HETEROSIS AND COMBINING ABILITY FOR YIELD AND YIELD COMPONENTS IN LINSEED *(LINUM USITATISSIMUM* L.)

J.P. Meena[1], H.R. Verma[2] and M.A. Shah[3]

Department of Plant Breeding & Genetics
Maharana Pratap University of Agriculture & Technology, Udaipur-313 001 (Raj.), India
Email: rajeshpatho@gmail.com

Abstract: Five linseed genotype namely KL-31, LCK-9216, LMH-16-5, Bellinka and Viking were crossed in a diallel fashion. The ten F_1 hybrids along with their five parents were sown in RBD with two replications in each of two environments *viz*, E_1 (Normal irrigation) and E_2 (limited irrigation). Analysis of variance indicated that significant variability was present among parents and hybrids in individual as well as pooled over the environment.

The highest heterotic cross was LMH-16-5 x Bellinka (77.55) followed by Kl-31 x Bellinka (44.79), LCK-9216 x Bellinka (27.87) and Bellinka x Viking (11.08). Their performance was consistent in individual as well as pooled over both the environment for seed yield and its contributing characters. In combining ability analysis, the magnitude of gca variance was higher than sca variance for all the characters, indicating preponderance of additive gene effects for these traits. Parents, KL-31, LMH-16-5 and LCK-9216 were good general combiner for seed yield and one or more other characters. Hybrids, LMH-16-5 x Bellinka, KL-31 x Bellinka and LCK-9216 x Bellinka exhibited high sca effects for seed yield and one or more other characters. These hybrids also exhibited higher magnitude of heterosis, heterobeltiosis and high mean performance. These crosses could be utilized for exploitation of heterosis and transgressive segregants.

Keywords: Heterosis, Combining ability, Environment, Genetic effects

INTRODUCTION

Linseed *(Linum usitatissimum* L.) is one of the most important oilseed crops grown during *rabi* season and generally cultivated on marginal lands with minimum input. Looking to various industrial applications of its oil and its cultivation by marginal farmers, a great need has arisen to develop the linseed genotype adapted to limited moisture condition. Heterosis breeding could be potential alternative for achieving quantum jump in production and productivity as commercial exploitation of heterosis in several crop plants has caused a major breakthrough in yield level. The heterosis component is largely depended on diverse parents with high degree of specific combining ability (gca). In practical heterosis breeding it is necessary to select combinations with high degree of specific combining ability (sca) as well as parents with high gca. The present study was under taken to select the parents for effective hybridization programme as well as for getting superior cross combination.

MATERIAL AND METHOD

Five linseed genotypes namely KL-31, LCK-9216, LMH-16-5, Bellinka and Viking were crossed in a diallel fashion. The ten F_1 hybrids along with their five parents were sown in RBD with two replications in each of two environments *viz*, E_1 (Normal irrigation) and E_2 (limited irrigation) at experimental farm of Rajasthan college of agriculture, Udaipur. Observation were recorded on five randomly selected plants in parents and F_1 hybrids for character days to flowering, days to maturity, plant height, number of primary branches per plant, number of capsules per plant, number of seeds per capsule, 1000-seed weight, biological yield per plant, harvest index and oil content in seed (%). The recorded were subjected to statistical analysis to estimate heterosis (Turner 1953) and combining ability analysis was carried out as per Griffing (1956) and Singh (1973 and 1979).

RESULT AND DISCUSSION

In the analysis of variance, mean sum of square due to genotype and it's partitioning into parents, hybrids and parents v/s hybrids were highly significant for all the characters except for number of seeds per capsule for parent v/s hybrids in both E_1 and E_2 environments. In the pooled analysis, mean square due to parent x environment, hybrids x environment and parents v/s hybrids x environment were significant for all the characters.

The highest heterotic cross was LMH-16-5 x Bellinka (77.55) followed by Kl-31 x Bellinka (44.79), LCK-9216 x Bellinka (27.87) and Bellinka x Viking (11.08). Their performance was consistent in individual as well as pooled over the environment for seed yield and its contributing characters *viz*., number of capsule per plant, number of seed per capsule,1000-seed weight, harvest index, number of primary branches per plant. For oil content in seed, only one hybrid LCK-9216 x KL-31 exhibited

[1] M.Sc., Department of Plant Breeding & Genetics, Rajasthan College of Agriculture, MPUAT, Udaipur, 313001
[2] Ph.D., Department of Plant Breeding & Genetics, Rajasthan College of Agriculture, MPUAT, Udaipur, 313001
[3] Professor, Department of Plant Breeding & Genetics, Rajasthan College of Agriculture, MPUAT, Udaipur

significant positive heterosis (2.32).

Hybrid LMH-16-5 x Bellinka exhibited significant positive heterobeltiosis for seed yield in both E_1 and E_2 environments, while economic heterosis in E_2 environment only. However the other three hybrid *viz.*, K-31 x Bellinka, LCK-9216 x Bellinka and LCK-9216 x Bellinka had significant and positive heterobeltiosis as well as economic heterosis in E_2 environment only. Of these, Kl-31 x Bellinka exhibited heterobeltiosis and economic heterosis for 1000-seed weight as well as for harvest index while LCK-9216 x Bellinka had exhibited heterobeltiosis and economic heterosis for number of capsule per plant and biological yield. These results for heterobeltiosis for various traits were in agreement with Makhija (1974), Patil and Chopde (1983), Dubey and Dixit (1991) and Mishra and Rai (1993[1]), while the results for economic heterosis for various traits were in agreement with Rao and Singh (1983) and Singh *et al.* (1987).

Analysis of variance for combining ability revealed importance of both additive as well as non additive gene action in the inheritance of the entire attribute studied. The magnitude of gca variance was higher than sca in both the environment as well as over the environment for all the characters, indicating preponderance of additive gene effects for these traits. Interaction effect gca x environment and sca x environment were significant for all the traits. Importance of additive effects for various traits studied were also reported by Badwal *et al.* (1972) and Dubey and Dixit (1991).

Out of five parents, KL-31, LCK-9216 and LMH-16-5 were good general combiners for seed yield in both the environments. Of these, KL-31 and LMH-16-5 were good general combiners for 1000-seed weight, number of capsule per plant, biological yield and earliness too in both the environments. The other good combiner, LCK-9216 exhibited good general combining ability for seed yield per plant, harvest index and seed oil contents.

Estimate of sca effects for seed yield revealed that out of ten crosses LMH-16-5 x Bellinka, KL-31 x Bellinka and LCK-92 x Bellinka exhibited significant and positive sca effects consistently under both the environment. All these crosses are of H x L type in E_2 environment, involving in comman Bellinka, and an exotic line for good fiber quality. Regarding seed oil content hybrid LCK-9212 x KL-31, KL-31 x LMH-16-5 and LMH-16-5 x Viking has sown significant specific combining ability effects in both the environments. Desirable combining ability also reported by Singh and Singh (1979) and Mishra and Rai (1993[2]).

Based on the present studies, three hybrid LMH-16-5 x Bellinka, KL-31 x Bellinka and LCK-9216 x Bellinka all H x L type combinations with high *per se* performance, high heterosis, high sca effects for seed yield and others related traits were promising and they could be utilized in exploiting commercial heterosis as well as getting desirable segregants in advanced generations (Table-1).

Table 1: Performance of three promising hybrids and their parents with respect to their per se, gca/sca effects and heterotic response

	Genotype	Seed Yield/ plant		No. of capsule/ plant		No. of seed/ capsule		1000-seed weight (g)		Biological yield/plant		Harvest index		Seed oil content	
		E1	E2	E1	E2	E1	E2	E1	E2	E1	E2	E1	E2	E1	E2
Per se performance	LMH-16-5 x Bellinka	11.53	10.73	177.00	162.50	7.50	7.11	8.21	8.41	24.75	21.75	46.56	49.35	35.54	35.86
	KL-31 x Bellinka	10.74	10.39	133.50	138.00	6.20	8.12	9.39	9.41	20.08	18.75	53.49	52.88	36.86	34.41
	KL-31 x LMH-16-5	9.28	8.37	189.00	165.00	6.17	6.53	7.72	7.75	23.70	20.45	39.14	40.94	39.28	40.38
GCA	Kl-31	+	+	+	+	-	-	+	+	-	+	+	+	+	+
	LMH-16-5	+	+	+	+	-	-	+	+	+	+	-	0	-	-
	LCK-9216	+	+	-	-	0	+	+	+	+	-	+	0	+	+
SCA	LMH-16-5 x Bellinka	+	+	+	+	+	+	+	+	+	+	+	+	-	-
	KL-31 x	+	+	-	-	-	+	+	+	-	-	+	+	-	-

	Bellinka														
	KL-31 x LMH-16-5	-	+	+	+	0	0	-	-	+	0	-	+	+	0
Heterosis	LMH-16-5 x Bellinka	+	+	+	+	+	+	+	+	+	+	+	+	-	-
	KL-31 x Bellinka	+	+	-	+	0	+	+	+	-	-	+	+	-	-
	KL-31 x LMH-16-5	-	+	+	+	0	0	-	-	+	-	-	+	0	0
Heterobeltiosis	LMH-16-5 x Bellinka	+	+	+	+	+	+			+	+	+	+		
	KL-31 x Bellinka		+		+		+	+	+			+	+		
	KL-31 x LMH-16-5		+	+	+		0			0			+		
Economic Heterosis	LMH-16-5 x Bellinka		+	+	+					+			+		
	KL-31 x Bellinka		+		+			+	+				+		
	KL-31 x LMH-16-5		+	+	+					0			+		

+ = Positive significant **-** = Negative significant 0 = Non significant

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REFERENCES

Anand, I.J. and Murty, B.R. (1969a). Serial analysis of combining ability in diallel and fractional diallel crosses in linseed. *TAG.*39: 88-94.

Badwal, S.S. Gupta, V.P. and Gill, K.S. (1972). Combining ability studies of selected world germplasm line of linseed. *J .Res PAU.* 9**:** 383-388.

Dhakar, J.M. (1994). Studies on heterosis, Combining ability and stability parameters in linseed (*Linus usitatissimum* L.). Ph.D. Thesis, RCA, RAU, Udaipur.

Dubey, C.S. and Dixit, P.K. (1991[2]). Combining ability in linseed. *J.T.C.I.* 1(1) :40-50.

Makhija, O.P. (1974). General studies of quantitative characters in linseed (*Linus usitatissimum* L.). Ph.D. Thesis, I.A.I.R., New Dehli.

Mishra, V.K. and Rai, M. (1993[1]). Estimate of heterosis for seed yield, components of seed and oil in linseed (*Linus usitatissimum* L.) *Indian J. Genet*., 52(2):161-164.

Mishra, V.K. and Rai, H. (1993[2]). Combining ability analysis for seed yield and quality components of seed and oil in linseed (*Linus usitatissimum* L.) *Indian J. Genet*., 56(2):155-161.

Patil, V.D. and Chopde, P.R. (1983). Heterosis in relation to general specific combining ability effects in linseed. *Indian J. Genet.*, 43(2): 226-228.

Rai, M. and Das, K. (1974). Combining ability for components of yield in linseed. *Indian J. Genet.,* 35: 462-466.

Roa, S.K. and Singh,S.P. (1983). Heterosis and inbreeding depression in linseed. *indian J. Agric. Sci.,* 53(60): 409-417.

Singh, K.P. and Singh, H.G. (1979). Combining ability analysis for quantitative traits in linseed. *Indian J. Agric. Sci.*, 49(8): 573-578.

Singh, P., Shrivastava, A.N., Singh, I.B. and Mishra, I. (1987a). Heterosis and inbreeding depression in relation to per se performance in linseed. *Farm. Sci. J.,* 2**(1): 68-73.**