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Micronutrient status of tobacco growing soils of Prakasam district, Andhra Pradesh

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Abstract

The present study was carried out by collecting 100 representative soil samples from tobacco growing soils of Prakasam district. The soils were found to be neutral to moderately alkaline in reaction. All the soil samples were non-saline. $CaCO_3$ ranged from nil to medium. The soils of the region were low to medium in organic carbon. Among all DTPA extracted micronutrients majority of the soil samples were sufficient in Mn, Fe and all soil samples were sufficient in Cu but Zn was deficient in majority of soil samples. The micronutrients were significantly and positively correlated with organic carbon and negatively correlated with calcium carbonate.

Keywords: Tobacco growing soils, zinc, iron, manganese, copper

Introduction

Tobacco, a quality conscious commercial crop is grown on the soils of Prakasam district. The tobacco growing area in Prakasam district was 71,593 ha. The wide variation in the physico-chemical and micronutrient status of the soil. These properties influence the type, grade and quality of tobacco produced. Among several other factors influencing tobacco productivity, soil fertility and fertilizer use contribute nearly 50 percent of yield and quality improvement (Krishnamurthy and Deosingh, 2002) [4].

The knowledge about the limitations related to soil fertility would help us making accurate fertilizer recommendation to the tobacco farmers. This would also help in increasing the yield of the major crops of the area like tobacco. Keeping all these points in view, the study was conducted in tobacco growing areas covering eight mandals of Prakasam district, Andhra Pradesh. The present investigation is formulated with the following objectives.

Materials and Methods

Survey was conducted in the tobacco growing areas of Prakasam district covering eight mandals during the month of June, 2014 and collected one hundred representative surface soil samples (0-15 cm) from farmer's fields. Soil reaction was determined in 1:2.5 soil water suspension using glass electrode pH meter and the conductivity was estimated using Wheatstone conductivity bridge (Jackson, 1973) [3].

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Organic carbon content of the soils was determined by wet digestion method of Walkley and Black as described by Jackson (1973) [3]. Free calcium carbonate content of soils was determined by neutralization with an acid (Schollenberger, 1945) [15]. Available zinc, copper, manganese and iron in the soils were determined in DTPA extract, using atomic absorption spectrophotometer. The ratings and procedure suggested by Lindsay and Norvell (1978) [8].

Results and Discussion

Physico-chemical Properties

The data regarding to soil reaction of tobacco growing soils of Prakasam district was presented in table 1. The analytical data of soil samples revealed that the pH of studied mandals in Prakasam district ranged from 7.2 to 8.4 with mean of 7.7. These soils were neutral to moderately alkaline in reaction. About 4 percent soil samples were under neutral (6.6-7.3), 70 percent samples were mildly alkaline (7.4-7.8) and remaining 26 percent were under moderately alkaline (7.9-8.4) in reaction according to Brady (2000) [1].

Similar results were obtained by Venkateswarlu *et al.* (1995) [17]. Those soils which were neutral to moderately alkaline in reaction which could be attributed to accumulation of clay, bases and lime. The pH had significant positive correlation with $CaCO_3$ (r=0.856**).

The data presented in table 1 indicated that EC of soil samples varied from 0.10 to 0.80 with a mean value of 0.27 dS m^{-1}. All soils were non-saline due to continuous preparatory cultivations and agricultural practices in tobacco growing areas. Similar results were reported by Krishnamurthy *et al.* (2007) [5].

The organic carbon content varied from 0.01 to 0.87 with a mean value of 0.31 percent. As per the ratings given by Ramamurthy and Bajaj, (1969) 95 samples were low in organic carbon content (<0.5%) while, the remaining 5 samples were medium (0.5-0.75%). These results were similar with the findings of Ratnam *et al.* (2001) [12]. Low organic carbon content in these soils might be due to rapid oxidation of organic matter in semi-arid climatic conditions and less application of organic manures like FYM, compost (Krishnamurthy *et al.* 1981) [7].

The data in table 1 indicated that $CaCO_3$ content in the tobacco growing soils of Prakasam district ranged from nil to 12.50 percent with a mean of 3.90 percent. These findings were in accordance with the earlier findings of Ram *et al.* (2014). The data revealed that 62 percent soil samples were low in $CaCO_3$ and remaining 38 percent soils were medium in $CaCO_3$ content according to the limits of Tamgadge *et al.* (1996) [16]. This wide variation was due to variation in pH, clay content of soil and soil forming factors and procedures. $CaCO_3$ accumulation was mainly due to calcification, a pedogenic process in semi-arid climate (Venkateswarlu *et al.* 1995) [17].

Table 1: Physico-chemical properties of tobacco growing soils of Prakasam district

S. No	Name of the mandal	pH		EC (dS m^{-1})		OC (%)		$CaCO_3$ (%)	
		Range	Mean	Range	Mean	Range	Mean	Range	Mean
1	Naguluppalapadu	7.4-8.2	7.7	0.14-0.34	0.20	0.16-0.48	0.31	0.00-10.00	3.76
2	Ongole	7.4-8.4	7.9	0.12-0.71	0.31	0.01-0.71	0.23	0.00-12.50	6.39
3	Santhanuthalapadu	7.6-8.2	7.9	0.20-0.31	0.27	0.20-0.35	0.24	2.00-12.30	8.33
4	Tanguturu	7.2-8.0	7.5	0.19-0.55	0.35	0.19-0.55	0.35	0.00-5.00	1.21
5	Kandukuru	7.4-8.0	7.7	0.15-0.78	0.28	0.15-0.45	0.31	0.00-6.00	3.13
6	Jarugumalli	7.4-7.9	7.7	0.11-0.80	0.39	0.23-0.64	0.36	0.00-6.00	3.33
7	Maddipadu	7.4-8.0	7.6	0.10-0.30	0.20	0.01-0.67	0.32	0.00-7.60	2.16
8	Korisapadu	7.3-8.0	7.6	0.12-0.27	0.17	0.15-0.87	0.37	0.00-5.00	2.34
	Overall	7.2-8.4	7.7	0.10-0.80	0.27	0.01-0.87	0.31	0.00-12.50	3.90

Table 2: Available micronutrient status of tobacco growing soils of Prakasam district

S. No	Name of the mandal	Zinc (ppm)		Iron (ppm)		Manganese (ppm)		Copper (ppm)	
		Range	Mean	Range	Mean	Range	Mean	Range	Mean
1	Naguluppalapadu	0.14-0.49	0.25	2.90-7.40	5.42	8.70-23.50	13.96	0.88-1.94	1.29
2	Ongole	0.09-0.60	0.20	0.10-7.80	4.26	0.83-24.60	12.06	0.72-1.84	1.06
3	Santhanuthalapadu	0.15-0.25	0.18	3.20-5.90	4.80	9.20-14.50	10.80	0.95-1.16	1.06
4	Tanguturu	0.12-2.18	0.45	2.00-10.20	6.64	7.80-43.95	24.63	0.79-3.40	1.45
5	Kandukuru	0.13-0.48	0.25	4.20-6.90	5.68	9.87-22.40	15.47	1.03-1.60	1.29
6	Jarugumalli	0.10-0.70	0.28	4.70-6.50	5.53	10.30-18.68	13.92	1.03-4.50	1.51
7	Maddipadu	0.16-5.20	0.69	3.90-6.50	5.71	9.50-21.90	15.58	0.68-3.10	1.47
8	Korisapadu	0.12-0.36	0.24	2.70-7.80	5.69	8.40-31.95	16.97	0.80-1.46	1.19
	Overall	0.09-0.70	0.32	0.10-10.20	5.38	0.83-43.95	15.15	0.68-4.50	1.29

Micronutrient status

The available zinc content varied from 0.09 to 0.70 with a mean of 0.32 ppm in studied mandals of Prakasam district. Considering the critical limit of 0.8 ppm, 98 percent soil samples were deficient and remaining 2 percent samples were sufficient in zinc. Similar results were reported earlier by Ramesh *et al.* (2003). The deficiency of Zn was attributed to low organic matter content and high lime content. This was confirmed by the positive correlation existed between organic carbon and Zn (r=0.141) (Table 2) and negative correlation with pH (r=-0.233**) and $CaCO_3$ (r=-0.247**) which, indicated that pH values coupled with lime will lead to the precipitation of soluble Zn into carbonate bound zinc. Low Zn in soils was due to inadequate application of Zn fertilizers (Krishnamurthy *et al.* 1997) [6].

The iron content of samples ranged from 0.10 to 10.20 with a mean value of 5.38 ppm. As per the critical limit of 4.5 ppm, 23 percent soil samples showed below critical limit and 77 percent samples showed above critical limit of available iron. On the whole about 77 percent of the soils were rich in iron and only 23 percent of the soils are deficient in available iron, which was in tune with the previous findings of Ghelani *et al.* (2004) [2]. The availability of iron increased with organic carbon (r=0.048) due to chelation with organic carbon whereas, the same decreased with increase in pH (r=-0.794**) and CaCO3 (r=-0.785**).

The available manganese content of soil samples ranged from 0.83 to 43.95 with mean of 15.15 ppm. About 98 percent soil samples showed above critical limit whereas only 2 percent of the samples below critical limit of available manganese. Less mobility of Mn^{+2} in the soils might have contributed for the accumulation of soluble forms of manganese. These results were corroborated with the findings of Ghelani *et al.* (2004) [2]. These variations in available Mn contents might be due to the variations in soil pH, $CaCO_3$ and clay content. The available Mn in these soil samples was positively correlated with organic carbon (r=0.158) content of soils whereas, it was significantly decreased with increase in pH (r=-0.520**), $CaCO_3$ (r=-0.562**) (Table 3) and clay (r=-0.829). These results were similar with Sathish *et al.* (2008) [13].

The available copper content of soil samples ranged from 0.68 to 4.50 with mean of 1.29 ppm. Cu content was above critical limit of >0.2 therefore the soils were considered to be sufficient in copper content. The sufficient copper content of the soils might be due to rich copper containing minerals and also due to indiscriminate application of Cu containing fungicides for plant protection, which were confirmed by Satyavathi and Reddy (2004) [14]. Similar observations were made by Ghelani *et al*. (2004) [2]. The increase in available copper increased with increase in organic carbon (r=0.394**) whereas Cu decreased significantly with increase in pH (r=-0.370**) and $CaCO_3$ (r=-0.416**).

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