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Line Vs Tester Analysis for Seed and Oil Yield in Sunflower

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A study was carried out in line x tester fashion with thirteen parents including three CMS lines and ten inbreds in sunflower. Thirty hybrids were developed and evaluated for seed yield, oil yield, oil content and days to fifty per cent flowering in two seasons *viz., rabi,* 2005-06 and *kharif* 2006. The combining ability analysis revealed significant differences among the parents for all the characters studied indicating the presence of preponderance of dominance gene action for all the characters. The parents 47A, CSFI 5156, CSFI 5168 and CSFI 5412 were the best general combiners for seed and oil yield per plant and oil content. The parents 47A, CSFI 5159, CSFI 5156, CSFI 5168 and CSFI 5419 were the best general combiners for oil content. The hybrids CSFH 6037, CSFH 6039, CSFH 6043 and CSFH 6045 were good specific combiners for seed yield per plant. The hybrids CSFH 6039, CSFH 6040, CSFH 6045, CSFH 6058 and CSFH 6053 were positive specific combiners for oil content. The parental line *viz.,* 47A and the testers *viz.,* CSFI 5159 and CSFI 5168, would be desirable parents for seed yield, oil content and oil yield per plant and the hybrids *viz.,* CSFH 6037, CSFH 6039, CSFH 6043, CSFH 6045 and CSFH 6058 were identified as best specific combiners for seed and oil yield and these hybrids could be exploited for heterosis in sunflower.

Key words: Sunflower, line x tester, *gca* effects, *sca* effects

Development of hybrid is of much value for increasing the production of sunflower. Modern sunflower breeding began with the development of F1 hybrids, after the discovery of cytoplasmic male sterility (Leclercq, 1969) and fertility restorer genes (Kinman, 1970). In India, heterosis breeding in sunflower was initiated in early seventies (Sindagi, et al. 1989) Improvement in sunflower emphasizes development of a heterotic hybrid that is achieved by tapping the excellent combining ability and heterotic vigour available in the genetically diverse parental lines. Involvement of genetically divergent parents in hybridization will result in enhanced vigour or heterosis in the resultant hybrid. In any breeding programme, the choice of the parents is an important aspect for the success of the crop improvement. Especially, in heterosis breeding the choice of good combiners play a vital role. Keeping these points in view, the present study was undertaken following line x tester analysis, in order to choose an appropriate parent for hybridization based on combining ability for the characters viz., seed yield, oil yield and oil content and identifying superior hybrid combination for exploitation of heterosis in sunflower.

Materials and Methods

The materials used in the present study consisted of three CMS lines and 10 inbreds in sunflower (*Helianthus annuus* L.). The three CMS lines viz.,17A, 47A and 851A and 10 testers viz., CSFI 5013, CSFI 5048, CSFI 5068, CSFI 5156, CSFI 5159, CSFI 5168, CSFI 5412, CSFI 5415, CSFI 5419, CSFI 5428 were raised in a crossing block at Department of Oilseeds, Tamil Nadu Agricultural University, Centre for Plant Breeding and Genetics (CPBG), Coimbatore during *kharif* 2005 and the second crossing block during *rabi* 2005-2006. Crossing was done in a line x tester fashion. A total of 30 hybrids were raised along with their 13 parents and check hybrids KBSH 44, TCSH 1 and Sunbred 275 during *rabi* 2005-2006 and *kharif* 2006 for studying the combining ability of hybrids. The experiment was laid out in a randomized block design with two replications. Each entry was raised in one row of 3 m length adopting a spacing of 60 cm between rows and 30 cm between plants. At the time of flowering, five plants in each of the hybrids and parents were selected at random and tagged. Observations were recorded on five randomly selected plants from each hybrid combination per replication for four traits viz., days to fifty per cent flowering, seed yield, oil content and oil yield. The general and specific combining ability effects of the parents were assessed by line x tester analysis (Kempthorne, 1957). To understand the real picture of genetic architecture of the hybrids and their parents, the data of both seasons were subjected to pooled analysis (Panse and Sukhatme, 1961).

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Results and Discussion

The analysis of the variance revealed significant differences among the parents for all the characters viz., days to fifty per cent flowering, seed yield per plant, oil content and oil yield (Table 1). Justifying the selection of parents for study in pooled analysis there was substantial variability among the testers, lines and line x testers for all characters (Table 1). This reflected the presence of average heterosis as evident from significance of seasons x lines, seasons x lines x testers for seed yield per plant and oil yield. The relative estimate of variances due to additive and dominance components revealed the preponderance of dominant component for all the characters studied for pooled seasons as reported earlier by Marinkovic et al. (2000) and Skoric *et al.* (2000). This indicates that the traits may be improved by heterosis breeding and commercial exploitation of hybrids is also possible with the present set of materials.

Table 1. Analysis of variance for combining ability is pooled over seasons of sunflower

Source	df	Days to fifty per cent flowering	Seed yield (g)	Oil content (%)	Oil yield (g)
Seasons	1	0.06	524.15 **	7.42 **	32.96 **
Lines	2	279.64 **	912.53 **	38.99 **	130.80 **
Testers	9	91.14 **	542.75 **	42.27 **	86.44 **
Line x Tester	18	104.65 **	471.22 **	39.25 **	72.75 **
Season x Lines	2	1.19	274.62 **	1.09	21.42 **
Season x Testers	9	0.37	148.51 **	0.75	12.55 **
Seasons x Lines x Testers	18	0.55	178.18 **	0.67	14.92 **
Error	58	0.53	40.02	1.23	3.71
Additive variance (F = 0)		12.39	34.01	0.17	5.20
Dominance variance(F = 0))		104.11	431.20	38.03	69.04

*, ** Significance of P at 5 and 1 % level respectively.

General combining ability of the parents for four traits (Table 2) revealed that among the females line 47A showed significant and positive gca effects for seed yield per plant, oil content and oil yield. The testers, CSFI 5159, CSFI 5168 and CSFI 5156 were found good general combiners for seed yield per plant, oil content and oil yield per plant in both seasons. The parents 17A, 851A, CSFI 5168 and CSFI 5415 were good combiners for days to flowering in both the seasons. Significant positive gca effect for oil content was observed in the parents 47A, CSFI 5159, CSFI5156, CSFI 5168 and CSFI 5419. The tester CSFI 5412 recorded significant and positive gca effects for seed and oil yield per plant. Considering the mean performance and gca effect together, the line 47A and the testers viz., CSFI 5159, CSFI 5168 and CSFI 5419 would be desirable parents for seed yield per plant, oil content and oil yield and CSFI 5412 for all the characters except oil content.

Table 2. General combining ability of parents for different characters in sunflower

Parents	Days to fifty per cent flowering	Seed yield (g)	Oil content (%)	Oil yield (g)
Lines				
17 A	-1.22**	1.98 **	-0.16	0.51**
47 A	3.03**	3.47 **	1.06 **	1.50 **
851 A	-1.82**	-5.45**	-0.9**	-2.01**
SE (lines)	0.08	0.68	0.12	0.21
Testers				
CSFI 5013	1.31**	-0.18	0.31	-0.02
CSFI 5048	0.39	-4.35	-2.66**	-2.47**
CSFI 5068	0.64	-11.20**	-0.11	-3.62**
CSFI 5156	-0.44	1.89	1.74 **	1.42 **
CSFI 5159	0.14	8.59 **	1.77 **	3.51 **
CSFI 5168	-4.44**	7.58**	1.77 **	2.95 **
CSFI 5412	4.06**	6.63**	0.57	2.15**
CSFI 5415	-4.36**	-3.17*	-3.52**	-2.45**
CSFI 5419	-0.52*	2.46	1.18*	1.60*
CSFI 5428	3.23**	-8.25**	-1.04*	-3.07**
SE(Testers)	0.17	1.45	0.25	0.44

*- Significance of P at 5 % level **-Significance of P at 1 % level

Specific combining ability of 30 hybrid combinations is presented (Table 3). Significant sca effects for seed yield per plant were recorded in five hybrids viz., CSFH 6037, CSFH 6039, CSFH 6043, CSFH 6045 and CSFH 6058. Of the five hybrids only three hybrids CSFH 6039, CSFH 6045 and CSFH 6058 recorded significant positive sca effects for both oil content and oil yield per plant. The hybrids

Table 3. Specific combining ability of hybrids for different characters in sunflower

Hybrids	Days to fifty per cent flowering	Seed yield (g)	Oil content (%)	Oil yield (g)
CSFH 6037	-1.78**	13.64**	1.11	4.62*
CSFH 6031	6.13**	5.18*	-3.07**	0.09
CSFH 6034	-5.37**	3.88	-0.12	1.20
CSFH 6039	8.72**	15.74**	3.95**	7.11**
CSFH 6038	8.88**	-14.43**	-2.92**	-5.93**
CSFH 6032	-4.28**	1.43	-1.70	-0.35
CSFH 6040	0.47	-7.42**	1.95**	-1.53*
CSFH 6033	-4.12**	-12.47*	-0.71	-3.53**
CSFH 6035	-4.45**	-8.08	1.19	-2.58
CSFH 6036	-4.2**	2.55	0.31	0.89
CSFH 6047	-0.53	-7.80	1.14	-2.17
CSFH 6041	-2.12**	1.69	1.97	1.20
CSFH 6044	2.88**	-0.53	-1.34	-0.67
CSFH 6049	-4.28**	-14.24*	-4.97**	-6.58**
CSFH 6048	-4.37**	-0.32	-1.17	-0.72
CSFH 6042	3.72**	4.14	0.16	1.66
CSFH 6050	-1.78**	4.39	1.51	2.26
CSFH 6043	3.63**	9.52**	-1.62	1.68*
CSFH 6045	0.80	13.73**	4.33**	6.63**
CSFH 6046	2.05**	-10.58**	-0.01	-3.30**
CSFH 6057	2.32**	-5.83	-2.25*	-2.46
CSFH 6051	-4.02**	-6.87	1.10	-1.29
CSFH 6054	2.48**	-3.34	1.46	-0.53
CSFH 6059	-4.43**	-1.50	1.01	-0.52
CSFH 6058	-4.52**	14.75**	4.09**	6.66**
CSFH 6052	0.57	-5.57	1.54	-1.31
CSFH 6060	1.32	3.03	-3.46**	-0.73
CSFH 6053	0.48	2.96	2.33*	1.84
CSFH 6055	3.65**	-5.65	-5.52**	-4.06
CSFH 6056	2.15*	8.03	-0.30	2.41
SE	0.24	2.05	0.36	62.00

*- Significance of P at 5 % level **- Significance of P at 1 % level

CSFH 6039, CSFH 6040, CSFH 6045, CSFH 6058 and CSFH 6053 were positive specific combiners for oil content.

Among the cross combinations, CSFH 6037 was found to be the best specific combiner for seed yield, oil yield, hundred seed weight with earliness in flowering. The hybrid CSFH 6039 was found to register significant positive sca effects for seed yield, oil content and oil yield, indicating that the hybrid CSFH 6039 might be specifically suitable for exploitation of increased seed yield, oil content and oil yield in sunflower. Positive and significant sca effect for seed yield and oil yield was observed in hybrid CSFH 6043. Hence the hybrids CSFH 6037, CSFH 6039, CSFH 6043, CSFH 6045 and CSFH 6058 could be used for exploitation of heterosis.

The investigation revealed that the line 47A and the testers viz., CSFI 5159, CSFI 5168 and CSFI 5419 would be desirable parents for seed yield per plant, oil content and oil yield and CSFI 5412 was suitable for most of the characters except oil content. Considering the mean performance and sca effects for seed yield and yield contributing traits, the hybrids viz., CSFH 6037, CSFH 6039, CSFH 6043, CSFH 6045 and CSFH 6058 were identified as best specific combiners for seed and oil yield in sunflower.

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