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UTILIZATION OF BRACKISH GROUNDWATER FOR CROPS WITH EM-TECHNOLOGY

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A pot experiment was conducted in a wire-house of the Department of Soil Science, University of Agriculture, Faisalabad for the production of wheat using brackish water in such a manner that sustained yields could be obtained without disturbing soil quality seriously. Three different types of organic manures viz. FYM, sugarcane filter cake and poultry manure were used with and without EM and brackish water of EC 2.87 dS m", SAR 12.24 (m mol L!)l!2and RSC,9.24 me t.'. The soil used was sanely clay loam having plf, 7.70, EC. 2.22 dS m'; SAR 5.8 (m mol L!)1I2Grain yield of crop was recorded at maturity and soil was analyzed at harvest. Results indicated that all the organic amendments treated with effective microorganisms (EM) were highly effective in sustaining the crop yield as well as the soil properties. The sugarcane filter cake + EM treatment was found superior in sustaining crop yield and soil characteristics. The effectiveness of the amendments in general followed the order: sugarcane filter cake> poultry manure> farm yard manure.
Key words: brackish groundwater, EM- technology

INTRODUCTION

Irrigation water is imperative for successful crop production in most of our agriculturally productive area that falls in arid and semiarid regions. Although irrigation water has the advantages over rainfall for being under control as to the time when required and amount of application but at the same time it has disadvantages like limitation of pumping and having variable amounts of salts. Underground water is available in enormous quantity, yet all of it is not' suitable for crop use, because it contains high concentration of soluble salts, which adversely affect the plant growth and soil properties.

Addition of organic material such as FYM and crop residues would be useful in improving soils that are otherwise deteriorated when brackish water containing excess of Na' and HCO:] is used for irrigation (Singh, 1969; Hornick and Parr,1987). The EM is a mixed culture of beneficial microorganisms such as photosynthetic bacteria, lactic acid bacteria, yeast, fermenting fungi andactinomycetes.The use of EM culture with organic amendments improves physical properties of the soil (Karim et al,, 1993). Therefore, this experiment was conducted to explore the possibilities for the utilization of brackish water by amending it with effective microorganisms (EM) for sustainable crop production.

MATERIALS AND METHODS

A pot experiment was conducted in a wire-house of the Department of Soil Science, University of Agriculture, Faisalabad for the production of wheat using brackish water. A bulk sample from surface soil (0-15 cm) was collected, dried and ground to pass through a 2-mm sieve. Ten kilograms of this soil were added to each pot. Original soil had sandy clay loam texture with pH, 7.70, EC, 2.22 dS m', SAR 5.8 (m mol L-!)1/2Ten wheat seeds (Inqalab-91) were sown in each pot while five plants were kept after thinning at a two-leaf stage. The treatments used followed by no leaching provision with brackish water (BW) were:

T!=Control (BW only); T_2=BW+ FYM @ 20 t ha'' ; T3=BW + FYM + EM @ 60L ha"; T_4=BW+ sugarcane filter cake (SFC) @ 20 t ha"; T_s =BW + SFC + EM @ 60L ha"; T_6=BW + poultry manure (PM) @ 20 t ha"; T_{70}BW + PM +EM @ 60L ha",

These three types of organic manures were mixed in the soil 20 days before the sowing of crop. Brackish water of EC 2.87 dS m", SAR 12.24 (m mol L')1/2and RSC 9.24 me L-! was applied along with each irrigation in the respective treatments when needed. The recommended dose of NPK was applied @ 150-100-75 kg ha" in the form of urea, SSP and ~S04. respectively. Yield components were recorded at harvest and soil was analyzed for EC. , pH and SAR (U.S. Salinity Lab. Staff, 1954). The data collected were analyzed by the ANOVA technique following completely randomized design (Steel and Torrie,1980) with three repeats.

RESULTS AND DISCUSSION

a) **IOOO-GrainWeight and Yield per Pot:** Results showed that the' treatment of SFC + BW supplemented with EM followed by SFC alone, proved better for grain yield and 1000-grain weight than other treatments (Table 1). All the treatments differed significantly over the control, The decrease in 1000-grain weight and yield in controlled pots may be

attributed to the accumulation of salts injurious to the crop and nutritional imbalances (Pearson, 1960; Mass and Hoffman, 1977). When brackish water was treated with organic amendments and EM, the deleterious effect of brackish water was reduced. The maximum increase in lOOO-grainweight and grain yield by SFC+EM treatment might be due to the high solubility effect as well as high contents of Ca , P plus other nutrients of SFC and microbes which further enhanced their availability.

The sugarcane filter cake was somewhat acidic and it also lowered soil SAR to a safe limit (Tables 2, 5) which may have resulted in more availability of certain nutrients such as 'P'. Studies by Shukla and Pandey (1988) also indicated the superiority of sugarcane filter cake treatment over the .Sesbania green manure. Microbes further increased the availability of nutrients (Hussain et al., 1991).

Table 1. Effect of brackish water and organic amendments with and without EM, on 1000-grain weight (g) and grain yield per pot (g)

Treatment	1000-grain weight	Grain yield per pot
Control	12.71 c	34.12 c
FYM+BW	18.57 b	56.24 b
FYM+BW+EM	17.90 b	60,41 b
SFC+BW	21,87 ab	65.21 ab
SFC+BW+EM	24.33 a	74.06 a
PM +BW	20.25 b	58.75 b
PM +BW+EM	19,47 b	60.31 b

Treatment means followed by the same letter(s) in a column are alike at 5% probability level.

Table 2. Analysis of organic amendments used in the experiment

	Sugarcane filter cake	Poultry manure	Farmyard manure
pH.	5.68	6.98	6.24
N(%)	2.08	3.2	2.17
P (%)	2.98	1,47	1,59
Ca (%)	3,48	1,97	2.20

b) EC" of Soil: The results presented in Table 3 revealed that there was maximum decrease in electrical conductivity with FYM + EM treatment followed by SFC + EM. This might be due to the fact that organic amendments added to the soil did contain sufficiently high concentration of Ca^{2+} to counter the deleterious effects of Na' (Abbas, 1996).

Table 3. Effect of brackish water and organic amendments with and without EM, on EC. of soil (dS m")

Treatment	Mean	Decrease over control (%)
Control	4.717 a	----
FYM+BW	4.273 b	9,42
FYM+BW+EM	3.997 e	15.26
SFC+BW	4.207 be	10.82
SFC+BW+EM	4.008 de	15.03
PM +.BW	4.253 b	9.83
PM +BW+EM	4.143 cd	12.17

Treatment means followed by the same letter(s) in a column are alike at 5% probability level.

c) Soil Reaction (pH.): The data given in Table 4 indicated that all the organic manures decreased the pH, significantly over the control. Maximum decrease in pH, was with FYM+EM treatment followed by SFC+EM. The decrease in pH. might be due to release of CO_2 and organic acids from the organic amendments which in turn decreased the pH. The results are in line with those of Palaniappon and Budha (1992).

Table 4. Effect of brackish water and organic amendments with and without EM, on pH.

Treatment	Mean	Decrease over control (%)
Control	7.91 a	----
FYM+BW	7.56 c	4,43
FYM+BW+EM	7,41d	6.32
SFC+BW	7.72 b	2,40
SFC+BW+EM	7,46 cd	5.69
PM +BW	7.54 cd	4.68
PM +BW+EM	7.50 cd	5.18

Treatment means followed by the same letter(s) in a column are alike at 5% probability level.

d) Sodium Adsorption Ratio (SAR): The SAR is associated with the sodic hazards of irrigation waters.The maximum decrease in SAR was observed for SFC + EM treatment(Table 5) which might be due to high Ca^{2+} concentration in SFC than that in PM treatment. According to Madaliar and Sharma (1965), manures when decompose in soil, release CO_2 which mitigates alkalinity besides making it more permeable. The CO_2 so released solubilizes soil $CaCO_3$

to make Ca^{2+} more available for countering the sodic hazard of irrigation waters.

$$CaC0_3 + CO_2 + H_20 = Ca(HC0_3)2$$
$$X\text{-}Na + Ca(HC0_3)2 = X\text{-}Ca^{2+} + 2NaHC0_3$$

Table 5. Effect of brackish water and organic amendments with and without EM, on SAR (m mol L·1)lfbf soil

Treatment	Mean	Decrease over control (%)
Control	18.65 a	----
FYM+BW	14.34 b	23.11
FYM+BW+EM	14.06 b	24.61
SFC+BW	12.55 c	32.71
SFC+BW+EM	12.38 c	33.62
PM +BW	13.37 be	28.31
PM +BW+EM	13.61 be	27.02

Treatment means followed by the same letterts) in a column are alike at 5% probability level.

Conclusion: Results of this study show that when brackish water of EC 2.85 (dS m'), SAR 12.24 (mmol L,1/12and RSC 9.24 (me L,l) is applied to soil along with EM inoculated sugarcane filter cake (SFC) or farm yard manure (FYM) or poultry manure, p'H, EC_e and SAR decreased while grain yield and 1000-grain weight are increased. Plant biomass also increases when these organic amendments are applied. However, SFC was found more effective in sustaining the soil properties than other amendments.

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