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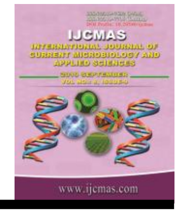

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Combining Ability and Gene Action in Sesame (*Sesamum indicum* L.) Elite Genotypes by Half Diallel Mating Design

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A B S T R A C T

An 8 x 8 diallel cross mating design with the parents and F_{1s} was used to estimate gene action and combining ability for yield and yield attributing traits in sesame (*Sesamum indicum* L.). Combing ability analysis revealed predominance of non-additive gene action for all traits *viz*,. days 50% flowering, days to maturity, plant height, number of branches per plant, number of capsules per plant, length of capsule, width of capsule, 1000 seed weight, yield per plant and oil content which can be improved by bi-parental mating or reciprocal recurrent selection. The parent AKT-306, LOCAL and G-1 were found as good combiner for seed yield per plant. The highest SCA effect for seed yield per plant was exhibited by cross G-1 x IC- 204025 along with superior SCA effect for five characters like plant height, number capsule per plant, seed per capsule, capsule length and capsule width. The character test weight had fixable additive genetic variance which can improve by simple selection. The crosses AKT-306 x YLM-17 and LOCAL x AKT-101 with significant SCA effects indicating the predominance of additive gene action for seed yield hence progeny selection in the segregating generation is more useful.

Introduction

Sesame (*Sesamum indium* L.) is an ancient oil yielding crop and popularly known as "Queen of oil seeds. Worldwide, it is used for its nutritional, medicinal, and industrial purposes. Sesame is commonly known as *Til* (Hindi/Marathi), *Tai* (Gujrat), *Tili* (Punjab), *Nuvulu* (telgu), *Ellu* (Tamil), *Rasi* (Orissa) besides these sesamum, *gingelly*, *benniseed*, *simsim*. The crop has its early origins in East Africa and India (Bedigian and Harlan 1986). Today, India and China is the world's largest producer of sesamum followed by Myanmar, Sudan, Uganda, Nigeria, Pakistan, Tanzania, Ethopia and Turkey. Sesame seed (approximately 50% oil, 25% protein and 15% carbohydrates) reported by (Burden 2005) are used in baking, candy making and other food industries.

Materials and Methods

The experimental material for the present study comprised of eight parent *viz.*, LOCAL, G-1, AKT-306, AKT-101, IC-205283, IC-203871, IC-204025 and YLM-17.Crosses were made among the parents in diallel fashion without reciprocals during, summer 2018. The resulting 28F_1s, their parents and standard check JlT-408 and phule til -1 were sown with a spacing of 45cm between rows and 20cm between plants during kharif, 2018 at research farm of agriculture botany, college of agriculture, Latur. The experiment was laid out in randomized block design with three replications Five plant were selected randomly from each replication and observation were recorded for various quantitative traits *viz.*, 50% flowering, Plant height (cm), number of branches per plant, number of capsules per plant, Length of capsule (cm), width of capsule (mm), test weight (gm), seed yield per plant (gm), oil content. The mean data was analysed by following method given by Griffings (1956).

Results and Discussion

Analysis of variance for combining ability indicated significant differences among treatment for all the traits. The data pertaining to the analysis of variance (Table-2) revealed significant differences among treatment, parents and F_1s for all the characters (except days to maturity and width of capsule for Parent *v/s* F_1s) indicated the presence of substantial amount of genetic variability among the treatments, parents and crosses in the experimental material used. The estimates of components of variance revealed different types of gene action for the characters studied. Dominant gene action was found to be more pronounced for the expression all traits (Table-1). Seed yield forms the major objective in any plant breeding programme and SCA variance was more than GCA variance exhibiting the role of non-additive gene action for inheritance of this trait. The character seed yield per plant is governed by both additive and non-additive gene action. non-additive gene action was preponderant over additive in the inheritance of seed yield per plant. Thus non additive gene action could be exploited by heterosis breeding. Goyal *et al.*, (1991), Thiyagu *et al.*, (2007), Parimala *et al.*, (2015) and Chudhari *et al.*, (2015) also reported the role of non- additive gene action for seed yield. However, importance of both additive and non-additive gene action was recorded by Kadu *et al.*, (1992).The results of GCA effects indicated that the parents, AKT-306, G-1 and LOCAL were proved as good general combiner for nine, six and five character including seed yield per plant and their contributing character. Parent IC-203871 and IC-204025 registered good general combiner for oil content but poor general combiner seed yield per plant. Parent IC-205283 exhibited good general combiner in earliness for characters days to 50% flowering and days to maturity. The GCA effects of parents were positively and significant associated with their mean value for majority of characters, However, these not true for all characters in all case, suggesting that inert allelic interaction were important in for these complementary epistatics effects. A close relationship between parent per se performance and their GCA effects is important in the choice of parents for crossing programme.

Good general combining ability of AKT-306 and LOCAL for one or more yield attributes might have resulted into high combining ability of these parent for seed yield these parent could therefore be effectively utilized in breeding programme for developing high yielding varieties/hybrids. The same results on general combining ability for these traits were reported previously by Khorgade *et al.*, (1989).

Table.1 Analysis of variance for different characters in Sesame

Source	D.F.	Days to 50 per cent flowering		Days to maturity		Plant height (cm)		Number of branches		Number of capsule per plant		Number seed per capsule		Length of capsule (cm)		Width of capsule (mm)		1000 Seed weight (g)		Seed yield per plant (g)		Oil content (%)	
Replications	2	2.583		3.814		20.721		0.107		10.015		1.605		0.054		0.006		0.005		0.945		3.374	
Treatments	35	29.180	**	12.733	**	667.54	**	2.426	**	529.65	**	126.95	**	0.210	**	1.165	**	0.930	**	44.044	**	45.779	**
Parents	7	22.375	**	3.184	*	288.36	**	0.933	**	332.35	**	31.29	**	0.208	**	0.303	**	0.685	**	18.128	**	38.560	**
F_1' s	27	31.786	**	15.679	**	764.25	**	2.796	**	576.28	**	133.78	**	0.192	**	1.432	**	0.991	**	52.051	**	48.699	**
Parents v/s F_1' s	1	6.482	*	0.032		710.50	**	2.880	**	651.78	**	613.46	**	0.718	**	0.001		0.995	**	9.271	**	17.468	**
Error	70	1.535		1.252		44.397		0.230		10.508		5.423		0.022		0.020		0.013		0.912		1.451	
GCA	7	33.098	**	7.767	**	503.66	**	1.070	**	288.770	**	42.545	**	0.120	**	0.927	**	0.464	**	36.396	**	33.830	**
SCA	28	3.884	**	3.363	**	152.22	**	0.743	**	148.497	**	42.277	**	0.057	**	0.253	**	0.271	**	9.252	**	10.617	**
δ2 gca/sca		0.8663		0.1494		0.2557		0.0491		0.0967		0.0006		0.1246		0.2728		0.0722		0.3033		0.2290	

Table.2 Estimates of general and specific combining ability effect for different characters in Sesame

Sr. No.	Parents/ crosses	Days to 50% flowering		Days to maturity		Plant height		No. of branches	
	Parents								
1	LOCAL	1.000	**	0.142		-1.979		0.535	**
2	G-1	-1.267	**	-0.658	**	-10.092	**	0.255	**
3	AKT-306	-0.800	**	0.275		4.110	**	0.222	**
4	AKT-101	1.833	**	0.808	**	-0.145		-0.225	**
5	IC-205283	-3.200	**	-1.225	**	-9.912	**	-0.378	**
6	IC-203871	0.633	**	-0.058		9.577	**	-0.092	**
7	IC-204025	-0.576	**	-0.758	**	5.684	**	-0.378	**
8	YLM-17	2.367	**	1.475	**	2.757	*	0.062	
	S.E.gi	0.2116		0.1911		1.137		0.0821	
	S.E.gi-gi	0.3199		0.2890		1.720		0.1241	
	Crosses								
9	LOCAL x G-1	1.933	**	1.193		16.237	**	0.671	*
10	LOCAL x AKT-306	-3.867	**	-1.741	**	1.458		0.904	*
11	LOCAL x AKT-101	-0.500		0.393		0.513		0.818	**
12	LOCAL x IC-205283	-0.467		-0.241		-26.120	**	-1.096	**
13	LOCAL x IC-203871	2.700	**	1.259	*	7.924	*	0.684	**
14	LOCAL x IC-204025	3.567	**	1.626	**	1.317		0.771	**
15	LOCAL x YLM-17	-2.033	**	-2.607	**	1.644		-0.202	
16	G-1 x AKT-306	-2.267	**	-2.941	**	17.071	**	1.051	**
17	G-1 x AKT-101	0.433		2.526	**	-15.707	**	0.031	
18	G-1 x IC-205283	-1.533	*	-1.107		-21.774	**	-1.482	**
19	G-1 x IC-203871	0.633		0.059		7.037		0.431	
20	G-1 x IC-204025	-0.833		0.426		16.664	**	0.784	**
21	G-1 x YLM-17	1.233		-0.807		-11.076	**	-0.989	**
22	AKT-306 x AKT-101	-0.033		-0.407		-3.043		-0.784	**
23	AKT-306 x IC-205283	1.667	*	0.293		2.291		1.084	**
24	AKT-306 x IC-203871	0.500		2.793	**	1.901		0.931	**
25	AKT-306 x IC-204025	-2.300	**	-1.507	*	-4.072		-0.849	**
26	AKT-306 x YLM-17	1.767	*	3.926	**	7.122		-0.156	
27	AKT-101 x IC-205283	2.033	**	2.093	**	0.226		0.531	*
28	AKT-101 x IC-203871	-0.467		-0.074		-3.843		-0.356	
29	AKT-101 x IC-204025	-1.600	*	-2.041	**	-3.883		-0.536	*
30	AKT-101 x YLM-17	0.133		1.393		17.311	**	-0.509	
31	IC-205283 x IC-203871	-3.100	**	-2.041	**	18.157	**	0.464	
32	IC-205283 x IC-204025	-2.900	**	-2.341	**	5.950		-0.782	**
33	IC-205283 x YLM-17	0.833		1.759	**	4.844		-0.089	
34	IC-203871 x IC-204025	-0.733		-0.507		2.767		-0.469	
35	IC-203871 x YLM-17	1.00		-1.074		8.588	*	0.624	*
36	IC-204025 x YLM-17	0.533		-0.041		-11.119	**	0.911	**
	S.E sij	0.6487		0.5860		3.488		0.2517	
	S.E sij - sik	0.9599		0.8670		5.161		0.3724	

* Significant at 5 % level, ** Significant at 1 % level

Table.3 Estimates of general and specific combining ability effect for different characters in Sesame

Sr. No.	Parents/ crosses	No of capsule per plant		No of seeds per capsule		Capsule length (cm)		Capsule width (mm)	
	Parents								
1	LOCAL	4.121	**	-0.528		0.053	*	0.583	**
2	G-1	-0.349		-1.694	**	0.070	**	0.259	**
3	AKT-306	10.689	**	3.626	**	0.190	**	0.118	**
4	AKT-101	-2.847	**	-1.601	**	0.001		-0.123	**
5	IC-205283	-7.511	**	1.113	**	0.017		-0.353	**
6	IC-203871	-1.628	**	0.859	*	-0.086	**	-0.214	**
7	IC-204025	-0.714		1.033	*	-0.159	**	-0.078	**
8	YLM-17	-1.761	**	-2.808	**	-0.085	**	-0.192	**
	S.E.gi	0.5536		0.3977		0.02540		0.0243	
	S.E.gi-gi	0.8370		0.6012		0.03841		0.0368	
	Crosses								
9	LOCAL x G-1	5.415	**	-0.016		0.63		0.165	*
10	LOCAL x AKT-306	3.877	*	5.930	**	0.209	*	0.350	**
11	LOCAL x AKT-101	20.786	**	3.090	*	0.332	**	0.418	**
12	LOCAL x IC-205283	-4.003	*	-7.623	**	-0.181	*	-0.359	**
13	LOCAL x IC-203871	-0.806		-1.503		-0.001		0.508	**
14	LOCAL x IC-204025	1.114		-2.476		0.172	*	-0.057	
15	LOCAL x YLM-17	-6.339	**	1.097		0.172	*	0.470	**
16	G-1 x AKT-306	5.867	**	-2.836	*	0.393	**	0.366	**
17	G-1 x AKT-101	-5.217	**	2.124		-0.251	**	0.141	
18	G-1 x IC-205283	-9.220	**	1.010		-0.090		0.064	
19	G-1 x IC-203871	4.831	**	-0.336		0.103		-0.315	**
20	G-1 x IC-204025	24.221	**	12.557	**	0.572	**	0.863	**
21	G-1 x YLM-17	2.064		0.664		-0.251	**	0.210	**
22	AKT-306 x AKT-101	3.898	*	-2.130		0.195	*	-0.434	**
23	AKT-306 x IC-205283	6.896	**	-0.576		-0.088		-0.198	*
24	AKT-306 x IC-203871	6.837	**	5.544	**	-0.058		-0.354	**
25	AKT-306 x IC-204025	-2.487		5.904	**	-0.118		-0.330	**
26	AKT-306 x YLM-17	14.293	**	8.744	**	0.215	*	0.918	**
27	AKT-101 x IC-205283	14.645	**	1.984		0.035		0.210	**
28	AKT-101 x IC-203871	11.849	**	-0.696		-0.068		0.148	
29	AKT-101 x IC-204025	-16.152	**	7.130	**	-0.149		-0.938	**
30	AKT-101 x YLM-17	-9.171	**	-7.563	**	-0.129		-0.180	**
31	IC-205283 x IC-203871	11.226	**	4.057	**	-0.188	**	-0.056	
32	IC-205283 x IC-204025	-11.488	**	-0.650		0.048		0.338	**
33	IC-205283 x YLM-17	-4.860	**	12.257	**	0.078		-0.481	**
34	IC-203871 x IC-204025	-21.303	**	6.604	**	0.095		-0.398	**
35	IC-203871 x YLM-17	-8.790	**	-7.356	**	0.045		-0.503	**
36	IC-204025 x YLM-17	-1.270		-9.263	**	0.064		-0.519	**
	S.E sij	1.6971		1.2191		0.0778		0.0368	
	S.E sij - sik	2.5110		1.8038		0.1152		0.1103	

* Significant at 5 % level, ** Significant at 1 % level

Table.4 Estimates of general and specific combining ability effect for different characters in sesame

Sr. No.	Parents/ crosses	1000 seed weight (g)		Seed yield per plant (g)		Oil content (%)	
	Parents						
1	LOCAL	0.177	**	1.443	**	-0.850	**
2	G-1	-0.063	**	0.395	*	-2.864	**
3	AKT-306	0.337	**	3.811	**	2.118	**
4	AKT-101	-0.336	**	-0.997	**	-0.138	
5	IC-205283	-0.053	**	-1.940	**	-0.373	
6	IC-203871	0.130	**	-0.146		0.630	**
7	IC-204025	0.015		-0.713	**	2.815	**
8	YLM-17	-0.208	**	-1.852	**	-1.339	**
	S.E.gi	0.0195		0.1631		0.2057	
	S.E.gi-gi	0.0296		0.2465		0.3110	
	Crosses						
9	LOCAL x G-1	0.260	**	-0.581	**	1.319	*
10	LOCAL x AKT-306	0.127	*	1.120	*	2.377	**
11	LOCAL x AKT-101	-0.300	**	4.681	**	-4.857	**
12	LOCAL x IC-205283	-0.416	**	-3.863	**	-1.365	*
13	LOCAL x IC-203871	0.400	**	-0.024		0.169	
14	LOCAL x IC-204025	-0.449	**	-1.026	*	4.653	**
15	LOCAL x YLM-17	-0.561	*	3.739	**	1.004	
16	G-1 x AKT-306	0.434	**	0.452		-0.639	
17	G-1 x AKT-101	-0.526	**	-1.458	**	-2.029	**
18	G-1 x IC-205283	0.157	*	0.269		4.769	**
19	G-1 x IC-203871	-0.193	**	2.508	**	-0.994	
20	G-1 x IC-204025	0.422	**	7.176	**	2.448	**
21	G-1 x YLM-17	0.512	**	-1.586	**	-7.089	**
22	AKT-306 x AKT-101	-0.626	**	1.187	*	-3.891	**
23	AKT-306 x IC-205283	0.324	**	1.583	**	4.417	**
24	AKT-306 x IC-203871	0.107		0.659		1.354	*
25	AKT-306 x IC-204025	-0.145	*	0.290		-0.198	
26	AKT-306 x YLM-17	0.445	**	4.545	**	-0.421	
27	AKT-101 x IC-205283	0.197	**	-0.523		2.664	**
28	AKT-101 x IC-203871	0.980	**	2.563	**	0.757	
29	AKT-101 x IC-204025	-0.671	**	-2.743	**	1.622	*
30	AKT-101 x YLM-17	0.719	**	-0.987		1.589	*
31	IC-205283 x IC-203871	0.097		-2.720	**	-3.328	**
32	IC-205283 x IC-204025	-0.021		-1.243	*	-4.470	**
33	IC-205283 x YLM-17	-1.165	**	-0.457		-2.916	**
34	IC-203871 x IC-204025	-0.305	**	-4.070	**	-5.413	**
35	IC-203871 x YLM-17	0.285	**	-3.585	**	-0.106	
36	IC-204025 x YLM-17	0.450	**	-1.517	**	2.539	**
	S.E sij	0.0600		0.4999		0.6306	
	S.E sij – sik	0.0888		0.7397		0.9331	

* Significant at 5 % level, ** Significant at 1 % level

Among the crosses studied, G-1 x IC-204025, AKT-306 x YLM-17, LOCAL x AKT-306 and LOCAL x AKT-101 were identified as the potential specific combiners for seed yield per plant and other yield contributing traits (Table-2,3,4).Highly significant positive SCA effect for number of capsule per plant was exhibiting in the crosses G-1 x IC-204025 (24.221), LOCAL x AKT-101 (20.786) and AKT-101 x IC-205283 (14.645). The hybrid G-1 x IC-204025, IC-205283 x YLM-17 and AKT-306 x YLM-17 were found to be good specific combiners for number of seed per capsules. The crosses, AKT-306 x IC-205283, G-1 x AKT-306 and AKT-306 x IC-203871 showed highly significant positive SCA effect for number of branches per plant. The crosses AKT-101 x IC-203871, AKT-101 x YLM-17 and G-1 x YLM-17 exhibited highest positive significant SCA effect for test weight. Good specific combiners for oil content were G-1 x IC-205283, LOCAL x IC-204025 and AKT-306 x IC-205283. The cross LOCAL x AKT-306 had both good combining parent for seed yield. Raikwar (2018) reported close relationship between GCA effects of parents and SCA effects of their resultant crosses. The cross, G-1 x IC-204025 had good x poor combining parents. Positive SCA in crosses between good and poor combiners could be ascribed to better complementation between favorable alleles of the parents involved. Goyal and kumar (1986) and Rajput and Kute (2017) also stressed the importance of good x poor crosses in obtaining superior combination.

The highest SCA effect for seed yield per plant was exhibited by cross G-1 x IC- 204025 along with superior SCA effect for five characters like plant height, number capsule per plant, seed per capsule, capsule length and capsule width. The character test weight had fixable additive genetic variance which can improve by simple selection. The crosses AKT-306 x YLM-17 and LOCAL x AKT-101 with significant SCA effects indicating the predomince of additive gene action for seed yield hence progeny selection in the segregating generation is more useful.

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