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Heterosis for seed yield and yield attributing characters in mungbean (Vigna radiata (L.) Wilczek)

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Abstract

Twenty eight mungbean hybrids derived from 8 x8 diallel excluding reciprocal crosses were studied to know the magnitude of heterosis, heterobetiosis and standard heterosis for yield and its component characters in mungbean. The hybrids with maximum heterosis were ML131 x K851 for 50 % flowering, BM-4 x K-851 for pods per plant, ML-5 x Malviva Jyoti for seeds per pod, ML-5 x Pairy mung and K-851 x TARM-1 for primary branches per plant, Pusa vishal x Malviya Jyoti for days to maturity. Heterosis was significant and positive for seed yield per plant for cross ML131 x TARM-1, (17.01) followed by Pusa vishal x Malviya Jyoti (15.52) hence, heterosis may be of greater significance for crop improvement programme, and it can be exploited for commercial purpose.

Keywords: mungbean, heterosis, heterobeltiosis

Introduction

In India, mungbean (*Vigna radiata* (L.) Wilczek) (2n= 2x= 22) is an important pulse after bengalgram and redgram crop. It is short duration legume crop, grown in all the three seasons' *viz.*, Kharif, Rabi and summer. In summer, the crop can be grown both as sole crop after wheat or in fields vacated by crops like potato, musterd and rice. The present yield potential of improved varieties is not enough to attract the farmers or consumers because of relatively smaller seed size and susceptibility to diseases. For this, study of heterosis in mungbean is important for the plant breeder to find out the superior crosses in first generation itself. Heterosis or hybrid vigour is manifested by F_1 hybrids. The estimates of heterosis also provide information about the nature of gene action involved in the expression of yield and its components characters. Heterosis may be defined as the superiority of an F_1 hybrid over both its parents in terms of yield and some other characters. Generally, heterosis is manifested as an increase in vigour, size, growth rate, yield or some other characteristics. But in some cases, the hybrid may be inferior to weaker parent. This is also heterosis. Often the superiority of F_1 is estimated over the average heterosis or relative heterosis. When heterosis is estimated over the best commercial variety or standard variety or local check, it is called standard or economic or useful heterosis.

The presence of heterosis in food legumes for grain yield and its components has been reported by several workers e.g., Gawande *et al.* (2001) [1], Khattak *et at.* (2002) [2], Xin *et al.* (2003) [9], Soehendi *et al.* (2005), Kumar *et al.* (2007) [7] and Sreelakshmi *et al*. (2012). Therefore, the present investigation was carried out to estimate the magnitude of heterosis in thirty six hybrids of mungbean.

Materials and Methods

Eight genotypes of mungbean *viz.*, ML-131, BM-4, ML-5, Pusa vishal, Malviya jyoti, Pairy mung, K-851 and TARM-1 were crossed in a diallel fashion (excluding reciprocal crosses) during Kharif, 2014. The parents and F_1 were sown in summer, 2015 in a field in a random block design (RBD) with three replications at Department of Genetics and Plant Breeding, SHIATS, Allahabad. Row to row and plant to plant distance was maintained at 30 x 10 cm, respectively. Observations were recorded on 5 random plants in parents and F_1 in each replication for days to 50% flowering, pods per plant, seeds per pod, days to maturity, 100 seed weight (g) and seed yield per plant (g). Heterosis and heterobeltiosis were calculated as present values, respectively. The increase or decrease over better parent of the experiment was also calculated. The mean values of the data recorded for seed yield per plant and their attributing characters in mungbean were subjected to half diallel fashion analysis of Griffing 1956 (Model- I) Method- 2 and heterosis over better parents (BP) and economic heterosis (EH) were calculated and tested as specified by Hays, (1955) [5].

Results and Discussion

Heterosis, a fundamental tool, used for the improvement of crops in the form of F_1 and F_2 populations by improving various yield contributing characters. The result exhibited that the significant heterosis occurred in the hybrids for 50% flowering, number of primary branches, number of clusters per plant, number of pods per plant, number of seeds per pod, days to maturity, 100 seed weight and seed yield per plant. (Dethe *et al*., 2008 [1], Dhuppe *et al*., 2010 [2], Suresh *et al*., 2010 and Zubair *et al*., 2010 [10].

Many crosses exceeded their performance beyond the lower and/ or upper limit of parents for various characters in desirable direction (Table 1). Based on the best crosses on heterobeltiosis identified for each character were ML-131 x K-851 for Days to 50% flowering, ML-5 x Malviya Jyoti for Primary Branches per plant, BM 4 x K-851 for Pods per plant, Pusa vishal x Malviya Jyoti for Cluster per plant, Pusa vishal x Malviya Jyoti for Seed per pod, Pusa vishal x Malviya Jyoti for Days to maturity, BM 4 x TARM-1 for 100 seed weight.

For earliness, a negative heterobeltiosis for days to 50% flowering and days to maturity is desirable. Only 16 showed significant negative heterosis over better parents, whereas, 16 showed significant negative heterosis over standard heterosis. Maximum negative heterobeltiosis (-9.63**) was observed in (ML-131 x K-851) followed by (ML-5 x K-851) and (Pusa vishal x K-851) (-6.67**). This suggests that while selecting parents and crosses for early maturity due considerations should be given to heterobeltiosis and F_1 rather than to magnitude of heterosis. Out of 28 crosses, (ML-5 x Malviva Jyoti, (10.00**) followed by Pusa vishal x Malviya Jyoti, (6.67*) and respectively ML-5 x Malviva Jyoti (8.55**) exhibited significant positive heterobeltiosis and for seeds per pod. The two and five crosses show positive heterobeltiosis and standard heterosis for primary branches per plant. Highest positive significant heterobeltiosis (26.19**) was obtained in crosses ML-5 x Malviya Jyoti. Number of primary branches per plant is generally associated with higher productivity. Hybrid ML5 x Malviya Jyoti (55.88**) showed high positive significant economic heterosis for seeds per pod.

Table 1: Range of heterosis (%) for 6 characters in mungbean

Characters	BP	EH
Days to 50% flowering	-9.63** to 3.88**	-8.59** to 4.69**
Pri. Branches/ plant	-28.57** to 26.19**	-32.35** to 55.88**
Pods per plant	-16.67** to 15.36**	-25.22** to 12.90**
Clusters per plant	-42.50** to 11.67**	-27.78** to 48.89**
Seed per pod	-16.22** to 6.67*	-18.42** to 8.55**
Days to maturity	-5.08** to 2.15**	-6.70** to 0.48
100 seed weight	52.87** to 11.40	-14.70** to 22.76**
Seed yield per plant	-36.20** to 10.81	-35.51** to 18.84**

BP=Better parent, EH= Economic heterosis

Table 2: The best crosses selected for different characters on the basis of heterobeltiosis and standard heterosis.

Characters	Best crosses based on heterobeltiosis	Heterosis (%)	Best crosses based on economic heterosis	Heterosis (%)
Days to 50% flowering	ML-131 x K-851	-9.63**	ML-5 x Malviya Jyoti	-8.59**
	ML-5 x K-851	-6.67**	Pusa vishal x Malviya Jyoti	-7.03**
	Pusa vishal x K-851	-6.67**		
Pri. Branches/ plant	ML-5 x Malviya Jyoti	26.19**	ML-5 x Malviya Jyoti	55.88**
Pods per plant	BM 4 x K-851	15.36**	ML-5 x Malviya Jyoti	12.90**
	Pairy mung x K-851	15.00**		
Clusters per plant	Pusa vishal x Malviya Jyoti	11.67**	Pusa vishal x Malviya Jyoti	48.89**
	-	-	ML-5 x Malviya Jyoti	44.44**
Seeds per pod	Pusa vishal x Malviya Jyoti	6.67*	ML-5 x Malviya Jyoti	8.55**
Days to maturity	Pusa vishal x Malviya Jyoti	-5.08**	ML-5 x Malviya Jyoti	-6.70**
	ML-5 x Malviya Jyoti	-4.51**	Pusa vishal x Malviya Jyoti	-5.26**
100 seed weight	BM 4 x TARM-1	52.87**	ML-5 x Malviya Jyoti	22.76**
	Pusa vishal x Malviya Jyoti	49.93**	Pusa vishal x Malviya Jyoti	14.81**
Seed yield per plant	-	-	ML-5 x5	18.84**
	-	-	Pusa vishal x5	15.94**

20 and 2 crosses exhibited significant positive heterobeltiosis and standard heterosis for 100 seed weight. It is indicating that significant contribution in producing better F_1 with high test weight. Whereas, two crosses ML-5 x Malviya Jyoti (18.84**) and Pusa vishal x Malviya Jyoti (15.94**), exhibited significant positive standard heterosis for seed yield per plant and there is no positive significant heterobeltiosis for seed yield per plant.

Estimates of significant positive as well as negative heterosis and heterobeltiosis were obtained by many crosses for different characters studied. High values for heterotic effects indicated that the parents used for the study were widely diverse. Considerable high heterosis for certain hybrids and low in remaining hybrids, revealed that nature of gene action varied with the genetic architecture of the parents. Such nature as well as magnitude of heterosis helps in identifying superior cross combination.

In the present study out of 28 crosses, 11 crosses for days to flowering, 12 crosses for plant height, 7 crosses for primary branches per plant, 2 crosses for clusters per plant, 17 crosses for pods per plant, 26 crosses for pod length, 28 crosses for 100 seed weight and three for seed yield per plant depicted significant relative heterosis in desired direction.

Conclusion

On the basis of present study it is concluded that crosses ML-5 x Malviya Jyoti (18.84**) and Pusa vishal x Malviya Jyoti (15.94**) showed high significant positive economic heterosis for crop improvement. The results indicated that exploitation of the heterosis heterobeltiosis and standard heterosis might be one of the promising methods to effect crop improvement in mungbean for seed yield and other traits.

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