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Correlation and path analysis for seed yield and yield attributing traits in Sesame germplasm (*Sesamum indicum* L.)

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Abstract
A field experiment was conducted during the 2013 in *kharif* season with 40 genotypes of sesame representing different geographical regions of India to study the correlation and path analysis for 14 characters. The estimate of correlation coefficient revealed that the genotypic correlations were higher than their corresponding phenotypic correlation for all the characters. It was observed that days to maturity, number of branches per plant, number of capsules per plant, number of seeds per capsule, 1000-seed weight and protein content showed significant positive association with seed yield per plant at genotypic as well as phenotypic levels. Plant height showed positively and significantly correlated with number of branches of per plant, number of capsules per plant, days to maturity, internode length and number of leaves. The results pointed out that more emphasis should be given on days to maturity, plant height, number of branches per plant, number of capsules per plant, number of seeds per capsule, protein content and1000- seed weight to improve grain yield. The results of path analysis showed that the characters *viz*., days to maturity, capsule length, number of branches per plant, protein content, number of branches per plant, number of capsules per plant, number of seed per capsule, 1000-seed Weight and leaf length had positive direct effect with seed yield, while plant height, internode length and number of leaves per plant and days to 50% flowering were having negative direct effect. Based on correlation and path analysis, it is suggested that emphasis should be given on number of branches per plant, number of capsules per plant, number of seed per capsule, 1000-seed weight for selecting the elite genotypes for further breeding program.

Keywords: Sesame, Seed yield, Correlation coefficient analysis and Path analysis

Introduction

Sesame (*Sesamum indicum* L.) is an annual plant which belongs to the *Pedaliaceae* family. It is considered to be the oldest of the oilseed plants and has been under cultivation in Asia for over 5000 years (Bisht *et al*., 1998) [4]. Sesame is described as the "Queen of oilseeds" because it contains contains 40-50% oil, 20-25% protein, 20-25% carbohydrate and 5-6% ash, calcium, phosphorous, oxalic acid and excellent qualities of seed oil and meal (Salunkhe *et al*., 1992) [10]. Now a days, it is widely cultivated as an oil crop in tropical and subtropical climates. Sesame is one of the ancient and traditional oilseed crops cultivated in India, for its quality oil. India rank second in area (1.82 million ha) and production (0.62 million tons) (FAOSTAT, 2015). Among predominantly growing major states of the country, Gujarat secure first rank in area having (0.35 million ha), production of 0.14 million tons (Anon. 2012) [1].

Yield is a poly genically controlled character and highly influenced by the environment. Selection merely based on yield is not effective. Selection based on its components increases yield as they are not only less complex but also relatively simply inherited and are much less influenced due to environmental deviations. The yield is a complex character resulting from interplay of various yield contributing characters, which have positive or negative association with yield and among themselves. To assess the magnitude of correlation for various characters with yield would be immense help in the indirect selection for improvement of yield.

Correlation coefficient analysis measures the mutual relationship between various characters and can be used to determine the component character on which selection can be done for yield improvement. Path analysis is standardized partial regression analysis, which further permits the partitioning of correlation coefficient in to components of direct effect and indirect effect of independent variable on dependent variable (Wright, 1921) [12]. Besides these, the effectiveness of selection for genetic improvement in yield and its contributing characters depends on genetic variability present in gene pool and extent of its heritability.

Hence, the present study was carried out to study the extent of variability present in the experimental material along with character association and path coefficient analysis for fourteen quantitative traits exist in forty sesame genotypes.

Material and Methods

A field experiment was conducted at Agronomy farm, B. A. College of Agriculture, A.A.U., Anand during the 2013 in *kharif* season. The experimental material comprised of 40 genotypes (Table 1) were evaluated in RBD with three replications. Data were collected for a total of 14 characters *viz*., day to 50% flowering, days to maturity, plant height (cm), capsule length (cm), leaf length (cm), internode length (cm), number of branches per plant, number of leaves per plant, number of capsule per plant, number of seeds per capsule, 1000 - seeds weight (g), oil content (%), protein content (%) and seed yield per plants (g). Genotypic and phenotypic correlation coefficients were calculated as per Miller *et al.,* (1958) [9]. The direct and indirect contribution of various characters to yield were calculated through Path coefficient analysis by Dewey and Lu (1959) [6] to estimate the actual contribution of each attribute and its influence through the other characters. Here, seed yield was used as the dependent variable while the other characters were considered as independent variables. The significant levels of the statistical analysis were described at the probability of 0.05 and 0.01.

Result and Discussion

The phenotypic and genotypic correlations among the yield and yield component characters in sesame are presented in (Table 1). The genotypic correlation coefficients were higher in magnitude than the phenotypic ones, indicating the presence of inherent association between various characters (Table 2). The correlation analysis indicated that seed yield showed significant positive correlation with days to maturity, number of branches per plant, number of capsules per plant, number of seeds per capsule, 1000- seed weight and protein content at genotypic as well as phenotypic levels indicating that selection made on the basis of these traits will help in increasing seed yield. Yol *et al.,* (2010) [14] obtained positive and significant correlation between seed yield and the number of capsule per plant and number of seeds per pod, which are similar to the present findings. In the study conducted by Sarwar *et al.,* (2007) [11], Arshad *et al.,* (2003) [2] and Atta *et al.,* (2008) [3], significant positive correlation were observed for seed yield with the number of capsule per plant.

Plant height showed positively and significantly correlated with days to maturity, number of branches of per plant and number of capsules per plant. Mahajan *et al.,* (2007) [8] reported positive and significant correlation between plant height and number of capsule per plant. The 1000-seed weight showed significant positive correlation with seed yield per plant and number seeds per capsule while it was negatively correlated with plant height and capsule length. Capsule length showed positive significant association with number seeds per capsule, whereas, number of leaves per plant was found positively associated with number of capsules per plant and oil content. Other characters, capsule length, protein content, plant height, number of leaves per plant, oil content, and internode length contributed positive association towards yield in respective order of magnitude. The days to 50% flowering was found negatively associated with seed yield.

The path coefficient analysis based on genetic correlation (Table 3) showed that the characters *viz*., days to maturity, capsule length, number of branches per plant, protein content, number of capsules per plant, number of seed per capsule and 1000-seed weight exerted high direct effect on seed yield per plant which revealed that maximum weightage should be given to these traits in selection for obtaining higher yield. Yingzhong and Yishou (2002) [13] found that the number of capsule per plant was the most important contributor to seed yield per plant. While, Chowdhury *et al.,* (2010) reported that the number of capsule per plant had substantial positive and direct contribution to oil yield.

Plant height and number of leaves per plant has high indirect effects via number of branches per plant, while high indirect effects of internode length via days to maturity. Number of capsules per plant was also highly contributed indirectly via number of branches per plan and days to maturity. These indirect effects had not only supported the low magnitude direct effect but also resulted in high significant positive correlation with seed yield. Number of leaves per plant exhibited higher negative direct effects on seed yield, while days to flowering, plant height and internode length exhibited low negative direct effects on seed yield. Therefore, number of branches per plant, number of capsules per plant, number of seed per capsule and 1000-seed weight parameters could be serve as selection criteria in breeding for yield improvement in sesame.

Table 1: List of genotypes studied

No	Genotypes	Pedigree / Source
V1	RT-127	Si3500 X Patan-64
V2	RT-125	Type13 X Rt-1
V3	RT-346	Rt-127 X Hy-24
V4	GT-1	Pure Line Selection
V5	GT-2	Gt-1 X Tc-25
V6	GT-3	Gt Til X Aht-85
V7	GT-4	Gt-1 X Rt-127
V8	VRI(SV)-1	Pureline Selction From Thirukkattappali
V9	TKG-55	Tc-25 X Tnau-1
V10	TKG-306	Cst-785 X Tkg-22
V11	TKG-22	Ht-6 X Jlt-3
V12	TMV-4	Mass Selection From Local Satur Variety
V13	TMV-6	Pureline Selection
V14	TMV-7	Si-250 X Es-22
V15	V-76-30	Amreli, Gujarat
V16	P.Zalawad	Amreli, Gujarat
V17	JTS-8	Omt-10 X Tc-289
V18	Bhavrodi-6	Amreli, Gujarat
V19	MT-75	Jlt-26 X Rt-127
V20	Shedvhar	Amreli, Gujarat
V21	JR-25	Amreli, Gujarat
V22	Rama	West Bengal
V23	SSM	Amreli, Gujarat
V24	MRUG-1	Selection Local Material
V25	Nirmla	Mutant of B-67
V26	T-4	T-10 X T-3
V27	TC-289	P.B. Til X E.C. 4619
V28	GP-238	Amreli, Gujarat
V29	Patan-64	Amreli, Gujarat
V30	SVPR-1	Selection From Western From Ghat
V31	T-12	Selection local material
V32	AKT-101	Maharashtra
V33	ES-274	Exotic
V34	Thilarani	Thilak X Kayamkulam -1
V35	Surya	Selection From Culture 42-1
V36	AT-24	Selection Local Material
V37	Thilak	Pure Line Selection
V38	Kayamkulam-1	Pure Line Selection
V39	Vri-2	JL-24 X CO1
V40	RSS-106	Amreli, Guajrat

Table 2: Genotypic and phenotypic correlation between seed yield and other traits of sesame under study

Characters		DFF	DTM	PLH	CL	IL	NBPP	NLPP	NCPP	NSPC	LL	TWT	OC	PC	SYPP
DFF	Rg		0.038	0.121	-0.338*	0.174	0.113	0.260*	0.001	-.434**	-0.592**	-0.064	0.205	0.134	-0.227
	Rp		0.033	0.128	-0.282*	0.170	0.112	0.207	-0.004	-.390**	-0.372*	-0.069	0.168	0.111	-0.169
DTM	Rg			0.566**	-0.430**	0.371*	0.507**	0.254	0.665**	0.136	0.162	-.153	0.252	0.037	0.412**
	Rp			0.491**	-0.402**	0.254	0.431**	0.228	0.620 **	0.141	0.135	-0.148	0.236	0.034	0.325*
PLH	Rg				-0.366*	0.492**	0.527**	0.351*	0.714**	0.028	0.053	-0.399*	0.382*	0.099	0.202
	Rp				-0.348	0.404**	0.400**	0.331*	0.654**	0.015	0.059	-0.365*	0.359*	0.097	0.134
CL	Rg					-0.142	-0.362*	-0.154	-0.333*	0.411**	0.040	0.112	-0.190	-0.032	0.081
	Rp					-0.122	-0.289*	-0.130	-0.314*	0.370*	0.076	0.108	-0.180	-0.029	0.056
IL	Rg						0.515**	0.183	0.423**	-0.078	0.115	-0.587**	0.282*	0.028	0.090
	Rp						0.385*	0.124	0.309	-0.050	0.095	-0.413**	0.210	0.000	-0.028
NBPP	Rg							0.621**	0.735**	0.083	0.077	-0.282*	0.486**	-0.039	0.392*
	Rp							0.521**	0.609**	0.098	0.119	-0.244	0.414**	-0.027	0.303*
NLPP	Rg								0.588**	0.189	-0.109	-0.094	0.567**	-0.009	0.158
	Rp								0.522 **	0.167	-0.053	-0.089	0.519**	0.007	0.110
NCPP	Rg									0.298*	0.154	-0.149	0.406**	0.186	0.506**
	Rp									0.282*	0.119	-0.150	0.389 *	0.178	0.401**
NSSC	Rg										0.271*	0.368*	0.062	0.091	0.534**
	Rp										0.215	0.342*	0.054	0.089	0.437**
LL	Rg											-0.120	-0.154	-0.080	0.178
	Rp											-0.071	-0.129	-0.058	0.110
TWT	Rg												-0.214	0.298*	0.361*
	Rp												-0.202	0.290*	0.285*
OC	Rg													-0.155	0.163
	Rp													-0.154	0.131
PC	Rg														0.418**
	Rp														0.343*
YPP	Rg														
	Rp														

***** Significant at 5% and 1% levels respectively. DFF:** Days to 50% flowering, **DTM:** Days to maturity, **PLH:** Plant height (cm), **CL:** capsule length (cm), **IL:** internode length (cm), **NBPP:** Number of branches per plant, **NLPP:** Number of leaves per plant, **NCPP:** Number of capsules per plant, **NSPC:** Number of seeds per capsule, **LL:** leaf length (cm), **TWT:** Test weight (g), **OC:** oil content (%), **PC:** protein content (%), S**YPP:** seed yield per plant (g),

Table 3: Path coefficient analysis showing direct and indirect effects of various traits on seed yield per plant in sesame.

Sr. No.	Genotypes	DFF	DTM	PLH	CL	IL	NBPP	NLPP	NCPP	NSPC	LL	TWT	OC	PC	'r_g' with SYPP
1.	DFF	-0.074	0.010	-0.007	-0.097	-0.010	0.057	-0.084	0.000	-0.056	-0.031	-0.022	0.041	0.046	-0.227
2.	DTM	-0.003	**0.272**	-0.035	-0.124	-0.022	0.254	-0.082	0.114	0.018	-0.053	0.009	0.051	0.013	0.412**
3.	PLH	-0.009	0.154	**-0.062**	-0.105	-0.029	0.264	-0.114	0.123	0.004	-0.138	0.003	0.077	0.034	0.202
4.	CL	0.025	-0.117	0.023	**0.287**	0.008	-0.182	0.050	-0.057	0.039	-0.038	0.053	0.002	-0.011	0.081
5.	IL	-0.013	0.101	-0.030	-0.041	**-0.058**	0.258	-0.059	0.073	0.010	0.006	-0.202	0.057	0.010	0.090
6.	NBPP	-0.008	0.138	-0.032	-0.104	-0.030	**0.502**	-0.201	0.126	0.011	0.004	-0.097	0.098	-0.013	0.392*
7.	NLPP	-0.019	0.069	-0.022	-0.044	-0.011	0.311	**-0.325**	0.101	0.024	-0.006	-0.032	0.114	-0.003	0.158
8.	NCPP	0.000	0.181	-0.044	-0.096	-0.025	0.369	-0.191	**0.172**	0.038	0.008	-0.051	0.082	0.063	0.506**
9.	NSSC	0.032	0.037	-0.002	0.118	0.005	0.041	-0.061	0.051	**0.128**	0.014	0.127	0.012	0.031	0.534**
10.	LL	0.044	0.044	-0.003	0.012	-0.007	0.038	0.035	0.026	0.035	**0.053**	-0.041	-0.031	-0.027	0.178
11.	TWT	0.005	-0.042	0.025	0.032	0.034	-0.141	0.030	-0.026	0.047	-0.006	**0.345**	-0.043	0.101	0.361*
12.	OC	-0.015	0.069	-0.024	-0.055	-0.016	0.244	-0.184	0.070	0.008	-0.008	-0.074	**0.201**	-0.053	0.163
13.	PC	-0.010	0.010	-0.006	-0.009	-0.002	-0.019	0.003	0.032	0.012	-0.004	0.103	-0.031	**0.340**	0.418**

Note: Diagonal values are direct effects

Residual effect = 0.2567, * ** Significant at 5% and 1% levels respectively.DFF: Days to 50% flowering, **DTM:** Days to maturity, **PLH:** Plant height (cm), **CL:** capsule length (cm), **IL:** internode length (cm), **NBPP:** Number of branches per plant, **NLPP:** Number of leaves per plant, **NCPP:** Number of capsules per plant, **NSPC:** Number of seeds per capsule, **LL:** leaf length(cm),, **TWT:** Test weight (g), **OC:** oil content (%), **PC:** protein content (%),S**YPP:**seed yield per plant (g)

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