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Study on combining ability for growth, yield and quality characters of Indian mustard

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Abstract
The study was conducted with objective to know the general and specific combining ability effects in F_1 and F_2 generations of hybrids obtained through diallel mating of 10 parents excluding reciprocals. The present study revealed that the The parents Ashirwad and Vardan proved to be best general combiners for twelve characters namely, days to 50 % flowering, length of main raceme, leaf area index, number of secondary branches, days to maturity, plant height, number of siliquae per plant, number of seed per siliquae, 1000-seed weight and oil content in general most of the parents maintained their superiority in both the generations and produced comparable estimates of gca effects. MK (L) 13-306 × MK (L) 13-301, MK (L) 13-310 × MK (L) 13-308, MK (L) 13-307 × MK (L) 13-308, Ashirwad × MK (L) 13-301 and MK (L) 13-304 × MK (L) 13-303, MK (L) 13-306 × MK (L) 13-301 in both the generations had desirable significant sca effects which are indicative of the presence of additive x additive interaction effects.

Keywords: Indian mustard, yield, general combining ability and specific combining ability

Introduction
India annually produces 6-8 million tonnes of mustard seed and ranks third in the world in production, having a market share of 11 per cent. It is one of the major sources of oil and oil meal in India. Mustard oil is traditionally the most important oil for the Northern, Central and Eastern parts of the country. Major mustard producing states in the country are Rajasthan, accounting more than 47% of its production followed by Uttar Pradesh, Haryana, Madhya Pradesh and Gujarat. The average area, production and productivity of rapeseed-mustard in the world was 33.63 million ha, 69.33 million tonnes and 2060 kg/ha, respectively in 2015-16 (USDA Circular series- 2018). In India the area, production and productivity of rapeseed-mustard was 5.74 million ha, 7.79 million tonnes and 1183 kg/ha, respectively during the 2015-16 (Ministry of Agriculture, GOI). Rapeseed and mustard is a major oil seed crop in Uttar Pradesh, with 0.63 million hectare area and 0.58 million tonnes production at the productivity 930 kg/hectare in 2014-15, contributing 10.79 percent area and 9.27% production of India (Directorate of Economics & Statistics, DAC&FW).
The seed and oil are used as condiments in the preparation of pickle and for flavour carrying out vegetables. The oil is utilized for human consumption throughout northern India in cooking and frying purposes. It is also used in the preparation of hair oil and medicine. It is used in soap making in mixture with mineral oils for lubrication. The oil cake is used as a cattle feed and manure. Green stems and leaves are a good source of green fodder for cattle. The leaves of young plants are used as green vegetables as they supply enough sulphur and minerals in the diet. In the tanning industry, mustard oil is used for softening of the leather.

Materials and Methods
The material for the present investigation consisted of Ten varieties/genotypes of Indian mustard, [*Brassica juncea* (L.)] which were selected on the basis of variability for various characters available in genetic material maintained in the selection of oil seeds, Department of Genetics and plant Breeding, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur-(UP).
Ten genetically diverse genotypes namely MK (L) 13-304, MK (L) 13-306, MK (L) 13-310, MK (L) 13-307, Ashirwad, MK (L) 13-308, MK (L) 13-301, Vardan, MK (L) 13-303 and MK (L) 13-305 using in a diallel set were crossed with each other (excluding reciprocals) in all the possible combinations to produce sufficient F_1 seeds of 45 crosses.

Testing of progenies along with parents

100 genotypes (10 parents, their 45 F_1's and 45 F_2's) were sown in Randomized Block Design with three replications during *Rabi* 2016-17. Each treatment was planted in one row, of 5 m length and 45 cm apart, Plant to plant distance was maintained 15 cm by thinning. All the recommended agronomic practices were adopted for raising a good crop at Oil seed Research Farm of C. S. Azad University of Agriculture & Technology, Kanpur-208002 (UP).

Results and Discussion

Combining ability analysis

Selection of parents is an important step for planning an appropriate hybridization programme. The combining ability analysis furnishes useful information of this aspect. Knowledge of the relative importance of additive and non additive gene action is essential to a plant breeder. The per se performance, gca and sca effects determine the potentiality of parents/crosses for mobilizing them in an efficient breeding programme.

The gca and sca variances were highly significant both in F_1 and F_2 generations of the present study for all the characters except days to 50 % flowering in both the generation and leaf area index, primary branches, secondary branches and seeds per silquae in F_1 generation, which revealed that additive as well as non additive genetic effects were involved in the expression of these traits (Table-1). However, additive effects were predominant for all the characters. Both gca and sca variances were found significant by Khulbe *et al.,* 1998 [1]; Prasad *et al.*, 2002 [2]; Sachan, 2003 [3]; Sharma *et al.*, 2004 [4]; Arifullah *et al*., 2012 [13]; Singh *et al*., 2013 [5]; Lal *et al*., 2013 [12] and Dholu *et al*., 2014 [14].

The *per se* performance of parents was compared with their gca effects in F_1 and F_2 generations for all the characters under study. It was concluded that the parents having best *per se* performance were proved to be the best general combiners for all the characters. Singh *et al.,* 1996 [6]; Khulbe *et al.,* 1998 [1], Sheikh and Singh, 1998 [9]; Prasad *et al.,* 2002 [2]; Singh *et al.,* 2003, Singh and Lallu 2004 [8] found similar results. It may be noted that if the character is uni-directionally controlled by a set of alleles and additive effects are important, the choice of parents on the basis of *per se* performance in most of the cases may be adequate but the choice of parents on the basis of phenotypic performance alone is not a sound procedure since phenotypically superior lines may yield poor recombinants in the segregating generation. It is therefore, essential that parents should be selected based on their combining ability estimates were non-allelic interactions are important.

On the basis of *per se* performance and gca effects (Table-1), the good general combiners common in both F_1 and F_2 generations were Ashirwad, MK (L) 13-310 and Vardan for days to 50 % flowering, for days to maturity parents *viz.*, Vardan and MK (L) 13-301 for plant height parents *viz.,* MK (L) 13-310, MK (L) 13-306 and Vardan, for length of main raceme, MK (L) 13-305, Ashirwad and Vardan, for leaf area index Vardan, MK (L) 13-304 and Ashirwad, for number of primary branches, Ashirwad and Vardan for number of secondary branches Ashirwad, MK (L) 13-303, for number of siliquae per plant MK (L) 13-306, Ashirwad, Vardan, for number of seeds per siliquae Vardan and MK (L) 13-310, for biological yield per plant MK (L) 13-303, MK (L) 13-304 and Ashirwad, for 1000-seed weight Ashirwad, Vardan and MK (L) 13-310, for harvest index Ashirwad, Vardan, MK (L) 13-310, for seed yield per plant Ashirwad, Vardan and MK (L) 13-304, for oil content MK (L) 13-301, MK (L) 13-305 and Ashirwad and for protein content Ashirwad, Vardan and MK (L) 13-304. The consistency of combiners was stable. Stability for the important traits has been described as one of the important needs for breeding objectives.

Parents Ashirwad and Vardan were good general combiner for twelve characters, MK (L) 13-310 was good general combiner for five characters, MK (L) 13-304 was good general combiners for four characters. The parents Ashirwad and Vardan proved to be best general combiners for twelve characters namely, days to 50 % flowering, length of main raceme, leaf area index, number of secondary branches, days to maturity, plant height, number of siliquae per plant, number of seed per siliquae, 1000-seed weight and oil content in general most of the parents maintained their superiority in both the generations and produced comparable estimates of gca effects.

The gca effects which included additive and additive x additive interactions (Griffing, 1956 b and Sprague, 1966) [17, 10] represent fixable genetic variance (Gilbert, 1967) [16]. The additive parental effects measured by gca effects are of practical use. On the other hand, sca effects representing dominance and epstatic components would not contribute much to the improvement of often cross-pollinated crops except in cases where commercial exploitation of heterosis is feasible. The crosses involving good general combiners having high sca effects may be utilized for further breeding purpose. Desirable transgressive segregants are also expected to be produced by making a large number of crosses. Jinks and Jones (1958) [19] further suggested that the superiority of many hybrids may not indicate their ability to produce transgressive segregants due to non-fixable genetic effects. Therefore, study of sca effects in segregating generations would be important.

For seed yield per plant, five cross combinations in F_1 and ninteen in F_2 generation were found desirable with significant sca effects. Relatively higher estimates of sca effects were usually recorded in those crosses which involved diverse interacting parents. Bhateria *et al.*, 1995 [18], Singh *et al.*, 1996 [6]; Sheikh and Singh, 1998 [9], Lal *et al.*, 2012 also reported corroborative findings.

MK (L) 13-306 × MK (L) 13-301, MK (L) 13-310 × MK (L) 13-308, MK (L) 13-307 × MK (L) 13-308, Ashirwad × MK (L) 13-301 and MK (L) 13-304 × MK (L) 13-303, MK (L) 13-306 × MK (L) 13-301 in both the generations had desirable significant sca effects which are indicative of the presence of additive x additive interaction effects. Similar results were also reported by Ghosh and Gulati, 2002 [15].

Table 1: Estimate of general combining ability effects and corresponding mean performance of parents in a 8x8 diallel cross for 12 characters in F_1 and F_2 generation of Indian mustard

Parents	Days to 50 % Flowering			Days to Maturity			Plant Height (cm)			Length of Main Raceme (cm)			Leaf Area Index (cm^2)		
	F_1	F_2	M	F_1	F_2	M	F_1	F_2	M	F_1	F_2	M	F_1	F_2	M
MK(L) 13-304	3.32**	3.41**	58.33	0.05	0.08	125.33	-3.49**	-3.67**	158.67	-5.20**	-5.37**	58.33	0.43**	0.45**	3.86
MK(L) 13-306	0.37**	0.29	51.33	1.49**	1.52**	127.00	-2.30**	-2.37**	159.33	-1.62**	-1.59**	65.33	-0.18**	-0.16**	2.66

MK(L) 13-310	-4.93**	-4.76**	40.67	1.30**	1.58**	126.33	-4.02**	-3.89**	156.33	-1.03**	-0.98**	65.00	0.04	0.06	3.10
MK(L) 13-307	4.18**	4.13**	59.33	0.58*	0.16	124.67	-0.66*	-0.48*	163.00	-2.59**	-1.98**	63.33	-0.51**	-0.54**	1.98
Ashirwad	-5.13**	-5.12**	40.33	-0.31	-0.76**	124.00	-3.24**	-3.62**	158.33	2.58**	2.85**	72.67	0.28**	0.24**	3.52
MK(L) 13-308	-0.02	-0.04	51.00	0.86**	1.38**	126.67	0.48	0.69**	165.67	1.66**	1.49**	70.67	-0.05	-0.13**	2.84
MK(L) 13-301	0.93**	0.88**	52.00	-0.98**	-1.01**	122.33	3.67**	3.83**	172.67	1.08**	0.77**	68.67	-0.02	0.02	2.58
Vardan	-5.10**	-5.15**	41.33	-4.42**	-4.51**	119.00	-1.61**	-1.95**	161.00	1.44**	1.71**	71.33	0.61**	0.71**	4.33
MK(L) 13-303	2.51**	2.54**	55.67	-0.31	-0.14	123.67	4.48**	4.49**	174.67	1.52**	1.04**	71.33	-0.27**	-0.34**	2.56
MK(L) 13-305	3.87**	3.82**	58.00	1.74**	1.69**	127.67	6.70**	6.97**	179.33	2.16**	2.07**	73.33	-0.33**	-0.31**	2.19
SE(gi) ±	0.66	0.72		0.60	0.50		0.65	0.54		0.51	0.45		0.13	0.13	

*, ** significant at 5 and 1 per cent level, respectively

Table 1: Contd….

Parents	Primary Branches/ Plant			Secondary Branches/ Plant			Siliquae/ Plant			Seeds/ Siliqua			Biological Yield/ Plant (gm)		
	F_1	F_2	M	F_1	F_2	M	F_1	F_2	M	F_1	F_2	M	F_1	F_2	M
MK(L) 13-304	-0.51**	-0.49**	6.33	-1.65**	-1.58**	v	3.65**	2.86**	319.67	-0.46**	-0.32**	12.33	1.94**	2.22**	52.67
MK(L) 13-306	-0.84**	-0.63**	5.67	0.29	0.09	15.67	7.76**	6.64**	327.67	-0.07	-0.09	13.33	-1.89**	-2.03**	44.33
MK(L) 13-310	-0.31	-0.52**	6.67	0.32	0.23**	14.67	-12.54**	-11.97**	284.00	0.38*	0.38**	14.00	-2.39**	-2.45**	43.33
MK(L) 13-307	0.19	-0.04	7.67	0.10	0.03	15.00	-5.63**	-4.92**	304.67	-0.40**	-0.62**	12.33	0.14	-0.31*	48.00
Ashirwad	0.83**	1.01**	8.67	0.71**	0.92**	16.33	17.07**	21.44**	325.33	0.18	0.41**	13.33	1.44**	2.19**	50.33
MK(L) 13-308	-0.48**	-0.46**	6.00	0.02	-0.08	15.00	0.09	-0.78*	311.67	-0.40**	-0.43**	12.67	-0.47**	-0.73**	46.67
MK(L) 13-301	-0.26	-0.21	6.33	-0.59**	-0.52**	13.33	-14.66**	-15.39**	274.33	0.13	0.16	12.67	0.00	-0.06	47.00
Vardan	0.69**	0.82**	8.33	0.27	0.56**	15.33	6.57**	7.92**	320.67	0.54**	0.82**	14.33	0.69**	1.05**	48.67
MK(L) 13-303	0.22	0.15	8.00	0.60**	0.53**	15.67	-0.21	-2.28**	315.67	0.10	-0.12	13.67	4.03**	3.61**	57.00
MK(L) 13-305	0.47**	0.37	8.33	-0.07	-0.19	14.67	-2.10**	-3.53**	303.00	-0.01	-0.18	13.00	-3.50**	-3.48**	40.33
SE(gi) ±	0.38	0.30		0.43	0.34		0.60	0.83		0.40	0.31		0.47	0.43	

*, ** significant at 5 and 1 per cent level, respectively

Table 1: Contd….

Parents	1000- Seed Weight (gm)			Harvest Index (%)			Seed Yield/ Plant (gm)			Oil Content (%)			Protein Content (%)		
	F_1	F_2	M	F_1	F_2	M	F_1	F_2	M	F_1	F_2	M	F_1	F_2	M
MK(L) 13-304	-0.16**	-0.13**	3.39	-0.74**	-0.54**	24.59	0.27**	0.27**	13.24	0.00	-0.05	38.89	0.64**	0.73**	24.52
MK(L) 13-306	-0.21**	-0.13**	3.13	0.69**	0.59**	28.11	-0.13*	-0.14**	12.26	-0.95**	-0.87**	36.81	-0.82**	-0.85**	21.77
MK(L) 13-310	0.21**	0.22**	4.00	1.36*	1.31**	30.53	0.19**	0.21**	12.62	0.04	-0.10**	38.18	-0.73**	-0.76**	22.04
MK(L) 13-307	-0.33**	-0.40**	3.02	-2.00**	-1.99**	23.34	-0.93**	-1.04**	10.63	-1.11**	-1.04**	36.69	0.09**	0.09**	23.68
Ashirwad	0.45**	0.52**	4.33	2.60**	2.89**	30.05	0.89**	0.91**	14.28	0.63**	0.74**	39.52	0.76**	0.86**	25.11
MK(L) 13-308	-0.05**	-0.06**	3.55	-0.56**	-0.66**	25.74	-0.20**	-0.06	11.60	-0.36**	-0.35**	37.81	-0.86**	-0.94**	21.36
MK(L) 13-301	0.15**	0.05**	3.68	-0.20	-0.32**	26.50	0.24**	0.07	12.19	1.49**	1.47**	40.98	0.35**	0.29**	24.08
Vardan	0.27**	0.39**	4.07	1.13**	1.41**	29.08	0.53**	0.56**	13.69	0.27**	0.39**	38.89	0.94**	1.15**	24.87
MK(L) 13-303	-0.27**	-0.39**	2.97	-2.14**	-2.26**	22.74	0.01	0.25**	12.82	-1.00**	-0.99**	36.71	0.07*	-0.15**	23.48
MK(L) 13-305	-0.07**	-0.08**	3.43	-0.13	-0.42**	26.43	-0.87**	-1.03**	10.22	1.00**	0.78**	40.06	-0.44**	-0.40**	22.78
SE(gi) ±	0.01	0.03		0.25	0.22		0.14	0.14		0.12	0.07		0.09	0.07	

*, ** significant at 5 and 1 per cent level, respectively

Table 2: Estimates of specific combining ability effects and corresponding mean performance of the crosses for 12 characters in a10 x10 diallel cross in F_1 and F_2 generation of Indian Mustard

S. No.	Crosses	Days to 50 % Flowering				Days to Maturity				Plant Height (cm)			
		F_1		F_2		F_1		F_2		F_1		F_2	
		S.C.A	Mean	S.C.A	Mean	S.C.A	Mean	S.C.A	Mean	S.C.A	Mean	S.C.A	Mean
1	MK(L) 13-304 × MK(L) 13-306	0.57	54.33	1.50*	57.00	0.03	124.33	-0.70	123.67	0.29	157.67	-0.30	157.00
2	MK(L) 13-304 × MK(L) 13-310	-0.13	48.33	1.22	51.67	-0.11	124.00	0.25	124.67	0.34	156.00	0.89	156.67
3	MK(L) 13-304 × MK(L) 13-307	0.09	57.67	-0.33	59.00	0.94	124.33	1.00	124.00	-1.35	157.67	-0.86	158.33
4	MK(L) 13-304 × Ashirwad	-0.60	47.67	0.25	50.33	0.16	122.67	-1.09*	121.00	0.90	157.33	-0.05	156.00
5	MK(L) 13-304 × MK(L) 13-308	-0.05	53.33	0.17	55.33	-1.00	122.67	-0.89	123.33	-1.83*	158.33	-1.02	159.33
6	MK(L) 13-304 × MK(L) 13-301	0.01	54.33	0.58	56.67	-0.84	121.00	-0.17	121.67	-2.02**	161.33	-1.16	162.33
7	MK(L) 13-304 × Vardan	-0.96	47.33	-1.39	48.67	-3.06	115.33	2.34**	116.00	2.26**	160.33	1.62	159.33
8	MK(L) 13-304 × MK(L) 13-303	-0.24	55.67	-0.42	57.33	-1.17	121.33	-2.03**	120.67	-0.83	163.33	-1.16	163.00
9	MK(L) 13-304 × MK(L) 13-305	-1.93*	55.33	-1.03	58.00	0.11	124.67	1.14	125.67	-2.71**	163.67	-3.30**	163.33
10	MK(L) 13-306 × MK(L) 13-310	0.15	45.67	-0.33	47.00	-0.22	125.33	0.14	126.00	1.48*	158.33	2.92**	160.00
11	MK(L) 13-306 × MK(L) 13-307	0.04	54.67	0.11	56.33	0.50	125.33	0.55	125.00	0.45	160.67	1.17	161.67
12	MK(L) 13-306 × Ashirwad	0.01	45.33	1.36	48.33	-0.28	123.67	-0.53	123.00	-0.30	157.33	0.31	157.67
13	MK(L) 13-306 × MK(L) 13-308	-0.77	49.67	-1.06	51.00	-0.11	125.00	0.33	126.00	1.31	162.67	-0.33	161.33
14	MK(L) 13-306 × MK(L) 13-301	-1.05	50.33	-1.31	51.67	0.05	123.33	0.72	124.00	-1.21	163.33	-0.80	164.00
15	MK(L) 13-306 × Vardan	0.32	45.67	1.06	48.00	-1.17	118.67	-1.78**	118.00	-0.94	158.33	-2.02**	157.00
16	MK(L) 13-306 × MK(L) 13-303	0.37	53.33	0.03	54.67	-0.95	123.00	-0.81	123.33	-1.02	164.33	-1.47	164.00
17	MK(L) 13-306 ×MK(L) 13-305	-0.66	53.67	0.75	56.67	-0.34	125.67	-0.31	125.67	-1.58*	166.00	-0.94	167.00
18	MK(L) 13-310 × MK(L) 13-307	0.01	49.33	0.50	51.67	1.03	125.67	1.83**	126.33	-0.16	158.33	-1.63**	157.33
19	MK(L) 13-310 × Ashirwad	-0.35	39.67	-1.25	40.67	0.25	124.00	1.08	124.67	-1.24	154.67	-1.83**	154.00
20	MK(L) 13-310 × MK(L) 13-308	0.87	46.00	1.00	48.00	1.08	126.00	0.94	126.67	0.70	160.33	1.53*	161.67

21	MK(L) 13-310 × MK(L) 13-301	1.26	47.33	2.42**	50.33	0.25	123.33	0.00	123.33	-1.49*	161.33	-0.61	162.67
22	MK(L) 13-310 × Vardan	-1.71*	38.33	-1.22	40.67	-2.64	117.00	-2.17**	117.67	-1.21	156.33	-1.16	156.33
23	MK(L) 13-310 × MK(L) 13-303	-1.32	46.33	0.08	49.67	-0.42	123.33	-0.20	124.00	0.04	163.67	-1.27	162.67
24	MK(L) 13-310 × MK(L) 13-305	0.32	49.33	0.81	51.67	-1.14	124.67	-2.70**	123.33	-0.85	165.00	-0.41	166.00
25	MK(L) 13-307 × Ashirwad	-0.80	48.33	-0.81	50.00	-0.70	122.33	-0.84	121.33	-0.60	158.67	-1.58*	157.67
26	MK(L) 13-307 × MK(L) 13-308	0.09	54.33	1.11	57.00	-0.20	124.00	1.03	125.33	-0.66	162.33	0.12	163.67
27	MK(L) 13-307 × MK(L) 13-301	-0.52	54.67	0.86	57.67	-0.36	122.00	-1.59**	120.33	-0.52	165.67	-1.69**	165.00
28	MK(L) 13-307 × Vardan	-0.16	49.00	0.56	51.33	-2.25	116.67	-2.42**	116.00	0.09	161.00	1.09	162.00
29	MK(L) 13-307 × MK(L) 13-303	-0.10	56.67	0.53	59.00	0.64	123.67	-1.45*	121.33	-0.66	166.33	0.31	167.67
30	MK(L) 13-307 × MK(L) 13-305	-0.46	57.67	-1.08	58.67	-1.09	124.00	-1.28*	123.33	1.12	170.33	1.84**	171.67
31	Ashirwad × MK(L) 13-308	0.73	45.67	1.69*	48.33	0.69	124.00	-0.39	123.00	-1.74	158.67	-2.41**	158.00
32	Ashirwad × MK(L) 13-301	0.45	46.33	0.11	47.67	-0.81	120.67	-1.67**	119.33	0.73	164.33	1.45*	165.00
33	Ashirwad × Vardan	-0.18	39.67	-0.53	41.00	-2.03	116.00	-2.50**	115.00	1.01	159.33	0.56	158.33
34	Ashirwad × MK(L) 13-303	-0.13	47.33	0.44	49.67	-0.81	121.33	0.80	122.67	-1.08	163.33	-1.55*	162.67
35	Ashirwad × MK(L) 13-305	-0.16	48.67	1.17	51.67	-0.20	124.00	-0.36	123.33	-0.96	165.67	0.64	167.33
36	MK(L) 13-308 × MK(L) 13-301	-2.32**	48.67	-1.64	51.00	0.03	122.67	0.53	123.67	0.34	167.67	0.81	168.67
37	MK(L) 13-308 × Vardan	-0.63	44.33	0.06	46.67	-4.20	115.00	-3.64**	116.00	-0.71	161.33	-0.41	161.67
38	MK(L) 13-308 × MK(L) 13-303	0.43	53.00	0.36	54.67	-0.31	123.00	0.00	124.00	-0.80	167.33	-0.52	168.00
39	MK(L) 13-308 × MK(L) 13-305	-0.27	53.67	-0.25	55.33	-0.36	125.00	-0.17	125.67	0.31	170.67	0.34	171.33
40	MK(L) 13-301 × Vardan	-0.24	45.67	-0.19	47.33	0.97	118.33	0.08	117.33	-0.58	164.67	-1.22	164.00
41	MK(L) 13-301 × MK(L) 13-303	-0.85	52.67	0.44	55.67	-1.14	120.33	-0.61	121.00	0.67	172.00	1.01	172.67
42	MK(L) 13-301 × MK(L) 13-305	3.12**	58.00	1.83	58.33	-1.20	122.33	-0.45	123.00	-0.21	173.33	-1.13	173.00
43	Vardan × MK(L) 13-303	0.84	48.33	1.14	50.33	1.97	120.00	2.55**	120.67	-1.38	164.67	-0.22	165.67
44	Vardan × MK(L) 13-305	-0.18	48.67	0.86	51.33	2.25	122.33	1.72**	121.67	-0.60	167.67	-1.36*	167.00
45	MK(L) 13-303 × MK(L) 13-305	-0.13	56.33	-0.17	58.00	-0.86	123.33	-0.64	123.67	-0.02	174.33	0.20	175.00
SE(ij) ±		1.99		2.17				1.49		1.95		1.62	

*, ** significant at 5 and 1 per cent level, respectively

Table 2: contd…..

S. No.	Crosses	Length of Main Raceme (cm)				Leaf Area Index (cm²)				Primary Branches/ Plant			
		F_1		F_2		F_1		F_2		F_1		F_2	
		S.C.A	Mean	S.C.A	Mean	S.C.A	Mean	S.C.A	Mean	S.C.A	Mean	S.C.A	Mean
1	MK(L) 13-304 × MK(L) 13-306	0.30	62.67	0.71	63.00	0.04	3.31	0.23	3.62	0.13	6.67	0.46	7.33
2	MK(L) 13-304 × MK(L) 13-310	0.38	63.33	1.10	64.00	-0.11	3.38	0.13	3.73	0.27	7.33	0.02	7.00
3	MK(L) 13-304 × MK(L) 13-307	-0.07	61.33	0.10	62.00	0.06	3.00	0.39	3.39	0.10	7.67	0.55	8.00
4	MK(L) 13-304 × Ashirwad	0.10	66.67	0.60	67.33	0.24	3.98	-0.09	3.70	0.13	8.33	0.49	9.00
5	MK(L) 13-304 × MK(L) 13-308	0.35	66.00	-0.04	65.33	-0.03	3.37	-0.26	3.16	0.10	7.00	-0.37	6.67
6	MK(L) 13-304 × MK(L) 13-301	0.27	65.33	0.35	65.00	-0.17	3.26	0.07	3.63	0.21	7.33	0.05	7.33
7	MK(L) 13-304 × Vardan	-0.09	65.33	-0.26	65.33	0.06	4.12	-0.04	4.22	0.60	8.67	0.68	9.00
8	MK(L) 13-304 × MK(L) 13-303	-0.84	64.67	-1.93**	63.00	0.07	3.25	0.29	3.50	-0.26	7.33	-0.65	7.00
9	MK(L) 13-304 × MK(L) 13-305	0.52	66.67	-0.29	65.67	-0.12	3.00	-0.44**	2.79	-0.18	7.67	0.13	8.00
10	MK(L) 13-306 × MK(L) 13-310	-0.87	65.67	-0.68	66.00	0.03	2.91	-0.27	2.72	0.27	7.00	-0.51	6.33
11	MK(L) 13-306 × MK(L) 13-307	0.35	65.33	0.66	66.33	-0.04	2.29	0.14	2.53	0.10	7.33	0.35	7.67
12	MK(L) 13-306 × Ashirwad	-0.48	69.67	0.16	70.67	-0.08	3.04	0.13	3.30	0.46	8.33	0.63	9.00
13	MK(L) 13-306 × MK(L) 13-308	0.77	70.00	0.18	69.33	0.05	2.84	-0.11	2.70	0.10	6.67	0.43	7.33
14	MK(L) 13-306 × MK(L) 13-301	-0.65	68.00	-1.09*	67.33	-0.04	2.78	-0.01	2.94	0.21	7.00	0.85*	8.00
15	MK(L) 13-306 × Vardan	0.32	69.33	0.96	70.33	0.04	3.49	0.15	3.80	-0.07	7.67	0.16	8.33
16	MK(L) 13-306 × MK(L) 13-303	1.57**	70.67	1.63**	70.33	0.19	2.76	-0.01	2.59	0.07	7.33	0.16	7.67
17	MK(L) 13-306 ×MK(L) 13-305	-0.07	69.67	-1.07*	68.67	-0.18	2.33	-0.04	2.59	-0.18	7.33	-0.40	7.33
18	MK(L) 13-310 × MK(L) 13-307	-0.23	65.33	-0.29	66.00	0.02	2.57	0.17	2.78	-0.10	7.67	-0.43	7.00
19	MK(L) 13-310 × Ashirwad	-0.40	70.33	-0.12	71.00	-0.23	3.11	-0.46**	2.93	-0.07	8.33	0.18	8.67
20	MK(L) 13-310 × MK(L) 13-308	4.52**	74.33	5.91**	75.67	0.33*	3.34	0.01	3.04	1.90**	9.00	2.32**	9.33
21	MK(L) 13-310 × MK(L) 13-301	-0.23	69.00	-1.04	68.00	-0.30	2.74	-0.10	3.07	-0.65	6.67	-0.59	6.67
22	MK(L) 13-310 × Vardan	0.41	70.00	0.68	70.67	0.11	3.78	0.32	4.18	0.07	8.33	0.38	8.67
23	MK(L) 13-310 × MK(L) 13-303	1.66**	71.33	0.68	70.00	0.14	2.93	-0.10	2.71	-0.12	7.67	0.05	7.67
24	MK(L) 13-310 × MK(L) 13-305	-0.98	69.33	-1.68**	68.67	0.02	2.75	0.50**	3.34	-0.37	7.67	-0.84*	7.00
25	MK(L) 13-307 × Ashirwad	1.16	70.33	1.21*	71.33	0.05	2.84	-0.19	2.60	0.10	9.00	0.38	9.33
26	MK(L) 13-307 × MK(L) 13-308	0.07	68.33	-0.09	68.67	0.02	2.48	-0.27	2.15	-0.26	7.33	-0.48	7.00
27	MK(L) 13-307 × MK(L) 13-301	-1.01	66.67	-0.70	67.33	-0.15	2.34	-0.38*	2.19	0.18	8.00	-0.40	7.33
28	MK(L) 13-307 × Vardan	0.63	68.67	0.68	69.67	0.07	3.18	0.32	3.59	0.57	9.33	0.57	9.33
29	MK(L) 13-307 × MK(L) 13-303	-0.12	68.00	0.35	68.67	0.12	2.36	-0.08	2.13	0.38	8.67	0.24	8.33
30	MK(L) 13-307 × MK(L) 13-305	0.57	69.33	1.99**	71.33	-0.10	2.08	-0.02	2.22	0.13	8.67	-0.32	8.00
31	Ashirwad × MK(L) 13-308	-1.09	72.33	-0.26	73.33	-0.05	3.20	0.28	3.49	0.10	8.33	0.46	9.00
32	Ashirwad × MK(L) 13-301	4.16**	77.00	2.80**	75.67	0.82**	4.09	1.04**	4.39	0.88	9.33	0.88*	9.67
33	Ashirwad × Vardan	0.46	73.67	0.52	74.33	-0.31*	3.59	-0.24	3.81	-0.07	9.33	-0.15	9.67
34	Ashirwad × MK(L) 13-303	-0.29	73.00	0.18	73.33	-0.27	2.76	0.06	3.06	0.07	9.00	0.18	9.33
35	Ashirwad × MK(L) 13-305	-0.26	73.67	-0.51	73.67	-0.06	2.91	-0.40**	2.62	0.15	9.33	-0.37	9.00
36	MK(L) 13-308 × MK(L) 13-301	-0.26	71.67	-1.18	70.33	-0.15	2.79	-0.04	2.94	-0.15	7.00	0.02	7.33

37	MK(L) 13-308 × Vardan	0.71	73.00	1.21*	73.67	0.07	3.64	0.36*	4.04	-0.10	8.00	-0.01	8.33
38	MK(L) 13-308 × MK(L) 13-303	-0.04	72.33	-0.12	71.67	0.05	2.75	-0.03	2.60	0.04	7.67	-0.34	7.33
39	MK(L) 13-308 × MK(L) 13-305	-1.34*	71.67	-2.48**	70.33	-0.16	2.48	0.04	2.70	0.13	8.00	0.10	8.00
40	MK(L) 13-301 × Vardan	-0.04	71.67	0.27	72.00	0.02	3.62	-0.05	3.78	0.35	8.67	0.74*	9.33
41	MK(L) 13-301 × MK(L) 13-303	0.55	72.33	0.60	71.67	-0.08	2.65	0.08	2.86	-0.18	7.67	-0.26	7.67
42	MK(L) 13-301 × MK(L) 13-305	2.57	75.00	4.24**	76.33	0.84**	3.50	0.48**	3.28	1.24**	9.33	1.18**	9.33
43	Vardan × MK(L) 13-303	-0.48	71.67	-1.34**	70.67	-0.36*	2.99	-0.69**	2.78	0.54	9.33	0.05	9.00
44	Vardan × MK(L) 13-305	-0.45	72.33	-0.04	73.00	0.12	3.41	0.26	3.75	-0.04	9.00	0.16	9.33
45	MK(L) 13-303 × MK(L) 13-305	-0.20	72.67	-0.04	72.33	-0.02	2.40	0.18	2.63	0.10	8.67	1.16**	9.67
SE(ij) ±		1.54		1.34		0.38		0.39		1.15		0.90	

*, ** significant at 5 and 1 per cent level, respectively

Table 2: contd…..

S. No	Crosses	Secondary Branches/ Plant				Siliquae/ Plant				Seeds/ Siliqua			
		F_1		F_2		F_1		F_2		F_1		F_2	
		S.C.A	Mean	S.C.A	Mean	S.C.A	Mean	S.C.A	Mean	S.C.A	Mean	S.C.A	Mean
1	MK(L) 13-304 × MK(L) 13-306	-0.05	14.00	0.62	14.67	5.54**	333.67	9.29**	336.67	0.06	13.33	0.28	13.67
2	MK(L) 13-304 × MK(L) 13-310	0.59	14.67	-0.19	14.00	-5.15**	302.67	-9.43**	299.33	0.28	14.00	0.81	14.67
3	MK(L) 13-304 × MK(L) 13-307	1.14	15.00	1.34**	15.33	7.93**	322.67	-2.49**	313.33	0.72	13.67	0.47	13.33
4	MK(L) 13-304 × Ashirwad	0.20	14.67	0.45	15.33	0.57	338.00	10.48**	352.67	0.47	14.00	1.44**	15.33
5	MK(L) 13-304 × MK(L) 13-308	-0.44	13.33	-0.55	13.33	6.54**	327.00	-1.30	318.67	-0.28	12.67	-0.39	12.67
6	MK(L) 13-304 × MK(L) 13-301	0.51	13.67	-0.44	13.00	-6.38**	299.33	8.98**	314.33	-0.14	13.33	0.03	13.67
7	MK(L) 13-304 × Vardan	0.98	15.00	1.14**	15.67	-1.93**	325.00	4.01**	332.67	-0.22	13.67	-0.31	14.00
8	MK(L) 13-304 × MK(L) 13-303	-0.69	13.67	-0.16	14.33	-0.49	319.67	-1.13	317.33	0.22	13.67	-0.36	13.00
9	MK(L) 13-304 × MK(L) 13-305	-1.36**	12.33	-0.77	13.00	2.07**	320.33	-10.55**	306.67	0.00	13.33	-0.31	13.00
10	MK(L) 13-306 × MK(L) 13-310	-0.02	16.00	-0.86	15.00	14.73**	326.67	21.12**	333.67	-0.44	13.67	-0.42	13.67
11	MK(L) 13-306 × MK(L) 13-307	0.53	16.33	0.34	16.00	-1.18	317.67	-6.93**	312.67	0.33	13.67	0.25	13.33
12	MK(L) 13-306 × Ashirwad	-0.08	16.33	0.12	16.67	11.46**	353.00	12.37**	358.33	-0.25	13.67	0.22	14.33
13	MK(L) 13-306 × MK(L) 13-308	0.28	16.00	0.78	16.33	-4.90**	319.67	-6.74**	317.00	-0.33	13.00	-0.61	12.67
14	MK(L) 13-306 × MK(L) 13-301	-0.44	14.67	-1.11**	14.00	-6.49**	303.33	-9.80**	299.33	0.47	14.33	-0.19	13.67
15	MK(L) 13-306 × Vardan	0.03	16.00	0.14	16.33	-1.38	329.67	2.23**	334.67	0.39	14.67	0.81	15.33
16	MK(L) 13-306 × MK(L) 13-303	0.03	16.33	-0.16	16.00	-1.93*	322.33	-5.91**	316.33	0.17	14.00	0.08	13.67
17	MK(L) 13-306 ×MK(L) 13-305	0.37	16.00	0.23	15.67	-6.71**	315.67	-8.66**	312.33	0.28	14.00	0.14	13.67
18	MK(L) 13-310 × MK(L) 13-307	-0.16	15.67	0.53	16.33	-2.88**	295.67	10.68**	311.67	-0.11	13.67	-0.56	13.00
19	MK(L) 13-310 × Ashirwad	0.56	17.00	0.98	17.67	-0.24	321.00	-0.68	326.67	-0.03	14.33	0.42	15.00
20	MK(L) 13-310 × MK(L) 13-308	1.26*	17.00	0.64	16.33	31.73**	336.00	29.87**	335.00	1.22**	15.00	0.92*	14.67
21	MK(L) 13-310 × MK(L) 13-301	0.20	15.33	0.42	15.67	-9.18**	280.33	-12.52**	278.00	0.03	14.33	0.33	14.67
22	MK(L) 13-310 × Vardan	-0.33	15.67	-0.33	16.00	-1.74**	309.00	-9.16**	304.67	-0.06	14.67	-0.06	15.00
23	MK(L) 13-310 × MK(L) 13-303	0.67	17.00	1.03**	17.33	-4.96**	299.00	-9.30**	294.33	0.06	14.33	-0.33	14.00
24	MK(L) 13-310 × MK(L) 13-305	0.01	15.67	0.42	16.00	-7.07**	295.00	-0.71	301.67	0.17	14.33	-1.25**	13.67
25	MK(L) 13-307 × Ashirwad	-0.22	16.00	-0.16	16.33	2.18**	330.33	2.59**	337.00	-0.58	13.00	1.25**	12.33
26	MK(L) 13-307 × MK(L) 13-308	0.14	15.67	-0.16	15.33	-1.85*	309.33	3.82**	316.00	0.67	13.67	0.00	14.00
27	MK(L) 13-307 × MK(L) 13-301	-0.24	14.67	0.62	15.67	-5.77**	290.67	-10.24**	287.33	-0.19	13.33	0.67	13.33
28	MK(L) 13-307 × Vardan	0.23	16.00	0.53	16.67	-0.99	316.67	11.79**	332.67	0.39	14.33	-0.39	14.67
29	MK(L) 13-307 × MK(L) 13-303	-0.11	16.00	-0.77	15.33	-0.54	310.33	-3.68**	307.00	-0.17	13.33	0.00	12.67
30	MK(L) 13-307 × MK(L) 13-305	-0.11	15.33	-1.05*	14.33	4.68**	313.67	1.23	310.67	0.28	13.67	0.22	13.00
31	Ashirwad × MK(L) 13-308	-0.47	15.67	-0.05	16.33	-1.54*	332.33	0.12	338.67	0.08	13.67	0.97	14.00
32	Ashirwad × MK(L) 13-301	-0.19	15.33	-0.27	15.67	27.87**	347.00	18.07**	342.00	1.56**	15.67	0.97	15.33
33	Ashirwad × Vardan	0.28	16.67	0.31	17.33	13.98**	354.33	19.09**	366.33	0.81	15.33	-0.42	16.00
34	Ashirwad × MK(L) 13-303	-0.05	16.67	0.01	17.00	0.10	333.67	0.62	337.67	-0.08	14.00	-0.03	13.67
35	Ashirwad × MK(L) 13-305	0.95	17.00	0.73	17.00	-3.35**	328.33	8.20**	344.00	-0.31	13.67	-0.19	14.00
36	MK(L) 13-308 × MK(L) 13-301	-0.49	14.33	0.06	15.00	-8.15**	294.00	5.62**	307.33	-0.19	13.33	0.47	13.33
37	MK(L) 13-308 × Vardan	-0.02	15.67	0.31	16.33	-2.38**	321.00	-7.68**	317.33	0.06	14.00	-0.58	14.67
38	MK(L) 13-308 × MK(L) 13-303	0.31	16.33	-0.33	15.67	-1.93**	314.67	-3.49**	311.33	-0.17	13.33	-0.53	12.67
39	MK(L) 13-308 × MK(L) 13-305	0.31	15.67	0.06	15.33	-7.04**	307.67	-10.91**	302.67	-0.39	13.00	-1.11	12.67
40	MK(L) 13-301 × Vardan	0.59	15.67	0.42	16.00	-5.29**	303.33	-11.74**	298.67	-0.47	14.00	1.17	13.67
41	MK(L) 13-301 × MK(L) 13-303	1.26*	16.67	1.78**	17.33	-4.52**	297.33	-7.21**	293.00	0.31	14.33	1.89**	15.00
42	MK(L) 13-301 × MK(L) 13-305	0.59	15.33	0.84	15.67	44.04**	344.00	44.37**	343.33	1.42**	15.33	0.50	15.67
43	Vardan × MK(L) 13-303	-0.27	16.00	0.03	16.67	20.60**	343.67	25.15**	348.67	0.22	14.67	0.22	15.00
44	Vardan × MK(L) 13-305	-0.27	15.33	0.09	16.00	-2.52**	318.67	-7.60**	314.67	0.00	14.33	-0.17	14.67
45	MK(L) 13-303 × MK(L) 13-305	0.73	16.67	0.45	16.33	-5.07**	309.33	0.26	312.33	0.11	14.00	0.00	13.33
SE(ij) ±		1.30		1.01		1.79		2.49		1.19		1.24	

*, ** significant at 5 and 1 per cent level, respectively

Table 2: contd…..

S. No	Crosses	Biological Yield/ Plant (gm)				1000- Seed Weight (gm)				Harvest Index (%)			
		F_1		F_2		F_1		F_2		F_1		F_2	
		S.C.A	Mean	S.C.A	Mean	S.C.A	Mean	S.C.A	Mean	S.C.A	Mean	S.C.A	Mean
1	MK(L) 13-304 × MK(L) 13-306	0.52	51.67	1.33*	52.67	0.00	3.44	0.05	3.61	0.18	28.04	0.31	28.17
2	MK(L) 13-304 × MK(L) 13-310	-0.31	50.33	0.41	51.33	0.04**	3.90	-0.14**	3.77	-0.40	28.13	-0.72**	27.86
3	MK(L) 13-304 × MK(L) 13-307	1.16	54.33	1.60**	54.67	0.05**	3.36	-0.09	3.21	-0.09	25.08	0.53	25.81
4	MK(L) 13-304 × Ashirwad	0.85	55.33	1.10	56.67	0.09**	4.19	0.25**	4.47	1.29**	31.07	1.54**	31.69
5	MK(L) 13-304 × MK(L) 13-308	0.77	53.33	1.02	53.67	0.06**	3.66	0.21**	3.85	0.72	27.34	1.59**	28.19
6	MK(L) 13-304 × MK(L) 13-301	0.96	54.00	0.02	53.33	-0.04**	3.75	-0.13**	3.62	-0.01	26.96	-0.24	26.72
7	MK(L) 13-304 × Vardan	1.94**	55.67	1.91**	56.33	-0.02	3.89	0.01	4.10	1.37**	29.67	1.16**	29.83
8	MK(L) 13-304 × MK(L) 13-303	-0.73	56.33	-2.31**	54.67	-0.03**	3.35	0.36**	3.67	-0.59	24.44	-0.77**	24.23
9	MK(L) 13-304 × MK(L) 13-305	-0.54	49.00	0.77	50.67	0.04**	3.62	-0.18**	3.44	1.23**	28.28	0.87**	27.71
10	MK(L) 13-306 × MK(L) 13-310	0.52	47.33	-0.34	46.33	-0.08**	3.73	0.12	4.03	2.03**	32.00	1.88**	31.59
11	MK(L) 13-306 × MK(L) 13-307	0.99	50.33	-0.15	48.67	0.28**	3.54	0.49**	3.79	0.76	27.37	0.70**	27.11
12	MK(L) 13-306 × Ashirwad	1.02	51.67	1.02	52.33	0.13**	4.18	0.15**	4.37	1.18**	32.39	1.44**	32.72
13	MK(L) 13-306 × MK(L) 13-308	0.60	49.33	-0.40	48.00	0.08**	3.63	-0.15**	3.49	-0.33	27.73	-0.43	27.31
14	MK(L) 13-306 × MK(L) 13-301	0.80	50.00	1.27*	50.33	0.08**	3.83	0.21**	3.96	-0.55	27.86	-0.86**	27.23
15	MK(L) 13-306 × Vardan	0.44	50.33	0.83	51.00	-0.06**	3.80	0.02	4.11	-0.66	29.08	-0.43	29.37
16	MK(L) 13-306 × MK(L) 13-303	1.44**	54.67	1.60**	54.33	0.03**	3.36	-0.18**	3.13	-0.94**	25.53	-1.09**	25.05
17	MK(L) 13-306 ×MK(L) 13-305	-0.37	45.33	0.35	46.00	0.06**	3.59	0.16**	3.78	0.71	29.19	0.23	28.21
18	MK(L) 13-310 × MK(L) 13-307	0.83	49.67	0.27	48.67	-0.03**	3.65	-0.30**	3.35	-1.21**	26.08	-0.88**	26.25
19	MK(L) 13-310 × Ashirwad	1.19	51.33	1.77**	52.67	0.01	4.49	0.11**	4.68	0.01	31.90	0.06	32.07
20	MK(L) 13-310 × MK(L) 13-308	1.44**	49.67	1.35**	49.33	0.46**	4.43	0.47**	4.45	-0.01	28.71	-0.92**	27.53
21	MK(L) 13-310 × MK(L) 13-301	-0.04	48.67	-0.65	48.00	0.08**	4.25	0.23**	4.33	0.56**	29.63	0.84**	29.64
22	MK(L) 13-310 × Vardan	1.27	50.67	1.58**	51.33	0.24**	4.53	0.28**	4.72	0.86**	31.27	1.28**	31.81
23	MK(L) 13-310 × MK(L) 13-303	0.60	53.33	1.69**	54.00	0.06**	3.81	-0.11**	3.55	0.06	27.20	0.13	26.99
24	MK(L) 13-310 × MK(L) 13-305	0.46	45.67	-0.23	45.00	-0.32**	3.64	-0.12**	3.85	-1.66**	27.49	-1.85**	26.85
25	MK(L) 13-307 × Ashirwad	1.33	54.00	2.30**	55.33	0.06**	3.99	0.25**	4.21	0.95**	29.47	0.28	28.99
26	MK(L) 13-307 × MK(L) 13-308	0.58	51.33	0.21	50.33	-0.03**	3.40	-0.08	3.30	0.35	25.72	0.15	25.30
27	MK(L) 13-307 × MK(L) 13-301	-0.23	51.00	0.88	51.67	-0.09**	3.52	-0.25**	3.24	-0.16	25.56	-0.11	25.39
28	MK(L) 13-307 × Vardan	0.41	52.33	1.10	53.00	-0.03**	3.71	0.17**	3.99	0.96**	28.01	1.31**	28.54
29	MK(L) 13-307 × MK(L) 13-303	1.08	56.33	-2.12**	52.33	-0.02	3.19	-0.02	3.03	-0.31	23.47	0.17	23.73
30	MK(L) 13-307 × MK(L) 13-305	0.60	48.33	0.96	48.33	0.04**	3.44	-0.14**	3.22	-0.07	25.72	-1.18**	24.21
31	Ashirwad × MK(L) 13-308	0.60	52.67	1.38**	54.00	-0.01	4.21	0.14**	4.44	1.13**	31.09	1.44**	31.47
32	Ashirwad × MK(L) 13-301	-0.87	51.67	-1.29**	52.00	0.48**	4.89	0.44**	4.85	-1.47**	28.85	-1.36**	29.02
33	Ashirwad × Vardan	1.10	54.33	1.27*	55.67	-0.03**	4.50	0.03	4.78	0.38	32.03	0.81**	32.91
34	Ashirwad × MK(L) 13-303	0.77	57.33	1.71	58.67	0.00	4.00	-0.23**	3.74	1.56**	29.94	1.05**	29.48
35	Ashirwad × MK(L) 13-305	1.30	50.33	1.13	51.00	0.01	4.21	-0.04	4.24	1.12**	31.51	1.80**	32.08
36	MK(L) 13-308 × MK(L) 13-301	1.05	51.67	1.30**	51.67	-0.16**	3.74	-0.22**	3.60	1.64**	28.80	1.62**	28.45
37	MK(L) 13-308 × Vardan	1.02	52.33	0.19	51.67	-0.04**	3.99	0.06	4.22	-0.30	28.19	-0.46	28.09
38	MK(L) 13-308 × MK(L) 13-303	0.35	55.00	1.30**	55.33	-0.05**	3.44	-0.25**	3.13	-1.01**	24.21	-1.64**	23.24
39	MK(L) 13-308 × MK(L) 13-305	0.55	47.67	-0.29	46.67	0.02	3.71	0.14**	3.84	-0.05	27.18	0.13	26.85
40	MK(L) 13-301 × Vardan	0.88	52.67	1.19*	53.33	-0.22**	4.00	-0.13**	4.15	-0.60	28.25	-0.70**	28.20
41	MK(L) 13-301 × MK(L) 13-303	-0.12	55.00	-0.37	54.33	-0.18**	3.51	-0.33**	3.16	1.76**	27.33	1.52**	26.75
42	MK(L) 13-301 × MK(L) 13-305	5.74**	53.33	5.71**	53.33	0.87**	4.76	0.69**	4.50	0.88**	28.46	0.64*	27.71
43	Vardan × MK(L) 13-303	0.85	56.67	1.52**	57.33	0.89**	4.70	0.81**	4.64	0.60	27.51	0.69**	27.64
44	Vardan × MK(L) 13-305	-0.29	48.00	-0.40	48.33	-0.16**	3.85	-0.16**	3.99	-0.40	28.52	-0.59	28.20
45	MK(L) 13-303 × MK(L) 13-305	0.05	51.67	-0.29	51.00	-0.10**	3.38	0.14**	3.51	0.69	26.34	1.01**	26.13
SE(ij) ±		1.42		1.28		0.03		0.10		0.75		0.66	

*, ** significant at 5 and 1 per cent level, respectively

Table 2: contd…..

S. No.	Crosses	Seed Yield/ Plant (gm)				Oil Content (%)				Protein Content (%)			
		F_1		F_2		F_1		F_2		F_1		F_2	
		S.C.A	Mean	S.C.A	Mean	S.C.A	Mean	S.C.A	Mean	S.C.A	Mean	S.C.A	Mean
1	MK(L) 13-304 × MK(L) 13-306	0.08	12.84	0.78**	13.75	1.19**	39.63	1.21**	39.76	0.31	24.24	0.41**	24.64
2	MK(L) 13-304 × MK(L) 13-310	-0.07	13.02	0.30	13.61	0.49**	39.93	0.12	39.44	-0.03	23.99	-0.32**	23.98
3	MK(L) 13-304 × MK(L) 13-307	0.17	12.13	-0.74**	11.32	-0.65**	37.63	-0.42**	37.96	0.02	24.87	1.10**	26.26
4	MK(L) 13-304 × Ashirwad	-0.02	13.77	0.39	14.41	0.09	40.12	0.29**	40.46	0.67**	26.19	0.62**	26.55
5	MK(L) 13-304 × MK(L) 13-308	-0.15	12.54	-1.08**	11.96	-0.11	38.93	-0.07	39.00	-0.09	23.80	-0.34**	23.79
6	MK(L) 13-304 × MK(L) 13-301	-0.29	12.85	-0.81**	12.36	-0.26	40.62	-0.57**	40.33	-0.04	25.07	0.60**	25.97
7	MK(L) 13-304 × Vardan	0.12	13.54	0.52**	14.18	-0.27	39.40	0.30**	40.12	0.54**	26.24	0.27**	26.48
8	MK(L) 13-304 × MK(L) 13-303	0.18	13.09	0.61**	13.97	0.21	38.60	0.03	38.46	0.16	24.99	0.05	24.97
9	MK(L) 13-304 × MK(L) 13-305	-0.17	11.85	0.30	12.38	0.31	40.71	0.08	40.28	0.20	24.51	0.16	24.83
10	MK(L) 13-306 × MK(L) 13-310	-0.16	12.53	0.21	13.12	-0.37	38.12	0.27**	38.77	0.44**	23.01	0.19	22.93
11	MK(L) 13-306 × MK(L) 13-307	0.08	11.63	-0.78**	10.87	-0.15	37.18	-0.24	37.32	-0.14	23.25	-0.17	23.41
12	MK(L) 13-306 × Ashirwad	-0.01	13.37	0.83	14.43	0.50**	39.57	0.50**	39.85	0.07	24.14	0.20**	24.56
13	MK(L) 13-306 × MK(L) 13-308	-0.27	12.03	0.03	12.66	0.09	38.18	0.06	38.31	0.07	22.50	-0.06	22.50
14	MK(L) 13-306 × MK(L) 13-301	0.43**	13.16	1.30**	14.06	0.02	39.95	0.18	40.25	0.33	23.98	-0.13	23.66
15	MK(L) 13-306 × Vardan	0.08	13.10	-0.70**	12.56	0.21	38.93	0.03	39.02	-0.17	24.07	0.18	24.83
16	MK(L) 13-306 × MK(L) 13-303	0.14	12.65	0.05	13.00	-0.09	37.35	-0.27**	37.34	0.36**	23.73	0.32**	23.67
17	MK(L) 13-306 ×MK(L) 13-305	-0.19	11.43	-1.13**	10.54	-0.01	39.43	0.12	39.50	0.15	23.01	0.80**	23.90
18	MK(L) 13-310 × MK(L) 13-307	0.08	11.96	-0.83**	11.16	-0.17	38.16	0.01	38.34	0.47**	23.95	0.69**	24.36
19	MK(L) 13-310 × Ashirwad	-0.14	13.57	-0.97**	12.98	0.47**	40.54	0.70**	40.81	-1.34**	22.82	-1.78**	22.65
20	MK(L) 13-310 × MK(L) 13-308	1.73**	14.35	1.37**	14.35	0.94**	40.02	1.08**	40.09	2.07**	24.60	2.59**	25.23
21	MK(L) 13-310 × MK(L) 13-301	-0.47**	12.59	-0.95**	12.16	0.71**	41.65	0.88**	41.72	-0.72	23.02	-0.98**	22.89
22	MK(L) 13-310 × Vardan	-0.07	13.27	0.81**	14.41	0.17	39.88	0.10	39.86	-0.22	24.11	0.11	24.84
23	MK(L) 13-310 × MK(L) 13-303	0.17	13.00	0.80**	14.09	-0.22	38.22	0.06	38.44	0.43**	23.89	0.27**	23.70
24	MK(L) 13-310 × MK(L) 13-305	-0.30	11.64	0.52**	12.53	0.60**	41.04	-1.07**	39.08	0.14	23.10	0.79**	23.97
25	MK(L) 13-307 × Ashirwad	0.11	12.69	1.11**	13.81	0.04	38.95	-0.07	39.10	0.42**	25.40	0.56**	25.85
26	MK(L) 13-307 × MK(L) 13-308	0.75**	12.24	1.39**	13.11	0.26	38.19	0.24**	38.32	-0.07	23.28	-0.36**	23.13
27	MK(L) 13-307 × MK(L) 13-301	-0.37	11.56	-0.93**	10.93	0.25	40.02	0.17	40.06	0.02	24.59	-0.31**	24.41
28	MK(L) 13-307 × Vardan	0.10	12.32	0.77**	13.12	1.02**	39.58	0.87**	39.69	0.03	25.18	0.33**	25.90
29	MK(L) 13-307 × MK(L) 13-303	-0.34	11.36	0.11	12.15	-0.12	37.16	-0.08	37.36	0.20	24.48	-0.02	24.26
30	MK(L) 13-307 × MK(L) 13-305	-0.34	10.48	0.13	10.89	0.50**	39.78	0.90**	40.11	0.28**	24.05	-0.14	23.89
31	Ashirwad × MK(L) 13-308	-0.20	13.13	0.37**	14.06	0.20	39.87	0.08	39.94	-0.03	23.99	0.52**	24.78
32	Ashirwad × MK(L) 13-301	0.96**	14.72	0.73**	14.54	0.60**	42.11	0.47**	42.15	0.26	25.50	0.83**	26.33
33	Ashirwad × Vardan	0.11	14.15	0.55**	14.86	-0.21	40.09	0.29	40.89	1.38**	27.21	1.22**	27.57
34	Ashirwad × MK(L) 13-303	-0.30	13.23	-1.07**	12.93	0.10	39.12	0.08	39.30	0.12	25.08	-0.23**	24.82
35	Ashirwad × MK(L) 13-305	-0.24	12.40	-1.20**	11.51	0.47**	41.49	0.54**	41.53	-0.49**	23.96	-0.04	24.76
36	MK(L) 13-308 × MK(L) 13-301	-0.62**	12.05	-0.07	12.76	-0.44**	40.10	-0.40**	40.19	0.09	23.69	-0.16	23.53
37	MK(L) 13-308 × Vardan	-0.09	12.87	0.41**	13.75	0.36	39.67	0.27**	39.78	-0.16	24.04	0.28**	24.82
38	MK(L) 13-308 × MK(L) 13-303	-0.08	12.36	-1.13**	11.89	0.49**	38.53	0.54**	38.67	0.17	23.50	0.03	23.28
39	MK(L) 13-308 × MK(L) 13-305	0.17	11.73	0.93**	12.68	-0.05	39.99	0.10	39.99	0.00	22.81	-0.31**	22.69
40	MK(L) 13-301 × Vardan	-0.29	13.10	-0.88**	12.58	0.84**	42.00	0.96**	42.29	0.75**	26.16	1.17**	26.95
41	MK(L) 13-301 × MK(L) 13-303	-0.21	12.68	0.55**	13.71	0.11	39.99	0.13	40.08	0.25	24.79	0.09	24.57
42	MK(L) 13-301 × MK(L) 13-305	2.70**	14.70	2.60**	14.47	0.97**	42.85	1.03**	42.75	0.54**	24.58	0.59**	24.83
43	Vardan × MK(L) 13-303	0.22	13.38	0.60**	14.25	0.50**	39.17	0.38**	39.25	-0.09	25.04	0.46**	25.80
44	Vardan × MK(L) 13-305	-0.21	12.07	-1.54**	10.84	-0.52**	40.15	-0.47**	40.17	0.18	24.80	-0.48**	24.61
45	MK(L) 13-303 × MK(L) 13-305	-0.11	11.65	0.52**	12.58	0.40**	39.79	0.71**	39.97	-0.06	23.69	0.15	23.95
SE(ij) ±		0.41		0.42		0.37		0.21		0.28		0.20	

*, ** significant at 5 and 1 per cent level, respectively

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