

## Characterization of Salt Affected Soils in Visakhapatnam District of North-Coastal Andhra Pradesh

**Key words :** Salt Affected Soils, Soils

As the cultivated area is diverted to non-agricultural purposes, shifting of cultivation to even problem soils has become inevitable to sustain crop production for feeding alarmingly increasing population. Department of Agriculture estimated in 1994 that the salt affected soils to an extent of 4.56 lakh ha are existing in Andhra Pradesh, of which 1.31 lakh ha are noticed in Visakhapatnam district alone (Venkata Raju and Padmanabham, 1995). The present land use of these soils is either fallow land or grazing lands for cattle or single crop paddy during *khari*. Characterization of these problem soils of Visakhapatnam district provides an insight and

understanding of the soils for effective utilization of the same for crop production.

Soil sampling was done at 50 locations and at each location, surface (0-15cm) and sub-surface (15-30cm) soil samples were collected in the salt affected areas located in different mandals of Visakhapatnam district viz., Chodavaram, K. Kotapadu, Munagapaka, Atchutapuram, Yellamanchili, Rambilli, S. Rayavaram, Anadapuram and Bheemili during 2003-04 to 2004-05. The soil types ranged from sandy, sandy loams, loams to clay loams. The soil samples were analysed for soil reaction (pH), Electrical Conductivity (EC),

Table 1. Occurrence of problem soils in Visakhapatnam district

S.No.	Characters	Soil pH	Soil Ec (dSm01)	ESP
I	CHODAVARAM mandal			
	0-15 cm	7.68 to 8.63	0.240-1.840	13-22
	15-30 cm	8.54 to 8.88	0.340-1.840	20-25
II	K.KOTAPADU mandal			
	0-15 cm	7.56 to 9.45	0.310-1.070	14-37
	15-30 cm	8.72 to 10.07	0.300-1.580	20-44
III	MUNAGAPAKA mandal			
	0-15 cm	7.92	0.790	13
	15-30 cm	8.03	0.550	17
IV	ATCHUTAPURAM mandal			
	0-15 cm	8.00 to 9.58	0.090-1.900	7-51
	15-30 cm	8.29 to 9.61	0.090-2.800	9-50
V	YELLAMANCHILI mandal			
	0-15 cm	8.12 to 8.55	1.790-4.300	21-24
	15-30 cm	8.14 to 8.56	1.400-2.700	20-21
VI	RAMBILLI mandal			
	0-15 cm	7.16 to 8.00	0.330-0.880	9-14
	15-30 cm	7.27 to 8.62	0.240-0.800	8-27
VII	S.RAYAVARAM mandal			
	0-15 cm	7.14 to 7.91	2.600-10.400	20-51
	15-30 cm	7.29 to 7.97	2.600-8.700	19-47
VIII	ANADAPURAM mandal			
	0-15 cm	8.49 to 10.13	0.260-1.030	6-41
	15-30 cm	8.42 to 10.14	0.300-1.800	6-47
IX	BHEEMILI mandal			
	0-15 cm	7.80 to 9.10	0.250-2.500	9-23
	15-30 cm	7.71 to 9.64	0.200-3.800	9-38

Table 2. Characterization of saline and alkali soils in different mandals in Visakhapatnam district.

S.No	Name of the mandal	Soil PH	SoilEC (dSm <sup>-1</sup> )	ESP	Soil Category	CEC (me/ 100 g. soil)	Exch.Na <sup>+</sup> (me/100 g.soil)	Exch.K <sup>+</sup> (me/100 g.soil)	Exch. Ca <sup>++</sup> + Mg <sup>++</sup> (me/ 100 g.soil)
<b>I CHODAVARAM</b>									
1	0-15 cm	8.05	0.700	14	Slightly alkali	25.40	3.53	0.37	21.5
	15-30cm	8.54	0.340	18	Slightly alkali	19.81	3.53	0.28	16.0
2	0-15 cm	8.42	1.000	16	Slightly alkali	31.53	5.16	0.37	26.0
	15-30cm	8.69	1.840	25	Slightly alkali	33.10	8.15	0.45	24.5
3	0-15 cm	8.33	0.240	13	Slightly alkali	23.47	3.00	0.77	19.7
	15-30cm	8.69	0.420	24	Slightly alkali	23.55	5.70	0.85	17.0
4	0-15 cm	7.68	0.310	13	Slightly alkali	23.56	3.00	0.56	20.0
	15-30cm	8.50	0.500	21	Alkali	23.72	4.89	0.83	18.0
5	0-15 cm	8.63	0.380	17	Alkali	26.30	4.35	0.45	21.5
	15-30cm	8.88	0.460	20	Alkali	28.28	5.70	0.58	22.0
6	0-15 cm	8.60	1.840	22	Alkali	42.20	9.24	0.46	32.5
	15-30 cm	8.50	1.800	21	Alkali	38.50	8.15	0.35	30.0
<b>II K.KOTAPADU</b>									
7	0-15 cm	9.45	0.740	37	Alkali	28.01	10.32	0.69	17.0
	15-30cm	10.07	1.070	44	Alkali	26.33	11.68	0.65	14.0
8	0-15 cm	8.94	0.440	27	Alkali	34.10	9.24	0.36	24.5
	15-30cm	9.18	0.560	28	Alkali	40.29	11.41	0.38	28.5
9	0-15 cm	8.64	0.320	24	Alkali	23.77	5.70	0.37	17.7
	15-30cm	8.79	0.590	25	Alkali	22.62	5.70	0.42	16.5
10	0-15 cm	8.62	0.470	25	Alkali	21.04	5.16	0.38	15.5
	15-30cm	9.20	0.860	42	Alkali	23.82	10.05	0.37	13.4
11	0-15 cm	7.56	0.650	-	Slightly alkali	19.73	3.00	0.23	16.5
	15-30cm	7.53	1.580	-	Slightly alkali	20.29	3.06	0.23	16.8
12	0-15 cm	8.95	0.450	22	Alkali	30.84	6.79	0.35	23.7
	15-30 cm	8.72	0.350	21	Alkali	27.77	5.70	0.37	21.7
13	0-15 cm	8.48	0.320	14	Slightly alkali	27.38	3.80	0.38	23.2
	15-30cm	8.77	0.300	20	Alkali	28.80	5.70	0.40	22.7
14	0-15 cm	8.75	0.310	18	Alkali	31.49	5.70	0.29	25.5
	15-30 cm	8.94	0.440	25	Alkali	27.60	6.79	0.31	20.5
<b>III MUNAGAPAKA</b>									
15	0-15 cm	7.92	0.790	13	Slightly alkali	16.37	2.17	0.20	14.0
	15-30 cm	8.03	0.550	17	Slightly alkali	12.54	2.17	0.17	10.2
<b>IV ATCHUTAPURAM</b>									
16	0-15 cm	9.58	0.470	26	Alkali	19.94	5.16	0.28	14.5
	15-30cm	9.11	0.530	25	Alkali	19.34	4.89	0.45	14.0
17	0-15 cm	9.32	0.620	26	Alkali	18.55	4.89	0.46	13.2
	15-30cm	9.49	0.400	27	Alkali	21.13	5.70	0.23	15.2
18	0-15 cm	8.25	0.100	7	Slightly alkali	11.51	0.81	0.20	10.5
	15-30cm	8.40	0.090	9	Slightly alkali	12.07	1.09	0.28	10.7
19	0-15 cm	9.22	0.400	24	Alkali	18.97	4.62	0.65	13.7
	15-30cm	9.30	0.220	24	Alkali	20.56	4.89	0.17	15.5
20	0-15 cm	8.50	1.900	18	Alkali	28.94	5.16	1.28	22.5
	15-30cm	8.52	2.800	19	Alkali	28.71	5.43	1.28	22.0
21	0-15 cm	8.78	0.350	22	Alkali	14.95	3.26	0.49	11.2
	15-30 cm	9.61	0.640	37	Alkali	25.14	9.24	0.90	15.0
22	0-15 cm	9.00	0.420	22	Alkali	18.47	4.07	0.40	14.0
	15-30cm	9.20	0.330	22	Alkali	14.81	3.26	0.35	11.2
23	0-15 cm	8.62	0.090	8	Degraded	14.12	1.09	0.33	12.7
	15-30 cm	8.80	0.120	11	alkali Soils	17.92	1.90	0.32	15.7
24	0-15 cm	8.00	0.130	13	Slightly alkali	21.23	2.72	0.51	18.0
	15-30 cm	8.29	0.090	14	Slightly alkali	22.66	3.26	0.41	19.0
25	0-15 cm	8.65	0.100	12	Alkali	19.97	2.45	0.32	17.2
	15-30cm	8.98	0.210	16	Alkali	23.83	3.80	0.33	19.7
26	0-15 cm	9.50	1.700	51	Alkali	34.95	17.66	0.49	16.8
	15-30 cm	9.40	2.200	50	Alkali	34.98	17.66	0.52	16.8

Contd...

S.No	Name of the mandal	Soil PH	SoilEC (dSm <sup>-1</sup> )	ESP	Soil Category	CEC (me/100 g. soil)	Exch.Na <sup>+</sup> (me/100 g.soil)	Exch.K <sup>+</sup> (me/100 + g.soil)	Exch. Ca <sup>++</sup> (me/100 g.soil)
<b>V YELLAMANCHILI</b>									
27	0-15 cm	8.12	1.790	24	Slightly alkali	38.04	9.24	0.60	28.2
	15-30cm	8.14	1.400	21	Slightly alkali	38.34	8.15	0.49	29.7
28	0-15 cm	8.55	4.300	21	Slightly alkali	44.57	9.24	0.63	34.7
	15-30cm	8.56	2.700	20	Alkali	40.52	8.15	0.37	32.0
<b>VI RAMBILLI</b>									
29	0-15 cm	7.88	0.670	14	Slightly alkali	34.86	4.89	0.47	29.5
	15-30cm	8.19	0.490	15	Slightly alkali	31.14	4.62	0.32	26.2
30	0-15 cm	7.16	0.330	13	Degraded alkali	29.77	3.80	0.47	25.5
	15-30cm	8.28	0.240	12	Slightly alkali	25.51	2.99	0.32	22.2
31	0-15 cm	8.00	0.540	14	Slightly alkali	23.60	3.26	1.34	19.0
	15-30cm	8.62	0.670	26	Alkali	26.42	6.79	1.43	18.2
32	0-15 cm	7.27	0.690	14	Degraded alkali	20.05	2.72	0.63	16.7
	15-30 cm	8.10	0.670	27	Slightly alkali	25.71	7.06	0.95	17.7
33	0-15 cm	7.27	0.880	9	Degraded alkali	20.73	1.90	0.83	18.0
	15-30 cm	7.37	0.800	8	Degraded alkali	21.40	1.63	0.77	19.0
<b>VII S.RAYAVARAM</b>									
34	0-15 cm	7.35	6.400	20	Degraded alkali	28.04	5.70	1.14	21.2
	15-30cm	7.82	6.800	19	Slightly alkali	25.04	4.89	1.15	19.0
35	0-15 cm	7.84	7.100	51	Degraded alkali	33.18	17.12	1.36	14.7
	15-30cm	7.93	5.800	47	Degraded alkali	33.44	15.76	1.48	16.2
36	0-15 cm	7.14	10.400	35	Degraded alkali	48.40	17.12	1.28	30.0
	15-30cm	7.29	6.600	35	Degraded alkali	46.68	16.30	1.38	29.0
37	0-15 cm	7.91	2.600	35	Degraded alkali	23.37	8.15	1.02	14.2
	15-30cm	7.97	2.600	39	Degraded alkali	20.23	7.88	1.15	11.2
38	0-15 cm	7.53	8.800	38	Degraded alkali	43.08	16.30	1.28	25.5
	15-30cm	7.47	8.700	40	Degraded alkali	43.03	17.10	1.41	24.5
<b>VIII ANADAPURAM</b>									
39	0-15 cm	9.09	0.390	14	Alkali	17.68	2.45	0.23	15.0
	15-30 cm	9.19	0.470	19	Alkali	18.77	3.53	0.24	15.0
40	0-15 cm	8.49	0.260	6	Slightly alkali	23.03	1.36	0.47	21.2
	15-30cm	8.42	0.300	6	Slightly alkali	24.22	1.36	0.36	22.5
41	0-15 cm	10.13	1.030	41	Alkali	19.11	7.88	0.23	11.0
	15-30 cm	10.14	1.190	47	Alkali	16.57	7.88	0.19	8.5
42	0-15 cm	9.78	0.430	16	Alkali	17.12	2.72	0.20	14.2
	15-30 cm	9.93	1.800	40	Alkali	24.84	10.05	0.29	14.5
43	0-15 cm	8.80	0.500	11	Alkali	28.63	3.26	0.37	25.0
	15-30cm	8.88	0.410	12	Alkali	27.83	3.26	0.37	24.2
<b>IX BHEEMILI</b>									
44	0-15 cm	8.35	0.460	11	Slightly alkali	31.32	3.53	0.59	27.2
	15-30cm	8.51	0.470	13	Alkali	34.63	4.62	0.51	29.5
45	0-15 cm	7.80	0.250	14	Slightly alkali	39.91	5.70	1.41	32.8
	15-30cm	7.71	3.800	14	Slightly alkali	40.95	5.70	1.05	34.2
46	0-15 cm	8.27	0.850	11	Slightly alkali	28.61	3.26	0.65	24.7
	15-30cm	8.32	1.160	13	Slightly alkali	30.27	4.07	0.50	25.7
47	0-15 cm	8.09	0.870	13	Slightly alkali	19.43	2.45	0.28	16.7
	15-30cm	8.27	0.200	14	Slightly alkali	21.94	3.00	0.24	18.7
48	0-15 cm	8.96	1.240	23	Alkali	25.23	5.70	0.83	18.7
	15-30 cm	9.64	1.700	38	Alkali	21.26	8.15	0.61	12.5
49	0-15 cm	9.10	0.640	23	Alkali	31.11	7.06	0.55	23.5
	15-30cm	9.41	1.060	26	Alkali	31.26	8.15	0.41	22.7
50	0-15 cm	8.41	0.250	9	Slightly alkali	14.76	1.36	0.20	13.2
	15-30 cm	8.31	1.520	9	Slightly alkali	12.60	1.09	0.31	11.2

Exchangeable Sodium Percent (ESP), Exchangeable Cations, Cation Exchange Capacity (CEC) by following standard procedures given in Jackson, (1967). The soils were classified into saline, saline-alkali and alkali soils as per USDA system of classification (USDA, 1954).

The data presented in Table 1 shows that alkali soils are located in Chodavaram, K. Kotapadu, Atchutapuram, Rambilli, Anandapuram and Bheemili mandals both in surface and sub-surface soils. Though ESP is found to be less in some locations (e.g. Atchutapuram), these soils can be treated as potential alkali soils. Krishna Moorthy (1963) reported that black soils of Rayalseema exhibited adverse soil physical properties even at lower ESP values. Saline soils are more common in those mandals which are closer to the sea coast (Atchutapuram and Rambilli), while alkali soils are found to be observed in the mandals away from sea coast (Chodavaram and K. Kotapadu mandals). Strongly saline soils are observed in S. Rayavaram mandal and saline-alkali soils are noticed in Yellamanchili mandal. The soil pH and EC is noted to increase with increasing depth in majority of soils indicating leaching of basic salts including sodium to lower layers. As these soils are located nearer to sea coast, high water table and more soluble salts might have led to accumulation of salts resulting in the formation of saline, alkali and saline-alkali soils.

These problem soils can be put to crop production through provision of drainage facility, reclaiming the saline soils by leaching of salts with good quality water (USDA, 1954), reclaiming alkali soils with amendments (Narasimham, 1986) and selection of salt tolerant crops like paddy, sugarcane, ragi, mustard, sunflower etc.

#### **Acknowledgements**

The author is highly grateful to Director of Research, Acharya N.G. Ranga Agricultural University, Rajendranagar, Hyderabad for providing facilities for carrying-out the research at Regional Agricultural Research Station, Anakapalle. The author is also grateful to Department of Agriculture, Visakhapatnam district for extending help and cooperation in collecting the samples in the district.

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(Received on 30.10.2008 and revised on 29.12.2008)