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EFFECT OF DIFFERENT LEVELS OF NITROGEN AND PHOSPHORUS ON GROWTH AND YIELD CHARACTERS OF BUSH BEAN (*DOLICHOS LABLAB var. TYPICUS*)

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Abstract

A field experiment was conducted during the year 2016 to find out the optimum dose of nitrogen and phosphorus on growth and yield attributes of bush bean *var.* Co (Gb)14. (*Dolichos lablab var. typicus*). The treatments consisted of four levels of N (0, 20, 30 and 40 kg ha^{-1}) and P_2O_5 (0, 40, 50 and 60 kg ha^{-1}), and with a constant dose of K @25 kg ha^{-1} and each treatment was replicated three times. The experiment was conducted in factorial randomized block design**.** Application of different levels of phosphorus from 0 to 60 kg ha^{-1} resulted linear increase in various growth and yield attributing traits of bush bean. Similarly, graded levels of nitrogen from 0 to 40 kg ha^{-1} showed gradual increase in the growth and yield attributes. The interaction of N and P showed significant enhancement in growth characters such as plant height, number of leaves, number of branches, leaf area, leaf area index, chlorophyll in leaf fresh tissue, number of nodes per plant, inter nodal length. The yield attributing characters such as number of pods per inflorescence, pod length, pod width, pod weight, Days to first pod harvest, last pod harvest, pod yield per plant, pod yield per plot and pod yield per hectare were also significantly differed due to N and P interaction. Among the interaction treatments application of N @ 40 kg ha^{-1} and P @ 60 kg ha^{-1} recorded the higher plant height (95.75 cm), number of leaves (75.04) and pod yield (8.93 t/ha) which was on par with the interaction dose of N_{40} P_{60} (8.86 t/ha).

Key words: Nitrogen, Phosphorus, Growth, Yield, Bush bean.

Introduction

Dolichos bean (*Dolichos lablab var. typicus*) is an important leguminous vegetable of India and is mainly grown for its tender pods which are cooked and consumed as vegetable. Being leguminous vegetable, the immature green pods of dolichos bean is a good source of protein, minerals and vitamins. It is one of the most ancient crop among the cultivated plants in Tamilnadu grown as either pure or mixed with other crops, such as finger millet, groundnut, castor, sorghum, field bean with limited rainfall. Among the constraints contributing to low productivity of bush bean inadequate use of fertilizers and lack of improved package of practices are important. Nitrogen plays an important role in various metabolic process of plant. It is an essential constituent of protein, chlorophyll and, is present in many other compounds helps in plant metabolism, such as nucleotides, phosphatides, alkaloids, enzymes, hormones, vitamins, etc. It imparts dark-green colour to plants, produces rapid early growth, improves capacity to fix atmospheric nitrogen symbiotically. Bush bean and responds to small quantity of nitrogenous fertilizers applied as starter dose. Application of 15 - 20 kg N/ha has been found optimum to get better production response in bush bean is observed by Patil *et al.,* (2011). Phosphorus is an essential constituent of nucleic acids and stimulates root growth as well as increase nodule activity in plant. Phosphorus is also an essential primary nutrient and is constituent of nucleic acids such as ribonucleic acid (RNA) and deoxyribonucleic acid (DNA), adenosine diphosphate (ADP) and adenosine triphosphate (ATP), nucleoproteins, amino acids, proteins, phosphotides, phytin and several coenzymes *viz.*, thiamine, pyrophosphate and pyrodoxylphosphite observed by Rai *et al.,* (2014). Supplementing N and P requirement of

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this crop through inorganic fertilizers is very important for growth, flowering and yield of the crops. In order to establish the optimum dose of N and P, the present study was conducted in a sandy loamy soil of Cuddalore district in Tamil nadu.

Materials and method

A field experiment was conducted during the year 2016 at Madathanthoppu village Chidambaram Taluk, Cuddalore district in Tamilnadu, in factorial randomized block design with three replications. The soil was medium sandy loamy in texture, alkaline in reaction (pH 7.3), low in available nitrogen (53.0 kg/ha), higher in available phosphorus (31.0 kg P_2O_5/ha) and higher in potassium (145.0 kg K_2O/ha) content. The experiment consisted four levels of nitrogen (control, 20, 30 and 40 kg/ha) and four levels of phosphorus (control, 40, 50 and 60 kg P_2O_5/ha), thereby, making sixteen treatment combinations.

Table 1: Effect of graded levels of N and P on growth and flowering characters in Dolichos bean (*Dolichos lablab var. typicus*).

Treatment	Plant height at 90 DAS (cm)	Number of leaves Per plant 90 DAS	Number of branch	Leaf area (cm^2)	Leaf area index (cm^2)	Total Chlorophyll in leaf (mg $g^{-1}$of fresh tissue)	Number of nodes per plant	Inter nodal length (cm)	Days to first flowering (d)	Number of Raceme per plant	Racemes Length (cm)
Nitrogen kg ha^{-1}											
0	70.04	48.01	4.67	16.66	3.74	1.22	3.65	2.51	41.75	6.51	34.20
20	77.75	55.75	6.59	17.11	4.76	1.63	4.47	3.39	38.00	8.98	40.36
30	84.57	65.25	8.65	17.30	5.80	1.50	5.30	4.23	33.50	11.72	50.87
40	86.88	66.52	8.98	17.60	5.95	1.52	5.47	4.39	32.97	12.20	50.46
SEd	**0.55**	**0.52**	**0.14**	**0.29**	**0.09**	**0.02**	**0.06**	**0.06**	**0.91**	**0.17**	**0.64**
CD 5%	**1.11**	**1.04**	**0.28**	**0.60**	**0.19**	**0.05**	**0.12**	**0.14**	**1.82**	**0.35**	**1.28**
Phosphorus kg ha^{-1}											
0	66.05	44.25	3.88	16.50	3.40	1.49	3.26	2.18	43.25	5.36	31.58
40	79.99	59.50	7.40	17.27	5.16	1.50	4.79	3.70	36.50	10.02	43.39
50	84.62	64.51	8.49	17.50	5.67	1.46	5.27	4.16	34.25	11.58	28.48
60	88.58	67.27	9.12	17.40	6.03	1.52	5.56	4.48	32.23	12.45	52.80
SEd	**0.55**	**0.52**	**0.14**	**0.29**	**0.09**	**0.02**	**0.06**	**0.06**	**0.91**	**0.17**	**0.64**
CD 5%	**1.11**	**1.04**	**0.28**	**0.60**	**0.19**	**0.05**	**0.12**	**0.14**	**1.82**	**0.35**	**1.28**
Interaction NXP											
N_0P_0	60.10	37.00	2.50	16.03	2.50	0.96	2.73	1.67	48.00	3.66	25.81
N_0P_{40}	66.53	46.03	3.96	16.56	3.50	1.26	3.26	2.26	42.00	5.33	31.96
N_0P_{50}	73.53	53.03	5.80	16.96	4.33	1.36	4.16	3.03	39.03	7.83	38.00
N_0P_{60}	79.63	56.00	6.43	17.10	4.63	1.30	4.46	3.36	38.00	8.73	40.13
$N_{20}P_0$	63.76	41.00	3.26	16.43	3.16	2.30	3.03	2.00	44.00	4.53	28.43
$N_{20}P_{40}$	80.00	58.00	7.06	17.23	4.96	1.40	4.70	3.60	37.00	6.60	43.06
$N_{20}P_{50}$	82.5	61.00	7.70	17.33	5.30	1.36	4.93	3.83	36.00	10.46	41.03
$N_{20}P_{60}$	84.73	63.00	8.33	17.46	5.63	1.46	5.23	4.08	35.03	11.33	48.93
$N_{30}P_0$	68.66	48.00	4.56	16.73	3.80	1.33	3.50	2.53	41.00	6.23	34.93
$N_{30}P_{40}$	84.73	66.00	8.96	17.60	5.96	1.46	5.46	4.33	34.00	12.16	51.06
$N_{30}P_{50}$	90.66	72.00	10.20	17.86	6.53	1.56	5.96	4.86	31.00	13.56	57.33
$N_{30}P_{60}$	94.23	73.03	10.86	17.03	6.93	1.66	6.26	5.15	28.00	14.93	60.16
$N_{40}P_0$	71.66	51.00	5.20	16.83	4.13	1.36	3.80	2.80	40.00	7.03	36.83
$N_{40}P_{40}$	88.33	68.00	9.60	17.70	6.23	1.50	5.73	4.63	33.00	13.00	47.46
$N_{40}P_{50}$	91.80	72.00	10.26	17.86	6.53	1.56	6.03	4.93	31.00	13.96	57.56
$N_{40}P_{60}$	95.73	75.04	10.89	18.00	6.93	1.66	6.33	5.20	27.93	14.83	60.00
SEd	**1.11**	**1.04**	**0.28**	**0.59**	**0.18**	**0.05**	**0.12**	**0.13**	**1.83**	**0.34**	**1.29**
CD 5%	**2.22**	**2.08**	**0.57**	**1.21**	**0.38**	**0.10**	**0.29**	**0.28**	**3.63**	**0.71**	**2.63**

Fertilizers were applied as per treatment schedule through single super phosphate (SSP) and urea at the time of sowing as basal dose. The bush bean *var.* Co (Gb) 14 was sown at a seed rate of 25 kg/ha with a row spacing of 60 cm. Six irrigations were applied during growing season. Intercultural operations *viz.,* thinning, hoeing and weeding were followed after 20 days of sowing to maintain recommended spacing and weed control. The growth and yield attributes were recorded time to time. For which five plants were tagged for non destructive Parameters. Fully developed green pods from randomly selected five plants from each plot were plucked and counted. The average number of pods per plants were worked out. After pod weight of plant for each net plot area was recorded in kg per plot and then converted to kg/ha. The data were analyzed with statistical tools as

Table 2: Effect of graded levels of N and P on yield characters in Dolichos bean (*Dolichos lablab var. typicus).*

Treatment	No. of Pods per inflorescence	No. Of Pods per plant	Pod length (cm)	Pod width (cm)	Single Pod Weight (g)	Days to First Pod harvest	Days to last Pod harvest	Pod Yield per plant (g)	Pod Yield per plot (Kg)	Pod yield per hectare (t)
Nitrogen kg ha^{-1}										
0	5.86	18.61	6.60	1.58	4.42	39.41	82.05	118.24	1.57	2.66
20	6.56	24.11	8.15	1.98	4.77	38.07	86.67	195.48	2.27	4.58
30	7.09	29.67	9.83	2.44	5.15	37.26	90.69	285.90	3.07	6.64
40	7.14	30.57	10.44	2.48	5.22	36.98	91.45	292.03	3.18	6.96
SEd	**0.11**	**0.21**	**0.15**	**0.08**	**0.08**	**0.39**	**0.63**	**4.19**	**0.04**	**0.09**
CD 5%	**0.23**	**0.84**	**0.31**	**NS**	**0.17**	**1.56**	**1.26**	**8.56**	**0.09**	**0.20**
Phosphorus kg ha^{-1}										
0	5.74	16.77	5.95	1.44	4.30	39.72	80.79	86.05	1.29	1.88
40	6.70	26.02	8.90	2.14	4.91	37.76	88.47	227.65	2.56	5.36
50	7.05	29.29	9.69	2.38	5.12	37.37	89.78	272.71	2.99	6.46
60	7.16	30.89	10.46	2.52	5.23	36.96	91.82	305.23	3.25	7.14
SEd	**0.11**	**0.21**	**0.15**	**0.08**	**0.08**	**0.39**	**0.63**	**4.19**	**0.04**	**0.09**
CD 5%	**0.23**	**0.84**	**0.31**	**NS**	**0.17**	**1.56**	**1.26**	**8.56**	**0.09**	**0.20**
Interaction NXP										
N_0P_0	5.63	13.35	4.94	1.20	4.09	39.63	76.9	34.58	0.82	0.62
N_0P_{40}	5.91	16.08	5.96	1.43	4.3	39.14	79.79	86.06	1.29	1.88
N_0P_{50}	6.35	21.97	7.5	1.79	4.65	38.39	84.09	163.3	1.99	3.77
N_0P_{60}	6.50	23.07	8.02	1.91	4.71	38.14	85.54	189.04	2.23	4.42
$N_{20}P_0$	5.77	15.08	5.44	1.32	4.2	39.38	78.35	60.33	1.06	1.27
$N_{20}P_{40}$	6.65	25.42	8.53	2.05	4.87	37.89	87	214.79	2.46	5.05
$N_{20}P_{50}$	6.79	27.15	9.05	2.19	4.98	37.64	88.47	240.54	2.68	5.68
$N_{20}P_{60}$	6.94	28.85	9.56	2.33	5.09	37.4	89.92	266.29	2.91	6.32
$N_{30}P_0$	6.06	18.53	6.47	1.55	4.42	38.89	81.24	111.8	1.53	2.51
$N_{30}P_{40}$	7.08	30.56	10.08	2.47	5.21	37.15	91.38	292.02	3.15	6.95
$N_{30}P_{50}$	7.38	34	10.59	2.75	5.43	36.65	94.3	343.5	3.63	8.22
$N_{30}P_{60}$	7.77	35.87	12.2	2.99	5.56	36.15	95.96	396.35	3.99	8.94
$N_{40}P_0$	6.20	20.24	6.99	1.67	4.54	38.64	82.66	137.55	1.76	3.13
$N_{40}P_{40}$	7.23	32.28	11.1	2.61	5.32	36.9	92.84	317.76	3.38	7.58
$N_{40}P_{50}$	7.56	34.08	11.61	2.77	5.44	36.4	94.4	343.52	3.67	8.24
$N_{40}P_{60}$	7.70	35.8	12.12	2.91	5.55	36.16	95.86	369.26	3.92	8.89
SEd	**0.23**	**0.42**	**0.30**	**0.16**	**0.17**	**0.78**	**1.27**	**8.38**	**0.09**	**0.19**
CD 5%	**0.46**	**1.68**	**0.62**	**NS**	**0.34**	**3.12**	**2.58**	**17.12**	**0.19**	**0.40**

suggested by Panse and Sukhatme (1985).

***Per se* effect of Nitrogen**

Increasing levels of N increased the growth and yield parameters of dolichos bean significantly (table 1&2). The highest plant height (86.88 cm) number of leaves (66.52 cm,) number of branches (8.98) leaf area (17.60) leaf area index (5.95) chlorophyll in leaf fresh tissue (1.52) number of nodes per plant (5.47) and inter nodal length (4.39 cm) were recorded in N @40 kg ha^{-1}. Nitrogen is the nutrition required for improvement of growth parameters through efficient metabolic activity and increased rate of photo synthesis. The present results are in accordance with the reports by Hazraand Chinanshuk Ghosh *et al.,* 2014, and Som, 1999. The flowering characters like days to first flowering (32.97) DAS, number raceme per plant (12.20) raceme length (50.46) cm, and number pods per inflorescence (7.14), the yield characters like pod length (10.44) cm, pod width (2.48) cm, pod weight (5.22g), Days to first pod harvest (36.98), Days to last pod harvest (91.45) DAS, pod yield per plant (292.03) g, pod yield per plot (3.18) kg and pod yield per hectares (6.96 tn/ha) were recorded the highest in the treatment which received the application of N 40 kg/ha^{-1}. The improvement in root nodulation and yield attributes with Nitrogen @ 40kg/ha application could be ascribed to its pivotal role in regulation of the metabolic and enzymatic processes of respiration and legume rhizobium symbiotic nitrogen fixation, which reflected in increased yield. Similar results were also reported by Rao *et al.,* 2001 and Singh *et al.* (2004).

***Per se* Effect of phosphorus**

Per se Phosphorus application had significant influence on growth characters and yield characters of Bush bean (table 1&2). The yield of bush bean increased with increasing dose of P_2O_5 Up to 60 kg/ha. Application of 60 kg P_2O_5/ha produced significantly higher growth and yield characters as compared to control and other treatments. The highest plant height of (88.58 cm), number of leaves (67.27 cm), number of branches (9.12), leaf area (17.40), leaf area index (6.03), chlorophyll fresh leaf tissue (1.52), number of nodes per plant (5.56) and inter nodal length (4.48 cm), was noticed at 60 kg P_2O_5 ha^{-1}. Increase in plant growth might be attributed due to the role of phosphorus in various metabolic process such as cell division cell development and cell enlargement (Singh *et al.,* 2005). Similarly flowering character like days to first flowering (32.23 DAS), number of flower per raceme (15.79), number of raceme per plant (12.45), raceme length (52.80 cm). ware also higher at 60 kg P_2O_5/ha^{-1} Twivedi *et al.,* 2002. and Pan *et al.,* 2004 in dolichos bean. Also envisaged similar trend of results with respect to increased P_2O_5 application. Application of 60 kg P_2O_5/ha^{-1} produced significantly higher yield attributes like number of pods per inflorescence (7.17), pod length (10.46) cm, pod width (2.52) cm, pod weight (5.23) cm, Days to first pod harvest (36.96) DAS, last pod harvest (91.82) DAS, pod yield per plant (305.23) g, pod yield per plot (3.25) kg and pod yield per hectare (7.14) t/ha. Increased yield attributes (pods/plant) resulted in higher pods per plant. Saileela *et al.*, 2015: Kharbamon *et al.,* 2017. 2015 also reported such increased higher pods per plant, pod yield per hectare in Bush bean.

Interaction effect

Interaction effect of nitrogen and phosphorus levels on growth and yield characters in Bush bean. Was fund significantly influenced the growth and yield attributes. The combined application of nitrogen and phosphorus @ 40 and 60 significantly increased the growth and yield characters and it remained at par with application $N_{30}P_{60}$, $N_{30}P_{50}$, $N_{20}P_{40}$, $N_{30}P_{40}$,$N_{20}P_{40}$, $N_{20}P_{60}$, and $N_{20}P_{50}$, over rest of treatments (Table 1 and 2). Nitrogen availability is depending more or less on phosphorus. Phosphorus enhances the symbiotic nitrogen (N) fixation process in legume crops and ultimately improved the uptake of nutrients the present results are in conformity with those reported by Navale *et al.* (2000) and Badran (2003).

Conclusion

On the basis of above results, it seems quite logical to conclude that for higher growth parameter and yield characters of Bush bean, combined application of nitrogen and phosphorus @ 40 and 60 kg/ha dose can be sufficient on medium sandy loamy soil of cuddalore district in Tamil nadu.

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