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QUALITATIVE RESPONSE OF THREE LENTIL (*Lens culinaris* Medic) CULTIVARS TO PHOSPHORUS APPLICATION

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Effect of different phosphorus levels viz. 0, 25, 50 and 75 kg ha^{-1} on the chemico-qualitative parameters of three lentil cultivars (Masoor-local, Masoor-85 and Masoor-93) were studied under field conditions on a sandy- clay loam soil for two years. The results evinced that seed protein concentration was significantly higher (25.36%) in Masoor-93 than Masoor-85 (23.24%) and Masoor-local (23.07%) where as seed P, K, Ca, Mg, Phytic acid contents and cooking quality were almost similar in all the cultivars. By contrast, phosphorus application @ 50 kg ha^{-1} significantly improved the cooking quality, seed phosphorus and phytic acid content over check.
Key words: Lentil, qualitative response, cultivars, phosphorus application

INTRODUCTION

Pulses are the important world food crops providing more plant protein than cereals. Human daily diet may be augmented by supplementation with protein rich pulse grains. Pulse grains also provide a source of rich protein to communities preferring vegetable protein in their diet. Lentil (*Lens culinaris* Medic) is an important "rabi" pulse crop of Pakistan giving an average seed yield of 646 kg ha^{-1} which is much lower than the world average yield of 946 kg ha^{-1} (FAO, 1999). The major constraints of poor yield of lentil are cultivation of low yield potential cultivars and poor management of fertilizers.

Among the three major plant nutrients, phosphorus contributes substantially to increased yield of legumes and lentil in particular by favourably affecting the physiological functions of the crop plants, root development and nodulation (Sharma and Singh, 1989). Pakistan soils are generally low in phosphorus and respond positively to phosphorus application (Sharar *et al.*, 1976). Phosphorus application not only increases the dry matter and grain yield of lentil but also enhances the nitrogen and phosphorus content of the seed. As the chemical composition of lentil seed and its cooking quality is mainly influenced by nutrition, so adequate supply of major and minor elements is essential to improve the cooking quality. Keeping all this in view, the present study was planned to determine the qualitative response of three lentil cultivars to phosphorus application under the agro-ecological conditions of Faisalabad in irrigated environment.

MATERIALS AND METHODS

The investigations were carried out on a sandy-clay loam soil at the University of Agriculture, Faisalabad for two years. The phosphorus levels were 0, 25, 50 and 75 kg ha^{-1} while the cultivars tested were Masoor-local, Masoor-85 and Masoor-93. A uniform basal dose of 50-50 kg NK ha^{-1} was used in all the treatments including control. The experiment was laid out in a split plot randomized complete block design with four replications keeping the cultivars in main and phosphorus levels in sub plots. The crop was sown in the second week of November every year in 25 cm rows apart with a single row hand drill using a recommended seed rate of 20 kg ha^{-1} for Masoor-local and Masoor-85 and 25 kg ha^{-1} for Masoor-93 in order to maintain uniform number of seeds per unit area in all the cultivars as seed of Masoor-93 was relatively bolder than the other two cultivars. The net plot size measured was 1 m x 2 m. All the fertilizers were well mixed into the soil at seedbed preparation before sowing the crop. The crop was kept free of weeds throughout the growing period by using appropriate agro-chemical weed control measures. In all two irrigations each of 7.5 cm were applied to mature the crop in addition to seedbed preparation irrigation of 10 cm. The crop was harvested at maturity during the second week of April each year, dried and then threshed manually. The data on chemical, quality parameters like seed composition, seed protein, phytic acid and cooking quality of the seed were recorded by using standard analytical techniques. Seed composition was determined by using the method given by Toth *et al.* (1948). Seed nitrogen was determined by Gunning and Habbard's method of sulphuric acid digestion (Jackson, 1962) and the protein was calculated by multiplying the percent nitrogen with 6.25. Phytic acid was determined by following the method prescribed by Wheeler and Ferrel (1971) while the cooking quality score was measured by following the method recommended by Shah and Abu-Shakra (1982). The cooking quality was determined by using an organoleptic test and scoring was done by allocation of marks in each fraction as decided by the experimenter. The lesser the score the better the cooking quality and vice versa. The data collected were subjected to Fisher's analysis of variance technique and least significant difference (LSD) test at 0.05 probability was used to compare the treatment means (Steel and Torrie, 1984).

RESULTS AND DISCUSSION

The data on chemical composition of seed and quality parameters of three lentil cultivars as affected by phosphorus application are depicted in Table 1.

Table 1. Qualitative traits of three lentil cultivars as affected by different phosphorus levels.
(2-year average data)

Cultivars	Protein (%)	Calcium	Magnesium	Potassium	Phosphorus	Phytic acid	Cooking quality (score)
	------------------- mg/100 g) -------------------						
Masoor-local	23.07 b	82.50	80.36	799.25	363.75	151.18	4.19
Masoor-85	23.24 b	88.75	80.39	809.22	376.41	157.37	4.41
Masoor-93	25.36 a	86.50	80.48	789.69	390.78	157.21	4.50
LSD (0.05 P)	0.74	NS	NS	NS	NS	NS	NS
Phosphorus levels (kg ha^{-1})							
0	23.37 b	81.67	80.36	788.42	299.54 b	134.75 c	5.79 a
25	23.83 ab	85.00	80.52	797.83	346.54 b	163.71 b	4.75 b
50	24.33 a	87.67	80.40	800.21	411.96 a	177.45 a	3.08 d
75	24.01 a	89.33	80.32	811.08	449.88 a	145.12 c	3.83 c
LSD (0.05)	0.51	NS	NS	NS	42.27	12.45	0.34

Entries not sharing a letter differ significantly at 0.05 P.
NS = Non-significant

Seed protein concentration

Seed protein concentration differed significantly among the cultivars with the maximum (25.36%) in Masoor-93 and the minimum (23.07%) in Masoor-local which was statistically at par with Masoor-85 (23.24%). The results indicated that cultivar Masoor-93 is inherently more efficient in protein synthesis than rest of the two cultivars. Similar results were reported by Sadiq *et al.* (1998). Phosphorus application although increased the seed protein concentration over control but the differences within the phosphorus levels were non-significant showing a range of 23.83 to 24.33%. Increase in seed protein concentration with phosphorus application has also been reported by Rathore *et al.* (1992).

Seed calcium and magnesium content

The calcium and magnesium content of the seed were statistically the same in all the cultivars showing a range of 82.50 to 88.75 and 80.36 to 80.48 mg/100 g of seed, respectively (Table 1). These results contradict with those of Bhatty (1984). Phosphorus application also did not affect the seed calcium and magnesium contents to a significant level which on an average varied from 81.67 to 89.33 and 80.32 to 80.52 mg/100 g of seed, respectively. The results clearly indicated that absorption of calcium and magnesium by lentil plants and their translocation into the seed is not influenced by the application of phosphorus to a significant level.

Seed potassium content

Although there were visible differences in seed potassium content among the cultivars but the differences were non-significant. However, the seed potassium content varied from 789.69 to 809.22 mg/100 g of seed among the different cultivars. These results differ from those of Bhatty (1989). Similarly, different phosphorus levels also had no significant effect on seed potassium content and showed a range of 797.83 to 811.08 mg/100 g of seed. The results clearly indicated that phosphorus application did not play any role in the absorption of potassium by the crop and its translocation into the seed. These results are in consonance with those of Jain *et al.* (1995a) who also reported non-significant effect of phosphorus application on seed potassium content of lentil.

Seed phosphorus content

Although there was wide range of differences in seed phosphorus content among the cultivars (363.75 - 390.78 mg/100 g of seed) but the differences among them were non-significant. These results contradict with those of Bhatty (1989). On the contrary, phosphorus application @ 50 and 75 kg ha^{-1} although increased the seed phosphorus content significanly over check but the difference between them was non-significant showing on the average seed phosphorus content of 411.96 and 449.88 mg/100 g of seed, respectively against the minimum of 299.54 mg/100 g of seed in check. Increase in seed phosphorus content with the application of phosphorus has also been reported by Jain *et al.* (1995b).

Seed phytic acid content

There was no significant variation in seed phytic acid content among the cultivars which showed a range of 151.18 to 157.37 mg/100 g of seed. These results are in line with those of Bhatty and Slinkard (1989). By contrast, phosphorus application @ 50 kg ha^{-1} improved significantly the seed phytic acid content (177.45 mg/100 g of seed) over all other treatments. It was followed by that of 25 kg ha^{-1} showing 163.71 mg/100 g of phytic acid in the seed. The lowest phytic acid (134.75 mg/100 g of seed) was recorded without phosphorus but it did not differ significantly from that recorded with 75 kg phosphorus ha^{-1} i.e. 145.12 mg/100 g of seed. The results clearly speak for the beneficial effect of phosphorus on seed phytic acid content.

Cooking quality of the seed

The cooking quality score although varied from 4.19 to 4.50 among the cultivars but the differences among them were statistically non-significant. However, the minimum cooking quality score (4.19) was recorded for Masoor-local indicating relatively better cooking quality of the seed against the maximum of 4.50 for Masoor-93. These results are not in line with those of Bhatty *et al.* (1983) who reported significant variation in cooking quality score among the different genotypes of lentil. By contrast, there was a significant reduction in cooking quality score with the application of phosphorus at different rates over check with significantly the minimum (3.08) at 50 kg ha^{-1} treatment against the maximum of 5.79 in check. The results further indicated that although phosphorus application beyond 50 kg ha^{-1} did not improve the cooking quality of lentil seed to a significant level but improved significantly over check and 25 kg phosphorus ha^{-1} treatment as indicated by their respective cooking quality score.

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