EFFECT OF SOME AMINO ACIDS ON THE PHYSIOLOGICAL CHARACTERISTICS OF MAIZE PLANT UNDER SOIL SALT STRESS CONDITIONS IN EGYPT AND TUNISIA

By

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Key words : [Proline amino acid - Salt sensitive plants – Soil salt stress – Maize crop]

INTRODUCTION

The increasing demand for water, especially in arid and semi-arid regions, such as Mediterranean environments (Egypt, Libya, Tunisia, Algeria and Morocco), has forced farmers to use low-quality water for irrigation, such as brackish water (Amer, 2010).

Soil of both Egypt and Tunisia along the Mediterranean see coast undergo salinity stress problems particularly sandy and calcareous soils. Although most areas depend on rain fed agriculture, however, some are irrigated. The majority of soil-salt stress is often caused from the accumulation of sodium, potassium and calcium soluble salts which are mostly associated with chloride and carbonate anions. One of the diagnostic problems in calcareous soil is the formation of surface soil crust due to the capillary rise of soluble salts especially in dry periods of soil moisture regime.

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The saline habitats are more prevalent in dry areas of these countries. Salinization, or development of salt affected soils, is one of the internal pedogenic processes that lead to soil degradation and thus land desertification. The salt accumulation may contribute to a partial or complete loss of the soil capacity to provide the required amounts of water to plants, changing fertile lands to «deserts». Frequently, salinization process practically creates irreversible chemical or physical internal soil degradation.

Salinity problems appear as a consequence of' salt accumulation in soil-root zones and depths, where soil moisture regime is characterized by strong losses of water by evaporation and transpiration, and by reduced leaching of the remaining salts.

Exploring suitable ameliorants or stress alleviant is one of the tasks of plant biologists. In recent decades, exogenous protectant such as osmoprotectants (proline, glycinebetaine, trehalose, etc.), plant hormone (gibberellic acids, jasmonic acids, brassinosterioids, salicylic acid, etc.), antioxidants (ascorbic acid, glutathione, tocopherol, etc.), signaling molecules (nitric oxide, hydrogen peroxide, etc.), polyamines (spermidine, spermine, putrescine), trace elements (selenium, silicon, etc.) have been found effective in mitigating the salt induced damage in plant **(Yusuf et al., 2012).**

These protectants showed the capacity to enhance the plant's growth, yield as well as stress tolerance under salinity. Some amino acids such as proline have been used to reduce salt stress damage to salt-sensitive plants, the foliar application of proline increased plant height, number of branches, fresh and dry weights of aerial vegetative parts **(Gamal El-Din and Abd El-Wahed, 2005)**.

Problems of salinization and water logged soils in Tunisia already largely affect on part of irrigated areas of the Mejerda Valley and the Center of Tunisia and the oasis in the south. mainly in the central and southern parts of the country. Salt-affected soils occur to a considerable extent in irrigated areas. The aridity conditions and high potential evapotranspiration, saline groundwater and seawater intrusion, poor water management/agronomic practices, use of low quality water for irrigation without proper management are the major causes of salt-affected soils commonly formed in depressions and low lying parts of the landscape. On the geochemical aspect, sodium chloride paths dominate all the saline soils in these areas of Tunisia, as well as, less soluble salt as calcium carbonate and gypsum. The major alkaline cations in these soils are calcium, magnesium, sodium and potassium combined with the anions of chlorides, sulfates or carbonates, which differ in their solubility. In a homogeneous climatic region and for the same soil moisture regime, more salt is soluble, more easily and quickly it will be leached outside the profile and outside the basin **(Hachich et al., 1994)**.

The objectives of the study were:

1 - To evaluate the effect of proline foliar application on the accumulation of ions in saline sensitive plants due to salinity stress that may have been caused by the high concentration of salts in soil irrigated with saline water;

2 - The possible beneficial effects result from the use of proline foliar application at different concentration were (15, 30 and 45 ppm) during the growing stages of salt-sensitive plants (Maize class Hybrid singles White 128) in order to reach the best possible productivity.

2. Materials and methods

This experiment was carried out at Al-Hamra Village, Wadi Al Natrun area, El-behera Governorate, during the optimum condition of maize cultivation (form May to November in the years of 2014 and 2015).

A field experiment was divided into four equal homogenous longitudinal areas. The main area was divided into four replicates. These plots were separated from each other by proof tracks (1.5 m width) to avoid leakage of different concentration levels of foliar proline. The four replicates were designed for each treatment. Each plot has a length of 10 meters and a width of 3.5 m. The whole experiment was divided into five lines with 70 cm a part end and the distance between successive plants is 30 cm. At the beginning, maize seeds were separated into four parts (T0, T1, T2 and T3) and mashing the seeds (T1, T2 and T3) for two hours in different concentration solutions of proilne (15, 30 and 45ppm), respectively. Then, three seeds were placed in each of the holes and reduced to one after germination. Proline was sprayed once a week during plant growth according to the designed treatments.

2.1. Water, soil and plant sampling:

Water samples collection and analyses were carried out according to standard methods for examination of water and waste water **(APHA, 2012)**. Three soil samples were collected at the depths of 0 – 20, 20 – 40 and 40 – 60 cm and kept in polyethylene bags before being sealed by twisting and tying the neck and dried, crushed to finely ground, then sieved through (2 mm) sieve. Plant samples of maize crop were collected at milk stage “120 DAS”.

2.2. Analytical methods.

2.2.1. Water analysis

Hydrogen ions activity (pH value), electrical conductivity (EC), total dissolved salts (TDS) calculated from EC values and total alkalinity (mg.l-1) were determined according to APHA (2012); sodium adsorption ratio (SAR, meq.l-1) (Suarez (1981). Na+ and K+ ware determined by flame photometer. Ca++ and Mg++, by titrimetric method using (EDTA). Soluble anions (Cl-, HCO3-, CO3= and SO4=) were analyzed using ion chromatography (IC) model DX-2500. Water samples analysis were carried out according to standard methods for examination of water (APHA, 2012). Guidelines to emphasize the long-term influence of water irrigation quality were adopted according to FAO (1985).

2.2.2. Soil analysis

Particle size distribution was determined using pipette method as described by Richards (1954). Soil extract (1: 2.5) was prepared. Organic matter (O.M.) %, using the method of by Jackson (1973). Calcium carbonate (CaCo3) %, using the Collin’s Calcimeter method (Wright, 1939). Available macronutrients [phosphorus (P) and potassium (K)] using the atomic absorption spectrophotometer (Berkin- Elemer 2380) were determined as described by Soltanpour and Schwab (1977) and Lindsay and Norvel (1978). Total nitrogen (N) was determined by the modified macro- kjeldahl technique as outlined by Jackson (1973).

2.2.3. Plant analysis:

2.2.3.1. Pretreatment

Segregation into different parts and corresponding parts from a few plant samples were composited; leaves were cleansed with gentle brushing with a stiff-bristled brush. Washing plant tissues with water was avoided, although roots were washed free of soil or sand (Ward and Johnston, 1962), removing of needles (leaves) from branch lets; air- drying leaves and all other plant material (branches, roots, etc.) were cut into small pieces. Before drying, pine needles and leaves were removed from the twigs; spruce needles were left to dry on the twigs (Kalra, 1971); plant samples were washed with tap water, and then oven dried at 70oC for 48 hours. Plant materials were ground and then mixed well according to Chapman and Pratt (1961). The mill was thoroughly cleansed between grinding individual samples. These samples were ground in an agate or porcelain mortar to avoid metallic contamination (Kalra, 1971). Also, samples were used for the determinations of proline, N, P, K and Na.

2.2.3.2. Accumulation percentage of proline and nutrient elements:

Proline % in plant was calorimetrically measured using non-hyrin reagent according to Bates et al., (1973). Nitrogen (N) of nitrates is fixed by combination with an aromatic compound, such as salicylic acid. The nitro groups are reduced and the total nitrogen is then liberated as ammonia by the usual kjeldahl digestion method followed by steam distillation (Jackson, 1973). Sodium (Na^+) and potassium

(K+), phosphorus (P), boron (B), copper (Cu), iron (Fe), manganese (Mn) and zinc (Zn), contents in plant samples were determined by Inductively Coupled Plasma Spectrometry (ICP).

2.2.4. Statistical analysis

The experimental design used in this study was a complete Randomized Design with four proline treatments (0, 15, 30 and 45 mgL-1) applied on four replications. Statistical analysis for the different determined parameters and crop production was evaluated using ANOVA as well as the least significant difference (LSD) tested at 0.05 signifance level (Snedicor and Cochran, 1980).

3. Results and discussion

3.1. Soil characteristics

Some soil physical and chemical properties of the studied area are shown in Table (1). Particle size distribution of the investigated surface and subsurface soils at the different depths gave a texture class a sandy soil with very low percentage of silt and clay. Particle size distribution was mainly sand soils of the investigated soil layers which contained poor content amount of calcium carbonate (CaCO3).

Table 1: Values of Soil physical and chemical properties of the studied soil location

Soil properties	Sampling depth (cm)		
	0 : 20	20 : 40	40 :60
Particle size distribution (%)			
Coarse sand	54.66	62.23	63.16
Fine sand	41.12	33.67	32.13
Silt	2.66	2.58	3.12
Clay	1.55	1.50	1.59
Texture class	sand	sand	sand
$CaCO_3$ %	0.70	0.55	0.30
EC ($dS.m^{-1}$)	2.51	2.67	2.76
pH	9.92	8.25	8.24
Soluble cations and anions ($meq.l^{-1}$)			
Ca^{++}	3.85	4.45	4.54
Mg^{++}	2.50	2.65	2.79
Na^{+}	17.50	18.26	18.88
K^{+}	1.25	1.32	1.42
HCO^{-}_{3}	5.47	5.87	6.32
Cl^{-}	17.02	17.73	17.85
$SO^{=}_{4}$	2.61	3.10	3.43
Available macro nutrients ($mg.Kg^{-1}$).			
N	2.54	8.89	1.30
P	2.43	4.16	1.18
K	61.67	101.58	54.84
Available micro nutrients ($mg.Kg^{-1}$).			
B	0.37	0.29	0.15
Cu	15.02	14.89	3.81
Fe	11.62	11.26	5.20
Mn	9.33	7.50	1.09
Zn	6.20	5.28	1.20

EC of the soil (1: 2.5) extract was 2.65 dS.m-1 (as a mean values). This means that the accumulation of salts is attributed to using salt water for irrigation. The amount of total soluble salts in all layers of the investigated soil profiles, are classified as saline soil. Mean values of soil pH range from 8.24 to 9.92. Mean values of cations (Ca++, Mg++, Na+ and K+) were (4.28, 2.65, 18.21 and 1.33 meq.l-1) respectively, while anions (HCO3-, Cl- and SO4=) were (5.89, 17.53 and 3.05 meq.l-1), respectively, (Table.1). Also, available macro-nutrients nitrogen, phosphorous and potassium (N,P and K) content are generally very low and irregular with soil depths . Available contents of nitrogen, phosphorus and potassium (N, P and K) are (4.24, 2.59 and 72.70 mg/Kg), respectively. Consequently, the concentrations of these elements in the different soil are low, as depicted in Table. 1.

3.2. Water quality for irrigation assessment

3.2.1. Hydrogen ions activity (pH value).

Data presented in Table (2) exhibited that the pH value is (7.88). It means that the pH of irrigation water is within the permissible limits for irrigation according to Ayers and Westcot (1985).

Table 2: physical, chemical and heavy metals analysis of irrigation water

Physical and chemical values in irrigation water sample													
pH	EC dS.m^{-1}	TDS mg.l^{-1}	Cations (meq.l^{-1})				Anions (meq.l^{-1})					SAR
			Ca	Mg	Na	K	Cl	HCO_3	SO_4	NO_3	PO_4	
7.88	8.61	5510.4	6.09	7.29	71.74	0.67	63.5	6.66	15.94	0.2	4.39	27.74

values of heavy metals in irrigation water sample (mg.l-1)						
Ba	Cu	Fe	Pb	Mn	Ni	Zn
0.037	0.045	1.823	0.008	0.092	0.018	0.031

3.2.2. Water salinity (EC and TDS)

3.2.3. Results of EC and TDS values are 8.61dS.m-1 and 5510.4 mg.l-1 respectively, (Table 2). These values indicate that the irrigation water is considered very high salinity class (EC dS.m-1 > 3.0) based on Ayers and Westcot (1985).

3.2.3. Soluble ions

Cations of calcium (Ca++), magnesium (Mg++), sodium (Na+) and potassium (K+) are natural constituents of raw water, which may be increased as a result of disintegration of rocks. Data presented in Table (2) revealed that values of soluble cations (Ca++, Mg++, Na+ and K+) were (6.09, 7.29, 71.74 and 0.67) meq.l-1, respectively. On the other hand, soluble anions (Cl-, HCO3-, SO4=, NO3- and PO4-3) were (63.5, 6.66, 15.94, 0.2 and 4.39) meq.L-1, respectively. Thus, the data obtained revealed that the cations followed the order: Na >

Ca > Mg > K, whereas anions have the sequence of: Cl- > SO4= > HCO3-. Meanwhile, SAR average values (Table.2) was (27.74), in both seasons, which displays a very high sodium hazard for soil and plants. High values of SAR for irrigation water cause replacing of Ca++ and Mg++ ions in the soil, and consequently, damaging of soil structure and reduction of water availability (Chapman, 1996).

As for the studied heavy metals, they were in the allowable limits of irrigation water according to FAO (1985). Even though, groundwater at Wadi Al-Natron can cause some problems due to irrigation at the along time as a result of heavy metals accumulation.

3.3. Physiological impact of proline on maize plant

3.3.1. Proline accumulation in plant as affected by its original spray concentrations.

Proline can adapt and adverse stress effect in many plant species. Adaptation can be happened through accumulation of proline in plant leaves (Roberto, et al., 2009). Results of proline accumulation in maize leaves (Table 3 and Fig. 1) were 0.012, 0.016, 0.014 and 0.013 % for T0, T1, T2 and T3, respectively.

The proline used was directly proportional to accumulation of proline in plant at T1 treatment, while it was reversely proportional to proline accumulated in plants at T2 and T3 treatments.

Statistical analysis of proline accumulation showed a significant effect between T1 and both of T2 and T3. Meanuhile, there was a significant difference between T0 and each of T1 and T2.

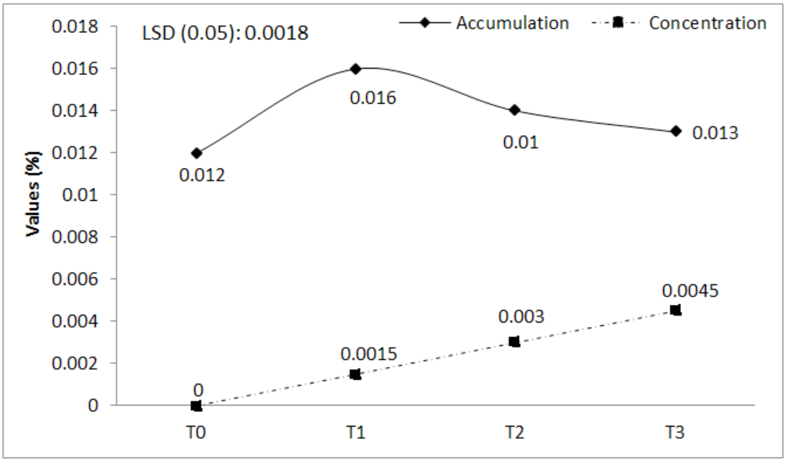

Fig.1: Relationship between concentration and accumulation of proline.

3.3.2. Accumulation of nitrogen (N), phosphorus (P) and potassium (K) as influenced by proline accumulation in maize leaves

Data depicted in Table (3) and Fig. (2) conspicuously displayed changes of (N, P, K) concentrations as affected by sprayed proline for T0, T1, T2 and T3 treatments. Proline accumulation percentage values for T0, T1, T2 and T3 were 12, 16, 14 and 13 %, respectively.

The corresponded percentages of (N, P, K) concoctions were 0.30, 0.18, 0.18 % with control treatment (T0), whereas (N, P, K) concentrations associated with T1 were 0.86, 0.52 and 0.84 %, respectively. On the other hand, (N, P, K) percentages were 0.77, 0.36 and 0.74 % with T2, while concentrations of (N, P, K) with T3 treatment were 0.34, 0.29 and 0.51, respectively. Fig. (3) obviously revealed that increment of (N, P, and K) was directly proportional to proline accumulated under all treatments applied.

Table 3: Accumulation of proline, macro-nutrients [nitrogen, phosphorus and potassium (N, P and K)] and sodium (Na) content (%) in maize leaves.

Items	T_0			T_1			T_2			T_3		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
Proline %	0.012	0.012	**0.012**	0.016	0.016	**0.016**	0.014	0.014	**0.014**	0.013	0.013	**0.013**
LSD (0.05%)	**0.0018**											
N %	0.281	0.319	**0.300**	0.869	0.845	**0.857**	0.816	0.729	**0.773**	0.329	0.365	**0.347**
LSD (0.05%)	**0.0574**											
P %	0.192	0.173	**0.183**	0.568	0.465	**0.516**	0.348	0.376	**0.362**	0.289	0.306	**0.297**
LSD (0.05%)	**0.0963**											
K %	0.159	0.205	**0.182**	0.824	0.858	**0.841**	0.756	0.729	**0.742**	0.485	0.541	**0.513**
LSD (0.05%)	**0.1692**											
Na %	0.429	0.492	**0.461**	0.186	0.208	**0.197**	0.237	0.216	**0.227**	0.327	0.359	**0.293**
LSD (0.05%)	**0.0780**											
Na : K	7 : 3	5 : 2	**5 : 2**	2 : 9	1: 4	**2 : 9**	3 : 10	3 : 10	**3 : 10**	2 : 3	2 : 3	**2 : 3**

(T0, T1, T2 and T3): Treatments sprayed foliarly with proline at concentrations of (0, 15, 30 and 45 ppm) respectively.
(S1 and S2): First and second seasons, respectively.

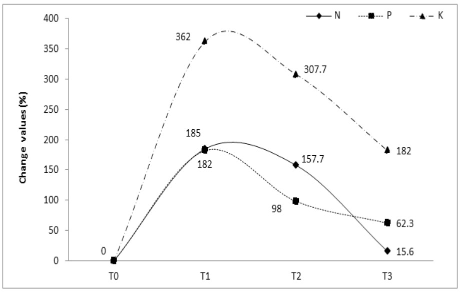

Fig.3: Accumulation changes of N, P and K (%).

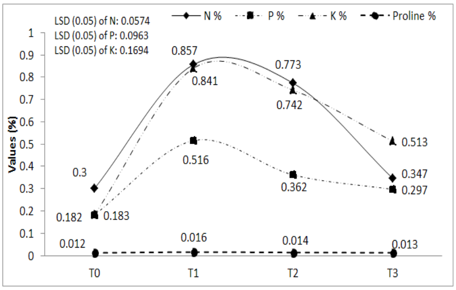

Fig.2: Relationship between accumulation of proline and N, P and K.

Statistical analysis possessed a similar trend with N concentrations which showed a significant difference between T1 and both of T2 and T3. On the other hand, there had been a significant difference between T0 and each of T1 and T2. Also, P concentrations exhibited a significant difference between T1 and both of T2 and T3. Meanwhile, there was a significant difference between T0 and each of (T1, T2, T3). K concentrations possessed a significant difference between

(T1, T2) and each of (T3, T0). Meanwhile, a significant difference between T0 and each of all treatments was occurred.

3.3.2. Accumulation of sodium (Na) % and relationship between Na+: K+ ratio with accumulation of proline in maize plant

High salt concentration in the external solution causes not only ion imbalance or disturbance in ion homeostasis, but also Na+: K+ ratio in which Na+ can reduce internal K+ concentration (Parida and Das, 2005; Rus et al., 2004; Kaya et al., 2007). Reduction of K+ uptake as influenced by high sodium concentration causes ionic toxicity and consequently a decrease in plant growth (Cuin et al., 2003; Kaya et al., 2007). Mean values of Na+ % in the two successive seasons (Table 3 and Fig. 4) were 0.461, 0.197, 0.227 and 0.293 % for treatments T0, T1, T2 and T3, respectively; but it was reversely proportional to proline accumulation in plants at all treatments.

Statistical analysis for Na concentrations revealed a significant difference between T1 and each of all treatments. Meanwhile, a significant difference was found between T1 and T3.

Na :K ratios (Table 3 and Fig. 5) were 5:2, 2:9, 3:10 and 2:3 for treatments T0, T1, T2 and T3, respectively, The sequence of Na:K ratios, as affected by proline spraying has the arrangement of T0> T3> T2>T1, which indicated that To (0.016% of proline accumulation) had the highest impact on lowering Na: K ratio, while T0 (0.012 of proline accumulation) possessed the lowest effect on Na: K ratio

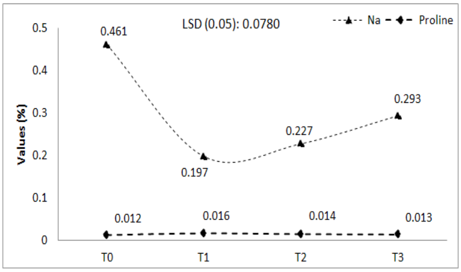

Fig. 4: Relationship between accumulation of proline and Na^+.

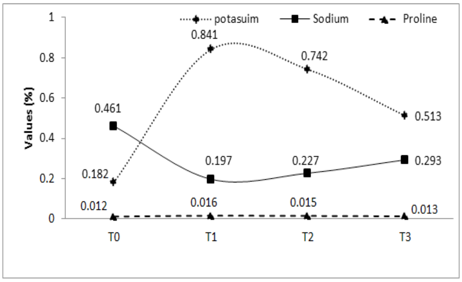

Fig.5: Relationship between proline and Na: K ratio.

3.3.3. Accumulation of micronutrients (B, Cu, Fe, Mn, and Zn %) in maize plant as affected by proline %.

Mean values of micro-nutrients, for the two growing seasons were displayed in Table (4) and Figs. (6 – 10). It was evident that each nutrient had four values as affected by T0, T1, T2 and T3, respectively. Values of Boron (B) were 0.0012, 0.0016, 0.0017 and 0.0014 %; for Copper (Cu), 0.0171, 0.0288. 0.0261 and 0.0048 %; for Iron (Fe); 0.123, 0.284, 0.253 and 0.172 %; for Manganese (Mn), 0.0108, 0.0218, 0.0185 and 0.0137 %; for Zinc (Zn), were 0.0119, 0.0163, 0.0105 and 0.0081%.

Table (4) and Figs. (6–10) revealed that the highest increase of the investigated micro-nutrients was almost occurred (except B %) with T1 of proline treatment, while the rest of micro nutrients concentrations were reduced using the other proline treatments. Consequently, (Fig. 11) displayed and described the increase percentage of each nutrient as affected by treatments T1, T2 and T3 in comparison with T0. Therefore, the increase

Table 4: Accumulation of micro-nutrients (B, Cu, Fe, Mn and Zn) content (%) in maize plant

Items	T_0			T_1			T_2			T_3		
	S_1	S_2	**Mean**	S_1	S_2	**Mean**	S_1	S_2	**Mean**	S_1	S_2	**Mean**
B (%)	0.0011	0.0012	**0.0012**	0.0017	0.0015	**0.0016**	0.0017	0.0017	**0.0017**	0.0013	0.0014	**0.0014**
Chinch of accumulation (%)						**33**			**42**			**16**
LSD (0.05%)							**0.00013**					
Cu (%)	0.0143	0.0199	**0.0171**	0.0258	0.0318	**0.0288**	0.0228	0.0294	**0.0261**	0.0049	0.0047	**0.0048**
Chinch of accumulation (%)						**68**			**53**			**-72**
LSD (0.05%)							**0.0084**					
Fe (%)	0.119	0.127	**0.123**	0.269	0.299	**0.284**	0.256	0.249	**0.253**	0.176	0.167	**0.172**
Chinch of accumulation (%)						**130**			**105.6**			**39.8**
LSD (0.05%)							**0.0592**					
Mn (%)	0.0104	0.0111	**0.0108**	0.0227	0.0209	**0.0218**	0.0197	0.0173	**0.0185**	0.0143	0.0131	**0.0137**
Chinch of accumulation (%)						**101.9**			**71.3**			**26.9**
LSD (0.05%)							**0.00419**					
Zn (%)	0.0113	0.0124	**0.0119**	0.0170	0.0156	**0.0163**	0.0099	0.0111	**0.0105**	0.0085	0.0077	**0.0081**
Chinch of accumulation (%)						**34**			**-11.8**			**-32**
LSD (0.05%)							**0.00318**					

(T0, T1, T2 and T3): Treatments sprayed foliarly with proline at concentrations of (0, 15, 30 and 45 ppm), respectively.
(S1 and S2): first and second seasons, respectively.

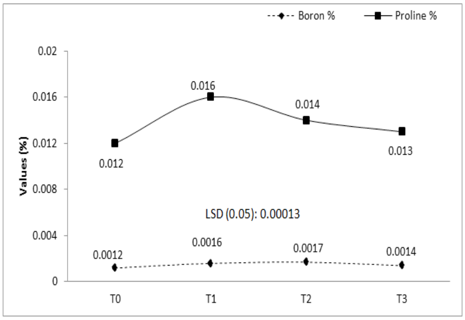

Fig.6: Relationship between proline accumulation and boron

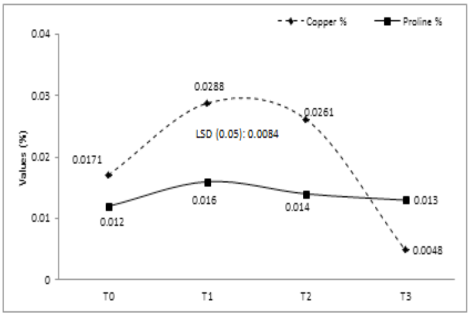

Fig. 7: Relationship between proline accumulation and copper.

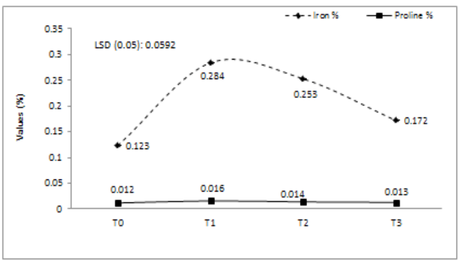

Fig.8: Relationship between proline accumulation and iron.

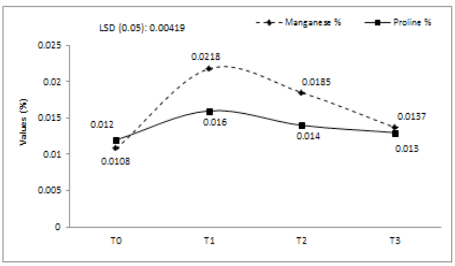

Fig.9: Relationship between proline accumulation and manganese.

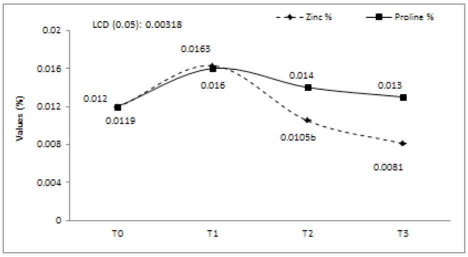

Fig.10: Relationship between proline accumulation and zinc.

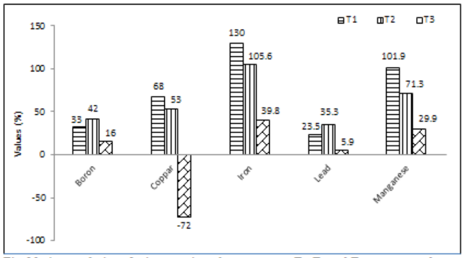

Fig. 10: Accumulation of micro nutrients by treatments T_1, T_2 and T_3 as compared to T_0 (control).

percentages, as a result of treatment T1, were 33.0, 68.0, 130.0, 101.9 and 34.0 % for B, Cu, Fe, Mn and Zn, respectively. with T2 treatment, micro-nutrients percentages were 42.0, 53.0, 105.6, 71.3 and -11.8 % for B, Cu, Fe, Mn and Zn, respectively. In contrast, T3 has concentrations of 16.0, -72.0, 39.8, 29.9 and -32.0 % for the same sequence of the above mentioned nutrients.

The positive behavior of proline acid in many physiological characteristics is attributed to the following :

- It plays an important role in adaptive on the tolerance of plant cells to salinity and water stresses by increasing the concentration of cultural osmotic components in order to equalize the osmotic potential of the cytoplasm.
- It also plays a considerable role in preventing the oxidation of cells that occur under stress conditions.

This behavior helps more leaf carotenoids and chlorophyll as well as higher carbohydrate content in the leaves and roots more than control. Therefore, this research paper recommend the use of proline to enhance plant growth and production in maize plants grown under saline conditions. (Ashraf and Foolad, 2007; Hossain and Fujita (2010); El-Sherbeny and Teixeira da Silva 2013; El-Naby et al., 2013).

Although salinization process may progressively develop under natural conditions where a combination of aridity and restricted drainage exists, they may only be accelerated when the soil moisture regime is drastically changed with the introducing irrigation, without appropriate drainage conditions (Rengazamy et al., 2003). Soil and water salinity cause osmosis to the growing plants, nutrient imbalance and cell toxicity (Elsahookie and Al-Khafajy, 2014).

Mechanisms of salt tolerance, not yet completely clear, can be explained to some extent, by stress adaptation effectors that mediate ion homeostasis, osmolyte biosynthesis, toxic radical scavenging, water transport and long distance response co-ordination (Hasegawa et al., 2000) . However, attempts to improve yield under stress conditions by plant improvement have been largely unsuccessful, primarily due to the multigenic origin of the adaptive responses. Therefore, a well-focused approach combining the molecular, physiological, biochemical and metabolic aspects of salt tolerance is essential to develop salt-tolerant crop varieties.

4.Conclusions

This research paper showed that the possibility of using saline water in the cultivation of vegetable crops sensitive to salinity along with proline amino acids sprayed on the plant. This study confirmed that there had been a positive effect of proline on saline sensitive plants when spraying it on maize plant leaves. All morphological and physiological characteristics of the maize plant were improved with proline treatments compared to control. This trend was compatible with many researchers. Also, results of this study exhibited that there was a conspicuous difference among saline sensitive plants when applying the different proline concentration on maize plant leaves at with the various concentrations used. The lowest concentration (15 ppm) was the best concentrations in physiological characteristics. However, concentration of 30 ppm was the critical limit that led to the beginning of the breakdown in properties and the concentration of 45 ppm subjected the plants to severe hazard in those characteristics.

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تأثير بعض الأحماض الأمينية على الخصائص الفسيولوجية لنبات الذرة النامى تحت ظروف تربة شديدة الملوحة فى مصر وتونس

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المستخلص :

تواجه المناطق الشمالية على امتداد ساحل البحر المتوسط لكل من مصر وتونس مشكلة الإجهاد الملحى للتربة. وتؤثر مشاكل الملوحة والأراضى الغدقة فى تونس بدرجة كبيرة على جزء من المناطق المروية فى وادى ميجردا، ووسط تونس، إلى جانب الواحات الواقعة فى الجنوب. ومن وجهة النظر الجيوكميائية، تسود أملاح كلوريد الصوديوم معظم الأراضى الملحية فى تلك المناطق من تونس، بالإضافة إلى الأملاح الأقل ذوباناً بدرجة كبيرة مثل كربونات الكالسيوم والجبس. وأهم الكاتيونات القلوية السائدة فى تلك الأراضى هى الكالسيوم، الماغنسيوم، الصوديوم والبوتاسيوم والتى ترتبط فى معظمها بأنيونات الكلورايد، الكبريتات والكربونات. لذلك أجريت تجربة حقلية على أرض بمنطقة وادى النطرون متوسط ملوحتها مستخلص عجينة التربة لها ٢,٦٥ ديسيسمنز| متر, والتى تروى بمياه آبار ذات ملوحة ٨,٦١ ديسيسمنز| متر خلال موسمى ٢٠١٤- ٢٠١٥ بغرض: أ- دراسة تقليل أثار الإجهاد الملحى على الصفات الفسيولوجية على نبات الذرة

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كأحد النباتات الحساسة للملوحة بواسطة استخدام ثلاث مستويات مختلفة من تركيز حمض البرولين (١٥ ، ٣٠ ، ٤٥ جزء فى المليون) رشاً على الذرة أثناء مراحل النمو المختلقة مقارنة بمعاملة كنترول لم تعامل بحمض البرولين (صفر جزء فى المليون). وأوضحت النتائج أن تأثير استخدام حمض البرولين فى المعاملات الثلاثة كان أفضل من المعاملة الكنترول التى لم يستخدم لها أى تركيزمن البرولين على الصفات الفسيولوجية للنبات من حيث نسبة تراكم حمض البرولين ونسبة المغذيات الكبرى والصغرى قى النبات والنسبة بين تراكم عنصرى الصوديوم إلى البوتاسيوم، كما أوضحت النتائج أن تركيز ١٥ جزء فى المليون من حمض البرولين كان دائماً الأفضل مقارنتاً بالتركيزات الأخرى (٣٠ ، ٤٥ جزء فى المليون) فيما ذكر من جميع الصفات والنتائج السابقة .

الكلمات الدالة: حمض البرولين الأمينى، النباتات الحساسة للملوحة، الإجهاد الملحى للتربة، نبات الذرة.