Agropedology 2017, 27 (01) 93 - 98

Nutritional Status of Sweet Orange-Growing Soil of YSR District, Andhra Pradesh, India

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Abstract: The soil samples at 0-30 cm and sub-surface 30-60 cm from fifty sweet orange orchards aged between 12 to 13 years were collected and analysed to know the nutrient status of orchards in YSR district of Andhra Pradesh. The results showed that, about 82 per cent of soils were deficient in available nitrogen and 20 per cent in available phosphorus, however, 68 per cent of samples were high in available potassium. Though these samples had adequate exchangeable calcium and magnesium but were low in DTPA- Fe (24%) and Zn (78%).

Key words: *Sweet orange, macro nutrients, micro nutrients*

Introduction

In India, sweet oranges are grown mainly in the states of Maharashtra, Andhra Pradesh, Punjab, Karnataka and parts of North – East region with an area of 2.78 lakh hectares (ha) and 45.26 lakh tones (Horticultural Statistics Division 2016).

In Andhra Pradesh, Prakasam, YSR, Ananthapur and SPSR Nellore districts cover 0.94 lakh ha under sweet orange with production of 13.16 lakh tonnes during 2014–15. YSR district alone cover 0.11 lakh ha with production of 1.54 lakh Mt (CPO 2015).

In YSR district sweet orange is cultivated on variety of soils ranging from red sandy loam/loamy sand soils to black sandy clays. Now the orchards have low productivity mainly due to multiple nutrient deficiencies. At present the information regarding the nutrient status of the sweet orange orchards of YSR district of Andhra Pradesh is scanty, considering the above facts the present investigation was carried out.

Materials and Methods

Fifty sweet orange orchards aged between 12 to 13 years were selected in different mandals *viz*., Atlur, Kondapuram, Lingala, Muddanur, Pulivendla, Simhadripuram, Thondur, Vempalli, Vemula, Verapunayunipalle and Vontimitta (Fig. 1). In each orchard, two pits were dug at random and composite soil samples were separately collected at two depths (0 – 30 and 30 – 60 cm) and collected samples were processed for laboratory analysis.

Available nitrogen in soil was determined by alkaline permanganate method as described by Subbiah and Asija (1956). Available phosphorus was extracted with 0.5 *M* sodium bi-carbonate (Olsen *et al*. 1954) as an extracting agent and determined using double beam US-VIS spectrophotometer. The available K was extracted with the neutral normal ammonium acetate and determined on Flame photometer (Jackson 1973). Calcium and magnesium were determined by versanate titration method (Vogel 1978), available S was estimated by extracting the soil sample with 0.15 per cent calcium chloride (Williams and Steinbergs 1959) and S content in the extract was determined by turbidimetric method (Chesnin and Yien 1951) The micronutrients cations were extracted with 0.005 *M* DTPA extractant (Lindsay and Norvell 1978) and contents were estimated by using Atomic Absorption spectrophotometer. Statistical

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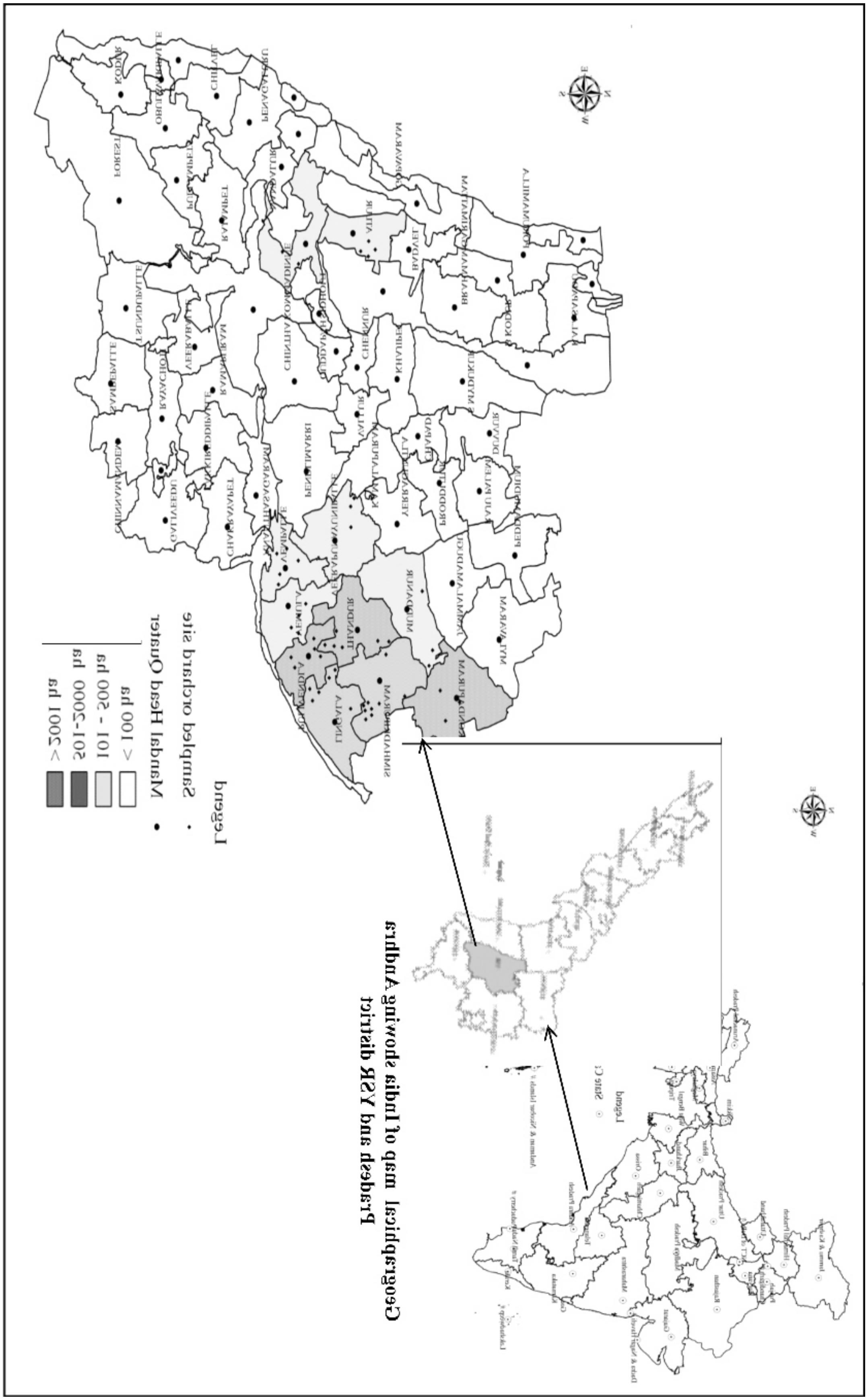

Fig. 1. Map showing area-wise distribution of sweet orange and sampled sites in the different mandals of YSR district of Andhra Pradesh

parameters such as range mean and standard deviation were calculated using Microsoft Excel.

Results and Discussion

Soil mineral nutrients

The data pertaining to soil nutrients status of sweet orange orchards in YSR district of Andhra Pradesh are presented in table 1 and table 2.

Available NPK

The soil available N varied from 125.26 to 307.33 kg ha^{-1} at 0-30 cm and 82.72 to 220.69 kg ha^{-1} at 30 to 60 cm. Available N was high in surface horizons and decreased with depth.

The available P content is 5.26 to 39.54 kg ha^{-1} with (surface) and 2.13 to 25.07 kg ha^{-1} in sub-surface soils, respectively (Table 1). However, the highest available P content was observed in the surface horizon and decreased with depth. It might be due to application of fertilizers to the surface soils. The lower available P content in lower horizons as compared to upper horizons might be due to the P fixation (Ranjha *et al*., 2002).

The available K content in the surface soils ranged from 116.14 to 955.92 kg ha^{-1} whereas in the sub-surface soils had 69.66 to 554.51 kg ha^{-1} (Table 1). This might be due to release of K from organic residues and applied K fertilizers.

As per the ratings of Muhr *et al*. (1965), it is noticed that 82 per cent soils were deficient and 18 per cent samples were medium in available N. About 20, 60 and 20 per cent soil samples were deficient, medium and high respectively for available P. In case of available

Table 1. Soil mineral nutrient content of the sweet orange growing soils of YSR district

Parameter	0 – 30 cm			30 – 60 cm		
	Range	Mean	SD	Range	Mean	SD
Available N (kg ha^{-1})	125.26- 307.33	224.31	51.05	82.72 - 220.69	150.79	40.04
Available P (kg ha^{-1})	5.26 - 39.54	17.79	9.095	2.13 - 25.07	11.16	6.08
Available K (kg ha^{-1})	116.14 - 955.92	365.00	169.34	69.66 - 554.51	258.54	95.59
Ex. Ca (cmol(p$^+$)kg^{-1})	8.50 - 45.25	27.13	8.47	6.00 - 46.50	29.52	8.83
Ex. Mg (cmol(p$^+$)kg^{-1})	2.25 - 41.50	13.48	8.97	2.75 - 22.50	10.51	4.86
Available S (mg kg^{-1})	14.37 - 73.41	30.12	13.19	8.35 - 29.16	16.58	4.51
DTPA-Fe (mg kg^{-1})	1.05 - 5.12	2.67	0.92	0.67 - 3.95	1.58	0.72
DTPA-Zn (mg kg^{-1})	0.08 - 1.23	0.37	0.25	0.01 - 1.19	0.26	0.20
DTPA-Mn (mg kg^{-1})	0.52 - 9.73	4.05	1.98	0.59 - 9.00	2.93	2.03
DTPA-Cu (mg kg^{-1})	0.37 - 2.87	1.33	0.53	0.42 - 2.60	0.92	0.41

(Ex. = Exchangeable)

K, 32 per cent soil samples were categorized as medium and 68 per cent as high **(Table 2)**. Similar results with regard to soil N, P and K was reported by Ranjha *et al.* (2002).

The available N, P and K were higher in surface soils than sub-surface soils. It might be due to addition of organic manures and fertilizers in surface layers. Similar results were reported by Dhale and Jagdish Prasad (2009) and Chaudhari *et al.* (2016).

Secondary nutrients

The exchangeable calcium in surface soils varied from 8.50 to 45. 25 cmol (p^+) kg^{-1} and in sub-surface soils, it was 6.00 to 46.50 cmol (p^+) kg^{-1} (Table 1).

The exchangeable magnesium showed a variation of 2.25 to 41.50 cmol (p^+) kg^{-1} and 2.75 to 22.50 cmol (p^+) kg^{-1} in surface and sub-surface soils, respectively (Table 1).

The available sulphur content of surface soils was 14.37 to 73.41 mg kg^{-1}, with a mean of 30.12 mg kg^{-1}. In sub-surface soils, the available S content varied from 8.35 to 29.16 mg kg^{-1}, with a mean of 16.58 mg kg^{-1} **(Table 1)**.

The exchangeable calcium status in the surface and sub-surface soils were above the critical limit of <1.50 cmol (p^+) kg^{-1} (Tandon 1989).

Exchangeable magnesium followed the distribution pattern of exchangeable calcium. As per the critical limit of Mg <1.00 cmol (p^+) kg^{-1} (Tandon 1989), all the soils had higher values in the surface and sub-surface soils. Similar results were reported by Venkata Subbaiah *et al.* (1982) in citrus-growing soils of Anantapur district in Andhra Pradesh.

The available S content was higher in surface soils than sub-surface soils. It might be due to application of organic manures and sulphur containing fertilizers in surface layers. As per the S critical limit (<10 mg kg^{-1}) prescribed by Tandon (1991), all the surface soils were sufficient in S content. Similar results were reported by Chaudhari *et al.* (2016).

Micronutrients (Fe, Cu, Mn and Zn)

The DTPA extractable micronutrients of surface soils was 1.05 to 5.12 mg kg^{-1} for Fe, 0.08 to 1.23 mg kg^{-1} for Zn, 0.52 to 9.73 mg kg^{-1} for Mn and 0.37 to 2.87 mg kg^{-1} for Cu (Table 1).

In the sub-surface soils of area, the DTPA extractable available Fe, Zn, Mn and Cu content was varied from 0.67 to 3.95, 0.01 to 1.19, 0.59 to 9.00 and 0.42 to 2.60 mg ha^{-1}, with a mean value of 1.58, 0.26, 2.93 and 0.92 mg kg^{-1}, respectively (Table 1).

In general, 24 and 78 per cent samples were very low in Fe and Zn, respectively. DTPA-Fe, Zn and Mn were low to an extent of 68, 18 and 8 per cent, respectively. Nearly 8, 4, 38 and 18 per cent soil samples were medium in DTPA-Fe, Zn, Mn and Cu respectively (Table 2). Chaudhari *et al.* (2016) also reported that maximum soil samples were deficient in Fe and Zn irrespective of soil depth.

The trend of variation in the micronutrient contents of soils might be due to variations in organic carbon content and micronutrient containing minerals in soil. Similar variations were also reported by Venkata Subbaiah *et al.* (1982) for Cu, Fe, and Mn status in soils of citrus orchards of Anantapur district.

Table 2 : Distribution of the mineral nutrients in the sweet orange orchards soils of YSR district

Parameter	Total samples	Very low		Low		Medium		High		Very high	
		Number of samples	(%)	Number of samples	(%)	Number of samples	(%)	Number of samples	(%)	Number of samples	(%)
Available N (kg ha^{-1})	50	–	–	41	82	9	18	–	–	–	–
Available P (kg ha^{-1})	50	–	–	10	20	30	60	10	20	–	–
Available K (kg ha^{-1})	50	–	–	–	–	16	32	34	68	–	–
DTPA-Fe (mg kg^{-1})	50	12	24	34	68	4	8	–	–	–	–
DTPA-Zn (mg kg^{-1})	50	39	78	9	18	2	4	–	–	–	–
DTPA-Mn (mg kg^{-1})	50	–	–	4	8	19	38	18	36	9	18
DTPA-Cu (mg kg^{-1})	50	–	–	–	–	9	18	41	82	–	–

* Soil nutrient indices were referred to the Muhr *et al*. (1965) and Lindsay and Norvell (1978).

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Received : September, 2017 Accepted : November, 2017