



Fayoum University
Faculty of Science
Botany Department

**Involvement of low molecular weight antioxidants in
mitigating the adverse effect of salt stress in some crop
plants.**

By

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Summary and Conclusion

Maize (*Zea mays* L.) is one of the most important crops, which plays a special role in people's nutrition. Maize has a significant role in food security in our country. But unfortunately abiotic stresses, such as salinity, decrease maize growth and productivity by reducing water uptake and cause nutrient disorders and ion toxicity.

Salinity is strongly phytotoxic partly because of the generation of reactive oxygen species (ROS) that damage organic molecules or inhibition of antioxidants system in plants.

To overcome the problems rose from salinity stress on plant growth intensive efforts have been directed by many investigators towards developing techniques that could mitigate the drastic effects on plants. The interactive treatments of salinity stress and antioxidants are one of the techniques recommended in alleviating the adverse effects of salinity on plant growth.

So, in this investigation, we observe the changes that might take place in germination, growth and some related physiological activities of maize (*Zea mays* L.) plants after being subjected to salt stress with application of antioxidants (ascorbic acid, glutathione and α -tocopherol) individually or in sequence.

Therefore, the work could be divided into two parts:

Part one:

Is concerned with the effect of antioxidants (ascorbic acid, glutathione and α -tocopherol) individually or in sequence and different concentrations of salinity on germination, fresh – dry matter, shoot-root length, the response of some antioxidant enzymes (superoxide dismutase, ascorbate peroxidase, catalase, and glutathione reductase) and some

metabolic changes in seedlings. Results obtained could be summarized as follows:

1-Salinization induced a considerable reduction in seed germination of the test plant, while this action was alleviated using antioxidants individually or in sequence.

2- The fresh - dry matter and shoot-root length of salinized plants were significantly reduced by increasing salinity level. Generally antioxidants treated grains were alleviated the adverse effects of NaCl on the growth of *Zea mays* seedlings when compared with the corresponding treatments with NaCl.

3-NaCl treated seedlings showed that the production of total protein was decreased with increasing NaCl levels. Presoaking grains in antioxidants individually or in sequence increased total protein content, the increase continued up to 100 mM, then decreased at higher salt levels.

4- The ascorbic acid, glutathione, and α -tocopherol contents of *Zea mays* significantly decreased with rising salinization levels. Soaking grains in antioxidants individually or in sequence then treated with NaCl increased the contents of ascorbic acid, glutathione, and α -tocopherol in seedlings up to 100 mM, then decreased in higher salt concentrations (150, and 200 mM) but still higher than corresponding NaCl.

5- The activity of enzymes SOD, APX, CAT and GR in maize seedlings significantly increased with increasing NaCl levels up to 100 mM, then decreased at higher levels (150, and 200 mM) in that their grains are non-treated with antioxidants. Grains presoaked in antioxidants individually or in sequence and treated with NaCl significantly increased the activity of SOD, APX, CAT and GR when compared with corresponding NaCl. The rise in the activities of preceding enzymes continued with increasing levels of NaCl up to 100 mM, then decreased at high salt levels (150, and 200 mM).

Part two:

The experiments of this part were carried out mainly to study the interactive effect of salinity alone and soaking application of antioxidants (ascorbic acid, glutathione, and α -tocopherol) singly or in sequence on growth, photosynthetic efficiency, relative water content, and the contents of some metabolites namely, total soluble sugar, proline, and protein. The results obtained could be summarized as follows:

- 1- Salinization induced a considerable decrease in the fresh -dry matter and shoot length of maize plants. Soaking in antioxidants (ascorbic acid, glutathione, and α -tocopherol) individually or in sequence led to a significant increase in the values of fresh - dry matter and shoot length of maize plants.
- 2- SPAD chlorophyll contents, the efficiency of photosystem-II (Fv/Fm), and the performance index (PI) decreased significantly in maize plants which were grown from non-antioxidants soaked grains and irrigated with different NaCl levels throughout the experiment. A maximal decreasing was detected at higher NaCl levels (150, and 200 mM). However, using of antioxidants as maize grains soaking, individually or in sequence, increased chlorophyll contents, the efficiency of photosystem-II (Fv/Fm), and the performance index (PI) in each NaCl level compared to the corresponding controls.
- 3- The NaCl salt stress significantly reduced the relative water content of maize plants, grown from non-antioxidants soaked grains throughout the experiment. A maximal decline in RWC was detected at higher NaCl levels (150, and 200 mM). However, the plants grown from antioxidants soaked grains, either individually or in sequence, revealed a significant rise in RWC in each NaCl level with respect to the corresponding control after 45 and 90 days, whereas, RWC still

decreased with increasing levels of NaCl throughout the experimental period.

- 4- Salinity led to a significant rise in the TSS and proline contents of maize plants, grown from non-antioxidants soaking grains, with increasing the NaCl concentrations up to 100 mM and there was a clear decrease at NaCl levels of (150, and 200 mM). However, the plants which are grown from grains soaking in antioxidants, either individually or in sequence, showed also, a significant increase in the TSS and proline contents in each NaCl level treatment. Also, the increase in TSS and proline contents accompanied by raising the NaCl concentrations up to 100 mM; and a clear decline in proline and TSS contents at NaCl levels 150, and 200 mM was observed.
- 5- Considerable decrease of contents of protein of the maize plants was recorded as a result of salinity stress. However soaking in antioxidants individually or in sequence exhibited increases of protein content up to 100 mM; and a clear decrease in plant protein content, at NaCl levels 150, and 200 mM was detected. Treatments with antioxidants alleviate the adverse effect of salinity on biosynthesis of protein.

Finally, it can be observed that salinity induced generally variable changes in the contents of some metabolites of the maize plants. Application of antioxidants individually or in sequence mitigated the adverse effects of salinity on growth and some metabolic mechanism of maize plants. Also, sequenced application of AsA-GSH- α -TOC was more effective than singly antioxidants application in all growth measurements, physiological determinations, etc.....