International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2020; 8(4): 2745-2748

Received: 22-05-2020
Accepted: 26-06-2020

P Venkata Subbaiah
Scientist, Soil Science, Saline Water Scheme, Bapatla, Andhra Pradesh, India

M Rajasri
Professor, Entomology, S.V. Agricultural College, Tirupati, Andhra Pradesh, India

Corresponding Author:
P Venkata Subbaiah
Scientist, Soil Science, Saline Water Scheme, Bapatla, Andhra Pradesh, India

Available nutrient status in rice growing soils of various Mandals in Krishna District

P Venkata Subbaiah and M Rajasri

DOI: https://doi.org/10.22271/chemi.2020.v8.i4af.10061

Abstract
A study was conducted to assess the fertility status of rice growing soils in various mandals of Krishna District in Andhra Pradesh during 2017-18. A total number of 105 soil samples (0-25 cm) were collected and were analysed for different chemical properties. Majority of the soils are sandy clay loam in texture and with neutral to slightly alkaline reaction and non saline in nature. Soils were low to medium in organic carbon and deficient with respect to available Nitrogen. High in available P and medium to high in available K and sufficient in available sulphur and DTPA extractable micronutrients like iron, manganese, zinc and copper. Simple correlation studies revealed that N, P, K and S were positively and significantly correlated with organic carbon. There was a negative correlation between pH and available P& Zn and highly significant negative correlation was also observed between pH and micro nutrient like Fe and Mn. Negative correlation was also observed between available P and Zn.

Keywords: Soil properties, soil fertility, rice, frontline demonstrations

Introduction
Rice (*Oryza sativa* L.) is known as staple food for one third of the world's population (Zhao *et al.*, 2011).Asia accounts for over 90% of the world's production of rice, with China, India and Indonesia producing the most.In India, it is grown in an area of 43.9 m.ha with a production of 99.24 m t and productivity of 2494 kg ha^{-1}. In Andhra Pradesh, it is grown in an area of 2.152 m ha with a production of 8.05 m.t and productivity of 3741 kg ha^{-1}. (Ministry of Agriculture, Govt of India, 2019) [6]. Soil fertility assessment of an area or region is an important aspect in the context of sustainable agricultural production. Information on the available nutrient status of soils is a pre requisite for advising individual farmers on fertilizer scheduling and to monitor changes in soil fertility over a period of time. The availablesoil nutrients *viz.*, nitrogen, phosphorus, potassium, sulphur, iron, manganese, zinc and copper micronutrient elements controls fertility and productivity of a particular soil (Singh and Mishra 2012) [13]. In Krishna district rice cultivated in various farming situations like canal command, tank fed, lift irrigation schemes and filter points with an extent of 3 lakh hectares. Soil nutrient status of any cultivable soil is the primary indicator of productivity. Hence, The present study was carried to assess the fertility status of the soil to know best possibilities in improving the nutrient management practices for attaining profitable yields of the crops.

Material and Methods
Surface soil samples (0-25cm) from 105 locations in rice growing soils were collected. The samples were air dried under shade in room temperature. Roots and other debris present in soil samples were removed before grinding the soil samples using wooden pestle and mortar to pass through 2 mm sieve. Processed soil samples were analysed for soil pH (Jackson 1973) [4], electrical conductivity (Jackson 1973) [4], organic carbon (Walkley and Black 1934) [20], available N (Subbaiah and Asija 1956) [15], available P (Olsen *et al*. 1954) [7], available K (Jackson 1973) [4], available sulphur (Chesnin and Yien 1951) [2] and DTPA extractable micro nutrients (Lindsay and Norvell, 1978) [5], The rating limits for soil test values *viz.*, soil organic carbon available nitrogen, P_2O_5, K_2O, S, Zn, B, Fe, Mn & Cu given by Tandon (2005) [17] presented in Table 1. was used for the assessment of the soil fertility status of rice growing soils. The statistical parameters like mean & correlation coefficient of soil properties were obtained as per the standard methodology given by Panse and Sukhatme (1961).

Table 1: Rating limits for soil test values

Nutrient	Low	Medium	High
Organic carbon	<0.5%	0.5 - 0.75%	>0.75%
Available N-$KMnO_4$ kg ha^{-1}	<280	280 - 560	>560
Available P_2O_5 kg ha^{-1}	<22.9	22.9 - 56.34	>56.34
Available K_2O kg ha^{-1}	<129.6	129.6 - 336	>336
Secondary & micronutrients (mg kg^{-1})	**Deficiency**		**Sufficiency**
Available S	<10		>10
Available Zn	<0.6		>0.6
Available B	<0.5		>0.5
Available Fe	<4.5		>4.5
Available Mn	<2.0		>2.0
Available Cu	<0.2		>0.2

In order to compare the levels of soil fertility of one area with those of another it was necessary to obtain a single value for each nutrient. Nutrient index (N.I) value is a measure of nutrient supplying capacity of soil to plants (Singh *et al*., 2016) [14]. The nutrient index approach introduced by Parker *et al*. (1951) [9]. This index is used to evaluate the fertility status of soils based on the samples in each of the three classes, i.e., low, medium and high. Crop wise nutrient index was evaluated for the soil samples analysed using the following formula:

Nutrient Index (N.I.) = (NL × 1 + NM × 2 + NH × 3) / NT

where, NL: Indicates number of samples falling in low class of nutrient status

NM: Indicates number of samples falling in medium class of nutrient status
NH: Indicates number of samples falling in high class of nutrient status
NT: Indicates total number of samples analysed for a given area.

Table 2: Nutrient index values and their interpretation

S. No.	Nutrient Index	Value	Interpretation
1	Low	<1.67	Low fertility status of the area
2	Medium	1.67-2.33	mediumfertility status of the area
3	High	>2.33	High fertility status of the area

Results and Discussion

Soil texture in rice growing soils varied from sandy loam (Jaggaiahpeta mandal) to sandy clay loam (Vatsavai, Penuganchiprolu, Nandigama, Kanchikacherla and Ibrahimpatnam mandals). This variation in soil texture might be due to the variation in topographic situation, nature of parent material, insitu weathering of clay, age of soils and alluvial sedimentation (Sampath Kumar and Sankar Reddy 2010) [10]. The soil reaction in terms of pH varied from 7.6 to 7.8 in rice growing soils of various mandals in Krishna district, this variation might be due to variation in soil texture and nature of parent materials and other agricultural practices of the area (Venkata Subbaiah, 2020) [19]. The electrical conductivity varied from 0.40 dSm^{-1} to 0.61 dSm^{-1}. The organic carbon content in rice growing soils varied from 0.27% to 0.52% (Table 3.)

Table 3: Soil test summary- texture, pH, EC and organic carbon of rice grown soils

S. No.	Mandal	Number of samples	Texture	pH (1:2.5)	EC (dSm^{-1})	OC (%)
1	Jaggaiahpeta	15	Sandy loam	7.6	0.52	0.27
2	Vatsavai	15	Sandy Clay loam	7.6	0.54	0.45
3	Penuganchiprolu	15	Sandy Clay loam	7.8	0.48	0.48
4	Nandigama	15	Sandy Clay loam	7.5	0.57	0.4
5	Ibrahimpatnam	15	Sandy Clay loam	7.8	0.4	0.39
6	Kanchikacherla	15	Sandy Clay loam	7.7	0.61	0.5
7	Chandarlapadu	15	Sandy Clay loam	7.8	0.58	0.52

Available N, P, K and S

The rice growing soils in various mandals of Krishna district were reported low available N. The available N ranged from 240 to 285 kg ha^{-1} with overall nutrient index values ranged from 1.06 to 1.53. The available P ranged from 28.54 to 36.0 kg ha^{-1} with nutrient index values ranged from 2.73 to 3.00 indicated high in available P.The available potassium ranged from 230 to 524 kg ha^{-1} with nutrient index values 2.33 to 2.93 indicated medium to high in available K (Table 4). The low available nitrogen status of these soils might be due to low organic carbon status of soil. Further semiarid conditions of the area might have favoured the rapid oxidation and less accumulation of organic matter (Finck and Venkateswarlu, 1982) [3]. High available P in these soils may be due to the continuous use of phosphatic fertilizers to the soils leads to build upavailable P in the soil similar results were also identified by Venkata Subbaiah (2020) [19] in redgram, blackgram, groundnut and sesamum growing soils of Krishna district. Medium to high available K in these soils may be due to higher application of potassic fertilizers and and intense weathering, release of potassium from organic residues and upward translocation of potassium from lower layers of soil through capillary rise of groundwater (Varaprasad *et al*., 2008) [18]. Available sulphur in rice growing soils varied from 33.45 mg kg^{-1} to 64.75 mg kg^{-1} and sufficient. Available sulphur was sufficient due to continuous application of sulphur containing fertilizers like SSP (Satish *et al*., 2011) [11].

Table 4: Soil test summary for available N, P and K in rice grown soils

S. No.	Mandal	Number of samples	Available N			Available P			Available K		
			Mean (kg ha^{-1})	Nutrient Index	Fertility status	Mean (kg ha^{-1})	Nutrient Index	Fertility status	Mean (kg ha^{-1})	Nutrient Index	Fertility status
1	Jaggaiahpeta	15	240	1.06	Low	28.54	2.73	High	230	2.33	Medium
2	Vatsavai	15	254	1.20	Low	36.00	2.86	High	326	2.93	High
3	Penuganchiprolu	15	265	1.20	Low	31.64	2.93	High	294	2.73	High
4	Nandigama	15	250	1.06	Low	30.00	2.93	High	324	2.83	High
5	Ibrahimpatnam	15	248	1.26	Low	28.64	2.80	High	312	2.83	High
6	Kanchikacherla	15	275	1.40	Low	32.45	2.80	High	416	2.93	High
7	Chandarlapadu	15	285	1.53	Low	32.00	3.00	High	524	2.93	High

Available micro nutrients

DTPA extractable Fe, Mn, Zn and Cu in rice growing soils of various mandals in Krishna district were ranged from 23.0 (Jaggaiahpeta) to 25.20 mgkg^{-1}(Vatsavai), 10.0 (Chandarlapadu)to 15.0 mg kg^{-1}(Nandigama), 0.8 (Jaggaiahpeta) to 1.35 mg kg^{-1}(Nandigama), 0.98 (Jaggaiahpeta) to 1.56 mg kg^{-1} (Kanchiakacherla) respectively (Table 5).The availability of these micronutrients were sufficient in soils for rice crop. This might be due to continuous application of these nutrients by the farmers in recent years and due to weathering of native minerals and similar findings were also reported by Soma Sekhar Babu *et al*. (2011) [12] in rice growing soils of Nellore district.

Table 5: Soil test summary for available S, Fe, Mn, Zn and Cu in rice grown soils

S. No.	Mandal	Number of samples	S	Fe	Mn	Zn	Cu
			(mg kg^{-1})				
1	Jaggaiahpeta	15	33.45	24.60	11.25	0.8	0.98
2	Vatsavai	15	45.65	25.20	14.26	1.02	1.24
3	Penuganchiprolu	15	40.16	23.00	12.00	0.84	1.54
4	Nandigama	15	40.00	24.80	15.00	1.35	1.42
5	Ibrahimpatnam	15	34.78	24.00	12.80	1.20	1.20
6	Kanchikacherla	15	58.35	23.50	10.80	1.22	1.56
7	Chandarlapadu	15	64.75	23.00	10.00	1.22	1.54

Correlation studies

Simple correlation were worked out between various soil characteristics and available soil nutrients and the correlation coefficients were presented in Table 6. Available N, P, K and S were positively and significantly correlated with organic carbon content of the soil. The positive correlation of most of the available nutrients with organic carbon might be due to the fact that the latter was the primary reservoir of the former (Shah *et al*., 2018) [16]. However, the negative correlation was observed between pH and available P and Zn, Fe, Mn. Available S was positively and significantly correlated with EC of the soil. Similar findings were also reported by Soma Sekhar Babu *et al*. (2011) [12].

Table 6: Correlation between Soil properties and Soil available nutrients in Rice growing soils

	pH	EC	OC	N	P	K	S	Fe	Mn	Zn	Cu
pH	1										
EC	-0.410	1.000									
OC	0.481	0.368**	1.000								
N	0.542**	0.511**	0.896**	1.000							
P	-0.049	0.434**	0.631**	0.433**	1.000						
K	0.391**	0.532**	0.784**	0.901**	0.358**	1.000					
S	0.298**	0.700**	0.798**	0.929**	0.517**	0.948	1.000				
Fe	-0.836**	-0.005	-0.597**	-0.758**	0.096	-0.537	-0.502	1.000			
Mn	-0.630**	-0.189	-0.235*	-0.595**	0.134	-0.469	-0.528	0.745	1.000		
Zn	-0.109	0.311**	0.381**	0.308**	-0.001	0.588	0.425**	0.004	0.219	1.000	
Cu	0.357**	0.445**	0.901**	0.845**	0.364**	0.690	0.697**	-0.669	-0.215	0.435	1

*at 5% level of Significance

** at 1% level of significance

Conclusions

The present study concluded that majority of the rice growing soilsare neutral to slightly alkaline in reaction, non saline, low in available nitrogen, high in available P & K and sufficient in available sulphur and other micronutrients. The pH of the soil was negatively correlated with available micronutrients. The correlation of organic matter with available nitrogen, phosphorous, potassium, sulphur was positive and significant.

References

1. Berger KC, Troug E. Boron determination in soils and plants, Industrial and Engineering Chemistry, Analytical Edition. 1939; 11:540-545.
2. Chesnin L, Yein CH. Turbidimetric method of sulphate sulphur in plant materials. Proceedings of Soil Science Society of America. 1951; 15:149-151.
3. Fick A, Venkateswarlu J. Vertisols and rice soils of tropics. Symposia of 12th International Congress of Soil Science, New Delhi held on 8-16 February, 1982.
4. Jackson ML. Soil Chemical Analysis. Prentice Hall of India (Pvt.) Ltd., New Delhi, 1973.
5. Lindsay WL, Norwell WA. Development of a DTPA soil test for zinc, iron, manganese, and copper. Journal of the American Society of Soil Science. 1978l; 42:421-428.
6. Ministry of Agriculture and Farmers’ Welfare, GOI, New Delhi. Annual Report, 2019.
7. Olsen SR, Cole CV, Watanabe FS, Dean LA. Estimation of available phosphorus in soil by extraction with sodium bicarbonate. USDA Circular. 1954; 939:1-19.
8. Panse VG, Sukhatme PV. Statistical Methods for Agricultural Workers. Indian Council of Agricultural Research, New Delhi, 1985.
9. Parker FW, Nelson WL, Winters E, Miles IE. The broad interpretation and application of soil test information. Agronomy Journal. 1951; 43(3):105-112.
10. Sampath Kumar D, Sankar Reddy K. Effect of biofertilizers on productivity, profitability and nitrogen use efficiency of low land rice (Oryza sativa). Journal of Research Angrau. 2010; 38(1-2):40-46.
11. Satish S, Sreenivasula Reddy K, Naidu MVS, Venkaiah K, Sumathi V. Delineation of nutrient in Bt Cotton Growing Soils of Kurnool District in Andhra Pradesh. The Andhra agricultural Journal. 2011; 58(4):467-470.

12. Soma Sekhar Babu, Naidu MVS, Venkaiah K. Nutrient Status of Rice (*Oryza Sativa* L.) Growing Soils in Various mandals of Nellore district in Andhra Pradesh. The Andhr a Agricultural Journal. 2011; 58(4):467-470.
13. Singh RP, Mishra SK. Available macro nutrients (N, P, K and S) in the soils of Chirigaon block of district Varanasi (U.P.) in relation to soil characteristics. Indian Journal of Science and Research. 2012; 3:92-100.
14. Singh G, Sharma M, Manan J, Singh G. Assessment of soil fertility status under different cropping sequences in District Kapurthala. J Krishi vigyan. 2016; 5(1):1-9.
15. Subbiah BV, Asija GL. A rapid procedure for the determination of available nitrogen in soils. Current Science. 1956; 25:259-260.
16. Shah TI, Rai AP, Mondal AK, Samanta A, Saradeep Kour, Pradeep Wali *et al*. Available micro nutrient staus of mothbean growing soil of poonch district (Jammu and Kasmir) in realtion to soil properties. Journal of the Indian Society of Soil Science. 2018; 66(4):436-439.
17. Tandon. Methods of analysis of soils, plants, waters, fertilizers & organic manures. Fertilizer Development and Consultation Organization. New Delhi, 2005.
18. Vara Prasad Rao AP, Naidu MVS, Ramavatharam N, Rama Rao G. Characterization, Classification and evaluation of soils on different landforms in Ramachandrapuram mandal of Chittoor district in Andhra Pradesh for sustainable land use planning. Journal of the Indian Society of Soil Science. 2008; 56(1):23-33.
19. Venkata Subbaiah P. Soil fertility assessment in Groundnut, Redgram, Blackgram, sesamum growing areas of Krishna district in Andhra Pradesh. The Andhra Agricultural Journal. 2020; 67(1):47-55.
20. Walakley A, Black CA. Estimation of organic carbon by chromic acid titration method. Soil Science. 1934; 37:29-38.