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Macro- and micronutrient uptake by nodulating and non-nodulating peanut lines*

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Abstract

Amounts of N, P, K, Ca, Mg, Zn, Fe, and Mn absorbed by a nodulating and a non-nodulating (Non-nod) peanut genotype at two nitrogen fertilizer levels (nil and 200 kg N ha^{-1}) were determined in a field experiment. The amounts of nutrient elements in the plant parts were greatest for N, followed by K, Ca, Mg, P, Fe, Mn, and Zn in descending order. Although there were differences in the uptake of other nutrients, the major difference between Non-nod and nodulating genotypes was in nitrogen indicating the poor yield of the Non-nod line due to its inability to acquire N.

Introduction

Peanut (*Arachis hypogaea* L.) usually depends on biological nitrogen fixation for its growth and development. Development of non-nodulating (Non-nod) peanut lines has provided a useful means of measuring the amounts of biologically fixed nitrogen (Nambiar *et al.*, 1986). It was found that the growth and yields of Non-nod peanut lines, even at high levels of applied fertilizer nitrogen, were very low relative to that of nodulated peanut lines. However, little information is available on the amounts of nutrients other than N taken up by Non-nod peanut lines as compared to nodulating peanut (Nambiar *et al.*, 1986; Walker *et al.*, 1984). The objective of this work was to determine the amounts of N, P, K, Ca, Mg, Zn, Fe, and Mn harvested in a Non-nod and a nodulating genotype (Robut 33–1) under two levels of fertilizer nitrogen (0 and 200 kg N ha^{-1}). In using Non-nod lines for evaluating biological nitrogen fixation by nodulating genotypes, it is important to know their relative abilities to take up nutrients from soil; ideally they should be similar.

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Materials and methods

The data were collected from an experiment on another subject described in detail by Nambiar *et al.* (1986). Data for a nodulating groundnut genotype Robut 33–1 and a Non-nod line are presented here. The experiment was conducted during the 1984–85 postrainy season on an Alfisol (pH 7.0) at ICRISAT Center, Patancheru, near Hyderabad, India. A basal application of 17 kg P ha^{-1} was given to all plots. The nitrate content (1) in the soil (0–15 cm depth) before starting the experiment was 1.7 ($\pm$0.07) mg kg^{-1} soil, indicating a low level of mineral N. The seeds were sown on 27 Nov. 1984, and the crop was harvested at maturity on 11 Apr. 1985.

The crop was grown on ridges 60 cm apart, and plant spacings within rows was 10 cm. The net harvested plot area was 3.6 m^2. Urea at nil, 67, 133 and 200 kg N ha^{-1} was applied in four equal split applications at 14, 35, 60 and 80 days after sowing (DAS).

For plant analyses, the haulm husk, and seeds were analyzed separately. The plant parts were dried in an oven at 60°C for 48 h and finely ground (< 0.44 mm) before analysis. Nitrogen and P were

Table 1. Yield and total nutrients harvested in two peanut genotypes, at two N levels

	0 kg N ha⁻¹		200 kg N ha⁻¹		SE ±	
	Robut 33-1	Non-nod	Robut 33-1	Non-nod	a[a]	b[b]
Haulm (kg ha⁻¹)						
	3249	1099	2660	1681	180.7	127.8
Pod (kg ha⁻¹)						
	3099	553	2438	1053	267.9	198.4
Total nutrients harvested (kg ha⁻¹)						
N	176.6	23.9	143.9	51.3	11.98	8.47
P	15.1	10.3	11.8	11.6	1.05	0.75
K	55.0	21.0	43.0	35.0	3.88	2.74
Ca	34.2	14.4	28.1	21.9	2.53	1.79
Mg	27.0	7.3	24.0	15.0	2.25	1.59
Fe	6.32	1.42	4.95	1.99	0.695	0.492
Zn	0.25	0.12	0.19	0.15	0.019	0.013
Mn	0.29	0.08	0.24	0.11	0.020	0.014

[a]a = Standard error of mean for comparing between the genotypes and nitrogen levels.
[b]b = Standard error of mean for comparing between the nitrogen levels of same genotype.

analysed on plant digests by an autoanalyzer colorimetric procedure (Technicon Industrial Systems, 1972). Contents of K, Ca, Mg, Zn, and Mn in the samples were determined in triacid digests by atomic absorption spectrophotometry (Jackson, 1967).

Results and discussion

Although data were collected and analyzed for four nitrogen treatments, only data for nil and 200 kg N ha⁻¹ are presented here because interpretation of the results is not affected by exclusion of data for 67 and 133 kg N ha⁻¹. Data on nutrient concentrations in different plant parts are also not presented. Only the trends in nutrient concentrations are briefly discussed.

The yields of pod and haulms differed for the nodulating and Non-nod genotypes. Application of nitrogen fertilizer idncreased the biomass yield and uptake of nitrogen in the Non-nod but appeared to decrease (not significant $P = 0.05$) nitrogen uptake in the nodulating genotype. However, the nodulating genotype outyielded the Non-nod line at both 0 and 200 kg N ha⁻¹ (Table 1).

Nutrient concentrations in nodulating and Non-nod genotypes

The concentrations of Fe and N in the haulm were higher in the nodulating genotype, Robut 33-1, whereas those of P, K, Ca and Zn were higher in the Non-nod. Although Mg concentrations in the Non-nod appeared lower, these differences were not significant. Except for P, K, N, and Fe, nutrient concentrations in the seed were similar in both genotypes. Seeds of the Non-nod genotype had higher P and K while the nodulating genotype had higher N and Fe.

Application of nitrogen fertilizer significantly influenced N and Fe concentrations. Iron concentrations were higher in the seeds of nodulating genotype grown without any fertilizer nitrogen, compared to that grown with 200 kg N ha⁻¹ applied. Concentrations of Fe were less in the Non-nod, and N application did not influence Fe concentrations in this genotype. There were no significant differences between genotypes and between N levels in nutrient concentrations in the husk, except that (a) at 200 kg N ha⁻¹, K and Ca concentrations were higher in the Non-nod than in the nodulating genotype, (b) at 200 kg N ha¹, Mn concentrations were higher in nodulating genotype, and (c) Non-nod had higher P concentrations at both N levels.

Total nutrient uptake

Nitrogen was assimilated in the largest amounts (176.6 kg ha⁻¹) by the nodulating genotype, followed by K, Ca, Mg, and P (Table 1). The total amounts of nutrients taken up were higher in the nodulating genotype as compared to Non-nod and N application tended to narrow the difference in nutrient uptake between the two genotypes. Total Mg harvested was generally more than P in the nodulating genotype and in Non-nod at 200 kg N ha^{-1}. Considerably higher amounts of Fe were also taken by the nodulating genotype as compared to the Non-nod both under 0 and 200 kg ha^{-1} N application.

Although there were differences in the uptake of other nutrients, the major difference between Non-nod and nodulating genotypes was in nitrogen content, indicating that the poor yield of Non-nod was primarily due to its inability to fix atmospheric nitrogen and poor efficiency in using mineral nitrogen (Nambiar *et al.*, 1986). Walker *et al.* (1984) reported that the leaves of three Non-nod lines had higher P, Ca, and Mg concentrations than those of three nodulating genotypes. In the present study, P concentrations were high in all plant parts of Non-nod and Ca concentrations were high in the haulm of Non-nod. Concentrations of Mg in the haulms of nodulating and Non-nod genotype were not significantly different. Although Walker *et al.* (1984) reported low Mg concentrations (0.14 to 0.16%) in the leves of three nodulating genotypes, Hallock *et al.* (1971) reported higher levels of Mg (0.12 to 0.6%) in different plant components in 15 commercial cultivars. It is possible that high level of Mg measured in the present study (27 kg ha^{-1}) is not required for optimum crop production, and is a luxury consumption. Most of the Mg and Ca remained in the shoot and husk, and only a small proportion of Mg and Ca is trnslocated to the seeds. Similar levels of Mg were also reported by other workers (Collins and Morris, 1942 cited in Kanwar *et al.*, 1983).

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References

Bremner J M 1965 *In* Methods of Soil Analysis, Part 2. Ed. C A Black pp 1185 1191. Chemical and Microbiological Properties. American society of agronomy, Madison, Wisconsin.

Collins F R and Morris H D 1942 New Georgia Agric. Exp. Stn Bull. p 330.

Hallock D L *et al.* 1971 Agron. J. 63, 251 256.

Jackson M L 1967 Soil Chemical Analysis. Prentice Hall of India Pvt. Ltd., New Delhi.

Kanwar J S *et al.* 1983 Groundnut, its nutrition and fertilizer responses in India. Indian Council of Agricultural Research, New Delhi. 33 54.

Nambiar P T C *et al.* 1986 Field Crops Res. 15, 165 179.

Technicon Industrial Systems 1972 Technician Auto analyzer II manual. Industrial method no. 218-72A. Technicon Industrial Systems, Tarrytown, New York.

Walker M E *et al.* 1984 Peanut Sci. 11, 60 63.