Bull. Fac. Agric. Cairo Univ., 61: 214-221 (2010)

GROWTH AND CHEMICAL CONSTITUENTS OF *Ceiba pentandra* L. PLANT IN RESPONSE TO DIFFERENT LEVELS OF SALINE IRRIGATION WATER

(Received: 17.1.2010)

By
M. A. El-Khateeb, A. Nabih, A. A. Nasr* and H. S. M. Hussien*

Department of Ornamental Horticulture, Faculty of Agriculture, Cairo University, Giza, Egypt.
**Botanical Gardens Research Department, Horticulture Research Institute, Agricultural Research Center, Giza Egypt.*

ABSTRACT

An experimental trial was consummated throughout two successive seasons (2006/07 and 2007/08) at the nursery of Ornamental Horticulture Department, Faculty of Agriculture, Cairo University. It was intended to find out how far *Ceiba pentandra* L. plant can withstand various salinity levels (1500, 3000, 4500 and 6000 ppm) of irrigation, to assess the possibility of planting such plant in new areas such as coastal lands. Accordingly, the previous salinity levels were tested for their effects on growth, development and chemical constituents. The results revealed that using the lowest salinity levels (1500 and 3000 ppm) had a beneficial effect on some plant traits, as they increased plant height, number of leaves/plant, fresh and dry weights of compound leaves, root length and fresh and dry weights of roots as well as stem diameter with only 3000 ppm of saline water. The contrary action was detected due to increasing salinity levels to 4500 and 6000 ppm in few cases as they decreased leaflet and compound leaf areas.

Chemical constituents of the different plant parts were also affected by the different salinity levels. All of them revealed a beneficial effect on total carbohydrates content in leaves, especially with the lowest levels (1500 and 3000 ppm), whereas in stem, the best result was gained as a result of salinity treatments at 1500, 3000 and 4500 ppm. The low levels (1500 and 3000 ppm) also caused an increment in indole content in leaves, whereas the highest one (6000 ppm) caused a decrement. Phenols as well as phenols/indoles ratio in the leaves increased progressively by increasing salinity level. Meanwhile, pigment content showed a decrement in plants receiving the different salinity levels, especially the highest one (6000 ppm).Thus, it could be concluded that *Ceiba pentandra* L. withstands salinity level up to 6000 ppm, with beneficial effects in some instances.

Key words: *Ceiba pentandra L., chemical constituents, growth, salinity.*

1. INTRODUCTION

Ceiba pentandra L. (Chorisia), Kapok tree, silk cotton tree, Family Malvaceae, is a very large majestic tree, with a conspicuously buttressed trunk. The kapok tree grows to more than 50-60m tall with widely spreading branches. The silk cotton tree is cultivated for kapok (cotton-like substance). Fixed oil from the seeds is used in edible products and the ground seeds in animal feed. It needs full sun to partly shade and organic rich soil. It can be used in landscaping as a specimen tree.

Salinity has a paramount importance in controlling the physiological pattern of many plants. The undesirable effect of high salinity levels is the major factor that forced many authors to investigate this problem in details. It is well known that salinity induces growth inhibition as a result of the imbalance in photohormone levels and through its effect on either the biosynthesis or destruction of the plant hormones. Many authors in this concern indicated that auxin and gibberellin contents decreased with increasing salinity Amzallage *et al.* (1992) on sorghum and Feng and Barker (1992) on tomato plants. Little information is available on the effect of salinity levels on growth and development of *Ceiba pentandra* plant, so, the literature on other plants seemed to be helpful in this respect. El-Khateeb (1993) on *Murraya exotica* found that salinity level above 3000 ppm significantly decreased most of the growth characters. Muthuchelian *et al.* (1996) grew *Erythrina variegata* seedlings under low (100 mM NaCl) and high (250 mM NaCl) levels of salinity. They concluded that seedlings exposed to high salinity showed significant reduction in growth rate and biomass production. Mohamed (2002) on *Leucaena leucocephala*, *Melia* *azadirachta* and *Dalbergia sisso*, reported that using saline water irrigation at the levels of 1000, 2000, 3000 and 4000 ppm/l (NaCl and $CaCl_2$) reduced stem length, stem diameter, number of leaves and fresh and dry weights of stems, leaves and roots, compared to the control. Rezkalla (2006) studied the effect of different salinity levels (0, 4000, 8000, 12000 and 16000 ppm) on growth and development of *Conocarpus erectus.* He found a gradual decrement on plant parameters with increasing salinity levels .

Concerning the effect on chemical constituents, Shehata (1992) on *Cupressus sempervirens* and *Eucalyptus camaldulensis,* found that total carbohydrates content in stems of seedlings significantly increased as salt levels in irrigation water was raised. El-Shewekh (1995) reported that salinity levels above 4000 ppm markedly decreased the contents of chlorophyll a and b of *Acalypha macrophylla*. Muthuchelian *et al.* (1996) added that pigment, starch and polysaccharide contents increased in salt stressed *Erythrina variegata* seedlings. Asmaael (1997) on *Casuarina equisetifolia* seedlings, found that chlorophyll a and b decreased as a result of high salinity, but carotenoides and total carbohydrates increased. Arshi *et al.* (2002) on senna plants, concluded that the different NaCl concentrati- ons (0, 40, 80, 120 and 160 mM) caused a pronounced reduction in total chlorophyll content, whereas proline content of the leaves increased markedly.

Planting some economic ornamental plants in the newly reclaimed lands, such as the coastal areas became the main subject in extensive studies in recent years. Some plants need much effort to be maintained in good quality under such conditions. Studying some factors that affect growth and development of these plants is indispensable under these conditions. The work embodied in this experiment was to study the effect of different salinity levels on growth and development of *Ceiba pentandra* L. plant.

2. MATERIALS AND METHODS

The experimental trial was consummated throughout two successive seasons (2006/2007 and 2007/2008) at the nursery of Ornamental Horticulture Department, Faculty of Agriculture, Cairo University. It was intended to find out how far *Ceiba pentandra* L. plant can withstand different salinity levels in order to produce plants of high quality. Accordingly, five levels of saline water were prepared as follows: NaCl salt was mixed well with CaCl salt at the ratio of 1:1 by weight. Saline water was then prepared from salt mixture at the levels of 1500, 3000, 4500 and 6000 ppm (5 treatments of saline water irrigation) besides tab water was used for untreated plants (control).

Uniform seedlings of *Ceiba pentandra* (12-15 cm tall) were collected from the nursery of Ornamental Horticulture Department, Faculty of Agriculture, Cairo University. They were planted on April 1st 2006 in clay pots (25cm diameter) filled with clay loamy soil (Table, A).

Table (A): Physical and chemical analysis of the clay loamy soil.

Clay	Sand	Silt	Ec	pH	SP
43.56	31.08	25.36	5.1	7.77	37.5
HCO_3 Meq/l	SO_4 Meq/l	O.M.	N %	P %	K %
1.30	10.78	1.31	0.67	0.24	0.31

In both seasons the treatments were arranged in randomized complete block design, with three replicates (3 pots/replicate).The plants left to grow in an open field and treated with the different salinity levels after 35 days from planting and then whenever necessary till the end of the experiment (July 15th). Each pot received one liter of saline water each time .Regular agricultural practices of chemical fertilization ((NPK 1:1:1) at (2.5 g./pot)) were carried out 3 times throughout the growth period. Data were recorded on:

2.1.Vegetative growth

Plant height (cm.), number of leaves/plant, number of leaflets/l. Leaf, leaflet area (cm^2), compound leaf area (cm^2), fresh and dry weights of leaves (g), stem diameter (cm), fresh and dry weights of stem (g), root length (cm) and fresh and dry weights of roots (g).

2.2.Chemical composition

The contents of chlorophyll a, b and carotenoids were determined (mg/g fresh weight leaf) according to Fahmy (1970). Total soluble indole was determined according to Larson *et al.* (1962) and modified by Selim *et al.* (1978). A total soluble phenol was determined by using Folin-Denis method (A.O.A.C., 1970).Total carbohydrates in dried leaves and stems were determined as described by Smith *et al.* (1956). Data were statistically analyzed (L.S.D. at 5%) according to (Snedecor and Cochran, 1980).

3. RESULTS AND DISCUSSION

3.1. Effect of saline water on plant height

Tables (1 and 2) prove that different trends on the obtained values were detected due to applying the different salinity levels on plant height and leaves parameters. In this connection, using the lowest levels (1500 and 3000 ppm) revealed many beneficial effects on the recorded values in both seasons. They elevated the number of leaves/plant, and fresh and dry weights of compound leaves. Meanwhile, the moderate level of saline water (3000 ppm) gave utmost high mean of plant height in the second season only. Whereas, a depressive effect was scored as a result of growing plants under the condition of high salinity levels (4500 and 6000 ppm). They decreased plant height, number of leaves/plant and compound leaf areas in the first season with 6000 ppm. On the other side, the number of leaflets/leaf was not significantly affected by the different salinity levels in both seasons.

The results ascribed to high salinity level could be interpreted by its effect in reducing the synthesis of DNA, RNA and protein in many and Kirkaby (1979) attributed the undesirable effect of high salinity levels on plant growth to disturbance in mineral balance or utilization.

The depressive effect of high salinity levels on the above mentioned plant traits are in parallel with those of Allen *et al.* (1994) on *Taxodium disticum*, Arshi *et al.* (2002) on *Cassia angustifolia* and Abd El-Saied (2007) on *Conocarpus erectus* concerning plant height, Mohamed (2002) on *Leucaena lecocephala*, *Melia azedrach* and *Dalbergia ssiso* regarding the number of leaves/plant and Marler and Mickelbert (1993) on *Spondias purpurea* and Shehata *et al.* (1994) on *Taxodium disticum*, concerning leaf area.

Table (1): Effect of different saline water irrigation on plant height, number of leaves/plant and number of leaflets/leaf of *Ceiba pentandra* during 2006/07 and 2007/08 seasons.

Treatments	Plant height (cm.)		Number of leaves/plant		Number of leaflets /Leaf	
	2006/07	2007/08	2006/07	2007/08	2006/07	2007/08
Control.	67.67	65.83	17.50	17.67	6.33	6.00
1500 ppm	65.17	69.50	16.33	20.17	6.67	6.33
3000 ppm	72.33	75.17	17.50	19.67	6.33	7.00
4500 ppm	53.83	55.83	15.00	15.67	6.67	6.33
6000 ppm	58.17	56.67	15.33	15.83	6.33	7.00
L.S.D. at 5%	7.91	7.12	N.S.	1.52	N.S.	N.S.

Table (2): Effect of different saline water irrigation on leaflet area, compound leaf area and leaves weight (g.) of *Ceiba pentandra* during 2006/07 and 2007/08 seasons.

Treatments	Leaflets area (cm^2)		Compound leaf area (cm^2)		Leaves weight (g.)			
					F. W.		D. W.	
	2006/07	2007/08	2006/07	2007/08	2006/07	2007/08	2006/0	2007/08
Control	13.78	14.53	81.94	79.06	15.43	20.06	3.41	4.17
1500 ppm	13.45	15.82	95.91	105.46	20.86	28.64	4.63	6.12
3000 ppm	13.73	16.97	94.01	92.47	23.13	29.86	5.18	7.24
4500 ppm	11.93	11.48	84.63	82.32	16.48	17.11	3.45	5.19
6000 ppm	10.83	12.48	73.91	76.70	15.56	20.47	3.16	4.19
L.S.D. at 5%	0.99	3.34	7.02	N.S.	4.69	3.65	0.95	1.86

plants which might lead to a disturbance in metabolism, cell division and elongation. In this respect, Mass and Niman (1978) stated that salinity retarded all plant growth processes such as cell enlargement and cell division. This might be done through their effect on RNA and DNA synthesis in the shoot of rice plant (Mittle and Dubey 1991). Moreover, Holloway and Alston (1992) and Mansour (1994) working on wheat, mentioned that increasing salinity level decreased water permeability and osmotic potential. However, Mass and Niman (1978) and Mengal

3.2. Stem diameter and its fresh and dry weights.

The results of the effect of salinity on stem parameter (Table 3) differed according to the different levels used. Supplying plants at the lowest and moderate levels (1500 and 3000 ppm) led to increase fresh weight of the stem than that gained from the control in both seasons. Meanwhile, stem diameter was significantly increased comparing with that attained from the control or other salinity treatments by receiving plants the moderate level (3000 ppm). Whereas, the contrary action was detected due to using the highest levels (4500 and 6000 ppm). They declined fresh and dry weights of stem in both seasons. In this connection, the beneficial effect of low level of saline water in improving stem diameter was also found by El-Leithy and El-Khateeb (1992) on *Thevetia nereifolia* using low levels (1000 or 2000 ppm) and Asmaael (1997) on *Casuarina equisetifolia* using (5000 ppm).

Pesarding, the depressive effects of salinity on fresh and dry weights might be attributed to the inhibitory effects induced by salinity on many metabolic processes including enzyme activities, protein and nucleic acid synthesis and the activities of the mitochondria and chloroplasts. Mass and Niman (1978), Mengal and Kirkaby (1979), Poustini and Baker (1994), Sharma (1995) and Ashraf and O'leary (1996) pointed out that CO_2 uptake was decreased by increasing salinity level. They also mentioned that the decrease in CO_2 uptake was paralled by a reduction in transpiration and stomatal conductance. They suggested that the change in stomatal resistance under saline conditions may be responsible for reducing photosynthesis and water use efficiency.

Furthermore, Walker and Dumbroff (1981), Prakash and Prathapseman (1988), Amzallage *et al.* (1992) and Feng and Barker (1992) mentioned that salinity-induced growth inhibition may result from imbalances in photohormone levels and through its effect on either the biosynthesis or destruction of the plant hormones. They also indicated that auxin and gibberellin contents decreased with increasing salinity of peach plants, while abscisic acid content increased with increasing salinity.

In this respect, Dunlap and Binzel (1996) suggested that the reduced level of IAA in the roots by increasing NaCl concentration may reflect the physiological response of tomato plant to salt stress. Moreover, the same authors mentioned that it is possible that IAA may be critical to water movement through the root system, and that the function of this hormone is impaired in the salt-stressed plants. The alteration of IAA metabolism in the roots may account for the reduction in growth potential via decreasing availability of water and increasing tissue water deficits.

3.3. Root parameter

Beneficial effects were scored on roots length due to using salinity levels in both seasons, with the mastery of (3000 ppm) saline water followed by (1500 ppm) in elevating the values than the control means and other treatments (Tabel,4). Also, the same trend was observed on fresh and dry weight of roots as affected by the lowest levels of saline water. Receiving saline water at (3000 ppm) showed its superiority in increasing the values followed by (1500 ppm). Meanwhile,

Table (3): Effect of different saline water irrigation on stem diameter (cm.) and weights (g.) of *Ceiba pentandra*, during the two seasons (2006/07 and 2007/08).

Treatments	Stem diameter (cm.)		Stem weight (g.)			
			F. W.		D. W.	
	2006/07	2007/08	2006/07	2007/08	2006/07	2007/08
Control.	0.77	0.67	13.21	17.50	3.65	5.04
1500 ppm	0.70	0.77	18.62	23.82	3.93	5.49
3000 ppm	0.73	0.97	18.41	27.39	4.54	6.09
4500 ppm	0.67	0.77	11.19	14.98	2.63	4.42
6000 ppm	0.63	0.73	14.48	12.94	3.07	3.55
L.S.D. at 5%	**N.S.**	**0.18**	**5.47**	**3.32**	**0.98**	**N. S.**

Table (4): Effect of different saline water irrigation on root length (cm.) and weight (g.) of *Ceiba pentandra*, during (2006/07 and 2007/08) seasons.

Treatments	Root length (cm.)		Root weight (g.)			
			F. W.		D. W.	
	2006/07	2007/08	2006/07	2007/08	2006/07	2007/08
Control.	15.50	25.50	11.05	13.48	2.81	3.06
1500 ppm	30.00	43.50	17.55	15.75	3.46	2.72
3000 ppm	59.38	47.50	21.64	29.32	7.17	9.76
4500 ppm	26.63	40.50	11.65	13.90	2.35	3.60
6000 ppm	25.17	28.38	11.01	12.66	2.21	2.43
L.S.D. at 5%	15.92	N. S.	2.61	4.11	0.68	1.25

raising salinity levels to (4500 and 6000 ppm) revealed insignificant effect on both parameters in the two seasons. Similar findings were also registered by Ng (1987) on *Casuarina equistifolia*

3.4. Chemical constituents

3.4.1. Pigment content (Chlorophyll (a), (b) and Carotenoids)

According to the data averaged in Table (5), it is evident that all salinity treatments caused a decrement on chlorophyll (a) and (b) and carotenoids, compared with the control means with clear effect when high levels were used. However, the aforementioned findings are in harmony with El-Shewekh (1995) on *Sambucus nigra* and Abd El-Saied (2007) on *Conocarpus erectus* concerning chlorophyll (a) and Shehata (1992) on *Cupressus sempervirens* and *Eucalyptus camaldulensis* and Ismail (1993) on *Nerium oleander*, *Adhatoda vasica* and *Lantana camara* regarding chlorophyll (b) and Farahat (1990) on *Schinus terebenthifolius* and *Myoporum acuminatum* and Abd El-Saied (2007) on *Conocarpus erectus* concerning carotenoid content.

Table (5): Effect of different saline water irrigation on chlorophyll (a), chlorophyll (b) and carotenoids (mg/g. F.W.) of *Ceiba pentandra*, in leaves during 2007/08 season.

Treatments	Chlorophyll a	Chlorophyll b	Carotenoids
Control.	0.863	0.845	1.04
1500 ppm.	0.810	0.637	0.718
3000 ppm.	0.808	0.511	0.644
4500 ppm.	0.671	0.525	0.475
6000 ppm.	0.744	0.535	0.442

3.4.2. Indoles, phenols and phenols/indoles ratio

As shown from the data given in Table (6), all salinity treatments caused a slight increment on indole content in leaves, with the highest records resulted from the lowest levels (1500 and 3000 ppm). Meanwhile, phenols as well as phenols/indoles ratio were augumentatively increased by increasing salinity levels in both seasons, to reach the maximum value by the highest one (6000 ppm).

From the above mentioned results, it can be suggested that several detrimental effects attributed to salinity stress on most of the studied growth characters might be partially due to the increase in the total soluble phenols concentration. Phenols may have indirect effect on physiological processes, through more non-specific effects on intermediary metabolism. For example, many phenolic compounds are capable of inhibiting ATP synthesis in mitochondria (Stenlid, 1970), affected the polar transport of auxins (Stenlid, 1976 and Popovici and Rezink, 1976), inhibiting enzyme activity (Van Summere *et al.*, 1975 and Stenlid, 1976) and inhibiting ion absorption through alterations in the permeability of the membrane resulting in decrease absorption of ions, or even loss of previously absorption of ions or other metabolites (Glass, 1974; Hanafy 1991 a, b and **Hanafy *et al.*, 2002).**

Table (6): Effect of different saline water irrigation on indoles, phenols and phenols/indoles ratio (mg./g. F.W.) of *Ceiba pentandra* during 2007/08 season.

Treatments	Indoles	Phenols	Phenols/ Indoles ratios
Control	0.257	0.323	1.261
1500 ppm.	0.378	0.418	1.262
3000 ppm.	0.387	0.513	1.461
4500 ppm.	0.352	0.623	2.006
6000 ppm.	0.320	0.930	3.287

3.4.3. Total carbohydrate contents in leaves and stems

As for total carbohydrates content (Table, 7) in leaves and stems they were gradually increased with increasing salinity level up to 3000 ppm in both leaves and stems, then they decreased, but over than control means in most cases. The highest records in this concern was registered by plants, treated with 3000 ppm of saline water in both seasons. However, the increment on total carbohydrate content in leaves and stems resulting from salinity treatments go in line with that scored by many authors in increasing total sugars content in leaves as a result of using different salinity levels on many plants (El-Bagoury *et al.*,1994, on *Lantana camara,*). In this respect, Strogonov (1970) claimed that accumulation of non-toxic substances such as sucrose, proline and amino acids which have protective properties are considered to be a protective adaptation and the survival of plant under salinity conditions depend

Table (7): Effect of different saline water irrigation on total carbohydrates (%) in leaves and stems and proline content (mg./100 g.) in leaves of *Ceiba pentandra*. during 2007/08 season.

Treatments	Total carbohydrates (%)		Proline (mg./100 g.) leaves
	Leaves	Stems	
Control	17.75	21.81	9.97
1500 ppm	29.31	33.63	19.22
3000 ppm	30.19	34.81	23.09
4500 ppm	24.77	25.15	24.60
6000 ppm	22.00	20.04	35.13

upon the regulation of metabolic processes and the quantitative ratio between the protective and toxic intermediates.

3.4.4.Proline content in leaves

It is clear from the data averaged in Table (7), that proline content in leaves augumentatively increased by raising salinity levels. The highest record was that of plants treated with the highest salinity level 6000 ppm as it reached 35.13 mg./100g. F.W. compared with 9.97 of control mean.

4.REFERENCES

Abd El-Saied Z. (2007). Environment Stress Aspects of *Conocarpus erectus* L in Egypt and Nigeria. M. Sc. Thesis. Institute of African Research and Studies, Cairo Univ., Egypt.

Allen-J. A., Chambers J. L. and Mekinney D. (1994). Interspecific variation in the response of *Taxodium disticum* seedlings to salinity. Forest. Ecol and Manage., 70 (1-3): 203-214.

Amzallage C. N., Lerner H. R. and Poljakoff-Mayber A. (1992). Interaction between mineral nutrient, cytokinin and gibberellins during growth of sorghum at high NaCl salinity. Journal of Experimental Botany, 43: 81-87.

A. O. A. C. (1970). Association of Official Agric. Chem. Official Method of Analysis, p. 832-849 and 873. Washington D. C. USA.

Arshi A., Abdin M. Z. and Iqbal M. (2002). Growth and metabolism of senna as affected by salt stress. Biologic Plant Arum, 45 (1) :295-298.

Ashraf M. and O'leary T. W. (1996). Responses of some newly developed salt-tolerant genotypes of spring wheat to salt stress , Yield components and ion distribution. Journal of Agronomy and Crop Science, 176 (2): 91-101.

Asmaael M. (1997). Effect of Saline Water Irrigation and Gibberellic Acid on Growth and Chemical composition of *Casuarina equisetifolia* L. Seedlings M. Sc. Thesis, Fac. Agric., Cairo Univ., Egypt.

Dunlap J. R. and Binzel M. L. (1996). NaCl reduces indole-3-acetic acid levels in the roots of tomato plants independent of stress induced abscisic acid: Plant Physiol., 112: 379-384.

El-Bagoury H.,El-Tantawy A., Abd El-Daym A. and Ismail M. (1994). Effect of salinity on growth and chemical composition of some ornamental shrubs.The First Conf. of Orn. Hort., 1: 319-338.

El-Khateeb M. A. (1993). Response of *Murraya exotica* seedlings to saline water. Bull. Fac. of Agric., Cairo Univ., 45 (1): 137-149.

El-Leithy A. S. and El-Khateeb M. A. (1992). Response of *Thevetia nereifolia*, L. seedlings to saline water irrigation. Bull. Fac Agric, Cairo Univ., 43 (1): 313-332.

El-Shewekh Y. (1995). The Response of Some Ornamental Shrubs to Irrigation With saline ater.M.Sc.Thesis,Fac.Agric.,Cairo Univ., Egypt.

Fahmy R. (1970). Quantitative Methods for Organic Compainds Determent Mination In Plant Tisues. Dar –El-Taawen Plus. Cairo.

Farahat M. M. (1990). Salinity and Drought Tolerance of *Schinus molle*, *Schinus terebinthifolius* and *Myoporum acum*. Ph. D. Thesis, Fac. Agric. Cairo Univ., Egypt.

Feng J. and Barker A. (1992). Ethylene evolution and ammonium accumulation on tomato plants under water and salinity stress. Journal of Plant Nutrition, 15: 2471-2490.

Glass A. D. M. (1974). Influence of phenolic acid on ion uptake. III. Inhibition of potassium adsorption. J. Exp. Bot., 25: 1104-1113.

Hanafy A. A. H. (1991a). Physiological studies on the nitrogen and phosphorus deficiencies in spinach plants (*Spinacia oleracea*, L.) I. Growth and organic components. Bull. Fac. of Agric. Univ. of Cairo, 42 (1): 87-110.

Hanafy A. A. H. (1991b). Physiological studies on the nitrogen and deficiencies in spinach plants (*Spinacia oleacea*, L.) II Chemical composition, distribution rate of production and specific absorption rate of different components. Bull. Fac. of Agric. Univ. of Cairo 42 (2): 589-610.

Hanafy A. A. H., Hasen H. M., Gad M. M. A. and Amin M. A.(2002). Micropropagation of *Myrtus communes* and increasing its tolerance to salinity stress by polyamines. Recent Technologies in Agriculture proceeding of the 2nd Congress. Fac. Agric, Cairo Univ., 28-30 October 2002, p. 995-1011.

Holloway R. E. and Alston A. M. (1992). The effects of salt and boron on growth of wheat Australian. J. of Agric. Res., 43(5):987-1001.

Ismail (1993). Effect of Salinity on Growth and Chemical Composition of *Adhatoda vasica*, *Nerium oleander* and *Lantana camara*, M. Sc. Thesis, Fac. Agric., Cairo Univ., Egypt.

Larson P., Harbo A., Klungsour S. and Ashein T. A. (1962). On the biogenesis of some indole compounds in *Acerobacter xylium*. Physiol. Plant, 15: 552-565.

Mansour M. M. F. (1994). Changes in growth, osomotic potential and cell permeability of wheat cultivars under salt stress. Biologia Plantarum, 36 (3): 429-434.

Marler T. E. and Mickelbert M. V. (1993). Growth and chlorophyll fluorescence of *Sponias purpurea* L., as influenced by salinity. Trop. Agri., 70 (3): 245-247.

Mass E. V. and Niman R. H. (1978). Physiological of plant tolerance salinity. In Crop Tolerance to Suboptimal Land Conditions. (Jung. G. A., ed) ASA Spec. Pulb., 32: 277-299.

Mengal K. and Kirkaby E. A. (1979). Principles of Plant Nutrition (eds) International Potash Institute, Berne, Switzerland.

Mittle R. and Dubey R. S. (1991). Influence of salinity on ribonuclease activity and status nuclic acids in rice seedling differing in salt tolerance. Plant physiology, 18 (1): 57-64.

Mohamed N. H. (2002). Effect of Irrigation with Different Levels of Sea Water and Fertilization on Growth and Mineral Content of Some Timer Tree Seedlings. M.Sc. Thesis, Fac. Agric., Alex. Univ., Egypt.

Muthuchelian K., Murugan C., Harigovindan R., Nedunchezhian N. and Kulandaivelu G. (1996). Ameliorating effect of triacontanol on salt stressed *Erythrina variegata* seedlings. Changes in growth biomass pigments and soluble accumulation. Biologic-Plantarum, 38 (1): 133-136.

Ng B. H. (1987). The effects of salinity on nitrogen fixation of *Casuarina equisetifolia*. Plant and Soil, 103 (1) 123-125.

Popovici G. and Rezink. H. (1976). The effect of some flavonoids on protoplasmic streaming in oat Z. Pflanzen Physiol, 80: 417-425.

Poustini K. and Baker D. A. (1994). Photosynthetic responses of two wheat cultivars to salinity. Iranian J. of Agric. Sci., 25 (1): 61-69.

Prakash L. and Prathapseman G. (1988). Effect of NaCl salinity and putrescence on shoot growth, Tissue ion concentration and yield of rice (*Oryza sativa* L.). J. Agron. Crop Sci., 160: 325-334.

Rezkalla B. B. (2006). Effect of different salinity treatments, irrigation intervals and their interaction on growth and chemical composition of *Conocarpus erectus* L. Egypt. J. Appl. Sci., 21 (S): 222-256.

Selim H. H. A., Fayek M. A. and Sweidan A. M. (1978). Reproduction of Bricher apple cultivar by Layering. Annals of Agric. Sci, Moshtohor, 9:157-166.

Sharama S. (1995). Studies on growth, water relations and distribution of Na+, K+ and other ions in wheat under short-term exposures to salinity. Indian Journal of Plant physiology, 38 (3): 233-235.

Shehata M. S. (1992). Effect of Soil Type and Water Table Level on Three Species. M. Sc. Thesis, Fac. Agric., Alex. Univ., Egypt.

Shehata M. S., El-Tantawy A. and Mansour H. A . (1994). Effect of saline irrigation water and growing media on growth and some chemical constituents of *Ficus retusa* (*Ficus nitida*) seedlings. J. Agric. Sci. Mansoura Univ., 19 (8): 2617-2635.

Smith F., Gilles M. A., Hamilton J. K. and Godess P. A. (1956). Colorimetric method for determination of sugar and related substances. Anal. Chem., 28: 350-358.

Snedecor G. W. and Cochran W. G. (1980). Statistical Methods, 6th ed., Iowa State Univ. Press, Iowa, USA.

Stenlid G. (1970). Flavonoids as inhibitors of the formation of adenosine triphosphate in plant mitochondria. Photochem., 9: 2251-2256.

Stenlid G. (1976). Effect of flavonoids on the polar transport of auxins. Physiol Plant, 38: 262-266.

Strogonov B. R. (1970). Structure and Function of Plant Cells Under Salinity Conditions.(In Russian) Nauka Publ. House, Moscow.

Van Summere C. F., Albresht J., Dedonder De Pooter H. and Pe J. (1975). Plant proteins and phenolics. In the Chemistry and Biochemistry of Plant proteins (Har bome, JB ed). P. 211-264, London: Academic Press.

Walker M. A. and Dumbroff E. B. (1981). Effect of salt stress on abscisic acid and cytokinin level in tomato. Zeitchwfifut Pflanzen Physiologic, 101: 461-470.