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. The treatments consist of nitrogen 10, 20, 30 kg/ha and phosphorus 30, 40, 50 kg/ha. The result reported that treatment 9 [Nitrogen 30 kg/ha + Phosphorus 50 kg/ha] significantly 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 highest stover yield (2.66t/ha) was obtained with the application of nitrogen 30 kg/ha along with phosphorus 50 kg/ha.Higher 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 far as an Indian dietary is concerned. The lysine rich protein of pulses are considered to the supplement the deficiency of this amino acid in cereals dietaries and brings at par with milk's protein in the terms of biological efficiency. It is because of this reason that pulses have also been called the "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 the human diet (Chandra and Lal, 1987). 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 lentil. Lentil is a legume crop and plays a great role in crop rotation for maintaining soil fertility and through root nodules, lentil can fix atmospheric nitrogen by symbiotic rhizobia therefore fertilizers and soil fertility has a major role for 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 an average productivity of about 894 kg/ha and Uttar Pradesh contributes an area about 0.46 million hectares with a 31.46% to all over India which has the production of about 0.45 million tonnes (38.47% to all over India) and productivity is 978kg/ha, (Agricultural Statistics at a Glance,2020).

Growing lentil 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 application and specially decrease of organic matter in soil (Datta *et al.* 2013). Application of nitrogen and phosphorus will enhance the nutrient availability and increases the productivity.

Nitrogen is a primary element and to special importance in the formation of protein in plants. Nitrogen deficiency is the most important which is almost of 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 limits the crop production. The availabilities and source of nitrogen fertilizer also affect crop yield and soil 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 atmospheric nitrogen fixed by lentil and the nitrogen use efficiency under field condition for better crop management (Kabir *et al*.2019).

Phosphorus (P) is non-renewable and second most important macro nutrient which is required for young tissues and performs a number of functions related to growth, development and metabolism of the plant. It is also called "the key to life" because it regulates many metabolic activities of the plant life. Phosphorus increases the hardiness of the crop and 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 entire life cycle of plant and also provide disease resistance (Singh *et al.* 2016).

Keeping these points in view, the present study entitled "**Response of Nitrogen and Phosphorus on Growth and Yield of Lentil (*Lens culinaris* medik.)"** was conducted at Crop Research Farm, Department of Agronomy, Naini Agriculture Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj, Uttar Pradesh during *rabi* season of 2021-22.

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 N and P 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 taking $1m^2$ area from each plot. And from it three plants were randomly selected for recording growth and yield parameters. 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 50 kg/ha), T_4 -(Nitrogen 20 kg/ha + Phosphorus 30 kg/ha), T_5 -(Nitrogen 20 kg/ha + Phosphorus 40 kg/ha), T_6 -(Nitrogen 20 kg/ha + Phosphorus 50 kg/ha), T_7 -(Nitrogen 30 kg/ha + Phosphorus 30 kg/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 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). Significant and higher number of plant height may be owing to phosphorus application in the soil might be due to increase availability and uptake of soil nutrients by the crop contributed by phosphorus fertilization. The higher availability of nutrients might have increased the photosynthetic ability and translocation of the metabolites to different parts which ultimately increased the root and shoot development of the crop. These findings corroborate the results of **Yumnam *et al.* (2018)**, in lentil.

Nodules/plant – Significantly 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 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 radiant energy resulting in 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 enlargement of tissues**. Fatima *et al.* (2013).**

Dry weight/plant- Significantly 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 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 **Tophia *et al.* (2018).**

Yield:

Grain yield – Significant and higher seed yield (1.83 t/ha) was observed in treatment-9 (Nitrogen 30 kg/ha+ Phosphorus 50kg/ha), which was significantly superior over 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 higher seed yield was with application of nitrogen which might have improved in different yield contributing characters due to higher nitrogen level (Fatima et. al, 2013). Further, application of phosphatic fertilizer therefore provided balance nutrition to the crop which resulted in higher seed yield of lentil. Phosphorus also increased the photosynthesis and translocation of assimilates to different plant parts for enhanced growth and yield attributing characters of the crop as observed in number of pods/plant and number of seeds/ pods. In the later stage, the excess assimilates stored in the leaves was translocated towards sink development which ultimately contributed to higher seed yield. These findings were supported by **Yumnam *et al.* (2018)**.

Stover yield – Significant and higher stover yield (2.66 t/ha) was observed in treatment-9 (Nitrogen 30 kg/ha+ Phosphorus 50kg/ha), which was significantly superior over 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 higher stover yield was with application of phosphorus might have contributed for better growth of 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): Higher Gross returns (93211 INR/ha) was recorded in treatment-9 (Nitrogen 30 kg/ha+ Phosphorus 50kg/ha) as compared to other treatments [Table 2].

Net returns (INR/ha): 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): 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 provides conclusive condition to the soil with the synergistic effect of Nitrogen and Phosphorus resulting better benefit cost ratio. These results are supported by the findings of **Sharma *et al.* (2018)** in maize.

CONCLUSION

It may be concluded that 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 was 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

REFERENCES:

Chandra, S.V. and Lal, B (1987). The effect of lead exposure on the testis of growing rats. *Experimental pathology* **31**(4):249-252.

Choubey, S.K., Dwivedi V.P. and Srivastava, N.K (2013). Effect of different levels of phosphorus and Sulphur on growth, yield and quality of lentil. *Indian Journal Science and Research* **4**(2)**:***149-150.*

Datta, S.K., Sarkar, M.A.R. and Uddin, F.M.J (2013). Effect of variety and level of phosphorous on the yield and yield components of lentil. *International Journal Research Innovation and Technology* **3**(1): 78-82.

Fatima, Kaneez, Hussain, Nazir, Pir, F.A. and Mehdi, Mohd (2013). Effect of nitrogen and phosphorus on growth and yield of lentil (Lens Culinaris*). Elixir International journal* **57** (20):14323-14325.

GOI 2020-21. Economics and Statistics of Indian Agriculture. Annual Report, Government of India, New Delhi.

Gomez, K. A and Gomez, A. A (1976). Three or more factor experiment. In: Statistical Procedure for Agricultural Research 2nd edition, p. 139 -141.

Humayun, Md, Kabir, Pronabananda, Das, Monirul, Md, Islam, Belal Md, Hossain, Monirul, Md, Islam, A.N.K. and Mamun, Roland, Rallos V (2019). Effect of different doses of nitrogen-on-nitrogen fixation and yield of lentil using tracer technique. *GSC*

Biological and Pharmaceutical Sciences 0**6**(03):069-075**.**

Mitra, A.K., Banerjee, K and Pal A.K (2006). Effect of different levels of phosphorus and Sulphur on yield attributes, seed yield, protein content of seed and economics of summer green gram**.** *Research on crops* **7**(2):404-405.

Patel, B., Himani, Shah, A.K., Barvaliya, M.M. and Patel, A.S (2017). Response of Greengram (vigna radiata L.) to different level of Phosphorus and organic liquid fertilizer. *International journal of current Microbiology and Applied Sciences* **6**(10):3443-3451**.**

Sharar, M.S., Ayub, M.M., Nadeem, A., M. and Naeem, M (2003). Effect of different combinations of nitrogen and phosphorus on the growth and yield of Three Varieties of lentil (lens culinaris Medik). *Pakistan Journal of Life Science* **1**(1):54-56.

Sharma, Pooja, Phurailatpa, Pandey, Girish, **Jawahar, S., Kalaiyarasan and Suseendran (2018).** Effect of different levels of nitrogen and phosphorus on yield and economics of hybrid maize (Zea mays L.). *International Journal of Research and Analytical Reviews* **5**(4):2348-1269.

Singh, Nariendar and Singh, Guriqbal, (2016). Response of lentil (Lens culinaris Medikus) to phosphorus. *Agricultural Reviews* **37**(1):27-34.

Verma, C.B., Pyare, Ram, Aslam, Moh, Verma, V.K., Singh and Sharma, Harshita (2017). Enhancing growth, yield and quality of lentil through foliar spray of zinc, urea and thiourea under rainfed condition. *Agri ways* **5**(2): 123-127.

Yumnam, Tophia, Luikham, Edwin, Singh and Herojit, A (2018). Influence of phosphorous on growth and yield of promising varieties of lentil (*Lens Culinaris* L.M). *International Journal of Current Microbiology and Applied Sciences* **7**(8):162-170.

Zafar, M., Maqsood, M., Ansar, Ramzan, M. and Ali, Zahid (2003). Growth and yield of lentil as affected by phosphorous. *International Journal of Agriculture and Biology* **5**(1):1560-8530.