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Macronutrient Status in Upland Soils of Krishna District in Andhra Pradesh

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ABSTRACT

The present study was carried out by collecting 212 representative soil samples fromVijaywada and Nuzivedudivisions of Krishna district. The soils were found to be neutral to moderately alkaline in reaction. All the soil samples were non-saline. The soils of the region were low to medium in organic carbon. The available nitrogen, phosphorus and potassium were low, low to medium and high, respectively.

Key words: *Nutrient status, N, P, K.*

Present day exploitative agriculture, which involved efforts to increase crop yield has not only depleted our soils of their nutrient reserve, but also resulted in the emergence of a number of nutrient deficiencies. The indiscriminate use of fertilizers over a period of time has resulted in imbalance of nutrients and deficiency of nutrients like sulphur and zinc in many soils. Also the availability of land per person for agriculture has been reduced and is likely to touch the limit of 0.10 ha by 2025(Mahendra Singh, 2010)with subsequent decrease in the production of food grains. Thus there is need to increase productivity of the soils to meet the requirement of increasing population i.e, possible through measurement of fertility of an agricultural soil (soil fertility evaluation) or characterization of soils to know about the productive potential.

Therefore soil characterization in relation to evaluation of fertility status of the soils of an area or region is an important aspect in the context of sustainable production. Hence, for sustainability of the present agricultural system and for management of soil resources, a spatial data base regarding the fertility status of soils is required.

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MATERIAL AND METHODS

Krishna District is located on the East coast of India between 15 °43'N latitude and 17° 10'N. latitude and between 80°00' E longitude and 81°33'E longitude, covering an area of about 8,727 Sq.Km. It accounts for 5.36% of the total geographical area of the state. The climatic conditions of the district consist of extremely hot summers and moderately cold winters and may be classified as tropical. The period starting from April to June is the hottest. The annual rainfall in the region is about 1028 mm and is contributed mostly by the Southwest monsoon. The black cotton soil is the most extensive and occurs in all most all mandals. The Sandy Clay loams formed along with rivers and streams**.**

The present study was taken up in Vijayawada and Nuzivedu divisons of Krishna district , Andhra Pradesh which consist alluvial and associated soils. Locations were selected based on crops grown randomly and soils were dug vertically down at two different depths (0-15 & 15-30 cm), soil samples were collected for analysisfrom 29 mandals.

Nutrient indices for soils were worked out as per the following formula given by Parker *et al*. (1951).

$$NI = \left[\frac{\text{No. of samples under low category} \times 1 + \text{No. of samples under medium category} \times 2 + \text{No. of sample under high category} \times 3}{\text{Total number of samples}} \right]$$

The nutrient indices so computed were classified as low, medium and high as per the ratings proposed by Ramamoorthy and Bajaj (1969).

Table A. Soil sampling details in different mandals of Vijayawada and Nuzivedu divisions of Krishna district

S.No.	Mandal	No.of samples collected
1	A.Konduru	7
2	Reddigudem	7
3	Mylavaram	7
4	Vissanapeta	7
5	Nuzivedu	7
6	Chatrai	7
7	Jaggaypeta	11
8	Ibhrahimpatnam	8
9	Gampalagudem	8
10	Pamidimukkala	7
11	Musunuru	7
12	Tiruvuru	7
13	Nandigama	7
14	Penuganchiprolu	8
15	Vatsvai	7
16	Chandarlapadu	7
17	Kanchikacherla	7
18	Verullapadu	7
19	Penamaluru	7
20	Kankipadu	7
21	Vuyyuru	7
22	Unguturu	7
23	Gannavaram	7
24	Agiripalli	7
25	Bapulapadu	7
26	G.Konduru	7
27	Thotlavalluru	14
28	Vijayawada(Rural)	5
29	Vijayawada(Urban)	4
	Total	212

Analysis of Samples

Soil samples collected from the study area were dried and crushed with the help of wooden pestle and passed through 2 mm sieve and then used for the determination of soil reaction, organic matter, macronutrients content by adopting standard laboratory methods. Soil pH was determined by glass electrode pH meter (Jackson 1973), EC with conductivity metermethod (Jackson 1973), organic carbon by wet digestion method (Walkley and Black's rapid titration method 1934), available nitrogen was estimated by alkaline $KMnO_4$ method (Subbiah and Asija 1956), Available phosphorus was extracted by 0.5N $NaHCO_3$ solution buffer at pH 8.5 (Olsen *et al.,* 1954) and phosphorus in the extract was determined by ascorbic acid method (Watanabe and Olsen,1965), Potassium in soil was estimated by neutral normal ammonium acetate (Muhr *et al.,* 1965). Nutrient index limits as adopted by Ramamoorthy and Bajaj (1969).

RESULTS AND DISCUSSION

Physico-chemical properties:

The data pertaining to soil reaction of upland soils of Krishna district is presented in table1. The data revealed that out of 200 surface soil samples, 56.6 % were found to be neutral (pH 6.5- 7.3), 41.5% were slightly alkaline (pH 7.4-7.8) and 1.88% were moderately alkaline (pH 7.9-8.4) in soil reaction. These results are in conformation with the findings of Ramesh and Hari Prasada Rao (2005), Jamuna*et al*. (2008) and Tantuja Nandy (2010) for coastal soils of Prakasam, Vizianagaram and Guntur district of Andhra Pradesh respectively. The development of alkalinity in these soils might be due to reaction of applied fertilizers with soil colloids which resulted in the retention of basic cations on the exchange complex of soil.

Electrical conductivity (EC) of the samples varied from 0.12 to 0.72 dS m^{-1} with mean values of 0.42 dS m^{-1}. The results revealed that 100 % samples were found under normal category. Similar results were reported by Sathish Babu *et al*. (2010) and Mahesh Kumar *et al*. (2011) in coastal soils of Guntur of Andhra Pradesh and Churu district of Rajasthan. The low electrical conductivity of the soils might be due to the leaching of the soluble salts from the soils as the study area experiences good amount of rains.

The organic carbon content of soils ranged from 0.15-0.72%. According to criteria given by Ramamoorthy and Bajaj (1969), soils of the present study area were found to be low to medium. Out of 200 soil samples , 80% were found to be low whereas, 19% samples were medium. Average nutrient index of the study area as a whole with respect to organic carbon was 1.20 , which indicated that soils are low in fertility status. Low organic carbon content in these soils might be due to rapid decomposition of organic matter in semi-arid climatic conditions and poor management of soils. These results were similar with the findings of Waghmare *et al*. (2009) and Venu Madhav and Prasada Rao (2003) in black soils of Latur district, Maharashtra and Krishna western delta of Andhra Pradesh, respectively.

Nutrient status

The available nitrogen content of soil samples ranged from 113 to 298 kg ha^{-1}(Table 2)with mean values of 242 kg $ha^{-1.}$ Out of 212 soil samples 97 % were found to be low whereas, 2 % surface samples

Table 1. Physico-chemical properties of upland soils of Krishna district

S.No	Name of the mandal	pH		EC (dS m^{-1})		OC (%)	
		Range	Mean	Range	Mean	Range	Mean
1	A.KONDURU	7.17-7.78	7.47	0.12-0.50	0.36	0.22-0.40	0.30
2	REDDIGUDEM	6.82-7.63	7.41	0.23-0.52	0.37	0.15-0.50	0.35
3	MYLAVARAM	7.21-7.71	7.42	0.24-0.53	0.33	0.19-0.52	0.30
4	VISSANAPETA	7.57-7.83	7.7	0.22-0.55	0.36	0.18-0.42	0.30
5	NUZIVEDU	7.19-7.65	7.51	0.32-0.52	0.39	0.15-0.39	0.29
6	CHATRAI	6.88-7.86	7.48	0.24-0.68	0.47	0.49-0.64	0.60
7	JAGGAYPETA	7.23-7.89	7.64	0.14-0.72	0.35	0.22-0.58	0.39
8	IBHRAHIMPATNAM	7.12-7.91	7.39	0.21-0.64	0.41	0.21-0.39	0.31
9	GAMPALAGUDEM	7.19-7.82	7.46	0.12-0.39	0.26	0.24-0.42	0.32
10	PAMIDIMUKKALA	6.98-7.86	7.4	0.13-0.64	0.41	0.21-0.47	0.35
11	MUSUNURU	7.31-7.79	7.48	0.24-0.62	0.41	0.21-0.46	0.31
12	TIRUVURU	7.39-7.79	7.63	0.22-0.69	0.38	0.24-0.48	0.33
13	NANDIGAMA	7.21-7.89	7.64	0.22-0.69	0.45	0.26-0.51	0.38
14	PENUGANCHIPROLU	7.29-7.63	7.42	0.19-0.43	0.28	0.27-0.46	0.36
15	VATSVAI	6.81-7.49	7.19	0.23-0.51	0.34	0.21-0.45	0.32
16	CHANDARLAPADU	7.09-7.79	7.45	0.19-0.42	0.27	0.22-0.42	0.32
17	KANCHIKACHERLA	6.87-7.86	7.26	0.22-0.31	0.27	0.23-0.45	0.35
18	VERULLAPADU	7.01-7.43	7.28	0.19-0.52	0.34	0.24-0.46	0.33
19	PENAMALURU	7.21-8.02	7.54	0.17-0.52	0.35	0.26-0.51	0.37
20	KANKIPADU	7.09-8.42	7.6	0.21-0.39	0.27	0.27-0.47	0.38
21	VUYYURU	7.01-8.04	7.4	0.22-0.50	0.31	0.49-0.63	0.56
22	UNGUTURU	6.90-7.39	7.18	0.19-0.31	0.25	0.23-0.51	0.35
23	GANNAVARAM	7.03-7.36	7.23	0.17-0.36	0.26	0.28-0.45	0.37
24	AGIRIPALLI	7.07-7.36	7.18	0.19-0.28	0.24	0.23-0.46	0.32
25	BAPULAPADU	7.03-7.43	7.21	0.19-0.42	0.31	0.21-0.53	0.38
26	G.KONDURU	7.00-7.63	7.22	0.18-0.61	0.33	0.27-0.49	0.38
27	THOTLAVALLURU	6.82-7.38	7.15	0.21-0.39	0.26	0.39-0.72	0.56
28	VIJAYAWADA(RURAL)	6.98-7.26	7.13	0.20-0.36	0.24	0.51-0.71	0.61
29	VIJAYAWADA(urban)	7.07-7.31	7.23	0.21-0.26	0.24	0.38-0.64	0.54
	OVERALL RANGE	6.81-8.42	7.61	0.12-0.72	0.33	0.15-0.72	0.43

were medium in available nitrogen content. The nutrient index values indicated that the soils under study were low to medium in available nitrogen content as per criteria given by Ramamoorthy and Bajaj (1969). This could be attributed to low organic matter content and semiarid climate

The available phosphorus content ranged from 11.2 to 96.3 kg ha^{1} (mean 53.75 kg ha^{1}) as shown in table 2. Out of 212 samples,12.26 % were found to be low, 71.22 % samples were medium and 16%were found to be high as per ratings given by Muhr*et al*. (1965). Nutrient indices for samples were found to be 2.83 which implied that soils were mediumin fertility status. The medium content of available phosphorus in these soils might be due to regular application of phosphatic fertilizers to realise higher yields. Similar observations were earlier made by Ramesh and Hari Prasada Rao (2005) in coastal soils of Prakasam district.

The data regarding available potassium of the soil samples presented in table 2 ranged from 247 to 866 kg K_2O ha^{-1} with mean value of 557 kg K_2O ha^{-1}. Out of 212 samples, 99% of samples were found to be high as per rating suggested by Muhr*et al*. (1965). On the whole, the soils of the study area were found to be high in available potassium content with nutrient index values of 2.99. Similarly low to medium content of potassium in coastal soils of Guntur district was observed by Sathish Babu *et al*. (2010). High available potassium content in these soils might be attributed to the prevalence of potassium rich minerals like illite and potassium feldspars and high fertilizers use.

Table 2. Nutrient status of upland soils of Krishna district

S.No	Name of the mandal	Available N (kg ha^{-1})		Available P_2O_5 (kg ha^{-1})		Available K_2O (kg ha^{-1})	
		Range	Mean	Range	Mean	Range	Mean
1	A.KONDURU	216-298	254	13.2-43.2	30.47	303-498	370
2	REDDIGUDEM	185-245	220	22.1-48.3	31.09	301-684	493
3	MYLAVARAM	191-232	211	24.1-51.8	36.29	279-498	354
4	VISSANAPETA	191-273	228	11.2-21.6	17.36	318-661	467
5	NUZIVEDU	198-254	222	19.6-43.2	28.73	277-391	321
6	CHATRAI	210-270	239	21.3-55.5	34.17	271-436	329
7	JAGGAYPETA	210-289	243	26.9-55.1	44.05	268-681	386
8	IBHRAHIMPATNAM	223-279	251	21.3-52.2	38.25	303-598	430
9	GAMPALAGUDEM	201-296	239	21.2-42.6	34.85	293-577	371
10	PAMIDIMUKKALA	232-273	248	28.5-50.2	37.83	277-368	331
11	MUSUNURU	223-248	235	46.8-66.2	56.79	294-413	341
12	TIRUVURU	207-260	234	49.6-69.1	59.39	289-559	398
13	NANDIGAMA	210-257	232	22.1-69.3	43.16	291-512	382
14	PENUGANCHIPROLU	210-276	240	37.8-58.8	47.85	263-373	315
15	VATSVAI	229-276	252	20.9-46.6	28.76	273-866	453
16	CHANDARLAPADU	207-254	228	58.3-96.3	77.36	330-786	470
17	KANCHIKACHERLA	220-279	252	22.9-43.5	36.03	367-652	531
18	VERULLAPADU	213-273	244	39.8-58.7	50.87	304-629	462
19	PENAMALURU	213-273	243	33.2-57.3	52.59	274-498	382
20	KANKIPADU	210-270	241	28.6-52.8	43.11	347-514	446
21	VUYYURU	229-276	245	19.8-42.3	30	274-430	349
22	UNGUTURU	220-263	236	24.1-70.9	48.17	291-494	359
23	GANNAVARAM	213-270	244	29.4-54.0	41.97	320-483	381
24	AGIRIPALLI	210-251	229	45.5-58.4	51.93	283-514	355
25	BAPULAPADU	204-257	228	58.3-81.5	68.77	328-503	365
26	G.KONDURU	113-263	215	23.9-55.4	41.96	247-607	453
27	THOTLAVALLURU	210-276	246	19.5-61.6	35.2	286-494	387
28	VIJAYAWADA(rural)	232-282	251	40.4-53.4	46.74	331-426	371
29	VIJAYAWADA(urban)	235-270	251	33.9-55.1	45.15	299-441	394
	OVERALL RANGE	113-298	242	11.2-96.3	53.75	247-866	557

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