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Genetic variability for plant type traits in *Brassica* species

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Abstract

Four species of *Brassica viz., Brassica juncea, B. napus, B. carinata* and *B. campestris* were evaluated over two years for plant type traits including basal branching. In *B. juncea* there was greater variation for plant height but not for seed yield. It was only next to *B. campestris* followed by *B. napus* for variation in basal branching trait. While, in *B. campestris* there was no genetic variation for basal branching trait, but it showed greater variation for days to flowering, total number of primary and secondary branches.

Key words: *Brassica,* basal branching, plant type, variability

Introduction

Breeding for stable and sustainable crop productivity demands in turn breeding for physiologically and morphologically efficient varieties /genotypes. In Oleiferous *Brassica,* particularly those grown in India, there is scope for improving their physiological efficiency (Rai, 1989). Labana (1984) suggested that an efficient plant type with harmonious source- sink relationships needs to be developed. *Brassica juncea,* a widely cultivated crop in the north India, bears more number of productive pods on secondary and tertiary branches than the main axis. In general, the pod bearing primary branches initiate at a good height from the base sometimes at 1 m. The main stem is not always strong enough to support the top-heavy shoot which is highly prone to lodging in the usual heavy winds before harvest resulting in avoidable yield loss. In areas of advanced agronomic crop management for pure cropping a desirable plant type should have a height of about 1 m. with compact growth habit and with branches having appressed siliqua filled with large number of bold seeds (Jain, 1984). Therefore, genotypes with medium plant height, basal branching i.e. branches within 30 cm from the base, more number of primary and secondary branches, profuse pod bearing and more number of bold seeds per pod should be looked for. In the present paper, a comparison was made on genetic variability for plant type traits particularly of basal branching in the four cultivated species of oilseed *brassica.*

Materials and methods

Four species of *Brassica viz., B. juncea, B. napus, B. carinata and B. campestris* each with 12 genotypes were evaluated over two years i.e., during winter seasons of 1990 and 1991. The experiment was laid out in a split plot design with species as main plots and genotypes as sub plots during both seasons. Each genotype was sown in two rows of 5 m length and the spacing was 45 cm between rows and 15 cm between plants.

Data were collected on various and morpho-physiological traits, which are of general and specific interest. The traits of general nature were days to first flowering (FT), plant height (HT), total number of primary (PB) and secondary (SB) branches, seed yield per plant (SY), and harvest index (HI). The plant type traits of specific interest were measured at the basal portion of the plant. A height of 30 cm from the ground was measured and it was referred as 'HI'. All those characters (PBI, SBI, SYI, HII) were termed as basal branching characters. Where, PBI=number of primary branches at HI; SBI=number of secondary branches at SYI=seed yield at H12 and HII=SYI/total biomass x 100.

The ANOVA was carried out following usual procedure of split plot analysis and the estimates of genetic variance were computed on expected mean square basis.

Results and discussion

Genetic variability is rational to plant breeding objective. The studies on variability for yield and its components are numerous, while those related to plant type attributes, particularly, basal branching are not available except for those of (Sun, 1946; Kasa and Kondra, 1986) where it was recognized as a trait.

The results presented in Table 1 showed that there were significant differences between species for all the traits studied. The genotypes within *B. campestris* showed significant variation for all the characters, while the intra-specific variation in *B. juncea* was significant for all except SB and SY. The variation was non significant in *B. napus* during one of the seasons for SB, SY, SYI and HII. While *B. carinata* genotypes showed no variation for all those traits connected with basal branching. Most of these results

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Table 1 ANOVA (mean squares) for 10 characters among four *Brassica* species

Source	df	FT	HT	PB1	SB1	SY1	HI1	PB	SB	SY	HI
Genotypes	47	**1359.5***	**7473.3***	**11.9***	**132.1***	**32.2***	**37.8***	**38.3***	**853.6***	**316.2***	**87.7***
		2822.3*	7910.7*	13.7*	136.4*	85.4*	124.3*	50.7*	1265.0*	235.0*	66.1*
B. juncea	11	**276.4***	**1729.6***	**3.6***	**56.6***	**46.2***	**18.8***	**6.3***	**72.1**	**88.9**	**32.1***
		95.6*	4059.3*	2.6*	33.1*	47.2*	28.4*	10.4*	159.0*	118.9	33.6*
B. napus	11	**354.6***	**455.6***	**3.0***	**16.7***	**2.3**	**3.3**	**4.8***	**14.5**	**93.7**	**47.1***
		1615.7*	1155.5*	1.9*	23.1*	28.7*	16.4*	11.8*	132.0*	221.7*	32.9*
B. carinata	11	**1246.4***	**1103.3***	**0.5***	**7.5**	**0.6**	**0.2**	**64.3***	**841.7***	**156.3***	**21.1**
		3360.1*	1740.3*	0.4	9.5	1.5	0.4	92.9*	1852.5*	229.6*	53.2*
B. campestris	11	**391.4***	**1725.4***	**4.8***	**187.0***	**57.2***	**69.8***	**25.6***	**385.2***	**179.6***	**181.2***
		51.3*	1834.3*	7.9*	140.4*	68.2*	109.4*	12.5*	237.9*	130.4*	54.8*
Between spp.	3	**12979.0***	**98697.0***	**142.9***	**1087.3***	**114.2***	**254.0***	**228.8***	**8556.4***	**3051.7***	**341.7***
		25433.0*	91706.0*	167.9*	1380.9*	803.8*	1380.3*	326.0*	11086.0*	855.5*	396.0*
Error	94	**12.5**	**87.1**	**0.5**	**8.5**	**2.4**	**2.0**	**1.2**	**75.1**	**75.1**	**14.7**
		20.5	136.4	0.4	8.1	11.2	2.3	2.0	56.4	67.5	8.0

Bold (1st row) : Winter, 1990; Light (2nd row) : Winter, 1991 * Significant at 5% level.

were supported by the estimates of genetic variance (Table 2).

The magnitude of genetic variation was less in each species except *B. campestris* during winter 1990 than 1991. Such difference between years or locations are common in plant breeding experiments and known as environment interaction. In *B. juncea* there was greater variation for plant height but not for seed yield.

Greater variation for plant height was reported by Uddin *et al*. (1983) too, but the lack of variability for seed yield has been main concern of mustard breeders. Meanwhile, *B. napus* did not show consistency in genetic variation for basal branching characters (PBI, SBI, SYI and HII). On the other hand, *B. carinata* showed greater variation for days to flowering, primary (PB) and secondary (SB) branches and seed yield (SY), but with no genetic variation for basal branching characters. Similar kind of variation was observed by Labana *et al.* (1987) particularly for plant height and number of primary and secondary branches. *B. campestris* was highly variable species for all those traits including harvest index (HI), indicating that there is a greater scope for utilizing genes governing those traits in the improvement of other related species.

Basal branching was recognized as a trait, but there were no systematic studies. Sun (1946) reported that some varieties of *B. juncea* (var. *Oblanceolata)* were extremely low branched ones, while some others (*B. juncea* var. *gracilis* and *orthocarpa)* no branch up to 90 cm above the ground. He also reported that in the material studied, *B. napus* and *B. carinata* branch at low height. The present study showed that *B. juncea* was only next to *B. campestris* followed by *B. napus* for variation in basal branching traits. Keeping in mind the fact that *B. juncea* lacks genetic variability for seed yield, the breeding for basal branching and higher yielding types in *B. juncea* will depend on the presence and success of introgression of genes for those traits from other species of *Brassica.*

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Table 2 Estimates of genetic variance for 10 traits in four species of *Brassica*

Trait	*B. juncea*		*B. napus*		*B. carinata*		*B. campestris*	
	A	B	A	B	A	B	A	B
FT	88.0	25.0	114.0	531.7	411.3	1113.2	126.3	10.3
HT	547.5	1307.6	122.8	339.7	338.7	534.6	546.1	566.0
PB1	1.0	0.7	0.8	0.5	0	0	1.4	2.5
SB1	16.0	8.3	2.7	5.0	0.3@	0.5	59.5	44.1
SY1	14.6	12.0	0	5.8	0.6@	3.1@	18.3	19.0
HI1	5.6	8.7	0.4	4.7	0.6@	0.6@	22.6	35.7
PB	1.7	2.8	1.2	3.3	21.0	30.3	8.1	3.5
SB	1.0@	34.2	20.2@	25.2	255.5	598.7	103.4	60.5
SY	4.6	17.1	6.2	51.4	27.1	54.0	34.8	21.0
HI	5.8	8.5	10.8	8.3	2.1	15.1	55.5	15.6

A = Winter, 1990; B = Winter, 1991 @ = Negative estimate

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