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Pankaj R Sante
ASPEE College of Horticulture and Forestry, Navsari, Gujrat, India

AI Patel
ASPEE College of Horticulture and Forestry, Navsari, Gujrat, India

TS Lachyan
College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra, India

RB Dhole
College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra, India

NR Phutankar
College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra, India

Correspondence
Pankaj R Sante
ASPEE College of Horticulture and Forestry, Navsari, Gujrat, India

Genetic studies of yield and yield attributing traits in vegetable Indian bean (*Lablab Purpureus* (L) Sweet.)

Pankaj R Sante, AI Patel, TS Lachyan, RB Dhole and NR Phutankar

Abstract
Lablab purpureus (L.) Sweet (Syn. *Dolichos lablab* L., 2n=22), self-pollinating crop, is an important legume as well as vegetable crop cultivated in India. In self-pollinated crop, variability is often created through hybridization between carefully chosen parents. The scope of exploitation of hybrid vigour will depend on the direction and magnitude of heterosis. In the present investigation, information on magnitude on heterosis were obtained for green pod yield per plant and its related components adopting full diallel analysis involving six diverse parents and its resultant thirty hybrid of vegetable Indian bean tested at Regional Horticulture Research Station, Navsari Agricultural University, Navsari during late in a randomized block design with three replications. Significant to highly significant positive heterosis for green pod yield per plant and its component characters were recorded by GNI-7 × GNI-5, GNI-5 × GNI-7, GNI-4 × GNI-7, GNI-7 × GNI-4, GNI-7 × GNI-14, GNI-14 × GNI-7 (Direct as well as reciprocals) showed high standard heterosis in positive direction for green pod yield per plants in Vegetable Indian bean. The maximum value of standard heterosis for green pod yield per plant observed for GNI-7 × GNI-5 over the commercial check (Gujarat papdi-1). The high heterotic response in this hybrid for green pod yield per plant resulted mainly due to the number of pods per plant and number of seeds per plant.

Keywords: Lablab purpureus, heterosis, diallel analysis

1. Introduction
Lablab purpureus (L.) Sweet (Syn. *Dolichos lablab* L., 2n=22) is an important legume as well as vegetable crop cultivated in the tropical region of Asia, Africa and America. It is commonly called hyacinth bean, bonavist bean, Indian bean, and "wal papdi in Gujarat state". It belongs to the family *Fabaceae*. In India, two botanical varieties are recognized and are sometimes considered as distinct species *vizs.*, *Dolichos lablab* var. *typicus prain*, is a garden type and cultivated for its soft and edible pods as an annual in nature and *Dolichos lablab* var. *lignosus* (L.) *prain*, is known as field bean, mainly cultivated for dry seed as a pulse, is bushy perennial (Purseglove, 1968) [10].

In self-pollinating crop like Indian bean, variability is often created through hybridization between carefully chosen parents. The scope of exploitation of hybrid vigour will depend on the direction and magnitude of heterosis. The information of such estimates is essential to plan efficient breeding programme for the improvement of the crop. Although the hybrid vigour can't be exploited commercially in highly self-pollinated crop like Indian bean, the heterotic F_1s can be used to isolate a higher frequency of productive derivatives in their later generation.

Choise of parents is concidered an important aspects in any breeding programme aimed at improving yield and its related attributes because the high yielding parent may not necessarily transfer its superiority to the progenies in the crosses. Land races, which are storehouse of genetic variability and ordinarily, are primitive varieties evolved without a systematic and sustained plan breeding efforts. It is therefore, necessary to identify promising lines, land races and involve them in crosses with appropriate mating design. The diallel crossing technique which was developed by Griffing (1956) [3, 4] is widely used for this study. In present study, we assess the nature and magnitude of heterotic expression for various characters.

2. Material and Methods
The present investigation was taken up to elicit information on heterosis for green pod yield and its component traits in vegetable Indian bean. The crossing programme carried out during late and an experiment was carried out during late at Vegetable Research Scheme, Regional

Horticulture Research Station (R.H.R.S), Navsari Agricultural University, Navsari which falls under the tropical zone characterized by fairly hot *summer*, moderately cold winter and warm heavy. The recommended agronomic practices and plant protection measures were adopted for raising a good crop. Observation were recorded on randomly selected five plants for thirteen quantitative traits *vizs*., Days to 50% flowering, Plant height (cm), Number of Primary branches per plant, Days to first picking, Days to last picking, Pod length (cm), Number of pods per plant, Number of seeds per pod, Average pod weight (g), Green pod yield per plant (g), Seed index (%), Shelling percentage (%) and Protein content (%). The data was analysed to compute heterosis (%) over standard check (SH) values.

The six parental genotypes were crossed in diallel fashion (including reciprocals) which resulted in thirty hybrids. The crosses were made during late. The emasculation and pollination was done as per method proposed by Rachie *et al*. (1975) [11]. The seeds of thirty crosses and six parents were collected separately. At the same time, all the six lines were selfed, so as to get sufficient seeds for the experiment. After pollination, the flowers tagged and labeled properly. The seeds of thirty (30) F_1s crosses and six parents were collected separately**.**

3. Results and Discussion

The analysis of variance for parents, hybrid, parents vs. hybrid, reciprocals computed for different 13 characters under investigation were presented in table 1.

The means squares due to treatments, hybrids, reciprocal and parents were found highly significant for all the characters except shelling percentage for treatments, days to 50% flowering and shelling percentage for hybrids and reciprocals and days to 50% flowering and number of primary branches per plant for parents showing sufficient variability among the treatment as well as parents, and reciprocals for the characters under studied and thus there had been chance for the improvement.

The heterotic response of F_1s is indicative of genetic diversity among the parents involved (Kadam *et al.,* 2013) [5]. In the present investigation the standard heterosis ranged from 26.97 to 43.97 for green pod yield per plant. The maximum standard heterosis recorded by crosses GNI-7 x GNI-5 (43.97%), GNI-5 x GNI-7 (43.89%), GNI-4 x GNI-7 (35.60%), GNI-7 x GNI-4 (34.19%), GNI-7 x GNI-14 (31.17%) and GNI-14 x GNI-7 (29.04%) (Table 3). Almost identical results have been reported by Aravindhan and Das (1996) [1, 9], Ponmariammal and Das (1996) [1, 9], Shashibhushan and Chaudhari (2000) [12], Patil *et al*. (2005) [8], Patel *et al.* (2009) [7] and Ushakumari *et al.* (2010) [13], Kadam *et al.* (2013) [5] in cow pea. It is interesting to note that top ranking crosses based on *per se* performance and standard heterosis was same.

The best cross showing high standard heterosis and their performance for green pod yield per plants and related parameters had been summarized in table 3. Out of these six top yielding cross only one cross GNI-5 x GNI-7 showed significant negative, which is desirable for plant height. These result revealed that plant height may be consider as major yield component in vegetable Indian bean**.**

The standard heterosis ranged from 1.11 (GNI-4 × GNI-5) to 44.56 (GNI-5 × GNI-7) for seed index. All the six crosses showed significant and standard positive heterosis for seed index (table 3). The seed index might be resulted in to increasing weight of pod which resulted in higher green pod yield per plant. These results were in agreement with those reported by several early workers like Shashibhuasa and Kadam *et al.* (2013) [5] in cowpea.

For shelling percentage range of heterosis varied from -5.75% (GNI –23 × GNI – 5) to 7.91% (GNI-7 x GNI-14) and for protein contain economic heterosis varied from -11.25 (GNI – 4 × GNI – 5) to 8.40 per cent (GNI – 5 × GNI – 7). The present finding is in close association with the result reported by Patel *et al.* (2009) [7] and Kadam *et al.* (2013) [5] in cow pea.

The heterosis for number of seeds per pods, number of pods per plant, pod length (cm) and average pod weight, positive heterosis is desirable. The range of heterosis for number of seeds per pod over standard check varied from 24.79 (GNI –7 × GNI – 14) to 35.10 per cent (GNI – 7 × GNI – 5) for best six crosses. The range of heterosis for number of pods per plant and pod length over standard check varied from 22.44 (GNI –14 × GNI – 7) to 28.29 per cent (GNI – 7 × GNI – 5) and -18.00 (GNI –4 × GNI – 7) to 2.14 (GNI –7 × GNI – 5) for best six crosses respectively. Similarly the range of heterosis for average pod weight over standard check varied from 5.08 (GNI –7 × GNI – 14) to 16.52 per cent (GNI – 5 × GNI – 7) for best six crosses. Expression of heterosis for green pod yield and its component was related to the gca effects of parents. Most of the high heterotic crosses involved at least on parent with high gca effect. The similar finding was resulted by Bhuwaneswari and Muthiah (2005) [2] in Indian bean and Kadam *et al.* (2013) [5] in cow pea.

Heterosis for Days to 50% flowering, Days to first picking and Days to last picking range from -1.17 (GNI –7 × GNI – 14) to 0.53 (GNI –5 × GNI – 7), -3.88 (GNI –7 × GNI – 14) to 3.83 (GNI –14 × GNI – 7) and -8.08 (GNI –7 × GNI – 14) to 4.00 (GNI –7 × GNI – 4) respectively for the best six crosses. The similar results revealed by Kadam *et al.,* (2013) [5] and Pal *et al*., (2007) [6].

Table 1: Comparison of top six promising crosses for green pod yield per plant on the basis of per se performance, standard heterosis, sca effects

Sources of variation	Replications	Treatments	Parents	Hybrids	Parents Vs Hybrids	Reciprocal	Error	Total
d.f	2	35	5	29	1	14	70	107
Days to 50 per cent flowering	11.08	18.04*	7.16	20.31*	6.67	16.95	10.84	13.2
Plant height (cm)	46.71	632.93**	1818.74**	445.73**	132.58	348.99**	63.98	249.76
Number of branches per plant	0.1	1.78**	0.16	2.04**	2.30**	2.04**	0.08	0.64
Number of days to first picking	7.95	69.32**	90.06**	62.19**	172.27**	49.12**	18.31	34.8
Number of days to last picking	8.53	198.85**	395.87**	155.90**	459.27**	99.80*	52.24	99.38
Pod length (cm)	0.24	2.53**	0.42**	2.83**	4.31**	3.01**	0.08	0.89
Number of pods per Plant	32.56	397.69**	180.47**	407.46**	1200.49**	418.83**	17	141.82
Number of seeds per pod	0.1	0.81**	0.47**	0.78**	3.42**	0.80**	0.09	0.33
Average pod weight	3.53	13.94**	8.52**	14.53**	23.86**	16.40**	1.8	5.8
Green pod yield per plant (g)	127.63	2977.53**	560.56*	3143.91**	10237.21**	3140.35**	227.48	1125.16
Seed index (%)	21.13	83.06**	402.37**	25.35**	160.08**	24.70**	10.33	34.32
Shelling percentage	9.66	21.90*	59.95**	14.71	40.41	14.09	11.37	14.78
Protein content (%)	0.01	3.44**	4.09**	3.40**	1.78	1.96**	0.71	1.59

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

Table 2: Range of mean and heterosis per cent per yield and yield attributing characters in vegetable Indian bean.

Sr. No.	Characters	Range of Means		Standard check (Gujarat papdi-1)
		parents	crosses	
1	Days to 50 per cent flowering	58.00 to 62.00	55.67 to 67.00	-14.37** to 3.08
2	Plant height (cm)	130.68 to 197.35	131.17 to 180.77	-12.56** to 20.51**
3	Number of branches per plant	4.52 to 5.17	4.16 to 6.67	-36.08** to 2.51
4	Number of days to first picking	74.33 to 87.00	68.67 to 89.33	-7.21 to 20.72**
5	Number of days to last picking	112.67 to 141.33	102.67 to 142.67	-12.99** to 20.90**
6	Pod length (cm)	4.52 to 5.02	4.13 to 7.15	-40.95** to 2.14
7	Number of pods per Plant	62.09 to 83.06	62.01 to 100.06	-20.50** to 28.29**
8	Number of seeds per pod	4.12 to 5.20	3.55 to 5.85	-18.09** to 35.10**
9	Average pod weight	15.86 to 19.50	15.35 to 23.30	-23.27** to 16.52**
10	Green pod yield per plant (g)	114.50 to 151.00	114.66 to 226.03	-26.97** to 43.97**
11	Seed index (%)	13.43 to 43.03	30.33 to 43.37	1.11 to 44.56**
12	Shelling percentage	47.75 to 59.47	51.84 to 59.35	-5.75 to7.91
13	Protein content (%)	19.44 to 22.52	18.99 to 23.20	-11.25** to 8.40*

Table 3: Promising hybrids for green pod yield per plant with standard check, their SCA, GCA effects and component character showing significant desired heterosis in Vegetable Indian bean

Sr. No	Hybrids	Mean yield per plant (g)	Standard heterosis (%)	SCA Effect	GCA effect		Significant standard heterosis in other traits in desirable direction
					P-1	P-2	
1.	GNI-7 X GNI-5 (Reciprocal cross)	226.03	43.97**	0.07	25.04** (G)	1.78 (A)	Number of pods per plant, Number of seeds per pod, Average pod weight, Seed index (%),Shelling percentage, Protein content
2.	GNI-5 X GNI-7 (Direct cross)	225.90	43.89**	50.87**	1.78 (A)	25.04** (G)	Plant height, Number of pods per plant, Number of seeds per pod, Average pod weight, Seed index (%), Protein content
3.	GNI-4 X GNI-7 (Direct cross)	212.89	35.60**	36.75**	1.72 (A)	25.04** (G)	Number of pods per plant, Number of seeds per pod, Seed index
4.	GNI-7 X GNI-4 (Reciprocal cross)	210.68	34.19**	1.10	25.04** (G)	1.72 (A)	Number of pods per plant, Number of seeds per pod, Seed index
5	GNI-7 X GNI-14 (Direct cross)	205.93	31.17**	28.41**	25.04** (G)	2.54 (A)	Number of pods per plant, Number of seeds per pod, Seed index
6.	GNI-14 X GNI-7 (Reciprocal cross)	202.60	29.04**	1.67	2.54 (A)	25.04** (G)	Number of pods per plant, Number of seeds per pod, Seed index

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

4. Conclusion

The present study revealed that out of 30 hybrids, six had significant and positive heterosis over commercial check Gujarat papdi-1 for green pod yield per plant. The maximum value was recorded for hybrid GNI-7 x GNI-5 (43.97) over the standard check (Gujarat papdi-1). This hybrid also exhibited high standard heterosis for number of pods per plant and number of seeds per pod. In present investigation of these top six performing hybrids thus clearly indicates that as the high heterosis for green pod yield per plant coupled with high heterosis for yield attributes suggest that there is a predominance of additive gene action for green pod yield per plant heterosis.

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