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Screening the promising genotypes against mustard aphid (*Lipaphis erysimi* Kalt.) under field conditions

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Abstract

Forty three mustard genotypes/varieties were tested against the mustard aphid *Lipaphis erysimi* (Kalt.) under natural field condition at the College of Agriculture and Research Station, Raigarh during *Rabi* season of the years 2013-14 and 2014-15. The result showed that the 6 moderately susceptible and 37 susceptible genotypes /varieties had aphid infestation. Generally, aphid infestation showed trend from flowering stage, reached the peak at pod formation stage, and then trend to the decline in all the genotypes/varieties.

Keywords: Promising genotypes against mustard aphid, *Lipaphis erysimi* Kalt., field

Introduction

Rapeseed-mustard is the third important oilseed crop in the world after soybean (*Glycine max*) and palm (*Elaeis guineensis* Jacq.) oil. Among the seven edible oilseed cultivated in India, rapeseed-mustard (*Brassica spp.*) contributes 28.6% in the total production of oilseeds. In India, it is the second most important edible oilseed after groundnut sharing 27.8%, in the India's oilseed economy. The share of oilseeds is 14.1% out of the total cropped area in India, rapeseed-mustard accounts for 3% of it.

Mustard seed is grown with a different consumption pattern in the country. Indian mustard is mainly used for extraction of mustard oil while black mustard is mainly used as a spice. White mustard is used as fodder crop or as green manure. Though the varieties grown under the *Brassica* family are varied from country to country, the trend in international future prices in canola and rape seed has an impact on domestic mustard seed as India is a major edible oil importing country.

Mustard - Rapeseed group of crops is among the oldest cultivated plants in human civilization. Biologically, the rapeseed and mustard plants belongs to the family Cruciferae and under the genus *Brassica* with large number of species and sub species cultivated in India. The rapeseed-mustard group broadly includes Indian mustard, yellow sarson, brown sarson, raya, and toria crops. Indian mustard *Brassica juncea* (L.) is predominantly cultivated in Rajasthan, UP, Haryana, Madhya Pradesh and Gujarat. It is also grown under some non-traditional areas of South India including Karnataka, Tamil Nadu, and Andhra Pradesh. The crop can be grown well under both irrigated and rainfed conditions.

The natural appearance of mustard aphid on variety and germplasm of mustard was observed on January (50 days after sowing) and disappeared after mid-February (92 days after sowing). The peak aphid population was found at a minimum, maximum and average temperature of 13.57 °C, 25.86 °C and 19.72 °C, respectively and a mean relative humidity of 88.86% on 24th January at 71 DAS. (Rashid *et al.*, 2009) ^[10]

Materials and Methods

The field experiment was conducted under the Chhattisgarh plains agro-climatic zone of Chhattisgarh. The site was located at College of Agriculture and Research Station, Raigarh during *Rabi* season of the years 2013-14 and 2014-15. The experiment conducted was paddy crop field and the set of genotypes/varieties were sown after harvesting of the paddy crop. The experiment was laid out in Randomized Block Design (RBD) with three replications; plot size 3 x 1 m with 30 x 8 cm spacing and 43 genotypes are tested. All the agronomical practices were followed except use of any insecticides.

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Table 1: List of mustard genotypes/varieties screened against mustard aphid

S. No.	Genotype (Mustard)	S. No.	Genotype (Mustard)
1	RGN 308	23	NRCHB 101
2	PRL-2009-3	24	NPJ-161
3	NPJ-170	25	NPJ-181
4	DRMRIJ 11-04	26	RGN-347
5	KMR(L) 12-1	27	Pusa Mustard-25
6	Kranti	28	RH 1003
7	RGN 323	29	PBR 418
8	PRL-2010-10	30	DRMR 675-39
9	NPJ-171	31	DRMRIJ 118
10	RH 0948	32	RB-74
11	RMWR-09-4	33	DRMR 1153-12
12	DRMR 10-40	34	C.G. Sarson-1
13	RMWR-09-7	35	NPJ-182
14	RH 0952	36	RH 1006
15	BAUM-09-46-5	37	Divya-55
16	PBR 388	38	RRN-772
17	Pusa Bold	39	RB-71
18	RRN-789	40	RGN-348
19	KMR (L) 12-2	41	BAUM-09-13-1
20	RRN-813	42	DRMR-1165-13
21	RH-932	43	RRN -778
22	RMWR 09-5		

The aphid (*L. erysimi*) population was recorded ten plants from each genotype were selected randomly and observations of aphid population were recorded at two stages *i.e.* flowering stage and at podding stage and then the mean aphid population per plant was worked out. The aphid count was done on 10 cm length of central twig.

Categorization of mustard genotypes on the basis of aphid population

Observations on the aphid population were recorded at weekly interval for the resistant against mustard aphid in different genotypes of mustard on 10 randomly selected plants. Based upon these observations relative performance of different genotypes against aphid will be worked out using the grading given by Sachan (2008) [11].

S. No.	Grade	Number of Aphid per plant
1	Resistant	: 0-50
2	Moderately resistant	: 51-100
3	Moderately susceptible	: 101-150
4	Susceptible	: 151-200
5	Highly susceptible	: >200

Categorization of mustard genotypes on the basis of aphid infestation index

Aphid infestation index (AII)

0. Plant free from aphid infestation
1. Only few aphids with very little injury
2. Small colonies on few twigs, no curling or yellowing of leaves
3. Aphid colonies on almost all the twigs, stunted growth, curling and yellowing of leaves
4. Heavy population of aphids on inflorescence, leaves, stem and siliqua.
5. Very heavy population of aphids on inflorescence, leaves, stem and siliqua.

The average aphid index was worked out by using following equation (Khedkar *et al.* 2011) [8]:

$$\text{Average aphid index} = \frac{0N + 1N + 2N + 3N + 4N + 5N}{\text{Total number of plants observed}}$$

Where, 0, 1, 2, 3, 4, 5 were the aphid index, N= Number of plants showing respective aphid index

To work out the aphid infestation index, the number of plants falling under each grade was multiplied by the respective grade number. The cumulative total was then divided by the number of plants observed. For estimating aphid infestation index, infestation index from 10 plants was recorded separately at two different crop growth stages *viz.*, flowering and podding. The mean aphid infestation index (MAII) was thus calculated has been transformed into the following three different categories:

Moderately resistant: All the plants of a variety score grade 0 to 1.

Moderately susceptible: All the plants of a variety score grade >1 to < 2.

Susceptible: All the plants of a variety score grade > 2.

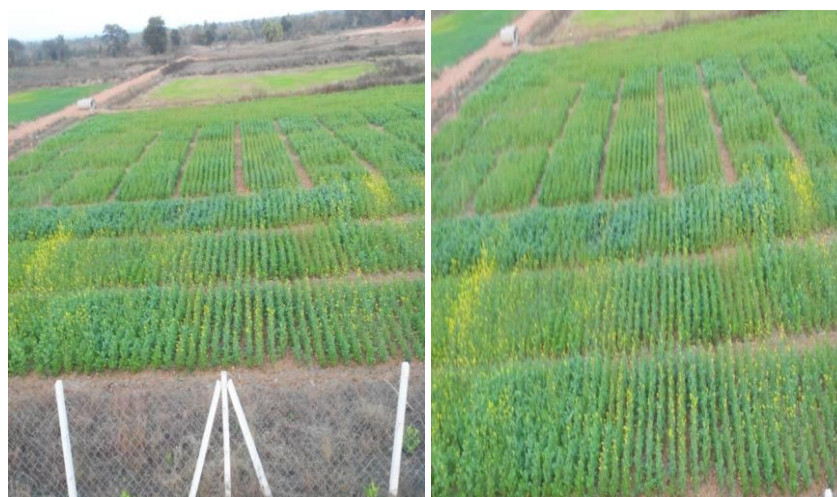


Fig 1: View of Experimental field for Screening of genotypes

Result and Discussion

The result of screening of 43 mustard genotypes against aphid incidence at flowering and siliqua stage of crop during both the years 2013-14 and 2014-15 were conducted. The overall mean population of aphid was also considered for comparative studies of different mustard genotypes.

1. Aphid population at flowering and podding stage during the year 2013-14

The data on aphid population at flowering and podding stage in mustard are presented in (table-2) during the year 2013-14. The results revealed that during this period the aphid population was ranged from 80.47 to 180.97 aphids per plant. The least infestation of aphid per plant at flowering stage was recorded in RH-932 (80.47) followed by NPJ-170 (81.20), RH-1006 (84.93), DRMRIJ-11-04 (90.77), RMWR-09-7(96.10) and RMWR-09-7 (96.83), whereas higher infestation of aphid per plant was recorded on RGN-348 (180.97), followed by RB-74 (167.97), NPJ-182 (161.20), DRMR-675-39 (151.70), respectively.

At siliqua stage aphid population in different genotypes was ranged from 103.23 to 269.50 per plant. The minimum aphid population per plant (103.23) was noted in NPJ-170, followed by RH-932 (121.47) NPJ-171 (123.77) and DRMR- 1165-13 (128.30plant⁻¹). Whereas, the maximum aphid population was recorded in genotype RGN-348 (269.50), followed by RRN-789 (246.20) and DRMR 675-39 (240.93).

The data presented in table-2 the average population of aphid at flowering and siliqua stage were ranged from 92.22 to 225.24 per plant during the year 2013-14. The lowest aphid population per plant was recorded NPJ-170 (92.22) followed by RH-932 (100.97), NPJ-171 (109.94) and DRMRIJ 11-04 (116.50) aphid per plant. The maximum aphid population was recorded in RGN-348 (225.24) followed by RB-74 (198.35), DRMR 675-39 (196.32), NPJ -182 (187.50), RRN-789 (187.15) and RRN -772 (186.80), respectively.

2. Aphid population at flowering and podding stage during 2014-15

The data presented in table-2 on aphid population at flowering and podding stage, the infestation level was recorded and ranged from 93.27 to 231.83 per plant in different genotypes of mustard during the year 2014-15.

The lowest incidence of the pest was noted in NPJ-170 having 93.27 aphids per plant and the next lowest aphid

population was recorded in NPJ-171 (105.93), KMR(L)12-1 (106.60) and RH-932 (106.60) per plant. The highest population of the aphids per plant (231.83) was recorded in Divya-55, followed by RGN-348 (216.87) and RH- 932 (201.60), respectively.

Genotypes of mustard at the siliqua stage were found to be infested intensively attack earlier. The minimum aphid population was evident in NPJ-170 (122.83 aphid per plant) followed by RH-932 (148.70), DRMRJ-11-04 (155.70) and Pusa mustard-25 (163.50), respectively. The maximum infestation of the pest was found on the variety RGN-789 (272.43/plant), followed by RGN-348 (271.40), DRMR-1153-12 (255.73) and RRN-772 (254.67) aphids per plant, respectively.

At both stages (flowering and siliqua) the mean aphid population ranged from 108.05 to 244.14 per plant. The minimum aphid population per plant was recorded in NPJ-170 (108.05) followed by RH-932 (127.65) and DRMRIJ-11-04 (134.14 /plant).

The maximum aphid population was recorded in RGN-348 (244.14/ plant), followed by Divya-55 (231.20), DRMR 675-39 (223.24), RB-74 (220.07) and RRN-789 (213.82/ plant), respectively.

Overall pooled mean for aphid population were observed on flowering and siliqua stage in both the years and subjected to process work out, the overall Performance of the genotypes on the basis of their mean are presented in table -2.

The perusal of the table showed that the least aphid population was noticed 100.14 per plant in genotype NPJ -170, followed by RH-932 (114.31), DRMRIJ-11-04 (125.32) and NPJ-171 (125.96). The highest incidence of aphids per plant was recorded in RGN-348 (234.69), followed by DRMR 675-39 (209.78), RB-74 (209.21) and Divya-55 (201.18), respectively

The present findings are in conformity with Shah *et al.*, (2015) ^[12], Ali and Rizvi (2011) ^[2], Khedhar *et al.*, (2011) ^[8], Mamun *et al.*, (2010) ^[9], Farooq and Tasawar (2007) ^[6] as they reported similar results with other set of mustard varieties. Ahmad *et al.*, (2013) ^[11] also reported that none of the genotype was found completely free from aphids attack. Vanguard with minimum (12.84) aphids per plant was the most tolerant followed by Crusher, Altex, Westar, Peela Raya, T-16-401, Torch, Rainbow, Raya Anmol, Oscar, Ganyou-5 while legend as most susceptible, in the order. Peela Raya had moderately high density of aphids per plant.

Table 2: Screening of different genotypes of mustard against aphid population at flowering and podding stages

S.N	Varieties	2013-14			2014-15			Pooled mean
		Aphids population /plant			Aphids population /plant			
		Flowering stage	Siliqua stage	Mean	Flowering stage	Siliqua stage	Mean	
1	RGN-308	128.91	169.27	149.09	130.73	194.37	162.55	155.82
2	PRL-2009-3	124.40	159.10	141.75	129.47	192.23	160.85	151.30
3	NPJ-170	81.20	103.23	92.22	93.27	122.83	108.05	100.14
4	DRMRIJ-11-04	90.77	142.23	116.50	112.57	155.70	134.14	125.32
5	KMR(L) 12-1	97.10	188.27	142.69	125.93	199.10	162.52	152.61
6	Kranti	116.47	186.43	151.45	135.43	197.07	166.25	158.85
7	RGN 323	127.03	172.27	149.65	126.03	186.80	156.42	153.04
8	PRL-2010-10	128.47	235.20	181.84	137.27	249.63	193.45	187.65
9	NPJ-171	96.10	123.77	109.94	105.93	178.03	141.98	125.96
10	RH-0948	113.07	182.23	147.65	130.77	183.10	156.94	152.30
11	RMWR-09-4	127.37	205.13	166.25	138.43	213.63	176.03	171.14
12	DRMR 10-40	127.53	216.77	172.15	135.10	223.03	179.07	175.61
13	RMWR-09-7	104.77	190.83	147.80	113.97	215.13	164.55	156.18
14	RH 0952	147.57	201.53	174.55	131.20	239.87	185.54	180.05

15	BAUM-09-46-5	127.03	230.33	178.68	135.57	235.87	185.72	182.20
16	PBR -388	98.73	174.43	138.58	113.63	217.93	165.78	152.18
17	Pusa Bold	128.27	194.97	161.62	135.00	211.80	173.40	167.51
18	RRN-789	128.10	246.20	187.15	155.20	272.43	213.82	200.49
19	KMR(L) 12-2	131.77	193.53	162.65	151.07	206.33	178.70	170.68
20	RRN -813	128.33	181.80	155.07	166.80	199.83	183.32	169.20
21	RH-932	80.47	121.47	100.97	106.60	148.70	127.65	114.31
22	RMWR- 09-5	106.53	182.13	144.33	146.60	195.07	170.84	157.59

S.N	Varieties	2013-14			2014-15			Pooled mean
		Aphids population /plant			Aphids population /plant			
		Flowering stage	Siliqua stage	Mean	Flowering stage	Siliqua stage	Mean	
23	NRCHB- 101	128.50	146.30	137.40	159.77	180.03	169.90	153.65
24	NPJ-161	125.33	229.60	177.47	150.37	224.10	187.24	182.36
25	NPJ -181	112.30	220.30	166.3	153.63	232.73	193.18	179.74
26	RGN -347	144.13	188.60	166.37	174.20	196.43	185.32	175.85
27	Pusa Mustard-25	108.84	176.12	142.48	158.97	166.19	162.58	152.53
28	RH- 1003	117.10	195.70	156.40	192.23	234.93	213.58	184.99
29	PBR- 418	106.43	190.50	148.47	132.63	209.97	171.30	159.89
30	DRMR 675-39	151.70	240.93	196.32	201.60	244.87	223.24	209.78
31	DRMRIJ- 118	126.30	192.87	159.59	152.73	209.57	181.15	170.37
32	RB-74	167.97	228.73	198.35	195.03	245.10	220.07	209.21
33	DRMR -1153-12	113.20	232.43	172.82	163.10	255.73	209.42	191.12
34	CG Sarson-1	111.97	159.63	135.80	167.99	178.37	173.18	154.49
35	NPJ -182	161.20	213.80	187.50	178.30	223.10	200.70	194.10
36	RH-1006	84.93	147.50	116.22	149.90	166.37	158.14	137.18
37	Divya-55	136.87	205.43	171.15	231.83	230.57	231.20	201.18
38	RRN-772	145.60	228.00	186.80	165.73	254.67	210.20	198.50
39	RB-71	119.87	176.13	148.00	137.13	177.17	157.15	152.58
40	RGN-348	180.97	269.50	225.24	216.87	271.40	244.14	234.69
41	BAUM -09-13-1	134.33	195.20	164.77	146.73	202.53	174.63	169.70
42	DRMR-1165-13	96.83	128.30	112.57	115.83	197.93	156.88	134.73
43	RRN-778	142.63	211.97	177.3	174.80	220.20	197.50	187.40

Categorization of mustard genotypes on the basis of aphid population and mean aphid infestation index (MAII)

Average aphid infestations in different mustard genotypes for two years are presented in table- 3 and 4.

The results of aphid population and mean aphid infestation index (MAII) of 43 genotypes of mustard were calculated. Out of them 06 genotypes were found to be moderately susceptible and rest other 37 genotypes categorized as susceptible (Table-3 and 4) and on the basis of aphid

population and mean aphid infestation index. Six genotypes were found to be moderately susceptible the NPJ-171(100.14/plant) (1.88), RH-932 (114.31/plant) (1.73), DRMR-1165-13 (1.90), DRMRIJ-11-04 (1.95), RH-1006 (1.95) and NPJ-170 (1.98) and rest other thirty seven genotypes were categorized as susceptible. The mean aphid infestation index was found in genotypes KMR (L)-12-1(2.00) to RGN-348 (2.50).

Table 3: Categorization of different mustard genotypes on the basis of mean aphid infestation index (MAII)

Score Grade	Category	Genotype
0 - 1	Moderately resistant	Nil
>1 - <2	Moderately Susceptible (6)	RH-932 (1.73), DRMRIJ- 11-04 (1.80), NPJ-171 (1.83), NPJ-170 (1.88), DRMR-1165-13 (1.90), RH-1006 (1.95)
>2	Susceptible (37)	KMR(L) 12-1 (2.00), DRMR -1153-12 (2.00), RGN-308 (2.08), DRMRIJ -118 (2.05), PRL-2009-3, RH-0948, RMWR- 09-5, RGN -347, Pusa Bold, RRN-789, RRN -813, RMWR-09-4, RMWR-09-7, RH 0952, BAUM-09-46-5, NPJ -182, NRCHB- 101, Divya-55, RB-71, BAUM -09-13-1, DRMR 10-40, KMR(L) 12-2, PBR- 418, Kranti, CG Sarson-1, RGN 323, Pusa Mustard-25, RH -1003, RB-74, RRN-772, PRL-2010-10, DRMR 675-39, NPJ-161, PBR 388 (2.43), NPJ -181 (2.43), RRN-778 (2.43), RGN-348 (2.50)

The result of present investigations are in agreement with Dubey (1994) ^[5] who reported that out of 36 varieties of *Brassica juncea*, none of the variety was least susceptible for aphid, 11th as moderately susceptible while 25th varieties as susceptible. Takar *et al.*, (2003) ^[13] also reported the varieties DLM-75, M-21, AG-5, DLRA-343 and Pusa Lord were highly resistant whereas, Kranti, Pusa Bold, Rohini, VSL-5, BIO-772, DLM-58, Brani, RH-8113, Pusa Basant, DLM-80

and DLM-68 as moderately. T-59 (Varuna), BIO-902, PCR-7 (Rajat) and DLM-29 found least resistant. Significantly lower aphid infestation and higher seed yield was recorded from the variety Varuna as against the Pusa bold, the highest aphid infestation. Higher aphid infestation recorded in Pusa Bold and proved to be highly susceptible Dhande *et al.*, (2005) ^[4]. Also supported by Jat *et al.*, (2007) ^[7] the minimum aphid, *L. erysimi* population observed in variety Varuna (T-59) while, it

was maximum on RZM followed by JM-1, GM-2, RH-30, PCR-7 and BIO-902. Thus, results on other set of mustard varieties emerged out from the present studies were more or less in conformity with the earlier report.

The similar result was also reported by Khedkar *et al.*, (2011) [8] in which the lowest (1.18) aphid index was recorded in variety GM-2 and it was at par with GM-1 and Gm-3 (1.26 and 1.34). The highest (2.61) aphid index was recorded in genotypes BIO-902, followed by variety Pusa Bold (2.052), Krishna (2.46), Varuna (2.29) and PCR-7(2.25). The varieties GM-2, Gm-1 and GM-3 found highly resistant to mustard aphid, whereas Vardan and Pusa Jaylaxmi were resistant. Pusa Jagnath and RH-30 was found susceptible. Vaibhav,

Pusa Jaykissan, Pusa Agrani, Pusa Bahar, Varuna, PCR-7, PM-67, Krishna, Pusa Bold and genotype BIO-902 proved to highly susceptible.

Chaudhary and Patel (2016) [3] reported that the screening of 60 lines of Indian mustard (*Brassica juncea* L.) for their resistance to the mustard aphid, *Lipaphis erysimi* (Kaltenbach) was carried out at Anand on basis of aphid infestation index (A.I.I.). Varieties NRCM 120, NRCM 353 and Rayad 9602 showed lowest aphid index and proved to be highly resistant (HR). Variety Vardan also showed lower aphid index and grouped into resistant (R), whereas varieties GM-2, HYOLA-401, GM-3 and GM-1 were categorized as susceptible and highly susceptible.

Table 4: Aphid population and mean aphid infestation index (MAII) of different mustard genotypes (Pooled value)

Entry S No.	Genotype	Mean Aphid Population plant ⁻¹ (Pooled Mean)	MAII	Category of genotype
1	RGN-308	155.82	2.08	S
2	PRL-2009-3	151.30	2.08	S
3	NPJ-170	100.14	1.88	MS
4	DRMRIJ -11-04	125.32	1.80	MS
5	KMR(L) 12-1	152.61	2.00	S
6	Kranti	158.85	2.20	S
7	RGN- 323	153.04	2.28	S
8	PRL-2010-10	187.65	2.35	S
9	NPJ-171	125.96	1.83	MS
10	RH-0948	152.30	2.08	S
11	RMWR-09-4	171.14	2.18	S
12	DRMR -10-40	175.61	2.25	S
13	RMWR-09-7	156.18	2.18	S
14	RH- 0952	180.05	2.18	S
15	BAUM-09-46-5	182.20	2.18	S
16	PBR- 388	152.18	2.43	S
17	Pusa Bold	167.51	2.13	S
18	RRN-789	200.49	2.13	S
19	KMR(L) 12-2	170.68	2.25	S
20	RRN -813	169.20	2.15	S
21	RH-932	114.31	1.73	MS
22	RMWR 09-5	157.59	2.08	S
23	NRCHB -101	153.65	2.23	S
24	NPJ-161	182.36	2.40	S
25	NPJ -181	179.74	2.43	S
26	RGN -347	175.85	2.08	S

Entry S. No.	Genotype	Mean Aphid Population plant ⁻¹ (Pooled Mean)	MAII	Category of genotype
27	Pusa Mustard-25	152.53	2.28	S
28	RH- 1003	184.99	2.28	S
28	RH- 1003	184.99	2.28	S
29	PBR 418	159.89	2.25	S
30	DRMR 675-39	209.78	2.35	S
31	DRMRIJ -118	170.37	2.05	S
32	RB-74	209.21	2.33	S
33	DRMR 1153-12	191.12	2.00	S
34	CG Sarson-1	154.49	2.25	S
35	NPJ -182	194.10	2.18	S
36	RH-1006	137.18	1.95	MS
37	Divya-55	201.18	2.23	S
38	RRN-772	198.50	2.33	S
39	RB-71	152.58	2.23	S
40	RGN-348	234.69	2.50	S
41	BAUM -09-13-1	169.70	2.23	S
42	DRMR-1165-13	134.73	1.90	MS
43	RRN-778	187.40	2.43	S

MS = Moderately susceptible, S = Susceptible

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