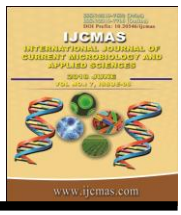
Int.J.Curr.Microbiol.App.Sci (2018) *7*(6): 582-594

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 7 Number 06 (2018)**
Journal homepage: http://www.ijcmas.com



Original Research Article https://doi.org/10.20546/ijcmas.2018.706.067

Classification and Characterization of Soils of Eturunagaram Division of Warangal District in Telangana State

E. Narsaiah[1*], T. Ramprakash[1], M. Chandinipatnaik[1], D. Vishnuvardhan Reddy[2] and G. Bhupal Raj[1]

[1]Department of Soil Science and Agricultural Chemistry, [2]Department of Crop Physiology, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad-500030, Telangana, India

**Corresponding author*

Keywords

Characterization, Nutrient status, Classification, Soils and Physical properties

Article Info

Accepted:
04 May 2018
Available Online:
10 June 2018

A B S T R A C T

Six typical pedons from Eturunagaram division of warangal district were studied for physical, physico-chemical and chemical properties of the area. The soils were shallow to very deep, dark yellowish brown to reddish brown in colour, sand to clay in texture and had varied structure including single grain, granular, sub-angular blocky and angular blocky. The clay content in soils varied from 10.5 to 62.2 per cent. The clay content increased with depth in all pedons. Silt fraction in the soils 5.0 to 28.3 per cent. The sand content in the soils under investigation varied from 15.2 to 84.5 percent. Most of the pedons exhibited more or less an increasing trend in bulk density with depth. These soils were near slightly acidic to moderate alkaline in reaction, non-saline and low to medium in organic carbon. The CEC varied from 4.8 to 49.4 cmol (p^+) kg^{-1} soil and dominated by Ca^{+2} followed by Mg^{+2}, Na^+ and K^+. The soils were low to medium in available nitrogen, low to high in available phosphorus and potassium. Available zinc was deficient to sufficient in all the horizon. The soils were sufficient in available iron, copper and manganese. The soils were classified as Typic Rhodustalfs, Typic Haplustalfs, Typic Haplusterts, Lithic Ustorthents and Vertic Haplustept.

Introduction

Soil is a component of the lithosphere and biosphere system. It is a vital natural resource on whose proper use depends on the supporting life systems and socio- economic development. The per capita cultivable land has been declining from 0.32 ha through 0.14 to less than 0.1 ha by 2020. The soil characterization determines the soil's individual inherent potentials and constraints for crop production besides giving detailed information about the different soil properties. Characterization and systematic classification of dominant soil groups is an essential tool and a pre-requisite for soil fertility evaluation and efficient soil-fertilizer-water management practices and thus crop management. The newly formed Telangana state has variable types of soils. Any progress and development

in agriculture depends largely on soil resources. Maintaining soil in the state of high productivity on sustainable basis is important for meeting basic needs of the people. Systematic study of soils is important for scientific utilization of these soils and land resources.

Materials and Methods

The pedons from the study area in eturunagaram division of warangal district, lies in Central Telangana Zone in Telangana state which lies between 18^{o} 12' & 18^{o} 20' North latitude and 79^{o} 36' & 80^{o} 07' East longitude. The study area is characterised by semi arid climatic condition, with the average rainfall of 803.2 mm (decennial average of 2004-13) of which 90.11 % is received during southwest monsoon, 4.80 % during northeast monsoon and 5.08 % during summer season. Mean monthly rainfall is highest in the month of July month (214.4 mm) followed by September (177.5 mm), August (164.1 mm) months. Annual mean maximum and minimum temperatures of the district are 32.44 ^{o}C and 23.31^{o}C respectively. The maximum and minimum mean monthly temperature ranges from 17.0^{o}C to 40.8^{o}C. The mean minimum temperature is recorded during December (17.0^{o}C) and maximum in May (40.8^{o}C). Mean annual air temperature of the district is 27.78 ^{o}C. Therefore, the temperature regime of the study area was classified as isohyperthermic. Natural vegetation comprises of *Ficus* spp, Tamarind (*Tamarindus indica*), neem (*Ajadiracchta indica*), *Prosopis* and ber (*Zizyphus jujube*) are predominated trees in the study area.

Results and Discussion

Soil morphology

The soil morphological description of the study area will be presented in the table 2.The depth of different pedons of study area of Eturnagaram division of Warangal district varied from 8 cm to 130 + cm and found to have moderately deep to very deep solum. The highest depth of horizon was found in pedon 3 of Mangapet BSS3 horizon and the lowest depth was observed the horizon of pedon 4 horizon of AP. Pedon 4 and 5 were moderately deep whereas pedons 1, 2, 3 and 6 were deep. Nasre *et al.*, (2013) noticed that soil depth is related to slope and degree of soil erosion. It was noticed that, soils developed on plateau top, escarpments, isolated hillocks and foot slopes were shallow and soils developed on undulating lands, alluvial plains and valleys were deep.

The colour of the soil pedons of Eturnagaram division of Warangal district were varied from strong brown to gray colour. Whereas hue in the range of 2.5 YR 5 YR,7.5 YR, value of 3 to 5 and chroma in the range of 2 to 6 respectively. Occurrence of iron oxides at various hydrated forms might have resulted in dark brown colour to the soils (Ramprakash and Seshagiri Rao, 2002). The texture of the pedons of study area was varied from sand to clay. The clay content in all the pedons were increased with increase in depth. Ramprakash and Seshagiri Rao (2002) observed that translocation of finer particles to lower horizons in coarse textured soils derived from resistant parent material could have resulted relatively finer texture in lower horizons. The structure of the soil pedons size of aggregate was medium, grade was week to strong, the type of aggregate was granular, sub-angular blocky to angular blocky. The pedons in the study area had single grain, sub-angular blocky and angular blocky structure. The blocky structures *i.e.*, sub-angular and angular blocky were attributed to the presence of higher quantities of clay fractions. Similar observations were reported by Meena *et al.*, (2012) in Malwa plateau of Banswara district in Rajasthan.

The consistence of the soil pedons of eturnagaram division pedons 1 to 6 varied from slightly hard to very hard, loose to very firm and nonsticky to non-plastic and very stick to very plastic, whereas in the pedon 1, 2, 3, 4, 5 were nonsticky to non-plastic and slightly sticky to slightly plastic in dry, moist and wet condition respectively. Sticky and plastic to very sticky and very plastic, firm to very firm and slightly hard to very hard consistence in wet, moist and dry conditions, respectively might be due to high clay content of the soils. Similar observations were also made by Leelavathi *et al.,* (2009) in soils of Yerpedu mandal of Chittoor district in Andhra Pradesh.

The detailed Physical properties of the study area of eturnagaram division of Warangal district presented in table 3. The sand percentage of the pedons varied from 15.2 to 84.5 per cent The highest sand percentage was found in pedon 1 (84.5 per cent) whereas the lowest sand percentage was observed in pedon (15.2 per cent) horizon of (BW2). Higher sand content in these surface soils could be attributed loss of finer fractions of soils due to erosion, movement of clay to deeper horizons due illuviation and more active chemical weathering in the lower horizons due to better availability of moisture. Similar findings were also reported by Basavaraju *et al.,* (2005)

The silt content varied from 5.0 to 28.3 per cent. The highest silt percentage was observed in pedon 6 of BW1 and lowest percentage of silt was observed in the pedon 5.0 percent. This might be due to variation in weathering of parent material or *in situ* formation. These results were in agreement with the findings of Satish Kumar and Naidu (2012a).

The clay content varied from 10.5 to 62.2 per cent**.** The highest the clay percent was recorded in the pedon 3 horizon of BSS2 (62.25 per cent) and lowest clay percentage was recorded in the pedon 1 of the AP horizon (10.5 percent). Increase in clay content with depth might be due to more intensive chemical weathering at deeper layer and eluviation of finer particles from surface horizon leaving behind coarse particles in surface layers. The enrichment of clay in Bw and Bss horizons of pedons 3 and 6 was primarily due to *in situ* weathering of parent material. Sharma *et al.,* (2004) observed an increase in clay content in sub-surface horizons as compared to surface horizons in soils of Neogal watershed in north-west Himalayas. The increase in clay content in the Bt horizon in the pedons 1, 2 and 5 is mainly due illuviation of the clay form the upper horizons. Similar enrichment Bt horizons with the clay content was reported by Ramprakash and Rao (2002) in Krishna district of Andhra Pradesh.

The bulk density of different pedons varied from 1.38 Mg m^3 to 1.85 Mg m^{-3}. The higher bulk density values in some pedons may be due to high clay content resulting in greater compaction in swelling clay soils. Similar results were reported by Ashokkumar and Jagdish Prasad (2010) who reported higher bulk density values in the soils of Ahmadnagar district of Maharashtra.

The particle density of different pedons varied from 2.55 to 2.65 Mg m^{-3}. Not much variation in the particle density was recorded among different pedons. No regular increasing or decreasing trend was recorded in particle density in any of the pedons studies in the Warangal district.

The saturated hydraulic conductivity was ranged from 0.21 cm hr^{-1} to 18.21 cm hr^{-1}. The hydraulic conductivity was recorded in the pedon 4 horizon of AP and lowest value of hydraulic conductivity. In all the pedons hydraulic conductivity decreased with increasing depth of the soil. Similar results were earlier reported by Ramprakash and

Seshagiri Rao (2002) in Vertisols and Alfisols of Krishna district. Increasing compaction of soil with the depth resulting increasing bulk density, decreasing pore density might have resulted in reduction of the hydraulic conductivity with depth in all the studies pedons.

Available water content in the study area ranged from 1.7 per cent to 15.7 per cent. The highest AWC was observed in BSS3 horizon of pedon 3. While the lowest value of Available water content is 1.7 per cent was observed in AP horizon of pedon 2. These differences in water holding capacity were due to variation in the depth, clay, silt and organic carbon content of the pedons. These results match with those of Thangasamy *et al.,* (2005) in soils of Sivagiri micro-watershed in Chittoor district of Andhra Pradesh.

The soil reaction of the study area was ranged from 6.3 to 8.8 *i.e.,* slightly acidic to strongly alkaline in reaction. The highest value of pH was observed in pedon 6 AP horizon and while the lowest pH was found in pedon 1 horizon of AP horizon. This wide variation in pH of soils was attributed to the nature of the parent material, leaching and presence of calcium carbonate and exchangeable sodium. Similar results were observed by Arun Kumar *et al.,* (2002). Furthermore, the soil reaction in these soils varied from near neutral to very strongly alkaline. The near neutral to very strongly alkaline pH may be attributed to the reaction of applied fertilizer material with soil colloids, which resulted in the retention of basic cations on the exchange complex of the soil.

The electrical conductivity ranged from 0.12 to 1.12 dSm^{-1}. The highest value of 1.12 dSm^{-1} was recorded in BW_2 horizon of pedon 6 and the lowest electrical conductivity was observed in horizon of Bt3 of pedon 5 indicating non-saline in nature. The results in the present study indicate the non-saline nature of soils. The lower electrical conductivity in soils was due to excess leaching of salts and due to free drainage conditions which favoured the removal of released bases by percolating and drainage water. Similar results were observed by Ramprasad *et al.,* (2013).

Table.1 Landscape characteristics of pedons:

Pedon	Location	Elevation above mean sea level (m)	Physiography	Slope (%)	Drainage	Parent material
1	Ramagundam	18^{0}19‘15.73”N 80^{0}27‘24.68”E	Rolling topography	3-8%	Well drained	Granite gneiss
2	Eturnagaram	18^{0}20‘08.10”N 79^{0}36‘10.72”E	Undulating inter flares with isolated mounds	3-8%	Excessively drained	Granite gneiss
3	Mangapet	18^{0}14‘59.14”N 80^{0}31‘21.97”E	Very gently sloping uplands	1-3%	Imperfectly drained with low permeability	Weathered basalt
4	Narlapur	18^{0}18‘39.41”N 80^{0}12‘22.09”E	Undulating inter flures	3-8%	Excessively drained	Granite
5	Medaram	18^{0}19‘28.01”N 80^{0}14‘36.17”E	Undulating inter flures	3-8%	Well drained	Granite gneiss
6	Govindaraopet	18^{0}12‘03.10”N 80^{0}07‘45.35”E	Valley	0-1 %	Poorly drained with moderate permeability	Alluvium – colluviums of lime stone

Table.2 Morphological description of the study area of Eturnagaram division of Warangal district in Telangana State

Horizon	Depth (cm)	Soil colour	Texture	Structure			Consistence			Efferve-scence	Boundary		Concretions $CaCO_3$		Remarks
		Moist		S	G	T	Dry	Moist	Wet		D	T	Q	S	
Pedon 1															
Ap	0-15	7.5YR 4/4	ls	m	2	sbk	sh	fr	sopo	eo	c	s	-	-	-
Bt1	15-32	2.5YR 4/4	scl	m	2	sbk	sh	fr	ssps	eo	g	s	-	-	Thin clay cutans
Bt2	32-50	2.5YR 3/4	sc	m	2	sbk	-	fi	sps	eo	c	s	-	-	Patch Thin clay cutans
Bt3	50-72	2.5YR 3/4	sc	m	2	sbk	-	fr	sps	eo	g	s	-	-	Thick clay cutans
Cr	72+	Weathered granite gneiss													
Pedon 2															
Ap	0-16	5.0YR 4/4	s			sg	l	vfr	nsps	eo	c	S	-	-	-
Bt1	16-28	5.0YR 4/4	scl	m	2	sbk	sh	fr	ssps	eo	g	s	-	-	Patchy thin clay cutans
Bt2	28-61	5.0YR 4/4	scl	m	2	sbk	-	fr	ssps	eo	a	s	-	-	Patchy thin clay cutans
C	61+	Weathered Parent Material													
Pedon 3															
Ap	0-18	10.0YR 4/2	c	m	2	sbk	-	f	sp	e	c	s	c	vf	-
BA	18-36	10.0YR 3/2	c	m	2	sbk	-	fi	vsvp	e	c	s	c	vf	-
Bss1	36-69	10.0YR 3/2	c	c	3	abk	-	vf	vsvp	es	g	s	c	f	Prominent intersecting slicken sides
Bss2	69-97	10.0YR 3/2	c	c	3	abk	-	vf	vsvp	es	c	s	c	vf	Prominent intersecting slicken sides
Bss3	97-130+	10.0YR 3/2	c	c	3	abk	-	vf	vsvp	es	-	-	c	vf	-

Horizon	Depth (cm)	Soil colour	Texture	Structure			Consistence			Efferve-scence	Boundary		Concretions $CaCO_3$		Remarks
		Moist		S	G	T	Dry	Moist	Wet		D	T	Q	S	
Pedon 4															
Ap	0-8	5.0YR 4/6	gls	f	1	sbk	l	vf	nopo	eo	c	s	-	-	15% fine quartz gravel
A2	8-18	2.5YR 3/6	gsl	m	1	sbk	s	fr	nopo	eo	g	s	-	-	60% quartz gravel
A3	18-29	2.5YR 3/4	sl	-	-	-	sh	fr	nopo	eo	g	s	-	-	55% quartz gravel
Cr	29+	Weathered Parent Material													
Pedon 5															
AP	0-18	5.0YR 3/3	sl	f	1	sbk	l	fr	nopo	eo	c	s	-	-	-
Bt1	18-40	2.5YR 3/6	scl	f	1	sbk	sh	fr	sspo	eo	c	s	-	-	-
Bt2	40-62	2.5YR 3/6	scl	f	2	sbk	sh	fr	ssps	eo	g	s	-	-	-
Bt3	62-82	2.5YR 3/6	scl	f	2	sbk	sh	fr	ssps	eo	g	s	-	-	-
Cr	82+	Weathered Parent Material													
Pedon 6															
Ap	0-16	10.0YR 3/1	c	m	3	sbk	-	fr	vsp	es	c	s	-	-	-
Bw1	16-45	10.0YR 3/3	c	m	2	sbk	-	fi	vsvp	es	a	s	-	-	Pressure faces
Bw2	45-72	10.0YR 3/2	c	m	2	sbk	-	vfi	s vp	ev	g	w	m	f	Non intersecting slickensides
Bw3	72-105	10.0YR 3/3	c	m	2	sbk	-	vfi	vsvp	ev	-	-	m	f	Non intersecting slickensides

Table.3 Physical properties of the study area

Pedon No. & Horizon	Depth (cm)	Sand (%) (0.2-0.05 mm)	Silt (%) (0.5 mm)	Clay (%) (< 0.002 mm)	Bulk density (Mg m^{-3})	Particle density (Mg m^{-3})	Hydraulic Conductivity (cm hr^{-1})	Water retention		Available Water Content (%)
								33 Kpa	1500 Kpa	
P1										
Ap	0-15	84.5	5	10.5	1.56	2.65	14.25	6.2	3.1	3.1
Bt1	15-32	70.9	6.5	22.6	1.59	2.53	8.6	12.9	6.5	6.4
Bt2	32-50	57.3	8.2	34.5	1.61	2.64	5.4	18.6	10.4	8.2
Bt3	50-72	48.5	11.4	42.5	1.62	2.58	4.2	21.2	12.8	8.4
Cr	72+	Weathered Parent Material								
P2										
Ap	0-16	84.5	5.5	8.5	1.48	2.61	16.5	4.2	2.5	1.7
Bt1	16-28	70.5	8.5	21	1.52	2.65	10.2	12.6	6.2	6.4
Bt2	28-61	60.5	9.5	30	1.52	2.62	6.5	16.5	9.1	7.4
C	61+	Weathered Parent Material								
P3										
Ap	0-18	21.5	26.5	52	1.76	2.61	1.45	30.4	20	10.4
BA	18-36	26.5	18.5	55	1.79	2.59	0.82	32.3	21.2	11.1
Bss1	36-69	28.5	14.5	57	1.81	2.52	0.54	33.8	22.1	11.7
Bss2	69-97	24.3	13.5	62.2	1.74	2.64	0.42	39.2	23.6	15.6
Bss3	97-130	21.5	19.3	59.2	1.85	2.63	0.21	36.5	20.8	15.7
P4										
Ap	0-8	83.2	6.5	10.3	1.54	2.63	18.21	6.1	3.6	2.5
A2	8-18	79.3	8.3	12.4	1.56	2.65	12.1	7.6	4.3	3.3
A3	18-29	73.2	12.3	14.5	1.62	2.64	11.8	9.2	4.9	4.3
Cr	29+	Weathered Parent Material								
P5										
AP	0-18	73.2	9.4	17.4	1.45	2.64	12.8	9.8	5.5	4.3
Bt1	18-40	64.3	8.9	26.8	1.47	2.61	8.6	15.4	8.2	7.2
Bt2	40-62	61.5	10.2	28.3	1.51	2.63	5.4	17.1	8.7	8.4
Bt3	62-82+	57.2	13.7	29.1	1.47	2.59	4.8	17.8	8.9	8.9
P6										
Ap	0-16	33.8	23	43.2	1.38	2.62	3.2	23.5	15.6	7.9
Bw1	16-45	18.3	28.3	53.4	1.39	2.65	2.9	33.6	19	14.6
Bw2	45-72	15.2	26.3	58.5	1.41	2.58	1.8	34.1	20.8	13.3
Bw3	72-105	15.8	24.3	59.9	1.52	2.65	1.5	36.1	22.1	14

Table.4 Physico chemical properties of study area

Pedon No. & Horizon	Depth (cm)	pH (1:2.5)	EC (dS m^{-1})	Organic carbon g kg^{-1}	$CaCO_3$ (%)	CEC [c mol (p+) kg^{-1}]	Exchangeable bases [c mol (p+)kg^{-1}]				ESP (%)	Base Saturation (%)
							Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}		
Pedon 1												
Ap	0-15	6.3	0.15	0.28	-	6.2	2.3	1.1	0	0.3	0	59.68
Bt1	15-32	6.7	0.13	0.35	-	11.5	5.9	2.1	0.2	0.3	1.74	73.91
Bt2	32-66	6.9	0.12	0.31	-	16.5	9.2	3.5	0.5	0.3	3.03	81.82
Bt3	50-72	7.3	0.16	0.28	-	21.2	10.5	5.7	0.6	0.2	2.83	80.19
Cr	72+	Weathered granite gneiss										
Pedon 2												
Ap	0-16	7.5	0.16	0.48	-	4.8	2.3	1.1	0	0.3	0	77.08
Bt1	16-28	7	0.34	0.4	-	10.4	4.4	1.9	0.3	1.8	2.88	80.77
Bt2	28-61	6.9	0.13	0.29	-	11.6	4.9	2.1	0.6	1.9	5.17	81.9
C	61+	Weathered Parent Material										
Pedon 3												
Ap	0-18	8.2	0.48	0.49	2.8	37.6	25.2	10.9	0.4	1.1	1.06	100
BA	18-36	8.3	0.53	0.36	3.2	39.1	26.2	10.8	0.9	1.2	2.3	100
Bss1	36-69	8.5	0.61	0.34	7.9	41.8	27.6	10.5	2.3	1.4	5.5	100
Bss2	69-97	8.5	0.58	0.3	6.5	45.6	28.9	12.4	3.1	1.2	6.8	100
Bss3	97-130	8.6	0.16	0.38	6.8	49.4	30.2	13.3	4.1	1.8	8.3	100
Pedon 4												
Ap	0-8	6.7	0.16	0.38	-	2.9	1.21	0.51	0.1	0.1	3.45	66.21
A2	8-18	6.5	0.14	0.32	-	3.7	1.49	0.66	0.1	0.2	2.74	67.12
A3	18-29	6.6	0.12	0.25	-	4.3	1.84	0.85	0.2	0.2	4.63	71.53
Cr	29+	Weathered Parent Material										
Pedon 5												
Ap	0-18	6.9	0.16	0.65	-	10.2	4.3	2.04	0.2	0.2	1.96	66.01
Bt1	18-40	6.8	0.21	0.48	-	13.4	6.1	2.31	0.2	0.2	1.49	65.65
Bt2	40-62	6.7	0.09	0.42	-	15.9	6.8	3.35	0.4	0.3	2.5	68.02
Bt3	62-82	6.8	0.12	0.39	-	17.2	7.9	3.45	0.6	0.2	3.5	71.27
Cr	82+	Weathered Parent Material										
Pedon 6												
Ap	0-16	8.8	0.15	0.72	9.8	28.5	18.1	8.5	0.3	0.9	1.05	97.54
Bw1	16-45	8.7	0.14	0.44	10.1	34.8	22.8	10.1	0.5	1	1.44	98.85
Bw2	45-72	8.6	0.42	0.32	12.2	36.5	24.3	10.2	0.6	1.1	1.64	99.18
Bw3	72-105	8.7	1.12	0.66	11.2	40.2	27.2	10.6	0.8	1.3	1.99	99.25

Table.6 Soil Nutrient Status of the Study Area

Pedon No. & Horizon	Depth (cm)	Available macronutrients			Available micronutrients				Ca/Mg	CEC/Clay
		N	P	K	Zn	Cu	Fe	Mn		
		kg ha^{-1}			mg kg^{-1}					
Pedon 1										
Ap	0-15	275	18.5	300	0.42	0.45	7.60	18.60	2.09	0.59
Bt1	15-32	252	16.5	280	0.46	0.42	6.40	17.20	2.81	0.51
Bt2	32-66	232	12.5	195	0.39	0.38	5.80	12.70	2.63	0.48
Bt3	50-72	205	10.5	156	0.28	0.32	5.40	12.50	1.84	0.50
Cr	72+	Weathered Parent Material								
Pedon 2										
Ap	0-16	285	16.5	364	1.66	1.95	23.27	12.09	2.09	0.56
Bt1	16-28	202	13.5	275	1.60	1.87	19.21	11.80	2.32	0.50
Bt2	28-61	115	10.5	186	1.50	1.40	17.31	8.60	2.33	0.39
C	61+	Weathered Parent Material								
Pedon 3										
Ap	0-18	265	19.5	364	0.49	1.28	5.80	9.65	2.31	0.72
BA	18-36	185	15.5	280	0.44	1.23	5.20	9.40	2.43	0.71
Bss1	36-69	175	12.5	260	0.36	0.72	4.60	6.50	2.63	0.73
Bss2	69-97	164	10.5	215	0.35	0.56	6.20	9.20	2.33	0.73
Bss3	97-130	155	9.5	198	0.36	0.42	4.50	7.40	2.27	0.83
Pedon 4										
Ap	0-8	208	19.0	235	0.95	0.46	6.78	5.35	2.37	0.28
A2	8-18	195	12.5	145	0.75	0.39	7.15	4.87	2.26	0.29
A3	18-29	175	10.1	109	0.87	0.54	10.06	5.45	2.16	0.30
Cr	29+	Weathered Parent Material								
Pedon 5										
Ap	0-18	292	16.5	307	0.93	1.15	8.5	22.6	2.11	0.59
Bt1	18-40	265	11.5	225	0.82	0.89	7.4	19.8	2.65	0.50
Bt2	40-62	224	8.7	185	0.64	0.65	6.6	14.2	2.04	0.56
Bt3	62-82	185	9.5	125	0.39	0.44	7.2	13.6	2.31	0.59
Cr	82+	Weathered Parent Material								
Pedon 6										
Ap	0-16	278	19.5	330	0.65	0.49	6.40	14.20	2.13	0.66
Bw1	16-45	165	25.6	245	0.60	0.41	11.6	25.6	2.26	0.65
Bw2	45-72	155	13.5	215	0.49	0.86	10.4	24.2	2.38	0.62
Bw3	72-105	145	8.5	185	0.39	0.72	8.2	15.6	2.57	0.67

Table.5 Soil Classification of the study area

Pedon 1	**:**	**Fine, mixed, isohyperthermic Typic Rhodustalfs**
Pedon 2	**:**	**Fine-loamy, mixed, isohyperthermic, Typic Haplustalfs**
Pedon 3	**:**	**Fine, smectitic, isohyperthermic TypicHaplusterts**
Pedon 4	**:**	**Loamy-skeletal, mixed, isohyperthermic Lithic Ustorthents**
Pedon 5	**:**	**Fine loamy, mixed, isohyperthermic Typic Rhodustalfs**
Pedon 6	**:**	**Fine, smectitic, isohyperthermic Vertic Haplustept**

The detailed Physico-chemical properties of the study area of Eturnagaram division of Warangal district presented in table 4. The organic carbon content in study area was found to be low to medium and ranged from 0.28 to 0.72 per cent. The highest Organic carbon was recorded in AP horizon of pedon 6 and whereas the lowest Organic carbon was recorded in AP horizon of pedon 4. Organic carbon content in all the pedons showed a decreasing trend with depth. Almost all the pedons showed a decreasing trend in organic carbon with depth, which may be due to the fact that the surface horizons showed more organic matter content than sub-surface horizons due to the addition of plant residues and farm yard manure to surface horizons which resulted in higher organic carbon content in surface horizons than in the lower horizons. This observation was in accordance with results of Basavaraju *et al.,* (2005) in soils of Chandragiri mandal in Chittoor district of Andhra Pradesh.

The $CaCO_3$ content in soil under study area ranged from 2.8 to 12.2 per cent. The highest value of $CaCO_3$ content was observed in the BW2 horizon of pedon 6 and whereas the lowest value of $CaCO_3$ content was found in the horizon of AP pedon 2. Higher contents of $CaCO_3$ observed in the lower horizons of most of the pedons might be due to high clay content which led to impeded leaching, consequently accumulation of $CaCO_3$ in the lower horizons. Similar results were reported by Ramprakash and Seshagiri Rao (2002) in soils of Krishna district, Andhra Pradesh.

The CEC value of in the study area ranged from 4.8 C mol (p+) Kg^{-1} to 49.4 C mol (p+) Kg^{-1} of soil. The highest CEC was observed in the horizon of BSS_3 of pedon 3 and while the lowest CEC was found in the horizon of AP horizon of pedon 2. The higher CEC values observed throughout the soil depth in the pedons 1 was due to illuvial accumulation of clay and also because of dominance of smectite clay mineral. These findings were amply supported by the observations of Satish Kumar and Naidu (2012) and Leelavathi *et al.,* (2010). Relatively low CEC is the reflection of parent material and higher degree of weathering leading to depletion of bases. Further, it may be due to dominance of clay minerals with low CEC especially illite and kaolinite. Similar findings were observed by Patil and Jagdish Prasad (2004) and Gangopadhyay *et al.,* (2001).

The exchangeable bases in all the pedons found to be in the order of $Ca2^{+}>Mg^{2+}>Na^{+}>K^{+}$ on the exchangeable complex. The percent base saturation on the exchange complex of soil under investigated area varied from 59.68 per cent to 100 per cent. Comparatively exchangeable bases in the present study were more or less in the order of Vertisols > Inceptisols > Entisols. The basic cations content was low in Entisols which might be due to less clay and high

silica content. Similar observations were earlier made by Sarkar *et al.,* (2001) and Arun Kumar *et al.,* (2002). Relatively higher exchangeable Ca was observed in surface horizons of some pedons which might be due to redistribution of Ca^{2+} by the vegetation.

These observations were in agreement with the findings of Patil and Jagdish Prasad (2004).

Soil classification

The detailed classification of the study area of eturnagaram division of Warangal district presented in table 5. Based on morphological, physical, physico-chemical, mineralogical and meteorological data, the soils in the study area of eturunagaram division of Warangal district were classified as Entisols, Alfisols, Inceptisols and Vertisols.

Whereas Pedon 4 do not have any diagnostic horizion and Presence of lithic contact within 50 cm of the mineral soil surface horizon were classified as Loamy-skeletal, mixed, isohyperthermic Lithic Ustorthents. Similarly, Mahapatra *et al.,* (2000) classified soils of Kashmir region into orthents at sub-order level as they exhibited regular decrease in organic carbon.

Presence of argillic horizon and base saturation of more than 50 % in all the sub-surface layers Hue of 2.5 YR or redder and Value, moist, of 3 or less and Dry value no more than 1 unit higher than the moist value were classified as Fine, mixed, isohyperthermic Typic Rhodustalfs (pedon 1 and 5).

Absence of lithic contact within 100 cm of the mineral soil surface and Absence of calcic, halic, salic and sodic horizons hence, these pedons 3were qualified to be placed under Fine, smectitic, isohyperthermic Typic Haplusterts. Ramprakash and Seshagiri Rao (2002) and Ramprakash (2005) taxonomically classified some soils of Krishna district in Andhra Pradesh,

Presence of argillic horizon, base saturation of more than 50% in all the sub-surface layers due to the absence of Lithic contact, cracks within 125 cm, lack of COLE value of more than 6.0, frigid temperatures, mesic or thermic soil temperatures, vertic properties, aquic conditions, saturation of water in any of the horizons for more than 20 days, pumice or pumice like fragments, entire lamille forms, 75% sand in the 75 cm argillic layer, calcic layer in the 100 cm depth of the pedon 2 was classified as Fine-loamy, mixed, isohyperthermic, Typic Haplustlafs.

Satyavathi and Suryanarayana Reddy (2004) and Ramprasad and Goverdhan (2011) classified the Alfisols of Telngana under Typic Rhodustlafs and Typic haplustalfs.

Pedons 6 had shown cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in normal years and slicken-sides or wedge shaped aggegates in a layer 15 cm or more thick that has its upper within 125 cm of the mineral soil surface were classified as Fine, smectitic, isohyperthermic Vertic Haplustept.

The presence of cambic sub-surface diagnostic horizon (Bw) in these pedon was recognized by the above features. Jagdish Prasad *et al.,* (2001) reported that presence of cambic sub-surface horizon was the diagnostic criteria for Inceptisols.

Hence, all the above pedons were keyed out as Inceptisols at order level. Satyavathi and Suryanarayana Reddy (2003) classified some soils of Telangana into Inceptisols based on the presence of cambic horizon.

Nutrient status

Macronutrient status

The nutrient status of the study area of eturnagaram division of Warangal district presented in table 6. The available nitrogen in the soils under present investigation ranged from 115 to 292 kg/ha. The lowest value of 115 kg ha^{-1} soil was observed in Bt1 horizon of pedon 2. The highest value of 292 kg ha^{-1} soil was noticed in AP horizon of pedon 6. The available nitrogen was found to be maximum in the surface horizons and decreased more or less with depth of the pedons, which might be due to decreasing trend of organic carbon with depth. This observation was in agreement with the results of Sarkar *et al.*, (2002) and Satish Kumar and Naidu (2012a).

The available phosphorus in soils of the study area varied from 8.5 to 25.6 kg ha^{-1} soil. The lowest value of 8.5 kg ha^{-1} soil was observed in B_3 horizon of pedon 6. The highest value of 25.6 kg ha^{-1} soil was noticed in BW_1 horizon of pedon 6. In general, higher available phosphorus was observed in the surface horizons and decreased regularly with depth. The reason for high available phosphorus in surface horizons might possibly be due to the confinement of crop cultivation to the rhizosphere which improves the organic carbon content in surface and supplementing the depleted phosphorus by external sources *i.e.*, fertilizers and presence of small amounts of free iron oxide and exchangeable Al^{3+} in the surface horizons (Thangasamy *et al.*, 2005).

The available potassium in soils of the study area ranged from 109 to 364 kg ha^{-1} soil. The lowest value of 109 kg ha^{-1} soil was observed in A3 horizon of pedon 4 and the highest value of 364 kg ha^{-1} soil was noticed in AP horizon of pedon 2 and 3 respectively. Most of the pedons exhibited more or less a decreasing trend with depth.

Slow weathering and fixation of released potassium might have resulted in low exchangeable potassium status (Ramprakash and Seshagiri Rao, 2002). Amount and type of clay, organic carbon, soil pH and CEC significantly affects the K-availability in the soil. Similar observations were also noticed by Sharma and Anil Kumar (2003) a significant and positive correlation between clay content and available K as K availability was largely controlled by clay minerals.

Micro nutrients

The available zinc was ranged for 0.28 to 1.66 mg kg^{-1} soil. The lowest value of 0.28 mg kg^{-1} soil was noticed in Bt horizon of pedon 1 and the highest value of 1.66 mg kg^{-1} of soil was recorded in AP horizon of pedon 2. The available copper in soils under study area ranged from 0.32 to 1.95 mg kg^{-1} soil. The lowest value of 0.32 mg kg^{-1} soil was observed in Bt_2 horizon of pedon 1 and the highest value of 1.95 mg kg^{-1} of soil was noticed in AP horizon pedon 2. The available iron ranged from 4.50 to 23.27 mg kg^{-1} soil. The lowest value of 4.50 mg kg^{-1} soil was recorded in BSS3 horizon of pedon 3 and whereas the highest value of 23.21 mg kg^{-1} soil was noticed in AP horizon of pedon.2. The available manganese in soils of the study area of ranged from 4.87 mg kg^{-1} to 25.6 mg kg^{-1} of soil. The lowest value of 4.87 mg kg^{-1} of soil was noticed in A_2 horizon of pedon 4 and the highest value of 25.6 mg kg^{-1} soil was observed in BW_1 horizon of pedon 6. The availability of these ions (Zn, Cu, Fe and Mn) increased with increase in organic matter because organic matter acts as a chelating agent for complexation of these micronutrients which reduces their adsorption, oxidation and precipitation into unavailable forms. Similar kind of

relationship between Zn and organic carbon was also reported by Mahesh Kumar *et al.*, (2011).

Based on morphological, physical and physico-chemical properties of eturunagaram division of warangal district were neutral to moderately alkaline, non-saline, low to medium in organic carbon and CEC. The exchangeable bases in all the pedons in the order of $Ca^{2+} > Mg^{2+} > Na^{+} > K^{+}$ on the exchange complex. Whereas, the soils were low to medium in available nitrogen, low to high in available phosphorus and potassium. Available zinc was deficient to sufficient in all the horizon. The soils were sufficient in available iron, copper and manganese. The soils were classified as Typic Rhodustalfs, Typic Haplustalfs, Typic Haplusterts, Lithic Ustorthents and Vertic Haplustept at sub group level.

References

Arun Kumar, V., Natarajan, S and Sivasamy, R. 2002. Characterisation and classification of soils of lower Palar-Manimuthar watershed of Tamil Nadu. *Agropedology*. 12: 97-103.

Basava Raju, D, Naidu M V S, Ramavatharam N, Venkaiah K, Rama Rao G and Reddy K S 2005 Characterization, classification and evaluation of soils in Chandragiri mandal of Chittoor district, Andhra Pradesh. *Agropedology* 15: 55–62.

Leelavathi, G.P., Naidu, M.V.S., Ramavatharam, N and Karuna Sagar, G. 2009. Studies on genesis, classification and evaluation of soils for sustainable land use planning in Yerpedu mandal of Chittoor district, Andhra Pradesh. *Journal of the Indian Society of Soil Science*. 57: 109-120.

Mahesh Kumar, Singh, S.K., Raina, P and Sharma, B.K. 2011. Status of available major and micronutrients in arid soils of Churu district of western Rajasthan. *Journal of the Indian Society of Soil Science*. 59(2): 188-192.

Meena, R.H., Giri, J.D., Chaudhary, S.R and Shyampura, R.L. 2012. Characterization and classification of the soils of Malwa plateau in Banswara district of Rajasthan. *Journal of Soils and Crops.* 22(2): 216-225.

Nasre, R.A., Nagaraju, M.S.S., Rajeev Srivastava, Maji, A.K and Barthwal, A.K. 2013. Characterization, classification and evaluation of soils of Karanji watershed, Yavatmal district of Maharashtra for land resource management using geospatial technologies. *Journal of the Indian Society of Soil Science.* 61(4): 275-286.

Ram Prakash, T and Rao, S.M. 2002. Characterization and classification of some soils in a part of Krishna district, Andhra Pradesh. *The Andhra Agricultural Journal*. 49: 228-236.

Ramprasad, M. Govardhan V, Praveenrao, V., and Bhave, M. H. V. 2013. Characterization and classification of rice growing soils of central Telangana region of Andhra Pradesh. *Journal of Research, ANGRAU* 41(2) 52-58.

Satish Kumar, Y.S and Naidu, M.V.S. 2012a. Characteristics and classification of soils representing major landforms in Vadamalapeta mandal of Chittoor district, Andhra Pradesh. *Journal of the Indian Society of Soil Science*. 60(1): 63-67.

Satyavathi, P. L. A and Reddy M 2004. Soil site suitability for six major crops in Telangana region of Andhra Pradesh. *Journal of the Indian Society of Soil Science*. 52(3): 220-225.

Satyavathi, P.L.A and Suryanarayan Reddy, M. 2003. Characterization and classification of shallow, medium, deep red and black soils of Northern

Telangana zone of AP. *Journal of Tropical Agriculture.* 41 (1&2): 23-29.

Sharma, V. K and Anil Kumar 2003 Characterization and classification of the soil of upper Maul Khad catchment in wet temperate zone of Himachal Pradesh. *Agropedology* 13: 39-49.

Sharma, V. K., Sharma P. D, Sharma S P, Acharya C L and Sood R K 2004a Characterization of cultivated soils of Neogal watershed in North-West Himalayas and their suitability for major crops. *Journal of the Indian Society of Soil Science.* 52: 63-68.

Thangasamy, A, Naidu M V S, Ramavatharam N and Raghava Reddy C 2005 Characterization, classification and evaluation of soil resources in Sivagiri micro-watershed of Chittoor district in Andhra Pradesh for sustainable land use planning. *Journal of the Indian Society of Soil Science*. 53: 11–21.

How to cite this article:

Narsaiah, E., T. Ramprakash, M. Chandinipatnaik, D. Vishnuvardhan Reddy and Bhupal Raj, G. 2018. Classification and Characterization of Soils of Eturunagaram Division of Warangal District in Telangana State. *Int.J.Curr.Microbiol.App.Sci.* 7(06): 582-594.
doi: https://doi.org/10.20546/ijcmas.2018.706.067