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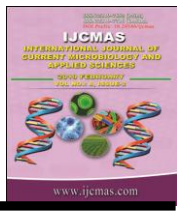

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Effect of Different Nutrient Levels on Yield Components, Nutrient Uptake and Post Harvest Soil Fertility Status of Dolichos Bean

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A B S T R A C T

The field experiment was conducted at experimental plot of Department of Vegetable Science, Kittur Rani Channamma College of Horticulture, Arabhavi, during the growing period of 2016-17 and 2017-18 to investigate the effect of different N, P and K interaction levels on nutrient uptake by dolichos bean and post harvest fertility status of soil. The field experiment was laid out in randomized block design comprising of eighteen treatments replicated thrice. Amongst all NPK fertilizer levels, higher fertilizer dose of 25:75:50 kg NPK per hectare recorded significantly maximum plant height, number of secondary branches and dry matter content per plant at harvest however, it was onpar with 25:75:25 kg NPK per hectare except dry matter content per plant in both the years (2016-17 and 2017-18) and pooled data respectively. However, pooled analysis data revealed that green pod yield per plant and pod yield per hectare as well as higher total N, P and K uptake were recorded significantly maximum in 25:75:50 kg NPK per hectare but the trend was different during both the experimental years. Physico-chemical properties of soil such as soil pH, EC, OC in soil after final harvest of dolichos bean were significantly influenced by NPK interactions levels during both the years (2016-17 and 2017-18) of investigation and in pooled data analysis except soil pH in 2017-18 growing season. Pooled data revealed that significantly highest available nitrogen, phosphorus and potassium availability in soil were recorded in higher fertilizer dose of 25:75:50 kg NPK per hectare which was onpar with 25:75:25 kg NPK per hectare except available potassium. Similar trend was also observed during the year 2016-17 and 2017-18 experimental years.

Introduction

Dolichos Bean (*Dolichos lablab* L.) is an important leguminous vegetable of Indian origin, popularly known as sem belongs to the family leguminosae. In India green and tender pods of dolichos bean which are cooked and consumed as vegetable and dry seeds used as pulse. Its foliage is also used as hay, silage and green manure. Dolichos bean can be grown in diverse range of environmental conditions due to its wider adaptability and drought resistance capacity. As a dual purpose (food and feed) legume, it can be grown as a

monocrop or in intercrop systems (Tapkeer *et al.*, 2017). In India, lablab as a pod vegetable crop mostly cultivated to a large extent in Karnataka and same districts of Tamil Nadu, Andhra Pradesh and Maharashtra. Being a legume, it has ability to fix nitrogen into soil thereby improving soil fertility and crop yields in an economic and environment friendly manner. The growth, yield and quality of crop are largely influenced by the fertility status of the soil. Therefore, altering the soil nutrients and fertility status by providing balanced and adequate nutrients as per the crop requirement is one of the easiest ways to boost the crop productivity of lablab bean (Dwivedi *et al.*, 2002). Being a leguminous crop, dolichos bean is highly responsive to nitrogenous fertilizer application especially in early stage. Similarly, application of phosphorus influences symbiotic nitrogen fixation and serves dual purpose in legume by increasing the yield and quality of green pods of current as well as succeeding crop of the dolichos bean (Turuko and Mohammed, 2014). Potassium also plays a crucial role in legumes by enhancing the production of starch and sugar that benefit the symbiotic bacteria and thus enhances the fixation of nitrogen (Rustamani *et al.*, 1999). Hence, the present investigation was carried out with view to study the effect of different nutrient levels on pod yield, nutrient uptake and post harvest soil fertility status of pod type dolichos bean (var. Arka Amogh).

Materials and Methods

The field experiment was conducted during rabi season of 2016-17 and 2017-18 at experimental plot of Department of Vegetable Science, K R C College of Horticulture, Arabhavi, Belgaum district. The experiment was laid out in randomized block design with eighteen treatments replicated thrice. The treatments comprised viz. T_1-0: 0: 0, T_2-0: 0: 25, T_3 -0: 0: 50, T_4 -0: 50: 0, T_5-0: 50: 25, T_6-0: 50: 50, T_7-0:75:0, T_8-0:75:25, T_9-0:75:50, T_{10}-25:0:0, T_{11}-25:0:25, T_{12}-25:0:50, T_{13}-25:50:0, T_{14}-25:50:25 (RDF), T_{15}-25:50:50, T_{16}-25:75:0, T_{17}-25:75:25 and T_{18}-25:75:50 kg NPK per hectare. Full dose of fertilizers were applied in the form of urea, single super phosphate and muriate of potash to soil before seed sowing as per the treatment requirements. The healthy and disease free authentic seeds of dolichos bean variety 'Arka Amogh' were collected from IIHR, Bangalore. The seeds were sown with recommended spacing of 45 × 15 cm. The soil of the experimental site was clay loam, having pH of 8.22, EC of 0.54 ds/m, O.M of 0.57 %, available N was 181.88 kg, P was 62.38 kg and K was 223.31 kg/ hectare. The treatment wise soil samples were collected, air dried and sieved through 2 mm sieve. The soils sample were analyzed for its chemical properties like pH and EC (Jackson, 1973), organic carbon (Wakley and Black, 1967), available nutrients viz. N, P_2O_5 and K_2O (Jackson, 1973) and uptake of different nutrients (Piper, 1966). Two years experimental data as well as pooled data were analyzed statistically as per the statistical methods *i.e.* Fisher's method described by Panse and Sukhatme (1978).

Results and Discussion

Effect of different nutrient levels on yield attributing characters in dolichos bean

The application of different levels of NPK fertilizers (Table 1) has significantly influenced the growth parameters such as plant height, number of secondary branches and dry matter content per plant at harvest and green pod yield of dolichos bean over no fertilizer application during both the season (2016-17 and 2017-18) and in pooled data. Among the different interaction levels of nitrogen phosphorous and potassium (NPK),

the plant height (98.13, 98.57 and 98.35 cm) and number of secondary branches (7.20, 7.13 and 7.17) were recorded significantly maximum in 25:75:50 kg NPK per hectare (T_{18}) which were on par with T_{17} in 2016-17, 2017-18 experimental year and in pooled data respectively. The enhancement in growth parameters could be due to the better and proper nourishment of the crop and also the better uptake of plant nutrients due to application of enhanced fertilizer dose. Similar results on plant height and number of branches were also obtained by Veeresh (2003), Kumar *et al.,* (2004), Shubhashree *et al.,* (2011) and Shahid *et al.,* (2015) in French bean, Sammauria *et al.,* (2009) in cluster bean and Singh and Tripathi (1994) in faba bean.

The NPK interaction has positive effect on dry biomass and recorded maximum dry weight of plant (35.97 g) in plants supplied with higher dose of fertilizer (25:75:50 kg/ha) followed by T_{17} (33.77 g) and T_{16} (29.67 g) over recommended fertilizer level of 25:50:25 kg NPK per hectare (22.70 g). The trend of accumulation was same in 2016-17 and 2017-18 successive growing seasons. The higher dry matter production with higher fertilizer dose was mainly due to higher green biomass and its accumulation in various plant parts. Similar results have also been noticed by Shrikanth *et al.,* (2008) who observed significantly higher dry matter in higher fertilizer level of 33:67:33 kg NPK per hectare. The data pertaining to the yield parameters i.e. pod yield per plant and pod yield per hectare were significantly influenced due to different NPK interaction levels in both the growing seasons and in pooled data analysis. On pooled basis, significantly higher fertilizer dose of 25:75:50 kg NPK per hectare (T_{18}) produced more pod yield per plant (163.95 g) followed by T_{17} and T_9 treatment which showed maximum improvement of 20.78 g (17 %) over recommended fertilizer dose of 25:50:25 kg NPK/hectare. Similarly, T_{18} also recorded significantly higher pod yield per plant but it was on par with T_{17} (161.50 g) in first season (2016-17) whereas in second season (2017-18) the trend was same as followed in pooled data. The significant variations amongst the NPK interaction levels were also noticed for production of pods per hectare in 2016-17, 2017-18 and in pooled data analysis. In pooled data, maximum pod yield per hectare was recorded at T_{18} (198.44 q) followed by T_{17} (193.43q) and T_9 (190.20 q) which showed maximum improvement of 30.79 q (26 %) over recommended fertilizer level T_{14} (25:50:25 kg NPK/ha). In first (2016-17) and second (2017-18) season of experiments, the result trend was same as followed in pooled data. This might be due to increased performance of growth parameters and also complementary effect of optimum combinations of nitrogen, phosphorus and potassium levels. These results confirmed the finding of Shrikanth *et al.,* (2008) and Dwivedi *et al.,* (2002) in dolichos bean.

Effect of different nutrient levels on uptake of nutrients by dolichos bean

Dolichos bean responds well to fertilizer levels. In the present study, higher fertilizer dose had significant influence on growth, yield and yield attributing characters with pod quality by uptaking higher nitrogen, phosphorus and potassium as compared to recommended fertilizer dose. The observation on nutrient uptake by dolichos bean was studied with respect to nitrogen, phosphorus and potassium as influenced by NPK interactions levels during both the years (2016-17 and 2017-18) of investigation and in pooled data analysis were presented in table 2. Pooled data revealed that significantly higher nitrogen uptake (94.50 kg/ha) was recorded by higher fertilizer dose of 25:75:50 kg NPK per hectare (T_{18}) followed by T_{17} (90.74 kg/ha) and T_{16} (85.76 kg/ha).

Table.1 Yield attributing characters and pod yield of dolichos bean as influenced by different nitrogen, phosphorus and potassium levels

Treatment	Plant height (cm)			Number of secondary branches per plant			Dry matter content at harvest (g)			Pod yield per plant (g)			Pod yield per hectare (q)		
	2016-17	2017-18	2016-17	2016-17	2016-17	Pooled	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled
0: 0: 0 (T_1)	76.93	76.27	76.60	4.20	4.27	4.23	17.00	16.33	16.67	111.47	111.07	111.27	120.69	120.10	120.40
0: 0: 25 (T_2)	81.50	79.60	80.55	4.53	4.53	4.53	17.07	16.90	16.98	115.57	114.00	114.78	126.77	124.44	125.60
0: 0: 50 (T_3)	81.87	79.93	80.90	4.80	4.60	4.70	17.20	17.00	17.10	117.23	116.47	116.85	129.23	128.10	128.67
0: 50: 0 (T_4)	84.70	82.23	83.47	5.93	5.73	5.83	19.10	18.97	19.03	130.67	128.20	129.43	149.14	145.48	147.31
0: 50: 25 (T_5)	85.03	83.27	84.15	5.87	5.73	5.80	19.93	19.40	19.67	138.20	137.47	137.83	160.30	159.21	159.75
0: 50: 50 (T_6)	85.77	84.07	84.92	6.00	5.80	5.90	20.50	19.93	20.22	142.17	140.20	141.18	166.17	163.26	164.72
0:75:0 (T_7)	86.10	84.93	85.52	6.67	6.60	6.63	28.30	27.07	27.68	134.10	130.83	132.47	154.22	149.38	151.80
0:75:25 (T_8)	89.80	87.13	88.47	6.80	6.67	6.73	28.93	27.77	28.35	157.80	154.80	156.30	189.33	184.89	187.11
0:75:50 (T_9)	93.30	92.83	93.07	6.87	6.73	6.80	29.57	28.20	28.88	159.30	157.47	158.38	191.56	188.84	190.20
25:0:0 (T_{10})	82.07	80.90	81.48	5.00	4.73	4.87	17.33	17.17	17.25	112.90	112.43	112.67	122.81	122.12	122.47
25:0:25 (T_{11})	82.40	81.27	81.83	5.13	5.60	5.37	17.80	17.23	17.52	119.73	118.10	118.92	132.94	130.52	131.73
25:0:50 (T_{12})	82.77	81.57	82.17	5.33	5.67	5.50	18.23	18.43	18.33	120.97	120.23	120.60	134.77	133.68	134.22
25:50:0 (T_{13})	86.43	85.83	86.13	6.20	6.07	6.13	22.33	22.00	22.17	136.77	134.90	135.83	158.17	155.41	156.79
25:50:25 (T_{14})	91.10	90.80	90.95	6.33	6.13	6.23	22.87	22.53	22.70	143.53	142.80	143.17	168.20	167.11	167.65
25:50:50 (T_{15})	92.83	91.97	92.40	6.47	6.40	6.43	23.53	23.40	23.47	146.50	146.07	146.28	172.59	171.95	172.27
25:75:0 (T_{16})	96.27	95.50	95.88	7.00	7.00	7.00	30.80	28.53	29.67	155.43	152.77	154.10	185.83	181.88	183.85
25:75:25 (T_{17})	97.17	96.83	97.00	7.07	7.00	7.03	34.93	32.60	33.77	161.50	159.80	160.65	194.77	192.10	193.43
25:75:50 (T_{18})	98.13	98.57	98.35	7.20	7.13	7.17	36.50	35.43	35.97	164.47	163.43	163.95	199.21	197.68	198.44
SE.m±	**1.26**	**0.94**	**0.67**	**0.04**	**0.04**	**0.03**	**0.51**	**0.59**	**0.40**	**1.37**	**1.25**	**1.07**	**2.03**	**1.85**	**1.59**
CD at 5 %	**3.62**	**2.70**	**1.92**	**0.13**	**0.10**	**0.08**	**1.46**	**1.71**	**1.14**	**3.94**	**3.60**	**3.09**	**5.85**	**5.32**	**4.58**

Table.2 Total nitrogen, phosphorus and potassium uptake (kg/ ha) by dolichos bean as influenced by nitrogen, phosphorus and potassium levels

Treatment	N uptake (kg/ ha)			P uptake (kg/ ha)			K uptake (kg/ ha)		
	2016-17	2017-18	2016-17	2016-17	2016-17	Pooled	2016-17	2017-18	Pooled
0: 0: 0 (T_1)	45.24	44.28	44.76	6.59	5.79	6.19	25.29	23.20	24.25
0: 0: 25 (T_2)	47.34	46.99	47.17	7.05	6.32	6.69	28.44	25.91	27.18
0: 0: 50 (T_3)	50.62	48.19	49.41	7.48	6.59	7.04	28.93	28.80	28.86
0: 50: 0 (T_4)	58.22	58.29	58.25	8.71	8.63	8.67	34.98	30.69	32.83
0: 50: 25 (T_5)	64.05	61.02	62.53	9.46	9.09	9.27	37.44	33.55	35.50
0: 50: 50 (T_6)	64.15	63.98	64.07	10.16	9.60	9.88	38.96	35.09	37.03
0:75:0 (T_7)	73.24	68.07	70.66	17.96	13.96	15.96	50.16	49.08	49.62
0:75:25 (T_8)	82.05	81.10	81.58	19.25	16.54	17.90	63.99	60.61	62.30
0:75:50 (T_9)	84.48	84.32	84.40	20.78	18.27	19.52	65.33	61.53	63.43
25:0:0 (T_{10})	51.80	49.93	50.86	7.20	6.42	6.81	27.97	25.26	26.61
25:0:25 (T_{11})	52.74	51.48	52.11	7.54	7.24	7.39	30.86	29.51	30.19
25:0:50 (T_{12})	56.65	54.67	55.66	8.40	8.21	8.31	33.46	29.72	31.59
25:50:0 (T_{13})	71.92	68.97	70.45	11.30	9.92	10.61	41.12	32.81	36.96
25:50:25 (T_{14})	74.44	71.63	73.04	12.47	10.74	11.61	44.69	38.67	41.68
25:50:50 (T_{15})	77.69	73.36	75.53	13.87	12.16	13.02	47.15	40.44	43.80
25:75:0 (T_{16})	86.67	84.85	85.76	21.79	15.70	18.75	61.39	58.50	59.94
25:75:25 (T_{17})	91.72	89.76	90.74	26.86	24.42	25.64	68.20	65.24	66.72
25:75:50 (T_{18})	96.38	92.61	94.50	29.61	29.56	29.59	72.20	69.67	70.94
SE.m±	**1.86**	**1.69**	**1.28**	**1.28**	**1.25**	**0.86**	**1.27**	**1.53**	**0.90**
CD at 5 %	**5.36**	**4.84**	**3.67**	**3.67**	**3.60**	**2.47**	**3.64**	**4.39**	**2.58**

Table.3 Soil fertility status of dolichos bean as influenced by nitrogen, phosphorus and potassium levels

Treatment	pH			EC (ds/ m)			OC (%)			Available nitrogen (kg/ ha)			Available phosphorus (kg/ ha)			Available potassium (kg/ ha)		
	2016-17	2017-18	2016-17	2016-17	2016-17	Pooled	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled
0: 0: 0 (T_1)	8.38	8.70	8.54	1.29	1.10	1.19	0.51	0.71	0.61	274.94	280.76	277.85	51.56	53.93	52.75	163.69	180.36	172.02
0: 0: 25 (T_2)	8.38	8.68	8.53	1.13	0.92	1.03	0.52	0.73	0.63	276.43	281.93	279.18	52.26	54.16	53.21	202.82	212.82	207.82
0: 0: 50 (T_3)	8.37	8.65	8.51	1.12	0.86	0.99	0.52	0.79	0.65	277.43	282.59	280.01	52.60	55.27	53.94	208.15	213.48	210.82
0: 50: 0 (T_4)	8.30	8.66	8.48	0.95	0.45	0.70	0.55	0.93	0.74	314.15	314.76	314.46	60.11	61.28	60.69	230.81	237.48	234.14
0: 50: 25 (T_5)	8.30	8.66	8.48	0.91	0.44	0.68	0.55	0.97	0.76	318.34	320.16	319.25	62.74	63.81	63.28	256.07	264.80	260.43
0: 50: 50 (T_6)	8.29	8.65	8.47	0.87	0.44	0.64	0.57	0.97	0.77	321.67	343.07	332.37	64.18	65.18	64.68	262.51	270.18	266.35
0:75:0 (T_7)	8.25	8.64	8.45	0.85	0.41	0.63	0.57	1.12	0.84	351.39	364.59	357.99	68.42	70.50	69.46	242.07	247.74	244.90
0:75:25 (T_8)	8.24	8.53	8.39	0.75	0.35	0.55	0.70	1.22	0.96	383.06	385.27	384.17	71.67	73.33	72.50	315.19	320.22	317.71
0:75:50 (T_9)	8.23	8.51	8.37	0.72	0.34	0.53	0.71	1.31	1.01	384.21	389.32	386.77	72.33	75.67	74.00	318.53	325.53	322.03
25:0:0 (T_{10})	8.32	8.79	8.55	1.15	0.65	0.90	0.53	0.82	0.67	280.76	283.83	282.29	52.99	55.30	54.15	176.69	183.69	180.19
25:0:25 (T_{11})	8.32	8.66	8.49	1.02	0.53	0.78	0.54	0.82	0.68	283.76	288.81	286.28	55.76	57.09	56.43	210.48	217.15	213.82
25:0:50 (T_{12})	8.32	8.66	8.49	1.01	0.51	0.76	0.54	0.84	0.69	285.28	305.55	295.41	57.87	60.20	59.03	215.82	222.48	219.15
25:50:0 (T_{13})	8.28	8.62	8.45	0.85	0.39	0.62	0.60	1.17	0.88	371.73	372.39	372.06	64.51	65.51	65.01	246.07	257.82	251.94
25:50:25 (T_{14})	8.27	8.54	8.41	0.82	0.37	0.59	0.62	1.18	0.90	376.39	377.10	376.75	65.18	66.84	66.01	280.31	285.48	282.89
25:50:50 (T_{15})	8.26	8.53	8.40	0.78	0.35	0.57	0.63	1.22	0.92	378.06	381.25	379.66	65.52	68.67	67.09	586.27	290.94	288.60
25:75:0 (T_{16})	8.22	8.48	8.35	0.71	0.29	0.50	0.73	1.33	1.03	386.40	390.34	388.37	73.67	77.30	75.50	312.22	315.89	314.06
25:75:25 (T_{17})	8.22	8.47	8.35	0.67	0.28	0.47	0.77	1.35	1.06	390.21	392.11	391.16	75.13	79.13	77.13	319.00	326.50	322.75
25:75:50 (T_{18})	8.20	8.43	8.32	0.66	0.23	0.44	0.90	1.44	1.17	395.62	394.91	395.26	79.50	82.67	81.09	326.88	332.37	329.63
SE.m±	**0.05**	**0.12**	**0.07**	**0.15**	**0.23**	**0.13**	**0.02**	**0.03**	**0.02**	**2.23**	**2.71**	**1.80**	**1.51**	**1.23**	**0.98**	**2.68**	**2.03**	**1.98**
CD at 5 %	**0.13**	**0.35**	**0.19**	**0.42**	**0.66**	**0.38**	**0.05**	**0.09**	**0.05**	**6.28**	**7.79**	**4.50**	**4.33**	**3.54**	**3.96**	**7.69**	**5.83**	**6.90**

Higher nitrogen uptake was recorded by T_{18} (96.38 and 92.61 kg/ha) treatment which was statistically on par with T_{17} (91.72 and 89.76 kg/ha) in 2016-17 and 2017-18 growing season respectively. Similar response of NPK fertilizer dose was also found for phosphorus uptake as that of nitrogen uptake trend and it was recorded maximum (29.61, 29.56 and 29.59 kg/ha) in higher fertilizer dose of 25:75:50 kg NPK per hectare (T_{18}) during 2016-17, 2017-18 and in pooled data respectively. Similarly, the interaction effect of nitrogen, phosphorus and potassium significantly influenced the plant potassium uptake. On pooled basis, significantly higher potassium uptake (70.94 kg/ha) was recorded in the treatment T_{18} next to best treatments were T_{17} (66.72 kg/ha) and T_9 (63.43). The uptake trend in 2016-17 and 2017-18 growing seasons was similar as followed in pooled data. However, lower nitrogen, phosphorus and potassium uptake were recorded under T_1 (no fertlization) in 2016-17, 2017-18 and in pooled analysis. Nutrient uptake increased significantly with the increasing rates of fertilization which was due to luxuriant crop growth, high dry matter production, yield and yield attributes, resulted in increased uptake of nutrients. These findings are also supported by Shubhashree *et al.,* (2011) in French bean.

Effect of different nutrient levels on soil fertility status of dolichos bean

Physico-chemical properties of soil included pH, EC, OC, nitrogen, phosphorus, potassium availability in soil after final harvest of dolichos bean as influenced by NPK interactions levels during both the years (2016-17 and 2017-18) of investigation and in pooled data analysis were presented table 3. Significantly suitable soil pH (8.20 and 8.32) for doilichos bean was recorded in higher fertilizer dose of 25:75:50 kg NPK per hectare (T_{18}) in 2016-17 and in pooled data respectively but it was on par with T_{17} and T_{16}. The NPK interaction levels were merely influence soil EC during 2016-17, 2017-18 and pooled data. The interaction effects of NPK were significant with respect to soil organic carbon during both the years and in pooled data. On pooled basis, T_{18} recorded significantly higher (1.17 %) percentage of organic carbon followed by T_{17} (1.06 %) and T_{16} (1.03 %). Similar trend was also followed in 2016-17 and 2017-18 growing seasons. Availability of soil nitrogen was significantly influenced by NPK interaction levels also in 2016-17 and 2017-18 growing season and in pooled data.

On pooled basis, after final harvesting of dolichos bean, the significantly highest available nitrogen in soil (395.26 kg/ha) was recorded in T_{18} over other treatment combinations except T_{17} (391.16 kg/ha) whereas, it was minimum in T_1 (277.85 kg/ha). Similar trend was also noticed during 2016-17 and 2017-18 growing seasons. Similarly, on pooled basis, significantly higher phosphorus availability (81.09 kg/ha) in soil was recorded in the treatment combination of T_{18} followed by T_{17} (77.13 kg/ha) and T_{16} (75.50 kg/ha). The trend was same for 2016-17 and 2017-18 growing seasons. The interaction effects of NPK levels were significant with respect to potassium availability in soil. On pooled basis, the higher fertilizer dose of 25:75:50 kg NPK per hectare (T_{18}) recorded significantly maximum (329.63 kg/ha) availability of potassium in soil next best was T_{17} (322.75 kg/ha) and T_9 (322.03 kg/ha) whereas, minimum was recorded in T_1 (172.02 kg/ha). Similar trend was also observed during the year 2016-17 and 2017-18 experimental years. From this, it is pointed out that dolichos species can be grown normally on soils with pH 8.8, which influence higher available NPK in soil through nitrogen fixation (Omokanye, 2001). Similar observation was also recorded by Yadav *et al.,* 2014 in cluster bean.

In conclusion, the results of two years experimental data showed that application of NPK fertilizers dose @ 25:75:25 kg per hectare is optimum dose (25:75:25 kg/ ha) as compared to recommended fertilizers for enhancing growth, pod yield and nutrient uptake capacity of dolichos bean by improving fertility status of soil.

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