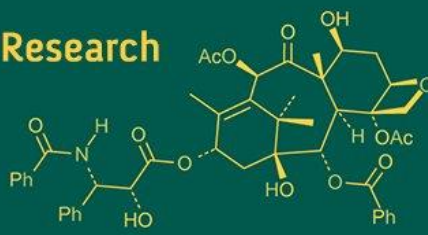


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Seasonal incidence of mustard aphid (*Lipaphis erysimi* Kalt.) and their bio-rational management on mustard crop (*Brassica juncea* L.)

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Abstract

Mustard aphid, *Lipaphis erysimi* (Kalt.), is a serious insect pest in the Bundelkhand Region and across mustard-growing regions of India. Keeping in view its severity, an experiment entitled "Seasonal incidence of mustard aphid (*Lipaphis erysimi* Kalt.) and their bio-rational management on mustard crop (*Brassica juncea* L.)" was conducted at the experimental site Rainfed Agricultural Research Farm, Narayan Bagh, Institute of Agricultural Sciences, Bundelkhand University, Jhansi. The research trials were conducted during i.e. Rabi, 2025-26. The mustard aphid, *Lipaphis erysimi* (Kalt), population increased gradually and reached a peak of 65.5 aphids/10 plants in the 8th SMW. (3rd week of February, 2026). The maximum population of aphids was recorded as 65.5 aphids/10 cm central twig/plant at a minimum temperature of 14.2°C, a maximum temperature of 29.5°C, the 44 Summary and a relative humidity of 75%. The effectiveness of management of different treatments against mustard aphid during the experimental period. Spinosad 45 SC 0.4 ml/l water is the best treatment recorded, with the lowest mustard aphid infestation, highest grain yield and a good cost: benefit ratio was obtained.

Keywords: Mustard aphid, *L. erysimi*, seasonal incidence, max T, min T, SMW, management, C: B ratio

Introduction

Rapeseed-mustard (*Brassica* spp.) is one of the most important oilseed crops in the world and is cultivated in more than 50 countries across six continents. India is the third-largest producer of rapeseed-mustard after China and Canada (FAO, 2019) [8]. During 2024-25, rapeseed-mustard was cultivated over an area of approximately 9.18 million hectares (91.8 lakh ha), with a production of about 13.26 million tonnes (132.6 lakh tonnes) and an average productivity of 1,444 kg ha⁻¹. Rajasthan is the leading producer, followed by Uttar Pradesh, Madhya Pradesh, Haryana and West Bengal. Rapeseed-mustard is one of the principal rabi oilseed crops of India and plays a vital role in ensuring edible oil security, enhancing farmers' income and supporting the oilseed-based agro-industry. Likewise, in the Bundelkhand region, rapeseed and mustard are also one of the major oilseed crops which contributes about more than 50% of the total oilseed production of the states of U.P. and M.P but the productivity is comparatively low. The productivity of rapeseed-mustard is adversely affected by several biotic factors, among which insect pests are the most important. About 38 insect pest species have been reported to infest rapeseed-mustard in India (Bakhetia and Sekhon, 1989) [4]. Among these, the mustard aphid, *Lipaphis erysimi* (Kaltenbach), is the most destructive and economically important pest in all mustard-growing regions of the country. Both nymphs and adults feed by sucking cell sap from leaves, inflorescences and developing pods, resulting in poor pod formation, reduced seed development, and significant yield loss. In addition, the aphids excrete large quantities of honeydew, which promotes the growth of sooty mould fungus, causing the leaves and pods to appear black and reducing the photosynthetic efficiency of the crop (Awasthi, 2002) [2]. The weather has a big impact on the life cycles, reproduction, and movement of invertebrate pests like insects, mites, and others. (Yadav *et al.*, 2025a) [55]. The mustard aphid has been reported to cause yield losses ranging from 35.4% to 96%, along with a 30.9% reduction in seed weight and a 2.75% decrease in oil content (Bakhetia and Sekhon, 1989; Bakhetia and Arora, 1986; Singh and Premchand,

1995) [4, 3, 14]. Hence, there is an urgent need to identify effective and economically viable insecticides for the management of this destructive insect pest. IPM is a decision support system where cultural, mechanical, genetic, biological and regulatory methods are incorporated (Yadav *et al.*, 2026) [57]. Although chemical control remains an important component of integrated pest management (IPM), its judicious use should be based on regular monitoring of crop growth, pest population, natural enemy abundance and the extent of actual or potential crop damage. Continuous monitoring provides essential information for assessing pest incidence and determining the appropriate timing and need for control measures. Insecticides dominate the biopesticide segment, comprising more than 94% of the market, and the vast majority of these sales are derived from the bacterium *Bacillus thuringiensis* Berliner (Bt). (Yadav *et al.*, 2025b) [56]. Biopesticides, including entomopathogenic fungi and bacteria, offer promising, eco-friendly pest management options. (Yadav *et al.*, 2025c) [57]. Indigenous products viz. Neem products are not only effective against crop pests but also ecologically safe and free from residual problems. (Kumar *et al.*, 2024) [39]. Such information enables farmers and researchers to make reliable, timely and repeatable pest management decisions, thereby ensuring effective pest suppression while minimizing unnecessary insecticide applications and their adverse environmental impacts.

Methods and Materials

The present investigation entitled “Seasonal incidence of mustard aphid (*Lipaphis erysimi* Kalt.) and its bio-rational management on mustard crop (*Brassica juncea* L.)” was carried out at the Experiment Farm, Rainfed Agricultural Research Farm Narayan Bagh, Institute of Agricultural Sciences, Bundelkhand University, Jhansi (U.P.). During Rabi season of 2025-26. The crop was sown on 15th October with a plot size of 2.5 X 2.5 m² with spacing 45 X 15 cm² (R X P). Variety are sown PM-30 and the RBD design was used for biorational management. Eight treatments were used 8 and replicated three times. The nymph and adult populations, as well as pod damage caused by *L. erysimi* Kalt., were assessed by counting from the top 10 cm of apical twigs of 10 randomly selected plants. Mustard aphids, *Lipaphis erysimi* Kalt., feed by sucking sap from leaves, buds and pods. Infested leaves may curl, and as the infestation progresses, plants can become stunted and may eventually wither and die. Sooty moulds often grow on the honeydew excreted by the aphids, further affecting plant health and vigour. In standard weather week basis with a view to study the impact of different weather parameters on pest incidence, a simple correlation between the population of the pest and weather parameters was worked out.

Observation to be recorded

- Estimation of incidence of mustard aphid (nymph/adult)
- Yield (kg/ha)
- Cost-benefit ratio

Result and Discussion

Studies were made to find out the incidence of mustard aphid, *Lipaphis erysimi* Kalt. was recorded at regular weekly intervals from the 10 randomly selected plants of the experimental field and its infestation on mustard crop as well as effects of weather conditions (temperature, rainfall, relative humidity, etc.) on mustard aphid infestation was studied during Rabi - 2025-26.

Seasonal incidence of mustard aphid in relation to abiotic factors

The appearance of mustard aphid started from 2nd standard week to 10th standard week; this population ranged from 5.5 to 65.5 aphids/10 cm central twig/plant in different standard weeks. The peak period of occurrence of this insect was observed in the 8th standard week (3rd week of February, 2026). The maximum population of aphids was recorded as 65.5 aphids/10 cm central twig/plant at a minimum temperature of 14.2°C, a maximum temperature of 29.5°C, and a relative humidity of 75%. The minimum population of 5.5 aphids/10 cm central twig/plant was recorded in the 2nd standard week with a minimum temperature of 8.6°C, a maximum temperature of 17.2°C, and a relative humidity of 65%. The findings are in agreement with Ahuja (1990) [17], who reported that aphids appeared in late December and reached a peak between 26 January and 1 February; (2018) also recorded that the incidence of aphid population commenced from 1st week of January. In the correlation analysis between mustard aphid population and weather variables, the population showed highly significant positive correlation with maximum and minimum temperature (0.896** and 0.839**). While the morning relative humidity ($r=-0.082^{NS}$) showed a negative non-significant correlation and evening relative humidity ($r=0.495^{NS}$) showed a non-significant positive correlation and rainfall ($r=-0.295^{NS}$) showed a non-significant negative correlation. Overall, correlation coefficient analysis clearly revealed that both maximum and minimum temperature had a positive significant influence on mustard aphid population, while the rest of the weather variables showed a negative impact. Pal *et al.* (2018) [59] reported that peak infestation of aphid occurred in 7th SMW; Biswas and Das (2000) [23] also reported that the aphid population build-up was noticed during January February. Gour and Pareek (2003) [10] revealed that the incidence of mustard aphid, *L. erysimi* started in the third week of November and reached to its peak in the second week of February. It is also following the records by several workers (Sahoo, 2012; Singh and Lal, 2012; and Singh *et al.*, 2018) [61, 54, 62], who have reported the peak of mustard aphid between 6th to 8th standard week. It is also in agreement with Meena *et al.* (2019) [63], who have recorded competitively higher aphid infestation on late-sown BSH-1 cultivar of rapeseed. It is closely similar to the study of Khan and Jha (2010) [64] and Saeed and Razaq (2014) [65] who recorded comparatively lower incidence of aphid population on crop sown by mid-October, where they did not attain ETL level (30 aphids/ plant), whereas in mid late sown (22th October to 5th November) and late sown (early to mid-November) crops, it was significantly higher numbers of aphid's infestation.

Evaluation of different biorational insecticides

First application

Pre-treatment observations recorded one day before spray; the aphid population ranged from 33.76 to 35.97 and it was non-significant among all the treatments. However, the data on aphids were also recorded on 7th day, 14 days after spray. The population of aphids on 7th day after spray ranged from 14.57 to 67.85 among all the treatments. The minimum population (14.57 aphid/plant) was recorded in the treatment Spinosad@ 0.3 ml/ha. It was followed by Neem oil @ 0.2 g/ha (17.66 aphid/plant) and NSKE @ 40 ml/l (21.69 aphid/plant), respectively. The next in order of effectiveness of

treatments were *Metarhizium anisopillae* 1.15% WP (26.27 aphid/plant) followed by *Beauveria bassiana* (28.10 aphid /plant). *Lananicillium lacanii* (30.71 aphid/plant), followed by Castor oil (31.75aphid/ plant), was effective among all treatments; however, it was significantly superior over the control. The Maximum population (61.45 aphid /plant) was recorded in the control plot. The population of aphids on 14th day after spray ranged from 11.17 to 84.67 among all the treatments. The minimum population (11.17 aphid/plant) was recorded in the treatment Spinosad@ 0.3 ml/ha It was followed by Neem oil @ 2 ml/ha (12.4 aphid/plant) and NSKE @ 40ml/l having (19.89aphid /plant), respectively. The next in order of effectiveness of treatments were *Metarhizium anisopillae* 1.15% WP (20.17 aphid/plant), followed by *Beauveria bassiana* (21.04 aphid /plant). *Lananicillium lacanii* (22.7 aphid/plant), followed by Castor oil (25.51aphid/ plant), was effective among all treatments; however, it was significantly superior over the control. Maximum population (84.67 aphid /plant) was recorded in the control plot. The present findings are in close agreement with those of Akter *et al.*, who reported 70.00% reduction in aphid population, and Sairam and Kumar, who recorded 65.00% reduction in aphid infestation. Among the entomopathogenic fungi evaluated, *Beauveria bassiana* resulted in 47.60% reduction in aphid population, which is comparable with the findings of Rawat *et al.*, who reported 53.00% control. Similarly, *Metarhizium anisopillae* achieved a 42.01% reduction in aphid population, which corroborates the results of Kumar and Kumar, who observed a 37.00% reduction. The efficacy of neem oil (5%), which recorded 33.42% reduction in aphid population, is also in agreement with the findings of Yadav *et al.* (2025) [55-57]. Furthermore, the present results are consistent with the observations reported by Kumar *et al.* (2023) [43], thereby confirming the effectiveness of these biorational treatments in the management of mustard aphid.

Second application

The population of aphids on 7th day after spray ranged from 7.3 to 113.15 among all the treatments. The minimum population (7.3 aphid/plant) was recorded in the treatment Spinosad@ 0.3 ml/ha. It was followed by Neem oil @ 0.2 g/ha (10.43 aphid/plant) and NSKE @ 20lit/ha having (11.8 aphid /plant), respectively. The next in order of effectiveness of treatments were *Metarhizium anisopillae* 1.15% WP (12.51 aphid/plant) followed by *Beauveria bassiana* (13.31 aphid /plant). *Lananicillium lacanii* (15.83 aphid/plant) followed by Castor oil (18.83 aphid/ plant) was effective among all treatments; however, it was significantly superior over control. The Maximum population (113.15 aphid /plant) was recorded in control plot. The same trend was observed in 14 DAS. The population of aphid on 14th day after spray, ranged from 4.97 to 119.7 among all the treatments. The minimum population (4.97 aphid/plant) was recorded in the treatment Spinosad@ 0.3 ml/ha. It was followed by Neem oil @ 0.2 g/ha (9.21 aphid / plant) and NSKE @ 20lit/ha having (10.32 aphid /plant), respectively. The next in order of effectiveness of treatments were *Metarhizium anisopillae* 1.15% WP (12.15 aphid/plant) followed by *Beauveria bassiana* (12.56 aphid /plant). *Lananicillium lacanii* (14.95 aphid/plant) followed by Castor oil (17.5 aphid/ plant) was effective among the all treatments however, it was significantly superior over control. Maximum population (119.7 aphid /plant) was

recorded in control plot. The present findings are in close agreement with those of Akter *et al.*, who reported 70.00% reduction in aphid population, and Sairam and Kumar, who recorded 65.00% reduction in aphid infestation. Among the entomopathogenic fungi evaluated, *Beauveria bassiana* resulted in 47.60% reduction in aphid population, which is comparable with the findings of Rawat *et al.*, who reported 53.00% control. Similarly, *Metarhizium anisopillae* achieved 42.01% reduction in aphid population, which corroborates the results of Kumar and Kumar, who observed 37.00% reduction. The efficacy of neem oil (5%), which recorded 33.42% reduction in aphid population, is also in agreement with the findings of Yadav *et al.* (2025) [55-57]. Furthermore, the present results are consistent with the observations reported by Kumar *et al.* (2023) [43], thereby confirming the effectiveness of these biorational treatments in the management of mustard aphid.

Incremental cost benefit ratio of different treatments on Indian mustard

The highest yield was observed in Spinosad (23.12q/ha) followed by Neem oil (21.00 q/ha), NSKE (19.73 q/ha), *Metarhizium anisopillae* (18.41 q/ha), *Beauveria bassiana* (17.97q/ha), *Verticillium leccani* (14.84 q/ha), Castor oil (14.58 q/ha) and lowest yield was reported in the control treatment (9.16 q/ha). Singh and Sachan (1994) [66] and Mukherjee and Singh (2017) [67], for different biorational insecticidal treatments. Proved that the highest net profit (₹ 51133/ha) was obtained from the Spinosad, while the lowest net profit (₹ 19300/ha) was estimated from the treatment of Castor oil. However, the present findings are in close conformity with the results reported by Singh and Sachan (1994) [66] and Mukherjee and Singh (2017) [67], who also observed similar trends in the effectiveness of the evaluated treatments against the target insect pest.

Table 1: Seasonal incidence of mustard aphid, *Lipaphis erysimi* (Kalt.) correlated to weather parameters

SM W	Max. T.	Min. T.	RH Morning (%)	RH Evening (%)	Rainfall (mm)	Mean population of aphids per 10 plants
47	32.1	21.8	84	58	0.015	0.00
48	29.6	20.6	82	55	0.555	0.00
49	20.4	12.4	78	54	2.555	0.00
50	18.2	11.4	74	54	0.125	0.00
51	20.3	11.8	72	52	0.225	0.00
52	18.5	9.8	70	51	0.01	0.00
1	18.2	9.2	68	51	0.125	0.00
2	17.2	8.6	66	51	0.001	5.5
3	18.3	8.4	65	50	0.125	8.8
4	18.6	10.5	63	51	0	16.5
5	21.4	12.6	68	56	0	30.5
6	22.6	12.8	71	60	0	45.5
7	26.6	13.5	72	62	0.001	50.5
8	29.5	14.2	75	64	0.001	65.5
9	35.6	18.6	81	71	0.025	25.5
10	38.8	19.2	85	74	0.025	12.5
Max T.						0.896**
Min. T.						0.839**
Morning Relative humidity (%)						-0.082 ^{NS}
Evening Relative humidity (%)						0.495 ^{NS}
Rainfall (mm)						-0.295 ^{NS}

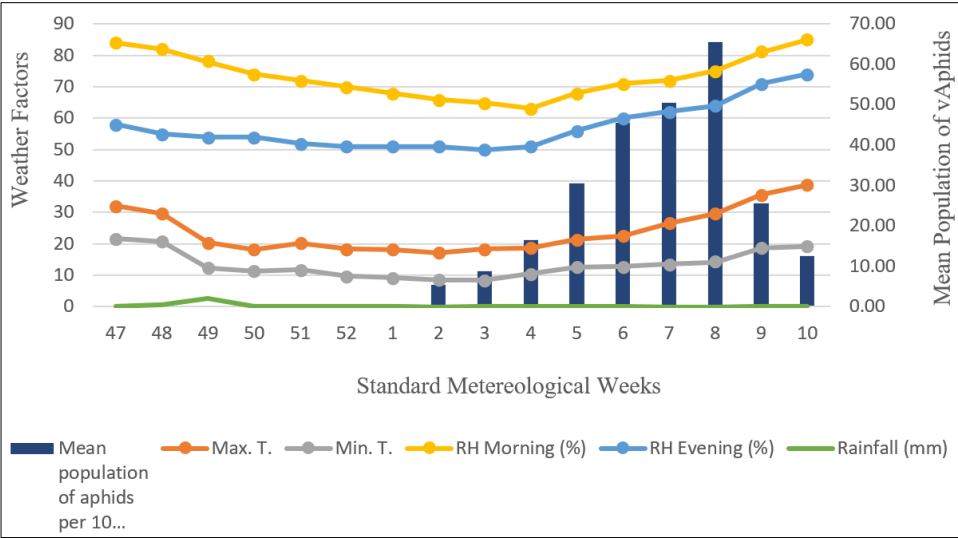


Fig 1: Seasonal incidence of mustard aphid (*Lipaphis erysimi*), Rabi 2025 -26



Plate 1: Incidence of mustard aphid

Table 2: Efficacy of Biorationals compounds against mustard aphid, *Lipaphis erysimi* (Kalt.)

Tr.	Treatments Details	Before first spray	I Spray		II Spray	
			7 DAS	14 DAS	7 DAS	14 DAS
T ₁	NSKE 5%	34.02	21.69	19.89	11.8	10.32
T ₂	Castor oil	33.76	31.75	25.51	18.83	17.5
T ₃	Spinosad 45 SC	35.41	14.57	11.17	7.3	4.97
T ₄	<i>Beauveria bassiana</i> 1.15% WP	34.97	28.1	21.04	13.31	12.56
T ₅	Neem oil	35.62	17.66	12.4	10.43	9.21
T ₆	<i>Metarhizium anisopilae</i> 1.15% WP	35.54	26.27	20.17	12.51	12.15
T ₇	<i>Lananicillium lacanii</i> 1.15% WP	35.39	30.71	22.7	15.83	14.95
T ₈	Control	35.97	67.85	84.67	113.15	119.7
SE(m)		0.646	0.654	0.411	0.943	0.081
CD @ 5%		N/A	2.002	1.259	2.887	0.249

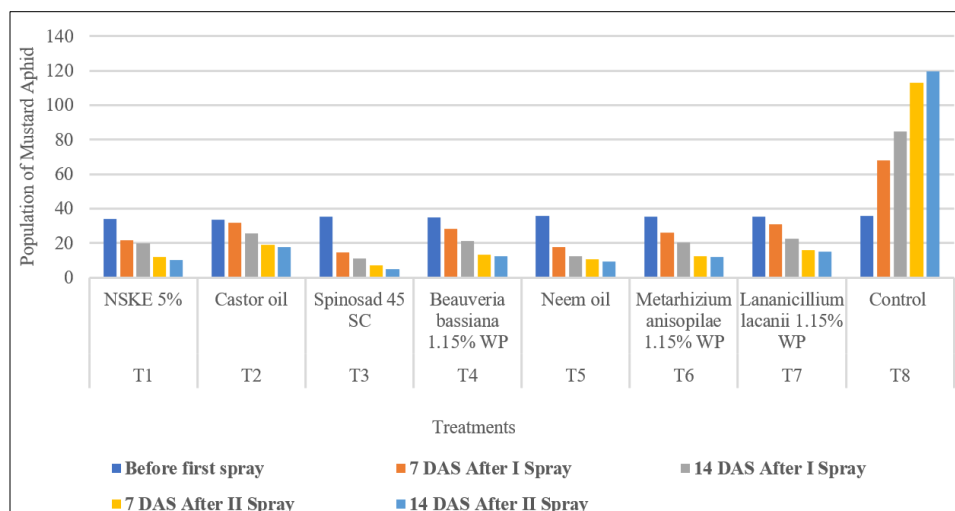


Fig 2: Efficacy of different treatments against aphid during (I SPRAY and II SPRAY)

Table 3: Effect of biorationals on yield of mustard crop

Treatments	Treatments Details	Yield (q/ha)
T ₁	NSKE 5%	15.41
T ₂	Castor oil	13.16
T ₃	Spinosad 45 SC	18.75
T ₄	<i>Beauveria bassiana</i> 1.15% WP	14.16
T ₅	Neem oil	17.00
T ₆	<i>Metarhizium anisopilae</i> 1.15% WP	14.58
T ₇	<i>Lananicillium lacanii</i> 1.15% WP	13.75
T ₈	Control	9.16



Plate 4: Spraying of bio-pesticides in different treatments

Table 4: Incremental cost- benefit of different treatments. 2025-26

Tr.	Treatments Details	Cost of Botanicals	Increase yield q/ha	Gross Income	Net return over the control	ICBR
T ₁	NSKE 5%	1050.00	6.25	87066.5	84016.5	32262.50
T ₂	Castor oil	800.00	4.0	74354	71054	19300.00
T ₃	Spinosad 45 SC	13250.00	9.59	105937	102887	51133.00
T ₄	<i>Beauveria bassiana</i> 1.15% WP	1120.00	5.0	80004	76884	25130.00
T ₅	Neem oil	1275.00	7.84	96050	92750	40996.00
T ₆	<i>Metarhizium anisopilae</i> 1.15% WP	1400.00	5.42	82377	78977	27223.00
T ₇	<i>Lananicillium lacanii</i> 1.15% WP	1175.00	4.59	77687.5	74512.5	22758.60
T ₈	Control	--	---	--	----	----

Conclusion

The mustard aphid, *Lipaphis erysimi* (Kalt) population increased gradually and reached its peak 65.5 aphid / 10 plant in 8th SMW. (3rd week of February, 2026). The maximum population of aphid was recorded as 65.5 aphids/10 cm central twig/plant. The Spinosad is the best treatment recorded followed by Neem oil, NSKE 5%, *Metarhizium anisopilae*, *Beauveria bassiana*, *Verticillium lacanii*, Castor oil. The maximum grain yield and C: B ratio was obtained from the treatment Spinosad.

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Author contribution statement

SS conceived and designed the research SM conducted the experiments. SM collected the data SS and AKC analyzed the data. SS and JKB wrote the manuscript and all the authors read and approved the manuscript.

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60. Note: Your text says “Pal et al. (2020)”, but the paper matching the statement about the aphid peak in the 7th standard week is actually Pal et al., 2018, not 2020. The paper reports the peak mustard aphid population on yellow sticky traps in the 7th standard week.

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