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Heterosis studies for yield and yield components in greengram [*Vigna radiata* (L.) wilczek]

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Abstract
Twenty one hybrids of greengram along with their seven parental lines in 7 x 7 half diallel fashion excluding reciprocal crosses were studied to assess the extent of heterotic effects over mid, better parent and check for yield and ten component characters. Out of 28 F_1 hybrids, four crosses *viz.*, Utkarsha x TM-96-2, Phule –M-605-21x TMB-146, Phule-M-402-1 x BM-2003-2 and Phule-M-402-1 x TMB-146 showed superior *per se* performance with significant positive heterosis for seed yield and most of the yield contributing characters. Based on heterotic studies, the best direct yield contributing character were pods per cluster, pods per plant, pod length, seeds per pod and 100 seed weight. These hybrids could be utilized for developing high yielding mungbean cultivars.

Keywords: Heterosis, green gram

Introduction
Mungbean (*Vigna radiata* (L.) Wilczek) is a self-pollinated legume originated in south Asia. Also known as green gram, it is short duration grain legume with wider adoptability. Mungbean is considered to be originated from *Vigna sablobata.* The origin of mungbean is supposed to be India (Vavilov, 1926 and Zukoveshij 1962) [14, 15]. It is mainly used in making Dal, snacks, curries and soup. The germinated seeds have more nutritional value compared with Asparagus or Mushroom. The food value of mungbean lie in its high and easily digestible protein.
Mungbean has established itself as a highly valuable short duration grain legume crop having many desirable characteristics like wider adaptability, low input requirement and ability to improve the soil fertility by fixing atmospheric nitrogen with the help of symbiotic bacteria, Rhizobium present in root nodules. Mungbean has been recognized as a very suitable crop for mixed, inter and multiple- cropping systems as well as for various crop rotations
For any successful breeding programme to improve grain yield and component characters, it is essential to know precisely the genetic architecture of these characters under prevailing conditions. It is very much essential to measure the extent of genetic dissimilarity among the parental lines involved in hybridization programmes for exploitation of heteroticvigour because high genetic dissimilarity among parental lines exhibits high heterotic response (Moll and Stuber, 1976) [17]
Study of heterosis in mungbean is important for the plant breeder to find out the superior crosses in first generation itself. In addition to this, the magnitude of heterosis provides basis for determining genetic diversity and also serves as guide to the choice of desirable parents. An attempt was, therefore made to know the magnitude of heterosis over better parent and standard variety for seed yield and its components in elite Indian mungbean genotypes (Gwande *et al*., 2001[1] and Joseph and Kumar, 2000) [16].

Materials and Methods
The parent for experiment included seven genotypes of mungbean (*Vigna radiata*L. *Wilczek*) as Phule-M-605-21, Phule-M-401-1, Utkarsha, BM-2003-2, BPMR-145, TM-96-2, TMB-146 and were crossed in half diallel mating system at Botany farm of PGI, M.P.K.V. Rahuri. All the genotypes (seven parent and 21 $F_{1,}$ s) were evaluated in Randomized Block Design with three replication during *kharif*, 2018. Each genotype was grown in one row of three meter length with a spacing of 30 cm between row and 10 cm between plants. Recommended agronomic and plant protection package of practice were followed to raise healthy crop. Data were recorded on five randomly selected competitive plants in each genotype and replication. Mean value on per plant basis were recorded for the characters, *viz,* Days to 50% flowering, Days to maturity, Plant height (cm), Number of clusters per plant, Number of pods per cluster, Number of pods per plants, Pod length (cm), Number of seeds per pod, 100 seed weight (g) and Seed yield per plant (g). The data were subjected to analysis heterosis over better parent

(BP) and standard variety (SV) were calculated and tested as specified by Hays (1955) [3].

Results and Discussion

The negative heterosis was considered to be desirable for days to 50 percent flowering and days to maturity. In other words, earliness in hybrids was desirable. Out of 21 crosses, only one cross Utkarsha x BPMR-145 (-7.96%) showed significant negative heterosis over mid parent, eight crosses showed negative heterosis over standard check (BPMR-145) and Utkarsha x BPMR-145 (-6.32%) is the only one cross showed significant negative heterosis over their respective superior parent for days to 50 percent flowering. These results were in agreement with the finding of Halkunde (1992) [2] and Patil (1992) [10]. For days to maturity, eleven crosses showed significant negative heterosis over mid parent Out of that Utkarsha x BPMR-145 (-9.60%) is ranked first. The cross, Utkarsha x BPMR-145 (-4.92 %) is showed highest significant negative heterosis over better parent. Whereas, in case of standard heterosis all twenty one crosses exhibited significant heterosis in desirable direction from which cross Utkarsha x TMB-146 (-17.41 %) recorded highest negative heterosis. These results are in consonance with the finding of Halkunde (1992) [2], Kelkar (1993) [5] and Sonawane, (2015) [12]. Highest positive significant heterosis among the 21 crosses, was recorded by BM-2003-2 x TMB-146 (7.96%) over mid parent, for better parent and standard check there is no significant heterosis respectively for plant height (cm). Similar results are reported by Srivastava *et al.*, (2013) [13]. Phule-M-605-21 x TMB-146 (80.00%) recorded highest significant positive relative heterosis, while standard heterosis and heterobeltiosis recorded by cross BM-2003-2 x TMB-146 and Phule-M-402-1 x TM-96-2 respectively, for number of clusters per plant. Similar results reported by Halkunde (1992) [2], Patil (1992) [10] and Jahagidar (2001) [4]. Out of 21 crosses, significant positive average heterosis was recorded in four crosses and heterobeltiosis was observed in five hybrids, only one cross BM 2002-1 X BPMR 38 (11.11%) is revealed significant positive standard heterosis over the check BPMR-145 for Number of pods per cluster. Similar results have also been reported by Patil (1992) [10] and Jahagidar (2001) [4]. BM-2003-2x TMB-146 recorded (100%), (86.57%), highest significant positive average heterosis, and better parent heterosis while cross Phule-M-402-1 x TMB-146 (89.02%) showed standard heterosis over check for number of pods per plant. These results were in agreement with the finding of Kelkar (1993) [5] and Patel *et al.*, (2009) [8]. Out of 21 crosses, Phule-M-605-21 x TMB-146 exhibited highest significant positive heterosis over mid parent and better parent, while significant positive Standard heterosis over the check BPMR-145 was recorded by cross BM-2003-2x BPMR-145 (11.59%) for pod length. This result was in agreement with the finding of Srivastava *et al.*, (2013) [13]. Among the 24 crosses, twelve crosses exhibited significant positive heterosis over mid parent, highest heterosis was recorded by BPMR-145 x TMB-146 (19.96%), seven crosses showed significant positive heterosis over better parent, maximum heterosis was depicted by the crosses BM-2003-2x BPMR-145 (14.18%) and significant positive Standard heterosis over the check BM 2003-2 was recorded by six crosses, BM-2003-2x BPMR-145 (14.53%) for number of seeds per pod. This result was in agreement with the finding of Sonawane (1995) [11] and Srivastava & Singh (2013) [13]. For 100 seed weight the highest significant positive heterosis over mid parent, better parent were recorded by same cross, Phule-M-605-21 x TM-96-2 (21.84%), (13.66%) with value respectively. Utkarsha x BM-2003-2 (8.39%) showed significant positive standard heterosis. Similar results have also been reported by Halkunde (1992) [2], Patil (1992) [10], Kelkar (1993) [5]. For seed yield per plant the highest mid parent and standard heterosis were recorded by same cross Utkarsha x TM-96-2 (66.95%) and (52.86%) respectively and highest better parent heterosis was observed in cross TM-96-2 x TMB-146 (41.87%). Dethe and Patil (2008) [10] Lakshmi *et al.* (2003), Srivastava *et al.*, (2013) [13], also reported the similar conclusions.

Table 1: Heterosis (%) over mid-parent (MP), better-parent (BP) and standard check (BPMR-145) for eleven characters in mungbean

Sr. No.	Crosses(F_{1s})		Days to 50% flowering			Days to maturity		
			MP	BP	SH	MP	BP	SH
1	Phule-M-605-21 X Phule-M-402-1		2.48	5.08	7.82*	5.91 **	7.68**	0.00
2	Phule-M-605-21 X Utkarsha		7.23 **	13.51**	9.57**	2.87 **	5.91**	-4.01**
3	Phule-M-605-21 X BM-2003-2		-3.77	00.00	0.00	-3.33 **	-0.98	-9.37**
4	Phule-M-605-21 x BPMR-145		6.28 *	10.43**	10.43**	-3.42 **	-1.39*	-5.35**
5	Phule-M-605-21 x TM-96-2		14.03 **	29.91**	9.57**	4.98 **	12.83**	-5.79**
6	Phule-M-605-21 x TMB-146		12.56 **	32.97**	5.21	3.00 **	11.35**	-8.03**
7	Phule-M-402-1 X Utkarsha		-4.80	-1.81	-5.21	-4.62 **	-3.44**	-12.49**
8	Phule-M-402-1 x BM-2003-2		4.72	6.07*	6.07*	7.02 **	7.80**	-1.33*
9	Phule-M-402-1 x BPMR-145		9.01 **	10.43**	10.43**	-0.93	2.88**	-4.46**
10	Phule-M-402-1 x TM-96-2		-1.40	9.27**	-7.82**	2.78 **	8.55**	-9.37**
11	Phule-M-402-1 x TMB-146		-4.31	9.89**	-13.04**	-0.25	5.95**	-12.49**
12	Utkarsha x BM-2003-2		2.65	4.48	0.86	-3.92 **	-3.48**	-12.53**
13	Utkarsha x BPMR-145		-7.96 **	-6.32*	-9.57**	-9.60 **	-4.92**	-13.83**
14	Utkarsha x TM-96-2		-0.96	6.18*	-10.43**	2.05 *	6.41**	-11.15**
15	Utkarsha x TMB-146		-2.97	7.68*	-14.79**	-4.64 **	00.00	-17.41**
16	BM-2003-2x BPMR-145		-4.35	-4.35	-4.35	-5.36 **	-0.98	-9.37**
17	BM-2003-2 x TM-96-2		-1.89	7.20*	-9.57**	-5.61 **	-1.07*	-17.41**
18	BM-2003-2x TMB-146		-5.83	6.59*	-15.65**	-4.10 **	1.08*	-16.51**
19	BPMR-145 x TM-96-2		0.94	10.30**	-6.96*	-4.14 **	5.24**	-12.13**
20	BPMR-145 x TMB-146		12.62 **	27.46**	0.86	-5.13 **	4.86**	-13.39**
21	TM-96-2 x TMB-146		15.96 **	19.78**	-5.21	10.22 **	10.81**	-8.47**
	SE±		1.03	1.19	1.19	0.51	0.59	0.59
	CD at 5%		2.07	2.39	2.39	1.03	1.19	1.19
	CD at 1%		2.76	3.19	3.19	1.37	1.58	1.58
	Range	Mini.	-7.96	-6.32	-15.65	-9.60	-4.92	-17.41
		Maxi.	15.96	32.97	10.43	10.22	12.83	0.00

*,** Significant at 5 and 1 per cent level, respectively.

Table 1: Continue….

Sr. No.	Crosses(F_{1s})		Plant Height			Number of primary branches		
			MP	BP	SH	MP	BP	SH
1	Phule-M-605-21 X Phule-M-402-1		-21.80 **	-23.85 **	-26.30**	21.43	21.43	16.27
2	Phule-M-605-21 X Utkarsha		-4.20 **	-15.32 **	-18.04**	18.52	14.29	23.25
3	Phule-M-605-21 X BM-2003-2		-22.43 **	-29.60 **	-31.85**	25.00	7.14	16.27
4	Phule-M-605-21 x BPMR-145		-12.51 **	-13.92 **	-13.91**	48.15 **	42.86 **	46.51*
5	Phule-M-605-21 x TM-96-2		-7.74 **	-16.36 **	-19.04**	41.67 **	21.43	31.39*
6	Phule-M-605-21 x TMB-146		0.03	-23.26 **	-25.73**	50.00 **	28.57 *	16.27
7	Phule-M-402-1 X Utkarsha		-7.32 **	-16.11 **	-23.06**	3.70	0.00	8.13
8	Phule-M-402-1 x BM-2003-2		-19.35 **	-24.99 **	-31.20**	58.33 **	35.71 *	31.39*
9	Phule-M-402-1 x BPMR-145		-18.32 **	-21.71 **	-21.70**	40.74 **	35.71 *	46.51*
10	Phule-M-402-1 x TM-96-2		-13.37 **	-19.51 **	-26.18**	16.67	0.00	8.13
11	Phule-M-402-1 x TMB-146		-3.08 *	-24.22 **	-30.49**	66.67 **	42.86 **	54.65*
12	Utkarsha x BM-2003-2		-12.36 **	-14.90 **	-32.86**	13.04	0.00	00.00
13	Utkarsha x BPMR-145		-19.34 **	-29.70 **	-29.7**	23.08	23.08	23.25
14	Utkarsha x TM-96-2		-5.37 **	-8.01 **	-27.58**	65.22 **	46.15 **	46.51*
15	Utkarsha x TMB-146		5.42 **	-10.62 **	-33.57**	-4.35	-15.38	-15.11
16	BM-2003-2x BPMR-145		-10.73 **	-20.15 **	-20.15**	56.52 **	38.46 *	31.39*
17	BM-2003-2 x TM-96-2		-8.11 **	-8.22 **	-27.58**	50.00 **	50.00 *	16.27
18	BM-2003-2x TMB-146		7.96 **	-10.64 **	-29.50**	70.00 **	70.00 **	16.27
19	BPMR-145 x TM-96-2		-18.01 **	-26.73 **	-26.73**	-4.35	-15.38	-23.25
20	BPMR-145 x TMB-146		-3.77 **	-27.01 **	-27.00**	21.74	7.69	8.13
21	TM-96-2 x TMB-146		1.56	-15.86 **	-33.77**	70.00 **	70.00 **	31.39*
	SE±		0.69	0.80	0.80	0.11	0.12	0.12
	CD at 5%		1.39	1.61	1.61	0.22	0.25	0.25
	CD at 1%		1.85	2.14	2.14	0.29	0.34	0.34
	Range	Mini.	-22.43	-29.7	-33.77	-4.35	-15.38	-23.25
		Maxi.	7.96	-8.01	-13.91	70.00	70.00	54.65

*,** Significant at 5 and 1 per cent level, respectively.

Table 1: Continue

Sr. No.	Crosses(F_{1s})		Number of clusters per plant			Number of pods per cluster		
			MP	BP	SH	MP	BP	SH
1	Phule-M-605-21 X Phule-M-402-1		7.42	4.24	43.10**	-26.47 **	-29.33 **	-19.08**
2	Phule-M-605-21 X Utkarsha		-12.56	-15.32	9.24	-20.05 **	-20.24 **	-16.03**
3	Phule-M-605-21 X BM-2003-2		22.28	6.31	37.17*	15.42 **	8.19	14.12**
4	Phule-M-605-21 x BPMR-145		24.87	10.81	43.10**	-9.77 *	-12.05 *	-7.25
5	Phule-M-605-21 x TM-96-2		26.32	8.11	39.61*	-6.10	-12.77 **	-8.01
6	Phule-M-605-21 x TMB-146		80.00 **	37.84 *	78.01**	2.35	0.00	10.68*
7	Phule-M-402-1 X Utkarsha		-9.01	-14.41	17.45	4.06	-0.22	14.12**
8	Phule-M-402-1 x BM-2003-2		37.00 **	16.10	79.75**	-1.85	-11.33 **	1.52
9	Phule-M-402-1 x BPMR-145		-8.82	-21.19	8.20	-13.74 **	-19.11 **	-7.63
10	Phule-M-402-1 x TM-96-2		69.54 **	41.53 **	94.24**	-14.64 **	-23.56 **	-12.59**
11	Phule-M-402-1 x TMB-146		18.64	-11.02	22.16	-7.80 *	-9.33 *	3.81
12	Utkarsha x BM-2003-2		6.45	-4.81	15.18	-3.61	-9.44 *	-4.96
13	Utkarsha x BPMR-145		17.89	7.69	30.19*	0.12	-2.18	2.67
14	Utkarsha x TM-96-2		61.75 **	42.31 **	83.24**	18.86 **	10.65 *	18.32**
15	Utkarsha x TMB-146		7.98	-15.38	2.26	-18.16 **	-20.23 **	-11.83*
16	BM-2003-2x BPMR-145		10.71	8.14	8.20	-4.89	-8.63	-8.39
17	BM-2003-2 x TM-96-2		51.55 **	48.78 **	41.88**	9.32 *	8.26	0.00
18	BM-2003-2x TMB-146		75.89 **	51.22 **	44.15**	12.03 **	2.76	13.74**
19	BPMR-145 x TM-96-2		35.76 *	30.23	30.19*	-1.07	-5.84	-5.72
20	BPMR-145 x TMB-146		15.86	-2.33	-2.26	-8.56 *	-12.87 **	-3.81
21	TM-96-2 x TMB-146		40.58 *	22.78	12.73	7.71	-2.07	8.39
	SE±		0.91	1.05	1.05	1.10	0.12	0.12
	CD at 5%		1.83	2.11	2.11	0.21	0.25	0.25
	CD at 1%		2.43	2.81	2.81	0.28	0.33	0.33
	Range	Mini.	-12.56	-15.38	-2.26	-26.47	-29.33	-19.08
		Maxi.	80.00	51.22	94.24	18.86	10.65	18.32

*,** Significant at 5 and 1 per cent level, respectively.

Table 1: Continue

Sr. No.	Crosses(F_{1s})		Number of pods per plant			Pod length		
			MP	BP	SH	MP	BP	SH
1	Phule-M-605-21 X Phule-M-402-1		-32.26 **	-33.24 **	1.78	-0.98	-4.47	-13.84**
2	Phule-M-605-21 X Utkarsha		-20.28 *	-31.25 **	1.78	-3.84	-14.89 **	-7.35*
3	Phule-M-605-21 X BM-2003-2		15.08	-8.04	36.15**	-18.20 **	-28.08 **	-20.57**
4	Phule-M-605-21 x BPMR-145		-3.02	-18.75 *	20.29*	-0.84	-8.89 **	-8.85*
5	Phule-M-605-21 x TM-96-2		6.02	-16.07	24.25**	3.39	2.08	-14.46**
6	Phule-M-605-21 x TMB-146		45.49 **	10.42	63.45**	11.42 **	8.33 **	-9.22**
7	Phule-M-402-1 X Utkarsha		8.57	-7.51	40.97**	-6.41 **	-14.43 **	-6.85*
8	Phule-M-402-1 x BM-2003-2		21.43 *	-4.02	46.33**	-6.92 **	-15.49 **	-6.60*
9	Phule-M-402-1 x BPMR-145		-16.23	-30.64 **	5.75	2.71	-2.37	11.09**
10	Phule-M-402-1 x TM-96-2		32.47 **	3.76	58.16**	-4.98	-9.45 **	-18.32**
11	Phule-M-402-1 x TMB-146		65.00 **	23.99 **	89.02**	7.14 **	0.60	-9.35**
12	Utkarsha x BM-2003-2		12.26	2.46	9.91	-16.31 **	-16.95 **	-8.22*
13	Utkarsha x BPMR-145		31.77 **	27.31 **	36.54**	-9.05 **	-12.71 **	-4.98
14	Utkarsha x TM-96-2		92.04 **	73.31 **	85.92**	-0.59	-12.98 **	-5.36
15	Utkarsha x TMB-146		1.08	-13.35	-7.07	-3.98	-17.07 **	-9.72**
16	BM-2003-2x BPMR-145		9.35	3.08	3.10	-4.22 *	-8.76 **	11.59**
17	BM-2003-2 x TM-96-2		41.06 **	39.30 **	23.33*	-0.35	-13.35 **	1.74
18	BM-2003-2x TMB-146		100.00 **	86.57 **	65.23**	0.15	-14.06 **	-4.98
19	BPMR-145 x TM-96-2		33.81 **	24.67**	24.65**	3.29	-6.19 *	-6.10*
20	BPMR-145 x TMB-146		10.72	-2.20	-2.18	4.47	-6.44 *	-6.35*
21	TM-96-2 x TMB-146		63.24 **	54.08 **	33.04**	7.36 **	5.70	-13.71**
	SE±		1.71	1.98	1.98	0.17	0.20	0.20
	CD at 5%		3.44	3.97	3.97	0.35	0.41	0.41
	CD at 1%		4.58	5.29	5.29	0.47	0.54	0.54
	Range	Mini.	-32.26	-33.24	-7.07	-18.20	-28.08	-20.57
		Maxi.	100.00	86.57	89.02	11.42	8.33	11.59

*,** Significant at 5 and 1 per cent level, respectively.

Table 1: Continue

Sr. No.	Crosses(F_{1s})		Number of seeds per pod			100 seed weight		
			MP	BP	SH	MP	BP	SH
1	Phule-M-605-21 X Phule-M-402-1		7.86 **	4.32	4.55	-3.72	-9.17 **	-13.74**
2	Phule-M-605-21 X Utkarsha		-3.83	-9.24 **	-4.26	-6.64 **	-14.91 **	-12.97**
3	Phule-M-605-21 X BM-2003-2		-1.40	-4.64	-4.45	-18.03 **	-26.38 **	-22.13**
4	Phule-M-605-21 x BPMR-145		8.14 **	4.72	4.65	5.45 **	-2.86	-2.86
5	Phule-M-605-21 x TM-96-2		3.46	2.00	-5.03*	21.84 **	13.66 **	-4.19*
6	Phule-M-605-21 x TMB-146		10.62 **	8.07 **	1.16	6.40 **	-3.40	-18.70**
7	Phule-M-402-1 X Utkarsha		-19.77 **	-21.79 **	-17.44**	3.41 *	-0.31	2.09
8	Phule-M-402-1 x BM-2003-2		-7.99 **	-7.99 **	-7.75**	-2.85	-7.81 **	-2.48
9	Phule-M-402-1 x BPMR-145		8.26 **	8.12 **	8.33**	4.27 *	1.65	1.71
10	Phule-M-402-1 x TM-96-2		1.72	-2.96	-2.71	11.17 **	-1.74	-6.67**
11	Phule-M-402-1 x TMB-146		9.30 **	3.35	3.58	15.03 **	-0.87	-5.91
12	Utkarsha x BM-2003-2		4.96 *	2.33	7.94**	2.50	0.84	8.39**
13	Utkarsha x BPMR-145		-2.77	-5.32 *	-0.09	1.85	0.68	7.82**
14	Utkarsha x TM-96-2		16.60 **	8.57 **	14.53**	6.49 **	-8.82 **	-6.67*
15	Utkarsha x TMB-146		-1.96	-9.49 **	-4.45	9.03 **	-8.88 **	-6.67*
16	BM-2003-2x BPMR-145		14.32 **	14.18 **	14.43**	-1.95	-4.63 *	0.95
17	BM-2003-2 x TM-96-2		-2.06	-6.57 *	-6.39*	-4.87 *	-19.65 **	-15.07**
18	BM-2003-2x TMB-146		14.75 **	8.51 **	8.72**	-5.14 **	-21.75 **	-17.17**
19	BPMR-145 x TM-96-2		7.74 **	2.91	2.90	12.87 **	-2.42	-2.48
20	BPMR-145 x TMB-146		19.96 **	13.57 **	13.56**	16.50 **	-1.72	-1.71
21	TM-96-2 x TMB-146		9.74 **	8.73 **	-1.06	-4.76 *	-7.50 **	-32.63**
	SE±		0.22	0.25	0.25	0.087	0.10	0.10
	CD at 5%		0.44	0.51	0.51	0.176	0.23	0.23
	CD at 1%		0.59	0.68	0.68	0.234	0.27	0.27
	Range	Mini.	-19.77	-21.79	-17.44	-18.03	-26.38	-32.63
		Maxi.	19.96	14.18	14.53	21.84	13.66	8.39

*,** Significant at 5 and 1 per cent level, respectively.

Table 1: Continue…

Sr. No.	Crosses(F_{1s})		Yield per plant		
			MP	BP	SH
1	Phule-M-605-21 X Phule-M-402-1		-4.98	-6.18	3.44
2	Phule-M-605-21 X Utkarsha		-28.88 **	-31.23 **	-20.85*
3	Phule-M-605-21 X BM-2003-2		-10.14	-13.71	-7.29
4	Phule-M-605-21 x BPMR-145		0.37	-3.10	4.06
5	Phule-M-605-21 x TM-96-2		16.31	-4.98	2.08
6	Phule-M-605-21 x TMB-146		55.69 **	27.39 **	36.91**
7	Phule-M-402-1 X Utkarsha		9.09	6.80	22.83*
8	Phule-M-402-1 x BM-2003-2		23.89 **	17.53 *	29.50**
9	Phule-M-402-1 x BPMR-145		-7.77	-12.04	-3.02
10	Phule-M-402-1 x TM-96-2		37.84 **	11.51	24.71**
11	Phule-M-402-1 x TMB-146		44.75 **	17.28 *	29.30**
12	Utkarsha x BM-2003-2		-6.51	-13.08	0.00
13	Utkarsha x BPMR-145		15.04 *	7.52	23.67**
14	Utkarsha x TM-96-2		66.95 **	32.89 **	52.86**
15	Utkarsha x TMB-146		-4.07	-23.53 **	-11.99
16	BM-2003-2x BPMR-145		15.44 *	14.80	14.80
17	BM-2003-2 x TM-96-2		26.01 **	6.39	5.21
18	BM-2003-2x TMB-146		43.17 **	21.08 *	19.70*
19	BPMR-145 x TM-96-2		31.21 **	10.28	10.32
20	BPMR-145 x TMB-146		1.07	-14.91	-14.91
21	TM-96-2 x TMB-146		42.16 **	41.87 **	-63.19**
	SE±		0.69	0.79	0.79
	CD at 5%		1.38	1.60	1.60
	CD at 1%		1.84	2.13	2.13
	Range	Mini.	-28.88	-31.23	-63.19
		Maxi.	66.95	41.87	52.86

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