

Original Research Article

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Correlation and Path Studies for Seed Yield and Its Attributing Traits in Indian Mustard [*Brassica juncea* (L.) Czern & Coss.]

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ABSTRACT

Keywords

Correlation, Path coefficient, Quantitative traits, Genetic advance, Genetic variability, Indian mustard

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An experiment was conducted to study the correlation and path coefficient analysis of 11 quantitative traits during *rabi* 2017-18 at Zonal Agricultural Research Station Morena, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, Madhya Pradesh, India comprised 27 genotypes of Indian mustard including 9 parental genotypes and 18 specific F₁ crosses. Analysis of variance on 11 quantitative traits was worked out which exhibited considerable amount of genetic variability in genotypes for all the traits. The mean, range, genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), habitability in broad sense and genetic advance were calculated. High GCV and genetic advance coupled with high heritability for number of primary and secondary branches/plant, number of siliquae/plant, test weight and seed yield indicated the effectiveness of selection for these traits. Seed yield had positively associated with plant height, days to 50% flowering, days to maturity, oil content and test weight at both genotypic and phenotypic level indicating that these traits would help in improving the seed yield. Path analysis revealed that days to 50% flowering showed maximum positive direct effect, followed by oil content, days to maturity and test weight at both genotypic and phenotypic levels.

Introduction

Indian mustard [*Brassica juncea* (L.) Czern & Coss.] is an important oilseed crop accounts for more than 80% of the total acreage under rapeseed-mustard crops in India (Meena *et al.*, 2015). It contributes nearly 27% of edible oil pool in India and more than 13% of the global edible oil production (Singh *et al.*, 2013a; Meena *et al.*, 2014). During last one and half day decade, the average productivity in India oscillating between 1.0 to 1.2

tonnes/ha which is much lower than the world average of 1.98 tonnes/ha. Moreover there is wider yield gaps when productivity of India is compared with countries like Germany (4.3 tonnes/ha), France (3.8 tonnes/ha) and UK (3.4 tonnes/ha) (Yadava *et al.*, 2012). The breeding strategy to derive high yielding cultivars depends upon the nature and magnitude of variation for different yield components. The assessment of genetic parameters like phenotypic coefficient of variation, genotypic coefficient of variation,

heritability and genetic advance is a prerequisite for making effective selection. The correlations and path analysis based on correlation coefficient further unravels the contribution of different traits towards seed yield. However some information related to these aspects is available in this crop, but it is known that genetic variability and correlation coefficient vary from material to material. Hence the present investigation is carried out to assess the nature and magnitude of genetic variability, their inter-relationships and contribution towards seed yield to generate high yielding recombinants for the development of high yielding cultivar(s) in Indian mustard.

Materials and Methods

Experimental material comprised of 27 genotypes including 9 parents (JM-1, JM-2, JM-3, RVM-1, RVM-2, JMM-927, Kranti and RH-749) and 18 one way specific F₁ crosses derived from different combination of these parents. Experiment was laid down in randomized complete block design with three replications during *rabi* season 2017-18 at Zonal Agricultural Research Station Morena, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, Madhya Pradesh, India. Recommended agronomic practices were followed for raising good crop. The observations on 11 quantitative traits [Plant height (cm), days to 50% flowering, days to maturity, number of primary & secondary branch/plant, number of siliquae /plant, siliqua length (cm), number of seeds/siliqua, oil content (%), test weight (g) and seed yield (Kg/ha)] were recorded on randomly selected 10 plants from each plot for each replication. Genetic parameters were estimated as per standard statistical procedure. Correlation coefficient (Johnson *et al.*, 1955) and Path coefficient analysis (Dewey and Lu, 1959) were analyzed.

Results and Discussion

Analysis of variance revealed that mean sum of squares due to treatments was highly significant for all 11 traits indicating presence of wide spectrum of variability (Table 1). High magnitude of variability has been reported earlier in Indian mustard for different traits by various researchers for days to 50% flowering, days to maturity, plant height, number of siliquae/plant, test weight and seed yield (Kumar and Mishra, 2007; Yadava *et al.*, 2011; Meena *et al.*, 2015; Meena *et al.*, 2017). The magnitude of phenotypic coefficient of variation (PCV) was higher than genotypic coefficient of variation (GCV) for all the traits. Estimates of GCV varied from oil content (1.30) to number of secondary branches/plant (20.05) and PCV estimates also showed similar trend for the respective traits (Table 2). Both GCV and PCV were high for number of primary and secondary branches/plant, number of siliquae/plant, test weight and seed yield indicating these as major yield contributing traits (Kardam and Singh, 2005; Yadava *et al.*, 2011). GCV along with heritability estimate gave the precise picture of genetic gain to be exploited through selection as suggested by Burton (1954). High GCV coupled with heritability and high genetic advance coupled with high heritability were observed for number of primary and secondary branches/plant, number of siliquae/plant, test weight and seed yield suggesting that the additive gene action might play major role in the expression of these characters and selection would be rewarding in further improvement of these characters.

Correlation coefficient analysis revealed that seed yield had significant positive association with days of 50% flowering and oil content at genotypic and phenotypic level (Table 3). Seed yield also exhibited positive correlation with plant height, days to maturity and test

weight at genotypic and phenotypic level indicating that these are the major yield attributing traits. Plant height showed significant positive correlation with days to 50% flowering and days to maturity. Number of primary branches/plant showed significant positive correlation with number of secondary branches/plant. Siliqua length showed significant positive correlation with number of seeds/siliqua. Similar findings were earlier

reported by many researchers (Kumar *et al.*, 1984; Kardam and Singh, 2005; Verma *et al.*, 2008; Yadava *et al.*, 2011; Singh *et al.*, 2013b; Meena *et al.*, 2017). Selection would be helpful in simultaneous improvement in these traits for yield improvement of Indian mustard. Rest of the characters with non significant correlation could be improved independently without affecting others.

Table.1 Mean sum of squares for various sources of variation in RBD analysis for 11 traits in Indian Mustard

Source of Variation	Replication	Treatment	Error
Degree of Freedom	2	26	52
Plant height (cm)	50.47	495.86**	46.55
Days to 50% Flowering	1.83	34.31**	2.29
Days to Maturity	15.16	37.79**	4.33
Primary branch/plant	0.52	1.28**	0.15
Secondary branch/plant	2.37	17.14**	0.94
Siliquae /plant	80.39	3403.37**	162.79
Siliqua length (cm)	0.01	0.26**	0.02
Seeds/Siliqua	1.04	2.37**	0.26
Oil content (%)	0.60	1.02**	0.16
Test weight (g)	0.87	1.93**	0.15
Seed Yield (Kg/ha)	21116.69	503199.1**	8800.41

** Significant (P=0.01)

Table.2 Estimates of different genetic parameters of variation for 11 traits among parents and crosses

Characters	Mean	Range		PCV (%)	GCV (%)	H ² (%)	GA as % of Mean
		Min.	Max.				
Plant height (cm)	176.88	147.67	199.00	7.92	6.92	76.29	12.45
Days to 50% Flowering	54.20	50.00	62.00	6.645	6.03	82.35	11.27
Days to Maturity	140.05	132.67	143.00	2.81	2.38	72.05	4.17
Primary branch/plant	5.36	4.33	6.78	13.52	11.46	71.79	20.00
Secondary branch/plant	11.59	7.22	17.78	21.72	20.05	85.18	38.11
Siliquae /plant	185.58	132.33	268.78	19.00	17.71	86.90	34.01
Siliqua length (cm)	4.26	3.64	4.76	7.43	6.53	77.11	11.81
Seeds/Siliqua	13.98	12.11	15.33	7.02	6.00	73.07	10.57
Oil content (%)	41.23	39.15	41.95	1.63	1.30	63.63	2.14
Test weight (g)	5.51	3.87	7.17	15.65	14.00	80.07	25.81
Seed Yield (Kg/ha)	3126.64	2185.36	3825.33	13.33	12.98	94.93	26.06

PCV: Phenotypic coefficient of variation, GCV: Genotypic coefficient of variation, H²: Heritability, GA: Genetic advance

Table.3 Genotypic and phenotypic correlation coefficients for 11 traits in Indian Mustard

Traits	Plant height (cm)	Days to 50% Flowering	Days to Maturity	Primary branch/plant	Secondary branch/plant	Siliquae /plant	Siliqua length (cm)	Seeds /Siliqua	Oil content (%)	Test weight (g)	Seed Yield (Kg/ha)
Plant height (cm)	P	0.6822**	0.4991**	-0.4262*	-0.0577	0.3126	-0.0014	0.2417	0.0187	-0.3705*	0.2891
	G	0.6202**	0.4808**	-0.4055*	-0.0901	0.2445	0.0391	0.2751	0.0247	-0.2686	0.2980
Days to 50% Flowering		P	0.3360*	-0.2461	-0.0545	-0.0930	-0.1580	-0.0854	0.0251	-0.3442*	0.5484**
		G	0.3322*	-0.2159	-0.0358	-0.0815	-0.1529	-0.0781	0.0656	-0.2892	0.5206**
Days to Maturity			P	-0.2095	0.1351	0.3168	0.0476	0.1533	-0.1518	-0.1799	0.2647
			G	-0.1959	0.0643	0.2821	0.0252	0.2378	-0.1070	-0.1747	0.2850
Primary branch/plant				P	0.3499*	0.1594	-0.0414	0.0622	-0.1083	-0.1098	-0.2889
				G	0.3230*	0.1083	-0.0065	0.0473	-0.1952	-0.0567	-0.2904
Secondary branch/plant					P	0.2914	0.1640	0.2179	-0.0470	-0.1464	-0.3511*
					G	0.2697	0.1355	0.2095	-0.0721	-0.1389	-0.3443*
Siliquae/plant						P	0.1844	0.3095	-0.2392	-0.3710*	-0.4913**
						G	0.1848	0.3852*	-0.2600	-0.3698*	-0.4798**
Siliqua length (cm)							P	0.6577**	0.1125	0.3649*	-0.2982
							G	0.5695**	0.0649	0.3181	-0.2854
No. of seeds/Siliqua								P	0.0984	-0.1458	-0.2718
								G	0.0341	-0.1373	-0.2686
Oil content (%)									P	0.0739	0.3846*
									G	0.1079	0.3524*
Test weight (g)										P	0.0620
										G	0.0691
Seed Yield (Kg/ha)											P
											G

P: Phenotypic correlation coefficients, G: Genotypic correlation coefficients, *, ** Significant at 5% and 1% respectively

Table.4 Path coefficients analysis for 11 traits towards seed yield in Indian Mustard

Traits		Plant height (cm)	Days to 50% Flowering	Days to Maturity	Primary branch/plant	Secondary branch/plant	Siliquae /plant	Siliqua length (cm)	Seeds /Siliqua	Oil content (%)	Test weight (g)	Seed Yield (Kg/ha)
Plant height (cm)	P	<u>-0.0460</u>	0.3135	0.1832	-0.0226	0.0130	-0.0861	0.0005	0.0163	0.0070	-0.0896	0.2891
	G	<u>0.0651</u>	0.1993	0.1588	-0.0125	0.0175	-0.0861	-0.0065	-0.0183	0.0066	-0.0259	0.2980
Days to 50% Flowering	P	-0.0314	<u>0.4596</u>	0.1234	-0.0131	0.0123	0.0256	0.0518	-0.0057	0.0093	-0.0833	0.5484**
	G	0.0404	<u>0.3213</u>	0.1098	-0.0067	0.0069	0.0287	0.0254	0.0052	0.0176	-0.0279	0.5206**
Days to Maturity	P	-0.0230	0.1544	<u>0.3671</u>	-0.0111	-0.0304	-0.0872	-0.0156	0.0103	-0.0564	-0.0435	0.2647
	G	0.0313	0.1067	<u>0.3304</u>	-0.0060	-0.0125	-0.0993	-0.0042	-0.0158	-0.0287	-0.0169	0.2850
Primary branch/plant	P	0.0196	-0.1131	-0.0769	<u>0.0530</u>	-0.0786	-0.0439	0.0136	0.0042	-0.0402	-0.0266	-0.2889
	G	-0.0264	-0.0694	-0.0647	<u>0.0308</u>	-0.0627	-0.0381	0.0011	-0.0032	-0.0524	-0.0055	-0.2904
Secondary branch/plant	P	0.0027	-0.0250	0.0496	0.0186	<u>-0.2248</u>	-0.0802	-0.0537	0.0147	-0.0174	-0.0354	-0.3511*
	G	-0.0059	-0.0115	0.0213	0.0100	<u>-0.1941</u>	-0.0949	-0.0225	-0.0140	-0.0193	-0.0134	-0.3443*
Siliquae/plant	P	-0.0144	-0.0427	0.1163	0.0085	-0.0655	<u>-0.2753</u>	-0.0604	0.0208	-0.0888	-0.0897	-0.4913**
	G	0.0159	-0.0262	0.0932	0.0033	-0.0523	<u>-0.3520</u>	-0.0306	-0.0257	-0.0697	-0.0357	-0.4798**
Siliqua length (cm)	P	0.0001	-0.0726	0.0175	-0.0022	-0.0369	-0.0508	<u>-0.3277</u>	0.0443	0.0418	0.0883	-0.2982
	G	0.0026	-0.0491	0.0083	-0.0002	-0.0263	-0.0650	<u>-0.1658</u>	-0.0379	0.0174	0.0307	-0.2854
No. of seeds/Siliqua	P	-0.0111	-0.0392	0.0563	0.0033	-0.0490	-0.0852	-0.2155	<u>0.0673</u>	0.0365	-0.0353	-0.2718
	G	0.0179	-0.0251	0.0786	0.0015	-0.0407	-0.1356	-0.0944	<u>-0.0666</u>	0.0091	-0.0133	-0.2686
Oil content (%)	P	-0.0009	0.0115	-0.0557	-0.0057	0.0106	0.0659	-0.0369	0.0066	<u>0.3713</u>	0.0179	0.3846*
	G	0.0016	0.0211	-0.0353	-0.0060	0.0140	0.0915	-0.0108	-0.0023	<u>0.2682</u>	0.0104	0.3524*
Test weight (g)	P	0.0171	-0.1582	-0.0661	-0.0058	0.0329	0.1021	-0.1196	-0.0098	0.0275	<u>0.2419</u>	0.0620
	G	-0.0175	-0.0929	-0.0577	-0.0018	0.0270	0.1302	-0.0527	0.0092	0.0289	<u>0.0965</u>	0.0691

Residual P=0.22807, G=0.32600, P: Phenotypic path coefficients, G: Genotypic path coefficients, Underlined values: Direct path coefficients *, ** Significant at 5% and 1% respectively

Path coefficient Analysis revealed that days to 50% flowering had maximum direct effect on seed yield at genotypic and phenotypic level this is also supported by the fact that indirect effect of days to maturity, number of secondary branches/plant, number of siliquae/plant, siliqua length and oil content (Table 4). Trait oil content was at second in its direct effect due to indirect effect of number of days to 50% flowering, number of secondary branches/plant, number of siliquae/plant and test weight. Traits days to 50% flowering and oil content were found significant at both genotypic and phenotypic level. Traits number of secondary branches/plant, number of siliquae/plant and siliqua length had negative direct effect on Seed yield at both genotypic and phenotypic level. Considering the result of path analysis it can be inferred that days to 50% flowering, days to maturity, number of primary branches/plant, oil content and test weight directly increase of seed yield of Indian mustard. Similar findings were earlier reported by many researchers (Singh *et al.*, 2003a; Singh *et al.*, 2003b; Singh *et al.*, 2009 and Singh *et al.*, 2011).

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