Electronic Journal of Plant Breeding, 5(1): 120-123 (Mar 2014)
ISSN 0975-928X

Research Note

Estimation of heterosis for seed yield and its attributing traits in linseed (*Linum usitatissimum* L.)

Vikas Pali* and Nandan Mehta
Department of Genetics and Plant Breeding, IGKV, Raipur – 492 012, Chhattisgarh, India
*Email: vikaspali21@gmail.com

(Received:18 Jan 2014; Accepted:12 Mar 2014)

Abstract
Heterosis over better parent (BP) for seed yield and yield components in linseed was studied using line × tester analysis involving ten genetically diverse strains used as lines and four testers. The heterosis over better parent for seed yield plant^{-1} ranged from 48.69 to 552.85 %. Five crosses consistently exhibited significant positive heterobeltiosis for higher seed yield plant^{-1}, viz., RLC-132 × RLC-92, R-4154 × Indira Alsi-32, R-4158 × Deepika, R-4129 × Kartika and RLC-132 × Kartika indicating that these crosses might be useful in linseed hybrid production. These crosses also had significant and positive heterosis for days to 50% flowering, number of capsules plant^{-1} and oil content and would be more desirable to exploit heterosis in linseed.

Key words: Better Parent, Heterosis, Linseed, Line × Tester

Linseed (*Linum usitatissimum* L.) belongs to the genus Linum of the family Linaceae..It is cultivated for the main products viz., fibre (flax fibre) and seed oil (linseed) or both (dual purpose linseed). Recently it has gained a new interest in the emerging market of functional food due to its high content of fatty acids, alpha linolenic acid (ALA), an essential Omega-3 fatty acid and lignin oligomers which constitute about 57 % of total fatty acids in linseed. The commercial exploitation of heterosis led to the remarkable yield advances in several cross pollinated crops. In self pollinated crops, it is now well recognized that heterosis is very useful to increase the productivity. Commercial exploitation of heterosis in linseed is regarded as a breakthrough in the field of linseed improvement for developing hybrids. Development of better hybrids using stable high yielding lines shall raise the yield of this crop. In order to achieve high yielding cross combination, it is essential to evaluate available promising diverse lines and their hybrid combinations for yield and yield components. In the present investigation the objective was to assess the extent of heterosis present in F_1 hybrids and to know the possibility of exploiting heterosis in hybrid breeding programme.

The experimental material comprised of ten promising linseed lines having higher yield and better agronomic characters *viz.*, RLC-122, RLC-132, R-2678, R-4129, R-4140, R-4141, R-4152, R-4154, R-4158 and R-4168. These were crossed with four different testers having broad genetic base and wide adaptability *viz.*, Kartika, Deepika, Indira Alsi-32 and RLC-92 in Line × Tester fashion to generate 40 F_1s. The 40 hybrids were raised , along with the respective parents in a randomized complete block design with three replications during *Rabi*, 2012-13. This experiment was carried out at Research cum Instructional Farm, Department of Genetics and Plant Breeding, College of Agriculture, AICRP on Linseed, I.G.K.V., Raipur, Chhattisgarh. The hybrids and parents were sown in a single row of 3 meter length with inter and intra-row spacing of 30 cm and 10 cm, respectively. All the recommended agronomical package of practices and plant protection measures were followed timely to raise a good crop.

Five plants were selected randomly in each replication from each parent and hybrid and observations were recorded for ten quantitative characters viz., days to 50% flowering, days to maturity, plant height, number of branches plant^{-1}, number of capsules plant^{-1}, number of seeds capsules^{-1}, 1000 seed weight, oil content, harvest index and seed yield plant^{-1}. The mean values were calculated and used for statistical analysis. The data recorded on F_1s were analyzed as per the method suggested by Kempthorne (1957). Heterosis over better parent for all the ten characters was estimated.

The heterobeltiosis for seed yield and its components in linseed are presented in Table 1. Earliness in flowering and maturity is a highly desirable trait in linseed. Hence the crosses exhibiting heterosis in negative direction are of immense value. The hybrid R-4152 × Kartika showed highest negative heterosis for days to 50% flowering (-23.40%) and the cross R-4154 × Indira Alsi-32 showed highest negative heterosis for days to maturity (-15.30%) over better parent. Similarly, negative heterosis for plant height is desirable and it was observed in the cross R-4129 × Kartika (-27.32 %). Significant and positive heterobeltiosis was observed for number of branches plant^{-1} in the crosses RLC-132 × RLC-92, R-4129 × Kartika and R-2678 × Deepika, respectively.

Majority of the crosses showed significantly positive heterobeltiosis for number of capsules plant^{-1} ranging from 45.36 to 288.67 %. Out of them, crosses R-4140 × Kartika, R-4152 × Indira Alsi-32, RLC-122 × Kartika and R-4152 × Deepika were found to have high heterotic values. There were only two crosses *viz.* R-2678 × RLC and R-4140 × Deepika showed significant positive heterobeltiosis for number of seeds capsule^{-1}. The cross RLC-132 × RLC-92 shown the maximum significant positive heterobeltiosis (50.2 %), while highest negative significant heterobeltiosis was observed for the cross R-132 × Deepika (-6.2 %) for 1000 seed weight. Significant and positive heterobeltiosis was observed for oil content in five crosses ranged from 0.56 to 4.40 per cent. The crosses R-2678 × Kartika followed by R-4158 × Deepika and R-2678 × Indira Alsi-32 exhibited higher heterebeltiosis for oil content.

Improvement in seed yield, through heterosis in linseed, was one of the major aims of present investigation. Most of the crosses showed positive heterobeltiosis for seed yield. On an average 32 crosses exhibited significant positive heterobeltiosis, out of them 15 crosses exhibited more than 100% heterobeltiosis. Surprisingly, the values of heterobeltiosis ranging from 48.69 to 552.85 %. Five crosses consistently exhibited high values of heterobetliosis for higher seed yield plant^{-1}, namely RLC-132 × RLC-92, R-4154 × Indira Alsi-32, R-4158 × Deepika, R-4129 × Kartika and RLC-132 × Kartika indicating that these crosses might be useful in linseed hybrid production.

Heterosis for yield was reflected through heterosis in yield components especially number of capsules plant^{-1}confirming the earlier findings of many workers reported high degree of heterosis for seed yield in linseed *viz.* Kansal and Gupta (1981), Singh *et al.* (1983), Dakhore *et al.* (1987), Rao *et al.* (1987), Saraswat *et al*. (1993), Tak and Gupta (1993), Verma and Mahto (1996), Foster *et al.* (1998), Kurt and Evans (1998), and Rede (1999).

The results of the present study indicated that the crosses exhibited high heterotic effect for yield and its important attributes, might possibly be useful in heterosis breeding programmes for further improvement. It could be worth finding out whether superior crosses showing heterosis were also throwing out superior segregants.

References

Dakhore, S.R., Narkhede, M.N. and Khargade, P.W. 1987. Heterosis in relation to combining ability effects in linseed (*Linum usitatissimum* L.). *PKV Res. J*., **11**(1): 7-12.

Foster, R., Pooni, H.S. and Mackay, I.J. 1998. Quantitative analysis of *Linum usitatissimum* L. crosses for dual purpose traits. *J. Agric. Sci*., **131**(1): 285-292.

Kansal, K.K. and Gupta, S.C. 1981. Note on heterosis in linseed. *Indian J. Agric. Sci*., **51**(9): 680-687.

Kempthorne, O. 1957. *An Introduction to Genetic Statistics*, New York, John Wiley and Sons, 1st Edn., pp. 456-471.

Kurt, O. and Evans, G.M. 1998. Genetic basis of variation in linseed (*Linum usitatissimum* L.) cultivars. *Turkish J.Agric. For.,* **22**(4): 373-379.

Rao, S.K., Singh, S.P. and Tawar, M.L. 1987. Heterosis for seed size and oil content in linseed. *J. Oilseeds Res.,* **4**(2): 242-245.

Rede, A.P. 1999. Genetic analysis of yield and yield attributing characters in linseed (*Linum usitatissimum* L.). *M.Sc. Thesis*, IGKV, Raipur, C.G.

Saraswat, A.V., Kumar, S., Kumar, S., Verma, M.M., Virk, D.S. and Chahal, G.S. 1993. Heterosis and inbreeding depression in some early hybrids of linseed. *Heterosis breeding in crop plants- theory and applications*; Short Communications, Symposium; Ludhiana, pp. 52-53.

Singh, R.S., Singh, S. and Chaudhary, R.K. 1983. *Heterobeltiosis in relation to per se performance and effects of general combining ability in linseed* (*Linum usitatissimum* L.). Pre-congress Scientific meeting on genetics and improvement of heterotic systems, TNAU, Coimbatore p. 14.

Tak, G.M. and Gupta, V.P. 1993. Studies on heterosis in linseed. *Indian J. Agri. Res.,* **27**(4): 181-184.

Verma, A.K. and Mahto, J.L. 1996. Hybrid vigour in linseed (*Linum usitatissimum* L.) for yield and its attributes under rainfed and irrigated environments. *J. Tropical Agri.,* **34**(1): 54-57.

Table 1. Heterobeltiosis (%) for seed yield and its components in linseed

Crosses	Days to 50% flowering	Days to maturity	Plant height (cm)	Number of branches plant^{-1}	Number of capsules plant^{-1}	Number of seeds capsule^{-1}	1000 seed weight	Oil content (%)	Harvest index (%)	Seed yield plant^{-1}
RLC-122 × Kartika	-8.21**	-14.08**	20.16**	66.45**	195.38**	-18.39**	-13.6**	-4.01**	19.69	25.54
RLC-122 × Deepika	17.27**	-7.32**	6.36	17.93	167.25**	6.48	15.6**	0.56*	12.91	65.25*
RLC-122 × Indira Alsi-32	3.63	-15.15**	5.50	10.33	58.28**	9.37	25.4**	1.73**	110.35**	112.35**
RLC-122 × RLC-92	-2.76	-1.97*	8.73	33.15	45.36**	-11.27	6.60	-1.49*	15.64	81.67**
RLC-132 × Kartika	18.10**	1.27	-6.43	25.18	65.32**	-1.56	14.8**	-4.13**	179.21**	335.67**
RLC-132 × Deepika	-5.96*	-5.38*	14.30**	23.08	82.34**	-7.35	-6.2*	-5.27**	120.64**	18.35
RLC-132 × Indira Alsi-32	-2.45	0.56	6.67	30.87	25.50	12.96	1.00	-7.50**	-64.51**	140.74**
RLC-132 × RLC-92	-16.14**	-8.22**	31.05**	138.47**	150.52**	-28.36**	50.2**	-3.10**	-45.35**	552.85**
R-2678 × Kartika	0.001	3.74	33.50**	33.64	141.36**	-3.65	3.50	4.40**	-51.34**	92.57**
R-2678 × Deepika	-9.75**	-4.53*	7.12	102.75**	71.07**	10.62	-11.5**	-8.63**	-9.11	180.57**
R-2678 × Indira Alsi-32	0.001	2.14	5.10	23.74	288.67**	14.71	-13.9**	2.89**	280.34**	130.58**
R-2678 × RLC-92	-2.57	0.63	-2.74	-8.54	21.35	18.75**	12.40	-4.42	74.75**	52.85*
R-4129 × Kartika	-14.55**	-8.22*	-27.32**	39.54	138.58**	-2.94*	36.7**	-1.70**	23.69	360.22**
R-4129 × Deepika	-2.65	0.28	4.32	27.58	17.68	0.93	4.90	-3.35**	41.35*	90.23**
R-4129 × Indira Alsi-32	2.64	-9.27**	-0.80	-20.30	48.23**	-17.57**	18.4**	-4.27**	78.95**	80.24**
R-4129 × RLC-92	-13.25**	-9.55**	5.58	13.10	67.25**	-0.52	0.80	-0.72*	85.64**	150.86**
R-4140 × Kartika	-12.44**	-14.75**	17.7**	124.89**	260.15**	-14.16	8.00	-6.00	90.65**	85.65**
R-4140 × Deepika	-2.87	-0.28	3.90	2.20	33.45	18.35**	-11.7**	-5.98**	65.16**	170.65**
R-4140 × Indira Alsi-32	3.75	-5.89*	-2.70	15.50	158.67**	15.23	5.00	-7.35**	-34.20**	65.12**
R-4140 × RLC-92	-2.70	0.78	-0.10	32.35	67.23**	-1.77	0.65	-3.85**	-10.35	85.24**
R-4141 × Kartika	-20.9**	12.47**	-10.7**	16.58	54.22**	0.68	-31.0**	-9.90	98.36**	97.65**
R-4141 × Deepika	1.90	-8.22**	18.36**	22.67	23.67	3.58	7.12	-8.25**	18.95	86.23**

*, ** Significant at 5% and 1% level, respectively

Electronic Journal of Plant Breeding, 5(1): 120-123 (Mar 2014)
ISSN 0975-928X

Table 1. contd..

Crosses	Days to 50% flowering	Days to maturity	Plant height (cm)	Number of branches plant^{-1}	Number of capsules plant^{-1}	Number of seeds capsule^{-1}	1000 seed weight	Oil content (%)	Harvest index (%)	Seed yield plant^{-1}
R-4141 × Indira Alsi-32	-11.60	0.24	3.80	-9.78	30.15	6.52	8.63	-7.66**	35.12*	22.14
R-4141 × RLC-92	-7.90**	12.12**	9.56*	43.85	78.26**	6.21	2.35	-9.27**	12.57	7.40
R-4152 × Kartika	-23.40**	0.58	2.50	21.57	67.26**	8.75	-0.60	-9.51**	19.69	58.57*
R-4152 × Deepika	-10.90**	5.38*	6.76	7.14	185.25**	-7.65	1.26	-8.61**	70.25**	70.54**
R-4152 × Indira Alsi-32	-11.00**	0.67	18.8**	6.50	234.38**	-18.39**	8.35	-7.09**	87.58**	10.28
R-4152 × RLC-92	-10.40*	-11.28**	4.32	3.70	88.23**	6.57	18.5**	-6.71**	26.50	25.61
R 4154 × Kartika	14.20**	0.87	-3.00	51.35*	15.57	-3.20	21.54**	-2.55**	220.35**	65.37**
R-4154 × Deepika	-13.20	-15.10**	4.80	-4.35	20.18	7.59	7.65	-4.87**	91.50**	94.40**
R-4154 × Indira Alsi-32	15.40**	-15.3**	-23.36**	13.21	104.58**	11.23	17.5**	-2.75**	25.67	412.65**
R-4154 × RLC-92	-4.10*	3.15	-14.35**	31.70	94.36**	-2.56	2.50	-3.72**	150.35**	39.90
R-4158 × Kartika	31.50**	2.89	0.58	9.09	29.75	-3.68	3.70	-1.60*	-14.04*	29.80
R-4158 × Deepika	-9.80**	11.2**	30.90**	8.65	84.78**	13.54	-0.90	2.95**	22.67	385.75**
R-4158 × Indira Alsi-32	7.87*	1.16	3.40	-11.35	62.34**	-6.65	5.60	-5.69	115.94**	56.70*
R-4158 × RLC-92	0.40	2.74	-1.72	17.78	32.54	0.95	12.54*	-3.50**	-9.11	124.90**
R-4168 × Kartika	-4.50**	6.36*	-1.21	-47.68**	78.25**	-12.35*	3.50	-1.09*	97.35**	132.60**
R-4168 × Deepika	-3.50**	2.75	7.58	2.50	5.80	9.35	-11.8**	-3.99**	72.28**	48.69*
R-4168 × Indira Alsi-32	-5.90	5.35*	0.20	35.47	24.16	8.47	5.20	-4.17**	125.64**	142.60**
R-4168 × RLC-92	-3.70	3.16	-8.50*	-34.86**	94.60**	-6.58	-6.75*	-0.96*	80.35**	106.30**
SE(sij)	2.13	1.85	3.42	2.36	6.74	0.79	0.55	0.45	2.89	0.78

*, ** Significant at 5% and 1% level, respectively