5. Summary and Conclusion

This work was carried out to investigate the effect of the quality and quantity of irrigation waters on some chemical properties of three soils of Egypt as well as on dry matter yield and chemical components of sorghum plant grown on these soils. Such a study which involved the interaction between irrigation water soil and plant might provide important measures in assessing the suitability of different waters for irrigating different soils.

To fulfill the purposes of this study, soil samples were taken from three different locations (Moshtohor, Meet-kenana and Ameriah). These soils varied widely in their physical and chemical properties and were used in conducting the pot experiment. The pots were divided into two groups, the first one was perforated from the bottom to allow drainage and the second contained inperforated pots. The studied soil samples were packed uniformly in the pots and planted with sorghum as an indicator plant. The irrigation treatments involved three salt concentrations in the used waters , namely, 500, 2000 and 5000 *ppm.* and each concentration *contained three SAR* values, namely, 1, 10 and 20. Irrigation waters were applied to the soils in quantities corresponding to their field capacities in the inperforated pots

and 1.3 fold of field capacities in the perforated ones. Daily applications of irrigation waters were carried out to replenish the water depletion occurred due to evapotranspiration and drainage.

At the end of experiment which extended 60 days, sorghum plants were harvested, oven dried, digested and analyzed to determine their contents of Ca^{++}, Mg^{++}, Na^{+}, k^{+}, N and P. Also, the upper (0-15cm) and lower (15-30 cm) soil layers in each pot were air dried, crushed, sieved through a 2 mm sieve and chemically analyzed to determine EC, soluble cations and anions and exchangeable cations. The obtained results can be summarized in the following:

1 - Increasing salt concentration in the used water increased the electrical conductivity of the studied soils, regardless to their SAR values .This increase was more pronounced in the soils packed in the inperforated pots due to salt accumulation in these soils owing to the absence of leaching. The *SAR* value of irrigation waters showed contradictory effects on soils salinity. However, the upper soil layers tended, generally, to maintain a relatively higher amount of soluble salts than the lower one due to evaporation.

2- Taking into consideration the initial concentration of the soluble cations and anions in the investigated soils, it can be noticed that:

a) Increasing salt concentration of the applied water to the soils packed in the inperforated pots increased their contents of soluble Na^+, K^+, Ca^{++} and Mg^{++}. Also, increasing the SAR values was associated with an increase in soluble Na^+ and a corresponding decrease in Ca^{++} content.

On the other hand,increasing the quantity of water applied to the soils packed in the perforated pots although caused a relatively lower increase in soils contents of Na^+ and Ca^{++}, the K^+ and Mg ions either, slightly increased or reduced according to the soil type, salt concentration and *SAR* values of the applied water.

b) The studied saline waters did not affect the soils content of soluble CO^{--}_3 which remained almost, the same, while HCO_3 ions increased in the sandy and clay soils with increasing salt concentration in the applied water above 500 *ppm.* The increase in soluble HCO_3^- seemed to be associated with the increase in *SAR* values of irrigation water.

c) Increasing the quantity of applied water, regardless to its salt concentration or *SAR* value, reduced the soil content of SO_4^{--}.

d) Exchangeable Na, generally, increased in the upper layers of the studied soils, and this increase was more pronounced by increasing salt concentration in the applied water. Also clay

soil contained the highest exchangeable Na^+. Increasing the *SAR* value of irrigation water was associated always by increasing the soils content of exchangeable Na^+.

e) Increasing both salt concentration and SAR value of the applied waters decreased the exchangeable Ca^{++} content of the investigated soils. However, the content of exchangeable Ca^{++} in the upper layer of calceareaus soil increased.

f) However, soil contents of Mg^{++} were high in the calcareous soils, the lowest Mg^{++} content was obtained in the sandy soil. In most cases, soil content of exchangeable Mg^{++} tended to decrease with increasing the *SAR* value.of irrigation water.

g) Increasing the applied quantity of irrigation water up to 1.3 soil field capacity, decreased to a great extent, exchangeable K^+ content in the sandy soil. Also, neither the salt concentration nor the quantity of irrigation water appear an effect on exchangeable K^+ content in the calcareous soil.

3 - Dry matter yield of sorghum plants grown on clay soil was the highest and followed by that of calcareous soil and finally that of sandy soil. It was found also that, increasing salt concentration in the applied water reduced the dry matter yield in all the investigated soils. While *SAR* values of irrigation water appeared no effect on dry matter yield.

4- Plants grown on sandy soil and irrigated up to either field capacity or 1.3 field capacity did not continue and died after 4 weeks upon utilization of the highest saline irrigation water.

5- Chemical constituents of the sorghum plants grown on the clay soil can be summarized as follows:

Increasing salt concentration in the applied water increased the plant content of Na^+ ions. Irrigation by waters of *SAR* equals 10 and increasing salt concentration from 2000 up to 5000 *ppm* increased Na^+ content in the plant by three tines.

Plant content of Na^+ seemed to be related to the status of Na^+ in the soil solution which was increased with increasing the salt concentration and *SAR* value of the applied water.

Plants content of K^+ decreased by increasing salt concentration, however, *SAR* value and quantity of irrigation water had no effect in this regard. Therefore, the dominant factor which affected appreciably the plant content of K^+ was the salt concentration of the applied water.

Calcium content in the plants irrigated either up to field capacity or 1.3 field capacity increased by increasing salt concentration in the applied water. However, increasing the *SAR* value reduced the plants content of Ca^{++}.

Magnesium content in the plants irrigated up to field capacity tended to decrease with increasing salt concentration of the irrigation water. However, there was no effect due to *SAR* value of the water.

The plant content of N was lower at the treatment irrigated up to field capacity than that of 1.3 fold of the field capacity. While, plant content of P was not affected by salt concentration, *SAR* value or quantity of the applied water.

6 - The results of chemical constituents of the plants grown on the sandy soil, can be summarized as follows.

Plant contents of both Na^{+} and Ca^{++} ions increased with increasing salt concentration of the irrigation water. However, upon irrigation with any salt concentration of the applied water, plants content of Na^{+} increased by increasing the *SAR* values of irrigation water. but that of Ca^{++} decreased. Also, plant contents of Na and Ca were higher upon irrigating the plants up to field capacity as compared with the other irrigation treatment (1.3 field capacity).

Plant content of K^{+} decreased by increasing the salt concentration in irrigation water. On the other hand, plants content of Mg varied according to salt concentrations in the applied

water, as well as its quantity, however, no trend was observed due to the variation in *SAR* values of the water. Also, Mg content in the plants irrigated up to field capacity was higher than that in the plants irrigated up to 1.3 field capacity.

Plants content of nitrogen decreased by increasing salt concentration in irrigation water and upon irrigation up to field capacity . However, an apposite trend was observed in the soil irrigated up to 1.3 of its field capacity. On the other hand, the plant content of N was increased by increasing the salinity of applied water. In this regard, *SAR* values of the applied water seemed to exert no effect on plants content of N.

Phosphorus content in plants grown on soil irrigated up to 1.3 fold of its field capacity increased with increasing the salt concentration of the applied water from 500 to 2000 *ppm*, but it decreased sharply when the salt concentration raised up to 5000 *ppm*.

7- Concerning the chemical constituents of the plants grown on calcareous soil, the obtained results show that increasing the salt concentration of the water whether that applied in quantities equivalent to the soil field capacity or 1.3 fold of its field capacity increased the plants contents of Na^{+} and Ca^{++} ions. However, at any of the used salt concentrations, increasing the *SAR* value increased plants content of Na^{+} and decreased Ca^{++}

content. The plant contents of Na^+ and Ca^{++} upon utilization of quantities of water equivalent to 1.3 field capacity, were relatively lower as compared with the former irrigation treatment.

Plant content of K^+ upon irrigating the soil up to filed capacity, tended to decrease with increasing salt concentration of the applied water, while, *SAR* value seemed to have no certain effect. Also increasing the quantity of irrigation water up to 1.3 field capacity increased the plants content of K^+.

The plants content of *Mg* was high upon irrigating the soil with the highest salt concentration of water (5000 *ppm*) and low upon the use of the lower salt concentration of water (2000 *ppm*).

On the other hand, N content in the plants grown on the inperforated pots was relatively lower than that grown on the perforated ones. Increasing the salt concentration of the applied water increased the plant content of N upon irrigating the soil up to 1.3 fold the field capacity. While, there was no effect due to *various SAR* values or concentration of the applied water upon irrigation with a quantity of water equivalent to soil field capacity.

The highest plants content of P was found upon utilization of the intermediate salt concentration of the applied water (2000 *ppm*). However, there was no influence of *SAR* values on the plants content of P.