SINAI Journal of Applied Sciences (ISSN: 2314-6079) Vol. (6) Is. (2), Aug. 2017 101-110

SINAI Journal of Applied Sciences

ARU-EGYPT SJAS Trust Science | It Creates

# IMPACT OF IRRIGATION WITH TREATED WASTE WATER ON GROWTH OF (*Casuarina equistefolia*) SEEDLINGS UNDER SINAI CONDITIONS

**Tarek. A. Ali[1*]; Hassan, H.M.S.[2]; El-Mekawy M.A.[2] and Ali, M.A.M.[2]**

1. Company of drinking water and Wastewater, North and South Sinai, Egypt.
2. Dept. Plant Prod., Fac. Environ. Agric. Sci., Arish Univ., Egypt.

## ABSTRACT

This study was conducted at the Experimental Farm, Fac. Environ. Agric. Sci., El-Arish at North Sinai Governorate, Egypt during the period from May 2014/ May 2016 to study the effect of some irrigation treatments on vegetative growth and chemical composition of *Casuarina equistefolia* Seedlings. Seedlings were planted and two types of water were used (wells water and treated waste water to irrigate at the following rates (wells water 100% - wells water 75%: 25% treated waste water - 50% wells water: 50% treated waste water - wells water 25%: 75% treated waste water - 100% treated waste water). Three irrigation intervals were used for each of the previous five treatments every one, two and three weeks. In each treatment the following measurements were taken i.e. plant height, number of main shoots, the main stem diameter. These measurements were taken every three months over a full 2 seasons (24 months).At the end of the experiment leaves were taken from Casuarina to determint N, P and K. Results of these study revealed that irrigation with 100% treated waste water (T.W.W) increased the growth and chemical composition (N, P and K) of *Casuarina equistefoli*a Seedlings compared with others Types water. These findings suggested that, dependence on treated waste water mainly in irrigation of wood trees and makes it a major source to produce some kinds like Casuarina.

**Key words:** *Casuarina equistefolia*, treated waste water, vegetative growth, wells water.

## INTRODUCTION

In Egypt, traditionally, there are four options, to deal with the treated domestic waste water effluent: by recycling into reuse system, discharge to a nearby desert vent water land, by discharge to a nearby sea or costal lakes or by discharge to Nile River main stream, branches or agricultural drain canals **(Hassan, 2015).** Benefiting from treated waste water and transforming it into an economic value sharing in some offsetting the high costs of for establishing waste water treatment plants, establishing a wood factory to be used in the manufacturing of furniture, housing and coal industries and all wood products production such as paper, particleboard, plywood, block board and fiber board so can replace imported wood by locally produced wood, which would improve the balance of payment, create job opportunities for genders living in these areas, protection against desertification, erosion, sand dune fixation, using nutrients in the waste water for productive purposes so reduce the need for applying chemical fertilizers, eliminate or reduce the need for costly and complicated waste water treatment processes. In particular the removal of nitrogen and phosphorus is unnecessary, exploiting marginal lands and poor, which is not suitable for the cultivation of traditional crops in deserts

* **Corresponding author: Tel.:** +201063432627
**E-mail address:** tota1386@yahoo.com

and turn them into green lands (forests) that can used as domestic tourist sites and as entertainment places for the residents in the new cities without any direct contact with this water (**Hassan, 2015**).

*Casuarina equistifolia,* belongs Family Casurinaceae is a large fast growing evergreen tree with graceful appearance resembles a feathery conifer. Bole is long and cylindrical. In rare cases and in the interiors, there are instances of developing thick branches. In it is natural state it is gregarious, forming pure crops with little or no under growth except grass and sporadic shrubs. The tree attains height up to 40 m with diameter of 60 cm (180 cm girth) often, buttressed at the base. It is short lived; its natural span of life seldom exceeds 50 years. In less favorable localities, it turns misshapen and hollow beyond 25 years of age **(Dean, 2010)**.

Casuarinas are commonly used in agroforestry plantations for soil stabilization, reclamation and coastal protection **Zhang *et al.* (2013).** They act as pioneer trees for degraded sites and for soil improvement there is no other species that can replace them at the foreshores. Low soil fertility will slow growth. However, *Casuarina equisetifolia* is characterized by high primary productivity in coastal sandy soils **Zhang *et al.* (2013).**

The aim of this study is to determine the effect of using treated waste water on the growth and chemical constitutes of Casuarina plant comparing to local wells water irrigation.

## MATERIALS AND METHODS.

The present study was conducted at the Experimental Farm, Fac. of Environmental Agric. Sciences, Arish Univ, during the period from May 2014/ May 2016, to study the effect of some irrigation treatments on vegetative growth and some chemical composition of *Casuarina equistefolia* seedlings. The seedlings were healthy and uniform and planted on May 2014 in sandy soil at the distance of 2x2 m. The seedlings were transplanted to the soil at one year old, flooding irrigation system was applied. Physical and chemical properties of the experimental soil are listed in Table (A). Also, chemicals analysis for wells water and treated waste water are listed in Table (B).

### The Experimental Treatments

### Irrigation water types

Two types of water were used to irrigate the seedlings at the following rates:

1- 100% wells water (W.W) (control)

2- 75% wells water (W.W): 25% treated waste water (T.W.W).

3- 50% wells water (W.W): 50% treated waste water (T.W.W).

4- 25% wells water (W.W): 75% treated waste water (T.W.W).

5-100% treated waste water (T.W.W).

### Irrigation intervals

Three irrigation intervals were used for each of the previous five treatments as follows :

1- Irrigation after one week (7 days).

2- Irrigation after two weeks (14 days).

3- Irrigation after three weeks (21 days).

### Recorded Data

The following data were recorded in the two seasons.

### Vegetative growth characteristics

**a- Plant height (cm):** for each treatment, total height of seedlings was measured from ground level to the top of the seedlings using a graduated stake.

**b- Main shoots number:** for each treatment, total number of main shoots by take number main shoots which coming out of the main leg.

**Table (A): Some initial chemical and physical characteristics of soil.**

| Parameter | Soil | |
|---|---|---|
| | May 2014- May 2015 | May 2015 – May 2016 |
| | Soluble ions* meq.$L^{-1}$ (soil past extract) | |
| $Ca^{++}$ | 3.03 | 2.10 |
| $Mg^{++}$ | 2.11 | 2.20 |
| $Na^{+}$ | 1.18 | 4.49 |
| $K^{+}$ | 0.48 | 0.31 |
| $Cl^{-}$ | 1.02 | 2.30 |
| $Co_3^{--}$ | n.d | n.d |
| $Hco_3^{-}$ | 2.00 | 2.40 |
| $So_4^{--}$ | 3.78 | 4.40 |
| EC ($dsm^{-1}$) | 0.68 | 0.91 |
| pH | 8.10 | 8.20 |
| Organic carbon ($g.kg^{-1}$) | 0.93 | 1.22 |
| Organic mater ($g.kg^{-1}$) | 1.60 | 2.10 |
| Ca $CO_3$ ($g.kg^{-1}$) | 3.95 | 3.95 |
| Clay (%) | 0.16 | 0.16 |
| Silt (%) | 0.33 | 0.33 |
| Fine sand (%) | 76.1 | 76.1 |
| Coarse sand (%) | 18.71 | 18.71 |
| Soil texture | Sandy soil | Sandy soil |

**Table (B): Some initial chemical characteristics of Wells water and treated waste water during (May 2014-May 2016).**

| Parameter | Water types (May 2014-May 2016) | |
|---|---|---|
| | Wells water | Treated waste water |
| $Ca^{++}$ (mg/l) | 18.12 | 23.6 |
| $Mg^{++}$ (mg/l) | 20.20 | 27.1 |
| $Na^{+}$ (mg/l) | 17.72 | 30.3 |
| $K^{+}$ (mg/l) | 0.25 | 0.41 |
| $Cl^{-}$ (mg/l) | 38.40 | 40.1 |
| $Co_3^{--}$ (mg/l) | n.d | 0.2 |
| $Hco_3^{-}$ (mg/l) | 6.25 | 10.13 |
| $So_4^{--}$ (mg/l) | 11.64 | 15.7 |
| $Ca\ CO_3$ ($g.kg^{-1}$) | - | 1.9 |
| pH | 6.70 | 7.62 |
| Temperature of water (c) | - | 25.92 |
| EC (dsm-1) | 5.65 | 5.80 |
| Turbidity(mg/l) | - | 122.76 |
| TDS (mg/l) | - | 1890 |
| TSS (mg/l) | - | 157.91 |
| Nitrate (mg/l) | - | 6.84 |
| Ammonia (mg/l) | - | 4.6 |
| Phosphate (mg/l) | - | 1.77 |
| T.V.B (mg/l) | - | 106.54 |
| Cholera (mg/l) | - | 165 |
| Coliform (mg/l) | - | 72.29 |
| D.O (mg/l) | - | 3.37 |

**EC**: Electrical conductivity

**T.D.S**: Total dissolved solids

**D.O**: Dissolved oxygen

**T.S.S**: Total suspended solids

**T.V.B**: Total viable bacteria

**c- Stem diameter (cm):** The diameter (cm) of the seedlings was recorded at 5 cm above the ground by using a caliper.

**Chemical constituents in plant**

Chemical analysis were determined in dried samples of leaves at $70^0$C taken, half gram powder of dried plant material of each sample was acid digested using a mixture of sulfuric and perchloric according to **(Chapman and Pratt, 1961).** The digest was analyzed for nitrogen and phosphorus according to the standard **(AOAC, 1975).** Potassium was determined in the digest using flame photometer **(Jackson, 1973**).

**Experiment design and Statistical analysis**

The obtained data were statistically analyzed according to the method described by **(Duncan, 1955).** Mean separation between means was performed by using Duncan, s (L.S.R) least significant Range.

## RESULTS AND DISCUSSION

## Vegetative Growth

**Plant height (cm)**

Results of (Table 1) clear that, there is no significant increase in *Casuarina equestifolia* plant height under all mentioned treatments after 3 monthes from planting. While, *Casuarina equestifolia* plant height significantly increased gradually after 6 monthes till 24 monthes. Also, presented results showed that, plant height recorded the highest value (584.25 cm) after 24 monthes when seedlings irrigated with 100% T.W.W every 7 days. On the other side, irrigation with 100 % wells water every 21 days after 24 monthes from planting recorded the lowest plant height (246.50 cm).

**Number of main shoots**

Results presented in Table (2) show that there is no significant increase in *Casuarina equestifolia* in number of main shoots under all mentioned treatments after 3 monthes from planting. While, *Casuarina equestifolia* main shoots number significantly increased after 6 monthes till 24 monthes. Also, presented results showed that, the greatest main shoots number was recorded 76.25 after 24 monthes with seedlings irrigated with 100 % (T.W.W) every 7 days. While, the least main shoots number's was recorded 17.50 which seedlings irrigated with (100% W.W) every 21 days.

**Stem diameter (cm)**

Results presented in Table (3) show that there was a significant increase in stem diameter after 3 monthes till 24 monthes. Also, presented results show that the highest value of stem diameter obtained (17.27 cm) after 24 monthes when seedlings irrigated with 100 % (T.W.W) every 7 days. While, the lowest value recorded by irrigation with (100% W.W) every 21 days (7.20 cm).

Similar results were obtained by **Ali *et al.* (2011)** they studied the effect of sewage irrigation treatments (primary and secondary effluents) compared with tap water on the growth of mahogany seedlings (*Swietenia mahagoni* (L.) Jacq) they found that, the primary effluent treatment was superior than other treatments in improving the growth parameters (plant height, stem diameter, leaf area, leaf number, fresh and dry weights of leaves, shoots and roots and shoot/root ratio). and these results are in aharmony with those found by **Guo and Smis (2000)** on *Eucalyptus globules*, **Khamis and Hassan (2012)** on *Tipuana speciosa*.These results are in accordance with those found by **Hassan *et al.* (2006)** who selected three types of trees *Taxodium distichum, Albizzia lebbek and Tipuana speciosa* on a farm in New Borg El Arab age one year for irrigation and treated with waste water-primary treated and the results showed that all the trees gave critical mass greater than those treated ordinary water. These results explained by many investigators, who found that irrigation with

**Table (1): Effect of some irrigation treatments on plant height (cm) of *Casuarina equestifolia* from May 2014 to May 2016**

| Treatment | | Plant height (cm) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Water types | Irrigation interval | After 3 months from planting | After 6 months from planting | After9 months from planting | After12 months from planting | After15 months from planting | After18 months from planting | After21 months from planting | After24 months from planting |
| 100%(W.W) | 7 days | 118.75 a | 142.75 ab | 146.75 ab | 171.75 a-d | 211.75 de | 246.75 ef | 256.75 ef | 306.75 gh |
| | 14 days | 118.00 a | 132.50 ab | 140.50 ab | 160.50 b-d | 194.50 e | 224.50 fg | 232.50 fg | 272.75 h-j |
| | 21 days | 113.25 a | 130.00 ab | 140.25 ab | 155.25 b-d | 185.25 e | 210.25 g | 216.25 g | 246.25 j |
| 75% (W.W) : 25% (T.W.W) | 7 days | 114.50 a | 144.00 ab | 148.25 ab | 174.25 a-d | 229.25 cd | 274.25 de | 286.25 de | 356.25 f |
| | 14 days | 110.25 a | 133.20 b | 146.25 b | 146.25 d | 186.25 e | 226.25 fg | 236.25 fg | 286.25 g-i |
| | 21 days | 105.50 a | 125.00 ab | 139.00 ab | 154.00 b-d | 184.00 e | 219.00 fg | 227.00 fg | 262.00 ij |
| 50% (W.W): 50% (T.W.W) | 7 days | 125.75 a | 153.25 ab | 157.25 ab | 184.25ab | 259.25 bc | 319.25 c | 334.25 c | 434.25 d |
| | 14 days | 106.25 a | 138.00 ab | 141.00 ab | 164.00 a-d | 229.00 cd | 284.00 d | 296.00 d | 366.00 f |
| | 21 days | 123.75 a | 135.00 ab | 137.00 ab | 151.00 cd | 209.50 de | 259.50 de | 269.50 de | 319.50 g |
| 25% (W.W): 75% (T.W.W) | 7 days | 106.25 a | 146.00 ab | 151.50 ab | 179.50 a-c | 269.50 b | 349.50 bc | 366.50 b | 486.50 b |
| | 14 days | 108.25 a | 144.25 ab | 148.25 ab | 173.25 a-d | 253.25 bc | 323.25 c | 335.75 c | 435.75 cd |
| | 21 days | 114.25 a | 137.50 ab | 140.50 ab | 158.50 b-d | 228.50 cd | 288.50 d | 298.75 d | 378.75 ef |
| 100% (T.W.W) | 7 days | 127.50 a | 161.20 a | 166.25 a | 194.25 a | 314.25 a | 414.25 a | 434.25 a | 584.25 a |
| | 14 days | 112.50 a | 142.75 ab | 148.75 ab | 177.75 a-d | 277.75 b | 362.75 b | 377.75 b | 452.75 bc |
| | 21 days | 126.25 a | 139.50 ab | 142.50 ab | 160.50 b-d | 250.50 bc | 320.50 c | 330.50 c | 410.50 de |

Means having the same letters within the same column are not significantly different according to Dunchan's multiple range tests at 5% level of probability.
**(W.W)**: wells water, **(T.W.W)** Treated waste water

**Table (2): Effect of some irrigation treatments on number of main shoots of *Casuarina equestifolia* from May 2014 to May 2016**

| Treatment | | Number of main shoots | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Water types | Irrigation interval | After 3 months from planting | After 6 months from planting | After9 months from planting | After12 months from planting | After15 months from planting | After18 months from planting | After21 months from planting | After24 months from planting |
| 100%(W.W) | 7 days | 3.75 a | 6.50 e-g | 8.50 b-e | 16.50 d | 22.50 fg | 27.50 g | 30.50 e | 35.50 g |
| | 14 days | 3.00 a | 5.50 fg | 6.50 fg | 11.50 ef | 16.50 j | 20.50 i | 22.50 h | 25.50 j |
| | 21 days | 4.25 a | 4.25 g | 4.25g | 7.25 h | 11.25 l | 14.50 k | 15.50 j | 17.50 l |
| 75% (W.W): 25% (T.W.W) | 7 days | 3.00 a | 7.00 ef | 10.00 de | 17.75 d | 24.75 ef | 30.75 f | 34.75 e | 41.75 f |
| | 14 days | 3.25 a | 6.50 e-g | 8.50 b-e | 13.50 e | 19.50 hi | 24.50 h | 27.50 g | 32.50 h |
| | 21 days | 2.50 a | 5.75 e-g | 5.75 fg | 8.75 gh | 13.75 k | 17.75 j | 19.75 i | 22.75 k |
| 50 (W.W) : 50 (T.W.W) | 7 days | 3.00 a | 8.50 b-e | 13.50 b | 22.50 bc | 31.50 c | 39.50 de | 44.50 c | 54.50 c |
| | 14 days | 3.00 a | 8.50 b-e | 10.75 cd | 17.75 d | 25.75 e | 31.75 f | 34.75 e | 41.75 f |
| | 21 days | 3.75 a | 6.00 e-g | 6.00 fg | 10.00 fg | 17.00 ij | 22.00 i | 23.00 h | 28.00 i |
| 25 (W.W) : 75 (T.W.W) | 7 days | 3.50 a | 9.75 a-c | 14.75 b | 24.75 b | 34.75 b | 44.75 b | 51.75 b | 63.75 b |
| | 14 days | 3.00 a | 9.50 a-d | 11.75 bc | 20.75 c | 28.75 d | 36.75 e | 41.75 d | 51.75 d |
| | 21 days | 3.25 a | 7.75 c-f | 7.75 ef | 12.75 e | 18.75 ij | 25.75 gh | 28.75 fg | 36.75 g |
| 100 (T.W.W) | 7 days | 4.00 a | 11.25 a | 15.25 a | 27.25 a | 39.25 a | 51.25 a | 61.25 a | 76.25 a |
| | 14 days | 3.25 a | 10.50 ab | 14.00 b | 22.00 c | 32.00 c | 42.00 c | 50.00 b | 61.75 b |
| | 21 days | 2.50 a | 8.50 b-e | 8.50 b-e | 13.50 e | 21.50 gh | 30.50 f | 35.50 e | 45.50 e |

Means having the same letters within the same column are not significantly different according to Dunchan s multiple range tests at 5% level of probability.

**(W.W)**: wells water, **(T.W.W)** Treated waste water.

**Table (3): Effect of some irrigation treatments on stem diameter (cm) of *Casuarina equestifolia* from May 2014 to May 2016.**

| Treatments | | Stem diameter (cm) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Water types | Irrigation interval | After 3 months from planting | After 6 months from planting | After9 months from planting | After12 months from planting | After15 months from planting | After18 months from planting | After21 months from planting | After24 months from planting |
| 100%(W.W) | 7 days | 4.06 a-c | 4.33 a-c | 5.33 bc | 6.33 c-f | 7.83 ef | 8.83 fg | 9.33 ef | 10.33 f |
| | 14 days | 4.35 a-c | 4.55 a-c | 5.05 bc | 5.55 e-g | 6.55 gh | 7.35 i | 7.65 hi | 8.45 h |
| | 21 days | 4.24 a-c | 4.44 a-c | 4.74 b-d | 4.99 gh | 5.97 hi | 6.57 ij | 6.77 jk | 7.20i |
| 75%(W.W) : 25% (T.W.W) | 7 days | 3.90 bc | 4.15 bc | 5.35 bc | 6.66 c-e | 8.39 d-f | 9.69 d-f | 10.54 d | 11.64 de |
| | 14 days | 3.70 bc | 3.86 bc | 4.38 cd | 5.13 f-h | 6.63 gh | 7.63 hi | 8.13 gh | 9.13 gh |
| | 21 days | 3.30c | 3.50 c | 3.80 d | 4.30 h | 5.30 i | 6.10 j | 6.40 j | 7.27 i |
| 50%(W.W):50% (T.W.W) | 7 days | 5.27 a | 5.55 a | 6.85 a | 8.77 a | 10.35 ab | 12.15 b | 13.15 b | 14.65 b |
| | 14 days | 4.65 ab | 4.74 a-c | 4.84 bc | 6.44 c-e | 8.24 ef | 9.74 d-f | 10.54 d | 11.79 d |
| | 21 days | 4.19 a-c | 4.28 bc | 4.98 b-d | 5.73 d-g | 7.23 fg | 8.53 gh | 9.03 fg | 10.03 fg |
| 25%(W.W):75% (T.W.W) | 7 days | 4.12 a-c | 4.37 a-c | 5.87 ab | 7.37 bc | 9.67 bc | 11.67 bc | 12.92 b | 14.67 b |
| | 14 days | 4.48 a-c | 4.65 a-c | 5.65 ab | 6.90 cd | 8.90 c-e | 10.70 cd | 11.70 c | 13.20 c |
| | 21 days | 3.85 bc | 4.01 bc | 4.81 b-d | 5.81 d-g | 7.61 fg | 9.11 e-g | 9.61 d-f | 10.61 ef |
| 100% (T.W.W) | 7 days | 4.83 ab | 4.97 ab | 6.77 a | 8.38 ab | 11.27 a | 13.77 a | 15.27 a | 17.27 a |
| | 14 days | 3.83 bc | 4.18 bc | 5.68 ab | 7.18 c | 9.48 b-d | 11.78 bc | 12.78 b | 14.28 b |
| | 21 days | 3.78 bc | 4.22 bc | 5.22 bc | 6.22 c-f | 8.22 ef | 10.22 d-e | 10.72 d | 11.72 d |

Means having the same letters within the same column are not significantly different according to Dunchan's multiple range tests at 5% level of probability.
**(W.W)**: wells water, **(T.W.W)** Treated waste water

different ratio of treaeted sewage water had stimulation effect on vegetative growth of trees **Kaneker *et al.* (1993**) on ***Acacia nilotica*, Berbec *et al.* (1999**) on poplar, **Bhati and Singh (2003**) on *Eucalyptus camaldulensis* and **(El-Sayed 2005)** on *Ceratonia siliqua.*

## Chemical Composition (N, P and K)

Results presented in Table (4), the N percentage affected significantly with the mention treatments and recorded (4.50%). While, the lowest N% was belonged to irrigation with (100% W.W) every 21 days and recorded (1.28%). Also, P percentage recorded the same trend with significant diffrances between all treatments in this regarde and the irrigation with (100% T.W.W) every 7 days recorded the highest P% value (0.42%) On the other side the minimum P% was belonged to irrigation with (100% W.W) every 21 days (0.09%). While, K percentage may have the same trend also with a significant diffrances between all irrigation treatments. The maximum K (%) was obtained by irrigation with (100% T.W.W) every 7 days (4.188%). Where as, the minimum K (%) was belonged to irrigation with (100% W.W) every 21 days and recorded (0.62%).

These results are in a greement with those found by **Abd El-Aal and Shetta (2007)** they studied the effect of sewage water irrigation on growth *Eucalyptus camaldulensis* and found that a hight increase in morale in the securities of the total chlorophyll content and increase the proportion of the elements Fe, Cu, N, P, K, Na and Ni also, In the parts of different plant, on three periods (6, 12, 18 months). Also**, Salehi *et al.* (2009)** they studied the effect of irrigation waste water and wheel water on *Robinia pseudoacacia* plant and the results were an increase in the concentration of phosphorus (P), nitrogen (N) and potassium (K) and increase on concentrations of certain elements such as: zinc (Zn), iron (Fe) and copper (Cu) in the water treatment plants for sewage treatment compared with those of water wells.

**Table (4): Effect of some irrigation treatments on chemical composition (N, P and K) of *Casuarina equestifolia* seedlings from May 2014 to May 2016.**

| Treatment | | N | P | K |
|---|---|---|---|---|
| Water type | Irrigation interval | (%) | (%) | (%) |
| 100% (W.W) | 7 days | 1.80 j | 0.18 fg | 1.07 j |
| | 14 days | 1.60 l | 0.12 hi | 0.70 l |
| | 21 days | 1.28 n | 0.09 g | 0.62 m |
| 75% (W.W): 25% (T.W.W) | 7 days | 1.92 i | 0.20 ef | 1.48 i |
| | 14 days | 1.69 k | 0.15 gh | 0.96 k |
| | 21 days | 1.54 m | 0.10 g | 0.73 l |
| 50%(W.W): 50% (T.W.W) | 7 days | 3.66 c | 0.31 a | 1.76 f |
| | 14 days | 2.89 g | 0.27 cd | 1.54 h |
| | 21 days | 2.70 h | 0.19 e-g | 1.07 j |
| 25%(W.W): 75% (T.W.W) | 7 days | 4.05 b | 0.38 a | 2.23 c |
| | 14 days | 3.21 d | 0.29 bc | 1.88 e |
| | 21 days | 2.95 f | 0.23 de | 1.63 g |
| 100% (T.W.W) | 7 days | 4.50 a | 0.42 a | 4.188 a |
| | 14 days | 3.62 c | 0.33 b | 2.44 b |
| | 21 days | 3.15 e | 0.29 bc | 2.04 d |

## Conclusion

The results demonstrated that:

1- The best treatment is irrigation with 100% treated waste water (T.W.W) every 7 days for *casuarina equestifolia* seedlings.

2- Dependence on treated wastewater mainly depends on the cultivation of woody trees and makes it a major source to produce some kinds like Casuarina.

## REFERENCES

**Abd El-Aal, M.A.M. and Shetta, N.D. (2007).** Extractive cellulose, hemicellulose and ash content variation in *Ecualyptus camaldulensis* trees grown in Egypt. Alex. J. Agric. Res., 52(2): 57-61.

**Ali, H.M.; El-Mahrouk, E.M.; Hassan, F.A. and El-Tarawy, M.A. (2011).** Usage of sewage effluent in irrigation of some woody tree lants. Part 3: *Swietenia mahogni* (L.) Jaq. Saui J. Biol. Sci., 18: 201-207.

**AOAC (1975).** Official Methods of Analysis 12th Ed. Washington, D.C.

**Berbec, S.; Sugier, C. and Szewczuk, D. (1999).** The effect of irrigation with municipal sewage on the catching and growth rate of poplar trees. Folia Univ. Agric., 77:27-31.

**Bhati, M. and Singh, G. (2003).** Growth and mineral accumulation in *Eucalyptus*

*camaldulensis* seedlings irrigated with mixed industrial effluents. Bioresource Technol. 88, 221.

**Chapman, H.D. and Pratt, P.F. (1961).** Methods of Analysis for Soils, Plants and Water. Univ. California, Berkeley, CA, USA.

**Dean (2010).** The Dean Forest College and Research Institute, Tamil Nadu Agricultural University, Mettupalayam, Tamil Nadu p. No. 301.

**Duncan, B.D. (1955).** Multiple Range and Multiple F test. Biometrics 11:1-42.

**El-Sayed, N.A.A. (2005).** Impact of irrigation with waste water effluent on soil Bio-pysicocl properties and on growth and heavy metals content of some fodder trees grown on calcium. Ph.D Thesis, Tanta University, Tanta Egypt.

**Guo, Y.T. and Sims, R.E.H. (2000).** Effect of meat works effluent irrigation on soils, tree biomass production and nutrient uptake in *Ecualyptus globulus* seedlings in growth cobinets. Bioresource Technol., 72: 243-251.

**Hassan, F.A. (2015).** Study of some technological properties of woods of some timber trees grown on municipal waste water. M.Sc. Forestry and Wood Technol., Fac. Agric., Alexandria Univ., p. 9-11.

**Hassan, F.A.; Nasser, R.A.; Hegazy, S.S. and El-Sayed, N.A.A. (2006).** Biomass performance, specific gravity, and fiber lengh for three tree species irrigated with sewage effluent and the persistence and distribution of pollution indicator bacteria in soil. Proc. 1st Inter. Conf. Strategy of Botanic Gardens Bull. CAIM Herbarium, Giza, Egypt. 7: 39-52.

**Jackson, M.L. (1973).** Soil Chemical Analysis. Prentice – Hall. India Private Limited, New Delhi.

**Kaneker, P.; Kumbhojkar, M.S.; Ghate, V.; Sarnaik, S. and Kelkar, A. (1993).** Evalution of *Acacia nilotica* (L) Del. and *Casuarina equestifolia* forest for tolerance and growth on microbially treated dyestuff wastewater. Environ. Pollut. 81: 47-50.

**Khamis, A.H. and Hassan, F.A. (2012).** Growth, chemical composition and soil properties of *Tipuana speciosa* (Benth.) Kuntze seedlings irrigated with sewage effluent. Appl. Water Sci., 2: 101–108.

**Salehi, A.; Tabari, M.; Mohammadi, J. and Ali-Azab, A.R. (2009).** Accumulation of Zn, Cu, Ni, and Pb in soil and leaf of *Robinia pseudoacacia* L. following irrigation with municipal effluent. Pajouhesh and Sazandeji, 21: 92-100.

**Zhang, L.H.; Zhang, S.J.; Ye, G.F.; Shao, H.B.; Lin, G.H. and Brestic, M. (2013).** Changes of tannin and nutrients during decomposition of branchlets of *Casuarina equisetifolia* plantationin subtropical coastal areas of China. Plant Soil Environ. 59(2): 74-79.

## الملخص العربي

# تأثير الري بمياه الصرف الصحي المعالجة علي نمو شتلات الكازورينا تحت ظروف سيناء

**طارق عبدالحميد على[١]، هاني محمد سامي حسن[٢]، محمد عبدالحميد المكاوى[٢]، محمد أحمد محمود علي[٢]**

١. الشركة القابضة لمياه الشرب والصرف الصحى بشمال وجنوب سيناء، مصر.
٢. قسم الإنتاج النباتي، كلية العلوم الزراعية البيئية، جامعة العريش، مصر.

أجريت هذه التجربة في المزرعة التجريبية بكلية العلوم الزراعية البيئية، جامعة العريش، محافظة شمال سيناء خلال الفترة من مايو ٢٠١٤ إلى مايو ٢٠١٦ لدراسة بعض معاملات الري على النمو الخضري والتركيب الكيميائي لشتلات شجرة الكازورينا زرعت الشتلات وتم استخدام نوعين من المياه، مياه آبار ومياه صرف صحي معالج وكان الري على النحو التالي (١٠٠% مياه آبار، ٧٥% مياه آبار: ٢٥% مياه صرف صحي معالج، ٥٠% مياه آبار: ٥٠% مياه صرف صحي معالج، ٧٥% مياه صرف صحي معالج: ٢٥% مياه آبار، ١٠٠% مياه صرف صحي معالج) وتم الري على ثلاث فترات: كل أسبوع، كل أسبوعين، كل ثلاثة أسابيع، في كل معاملة تم أخذ القياسات (ارتفاع النبات، عدد الأفرع الرئيسية، قطر الساق) خلال عامين (٢٤ شهر) وفي نهاية التجربة تم أخذ أوراق شتلات الكازورينا وتقدير نسبة النيتروجين، والفوسفور، والبوتاسيوم، قد أثبتت النتائج أن الري بمياه الصرف الصحي المعالج بنسبة ١٠٠% أدى إلى زيادة النمو وزيادة المحتوى الكيميائي من (النيتروجين والفوسفور والبوتاسيوم) مقارنة بباقي المعاملات تحت الدراسة. هذه النتائج تقترح أنه يجب الاعتماد على مياه الصرف الصحي المعالجة اعتماداً أساسياً في زراعة الأشجار الخشبية وغير المثمرة وجعلها مصدراً رئيسياً لري هذه الأنواع مثل أشجار الكازورينا.

**الكلمات الإسترشادية:** كازورينا، مياه الصرف المعالجة، النمو الخضرى ومياه الآبار.

---

**المحكمـــــون:**
**١- أ.د. أحمـد شـاكر حسين** أستاذ الزينة والنباتات الطبية والعطرية، كلية الزراعة، جامعة الزقازيق، مصر.
**٢- أ.د. عمـر رأفـت ربيـع** رئيس بحوث الغابات والأشجار الخشبية، معهد بحوث البساتين، مركز البحوث الزراعية، مصر.