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Research Article

Heterosis and combining ability for grain yield and yield component traits in maize (*Zea mays* L.)

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Abstract
Fifteen hybrids obtained by crossing five Lines with three Testers were evaluated to study heterosis and combining ability for grain yield per plant and its component traits. Further, heterosis studies revealed that almost all the Line x Tester combinations registered significant positive heterosis over both mid and better parents for grain yield per plant. The crosses namely BM-256 x BM-85, BM-256 x BM-143, BM-3 x RNBL-4351, BM-421 x BM-85 recorded higher level of significant relative heterosis and heterobeltiosis for grain yield per plant. Combining ability analysis suggested the preponderance of non-additive type of gene action for majority of the traits *viz.,* days to 50% tasseling, days to 50% silking, 100-seed weight, grain protein content and grain yield per plant. Out of the five lines tested in the present investigation, genotypes namely BM-421 and BM-256 recorded significant general combining ability effects in desirable direction for majority of the traits; while the tester, BM-143 recorded significant general combining effect for grain protein content. None of the 15 Line x Tester combinations recorded significant *sca* effect for grain yield per plant. The cross BM-77 x BM-85 recorded significant *sca* effect for plant height and grain protein content.

Key words:
Maize, Line x Tester analysis, Heterosis and Combining ability

Introduction:

Maize is a highly allogamous crop and there is a wide scope for exploitation of hybrid vigour, hence it has been successfully exploited for the production of hybrids. Parental selection is very important in hybrid development. In this context, L x T analysis (Kempthome, 1957) has widely been used for evaluation of inbred lines by crossing them with testers. The value of any inbred line in hybrid breeding ultimately depends on its ability to combine very well with other lines to produce superior hybrids. Hence, Combining ability analysis is an important tool to identify parents with better potential to transmit desirable characteristics to the progenies and to identify the best specific cross(s) for yield.

The exploitation of heterosis in maize (*Zea mays* L.) can be accomplished through the development and identification of high *per se* performance vigorous parental lines and their subsequent evaluation for combining ability in cross combinations to identify the hybrids with high heterotic effects. The information about the heterotic patterns and combining ability of the parents and crosses facilitate the breeders in the selection and development of the single cross hybrids.

Material and Methods

The experimental material consisted of 24 genotypes, comprising of 5 Lines (BM-421, BM-256, BM-77, BM-211 and BM-3), three Testers (RNBL-4351, BM-143 and BM-85) and their resultant 15 hybrids produced by line x tester mating design were evaluated along with one standard check DHM-117. The experimental materials were raised in randomized block design with three replications in experimental field at Agricultural College farm, Bapatla during *Kharif* 2012. Each genotype was raised in five rows of three metre length with a spacing of 60 x 25 cm. Observations were recorded on ten randomly selected plants per treatment per replication for the traits namely plant height (cm), cob length (cm), kernel rows per cob and grain yield per plant (g) and were used for statistical analysis. However, days to 50% tasseling, days to 50% silking, days to maturity, 100-seed weight (g) and grain protein content (%) were recorded on plot basis. The data on the following yield and yield component traits were recorded.

Line x Tester analysis was carried out according to Kempthorne (1957). The heterosis was estimated in terms of three parameters, *i.e.* relative heterosis, heterobeltiosis and standard heterosis. Mean values per replication for all traits were subjected to analysis of variance according to Panse and Sukhatme (1985) for randomized block design. The estimates of general and specific combining ability and their variances were obtained by using covariance of half sibs and full sibs.

Results and Discussion

The analysis of variance for combining ability revealed that lines had significant amount of variability for the characters *viz.*, days to 50% tasseling, days to maturity, kernel rows per cob, 100-seed weight and grain protein content, while testers had significant variability for plant height and grain protein content. However, crosses had significant amount of variability for all characters except for days to maturity and grain yield per plant. The parents *vs* hybrids were significant for majority of the characters except days to maturity and grain protein content which suggested the presence of substantial amount of heterosis in crosses for majority of the characters (Table 1). In case of Line x Tester effects significant amount of variability was observed for days to 50% tasseling, days to 50% silking, plant height, 100-seed weight and grain protein content.

The estimates of relative heterosis (RH) and heterobeltiosis (BH) were ranged from -7.69 to 0.67 and -9.09 to 0.67 for days to 50% tasseling, -7.55 to 4.55 and -8.13 to 1.90 for days to 50% silking, -6.38 to 2.48 and -8.79 to 0.76 for days to maturity, 10.30 to 53.86 and 1.41 to 45.77 for plant height, 14.76 to 45.02 and 4.48 to 44.91for cob length, 1.79 to 23.38 and -6.68 to 22.01 for kernel rows per cob, -0.28 to 48.51 and -1.85 to 44.04 for 100-seed weight, -12.54 to 18.44 and -14.18 to 17.54 for grain protein content and 70.96 to 134.12 and 56.75 to 131.81 for grain yield per plant (Table 2), respectively.

Out of the 15 hybrids, 9 and 10 hybrids were found significant and negative heterosis over mid and better parent for days to 50% tasseling, 6 and 6 hybrids recorded significant negative heterosis over mid and better parent for days to 50% silking, 2 and 1 hybrid recorded significant negative heterosis over mid and better parent for days to maturity. Negative heterosis is desirable for these characters which indicates the earliness.

Among 15 hybrids over mid and better parent, 12 and 8 hybrids recorded significant positive heterosis for plant height, all 15 and 11 hybrids recorded positive significant heterosis for cob length, 10 and 7 hybrids for kernel rows per cob, 14 and 13 hybrids for 100-seed weight, 15 and 9 hybrids for grain protein content showed positive and significant heterosis.All 15 and 14 hybrids exhibited positive and significant relative heterosis and heterobeltiosis for grain yield per plant. The cross BM-421 x BM-143 recorded highest positive significant heterosis over mid parent and better parent. These results were in accordance with the findings of Appunu and Satyanarayana (2007) and Raghu *et al.* (2012).Improvement in yield is one of the objectives, thus the heterosis can be useful only with superiority over the best checks. The check included in the present study is DHM-117 which is a promising hybrid released by ANGRAU in Andhra Pradesh. The estimates of standard heterosis (SH) ranged from -16.67 to -7.41, -19.44 to -10.56 and -13.54 to -6.60 for days to 50% tasseling, days to 50% silking and days to maturity (Table 2), respectively. All 15 hybrids exhibited significant standard heterosis in desirable direction.

The range of standard heterosis ranged from -24.57 to 4.04 for plant height, 13.40 to 10.90 for cob length, -11.06 to 2.65 for kernel rows per cob, -28.94 to 5.39 for 100-seed weight, -15.47 to 7.00 for grain protein content and -21.30 to 0.99 for grain yield per plant. None of the 15 Line x Tester combinations recorded significant positive standard heterosis for plant height, cob length, kernel rows per cob, 100-seed weight and grain yield per plant over check DHM-117. The hybrid BM-256 x BM-143 recorded maximum grain yield per plant (130.03) over the standard check. Similar results of positive heterosis over standard parent were reported by Appunu and Satyanarayana (2007), Dubey *et al.* (2009) and Raghu *et al.* (2012).

Analysis of variance for combining ability for yield and yield contributing characters in maize is presented in the Table 3. Further the variation present in the hybrids is partitioned into portions attributable to lines, testers, lines x tester components. The per cent contribution towards the total variance was maximum due to the interaction of lines and testers for the traits grain yield per plant, 100-seed weight, days to 50% silking, grain protein content, days to 50% tasseling and days to maturity while contribution of lines alone was maximum towards the total variance for cob length, kernel rows per cob and plant height (Table 3).

However the ratio of variance to the total variance suggested the preponderance of non-additive gene action for majority of the traits *viz.*, days to 50% tasseling, days to 50% silking, 100-seed weight, grain protein content and grain yield per plant. Similar results were reported by Venugopal *et al.* (2002), Sumalini and Rani (2010), Premlatha *et al.* (2011) and for non-additive gene action. While cob length which is governed by additive gene action and traits like kernel rows per cob and days to maturity were governed by both additive and non-additive gene action.

Estimates of general and specific combining ability: Out of the five lines tested in the present investigation, BM-421 and BM-256 recorded significant general combining ability effects in desirable direction for four (days to 50% tasseling, plant height, cob length and grain protein content) and three characters (days to 50% silking, kernel rows per cob and grain yield per plant) followed by BM-77 for 100-seed weight and grain protein content and BM-211 for 100-seed weight, respectively (Table 4). While the tester, BM-143 recorded significant general combining effect for grain protein content (Table 4).

Further the tested lines were given ranking based on the respective combining abilities of all the characters studied, the genotypes namely BM-421 and BM-256 ranked first followed by BM-211 (Table 4). Therefore these lines can be utilized in improvement of the respective traits in any breeding programme wherever hybridization is involved. Due to their good combining ability these lines can be utilized straightaway as parents for production of good hybrids by crossing with other divergent lines and can also be employed in the development of synthetic varieties. None of the 15 Line x Tester combinations recorded significant *sca* effect for grain yield per plant (Table 5). The cross BM-77 x BM-85 recorded significant *sca* effect for plant height and grain protein content. The crosses BM-3 x RNBL-4351 and BM-421 x BM-85 recorded significant *sca* effects for 100-seed weight. The *gca* effects of parents and *sca* effects of their hybrid combinations indicated that the crosses with high *sca* effects were resulted due to high x low, low x low and high x high *gca* combinations. Therefore, one can afford to include some low general combiners also along with good combiners in hybridization programmes.

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Table 1. Analysis of variance (mean squares) for grain yield and its attributing characters

Source of variation	Df	Days to 50% tasseling	Days to 50% silking	Days to maturity	Plant height	Cob length	Kernel rows per cob	100-seed weight	Grain protein content	Grain yield per plant
Replications	2	0.710	0.522	1.797	6.437	3.032	0.935	0.873	0.185	91.591
Genotypes (G)	22	8.130**	6.949**	17.086	2141.649**	13.733**	2.939**	31.570**	1.380**	2546.633**
Parents (P)	7	5.804**	3.500	24.423	1200.839**	2.768	2.443**	8.303**	0.599**	65.456
Lines (F)	4	8.233**	4.733	32.767*	786.468	0.315	3.251**	13.388**	0.551**	83.609
Testers (M)	2	3.444	2.778	8.444	2327.307**	7.165	1.240	0.881	0.994**	54.613
(F Vs M)	1	0.803	0.011	23.003	605.388	3.784	1.619	2.809	0.000	14.532
Crosses	14	4.613**	6.327*	11.181	928.743**	2.994*	1.255*	15.112**	1.869**	272.427
Parents Vs. Crosses	1	73.667**	39.792**	48.392	25708.004**	240.842**	29.974**	424.846**	0.001	51753.749**
Line Effect	4	7.256	6.922	14.522	1486.895	6.479	2.598	20.251	1.966	312.150
Tester Effect	2	1.689	3.356	16.467	717.281	1.155	0.375	0.218	1.458	70.736
Line x Tester Effect	8	4.022*	6.772*	8.189	702.533*	1.711	0.804	16.265**	1.924**	302.988
Error	44	1.453	2.613	12.433	322.405	1.456	0.532	0.697	0.103	938.771
Total	68	3.591	3.954	13.626	901.690	5.474	1.323	10.690	0.519	938.771

Table 2. Magnitude of Relative Heterosis (RH), Heterobeltiosis (BH) and Standard Heterosis (SH) for days to 50% tasseling, days to 50% silking and days to maturity

Sl. No.	Hybrids/ crosses	Days to 50% tasseling			Days to 50% silking			Days to maturity		
		RH	BH	SH	RH	BH	SH	RH	BH	SH
1	BM-421 x RNBL-4351	-3.45	-6.04**	-13.58**	-1.65	-2.61	-17.22**	-4.60	-8.79**	-13.54**
2	BM-421 x BM-143	-6.57**	-8.78**	-16.67**	4.55	1.90	10.56**	-1.56	-4.18	-12.50**
3	BM-421 x BM-85	-2.11	-2.80	-14.20**	0.65	-1.90	-13.89**	0.00	-3.37	-10.42**
4	BM-256 x RNBL-4351	-6.80**	-8.05**	-15.43**	-6.15**	-7.05**	-19.44**	-5.82*	-8.06*	-12.85**
5	BM-256 x BM-143	-3.07	-4.05	-12.35**	-3.82	-4.43	-16.11**	1.34	0.76	-7.99*
6	BM-256 x BM-85	-4.17*	-4.83*	-14.81**	-5.73*	-6.33*	-17.78**	-2.47	-3.75	-10.76**
7	BM-77 x RNBL-4351	0.67	0.67	-7.41**	0.96	-0.63	-12.78**	-1.32	-4.03	-9.03**
8	BM-77 x BM-143	-2.36	-2.68	-10.49**	-4.43	-4.43	-16.11**	-1.73	-2.66	-11.11**
9	BM-77 x BM-85	-4.11*	-6.04**	-13.58**	-5.70*	-5.70*	-17.22**	2.48	0.75	-6.60*
10	BM-211 x RNBL-4351	-7.69**	-8.00**	-14.81**	-4.79*	-6.88**	-17.22**	-3.35	-4.76	-9.72**
11	BM-211 x BM-143	-2.68	-3.33	-10.49**	-3.14	-3.75	-14.44**	-3.03	-3.40	-11.11**
12	BM-211 x BM-85	-4.44*	-6.67**	-13.58**	-7.55**	-8.13**	-18.33**	-3.01	-3.37	-10.42**
13	BM-3 x RNBL-4351	-7.59**	-9.09**	-13.58**	0.65	-0.64	-13.33**	-6.38*	-6.88	-10.76**
14	BM-3 x BM-143	-5.96**	-7.79**	-12.35**	-6.03**	-6.33*	-17.78**	-3.15	-5.43	-9.38**
15	BM-3 x BM-85	-4.38*	-7.79**	-12.35**	-3.49	-3.80	-15.56**	-1.29	-2.90	-6.94*
Range	Max.	0.67	0.67	-7.41	4.55	1.90	-10.56	2.48	0.76	-6.60
	Min.	-7.69	-9.09	-16.67	-7.55	-8.13	-19.44	-6.38	-8.79	-13.54
	Average	-4.31	-5.68	-13.05	-3.04	-4.05	-15.85	-2.26	-4.00	-10.21

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

Table 2 (Continued). Magnitude of Relative Heterosis (RH), Heterobeltiosis (BH) and Standard Heterosis (SH) for plant height, cob length and kernel rows per cob

Sl. No.	Hybrids/ crosses	Plant height			Cob length			Kernel rows per cob		
		RH	BH	SH	RH	BH	SH	RH	BH	SH
1	BM-421 x RNBL-4351	25.03**	18.11*	4.04	33.06**	33.03**	-3.69	6.49	4.59	-11.06**
2	BM-421 x BM-143	46.48**	30.82**	2.48	38.33**	26.05**	10.90	23.38**	22.01**	0.04
3	BM-421 x BM-85	17.57*	10.33	-13.58	45.02**	44.91**	4.86	8.91*	4.90	-7.16
4	BM-256 x RNBL-4351	21.32*	3.76	-8.60	39.52**	37.88**	2.22	11.48**	8.82	-2.82
5	BM-256 x BM-143	28.23**	27.20*	-20.38**	22.55**	12.90	-0.66	21.13**	14.94**	2.65
6	BM-256 x BM-85	29.14**	23.42*	-15.23*	36.76**	35.02**	0.10	13.29**	12.78**	0.72
7	BM-77 x RNBL-4351	20.84*	2.57	-9.65	32.78**	30.53**	-2.18	10.69*	9.52*	-6.88
8	BM-77 x BM-143	41.92**	41.76**	-12.69	21.68**	12.66	-0.88	13.10**	11.02*	-7.59
9	BM-77 x BM-85	53.86**	45.77**	0.11	27.17**	24.88**	-6.42	5.09	1.96	-9.76*
10	BM-211 x RNBL-4351	10.30	1.58	-10.52	36.88**	34.67**	-2.50	2.53	-4.71	-5.64
11	BM-211 x BM-143	45.97**	33.60**	-0.92	20.33**	8.07	-4.92	3.14	-6.68	-7.59
12	BM-211 x BM-85	17.35	13.01	-16.19*	29.11**	27.16**	-8.13	1.79	-3.61	-4.56
13	BM-3 x RNBL-4351	19.17*	1.41	-10.67	19.76**	19.61*	-13.40*	18.35**	17.18**	1.65
14	BM-3 x BM-143	29.01**	28.75*	-20.39**	14.76*	4.48	-8.07	16.44**	12.03	-2.82
15	BM-3 x BM-85	15.58	9.82	-24.57**	31.82**	31.80**	-4.78	10.90**	9.80*	-2.82
Range	Max.	53.86	45.77	4.04	45.02	44.91	10.90	23.38	22.01	2.65
	Min.	10.30	1.41	-24.57	14.76	4.48 to	-13.40	1.79	-6.68	-11.06
	Average	28.12	19.46	-10.45	29.97	25.58	-2.50	11.11	7.64	-4.24

Table 2 (Continued). Magnitude of Relative Heterosis (RH), Heterobeltiosis (BH) and Standard Heterosis (SH) for 100-seed weight, grain protein content and grain yield per plant

Sl. No.	Hybrids/ crosses	100-Seed weight			Grain protein content			Grain yield per plant		
		RH	BH	SH	RH	BH	SH	RH	BH	SH
1	BM-421 x RNBL-4351	25.37**	21.89**	-9.49**	8.95**	2.70	3.61	91.34**	89.70**	-20.86*
2	BM-421 x BM-143	-0.28	-1.85	-28.94**	18.44**	17.54**	4.97	82.43**	71.22**	-18.57*
3	BM-421 x BM-85	30.81**	30.61**	-8.41**	-1.85**	-2.94	-11.35**	115.20**	110.94	-8.38
4	BM-256 x RNBL-4351	27.42**	20.08**	-10.83**	-12.31**	-14.10**	-13.33**	111.08**	107.17**	-11.79
5	BM-256 x BM-143	43.07**	36.44**	-1.21	-8.48**	-12.65**	-15.47**	124.09**	112.36**	0.99
6	BM-256 x BM-85	48.51**	44.04**	0.70	-9.34**	-11.89**	-14.73**	134.12**	131.81**	0.68
7	BM-77 x RNBL-4351	14.21**	5.39	-7.44*	11.28**	3.39	4.31	85.88**	66.10**	-13.48
8	BM-77 x BM-143	31.55**	20.00**	5.39	-2.34**	-3.09	-14.77**	97.65**	89.04**	-1.52
9	BM-77 x BM-85	20.71**	8.40*	-4.80	15.68**	12.68**	2.91	70.96**	56.75**	-18.35*
10	BM-211 x RNBL-4351	28.14**	24.83**	-2.25	-10.83**	-12.63**	-11.85**	115.45**	107.25**	-8.02
11	BM-211 x BM-143	28.11**	23.29**	-3.46	15.82**	10.52**	7.00*	83.88**	77.74**	-15.47
12	BM-211 x BM-85	41.13**	33.56**	4.59	-9.36**	-11.92**	-14.73**	111.62**	109.36**	-7.08
13	BM-3 x RNBL-4351	42.75**	41.75**	5.26	-12.54**	-14.18	-13.41**	117.09**	106.44**	-6.15
14	BM-3 x BM-143	37.57**	36.81**	0.16	9.03**	3.88	0.89	95.44**	91.13**	-9.10
15	BM-3 x BM-85	18.23**	15.57**	-15.39**	-10.25**	-12.93**	-15.43	77.06**	73.11**	-21.30*
Range	Max.	48.51	44.04	5.39	18.44	17.54	7.00	134.12	131.81	0.99
	Min.	-0.28	-1.85	-28.94	-12.54	-14.18	-15.47	70.96	56.75	-21.30
	Average	29.15	24.05	-5.07	0.13	-3.04	-6.76	100.89	93.34	-10.56

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

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Table 3. Estimates of genetic components of variance and proportional contribution of Lines, Testers and Line x Tester interaction to total variance for different characters

	Days to 50% tasseling	Days to 50% silking	Days to maturity	Plant height	Cob length	Kernel rows per cob	100-seed weight	Grain protein content	Grain yield per plant
gca	0.0375	-0.1361	0.6088*	33.2963	0.1755*	0.0568*	-0.5026	-0.0176	-9.2954
sca	0.8566*	1.3865*	-1.4149	126.7094	0.0850	0.0906	5.1895**	0.6068**	43.2128
2gca/ 2gca+sca	0.0805	-0.2443	-6.1713	0.3445	0.8050	0.5563	-0.2402	-0.0616	-0.7550
Narrow sense heritability (%)	5.2976	13.7127	30.8468	22.1407	38.1073	29.7664	22.7569	5.8229	22.5602
Contribution (%)									
Lines	44.9415	31.2594	37.1096	45.7421	61.8350	59.1206	38.2888	30.0472	32.7375
Testers	5.2306	7.5765	21.0392	11.0331	5.5127	4.2649	0.2062	11.1446	3.7093
Line x Tester	49.8279	61.1641	41.8512	43.2248	32.6523	36.6145	61.5050	58.8082	63.5532

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

Table 4. Estimates of general combining ability (*gca*) effects of parents for grain yield per plant and its component characters

Parents	Days to 50% tasseling	Days to 50% silking	Days to maturity	Plant height	Cob length	Kernel rows per cob	100-seed weight	Grain protein content	Grain yield per plant
Lines/Females									
BM-421	-0.956*	1.178*	-1.867	16.444*	1.116**	-0.279	-2.619**	0.501**	-6.923
BM-256	-0.622	-1.156*	-0.311	-8.711	0.522	0.680**	0.322	-0.665**	9.257*
BM-77	1.378**	0.289	1.244	6.178	-0.112	-0.589*	0.694*	0.364**	-0.713
BM-211	0.044	-0.489	-0.200	2.521	-0.458	-0.259	1.168**	0.020	0.473
BM-3	0.156	0.178	1.133	-16.432*	-1.068*	0.448	0.435	-0.219	-2.093
SE	0.402	0.539	1.175	5.985	0.402	0.243	0.278	0.107	4.389
CD at 5%	0.823	1.104	2.407	12.260	0.824	0.498	0.570	0.219	8.990
Testers/Males									
RNBL-4351	0.044	-0.089	-0.933	6.842	-0.240	-0.109	0.030	0.054	-1.931
BM-143	0.311	0.511	-0.200	0.143	0.304	0.181	-0.133	0.282**	2.351
BM-85	-0.356	-0.422	1.133	-6.986	-0.064	-0.073	0.102	-0.335**	-0.419
SE	0.311	0.417	0.910	4.636	0.311	0.188	0.26	0.083	3.400
CD at 5%	0.637	0.855	1.865	9.496	0.638	0.385	0.442	0.170	6.964

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

Table 5. Estimates of specific combining ability (*sca*) effects of hybrids for grain yield per plant and its component characters

Crosses	Days to 50% tasseling	Days to 50% silking	Days to maturity	Plant height	Cob length	Kernel rows per cob	100-seed weight	Grain protein content	Grain yield per plant
BM-421 x RNBL-4351	0.622	-1.911	0.400	6.138	-1.078	-0.660	1.491**	0.335	-4.409
BM-421 x BM-143	-1.31	1.489	-0.133	9.667	0.872	0.756	-3.179**	0.224	-5.741
BM-421 x BM-85	0.689	0.422	0.533	-15.804	0.206	-0.096	1.689**	-0.559**	10.149
BM-256 x RNBL-4351	-0.711	-0.911	-1.289	5.623	0.526	-0.352	-1.784**	0.048	-8.909
BM-256 x BM-143	0.689	0.489	2.644	-11.604	-0.512	0.198	0.773	-0.364	3.269
BM-256 x BM-85	0.022	0.422	-1.356	5.981	-0.014	0.155	1.011*	0.316	5.639
BM-77 x RNBL-4351	1.622*	1.644	0.822	-11.396	0.407	0.293	-1313*	0.532**	-1.109
BM-77 x BM-143	-0.311	-0.956	-1.911	-10.866	0.086	-0.107	2.041**	-1.333**	9.999
BM-77 x BM-85	-1.311	-0.689	1.089	22.262*	-0.493	-0.186	0.728	0.801**	-8.891
BM-211 x RNBL-4351	-1.044	-0.244	1.600	-9.509	0.699	0.153	-0.497	0.510*	4.725
BM-211 x BM-143	1.022	0.822	-0.467	16.690	-0.258	-0.437	-0.634	0.878**	-9.147
BM-211 x BM-85	0.022	-0.578	-1.133	-7.181	-0.441	0.284	1.131*	-0.368	4.423
BM-3 x RNBL-4351	-0.489	1.422	-0.733	9.144	-0.554	0.566	2.103**	-0.405*	9.701
BM-3 x BM-143	-0.089	-1.844	-0.133	-3.886	-0.188	-0.410	1.000*	0.594**	1.619
BM-3 x BM-85	0.578	0.422	0.867	-5.258	0.742	-0.156	-3.102**	-0.189	-11.321
SE	0.696	0.933	2.036	10.367	0.696	0.421	0.482	0.186	7.601
CD at 5%	1.425	1.912	4.170	21.235	1.427	0.863	0.987	0.380	15.571

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