SELECTION FOR APHID TOLERANCE IN INDIAN MUSTARD

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INTRODUCTION

In India despite the availability of high yielding varieties and production technologies, the average productivity is as low as 700 Kg/ha as compared to those of the Netherlands (3500 Kg/ha.), Germany (3073 Kg/ha) and France (2824 Kg/ha.). This low productivity in India is attributable to the low input conditions under which these crops are normally grown and the high degree of vulnerability to major pests and diseases. Among the biotic stresses, infestation by aphid occupies the enviable position in damaging the crop. This pest causes damage to the tune of 8.6-91.3 per cent (Vir and Henzy, 1987 and Nath and Saha, 1974). Although the chemical control of this pest is possible, looking at the cost of insecticides and their residual effects, it is likely to cause, it is beneficial to breed highly tolerant and resistant varieties. The sources of resistance to aphid are not so far available. Therefore, the present investigation is an effort to evaluate some elite lines and germplasm collections for tolerance/resistance to mustard aphid (Lipaphis erysimi).

MATERIALS AND METHODS

The material for the present study comprised of 208 advance generation bulks of Dira-313 and Dira-326. These, alongwith the checks Pusa Bold, Varuna and Pusa Barani were evaluated at the Regional Station of the Indian Agricultural Research Institute (IARI), at Wellington, Nilgiri Hills situated in South India. Infestation was observed in terms of grade ranging from 0 to 5. During 1988-89 rabi (winter) tolerant single plant selections from the above progeny rows along with the checks were planted at IARI, New Delhi under late-sown conditions i.e. 3rd week of November which is about one and a half months later than the normal sowing (Normal planting is done between 7th to 15th October). The aphid infestation was very heavy and no control measures were taken to protect the crop. This facilitated proper screening. The grouping based on visual scores was done separately and seed yield of each group recorded (Table-1).

During 1989-90, some of the single plant selections were graded again and the yields of such plants along with checks, were taken (Table-2). In another experiment conducted in 1989-90, 85 lines, including those of Dira-313 and Dira-326 were subjected to rigorous screening under heavy natural infestation in the field. This included different aphid infestation indices like mean aphid infestation index (MAII), fecundity of aphid (F.A.), aphid infestation progress (AIP) and yield loss, using protected and unprotected plot of each line. Mean aphid infestation index on leaf (MAII) was calculated on the basis of aphid population on the 5th leaf

from base upwards in five plants per plot. Based on population of aphids present on each leaf, plants were designated as having low or high aphid infestation according to the classification of Pathak (1961). In the present study, three observations were taken on the sampled leaves of each of the five random plants per plot on weekly intervals. The average grades of all the plants for each plot were worked out. Finally, three mean aphid infestation indices (MAII) were calculated for each plot, based on the formula of Rajan (1961). The genotypes with higher values of index were considered highly susceptible to aphid attack and vice-versa.

Fecundity of aphid (FA) was recorded on the inflorescence of mustard plant to test the antibiosis in mustard aphid. For this purpose, multiplication of four apterous adult aphids, was studied on the duplicate random samples of plants having partially developed floral buds. Aphid counts were taken 15 days after the release of four apterous aphid on the floral buds and their subsequent cover with butter paper bags. All necessary precautions were taken for this purpose. Values of number of aphids produced on two samples of inflorescence per plot, were used to calculate the mean fecundity of aphid.

Aphid infestation progress (AIP) was worked out, based on weekly observations on progressive development of aphid on the sampled leaves from initiation to final intensity of infestation. It was calculated according to the formula given by Pandey et al. (1989) for calculating area under disease progress curve. Yield loss due to aphid was calculated in per cent, based on the seed yield of protected and unprotected plots.

RESULTS AND DISCUSSION

Results on preliminary screening for aphid during 1988-89, 1989-90 are presented in Table 1 and 2. The grouping of tolerant and susceptible plants on the basis of infestation scores throws some light on the intensity of infestation in terms of yield. The highly susceptible checks Pusa Barani with grade of 5 gave an average of 2.5 gm/plant as compared to tolerant selections with average yield of 18.80 gm/plant.

A comparison of aphid tolerant selections and susceptible checks revealed, that the range in yield per plant of tolerant selections with aphid score of 2 to 3 varied from 5.2 gm to 11.6 gm per plant whereas susceptible national checks like Varuna and RH 30 had an aphid score of 5 with yield ranging from 0.3 to 1.0 gm/plant, showing almost a total loss of yield. It would be observed from Table-3 that 3 genotypes revealed relatively lower values for mean aphid infestation index (MAII), aphid infestation progress (AIP), fecundity of aphid (FA) and yield loss ranging from 3.31 to 10.45 per cent as against the susceptible Check Pusa Bold showing a loss of 27.46 per cent. Remaining 24 genotypes showed lower to moderate values for MAII (1.67-2.34), moderate to high values for AIP (23.10-34.30), higher values for fecundity (207 to 304) and lower to moderate values for yield loss (-3.87 to 10.58 per cent) compared to check (27.46). Despite high fecundity of aphid these genotypes showed relatively lower yield losses and therefore could be

considered as tolerant to aphid. However, the lower yield loss in untreated, compared to treated plots in some cases could be due to their higher tolerance and favourable interaction with the environment. It would be seen that two genotypes viz. Dira 313-1-1 and Dira 326-39-5 showed the lowest value for FA, MAII and AIP, the latter two parameters pertaining to increase of aphid population on the leaves in earlier stages and former (FA) being for the multiplication of aphid on the inflorescence of plants. Based on these three parameters, the above said three lines have shown consistency in supporting lower populations of aphids and can be considered as relatively resistant to aphid. Remaining twenty-four lines with higher AIP and FA also showing lower yield loss, can be considered relatively tolerant as compared to Pusa Bold (yield loss = 27.46 per cent).

Singh et al. (1965) classified different crucifers on the basis of fecundity groups and fecundity was reported to be inversely related to resistance. Kundu and Pant (1967) on their studies with mustard aphid on development, reproduction period and fecundity, reported differential response of these traits. In the present study also, lines with higher fecundity showed higher yield loss and those with lower fecundity the lower yield loss; the lines with higher fecundity and lower yield loss can be considered to be more tolerant.

Variability observed for relative resistance, tolerance and susceptibility based on different aphid infestation parameters, provides a realistic picture under heavy infestation of aphid. It would be desirable to undertake hybridization programmes between relatively resistant and tolerant genotypes. Recurrent hybridization between these selections might help in raising the level of resistance for its utility in breeding work.

CONCLUSIONS

Rigorous screening of both germplasm and advanced breeding lines was done under heavy natural infestation in the field, taking into consideration, parameters like aphid infestation indices, fecundity, aphid infestation progress and yield loss. Out of the genotypes screened, 3 genotypes revealed relatively lower values for aphid infestation index, aphid infestation progress, fecundity of aphid and yield loss ranging from 3.31-10.45 per cent as against the susceptible check like Pusa Bold, which recorded a loss of 27.45 per cent. The two genotypes Dira 313-1-1 and Dira 326-39-5 showed lowest values for both aphid population on the leaves and inferescence of the plants thus showing consisterey in supporting smaller population of aphids. Based on aphid infestation parameters, variability was observed for relative tolerance and resistance.

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Table-1. Reaction to aphid and comparison of yields of tolerant and susceptible selections, 1988-89

Reaction to aphid 0-5	Intensity	Number of plants in each category	Mean yield/plant of each group (gms)
(A) Selection			
2	Tolerant	38	18.80
3	Moderately susceptible	156	8.99
4	Susceptible	201	7.63
(B) Checks			
Pusa Bold 3.5	Moderately susceptible	21	8.07
Varuna 4	Susceptible	14	5.38
Pusa Barani 5	Highly susceptible	13	3.59

0 = No infestation; 5 = Heavy infestation

Table-2. Relative tolerance of mustard lines to (*Lipaphis erysimi*), 1989-90

Line/Check name	Aphid score (0-5)*	Seed yield/ plant (gm)
Dira 326-1	3	5.2
2	3	7.1
3	3	11.5
4	3	8.8
5	3	7.8
6	3	8.1
7	3	9.6
8	3	6.7
Dira 313-1	2	7.0
2	2	11.6
3	3	7.0
4	3	7.1
Checks		
Varuna	5	(Range 0.3-1.0)
RH.30	5	0.2-0.3)

*0= No aphid, 5 = heavy aphid

Table 3. Evaluation based on different aphid infestation parameters in genotypes of mustard

Name of Germplasm	MAII (leaf)	AIP (leaf)	Fecundity (FA) (15 days)	Yield loss (per cent)	Infestation
B-151	1.87	24.51	240.00	-2.76	T
B-292	1.67	23.10	207.00	-3.86	T
B-342	1.80	24.50	222.50	-3.87	T
B-384	2.00	32.90	269.00	0.95	T
B-400	1.94	27.30	293.50	0.68	T
NKG-181	2.06	27.30	283.50	-2.91	T
IB-595	2.14	29.40	304.50	3.43	T
IB-267	2.00	28.00	276.00	4.67	T
IB-630	2.27	31.50	281.00	1.54	T
PR-8601	2.34	32.90	234.00	-3.09	T
RCC-145	2.06	28.70	287.50	2.04	T
EBG-2530	2.14	29.40	284.50	3.34	T
DIRA-313-1-1	1.46	21.00	72.50	3.31	R
DIRA-313-25-1	2.14	30.80	245.50	5.00	T
DIRA-313-27-1	1.80	25.20	231.50	2.45	T
B-156	1.74	23.80	268.00	9.19	T
B-428	1.86	25.20	250.50	8.82	T
BEC-108	2.20	30.10	300.00	5.63	T
RC-108	1.94	27.30	255.00	9.21	T
NKG-24	2.14	29.40	236.50	9.67	T
IB-625	2.14	34.30	279.00	7.31	T
NC-57695	2.27	31.50	261.50	10.34	T
PR-8605	1.87	25.90	290.00	10.58	T
RH-8554	2.06	28.00	233.00	9.67	T
EBJ-2528	2.20	30.80	242.00	8.39	T
DIRA-326-37-1	1.54	21.70	191.50	5.65	R
DIRA-326-39-5	1.40	19.60	76.60	10.45	R
VARUNA	2.06	28.00	274.50	11.35	S
PUSA BOLD	2.20	30.80	262.50	27.46	S