*Plant Archives* Vol. 17 No. 2, 2017 pp. 1237-1241 ***ISSN 0972-5210***

# YIELD RESPONSE OF SESAME GENOTYPES FOR GENE ACTION UNDER NORMAL CONDITION

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## Abstract

The present study, combining ability estimates were worked out through Line × Tester analysis of 24 hybrids developed by crossing six lines with four testers to know the genetic architecture of 8 morphological traits under normal condition. The present study was conducted at Plant Breeding Farm, Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University to estimate combining ability, gene action and proportional contribution of cross components in sesame genotypes. The analysis of variance of combining ability displayed variances of specific combining ability (SCA) were higher in magnitude than the corresponding general combining ability (GCA) variances for all the traits under study which indicated preponderance of non-additive gene action governing these traits. Based on *per se* and *gca* effects the parents TMV 7 and TMV 4 among the lines and among the testers, TMV 5 were found to be the best general combiner for grain yield and its component characters. The hybrids namely, TMV 4 × SVPR 1 and TMV 4 × TMV 6 were rated as superior crosses since they possessed high *per se* performance for most of the economic traits studied.

***Key words :*** Combining ability, GCA, SCA, L × T, sesame.

## Introduction

Sesame (*Sesamum indicum* L.) belongs to the family Pedaliaceae. It is regarded as the "Queen of oil seeds" by virtue of its excellent oil quality. Sesame is an important source of edible oil. It is grown in tropical and subtropical zones.

Sesame seeds contain 40-50% oil, 20-25% protein, 20-25% carbohydrate and 5-6% ash. Sesame oil is highly stable due to the presence of natural antioxidants such as sesamin (0.5-1.0%) and sesamolin (0.3-0.5%). Sesame oil is rich in essential fatty acids like linoleic acid (37-47%). Of this, linoleic acid gives antibacterial and anti inflammatory properties. Sesame oil is also rich in minerals like copper, manganese, calcium and magnesium.

Sesame ranks third among oil seeds in India after groundnut and mustard. India ranks first in area and production in the world contributing 15% among area and 13.27% among production (FAOSTAT, 2014). In 2014-2015, sesame occupies an area of 11.25 m ha with the production of 6.23 m tones in the world. In India, it is grown in an area of 1.74 m ha with the production of 0.82 m tones. In Tamil Nadu, it is grown in an area of 64242 ha with the production of 45000 tones (INDIASTAT, 2015). The varietal improvement of sesame had been oriented by developing pure line varieties through conventional breeding. In recent years, this is attempted through hybridization.

The success of heterosis breeding programme largely depends on the efficiency of choosing appropriate parents of good genetic potential. The parents should possess wide genetic diversity and good combining ability for various economic traits. Many biometric tools are made available to the breeder for selecting the desirable parents. Line × Tester analysis appears to be an ideal method to evaluate parents and crosses (Kempthorne, 1957).

## Materials and Methods

Ten selected genotypes of which six genotypes (VRI 1, VEERAGANUR LOCAL, SENGUR LOCAL, TMV 3, TMV 4, TMV 7) were used as lines and four varieties (TMV 5, TMV 6, SVPR 1 and VRI 2) as testers. These parents are crossed to produce twenty four hybrids using Line × Tester mating design (Kempthorne, 1957). A total twenty four hybrids with ten parents along with standard

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parent TMV 5. The study was conducted at Plant Breeding Farm, Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University during two seasons January to March, 2016 and January to March, 2017. The experiment was laid out in a randomized block design with three replications. Two seeds per hill were dibbled at a spacing of 30 cm within row and 30 cm between plants in a row. Thinning was done on the 15th day leaving one vigorous plant per hill. Recommended cultural practices and plant protection measures were adopted.

Observations were recorded on five competitive plants both in parents and hybrids in each replication for the following eight traits *viz.,* days to first flower, plant height, number of branches per plant, number of capsules

**Table 1 :** Analysis of variance for combining ability analysis in sesame.

| Source of variation | d f | MSS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Days to first flower (days) | Plant height (cm) | Number of branch-es/plant | Number of capsules per plant | Capsule length (cm) | Number of seeds per capsule | Thousa-nd seed weight (g) | Grain yield per plant (g) |
| **Replication** | 2 | 0.3097 | 7.8187 | 0.0232 | 6.7964 | 0.0010 | 0.0336 | 0.0006 | 1.0777 |
| **Hybrid** | 23 | **11.2088**** | **219.9423**** | **3.1291**** | **1758.7719**** | 0.0372 | **20.6819**** | 0.0603 | **56.0167**** |
| **Lines** | 5 | **14.6147**** | **537.3151**** | **7.5849**** | **3981.3320**** | 0.0624 | **18.7957**** | 0.0621 | **144.1411**** |
| **Testers** | 3 | **40.0498**** | **73.4412**** | **2.9046*** | **1825.2137**** | 0.0432 | **38.4432**** | 0.1063 | **25.7207**** |
| **L x T** | 15 | 4.3053** | 143.4516** | 1.6887 | 1004.63601** | 0.0276 | 17.7583** | 0.0504 | 32.7010** |
| **Error** | 66 | 0.2177 | 3.2900 | 0.0336 | 9.8637 | 0.0013 | 0.1796 | 0.0005 | 0.9164 |
| **GCA Variance** | | 0.1741 | 1.9290 | 0.0363 | 19.0189 | 0.0002 | 0.0737 | 0.0002 | 0.5880 |
| **SCA Variance** | | 1.3573 | 46.6937 | 0.5515 | 331.9938 | 0.0088 | 5.8493 | 0.0166 | 10.5468 |
| **GCA/SCA Variance** | | **0.1282** | **0.0413** | **0.0658** | **0.0572** | **0.0227** | **0.0125** | **0.0120** | **0.0557** |

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

**Table 2 :** General combining effects of parents for different traits in sesame genotypes.

| | Days to first flower (days) | Plant height (cm) | Number of branches per plant | Number of capsules per plant | Capsule length (cm) | Number of seeds per capsule | Thousand seed weight (g) | Grain yield per plant (g) |
|---|---|---|---|---|---|---|---|---|
| **Lines** | | | | | | | | |
| VRI 1 | -0.74** | -2.37** | -0.28** | -0.66 | -0.02* | 0.82** | -0.10** | -1.02** |
| Veeraganur Local | -1.56** | -11.29** | -1.47** | -34.69** | -0.06** | -1.45** | -0.05** | -6.05** |
| Sengur Local | 0.13 | 1.05 | 0.55** | 2.22* | -0.04** | -0.92** | -0.01 | -0.05 |
| TMV 3 | -0.24 | -0.52 | 0.40** | 5.66** | 0.02 | -0.71** | 0.02* | 1.40** |
| TMV 4 | 1.45** | 7.82** | 0.66** | 18.24** | 0.14** | 1.89** | 0.08** | 4.30** |
| TMV 7 | 0.97** | 5.31** | 0.14* | 9.23** | -0.03** | 1.37** | 0.07** | 1.42** |
| S.E. (GCA effects for line) | 0.1395 | 0.5300 | 0.0535 | 0.8490 | 0.0095 | 0.1324 | 0.0069 | 0.2973 |
| **Testers** | | | | | | | | |
| TMV 5 | -1.22** | -0.54 | 0.10* | -4.00** | 0.06** | 1.87** | 0.04** | 0.71** |
| TMV 6 | -1.01** | -0.07 | 0.38** | 14.84** | -0.03** | 0.33 | -0.12** | 1.32** |
| SVPR 1 | 0.21 | -2.12** | -0.57** | -7.57** | -0.05** | -0.68** | 0.04** | -1.27** |
| VRI 2 | 2.02** | 2.73** | 0.08 | -3.27** | 0.03** | -1.52** | 0.03** | 0.66** |
| S.E. (GCA effects for testers) | 0.1139 | 0.4327 | 0.0436 | 0.6932 | 0.0078 | 0.1081 | 0.0056 | 0.2428 |

*,** Significant at 5 and 1 per cent respectively; S.E.- Standard Error.

per plant, capsule length, number of seeds per capsule, thousand seed weight and seed yield per plant.

The statistical analysis was performed by using Line × Tester analysis by Kempthorne (1957) and genetic components of each parameter following Singh and Chaudhary (1985).

## Results and Discussion

### Analysis of variance

The analysis of variance showed significant variations for the yield and different yield contributing characters among the genotypes, crosses, lines, testers and Line × Tester interactions. The significant differences among

**Table 3 :** Specific combining ability effects of hybrids for different traits in sesame genotypes.

| Cross | Days to first flower (days) | Plant height at maturity (cm) | Number of branches per plant | Number of capsules per plant | Capsule length (cm) | Number of seeds per capsule | Thousand seed weight (g) | Grain yield per plant (g) |
|---|---|---|---|---|---|---|---|---|
| VRI 1 x TMV 5 | -0.97** | -8.09** | -0.63** | -24.19** | 0.01 | 1.70** | 0.07** | -3.82** |
| VRI 1 x TMV 6 | -0.69* | 0.25** | 0.22 | 6.94** | -0.06** | -1.64** | -0.09** | 2.41** |
| VRI 1 x SVPR 1 | 0.99** | 1.93 | -0.03 | -14.75** | 0.03 | 0.38 | -0.21** | -3.76** |
| VRI 1 x VRI 2 | 0.68* | -3.05** | -0.50** | 1.41 | 0.02 | -0.44 | -0.12** | 2.32** |
| VEERAGANUR LOCAL x TMV 5 | -0.33 | -10.10** | -0.73** | -10.03** | -0.05* | 0.14 | -0.04* | -2.21** |
| VEERAGANUR LOCAL x TMV 6 | -0.50 | 1.80 | -0.38** | 1.87 | 0.02 | 0.48 | 0.10** | -0.93 |
| VEERAGANUR LOCAL x SVPR 1 | -1.86** | -0.61 | 0.67** | 0.61 | 0.02 | 0.85** | 0.00 | -0.14 |
| VEERAGANUR LOCAL x VRI 2 | 2.69** | 2.30* | 0.45** | 7.54** | -0.20** | -1.47** | -0.06** | -0.05 |
| SENGUR LOCAL x TMV 5 | -0.21 | 3.86** | 0.35** | 13.62** | -0.10** | 0.07 | 0.19** | 2.18** |
| SENGUR LOCAL x TMV 6 | 0.58* | -4.67** | -0.13 | -10.54** | 0.07** | -0.83** | 0.05** | -1.28* |
| SENGUR LOCAL x SVPR 1 | 0.59* | 0.05 | -0.25* | -9.23** | -0.00 | -1.08** | 0.05** | -1.98** |
| SENGUR LOCAL x VRI 2 | -0.96** | 0.76 | 0.04 | -1.07 | 0.03 | 1.84** | -0.03* | -0.16 |
| TMV 3 x TMV 5 | 0.99** | 5.94** | 0.42** | 12.32** | 0.07** | -0.30 | -0.03 | 1.98** |
| TMV 3 x TMV 6 | 0.28 | -5.53** | 0.21 | -9.08** | -0.06** | 0.28 | 0.02 | -0.45 |
| TMV 3 x SVPR 1 | -0.35 | -1.25 | -0.74** | -0.94 | -0.03 | -1.62** | 0.06** | -0.10 |
| TMV 3 x VRI 2 | -0.93** | 0.84 | 0.11 | -2.31 | 0.03 | -3.11** | -0.05** | -1.42* |
| TMV 4 x TMV 5 | -0.03 | 6.59** | -0.30** | -12.56** | 0.03 | -1.12** | 0.14** | -1.53* |
| TMV 4 x TMV 6 | 0.72* | 4.59** | 1.16** | 37.54** | 0.12** | 5.02** | 0.23** | 5.26** |
| TMV 4 x SVPR 1 | -0.44 | 5.90** | 0.87** | 19.58** | 0.12** | 2.90** | 0.01 | 3.41** |
| TMV 4 x VRI 2 | -0.25 | -9.25** | -0.78** | -13.96** | -0.03 | -2.86** | -0.03* | -2.46** |
| TMV 7 x TMV 5 | 0.55 | 8.40** | 0.89** | 20.83** | 0.14** | 3.70** | 0.05** | 4.92** |
| TMV 7 x TMV 6 | -0.39 | -8.04** | -1.06** | -26.72** | -0.09** | -0.17 | -0.07** | 1.32** |
| TMV 7 x SVPR 1 | 1.08** | -2.15** | -0.51** | 4.72** | -0.08** | -2.24** | 0.08** | -1.27** |
| TMV 7 x VRI 2 | -1.23** | 8.40** | 0.68** | 8.38** | 0.03** | -0.49 | -0.05** | 0.66** |
| SCA effects for hybrids | 0.2789 | 1.0599 | 0.1069 | 1.6979 | 0.0191 | 0.2649 | 0.0137 | 0.5946 |

*,** Significant at 5 and 1 per cent respectively S.E.- Standard Error.

the lines, testers and Line × Testers indicated that the genotype had wide genetic diversity among themselves for days to first flower, plant height, number of branches per plant, number of capsules per plant, capsule length, number of seeds per capsule, thousand seed weight and seed yield per plant. In combining ability, significant variances for lines and testers were observed for all the eight characters.

The estimates of GCA and SCA variances revealed that the SCA variances had greater magnitude than GCA variance for all the characters studied, indicating the preponderance of non-additive gene action (table 1). The significant differences between Line × Testers interaction indicates that SCA attributed heavily in the expression of these traits and demonstrates the importance of dominance or non additive variances for all the traits (Sanghera and Hussain, 2012). And also the variances of SCA were higher than the GCA variances for these traits which indicated preponderance of non additive gene action in the inheritance of traits. It suggested the greater importance of non-additive gene action in the expression and indicated very good prospect for exploitation of non additive genetic variation for yield and its component characters through hybrid breeding. The lines TMV 4 and TMV 7 as well as in testers TMV 5 and TMV 6 were observed to be good general combiners for most of the characters studied.

### General combining ability (*gca*) effects

Among the lines studied, TMV 4 recorded the highest mean value for all the traits except days to first flower. The line, TMV 7 also had significant high mean for all the traits except days to first flower and capsule length. Among the testers, TMV 5 recorded high *per se* performance for the traits *viz*., plant height, number of branches per plant, number of capsules per plant, capsule length, number of seeds per capsule, thousand seed weight and seed yield per plant. The tester, SVPR 1 recorded significantly high mean performance for the traits *viz.,* days to first flower, number of capsules per plant, thousand seed weight and seed yield per plant. Thus, based on the *per se* performance the lines, TMV 4 and TMV 7 and the testers TMV 5 and SVPR 1 have been estimated as superior parents and they might be useful for the incorporation of the respective traits in hybridization programme (table 2).

### Specific combining ability (*sca*) effects

TMV 4 × TMV 6 had positive and highly significant *sca* effects for the traits *viz.,* plant height, number of branches per plant, number of capsules per plant, capsule length, number of seeds per capsule, thousand seed weight. The crosses, TMV 4 × TMV 6 and TMV 7 × TMV 5 possessed high *per se* performance for most of the traits. Also, the hybrid TMV 7 × TMV 5 had high × high combiners with non significant *sca* effects for number of branches per plant, number of capsules per plant, number of seeds per capsule, thousand seed weight and seed yield per plant (table 3).

## Conclusion

In the present study, TMV 4 × TMV 6, TMV 7 × TMV 5 and TMV 4 × SVPR 1 are identified as good general combiner for almost all the traits studied. The hybrids, TMV 4 × TMV 6 and TMV 4 × SVPR 1 were recorded with high *per se* performance and highly significant *sca* effects for seed yield and its component traits were found to be suitable for heterosis breeding.

## References

Ali, K. A. (2009). Inheritance, combining ability and heterosis for economic traits in sesame (*Sesamum indium* L.). *Ph.D. Thesis,* Sudan Academy of Sciences, Khartoum (Sudan).

Backiyarani, S., A. A. Devarathinam and S. Shanthi (1997). Combining ability studies on economic traits in sesame. (*Sesamum indicum* L.). *Crop Res*., **13(1)** : 121-125.

Baker, R. J. (1978). Issue in diallel analysis. *Crop Sci*., **18** : 536-583.

Banerjee, P. P. and P. C. Kole (2009). Combining ability analysis for seed yield and some of its component characters in sesame (*Sesamum indicum* L.). *Inter. J. Plant Breed. Genet*., **3(1)** : 1819-3595.

Bharathi Kumar, K. and P. Vivekanandan (2009). Studies on combining ability studies in sesame (*Sesamum indicum* L.). *Elect. J. Plant Breed.,* **1** : 33-36.

Fahmy, R. M., M. A. Abd Satar and T. H. A. Hassan (2015). Heterosis, combining ability and gene action for yield and its attributes of $F_1$ crosses in sesame. *Egypt. J. Plant Breed*., **19(3)** : 917 – 943.

Haripriya, S. and C. D. R. Reddy (1993). A study on combining ability for seed yield in sesame (*Sesamum indicum* L.). *J. Res. APAU*., **21(1)** : 42-45.

Griffing, B. (1956). Concept of general and specific combining ability in relation to diallel crossing system, *Australian J. Bio. Sci*., **9** : 463-493.

Joshi, H. K., S. R. Patel, A. R. Pathak and R. K. Patel (2015). Combining ability analysis for yield and yield components in sesame (*Sesamum indicum* L.). *Elect. J. Plant Breed*., **6(2)** : 454-458.

Kempthorne, O. (1957). *An introduction to genetic statistics*. John Wiley and Sons, Inc., New York.

Manivannan, N. (1997). Combining ability in sesame (*Sesamum indicum* L.). *J. Oilseeds Res*., **14(2)** : 165-167.

Meenakumari, B., N. Manivannan and K. Ganesamurthy (2015). Combining ability analysis in sesame (*Sesamum indicum* L.). *Elect. J. Plant Breed*., **6(3)** : 700-708.

Muhammad Hassan, S. and F. Sh. Sedeck (2015). Combining ability and heterosis in sesame. *World Applied Sci. J*., **33(5)** : 690-698.

Rajput, S. D. and N. S. Kute (2012). Combining ability for yield and its contributing characters in sesame (*Sesamum indicum* L.). *Bioinfolet.,* **9(4 B)** : 831-833.

Ramesh, S., N. Shekhawat, S. S. Macwana, R. Choudhary and B. R. Patel (2014). Line × Tester analysis in sesame (*Sesamum indicum* L.). *Inter. J. Life Sci*., **9(4)** : 1657-1660.

Singh, R. K. and B. D. Chaudhury (1985). *Biometrical methods in quantitative genetic analysis*. Kalyani publishers, New Delhi.

Vaithiyalingam, M. (2015). Combining ability analysis for yield and yield components in sesame (*Sesamum indicum* L.) genotypes. *Elect. J. Plant Breed*., **6(4)** : 950-955.