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GENETIC ANALYSIS FOR SINGLE STEMMED SESAME (*SESAMUM INDICUM* L.)

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ABSTRACT

Gene effects, heterosis, inbreeding depression and type of epistasis were studied for nine characters in two crosses of sesame involving single stemmed varieties. The study revealed that additive as well as nonadditive gene effects were operative for the expression of most of the characters under study, except days to flowering where additive gene action was important. The extent of heterosis was low due to mutual cancellation of gene effects for the characters studied. Inbreeding depression was highest for capsules/plant in both crosses. The use of biparental approach, inter se mating and/or reciprocal recurrent selection would be the most appropriate breeding methods to improve these characters, except days to flowering which could best be improved by adopting pedigree method of selection.

Key words: *Sesamum indicum*, sesame, gene effects, heterosis, inbreeding depression.

The single stemmed varieties of *Sesamum indicum* have special significance because of their suitability under intercropping. The system of breeding to be adopted to evolve commercial varieties depends on the type of gene action involved. The information on gene effects in sesame is very scanty, especially for single stemmed genotypes. The present investigation, therefore, aims to analyse the gene effects, heterosis, inbreeding depression and type of epistasis in single stemmed varieties of sesame under semiarid conditions of Rajasthan.

MATERIALS AND METHODS

The experimental materials comprised parents (P_1 and P_2), their F_1, F_2, B_1, ($F_1 \times P_1$), and B_2 ($F_1 \times P_2$) generations of two single crosses designated as cross I (S. local × C-50) and cross II (S. local × N-66-95), which involved single stemmed varieties of sesame. The experiment was laid in kharif (July-October), 1974 in a randomized block design with four replications at the Regional Station of Agricultural Research, University of Udaipur, Sumerpur, located in the semiarid zone of Western Rajasthan. Each replication had single row of 5 m length for parents and F_1 and 5 rows of 5 m length for each F_2, and backcross generations. The spacing was 45 cm between rows and 20 cm between plants. Five competitive plants from each parent

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and F_1 and 40 plants from each F_2 and backcross generations were randomly chosen and observations recorded on days to flowering and maturity, plant height, height at 1st bearing, fruit length, capsules/plant, capsule length, caspsule girth, and seeds per capsule.

The data were statistically analyzed following Panse and Sukhatme [1] and the gene effects were estimated according to Hayman [2]. The components of heterosis were worked out according to Jinks and Jones [3].

RESULTS AND DISCUSSION

The mean values for six generations (P_1, P_2, F_1, F_2, B_1, and B_2) for various characters are presented in Tables 1 and 2, while the genetic parameters obtained are given in Tables 3 and 4.

Table 1. Generation means for various characters in sesame cross I (S. Local × C-50)

Generation	Mean values of various characters								
	days to flowering	days to maturity	plant height (cm)	height at 1st bearing (cm)	fruiting length (cm)	capsules per plant	capsule length (cm)	capsule girth (cm)	seeds per capsule
P_1	47.5	83.7	69.6	22.4	45.2	24.1	2.53	2.88	67.1
P_2	46.4	86.4	65.3	24.7	34.8	17.5	2.09	3.66	94.0
F_1	45.0	83.6	72.9	24.6	43.9	29.6	2.42	2.98	66.2
F_2	43.1	82.0	78.8	25.6	47.3	26.5	2.65	2.98	68.5
B_1	47.1	81.5	70.2	25.0	43.2	25.9	2.47	2.95	65.2
B_2	44.4	82.2	74.6	23.3	50.5	31.7	2.50	2.92	68.0

Table 2. Generation means for various characters in sesame cross II (S. Local × N-66-95)

Generation	Mean values of various characters								
	days to flowering	days to maturity	plant height (cm)	height at 1st bearing (cm)	fruiting length (cm)	capsules per plant	capsule length (cm)	capsule girth (cm)	seeds per capsule
P_1	47.5	83.7	69.6	22.4	42.5	24.1	2.53	2.88	68.1
P_2	52.1	84.0	70.7	34.7	34.0	16.4	2.70	2.90	69.3
F_1	49.5	83.3	69.8	28.7	36.5	25.2	2.64	2.85	67.5
F_2	47.2	81.6	71.2	30.6	35.9	21.4	2.51	2.89	66.0
B_1	45.8	81.2	64.9	25.4	38.5	23.2	2.61	2.84	69.4
B_2	51.3	85.3	62.3	30.9	32.8	18.9	2.46	2.83	66.0

The mean values of F_1 and F_2 for days to flowering and days to maturity in cross I and F_2 for days to flowering and F_1 and F_2 for days to maturity in cross II were lower than their earlier parent. Lower mean values than their earlier parents in other segregating generations (B_2 in cross I and B_1 in cross II for days to flowering; and B_1 and B_2 in cross I, and B_1 in cross II for days to maturity) revealed desirable recombinations for these traits and occurrence of transgressive segregations.

It was noticed that mean values in F_1 for plant height in cross I and capsules/plant in both crosses I and II were higher than their superior parents, indicating the presence of heterosis in F_1. Higher mean values observed for plant height, fruiting length, capsules per plant and capsule length in F_2 in cross I, and plant height, height at first capsule (lower value) and fruiting length in cross II exhibited desirable recombinations in segregating population and presence of heterosis in F_2. Similarly, higher plant height in B_1 and B_2; fruiting length and number of capsules in B_2 in cross I than their superior parents revealed the occurrence of transgressive segregation (Tables 1 and 2).

Table 3. Gene effects, heterosis, inbreeding depression and type of epistasis in cross I (S. Local × C-50)

Character	m	d	h	i	j	l	Heterosis	Inbreeding depression (%)	Type of epistasis
Days to flowring	43.1**	2.8	8.8	10.8**	4.5	9.9	−2.5	4.7	D
Days to maturity	82.0**	−0.7	−2.0	−0.6	1.4	10.3**	−0.1	1.9	D
Plant height	79.8**	−4.4	−20.2	−25.7*	−13.0	17.0	−3.3	−7.5	D
Height at 1st bearing	25.6**	1.7	−4.7	−5.8	5.7	5.4	2.2	−3.9	D
Fruiting length	43.3**	−7.3**	2.1	−1.8	−25.0**	−17.9	−1.9	−7.2	D
Capsules/plant	26.5**	−6.7**	16.0*	7.2	−20.0**	−19.5	5.6	11.7	D
Capsule length	2.7**	−0.03	−0.6	−0.7	−0.5**	0.2	−0.1	−8.7	D
Capsule girth	3.0**	0.03	−0.4	−0.2	0.8**	0.9	0.1	0.3	D
Seeds/capsule	68.5**	−2.8	−21.9	−7.5	21.4*	34.5*	−6.5	−3.4	D

*P = 0.05, ** P = 0.01; D — duplicate epistasis.

The partitioning of genic components of variances (Tables 3 and 4) revealed that mean values were highly significant for all the characters in both the crosses. It was observed that additive × additive gene effect in cross I and additive type of gene action in cross II were mainly responsible for the inheritance of days to flowering, indicating that simple selection could be effective in these crosses. Yermanos and Kotecha [4] observed both additive and nonadditive gene actions involved in the expression of flowering trait in different crosses of sesame. For days to maturity, epistatic gene effects, viz., dominance × dominance in cross I and additive × dominance in cross II predominantly controlled the expression of this trait.

Table 4. Gene effects, heterosis, inbreeding depression and type of epistasis in cross II (S. Local × N-66-95)

Character	m	d	h	i	j	l	Heterosis	Inbreeding depression (%)	Type of epistasis
Days to flowring	47.2**	−5.6**	5.1	5.4**	−6.5	−1.1	2.0	4.9	D
Days to maturity	81.6**	−3.9	5.4	6.0	−7.4**	−4.1	−0.5	2.0	D
Plant height	71.2**	2.6	−30.8*	−30.4*	6.4	56.0*	0.1	−2.0	D
Height at 1st bearing	30.6**	−5.5**	−9.6	−9.8	1.1	11.6	6.3	−6.2	D
Fruiting length	35.9**	5.7	−2.8	−1.1	2.8	8.1	−6.0	1 7	D
Capsules/plant	21.4**	4.3	3.5	−1.5	0.9	8.1	1.1	17.6	C
Capsule length	2.5**	0.2	0.1	0.1	0.5	0.3	0.1	5.2	C
Capsule girth	2.9**	0.1	−0.3	−0.3	−0.04	0.4	−0.3	−1.4	D
Seeds/capsule	66.0**	3.4	5.7	6.9	8.0	−5.1	0.4	2.4	D

* P = 0.05, ** P = 0.01; D–duplicate epistasis; C–compementary epistasis.

It was observed that additive × additive gene effect in cross I; and dominance, additive × additive, and dominance × dominance in cross II had significant contribution in the inheritance of plant height. For height at 1st bearing and fruiting length, additive gene effect in cross I showed significant contribution, whereas none of the gene effects was significant for this character in cross II.

The data revealed that .the largest component for the fruiting length were additive and additive × dominance in cross I. This indicated that both fixable as well as nonfixable type of gene actions were involved for the expression of this character. In cross II, none of the gene effects was significant.

It is evident that additive, dominance, and additive×dominance gene effects for capsules/plant; additive × dominance for capsule girth; and additive × dominance and dominance × dominance gene effects for seeds/capsule in cross I had significant contribution in inheritance. For capsule length in cross I and fruiting length, number of capsules, capsule length, capsule girth, and seeds/capsule in cross II, none of the gene effects was significant, which indicates that both additive and nonadditive gene effects were equally important for the expression of these traits.

Srivas and Singh [5] pointed out the existence of both nonadditive as well as additive types of gene actions but predominance of nonadditive gene action for plant height, height at 1st capsule, branches/plant, capsules/plant, and seed yield, while Sharma and Chauhan [6] observed additive and additive × additive component of genetic variances predominantly governing the inheritance of days to flower, number of primary and secondary branches, plant height, capsules/plant, days to maturity, and 1000-seed weight in sesame.

It was found that heterosis calculated on the basis of gene effects for different characters under study was either very low or almost absent, a situation which might have arisen due to mutual cancellation of gene effects observed for the various characters studied. It was, however, observed that capsules/plant in both crosses showed the highest positive heterosis. Days to flowering and maturity, and capsule girth in cross I and days to maturity, seeds/capsule, plant height, and capsule length in cross II were the other characters which showed desirable but low magnitude of heterosis. Pal [7] reported that the estimates of heterosis in sesame are meagre. Sarathe and Dabral [8] and Srivas and Singh [5], however, reported varying degree of heterosis for various characters in sesame.

The data further revealed that days to flowering, days to maturity, capsules/plant, and capsule girth in cross I and days to flowering and maturity, fruiting length, number of capsules, capsule length, and seeds/capsule in cross II exhibited inbreeding depression. Other characters showed the absence of inbreeding depression in the respective crosses. Duplicate type of epistasis was observed for the inheritance of all characters in both the crosses except for number of capsules and capsule length in cross II, where complementary type of epistasis was involved.

The choice of a breeding method primarily depends upon the nature and magnitude of gene action. When additive effect forms the principal factor for genetic variance, use of pedigree method would be desirable. Comstock et al. [9] suggested the use of reciprocal recurrent selection which would be more effective when both additive and nonadditive gene effects are involved in the expression of a trait. In certain self-fertilizing crops like groundnut [10], soybean [11], cotton [12], barley [13] and wheat [14], where pronounced nonadditive effects along with some additive effects were observed, production of hybrids, if commercial seed production is feasible, would be desirable. However, for the development of lines, biparental approach, inter se crossing and/or reciprocal recurrent selection have been suggested to be more appropriate.

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