Effect of Phosphorus and Potassium on Growth and Yield of lentil *(Lens culinaris L.)*

ABSTRACT

The field experiment was conducted during *Rabi* season 2022 at experimental field of Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India. The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH7.3), low in organic carbon (0.48%), available nitrogen (230 kg/ha), available phosphorus (13.60 kg/ha) and available potassium (215.4 kg/ha). The research consists 3 levels of Phosphorus 30, 40, 50 kg/ha and Potassium 15, 20, 25 kg/ha. The experiment was layout in Randomized Block Design with 9 treatments each replicated thrice. Higher plant height (25.20 cm), plant dry weight (10.34 g), and the yield attributes namely seeds/pod (2.27), pods/plant (91.90), seed yield (1847.93 kg/ha) and stover yield (2948.20 kg/ha) was with the treatment 9 [Phosphorus 50 kg/ha + Potassium 25 kg/ha].

Keywords: *Lentil, Phosphorus, Potassium, Growth and Yield*

INTRODUCTION

Lentil is one of the world's oldest crops having been cultivated in southwestern Asia since 7000 bc. The crop is best adapted for production in temperate climates but is now produced in different parts of the world. India ranked first in area and second in the production with 39.79% and 22.79% of world area and production respectively. The highest productivity was recorded in Croatia (2862 kg/ha) followed by New Zealand (2469 kg/ha). Canada rank first in production (41.16%) due to very high level of productivity (1633 kg/ha) as compared to India (611 kg/ha). (FAO State., 2014). It is grown in different cropping systems under irrigated (10%) as well as rainfed conditions (90%) in most regions of the world. It is grown as mono cropping, mixed cropping, intercropping and relay cropping. As intercropping it better exploits the resources than sole crops and also provides "Biological Insurance" i.e. when one crop fails then second crop provides some returns. It can be intercropped successfully in wheat, barley, mustard and linseed. Lentil is one of the most important food legumes consumed widely throughout the world. Lentils are produced in diverse agroecological regions, such as Asia, North and South America, Africa, and Oceania. During the last two decades (2001–2020), world production of lentils increased by 107%, from 3.15 to 6.54 million metric tons. Canada leads lentil producing countries (with 44% share of the global output), followed by India and Australia having 18% and 8% share, respectively.

Phosphorus is the key element for successful pulse production because it is involved in root development, stalk and stem strength, flower and seed formation, crop maturity and production, N-fixation, crop quality and resistance to plant diseases by enhancing the physiological functions. It plays an important role in stimulating biological activities such as nodulation, nitrogen fixation, and nutrient uptake in the soil and rhizosphere environment, resulting in higher legume crop yield. Phosphorus application reduces the negative effects of drought on physiological parameters and has the potential to increase yield in water-stressed conditions. **(Singh. N and Singh. G 2016).**

Potassium mainly effects the nodulation of pulse crop thus increases the seed yield through better fixation of nitrogen. It is one of the major elements taken up by the plant. Plants absorb Potassium in larger amounts as compared to other minerals except nitrogen. It helps in formation of proteins and chlorophyll. Potassium is a key nutrient in the plants which is tolerance to stress such as high/low temperatures, drought, disease and pest occurrences. Though, it is not a constituent of organic structures but it regulates enzymatic activities, translocation of photosynthates and considerably improves seed yield of chickpea if applied as a fertilizer. (**Degela *et al.*, 2021**)

MATERIALS AND METHODS

The methodology, materials, and the techniques adopted in this present experiment entitled, “Effect of Phosphorus and potassium on growth and yield of lentil”, was carried out at Crop Research Farm of the Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.) during *Rabi* season of 2022. The details of the procedures adopted for raising the crop and criteria used for treatment evaluation and methods adopted during the course of investigation are presented in this chapter are summarized here under the following headings.

In order to study the two nutrients, phosphorus and potassium are taken. The experiment was conducted at during *Rabi* 2022, at Crop Research Farm, Naini Agricultural Institute, SHUATS, Prayagraj. The experimental site of the study is geographically located at 25.28°N latitude, 81.54°E longitude and 98 m altitude above the mean sea level (MSL). The soil of the experimental field constituting a part of central Gangetic alluvium is neutral and deep. Pre- sowing soil samples were taken from a depth of 15 cm with the help of an auger. The composite samples were used for the chemical and mechanical analysis. The soil was sandy loam in texture, low in organic carbon (0.36%) and medium in available nitrogen (171.48 kg/ha), phosphorous (15.2 kg/ha) and low in potassium (232.5 kg/ha). The treatments consist of phosphorus (30, 40, 50 kg/ha) and potassium (15, 20, 25 kg/ha) respectively. The experiment was laid out in randomized block design with nine treatments each replicated thrice and control i.e., recommended N, P and K (20:40:20 kg/ha). Growth characteristics namely plant height (cm), plant dry weight (g), were recorded. The crop was completely harvested at physiological maturity stage and their post-harvest observations such as number of seeds/pod, pods/plant, seed yield (kg/ha) and stover yield (kg/ha) were recorded. The data recorded for different characteristics were subjected to statistical analysis by adopting the method of analysis of variance (ANOVA) as described by **Gomez (1984).**

RESULTS AND DISCUSSIONS

GROWTH PARAMETERS

At 100 DAS, Higher plant height (25.20 cm) was recorded significantly in the treatment no.9 [Phosphorus 50 kg/ha + Potassium 25 kg/ha]. However, treatment no.8 [Phosphorus 50 kg/ha + Potassium 20 kg/ha] was found to be statistically at far with treatment no. 9. Maximum plant dry weight (10.34 g) was recorded significantly in the treatment no.9 [Phosphorus 50 kg/ha + Potassium 25 kg/ha]. However, treatment no.8 [Phosphorus 50 kg/ha + Potassium 20 kg/ha] was found to be statistically at far with treatment no. 9.

Increase in phosphorus levels increases the availability of plant nutrients might have increased photosynthetic capacity and the translocation of metabolites in different parts which ultimately increased the root and shoot development of the crop. Phosphorus increases root proliferation, nodulation and nitrogen fixation in legumes, increases dry matter production. Similar results are observed by **Goud *et al.* (2021).** Similar results are observed by **Goud *et al.* (2021).** Potassium plays vital role in meristematic growth through synthesis of Phyto hormone like Cytokine, which helps in plant growth. Similar results are observed by **Yellamati *et al.* (2021).** Potassium in that application plays a crucial role in meristematic growth through its effect on the synthesis of phytoharmones. Similar results are observed by **Reddy *et al.* (2021).**

YIELD ATTRIBUTES

At harvest, the data recorded more seeds/pod (2.27) in treatment no.9 [Phosphorus 50 kg/ha + Potassium 25 kg/ha]. However, treatment no.7 [Phosphorus 50 kg/ha + Potassium 15 kg/ha], treatment no.8 [Phosphorus 50 kg/ha + Potassium 20 kg/ha] was statistically at par with treatment no.9. Highest pods/plant (91.90) in treatment no.9 [Phosphorus 50 kg/ha + Potassium 25 kg/ha].However, treatment no.7[Phosphorus 50 kg/ha + Potassium 15 kg/ha], treatment no.8 [Phosphorus 50 kg/ha + Potassium 20 kg/ha] was statistically at par with treatment no.9. Higher seed yield (1847.93 kg/ha) in treatment no.9 [Phosphorus 50 kg/ha + Potassium 25 kg/ha]. However, treatment no.8 [Phosphorus 50 kg/ha + Potassium 20 kg/ha] was statistically at par with treatment no.9. Higher stover yield (2948.20 kg/ha) in treatment no.9 [Phosphorus 50 kg/ha + Potassium 25 kg/ha]. However, treatment no.7 [Phosphorus 50 kg/ha + Potassium 15 kg/ha] and treatment no.8 [Phosphorus 50 kg/ha + Potassium 20 kg/ha] was statistically at par with treatment no.9.

More supply of Phosphorus which increase the vegetative growth but not reproductive. At grain filling stage, balanced nutrition improves the photosynthesis efficiency and assimilates production which leads to enhance the yield. Similar results are observed by **Singh, N and Singh, G. (2016).** Phosphorus helps in utilizing nutrient efficiency, resulting in better canopy and a further increase in radiant energy uptake and utilization with a greater effective and total number of pods per plant. Similar results are observed by **Goud *et al.* (2021).** Phosphorus is known to encourage flowering and fruiting, which may have stimulated plants to produce more pods per plant and also allows more seeds to develop per pod resulting in increased grain yield. Similar results are observed by **Goud *et al.* (2021).** Phosphorus increases the production of plant biomass, nodule number and weight and chlorophyll content in leaf exhibited significant positive correlation with grain and straw yield. Similar results have been reported by **Prajapati *et al.* (2022).** Potassium serves as a catalyst for a variety of enzymes and in the synthesis of peptide bonds. Due to fewer flower drop and more efficient transfer of photosynthates from source to sink resulting in higher number of pods per plant. Similar results are observed by **Tauseef *et al.* (2022).** The higher grain yield could be due to potassium in that application stimulates the cumulative effect improvement in yield attributes viz., ear head length, number of grains/ear head, test weight and enhances the development of strong cell walls and therefore stiffer straw which might be resulted into profuse tillering. Similar results are observed by **Reddy *et al.* (2021).**

CONCLUSION

From the observations, it is concluded that among the studied that the application of Phosphorus 50 kg/ha along with Potassium 25 kg/ha (treatment 9) was found to be more desirable that gives higher growth parameters and yield attributes in Lentil crop.

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Table 1. Effect of phosphorus and potassium on growth attributes of lentil.

S. No.	Treatment combination	Plant height (cm)	Dry weight (g)
1.	Phosphorus 30 kg/ha + Potassium 15 kg/ha	23.33	8.73
2.	Phosphorus 30 kg/ha + Potassium 20 kg/ha	23.37	8.88
3.	Phosphorus 30 kg/ha + Potassium 25 kg/ha	23.47	9.08
4.	Phosphorus 40 kg/ha + Potassium 15 kg/ha	23.77	9.26
5.	Phosphorus 40 kg/ha + Potassium 20 kg/ha	24.07	9.51
6.	Phosphorus 40 kg/ha + Potassium 25 kg/ha	24.53	9.69
7.	Phosphorus 50 kg/ha + Potassium 15 kg/ha	24.63	9.89
8.	Phosphorus 50 kg/ha + Potassium 20 kg/ha	25.03	10.15
9.	Phosphorus 50 kg/ha + Potassium 25 kg/ha	25.20	10.34
	F-Test	S	S
	SEm(±)	0.17	0.08
	CD (p = 0.05)	0.51	0.24

Table 2. Effect of phosphorus and potassium on yield attributes and yield of lentil.

S. No.	Treatment combination	Seeds/pod (no.)	Pods/plant (no.)	Seed yield (kg/ha)	Stover yield (kg/ha)
1.	Phosphorus 30 kg/ha + Potassium 15 kg/ha	1.73	87.90	1471.23	2084.17
2.	Phosphorus 30 kg/ha + Potassium 20 kg/ha	1.80	88.53	1489.67	2113.03
3.	Phosphorus 30 kg/ha + Potassium 25 kg/ha	1.87	88.87	1525.07	2204.93
4.	Phosphorus 40 kg/ha + Potassium 15 kg/ha	1.93	89.23	1573.10	2356.80
5.	Phosphorus 40 kg/ha + Potassium 20 kg/ha	2.00	89.63	1634.30	2500.93
6.	Phosphorus 40 kg/ha + Potassium 25 kg/ha	2.07	89.97	1732.00	2640.40
7.	Phosphorus 50 kg/ha + Potassium 15 kg/ha	2.13	90.30	1749.40	2790.87
8.	Phosphorus 50 kg/ha + Potassium 20 kg/ha	2.20	91.43	1828.97	2938.37
9.	Phosphorus 50 kg/ha + Potassium 25 kg/ha	2.27	91.90	1847.93	2948.20
	F-Test	S	S	S	S
	SEm(±)	0.05	0.15	22.19	53.49
	CD (p = 0.05)	0.16	0.63	65.93	158.93