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ESTIMATES OF HETEROSIS FOR SEED YIELD, COMPONENTS OF SEED AND OIL IN LINSEED (*LINUM USITATISSIMUM* L.)

V. K. MISHRA AND M. RAI*

Department of Agricultural Botany, Janata Mahavidyalaya, Ajitmal, Etawah 206121

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ABSTRACT

A diallel analysis involving 10 parents and their 45 F_1s for seed yield and 8 other attributes determining quality of seed and oil under four different environments was made to have information on the extent of heterosis and relative magnitude of general and specific combining ability effects. The extent of heterosis over better parent indicated that seed yield was most heterotic character followed by stearic acid, oleic acid, linoleic acid and protein content. Most heterotic and the best specific cross, SPS 23-10 x LC 185 for seed yield and oleic acid and Sweta x LCK 152 for lower value of linolenic acid and oleic acid was identified as potential combinations showing considerable scope for exploitation of heterosis in linseed. It was concluded that selection of cross combination based on heterotic response would be more realistic than that on sca effects.

Key words: Linseed, heterosis, seed yield, quality characters.

Availability of male sterility and efficient fertility restoration systems and good mechanism of pollen transfer, usually enable commercial exploitation of hybrid vigour in self- pollinated crops. In linseed, where cytoplasmic male sterile lines are available, it is of interest to estimate the extent of heterosis for development of hybrids.

MATERIALS AND METHODS

Ten diverse varieties of linseed were crossed in all possible combinations without reciprocals. Seeds of parents and their 45 F_1s were sown under irrigated as well as rainfed conditions at two locations Ajitmal and Kanpur in a randomized block design with three replications, keeping single row of genotypes with inter- and intrarow distance maintained at 25 cm and 5 cm, respectively. During the crop growth period five competitive plants were randomly selected and tagged. The data were recorded for seed yield per plant, protein and

*Present address: Assistant Director General (Seeds), ICAR, Krishi Bhavan, New Delhi 110001.

oil contents of seed and iodine value, palmitic acid, stearic acid, oleic acid, linoleic acid and linolenic acid of oil.

Biochemical analysis was done using soxhlet procedure for oil content, micro-kjeldahl method for protein content and trans-estrification and gas liquid chromatography for fatty acid composition. Heterosis was computed over better parent (BP) and combining ability estimates were made as suggested by Griffing [1].

RESULTS AND DISCUSSIONS

The mean squares of pooled data for all the characters showed that the differences due to both environments and genotypes were highly significant (Table 1). Differences due to G x E interaction were also highly significant for all the traits. Varying degree of heterosis was generally associated with greater sensitivity to the environments [2]. The range of BP heterosis for different characters are also presented in Table 1. It may be seen that of the 45 hybrids evaluated a number of them exhibited significant heterosis for seed yield per plant, iodine value, palmitic acid, stearic acid and linolenic acid. None of the hybrids showed significant heterosis for oil content. The magnitude of heterosis was the highest in SPS 23-10 x LC 185 for seed yield per plant (79.1%).

Table 1. ANOVA (mean squares) of pooled data over four environments for 10 parents and their 45 F_1s of linseed

Source	d.f.	Seed yield per plant	Protein content	Oil content	Iodine value	Palmitic acid	Stearic acid	Oleic acid	Linoleic acid	Linolenic acid
Environments (E)	3	1258.6**	724.2**	374.4**	2936.7**	77.9**	150.8**	510.2**	282.7**	259.8**
Replications (R)	2	6.0	52.0**	212.7**	242.5**	4.8**	6.4**	19.3**	77.8**	174.6**
E x R	6	12.6**	31.3**	315.2**	148.0**	1.8**	10.5**	29.7**	87.2**	132.4**
Genotypes (G)	54	20.6**	34.2**	11.2**	151.1**	3.5**	1.9**	34.6**	17.2**	43.7**
G x E	162	10.7**	12.2**	6.2**	101.2**	3.3**	1.7**	23.3**	12.1**	32.7**
Error	432	3.2	8.6	5.6	12.8	0.4	0.5	3.1	3.1	4.6
No. of significant heterotic crosses										
Negative		1	9	6	25	18	19	3	15	25
Positive		25	7	0	3	7	7	17	2	2
Range of heterosis (%)										
Lowest value		– 27.7	– 17.3	– 6.1	– 7.7	– 32.2	– 43.7	– 6.1	– 29.4	– 14.4
Highest value		+ 79.1	+ 18.7	+ 1.3	+ 5.1	+ 17.9	+ 40.7	+ 20.3	+ 19.6	+ 4.1

**Significant at P = 0.01.

The three best crosses on the basis of heterotic response were compared to those selected on the basis of their sca effects (Table 2). The linolenic acid (lower value) was the only character where all the three crosses had the same rank in both the comparisons. For oleic acid and linolenic acid (higher value), there were two common crosses occupying different positions and for rest of the characters only one cross was common. It appeared that ranking

Table 2. Best crosses identified on the basis of heterotic response, sca effects and gca effects of the parents involved in linseed

Character	Heterotic crosses	Sca effects	Common crosses	Gca effects	
				P_1	P_2
Seed yield plant	SPS 23-10 x LC 185 T 397 x Sweta T 397 x SPS 23-10	SPS 23-10 x LC 185	SPS 23-10 x LC 185	-0.09	-0.68*
Protein content	SPS 23-10 x LCk 152 Sweta x R 17 Neelam x R 552	SPS 23-10 x LCK 152	SPS 23-10 x LCK 152	0.43	0.06
Oil content	K 2 x SPS 23-10	NIL	—	0.05	0.29
Iodine value	R 552 x LCK 152 SPS 23-10 x R 17 T 397 x R 552	Neelum x R 17 T 397 x R 552 Sweta x LC 185	T 397 x R 552	0.26	1.12
Palmitic acid	R 17 x LS 2 SPS 23-10 x LS 2 LCK 152 x LS 2	T397 x LS2 Sweta x LCK 152 R 17 x LS 2	R 17 x LS 2	-0.17	0.02
Stearic acid	T 397 x R 552 LS 2 x LC 185 R 552 x R 17	R 552 x R 17	R 552 x R 17	0.05	0.01
Oleic acid	Sweta x LCK 152 T 397 x K 2 SPS 23-10 x LC 185	SPS 23-10 x LC 185 Sweta x LCK 152 K 2 x LS 2	Sweta x LCK 152 SPS 23-10 x LC 185	-0.18 0.05	0.11 -0.12
Linoleic acid	T 397 x LS 2 Sweta x LC 185 Sweta x K 2	Sweta x K 2	Sweta x K 2	0.03	-0.19
Linolenic acid	Sweta x LCK 152 K 2 x LS 2	Sweta x LCK 152 K 2 x LS 2	Sweta x LCK 152 K 2 x LS 2	0.27 -0.07	-1.18** -0.63
(Lower value)	Neelam x SPS 23-10	Neelam x SPS 23-10	Neelam x SPS 23-10	-0.33	0.32
Linolenic acid (Higher value)	Sweta x LC 185 LS 2 x LC 185 R 552 x LCK 152	LS 2 x LC 185 Neelam x R 17 Sweta x LC 185	LS 2 x LC 185 Sweta x LC 185	-0.63 0.03	0.92** 0.92**

*,**Significant at P = 0.05 and P = 0.01, respectively.

on the basis of heterotic response was generally not reflected by the ranking based on sca effects. The cross showing high mean performance did not show high sca effects. This suggests that the selection of the cross combination based on heterotic response would be more realistic rather than on the basis of sca effects.

The common crosses in both heterotic response and sca effects in relation to gca effects are also presented in Table 2. On the basis of gca effects, the cross combinations SPS 23-10 x LC 185 for seed yield per plant and K 2 x LS 2 for lower value of linolenic acid proved to be low x low combination thus expressing the role of non additive gene action which could not be easily exploited in further breeding programme [3, 4].

The variety LC 185 had significantly positive gca effects for higher value of linolenic acid in pooled estimates. Both common crosses exhibited high x low combination. This revealed that apparently in this set of crosses additive gene action present in good combiner and complementary epistatic gene action present in the poor combiner, acted in the complementary fashion to maximise desirable effects which could suitably be exploited by selection of desirable homozygous lines among segregating progenies derived from a cross. For better utilization of these crosses, the inter se crossing among hybrids in all possible combinations or multiple parents inputs into a central gene pool will lead to realization of better recombinants and will also help in breaking undesirable linkage, if any, as advocated by Jensen [5].

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