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Effect of compost, silicon and irrigation period on quality, growth and chemical composition of *Taxodium distichum* L.(rich)seedlings

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ABSTRACT

Nowadays, using compost and silicon is the main subject in extensive studies in recent years for reducing amount of irrigation water with producing clean crops and reduce pollution environment .So, this study was conducted at the nursery of Timber trees and Forestry Res. Dept., Hort. Res. Inst., Giza, Egypt, during the seasons 2011, 2012 in order to identify the response of *Taxodium distichum* seedlings {one year old }to different rates of compost (zero , 2.5 & 5 g/ bag as a drench), silicon at 0, 1.00 and 2.00 g/l as a foliar spray, as well as their combined treatments along with different irrigation periods (every "5 &10 days")and their effects on growth and chemical composition of Taxodium seedling. The results indicated that irrigation every 5 days significantly increased seedling quality (SQ), survival % and chlorophyll (b) in both seasons. Meanwhile, irrigation seedlings every 10 days significantly increased plant height, stem diameter, number of the branches/plant, number of leaves/plant, root length, fresh and dry weights of aerial parts (stems and leaves), roots fresh and dry weights, the seedling quality index (QI), leaf contents of chlorophyll a, carotenoids, total chlorophyll(a + b) and total indoles and phenols in both seasons. Seedlings of Taxodium registered different trends in response to different treatments. Control treatment had significantly thicker stem diameter, heavier dry weights of aerial parts (stems and leaves) and survival %**,** while submitted compost at the rate of 2.5 g / bag led to significant increments in survival %, pigments, total indoles and phenols. Meanwhile, using compost at 5g/bag increased the number of branches/plant and survival %. Foliar spraying with silicon at the rate of 1g/l significantly increased plant height, chlorophyll (a) in the two seasons. However, using 2 g/l silicon as a foliar spray significantly increased number of leaves/plant, root length, fresh and dry weights of aerial parts (stems and leaves) and roots, and the seedling quality index (QI)in the two seasons, also, SQ in the first season comparing to control and other application used. From the obtained results it could be recommended, to get the best rate of shoot and root growth accompanied by the highest content of chemical constituents, small *Taxodium* seedlings (12 months old) should be with compost (at the rate of 2.5 g / bag of 14 cm diameter) with irrigation every 10 days.

Key words: Compost, Silicon, Vegetative growth, Chemical Composition, *Taxodium distichum*

Introduction

Taxodium distichum L (Fam. Taxodiaceae), has been widely cultivated as an ornamental and timber tree. Its length reached 40 m, it occurs naturally in swaps, flood plants and along the edges of lakes and rivers, it likes an acidic soil and will develop yellowing of the leaves if grown in neutral or calcareous soils. Salinity is the major constraint affecting plant growth and productivity around the world. It is estimated that 10% of the world s current croplands are affected by salinity; about 1500 million ha. of non irrigated areas ’where cropping relies on limited rainfall is affected by salt (Allen, 1994). Researchers are interested in improving the physical status of soils in order to solve the problem of the poor soil and obtain satisfactory plant growth. Soil conditioners are widely utilized to compensate the limited supply of nutrients as well as increase water use efficiency (John and David 2000). Decomposition of the compost allows more releasing of inorganic elements in available forms to be more easily taken by the plant roots. In addition, organic acids released during decomposition help more releasing of the nutrients from the mineral portion of the soil (Shanks and Gouin, 1985). As the organic matter decompose, it becomes chemically altered; this change gives it a negative charge that attracts and holds inorganic elements such as k, Ca, Mg and other micronutrients in forms that make them available for the growing plants. Elements "held" by organic matter can be easily washed by rain (Wallace and Wallace, 1990). Organic matter absorbs water like sponge, increases soil moisture for a long time, thus water use efficiency (WUE) could be improved (John and David, 2000).

Silicon (Si) has received little attention from plant nutrition scientists, most likely because it is not included in the group of elements considered as essential to plants. Notwithstanding, beneficial effects of Si have been demonstrated for many plant species, especially when these plants are submitted to some type of stress, whether biotic or abiotic (Takahashi, 1995; Korndörfer *et al*., 1999; Faria, 2000; Datnoff *et al*., 2001). Meanwhile,

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Debicz, and Wroblewska, (2011) mentioned that silicon is known as an element stimulating plant immunity and resistance to unfavorable conditions. Additional treatment with silicon may also cause a positive change in plant performance, improving the quality of ornamental plants. In the years 2009-2010, a two-factorial experiment was conducted involving three cultivars of seasonal ornamental plant species: creeping zinnia (*Sanvitalia speciosa*) 'Sunbini', vervain Verbena 'Patio Blue', and purslane *Portulaca umbraticola* 'Duna Red'. The experiment proved the beneficial effect of fertilization with silicon on plant development of Verbena and the number of shoots of all examined plant species. The latter finding is consistent with that of Kamenidou, *etal.*, (2011) on (*Helianthus annuus* L. 'Ring of Fire'), Si supplementation is documented to increase resistance to biotic and abiotic stresses in greenhouse crops, which accumulate Si in their tissues. However, optimum Si fertilization rates and acceptable Si levels in tissues and substrate have not been established for floriculture greenhouse production. A positive correlation was observed between substrate Si concentration and leaf Si concentration for all three Si sources used in this study.

Nowadays, the determination of water requirements of any plant is necessary to reduce the amount of water used in the agricultural production in A.R.E. However, little information is available regarding the effect of irrigation treatments on growth and development of *Taxodium distichum* L. plant. So, the literature on other plants may be helpful in this concern. El-Khateeb(1996) found that leaves of fig transplants was greatest when the plants were grown under low water stress, while these values gradually decreased with increasing the soil moisture tension. Treder *et al* (1998) on plum cv. Volar seedling rootstocks as were drip irrigated to maintain soil moisture of 0to 0.2 MP a, or un irrigated significantly increased the shoot growth of plum cv. Valor in the 3 years after planting and significantly increased trunk cross-sectional area from the second year after planting onwards. On *Hibiscus rose sinensis* plants, Garas (2011) claimed that applying the moderate irrigation level (0.75 l /pot) was the best for improving plant morphological traits, but with the exception of using the highest level (1 l/pot) which gave highest number of branches and leaves /plant. Meanwhile, the lowest irrigation level (0.50 l/ pot) or the moderate one (0.75 l/pot) were the best for raising the accumulation rate of plant chemical constituents.

The experimental trial was intended to produce vigorous growth of *Taxodium distichum* L. seedlings by studying the individual as well as the combined effect of different treatments of compost, silicon and irrigation periods.

Materials And Methods

An investigation was performed under the full sun condition at the nursery of the Timber trees and Forestry Res. Dept., of Experimental Farm of Hort. Res. Inst., Giza, Egypt during 2010/2011 and 2011/2012 seasons to study the effect of compost, silicon, irrigation periods and their combination on vegetative growth and chemical composition of *Taxodium distichum* seedlings. So, twelve months old of *Taxodium* transplants with initial height of 12-14 cm (10-12 leaves) were planted on February, 20th in both seasons. They were planted in 14 cm diameter black polyethylene bags" one plant / bag" filled with about 700 g of a mixture of sand and loam (1:1 by volume). The physical and chemical properties of the used sand and loam soil are shown in **Table (a)**, which was analyzed according to Champan and Pratt (1978).

Table a: Some physical and chemical properties of the used sand and loam soil during 2011 and 2012 seasons.

Soil type	Season	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 soil	2011	89.03	2.05	0.40	8.52	23.01	3.56	7.90	7.50	1.63	33.60	0.50	3.20	22.00	18.03
	2012	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
Loamy soil	2011	10.18	46.17	19.53	24.12	35.00	3.48	8.27	17.50	9.42	20.00	0.79	3.80	10.00	33.91
	2012	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	34.45

After a month from planting" on March 20th ", compost was added as a drench to the soil. Meanwhile, silicon was applied as a foliar spray on the foliage till run-off, point .The seedlings were monthly received the following treatments three times in both seasons.

1-No fertilization, was referred to as control. (Exposed to two irrigation periods (5 and 10 days) with 150 ml water for each one bag.

2- Compost at 2.5 g /bag.
3-Compost at 5 g /bag
4- Silicon at 1g/l
5- Silicon at 2g/l
6- Compost at 2.5 g /bag plus 1 g /l silicon.
7- Compost at 5 g /bag plus 2 g/l silicon
8- Compost at 2.5 g /bag plus 1g /l silicon.
9- Compost at 5 g/bag plus 2g /l silicon.

-Silicon (dissolve 1 & 2 g silicon in /l water, and each plant received 20 ml.

-All treatments exposed to two irrigation periods (5 and 10 days).
Some chemical composition of the compost used in the two seasons are indicated in **Table (b)**

Table b: Some chemical properties of the compost in the two seasons:

Macro elements %			pH	Organic carbon	moisture content
N	P	K			
1.4	0.47	0.802	7.8	17.18%	35.7%

-Silicon "Si $\mathbf{SO_4}$" extracts (from Stimuli World Trading Company in Egypt).

-All plants under the various treatments received the usual agricultural practices such as weeding ….etc. whenever needed.

-Data were taken at the end of each season (on 8th September) as follows:

Plant height (cm.), stem diameter at soil surface (cm.), number of branches/plant, number of leaves/plant, root length (cm.),as well as, fresh and dry weights of aerial parts(stems and leaves) and fresh and dry weights of roots (g). Survival %, (SQ) (Equation 1) was assessed based on Thompson (1985). Also, the seedlings quality index (QI) (Dickson *et al*., 1960)

SQ=H (plant height) / D (stem diameter) [1]

The seedling quality index (QI)= Total seedling dry weight(g) /height (cm)/diameter (mm)+shoot dry weight(g)/root dry weight(g) [2]

- Photosynthetic pigments (chlorophyll a, b and carotenoids, mg/g f.w.) were determined according to Moran, (1982).
- The content of total indoles was determined in the methanol extract, using P-dimethyl aminobenzaldhyde test "Erlic's reagent" according to A.O.A.C. (1990)
- Total soluble phenols were determined colorimetrically by using Folin Circulate reagent A.O.A.C. (1990) were determined in the second season only.
- The layout of the experiment in the two seasons was a factorial experimental in randomized complete block design (RCBD) with three replicates (Mead *et al.*, 1993), as each replicate contained nine plants.
- Data were then tabulated and subjected to analysis of variance (using comparing means) according to SPSS Program (Levesque, 2007) using Duncan's Multiple Range Test (1955), which was used to verify the significance level among means of various treatments.

Results And Discussion

Data in **(Table 1**) show the effect of compost, silicon, irrigation periods and the combined treatments on growth of *Taxodium distichum* seedling. **(Table 1a)** The data indicted that irrigation every 10 days significantly increased plant height, stem diameter, number of branch's /plant, number of leaves/plant and root length comparing with that gained from irrigation every 5 days.

Regarding the effect of compost and silicon treatments, it is clear, from data presented in **(Table 1b)** that treating with silicon as a foliar spray at the rate of 1g/l rate in the two seasons, gave the tallest seedlings comparing with control and all other treatments used in the two seasons. Stem diameter of untreated plants was superior in comparison with the other treatments used in the first season, but the data in the same **Table** indicate that all treatments in the second season gave a similar trend in stem diameter. However, untreated plants as well as plants received compost at 5g /bag significantly increased the number of branch's /plant in the two seasons. On the other hand, foliar spray with silicon at 2 g /l gave the utmost high means of the number of leaves per seedling and root length in both seasons.

Table (1 c) reflect the effect of compost, silicon and their combinations, under two periods of irrigation on growth of Taxodium seedling. It is obvious that addition compost at 5gm/bag or compost at 5g /bag plus 2g/l silicon reduced plant height comparing with that obtained from all other treatments or control, which gave similar trend when seedling were irrigated at 5 days in the first season, whereas in the second one silicon at 2 g/l a significantly increased seedlings height comparing with all treatments used. Meanwhile, irrigating seedlings every10 days plus compost at 2.5g /bag increased seedlings height, comparing with all treatments and untreated plants. However, the treatments of compost at 2.5g/bag or silicon 1g/l gave the highest plant height. Referring, stem diameter of seedlings treating with silicon at 1g/l as a foliar spray gave 0.81 (cm) compared with 0.67 (cm) for untreated plants. Meanwhile, addition of compost at 2.5g/bag gave the utmost high means, in this concern..

The number of branch's /plant was higher for the untreated plants and also with addition of compost at 5g/bag for seedling irrigated every 5days.However,under the irrigation treatment every 10 days, the addition of compost at 2.5g/bag resulted in significant increment in number of branch's/plants comparing with all treatments used in the two seasons. It is also, obvious from the same **Table (1c)** that addition of compost at 2.5g/bag induced significant increase in number of leaves /seedling in both seasons with using irrigation at 5 days intervals .Meanwhile, under 10 days irrigation, foliar spray with silicon at 2 g/l significantly increased the number of leaves per seedling compared with the other treatments in both seasons. Irrigating seedlings every 5 days accompanied with the addition of compost at 5g/bag significantly increased root length in the two seasons. Meanwhile**,** irrigating seedlings every 10 days with applying silicon at 2g /l as a foliar spray induced highly significant increase in root length in the two seasons.

Referring the effect of irrigation periods, it is clear from data mentioned above that the long irrigation period (10days) proved its mastery in improving most plant traits. However, a lot of scientists confirmed such effect, Garas (2011)on *Hibiscus rose sinensis* plants claimed that the lowest irrigation level (0.50 l/ pot) or the moderate one (0.75 l/pot) were the best for raising the accumulation rate of plant chemical constituents. Meanwhile, applying the moderate irrigation level (0.75 l /pot) was the best for improving plant morphological traits.

Table 1a: Effect of irrigation periods on vegetative growth and root traits of *Taxodium distichum* seedlings during 2011and 2012 seasons.

Treatments	Plant height (cm)	Stem diameter (cm)	No.branches/ plant	No. leaves/ plant	Root length(cm)
	First season: 2011				
Irrigation at 5 days intervals	35.04B	0.55B	1.26A	18.41B	23.89B
Irrigation at 10 days intervals	36.82A	0.62A	1.07B	29.64A	25.78A
	Second season: 2012				
Irrigation at 5 days intervals	36.00B	0.54B	1.23B	29.34A	23.52B
Irrigation at 10 days intervals	37.21A	0.72A	1.38A	28.64A	25.78A

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

Table 1b: Effect of compost, silicon and their combination on vegetative growth and root traits of *Taxodium distichum* seedlings during 2011and 2012 seasons.

Treatments	Plant height (cm)	Stem diameter (cm)	No.branches/ plant	No. leaves/ plant	Root length(cm)
	First season: 2011				
Control	37.84AB	0.71A	2.00A	22.01AB	20.67BC
Compost at 2.5g/bag	34.67B	0.56AB	1.84AB	28.67AB	25.67AB
Compost at 5g/bag	36.84AB	0.67AB	2.00A	25.00AB	25.84AB
Silicon 1 g/l	41.17A	0.57AB	1.00A-C	24.34AB	18.51C
Silicon 2g/l	38.34AB	0.49B	0.67BC	30.34A	30.34A
Compost at 2.5g /bag + 1 g/l silicon	37.00AB	0.51B	0.34C	29.00AB	26.00AB
Compost at 2.5g /bag + 2g /l silicon	35.17B	0.61AB	0.34C	16.17C	26.5AB
Compost at 5g /bag + 1 g/l silicon	27.5C	0.57AB	1.00A-C	19.17BC	24.67AB
Compost at 5g /bag + 2g /l silicon	34.84B	0.59AB	1.34A-C	25.84AB	25.34AB
	Second season:2012				
Control	36.42AB	0.77A	1.00AB	27.17AB	20.67AB
Compost at 2.5g/bag	36.67AB	0.57A	1.67AB	28.67AB	24.17A
Compost at 5g/bag	37.67AB	0.71A	2.34A	32.67A	25.00A
Silicon 1 g/l	44.34A	0.65A	1.67AB	32.67A	17.67B
Silicon 2g/l	40.17AB	0.66A	1.51AB	32.84A	30.17A
Compost at 2.5g /bag + 1 g/l silicon	37.34AB	0.49A	0.34B	27.17AB	28.00A
Compost at 2.5g /bag + 2g /l silicon	33.84BC	0.64A	0.51B	22.17B	26.17A
Compost at 5g /bag + 1 g/l silicon	26.67C	0.54A	1.34AB	23.00B	24.34A
Compost at 5g /bag + 2g /l silicon	37.34AB	0.66A	1.34AB	34.5A	25.67A

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

Fresh and dry weights of aerial parts (leaves and stem) and roots:

The results tabulated in **Tables (2 "a, b and c")** reveal the influence of compost, silicon, two irrigation periods and their combination on aerial parts (leaves & stem) and roots dry weights. **Table (2a)** clear that irrigating seedlings every 10 days significantly increased the fresh and dry weights of both aerial parts (leaves & stem) and roots comparing with the means of 5 days irrigation treatment.

On the other hand, **Table (2b)** show that fresh and dry weights of aerial parts (leaves & stem) and roots were the heaviest by using silicon at 1 or 2g /l comparing with that gained from the other treatments used in the two seasons.

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Table 1 c: Effect of compost, silicon, irrigation periods and their combination on vegetative growth and root traits of *Taxodium distichum* seedlings during 2011and 2012 seasons.

Treatments	Plant height (cm)		Stem diameter (cm)		No. branches/ plant		No. leaves/ plant		Root length(cm)	
	First season: 2011									
Irrigation periods	5 day	10 day	5 day	10 day	5 day	10 day	5 day	10 day	5 day	10 day
Control	37.00A	38.67 C	0.67A	0.8A	1.34A-C	1.67AB	21.34AB	22.67F	20.67C	20.67F
Compost at 2.5g/bag	27.00 B	42.34A	0.44B	0.67A-C	2.00AB	2.67A	26.67A	30.67C	20.67C	30.67B
Compost at 5g/bag	36.00 A	37.34 C	0.54AB	0.81A	2.67A	1.34AB	21.34AB	28.67D	32.00A	19.67G
Silicon 1 g/l	41.00A	41.34AB	0.64AB	0.51BC	2.00AB	0.00B	22.00AB	26.67E	6.34D	30.67B
Silicon 2g/l	37.00A	39.67BC	0. 54AB	0.44C	0.67BC	0.67B	22.00AB	38.67A	25.00B	35.67A
Compost at 2.5g /bag + 1 g/l silicon	36.00 A	38.00C	0.47 AB	0.54A-C	0.67BC	0.00B	22.34AB	35.67B	26.34B	25.67C
Compost at 2.5g /bag + 2g /l silicon	40.00A	30.34E	0.64AB	0.57A-C	0.00C	0.67B	8.67C	23.67F	30.34A	22.67E
Compost at 5g /bag + 1 g/l silicon	25.34B	29.67E	0.51AB	0.64A-C	0.67BC	1.34AB	15.00B	23.67F	26.67B	22.67E
Compost at 5g /bag + 2g /l silicon	35.67A	34.00D	0.51AB	0.67A-C	1.34A-C	1.34AB	15.00B	36.67B	27.00B	23.67D
	Second season:2012									
Control	33.34B-C	39.34AB	0.54A	0.77A	0.00C	2.00AB	31.67A-C	22.67CD	20.34D	21.00BC
Compost at 2.5g/bag	30.67C	42.67A	0.67A	0.87A	1.00A-C	2.34A	25.67B C	31.67A-C	20.00D	28.34AC
Compost at 5g/bag	37.34 A-C	38.00AB	0.61A	0.54A	2.67AB	2.00AB	37.34 A	28.00A-D	31.00A	19.00C
Silicon 1 g/l	47.00A	41.67A	0.57A	0.84A	3.00A	0.34B	38.67A	26.67B-D	8.00E	27.34BC
Silicon 2g/l	44.34AB	36.00AB	0.67A	0.62A	2.00A-C	1.00AB	32.00AB	33.67AB	23.34C	37.00A
Compost at 2.5g /bag + 1 g/l silicon	33.34B-C	39.34AB	0.47A	0.84A	0.00C	0.67AB	21.00C	33.34AB	26.00BC	30.00AB
Compost at 2.5g /bag + 2g /l silicon	36.00A-C	31.67AB	0.41A	0.57A	0.00C	1.00AB	21.67BC	22.67CD	30.00A	22.34BC
Compost at 5g /bag + 1 g/l silicon	25.34C	28.00B	0.47A	0.74A	1.67A-C	1.00AB	25.00BC	21.00D	26.34BC	22.34BC
Compost at 5g /bag + 2g /l silicon	36.00A-C	38.00AB	0.37A	0.71A	0.67BC	2.00AB	31.00A-C	38.00A	26.67B	24.67BC

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

Table 2a: Effect of irrigation periods treatments on fresh and dry weights of different parts of *Taxodium distichum* seedlings during 2011and 2012 seasons.

Treatments	Fresh weight (g)		Dry weight (g)	
	Aerial parts	Roots	Aerial parts	Roots
	First season: 2011			
Irrigation at 5 days intervals	5.92B	1.8B	2.37B	0.94B
Irrigation at 10 days intervals	11.89A	4.73A	3.38 A	1.87A
	Second season: 2012			
Irrigation at 5 days intervals	8.75B	3.44B	3.39A	1.52B
Irrigation at 10 days intervals	10.37A	3.82A	3.31A	1.75A

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

Table 2b: Effect of compost, silicon and their combination on fresh and dry weights of different parts of *Taxodium distichum* seedlings during 2011and 2012 seasons.

Treatments	Fresh weight (g)		Dry weight (g)	
	Aerial parts	Roots	Aerial parts	Roots
	First season: 2011			
Control	7.77AB	3.02AB	4.61A	1.29C
Compost at 2.5g/bag	7.91AB	2.79AB	2.79BC	1.49C
Compost at 5g/bag	11.49A	3.69AB	2.54C	1.14C
Silicon 1 g/l	12.89A	4.81A	3.71AB	1.86B
Silicon 2g/l	11.77A	4.64A	3.88B	2.23A
Compost at 2.5g /bag + 1 g/l silicon	10.39A	4.16A	2.62BC	1.99B
Compost at 2.5g /bag + 2g /l silicon	4.11B	1.73 B	1.72D	0.81D
Compost at 5g /bag + 1 g/l silicon	3.91B	1.74B	1.59D	0.92D
Compost at 5g /bag + 2g /l silicon	9.96AB	3.59AB	2.44C	0.95D
	Second season: 2012			
Control	8.74AC	3.29AC	4.68AB	1.58 B
Compost at 2.5g/bag	8.46BC	2.87BC	2.95DE	1.25B
Compost at 5g/bag	11.77AB	4.28AB	2.55E	1.34B
Silicon 1 g/l	13.37AB	5.19A	4.06BC	2.47A
Silicon 2g/l	13.75A	4.99A	4.96A	2.40A
Compost at 2.5g /bag + 1 g/l silicon	10.41AB	3.82A-C	2.71DE	2.05AB
Compost at 2.5g /bag + 2g /l silicon	4.94C	2.14C	2.23E	0.95C
Compost at 5g /bag + 1 g/l silicon	4.94C	2.15C	3.46CD	1.32B
Compost at 5g /bag + 2g /l silicon	9.77AC	3.89A-C	2.59E	1.35B

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

Meanwhile, **Table (2c)** show that the fresh and dry weights of aerial parts (leaves & stem) was significantly heavier when 1g/l of silicon was used as a foliar spray comparing with that obtained from the other treatments when plants were irrigated every 5 days in both seasons . However, irrigation every 10 days plus spraying silicon at 2g/l increased fresh and dry weights of aerial parts in the two seasons. The same **Table** reflected also, the response of fresh and dry weights of roots to compost, silicon, irrigation periods and interactions between them .In this connection, 5days irrigation treatment with using silicon at 1g/l increased roots fresh and dry weights in the first and second seasons. While, roots fresh and dry weights of seedling irrigated every 10 days

were significantly heavier when 2g/l silicon was used in the first season, while in the second one, silicon at 1 or 2g /l induced the heaviest roots fresh and dry weights, comparing with that gained from other applications.

Concerning, the favorable effect of silicon were noticed on some plant traits in the present study, many reports of many authors confirmed such results (Kamenidou, *etal.*, (2011) on (*Helianthus annuus* L. 'Ring of Fire').

The seedling quality (SQ), the seedling quality index (QI) and Survival %:

The results of **Tables (3) and Figs (1,2& 3)** reveal the effect of compost, silicon treatments and the combination between them and the two irrigation periods on the seedling quality(SQ), the seedling quality index (QI) and survival % of *Taxodium distichum* seedlings **.** According to data in **Table (3 a)** irrigation every 5 days recorded significant increase in seedling quality (SQ) and survival %. While, irrigation with 150ml water for one each bag every 10 days, significantly increased the seedling quality (SQ) in the two seasons.

Data of **Table (3 b)** show that spraying 2g /l silicon on Taxodium seedlings was the best treatment in raising the seedling quality (SQ) in the first season and the seedling quality index (QI) in both seasons. Meanwhile, untreated seedlings or addition of compost at 2.5 and 5g /bag recorded 100% of seedling survival in the two seasons.

Data presented in histograms**(Figs 1,2& 3)** show the influence of compost, silicon treatments and their combination with the two irrigation periods on the seedling quality(SQ), the seedling quality index (QI) and survival % of *Taxodium distichum* seedlings. It is obvious that addition of compost at 5g /bag plus 2g /l silicon as a foliar spray induced a significant increase in seedling quality (SQ) at 5days irrigation treatment (69.94 - 97.29) in the first and second seasons respectively, while the application of silicon at 2g/l alone recorded "90.16" at 10 days irrigation, in the first season, comparing to the untreated plants and other treatments used. In the second season, the treatment of irrigation at 10days plus addition of compost at 5g /bag gave (70.38) while, applying silicon at 2g/l (58.07) comparing with that obtained from all treatments and control.

The seedling quality index (QI) was highly increased at seedlings treated with 5days of irrigation (control) in the first seasons, while foliar spray with silicon at 1g/l significantly increased the values (0.23) at 5days of irrigation comparing with control (0.19) in the second season .However, in 10days of irrigation treating seedlings with 2g/l silicon induced highly values in QI in both seasons. Survival % was 100% when seedling were treated with compost at 2.5 and 5 g/bag and control in 5 and 10 days of irrigation in both seasons.

Table 2c: Effect of irrigation periods, compost, silicon, treatments and their combination on fresh and dry weights of different parts of *Taxodium distichum* seedlings during 2011and 2012 seasons.

Treatments	Fresh weight (g)				Dry weight (g)			
	Aerial parts		Roots		Aerial parts		Roots	
	First season: 2011							
Irrigation periods	5 day	10 day	5 day	10 day	5 day	10 day	5 day	10 day
Control	6.34BC	9.21E	1.67B-D	4.37F	4.64A	4.57B	1.14AB	1.45CD
Compost at 2.5g/bag	4.67C	11.14DE	1.67B-D	3.91G	2.34C	3.24E	1.11AB	1.87BC
Compost at 5g/bag	9.67AB	13.32CD	2.67AB	4.71E	3.00B	2.07F	1.27A	1.00D
Silicon 1 g/l	12.67A	13.11CD	3.34A	6.27C	3.34B	4.07C	1.28A	2.44B
Silicon 2g/l	4.27C	19.27A	2.00B-D	7.27A	2.34C	5.41A	0.92AB	3.54A
Compost at 2.5g /bag + 1 g/l silicon	3.67C	17.11AB	1.17D	7.14B	1.16D	4.07C	0.64B	3.34A
Compost at 2.5g /bag + 2g /l silicon	3.01D	5.21F	1.31CD	2.14H	1.17D	2.27F	0.74B	0.87D
Compost at 5g /bag + 1 g/l silicon	3.67C	4.14F	1.34CD	2.14H	1.34D	1.84F	0.77AB	1.07D
Compost at 5g /bag + 2g /l silicon	5.34BC	14.57BC	2.34A-C	4.84D	2.00C	2.87E	0.62B	1.27CD
	Second season: 2012							
Control	8.99AB	8.49CD	3.09AB	3.48BC	4.95A	4.41B	1.48A	1.67BC
Compost at 2.5g/bag	6.49B	10.43BC	2.06B	3.68A-C	2.79B	3.11D	1.06A	1.43BC
Compost at 5g/bag	12.49AB	11.04BC	4.92AB	3.65A-C	3.22B	1.88G	1.89A	0.78C
Silicon 1 g/l	15.17A	11.58A-C	5.94A	4.44AB	4.06A	4.05BC	2.44A	2.49AB
Silicon 2g/l	11.03AB	16.48A	4.24AB	5.77A	4.69A	5.22A	1.85A	2. 95A
Compost at 2.5g /bag + 1 g/l silicon	5.66B	15.16AB	1.89B	5.75A	1.58C	3.84C	0.91A	3. 19A
Compost at 2.5g /bag + 2g /l silicon	5.09B	4.78D	2.36B	1.93C	2.34BC	2.12FG	0.98A	0.91C
Compost at 5g /bag + 1 g/l silicon	6.06B	3.58D	2.47B	1.83C	4.24A	2.68DE	1.48A	1.15C
Compost at 5g /bag + 2g /l silicon	7.74AB	11.79A-C	3.96AB	3.83A-C	2.69B	2.49EF	1.55A	1.15C

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

Table 3a: Effect of irrigation periods on SQ, the seedling quality index(QI) and Survival% of *Taxodium distichum* seedlings during 2011and 2012 seasons.

Treatments	SQ	QI	Survival%
	First season: 2011		
Irrigation at 5 days intervals	63.86A	0.06B	87.66A
Irrigation at 10 days intervals	61.07B	0.17A	77.78B
	Second season: 2012		
Irrigation at 5 days intervals	69.71A	0.12B	87.66A
Irrigation at 10 days intervals	52.44B	0.19A	77.78B

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

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Table 3b: Effect of compost, silicon and their combination on SQ, the seedling quality index (QI) and Survival% of *Taxodium distichum* seedlings during 2011and 2012 seasons.

Treatments	SQ	QI	Survival%
	First season: 2011		
Control	51.79H	0.15C	100A
Compost at 2.5g/bag	62.28D	0.11E	100A
Compost at 5g/bag	56.38G	0.08F	100A
Silicon 1 g/l	72.57C	0.12D	83.34B
Silicon 2g/l	79.34A	0.2A	83.34B
Compost at 2.5g /bag + 1 g/l silicon	73.49B	0.19B	83.34B
Compost at 2.5g /bag + 2g /l silicon	57.86E	0.03H	55.56 E
Compost at 5g /bag + 1 g/l silicon	48.13I	0.06G	66.67D
Compost at 5g /bag + 2g /l silicon	60.34E	0.06G	72.23C
	Second season:2012		
Control	56.42F	0.21C	100A
Compost at 2.5g/bag	47.42G	0.09E	100A
Compost at 5g/bag	65.8C	0.1E	100A
Silicon 1 g/l	66.04C	0.24B	83.34B
Silicon 2g/l	62.13D	0.34A	83.34B
Compost at 2.5g /bag + 1 g/l silicon	58.89E	0.18D	83.34B
Compost at 2.5g /bag + 2g /l silicon	71.89B	0.06F	55.56 E
Compost at 5g /bag + 1 g/l silicon	45.88H	0.12E	66.67D
Compost at 5g /bag + 2g /l silicon	75.41A	0.1E	72.23C

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

Results of growth parameters are in agreement with those obtained by Debicz, and Wroblewska, (2011) mentioned that silicon may cause a positive change in plant performance, improving the quality of ornamental plants in three cultivars of ornamental plant species: *Sanvitalia speciosa* 'Sunbini', vervain Verbena 'Patio Blue', and *Portulaca umbraticola* 'Duna Red'.

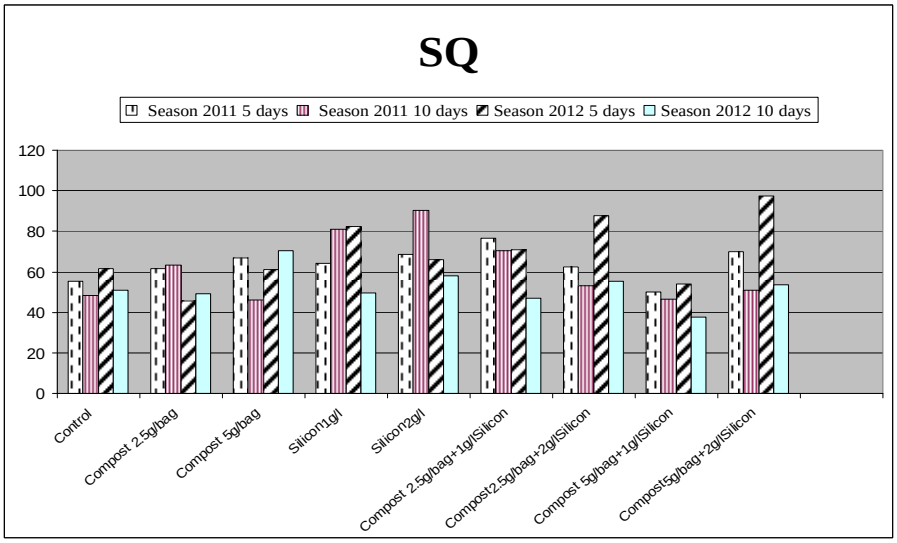

Fig. 1: Effect of compost, silicon, irrigation periods and their combined treatments on the seedling quality (SQ) of *Taxodium distichum* seedlings during 2011and 2012 seasons.

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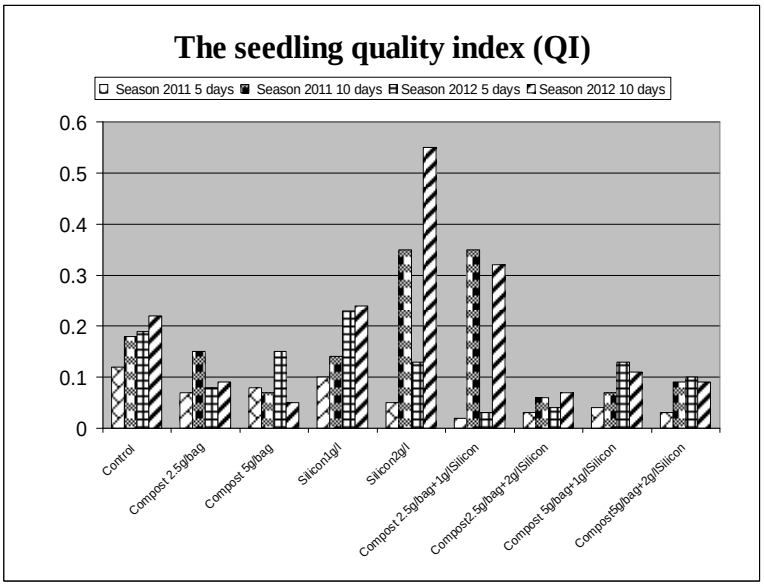

Fig. 2: Effect of compost, silicon, irrigation periods and their combined treatments on the seedling quality index of *Taxodium distichum* seedlings during 2011and 2012 seasons.

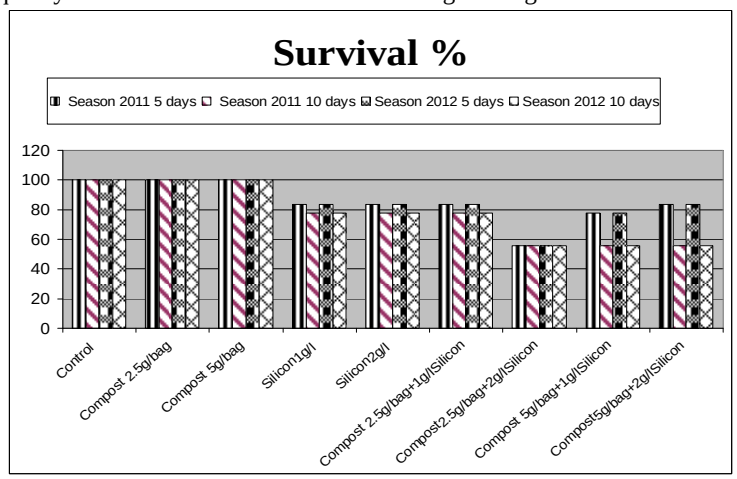

Fig. 3: Effect of compost, silicon, irrigation periods and their combination on survival% of *Taxodium distichum* seedlings during 2011and 2012 seasons.

Chemical composition:

Pigments:

Table (4a) show that 10 days of irrigation increased the contents of chlorophyll (a), carotenoids and total chlorophyll comparing with that obtained from 5 days of irrigation. Meanwhile, irrigation at 5 days interval significantly increased the content of chlorophyll (b) in the leaves. However, **Table (4b)** indicate that addition compost at 2.5g/bag significantly maximized the content of all pigments content in the current study (chlorophyll a & b, carotenoids and total chlorophyll)in comparison with that gained from the other treatments used under investigation. The interaction effect of compost, silicon, and irrigation periods on the content of pigments of *Taxodium distichum* seedlings **(Table 4c)** cleared that foliar spray with silicon at 1g/l significantly improved chlorophyll (a) content in both periods of irrigation, comparing with that registered from the other interactions. Meanwhile, chlorophyll (b) was statistically increased by using compost at 2.5g/bag as compared with the other interaction in the two periods of irrigation .On the other hand, carotenoids was increased by the addition of compost at 5gm/bag plus 1g /l silicon, when seedling were irrigated every 5 days, of irrigation .Meanwhile, irrigation every 10 days without any treatments, was superior for increasing the content of carotenoids, comparing with that obtaining from the other treatments used. Total chlorophyll (a+ b) was significantly maximized when seedlings treated with compost at 2.5g /bag in two periods of irrigation.

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Table 4a: Effect of irrigation periods on pigments content in leaves of *Taxodium distichum* seedlings during 2012 season.

Treatments	Chlorophyll (a) (mg/g f.w.)	Chlorophyll (b) (mg/g f.w.)	Carotenoids (mg/g f.w.)	Total Chlorophyll (a+b) (mg/g f.w.)
Irrigation at 5 days intervals	1.09B	0.36A	0.99B	1.46B
Irrigation at 10 days intervals	1.29A	0.18B	1.09A	1.54A

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

Table 4b: Effect of compost, silicon, and their combination on pigments content in leaves of *Taxodium distichum* seedlings during 2012 season.

Treatments	Chlorophyll (a) (mg /g f. w.)	Chlorophyll (b) (mg/g f. w.)	Carotenoids (mg/g f. w.)	Total Chlorophyll (a + b) (mg/g f. w.)
Control	1.54A	0.38B	1.18A	1.92B
Compost at 2.5g/bag	1.59A	1.04A	1.16A	2.62A
Compost at 5g/bag	1.09 B	0.13 B	0.98BD	1.23C
Silicon 1 g/l	1.62A	0.18 B	1.12AB	1.79B
Silicon 2g/l	0.89 B	0.11 B	1.01BD	1.03D
Compost at 2.5g /bag + 1 g/l silicon	1.04 B	0.17 B	0.96CD	1.22C
Compost at 2.5g /bag + 2g /l silicon	1.03 B	0.18 B	0.93D	1.23C
Compost at 5g /bag + 1 g/l silicon	1.05 B	0.11 B	1.09AC	1.36C
Compost at 5g /bag + 2g /l silicon	0.89 B	0.15 B	0.91D	1.06D

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

Table 4c: Effect of compost, silicon, irrigation periods and their combination on pigments content in leaves of *Taxodium distichum* seedlings during 2012 season.

Treatments	Chlorophyll (a) (mg/g f.w.)		Chlorophyll (b) (mg/g f.w.)		Carotenoids (mg/g f.w.)		Total Chlorophyll (a+b) (mg/g f.w.)	
Irrigation periods	5days	10days	5days	10days	5days	10days	5days	10days
Control	1.52B	1.55B	0.54B	0.22BC	1.17AB	1.19A	2.06B	1.77B
Compost at 2.5g /bag	1.47C	1.69A	1.61A	0.47A	1.14B	1.18B	3.08A	2.16A
Compost at 5g /bag	0.83F	1.35C	0.11D	0.17CD	0.82E	1.15C	0.94F	1.52D
Silicon 1g /l	1.57A	1.67A	0.24C	0.11DF	1.04C	1.20A	1.81C	1.78B
Silicon 2g /l	0.87E	0.91E	0.17CD	0.11DF	1.07C	0.96G	1.04E	1.02F
Compost at 2.5g /bag + 1g /l silicon	0.85EF	1.23D	0.22C	0.13DE	0.82E	1.11D	1.07E	1.36E
Compost at 2.5g /bag + 2g /l silicon	0.71G	1.35C	0.11D	0.28B	0.78F	1.09E	0.82G	1.63C
Compost at 5g /bag + 1g /l silicon	1.14D	0.95E	0.11D	0.10EF	1.18A	1.02F	1.25D	1.46D
Compost at 5g /bag + 2g /l silicon	0.84EF	0.96E	0.19C	0.12DE	0.86D	0.96G	1.03E	1.08F

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

Total indoles and phenols:

Data in **Tables (5 a, b and Fig (4)** indicate that irrigation at 10 days interval significantly increased the content of phenols in the current study. Meanwhile, **Table (5 b**) reveal that all treatments gave insignificant increases in either total indoles or phenols. Data registered in **Fig(4)** show also that the lowest content of total indoles was registered by using compost at 5gm /bag plus silicon at 2g/l treatment at 5 days of irrigation, but irrigation every 10 days gave insignificant increase on the same constituents. Total phenols on the other side, was significantly increased by addition of compost at 2.5g/bag when seedlings were irrigated every5 days, but the lowest content (0.14mg/g) was occurred by irrigation every 10 days.

Likewise, the beneficial effect of irrigation in improving some plant parameters of *Taxodium distichum* L. seedlings in the current study was also noticed by many researchers on the other plants. In this connection Garas (2011) on *Hibiscus rose sinensis* plants claimed that the lowest irrigation level (0.50 l/ pot) or the moderate one (0.75 l/pot) were the best for raising the accumulation rate of plant chemical constituents.

Table 5a: Effect of irrigation periods treatments on total indoles and phenols of *Taxodium distichum* seedlings during 2012 season.

Treatments	Total indoles mg/g	Total phenols mg/g
Irrigation at 5 days intervals	0.12B	0.18A
Irrigation at 10 days intervals	0.15A	0.17A

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

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Table 5b: Effect of compost, silicon, and their combination on total indols and phenols content in leaves of *Taxodium distichum* seedlings during 2012 season.

Treatments	Total indoles (mg/g f.w.)	Total phenols (mg/g f.w.)
Control	0.09A	0.16A
Compost at 2.5g /bag	0.14A	0.22A
Compost at 5g /bag	0.14A	0.16A
Silicon 1g /l	0.15A	0.18A
Silicon 2g /l	0.15A	0.16A
Compost at 2.5g /bag + 1g /l silicon	0.15A	0.15A
Compost at 2.5g /bag + 2g /l silicon	0.12A	0.17A
Compost at 5g /bag + 1g /l silicon	0.15A	0.17A
Compost at 5g /bag + 2g /l silicon	0.11A	0.21A

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

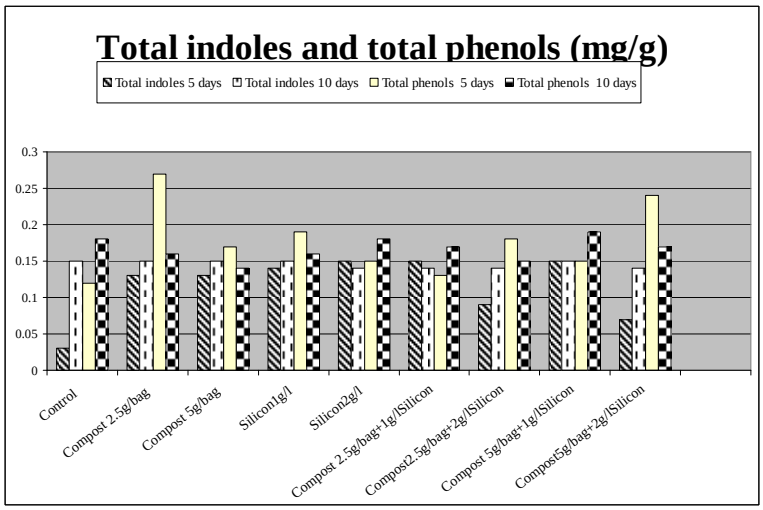

Fig. 4: Effect of compost, silicon, irrigation periods and their combination treatments on total indoles and phenols content in leaves of *Taxodium distichum* seedlings during 2012 season.

Conclusion:

From the aforementioned results, it could be recommended the use of compost at 2.5 g/bags with irrigation at 10 days interval for the best growth of *Taxodium distichum* seedlings and to obtain attractive and high quality of *Taxodium distichum* seedlings,with shortening the growth duration in nursery and reducing the coast of seedlings production and save our environment.

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