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ASSESSMENT OF HETEROTIC EFFECTS IN SESAME (*SESAMUM INDICUM* L.)

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Abstract

The recent approach for sesame production includes the improvement of yield is necessary to cater for consumer demand. Therefore, a field experiment was conducted using Line × Tester mating design for yield and yield attributing traits by using 10 parents (6 Lines and 4 Testers) and 24 hybrids. A total 24 hybrids with their 10 parents with standard check TMV 5, were evolved for standard parent. The hybrids *viz.,* TMV 4 × SVPR 1 and TMV 4 × TMV 6 were found to be best for exploitation of heterosis based on standard heterosis pertaining to seed yield per plant while the cross combination, VEERAGANUR LOCAL × SVPR 1 and VEERAGANUR LOCAL × TMV 5 showed highly significant negative standard heterosis for earliness and apart from seed yield.

Key words : Sesame genotypes, heterosis, L × T.

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 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

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

Heterosis

The mean of parents and F_1 hybrids were utilized for the estimation of heterosis. The heterobeltiosis (d_{ii}) and standard heterosis (d_{iii}) were estimated as follows:

$$\text{Heterobeltiosis } (d_{ii}) = \frac{\overline{F_1} - \overline{BP}}{\overline{BP}} X100$$

$$\text{Standard heterosis } (d_{iii}) = \frac{\overline{F_1} - \overline{SV}}{\overline{SV}} X100$$

Where,

F_1 = mean of the F_1 hybrid

BP = mean of the better parent

SV = mean of the standard variety

In the present study, TMV 5 was considered as the standard parent.

Test of significance of heterosis

The significance of heterosis was tested using the formula as suggested by Wynne *et al*. (1970).

i. 't' over Heterobeltiosis (d_{ii}) = $\dfrac{F_1 - BP}{\left(2\sigma^2{}_e / r\right)^{1/2}}$

ii. 't'over standard heterosis(d_{iii}) = $\dfrac{F_1 - SV}{\left(2\sigma^2{}_e / r\right)^{1/2}}$

Where,

'σ^2_e' is the error variance obtained from the analysis of variance.

'r' is the number of replications. The calculated 't' value was compared with the table of 't' at the error degrees of freedom.

Results and Discussion

The values of heterosis for hybrids were estimated based on better parent (d_{ii}) and standard parent performance (d_{iii}) (table 1). Negative heterosis for days to first flower is desirable for breeding early maturing hybrids and varieties. In this trait most of the hybrids exhibited negative significant values in heterobeltiosis. The maximum significant and negative value was recorded in cross VEERAGANUR LOCAL × SVPR 1 (-8.62 per cent) followed by VEERAGANUR LOCAL × TMV 6 (-8.39 per cent). Twelve hybrids showed negatively significant values ranged from -8.62 to -1.90 per cent for days to first flower for standard heterosis.

Positive heterosis is a desirable plant height for breeding hybrids and varieties. For heterobeltiosis, values ranged from 0.85 to 24.08 per cent. The maximum significant and positive value was recorded by TMV 7 × VRI 2 (24.08 per cent). Five crosses were recorded positive significant standard heterosis which ranged from 2.02 to 7.07 per cent. The highly significant and positive value was recorded by the cross TMV 4 × TMV 5 (7.07 per cent) for plant height.

For number of branches per plant in heterobeltiosis was positive and significant for ten hybrids and ranged from 4.48 to 19.78 per cent. The highest significant and positive heterobeltiosis was observed in cross TMV 4 × TMV 6 (19.78 per cent). Twelve hybrids recorded significantly positive standard heterosis which ranged from 7.78 to 21.11 per cent. The maximum significantly positive standard heterosis was noticed in TMV 4 × TMV 6 (21.11 per cent).

Number of capsules is one of the important yield contributing component trait. Fifteen hybrids were recorded with positive and significant values in heterobeltiosis, the hybrid TMV 4 × TMV 6 (81.93 per cent) showed the maximum and significantly positive value. Seventeen hybrids recorded significantly positive standard heterosis ranged from 9.40 to 73.31 per cent. The maximum significantly positive standard heterosis was observed in TMV 4 × TMV 6 (73.31 per cent).

Among the hybrids estimated for heterobeltiosis, TMV 4 × TMV 6 was recorded the maximum positive significant value (14.71 per cent) capsule length, Six hybrids were recorded positively significant standard heterosis. Among them, TMV 4 × SVPR 1 (10.68 per cent) recorded the maximum significant positive value for capsule length.

Among the hybrids, nine hybrids exhibited positively significant heterobeltiosis for number of seeds per capsule which ranged from 1.30 to 2.96 per cent. TMV 4 × TMV 6 (2.96 per cent) recorded the maximum significant positive value. For standard heterosis, all ten hybrids were showed significantly positive values. TMV 4 × SVPR 1 (3.04 per cent).

Table 1 : Extend of heterosis over better parent and standard variety in twenty four sesame hybrids for eight characters.

Cross	Days to first flower (days)		Plant height (cm)		Number of branches/plant		Number of capsules/plant		Capsule length (cm)		Number of seeds/capsule		Thousand seed weight (g)		Seed yield per plant (g)	
	dii	diii	dii	diii	dii	diii	dii	diii	dii	diii	dii	diii	dii	diii	dii	diii
VRI 1 × TMV 5	-7.99**	-7.99**	-18.05**	-18.05**	-13.33**	-13.33**	-21.06**	-21.06**	-3.45**	-3.45**	2.25**	2.25**	-0.44	-0.33	-30.82**	-30.82**
VRI 1 × TMV 6	-6.36**	-6.80**	21.56**	-4.11**	19.13**	21.11**	63.69**	59.61**	0.00	-5.49**	-5.34**	-5.39**	-10.80**	-10.70**	42.80**	31.83**
VRI 1 × SVPR 1	-2.84**	0.08	21.69**	-5.52**	-12.00**	-14.44**	-12.71**	-14.18**	4.49**	1.15	-1.13*	-1.18*	-11.21**	-9.17**	-30.44**	-33.58**
VRI 1 × VRI 2	-0.91	3.64**	16.25**	-9.67**	-5.92*	-11.67**	15.72**	9.79**	0.40	-0.13	1.42**	1.37**	4.58**	4.69**	27.97**	11.59**
VEERAGANUR Local × TMV 5	-8.39**	-8.39**	-29.10**	-29.10**	-35.00**	-35.00**	-44.33**	-44.33**	0.38	0.38	1.52**	1.52**	2.29**	2.29**	-50.04**	-50.04**
VEERAGANUR Local × TMV 6	-7.87**	-8.31**	14.14**	-9.94**	-25.27**	-24.44**	-3.77	-8.33**	4.97**	7.54**	-0.66	-0.71	1.64**	1.53*	-5.27	-12.55**
VEERAGANUR Local × SVPR 1	-11.29**	-8.62**	1.61	-21.12**	-20.57**	-22.78**	-34.95**	-36.05**	4.97**	7.54**	2.79**	1.08*	1.28*	3.60**	-38.74**	-41.51**
VEERAGANUR Local × VRI 2	1.82*	6.49**	11.62**	-13.27**	-10.06**	-15.56**	-18.72**	-22.89**	4.97**	7.54**	2.22**	1.42**	1.20	1.09	-19.87	-30.12**
SENGUR Local × TMV 5	-5.68**	-4.11**	-2.53	-2.53	4.48*	16.67**	28.35**	35.05**	-8.30**	-8.30**	-2.69**	-2.69**	-5.79**	-5.79**	15.43**	15.43**
SENGUR Local × TMV 6	-3.35**	-1.74	10.55**	-10.68**	1.49	13.33**	14.40**	20.37**	-0.13	-1.28	-6.71**	-6.76**	4.28**	1.09	8.81	0.45
SENGUR Local × SVPR 1	-1.77*	1.19	13.88**	-7.98**	-14.43**	-4.40	-9.09**	-4.35	0.39	0.77	-4.28**	-5.88**	-0.11	2.18**	-14.19**	-18.06**
SENGUR Local × VRI 2	-2.65**	1.82*	20.84**	-2.36	-0.50	11.11**	4.79	10.26**	0.65	-0.51	-8.95**	2.15**	3.06**	-0.76	18.21**	3.08
TMV 3 × TMV 5	-8.64**	-2.14*	3.87*	3.87*	15.56**	15.56**	29.11**	29.11**	0.13	0.13	-2.94**	-2.94**	0.55	0.55	15.67**	15.67**
TMV 3 × TMV 6	-9.75**	-3.32**	11.14**	-7.24**	15.38**	16.67**	28.69**	26.11**	-1.31	-3.96**	2.20**	2.15**	-0.11	-3.17**	21.45**	13.40**
TMV 3 I × SVPR 1	-8.42**	-1.90*	13.84**	-4.98**	-12.57**	-15.00**	11.28**	9.40**	3.15**	0.38	-5.86**	-6.37**	1.28*	3.60**	21.45**	13.40**
TMV 3 I × VRI 2	-5.69**	1.03	22.24**	2.02	17.16**	10.00**	15.14**	12.83**	4.46**	1.66	-4.28**	-4.80**	2.82**	-0.66	11.65*	4.25
TMV 4 × TMV 5	-4.05**	-0.55	7.07**	**7.07****	6.01*	7.78**	14.71**	14.71**	-4.21**	-4.21**	-3.73**	-2.55**	**7.16****	**7.86****	12.08**	12.08**
TMV 4 × TMV 6	-1.83*	1.74	16.56**	5.52**	19.78**	21.11**	**81.93****	**73.31****	**14.71****	-3.83**	**2.96****	-7.84**	-6.29**	-5.68**	37.09**	26.94**
TMV 4 × SVPR 1	-1.68	1.90*	6.99**	-3.13*	14.21**	16.11**	50.72**	48.17**	0.53	**10.68****	1.79**	**3.04****	1.49*	3.82**	37.09**	26.94**
TMV 4 × VRI 2	1.97*	6.65**	4.24*	-5.62**	-2.19	-0.56	16.84**	13.93**	0.67	-3.58**	0.53	1.76**	1.19	1.86**	23.78**	14.62**
TMV 7 × TMV 5	-0.32	-0.32	-6.20**	-6.20**	15.68**	18.89**	30.13**	34.81**	-3.19**	-3.19**	-5.83**	-4.31**	0.66	0.66	16.72**	16.72**
TMV 7 × TMV 6	-1.59	-2.06*	0.85	-15.66**	-11.35**	-8.89**	5.82*	9.63**	-0.82	-7.02**	-8.05**	-6.56**	-6.47**	-8.41**	-9.65*	-12.38**
TMV 7 × SVPR 1	1.31	4.35**	5.48**	-11.79**	-17.84**	-15.56**	16.03**	20.21**	0.00	-3.19**	-9.83**	-8.37**	-0.53	1.75**	10.60*	7.25
TMV 7 × VRI 2	-1.36	3.16**	24.08**	3.77*	11.89**	15.00**	25.04**	29.54**	9.13**	3.83**	1.30*	2.94**	-0.78	-2.84**	25.96**	22.15**

*significant at 5% level ** significant at 1% level d_{ii}= Heterobeltiosis, d_{iii}= Standard heterosis.

For thousand seed weight the magnitude of positively significant heterobeltiosis for ten crosses. The maximum significant and positive heterobeltiosis was observed in TMV 4 × TMV 5 (7.16 per cent). Standard heterosis was observed to be significant and positive in ten crosses which were ranged from 1.53 to 7.86 per cent. The maximum positive and significant value was noticed in the cross TMV 4 × TMV 5 (39.97 per cent).

For seed yield per plant, a total of fifteen hybrids exhibited significantly positive heterobeltiosis where, the maximum significant and positive value was noticed in the cross VRI 1 × TMV 6 (42.80 per cent). In case of standard heterosis, thirty hybrids are recorded the positively significant values. The maximum positive significant was observed in TMV 4 × TMV 6 (26.94 per cent).

Conclusion

The magnitude of heterobeltiosis and standard heterosis were high significant for seed yield per plant in almost crosses, Based on standard heterosis, the hybrids TMV 4 × SVPR 1, TMV 4 × TMV 6, TMV 4 × TMV 5 and VRI 1 × VRI 2 also recorded significantly high standard heterosis for seed yield and most of its associated traits. The hybrids, TMV 4 × SVPR 1, TMV 4 × TMV 6 were recorded with high *per se* performance, highly significant *sca* effects and high standard heterosis for seed yield and its component traits were found to be suitable for heterosis breeding.

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