RESEARCH ARTICLE

CORRELATION AND PATH ANALYSIS IN INDIAN MUSTARD

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Abstract: The present study was carried out with 50 Indian mustard hybrids to examine the association among yield component traits and their direct and indirect influence on seed yield per plant. The characters, *viz.* number of seeds per siliqua, number of secondary branches per plant, number of primary branches per plant, number of siliqua on main shoot, siliqua length, main shoot length and 1000-seed weight, showed significant correlation at both the genotypic and phenotypic levels. Number of secondary branches per plant had the greatest direct effect on seed yield per plant, followed by number of seeds per siliqua, 1000-seed weight, plant height, main shoot length and number of siliqua on main shoot.

Keywords: Correlation, Indian mustard, Hybrid, Siliqua

INTRODUCTION

Indian mustard plays a crucial role in the Indian agricultural economy and shares about 23.5% of the oilseeds area with 24.2% of the oilseeds production in the country. During the *Rabi* season, it is widely cultivated under both irrigated and rainfed conditions. The area, production and productivity of rapeseed-mustard in India is 6.23 million ha, 9.26 million tonnes and 1511 kg/ha, respectively, during 2018–19. The prominent mustard-growing states include Rajasthan, Uttar Pradesh, Haryana, West Bengal, Madhya Pradesh, Gujarat, and Assam, accounting for 92% of total production. The mustard seed contains essential nutrients such as selenium, magnesium, dietary fibre, omega-3 fatty acids, vitamin B3, calcium, protein and zinc (Kaur *et al.* 2019). The oil content of Indian mustard ranges between 38 and 46% (Tomar *et al.* 2015). Mustard oil contains little saturated fat and a lot of monounsaturated, polyunsaturated, and omega-3 fatty acids. This oil is commonly used in combination with other vegetable oils (sunflower, soybean, corn, etc.) to increase the omega-3/omega-6 fatty acid content. Oil cake is the coarse residue that is obtained after the oil has been extracted from the mustard seed. The mustard oil cake is a valuable protein source and is recommended feed for cattle.

Nowadays, breeding efforts are moving towards hybrid breeding. For high-yielding hybrids, we must have parental lines with yield-contributing traits. Correlation analysis is a statistical technique used to measure associations among traits. The correlation coefficient does not provide clear information about the cause and effect relationship. For this, path coefficient analysis is used to split correlation coefficients into direct and indirect effects.

The goal of this study is to analyze and draw conclusions about the nature of interrelationships among seed yield per plant and yield component traits employing Indian mustard hybrids.

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METHODS AND MATERIALS

The present study was conducted at the farm area of Oilseeds Section, Department of Genetic and Plant Breeding, CCS Haryana Agricultural University, Hisar during 2017-18. Fifty Indian mustard hybrids were sown in RBD design with three replications. The sowing of these hybrids were done in a paired row of 5m long with a spacing of 15 cm between plant to plant and 30 cm between row to row. All cultural practices were followed to raise a healthy crop. The data was collected from five competitive plants for traits including plant height, number of primary branches per plant, number of secondary branches per plant, main shoot length, number of siliqua on main shoot and seed yield per plant. For siliqua length and number of seeds per siliqua, we took five siliquae from each hybrid in each replication. For these traits, we took the average value for the final analysis. Days to 50% flowering and days to maturity were recorded on the plot basis. For 1000-seed weight, we counted a thousand seeds of each hybrid in each replication and then weighed these seeds in gm.

The correlation was calculated using the analysis of variance and covariance as suggested by Searle (1961). The significance of the coefficient of correlation (r) was determined by comparing the observed value or correlation coefficient to the tabulated value for (n-2) degrees of freedom (Snedecar and Cochran, 1967). Path-coefficient analysis was used to split the correlation into direct and indirect effects caused by the dependent variable. The path coefficient analysis was proposed by Wright (1934), and it was further elaborated by Dewey and Lu (1959).

Statistical Analysis

The statistical analysis was computed using the R software (version 3.6.1) with the Variability and TraitStats packages.

RESULTS AND DISCUSSION

Correlation

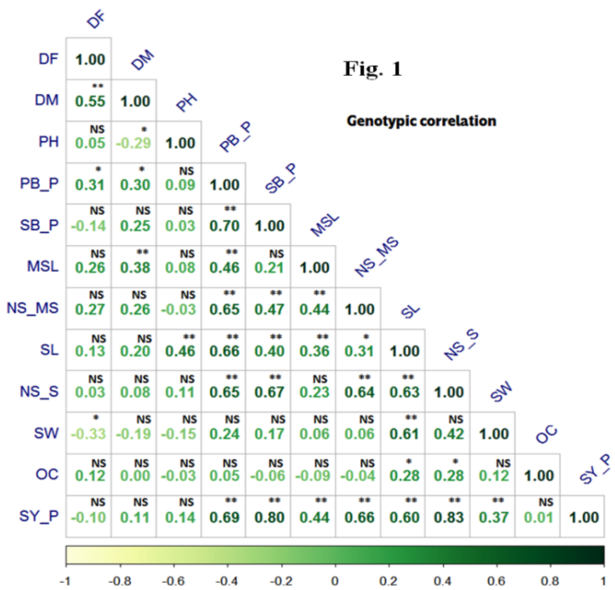
In crops, seed yield is the most challenging trait. Yield-related characters in Indian mustard (primary branches, secondary branches, number of siliqua on main shoot, siliqua length, number of seeds per siliqua and 1000-seed weight) affect seed yield directly or indirectly by some known or unknown mechanisms. Environmental conditions also have a significant impact on seed yield per plant (Shi *et al*., 2009). The correlation coefficient measures the type of association among traits. The coefficient's value ranges from -1 to 1, reflecting whether the relationship is neutral, favourable or negative. Low, moderate, and strong positive linear relationships are associated with values ranging from 0.0 to 0.3, 0.3 to 0.7, and 0.7 to 1.0, respectively, while low, moderate and high negative linear relationships are associated with values ranging from 0.0 to - 0.3, - 0.3 to - 0.7, and - 0.7 to - 1.0 respectively (Ratner., 2009).

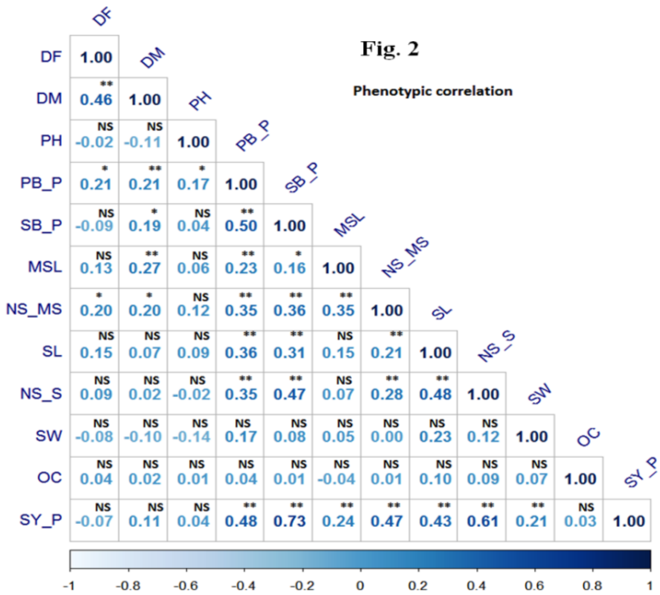
In the present study, the genotypic correlation coefficient (Fig.1) ranged between - 0.33 and 0.83, while the phenotypic correlation coefficient (Fig. 2) ranged between - 0.11 and 0.73. The values of genotypic correlation coefficients were higher than those of the phenotypic correlation coefficients. This indicates that environmental factors had an effect at the phenotypic level. The number of seeds per siliqua was found to have the strongest positive correlation with seed yield per plant (r = 0.83, 0.61), followed by number of secondary branches per plant (r = 0.80, 0.73), number of primary branches per plant (r = 0.49, 0.48), number of siliqua on main shoot (r = 0.66, 0.61), siliqua length (r = 0.60, 0.43), main shoot length (r = 0.44, 0.24), and 1000-seed weight (r = 0.37, 0.2). Ranjit *et al*., (2021) and Pandey *et al* ., (2020) have reported similar results for one or more traits in Indian mustard . Improving these traits may help hybrids to perform better in terms of seed yield per plant.

Path coefficient analysis

The correlation coefficient provides information about the association among traits. It is unclear whether this association is real or due to the indirect effect of other traits. For more clarity about this association, we further go to the path coefficient analysis by assuming the yield is an independent trait and it depends on the remaining yield contributing traits. This analysis facilitates the separation of direct and indirect effects *via* other attributes by partitioning correlation coefficient for better cause and effect interpretation.

The path coefficient analysis (Fig. 3) showed the maximum direct effect on seed yield per plant by secondary branches (0.43), followed by number of seeds per siliqua (0.38), 1000-seed weight (0.29), plant height (0.26), main shoot length (0.24) and number of siliqua on main shoot (0.18). Roy *et al.* (2018) also reported a high direct effect of the number of seeds per siliqua on seed yield per plant. Reaming traits had either a low direct effect or a negative effect on the seed yield per plant. Siliqua length has a negative direct effect while contributing indirectly to the seed yield per plant through other traits such as secondary branches, number of seeds per siliqua and 1000-seed weight.





DF = Days to 50% flowering, DM = Days to maturity, PH = Plant height (cm), PB_P = Number of primary branches/plant, NS_P = Number of secondary branches/plant, MSL = Main shoot length (cm) NS_MS = Number of siliqua on main shoot, SL= Siliqua length (cm), NS_S = Number of seeds/siliqua, SW = 1000–seed weight (g), SY_P = Seed yield /plant (g), OC = Oil content (%)

	DF	DM	PH	PB_P	SB_P	MSL	NS_MS	SL	NS_S	SW	OC
DF	**-0.08**	0.03	0.01	0.00	-0.06	0.06	0.05	-0.04	0.01	-0.10	0.00
DM	-0.05	**0.06**	-0.08	0.00	0.11	0.09	0.05	-0.05	0.03	-0.06	0.00
PH	0.00	-0.02	**0.26**	0.00	0.01	0.02	-0.01	-0.13	0.04	-0.04	0.00
PB_P	-0.03	0.02	0.02	**0.01**	0.30	0.11	0.11	-0.18	0.25	0.07	0.00
SB_P	0.01	0.02	0.01	0.01	**0.43**	0.05	0.08	-0.11	0.25	0.05	0.00
MSL	-0.02	0.02	0.02	0.01	0.09	**0.24**	0.08	-0.10	0.09	0.02	0.00
NS_MS	-0.02	0.02	-0.01	0.01	0.21	0.11	**0.18**	-0.08	0.24	0.02	0.00
SL	-0.01	0.01	0.12	0.01	0.17	0.09	0.05	**-0.27**	0.24	0.18	0.01
NS_S	0.00	0.01	0.03	0.01	0.29	0.05	0.11	-0.17	**0.38**	0.12	0.01
SW	0.03	-0.01	-0.04	0.00	0.07	0.01	0.01	-0.17	0.16	**0.29**	0.00
OC	-0.01	0.00	-0.01	0.00	-0.03	-0.02	-0.01	-0.07	0.11	0.04	**0.02**

Fig. 3. Genotypic path analysis among Indian mustard traits on seed yield per plant

DF = Days to 50% flowering, DM = Days to maturity, PH = Plant height (cm), PB_P = Number of primary branches/plant, NS_P = Number of secondary branches/plant, MSL = Main shoot length (cm) NS_MS = Number of siliqua on main shoot, SL= Siliqua length (cm), NS_S = Number of seeds/siliqua, SW = 1000–seed weight (g), OC = Oil content (%)

CONCLUSION

The critical examination of correlation and path coefficient demonstrates that traits *viz.* number of seeds per siliqua, secondary branches per plant, primary branches per plant, and 1000-seed weight exhibited positive correlation and a high direct effect on the seed yield per plant. There is an opportunity to improve seed yield per plant of Indian mustard hybrids by focusing on parental lines with these characteristics.

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