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Influence of inorganic fertilizer, organic manure and biofertilizers on nutrient content and uptake of 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 influence of inorganic fertilizer, organic manure and biofertilizers on nutrient content and uptake of Indian Bean (*Dolichos lablab* L.). Recommended dose of fertilizer recorded significantly the highest content and uptake of N and P. Application of biocompost @ 2.5 t/ha recorded significantly the highest nutrient content and uptake of *rabi* Indian Bean. Similar trend also recorded in case of available nutrient in soil after harvest. Most of the nutrient content, uptake and available nutrient in soil after harvest of Indian bean recorded significantly the highest under seed inoculation with *Rhizobium* + PSB over no seed inoculation.

Keywords: Indian bean, biofertilizer, uptake, content

Introduction

The Indian Bean (*Dolichos lablab* L.) belongs to the family Leguminosae and considered as nutritious vegetable. The green tender pods are used as vegetable and also the dry seeds. Its fresh green pod contain 86.1% moisture, 3.8% protein, 6.7% carbohydrates, 0.75% fat, 0.9% mineral matter and vitamin-A 312 I.U. (Singh *et al.* 2004) [13]. In south Gujarat, It is mostly grown during *rabi* season in field vacated by *kharif* crops like paddy. Recommended / cultivated field bean varieties like G.wal-1 and N-wal- 125-36 and local vegetable purpose varieties like katargram and kapasia are grown by the farmers. Apart from there, new variety GNIB -22 found most promising for vegetable purpose due to its short stature plants, early picking and short duration. 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. Phosphorus nutrition has a special significance in Indian Bean production. Besides its role in metabolic process and energy transformations, P considerably influences root proliferation which are seat of biological N fixation and helps plants to draw nutrients from lower layers and consequently thrive under moisture stress conditions (Singh *et al.* 2003) [16]. Phosphorus availability is a limiting factor for plant production in many agricultural soils. A large portion of applied phosphorus fertilizer may be fixed to iron and aluminium oxides and then not available to plant uptake (Kumar *et al.* 2015) [6]. The very high phosphatic fertilizer prices also demand the need for recycling and exploitation of fixed phosphorus to improve crop production. Therefore, the current trend is to explore the possibility of supplementing fertilizers with organic manures and biofertilizers. 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 during *rabi* season of 2017-18 at the College Farm, Navsari Agricultural University, Navsari. 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 P₂O₅ (21.17 kg/ha) and high in available K₂O (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 row 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 observation on N, P₂O₅ and K₂O content (%), N, P and K uptake (kg/ha), Organic carbon (%), Available N, P and K (kg/ha) was recorded. Random samples of plants from each net plot area were collected for chemical analysis. The samples were oven dried at 60 °C for 24 hours, powdered by mechanical grinder and analyzed for respective nutrient content using following procedures.

Particular	Procedure used	Reference
Nitrogen (%)	Modified Kjeldahl's method	Jackson (1973) ^[2] .
Phosphorus (%)	Vanadomolybdo phosphoric acid yellow color method	Jackson (1973) ^[2] .
Potassium (%)	Flame photometric method	Jackson (1973) ^[2] .

The uptake values plant of macronutrients were calculated by using following formula and were expressed as kg/ha and was subjected to statistical analysis as per method suggested by Panse and Sukhatme (1967)^[8].

$$\text{Nutrient uptake (kg/ha)} = \frac{\text{Content (\%)} \times \text{Dry matter yield}}{100}$$

Result and Discussion

Effect of Inorganic fertilizer

Significantly the highest nutrient content and uptake were recorded by 100% RDF except K₂O content which was not significantly affected by application of RDF. As compared to 75% RDF and 50% RDF the magnitude of increase in N content under 100% RDF was to the tune of 7%, 13.17%. As compared to 75% RDF and 50% RDF the magnitude of increase in P content under 100% RDF was to the tune of 11.65%, 14.90%. Similarly significantly the highest uptake of N, P and K by plant were recorded with application of 100% RDF. The increase in uptake of nutrients by plant of Indian Bean might be due to RDF application higher dry matter accumulation, N fixation and accumulation of phosphorus by better development of root nodules. Higher dry matter production due to increased availability of nutrients from the RDF might have enhanced the K uptake. These results are in closed conformity with the finding of Kumar *et al.* (2014)^[4], Singh *et al.* (2016)^[14], Singh and Kumar (2016)^[15] and Patel *et al.* (2016a)^[10].

Application of 100% RDF recorded significantly the highest available P after harvest in soil to the tune of 11.21%, 20.77% as compared to application of 75% RDF and 50% RDF. While significantly higher value of available N after harvest of crop recorded with 100% RDF application which remain at par with 75% RDF application. The marked increases in available N and P after harvest of crop might be due to residual effect of fertilizer. Almost similar findings were also reported by Shukla *et al.* (2013)^[12], Singh *et al.* (2016)^[14] and Patel *et al.* (2016a)^[10].

Effect of organic manure

Significantly the highest nutrient content, uptake and available nutrient after harvest in soil were recorded under the application of biocompost 2.5 t/ha over the application of FYM 2.5 t/ha. The magnitude of increase in N content, P₂O₅

content, N uptake, P uptake and K uptake in case of application of biocompost 2.5 t/ha as compared to FYM 2.5 t/ha to the tune of 6.83%, 13.17%, 20%, 25.34% and 16.19%, respectively. This might be due to RDF application higher dry matter accumulation, N fixation and accumulation of phosphorus by better development of root nodules. Higher dry matter production due to increased availability of nutrients from the RDF might have enhanced the K uptake. These results are in closed conformity with the finding of Kumar *et al.* (2014)^[4], Singh *et al.* (2016)^[14], Singh and Kumar (2016)^[15] and Patel *et al.* (2016a)^[10]. The magnitude of increase in available N and P after harvest in soil by the application of biocompost 2.5 t/ha over the application of FYM 2.5 t/ha were to the tune of 8.16% and 10.50%, respectively. It might be due to residual effect of fertilizer. Almost similar findings were also reported by Shukla *et al.* (2013)^[12], Singh *et al.* (2016)^[14] and Patel *et al.* (2016a)^[10].

Effect of biofertilizer

Significantly the highest nutrient N, P content and uptake was resulted with application of biofertilizer over without biofertilizer application (Table-1). The magnitude of increase in nutrient content and uptake by seed inoculated with biofertilizer were to the tune of 7.25%, 13.98% and 13.38%, 19.88%, respectively. This might be due to PSB enhanced the availability of phosphorus to plants, which might have utilized by the crop in greater root development and nodulation that in turn resulted in higher nitrogen fixation in the soil by nodules. Thus, increased availability of nitrogen and phosphorus might have resulted in greater uptake by plant for proper development and ultimately increased their content and uptake in seed and straw. Similar results were also observed by Patel *et al.* (2016b)^[11], Khan *et al.* (2017)^[3], Venkatarao *et al.* (2018)^[17] and Pargi *et al.* (2018)^[9]. Increasing of available N and P after harvest of crop with seed inoculation of biofertilizer in the tune of 8.19% and 10.95%, respectively. This could be due to higher mobilization of N, P and K. This indicates that crop might not have utilized all the available nutrients native to the soil. These findings lend support to the report of Singh *et al.* (2016)^[14], Patel *et al.* (2016a)^[10] and Choudhry *et al.* (2017)^[1].

Interaction effect

Interaction effects of organic manures and biofertilizers (OxB) were found to be significant for P uptake by plant. An

appraisal of data presented in Table-3 showed that treatment combination biocompost @ 2.5 t/ha with *Rhizobium* + PSB seed inoculation obtained significantly the highest P uptake of

40.96 kg/ha over the other interaction combination. Similar findings got by Nadeem *et al.* (2018)^[7].

Table 1: Effect of integrated nutrient management on N, P₂O₅ and K₂O content and uptake in plant of Indian Bean at harvest

Treatments	N content (%)	P ₂ O ₅ content (%)	K ₂ O content (%)	N uptake (kg/ha)	P uptake (kg/ha)	K uptake (kg/ha)
(A) Fertilizer application (F)						
F ₁ -50% RDF	2.077	0.708	2.524	75.0	25.7	91.0
F ₂ -75% RDF	2.225	0.735	2.584	91.7	30.3	106.0
F ₃ -100% RDF	2.392	0.832	2.632	111.7	39.0	122.7
S.Em. ±	0.052	0.024	0.074	2.24	0.94	2.96
C.D. at 5%	0.153	0.070	NS	6.57	2.75	8.69
(B) Organic manure (O)						
O ₁ -FYM @ 2.5 t/ha	2.152	0.705	2.546	82.5	27.1	97.1
O ₂ -Biocompost @ 2.5 t/ha	2.310	0.812	2.614	103.0	36.3	116.0
S.Em. ±	0.042	0.019	0.061	1.83	0.77	2.42
C.D. at 5%	0.124	0.057	NS	5.36	2.25	7.09
(C) Biofertilizer (B)						
B ₁ -No biofertilizer	2.147	0.701	2.549	86.1	28.2	101.5
B ₂ - <i>Rhizobium</i> + PSB	2.315	0.815	2.611	99.4	35.2	111.6
S.Em. ±	0.042	0.019	0.061	1.83	0.77	2.42
C.D. at 5%	0.124	0.057	NS	5.36	2.25	7.09
Interaction	NS	NS	NS	NS	O × B	NS
C. V. %	8.07	10.87	9.94	8.36	10.26	9.63

Table 2: Organic carbon, Available N, P and K in soil after harvest of Indian Bean as influenced by various treatments

Treatments	Organic carbon (%)	Available N (kg/ha)	Available P (kg/ha)	Available K (kg/ha)
(A) Fertilizer application (F)				
F ₁ -50% RDF	0.536	228.32	22.96	337.70
F ₂ -75% RDF	0.555	238.89	25.73	344.72
F ₃ -100% RDF	0.569	253.48	28.98	346.77
S.Em. ±	0.011	6.31	0.56	10.21
C.D. at 5%	NS	18.50	1.65	NS
(B) Organic manure (O)				
O ₁ -FYM @ 2.5 t/ha	0.551	230.01	24.46	340.60
O ₂ -Biocompost @ 2.5 t/ha	0.556	250.45	27.33	345.53
S.Em. ±	0.009	5.15	0.46	8.34
C.D. at 5%	NS	15.11	1.35	NS
(C) Biofertilizer (B)				
B ₁ -No biofertilizer	0.550	229.96	24.39	340.33
B ₂ - <i>Rhizobium</i> + PSB	0.556	250.50	27.39	345.80
S.Em. ±	0.009	5.15	0.46	8.34
C.D. at 5%	NS	15.11	1.35	NS
Interaction	NS	NS	NS	NS
C. V. %	7.04	9.10	7.54	10.31
Initial value	0.529	227.63	21.17	333.56

Table 3: Interaction effect of biofertilizer and organic manure on uptake of phosphorus by Indian Bean

Treatment	P uptake (kg/ha)	
	B ₁ -No biofertilizer	B ₂ - <i>Rhizobium</i> + PSB
O ₁ -FYM @ 2.5 t/ha	24.72	29.41
O ₂ -Biocompost @ 2.5 t/ha	31.65	40.96
S.Em. ±	1.08	
C.D. at 5%	3.17	

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