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Qualitative and Quantitative Response of three Cultivars of Lentil (*Lens culinaris* Medic) to Phosphorus Application

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ABSTRACT

Investigations to see the yield and cooking quality response of three varieties of lentils to phosphorus application were carried out at the University of Agriculture, Faisalabad. Varieties used were local, Masoor-85 and Masoor-93. The phosphorus levels were 0, 25, 50 and 75 kg P_2O_5 ha^{-1}. Masoor-93 yielded higher than to other varieties when treated with 50-75-50 kg N, P_2O_5, K_2O ha^{-1} and the increase in grain yield was attributed to increase in the number of seeds per pod, total seed weight per plant and weight per 1000 grains. Cooking quality was significantly improved with phosphorus application over the control but the varieties were at par with one another in their cooking scores.

Key Words: Lentil cultivars; Phosphorus levels; Growth; Yield

INTRODUCTION

Grain legumes being rich in protein provide balanced human diet especially when taken in combination with cereals. Besides a high protein level, which on an average amounts to 23.7% (Pellett & Shadarovian, 1970), grain possesses a considerable amount of iron, calcium, sodium, phosphorus and magnesium.

Legume crops are able to fix atmospheric nitrogen and enrich the soil with nitrogen when included in different crop rotations practised by the farmers. Crops with phosphorus, yield higher when their needs for phosphorus are met judiciously (Singh *et al*., 1991). It has also been reported that cooking quality alongwith the nutritional status of legume grains especially lentil is improved with phosphorus applications (Malik, 1980).

Cooking quality generally depend on the varieties, fertility status of the soil and seed maturity of the crop seed. Not much data are available to find a potent cause responsible for producing good cooking quality lentils. With this in view, the present investigations were carried out to determine astute phosphorus requirements for three cultivars of lentil grown under Faisalabad conditions.

MATERIALS AND METHODS

The experiment was conducted on a sandy loam soil containing 0.038% N, 6.8 ppm P and 141 ppm K. Quadruplicated experiment was laid out using RCBD in split plot arrangement.

The treatments included three varieties (Local, Masoor-85 and Masoor-93) and four N, P_2O_5, K_2O levels i.e. 0-0-0, 50-25-50, 50-50-50 and 50-75-50 kg ha^{-1}.

The crop was sown in the first week of November on a well prepared seed bed, using 20 kg seed ha^{-1}. Sowing was done twice with the help of a single row hand drill. Weeding was done to keep the field free of weeds. Cooking quality test was performed as follows:

- 10 g of seeds of lentils were weighed and added to a 250 mL conical flask. .
- 50 mL of distilled water was added to each flask.
- The flasks were covered with watch glasses and submerged in water in a water bath.
- The samples were left in water till their full cooking. The time taken for a good cooking sample was standardized as 35 minutes.
- For uniform cooking, each sample was shaken twice during the cooking period.
- The contents of each flask were poured over a strainer to separate water from the seed.
- The cooked sample was placed over a piece of cloth on a flat surface for determining texture and tenderness of the cooked seeds.
- The texture and tenderness of the cooked seeds were determined by pressing the seeds with the back of a spoon and feeling the softness as well as the physical state of paste formation.
- Results of this cooking test were reported by utilizing a score index of 1 to 15, the lower the score, the better was cooking and vice versa.

Data on growth, yield and grain cooking quality characteristics were analysed statistically and the treatment means were tested using LSD test at P = 0.05 (Steel & Torrie, 1986).

RESULTS AND DISCUSSION

Data pertaining to seed yield, yield components and grain cooking quality are presented in Table I. Various yield components and seed yield ha^{-1} of the three varieties were affected significantly by different doses of phosphorus. Number of seeds per pod in all the three varieties was increased with the application of phosphorus with the maximum (1.95) in the local variety treated with 50 kg P_2O_5 ha^{-1} (V_1F_2). It was followed by V_2F_3 which in turn did not differ significantly from V_2F_1. Non-significant differences were found among V_2F_1, V_1F_1 and V_1F_3 treatments which on the average produced 1.76, 1.74 and 1.73 seeds per pod, respectively. Masoor-93 produced the lowest number of seeds per pod at all levels of phosphorus. However, the minimum number of seeds formed per pod in Masoor-93 was 1.33 with no fertilizer treatment (V_3F_0). The results indicated that local variety of Masoor was more responsive to added fertilizer up to 50 kg ha^{-1}. It was followed by Masoor-83; whereas, Masoor-93 was least responsive to phosphorus application. Increase in the number of seeds per pod with added phosphorus was also reported by Sharar *et al*. (1976) and Rathore *et al*. (1992).

Statistical analysis of the data pertaining to test weight of the seeds showed that the interactive effects of the two factors were significant. Masoor-93 when treated with 75 kg P_2O_5 ha^{-1} (V_3F_3) produced bold grains and the weight/1000 grain recorded was significantly higher (24.96 g) of all the treatments. It was followed by V_3F_2 combination where the test weight was 24.36 g. Though the test weight in V_3F_0, V_3F_1 combination was statistically same but it was significantly higher than rest of the treatments. The test weight in V_1F_2 was significantly higher than all other treatment combinations except V_2F_3. The test weight in Masoor-85 was significantly lower of all the treatments (16.42 g) when it was treated with no fertilizer (V_2F_0). Increase in weight/ 1000 grains was observed in all the varieties when they were treated with increasing doses of phosphorus. However, Masoor-93 proved to be the most responsive one to the highest dose of phosphorus (75 kg ha^{-1}). Improvement in the test weight of grains of Masoor-93 with NPK @ 50-75-50 kg ha^{-1} might be attributed to adequate supply of all the three essential elements which ultimately in healthy and bold seed formation in this treatment. Formation of bold seeds with complete fertilizer application has also been reported by Mahmood (1988) and Kumar *et al*. (1993).

The total seed weight/ plant in different varieties differed significantly in response to the different doses of phosphatic fertilizer. Masoor-93 significantly produced the highest seed weight per plant (2.17 g) when treated with phosphorus at the highest level of 75 kg ha^{-1} (V_3F_3). Total weight of seeds/ plant was 1.80 g in V_3F_2 and it did not differ significantly from V_3F_1 where the seed weight recorded per plant was 1.60 g. Non-significant difference was found between V_3F_1 and V_1F_2 combinations which produced 1.60 and 1.44 g total weight of seed per plant, respectively. Similarly treatment combinations V_1F_2, V_2F_3 and V_3F_0 were at par with one another but they differed significantly from V_1F_0 and V_1F_1 which were at par with each other. The total weight of seed per plant was the lowest (0.94 g) in V_1F_0. The increase in the total seed weight per plant in Masoor-93 receiving 75 kg P_2O_5

Table I. Qualitative and quantitative response of three varieties of lentil to phosphorus applications

	No. of seeds per pod	Test weight (g)	Seed weight per plant (g)	Seed yield (t ha^{-1})	Cooking quality
F_0	1.56	18.71	1.15	1.33	5.50 a
F_1	1.67	19.30	1.30	1.65	3.42 b
F_2	1.73	19.58	1.48	1.93	2.67 b
F_3	1.73	19.76	1.58	2.18	2.58 b
V_1	1.78	17.01	1.17	1.52	3.38
V_2	1.74	16.96	1.23	1.51	3.50
V_3	1.51	24.05	1.74	2.29	3.75
V_1F_0	1.68 ef*	16.43 g	0.94 h	1.18 fg	5.50
V_1F_1	1.74 cd	17.17 ef	1.12 gh	1.16 ef	3.25
V_1F_2	1.95 a	17.69 d	1.44 cd	1.83 cd	2.50
V_2F_3	1.73 cd	16.73 fg	1.18 efg	1.60 de	2.25
V_2F_0	1.67 ef	16.42 g	1.16 fg	1.10 g	5.25
V_2F_1	1.76 bc	17.13 ef	1.19 efg	1.50 e	3.50
V_2F_2	1.71 de	16.69 fg	1.18 efg	1.52 e	2.75
V_2F_3	1.80 b	17.59 de	1.38 de	1.93 c	2.50
V_3F_0	1.33 h	23.27 c	1.36 def	1.72 cde	5.75
V_3F_1	1.50 g	23.60 c	1.60 bc	1.99 c	3.50
V_3F_2	1.54 g	24.36 b	1.80 b	2.43 b	2.75
V_3F_3	1.65 f	24.96 a	2.17 a	3.01 a	3.00

*Any two means carrying the same letter do not differ significantly from each other at 0.05 P

ha^{-1} might be ascribed to a significant increase in test weight (1000-grain weight) recorded in the same treatment combinations. The results further indicated that in each variety, the total seed weight per plant increased with an increase in the level of phosphatic fertilizer. The addition of phosphatic fertilizer alongwith N and K to lentils seems to be a source balanced nutrition needed for formation of healthy and bold seeds by the plants. These results are in agreement with those of Abedin (1987) and Arshad (1988).

Seed yield recorded in t ha^{-1} clearly indicated that Masoor-93 treated with N, P_2O_5, K_2O @ 50-75-50 kg ha^{-1} produced the maximum seed yield of 3.01 t ha^{-1} (V_3F_3) and it differed significantly from all other interactions. It was followed by that recorded in V_3F_2 which yielded significantly higher than V_3F_1 combination which in turn was *at par* with V_2F_3, V_1F_2 and V_3F_0 yielding 1.93, 1.83 and 1.72 t ha^{-1}, respectively. The yield was the minimum in V_2F_0 where Masoor-93 was sown at zero phosphorus level but non-significant difference was found between V_2F_0 and V_1F_0. In general, the trend of the results was similar to that noticed for crop yield components namely, test weight and total seed weight per plant.

Increase in the yield of Masoor-93 at the highest phosphorus level was attributed to maximum weight of total seed per plant and weight per 1000 grains in this treatment combination. Masoor-93 proved to be more responsive to higher doses of phosphorus than the other two varieties i.e. Masoor-83 and Local. These results are in agreement with those reported by Sharar *et al*. (1976), Kumar and Agarwal (1993) and Venkateswarlu and Ahlawat (1993).

The data pertaining to cooking scores shown in Table I revealed that all varieties and their interaction with phosphorus levels did not have significant effect on the cooking quality. The differences among different phosphorus levels, however, reached a level of significance and the cooking quality was the poorest at zero application of phosphorus to the crop. A significant improvement in cooking quality was found in all the phosphorus added treatments over no phosphorus treatment but all of them. The cooking score was 5.50 with no fertilizer and ranged from 3.42 to 2.58 showing better cooking quality with an increase in the dose of phosphorus from 25 to 75 kg ha^{-1}. It might be attributed to increased phytic acid contents in the phosphorus added plots as compared to the control. Similar findings were reported by Ali (1979), Malik (1980), and Shah and Shakra (1982).

REFERENCES

Abedin, Z., 1987. Quantitative responses of soybean (*Glycine max* L.) to single and combined application of NPK. M.Sc. Thesis, Dept. Agron., Univ. Agri., Faisalabad, Pakistan.

Ali, A., 1979. Effect of plant nutrition on the seed yield, mineral composition and cooking quality of Lentil. M.Sc. Thesis, Dept. Agron., Univ. Agri., Faisalabad, Pakistan.

Arshad, M., 1988. Seed yield and protein contents of Lentil (*Lens culinaris* M.) as influenced by NPK application. M.Sc. Thesis, Dept. Agron., Univ. Agri., Faisalabad, Pakistan.

Kumar, P. and J.P. Agarwal, 1993. Response of Lentil (*Lens esculentus*) to Rhizobium inoculation, nitrogen and phosphorus fertilization. *Indian J. Agronomy*, 38: 318–0.

Kumar, P., J.P. Agarwal and S. Chandra, 1993. Effect of inoculation, nitrogen and phosphorus on growth and yield of Lentils. *Lens,* 20: 57–9.

Mahmood, M.A., 1988. Seed yield and protein contents of Lentil as influenced by NPK application. M.Sc. Thesis, Dept. Agron., Univ. Agri., Faisalabad, Pakistan.

Malik, K.M., 1980. Effect of seed mineral composition on the cooking quality of Lentils. M.Sc. Thesis, Dept. Agron., Univ. Agri., Faisalabad, Pakistan.

Pellet, P.L. and S. Shadarevian, 1970. Food composition tables for use in the Middle East. American University of Beirut, Beirut. Lebanon. 2nd ed,; 116, *Pakistan J. Agric. Res*., 20: 121–5.

Rathore, R.S., R. Khandwe, N. Khandwe and P.P. Singh, 1992. Effect of irrigation schedules, phosphorus level and phosphate solubilizing organism on Lentil. *Lens*, 19: 17–9.

Shah, S.H. and S.A. Shakra, 1982. Interactive relationship of plant nutrition and cooking quality in Lentils (*Lens culinaris* M.). *J. Agric. Res.,* 20: 121–5.

Sharar, M.S., M.A. Gill, A.A. Gil and A. Shafqat, 1976. Lentil yield and quality as influenced by irrigation and fertilizer levels. *Pakistan J. Agric. Sci*., 13: 231–4.

Singh, B., C.M. Singh, M. Bhargava and R.D. Sood, 1991. Effect of NPK fertilizers in cultivars field on rainfed Lentil. *Indian J. Pulses Res*., 4: 105–6.

Steel, R.G.D. and J.H. Torrie, 1986. Principles and Procedures of Statistics. 2nd Ed. McGraw Hill Book Co., Inc. Singapore: 172–8.

Venkateswarlu, V. and I.P.S. Ahlawat, 1993. Effect of soil moisture regime, seedrate and phosphorus fertilizer on growth and yield attributes and yield of late sown Lentil (*Lens culinaris* M.). *Indian J. Agron*., 38: 236–43.

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