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EFFECT OF IRRIGATION WITH SALINE WATER AND SOME NATURAL ACTIVATORS ON GROWTH AND QUALITY OF *THUJA ORIENTALIS* PLANTS

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ABSTRACT: Two independent pot experiments were conducted under the open field at the nursery of Hort. Res. Inst., ARC., Giza, Egypt during 2016 and 2017 seasons to study the effects of irrigating with saline water prepared from NaCl and $CaCl_2$ pure salts (1:1, by weight) at the rates of 0, 1000, 3000 and 5000 ppm and spraying with some natural extracts i.e. Oligo-X (an algae extract containing immunity and internal resistant stimulants, as well as N, P, K, Fe, Zn, Mn and some growth regulators) at the concentrations of 0, 0.5 and 1.0 ml/l and green tea extract at the rates of 0, 0.5 and 1.0 ml/l, and their interaction on growth, quality and chemical composition of 6-months-old *Thuja orientalis* (*Platycladus orientalis*) transplants cultivated in 25-cm-diameter plastic pots filled with about 3.0 kg of pure sand and loam (1:1, v:v) when applied six times with one month interval during the growing seasons.

The results in both seasons showed that all vegetative and root growth measurements were significantly improved by increasing the natural extract rate regardless of saline water concentration, but they were significantly decreased in response to all saline water treatments. A similar trend was also gained with regard to pigments contents (mg/l00 g f.w.), the percentage of total carbohydrates (%), but the percentage of proline content (mg/g d.w.) was reduced with raising natural extracts, as was gradually increased with increasing salinity water.

According to these results, it could be concluded that 6-months-old transplants of *Thuja orientalis* could be irrigated with saline water up to 5000 ppm, especially if it was sprayed with algae extract at 1.0 ml/l which greatly improved growth and chemical constituents under salinity stress.

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INTRODUCTION

Thuja orientalis (oriental arborvitae), is a tree or a shrub woody plant grown for their handsome evergreen foliage and formal habit, belongs to Fam. Pinaceae. Of easy cultivation in any soil, thriving best in full sun and propagated mainly by seeds in spring.

Several forms of *T. orientalis* are hardy as far North as Massachusetts and its favorites for formal gardens since they are all of regular symmetrical habits and are well adapted for hedges and windbreaks (Bailey, 1976).

Salinity, however may cause some harms for plants. In this connection, Mansour and Hussein (2002) found that increasing salinity of irrigation water up to 6000 ppm reduced the growth, as well as the chlorophylls, carotenoids and total carbohydrates contents of Tifway plants grown in sand, clay or sand + clay (1:1, v/v). Lawn coverage, plant height and clippings fresh and dry weights were significantly reduced, especially for plants grown in sand, while those grown in clay had higher Na, Ca and Cl contents. Peacock *et al.* (2004) mentioned that diluted sea water at the rates between 7000 and 27000 ppm resulted a great reduction in shoot weight of Tifway which reached 43%, while root and crown weights were unaffected.

Similarly, were those results attained by Lee *et al.* (2004) on 4 Bermudagrass (*Cynodon dactylon* × *C. transvaalensis*) cultivars (Tifgreen, Tifway, Tifsport and TifEagle), Adavi *et al.*, (2006) on Tifway and Pessarakli and Touchane (2006) who indicated that root and shoot lengths of Tifway-419 and seashore Paspalum were stimulated at the low levels of NaCl (5000 and 10000 ppm), but substantially decreased at the high levels (20000 and 30000 ppm). As the exposure time to salt stress progressed, shoot and root fresh and dry weights were more severely affected. Tifway-419 was more affected than Paspalum under any level of NaCl applications. Uptake of Na and Cl was increased, whereas K uptake was decreased.

Sadder (2013) mentioned that *Atriplex halimus* is a xero-*halophte* shrub adapted to extreme drought and salinity stresses. These characteristics are controlled by special genes which their expression was much higher at 150 mM than at 300 mM NaCl stress level, indicating their specificity for low level salt stress. Photosynthetic activity was slightly decreased with both extended stress exposure and increased salt concentration, while total chlorophyll and proline were increased under saline stress. Similar observations were also recorded on other trees and shrubs, such as those of Al-Qubaie *et al*. (2003) on *Ficus benghalensis, Tamarix articulata, Jasminum azoricum, Concarpus erectus* and *Ziziphus spina-christi*,

Fertilization is still the most important agricultural process necessary for improving growth and quality of plants, especially natural activators such as Oligo-X, as natural preparations containing one or more of beneficial microorganisms that can release nutrients from rocks and organic matter in the soil to become available for plants, has become one of the most important requirements to protect environments from pollution, besides getting a safe and clean product. Some of the microorganisms can fix atmospheric nitrogen in a free living state, e.g. *Azotobacter* and *Azospirillum* (Darwish, 2002). Several reports stated that the natural biological balance which is disturbed by the misuse of chemical fertilizers, besides improving growth and keeping quality of the plants. In this regard, Poincelot (1993) indicated that algae extracts contain high amounts of N, P, K, Fe, Zn, Mn and Oligo-saccharides, which are basically necessary for growth. Canaway (1992) found that Alginure (a seaweed extract) improved covering rate and playing of *Lolium perenne* cv. Loretta turf when was applied at 50, 75, 100, 150 and 175 g/m^2 to the sand rootzone. The resilience and hardness of the plants were increased linearly with increasing Alginure rate. Poincelot (1991) postulated that cuttings of *Senecio deffersii* treated with ROOTS (a commercial preparation which contains kelp extracts and humic acid) at 1% as a 15-s dip showed greater rooting and produced roots 3-6 times longer than control. Similar observations were also pointed out by Poincelot (1993) on Begonia, Dahlia and Petunia, Staden *et al.* (1994) on *Tagetes patula* and Bettoni *et al.* (2009) on *Kalanchoe blossfeldiana*.

Tea is the second most consumed beverage after water and has been enjoyed around the world for centuries. Very few substances are thought to be as widely

beneficial to a person's health with few side effects as green tea. Houston and Kimball (2013) showed that green tea is the unfermented form of tea (*Camellia sinensis*) and commonly used as botanical cosmeceuticals due to the antioxidant and anti-inflammatory properties found in refined tea leaves due to the presence of some compounds (phospholipids, essential fatty oils, isoflavones, proteases, phytosterols and vitamins).

Although there are scanty studies regarding the using of green tea extract in agriculture, the comprising chemical components gave it the qualifications to be used with plants. In this regard the chemical composition of tea leaves has been well documented. The main constituents of tea leaves are polyphenols (Balentine *et al.*, 1997). The fresh tea leaves contain caffeine (approximately 3.5% of the total dry weight), theobromine (0.15 – 0.2%), theophylline (0.02–0.04%) and other methylxanthines, lignin (6.5%), organic acids (1.5%), chlorophyll (0.5%) and other pigments, theanine (4%) and free amino acids (1–5.5%), as well as numerous flavour compounds (Graham, 1992). In addition, a wide variety of other components exists, including, flavones, phenolic acids and depsides, carbohydrates, alkaloids, minerals, vitamins and enzymes (Chaturvedula and Prakash, 2011).

However, the current work aims to detect the beneficial effect of spraying with natural activators (Oligo-X and green tea extracts) to decrease the deleterious effect of irrigated with saline water on growth performance and chemical composition of Thuja plants.

MATERIALS AND METHODS

A study was consummated under open field at the nursery of Hort. Res. Inst., Giza, Egypt during 2016 and 2017 to study the effects of irrigating with saline water and spraying with some natural extracts i.e. Oligo-X at the concentrations of 0, 0.5 and 1.0 ml/l and green tea extract at the rates of 0, 0.5 and 1.0 ml/l, and their interaction on growth, quality and chemical composition of *Thuja orientalis* (*Platycladus orientalis*) transplants to determine the most effective treatment for healthy growth and high plant quality.

Six-months-old transplants *Thuja orientalis* (15-20 cm long with 4-5 branchs) were cultured on March, 1st in both seasons in 25-cm-diameter plastic pots (one transplant/pot) filled with a mixture of about 3.0 kg of pure sand and loam (1:1, v/v). The physical and chemical analysis of the used sand and loam are shown in Table (a).

NaCl salt was mixed well with $CaCl_2$ salt at the ratio of 1:1, by weight. Saline water was then prepared from the salts mixture at the rates of 0, 1000, 3000 and 5000 ppm. Afterwards, the plants were irrigated with 250 ml of the previous saline water concentrations per plant.

Oligo-X (an algae extract containing immunity and internal resistant stimulants, as well as N, P, K, Fe, Zn, Mn and some growth regulators) at the concentrations of 0, 0.5 and 1.0 ml/l. The main components of the used Oligo-X during the two seasons are shown in Table (b).

Green tea leaves were purchased from a local supermarket in Giza, Egypt and grounded using a blender then extracted by water according to the method described by Siripatrawan and Harte (2010). Hence, green tea water extract solution was prepared by mixing the ground tea powder in a distilled water (1:5 w/w) controlled at 90 ℃ in an Erlenmeyer flask and stirred by shaking incubator for 10 min. The water extract of green tea was filtered through Whatman No. 1 filter paper and was used at the rates of 0, 0.5 and 1.0 ml/l.

One month after planting, the transplants received the following treatments:

1. No treatment, referred to as control.
2. Oligo-X at the concentrations of 0, 0.5 and 1.0 ml/l.
3. Green tea extract at the rates of 0, 0.5 and 1.0 ml/l.

Table a. Some physical and chemical properties of the used sand and loam during the two seasons.

Soil type	Seasons	Particle size distribution (%)				S.P	E.C. (ds/m)	pH	Cations (meq/l)				Anions (meq/l)		
		Coarse sand	Fine sand	Silt	Clay				Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3^{-}	Cl^{-}	SO_4^{--}
Sandy	2016	84.76	6.29	1.50	7.45	21.87	3.71	7.80	19.42	8.33	7.20	0.75	1.60	7.80	26.30
	2017	88.01	5.27	1.19	8.53	22.18	3.99	7.32	17.53	7.53	8.99	0.54	2.18	8.01	18.03
Loamy	2016	10.30	46.54	18.88	24.28	33.07	3.36	7.96	18.00	8.95	20.50	0.85	3.65	10.20	34.25
	2017	10.33	48.19	18.77	22.71	33.38	3.35	7.99	19.03	8.85	21.55	0.84	3.02	10.29	35.68

Table b. The main components of the used Oligo-X during the two seasons.

Component	Value	Component	Value
Oligosaccharides	3.0%	**K_2O**	12.0%
Algaic acid	5.0%	**P_2O_5**	0.5%
Zeatin	0.003%	**N**	1.0%
Mannitol	0.001%	**Zn**	0.3%
Cytokinin	0.001%	**Fe**	0.2%
IAA	0.0002%	**Mn**	0.1%
Betonin	0.02%		

4. Saline water at the rates of 0, 1000, 3000 and 5000 ppm.
5. Both of each Oligo-X and green tea extracts were combined with saline water to form interaction treatments.

All treatments were repeated at one month interval, so the plants received such treatment 6 times throughout the course of the study, which was terminated on 1st of September for both seasons.

The layout of the experiment in the two seasons was a complete randomized design (Mead *et al*., 1993) with three replicates, as each replicate consisted of six plants.

At the end of each season the following data were taken: plant height (cm), number of branches/plant, number of roots/plant, root length (cm) and as well as, fresh and dry weights of vegetative parts and roots (g). However, in fresh leaf samples taken from the middle parts of the plants, photosynthetic pigments (chlorophyll a, b and carotenoids, mg/100 g f.w.) were determined according to Moran (1982). However, in dry samples, the content of total carbohydrates percentage (Herbert *et al*., 1971) were measured. Furthermore, content of the free amino acid proline as mg/g d.w. was assessed using the method explained by Bates *et al*. (1973).

Data were then tabulated and the morphological ones were undergone to analysis of variance using the program of SAS Institute Program (1994), followed by Duncan's Multiple Range Test (Duncan, 1955), to detect the significancy among the means of various treatments.

RESULTS AND DISCUSSION

Effect of saline irrigation water on:

Vegetative and root growth parameters:

From data averaged in Tables (1, 2, 3 and 4), it could be concluded that salinity of irrigation water up to 5000 ppm had non deleterious effect on plant height (cm),

Table 1. Effect of irrigation with saline water and some natural activators on plant height (cm) of Thuja plants during two seasons (2016 and 2017).

Saline water / Natural activators	Zero	1000 ppm	3000 ppm	5000 ppm	Mean
			First season		
Control	24.00 i-k	23.33 jk	21.67 kl	20.00 l	22.25 e
Algae extract (0.5 ml/l)	33.67 ab	31.33 b-d	30.00 c-f	28.00 e-h	30.75 b
Algae extract (1.0 ml/l)	36.00 a	34.67 a	33.67 ab	31.33 b-d	33.92 a
Green tea extract (0.5 ml/l)	31.00 b-e	26.67 g-i	25.00 h-j	23.33 jk	26.50 d
Green tea extract (1.0 ml/l)	33.00 a-c	28.67 d-g	27.00 f-i	25.00 h-j	28.42 c
Mean	31.53 a	28.93 b	27.47 c	25.53 d	
			Second season		
Control	27.60 g-i	27.04 hi	25.54 ij	22.83 j	25.75 e
Algae extract (0.5 ml/l)	38.46 a-c	36.22 cd	33.85 de	32.74 ef	35.32 b
Algae extract (1.0 ml/l)	41.58 a	39.48 ab	38.38 bc	36.26 cd	38.92 a
Green tea extract (0.5 ml/l)	35.54 c-e	30.21 fg	29.14 gh	26.91 hi	30.45 d
Green tea extract (1.0 ml/l)	37.71 bc	32.87 ef	30.60 fg	29.50 gh	32.67 c
Mean	36.18 a	33.16 b	31.50 c	29.65 d	

Means having the same letters within a column are not significantly different according to Duncan's multiple range test (DMRT) at 5% level.

Table 2. Effect of irrigation with saline water and some natural activators on number of branches of Thuja plants during two seasons (2016 and 2017).

Saline water / Natural activators	Zero	1000 ppm	3000 ppm	5000 ppm	Mean
			First season		
Control	10.33 hi	10.00 hi	9.33 hi	7.33 i	9.25 e
Algae extract (0.5 ml/l)	23.00 bc	21.33 b-e	20.00 c-f	18.33 d-f	20.67 b
Algae extract (1.0 ml/l)	28.67 a	25.00 ab	23.00 bc	20.67 b-f	24.33 a
Green tea extract (0.5 ml/l)	17.00 e-g	13.33 gh	12.00 h	10.67 hi	13.25 d
Green tea extract (1.0 ml/l)	22.33 b-d	16.67 fg	16.67 fg	13.00 gh	17.17 c
Mean	20.27 a	17.27 b	16.20 b	14.00 c	
			Second season		
Control	11.81 hi	11.65 hi	10.85 hi	8.33 i	10.66 e
Algae extract (0.5 ml/l)	26.95 bc	24.13 b-e	23.13 c-f	21.19 d-f	23.85 b
Algae extract (1.0 ml/l)	33.80 a	28.72 b	26.62 bc	24.09 b-e	28.31 a
Green tea extract (0.5 ml/l)	19.47 e-g	14.99 gh	13.91 h	12.00 hi	15.09 d
Green tea extract (1.0 ml/l)	25.96 b-d	19.02 fg	19.59 e-g	15.11 gh	19.92 c
Mean	23.60 a	19.70 b	18.82 b	16.14 c	

Means having the same letters within a column are not significantly different according to Duncan's multiple range test (DMRT) at 5% level.

Table 3. Effect of irrigation with saline water and some natural activators on number of roots of Thuja plants during two seasons (2016 and 2017).

Saline water / Natural activators	Zero	1000 ppm	3000 ppm	5000 ppm	Mean
			First season		
Control	23.33 bc	13.00 hi	12.33 hi	11.67 ij	15.08 c
Algae extract (0.5 ml/l)	24.00 b	17.33 e	15.00 g	12.00 h-j	17.08 b
Algae extract (1.0 ml/l)	28.00 a	17.33 e	16.67 ef	15.67 fg	19.42 a
Green tea extract (0.5 ml/l)	22.00 cd	13.33 h	12.00 h-j	10.67 j	14.50 c
Green tea extract (1.0 ml/l)	24.00 b	22.00 cd	20.67 d	13.33 h	20.00 a
Mean	24.27 a	16.60 b	15.33 c	12.67 d	
			Second season		
Control	26.90 bc	14.56 f	14.29 f	13.69 fg	17.36 c
Algae extract (0.5 ml/l)	27.36 b	19.24 e	17.40 e	13.95 fg	19.49 b
Algae extract (1.0 ml/l)	32.58 a	19.30 e	19.18 e	18.44 e	22.38 a
Green tea extract (0.5 ml/l)	25.23 cd	15.13 f	13.64 fg	11.91 g	16.47 c
Green tea extract (1.0 ml/l)	27.27 b	24.85 d	23.98 d	15.10 f	22.80 a
Mean	27.87 a	18.62 b	17.70 c	14.62 d	

Means having the same letters within a column are not significantly different according to Duncan's multiple range test (DMRT) at 5% level.

Table 4. Effect of irrigation with saline water and some natural activators on root length (cm) of Thuja plants during two seasons (2016 and 2017).

Saline water / Natural activators	Zero	1000 ppm	3000 ppm	5000 ppm	Mean
			First season		
Control	25.00 f-i	24.67 f-i	23.33 hi	20.67 i	23.42 c
Algae extract (0.5 ml/l)	33.33 a-c	31.33 b-d	32.67 a-c	27.00 d-h	31.08 a
Algae extract (1.0 ml/l)	36.67 a	34.00 ab	30.34 b-e	31.00 b-d	33.00 a
Green tea extract (0.5 ml/l)	29.00 b-f	25.33 e-i	23.67 g-i	22.33 hi	25.08 bc
Green tea extract (1.0 ml/l)	30.67 b-d	28.67 c-g	26.33 d-h	24.00 f-i	27.42 b
Mean	30.93 a	28.80 ab	27.27 b	25.00 c	
			Second season		
Control	28.58 f-i	28.67 f-i	26.72 hi	23.67 i	26.91 c
Algae extract (0.5 ml/l)	38.32 a-c	36.26 b-d	38.43 a-c	31.32 d-h	36.08 a
Algae extract (1.0 ml/l)	42.77 a	39.35 ab	33.68 b-f	35.86 bcd	37.92 a
Green tea extract (0.5 ml/l)	32.78 c-g	28.90 f-i	27.29 g-i	25.72 hi	28.67 bc
Green tea extract (1.0 ml/l)	35.64 b-e	33.34 c-f	30.11 e-h	26.64 hi	31.43 b
Mean	35.62 a	33.30 ab	31.25 b	28.64 c	

Means having the same letters within a column are not significantly different according to Duncan's multiple range test (DMRT) at 5% level.

number of branches, number and length of roots as the means of these parameters were closely near to those of control with non-significant differences in most cases of the two seasons curried, except for 1000 ppm concentration which improved vegetative growth of salinized plants with significant differences over control,

In addition, spraying with natural activators (Oligo-X and green tea extract) caused significant increase in all characters especially the high level of natural activators, while, spraying with natural activators (Oligo-X and tea extract) decreased the depressive effect of saline water on growth performance of plants.

From data averaged in Tables (5, 6, 7 and 8), the utmost high fresh and dry weights (g), in the two seasons were recorded by 1000 ppm salinity treatment with spraying by Oligo-X at a concentration of 1.0 ml. The opposite was the right concerning 5000 ppm level with spraying by Oligo-X at concentration of 1.0 ml followed by spraying with green tea extract at the same concentration, as significantly reduced fresh and dry weights (g), in the two seasons, but they were significantly decreased in response to all saline water treatments However, no-one has offered an acceptable explanation of this phenomenon, but it coincides with the results attained by Shahin (1990) on Bermudagrass and Pessarakli and Touchane (2006) who mentioned that high Na level in the outer medium enhanced cell expansion and growth of Tifway 419 and seashore Paspalum. On the other hand, the reduction of growth due to high salinity concentrations may be attributed to a decrease in all volume at a constant cell number caused by salinity (Adavi *et al*., 2006). Likewise, Pessarakli and Touchane (2006) postulated that mechanism of salt may result in cell division inhibitory and hence, reduces the rate of plant development. However, Jou *et al.* (2006) indicated that ATPase participates in the endoplasmic reticulum Golgi mediated protein sorting machinery for both housekeeping function and compartmentalization of excess Na^+ under high salinity. On the same line, were those results revealed by Shahin (1990) on ryegrass, Lee *et al*. (2004) on 4 Bermudagrass cultivars, Adavi *et al*. (2006) and Abdel Fattah *et al*. (2008) on Tifway.

Chemical composition:

Data presented in Tables (9 and 10) exhibit that pigments content (chlorophyll a, b and carotenoids as mg/100 g f.w.) and total carbohydrates (%) in the leaves of Thuja plants were gradually decreased as a result of irrigation with various levels of saline water, but progressively increased with increasing Oligo-X followed by green tea extract rate. As for proline content (mg/g d.w.) in the leaves, it was cumulatively increased with raising either salinity level only or with natural activators. So, the highest record of this trait was registered by plants treated with the highest levels of both salinity (5000 ppm), while spraying by natural activators only were gradually decreased as a result. It was suggested that accumulation of some amino acids and amides in the leaves of salinity-stressed plants may be due to *de novo* synthesis and not to the result of degradation (Gilbert *et al.*, 1998).

Such results, in general showed a similar trend to those of Pessarakli and Touchane (2006) on Tifway-419 and seashore Paspalum and Hunter and Butler (2005) on *Agrostis stolonifera.*

From the previous findings, it could be concluded that Thuja plants can relatively tolerate irrigation with saline water up to 5000 ppm, especially if treated with natural activators (Oligo-X and extract of tea) to decrease the deleterious effect of irrigation with saline water on growth performance and chemical composition of Thuja plants.

Table 5. Effect of irrigation with saline water and some natural activators on vegetative parts fresh weight (g) of Thuja plants during two seasons (2016 and 2017).

Saline water / Natural activators	Zero	1000 ppm	3000 ppm	5000 ppm	Mean
			First season		
Control	33.50 i	30.58 ij	31.05 i	23.71 j	29.71 e
Algae extract (0.5 ml/l)	58.71 bc	58.02 b-d	53.47 cd	51.41 d-f	55.40 b
Algae extract (1.0 ml/l)	71.10 a	63.14 b	56.11 cd	52.61 c-e	60.74 a
Green tea extract (0.5 ml/l)	42.31 gh	37.25 hi	36.77 hi	32.61 i	37.23 d
Green tea extract (1.0 ml/l)	52.52 c-e	46.28 e-g	44.58 fg	40.41 gh	45.94 c
Mean	51.63 a	47.05 b	44.40 b	40.15 c	
			Second season		
Control	39.67 j-l	35.06 lm	35.90 kl	27.41 m	34.51 e
Algae extract (0.5 ml/l)	67.19 b-d	67.89 bc	61.85 c-e	59.24 ef	64.04 b
Algae extract (1.0 ml/l)	80.81 a	72.56 b	63.92 c-e	58.74 e-g	69.01 a
Green tea extract (0.5 ml/l)	49.23 hi	42.79 i-k	40.88 j-l	37.45 kl	42.59 d
Green tea extract (1.0 ml/l)	59.79 d-f	52.32 f-h	51.28 gh	46.85 h-j	52.56 c
Mean	59.34 a	54.12 b	50.77 b	45.94 c	

Means having the same letters within a column are not significantly different according to Duncan's multiple range test (DMRT) at 5% level.

Table 6. Effect of irrigation with saline water and some natural activators on vegetative parts dry weight (g) of Thuja plants during two seasons (2016 and 2017).

Saline water / Natural activators	Zero	1000 ppm	3000 ppm	5000 ppm	Mean
			First season		
Control	15.50 h-j	14.40 i-k	14.53 i-k	11.38 k	13.95 d
Algae extract (0.5 ml/l)	30.25 ab	27.17 b-d	26.32 b-e	23.81 d-f	26.89 a
Algae extract (1.0 ml/l)	32.62 a	29.45 a-c	25.82 c-e	23.02 ef	27.73 a
Green tea extract (0.5 ml/l)	18.28 g-i	17.16 g-j	17.76 g-j	13.95 jk	16.79 c
Green tea extract (1.0 ml/l)	23.78 d-f	23.98 d-f	20.43 fg	18.94 gh	21.78 b
Mean	24.08 a	22.43 ab	20.97 b	18.22 c	
			Second season		
Control	17.99 f-h	15.96 hi	16.49 g-i	13.17 i	15.90 d
Algae extract (0.5 ml/l)	35.60 ab	30.96 bc	29.03 c	27.18 cd	30.69 a
Algae extract (1.0 ml/l)	36.86 a	34.84 ab	29.47 c	27.07 cd	32.06 a
Green tea extract (0.5 ml/l)	21.33 ef	19.55 e-h	20.56 e-h	15.90 hi	19.34 c
Green tea extract (1.0 ml/l)	27.50 cd	28.38 cd	23.92 de	21.18 e-g	25.24 b
Mean	27.86 a	25.94 ab	23.89 b	20.90 c	

Means having the same letters within a column are not significantly different according to Duncan's multiple range test (DMRT) at 5% level.

Table 7. Effect of irrigation with saline water and some natural activators on roots fresh weight (g) of Thuja plants during two seasons (2016 and 2017).

Saline water / Natural activators	Zero	1000 ppm	3000 ppm	5000 ppm	Mean
			First season		
Control	11.04 ij	9.57 ij	8.63 j	9.29 j	9.63 d
Algae extract (0.5 ml/l)	23.98 b	20.23 cd	16.49 ef	17.48 d-f	19.55 b
Algae extract (1.0 ml/l)	29.78 a	22.55 bc	18.48 de	15.35 e-g	21.54 a
Green tea extract (0.5 ml/l)	15.10 e-g	11.18 h-j	9.40 j	9.53 ij	11.30 d
Green tea extract (1.0 ml/l)	17.05 d-f	15.08 e-g	14.54 f-h	12.95 g-i	14.90 c
Mean	19.39 a	15.72 b	13.51 c	12.92 c	
			Second season		
Control	12.70 i-k	11.13 jk	9.91 k	10.60 k	11.08 d
Algae extract (0.5 ml/l)	27.67 b	23.34 cd	19.45 d-g	19.98 d-f	22.61 b
Algae extract (1.0 ml/l)	34.00 a	26.69 bc	21.26 de	17.30 e-h	24.81 a
Green tea extract (0.5 ml/l)	17.28 e-h	13.12 h-k	10.77 k	10.83 k	13.00 d
Green tea extract (1.0 ml/l)	19.66 d-f	17.74 e-g	16.91 f-i	15.31 g-j	17.41 c
Mean	22.26 a	18.40 b	15.66 c	14.80 c	

Means having the same letters within a column are not significantly different according to Duncan's multiple range test (DMRT) at 5% level.

Table 8. Effect of irrigation with saline water and some natural activators on roots dry weight (g) of Thuja plants during two seasons (2016 and 2017).

Saline water / Natural activators	Zero	1000 ppm	3000 ppm	5000 ppm	Mean
			First season		
Control	8.16 e-g	7.44 fg	6.77 g	7.40 fg	7.44 d
Algae extract (0.5 ml/l)	17.93 a	16.31 ab	11.88 c	10.51 cd	14.16 b
Algae extract (1.0 ml/l)	18.02 a	17.59 a	14.85 b	11.40 c	15.47 a
Green tea extract (0.5 ml/l)	10.27 c-e	6.83 g	6.49 g	6.44 g	7.51 d
Green tea extract (1.0 ml/l)	11.90 c	10.41 c-e	9.71 c-f	8.25 d-g	10.07 c
Mean	13.26 a	11.72 b	9.94 c	8.80 d	
			Second season		
Control	9.35 e-g	8.70 fg	7.95 g	8.26 g	8.57 c
Algae extract (0.5 ml/l)	20.70 a	19.01 ab	13.74 c	12.18 cd	16.41 a
Algae extract (1.0 ml/l)	20.12 a	19.58 ab	17.04 b	12.96 c	17.42 a
Green tea extract (0.5 ml/l)	11.86 c-e	8.08 g	7.28 g	7.45 g	8.67 c
Green tea extract (1.0 ml/l)	13.68 c	12.02 c-e	11.19 c-f	9.50 d-g	11.60 b
Mean	15.14 a	13.48 b	11.44 c	10.07 d	

Means having the same letters within a column are not significantly different according to Duncan's multiple range test (DMRT) at 5% level.

Table 9. Effect of irrigation with saline water and some natural activators on pigments content in the leaves of Thuja plants during the second season (2017).

Saline water / Natural activators	Zero	1000 ppm	3000 ppm	5000 ppm	Mean
			Chlorophyll a "mg/100 g f.w."		
Control	0.777 cd	0.713 f	0.586 hi	0.498 j	0.644 d
Algae extract (0.5 ml/l)	0.811 b	0.782 bc	0.661 g	0.613 h	0.717 b
Algae extract (1.0 ml/l)	0.877 a	0.790 bc	0.784 bc	0.720 ef	0.793 a
Green tea extract (0.5 ml/l)	0.792 bc	0.725 ef	0.604 hi	0.576 i	0.674 c
Green tea extract (1.0 ml/l)	0.810 bc	0.747 de	0.651 g	0.607 hi	0.704 b
Mean	0.813 a	0.752 b	0.657 c	0.603 d	
			Chlorophyll b "mg/100 g f.w."		
Control	0.623 b-e	0.606 d-g	0.574 gh	0.539 i	0.586 d
Algae extract (0.5 ml/l)	0.658 a	0.630 a-d	0.626 a-d	0.575 f-h	0.622 b
Algae extract (1.0 ml/l)	0.659 a	0.646 a-c	0.644 a-c	0.613 c-e	0.641 a
Green tea extract (0.5 ml/l)	0.638 a-d	0.624 b-e	0.592 e-h	0.566 hi	0.605 c
Green tea extract (1.0 ml/l)	0.656 ab	0.629 a-d	0.607 d-f	0.569 hi	0.615 bc
Mean	0.647 a	0.627 b	0.609 c	0.573 d	
			Carotenoids "mg/100 g f.w."		
Control	0.076 ab	0.073 ab	0.068 ab	0.057 b	0.069 a
Algae extract (0.5 ml/l)	0.092 a	0.083 ab	0.073 ab	0.067 ab	0.079 a
Algae extract (1.0 ml/l)	0.093 a	0.084 ab	0.075 ab	0.069 ab	0.080 a
Green tea extract (0.5 ml/l)	0.082 ab	0.077 ab	0.071 ab	0.059 b	0.072 a
Green tea extract (1.0 ml/l)	0.086 ab	0.081 ab	0.072 ab	0.065 ab	0.076 a
Mean	0.086 a	0.079 a	0.072 ab	0.063 b	

Means having the same letters within a column are not significantly different according to Duncan's multiple range test (DMRT) at 5% level.

Table 10. Effect of irrigation with saline water and some natural activators on total carbohydrates and proline concentrations in the leaves of Thuja plants during the second season (2017).

Saline water / Natural activators	Zero	1000 ppm	3000 ppm	5000 ppm	Mean
	Total carbohydrates (%)				
Control	14.210 f	11.370 ij	10.840 jk	7.200 m	10.900 e
Algae extract (0.5 ml/l)	21.500 b	18.310 c	12.810 g	11.580 hi	16.050 b
Algae extract (1.0 ml/l)	22.430 a	18.770 c	16.210 d	11.620 hi	17.260 a
Green tea extract (0.5 ml/l)	15.840 d	12.920 g	12.070 h	8.760 l	12.400 d
Green tea extract (1.0 ml/l)	18.620 c	15.080 e	12.680 g	10.680 k	14.260 c
Mean	18.520 a	15.290 b	12.920 c	9.968 d	
	Proline contents (mg/g d.w.)				
Control	0.137 gh	0.153 e-g	0.312 a	0.342 a	0.236 a
Algae extract (0.5 ml/l)	0.114 h-j	0.140 gh	0.183 c-e	0.186 c-e	0.156 c
Algae extract (1.0 ml/l)	0.083 j	0.100 ij	0.173 d-f	0.184 c-e	0.135 d
Green tea extract (0.5 ml/l)	0.132 g-i	0.149 fg	0.210 bc	0.226 b	0.179 b
Green tea extract (1.0 ml/l)	0.132 g-i	0.145 f-h	0.187 cd	0.189 cd	0.163 bc
Mean	0.120 c	0.138 b	0.213 a	0.225 a	

Means having the same letters within a column are not significantly different according to Duncan's multiple range test (DMRT) at 5% level.

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تأثير الرى بالماء المالح وبعض المنشطات الطبيعية على نمو وجودة نباتات التويا

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أجريت تجربة أصص بالحقل المفتوح بمشتل معهد بحوث البساتين، مركز البحوث الزراعية، الجيزة، مصر خلال موسمي ٢٠١٦ و ٢٠١٧ لدراسة تأثير الرش بالمنشطات الطبيعية (مستخلص الطحالب (اوليجو-X) بمعدلات صفر، ٠,٥ و ١,٠ مل/لتر ومستخلص الشاى الاخضر بمعدلات صفر، ٠,٥ و ١,٠ مل/لتر) على تحمل نبات التويا لملوحة مياه الرى بتركيزات صفر، ١٠٠٠، ٣٠٠٠ و ٥٠٠٠ جزء فى المليون والتفاعل بينهم على النمو الخضري، الجذري، والتركيب الكيماوي لنباتات التويا عمر ستة أشهر والمنزرعة في أصص بلاستيك قطرها ٢٥سم ومملوءة بخليط متساوي من الرمل + الطمي بنسبة١:١ حجماً.

أوضحت النتائج المتحصل عليها أن جميع المعاملات احدثت تحسناً معنوياً في ارتفاع النبات (سم)، عدد الافرع، وعدد وطول الجذور والوزن الطازج والجاف للمجموع الخضرى والجذرى الناتج نتيجة لزيادة المعدل المضاف للمنشطات الطبيعية بصرف النظر عن تركيز ملوحة مياه الري، بينما انخفضت هذه القياسات معنوياً و بشكل متزايد كلما زاد تركيز الملوحة في مياه الري مقارنة بالكنترول. و لقد تم الحصول أيضاً على اتجاه مشابه فيما يتعلق بمحتوى الأوراق من الصبغات للنبات (ملجم/١٠٠ جم وزن طازج) والنسبة المئوية للكربوهيدرات الكلية، حيث زادت بزيادة معدل إضافة المنشطات الطبيعية و انخفضت بزيادة تركيز الملوحة، بينما كان العكس صحيحاً. أما بالنسبة لمحتوى البرولين (ملجم/جم مادة جافة) فقد انخفض بزيادة معدل المنشطات الطبيعية و ازداد تصاعدياً بزيادة تركيز الملوحة.

و عليه، فانه طبقاً لظروف هذا العمل البحثي، يمكن القول بإيجاز أن نبات التويا يستطيع إلى حد ما تحمل ملوحة مياه الري حتى ٥٠٠٠ جزء في المليون، خاصة عند معاملته مستخلص الطحالب بمعدل ١,٠ مل/لتر، و الذي أدى بشكل كبير الى تحسين النمو و المحتويات الكيماوية رغم إجهاد الملوحة.