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Efficacy of Some Bio-pesticides against Mustard Aphid *Lipaphis erysimi* (Kalt) in Mustard (*Brassica juncea*)

Nikhil Kumar [a++*] and Ashwani Kumar [a#]

[a] *Department of Entomology, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj-211007 (U.P), India.*

Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Management of Mustard aphid *Lipaphis erysimi* (kaltbach) using Bio-pesticides in field condition was carried out during *Rabi* 2022-23 at central Research field SHUATS Prayagraj,UP, India. The management of Mustard aphid was done using 8 different treatments and benefit cost ratios were calculated. One spray is applied to protect the crop from mustard aphid (*Lipaphis erysimi*) using randomized block design with three replications. The observations of mustard aphid (*Lipaphis erysimi*) 24 hours before (Pre-treatment) and 3rd, 7th and 14th day after spraying (post-treatment) were recorded for computing the per cent of pest reduction. The treatment Spinosad 45%SC (T_6) (86.75%) shows highest per cent reduction and the most effective treatment followed by Imidacloprid 17.8%SL (T_7) (76.97%), Nisco sixer plus 45 SC (T_1) (61.83 %), *Verticillium lecanii* (2×10^8 Spore/ml) (T_2) (51.04%), *Beauveria bassiana* (2CFU×10^8 ml) (T_4) (47.60%), *Metarhizium*

[++] *M.Sc. Scholar;*
[#] *Associate Professor;*
**Corresponding author: E-mail: ram.k7688999649@gmail.com;*

anisopliae (2×10^8 CFU/gm) (T_3) (42.01%), Least percentage reduction was obtained with Neem oil 5% EC (T_5) (33.42%). While Spinosad 45%SC (T_6) shows higher cost benefit ratio with (1:7.96), followed by Imidacloprid 17.8%SL (T_7) (1:7.83), Nisco sixer plus (1:6.57), *Metarhizium anisopliae* (2×10^8 CFU/gm) (T3) (1:5.79), *Beauveria bassiana* ($2CFU\times10^8$ ml) (T_4) (1:5.64), *Verticillium lecanii* (2×10^8 Spore/ml) (T_2) (1:5.63) and Neem oil 5% EC (T_5) (1:5.03).

Keywords: Biopesticides; insecticides; Lipaphis erysimi; management; mustard; mustard aphid; spinosad 45SC.

1. INTRODUCTION

"The origin of *B. juncea* is conflicting Middle East seems to be the place of origin since the putative parent species; *B. nigra* and *B. campestris* would have crossed. India is the third largest rapeseed-mustard producer in the world after China and Canada with 12 per cent of world's total production. In the country, it is used to make oil and its waste is used for feeding animals. This crop accounts for nearly one-third of the oil produced in India, making it the country's key edible oilseed crop. Due to the gap between domestic availability and actual consumption of edible oils, India has to resort to import of edible oils. Rapeseed-mustard is the major source of income especially even to the marginal and small farmers in rainfed areas Since these crops are cultivated mainly in the rain- fed and resource scarce regions of the country, their contribution to livelihood security of the small and marginal farmers in these regions is also very important. By increasing the domestic production substantial import substitution can be achieved" Kumar et al*.,* [1].

"Rapeseed-mustard crops in India comprise traditionally grown indigenous species, namely toria [*Brassica campestris syn. Brassica. rapa L*. *var. toria*, 2n (AA) = 20], brown sarson [*Brassica. campestris syn*. *Brassica rapa L*. var. brown sarson, 2n (AA) = 20], yellow sarson [*Brassica. campestris syn*. *Brassica rapa L"* (Directorate of Rapeseed-Mustard Research).

"In India mustard is predominantly cultivated in Rajasthan (50%), Uttar Pradesh (12.3%), Haryana (11.2%), Madhya Pradesh (9.8%), Gujarat (6.5%) and West Bengal (5.1%). Among these states, Rajasthan, Uttar Pradesh and Madhya Pradesh are the major rapeseed-mustard growing states and cover the 70 per cent of the total national acreage and contribution around 72 per cent of production" [2]. Uttar Pradesh is a leading mustard producing.

State of India. "60% of total mustard production is from this state. In Uttar Pradesh area (759 ha) and production (956.72tn), yield 1260 kg/ha. The word 'rape' and 'mustard' have been derived from the word rapum meaning turnip and European practice of mixing the sweet 'must' of old wine with crushed seeds of black mustard [*Brassica nigra* (L.) Koch] to form a hot paste, respectively" Hemingway [3]. Mustard oil contains fatty acids. It contains an excellent ratio of monounsaturated and polyunsaturated fatty acids. The oil has no trans-fat, and since it is a plant-based product, it doesn't contain cholesterol. Mustard oil has 6% omega-3 alpha-linolenic acid and 15% omega- 6 linoleic acid. This optimum omega-3 and omega-6 fatty acids ratio makes mustard oil more beneficial and preferred over several other oils. In addition, this rich oil contains 42% erucic acid and 12% oleic acid.

Aphids are "stealthy" pests. In contrast to chewing herbivores, which macerate plant tissue, they are adapted to feed on phloem sap. "The aphids have short generation times and extremely high asexual fecundity which leads in a rapid increase in aphid population density and subsequent elevated consumption levels of phloem sap, initiating and sustaining plant defence responses additionally detracts resources otherwise used for plant growth and development. Thus, the depletion of nutrients can become a serious problem and may have a severe impact on host plant" Gill and Singh [4]. The mustard aphid, is found on Brassica crops with worldwide distribution and severe damage and outbreaks.

2. MATERIALS AND METHODS

Field experiment was carried out at the Central Research Farm of Sam Higginbottom University of Agriculture Technology And Sciences, Prayagraj, U.P. during *rabi* season 2022-2023. Trail was laid out in randomised block design consisting of eight treatments including control. Each treatment was replicated thrice and T-59 mustard variety were sown with the spacing of 45×30 cm. Standard agronomic practices were followed to ensure a good crop stand. Seven

Biopesticides *i.e;* Nisco sixer plus 45SC, *Verticillum lecanii*, *Metarhizium anisopliae* (2×10^{8}CFU/ml), *Beauveria bassiana* (2CFU×10^8 ml), Neem oil 5% EC, Spinosad 45%SC, Imidacloprid 17.8%SL were tested along with a control. The observations on count of percent aphid population reduction and cost benefit ratio were recorded on five selected random plant First count was done one day before insecticide application and post treatment counts were made after 3,7,14 days. One spray was given with an interval of 15 days. In order to evaluate the per cent of aphid population reduction and cost benefit ration on five randomly selected and tagged plants per net plot. Nymph and Adult population of mustard aphid *Lipaphis erysimi* were recorded from each net plot and the population was worked out per plant. The formula used for the calculation of percentage reduction of pest population over control using following formula giving by referring it to be modification of Abbott (1925). The average percent reduction of pest population of all two sprays was worked out by using Henderson and Tilton formula described as under nymph and adult population of mustard aphid were observed on leaves and stem, selected randomly in five different places in an given area and computed as per the formulae.

$$(\text{Percent Population reduction } = \frac{Ta}{Ca} \times \frac{Cb}{Tb}) \times 100$$

Where,
Ta = Number of insects on treated plots after insecticidal application
Tb = Number of insects in treated plots before insecticidal application
Ca = Number of insects in untreated plots after insecticidal application
Cb = Number of insects in untreated plots before insecticidal application

The data on percentage reduction of aphid population were transformed into angular values (Bliss, 1937) subjected to analysis of variance.

The marketable yield achieved from various treatments were collected weighed separately. the cost of treatments used in this experiment was calculated. The affordable overall cost of plant protection included the cost of treatments, sprayer rental and spray manpower cost. During the research period, there was one spray and total plant protection expenditure were computed. The following formula may be used to compute the cost-Benefit ratio.

$$C:B = \frac{Gross\ returns\ Rs/ha}{Cost\ of\ plant\ cultivation\ Rs/ha}$$

Where,
CBR= Cost-Benefit ratio
Gross returns= Marketable yield× Merket price

3. RESULTS AND DISCUSSION

The data on Per cent reduction of showed that all the insecticides were significantly superior over control in reducing the aphid population which were the mean of 3, 7, and 14 DAS after insecticidal application. Pooled analysis (Table 1) among all the treatments least nymph and adult population of mustard aphid was recorded in Spinosad 45 SC (86.75%). Similar findings made by Akter et al., [5] with (70.00%) aphids / plant and Sairam and Kumar [6] with (65.00%) aphids/plant. The next best treatment found Imidacloprid 17.8 SL (76.97%) aphid/ plant which lines with the findings Dotasara et al., [7] with (65.00%). The next best treatment found Nisco sixer plus 45 SC (61.83%) aphid/ plant which lines with the finding Sreeja and Kumar [8] with (58.91%) aphid/plant. *Verticillum lecanii* (2×10^8 spore/ml) (51.04%) is the next best treatment is found to be the next effective treatment which is in line with Sajid and Khuram [9] with (83%) aphid/plant followed by *Beauveria bassiana* (2×10^{8}CFU/ml) (47.60 %), these results are support with Rawat et al*.,* [10] with (53%). The result of *Metarhizium anisopliae* (2×10^8 CFU/ml) (42.01%) which is support with Kumar and Kumar [11]. With (37.00%) Followed by neem oil 5 % (33.42%) is found to least effective but comparatively superior over the control which support Yadav et al*.,* [12].

When the cost-benefit (Table 2) ratio was calculated, an intriguing outcome was obtained with in Spinosad 45% Sc (1:7.96) with the similar findings made by Khandelwal and Kumar [13] with the cost benefit ratio (1: 7.61) followed by Imidacloprid 17.8 SL (1:7.83) with the similar findings made by Sreeja and Kumar [8] with (1:7.20), Nisco sixer plus @ 2ml/lit (1:6.57) with similar finding made by Singh and Kumar [14] (1:4.87). *Metarhizium anisopliae* (2×108 CFU/gm) (1:5.79) with similar findings made by Singh and Kumar [14] with (1:4.87) *Beauveria bassiana* (2CFU×10^8 ml) (1:5.64), *Verticillium lecanii* (2×10^8 Spore/ml) (1:5.63) with the similar finding made by Singh et al*.,* [15] with (1:5.60), Neem oil 5% EC (1:5.03) with similar findings made by Pal et al. [16] with (1:3.19). Least monetary return was obtained with control (1:2.81).

Table 1. Efficacy of different bio pesticides against mustard aphid (*Lipaphis erysimi*) on reduction percent over control during *rabi* season 2022-2023 (1st spray)

Treatment		Percent Population reduction of mustard aphid /5 plants				
		1DBS	3DAS	7DAS	14DAS	MEAN
T0	Control	267.66	00	00	00	00
T1	Nisco sixer plus 45 SC	284.13	45.75	49.67	89.02	61.83
T2	*Verticillum lecanii* (2×10^8 spore/ml)	280.46	31.81	33.83	86.09	51.04
T3	*Metarhizium anisopliae* (2×10^8 CFU/ml)	264.53	20.59	22.16	81.77	42.01
T4	*Beauveria bassiana* (2×10^8CFU/ml)	255.53	26.69	29.79	84.91	47.60
T5	Neem oil 5%	277.20	10.50	12.14	76.02	33.42
T6	Spinosad 45 SC	273.86	79.98	88.09	96.81	86.75
T7	Imidacloprid 17.8 Sl	269.80	68.11	71.96	90.34	76.97
F-TEST		NS	S	S	S	S
S.Ed (±)		-	5.57	6.12	4.96	-
CD (5%)		--	11.953	13.133	9.830	

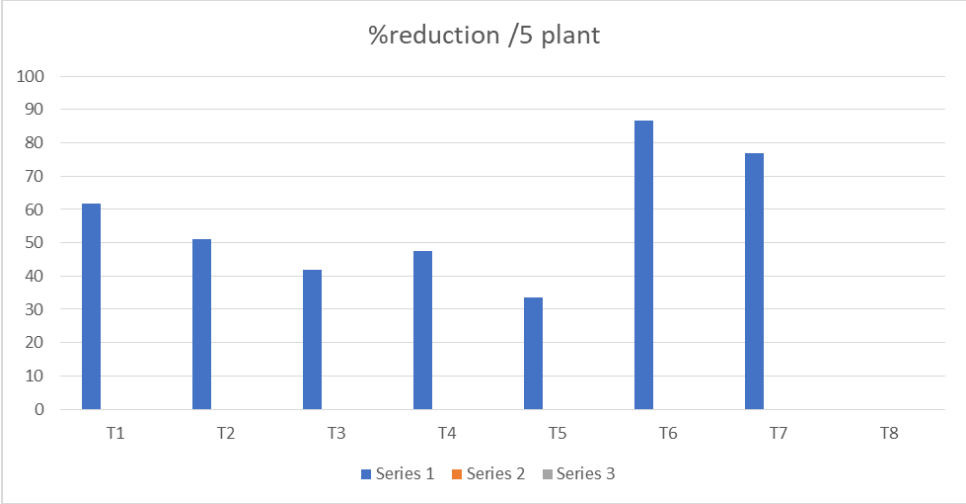

Fig. 1. Graphical representation efficacy of different bio pesticides against mustard aphid (*Lipaphis erysimi*) on reduction percent over control

Table 2. Economics of treatments and cost Benefit ratio under consideration for control of mustard aphid during *rabi* season 2022-2023

S. no	Treatment	Yield q/ha	Cost of yield(₹/q)	Total cost of yield (₹)	Commoncost of cultivation (₹)	Treatment cost (₹)	Gross Return(₹)	Total costof cultivation(₹)	B:CRatio
T0	Control	7.83	5465	42790.9	15184	0	42790.9	15184	**1:2.81**
T1	Nisco sixerplus @2ml/lit	20.83	5465	113835.9	15184	2120	113835.9	17304	**1:6.57**
T2	*Verticilliumlecanii* (2×10^8Spore/ml)	18.83	5465	102905.9	15184	3080	102905.9	18264	**1:5.63**
T3	*Metarhiziu manisopliae*(2×10^8CFU/gm)	17.36	5465	94872.4	15184	1196	94872.4	16380	**1:5.79**
T4	*Beauveriabassiana* (2×10^8CFU/gm)	17.58	5465	96074.7	15184	1832	96074.7	17016	**1:5.64**
T5	Neem oil5% Ec	16.38	5465	89516.7	15184	2606	89516.7	17790	**1:5.03**
T6	Spinosad45% Sc	25.71	5465	140505.1	15184	2450	140505.1	17634	**1:7.96**
T7	Imidacloprid17.8 Sl	22.91	5465	125203.1	15184	800	125203.1	15984	**1:7.83**

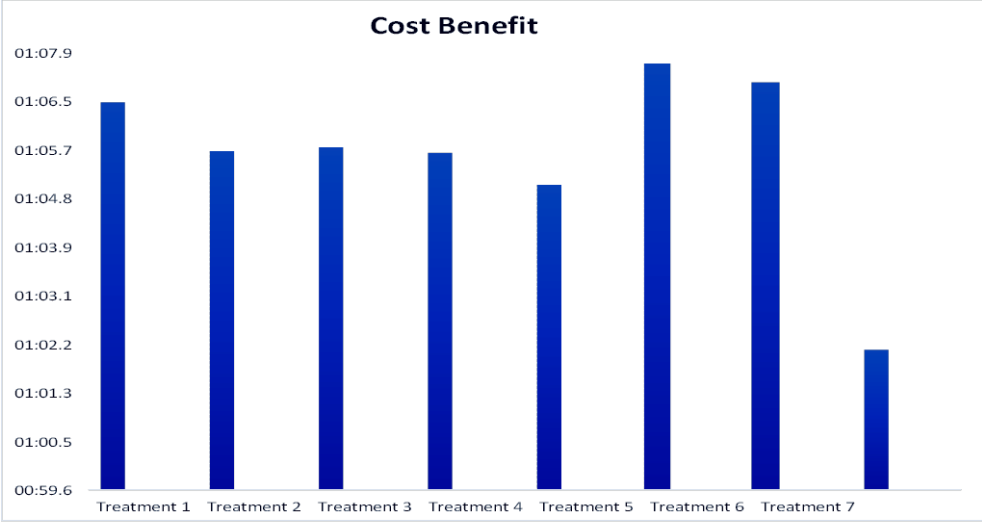

Fig. 2. Graphical representation of Cost benefit ratio of different treatment against mustard aphid *(Lipaphis erysimi)*

4. CONCLUSION

When it comes to managing population of *Lipaphis erysimi*, Spinosad 45%SC is more effective than Imidacloprid 17.8% SL, Nisco sixer plus 45 SC, *Verticillum lecanii* (2×10^8 Spore/ml), *Metarhizium anisopliae* (2×10^8 CFU/gm), *Beauveria bassiana* (2CFU$\times10^8$ ml), Neem oil 5%. Spinosad 45SC had the best economic cost-benefit ratio (1:7.96) followed by Imidacloprid 17.8% SL (1:7.83), Nisco sixer plus 45 SC (1:6.57), *Metarhizium anisopliae* (2×10^8 CFU/gm) (1:5.79), *Beauveria bassiana* (2CFU$\times10^8$ ml) (1:5.64), *Verticillum lecanii* (2×10^8 Spore/ml) (1:5.63) and Neem oil 5% (1:5.03). Studies were needed on the future to confirm the result Therefore, additional trials must be carried out in the future to collaborate the findings that can benefit farmers in practical way for the sustainable production of mustard and avoid the losses of insect pest.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Kumar, Arvind OP, Premi, Thomas L. “Rapeseed-mustard cultivation in India-an overview." National Research Centre on Rapeseed-Mustard;2008.
2. Chauhan JS, Singh KH, Singh VV, Kumar S. Hundred years of rapeseed mustard breeding in India: Accomplishments and future strategies. Indian Journal of Agric Science. 2011;81(12):1093-1109.
3. Gill, Singh. Glutathione and glutathione reductase: a boon in disguise for plant abiotic stress defense operations. Plant Physiology and Biochemistry. 2013;70(4) 204- 212.
4. Hemingway JS. Mustards, Brassica species and Sinapis alba (Cruciferae) in Evolution of crop plants, NW. Simmonds Eds., Longman, London and New York. 1976;56-59.
5. Akter A, Ali E, Islam MMZ, Karim R, Razzaque AHM. Effect of GA3 on growth and yield of mustard. International Journal of Sustainable Crop Production. 2007;2(2):16-20.
6. Sairam B, Kumar A. Field efficacy of selected bio pesticides and Fipronil against mustard aphid, *Lipaphis erysimi* (Kalt.). The Pharma Innovation Journal. 2022;11(8):1640- 1644.
7. Dotasara SK, Agrawal N, Singh N, Swami D. Efficacy of some newer insecticides against mustard aphid *Lipaphis erysimi* Kalt. In cauliflower. Journal of Entomology and Zoology Studies. 2017;5(2):654-656.
8. Sreeja S, Kumar A. Field efficacy of selected chemicals and biopesticides against mustard aphid [*Lipaphis erysimi* (Kaltenbach)] on mustard [*Brassica juncea* (L.)] at Prayagraj (UP). The Pharma Innovation. 2022;11(5): 1706- 1710.
9. Sajid M, Zia K. *In vitro* efficacy of biopesticide (*Beauveria bassiana, Metarhizium anisopliae, Bacillus thuringiensis*) against mustard aphid *Lipaphis erysimi* Kalt. (Hemiptera: Aphididae). Journal Plant Protection. 2017;1(2): 85-90.
10. Rawat PR, GC Y, Thapa RB, Rijal JP. Evaluation of entomopathogenic fungi with other pesticides against mustard aphid *Lipaphis erysimi* (Kalt.) under field condition of Chitwan, Nepal. Published in proceedings of Workshop of Plant Protection Society of Nepal; 2008.
11. Kumar S, Kumar A. Bio-efficacy of biopesticides and certain chemical insecticides against mustard aphid (*Lipaphis erysimi* Kalt.) on mustard crop under field condition. International Journal of Plant Protection. 2016;9(1):129-132.
12. Yadav SK, Singh RB, Gautam MP, Singh G, Giri SK. Bio-efficacy of insecticides against mustard aphid (*Lipaphis erysimi* Kalt.) on mustard (*Brassica juncea* L.). Journal of Entomology and Zoology Studies. 2021;9(1):1882-1886.
13. Khandelwal R, Kumar A. Evaluation of chemical insecticides along with cypermethrin and biopesticides against

mustard aphid [*Lipaphis erysimi*] (Kalt.) in mustard (*Brassica juncea*). The Pharma Innovation Journal. 2022;11(10):375-378.

14. Singh SA, Kumar A. Comparative efficacy and cost benefit ratio of newer insecticides and bio-pesticides against mustard aphid, *Lipaphis erysimi* (Kaltenbach). The Pharma Innovation Journal. 2022;11(10): 305-300.
15. Singh DK, Pal S, Dwivedi RK, Pal RK. Efficacy of insecticides against Mustard aphid, *Lipaphis erysimi* (Kalt.) Annals of Plant Protection Sciences. 2014;22(1):39-41.
16. Pal DS, Singh DK, Gautam SP, Kumar A. Biorational management of mustard aphid, *Lipaphis erysimi* (Kalt). International Journal of Chemical Studies. 2020;8(2): 2554-2557.

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