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RESEARCH ARTICLE

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Character Association and Path Coefficient Analysis in Indian Mustard (*Brassica juncea* L.)

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ABSTRACT

Background: Correlation analysis informs us about the relative importance of the breeding traits and quite useful for plant breeders to formulate their breeding and selection strategies. Path coefficient analysis splits the correlation coefficient into the measures of indirect and direct effect. It identifies the indirect and direct influence of different autonomous genotype on a dependent trait. Present study aimed to determine major seed contributing components affecting seed yield and also to know the relationship among these components.

Methods: Present investigation was carried out on 147 advanced breeding lines to know the correlations and path coefficient for 12 yield and yield contributing traits. The material was evaluated in augmented block design with 07 blocks, each block having 21 lines. A set of three check varieties were repeated in each block. Observations were recorded on number of primary branches/plant, number of secondary branches/plant, plant height (cm), silique/plant, fruiting zone length (cm), main shoot length (cm), number of seeds/siliquae, siliquae length (cm), biological yield/plant (g), seed yield/plant (g), harvest index and test weight.

Result: The seed yield per plant showed positive and significant correlation with primary branches per plant (0.273), secondary branches per plant (0.280), siliquae per plant (0.627), biological yield per plant (0.744), harvest index (0.188), test weight (0.212) and oil content (0.225). Biological yield per plant (0.5747) had maximum direct effect on seed yield per plant followed by siliquae per plant (0.2438), harvest index (0.127), oil content (0.118) and test weight. These characters have positive and significant association with seed yield per plant. The study thus indicated that biological yield per plant, siliquae per plant, harvest index and test weight are the important characters which should be considered in selection programme in Indian mustard.

Key words: *Brassica*, Correlations, Path coefficient, Seed yield.

INTRODUCTION

Indian mustard (*Brassica juncea* L), a member of group rapeseed-mustard is an important rabi oilseed crop in India because of its growing habit and wider range of adaptation. Central Asia-Himalayas is a primary center of diversity for this species with migration to China, India and Caucasus (Hemingway, 1976). The species has probably evolved in the Middle East, where its putative diploid progenitors are sympatric (Prakash and Hinata, 1980). It is highly polymorphic and includes both leafy and oliferous varieties. In India *Brassica juncea* is a predominant species which accounts for nearly 80% hectare of the oil seed Brassica. In terms of area of rapeseed-mustard under oilseeds, India holds premier position in the world but the productivity and yield is less than the world average. The demand - supply gap of oils in future is anticipated to increase further due to expected increase in population and better living standard. The requirement of total vegetable oils has been estimated to be increase up to 29.05 million tonnes by 2030 (Anonymous, 2015).

Seed yield is a complex character, governed by polygene and is the ultimate result of complex relationship among different yield components along with seed and seedling characteristics and thus, improvement in seed yield is very difficult to achieve by direct selection. Therefore, it is imperative to determine major seed contributing components affecting seed yield and also to know the relationship among these components. Path analysis is useful in selection of characters that have direct and indirect effects on yield.

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MATERIALS AND METHODS

The present investigation was carried out at Directorate of Rapeseed-mustard Research, Bharatpur during *rabi* 2019-20. Bharatpur is situated at 77.30°E of longitude and 27.15°N of latitude and is about 178.37 meters above mean sea level. The climate of Bharatpur region is sub-tropical and semi arid. Summer season is quite hot with mean maximum daily temperature ranging from 35-47°C and mean minimum temperature from 12 to 19°C. It receives about 700 mm of rainfall. Material for present investigation consisted of 147 advanced breeding lines derived from diverse sources.

The material was divided into 07 blocks, each block having 21 lines. A set of three check varieties were repeated in each block. Each entry/check was sown in three rows of 5 meter length having row to row and plant to plant distance

30x 10 cm respectively. All recommended package of practices were followed to raise a healthy crop. Observations were recorded on number of primary branches/plant, number of secondary branches/plant, plant height (cm), silique/plant, fruiting zone length (cm), main shoot length (cm), number of seeds/siliquae, silique length (cm), biological yield/plant (g), seed yield/plant (g), harvest index and test weight. Harvest index (%) was calculated as ratio of economic yield to biological yield. The correlations were computed as suggested by Singh and Choudhary (1995) and path coefficient as described by Dewey and Lu (1959).

RESULTS AND DISCUSSION

Genotypic correlation coefficients were worked out among different pairs of characters including seed yield per plant (Table 1). The seed yield per plant showed positive and significant correlation coefficient with primary branches per plant (0.273), secondary branches per plant (0.280), siliquae per plant (0.627), biological yield per plant (0.744), harvest index (0.188), test weight (0.212) and oil content (0.225). Similar significant and positive correlations of yield with these characters have been earlier reported by Kardam and Singh (2005), Lohia *et al* (2013), Kumar and Singh (2013), Lodhi *et al* (2014), Akabari *et al* (2015) and Verma et al (2016). Among the various inter relationships between remaining traits, plant height had positive and significant association with primary and secondary branches per plant (0.631, 0.187), fruiting zone length (0.419), main shoot length (0.312), siliquae on main shoot (0.365), siliquae per plant (0.204) and siliquae length. Earlier positive association of plant height with number of siliquae on main shoot and primary branches per plant was reported by Kumar and Singh (2013). Primary branches per plant exhibited significant and positive association with secondary branches per plant (0.375), fruiting zone length (0.324), main shoot length (0.196), siliquae on main shoot (0.256), siliquae per plant (0.388), siliquae length (0.363), seeds per siliqua (0.225) and biological yield per plant. Patel *et al* (2000), Srivastava and Singh (2002) and Gosh and Gulati (2001) also reported positive association of primary branches per plant with secondary branches per plant. Fruiting zone length had positive and significant association with main shoot length (0.471), siliquae on main shoot (0.511), siliquae per plant (0.178) and siliquae length (0.317). Earlier Badsra and Chaudhary (2001) reported same results.

Siliquae per plant had positive and significant association with seeds per siliqua (0.214) and biological yield per plant (0.631). This report is in agreement to earlier reports made by Patel *et al* (2000) and Singh and Mishra (2002). Main shoot length showed positive and significant association with siliquae on main shoot (0.663) and siliquae length (0.194). This result is in conformity with the earlier reports of Lodhi *et al* (2014). Siliquae on main shoot was positively and significantly correlated with siliquae per plant (0.251), siliquae length (0.265) and seeds per siliqua (0.201). Siliqua length had positive and significant association with

Table 1: Estimation of genotypic correlation coefficient for different quantitative characters and seed yield.

Characters	Plant height (cm)	Primary branches per plant	Secondary branches per plant	Fruiting zone length	Main shoot length	Siliquae on main shoot	Siliquae per plant	Siliquae length	Seeds per siliqua	Biological yield per plant (g)	Seed yield per plant (g)	Harvest index (%)	Test weight (g)	Oil content (%)
Plant height (cm)	1													
Primary branches per plant	0.631**	1												
Secondary branches per plant	0.187*	0.375**	1											
Fruiting zone length	0.419*	0.324**	0.509**	1										
Main shoot length	0.312**	0.196*	0.209*	0.471**	1									
Siliquae on main shoot	0.365*	0.256**	0.278*	0.511**	0.663**	1								
Siliquaeper plant	0.204*	0.388**	0.447**	0.178*	0.157^{NS}	0.251**	1							
Siliquae length	0.379*	0.363**	0.227**	0.317**	0.194*	0.265**	0.073^{NS}	1						
Seeds per siliqua	0.095^{NS}	0.225**	0.122^{NS}	0.147^{NS}	0.051^{NS}	0.201*	0.214**	0.534**	1					
Biological yield per plant (g)	0.099^{NS}	0.340**	0.331**	0.061^{NS}	0.102^{NS}	0.153^{NS}	0.631**	-0.121^{NS}	0.010^{NS}	1				
Seed yield per plant (g)	0.099^{NS}	0.273**	0.280**	0.054^{NS}	0.042^{NS}	0.086^{NS}	0.627**	-0.075^{NS}	0.099^{NS}	0.744**	1			
Harvest index (%)	-0.033^{NS}	0.048^{NS}	0.001^{NS}	-0.005^{NS}	0.116^{NS}	0.016^{NS}	0.139^{NS}	0.119^{NS}	0.086^{NS}	0.041^{NS}	0.188*	1		
Test weight (g)	0.064^{NS}	0.012^{NS}	0.032^{NS}	0.021^{NS}	-0.068^{NS}	0.060^{NS}	0.051^{NS}	0.071^{NS}	0.093^{NS}	0.154^{NS}	0.212*	0.119^{NS}	1	
Oil content (%)	-0.006^{NS}	0.078^{NS}	0.162^{NS}	0.054^{NS}	-0.002^{NS}	0.148^{NS}	0.135^{NS}	0.069^{NS}	0.026^{NS}	0.131^{NS}	0.225**	0.055^{NS}	0.229**	1

Table 2: Direct and indirect effect of yield components on seed yield.

Characters	Plant height (cm)	Primary branches per plant	Secondary branches per plant	Fruiting zone length	Main shoot length	Siliquae on main shoot	Siliquae per plant	Siliquae length	Seeds per siliqua	Biological yield per plant (g)	Harvest index (%)	Test weight (g)	Oil content (%)
Plant height (cm)	0.07913	0.04994	0.01482	0.03318	0.02469	0.0289	0.01617	0.03	0.00749	0.00783	-0.0026	0.00503	-0.00051
Primary branches per plant	-0.02962	-0.04693	-0.0176	-0.0152	-0.00919	-0.01204	-0.01823	-0.01704	-0.01056	-0.01595	-0.00225	-0.00055	-0.00367
Secondary branches per plant	-0.00218	-0.00436	-0.01162	-0.00592	-0.00243	-0.00323	-0.0052	-0.00263	-0.00142	-0.00384	-0.00002	-0.00037	-0.00188
Fruiting zone length	0.01185	0.00915	0.0144	0.02826	0.0133	0.01443	0.00502	0.00894	0.00414	0.00173	-0.00014	0.00059	0.00152
Main shoot length	-0.00354	-0.00222	-0.00237	-0.00533	-0.01133	-0.00751	-0.00178	-0.00219	-0.00057	-0.00115	-0.00131	0.00077	0.00002
Siliquae on main shoot	-0.03723	-0.02615	-0.02838	-0.05206	-0.06759	-0.10195	-0.02561	-0.02701	-0.02054	-0.01557	-0.00161	-0.00607	-0.01506
Siliquae per plant	0.04981	0.09472	0.10905	0.04335	0.03838	0.06126	0.24385	0.01773	0.05222	0.15376	0.03387	0.01239	0.03296
Siliquae length	-0.03401	-0.03258	-0.02033	-0.0284	-0.01738	-0.02377	-0.00653	-0.08973	-0.04793	0.01089	-0.01064	-0.00638	-0.00623
Seeds per siliqua seeds per siliqua	0.00857	0.02037	0.01108	0.01326	0.00459	0.01823	0.01938	0.04836	0.09052	0.00094	0.00777	0.00838	0.00233
Biological yield per plant (g)	0.05689	0.19534	0.18998	0.03526	0.05854	0.0878	0.36244	-0.06976	0.00596	0.57479	0.02372	0.0884	0.07507
Harvest index (%)	-0.00418	0.0061	0.00018	-0.00062	0.01472	0.00201	0.01765	0.01507	0.0109	0.00524	0.12704	0.01515	0.007
Test weight (g)	0.00427	0.00078	0.00215	0.00141	-0.00456	0.004	0.00341	0.00477	0.00622	0.01033	0.00801	0.06714	0.01537
Oil content (%)	-0.00077	0.00925	0.01912	0.00635	-0.00021	0.01749	0.016	0.00822	0.00304	0.01546	0.00653	0.02711	0.11839

seeds per siliqua. Similar reports were earlier obtained by Gupta and Thakur (2002). Few correlations (Plant height with harvest index and oil content, Fruiting zone length with harvest index, main shoot length with test weight and oil content, siliquae length with biomass and seed yield) were found to be negative between each other. Adams (1967) reported that negative correlation arises in response to competition between developmentally flexible components. Based on above study it can be concluded that characters, which exhibited positive association with seed yield, are important characters and should be considered in selection programme.

Partitioning of the correlation coefficients in to direct and indirect effects were done at the genotypic level and the results are presented in Table 2. A critical perusal of result in the table revealed that biological yield per plant (0.5747) had maximum direct effect on seed yield per plant followed by siliquae per plant (0.2438), harvest index (0.127), oil content (0.118) and test weight. These characters have positive and significant association with seed yield per plant. This confirmed the role of these characters in determining the seed yield. Similar findings were earlier reported by Patel *et al*, 2000; Kardam and Singh 2005 in Indian mustard. The residual effect was of relatively high magnitude which indicated that more variables need to be included in study apart from present characters explaining the variation in seed yield per plant. The study thus indicated that biological yield per plant, siliquae per plant, harvest index and test weight are the important characters which should be considered in selection programme in Indian mustard. Indirect selection through such traits having high or moderate positive effect on seed yield would also be rewarding in yield improvement.

CONCLUSION

Present study was conducted on 147 advanced breeding lines derived from diverse sources. Observations were recorded on 12 morphological traits. Genotypic correlation coefficients and path coefficient analysis was performed. The seed yield per plant showed positive and significant correlation with primary branches per plant, secondary branches per plant, siliquae per plant, biological yield per plant, harvest index, test weight and oil content. Biological yield per plant had maximum direct effect on seed yield per plant followed by siliquae per plant, harvest index, oil content and test weight. These characters have positive and significant association with seed yield per plant. This confirmed the role of these characters in determining the seed yield. Indirect selection through such traits having high or moderate positive effect on seed yield would be rewarding in yield improvement.

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