Biological Forum – An International Journal ***(Special Issue 2015)*** **7**(2): 31-34(2015)

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Effect of Saline Water on Morphological Characteristics of *Conocarpus* plant for Using in Green Space of Warm and Arid Cities

Mohammad Jalaly*, Maryam Abdolahpour*, Amineh Hajizadeh*
**Bastak municipality, Hormozgan, Iran*

(Corresponding author: Mohammad Jalaly)
(Received 22 May, 2015, Accepted 25 July, 2015)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: Ecological conditions of warm and arid cities has limited accessing to water and soil resources with good quality water to establishment, maintenance and expansion of green space in these cities. This issue necessitated usage of compatible plant species to high salinity of water and soil. This study assessed the effect of salinity on the morphological characteristics of Conocarpus ornamental plant and to be identified the maximum rate of the water and soil EC which that condition, Conocarpus ornamental plant can be optimal growth. For this purpose, Experiment was conducted with treatment 0,5,10,15 and 20 g/ L Na Cl. The results indicate that with increasing of salinity, fresh weight of root, dry weigh of stem and fresh weigh of stem decreased and There was no significant difference at 5% level of Duncan test. fresh weight of leaf with increasing of levels of salinity decreased but this decrease was not significant in10,15 and 20 gr/lit treatments. The percent of bushes' height increment decrease with increasing of salinity levels, and in 5, 10 and 15 gr/ Lit sodium chloride salt treatment wasn't significantly and in 0 and 15 gr/Lit sodium chloride salt treatment was significantly.

Keywords: Salinity, Fresh and dry weight, Morphological Characteristics, *Conocarpus*

INTRODUCTION

Based on available information, 7% of the world lands are saline. According to FAO report, 12.5% of the country is covered by arid and semi-arid regions with saline and alkaline soil. Several factors including saline groundwater, the presence of saline layers at irrigation soil surface and evaporation, wind effects and surface water flow carrying pollutants cause soil salinity (Kiyani *et al.,* 2006). Fluctuations in rainfall in the country are very great and regarding growing population, cities and industry development, water scarcity is a serious issue and concern of the country planners. In addition to drought, also salinity is presented as an issue and its importance is increasing every day. The issue of water scarcity in most arid and semi-arid regions is a great problem that makes most of the construction activities; including development of urban green space difficult (Dastourani, 2008). Limitations and lack of access to appropriate water and soil sources with appropriate quality for the development of green space and drought and salinity stress are essential issues for green space development in hot and arid cities. These factors have caused the use of saline and unusual water to become very important. But the use of saline irrigation water can cause two major problems in producing the crop (Hasanpour and Darvishi, 2010). On the one hand, proportional to increasing molar concentration of salts in the soil liquid phase, osmotic pressure is increased and water uptake by the roots is hardly done. As far as the upper limit of the concentration prevents plant water feeding, as a result by the presence of sufficient humidity in the roots' activity area at the plant has a physiological drought. On the other hand, high concentration of chloride and sodium (NaCl) and other salts in irrigation water damage the plants due to osmotic effects that slow the absorption of water and also because of sodium inhibitory effect on enzymes in the cytoplasm (Abedi *et al*., 2002). So in order to avoid the effects of salinity, using salinity and drought tolerance species is important (Bagherzadeh *et al*.).

Soleiman *et al*. (2009) in Kuwait in their study examined the resistance of ornamental species *Peltaphorum ferruginum, Thespeisia populnea, Ficus pumila, Duranata goliana, Auamanda cathartica* to salinity at three salinity levels of 0, 2.5 and 5 ds / m and concluded that at different levels, above resistant species have the highest growth and in salinity 5 ds/ m that was the highest salinity of the treatments the plant species have been well grown. In a study that was conducted by Hanafi *et al*. (2010) at Cairo University on conocarpus plant and its response to saline irrigation water at salinity levels in 1500, 2500, 3500 and 4500 ppm it was found that by increasing salinity level the relative growth of the plant was significantly decreased. In addition also it was reported that salinity significantly decreased conocarpus plant height, leaf wet and dry weight and leaf area. In a study that was conducted in Saudi Arabia by L. Johann *et al*. (2003), they concluded that conocarpus seedling is resistant in salt concentration 9000 ppm (9 grams per liter of salt). Irrigation of control treatments, 3, 6 and 9 grams per liter of salt is done every ten days.

The present study was conducted aimed to examine the tolerance of conocarpus ornamental plant to salinity irrigation water in Bastak. In Bastak, due to scattered salt domes in the plains and in addition hot and arid climate, high evaporation and little rainfall, groundwater use is associated with the issue. Currently, in most parts of Bastak plain groundwater is so bad that even is inappropriate for irrigation (Afifi *et al*., 2008). In general, climate limitations, soil and water resources salinity provided inappropriate conditions for natural development of plants in the study area and also created serious obstacles in artificial establishing of plant growth and urban green space. Regarding limited water resources available, the use of saline water, and as well as planting salt-tolerant plant species can both protect water resources, compensate water scarcity needed for the development of urban green space. Conocarpus ornamental plant is one of salt-tolerant plant species and consistent in most parts of the world (Galston, 2002). The question that should be answered is that: Is it possible to use non-conventional water such as saline water for irrigation of conocarpus ornamental plant?

MATERIAL AND METHODS

The experiment examining different levels of salinity on morphological features of conocarpus ornamental plant was done from April 9, 2011 till June 10, 2011 for 60 days in 22 February Park in Bastak. Longitude of Bastak is 54 degrees and 23 minutes and its latitude is 27 degrees and 14 minutes. Height of Bastak above sea level is 485 meters and has hot and arid climate.

The experiment was done in the form of completely random blocks' design. The experiment treatments include:

1. Control treatment, irrigation by the region water (zero treatment), 2. Treatment of 5 grams per liter of salt of sodium chloride, 3. Treatment of 10 grams per liter of salt of sodium chloride, sodium chloride salt, 4. Treatment of 15 grams per liter of salt of sodium chloride, and 5. Treatment of 20 grams per liter of salt of sodium chloride.

Each of the treatments has four replications and each replication has 10 seedlings. In order to conduct the experiment treatments and completely random blocks' design, first the above treatments are written on small papers, then the replications are selected randomly and design layout was determined. After arranging the treatments in the experiment site, control treatment was irrigated by the region water that its information is given as follows (Table 2). For treatments of 5 gr/ L, 10 gr/ L, 15 gr/ L and 20 gr/ L of salt, the amount of salt of each treatment was weighed using a digital scale based on each treatment tanks' volume separately from salt without iodine. The treatments were irrigated based on preparing salt water for 2 months, once every 2 days, by 250 cc of each treatment and alike.

Table 1: Soil Characteristics befor the beginning of experiment.

Row	Depth (Cm)	EC	(ph)	(ppm)Cl	(ppm)Na	(ppm)K
1	0-30	6/78	7/78	1260/25	805	13/26
2	30-60	9/09	8/03	1721/75	1104	17/55

Table 2: Irrigation Water Characteristics.

Characteristics / Treatment	(cm/us)EC	(mg/l)Sal.	Temp
0 gr/l	1856	0/8	30
5 gr /l	9680	5/5	30
10 gr /l	17960	10/8	30
15 gr /l	25600	15/4	30
20 gr /l	32400	20/3	30

After picking the treatments and before beginning, first the primary height and at the end of conducting the experiment also secondary height of all seedlings was measured and recorded with a ruler. Then the samples were taken out (each treatment replication) of the pots and plant samples, including root, stem and leaves were separated. And after washing, their wet weight was measured and recorded by a digital scale.

After measuring wet weight of plant organs (root, stem and leaf), in order to measure their dry weight each plant organs of each treatment replication transferred to the oven was applied for 48 hours at 70 ° C in the oven. And then they were weighed separately in terms of root, stem and leaf by a digital scale and plant organs' dry weight was recorded.

The experiment was analyzed in the form of a completely random blocks' design. Average comparison was conducted using Duncan test at 5% level. Statistical analysis of the raw data was conducted by statistical software Spss and Ms tatc.

RESULTS AND DISCUSSION

According to the results of total data variance analysis on wet and dry average weight of root and stem, the effect of saline water is insignificant between repetitions and treatments. In the case of a leaf wet and dry weight and bush height increase, increasing salinity in the replications is insignificant, but between the treatments is significant at 1% level of Duncan test (Table 3).

Table 3: Analysis of variance on Morphological Characteristics of Conocarpus plant.

S.O.V	df	(MS)						
		Root fresh weight	Root dry weight	Stem fresh weight	Stem dry weight	Leaf Fresh weight	Leaf dry weight	Percent of bushes' height increment
Replication	3	0/577^{ns}	0/135^{ns}	0/034^{ns}	0/010^{ns}	0/080^{ns}	0/009^{ns}	10/236^{ns}
Treatment	4	1/214^{ns}	0/295^{ns}	0/197^{ns}	0/044^{ns}	1/440**	0/418**	92/505**
Error	12	0/632	0/120	0/100	0/033	0/070	0/043	13/626
CV		27/90	38/99	25/55	27/34	24/35	39/31	40/80

ns Not Significant, ** Significant at 1% level of probability.

Examining the results of data analysis in the treatments of 0 gr/ L, 5 gr/ L, 10 gr/ L, 15 gr/ L and 20 gr/ L of sodium chloride salt indicates that by increasing salinity (in grams), wet and dry weight of the root, wet weight of the stem, wet and dry weight of the leaf and bushes' height are decreased in the treatments.

In examining the effect of salinity on the root wet weight, maximum wet weight of the root was observed in 0 grams per liter treatment (control) that had no significant difference with the treatments of 5 grams per liter, 10 grams per liter and 20 grams per liter of sodium chloride salt, and the minimum amount was related to the treatment of 15 grams per liter. Regarding these results it can be concluded that in terms of the root wet weight in grams per liter of sodium chloride salt had no significant difference with the minimum amount of salt used that in this comparison is significant (5 grams per liter) and in the same conditions of temperature, environment and lighting, also conocarpus plant can be irrigated by water that its amount of salt is 20 grams per liter (Ec = 32400 us/ cm) (Table 4).

Table 4: The Effect of Saline Treatments on Morphological Characteristics of Conocarpus Plant.

Characteristics / Treatment	Root fresh weight (gr)	Root dry weight (gr)	Stem fresh weight (gr)	Stem dry weight (gr)	Leaf Fresh weight (gr)	Leaf dry weight (gr)	Height Increase (%)
0 g/l	3/60^{a}	1/13^{a}	1/58^{a}	0/73^{a}	1/97^{a}	0/98^{a}	15/42^{a}
5 g/l	3/18^{ab}	1/18^{a}	1/26^{ab}	0/75^{a}	1/42^{b}	0/72^{ab}	7/80^{bc}
10 g/l	2/78^{ab}	0/76^{ab}	1/26^{ab}	0/67^{a}	0/82^{c}	0/46^{bc}	12/20^{ab}
15 g/l	2/24^{b}	0/52^{b}	1/09^{ab}	0/48^{a}	0/72^{c}	0/22^{c}	3/16^{c}
20 g/l	2/45^{ab}	0/86^{ab}	1/00^{b}	0/68^{a}	0/50^{c}	0/26^{c}	6/66^{bc}

Means within the same column and factors, followed by the same letter aren't significantly difference.

Examining the results of data analysis on the root dry weight and comparing the effect of salinity treatments shows maximum root dry weight was related to the treatment of 5 grams per liter of sodium chloride salt that had no significant difference with the treatments of 0 grams per liter, 10 grams per liter and 5 grams per liter and the minimum amount was observed in the treatment of 15 grams per liter. Therefore, if all the conditions for conocarpus plant growth are provided and only water conditions with compared salinity treatments are provided, for optimized use of saline water resources, water with 5 g/ L of salt is can be used compared to the control (0 g per liter) and also if there is water with 10 and 20 g/ L of salt, for conocarpus plant in terms of examining dry weight and also the saving and optimized use of urban water resources, water with 20 grams per liter of salt is also recommended (Table 4).

Comparison of the effect of salinity treatments on the stem wet weight shows that the maximum stem weight was observed in the treatment of 0 g/ L of salt that had no significant difference with the treatments of 5, 10 and 15 grams per liter of salt and the minimum amount was related to the treatment of 20 grams per liter of salt.

So about the stem wet weight of conocarpus plant, if other conditions are similar using water with 15 grams per liter of salt is good and we can recommend using it for this feature.

In examining the effect of salinity on the stem dry weight it was observed that by increasing the amount of salinity up to 5 grams per liter the root dry weight was increased and the maximum amount was in the treatment that had no significant difference with other applied treatments. The stem dry weight was decreased in the treatment of 15 grams per liter of salt and again increased in treatment of 20 grams per liter of salt. So in terms of saving in water resources and in the presence of other identical conditions related to this feature, using water with 20 grams per liter of salt is also recommended. The maximum leaf wet weight was related to the treatment of 0 grams per liter of salt (control treatment) that had a significant difference with other treatments. But the difference of the leaf wet weight is insignificant in the treatments of 10, 15 and 20 grams per liter of salt.

If all conditions of conocarpus plant growth are the same and also the amount of salt in water is from 10 to 20 grams per liter, in terms of water use saving, the use of water with 20 grams per liter of salt is also recommended. Examining the results of salinity treatments' comparison on the leaf dry weight shows that the maximum leaf dry weight was observed in control treatment that had no significant difference with the treatment of 5 grams per liter of salt and the minimum leaf dry weight was in the treatment of 20 grams per liter of salt. The treatment of 15 grams per liter of salt was insignificant with the treatment of 20 grams per liter of salt and no significant difference is observed in their leaf dry weight. In the two treatments (15 grams and 20 grams per liter of salt) by increasing salinity from 15 grams to 20 grams per liter of salt, the amount of the leaf dry weight is also increased in number, but this value is insignificant (Table 4).

The results of statistical data analysis show that by increasing the amount of salinity in studied treatments, bushes' height in the treatments is decreased. The maximum increase percentage of the bush height was observed in 0 grams per liter of salt treatment (control treatment) that had no significant difference with the treatment 10 grams per liter of salt. Minimum decrease percentage of the bush height was observed in 15 grams per liter of salt treatment that had no significant difference with 5 and 20 grams per liter of salt treatments (Table 4).

In this study, the effect of saline irrigation water at five levels of 0, 5, 10, 15 and 20 grams per liter of sodium chloride salt on morphological characteristics (the root wet and dry weight, the stem wet and dry weight, the leaf wet and dry weight and the bush height) of conocarpus plant was evaluated. The results showed that the root wet and dry weight, the leaf wet and dry weight and plant height were decreased by increasing different salinity levels that are similar results with to the findings of the study of Evan *et al*. (2002) on decreased root wet weight of eucalyptus plant, the study of Elizabeth (2005) on decreased root dry weight of Amaranthus flower by increasing salt concentration of the treatments, the results of Hanafi *et al*. (2010) study based on decreased wet and dry weight and conocarpus plant height by increasing salinity. But the results of examining the stem dry weight in this study showed that by increasing salinity concentration, the stem dry weight was also increased that is not consistent with the results of Elizabeth (2005) study on decreased *Amaranthus* stem dry weight by increasing salinity concentration.

Based on the results of this study, saltwater with different levels of salinity for irrigation of conocarpus ornamental plant can be used. No significant difference was observed between evaluated morphological characteristics at applied salinity levels in conocarpus ornamental plant. However, in some applied levels with high salinity, there was a significant difference between the growth factors. So using the results of this study, there is a possibility to use poor quality water with different salinity levels up to 10 gr/ l of salt directly and to 15 gr/ l of salt alternately with fresh water for the irrigation of conocarpus ornamental plant.

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