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Short communication

Nutrient Status of Some Coastal Soils of Guntur District, Andhra Pradesh

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Knowledge regarding amount and availability of nutrients is a pre-requisite before planning cultivation of any crop. Soil testing for macro and micronutrients is necessary for making fertilizer recommendations to increase crop production. As precise information on the nutrient status of the coastal soils of Guntur district, Andhra Pradesh represented by Pedapuluguvaripalem village is virtually lacking, hence the present investigation was undertaken.

The soil samples collected horizon-wise were analysed for available nitrogen by alkaline potassium permanganate method (Subbaiah and Asija, 1956), available phosphorus by Watanabe and Olsen's method and available potassium by Jackson (1973). Soil available micronutrients were estimated using standard procedures as described by Lindsay and Norvell (1978). Total micronutrients were determined following the method described by Hesse (1971).

The soils were derived from coastal marine sands (Table 1). The soils varied in their depth according to their location and topography. The soils exhibited variable texture with depth from coarse to fine except few where coarse texture existed throughout the depth. The textural variations could be due to the differential deposition of sediments at various periods. The surface horizons in most of the soils were neutral to slightly alkaline which may be due to cumulative effect of vegetation, parent material and climate. The sub-surface horizons recorded relatively higher pH due to presence of high amount of exchangeable sodium and relatively high proportion of soluble salts dominated with sodium bicarbonate and carbonate. The electrical conductivity varied from 0.41 to 8.12 dS m^{-1} with wide variation in most of the profiles (Table 2). The high electrical conductivity (EC) values could be due to the seepage of brackish water from the aquaponds present in the vicinity. The distribution of salt content varied widely in all the profiles due to variation in texture and structure of the soils. The organic carbon content of the soils ranged from 0.75 to 5.85 per cent (Table 2). Organic carbon content was higher at the surface because of addition of organic residues to the surface soil. Variable texture and fluvial nature of sediments resulted in irregular deposition of organic carbon in sub-surface. Calcium carbonate content ranged from nil to 2.1 per cent.

The available nitrogen content ranged from 28 to 247 kg ha^{-1} (Table 3). High contents were observed in the surface than in sub-surface layers which could be attributed to high organic carbon at the surface and its subsequent decrease with depth. Overall status of available nitrogen was low and irregular in most of the soils. It showed positive and significant correlation (r = +0.62) with organic carbon (Table 5). The available phosphorus ranged from 6.6 to 90.1 kg ha^{-1} (Table 3). High values were recorded in surface than sub-surface which may be due to confinement of crop cultivation to

Table 1. *Site characteristics of the soil profiles*

Profile No.	Climate	Slope (%)	Topography	Drainage	Parent material	Naturalvegetation	Land use
1	Semi-arid	0-1	Plain	Poorly drained	Coastal marine sediments	*Acacia spp*., grasses, *Borassus spp*.	paddy
2	Semi-arid	0-1	Plain	Moderately well drained	Coastal marine sediments	*Acacia spp*., grasses, *Borassus spp*.	paddy
3	Semi-arid	0-1	Plain	Excessively drained	Coastal marine sediments	Neem, *Acacia spp*., grasses, *Borassus spp*.	paddy
4	Semi-arid	0-1	Plain	Moderately well drained	Coastal marine sediments	Neem, *Acacia spp*., grasses, *Borassus spp*.	paddy

Table 2. Physical and chemical properties of soils

Profile No. & Horizon	Depth (m)	Textural Class	Clay (%)	pH	E.C. (dS m^{-1})	Organic Carbon (g kg^{-1})	$CaCO_3$ (%)
Profile – 1							
Ap	0.00-0.17	ls	7.64	7.03	0.49	0.420	-
2B	0.17-0.33	c	36.50	9.26	1.61	0.295	0.3
2Bw1	0.33-0.51	c	36.30	9.54	2.00	0.225	0.3
2Bw2	0.51-0.74	c	37.20	9.63	2.00	0.225	0.5
2Bw3	0.74-1.00	c	42.80	9.56	1.68	0.195	0.4
2Bw4	1.00+	c	43.82	9.60	1.68	0.150	2.1
Profile-2							
Ap	0.00-0.14	ls	9.29	7.53	0.41	0.325	–
A2	0.14-0.29	ls	11.49	9.06	0.64	0.106	–
2Bw1	0.29-0.49	scl	24.50	9.36	1.66	0.160	–
2Bw2	0.49-0.72	scl	21.50	9.86	1.96	0.075	–
2BC	0.72-0.96	sl	18.42	9.89	1.60	0.300	–
3C	0.96+	ls	10.20	9.86	0.97	0.180	–
Profile-3							
Ap	0.00-0.12	ls	6.89	7.78	0.54	0.585	–
AC	0.12-0.29	ls	7.50	8.12	2.88	0.225	–
C1	0.29-0.40	ls	9.20	7.92	3.56	0.196	–
C2	0.40-0.67	ls	9.10	8.06	3.44	0.165	–
C3	0.67+	ls	8.10	8.06	3.54	0.150	–
Profile-4							
Ap	0.00-0.20	ls	8.10	7.83	0.43	0.270	–
2Bw1	0.20-0.50	scl	25.57	8.86	4.93	0.150	1.2
2Bw2	0.50-0.71	scl	28.23	8.70	8.12	0.165	1.1
2Bw3	0.71-0.90	scl	27.42	8.68	6.71	0.136	0.5
3C1	0.90-0.96	sl	10.20	8.88	6.89	0.075	0.1
3C2	0.96-1.10	sl	9.20	8.93	8.07	0.075	–

the rhizosphere and supplementing of the depleted phosphorus through application of phosphatic fertilizers. Contribution of available phosphorus was significantly from ($r = +0.59$) organic matter and less by clay content ($r = -0.07$). Wide variations within a profile were observed. The available potassium content ranged from 241 to 2016 kg ha^{-1}. The high values of potassium could be attributed to intense weathering of potash bearing minerals, release of K, application of K fertilizers and upward translocation of K from lower depths with capillary rise of ground water. No specific trend was observed in coastal soils of Guntur district, which may be ascribed to the nature and distribution of parent material and its degree of weathering.

Available zinc values varied from 0.12 to 0.82 mg kg^{-1} (Table 3) among different profiles. Irregular distribution was observed in all the profiles. Most of the profiles were deficient in available Zn with content less than the critical limit of 0.8 mg kg^{-1} (Lindsay and Norvell, 1978). It showed positive correlation ($r = +0.35$) with organic carbon and negative correlation with ($r = -0.20$) with pH. The other DTPA extractable cations (Cu, Fe and Mn) were above the critical limit and were irregularly distributed. The available copper content varied from 0.38 to 5.72 mg kg^{-1} while, iron and manganese ranged from 2.60 to 35.36 and 0.89 to 14.79 mg kg^{-1}, respectively. These cations were positively and significantly influenced by organic carbon and negatively influenced by pH (Table 5).

Table 3. *Available macro and micronutrient contents of the soils*

Profile No. & horizon	Depth (m)	Available macronutrients (kg ha^{-1})				Available micronutrients (mg kg^{-1})			
		N	P_2O_5	K_2O	S (mg kg^{-1})	Zn	Cu	Mn	Fe
Profile 1									
Ap	0.00-0.17	185	90.10	470	9.75	0.50	5.36	9.22	10.80
2B	0.17-0.33	116	20.50	1344	15.25	0.26	5.00	4.30	4.08
2Bw1	0.33-0.51	97	41.00	1846	12.00	0.40	5.72	3.93	5.40
2Bw2	0.51-0.74	100	37.00	1680	16.25	0.34	5.38	3.57	4.76
2Bw3	0.74-1.00	94	32.80	2016	8.75	0.48	4.80	3.45	3.20
2Bw4	1.00_+	78	20.50	1680	10.75	0.62	5.00	4.85	2.60
Profile 2									
Ap	0.00-0.14	247	85.00	295	9.75	0.82	2.10	9.96	8.70
A2	0.14-0.29	103	20.51	322	13.00	0.12	1.40	5.66	8.10
2Bw1	0.29-0.49	81	14.60	510	7.75	0.20	2.84	2.10	6.00
2Bw2	0.49-0.72	53	10.00	497	18.50	0.24	0.94	0.89	5.82
2BC	0.72-0.96	65	8.40	483	14.00	0.32	0.80	1.28	6.32
3C	0.96+	43	6.60	295	10.50	0.12	0.48	3.13	5.70
Profile 3									
Ap	0.00-0.2	122	35.64	241	7.25	0.30	1.98	14.79	35.36
AC	0.12-0.29	75	13.85	403	17.00	0.30	1.60	7.75	11.16
C1	0.29-0.40	72	14.88	376	21.75	0.26	1.10	5.78	8.68
C2	0.40-0.67	50	17.44	322	21.25	0.24	0.82	3.62	18.08
C3	0.67+	62	15.39	302	19.00	0.28	0.74	3.26	24.16
Profile 4									
Ap	0.00-0.20	153	20.51	288	7.75	0.14	2.50	11.71	20.80
2Bw1	0.20-0.50	112	12.31	268	13.00	0.16	2.40	3.96	10.16
2Bw2	0.50-0.71	72	10.00	840	9.00	0.22	1.62	1.90	3.56
2Bw3	0.71-0.90	40	9.50	336	8.00	0.24	0.66	2.58	4.74
3C1	0.90-0.96	28	8.40	336	6.75	0.24	0.38	8.64	6.92
3C2	0.96-1.10	40	10.00	336	8.75	0.18	5.28	2.95	6.92

The total nitrogen content of the samples varied from 100 to 560 mg kg^{-1} (Table 4). In all the profiles, the total N content showed a distinct declining trend with depth which closely followed the same pattern as organic carbon except few profiles where it was irregular. This declination may be attributed to presence of higher organic carbon in the surface due to addition of organic matter through plant residues and fertilizers. Total N showed positive and significant correlation (r = +0.85) with organic carbon.

The total P content ranged from 37 to 325 mg kg^{-1} which increased with increase in fineness of the soil. Except profile 1 and 3, other two profiles showed declining trend with depth which might be due to build up of annually applied phosphatic fertilizers in the form of insoluble phosphates. The profiles exhibited high total K content ranging from 625 to 7500 mg kg^{-1}. Highest values were found in surface layers except for profile 1 and 2. The distribution of K throughout the profiles did not follow any trend.

The total Zn content varied from 16.73 to 58.48 mg kg^{-1}. The surface of all profiles had lower Zn content than the sub-surface. The distribution of Zn was apparently variable with varying soil texture. Increase in Zn content with increase in clay was observed. The total copper content varied from 17.5 to 107.5 mg kg^{-1}. The total Cu increased with increase in clay content. Total Mn concentrations were low in surface than sub-surface and total Fe also followed similar trend. The distribution and content of total micronutrient were influenced by texture organic matter and type of parent material.

Table 4. *Total macro and micronutrient contents of the soils*

Profile No. & horizon	Depth (m)	Total macronutrients (mg kg^{-1})			Total micronutrients (mg kg^{-1})			
		N	P	K	Zn	Cu	Mn	Fe
Profile 1								
Ap	0.00-0.17	420	155	2500	23.62	47.5	261	2.45
2B	0.17-0.33	320	262	3750	54.07	92.5	397	5.40
2Bw1	0.33-0.51	280	250	4500	56.13	103.5	398	5.90
2Bw2	0.51-0.74	280	300	4570	58.48	105.0	398	6.27
2Bw3	0.74-1.00	140	312	5750	58.10	107.5	357	6.96
2Bw4	1.00_{+}	100	212	3250	55.10	100.0	297	6.26
Profile 2								
Ap	0.00-0.14	560	162	1125	18.23	27.5	135	1.59
A2	0.14-0.29	140	137	1875	20.93	32.5	217	2.00
2Bw1	0.29-0.49	280	75	3750	34.70	60.0	274	2.10
2Bw2	0.49-0.72	140	37	3000	25.13	37.5	170	2.68
2BC	0.72-0.96	560	100	2500	23.80	45.0	171	2.77
3C	0.96+	280	150	1750	16.73	27.5	196	3.65
Profile 3								
Ap	0.00-0.12	560	87	1750	34.20	42.5	125	2.59
AC	0.12-0.29	280	325	1500	37.98	50.0	202	3.50
C1	0.29-0.40	280	287	895	35.72	51.5	216	2.48
C2	0.40-0.67	140	287	875	32.43	52.0	232	2.36
C3	0.67+	140	262	625	17.23	17.5	120	1.58
Profile 4								
Ap	0.00-0.20	280	162	7500	29.10	47.5	237	2.21
2Bw1	0.20-0.50	140	175	6500	37.70	70.0	257	4.22
2Bw2	0.50-0.71	140	212	5875	43.45	77.5	326	4.48
2Bw3	0.71-0.90	120	112	2500	24.20	35.0	148	2.33
3C1	0.90-0.96	100	175	1500	23.58	22.5	218	2.05
3C2	0.96-1.10	100	225	1875	24.88	32.5	474	2.02

Table 5. *Correlation coefficients (r) between elements*

Variables	'r'value	Variables	'r'value
Available N vs O.C.	0.62**	Available Zn vs pH	-0.20
Total N vs O.C.	0.85**	Available Cu vs pH	0.13
Available P_2O_5 vs O.C.	0.59**	Available Fe vs pH	-0.61**
Available Zn vs O.C.	0.35	Available Mn vs pH	-0.69**
Available Cu vs O.C	0.19	Available P_2O_5 vs clay	-0.07
Available Fe vs O.C.	0.54**	Available Mn vs O.C.	0.66**
Available K_2O vs clay	0.87**	Available Cu vs clay	0.55**

**Significant at 1%

The coastal soils exhibited low nutrient status in available and total nitrogen, low to high in available and total phosphorus and high in available and total potassium. Significant influence of organic carbon and clay was observed on macro and micronutrients. The available micronutrients exhibited sufficient levels except zinc, while total micronutrients showed wide variation according to texture, parent material and clay content.

Department of Soil Science and Agril. Chemistry
Agricultural College
Bapatla - 522 101, Guntur, Andhra Pradesh
E-mail : tantujanandy@gmail.com

T. NANDY

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