

# Combining Ability Studies for Yield and Oil Content in Sunflower

Y.V. Deshmukh<sup>1</sup>, C.B. Salunke<sup>1</sup> and S.V. Bhosale<sup>1</sup>

**Abstract:** The present investigation was undertaken at Post Graduate Intuitional farm Department of Botany Mahatma Phule Krishi Vidyapeeth, Rahuri. A field experiment was conducted during Rabi-2015 with a view to know the direction and magnitude of combining ability in sunflower. Three male sterile lines (SVSAL-1, SVSAL-2, SVSAL-3) and fifteen restorers (SVSR 1- 15) along with standard checks (Phule Raviraj, SVSH-475) were obtained from the Agricultural Research Station, Savali Vihir Farm (MPKV Rahuri), Kopergaon, Dist. Ahmednagar (M.S.). Forty five hybrids were sown along with parents and standard check viz; Phule Raviraj, SVSH-475 in December 2015. Among the parents SVSAL-1, SVSR-4, SVSR-3, were found to possess significant positive *gca* effect for yield and for most of the yield contributing characters, which are important and hence needs to be further evaluation and confirmation for commercial exploitation.

**Keywords:** Sunflower, *gca*, *sca*, oil content, yield.

## INTRODUCTION

Sunflower (*Helianthus annuus*) is an important oilseed crop belong to the family Asteraceae, tribe Heliantheae, sub tribe Helianthae which includes 20 genera. It is diploid ( $2n = 34$ ) and highly cross pollinated crop. It contains about 42 to 46 per cent of oil. The oil has a good flavor, colour and good quality from health point of view, due to high concentration of polyunsaturated fatty acids (55 to 60% linoleic acid, 25 to 30% oleic acid), which are known to reduce the risk of coronary disease by reducing the cholesterol in blood plasma. Oil also contains proteins and A, D, and E vitamins, and is used for culinary, salad, preparation of vanspati ghee, manufacture of soaps and in cosmetics. Moreover, oil has excellent nutritional properties, particularly free from toxic compounds. Sunflower cake is rich in protein and used for cattle and poultry feed. The concept of combining ability is meant for reducing the number of crosses to be advanced. It enables to select desirable parents and specific cross combinations. Relative amount of *gca* and *sca* effects

is a foundation for any fruitful breeding program. The choice of parents should be based on complete genetic information and knowledge of combining ability of parents and not merely on yield performance. The present study was therefore, undertaken with following objective to study the general and specific combining ability of the parents and crosses respectively for yield and oil content in sunflower.

## MATERIAL AND METHODS

Three male sterile lines (SVSAL-1, SVSAL-2, SVSAL-3) and fifteen restorers (SVSR 1- 15) along with standard checks (Phule Raviraj, SVSH-475) were obtained from the Agricultural Research Station, Savali Vihir Farm (MPKV Rahuri), Kopergaon, Dist. Ahmednagar (M.S.). The seed material was planted at Post Graduate Institute Farm, Department of Botany, Mahatma Phule Krishi Vidyapeeth, Rahuri, during *Kharif* 2015 in order to produce crosses in line x tester fashion. Forty five hybrids were sown along with parents

<sup>1</sup> Department of Agricultural Botany, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri-411722 Maharashtra (India) Email : sushantgpb@gmail.com

and standard check viz; Phule Raviraj, SVSH-475 in December 2015.

## OBSERVATIONS RECORDED

Five random competitive plants from each treatment of each replication were selected for recording the observations averages were worked out for statistical analysis.

Sr. No.	Source of variation	DF	Days of 50% flowering	Days to maturity	Plant height at maturity (cm)	Stem girth at base (cm)	Head Diameter (cm)	Total No. of seeds/head	Number of filled seeds/head	Seed filling percentage	100 seed weight (g)	Percent oil content	Seed yield per plant (g)
1.	Replications	1	1.06	0.01	10.41	0.10	0.79	322.01	1215	3.96	0.02	0.01	6.52
2.	Crosses	44	78.33**	21.52**	347.78**	1.34**	3.20**	254238.28**	204203.67**	21.02**	2.72**	62.83**	563.12**
3.	Females	2	562.52**	44.31**	411.01*	0.55*	5.63*	451133.45**	335779.8*	55.19	11.37**	94.71	1590.74*
4.	Males	14	16.45*	18.78**	316.00*	2.13	0.87	299265.31**	168369.6*	27.36	3.54*	49.30	598.33*
5.	Females x males	1	55.47**	20.35**	356.64**	1.03**	4.10**	209847.52**	207501.13**	14.05**	1.34**	66.05**	431.33**
6.	Error	44	2.756	3.878	1.45	0.01	0.07	94.94	155.96	8.02	0.03	0.70	0.51

due to male was significant for days to 50 percent flowering, days to maturity, plant height at maturity, total number of seeds per head, number of filled seeds per head, 100 seed weight and seed yield per head.

## General and specific combining ability effect of parents and their hybrids

The estimates of general combining ability effects of the female and male parent and specific combining ability effects of the hybrids are presented in Table 7 and Table 8, respectively.

### Days to 50 per cent flowering

Out of the 3 females, SVSAL-2 showed significantly highest negative gca effects whereas the female SVSAL-1 and SVSAL-2 showed positive gca effect.

Among the males, 6 male parents showed negative gca effects of which SVSR-12 was highly significant whereas SVSR-10 exhibited highest significant positive gca effect.

Out of 45 hybrids, 25 showed negative sca effects whereas one hybrid showed high significant negative sca effect. The cross SVSAL-1 X SVSR-15 showed higher negative sca effect.

## RESULTS AND DISCUSSION

### Analysis of variance for combining ability

The analysis of variance for combining ability carried out by L x T analysis for 11 characters are presented in Table 1. It observed that variance due to female was significant for all character except Seed filling percentage, percent oil content. The variance

### Days to maturity

Out of 3 female, SVSAL-2 showed negative significant gca effect. The female SVSAL-1 and SVSAL-3 showed positive gca effect. Six males showed negative gca effects of which SVSR-8 showed highest gca effect.

Out of 45 hybrids, 22 expressed negative gca effects, of these only SVSAL-1 X SVSR-15, SVSAL-2 X SVSR-12 and SVSAL-3 X SVSR-6 were significant, rest of hybrids showed positive gca effects.

### Plant height at maturity

The female SVSAL-3 exhibited positive significant gca effect for plant height at maturity. The females SVSAL-1 and SVSAL-2 showed negative gca effect.

Out of 15 males, 8 expressed positive gca effects, of which SVSR-3 and SVSR-14 was highly significant for this trait while seven males showed negative gca effects.

Twenty-two hybrids expressed positive sca effects of which ten significant. The cross SVSAL-2 X SVSR-7 showed higher positive sca effect while the cross SVSAL-1 X SVSR-3 showed higher negative sca effect.

### ***Stem girth***

The female SVSAL-1 and SVSAL-3 showed significantly positive gca effects whereas SVSAL-2 exhibited significantly negative gca effects.

Out of 15, 4 males showed positive gca effects and found significant. The male SVSR-3 showed highest significantly positive gca effect.

Among the crosses, twenty-two expressed positive sca effects out of which seventeen found significantly superior for stem girth.

The cross SVSAL-1 X SVSR-1 showed higher positive sca effect while the cross SVSAL-1 X SVSR-15 showed higher negative sca effect.

### ***Head diameter***

Female parent SVSAL-1 showed significantly positive gca effects for head diameter while SVSAL-2 and SVSAL-3 female expressed negative gca effects.

Out of 15, eight males showed positive gca effects of which two were significant and the male SVSR-11 showed higher positive gca effect.

Among the 45 hybrids, 20 showed positive sca effects. The cross SVSAL-3 X SVSR-6 showed higher positive sca effect.

### ***Total number of seeds per head***

The female SVSAL-1 showed positively significant gca effect. The females SVSAL-2 and SVSAL-3 expressed negatively significant gca effects for this character. Four males showed positive gca effects and found significant. The male SVSR-15 showed higher positive gca effect.

Among the 45, 17 hybrids showed positive sca effects out of which eleven found significant. The cross SVSAL-1 X SVSR-7 showed highest positively significant sca effect.

### ***Number of filled seeds per head***

The females viz: SVSAL-1 and SVSAL-3 showed positive significant gca effects for number of filled seeds per head. The female parent SVSAL-2 expressed significantly negative gca effects.

Eight males showed positive gca effects of which four were significant. The male SVSR-15 showed higher positive gca effect.

Out of 45, 11 hybrids exhibited significantly positive sca effects. The cross SVSAL-1 X SVSR-7 showed higher sca effect.

### ***Seed filling percentage***

Two female viz., SVSAL-3 showed significant positive gca. SVSAL-1 and SVSAL-2 females showed negative significant gca for Seed filling percentage.

Among fifteen males seven showed positive significant gca effects for seed filling percentage.

Out of 45 crosses, 21 showed positive sca effects among which nineteen showed significant values for Seed filling percentage.

### ***Hundred seed weight (g)***

Two female viz., SVSAL-1 showed significant positive gca effect. Whereas the female parents SVSAL-2 and SVSAL-3 expressed negative gca effects for 100 seed weight.

Out of 15, 7 males showed positive gca effects, of which five were found significant.

Out of 45, 21 hybrids expressed positive sca effects and among them 19 were significant. The hybrid SVSAL-1 X SVSR-4 showed significantly higher sca effect for the 100 seed weight.

### ***Per cent oil content***

The female that showed significantly positive gca effects were SVSAL-2 and SVSAL-3 while SVSAL-1 showed negative gca effects for per cent oil content.

Among the males eight showed positive gca effects for percent oil content out of which five were significant while seven males showed negative gca effects.

Out of 45, 27 hybrids showed positive sca effects, of which seven showed significantly positive sca effects. The hybrid SVSAL-3 X SVSR-11 showed significantly higher sca effects for per cent oil content.

### Seed yield per plant

Among the female, SVSAL-1 showed positively significant gca effects other females SVSAL-2 and SVSAL-3 expressed significant negative gca effects for seed yield per plant.

Out of 15 males, 8 showed positive gca effects of which two were significant.

It is observed that 20 crosses showed positive sca effects for seed yield per plant and among these 8 found significant. The hybrid SVSAL-1 X SVSR-7 showed significantly higher sca effects for seed yield per plant.

### Per cent oil content

Seven hybrids exhibited significant positive sca effects of which SVSAL-1 X SVSR-7, SVSAL-2 X SVSR-3, SVSAL-2 X SVSR-12, SVSAL-3 X SVSR-10, SVSAL-3 X SVSR-11 and SVSAL-3 X SVSR-14 were the best cross combinations with highly significant positive sca effects. Parents showed average x average, good x good and poor x poor general combining ability.

Makne (1993), Bajaj *et al.* (1997) and Satish Chandra *et al.* (2011) also noticed best specific combinations for per cent oil content having parents of varied combining ability.

### Seed yield per plant (g)

For seed yield per plant, eight hybrids exhibited significant positive sca effects. The hybrids SVSAL-1 X SVSR-6, SVSAL-1 X SVSR-7, SVSAL-1 X SVSR-9, SVSAL-2 X SVSR-8, SVSAL-2 X SVSR-10, SVSAL-3 X SVSR-1, SVSAL-3 X SVSR-12 and SVSAL-3 X SVSR-14 showed significant positive sca effects. In this combination were of poor x good, good x good and good x poor general combining ability parent. Thus a specific parent does not contributed in producing high sca hybrids. Alone *et al.* (1996), Bajaj *et al.* (1997), Muhammad *et al.* (2011) also observed similar results.

From the results of general combining ability effects, it appears that the inclusion of female parents SVSAL-1 and SVSAL-3 and male parents SVSR-3, SVSR-4, SVSR-8 and SVSR-11 in the hybrid breeding programme would be an opportunity to develop better hybrids.

Estimation of specific combining ability effects revealed that none of the hybrids exhibited high sca effects simultaneously for all or majority of the characters studied. The hybrids SVSAL-2 X SVSR-15 for days to 50 per cent flowering, SVSAL-3 X SVSR-12 for days to maturity, SVSAL-2 X SVSR-6 for plant height at maturity, SVSAL-1 X SVSR-1 for stem girth, SVSAL-3 X SVSR-6 for head diameter, SVSAL-1 X SVSR-7 for total number of seeds per head, SVSAL-1 X SVSR-7 for number of filled seeds per head, SVSAL-1 X SVSR-4 for seed filling percentage, SVSAL-1 X SVSR-4 for hundred seed weight, SVSAL-3 X SVSR-11 for percent oil content and SVSAL-1 X SVSR-6 showed highest sca effects than the others for seed yield per plant. It appears that hybrids derived from the female parent SVSAL-1 and male parents SVSR-4 and SVSR-11 were exhibiting higher gca effects for more number of characters than the hybrids derived from other parents.

### CONCLUSION

Among the parents SVSAL-1, SVSR-4, SVSR-3, were found to possess significant positive gca effect for yield and for most of the yield contributing characters, which are important and hence needs to be further evaluation and confirmation for commercial exploitation.

### References

- Madrap, I. A and Makne, V. G., (1993), Heterosis in relation to combining ability effect and phenotypic stability in sunflower. *Indian J. Agric Sci.* 63 (8): 484-488.
- Bajaj, R. K., Aujla, K. K and Chahal, G. S., (1997), Combining ability studies in sunflower crop improvement 24 (1) : 50-54.
- Satish Chandra B., S. Sudheer Kumar., A. R. G. Ranganadha., M. Y. Dudhe., (2011), Combining Ability Studies for Development of New Hybrids over Environments in Sunflower (*Helianthus annuus* L.). *J. Agricultural Science.* 3 (2).
- Alone, R. K., Patil, R. D., Mate, S. N and Manjare, M. R., (1996), Combining ability in sunflower. *Indian J. Agric Res.* 30 (3-4) : 215-220.
- Muhammad Waqas Ahmad., Muhammad Shahzad Ahmed and Hammad Nadeem Tahir., (2012), Combining ability analysis for achene yield and related traits in sunflower (*Helianthus annuus* l.). *Chilean J. Agric. Res* 72(1).