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Correlation and path coefficient analysis among yield and yield contributing traits in Indian mustard (*Brassica juncea* L.)

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Abstract
An investigation was undertaken with fifty mustard genotypes to study the correlation and path coefficient analysis of twelve yield contributing characters. Correlation analysis revealed that seed yield per plant is positively and significantly correlated with harvest index followed by number of secondary branches per plant and number of siliquae per plant at genotypic level. Path coefficient analysis revealed that days to maturity, number of secondary branches per plant, number of siliquae per plant, siliqua length, 1000 seed weight, harvest index and oil content had direct positive effect on seed yield per plant. Whereas, days to 50% flowering, plant height, number of primary branches per plant and number of seed per siliqua had direct negative effects on seed yield per plant both at genotypic and phenotypic levels. Based on the results it has been concluded that harvest index, number of secondary branches per plant and number of siliquae per plant exerted high correlation and direct influence on seed yield per plant. These traits may be considered for selection and to improve the yield of mustard genotypes.

Keywords: *Brassica juncea*, correlation, Indian mustard, path coefficient analysis

Introduction

Indian mustard (*Brassica juncea* L.) is an important *Rabi* oilseed crop extensively grown as rainfed crop in India. Mustard oil meets the one third of edible oil requirement of the country, to meet these needs the country highly depends on imports of vegetable oil. Import of vegetable oils during July 2019 is up by 26% to 14.12 lakh tones as compared to 11.19 lakh tones in July 2018, according to data compiled by the Solvent Extractors' Association of India (SEA). There is a need to decrease the Import of vegetable oils by expanding the area under oil seed crops. It is important to increase the yields of mustard crop by improving the available germplasm lines, for that we need to know various yield contributing characters and the relationship among them and with the seed yield. In this experiment, we studied correlation or mutual association among different yield contributing characters and the direct and indirect effects also estimated through path coefficient analysis. The inter-relationship between the yield components will be helpful to a breeder to assess the nature, extent and direction of selection pressure on characters.

Material and Methods

Experiment was conducted at Regional Agriculture Research Station, Polasa, Jagtial during *rabi*, 2020-21. The research plot was laid out in Randomized Block Design (RBD) with two replications and fifty genotypes of Indian mustard including two local checks *i.e.*, NRCHB-101 and Black gold. Each genotype was sown in two rows of three meters length, with inter-row spacing of 45 cm and intra row spacing of 10 cm. Sowing was done by dibbling the seed at 2-3 cm depth. All the standard package of practices were followed during crop growth period. The observations were recorded for twelve yield contributing characters *viz*., days to 50% flowering, days to maturity, plant height (cm), number of primary branches per plant, number of secondary branches per plant, number of siliquae per plant, number of seed per siliqua, siliqua length (cm), 1000 seed weight (g), seed yield per plant (g), harvest index (%) and oil content (%). Data was recorded for five randomly selected plants of each genotype in both the replications. The data was subjected to analysis of variance, phenotypic and genotypic coefficients of variations and other genetic parameters like heritability and genetic advance were calculated. Correlation coefficients were calculated as per the formulae suggested by Falconer (1981) [4].

The direct and indirect effects both at genotypic and phenotypic levels were estimated by taking seed yield as dependent variable, using path coefficient analysis as suggested by Wright (1921) [13] and Dewey and Lu (1959) [3]. The calculations were performed through computer generated programme WINDOSTAT, a statistical package at Computer Centre, PJTSAU, Rajendranagar, Hyderabad, Telangana, India.

Results and Discussion

Correlation analysis gives us an estimate of degree of association among two or more variables or characters. The dependence of yield on different yield attributing characters can be known by correlation coefficients. The results of genotypic correlation coefficients were presented in table 1. Seed yield per plant found have highest positive significant association with harvest index (0.641), followed by number of secondary branches per plant (0.50) and number of siliquae per plant (0.358). The similar results were reported by Kumar *et al*. (2016) [6], Jat *et al*. (2019) [5], Pal *et al*. (2019) [9], Pandey *et al*. (2020) [10] for harvest index, Rauf and Rahim (2018) [11], Kumar *et al*. (2019) [7], Pal *et al*. (2019) [9], Lakra *et al*. (2020) [8], Shar *et al*. (2020) [12] for number of siliquae per plant, Akabari and Niranjana (2015) [1], Yadav and Pandey (2018) [14], Kumar *et al*. (2019) [7], Pal *et al*. (2019) [9] for number of secondary branches per plant.

Some characters *viz*., plant height, number of primary branches per plant, 1000 seed weight and oil content found to have positive and non-significant association with seed yield per plant. While four characters *viz*., Days to 50% flowering (-0.150), days to maturity (-0.171), Siliqua length (-0.018) and number of seed per siliqua (-0.033) exhibited non-significant negative correlation with seed yield per plant at genotypic level. These results were in confirmation with Kumar *et al*. (2016) [6], Rauf and Rahim (2018) [11], Kumar *et al*. (2019) [7] for days to 50% flowering and days to maturity. The similar results for siliqua length were reported by Kumar *et al*. (2016) [6] and Pal *et al*. (2019) [9]. The non-significant negative association for number of seed per siliqua was reported by Yadav and Pandey (2018) [14].

Path coefficient analysis gives an estimate of direct and indirect effects of different yield contributing characters on seed yield per plant. Path coefficient analysis along with correlation coefficient analysis will be very efficient in the selection. The results of genotypic and phenotypic path coefficient analysis were presented in table 2. In the present study, the highest direct positive effects were observed for harvest index followed by number of secondary branches per plant and 1000 seed weight and number of siliquae per plant. Such direct and positive effects were also obtained by Kumar *et al*. (2019) [7] and Lakra *et al*. (2020) [8] for number of secondary branches per plant, Rauf and Rahim (2018) [11] and Pal *et al*. (2019) [9] for number of siliquae per plant, and Devi, B. (2018) [2], Pal *et al*. (2019) [9] and Pandey *et al*. (2020) [10] for 1000 seed weight and harvest index.

The negative direct effects on seed yield per plant were observed for plant height, number of primary branches per plant and number of seed per plant. The results were similar to the findings of Kumar *et al*. (2016) [6], Devi, B. (2018) [2] and Pal *et al*. (2019) [9] for plant height and Kumar *et al*. (2016) [6] and Lakra *et al*. (2020) [8] for number of primary branches per plant and number of seed per siliqua. The direct contribution of days to maturity was positive and low and it has indirect negative effects via number of primary branches per plant, number of secondary branches per plant, number of siliquae per plant, number of seed per plant, 1000 seed weight, harvest index and oil content and these results were in accordance with the results of Devi, B. (2018) [2], Kumar *et al*. (2019) [7] and Pal *et al*. (2019) [9].

Table 1: Genotypic correlation coefficient for yield and yield contributing traits in mustard genotypes

Trait	DFF	DM	PH (cm)	NPB	NSB	NSP	SL (cm)	NSS	TSW (g)	HI (%)	OC (%)	SYP (%)
Days to 50% flowering	1.00	0.668 **	0.026	0.133	-0.100	0.066	0.015	0.040	-0.049	-0.132	-0.045	-0.150
Days to maturity		1.00	0.212	-0.026	-0.127	-0.025	0.042	0.042	-0.164	-0.217	-0.195	-0.171
Plant height (cm)			1.00	0.307 *	0.422 **	0.382**	0.300 *	-0.120	0.125	0.0006	0.0006	0.163
No. of primary branches plant^{-1}				1.00	0.595 **	0.545 **	0.072	-0.066	0.424 **	0.117	-0.024	0.204
No. of secondary branches plant^{-1}					1.00	0.478 **	0.080	-0.030	0.122	0.122	-0.162	0.500 **
No. of siliquae plant^{-1}						1.00	-0.105	-0.122	0.339 *	0.127	0.047	0.358 *
Siliqua length (cm)							1.00	0.303 *	0.142	-0.056	-0.008	-0.018
No. seed siliqua^{-1}								1.00	0.067	0.135	0.159	-0.033
1000 seed weight (g)									1.00	-0.016	0.098	0.231
Harvest index (%)										1.00	0.231	0.641 **
Oil content (%)											1.00	0.124

* Significant at 5 per cent level, ** Significant at 1 per cent level

Table 2: Genotypic and phenotypic path coefficients of yield and yield contributing traits in mustard

Trait		DFF	DM	PH (cm)	NPB	NSB	NSP	SL (cm)	NSS	TSW (g)	HI (%)	OC (%)	SYP (g)
DFF	G	0.0245	0.0197	0.0010	0.0043	-0.0026	0.0018	0.0001	0.0010	-0.0011	-0.0024	-0.0009	-0.1501
	P	-0.0352	-0.0206	-0.0005	-0.0037	0.0033	-0.0022	-0.0009	-0.0014	0.0019	-0.0107	0.0019	-0.1505
DM	G	0.0465	0.0578	0.0151	-0.0035	-0.0079	-0.0018	0.0011	-0.0063	-0.0114	-0.0180	-0.0172	-0.2401
	P	0.0384	0.0656	0.0119	-0.0037	-0.0081	-0.0015	0.0038	-0.0061	-0.0095	-0.0107	-0.0098	-0.1260
PH (cm)	G	-0.0031	-0.0190	-0.0727	-0.0263	-0.0320	-0.0288	-0.0239	0.0083	-0.0090	0.0008	0.0187	0.1601
	P	-0.0004	-0.0058	-0.0321	-0.0087	-0.0130	-0.0119	-0.0089	0.0040	-0.0041	-0.0003	0.0046	0.1670
NPB	G	-0.0948	0.0326	-0.1957	-0.5403	-0.3558	-0.3472	-0.0553	0.0585	-0.2627	-0.0570	0.0088	0.2232
	P	-0.0251	0.0019	-0.0650	-0.2388	-0.1330	-0.1152	-0.0126	0.0093	-0.0920	-0.0298	0.0068	0.1931
NSB	G	-0.0579	-0.0742	0.2385	0.3567	0.5415	0.2629	0.0486	-0.0237	0.0678	0.196	-0.1145	0.5208
	P	-0.0367	-0.0480	0.1579	0.2169	0.3893	0.1835	0.0279	-0.0071	0.0470	0.1173	-0.0540	0.4813
NSP	G	0.0180	-0.0077	0.0991	0.1607	0.1214	0.2500	-0.0267	-0.0318	0.0856	0.0327	0.0215	0.3609

	P	0.0089	-0.0033	0.0539	0.0704	0.0687	0.1459	-0.0151	0.0174	0.0491	0.0183	0.0036	0.3555
SL (%)	G	0.0002	0.0017	0.0302	0.0094	0.0083	-0.0098	0.0921	0.0322	0.0138	-0.0056	-0.0021	-0.0132
	P	0.0001	0.0003	0.0015	0.0003	0.0004	-0.0006	0.0056	0.0015	0.0008	-0.0003	0.0000	-0.0226
NSS	G	-0.0078	0.0215	0.0226	0.0214	0.0086	0.0250	-0.0690	-0.1972	-0.0146	-0.0314	-0.0309	-0.0290
	P	-0.0043	0.0098	0.0131	0.0041	0.0019	0.0125	-0.0277	-0.1046	-0.0065	-0.0123	-0.0173	-0.0373
TSW (g)	G	-0.0171	-0.0738	0.0465	0.1817	0.0468	0.1280	0.05610	0.0277	0.3737	-0.0084	0.0471	0.2381
	P	-0.0127	-0.0346	0.0303	0.0921	0.0288	0.0804	0.0324	0.0150	0.2391	-0.0027	0.0203	0.2253
HI (%)	G	-0.0562	-0.1779	-0.0065	0.0603	0.2074	0.0748	-0.0347	0.0912	-0.0128	0.5720	0.1878	0.7021
	P	-0.0801	-0.0819	0.0051	0.0629	0.1517	0.0631	-0.0271	0.0593	-0.0057	0.5035	0.0701	0.5972
OC (%)	G	-0.0025	-0.0208	-0.0181	-0.0011	-0.0148	0.0060	-0.0016	0.0110	0.0088	0.0230	0.0701	0.1885
	P	-0.0033	-0.0094	-0.0091	-0.0018	-0.0087	0.0015	0.0000	0.0104	0.0053	0.0088	0.0629	0.0891

Residual effect = 0.5189

DFF-Days to 50% flowering, DM-Days to maturity, PH-Plant height (cm), NPB-Number of primary branches per plant, NSB- Number of secondary branches per plant, NSP- Number of siliquae per plant, SL- Siliqua length (cm), NSS- Number of seed per siliqua, TSW- 1000 seed weight (g), SYP-Seed yield per plant (g), HI- Harvest index (%), OC- Oil content (%).

Conclusion

The results in the present study revealed that three characters *viz*., harvest index, number of secondary branches per plant and number of siliquae per plant were directly, significantly and positively correlated with the seed yield per plant. Hence, the direct selection for these traits through simple breeding procedures will be helpful in improving the yield of the mustard genotypes.

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