> (10 ⁸ CFU/ml)	27.45 (5.24)	25.02 (5.00)	22.65 (4.76)	23.27 (4.82)	24.60 (4.96)	24.28 (5.28)	20.07 (4.48)	15.18 (3.90)	15.27 (3.91)	18.48 (4.30)	21.54 (4.64)
T ₅	<i>Azadirachtin indica</i> (0.03%EC)	29.25 (5.41)	24.47 (4.95)	20.60 (4.54)	23.13 (4.81)	24.36 (4.94)	24.06 (4.90)	18.98 (4.36)	12.57 (3.47)	12.17 (3.49)	16.68 (4.08)	20.52 (4.53)
T ₆	Acetamiprid (20%SP)	31.02 (5.57)	19.98 (4.47)	17.43 (4.17)	18.50 (4.30)	21.73 (4.66)	19.23 (4.38)	15.41 (3.93)	8.89 (2.98)	8.93 (2.99)	12.82 (3.58)	17.28 (4.16)
T ₇	Control (Untreated)	30.52 (5.52)	33.82 (5.82)	35.06 (5.92)	36.02 (6.00)	33.86 (5.82)	35.23 (6.09)	37.33 (6.11)	39.67 (6.30)	41.35 (6.43)	39.68 (6.30)	36.77 (6.06)
	S E. ±	1.62	0.30	0.18	0.23	-	0.25	0.19	0.18	0.20	-	-
	CD at 5%	NS	0.92	0.57	0.73	-	0.77	0.59	0.56	0.63	-	-

Figures in parenthesis are square root transformed values $\sqrt{x + 0.5}$,
DBS = day before spray, and DAS = days after spray.

**Figure 1.** Effect of biopesticide on Aphid after first and second spray

Effect on seed yield and economic performance

The seed yield and economic performance of mustard under different treatments are presented in Table 3 and Fig. 2. Acetamiprid (T₆) recorded the maximum seed yield (10.27 q/ha), with a yield advantage of 4.25 q/ha over the untreated control. It also resulted in the highest net return (Rs. 36,408/ha) and ICBR (1:4.4) among all the treatments. Considering only the biopesticide treatments, *Beauveria bassiana* (T₂) showed the highest performance, producing 9.98 q/ha

seed yield, a yield increase of 3.96 q/ha, a net return of Rs. 34,618/ha and an ICBR of 1:3.7. It was followed by *Azadirachtin indica* (9.53 q/ha; 3.51 q/ha; Rs. 31,617/ha; 1:2.4), *Verticillium lecanii* (8.79 q/ha; 2.77 q/ha; Rs. 27,448/ha; 1:0.9), *Metarhizium anisopliae* (7.96 q/ha; 1.94 q/ha; Rs. 22,518/ha; 1:8.9) and *Bacillus thuringiensis* (7.27 q/ha; 1.25 q/ha; Rs. 18,318/ha; 1:7.3), respectively. The minimum seed yield of 6.02 q/ha was obtained in the untreated control. Supporting the present findings,

Vinyas *et al.* (2023) reported favourable economic returns from Azadirachtin 10000 ppm (1:16.97) and *Beauveria bassiana* (1:13.50). Thus, among the evaluated biopesticides, *B. bassiana* demonstrated

comparatively better performance in terms of seed yield and economic returns under the present investigation.

Table 3. Economics of various biorational insecticide treatment against major insect-pests of mustard *rabi-2025-25*

S.No.	Treatments	Dose ml/g/lit.	Yield (q/ha)	Increase in yield over control	Cost	Gross return	Net return (Rs)	I.C.B.R.	Rank
T ₁	<i>Bacillus thuringiensis</i> (10 ⁹ CFU/ml)	10 ml.	7.27	1.25	25270	43608.00	18338.00	1:7.3	6
T ₂	<i>Beauveria bassiana</i> (10 ⁸ CFU/ml)	10 ml.	9.98	3.96	25270	59888.00	34618.00	2:3.7	2
T ₃	<i>Metarhizium anisopliae</i> (10 ⁸ CFU/ml)	10 ml.	7.96	1.94	25270	47788.00	22518.00	1:8.9	5
T ₄	<i>Verticillium lecanii</i> (10 ⁸ CFU/ml)	10 ml.	8.79	2.77	25270	52718.00	27448.00	2:0.9	4
T ₅	<i>Azadirachta indica</i> (0.03%EC)	5 ml.	9.53	3.51	25537	57154.00	31617.00	2:2.4	3
T ₆	Acetamiprid (20%SP)	2gm.	10.27	4.25	25200	61608.00	36408.00	2:4.4	1
T ₇	Control (Untreated)	-	6.02	-	25000	-	-	-	-

ICBR = Incremental cost benefit ratio

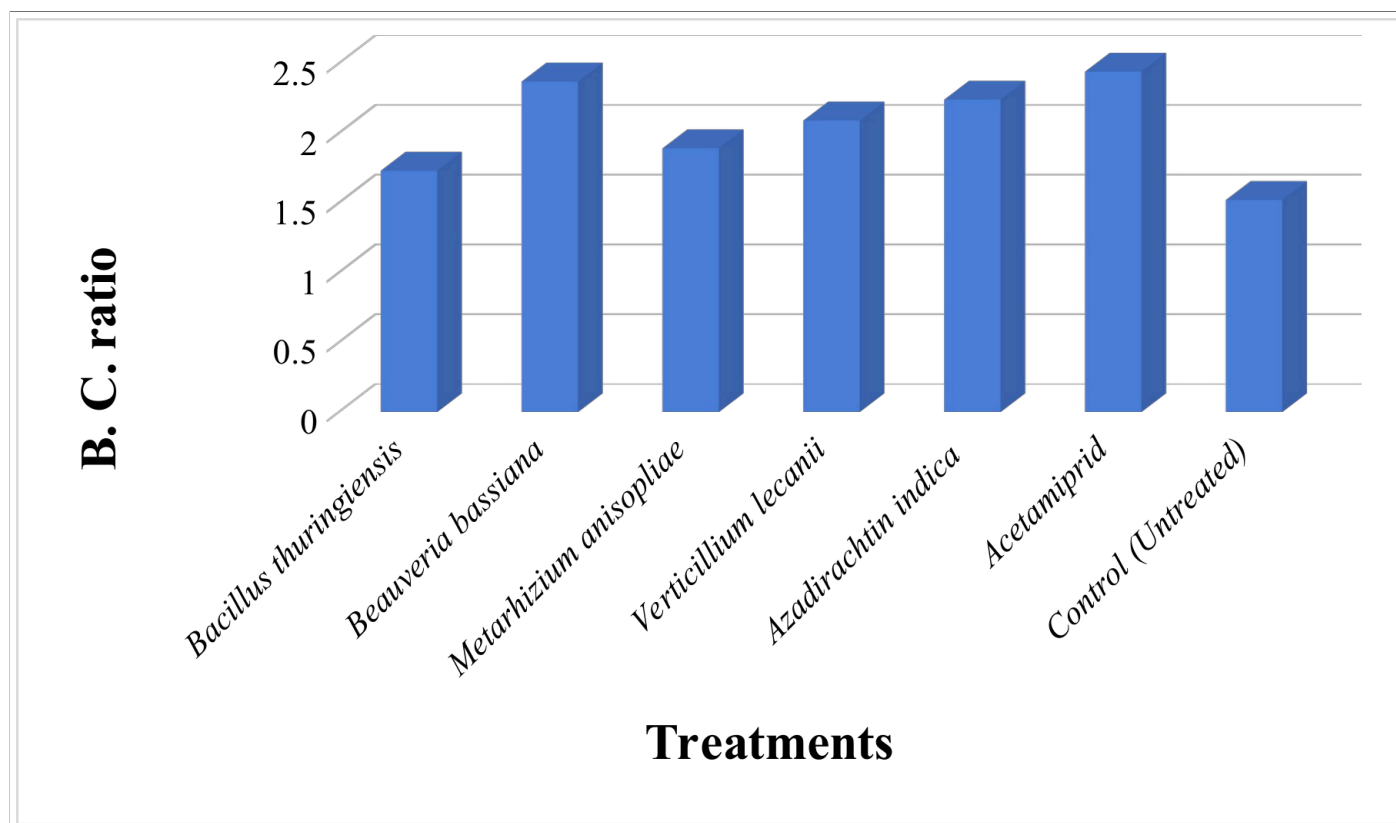


Figure 2. Economics of different biorational insecticide treatments against major insect-pests of mustard during Rabi 2024–25

Conclusion

The present study revealed that *Lipaphis erysimi* was a major pest of mustard. Among the biorational treatments, *Beauveria bassiana* (T₂) performed better than the other treatments, with lower aphid popula-

tion, higher seed yield, net return and ICBR. Therefore, *B. bassiana* may be considered a promising biorational insecticide for the management of mustard aphid, while Acetamiprid 20% SP (T₆) served as the chemical check.

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