5- SUMMARY

The current study was carried out to investigate the effect of seed pretreatments with certain soaking solutions on salt tolerance of wheat plants.

Tested soil samples were taken out from the fields of permenant experiments in the form of Agricultural Research Center- Giza Governorate. Sea water sample was collected from El- Madia No. 6, Al- Esmailia Governorate and was diluted with tap water having a final concentration of about (5242) ppm for using in irrigation.

Six groups of soaking solutions are used. The first group involved four growth regulators, i.e. Indole -3- acetic acid (IAA), Indole -3- butyric acid (IBA), alpha- Napthalene acetic acid (NAA) and Gibberellic acid (GA). The second group involved three amino acids, namely, Proline, Glutamic and Aspartic acids. The third group included the chloride solutions of both sodium and magnesium while the fourth group contained two solutions of potassium in either form KH_2PO_4 or KNO_3. The fifth group involved sulphate solutions of each Zn, Mn, Cu or Fe. Distilled water was the sixth group of soaking solutions.

To fulfill the purpose of this study, two pot experiments were conducted under the greenhouse conditions using wheat seeds (Sakha- 8 varities).

1- A preliminary experiment :

Different concentrations of the studied soaking solutions as well as different periods of soaking were investigated to find out the most suitable concentrations of each of the soaking solution along with the best period of soaking.

The studied concentrations of the growth regulators were 100, 200, 300 and 400 ppm while the amino acids were used in four concentrations, namely, 5, 10, 15 and 20 ppm. Concentrations of the chloride solutions were 1 %, 2 %, 3 % and 4 % whereas, potassium solutions concentrations were 500, 1000, 2000 and 3000 ppm. Soaking of the previously mentioned concentrations of the different soaking solutions covered a period of either 12 or 24 hours. Concentrations of sulphate solutions of the micronutrients were 0.02 %, 0.03 %, 0.04 % and 0.05 %. Soaking periods herein extended up to either 6 or 12 hours.

Another set of wheat seeds were soaked in the distilled water for either of 6, 12 or 24 hours along with untreated seeds (which irrigated with tap water) were also tried.

Each pot fertilized with N, P and K at rates of 75.5 kg, 100 kg and 50 kg/ fed. in the form ammonium sulphate (20.5 % N), superphosphate (15.5 % P_2O_5) and potassium sulphate (48 % K_2O), respectively. Each treatment was replicated three times.

Irrigation of the pots was conducted using a diluted sea water and moisture content was maintained at 70 % of the field capacity. After 45 days from sowing, plants were collected, dried at 70°C and the dry weight per pot was recorded.

2- Biological main experiment :

The most suitable concentration of soaking solutions along with the best period of soaking were choosen from the preliminary experiment. A complete randomized design was used for this experiment. The N, P and K fertilization was conducted at the same rates followed in the preliminary experiment. The moisture content of each pot was maintained at the field capacity using the same diluted sea water.

During the growing season of wheat plants, three randomely selected pots were taken from each treatment four times, i.e. at 15, 45, 75 and 140 days after sowing.

Results of the conducted experiments could be summarized in the following: -

A- The preliminary experiment :

1- The best treatments which gave the most favourable response for growth by wheat plants were seed soaking for 12 hours interval in solutions of 200 ppm (IAA), 300 ppm (IBA), 100 ppm (NAA), 300 ppm (GA), 5 ppm for all amino acids, 3 %

NaCl, 2 % $MgCl_2$, 1000 ppm (KH_2PO_4), 500 ppm (KNO_3) and 0.03 % for each of micronutrients sulphate solutions.

2- Soaking seeds in distilled water resulted in no response for plant growth, however, investigated period was 6, 12 and/or 24 hours as compared with untreated seeds.

B- <u>Biological main experiment :</u>

1- Plant height was significantly affected by the various soaking solutions. The most favourable treatments were NAA, NaCl, KNO_3, $ZnSO_4$ and/or Aspartic acid.

2- Number of tillers were significantly affected by the various soaking solutions and the most response when seeds were soaked in solutions of NAA, $MgCl_2$, KNO_3, $MnSO_4$ and/or Proline.

3- Dry matter weights of wheat plants were significantly affected by the various soaking solutions during various growth periods and the most favourable media after 140 days (straw yield) was $CuSO_4$, Proline, KNO_3, NaCl and/or NAA.

4- Dry matter weight of wheat roots after 140 days of sowing were significantly affected by the various soaking solutions. The corresponding average values could be arranged according the various soaking solutions:
NAA > Proline > $CuSO_4$ > KNO_3 > Aspartic > Glutamic > $MnSO_4$ > KH_2PO_4 === IAA === $ZnSO_4$ === IBA > NaCl === $FeSO_4$ > $MgCl_2$ === GA > Distilled water.

5- Root length was significantly affected by the various soaking solutions at harvesting (140 days) and could be arranged descendingly in the following order :
NAA > NaCl > KNO_3 > GA === $MgCl_2$ > Proline > IBA > KH_2PO_4 > Aspartic === $MnSO_4$ === $CuuSO_4$ === $ZnSO_4$ > IAA > $FeSO_4$ > Glutamic > Distilled water.

6- Number of spikes of wheat plants at harvesting were markedly influenced by the various soaking solutions and could be arranged in the descending order :
$CuSO_4$ === Proline > $MnSO_4$ > $FeSO_4$ > Aspartic === IAA > IBA === $ZnSO_4$ > KNO_3 === Glutamic > NAA > NaCl > $MgCl_2$ > KH_2PO_4 > GA > Distilled water.

7- Significant difference was occurred between the various soaking solutions on both weight of spikes and number of wheat grains. The most favourable response of different soaking solutions were IBA, Aspartic, Proline and/or $FeSO_4$ on either weight of spikes or number of wheat grains.

8- Seed index (weight of 1000 grains) was significantly affected by the various soaking solutions, results gave generally a relatively less favourable and sometimes even inhibiting effect of developed plants under saline conditions.

9- The effect of the various soaking solutions after 140 days from sowing at harvesting on the nutrients uptake of straw yield could be summarized as follow :

A- Nitrogen was significantly influenced by IAA, NAA, GA, Proline, Glutamic acid, NaCl, KNO_3, $ZnSO_4$ and $CuSO_4$.

B- Phosphorus was significantly affected by IAA, IBA, NAA, NaCl, all the amino acids, potassium solutions and all the sulphate solutions of the micronutrients.

C- Potassium was significantly influenced by Proline, KNO_3 and $ZnSO_4$.

D- Zinc was significantly affected by IAA, NaCl. and $FeSO_4$.

E- All the various soaking pretreatments, except Proline was insignificantly effect on manganese uptake.

F- All the studied soaking solutions was influenced insignificantly on copper uptake.

G- Iron was significantly affected by IBA, Proline,partic acid, NaCl, KNO_3, $ZnSO_4$, $MnSO_4$ and $CuSO_4$.

10-A- Nitrogen uptake of grain yield was significantly affected by IAA, IBA, Proline, Glutamic acid, Aspartic acid, NaCl, $MgCl_2$, $ZnSO_4$ and $FeSO_4$, however, phosphorus uptake was significantly affected by IAA, IBA, GA, Proline, Glutamic acid, Aspartic acid, NaCl, $MgCl_2$, KH_2PO_4, KNO_3, $ZnSO_4$, $MnSO_4$, $CuSO_4$ and $FeSO_4$, while, potassium uptake was affected significantly by IAA, IBA, Proline, Glutamic acid, NaCl, $MgCl_2$, $ZnSO_4$, $CuSO_4$ and $FeSO_4$.

B- Protein yield in grains increased due to soaking solutions and the highest increase was achieved upon soaking in IAA and IBA, while the lowest value was achieved upon using distilled water for soaking .

C- Concerning the effect of the soaking solutions on the micronutrients uptake of grain yield, IAA, GA, Aapartic acid and NaCl affected significantly zinc uptake, while manganese uptake was significantly with all the studied soaking solutions, except for KNO_3 treatment, whereas copper uptake was markedly affected by the various soaking solutions. Except for GA and $MgCl_2$ solutions, seed pretreatments revealed a pronounced responsed on iron uptake of grain yield.

11- The mean net influxes of nitrogen and potassium were highest at the first period of growth (15- 45) days and decreased markedly particularly with potassium with development of plant age up to (45- 75) days while at (75- 140) days a slightly decrease occurred.

The mean net influx of phosphorus was increased up to 75 days and decreased relatively with advancement plant age, up to 140 days after sowing due to salinity conditions.

12- Considering effect of the soaking solutions on the mean net influxes of nitrogen, phosphorus and potassium at the third period of growth (75- 140) days, it could be found that :

A- Glutamic acid was the most effective on mean value of N- influxes while NAA was the least. The other soaking solutions could be arranged descendingly in the following order:

IAA > GA > IBA > $FeSO_4$ > Proline > KNO_3 > NaCl === $MgCl_2$ > $ZnSO_4$ > $CuSO_4$ > KH_2PO_4 > Aspartic acid > $MnSO_4$.

B- IAA was the highest mean value of P- influxes, whereas the lowest value occurred in plants whose seeds were soaked in NAA treatment. The corresponding average values of P- influxes irrespective to the other seed soaking pretreatments can be shown from the following descending order :
$FeSO_4$ > Glutamic acid > IBA > $MnSO_4$ > Proline > $ZnSO_4$ === $CuSO_4$ > Aspartic acid > NaCl > GA === $MgCl_2$ === KH_2PO_4 > KNO_3.

C- Aspartic acid showed the most pronounced affect on mean net K-influx whereas the lowest mean potassium flow rate existed in case of IAA seed soaking media. The other soaking media are arranged descendingly as follows :
$CuSO_4$ > GA > KH_2PO_4 > Glutamic acid === $MnSO_4$ > IBA > NAA === NaCl === $MgCl_2$ > $ZnSO_4$ > Proline > KNO_3 === $FeSO_4$.

13- The mean net influxes of zinc, manganese, copper and iron, generally, were highest during the first period of wheat plants (15- 45) days and then decreased with development of plant age up to 75 days after sowing. However, with increasing plant age up to 140 days resulted in decreasing the mean net of micronutrients influx, such decrease hold sharply with both manganese and copper mean net influxes.

14- With respect to the effect of various seed soaking pretreatments on the mean net of the studied micronutrients influxes during the second period of growth (45- 75) days, it could be found that mean net of Cu- influxes showed that the highest mean values of Cu- influx with the various groups of seed soaking pretreatments such as growth regulators (GA), amino acids (Glutamic), chloride solutions (NaCl), potassium solutions (KN_2PO_4) and micronutrients sulphate solutions ($CuSO_4$) followed a particular pattern about similar to that obtained with mean net influxes of phosphorus, manganese and iron during the same period.

15- Concerning the third period (75- 140) days after sowing, it could be found that :

A- The highest mean value of net Zn- influx occurred with plants whose seeds were soaked with IAA, whereas the lowest mean value existed in case of Proline. The other seed soaking media could be arranged in the following descending order:

Glutamic acid === NaCl === $FeSO_4$ > IBA === GA === Aspartic acid === KNO_3 > KH_2PO_4 > NAA === $MnSO_4$ > $MgCl_2$ === $ZnSO_4$ === $CuSO_4$.

Also, it seemed to be the highest mean values of Zn- influx within each group of seed soaking pretreatments viz., growth regulators (IAA), amino acids (Glutamic), chloride solutions (NaCl), potassium solutions (KNO_3) and micronutrients sulphate solutions ($FeSO_4$) followed a particular pattern about similar to that obtained with mean net influxes of phosphorus during the mention period.

B- The mean values of Mn- influxes was varied widely from seed soaking pretreatments in KH_2PO_4 to Aspartic acid as a soaking solution. The descending order of the other soaking solutions are :

$CuSO_4$ > IBA > $FeSO_4$ > $ZnSO_4$ > GA > $MnSO_4$ > IAA > $MgCl_2$ > KNO_3 > Proline > NaCl > Glutamic acid > NAA.

C- The mean values of Cu- influxes was highest with soaking in both IAA and Glutamic acid, whereas soaking in $CuSO_4$ resulted in the lowest mean net Cu- influxes. The other soaking solutions are arranged descendingly in the following order:

$FeSO_4$ > Proline === $MnSO_4$ > IBA > Aspartic acid > $ZnSO_4$ > KH_2PO_4 > GA === NaCl > $MgCl_2$ > KNO_3 > NAA .

D- The mean values of Fe- influxes was highest by soaking in either Glutamic or Aspartic acids and the lowest with soaking in NAA. The other soaking solutions are arranged descendingly in the following order :

IBA > Proline > KH_2PO_4 > IAA > $FeSO_4$ > $MnSO_4$ > $ZnSO_4$ > $CuSO_4$ > GA > KNO_3 > $MgCl_2$ > NaCl.

Several mechanisms seemed to be involved; these mechanisms were suggested to be such as activation of the biochemical processes in embryos, the influence on cell permeability, phosphate accumulation in seeds or trace-elements such as zinc, manganese, copper and/ or iron or/ and their accompained cation/ anion in the soaking media.

According to that, a suggestion could be introduced that soaking practice seemed to be more influential on grown plants than factors dealing with environmental conditions of saline soil. This was suggested to be a resultant of influence of seed soaking on developed root system whose contact with soil particles seemed to be more efficient than with fertilizer to supply the plant with total needs of different elements and these detected later in the developed plants and grain yield.