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MORPHOLOGICAL, ANATOMICAL AND PHYSIOLOGICAL STUDIES ON *Senna occidentalis* (L.) Link PLANTS GROWN UNDER STRESS OF DIFFERENT LEVELS OF SALINITY IN IRRIGATION WATER

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ABSTRACT

The current investigation was carried out at the wire green -house of Agricultural Botany Department, Faculty of Agriculture, Cairo University, Giza, Egypt during the two growing seasons of 2005 and 2006 in order to investigate the effect of different levels of salinity in irrigation water (0, 2000, 4000, 6000 and 8000 ppm) on plant survival, vegetative growth, stem anatomy, photosynthetic pigments and proline contents in leaves of coffee senna (*Senna occidentalis* (L.) Link).

Results obtained could be summarized in the following:

1- The relatively low used concentration of 2000 ppm salinized water as well as the first median concentration of 4000 ppm salinized water showed no significant effect on the percentage of plant survival of coffee senna in both studied seasons. By contrast, the tested second median concentration of 6000 ppm salinized water as well as the relatively high used concentration of 8000 ppm salinized water reduced significantly the percentage of plant survival of coffee senna in both studied seasons with significant difference between these two used concentrations.

2- The adopted concentration of 2000 ppm salinized water had no significant effect on all investigated morphological characters of vegetative growth (plant height, diameter of the main stem, number of branches/plant, fresh and dry weights of leafless shoot/plant, number of developed leaves / plant and fresh and dry weights of leaves/plant) of coffee senna plant in both studied seasons. On the other hand, the other tested concentrations of salinized water (4000, 6000 and 8000 ppm) induced significant decreases in all investigated morphological characters of vegetative growth of coffee senna plant in both studied seasons and the rate of reduction increased proportionally with increasing salt concentration in irrigation water and expressed its maximum with salinity level of 8000 ppm.

3- The effect of 6000 ppm salinized water on stem anatomy of coffee senna was investigated. It is clear that the decrease in stem diameter of coffee senna plant due to salinity stress could be attributed mainly to the prominent decrease in all included tissues. The thickness of cortex, fibrous tissue, phloem tissue, xylem tissue and pith diameter were decreased by 5.1, 39.7, 44.4, 39.1, and 21.0% less than the control; respectively.

4- The assigned low concentration of 2000 ppm artificial salinized water showed no significant effect on chloroplast pigments (chlorophyll a, chlorophyll b and carotenoids) in leaves of coffee senna plants aged eight months. By contrast, the other tested concentrations of salinized water (4000, 6000 and 8000 ppm) decreased significantly chloroplast pigments and the rate of reduction increased steadily as salinity level increased reached its maximum at salinity level of 8000 ppm.

5- The relatively low used concentration of 2000 ppm salinized water had no significant effect on free proline content in leaves of coffee senna plants eight

months old. On the other hand, increasing salinity level more than 2000 ppm induced significant increase in proline content and the rate of promotion increased proportionally with increasing salt concentration in irrigation water and expressed its maximum with salinity level of 8000 ppm.

6- It could be stated that coffee senna plants can grow well under salinity level of 2000 ppm without significant negative effect on the percentage of plant survival and their morphological characters of vegetative growth. Moreover, coffee senna could tolerate salinity up to 8000 ppm but with significant reduction in vegetative growth attributes.

Keywords: Coffee senna, *Senna occidentalis* (L.) Link, *Cassia occidentalis* L., Salinity, Vegetative Growth, Stem Anatomy, Physiology.

INTRODUCTION

In Egypt, most of the newly reclaimed soils are sandy, calcareous and some of them are salty. The area considered salt-affected to different degrees is approximately two million feddans (El-Gabaly, 1975). Most of this area is located in the northern part of the Nile Delta and newly reclaimed lands at Noubaria, Fayoum and Sinai. Such area could be devoted to crops and woody plants especially trees or shrubs that are tolerant to salts. Moreover, expansion of the agricultural area requires an enormous amount of irrigation water, which is not currently sufficient to meet all the expected demand. Therefore, the possibility of using saline water for irrigation specially from underground or drainage water is expected. The application of saline water for irrigation is dependent upon the concentration, composition of dissolved salts and the degree to which the plant species are salt tolerant.

It is well established that salinity inhibits growth and reduces yield in many crop plants. The damage of salinity differs in different plant species, depending on the organ of the plant being harvested, and in many cases the shoot is affected more than the root. One of the new strategy in facing the salinity problem in Egypt is the use of salt-tolerant species, specially woody plants for cultivation in newly reclaimed soils. In this respect, many Egyptian investigators studied the effect of salinity levels on vegetative growth characters of several woody plants and found that salinity inhibited vegetative growth and decreased plant survival. They recorded significant decreases in the percentage of plant survival, plant height, stem diameter, fresh weight of shoot and dry weight of shoot of investigated species. For instance, Nofal *et al*., (1983) on *Thuja orientalis*, Abd-El-Dayem (1988) on *Khaya senegalensis* and on *Swietenia mahogani*, Mohamed (1988) on *Casuarina sp*., Shehata (1992) on *Cupressus sempervirens* and on *Eucalyptus camalduelensis*, Ismail (1993) on *Adhatoda vasica*, El-Shawakh (1995) on *Acalypha macrophylla* and on *Justicia gendaruss*, Mohamed (1996) on *Casuarina glauca* and *Casuarina cunninghamiana*, Maximous and Abd-El-Dayem (1998) on three species of the genus *Pinus* and Reda *et al*., (2000) on *Leucaena leucocephala*.

Senna occidentalis (L.) Link (*Cassia occidentalis* L.) is one of the most promising shrubs for cultivation in newly reclaimed soils. It is belonging to the family *Caesalpiniaceae* and is widespread in warm areas of the world. It reaches heights of about 2 meters and produces yellow flowers in the leaf

axils (Hall and Vandiver, 1991). *Senna occidentalis* is used for landscape purposes as a medium – size flowering shrub, and as a source of colour during the warm months of the year. In addition to its uses as a flowering shrub for landscape purposes, *Senna occidentalis* is known as "coffee senna", since its seeds are brewed into a coffee-like beverage for asthma, and its flower infusion for bronchitis in the Peruvian Amazon (Soukup, 1970). Leaf extracts of *Senna occidentalis* exhibited broad-spectrum activity as antibacterial and antifungal (Caceres *et al*., 1991; Hussain and Deeni, 1991; Perez and Anesini, 1994; Perez and Suarez, 1997; Jain *et al*., 1998; Tona *et al*., 1999 and Samy and Ignacimuthu, 2000). Also, *Senna occidentalis* is used in treatment of liver diseases, and its leaf extracts afford significant hepatoprotection (Saraf *et al*., 1994 and Jafri *et al*., 1999). Moreover, *Senna occidentalis* plants have been used to reduce the numbers of mosquitoes indoors at night (Palsson and Jaenson, 1999). Its dry leaf powders and leaf extracts proved to be effective in the control of a large variety of insects (Facknath and Kawol, 1993; Hiremath *et al*., 1995; Maheshwari and Dwivedi, 1996 and 1997 and Dwivedi and Kumar, 1998).

Therefore, it could be stated that *Senna occidentalis* has an enormous potential for use as an ornamental shrub, a medicinal plant, and for pest control. This is particularly important in newly-reclaimed desert areas, where much of the landscape development takes place and where large areas of medicinal plants are cultivated.

The present investigation is an attempt to bring to light more information about the effect of salinity on plant survival as well as on the morphology of vegetative growth and stem anatomy of *Senna occidentalis* plants. Moreover, the effect of salinity on photosynthetic pigments and proline contents in leaves of coffee senna plants were also investigated.

MATERIALS AND METHODS

The present investigation was carried out at the wire green-house of Agricultural Botany Department, Faculty of Agriculture, Cairo University, Giza, Egypt during the two growing seasons of 2005 and 2006 in order to investigate the effect of different levels of salinity (0.0, 2000, 4000, 6000 and 8000 ppm) on plant survival, vegetative growth, stem anatomy, photosynthetic pigments and proline contents in leaves of coffee senna (*Senna occidentalis* (L.) Link) .

Seeds of *Senna occidentails* were obtained from El-Orman Botanic Garden, Ministry of Agriculture, Giza, Egypt. Seeds were treated by boiling water and then soaked in tap water for 12 hours before sowing. Seeds were sown on eighteenth March, 2005 in the first season and replicated on sixteenth March, 2006 in the second one to provide the experimental plant materials. Seeds were sown in plastic trays, 40×60 cm, filled with peatmoss and clean sand at the ratio of 1:1 by volume. One month from sowing date, the emerged uniform seedlings were transplanted to plastic pots, one seedling per pot, (25 cm diameter) filled with about 7 kg of clay and clean sand at the ratio of 1:1 by weight. Each pot was received NPK at the recommended rates.

The experiment was made in a randomized complete design with four replicates. The replicate contained 50 pots, each 10 pots were assigned for one treatment. The treatments were five levels of salinity in irrigation water; namely, 0.0 (using tap water as a control), 2000, 4000, 6000 and 8000 ppm of salt mixture (NaCl : $CaCl_2$, 1:1 w/w). Each level of salinity in irrigation water was added regularly (500 ml/pot/week) during the whole period of the experiment (seven months from transplanting; i.e., the age of eight months from sowing date). Irrigation treatments were applied four times with salt-water followed by one irrigation with tap-water (for leaching the accumulated salts) and then repeated in the same manner till the end of the experiment.

Recording of data:

I- Plant survival and morphological characters of vegetative growth:

At the end of the experiment in each of the two growing seasons (seven months from transplanting), the percentage of plant survival was recorded for each treatment. For recording the data of vegetative growth characters, 20 plants from each treatment, five from each replicate, were lifted from pots for this purpose. The recorded data were:

1- Plant height (cm).
2- Stem diameter (mm) at its median portion.
3- Number of developed branches / plant.
4- Fresh weight of stems (g) / plant.
5- Dry weight of stems (g) / plant.
6- Number of developed leaves / plant.
7- Fresh weight of leaves (g) / plant.
8- Dry weight of leaves (g) / plant.

II- Anatomical studies:

Plants used for examination were taken throughout the second growing season of 2006 at the age of four months from sowing date; i.e., three months from transplanting. Specimens, which were taken from the median portion of the main stem, were killed and fixed for one week in F.A.A. (10 ml formalin, 5 ml glacial acetic acid and 85 ml ethyl alcohol 70%). The selected materials were washed in 50% ethyl alcohol, dehydrated in a normal butyl alcohol series, embedded in paraffin wax of melting point 56^{o}C, sectioned to a thickness of 20 microns, double stained with crystal violet-erythrosine, cleared in xylene and mounted in Canada balsam (Nassar and El-Sahhar, 1998). Slides were examined microscopically and photomicrographed.

III- Physiological studies:

Photosynthetic pigments and free proline were determined quantitatively in leaves of treated and untreated plants at the end of the experiment in the first growing season of 2005 when plants aged eight months from sowing date.

Photosynthetic pigments (chlorophyll a, chlorophyll b and carotenoids) were extracted by using dimethyl formamide and determined according to Nornai (1982) as mg/g fresh weight of coffee senna leaves.

Free proline was determined according to the method described by Bates *et al.,* (1973). Bush and Lomb spectrophotometer (model spectranic 2000) was used. The absorbance was measured at 520 nm. Free proline content was estimated as mg/g fresh weight of coffee senna leaves.

Statistical analysis:

Data on plant survival, morphological characters of vegetative growth, photosynthetic pigments and free proline were subjected to conventional methods of analysis of variance according to Snedecor and Cochran (1982). The least significant difference (L.S.D.) at 0.05 level was calculated for each investigated character under different assigned treatments.

RESULTS AND DISCUSSION

I- Percentages of plant survival:

The percentages of plant survival of *Senna occidentalis* grown under different levels of salinity stress in two seasons and the results of their statistical analysis are shown in Table (1).

It is realized from Table (1) that the low used concentration of 2000 ppm salinized water as well as the first median concentration of 4000 ppm salinized water showed no significant effect on the percentage of plant survival of coffee senna in both studied seasons. By contrast, the second median concentration of 6000 ppm salinized water as well as the relatively high used concentration of 8000 ppm salinized water reduced significantly the percentage of plant survival of coffee senna in both studied seasons with significant difference between these two used concentrations.

Such decrease in the percentage of plant survivals due to salinity stress could be attributed to the toxicity of one or more specific ions, osmotic inhibition of water absorption under relatively high level of salinity and / or the combination of the previous two factors as mentioned by Seatz *et al*., (1958).

Similar results were also reported by Nofal *et al*., (1983), Abd-El-Dayem (1988), Mohamed (1988), Shehata (1992), Ismail (1993), El-Shawakh (1995), Mohamed (1996) and Maximous and Abd-El-Dayem (1998) as well as by Reda *et al*., (2000).

II- Morphological characters of vegetative growth:

Data on morphological characters are presented in Table (1):

1- Plant height:

Results presented in Table (1) clearly show that the relatively low used concentration of 2000 ppm salinized water had no significant effect on height of coffee senna plants in both studied seasons. Whereas, the other used concentrations of salinized water (4000, 6000 and 8000 ppm) retarded significantly plant height of coffee senna in the two studied seasons. Worthy to note that, the significant decrease in plant height was more pronounced as the salinity level increased and expressed its maximum with salinity level of 8000 ppm, being 49% less than the control in the first season and 50.4% less than the control in the second one.

Table (1): Percentages of plant survival and morphological characters of vegetative growth of coffee senna plants, 8 months old, as affected by different levels of salinity in two growing seasons

Salinity level (ppm)	Plant survival %	Plant height (cm)	Stem diameter (mm)	Number of branches / plant	Fresh weight of stems (g)/ plant	Dry weight of stems (g)/plant	Number of leaves/ plant	Fresh weight of leaves (g)/ plant	Dry weight of leaves (g)/plant
First season of 2005									
0.0	100.0	201.6	19.2	4.7	97.1	49.7	68.4	130.8	66.9
2000	100.0	203.9	19.1	4.8	98.5	50.2	69.3	132.7	67.5
4000	100.0	168.4	16.4	4.2	81.8	42.1	56.6	108.8	56.3
6000	82.5	137.2	13.9	3.3	67.7	33.9	47.5	89.3	46.8
8000	72.5	102.8	12.3	2.5	55.2	28.4	33.9	66.4	34.3
L.S.D. (0.05)	9.27	18.30	1.45	0.62	9.28	5.17	6.03	11.84	6.25
Second season of 2006									
0.0	97.5	192.7	18.6	4.5	93.8	47.6	69.2	132.9	70.2
2000	100.0	196.2	18.8	4.5	96.2	48.9	70.1	131.5	68.3
4000	95.0	157.4	15.5	3.9	77.1	40.2	58.2	113.1	58.2
6000	85.0	135.3	13.2	3.1	63.4	32.5	46.6	87.9	45.7
8000	70.0	95.6	10.5	2.2	51.3	26.1	33.4	65.6	34.2
L.S.D. (0.05)	8.46	16.9	1.67	0.58	7.74	4.63	5.49	12.17	5.89

2- Diameter of the main stem:

The mean values of main stem diameter at its median portion of coffee senna plants grown under different levels of salinity stress in two successive seasons and the results of their statistical analysis are given in Table (1).

It is obvious that the control plants recorded a mean stem diameter of 19.2 mm in the first season and of 18.6 mm in the second one, which proved significant difference with all assigned treatments of salinity, in both studied seasons, except that of plants grown under salinity stress of 2000 ppm where the difference was insignificant. It is evident that increasing salt concentration in irrigation water more than 2000 ppm significantly decreased diameter of the main stem and the maximum decrease was detected at salinity level of 8000 ppm, being 35.9% less than the control in the first season and 43.5% less than the control in the second season.

3- Number of branches per plant:

It is realized from Table (1) that the assigned low concentration of 2000 ppm artificial salinized water showed no statistical effect on number of developed branches per coffee senna plant in both studied seasons. On the other hand, increasing salinity level more than 2000 ppm induced retardation in number of branches developed per coffee senna plant. Worthy to mention that the rate of reduction increased steadily as the salinity level increased reached its maximum at salinity level of 8000 ppm, being 46.8 and 51.1% less than the control in the first and second season; respectively.

4- Fresh weight of stems (leafless shoot) per plant:

It is clear from Table (1) that the relatively low used concentration of 2000 ppm salinized water showed no significant effect on fresh weight of leafless shoot per coffee senna plant in both studied seasons. At the same time, the other used concentrations of salinized water (4000, 6000 and 8000 ppm) reduced significantly fresh weight of leafless shoot in both studied seasons and the rate of reduction increased proportionally with increasing salt concentration in irrigation water and expressed its maximum with salinity level of 8000 ppm which reduced fresh weight of leafless shoot per coffee senna plant by 43.1% less than the control in the first season and by 45.3% less than the control in the second one.

5- Dry weight of stems (leafless shoot) per plant:

Data presented in Table (1) clearly show that the assigned low concentration of 2000 ppm artificial salinized water had no statistical effect on dry weight of leafless shoot per coffee senna plant in the two studied seasons. By contrast, increasing salinity level more than 2000 ppm induced significant decrease in this respect. Worthy to note that the rate of reduction increased steadily as the salinity level increased reached its maximum at salinity level of 8000 ppm, being 42.9 and 45.2% less than the dry weight of leafless shoot per control plant in the first and second season; respectively.

6- Number of developed leaves per plant:

It is noted from Table (1) that the relatively low used concentration of 2000 ppm salinized water showed no significant effect on number of leaves developed per coffee senna plant in both studied seasons. While, the other used concentrations of salinized water (4000, 6000 and 8000 ppm) decreased significantly the number of developed leaves per plant in the two studied seasons. Worthy to mention that the significant decrease in number of leaves developed per coffee senna plant was more pronounced as the salinity level increased and expressed its maximum with salinity level of 8000 ppm, being 50.4 and 51.7% less than the number of leaves developed per control plant in the first and second season; respectively.

7- Fresh weight of leaves per plant:

It is realized from Table (1) that the low assigned concentration of 2000 ppm salinized water showed no significant effect on fresh weight of leaves per coffee senna plant in both studied seasons. At the same time, the two assigned median concentrations of 4000 and 6000 ppm salinized water as well as the relatively high used concentration of 8000 ppm salinized water decreased significantly fresh weight of leaves per coffee senna plant in both studied seasons. Moreover, the rate of reduction increased proportionally with increasing salt concentration in irrigation water and expressed its maximum with salinity level of 8000 ppm, which reduced fresh weight of leaves per coffee senna plant by 49.2% less than the control in the first season and by 50.6% less than the control in the second one.

8- Dry weight of leaves per plant:

The mean values of dry weight of leaves per plant of coffee senna grown under different levels of salinity stress in two seasons and the results of their statistical analysis are shown in Table (1).

Data presented in Table (1) clearly show that the control plants recorded a mean dry weight of 66.9 g in the first season and of 70.2 g in the

second one, which proved significant difference with all assigned treatments of salinity in both studied seasons, except that of plants grown under salinity level of 2000 ppm where the difference was insignificant. It is evident that increasing salt concentration more than 2000 ppm in irrigation water significantly decreased dry weight of leaves per coffee senna plant in both studied seasons and the rate of reduction increased steadily as the salinity level increased reached its maximum with salinity level of 8000 ppm, being 48.7 and 51.3% less than the dry weight of leaves per control plant in the first and second season; respectively.

From the aforementioned results, it could be stated that the relatively low used concentration of 2000 ppm salinized water had no significant effect on all investigated morphological characters of vegetative growth (plant height, diameter of the main stem, number of branches per plant, fresh and dry weights of leafless shoot per plant, number of developed leaves per plant and fresh and dry weights of leaves per plant) of coffee senna plant in both studied seasons. By contrast, the other used concentrations of salinized water (4000, 6000 and 8000 ppm) induced significant decreases in all investigated morphological characters in both studied seasons and the rate of reduction increased proportionally with increasing salt concentration in irrigation water and expressed its maximum with salinity level of 8000 ppm.

The present findings are generally in harmony with those obtained by Nofal *et al*., (1983), Abd-El-Dayem (1988), Mohamed (1988), Shehata (1992), Ismail (1993), El-Shawakh (1995), Mohamed (1996) and Maximous and Abd-El-Dayem (1998) as well as by Reda *et al*., (2000) on leucaena plant.

III- Stem anatomy:

Microscopical measurements of certain histological characters in transverse sections through the median portion of the main stem of coffee senna plants grown under salinity stress of 6000 ppm and those of control plants are given in Table (2). Likewise, microphotographs illustrating these treatments are shown in Figure (1).

It is realized from Table (2) and Figure (1) that the salinity level of 6000 ppm reduced the diameter of the main stem by 30.8% less than the control. It is clear that the decrease in stem diameter of coffee senna plant due to salinity stress could be attributed mainly to the prominent decrease in all included tissues. The thickness of cortex, fibrous tissue, phloem tissue, xylem tissue and pith diameter were decreased by 5.1, 39.7, 44.4, 39.1 and 21.0% less than the control; respectively.

The present findings are generally in accordance with those reported by Reda *et al.,* (2000).

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Table (2): Measurements in micron of certain histological features in transverse sections through the median portion of the main stem of normal coffee senna plants and of those grown under salinity stress of 6000 ppm, plants aged four months from sowing data. (Means of three sections from three specimens)

Characters	Treatments		
	Control plants	Plants under salinity stress of 6000 ppm	± % to control
Diameter of the main stem	8649	5985	-30.8
Thickness of cortex	178	169	-5.1
Thickness of fibrous tissue	335	202	-39.7
Thickness of phloem tissue	293	167	-44.4
Thickness of xylem tissue	2116	1289	-39.1
Diameter of the pith	2697	2131	-21.0

IV- Physiological studies:

Photosynthetic pigments and free proline were determined quantitatively in leaves of treated and untreated plants of coffee senna aged eight months from sowing date of the first season 2005. Data on these fractions are presented in Table (3).

1- Photosynthetic pigments:

Data in Table (3) clearly show that the relatively low used concentration of 2000 ppm salinized water had no statistical effect on chloroplast pigments (chlorophyll a, chlorophyll b and carotenoids) in leaves of coffee senna plants aged eight months. By contrast, the other tested concentrations of salinized water (4000, 6000 and 8000 ppm) decreased significantly chloroplast pigments and the rate of reduction increased steadily as salinity level increased reached its maximum at salinity level of 8000 ppm, being 44.4, 45.9 and 48.1% less than the control for chlorophyll a, chlorophyll b and carotenoids; respectively. The present findings are generally in harmony with those reported by Darwish and Reda (2000).

2- Free proline :

It is realized from Table (3) that the assigned low concentration of 2000 ppm artificial salinized water showed no significant effect on free proline content in leaves of coffee senna plants eight months old. On the other hand, increasing salinity level more than 2000 ppm induced significant increase in proline content and the rate of promotion increased proportionally with increasing salt concentration in irrigation water and expressed its maximum with salinity level of 8000 ppm which increased free proline content in leaves of coffee senna plants by 47.5% more than the control. Similar results were also recorded by Darwish and Reda (2000) as well as by Reda *et al*., (2000).

In this connection, Pessarakli (1994) stated that the accumulation of soluble proline in leaves of many higher plant species could be induced by environmental stresses such as light, temperature, drought and salinity. Also, it was found that the amount of proline accumulation correlates with the degree of salinity, being in agreement with the present findings. Flowers *et al*., (1977) postulated that proline may function as a compatible solute which

had an important role of balancing cytoplasmic and vacular water potentials. Ridge *et al*., (1993) pointed out that proline may serve as a substrate for respiration, an energy source and a storage compound for the recovering plant following stress.

Table (3): The effect of salinity on photosynthetic pigments and free proline contents in leaves of coffee senna plants at the age of 8 months from sowing date of the first season

Salinity level (ppm)	Photosynthetic Pigments (mg/g.F.W.)			Free proline (mg/g F.W.)
	Chl.a	Chl.b	Carotenoids	
0.0	2.795	0.974	0.293	1.239
2000	2.827	0.981	0.298	1.228
4000	2.319	0.757	0.246	1.394
6000	1.946	0.639	0.195	1.616
8000	1.555	0.527	0.152	1.827
L.S.D. (0.05)	0.328	0.109	0.037	0.144

REFERENCES

Abd-El-Dayem, A. M. A.(1988). Physiological studies on some ornamental trees. Ph.D. Thesis, Fac. of Agric., Tanta Univ., Kafr El-Sheikh, Egypt.

Bates, L. S.; R. P. Waldren and I. D. Teare (1973). Rapid determination of free proline for water stress studies. Plant and Soil, 39:205-207.

Caceres, A.; B. R. Lopez; M. A. Giron and H. Logemann (1991). Plants used in Guatemala for the treatment of dermatophytic infections. I. Screening for antimycotic activity of 44 plant extracts. J. Ethnopharmacol., 31 (3) : 263-276.

Darwish, Mona A. and Faten M. Reda (2000). Effect of salinity on growth and leaf anatomy of *Atriplex halimus* L. grown in sandy soil. Egypt. J. Appl. Sci., 15 (8): 178-193.

Dwivedi, S. C. and R. Kumar (1998). Evaluation of *Cassia occidentalis* leaf extract on development and damage caused by *Trogoderma granarium,* Khapra bectle. J. Ecotoxicol. Environ. Monitoring, 8 (1):55-58.

El-Gabaly, M. M. (1975). Reclamation and management of salt affected soil. Inter. Symposium on new developments in the field of salt affected soils. Dec. 4-9, p. 401-434, Ministry of Agriculture, Egypt.

El-Shawakh, Y. M. (1995). The response of some ornamentals shrubs to irrigation with saline water. M. Sc. Thesis, Fac. of Agric., Cairo Univ., Egypt.

Facknath, S. and D. Kawol (1993). Antifeedant and insecticidal effects of some plant extracts on the cabbage webworm, *Crocidolomia binotalis*. Insect Science and its Application, 14 (5): 571-574.

Flowers, T. J.; P. F. Troke and A. R. Yeo (1977). The mechanism of salt tolerance in halophytes. Ann. Rev. Plant Physiol., 28:89-121.

Hall, D. W. and V. V. Vandiver (1991). Coffee senna, *Cassia occidentalis* L. Weeds in Florida. SP 37, Florida Cooperative Extension Service, I.F.A.S., Univ. of Florida.

Hiremath, I. G.; A. Youngjoon; K. Soonll; C. Byumg Ryul; C. JumRae; Y. J. Ahn; S. I. Kim; B. R. Choi and J. R. Cho (1995). Insecticidal and acaricidal activities of African plant extracts against the brown planthopper and two-spotted spider mite. Korean J. Appl. Entomol., 34 (3) : 200-205.

Hussain, H. S. N. and Y. Y. Deeni (1991). Plants in Kano ethnomedicine, screening for antimicrobial activity and alkaloids. Inter. J. Pharmacognosy, 29 (1):51-56.

Ismail, M. F. M. (1993). Effect of salinity on growth and chemical composition of some ornamental shrubs. M. Sc. Thesis, Fac. of Agric., Cairo Univ., Egypt.

Jafri, M. A.; M. J. Subbani; K. Javed and S. Singh (1999). Hepatoprotective activity of leaves of *Cassia occidentalis* against paracetamol and ethyl alcohol intoxication in rats. J. Ethnopharmacol., 68 (3):355-361.

Jain, S. C.; R. A. Sharma; R. Jain and C. Mittal (1998). Antimicrobial screening of *Cassia occidentalis* L. in *vivo* and in *vitro*. Phytotherapy Res., 12 (3):200-204.

Maheshwari, H. K. and S.C. Dwivedi (1996). Evaluation of botanicals for the management of *Tribolium castaneum* (Coleoptra: Tenebrionidae). Insect Environment, 2 (3) : 72-73.

Maheshwari, H. K. and S.C. Dwivedi (1997). Screening of some plant extracts for their oviposition deterrent properties against the pulse beetle, *Callosobruchus chinensis* (L.). Uttar Pradesh J. Zoology, 17 (1):30-32.

Maximous, S. L. and A. M. A. Abd –El-Dayem (1998). Seedling growth of three pine species as affected by saline water. I-Influnce of salinity on vegetative growth. Egypt. J. Appl. Sci., 13 (9): 236-248.

Mohamed, D. Y. (1988). Study on the physiological drought resistance in casuarina plants. Ph. D. Thesis, Fac. of Agric., Zagazig Univ., Egypt.

Mohamed, S. G. (1996). Physiological and technological studies on casuarina seedlings. Ph. D. Thesis, Fac. of Agric., Zagazing Univ., Egypt.

Nassar, M. A. and K. F. El-Sahhar (1998). Botanical; Preparations and Microscopy (Microtechnique). Academic Bookshop, Dokki, Giza, Egypt, 219 pp. (In Arabic).

Nofal, E. M.; M. A. El-Tantawy and E. M. Badawy (1983). Effect of sodium and calcium chlorids in soil on the growth and chemical analysis of *Thuja orientalis* and *Adhatoda vasica* Ness. J. Agric. Res., Tanta Univ., 9 (19):150-162.

Nornai, R. (1982). Formulae for determination of chlorophyllous pigments extracted with N. N. Dimethyl Formamide. Plant Physiol., 69:1371-1381.

Palsson, K. and T. G. T. Jaenson (1999). Plant products used as mosquito repellents in Guinea Bissau, West Africa. Acta Tropica, 72 (1): 39-52.

Perez, C. and C. Anesini (1994). In vitro antibacterial activity of Argentine folk medicinal plants against *Salmonella typhi*. J. Ethnopharmacol., 44 (1) : 41-46.

Perez, C. and C. Suarez (1997). Antifungal activity of plant extracts against *Candida albicans*. Amer. J. Chinese Medicine, 25 (2): 181-184.

Pessarkli, M. (1994). Handbook of Plant and Crop Stress. Marcel Dekker Inc., New York, Basel, HongKong, 659pp.

Reda, Faten M.; S. L. Maximous and O. S. M. El-Kobisy (2000). Morphological and anatomical studies on leucaena (*Leucaena leucocephala*) plants grown under stress of different levels of salinity in irrigation water. Bull. Fac. Agric., Cairo Univ., 51:309-330.

Ridge, I.; P. Murphy; M. Bell and P. Parker (1993). Plant Physiology. Biology Form and Function. Edit. Irene Ridge. Hodder and Stoughton Ltd. The Open University, UK.

Samy, R. P. and S. Ignacimuthu (2000). Antibacterial activity of some folklore medicinal plants used by tribals in Western Ghats of India. J. Ethnopharmacol., 69 (1): 63-71.

Saraf, S.; V. K. Dixit; S. C. Tripathi and G. K. Patnaik (1994). Antihepatotoxic activity of *Cassia occidentalis*. Inter. J. Pharmacognosy, 32 (2):178-183.

Seatz, L. F.; A. T. Sterges and S. R. Kramer (1958). Anion effect of plant growth and anion composition. Soil Sci. Soc. Amer. Proc., 22 (6):149-152.

Shehata, M. S. (1992). Effect of salinity and soil moisture content on seedlings growth of *Cupressus sempervirnes* and *Eucalyptus camaldulensis*. Ph. D. Thesis, Faculty of Agric., Cairo Univ., Egypt.

Snedecor, G. W. and W. G. Cochran (1982). Statistical Methods. The Iowa State University Press. 7th Edit., 2nd Printing, 507 pp.

Soukup, J. (1970). Vocabulary of the common Names of the Peruvian Flora and Catalog of the Genera. Editorial Salesiano, Lima, 436 pp.

Tona, L.; N. P. Ngimbi; M. Tsakala; K. Mesia; K. Cimanga; S. Apers; T. de Bruyne; L. Picters; J. Totte and A. I. Vlietinck (1999). Antimalarial activity of 20 crude extracts from nine African medicinal plants used in Kinshasa, Congo. J. Ethnopharmacol., 68 (1-3) : 193-203.

دراسات مورفولوجية وتشريحية وفسيولوجية على نباتات الـ *Senna occidentalis* (L.) Link النامية تحت إجهاد مستويات مختلفة من ملوحة ماء الرى

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أجرى هذا البحث فى الصوبة السلكية التابعة لقسم النبات الزراعى بكلية الزراعة جامعة القاهرة بالجيزة خلال موسمى النمو 2005 و 2006 بهدف دراسة تأثير مستويات مختلفة من ملوحة ماء الرى (صفر ، 2000، 4000، 6000، 8000 جزء فى المليون) على نسبة بقاء النباتات ومورفولوجيا النمو الخضرى وتشريح الساق ومحتوى الاوراق من صبغات البناء الضوئى والبرولين الحر لنباتات الـCoffee senna.

ويمكن إيجاز أهم النتائج المتحصل عليها فيما يلى:

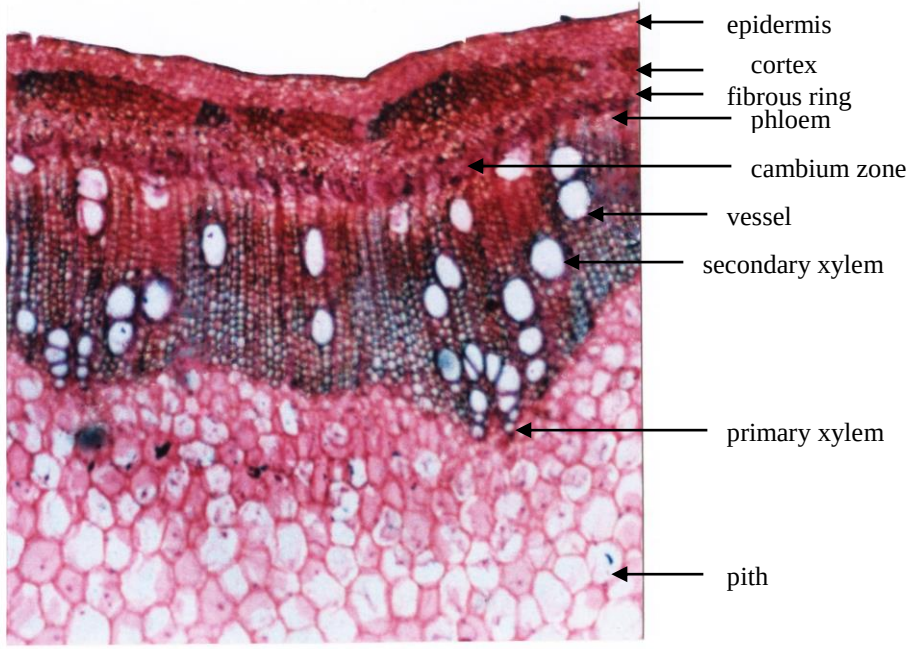
1- لم يظهر أى من التركيزين 2000 و 4000جزء فى المليون من ملوحة مارى الرى تأثيرا معنويا على نسبة بقاء النباتات فى كلا موسمى الدراسة. وعلى العكس من ذلك أدى استخدام أى من التركيزين 6000 و 8000 جزء فى المليون من ملوحة ماء الرى إلى حدوث نقص معنوى فى نسبة بقاء النباتات فى كلا موسمى الدراسة.

2- لم يكن للتركيز المنخفض نسبيا (2000 جزء فى المليون) من ملوحة ماء الرى أى تأثير معنوى على جميع الصفات المورفولوجية للنمو الخضرى لنباتات الـ Coffee senna فى كلا موسمى الدراسة وهى ارتفاع النبات، قطر الساق الرئيسية، عدد الافرع على النبات، الوزن الرطب والجاف للساق والافرع، عدد الاوراق على النبات والوزن الرطب والجاف لأوراق النبات. وعلى العكس من ذلك أدى استخدام أى من التركيزات الاخرى من ملوحة ماء الرى وهى 4000، 6000 و 8000 جزء فى المليون إلى حدوث نقص معنوى فى جميع الصفات المورفولوجية السابقة للنمو الخضرى لنباتات الـ Coffee senna فى كلا موسمى الدراسة وإزداد النقص معنويا لكل الصفات مع زيادة تركيز الملوحة فى ماء الرى حيث بلغ أقصى نقص معنوى عند مستوى ملوحة 8000 جزء فى المليون.

3- تم دراسة تأثير ملوحة ماء الرى بتركيز 6000 جزء فى المليون على التركيب التشريحى للساق الرئيسية حيث أدى استخدام هذا التركيز من الملوحة فى ماء الرى إلى حدوث نقص واضح فى قطر الساق نتيجة للنقص الذى حدث فى جميع الانسجة المكونة للساق (حدث نقص واضح فى سمك كل من القشرة ونسيج الالياف واللحاء والخشب وقطر النخاع) مقارنة بالتركيب التشريحى للساق الرئيسية فى النباتات الغير معاملة.

4- أدى استخدام ملوحة ماء الرى بأى من التركيزات المتوسطة والعالية نسبيا (4000، 6000و 8000 جزء من المليون) إلى حدوث نقص معنوى فى محتوى أوراق نباتات الـ Coffee senna من صبغات البناء الضوئى مع زيادة النقص فى محتوى الصبغات بزيادة التركيز المستخدم من الملوحة حتى 8000 جزء فى المليون. وعلى العكس من ذلك أدى أستخدام أى من هذه التركيزات إلى زيادة محتوى الاوراق من البرولين الحر مع زيادة المحتوى بزيادة تركيز الملح حتى 8000 جزء فى المليون.

5- يمكن القول أن نباتات الـ Coffee senna تستطيع النمو جيدا تحت مستوى ملوحة ماء رى 2000 جزء فى المليون دون أى تأثير على الصفات الموروفولوجية للنمو الخضرى ونسبة بقاء النباتات. أكثر من ذلك، يمكن لنباتات الـCoffee senna أن تتحمل ملوحة ماء الرى حتى 8000 جزء فى المليون ولكن مع حدوث نقص معنوى (يمكن تقبله خصوصا فى الاراضى المستصلحة) فى نسبة بقاء النباتات وجميع صفات النمو الخضرى ومحتوى الاوراق من صبغات البناء الضوئى.



Control **Salinity level of 6000 ppm**

Figure (1): Transverse sections through the median portion of the main stem of *Senna occidentalis* (L.) Link, aged four months, as affected by salinity stress. (x144)