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Soil Fertility Evaluation of Naira Village, Srikakulam District, Andhra Pradesh

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ABSTRACT

Representative soil samples (red and black) were collected from different farmer fields in Naira village, Srikakulam district and assessed or their nutrient status. Majority of soils were light on texture. The soils ranged from acidic to neutral in reaction and normal in conductivity. Soil available nitrogen status was found to be low in all the samples. Soil available phosphorus (P_2O_5) varied from low to high. Soil potassium (K_2O) content was high in majority of samples. Available calcium and magnesium content in soils was above the critical level. Available sulphur was found to be sufficient. The soils were in micronutrient except for some ones.

Key words : Available nutrients, Micronutrients, Soil Properties.

The capacity of soil for sustaining production depends on its fertility status. A comprehensive knowledge of soil fertility status is quite essential for efficient use of any production input. The soil, a natural growth medium for all crops not only helps the crop to establish but also provides basic needs for growth, development and production on which nature survives. Soil fertility affects considerably the land use of any agro-ecosystem. Present day exploitive agriculture to increase crop yield has not only depleted soils of their native nutrient reserve, but also resulted in the emergence of a number of nutrient deficiencies. Therefore, soil characterization to evaluate fertility status of soils of an area or region is an important aspect in context of sustainable agricultural production. General idea of fertility status of larger areas is often misleading. Hence assessing fertility status at village level will be of greater importance for nutrient management with better precision. Naira village of Srikakulam district has soils with variable potential for different crops.

MATERIAL AND METHODS

A total of 114 soil samples were collected from representative areas in Naira village. Soil samples were dried, ground and passed through 2 mm sieve. The physico-chemical properties of the soils like pH, eletrical conductivity (EC), organic carbon (OC) contents as well as cation exchange capacity (CEC) and $CaCO_3$ were determined by following standard procedures.

The samples were analysed by alkaline permanganate method for soil N, Olsen's method for soil P, ammonium acetate method for K and versenate method for available Ca and Mg. Available sulphur was determined turbidimetrically using 0.15 % $CaCl_2$ extractant. DTPA extractable micronutrients were determined by Atomic adsorption spectrophoto meter.Partice size distribution was found by Bouyoucos hydrometer. Correlation among different soil properties were worked out as per the procedure given by Panse and Sukhatma (1978).

RESULTS AND DISCUSSION

Majority of soils collected from Naira village are red loamy sand, sandy loam, sandy clay loam and few were black sandy clay loam and sandy clay soils. The pH value the soils ranged from 4.40 to 7.79 with a mean of 5.92 (Table 1). About 34.3 per cent of the soil samples were found to be neutral (6.5 to 7.5) in soil reaction, 10.5 per cent of the soil samples were slightly acidic (6.0 to 6.5) while, remaining 55.2 per cent of the samples were acidic (pH < 6.0). The acidic soil reaction of soils might be due to the parent material, topography and also continuous use of acid producing nitrogenous fertilizers. On an average all the soils were foundto be non-saline with EC values ranging from 0.03 to 0.99 (mean of 0.21) dS m^{-1}. Agronomic practices also responsible for low EC due to continuous irrigation practices which resulted in leaching of salts to the lower regions. Crops can grow well in these

Table 1. Range and mean values of different physico-chemical, chemical, major and micronutrients in the soils of Naira village.

Soil properties	Red soils		Black soils		Over all	
	Range	Mean	Range	Mean	Range	Mean
pH	4.40 to 6.45	5.35	6.54 to 7.79	7.02	4.40 to 7.79	5.94
EC (dS m^{-1})	0.03 to 0.27	0.10	0.14 to 0.99	0.42	0.03 to 0.99	0.21
OC (%)	0.15 to 0.99	0.39	0.23 to 0.86	0.48	0.15 to 0.99	0.42
CEC (cmole (p^+) kg^{-1})	10.30 to 29.80	17.82	20.40 to 42.15	28.77	10.30 to 42.15	23.66
$CaCO_3$ (%)	Nil	Nil	0.0 to 1.75	0.20	0.0 to 1.75	0.07
N (kg ha^{-1})	135 to 256	199.50	138 to 60	202.00	135 to 260	200.00
P_2O_5 (kg ha^{-1})	20.45 to 86.18	39.62	20.52 to 59.86	41.52	20.45 to 86.18	40.27
K_2O (kg ha^{-1})	101 to 489	196.00	134 to 510	333.00	101 to 510	243.00
Ca (cmole (p^+) kg^{-1})	2.60 to 22.25	11.55	12.25 to 25.34	17.72	2.60 to 25.34	13.66
Mg (cmole (p^+) kg^{-1})	0.5 to 6.25	1.89	3.25 to 10.45	18.25	0.50 to 10.45	3.45
S (ppm)	8.8 to 42.5	16.20	10.00 to 64.20	34.00	8.8 to 64.20	22.27
Fe (ppm)	12.57 to 88.34	40.96	8.26 to 78.91	34.86	8.26 to 88.34	38.87
Cu (ppm)	0.61 to 4.69	1.96	0.55 to 6.0	3.15	0.55 to 6.00	2.36
Zn (ppm)	0.31 to 2.96	1.05	0.66 to 2.45	1.48	0.31 to 2.96	1.20
Mn (ppm)	15.22 to 74.45	34.60	5.10 to 36.80	16.69	5.10 to 74.45	28.47

soils because of non saline nature. The organic carbon content in soils ranged from 0.15 to 0.99 per cent with a mean of 0.42 per cent. Only 3.5 per cent of soils were under high, 29.0 per cent of soils under medium and remaining 67.5 per cent of samples were low in organic carbon status. Low organic carbon content in soils might be due to high temperature and good aeration in the soils which increase the rate of oxidation of organic matter. CEC of soils ranged from 10.30 to 42.15 cmole (p^+) kg^{-1} with a mean value of 23.66 cmole (p^+) kg^{-1}. Soils with clayey contained higher amounts CEC compared to the soils with sandy loam and sandy clay. CEC had significant positive correlation with clay (0.992**) content in these soils. Calcium carbonate content in these soils ranged from nil to 1.75 %. Some of the black soils were having calcium carbonate content and remaining soils did not have calcium carbonate content.

The available nitrogen content in soils varied from 135 to 260 kg ha^{-1} with a mean of 200 kg ha^{-1}. The nutrient index value is 1.0 indicating that soils under study were low in nitrogen fertility status. All these soils were recorded as low in status with respect to nitrogen. Nitrogen content had significant positive correlation with organic carbon (0.488**). The low available nitrogen status of these soils might be attributed to low organic matter content. Further the semi-arid conditions of the area might have favoured the rapid oxidation and less accumulation of organic matter releasing more NO_3-N, which could have been lost by leaching, which was in accordance with the earlier reports of Prasad *et al.* (1997), Revathi *et al.* (2005) and Srinivas *et al.* (2011).

The available phosphorus content in soils varied from 20.45 to 86.18 with a mean of 40.27 kg P_2O_5 ha^{-1}. Out of all 10.5 per cent of samples were rated as low, 62.3 per cent of samples were under medium and remaining 27.2 per cent of samples were high in available phosphorus status. The nutrient index value for available P_2O_5 of 2.16 indicated the medium status of

Table 2. Correlation coefficients (r) among different physic-chemical properties, major and micronutrients in soils

	pH	EC	O.C	Clay	CEC	$CaCO_3$	N	P	K	S	Ca	Mg	Zn	Mn	Fe	Cu
pH	1.000	0.704	0.178	0.532	0.561	0.394	-0.024	-0.034	0.478	0.678	0.520	0.709	0.246	-0.527**	-0.216*	0.473
EC		1.000	0.346	0.535	0.569	0.352	0.143	0.145	0.601	0.738	0.513	0.654	0.239	-0.500	-0.240	0.544
O.C			1.000	0.469	0.481	0.043	0.488**	0.620	0.595**	0.311**	0.494	0.338	0.157	0.072	0.089	0.514
Clay				1.000	0.992**	0.172	0.147	0.256	0.723**	0.576	0.953**	0.813**	0.197	-0.369	-0.204	0.674
CEC					1.000	0.199	0.149	0.265	0.751**	0.593	0.960**	0.836**	0.200	-0.413	-0.198	0.681
$CaCO_3$						1.000	-0.119	-0.108	0.245	0.292	0.200	0.239	0.042	-0.343	-0.363	0.220
N							1.000	0.512	0.273	0.166	0.124	0.116	-0.140	0.170	0.218	0.254
P								1.000	0.307	0.141	0.241	0.089	-0.191*	0.126	0.144	0.324
K									1.000	0.542	0.712	0.664	0.209	-0.376	-0.175	0.657
S										1.000	0.528	0.686	0.305	-0.454	-0.164	0.576
Ca											1.000	0.742	0.191	-0.359	-0.209	0.643
Mg												1.000	0.377	-0.570	-0.145	0.604
Zn													1.000	-0.195	-0.060	0.243
Mn														1.000	0.230	-0.175
Fe															1.000	-0.153
Cu																1.000

** 0.01 % Level of significance * 0.05% Level of significance

available phosphorus in the soils. Available phosphorus positive significant correlation with organic carbon (r = 0.620**) and clay content (r = 0.256**). The medium to high values of available phosphorus in soils might be attributed to regular application of inorganic phosphatic fertilizers. Similar results were observed by Jamuna *et al.* (2008) and Srinivas *et al.* (2011). The available potassium content of the soil samples ranged from 101 to 510 with a mean value of 243 kg K_2O ha^{-1}. About 61.5 per cent of the soil samples were medium in available potassium status, 17.5 per cent were in low and the remaining 21 per cent were high in their status. The nutrient index value of 2.1 indicated that the soils under investigation were medium in available potassium content. The high available potassium status of soils could be ascribed due to more weathering of potassium bearing minerals and clay content. Available potassium showed highly positive and significant correlation with CEC (r = 0.751**) and clay (r = 0.723**) content of soil, which was in tune with the previous findings of Ramesh and Rao (2005) and Revathi *et al.* (2005).

The available calcium content of the soil samples ranged from 2.60 to 25.34 cmole (p^+) kg^{-1} with a mean value of 13.66 cmole (p^+) kg^{-1}. All the soil samples were sufficiently rich in calcium content showing above critical limit of 2 cmole (p^+) kg^{-1}. Higher values of available calcium were noticed in soils having high CEC as was also corroborated by a highly positive significant correlation (r = 0.960**) (Table 2). Available calcium content also showed significant positive correlation with clay (r = 0.953**) and organic carbon (r = 0.494**) which was in accordance with the earlier reports of Rao *et al.* (2005), Rashmi *et al.* (2009) and Gupta *et al.* (2005). The available magnesium content of the soil samples ranged from 0.50 to 10.45 with a mean value of 3.45 cmole (p^+) kg^{-1}. Available magnesium content showed positive correlation with organic carbon (r = 0.338**), clay (r = 0.813**) and CEC (r = 0.836**). All the soils analyzed were found to be under the category of above critical limit of 0.5 cmole (p^+) kg^{-1}. Similar results were also observed by Rao *et al.* (2005) and Gupta *et al.* (2005). The available sulphur content of the soil samples ranged from 8.80 to 64.20 with a mean value of 22.2 ppm. On the whole, majority of the soils were found to be above critical limit of 10 ppm in available sulphur content. Available sulphur content was found to be significantly correlated with organic carbon (r = 0.258**), clay (r = 0.555**) and CEC (r = 0.568**) indicating that the availability of sulphur in these soils is a function of organic matter and clay content as well as CEC. Presence of sufficient level of available sulphur in these soils might be due to continuous addition of sulphur containing inorganic fertilizers like single super phosphate, ammonium sulphate and gypsum fertilizers besides organic sources which enhanced the sulphur level in soils. These findings were in accordance with the previous findings of Jat and Yadav (2006) and Gupta *et al*. (2005).

The maximum and minimum available iron content of all the soil samples ranged from 8.26 to 88.34 ppm with a mean value of 38.87 ppm. All the soils were found to be well above the critical limit of 4.0 ppm. The amount of available iron content is influenced by $CaCO_3$ and soil reaction. This study showed that the available iron content negatively correlated with $CaCO_3$ (r = -0.363**) and pH (r = -0.206*). Similar results were established by Prasad *et al.* (1997) and Satyavathi and Reddy (2004). Available manganese content in soils varied from 5.10 to 74.45 ppm with a mean value of 28.47 ppm. Considering 3 ppm as the critical limit for manganese, all the soil samples were found to be sufficient in manganese content. Available manganese content showed a negative correlation with pH (r = -0.512**), $CaCO_3$ (r = -0.343**) and clay (r = -0.369**) content. According to Pharande *et al.* (1996) higher available manganese values in soils could be due to soils derived from basaltic parent material which contained higher ferromagnesium minerals. These findings were in tune with the findings of Ramesh and Rao (2005) and Dhage *et al.* (2000).

The available copper content in soil samples were varied from 0.55 to 6.00 with a mean of 2.36ppm found to be above the critical limit (0.2ppm) in the available copper content indicating that these soils were adequately supplied with copper. Available copper showed positive correlation with soil pH (r = 0.479**), organic carbon (r = 0.514**), clay (r = 0.674**), CEC (r = 0.681**) and $CaCO_3$ (r = 0.220**) content. The high copper content of these soils might be due to the indiscriminate application of copper fungicides for plant protection, which was also confirmed by Satyavathi and Reddy (2004), Pharande *et al.* (1996) and Ramesh and Rao (2005). The available zinc content ranged from 0.31 to 2.96 ppm with a mean value of 1.20 ppm. About 15.8 per cent samples below critical limit (0.7 ppm) and remaining 84.2 per cent of samples were above critical limit. Available zinc showed significant and positive correlation with soil pH (r = 0.226*), organic carbon (r = 0.157*), CEC (r = 0.200*) and clay (r = 0.197*) content. The present study also showed significant negative correlation between available zinc content and available phosphorus (r = -0.191*). These results were endorsed by Diwale and Chavan (1999) and Pharande *et al.* (1996).

From this study it is concluded that 67.5 per cent soils were low in organic carbon, all the soils were low in available N, 62.3 per cent soils were medium in available P_2O_5 and 61.5 per cent soils were medium in available K_2O content. All the secondary and micronutrients were found to be sufficient in respective critical levels. This study clearly indicated that addition of organic manures and incorporation of crop residues to soils would increase availability of nutrients in the soil.

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