Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2020; 9(4): 457-459
Received: 22-05-2020
Accepted: 24-06-2020

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Integrated nutrient management in *Rabi* Indian bean (*Dolichos lablab* L.)

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Abstract
A field experiment was carried out at College Farm, Navsari Agricultural University, Navsari on clayey soils during *rabi* season of 2017-18 to study the "Integrated nutrient management in *rabi* Indian Bean (*Dolichos lablab* L.)". Recommended dose of fertilizer recorded significantly the highest growth and yield attributes *viz*., plant height, dry matter accumulation/plant, number of branches at 30 DAS, number of pods/plant, pod yield/plant, pod yield, stover yield and harvest index of *rabi* Indian Bean except number of branches at 60 DAS and test weight which remained at par with treatment 75% RDF. Application of biocompost @ 2.5 t/ha recorded significantly the highest growth as well and yield attributing characters and yields of *rabi* Indian Bean. All the growth attributes, yield attributes and yields of Indian Bean recorded significantly the highest under seed inoculation with *Rhizobium* + PSB over no seed inoculation.

Keywords: Biocompost, Indian bean, biofertilizer

Introduction
The Indian Bean (*Dolichos lablab* L.) belongs to the family Leguminoceae and considered as nutritious vegetable as they contain high amount of vegetable protein, besides carbohydrates and vitamins. The green tender pods are used as vegetable and also the dry seeds. Indian Bean (*Dolichos lablab* L.) is commonly known as 'Balar' and valpapdi. Nutrients applied in RDF are nitrogen and phosphorus from which Nitrogen is the key element in crop growth and is the most limiting nutrient in Indian soil. The paramount importance of nitrogen for increasing the yield has been widely accepted. Indian Bean responds well to phosphatic fertilizers in almost all the soil types. It plays vital role in plant nutrition. For good soil helth use of judicious combination of organic and inorganic fertilizer is essential. Biocompost and FYM supplies many nutrients for plants and the carbon containing compounds are food for soil flora and fauna. It also improves aeration and encourages good root growth by providing enough pores in the rhizosphere. Biofertilizer are relatively inexpensive source of nitrogen for crop production. They help in improving soil fertility by way of accelerating biological nitrogen fixation from atmosphere, solubilization of insoluble nutrients which present in the soil, stimulating plant growth and development, maintaining soil reaction and improving physical and biological properties of soil and thereby making nutrients easily available to the plants.

Material and Methods
A field experiment was conducted at the College Farm, Navsari Agricultural University, Navsari during *rabi* season of 2017-18. The soil of experimental field was clay in texture, low in organic carbon (0.40%) and low in available nitrogen (227.63 kg/ha), medium in available P_2O_5 (21.17 kg/ha) and high in available K_2O (333.56 kg/ha). The soil was found slightly alkaline (pH 7.8) in nature with normal electric conductivity of 0.40dS/m. The experiment was laid out in randomized block design with factorial concept (FRBD) with three replications. Total twelve treatment combinations consisting of three levels of fertilizer *viz*., 50% RDF (10:20:00 NPK kg/ha), 75% RDF (15:30:00 NPK kg/ha) and 100% RDF (20:40:00 NPK kg/ha), two organic manure *viz*. (FYM and biocompost @ 2.5 t/ha) and two biofertilizer *i.e.* No seed inoculation and seed inoculation with *Rhizobium* + PSB. Indian Bean variety "GNIB-22" was sown on 9 November 2017 using seed rate 25 kg/ha with raw spacing 60 cm and plant spacing 30 cm and crop was harvested in three picking on 22 January, 8 February and 20 February 2018. The field observation on plant height, number of branches/plant, dry matter accumulation/plant, days to 50% flowering, number of pods/plant, number of seeds/pod, pod length, test weight, pod yield/plant, pod yield, stover yield and harvest index was recorded. Five plants from each plot were randomly selected and observations like plant height, dry matter accumulation/plant, number of pods/plant, days to 50% flowering were recorded and

averaged. The yields attributed were recorded at harvesting to assess the contribution of yield. The experimental data analyzed statistically by applying the technique of analysis of variance (ANOVA) prescribed for the design to test the significance of overall difference among treatments by the F test and conclusion were drawn at 5% probability level. Economics of treatments also worked out.

Result and Discussion

Effect of Inorganic fertilizer

Significantly the highest plant height and dry matter accumulation per plant were recorded by 100% RDF. While in case of higher number of branches per plant was recorded by application of 100% RDF (12.58) which was at par with the 75% RDF (11.95). As compared to 75% RDF and 50% RDF the magnitude of increase in pod yield per plant under 100% RDF was to the tune of 20.98% and 35.63%, respectively. This might be due to positive effect of nutrient on growth character due to augment of cell division and cell expansion. Application of inorganic fertilizer enhanced the availability of nutrients especially nitrogen which is mainly responsible for vegetative growth and phosphorus played important role in root development and increased nodule activity in plant. The present findings are in close agreement with those reported by Priyadarshini *et al.* (2017) [12], Joshi *et al.* (2018) [4], Pargi *et al.* (2018) [8] and Pandey *et al.* (2019) [7]. Application of 100% RDF produced significantly the highest pod yield to the tune of 20.30%, 35.61% and stover yields to the tune of 9.81%, 19.07% as compared to application of 75% RDF and 50% RDF, respectively. The marked increases in pod and stover yield might be due to the cumulative effect of improvement in yield attributes *viz*., number of pod per plant, number of seed per pod and test weight. The increase in straw yield with application RDF might have attributed to the higher photosynthetic activity in Indian Bean plant leading to a better supply of carbohydrates resulted in more number of branches and dry matter. Results were confirmed by kumar *et al.* (2017) [5], Aziz *et al.* (2017) [1], Joshi *et al.* (2018) [4], Pargi *et al.* (2018) [8] and Pandey *et al.* (2019) [7].

Effect of organic manure

Significantly the highest growth and yield attributes were recorded under the application of biocompost 2.5 t/ha as compared to the application of FYM 2.5 t/ha (Table-1). The magnitude of increase in pod yield and stover yield by the application of biocompost 2.5 t/ha over the application of FYM 2.5 t/ha were to the tune of 33.17% and 12.60%, respectively. This is due to the favorable effect of biocompost on chemical physical and biological properties of soil leads to easy availability of nutrients might have reflected in higher growth parameter. The findings are in agreement with the results reported by Baviskar (2008) [2], Sarvanan and Panneerselvam (2014) [13] and Patel *et al.* (2015) [9].

Effect of biofertilizer

Application of biofertilizer was resulted in significantly the highest growth and yield attribute over without biofertilizer application (Table-1). The magnitude of increase in pod yield and stover yield by seed inoculated with biofertilizer were to the tune of 14.61% and 5.41%, respectively. It might be due to dual inoculation benefiting the plants by providing atmospheric N and rendering the insoluble phosphorus into available form. The enhanced availability of P favored N fixation and rate of photosynthesis and consequently led to better growth and yield attributes. *Rhizobium* + PSB seem to be on account of their impact on nutritional environment and involvement in various physiological processes in the plant systems which are considered to be pre-requisits for growth of the crop. The present results are in accordance with that of Singh *et al.* (2016), Patel *et al.* (2018) [11], Nadeem *et al.* (2018) [6] and Pandey *et al.* (2019) [7].

Table 1: Effect of different treatment on growth and yield attribute of Indian bean

Treatments	Plant height (cm)		Number of branches per plant		Dry matter accumulation /plant (g)	Number of pods per plant	Test weight (g)	Pod yield per plant (g)
	At 30 DAS	At 45 DAS	At 30 DAS	At 60 DAS				
(A) Fertilizer application (F)								
F_1-50% RDF	16.87	30.21	6.18	11.18	17.37	37.97	12.59	36.52
F_2-75% RDF	18.16	32.30	6.83	11.95	22.73	41.03	13.35	44.83
F_3-100% RDF	19.33	35.46	7.57	12.58	29.72	44.06	13.88	56.73
S.Em. ±	0.36	0.71	0.14	0.28	0.51	0.85	0.23	1.14
C.D. at 5%	1.05	2.08	0.42	0.81	1.48	2.50	0.68	3.36
(B) Organic manure (O)								
O_1-FYM @ 2.5 t/ha	17.68	31.80	6.61	11.57	22.47	38.93	12.95	41.98
O_2-Biocompost @ 2.5 t/ha	18.56	33.51	7.11	12.24	24.07	43.11	13.60	50.07
S.Em. ±	0.29	0.58	0.12	0.23	0.41	0.70	0.19	0.93
C.D. at 5%	0.86	1.70	0.34	0.66	1.21	2.04	0.56	2.74
(C) Biofertilizer (B)								
B_1-No biofertilizer	17.67	31.77	6.53	11.52	22.00	39.89	12.93	41.55
B_2-*Rhizobium* + PSB	18.57	33.55	7.19	12.29	24.54	42.14	13.62	50.51
S.Em. ±	0.29	0.58	0.12	0.23	0.41	0.70	0.19	0.93
C.D. at 5%	0.86	1.70	0.34	0.66	1.21	2.04	0.56	2.74
Interaction	NS	NS	NS	NS	NS	NS	NS	F × O
C. V. %	6.86	7.52	7.16	8.02	7.53	7.20	6.08	8.62

Interaction effect

Interaction effects of inorganic fertilizers and organic manures (FxO) were found to be significant for pod yield per plant and pod yield. The magnitude of superiority of treatment combination of 100% RDF and application of 2.5 t/ha biocompost for pod yield per plant in terms of percentage over 100% RDF+FYM @ 2.5 t/ha, 75% RDF+Biocompost @ 2.5 t/ha, 50% RDF+Biocompost @ 2.5 t/ha, 75% RDF+FYM @ 2.5 t/ha and 75% RDF+FYM @ 2.5 t/ha was to the tune of 8.03%, 12.58%, 33.25%, 35.72% and 43.15%, respectively. An appraisal of data presented in Table-3 showed that treatment combination 100% RDF and application of 2.5 t/ha

biocompost obtained significantly the highest pod yield of 3384 kg/ha. Similar findings got by Elamin and Madhvi (2015) [3].

Table 2: Effect of different treatments on pod and stover yield of Indian bean

Treatments	Pod yield (kg/ha)	Stover yield (kg/ha)	Harvest index (%)
(A) Fertilizer application (F)			
F_1-50% RDF	2005	2938	40.29
F_2-75% RDF	2482	3274	42.56
F_3-100% RDF	3114	3630	46.07
S.Em. ±	65.76	69.63	0.70
C.D. at 5%	193	204	2.05
(B) Organic manure (O)			
O_1-FYM @ 2.5 t/ha	2173	3086	40.82
O_2-Biocompost @ 2.5 t/ha	2894	3475	45.13
S.Em. ±	53.69	56.85	0.57
C.D. at 5%	158	167	1.68
(C) Biofertilizer (B)			
B_1-No biofertilizer	2361	3194	41.95
B_2-*Rhizobium* + PSB	2706	3367	44.00
S.Em. ±	53.69	56.85	0.57
C.D. at 5%	158	167	1.68
Interaction	F × O	NS	NS
C. V. %	8.99	7.35	5.65

Table 3: Interaction effect of various treatments on yield and yield attribute of Indian bean

Treatment	Pod yield per plant (g)		Pod yield (kg/ha)	
	O_1-FYM @ 2.5 t/ha	O_2-Biocompost @ 2.5 t/ha	O_1-FYM @ 2.5 t/ha	O_2-Biocompost @ 2.5 t/ha
F_1-50% RDF	33.60	39.45	1697	2313
F_2-75% RDF	37.99	51.67	1978	2985
F_3-100% RDF	54.36	59.10	2845	3384
S.Em. ±	1.61		92.99	
C.D. 5%	4.74		272.75	

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