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Impact of Phosphorus and Zinc on Yield, Quality and Nutrient Content of Lentil (*Lens culinaris (L))* crop

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Abstract

A plot experiment was conducted to study the effect of phosphorus and zinc on the yield and nutrient content of lentil crop. The experiment was laid out in a randomized block design with phosphorus (0, 30, 60 and 120 kg ha^{-1}) and four levels of zinc (0, 0.5, 1 and 2 mg ha^{-1}) with three replications. The results revealed that increasing dose of phosphorus up to 120 kg/ha and Zn up to 0.5/ha enhanced the lentil yield significantly. Protein yield was also improved by the application of both of these two (P and Zn) nutrients. Phosphorus and zinc addition had a beneficial effect on absorption and utilization of (N, P and Zn) of lentil.

Key words: Phosphorus, zinc, yield, nutrient content, lentil

Introduction

Lentil is an important annual leguminous crop which is locally called "Masoor" belongs to the family Fabaceae. Human diet consists of vegetable protein in good amount. 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. Phosphorus plays a remarkable role in plant physiological processes. It is an essential constituent of majority of enzymes which are of great importance in the transformation of energy in carbohydrate metabolism in different types of plants and is closely related in cell division and grain development. In micro-nutrients, zinc is very important in reproductive phase like fertilization and pollen grain formation as pollen grain contains a high amount of zinc. Most of the zinc is trans-located to seeds during fertilization and lower application of zinc causes deficiency of zinc in the seed and also the seed yield is quietly reduced.

Materials and Methods

A field experiment was conducted in the field of Agriculture (Department of Soil Science & Agricultural Chemistry), Nehru Mahavidyalaya Lalitpur (Uttar Pradesh) during the winter season of 2023-24. The soil had EC 0.20 dSm^{-1}, pH 7.9, organic carbon 4.68 g kg^{-1}, and available N 84.67, P 5.13, K 96.45 kg ha{ ^{1} and zinc 5.84 mg kg^{-1}. The experiment was laid out in a randomized block design with four levels of phosphorus (0, 30, 60 and 120 kg ha^{-1}) and four levels of zinc (0, 0.5, 1 and 2 mg ha^{-1}) with three replications. The recommended dose of nitrogen and potassium were applied as urea and MOP. Phosphorus and zinc were supplied through phosphorus penta oxide and zinc sulphate as per treatments. Lentl was sown on October 25, 2023 and irrigated at appropriate times based on soil and crop appearance. Weeds were removed periodically. The crop was harvested at maturity. Grain and straw samples were analysed for N content by the Kjeldahl method (Jackson, 1973). Grain and straw

samples were digested in di-acid (HNO_3 :$HClO_4$) and the digest was analyzed for phosphorus by the vanadomolybdo phosphoric acid yellow color method, for K by flame photometer, and for Mn by atomic absorption spectrophotometer (Jackson, 1973). Nutrient uptake was calculated using yield data in conjunction with their respective contents.

Results and Discussion

Yield studies

The data given in to table 1 reveals that phosphorus application have a marked effect on seed yield and stover yield of lentil. P application had a significant response on seed yield and stover yield production of lentil. All the higher doses of P significantly enhanced the seed yield and stover yield production. The percent enhancement were 5.55, 9.80 and 14.37% (seed yield) and 4.87, 8.78 and 13.59% (stover yield) over control (due to 30, 60 and 120 kg P/ha) of lentil, respectively. All the higher doses of zinc clearly significantly superior over control enhancing the seed and stover yield production of lentil. The lowest average value of seed yield and stover yield were recorded in control treatment. The seed yield 1.31, 2.55 and 3.55% and stover yield 1.00, 2.12 and 3.49% increased of lentil due to 0.5, 1.0, 2.0 ppm Zn/ha. Similar results have been reported by Kumari, et al. (2024) and Munna, et al. (2016)

Protein content

A study of Table 1 reveals that the P application has a significant effect on the protein content in seed and stover yield of lentil crop. P application caused significant enhancements in protein content 3.37, 6.37 and 6.51% in seed and 2.44, 6.12 and 8.77% in stover due to 30. 60 and 120 kg P/ha. All the higher doses of phosphorus 30, 60 and 120 kg/ha application were found significantly superior over control in enhancing the protein content in seed and stover of lentil. Application of zinc increased the protein content in seed and stover of lentil and this effect was significant with each level of zinc. All the levels of zinc significantly increased the protein content. The percent enhancement were 0.088, 5.12 and 8.17% in seed and 2.61, 6.15 and 9.51 in stover of lentil due to 0.5, 1.0 and 2.0 ppm Zn/ha over control, respectively. Similar results have been reported by Kumari, et al. (2024) and Munna, et al. (2016)

Nutrients composition

Nitrogen content

Application of phosphorus significant effect on the N content in seed and stover yield of lentil

Table 1: Effect of phosphorus and zinc on seed and stover yield (gram/plot) and protein content (%) of lentil crop

Treatments	Grain yield	Straw yield	Protein content (%) in seed	Protein content (%) in stover
Phosphorus (kg ha^{-1})				
P_0	306	1375	21.03	4.90
P_1	323	1442	21.74	5.02
P_2	336	1496	22.37	5.20
P_3	350	1562	22.40	5.33
SEm±	1.05	1.45	0.09	0.01
CD @ 5%	2.15	2.96	0.20	0.03
Zinc (mg ha^{-1})				
Zn_0	323	1445	22.64	536
Zn_1	327	1459	22.62	5.22
Zn_2	331	1475	21.48	5.03
Zn_3	334	1495	20.79	4.85
SEm±	1.05	1.45	0.09	0.01
CD @ 5%	2.15	2.96	0.20	0.03

Table 2: Effect of phosphorus and zinc on N, P and Zn content (%) in seed and stover of lentil crop

Treatments	N content (%) in grain	N content (%) in straw	P content (%) in grain	P content (%) in straw	Zn content (%) in grain	Zn content (%) in straw
Phosphorus (kg ha^{-1})						
P_0	3.36	0.782	0.281	0.143	36.82	25.31
P_1	3.47	0.802	0.312	0.144	38.42	26.14
P_2	3.58	0.832	0.339	0.163	40.02	27.25
P_3	3.58	0.852	0.372	0.179	41.36	28.40
SEm±	0.015	0.11	0.04	0.02	0.21	0.16
CD @ 5%	0.032	0.24	0.09	0.04	0.43	0.33
Zinc (mg ha^{-1})						
Zn_0	3.62	0.80	0.355	0.169	37.50	24.75
Zn_1	3.62	0.83	0.354	0.170	38.79	26.18
Zn_2	3.43	0.80	0.316	0.148	39.84	27.47
Zn_3	3.32	0.77	0.278	0.142	40.49	28.71
SEm±	0.015	0.11	0.04	0.02	0.21	0.16
CD @ 5%	0.032	0.24	0.09	0.04	0.43	0.33

crop. Application of phosphorus caused a significant enhancement in N content 3.27, 6.54 and 6.54% in seed and 2.55, 6.38 and 8.94% in stover due to 30, 60 and 120 kg P/ha. All the higher doses of phosphorus 30, 60 and 120 kg/ha application were found significantly superior over control in enhancing the N content in seed and stover of lentil (table-2). Zinc application has a significant effect on nitrogen content in seed and stover of lentil plant. All higher doses of Zn application were found significantly increased N content 0, 5.24 and 8.28% in seed and 2.62, 6.41, 9.62% in stover of lentil over control due to 0, 0.5, 1.0, 2.0 Zn ppm/ha respectively. Similar results have been reported by Kumari, et al. (2024) and Munna, et al. (2016).

Phosphorus content

The data given in Table 2 clearly indicate that the P application has a significant effect on the phosphorus content in seed and stover yield of lentil crop. P application caused a significant enhancements in P content 10.97, 20.42 and 32.32% in seed and 0.83, 13.63 and 25.19% in stover yield due to 30, 60 and 120 kg P/ha. Zinc application has a significant effect on phosphorus content in seed and stover of lentil. All higher doses of Zn application were found significantly increased P content 0.28, 11.04 and 21.78% in seed and 0.52, 12.71 and 15.89% in stover of lentil over control. Similar results have been reported by Kumari, et al. (2024) Singh, et al. (2020) and Munna, et al. (2016).

Zinc content

The data given in Table 2 clearly indicate that the phosphorus application has a significant effect on the Zn content in seed and stover yield of lentil crop. P application caused significant enhancements in Zn content 4.34, 8.69 and 12.33% in seed and 2.35, 5.49 and 8.75 in stover due to 30. 60 and 120 kg P/ha. All the higher doses of phosphorus 30, 60 and 120 kg/ha application were found significantly superior over control in enhancing the Zn content in lentil. Zinc application has a significant effect on zinc content in seed and stover of lentil. All higher doses of Zn application were found significantly increased Zn content 3.44, 6.24 and 7.97% in seed and 4.11, 7.82 and 11.39% in stover of lentil over control.Similar results have been reported by Kumari, et al. (2024), Singh, et al. (2020) and Singh, et al. (2024).

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