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Nutrient Status of Rice (*Oryza sativa* L.) Growing Soils In Vijayapuram Mandal of Chittoor District In Andhra Pradesh

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ABSTRACT

A survey was undertaken during the year 2011 to study the nutrient status of rice growing soils in Vijayapuram mandal of Chittoor district in Andhra Pradesh. One hundred and ten surface soil samples were collected in Rice-rice sequential cropping system and soil samples were analyzed in soil testing lab of our KVK. The analysis of the soils revealed that the texture of the soils varied from sandy loam to sandy clay loam, neutral to slightly alkaline in reaction, non-saline, low to medium in organic carbon and available nitrogen, medium to high in available P and K. The available Fe, Mn and Cu were found to be above their respective critical limits in all the soils. However, 40 per cent samples were deficient in available Zn. Simple correlation studies revealed that N was positively and significantly correlated with organic carbon. Available N, K and Mn were positively and significantly correlated with soil pH. DTPA extractable Zn was found to be positively and significantly correlated with electrical conductivity.

Key words : Correlation coefficient, Macronutrients, Micronutrients, Rice.

Mineral nutrition has been recognized as an important constraint in crop production. Systematic and periodic identification of current nutrient deficiencies and sufficiency is a prerequisite for sustaining the productivity and fertility of soils. Rice (*Oryza sativa* L.) is the most important and staple food crop for more than two thirds of the population. India has the largest area under rice (about 43.97 m ha) and with a production of about 104.32 million tones with an average productivity of 2.37 t ha^{-1} (Directorate and Economics and Statistics, Department of Agriculture and Cooperation, 2013). In Andhra Pradesh rice occupies an area of 40.95 lakh hectares with the production of 128.91 lakh tonnes with an average yield of 3.14 tonnes ha^{-1} and in Chittoor district the crop was grown in an area of 51,106 ha annually with a production of 1.68 lakh tonnes and with an average yield of 3.30 tonnes ha^{-1} (Commissioner of Agriculture, Andhra Pradesh, 2011). Rice-rice sequential cropping is an important cropping system in the rice growing areas of Chittoor district. As this system needs large amount of nutrients to achieve high productivity, use of inorganic fertilizers and scarce use of organic manures year after year, has resulted in reduced crop yields. It is well recognized that inorganic fertilizers are not a complete substitute for organic manures and vice versa and their role is complementary (Swarup and Wanjari, 2000). Keeping the above facts in view, the present investigation was taken up.

MATERIAL AND METHODS

The study area Vijayapuram mandal lies in between 13° 19' 48" of Northern latitude and 79° 40' 48'' of Eastern longitude in Chittoor district *viz.,* Alapakam, Kammakandriga and Pannuru villages and the investigation was carried in the year 2011. One hundread and ten soil samples were collected from rice-growing fields in the above mentioned villages of Vijayapuram mandal of Chittoor district. From each field soil samples were collected randomly from a depth of 0-30 cm and the samples in each field were composited, so as to obtain one composite sample from each field totaling to 110 soil samples.

All the soil samples were analyzed for pH, EC, organic carbon as per the standard procedures (Jackson, 1973). Available N was determined by alkaline permanganate method. The available P was extracted with 0.5M $NaHCO_3$ extractant and was determined by using ascorbic acid as reducing agent and the available K in the soils was extracted by employing Neutral normal ammonium acetate and determined by aspirating the extract into the flame

photometer (Jackson, 1973). DTPA extractable Fe, Mn, Zn and Cu were determined as per Lindsay and Norvell (1978).

Soil samples were rated as low, medium and high categories as per the limit suggested by Muhr *et al.* (1965) for organic carbon, available N, P and K. In respect of available Fe, Mn, Zn and Cu ratings given by Lindsay and Norvell (1978) were followed. Nutrient Indices (N.I.) for available N, P and K were worked out as per the formula given by Parkar *et al.* (1951). Simple correlation analysis was carried out between soil physico-chemical characteristics and available soil nutrients by adopting standard procedures.

RESULTS AND DISCUSSION

Soil texture, pH, EC and Organic Carbon:

The soil texture in the rice growing soils varied from sandy loam to sandy clay loam in Alapakam and Pannuru villages, where as in Kammakandriga village, the texture of soil is sandy clay loam (Table 1). This variation in soil texture might be due to the variation in topographic position, nature of parent material, *in situ* weathering of clay and age of soils. Similar results were reported by Sampath Kumar and Sankar Reddy (2010) in rice grown soils of Chittoor district. pH of the rice growing soils was varied from 7.16 to 7.71. The variation in pH might be attributed to the variation in nature of parent material and degree of weathering. Similar findings were reported by Leelavathi *et al.* (2009). The soils were non-saline with EC values varying between 0.59 and 0.72 dSm^{-1}. The organic carbon content in the soils ranged from 0.45 to 0.50 per cent. The low organic carbon content in the soils are possibly because of high temperature and good aeration in the soil which increased the rate of oxidation of organic matter. These findings were in good agreement with the findings of Singh and Mishra (2012).

Available N, P and K :

The rice growing soils of the study area were low to medium in available N with overall nutrient index values ranging from 1.28 to 1.71, while available P and K were medium to high with overall nutrient index values varying from 2.60 to 3.00 and 2.28 to 2.80, respectively (Table 2). The low available nitrogen status of these soils might be attributed to low organic carbon content. Further, the semi-arid conditions of the area might have favoured the rapid oxidation and less accumulation of organic matter releasing more nitrate nitrogen (NO_3-N) which could have been lost by leaching (Finck and Venkateswarlu, 1982). Medium to high availability of P in the soils may be due to the continuous use of phosphatic fertilizers like Di Ammonium Phosphate and Single Super Phosphate by the farmers in these areas. The higher values of K could be attributed to more intense weathering, release of K from organic residues, application of K fertilizers and upward translocation of potassium from lower depth along the capillary raise of ground water. These findings were in agreement with the findings of Vara Prasad Rao *et al.* (2008).

Available Fe, Mn, Zn and Cu :

DTPA extractable Fe, Mn, Zn and Cu in rice growing soils ranged from 18.00 to 24.09, 11.40 to 13.92, 0.61 to 0.86 and 0.94 to 1.52 mg kg^{-1} soil, respectively (Table 3). All the available micronutrients except Zn were above their respective critical limits. However, 40 percent of the samples were deficient in available Zn. The lower Zn values obtained in the study area might be due to the presence of medium textured soils like sandy clay loams in which fixation of Zn occurred in the octahedral layers substituting for magnesium (Elgabaly, 1950). These observations were in congruence with findings of Lakshminarayana and Rajagopal (2004) in rice growing soils of Andhra Pradesh.

Correlation studies :

Simple correlations were worked out between various soil characteristics and available soil nutrients and the correlation coefficients were presented in Table 4. Available N was positively and significantly correlated with organic carbon. Positive relationship between organic carbon and available nitrogen was due to the close relationship between organic carbon and different forms of nitrogen which in turn might be due to the association of ammonical nitrogen (NH_4-N) on humus complex in the soil (Verma *et al.,* 1980). Available N, K and Mn were positively and significantly correlated with soil pH. It might be due to organic matter and clay fraction are the

Table 1. Soil test summary - Soil Texture, pH, E.C and Organic Carbon (mean values) in rice grown soils of Vijayapuram mandal.

S. No.	Village	Number of samples	Soil texture	PH (1:2.5)	E.C (dSm^{-1})	Organic carbon (%)
1.	Aalapakam	28	sl - scl	7.56	0.63	0.45
2.	Kammakandriga	07	scl	7.71	0.72	0.50
3.	Pannuru	75	sl - scl	7.16	0.59	0.46

SL: Sandy Loam, SCL: Sandy Clay Loam

Table 2. Soil test summary - Available N, P and K in rice grown soils.

S. No.	Village	Number of samples	Available N			Available P			Available K		
			Mean (kg ha^{-1})	Fertility index	Fertility status	Mean (kg ha^{-1})	Fertility Index	Fertility status	Mean (kg ha^{-1})	Fertility Index	Fertility status
1.	Aalapakam	28	236.36	1.28	L	34.62	2.78	H	278.00	2.71	H
2.	Kammakandriga	07	324.68	1.71	M	39.92	3.00	H	257.14	2.28	M
3.	Pannuru	75	211.33	1.33	L	29.48	2.60	H	274.26	2.80	H

L: Low, M: Medium, H: High

Table 3. Soil test summary – Available Fe, Mn, Zn and Cu.

S. No.	Village	Number of samples	Available micronutrients (mg Kg^{-1})			
			Fe	Mn	Zn	Cu
1.	Aalapakam	28	18.00	13.35	0.86	1.28
2.	Kammakandriga	07	22.28	13.92	0.64	0.94
3.	Pannuru	75	24.09	11.40	0.61	1.52

Table 4. Correlation coefficients (r) between physico-chemical characteristics of soil and available soil nutrients.

	N	P	K	Fe	Mn	Zn	Cu
pH	0.254**	-0.144	0.441*	-0.089	0.194**	-0.096	-0.131
E.C	-0.070	0.483*	0.170	-0.093	0.052	0.260**	0.055
O.C	0.915*	-0.051	0.090	0.032	-0.039	-0.035	-0.086

** At 1% level of significance * At 5% level of significance

primary reservoirs of exchangeable potassium. Kalbande and Swamynatha (1976) reported similar relationship between exchangeable potassium and pH in black soils of Tungabhadra catchment. DTPA extractable Zn was found to be positively and significantly correlated with soil electrical conductivity and a non-significant relationship was observed with other soil properties. Similar relationship has been reported by Siddhamalai *et al.*(2002). The results lead to a conclusion that the rice grown soils in the Aalapakam, Kammakandriga and Pannuru villages of Vijayapuram mandal of Chittoor district were sandy loam to sandy clay loam in texture, neutral to slightly alkaline in reaction. The organic carbon content and available nitrogen is low to medium, whereas available P and K were

medium to high in status. The micro nutrients Fe, Mn, and Cu were found above critical limits in the study area. But the available Zn was deficient in 40 percent of the soils. Therefore effective measures viz., adoption of soil test based integrated plant nutrition system which ensures balanced nutrition coupled with improved package of practices are to be adopted for obtaining sustained soil fertility and crop productivity.

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