5. SUMMARY

Salt affected soils are those having excessive concentrations of soluble salts and or/exchangeable sodium sufficient to interrupt the growth of most crop plant, either directly due to the osmotic and specification toxicity effects or indirectly by changing the physico-chemical properties of the soil such as, poor water permeability, poor aeration and root penetration problems.

The present work aims at comparing the effect of using either natural or synthetic soil conditioners at different application rates individually or in combination with gypsum on some physical and chemical properties of some fine textured salt affected soils of Egypt.

With this respect, two salt affected soils were chosen in the present study namely; saline sodic clay soil from Sakha, Kafr El-Sheikh Governorate (pH= 8.1, EC= 19.05 dS/cm^{-1} and ESP= 50.6) and sodic clay soil from Tal El-Kebeir, Sharkia Governorate. (pH= 8.8, EC= 3.95 dS/cm^{-1} and ESP= 68.4).

Examined soil conditioners were:

1. Natural soil conditioners:
   a) Composted bark (Cb): Prepared from fresh hard wood poplar bark (collected from Nile Matches Company "NIMCO", Alexandria).
   b) Farmyard manure (FYM): collected from the surrounding areas of examined soils.
   c) Agricultural gypsum (G); used by the General Authority of Land Reclamation.

2. Synthesized soil conditioners:
   a) a locally prepared polyacrylamide (PAM) 20% active material and Mol.Wt ≃ 1 million.
   b) A locally prepared bitumen emulsion (Bit.): 50% active material.
   c) A locally prepared polyvinyl acetate emulsion (PVAc): 50% active material.

Either composted bark or the three examined synthesized soil conditioners were prepared in the National Research Centre, Cairo, Egypt (Soils and Water Use Dept. and Polymers and Pigments Dept.).

The rates of application were: 2 and 4% (W/W) for both Cb and FYM, gypsum requirements (GR) and 0.1% and 0.2% (active

material) for PAM and 0.5-1.0% (active material) for both Bit. and PVAc.

The optimal conditions for soil conditioning such as initial (10-15% W/W) and final (30-35% W/W) moisture content were adopted.

After conditioning, soils were allowed to dry in the air before being passed through a 8 mm sieve. Fife hundred grams of air dried soils were uniformly placed in polyethylene cylinders (30 cm long and 5 cm in diameter). Water was added at the rate of 400 m^3/fed/irrigation (i.e. 200 cm3 water/cylinder/irrigation) every 15 days for one year (24 irrigations). After 3, 6 and 12 months from the beginning of the experiment (i.e. after 6, 12 and 24 irrigations), physical and chemical properties of each soil were determined.

In another experiment, gypsum requirements were determined for each soil (treated with either natural or synthesized materials) and mixed with the soil. Treated soils with gypsum were uniformly placed in cylinders and leached biweekly for one year as previously mentioned above. Properties of soils after 3, 6 and 12 months were also determined.

Obtained results could be summarized as follows:

I. Leaching either saline sodic or sodic soils without addition of soil conditioners deteriorates soil hydro-physical and chemical properties. Such deterioration gradually increases by continuing leaching process.

II. Effect of applying natural or synthesized soil conditioners either alone or together with gypsum and leaching salt affected soil on some hydrophysical properties of soils:

1. Stability of sil structure:

A. Micro structure:

1. Micro-structure was expressed by a) size distribution of micro-structural units > 2 μ, > 5 μ, > 20 μ and > 50 μ, and their MWD. b) fraction of silt+clay not detached and remains in water stable structural units > 0.02 mm.

2.a. Compared with untreated soils and under the same conditions of leaching, addition of organic materials (Cb or FYM) and leaching for 3 months slightly improved soils micro-structure. Such improvement increases by leaching for another 3 months. By

continuning leaching for another 6 months, no more improvement in soils micro-structure was noticed.

b. When applying gypsum, the improvement in soils micro structure was much higher than that obtained using O.M. as soil conditioners - and gradually increased by continuning leaching till the end of the experiment.

c. Synthesized conditioners showed more improvement in soil micro structure for both soils than that obtained with natural conditioners. Moreover, most of the improvement appears at the end of the 1st three months of conditioners addition.

d. In all cases, the improving effect increases by doubling the application rate of the examined conditioners.

e. Gypsum addition in combination with either natural or synthesized conditioners decreases soils dispersiability, i.e. increases their aggregates formation. This beneficial effect was higher and longer than that obtained when soil conditioners were added individually

B. Macro-structure :.

1. Macro structure was expressed by size distribution of water stable structural units > 2.0; 2.0-0.84; 0.84-0.42; 0.42-0.21; 0.21-0.106 and <0.106 mm in diameter and MWD of this distribution.

2.a. Soil conditioning increases, with various degrees, the percentages of water stable structural units > 2 mm and > 0.21 mm in diameter on the expense of smaller units. Such improvement increases by doubling the application rates.

b. As previously mentioned with micro-structure the slighlty improving effect of O.M. continunes for the 1st 6 months. When applying gypsum, the improvement in the water stability of soil structure was much higher than that of O.M. and continues till the end of the experiment. Data of synthesized conditioners showed higher improvement in sil structure (after the 1st three months) than that obtained with natural conditioners. Obtained structure remains stable for another 9 months.

c. applying conditioners (natural or synthesized) together with gypsm greatly increase the stability of soil structure and in turn the MWD of water stable structure units. Such stable structure did not affect by leacing.

Generally, the improving effect of studied conditioners on the stability of soil structure could be descendingly arranged as follows:

Synthesized conditioners + gypsum ≥ synthesized conditioners ≥ organic materials+gupsum > gypsum > organic materials.

2. Soil swellability :

a. Soil conditioning decreases the swellability of studied soils as measured by the change in their water content at a hydrostatic suction of 15 mb. More decrease in soil swellability was obtained by increasing the applicate rate.

b. The best effect of O.M. appears after 6 months. By time proceeding, an adverse effect was measured, while the effect of gypsum was higher and continuos till the end of the experiment.

c. For the first 6 months, the improving effect of synthesized conditioners was much higher than that of gypsum. After that, the effect of synthesized material, was more or less the same as that of gypsum.

d. Addition of gypsum requirements to treated soils with either natural o · synthesized conditioners leads to an increasing decrease in soil swellability more than that obtained when applying examined conditioners individually.

3. Hydraulic properties of soils under saturated conditions:

a. Applying conditioners to salt affected soils leads to positive changes in their hydraulic properties under saturated conditions measured by hydraulic conductivity (K_{sat} $m.day^{-1}$); intrinsic permeability (K^{-} m^2); and mean diameter of soil pores. Such improving effect increases with the application rate of examined conditioners.

b. The improving effect of O.M. continued during the 1st six months of the experiment while addition of gypsum to soils treated with O.M. greatly increases water movement in the soil. Such beneficial effect increases by time.

c. Gypsum takes medium position between organic additions and synthesized materials. Obtained improvements continually increase during the experiment.

d. The highest values of hydraulic properties were recorded for soils treated with synthesized materials together with gypsum. This highly positive effect increases also by time.

III. Effect of applying natural or synthesized soil conditioners either alone or together with gypsum and leaching salt affected soils on some chemical properties of soils :

a. Treating either saline sodic or sodic soils with soil conditioners decreases their gypsum requirements. Such decrease is much more higher when applying synthesized materials.

b. With only some exceptions (CEC of soils treated with O.M.), treating salt affected soils under study with soil conditioners decreases - by various degrees - soil pH, EC and soluble ions in the saturated extract, CEC and ESP. These effects increase by increasing the application rate of the conditioners.

c. The effect of applied conditioners on the studied properties could be descendingly arranged in the following order:

Synthesized conditioners + gypsum > organic materials + gypsum ≥ synthesized conditioners > gypsum > organic materials.

Generally, the improving effect of the studied synthesized conditioners - either alone or when combined with gypsum - on hydrophysical and chemical properties of soils could be arranged as follows :

$$PAM > Bit \geq PVAc$$

while the improving effect of both organic materials, i.e. Cb and FYM is more or less the same.