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Effect of Nitrogen, Phosphorous and Boron on Seed Yield, Seed quality and Economics of Dolichos Bean (*Lablab purpureus* L.) var. Arka Amogh

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ABSTRACT: A field experiment 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 effect of nitrogen, phosphorous and boron on seed yield, seed quality and economics of Dolichos bean (*Lablab purpureus* L.) var. Arka Amogh. It was observed that T_{10} with highest NPK (35:70:50 kg/ha) + FYM (15 t/ha) + B (1.5 kg/ha) produced maximum 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), highest germination percentage (92.7 %), vigour index-1 (3487.37), vigour index-2 (12672.23) and highest B:C ratio (3.79) which was found to be at par with T_8 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 higher marketable seed yield/ha with better quality and fetch more profit in seed production of dolichos bean, var. Arka Amogh.

Keywords: Dolichos bean, seed yield, seed quality, Economics.

INTRODUCTION

The Indian Bean (*Lablab purpureus* L.) is a leguminous vegetable with chromosome number (2n = 22). It is also known as Sem, Hyacinth bean, Indian bean, and Lablab bean. It is native to India and belongs to the Fabaceae family (Nene, 2006). It is known as poor man's meat due to presence of high amount of protein (Joshi and Rahevar 2015). Nitrogen treatment at lower doses is beneficial in the early stages for better vigour. It also aids in the growth of leaves and stems, as well as overall growth and production. Nitrogen also promotes vegetative growth, which increases translocation of photosynthates and accumulation at the sink (pod), resulting in improved pod characteristics and overall output (Vimala and Natarajan 2000). In plants, phosphorus promotes root development and nodulation. It is also found in nucleic acids like DNA and RNA, as well as ATP and ADP, amino acids, nucleoproteins, proteins, phytin, phosphatides and a number of coenzymes like thiamine, pyrodoxyl phosphite and pyrophosphate (Rai *et al*., 2014). Phosphorous also helps in better and massive nodulation resulting in enhanced nitrogen absorption, well-filled beans, thus achieving greater yield (Sammauria *et al.,* 2009). Phosphorus treatment increases the yield of green tender beans for the grown crop and also subsequent crops (Turuko and Mohammed 2014). Boron is required for proper tissue growth and differentiation, as well as for reducing infertility and deformity in reproductive organs (Singh *et al*., 2006). Boron improves grain and stover yield, nutritional content, nutrient absorption, and crop quality in legumes (Singh *et al*., 2004; Singh *et al*., 2006). Boron treatment increases primary nutrient absorption and improves both nitrogen availability in soil and nodulation activities in pulses (Ganie *et al*., 2014); (Yakuba *et al*., 2010). Boron deficiency reduces crop productivity in legumes (Mani and Haldar 1996). Balanced nutrients are critical in determining the effectiveness of seed development in lablab bean and thereby better yield of top quality seeds Apart from the genetic potential of the variety, soil fertility has a significant impact on crop growth, seed production, and seed quality.

MATERIALS AND METHODS

The purpose of this field experiment was to look at the effects of different nitrogen, phosphorus, and boron levels on growth, seed yield and seed quality. The treatments were T_1 with NPK (25:60:50 kg/ha), T_2 with NPK (25:60:50 kg/ha) + FYM (15 t/ha), T_3 with NPK (25:60:50 kg/ha) + FYM (15 t/ha) + B (1 kg/ha), T_4 with NPK (25:60:50 kg/ha) + FYM (15 t/ha) + B (1.5 kg/ha), T_5 with NPK (25:70:50 kg/ha) + FYM (15 t/ha) + B (1 kg/ha), T_6 with NPK (25:70:50 kg/ha) + FYM (15 t/ha) + B (1.5 kg/ha), T_7 with NPK (35:60:50 kg/ha) + FYM (15 t/ha) + B (1 kg/ha), T_8 with NPK (35:60:50 kg/ha) + FYM (15 t/ha) + B (1.5 kg/ha) T_9 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 the form of urea for nitrogen, SSP (single super phosphate) for phosphorous, MOP (muriate of potash) for potassium, and Borax for boron were used. Before sowing, seeds were treated with fungicide (carbendazim 50% WP) at a rate of 2g/kg seeds, and a field spacing of 45X30 cm was maintained. Standard recommended cultivation practices were followed throughout the cropping period.

Table 1: Mean performance of different treatments on Arka Amogh for Number of pods/plant, Number of seeds/pod, 100 seed weight (g), Average dried seed yield/pod(g).

Treatments		Number of pods/plant	Number of seeds/pod	100 seed weight (g)	Average dried 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 2: 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

Table 3: Mean performance of different treatments on Arka Amogh for Germination percentage, Vigour index 1 and Vigour index 2.

Treatments		Germination percentage	Vigour index 1	Vigour index 2
T_1	NPK(25:60:50 kg/ha)	86.7	2833.36	10289.50
T_2	NPK(25:60:50 kg/ha)+FYM(15 t/ha)	87.3	2929.79	10646.50
T_3	NPK(25:60:50 kg/ha)+FYM(15 t/ha)+B(1 kg/ha)	88.0	2985.84	10845.28
T_4	NPK(25:60:50 kg/ha)+FYM(15 t/ha)+B(1.5 kg/ha)	88.7	3056.60	11097.36
T_5	NPK(25:70:50 kg/ha)+FYM(15 t/ha)+B(1 kg/ha)	88.7	3097.40	11244.73
T_6	NPK(25:70:50 kg/ha)+FYM(15 t/ha)+B(1.5 kg/ha)	91.3	3333.36	12107.37
T_7	NPK(35:60:50 kg/ha)+FYM(15 t/ha)+B(1 kg/ha)	89.3	3165.69	11500.18
T_8	NPK(35:60:50 kg/ha)+FYM(15 t/ha)+B(1.5 kg/ha)	92.0	3429.76	12525.29
T_9	NPK(35:70:50 kg/ha)+FYM(15 t/ha)+B(1 kg/ha)	90.0	3255.30	11819.49
T_{10}	NPK(35:70:50 kg/ha)+FYM(15 t/ha)+B(1.5 kg/ha)	92.7	3487.37	12672.23
S.E (m)+		2.805	157.038	436.146
C.D.at 5%		NS	466.531	1295.710
CV %		5.43	8.61	6.58

Table 4: Economics of seed production in dolichos bean, var. Arka Amogh.

Calculation of B:C for seed production of dolichos bean, var. Arka Amogh			
Components	**T_1 NPK (25:60:50 kg/ha) (Rupees)**	**T_8 NPK (35:60:50 kg/ha) + Boron 1.5 kg/ha + FYM 15t/ha (Rupees)**	**T_{10} NPK (35:70:50 kg/ha) + Boron 1.5 kg/ha + FYM 15 t/ha (Rupees)**
Tractor ploughing	8000	8000	8000
Layout cost	18600	18600	18600
Seed cost	12500	12500	12500
FYM	-------	15400	15400
N (Urea)	310.75	435	435
P (SSP)	1357	1357	1583
K (MOP)	1800	1800	1800
B (Borax)	-------	1250	1250
Application of FYM + Fertilizers	6240	7800	7800
seed sowing	6240	6240	6240
Irrigation charge	6000	6000	6000
Weeding	7800	7800	7800
Hoeing and top dressing	6240	6240	6240
Pest control	15000	15000	15000
Harvesting cost	15720	15720	15720
Seed drying	3120	3432	3432
Seed extraction	10800	11736	11736
Packaging	6000	6000	6000
Watch and ward	10000	10000	10000
Roguing	3000	3000	3000
Certification	5000	5000	5000
Total cost	**143727.75**	**163310**	**163536**
Total marketable seed yield/ha	1605.6 kg	2400.6 kg	2480.4 kg
Selling price/kg seed	250	250	250
Total income	**401400**	**600150**	**620100**
B:C ratio	**2.79**	**3.67**	**3.79**

RESULTS AND DISCUSSIONS

Effect on Yield attributing characters. The result revealed that maximum number of pods/plant was recoreded 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 could be attributed to higher nitrogen dosages, which boosted vegetative growth (number of branches, number of leaves, plant height, and canopy), resulting in higher photosynthate translocation and accumulation, as well as improved pod number and overall output (Vimala and Natarajan 2000). The present trend of number of pods/plant also corroborate with the results of Mishra *et al.* (2010); Tahir *et al.* (2014). 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). There was no significant difference in the amount of seeds/pod across treatments. The minor increase in the number of seeds per pod could be related to the use of more nutrients and boron, which enhances reproductive activities and increases grain output. 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); Uddin *et al.* (2020); Shrikant (2007). 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 could be attributed to an improvement in all growth parameters as a result of higher plant nutrition and high-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). Increased nitrogen helps in improving vegetative growth, which results in more solar light utilisation and better photosynthetic activity. Boron and phosphorus facilitate nutrient uptake by the plant. Phosphorous promotes root nodulation, which boosts atmospheric nitrogen fixation. Boron helps in pollination, seed setting and overall seed quality. Similar results were also reported with higher boron application by Mishra *et al*. (2001) in chick pea, Tahir *et al.* (2014); Naik *et al.* (2002) 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.

Effect on Seed quality. There was no significant difference in germination percentage among the treatments. However, highest germination percentage was observed in T_{10} (92.7 %) followed by T_8 (92 %), T_6 (91.3 %) and T_9 (90.0 %). The lowest germination percentage was obtained in T_1 (86.7 %) followed by T_2 (87.3 %) and T_3 (88.0 %). Similar observations were also reported by Madalageri and Rao (1989) in cluster bean. Higher germination percentage was reported in french bean by Khyad (1996) with increased phosphorous application. In case of vigour index-1 and vigour index-2 the result was found to be highest in T_{10} with vigour index-1 (3487.37) and vigour index-2 (12672.23) followed by T_8 with vigour index-1 (3429.76) and vigour index-2 (12525.29) and lowest in T_1 with vigour index-1 (2833.36) and vigour index-2 (10289.50) where, lower rates of fertilizers were applied. Shrikant (2007); Khyad (1996) also reported similar findings in dolichos bean and french bean respectively.

Economics. The B:C ratio was found to be highest in T_{10} (3.79) followed by T_8 (3.67) and lowest in T_1 (2.79). This is due to high quantity of marketable seed yield in T_{10} which resulted in higher total income/ha and ultimately increased the B:C ratio. From the perusal of data obtained from the experiment it is observed that in treatment T_{10}, application of NPK (35:70:50 kg/ha) + FYM (15 t/ha) + B (1.5 kg/ha) produced maximum marketable seed yield/ha (2480.4 kg) with less quantity of unmarketable seed yield/ha (363.6 kg). Whereas, in treatment T_8 application of NPK (35:60:50 kg/ha) + FYM (15 t/ha) + B (1.5 kg/ha) produced 2400.6 kg marketable seeds and 377.4 kg unmarketable seeds/ha. Both were found to be statistically at par. But, taking in to consideration the B:C ratio of 3.79 in T_{10} and 3.67 in T_8, it is recommended to use higher dose of nitrogen and phosphorous along with boron [NPK (35:70:50kg/ha) + FYM (15t/ha) + B (1.5kg/ha)] in dolichos bean, var. Arka Amogh to get more marketable seed yield/ha.

CONCLUSION

Based on the findings of the experiment, it can be concluded that a fertilizer dose of NPK (35:70:50 kg/ha) + FYM (15 t/ha) + B (1.5 kg/ha) should be used to achieve a better quality marketable seed yield/ha and fetch higher profit in seed production of dolichos bean, var. Arka Amogh.

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Conflict of Interest. None.

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