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SOIL PROPERTIES AS INFLUENCED BY AGRONOMIC MANAGEMENT OPTIONS ON VARIOUS RICE VARIETIES GROWN UNDER SALINE IRRIGATION WATER

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ABSTRACT
A field experiment was carried out to investigate the influence of agronomic management options in various rice varieties under saline irrigation water during *kharif* 2018 at College Farm, College of Agriculture, Rajendranagar, Hyderabad. Slight insignificant decrease in mean pH was observed with In situ green manuring (7.38) and FYM application (7.37) plots. Maximum reduction in EC was noticed with In situ green manuring (0.86 dSm^{-1}) which was significantly superior over FYM application (1.06 dSm^{-1}), leaching of salts with irrigation water (1.24 dSm^{-1}) and control (1.51 dSm^{-1}). Among the management practices, In situ green manuring recorded maximum organic carbon (0.53%) which was on par with FYM application (0.51 %), The highest available nitrogen was recorded with In situ green manuring (278.20 kg N ha^{-1}) followed by FYM application (273.91 kg N ha^{-1}). Significantly the highest available phosphorus was recorded by the In situ green manuring (43.51 kg P_2O_5 ha^{-1}) than the other management practices. A build up of available potassium (1.19 to 9.59 %) was noticed in all the management practices. No significant differences were observed when different varieties were raised in sub plots. The results of the present study indicated that In Situ green manuring was the best among all the treatments tested to mitigate the adverse effect of the poor quality water.

INTRODUCTION

World population is increasing rapidly by every passing year and there will be a need to produce 87% more by 2050 of what we are producing today especially food crops such as rice, wheat, soybean and maize (Kromdijk and Long, 2016). Rice is a salt sensitive crop species for which soil and irrigation water salinity is a major factor restricting yield throughout substantial areas of Africa, south and south-eastern Asia. Salinity can be termed as severe abiotic stress which includes all the problems due to salts primarily by an abundance of sodium chloride from natural accumulation or irrigation (Flowers and Flowers, 2005).

Indiscriminate use of poor quality water for irrigating agricultural crops deteriorates the productivity of soils through salinity, sodicity and toxic effects. In addition to reduced productivity, the use of poor quality water deteriorates the quality of produce and also limits the choice of cultivable crops (Minhas and Gupta, 1993). Salinity problems associated with poor quality irrigation water are becoming more prevalent across the country as fresh water sources become more scarce. Yaduvanshi (2001) reported that continuous application of green manure and FYM for five years reduced the soil pH from 8.7 to 8.3. Singaravel *et al*. (2001) reported that among application of various amendments green leaf manure and FYM decreased the EC and pH over control under saline conditions. Bharmbe *et al*. (2001) reported that soil reaction and electrical conductivity were considerably decreased under sub-surface drainage along with incorporation of crop residue and green manuring crops under saline conditions. Chowdary *et al*. (2015) noticed that when compared to initial status, green manuring in combination with different quality of irrigation water recorded higher buildup of available N (377.73 kg N ha^{-1}) and K status (425.75 kg K_2O ha^{-1}) while the higher available P status was observed with FYM application (58.92 kg P_2O_5 ha^{-1}) in sorghum. Maruthi *et al*. (2010) suggests the detrimental impact of saline effluent on water quality, rendering it unsuitable for the propagation of life and unfit for agricultural purpose. Under these circumstances economical and viable agronomic options for managing these saline irrigation waters for cultivation of rice is an important area to be studied. Therefore the present research was carried out with an objective to evaluate soil properties as influenced by agronomic management options on various rice varieties grown under saline irrigation water.

MATERIALS AND METHODS

A field experiment was conducted during *kharif*, 2018 at College Farm, College of Agriculture, Rajendranagar, Hyderabad. The experiment was laid out in strip plot design with four agronomic management options for mitigating the affects of saline irrigation water which were taken as main plots and evaluated with three popular rice varieties of Telangana and one saline tolerant check variety which were transplanted in sub plots and replicated thrice. The main treatments comprised of four management practices viz., M_1: Application of 10 t ha^{-1} FYM, M_2: In situ green manuring of dhaincha @ 40 kg ha^{-1} before transplanting, M_3: Leaching of salts through application of irrigation water as per the leaching requirement, M_4: Check (No agronomic management practice). The sub treatments comprised of four different varieties viz., V_1: RNR 15048 (Telangana Sona), V_2: KNM 118 (Kunaram Sannalu), V_3: JGL 11118 (Anjana) and V_4: CSR 36 (Check Variety).

The irrigation water used was analyzed for different water quality parameters by following standard methods (Dhyan Singh *et al.*, 2005) and the results indicated that water belongs to C_4S_1. For enabling the leaching of salts through application of irrigation water as per the leaching requirement, Leaching fraction was calculated using the formula given by Rhoades, 1974 and Rhoades and Merrill, 1976:

$$LR = \frac{Ec_w}{5(Ec_e) - Ec_w}$$

LR = the minimum leaching requirement needed to control salts within the LR = the minimum leaching requirement needed to control salts within the tolerance (EC_e) of the crop with ordinary surface methods of irrigation

EC_w = salinity of the applied irrigation water in dSm^{-1}

EC_e = average soil salinity tolerated by the crop as measured on a soil saturation

extract.

Chemical properties like available Nitrogen (kg ha^{-1}) was analyzed using Alkaline permanganate method using KELPLUS SUPRA LX -Analyser (Subbaiah and Asija, 1956). Available P_2O_5 (kg ha^{-1}) by Olsen's method for extraction and ascorbic acid method for estimation by using UV- VIS UV5704SS Spectrophotometer at 420 nm (Olsen *et al.*, 1954). Available K_2O (kg ha^{-1}) was estimated by using neutral normal ammonium acetate method using ELICO CL361 flame photometer (Piper, 1966). Physico-chemical properties like pH analyzed using glass electrode pH meter and EC by using Solubridge method (Jackson, 1973). Organic carbon was estimated by walkley and Black's modified method (Jackson, 1967). The data on various parameters studied during the course of investigation were statistically analysed, applying the technique of Analysis of Variance described by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

pH

The data indicated non significant changes in pH either due to management practices or varieties or their interactions (Table 1). The pH of experimental soil ranged from 7.37 to 7.43 in different treatments and was close to the initial status (7.4). However, slight insignificant decrease in mean pH was observed with In situ green manuring (7.38) and FYM application (7.37) plots, this might be due to formation of humic and carbonic acids upon decomposition and mineralization of organic materials. Similar decrease in pH due to FYM was also observed by Yaduvanshi (2005).

Electrical Conductivity (dSm^{-1})

The data pertaining to changes in electrical conductivity (EC) is presented in (Table 1). All the management practices resulted in reduction in EC over control. Maximum reduction in EC was noticed with In situ green manuring (0.86 dSm^{-1}) which was significantly superior over FYM application (1.06 dSm^{-1}), leaching of salts with irrigation water (1.24 dSm^{-1}) and control (1.51 dSm^{-1}). Similarly, the management practices, application of FYM and leaching of salts through irrigation were found to be significantly superior in reducing the soil electrical conductivity over control. Higher EC was noticed in control where no management practices were followed.

However, the differences in EC of soil were insignificant when different varieties were cultivated. Similarly, The interaction effect of management practices and varieties was non significant and it was ranging from 0.83 to 1.56 dSm^{-1}.

The decrease in EC was more under In situ green manured plots followed by the FYM applied plots. The decrease in EC

Table 1: Soil Physico-chemical properties as influenced by agronomic management options to various rice varieties under saline irrigation water

Treatments	pH	EC (dSm^{-1})	OC (%)
M_1 : Application of FYM @ 10 t ha^{-1}	7.37	1.06	0.51
M_2 : In SituGreen manuring of Dhaincha @ 40 kg ha^{-1}	7.38	0.86	0.53
M_3 : Leaching of salts through application of irrigation water as per the leaching requirement	7.4	1.24	0.4
M_4 : Control (No agronomic management practice)	7.41	1.51	0.37
S.Em (±)	0.04	0.03	0.01
CD(P=0.05)	NS	0.1	0.06
V_1: RNR 15048 (Telangana Sona)	7.4	1.15	0.43
V_2 : KNM 118 (KunaramSannalu)	7.37	1.17	0.47
V_3: JGL 11118 (Anjana)	7.41	1.19	0.45
V_4 : CSR 36 (Check Variety)	7.39	1.15	0.46
S.Em (±)	0.01	0.04	0.01
CD(P=0.05)	NS	NS	NS
M at same V			
S.Em (±)	0.07	0.35	0.02
CD(P=0.05)	NS	NS	NS
V at same M			
S.Em (±)	0.08	0.04	0.02
CD(P=0.05)	NS	NS	NS
Initial values (pre harvest)	7.4	1.5	0.41

Table 2: Soil nutrient status as influenced by agronomic management options to various rice varieties under saline irrigation water

Treatments	Available Nitrogen (kg ha^{-1})	Available phosphorous (kg ha^{-1})	Available potassium (kg ha^{-1})
M_1 : Application of FYM @ 10 t ha^{-1}	273.91	40.19	345.03
M_2 : In SituGreen manuring of Dhaincha @ 40 kg ha^{-1}	278.2	43.51	373.6
M_3 : Leaching of salts through application of irrigation water as per the leaching requirement	268.33	38.5	344.96
M_4 : Control (No agronomic management practice)	262.3	36.71	333.61
S.Em (±)	5.85	0.61	4.93
CD(P=0.05)	NS	1.12	17.05
V_1: RNR 15048 (Telangana Sona)	272.39	40.15	352.13
V_2 : KNM 118 (KunaramSannalu)	268.78	39.68	348.37
V_3: JGL 11118 (Anjana)	266.6	38.85	344.24
V_4: CSR 36 (Check Variety)	274.97	40.22	352.46
S.Em (±)	3	1.12	4.29
CD(P=0.05)	NS	NS	NS
M at same V			
S.Em (±)	6.69	1.79	5.33
CD(P=0.05)	NS	NS	NS
V at same M			
S.Em (±)	8.23	1.67	6.75
CD(P=0.05)	NS	NS	NS
Initial status (pre harvest)	260.1	37.01	340.9

could be due to the addition of readily decomposable organic matter in the form of green manure which would result in decreased Eh, accumulation of CO_2 and due to the decomposition of organic acids. Electrical conductivity was more in the control than the GM, FYM and leaching. This may be due to stagnation of saline irrigation water alone, where there were absolutely no organic sources. Reductions in soil EC with application of organic manures were reported in wheat by Khan *et al*. (2010) and Muhammad *et al*. (2007).

Organic carbon (%)

Among the management practices, In situ green manuring recorded maximum organic carbon (0.53%) which was on par with FYM application (0.51 %). Both In situ green manuring and FYM application were found to be significantly superior over leaching (0.40 %) and control (0.37%). When compared to initial status, the buildup of organic carbon was to a tune of 29.26% with In situ green manuring and 24.39% with application of FYM. While leaching and control recorded a depletion of 2.43% and 9.75% of OC respectively when compared to the initial status (0.41%). The effect of varieties was not significant on soil organic carbon status and ranged from 0.43% to 0.47%. The interaction effect between management practices and varieties was also found to be non significant and it ranged from 0.34 to 0.54 kg^{-1} (Table 1).

The increase in organic carbon under In situ green manuring and FYM application might be due to the direct addition of considerable amount of organic matter in these plots when compared to other treatments. Results corroborate with the findings of Yaduvanshi (2001) and Bharmbe *et al*. (2001)

Available nitrogen (kg ha^{-1})

Compared to initial available nitrogen (260.10 kg N ha^{-1}) a marginal and non significant buildup in the available nitrogen status at harvest was noticed in different treatments.

Among management practices, the highest available nitrogen was recorded with In situ green manuring (278.20 kg N ha^{-1}) followed by FYM application (273.91 kg N ha^{-1}). When compared to initial status, available nitrogen in the experimental plots was more by 6.95% with In situ green manuring, followed by FYM (5.30 %), leaching (3.16%) and control (0.84 %).The interaction between management practices and varieties were non significant and it ranged from 259.46 to 283.53 kg N ha^{-1}. (Table 2)

When compared to initial status, the available N in all sub plots (varieties) with a main plot combination of In situ green manuring recorded buildup. Higher buildup of N was possible due to application of organic manures like green manures or FYM and thus improved the soil microbial activities of the soil and resulting in higher available nitrogen content in the soils. In addition, these manures have contributed considerable amount of N to the soil. The results were in conformity with Chowdary *et al*. (2015)

Available phosphorous (kg ha^{-1})

Compared to initial soil available phosphorus (37.01 kg P_2O_5 ha^{-1}), a buildup in the available phosphorus status at crop harvest was noticed in different treatments. Among management practices, significantly the highest available phosphorus was recorded by the in situ green manuring (43.51 kg P_2O_5 ha^{-1}) than the other management practices. The available phosphorous under application of FYM (40.19 kg P_2O_5 ha^{-1}) was on par with leaching (38.50 kg P_2O_5 ha^{-1}) but significantly higher than control (36.71 kg P_2O_5 ha^{-1}). The lowest available phosphorus was observed in control. When compared to initial available phosphorus, a buildup of 2.65 % to 18.52% was noticed. The highest buildup was noticed with In situ green manuring (18.52%) followed by application of FYM (8.5 %), leaching of salts with irrigation water (4.02 %) while a reduction of 0.8 % of available phosphorous was observed in the control .

No significant differences were observed when different varieties were raised in sub plots. The interaction effect was also found to be non significant. The mean phosphorus status under various treatments ranged from 35.23 to 45.23 kg P_2O_5

ha^{-1}. When compared to initial status, the In situ green manuring in combination with different varieties recorded higher available P status and it was closely followed by FYM application in combination with different varieties (Table 2).

When the organic manures were added to the soil, during their decomposition, appreciable amounts of carbon di-oxide gets released, which forms the carbonic acid leading to increased solubility of P resulting in higher availability. In addition, some amounts of P got added to soil as a constituent of green manure/FYM. The results obtained were in agreement with the findings of Chowdary *et al*. (2015).

Available potassium (kg ha^{-1})

The data pertaining to status of available potassium are presented in Table 2. A build up of available potassium (1.19 to 9.59 %) was noticed in all the management practices. A depletion of available K was noticed in control, when compared to initial status (340.9 kg K_2O ha^{-1}).

Among the management practices significantly the highest available potassium was recorded by the In situ green manuring (373.6 kg K_2O ha^{-1}) which was followed by FYM application (345.03 kg K_2O ha^{-1}) and leaching of salts with irrigation water (344.96 kg K_2O ha^{-1}. The lowest available Potassium was observed in control (333.61 kg K_2O ha^{-1}). Maximum buildup was noticed with In situ green manuring (9.59 %) followed by FYM (1.21 %), leaching (1.19 %) and a depletion of 2.13% was observed in control. Among sub treatments, there was no significant difference among varieties. there was no significant effect on interaction of main and sub treatments and available potassium in various treatments ranged from 329.13 to 387.4 kg K_2O ha^{-1}

The higher available K status in green manure applied plots could be due to the release of organic acids during decomposition process, which might have mobilized the non exchangeable forms of K. The slow and steady releasing nature of green manure throughout the cropping season resulted in higher availability resulted increase in readily available form of K in soil solution. In addition green manures have contributed considerable quantity of potassium to soil Chowdary *et al*. (2015)

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