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PHYSICO-CHEMICAL PROPERTIES OF SALT AFFECTED SOILS OF YERPEDU MANDAL OF CHITTOOR DISTRICT OF ANDHRA PRADESH

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ABSTRACT

Thirty one representative surface soil samples collected from 11 villages of Yerpedu mandal were analyzed for physico-chemical properties. Soils were slightly to strongly alkaline in reaction and non saline to strongly saline. Texturally soils were classified as loamy sand, sandy loam, sandy clay loam, sandy clay, clay loam and clay. The soils were low in organic carbon (0.28%), calcareous (7.53% $CaCO_3$) and cation exchange capacity varied from 36.28 to 69.22 c mol (p+) kg^{-1} soil. The soil organic carbon per cent was low (0.28%), soils were calcareous (7.53% $CaCO_3$), cation exchange capacity (CEC) ranged from 36.28 to 69.22 c mol (p+) kg^{-1} and ESP varied from 7.03 to 37.83 with a mean value of 19.75.

KEYWORDS: Physico-chemical properties, salt affected soils, sodic, saline-alkali.

INTRODUCTION

All the soils contain some amount of soluble salts, which are essential for the healthy growth of plants. If the quantity of these soluble salts in soil exceeds certain value, the growth and yield of crops are adversely affected. Soils, with excess soluble salts, are called the salt affected soils. Soils turn saline generally due to weathering of parent materials (causing fossil or primary salinity), or from anthropogenic activities involving the improper management of land and water resources (contributing to man-made or secondary salinity). It is estimated that 8.09 M ha of land in India was with salt affected soils and causing degradation of land and pose serious problem for the productivity of crops. Hence, characterization of these soils is a pre- requisite for the profitable soil management and sustainable crop production. The present investigation was taken up to study the physico-chemical properties and to characterize salt affected soils of Yerpedu mandal.

MATERIALS AND METHODS

Thirty one surface (0-20 cm) soil samples were collected from farmer fields of 11 villages of Yerpedu mandal having salinity/ sodicity problems. Collected soil samples were analyzed for pH and ECE from saturation extract as described by Jackson (1973). The soil organic carbon was estimated by wet digestion method of Walkey and Black (1934).

The CEC was analyzed as per the standards method of Bower *et al.* (1952), while soil texture and free $CaCO_3$ were determined as per Piper (1966).

RESULTS AND DISCUSSION

Soil texture

The clay content of soils of Yerpedu mandal ranged from 6.92 to 45.29 per cent with a mean value of 28.25 per cent, indicating that the soils varied from loamy sand to clayey as shown in Table 1. The wide variation in the texture of the soils might be attributed to the differences in composition of parent material in the study area. Similar results were also reported by Kumar *et al* (2013).

Soil reaction

It is evident from the data that pH of the soils varied between 7.60 to 10.04 with a mean value of 8.68 indicating that soils were slightly alkaline to strongly alkaline in reaction (Table 1).The distribution of soil samples into different pH classes (7.5 to 8.0, 8.0 to 8.5, >8.5) as suggested by Brady and Well (2007) indicated that 61.3 per cent of soil samples were strongly alkaline while 25.8 and 12.9 per cent samples were mildly and moderately alkaline in reaction respectively. High

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alkalinity in the study area might be due to increase in soluble sodium, clay and $CaCO_3$.

Electrical conductivity

The values of ECe varied between 0.49 and 9.58 dSm^{-1} with a mean value of 2.33 dSm^{-1}. The highest value of 9.58 dSm^{-1} was observed in Pagali village while lowest value of 0.49 $dSm^{-1}$was seen in Jangalapalli village. According to the classification given by soil survey division staff (1995), 51.6, 38.71, 6.45 and 3.22 per cent of soil samples were non-saline, slightly saline, moderately saline and strongly saline respectively. Relatively higher soluble salt content in soils of study area was mainly due to semi-arid climate where temperature was very high due to which water table moves below the root zone leaving behind the salts on the surface leading to high concentration of soluble salts in surface. Similar results were also reported by Mandal and Sharma (1997)

Organic carbon

The soils in the study area were poor in organic carbon status (with the average value less than below 0.5 per cent). Only two villages Rajulapallem and Gudimallem of Yerpedu mandal had shown organic carbon more than 0.5 per cent. The organic carbon content of different villages in Yerpedu mandal varied from 0.05 (Pagali) to 0.78 per cent (Gudimallem) with a mean value of 0.28 per cent. As per the ratings for organic carbon proposed by Ramoorthy and Bajaj (1969) majority of soils falls under low organic carbon status (87.1 per cent), while 9.7 and 3.2 per cent of soil samples were medium and high respectively. The low organic carbon status in study area is due to lesser application of organic manures mainly FYM by the farmers, high temperatures and good aeration in the soil which increases the rate of oxidation of organic matter. Furthermore higher pH and presence of considerable amount of $CaCO_3$ might be responsible for lowering the organic carbon status of the soils. These findings were in conformity with the findings of Dhale and Prasad (2009).

Calcium carbonate

The $CaCO_3$ content varied from 0.50 (Jangalapalli) to 16.00 per cent (Rajulapallem) with a mean value of 7.53 per cent indicating the calcareous nature of the soils. This might be due to presence of higher amount of clay in the soils and existence of semi-arid climate and also due to less leaching of calcium because of high clay content and dry season resulted in accumulation of more $CaCO_3$ in soils. The findings were in tune with Kawde Kawade *et al.* (2005).

Cation exchange capacity

The CEC values of soils of Yerpedu mandal ranged from 36.28 to 69.22 c mol (p+) kg^{-1} with a mean value of 52.97 c mol (p+) kg^{-1}. The highest value of 69.22 and lowest value of 36.82 c mol (p+) kg^{-1} was reported in Modugulapalem and Jangalapalli villages, respectively. The high CEC values might be due to dominance of smectite type of clay minerals present in soils. These the results are in agreement with the findings of Yereshmi *et al*. (1997).

Exchangeable sodium percentage

The highest ESP value of 37.83 was recorded in Rajulapalem village and the lowest value of 7.03 in Katrakayalagunta village. The overall ESP ranged from 7.03 to 37.83 with a mean value of 19.75. The distribution of soil samples in to different ESP classes as suggested by CSSRI (2004) revealed that 32.25 per cent samples varied from non to slightly alkaline 61.29 per cent samples in slight to moderately alkaline and 6.45 per cent of soil samples fell under moderate to highly alkalinity. Relatively heavier texture of the soils, arid climate, high exchangeable sodium and proximity to soil erosion and low-lying area with poor drainage could be attributed as probable reasons for the highest ESP observed in study area. (Polara *et al*., 2006).

According to the classification of salt affected soils given by Richards (1954) soils of Yerpedu mandal was classified as normal (pH <8.5, EC <4dSm^{-1}, ESP <15), saline (pH <8.5, EC >4 dSm^{-1}, ESP <15), sodic (pH >8.5, EC <4dSm^{-1}, ESP >15) and saline-sodic (pH ~8.5, EC >4dSm^{-1}, ESP >15). However soil samples were sodic seventeen (54.83 per cent) and three (9.67 per cent) were saline-sodic and eleven 11(35.48 per cent) soil samples were normal soils.

CONCLUSION

The soil samples with study area were slightly alkaline to strongly alkaline in reaction, non saline to strongly saline and low in organic carbon. Soils were calcareous with high calcium carbonate content. Texturally soils varied from loamy sand to clay. The cation exchange capacity of the soils was high indicating a high

Table 1. Physico-chemical properties of salt affected soils of Yerpedu mandal of Chittoor district of Andhra Pradesh

S. No	Name of the Village	pHs	ECe (dSm^{-1})	OC (%)	$CaCO_3$ (%)	CEC (c mol kg^{-1})	ESP	Clay (%)	Texture	Classification of soils
1.	Pallem	9.12	1.28	0.08	11.00	37.28	23.62	7	LS	Sodic
2.	Pallem	9.64	1.59	0.17	8.00	39.38	24.23	9.64	LS	Sodic
3.	Pallem	9.21	1.34	0.13	8.00	38.18	23.61	11.36	LS	Sodic
4.	Pallem	9.36	1.87	0.34	9.00	57.86	25.02	37.16	SC	Sodic
5.	Pallem	9.74	2.14	0.33	8.50	56.06	37.83	36.13	SC	Sodic
6.	Rajulapalem	9.25	1.69	0.65	8.50	55.58	18.14	35.92	SC	Sodic
7.	Rajulapalem	8.71	2.56	0.56	4.00	55.78	18.06	29.92	SC	Sodic
8.	Rajulapalem	9.46	1.92	0.06	16.00	63.12	28.42	32.95	CL	Sodic
9.	Pagali	10.04	2.34	0.07	8.50	55.98	24.99	35.92	SC	Sodic
10.	Pagali	8.20	4.16	0.05	8.50	58.84	16.78	42.95	SC	Sodic
11.	Pagali	9.70	1.92	0.06	7.50	64.52	32.29	30.21	CL	Sodic
12.	Pagali	9.80	2.09	0.09	11.00	60.88	27.87	28.91	CL	Saline-sodic
13.	Pagali	8.42	2.96	0.08	6.00	64.92	16.61	30.67	CL	Normal
14.	Pagali	8.60	9.58	0.07	8.00	65.28	17.03	37.65	CL	Saline-sodic
15.	Katrakayalagunta	7.70	1.82	0.29	4.00	51.28	7.03	25.32	SCL	Normal
16.	Kobaka	8.10	2.27	0.21	8.50	63.08	10.67	36.92	CL	Normal
17.	Panguru	8.04	2.13	0.15	10.00	59.50	14.10	28.38	CL	Normal
18.	Kobaka	9.60	4.78	0.09	8.50	47.26	29.96	29.31	SCL	Saline-sodic
19.	Modugulapallem	8.76	2.56	0.27	8.50	69.22	17.74	45.29	C	Sodic
20.	Modugulapallem	8.62	2.14	0.17	8.00	37.30	24.10	6.92	LS	Sodic
21.	Munagalapalem	8.66	1.20	0.34	6.00	45.78	17.50	23.84	SCL	Sodic
22.	Govindavaram	7.60	1.29	0.41	6.00	49.34	14.24	30.64	SCL	Normal
23.	Katrakayalagunta	7.95	1.64	0.49	7.50	59.08	12.87	28.93	CL	Normal
24.	Govindavaram	8.00	1.21	0.31	4.00	61.28	14.07	33.67	CL	Normal
25.	Jangalapalli	7.60	1.64	0.29	0.50	58.82	12.04	42.36	SC	Normal
26.	Govindavaram	8.63	3.41	0.35	6.00	37.16	24.83	6.92	LS	Sodic
27.	Jangalapalli	7.71	2.24	0.44	11.00	59.28	14.29	29.63	CL	Normal
28.	Vikruthamala	8.57	1.52	0.41	7.50	40.80	20.98	25.37	SCL	Sodic
29.	Govindavaram	8.71	1.23	0.74	7.50	40.00	19.51	24.87	SCL	Sodic
30.	Jangalapalli	7.60	0.49	0.32	0.50	36.28	9.18	19.36	SL	Normal
31.	Gudimallem	7.94	3.25	0.78	7.00	52.94	10.65	31.68	SCL	Normal
	Range	**7.60-10.04**	**0.49-9.58**	**0.05-0.78**	**0.50-16.00**	**36.28-69.22**	**7.03-37.83**	**6.92-45.29**		
	Mean	**8.68**	**2.33**	**0.28**	**7.53**	**52.97**	**19.75**	**28.25**		

CL: clay loam, C: clay, SCL: sandy clay loam, SC: sandy clay, LS: loamy sand, SL: sandy loam.

sorption capacity of the soils. 67.7 per cent samples showed high ESP values.

However salt build-up, soil alkalization and raising water table affected soil productivity. The alkali soils can be reclaimed by application of amendments with better soil and water management practices. Gypsum is a commonly used material to supply calcium for reclamation of sodic soils. Elemental sulphur can also be used for reclamation of sodic soils when free lime exists in soil.

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