Heterosis for yield and yield attributing characters in *rabi* mungbean [*Vigna radiata* (L.) Wilckzek]

G.B. Vaidya*, D.A. Chauhan, A.V. Narwade, B.H. Kale and M.M. Pandya

Department of Genetics and Plant Breeding, N.M. College of Agriculture, N.A.U., Navsari- 396 450, India.

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**ABSTRACT**

Twenty one crosses resulting from 7 x 7 diallel excluding reciprocal were studied to know the magnitude of heterosis over better parent and standard variety for yield and its attributing characters in *rabi* mungbean. The highest heterosis to the extent of 37.23% over the check Co-4 and 82.20 % over the check GBM-1 was observed in cross combination Co-4 x Meha for seed yield per plant, which also exhibited high heterosis percentage for yield and yield components. The promising hybrids viz., Co-4 x Meha, Co-4 x GBM-1, GBM-1 x Meha and Rm-9-129 x Co-4 were identified which have great potential to exploit the hybrid vigour or to isolate the desirable segregants for the development of *rabi* mungbean varieties with chilling tolerant ability or photo-thermo insensitivity, so as to exploit potential of *rabi* mungbean in heavy rainfall zone as rice fallows. 

**Key words:** Dialled crossing, Mungbean.

**INTRODUCTION**

Green gram (*Vigna radiata* L.) is an important pulse crop of Central Asia and India. Development of *rabi* mungbean requires special attention as *Kharif/Summer* genotype will not directly fit to shorter day length and low temperature. Genotype for *rabi* season must have chilling tolerant ability or photo-thermo insensitivity for higher potentiality. Very few genetic inputs are available in South Gujarat region where ample potential for *rabi* mung bean is there. South Gujarat comes under heavy rainfall zone and plenty of land is available for this crop as rice fallows. Further, as per the changing climate scenario it is an urgent need to develop a photo-thermo insensitive varieties which can be widely adapted in larger geographical area and in throughout the year.

**MATERIALS AND METHODS**

The seven parental genotypes viz., Rm-9-129, Rm-9-133, Rm-9-126, Rm-9-134, Co-4, GBM-1 and Meha were crossed in diallel fashion (excluding reciprocals). An experiment involving 21 F1’s and 7 parental lines was conducted in randomized block design with three replications during *rabi* 2011-12 at Pulses research station, Navsari Agricultural University, Navsari. Each parent and F1 was represented by a single row of 2 m length spaced at 30 cm distance. The plant to plant spacing of 10 cm within a row was maintained. Observation was recorded on five randomly selected competitive plants for thirteen characters. Heterosis, over mid parent, better parent, and standard check were calculated as per the standard procedure.

**RESULTS AND DISCUSSION**

Presence of adequate variability among the genotypes were revealed through highly significant differences among themselves for all the traits studied. The mean squares due to genotypes, parents, hybrids and parents vs. hybrids were found highly significant for all the characters studied except for harvest index. Mean squares due to parents vs. hybrids were found to be significant for all the characters under study. This indicated that the mean performances of hybrids were significantly differed from that of parents and showed that the selected material was appropriate for the study of manifestation of heterosis.

Based on the mean performance, the best crosses identified for each character were, Rm-9-129 x Rm-9-126 (Days to 50% flowering and Days to maturity), Co-4 x Meha (Plant height, No. of branches per plant, No. of clusters per plant, No. of pods per plant, 100 seed weight, Seed yield per plant and Straw yield), Co-4 x GBM-1 (Pod length and No. of seeds per pod), Rm-9-129 x Co-4 (Harvest Index) and Rm-9-133 x Rm-9-126 (Protein content).

Most heterotic crosses identified on the basis of range, mean performance and heterosis parameter are presented in (Table 1) There is a tremendous variation in flowering and maturity of different genotypes which may be due to the interaction between the genotype, temperature and photoperiod. For earliness, a negative heterosis for days to 50 per cent flowering and days to maturity is desirable. (Table 2) For days to 50 per cent flowering out of twenty one, sixteen and three hybrids manifested highly significant negative heterosis over their mid parent and better parent, respectively. The cross Rm-9-129 x Rm-9-126 (-13.74 per cent) followed by Rm-9-129 x Rm-9-134 (-9.79 per cent) displayed the significant heterobeltiosis. In case of standard heterosis the hybrids Rm-9-129 x Rm-9-126 was at pinnacle.

*Corresponding author’s e-mail: gaurav.vaidya87@gmail.com.
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<thead>
<tr>
<th>Characters</th>
<th>Range</th>
<th>Heterosis (%)</th>
<th>Best hybrid</th>
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<td>Parents</td>
<td>Crosses</td>
<td>Based on mean performance</td>
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<tr>
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<td>56.16 to 56.32 to</td>
<td>14.32 to 17.12 to 0.28 to 12.12</td>
<td>Rm-9-126 Rm-9-126 Rm-9-126 Rm-9-126</td>
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<td>-14.71 to -10.27 to -35.73 to -32.35 to</td>
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<td>9.88 to 13.39 to 1.26 to 6.58</td>
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<td></td>
<td>45.95 to 55.59 to</td>
<td>32.25 to 20.98 to 20.98 to 34.73</td>
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<td>53.85 to 31.25 to 31.25 to 47.97</td>
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<td>No. of pods per plant</td>
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<td>-30.69 to -23.91 to -65.71 to -58.41 to</td>
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<td>60.06 to 34.39 to 34.49 to 63.14</td>
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<td>22.97 to 14.52 to 18.75 to 13.77</td>
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<tr>
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<td>19.16 to 25.52 to</td>
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<td>Protein content</td>
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Table 2: Magnitude of heterosis over better parent (BP), mid parent (MP) and check (C1, C2) for various characters in green gram.

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<th>Days to Flowering</th>
<th>Days to Maturity</th>
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<td>C.D. at 1%</td>
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* Significance at 5 % level
** Significance at 1 % level
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<th>Pods Per Plant</th>
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<td>41.98**</td>
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* Significance at 5 % level
** Significance at 1 % level

Continue Table 2 contd...
### Crosses

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

Continue Table 2 contd....
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<th>Crosses</th>
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<th>Straw Yield</th>
<th>Harvest Index</th>
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* Significance at 5 % level
** Significance at 1 % level

Continue Table 2

contd...
Followed by Rm-9-126 x Rm-9-134 for both the checks. Rm-9-129 x Rm-9-126 exhibited the standard heterosis of -46.23 and -39.88 percent while in case of Rm-9-126 x Rm-9-134 it was -39.64 and -32.51 for Check 1 (Co-4) and check-2 (GBM-1) respectively (Table 2). For days to maturity out of twenty one, thirteen hybrids manifested negatively significant relative heterosis. The cross combination Rm-9-129 x Rm-9-126 exhibited the highest significant heterobeltiosis (-10.27 per cent) and standard heterosis of -35.73 and -32.35 percent over the checks Co-4 and GBM-1 respectively, followed by Rm-9-129 x Rm-9-133 exhibiting the higher heterobeltiosis (-9.06 per cent) and standard heterosis over Co-4 (-28.55 per cent) and over GBM-1 (-24.79 per cent) (Table 2). The parents Rm-9-126, Rm-9-129 and Rm-9-133 were early flowering and maturing. This suggested that, while selecting parents and crosses for days to 50% flowering and days to maturity due consideration should be given to mean performance of parents and F1’s rather than the magnitude of heterosis. This result is similar with the findings reported by, Anbumalarmathi et al. (2004), Saravanan et al. (2009), Intwala et al. (2009) and Reddy et al. (2011) for days to flowering and maturity.

Thirteen and five hybrids recorded the significant relative heterosis and heterobeltiosis for plant height. The cross combinations Co-4 x Meha (20.98 per cent) noted the highest heterobeltiotic effect and was also found to exhibit maximum standard heterosis over check-1 Co-4 (20.98 per cent) and over check 2 GBM-1 (34.73 per cent). The result is getting support from the findings of Aher et al. (2000), Loganathan et al. (2001), Dethe and Patil (2008), Patel et al. (2009) and Saravanan et al. (2009). The estimates of relative heterosis for number of branches per plant indicated that seventeen hybrids had significant and positive heterosis in desired direction. Cross combination Co-4 x Meha (36.21 per cent) had the highest heterobeltiosis and standard heterosis over check 1 Co-4 (36.21) and check 2 GBM-1 (49.09). For number of clusters per plant thirteen hybrids have shown significant and positive relative heterosis where as the hybrid Co-4 x Meha (31.25 per cent) exhibited significant heterobeltiosis and standard heterosis of (31.25 per cent and 47.97 per cent) in case of checks Co-4 and GBM-1 respectively. In case of number of pods per plant thirteen hybrids exhibited significant positive heterosis over mid parent and the hybrid Co-4 x Meha (34.49 per cent) exhibited the maximum heterosis over their better parent. The hybrids Co-4 x Meha and Co-4 x GBM-1 were the top performer with 34.49 per cent and 18.96 per cent of standard heterosis in case of check Co-4 and 63.14 per cent and 44.30 per cent of standard heterosis in case of check GBM-1 respectively. Seventeen hybrids registered significant positive heterosis over mid parent for pod length with the hybrid Co-4 x GBM-1 (16.98 per cent) on the top for heterobeltiosis while, this cross combination also expressed the maximum economic heterosis of 20.39 per cent over check Co-4 and 16.98 per cent over check GBM-1. The estimates of relative heterosis for number of seeds per pod indicated that seventeen hybrids had significant heterosis in desired direction. The highest heterobeltiosis to the extent of 14.52 per cent was recorded by Rm-9-129 x Rm-9-134. The cross combination Co-4 x GBM-1 retained the top position with the standard heterosis of 18.75 per cent and 13.77 per cent over the checks Co-4 and GBM-1 respectively. In case of seed yield thirteen hybrids exhibited significant positive relative heterosis and the combinations Co-4 x Meha (37.23 per cent) was recognised as the most promising one in case of heterobeltiosis. With respect to standard heterosis the hybrids Co-4 x Meha (37.23 per cent) followed by Co-4 x GBM-1 (16.83 per cent) were found as be the best performer in case of check Co-4 while in case of check GBM-1 also these hybrids retained their position in the same manner with the economic heterosis of 82.20 per cent and 55.11 per cent respectively. Ten hybrids exhibited significant positive relative heterosis for 100 seed weight whereas, the combination Rm-9-133 x Meha (18.45 per cent) noted the highest heterobeltiotic effect for 100 seed weight. Hybrids Co-4 x Meha recognized with maximum heterosis of 12.83 per cent and 24.58 per cent over the checks Co-4 and GBM-1 respectively. Thirteen hybrids had significant and positive relative heterosis for straw yield while the cross combination Co-4 x Meha (33.19 per cent) was associated with maximum heterosis over their better parent and this cross combination also demonstrated positive significant heterosis over check Co-4 (33.19 per cent) and over check 2 GBM1 (58.51 per cent). The estimates of relative heterosis for harvest index

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<td>C.D. at 1%</td>
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* Significance at 5 % level  ** Significance at 1 % level

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indicated that five hybrids had significant and positive heterosis, while none of the hybrid has shown significant positive heterosis over better parent and the check Co-4 and GBM-1. Fourteen hybrids have shown significant and positive mid parent heterosis for protein content. The hybrids Rm-9-133 x Rm-9-126 (6.62 per cent) showed the highest heterosis over better parent and also recorded the highest standard heterosis of 9.72 per cent and 10.43 per cent over the checks Co-4 and GBM-1 respectively. Similar findings were also reported in greengram by Reddy (1998), Joseph and Santoshkumar (2000), Sawale et al. (2003), Anbumalarthi et al. (2004), Kumar et al. (2007), Barad et al. (2008), Dhuppe et al. (2010) and Reddy et al. (2011).

The study of heterobeltiosis and standard heterosis for seed yield/plant and its component revealed that the cross combination Co-4 x Meha expressed the highest heterobeltiosis and standard heterosis along with the crosses Co-4 x GBM-1 and GBM-1 x Meha (Table 2). Theses crosses also manifested the high better parent and standard heterosis for the other yield attributing traits like plant height, branches per plant, clusters per plant, pods per plant, pod length, seeds per pod, 100 seed weight and straw yield. This implies that heterosis is a complex character like yield and can be expressed by single or several gene combinations. As these crosses showing heterosis for seed yield also exhibited high heterosis for straw yield suggesting straw yield at harvest might play an important role in heterosis of seed yield thus heterosis for straw yield can be used reliably as an index for predicting heterosis for seed yield between genotypes of mungbean. For harvest index it was observed that only numerical increment was observed against all checks, which might be due to its high energy consumption for biomass rather than economic part. On the whole, considerable heterobeltiosis and standard heterosis observed for seed yield and other associated characters suggested the presence of large genetic diversity among the genotypes and also the unidirectional distribution of allelic constitution towards desirable heterosis in the present material. Low magnitude of desirable heterosis and heterobeltiosis was observed for some of the characters viz., harvest index, straw yield, days to flowering, days to maturity, and 100-seed weight (g) indicating the narrow genetic base among the genotypes and also the ambidirectional distribution of allelic constitution contributing towards undesirable heterosis or may be due to mutual cancellation of effect of dominant alleles present in the material.

Out of twenty one crosses studied, the most promising combinations which showed heterotic expression for seed yield and yield attributing components viz., plant height, branches per plant, clusters per plant, pods per plant, pod length, seeds per pod, 100 seed weight and straw yield over better parent and standard check were Co-4 x Meha, Co-4 x GBM-1, GBM-1 x Meha and Rm-9-129 X Co-4, suggesting the predominance of additive gene action for seed yield heterosis. Therefore exploitation of these hybrids could be more rewarding for breeding programme.

REFERENCES