



Physico-Chemical Properties and Macronutrient Status of Soils in Kavali Revenue Division in Nellore District, Andhra Pradesh

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ABSTRACT

Two hundred soil samples (100 each surface and sub-surface) collected from 18 mandals of Kavali division in Nellore district were analysed for their physico-chemical properties and available N, P and K. The data revealed that the soils were in low organic carbon content and available nitrogen, medium to high in available phosphorus and high in available potassium. Soil pH varied from strongly acidic to strongly alkaline and non-saline to very strongly saline. The available nitrogen and phosphorus were significantly and positively correlated with the organic carbon which significantly and negatively correlated with soil pH.

Key words : Correlation, Macronutrients, pH .

Nellore district is the southern most coastal district in Andhra Pradesh. The geographical area is about 13.07 lakh ha. The study area (Kavali division in Nellore district, Andhra Pradesh) comprising of 18 mandals is located at 14° 55' to 14° 92' N longitude and 79° 59' to 79° 98' E latitude. The present study was carried out to study physico-chemical properties, available nitrogen, phosphorus and potassium status of the soils.

MATERIAL AND METHODS

Soil samples [surface (0-20 cm) and sub-surface (20-40 cm)] were collected from 100 locations covering 18 mandals of Kavali division of Nellore district. The soil samples were analysed for pH, EC, OC and available macro nutrients using standard procedures (Jackson, 1973).

RESULTS AND DISCUSSION

Physico-chemical properties of soils

It was observed that soil pHs varied from 4.81 to 10.41 with an average of 8.10. According to the classification suggested by Department of Agriculture (1984), 8 samples were acidic (pHs <6), 13 samples were neutral (pHs 6.5 to 7.5), 15 samples were mildly alkaline (pHs 7.5 to 8.0), 33 samples were moderately alkaline (pH 8.0 to 8.5) and 15 samples were strongly alkaline (pHs >8.5) in reaction. The minimum value of pHs 4.81 was observed in Bogole mandal and maximum value of pHs 10.41 was observed in Varikuntapadu mandal. The relatively high pH of the soils might be due to the presence of high degree of base saturation. The

electrical conductivity and organic carbon content of the soils varied from 0.15 to 37.00 dS m⁻¹ and 0.04 to 0.80%, with mean values of 4.33 dS m⁻¹ and 0.39%, respectively. On the basis of the limits suggested by Soil Survey Division Staff (1995) for judging the salt problem of soils, 50% of samples were normal (ECe <2 dS m⁻¹), 20% of samples were slightly saline (ECe 2 to 4 dS m⁻¹), 20% of samples were found moderately saline (ECe 4 to 8 dS m⁻¹), 4% of samples were found strongly saline (ECe 8 to 16 dS m⁻¹) and 4% of samples were found very strongly saline (ECe >16 dS m⁻¹). The organic carbon was low (<0.50%) in 81%, medium (0.50 to 0.75%) in 16% and high (>0.75%) in 3% of soil samples. High temperature and good aeration of the soil increased the rate of oxidation of organic matter resulting in low organic carbon content. The soil texture varied from sandy loam to clay. The means of soil properties and available macronutrients are presented in Table 1.

Available nutrient status

Available N varied from 43.90 to 341.80 kg ha⁻¹ with an average value of 182.51 kg ha⁻¹. On the basis of ratings suggested by Ramamoorthy and Bajaj (1969), 95% samples were low (<280 N kg ha⁻¹) and the remaining 5% samples were found to be medium (280 to 560 N kg ha⁻¹) in available N (Table 1a). A significant positive correlation ($r=0.648^{**}$) was found between organic carbon and available nitrogen (Table 2). This relationship was found because most of the soil nitrogen is in organic form. Similar results were also reported by Kanthaliya

Table 1 (a). Physico-chemical properties and available nutrient status of surface soils of the study area

S.No	Mandal	Number of samples	Surface											
			Physico-chemical properties						Available macronutrients					
			pHs		ECe (dSm ⁻¹)		OC (%)		N (kg ha ⁻¹)		P ₂ O ₅ (kg ha ⁻¹)		K ₂ O (kg ha ⁻¹)	
Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean			
1	Sitaramapuram	5	7.25-9.16	7.95	0.23-2.88	1.17	0.13-0.45	0.33	122.30-203.80	164.30	34.88-143.62	66.47	188.10-604.80	370.90
2	Udayagiri	4	7.25-10.10	8.47	0.78-2.41	1.47	0.27-0.72	0.43	156.80-250.80	194.40	14.56-153.80	89.28	215.00-739.20	464.10
3	Varikuntapadu	4	8.20-10.41	9.32	1.20-37.20	19.45	0.23-0.40	0.35	87.80-156.80	134.00	12.31-199.02	122.08	241.90-806.40	463.60
4	Dattalur	3	8.06-9.00	8.62	0.49-3.58	1.55	0.18-0.26	0.23	122.30-194.40	153.60	10.25-12.31	10.90	134.40-470.40	264.30
5	Marripadu	3	8.16-9.45	8.65	0.70-3.01	1.49	0.12-0.64	0.39	122.30-213.24	164.10	18.46-34.88	24.61	134.40-806.40	537.60
6	Vinjamur	4	7.15-9.45	8.44	0.39-2.14	1.01	0.16-0.48	0.32	94.00-181.88	133.20	12.31-88.22	49.24	376.30-873.60	547.60
7	Kaligiri	5	6.88-10.40	8.78	0.39-5.42	1.99	0.10-0.28	0.22	43.90-197.50	105.30	13.33-45.14	35.08	174.70-806.40	395.10
8	Kondapuram	5	7.80-8.21	7.99	0.73-7.10	2.06	0.50-0.72	0.62	185.00-244.60	214.40	45.14-65.65	56.21	604.80-1411.2	873.60
9	Kavali	5	6.10-9.09	8.12	0.18-11.84	4.47	0.05-0.48	0.28	90.90-188.10	147.30	28.75-65.65	39.80	188.10-537.60	376.30
10	Bogole	3	4.81-5.58	5.28	0.15-0.78	0.37	0.10-0.50	0.27	275.90-476.60	403.40	41.03-256.48	159.35	80.60-537.60	246.30
11	Jaladanki	9	8.18-10.02	8.87	0.96-19.62	5.75	0.04-0.42	0.20	62.70-203.80	147.70	24.62-162.09	64.51	107.50-443.50	271.70
12	Kowuru	7	6.08-8.52	7.69	0.39-34.13	6.94	0.12-0.72	0.43	119.10-263.40	180.00	43.08-205.18	112.55	201.60-806.40	430.00
13	Kodavatur	4	6.80-8.50	7.66	0.21-2.14	1.21	0.28-0.64	0.46	147.40-203.80	178.70	38.98-119.00	74.88	349.40-537.60	436.70
14	Alluru	3	5.30-7.80	6.17	0.18-0.44	0.33	0.54-0.62	0.58	225.70-275.90	250.80	88.22-235.96	168.93	362.80-604.80	479.30
15	Vidavatur	6	5.59-8.50	7.19	0.18-31.83	5.71	0.34-0.80	0.50	87.80-341.80	178.70	34.88-209.28	117.63	67.20-1545.60	557.70
16	Buchireddipalem	9	7.77-10.03	8.52	0.81-5.68	3.25	0.18-0.80	0.51	137.90-297.90	212.50	22.57-196.97	130.85	188.10-537.60	347.90
17	Dagadarti	14	6.80-10.24	8.23	0.18-36.41	6.52	0.21-0.72	0.42	134.80-260.20	186.00	28.72-121.05	67.26	376.30-604.80	421.40
18	Sangam	7	7.53-8.53	8.07	3.19-7.59	5.06	0.34-0.72	0.52	144.20-235.20	204.70	28.72-127.21	59.20	349.40-806.40	533.70
	Range	100	4.81-10.41	8.10	0.15-37.20	4.33	0.04-0.80	0.39	43.90-341.80	182.51	10.25-256.48	80.29	67.20-1545.60	438.82

Table1 (b). Physico-chemical properties and available nutrient status of sub-surface soils of the study area

S.No	Mandal	Number of samples	Sub Surface											
			Physico-chemical properties					Available macronutrients						
			pHs		E _{ce} (dSm ⁻¹)		OC (%)		N (kg ha ⁻¹)		P ₂ O ₅ (kg ha ⁻¹)		K ₂ O (kg ha ⁻¹)	
Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean			
1	Sitaramapuram	5	7.40-9.20	8.04	0.30-1.26	0.624	0.18-0.48	0.29	109.7-206.80	159.20	14.36-86.17	43.90	147.80-739.20	327.90
2	Udayagiri	4	7.04-10.10	8.39	0.43-1.59	1.24	0.14-0.42	0.30	128.5-181.80	155.90	12.31-77.96	45.14	120.90-940.80	584.60
3	Varikuntapadu	4	8.85-10.30	9.50	1.74-7.22	3.77	0.19-0.32	0.25	72.1-166.20	126.90	10.25-129.26	56.93	255.30-739.20	524.10
4	Dattalur	3	8.58-8.91	8.69	0.69-1.26	1.01	0.05-0.26	0.19	94.0-166.20	127.50	10.25-21.54	14.35	94.00-255.30	174.60
5	Marripadu	3	8.11-9.59	8.66	0.48-1.02	0.74	0.18-0.44	0.35	81.5-159.90	133.70	10.25-28.72	16.40	107.50-430.00	255.30
6	Vinjamur	4	7.30-9.68	8.66	0.23-5.50	1.92	0.16-0.31	0.25	100.3-194.40	152.00	26.67-45.14	34.37	201.60-524.10	419.90
7	Kaligiri	5	6.76-10.67	8.88	0.23-9.59	2.60	0.09-0.35	0.22	25.0-163.00	90.80	16.41-61.55	29.13	241.90-940.80	451.50
8	Kondapuram	5	7.72-8.59	8.22	0.61-3.90	1.33	0.19-0.58	0.38	166.2-219.50	194.40	28.75-45.14	36.11	336.00-672.00	459.60
9	Kavali	5	6.00-9.09	8.29	0.23-7.02	3.17	0.07-0.39	0.20	68.9-153.60	117.20	14.36-45.14	23.38	201.60-407.40	301.80
10	Bogole	3	5.06-6.08	5.71	0.38-0.64	0.50	0.09-0.30	0.28	181.8-200.70	190.20	28.75-92.33	66.34	40.30-80.60	53.70
11	Jaladanki	9	8.62-10.00	9.01	0.97-13.63	4.54	0.02-0.44	0.16	50.1-141.10	118.40	10.25-67.70	33.63	107.50-407.40	269.70
12	Kowuru	7	4.76-8.62	7.55	0.28-17.00	4.21	0.03-0.62	0.28	59.5-263.40	152.10	20.50-211.30	76.19	241.9-1075.20	535.60
13	Kodavatur	4	7.21-8.62	7.82	0.56-1.87	1.13	0.03-0.43	0.23	109.7-200.70	138.70	51.29-151.83	91.30	241.90-322.50	285.50
14	Alluru	3	5.71-7.18	6.39	0.20-2.31	1.01	0.22-0.45	0.33	213.2-238.30	237.20	55.39-129.26	92.32	67.20-416.60	259.80
15	Vidavalur	6	5.80-8.48	7.14	0.18-27.44	5.20	0.29-0.74	0.46	56.4-269.60	172.90	22.57-106.69	67.36	26.80-1209.60	365.10
16	Buchireddipalem	9	8.00-10.00	8.81	0.77-4.44	2.52	0.14-0.50	0.34	65.8-213.20	152.90	28.75-153.88	58.47	134.40-336.00	232.90
17	Dagadarti	14	7.18-10.30	8.44	1.23-11.26	3.69	0.21-0.60	0.36	84.6-228.90	152.70	12.31-215.44	47.91	255.30-604.80	386.40
18	Sangam	7	7.87-8.93	8.33	2.05-6.43	3.96	0.14-0.57	0.43	112.8-225.70	180.00	18.46-55.39	31.21	94.00-806.40	334.00
	Range	100	4.76-10.67	8.25	0.18-27.44	2.84	0.02-0.74	0.30	25.00-269.60	150.01	10.25-215.44	47.52	26.80-1209.60	345.06

Fig. 1: Comparison of physico-chemical properties and nutrient status in surface and sub-surface soils of Kavali division

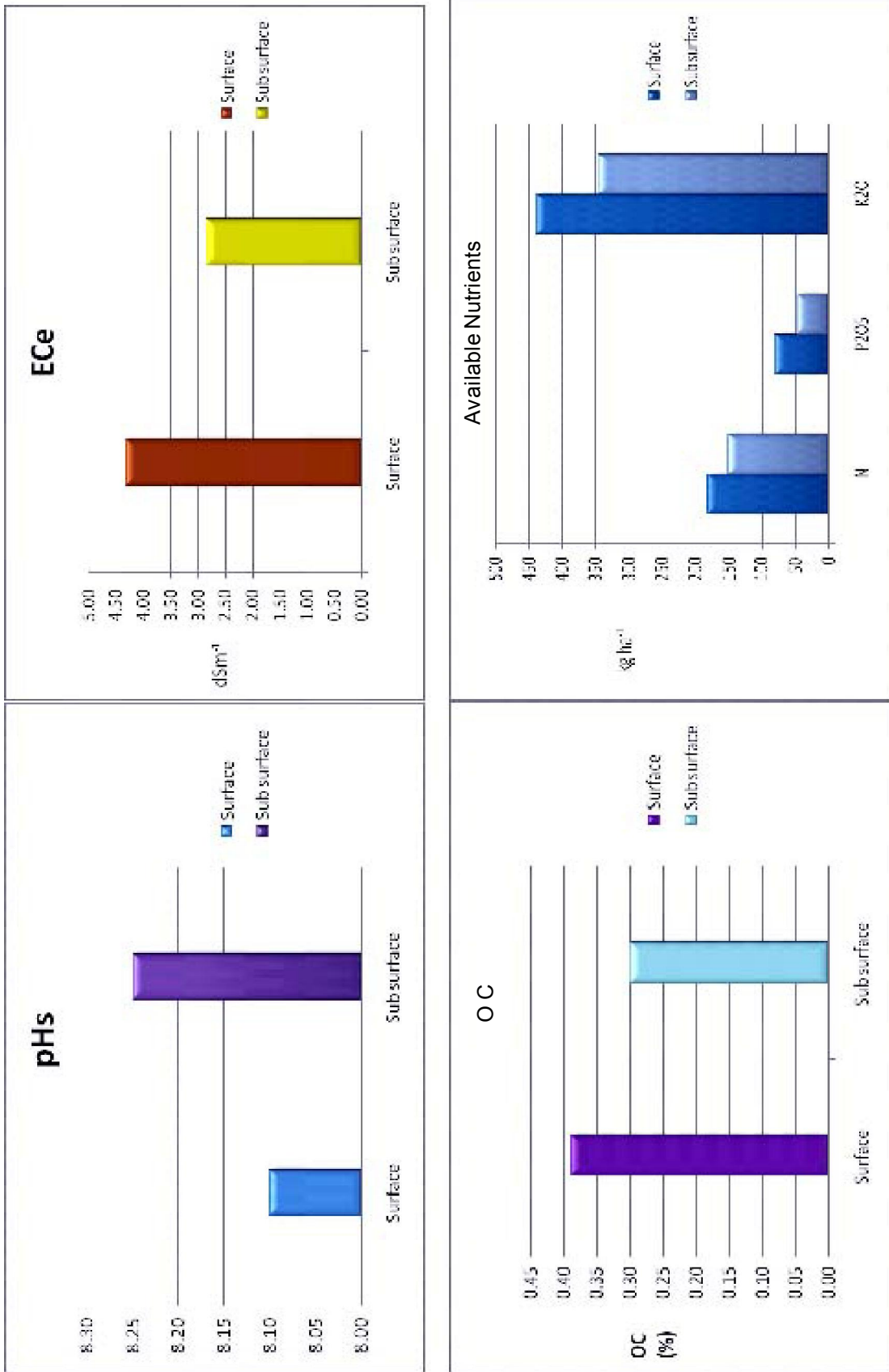


Table 2. Correlation coefficient (r) values of pH, organic carbon and calcium carbonate with macronutrients

Soil properties	Available Nutrients		
	N	P ₂ O ₅	K ₂ O
pH	-0.544**	-0.258**	-
Organic carbon	0.648**	0.271**	0.354**

** Significant at 5% level

and Bhatt (1991) and Meena *et al.* (2006). Available N was negatively correlated ($r=-0.544^{**}$) with pH. Meena *et al.* (2006) also noticed similar relation in soils of Tonk district of Rajasthan. This might be due to increased rate of denitrification at lower pH values (Tisdale *et al.*, 1997).

The available phosphorus varied from 10.25 to 256.48 kg ha⁻¹ with a mean value of 80.29 kg ha⁻¹. The range is quite large which might be due to variation in soil properties *viz.*, pH, calcareousness and organic matter content. On the basis of limits suggested by Muhr *et al.* (1965), 9% samples were low (<22.4 kg P₂O₅ ha⁻¹), 34% medium (<22.4 kg P₂O₅ ha⁻¹) and 57% samples were high (<56 kg P₂O₅ ha⁻¹) in available phosphorus. A significant positive correlation ($r=0.271^{**}$) was found between organic carbon and available phosphorus (Table 2). Similar results were reported by Meena *et al.* (2006). This relationship might be due to the presence of about 50% of total phosphorus in organic form. The products of decomposition of organic matter form protective cover and thus reduce phosphorus adsorption/ phosphate fixation (Tisdale *et al.*, 1997). Available phosphorus was significant and negatively correlated with pH ($r=-0.258^{**}$). Similar results were also recorded by Meena *et al.* (2006) in soils of Rajasthan. This may be due to precipitation of phosphorus as Ca-phosphate and thereby reducing the phosphorus availability (Tisdale *et al.*, 1997).

Available potassium (K₂O) in the soils ranged from 67.20 to 1545.60 kg ha⁻¹ with an average of 438.82 kg ha⁻¹. According to Muhr *et al.* (1965), 10% samples were low (<168 K₂O ha⁻¹), 22% samples were medium (168 to 336 K₂O ha⁻¹) and 68% samples were high (>336 K₂O ha⁻¹) in available potassium content. A significant positive correlation ($r=0.354^{**}$) was observed between organic carbon and available potassium (Table 2). Similar results were reported by Chouhan (2001) in Jodhpur district of Rajasthan and Meena *et al.* (2006) in Tonk district of Rajasthan.

Sub-surface soils have high mean pHs value (8.25) as compared with surface (8.10) soil samples. Surface soils have high mean ECe values (4.33 dS m⁻¹) as compared with sub- surface (2.84 dS m⁻¹)

soil samples. Surface soils have high mean OC, N, P₂O₅ and K₂O values (0.39%, 182.51, 80.29, and 438.82 kg ha⁻¹, respectively) as compared with sub-surface (0.30%, 160.01, 42.71, and 345.06 kg ha⁻¹, respectively) soil samples.

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