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Population dynamics of mustard aphid, *Lipaphis erysimi* Kalt. And their correlation with abiotic factors in different varieties of Indian mustard, *Brassica juncea* L.

Rahul, RS Singh and Sachin Kumar

Abstract
The aphid population appeared in first week of January at the flowering stage, which peaked during 7th standard week (Feb., 12-18) 115.5-155.0, 98.01-121.0 and 75.5-108.6 aphids/plant on mustard variety Urvashi, Vardan, Varuna and Rohini, respectively, when meteorological conditions *viz*., maximum temperature was 23.8 ^{0}C and minimum temperature 8.8 ^{0}C with maximum relative humidity 85.0% and minimum 46.0% were prevailing during 2010-11 and 2011-12.

Keywords: Mustard aphid, (*Lipaphis erysimi*) aphid population

Introduction
Rapeseed-mustard *Brassica juncea* (L.) is an important oilseed crop, which is a valuable source of edible oil. Average productivity of rapeseed- mustard in India is only 1014 kg ha^{-1}, which is far below than 1883 kg ha^{-1} yield at global level. Mustard aphid (*Lipaphis erysimi* Kalt.) have been reported as a major constraint responsible for this low yield level, which causes average yield losses ranging 27.3- 94.5% in Indian mustard due to aphid in U.P. [Singh and Malik, (1998) [11], Singh *et al.*, (2000) [10] and Malik *et al.*, (2003) [5]]. The infestation of aphid in rapeseed-mustard causes losses in seed yield along with the oil content in seeds. However, numbers of chemicals have been recommended for the management of this pest by several workers, but their indiscriminate use for suppressing the pest population increases the environmental hazards. Use of insecticides for the management of insect- pests in different crops is an integral part of integrated pest management, which should be eco-friendly, economically viable and socially acceptable. A number of newer chemicals have been registered in different groups for their better efficacy against different insect-pests. Thus, it is imperative to find out a selective molecule for the cost effective management of mustard aphid. Therefore, efforts were made to determine the efficacy and economics of some newer insecticides for the management of mustard aphid on Indian mustard in central Uttar Pradesh.
Oilseed *Brassicas* also referred to as rapeseed-mustard, an important group of oilseed crops in the world, comprise eight cultivated crops of tribe Brassicaceae within the family cruciferae (Brassicaceae). Rapeseed-mustard is one of the important edible oilseeds spread in 53 countries over six continent in the world. The estimated area, production and productivity of rapeseed-mustard in the world was 36.37 million ha, 72.53 million tones, and 1994 kg ha^{-1}, respectively during the year 2012-13 (Status paper on oilseeds, 2014). Globally India accounts for 19.29 per cent in total acreage and 11.27 per cent in total production of rapeseed-mustard (USDA, 2013). It shows that productivity of rapeseed-mustard in India is much lower than the world's average. Here rapeseed-mustard crop is grown on 67.01 lakh ha area, 79.6 lakh tonnes production and 1188 kg ha^{-1} productivity next to soybean and groundnut during the year 2013-14 (Status paper on oilseeds, 2014). The most important state of rapeseed-mustard growing in India is Rajasthan. It ranks first with 30.79 lakh ha area, 38.28 lakh tonnes production and 1243 kg ha^{-1} of average productivity during the year 2013-14. Uttar Pradesh is the second largest state of growing mustard in the country. The area, production and productivity of mustard in Uttar Pradesh were 6.63 lakh ha, 7.7 lakh tonnes and 1161 kg ha^{-1}, respectively during the year 2013-14. The present study was done to observe the "Population dynamics of mustard aphid, *Lipaphis erysimi* Kalt. And their correlation with abiotic factors in different

varieties of Indian mustard, *Brassica juncea* L."

Materials and Methods

The field experiments were carried out during winter seasons of 2010-11 and 2011-12. The field experiment was conducted at Student's Instructional Farm**,** C.S. Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh. Experimental field was well levelled and had assured irrigation facilities. The experimental soil was sandy loam in texture and slightly alkaline in nature. The required seeds of all the mustard were obtained from oilseeds section of university during each year of experiment. All 4 treatment combinations (irrigation x genotypes) were tested in a split plot design with three replications. All treatments were allocated to different plots randomly in each replication.

To determine the population dynamics of aphid in relation to prevailing weather parameters, recorded at weekly intervals on 10 randomly selected plants on 10 cm top shoots of mustard varieties Varuna, Vardan, Rohini and Urvashi in three replication under field conditions. The meteorological data was obtained from the university observatory to correlate with pest population.

Meteorological observations:

The weather data on meteorological parameters *viz*., minimum and maximum Temperature (^{0}C), Relative humidity (%), Rain fall (mm), and Wind speed (km/h) of study period, collected from Department of Agronomy of the University, (Table: 4.1, 4.2 and Fig: 1 & 2)

Table 1: Effect of different varieties on Population dynamics of mustard aphid during 2010-11

Meteorological observations							Urvashi	Vardan	Varuna	Rohini
Standard Weeks	Temperature ^{0}C		Relative Humidity		Rainfall	Wind Speed (km/h)	Average number of aphid/10cm twig			
	Max. ^{0}C	Min. ^{0}C	Max. (%)	Min. (%)	Average (mm)					
1	12.9	5.4	95	71	0.0	4.8	2.50 (1.58)	2.34(1.53)	1.80(1.34)	1.51(1.23)
2	12.7	5.1	94	59	0.0	2.0	5.95 (2.44)	3.39(1.84)	3.57(1.89)	2.96(1.72)
3	21.9	7.1	83	35	0.0	4.6	13.76 (3.71)	7.24(2.69)	7.67(2.77)	7.13(2.67)
4	24.0	8.8	84	43	0.0	2.5	21.07 (4.59)	12.82(3.58)	22.66(4.76)	22.47(4.74)
5	23.6	8.9	88	44	0.0	3.0	31.02 (5.57)	22.47(4.74)	27.25(5.22)	28.20(5.31)
6	20.9	11.4	89	41	0.0	2.9	68.06 (8.25)	55.80(7.47)	44.09(6.64)	36.60(6.05)
7	24.5	12.9	88	54	6.2	4.0	115.0 (10.7)	98.01(9.90)	75.5(8.69)	55.80(7.47)
8	25.0	10.4	89	44	0.0	2.0	65.12 (8.07)	48.86(6.99)	34.34(5.86)	30.69(5.54)
9	26.9	13.5	83	49	1.8	2.2	19.98 (4.47)	17.22(4.15)	11.29(3.36)	9.00(3.00)
10	29.1	14.9	73	36	0.0	4.9	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)

NB: Figures in parentheses are square root transformed values $\sqrt{x} + 0.5$

Table 2: Effect of different varieties on Population dynamics of mustard aphid during 2011-12

Meteorological observations							Urvashi	Vardan	Varuna	Rohini
Standard Weeks	Temperature ^{0}C		Relative Humidity		Rainfall	Wind Speed (km/h)	Average number of aphid/10cm twig			
	Max. ^{0}C	Min. ^{0}C	Max. (%)	Min. (%)	Average (mm)					
1	19.1	11.1	98	82	4.5	1.8	5.81(2.41)	4.49(2.12)	3.65(1.91)	2.99(1.37)
2	18	7.3	89	75	0.0	2.1	12.60(3.55)	10.69(3.27)	9.06(3.01)	7.40(2.72)
3	19.3	7.5	91	59	0.0	4.1	18.49(4.30)	16.73(4.09)	13.19(3.73)	11.16(3.34)
4	21.9	5.8	91	56	0.0	3.7	26.63(5.16)	23.62(4.86)	23.33(4.83)	17.64(4.20)
5	22.4	5.6	90	53	0.0	1.9	69.39(8.33)	51.55(7.18)	36.48(6.04)	29.05(5.39)
6	21.3	8.3	87	51	7.2	3.3	86.39(9.32)	68.06(8.25)	58.98(7.68)	43.03(6.56)
7	23.8	8.8	85	46	0.0	2.3	155.0(12.45)	121.0(11.0)	108.16(10.4)	86.49(9.3)
8	28.4	11.5	88	45	0.0	4.9	73.96(8.60)	58.38(5.66)	47.75(6.19)	38.19(6.19)
9	27.4	10.3	78	47	1.8	6.4	23.72(4.87)	21.81(4.67)	13.84(3.72)	12.46(3.53)
10	28.4	11.5	73	34	0.0	3.9	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)

NB: Figures in parentheses are square root transformed values $\sqrt{x} + 0.5$

Experimental findings and Discussion

Population dynamics of *Lipaphis erysimi*

The data recorded on seasonal incidence of the aphid on 10 cm top shoot of the main shoot per plant collected at weekly intervals as per techniques, adopted by Mathur and Singh (1986b) [6], the impact of environmental factors on aphid population, infestation and incidence has been calibrated.

It is clear from the data on aphid incidence and weather parameters that aphid (*Lipahis erysimi* Kalt.) appeared was 2.50, 2.34, 1.80 and 1.51 aphid/10 cm terminal shoot/plant on Urvashi, Vardan, Varuna, and Rohini varieties respectively during 2010-11, 5.81, 4.49, 3.65 and 2.99 aphid/10 cm terminal shoot/plant on Urvashi, Vardan, Varuna, and Rohini varieties respectively in 2011-12 the first week of January when maximum temperature was below, 20 ^{0}C along with more than 90 per cent relative humidity (Table: 4.1 & Fig.3).

The aphid incidence recorded in 2010-11during 2nd standard week (January 8-14) was 5.95, 3.39, 3.57, and 2.96 aphids/plant of terminal top shoot/plant on Urvashi, Vardan, Varuna, and Rohini varieties, respectively with 17.07 ^{0}C maximum and 5.01 ^{0}C minimum temperature with 94.0 per cent relative humidity in the morning, while in 2011-12 during 2nd standard week was 12.60, 10.69, 9.06 and 7.40 aphids/10 cm terminal shoot/plant on Urvashi, Vardan, Varuna and Rohini varieties, respectively with 18.0 ^{0}C maximum and 7.3 ^{0}C minimum temperature with 89.0 per cent relative humidity (morning). Aphid incidence recorded in 2010-11 during 3rd standard week (January 15-21) was 13.76, 7.24, 7.67 and 7.13 aphids/plant on Urvashi, Vardan, Varuna, and Rohini varieties, respectively with 21.09 ^{0}C maximum

and 7.01 ^{0}C minimum temperature with 83.0 per cent relative humidity in the morning, while in 2011-12, (3rd standard week) it was 18.49, 16.73, 13.91 and 11.16 aphids/plant of terminal top shoot/plant on Urvashi, Vardan, Varuna and Rohini varieties, respectively with 19.3 ^{0}C maximum and 5.8 ^{0}C minimum temperature with 91.0 per cent relative humidity (morning).

The aphid incidence recorded in 2010-11 during 4th standard week (January 22-28) on Urvashi, Vardan, Varuna, and Rohini was 21.07, 12.82, 22.66 and 22.47 aphids/plant of terminal top shoot/plant with 24.06 ^{0}C maximum and 8.05 ^{0}C minimum temperature with 84.0 per cent relative humidity in the morning, while in 2011-12, (4th standard week) it was 26.63, 23.62, 23.33 and 17.64 aphids/10 cm terminal shoot/plant on Urvashi, Vardan, Varuna and Rohini varieties, respectively with 21.9 ^{0}C maximum and 5.8 ^{0}C minimum temperature with 91.0 per cent relative humidity (morning). Aphid population recorded in 2010-11 during 5th standard week (29Jan.-4Feb.) 31.02, 22.47, 27.25 and 28.20 aphids/10 cm terminal shoot/plant on Urvashi, Vardan, Varuna, and Rohini varieties, respectively with 23.06 ^{0}C maximum and 8.09 ^{0}C minimum temperature with 88.0 per cent relative humidity in the morning, while in 2011-12 (5th standard week) it was 35.05, 31.14, 28.62 and 21.62 aphids/plant of terminal top shoot/plant on Urvashi, Vardan, Varuna and Rohini varieties respectively with 22.4 ^{0}C maximum and 5.6 ^{0}C minimum temperature with 90.0 per cent relative humidity (morning), The aphid incidence recorded in first year 6th standard week (February 5–11) it was 68.06 aphids/10 cm terminal shoot/plant on Urvashi, 55.80 on Vardan, 44.09 on Varuna, and 36.60 aphids/plant Rohini with 20.9 ^{0}C maximum and 11.4 ^{0}C minimum temperature and 89.0 per cent relative humidity and aphid intensity in second year 6th standard week (February 5 - 11) it was 86.86 aphids/10 cm terminal shoot/plant on Urvashi, 68.06 on Vardan, 58.98 on Varuna, and 43.03 aphids/plant Rohini with 21.3 ^{0}C maximum and 8.3 ^{0}C minimum temperature and 87.0 per cent relative humidity during 2011-12 (Table: 4.2 & Fig. 4).

Aphid population reached its peak of 115.5, 98.01, 75.5 and 55.80 aphids/plant in the terminal top shoot/plant on Urvashi, Vardan, Varuna and Rohini varieties, respectively in the first year at 7th standard week (February 5-11) because of 88.0 per cent maximum relative humidity (morning) associated with 26.04 ^{0}C maximum and 11.03 ^{0}C minimum temperature in the year 2010-11, The peak aphid population recorded in 7th standard weeks (February 12-18) with 155.0, 121.0, 108.16 and 86.49 aphids/10 cm twig on Urvashi, Vardan, Varuna and Rohini i.e., respectively with 23.8 ^{0}C maximum and 8.8 ^{0}C minimum temperature and 85.0 per cent relative humidity in the year 2011-12 (Table: 4.2 & Fig. 4).

The aphid population recorded in first year 8th standard week (February 19-25) was 65.12 aphids/10 cm twig on Urvashi, 48.86 on Vardan, 34.34 on Varuna, and 30.69 aphids/plant on Rohini with 25.0 ^{0}C maximum and 10.4 ^{0}C minimum temperature and 89.0 per cent relative humidity and aphid incidence in second year 8th standard week (February19-25) was 73.96 aphids/10 cm terminal shoot/plant on Urvashi, 58.38 on Vardan, 47.75 on Varuna, and 38.19 aphids/10 cm twig on Rohini with 28.4 ^{0}C maximum and 11.5 ^{0}C minimum temperature and 88.0 per cent relative humidity in the year 2011-12. The aphid incidence recorded in fist year 9th standard week (February 26–4 March) was 19.98 aphids/plant on Urvashi, 17.22 on Vardan, 11.29 on Varuna, and 9.00 aphids/10 cm twig on Rohini with 26.9 ^{0}C maximum and 13.5 ^{0}C minimum temperature and 83.0 per cent relative humidity and aphid population in second year 9th standard week (February 26-4 March) was 23.72 aphids/plant on Urvashi, 21.81 on Vardan, 13.84 on Varuna, and 12.46 aphids/10 cm twig on Rohini with 27.4 ^{0}C maximum and 10.3 ^{0}C minimum temperature and 78.0 per cent relative humidity during 2011-12.

These results are in accordance with those of Srivastava *et al.* (1995) [12] who noticed the mustard aphid, *Lipaphis erysimi* (Kalt.) towards the end of December on flowering stage of mustard crop. The range of maximum temperature 15.8 to 24.7 ^{0}C, minimum temperature 10.2 to 16.0 ^{0}C and relative humidity 61 to 65% prevailing in February was found conducive for the rapid multiplication of aphid on Indian mustard, *brassica juncea* (L.) Czern & Coss. Rohilla *et al.* (1996) [9] studied the abundance of Aphidoidea on 5 rapeseed cultivars (*Brassica campestris* cv. brown sarson (BSH-1) and yellow sarson (YSPb-24, *B. juncea* RH-30, *B. napus* HNS-3 and *B. nigra*). *Lipaphis erysimi* appeared on *B. napus* in the 3rd week of January and in the 1st week of January on all other cultivars. Infestation reached its peak on *B. napus* in the last week of February and in the 2nd week on the other cultivars. Pest incidence increased with an average temperature of 13.7 ^{0}C and a relative humidity of 65%. It decreased with temperatures above 35 ^{0}C, <60% relative humidity, >10 mm/day of rain and host crop maturity. Singh and Malik (1998) [11] reported that population buildup of *L. erysimi* on (*B. juncea* cv. Varuna) started in the beginning of January and peaked in middle of February. No Aphid was found from the beginning of March. Increasing temperature was favorable for aphid multiplication, but increasing relative humidity and wind velocity had a negative effect on this pest. Biswas and Das (2000) [1] observed the first aphid infestation on mustard in the first week of January in 1997 and in the third week of January in 1998. The aphid population build-up was noticed during January-February, reaching the peak on the 8thFebruary in both 1997 (98.26 aphids/plant) and 1998 (76.22 aphids/plant). Panda *et al.* (2000) [7] reported that the aphid species infested the crop from the 52nd to the 14th standard week (SW) with its peak population 302.10 aphid/plant during 7th standard week on 70 day old crops. Minimum temperature between 7.1-15.1 ^{0}C, maximum temperature between 24.9-29 ^{0}C and mean relative humidity between 61-65.5% were found to be congenial for the proper development of aphid population. Kumar *et al. (*2000) [4] reported that the aphid appeared during the second half of January with an initial intensity of 2.80 aphids / plant on 53.33% of plants and 0.60 aphid index on 66 day-old crops in 1993-94. The respective values for the same week during 1994-95 were 1.33 aphids per plant on 40% of plants and 0.43 aphid indexes on 82-day-old crops. The aphid population rapidly decreased to zero in late February/early March.

Relationship of aphid dynamics with prevailing weather parameters

It is obvious from the data on mustard aphid population and weather parameters (Table: 3) that relationship of aphid intensity with prevailing weather parameters during session result that non-significant negative simple correlation was computed with minimum (r=-0.002), maximum temperature (r=-0.029), relative humidity with minimum (r=-0.006), maximum (r=0.335) and rainfall (r=-0.739**) on Urvashi variety. Aphid population observed on Vardan non-significant positive simple correlation with minimum (r=-0.035),

maximum temperature (r=-0.019), relative humidity with minimum (r=0.300), maximum (r=0.320) and rainfall (r=0.778**). Aphid intensity observed mustard Varuna had non-significant positive simple correlation which on was computed with minimum (r=0.009), maximum temperature (r=-0.028), relative humidity with minimum (r=0.010), maximum (r=0.319) and rainfall (r=0.739**) on mustard varieties. Aphid intensity observed mustard on Rohini had non-significant negative simple correlation which was computed with minimum (r=-0.071), maximum temperature (r=-0.026), relative humidity with minimum (r=-0.029), maximum(r=0.336) and rainfall (r=0.744**) on mustard varieties.

During second year (2011-12) it is obvious from the data on mustard aphid dynamics and weather parameters that relationship of aphid population with prevailing weather parameters during session resulted significant negative simple correlation which was computed with minimum (r=-0.420*), maximum temperature (r=-0.237), relative humidity with minimum (r=-0.091), maximum (r=0.306) and non-significant rainfall (r=0.342) on Uravashi variety. Aphid population observed on Vardan had significant negative simple correlation with minimum (r=-0.436*), maximum temperature (r=-0.231), relative humidity with minimum (r=-0.101), maximum (r=0.304) and non-significant rainfall (r=0.271) on mustard varieties. Aphid population observed on mustard Varuna significant positive simple correlation was computed with minimum (r=0451*), maximum temperature (r=-0.223), relative humidity with minimum (r=0.106), maximum(r=0.319) and rainfall (r=0.224). Aphid intensity observed on mustard Rohini had non-significant negative simple correlation which was computed with minimum (r=-0.407), maximum temperature (r=-0.194), relative humidity with minimum (r=-0.117), maximum (r=0.288) and rainfall (r=0.176) on these varieties (Table: 3).

The effect of environment on mustard aphid can be argued with those of Kumar *et al. (*2000) [4] who reported that increase in the aphid population were positively correlated with temperature and negatively correlated with relative humidity and wind velocity. Temperature between 11.42-25.14 ^{0}C, relative humidity at 84.10-57.57% and wind velocity below 3.0 km/h were conducive for the aphid on cv. Varuna. Reza *et al.* (2004) [8] reported that the aphid population was positively related with temperature, but relative humidity had shown slight response on its intensity and without any significant response of little rainfall. At the time of peak infestation, the maximum and minimum temperature was 27.37 and 14.62 ^{0}C, respectively. The maximum and minimum relative humidity was 95.28 and 62.28%, respectively. A rainfall of 7.40 and 13.10 mm in the 4th and 5th standard weeks, respectively, decreased down the aphid population from 274.33 to 186.33aphids/plant. None of the ecological parameters alone was responsible for rapid multiplication of the aphid. Jat *et al*. (2006) [3] reported that correlation coefficient workout between aphid population and morning and evening relative humidity showed a significant negative correlation (r =-0.485 and-0.464) respectively. Jandial *et al.* (2007) [2] studied the effect of temperature and relative humidity on population buildup of *L. erysimi* (Kalt.) on mustard during 2002-04, which indicated that mustard aphid incidence was higher when maximum and minimum temperature ranged between 20-27 ^{0}C and 5-10 ^{0}C, respectively, and relative humidity during morning and evening hours ranged from 72 to 90% and 53 to 61%, respectively. Positive and non-significant correlation existed between maximum temperature and aphid population during both the years, while negative and non-significant correlation observed with minimum temperature, morning and evening relative humidity.

Summary and conclusion

1. Population dynamics

a. The aphid population appeared in first week of January with its population level of 2.50-5.81, 2.34-4.49, 1.80-3.65 and 1.51-2.99 aphids/10 cm twig shoot/plant on Urvashi, Vardan, Varuna, and Rohini varieties of Indian mustard during first week of January in both year when the maximum temperature was 12.9-19.1 ^{0}C and minimum temperature 5.4-11.1 ^{0}C with relative humidity maximum 95-98% and minimum 71-82% during 2010-11 and 2011-12, respectively.

b. The aphid population increased and reached at its peak 115.5-155.0 aphids/10 cm twig shoot/plant on Urvashi, 98.01-121.0 on Vardan, 75.5-108.16 on Varuna, and 55.80-86.49 aphids/10 cm twig shoot/plant on Rohini varieties of Indian mustard during 7th standard week (Feb.12-18) in second week of February in both years when the maximum temperature ranged between 24.5 to 23.8 ^{0}C and minimum temperature ranged between 12.9 to 8.8 ^{0}C with relative humidity maximum ranged between 88 to 85% and minimum ranging from 54 to 46% during 2010-11 and 2011-12, respectively.

c. The population of the aphid was wiped out from mustard crop in the last week of February and first week of March during 2010-11 and 2011-12, respectively, when the aphid prevailed up to the age of 120 days in all the varieties. This stage, temperature ranged between 28.4 to 29.1 ^{0}C (maximum) and 11.5-14.9 ^{0}C (minimum) along with relative humidity maximum 73.0-71.0 per cent and minimum 34.0-36.0 per cent during the preceding week which was in conducive for its multiplication and responsible for its migration from the mustard crop, respectively.

d. Simple correlation coefficient of aphid was calculated. The maximum temperature was negatively correlated with aphid incidence (r= -0.029 – -0.237). It means when temperature increased the population of aphid decreased. The minimum temperature (r= 0.071 – 0.451) was positively correlated with aphid incidence, means when temperature increased the population of aphid also increased while minimum (r= 0.106 – 0.300%), and maximum (r= 0.319 – 0.336%) relative humidity has positive relation with the aphid population and rainfall (r= 0342 – 0.778) on mustard varieties during 2010-11 and 2011-12, respectively.

2. Effect of different varieties on the incidence of mustard aphid, *L. erysimi.*

a. Significantly lowest aphid population on Rohini ranged between 55.8 to 86.4 aphids/10 cm twig shoot/plant was noticed from November sown crop during 2010-11 and 2011-12, respectively, which provided significantly highest seed yield of 18.39 and 16.83 q/ha in during 2010-11 and 2011-12, respective years.

b. Significantly minimum aphid population on Vardan (98.0–121.0), Varuna (75.5-108.1) aphids/10 cm twig shoot/plant during both the years proved to be the least combination as it received significantly minimum aphid

population. This provided seed yield of 14.05-13.61 and 16.19-14.67 q/ha, during 2010-11 and 2011-12, respectively.

c. Variety on Urvashi (115.5-155.0 aphids/10 cm twig shoot/plant during both the years proved to be the best combination as it received significantly highest aphid population. This provided significantly decreased seed yield of 13.00 and 12.30 q/ha seed yield, respectively.
d. None of the varieties found immune to the mustard aphid. The Rohini was found moderately resistant followed by Varuna. Urvashi mustard variety was found most susceptible to aphid, *Lipahis erysimi* and Vardan was also susceptible.

Conclusion

The present investigation, efforts have been made to develop techniques of management of mustard aphid in mustard crop by using resistant varieties and application of nutrients. The following conclusions have been drawn from the above study. Out of four important varieties of mustard *viz*., Urvashi, Vardan, Varuna and Rohini tested, Rohini was found moderately resistant while Urvashi was found most susceptible variety to mustard aphid.

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