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Genetic variability, correlation and path analysis over environments in mustard (*Brassica juncea* (L.) Czern & Coss)

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Abstract

Sixty six mustard genotypes consisting of 11 diverse parents and their 55 hybrids resulting from diallel mating design excluding reciprocals were evaluated for genetic parameters. Wide range of phenotypic variation was observed for seed yield per plant and its important components. The estimates of genotypic and phenotypic variances indicated the presence of considerable genotypic and phenotypic variability in the material. The GCV was maximum for seed yield per plant followed by biological yield per plant and primary branches per plant. High heritability coupled with moderate genetic advance for yield per plant and most of the yield components attributed additive gene effects and hence, these traits had higher selection value. The correlation analysis revealed that all the characters except days to maturity, siliqua length and seeds per siliqua showed positive correlation with seed yield per plant. Path analysis, however, revealed that seed yield in mustard can be increased by selecting the plant with more height and having more number of secondary branches per plant, as it manifested high and positive direct effects and significant correlation with seed yield per plant.

Key Words: Genetic variability, correlation, path analysis, mustard

Introduction

Improvement in yield is the ultimate goal of any breeding programme. Yield being a complex character depends upon a large number of component characters. Study of inter-relationship of yield with its components is of greater value in formulating a selection programme. The effectiveness of selection in plant breeding depends upon the variability present in the material and the extent to which it is heritable. Selection directly based on the performance of seed yield, a complex trait, is usually not very effective; however, the one based on the component traits is likely to prove more efficient. A correlation study provides estimates of the degree of association of seed yield with its components and also among the components. Path analysis is an important tool in partitioning the correlation coefficient into direct and indirect effects of independent variables on the dependent variables. Hence, an attempt has been made to understand all these aspects.

Materials and methods

The experimental material used in the present study consisted of 66 genotypes consisting of 55 F_1 hybrids were obtained through mating of 11 diverse parents (GM 1, GM 2, SKM 9927, RH 9322, JYM 1, Jawahar Mustard 1, RN 539, BIO 902, TM 40, TM 24 and BPR-6-166-24-3) in all possible combinations through diallel mating design excluding reciprocals. The experiment was grown in randomized block design with three replications in four environments during *rabi* 2003-04 at Main Castor-Mustard Research Station, S. D. Agricultural University, Sardarkrushinagar. The environments were created by the combinations of two sowing dates (8.10.2003 and 23.10.2003) and two nitrogen levels (50 and 100 kg N/ha). Each genotype was grown in a single row of 5 meter length. The inter and intra row distances were kept 45 am and 15 cm, respectively, which accommodated 33 plants per plot. All recommended agronomical practices were followed for raising the good crop. However, the plant

Table 1 : Mean, ranges, variability parameters, heritability and genetic advance for different traits pooled over environments in mustard.

Character	Mean	Range	Genotypic variance ($ó^2g$)	Phenotypic variance ($ó^2p$)	GCV (%)	PCV (%)	ECV (%)	H^2b	GA as % of mean
Days to maturity	24.60	9.90 to 41.20	29.73	36.36	22.17	24.51	18.12	81.80	41.29
Plant height (cm)	113.37	109.00 to 119.00	3.49	6.56	1.65	2.26	2.67	53.30	2.47
Length of main branch (cm)	166.18	130.00 to 193.47	86.24	156.55	5.59	7.53	8.74	55.10	8.54
Number of primary branches per plant	78.53	68.07 to 93.53	33.63	51.52	7.38	9.14	9.33	65.30	12.29
Number of secondary branches per plant	4.78	3.73 to 6.57	0.40	0.48	13.21	14.53	10.50	82.60	24.73
Number of siliquae per main branch	11.74	7.93 to 14.67	1.68	3.03	11.05	14.83	17.14	55.50	16.96
Number of siliquae per plant	40.11	27.37 to 52.20	1.03	33.19	11.71	14.36	14.43	66.40	19.64
Siliqau length (cm)	281.47	208.50 to 365.40	635.49	1173.41	8.96	12.17	14.27	54.20	13.58
Seeds per siliqua	5.34	4.40 to 6.30	0.17	0.17	7.67	7.72	1.51	98.70	15.70
1000-seed weight (g)	14.47	10.54 to 18.17	2.38	2.44	10.67	10.78	2.75	97.80	21.73
Seed yield per plant (g)	5.46	3.99 to 7.17	0.38	0.39	11.34	11.43	2.50	98.40	23.17
Biological yield per plant (g)	88.71	50.33 to 158.33	384.72	457.26	22.11	24.10	16.63	84.10	41.78
Harvest index (%)	28.14	14.24 to 34.98	8.79	16.21	10.54	14.31	16.77	54.20	15.98
Oil content (%)	40.34	38.26 to 43.16	1.17	1.24	2.68	2.76	1.17	94.00	5.35

Table 2. Genotypic and phenotypic correlation coefficient among different characters pooled over environments in mustard.

Character	Correlation	Plant height (cm)	Length of main branch (cm)	Number of primary branches per plant	Number of secondary branches per plant	Number of siliquae per main branch	Number of siliquae per plant	Siliqau length (cm)	Seeds per siliqua	1000-seed weight (g)	Biological yield per plant (g)	Harvest index (%)	Oil content (%)	Seed yield per plant (g)
Days to maturity	rg	0.16	-28.01**	0.47**	-0.44**	-0.52**	-0.14	0.23	-9.06**	0.31*	-0.03	0.43**	-0.12	-0.23
	rp	0.09	0.03	0.07	-0.04	-0.13	0.08	0.08	-0.07	0.11	0.09	-0.19*	-0.06	-0.05
Plant height (cm)	rg		94.54**	-0.50**	0.28*	1.09**	-0.08	0.40**	-8.84**	0.47**	0.16	0.60**	0.38**	0.30*
	rp		0.34**	0.06	0.10	0.13	-0.06	0.14	-0.09	0.15	0.05	0.08	0.09	0.07
Length of main	rg			32.95**	15.29**	-3.78*	74.47**	16.34**	-3.21**	26.62**	79.78**	-19.39**	52.88**	49.11**
branch (cm)	rp			0.26**	0.17*	0.02	0.18*	0.06	-0.12	0.07	0.29**	0.08	0.22**	0.18*
Number of primary	rg				9.92**	1.21**	7.71**	1.66**	-9.48**	3.56**	8.93**	7.16**	1.90**	8.90**
branches per plant	rp				0.42**	0.09	0.34**	0.09	-0.10	0.20*	0.40**	0.17*	0.12	0.44**
Number of secondary	rg					0.55**	0.88**	0.11	1.48**	0.46**	0.71**	0.85**	0.08	0.89**
branches per plant	rp					-0.01	0.32**	0.04	0.02	0.16	0.30**	0.18*	0.08	0.39**
Number of siliquae	rg						0.52**	-0.19	-0.19	0.36**	0.42**	0.47**	0.33**	0.48**
per main branch	rp						0.07	-0.08	-0.03	0.15	0.11	0.07	0.09	0.14
Number of siliquae	rg							-0.03	-14.73**	0.55**	0.92**	0.90**	0.40**	1.04**
per plant	rp							0.02	-0.36**	0.26**	0.43**	0.10	0.19*	0.42**
Siliqau length (cm)	rg								11.04**	0.14	0.08	-0.20	-0.29*	-0.03
	rp								0.58**	0.13	0.04	0.09	-0.25**	-0.04
Seeds per siliqua	rg									-1.25**	-8.15**	3.23**	0.77**	-4.58**
	rp									-0.06	-0.37**	0.08	0.02	-0.23**
1000-seed weight (g)	rg										0.27*	0.12	0.08	0.23
	rp										0.16	0.07	0.08	0.17*
Biological yield	rg											0.54**	0.07	0.93**
per plant (g)	rp											0.11	0.07	0.72**
Harvest index (%)	rg												0.32**	0.81**
	rp												0.14	0.58**
Oil content (%)	rg													0.19
	rp													0.16

*, ** indicate significance at 5 % and 1 %.0.27*

Table 3. Direct and indirect effects of different characters on seed yield per plant in mustard.

Character	Days to maturity	Plant height (cm)	Number of secondary branches per plant	Number of siliquae per main branch	Number of siliquae per plant	Siliqau length (cm)	1000-seed weight (g)	Biological yield per plant (g)	Harvest index (%)	Oil content (%)	Correlation with seed yield per plant
Days to maturity	**1.387**	-0.068	-2.216	0.444	0.469	-0.286	-0.225	-0.047	0.479	-0.170	-0.23
Plant height (cm)	-0.223	**0.427**	1.404	-0.924	0.271	-0.482	-0.340	0.290	-0.665	0.544	0.30
Number of secondary branches per plant	-0.615	0.120	**4.994**	-0.460	-3.078	-0.138	-0.326	1.243	-0.952	0.110	0.89
Number of siliquae per main branch	-0.727	0.466	2.753	**-0.847**	-1.826	0.232	-0.259	0.745	-0.520	0.469	0.48
Number of siliquae per plant	-0.186	-0.033	4.385	0.441	**-3.506**	0.036	-0.393	1.614	-1.008	0.569	1.04
Siliqau length (cm)	0.326	0.169	0.566	0.162	0.105	**-1.214**	-0.103	0.150	0.221	-0.416	-0.03
1000-seed weight (g)	0.435	0.202	2.273	-0.306	-1.921	-0.174	**-0.717**	0.476	-0.140	0.119	0.23
Biological yield per plant (g)	-0.037	0.071	3.540	-0.360	-3.228	-0.104	-0.195	**1.753**	-0.606	0.097	0.93
Harvest index (%)	-0.595	0.254	4.263	-0.394	-3.169	0.241	-0.090	0.952	**-1.116**	0.464	0.81
Oil content (%)	-0.164	0.162	0.362	-0.277	-1.393	0.352	-0.060	0.118	-0.361	**1.433**	0.19

Figures in bold letters indicates direct effects
Residual effect = 0.0709

protection measures were not adopted. The observations were recorded on five randomly selected plants for each treatment in each replication for seed yield and its components.

Phenotypic and genotypic variance and genetic advance (1), phenotypic and genotypic coefficient of variability (2), heritability in broad sense (3), correlation coefficient (4) and path co-efficient analysis (5) were estimated for seed yield per plant and its component traits.

Results and discussion

The estimates of phenotypic range, genotypic and phenotypic variances, genotypic, phenotypic and environmental coefficient of variability, heritability and genetic advance are presented in Table 1. The results revealed the presence of wide range of phenotypic variation for seed yield per plant and its attributing traits like plant height, length of main branch, number of siliquae per main branch, number of secondary branches per plant, biological yield per plant and harvest index, which would facilitate greater options for selections of desirable and suitable phenotypes from the experimental material and hence, would provide greater chances of success in breeding programme. Choudhary *et al.* (6) and Gupta (7) observed wide phenotypic variability for seed yield per plant and its important yield components.

The estimates of genotypic and phenotypic components of variances (Table 1) revealed that secondary branches per plant followed by biological yield per plant and plant height exhibited the highest values for $\acute{o}^2g$ and $\acute{o}^2p$, which indicated the presence of great deal of genotypic and phenotypic variability for these traits. The GCV was maximum for seed yield per plant (22.17%) followed by biological yield per plant (22.11%), number of primary branches per plant (13.21%), number of siliquae per main branch (11.71%) and 1000-seed weight (11.34%). The differences between GCV and PCV was maximum for number of siliquae per plant and number of secondary branches per plant suggesting that these characters were highly influenced by environment. Moderate to high heritability coupled with moderate genetic advance was recorded for seed yield per plant and biological yield per plant. These traits had higher selection value, attributed to higher degree of additive gene effects. Seed yield per plant exhibited high significant positive correlation with all the characters except days to maturity, siliquae length and seeds per siliquae (Table 2). Seed yield per plant also showed positive but non-significant correlation with oil content. Kadam and Singh (8) and Rai *et al.* (9) reported such positive associations. While exercising selection, emphasis must be laid on the above said all the characters, which provides simultaneous improvement in seed yield. Significant correlation between important yield contributing traits was also observed.

The results on genotypic correlation coefficients and path coefficients on seed yield per plant are given in Table 3. The results revealed that number of secondary branches per plant had high direct effect on seed yield per plant followed by plant height. On the other hand, number of siliquae per plant, siliqua length, harvest index, number of siliquae per main branch and 1000-seed weight exhibited direct negative influence on seed yield per plant. This indicated that in mustard, yield can be increased in mustard by selecting the plant with more height and having more number of secondary branches per plant, as these traits showed high positive direct effects and significant positive correlations with seed yield per plant. Ramani *et al.* (10) and Shalini *et al.* (11) found similar results for seed yield per plant in mustard. The indirect effects of other important yield contributing traits with each other was substantial, indicated selection for yield contributing trait may also results in increased seed yield in mustard.

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