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Study of Correlation and Path Analysis In Indian Mustard [*Brassica Juncea* (L.) CZERN & COSS]

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ABSTRACT
This experiment was conducted at the research area of the Oilseeds Section, Department of Genetics & Plant Breeding, CCS Haryana Agricultural University, Hisar. Two hundred diverse germplasm lines of Indian mustard were grown in a randomized block design with two replications for ten quantitative traits.The present research was carried out to determine the best selection criteria for yield improvement in Indian mustard based on its attributed traits. Seed yield per plant was found to be positively and significantly correlated with number ofprimary branches/ plant, number ofsecondary bra nches/plant. Path analysis revealed that characters such as primary branches/ plant, number of secondary branches/plant, germination percentage and seedling vigour were the major component traits of seed yield and hence these characters might bring priority in selection in view of improvement in seed yield of mustard.
Key words: Brassica juncea, correlation, path analysis, seed yield.

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INTRODUCTION

Indian mustard (*Brassica juncea* 2n=4x=36) is anmain species of brassicacae family and it is the second most essential oilseed crops after groundnut. Indian mustard popularly known as rai, raya or laha is one of the most important oil seed crops of the country and it occupies considerably large acreage among the *Brassica* group of oil seed crops. India stands first in acreage along with production of rapeseed and mustard in Asia. The crops are cultivated on an area of 6.70 million ha with a production of 7.96 million tones, with an average yield of 1188 kg/ha [14]. Yield is the net resultant outcome of many variables that affect plant growth throughout the growing period. Presence of genetic variability is a prerequisite for the success of any breeding programme. Yield is the net resultant outcome of many variables that affect plant growth throughout the growing period. Presence of genetic variability is a prerequisite for the success of any breeding programme. Main aim of any crop improvement programme is to enhance yield. As certained fact, yield is a complex trait and is dependent on many other secondary characters which are mostly inherited quantitatively. The different morphological traits vary in their relationship with yield in terms of their nature as well as magnitude, though they show a continuous variation and are influenced by environment. Correlation coefficient is an important statistical method in selection for higher yield by establishing relationship between the yield and its related components. The estimates of correlation coefficient, although, indicate inter- relationship of different traits, but it does not furnish information on cause and effect. Under such situation path analysis helps the breeder to identify the index of selection.The path coefficient analysis splits the correlation coefficient into direct and indirect effects [8], thus helps the breeders to get a deep insight to choose criterion for selection for higher yield. The present investigation was undertaken to appraise the trait association, and path coefficient analysis in Indian mustard.

MATERIAL AND METHODS

This experiment was conducted at the research area of the Oilseeds Section, Department of Genetics & Plant Breeding, CCS HAU, Hisar. The material for present study comprised of 200 germplasm lines of Indian mustard. Each germplasm lines were grown in a randomized block design with two replications having plot size of 2 rows x 3m. All the recommended cultural practices were followed throughout the crop season. Observations were recorded on five competitive plants excluding border plants in each germplasm lines, which were randomly selected from each replication. Data on individual plants were recorded for Number of primary branches per plant, number of secondary branches per plant, germination percentage, speed of germination, seedling vigour and seed yield. The analysis of variance for Randomized Block Design was carried out for individual characters to test the significance of difference among the genotypes following the method [26] .Correlation coefficients were determined by using the variance and covariance components as suggested by [2].The path analysis was carried out as per the procedure described by[8].

Germination percentage

Fifty seed per replicates for each treatment were placed on sufficiently moistened filter paper in germination plate (top of paper) at the temperature 25±1^{o}C with 92 to 95 percent RH in the seed germination. The first count of germination was recorded on 4th day and final count was recorded on 7th day. Only the normal seedling considered for percent germination according to the rules of the [9] Number of normal seedling obtained was expressed as percent germination.

Germination percentage (G %) = n / N × 100,

Where, n is the number of germinated seed at the seventh day; N is the number of total seeds.

Speed of germination

The number of seedling emerged were counted on each day up to seedling establishment (21th day) and the speed of emergence was calculated as described by [13]

$$\text{Speed of emergence} = \frac{\text{No.of seedling emerged}}{\text{First day of count}} + \ldots\ldots + \frac{\text{No.of seedling count}}{\text{Day of last count (21th Day)}}$$

Seedling vigour

From the observation recorded for standard germination and seedling length, seedling vigour was calculated according to methods suggested by[3].

Vigour Index = Germination (%) X Seedling length

Data thus collected were subjected to estimation of genetic parameters like genotypic and phenotypic variances, genotypic and phenotypic coefficients of variability, heritability and genetic advance according to [5].The Correlation Coefficients between all possible combinations of variables were worked out according to [2] and the Path-Coefficient technique was performed according to the method suggested by [8]

RESULTS AND DISCUSSION

The analysis of variance revealed that the mean sum of squares of all the 6 characters were highly significant for all the characters studied indicating genetic variability among the experimental materials.The coefficient of variation was low (<10%) for all the characters except number of primary branches per plant, secondary branches per plant and seed yield, which indicates that effective local control of experiment was done (Table 1).

Table 1: Analysis of variance for seed yield, its component characters and seedling characters in *Indian* mustard

Source of variation	Degree of freedom	Primary branches/ plant	Secondary branches/ plant	Germination (%)	Speed of germination	Seedling vigour	Seed yiel.d/plant (g)
Replications	1	3.52	96.38	45.56	0.02	5030.00	0.18
Treatments	199	0.98*	52.67*	11.18*	6.52*	8766.15*	66.09*
Error	199	0.50	2.34	5.11	0.04	530.76	9.78
CV (%)		13.70	10.63	2.51	2.38	2.47	10.62

***Significant at P=0.05**

The reason for high magnitude of variability in the present study may be due the fact that thegenotypes selected were developed in different breeding programmes representing different agro-climatic conditions of the country.The present study revealed, genotypic correlation coefficients, in general, were higher in magnitude than their corresponding phenotypic correlation coefficients for most of the character combinations, suggesting that association between various characters, was genetically controlled and environments played a backward role in determining phenotypic correlation coefficients (Table 2).

Table 2: Genotypic (above diagonal) and phenotypic (below diagonal) correlation coefficients among different characters in *Indian* mustard

Characters	Primary branches/ plant	Secondary branches/ plant	Germination (%)	Speed of germination	Seedling vigour	Seed yield/ plant(g)
Primary branches/plant	1.000	0.456	-0.260	-0.207	0.013	0.231*
Secondary branches/plant	0.234*	1.000	-0.093	-0.115	-0.035	0.142*
Germination (%)	-0.099	-0.050	1.000	1.148	0.116	-0.059
Speed of germination	-0.090	-0.109	0.716*	1.000	0.191	-0.028
Seedling vigour	-0.002	-0.030	0.334*	0.188*	1.000	-0.025
Seed yield/plant (g)	0.155*	0.137*	0.021	-0.021	0.002	1.000

***Significant at p=0.05**

The seed yield per plant was found positive and significantly associated with number of primary branches per plant (0.155*), number of secondary branches per plant (0.137*) and negative correlation with speed of germination,indicating that these are the major yield attributing traits. However non-significant and positive association was observed for germination percentage and seedling vigour. Selection would be helpful in simultaneous improvement in these traits for yieldimprovement of Indian mustard. Rest of the characters with non-significant correlationcould be improved independently without affecting others.Number of primary branches had positive and significant correlation with number of secondary branches per plant and seed yield.Similar observations were also made by Doddabhimappa *et al.* (2009). Number of primary branches per plant had negative correlation with germination percentage (-0.099) and speed of germination (-0.090). Number of secondary branches had negative correlated with speed of germination (-0.109). Germination percentage had positive and significant correlation with speed of germination (0.716*) and seedling vigour (0.334*). Speed of germination had positive and significant association with seedling vigour (0.188*). The results are in agreement with [7] for positive correlation with seed yield, [17] for number of primary branches per plant, [11] for number of primary and secondary branches per plant, [15] for number of primary and secondary branches per plant, [19], [20] and [10] for number of primary branches per plant, [23] for significant and positive correlation of number of primary and secondary branches per plant with seed yield, [22] and [16] for positive association of number of primary and secondary branches per plant with yield, [14] for positive correlation with number of secondary branches per plant with seed,[24]) for number of secondary branches per plant,[25] and [12] for number of primary branches per plant and number of secondary branches per plant with seed yield in indian mustard.The estimates of correlation coefficient, although, indicate inter- relationship of different traits, but it does not furnish information on cause and effect. Under such situation path analysis helps the breeder to identify the index of selection.Considering seed yield per plant as effect and five characters as causes, genotypic correlation coefficients were apportioned by using method of path analysis to find out the direct and indirect effects of yield contributing characters towards the seed yield (Table 3).

Table 3: Direct and indirect effects of different characters on seed yield in *Indian* mustard

Characters	Primary branches/plant	Secondary branches/ plant	Germination (%)	Speed of germination	Seedling vigour	Seed yield/ plant(g)
Primary branches/plant	0.0115	0.0053	-0.0030	-0.0024	0.0001	0.2311
Secondary branches/plant	0.2511	0.5507	-0.051	-0.0635	-0.0196	0.1425
Germination (%)	-0.1086	-0.0386	0.4171	0.4790	0.0484	-0.0592
Speed of germination	0.0993	0.0552	-0.5497	-0.4787	-0.0916	-0.0283
Seedling vigour	0.0003	-0.0009	0.0029	0.0049	0.0254	-0.0255

R^2= 0.23

Number of secondary branches per plant (0.5507) had the highest direct contribution towards grain yield per plant followed by germination percentage (0.4171), seedling vigour (0.0254) and number primary branches per plant (0.0115). Germination percentage had high indirect effect via speed of germination and seedling vigour.These findings are in congruity with the findings of [19] [18], [25], [17] and [12], [1] for direct effect of secondary branches per plant followed by number of primary branches per plant, [6] for maximum direct effect of secondary branches per plant on yield[10] for primary branches per plant which had direct effect on yield, [25] for positive direct effect of primary branches per plant with seed yield and [21] for highest positive direct of secondary branches per plant with seed yield. In this study has clearly indicated the need for giving due weightage for number of secondary branches per plant, number of primary branches per plant and seedling vigour for improving seed yield in mustard. These variables were with maximum potential of selection for seed yield improvement because these traits possessed positive and significant correlation as well as high direct effect on yield.

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