



NUTRIENT STATUS OF GROUNDNUT (*Arachis hypogaea* L.) GROWING SOILS IN EASTERN MANDALS OF CHITTOOR DISTRICT, ANDHRA PRADESH

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ABSTRACT

A survey was undertaken to study the nutrients status of groundnut growing soils in eastern mandals of Chittoor district of Andhra Pradesh. The texture of the soils varied from sandy loam to sandy clay loam, neutral to slightly alkaline in reaction, non-saline, low to medium in organic carbon and available nitrogen and medium to high in available P and K. However, available Ca, Mg, S, Fe, Mn, Zn and Cu were found to be above critical limits in all the soils. Simple correlation studies revealed that available N, S, Fe, Mn, Cu and Zn were positively and significantly correlated with clay content and organic carbon. However, available P, K, Ca and Mg were negatively and significantly correlated with clay content.

KEYWORDS: Groundnut soils, Macronutrients, Micronutrients

INTRODUCTION

Mineral nutrition has been recognized as an important constraint in crop production. Systematic and periodic identification of current nutrient deficiencies and sufficiencies is a prerequisite for sustaining the productivity and fertility of soils. Groundnut is a major oilseed cum cash crop in India as well as in particular in Andhra Pradesh. It is cultivated in an area of about 13.86 lakh ha with an annual production of 12.34 lakh tones (www.nmoop.gov.in Status paper on oilseeds, 2014) in Andhra Pradesh. Several groundnut growing areas of our country are unable to supply the available nutrients at the rate at which the groundnut the crop requires for its maximum growth and yield. Hence, the present survey was taken up to study the nutrient status in groundnut growing soils of eastern mandals in Chittoor district of Andhra Pradesh.

MATERIALS AND METHODS

The study area includes major groundnut grown eastern mandals in Chittoor district of Andhra Pradesh viz., Vadamalapet, Narayanavanam, Nagari, Vijayapuram, Nindra, Nagalapuram, Kalahasti, Thottembedu, Karvetinagaram, G.D Nellore and Yerpedu which lies in between 13° 30' and 14° 00' N latitudes and 78° 05' and 78° 50' E longitudes.

Soil samples were collected from 60 groundnut growing fields located these in Eastern mandals of Chittoor

district. From each field, three soil samples were collected at a depth of 0-30 cm and the samples in each field were thoroughly mixed so as to obtain one composite sample. All the 60 soil samples were analysed for pH, EC, organic carbon and available K by adopting standard procedures (Jackson, 1973). Available N was determined by alkaline permanganate method (Subbiah and Asija, 1956). The available P was extracted with 0.5M NaHCO₃ extractant (Olsen *et al.*, 1954) and determined by using ascorbic acid as reducing agent (Watanabe and Olsen, 1965). Available Ca and Mg were determined by versenate method (Chopra and Kanwar, 1991) whereas available S was determined by turbid metrically using 0.15% CaCl₂ extractant (Cottenie *et al.*, 1979) and available (DTPA extractable) Fe, Mn, Zn and Cu were determined as per Lindsay and Norvell (1978).

Soil samples were rated as low, medium and high categories as per the limit suggested by Muhr *et al.* (1965) for organic carbon, available N, P and K. Available Ca and Mg were classified based on the critical limits proposed by Tandon (1989) while available S was rated as per the critical limits established by Tandon (1991). In respect of available Fe, Mn and Cu, the ratings given by Lindsay and Norvell (1978) were followed. Nutrient Indices (N.I) for available N, P and K were worked out as per the formula given by Parkar *et al.* (1951). Simple correlation analysis was also carried out between soil physical and physico-chemical characteristics and available soil nutrients as per the procedures described by Gomez and Gomez (1984).

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RESULTS AND DISCUSSION

The texture of the soils varied from sandyloam to sandyclayloam (Table 1). This variation in soil texture might be due to the variation in topographic position, nature of parent material, *in situ* weathering of clay and age of soils. pH of the groundnut growing soils varied from 6.43 to 8.70. The variation in pH might be attributed to the variation in nature of parent material and degree of weathering. Similar findings were reported by Leelavathi *et al.* (2009) in soils of Chittoor district. The EC values varied between 0.04 and 0.86 dSm⁻¹ indicating non-saline nature of these soils. The organic carbon content in these soils ranged from 0.13 to 0.50 per cent. The low organic carbon content in these soils might be due to rapid oxidation of organic matter as the climate of the area is tropical.

Available N, P, K, Ca, Mg and S

The groundnut growing soils were low in available N with overall nutrient index value 1.00 while available P and K were low to high with overall nutrient index values varying from 1.25 to 2.40 and 1.00 to 2.20, respectively (Table 2). The low available nitrogen status of these soils might be attributed to low organic carbon

content. Further, the semi-arid conditions of the area might have favoured the rapid oxidation and less accumulation of organic matter releasing more NO₃-N which could have been lost by leaching (Finck and Venkateswarlu, 1982). Medium to high availability of P in these soils was attributed to the continuous use of phosphatic fertilizers like single super phosphate by the farmers. The higher values of K could be ascribed to more weathering of potassium bearing minerals, alternate wetting and drying cycles and release of K from decomposing organic matter added to the surface.

Available Ca (1.75 to 16.00 cmol (P⁺) kg⁻¹ soil), Mg (0.25 to 14.00 cmol (P⁺) kg⁻¹ soil) and S 10.25 to 48.75 mg kg⁻¹ soil in these groundnut growing soils were found to be above their respective critical limits (Table 3). Similar findings were reported by Thangasamy (2002).

Available Fe, Mn, Cu and Zn

Available (DTPA extractable) Fe, Mn, Zn and Cu in groundnut growing soils ranged from 7.31 to 34.48, 2.10 to 23.80, 1.02 to 2.76 and 0.59 to 2.62 mg kg⁻¹ soil, respectively (Table 3). All the available micronutrients are above their respective critical limits. These findings were in accordance with findings of Bhupal Raj *et al.* (2006)

Table 1. Soil test summary - soil texture, pH, EC and organic carbon (mean values) in groundnut grown soils of Chittoor district

Sl. No.	Mandal	Number of samples	Soil texture	pH (1:2.5)	EC (dSm ⁻¹)	Organic carbon (%)
1.	Vadamalapet	4	s-sl	7.37	0.13	0.27
2.	Narayanavanam	5	s-sl	7.20	0.28	0.13
3.	Nagari	6	ls-c	7.53	0.45	0.50
4.	Vijayapuram	5	s-sl	7.01	0.18	0.14
5.	Nindra	5	sl-c	7.71	0.26	0.43
6.	Nagalapuram	10	sl-scl	7.38	0.25	0.35
7.	Kalahasti	5	sl-scl	8.08	0.18	0.21
8.	Thottembedu	5	sl-scl	7.68	0.28	0.18
9.	Karvetinagaram	6	ls-scl	7.44	0.20	0.17
10.	G.D Nellore	5	ls-scl	7.38	0.18	0.26
11.	Yerpedu	4	s-c	7.89	0.27	0.37
	Total	60	s-c	7.52	0.24	0.24

ls: loamy sand; sl: sandy loam; scl: sandy clay loam; s: sand; c: clay

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Table 2. Soil test summary - available N, P and K in groundnut grown soils of Chittoor district

Sl. No.	Mandal	Number of samples	Available N			Available P			Available K		
			Mean (kg ha ⁻¹)	Nutrient index	Fertility status	Mean (kg ha ⁻¹)	Nutrient Index	Fertility status	Mean (kg ha ⁻¹)	Nutrient Index	Fertility status
1.	Vadamalapet	4	162.8	1.00	L	10.1	1.25	L	85.7	1.00	L
2.	Narayanavanam	5	135.3	1.00	L	15.7	1.80	M	104.9	1.20	L
3.	Nagari	6	143.1	1.00	L	15.3	1.83	M	132.4	1.33	L
4.	Vijayapuram	5	145.3	1.00	L	16.7	2.00	M	94.3	1.00	L
5.	Nindra	5	120.4	1.00	L	20.2	2.20	M	222.2	2.20	M
6.	Nagalapuram	10	130.4	1.00	L	17.0	1.90	M	122.4	1.30	L
7.	Kalahasti	5	135.5	1.00	L	18.0	2.00	M	97.8	1.00	L
8.	Thottembedu	5	160.4	1.00	L	10.4	1.40	L	86.2	1.00	L
9.	Karvetinagaram	6	160.7	1.00	L	12.4	1.50	L	85.5	1.00	L
10.	G.D Nellore	5	120.4	1.00	L	21.2	2.40	H	206.4	2.00	M
11.	Yerpedu	4	144.1	1.00	L	16.8	2.00	M	95.6	1.00	L

L: Low; M: Medium; H: High

Table 3. Soil test summary - available Ca, Mg, S, Fe, Mn, Zn and B in groundnut grown soils of Chittoor district

Sl. No.	Mandal	Number of samples	Available secondary nutrients				Available micronutrients (mg kg ⁻¹)			
			Ca (cmol (p+) kg ⁻¹)	Mg (cmol (p+) kg ⁻¹)	S (mg kg ⁻¹)	Fe	Mn	Cu	Zn	
1.	Vadamalapet	4	4.06	1.97	37.08	27.66	16.05	2.19	1.99	
2.	Narayanavanam	5	6.28	4.24	28.00	21.82	9.26	1.56	1.49	
3.	Nagari	6	6.44	4.11	29.12	22.61	10.87	1.72	1.59	
4.	Vijayapuram	5	5.72	3.72	28.75	22.85	9.20	1.56	1.53	
5.	Nindra	5	10.32	8.39	19.30	15.69	6.05	1.34	1.09	
6.	Nagalapuram	10	6.78	4.70	25.72	21.14	8.09	1.48	1.40	
7.	Kalahasti	5	6.35	3.96	27.50	22.53	8.15	1.40	1.38	
8.	Thottembedu	5	4.01	2.04	36.50	27.05	15.08	2.14	1.95	
9.	Karvetinagaram	6	4.35	2.42	34.79	25.54	13.30	1.98	1.89	
10.	G.D Nellore	5	9.22	7.27	19.05	17.75	5.54	1.28	1.10	
11.	Yerpedu	4	5.78	3.87	28.75	22.61	9.04	1.55	1.52	

Table 4. Correlation coefficients (r) between soil characteristics and available soil nutrients

	N	P	K	Ca	Mg	S	Fe	Mn	Cu	Zn
Clay	0.203**	-0.136*	-0.159**	-0.207**	-0.194**	0.208**	0.203**	0.172**	0.167	0.179*
PH	-0.961	0.962	0.671**	0.899*	0.879**	-0.952	-0.921*	-0.965*	-0.971*	-0.973
EC	-0.733*	0.714	0.910**	0.905**	0.927**	-0.782	-0.862	-0.674	-0.622	-0.749
OC	0.875**	-0.875	-0.823**	-0.794**	0.894**	0.894**	0.880**	0.918**	0.896**	0.907**

*: Significant at 1% level; **: Significant at 5% level

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who stated that micronutrients in soils of Andhra Pradesh were found to be above their respective critical limits.

CORRELATION STUDIES

pH, EC, OC and Clay vs Available macronutrients

Simple correlations were worked out between various soil characteristics and available macronutrients (Table 4). Available N and S were positively and significantly correlated with clay content and organic carbon while available P, K and Ca were negatively and significantly correlated with clay content of the soil. The positive association of available N and S with clay content and organic carbon might be due to the fact that the later were the primary reservoirs of the former. However, the negative relation between available P and clay content might be due to the fixation of the applied P (Singh *et al.*, 2001).

Available P, K, Ca and Mg were positively and significantly correlated with soil pH and EC of the soil. Available potassium was positively and significantly correlated with pH of the soils. In these soils organic matter and clay fraction might be the primary reservoirs of exchangeable potassium. Kalbande and Swamynatha (1976) reported similar relationship between exchangeable potassium and pH in black soils of Tungabhadra catchment.

pH, EC, OC and clay Vs Available micro nutrients

Available Fe, Mn, Zn and Cu were positively and significantly correlated with clay content and organic carbon. The positive relationship between organic carbon and available micronutrients is ascribed to its affinity to influence the solubility and availability of micronutrients by chelation effect which might have protected the later from oxidation and precipitation which consequently increased their availability (Prasad and Sakal, 1991).

Available micronutrients were negatively and significantly correlated with soil pH, which might be due to the fact that these micronutrients are oxidized to their respective higher oxides which are unavailable to plants. Similar findings were reported by Munaswamy *et al.* (1989)

CONCLUSION

The ground nut grown soils were neutral to slightly alkaline in reaction, non-saline, low to medium in available N and medium to high in available P and K. Hence, integrated uses of organics with inorganic

fertilizers coupled with inoculation of efficient strain of *Rhizobium* not only increases the available N but also sustains the yield of groundnut crop.

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