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RESISTANCE OF *Conocarpus lancifolius* Engl. TO DIFFERENT LEVELS OF SALINITY AND WATER SUPPLY

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ABSTRACT

While the current tendency in Iraq is to utilize the ground water in irrigation of shelterbelts and plantations of *Conocarpus lancifolius*, this research has conducted to explore the limits of salinity and water deficiency under which *C. lancifolius* can survive and develop good biomass. Four levels of salt and three levels of water supply were applied on six - month seedlings for the period of 210 days. They were grown under climatic conditions of Baghdad city. Results showed that the adverse effect of water deficit on shoot length and number of branches increased with time, especially at hot months. End growth parameters showed that water deficiency affected more than salinity. All seedlings survived even under 12000 ppm concentration of salinity. Slight reduction in growth has obtained when irrigation was once each two days, but it was much more when the interval elongated to 3 days. The increase in salt concentration had no significant effects on dimensional properties, while weight parameters showed regular adverse relation to percent of salt in irrigation water.

Keywords: *Conocarpus lancifolius*, salinity, resistance, water supply.

INTRODUCTION

Arid and semi arid climates are the dominant in Iraq. Therefore, the largest part of the area is desserts or semi desserts with high levels of salinity. Some salt-tolerance annual plants and shrubs are scattering among these lands in different intensities. Lack or limited efforts at present are submitting to afforestation by drought resistance trees in the country. Species like *Tamarix, Eucalyptus, Casuarina* were introduced before some decades and used extensively in a big projects of plantation. Unfortunately, conditions of war, blockade… etc, have had their sever effect on these plantations development as well as there existence. However, the country is in an urgent need to replant these areas in addition to establishing a new plantation of tolerant species.

Salinity of Iraqi soils is almost resulted from the deposition of Na salts. The presence of these salts in the growing medium of the plant causes nutritional disorder in the tree plants as in other plants (Akram *et al*., 2007). Therefore, selection of tolerant tree species is of a vital importance since most of Iraqi lands are saline soils. Salt tolerance in the plant is a complex phenomenon. Various genetical, physiological and environmental factors are involved (Shirazi *et al*., 2006). To ameliorate salt - affected soils, traditional practices are followed such as drainage, leaching, and soil amendments. These procedures need large efforts and big expenses. The alternative way is the biological approach, which involves selection and planting of salt tolerant plants. Such plants have the potential to ameliorate salt-lands and can be grown using poor quality water (Maqsood and Qamar, 2003, 2004).

Conocarpus lancifolius is a tree species restricted to a small area around the southern red sea coasts, is a well known riverine tree in Somalia (Wayne Teel, 2004). Natural stands of this tree occur in this country and parts of the Arabian Peninsula, and it is cultivated in Djibouti, Yemen, Sudan, and Kenya (Mahmood Iqbal Sheikh, 1993) and recently to more other countries. It is light demanding, tolerates a hot, dry atmosphere (Desmond Mahony, 1990). There were some attempts for using *Conocarpus* in ameliorating salt- affected soils being experimented in Gulf - Arab countries, and Pakistan (Shirazi *et al*., 2006, Redha *et al*. (a), 2012, Redha *et al*. (b), 2012, EI-Juhany, and Aref. 2005). Most of findings referred that this species has the ability to grow under different levels of growth stresses resulted from high levels of salinity or water deficiency.

Keeping in view a study was conducted to investigate the possibility of using *C. lancifolius* in afforestation of naked areas, shelterbelts, and in greenery using the ground water which is characterized by unfixed content of salt. The study used different levels of salt in addition to different intervals of irrigation through a period of complete growth season. Among these, growth stresses were investigated in terms of symptoms and measurements of growth parameters.

MATERIALS AND METHODS

The experiment has conducted in the experimental area of Iraqi Natural History Research Center and Museum, University of Baghdad, Iraq. Forty-eight, six-month old seedling of *Conocarpus lancifolius* were purchased from local private nursery. They were selected to be of uniform shape and size, replanted in larger polyethylene pots after removing the old small one. By filling pots, root-soil complex was surrounded by the soil from all sides. Experiment started at 1st March and ended at 30thSeptember, that's practically a complete growth season in Iraq. Seedlings were submitted to normal irrigation by fresh water for one month to assist their roots to grow and distribute in the new pots normally. After that, four levels of water salinity have been used in irrigation. In addition to fresh water three other levels were applied (3000, 6000, 12000 ppm) representing slightly,

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moderately, and highly saline water, respectively. Irrigation regime included three intervals of water supply; one, two, and three days.

The experiment was designed as factorial experiment with 2 factors; 1- Salinity: (4 levels) and 2- water supply: (3 levels), with 4 replications for each treatment combination.

Seedlings stayed in the field under care for 210 days during which they were irrigated by one liter of water (according to plan of irrigation). Shoot length and number of branches were recorded at the end of each month. Other parameters (Shoot green weight, shoot dry weight, stem diameter, root green weight, root dry weight, and root length) were taken after plants being harvested.

Data were statistically analyzed by (Statistica Edition 99, 1997) for significances and statistical differences between treatments.

RESULTS AND DISCUSSIONS

Monthly measurements of shoot length offered evidence that irrigation is the most critical factor Figure-1. The difference between the three intervals was not detectable at the beginning of growing season until May. It started recognized since this month (May) as maximum air temperature exceeded 40°C, after which the effect was more and more clear. Yellowing of plant shoot and growth weakness was easily observed on plants subjected to more water deficit. These symptoms accompanied with deterioration in growth parameters records. Simpson *et al*., (1998) when worked on nutrient disorders stated that reliance on visual symptoms means that some sever nutrient stress situation exist, as a result of which productivity is already adversely affected. The difference in shoot length -as average-between one day and three days increased from 7 cm to 30 cm during the last five months (May to end of September). While daily irrigation resulted in regular increase of shoot length, two and three days intervals affected dependently on month (i.e. on climate). Since the beginning of July 3-day's interval affected severely on shoot length and this effect continued until the experiment ended.

Water salinity showed unexpected results when plants appeared quite similar responses to the three levels of salinity. Fresh water is the only one showed considerable higher shoot length than others at any of the growing months.

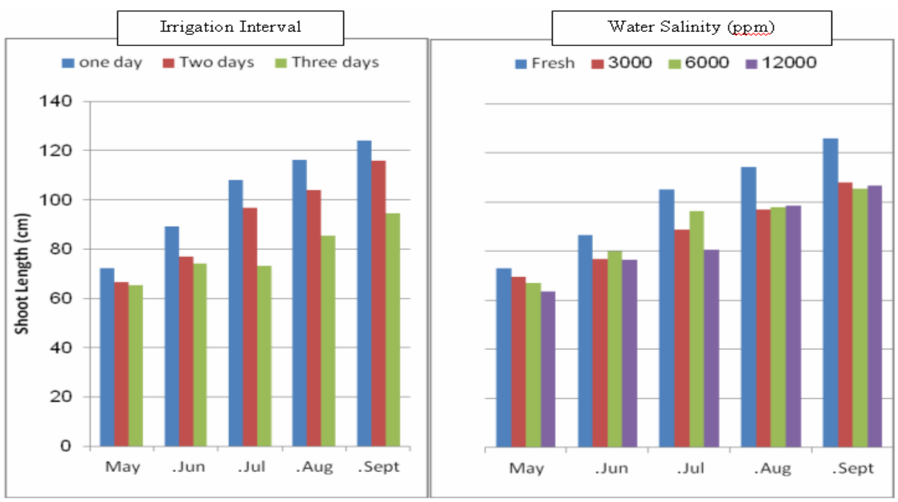

Figure-1. Shoot length development of *C. lancifolius* as affected by irrigation and salinity.

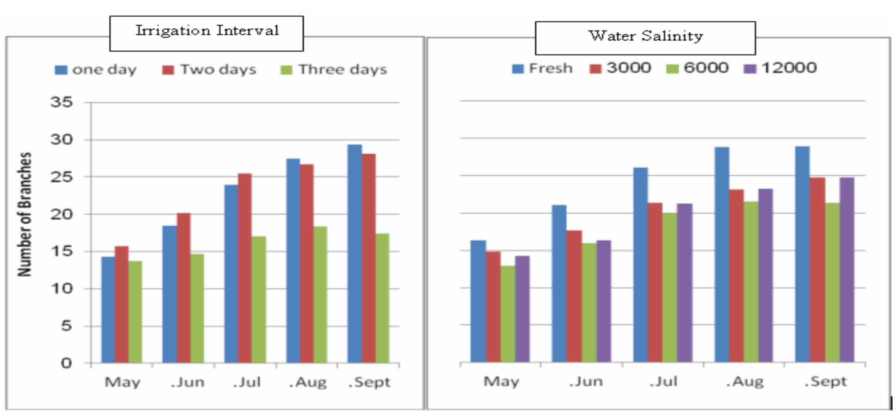

Figure-2. Total number of branches of *C. lancifolius*seedlings as affected by irrigation and water salinity.

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Similar results were obtained with the number of branches (Figure-2). Plants irrigated once or twice each two days were not significantly different in number of branches along the whole season. Considerable drop has occurred with plants irrigated once each three days, especially during the hot months. At plant harvest, fresh water irrigation produced more branches by about 15% compared with saline water regardless to the salt level applied. The adverse effect of water deficit appeared more pronounced on number of branches than on shoot length. At end of September, seedlings irrigated once each 3 days had about 60% branches of plants daily irrigated. These results concurs with what El-Juhany and Aref, (2005) found on *C. erectus* when they assured that over ground traits significantly decreased in low water supply and high salt concentrations, with more decreases in the former.

These two and other growth parameters obtained after plants being harvested also explain that *Conocarpus lancifolius* seedlings were affected by water deficiency more than by water salinity within the tested levels. Table-1 shows that no significant differences between one day and two days intervals of irrigation. In contrast, 3-days interval appeared significant differences in all growth parameters. Growth reduction was higher between second and third level than between the first two. Most of traits decreased by 30% - 40% when seedlings were irrigated once each three days rather than daily irrigation. Weight parameters and number of branches influenced more by water deficiency than dimensional parameters. Redha, *et al*. (a) found that growth and development of *C. lancifolius* is supported by elevated temperature but it suffered from drought and salinity stress. In addition, Ansary and Al-Ghanim, (2008) found that the only other species in the genus - *erectus* tolerates a moderate soil water stress over a long period rather than a severe stress for a short time.

Table-1. Growth parameters of *Conocarpus lancifolius* seedlings as affected by water supply.

Property	Irrigation interval					Mean
	One day	Two days	(±) %	Three days	(±) %	
Shoot length (cm)	124.17 (A)	115.79 (A)	- 6.75	94.63 (B)	- 23.79	111.53
Stem diam. (mm)	11.13 (A)	10.92 (A)	- 1.89	9.25(B)	- 16.89	10.43
Branches no.	29.33 (A)	28.08 (A)	- 4.26	17.33 (B)	- 40.91	24.91
Shoot gr. wt. (gm)	106.49 (A)	117.38 (A)	+10.23	64.43 (B)	- 39.50	96.10
Shoot dr. wt. (gm)	51.17 (A)	48.33 (A)	- 5.56	30.88 (B)	- 39.65	43.46
Root length (cm)	58.42 (A)	50.50 (AB)	- 13.56	39.71 (B)	- 32.03	49.54
Root gr. wt. (gm)	40.42 (A)	34.50 (A)	- 14.65	22.88 (B)	- 43.39	32.60
Root dr. wt. (gm)	24.98 (A)	19.58 (AB)	- 21.62	13.87 (B)	- 44.48	19.48
(Rt : Sht)Dry wt. ratio	48.66 (A)	40.00 (A)	- 17.80	45.67 (A)	- 6.14	44.78

Note: Means in Table 1 and 2 having same letter are not different statistically at $p \leq 0.05$.

Comparing with control, Table-2 shows that all traits (except root length) decreased by using salty water. Although some differences were not significant at $p \leq 0.05$, it is easy to recognize that among the three salty levels, weight parameters increased as salt concentration increased in irrigation water. In regards to root, highest traits values were obtained from (IV) level comparing with (II) and (III) salt concentrations. The result agreed with what Brouwer, 1963 said and El-Juhany and Aref, (2005) found when they referred that below-ground biomass increased in high salt concentration treatments. The availability and uptake of nutrients by plants in saline environments are affected by many factors in the soil - plant environment such as aeration, temperature, and stresses both biotic and abiotic as Grattan and Grieve, (1999) said. They referred that the concentration and ratios of accompanying elements can influence the uptake and transport of a particular nutrient and indirectly may affect the uptake and translocation of others.

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Table-2. Growth parameters of *Conocarpus lancifolius* as affected by water salinity.

Property	**Water salinity** (ppm)			
	(I) **Fresh**	(II) **3000**	(III) **6000**	(IV) **12000**
Shoot length (cm)	126.06 (A)	107.94 (A)	105.44 (A)	106.67 (A)
Stem diam. (mm)	12.44 (A)	9.67 (B)	9.89 (B)	9.72 (B)
Branches no.	28.89 (A)	24.72 (A)	21.28 (A)	24.78 (A)
Shoot gr. wt. (gm)	140.00 (A)	77.86 (B)	77.00 (B)	89.50 (B)
Shoot dr. wt. (gm)	56.30 (A)	38.40 (B)	34.61 (B)	44.50 (AB)
Root length (cm)	47.56 (A)	48.28 (A)	46.78 (A)	55.56 (A)
Root gr. wt. (gm)	44.55 (A)	27.22 (B)	27.61 (B)	30.77 (AB)
Root dr. wt. (gm)	27.96 (A)	15.53 (B)	15.86 (B)	18.56 (B)
(Rt : Sht) Dry wt. ratio	50.45 (A)	39.97 (A)	45.47 (A)	43.22 (A)

When the effect of water supply interacted with the effect of salt concentration the growth response of plant referred that reduction in growth parameters resulting from water deficit decreased as salt concentration increased (Table-3). Most of these traits had no clear trend at 1200 ppm level of concentration. The case was more evident in root weight (green and dry). Gradual decrease in these two properties has obtained from (I) to (III) interval for each of (fresh, 3000, 6000 ppm) salt level only.

Table-3. Mean and standard deviation of *Conocarpus lancifolius* seedling properties under the effect of salinity and water supply.

Property	Irrig. (Day)	**Water salinity** (ppm)							
		Fresh		**3000**		**6000**		**12000**	
		X	**sd**	**X**	**sd**	**X**	**sd**	**X**	**sd**
Shoot length (cm)	I	143.00	10.82	118.33	31.94	131.33	11.01	104.00	14.53
	II	135.67	33.53	114.50	6.50	102.00	14.11	111.00	5.29
	III	99.50	9.50	91.00	6.00	83.00	2.00	105.00	18.36
Stem diam. (mm)	I	13.33	0.58	10.67	0.62	11.33	1.15	9.17	2.75
	II	14.00	1.00	9.67	0.59	9.67	1.16	10.33	1.53
	III	10.00	0.99	8.67	0.49	8.67	0.58	9.67	0.58
Branches no.	I	32.33	1.53	29.67	4.73	33.00	3.46	22.33	6.36
	II	35.33	5.51	28.00	5.00	18.33	8.14	30.67	3.21
	III	19.00	3.00	16.50	2.50	12.50	0.50	21.33	4.16
Shoot gr. wt. (gm)	I	149.33	37.87	100.33	31.26	95.67	22.72	80.50	33.90
	II	174.67	86.12	90.83	2.75	85.33	40.10	118.67	44.05
	III	96.00	10.00	42.40	0.53	50.00	4.00	69.33	34.12
Shoot dr. wt. (gm)	I	69.20	7.02	48.07	22.38	46.50	15.49	40.93	5.26
	II	63.40	8.30	37.93	3.55	35.03	15.17	56.97	18.86
	III	36.40	15.40	29.20	6.10	22.30	3.50	35.60	6.97
Root length (cm)	I	52.00	7.81	55.33	11.93	63.67	24.19	62.67	4.51
	II	53.67	24.79	46.00	1.00	46.67	17.16	55.67	23.01
	III	37.00	10.00	43.50	8.50	30.00	1.00	48.33	12.58
Root gr. Wt. (gm)	I	55.00	14.11	37.67	13.32	40.67	11.37	27.63	10.34
	II	48.67	32.19	25.00	2.00	26.67	11.93	37.67	14.84
	III	30.00	3.00	19.00	1.00	15.50	3.50	27.00	6.08
Root dr. wt. (gm)	I	35.23	7.26	23.50	8.41	22.33	11.83	18.87	3.20
	II	29.93	18.66	13.30	1.10	14.30	6.89	20.77	4.20
	III	18.70	4.60	9.80	1.90	10.93	0.95	16.03	3.77
Dry (Rt : Sht) ratio	I	50.62	5.72	51.20	3.80	46.47	11.33	46.38	8.74
	II	46.24	24.56	35.09	0.39	40.50	10.27	38.15	8.24
	III	54.50	11.41	33.63	0.53	49.40	3.56	46.14	8.19

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This experiment showed that higher salt level when combined with water deficiency (within certain limits) was not necessarily lead to minimum traits. That because salt tolerance in the plant is a complex phenomenon. Various genetical, physiological and environmental factors are involved (Shirazi *et al*., 2006). As the plant is newly introduced species, and it was found that it severely affected by frost during winter, it becomes so necessary to study how it grows under plantation and shelterbelts conditions in its different old stages.

CONCLUSIONS

From the above-mentioned results, some points can be concluded:

- *Conocarpus lancifolius* is a salt tolerant species and suitable for ground water irrigation in Iraq.
- Water supply has more effect than salinity on growth especially in hot climates.
- Daily irrigation is not obligatory even at maximum summer temperatures.
- Root weight is the most affected trait by water deficiency.
- Three days irrigation interval resulted in high reduce of plant biomass.

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