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SUSTAINABLE MANAGEMENT OF PHYSICO-CHEMICAL PROPERTIES OF SODIC LAND THROUGH ORGANIC AMENDMENTS

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ABSTRACT
The experiment was under taken in sodic land affected site of Regional Research Station, Daleep Nagar, Kanpur, C.S. Azad University of Agriculture and Technology, Kanpur during 2017-2018 and 2018-19. The main objective was to find out the best organic amendment for sodic land reclamation. The site was sodic affected, having loom texture, pH 9.43, organic carbon 0.30%, available N 175.00 kg/ ha, available P_2O_5 12.00 kg/ ha and available potash 168 kg/ ha. The eight treatments i.e., control, FYM@ 15t/ha, green manuring of dhaincha, (in situ), paddy residues recycling @ 5 t/ ha, FYM@ 15 t/ ha + green manuring of dhaincha (in situ), FYM@ 15 t/ ha + green manuring of dhaincha (in situ) + paddy residues recycling @ 5 t/ ha and gypsum @ 10 t/ ha, were tested. Addition of FYM@ 15 t/ ha + green manuring of dhaincha (in situ) + paddy residues cycling @ 5 t/ ha responded well and reduced pH and EC (dsm^{-1}) upto 8.9 and 0.27 respectively in comparison to base year and control. The availability of NPK contents was also increased with the aforementioned organic amendments. The increase in N content from 175 kg/ ha to 205 kg/ ha., P content from 12.00 kg/ ha to 13.50 kg/ ha and K content from 168 kg/ ha to 176 kg/ ha was analysed.

KEYWORD: Manure, Nitrogen, Organic amendments, phosphorus, potash, sodic land.

INTRODUCTION

Salt affected soils in India have been classified into either (a) alkali or sodic and (b) saline. Alkali soils have excess of carbonates and bicarbonates, high pH and ESP, poor soil physical properties and low organic matter content. They are most commonly reclaimed by gypsum addition and leaching with good quality water. The have been the subject of intensive investigations in last four decades and several reviews on nutrient management in alkali (sodic) soils or soils irrigated with alkali (or sodic) where are available which also have addressed integrated nutrient management *(Chhbra and Abrol, 1983; Gupta and Abrol, 1999; Swarup, 1994)* and hence it is not dealt here detail. Saline soils on the other hand contain excess of neutral soluble salts, pH is around neutrality and plant growth is chiefly inspired by osmotic and ionic effect. It is well known that at given level of salinity, the growth and yield of crops are depressed more when the nutrition is disturbed than when it is normal (Hassan et al, 1970). Crop responses to fertilizers under saline and alkali soil conditions is a complex phenomenon (Bernstein et al. 1974). The two most important factors are (a) the nutrient status of soil before fertilization and (b) the level of salinity in the soil. Response is also highly dependent on ratio among major cations, viz, Na^+, K^+, Mg^{2+} and Ca^{2+}, and the major anions especially Cl and SO_4^{2-}.

Application of organic materials improves biological activity of soils in the short term (Rao and Pathak, 1996) and in the long run improves leaching, sequesters salts and thus exerts an ameliorative action. Salinity decreased the mineralization of N from added Sesbania and Lucerne green manure (Singh and Rai, 1975) NaCl (0.05-0.2%) decreased the nitrification of FYM and groundnut cake in a vertical. Phosphatic addition increased the mineralization and reduced the N losses. Rao and Pathak (1996) also reported the breakdown of added Sesbania was inhibited with progressive increase in salinity. In the ECe range of 16-26 dS/m breakdown was 84% of that in non-saline soil.

On pre-dominantly saline soils which was dominated by sulphate, there was marked response to application of 3 t/ ha Sesbania green manure followed by leaching (Singh, 1959). The application of 5 t/ ha of Sesbania green manure has been effective in giving higher yield of rice in saline soils (Krishna Rao and Raja Rao, 1960). The incorporation of wheat straw and maize stovers at 7.5 t/ ha for three years improved soil physical properties and productivity very significantly and salt content decreased gradually. Application of 20 t/ ha of FYM to wheat irrigated with saline water increased the gram yield significantly (Singh, et al. 1981). The use of FYM also increases the available P and K content of soil besides improvement in N status of soil (Bandyopadhyay and Bandyopadhyay, 1984). Application of organic manure also increases the efficiency of phosphatic fertilizers. Therefore, this article well focuses on management of sodic land with various organic amendments.

MATERIAL AND METHODS

The experiment was under taken in sodic land affected site of Regional Research Station, Daleep Nagar, Kanpur, C.S. Azad University of Agriculture and Technology, Kanpur during rainy season of 2017 & 2018. The main objective was to find out the best organic amendment for sodic land reclamation. The soil sample was collected before the use of amendment. The experimental site was sodic soil, having loamy texture, pH 9.43, organic carbon 0.30%,

available N 175.00 kg/ ha, available phosphate 12.00 kg/ ha and available potash 168.00 kg/ ha thus the nutrients of experimental soil were analysed low in organic carbon, available nitrogen medium in available phosphorus and potassium. The pH was determined by Electrometric glass electrode method (Piper 1950), while organic carbon was determined by Colorimetric method (Datta, et al., 1962). The nitrogen was analysed by Kjeldahl's method as discussed by Piper (1950). The available phosphorus and potassium were determined by Olsen's method (Olsen et. al. 1954) and Flame photometric method (Singh, 1971), respectively. The eight treatments i.e., control FYM@ 15 t/ ha, green manuring of Dhaincha (*in situ*), paddy residues recycling @ 5 t/ ha, FYM@ 15 t/ ha + green manuring of dhaincha *(in situ)*, paddy residues recycling @ 5 t/ ha + green manuring of dhaincha *(in situ)*, FYM@ 15 t/ ha + green manuring of dhaincha *(in situ)* + paddy residues recycling @ 5 t/ ha and gypsum @ 10 t/ ha were tested. The FYM was applied before the on set of monsoon, while paddy residues and gypsum added at the time of showering. The seeding of dhaincha for green manuring was done after on set of rains. The paddy residues in treatment of FYM @ 15 t/ ha + green manuring dhaincha (in situ) + paddy residues cycling @ 5 t/ ha was added at the time of dhaincha turning in to soil for green manuring. After completion of experiment the treatment wise soil samples were collected and analysed and compared with initial status of soil nutrients.

RESULT AND DISCUSSION

The average data of analysed physico-chemical properties have been reported in Table-1 & 2 and discussed here under appropriate heads.

Effect on pH

Addition of FYM@ 15 t/ ha + green manuring of dhaincha (in situ) + paddy residues recycling @ 5 t/ ha was declined pH upto 8.90 over the base year pH (9.43) and control treatment pH (9.30). The pH value recorded under this treatment was at par to the addition of gypsum @ 10 t/ ha (pH 8.90) and paddy residues recycling @ 5 t/ ha + green manuring of dhaincha (pH 9.00). The nominal reduction in pH was also analysed in the other tested treatments over the control treatment and base year analysed pH value. The considerable reduction in salinity due to addition of organic matter supported to the reduction of pH.

Effect on EC (dsm^{-1})

The use of FYM@ 15 t/ ha + green manuring of dhaincha *(in situ)* + paddy residues recycling @ 5 t/ ha was reduced status of EC (dsm^{-1}) upto 0.27 over the base year EC (dsm^{-1} – 0.30) and control treatment EC (dsm^{-1} – 0.30). The EC (dsm^{-1}) analysed under this treatment was at part to the applied gypsum @ 10 t/ ha (0.27). The nominal reduction in EC (dsm^{-1}) was also analysed in the other tested combination treatments over the control treatment and base year results recorded on EC (dsm^{-1}). The considerable reduction in salinity due to addition of organic matter, supported to the reduction of EC (dsm^{-1}).

EFFECT ON ORGANIC CARBON

The notable improvement was analysed in organic carbon from the addition of FYM @ 15 t/ ha + green manuring of dhaincha *(in situ)* + paddy residues recycling @ 5 t/ ha by a margin of 0.08% in comparison to control. The other treatments also displayed the improvement in organic matter in comparison to control except addition of gypsum @ 10 t/ ha. Application of gypsum @ 10 t/ ha was failed in improvement of organic carbon. The amendment of organic matter in the reclamation of sodic soil was responsible of improvement of organic carbon in salt affected soil.

TABLE 1: Initial soil properties of experimental field

pH	EC (dsm^{-1})	OC (%)	Available nutrients Kg ha^{-1}		
			Nitrogen (N)	Phosphorus (P)	Potash (K_2O)
9.43	0.30	0.30	175.00	12.00	168.00

TABLE 2: Soil properties after treatment

Treatments	pH	EC (dsm^{-1})	OC (%)	Available nutrients Kg ha^{-1}		
				Nitrogen (N)	Phosphorus (P)	Potash (K_2O)
T1	9.3	0.30	0.31	175.00	12.20	168.00
T2	9.2	0.29	0.35	180.00	12.50	170.00
T3	9.2	0.29	0.35	181.00	12.68	171.00
T4	9.1	0.28	0.34	185.00	12.30	172.00
T5	9.1	0.27	0.36	196.00	12.72	171.00
T6	9.0	0.28	0.35	195.00	13.01	172.00
T7	8.9	0.27	0.39	205.00	13.50	176.00
T8	8.9	0.27	0.31	190.00	12.85	170.00

EFFECT ON AVAILABILITY OF NPK CONTENTS

Results available in Table-2 clearly indicate that addition of 15 t FYM/ ha + green manuring of dhaincha *(in situ)* + Recycling of paddy residues @ 5t/ ha increased the availability of N by 205 kg/ ha, phosphate by 13.50 kg/ ha and potassium by 176 kg/ ha, which was highest over all the tested treatments and also found superior over the base year NPK content availability. The order of performance of treatment was FYM@ 15t/ ha +green manuring dhaincha *(in situ)* + paddy residues recycling @ 5 t/ ha > paddy residues recycling @ 5 t/ha + green manuring dhaincha *(in situ)* > FYM @ 15t/ ha + green manuring dhaincha *(in situ)* > FYM @ 5 t/ ha > gypsum @ 10 t/ ha> control. The regular application of FYM, green manuring and plant residues in to saline soils increases the nutrients

availability in soil (Bandyopadhyay and Bandyopadhyay, 1984).

CONCLUSION

The farm house holds having sodic land may be advocated for addition of FYM @ 15t/ ha + green manuring dhaincha (*in situ*) + paddy residues recycling @ 5t/ ha to the reclamation of their holdings.

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