Madras Agric. J., 82(6,7,8): 445-449 June, July, August 1995
https://doi.org/10.29321/MAJ.10.A01228

COMBINING ABILITY ANALYSIS FOR YIELD COMPONENTS OF SESAME IN DIFFERENT ENVIRONMENTS

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ABSTRACT

Genetics of yield components was investigated from combining ability analysis of line x tester under six different environments in (*Sesamum indicum*). Among the parents, Si 930, Si 1669 and Si 1702 were found to be good general combiners for seed yield and other desirable traits. The hybrid combinations Si 953 x Co 1 and Si 1669 x TMV 3 were superior for yield and oil content respectively. There appeared to be a relationship between the *sca* effect of hybrids and their *per se* performance.

KEY WORDS : Sesame, Yield Components, Environment, Combining Ability

Combining ability studies reveal the nature of gene action and lead to identification of parents with general combining ability effects *(gca)* and the cross combinations with high specific combining ability *(sca)* effects. Among the different biometrical methods employed to study combining

Table 1. **Pooled analysis of variance of line x tester analysis.**

Source	df	Mean squares				
		Days to 50% flowering	Plant height (cm)	First capsule bearing node	Capsule bearing portion of main stem	Number of branches per plant
Environments	5	664.55**	47378.50**	60.30**	12767.18**	577.18**
Hybrids	59	11.17**	211.58**	0.49**	76.54**	6.86**
Lines	19	20.14**	391.95**	0.64	115.20	8.36
Testers	2	14.44	25.25	0.28	18.75	17.50
Linesx Testers	38	6.52**	131.20**	0.43**	60.25**	5.55**
Linesx Env.	95	7.87**	145.35**	0.65**	93.40**	6.01**
Testersx Env.	10	3.14**	170.36**	0.76**	79.45**	6.62**
(Lines x Testers) x Env.	190	5.63**	165.05**	0.45**	69.21**	3.83**
Error	984	0.33	60.98	0.16	24.23	1.57
GCA		0.053	0.409	-0.001	-0.051	0.024
SCA		0.049	-1.881	-0.001	-0.498	0.096

Source	df	Mean squares							
		Number of capsules on branches	Number of capsules per plant	Capsule length (cm)	1000 seed weight (g)	Seed yield (g)	Total drymatter production (g)	Harvest index (per cent)	Oil content (per cent)
Environments	5	64252.43**	82628.46**	18.54**	13.03**	888.59**	19405.39**	9858.13**	832.72**
Hybrids	59	540.35**	635.53**	0.12**	0.92**	11.47**	157.63**	155.13**	28.41**
Lines	19	492.20	598.70	0.13	0.47	10.70	264.17**	218.35	35.33
Testers	2	25.94	4.88	0.06	3.43*	12.37	105.62	192.28	9.06
Linesx Testers	38	591.51**	687.13**	0.11**	1.02**	11.81**	107.10**	121.57**	25.97**
Linesx Env.	95	598.16**	722.85**	0.11**	0.64**	10.30**	132.61**	144.07**	20.44**
Testersx Env.	10	696.48**	869.35**	0.08**	2.30**	9.75**	92.12**	182.20**	14.77**
(Lines x Testers) x Env.	190	413.99**	526.95**	0.07**	0.53**	10.26**	136.46**	122.30**	22.39**
Error	984	140.71	166.83	0.03	0.02	1.45	31.91	25.50	0.20
GCA		-2.733	-3.162	-0.0001	-0.00006	-0.0001	0.492	0.207	0.005
SCA		9.862	8.899	0.002	0.028	0.086	-1.631	-0.041	0.198

* Significant at P = 5%; ** Significant at P = 1%.

Table 2. GCA effects of three best combiners for 13 traits in sesame under different environments

Character	Rank	Parent	E1	E2	E3	E4	E5	E6	Pooled
Days to 50%	I	TC 45	0.11	0.70*	0.96*	0.72*	-1.69**	-0.28*	0.08
flowering	II	AT 9	0.005	-1.51**	-0.81**	-0.05	-0.69**	-1.62**	-0.78**
	III	Si1147	1.22**	0.14	1.84**	1.27**	-1.25**	0.17	0.51**
Plant height	I	JLT 7	1.53	0.81	4.83	0.79	4.05	-7.47**	0.76
	II	Si930	5.97	2.04	0.82	4.83	3.14	7.80**	4.10**
	III	Si953	6.27	1.28	-4.42	-2.86	-0.23	-0.21	-0.02
First capsule	I	TC 45	-0.02	0.02	-0.12	0.01	-0.14	0.30**	0.01
bearing node	II	G51-266	0.44**	0.27	-0.09	-0.13	0.44**	0.31**	0.20**
	III	S0554	-0.24	-0.10	0.01	0.27	0.17	-0.53**	-0.07
Capsule bearing	I	S1930	3.25	3.73	-0.84	1.10	-1.00	4.52**	1.79
portion of main	II	Si1248	3.92	-0.45	0.08	3.54	0.21	10.43**	2.95**
stem	III	JLT 7	-0.26	2.22	4.89*	1.90	-1.77	-2.16*	0.80
Number of	I	EC137-935	-0.36	-0.20	-0.05	0.07	-0.84**	-1.62**	-0.50*
branches per plant	II	Si 953	0.43	1.06	-0.59	-0.96*	-0.13	-0.49*	-0.11
	III	Si1755	1.12	-0.62	0.17	-0.35	-0.54*	0.98**	0.12
Number of	I	EC137-935	-3.21	10.55	0.79	1.77	-4.95**	-10.81**	-0.97
capsules on	II	Si 930	1.11	14.74	2.37	9.57**	9.62**	5.78**	7.20**
branches	III	Si1702	14.00**	-14.10	-2.76	11.85**	-4.52**	-3.45**	0.16
Number of	I	EC137-935	-3.93	10.46	0.32	-0.41	-3.76*	-12.92**	-1.70
capsules per plant	II	Si 930	2.19	15.71	2.80	10.47**	7.81**	4.96**	7.32**
	III	Si1702	14.98**	-12.37	-3.27	7.73*	-1.38	-3.68**	0.33
Capsule length	I	Si1702	-0.05	0.15	0.14*	0.17*	0.22**	0.18**	0.13*
	II	Si1669	0.02	0.28	-0.009	-0.03	-0.17**	-0.09	-0.0002
	III	Si1248	0.08	0.22	0.03	0.04	-0.16**	0.36**	0.02
1000 seed weight	I	Si1669	-0.06	-0.37**	0.18	0.51**	0.43**	-0.07**	0.10*
	II	Si1702	0.06	0.05	0.36**	-0.10**	0.15**	-0.23**	0.05*
	III	S0554	-0.0001	-0.18**	-0.17	0.009	-0.11**	-0.43**	-0.15**
Seed yield	I	EC137-935	-0.08	-1.09	-0.06	-0.46**	1.27**	0.89**	0.08
	II	Si 930	-0.026	0.82	0.66**	-0.87**	-0.05	-1.43**	-0.19
	III	Si1669	1.00	0.93	-0.23	1.01**	0.03	0.92**	0.61**
TDMP	I	Si1669	1.73	2.48	-0.91	1.56**	6.59**	3.31**	2.46*
	II	EC137-935	-2.12	-0.32	0.36	-0.08	-1.37**	-1.95**	-0.91
	III	Si930	0.97	5.21	2.56**	0.08	1.80**	2.40**	2.17*
HI	I	S0554	0.50	1.61	-3.83	3.92**	2.95**	-1.91**	0.54
	II	Si930	-1.25	-0.62	-4.09	-7.19**	-2.45**	-5.72**	-3.55**
	III	AT 9	-3.32	-1.09	2.22	-4.35**	-4.74**	0.88	-1.73
Oil content	I	Co1	0.04	-0.65**	-0.03	-0.08	-0.16*	-0.17*	-0.17**
	II	IS232	1.96**	-4.55**	-0.33	-2.48**	0.16	0.08	-0.85**
	III	Si1703	-0.58**	-1.64**	-1.68**	0.08	-2.33**	-1.10**	-1.21**

*, ** Significant at 5% and 1% level respectively.

ability, the one proposed by Kempthorne (1957) known as the line x tester analysis was followed in this study.

MATERIALS AND METHODS

Twenty accessions of sesame differing in duration, growth habit, plant stature, branching and seed yield were used as lines. The three commercial varieties of Tamil Nadu *viz.*, TMV 3, Co 1 and Paiyur 1 were chosen as testers. Crosses were effected between 20 lines and 3 testers to get 60 F1 hybrids in line x tester mating design. The 60 F1 hybrids and 23 parents were studied in six different environments. The environments were created by planting experimental materials at three different seasons *viz.*, *kharif* 1991, *rabi* 1991, and summer 1992 in red soil and black soil conditions.

The experiment was sown in randomised block design with three replications in each of the above environments. A single row of 4.5 m length was allotted to each genotype for each replication with a spacing of 45 cm between successive rows and 15

Table 3. Three superior crosses selected on the basis of *per se* performance and *sca* effects and *gca* effects of the parents involved in these crosses for the yield components

	sca effects	*gca* effects		*per se* performance	*gca* effect
			Days to 50% floweing		
Si 1278 x Paiyur-1	-1.06**	(MxL)	Si 1249 x Paiyur 1	40.4	(HxM)
EC137-935 x Co.1	-0.91**	(LxH)	Si 1249 x TMV.3	40.6	(HxM)
Si 1755 x TMV.3	-0.72**	(LxL)	Si 1278 x Paiyur 1	40.7	(MxM)
			Plant height		
EC137-935 x Co.1	3.81**	(LxL)	Si 1248 x Co.1	77.5	(HxM)
S0554 x TMV.3	3.72**	(LxL)	Si 930 x TMV.3	77.2	(HxM)
Si1669 x Paiyur.1	3.42**	(LxM)	Si 1248 x TMV.3	77.0	(HxM)
			First capsule bearing node		
Si 1702 x Co.1	-0.26*	(MxM)	Si 1702 x Co.1	3.82	(MxM)
Si 1278 x Paiyur.1	-0.25	(MxL)	IS 232 x Paiyur.1	3.90	(LxM)
JLT 7 x TMV.3	-0.22	(LxL)	Si 1669 x Co.1	3.91	(LxL)
			Capsule bearing portion of main stem		
Si 1147 x Co.1	3.06	(LxL)	Si 1248 x Co.1	40.3	(HxL)
Si 1703 x Co.1	2.56	(MxL)	Si 930 x TMV.3	39.4	(MxM)
Si 953 x Co.1	2.51	(LxL)	Si 1702 x TMV.3	39.3	(MxM)
			Number of branches per plant		
Si 1669 x Paiyur.1	1.01*	(LxL)	Si 930 x TMV.3	8.4	(HxH)
S0554 x Co.1	0.92*	(LxL)	Si 930 x Paiyur 1	7.9	(HxL)
OTS.2 x TMV.3	0.67	(LxH)	Si 1703 x Co.1	7.8	(HxL)
			Number of capsules on branches		
Si 1669 x Paiyur.1	10.30**	(LxL)	Si 930 x TMV.3	59.9	(HxL)
Si 930 x TMV.3	9.46*	(HxL)	Si 1703 x Co.1	55.0	(MxM)
Si 1703 x Co.1	8.14*	(MxM)	Si 1147 x Co.1	53.3	(MxM)
			Number of capsules per plant		
TC45 x TMV.3	11.11**	(LxL)	Si 930 x TMV.3	74.8	(HxL)
Si 1669 x Paiyur 1	10.70*	(LxL)	Si 1703 x Co.1	70.8	(HxM)
Si 930 x TMV.3	9.46*	(HxL)	Si 1147 x Co.1	69.5	(HxM)
			Capsule length		
Si 1249 x TMV.3	0.15*	(LxM)	Si 1703 x Paiyur 1	2.4	(HxL)
Si 1703 x Paiyur 1	0.14*	(MxL)	Si 930 x TMV.3	2.3	(HxM)
JLT 7 x TMV.3	0.11*	(LxM)	Si 1702 x TMV.3	2.3	(HxM)
			1000 seed weight		
G51-266 x TMV.3	0.24**	(HxH)	Si 930 x TMV.3	3.4	(HxH)
Si 1150 x Paiyur 1	0.50**	(LxL)	G 51-266 x TMV.3	3.1	(HxH)
Si 1278 x Co.1	0.35**	(MxL)	OTS.2 x TMV.3	3.0	(HxH)
			Seed yield		
Si 953 x Co.1	1.77**	(MxM)	Si 953 x Co.1	8.1	(MxM)
OTS 2 x TMV.3	1.43**	(MxM)	G 51-266 x Co.1	7.9	(HxM)
Si 1249 x TMV.3	1.29**	(LxM)	Si 1703 x Co.1	7.7	(HxM)
			TDMP		
Si 953 x Co.1	6.46**	(HxM)	Si 953 x Co.1	32.2	(HxM)
Si 1669 x Paiyur 1	4.25*	(HxL)	JLT7 x Co.1	30.7	(HxM)
JLT 7 x Co.1	3.76*	(HxM)	Si 1669 x Paiyur 1	28.9	(HxL)
			HI		
Si 1755 x Co.1	4.54**	(MxM)	Si 1755 x Co.1	35.3	(MxM)
Si 1278 x Paiyur 1	3.75*	(HxL)	Si 1249 x TMV.3	35.1	(HxM)
OTS.2 x TMV.3	3.21	(MxM)	OTS.2 x TMV.3	34.4	(MxM)
			Oil content		
Si 1702 x TMV.3	2.44**	(LxM)	Si 1669 x TMV.3	45.9	(HxM)
S0554 x Co.1	1.61**	(LxL)	Si 1150 x TMV.3	45.7	(HxM)
Si 1147 x Paiyur.1	1.60**	(LxH)	G 51-266 x TMV.3	45.6	(HxM)

* Significant at 5% level ** Significant at 1% level.

cm between plants within the row. Observations on days to 50 per cent flowering, plant height, first capsule bearing node, capsule bearing portion of main stem, number of branches per plant, number of capsules on branches, number of capsules per plant, capsule length, 1000 seed weight, seed yield, total dry matter production (TDMP), harvest index (HI) and oil content were recorded. The analysis of combining ability was carried out for the six environments individually (Kempthorne, 1957) and also the pooled analysis over environments (El-itriby *et al.*, 1981).

RESULTS AND DISCUSSION

In the pooled analysis, variances due to environments, hybrids, line x tester, line x environment, tester x environment and (line x tester) x environment interactions were significant for all the characters studied, suggesting the influence of the non-genetic factors (Table 1). The importance of non-additive gene action was observed for number of branches per plant, number of capsules on branches, number of capsules per plant, 1000 seed weight, seed yield and oil content. The present findings are in close agreement with the earlier reports (Khorgade *et al.*, 1988; Kandaswami, 1992; Anandakumar and Sree Rangasamy, 1987; Khorgade *et al.*, 1989; Krishna doss *et al.*, 1987; Omar Sheik, 1989). Predominance of additive gene action was observed for days to 50 per cent flowering, plant height and HI. Similar results were reported by earlier workers (Anitha, 1988; Reddy *et al.*, 1982; Singh *et al.*, 1983).

The estimates of *gca* effects are presented in Table 2. Parent Si 1669 was a good general combiner for seed yield. It was also a good general combiner for 1000 seed weight and TDMP. Si 930 recorded positive significant *gca* effects for plant height, number of capsules on branches, number of capsules per plant and TDMP. It is interesting to note that parents Si 1702 and Si 1669 which were the best general combiners for capsule length and TDMP respectively, were also found to possess highest *gca* effects for the respective characters.

Analysis of *sca* effects revealed that Si 953 x Co 1 possessed significant positive *sca* effect for seed yield, capsule bearing portion of main stem and TDMP. The hybrid Si 1669 x paiyur 1 was found to register significant positive *sca* effect for plant height, number of branches per plant, number of capsules on branches, number of capsules per plant and TDMP. The hybrid Si 1702 x TMV 3 possessed significant positive *sca* effect for oil content (Table 3).

In general, good combining parents (with significant positive *gca* effects) yield better hybrids. The crosses from high x high, high x medium and high x low combining parents *i.e* atleast one parent was a good general combiner. have given better specific combinations. Result by Sharma and Chauhan (1983) in sesame indicated a similar trend in the cross combinations handled by them. A comparison of *per se* performance with their *sca* effects revealed that there was an association between *per se* performance of a cross combination and its corresponding *sca* effect. For example, the combination Si 953 x Co1 recorded the highest *per se* performance and highest *sca* effect for seed yield.

Improvement of the characters studied may be possible by the simultaneous exploitation of both additive and non-additive genetic components. Hence, biparental mating followed by recurrent selection might hasten the genetic improvement of these characters in sesame.

ACKNOWLEDGEMENT

The authors are grateful to the Tamil Nadu Agricultural University, Coimbatore for the facilities provided.

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Received: April 1994 Revised : August 1994)

Iadras Agric. J., 82(6,7,8): 449-452 June, July, August 1995

LINE X TESTER ANALYSIS OF COMBINING ABILITY IN COTTON

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ABSTRACT

In a line x tester study of cotton (*Gossypium hirsutum* L.) involving 11 lines and 3 testers (33 hybrids), it was found that all the characters studied (i.e., plant height, number of monopodia, days to 50% flowering, days to 50% boll bursting, boll weight and yield of seed cotton) are controlled by additive but predominantly non-additive gene action. The best general combiners in the parents were 138 F, 83 and MCU6 for earliness and for 50 per cent boll bursting and 133 F for higher boll weight. The hybrid 108F x MCU 6 was considered as the best cross, because it recorded significant positive *sca* effect for both yield of seed cotton and boll weight.

KEY WORDS : Cotton, Line x Tester Analysis, Combining Ability

The concept of combining ability plays a ignificant role in crop improvement, since it helps he breeder to determine the nature of gene action nvolved in the expression of quantitative traits of conomic importance. Combining ability studies elp in the identification of parents with general ombining ability effects and in identifying cross ombinations showing high specific combining bility effects. The line x tester analysis of empthorne (1957) is an useful tool for screening he lines with rapidity and with a reasonable degree f confidence. In the present investigation, 11 lines nd 3 testers and their 33 hybrids were studied for ombining ability of parents and best cross ombinations.

MATERIALS AND METHODS

The materials consisted of 14 short duration arieties of cotton of 11 lines *viz.*, CRH 68, 2421Y, ashkant 2, Tashkant 3, 138 F, Tashkant 1, 133F., 3, Cul-12, 108F, RF5-2, and 3 testers MCU 6, CU 7, P216F. All the 14 parents (11 lines and 3 testers) and their constituent 33 hybrids were raised in a randomised block design with three replications adopting a spacing of 45 x30 cm during summer 1991. Observations were recorded for six characters *viz.*, plant height, number of monopodia, days to 50 per cent flowering, days to 50 per cent boll bursting, boll weight and yield of seed cotton. Combining ability analysis was performed as suggested by Kempthorne (1957).

RESULTS AND DISCUSSION

The analysis of variance (Table 1) for combining ability revealed that mean square due to testers is of greater magnitude in comparison with those of lines and hybrids except in the case of number of monopodia in which the hybrid mean square is high indicating greater diversity among testers for these characters. There was positive significant differences for the traits, plant height, number of monopodia in the case of hybrids, days to 50 percent flowering, number of bolls per plant, days to 50 percent boll bursting and yield of seed