Original Research Article

STUDIES ON SOIL PHYSICO-CHEMICAL PROPERTIES IN RICE BASED CROPPING SYSTEMS OF LONG TERM FERTILIZER EXPERIMENTS

ABSTRACT

Soil samples collected from All India Coordinated Rice Improvement Programme from three different locations initiated in 1989-90 *viz*. Maruteru-MTU (Andhra Pradesh-Rice Rice cropping system), Titabar-TTB (Assam-Rice Rice cropping system) and Mandya-MND (Karnataka- Rice Cowpea cropping system); with 8 treatments involving combinations of organic and inorganic sources of nutrients and three replications laid under Randomised Block Design, were processed and analysed for different soil physicochemical properties *viz*. pH, EC, OC and CEC properties to study the effect of varied fertilization practices in the long run which help in assessing the soil health status. Over 30 years of continuous experimentation, the above mentioned physico-chemical, did not vary significantly among different treatments except organic carbon content. It ranged from 0.52-0.63%, 0.22-0.31% and 0.26-0.40% in Maruteru, Titabar and Mnadya respectively.

1. INTRODUCTION

Rice based cropping systems (RBCS) are the major food production systems in the country cultivated in about 28.0 m ha with a wide range of crops of varied productivity levels and inherent problems of nutrient availability and physical impairments. . Continuous cropping with imbalanced and blanket fertilizer use, decreasing use of organic manures and less consideration for field variability in soil fertility are known to influence nutrient dynamics in the soil, crop nutrition, response to applied nutrients and consequently impact crop yields, soil quality and its productivity in the long run particularly in intensive cropping systems. This has been the major production constraint in sustainable agriculture. Monoculture of submerged rice systems during the monsoon is the mainstay of agriculture in these areas with low productivity. Lenka [5]. Since the soils are salt affected and problematic, maintenance of soil quality through proper nutrient management assumes great importance to achieve sustainable crop production.

2. MATERIALS AND METHODS

2.1. Study Site

A 30 year old ongoing experimental site under AICRIP (All India Coordinated Rice Improvement Programme) with geographic coordinates with 16^0 38' N, $81^0$44' E , 26°36' N, 94°12' E, 12º31' N, 76º54' E of A.P (MTU), Assam (TTB) and Karnataka (MND) were selected for this study to investigate the effect of varied fertilization practices on soil physico chemical properties in long term fertilizer experiments of rice based cropping systems. Laboratory studies were conducted at ICAR-IIRR (Indian Institute of Rice Research), soil science laboratory, Rajendranagar, Hyderabad.

The experiment was laid out in randomised block design with eight treatments replicated three times. The treatments constituted of T_1-control; T_2-100% NK (-P); T_3-100% NP (-K); T_4-100% RDF; T_5-100% RDF+FYM @ 5t ha^{-1}; T_6-50%RDF+ 50%FYM-N; T_7-50% RDF+ 25% FYM-N+ 25%GM-N and T_8-FYM@10 t ha^{-1}.

2.2. Soil collection and analysis

From three locations, altogether Seventy two Surface (0-15 cm depth) soil samples from eight treatments were collected after *Kharif* 2019 crop harvest from three replications, processed with < 2mm sieve, and analysed for physico chemical parameters namely soil reaction (pH), total soluble salts (EC), organic carbon (OC) and cation exchange capacity (CEC). Soil reaction (pH) was determined in 1:2.5 soil: water suspension using pH meter (Elico LI 610) after intermittent shaking of the sample with distilled water for 30 minutes. Jackson [4]; Total soluble salts were determined in 1:2.5 soil water suspension using digital EC meter(Elico CM 183. Jackson [4] and expressed as Electrical Conductivity(dS m^{-1}); Organic carbon content was determined in 0.5 mm sieved soil samples by wet digestion method. Walkley and Black [9]. and Cation exchange capacity was determined by the procedure given by Chapman [1] by ammonium saturation method.

2.3. Statistical analysis

The data obtained from the experimental trial in respect of various observations were statistically analyzed following the analysis of variance technique for randomized block design as suggested by Gomez and Gomez [3]. The statistical significance was tested with ‘F’ test at 0.05 level of probability and wherever the ‘F’ value was found significant, critical difference (CD) was worked out to the test of significance.

3. RESULTS AND DISCUSSION

3.1. Soil reaction

The data on soil pH after harvest as influenced by varied fertilization practices in LTFE of RBCS is presented in Table 1. pH of the soil samples at the initiation of experiment *i.e* in 1989 were recorded as 6.28 (slightly acidic), 5.20 (strongly acidic) and 5.87 (moderately acidic) at Maruteru (MTU), Titabar (TTB) and Mandya (MND) respectively.

Highest pH was recorded in T_7 (50% RDF+25% FYM-N+25% GM-N) as 6.50 (neutral) in Maruteru, 6.50 (neutral) in Mandya with 100% RDF+FYM (T_5) and in T_8 (FYM@10 t ha^{-1}) as 5.70 (moderately acidic) in Titabar. Lowest was in control 6.00, 5.88 and 5.27, respectively, at MTU, MND and TTB. The Rice-Pulse (cowpea) system at MND might have brought more favourable effect in pH compared to Rice-Rice system at MTU and TTB. These findings support with several other workers like Subehia et al. [7]

Table 1. Effect of varied fertilization practices on soil reaction in long term fertilizer experiments of RBCS.

Trt. No	Treatment Details	MTU	TTB	MAN
T_1	Control	6.00	5.27	5.88
T_2	100% NK(-P)	6.02	5.45	6.15
T_3	100% NP(-K)	6.07	5.52	6.07
T_4	100% RDF	6.18	5.57	6.26
T_5	100% RDF + FYM@5t ha^{-1}	6.35	5.63	6.50
T_6	50% RDF + 50% FYM-N	6.18	5.67	6.16
T_7	50% RDF + 25% FYM-N + 25%GM-N	6.50	5.64	6.22
T_8	FYM@10t ha^{-1}	6.01	5.70	6.19
	Mean	6.16	5.56	6.18
	SEm±	0.23	0.19	0.19
	CD (p=0.05)	NS	NS	NS
	CV (%)	6.65	5.88	5.45
	Initial values	6.28	5.20	5.87

3.2. Total soluble salts (EC- dS m^{-1})

The data on EC is presented in Table 2. after harvest by varied fertilization practices in RBCS. The initial soluble salts content of soil was 0.68, 0.28, 0.28 dS m^{-1} in Maruteru, Titabar and Mandya which were identified as normal to all the crops and further changed to 0.52, 0.22 and 0.26, respectively, in control.

The maximum soluble salt content was found in T_5 (100% RDF+FYM) of 0.63 dSm^{-1} in Maruteru; T_7 (50% RDF+25% FYM-N+25% GM-N) of 0.31 in Titabar and 0.40 in Mandya and minimum in control of 0.52, 0.22 and 0.26 dSm^{-1} respectively. The reason for increase in EC of FYM treated plots is due to the release of basic cations from the materials and formation of some soluble salts of those ions. Divya et al [2]. However, the influence among different treatments was non significant for each other. Higher amount of total soluble salt content was observed in clay soils of MTU which can retain positively charged ions more compared to light textured soils of TTB and MND.

Table 2. Effect of varied fertilization practices on total soluble salts (EC-dSm^{-1}) in long term fertilizer experiments of RBCS.

Trt. No	Treatment Details	MTU	TTB	MND
T_1	Control	0.52	0.22	0.26
T_2	100% NK(-P)	0.53	0.24	0.28
T_3	100% NP(-K)	0.58	0.25	0.38
T_4	100% RDF	0.62	0.30	0.30
T_5	100% RDF + FYM@5t ha^{-1}	0.63	0.29	0.32
T_6	50% RDF + 50% FYM-N	0.54	0.23	0.26
T_7	50% RDF + 25% FYM-N + 25%GM-N	0.57	0.31	0.40
T8	FYM@10t ha^{-1}	0.54	0.25	0.30
	Mean	0.57	0.26	0.31
	SEm±	0.03	0.03	0.02
	CD (p=0.05)	NS	NS	0.07
	CV (%)	9.38	18.49	13.13
	Initial values	0.68	0.28	0.28

3.3. Organic carbon (%)

Soil samples after harvest were analysed for organic carbon content and it was presented in Table 3. Organic carbon ranged from 0.85 to 1.32 %, 0.58 to 1.57 %, 0.19 to 0.67 % respectively, at Maruteru, Titabar, Mandya which is descripted as high, medium to high and low to medium while the initial values were 0.89% (high), 0.95% (high) and 0.31% (low), respectively.

The maximum content in Maruteru was recorded in T_5 (100% RDF+FYM) followed by T_8 (FYM@10 t ha^{-1}) and both of them were on par with each other and all the organically treated plots did not vary significantly. Results of Titabar were found to be in line with Maruteru. At Mandya, T_7 (50% RDF+ 50% N-FYM+ 50% N-GM) with 0.67% was found to be superior followed by T_6 (50%RDF+50%FYM-N) with 0.51%. In all the locations, control was found to be the lowest. The treatments that received organics recorded higher organic carbon compared to other treatments at all 3 locations.

Organic carbon content was highest in case of FYM treated plots because of the direct addition of organic matter to soil and stimulating effects of organics on increasing growth and also activity of microorganisms as pointed out by Sepehya et al. [6]; Tripathi et al. [8]

3.4. Cation exchange capacity [c mol (p^{+1}) kg^{-1}]

The data on cation exchange capacity in soil as influenced by different treatments was presented in Table 4. There was no significant difference observed among the treatments. Values of CEC were varied from 48.60, 18.97, 15.54 cmol (p^{+1}) kg^{-1} in control to a maximum of 60.91, 32.96 and 21.72 c mol (p^{+1}) kg^{-1} in 100% RDF+FYM (T_5) in Maruteru, Titabar and Mandya, respectively. There was an increase in all the treatments compared to control in all locations. Clayey soils of Maruteru with Rice-Rice cropping system showed higher cation exchange capacity, sandy loam soils of Mandya (Rice-Cowpea) recorded lower values and silty clay soils of Titabar recorded intermediate values.

Table 3. Effect of varied fertilization practices on organic carbon (%) content in long term fertilizer experiments of RBCS.

Trt. No	Treatment Details	MTU	TTB	MND
T_1	Control	0.85	0.58	0.19
T_2	100% NK(-P)	0.91	0.92	0.31
T_3	100% NP(-K)	1.01	1.10	0.30
T_4	100% RDF	1.10	1.33	0.34
T_5	100% RDF + FYM@5t ha^{-1}	1.32	1.57	0.46
T_6	50% RDF + 50% FYM-N	1.21	1.40	0.51
T_7	50% RDF + 25% FYM-N + 25%GM-N	1.27	1.43	0.67
T_8	FYM@10t ha^{-1}	1.30	1.55	0.50
	Mean	1.12	1.24	0.41
	SEm±	0.06	0.10	0.03
	CD (p=0.05)	0.19	0.29	0.10
	CV (%)	9.55	13.40	8.7
	Initial values	0.89	0.95	0.31

Application of recommended dose of fertilizers along with organics increased CEC of soils by 3.36% in Maruteru, 25.13% in Titabar and 11.90% in Mandya over application of inorganics alone.

Table 4. Effect of varied fertilization practices on cation exchange capacity [c mol (p^{+1}) kg^{-1} soil] in long term fertilizer experiments of RBCS.

Trt. No	Treatment Details	MTU	TTB	MND
T_1	Control	48.60	18.97	15.54
T_2	100% NK(-P)	56.60	20.22	18.72
T_3	100% NP(-K)	59.52	20.70	17.04
T_4	100% RDF	58.93	26.34	19.41
T_5	100% RDF + FYM@5t ha^{-1}	60.91	32.96	21.72
T_6	50% RDF + 50% FYM-N	57.50	22.36	19.63
T_7	50% RDF + 25% FYM-N + 25%GM-N	58.50	22.62	18.70
T_8	FYM@10t ha^{-1}	57.00	23.72	19.33
	Mean	57.19	23.49	18.76
	SEm±	3.79	2.06	1.44
	CD (p=0.05)	NS	NS	NS
	CV (%)	13.36	15.58	13.40

Conclusions

Irrespective of the locations and cropping systems, varied fertilization practices with the use of organics or inorganics did not show significant influence on soil reaction (pH), electrical conductivity (EC) and cation exchange capacity (CEC) of soils among different treatments. Organic carbon varied significantly among the treatments at all three locations with higher values in the treatments that received organics. However, the highest percent build up of organic carbon over initial status was observed in 100% RDF+FYM treatment at Maruteru (MTU) and Titabar (TTB); and in 50% RDF+ 25% FYM-N+ 25% GM-N treatment at Mandya (MND). Balanced usage of souces for N, P and K improved the soil physico chemical parameters over initial status.

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