Short scientific report

Journal of Plantation Crops, 2009, 37 (3): 232-234

Status of available major and micronutrients in the coffee soils of Chikmagalur district in Karnataka

(Manuscript Received: 13-10-08, Revised: 05-05-08, Accepted: 20-09-09)

Keywords: Chikmagalur soils, micronutrient status

Recent developments in agriculture resulting in higher yield per unit area have compelled the farmer to review his earlier out look on the fertilizer needs. The present day farmer cannot afford to be complacent with the soil sources to meet the micronutrient demand of the high yielding varieties of crops. In India micronutrient deficiencies are quite widespread in acidic soils due to cultivation of high yielding varieties and use of chemical fertilizers. Coffee, like any other crop plant, needs all the trace elements in adequate and balanced amount for higher production and better quality. The information on available micronutrient status of five zones in Chikmagalur district is scanty and hence, the present study was initiated to know the current status of four micronutrient cations viz., Zn, Fe, Cu and Mn in soils cropped to coffee and to find out their relationship with some of the soil characteristics.

Two hundred and fifty surface soil samples (0-22 cm) were collected from different coffee estates in Chikmagalur district during 2005. A total of 50 soil samples were collected from each liaison zone viz., Koppa, Kalasa, Balehonnur, Mudigere and Goonibeedu, which represents the major coffee growing zones of the district. Soil samples were processed, air dried and passed through 2 mm sieve and analysed for pH, organic carbon, available P and available K by following standard procedures of Jackson (1973). Available Zn, Fe, Cu and Mn were extracted with DTPA (Lindsay and Norvell, 1978) and determined using Atomic Absorption Spectrophotometer of model GBC-932. Simple correlation co-efficient was worked out between available micronutrients and soil characteristics as suggested by Sundaraj *et al*. (1972).

The results indicated that the soil pH ranged from 4.5 to 7.22 (Table 1). The soils cropped to coffee are situated in medium to high rainfall areas and hence, acidic pH is expected. Similar results were also reported by Ananthanarayana and Ravindra (1998). The organic carbon of soils ranged from 0.50 to 4.93 per cent in Chikmagalur district. Since coffee in India is grown invariably under shade, the addition of leaf litter from shade trees contributes to the build up of organic matter in the soil. The mean available P and K levels in the present study were found to be medium to high in all the zones, possibly due to heavy fertilization of these soils.

Table 1. pH, OC, available and available K of coffee growing soils of Chikmagalur district

Zone	pH	OC(%) range	Mean	Av. P range (kg/ha)	Mean	Av. K range (kg/ha)	Mean
Koppa	4.6-6.4	0.75-4.48	1.80	8-280	34	80-450	255
Kalasa	4.8-7.2	0.84-4.76	2.15	8-180	44	50-490	258
Mudigere	4.5-6.4	0.5-4.93	2.10	10-100	39	85-530	239
Gonibeedu	4.8-6.5	0.56-3.3	1.74	8-200	58	100-630	289
Balehonnur	4.7-6.4	0.54-4.44	2.03	4-200	34	40-500	231

The DTPA extractable Zn ranged from 0.07 to 11.25 ppm. In Kalasa, the highest mean available Zn content 2.15 ppm was recorded followed by Koppa (2.02 ppm), Mudigere (1.55 ppm), Balehonnur (1.51 ppm) and Goonibeedu (1.25 ppm) zones (Table 2). Lindsay and Norvell (1978) suggested the critical limit of DTPA extractable Zn as 0.5 to 1.0 ppm. For Indian soils, Takkar and Mann (1975) suggested the critical limit as 0.6 ppm, according to which about 66 per cent of the soils analysed

Table 2. Range and mean values of DTPA extractable micronutrients in coffee growing soils of Chikmagalur district

Zone	Zn (ppm)		Fe (ppm)		Mn (ppm)		Cu (ppm)	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Koppa	0.65-10.72	2.02	2.5 -111	28.28	12.15-117.00	56.12	0.75-113.00	14.59
Kalasa	0.32-9.76	2.15	7.25-122	40.48	3.23-139.75	61.68	1.53-128.85	17.70
Mudigere	0.18-11.25	1.55	11.68-101	33.93	5.99-120.50	42.00	0.20-83.72	7.39
Gonibeedu	0.10-7.76	1.25	8.43-251	39.01	8.38-121.00	43.30	0.41-50.00	11.45
Balehonnur	0.07-3.95	1.51	17.48-215	60.94	6.5-196.00	62.71	0.74-104.00	11.98

had the available Zn content below the critical limit. The available Zn content was exceptionally high in some soils, probably due to the application of zinc sulphate along with the Bordeaux mixture spray, which is a regular practice in many plantations.

The DTPA extractable Fe content of soils ranged from 2.5 to 251 ppm. Mean Fe content was the highest in Balehonnur (60.94 ppm) followed by Kalasa (40.48 ppm), Goonibeedu (39.01 ppm), Mudigere (33.93 ppm) and Koppa (28.28ppm) zones (Table 2). The soil available Fe content of 2 ppm was indicated to be critical for normal plant growth (Arora and Sekhon, 1981). However, Lindsay and Norvell (1978) suggested the critical limit of iron as 6.0 ppm. Considering even the highest value of critical limits of Fe as 6 ppm, the soils of Chikmagalur appeared to be quite sufficient in available Fe.

The DTPA extractable Mn content of soils of ranged from 3.23 to 196.0 ppm. The mean Mn content was the highest (62.71 ppm) in Balehonnur followed by Kalasa (61.68 ppm), Koppa (56.12 ppm), Gonibeedu (43.30 ppm) and Mudigere (42.00 ppm) zones (Table 2). Lindsay and Norvell (1978) and Arora and Sekhon (1981) reported 1 ppm of DTPA extractable Mn as the critical limit for this micro nutrient. Higher values such as 2 ppm, 3 ppm and 4.7 ppm of DTPA extractable Mn have been reported by Gupta (1993), Shukla and Gupta(1975) and Anonymous (1976), respectively. Accordingly the soils of Chikmagalur district are well supplied with Mn. Ananthanarayana and Ravindra (1998) reported that under acid soil conditions, mobility of micronutrients especially Zn, Fe, Mn and Cu is high and as such their deficiencies are not noticed. But, toxicity of Mn and Fe along with Al can be expected in acid soils under bad management and water logged condition.

The DTPA extractable Cu content varied widely. It ranged from 0.20 to 128.85 ppm. The mean Cu content was the highest in Kalasa zone (17.70 ppm) followed by Koppa (14.59 ppm), Balehonnur (11.98 ppm), Gonibeedu (11.45 ppm) and Mudigere (7.39 ppm) zones (Table 2). Cu content of 0.2 ppm is considered to be critical for most of the crop plants (Lindsay and Norvell, 1978). Sakal *et al*. (1988) reported that a higher concentration of even 0.66 ppm was critical. The present study indicated that in most of the soils DTPA extractable Cu content is very high. This might be due to the accumulation of copper in soil as the coffee estates are being sprayed with Bordeaux mixture twice in a year to control coffee leaf rust, which is a major disease of arabica coffee. However, the copper toxicity symptoms were not noticed in any of the estates probably due to high organic matter status of these soils.

The correlation studies indicated a significant positive relationship between Zn and soil organic carbon (r = 0.285*) (Table 3) and no correlation was observed between available Fe and major nutrients. A significant positive correlation between DTPA extractable Mn with organic carbon content (r = 0.172*), and available K(r = 0.287**), whereas, relationship with pH and available P was found to be non-significant. Similar results are available (Sharma *et al.*, 1985 and Ananthanarayana and Ravindra, 1998). There is a significant positive relation between DTPA extractable Cu and available P (r = 0.231*) and significant negative correlation with pH (r = 0.212*). These results are in conformity with the findings of Sakal *et al*. (1988), Singh and Choudhary (1990) and Maji *et al*. (1993).

The range and mean of micronutrients in the present study indicated that all soils are well supplied with micronutrient cations except Zn. However, considering the critical limits prescribed by various authors, there is a need to fix higher critical limits for micronutrients under acid soil conditions. Gupta, (1993) reported that the critical limits for soil micronutrients

Table 3. Simple correlation co-efficient (r) between available micronutrients and soil characteristics

Soil characteristics	Correlation co-efficient			
	Zn	Fe	Mn	Cu
pH	- 0.0031	0.0014	0.0775	- 0.2124*
Organic carbon	0.285*	0.0474	0.172*	0.0666
Available P	0.111	0.169*	0.005	0.231*
Available K	0.145*	- 0.055	0.287*	0.010

r - value @ 5% = 0.123

vary with the soil, crop and extractant used. Even for the same crop, critical limits are not universal for different soils since several factors modify the availability of these micronutrients in soils.

Thus, it can be concluded that soils of Chikmagalur district are well supplied with all micronutrients studied except zinc. The toxicity of Mn and Al can interfere with crop production, if proper care is not taken.

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