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Degree of Dominance and Generation Mean Variance Analysis for Biometrical Traits in Sesame (*Sesamum indicum* L.)

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The experiment was conducted with six generations derived from five inter varietal crosses TMV 5 x KS99037(C1), TMV 5 x KS990812 (C2), TMV 5 x KS990813 (C3), TMV 5 x KS99153 (C4) and TMV 5 x Cordebergea (C5) involving six genotypes of sesame to study the components of variances and degree of dominance for different traits. The observations on days to first flowering, days to maturity, plant height, number of primary branches, number of capsules per plant, capsule length, number of seeds per capsule, 100 seed weight and seed yield per plant were recorded for the selected individual plants. The variances estimated from different generations were partitioned into different genetic components of variation. The degree of dominance was greater than unity in TMV 5 x KS99037 for days to maturity, in TMV 5 x KS990812 for days to first flowering, in TMV 5 x KS990813 for days to first flowering and days to maturity, in TMV 5 x Cordebergea for number of seeds per capsule which showed over dominance for the respective traits. Hence, it is suggested for adoption of heterosis breeding for these crosses in sesame. The cross TMV 5 x KS99037 for days to first flowering, number of branches per plant and oil content and TMV 5 x KS990813 for plant height and number of capsules per plant showed partial dominance for the respective traits. The recombination breeding followed by selection in the later generation will improve the respective traits. The traits, plant height, number of capsules per plant and 100 seed weight were largely controlled by both additive and dominance variance. The pedigree or recombination breeding followed by selection in later generations would improve these characters. The environmental variance for the characters days to maturity, number of branches per plant, number of capsules per plant, capsule length, number of seeds per capsule and 100 seed weight revealed that environment plays an important role for the expression of these traits.

Key words: Sesame, gene action, components of variance, additive and dominance

Sesame (*Sesamum indicum* L.) is an important edible oil seed crop of India which occupies the third rank next to groundnut and mustard. By virtue of excellent quality of its oil it is referred to as the "Queen of the oil seed crops". Sesame seed is of high economic importance due to its oil content, nutrient content and protein. Sesame oil is of immense importance in Aurvedic Medicines, daily household purposes and in religious ceremonies. But the productivity of this crop in India is very low when compared with the world average. For breaking the present yield barrier and evolving varieties with high yield potential, it is desirable to combine the genes from genetically diverse parents. The success in identifying such parents mainly depends on the gene action that controls the trait under improvement. Formulation of a comprehensive breeding programme for the improvement of any crop largely depends upon the nature of gene action involved for any particular trait to be improved. The development in statistical genetics have made possible to study the various facets of the operation of quantitative genes and to use this information in formulating appropriate breeding strategy to effect genetic improvement of a particular trait. The present study therefore was aimed at studying the genetics of important quantitative characters including seed yield, so as to formulate suitable breeding strategy.

Materials and Methods

The experiment was conducted with six generations *viz.,* P_1, P_2, F_1, F_2, B_1 and B_2 derived from five inter varietal crosses TMV 5 x KS99037(C_1) TMV 5 x KS990812 (C_2), TMV 5 x KS990813 (C_3), TMV 5 x KS99153 (C_4) and TMV 5 x Cordebergea (C_5). These five crosses were effected in a crossing block to obtain the hybrid seeds. The F_1 plants were back crossed with the parents *viz*., P_1 and P_2, keeping the F_1 as the ovule parents to get their respective back cross families B_1 and B_2. The F_1s were also grown separately to obtain F_2 seeds. With the reserved seeds of direct F_1 hybrids of the five cross combinations, seeds for all the six generations *viz*.,

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P_1, P_2, F_1, F_2, B_1 and B_2 were obtained. All the six generations were raised at Department of Oilseeds, Tamil Nadu Agricultural University, Coimbatore during rabi, 2005. The parents and F_1s were planted in four rows of 6 m length. The B_1 and B_2 were planted in 6 rows of 6m length, while the F_2 of each crosses were raised in 12 rows of 6m length. The inter and intra row spacing was maintained at 30 x 30 cm. Fifty plants each from parents and F_1 s , 100 plants from B_1 and B_2 generations and 275 plants from F_2 populations were randomly selected.

Observations on days to first flowering, days to maturity, plant height, number of primary branches, number of capsules per plant, capsule length, number of seeds per capsule, 100 seed weight and seed yield per plant were recorded for all these selected individual plants. The variances estimated from different generations were partitioned into different genetic components of variation *viz*., non-heritable variance due to environment (E), fixable variance due to additive genes (D), non fixable variance due to dominance (H), co variance of additive and dominance effects (F) and dominance ratio followed by Mather and Jinks (1977).

Results and Discussion

The estimates of different genetic components of variances and their ratios for yield and its components were presented in Table 1.

Days to first flowering: The variance due to environment was lower than the additive and dominance variances in only two crosses (C_3 and C_5), but was higher than both the variances in the cross C_1. The additive variance was negative in three crosses and it was positive in two crosses (C_1 and C_3). The dominance variance was positive in all the crosses except C_2 and it was higher than the additive variance in all the crosses except C_1. The covariance of additive x dominance (F) component was positive in three crosses C_1, C_4 and C_5. It indicated the predominance of dominant alleles in the parents of these crosses for this trait. The dominance ratio was recorded as more than unity in the cross C_2 and C_3 which indicated the over dominance gene action which inturn showed that the heterosis could be exploited from these crosses for days to first flowering. The cross C_1 showed partial dominance gene action since it recorded the dominance ratio of less than unity. Dominance gene action was reported by Godawat and Gupta (1995) and Ramesh *et al.* (2000) for days to flowering.

Days to maturity: The environmental variance was lower than the additive and dominance variances in two crosses namely, C_3 and C_5. But the cross C_2 was highly influenced by the environment. The additive variance was positive in two crosses (C_1 and C_3) and it was negative in three crosses where as dominance variance was positive in all the five crosses. The F component was positive in C_1, C_4 and C_5 but it was negative in C_2 and C_3 crosses. The dominance gene action was greater than the additive gene action in all the five crosses for days to maturity. The dominance ratio was recorded as more than unity in the crosses C_1 and C_3 which indicated the over dominance gene action. These crosses may be utilized to exploit heterosis. Similar result was reported by Sivagamy (2003) for this trait.

Plant height: The environmental effect on this character was low compared to additive and dominance components in the crosses C_1, C_2 and C_5. Additive variance was positive in all the five crosses and it was higher than dominance variance in three crosses viz., C_1, C_2 and C_3. The dominance variance was negative in all the crosses except C_3. The covariance of additive x dominance was positive in all the crosses except C_2. It can be assumed that the parents of these crosses carried more dominant alleles, but the dominance ratio was less than one for the cross C_3 which indicated partial dominance. It may be suggested that the character plant height can be improved through pedigree breeding followed by selection.

Number of branches per plant: The variance due to environment was lower than the additive and dominance variances in two crosses viz., C_1 and C_2 and it was high in the remaining three crosses. The additive variance was positive in all the crosses while the dominance variance was negative in all the crosses except C_1. The F component was positive in C_1 and C_3, but it was negative in the remaining crosses. The dominance variance was higher than the additive variance in all crosses except C_1. The dominance ratio was recorded as less than one for the cross C_1 indicating the partial dominance gene action for this trait. The heterosis can be exploited from the cross C_1 since the parents of this cross also carried more dominant alleles for this trait. The same result was already reported by Vidhyavathi (2002).

Number of capsules per plant: The cross C_5 was less influenced by the environment compared to all the other four crosses for this trait. Additive variance was positive in all the crosses except C_1, whereas the dominance variance was positive in only two crosses C_1 and C_3. The dominance ratio was less than one in the cross C_3 which indicated the partial dominance gene action for this character. The F component was positive in all the crosses except C_2. In general, for all the crosses, the additive variance was higher than the dominance variance and hence it may be largely controlled by additive gene action. This indicated that the individual genotype could be evaluated readily from its phenotypic expression. Simple selection or simple recurrent selection would be more effective for this trait. The additive gene action for this trait was also reported by Das and Gupta (1999) and Ramesh *et al.* (2000).

Table 1. Estimates of various genetic components of variance for different characters in sesame

Cross	E	D	H	F	[H / D]½
Days to first flowering					
TMV5 x KS99037	12.69	6.32	0.28	7.98	0.21
TMV 5 x KS990812	9.29	-2.26	-36.12	-6.61	3.99
TMV 5 x KS990813	4.82	13.8	24.28	-9.14	1.32
TMV 5 x KS99153	9.05	-3.02	26.44	6.81	-
TMV5xCordebergea	9.81	-11.1	39.72	2.15	-
Days to maturity					
TMV 5 x KS99037	41.12	8.26	56.92	25.67	2.63
TMV 5 x KS990812	33.67	-0.54	31.53	-11.83	-
TMV 5 x KS990813	13.59	120.4	130.76	-26.52	1.04
TMV 5 x KS99153	27.67	-20.78	126.68	26.73	-
TMV5 x Cordebergea	32.72	-74.04	219.04	3.88	-
Plant height (cm)					
TMV 5 x KS99037	261.41	386.74	-291.84	48.77	-
TMV 5 x KS990812	178.96	679.56	-650.08	-216.58	-
TMV 5 x KS990813	181.08	480.42	110.48	15.47	0.48
TMV 5 x KS99153	332.89	299.2	-509.12	138.1	-
TMV 5x Cordebergea	358.77	411.78	-643.52	15.17	-
Number of branches per plant					
TMV5 x KS99037	1.86	2.2	0.76	0.34	0.59
TMV 5 x KS990812	3.31	0.76	-1.32	-0.18	-
TMV 5 x KS990813	2.34	5.6	-7.44	0.64	-
TMV 5 x KS99153	3.19	2.1	-3.0	-0.27	-
TMV5 x Cordebergea	2.25	4.28	-7.64	-0.38	-
Number of capsules per plant					
TMV 5 x KS99037	793.89	-598.64	2041.6	241.8	-
TMV 5 x KS990812	775.38	980.04	-852.6	-426.22	-
TMV 5 x KS990813	765.69	830.96	197.67	251.9	0.49
TMV 5 x KS99153	872.79	1531.82	-558.68	401.25	-
TMV5 x Cordebergea	717.78	1147.46	-911.0	32.05	-
Capsule length (cm)					
TMV 5 x KS99037	0.042	-0.044	0.088	-0.018	-
TMV 5 x KS990812	0.057	-0.19	0.376	0.087	-
TMV 5 x KS990813	0.21	0.042	-0.71	-0.02	-
TMV 5 x KS99153	0.042	-0.098	0.268	0.029	-
TMV5 x Cordebergea	0.052	0.094	-0.076	0.001	-
Number of seeds per capsule					
TMV 5 x KS99037	54.98	-12.52	19.2	-12.12	-
TMV 5 x KS990812	59.3	-61.72	133.6	54.9	-
TMV 5 x KS990813	64.19	167.8	-189.52	15.7	-
TMV 5 x KS99153	90.31	247.6	-522.36	-12.32	-
TMV5 x Cordebergea	70.76	13.62	63.76	2.93	2.16

100 seed weight (g)					
TMV 5 x KS99037	0.002	-0.002	0.0008	0.001	-
TMV 5 x KS990812	0.0018	0.0012	-0.0004	-0.0008	-
TMV 5 x KS990813	0.0019	-0.001	0.0016	-0.0005	-
TMV 5 x KS99153	0.0018	-0.001	0.0024	-0.0001	-
TMV5 x Cordebergea	0.0019	0.002	-0.004	-0.0012	-
Seed yield per plant (g)					
TMV 5 x KS99037	16.5	-62.26	101.2	26.23	-
TMV 5 x KS990812	17.32	12.86	-254.16	-11.57	-
TMV 5 x KS990813	15.3	11.5	-15.48	9.13	-
TMV 5 x KS99153	16.41	-40.54	120.84	20.53	-
TMV5 x Cordebergea	13.07	42.62	-42.44	-6.87	-
Oil content (%)					
TMV 5 x KS99037	2.45	-1.3	-1.04	-0.83	0.89
TMV 5 x KS990812	2.17	2.66	-3.92	-0.17	-
TMV 5 x KS990813	2.01	5.42	-6.52	-0.73	-
TMV 5 x KS99153	1.96	-1.46	1.36	-0.39	-
TMV5 x Cordebergea	3.05	3.46	-5.12	-1.99	-

E - Non heritable variance due to environment
D-Fixable variance due to additive genes
H- Non fixable variance due to dominance
F-Co variance of additive and dominance effects[H / D]½ - Dominance ratio

Capsule length: This character was less influenced by the environment. The additive variance was positive in C_3 and C_5 while the dominance variance was positive in C_1, C_2 and C_4. The covariance of additive x dominance was positive in C_2, C_4 and C_5 but it was negative in the remaining crosses. The dominance variance was higher than the additive variance in four crosses; hence recombination breeding followed by selection in the later generation will improve this trait. Senthil kumar and Ganesan (2002) reported dominance gene action for this trait.

Number of seeds per capsule: The crosses C_1 and C_5 were highly influenced by the environment. The additive variance was negative in two crosses viz., C_1 and C_2 and it was positive in the remaining crosses while, dominance variance was positive for C_1 , C_2 and C_5 and negative for the remaining crosses. The covariance of additive x dominance was positive in C_2, C_3 and C_5. It was assumed that the parents of these crosses carried more of dominant alleles. The dominance of the cross C_5 was also confirmed by the dominance ratio which was very high, more than unity in the cross C_5, indicating the over dominance gene action and exploitation of heterosis for this character through this cross could be possible. The non additive gene action for this trait was earlier reported by Solanki and Gupta (2001) and Deepa Sankar and Ananda Kumar (2003).

100 seed weigh: The environment influence was observed for this trait.The additive variance was positive in C_2 and C_5 but the dominance variance was positive in C_1, C_3, and C_4. The F component was negative in all the crosses except C_1. There was not much difference between dominance and additive variances. Pedigree breeding followed by selection would improve this character. Additive variance for this trait was reported by Ramesh et al, (2000) and Sivagamy (2003).

Seed yield per plant: Seed yield was not much affected by the environment for these crosses and the environment variance was lower than the additive and dominance variances. The additive variance was positive for C_2, C_3 and C_5 while the dominance variance was positive for C_1 and C_4. The F component was positive for C_1, C_3 and C_4 and it was negative for the remaining crosses. Dominance variance was higher than the additive variance for all the crosses. Recombination breeding with selection in later generation might be followed for the improvement of this trait. Dominance gene action for seed yield was reported by Saravanan and Nadarajan (2003) and Senthil Kumar *et al.* (2004)

Oil content: The dominance variance was slightly higher than additive variance and it was positive for C_4 only while the additive variance was positive in the cross C_2, C_3 and C_5 and it was negative in C_1 Environmental influence was comparatively low for this trait in three crosses namely C_2, C_3 and C_5. The F component was negative for all the crosses indicating the presence of recessive alleles in the parents. The dominance variance for the cross C_1 was less than one which showed the partial dominance gene action. Recombination breeding with selection in later generation might be followed for the improvement of this trait. Additive variance for this trait was reported by Devasena et al. (2001) and Sivagamy (2003).

In the present study, Environmental variance for days to maturity, number of branches per plant, number of capsules per plant, capsule length, number of seeds per capsule and 100 seed weight showed that environment plays an vital role in the expression of these traits. Plant height, number of capsules per plant and 100 seed weight were controlled by both additive and dominance variance. Pedigree or recombination breeding followed by selection in later generations would improve these characters. The cross TMV 5 x KS99037 for days to first flowering, number of branches per plant and oil content, TMV 5 x KS990813 for plant height and number of capsules per plant, showed partial dominance for the respective traits. Recombination breeding followed by selection in the later generation will improve the respective traits. Degree of dominance was greater than unity in TMV 5 x KS99037 for days to maturity, TMV 5 x KS990812 for days to first flowering, TMV 5 x KS990813 for days to first flowering and days to maturity, TMV 5 x Cordebergea for number of seeds per capsule, showed over dominance for the respective traits. Hence, it is suggested for adoption of heterosis breeding for these crosses in sesame.

References

Das, S. and Gupta, T. 1999. Combining ability in sesame. *Indian J. Genet.,* **59**: 69-75.

Deepa Sankar, P. and Ananda Kumar, C.R. 2003. Genetic analysis of yield and related components in sesame (*Sesamum indicum* L.) *Crop Res*. **25**: 91-95.

Devasena, N., Muralidharan, V. and Punitha, D. 2001. Combining ability for yield related traits in sesame (Sesamum indicum L.). *J. Oilseeds Res.,* **18**: 115-117.

Godawat, S.L. and Gupta, S.C. 1985. Inheritance of grain yield and its components in sesame. *J. Oilseeds Res.,* **2:** 260-267.

Mather, K. and Jinks, J.L. 1977. Introduction to Biometrical Genetics. Chapman and Hall Ltd., London.

Ramesh, S., Sherif, R. A., Mohan Rao, A. and Lalitha Reddy, S. S. 2000. Line x tester Analysis of quantitative traits in sesame (*Sesamum indicum* L.) *Mysore J. Agric.* Sci., **34:** 308-310.

Saravanan, S. and Nadarajan, N. 2003. Combining ability studies in sesame. *Crop Res*., **25**: 319 - 324.

Senthil Kumar, P and Ganesan, J. 2002. Line x Tester analysis for combining ability in sesame (*Sesamum indicum* L.). *Sesame and Safflower Newsl*., **17**: 12-14

Senthil Kumar, P., Pushpa, R., Karuppiah, P and Ganesan, J. 2004. Studies on combining ability in sesame (*Sesamum indicum* L.). *Crop Res.*, **27**: 99-103.

Sivagamy, 2003. Combining ability, heterosis for yield and its attributes in sesame (*Sesamum indicum* L.). M.Sc.(Ag.) Thesis, Tamil Nadu Agricultural University, Coimbatore, India.

Solanki, Z.S. and Gupta, D. 2001. Combining ability and heterosis studies for seed yield and its components in sesame. *Sesame and Safflower Newsl.,* **16**: 9-12.

Vidhyavathi, 2002. Study of heterosis and combining ability in sesame (*Sesamum indicum* L.) M.Sc.(Ag.) Thesis, Tamil Nadu Agricultural University, Coimbatore, India.

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