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Assessment of physico-chemical properties in soil from mango orchards of YSR Kadapa District of Andhra Pradesh

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Abstract
For present investigation, total 250 surface and 66 profile samples were collected from five mango orchards of YSR Kadapa District. An effort had been made to study the influence of soil depth on distribution of various physico-chemical properties. From the data, it could be concluded that the physico-chemical properties of soils of mango orchards characteristically represented typical Snady loamy soils in the 'Low Rainfall' zone in the Southern region. For improvement of physico-chemical properties of the soil, it was also concluded that, integrated nutrient approach and appropriate management practices should be followed.

Keywords: YSR Kadapa district, mango Baneeshan, physico-chemical properties

Introduction
The Indian famous and the prime variety of mango, the Baneeshan, enjoys virtual dominance both in domestic as well as international market due to its typical sugar-acid blend, attractive colour and shape, pleasant aroma, highly appreciable flavour, taste and distinctly having long keeping quality (Burondkar and Jadhav, 2009) [2].
The Baneeshan is chiefly produced in YSR Kadapa District under study. The district is geographically situated in latitude of 14.280 to 14.666 N and longitude 78.490 to 78.816 E with tropical climate and low rainfall (average annual rainfall of 753 mm). The soils of the district is mainly red and black soilsc. Here, mango is grown on plain to slightly hilly areas under rain-fed conditions.
Heavy rainfall and sloppy area possibly leads to alternation of physical and chemical properties which further affects the availability of various nutrients and finally soil fertility (Pereira *et al.*, 1986) [7]. The fertility status of soil is one of the most important factor governing the yield and quality of mango fruit. In case of mango crop, soil depth, texture, drainage, pH and native fertility are very important for sustaining its productivity. The crop is very sensitive to poor drainage and water logging conditions (Schaffer *et al.*, 1992) [13]. In addition, the crop is susceptible to higher salinity levels (Jindal *et al.*, 1975) [4].

Material and Methods
Twelve mandals encompassing YSR Kadapa district were selected from different locations namely Chitvel, Chinnamandem, Chakrayapeta, Galiveedu,Kodur, Lakkireddypalle, Penagaluru, Ramapuram, Rayachoty, Sambepalle, T.Sundupalle and Veeraballe. At each Mandal ten Villages of mango growing orchards were selected. From each of the mentioned mango orchards, 250 surface samples (0 to 30 cm) and one profile sample were collected. Thus, in all 250 surface soil samples and 64 profile samples were collected in the month of April 2019. The collection of samples, their processing, analysis and statistical analysis of data were done by following standard procedures.

Results and Discussions

Table 1: Physico-Chemical Properties of Surface Soil Samples

Parameter	Range		Average	Class
	From	To		
Sand %	35.16	66.90	52.23	Sandy Clay Loam
Silt %	10.12	23.76	17.24	
Clay %	16.83	44.40	30.71	
MWHC %	47.68	69.43	58.29	Medium to High
B. D. Mg m^{-3}	1.11	1.38	1.25	-
P.D Mg m^{-3}	2.16	2.67	2.37	-
pH	6.8	8.45	7.62	Neutral to moderatetly alkaline
EC dS m^{-1}	0.11	0.69	0.40	Normal
OC %	0.13	0.72	0.425	Low to medium

Table 2: Physico-chemical properties of chitvel profile soil samples

Mango Orchard Soil Depth (m)	Mechanical Composition			Textural class	MWHC %	BD	PD	pH	E.C. dS m^{-1}	OC %
	Sand	Silt	Clay			Mg m-3				
	%									
Chitvel										
0.00-0.18	63.55	24.12	19.66	SL	50.85	1.42	2.46	7.55	0.31	0.18
0.18-0.40	60.75	20.12	25.32	GSCL	34.12	1.39	2.34	7.73	0.33	0.16
0.40-0.55	58.40	18.49	25.11	GSCL	33.41	1.22	2.31	7.88	0.35	0.16
Mean	60.90	20.91	23.36		39.46	1.34	2.37	7.72	0.33	0.16
Chakrayapeta										
0.00-0.30	69.32	7.08	23.60	SL	50.17	1.32	2.50	7.25	0.37	0.39
0.30-0.74	68.18	9.09	22.73	SCL	49.70	1.44	2.71	7.31	0.33	0.28
0.74-1.23	58.28	9.38	32.34	SCL	46.29	1.52	2.57	7.16	0.32	0.25
1.23-1.75	54.88	24.13	20.99	SCL	45.12	1.37	2.48	7.20	0.49	0.14
1.75-2.00	77.08	8.56	14.36	SCL	46.50	1.31	2.45	7.45	0.28	0.08
Mean	65.54	11.64	22.80		47.55	1.39	2.54	7.27	0.35	0.21
Chinnamandem										
0.00-0.30	67.08	14.28	18.64	SL	56.52	1.35	2.46	7.61	0.14	0.45
0.30-0.62	69.08	15.00	15.92	SL	55.45	1.28	2.52	7.50	0.19	0.34
0.62-0.76	71.25	17.21	11.54	GSL	48.41	1.32	2.54	7.42	0.34	0.30
0.76-1.00	62.15	23.13	14.72	GSL	45.15	1.38	2.66	7.86	0.24	0.22
Mean	67.39	17.40	15.20		51.38	1.33	2.54	7.59	0.22	0.32
Galiveedu Profile I										
0.00-0.30	71.08	14.28	14.64	SL	59.80	1.28	2.61	7.85	0.28	0.49
0.30-0.60	69.08	17.28	13.64	SL	57.04	1.31	2.50	7.91	0.32	0.39
0.60-0.93	65.36	19.72	14.92	SL	52.46	1.31	2.45	7.52	0.27	0.30
0.93-1.23	63.90	24.82	11.28	SL	48.61	1.49	2.51	7.40	0.22	0.25
1.23-1.52	62.36	25.88	11.76	SL	43.25	1.51	2.49	7.40	0.24	0.22
Mean	66.35	20.39	13.24		52.23	1.38	2.51	7.61	0.26	0.33
Galiveedu Profile II										
0.00-0.20	68.80	12.28	18.92	SL	48.65	1.38	2.70	7.21	0.29	0.44
0.20-0.76	64.80	10.17	25.03	GSCL	44.82	1.58	2.83	7.40	0.19	0.35
0.76-0.99	69.32	7.08	23.60	GSCL	46.66	1.49	2.51	7.35	0.18	0.33
0.99-1.20	68.18	9.09	22.73	GSCL	40.78	1.49	2.47	7.52	0.24	0.27
Mean	67.77	9.65	22.57		45.22	1.48	2.62	7.37	0.22	0.34
Profile Mean	67.06	15.02	17.90		4.72	1.43	2.54	7.49	0.24	0.33
Koduru Profile I										
0.00-0.17	19.78	44.31	32.41	SICL	43.06	1.30	2.48	8.01	0.29	0.52
0.17-0.49	17.52	40.09	42.39	SIC	38.78	1.38	2.24	7.85	0.21	0.49
0.49-0.79	12.25	41.29	46.46	SIC	40.83	1.44	2.45	7.72	0.23	0.36
0.79-1.21	17.00	41.49	41.51	SIC	38.35	1.42	2.50	7.56	0.19	0.32
1.21-1.70	13.46	42.06	44.48	SIC	37.13	1.50	2.41	7.55	0.18	0.40
Mean	16.00	41.84	41.45		39.63	1.40	2.41	7.73	0.22	0.41
Koduru Profile II										
0.00-0.20	63.90	24.82	11.28	SL	48.65	1.38	2.70	7.26	0.16	0.38
0.20-0.41	62.36	25.88	11.76	SL	45.02	1.58	2.83	7.51	0.19	0.31
0.41-0.70	69.32	7.08	23.60	SCL	44.94	1.49	2.51	7.55	0.20	0.22
0.70-0.90	68.18	9.09	22.73	SCL	42.67	1.49	2.47	7.60	0.22	0.19
Mean	65.94	16.71	17.34		45.32	1.48	2.62	7.48	0.19	0.27
Koduru Profile III										
0.00-0.21	71.34	8.19	20.47	SCL	49.56	1.42	2.60	7.62	0.21	0.34
0.21-0.51	74.14	14.10	11.76	SL	44.82	1.39	2.51	7.71	0.23	0.28
0.51-0.81	74.07	4.32	21.61	SCL	46.66	1.35	2.59	7.82	0.29	0.21

0.81-1.10	79.41	6.18	14.41	SL	40.78	1.53	2.49	8.01	0.30	0.11
Mean	74.74	8.19	17.06		45.45	1.42	2.54	7.79	0.25	0.23
Profile Mean	52.22	22.24	25.28		43.46	1.43	2.52	7.66	0.22	0.30
Lakkireddy palle										
0.00-0.25	77.08	8.56	14.36	SL	50.17	1.32	2.50	6.91	0.14	0.27
0.25-0.60	79.08	7.00	13.92	SL	49.70	1.44	2.71	7.12	0.18	0.19
0.60-0.55	81.00	10.34	10.36	SL	46.29	1.52	2.57	7.85	0.19	0.14
0.55-1.13	70.18	9.09	20.73	SCL	45.12	1.37	2.48	7.60	0.16	0.10
Mean	76.83	8.74	14.84		48.07	1.41	2.56	7.37	0.16	0.17
Penagaluru										
0.00-0.16	54.88	24.13	20.99	SCL	49.68	1.39	2.47	7.25	0.16	0.29
0.16-0.40	58.28	9.38	32.34	SCL	56.02	1.28	2.50	7.54	0.23	0.19
0.40-0.69	22.76	37.28	39.96	CL	46.94	1.36	2.45	7.79	0.26	0.18
0.69-0.89	21.99	43.79	34.22	CL	42.67	1.37	2.42	8.01	0.21	0.11
Mean	39.47	28.64	31.87		48.82	1.35	2.46	7.64	0.21	0.19
Sambepalle										
0.00-0.19	63.90	24.82	11.28	SL	50.85	1.42	2.46	6.95	0.25	0.48
0.19-0.41	65.23	12.20	22.57	GS L	54.12	1.39	2.34	7.20	0.29	0.37
0.41-0.65	58.40	18.49	25.11	GSL	53.21	1.22	2.31	7.10	0.30	0.22
0.65-1.00	55.50	21.40	23.10	GSL	53.11	1.20	2.30	7.20	0.22	0.14
Mean	60.75	19.22	82.06		52.82	1.30	2.35	7.11	0.26	0.30
Ramapuram Profile 1										
0.00-0.20	65.32	9.08	23.60	SCL	43.06	1.30	2.48	7.52	0.11	0.35
0.20-0.49	64.18	14.09	22.73	SCL	38.78	1.38	2.24	7.68	0.13	0.22
0.49-0.67	65.28	14.38	20.34	SCL	40.83	1.44	2.45	7.88	0.14	0.16
Mean	64.92	12.51	22.22		40.89	1.37	2.39	7.69	0.12	0.24
Ramapuram Profile 2										
0.00-0.20	62.32	10.08	27.60	SCL	30.55	1.53	2.44	7.56	0.19	0.31
0.20-0.41	61.18	14.09	24.73	SCL	21.35	1.30	2.30	8.01	0.23	0.22
0.41-0.70	65.28	17.38	18.34	SCL	20.37	1.19	2.48	7.79	0.27	0.26
Mean	62.92	13.85	23.55		24.09	1.34	2.40	7.78	0.23	0.26
Profile Mean	63.92	13.18	22.8		32.49	1.33	2.39	7.73	0.17	0.25
Rayachoty										
0.00-0.30	63.55	24.12	19.66	SL	60.26	1.25	2.56	7.41	0.19	0.50
0.30-0.61	60.75	20.12	25.32	GSCL	60.54	1.18	2.62	7.10	0.23	0.40
0.61-0.99	58.40	18.49	25.11	GSL	65.51	1.22	2.64	7.25	0.28	0.29
0.99-1.16	53.52	23.40	23.08	GSL	65.51	1.28	2.76	6.98	0.31	0.22
Mean	59.05	21.53	23.92		62.95	1.23	2.64	7.18	0.25	0.35
T. sundupalle										
0.00-0.18	54.88	24.13	20.99	SCL	67.24	1.17	2.58	8.45	0.16	0.33
0.18-0.50	89.85	4.15	6.00	S	62.90	1.30	2.60	8.51	0.18	0.19
0.50-0.71	91.05	4.90	5.06	S	65.36	1.33	2.40	8.64	0.36	0.19
0.71-1.22	72.18	9.09	18.73	SCL	60.89	1.37	2.58	8.69	0.29	0.14
1.22-1.50	17.79	40.56	41.65	SCl	60.25	1.36	2.24	8.71	0.33	0.09
Mean	65.15	16.54	18.48		63.32	1.30	2.48	8.60	0.26	0.18
Veeraballe										
0.00-0.20	83.08	5.28	11.64	L S	56.07	1.29	2.58	8.22	0.30	0.36
0.20-0.42	85.00	3.64	11.36	LS	59.32	1.31	2.52	7.54	0.20	0.17
0.42-0.61	90.15	4.80	5.05	S	56.33	1.38	2.50	7.77	0.15	0.14
0.61-90	91.25	3.69	5.06	S	47.81	1.39	2.48	7.98	014	0.07
0.90-1.20	72.18	9.09	18.73	SCL	47.93	1.48	2.47	8.12	0.16	0.05
Mean	84.33	5.30	10.36		53.49	1.37	2.51	7.92	0.19	0.15

S - Sandy, SL - Sandy Loam, SCL - Sandy Clay Loam, LS - Loamy Sand, SIC - Silty Clay, SICL - Silty Clay Loam, GSL - Gravelly Sandy Loam, GSCL - Gravelly Sandy Clay Loam

The consolidated data in the above tables (table 1 and 2) is elaborated below.

The data on mechanical composition revealed dominancy of 'Sandy clay loam' textural class for surface samples and 'sandy loam' for profile samples. For all the profiles, the sand content showed a decreasing trend with soil depth with exception of T.Sundupalle and Veeraballe mandal locations. However, the higher sand content in the surface soil than in the profile may be due to less weathering of the parent material in upper surface of the soil (Sehgal, 1996). In all the mango orchards, silt content did not show any definite trend in its distribution with soil depth with an exception of Ramapuram (I) and (II),Veeraball where a decreasing trend of silt content was observed. Increasing trend of clay content with soil depth was seen for all Mandals, while Galiveedu (I), Chakrayapta and Veeraballe were found as exceptions for these findings. However, increase in the clay content with the soil depth might be due to translocation of clay fraction from the surface soil down to the profile (Subbaiah and Manickam, 1992) [17]. These results were also in conformity with Suryavanshi (2010) [18].

The bulk density at all soil profiles did not show any definite trend with exception of T.Sundupall and Veeraball mango orchards where an increasing trend of bulk density was observed. In case particle density, soil profiles showed no definite trend of decreasing with soil depth with exception of

Kodur (I) location. At Veeraballe an increasing trend of particle density with soil depth was seen.

All the surface and profile soil samples were categorized into 'medium to high' class (on the basis of ratings given by Sankaram, 1996) [12] of maximum water holding capacity. At profile samples an decreasing trend with soil depth was noticed except Rayachotymandal mango orchards. Similar findings were observed by Sankpal (2008) [11] for lateritic soils. The increasing trend of maximum water holding capacity may be due to increase in clay content with soil depth (Revandkar, 1990) [9].

The samples (surface and profile) were 'neutral to moderatly alkaline in reaction indicated slight alkaline nature of soils of mango orchards. Similar results were indicated by Gaidhani (2008) [3]. The high pH values of all mango orchards might be due to higher leaf litter addition to soil which helps in acceleration of mineralization process (Sanborn, 2001 and Wilson, 2007) [10, 19]. The data related to soil pH further showed an increasing trend for pH values with soil depth at all Mandals while Koduru (I), Koduru (II) and Chakrayapeta locations were found as exceptions for these findings. The increasing trend of pH for most of the mandals attributed to increase in soil alkalinity with depth due to deposition of basic salts by irrigation and eluviations (Patil *et al.*, 2008) [6].

Electrical conductivity for surface and profile samples were found under 'normal' class (based on the ratings given by Seth, 1967) [15] which indicated that all the mango orchards had low salt concentration. Similar results were observed by Shinde (2006) [16] for lateritic soils of Konkan. Electrical conductivity showed definite trend of incrasing with soil depth at all mango orchards with exceptions of Veeraballe and Koduru (I) locations.

In case of organic carbon, all the samples (surface and profile) were categorised as "Low to medium" (as per the ratings given by Banger and Zende, 1978) [1] indicated presence of insufficient amount of organic carbon content in the soils of mango orchards. The results are in conformity with Suryavanshi (2010) [18]. However, the high amount of organic carbon content in the soils may be attributed to luxurious growth of grasses and vegetation due to heavy rainfall and thus addition of organic matter through litter, residues and cover crops and thereby subsequent increased humification (Preethi *et al.*, 1998) [8]. The data on organic carbon content showed that all mango orchards had a decreasing trend of organic carbon with depth of soil. The high carbon content in the surface soil than subsurface layers may be attributed to profused root growth of grasses in surface layers than subsurface (Mahajan, 2001) [5].

Conclusions

From the data, it could be concluded that the physico-chemical properties of soils of mango orchards characteristically represented typical Loamy soils in the 'Low Rainfall zone in the Southren region of Andhrapradesh. The soils had higher content of sand than clay content. Also the soil samples were found to be moderately alkaline in reaction. Considering the findings, in future balanced use of organic and inorganic fertilizers along with appropriate management practices should be followed for improvement of physico-chemical properties to sustain fertility status.

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