Original Research Article

Influence of nitrogen and boron on growth and yield of Lentil

(*Lens culinaris* Medikus.)

ABSTRACT

A field experiment was conducted during *Rabi* season of 2021-22 at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology And Sciences, Prayagraj (U.P.) India. To study the Response of Nitrogen and Boron on growth and yield of Lentil. The treatments consist of nitrogen 10, 20, 30 kg/ha and boron 1.0, 1.5, 2.0 kg/ha. The soil of experimental plot was sandy loamy in texture, nearly neutral in soil reaction (pH 7.8), low in organic carbon (0.35%). Results revealed that the higher plant height (36.40 cm), higher plant dry weight (22.70 g/plant), higher number of pods/plant (174.44), higher number of seeds/pod (1.72), higher seed yield (1.75 t/ha) and higher stover yield (2.67 t/ha) were significantly influenced with application of Nitrogen 30 kg/ha + Boron 2.0 kg/ha. Higher gross returns (INR 89,059/ha), higher net returns (INR 59,652/ha) and higher B:C ratio (2.03) were also recorded in treatment-9 (Nitrogen 30 kg/ha + Boron 2.0 kg/ha).

Keywords: *Lentil, nitrogen, boron, growth parameters, yield attributes and Economics.*

INTRODUCTION

Lentil has been one of the world's oldest agricultural crop, resistant to drought and cultivated across the world. *Lens* is a Latin word that describes exactly the shape of the seed of a cultivated legume now known as *Lens culinaris*, a name given by the German botanist Medikus in 1787 **(Cubero, 1981)**. locally called as “Masoor” belongs to the family *Fabaceae*. Lentil is a cool season pulse crop and is also relatively tolerant to drought. It is a valuable human food, consists of vegetable protein in good amount. Lentil contains protein, carbohydrates, oils and ash at the rate of 23.25%, 59%, 1.8% and 0.2%, respectively along with iron, calcium, phosphorus and magnesium. A significant amount of vitamin A and B is also provided by lentil **(Zafar *et al*. 2003)**. lentil restores the soil fertility and improves the soil health keeping the soil alive and productive. It is evident that pulse containing cropping pattern helped to increase the organic matter in the soil **(Islam *et al.* 1988)**. In the Indian subcontinent, lentils have been grown as a green manure in one year rotation with cereals, especially rice **(Saxena and Hawtin 1981)**. Lentils are generally known to have biomedical functions including antioxidative, anti-cancer, anti-inflammatory, antihypertensive, and thrombolytic properties **(Singh and Singh 2014)**. lentil-based cropping systems are profitable and also have high water productivity, hence are suitable for mostly un-exploited rice-fallows under water-deficit conditions **(Reddy and Reddy 2010)**.

In present scenario, global production of lentil was 6.5 million tonnes and India with 18% of the world's total. Lentil is being cultivated in India in an area of about 1.32 million hectares with a production of 1.18 million tonnes and an average productivity of about 894 kg/ha and Uttar Pradesh contributes an area about 0.46 million hectares with a 31.46% in all over India which has the production of about 0.45 million tonnes (38.47% in all over India) and productivity is 978kg/ha, **(Agricultural Statistics at a Glance, 2021)**.

Plant nutrition is an important factor in increasing lentil crop productivity. Nitrogen is a vital and necessary nutrient for greater plant development and productivity. Leaf senescence is triggered by plant hormones, drought, and insufficient supply of nutrients, especially N **(Lim *et al.* 2007)**. Eighty percent of the fixed nitrogen comes from symbiotic associations with grain legumes (pulses) and the rest from free-living or associative systems **(Graham *et al.* 1988).** Boron is very important in cell division and in pod and seed formation **(Vitosh *et al.* 1997)**. Reproductive growth, especially flowering, fruit and seed set is more sensitive to B deficiency than vegetative growth **(Noppakoonwong *et al.* 1997)**. The most important functions of boron in plants are thought to be its structural role in cell wall development, cell division, seed development and stimulation or inhibition of specific metabolic pathways for sugar transport and hormone development (**Ahmed *et al*, 2009)**.

MATERIALS AND METHODS

A field experiment was conducted during *Rabi* season of 2021-22 at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology And Sciences, Prayagraj (U.P.) India. The soil of experimental plot was sandy loamy in texture, nearly neutral in soil reaction (pH 7.8), low in organic carbon (0.35%),The treatments consisted of Nitrogen 10 kg/ha+ Boron 1.0 kg/ha, Nitrogen 10 kg/ha + Boron 1.5 kg/ha, Nitrogen 10 kg/ha + Boron 2.0 kg/ha, Nitrogen 20 kg/ha + Boron 1.0 kg/ha, Nitrogen 20 kg/ha + Boron 1.5 kg/ha, Nitrogen 20 kg/ha + Boron 2.0 kg/ha, Nitrogen 30 kg/ha + Boron 1.0 kg/ha, Nitrogen 30 kg/ha + Boron 1.5 kg/ha, Nitrogen 30 kg/ha + Boron 2.0 kg/ha. The experiment was laid out in Randomized Block Design, with 9 treatments replicated thrice. The observations were recorded for plant height, plant dry weight, number of pods/plant, number of seeds/pod, grain yield and stover yield. The data were subjected to statistical analysis by analysis of variance method **(Gomez and Gomez, 1976).**

RESULT AND DISCUSSION

GROWTH PARAMETERS

Plant height – At harvest the significantly and higher plant height (36.40 cm) was observed in treatment-9 (Nitrogen 30 kg/ha + Boron at 2.0 kg/ha) [Table 1]. However, treatment-7 (Nitrogen 30 kg/ha + Boron 1.0 kg/ha) and treatment-8 (Nitrogen 30 kg/ha + Boron 1.5 kg/ha) were statistically at par with treatment-9 (Nitrogen 30 kg/ha + Boron at 2.0 kg/ha). Significant and higher plant height was recorded may be owing to nitrogen application in the soil might be due to nitrogen have favoured rapid growth and enlargement of tissues. Similar results were obtained by **(Kaneez Fatima).** Further, increase in plant height might be the involvement of boron in different physiological processes like enzyme activation, electron transport, chlorophyll formation, stomatal regulation, etc. with increase in levels of boron the plant height gradually increased, which might be attributable to greater photosynthetic activity and chlorophyll synthesis due to boron fertilization resulting into better vegetative growth. These findings corroborate the results of **Myageri and Dawson (2021).**

Dry weight/plant – At harvest, the significantly higher plant dry weight (22.70 g) was observed in treatment-9 (Nitrogen 30 kg/ha + Boron at 2.0 kg/ha) [Table 1]. However, treatment-8 (Nitrogen 30 kg/ha + Boron 1.5 kg/ha) was statistically at par with treatment-9 (Nitrogen 30 kg/ha + Boron at 2.0 kg/ha). Significant and higher dry weight was recorded with the application of Nitrogen (30 kg/ha). This might be due to nitrogen promote hasten growth in terms of higher plant height, a greater number of leaves/plant and greater number of branches/plant. Similar results were reported by **Balai *et al.* (2017)**. Further, dry weight was increased significantly with increasing levels of Boron (2 kg/ha). As boron generally influences cell division and nitrogen absorption from the soil might enhance plant growth which reflects in terms of plant dry weight. Similar results were obtained by **Myageri and Dawson (2021).**

YIELD ATTRIBUTES

Number of Pods/plant –The significant and higher number of pods/plant (174.44) was observed in treatment-9 with (Nitrogen 30 kg/ha + Boron at 2.0 kg/ha) [Table 2], which was significantly superior over rest of the treatments. However, treatment-8 (Nitrogen 30 kg/ha+ Boron 1.5 kg/ha), was found to be statistically at par with treatment-9 (Nitrogen 30 kg/ha+ boron at 2.0 kg/ha). Significant and higher number of pods/plants was recorded with application of nitrogen (30 kg/ha) has shown the most effective in increasing the quantity of pods/plant, it might have show`s a favourable influence on soil chemical characteristics, particularly near the rhizosphere. As a result, all of these variables may produce an increase in nutrient absorption from the soil, resulting in increase in total number of pods/plant, either directly or indirectly. These results were similar with that of **Tojammel Haq and Ahmed (2022).** Further, increasing number of pods/plant with application of boron (2kg/ha), which helps in the formation of flower and pollen grain formation. Similar findings were under the conformity with **Padbhushan and Kumar (2014)**.

Number of seeds/pods –The significant and higher number of seeds/pod (1.72) was observed in treatment-9 with (Nitrogen 30 kg/ha + Boron at 2.0 kg/ha) [Table 2]. which was significantly higher over rest of the treatments. However, treatment-7 (Nitrogen 30 kg/ha + Boron 1.0 kg/ha) and treatment-8 (Nitrogen 30 kg/ha + Boron 1.5 kg/ha) were statistically at par with treatment-9. Significant and higher number of seeds/pod was observed with the application of Nitrogen (30 kg/ha), might be due to the balanced application of nitrogen also contributed to increase in plant growth which in turns increased the fruit bearing branches, seed setting and seed development. Similar results are reported by **Malik *et al.* (2003).**

Seed yield – The significant and higher seed yield (1.75 t/ha) was observed in Treatment-9 (Nitrogen 30 kg/ha + Boron at 2.0 kg/ha) [Table 2]. However, Treatment-8 (Nitrogen 30 kg/ha + Boron 1.5 kg/ha), was statistically at par with Treatment-9 (nitrogen 30 kg/ha

+ boron at 2.0 kg/ha). Significant and higher seed yield was with application of nitrogen which might have improved in different yield contributing characters due to higher nitrogen level. These findings are similar with **Fatima *et al*. (2013).** Further, increasing seed yield might be due to application Boron (2kg/ha) it plays a vital role in increasing seed yield because zinc and boron takes place in many physiological processes of plant such as chlorophyll formation, stomatal regulation, starch utilization which enhance seed yield. Boron is a required for many physiological processes and plant growth, also adequate nutrition is a critical for increase yields and quality of crops. These results are in confirmatory with the work of **Myageri and Dawson (2021).**

Stover yield – The significant and higher stover yield (2.67 t/ha) was observed in treatment-9 (Nitrogen 30 kg/ha + Boron at 2.0 kg/ha) [Table 2]. However, treatment-8 (Nitrogen 30 kg/ha + Boron 1.5 kg/ha), was statistically at par with treatment-9 (nitrogen 30 kg/ha + boron at 2.0 kg/ha). Significant and higher stover yield was with application of boron. Dry matter of straw is more in soil applied boron, the improvement in dry matter yield can be attributed to the role of B in stabilizing certain constituents of cell wall and plasma membrane, enhancement of cell division, tissue differentiation and metabolism of nucleic acids, carbohydrates, proteins, auxins and phenols. Similar findings were under the conformity with **Padbhushan and Kumar (2014)**.

Economic Analysis

Gross Returns (INR/ha): Highest gross return (89,059.00 INR/ha) was obtained in treatment-9 (Nitrogen 30 kg/ha + Boron 2.0 kg/ha) as compared to other treatments [Table 3].

Net Returns (INR/ha): Net returns (59,652.00 INR /ha) was found to be highest in treatment-9 (Nitrogen 30 kg/ha + Boron 2.0 kg/ha) as compared to other treatments [Table 3].

Benefit Cost Ration (INR/ha): Benefit Cost ratio (2.03) was found to be highest in treatment-9 with (Nitrogen 30 kg/ha + Boron 2.0 kg/ha) as compared to other treatments [Table 3]. The statistically higher Benefit cost ratio was with the application of (Nitrogen 30kg/ha and Boron (2.0 kg/ha), may be due to the nitrogen and boron provides conclusive condition to the soil with the synergistic effect of Nitrogen and Boron resulting better benefit cost ratio. These results are supported by the findings of **Sharma *et al.* (2018).**

CONCLUSION

It was concluded that application of nitrogen and boron performs positively and improves growth and yield attributes of lentil with application of nitrogen 30 kg/ha along with boron 2.0 kg/ha resulted in achievement of maximum seed yield and stover yield. These findings are based on one season therefore, further trails may be required for further confirmation.

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Table-1: Influence of nitrogen and boron on growth parameters of lentil at 120 days after sowing.

S.No.	Treatments	Plant height (cm)	Dry weight (g/plant)

1.	Nitrogen 10 kg/ha+ Boron 1.0 kg/ha	34.45	18.39
2.	Nitrogen 10 kg/ha + Boron 1.5 kg/ha	34.54	18.45
3.	Nitrogen 10 kg/ha + Boron 2.0 kg/ha	34.69	19.61
4.	Nitrogen 20 kg/ha + Boron 1.0 kg/ha	34.91	19.53
5.	Nitrogen 20 kg/ha + Boron 1.5 kg/ha	35.31	20.30
6.	Nitrogen 20 kg/ha + Boron 2.0 kg/ha	35.49	20.71
7.	Nitrogen 30 kg/ha + Boron 1.0 kg/ha	35.99	21.51
8.	Nitrogen 30 kg/ha + Boron 1.5 kg/ha	35.90	22.13
9.	Nitrogen 30 kg/ha + Boron 2.0 kg/ha	36.40	22.70
	F test	S	S
	SEd (±)	0.21	0.22
	CD (P=0.05)	0.64	0.65

Table-2: Influence of nitrogen and boron on yield attributes of lentil at 120 days after sowing.

S. No.	Treatments	Pods/plant	Seeds/pod	Grain yield (t/ha)	Stover yield (t/ha)
1.	Nitrogen 10 kg/ha+ Boron 1.0 kg/ha	159.57	1.27	1.41	2.10
2.	Nitrogen 10 kg/ha + Boron 1.5 kg/ha	162.27	1.33	1.46	2.21
3.	Nitrogen 10 kg/ha + Boron 2.0 kg/ha	164.30	1.41	1.54	2.18
4.	Nitrogen 20 kg/ha + Boron 1.0 kg/ha	160.50	1.46	1.54	2.11
5.	Nitrogen 20 kg/ha + Boron 1.5 kg/ha	165.47	1.52	1.57	1.98
6.	Nitrogen 20 kg/ha + Boron 2.0 kg/ha	166.83	1.60	1.56	2.32
7.	Nitrogen 30 kg/ha + Boron 1.0 kg/ha	169.50	1.63	1.63	2.53
8.	Nitrogen 30 kg/ha + Boron 1.5 kg/ha	172.54	1.66	1.69	2.66
9.	Nitrogen 30 kg/ha + Boron 2.0 kg/ha	174.44	1.72	1.75	2.67
	F-Test	S	S	S	S
	SEm$\pm$	0.72	0.03	0.02	0.09
	CD (P=0.05)	2.15	0.10	0.06	0.026

Table:3: Influence of nitrogen and boron on economics of lentil.

	Treatments	Cost of cultivation (INR/ha)	Gross return (INR/ha)	Net return (INR/ha)	B:C Ratio
1.	Nitrogen 10 kg/ha+ Boron 1.0 kg/ha	27,771	71,893.00	44,122.00	1.59
2.	Nitrogen 10 kg/ha + Boron 1.5 kg/ha	28,371	74,528.00	46,157.00	1.63
3.	Nitrogen 10 kg/ha + Boron 2.0 kg/ha	28,971	78,608.00	49,637.00	1.71
4.	Nitrogen 20 kg/ha + Boron 1.0 kg/ha	27,988	78,421.00	50,433.00	1.80
5.	Nitrogen 20 kg/ha + Boron 1.5 kg/ha	28,588	80,274.00	51,686.00	1.81
6.	Nitrogen 20 kg/ha + Boron 2.0 kg/ha	29,188	79,713.00	50,525.00	1.73
7.	Nitrogen 30 kg/ha + Boron 1.0 kg/ha	28,206	83,181.00	54,975.00	1.95
8.	Nitrogen 30 kg/ha + Boron 1.5 kg/ha	28,806	86,054.00	57,248.00	1.99
9.	Nitrogen 30 kg/ha + Boron 2.0 kg/ha	29,406	89,059.00	59,652.00	2.03