



## Fertility Status of Soils of Tenali Division, Guntur District of Andhra Pradesh

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### ABSTRACT

The present study was conducted in Tenali revenue division of Guntur district by collecting 114 representative soil samples using GPS. Texturally they were sand, loamy sand, sandy clay loam, sandy clay and clay showing wide variation in texture. The sand, silt and clay content of the soil ranges from 20.6 to 92.0, 3.0 to 15.0 and 4.0 to 65.5 per cent, respectively. The pH (5.6 to 8.5) and EC (0.11 to 9.01 dS m<sup>-1</sup>) values indicated that soils were found to be medium acid to moderately alkaline and non-saline in nature. The soils of Tenali division were non-calcareous with highest CaCO<sub>3</sub> content of 4.20%. The analyzed samples showing medium in organic carbon and CEC and their ranges from 0.20 to 0.72 per cent and 11.91 to 60.87 cmol (p<sup>+</sup>) kg<sup>-1</sup>, respectively. Among the exchangeable basic cations, Ca was dominant followed by Mg, K and Na with mean values of 30, 2.35, 2.34 and 0.71 cmol (p<sup>+</sup>) kg<sup>-1</sup> soil, respectively.

Key words: *Electro-chemical properties, Physical, Physico-chemical.*

Soil plays a major role in determining the sustainable productivity of an agro-ecosystem. The sustainable productivity of a soil mainly depends upon its ability to supply essential nutrients to the growing plants. Plants take their nutrients mostly from soil. It is well known that the optimum plant growth and crop yield depends not only on the total amount of nutrients present in the soil at a particular time but also on their availability which in turn is controlled by physico-chemical properties like soil texture, organic carbon and calcium carbonate, cation exchange capacity, pH and electrical conductivity of soil. Hence a study was formulated to evaluate the fertility status of the soils of Tenali revenue division.

### MATERIAL AND METHODS

The Guntur district is located in east coast of Andhra Pradesh in India. It is around 40 miles to the west of Bay of Bengal. It is divided into 57 mandals under three revenue divisions with headquarters at Tenali (18 mandals), Guntur (19 mandals), Narasaraopet (20 mandals). The study area Tenali revenue division includes 18 mandals with different types of soils. The global position of the present study area lies between 16.50° Northern latitude and 80.55° Eastern longitude with an average elevation of thirty three metres

above mean sea level. The average annual rainfall is 850 mm. The existing crops in this division are rice, banana, vegetables and turmeric. One hundred and fourteen (Table 1) representative surface soil samples (0-30 cm) were collected from sandy, red and black soils of different mandals in Tenali revenue division.

Particle size analysis of the soil samples was carried out by following Bouyoucos hydrometer method (Piper, 1966), soil reaction and soluble salt content were determined in 1:2.5 soil: water suspension (Jackson, 1973), the organic carbon content was determined by Walkley and Black's "wet digestion method" as outlined by Jackson (1973). Calcium carbonate in the soil was estimated by rapid titration method and was expressed as per cent (Piper, 1966). The exchangeable cations and CEC, PBS was estimated by procedure given by (Bower *et al.*, 1952).

### RESULTS AND DISCUSSION

#### Physical Properties:

The data on particle size distribution of soils indicated that soil separates sand, silt and clay contents were ranging from 20.6 to 92.0, 3.0 to 15.0 and 4.0 to 65.5 with mean values of 44.9, 9.7, 45.4 per cent, respectively (Table 2). Based on the proportion of these three soil separates, these soils

**Table 1. Details of sampling sites.**

S.No	Mandal	Sampling sites in each mandal
1	Tenali	Tenali, Angalakuduru, Burripalem, Chinaravuru, Nandivelugu, Gudivada, Kolakaluru
2	Duggirala	Duggirala, Penumuli, Katamarajukonduru, Chiluvuru, Srungarapuram, Pedakonduru, Chinapalem, Morampudi, Emani
3	Vemuru	Vemuru, Jampani, Kuchelapadu, Chavali, Varahapuram
4	Kollipara	Kollipara, Pidaparru, Vallabhapuram
5	Kolluru	Kolluru, Pothrlanka, Gajulalanka, Ravikampadu, Donepudi
6	Ponnuru	Ponnuru, Vellaluru, Muniapalle, Doppalapudi, Mulukuduru, Sitarampuram, Kondamudi
7	Tsundururu	Edlapalli, Pengudurupadu, Vetapalem, Tsundururu, Manduru, Alapadu, Modukuru
8	Chebrolu	Chebrolu, Narakoduru, Vejandla, Vadlamudi, Manchala, Sekuru, Pattareddypalem
9	Amrataluru	Kuchipudi, Mulapuru, Pedapudi, Amrathaluru, Moparru, Inturu, Govada
10	Bapatla	Bapatla, Pinnaboinavaripalem, Sturatpuram, Kankatapalem, Narasayapalem, Jammulapalem, Appikatla
11	Karlapalem	Yazali, Buddham, Karlapalem, Ganapavaram, Perali
12	Pittalavanipalem	Komali, Chandolu, Pittalavanipalem, Kazipalem, Alluru
13	Kakumanu	Kollimarla, Vellur, Garikapadu, Kommuru, Kakumanu, Bodipalem, Returu
14	Repalle	Repalle, Morthota, Singupalem, Thumala, Gangadipalem, Lankavanidibba, Bethapudi
15	Nagaram	Chinnamatlapudi, Siripudi, Nagaram, Dhulipudi, Sajjavaripalem, Kattava, Nagallavaripalem
16	Bhattiprolu	Velataluru, Bhattiprolu, Ilavaram, Surepalli, Pallekona, Pedalanka, Oleru
17	Cherukupalli	Kanagala, Gudavalli, Rajolu, Cherukupalli, Rambotlapalem, Balasulapalem
18	Nizampatnam	Dindi, Gokarnamatam, Komravolu, Kuchinapudi, Aduvaladeevi, Kothapalem

were classified under five textural classes. Clay texture was dominant in the study area with 60.5% followed by sandy clay (16.7%), sand (13.2%), sandy clay loam (6.1%) and loamy sand (3.5%). As per the criteria given by Brady and Weil (2002) clay and sandy clay texture were grouped as clay soils (77.2%), sand and loamy sand texture as sandy soils (16.7%) and sandy clay loam texture as loamy soils. Similar particle size distribution and textural classes were reported by Ramalakshmi *et al.*, (2002) for soils of Bapatla - Karlapalem mandals of Guntur district and Seshagirirao *et al.* (2004) for soils of coastal areas in Andhra Pradesh.

The bulk density of soils of Tenali division ranged from 1.20 to 1.69 with a mean value of 1.34 Mg m<sup>-3</sup> (Table 2). The mean bulk density of acid soils was maximum (1.49 Mg m<sup>-3</sup>) followed by

neutral (1.35 Mg m<sup>-3</sup>) and alkaline soils (1.32 Mg m<sup>-3</sup>). Acid soils were mostly sandy while neutral and alkaline soils were loamy or clay in texture. The bulk density was ranging from 1.41 to 1.69 (mean 1.54), 1.27 to 1.51 (mean 1.36) and 1.20 to 1.42 (mean 1.29) Mg m<sup>-3</sup> in sandy, loamy and clay soils, respectively. These results were coinciding with those of Ramprakash and Seshagirirao (2002) in soils of Krishna district, Ramarao (2003) in soils of Chirala mandal, Andhra Pradesh.

The water holding capacity of soils of Tenali division was in between 10.01 and 65.00 with mean value of 46.95 per cent (Table 2). Acid soils had low WHC (mean 27.11%) compared to neutral (mean 42.82%) and alkaline (mean 51.35%) soils. Acid soils were dominated by sand content, whereas neutral and alkaline soils by clay content. In sandy,

**Table 2. Range and mean values of different physical properties of soils.****a) Based on pH**

Soil Property	Acid soils		Neutral soils		Alkaline soils		Overall	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Clay %	5.0-44.4	23.7	4.0-65.0	40.7	5.0-65.5	50.2	4.0-65.5	45.4
Silt %	4.0-11.0	7.50	3.0-15.0	9.20	4.0-15.0	10.2	3.0-15.0	9.70
Sand %	45.6-90.0	68.8	20.6-92.0	50.1	21.0-89.0	39.5	20.6-92.0	44.9
BD(Mgm <sup>-3</sup> )	1.30-1.65	1.49	1.20-1.64	1.35	1.20-1.69	1.32	1.20-1.69	1.34
WHC (%)	10.12-52.49	27.11	10.01-64.15	42.82	10.52-65.00	51.35	10.01-65.00	46.95

**b) Based on texture**

Soil Property	Sandy soils		Loamy soils		Clay soils	
	Range	Mean	Range	Mean	Range	Mean
Clay %	4.0-8.0	5.9	28.4-34.4	32.2	37.4-65.5	55.1
Silt %	3.0-6.0	4.5	9.7-15.0	11.3	5.0-15.0	10.8
Sand %	88.0-92.0	89.7	55.6-60.6	56.9	20.6-51.6	34.1
BD(Mgm <sup>-3</sup> )	1.41-1.69	1.54	1.27-1.51	1.36	1.20-1.42	1.29
WHC (%)	10.01-14.52	11.45	28.37-52.60	41.98	34.31-65.00	55.09

loamy and clay soils, the WHC was varying from 10.01 to 14.52, 28.37 to 52.60 and 34.31 to 65.00 with mean values of 11.45, 41.98 and 55.09 per cent, respectively. These findings coincided with Ramalakshmi *et al.* (2002) in soils of Bapatla-Karlapalem mandals of Andhra Pradesh and Likhar and Jagdishprasad (2011) in soils of Nagpur.

**Physico-Chemical characteristics:**

The data pertaining to the range and mean pH values of each mandal are presented in table 3. The pH of soils of study area was ranged from as low as 5.6 (medium acid) to a maximum of 8.5 (strongly alkaline) with a mean of 7.4 (mildly alkaline). As per the guidelines of Brady and Weil (2000), about 5 per cent of the soils of the study area were acidic (d<sup>''</sup> pH 6.5), 38 per cent were neutral (pH 6.6 to 7.3) and 57 per cent were alkaline (e<sup>''</sup> pH 7.4) in reaction. Some of the acid soils were slightly acidic (pH 6.1 to 6.5) and some moderately acidic (pH 5.6 to 6.0) in reaction, while the alkaline soils were mildly alkaline (pH 7.4 to 7.8), moderately alkaline (pH 7.9 to 8.4) and strongly alkaline (pH 8.5 to 9.0) in reaction. Similar range of pH values were reported by Ramesh *et al.* (2003) in soils of

Singarayakonda of Andhra Pradesh and Singh and Sharma (2007) in soils of different agro-ecological zones of Punjab.

The EC of surface soils of Tenali division of Guntur district ranged from 0.11 to 9.01 with a mean of 0.46 dS m<sup>-1</sup> (Table 3). The data pertaining to the total soluble salts in terms of EC values of the acid soils ranged from 0.12 to 0.97 with a mean of 0.36 dS m<sup>-1</sup> and the EC values of neutral and alkaline soils ranged from 0.11 to 0.80 and 0.14 to 9.01 with mean values of 0.29 and 0.59 dS m<sup>-1</sup>. The results were in accordance with the findings of Singaravel *et al.* (1996) for coastal soils of Tamilnadu and Shankaraiah *et al.* (2006) for soils of Karimnagar district, Andhra Pradesh.

The organic carbon content in soils of Tenali division of Guntur district ranged from 0.20 to 0.72 per cent with a mean of 0.52 per cent (Table 3). The organic carbon content in acid soils varied from 0.29 to 0.42 per cent with a mean value of 0.34 per cent, while in neutral and alkaline soils it ranged from 0.22 to 0.70 and 0.20 to 0.72 with mean values of 0.54 and 0.52 per cent, respectively. Only 40 per cent of soils were low and remaining 60 percent of samples were medium in organic carbon status.

**Table 3. Range and mean values of different physico-chemical properties of soils.****a) Based on pH**

Soil Property	Acid soils		Neutral soils		Alkaline soils		Overall	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
pH	5.6-6.4	6.0	6.6-7.3	7.0	7.5-8.5	7.9	5.6-8.5	7.40
EC (dSm <sup>-1</sup> )	0.12-0.97	0.36	0.11-0.80	0.29	0.14-9.01	0.59	0.11-9.01	0.46
CaCO <sub>3</sub> %	0-0	0-0	0-1.88	0.46	0.13-4.20	1.87	0.00-4.20	1.24
OC %	0.29-0.42	0.34	0.22-0.70	0.54	0.20-0.72	0.52	0.20-0.72	0.52

**b) Based on texture**

Soil Property	Sandy soils		Loamy soils		Clay soils	
	Range	Mean	Range	Mean	Range	Mean
pH	5.5-8.5	7.0	5.7-7.8	7.1	6.0-8.3	7.5
EC (dSm <sup>-1</sup> )	0.11-9.01	1.02	0.14-0.43	0.29	0.12-0.97	0.35
CaCO <sub>3</sub> %	0.00-3.52	0.46	0.00-1.60	0.82	0.00-4.20	1.47
OC %	0.27-0.70	0.47	0.35-0.72	0.57	0.20-0.71	0.53

**Table 4. Range and mean values of exchangeable cations and CEC of soils.**

cmol kg <sup>-1</sup> soil	Acid soils		Neutral soils		Alkaline soils		Overall	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Ex.Ca	10.0-28.0	16.0	10.0-43.0	26.0	10.0-49.0	34.0	10.0-49.0	30.0
Ex.Mg	0.40-1.90	1.04	0.20-4.50	2.17	0.50-5.20	2.59	0.20-5.20	2.35
Ex.K	0.60-2.87	1.52	0.87-5.39	2.24	0.87-4.87	2.51	0.60-5.39	2.34
Ex.Na	0.12-0.82	0.44	0.10-0.87	0.44	0.10-3.69	0.91	0.10-3.69	0.71
CEC	11.91-43.48	22.26	12.50-58.70	35.40	12.56-60.87	44.33	11.91-60.87	39.77

Overall, the soils were medium in organic carbon content. The results were in tune with the previous findings of Madhuvani *et al.* (2001) for coastal soils of Guntur.

The data pertaining to calcium carbonate content are presented in the table 3. Calcium carbonate content in the soils ranged from nil to 4.20 percent with a mean of 1.24 percent. In case of acid soils, calcium carbonate was absent. Calcium carbonate content in neutral soils ranged from nil to 1.88 with a mean of 0.46 percent while the calcium carbonate content of alkaline soils ranged from 0.13 to 4.20 with a mean of 1.87 percent. These results were in accordance with the findings of Varaprasadrao *et al.* (2008)

in soils of Ramachandrapuram mandal of chittoor district, Andhra Pradesh.

**Electrochemical Properties:**

The data presented in table 4 revealed that cation exchange capacity of soils of Tenali division of Guntur district was widely varying. The cation exchange capacity of soils of Tenali division varied from 11.91 to 60.87 with a mean value of 39.77 cmol (p<sup>+</sup>) kg<sup>-1</sup>. In case of acid soils, CEC ranged from 11.91 to 43.48 with mean value 22.26 cmol (p<sup>+</sup>) kg<sup>-1</sup>. The CEC in neutral and alkaline soils ranged from 12.50 to 58.70 and 12.56 to 60.87 with mean values of 35.40 and 44.33 cmol (p<sup>+</sup>) kg<sup>-1</sup>. The CEC was more in these soils because of presence of clay and organic matter and these fractions had

a large number of negative charges on their surface, thus they attracted cations and contributed to higher CEC values. Similar findings were reported by Sharma and Kanwar (2010) in soils of Himachal Pradesh, Likhar and Jagdishprasad (2011) in orange growing soils of Nagpur district.

The results further revealed that in all the soils the contents of exchangeable cations were found in the order of  $\text{Ca}^{2+} > \text{Mg}^{2+} > \text{K}^{+} > \text{Na}^{+}$ .

Exchangeable calcium was found to be the most dominant cation on the exchangeable complex ranging from 10 to 49  $\text{cmol (p}^{+}) \text{ kg}^{-1}$  of soil with a mean value of 30  $\text{cmol (p}^{+}) \text{ kg}^{-1}$ . In case of acid soils, exchangeable calcium varied from 10 to 28 with a mean value of 16  $\text{cmol (p}^{+}) \text{ kg}^{-1}$ , while in neutral and alkaline soils it ranged from 10 to 43 and 10 to 49 with mean values of 26 and 34  $\text{cmol (p}^{+}) \text{ kg}^{-1}$ . Similar results were reported by Likhar and Jagdishprasad (2011) in soils of Nagpur district, Maharashtra.

Exchangeable magnesium was the second most dominant cation next to exchangeable calcium, but higher than exchangeable sodium and exchangeable potassium. The exchangeable magnesium in surface soils of Tenali division ranged from 0.20 to 5.20 with a mean value of 2.35  $\text{cmol (p}^{+}) \text{ kg}^{-1}$ . In case of acid soils, exchangeable magnesium was ranged from 0.40 to 1.90 with a mean value of 1.04  $\text{cmol (p}^{+}) \text{ kg}^{-1}$  while in neutral and alkaline soils it ranged from 0.20 to 4.50 and 0.50 to 5.20 with mean values of 2.17 and 2.59  $\text{cmol (p}^{+}) \text{ kg}^{-1}$ .

The exchangeable potassium content ranged from 0.60 to 5.39 with a mean value of 2.34  $\text{cmol (p}^{+}) \text{ kg}^{-1}$  and was found next to  $\text{Ca}^{+2}$  and  $\text{Mg}^{+2}$ . The exchangeable potassium was low compared to  $\text{Ca}^{+2}$  and  $\text{Mg}^{+2}$  which might be due to slow weathering of mica and fixation of released potassium (Balpande *et al.*, 2007). In case of acid soils, the exchangeable potassium ranged from 0.60 to 2.87 with a mean value 1.52  $\text{cmol (p}^{+}) \text{ kg}^{-1}$ , while in neutral and alkaline soils it ranged from 0.87 to 5.39 and 0.87 to 4.87 with mean values 2.24 and 2.51  $\text{cmol (p}^{+}) \text{ kg}^{-1}$ .

Among the exchangeable cations analysed from the one hundred and fourteen surface soil samples, the exchangeable sodium was found least ranging from 0.10 to 3.69  $\text{cmol (p}^{+}) \text{ kg}^{-1}$  with a mean value of 0.71  $\text{cmol (p}^{+}) \text{ kg}^{-1}$ . In case of acid

soils, exchangeable sodium ranged from 0.12 to 0.82 with a mean value of 0.44  $\text{cmol (p}^{+}) \text{ kg}^{-1}$  while in neutral and alkaline soils it ranged from 0.10 to 0.87 and 0.10 to 3.69 with mean values 0.44 and 0.91  $\text{cmol (p}^{+}) \text{ kg}^{-1}$ .

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