

**Research Article****Combining ability analysis for seed yield and its components in Sunflower (*Helianthus annuus* L.).****K. Mohanasundaram, N. Manivannan and P. Vindhiya varman****Abstract**

Twenty four lines were crossed with two testers in an L x T mating design to estimate the combining ability for seed yield in sunflower. Non-additive genetic variance played a preponderant role in the inheritance of all the characters studied viz., days to 50 % flowering, days to maturity, plant height, head diameter, volume weight, hundred seed weight and seed yield per plant. The lines 27, 436 and tester 234A can be considered as superior parents in the present study as they recorded high *per se* performance with positively significant general combining ability effect for seed yield/plant. Among the 48 hybrids evaluated, crosses viz., 234A x 436, 234A x 440 and 234A x 235 were considered as superior hybrids as they recorded high *per se* performance and significant *sca* effect for seed yield/plant.

**Key words:** Sunflower, combining ability, yield

**Introduction**

In any breeding programme, the choice of parents is an important aspect for the success of the crop improvement. For improvement of any plant character through hybridization, it is necessary to understand the nature of gene action and genetic architecture of the donor parents for that character. Improvement in sunflower emphasizes the urgency of generating heterotic hybrids that is achieved by tapping the excellent combining ability and heterotic vigour available in the genetically divergent. Keeping these points in view, the present investigation was undertaken with the following specific objectives, to choose an appropriate parent for hybridization based on combining ability and to study inter-relationship between *gca* and *sca* hybrids and non-additive gene action for exploitation of vigour in sunflower.

**Materials and methods**

The experimental materials used in the present study consisted of 26 genotypes include 24 lines viz., 27, 102, 105, 124, 214, 71, 131, 227, 373, 120, 235, 60, 445, 108, 440, 121, 447,

145, 84, 201, 254, 85, 436 and 82 and 2 testers which include 17A, 234A in sunflower (*Helianthus annuus* L.). The 24 lines and 2 testers were raised in a crossing block at Department of Oilseeds, Tamil Nadu Agricultural University, Coimbatore during December 2007. Crossing was done in a line x tester fashion. A total of 48 hybrids were raised along with 26 parents and check hybrids CSFH 5060 and Sunbred 275 during *kharif* 2008 for studying the combining ability of hybrids. The experiment was laid out in a randomized block design with two replications. At the time of flowering, five plants in each of the hybrids and parents were selected at random and tagged. Observation were recorded on five randomly selected plants from each hybrid combination per replication for seven traits viz., days to fifty per cent flowering, days to maturity, plant height, head diameter, volume weight, hundred seed weight and seed yield. The gene action for yield and yield components besides general and specific combining ability effects of the parents, were assessed by line x tester analysis (Kempthorne, 1957).

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## Result and discussion

The ANOVA indicated that the variance due to genotypes were highly significant differences for all the characters studied except for days to maturity. Crosses also exhibited highly significant differences for days to 50 per cent flowering, plant height and seed yield per plant. Parent *vs* crosses differed significantly for all the characters studied except for days to 50 per cent flowering. For efficient selection, presence of variability among the genotypes for the traits of interest is a prerequisite.

Analysis of variance for combining ability revealed that variance due to lines was highly significant for four traits *viz.* days to 50 per cent flowering, plant height, volume weight and 100 seed weight. Testers exhibited highly significant differences for days to 50 per cent flowering. The interaction effect (L x T) was also highly significant difference for days to 50 per cent flowering, days to maturity, plant height and seed yield per plant. It indicated significance difference of *sca* effects among the hybrids. In this present investigation, analysis of gene action expressed the higher proportion of SCA than GCA for all the character studied (Table 1). It indicated that these characters were controlled preponderantly by non-additive genes. This experiment results proposing the preponderance of non-additive gene action for the characters studied have supporting evidences from the early workers like Sassikumar *et al.* (1997), Adefris Teklewood (1998), Radhika *et al.* (2001) and Sakthivel (2001) and Varaprasad *et al.* (2006).

The *per se* performance of parents is the first important criterion for selection. Perusal of the *per se* performance of parents indicated that the parents 120 recorded high seed yield among the parents. The parent 234A was significantly superior *per se* performance for days to fifty per cent flowering (earlier), head diameter and volume weight. 440 exerted significance difference for plant height. 227 and 145 recorded high volume weight.

The second criterion of selection is the general combining ability (*gca*) effects of parents as the parents with high mean values may not necessarily be able to transmit their superior traits to their progenies. The result indicated that five parents *viz.*, 27, 445, 227, 201 and 436 recorded significantly positive *gca* effects for volume weight. The line 201 also recorded positive and significant *gca* effects for days to 50% flowering and volume weight and the tester 234A for days to 50% flowering (Table 2). Among

the twenty six parents studied the lines 27, 436 and tester 234A were adjudged as the best parents with respect to mean performance. Thus, it would be worth while to use above parents in breeding programme for exploiting additive gene effects. Similar results were reported by Sassikumar *et al.* (1997), Kumar *et al.* (1998), Yogeesh *et al.* (2006). Among the 48 crosses evaluated the crosses 234A x 436, 234A x 440 and 234A x 235 recorded significant *sca* effects for seed yield and its component traits (Table 3). The cross 234A x 436 involved one good combiner for seed yield. Such occurrence of good hybrids by the combination of one good combiner may be due to cumulation of favorable genes and partly due to dominance interaction. Some cross combinations due to crossing between parents with poor *gca* and yet the hybrids had highly significant *sca*. These could be because of cancellation of undesirable effects. In such combinations, to obtain better segregants, selection may be postponed to later generation to develop high yielding inbreds. Thus, based on *gca*, the parents 27, 436 and 234A could be better choices for improvement of yield and component traits through hybridization. The crosses 234A x 436, 234A x 440 and 234A x 235 which had highly significant *sca* effect for most of the yield contributing traits may be exploited for the development of hybrids since they also had high *per se* performance.

## References

- Adefris Teklewood. 1998. Genetic divergence study in sunflower (*Helianthus annuus* L.). **M.Sc. (Agri.) Thesis**, University of Agricultural Sciences, Bangalore.
- Kempthorne, O. 1957. An introduction to genetic studies. **John Wiley and Sons, Inc.**, New York.
- Kumar, A.A., M. Ganesh and P. Jamila. 1998. Combining ability analysis for yield and yield contributing characters in sunflower. **Ann. Agric. Res.**, 19(4): 437-440.
- Radhika, P., K. Jagdeshwar and H.A.Khan. 2001. Heterosis and combining ability through Line x Tester analysis in sunflower (*Helianthus annuus* L.). **J. Res. ANGRAU**, 29: 35-43.
- Sakthivel, K. 2001. Study of sunflower (*Helianthus annuus* L.). Hybrids over seasons for combining ability and heterosis. **M.Sc. (Agri.) Thesis**, Tamil Nadu Agricultural University, Coimbatore.
- Sassikumar, D. 1997. Heterosis, Combining ability and correlation studies in sunflower (*Helianthus annuus* L.). **M.Sc. (Agri.) Thesis**, Tamil Nadu Agricultural University, Coimbatore.



Varaprasad, B.V., A. Vishnuvardhan Reddy and T. Nageswara Rao. 2006. Combining ability studies for seed yield and yield contributing characters in sunflower, (*Helianthus annuus* L). **J. Oil seeds Res.**, **23**(1): 86-88.

Yogeesh, L.N., E. Gangappa, Y.S. Manjunatha, Y.G. Shadakshai, R. Munirajappa and J. Shivanna. 2006. Line x Tester analysis in sunflower (*Helianthus annuus* L). **In:** Abstracts of Second National Plant Breeding Congress, 1-3 Mar' 06, TNAU, Coimbatore. p.180.

**Table 1. Analysis of variance for combining ability**

Sources	df	Days to 50 percent Flowering	Days to maturity	Plant height (cm)	Head diameter (cm)	Volume weight per 100ml (g)	100 - seed weight (g)	Seed yield per plant (g)
Lines	23	15.17 **	10.99	568.45 *	1.27	20.65 **	0.71*	87.91
Testers	1	90.09 **	4.17	52.51	0.07	14.03	0.09	61.57
Line X testers	23	13.83 **	29.34 **	562.40 **	2.10	13.47	0.47	150.75 **
Error	47	1.40	10.01	295.95	1.43	10.08	0.40	59.79
<b>Varinace components</b>								
$\sigma^2$ <i>gca</i>		0.0319	-0.1331	-0.1104	-0.0063	0.0493	0.0014	-0.4567
$\sigma^2$ <i>sca</i>		6.2171	9.6636	133.2294	0.3369	1.6953	0.0436	45.4795
<i>gca/sca</i>		0.005	-0.014	-0.0008	-0.0187	0.029	0.032	-0.01

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

**Table 2. Estimates of *gca* effects for different character in sunflower**

Parents	Days to 50 percent Flowering	Days to maturity	Plant height (cm)	Head diameter (cm)	Volume weight per 100ml (g)	100 - seed weight (g)	Seed yield per plant (g)
Lines							
F4 27	1.80 **	2.79	-6.92	0.05	-1.83	0.65 *	0.89
F4 102	0.80	1.04	16.33	0.78	-0.73	0.42	10.12 *
F4 105	-3.95 **	-3.21 *	-15.54	-1.09	-0.56	-0.17	-5.78
F4 124	-1.70 **	-1.96	6.96	-0.85	-2.66	-0.19	-4.08
F4 214	-2.70 **	-0.21	-6.39	0.07	0.72	0.13	-3.46
F4 71	1.55 *	-2.21	-13.76	-0.67	-4.61 **	-0.87 **	-7.28
F4 131	1.55 *	-1.71	-9.91	-0.67	-1.78	-0.50	-2.03
F4 227	-3.45 **	-2.96	-2.47	0.36	5.64 **	0.59	5.64
F4 373	2.05 **	-0.21	-6.78	-0.09	0.72	-0.38	-9.18 *
F4 120	-0.95	0.54	-3.50	-0.46	0.69	-0.32	-0.36
F4 235	2.30 **	0.29	7.00	-0.72	-2.33	-0.24	4.92
F4 60	2.30 **	-0.21	18.03 *	-0.20	0.72	-0.17	-2.66
F4 445	2.55 **	2.29	10.52	0.74	-0.31	0.70 *	2.32
F4 108	1.30 *	-0.71	-3.67	-0.08	-1.68	-0.63	-3.46
F4 440	-1.20 *	0.54	-3.14	0.55	0.44	0.63	8.34 *
F4 121	-1.20 *	-0.21	1.29	0.10	1.42	-0.04	0.02

**Table 2. Contd..**

Parents	Days to 50 percent Flowering	Days to maturity	Plant height (cm)	Head diameter (cm)	Volume weight per 100ml (g)	100 - seed weight (g)	Seed yield per plant (g)
F4 447	1.05	3.54 *	24.69 **	0.72	0.54	0.14	2.72
F4 145	-2.70 **	-0.46	13.50	0.79	-0.51	0.31	2.17
F4 84	0.55	0.21	-13.86	-0.16	-1.06	0.13	0.02
F4 201	-1.70 **	-0.46	18.77 *	0.47	3.29 *	0.02	3.97
F4 254	0.05	0.79	-7.54	0.26	1.07	-0.05	-2.18
F4 85	-0.20	1.29	-4.98	0.07	-1.53	0.12	-0.98
F4 436	1.55 *	0.29	18.50 *	0.59	4.74 **	0.20	2.94
F4 82	0.30	1.29	-1.11	-0.57	-0.36	-0.49	-2.56
<b>Testers</b>							
17 A	0.97 **	-0.21	-0.74	-0.03	0.38	-0.03	-0.80
234 A	-0.97 **	0.21	0.74	0.03	0.38	0.03	0.80
<b>SE (Lines)</b>	0.59	1.58	8.60	0.60	1.59	0.31	3.87
<b>SE (Testers)</b>	0.17	0.46	2.4	0.17	0.46	0.09	1.12

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

**Table 3. Estimates of specific combining ability (*sca*) effects of best three crosses based on *per se* performance**

Characters	234A x F4 436		234A x F4 440		234A x F4 235		SE	(CD at 5% level)
	<i>per se</i>	<i>sca</i>	<i>per se</i>	<i>sca</i>	<i>per se</i>	<i>sca</i>	<i>per se</i>	<i>per se</i>
Days to 50% flowering	54	-1.53	51.5*	-1.28	60.5	4.22*	1.04	2.90
Days to maturity	83	4.29	78	-0.96	83.5	4.79*	2.82	11.53
Plant height	194.26	21.18	159.94	8.50	184.51	22.93	11.53	0.81
Head diameter	13.29*	1.57	12.11	0.43	11.53	1.12	0.81	2.27
Volume weight	49.8*	2.34	45.25	2.09	37.8	-2.58	2.52	7.05
Hundred seed weight	4.19	1.10	4.89	0.39	4.02	0.73	0.52	1.46
Seed yield per plant	45.1*	17.47**	40.55*	7.52	41.6*	12.00*	4.94	13.8

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