productivity of some salt affected soils asinflu enced by chemical amend ements and organic materials

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5- SUMMARY AND CONCLUSIONThe obligation over population which doesn't corresponds to an equal increment for the agricultural soils caused the problem of the food gab, which consequently caused problems for the food security. Such a problem does not affect only the economic sides but also affects political decisions, social security and also national culture. So the one, who does not have his power, does not have his freedom.In order to provide food and agricultural products for the fast-growing world population, it is necessary to improve the productivity of the cultivated land and put more lands into agriculture.Soil salinity is one of the major problems in Egyptian agriculture. It has been estimated that about 1/3 of the irrigated land of Egypt is salt-affected to different degrees. These soils are poorly or non-productive and have to be reclaimed or improved to meet the requirements of the rapid increase in population.The rate at which these soils can be reclaimed depends on the rate of water flow through the profile and the amount of soluble calcium made available for the exchange reaction.The polyvalent salts are effective in improving flocculation of clays, while organic materials usually result in a255direct aggregation and stabilization of the obtained soil structure. Therefore, it could be possible that a combination of them may have interactive effects in saline sodic and sodic soilreclamation.The aim of this study was to know the effectiveness of reclamation under effect of some chemical and organic soil amendments through counting the quantity of leaching water and the time required for completing the reclamation process.To fulfill the purposes of this study a laboratory experiment was conducted using two sodic soils, i.e a saline sodic soil taken from Tal Al-Ohda area, located east of El-Wadi drain Tal Al-Kabir in El-Esmaillia Governorate. Egypt and a non saline-sodic soil taken from Tal Al-Hatab area, located east of El-Wadi drain, Tal Al-Kabir in El-Esmaillia, Governorate. Eygpt. Some amendments were used like the chemical amendments such as gypsum, calcium chloride, acids (i.e. H_2SO_4 and HCl) and organic materials [i.e. sugar cane compost and bean compost]. These amendments used individually and combination of sugar cane compost used with calcium chloride, with each of the two kinds of soils with the continuous leaching with tap water. The combination of gypsum used with Ca-enriched high salt water dilution which includes in calcium with the continuous leaching successive dilution.Plastic columns having an 8.5cm inner diameter and 30 cm height were used. 1.0 kilogram portions of the studied256soils were packed uniformly in each column to the height of 20 cm.The studied treatments were: Control (untreated soil), Gypsum (full gypsum requirement G.R), H_2SO_4 (full requirement), HC1 (full requirement), sugar cane compost at a rate of 2 %, bean compost at a rate of 2 %, sugar cane compost at a rate of 4 % + CaC12 (full requirement), sugar cane compost at a rate of 6 % + CaC12 (full requirement), sugar cane compost at a rate of 8 % + CaC12 (full requirement), Ca-enriched HSWD alone, Ca-enriched HSWD + 50 % G.R and Ca-enriched HSWD + 100 % G.R. All treatments were replicated 3 times.The comparison between the investigated amendments depended on their efficiencies in improving physical and chemical properties of the studied soils. This was evaluated through the following:•Maintaining an adequate hydraulic conductivity during the leaching process.•Getting rid of both excessive soluble salts and exchangeable sodium besides the leaching requirements for both desalinization and desodification process. The results obtained could be summarized in the following:Application of the various amendments had greatly increased water movement through columns of the saline-sodic soils, in particular, the combined treatments, i.e. HSWD + full257GR, sugar cane compost 8 % + CaC12, sugar cane corn ost 6 % + CaC12, HSWD + 50 % G.R, sugar cane compost 4 + CaC12 and H2SO4 which were more superior than the other tre, tments.Also, the application of various amendments to the sodic soil had greatly increased water movement through soil columns. The effect of applications of HSWD + full GR, HS + 50 % G.R, sugar cane compost 8 % + CaC12, sugar cane co post 6 % + CaC12, sugar cane compost 4 % + CaC12, HSWD alo e, H2SO4 and HC1 seemed more superior than the other applicatio s.258amendments had greatly increased water penetration thr columns. The effects of sugar cane compost 8 % HSWD + full GR, sugar cane compost 6 % + CaC12, s compost 4 % + CaC12, HSWD + 50 % G.R, H2SO4 and more superior than the other amendments.Also, in the s similar behavior was found. The effects of the used am followed the descending order: HSWD + full GR > HS % G.R > HSWD alone > sugar cane compost 8 % + sugar cane compost 6 % + CaC12 = H2SO4 > HC1> s compost 4 % + CaC12 > gypsum > sugar cane compo bean compost 2 % > untreated soil (control).soil, the f various ugh soilCaCl2, gar cane Cl were dic soil, ndmentsD + 50 CaC12 > ar cane •t 2 % >Regarding the water stable aggregates in the saline sodic soil, the obtained results revealed that the application of various amendments had greatly increased water stable aggregates. The effect followed the descending order: HSWD + 50 % G.R > sugar cane compost 6 % + CaC12 > HSWD + full GR > sugar cane compost 8 % + CaC12 > gypsum > sugar cane compost 4 % + CaC12 > HC1 > H2SO4 > sugar cane compost 2 % > bean compost 2 % > HSWD alone > untreated soil (control).Concerning the water stable aggregates, in sodic soil, the obtained results revealed that the application of various amendments had greatly increased water stable aggregates in following descending order: sugar cane compost 8 % +CaCl2 > sugar cane compost 6 % + CaC12 > sugar cane compost 4 % + CaC12 > HSWD + full GR > HSWD + 50 % G.R > gypsum > HCl > H2SO4 > sugar cane compost 2 % > bean compost 2 % > HSWD alone > untreated soil (control).The obtained data revealed that, the EC values of saline sodic soil tended to decrease due to all the used treatments. The applications of gypsum and H2SO4 seemed to be more effective in salt removal from soil where the DROP in the electrical conductivity (EC) of the effluent was noticed after about 1.5 -2.5 pore volume (PV) of leachate through soil profile. Application of HSWD on the other had, needed quantity of leaching water equals 5.0 — 7.0 pore volume to make an equalreduce in EC.The effluent concentration curves showed a ecrea§e in all ions with increasing the leaching volume, except for the CO3- and HCO3” one, which showed slightly change • between increase at the beginning of leachate followed by decr ase.Regarding the cumulative leached chlorides, it as similar due to all treatments and most of it was leached by bout 1.5 -2.0 PV of leachate except for the HSWD treatme is which needed about 3.5 — 4.5 PV. However the cumulati e leachedamounts were_ much higher in cases of HSWD + gypsum, sugar cane compost + CaC12 and HCI.The cumulative leached sulphate continuously especially, in cases of the treatments received amendments (H2SO4, gypsum and HSWD + gypsmaximum SO4- removal occurred after about 1.5 leachate had been collected through soil treated wi gypsum and HSWD + full GR treatments.increased sulphate I. Almost4.5 PVH2SO4,The cumulative leached sodium followed a sto that of SO4- and Cl at the beginning of the leaching while it went parallel to SO4- thereafter, in particular up of the combined treatments between HSWD + full cane compost 8 % + CaC12, sugar cane compost 6 %HSWD + 50 % GR, sugar cane compost 4 % + CaC12 HCI and gypsum.lar trend process, •n usage R, sugarCaC12, H2SO4,260The obtained data in sodic soil, revealed that, the EC values in all treatments tended to decrease obviously in the beginning due to application of all treatments, thereafter slightly decreased up to end of the experiment. Applications of sugar cane compost 2 % and bean compost 2 % were more effective in salt removal from soil. The DROP in the electrical conductivity (EC) of the effluent was noticed after about 1.0 - 1.5 pore volume (PV) of water percolated through soil profile. This was true for all the treatments except for HSWD treatment which needed quantity of leaching water equals 2.5 — 4.0 pore volume to make equal reduction in salts. After that, the rate of EC decrease was more steady until it reached more or less constant values.The effluent concentration curves showed a decrease in all ions with increasing the leaching volume, except for CO3- and HCO3- which showed slightly changes between increase at the beginning of leachate followed by decrease.Regarding the cumulative leached chlorides, in all the treatments, most of them were leached by about 1.0 — 1.3 PV of leachate volume except for HSWD treatments which needed about 2.5 — 3.0 PV. However the cumulative leached amounts were much higher due to Ca-enriched HSWD + gypsum, sugar cane compost + CaC12 and HC1 applications.The cumulative leached sulphate continuous! increased especially, in the treatments received sulphate endments (HSWD+ gypsum, H2SO4 and gypsum). Most SO4- w. s removal after about 1.3 — 3.0 PV leachate had been collected ough soil treated with HSWD + full GR, HSWD + 50 % GR, sum, and H2 S 04 treatments.The cumulative leached sodium followed a tre d similar to that shown in the saline sodic soil. In particular upo usage of the combined treatments between HSWD + full GR, H + 50 % GR, HSWD alone, H2SO4, sugar cane compost 8 % + CaC12, sugar cane compost 6 % + CaC12, sugar cane comp s st 4 % + CaCl2, HCl and gypsum.Concerning, the saline-sodic soil after leac content was sharply decreased in all soil depths, parti the surface ones. The highest EC, values were fo HSWD alone, untreated soil (control), sugar cane corn bean compost. 2 % and HSWD + 50 % GR treatme lower depth (10-20) cm.g, salt ularly inin the ost 2 %, is in theThe reduction in soil salinity (the leaching requi ements) followed the descending order: the application of s gar cane compost 6 % + CaC12, gypsum, sugar cane compost 8 % + CaCl2, sugar cane compost 4 % + CaC12, H2SO4 d HC1. Moreover, sugar cane compost + CaC12 and gypsum app ications greatly reduced the leaching requirements.262Concerning the reduction of exchangeable sodium, the applications of acids, sugar cane compost + CaC12, gypsum or HSWD +gypsum gave the best results. Generally, the untreated soil required more leaching water for desodification than the treated ones. Moreover, the desodification required more leaching water as compared to the desalinization. The studied treatments could be arranged according to their efficiency in reducing exchangeable Na÷ on saline sodic soils in the following decreasing order:H2SO4 > sugar cane compost 8 % + CaC12 > sugar cane compost 4 % + CaC12 > HC1> sugar cane compost 6 % + CaC12 > Gypsum > HSWD + full G.R > HSWD + 50 G.R > HSWD alone > sugar cane compost 2 % > bean compost 2 % > untreated soil (control).Calcium carbonate content was lower of the amended soils. The clear decrease in CaCO3 % occurred in the upper depth as compared with the deeper ones. The changes in CaCO3 contents due to application of H2SO4 and HC1 were more eminent. The CaCO3 contents remained in soil after leaching could be arranged descendingly to be with the untreated soil (control) > sugar cane compost 4 % + CaC12 > sugar cane compost 6 % + CaC12> HSWD alone > sugar cane compost 8 % + CaC12 > sugar cane compost 2 % > bean compost 2 % > HSWD + 50 % G.R > Gypsum > HSWD + full G.R > HC1 > H2SO4 in the upper depth (0-10) cm.263According to the previous results, it can be concluded that using the combination treatments weather between sugar cane compost + CaC12 or Ca-enriched HSWD + gypsum as well acids gave the best results due to their high efficiency in reducing exchangeable sodium in saline sodic soil; lowering water leaching requirements, and reducing the reclamation period.Concerning, the sodic soil after leaching, salt content was markedly decreased in most soil depths, particularly in the surface one. The highest ECe values were found in the HSWD + 50 % GR, sugar cane compost 2 % and HSWD + full GR treatments in the lower depth (10-20) cm.Concerning the reduction of exchangeable sodium, the applications of acids, sugar cane compost + CaC12, gypsum or HSWD +gypsum gave the best results. Generally, the untreated soil required more leaching water for desodification than the treated ones. Moreover, the desodification process required more leaching water as compared to the desalinization one. The studied treatments could be arranged according to their efficiency in reducing exchangeable Na’ in sodic soils in adecreasing order as follows:H2SO4 > sugar cane compost 8 % + CaC12 > sugar cane compost 6 % + CaC12 > HCl > sugar cane compost 4 % + CaCl2 > HSWD + full G.R > HSWD + 50 % G.R > Gypsum > HSWD alone > sugar cane compost 2 % > bean compost 2 % > untreatedsoil (control).264Lower values of CaCO3 % were eminent in all the upper depths (0-10 cm) of the amended soil. The changes in CaCO3 contents due to H2SO4 and HC1 treatments were more eminent. According to the amount of CaCO3 contents remained after leaching the treatments could be arranged as follows:Control (untreated soil) > Gypsum > sugar cane compost 2 % > bean compost 2 % = sugar cane compost 4 % + CaCl2 > HSWD alone > sugar cane compost 6 % + CaC12 > HSWD + full G.R > HSWD + 50 % G.R > sugar cane compost

8 % + CaC12 > HC1 > H2SO4 in the upper depth (0-10) cm.According to the previous results, it can be concluded that using the a combination of sugar cane compost + CaC12 or Ca-enriched HSWD + gypsum or acids gave the best results due to their high efficiency in reducing exchangeable sodium; lowering water leaching requirements, and reducing the reclamation period.Concerning the pots experiment, conducted on the saline sodic soil, the obtained results revealed, generally, that the germination rate was 100 % due to most treatments except in cases of the HSWD, untreated soil (control), sugar cane compost 2 % and bean compost 2 %.The values of plants length ranged between (22.20 —25.40 cm), (9.02 — 39.46 cm) and (4.86 — 23.38 cm) for chemical, organic-chemical and HSWD treatments respectively.265cane compost 8 % + CaC12 = sugar cane co post 4 % + CaC12 > H2SO4 > HCl > HSWD + 50 % GR sugar cane compost 2 % > bean compost 2 % > HSWD full GR > untreated soil (control) > HSWD alone.3-Desodification started after passing 4.2 P.V o tap water and 5.39 P.V for Ca-enriched HSWD for saline sodic soil, while, in sodic soil, the desodification began er passing 1.36 P.V for tap water and 2.62 P.V for C -enrichedHSWD.4-The reduction in exchangeable sodium in saline sodic soil followed the order: H2SO4 > sugar cane com ost 8 % + CaC12 > sugar cane compost 4 % + CaC12 > H 1> sugar cane compost 6 % + CaC12 > Gypsum > HSWD full G.R > HSWD + 50 % G.R > HSWD alone > gar cane compost 2 % > bean compost 2 % > untr ated soil (control) while, in the sodic soil it followed e order: H2SO4 > sugar cane compost 8 % + CaC12 > s gar cane compost 6 % + CaC12 > HC1> sugar cane comp s st 4 % + CaC12 > HSWD + full G.R > HSWD + 50 00 G.R > Gypsum > HSWD alone > sugar cane compost 2 % > bean compost 2 % > untreated soil (control).5-To shorten reclamation time, the best results tr atments were in the order: sugar cane compost + CaC12> I SWD + gypsum > acids. This order characterized both th studiedsoils.Also the values of dry weight ranged between (0.672 — 0. 828 g/pot), (0.322 — 1.082 g/pot) and (0.160 — 0.475 g/pot) for chemical, organic-chemical and HSWD treatments respectively.Concerning the pots experiment conducted on the sodic soil the obtained results, revealed the germination rate was 100 % in most treatments except for the HSWD, bean compost 2 % and untreated soil (control) applications.Regarding the plants length, the obtained results, revealed that values of plants length ranged between (23.90 — 28.96 cm), (11.72 — 30.21 cm) and (9.20 — 32.16 cm) for chemical, organic-chemical and HSWD treatments respectively.The values of dry weight ranged between (0.786 — 0. 883 g/pot), (0.527 — 0.956 g/pot) and (0.230 — 0.838 g/pot) for chemical, organic-chemical and HSWD treatments respectively.CONCLUIONS1-The amounts of leaching water required for desalinization were less those required for desodification during leaching processes in both of saline sodic and sodic soils.2-The reduction in salinity for saline sodic soil followed the order: sugar cane compost 6 % + CaCl2 > gypsum > sugar266RECOMMENDATIONS1-Reclamation of the sodic soils requires soil amendments especially when the soil is low in its content of sol ble salts. This is necessary for maintaining a stable d goodstructure.2-The amendments containing Ca2+ are suitable and I referred especially when the soil to be reclaimed is po e r in its content of soluble Cat'. This is very important for eeping a continuous supply for Ca2t requires replacing exc geable Na+ on the soil complex.3-Usage of the organic matter (composts) as a soil amendments requires longer period of time and is c c sidered of no beneficial effect on the reclamation process.4-The Ca-enriched HSWD technique is very effe tive in reclamation of sodic soils whether they were sal' e or not. Moreover, these technique saves a considerable qu tity of the fresh water required for reclamation besides it re a uce the time required for reclamation.5-The investigation has proved the efficiency o using combinations of HSWD + gypsum and compost + •aC12 for reclaiming the sodic soils.6-The calcium chloride as a highly soluble substance is very effective in reclamation especially when this sub •tance is found as a by-product.2687-H2SO4 and HC1 acids can be used very effectively in reclamation sodic soils only if these soils contain a percent of calcium carbonate not less than 3 %.8-Adequate drainage is of a vital role in complement of the leaching process and maintaining the reclaimed soils against secondary salinization and deterioration.