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Varietal response of Indian bean (*Lablab purpureus* L.) for biofertilizers

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Abstract
The present investigation entitled "varietal response of Indian bean (*Lablab purpureus* L.) for biofertilizers" was carried out during *kharif* season 2020-21 at College farm, College of Horticulture, Sardarkrushinagar Dantiwada Agricultural University, Jagudan, Dist. Mehsana, Gujarat, India. There were twelve treatments having the various combinations of varieties (GJIB 2, GJIB 11, GNIB 22, and Arka Jay) along with different biofertilizers (*Rhizobium*, PSB, *Rhizobium* + PSB). Treatments were replicated thrice in a randomized block design with factorial concept. The observations were recorded and subjected to statistical analysis as per the standard procedure. Variety GJIB 11 (v_2) registered minimum days taken for 50% germination (4.00), while maximum plant height at 60 DAS (114.68 cm) and at final harvest (166.02 cm), number of branches per plant (28.29), pods per cluster (6.73), days taken for last picking (155.56), yield per plant (306.03 g), per plot (2.82 kg) and per hectare (139.09 q). Whereas, variety GNIB 22 (v_3) was found superior by recording minimum days taken for initiation of flower (41.53), first picking (74.91) and recorded maximum number of clusters per plant (25.44) as well as pickings (9.11). Application of biofertilizer Rhizobium + PSB (b_3) enhanced the plant height at 60 DAS (76.41 cm) and at final harvest (109.93 cm). Whereas, increase number of branches per plant (23.97), cluster per plant (18.39), yield per plant (229.71 g), yield per plot (2.14 kg) and yield per hectare (105.56 q) of Indian bean. The interaction effect of varieties and biofertilizers were found non-significant for all characters.

Keywords: Varietal, bean, biofertilizers, *Lablab purpureus* L.

Introduction
Indian bean (*Lablab purpureus* L.) is a sweet, bushy semi-erect herb belongs to family Fabaceae with 2n = 22 chromosomes. Its green pods and seeds are highly nutritive in nature and are rich in carbohydrates (6.7 g), protein (3.8 g), fat (0.7 g), minerals (0.9 g), magnesium (34.0 g), calcium (210 mg), phosphorus (68.0 mg), sodium (55.4 mg), iron (1.7 mg), potassium (74.0 mg), sulphur (40.0 mg), vitamin A (312 IU), riboflavin (0.06 mg), vitamin C (9.0 mg), nicotinic acid (0.7 mg) and fiber (1.8 g) per 100 g of edible portion. (Thamburaj and Singh, 2003) [26]. Pre sowing seed treatment is the treatment given to the seeds before sowing to improve the early germination, vigour and maintain the health of the seed. Seed treatment describes both specific products and specific techniques, which can improve the micro environment for the germination of seeds. Biofertilizers play an important role in increasing availability of nitrogen and phosphorus. They increase the biological fixation of atmospheric nitrogen and enhance phosphorus availability to the crop. The seeds treated with bacterial culture of *Rhizobium* increase nodulation and influence yield as well as economize the input cost of fertilizer to some extent. It also renders protection against soil deterioration and environmental pollution caused by heavy use of chemical fertilizers. The efficient strain of *Rhizobium* can fix about 90 kg of nitrogen per hectare in one season and enrich soil nitrogen (Mishra *et al.*, 2013) [9]. Among the biofertilizers, PSB possess the ability to bring insoluble phosphate in soluble form by secreting organic acid which is available for plant. PSB also decomposes soil protein and produce ammonia, which may serve as source of nitrogen for crop growth and thereby increase soil micro flora, causes reduction in toxic substances produced by plant pathogens. Inoculation of seeds with *Rhizobium* and PSB culture increase nodulation, crop growth, nutrient uptake and crop yield (Shrivastava and Ahlawat, 1993) [22].

Materials and Methods

The experiment was comprised with two factors with four different varieties (GJIB 2, GJIB 11, GNIB 22 and Arka Jay) and three levels of biofertilizers (*Rhizobium* culture, PSB and *Rhizobium* culture + PSB). Plants were sown at a distance of 75 cm × 30 cm. The mean data of five selected and tagged plants were recorded on days taken for 50% germination, plant height at 60 DAS and at final harvest (cm), number of branches per plant, days taken for initiation of flower, days taken for first picking, days taken for last picking, number of pods per cluster, number of clusters per plant, number of pickings, yield per plant (g), yield per plot (kg) and yield per hectare (q) was subjected to statistical analysis following analysis of variance technique (Panse and Sukhatme, 1985) [11].

Results and Discussion

Growth parameters

Significantly minimum days taken for 50%germination (4.00) was observed in variety GJIB 11 (v_2), which was statistically at par with variety Arka Jay (v_4). It is due to genetic characteristics of the varieties. These results are in conformity with the findings of Pawar *et al.* (2016) [15] in cowpea and Anupama *et al*. (2016) [2] in cluster bean.

Significantly maximum plant height at 60 days after sowing (114.68 cm) and last picking (166.02 cm) was recorded in variety GJIB 11 (v_2). This might be due to genetical variability of varieties. This type of varietal difference was also reported by Ro *et al.* (2019) [20], Champaneri *et al.* (2020) [3] and Desai *et al.* (2020) [5] in Indian bean. Maximum plant height at 60 days after sowing (76.41 cm) and at last picking (109.93 cm) was observed with *Rhizobium* + PSB(b_3). It may be due to the biosynthesis of growth promoting substances like vitamin B_{12} and auxin (Patel *et al.*, 2018) [12]. These results are in close conformity with the findings of Champaneri *et al.* (2020) [6] in Indian bean, Anupama *et al.* (2016) [2] and Prajapati *et al.* (2017) [16] in clusterbean and Shalu and Rattan (2023) [21] in pea.

Maximum number of branches per plant (28.29) were recorded in variety GJIB 11 (v_2), which was statistically at par with varieties GJIB 2 (v_1). The variation in the number of branches of different varieties could be assigned to their genetical behavior. This type of varietal difference was also reported by Champaneri *et al.* (2020) [6] in Indian bean, Anupama *et al*. (2016) [2] in cluster bean. Treatment *Rhizobium* + PSB (b_3) produced significantly maximum number of branches per plant (23.97), which was statistically at par with treatment *Rhizobium* (b_1). It is due to the fact that *Rhizobium* + PSB inoculation may be attributed to increased nodulation implies greater symbiotic fixation of atmospheric nitrogen, conversion of unavailable phosphorus to available forms particularly during the early crop growth phase which would have helped in the absorption of all major and minor nutrient required for the plant to put forth early vigour in vegetative phase and helps to increase number of branches per plant (Prasad *et al.* (2013) [17] in cowpea). Similar results have been also obtained Nadeem *et al.* (2018) [10] in cowpea, Choudhary *et al.* (2014) [4] and Anupama *et al*. (2016) [2] in clusterbean, Ramana *et al.* (2011) [18] in French bean, Patel *et al.* (2013) [14] in green gram and Shalu and Rattan (2023) [21] in pea.

Minimum days taken for initiation of flower (41.53) was observed with variety GNIB 22 (v_3), which was statistically at par with the variety Arka Jay (v_4) *i.e.* 43.40. Variety GNIB 22 requires minimum days taken for initiation of flower. It is due to genetic characteristic of the varieties. These results are in conformity with the findings of Dewangan *et al.* (2018) [7] in Indian bean, Anupama *et al*. (2016) [2] and Reddy *et al.* (2017) [19] in clusterbean.

Minimum days taken for first picking (74.91) was observed in variety GNIB 22 (v_3), which was at par with variety Arka Jay (v_4) *i.e.* 76.93. The variation in days taken for first picking under different varieties could be attributed to its inherent genetic setup and or adoptability to climate and soil condition of this region. Such type of varietal difference was also reported by Singh *et al.* (2011) [23], Dewangan *et al.* (2018) [7], Ro *et al.* (2019) [20] and Champaneri *et al.* (2020) [3] in Indian bean, Anupama *et al*. (2016) [2] in cluster bean and Amin *et al.* (2014) [1] in cowpea.

Significantly a minimum day taken for last picking (139.89) was observed in variety GNIB 22 (v_3). The variation in days taken for last picking under different varieties attributed to its inherent genetic setup and adoptability to climate and soil condition of this region. Such type of varietal difference was also reported by Dewangan *et al.* (2018) [7] in Indian bean, Pawar *et al.* (2016) [15] in cowpea.

Yield parameters

Significantly maximum number of pods per cluster (6.73) was recorded in variety GJIB 11 (v_2). Variety GJIB 11 (v_2) was significantly superior to other varieties with respect to number of pods per cluster, as it is a varietal character. The difference in number of pods per cluster of various variables may be due to its inherent genetic set up and suitability of climate and soil conditions of this region. These results are in line of the findings reported by Singh *et al.* (2011) [23] in Indian bean, Anupama *et al*. (2016) [2] and Reddy *et al.* (2017) [19] in clusterbean and Ramana *et al.* (2011) [18] in French bean.

Maximum number of clusters per plant (25.44) was observed in variety GNIB 22 (v_3). GNIB 22 (v_3) registered significantly superior to other varieties. The variation in various variables could be assigned to their inherent characteristic. Such type of varietal difference was also reported by Singh *et al.* (2011) [23] and Ro *et al.* (2019) [20] in Indian bean, Anupama *et al*. (2016) [2] in clusterbean, Ramana *et al.* (2011) [18] in French bean and Amin *et al.* (2014) [1] in cowpea. Significantly maximum number of clusters per plant (18.39) was observed with the treatment b_3 (*Rhizobium*+ PSB). Significantly higher number of clusters per plant was registered under the treatment *Rhizobium* + PSB (b_3). This might be due to the seed inoculation with *Rhizobium* + PSB increase the nitrogen fixing and converted insoluble phosphorus into available form. The enhanced availability of P increase rate of photosynthesis and consequently led to better number of clusters per plant (Patel *et al.* (2013) [14] in greengram). This finding corroborates with the findings of Deshmukh *et al.* (2014) [6], Anupama *et al*. (2016) [2] and Patel and Kumari (2018) [12] on clusterbean, Ramana *et al.* (2011) [18] and Thakur *et al.* (2018) [25] on French bean.

Variety GNIB 22 (v_3) registered maximum number of pickings (9.11) over other varieties. GNIB 22 (v_3) was found significantly superior to other varieties. The variation in various variables could be assigned to their genetic characteristic. Such type of varietal difference was also reported by Dewangan *et al.* (2018) [7] in Indian bean, Anupama *et al*. (2016) [2] in clusterbean, Ramana *et al.* (2011)

[18] in French bean and Amin *et al.* (2014) [1] in cowpea.

Variety GJIB 11 (v_2) registered maximum pod yield per plant (306.03 g), yield per plot (2.82 kg) and yield per hectare (139.09q) over other varieties. Among the varieties, GJIB 11 (v_2) recorded maximum pod yield per plant, per plot and per hectare (q) and minimum was recorded in GNIB 22 (v_3). The differences in yielding ability of varieties were affected due to its genetic potential, variability with respect to adaptability to soil and climate of this region. The increase in plant height, number of cluster per plant and number of branches per plant with the variety GJIB 11 may be attributed to the increased growth, as a consequence of longer growing period available for vegetative phases as compared to other cultivars which may be lead to increased assimilation and accumulation of photosynthates for the formation of yield attributes. This is the agreement with the findings of Dewangan *et al.* (2018) [7], Ro *et al.* (2019) [20], Champaneri *et al.* (2020) [3] and Desai *et al.* (2020) [5] in Indian bean. Anupama *et al.* (2016) [2] and Reddy *et al.* (2017) [19] in cluster bean.

Significantly higher yield per plant (229.71 g), yield per plot (2.14 kg) and yield per hectare (105.56 q) was registered by treatment *Rhizobium* + PSB (b_3). Increased yield and yield parameters by the *Rhizobium* + PSB could be due to the greater availability of nutrients in the soil and resulted better growth and development which might be attributed to higher fixation of nitrogen and better mobilization of phosphorus and increased allocation of photosynthates towards the economic parts and also hormonal balance on the plant system (Ramana *et al.* 2011) [18]. PSB with *Rhizobium* produce more organic acids like gluconic, guccinic, lactic, oxalic, citric and aketogluconic acid which convert the insoluble phosphate to soluble one (Stevenson, 1967) [24] and synthesis growth promoting substances which augment plant growth (Gaind and Guar, 1992) [8]. The overall development of plant in terms of root and shoot which might have absorbed more nutrient and enhanced photosynthesis and production of assimilates, which in tum increased the yield of Indian bean. This finding corroborates with the findings of Ramana *et al.* (2011) [18] and Thakur *et al.* (2018) [25] in French bean, Deshmukh *et al.* (2014) [6] and Patel and Kumari (2018) [13] in clusterbean.

Table 1: Response of varieties of Indian bean (*Lablab purpureus* L.) along with biofertilizers on growth parameters

Treatment	Days taken for 50% germination	Plant height		Number of branches per plant	Days taken for initiation of flower	Days taken for first picking	Days taken for last picking
		At 60 DAS	At final harvest				
v_1	4.44	107.56	155.58	27.49	68.54	98.73	151.00
v_2	4.00	114.68	166.02	28.29	73.27	99.40	155.56
v_3	4.67	27.60	38.41	30.71	41.53	74.91	139.89
v_4	4.33	45.02	63.93	21.93	43.40	76.93	147.56
S.Em.±	0.15	1.94	2.84	0.617	0.83	1.07	2.00
C.D. at 5%	0.43	5.52	8.09	1.76	2.38	3.06	5.68
b_1	4.25	74.67	107.38	22.73	57.02	87.55	148.83
b_2	4.42	70.07	100.64	21.87	57.70	86.50	148.50
b_3	4.42	76.41	109.93	23.97	55.33	88.43	148.17
S.Em.±	0.13	1.68	2.46	0.534	0.72	0.93	1.73
C.D. at 5%	NS	4.78	7.01	1.52	NS	NS	NS
C.V. %	10.50	7.89	8.04	8.09	4.42	3.68	4.03

Table 2: Interaction effect of varieties and biofertilizers of Indian bean (*Lablab purpureus* L.) on growth parameters

Treatment	Days taken for 50% germination	Plant height		Number of branches per plant	Days taken for initiation of flower	Days taken for first picking	Days taken for last picking
		At 60 DAS	At final harvest				
v_1b_1	4.33	110.78	160.30	27.87	68.13	97.27	152.67
v_1b_2	4.33	100.20	144.80	26.67	69.74	97.87	151.00
v_1b_3	4.67	111.69	161.63	27.93	67.73	101.07	149.33
v_2b_1	4.00	116.20	168.24	28.27	73.13	97.74	155.33
v_2b_2	4.00	110.19	159.43	27.33	73.60	99.40	156.00
v_2b_3	4.00	117.66	170.38	29.27	73.07	101.07	155.33
v_3b_1	4.33	27.62	38.44	13.40	42.53	77.53	139.33
v_3b_2	4.67	26.48	36.77	12.80	43.47	72.40	141.00
v_3b_3	5.00	28.70	40.02	14.93	38.60	74.80	139.33
v_4b_1	4.33	44.07	62.53	21.40	44.27	77.67	148.00
v_4b_2	4.67	43.41	61.57	20.67	44.00	76.33	146.00
v_4b_3	4.00	47.58	67.68	23.73	41.93	76.80	148.67
S.Em.±	0.26	3.36	4.92	1.07	1.45	1.86	3.46
C.D. at 5%	0.75	9.56	14.01	3.04	4.12	5.30	9.84
C.V. %	10.50	7.89	8.05	8.10	4.42	3.69	4.03

Table 3: Response of varieties of Indian bean (*Lablab purpureus* L.) along with biofertilizers on yield parameters

Treatment	Number of pods per cluster	Number of clusters per plant	Number of pickings	Yield per plant	Yield per plot	Yield per hectare
v_1	5.20	13.33	5.89	266.87	2.47	121.97
v_2	6.73	13.33	5.56	306.03	2.82	139.09
v_3	2.60	25.44	9.11	55.42	0.60	29.52
v_4	2.64	18.54	8.22	237.96	2.21	109.24
S.Em.±	0.12	0.42	0.26	7.59	0.07	3.56
C.D. at 5%	0.36	1.19	0.74	21.61	0.21	10.12

b_1	4.30	17.69	7.33	217.71	2.04	100.66
b_2	4.22	16.91	7.17	202.28	1.90	93.66
b_3	4.37	18.39	7.08	229.71	2.14	105.56
S.Em.±	0.11	0.36	0.22	6.58	0.06	3.08
C.D. at 5%	NS	1.03	NS	18.72	0.18	8.77
C.V. %	8.76	7.03	10.80	10.52	10.68	10.67

Table 4: Interaction effect of varieties and biofertilizers of Indian bean (*Lablab purpureus* L.) on yield parameters

Treatment	Number of pods per cluster	Number of clusters per plant	Number of pickings	Yield per plant	Yield per plot	Yield per hectare
v_1b_1	5.20	13.33	6.33	266.77	2.47	121.97
v_1b_2	5.13	12.60	5.67	250.10	2.33	115.06
v_1b_3	5.27	14.07	5.67	283.74	2.61	128.89
v_2b_1	6.73	13.27	5.67	308.70	2.85	140.90
v_2b_2	6.67	12.67	6.00	284.39	2.62	129.22
v_2b_3	6.80	14.07	5.00	324.99	2.98	147.16
v_3b_1	2.60	25.67	9.33	56.15	0.60	29.79
v_3b_2	2.53	24.50	9.00	50.58	0.56	27.49
v_3b_3	2.67	26.17	9.00	59.53	0.63	31.28
v_4b_1	2.67	18.50	8.00	239.24	2.23	109.96
v_4b_2	2.53	17.87	8.00	224.05	2.08	102.88
v_4b_3	2.73	19.27	8.67	250.59	2.33	114.90
S.Em.±	0.22	0.72	0.45	13.15	0.12	6.16
C.D. at 5%	0.62	2.05	1.28	37.44	0.36	17.54
C.V. %	8.77	7.08	10.80	10.52	10.68	10.68

Conclusion

It can be concluded that for achieving maximum yield, seed of Indian bean variety GJIB 11 should be treated with *Rhizobium* + PSB @ 25 ml per kg.

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