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Effect of Zinc and Boron application on Yield of Lentil and Nutrient Balance in the Soil under Indo-Gangetic Plain Zones

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ABSTRACT

A field experiment was undertaken at Indian Institute of Pulses Research, Kanpur to study the response of lentil cultivars on yield and nutrient balance in the soil in relation to various levels of zinc and boron. Results revealed that lentil cultivar PL 639 produced significantly highest grain, straw and biological yield of lentil than the other cultivars of lentil. Grain, straw and biological yield of lentil was significantly increased with the application of 1 kg B/ha than control. Highest available nutrient viz., N, P, K, S, Zn and B in the soil showed increasing trend with lentil cultivar in sequence in DPL 62< K 75 < PL 406 < PL 639 after two consecutive crop season. The contents of available N, K, Zn and B in the soil showed increasing trend while available P and S showed decreasing trend with the increasing levels of zinc. Highest available N, P, K, S, Zn and B in the soil was restored more in 1 kg B/ha applied plot, however, minimum available N, P, K, S, Zn and B in the soil was obtained in control. Hence, application of zinc @ 8-10 kg and boron @ 1kg/ha is recommended for sustainable lentil production.

Keywords: Lentil, Micronutrients, Nutrient balance, Pulses, Zinc

INTRODUCTION

Pulses are the rich source of proteins for millions of vegetarian population. India is a major pulse growing country in the world. Lentil (*Lens culinaris* Medik) is the third most important pulse crop of North India (Singh *et al.*, 2014). In India it is cultivated in area of 1.47 mha with the production of 0.9 m tones and productivity of 675 kg/ha (Singh *et al.*, 2013a.) Being the important pulse from nutrition and soil health point of view it becomes essential to find out the constraints which adversely affects its growth and production (Singh and Bhatt, 2013). Legume production including Lentil is largely influences by the genotypic potential and their ability to resist biotic and abiotic stress (Singh *et al.*, 2012). Among various edaphic factors, availability of adequate plant nutrients especially micro nutrients is of prime importance which has been reported to influence growth and yield of lentil (Saxena and Singh, 1971; Singh and Kumar, 2009). Zinc plays an important role in the biosynthesis of plant hormone, particularly Indole acetic acid (Singh *et al*., 2014 and Skoog, 1940) and maintaining the normal auxin dehydrogenase, carbonic anhydrase, proteinase and acts as co-factor for several others. It plays a vital role in the synthesis of proteins and nucleic acid and helps in the utilization of nitrogen and phosphorus in the plant. Several studies reported that the deficiency of micro nutrients in alluvial soil of Indo-gangetic plains is severe and thereby response to added micronutrients such as zinc and boron of lentil is beneficial (Singh and Bhatt, 2013). Keeping above facts in view, the present investigation was undertaken

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to find out the suitable cultivars with different levels of zinc and boron on yield and nutrient balance in the soil of lentil.

MATERIALS AND METHODS

A field experiment was undertaken during two consecutive *rabi* seasons of 2003-04 and 2004-05 at Indian Institute of Pulses Research, Kanpur to study the yield and nutrient balance in the soil as influenced by lentil cultivars and various levels of zinc and boron.. The treatment combinations comprised with 4 cultivars of lentil viz., DPL 62, K 75, PL 406 and PL 639, 3 levels of zinc viz., 0, 5 and 10 kg Zn/ha and two levels of boron viz., 0 and 1 kg B/ha were evaluated in randomized block design with three replications. The soil of experimental field was sandy loam in texture having pH of 7.6. The experimental soil contains low in organic carbon (0.51 %), available nitrogen (163.1 kg/ha), available phosphorus (8.5 kg/ha) and available potassium (158 kg/ha). The recommended dose of NPK (20 kg N + 45 kg P_2O_5 + 40 kg K_2O/ha) were applied as basal dressing in the form of DAP and muriate of potash, respectively. The zinc and boron was also applied as per treatment as basal dressing in the form of elemental zinc and borax, respectively. The lentil seed was sown on 04.11.2003 and 23.11.2004 and harvested on 21.03.2004 and 16.03.2005 in the respective years of study. The rainfall received during the crop season was 38.4 and 65.2 mm in 2003-04 and 2004-05, respectively.

RESULTS AND DISCUSSION

Perusal of data present in table 1 revealed that significantly highest grain (1750.38 kg/ha), straw (2751.28 kg/ha) and biological (4495.53 kg/ha) yield of lentil was recorded in lentil cultivar of PL 639 as compared to rest of the cultivars (Table 1). The increase in grain and straw yield in lentil cultivar PL 639 was to the tune of 24.64 and 73.16 per cent than DPL 62. These results are in partial conformity of the work of Reddy and Ahlawat (1996) and Reddy and Ahlawat (2001).

Table 1: Pooled grain, straw and biological yield of lentil as affected by various cultivars, zinc and boron levels

Treatment	Grain yield (kg/ha)	Straw yield (kg/ha)	Biological yield (kg/ha)
Lentil cultivars			
DPL 62	1404.38	1588.82	2998.25
K 75	1518.60	2157.50	3674.53
PL 406	1577.94	2511.94	4099.05
PL 639	1750.38	2751.28	4495.53
S.Em ±	15.3	19.21	54.39
CD (P=0.05)	44.52	54.69	163.16
Zinc levels (kg Zn/ha)			
0	1476.60	2136.50	3613.29
5	1565.95	2248.91	3779.28
10	1645.88	2371.81	4016.77
S.Em ±	13.54	16.63	50.93
CD (P=0.05)	38.56	47.37	141.16
Boron levels (kg B/ha)			
0	1532.63	2185.99	3734.91
1	1593.02	2267.26	3895.10
S.Em ±	11.05	13.58	40.25
CD (P=0.05)	31.48	38.68	115.49

The available N, P, K, S, Zn and B in the soil showed increasing trend in the soil in cultivars sequence: DPL 62 < PL 406 < PL 639 (Table 2). The increase in available nutrients status in the soil might be more nutrients content and uptake in plant due to different varieties of lentil during both the years (Table 2). Similar finding was also reported by Singh *et al*, (2013b) from Patna on lentil.

Table 2: Available nutrients status in soil as influenced by different treatments in the experimental soil before and after experiment.

Treatments	Available nutrients (Kg/ ha)					
	N	P	K	S	Zn	B
Lentil cultivars						
DPL62	165.50	08.60	159.50	12.49	0.899	0.923
K75	166.40	08.70	159.35	12.74	0.910	0.930
PL406	168.40	08.70	161.25	12.84	0.914	0.937
PL639	170.20	08.80	161.75	12.90	0.919	0.945
Zinc levels (Kg/ha)						
0	161.0	08.80	158.60	12.85	0.890	0.901
5	168.0	08.70	159.91	12.73	0.911	0.925
10	170.10	08.60	162.82	12.70	0.935	0.945
Boron levels (Kg/ha)						
0	167.24	08.70	160.11	12.60	0.895	0.921
1	168.15	08.80	160.82	12.70	0.935	0.945
Initial soil	163.10	08.50	158,00	12.30	0.440	0.450

Results depicted in table 1 confirm that every increasing dose of zinc significantly increased the grain, straw and biological yield of lentil Application of highest tested dose of zinc *i.e.* 10 kg Zn/ha produced significantly more grain (1645.88 kg/ha), straw (2371.81 kg/ha) and biological (4016.77 kg/ha) yield of lentil as compared to 0 and 5 kg Zn/ha (Singh and Bhatt, 2013). The increase in grain and straw yield of lentil with the application of 10 kg Zn/ha to the tune of 11.5 and 11.01 per cent than control (Singh *et al*., 2013b). The increase in grain and straw yield of zinc might be due to increase in growth

Table 3: Weather during experimental period (2003-2005)

Months	Avg. Temperature (°C)		Avg. Humadity (%)		ET (mm)		Rain Fall (mm)	
	2003-04	2004-05	2003-04	2004-05	2003-04	2004-05	2003-04	2004-05
October	26.44	25.60	69.79	71.21	3.95	3.30	0	23.3
November	21.63	21.17	71.32	68.92	2.66	2.09	0	0
December	16.32	16.72	78.68	76.11	1.40	1.65	0	0
January	12.95	15.60	86.55	73.03	0.73	1.75	38.4	26.3
February	18.32	18.56	68.62	67.69	2.74	3.35	0	0
March	26.83	25.08	44.40	59.98	5.90	5.20	0	15.6
Total/Mean	20.41	20.45	69.88	69.48	2.89	2.89	38.4	65.2

and yield attributing characters of lentil. Similar results are in close conformity with the findings of Gangwar and Singh (1991), Reddy and Ahlawat (1996) and Singh *et al,* (2013b). The available N, K, Zn and B showed increasing trend but P and S in the soil showed decreasing trend with the increasing levels of zinc. This may be due to soil nutrient dynamics highly associated with slightly pH as compare to Zn (Singh and Kumar, 2009).

Further results showed that application of 1 kg B/ha significantly increased the grain (1593.2 kg/ha), straw (2267.26 kg/ha) and biological (3895.10 kg/ha) yield of lentil as compared to control (Table 1). The increase in grain and straw yield of lentil with the application of 1 kg B/ha to the tune of 3.95 and 3.71 per cent was than control. The increase in grain and straw yield of lentil with the application of boron might be due to increase in growth and yield attributing characters. These results are in close conformity with the findings of Bhuiyan *et al.,* (1998) and Balachandra *et al.,* (2003). In other side, low average temperature (12.95^{0}C) in January and high humidity (86.54) in 2003-04 and relatively more rainfall (38.4 mm) might favours higher yield than 2004-05 (Table 3) that leads profuse flowering and pod setting and thus, its effects on lentil seed yield was positive on all cultivars. Similar observation was also seen by Vijaylakshmi (2012).

Highest available N, P, K, S, Zn and B in the soil was restored more in 1 kg B/ha applied plot, however, minimum available N, P, K, S, Zn and B in the soil was obtained in control (Table 2). These results are in conformity with the work of Singh *et al.* (2002).

CONCLUSION

This study confirms that increasing levels of zinc decrease availability of phosphorus and sulfur. Further deficiency of micronutrients in alluvial soil of Indo-gangetic plains is severe and thereby response to added micronutrients such as zinc and boron in lentil is beneficial. Application of zinc @ 8-10 kg and boron @ 1kg/ha is recommended.

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