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Effect of phosphorus and sulphur on lentil (*Lens culinaris*) under rainfed condition

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ABSTRACT

A field experiment was conducted during the winters of 1990–91, 1991–92 and 1992–93 to study the effect of phosphorus and sulphur on growth, yield attributes and yield of lentil (*Lens culinaris* Medikus). Plant height and nodules/plant increased significantly up to 45 kg P_2O_5/ha. Application of 30 kg S/ha increased the plant height and nodules/plant significantly during 1991–92 and 1992–93. Application of P 45 kg/ha ad S 30 kg/ha significantly increased the pods/plant and 1,000-seed weight and also gave the highest seed and straw yields during all the 3 years. The harvest index was also recorded maximum when 45 kg P/ha and 30 kg S/ha were applied during all the 3 years except during 1991–92.

Lentil (*Lens culinaris* Medikus) can meet its nitrogen requirement by symbiotic fixation of atmospheric N and response to potash is very little on Indian soils (Jaggi and Sharam 1992); however, lentil responds to phosphorus and sulphur under unirrigated conditions (Tiwari and Pandey, 1988). Apart from other nutrients, the lentil removes S from soils in amount slightly less or equal to P, but so far S application has not been in practice. Sulphur is a main constituent of the S containing amino acids and protein, therefore, the application of sulphur has been found to increase the yield and quality of lentil. Among the mineral elements essential to lequme crops like lentil, none plays a more central role than P. However, very limited information is available on these aspects under agro-climatic conditions of unirrigated region of eastern Uttar Pradesh. The present study was therefore, initiated to find out the effect of graded doses of P and S on the growth, yield-attributing characters and yield of lentil.

MATERIALS AND METHODS

A field experiment was conducted during the winter (*rabi*) seasons of 1990–91, 1991–92 and 1992–93 at Kumarganj Faizabad. The soil was silty loam, neutral in reaction, poor in N, medium in P (16.0 kg P_2O_5/ha) and rich in K. The sulphate-sulphur level of the plot was 6.426 ppm, which was quite below the critical limit of lentil crop. The rainfall received during the first, second and third year was 267.3, 33.0 and 47.6 mm, respectively during the crop season.

The experiment was laid out in factorial randomized block design with 3 replications. The treatments comprised 4 levels of P (0, 15,30 and 45 kg P_2O_5/ha) and 3 levels of S (0, 15 and 30 kg S/ha). The N and K were applied @ 20 kg N/ha and 20 kg K_2O/

ha respectively. Diammonium phosphate, elemental S, urea and muriate of potash were the sources of P, S, N and K respectively. Amount of N being inadvertently added through diammonium phosphate was duly adjusted with urea. 'LH 84-8' lentil was used as a test crop. The crop was sown by using 40 kg seed/ha in the second fortnight of October during all the 3 years.

RESULTS AND DISCUSSION

Effect of P on growth

Application of P caused significant variation in plant height at harvest during 1991–92 and 1992–93 and nodules/plant at 60 days after sowing during the 3 years. Application of P 45 kg/ha gave the maximum plant height and nodules/plant and was statistically superior to 0 and 15 kg/ha (Table.1). P 30 kg/ha was statistically at par with 45 kg/ha in this respect. Venkteswarlu and Ahlawat (1993) also reported that application of P improved the growth and nodulation in lentil.

Effect of S on growth

The difference in plant height at harvest due to application of S was statistically significant during second and third years. In the second and third years tallest plant and during all the 3 years the maximum nodules/plant were observed with 30 kg S/ha, but differences in plant height and number of nodules due to 15 kg S/ha and 30 kg S/ha were not significant during 1992–93.

Effect of P on yield attributes

Number of pods/plant and 1,000 seed weight increased significantly with increasing levels of P in all the 3 years (Table 1). P 45 kg/ha produced maximum pods/plant and test weight of seeds; however, the differences in pods/plant and test weight due to 30 kg P/ha and 45 kg P/ha were statistically non-significant during all the 3 years. Yield-contributing characters like pods/plant and 1,000 seed weight are the resultant of vegetative growth of the plants and the vegetative growth of lentil in terms of plant height and nodules/plant increased with increasing levels of P (Table 1). Similar findings were also reported by Tiwari and Pandey (1988) and James Watt and Singh (1992).

Effect of S on yield attributes

Number of pods/plant was maximum with the application of 30 kg S/ha during all the 3 years of experimentation, however, the difference in number of pods/plant due to 15 kg S/ha and 30 kg S/ha was non-significant during all the years. The test weight of seeds was maximum with the application of S @ 30 kg/ha during all the years. These results confirm the findings of Tiwari and Pandey (1988).

Effect of P on seed and straw yields and harvest index

The seed and straw yields increased significantly with the increasing levels of P up to 45 kg/ha during all the 3 years (Table 2); however, the differences in seed and straw yields due to 30 and 45 kg P/ha were statistically non-significant during all the 3 years, because the megnitude of response to P application depends on the amount of moisture available into the soil, which is the limiting factor under rainfed conditions. These findings confirm the observations of Tiwari and Pandey (1988), James Watt and Singh (1992) and Venkateswarlu and Ahlawat (1993).

The harvest index, which is the yield of plant parts of economic interest (economic yield) as percentage of total biological yield,

Table 1. Growth and yield attributes of lentil as affected by phosphorus and sulphur application

Treatment	Plant height (cm) at harvest			Nodules/plant*			Polds/plant			1,000-seed weight (g)		
	Y_1	Y_2	Y_3	Y_1	Y_2	Y_3	Y_1	Y_2	Y_3	Y_1	Y_2	Y_3
P (kg/ha)												
0	30.9	27.9	31.6	2.8	4.1	4.9	47.0	50.3	58.8	17.8	18.6	16.4
15	30.8	31.7	32.3	4.2	5.9	6.4	55.7	59.2	73.6	19.0	20.3	17.0
30	32.5	33.2	35.3	6.1	7.0	7.8	61.5	74.5	93.1	20.7	21.2	18.7
45	32.4	33.7	35.5	6.3	7.2	8.0	66.0	75.9	95.7	20.9	21.2	18.8
CD (P = 0.05)	NS	1.4	2.8	0.3	0.1	0.5	6.6	16.3	9.3	0.2	0.1	0.2
S (*kg/ha*)												
0	31.4	28.8	31.6	4.2	5.1	6.2	50.5	53.2	70.2	19.0	19.9	17.2
15	31.8	31.8	33.7	4.8	5.8	6.8	62.7	66.2	81.6	19.5	20.4	17.6
30	31.6	34.2	35.6	5.5	7.3	7.2	68.0	73.6	89.1	20.3	20.7	18.3
CD (P = 0.05)	NS	1.2	2.5	0.3	0.1	0.5	5.7	14.1	8.0	0.2	01	0.2

Y_1, 1990–91; Y_2, 1991–92; Y_3, 1992–93; * At 60-day stage

Table 2. Grain and straw yields and harvest index of lentil as affected by phosphorus and sulphur application

Treatment	Seed yield (q/ha)				Straw yield (q/ha)				Harvest index (%)		
	Y_1	Y_2	Y_3	Pooled	Y_1	Y_2	Y_3	Pooled	Y_1	Y_2	Y_3
P (kg/ha)											
0	4.35	8.03	10.19	7.52	19.81	31.86	25.60	25.76	18.00	20.68	28.47
15	4.65	10.20	11.98	8.94	20.65	41.67	27.57	29.96	18.60	18.94	30.29
30	6.25	11.79	14.63	10.89	26.30	49.57	32.57	36.15	19.20	18.85	30.99
45	6.61	11.82	15.15	11.19	26.80	51.14	31.06	36.33	19.78	18.73	32.79
CD (P = 0.05)	0.65	1.08	1.05	2.31	3.59	2.57	2.64				
S (*kg ha*)											
0	4.49	8.88	10.90	8.12	24.80	41.50	24.99	30.43	18.10	17.57	30.54
15	5.80	10.63	12.77	9.73	31.35	43.79	28.63	34.59	18.50	19.29	30.85
30	6.11	11.87	15.21	11.06	32.16	45.42	33.94	37.17	19.00	20.45	30.95
CD (P = 0.05)	0.56	0.94	0.92	0.91	2.31	3.54	2.42	2.51			

Y_1, 1990–91; Y_2, 1991–92; Y_3, 1992–93

was maximum when higher dose of P (45 kg/ha) was applied during 1990–91 and 1992–93 because increasing dose of P increased the seed yield of lentil (Table 2). However, during 1991–92 the harvest index was observed more when no P was applied. It is due to the fact that during 1991–92 much bolder seeds were found than 1990–91 and 1992–93 in all the treatments, as evident from 1,000 seed weight (Table 1). During 1991–92 in the control plots the seed yield of lentil was recorded more in respect of biological yield, which in turns gave the more value of harvest index. However, in P-treated plots increase in the seed yield of lentil was not of same magnitude as it was in case of biological yield of lentil which was responsible for lower values of harvest index under P-treated plots as compared with the control one.

Effect of S on seed and straw yield and harvest index

Seed and straw yields increased significantly with an increase in levels of S up to 30 kg/ha (Table 2) during all the 3 years. Tiwari and Pandey (1988) also reported that S application had very impressive and significant effect on seed and straw yield of lentil. They further reported that the seed and straw yields increased significantly with increase in levels of S up to 40 kg/ha and thereafter a slight decrease in the yield was reported.

The harvest index was also increased with the increase in the levels of S up to 30 kg/ha during all the 3 years.

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