Studies on reclamation of saline sodic soils

F.A.M.Farag

A field experiment was carried out on reclamation of a saline sodic clay soil by El-Salam Canal water (EC 1.8 dSm', SAR 5.5, Adj. SAR 12.3) at a location in south El-Hosoiniya plain, north east of the Delta region, Sharqueya Governorate. The aim was to asses the efficiency of reclamation using two calcium chemical amendments, gypsum "GP" and lime "LM", and three organic amendments, farmyard manure "FYM"; rice straw compost "RSC" and rice straw "RST" and their interaction in reclaiming the soil. Application rate of chemical amendment was calculated by equation so as to decrease ESP to a final value of 10. The amount was 10.1 Mg gypsum/fed or 5.8 Mg lime/fed. The organic amendments were applied at 10 Mg/fed. After reclamation, rice and barley were grown and yields were measured. Reclamation was executed using the intermittent leaching technique for two cycles. Each cycle comprised applying 600 m3/fed followed by 900 m3/fed with two weeks interval. The pre-leaching values of soil parameters before reclamation were: EC: 81.8 dS/m (in topsoil) and 66.7 dS/m (in subsoil), other comparable parameters were ESP 43.1 and 45.7, pH: 8.1 and 8.0, SAR : 58.3 and 48.6 for topsoil and subsoil respectively for each parameter. Application of amendment materials was done with mixing within the top 15 cm of the soil surface. "GP" was superior to lime; and organic amendments enhanced the reclamation effect of chemical amendments. Soil status for the post-leaching stage, showed that (GP+FYM) reduced EC to 20.4 in topsoil and 18.0 dSm-1 subsoil. (GP+RST) reduced EC to 26.9 in topsoil and 27.5 in subsoil, and (GP+RSC), values were 30.7 and 40.3. "LM" was of lowerefficiency giving comparable values as follows: (L +FYM): 34.2 and 31.1; (LM -FRSC): 44.6 and 33.2; (LM+RST : 26.5 and 19.0. Application of "GP" or "LM" singly gave the llowings: "GP": 29.7 and 29.4; "LM": 35.8 and 31.0 dSm-I. App ication of "RST" singly reduced EC to 19.2 in topsoil and 18 dSm-1 in subsoil pH and sodicity were reduced, more by "GP ' than by "LM". ESP results were as follows: (GP+RST): 26.4 and 29.5; (GP+FYM) : 22.2 and 29.4; (GP+RSC): 34.6 and 4 .0; "GP" alone : 29.3 and 31.7. Results for "LM" were: (LM+ T): 31.7 and 22.6; (LM+FYM): 35.5 and 41.5; (LM+RSC): 40.2 and 39.7. The no-amended treatment (water only trea nt) gave 29.5 and 33.4 for topsoil and subsoil, respectivel . Higher Efficiency of gypsum was enhanced by organic am ndments; particularly "RST". More decrease in such values occurred following ac full season of the reclaimed soil.The four highest yields of rice grains (Mg/fed were as follows: (GP+RST): 2.400, "GP" only 2.133; (L +FYM): 1.647, (LM+RSC): 1.507. Lowest yield was that of no chemical amendment "NCA"; no-organic amendment "N • A" (the absolute control) giving 0.504 Mg/fed. Yields of barl y grains were as follows: the four highest: (GP+RST): 2.74 , "GP": 2.500, (GP+FYM): 2.467 and (LM+RST): 2.293 Mg/fed. Efficient response was enhanced mainly by "RST' due to facilitating percolation and easy decomposition; an "FYM" principally due to its being a source of plant nutrient.Soil status for the post-rice stage, sho ed that (GP+FYM) reduced EC to 7.2 in topsoil and 5.4 dSm subsoil, whereas, (GP+RST) reduced EC to 8.5 in topsoil and .2 dSm-1 in subsoil, and (GP+RSC), values were 11.8 and 9.5 dSm' in6-,Sluninia1ytopsoil and subsoil, respectively. "LM" was lower efficiency giving comparable values as follows: (LM+FYM): 19.6 and 15.2; (LM+RSC): 24.3 and 14.9 and (LM+ RST): 12.5 and 13.8 in topsoil and subsoil respectively. Application of "GP" or "LM" singly gave the followings: "GP": 8.7 and 11.2; "LM": 25.4 and 22.1 dSm-1. Application of "RST" singly reduced EC to 13.7 in topsoil and 13.0 dSm-1 in subsoil. pH and sodicity were reduced, more by "GP" than by "LM". ESP results were as follows: (GP+RST): 8.44 and 10.16; (GP+FYM): 14.23 and 15.56; (GP+RSC): 16.74 and 19.28; "GP" alone: 9.99 and 8.63. Results for "LM" were: "LM": 27.42 and 29.30; (LM+RST): 18.01 and

23.38; (LM+FYM): 27.50 and 31.47; (LM+RSC): 30.47 and 30.53. The no-amended treatment (water only treatment) gave 28.85 and 30.77 for topsoil and subsoil, respectivelyLaboratory column experiment”GP” was of great efficiency in increasing the amount of leachates. Its combination with ”RST” in particular enhanced its efficiency. At end of 10 weeks of leaching, the overall volume (cumulative) of leachates (ml/column) were as follows: 3581 (RST) > 1421 (GP+RST) > 1099 (GP+FYM) > 944 (GP)> 160 (LM+FYM) > 149 (LM+RST). Others were between 60 and 113 ml/column. Amounts of leached salts were in line with the amounts of leached leachates. They were as follows (cumulative g/column): 20.67 (RST) > 16.36 (GP+FYM) > 15.93 (GP) > 13.75 (GP +RST) > 11.40 (GP +RSC) and 7.25 (NCA + NOA). Others leached from 2.14 to 5.47 g/column.The Enhancing effect of rice straw in reclaiming the saline soil and decreasing its salinity through enhancement ofwater percolation is consistently displayed in this column experiment. This material increased the effectiveness of gypsum and made the use of lime practical proposal for desalinating saline soils.Original values of soil parameters before leaching the columns were: EC: 73.0 dS/m other comparable parameters were ESP: 44.4, pH: 8.0. and SAR: 51.0. After 10 weeks of leaching without amendments, salinity and sodicity were reduced. ”GP” + ”FYM” reduced EC to 2.75 dS/m, and (LM +FYM) reduced it to 2.76 dS/m. The (GP+RST) treatment reduced EC to 3.34 dS/m. Gypsum ”GP” alone, or (GP+FYM) or (GP+RST) reduced soil pH whereas lime showed an increase in pH.(GP+RST) reduced SAR to 4.30 and ESP to 3.67. (GP+FYM) reduced SAR to 5.92 and ESP to 5.92 and (LM+RST) reduced SAR to 12.25 and ESP to 9.98.Thus, although lime is not as efficient as gypsum for sodic soils, its effectiveness may be enhanced to a practical level (if gypsum is scarce) by mixing it with fresh rice straw in particular. This may offer a way to use surplus of rice straw instead of burning it. Even when used alone, rice straw may help reclaiming saline non-sodic soils, and to a less degree saline sodic ones. A mixture of lime with farmyard manure although may not be as efficient as (lime + rice straw) in reclamation, it is useful from the viewpoint of plant nutrition.Regular annual or biannual (or every 4-5 years) application of ”GP” mixed with farmyard manure or rice straw may be recommended to improve soil fertility and increase soil productivity. Lime on the other hand may be used mixed with rice straw or farmyard manure in order to obtain effective positive response in reducing sodicity and increasing yield of crops subsequently grown after reclamation.