Genetic Variation and Character Association in F_6 Progenies of Interspecific Crosses between *Brassica juncea* and *B. carinata*

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One Hundred F_6 progenies of inter-specific crosses between *B. juncea* × *B. carinata* with 4 check varieties were evaluated in an Augmented Randomized Block Design with five blocks to study genetic variation and character association between yield and yield contributing traits. High heritability values accompanied with high genetic advance were observed for fruiting zone length (58%, 31%), number of siliquae/plant (63%, 33%) and seed yield/plant (75%, 97%). The seed yield/plant showed positive and significant correlation coefficient with plant height (0.364), number of siliquae/plant (0.242), number of seeds/siliqua (0.586). Progenies, 06-727, 06-729 and 06-754 exhibited significant superiority over the best check for seed yield, suggesting their use in crossing programme to throw desirable segregants for abiotic stresses.

Key Words: ***Brassica juncea*, *Brassica carinata*, Character association, Genetic variation, Heritability, Mustard**

Introduction

Indian mustard [*Brassica juncea* (L.) Czern & coss] is an annual, *rabi* oilseed crop and possesses unique position by virtue of its high oil content. About 34 per cent of the cropped area in the semi-arid region under this crop is rainfed. Depending on planting time and winter rain, the crop is exposed to water stress at one or more phonological stages when stored water becomes depleted (Kumar, 2001). This calls for screening and development of drought tolerant genotypes. On the other hand, tropical origin of *B. carinata* may allow it to tolerate high temperature during the reproductive period better than the other species and possess genes for drought tolerance, which may be transferred to genetic background of adaptive varieties of Indian mustard. Therefore, assessment of genetic variation among the progenies obtained from interspecific hybridization is expected to identify high yielding progenies with greater tolerance to stresses.

Materials and Methods

The material for present investigation consisted of 100 selected F_6 progenies of 4 crosses of *B. juncea* × *B. carinata*. These progenies were evaluated at Research farm of DRMR, Bharatpur during *rabi* 2006-07 in an Augmented Randomized Block Design with five blocks. Each block consisted of 20 progenies and 4 check varieties namely, Varuna, RH-819, Kiran and PBR-97. In each block, progenies and check varieties were randomized and allotted to each plot. Each plot was having two rows of 3 m length with 30 cm x 10 cm spacing. The crop was kept un-irrigated except one pre-sowing irrigation. Ten plants were randomly selected from each plot to record the data on plant height, primary branches per plant, fruiting zone length, siliquae on main shoot, number of siliquae per plant, number of seeds per siliqua, seed yield per plant, 1000-seed weight and oil content. Analysis of variance was performed as per the method suggested by Federer (1956). GCV, PCV, heritability, genetic advance and correlation coefficient were calculated as per standard procedure. Rating of progenies for reaction to *Alternaria* blight and white rust was done as per scale given by Conn *et al*. (1990).

Results and Discussion

The analysis of variance revealed that significant amount of variability was present in the progenies for most of the characters under study except primary branches per plant, main shoot length and 1000-seed weight (Table 1). This suggests that the material has adequate variability and response to selection may be expected in the breeding programme for seed yield per plant. Estimates of genotypic and phenotypic coefficient of variations (Table 2) showed that the phenotypic variances were higher than genotypic variance indicating the role of environmental factors on character expression. The variance of various characters was compared on the basis of coefficient of variation. It was observed that seed yield per plant followed by number of siliquae per plant exhibited higher estimates

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Table 1. Mean squares for different characters of F_6 progenies in interspecific crosses between *Brassica juncea* × *B. carinata*

Source of variation	d.f	Plant height (cm)	Fruiting zone length (cm)	Number of primary branches per plant	Main shoot length (cm)	Number of siliquae on main shoot	Number of siliquae per plant	Number of seed per siliqua	Seed yield per plant (g)	1000-seed weight (g)	Oil content (%)
Treatment (c+g)-1	103	308.39**	245.28*	1.27	98.78	49.55	688.33*	2.52**	91.5**	0.32	2.78**
Check (c-1)	3	1437.2**	2175.82**	6.67**	1057.94**	129.21	4502.52**	14.07**	117.02*	2.75**	9.72
Progenies (g-1)	99	230.75*	189.14*	1.1	61.45	47.44**	530.66*	1.67*	90.69**	0.23	2.56**
Check vs Progenies	1	4609.2**	14.27	1.83	916.97**	19.27	4854.91**	51.5**	95.2**	1.48**	3.52*
Error (b-1) 0.62 (c-1)	12	61.24		78.26	0.6	55.54	20.27	194.94	0.72	22.31	0.21

Table 2. Overall mean value of progenies, their range, genotypic and phenotypic coefficients of variation, heritability in broad sense and genetic advance as percentage of mean for different characters of F_6 progenies of interspecific crosses between *Brassica juncea* × *B. carinata*

Characters	Mean	Range	Genotypic coefficient of variation (GCV)	Phenotypic coefficient of variation (PCV)	Heritability in broad sense (%)	Genetic advance as percentage of mean
Plant height (cm)	120.6	85.7-168.20	10.79	12.59	73	18.94
Fruiting zone length (cm)	53.9	14.6-80.90	19.53	25.51	58	30.48
*Number of primary branches per plant	5.1	2.3-9.2	–	–	–	–
*Main shoot length (cm)	41.3	15.76-69.64	–	–	–	–
Number of siliquae on main shoot	31	10.7-46.60	16.95	22.18	57	26.05
Number of siliquae per plant	91.6	45.7-137.30	20	25.14	63	32.63
Number of seeds per siliqua	11.7	7.5-16.05	8.33	11.04	56	12.74
Seed yield per plant (g)	15.1	2.7-37.80	54.76	63.07	75	97.43
*1000-seed weight (g)	3.6	2.1-5.27	–	–	–	–
Oil content (%)	40.6	36.3-44.07	3.43	3.95	75	6.09

* As mean sum of squares were non-significant for these characters, genetic parameters were not calculated

of genotypic as well as phenotypic coefficient of variation. These findings are similar to earlier reports of Shalini *et al*. (2000) and Pant and Singh (2001). The heritability estimates were of higher magnitude (>50%) for all the characters, where as high heritability values accompanied with high genetic advance were observed for fruiting zone length (58%, 31%), number of siliquae per plant (63%, 33%) and seed yield per plant (75%, 97%). Similar results of high heritability and high genetic advance for these characters were earlier reported by Uddin *et al.* (1995). This indicates that selection will be more effective in the present material for these characters.

Genotypic phenotypic correlation coefficients were worked out among different pairs of characters including seed yield per plant (Table 3). The seed yield per plant showed positive and significant correlation coefficient with plant height (0.364), number of siliqua/plant (0.242), number of seeds per siliqua (0.586). Similar significant and positive correlations of yield with these characters have been earlier reported by Kardam and Singh (2005). Among the various inter relationships between remaining traits, fruiting zone length showed significant positive association with primary branches per plant (0.276), main shoot length (0.219) and siliquae on main shoot (0.287). The other important associations noted are significant and positive association of number of siliquae on main shoot and number of siliquae/plant with main shoot length. However, number of seeds per siliqua had negative association with fruiting zone length, number of primary branches per plant and 1000-seed weight. Oil content also showed negative association with these characters. Adams (1967) reported that negative correlation arises in response to competition between developmentally flexible components. Based on above study, it can be concluded that characters, which exhibited positive association with seed yield, are important characters and should be considered in selection programme. Progenies were also assessed for their reaction to *Alternaria* blight and white rust. However, present material could not be differentiated for biotic stresses as all entries rated between 0 to 1 scale which may be due to low selection pressure of diseases.

Table 3. Correlation coefficient on the basis of unadjusted values (phenotypic level) and adjusted values (genotypic level) between different characters of F_6 progenies of interspecific crosses between *Brassica juncea* x *B. carinata*

Characters		Plant height (cm)	Fruiting zone length (cm)	Primary branches per plant	Main shoot length (cm)	Siliquae on main shoot	Siliquae per plant	Seeds per siliqua	Seed yield per plant (g)	1000-seed weight (g)
Fruiting zone	P	0.119								
length (cm)	G	0.257								
Number of primary	P	0.209*	0.276**							
branches per plant	G	0.244	0.345							
Main shoot length	P	0.151	0.219*	0.053						
(cm)	G	0.228	0.442	0.483						
Number of siliquae	P	(-)0.028	0.287**	0.117	0.332*					
on main shoot	G	0.056	0.384	0.204	0.523					
Number of	P	0.234*	0.143	0.073	0.200*	0.242*				
siliquae per plant	G	0.214	0.129	0.054	0.181	0.208				
Number of	P	0.199	(-)0.001	(-)0.384**	0.105	0.183	0.299**			
seeds per siliqua	G	0.038	(-)0.158	(-)0.377	(-)0.101	0.003	0.255			
Seed yield	P	0.364**	0.141	(-)0.162	0.075	0.175	0.242*	0.586**		
per plant (g)	G	0.332	0.209	(-)0.113	0.141	0.203	0.231	0.431		
1000-seed	P	0.186	0.173	0.276**	0.061	(-)0.018	(-)0.051	(-)0.191	0.151	
weight (g)	G	0.268	0.322	0.258	0.406	0.116	(-)0.040	(-)0.262	0.324	
Oil content	P	0.034	(-)0.073	(-)0.246*	0.002	0.110	0.103	0.298**	0.235*	-0.108
(%)	G	0.039	(-)0.049	(-)0.291	(-)0.099	0.077	0.101	0.276	0.278	0.0492

*Significant at p=0.05, ** Significant at p= 0.01

Ten best progenies on the basis of performance were selected (Table 4). The progenies, 06-727, 06-729 and 06-754 were significantly superior to the best check for seed yield and also high in oil content (%). Hence, it is suggested that these progenies be tested in multi-locational trials and also be used in hybridization programme to develop high yielding varieties for drought situations after stabilization.

Table 4. Evaluation data on best ten progenies along with parents and checks for seed yield and its components

Progenies	Seed yield/ plant (g)	Oil content (%)	Plant height (cm)	Fruiting zone length (cm)	Number of primary branches	Main shoot length (cm)	Number of siliquae on main shoot	Number of siliquae per plant	Number of seed per siliqua	1000-seed weight (g)
06-727**	37.8	42.5	164.2	76.9	6.1	48.7	23.1	122.8	15.8	4
06-729**	36.8	44.07	125.2	64.7	5.1	45.3	38.4	106.4	12.6	4.4
06-754**	35.6	42.8	116.2	48.3	3.6	38.2	28.5	109.2	14.0	3.2
06-828	29.9	42.4	156.4	30.1	7.1	69.6	31.6	115.7	13.5	4.8
06-751	29.7	41.7	110.2	47.1	4.4	29.4	25.2	88.1	13.3	3.3
06-796	28.3	41.3	138.4	70.7	5.8	56.9	36.7	107.1	14.3	4.3
06-812	27.8	41.8	118.4	53.6	4.8	41.3	42.5	64.7	12.5	4.5
06-789	26.9	38.0	130.7	78.6	9.2	39.6	33.4	125.5	9.7	4.1
06-757	26.7	41.6	98.2	54.5	3.5	32.7	27.1	85.6	15.0	2.7
06-793	26.3	39.7	127.4	69.5	5.4	53.3	31.6	58.7	12.3	3.9
Check/Parents										
RH 819	12.6	41.2	120.6	39.9	4.2	34.3	25.9	72.6	12.7	3.8
PBR 97	19.6	41.4	127.6	65.8	5.1	51.4	37.3	95.8	12.4	4.0
KIRAN	7.9	39.3	159.0	78.5	7.0	15.8	29.6	137.3	12.9	3.0
VARUNA	12.3	38.6	141.6	34.8	5.6	33.8	34.5	129.1	16.0	4.8
CD[#] (5%)	12.5	2.03	20.2	22.8	2.0	19.21	11.6	35.9	2.19	1.2

[#]Between check varieties and progenies, ** Significantly superior than the best check

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