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LINE × TESTER ANALYSIS IN SESAME (*SESAMUM INDICUM* L.)

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ABSTRACT

A line x tester analysis in sesame was carried out with ten lines and four testers. Studies revealed the preponderance of non-additive gene action for days to 50 per cent flowering, days to maturity, plant height, number of effective branches, number of capsules/plant, number of seed/capsule, capsule length and additive gene action for 1000-seed weight and seed yield/plant. Three parents, ES-274, SSM and TILAK were good general combiner for earliness and parents namely, G Til-3, GTI-4, BHACAU 1 and VRI (SV) 1 were good general combiner for seed yield per plant. Eight hybrids had superior *per se* performance for seed yield, its component characters and earliness. With regard to seed yield, three hybrids had both the parent as desirable combiner. Crosses involving VRI (SV) 1 as line performed batter with all the testers under study indicating that this genotype can be utilized in future breeding programmes. The crosses, BHACAU-7 x G.T.4, VRI(SV)1 x G.T.1, VRI(SV)1 x G.T.2, VRI(SV)1 x G.T.3 and VRI(SV)1 x G.T.4 recorded significant *sca* effects and the gene action might be of additive type of epistasis. In future, these crosses can be utilized for pedigree breeding programme. However, selection should be postponed to later generation due to the presence of additive type of epistatic gene action. For breakdown of linkages and epistasis present in yield related traits and seed yield per plant can be broken by using biparental matting.

INTRODUCTION

Sesame (*Sesamumindicum*L.) is a crop, which is cultivated in diverse agroecological situations. It is called as the "Queen of oil seeds" because of its excellent qualities of the seed, oil and meal. Sesame is highly nutritive (oil 50%, protein 25 %) and its oil contains an antioxidant called sesamol which imparts a high degree of resistance against oxidative rancidity. It is an important annual oilseed crop in the tropics and warm subtropics, where it is usually grown in small patches (Bedigian and Harlan, 1986). India ranks second in area (17.8 lakh ha) and production (7.69 lakh tones) among the sesame growing countries (FAOSTAT, 2011). Development of short duration varieties in sesame is gaining importance due to their use as rice fallow crop, catch crop or relay crop. Apart from their wider use, they have several advantages like they require less crop management period, permits multiple cropping system, reduces overall production cost and allows escape from terminal drought. For breaking the present yield barrier and evolving varieties with high yield potential, it is desirable to combine the genes from genetically diverse parents. The success in identifying such parents mainly depends on the gene action that controls the trait under improvement, combining ability and genetic architecture. So far, only one short duration variety, VRI 1 with 75 days duration has been released in Tamil Nadu, Moreover, reports related to early maturity in sesame are very scanty. There are several techniques for evaluating the varieties or cultivars or lines in terms of their combining ability and genetic architecture. Diallel, partial diallel and line X tester techniques are in common use. Among these, Line x Tester analysis technique is more suitable for large number of genotypes for understanding the genetical basis at population level (Kempthorne, 1957). An added advantage of this method is that it gives an overall genetic picture of the materials under investigation in a single generation. In a crop like sesame due to epipetalous flower structure there is good scope for exploitation of heterosis. Further, an understanding of the combining ability and gene action is a prerequisite for any successful hybridization programme. Therefore, the present study was carried out with a view to understand the nature of gene action and combining ability for yield, its attributes and earliness through line x tester analysis in sesame.

MATERIALS AND METHODS

Ten lines *viz.*, ES-274, BHACAU-7, RSS-106, SSM, Surya, Kayamkulam, Tilak, GP286, VRI(SV)1 and Tilaraniand four testers *viz.*, Guj.Til-1, Guj.Til-2, Guj.Til-3 and Guj.Til-4 with varying agronomic and morphological characters were selected and crossed in Line x Tester fashion during *kharif*, 2011. The 14 parents, their 40 hybrids and a short duration check Guj.Til-4 were raised during *rabi*/ summer 2011-2012 in randomised block design replicated thrice at Department of Agricultural Botany, B. A. College of Agriculture, Anand Agricultural University, Anand. Each entry was raised in single row of four meter length. Observations were recorded on five randomly selected plants/entry/replication for ten characters *viz.*, days to 50 per cent flowering, days to maturity, plant height, number of effective branches, number of capsules/ plant, 1000-seed weight, harvest index, oil content, protein content and seed yield/ plant. The data obtained for each character were analysed by the usual standard statistical procedure (Panse and Sukhatme, 1978). The variation among the hybrids was partitioned further into sources attributed to general combining ability and specific combining ability components in accordance with the procedure suggested by Kempthorne (1957).

RESULTS AND DISCUSSION

The analysis of variance for the mean sum of squares for parents showed significant differences for almost all characters studied except number of seeds per capsule indicating the presence of sufficient variability among parents. Presence of significance in parents*vs* crosses provided adequacy for comparing the heterotic expression for days to maturity and seed yield/plant. Bharathi Kumar *et al.* (2009) reported significant differences among parents and hybrids for days to 50 per cent flowering, plant height, number of capsules/ plant and seed yield/plant and non-significant differences for 1000-seed weight. GCA and SCA variance revealed the preponderance of non-additive gene action for days to 50 per cent flowering, days to maturity, plant height, number of primary branches and number of capsules/plantand additive gene action for 1000-seed weight and seed yield/plant. Presence of non additive gene action were reported by Yamanura *et al.* (2009) for days to 50 per cent flowering, 1000-seed weight and Manivannan and Ganesan (2001) and Mishra and Sikarwar (2001) for days to maturity, capsules/plant and seed yield/plant.

In any breeding programme, the choice of parent is of prime importance. The *per se* performance of parents can be considered as one of the important criterion. Among the 14 parents, the lines Tilak, GP286, VRI (SV) 1 showed superior *per se* performance over Guj.Til-4 for seed yield/plant (Table 1). It also showed superior *per se* for number of primary branches and capsules/ plant than Guj.Til-4. The line SSM showed superior performance than Guj.Til-4 for day's tomaturity and the line VRI (SV) 1 for number of primary branches and capsules/ plant. Hence, based on *per se* performance, the lines Tilak, SSM, GP286, VRI (SV) 1 were considered as the desirable parents. Significant variation for yield and yield related trait were reported by Anjay *et al.* (2013) and Narendra *et al.* (2013).

The second criterion in the choice of parents is the general combining ability of the parents. Though the *per se* performance is important, the parents selected based on *per se* performance may not show desirable *gca* effects in event of non-additive gene action. The line VRI (SV)1 and the tester Guj.Til-3 and Guj.Til-4 showed high *gca* for seed yield/ plant. In addition to seed yield, the tester Guj.Til-4 also showed high *gca* for number of primary branches and days to maturity (Table 2).

Considering the earlinese parameters namely, days to 50 per cent flowering and days to maturity, the line, Tilak and the tester. Guj.Til-4 showed desirable *gca* effects. Based on aforesaid discussion it may be suggested that lines, VRI (SV)1 and Tilak and the testers Guj.Til-3 and Guj.Til-4 are the best general combining parents. These parents could be used in the breeding programme to improveseed yield and its component characters alongwith early maturity. It may be inferred that the early maturing genotypes can maintain their superiority in *per se* performance and also combining ability effects. However, the parents that showed superior *per se* performance for seed yield and its component characters could not express high *gca* effects for the respective character. It indicates the poor association between *per se* performance and *gca* effects of parents for yield component characters. This was also reported by Ranjith Rajaram *et al.* (2011) and Patel *et al.* (2005). Such an absence of parallelism may be due to epistatic interactions.

The *per se* performance was considered as the first andforemost important criterion for the selectionof superior

Table 1: Mean performance of parents

Parents	Days to flowering	Plant height (cm)	Branches per plant	Capsules per plant	Capsule length (cm)	Days to maturity	Seeds per capsule	1000- seeds weight (g)	Yield per plant (g)
Males/Testers									
Guj.Til-1	40.33	62.00	2.73	40.90	2.47	82.67	50.84	3.55	7.59
Guj.Til-2	33.67	93.33	3.27	41.07	1.91	71.67	48.25	3.61	7.81
Guj.Til-3	32.00	83.33	3.40	43.52	2.88	80.33	47.32	4.12	8.06
Guj.Til-4	31.67	87.67	3.33	40.40	2.59	68.67	51.71	3.87	7.85
Females/Lines									
ES-274	33.67	85.00	3.00	37.96	2.05	73.67	53.01	3.61	8.10
BHACAU-7	42.33	102.33	4.20	41.91	2.20	83.67	46.40	3.27	9.27
RSS-106	32.67	78.00	3.40	37.01	2.68	73.00	53.25	3.60	8.35
SSM	34.00	69.00	2.73	46.07	2.27	72.00	52.83	3.72	8.24
Surya	41.00	100.67	4.40	44.13	2.05	95.00	48.19	3.81	11.02
Kayamkulam	42.00	104.33	4.60	39.99	1.90	90.00	54.91	3.39	10.55
Tilak	34.33	101.67	3.27	43.47	2.84	72.00	50.39	3.73	11.71
GP286	41.00	89.33	4.80	43.75	1.59	93.33	54.95	3.54	10.80
VRI(SV)1	42.00	113.67	6.47	42.60	2.16	109.67	53.23	3.77	11.54
Tilarani	41.33	89.67	4.60	41.16	2.55	87.67	58.42	3.71	9.81
Mean	37.29	90.00	3.87	41.71	2.30	82.38	51.69	3.66	9.41
S.Em. ±	1.04	3.00	0.18	1.69	0.04	1.93	1.46	0.14	0.10
C.D. at 5%	2.91	8.42	0.51	4.74	0.12	5.42	2.74	0.39	0.27

Table 2: Estimates of *gca*effects for different characters

Parents	Days to flowering	Plant height (cm)	Branches per plant	Capsules per plant	Capsule length (cm)	Days to maturity	Seeds per capsule	1000-seed weight (g)	Yield per plant (g)
Males									
Guj.Til-1	0.14	1.99**	-0.44**	0.10	0.02*	0.38	-1.35*	0.12**	-0.22**
Guj.Til-2	0.34	-2.28**	-0.23**	-0.33	-0.10**	-0.56	1.46*	-0.08**	-0.05**
Guj.Til-3	-0.02	3.72**	-0.07	-0.35	0.06**	1.64**	0.74	-0.08**	0.09**
Guj.Til-4	-0.46	-3.44**	0.73**	0.57	0.02	-1.46**	-0.84	0.04	0.19**
S.E. (g_i)	0.26	0.73	0.04	0.45	0.01	0.38	0.58	0.03	0.02
Females									
ES-274	-2.38**	-10.71**	-1.50**	3.60**	0.15**	1.76**	7.42**	-0.05	-0.90**
BHACAU-7	-0.71	3.21*	-0.73**	-1.84**	0.24**	-0.99	2.98**	0.16**	0.29**
RSS-106	-0.88	-2.88*	-0.67**	-3.36**	-0.04*	0.26	-0.81	-0.13*	-0.93**
SSM	-2.54**	-9.54**	0.04	8.31**	0.12**	-0.16	4.48**	0.17**	-0.37**
Surya	2.04**	10.96**	-0.55**	1.50**	-0.18**	-2.91**	-2.17*	-0.02	-0.25**
Kayamkulam	0.96*	7.13**	1.05**	-9.53**	0.14**	-0.66	-4.58**	-0.25**	-0.35**
Tilak	-1.46**	-6.79**	1.17**	-4.31**	0.17**	-5.58**	-4.15**	0.19**	-0.57**
GP-286	2.46**	6.46**	0.14	-1.66**	-0.32**	2.51**	2.80**	-0.11	-0.27**
VRI(SV)-1	0.29	8.21**	1.30**	0.53**	-0.03	10.34**	-3.21**	0.44**	4.45**
Tilarani	2.21**	-6.04**	-0.25**	6.76**	-0.26**	-4.58**	-2.77**	-0.39**	-1.10**
S.E. (g_j)	0.45	1.26	0.07	0.07	0.02	0.66	1.01	0.06	0.04

*, **Significant at 5% and 1%; S.E. (gi) = Standard error of males & S.E. (gj) = Standard error of females;

Table 3: Performance of promising hybrids for seed yield per plant and days to maturity

Hybrids	*Per se* Performance	Better Parent Heterosis	Standard Heterosis	*Sca*effect	Significant heterosis for other traits over better parent	Significant heterosis for other traits over standard check
VRI(SV)-1 x G.T.3	15.39	33.39**	96.01**	1.25**	DFF, BP, CP, CL, DM, SC	DFF, PH, BP, DM, SC, HI
VRI(SV)-1 x G.T.2	13.83	19.84**	76.10**	-0.17**	DFF, PH, BP, DM	DFF, PH, BP, CP, CL, DM
VRI(SV)-1 x G.T.4	13.73	19.02**	74.89**	-0.51**	DFF, PH, BP, CP, CL, DM,	DFF, PH, BP, CP, CL, DM
VRI(SV)-1 x G.T.1	13.25	14.84**	68.75**	-0.58**	DFF, PH, BP, CP, CL, DM	PH, CL, DM, TW, HI
BHACAU-7 x G.T.4	11.28	21.75**	43.65**	1.21**	DFF, BP, HI	PH, BP, DM, HI

*, ** Significant at 5 and 1 per cent level, respectively.

crosses. Five hybrids namely,VRI(SV)-1 x Guj.Til-3, VRI(SV)-1 x Guj.Til-2, VRI(SV)-1 x G.T.4, VRI(SV)-1 x G.T.1 and BHACAU-7 x G.T.4recorded superior mean seed yield than Guj.Til-4. The hybrid, SSM x G.T.4 recorded equal *per se* performance with Guj.Til-4 for days to 50per cent flowering, number of primarybranches, number of capsules/plantand 100-seedweight.

The hybrid, SSM x G.T.4 showed on par performance with Guj.Til-4 for all characters except number of effective branches per plant. Based on *per se* performance, all the above five hybrids canbe considered as desirable.

Breeding strategy: Selection of hybrids for pedigree breeding is based on their *par se* performance, *gca*effects of their parents and *sea* effect of hybrids. Griffing (1956) suggested that the high *gca* effects are due to additive gene action as well as additive x additive type of epistatic gene action. These additive type of gene action are fixable while, non-additive gene action are non fixable. The estimates of *per se* performance, heterosisstatus and *sca* of selected hybrids are presented in Table 3. Considering the combining ability of these selected five hybrids, all the hybrids had at least one parent as desirable combinerfor days to maturity and days to flowering.

Hence, this cross can be utilized for pedigree breeding programme to evolve high yielding early maturing varieties. The crosses, VRI(SV)-1 x Guj.Til-3 and BHACAU-7 x G.T.4 recorded significant *sca* effects and the gene action might be of additive type of epistasis. These crosses also can be utilized for pedigree breeding programme. However, selection should be postponed to later generation due to the presence of additive type of epistatic gene action.

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