Original Research Article

Assessment of *Lipaphiserysimi* Multiplication Rates on Various Mustard Cultivars in vitro condition

ABSTRACT

Mustard cultivation, a vital aspect of agriculture in India, faces significant challenges due to the infestation of Lipaphiserysimi, commonly known as the mustard aphid. This study aimed to assess the in-vitro multiplication of aphids across various mustard cultivars during the *Rabi* season, 2019-20 ~~rabi season~~. A total of 45 cultivars were evaluated using a completely randomized design (CRD) with three replications. ~~The aphid multiplication index was calculated following Sharma's method, and cultivars were classified based on their resistance to L. erysimi. Results revealed a range of responses among cultivars.~~ Two cultivars, Aravali and RP-9, classified as highly resistant, had the lowest aphid multiplication index values (provide figures). The resistant category included three cultivarsDurgamani, RH-406, and RVM-2. Thirty-seven cultivars were identified as moderately resistant. Three cultivars, YSH-406, Rohini, and NC-1, were found to be moderately sensitive.

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INTRODUCTION

The Mustard crop (*Brassica napus* L.), a member of the Brassicaceae family, holds a significant position among oil crops (Din *et al*., 2022). Cultivated for diverse applications including fodder, feed, vegetables, and edible oil, canola's byproduct, the oilseed cake, serves as valuable animal feed. Its prominence in agriculture is chiefly attributed to its superior oil quality (Chand *et al.,*2017).In India, three cruciferous members of the *Brassica* species are cultivated under the name rapeseed and mustard. Among these, *B. juncea*, commonly called Indian mustard or "rai," stands out as the primary oil-yielding crop. Additionally, three ecotypes of *B. rapa* ssp. *oleifera*, namely brown *sarson*, yellow *sarson*, and toria, along with *B. napus*, are cultivated to a lesser extent (Bhatia *et al*., 2011). Rapeseed mustard is pivotal in India's

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agricultural landscape, contributing nearly one-third of the country's total oil production. As a result, it serves as a cornerstone of India's edible oilseed crop industry.

Lipaphiserysimi (Kaltenbach), commonly referred to as the mustard aphid, presents a significant obstacle to the successful cultivation of oilseed Brassicas in India compared to other insect pests (Kumar *et al.*, 2011; Atri *et al*., 2012). This pest infests the crop from its initial seedling stage until maturity, posing a persistent threat throughout the plant's growth cycle (Singh, 2013). It has been reported that *Lipaphiserysimi* causes notable losses in mustard crops, with documented losses reaching approximately 41.14% (Dotasara*et al*., 2018). Aphids are known for their ability to have multiple generations within a single year and possess a high rate of reproduction due to parthenogenesis. Both adult and nymph stages of the aphid feed on cell sap, causing damage to seeds, leaves, inflorescence, and stems. Severe infestations can lead to the secretion of honeydew, which promotes the growth of ~~fungus~~ sooty molds on affected plant parts, consequently reducing the rate of photosynthesis and indirectly impacting plant growth and yield (Patel *et al*., 2019). To gain further insight into the proliferation of the mustard aphid, this study aims to investigate its in-vitro multiplication across a variety of cultivars.

METHODS AND MATERIALS

During the 2019–20 ~~rabi~~ *Rabi* season, the trial was conducted in the Poly house of the Department of Entomology, College of Agriculture, Jawaharlal Nehru Krishi Vishwavidyalaya, Jabalpur, Madhya Pradesh, India. To calculate the aphid multiplication index under regulated conditions, a total of 45 mustard types were evaluated. In the 2019–20 ~~rabi~~ *Rabi* season, sowing took place in the third week of November. Before they germinated, the mustard kinds were planted in poly bags and left outside the polyhouse. After they germinated, they were moved, spaced 15 by 30 cm apart, into the polyhouse to provide an environment free of pests. The study used a completely randomized design (CRD) with three replications. Another polyhouse had a similar arrangement (set 2) for the experiment.

Using a soft camel hair brush, aphids were collected from diagnosed plants in the field and placed onto a petri dish. Ten aphids, or nymphs, were then introduced to each 30-day-old plant. Aphid proliferation was seen 10 days after discharge. The multiplication index was calculated via Sharma's (2007) recommended method.

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$$M.I=N1/N2$$

where

M. I.: is the multiplicity index, N1: Aphid number at ten days following the nymphs' release, N2: The quantity of nymphs (aphids) that were first released

Analytical statistics

Aphid Index construction and classification

The classification of the aphid index was determined using the normal distribution's pointes of inflexion, which are denoted as μ, μ+ σ, μ+ 2σ, μ+ 3σ, μ- σ, μ- 2σ, and μ- 3σ, in that order. The five categories were displayed as follows:

μ + 2σ< HS < μ+ 3σ

μ + σ< S < μ+ 2σ

μ < MS< μ+ σ

μ - σ< MR< μ

μ - 2σ< R< μ- σ

μ - 3σ< HR< μ- 2σ

Where: HS = Highly susceptible, S = Susceptible, MS = Moderately susceptible, MR = Moderately resistant, R = Resistant, HR = Highly resistant, σ = Standard deviation of mean aphid index value, μ = Mean aphid index value,

It did, however, indicate that if the categories fell one point below the distribution and on the upper side of the normal distribution, then our aphid index should be favorably biassed. The mean aphid index values were subjected to an analysis of variance at a significance level of 5% to compare many cultivars.

RESULTS AND DISCUSSION

~~The c~~Classification of different cultivars was conducted by analyzing combined data from both sets, considering preferences and average aphid multiplication index values. Among the categorized cultivars, those classified as highly resistant with mean aphid multiplication index values less than 4.04 included Aravali (3.24) and RP-9 (3.93), exhibiting the lowest aphid multiplication index values. Following this, the resistant category comprised RVM-2 (4.61), RH-406 (5.06), and *Durgamani* (5.12), with mean aphid multiplication index values ranging from more than 4.04 to less than 5.13.

Furthermore, thirty-seven cultivars demonstrated moderate resistance, with mean aphid multiplication index values ranging from 5.13 to 8.26. These cultivars include namely JTC-1 (5.24), *Maya* (5.28), RVM-3 (5.60), GSL-1 (5.62), Gujarat mustard-2 (5.64), IJ-31 (5.66), Shradda (5.64), China Kovind (5.66), RGN-73 (5.64), GSC-7 (5.73), NRC-HB-506 (5.73), RVM-1 (5.60), Kranti (5.90), Bhagirathi (5.94), DRMRIJ-31 (6.04), Jawahar mustard-2 (6.03), Geeta (6.09), SEJ-2 (6.11), Kiran (6.20), NRCDR-2 (6.28), BR-40 (6.33), Basanti (6.33), Ashirwad (6.33), PC-5 (6.37), NRCHB-101 (6.42), Jaganath (6.56), Jawahar mustard-1 (6.58), RH-749 (6.75), Varuna (6.71), Swarn Jyoti (6.81), Gujarat mustard-1 (6.85), JM-3 (7.04), Krishna (7.54), JM-2 (7.74), Pusa Bold (7.72), BSH-1 (7.92), and Lakshmi (7.77). Moderately sensitive cultivars, including YSH-406 (8.32), Rohini (8.50), and NC-1 (8.53), were identified with mean aphid multiplication index values ranging from higher than 8.26 to less than 9.35.

Table 1. ~~The a~~Average scale values for aphid multiplication observed on mustard cultivars (30 days old) during the *Rabi* season (Pooled data)

Sr.No	~~Different~~ Rapesee-Mustard Cultivars	Multiplication index value(MIV)		Pooled data of two year
		2019	2020	
1	Gujaratmustard-1	6.64*(2.67)**	7.05(2.74)	6.85(2.71)
2	JM-2	7.21(2.77)	8.27(2.96)	7.74(2.87)
3	Krishna	7.22(2.77)	7.86(2.89)	7.54(2.83)
4	NRCHB-101	6.72(2.68)	6.11(2.57)	6.42(2.63)
5	Maya	5.24(2.39)	5.32(2.41)	5.28(2.40)
6	Jawaharmustard-2	6.14(2.57)	5.92(2.53)	6.03(2.55)
7	IJ-31	5.55(2.45)	5.76(2.50)	5.66(2.48)
8	Jaganath	6.45(2.63)	6.66(2.67)	6.56(2.65)
9	DRMRIJ-31	5.74(2.49)	6.34(2.61)	6.04(2.55)
10	GSC-7	5.21(2.38)	6.24(2.59)	5.73(2.49)
11	Bhagirathi	5.52(2.45)	6.36(2.61)	5.94(2.53)
12	BR-40	6.09(2.56)	6.57(2.65)	6.33(2.61)
13	Jawaharmustard-1	6.58(2.66)	6.57(2.65)	6.58(2.63)
14	Kranti	5.44(2.43)	6.36(2.61)	5.9(2.52)
15	Rohini	8.95(3.07)	8.05(2.92)	8.5(3.00)
16	RP-9	3.63(2.02)	4.23(2.17)	3.93(2.10)
17	RH-406	5.45(2.43)	4.66(2.27)	5.06(2.35)

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18	NC-1	8.65(3.02)	8.41(2.98)	8.53(3.00)
19	Gujaratmustard-2	5.72(2.49)	5.55(2.45)	5.64(2.47)
20	Kiran	6.14(2.57)	6.26(2.6)	6.20(2.58)
21	Lakshmi	7.39(2.80)	8.14(2.93)	7.77(2.87)
22	RH-749	6.80(2.70)	6.69(2.68)	6.75(2.69)
23	RGN-73	5.25(2.39)	6.02(2.55)	5.64(2.47)
24	PC-5	5.92(2.53)	6.81(2.70)	6.37(2.62)
25	NRC-HB-506	5.32(2.41)	6.13(2.57)	5.73(2.49)
26	China Kovind	4.95(2.34)	6.36(2.61)	5.66(2.48)
27	NRCDR-2	6.13(2.57)	6.42(2.63)	6.28(2.60)
28	PusaBold	8.04(2.92)	7.40(2.81)	7.72(2.86)
29	JTC-1	5.35(2.41)	5.12(2.37)	5.24(2.39)
30	JM-3	7.82(2.88)	6.25(2.59)	7.04(2.74)
31	GSL-1	5.52(2.44)	5.72(2.49)	5.62(2.47)
32	Geeta	5.75(2.50)	6.42(2.64)	6.09(2.56)
33	Durgamani	5.33(2.41)	4.95(2.33)	5.12(2.36)
34	BSH-1	8.21(2.95)	7.64(2.85)	7.92(2.90)
35	Basanti	6.13(2.57)	6.54(2.65)	6.33(2.61)
36	SEJ-2	5.85(2.51)	6.37(2.62)	6.11(2.54)
37	Ashirwad	6.34(2.61)	6.32(2.61)	6.33(2.61)
38	Aravali	3.34(1.95)	3.14(1.90)	3.24(1.93)
39	YSH-406	8.23(2.95)	8.41(2.98)	8.32(2.96)
40	Shradda	5.82(2.51)	5.45(2.43)	5.64(2.47)
41	RVM-3	5.44(2.43)	5.75(2.50)	5.60(2.46)
42	Varuna	6.44(2.63)	6.98(2.73)	6.71(2.66)
43	Swarn Jyoti	7.25(2.78)	6.36(2.61)	6.81(2.70)
44	RVM-2	4.43(2.19)	4.80(2.30)	4.61(2.26)
45	RVM-1	5.94(2.53)	5.57(2.46)	5.76(2.50)
	SE(m)±	0.154	0.135	0.145
	C.D. (5%)	0.426	0.382	0.407

~~*Three replications each~~

**Figures in parentheses are t~~T~~ransformed value using ($\sqrt{x}$ + 0.5)

Table 2. Mustard cultivars are classified according to their sensitivity to *L. erysimi* using aphid multiplication index values (pooled).

S.No	Rapesed-Mustard Cultivars	Category of resistance	MAMIV* scale and SD** (Based on normal distribution values)
1	RP-9, Aravali	Highly resistant	<4.04
2	RH-406, Durgamani, RVM-2	Resistant	>4.04 but <5.13
3	Maya, JM-2, Geeta, RVM-3, BR-40, GSC-7, Ashirwad, RGN-73, Swarn Jyoti, Gujarat mustard-2, NRCHB-101, Jawahar mustard-2, JTC-1, Kiran, Pusa Bold, Krishna, NRC-HB-506, Basanti, SEJ-2, Jawahar mustard-1, PC-5, Gujarat mustard-1, Bhagirathi, RVM-1, Varuna, JM-3, IJ-31, Shradda, BSH-1, Lakshmi, RVM-2, China Kovind, RH-749, Kranti, DRMRIJ-31, GSL-1, and Jaganath		

4	NC-1, Rohini, YSH-401,	Moderately resistant	>5.13 but <8.26
5	No cultivars	Moderately susceptible	>8.26 but <9.35
6	No cultivars	Susceptible	>9.35 but <10.44

Jadon (2008) observed the lowest multiplication index (8.13) on the Geeta variety, whereas the highest multiplication index (12.77) was documented on the RK-05-1 variety. Dhillon *et al*. (2018) noted varying degrees of resistance among genotypes PM 30, PM-21, Pusa Bold, and Pusa Vijay when subjected to artificial infestation screening techniques against *Lipaphiserysimi.*

CONCLUSION

In the findings derived from the in-vitro conditions, cultivars were classified ranging from highly resistant to highly susceptible based on their response. Cultivars Aravali (3.23) and RP-9 (3.93) exhibited lower aphid multiplication, indicating they fall into the highly resistant category. Conversely, cultivars NC-1 (8.53), Rohini (8.48), and YSH-401 (8.30) displayed higher aphid multiplication index values, placing them in the moderately susceptible category.

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