Comparative efficacy of chemicals with biopesticides against Mustard aphid, *Lipaphiserysimi* (Kalt.) on Mustard (*Brassica juncea*L.)

Abstract

Research experiment was carried out under the field conditions during the *Rabi* season of 2023-2024 at Central research field SHUATS Prayagraj, UP, India. The management of mustard aphid, *Lipaphiserysimi*(Kalt) was done using different treatments and benefit cost ratio of all the treatments were calculated. One spray was applied to protect the crop from *Lipaphiserysimi*usingrandomized block design with three replications. The observation of mustard aphid, *Lipaphiserysimi*24 hours before (Pre-treatment) and 3rd, 7th, and 14th day after spraying (Post-treatment) were recorded for computing the per cent population reductionof pest. The different chemicals and biopesticides treatments revealed that Imidacloprid 17.8% SL (87.21%) shows the highest per sent reduction and was the most effective treatment followed by Cypermethrin 10% EC (84.31%), Nisco sixer plus 45 SC (78.06%), *Bacillus thuringiensis* (73.02%), *Beauveria bassiana* (2×10^{8}CFU/ml) (70.02%), *Verticillium lecanii*1.15% WP (68.78%) the least per cent reduction was observed in Neem oil 5% EC (64.85%). The highest crop production, at 38.33 q/ha on average was recorded in Imidacloprid 17.8 SL with cost benefit ratio of (1:9.71) followed by Cypermethrin 10% EC 34.00q/ha with (1:8.54) C:B ratio, Nisco sixer plus 31.66 q/ha with (1:7.22) C:B ratio, *Bacillus thuringiensis* 28.33q/ha with (1:6.53) C:B ratio, *Verticillium lecanii* 1.15% WP 26.00q/ha with (1:6.07) C:B ratio, *Beauveria bassiana* (2CFU×10^{8} ml) 26.66q/ha (1:6.04) C:B ratio,Neem oil 5% EC 21.66q/ha with (1:4.64) C:B ratio and control 15.00q/ha with (1:3.93) C:B ratio.

Keywords: Biopesticides, Chemicals,Imidacloprid,*Lipaphiserysimi*, Management, Mustard Aphid.

Introduction

Mustard is an important oilseed crop which is grown in subtropical as well as tropical countries in the world. India is the second largest producer of this crop in the World **(Dwivedi *et al.*,2019)[6]**. It belongs to the Family- Brassicaceae and genus Brassica.

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)[12]**. 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 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 **(Daravath*et al*., 2016)[4].**

The estimated area, production and yield of rapeseed-mustard in the world was 30.74 million ha, 59.93 million tonnes and 1 950 kg/ha respectively during 2009–10. During the last seven years, there has been a considerable increase in productivity from 1540 kg/ha in 2003–04 to 1 950 kg/ha in 2009–10 and production has also increased from 39.42 million tonnes in 2003–04 to 59.93 million tonnes in 2009–10. Globally, India account for 21.7% and 10.7% of the total acreage and production (**USDA 2010).**

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), *Brevicorynebrassicae* (Linnaeus) and *Myzuspersicae* (Sulzer) are the key pests **(Lal *et al.*,2018)[11]** resulting in both qualitative and quantitative losses.

Among all the insect pests, the mustard aphid, *Lipaphiserysimi* (Kaltenbach) (Homoptera: Aphididae) has gained the status of key pest of rapeseed-mustard in India. It feeds by sucking sap from its host and damage to the crop ranging from 9 to 96% in different agroclimatic conditions of India **(Singh and Sharma, 2009)[18].** Large colonies of the aphid could cause the plant to become deformed due to curling and shrivelling of leaves. Under severe infestation, both sides of leaves are attacked. On mustard, *Lipaphiserysimi* prefers to feed on flowers as well as foliage of mustard **(Gautam *et. al.*, 2019)[7].**

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 2023-2024. Trail was laid out in randomised block design consisting of eight treatments including control. Each treatment was replicated thrice and MD Rani Super Gold mustard variety was sown with the spacing of 45×30 cm. Standard agronomic practices were followed to ensure a good crop stand. Seven chemicals and biopesticides viz, Nisco sixer plus,Cypermethrin 10% EC, *Bacillus thuringiensis*,Imidacloprid 17.8%SL, *Beauveria bassiana* (2×10^8CFU/ml), *Verticillumlecanii*1.15% WP,Neem oil 5% ECwere tested along with auntreated control.The chemicals and biopesticidesare sprayed at recommended doses when the aphid reaches its ETL level of 10%.

Aphid population was counted from five randomly selected plants in each plot and population per 5 plants were noted. The population of *Lipaphiserysimi* wasrecorded before one day spraying and on 3rd, 7th, and 14th day after insecticidal applications for one spray.

Theformulagivingby**HendersonandTilton(1955)**usedto calculationpercentagereductionofpestpopulationovercontrol.

$$\text{Per cent population reduction} = (1 - \frac{\text{Ta}}{\text{Ca}} \times \frac{\text{Cb}}{\text{Tb}}) \times 100$$

Where,

Ta = Number of insects on treated plots after insecticidal application
Tb = Number of insects in treated plots before insecticidal application
Ca=Numberofinsectsinuntreatedplotsafterinsecticidalapplication
Cb=Numberofinsects inuntreatedplotsbeforeinsecticidalapplication

Healthy mustard seeds were harvested and their weight from each treatment was expressed as marketable yield in quintal per hectare. Ultimately, the cost benefit ratio was calculated on the basis of prevailing market price of yield, insecticides and spraying cost.

$$\mathbf{B:CRatio} = \frac{\mathbf{Grossreturns\ (Rs/ha)}}{\mathbf{Costofplantcultivation\ (Rs/ha)}}$$ **[Hegde *et al.*,(2017)][8]**

Result and discussion

The results (Table-1) after spray revealed that all the treatments were significantly superior over the control. The data on the percent population reduction of *Lipaphiserysimi*in mustard 3^{rd},7^{th} and 14^{th} day after spray revealed that the chemical treatments were significantly superior over control. Among all the treatments highest percent population reduction of mustard aphid was recorded in Imidacloprid 17.8% SL (87.21%) followed by Cypermethrin 10% EC (84.31%), Nisco sixer plus (78.06%), *Bacillus thuringiensis*(73.02%), *Beauveriabassiana* (2×10^8CFU/ml) (70.02%),*Verticillumlecanii*1.15% WP (68.78%) and Neem oil 5 % (64.85%).

The highest cost benefit ratio was recorded in Imidacloprid 17.8% SL (1:9.71)followed by Cypermethrin 10% EC (1:8.54), Nisco sixer plus (1:7.22), *Bacillus thuringiensis*(1:6.53), *Verticillium lecanii*1.15% WP (1:6.07), *Beauveria bassiana* (2×10^8CFU/ml) (1:6.04), Neem oil 5%Ec(1:4.64) and control (1:3.93).

The data on the percent population reductionspray inImidacloprid 17.8 SL (87.21%). Which is supportedwith**Sreeja and Kumar (2022)[19]** and **Dotasara** (**2017)[5].**Cypermethrin 10% EC was also found to be very effective (84.31%). The same results were observed by**Bandral (2006)[3]**. The next best treatment found Nisco sixer plus 45 SC (78.06%) aphid/plant which lines with the finding **Khandelwal and Kumar (2022)[9]**. *Bacillus thuringiensis*(73.08%) is the next best treatment is found to be the next effective treatment which is in line with **Sajid and Zia (2017)[15].**

The data showed that the highest grain yield of 38.33 q/ha was registered in Imidacloprid 17.8 SL which was followed by Cypermethrin 10% EC34.00 q/ha, Nisco sixer plus 31.66 q/ha, *Bacillus thuringiensis* 28.33 q/ha, *Beauveria bassiana* (2×10^8CFU/ml) 26.66 q/ha, *Verticillumlecanii*1.15% WP 26.00 q/ha, Neem oil 5% EC21.66 q/ha. As low as 15.00 q/ha was recorded in untreated plot control. These findings are supported with**Raju and Tayde (2022)[13]**forImidacloprid 17.8 SL. The findings supported with**Sarkar and Kumar (2022)[16]**for Cypermethrin 10% EC.

The Cost benefit ratio ranged between 1:9.71 and 1:3.93. Maximum cost benefit ratio (1:9.71) was obtained in Imidacloprid 17.8 SL treated plants,which is supported with the findings of**Vishal *et al.*, (2019)[20]**and **Ahlawat *et. al.*, (2018)[1]**,followed by cost benefit ratio (1:8.54)were recorded in Cypermethrin 10% ECtreated plants, the results are similar to

the findings of **Singh and Kumar(2022)[17]**.Nisco sixer plus also had a profitable cost benefit ratio (1:7.22)with the similar findings made by **Sreeja and Kumar (2022)[19]**,*Bacillus thuringiensis*(1:6.53) with similar finding made by **Sairam and Kumar (2022)[14],***Verticillium lecanii* (2×10^8 Spore/ml) (1:6.07)with the similar findings made by **Kumar and Kumar(2023)[10]**, *Beauveria bassiana* (2×10^8CFU/ml) (1:6.04) with the similar finding made by **Sarkar and Kumar (2022)[16]**,Neem oil 5% EC (1:4.64) with similar findings made by **Aswitha and Yadav(2023)[2]**. Lest monetary return was obtained with control (1:3.93).

Table 1. Evaluation of insecticides against mustard aphid,*Lipaphiserysimi* Kalt.in mustard during *rabi* 2023- 2024

S.NO	**Treatment name**	**Doses**	**% Reducation / 5 Plants**					**Yield** (q/ ha)	**B:C ratio**
			1DBS MEAN	3DAS	7DAS	14DAS	MEAN		
T_0	Control	-	226.53	00	00	00	00	15.00	1:3.93
T_1	NiscoSixerPlus	2ml/lit.	229.13	76.86	77.40	79.86	78.06^c	31.66	1:7.22
T_2	Cypermethrin 10% EC	0.6ml/lit	229.53	79.23	84.89	88.82	84.31^b	34.00	1:8.54
T_3	*Bacillus thuringiensis*	2ml/ lit	223.86	71.20	73.10	74.95	73.08^d	28.33	1:6.53
T_4	Imidacloprid 17.8% SL	0.5ml/lit	235.20	82.28	87.01	92.34	87.21^a	38.33	1:9.71
T_5	*Beauveria bassiana* ($2x10^8$CFU/ml)	2.5gm/lit	222.40	68.20	69.87	72.00	70.02^e	26.66	1:6.04
T_6	Neemoil 5%	5ml/lit	227.06	62.97	64.70	66.88	64.85^f	21.66	1:4.64
T_7	*Verticilliumlecanii*1.15% WP	2gm/lit	219.66	66.76	68.76	70.83	68.78^e	26.00	1:6.07
	F-TEST		NS	-	-	-	S		
	C.V.		3.285	-	-	-	2.04		
	CD (5%)		-	-	-	-	2.729		

DBS- Day Before Spraying, DAS- Day After Spraying, NS- Non- Significant, S- Significant

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