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SOIL-SITE SUITABILITY EVALUATION FOR THE MAJOR CROPS GROWN IN CHILLAKUR MANDAL OF SPSR NELLORE DISTRICT, ANDHRA PRADESH

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ABSTRACT

A survey was undertaken in Chillakur mandal of SPSR Nellore district to evaluate the suitability of soils for rice, groundnut, sunflower and sesame crops. These soils belongs to Entisols and Inceptisols. Pedons 1, 3 and 4 (Typic Ustorthent), showed texture, organic carbon and shallow depth as major limitations. Organic carbon and pH are the major limitations in pedon 2 (Typic Haplustept). Pedons 5 and 6 (Typic Haplustept) exhibited organic carbon as major limitation whereas pedon 7 (Typic Ustipsamment) had texture and organic carbon as major limitations. The limitation levels of the land characteristics varied from crop to crop. The soil-suitability classes can be improved if the correctable limitations (soil fertility characteristics) were altered through soil amelioration measures. On the basis of soil potentials and constraints, suitable management practices were suggested to achieve sustainable yields in these crops grown on these soils.

KEY WORDS: Crop suitability, Land Evaluation, Limitations, Potentials.

INTRODUCTION

The performance of any crop was largely dependent on soil parameters (depth, texture, drainage *etc.*) as conditioned by climate and topography. Soil-site characterization for predicting the crop performance of an area forms land evaluation.The yield influencing factors for important crops have to be evaluated and the results obtained may be applied for higher production of these crops through proper utilization of similar soils occur elsewhere in same agro-climatic sub-region under scientific management practices (Khadse and Gaikwad, 1995).Studies on soil-site suitability evaluation is not available for crops in Chillakur mandal, in particular and SPSR Nellore district of Andhra Pradesh, in general. Hence, an attempt has been made to evaluate the soil suitability for four major crops *viz.,* rice, groundnut, sunflower and sesame on Entisols and Inceptisols in Chillakur mandal of SPSR Nellore district in Andhra Pradesh.

MATERIAL AND METHODS

Study area

The study area lies in between 14°01′and 14°12′ N latitudes and 79°51′ and 80°04′ E longitudes with an altitude ranging from 3 to 41 m (MSL). The soils have been developed from granite-gneiss and alluvium parent material. The area qualifies for semi-arid monsoonic climate with distinct summer, winter and rainy seasons. The area experiences mean annual (2005-2014) precipitation of 1113 mm. The mean annual temperature was 28.7°C with a mean summer temperature of 32.9°C and the mean winter temperature of 25.6°C. The soil moisture regime has been computed as ustic and soil temperature regime as isohyperthermic. The natural vegetation comprises of *Acacia nilotica, Parthenium hysterophorus, Cynodon dactylon, Azadirachta indica, Calotropis gigantia, Cyprus rotundus, Pongamia pinneta etc.*

Methodology

Seven typical pedons were studied on different landforms (plains and uplands) for their morphological characteristics following the procedure given by Soil Survey Staff (1951). Horizon-wise soil samples were collected from the typifying pedons and analyzed for their physical, physico-chemical and chemical properties following the standard procedures (Table 2). Soils were classified according to keys to Soil Taxonomy (Soil Survey Staff, 2014).These pedons were selected for

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evaluation and their suitability assessed using limitation method regarding number and intensity of limitations (Sys *et al.,* 1991).

The land scape and soil requirements for these crops (Sys *et al.,* 1991) were matched with generated data at different limitation levels: no (0), slight (1), moderate (2), severe (3), very severe (4). The number and degrees of limitations suggested the suitability of class of each soil for a particular crop (Sys *et al.,* 1991). The potential land suitability (Table 3) sub-classes were determined after considering the improvement measures to correct these limitations (Sys *et al.,* 1993). The present suitability classes can be improved if the correctable limitations such as pH, organic carbon and low fertility status are corrected / altered through soil amelioration measures.

RESULTS AND DISCUSSION

Soil characteristics were given in table 1 and the site and weighted means of soil characteristics were given in table 2. These soils were developed from granite-gneiss and alluvium parent material. The kind and degree of limitations for the four commonly growing crops were presented in table 3. Soils with more than four slight limitations, and / or with more than three moderate limitations were grouped under moderately suitability class (S2); the soil with more than three moderate limitations, and / or one or more severe limitation (s) was grouped under marginally suitability (S3) class; the soils with very severe limitations which can be corrected was categorized as N1 (temporarily not suitable); the soils with very severe limitations which cannot be corrected grouped under unsuitable class N2 (Sys *et al.*, 1991). This method also identifies the dominant limitation that restricts the crop growth in the sub-class symbol such as climatic (c), topographic (t), wetness (w), physical soil characteristics (s), soil fertility (f) and soil salinity / alkalinity (n). The suitability classes and sub-classes were decided by the most limiting soil characteristics. The soils vary in their suitability for different crops according to the criteria for the determination of the land suitability classes (Table 3).

Pedons1, 3 and 4, which were classified under Typic Ustorthents were marginally suitable (S3) for rice, groundnut, sesame and sunflower crops. The major limiting factors for growth of rice, groundnut, sesame and sunflower in these soils were wetness, texture, shallow depth and low organic carbon. Kumar and Naidu (2012) reported that Typic Ustorthents were marginally suitable for growing rice crop in Vadamalapeta mandal of Chittoor district in Andhra Pradesh.

Pedons 2, 5 and 6 were grouped under Typic Haplustepts. All pedons were marginally suitable (S3) for crops like rice, groundnut, sesame and sunflower. Soil fertility characteristics *viz*., pH and organic carbon and physical soil characteristics like texture and drainage were the limitations. Organic carbon and pH were major limitations for all the four crops whereas soil texture was a limitation for rice crop. However, heavy texture and improper drainage were found to be important soil related constraints in growing these crops. Leelavathi *et al*. (2010) reported that Typic Haplustepts were marginally suitable (S3) for growing paddy crop in Yerpedu mandal of Chittoor district in Andhra Pradesh.

Pedon 7 was grouped under Typic Ustipsamment, was marginally suitable (S3) for growing groundnut, sesame and sunflower crops and temporarily not suitable (N1) for rice crop. This soil had limitations of excessively drained, physical characteristics like sandy texture and fertility characteristics like low sum of basic cations (low fertility) and low organic carbon. These findings were in good agreement with results of Sekhar *et al*. (2014) who stated that Typic Ustipsamment was temporarily not suitable (N1) for growing rice crop in soils of central and eastern parts in Prakasam district of Andhra Pradesh.

CONCLUSION

The soil-site suitability for different crops like rice, groundnut, sunflower and sesame revealed that all the pedons (1, 2, 3, 4, 5, 6 and 7) exhibited low organic carbon as severe limitation. Shallow depth was a major limitation for pedons 1, 3 and 4 whereas texture was a major limitation for growing rice crop in pedon 7. High pH is a major limitation in pedon 2. Organic carbon status in these soils can be improved by the application of farm yard manure, green manuring and inclusion of legumes in rotation and pH can be controlled by application of organic manures and sulphur. Soil texture can be improved by mixing with tank silt year after year. By correcting the above limitations sustainable yields can be achieved in rice, groundnut, sunflower and sesame crops. Hence, green manuring, addition of crop residues and organic manures in combination with chemical fertilizers in balanced form not only helps to achieve sustainable yields of crops but also maintains the soil health without undergoing deterioration.

Table 1. Relevant characteristics of the selected pedons

Depth (m)	Sand (2-0.05%)	Silt (0.05 -0.002)	Clay (<0.002)	$CaCO_3$ (%)	CEC [cmol (p+) kg^{-1} soil]	BS (%)	Sum of basic cations [cmol (p+) kg^{-1} soil]	pH (1:2.5 H_2O)	OC (%)	EC (dSm^{-1})	ESP
	—— % of <2 mm soil ——										
Pedon 1: Typic Ustorthent											
0.00-0.20	49.10	22.30	28.60	4.50	9.67	79.94	7.57	6.60	0.32	0.01	1.65
0.20-0.52	25.40	40.70	33.90	4.00	14.78	75.51	10.96	6.73	0.30	0.02	1.35
0.52+	**Weathered gneiss**										
Pedon 2: Typic Haplustept											
0.00-0.18	15.70	53.80	30.50	9.50	16.52	72.76	11.69	7.43	0.61	0.08	2.00
0.18-0.33	43.70	27.70	28.60	11.50	14.78	79.84	11.48	7.93	0.57	0.02	2.17
0.33-0.55	41.60	25.80	32.60	10.00	17.93	70.50	12.21	8.40	0.46	0.03	2.40
0.55-0.80	37.70	24.00	38.30	12.00	20.87	64.21	13.05	8.50	0.43	0.05	1.68
0.80-1.15	38.00	29.70	32.30	15.00	21.84	69.96	14.99	8.20	0.38	0.03	1.33
1.15-1.50+	41.00	28.20	30.80	16.00	25.52	70.53	17.62	8.40	0.41	0.30	1.49
Pedon 3: Typic Ustorthent											
0.00-0.20	54.00	33.60	12.40	6.00	5.15	85.44	4.28	7.70	0.28	0.03	2.33
0.20-0.33	49.80	23.80	26.40	6.50	14.34	74.97	10.57	7.58	0.26	0.02	1.26
0.33-0.52+	50.30	18.50	34.60	5.50	18.69	71.70	13.25	7.60	0.23	0.02	0.80
0.52 +	**Weathered gneiss**										
Pedon 4: Typic Ustorthent											
0.00-0.25	33.30	32.10	31.20	4.50	6.30	84.29	5.25	6.10	0.24	0.02	0.95
0.25-0.55	62.30	15.60	22.10	3.50	5.10	98.24	4.94	6.33	0.22	0.03	1.37
0.55+	**Weathered gneiss**										

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Depth (m)	Sand (2-0.05%)	Silt (0.05 -0.002)	Clay (<0.002)	$CaCO_3$ (%)	CEC [cmol (p+) kg^{-1} soil]	BS (%)	Sum of basic cations [cmol (p+) kg^{-1} soil]	pH (1:2.5 H_2O)	OC (%)	EC (dSm^{-1})	ESP
	—— % of <2 mm soil ——										
Pedon 5: Typic Haplustept											
0.00-0.21	55.20	21.10	23.70	5.50	13.80	59.06	8.06	6.20	0.57	0.03	0.65
0.21-0.35	51.50	19.10	29.40	6.00	14.24	66.64	9.32	6.21	0.54	0.03	1.19
0.35-0.57	33.20	28.50	32.10	7.50	14.56	60.99	8.70	6.38	0.49	0.03	1.24
0.57-0.78	42.30	25.60	38.30	6.50	22.82	60.65	13.69	6.17	0.46	0.03	0.66
0.78-1.00	40.60	28.40	31.00	7.00	15.43	72.33	11.07	6.60	0.41	0.03	0.58
1.00+	**Weathered gneiss**										
Pedon 6: Typic Haplustept											
0.00-0.27	58.70	18.20	23.10	8.50	10.22	66.93	6.74	6.30	0.46	0.32	0.98
0.27-0.37	54.80	20.40	24.10	7.00	6.74	88.43	5.79	6.80	0.43	0.02	2.52
0.37-0.58	52.40	21.70	25.90	5.50	9.46	67.34	6.19	7.12	0.42	0.03	1.90
0.58-0.78	18.70	50.40	30.90	6.50	12.06	66.42	7.88	7.24	0.32	0.06	1.08
0.78-0.91	17.40	52.60	30.00	6.00	10.00	63.50	6.20	7.28	0.35	0.02	1.50
0.91-1.20	15.20	53.40	31.40	8.00	10.90	61.56	6.60	7.20	0.22	0.21	1.01
1.20-1.50+	14.30	55.00	30.70	8.50	9.45	70.26	6.46	6.90	0.20	0.02	1.90
Pedon 7: Typic Ustipsamment											
0.00-0.30	88.4	5.30	6.30	1.50	5.40	57.59	3.04	6.23	0.24	0.05	1.30
0.30-0.58	90.6	4.20	5.20	2.00	4.70	61.91	2.84	6.40	0.22	0.04	1.49
0.58-0.80	90.5	3.70	5.80	2.00	5.10	76.67	3.83	6.45	0.18	0.03	1.57
0.80-0.98	90.6	3.20	6.20	2.50	5.30	71.51	3.71	6.50	0.14	0.03	1.51
0.98-1.27	89.6	4.30	6.10	2.00	5.10	65.10	3.26	6.20	0.16	0.31	1.18
1.27-1.48	90.6	3.70	5.70	2.00	4.90	55.10	2.64	6.10	0.12	0.02	1.22
1.48-1.90+	91.2	3.30	5.50	2.50	4.80	53.96	2.54	7.50	0.12	0.31	1.04

Table 2. Site and soil characteristics of studied profiles for crop suitability classification

Pedon No.	Land form	Parent material	Wetness (W) drainage	Physical soil characteristics (s)				Soil fertility characteristics (f)					Salinity and alkalinity (n)	
				Texture	Coarse fragments Volume (%)	Soil depth (m)	$CaCO_3$ (%)	Apparent CEC [c mol (p+) kg^{-1} soil]	Sum of basic cations [c mol (p+)kg^{-1} soil]	BSP	pH 1:2.5	OC (%)	EC (dSm^{-1})	ESP
1	Upland	Weathered gneiss	Well drained	scl	Nil	0.52+	4.19	39.68	8.25	77.21	6.63	0.32	0.02	1.65
2	Plain	Weathered gneiss	Somewhat poorly drained	sicl	Nil	1.50+	11.64	53.70	11.63	70.63	7.57	0.60	0.04	2.40
3	Upland	Weathered gneiss	Well drained	sl	< 15	0.52+	5.94	49.10	5.54	77.80	7.68	0.28	0.02	2.33
4	Upland	Weathered gneiss	Well drained	scl	Nil	0.55+	3.95	21.64	5.25	91.90	6.20	0.24	0.02	1.37
5	Plain	Weathered gneiss	Well drained	scl	Nil	1.00+	6.55	51.63	8.26	63.80	6.20	0.57	0.02	1.24
6	Plain	Weathered gneiss	Well drained	scl	Nil	1.50+	6.95	38.98	6.74	68.13	6.3	0.46	0.12	2.52
7	Plain	Coastal alluvium	Excessively drained	s	Nil	1.90+	1.94	87.58	3.04	65.65	6.23	0.24	0.04	1.57

Table 3. Limitation levels of the land characteristics and land suitability classes

Soil	Crop	Wetness (w) drainage	Physical soil characteristics (s)			$CaCO_3$ (%)	Soil fertility characteristics (f)			Alkalinity (n)	Actual land suitability sub-class	Potential land suitability sub-class
			Texture	Coarse fragments (Vol. %)	Soil depth (cm)		Sum of basis cations [cmol (p+) kg^{-1} soil]	pH 1:2.5	OC (%)	ESP		
Typic Ustorthents	Rice	2	2	0	2	1	0	0	3	0	S3wsf	S2ws
	Groundnut	0	0	0	2	0	0	0	3	0	S3sf	S2s
	Sesame	0	0	0	2	-	0	1	3	0	S3sf	S2s
	Sunflower	0	1	0	3	0	0	0	3	0	S3sf	S3s
Typic Haplustepts	Rice	2	2	0	0	1	0	1	3	0	S3wsf	S2ws
	Groundnut	1	1	0	0	0	0	2	3	0	S3sf	S1
	Sesame	2	0	0	0	-	0	3	3	0	S3wf	S1w
	Sunflower	2	0	0	0	1	0	2	3	0	S3wsf	S1w
Typic Ustorthents	Rice	2	3	2	2	1	1	1	3	0	S3wsf	S3ws
	Groundnut	0	0	2	2	0	0	2	3	0	S3sf	S2s
	Sesame	0	0	1	2	-	1	2	3	0	S3sf	S2s
	Sunflower	0	2	1	3	0	0	2	3	0	S3sf	S3s
Typic Ustorthents	Rice	2	2	0	2	1	0	0	3	0	S3wsf	S2ws
	Groundnut	0	0	0	2	0	0	1	3	0	S3sf	S2s
	Sesame	0	0	0	2	-	0	0	3	0	S3sf	S2s
	Sunflower	0	1	0	3	1	0	1	3	0	S3sf	S3s
Typic Haplustepts	Rice	2	2	0	0	2	0	0	3	0	S3wsf	S2ws
	Groundnut	0	0	0	1	0	0	1	3	0	S3f	S1
	Sesame	0	0	0	1	-	0	0	3	0	S3f	S1
	Sunflower	0	1	0	2	1	0	1	3	0	S3sf	S2s
Typic Haplustepts	Rice	2	2	0	0	2	0	0	3	0	S3wsf	S2ws
	Groundnut	0	0	0	0	0	0	1	3	0	S3f	S1
	Sesame	0	0	0	0	-	0	1	3	0	S3f	S1
	Sunflower	0	1	0	0	1	0	1	3	0	S3f	S1
Typic Ustisamments	Rice	2	4	0	0	0	2	1	3	0	N1wsf	N1ws
	Groundnut	0	3	0	0	0	1	1	3	0	S3sf	S3s
	Sesame	0	3	0	0	-	2	1	3	0	S3sf	S3s
	Sunflower	0	3	0	0	0	1	1	3	0	S3sf	S3s

Limitations: 0-No; 1-Slight; 2-Moderate; 3-Severe, 4-Very severe; Suitability classes: f-Soil fertility limitations; s-Physical soil limitations;

REFERENCES

Khadse, G.K and Gaikwad, S.T. 1995. Soil based Agro-technology transfer: A case study. *Agropedology*. 5: 91-96.

Kumar, Y.S.S and Naidu, M.V.S. 2012. Soil-site suitability evaluation for commonly growing crops in Vadamalapeta mandal of Chittoor district, Andhra Pradesh. *The Andhra Agricultural Journal*. 59(2): 230-235.

Leelavathi, G.P., Naidu, M.V.S., Ramavatharam, N and Sagar, G.K. 2010. Soil-site suitability evaluation for commonly growing crops in Yerpedu mandal of Chittoor district, Andhra Pradesh. *Agropedology.* 20(2): 133-138.

Sekhar, C.H.C., Balaguravaiah, D and Naidu, M.V.S. 2014. Studies on genesis, characterization, and classification of soils in central and eastern parts of Prakasam district in Andhra Pradesh. *Agropedology.* 24(2): 125-137.

Soil Survey Staff. 1951 *Soil Survey Manual*. US Department of Agricultural Hand book No.18.

Soil Survey Staff. 2014. *Soil Taxonomy*. Second edition, Agricultural Hand Book No.436, USDA, Natural Resources Conservations Service, Washington, DC 1-782.

Sys C., Ranst, V. E and Debaveye, J. 1991. *Land evaluation, Part 2 Methods in Land Evaluation*. Agricultural Publications (7), Belgium.

Sys C., Ranst V. E., Debaveye, J. and Beernaert F. 1993. *Land evaluation, Part 3 Crop requirements*. Agricultural Publications (7), Belgium.