GENETIC ANALYSIS OF YIELD AND ITS COMPONENTS IN INDIAN MUSTARD (BRASSICA JUNCEA (L.) CZERN & COSS.)

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Studies on gene effects of quantitative characters in Indian mustard (*Brassica juncea* (L.) Czern & Coss.) are very limited. Singh *et al.* (1981) suggested that epistatic gene effects should be separated from the dominance effects as significant amount of non-allelic gene effects were observed for most of the traits. The knowledge of gene effects can be obtained by generation mean analysis of a cross (Hayman, 1958). Besides, the knowledge of other parameters like heritability, genetic advance and correlation coefficient among the attributes are obviously essential in planning efficient and productive breeding programme for crop improvement. In the present study, therefore, an attempt has been made in this direction.

MATERIAL AND METHODS :

The material comprised 21 genotypes, F_1 and F_2 and two backcrosses (B_1, B_2) generations of five varietal crosses involving seven parents i.e. Prakash, RH-30, Pusa bold, RC 781, RH 7513, RCU 101 and Yellow Rai K1. The material was grown in randomized block design with three replications during rabi 1979-80 under normal and stressed environments. The parents and F_1's were sown in two rows ; B_1 and B_2 in four rows each and F_2's in eight rows of 4 m length. The rows were spaced at 45 cm apart and plants within a row were at 15 cm distance. Observations were recorded on 40, 20 and 10 competitive plants per replications from each F_2, backcrosses and non-segregating (P_1, P_2 and F_1) generation respectively in both the environments on days to flowering, days to maturity, plant height, number of primary branches per plant, number of secondary branches per plant, number of inflorescences per plant, length of siliqua, number of seeds per siliqua, number of siliquae per plant, 1000-seed weight and seed yield.

The genetic analysis for gene effects were carried out according to Hayman (1958) followed by joint scaling test (Cavalli, 1952).

RESULTS AND DISCUSSION :

The analysis of variance revealed significant differences among the genotypes as well as crosses for all metric traits in both the environments. The high and fluctuating values of coefficients of variation (genotypic and phenotypic) were observed for seed yield and number of siliquae per plant which indicated their sensitivity to the environmental fluctuations (Table-1). Such variation was also reported for seed yield by Labana et al. (1980) in Indian mustard. The high values of genetic coefficient of variation alongwith higher values of heritability and genetic advance for days to flowering, 1000-seed weight, number of primary branches, number of secondary branches and plant height may offer a scope for their improvement by phenotypic selection.

The results of path analysis presented in Table-2 indicated that direct effect in the order of number of primary branches per plant, number of siliquae per plant, number of inflorescences per plant and 1000 seed weight and indirect effect of plant height via most of these traits exerted a marked influence on seed yield. The negative indirect effects of days to flowering, days to maturity and length of siliqua, though small, can jointly offset much of the direct effect resulting in no correlation. As the direct effects of days to flowering, days to maturity, number of secondary branches and length of siliqua were negative and low in spite of high genotypic correlation coefficients. This was mainly because of negative indirect effects of these characters in combination with high negative indirect effects of number of secondary branches per plant. It was also observed that low correlation between yield and number of seeds per siliqua might have resulted from its negative indirect effects via other associated variables, in general, and number of secondary branches, in particular.

The estimates of gene effects indicated that the additive gene effects (d) were significant in crosses Prakash x Y. Rai K-1 ; RH-30 x RC 781 and RCU 101 x RH 30 for all the traits except number of seeds per siliqua and seed yield in cross RCU 101 x RH 30. Other two crosses namely RH 7513 x Pusa bold and Prakash x RH 30 also showed significant values of additive effects for days to flowering and 1000-seed weight over both the environments. Hence, additive gene effects played important role in the inheritance of most of the traits. The domiannce gene effects (h) were significant in all the crosses for days to maturity over both the environments and number of seeds per siliqua in one or the other environment. However, dominance effects differed in their direction of expression. For all other characters the dominance gene effects showed significance in one or the other cross over both the environments. This indicated that the dominance effect was also involved in the inheritance of most of the traits. Singh et al. (1981) also reported the importance of both additive and dominance gene effects in the inheritance of various agronomic traits of Indian mustard.

Considering individual digenic epistatic effects, the type and magnitude varied for some characters in both the environments suggested that the gene effects should be studied in a wide range of environments before deciding the breeding methodology. Additive x additive (i) effects appeared to be more important for days to flowering, plant height, number of primary branches per plant and 1000-seed weight. The dominance x dominance (l) epistatic effects seemed to be contributing more than additive x additive (i) effects to days to maturity, number of secondary branches per plant, number of inflorescences per plant, length of siliqua, number of seeds per siliqua, number of siliquae per plant and seed yield. The additive x dominance interaction effects were generally low for all the traits. However, Singh et al. (1970) reported the contribution of additive and dominance x dominance towards variation in plant height, all type of gene effects except additive for number of primary branches.

In the present study, high direct effect of number of primary branches, number of siliquae per plant, plant height and 1000-seed weight towards the expression of seed yield along with their high heritability and genetic advance envisage that these components deserve due attention and could be improved by handling the segregating material through F_2 inter-mating because of the importance of both additive and dominance gene effects involved in the inheritance of these attributes, owing to predominant role of additive gene effects for the control of days to flowering, the simple selection would be quite effective which will also improve maturity as there is high association of these two characters. The dominance component could be exploited through heterosis breeding or partially through population improvement as advocated by Rai (1979).

REFERENCES :

Cavalli, L.L. (1952). Quantitative Inheritance, H.M.S.O. London. pp. 135-144.

Hayman, B.I. (1958). Heredity, 12: 371-390.

Labana, K.S., B.D. Chaurasia and Balwant Singh (1980). Indian J. agric. Sci., 50: 803-806.

Rai, B. (1979). Heterosis Breeding. Agro-Biological Publication. New-Delhi: 133-140.

Singh, A.B., Y.S. Chauhan and P. Singh (1981). Indian J. Genet., 41: 130-136.

Singh, D., D. Singh and R.S. Verma (1970). Indian J. agric. Sci. 40: 283-287.

Wright, S. (1921). J. agric. Res., 20: 557-585.

Table-2 : Direct and indirect effects of different characters on seed yield in Indian mustard.

Character	1	2	3	4	5	6	7	8	9	10	11	12
1.	E_1	–0.21	–0.37	0.37	2.36	–2.62	–0.12	–0.08	0.02	0.99	0.33	0.67
	E_2	–0.01	0.06	0.53	0.20	–1.42	1.05	–0.03	0.04	0.03	0.17	0.62
2.	E_1	–0.19	–0.40	0.31	2.08	–2.30	–0.10	–0.07	0.01	0.91	0.32	0.57
	E_2	–0.01	0.07	0.48	0.18	–1.23	0.88	–0.03	0.01	0.03	0.17	0.55
3.	E_1	–0.17	–0.27	0.47	2.03	–2.29	–0.12	–0.10	0.03	1.04	0.36	0.98
	E_2	–0.01	0.05	0.68	0.16	–1.11	00.93	–0.04	0.07	0.02	0.18	0.93
4.	E_1	–0.20	–0.35	0.40	2.43	–2.70	–0.12	–0.09	0.02	1.00	0.33	0.72
	E_2	–0.01	0.06	0.53	0.21	–1.44	1.09	–0.04	0.05	0.02	0.17	0.64
5.	E_1	–0.20	–0.34	0.40	2.42	–2.71	–0.12	–0.09	0.02	1.01	0.33	0.72
	E_2	–0.01	0.06	0.51	0.20	–1.48	1.09	–0.03	0.06	0.03	0.15	0.58
6.	E_1	–0.20	–0.32	0.45	2.35	–2.66	–0.13	–0.10	0.04	1.04	0.34	0.81
	E_2	–0.01	0.05	0.57	0.20	–1.44	1.12	–0.03	0.06	0.03	0.17	0.71
7.	E_1	–0.11	–0.18	0.32	1.39	–1.56	–0.09	–0.15	0.02	0.76	0.24	0.64
	E_2	–0.01	0.03	0.39	0.11	–0.73	0.59	–0.07	0.07	0.02	0.13	0.54
8.	E_1	–0.05	–0.06	0.18	1.02	–1.20	–0.06	–0.04	0.08	0.62	0.01	0.50
	E_2	–0.01	0.00	0.20	0.05	–0.39	0.28	–0.02	0.22	0.01	–0.01	0.34
9.	E_1	–0.19	–0.34	0.46	2.23	–2.52	–0.12	–0.11	0.04	1.08	0.34	0.87
	E_2	–0.01	0.06	0.68	0.20	–1.39	1.08	–0.04	0.09	0.03	0.19	0.90
10.	E_1	–0.16	–0.31	0.40	1.88	–2.12	–0.10	–0.09	0.00	0.88	0.42	0.80
	E_2	–0.01	0.05	0.54	0.15	–0.96	0.85	–0.04	–0.01	0.02	0.23	0.83

Figures underlined indicate direct path effects.
1. Environment – 2. Days to flowering – 3. Days to maturity – 4. Plant height – 5. Primary branches – 6. Secondary branches – 7. Number of inflorescences – 8. Length of siliquae – 9. Seeds per siliqua – 10. Siliquae per plant – 11. 1000-seed weight. – 12. Correlation coefficient with seed yield.

Table-1 : Mean, coefficients of variation, heritability and genetic advance for various characters in Indian mustard.

Character	Environment	General mean	Coefficients of variation		Heritability (h^2) broad-sense	G.A. as per cent of mean
			Genotypic	Phenotypic		
Days to flowering	E_1	59.00	27.39	27.42	99.84	56.39
	E_2	56.97	25.38	25.40	99.89	52.25
Days to maturity	E_1	141.36	6.54	6.55	99.95	13.46
	E_2	136.18	6.81	6.82	99.94	14.02
Plant height (cm)	E_1	211.70	19.69	20.07	96.24	39.79
	E_2	203.97	18.49	19.19	92.76	36.68
No. of primary branches	E_1	6.88	24.83	26.88	85.33	47.24
	E_2	6.87	28.90	30.32	90.87	56.77
No. of secondary branches	E_1	23.54	26.92	30.20	79.43	49.40
	E_2	21.64	25.78	28.92	79.45	47.34
No. of inflorescences	E_1	47.99	22.25	28.21	62.21	36.15
	E_2	42.01	20.71	27.20	57.96	32.47
Length of siliqua (cm)	E_1	3.44	9.93	11.25	77.93	18.02
	E_2	3.57	11.29	11.94	89.39	21.85
No. of seeds per siliqua	E_1	13.63	10.92	11.66	87.70	21.06
	E_2	13.87	9.90	10.69	85.72	18.89
No. of siliquae per plant	E_1	598.55	30.13	37.06	66.10	50.47
	E_2	496.80	19.39	29.70	42.62	26.08
1000-seed weight (g)	E_1	2.97	30.76	35.20	76.34	55.55
	E_2	3.14	31.51	32.28	95.29	63.37
Seed yield (g)	E_1	21.17	35.89	41.14	76.10	64.48
	E_2	19.64	27.78	31.77	76.45	