



Character Association and Selection Indices in Sesame

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ABSTRACT

Investigations on extent of character association, path coefficient analysis and selection indices were conducted in sesame during *kharif* 2008 and *rabi* 2008-09. Correlation studies showed that, the seed yield per plant had significant positive association with days to 50% flowering, number of primaries, capsules per plant, seeds per capsule and oil content. Path coefficient analysis revealed that seeds per capsule, capsules per plant and oil content had high positive direct effect on seed yield per plant. Selection indices studies by using discriminant function technique revealed that the function including number of seeds per capsules as one of the components recorded high expected genetic advance and relative efficiency. The index which includes all the ten characters were showed maximum genetic advance and relative efficiency suggesting that simultaneous selection for all these characters would be better over straight selection for seed yield.

Key words : Correlation, Genetic Advance, Path Coefficient Analysis, Selection indices, Sesame.

Sesame (*Sesamum indicum* L.) is one of the world's oldest oil seed crop and is the 6th most important oil seed crop grown in India. Breeding for higher yield is the major objective in any crop improvement programme. The practice of selection based on individual traits may not be rewarding always. A better understanding of the contribution of such traits to the genetic makeup of the crop may be obtained through correlation studies. Path analysis permits the separation of the correlation coefficient into components of direct and indirect effects. Considerable emphasis is currently being placed upon the improvement of yield through simultaneous selection for various yield attributes. The discriminant function affords an efficient method for simultaneous selection (Smith, 1936) Hence present investigation was carried out to study the extent of character association among yield and yield attributes, path coefficient analysis and to assess relative efficiency of different selection indices formulated through the use of discriminant function technique.

MATERIAL AND METHODS

Sixty genotypes of sesame were evaluated for ten characters *i.e.*, days to 50% flowering, plant height, days to maturity, number of primaries, number of secondaries, capsules per plant, seeds per capsule, 1000-seed weight, oil content and seed yield per plant. All the 60 genotypes were grown in Randomized Block Design with three replications at Agricultural

College Farm, Bapatla during *kharif* 2008 and *rabi* 2008-09. Each genotype was sown in single row of 3 m length with 30 x 10 cm inter and intra row spacing. All agronomic measures were undertaken for good crop growth. Data were recorded on ten randomly selected plants from each row for recording observations.

Analysis of variance was done by using the standard statistical procedure given by Panse and Sukhatme (1961). The phenotypic and genotypic correlations were worked as suggested by Falconer (1964). Path coefficient analysis was done as suggested by Dewey and Lu (1959). Selection indices were constructed based on the Fisher and Yates (1963) discriminant function. The expected genetic advance and relative efficiency in percentage were computed according to Brim *et al.* (1959).

RESULTS AND DISCUSSION

The analysis of variance indicated significant differences among the genotypes for all characters. All the traits showed higher magnitude of genotypic correlations than phenotypic correlations (Table 1) indicating that there was strong inherent association between characters, which was truly reflected in phenotypic expression.

The correlation between seed yield per plant with different yield attributes and among the attributes themselves are presented in Table 1.

Table 1. Phenotypic and genotypic correlation coefficients in 60 genotypes of sesame (*Sesamum indicum* L.) during *kharif*-2008 and *rabi*-2009.

Character		Days to 50% Flowering		Plant height		Days to maturity		Number of primaries		Number of secondaries	
		K	R	K	R	K	R	K	R	K	R
50% Flowering	P	-	-	-0.1857	-0.1230	0.2644**	0.4700**	-0.0037	0.1446	0.1106	0.2574**
	G			-0.2385	-0.1597	0.2879**	0.5769**	-0.0081	0.1995**	0.1269	0.2973**
Plant height	P			-	-	0.0831	-0.1025	0.1521*	0.1670*	0.1659*	0.1801*
	G					0.1173	-0.1002	0.1762*	0.2103**	0.2232**	0.2506**
Days to maturity	P					-	-	-0.0972	0.0247	-0.1118	0.0887
	G							-0.0979	0.0177	-0.1152	0.1166
Number of primaries	P							-	-	0.3251**	0.3149**
	G									0.4164**	0.3979**
Number of secondaries	P									-	-
	G										
Capsules per plant	P										
	G										
Seeds per capsule	P										
	G										
1000 seed weight	P										
	G										
Oil content	P										
	G										

Character		Capsules per plant		Seeds per capsule		1000 seed weight		Oil content		Correlation with Seed yield per plant	
		K	R	K	R	K	R	K	R	K	R
50% Flowering	P	0.3055**	0.2341**	0.3955**	0.3539**	0.1041	0.1403	0.3429**	0.3501**	0.3582**	0.4674**
	G	0.3751**	0.3211**	0.4286**	0.3885**	0.1145	0.1368	0.3562**	0.3764**	0.3916**	0.548**
Plant height	P	0.0577	-0.0703	0.0086	0.0423	0.0311	0.0796	-0.0148	-0.0558	-0.0712	-0.0824
	G	0.1088	-0.0848	-0.0079	0.0543	0.0313	0.1103	-0.0169	-0.0638	-0.0651	-0.0828
Days to maturity	P	0.1521*	0.1378	0.2509**	0.3688**	-0.0302	-0.0060	0.0915	0.3059**	0.1465**	0.3760**
	G	0.2119**	0.1636*	0.2734**	0.3922**	-0.0268	-0.0081	0.0949	0.3311**	0.1454	0.4439**
Number of primaries	P	0.2161**	0.2070**	0.2902**	0.1517*	-0.0188	0.0418	0.0002	0.1693*	0.2043**	0.2632**
	G	0.2666**	0.2484**	0.3297**	0.1629*	-0.0370	0.0465	0.0007	0.1894*	0.2742**	0.2977**
Number of secondaries	P	0.3043**	0.0574	0.2179**	0.1855*	0.0210	-0.0300	-0.0152	0.0478	0.2303**	0.0587
	G	0.3677**	0.1182	0.2351**	0.2171**	0.0205	-0.0309	-0.0157	0.0550	0.2995**	0.0265
Capsules per plant	P	-	-	0.5653**	0.3648**	0.0735	0.0421	0.1835*	0.3209**	0.6253**	0.4371**
	G			0.6734**	0.4294**	0.0828	0.0566	0.2199**	0.3806**	0.8905**	0.5351**
Seeds per capsule	P			-	-	-0.0087	0.1383	0.3038**	0.3169**	0.6656**	0.3669**
	G					-0.0089	0.1387	0.3130**	0.3224**	0.7708**	0.4029**
1000 seed weight	P					-	-	0.1750*	0.3147**	0.2966**	0.1335
	G							0.1759*	0.3279**	0.3574**	0.1410
Oil content	P							-	0.3279**	0.2753**	0.4666**
	G								-	0.3155**	0.5019**

* = Significant at 5% level ** = Significant at 1% level P = Phenotypic correlation coefficient
 G = Genotypic correlation coefficient K = *kharif* R = *rabi*

Table 2. Estimates of phenotypic, genotypic direct (bold) and indirect effects between yield and its components in 60 genotypes of sesame (*Sesamum indicum* L.) during *kharif* 2008 and *rabi* -2009.

Character	Days to 50% Flowering		Plant height		Days to maturity		Number of primaries		Number of secondaries		Capsules per plant		Seeds per capsule		1000 seed weight		Oil content		
	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	
Days to 50 % flowering	P	0.0619	0.2460	-0.0115	-0.0303	0.0164	0.1156	-0.0002	0.0356	0.0068	0.0633	0.0189	0.0576	0.0245	0.0871	0.0064	0.0345	0.0212	0.0861
Plant height (cm)	G	-0.0240	0.2992	0.0057	-0.0478	-0.0069	-0.0031	0.0002	0.0065	-0.0030	0.0077	-0.0090	-0.0026	-0.0103	0.0017	-0.0027	0.0034	-0.0085	-0.0020
Days to maturity	P	-0.01	0.0027	0.0549	-0.0220	0.0046	0.0022	0.0083	-0.0036	0.0091	-0.0039	0.0032	0.0015	0.0005	-0.0009	0.0017	-0.0017	-0.0008	0.0012
Number of primaries	G	-0.0005	-0.005	0.0019	-0.0310	0.0002	0.1726	0.0003	0.0597	0.0004	0.0890	0.0002	0.0961	0.0000	0.1163	0.0001	0.0409	0.0000	0.1126
Number of secondaries	P	-0.009	0.0657	-0.0028	-0.0140	-0.0336	0.1398	0.0033	0.0035	0.0038	0.0124	-0.0051	0.0193	-0.0084	0.0516	0.0010	-0.0008	-0.0031	0.0428
Capsules per plant	G	-0.0250	0.0980	-0.0102	-0.0170	-0.0868	0.1698	0.0085	0.0030	0.0100	0.0198	-0.0184	0.0278	-0.0237	0.0666	0.0023	-0.0014	-0.0082	0.0562
Seeds per capsule	P	0.0000	0.0237	-0.0015	0.0273	0.0010	0.0040	-0.0100	0.1638	-0.003	0.0516	-0.0022	0.0339	-0.0029	0.0248	0.0002	0.0069	0.0000	0.0277
1000 seed weight	G	0.0000	0.0403	-0.0007	0.0424	0.0004	0.0036	-0.0041	0.2018	-0.002	0.0893	-0.0011	0.0501	-0.0013	0.0329	0.0002	0.0094	0.0000	0.0382
Oil content	P	0.0009	-0.0260	0.0014	-0.0180	-0.0010	-0.0090	0.0028	-0.0318	0.0085	-0.1011	0.0026	-0.0058	0.0019	-0.0187	0.0002	0.0030	-0.0001	-0.0048
Correlation with Seed yield per plant	G	-0.005	-0.067	-0.0089	-0.0570	0.0046	-0.026	-0.0166	-0.0900	-0.0400	-0.2261	-0.0147	-0.0267	-0.0094	-0.0491	-0.0008	0.0070	0.0006	-0.0124
	P	0.0986	0.0554	0.0186	-0.0170	0.0491	0.0326	0.0697	0.0490	0.0982	0.0136	0.3226	0.2367	0.1824	0.0864	0.0237	0.0100	0.0592	0.0760
	G	0.2451	0.0969	0.0711	-0.0260	0.1384	0.0494	0.1742	0.0750	0.2402	0.0357	0.6533	0.3019	0.4400	0.1297	0.0541	0.0171	0.1437	0.1149
	P	0.1846	0.0241	0.0040	0.0029	0.1171	0.0251	0.1355	0.0103	0.1017	0.0126	0.2639	0.0248	0.4668	0.0681	-0.0041	0.0094	0.1418	0.0216
	G	0.1597	0.0183	-0.0030	0.0026	0.1019	0.0185	0.1229	0.0077	0.0876	0.0102	0.2510	0.0202	0.3727	0.0472	-0.0033	0.0065	0.1167	0.0152
	P	0.0276	0.0007	0.0083	0.0004	-0.0080	0.0000	-0.0050	0.0002	0.0056	-0.0001	0.0195	0.0002	-0.0023	0.0006	0.2655	0.0047	0.0465	0.0015
	G	0.0349	-0.0004	0.0095	-0.0001	-0.0082	0.0000	-0.0113	0.0000	0.0062	0.0000	0.0252	0.0000	-0.0027	-0.0001	0.3046	-0.0008	0.0536	-0.0003
	P	0.0036	0.0751	-0.0002	-0.0120	0.0010	0.0656	0.0000	0.0363	-0.0002	0.0103	0.0019	0.0689	0.0032	0.0680	0.0019	0.0676	0.0106	0.2146
	G	0.0063	0.0675	-0.0003	-0.0114	0.0017	0.0594	0.0000	0.0340	-0.0003	0.0099	0.0039	0.0683	0.0056	0.0578	0.0031	0.0588	0.0178	0.1794
	P	0.3582**	0.4674*	0.0712	-0.082	0.1465	0.3760*	0.2043**	0.2632*	0.2303*	0.0587	0.6253*	0.4371*	0.6656*	0.3669*	0.2966*	0.1335	0.2753*	0.4666*
	G	0.3916*	0.5480*	0.0651	-0.083	0.1454	0.4439*	0.2742*	0.2977*	0.2995*	0.0265	0.8905*	0.5351*	0.7708*	0.4029*	0.3574*	0.1410	0.3155*	0.5019*

* = Significant at 5% level ** = Significant at 1% level P = Phenotypic correlation coefficient

G = Genotypic correlation coefficient K = *kharif* R = *rabi*

Table3. Economic Weights (ai) and Weighing coefficients (bi) for different characters in sesame (*Sesamum indicum* L.) in classical selection indices during *kharif* 2008 and *rabi* 2008 - 09.

Plant character.	Economic weights (ai)		Weighing coefficients (bi)	
	<i>kharif</i>	<i>rabi</i>	<i>kharif</i>	<i>rabi</i>
Days to 50% flowering	0.0251	0.0258	0.0208	0.0319
Plant height(cm)	0.0121	0.0114	0.0090	0.0125
Days to maturity	0.0119	0.0123	0.0128	0.0112
Number of primaries	0.3150	0.2892	0.2415	0.2782
Number of Secondaries	0.3730	0.3463	0.4054	0.2713
Number of capsules per plant	0.0246	0.0231	0.0231	0.0163
Number of seeds per capsule	0.0127	0.0123	0.0169	0.0135
1000-seed weight(g)	0.3589	0.3270	0.3712	0.2843
Oil content(%)	0.0216	0.0209	0.0277	0.0367
Seed yield per plant(g)	0.1119	0.1045	0.0786	0.0824

Table 4. Selection criterion values for 60 genotypes of sesame (*Sesamum indicum* L.) in classical selection indices during *Kharif* -2008, *rabi* 2008 -09

Sl. No	Genotype	Selection criteria		Sl. No	Genotype	Selection criteria	
		<i>kharif</i>	<i>rabi</i>			<i>kharif</i>	<i>rabi</i>
1	Swetha til	10.006	10.416	31	RT-46	9.063	9.398
2	Chandana	9.761	10.119	32	K-5170	9.338	10.264
3	Gowri	10.494	10.940	33	AKT-132	10.817	11.029
4	Madhavi	10.025	10.509	34	VRI-1	11.193	11.270
5	Vinayak	9.935	10.648	35	VSP-7	9.551	10.083
6	BPT Local	9.420	10.309	36	VSP-8	9.535	9.777
7	Tanuku Brown	10.677	11.235	37	VSP-9	9.392	10.117
8	Nellore Brown Local	9.733	9.958	38	VSP-10	9.844	9.943
9	NRD-1110	9.405	10.121	39	VSP-11	9.829	9.838
10	G2	9.291	9.742	40	VSP-12	9.301	9.792
11	G4	9.799	9.937	41	VSP-13	9.886	9.882
12	G12	9.039	9.558	42	VSP-14	8.499	9.456
13	G18	9.880	10.353	43	VZM-7	9.182	9.607
14	G33	9.543	9.913	44	VZM-8	9.486	10.026
15	G35	9.223	9.763	45	VZM-10	9.765	10.058
16	EC-355653	11.846	12.223	46	VZM-11	9.912	10.106
17	EC-357308	10.120	10.689	47	VZM-12	9.708	9.810
18	EC-358022	9.880	10.165	48	VZM-21	9.628	9.943
19	EC-358039	11.048	11.475	49	VZM-22	9.629	9.756
20	EC-358069	10.151	10.514	50	VZM-23	9.439	10.171
21	DCR-1794	9.629	10.177	51	VZM-25	9.881	10.109
22	DCB-1799	10.145	10.083	52	VZM-26	9.539	9.966
23	TMV-4	9.320	10.634	53	VZM-28	9.074	9.522
24	TMV-5	9.984	10.543	54	SI-75	9.365	10.086
25	VB-7901	9.700	10.303	55	SI-320	9.973	10.175
26	YLM-11	10.475	10.255	56	SI-5354	9.650	10.268
27	YLM-17	10.327	10.586	57	JCS-9426	9.853	10.192
28	YLM-66	9.581	10.053	58	E8	10.073	10.226
29	So-12-2154	9.080	9.879	59	PS-201	9.426	10.099
30	SD-2132	9.618	10.177	60	SKL-LOCAL	10.065	10.312

Table 5. Selection indices for different character combinations in sesame (*Sesamum indicum* L.) during kharif 2008

Character combination	Genetic advance	Relative efficiency (%)
Plant height (x_1)	0.0300	29.10
Days to 50% flowering (x_2)	0.0495	48.00
Days to maturity (x_3)	0.0652	63.24
Number of primaries (x_4)	0.0057	5.58
Number of secondaries (x_5)	0.0062	6.03
Number of capsules per plant (x_6)	0.0694	67.33
Number of seeds per capsule (x_7)	0.2064	200.32
1000-seed weight (x_8)	0.0083	8.06
Oil content (x_9)	0.0338	32.76
Seed yield per plant (x_{10})	0.1030	100.00
$(x_1) + (x_{10})$	0.1090	105.80
$(x_2) + (x_{10})$	0.0680	65.98
$(x_3) + (x_{10})$	0.0756	73.37
$(x_4) + (x_{10})$	0.0325	31.53
$(x_5) + (x_{10})$	0.0329	31.94
$(x_6) + (x_{10})$	0.1049	101.80
$(x_7) + (x_{10})$	0.2335	226.60
$(x_8) + (x_{10})$	0.0345	33.47
$(x_9) + (x_{10})$	0.0527	51.14
$(x_6) + (x_7) + (x_{10})$	0.2960	269.91
$(x_3) + (x_6) + (x_7) + (x_{10})$	0.3224	297.00
$(x_1) + (x_3) + (x_6) + (x_7) + (x_{10})$	0.3423	332.23
$(x_1) + (x_2) + (x_3) + (x_6) + (x_7) + (x_{10})$	0.3640	353.23
$(x_1) + (x_2) + (x_3) + (x_6) + (x_7) + (x_9) + (x_{10})$	0.3764	365.36
$(x_1) + (x_2) + (x_3) + (x_5) + (x_6) + (x_7) + (x_9) + (x_{10})$	0.3789	367.78
$(x_1) + (x_2) + (x_3) + (x_4) + (x_5) + (x_6) + (x_7) + (x_9) + (x_{10})$	0.3803	369.69
$(x_1) + (x_2) + (x_3) + (x_4) + (x_5) + (x_6) + (x_7) + (x_8) + (x_9) + (x_{10})$	0.3817	370.37

Seed yield per plant recorded significant and positive association with days to 50% flowering, number of primaries, capsules per plant, seeds per capsule and oil content at both phenotypic and genotypic levels.

Based on the magnitude of correlation coefficient values capsules per plant, seeds per capsule and number of primary branches may be regarded as very closely related characters with seed yield per plant. Hence, higher yield could be obtained by exerting selection pressure over any of these traits. Similar findings were reported by Banerjee and Kole (2006) and Mothilal (2006). The number of capsules per plant had a highly significant association with seeds per capsule and seed yield per plant. Therefore it can be considered as principal yield determining factor.

In path coefficient analysis Table 2, it was observed that seeds per capsule exhibited highest direct positive effect and indirect effect through other characters viz., capsules per plant, number of primaries and days to 50% flowering. Since this trait showed high correlation and high direct effect on seed yield per plant, yield can be improved by making selection for this character during yield improvement programme. Babu *et al.* (2004) and Banerjee and Kole (2006) also reported the similar findings.

In classical selection indices the economic weights (a_i values) allotted for each character are presented in Table 3. Suffix *K* indicates *kharif* and suffix *R* indicates *rabi* Inverse of mean value for respective characters were considered as allotted weights. Among the

Table 6. Selection indices for different character combinations in sesame (*Sesamum indicum* L.) during *rabi* 2008 – 09.

Character combination	Genetic advance	Relative efficiency (%)
Plant height (x_1)	0.0372	38.26
Days to 50% flowering (x_2)	0.0450	46.30
Days to maturity (x_3)	0.0524	53.87
Number of primaries (x_4)	0.0056	5.76
Number of secondaries (x_5)	0.5300	5.41
Number of capsules per plant (x_6)	0.0690	71.00
Number of seeds per capsule (x_7)	0.2119	218.01
1000-seed weight (x_8)	0.0079	8.15
Oil content (x_9)	0.0372	38.26
Seed yield per plant (x_{10})	0.0972	100.00
(x_1) + (x_{10})	0.0987	101.57
(x_2) + (x_{10})	0.0467	48.07
(x_3) + (x_{10})	0.0529	54.40
(x_4) + (x_{10})	0.0099	10.22
(x_5) + (x_{10})	0.0094	9.64
(x_6) + (x_{10})	0.0700	72.06
(x_7) + (x_{10})	0.2131	237.35
(x_8) + (x_{10})	0.2007	122.65
(x_9) + (x_{10})	0.0406	41.74
(x_6) + (x_7) + (x_{10})	0.2762	284.17
(x_3) + (x_6) + (x_7) + (x_{10})	0.3030	311.82
(x_2) + (x_3) + (x_6) + (x_7) + (x_{10})	0.3317	341.30
(x_2) + (x_3) + (x_6) + (x_7) + (x_9) + (x_{10})	0.3511	361.27
(x_1) + (x_2) + (x_3) + (x_6) + (x_7) + (x_9) + (x_{10})	0.3609	371.33
(x_1) + (x_2) + (x_3) + (x_5) + (x_6) + (x_7) + (x_9) + (x_{10})	0.3629	373.41
(x_1) + (x_2) + (x_3) + (x_4) + (x_5) + (x_6) + (x_7) + (x_9) + (x_{10})	0.3648	375.38
(x_1) + (x_2) + (x_3) + (x_4) + (x_5) + (x_6) + (x_7) + (x_8) + (x_9) + (x_{10})	0.3664	377.07

characters studied number of secondaries per plant got height weightage value (0.3730 K and 0.3463 R) followed by 1000 seed weight (0.3589 K and 0.3270 R) during both the seasons.

The weighing coefficients (bi values) are presented in Table 3. Among the characters studied number of secondaries per plant got higher bi value (0.4054) followed by 1000 seed weight (0.3712) during *kharif*. Whereas, during *rabi* 1000 seed weight (0.2843) showed higher bi value followed by number of primaries (0.2782).

The selection criteria for 60 genotypes of sesame are given in Table 4. Higher value of selection criteria were observed for the genotypes EC -355653 (11.846 K & 12.223 R), VRI -1 (11.193 K & 11.270 R), EC -358039 (11.048 K & 11.475 R), AKT- 132 (10.817 K & 11.029 R) and Tanuku brown (10.677 K & 11.235 R). While the lowest value

was observed for the genotype VSP -14 (8.499) during *kharif* and RT -46 (9.398) during *rabi*.

Selection indices comprising various combination of characters along with their genetic advance and relative efficiency are presented for *kharif* in Table 5 and for *rabi* in Table 6. Among two component character indices, seed yield along with number of seeds per capsule showed highest genetic advance (0.2335 K & 0.2131 R) with a relative efficiency of 226.60 K & 237.35 R. Like wise, three character combinations exhibited still higher values of genetic advance and relative efficiency. The maximum genetic advance (0.3817 K & 0.3664 R) and relative efficiency (370.37 K & 377.07 R) were shown when all the ten characters were included in the index. Khorgade *et al.* (1998) found that index comprising number of capsules per plant, 1000 seed weight and seed yield per

plant had highest genetic advance and relative efficiency in sesame. Jyoshna Devi *et al.* (2006) observed a linear increase in genetic advance and relative efficiency with the inclusion of more number of characters in the index along with seed yield per plant.

Hence it can be concluded that the inclusion of characters one by one in the function resulted in the increased efficiency of selection. The indices in which the number of seeds per capsule is included as one of the characters showed highest genetic advance and relative efficiency.

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