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Effect of nitrogen, phosphorous and boron on growth and seed yield of Dolichos bean (*Lablab purpureus* L.) var. Arka Amogh

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Abstract
A field experiment entitled "Effect of nitrogen, phosphorous and boron on growth and seed yield of Dolichos bean (*Lablab purpureus* L.) var. Arka Amogh" was carried out with ten treatments and three replications in Randomized complete block design with varied level of nitrogen, phosphorous and boron to study the growth and seed yield of dolichos bean var. Arka Amogh. It was observed that T10 with highest NPK (35:70:50 kg/ha) + FYM (15 t/ha) + B (1.5 kg/ha) produced maximum plant height (96.2 cm), leaves/plant (34.6), average leaf area (335.6 cm^2), number of pods/plant (33.7), number of seeds/pod (4.3), 100 seed weight (32.71 g), average seed yield/pod (1.407 g), total seed yield/ha (2844 kg), total marketable seed yield/ha (2480.4 kg), lowest unmarketable seeds/ha (363.6 kg) which was found to be at par with T8 with NPK (35:70:50 kg/ha) + FYM (15 t/ha) + B (1.5 kg/ha). So, from the experiment, it can be concluded that the fertilizer dose of NPK (35:70:50 kg/ha) + FYM (15 t/ha) + B (1.5 kg/ha) should be applied to get better plant growth and higher marketable seed yield/ha in dolichos bean, var. Arka Amogh.

Keywords: Nitrogen, phosphorous, Dolichos bean

Introduction

The Indian Bean (*Lablab purpureus* L.) with chromosome number (2n = 22) is one of the most important leguminous vegetable crop also known as Sem, Hyacinth bean, Indian bean and Lablab bean. It belongs to family Fabaceae and is native to India (Nene, 2006) [10]. It is considered very nutritious due to higher protein as well as carbohydrates, vitamins and dietary fibre. Nitrogen treatment at lower doses in the early stages is beneficial for a better vigour. It also helps in enhancing the growth of leaves, stems and overall growth and production. Nitrogen also promotes vegetative growth, which leads to higher translocation and accumulation of photosynthates at the sink (pod), which improves pod characteristics and overall output (Vimala and Natarajan, 2000) [20]. Phosphorus promotes root development and increases nodule activity in plants. It is found in nucleic acids such as DNA, RNA as well as in ATP and ADP, amino acids, nucleoproteins, proteins, phytin, phosphatides and several coenzymes like thiamine, pyrodoxyl phosphite and pyrophosphate. Phosphorous also helps in better and massive nodulation resulting in enhanced nitrogen absorption, well-filled beans, thus achieving greater yield. Phosphorus treatment increases the yield of green tender beans for the grown crop and also subsequent crops (Turuko and Mohammed, 2014) [18]. Boron is an important element necessary for the regular development among most plants. Boron is essential for optimal tissue growth and differentiation, as well as aiding the reduction of infertility and deformity in reproductive organs (Singh *et al.*, 2006) [16]. Boron increases grain and stover yield, nutritional content, absorption of nutrients and crop quality in legumes (Singh *et al.*, 2004 and Singh *et al.*, 2006) [15, 16]. The boron treatment boosts primary absorption of nutrients (Ganie *et al.*, 2014) [4] and improves both availability of nitrogen in soil and nodulation activities in pulses (Yakuba *et al*., 2010) [21]. Balanced nutrients play a critical role in determining the effectiveness of seed development in lablab bean and thereby better yield of top quality seeds. Besides the genetic potential of the variety, the fertility level of the soil has a significant impact on crop growth, seed production and seed quality.

Materials and Methods

This field experiment was conducted to investigate the effects of varying nitrogen, phosphorous, and boron levels on growth, flowering and fruiting behaviour and seed yield.

The treatments were T1 with NPK (25:60:50 kg/ha), T2 with NPK (25:60:50 kg/ha) + FYM (15 t/ha), T3 with NPK (25:60:50 kg/ha) + FYM (15 t/ha) + B (1 kg/ha), T4 with NPK (25:60:50 kg/ha) + FYM (15 t/ha) + B (1.5 kg/ha), T5 with NPK (25:70:50 kg/ha) + FYM (15 t/ha) + B (1 kg/ha), T6 with NPK (25:70:50 kg/ha) + FYM (15 t/ha) + B (1.5 kg/ha), T7 with NPK (35:60:50 kg/ha) + FYM (15 t/ha) + B (1 kg/ha), T8 with NPK (35:60:50 kg/ha) + FYM (15 t/ha) + B (1.5 kg/ha) T9 with NPK (35:70:50 kg/ha) + FYM (15 t/ha) + B (1 kg/ha) and T10 with NPK (35:70:50 kg/ha) + FYM (15 t/ha) + B (1.5 kg/ha). Inorganic fertilizers in form of urea for nitrogen, SSP (Single super phosphate) for phosphorous, MOP (Muriate of potash) for potassium and Borax for boron were applied. Before sowing, seeds were treated with fungicide (carbendazim 50% WP) at a rate of 2g/kg seeds and spacing of 45X30 cm was maintained within the field. Standard recommended cultivation practices were followed during the entire cropping period.

Table 1: Mean performance of different treatments on Arka Amogh for Plant height (cm), Number of leaves/plant, Average leaf area (cm²)

Treatments		Plant height (cm)	Number of leaves/plant	Average leaf area (cm²)
T_1	NPK(25:60:50 kg/ha)	75.2	24.2	261.6
T_2	NPK(25:60:50 kg/ha)+FYM(15 t/ha)	77.4	25.1	270.1
T_3	NPK(25:60:50 kg/ha)+FYM(15 t/ha)+B(1 kg/ha)	79.9	25.9	274.7
T_4	NPK(25:60:50 kg/ha)+FYM(15 t/ha)+B(1.5 kg/ha)	82.8	26.8	282.5
T_5	NPK(25:70:50 kg/ha)+FYM(15 t/ha)+B(1 kg/ha)	85.5	28.1	291.4
T_6	NPK(25:70:50 kg/ha)+FYM(15 t/ha)+B(1.5 kg/ha)	91.3	32.3	321.7
T_7	NPK(35:60:50 kg/ha)+FYM(15 t/ha)+B(1 kg/ha)	87.8	30.2	298.6
T_8	NPK(35:60:50 kg/ha)+FYM(15 t/ha)+B(1.5 kg/ha)	94.4	33.8	329.3
T_9	NPK(35:70:50 kg/ha)+FYM(15 t/ha)+B(1 kg/ha)	89.6	31.4	308.3
T_{10}	NPK(35:70:50 kg/ha)+FYM(15 t/ha)+B(1.5 kg/ha)	96.2	34.6	335.6
S.E(m)±		2.702	1.397	11.395
C.D.at 5%		8.026	4.150	33.853
CV%		5.44	8.27	6.64

Table 2: Mean performance of different treatments on Arka Amogh for Number of pods/plant, Number of seeds/pod, 100 seed weight (g), Average seed yield/pod(g)

Treatments		Number of pods/plant	Number of seeds/pod	100 seed weight (g)	Average seed yield/pod(g)
T_1	NPK(25:60:50 kg/ha)	29.3	3.9	30.98	1.208
T_2	NPK(25:60:50 kg/ha)+FYM(15 t/ha)	29.8	4.0	31.17	1.247
T_3	NPK(25:60:50 kg/ha)+FYM(15 t/ha)+B(1 kg/ha)	30.1	4.0	31.42	1.257
T_4	NPK(25:60:50 kg/ha)+FYM(15 t/ha)+B(1.5 kg/ha)	30.5	4.0	31.68	1.267
T_5	NPK(25:70:50 kg/ha)+FYM(15 t/ha)+B(1 kg/ha)	30.8	4.1	31.81	1.304
T_6	NPK(25:70:50 kg/ha)+FYM(15 t/ha)+B(1.5 kg/ha)	32.3	4.2	32.49	1.365
T_7	NPK(35:60:50 kg/ha)+FYM(15 t/ha)+B(1 kg/ha)	31.2	4.1	31.89	1.307
T_8	NPK(35:60:50 kg/ha)+FYM(15 t/ha)+B(1.5 kg/ha)	33.0	4.3	32.63	1.403
T_9	NPK(35:70:50 kg/ha)+FYM(15 t/ha)+B(1 kg/ha)	31.6	4.2	32.37	1.360
T_{10}	NPK(35:70:50 kg/ha)+FYM(15 t/ha)+B(1.5 kg/ha)	33.7	4.3	32.71	1.407
S.E(m)±		1.066	0.154	1.531	0.052
C.D.at 5%		3.167	NS	NS	0.156
CV%		5.91	6.5	8.31	6.93

Table 3: Mean performance of different treatments on Arka Amogh for Total seed yield/ha(kg), Unmarketable seed yield/ha(kg), Marketable seed yield/ha (kg)

Treatments		Total seed yield/ha (kg)	Unmarketable seed yield/ha(kg)	Marketable seed yield/ha (kg)
T_1	NPK(25:60:50 kg/ha)	2124.0	518.4	1605.6
T_2	NPK(25:60:50 kg/ha)+FYM(15 t/ha)	2229.0	505.8	1723.2
T_3	NPK(25:60:50 kg/ha)+FYM(15 t/ha)+B(1 kg/ha)	2269.8	496.2	1773.6
T_4	NPK(25:60:50 kg/ha)+FYM(15 t/ha)+B(1.5 kg/ha)	2319.0	477.6	1841.4
T_5	NPK(25:70:50 kg/ha)+FYM(15 t/ha)+B(1 kg/ha)	2410.2	484.2	1926.0
T_6	NPK(25:70:50 kg/ha)+FYM(15 t/ha)+B(1.5 kg/ha)	2644.8	400.2	2244.6
T_7	NPK(35:60:50 kg/ha)+FYM(15 t/ha)+B(1 kg/ha)	2447.4	476.4	1971.0
T_8	NPK(35:60:50 kg/ha)+FYM(15 t/ha)+B(1.5 kg/ha)	2778.0	377.4	2400.6
T_9	NPK(35:70:50 kg/ha)+FYM(15 t/ha)+B(1 kg/ha)	2577.6	445.2	2132.4
T_{10}	NPK(35:70:50 kg/ha)+FYM(15 t/ha)+B(1.5 kg/ha)	2844.0	363.6	2480.4
S.E(m)±		88.272	17.166	75.470
C.D.at 5%		262.239	50.998	224.207
CV%		6.20	6.54	6.50

Results and Discussions

Growth parameters

Maximum plant height was observed in T_{10} (96.2 cm), which was found to be at par with T_8 (94.4 cm), T_6 (91.3 cm) and T_9 (89.6 cm). The noted increase might be due to early and abundant nitrogen supplement resulting in an ideal nutrition availability. The increase in phosphorous dose also helped in enhanced nitrogen absorption and more root nodulation, promoting biological nitrogen fixation in the plant and resulted in increased cell size and cell number facilitating a faster growth rate than the T_1 with lower rates of N:P:K application. Patil *et al.*, (1995) [12], Ahlawat (1996) [1], Parmar *et al.*, (1999) [11], Kumar and Puri (2002) [6], Shrikant *et al.*, (2007) [14], Quddus *et al.*, (2011) [13] had also reported this type of findings. It is evident from the table that maximum number of leaves/plant was recored in T_{10} (34.6), which was found to be at par with T_8 (33.8), T_6 (32.3) and T_9 (31.4). This might be due to increased nitrogen and phosphorous application, since nitrogen aids in the development of total chlorophyll content, while phosphorous aids in root nodulation and nutrient absorption in the plant, which eventually enhances photosynthesis. The energy gained from photosynthesis is stored in form of ATP and ADP for later use in development, resulting in robust plant growth. Jaishankar and Manivannan (2018) [5] and Ayub *et al.*, (2012) [2] also reported similar findings.

Yield attributing characters

The result revealed that maximum number of pods/plant was recorded in T_{10} (33.7) followed by T_8 (33), T_6 (32.3), T_9 (31.6), T_7 (31.2) and T_5 (30.8). This might be due to higher doses of nitrogen which, increased the vegetative growth (number of branches, number of leaves, plant height and canopy) which, leads to higher translocation and accumulation of photosynthates and improved pod number and total output. (Vimala and Natarajan, 2000) [20]. The present trend of number of pods/plant also corroborate with the results of Mishra *et al.*, (2010) [7] and Tahir *et al.*, (2014) [17]. The highest number of seeds/pod was recorded in T_{10} (4.3) and T_8 (4.3) followed by T_9 (4.2) and T_6 (4.2) and lowest in T_1 (3.9) followed by T_2 (4), T_3 (4), T_4 (4), T_5 (4.1) and T_7 (4.1). It was observed that there was no significant variation in number of seeds/pod among the treatments. The slight increase in number of seeds/pod might be attributed to application of higher nutrients and boron which helps in reproductive activities and increases grain yield. 100 seed weight was not influenced by different treatments and didn't vary significantly among the treatments but maximum 100 seed weight in T_{10} (32.71 g) was obtained as compared to T_1 (30.98 g). This is due to good filled seeds in T_{10}. Similar results were also reported by Doddamani *et al.*, (2020) [3], Uddin *et al.*, (2020) [19] and Shrikant (2007) [14]. The highest dried seed weight/pod was found in T_{10} (1.407 g) followed by T_8 (1.403 g), T_6 (1.365 g), T_9 (1.360 g) and T_7 (1.307 g). This result might be attributed to increase in all growth parameters due to higher plant nutrition and good quality seed production due to boron application. The highest seed yield/ha was obtained in T_{10} (2844.0 kg), which was found to be at par with T_8 (2778.0 kg) and T_6 (2644.8 kg). The highest quantity of marketable seeds/ha was obtained in T_{10} (2480.4 kg), which was found to be at par with T_8 (2400.6 kg) while, maximum unmarketable seed yield/ha was recoreded in T_1 (518.4 kg) followed by T_2 (505.8 kg), T_3 (496.2 kg), T_5 (484.2 kg), T_4 (477.6 kg) and T_7 (476.4 kg). The treatments T_{10} with minimum unmarketable seed yield/ha (363.6 kg) was found to be at par with T_8 (377.4 kg), T_6 (400.2 kg) and T_9 (445.2 kg). Higher nitrogen helps in increasing vegetative growth such as plant height, number of branches, number of leavers, leaf area which ultimately results in utilizing more sun light and better photosynthetic activity. Boron and phosphorous facilitate nutrient uptake by the plants. Phosphorous helps in higher root nodulation which increases atmospheric nitrogen fixation and due to better root system nutrient uptake increases. Boron helps in pollination, seed setting, seed filling and increases good quality seed. Similar results were also reported with higher boron application by Mishra *et al*., (2001) [8] in chick pea, Tahir *et al.*, (2014) [17] and Naik *et al.*, (2002) [9] in Soy bean. Thus it can be concluded that application of higher dose of nitrogen and phosphorous along with boron [NPK (35:70:50kg/ha) + FYM (15t/ha) + B (1.5kg/ha)] is required to get higher marketable seed yield/ha in dolichos bean, var. Arka Amogh.

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