RESEARCH ARTICLE

CORRELATION AND PATH ANALYSIS IN SESAME (*SESAMUM INDICUM* L.)

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Abstract: Genetic variability forms the basis for crop improvement hence detailed appraisal of the accessions for different morphological, agronomic and quality traits is necessary in order to identify useful traits either for direct or indirect use in improvement programs. The present experiment was carried out at Niger Research Station, Navsari Agricultural University, Varanasi, (Vansda) during summer 2019. The magnitudes of genotypic correlations were higher as compared to the corresponding phenotypic correlations which indicate that there was an inherent association between the characters at genotypic level. Seed yield per plant was found to be highly significant and positively correlated with plant height, branches per plant, capsules per plant, capsule length and harvest index at both genotypic and phenotypic levels while days to maturity and capsule width had highly significant correlation with seed yield per plant at genotypic level indicating that these attributes were mainly influencing the seed yield in sesame. Thus, selection practiced for the improvement in a character will automatically result in the improvement of other character even though direct selection for improvement has not been made for the yield character. While, non-significant positive correlation with seed yield per plant was observed for leaf area and 1000 seed weight at both genotypic and phenotypic levels. Highly significant negative correlation observed for days to 50 % flowering and total oil content indicated that selection for such negatively correlated trait would be very crucial affecting the progress under selection and it would be hard to apply simultaneous selection for these characters for development of new variety. Path coefficient analysis revealed highest positive direct effect on seed yield was recorded for branches per plant followed by days to maturity, harvest and 1000 seed weight. Thus, these traits turned out to be the major components of seed yield per plant.

Keywords: Path coefficient, Correlation analysis, Sesame

INTRODUCTION

The word sesame derived from Latin word 'sesamum' and Greek word 'sesamon' which means seed or fruit of sesame plant. Sesame (*Sesamum indicum* L), also known as 'ellu' in 'Kannada', 'til' in Hindi and 'nuvvulu' in Telugu, is an ancient crop known to mankind. It is an indigenous crop of India after groundnut and brassica oilseeds. it was originated in south western Africa. In Africa most of the cultivated and wild species of sesame occurs. It might have introduced through countries like Indonesia and Malaysia before Aryan dynasty. *Sesamum indicum*. L is one among total 13 genera. It belongs to the family Pedaliaceae and order Tubiflorae. There are 36 species including the cultivated species (*Sesamum indicum* L.) which has chromosome number 2n=26.

India holds a premier position in the global oil seeds scenario accounting for 29 per cent of the total area and 26 per cent of production. In India, sesame is cultivated in 17.138 lakh hectare with a production of 7.84 lakh tonnes and productivity of 457 kg /ha. Madhya Pradesh contributes 19.71% and 23.68% share of country's area (3.80 lakh ha) and production (1.94 lakh tonnes), respectively with productivity of 511 Kg/ha.

Correlation analysis is a statistical measure used to measure the degree and direction of relationship between two or more variables. Most of the characters of interest to breeders are complex and are the result of the interaction of a number of components. Understanding the relationship between yield and its components is of paramount importance for making the best use of these relationships in selection. Character association derived by correlation coefficient, forms the basis for selecting the desirable plant, aiding in evaluation of relative influence of various component characters on seed yield.

The path coefficient analysis is simply a standardized partial regression coefficient which splits the correlation coefficient into the measure of direct and indirect effects. The concept of path coefficient was developed by Wright (1921). Path coefficient analysis was applied for assessment by Dewey and Lu (1959) in crested wheat grass.

The path analysis unravels whether the association of independent characters with dependent variable is due to their direct effect on it or is a consequence of their indirect effect via some other traits. If the correlation between dependent and independent variables is due to their direct effects of the character, it reflects a true relationship between them and selection can be practiced for such character in order to improve the dependent variable. But, if the association is mainly through indirect effect of the character via another component character, then the breeder has to select for the latter through which the indirect effect is exerted.

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MATERIALS AND METHODS

The present study was carried out Niger Research Station, Navsari Agricultural University, Vanarasi (Vansda) during summer 2019 using forty diverse genotypes of sesame. The soil of experimental plot was medium black having medium to poor drainage and good water holding capacity with pH 7.5 to 7.8. Vanarasi is situated between the parallels of 20.7782164° N latitude and 73.3466564° E longitude. The climate of this area is tropical characterized by fairly hot summer, moderately cold winter with humid and warm monsoon. The rainfall of this region is heavy and normally received from June to September. Most of the precipitation is received through southwest monsoon, concentrating in the months of July and August. The forty different genotypes were grown in randomized block design in three replications with spacing 60 x 15 cm^2. The experimental plot size is 25.20 m^2 comprising of 40 genotypes with row length of 3.30 m. with 22 plants in each row in which 1 plant at each border. For raising a successful and healthy crop all the recommended package of practices were adopted.

Five plants are randomly selected, excluding the border ones, from each plot of all the three replications were tagged and used for recording the observations at harvesting stage. The average value of data from these plants were computed and used for statistical analysis. Observation was recorded for thirteen characters viz., Days to 50 % flowering, Days to maturity, Plant height (cm), Branches per plant, Capsules per plant, Capsule length (cm), Capsule width (cm), Leaf area (cm^2), Seeds per capsule, 1000 Seed weight (g), Total oil content (%), Harvest index (%), Seed yield per plant (g). The calculation of data by analysis of variance with formula suggested by Panse and Sukhatme (1978).

Analysis of covariance for all possible pairs of thirteen characters was carried out (Panse and Sukhatme, 1987) for each family. Path analysis suggested by Dewey and Lu (1959) was adopted for each genotype separately in order to partition the genotypic correlation between variables with seed yield into direct and indirect effects of those variables on yield. The estimates of genetic variability parameters, correlation and path coefficients analysis were calculated by analysing data using INDOSTAT statistical package.

RESULTS AND DISCUSSION

In present study, higher degree of genotypic correlation coefficients than their phenotypic counterparts in most of the characters did indicate that there was a higher degree of inherent association between two characters at genotypic level. The correlation coefficients studies among the different traits were worked out at phenotypic and genotypic levels and presented in Table 1.

Genotypic Correlation

In the present investigation, seed yield per plant was found to be highly significant and positively correlated at genotypic level with plant height (0.815), capsule width (0.689), harvest index (0.664), capsule length (0.545), days to maturity (0.492), capsules per plant (0.382), and branches per plant (0.379). These results indicating that these attributes were mainly influencing the seed yield in sesame. Thus, selection practiced for the improvement in a character will automatically result in the improvement of other character even though direct selection for improvement has not been made for the yield character. Similar results exhibiting highly significant and positive correlation between seed yield and other traits as obtained in the present investigation were also reported by Parameshwarappa *et al.* (2009); Sumathi *et al.* (2010); Akbar *et al.* (2011); Abate *et al.* (2015); Abhijitha *et al.* (2017); Mahalaxmi *et al.* (2018); Mansoor *et al.* (2018); Singh *et al.* (2018); Bhattacharjee *et al.* (2019).

Table 1. Phenotypic and Genotypic correlation coefficient for yield and yield related traits in sesame genotypes

		Days to 50% flowering	Days to maturity	Plant height (cm)	Branches per plant	Capsules per plant	Capsule length (cm)	Capsule width (cm)	Leaf area (cm^2)	Seeds per capsule	1000 seed weight (g)	Total oil content (%)	Harvest index (%)
Days to 50% flowering	r_p	**1**											
	r_g	**1**											
Days to maturity	r_p	0.019	**1**										
	r_g	-0.057	**1**										
Plant height (cm)	r_p	-0.256**	0.156	**1**									
	r_g	-0.748**	0.592**	**1**									
Branches per plant	r_p	-0.213*	0.210*	0.342**	**1**								
	r_g	-0.270**	0.308**	0.794**	**1**								
Capsules per plant	r_p	-0.054	0.385**	0.345**	0.709**	**1**							
	r_g	-0.097	0.543**	0.756**	0.831**	**1**							
Capsule	r_p	-0.231*	0.172	0.243**	0.215*	0.170	**1**						

length (cm)	r_g	-0.421**	0.346**	0.481**	0.282**	0.248**	**1**						
Capsule width (cm)	r_p	-0.117	0.183*	0.204*	0.350**	0.237**	0.412**	**1**					
	r_g	-0.073	0.311**	0.232*	0.472**	0.381**	0.603**	**1**					
Leaf area (cm^2)	r_p	0.055	0.012	0.090	0.280**	0.190*	0.155	0.330**	**1**				
	r_g	0.067	0.025	0.205*	0.304**	0.227*	0.172	0.402**	**1**				
Seeds per capsule	r_p	0.041	-0.144	-0.108	-0.142	0.017	-0.142	-0.196*	0.083	**1**			
	r_g	0.224*	-0.153	-0.071	-0.191*	-0.044	-0.182*	-0.349**	0.122	**1**			
1000 seed weight (g)	r_p	-0.325**	-0.129	0.218*	0.060	0.043	0.025	-0.061	-0.018	0.080	**1**		
	r_g	-0.452**	-0.162	0.555**	0.106	0.085	0.129	-0.120	-0.021	0.293**	**1**		
Total oil content (%)	r_p	0.174	-0.216*	-0.287**	-0.242**	-0.313**	-0.213*	-0.259**	0.023	0.266**	-0.032	**1**	
	r_g	0.382**	-0.412**	-0.725**	-0.342**	-0.401**	-0.424**	-0.392**	0.020	0.534**	-0.057	**1**	
Harvest index (%)	r_p	-0.140	0.184*	0.167	0.146	0.241**	0.184*	0.323**	0.062	-0.006	0.105	-0.352**	**1**
	r_g	-0.187*	0.321**	0.530**	0.180*	0.266**	0.224*	0.397**	0.079	-0.108	0.134	-0.525**	**1**
Seed yield per plant (g)	r_p	-0.150	0.360*	0.295**	0.329**	0.324**	0.374**	0.471**	0.112	-0.262**	0.025	-0.359**	0.520**
	r_g	-0.266**	0.490**	0.815**	0.379**	0.382**	0.545**	0.689**	0.140	-0.329**	0.079	-0.580**	0.664**

* and ** = significant at 5%, and 1% level respectively.

Phenotypic Correlation

In the present investigation, seed yield per plant was found to be highly significant and positively correlated at phenotypic level with harvest index (0.520), capsule width (0.471), capsule length (0.374), branches per plant (0.329), capsules per plant (0.324), plant height (0.295).Such associations were commonly reported in sesame by Sumathi *et al*. (2010); Akbar *et al*. (2011); Abate *et al*. (2015); Abhijitha *et al*. (2017); Aye *et al*. (2018); Mahalaxmi *et al*. (2018); Mansoor *et al*. (2018); Singh *et al*. (2018); Bhattacharjee *et al*. (2019)

Path Coefficient Analysis

Path coefficient has greater significance and could be effectively utilized in formulating an effective selection scheme. Hence, knowledge of association between the traits can greatly help in avoiding inversely related compensation effects during selection. Yield is a complex character and it is the sum total of the several component characters which directly or indirectly contributed to it. The direct and indirect effect of different characters on seed yield per plot presented in table 2.

The highest positive direct effect on seed yield was recorded for branches per plant followed by days to maturity, harvest index, 1000 seed weight, capsule length, capsule width, leaf area and seeds per capsule. These results are in accordance with Parmeshwarappa *et al*. (2009); Sumathi *et al*. (2010); Yol *et al*. (2010): Singh *et al*. (2018); Singh and bisen (2018); Aye and Htwe (2019); Hukumchand *et al*. (2019); Mohammed (2019); Navneetha *et al*. (2019). for days to maturity, plant height, branches per plant, seeds per capsule, capsule length, 1000 seed weight and harvest index.

The negative direct effect of plant height was high followed by total oil content, capsules per plant and days to 50 % flowering. Such negative direct effects were also reported by Sumathi *et al*. (2010); Yol *et al*. (2010); Abate *et al*. (2015); Ramazani (2016); Mahalaxmi *et al*. (2018), Singh *et al*. (2018); Singh and Bisen (2018); Aye and Htwe (2019); Hukumchand *et al*. (2019); Mohammed (2019) for days to 50 % flowering; Navneetha *et al*. (2019) and Sarvanan *et al*. (2020) for days to 50 % flowering, plant height, capsules per plant and total oil content.

Regarding indirect effects, all the traits namely days to 50 % flowering, capsules per plant, capsule length, capsule width, leaf area, seed per capsule and 1000 seed weight were small and negligible. Indirect effects *via* the characters *viz*., days to maturity, plant height, branches per plant, total oil content, harvest index and seed yield per plant were high. Therefore, indirect selection practiced on these characters will results in the improvement of respective characters and ultimately in seed yield.

CONCLUSION

Seed yield per plant showed highly significant positive correlation with plant height, branches per plant, capsule per plant, capsule length and harvest index at genotypic and phenotypic level and days to maturity and capsule width at genotypic level. Thus, selection practiced for the improvement in one trait will automatically result in the improvement of other trait even through direct selection for improvement has not been made for the yield character. While, total oil content and seed per capsule showed highly significant negative correlation at genotypic and phenotypic level and days to 50 % flowering at genotypic level, therefore selection practiced for the improvement in these traits will ineffective for improvement of other trait.

Path coefficient analysis revealed the highest positive direct effect on seed yield per plant was recorded by branches per plant, followed by days to maturity, harvest index, 1000 seed yield, capsule length, capsule width, leaf area and seeds per capsule. It revealed that there was true relationship between these characters and seed yield per plant. Hence, direct selection of these characters could be carried out for the future breeding programmes. Negative direct effect was observed on seed yield per plant by plant height, total oil content, capsules per plant and days to 50 % flowering which might be due to their negative indirect effects via another trait on them.

Table 2. Genotypic path coefficient showing direct and indirect effects for yield and yield related traits in sesame genotypes

	Days to 50% flowering	Days to maturity	Plant height (cm)	Branches per plant	Capsules per plant	Capsule length (cm)	Capsule width (cm)	Leaf area (cm^2)	Seeds per capsule	1000 seed weight (g)	Total oil content (%)	Harvest index (%)
Days to 50 % flowering	**-0.1744**	0.0100	0.1304	0.0470	0.0168	0.0734	0.0126	-0.0116	-0.0390	0.0788	-0.0667	0.0326
Days to maturity	-0.0300	**0.5232**	0.3096	0.1611	0.2842	0.1809	0.1627	0.0131	-0.0802	-0.0845	-0.2155	0.1681
Plant height (cm)	0.4916	-0.3892	**-0.6576**	-0.5221	-0.4970	-0.3164	-0.1522	-0.1345	0.0469	-0.3650	0.4768	-0.3483
Branches per plant	-0.1669	0.1907	0.4917	**0.6192**	0.5143	0.1745	0.2923	0.1880	-0.1184	0.0658	-0.2118	0.1112
Capsules per plant	0.0305	-0.1718	-0.2390	-0.2626	**-0.3162**	-0.0784	-0.1206	-0.0719	0.0140	-0.0268	0.1267	-0.0841
Capsule length (cm)	-0.0657	0.0540	0.0751	0.0440	0.0387	**0.1561**	0.0941	0.0268	-0.0284	0.0202	-0.0661	0.0350
Capsule width (cm)	-0.0075	0.0323	0.0241	0.0491	0.0396	0.0627	**0.1040**	0.0417	-0.0363	-0.0125	-0.0407	0.0413
Leaf area (cm^2)	0.0038	0.0014	0.0115	0.0171	0.0128	0.0097	0.0227	**0.0564**	0.0069	-0.0012	0.0011	0.0044
Seeds per capsule	0.0105	-0.0072	-0.0034	-0.0090	-0.0021	-0.0086	-0.0164	0.0058	**0.0470**	0.0138	0.0251	-0.0051
1000 seed weight (g)	-0.1378	-0.0492	0.1693	0.0324	0.0258	0.0394	-0.0366	-0.0063	0.0893	**0.3050**	-0.0175	0.0407
Total oil content (%)	-0.1274	0.1373	0.2417	0.1140	0.1335	0.1411	0.1306	-0.0066	-0.1778	0.0191	**-0.3333**	0.1748
Harvest index (%)	-0.0922	0.1583	0.2610	0.0885	0.1311	0.1105	0.1957	0.0387	-0.0532	0.0658	-0.2585	**0.4928**
Genotypic correlation with seed yield per plant (g)	-0.2655	0.4898	0.8145	0.3787	0.3816	0.5449	0.6889	0.1396	-0.3291	0.0785	-0.5803	0.6635

Genotypic residual effect= 0.652, Numbers in bold indicate direct effects

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