Research Article

Early generation selection for aphid resistance and seed yield in Indian mustard (Brassica juncea L. Czern and Coss)

Madhorao D. Katre, Ram Babu Raman, S. P. Sinhamahapatra, Kale Vinod Ashok, P. M. Mohapatra

Abstract

Single plant selection in F_2 progeny was effective when the performance of the selected F_2 single plant families were compared with the respective bulk progenies. The mean first infestation scores for aphids of all the families were significantly lower than the respective bulk progenies. Selected single plant progenies also recorded higher mean values for important traits related to aphid infestation. Seed yield per plant showed significantly positive genotypic correlation with height up to first branch, number of siliqua on branches, total number of siliqua per plant and 100 seed weight. First infestation score for aphids showed significantly negative correlations with length of main raceme, number of primary and secondary branches. Second infestation score showed significantly negative correlation with length of main raceme and number of primary branches but showed significantly positive correlation with first aphid infestation score. The result suggested that lines with higher aphid resistance and higher seed yield could be selected from the progenies, if selection is practiced for shorter plant height, more number of primary branches, higher number of seeds per siliqua and 100 seed weight along with lower infestation scores.

Introduction

Among the various pests attacking oil seed *Brassicas,* mustard aphid (*Lipaphis erysimi* K alt) is very serious pest and is one of the main limiting factors in the production of rapeseed and mustard. Insecticidal sprays although can control this pest is difficult and costly but it leads to imbalances in the ecosystem and various health hazards. Host plant resistance seems to be one of the best methods for keeping pest populations under control and therefore, recommended as an essential part of integrated pest management. Genotypes are reported to differ significantly in their levels of resistance although none was found to be immune to aphids. Increasing the level of resistance through hybridization of resistant parents has been advocated (Kumar *et al*., 1994). Further, increasing the level of resistance by increasing the frequency of resistance alleles in additive fashion involving comparatively resistant parents is also advocated (Singh *et al*., 2000). In view of the above background, the present study consisting of diallel cross derived F_2, F_3 and F_4 progenies was undertaken to assess the effect of early generation selection for aphid resistance and seed yield.

Department of Plant Breeding,
Faculty of Agriculture, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia,
West Bengal-741252

Materials and method

Seven true breeding advance elite lines developed through hybridization among some selected aphid resistant lines and an aphid resistant variety T 6342 were involved in a half diallel cross. All the eight parents and their 28 F_2 progenies along with an aphid susceptible variety Varuna were grown in the previous year. Nine F_3 families each comprising of maximum four F_2 single plant progenies and bulk progenies of each F_3 were grown in RBD with two replications.

Results and Discussion

All the six families showed significant variations for all the fourteen characters excepting first aphid infestation score for which only two families showed significant variation. This result suggests that progenies within families differ significantly for most of the traits in the F_3 generation. As the families also differed significantly, the progenies within families also differed significantly as well for most traits, it could be predicted that selection for second infestation score and seed yield per plant would be effective and both aphid resistance and seed yield could be further improved. It also emphasized that second infestation score is more reliable for testing aphid infestation as it showed significant variation. Kumar *et al* (1990, 1994) found that both GCA and SCA variances to be significant for aphid infestation score. Roy *et al* (2009) reported that

dominance variance is more important than additive variance in controlling aphid infestation score using the present materials. Presence of significant variation for both the scores in F_2 generation and presence of significant variation still in F_3 generation lead to suggest that additive genetic variance played considerable role controlling aphid infestation score and therefore selection would be effective. Single plant selection in F_2 generation was effective when the performance of the selected F_2 single plant families were compared with the respective bulk progenies (Table 1). Out of nine families, six recorded higher seed yield than respective bulk progenies of which $F_{3\text{-}10}$, $F_{3\text{-}19}$ and $F_{3\text{-}21}$ were significantly different. Three families recorded lower values of seed yield than their respective bulk progenies. The mean infestation score of all the families were significantly lower than the mean infestation score of the bulk progenies. However, single plant F_3 families recorded higher second infestation scores than the respective bulk progenies. Selected single plant progenies of the families also scored higher mean values for the important traits like number of seeds per siliqua, siliqua on top 10 cm and 100 seed weight which are related to aphid infestation. This result also indirectly support the effectiveness of selection for aphid resistance in F_2 generation.

Generally yield loss due to aphid infestation occurs mainly through less number of filled seeds per siliqua, lesser seed weight and top of the raceme being heavily affected producing less number of filled siliqua. As the selected plant progenies showed superior mean values in comparison to bulk F_3 lines, for these traits it can be suggested that selection for aphid resistance and higher seed yield would be effective.

The analysis of variance for different characters of nine F_3 progenies and eight parents is presented in Table 2. Significant variations were found among progenies for all the characters studied. Parents also differed significantly for all the characters except plant height vs. progenies (F_3) revealed significant difference for number of primary branches, number of siliqua per plant, first and second infestation scores and seed yield indicating that progenies differed from the parents for seed yield as well as aphid infestation scores. Therefore, selection among the lines for higher seed yield and aphid resistance would be effective.

The values of genotypic correlation coefficients of F_3 progenies are presented in Table 3. Seed yield per plant showed significantly positive genotypic correlation with height up to first branch, total number of siliqua per plant and 100 seed weight. Both the infestation scores showed significantly negative correlation with number of primary branches only and they themselves were positive correlated. Hence it could be suggested that aphid resistance with high seed yield could be achieved if selection is practiced in the early generations (F_2-F_3) for shorter plant height, more number of seeds per siliqua and higher 100 seed weight along with lower scores of aphid infestation.

References:

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Table 1 Mean value of different characters of different families and their bulk progenies

F_3 families vs. bulk	Plant height (cm)	Number of branches	Number of siliqua per plant	Seeds per siliqua	100 seed weight (g)	First infestation score on 72 DAS	Second infestation score on 79 DAS	Seed yield per plant (g)
F_3-10(1x2)	105.87	4.32	114.11	11.57	0.25	1.62	1.81	2.26
F_3-10-bulk	96.40	3.76	97.50	9.75	0.21	1.72	1.75	1.91
F_3-15(1x8)	105.65	4.16	98.13	11.57	0.24	2.50	2.14	2.00
F_3-15-bulk	111.81	4.00	134.50	12.17	0.24	1.25	1.50	1.77
F_3-19(2x6)	111.41	3.53	122.35	10.40	0.26	1.56	1.81	3.05
F_3-19-bulk	119.00	4.22	151.60	11.92	0.21	1.75	2.00	2.45
F_3-21(2x8)	107.30	3.66	117.57	9.63	0.24	1.99	2.14	2.46
F_3-21-bulk	106.00	3.53	90.60	9.05	0.25	2.25	2.75	2.03
F_3-22(3x4)	116.47	4.66	100.10	11.78	0.24	1.83	1.98	1.98
F_3-22-bulk	103.90	3.57	84.50	11.55	0.26	2.50	1.75	1.81
F_3-24(3x6)	105.83	3.92	92.37	10.92	0.23	2.06	1.97	1.89
F_3-24-bulk	103.60	4.33	131.50	11.15	0.25	2.75	1.75	1.68
F_3-14(1x7)	108.13	3.53	84.16	10.71	0.23	1.96	2.17	1.51
F_3-14-bulk	115.72	4.42	86.30	9.35	0.24	1.75	1.25	1.81
F_3-27(4x5)	113.28	4.10	108.90	15.41	0.27	1.24	2.58	2.05
F_3-27-bulk	125.96	4.37	115.60	10.67	0.22	1.50	2.00	2.38
F_3-30(4x8)	110.60	4.46	95.13	11.93	0.26	2.58	1.99	2.01
F_3-30-bulk	113.45	4.26	144.50	13.45	0.26	2.50	2.00	2.36
F_3 family mean	109.39	4.03	103.64	11.54	0.24	1.92	2.06	2.13
F_3 bulk mean	110.64	4.05	115.17	11.00	0.23	2.00	1.86	2.02
CD at 5 %	4.96	0.55	6.32	0.45	0.01	0.31	0.12	0.37

Table 2 Analysis of variances for different characters of parents and selected F_3 progenies of Indian mustard

Source of variation	df	Plant height	No. of branches	No. of siliqua per plant	No. of seeds per siliqua	100 seed weight	First infestation score on 72 DAS	Second infestation score on 79 DAS	Seed yield per plant
Replication	1	9.62^{NS}	0.01^{NS}	102.38^{NS}	0.23^{NS}	0.001^{NS}	0.26^{NS}	0.07^{NS}	0.03^{NS}
Treatment	16	47.67**	0.75**	2693.22**	1.700**	0.002**	0.65**	0.25**	1.98**
Parents	7	6.94^{NS}	0.67**	4438.70**	1.68**	0.003**	0.55*	0.31^{NS}	2.81**
F3 Progenies	8	89.24**	0.50**	1200.80**	1.92**	0.001**	0.66**	0.19*	0.79**
Parent vs.progenies	1	0.16^{NS}	3.34**	2412.8**	0.09NS	0.004NS	1.30**	0.34*	5.73**
Error	16	2.62	0.03	30.09	0.06	0.002	0.07	0.07	0.04

*, **= Significant at 5 % and 1 % levels respectively, NS= non significant

Table 3 Genotypic correlation coefficients among different characters of selected F_3 progenies

Sl. No.	Characters	2	3	4	5	6	7	7	9	10	11
1	Plant height	0.79*	0.14	0.86**	0.92**	0.04	0.04	0.03	-0.50	-0.17	0.05
2	Length of main raceme		0.55	0.73*	0.87**	0.15	0.22	-0.50	-0.73*	-0.66*	-0.12
3	Height up to 1st branch			0.55	0.29	0.73*	0.09	0.29	-0.01	-0.07	0.61
4	No. of primary branches				0.88**	-0.05	-0.20	0.16	-0.61*	-0.66*	0.16
5	No. of secondary branches					0.03	-0.08	0.20	0.83**	-0.38	0.21
6	No. of siliqua per plant						0.61*	0.16	0.28	0.39	0.79**
7	No. of seeds per siliqua							-0.52	0.25	0.51	-0.02
8	100 seed weight								0.13	0.21	0.66*
9	Aphid infestation score 1st									0.80**	0.23
10	Aphid infestation score 2nd										0.20
11	Seed yield per plant										……