Original Research Article

TITLE:

RESPONSE OF NITROGEN AND PHOSPHORUS ON GROWTH AND YIELD OF LENTIL

(*Lens culinaris medik.*)

Abstract: The experiment was conducted during *Rabi*, 2021-22, Crop Research Farm, Department of Agronomy, Naini Agriculture Institute, Sam Higginbottom University of Agriculture Technology And Sciences, Prayagraj, Uttar Pradesh, to study the response of nitrogen and phosphorus on growth and yield of lentil *(Lens culinaris medik.*) The treatments consist of nitrogen 10, 20, 30 kg/ha and phosphorus 30, 40, 50 kg/ha. Theresult reported that treatment 9[Nitrogen 30 kg/ha + Phosphorus 50 kg/ha] gave significantly the higher plant height (38.02 cm), number of nodules (37.44), dry weight (13.80 g/plant). It is also observed that the highest grain yield (1.83 t/ha) and the highest stoveryield (2.66t/ha) was obtained with the application of nitrogen 30 kg/ha along with phosphorus 50 kg/ha. The highest gross return (93211 INR/ha), net returns (63830 INR/ha)and B:C ratio (2.17) were also recorded with application of Nitrogen 30kg/ha + Phosphorus 50kg/ha.

Key words: Lentil, Nitrogen, Phosphorus, growth parameters, yield and economics.

INTRODUCTION

"Pulses are the important crops in our country and are the main sources of vegetable protein as faras an Indian diet is concerned. The lysine rich protein of pulses is considered to supplement the deficiency of this amino acid in cereals dietaries and brings at par with milk's protein in the termsof biological efficiency. It is because of this reason that pulses have also beencalled "the poor man's meat." Pulses are major sources of vitamins like riboflavin, thiamine,niacin, and iron. Medical considerations encourage the presence of certain quality of fiber in thehuman diet" (Singh *et al.* 2018). The human diet 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 lentils.'Lentil is a legume crop and plays a great role in croprotation for maintaining soil fertility, and through root nodules, lentil can fix atmospheric nitrogenby symbiotic rhizobia therefore fertilizersand soil fertility has a major role in obtaining higher yield" (Zafar *et al.*2003).

Lentil is being cultivated in India in an area of about 1.32 million hectares with a production of 1.18 million tonnes and average productivity of about 894 kg/ha and Uttar Pradesh contributes an area about 0.46 million hectares with a 31.46% all over India which has the production of about 0.45 million tonnes (38.47% to all over India) and productivity is 978kg/ha, (Government of India,2020).

Growing lentils without fertilizer application or at a very low rate is considered a major factor for low yield (Sharar *et al*.2003). "The other reasons such as lack of quality optimum seed rate, using local varieties as planting material, appropriate time of sowing, lack of judicious fertilizer applications and especially decrease of organic matter in the soil" (Datta *et al.* 2013). The application of nitrogen and phosphorus will enhance nutrient availability and increases productivity.

Nitrogen is a primary element and of special importance in the formation of protein in plants. Nitrogen deficiency is the most important which is an almost universal occurrence in Indian soils. It is also present in chlorophyll green pigments that are receptors of high energy in photosynthesis (Verma *et al*. 2017). "Nitrogen is the most essential nutrient that frequently limitscrop production. The availabilities and source of nitrogen fertilizer also affect crop yield andsoil health. Having effective biological nitrogen fixations, legumes can therefore be grown without nitrogen fertilizer as atmosphere had had more than 70%nitrogen. Thus, to understand the actual benefits of this plant, microbial interactions, it is essential to determine the amount of theatmospheric nitrogen fixed by lentil and the nitrogen use efficiency under field condition for better crop management" (Kabir *et al*.2019).

"Phosphorus (P) is a non-renewable and second most important macro nutrient which is required for young tissues and performs a number of functions related to the growth, development, and metabolism of the plant. It is also called "the key to life" because it regulates many metabolic activities of plant life. Phosphorus increases the hardiness of the crop and an adequate supply of phosphorus results in rapid growth. Phosphorous is essential for the health and vigor of plants. It improves the flower formation, uniform, and earlier crop maturity. Supports development throughout the entire life cycle of the plant and also provides disease resistance" (Singh *et al.* 2016).

MATERIALS AND METHODS

The experiment was conducted during *Rabi* of 2021-22, Crop Research Farm, Department of Agronomy, Naini Agriculture Institute, Sam Higginbottom University of Agriculture Technology And Sciences, Prayagraj, Uttar Pradesh. Which is located at 25.24' 42'' N latitude, 81·50' 56" E longitude, and 98m altitude above the mean sea level (MSL). The experiment was conducted in Randomized Block Design with 10 treatments each replicated thrice. The plot size of each treatment was 3m x 3m. Factors are three levels of nitrogen (10, 20, and 30 kg/ha) and three levels of phosphorus (30, 40, and 50 kg/ha). The Nitrogen and Phosphorus were supplied in the form of urea and SSP. And both are applied as basal at the time of sowing. The lentil variety KLS-0903 was sown on 1November 2021 by maintaining a spacing of 30cm × 10cm. Harvesting was done by taking 1m^2 area from each plot.The treatment details are as follows, T_1 -(Nitrogen 10 kg/ha + Phosphorus 30 kg/ha), T_2 -(Nitrogen 10 kg/ha + Phosphorus 40 kg/ha, T_3 – (Nitrogen 10 kg/ha + Phosphorus 50kg/ha), T_4 -(Nitrogen 20 kg/ha + Phosphorus 30 kg/ha), T_5 -(Nitrogen 20 kg/ha + Phosphorus 40kg/ha), T_6 -(Nitrogen 20 kg/ha + Phosphorus 50 kg/ha), T_7 -(Nitrogen 30 kg/ha + Phosphorus 30kg/ha), T_8 -(Nitrogen 30 kg/ha + Phosphorus 40 kg/ha), T_9 -(Nitrogen 30 kg/ha + Phosphorus 50 kg/ha),T_{10}-(N 20 Kg/ha + P 40 kg/ha +k 20 kg/ha) Control. The observations were recorded for plant height, nodules/plant, dry weight, grain yield and stover yield. The data were subjected to statistical analysis by analysis of variance method (Gomez and Gomez, 1976).

RESULTS AND DISCUSSION:

Growth parameters:

Plant height – Significant and the highest plant height (32.02 cm) was recorded in T_9 (N 30 kg/ha + P 50 kg/ha) [Table 1]. However, treatment-8 Nitrogen 30 kg/ha + Phosphorus 40kg/ha) was statistically at par with treatment-9 (Nitrogen30 kg/ha+ Phosphorus 50kg/ha). A considerable and larger plant height may be attributable to the application of phosphorus to the soil, which may have increased the crop's ability to access and absorb soil nutrients. The improved photosynthetic capacity and metabolite translocation to various areas may have been boosted by the increased nutrient availability, which eventually boosted the crop's root and shoot development. These results support the findings of Yumnam et al. (2018) in lentil.

Nodules/plant – Significant and the higher number of nodules/plant (37.44) was recorded in treatment-9 (Nitrogen 30/ha+ Phosphorus 50kg/ha) [Table 1]. However, treatment-8 (Nitrogen 30 kg/ha +Phosphorus 40kg/ha) was found to be statistically at par with treatment-9 (Nitrogen 30 kg/ha+ Phosphorus 50kg/ha). Significant and the higher number of nodules/plant was with application of (Nitrogen 30kg/ha phosphorus 50kg/ha) might helped in efficient utilization of nutrients, which resulted in attaining better crop canopy and further increased absorption and utilization of radiantenergy resulting in the higher effective and total number of nodules/plants**. Patel** ***et al.*** **(2017**) in green gram who reported that application of phosphorus increased the number of nodules/plants.Further, the application of higher dose nitrogen might have favored rapid growth and enlargementof tissues**. Fatima** ***et al.*** **(2013).**

Dry weight/plant- Significant and the higher dry weight (13.80 g) was recorded in treatment-9 (Nitrogen 30 kg/ha+ Phosphorus 50kg/ha) [Table 1]. However, treatment- 7 (Nitrogen 30 kg/ha + Phosphorus 30kg/ha) was found to be statistically at par with treatment-9 (Nitrogen 30 kg/ha+ Phosphorus 50kg/ha). Significant and higher dry weight is observed with the application of phosphorus increases in dry weight due to an increase in photosynthetic ability and translocation of metabolites to different parts which ultimately increased the shoot development of the crop. Similar results were found in **Yumnam** ***et al.*** **(2018).**

Yield:

Grain yield – Significant and the higher seed yield (1.83 t/ha) was observed in treatment-9 (Nitrogen30 kg/ha+ Phosphorus 50kg/ha), which was significantly superior over to the rest of the treatments. However, treatment -1 (Nitrogen 10kg/ha+ Phosphorus 30kg/ha) was found to be statistically at par with treatment -9 (Nitrogen 30kg/ha+ Phosphorus 50kg/ha) [Table 1]. Significant and higherseed yield was with the application of nitrogen which might have improved in different yield contributing characters due to higher nitrogen level (Fatima et. al, 2013). Furthermore, the use of phosphatic fertiliser gave the crop balanced nutrition, leading to a better yield of lentil seeds. Additionally, phosphorus promoted photosynthesis and the movement of assimilates across various plant sections for improved development and yield characteristics of the crop as seen in the number of pods/plant and the number of seeds/pods. The extra assimilates that had been stored in the leaves were later transferred to sink development, which helped to increase seed output. These findings were supported by **Yumnam *et al.* (2018)**.

Stover yield – Significant and the higher stover yield (2.66 t/ha) was observed in treatment-9 (Nitrogen 30 kg/ha+ Phosphorus 50kg/ha), which was significantly superior over to the rest of the treatments. However, treatment 8- (Nitrogen 30kg/ha+ Phosphorus 40kg/ha) was found to be statistically at par with treatment-9 (Nitrogen 30kg/ha+ Phosphorus 50kg/ha) [Table 1]. Significant and the higher stover yield with the application of phosphorus might have contributed for better growth of the plant as expressed in terms of plant height, number of nodules/plants, dry weight, which improved nutrient uptake, resulted increased in stover yield. Similar findings were reported by **Choubey *et al.* (2013)**.

Gross returns (INR/ha): The higher gross returns (93211 INR/ha) were recorded in treatment-9 (Nitrogen 30 kg/ha+ Phosphorus 50kg/ha) as compared to other treatments [Table 2].

Net returns (INR/ha): The higher net returns (63830 INR/ha) was recorded in treatment-9 (Nitrogen 30 kg/ha+ Phosphorus 50kg/ha) as compared to other treatments [Table 2]. The statistically higher Net returns was with the application of treatment -9 (Nitrogen 30kg/ha+ phosphorus 50kg/ha). With increasing levels of phosphorus, the grain and straw yield increased this attributed to a higher Net return. These results are in conformity with those observed by **Mitra *et al.* (2006).**

Benefit Cost ratio (B:C): The higher benefit cost ratio (2.17) was recorded in treatment-9 (Nitrogen 30 kg/ha+ Phosphorus 50kg/ha) as compared to other treatments [Table 2]. The statistically higher benefit cost ratio was with the application of treatment-9 (Nitrogen 30kg/ha + phosphorus 50kg/ha), due to the nitrogen and phosphorus providing conclusive condition to the soil with the synergistic effect of Nitrogen and Phosphorus resulting in better benefit cost ratio. These results are supported by the findings of **Sharma *et al.* (2018)** in maize.

CONCLUSION

It may be concluded that the application of Nitrogen and Phosphorus performs positively and improves the growth parameters and yield attributes of lentil. Maximum grain yield, gross return, net return, and benefit cost ratio were recorded with the application of Nitrogen 30kg/ha with phosphorus 50kg/ha. These findings are based on one season therefore, further trails may be required for further confirmation.

Table 1. Influence of nitrogen and phosphorus on growth parameters of lentil.

Treatments	Plant height (cm)	Nodules/plant	Dry weight(g)	Grain yield (t/ha)	Stover yield (t/ha)
Nitrogen 10 kg/ha + phosphorus 30 kg/ha	33.90	33.78	12.48	1.42	2.10
Nitrogen 10 kg/ha + phosphorus 40 kg/ha	34.43	34.10	12.51	1.47	2.21
Nitrogen 10 kg/ha + phosphorus 50 kg/ha	34.69	35.55	12.78	1.54	2.18
Nitrogen 20 kg/ha + phosphorus 30 kg/ha	34.91	34.71	13.04	1.54	2.11
Nitrogen 20 kg/ha + phosphorus 40 kg/ha	35.31	36.42	13.10	1.57	2.13
Nitrogen 20kg/ha + phosphorus 50 kg/ha	35.43	35.89	13.36	1.62	2.32
Nitrogen 30kg/ha + phosphorus 30 kg/ha	36.32	35.33	13.57	1.65	2.53
Nitrogen 30kg/ha + phosphorus 40 kg/ha	37.57	37.00	13.62	1.77	2.66
Nitrogen 30kg/ha + phosphorus 50 kg/ha	38.02	37.44	13.80	1.83	2.66
Control	34.71	34.54	12.25	1.50	2.05
F test	S	S	S	S	S
SEm (±)	0.20	0.34	0.12	0.01	0.07
CD (P=0.05)	0.59	1.02	0.35	0.43	0.022

Table 2. Influence of nitrogen and phosphorus on economics of lentil.

Treatments	Gross return	Net return	B:C ratio
Nitrogen 10 kg/ha + phosphorus 30 kg/ha	72573	44731	1.61
Nitrogen 10 kg/ha + phosphorus 40 kg/ha	75089	46695	1.64
Nitrogen 10 kg/ha + phosphorus 50 kg/ha	78642	49696	1.72
Nitrogen 20 kg/ha + phosphorus 30 kg/ha	78778	50719	1.81
Nitrogen 20 kg/ha + phosphorus 40 kg/ha	80274	51663	1.81
Nitrogen 20kg/ha + phosphorus 50 kg/ha	82807	53644	1.84
Nitrogen 30kg/ha + phosphorus 30 kg/ha	84371	56094	1.98
Nitrogen 30kg/ha + phosphorus 40 kg/ha	90202	61373	2.13
Nitrogen 30kg/ha + phosphorus 50 kg/ha	93211	63830	2.17
Control	76279	47668	1.67

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