Research Article
The J. Res. PJTSAU 51(1&2) 1-7, 2023

SOIL FERTILITY STATUS OF THE RICE AND MAIZE GROWING SOILS OF VIKARABAD DISTRICT OF TELANGANA

B. POOJA[1], M. CHANDINI PATNAIK[2], P. SURENDRA BABU[3] and D. SREELATHA[4]

[1] Department of Soil Science and Agricultural Chemistry, College of Agriculture, Rajendranagar
[2] Senior Principal Scientist and University Head (Retd.) AICRP on Micronutrients, ARI, Rajendranagar
[3] Senior Principal Scientist and University Head (Retd.) AICRP on Micronutrients, ARI, Rajendranagar
[4] Department of Agronomy, RARS, Jagtial
Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad-30

Date of Receipt: 02-01-2023 Date of Acceptance: 19-01-2023

ABSTRACT

The investigation was conducted at ARI, Ranjendranagar, to know the soil fertility status of the rice and maize growing soils of Vikarabad, Ranga Reddy and Yadadri district of Telangana. Soil samples were collected by random sampling method and soils were analyzed for their fertility status. In paddy grown soils, the pH, electrical conductivity, and organic carbon ranged from 6.06 to 8.08, 0.03 to 0.62 dS m^{-1} and 0.12 to 1.28 percent and in maize grown soils ranged from 5.31 to 7.94, 0.02 to 0.37 dS m^{-1} and 0.12 to 1.26 %, respectively. The paddy soils were very low to medium in available nitrogen, low to very high in available phosphorus, low to high in available potassium. The maize soils were very low to medium in nitrogen content, medium to very high in available phosphorus, low to high in available potassium. Paddy and maize soils were deficient in zinc to an extent of 20 and 37 %.

Soil is the most important constituent to the basic needs of human beings and important component of our farming. Crop production and productivity depends upon physico-chemical characteristics of the soil. The key point of sustainable agriculture is to maintain the balance among physical, chemical and biological constituents of soils. Some elements are required by plants for completing their life cycle and other are less important for plants but their high concentration in soil solution influence the crop growth. The present study was carried out to study the impact of available nutrients on crop performance.

MATERIAL AND METHODS

Sampling Procedure

Survey was carried out during summer of 2020-21 and *kharif* season of 2021-22 in Vikarabad, Rangareddy and Yadadri districts of Telangana state. Soil samples were collected from various villages of Pudur, Pargi, Vikarabad, Dharoor and Yalal *mandals* in Vikarabad district, Bhudan Pochampally and Choutuppal *mandals* in Yadadri district, Abdullapurmet and Hayatnagar *mandals* in Rangareddy districts. Altogether, 71 soil samples were collected during this survey.

Methods of soil analysis

Standard methodologies were adopted for various physico-chemical and chemical characteristics. Determination of soil pH and EC was done in 1:2.5 soil-water suspension using digital pH meter and EC bridge (Jackson, 1958). Organic carbon (%) was estimated by the wet oxidation method of Walkley and Black (1947). Available nitrogen was determined using alkaline potassium permanganate method as given by Subbiah and Asija (1956), available phosphorous by Olsen reagent of ascorbic acid method (Jackson, 1973). available potassium by neutral normal ammonium acetate (Jackson, 1973). Micronutrients *i.e.,* Zinc and heavy metal *i.e.,* lead was determined in the extract by extracting soil samples with diethylene triamine penta acetic acid (DTPA) as described by Miles and Parker (1979). Physico-chemical and chemical characteristics of paddy soils are given in table 1 and maize soils in table 4. Paddy and maize Samples collected were categorized (Surendra Babu *et al*, 2012) and is presented in tables 2 and 5.

Email: poojapoojitha1911@gmail.com

Table 1: Physico- chemical and chemical characteristics of rice soils

S.No.	Soil Characteristics	Range	Mean
1	pH	6.06-8.08	—
2	EC (dSm^{-1})	0.03-0.62	0.19
3	Organic carbon (%)	0.12-1.28	0.39
4	Available nitrogen (kg ha^{-1})	103-304	188
5	Available phosphorus (kg ha^{-1})	17-101	65
6	Available potassium (kg ha^{-1})	49-416	252
7	Available zinc (mg kg^{-1})	0.29-3.11	1.29
8	Available lead (mg kg^{-1})	0.6 – 3.67	1.26
9	Total lead (mg kg^{-1})	4.09-199	74

RESULTS AND DISCUSSION

Physico-chemical Characteristics

pH

The soil pH in paddy soils ranged from 6.06 to 8.08 and in maize soils, it ranged from 5.31 to 7.94 there by indicating the soils are acidic to moderately alkaline in reaction. The variation in soil pH was related to the parent material, and topography. Relatively higher pH value in paddy soils because of more of black soils was due to the accumulation of the high amounts of exchangeable bases in solum as they are poorly drained. (Dasog and Patil, 2011).

Electrical Conductivity

The electrical conductivity of paddy soils ranged from 0.03 to 0.62 with a mean of 0.19 dSm^{-1} and in maize soils it ranged from 0.02 to 0.37 with a mean of 0.13 dSm^{-1} indicating that, these soils were normal in soluble salt content (Sathyanarayana *et al.,* 2021).

Soil Organic Carbon

The organic carbon content of paddy soils ranged between 0.12 and 1.28 with a mean of 0.39 percent. Seventy five percent soils were low, 15 % were medium and 10% were high in organic carbon status (Table 2 and Fig. 1) and in maize soils, it ranged from 0.12 to 1.26 with a mean of 0.42 % (Table 5 and Fig. 2). Organic carbon content of the maize soils was low to high. Soils are low, medium and high in organic carbon status to an extent of 67, 27 and 6 percent, respectively. The low organic matter content in the soils was attributed to the prevalence of tropical condition, where the degradation of organic matter occurs at a faster rate coupled with low vegetation cover, thereby leaving less organic carbon in the soils (Sireesha and Naidu, 2013).

Available Major Nutrients

Nitrogen

The paddy soils were very low to medium in available nitrogen. Available nitrogen content of paddy soils ranged from 103 to 304 kg ha^{-1} with a mean of 188 kg ha^{-1}. The soils were very low (< 140 kg/ha), low and medium in nitrogen to an extent of 22, 76 and 2 percent, respectively (Table 2 and Fig. 1). The available nitrogen content of maize soils ranged from 90 to 341 kg ha^{-1} with a mean of 171 kg ha^{-1}. The soils were very low to medium in nitrogen content. Forty, 57 and 3 percent soils were very low, low and medium in available nitrogen status (Table 5 and Fig. 2). The main reason being low organic matter content, low rainfall and low vegetation were reported to cause faster degradation and removal of organic matter leading to nitrogen deficiency (Ashok, 2001).

Phosphorous

The available phosphorus content in paddy soils ranged from 17 to 101 kg ha^{-1} with a mean of 65 kg ha^{-1}. The collected soils were categorised as low, medium, high and very high (> 82 kg P_2O_5 ha^{-1}) phosphorus status of 5, 29, 34 and 32 percent, respectively (Table 2 and Fig. 1). The maize soils collected are medium to very high in available phosphorus. The soils are categorised as medium, high

Table 2: Percentage of rice samples falling under different categories

	Very Low	Low	Medium	High	Very High
OC (%)	0	75	15	10	0
N (kg ha^{-1})	22	76	2	0	0
P (kg ha^{-1})	0	5	24	64	7
K (kg ha^{-1})	0	17	61	22	0
Pb (mg kg^{-1})	0	15	78	7	0
		Deficient	**Sufficient**		
Zn (mg kg^{-1})	0	20	80	0	0

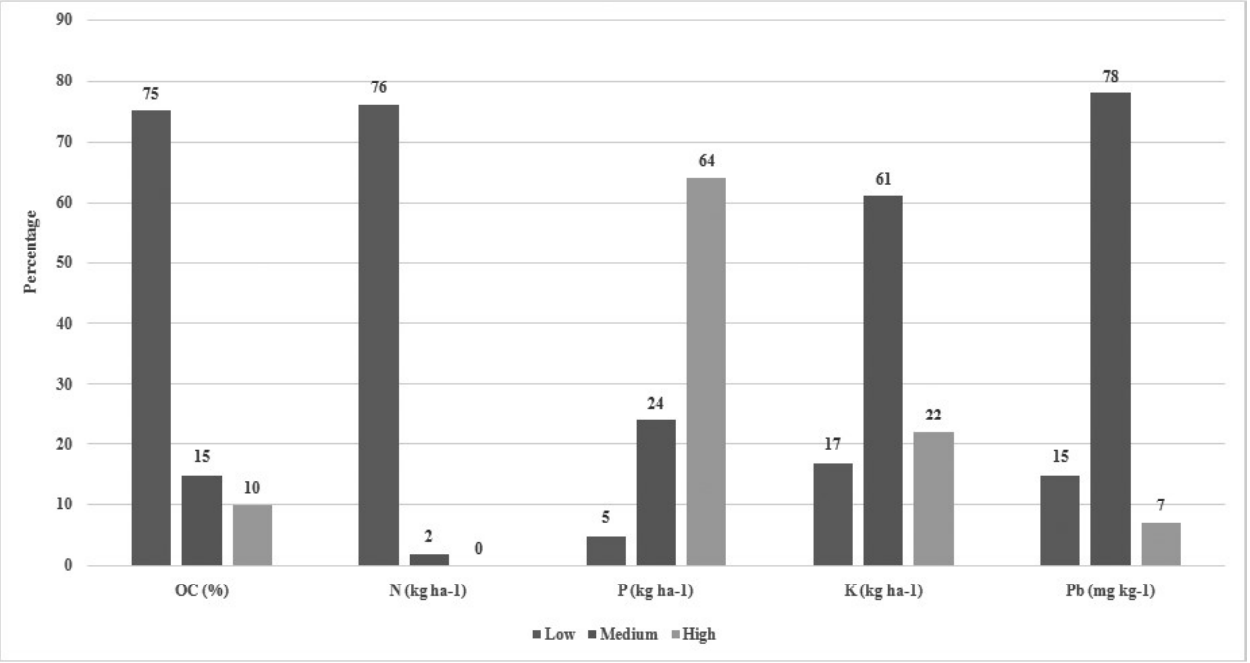

Figure 1. Percentage of rice samples falling under different categories

Table 3: Correlation coefficient between soil properties and available soil nutrients of paddy grown soils

	pH	*EC*	*OC*	*N*	*P*	*K*	*Zn*	*Pb*	*Total Pb*
pH	1								
EC	0.084	1							
OC	-0.045	0.112	1						
N	-0.187	-0.212	-0.017	1					
P	-0.269	0.137	0.102	0.038	1				
K	0.188	0.032	0.164	-0.072	-0.334	1			
Zn	-0.376	0.211	0.021	0.080	0.240	0.115	1		
Pb	-0.247	0.429	0.020	-0.001	0.127	-0.160	0.192	1	
Total Pb	-0.221	-0.141	-0.162	-0.015	0.127	0.013	0.483	-0.097	1

and very high to an extent of 37, 23 and 40 percent (Table 5 and Fig. 2).

Potassium

The available potassium status of these soils is low to high. It varied between 49 and 416 with a mean of 252 kg K_2O ha^{-1} and was grouped to an extent of 17, 61, 22 percent in low, medium and high potassium categories, respectively (Table 2 and Fig. 1). The available potassium content of maize soils ranged from 71 to 412 kg ha^{-1} with a mean of 267 kg ha^{-1}. Maize soils collected were low to high in available potassium and categorized into low, medium and high to an extent of 17, 50 and 33 percent, respectively (Table 5 and Fig. 2). This might be due to predominance of K rich micaceous and feldspar minerals in parent (Pal, 1985 and Ravikumar, 2004).

Zinc

The DTPA extractable Zn content of the paddy soils varied between 0.29 and 3.11 mg kg^{-1} with a mean of 1.29 mg kg^{-1}. Soils were deficient in Zn to an extent of 20 percent and the rest 80 % were sufficient in zinc (Table 2 and Figure 1). The DTPA extractable Zn content of the maize soils collected from Vikarabad district varied between 0.35 and 3.33 with a mean of 0.94 mg kg^{-1}. Maize soils collected were deficient in zinc to an extent of 37 percent (Table 5 and Figure 2). The larger extent of zinc deficiency was attributed to the alkaline soil reaction and richness of $CaCO_3$, which might due to high precipitation of zinc as hydroxide and carbonates.

Available and Total Lead

The available Pb recorded in paddy soils was in the range of 0.60 to 3.67 mg kg^{-1} with a mean of 1.26 mg kg^{-1} and was grouped to an extent of 15, 78, 7 percent in low, medium and high lead categories, respectively (Table 2 and Figure 1). The total lead of paddy soils varied between 4.09 and 199 mg kg^{-1} with a mean of 74 mg kg^{-1}. The maize soils recorded the DTPA extractable lead in the range of 0.23 and 1.77 mg kg^{-1} with a mean of 0.82 mg kg^{-1} and was grouped to an extent of 20, 67, 13 percent in low, medium and high potassium categories, respectively (Table 5 and Figure 2). The total Pb under maize cultivation varied between 7.92 and 347 mg kg^{-1} with a mean of 98 mg kg^{-1}.

Correlation of physico-chemical properties and major nutrients of paddy soils

The data on correlation between soil properties and available nutrients in paddy supporting red soil of Vikarabad district of Telangana are presented in table 3 revealed the pH of the soil is negatively non-significantly correlated with nitrogen (r = -0.187), organic carbon (r = -0.045) and phosphorus (r = - 0.269) and positively non-significantly correlated with potassium (r = 0.188) Fernàndez and Hoeft (2012) reported the similar results. The OC of the soil is negatively non-significantly correlated with nitrogen (r = -0.017) and positively non-significantly correlated with phosphorus (r = 0.102), potassium (r = 0.164) similar results were reported by Kartikeyan *et al.,* (2014). The nitrogen of the soil is positively non-significantly correlated with phosphorus (r = 0.038), and negatively non-significantly correlated with potassium (r = -0.072). Similar results reported by Srinidhi *et al.,* (2020). The phosphorous of the soil negatively significantly correlated with potassium (r = -0.334). The potassium positively non-significantly correlated with zinc (r = 0.115) and negatively non-significantly correlated with lead (r= -0.160).

Correlation of physico-chemical properties and major nutrients of maize soils

The data on correlation between soil properties and available nutrients in paddy supporting red soil of Vikarabad district of Telangana are presented in table 6 revealed the pH of the soil is positively non-significantly correlated with nitrogen (r = 0.113), organic carbon (r = 0.103) and potassium (r = 0.290) and negatively non-significantly correlated with phosphorus (r = -0.177) The OC of the soil is positively non-significantly correlated with nitrogen (r = 0.315), potassium (r = 0.208) and negatively non-significantly correlated with phosphorus (r = -0.085). The nitrogen of the soil is positively non-significantly correlated with phosphorus (r = 0.118) and potassium (r = -0.296). The phosphorous of the soil negatively significantly correlated with potassium (r = -0.279). The potassium positively non-significantly correlated with lead (r = 0.024) and negatively non-significantly correlated with zinc (r= -0.109).

CONCLUSION

It can be concluded that the paddy supporting soils Vikarabad district of Telangana are categorized

Table 4: Physico- chemical and chemical characteristics of maize soils

S.No	Parameters	Range	Mean
1	pH	5.31-7.94	—
2	EC (dSm^{-1})	0.02-0.37	0.13
3	Organic carbon (%)	0.12-1.26	0.42
4	Available nitrogen ($kg\ ha^{-1}$)	90-341	171
5	Available phosphorus ($kg\ ha^{-1}$)	28-101	68
6	Available potassium ($kg\ ha^{-1}$)	71-412	267
7	Available zinc ($mg\ kg^{-1}$)	0.35-3.33	0.94
8	Available lead ($mg\ kg^{-1}$)	0.23-1.77	0.82
9	Total lead ($mg\ kg^{-1}$)	7.92-347	98

Table 5: Percentage of maize samples falling under different categories

	Very Low	Low	Medium	High	Very High
OC (%)	0	70	30	0	0
N ($kg\ ha^{-1}$)	43	43	13	0	0
P ($kg\ ha^{-1}$)	0	0	30	50	20
K ($kg\ ha^{-1}$)	0	17	53	30	0
Pb ($mg\ kg^{-1}$)	0	20	67	13	0
		Deficient	**Sufficient**		
Zn ($mg\ kg^{-1}$)	0	40	60	0	0

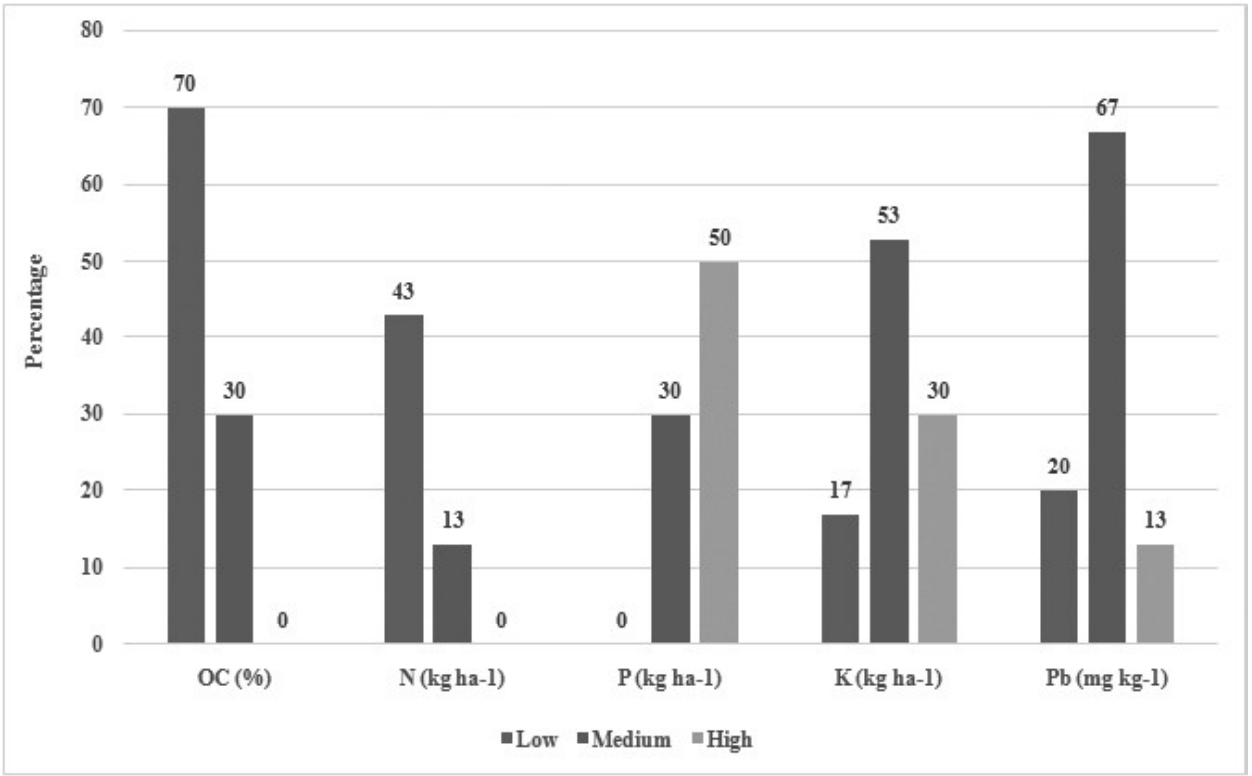

Figure 2: Percentage of maize samples falling under different categories

Table 6: Correlation coefficient between soil properties and available soil nutrients of maize grown soils

	pH	*EC*	*OC*	*N*	*P*	*K*	*Zn*	*Pb*	*Total Pb*
pH	1.000								
EC	0.408	1.000							
OC	0.103	0.079	1.000						
N	0.113	0.017	0.315	1.000					
P	-0.177	-0.283	-0.085	0.118	1.000				
K	0.290	0.361	0.208	0.296	-0.279	1.000			
Zn	0.066	0.194	-0.031	0.065	-0.165	-0.109	1.000		
Pb	0.399	0.312	0.172	0.192	-0.257	0.024	0.490	1.000	
Total Pb	-0.072	-0.409	-0.102	-0.170	-0.165	-0.078	0.457	0.198	1.000

under slightly acidic to moderately alkaline in reaction. soil samples are low in organic carbon content (75 %) and nitrogen (76 %) and high in available phosphorus (64 %), medium in potassium (61 %) and lead (78 %) and 80 % soils are sufficient in zinc. Maize supporting soils were acidic to slightly alkaline in reaction. Low in organic carbon content (70 %) and nitrogen (43 %) and high in available phosphorus (50 %), medium in potassium (53 %) and lead (67 %) and 60 % soils are sufficient in zinc.

REFERENCES

Ashok, L.B. 2001. Sulphur status of selected soil series of Karnataka and studies on direct and residual effect of graded level of sulphur on crop. Ph.D. Thesis. University of Agricultiral Sciences Bangalore, Karnataka

Dasog, G.S., and Patil, P. L. 2011. Genesis and classification of black, red and lateritic soils Of Karnataka. In: Soil Science Research in North Karnataka, Dharwad chapter of ISSS (Ed.), 76th annual convention of ISSS, pp. 1-10.

Fernandez, F.G and Hoeft, R.G. 2012. Managing soil pH and crop nutrients. In: Nafziger (ed.), Illinois Agronomy Handbook. Available online at: http:/ /extension. cropsci. illinois. edu/ handbook/pdfs/ chapter08.pd.

Jackson, M. L. 1958. *Soil chemical analysis.* Verlag: Prentice Hall, Inc., Englewood Cliffs, NJ. 498 (1) 39-40

Jackson, M. L., 1973. Soil Chemical Analysis. Prentice Hall of India (Pvt.) Ltd., New Delhi.

Miles, L.J and Parker, G.R. 1979. DTPA soil extractable and plant heavy metal concentrations with soil-added cd treatments. *Plant and Soil* 51(1): 59-68

Kartikeyan, K., Pushpanjali and Prasad, J. 2014. Soil fertility status of soybean (*Glycine max* L.) growing soils of Malwa plateau, Madhya Pradesh. *Journal of the Indian Society of Soil Science* 62(2): 170-178.

Pal, D.K. 1985. Potassium release from muscovite and biotite under alkaline conditions. *Pedologie* 35: 133-146

Patil, S.S., Patil V.C and AL-Gaddi K.A., 2011. Spatial variability in fertility status of surface soils. *World applied sciences Journal.*, 14(7): 1020-1024. *Pedologie,* 35: 133-136.

Ravikumar, M. A., 2004. Soil resource characterization of 48A distributary of Malaprabha right bank command for sustainable land use planning. M. Sc. (Agri.) Thesis, University of Agricultural Sciences Dharwad, Karnataka.

Sathyanarayana, E., Padmaja, G., Saranya, S., Bharghavi, J, Santhosh Kumar, M., Rajashekhar, M., Veeranna, J and Kumari Sunita. 2021. Soil fertility status of soybean growing soils of Adilabad district, Telangana. *The Pharma Innovation Journal*; 10(10): 1112-1120

Sireesha, P.V.G., and Naidu, M. V. S., 2013. Studies on genesis, characterization and classification of soils in semi-arid agro- ecological region: A case study in Banaganapalle mandal of Kurnool district in Andra Pradesh. *Journal of the Indian Society of Soil science.* 61(3):161-178.

Srinidhi, P., Singh, Y.V., Sharma, P.K., Singh, R.K., Latare, A.M., Srinath, I and Yogesh, Y.C. 2020. Physico-chemical analysis of soils in Madanapalle block, Chittor district of Andhra Pradesh. *International Journal of Communication Systems* 8(3): 154-158.

Subbaiah, B.U., and Asija, G.L., 1956. Rapid procedure for the estimation of the available nitrogen in soil. *Current Science*. 25:259-260.

Surendra Babu, P., Ramana Reddy., Chandini Patnaik,M and Madhavi, A. 2012. Manual for Soil, Water and Plant Analysis

Walkley, A.J., and Black, C.A., 1934. Estimation of soil organic carbon by the chromic acid titration method. *Soil Science* 37: 29-38