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Screening of Mustard Varieties for Resistance against Mustard Aphid, (Kaltenbach)

Amar Chand [a,b], S. K. Khinchi [a,b], Mandeep Redhu [c], Arvind [a,d*], Renu Choudhary [e], Arjun Choudhary [a] and Rohit Kumar Nayak [a]

[a] Department of Entomology, SKN College of Agriculture, Sri Karan Narendra Agriculture University, Jobner, 303329 Rajasthan, India.
[b] Agriculture University, Jodhpur, 342304 Rajasthan, India.
[c] College of Agricultural, Life and Physical Sciences, Southern Illinois University Carbondale, IL (62901), USA.
[d] College of Agriculture, CCS Haryana Agricultural University, Hisar (125004), India.
[e] College of Agriculture, Bikaner, 334006, Rajasthan, India.

Authors' contributions

This work was carried out in collaboration among all authors. Author AC designed the study, performed the statistical analysis, wrote the protocol, managed the literature searches, and wrote the first draft of the manuscript. Author SKK managed the analyses of the study. All authors read and approved the final manuscript.

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ABSTRACT

The present investigation was conducted at Agronomy Farm and Laboratory, Department of Biochemistry, S.K.N. College of Agriculture, Jobner (Rajasthan) during Rabi, 2019-20 and Rabi, 2020-21 to screen out the varieties of mustard for their resistance to mustard aphid, *Lipaphis*

**Corresponding author: E-mail: arvindmor555@gmail.com;*

erysimi. The overall pooled mean aphid population ranged from 42.99 to 80.55 per 10 cm terminal shoots of five plants on different varieties. The minimum aphid infestation (42.99 aphids/ 10 cm terminal shoot) was recorded on Varuna followed by Bio-902 (44.63 aphids/ 10 cm terminal shoot) and both were found statistically same in reaction to aphid incidence. The maximum infestation/ 10 cm terminal shoot was recorded on Kranti (80.55 aphids) followed by GM-2 (79.99 aphids), and RH-30 (79.46 aphids) which remained at par to harbour the aphid population. The variability of resistance in mustard varieties in the decreasing order was Varuna, Bio-902, NRCDR-2, Pusa Bold, Laxmi, NRCHB-101, Rohini, Durgamani, Vardan, RH-9304, GM-1, Maya, RH-30, GM-2 and Kranti. The statistical characterization of results revealed that out of fifteen mustard varieties, two varieties Varuna and Bio-902 were found less susceptible to the mustard aphid, *L. erysimi*. Nine varieties *viz.*, NRCDR-2, Laxmi, Pusa Bold, NRCHB-101, Rohini, Vardan, RH-9304, Durgamani and GM-1 were categorized as moderately susceptible, whereas, four varieties *viz.*, Maya, RH-30, GM-2 and Kranti were categorized as highly susceptible in both years of the study.

Keywords: Mustard; insect; pest; yield; variety; aphid; resistance.

1. INTRODUCTION

Brassica juncea (L.) Czern. and Coss., commonly referred to as Indian mustard, is one of the most significant rabi oilseed crops cultivated all throughout India. It holds an important place in the Indian economy. Brassica (rapeseed and mustard) makes for approximately 30% of India's total oilseed production and is the second-largest culinary oilseed commodity in the country after groundnut. Its green leaves are a good supply of green vegetables and fodder in addition to being a high source of protein, minerals, vitamin A, and vitamin C. Mustard seeds ranged in oil content from 35% to 45% [1]. Rajasthan, Gujarat, Madhya Pradesh, Uttar Pradesh, West Bengal, Haryana, and Punjab are the major mustard producing states of India. In 2019-20, the area, production and average productivity of rapeseed and mustard in India were 6.78 mha and 9.12 mt and 1345 kg ha^{-1} respectively [2]. In Rajasthan, the area, production and average productivity of rapeseed and mustard were 2.95 mha and 4.22 mt and 1431 kg ha^{-1} respectively [2]. It is predominantly cultivated in the Alwar, Bharatpur, Sri Ganganagar, Tonk, Sawai Madhopur, and Jaipur districts of Rajasthan [3].

Several biotic and abiotic factors have been considered as causes for the low productivity of mustard and rapeseed. Insect pests are major biotic constraints in achieving potential mustard production. More than 43 species of insect pests invaded the crop, among them major ones being the mustard aphid, *Lipaphis erysimi* (Kaltenbach), mustard sawfly, *Athalia lugens proxima* (Klug.), painted bug, *Bagrada hilaris* (Kirk.) and leaf miner, *Phytomyza horticola* (Gourealla) [4] causing the significant damage to the crop. The conventional means of insect management by insecticidal spray are an effective way to prevent insect pest damage to crops, but their injudicious and indiscriminate use causes many issues, including environmental pollution, increased production costs, food poisoning, and pest resurgence, which does not improve sustainable agricultural production. The worldwide research also supports adopting alternatives of insecticidal spray for IPM and recommends the use of bio-control agents, plant products and various bio-rational insecticides. But, owing to slow action and lesser efficacy at the field level, field application of these alternatives is less popular among farmers. Under such circumstances, the uses of resistant genotypes are the best approach to combat the pest problem. The resistant genotypes offered insect pest management at no additional economic or ecological cost. Resistant genotypes are nonpolluting, ecologically, biologically, socially acceptable and economically feasible. Worldwide, resistant sources have been emphasized for their ease of adoption, ease of use, economy, and safety, making them ideal tools for integrated pest management. A pest management strategy should be economically feasible, ecologically safer and socially acceptable. Therefore, the present research investigation has been undertaken with the aim of screening mustard varieties for resistance against major insect pests.

2. MATERIALS AND METHODS

The present study was conducted at Agronomy Farm and Laboratory, Department of Entomology, S.K.N. College of Agriculture, Jobner during two consecutive years, *i.e.,* Rabi, 2019-20 and Rabi, 2020-21. Geographically,

Jobner is located at 78º28' N and 26º26' E and has an elevation of 427 masl in the Jaipur district of Rajasthan. This region is classified under agro-climatic zone III a, *i.e.,* Semi-arid Eastern Plain Zone. The experiment was laid down in Randomized Block Design with 15 varieties [NRCDR-2, Kranti (PR-15), Laxmi, Pusa bold, Maya, Bio-902, Varuna, GM-1, GM-2, Rohini, NRCHB-101, Vardan, RH-30, Durgamani and RH-9304 (Vasundhara)] replicated thrice. The seeds of individual varieties were sown manually in the replicated plots of size 3.0 x 2.4 m^2 by hand-driven plough at the rate of 5kg/ ha by maintaining row and plant dimensions of 30 cm and 10 cm, respectively. For raising a good crop, all the recommended agronomical package of practices of this zone were followed except for plant protection measure and crop was allowed for natural aphid infestation. For the observations, five plants were randomly selected and tagged and the on the population of aphids was recorded soon after their initiation till they the crop harvests at weekly intervals. The number of aphids was counted using the magnifying lens from the terminal portion (10 cm) of the central plant shoot per plot. Data on the mean aphid population were square root transformed as per the method described by [5[and further analysis was done in MS-Excel.

3. RESULTS AND DISCUSSION

Since there was an abundance of aphids, *Lipaphis erysimi* Kalt. on mustard, this was considered to be the most serious insect pest. Aphid population was recorded at the weekly interval by observing 10 cm per shoot on five ear-marked plants per plot. It was worthwhile to mention that among the tested varieties, none of them was found completely free from aphid infestation.

The overall mean aphid population during Rabi, 2019-20 ranged from 43.7 to 79.6 per 10 cm terminal shoot of five plants on different varieties (Table 1 and Fig. 1). The minimum aphid infestation/ 10 cm terminal shoot (43.7 aphids) was recorded on Varuna followed by Bio-902 (45.0 aphids) and both showed statistically same effects in their degree of infestation. The maximum infestation/ 10 cm terminal shoot was recorded on Kranti (79.6 aphids) followed by GM-2 (79.2 aphids), RH-30 (78.9 aphids), and Maya (78.03 aphids) forming a non-significant group. The increasing order of aphid population was recorded on different varieties Varuna, Bio-902, NRCDR-2, Pusa Bold, Laxmi, NRCHB-101, Rohini, Durgamani, Vardan, RH-9304, GM-1, Maya, RH-30, GM-2, Kranti.

The mean aphid population during Rabi, 2020-21 ranged from 42.3 to 81.5 per 10 cm terminal shoot on different varieties (Table 1 and Fig. 1). The minimum aphid infestation (42.3 aphids/ 10 cm terminal shoot) was recorded on Varuna followed by Bio-902 (44.2 aphids/ 10 cm terminal shoot), showed statistically same effects in their degree of infestation. The maximum infestation was recorded on Kranti (81.5 aphids/ 10 cm terminal shoot) followed by GM-2 (80.8 aphids/ 10 cm terminal shoot), RH-30 (80.1 aphids/ 10 cm terminal shoot), Maya (79.2 aphids/ 10 cm terminal shoot) and was at par to harbour the aphid population. The order of different varieties possessing a higher population of aphids was found to be: Varuna, Bio-902, NRCDR-2, Pusa Bold, Laxmi, NRCHB-101, Rohini, Durgamani, Vardan, RH-9304, GM-1, Maya, RH-30, GM-2 and Kranti.

The mean aphid population of both the seasons (Rabi, 2019-20 and Rabi, 2020-21) ranged from 43.0 to 80.5 per 10 cm terminal shoots of five plants on different varieties (Table 1 and Fig. 1). The minimum aphid infestation (43.0 aphids/ 10 cm terminal shoot) was recorded on Varuna followed by Bio-902 (44.6 aphids/ 10 cm terminal shoot) and both showed statistically same effects in their reaction to aphid incidence. The maximum infestation/ 10 cm terminal shoot was recorded on Kranti (80.5 aphids) followed by GM-2 (80.0 aphids), and RH-30 (79.5 aphids) and remained at par to harbor the aphid population. The remaining varieties ranked in the middle order of aphid infestation. The variability of resistance in mustard varieties was in the order of Varuna, Bio-902, NRCDR-2, Pusa Bold, Laxmi, NRCHB-101, Rohini, Durgamani, Vardan, RH-9304, GM-1, Maya, RH-30, GM-2 and Kranti.

As all varieties were not found completely resistant against *L. erysimi*, so for the sake of convenience in interpreting the result the varieties were categorized on the basis of pooled mean population of aphid. The statistical categorization of varieties was done based on the formula $\bar{X} \pm \sigma$, where the mean, $\bar{X}$ = 63.07 and the standard deviation, σ = 12.15 were computed as given in Table 2. Taking into consideration the above categorization, the varieties Varuna and Bio-902 were categorized as less susceptible. The varieties NRCDR-2, Laxmi, Pusa Bold, NRCHB-101, Rohini, Vardan, RH-9304, Durgamani and GM-1 were

categorized as moderately susceptible while varieties Maya, RH-30, GM-2 and Kranti were highly susceptible (Table 2).

Results obtained in the present investigation were supported by [6] who reported that variety Varuna and Bio-902 were found as less susceptible to the mustard aphid, *L. erysimi*. Similarly, [7,8] also reported variety T-59 (Varuna) and Bio-902 as highly resistant against mustard aphid *L. erysimi*. The findings of [9,10] supported present findings about the resistance strain of variety Varuna against *L. erysimi*. The result of [11] found that the variety Varuna is highly susceptible to mustard aphids which do not support the present result of the investigation. The inconsistency is most likely due to differences in meteorological conditions, soil types, and insect population intensity in different areas. In the present findings, it was observed that the varieties Maya, RH-30, GM-2 and Kranti were categorized as highly susceptible to the mustard aphid, *L. erysimi*. These findings corroborate the findings of [12,9] who reported the variety Kranti as highly susceptible to *L. erysimi* on mustard. These findings also corroborate the findings of [8] who reported that the variety GM-2 was least resistant against *L. erysimi* on mustard. While [13] registered GM-2 as a highly resistant variety does not support the present findings. The varieties *viz.*, NRCDR-2, Laxmi, Pusa Bold, NRCHB-101, Rohini, Vardan, RH-9304, Durgamani and GM-1 were categorized as moderately susceptible against the mustard aphid, *L. erysimi*. These findings corroborate the findings of [14] who reported variety Pusa Bold and Rohini as moderately resistant against *L. erysimi* on mustard. [15] also reported that the varieties NRCHB-101, Rohini and Laxmi are moderately resistant against *L. erysimi* on the mustard crop.

Table 1. Screening of different varieties for their resistance to mustard aphid, *Lipaphis erysimi* (Kalt.)

Varieties	Mean aphid population (10 cm terminal shoot/ five plants)		
	Rabi, 2019-20	Rabi, 2020-21	Pooled (Rabi, 2019-20 and Rabi, 2020-21)
NRCDR-2	51.9 (7.23)*	53.1 (7.32)	52.5 (7.28)
Kranti	79.6 (8.95)	81.5 (9.05)	80.5 (9.00)
Laxmi	58.1 (7.65)	57.5 (7.61)	57.8 (7.63)
Pusa Bold	57.1 (7.59)	56.4 (7.55)	56.8 (7.57)
Maya	78.0 (8.86)	79.2 (8.93)	78.6 (8.90)
Bio-902	45.0 (6.75)	44.2 (6.68)	44.6 (6.72)
Varuna	43.7 (6.64)	42.3 (6.54)	43.0 (6.59)
GM-1	64.9 (8.09)	66.6 (8.19)	65.7 (8.14)
GM-2	79.2 (8.93)	80.8 (9.01)	80.0 (8.97)
Rohini	59.9 (7.77)	60.0 (7.78)	60.0 (7.78)
NRCHB-101	58.8 (7.70)	58.6 (7.69)	58.7 (7.69)
Vardan	62.5 (7.93)	63.2 (7.98)	62.8 (7.96)
RH-30	78.9 (8.91)	80.1 (8.98)	79.5 (8.94)
Durgamani	61.1 (7.85)	61.6 (7.88)	61.3 (7.86)
RH-9304	63.7	64.7	64.2

Varieties	Mean aphid population (10 cm terminal shoot/ five plants)		
	Rabi, 2019-20	Rabi, 2020-21	Pooled (Rabi, 2019-20 and Rabi, 2020-21)
	(8.01)	(8.07)	(8.04)
SEm+	0.09	0.10	0.06
CD (p=0.05)	0.25	0.28	0.18

**figures in parenthesis are √x+0.5 transformed values*

Table 2. Categorization of mustard varieties with respect to aphid susceptibility (Pooled of Rabi, 2019-20 and Rabi, 2020-21)

S. No.	Mean aphid population/ 10 cm terminal shoot 2019-20 & 2020-21 (Pooled)	Varieties	Category of varieties
1.	Below- 50.92	Varuna and Bio-902	Less susceptible
2.	50.92-75.22	NRCDR-2, Laxmi, Pusa Bold, NRCHB-101, Rohini, Vardan, RH-9304, Durgamani and GM-1	Moderate susceptible
3.	Above - 75.22	Maya, RH-30 ,GM-2 and Kranti	Highly susceptible

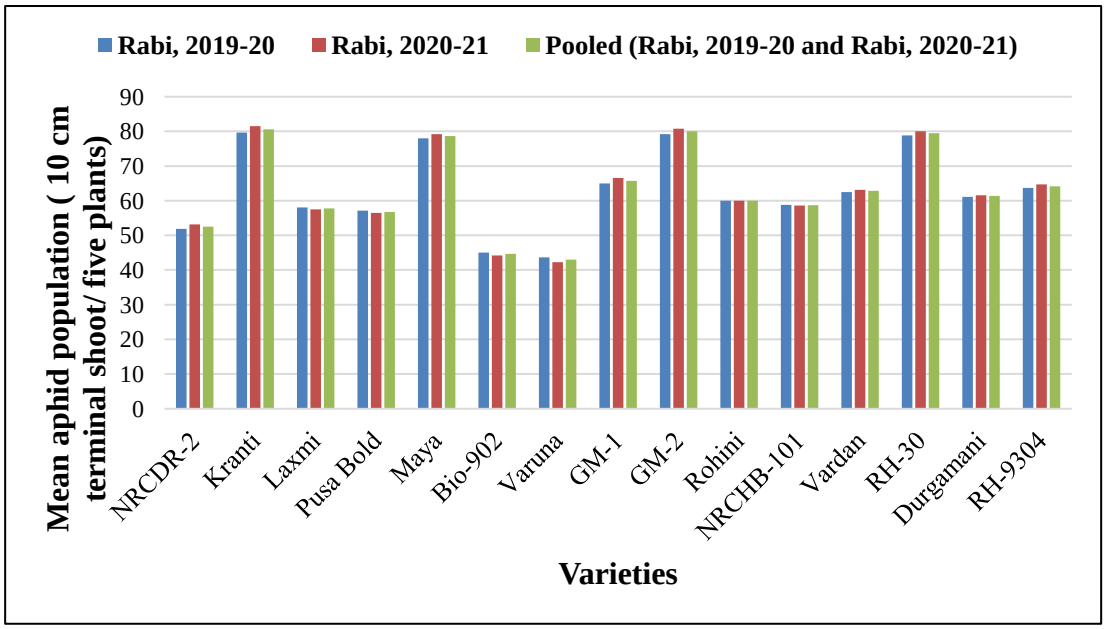

Fig. 1. Screening of different varieties for their resistance to mustard aphid, *Lipaphis erysimi* (Kalt.)

4. CONCLUSION

For the resistance to the mustard aphid, *L. erysimi*, fifteen varieties of mustard were tested. The results indicated that no variety was totally unaffected from aphid infestation. However, different varieties showed varying degrees of susceptibility to the aphid, *L. erysimi*. Based on the statistical categorization (X ± σ), the varieties Varuna and Bio-902 were categorized as less susceptible. NRCDR-2, Laxmi, Pusa Bold, NRCHB-101, Rohini, Vardan, RH-9304, Durgamani and GM-1 were categorized as moderately susceptible while the varieties Maya, RH-30, GM-2 and Kranti were categorized as highly susceptible.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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