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## Study of correlation and path coefficient among the characters of Indian mustard

**Ankit Kumar, Mahak Singh, RK Yadav, Poonam Singh and Lallu**

### Abstract

The present investigation was conducted with aim to know the magnitude of association of growth, yield and quality traits of mustard. Correlation study indicated that seed yield per plant had significant and positive correlation with 1000 seed weight, leaf area index, harvest index, oil content, protein content, biological yield per plant, seeds per silquae, silquae per plant, primary branches per plant and length of main raceme. However it was negatively and significantly associated with days to 50 % flowering, days to maturity and plant height at phenotypic level. The higher magnitude of positive direct effect at phenotype level on seed yield per plant was exerted by 1000 seed weight followed by biological yield per plant and leaf area index. However negative direct effects were exerted by days to 50 % flowering and primary branches per plant.

**Keywords:** Indian mustard, seed yield, correlation and path coefficient

### Introduction

India annually produces 6-8 million tonnes of mustard seed and ranks third in the world in production, having a market share of 11 per cent. It is one of the major sources of oil and oil meal in India. Mustard oil is traditionally the most important oil for the Northern, Central and Eastern parts of the country. Major mustard producing states in the country are Rajasthan, accounting more than 47% of its production followed by Uttar Pradesh, Haryana, Madhya Pradesh and Gujarat. The average area, production and productivity of rapeseed-mustard in the world was 33.63 million ha, 69.33 million tonnes and 2060 kg/ha, respectively in 2015-16 (USDA Circular series- 2018). In India the area, production and productivity of rapeseed-mustard was 5.74 million ha, 7.79 million tonnes and 1183 kg/ha, respectively during the 2015-16 (Ministry of Agriculture, GOI). Rapeseed and mustard is a major oil seed crop in Uttar Pradesh, with 0.63 million hectare area and 0.58 million tonnes production at the productivity 930 kg/hectare in 2014-15, contributing 10.79 percent area and 9.27% production of India (Directorate of Economics & Statistics, DAC&FW).

The seed and oil are used as condiments in the preparation of pickle and for flavour carrying out vegetables. The oil is utilized for human consumption throughout northern India in cooking and frying purposes. It is also used in the preparation of hair oil and medicine. It is used in soap making in mixture with mineral oils for lubrication. The oil cake is used as a cattle feed and manure. Green stems and leaves are a good source of green fodder for cattle. The leaves of young plants are used as green vegetables as they supply enough sulphur and minerals in the diet. In the tanning industry, mustard oil is used for softening of the leather.

### Materials and Methods

The material for the present investigation consisted of Ten varieties/genotypes of Indian mustard, [*Brassica juncea* (L.)] which were selected on the basis of variability for various characters available in genetic material maintained in the selection of oil seeds, Department of Genetics and plant Breeding, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur-(UP).

Ten genetically diverse genotypes namely MK (L) 13-304, MK (L) 13-306, MK (L) 13-310, MK (L) 13-307, Ashirwad, MK (L) 13-308, MK (L) 13-301, Vardan, MK (L) 13-303 and MK (L) 13-305 using in a diallel set were crossed with each other (excluding reciprocals) in all the possible combinations to produce sufficient F<sub>1</sub> seeds of 45 crosses.

### Testing of progenies along with parents

100 genotypes (10 parents, their 45 F<sub>1</sub>'s and 45 F<sub>2</sub>'s) were sown in Randomized Block

Design with three replications during *Rabi* 2016-17. Each treatment was planted in one row, of 5 m length and 45 cm apart, Plant to plant distance was maintained 15 cm by thinning. All the recommended agronomic practices were adopted for raising a good crop at Oil seed Research Farm of C. S. Azad University of Agriculture & Technology, Kanpur-208002 (UP).

**Results and Discussion**

**Genotypic and phenotypic correlation coefficients**

The aim of correlation studies is primarily to know the suitability of various characters for indirect selection because selection for one or more traits results in correlated response of several other traits (Searle, 1965) [7] and the pattern of variation will also be changed (Waddington and Robertson, 1966) [10]. Therefore, the knowledge of genetic correlation existing between yield and its components is essential.

All possible phenotypic and genotypic correlation coefficients for P + F<sub>1</sub> + F<sub>2</sub> generation were worked out for all the character combinations under study (Table-1). Though the significance of genotypic correlation could not be tested as no suitable statistical test is available (Nasar *et al.*, 1973) [4], yet their magnitude is considered in relation to the corresponding phenotypic estimates.

Seed yield per plant had significant and positive correlation with 1000 seed weight, leaf area index, harvest index, oil content, protein content, biological yield per plant, seeds per silquae, silquae per plant, primary branches per plant and length of main raceme. However it was negatively and significantly associated with days to 50 % flowering, days to maturity and plant height at phenotypic level.

Days to 50 % flowering exhibited positive and significant correlation with days to maturity, plant height and negative significant with remaining characters except biological yield per plant. Days to maturity had significant and negative

correlation with length of main raceme, leaf area index, number of primary branches, number of silquae per plant, seeds per silquae, biological yield per plant, 1000-seed weight and harvest index, oil content, protein content and significant positive association with plant height. Plant height showed significant and positive association with length of main raceme and negative significant association with leaf area index, silquae per plant, 1000 seed weight and harvest index. Length of main raceme had significant positive association with number of primary branches, number of secondary branches, silquae per plant, number of seed per silquae, 1000 seed weight, harvest index and oil content. Leaf area index exhibited positive and highly significant correlation with number of silquae per plant, number of seeds per silquae, biological yield per plant, 1000-seed weight, harvest index and oil content and protein content. Primary branches per plant had positive significant association with secondary branches, silquae per plant, seeds per silquae, biological yield per plant, 1000 seeds weight, harvest index, oil content and protein content. Number of secondary branches showed significant and positive correlation with number of silquae per plant, number of seed per silquae, 1000-seed weight and harvest index. Silquae per plant exhibited positive and significant correlation with number of silquae per plant, biological yield per plant, 1000-seed weight, harvest index and protein content. Seeds per silquae exhibited positive and significant correlation with 1000-seed weight, harvest index, oil content and protein content.

Biological yield per plant and showed positive and highly significant association with protein content. 1000 seeds weight had significant and positive correlation with harvest index, oil content and protein content. Harvest index showed significant association with oil content. Similar findings were reported by Uddin *et al.*, 1995 [9] and Pant *et al.*, 2002 [5], Priyamedha *et al.*, 2013 [6].

**Table 1:** Estimates of phenotypic (rp) and genotypic (rg) correlation among 15 characters in P + F<sub>1</sub> + F<sub>2</sub> generation in Indian mustard

Characters		Days to Maturity	Plant Height (cm)	Length of Main Raceme (cm)	Leaf Area Index (cm <sup>2</sup> )	Primary Branches/ Plant	Secondary Branches/ Plant	Silquae / Plant	Seeds / Siliqua	Biological Yield/ Plant (gm)	1000- Seed Weight (gm)	Harvest Index (%)	Oil Content (%)	Protein Content (%)	Seed Yield/ Plant (gm)
		rp	rg	rp	rg	rp	rg	rp	rg	rp	rg	rp	rg	rp	rg
Days to flowering	rp	0.350**	0.498**	-	-	-0.162*	-	-0.169*	-	0.040	-	-	-0.205*	-0.164*	-
	rg	0.428	0.561	-0.347	-0.605	-0.315	-0.480	-0.180	-1.068	0.026	-0.704	-0.805	-0.215	-0.171	-0.603
Days to Maturity	rp		0.163*	-0.191*	-	-	-0.071	-0.174*	-	-	-	-	-	-	-
	rg		0.088	-0.266	-0.644	-0.570	-0.144	-0.208	-0.942	-0.542	-0.385	-0.236	-0.297	-0.715	-0.463
Plant height (cm)	rp			0.428**	-	0.055	-0.006	-	-0.071	-0.104	-	-	0.170*	-0.121	-
	rg			0.473	-0.518	0.239	0.050	-0.281	-0.108	-0.111	-0.289	-0.484	0.184	-0.139	-0.429
Length of main raceme (cm)	rp				0.056	0.400**	0.449**	0.225**	0.352**	0.035	0.476**	0.259**	0.389**	0.100	0.236**
	rg				0.046	0.798	0.750	0.243	1.047	0.049	0.516	0.287	0.436	0.099	0.265
Leaf Area Index (cm <sup>2</sup> )	rp					0.145*	-0.065	0.380**	0.207**	0.237**	0.514**	0.373**	0.309**	0.472**	0.659**
	rg					0.344	-0.293	0.471	0.985	0.308	0.635	0.509	0.366	0.580	0.874
Primary Branches/ Plant	rp						0.347**	0.343**	0.308**	0.263**	0.392**	0.188*	0.282**	0.424**	0.199*
	rg						0.650	0.630	1.332	0.487	0.698	0.361	0.505	0.866	0.450
Secondary Branches/ Plant	rp							0.181*	0.217**	0.099	0.191*	0.192*	-0.060	-0.030	0.076
	rg							0.309	1.328	0.133	0.335	0.394	-0.132	-0.050	0.184
Siliquae/ Plant	rp								0.216**	0.357**	0.408**	0.356**	0.012	0.382**	0.501**
	rg								0.701	0.381	0.410	0.378	0.012	0.392	0.545
Seeds/ Siliqua	rp									0.142	0.406**	0.236**	0.257**	0.217**	0.357**
	rg									0.341	1.463	0.999	0.943	0.786	1.319

Biological Yield/ Plant (gm)	rp														0.104	-0.141	-0.044	0.581**	0.431**
	rg														0.113	-0.123	-0.068	0.643	0.474
1000- Seed Weight (gm)	rp															0.710**	0.621**	0.364**	0.688**
	rg															0.739	0.641	0.378	0.744
Harvest Index (%)	rp																0.422**	0.164	0.458**
	rg																0.453	0.171	0.508
Oil Content (%)	rp																	0.338**	0.320**
	rg																	0.352	0.349
Protein Content (%)	rp																		0.478**
	rg																		0.530

\*, \*\* significant at 5 and 1 per cent level, respectively

**Genotypic and phenotypic path coefficient**

Path coefficient is simply standardized partial regression coefficient which splits the correlation coefficient into the measure of direct and indirect effects of a set of independent variables on the dependent variable. The path coefficient analysis was carried out at phenotypic and genotypic level to resolve direct and indirect effect of eighteen characters on pod yield per plant.

The direct and indirect effects of different characters on pod yield at phenotypic and genotypic level had been presented in Table -2.

The higher magnitude of positive direct effect at phenotype level on seed yield per plant was exerted by 1000 seed weight

followed by biological yield per plant and leaf area index. However negative direct effects were exerted by days to 50 % flowering and primary branches per plant.

Other traits effects minimal direct effects on the seeds yield per plant. 1000 seeds weight exhibited highest indirect effects via days to 50 % flowering, days to maturity, plant height, length of main raceme, leaf area index, primary branches per plant, siliquae per plant, seeds per siliquae, harvest index, oil content and protein content at phenotypic level. Similar findings were reported by Gangapur *et al.* (2009) [1] Tahira *et al.* (2014) [8] Mekonnen *et al.* (2014) [3] and Kumar *et al.* (2016) [2].

**Table 2:** Estimates of pehnotypic (rp) and genotypic (rg) path among 15 characters in P + F<sub>1</sub> + F<sub>2</sub> generation in Indian mustard

Characters		Days to 50 % flowering	Days to Maturity	Plant Height (cm)	Length of Main Raceme (cm)	Leaf Area Index (cm <sup>2</sup> )	Primary Branches/ Plant	Secondary Branches/ Plant	Siliquae / Plant	Seeds / Siliqua	Biological Yield/ Plant (gm)	1000- Seed Weight (gm)	Harvest Index (%)	Oil Content (%)	Protein Content (%)
		rp	rg	rp	rg	rp	rg	rp	rg	rp	rg	rp	rg	rp	rg
Days to flowering	rp	-0.148	-0.052	-0.074	0.047	0.069	0.024	0.048	0.025	0.042	-0.006	0.098	0.106	0.030	0.024
	rg	1.458	0.624	0.819	-0.506	-0.882	-0.460	-0.701	-0.263	-1.557	0.038	-1.027	-1.175	-0.313	-0.249
Days to Maturity	rp	0.031	0.088	0.014	-0.017	-0.037	-0.031	-0.006	-0.015	-0.025	-0.039	-0.029	-0.018	-0.022	-0.052
	rg	-0.866	-2.026	-0.178	0.538	1.306	1.156	0.292	0.421	1.910	1.098	0.781	0.478	0.601	1.450
Plant height (cm)	rp	0.006	0.002	0.012	0.005	-0.005	0.001	0.000	-0.003	-0.001	-0.001	-0.003	-0.005	0.002	-0.001
	rg	-1.142	-0.178	-2.033	-0.962	1.052	-0.487	-0.102	0.571	0.219	0.226	0.589	0.983	-0.373	0.283
Length of main raceme (cm)	rp	0.002	0.001	-0.003	-0.006	0.000	-0.002	-0.003	-0.001	-0.002	0.000	-0.003	-0.002	-0.002	-0.001
	rg	-1.333	-1.020	1.816	3.838	0.175	3.064	2.880	0.932	4.019	0.189	1.982	1.101	1.673	0.378
Leaf Area Index (cm <sup>2</sup> )	rp	-0.130	-0.119	-0.112	0.016	0.278	0.040	-0.018	0.106	0.058	0.066	0.143	0.104	0.086	0.131
	rg	1.362	1.452	1.166	-0.103	-2.252	-0.776	0.659	-1.061	-2.219	-0.695	-1.429	-1.146	-0.825	-1.307
Primary Branches/ Plant	rp	0.024	0.054	-0.008	-0.060	-0.022	-0.150	-0.052	-0.052	-0.046	-0.040	-0.059	-0.028	-0.042	-0.064
	rg	-0.118	-0.214	0.090	0.299	0.129	0.374	0.243	0.236	0.499	0.182	0.261	0.135	0.189	0.324
Secondary Branches/ Plant	rp	0.016	0.004	0.000	-0.023	0.003	-0.017	-0.050	-0.009	-0.011	-0.005	-0.010	-0.010	0.003	0.001
	rg	1.459	0.438	-0.152	-2.280	0.889	-1.975	-3.038	-0.938	-4.035	-0.405	-1.018	-1.196	0.401	0.151
Siliquae/ Plant	rp	-0.022	-0.022	-0.034	0.029	0.049	0.044	0.023	0.129	0.028	0.046	0.053	0.046	0.002	0.049
	rg	0.049	0.056	0.076	-0.065	-0.127	-0.170	-0.083	-0.269	-0.189	-0.103	-0.111	-0.102	-0.003	-0.106
Seeds/ Siliqua	rp	-0.026	-0.026	-0.006	0.032	0.019	0.028	0.020	0.020	0.091	0.013	0.037	0.022	0.023	0.020
	rg	1.623	1.433	0.164	-1.592	-1.498	-2.026	-2.019	-1.066	-1.520	-0.519	-2.224	-1.518	-1.433	-1.194
Biological Yield/ Plant (gm)	rp	0.013	-0.148	-0.034	0.012	0.079	0.087	0.033	0.119	0.047	0.332	0.035	-0.047	-0.015	0.193
	rg	0.002	-0.037	-0.008	0.003	0.021	0.033	0.009	0.026	0.023	0.069	0.008	-0.008	-0.005	0.044
1000- Seed Weight (gm)	rp	-0.295	-0.149	-0.124	0.212	0.229	0.175	0.085	0.182	0.181	0.047	0.446	0.317	0.277	0.162
	rg	-2.267	-1.241	-0.932	1.663	2.043	2.248	1.080	1.321	4.713	0.364	3.220	2.380	2.065	1.216
Harvest Index (%)	rp	0.014	0.004	0.009	-0.005	-0.008	-0.004	-0.004	-0.007	-0.005	0.003	-0.014	-0.020	-0.009	-0.003
	rg	-1.330	-0.390	-0.799	0.474	0.840	0.596	0.650	0.624	1.650	-0.203	1.220	1.651	0.748	0.283
Oil Content (%)	rp	0.005	0.006	-0.004	-0.009	-0.007	-0.006	0.001	0.000	-0.006	0.001	-0.014	-0.009	-0.022	-0.007
	rg	0.518	0.716	-0.443	-1.051	-0.884	-1.219	0.319	-0.029	-2.274	0.163	-1.547	-1.093	-2.412	-0.848
Protein Content (%)	rp	-0.004	-0.015	-0.003	0.003	0.012	0.011	-0.001	0.010	0.005	0.014	0.009	0.004	0.008	0.025
	rg	-0.018	-0.075	-0.015	0.010	0.060	0.090	-0.005	0.041	0.082	0.067	0.039	0.018	0.037	0.104
Correlation with yield	rp	0.513*	0.372*	0.366*	0.236*	0.659*	0.199*	0.076	0.501**	0.357*	0.431**	0.688**	0.458**	0.320**	0.478**
	rg	-0.603	-0.463	-0.429	0.265	0.874	0.450	0.184	0.545	1.319	0.474	0.744	0.508	0.349	0.530

\*, \*\* significant at 5 and 1 per cent level, respectively

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