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Maximization of lentil (*Lens culinaris*) yield through management of nutrients*

M K MANDAL[1], R PATI[2], D MUKHOPADHYAY[3] and K MAJUMDAR[4]

Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal 736 165

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Lentil [*Lens culinaris* (L.) Medik] is an important pulse crop of winter season. It is mainly grown on marginal lands as well as in a wide range of soils from light loamy sand to heavy clay soil in northern parts to the extend of an altitude of 3 500 m in north-west hills. The yield of crop is influenced by the availability of the nutrients in soils. The flowering and maturity of the crop is affected by phosphates (Zafar *et al*. 2003). Besides, the content of protein, K, Fe, Mn, Zn are also regulated by the addition of phosphate in soil (Zeidan 2007).Occurrence of chlorosis in lentil is prevented by the application of micronutrients and significant yield increase of the crop was reported by the combined application of macro and micronutrients (Zeidan *et al.* 2006). The genotypes having prolific root hair formation were found to be superior (Gahoonia *et al.* 2006) in uptake of the nutrients (K, P, Fe, Mn, Cu, Zn, Mo), whose availability in soil was usually low and transport to the root was diffusion-limited. Factors like root release organic acids (Ryan *et al*. 2001) and change in rhizosphere redox potential for micronutrient acquisition (Shiferaw *et al*.1992) also play the important role in accumulation of nutrients to plants. Soil acidity along with very low soil status of some micronutrients (B, Zn and Mo), lack of adoption of improved agro-techniques including fertilizer application appears to be the problem in maximising the yield of crops in this region. Based on the above perspectives, the present investigation was undertaken to find out the effects of the given nutrients towards maximisation of yield of lentil.

Table 1 Effect of nutrients on grain yield of Lentil

Treatment	Grain yield (tonnes/ha)			Δ Yield (tonnes /ha)	Harvest index
	1st year	2nd year	Mean		
T_1 (OPT)	0.749	0.761	0.755		0.074
T_2 (OPT-P)	0.511	0.759	0.635	0.120 (16)	0.062
T_3 (OPT-K)	0.509	0.552	0.531	0.224 (30)	0.059
T_4 (OPT-S)	0.534	0.679	0.607	0.148 (20)	0.055
T_5 (OPT-Zn)	0.673	0.613	0.643	0.112 (15)	0.073
T_6 (OPT-B)	0.559	0.592	0.576	0.179 (24)	0.058
T_7 (125% OPT)	0.561	0.805	0.683		0.061
T_8 (125% OPT-P)	0.505	0.627	0.566	0.117 (17)	0.056
T_9 (125% OPT-K)	0.477	0.558	0.518	0.165 (24)	0.051
T_{10} (125% OPT-S)	0.450	0.749	0.600	0.085 (12)	0.058
T_{11} (125% OPT-Zn)	0.493	0.676	0.585	0.098 (15)	0.051
T_{12} (125% OPT-B)	0.709	0.786	0.748		0.070
CD (*P*=0.05)			0.29		

Δ Yield, Yield of optimum-yield of omitted nutrient treatment; Data in parentheses are per cent yield loss; OPT, optimum

*Short note

[1,2]Senior Research Fellows (E-mails: mkmssac@gmail.com, rajibpati@gmail.com,

[3]Reader (E-mail: dibsm1@yahoo.co.in), Department of Soil Science and Agricultural chemistry

[4]Director, (E-mail: kmajumdar@ipni.net), IPNI-India Programme, Gurgaon 122 016

The experiments were conducted at the University farm during 2006–07. The soil samples were collected from the experimental plots, before the start of the experiment and analyzed to have a definite soil test-based fertilizer recommendations. No organic amendments were applied prior to sowing of the crops. Soil and plant samples were

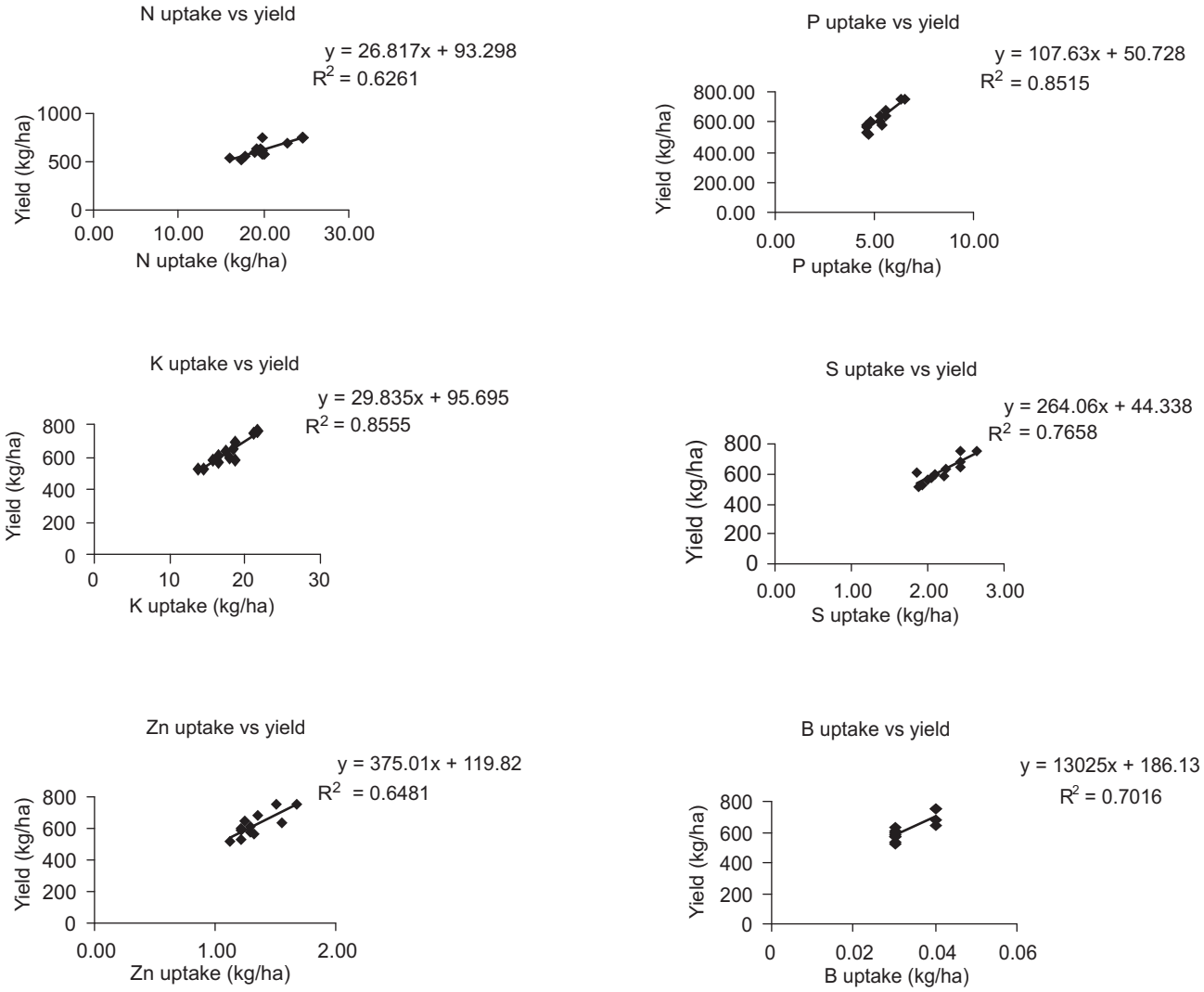

Fig 1 Relation between yield and uptake of nutrients in lentil

analyzed at harvest following the methods as described by Jackson (1967). The soils were slightly acidic (*p*H 5.5–6.4) in reaction and sandy loam in texture with low status of the available N-P-K (211-11.4-95 kg/ha). The content of S and Zn (33.7 and 1.25 kg/ha) was quite high in terms of critical limit, while the extractable Boron (0.28 kg/ha) was low in the given soils. For experimental trial, the genotype of lentil was selected as 'B 77' ('Asha') which is commonly recommended for the cultivation in the northern hills region and West Bengal to avert the rust disease, prominent in this region. The soil test-based fertilizer recommendation of 20 kg N , 50 kg P, 50 kg K, 40 kg S , 1.5 kg B/ha and Zn as Zn-EDTA (0.05%) at 6 weeks of the crop was considered as optimum (OPT). Nitrogen was incorporated in all the treatment combinations when applied as basal. There were 12 treatments in the experiment based on fertilizer doses. The first treatment (T_1) as optimum and subsequent (T_2–T_6) omission of P, K, S, Zn and B from the optimum were considered. The treatment (T_7) were 125% of the optimum, where N-P-K were applied as 25% higher than the optimum (T_1) and the rest treatments (T_8–T_{12}) were omission treatments as described earlier. The randomized block design with 4-fold replications was followed during experiment.

The average grain yield of lentil for the two seasons varied from 0.518 to 0.755 tonnes/ha (Table 1). The absence of any nutrient from the optimum combination caused yield losses from 15 to 30%. The loss was relatively more pronounced by the exclusion of K and B, yet the yield losses were quite comparable with the omission of nutrients from the 125% optimum treatment and varied from 12 to 24% with the highest in the POT-K plot (T_9). The yield data showed that K, P, Zn and to some extend S were the limiting factors under the present experimental set-up. It was also observed that the treatment 125% optimum-B showed significant yield increase over the OPT-B. This indicated the need for B application for this crop at the optimum level, beyond which

Table 2 Nutrient uptake (kg/tonne) of lentil

	N	P_2O_5	K_2O	S	Zn	B
Min.	286.89	470.92	259.64	1.86	1.12	0.03
Max.	404.05	551.76	310.70	2.64	1.68	0.04
Mean	345.47	511.34	285.17	2.25	1.40	0.04

there might be increase in yield of the given crop but of non-utilization of the excess applied B. The harvest index was comparable under the limiting nutrient condition. The mean yield of lentil for two seasons (2006–07) was correlated with uptake of all the nutrients (Fig 1) and thus suggesting the inter dependence of nutrient towards yield maximization. The range of nutrient uptake was given in Table 2. The root induced rhizosphere *p*H might influence the availability of soil inorganic phosphorus (Gahoonia and Nielsen 1992) and micronutrients to plants (Marschner and Romheld 1996).

From the experimental trial, it was quite clear that addition of secondary (S) and micronutrients (B, Zn) had a significant influence on yield maximization, if based on soil-test based recommendation, otherwise, yield losses were there for omission of any one of the given nutrients. The uptake of nutrients by the plant was reflected on the yield of crop. Hence, application of the nutrient at the optimum combinations revealed the maximum yield of lentil.

SUMMARY

The field experiments were conducted during 2006–07 to study the soil test-based fertilizer recommendations in terms of yield maximization of 'B 77' lentil (*Lens esculenta* L.). The variety was selected with the targeted yield of 0.8 tonnes/ha and soil-test based recommendation as N-P-K-S-B: : 20: 50: 50: 40: 1.5 (as 100%) was considered for fertilizer levels, while Zn as Zn-EDTA @ 0.05% at 6th weeks of crops were applied. The average grain yield of lentil for the first year varied from 0.450 to 0.749 tonnes/ha, while that for the second year from 0.552 to 0.805 tonnes/ha. The average maximum yield (0.755 tonnes/ha) was obtained in the treatment where N-P-K-S-Zn-B as 100% was applied in soil.

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