

SHORT COMMUNICATION

Components of Genetic Variation in Yield Traits of Linseed (*Linum usitatissimum* L.)

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Ten diverse linseed parents were crossed in half diallel to estimate the components of genetic variation. It was revealed that non-additive genetic component contributed to the genetic expression of stem diameter, number of capsules per plant, number of tillers per plant, fibre strength and fibre fineness in both F_1 and F_2 generations. Some of the traits, viz., days to flower, plant height, technical plant height, days to maturity and fibre yield per plot displayed over dominance in the F_2 generation, while days to maturity and fibre yield per plot expressed partial dominance in the F_1 generation.

Key Words: Linseed, Genetic components, Seed yield, Oil content, Fibre yield

The component analysis besides providing necessary information on the type of gene action governing different traits also determines the nature and magnitude of genetic variation present in the population and help in planning efficient breeding methodology. Various Crop-breeding programmes are generally targeted to increase the productivity which requires consideration not only of yield but also of their components that have a direct or indirect bearing on economic yield. Breeders often select directly for seed and fibre yield to achieve yield improvement in linseed. The present study was, therefore, undertaken with the objective to estimate the components of genetic variation for yield traits of linseed.

Ten parents of linseed having diverse geographical origin, viz., Shubhra (Mukta x K2), Garima (T-126 x Neelum), Shekhar (Laxmi-27 x Ec1387), Janaki (New River x LC-216), J-23 (EC 9882 x Heera), T 397 (T 491 x T-1193-1), Gaurav (Selection 3 x EC-152), Belinca (Exotic Collection, Netherlands), Rasmi (Gaurav x Janaki), Nagarkot (New River x LC-216) were crossed in all possible combinations excluding reciprocals at Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, during *rabi* 2002. The 45 F_1 s, 45 F_2 s and 10 parents were sown in a randomized block design with three replications having 10 m² plot size. Each plot had 6 rows of 5 m length with row to row distance of 30 cm. The observations were recorded for 13 traits, viz., days to flower, plant height (cm), technical plant height (cm), days to maturity, stem diameter (mm), number of capsules per plant, number of tillers per plant, seed yield per plant (g), oil content (%), fibre lengths (cm), fibre strength (g/tax), fibre fineness (tax) and fibre yield per

plot (kg). Components of genetic variation were worked out by following the approach of Hayman (1958).

The estimates of six genetic parameters, viz., \hat{D} , \hat{H}_1 , \hat{H}_2 , \hat{F} , \hat{h}^2 and \hat{E} along with their related statistics (Comstock and Robinson, 1948) are presented in Table 1. The mean value of the degree of dominance (\hat{H}_1/\hat{D})^{0.5} indicated over dominance for eight traits, viz., stem diameter, number of capsules per plant, number of tillers per plant, seed yield per plant, oil content, fibre length, fibre strength and fibre fineness in both F_1 and F_2 generations whereas, days to flower (50%), plant height, technical plant height, days to maturity and fibre yield per plot were found over dominance in F_2 generation only. Days to maturity and fibre yield per plot expressed partial dominance in the F_1 generation and significant \hat{h}^2 for the characters also confirmed the importance of dominance gene action. Similar findings were in agreement to Swarnkar *et al.* (2005) and Polonetskaya *et al.* (2002) for plant height, days to flower, number of capsules per plant and number of tillers per plant. The proportion of genes with positive and negative effect ($\hat{H}_2/4\hat{H}_1$) was lesser compared to the theoretical value (0.25) in both F_1 and F_2 generations for all the characters, indicating that the positive and negative alleles were distributed in a considerable symmetrical manner across the parents.

The proportion of dominant and recessive genes was more than unity for most of the characters in both F_1 and F_2 generations, except for fibre length and strength which showed excess of dominant genes. However, this ratio was lesser than unity for stem diameter in F_1 denoting excess of recessive alleles in the parents.

Table 1. Estimates of genetic parameters \hat{D} , \hat{H}_1 , \hat{H}_2 , \hat{F} , \hat{h}^2 , \hat{E} and related statistics for 13 characters in 10x10 diallel cross of linseed

Genetic parameters and related statistics	Days to 50% flowering		Plant height		Technical plant height		Days to maturity		Stem diameter	
	F ₁	F ₂	F ₁	F ₂	F ₁	F ₂	F ₁	F ₂	F ₁	F ₂
\hat{D}	91.22 ±5.70	91.01** ±6.67	326.95** ±14.71	326.30** ±19.83	245.30** ±8.62	245.12** ±10.59	77.64** ±5.33	77.77** ±3.67	0.09 ±0.11	0.09 ±0.06
\hat{F}	22.32 ±13.15	71.34* ±30.78	21.83 ±33.94	124.43 ±91.50	40.88* ±19.90	103.74* ±48.86	12.79 ±12.30	51.87** ±16.94	-0.12 ±0.26	0.32 ±0.29
\hat{H}_1	66.70** ±12.13	295.93** ±56.80	168.95** ±31.31	737.07** ±168.83	149.90** ±18.36	379.14** ±90.15	47.60** ±11.35	162.29** ±31.25	1.18** ±0.24	2.28** ±0.53
\hat{H}_2	51.31** ±10.31	247.05** ±48.27	134.39** ±26.61	542.07** ±143.49	126.38** ±15.60	327.18** ±76.61	35.61** ±9.65	115.22** ±26.56	0.98** ±0.20	1.83** ±0.45
\hat{h}^2	2.05 ±6.90	40.81** ±8.08	1.30 ±17.81	64.72* ±24.01	33.37** ±10.44	37.15** ±12.82	0.46 ±6.46	22.17** ±4.44	0.28* ±0.14	0.09 ±0.08
\hat{E}	1.10 ±1.72	1.31 ±2.01	1.62 ±4.43	2.27 ±5.98	1.83 ±2.60	2.01 ±3.19	0.50 ±1.61	0.37 ±1.11	0.03 ±0.03	0.03 ±0.02
$(\hat{H}_1/\hat{D})^{0.5}$	0.85	1.80	0.72	1.50	0.78	1.24	0.78	1.44	3.56	4.92
$(\hat{H}_2/4\hat{H}_1)$	0.19	0.21	0.20	0.18	0.21	0.22	0.19	0.18	0.21	0.21
$[(4\hat{D}\hat{H}_1)^{0.5} + F/$ $(4\hat{D}\hat{H}_1)^{0.5} - F]$	1.34	1.56	1.10	1.29	1.24	1.41	1.24	1.60	0.69	2.04
\hat{h}^2/\hat{H}_2	0.04	0.17	0.01	0.12	0.26	0.11	0.01	0.19	0.28	0.05
r	-0.45	0.87	-0.88	-0.08	-0.14	-0.20	0.75	0.70	-0.30	0.58

Table 1 contd.

Genetic parameters and related statistics	No. of capsules/plant		No. of tillers/plant		Seed yield/plant		Oil content		Fibre length	
	F ₁	F ₂	F ₁	F ₂	F ₁	F ₂	F ₁	F ₂	F ₁	F ₂
\hat{D}	504.26** ±53.87	503.52** ±47.85	0.38 ±0.20	0.38 ±0.24	0.92** ±0.14	0.93** ±0.09	1.53 ±0.94	1.54 ±0.74	33.76** ±5.41	33.74** ±2.02
\hat{F}	493.22** ±124.29	1083.73** ±220.81	0.76 ±0.46	1.29 ±1.10	0.57 ±0.31	0.60 ±0.39	0.55 ±2.18	0.76 ±3.43	-30.04* ±12.49	-53.13** ±9.34
\hat{H}_1	718.52** ±114.67	2228.89** ±407.41	1.82** ±0.42	7.78** ±2.04	1.45** ±0.29	4.70** ±0.73	11.84** ±2.01	32.18** ±6.33	55.01** ±11.52	184.04** ±17.23
\hat{H}_2	513.71** ±97.45	1583.36** ±346.25	1.24** ±0.36	5.96** ±1.73	1.20** ±0.25	3.65** ±0.62	11.38** ±1.71	28.38** ±5.38	39.33** ±9.79	127.07** ±14.64
\hat{h}^2	1.17 ±65.23	-0.76 ±57.94	0.49 ±0.24	0.34 ±0.29	1.52** ±0.17	0.90** ±0.10	1.97 ±1.14	0.74 ±0.90	18.23** ±6.55	19.67** ±2.45
\hat{E}	4.43 ±16.24	5.16 ±14.43	0.10 ±0.06	0.10 ±0.07	0.05 ±0.04	0.03 ±0.03	0.08 ±0.28	0.07 ±0.22	0.69 ±1.63	0.71 ±0.61
$(\hat{H}_1/\hat{D})^{0.5}$	1.19	2.10	2.18	4.52	1.26	2.24	2.78	4.56	1.28	2.34
$(\hat{H}_2/4\hat{H}_1)$	0.18	0.17	0.17	0.19	0.21	0.19	0.24	0.22	0.18	0.17
$[(4\hat{D}\hat{H}_1)^{0.5} + F/$ $(4\hat{D}\hat{H}_1)^{0.5} - F]$	2.39	3.09	2.68	2.20	1.66	1.34	1.14	1.11	0.48	0.50
\hat{h}^2/\hat{H}_2	0.002	0.00	0.39	0.06	1.26	0.25	0.17	0.03	0.46	0.15
r	0.59	0.48	0.15	-0.42	-0.51	0.79	-0.41	-0.72	-0.40	-0.09

Table 1 contd.

Genetic parameters and related statistics	Fibre strength		Fibre fineness		Fibre yield/ plot	
	F ₁	F ₂	F ₁	F ₂	F ₁	F ₂
\hat{D}	6.18** ± 1.99	6.22** ± 1.09**	0.42** ± 0.07	0.41** ± 0.04	0.31** ± 0.02	0.31** ± 0.01
\hat{F}	-5.76 ± 4.59	-9.13 ± 5.04	0.20 ± 0.17	0.22 ± 0.17	0.02 ± 0.04	0.17* ± 0.06
\hat{H}_1	36.08** ± 4.23	78.23** ± 9.31	0.57** ± 0.16	1.15** ± 0.32	0.17** ± 0.04	0.57** ± 0.11
\hat{H}_2	28.14** ± 3.60	62.95** ± 7.91	0.50** ± 0.13	1.09** ± 0.27	0.14** ± 0.03	0.41** ± 0.09
\hat{h}^2	56.37** ± 2.41	19.32** ± 1.32	0.80** ± 0.09	0.07 ± 0.05	0.00 ± 0.02	0.01 ± 0.02
\hat{E}	0.81 ± 0.60	0.76** ± 0.33	0.00 ± 0.02	0.01 ± 0.01	0.01 ± 0.01	0.01 ± 0.00
$(\hat{H}_1/\hat{D})^{0.5}$	2.42	3.55	1.17	1.66	0.75	1.35
$(\hat{H}_2/4\hat{H}_1)$	0.20	0.20	0.22	0.24	0.19	0.18
$[(4\hat{D}\hat{H}_1)^{0.5} + F/$ $(4\hat{D}\hat{H}_1)^{0.5} - F]$	0.68	0.66	1.53	1.38	1.08	1.50
\hat{h}^2/\hat{H}_2	2.00	0.31	0.17	0.07	0.00	0.01
r	-0.76	-0.65	-0.44	-0.21	-0.08	0.33

r = Correlation coefficient; * Significant at 5 per cent level; ** Significant at 1 per cent level

The estimated ratio of (\hat{h}^2/\hat{H}_2) was less than unity for most of the characters in F₁ and F₂ generations except seed yield per plant in the F₁ generation. The characters having lesser value than unity indicated that at least one major gene was controlling their inheritance while the characters displaying values higher than unity were governed by more than one major gene. The coefficient of correlation (r) between parental order of dominance (Wr + Vr) and parental measurement (Yr) was negative for most of the characters in both F₁ and F₂ generations. However, it was positive for days to maturity and number of capsules per plant. In F₁ generation, number of tillers per plant and in F₂ generation days to flower, stem diameter, seed yield per plant and fibre yield per plot showed positive "r" values. The positive value of "r" indicated that negative genes were dominant for most of the traits. On the contrary, negative values showed that positive genes were mostly dominant for expression of

these traits. The presence of preponderance of non additive genetic variation for majority of characters may be exploited in breeding programme of linseed.

References

- Comstock RE and HF Robinson (1948) The component of genetic variance in population of bi-parental progenies and their use in estimating the average degree of dominance. *Biometrics* **4**: 254-266.
- Hayman BI (1958) The separation of epistasis from additive mean and dominance variation in generation means. *Heredity* **12**: 371-390.
- Polonetskaya LM, LV Khotyleva, VL Sakovich, LM Polifedova, VF Burdus and VS Bogdan (2002) Diallel analysis of combining ability of fibre flax (*Linum usitatissimum* L. var. *elongata*). *Seryya Biyalagiehnnykh Navuk* **3**: 38-41
- Swarnkar SK, RL Srivastava, P Singh, YP Malik and AL Yadav (2005) Studies on combining ability and heterosis in linseed (*Linum usitatissimum* L.). *Farm Sci. J.* **14(1)**: 4-6.