International Research Journal of Applied and Basic Sciences
© 2018 Available online at www.irjabs.com
ISSN 2251-838X / Vol, 12 (1): 54-57
Science Explorer Publications

Physiological Parametre Activity of *Lens culinaris* Medik under Caspian Sea Water Treatment.

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ABSTRACT: Growing plants using seawater is gaining increasing interest because of shortages of irrigated freshwater. In this research, Lens culinaris Medik was grown in triplicate in pots containing sterilized Perlite and watered with full-strength (12.5%) and half-strength (6.25%)Caspian Seawater under ambient laboratory conditions (18/6 light/dark and 24º C). Plants in control pots were watered with tap water. Results showed delay in the beginning of germination and a reduction in germination percentage with 12.5% seawater treatment , both shoots and roots of plants grew faster and were significantly heavier under 6.25% seawater treatment, however, total chlorophyll and carotenoid contents of leaves were greater in pots watered with full-strength seawater. Also determined heavy metals concentration Fe, Cu and Zu.

***Keywords**:* Caspian Seawater, Lens culinaris, irrigation, seawater cultivation

INTRODUCTION

Caspian Seawater is unique in its chemical characteristics as it is saline about 12.5% and much less than average oceanic seawater salinity of 38%. High sodium sulfate and magnesium sulfate characterize Caspian Seawater into bitter taste (Bayrami, et al. 2004). Anions such as chloride and sulfates and cations such as Mg, Ca, Fe, Mn, Zn and organic matter provide abundant nutrients for plant, animal and microbial growth. Caspian Seawater is well-oxygenated because of frequent discharges from many rivers yearlong, algal and phytoplankton photosynthesis (Alizadeh, 2006) and adequate circulation, both in surface and depth. Southern waters of the Caspian Sea are richer in nutrients primarily due to agricultural run-offs and west-east circulation pattern. Application of saline water has received much attention in recent years. For example, Sohrabi et al. (1998) reported cotton plants yielded 19% more product when watered with saline water with EC of 7.8 ds/m compared to controls watered with regular tap water. Cramer, et al (1987) and Zhong and Lauchli (1993) reported salinity reduced germination rate in cotton. Esmaili, et al. (2004) reported reduced weight and height in fodder corn plants watered with Caspian Seawater. Sadughi, et al (2012), on the other hand indicated that half-strength Caspian Seawater did not affect germination rate on sugar beet (Beta vulgaris) significantly, compared with controls grown in tap water; but significant reduction in germination rate occurred when diluted seawater (80%) was applied. Sharifian and Shahmoradi (2012) also reported similar results for wheat, except that wheat could recover its growth under constant moderate salinity, but not at higher salinities. In contrast wheat reduced its growth and yielded under greater salinities when watered with regular Caspian Seawater. Since, L. culinaris is a popular and well-liked product in many parts of world, contains 23-27% protein (Anvar, 1993; Bagheri, et al., 1997) and is cultivated in marginal lands , it was selected to investigate its growth under salinity from Caspian Seawater in line with similar research, e. g., Petersen(1996), Hamdy,et al (2005), Abasian and Esmaili (2005) and Al Busaidi, et al. (2007), in order to introduce alternative water source for its cultivation.

MATERIALS AND METHODS

Twenty seeds of L.culinaris were surface sterilized in 2%solution of sodium hypochloride and planted in 12 plastic pots containing 120g autoclaved perlite. Twelve pots were watered with tap water for first 5 days and then eight treatment pots were watered with 25 cc Caspian seawater (4 each of full-strength, 12.5% and half-strength, 6.25%)every other day . Control pots were watered with tap water. Plants were allowed to grow under ambient laboratory conditions, 16:8 light/dark, 22-25º C and humidity of 65% for 25 days. Supplemental Kewit and Hoagland micronutrients were provided equally to all pots during growth. After harvesting, whole plant (shoot and

root) fresh weight, oven-dried weight (at 105 º C until constant weight), plant length and were measured. Chlorophylls a and b and carotenoids of leaves were determined using method of Linchenthaler (????) and UNICO spectrophotometer at 645, 662 and 470 nm, respectively. Carbon dioxide uptake was measured using CO_2 analyzer AZ77535. Duncan statistical analysis was performed using SPSS software at *p ≤0.05.*
Caspian Seawater characteristics are summarized in Table 1.

Table 1. Average Seasonal Caspian Seawater Characteristics

Characteristics*	Quantity	Tap Water
Na (mmols/l)	155	2
Ca (mmols/l)	72	5
Mg (mmols/l)	18	1
Cl (mmols/l)	173	2
CO_3^{--} (mmols/l)	2.8	2.7
SO_4^{--} (mmols/l)	63	3.2
EC (ds/m)	24	0.8

*After Dordipour, et al. (2004).

Results of L. Culinaris germination and germination percentage are presented in Table 2.

Table 2. L. culinaris Germination under Different Water Treatment

Water Quality	No. of seed germination	Germination %
Tap water	20	97
Half-strength Seawater	18	96
Full-strength Seawater	14	90

Results of L. Culinaris biomass measurements are presented in Table 3.

Table 3. L. culinaris biomass measurements under Different Water Treatment

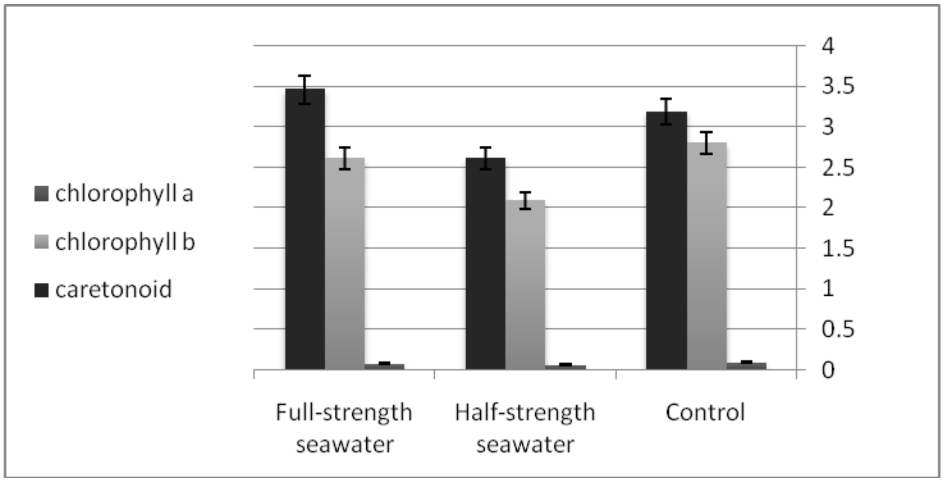
Water Quality	Shoot (cm)	Root (cm)	Fresh Weight (g)	Dry Weight (g)	CO_2 uptake (ppm)
Tap water	18.50±1.56	8.50±0.42	0.27±0.01	0.03±0.001	649±5
Half-strength Seawater	23.00±1.93	9.00±0.51	0.31±0.02	0.04±0.001	732±5
Full-strength Seawater	19.00±1.31	8.00±0.35	0.24±0.02	0.03±0.001	661±5

Results showed improved growth parameters and CO_2 uptake significantly in plants watered with half-strength Caspian Seawater than both full-strength and tap water (control) treated plants throughout 25 days of study period. Plants watered with 12.5% full - strength seawater, also produced more biomass than control plants. The greatest rate of shoot growth occurred in first 15 days of the experiment under half-strength seawater and afterwards rate of growth declined (Table 4). Significantly different growth rate occurred for root under 6.25 % seawater treatment but not in 12.5% seawater treatment compared with control. Similar findings are reported for dry weight compared with control.

Results of contents of chlorophylls a and b were significantly lower than that of control but caretonoids content was greater in plants treated with 12.5%seawater(Figure 1).

Table 4. Rate of growth of L. culinaris in different water treatments compared with control at 15 days

Period (Days)	Control (cm)	Half-strength seawater (cm)	Full-strength seawater (cm)
8	8	11	10
16	14.51	17.5	16
20	17.80	22	18.5
25	18.5	23.5	19

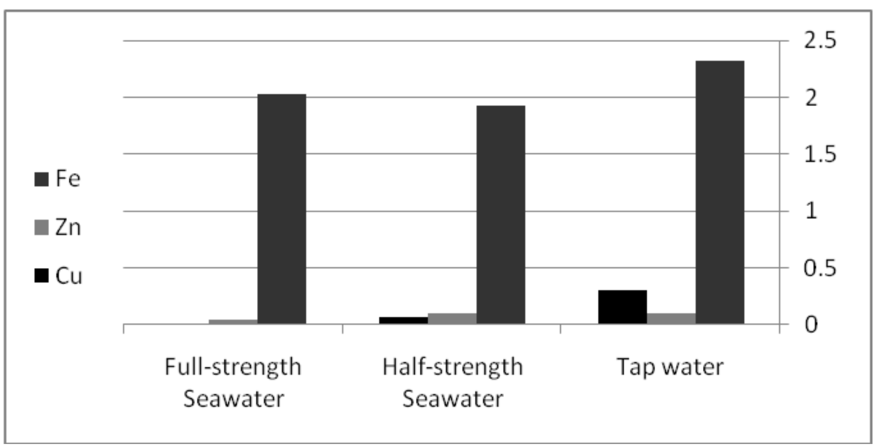


Figutre 1. Contents of chlorophylls a and b and caretonoids in plants treated with Caspian Seawater and controls (µgr.g^{-1} fw)

The result showed reduction heavy metals concentration Fe, Cu and Zu under treated with Half-strength Seawater (table5).

Table 5. L. culinaris measure the concentration of heavy metals under Different Water Treatme1. Department of Plant Science, Kharazmi University, Tehran, Iran nt.

Water Quality	Fe (ppm)	Cu (ppm)	Zn (ppm)
Tap water	2.32	0.3	0.1
Half-strength Seawater	1.93	0.07	0.1
Full-strength Seawater	2.03	0	0.05



Figutre 2. Concentration of heavy metals in plants treated with Caspian Seawater and controls (ppm)

DISCUSSION

Effects of salinity on plant growth have been widely studied. Physiological responses of plants have been different in vegetative and reproductive phases of plant growth as reported for wheat (Francois, et al. 1994). Primary effects of salinity has been usually to alter pigment contents and photosynthetic activity of plants (Dordipour, et al 2004), as observed in plants treated with full-strength seawater compared with plants treated with tap water or lesser salinity half-strength seawater. Results of this research showed L.culinaris seeds could germinate and grow better in saline conditions of 6.25% Caspian seawater. Although, chlorophyll contents of leaves of L. culinaris decreased under salinity, increase in caretnoid contents indicated potential ability of plant to combat salinity stress effects and to scavenge reactive oxygen species (ROSs). Such reaction has been reported for tomato plants (D’ Amico et al. 2003; Hajer et al. 2006). Although, this investigation has indicated potential application of diluted Caspian Seawater in irrigated farming, still further studies are required to exactly develop protocols for candidate plant species and localities, particularly paying attention to soil characteristics and chemical behavior in conjunction with added saline water during irrigation.

ACKNOWLEDGEMENTS

Authors would like to thank Faculty of Biological Sciences, Kharazmi University for financial and laboratory support.

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