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PATH CORRELATION COEFFICIENT ANALYSIS FOR YIELD ATTRIBUTES TRAITS OF INDIAN MUSTARD (*Brassica juncea* L.)

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ABSTRACT

Twenty two newly developed genotypes of Indian mustard [*Brassica juncea* (L.) Czern & Coss.] were studied at Student Instructional Farm of C. S. Azad University of Agriculture and Technology, Kanpur, (Utter Pradesh) India, during Rabi seasons in the years 2009-2010 and 2010-2011 to investigation the association among yield components traits and their direct and indirect influenced on seed yield under randomize block design with three replications. Analysis of variance revealed significant differences among genotypes for all the 10 characters studied. Higher magnitude of heritability coupled with higher genetic advance expressed as percentage of mean observed for number of secondary branches/plant and seed yield/plant. Seed yield/plant exhibited positive and significant association with number of secondary branches/plant, number of siliquae on main shoot and total siliquae/plant both at genotypic and phenotypic level. Further, path coefficient analysis also revealed that number of secondary branches/plant number of siliquae on main shoot and total siliquae/plant had positive and direct effect on seed yield/plant, indicate that indirect selection for these traits in improving seed yield. The result suggested that high yielding genotypes could be selected in further study for breeding programme for late sown conditions.

Key words : *Brassica juncea, correlation, heritability, path analysis, yield.*

Indian mustard [*Brassica juncea* (L.) Czern & Coss.] commonly known as rai/raya is predominately grown in the country occupying 85 to 90 % of the total area under rapeseed mustard crop. India produced 6.78 million tonnes from an area of 5.92 million hectares with the productivity of 1145 Kg/ha and total nine oilseed produce 26.44 million tonnes from an area of 30.01 million hectares with the productivity of 1135 Kg/ha. In Utter Pradesh total oilseeds produce 1.13 million tonnes from an gross area of 0.95 million hectares with the productivity of 828 Kg/ha with the contribution of 4.28 % total area and 3.12 % total production across the country while rape-seed and mustard produced 0.64 million tonnes from an area of 0.72 million hectares with the productivity of 1125 Kg/ha with the contribution of 10.80 % total area and 10.61 % total production across the country in 2011-12 (1).

Indian mustard will be impacted by climate change in several ways. Drought, heat and salinity are the major abiotic stresses affecting productivity of oilseeds. Among them high temperature during post reproductive phase is most sensitive which limits productivity of rapeseed mustard in the semi-arid regions and the current challenges is to reduce the yield gaps under late sown situation. A 1°C increase in temperature may reduce rapeseed-mustard yield by 3 to 7%. Selection parameters which influence seed yield, with consist of greater genetic diversity, is a good strategy in any crop improvement programme (2). Yield is a complex trait and it is depends upon other parameters which are mostly inherited quantitatively. Direct selection for yield is not much effective because different morphological traits vary in their relationship with it, both in terms of their nature as well as magnitude. The components which have high heritability and positive correlation with yield can be use in the indirect selection for yield and act as an alternate mode of selection for yield improvement. Further study of correlation with seed yield, genotypic coefficient of variation, phenotypic coefficient of variation, heritability in broad sense (%) genetic advance as percentage of mean and path coefficient reveal different ways in which component attributes influence the complex trait. In order to achieve the goal of increased production by increasing the yield potential of the mustard crop, knowledge of direction and magnitude of association between various traits is essential for further breeding programme. Keeping the above fact in view, the present experiment was carried out to study the association of seed yield and its component traits involving 22 new developed genotypes of Indian mustard for terminal heat tolerance, due to late sown condition.

MATERIALS AND METHODS

An field experiment was conducted during two *rabi* season in 2009-10 and 2010-11 at Student Instructional Farm (SIF) of C. S. Azad University of Agriculture and Technology, Kanpur. The plant material used genetically pure in the present study 22 new developed mustard genotypes viz. DRMR-802, PBR-331, NRCDR-601, RH-0216, NPJ-113, RB-50, NPJ-117, RH-0447, DLM-2, RH-0305, NRCDR- 701, RH-0116, NRCDR-02, RB-55, RH-8814, DRMR-537-40, RGN-773, PBR-330, RGN-197, BPR-349-9, BPR-549-9 and RH-555A seed of these advance mustard genotypes was provided by oilseed section C.S. Azad University of Agriculture and Technology. The experiment was laid out in randomize block design with three replications. Each genotypes was sown in six row with the spacing of 15 cm plant to plant, 45 row to row, plots size 2.25 x 5 m. Standard cultural practices should be adopted for raising the crop. Data were recorded for ten characters, viz. plant height at physiological maturity (cm), secondary branches/ plant, number of siliquae on main shoot, total siliquae/plant, siliquae length (cm), number of seed/siliquae, 1000-seed weight (g), harvest index (%), oil content (%) and seed yield/plant. Data of the morphological traits were recorded on randomly selected 5 competitive plants in the middle three row of each plot. Statistical analysis was done according to standard statistical procedure. The mean value of the recorded data was subjected to ANOVA using Statistical Package for Augmented Design (SPAD) (3). Phenotypic and genotypic correlation of variations were computed as per the method described by (4). Phenotypic and genotypic correlation between yield and yield related traits were estimated by the using the method described by (5) path coefficient analysis was done by SAS 9.2V.

RESULTS AND DISCUSSION

Among the tested mustard genotypes were observed significant different for all the characters. Phenotypic coefficient variation (PCV) was higher than genotypic coefficient variation (GCV) for all the observed characters indicating environmental factors influencing their expression to some degree (Table-1). High PCV and GCV were observed for number of secondary branches/plant (31.59 and 30.74), seed yield/plant (17.20 and 15.98) and total siliquae/plant (15.02 and 12.78), number of seed siliquae (13.24 and 8.59) and

Table-1: Estimation of different genetic parameters of 10 yield related traits in newly developed mustard genotypes (Pooled over two years 2009-10 and 2010-11)

Characters	Mean	Range	Genotypic coefficient of variation (GCV)	Phenotypic coefficient of variation (PCV)	Heritability in broad sense (%)	Genetic advance as percentage of mean
PHM	172.5	149.7 – 190.6	7.36	7.83	88	50.61
SB	18.4	12.8 – 31.2	30.74	31.59	95	23.26
NSM	70.5	61.5 – 74.4	4.95	6.84	52	10.69
TSP	562.7	401.8 – 662.4	12.78	15.02	72	25.77
SL	6.5	5.4 – 8.8	8.08	18.03	20	0.93
NSS	13.2	9.7 – 14.7	8.59	13.24	42	3.13
TSW	4.3	3.8 – 4.5	1.94	10.01	04	0.06
HI	25.0	21.3 – 28.4	6.38	7.79	67	5.54
OC	35.3	30.9 – 39.9	5.88	6.67	78	7.75
dctlparSYP	31.72	20.20 – 43.70	15.98	17.20	86	19.10

PHM = plant height at physiological maturity (cm); SB = number of secondary branches/plant;
NSM = number of siliquae on main shoot; TSP = total siliquae plant^{-1}; SL = siliquae length (cm);
NSS = number of seed/siliquae; TSW = 1000-seed weight (g); HI = harvest index (%);
OC = oil content (%); SYP = seed yield plant^{-1} (g)

Table-2: Phenotypic (pcc) and genotypic (gcc) correlation coefficient among yield and its component in Indian mustard (Pooled of 2 years).

Variables		SYP	PHM	SB	NSM	TSP	SL	HSS	TSW	HI	OC
SYP	pcc	-	0.455**	0.591**	0.092	0.608**	0.025**	0.468**	0.501**	0.749**	0.184
	gcc	-	0.438**	0.609**	-0.141	0.751**	-0.590**	0.487**	0.627**	0.923**	0.082
PHM	pcc			0.136	0.306*	0.059	0.089	0.464**	0.407**	0.237**	0.032
	gcc			0.132	0.229*	0.003	-0.037	0.466**	0.885**	0.272	-0.032
SB	pcc				-0.237	0.268	-0.100	-0.092	0.159	0.632**	0.014
	gcc				-0.391**	0.699**	-0.342**	-0.195	0.178	0.689**	-0.049
NSM	pcc					-0.187	0.164	0.540**	0.217	-0.072	0.298*
	gcc					-0.386**	-0.555**	0.365**	-0.155	-0.206	0.231
TSP	pcc						-0.139	-0.031	0.042	0.596**	-0.066
	gcc						-0.351**	-0.279	0.724**	0.763**	-0.072
SL	pcc							0.167	0.221	-0.195	0.346**
	gcc							-0.574**	-0.791**	-0.582**	0.425**
NSS	pcc								0.350**	0.220	0.223
	gcc								0.724**	0.256	0.180
TSW	pcc									0.369**	0.397**
	gcc									0.911**	0.716**
HI	pcc										0.088
	gcc										-0.099
OC	pcc										1.00
	gcc										1.00

*, ** = significant at 0.05 and 0.01% levels, respectively; PHM = plant height at physiological maturity (cm); SB = number of secondary branches/plant; NSM = number of siliquae on main shoot; TSP = total siliquae/plant; SL = siliquae length (cm); NSS = number of seed/siliquae; TSW = 1000-seed weight (g); HI = harvest index (%); OC = oil content (%); SYP= seed yield/plant (g)

Table 3. Phenotypic (upper value) and genotypic (lower value) direct and indirect path coefficients for yield related traits in Indian mustard (Pooled of 2 years)

Variables	PHM	SB	NSM	TSP	SL	NSS	TSW	HI	OC	Correlation value
PHM	0.134	0.027	-0.018	0.019	0.003	0.154	0.074	0.062	0.001	0.455**
	0.135	-0.010	-0.052	0.000	0.0101	-0.006	0.214	0.153	-0.008	0.438**
SB	0.018	0.199	0.014	0.199	-0.003	-0.031	0.029	0.165	0.000	0.591**
	0.018	-0.074	0.089	0.085	0.093	0.002	0.020	0.389	-0.012	0.609**
NSM	0.041	-0.047	-0.058	-0.059	0.005	0.179	0.039	-0.019	0.011	0.092
	0.031	0.029	-0.226	-0.047	0.150	-0.004	-0.018	-0.116	0.060	-0.141
TSP	0.008	0.125	0.011	0.317	-0.004	-0.010	0.008	0.156	-0.002	0.608**
	0.000	-0.052	0.087	0.121	0.095	0.003	0.082	0.430	-0.017	0.751**
SL	0.012	-0.020	-0.010	-0.044	0.030	0.055	0.040	-0.051	0.012	0.025
	-0.005	0.025	0.126	-0.043	-0.271	0.007	-0.203	-0.328	0.102	-0.590**
NSS	0.062	-0.018	-0.031	-0.010	0.005	0.332	0.063	0.058	0.008	0.468**
	0.063	0.014	-0.083	-0.034	0.155	-0.012	0.196	0.144	0.043	0.487**
TSW	0.055	0.032	-0.013	0.013	0.007	0.116	0.181	0.096	0.014	0.501**
	0.255	-0.013	0.035	0.088	0.485	-0.021	0.114	0.514	0.171	0.627**
HI	0.032	0.126	0.004	0.189	-0.006	0.073	0.067	0.262	0.003	0.749**
	0.037	-0.051	0.047	0.092	0.158	-0.003	0.103	0.564	-0.024	0.923**
OC	0.004	0.003	-0.017	-0.021	0.010	0.074	0.072	0.023	0.036	0.184
	-0.004	0.004	-0.057	-0.009	-0.115	-0.002	0.081	-0.056	0.239	0.082

*, ** = significant at 0.05 and 0.01% levels, respectively;
PHM = plant height at physiological maturity (cm); SB = number of secondary branches/plant; NSM = number of siliquae on main shoot;
TSP = total siliquae/plant; SL= siliquae length (cm); NSS = number of seed/siliquae;
TSW = 1000-seed weight (g); HI = harvest index (%); OC = oil content (%)

siliquae length (18.03 and 8.08). The estimation of PCV and GCV alone are not much helpful in determining the portion. The amount of genetic advance to be expected from selection can be achieved by estimating heritability along with coefficient of variation. High heritability were recorded in secondary branches

(95%), plant height at physiological maturity (88%), seed yield/plant (86%) and oil content (78%). Genotypic and phenotypic coefficients of variance were higher for number of secondary branches/plant and seed yield/plant under late sown condition reported by (6).

High heritability coupled with high genetic advance as per of mean and GCV were noted for number of secondary branches/plant (95%) indicating simple selection can bring significant improvement in this trait. Phenotypic and genotypic correlation coefficient work out among component traits including seed yield/plant revealed that in general phenotypic correlation coefficient were similar to genotypic correlation coefficient magnitudes (Table-2). Phenotypic correlation was slightly higher than genotypic correlation coefficient for some characters, which may be due to variability of environment on the association of these characters. The seed yield/plant showed positive and significant association with number of secondary branches/plant and number of siliquae/plant both at phenotypic and genotypic levels. Similar results were also reported by (2) in *Brassica juncea.* Among variation interrelationship between remaining traits, plant height showed positive and significant correlation with number of secondary branches/plant, total branches/plant. In the present investigation the number of secondary branches/plant was to be positively and significant associate with total siliquae/ plant at both phenological and genotypic level, which show that result in a substantial increase in seed yield/ plant. Similar results were also reported earlier by (7).

Results of phenotypic and genotypic path coefficient analysis indicate that harvest index, total siliquae/plant, secondary/plant, number of seed/ siliquae and plant height at physiological maturity positive phenotypic and genotypic direct effect on seed yield (Table-3), which show that the correlation coefficient between seed yield and its other traits.

On the basis of study, it was found that Indian mustard genotypes viz. RH-8814, NRCDR-02, BPR-549-9, RB-55, DRMR-537-40, NRCR-701 and RGN-197 were selected on the basis of yield performance/plant under late sown condition and recommended for further study for breeding programme. They have been identified as most heat-tolerant as they maintained higher yield and its component traits. RB-55, BPR-349-9 and DRMR-537-40 categorized as moderately tolerant to temperature.

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