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Effect of nitrogen levels and boron on growth and economics of greengram (*Vigna radiata* L.)

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Abstract
A field experiment was conducted during *kharif*, 2020 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 7.6), low in organic carbon (0.36%), available N (210%), available P (13.05 kg/ha) and available K (156.44 kg/ha). The treatments consisted of nitrogen levels *viz.* N_1 - 15 kg/ha, N_2 - 20 kg/ha, N_3 - 25 kg/ha and application of boron *viz.* B_1 - 1 kg at 15 DAS soil application, B_2 - 2 kg at 25 DAS soil application, B_3 - 0.2% at 35 DAS foliar application. The experiment was laid out in Randomized Block Design with nine treatments which are replicated thrice. The results showed that *viz.* plant height (41.86 cm), number of branches per plant (3.80), number of nodules per plant (26.27), dry weight (9.43 g), crop growth rate (8.16 g/m^2/day), relative growth rate (0.04 g/g/day) were also recorded significantly higher with the application of nitrogen at 25 kg/ha + boron 0.2% foliar application at 35 DAS However, higher gross returns (Rs. 77,008.67/ha), net returns (Rs. 53,893.67/ha) and benefit: cost ratio (2.33) was obtained with nitrogen at 25 kg/ha + boron 0.2% foliar application at 35 DAS.

Keywords: Economics, greengram, nitrogen (N), boron (B)

Introduction
India is the highest producer as well as consumer of pulses in the world and contributes 25.5% of total global pulse production. Greengram is the third important pulse crop of India grown in nearly 8 per cent the total pulse area of the country. Energy in agriculture is important in terms of crop production and agro processing for value adding (Karimi *et al*., 2008) [5]. The food legumes, particularly the grain or pulses are important food stuff in all tropical and subtropical countries (Mohbe *et al.,* 2017) [6]. They constitute integral part of human diet as mature dry seeds and may also be used as immature green seeds or as green pods with immature seeds in it. They can be used for animals in the form of hay and straw. The pulses have high protein contents (average 20-25%). Dharwe *et al*. (2017) [2] in addition to their value as food stuff, they are also important in cropping system. India is the world largest home land of vegetarian and world leader in pulses production and import to provide protein supplement. Rapid population growth and low production especially to pulses have enhanced the problem of food security. Mungbean is an excellent source of protein (25%) with high quality of lysine (460 mg/g) and tryptophan (460 mg/g). It also has remarkable quantity of ascorbic acid when sprouted and also have riboflavin (21 mg/100 g) and minerals (3.84 W/100 g). The total area production of 14.76 M tonnes in the country. The greengram being a leguminous crop, meets its nitrogen requirement through symbiotic N-fixation. Nitrogen is the chief promoter of plant growth. However, in case of greengram, nitrogen does not usually show its effect, except that the vegetative growth is increased. However, the starter dose is required for initial growth. Nitrogen is one of the most important primary nutrients among non-metal elements which require in large quantity for the plant growth and nutrition. Boron is a trace element that can be applied in soil as well as foliar. Foliar applied boron in greengram increased the plant height, number of nodules per plant, dry weight, boron is mostly deficient in calcareous soils. At present, productivity and profitability of agriculture depends on energy consumption (Alam *et al*., 2005) [1]. Energy use in agriculture has developed in response to increasing populations, limited supply of arable land and desire for an increasing standard of living. In all societies, these factors have encouraged an increase in energy inputs to maximise, yields, minimise labour-intensive practices, or both (Esengun *et al*., 2007) [3].

Efficient use of these energies helps to achive increased production and productivity and contribute to economy, profitability and competitiveness of agriculture sustainability to rural living (Singh *et al*., 2002) [9]. Keeping these things in view, the present experiment was conducted to study the energetics and economics of greengram production in relation to varying level of nitrogen.

Materials and Methods

The experiment was conducted during the *kharif* season, 2020, at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, 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. Prayagraj belongs to sub-tropical and semi-arid climatic condition, with both extremes of temperature, i.e. winter and summer. It receives southwest monsoon rains which commence in the month of July and withdraws by the end of September. The soil of the experimental plot was sandy loam in texture, nearly in soil reaction (pH 7.6), low in organic carbon (0.36%), available N (210%), available P (13.05 kg/ha) and available K (156.45 kg/ha). The experiment consisting of nine treatments which are replicated thrice in Randomized Block Design with the combination levels of nitrogen and application of boron. The treatment combinations which are T_1: 15 kg N/ha + 1 kg of boron at 15 DAS (soil application), T_2: 15 kg N/ha + 2 kg of boron at 25 DAS (soil application), T_3: 15 kg N/ha + 0.2% foliar application of boron at 35 DAS, T_4: 20 kg N/ha + 1 kg of boron at 15 DAS (soil application), T_5: 20 kg N/ha + 2 kg of boron at 25 DAS (soil application), T_6: 20 kg N/ha + 0.2% foliar application of boron at 35 DAS, T_7: 25 kg N/ha + 1 kg of boron at 15 DAS (soil application), T_8: 25 kg N/ha + 2kg of boron at 25 DAS (soil application), T_9: 25 kg N/ha + 0.2% foilar application of boron at 35 DAS. The soil of the experimental plot was sandy loam in texture, nearly in soil reaction (pH 7.6), low in organic carbon (0.36%), available N (210%), available P (13.05 kg/ha) and available K (156.45 kg/ha). Fertilizers were applied as band placement, for which 4-5 cm 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 fertilizer N:20, P:40 and K:20 were applied according to the treatment details. Irrigation was based on the necessity and as per the time of sowing. The growth parameters *viz*. plant height (cm), number of branches per plant, number of nodules per plant, dry weight (g), crop growth rate (g/m^2/day), relative growth rate (g/g/day) were recorded at harvest. Gross returns, Net returns and B:C ratio were recorded with standard process of observation. The data was statistically analysed using analysis of variance (ANOVA) as applicable to Randomized Block Design (Gomez and Gomez, 1984) [4].

Results and Discussion

Growth attributes

Data presented in Table 1 significantly shows that maximum plant height (41.86 cm) was recorded with the levels of nitrogen and application of boron i.e. nitrogen 25 kg/ha + boron 0.2% foliar application at 35 DAS. Whereas, with nitrogen 25 kg/ha + boron 1kg/ha at 15 DAS (soil application) (39.99 cm) are found statistically at par to nitrogen 25 kg/ha + boron 0.2% foliar application at 35 DAS, compared to other treatment combinations. Number of branches per plant (3.80) were recorded with the levels of nitrogen and application of boron i.e. nitrogen 25 kg/ha + boron 0.2% foliar application at 35 DAS. Whereas, with the nitrogen 25 kg/ha + boron 2 kg/ha at 25 DAS (soil application) (3.67) are found statistically at par to nitrogen 25 kg/ha + boron 0.2% foliar application at 35 DAS. Number of nodules per plant (26.27) were recorded with the levels of nitrogen and application of boron i.e. nitrogen 25 kg/ha + boron 0.2% foliar application at 35 DAS. Whereas, with the nitrogen 25 kg/ha + boron 1 kg/ha at 15 DAS (soil application) (25.33) are found statistically at par to nitrogen 25 kg/ha + boron 0.2% foliar application at 35 DAS. Plant dry weight (9.43 g/plant) were recorded with the levels of nitrogen and application of boron i.e. nitrogen 25 kg/ha + boron 0.2% foliar application at 35 DAS. Whereas, with nitrogen 25 kg/ha + boron 2 kg/ha at 25 DAS (soil application) (8.93) are found statistically at par to nitrogen 25 kg/ha + boron 0.2% foliar application at 35 DAS. Crop growth rate (8.16 g/m^2/day) were recorded with the levels of nitrogen and application of boron i.e. nitrogen 25 kg/ha + boron 0.2% foliar application at 35 DAS. Whereas, with nitrogen 20 kg/ha + boron 2 kg/ha at 25 DAS (soil application) (7.40 g/m^2/day) are found statistically at par to Nitrogen 25 kg/ha + Boron 0.2% Foliar Application at 35 DAS and Relative growth rate (0.04 g/g/day) were recorded with the levels of nitrogen and application of boron *i.e.* nitrogen 25 kg/ha + boron 0.2% foliar application at 35 DAS. Whereas, nitrogen 15 kg/ha + boron 1 kg/ha at 15 DAS (soil application) (0.03 g/g/day) are found statistically at par to nitrogen 25 kg/ha + boron 0.2% foliar application at 35 DAS. This might be due to increase in growth attributes and Rajana Praveena *et al*., (2018) [8] has reported that boron plays an important role in tissue differentiation and carbohydrate metabolism it is also a constituent of cell membrane and essential for cell division, maintenance of conducting tissue with regulatory effect on other element. It is also necessary for sugar translocation in plant and development of new cell in meristematic tissue increases through all growth parameters. Movalia Janaki *et al*., (2018) [7] determined the reason for increase in branches. Boron plays an important role in plant metabolism and translocation of photosynthates from source to sink. Singh *et al.,* (2006) [10] reported that the growth parameters were significantly enhanced by split application of nitrogen over control.

Economics

Due to the increment of yield the Grain yield (1260.44 kg/ha) and Stover yield (2764.53 kg/ha) were increased in 25 kg N/ha + 0.2% B at 35 DAS (Foliar Application). Due to this the production values are increased by cost of cultivation (Rs. 23,115/ha), Gross Returns (Rs. 77,008.67/ha), Net Returns (Rs. 53,893.67/ha) and B:C ratio (2.33) were increased in 25 kg N/ha + 0.2% B at foliar application at 35 DAS.

Table 1: Effect of nitrogen levels and boron on growth attributes of greengram (*Vigna radiata* L.)

S. No.	Treatments	Plant height (cm)	Branches/ plant (no.)	Nodules/plant (no.)	Dry weight (g/plant)	CGR ($g/m^2/day$)	RGR (g/g/day)
1.	Nitrogen 15 kg/ha + Boron 1 kg/ha at 15 DAS soil application	31.23	2.54	21.00	7.80	6.82	0.03
2.	Nitrogen 15 kg/ha + Boron 2 kg/ha at 25 DAS soil application	33.60	2.67	21.80	8.20	6.89	0.03
3.	Nitrogen 15 kg/ha + Boron 0.2% foliar application at 35 DAS	34.53	2.81	22.47	8.30	6.96	0.03
4.	Nitrogen 20 kg/ha + Boron 1 kg/ha at 15 DAS soil application	38.67	2.93	23.13	8.37	7.41	0.03
5.	Nitrogen 20 kg/ha + Boron 2 kg/ha at 25 DAS soil application	39.08	3.13	23.20	8.47	7.40	0.03
6.	Nitrogen 20 kg/ha + Boron 0.2% foliar application at 35 DAS	39.56	3.23	24.53	8.73	7.43	0.03
7.	Nitrogen 25 kg/ha + Boron 1 kg/ha at 15 DAS soil application	39.99	3.47	25.33	8.83	7.73	0.04
8.	Nitrogen 25 kg/ha + Boron 2 kg/ha at 25 DAS soil application	40.53	3.67	25.40	8.93	8.10	0.03
9.	Nitrogen 25 kg/ha + Boron 0.2% foliar application at 35 DAS	41.86	3.80	26.27	9.43	8.16	0.04
S.Em±		0.76	0.08	0.41	0.19	0.30	0.00
CD (P = 0.05)		2.27	0.23	1.22	0.58	0.90	0.01

Table 2: Economics on nitrogen levels and boron of greengram (*Vigna radiata* L.)

S. No.	Treatments	Cost of cultivation (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	B:C ratio
1.	Nitrogen 15 kg/ha + Boron 1 kg/ha at 15 DAS soil application	21,545.00	50,716.68	29,171.68	1.35
2.	Nitrogen 15 kg/ha + Boron 2 kg/ha at 25 DAS soil application	23,045.00	49,484.38	26,439.38	1.14
3.	Nitrogen 15 kg/ha + Boron 0.2% foliar application at 35 DAS	23,045.00	51,726.69	28,681.69	1.24
4.	Nitrogen 20 kg/ha + Boron 1 kg/ha at 15 DAS soil application	21,580.00	54,844.08	33,264.08	1.54
5.	Nitrogen 20 kg/ha + Boron 2 kg/ha at 25 DAS soil application	21,280.00	65,559.53	44,279.53	2.08
6.	Nitrogen 20 kg/ha + Boron 0.2% foliar application at 35 DAS	23,080.00	65,734.81	42,654.81	1.84
7.	Nitrogen 25 kg/ha + Boron 1 kg/ha at 15 DAS soil application	21,615.00	63,455.73	41,840.73	1.93
8.	Nitrogen 25 kg/ha + Boron 2 kg/ha at 25 DAS soil application	21,315.00	70,897.19	49,582.19	2.32
9.	Nitrogen 25 kg/ha + Boron 0.2% foliar application at 35 DAS	23,115.00	77,008.67	53,893.67	2.33

Conclusion

It can be concluded that obtaining higher growth and economics with the levels of nitrogen and application of boron i.e. nitrogen 25 kg/ha + boron 0.2% foliar application at 35 DAS is the best for rainfed cultivation of greengram.

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