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Field Evaluation of Selected Insecticides and Botanical against Mustard Aphid, *Lipaphis erysimi* (Kalt.) on Mustard, *Brassica juncea* L.

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Authors' contributions

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

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Original Research Article

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ABSTRACT

A field trial was conducted at Central Research Farm [CRF], SHUATS, Naini, Prayagraj during the *Rabi* season. Six treatments were evaluated against *Lipaphis erysimi*. i.e. Fipronil 5% SC @ 0.5ml/lit, Difenthurion 50% WP @ 0.20g/lit, Profenophos 50% EC @ 1ml/lit, Thiamethoxam 25% WG @ 0.25g/lit, Imidacloprid 17.8% SL @ 0.5ml/lit and NSKE 5% @ 5ml/lit were evaluated against mustard aphid *Lipaphis erysimi*. Results revealed that, among the different treatments, the lowest population of mustard aphid was recorded in Imidacloprid 17.8% SL (22.82). Thiamethoxam 25% WG (33.63) was found to be the next best treatment followed by Difenthurion 50% WP (47.18), Fipronil 5% SC (54.15), and Profenophos 50% EC (60.12), whereas NSKE 5% (80.23) was found to be the least effective against this pest. The plot treated with the highest yield Imidacloprid 17.8% SL (24.6 q/ha) followed by Thiamethoxam 25% WG (21.8 q/ha), Difenthurion 50% WP (18.2 q/ha), Fipronil 5% SC (16.4 q/ha), Profenophos 50% EC (14.3 q/ha) and NSKE 5% (13.5 q/ha) as compared to the control plot (9.2 q/ha).Among the treatments, the best and most economical treatment was Imidacloprid 17.8% SL (1:7.24) followed by Thiamethoxam 25% WG (1:6.43), Difenthurion 50% WP (1:5.24), Fipronil 5% SC (1:4.64), Profenophos 50% EC (1:3.94) and NSKE 5% (1:3.90) as compared to control plot (1:2.83).

Keywords: Cost-Benefit ratio; evaluation; Imidacloprid; insecticides; Lipaphis erysimi.

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1. INTRODUCTION

"Mustard, *Brassica juncea* (L.) Czern and Coss is an important oilseed crop belonging to the family cruciferaceae (Syn. Brassicaceae). Indian mustard or brown mustard is natural amphidiploids 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" [1]. "Mustard (*Brassica spp*.) is one of the first domesticated crops which has wide dispersal, and has been grown as herb in Asia, North Africa, and Europe for thousands of years" [2].

"It contributes about 28.6% of the total oilseed production in India, whereas it is the second most important edible oilseed after groundnut, sharing 27.8% of India's oilseed economy" (Kumar *et al*., 2018). "Mustard plays an important role in the oil seed economy of the country. The oil contents of mustard seeds ranges from 32 to 40 %, and protein content ranges from 15 to 17 %" [3].

"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).

"Mustard production in India stands in between 8-9 million tons with a significant increase in between 2000 and 2019" [4]. "It is cultivated over an area of 5.75 million ha with production and productivity of 6.80 million tonnes and 1183 kg/ha respectively in India [5]. In India, the major production regions of mustard are Rajasthan, Haryana, Uttar Pradesh, and Madhya Pradesh while the major consumption (as raw pellets) regions are Rajasthan, Uttar Pradesh, Haryana, and Punjab" [4]. "Uttar Pradesh accounts for 1198.5 ha. 10.85% and 11.19% of area and production, respectively in the country with an average yield of 11.49 q/ha which is equivalent to the national average (11.17 q/ha)" [6].

Mustard plant is attacked by a number of insect pests [7,8]. Bakhetia, 1983 found "more than three dozen insect pests, associated with various phonological stages of these crops. Among them, *Lipaphis erysimi*, commonly known as the mustard aphid is most destructive. It belongs to the family Aphididae of the order Homoptera". "The insect is distributed to many other countries of the world. The attack is severe in those regions where the number of cloudy days is greater during the pest activity period"[9].

"Aphids are small, soft-bodied, pearl-shaped insects that have a pair of cornicles (honey tubes) projecting out from the fifth or sixth abdominal segment" [10-14]. "The aphid attacks generally during December and continue till March. About 45 generations are completed in a year" [15].

"The damage is caused by both nymph and adult stages as they suck the cell sap from leaves and turn yellow from green and growth of plants is stunted. It found on all parts of plant; leaves, stem, blooming flowers and silique forming inflorescence, in sevre cases, the plants may even die" [16].

"Mustard aphid is the major constraint responsible for low yield as well as low quality seed, which is considered as key factor in reducing mustard production and can cause yield loss up to 90%" [17]. "It may cause a yield loses ranging from 35.4 to 96% in favourable conditions and can reduce 5-6% oil content" [18].

"Chemical control is more accurate as it controls about 90% of the aphid population, but due to its high rate of reproduction, in a period of 2-3 weeks after treatment of insecticide, the aphid population reaches around the same number as before treatment. That's why it is mandatory for insecticides to have effective control over ustard aphid population for a longer period of time" [19].

1.1 Objectives

1. To evaluate the chemical insecticides and botanicals against mustard aphid, *Lipaphis erysimi* (Kalt.) in mustard (*Brassica juncea*) during the *Rabi* season 2021.
2. To Calculate the Crop Economics – Benefit Cost ratio [B:C ratio].

2. MATERIALS AND METHODS

The experiment was conducted at the experimental research plot of the Department of Entomology, Central Reasearch Farm, Sam Higginbottom University of Agriculture Technology and Sciences, during the *Rabi* season of 2021, in a Randomised Block Design with Six treatments replicated three times using variety Rohini seeds in a plot size of 2m×2m at a spacing of 45cm × 30cm with a recommended package of practices excluding plant protection. The soil of the experimental site was well drained and medium high. The research field situated at 25^{0}27 North latitude 80^{0}05” East longitude and at an altitude of 98 metres above sea level. The maximum temperature reaches up to 42^{0}C in summer and drops down to 4^{0}C in the winter.

2.1 Preparation of Insecticidal Spray Solution

The desired concentration of insecticidal spray solution for each treatment was freshly prepared each and every time at the site of experiment, just before the start of spraying operations. The quantity of spray materials required for the crop was gradually increased as the crop advanced in age.

The spray solution of the desired concentration was prepared by adopting the following formula:

$$V = \frac{(C \times A)}{\%\ a.i.}$$

Where, V=Volume of a formulated pesticide is required.
C= Required concentration.
A= Total volume of solution to be prepared
% a.i. = Given Percentage strength of a formulated pesticide

Data for mustard aphid was recorded on five randomly selected plants at the top 10 cm of the central shoot. When the aphid population reached an economic threshold level, treatment of insecticides was done. Five plants from each treatment were randomly selected, tagged and the mustard aphid population was recorded on them. Insect populations were recorded 24 hours before application. Besides this, the insect pest population was recorded at time intervals of 3 days, 7 days and 14 days after treatment. The experiment was repeated twice to minimise possible errors.

3. RESULTS AND DISCUSSION

The population of *Lipaphis erysimi* one day before the first spray was in a range of 120.2 to 136.4 aphids/ 10 cm central shoot prior to the application of treatments during *Rabi*. The chemical insecticides were more effective than the botanical. Efficacy of botanical and selected insecticides against mustard aphid populations on mustard showed that the data on the population of *Lipaphis erysimi* on three days after the first spray revealed that all the treatments were significantly superior over control. Among all the treatments, the plot treated with Imidacloprid @ 0.5ml/lit (26.46) proved to be the most effective. The next best treatment was Difenthurion at 0.25g/lit (89.53), followed by Fipronil at 0.5ml/lit (90.26), Profenophos at 1ml/lit (94.6), and @ NSKE 5%, 5 ml/lit (118.26), which was the least effective of all treatments. respectively on the 7th and 14th day after spray.

The population of *Llipaphis erysimi* one day before the second spray was in a range of 51 to 166.6. Three days after the second spray, all the insecticidal treatments were significantly superior over the untreated control. The lowest aphid population was recorded in the treatment of Imidacloprid @ 0.5ml/lit (22.6) followed by Thiamethoxam @ 0.25g/lit (30.73), which was a standard check. The next effective treatments were Difenthurion @ 0.20g/lit (36.4), Fipronil @ 0.5ml/lit (43.46), Profenophos @ 1ml/lit (48.067) and NSKE 5% @ 5ml/lit (62.46), whichleast effective as they recorded significantly higher populations than they rest of the treatments. However, it was significantly superior than untreated control.

The difference in yields among the different treatments was significant. The highest yield was recorded in Imidacloprid 17.8% SL (24.6 q/ha) these findings were supported by Chandra *et al*., [20] with (24.87 q/ha) followed by Thiamethoxam 25% WG (21.8 q/ha) these findings were supported by Patel *et al*., [21] with (21.69 q/ha) and Chandra *et al*., [20] with (21.87 q/ha). The next best treatment was Difenthurion 50% WP (18.2 q/ha) these findings were supported by Sen *et al*., [22] with (16.17 q/ha) followed by Fipronil 5% SC (16.4 q/ha) which is in line with the similar findings of Maurya *et al*., [23] with (16 q/ha) and Patel *et al*., (2017) with (16.62 q/ha). The next best treatment was Profenophos 50% EC (14.3 q/ha) which is in line with the similar findings of Jat and Singh [24] with (14.10 q/ha) and the lowest yield was recorded in NSKE 5% (13.5 q/ha) with similar findings of Kumar *et al*., [5] with (13.90q/ha) as compared to control plot (9.2q/ha).

Table 1. Efficacy of botanical and selected insecticides against mustard aphid *Lipaphis erysimi* (Kalt.)

S. No.	Treatments	Population of *Lipaphis erysimi*/10 cm apical twig									Yield (q/ha)	B:C ratio
		First spray				Second spray						
		3DAS	7DAS	14DAS	Mean	3DAS	7DAS	14DAS	Mean	OveralMean		
T_1	Fipronil 5% SC	90.26	74.86	78.33	81.15	43.66	26.33	11.46	27.15	54.15	16.4	1:4.64
T_2	Difenthurion 50% WP	89.53	72.26	56.53	72.77	36.40	18.80	9.60	21.60	47.18	18.2	1:5.24
T_3	Profenophos 50% EC	94.60	83.80	90.33	89.57	48.06	29.60	14.33	30.66	60.12	14.3	1:3.94
T_4	Thiamethoxam 25%WG	58.80	39.33	50.66	49.60	30.73	14.46	7.73	17.64	33.63	21.8	1:6.43
T_5	Imidacloprid 17.8% SL	26.46	32.86	38.26	32.53	22.60	11.53	5.20	13.11	22.82	24.6	1:7.24
T6	NSKE 5%	118.26	96.53	112.46	109.08	62.46	53.40	38.26	51.37	80.23	13.5	1:3.90
T_0	Control	132.33	140.46	166.66	146.48	182.53	216.26	193.53	197.44	171.96	9.2	1:2.83
	F-test	S	S	S	S	S	S	S	S	S	-----	-----
	S. Ed (±)	0.35	0.39	0.35	5.28	0.36	0.30	0.24	4.77	19.65	-----	-----
	C.D. (P = 0.5)	0.77	0.86	0.76	19.95	0.80	0.66	0.53	18.00	68.03	-----	-----

4. CONCLUSION

From the critical analysis of the present findings, it can be concluded that Imidacloprid 17.8% SL is more effective in controlling population of mustard aphid followed by Thiamethoxam 25% WG, Difenthurion 50% WP, Fipronil 5% SC, Profenophos 50% EC and NSKE 5% in managing *Lipaphis erysimi*. Among the treatments studied, Imidacloprid 17.8% SL gave the highest cost benefit ratio (1:7.24) and marketing yield (24.6 q/ha) followed by Thiamethoxam 25% WG (1:6.43 and 21.8 q/ha), Difenthurion 50% WP (1:5.24 and 18.2 q/ha), Fipronil 5 % SC (1:4.64 and 16.4 q/ha), Profenophos 50% EC (1:3.94 and 14.3 q/ha) and NSKE 5% (1:3.90 and 13.5 q/ha) as such more trials are required in future to validate the findings.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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