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Hybrid Vigour Study in Mungbean [Vigna Radiata (L.) Wilczek]

Abstract

Twenty one crosses resulting from 7 x 7 diallel excluding reciprocals were studied to know the magnitude of heterosis over mid parent and better parent for seed yield and its components in mungbean. The highest heterosis to the extent of 111.46 % over mid parent and 56.76 % over better parent for seed yield per plant was observed in the cross Rm-10-509 x GBM-1, which exhibited high heterosis (%) for either one or more yield components. The promising hybrids viz., Rm-10-501 x GBM-1, Co-4 x GBM-1, and Rm-10-503 x Co-4 were identified, which have immense potential to exploit the hybrid vigour or to isolate desirable segregants.

Keywords: Mungbean, Diallel Mating Design, Heterosis, Heterobeltiosis

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Introduction

Mungbean [Vigna radiata (L.) Wilczek] (2n=2x=22) is a third important pulse after bengalgram and redgram. The present yield potential of improved varieties is not enough to attract the farmers because of relatively smaller seed size, low yield potential and susceptibility to diseases. 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 a basis for determining genetic diversity and also, serves as guide to the choice of desirable parents (Swindell and Poehlman, 1976). An attempt was, therefore made to know the magnitude of heterosis over mid parent and better parent for seed yield and its components traits in elite Indian mungbean genotypes.

Materials And Methods

Seven parents, Rm-10-501, Rm-10-512, Rm-10-507, Rm-10-509, Rm-10-503, Co-4 and GBM-1 were crossed in diallel fashion (excluding reciprocals). An experiment comprising seven parents and 21 resistant F1s was conducted in randomized block design with three replications at College farm, Navsari Agricultural University, Navsari during Rabi, 2012-13. All the 28 treatments were grown in single progeny row of 3 m length with spacing of 30 cm between rows and 10 cm between plants. The experimental plots were surrounded by non-experimental guard rows to avoid any possible border effects. Observations were recorded on seed yield and its nine components traits (Table 1). Data was subjected to analysis of variance for mean performance (Panse and Sukhatme, 1995) and heterosis over mid parent (MP) and better parent (BP) was calculated and tested as specified by Turner (1953) and Hays (1955).

Results And Discussion

through highly significant differences among themselves for all the studied traits. The parents and hybrids also manifested highly significant differences for most of the traits except for seeds per pod (Table 1). The parents vs. crosses also showed significant differences for all the characters implied the presence of heterosis in the cross combinations. Many crosses exceeded their performance beyond the lower and upper limit of parents for various characters in desirable direction (Table 3). Based on the mean performance, the best crosses identified for each character were parent Rm-10-501 x Rm-10-503 (days to 50% flowering), Rm-10-501 x Rm-10-503 (days to maturity), Rm-10-507 x Rm-10-509 (plant height), Rm-10-501 x Rm-10-512 (branches/ plant), Rm-10-512 x Rm-10-509 (seed yield/ plant), Rm-10-512 x Rm-10-509 (pods/ plant), Rm-10-507 x Rm-10-509 (seeds/ pod) and Rm-10-512 x Rm-10-507 (100-seed weight).

For earliness, a negative heterosis for days to 50% flowering and days to maturity is desirable. Only one cross, Rm-10-507 x Co-4 showed significant negative heterosis over mid parent; whereas, none of the crosses exhibited significant negative heterobeltiosis for days to maturity.

The parents Rm-10-501 and Rm-10-503 were early maturing but could not produced F1 with negative significant heterobeltiosis. This suggests that while selecting parents and crosses for early maturity, considerations should be given to mean performance of parents and F1s rather than to magnitude of heterosis. These findings are in agreement with Intwala et al. (2009) and Reddy et al. (2011). Out of 21 hybrids, the Rm-10-507 x Rm-10-503 evinced that the highest mid parent heterosis (-14.20%) for plant height followed by Rm-10-509 x Rm-10-503 (-13.76%) while the highest positive heterobeltiosis was displayed by the hybrid, Rm-10-512 x Rm-10-509 (32.62%), where none of the crosses was found significant for negative heterobeltiosis. Out of 21 crosses, sixteen and twelve crosses exhibited significant positive heterosis over mid parent and better parent, respectively for branches per plant. The hybrid, Rm-10-507 x Rm-10-503 followed by Rm-10-509 x GBM-1 displayed highest mid parent heterosis and non significant heterobeltiosis. These have been reported by Patel et al. (2009) and Dhuppe et al. (2010). The highest significant mid parent heterosis and non-significant heterobeltiosis were evinced by the cross Rm-10-503 x Co-4 for clusters per plant. These findings are in accordance with earlier reports by Intwala et al. (2009) and Vasline et al. (2009).

Out of 21 crosses, eleven and seven crosses exhibited significant positive heterosis over mid parent and better parent, respectively for pods per plant. The hybrid, Rm-10-509 x GBM-1 followed by Rm-10-503 x Co-4 displayed highest mid parent heterosis and heterobeltiosis. The crosses involving parent Rm-10-509 as one of the parents exhibited significant heterosis over mid parent and better parent, indicating its importance in transferring this character in F1 as has been reported earlier by Dhuppe et al. (2010), and Reddy et al. (2011). Whereas, the mid parent heterosis and heterobeltiosis were amounted upto 22.09% and 13.82%, respectively for seeds per pod, an important yield component in mungbean. Two cross combinations viz., Rm-10-503 x Co-4 and Rm-10-512 x Rm-10-503 evinced significant mid parent and better parent heterosis. Reddy et al. (2011) also arrived at similar conclusions.

In the present investigation, ten and five crosses manifested significant positive heterosis over mid parent and better parent seed yield per plant, respectively, where the highest relative heterosis was observed in Rm-10-509 x GBM-1 (39.35%) followed by Rm-10-503 x Co-4 (38.42%); whereas hybrid Rm-10-509 x GBM-1 (14.89%) showed highest significant heterobeltiosis followed by Rm-10-501 x GBM-1 (13.62%). The crosses consisting GBM-1 as one of the parents mostly exhibited significant heterosis, indicating its significant contribution in producing better F1 with high test weight. Intwala et al. (2009) and Patel et al. (2009) observed heterobeltiosis for this character; while Aher et al. (2000) noticed positive heterobeltiosis for 100 seed weight.

Seed yield, the complex character, decides the economic worth of the hybrids. The high expression of heterosis for seed yield was evident in the present investigation. Similar results were reported earlier by Patel et al. (2009) and Reddy et al. (2011). Among 21 hybrids twelve and five crosses evinced significant and positive heterosis over mid parent and better parent, respectively. The hybrid Rm-10-509 x GBM-1 (56.76%) and (111.46%) followed by Rm-10-501 x GBM-1 (36.68%) and (57.68%), Co-4 x GBM-1 (30.25%) and (48.88%), and Rm-10-503 x Co-4 (27.06%) and (97.53%) displayed highest significant better and mid parent heterosis and heterobeltiosis for seed yield per plant. Heterosis over mid parent and better parent indicated that, in general, magnitude of positive heterosis was higher than negative heterosis. This might be attributed to both epistasis and over dominance. Based on the per se performance and heterosis among the crosses, it could be concluded that hybrids viz., Rm-10-509 x GBM-1, Rm-10-501 x GBM-1, Co-4 x GBM-1 and Rm-10-503 x Co-4 were found better for most of traits (Table 4). It clearly suggests that while selecting best cross combinations this evidence needs to be given due consideration.

In the present study, significant positive heterosis for seed yield was associated with heterosis for earliness, plant height, pods per plant, clusters per plant, and 100 seed weight in most of the heterotic combinations. Patel et al. (2009) and Reddy et al. (2011) reported similar results. This would clearly indicate that heterosis for yield was through heterosis for individual yield components or additive or synergistic effects of the component characters or alternatively due to the multiplicative effect of partial dominance of component characters. The different magnitude in heterosis for various characters in F1 over the parental means in the present study indicated over all dominance or positively acting genes and increased diversity between the parental genotypes in the expression of heterosis. A few modifier genes with negative effect might also be involved in the expression of heterosis. The cross combinations, Rm-10-509 x GBM-1 (56.76%) and (111.46%) followed by Rm-10-501 x GBM-1 (36.68%) and (57.68%), Co-4 x GBM-1 (30.25%) and (48.88%), and Rm-10-503 x Co-4 (27.06%) and (97.53%) exhibited significant better and mid parent heterosis and heterobeltiosis for seed yield per plant and some of its components. Though this study focused the scope for exploiting heterosis, but being self-pollinated legume crop, it can only be made use of through isolation of transgressive sergeants in subsequent generations. Further selection of crosses should not rest only on the per se performance or heterosis for seed yield; but the performance of parents and their hybrids for yield and its attributing traits should also be considered.

Conclusion

The crosses Co4 x GBM-1, Rm-10-503 x Co-4, Rm-10-509 x GBM-1 and Rm-10-501 x GBM-1 were the best performer for seed yield per plant and these crosses had also the high magnitude of per se performance for other yield attributes. A mark degree of heterobeltiosis varied from cross to cross. The characters with favorable heterosis over better parent in more number of crosses were number of branches per plant, number of seeds per pod, pod length, number of pods per plant, and protein content.

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Table 1. Analysis of variance (mean squares) for different characters in Green gram.

Source of variation	d.f.	Days to Flowering	Days to Maturity	Plant Height (cm)	Branches per Plant	Clusters Per Plant	Pods per Plant	Pod Length (cm)	Seeds per Pod	Seed Yield per Plant (g)	100 seed weight (g)
Replication	2	**2.14**	**1.25**	**0.35**	**0.001**	**0.11**	**5.26**	**2.04**	**0.012**	**0.36**	**0.03**
Genotype	27	**164.43****	**159.36****	**143.52****	**1.69****	**34.06****	**377.93****	**198.40****	**4.64****	**14.73****	**3.36****
Parents	6	**157.34****	**130.51****	**78.26****	**0.85****	**33.22****	**339.96****	**120.19****	**2.82****	**11.46****	**3.11****
Hybrids	20	**137.22****	**136.63****	**158.93****	**1.69****	**35.48****	**391.60****	**220.64****	**5.34****	**15.56****	**3.47****
Parents vs Hybrids	1	**751.20****	**787.16****	**226.80****	**6.72****	**10.68****	**332.37****	**222.89****	**1.45****	**17.83****	**2.67****
Error	54	**3.48**	**9.74**	**5.70**	**0.015**	**0.14**	**2.40**	**0.89**	**0.02**	**0.23**	**0.02**

Significance at 5 % level,** * Significance at 1 % level**

Table 2. Range of heterosis (%) for nine characters in mungbean

Characters	Per se performance		Range of heterosis (%) over	
	Parent	Hybrid	Mid parent	Better parent
Days to 50% flowering	Rm-10-501 (34.91)	Rm-10-501 x Rm-10-503 (30.10)	-32.13 to2.70%	-41.12 to -1.82%
Days to maturity	Rm-10-501 (65.95)	Rm-10-501 x Rm-10-503 (60.10)	-17.06 to 1.18%	-24.59 to -2.35%
Plant height (cm)	Rm-10-509 (30.83)	Co-4 x GBM-1 (49.40)	-14.20 to 43.81%	-19.30 to 32.62%
Branches per plant	C0-4 (2.92)	Co-4 x GBM-1 (3.97)	-8.05 to 71.83%	-26.34 to 64.86%
Cluster per plant	Co-4 (11.40)	Co-4 x GBM-1 (13.58)	-38.04 to 80.51%	-56.14 to 26.53%
Pods per plant	Co-4 (38.45)	Co-4 x GBM-1 (45.70)	-16.48 to 76.76%	-18.23 to 34.30%
Seeds per pod	GBM-1 (8.38)	Co-4 x GBM-1 (9.40)	-19.79 to 22.09%	-15.58 to 13.82%
100 seed weight (g)	Co-4 (5.20)	Co-4 x GBM-1 (5.60)	-6.79 to 39.35%	-19.15 to 14.89%
Seed yield per plant (g)	Co-4 (6.91)	Co-4 x GBM-1 (9.00)	-21.23 to 111.46%	-45.56 to 56.76%

Table 3. Crosses showing maximum beneficial heterosis over mid (MP) and better parents (BP)

Characters	Maximum beneficial heterosis			
	Over MP		Over BP	
	Cross	Heterosis (%)	Cross	Heterosis (%)
Days to 50% flowering	Rm-10-507 x Co-4	-32.13**	Rm-10-507 x Co-4	-41.12**
Days to maturity	Rm-10-507 x Co-4	-17.06**	Rm-10-507 x Co-4	-24.59**
Plant height (cm)	Rm-10-507 x Rm-10-503	-14.20**	Rm-10-509 x Rm-10-503	-19.30**
Branches/ plant	Rm-10-507 x Rm-10-503	71.83**	Rm-10-507 x Rm-10-503	64.86**
Cluster/plant	Rm-10-503 x Co-4	80.51**	Rm-10-509 x GBM-1	26.53**
Pods / plant	Rm-10-509 x GBM-1	76.76**	Rm-10-509 x GBM-1	34.30**
Seeds / pod	Rm-10-503 x Co-4	22.09**	Rm-10-512 x Rm-10-503	13.82**
100 seed weight (g)	Rm-10-509 x GBM-1	39.35**	Rm-10-509 x GBM-1	14.89**
Seed yield/ plant (g)	Rm-10-509 x GBM-1	111.46**	Rm-10-509 x GBM-1	56.76**

Table 4. Selected promising crosses on the basis of heterosis (%) for seed yield per plant and its components traits in mungbean.

Crosses		Seed yield/ plant (g)	Days to 50% flowering	Days to maturity	Plant height (cm)	Branches/ plant	Cluster/ plant	Pods / plant	Seeds / pod	100 seed weight (g)
Rm-10-509 x GBM-1	MP	111.46**	2.70	0.98	26.04**	65.59**	69.05**	76.76**	21.40**	39.35**
	BP	56.76**	-3.95	-2.44	10.17**	45.28**	26.53**	34.30**	7.19**	14.89**
Rm-10-501 x GBM-1	MP	57.68**	-16.39**	-5.43	23.41**	35.43**	43.00**	50.58**	12.22**	31.37**
	BP	36.68**	-29.08**	-14.27**	11.94*	29.81**	24.95**	29.95**	2.42	13.62**
Co-4 x GBM-1	MP	48.88**	-8.00*	-4.48	13.43**	42.81**	26.33**	30.26**	14.52**	13.13**
	BP	30.25**	-12.86**	-7.22*	7.65	36.43**	19.12**	18.86**	11.95**	7.69**
Rm-10-503 x Co-4	MP	97.53**	-17.04**	-6.92*	20.07**	59.22**	80.51**	72.04**	22.09**	38.42**
	BP	27.06**	-29.81**	-14.77**	6.32	26.12**	17.02**	12.98**	7.86**	6.35*
S.Ed.±	MP	0.34	1.32	2.21	1.69	0.09	0.27	1.10	0.12	0.12
	BP	0.39	1.52	2.55	1.95	0.10	0.31	1.27	0.14	0.14

***, ** significant at 5% and 1% level, respectively.**

MP= Mid parent; BP= Better parent