

Original Research Article

“Comparative efficacy and economics of biopesticides and Imidacloprid against mustard aphid [*Lipaphiserysimi* (Kalt.)] (Hemiptera: Aphididae)”

ABSTRACT

The present investigation was conducted during *rabiseason* of 2022 at Crop Research farm, NAI, SHUATS, Prayagraj using Randomized Block Design (RBD) method in three replications. Results revealed that among all the treatments combination insecticide *Metarhiziumanisopliae* (T₇) recorded lowest reduction percent of aphid (47.94%), followed by Nisco MECH 333 (T₆) (53.00%), Nisco MECH 333 + Neem oil 5% (T₁) (54.63%), Neem oil 5% (T₄) (55.33%), Spinosad 240 EC (T₃) (63.94%) and Spinosad 240 EC + Neem oil 5% (T₂) (69.37%). Imidacloprid 17.8 SL (T₅) (74.77%) was highest effective among all the treatments during 1st spray is also superiorly significant and more effective as compared to all other treatments. While, the highest yield 18.15 q/ha was obtained from the treatment Imidacloprid 17.8% SL. The best economics cost benefit ratio was obtained with Imidacloprid 17.8 SL (T₅) (1:6.43) Followed by Spinosad 240 EC + Neem oil 5% (T₂) (1:5.96), Spinosad 240 EC (T₃) (1:5.64), Neem oil 5% (T₄) (1:5.06), Nisco MECH 333 + Neem oil 5% (T₁) (1:4.87), *Metarhiziumanisopliae* (T₇) (1:4.65), Nisco MECH 333 (T₆) (1:4.21), Least monetary return was obtained with control (1:3.25).

Keywords: Comparative efficacy, Economics, Imidacloprid, Insecticides, *Lipaphiserysimi*, Mustard.

1. INTRODUCTION

Mustard is among the oldest recorded spices as seen in Sanskrit records dating back to about 3000 BC (Mehra, 1968) and was one of the first domesticated crops. Originally it was the condiment that was known as mustard and the word was derived from the *Latin mustum*. Mustard, *Brassica juncea* (L.) Czernand Coss is an important oilseed crop belonging to family *cruciferae* (Syn. Brassicaceae). Indian mustard or brown mustard is having chromosome no (2n=36). It is self-pollinated but certain amount (2-15%) pollination occur due to insects and other factors. The origin place of mustard is China, northeastern India from where it has extended up to Afghanistan via Punjab (Kalasariya, 2016). Mustard is also rich in minerals like Calcium, Manganese, Copper, Iron, Selenium, Zinc, Vitamin (A, B and C) and proteins. 1000 g mustard seed contains 508 k. cal. energy, 28.09 g carbohydrates, 26.08 g

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proteins, 26.08 g total fat and 12.2 g dietary fiber, 31 I.U. Vitamin A, 4.733 mg Niacin, 7.1 mg Vitamin C, 266 mg Calcium, 9.21 mg Iron, 370 mg Magnesium, 13 mg Sodium and 738 mg Potassium (Daravathet *et al.*, 2016). India ranks world's third important oil crop in terms of production and area. it is one of the three major oilseeds crops along with groundnut and soybean contributing around 25 per cent of the total oilseeds production. (Senet *et al.*, 2017).

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Mustard plays an important role in the oil seed economy of the country. It has 38 to 42% oil and 24% protein. (Meena *et al.*, 2015). More than 43 species of insect pests infest rapeseed-mustard crop in India, out of which a dozen species are considered as major pests. The aphid species, viz., *Lipaphiserysimi* (Kaltenbach), *Brevicoryne brassicae* (Linnaeus) and *Myzus persicae* (Sulzer) are the key pests (Lalet *et al.*, 2018) resulting in both qualitative and quantitative losses. Among these, mustard Aphid, *Lipaphiserysimi* Kalt. (Hemiptera: Aphididae) is the most destructive insect pest of mustard (Pragya *et al.*, 2017).

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Lipaphiserysimi belongs to family Aphididae and is commonly known as mustard aphid. It is a cosmopolitan insect and found on both the leaf surfaces and in leaf folds of developing heads, on leaf stalks, and on leaf axles. They are found primarily on the growing points of the host plants, including tips, flowers and developing pods and cover the whole plant with high density (Nelson and Rosenheim, 2006). They suck sap from the hosts and infested plants become stunted and distorted. Their infestation causes wilting, yellowing and stunting of plants (Khan *et al.*, 2015). On the other hand, aphid produces a good amount of honey dew which facilitates the growth of the fungus that makes the leaves and pods appear dirty black and also interferes in the photosynthetic activity of the leaves (Sharma *et al.*, 2020). It is predominant and capable of causing up to 96 per cent yield losses and 5-6 per cent reduction in oil content (Lalet *et al.*, 2018). For the control of insects primarily mustard aphids, most of the mustard growing farmers ~~of~~ apply synthetic pesticides and even banned pesticides in some cases in a repeated manner with ~~the~~ higher doses. Due to the repeated doses of insecticide, aphid has gained resistance over pesticides and hazardous use of pesticide has induced Photo-toxicity, destruction of beneficial organism, disruption of agro-ecosystem and human health hazards. So, the alternative of chemical pesticide can be bio-insecticide, which is economically cheaper, environmentally sound and non-hazardous to human, animal and natural predator and pollinator but effective against harmful pest.

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~~In order to~~ preventing the infestation of the mustard aphid and to produce a quality crop production, it is essential to manage the pest population at proper time with suitable and appropriate measures. Keeping the above facts in mind the present investigation was undertaken to manage mustard aphid, *Lipaphiserysimi* (Kaltenbach) through eco-friendly bio-

pesticides and its comparison with some chemical insecticides. So that a pest management module may be devised with minimum input and maximum benefit to farmers

2. MATERIALS AND METHODS

The experiment was conducted during rabi season 2022 at Central Research Field (CRF) of Sam Higginbottom University of Agriculture, Technology and Sciences, Naini, Prayagraj, Uttar Pradesh, India, in a randomized block design with eight treatments replicated three times using variety, kalasona seeds in a plot size of 2m×2m at a spacing of 15cm×20cm with a recommended package of practices excluding plant protection. The soil of the experimental site was well drained and medium high. The observations on population of sucking pest were recorded visually using a magnifying lens early on top 10cm central apical twig per plant from five randomly selected and tagged plants in each plot. The population of aphids was recorded in the field on the five randomly selected plants from each plot one day before spray and 3rd, 7th and 14th days after spray of insecticides. The numbers of aphids/plant were converted into % reduction of aphid population over the control by the formula given below,

Percent reduction over control =

$$\frac{(\text{Population recorded in control plot} - \text{Population recorded after spray})}{\text{population recorded in control plot}}$$

(Kumar *et al.*, 2020)

The economical and healthy marketable yield obtained from different treatments was collected separately and weighed. The cost of insecticides used in this experiment was recorded during Rabi season of 2022-23. The cost of botanicals used was obtained from nearby market. The economical total cost of plant protection consisted of cost of treatments, sprayer rent and labour charges for the spray. There were two sprays throughout the research period and the overall plant protection expenses were calculated. The B:C ratio can be calculated by formula:

$$B:C = \frac{\text{Gross returns}}{\text{Total costs incurred}}$$

Where,

BCR = Benefit Cost Ratio
Gross returns = Marketable yield × Market price

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3. RESULTS AND DISCUSSION

In the experiment, eight different treatments, consisting application of Control (T₀), Nisco MECH 333 + Neem oil 5% (T₁), Spinosad 240 EC+ Neem oil 5%(T₂), Spinosad 240 EC(T₃), Neem oil 5%(T₄), Imidacloprid 17.8 SL(T₅), Nisco MECH 333(T₆), *Metarhiziumanisopliae*(T₇) were tested to compare the efficacy against *Lipaphiserysimi* and their influences on yield of mustard. The results obtained are discussed in the light of available relevant literature in this chapter as before.

Result revealed that all the treatments except untreated control are effective and at par. Among all the treatments combination insecticide *Metarhiziumanisopliae*(T₇) recorded lowest reduction percent of aphid (47.94%), followed by Nisco MECH 333(T₆) (53.00%), Nisco MECH 333 + Neem oil 5% (T₁) (54.63%), Neem oil 5% (T₄) (55.33%), Spinosad 240 EC (T₃) (63.94%) and Spinosad 240 EC+ Neem oil 5%(T₂) (69.37%). Imidacloprid 17.8 SL (T₅) (74.77%) was highest effective among all the treatments during spray.

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The data on the mean per cent population reduction of first spray overall mean revealed that all the treatments except untreated control are effective and at par. Among all the treatments lowest per cent reduction of mustard aphid as well as increasing the yield was recorded in Imidacloprid 17.8% SL (88.184%). Similar findings made by **Chandra et al. (2014)**, **Aziz et al. (2014)**, **Sen et al. (2017)**, **Maurya et al. (2018)**, **Patel et al. (2020)** and **Rashid et al. (2021)**. Spinosad 45% SC (81.498%) is found to be the next best treatment which is in line with the findings of **Akter et al. (2021)**, **Khanalet al. (2020)** **Vishvendra et al. (2018)** they reported that was found most effective in reducing percent population of *Lipaphiserysimi*.

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Spinosad 45% SC is found to be the next best treatment which is in line with the findings of **Bhatta et al. (2019)** and **Shiva and Rajesh (2020)** Neem oil 5% (72.976%) is found to be the next effective treatment which is in line with the findings of **Yadav et al. (2021)**, **Kumar and Kumar (2016)** and Nisco MECH 333 (68.251%) is found to be the next effective treatment which is in line with the findings of **Zorempui and Kumar (2019)**. The result of Sixer plus (58.914%) which is at par with *Metarhiziumanisopliae* (53.123%) is found to be least effective but comparatively superior over the control, these findings are supported by **Meena et al. (2013)**, **Kumar et al. (2020)**.

The yields among the treatments were significant. The highest yield was recorded in Imidacloprid 17.8% SL (18.15q/ha) followed by Spinosad 240 EC (17.85q/ha), Spinosad 240

EC+ Neem oil 5% (16.35q/ha), Neem oil 5% (14.98q/ha), Nisco MECH 333+ Neem oil 5% (14.58q/ha), Nisco MECH 333 (13.03 q/ha), *Metarhiziumanisopilae* (12.55q/ha), as compared to control plot (9.17q/ha). These findings are supported by Vishal *et al.* (2019), Bhatta *et al.* (2019), Akter *et al.* (2021), Yadav *et al.* (2021), Aziz *et al.* (2014), Meena *et al.* (2013), Sreeja and Kumar (2022). Respectively.

When cost benefit ratio was worked out, interesting result was achieved. Among the treatments studied, the best and most economical treatment was Imidacloprid 17.8% SL (1: 5.20) followed by Spinosad 45% SC (1: 4.87), Spinosad 240 EC+ Neem oil 5 (1: 4.58), Neem oil 5% (1: 4.15), MECH 333 + Neem oil 5% (1: 3.98), Nisco MECH 333 (1: 3.46), *Metarhiziumanisopilae* (1:3.42), as compared to Control (1: 2.74). These findings are supported by Ahlawat *et al.* (2018), Akter *et al.* (2021), Sreeja and Kumar (2022).

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Table. 1 Efficacy of biopesticides and Imidacloprid against mustard aphid (*L. erysimi* Kalt.) on reduction per cent over control during rabiseason 2022 (1st spray).

S. No.	Name of treatments	Dosages	Population of <i>L. erysimi</i> /top 10 cm central twig of plant (Day before spray)	Per cent population reduction of <i>L. erysimi</i> /top 10 cm central twig of plant			
				3 rd DAS	7 th DAS	14 th DAS	Mean
T ₀	Control	-	256.73	0	0	0	0.00
T ₁	Nisco MECH 333 +Neem oil 5%	2ml/ lit. + 5 ml/lit.	256.47	29.77	62.74	69.78	54.10
T ₂	Spinosad240EC+ Neem oil5%	0.75ml/ lit + 5ml/lit	243.07	48.23	74.61	85.69	69.51
T ₃	Spinosad240EC	0.75 ml/lit	269.00	37.8	71.97	83.02	64.26
T ₄	Neem oil5%	5 ml/lit	251.73	31.38	64.87	71.52	55.92
T ₅	Imidacloprid17.8SL	1ml/2.5 lit of water	254.47	53.45	78.27	91.71	74.48
T ₆	Nisco MECH 333	2ml/lit.	249.27	27.6	60.7	71.25	53.18

T₇	<i>Metarhiziumanisopliae</i>	5gms/lit	245.40	21.02	55.32	67.78	48.04
Overall mean			NS	35.60	66.92	84.60	59.92
F-test				S	S	S	S
S.Ed (±)				0.81	0.58	0.69	0.29
C.D.(P=0.05)				1.701	1.249	1.479	0.622

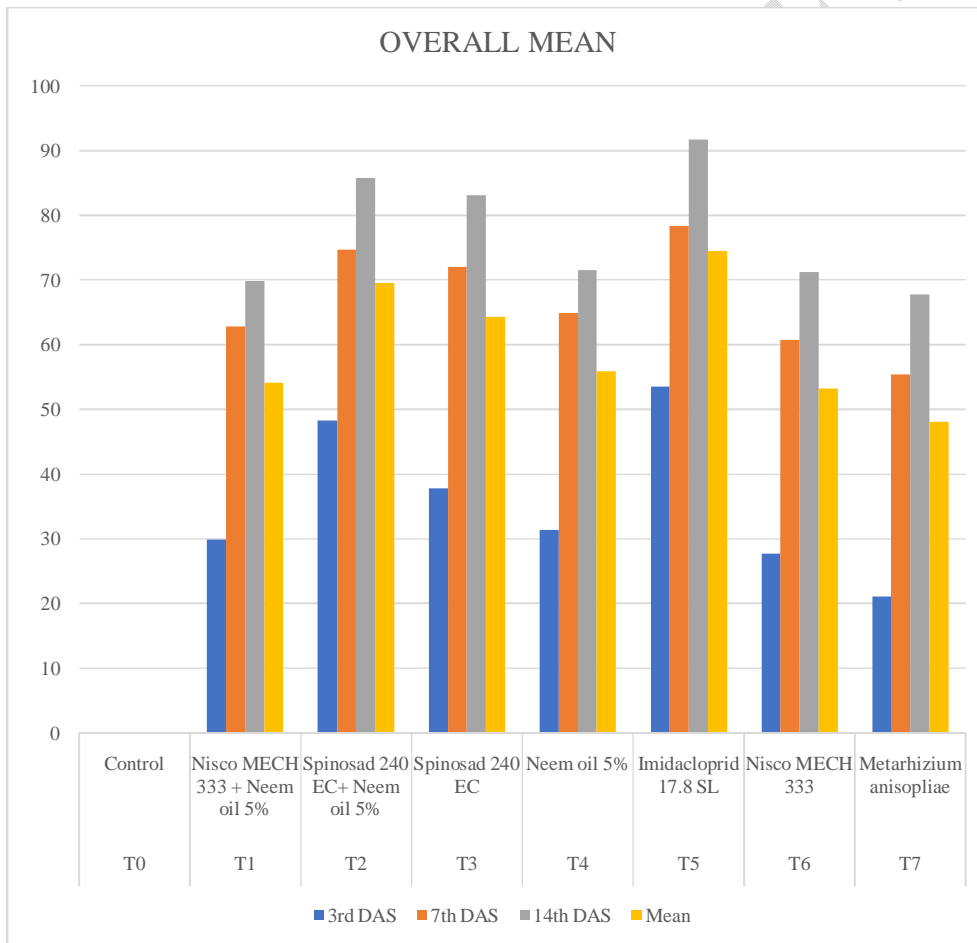


Fig. 1.The efficacy of biopesticides and Imidacloprid against mustard aphid, (*L. erysimi* Kalt.) (Mean)

Table.2 Economics of treatments and Benefit: cost ratio taken up for the management of mustard aphid during rabi season 2022

S. No	Treatments	Yield of q/ha	Cost of yield / ₹/q	Total cost of yield (₹)	Common cost (₹)	Treatment cost (₹)	Cost of cultivation	Net return	Total cost (₹)	B:C ratio
T ₀	Control (Water spray)	9.17	6500	59605	21749	—	21749	37856	21749	1: 2.74
T ₁	NiscoMECH 333 + Neem oil 5%	14.58	6500	94770	21749	2080	23829	70941	23829	1: 3.98
T ₂	Spinosad 240 EC+ Neem oil 5%	16.35	6500	106275	21749	1472	23221	83054	23221	1: 4.58
T ₃	Spinosad 240 EC	17.85	6500	116025	21749	2100	23849	92176	23849	1: 4.87
T ₄	Neem oil 5%	14.98	6500	97370	21749	1700	23449	73921	23449	1: 4.15
T ₅	Imidacloprid 17.8% SL	18.15	6500	117975	21749	960	22709	95266	22709	1: 5.20
T ₆	Nisco MECH 333	13.03	6500	84695	21749	2720	24469	60226	24469	1: 3.46
T ₇	<i>Metarhizium anisopilae</i> (10 ⁸ spore load/gm)	12.55	6500	81575	21749	2088	23837	58126	23837	1: 3.42

4. CONCLUSION

From the critical analysis of the present findings, it can be concluded that Imidacloprid 17.8% SL is more effective in controlling per cent population reduction of mustard aphids followed by Spinosad 240 EC, Spinosad 240 EC + Neem oil 5%, Neem oil 5%, Nisco MECH 333++ Neem oil 5%, in managing *Lipaphiserysimi*. Among the treatments studied, Imidacloprid 17.8% SL gave the highest economical cost benefit ratio (1: 5.20) and marketing yield (18.15 q/ha) followed by Spinosad 240 EC (1: 4.87 and 17.85 q/ha), Spinosad 240 EC+ Neem oil 5% (1: 4.58 and 16.35 q/ha), Neem oil 5%, Nisco MECH 333 + Neem oil 5%, Nisco MECH 333, *Metarhiziumanisopila* respectively as such more trials are required in future to validate the findings. Hence more trails are needed to be conducted in future to validate the findings which can be useful for the farmers in a feasible manner for sustainable production of mustard and to prevent the losses occurring from this insect pest infesting the crop.

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