

Original Research Article

Correlation and path analysis in Sesame (*Sesamum indicum* L.) genotypes

Abstract:

Aims: Assessment of correlation between yield and yield contributing traits in Sesame, as well as to determine their direct and indirect effects on fruit yield of sesame genotypes.

Study design: Randomized block design (RBD) with two replications.

Place and Duration of Study: Oilseeds Research Station, Department of genetics and plant breeding, College of Agriculture, VNMKV, Latur (MS), between July 2016 and January 2017.

Methodology: The mean values were utilized for statistical analysis. The correlation and path analysis was performed by using the software SPSS version 17.0 and GENRES using Sixty five accessions were evaluated for the following eleven traits: days to 50% flowering (D50%), days to maturity (DM), capsule length (CL), capsule width (CW), plant height (PH), number of branches per plant (NBP), number of capsules per plant (NCP), number of seeds per capsule (NSC), 1000-seed weight (1000SW), oil content (OC), seed yield per plant (SYP).

Results: The correlation analysis indicated that CL (0.237), PH (0.225), NCP (0.806), NSC (0.372), 1000SW (0.657) and OC (0.532) positively correlated with seed yield at genotypic as well as phenotypic levels, respectively. Path coefficient analysis indicated that NCP (0.746), 1000SW (0.356), OC (0.007), NSC (0.267), CL (0.0608) and PH (0.034) exhibited positive direct effect on seed yield.

Conclusion: Positive indirect effect was observed by both DM, NBP has expressed positive and indirect effect on yield *via* their component traits. Selection among genotypes based on these analyses can be made for further improvement in fruit yield and component characters

Keywords: Sesame, correlation, path analysis, direct and indirect effects, selection

Introduction: Sesame (*Sesamum indicum* L.) is one of the ancient and traditional oilseed crops cultivated in India, for its quality oil. Yield is a polygenetically 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. Path co-efficient analysis provides an efficient means of partitioning of correlation co-efficient into direct and indirect effects of the component characters. Selection on the basis of direct and indirect effects is much more useful than selection for yield per se alone.

There are many genotypes of sesame having different characters prevailing in India. In order to develop effective breeding programs, study of the correlation between yield and its components, as well as their respective contributions to yield, is crucial. Path coefficient analysis is also an important tool for the better understanding of the crop inheritance in respect of yield. It gives specific measures on the direct and indirect effect of each component character on yield.

Considering the above factors, the present study was undertaken to improve seed yield of sesame using correlation and path analysis of yield and yield contributing characters of sixty-five sesame accessions found in India.

Materials and Methods

The field experiment of the present study was carried out at oil seeds research station, Latur during *kharif 2016*. Sixty-five accessions (Table-1) were raised during July, 2016 in randomized block design (RBD) with two replications. The 65 sesame genotypes were sown on 1st July, 2016 with two replications in a Randomized Block Design. Each genotype in each replication was sown by dibbling the seeds in a single row plot of 9.0 m length, with 45 cm row spacing and 10 cm hill spacing. Thinning of seedlings was carried out after 10 days of sowing by keeping one seedling per hill. The recommended cultural practices were adopted in respect of irrigation, weeding and fertilization. Plant protection measures were taken up as and when required. The genotypes were harvested as and when they attained physiological maturity.

Statistical analysis: The mean values were utilized for statistical analysis. The correlation and path analysis was performed by using the software SPSS version 17.0 and GENRES.

Results:

The observations recorded on sixty-five accessions on eleven characters viz., Days to 50% flowering, days to maturity, capsule length, capsule width, plant height, number of branches per plant, number of capsules per plant, number of seeds per capsule, 1000-seed weight, oil content, seed yield per plant were analyzed statistically for genetic parameters and character association among them was presented hereunder.

Seed yield is a complex character and is considered as the ultimate product of its components. Hence, selection of superior genotypes based on seed yield is difficult due to the integrated structure of plant in which most of the characters are interrelated and being governed by more number of genes (Lule *et al.*, 2012). The inter-relationship of component characters of yield provides an idea for the selection and simultaneous improvement of desirable yield attributing traits. Hence, correlation studies were undertaken to know the association of seed yield with its component traits.

The genotypic correlation coefficients between yield and its component character and inter correlation among the traits were presented in the Table No.2. seed yield per plant exhibited positive significant correlation with number of capsules (0.806), 1000-seed weight (0.657), oil content (0.532), number of seeds per capsule (0.372), capsule length (0.237) and plant height (0.225) while capsule width (0.086) and days to 50% flowering shown non-significant correlation with seed yield per plant and negative non-significant correlation with days to maturity (-0.122) and number of branches per plant (-0.041) at both genotypic and phenotypic levels.

Path analysis: the genetic architecture of seed yield is based on balance or overall net effect produced by various yield components interacting with one another. The association of different

component characters among themselves and with yield is quite important for devising an efficient selection criterion for yield. The total correlation between yield and its component characters may be some times misleading, as it might be an over-estimate or under-estimate because of its association with other characters. If relationship is due to multiple effects of gene(s) it is difficult to separate these effects by selecting a particular character. Hence, indirect selection by correlated response may not be fruitful. When many characters are affecting a given character, splitting total correlation into direct and indirect effect of cause as devised by Wright (1921) would provide more meaningful interpretation. The direct and indirect effects of different yield contributing traits on yield were estimated using genotypic and phenotypic correlation coefficients are presented in Table 3.

Direct effects: Days to 50% flowering (0.0082), capsule length (0.0608), capsule width (0.028), plant height (0.034), number of capsules per plant (0.746), number of seeds per capsule (0.267), 1000 seed weight (0.356), oil content (0.0078) exhibited positive direct effect on seed yield, whereas negative direct effect was observed for Days to maturity (-0.0229) and number of branches per plant (-0.107).

Indirect effects: Maximum positive indirect effect was exerted by number of capsules per plant via plant height (0.233) followed by oil content (0.229). 1000 seed weight exerted maximum positive indirect effect via oil content (0.209) followed by number of capsules per plant (0.099). oil content exerted positive indirect effect via 1000-seed weight (0.0046) followed by number of capsules per plant (0.0024), number of seeds per capsule exerted maximum positive indirect effect via capsule length (0.160) followed by capsule width (0.128).

Discussion:

Present study revealed that the traits viz., number of capsules, 1000-seed weight, oil content, number of seeds per capsule, capsule length and plant height exhibited significant positive character association with seed yield at both phenotypic and genotypic levels. The results are in accordance with the earlier reports of Ismaila and Usman (2014) for capsule length and plant height, Bharathi *et al.* (2015), Fazal *et al.* (2015) and Mahmoud *et al.* (2015) for number of capsules, number of seeds per capsule and 1000-seed weight, Kumar *et al.* (2012) and Tripathy *et al.* (2016) reported positive correlation for oil content. As a nutshell, these characteristics can be used to improve seed yield per plant using them in selection criteria.

It is observed that number of capsules per plant exhibited highest direct positive effect and indirect effect through other characters 1000-seed weight and plant height. Since this trait has a strong correlation and direct effect on seed yield per plant, selecting for this trait may greatly contributes to seed yield per plant. These results are in agreement with Abate and Mekbib (2015), Bharathi *et al.* (2015) and Fazal *et al.* (2015). 1000-seed weight (g) exhibited a considerable amount of direct effect on seed yield per plant at both genotypic and phenotypic levels. Positive direct effect of this trait was also reported by Vanishree *et al.* (2011), Bharathi *et al.* (2015) and Fazal *et al.* (2015). Capsule length also exhibited fair amount of direct effect and

is correlated positively significant with seed yield per plant. This result is in harmony with the reports of Gidey *et al.* (2012) and Shekhawat *et al.* (2013). Plant height influenced seed yield per plant by positive direct effect. These results are similar with Gangadhara *et al.* (2012), Shekawat *et al.* (2013), Vanishree *et al.* (2013) and Abate and Mekbib (2015). Capsule width influenced seed yield per plant by positive direct effect. These results are in agreement with Bamrotiya *et al.* (2016). However, Sumathi and Mualalidharan (2010), Tripathy *et al.* (2016) reported negative association of this trait with seed yield. Days to 50% flowering influenced seed yield per plant by low positive direct effect at both levels. These results are in agreement with Gangadhara *et al.* (2012), Kumar *et al.* (2012), Thirumala rao *et al.* (2013), Vanishree *et al.* (2013) and Abate and Mekbib (2015). Oil content influenced seed yield plant⁻¹ by low positive direct effect at both levels. These results are in accordance with Abate and Mekbib (2015), Tripathy *et al.* (2016) and Saxena *et al.* (2016). Days to maturity influenced seed yield per plant negatively direct effect at both levels. The similar reports were reported by Gidey *et al.* (2013), Kumar *et al.* (2012), Tirumalarao *et al.* (2013) and Abate and Mekbib (2015).

Number of branches also showed negative direct effect on seed yield at both levels. These results are in congruence with Vanishree *et al.* (2011), Bharathi *et al.* (2015) and Fazal *et al.* (2015).

The results indicated those characters with positive correlation have shown high direct effects. Hence, number of capsules, 1000-seed weight, oil content (%), number of seeds per capsule, capsule length and plant height has high direct and correlation values.

The residual effect from path analysis was 0.167, which indicated the adequacy of the characters chosen for the study and the characters studied contributed about 81.3 percent towards seed yield. The results of path analysis study affirm that the characters like number capsules per plant, capsules length, number of seeds per capsule, 1000 seed weight, oil content were most important yield determinants, because of their high direct effects via many other yield improving characters and indirect contribution of these characters towards the yield is negligible. This suggests that emphasis must be given on such traits while exercising selection to improve the yield in sesame.

Conclusion

Correlation studies indicated that capsule length, plant height, number of capsules, number of seeds, 1000-seed weight and oil content (%) except days to 50% flowering and capsule width had significant positive association with seed yield.

Path coefficient analysis revealed that high positive direct effect of number of capsules, number of seeds, 1000-seed weight and capsule length with seed yield. Therefore, simultaneous selection for the said traits is suggested for improvement of seed yield in sesame.

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Table 1: Details of sixty-five genotypes of sesame:

S.No	Genotype	Source	S. No	Genotype	Source
1	SI-413-A	P.C. Unit, Jabalpur.	34	IC-42200	P.C. Unit, Jabalpur.
2	SI-205-61	P.C. Unit, Jabalpur.	35	IC-23233	P.C. Unit, Jabalpur.
3	SI-199-2-84	P.C. Unit, Jabalpur.	36	NIC-16220	P.C. Unit, Jabalpur.
4	SI-1147	P.C. Unit, Jabalpur.	37	EC-231-2-84	P.C. Unit, Jabalpur.
5	IS-299A	P.C. Unit, Jabalpur.	38	EC-370840	P.C. Unit, Jabalpur.
6	ES-44	P.C. Unit, Jabalpur.	39	EC-209	P.C. Unit, Jabalpur.
7	ES-146-1-84	P.C. Unit, Jabalpur.	40	EC-89111	P.C. Unit, Jabalpur.
8	ES-113-18-84	P.C. Unit, Jabalpur.	41	EC-377015	P.C. Unit, Jabalpur.
9	EC-370936	P.C. Unit, Jabalpur.	42	SI-983	P.C. Unit, Jabalpur.
10	IC-204001	P.C. Unit, Jabalpur.	43	OSC-3209	P.C. Unit, Jabalpur.
11	GM-NIC- 7909	P.C. Unit, Jabalpur.	44	DS-21	P.C. Unit, Jabalpur.
12	GM-NIC- 7913	P.C. Unit, Jabalpur.	45	EC-101396	P.C. Unit, Jabalpur.
13	GM-NIC- 8202	P.C. Unit, Jabalpur.	46	SI-5354	P.C. Unit, Jabalpur.
14	GM-NIC- 8631	P.C. Unit, Jabalpur.	47	IS-424	ORS, Latur.
15	GM-NIC- 8934	P.C. Unit, Jabalpur.	48	SI-3168	ORS, Latur.
16	GM-NIC- 16146	P.C. Unit, Jabalpur.	49	KMR-69	ORS, Latur.
17	GM-NIC- 16226	P.C. Unit, Jabalpur.	50	KMR-114	ORS, Latur.
18	GM-NIC- 16330	P.C. Unit, Jabalpur.	51	GT-3	ORS, Latur.
19	GM-NIC- 16332	P.C. Unit, Jabalpur.	52	SI-1003	ORS, Latur.
20	GM-NIC- 8254	P.C. Unit, Jabalpur.	53	YLM-17	ORS, Latur.
21	NIC-7855	P.C. Unit, Jabalpur.	54	EC-303423	ORS, Latur.
22	NIC-7903	P.C. Unit, Jabalpur.	55	PKDS-8	ORS, Latur.

23	NIC-10621	P.C. Unit, Jabalpur.	56	JLT-07	ORS, Latur.
24	NIC-16114	P.C. Unit, Jabalpur.	57	TKG-22	ORS, Latur.
25	NIC-16324	P.C. Unit, Jabalpur.	58	EC-S-0523A	ORS, Latur.
26	NIC-16104	P.C. Unit, Jabalpur.	59	EC-S-0223	ORS, Latur.
27	NIC-8263	P.C. Unit, Jabalpur.	60	TKG-306	ORS, Latur.
28	EC-310439	P.C. Unit, Jabalpur.	61	IS-207	ORS, Latur.
29	ES-42-2-84	P.C. Unit, Jabalpur.	62	JLT-408	ORS, Latur.
30	K-5170	P.C. Unit, Jabalpur.	63	MADURI	ORS, Latur.
31	UKNM-1067	P.C. Unit, Jabalpur.	64	G-1	ORS, Latur.
32	UKNM-2386	P.C. Unit, Jabalpur.	65	SWETA	Local selection from Telangana
33	IC-41962	P.C. Unit, Jabalpur.			

Table 2: Phenotypic (P) and Genotypic (G) correlation coefficients among yield attributes in 65 sesame genotypes

Character		DF 50%	DM	CL (cm)	CW (cm)	PH (cm)	NBP	NCP	NSC	1000 SW (g)	OC (%)	SYP (g)
DF 50%	G	1.0000	0.6479**	0.2029*	0.0434	0.1708	-0.1128	-0.0247	0.1629	-0.0217	0.1433	0.0434
	P	1.0000	0.6305**	0.1769*	0.0504	0.1373	-0.0870	-0.0393	0.1538	-0.0054	0.0979	0.0350
DM	G		1.0000	0.2204*	0.1203	0.3166**	0.0815	-0.2138	0.1353	-0.0039	0.0838	-0.1226
	P		1.0000	0.1995*	0.1160	0.2751**	0.0783	-0.2076	0.1160	-0.0120	0.0643	-0.1308
CL (cm)	G			1.0000	0.2720**	0.0597	-0.1412	-0.0835	0.6020**	0.1575	0.1127	0.2378**
	P			1.0000	0.2277**	0.0548	-0.1300	-0.0640	0.5319**	0.1322	0.1025	0.2189*
CW (cm)	G				1.0000	-0.0043	-0.0646	-0.1538	0.4830**	0.0640	0.0372	0.0864
	P				1.0000	-0.0338	-0.0612	-0.0961	0.3685**	0.0508	0.0340	0.0843
PH (cm)	G					1.0000	0.5133**	0.3128**	0.0030	0.0273	0.1320	0.2225*
	P					1.0000	0.4726**	0.2832**	-0.0233	0.233	0.1241	0.1986*
NBP	G						1.0000	0.2232*	-0.2762**	-0.0861	-0.0914	-0.0411
	P						1.0000	0.2162*	-0.2501**	-0.0678	-0.0884	-0.0262
NCP	G							1.0000	-0.0875	0.2780**	0.3070**	0.8065**
	P							1.0000	-0.0975	0.2378**	0.2739**	0.7935**
NSC	G								1.0000	0.2548**	0.2412**	0.3726**
	P								1.0000	0.2864**	0.2164*	0.3812**
1000SW (g)	G									1.0000	0.5885**	0.6578**
	P									1.0000	0.5512**	0.6437**
OC (%)	G										1.0000	0.5325**
	P										1.0000	0.4941**
SYP (g)	G											1.0000
	P											1.0000

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

Table 3: Phenotypic (P) and Genotypic (G) Path coefficients among yield attributes in 65 sesame genotypes

Characters		DF 50%	DM	CL (cm)	CW (cm)	PH (cm)	NBP	NCP	NSC	1000 SW (g)	OC (%)	Correlation with SYP (g)
DF 50%	G	0.0082	0.0053	0.0017	0.0004	0.0014	-0.0009	-0.0002	0.0013	-0.0002	0.0012	0.0434
	P	0.0183	0.0115	0.0032	0.0009	0.0025	-0.0016	-0.0007	0.0028	-0.0001	0.0018	0.0350
DM	G	-0.0148	-0.0229	-0.0050	-0.0028	-0.0072	-0.0019	0.0049	-0.0031	0.0001	-0.0019	-0.1226
	P	-0.0201	-0.0318	-0.0063	-0.0037	-0.0087	-0.0025	0.0066	-0.0037	0.0004	-0.0020	-0.1308
CL	G	0.0123	0.0134	0.0608	0.0165	0.0036	-0.0086	-0.0051	0.0366	0.0096	0.0069	0.2378**
	P	0.0081	0.0091	0.0457	0.0104	0.0025	-0.0059	-0.0029	0.0243	0.0060	0.0047	0.2189*
CW	G	0.0012	0.0034	0.0077	0.0283	-0.0001	-0.0086	-0.0051	0.0366	0.0096	0.0069	0.0864
	P	0.0008	0.0018	0.0035	0.0156	-0.0005	-0.0010	-0.0015	0.0057	0.0008	0.0005	0.0843
PH	G	0.0060	0.0111	0.0021	-0.0002	0.0349	0.0179	0.0109	0.0001	0.0010	0.0046	0.2225*
	P	0.0046	0.0092	0.0018	-0.0011	0.0334	0.0158	0.0095	-0.0008	0.0008	0.0041	0.1986*
NBP	G	0.0121	-0.0087	0.0151	0.0069	-0.0551	-0.1073	-0.0240	0.0296	0.0092	0.0098	-0.0411
	P	0.0080	-0.0072	0.0120	0.0056	-0.0435	-0.0921	-0.0199	0.0230	0.0062	0.0081	-0.0262
NCP	G	-0.0185	-0.1595	-0.0623	-0.1148	0.2334	0.1666	0.7462	-0.0653	0.2075	0.2291	0.8065**
	P	-0.0292	-0.1541	-0.0475	-0.0714	0.2103	0.1605	0.7424	-0.0723	0.1765	0.2033	0.7935**
NSC	G	0.0435	0.0361	0.1607	0.1289	0.0008	-0.0737	-0.0234	0.2670	0.0680	0.0644	0.3726**
	P	0.0456	0.0344	0.1575	0.1091	-0.0069	-0.0741	-0.0289	0.2961	0.0848	0.0641	0.3812**
1000 SW (g)	G	-0.0077	-0.0014	0.0561	0.0228	0.0097	-0.0307	0.0990	0.0908	0.3562	0.2096	0.6578**
	P	-0.0020	-0.0043	0.0480	0.0185	0.0084	-0.0246	0.0863	0.1040	0.3630	0.2001	0.6437**
OC (%)	G	0.0011	0.0007	0.0009	0.0003	0.0010	-0.0007	0.0024	0.0019	0.0046	0.0078	0.5325**
	P	0.0009	0.0006	0.0010	0.0003	0.0012	-0.0008	0.0026	0.0020	0.0051	0.0093	0.4941**

Genotypic residual effect = 0.1671