Original Research Article

"Effect of Spacing and Boron levels on growth and yield of Black gram (*Vigna Mungo* L.)"

Abstract

A field experiment was conducted during *Zaid* 2022 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 6.9), low in organic carbon (0.112 %), available N (278.93 kg/ha), available P (10.8 kg/ha) and available K (206.4 kg/ha). The treatments comprised of row spacing (25,30,35 cm) and boron levels (1.0,1.5,2.0 kg/ha) respectively. The experiment was laid out in Randomized Block Design with nine treatments each replicated thrice. The results showed that application of 35 ×10 cm + 2.0 kg B/ha has recorded significantly higher plant height (44.53 cm), number of branches per plant (9.27), number of nodules (35.53), dry weight (10.44 g).However Higher number of pods per plant (30.73), seeds per pod (6.40), test weight (42.48 g), seed yield (930.33 kg/ha) and stover yield (2040.33 kg/ha) gross return (Rs 58,610.79/ha)**,** net return (Rs 34,311/ha) and B:C ratio (1.41) were recorded in treatment 25 × 10 + B 2.0 kg/ha.

Key words: *Boron, Black gram, Economics, Spacing, Yield.*

Introduction

Black gram (*Vigna Mungo* L.) is one of important pulse crop. It is cultivated in many tropical and sub-tropical countries of World. It is grown throughout India. Black gram is widely grown grain legume and belongs to the family Fabaceae and assumes considerable importance from the point of food and nutritional security in the world. It is also known as urad bean, urad dal, urad. It also acts as cover crop and its deep root system protects the soil from erosion. Besides, this green fodder of urad bean is very nutritive and is especially useful for mulch cattle. urad bean being leguminous has the capacity to fix atmospheric nitrogen and thus helps in restoring the soil fertility (Shamim, M Z; Pandey, A 2017).

Black gram is grown well in moisture retentive light soil, but loamy and clay loam are suitable for the cultivation of Black gram. Loam to clay loam with neutral PH are best suited for Black gram cultivation. It is susceptible to waterlogged conditions of the soil. It is popular because of its nutritional quality having *viz.*, rich protein (24%), carbohydrates (59.6%), fat (1.4%), Minerals (3.2%), phosphorous (385 mg/100g). and it is rich source of calcium and iron. It defers from other pulses in its peculiarity of attaining a somewhat mucilaginous pasty character, giving additional body to the mass due to long polymer chain of polysaccharide chain of carbohydrates. Tamil Nadu leads first in productivity with an average yield of 775 kg/ha. It contained 24.7 % protein, 0.6 % fat, 0.9 % fibre and 3.7 % ash as well as sufficient quantity of calcium, phosphorus and important vitamins. Due to cheaper protein source, it is designated as “poor man’s meat” (Aslam *et al.,* 2010).

Boron (B) is an essential micronutrient required for crop growth and yield due to its major role in formation and maintenance of cell wall and cell membrane integrity. Course textured acid soils of humid are deficit in boron. Calcareous soils and those with low organic matter content are more prone to B deficiency (Dwivedi et al., 1990 and Niaz et al., 2013). Boron (B) observed in the form of boric acid or borate is an essential micronutrient element for plant growth and development (Loomis and Durst 1992). Boron is retained in soils by adsorption on to minerals and humic particles and by forming insoluble precipitates (Goldberg and Glaubig, 1985). 4-5 lines related to boron importance for pulse crops.

Plant density can have a major effect on the final yield of most of the legumes and the general response of yield to increasing population is well documented. To realize the maximum yield potential of black gram during summer and rainy season, maintenance of optimum space made available to individual plant is of prime importance. Row and plant spacing has to be worked out to get desired spacing. The spacing requirement depends upon the growth behaviour of genotype. So, it is required to maintain spacing for obtaining higher yield (P Veeramani, 2019).

MATERIALS AND METHODS

The experiment was conducted during the *Zaid* season 2022, at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj (U.P.) which is located at 25^0 30’ 42’’N latitude, 81^0 60’ 56” E longitude and 98 m altitude above the mean sea level (MSL). This area is situated on the right side of the Yamuna River by the side of Prayagraj - Rewa road about 12 km from the city. The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 6.9), low in organic carbon (0.112 %), available N (278.93 kg/ha), available P (10.8 kg/ha) and available K (206.4 kg/ha). The crop was sown on 28th February 2022 using Shekhar-2 variety. The experiment was laid out in Randomized Block Design with nine treatments each replicated thrice viz. T_1:25 ×10 cm + B 1.0 kg/ha, T_2: 25 ×10 cm + B 1.5 kg/ha, T_3: 25 ×10 cm + B 2.0 kg/ha, T_4: 30 ×10 cm + B 1.0 kg/ha, T_5: 30 ×10 cm + B 1.5 kg/ha, T_6: 30 ×10 cm + B 2.0 kg/ha, T_7: 35 ×10 cm + B 1.0 kg/ha, T_8: 35 ×10 cm + B 1.5 kg/ha, T_9: 35 ×10 cm + B 2.0 kg/ha. Fertilizers were applied as band placement, for which 4-5cm deep furrows were made along the seed rows with a hand hoe. The nutrient sources were Urea, SSP and MOP to fulfil the requirement of nitrogen, phosphorous and potassium. The recommended dose of 20 kg/ha nitrogen,40 kg/ha phosphorous and 20 kg/ha potassium and Boron 1.0, 1.5,2.0 kg/ha were applied according to the treatments. The sources used for applying N P K and boron were Urea (N 46%), Single Super Phosphate (P 16%) and Muricate of Potash (K 60%), Boron (Di Sodium Tetra Borate Penta Hydrate) (B 14.5%) respectively. Seeds were sown in line manually on 28 Feb 2022 at a depth of 4-5 cm in furrows with seed rate of 15-20 kg/ha. Seeds are covered with soil immediately after sowing the seeds. The spacing of crop between row-row 25, 30,35 cm and plant to plant was 10 cm according to the treatment details. The growth parameters were recorded at periodical intervals of 15,30,45,60 DAS and at harvest stage from the randomly selected five plants in each treatment. Statistically analysis was done for all the parameters in one-way Anova and mean compared at 5% probability level of significant results.

Results and Discussion

Effect of Spacing and Boron levels on growth parameters are given in table 1.

GROWTH ATTRIBUTES

Significantly highest plant height (44.53 cm) was recorded with application of (2.0 kg/ha boron at 35 × 10 cm spacing) T_9 and T_8 (35 × 10 cm + B 1.5 kg/ha) (44.00 cm) was statistically at par with T_9. The spacing practices had significant effects on plant height (cm); however, an increasing trend with optimum geometry level could be noticed. This may be due to the competition between the inter and intra plants for sun light, water, nutrients and space at closer spacing, whereas optimum spacing helped in significantly highest plant height. Significant results were obtained due to the optimum spacing of 35x10 cm and similar results were obtained by Singh *et al*. (2009). The increase in plant height may be due to appropriate dose of boron. Because B plays important role in various enzymatic and other biochemical reactions. Similar results were discussed by Zahoor *et al.* (2011), Gitte *et al.* (2005). significantly highest No. of branches (9.27) was recorded with application of (2.0 kg/ha boron at 35 × 10 cm spacing) T_9 and T_8 (35 × 10 cm + B 1.5 kg/ha) (9.20) was statistically at par with T_9. The optimum plant spacing between plants resulted in enhanced space, sunlight, nutrients and soil moisture for increased photosynthesis, metabolic activities, growth and development which resulted in higher number of branches. The results were in accordance with Amruta *et al.*, (2015) and Jiotode *et al.*, (2017). The significantly maximum number of branches/plants was due to application of boron. This might be due to the reason for the increase in this yield attribute that the boron plays important role in plant metabolism and translocation of photosynthates from source to sink. These similar findings obtained by (Janaki *et al.*,2018). significantly highest No. of nodules (6.33) was recorded with application of (2.0 kg/ha boron at 35 × 10 cm spacing) T_9 and T_8 (35 × 10 cm + B 1.5 kg/ha) (6.13) was statistically at par with T_9. The optimum spacing resulted in increase of nodulation, root development and growth, such increase in nodulation, root and growth might be due to increase in number of nodules which might have supplied sufficient nitrogen by nitrogen fixation and finally enhance productivity of Black gram. Prasad *e.t al.* (2014). significantly highest dry weight (10.44) was recorded with application of (2.0 kg/ha boron at 35 × 10 cm spacing) T_9 however T_8 (35 × 10 cm + B 1.5 kg/ha) (10.39 g) which was statistically at par to T_9. Higher dry matter production is observed in 40 × 10 cm^2 spacing due to better photosynthetic activity because of greater exposure to light and increased availability of nutrients to plants have also resulted in higher root dry weight on the plants results reported by Khan *et al.*, (2017).

Effect of Spacing and Boron levels on yield parameters of Black gram are given in table 2.

YIELD ATTRIBUTES AND YIELD

The treatment T_3 (25 × 10 cm + B 2.0 kg/ha) recorded significantly highest number of pods/plant (30.73). However, T_2 (25 × 10 cm + B 1.5 kg/ha) (30.33) was found to be statistically at par to T_3. Higher number of pods/plants might be possible due to more vigour and strength attained by the plants as a result of better photosynthetic activities with sufficient availability of light, and supply of nutrients in balanced quantity of the plants at growing stages. Jitendra kumar *et al*. (2015) observed the similar results. The treatment T_3 (25 × 10 cm + B 2.0 kg/ha) recorded significantly highest number of Seeds/Pod (6.40). However, T_2 (25 × 10 cm + B 1.5 kg/ha) (6.13) was found to be statistically at par to T_3. The increase in number of seeds per pod might be due to increase in translocation of assimilates from source to sink. Shivay and Shekawat, (2008). Significantly highest Test weight (42.48 g) was recorded with T_3 (25 × 10 cm + B 2.0 kg/ha) and T_2 (25 × 10 cm + B 1.5 kg/ha) (42.14 g) was statistically at par with T_3. Test weight of black gram seeds were increased due to role of boron in increasing pollen viability and stigmatic receptivity which brings in increased seed set & increased translocation of photosynthesis to sink which increases test weight Prasad *et al*.2015. Better availability of moisture and moderation of soil temperature which led to greater uptake of nutrients and reduced number of days taken to meet the required heat units for proper growth and development of plants and ultimately the yield attributes. The results were recorded similar with Anand *et al.* (2020). The treatment T_3 (25 × 10 cm + B 2.0 kg/ha) (930.33 kg/ha) recorded significantly higher over rest of the treatments. The B application improved the seed yield because it maintains good balance between photosynthesis and respiration. Boron removal alters the cell wall structure, with a transitory decrease in elasticity modulus, flowed by a secondary hardening and reduction in the incidence of plasma membrane – bound reductase activity for better translocation to sink Shekawat and shivay (2008) similar results were obtained by Yu *et al*., (2002). The treatment T_3 (25 × 10 cm + B 2.0 kg/ha) (2045.33 kg/ha) was found significantly higher. However, T_2 (25 × 10 cm + B 1.5 kg/ha) (2040.33 kg/ha) was found to be statistically at par to T_3. Significantly highest harvest index was observed in T_3 (25 × 10 cm + B 2.0 kg/ha) (31.32) superior over rest of all treatments.

Conclusion

Based on the findings of the experiment it can concluded that maintaining a spacing of 25 × 10 cm and application of Boron @ 2.0 kg/ha in black gram during *zaid* season was found to be more productive as well as economically viable.

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Table 1 Effect of Spacing and Boron levels on growth attributes of Black gram.

S.No.	Treatments	At Harvest				At 60-75 DAS	
		Plant height(cm)	No. of Branches	Nodules/plant	Plant dry weight (g/plant)	Crop growth rate (g/m^2/day)	Relative growth rate (g/g/day)
1	25 ×10 cm + B 1.0 kg/ha	39.67	7.60	4.40	9.55	3.64	0.02
2	25 ×10 cm + B 1.5 kg/ha	39.90	7.80	4.67	9.65	2.26	0.02
3	25 ×10 cm + B 2.0 kg/ha	40.93	8.00	4.93	9.76	4.50	0.02
4	30 ×10 cm + B 1.0 kg/ha	41.57	8.20	5.20	9.84	3.27	0.02
5	30 ×10 cm + B 1.5 kg/ha	41.90	8.40	5.40	9.95	3.37	0.02
6	30 ×10 cm + B 2.0 kg/ha	42.70	8.60	5.67	10.16	4.51	0.02
7	35 ×10 cm + B 1.0 kg/ha	43.33	8.80	5.87	10.24	3.28	0.02
8	35 ×10 cm + B 1.5 kg/ha	44.00	9.20	6.13	10.39	3.45	0.02
9	35 ×10 cm + B 2.0 kg/ha	44.53	9.27	6.33	10.44	3.50	0.02
	F test	S	S	S	S	NS	NS
	S. EM (±)	0.18	0.07	0.07	0.02	0.59	0.01
	CD (P=0.05)	0.53	0.20	0.20	0.05	1.76	0.04

Table 2 Effect of Spacing and Boron levels on yield attributes of Black gram.

Treatments	At harvest					
	Pods/plant (No's)	Seed/pod (No')	Test weight (g)	Seed yield (kg/ha)	Stover yield (kg/ha)	Harvest index (%)
1. 25 ×10 cm + B 1.0 kg/ha	29.67	5.87	40.48	828.33	2032.67	28.95
2. 25 ×10 cm + B 1.5 kg/ha	30.33	6.13	42.14	862.67	2045.33	29.66
3. 25 ×10 cm + B 2.0 kg/ha	30.73	6.40	42.48	930.33	2040.33	31.32
4. 30 ×10 cm + B 1.0 kg/ha	28.80	5.20	37.63	739.67	1981.67	27.17
5. 30 ×10 cm + B 1.5 kg/ha	29.20	5.40	38.53	772.00	1989.00	27.95
6. 30 ×10 cm + B 2.0 kg/ha	29.40	5.60	39.36	793.67	2002.00	28.39
7. 35 ×10 cm + B 1.0 kg/ha	28.00	4.33	34.40	651.00	1957.00	24.96
8. 35 ×10 cm + B 1.5 kg/ha	28.40	4.60	35.78	685.00	1968.00	25.81
9. 35 ×10 cm + B 2.0 kg/ha	28.60	4.93	36.27	713.33	1977.00	26.51
F test	S	S	S	S	S	S
S. EM (±)	0.16	0.09	0.14	4.47	3.56	0.12
CD (P = 0.05)	0.47	0.27	0.41	13.41	10.66	0.35