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Effect of Irrigation Water Salinity and Zinc Fertilization on Growth of *Swietenia macrophylla*

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ABSTRACT

This study was conducted to evaluate the effect of zinc application at different levels (10, 20 and 40 mg/kg soil) as $ZnSo_4 .7 H_2O$ on growth and chemical composition of *Swietenia macrophylla* under salinity stress at three concentrations (2000, 4000 and 6000 ppm) NaCl. Tap water was used as control. The results revealed that, salinity at 6000 ppm caused death of seedlings. Salinity levels (2000 and 4000 ppmNaCl alone) significantly decreased survival percentage and growth parameters (stem length, stem diameter, leaf area, leaves number, root length and fresh and dry weight for plant parts. Also, salinity decreased N,P,K, Ca, Mg, Zn, Chlorophyll and total carbohydrates in plant parts. While, salinity increased Na, Cl and proline content when compared to control. Zn application increased survival percentage and growth parameters (stem length, stem diameter, leaf area, leaves number, root length and fresh and dry weight for plant parts under salinity stress when compared to salinity treatments without Zn. Also, Zn application increased NPK, Ca, Mg, Zn, Chlorophyll and total carbohydrates in plant parts. While, Zn decreased Na, Cl and proline content. In this study 20 mg Zn /kg soil recorded the best result with three salt concentrations.

Keywords: salinity stress, Zn, *Swietenia macrophylla,* growth parameters

INTRODUCTION

Soil salinity is a major constraint to the cultivation of horticultural crops. Sustainable management of land and water resources in arid and semi – arid regions is of concern as a result of increasing population pressure and the need for more food and fiber. Soil and water salinity is wide spread across the arid and semi – arid regions of south Asia, central Asia, Arabian peninsula, and North Africa and affected agricultural productivity and livelihood of rural population. While natural process (primary) and anthropogenic activities (secondary) because salinity, the latter contributed more to agricultural productivity losses in these regions. Recent estimates suggest that up to 50% of mitigated land has become saline in these regions (Sakadevan and Nguyen, 2010). A biotic stress tolerance is important for trees that have to withstand unfavorable environmental conditions for longer periods of time than crop plants with short life cycles (excess NaCl) is a common a biotic stress factor that limited trees growth by interfering with major physiological function, disrupting ion homeostasis and diminishing nutrient uptake in plant cell (Chen *et al.,* 2014). *Swietenia macrophylla* King, Fam. Meliaceae. It is tropical tree species native to Central and South America. It is distributed generally corresponds to forests classified as tropical dry with annual temperature average of greater than or equal to 24 ^{0}C and 1000 – 2000 mm annual precipitation (Holdridge, 1967). The species has been extensively planted in southern Asia and Pacific it has also been introduced into west Africa and north Africa especially Egypt. It is one of three species in the genus, it is a long – lived fast growing tree can reach height of up to 40m with a trunk up to 2m in diameter (Pennington, 2002). It is one of the most important timber species in world trade. It is principally used for making furniture and interior things and has been an important component in construction and ship building (Lamb,1966).

Zinc is an essential micronutrient for carbohydrate and protein metabolisms, membrane integrity, auxin synthesis and reproduction (Alloway, 2008). Zn deficiency depresses plant leaf photosynthetic capacity. The reduction in chlorophyll level and the destruction of chloroplast ultra-structure led to decrease in photosynthesis in Zn deficiency plant. In cauliflower, reduction in photosynthesis induced by Zn deficiency intercellular Co_2 concentration and stomata conductance (Sharma *et al*., 1994).The protective role of Zn was ascribed to its role in maintenance of plasma membrane integrity and thus controlling the Na+ and other toxic ions uptake. Zinc ions, are also known to be strong inhibitors of enzymes generating oxygen radicals and protect salt stressed plants from damaging attack of these compounds (Kawano *et al*., 2002; Weisany *et al*., 2012). This work aims to study the effect of water salinity on growth of *Swietenia macrophylla* and study the effect of Zn fertilization on the growth and chemical composition of *Swietenia macrophylla* under saline conditions.

MATERIALS AND METHODS

The presented work was carried out at the experimental area of Timber trees and Forestry Department , Horticulture Research Institute. ARC, Giza, Egypt, during two successive seasons of 2013 and 2014. The experiment conducted investigated growth and chemical constituents of *Swietenia macrophylla***.** Homogenous seedlings of *Swietenia macrophylla* (one year old) were used as a plant material. The seedlings introduced from the nursery of Forestry Department. Horticulture Research Institute. ARC. Seedlings were transplanted in a plastic pot 25 cm diameter filled with 5 Kg silty sand soil every pot contained one transplant**.** The salt used NaCl (sodium chloride) was used in order to prepare the artificial saline water (2000, 4000 and 6000 ppm), which prepared directly before every irrigation. 600 ml of the artificial saline water was added to each pot. All experimental seedling plants were irrigated with the treatments saline solution two times a week and the pots were leached with tap water once each month to avoid salt accumulation in the root zone. The salt purchased from salt of El-Magara, El-Arish. El-Safa Company. Three concentrations of salt (2000, 4000 and 6000 ppm) were used for testing salt stress.

Salt analysis: 0.07% K, 0.18% Mg, 0.52% Ca , 45.2% Na and 36.0% Cl.

Zinc treatments: Zinc sulphate ($Zn\ S0_4.\ 7\ H_2O$) was used zinc fertilizer. Zinc was added to the soil after transplanting at three levels (10, 20 and 40 mg/kg soil. On November 30th after growing seasons the following data were recorded.

Growth parameters: Survival percentage, stem length (cm), stem diameter (cm), leaves number, leaf area (cm^2), root length (cm), fresh and dry weight (gm) for plant parts.

Chemical analysis: Total Nitrogen was determined in the dried stems, leaves and roots colorrimetrically according to the method described by Plummer (1978), phosphorous percentage was determined by using colorimmetrically according to Jackson (1958).Potassium and Sodium percentage were determined by using the Flame photometric method according to piper (1950).

Calcium percentage was determined according to Richards *et al.* (1954). Chloride percentage was determined according to the methods described by Higinbothan *et al.* (1967). Zinc and Magnesium percentage were determined according to Brandifeld and Spincer (1965).The proline concentration was determined in fresh leaves according to Bates *et al.* (1973), and leaves pigments according to Saric *et al.* (1976).

Statistical analyses: The experiment was based on a Randomized Complete Block Design (RCBD) including 13 treatments. Each treatment had three replicates and each replicate had three seedlings. The obtained data on survival percentage, growth parameters (stem length, stem diameter, leaves number, leaf area, root length and fresh and dry weight for leaves, stem and root) were statistically analyzed according to Snedecor and Cochran (1980). Means treatments were compared using the new L.S.D values at 5% level.

RESULTS AND DISCUSSION

Data presented in Table (1) indicated that, salinity concentrations (2000 and 4000 ppm.) significantly decreased survival percentage, while the highest concentration (6000 ppm) caused death of seedlings as compared to control in the two seasons. Also, growth parameters, (stem length, stem diameter, leaves number, leaf area, and root length) significantly decreased in response to salinity concentrations.

Table 1. Effect of salinity and zinc treatments on survival (%), stem length (cm), stem diameter (cm), leaves number, leaf area (cm^2) and root length (cm) of *Swietenia. macrophylla* during two seasons (2013 and 2014).

Treatment		Survival (%)		Stem length (cm)		Stem diameter		Leaves number		Leaf area (cm^2)		Root length (cm)	
		1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2d
Control		100.00	100.00	53.00	56.00	1.30	1.07	20.00	18.33	50.08	49.46	58.67	47.67
2000 Ppm NaCl	To	55.56	66.67	27.00	29.33	0.50	0.53	12.67	13.67	30.57	29.72	20.00	18.67
	T1	100.00	100.00	37.33	35.33	0.70	0.67	16.67	16.00	34.90	37.52	36.67	32.00
	T2	100.00	100.00	32.67	33.33	0.80	0.70	18.00	16.33	37.92	38.04	36.00	33.33
	T3	100.00	100.00	31.33	34.33	0.63	0.77	19.00	17.67	42.93	42.90	32.67	30.33
4000 Ppm NaCl	To	22.22	33.33	21.33	23.00	0.40	0.43	11.33	11.00	25.90	24.61	15.00	14.33
	T1	100.00	100.00	31.00	32.00	0.63	0.53	12.33	14.00	26.67	24.74	35.67	32.67
	T2	100.00	100.00	31.33	31.67	0.70	0.57	17.33	17.00	31.57	29.72	33.00	26.33
	T3	100.00	100.00	34.33	35.67	0.53	0.47	12.67	12.33	34.43	37.88	28.67	26.67
LSD at 0.05		15.84	18.81	5.17	4.46	0.18	0.15	2.86	2.68	6.49	6.27	4.73	4.49

T_0 :salinity only, T_1 :Zn at 10 mg, T_2: Zn at 20 mg and T_3: Zn at 40 mg/kg soil 1 st: first season, 2 nd: second season

Furthermore in Table (2) fresh and dry weight for plant parts (stem, leaves and root) significantly decreased in response to Salt concentrations .These results are in harmony with Chaudhry *et al.*(1993) who reported that, the highest salt concentrations produced dieback in *Acacia nilotica, Albizia lebbeck* and *Leucaena leucocephala*, Habibi and Amiri (2013) who reported that, growth of trifoliate orange was inhibited in the 5th week, then plantlets were died, due to adversely salinity, Ball (1988) *on Aegiceras cornicultum* and *Avicennia marina*, Mohamed (1988) on *Casuarina cunninghamiana*, Rowland *et al.* (2004) on *Poplus deltoids,* Khan *et al.* (2009) on *Acacia nilotica* and Soliman *et al.* (2015) on *Moringa peregrine* ,showed that, salinity levels significantly reduced growth parameters (plant height, root length, number of leaves, number of branches , shoot and root fresh and dry weight) . For Zn with NaCl, Table (1) cleared that, survival percentage significantly increased (100 %) under salinity concentrations (2000 and 4000 ppm) in response to Zn application as compared to (2000 and 4000 ppm) NaCl alone, in the two seasons. Also, Zn application at 10 mg/kg soil with 2000 ppm NaCl soil significantly increased stem length to (37.33 and 35.33 cm) as compared to 2000 ppm NaCl alone (27.00 and 29.33 cm) and Zn at 40 mg/kg soil with 4000 ppm NaCl significantly increased stem length to (34.33 and 35.67 cm.) as compared to 4000 ppm NaCl alone (21.33 and 23.00 cm) in the two seasons, respectively. Zn at 20 mg/kg soil combined with 2000 and 4000 ppm NaCl significantly increased stem diameter to (0.80 and 0.70 cm) and (0.70 and 0.57cm) as compared to 2000 (0.50 and 0.53cm) and 4000 ppm NaCl alone (0.40 and 0.43cm) in the two seasons, respectively. While Zn application increased leaves number to (19.00 and 17.67) and (17.33 and 17.33) as compared to 2000 ppm (12.67 and 13.6) and 4000 ppm NaCl alone (11.33 and 11.00) in the two seasons respectively. Also, Table (2) cleared that, Zn application (20 mg/kg soil) with 2000 and 4000 ppm. NaCl increased leaves fresh weight (25.71 and 28.90 gm) and (18.77 and 17.86 gm) as compared to 2000 (11.37 and 10.73gm) and 4000 ppm NaCl alone (11.31 and 10.66gm). The same trend was found with leaves dry weight, stem fresh and dry weight and root fresh and dry weight. Improve salt tolerance by application Zn was obtained by Hakan *et al.* (2006), Saleh and Maftoun (2008), Jiang *et al.* (2014) and Amir *et al.* (2016), who reported that, Zinc is a critical mineral nutrient that protects plant cells from salt-induced cell damage.

Table 2. Effect of salinity and zinc treatments on stem, leaves and root fresh and dry weight (gm) of *Swietenia macrophylla* during two seasons (2013 and 2014).

Treatment		Fresh weight (gm)						Dry weight (gm)					
		stem		leaves		root		stem		leaves		root	
		1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Control		40.20	39.19	46.50	41.31	32.86	30.48	14.93	15.57	16.20	15.41	16.08	15.75
2000	To	7.30	6.56	11.37	10.73	6.50	9.19	4.60	4.15	4.06	3.37	2.49	4.69
Ppm	T1	15.29	17.00	22.67	22.21	15.10	16.14	7.43	7.85	9.38	8.38	8.62	7.41
NaCl	T2	17.53	18.74	25.71	28.90	19.18	20.81	8.56	8.44	7.93	7.58	6.98	5.83
	T3	16.17	17.03	25.37	27.33	12.98	13.31	5.95	6.88	7.38	7.07	4.05	3.89
4000	To	5.45	5.13	11.31	10.66	4.02	7.96	3.48	3.36	3.20	2.86	2.14	3.83
Ppm	T1	15.74	14.43	20.71	19.70	18.94	22.56	6.22	6.31	5.13	5.02	7.52	7.24
NaCl	T2	15.19	13.25	18.77	17.86	13.21	13.18	5.85	6.77	4.68	5.13	5.89	6.77
	T3	11.34	10.66	16.12	15.21	6.00	5.87	5.48	4.33	3.59	3.85	4.42	3.41
LSD at 0.05		4.01	2.84	5.79	3.24	3.89	2.62	2.09	1.51	1.76	1.68	2.68	1.44

T_0:salinity only, T_1:Zn at 10 mg, T_2: Zn at 20 mg and T_3: Zn at 40 mg/kg soil 1st: first season, 2nd: second season

Chemical constituent:

Data presented in Tables (3) indicated that 2000 and 4000 ppm NaCl alone decreased N and P content in plant parts as compared to control. While, Zn application with two salt concentrations increased N and P % as compared to NaCl alone in leaves, stem and root of *S. macrophylla.* The same effect was found with K, Ca content in Table (4) and Zn in Table (6) in the two seasons. These results are in line with Mohamed *et al*. (2011) on wheat (*Triticuma estivum*L.) Amir and Kafi (2013) on maize Malakouti (2011) on Pistachio, and Soliman *et al* (2015) on *Moringa peregrine* who reported that, salinity decreased N, P, K, Ca and Zn, while micronutrient application induced stimulatory effects on nutrients uptake either before or after the salinization treatments. For Na and Cl content, data presented in Table (5) indicated that, salinity treatments significantly increased Na and Cl % as compared to control, while Zn application at the concentrations of 40 mg/kg soil with two salt concentrations decreased leaves Na % from (1.93 and 2.01%) and (2.22 and 2.37%) for 2000 and 4000 ppm NaCl alone to (1.21 and 1.25%) and (1.27 and 1.40%) in the two seasons, respectively. Also, Zn application (40 mg/kg soil) significantly decreased leaves Cl % from (2.19 and 2.11%) and (2.39 and 2.25%) for 2000 and 4000 ppm NaCl alone to (1.17 and 1.09%) and (1.32 and 1.22%) in the two seasons, respectively. These results are in agreement with Saleh and Maftoun (2008), Weisany *et al.* (2014), Soliman *et al.* (2015) and Amir *et al.* (2016), who reported that, salinity increased Na and Cl content, while Zn application decreased Na and Cl accumulation under salinity stress.

Table 3. Effect of salinity and zinc treatments on leaves, stem and root Nitrogen and phosphorous (%) in *Swietenia macrophylla* during two seasons (2013 and 2014).

Treatment		Nitrogen (%)						phosphorous (%)					
		leaves		stem		root		leaves		stem		Root	
		1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Control		2.39	2.11	1.54	1.69	1.13	1.06	0.71	0.77	0.66	0.56	0.29	0.30
2000	To	1.79	1.83	1.01	1.16	0.87	0.81	0.38	0.32	0. 36	0.31	0.15	0.16
Ppm	T1	2.12	2.07	1.66	1.59	1.00	0.92	0.58	0.57	0.38	0.34	0.19	0.20
NaCl	T2	2.16	2.09	1.79	1.71	0.97	0.95	0.48	0.47	0.36	0.33	0.19	0.19
	T3	2.20	2.13	1.76	1.79	0.89	0.83	0.44	0.42	0.36	0.32	0.16	0.18
6000	To	1.00	1.16	0.89	0.91	0.79	0.72	0.31	0.32	0. 24	0.23	0.13	0.13
Ppm	T1	1.89	1.92	1.56	1.52	0.82	0.87	0.36	0.36	0.26	0.25	0.15	0.17
NaCl	T2	2.06	2.21	1.54	1.50	0.88	0.84	0.36	0.35	0.25	0.24	0.14	0.16
	T3	2.03	2.20	1.49	1.44	0.89	0.83	0.33	0.35	0.25	0.23	0.14	0.15
LSD at 0.05		0.78	0.71	0.51	0.47	0.19	0.17	0.23	0.25	0.24	0.19	0.11	0.08

T_0:salinity only, T_1:Zn at 10 mg, T_2: Zn at 20 mg and T_3: Zn at 40 mg/kg soil 1st: first season, 2nd: second season

Table 4. Effect of salinity and zinc treatments on leaves stem and root Potassium and Sodium (%) in *Swietenia macrophylla* during two seasons (2013 and 2014).

Treatment		Potassium (%)						Calcium (%)					
		leaves		stem		root		leaves		stem		root	
		1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Control		0.89	0.85	0.75	0.71	0.55	0.57	2.68	2.56	2.83	2.71	1.58	1.65
2000 Ppm NaCl	To	0.60	0.63	0.49	0.57	0.40	0.39	2.29	2.14	2.23	2.17	1.18	1.26
	T1	0.72	0.69	0.63	0.62	0.46	0.42	2.52	2.40	2.43	2.37	1.32	1.43
	T2	0.79	0.69	0.63	0.63	0.48	0.47	2.57	2.44	2.44	2.41	1.39	1.44
	T3	0.80	0. 71	0.65	0.69	0.49	0.52	2.65	2.51	2.47	2.41	1.45	1.45
4000 Ppm NaCl	To	0.41	0.46	0.35	0.40	0.27	0.23	2.14	2.01	2.17	2.06	1.14	1.22
	T1	0.61	0.63	0.51	0.55	0.36	0.34	2.23	2.18	2.27	2.21	1.28	1.29
	T2	0.62	0.65	0.53	0.56	0.43	0.40	2.25	2.22	2.36	2.29	1.32	1.33
	T3	0.63	0.63	0.55	0.59	0.43	0.42	2.26	2.23	2.49	2.41	1.34	1.40
LSD at 0.05		0.19	0.17	0.14	0.11	0.13	0.16	0.35	0.31	0.41	0.37	0.25	0.21

T_0:salinity only, T_1:Zn at 10 mg, T_2: Zn at 20 mg and T_3: Zn at 40 mg/kg soil 1st: first season, 2nd: second season

Table 5. Effect of salinity and zinc on leaves stem and root Sodium and Chloride (%) in *Swietenia macrophylla* during two seasons (2013 and 2014).

Treatment		Sodium (%)						Chloride (%)					
		leaves		stem		root		leaves		stem		root	
		1st	2^{nd}	1st	2nd	1st	2^{nd}	1st	2nd	1st	2nd	1st	2nd
Control		0.71	0.76	0.66	0.63	0.52	0.53	0.59	0.57	0.53	0.57	0.29	0.34
2000 Ppm NaCl	To	1.93	2.01	1.11	1.21	1.18	1.11	2.19	2.11	1.02	1.22	0.64	0.73
	T1	1.29	1.34	0.87	0.88	0.78	0.73	1.76	1.71	0.73	0.78	0.49	0.57
	T2	1.29	1.32	0.83	0.85	0.58	0.55	1.17	1.12	0.56	0.66	0.38	0.40
	T3	1.21	1.25	0.81	0.84	0.56	0.51	1.17	1.09	0.55	0.60	0.39	0.40
4000 Ppm NaCl	To	2.22	2.37	1.37	1.49	1.20	1.29	2.39	2.25	1.24	1,52	0.73	0.75
	T1	1.54	1.62	0.92	0.97	0.89	0.84	1.90	1.85	0.69	0.87	0.58	0.57
	T2	1.35	1.43	0.91	0.95	0.87	0.81	1.36	1.27	0.68	0.71	0.45	0.48
	T3	1.27	1.40	0.87	0.89	0.86	0.79	1.32	1.22	0.68	0.72	0.44	0.47
LSD at 0.05		0.29	0.23	0.24	0.26	0.38	0.44	1.02	0.95	0.47	0.0.54	0.54	0.23

T_0:salinity only, T_1:Zn at 10 mg, T_2: Zn at 20 mg and T_3: Zn at 40 mg/kg soil 1^{st}: first season, 2^{nd}: second season

Table 6. Effect of salinity and Zinc treatments on leaves stem and root Zinc(%), chlorophyll A, chlorophyll B and proline (%) in *Swietenia macrophylla* during two seasons (2013 and 2014).

Treatment		Zinc (%)						Chlorophyll A (mg/g)		Chlorophyll B (mg/g)		Proline (%)	
		leaves		stem		root							
		1st	2^{nd}	1st	2nd	1st	2^{nd}	1st	2nd	1^{st}	2nd	1st	2nd
Control		0.10	0.11	0.11	0.13	0.09	0.10	0.652	0.694	0.427	0.399	0.13	0.11
2000 Ppm NaCl	To	0.08	0.09	0.08	0.08	0.05	0.06	0.553	0.564	0.354	0.294	0.39	0.40
	T1	0.15	0.17	0.19	0.19	0.14	0.15	0.631	0.672	0.393	0.336	0.29	0.28
	T2	0.20	0.20	0.21	0.22	0.15	0.16	0.644	0.683	0.400	0.344	0.25	0.26
	T3	0.21	0.21	0.23	0.24	0.18	0.18	0.646	0.684	0.400	0.362	0.21	0.19
4000 Ppm NaCl	To	0.07	0.07	0.07	0.07	0.03	0.03	0.500	0.477	0.30	0.200	0.50	0.50
	T1	0.14	0.16	0.12	0.13	0.12	0.13	0.581	0.593	0.354	0.273	0.45	0.44
	T2	0.17	0.18	0.16	0.16	0.13	0.15	0.584	0.582	0.357	0.294	0.44	0.43
	T3	0.18	0.20	0.17	0.17	0.14	0.15	0.588	0.573	0.381	0.363	0.44	0.43
LSD at 0.05		0.09	0.07	0.13	0.08	0.09	0.06	0.081	0.057	0.071	0.092	0.21	0.23

T_0:salinity only, T_1:Zn at 10 mg, T_2: Zn at 20 mg and T_3: Zn at 40 mg/kg soil 1^{st}: first season, 2^{nd}: second season

Salinity treatments at 2000 and 4000 ppm significantly decreased chlorophyll content (Table (6), while proline content was significantly increased under salinity stress as compared to control. Zn application

with 2000 and 4000 ppm significantly increased chlorophyll (a and b) and significantly decreased proline content as compared to NaCl alone.

While Zn application with two salt concentrations decreased proline% from (0.39 and 0.40%) and (o.50 and 0.50 %) for 2000 and 4000 ppm. NaCl alone to (0.21and 0.19%) and (0.44 and 0.43%), in the two seasons, respectively. These results are in agreement with Saleh and Maftoun (2008) on *Oryza sativa* Shahriaripour *et al.* (2010), on *Pistacia vera*, Vahid (2016) on *Pistacia vera* who maintained that, addition of Zn to the soil due to significantly decreased the proline, while Zn application increased chlorophyll A and chlorophyll B in the plant under salinity stress .

CONCLUSION

In this study, we showed that, can be alleviated in *Swietenia macrophylla* plant by using Zn fertilization (Zn $So_4.H_2O$) under salinity stress. Growth parameters and chemical composition of *S. macrophylla* can be improved by using Zn at (20 mg/kg soil).

REFERENCES

Alloway, B. J. (2008). Zinc in soils and crop nutrition. Second edition IZA and IFA Brussels Belgium and Paris. P 130.

Amir, H. S. and M. Kafi (2013). Alleviative effects of zinc on Physiological properties and antioxidants activity of maize plant under salinity stress. International Journal of Agriculture and Crop Science. 5-5: 529 - 537.

Amir, H. S.; M. Kafi and M. Passarakli (2016). Interactive effects of Salinity stress and Zn availability on physiological properties, antioxidant activity and micronutrients content of Wheat (*Triticum aestivum*) plants. Soil science and Plant analysis vol. 47.

Amiri, A.; B. B. aninasap ; C. Ghobadi and A. H. Khoshgoftarmanesh (2016). Zinc soil application enhance photosynthetic capacity and antioxidant enzyme activities in almond seedlings affected by salinity stress. Photosynthetica. vol. 54: 267 – 274.

Ball, M. C. (1988): Salinity tolerance in the *Avicennia marina* L , water use in relation growth. Carbon partitioning, and salt balance. Forest. Abst. 50 (3), 1282.

Bates, L. S.; R. P. Waldern and L. D. Teare (1973). Rabid Determination of free proline for water stress studies. Plant and soil, 39: 205 - 207.

Brandifeld, E.G. and D. Spincer (1965). Determination of Magnesium,Calcium, Zinc, Iron and Copper by Atomic desorption Spectrosc. Food. Agric. Sci, 16: 33 - 38.

Chaudhry, M. A.; H. Altaf and A. Hussain (1993). Sodium chloride Stress studied on growth of some leguminous forest tree seedlings. Pakistan Jour. Forest., 43 (1):21-27.

Chen, S. : P. Hawighorst; J. Sun and A. Polle (2014). Significance of stress signaling networks, mycorrhization and soil amendments for cellular and whole plant nutrition. Environmental and Experimental Botany, 107, 113 – 124.

Habibi, F. and M. E. Amiri (2013). Influence of in vitro salinity on growth, mineral uptake and physiological responses of two citrus rootstocks. International Journal of Agronomy and Plant Production; 4 (6):1320-1326.

Hakan A.; A. Aktas; O. Levent and C. Ismail (2006). The effect of growth and shoot concentrations of sodium and potassium in pepper plants under salinity stress. Turk J Agric. For 30 : 407-412.

Hendawy, S. F. and Kh. A., Khalid (2005). Response of Sage (*Salvia officinalis*) plants to zinc Application under different salinity levels. Journal of Applied Science Research 1 (2): 147 – 155.

Higinbothan, N.; B Etherto and R. J. Faster (1967). Mineral ion content and cell transmembrane electropotential of Pea and Oat seedling tissue. Physiol. 42: 37- 46.

Holdridge, L. R. (1967): Life Zone Ecology. Tropical Science Center, San Jose, Costarica, Book, P 200 -206.

Jackson, N. L. (1958). Soil Chemical Analysis Constable. Ltd. Co., London PP. 498.

Jiang W. X. ; H. Sun; H. L. Xu1; N. Mantri and H. F. Lu (2014).Optimal concentration of zinc sulfate in foliar spray to alleviate salinity stress in *Glycine soja*. Agr. Sci. Tech. Vol. 16: *00,* 445 -460.

Kawano, T. ; N., Kawano ; S., Muto and F., Lapeyrie (2002).

Retardation and inhibition of the cation induced superoxide generation in BY-2 tobacco cell suspension culture by Zn^{+2} and Mn^{+2} physiol Plant 114: 395-404.

Khan, G. S.; Z. H. Khan; J. mran; M. U. Quraishi; S . Yaqoob and S. H. Khan (2009). Effect of salinity on germination and growth of some forest tree species at seedling stage. A GRIS 47 (3) 271 – 279.

Lamb, F.B. (1966). Mahogany in Tropical America: its ecology and management. University of Michigan Press, Michigan. 220 pp.

Malakouti, M. J. (2011). Increasing the yield and quality of pistachio Nuts by applying balanced amounts of fertilizers. Acta Horticulturae (ISHS) 726: 293-300.

Mohamed, M. E. ; Z. M. Mobarak and Z. A. Salama (2011). Micronutrients (Fe, Mn, Zn) foliar spray for increasing salinity tolerance in wheat *Triticum aestivum* L. African Journal of plant Science vol. 5(5) pp. 314 – 322.

Mohamed, S. Y. (1988). Study on the physiological drought resistance In Casuarina plants Ph.D. Thesis, Fac. Agric., Zagazig Univ., Egypt.

Pennington, T. D. (2002). Mahogany carving a future. Biologist 49: 204 –208.

Piper, C. S. (1950). Soil and Analysis Inter. SC. Palp, New York, PP.368.

Plummer, D. T. (1978). An Introduction to Practical biochemistry English Book. Published by London New York Mc. Graw Hill. P 362 .

Richards, L. A.; L. E. Ahison; L. Beun and C. A. Bower (1954). Diagnosis and Improvement of Saline and Alkali Soils. Agriculture Hand book N0. 60.

Rowland, D. L.; A. A. Sher and D. L. Marshall (2004). Inter and intra- population variation in seedling performance of Rio Grandecotton wood under low and high salinity. Canadian Journal of Forest Research. 34 (7) : 1458 – 1466.

Saleh , J. and M. Maftoun (2008). Interactive effects of NaCl levels and Zinc source and levels on the growth and mineral composition of Rice. Agric. Sci. Tecnol. 10: 325-336.

Sakadevan, K. and M. Nguyen (2010). Extent, impact, and response to Soil and Water Salinity in Arid and Semi Arid Regions. Book of Academic press, Chapter two, 109, 55-74.

Saric, M.; R. Kastrori; R. Curic; I. Supina and I. Geric (1976).Chlorophyll Determination. Univ. U. Novensadu Prakti Kum.12 Fiziologize Biljaka Beograd Hucna Anjlge, 215 pp.

Shahriaripour, R. ; A. TajabdiPour ; V. Mozafari ; H. Dashti and E. Adhami (2010). Effect of salinity soil and zinc application on growth and chemical composition of pistachio seedlings. Journal of Plant Nutrition, 33, 8: 1166 - 1179.

Sharma , P. N. ; N. Kumar and S. S. Bisht (1994). Effect of Zinc deficiency on Chlorophyll content, photosynthesis and water relations of cauliflower plants . photosynthetica 30, 353 - 359

Snedecor, G. W. and W. G. Cochran (1980). Statistical Methods. 7^{th} ed ., The lowa State Univ. Press. Ames., lowa., U. S. A., PP. 593.

Soliman, A. S.; S. A. El- Feky and E. Darwish (2015). Alleviation of Salts tress on *Moringa peregrine* using foliar application of Nano fertilizers. Journal of Horticulture forestry, 7 (2): 36 – 47.

Vahid , T. (2016). The effectiveness of Zinc in alleviating salinity stress on Pistachio seedlings. Fruits, (71) 433-445.

Weisany, W. ; Y., Sohrabi ; G., Heidari; A., Siosemardeh, and K. Ghassemi (2012). Changes in antioxidant enzymes activity and plant performance by salinity stress and Zinc application in Soybean (*Glysine max* L.), plant Omi CS J,. 5: 60-67.

Weisany, W.; Y. Sohrabi and H. Badakhan (2014). Effects of Zinc application on growth, absorption and distribution of mineral nutrients under salinity stress Soybean (*Glycine* Max L.). Plant nutrition vol. 37 (14) p. 2255-2269.

تأثير ملوحة ماء الري والتسميد بالزنك على نمو شتلات الماهوجنى عريض الأوراق (*Swietenia macrophylla*)

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أجريت هذه التجربة لدراسة تأثير إضافة الزنك بمستويات مختلفة من كبريتات الزنك (١٠ و٢٠ و٤٠ ملجم/كجم تربة) على النمو و التركيب الكيميائي لأشجار الماهوجنى عريض الأوراق تحت مستويات مختلفة من الملوحة وهى (٢٠٠٠و ٤٠٠٠ و ٦٠٠٠ جزء فى المليون) كلوريد صوديوم . أظهرت النتائج ان التركيز الملحي ٦٠٠٠ جزء فى المليون أدى إلى موت الشتلات , بينما التركيزات الملحية الأخرى (٢٠٠٠ و ٤٠٠٠ جزء فى المليون) دون إضافة الزنك أدت الى نقص معنوي فى نسبة البقاء وكذلك قياسات النمو (طول وقطر الساق-مساحة الورقة-عدد الأوراق-طول الجذر-الوزن الطازج والجاف لأجزاء النبات). أيضا أدت الملوحة إلى نقص محتوى كل من النتروجين – الفوسفور- البوتاسيوم – الكالسيوم - الماغنسيوم - الزنك - الكلوروفيل و الكربوهيدرات الكلية في أجزاء النبات. بينما أدت الملوحة الى زيادة محتوى كل من الصوديوم- الكلوريد –البرولين مقارنة بالكنترول. أدت إضافة الزنك الى زيادة كل من نسبة البقاء- طول وقطر الساق-مساحة الورقة-عدد الأوراق-طول الجذر-الوزن الطازج والجاف لأجزاء النبات تحت الظروف الملحية مقارنة بالمعاملات الملحية فقط. كذلك أدت إضافة الزنك إلى زيادة محتوى كل من النتروجين –الفوسفور- البوتاسيوم – الكالسيوم – الماغنسيوم – الزنك - الكلوروفيل و الكربوهيدرات الكلية في أجزاء النبات المختلفة.بينما أدت إضافة الزنك إلى نقص محتوى الصوديوم و الكلوريد و البرولين في أجزاء النبات المختلفة. أعطى التركيز ٢٠ ملجم /كجم تربة من كبريتات الزنك أفضل النتائج تحت التركيزات الثلاث من الملوحة .