Mesopotamia Environmental Journal
ISSN 2410-2598
Journal homepage http//:www.mej.uobabylon.edu.iq

Doi: http://dx.doi.org./10.31759/mej.2023.7.1.0060

Usage of Eastern Euphrates drainage water in irrigation of Olerace (*Spinacia oleracea*)

Batool Mohammed Hassan[1] **Imad Amer Subhi[2]**

[1,2] Department of Biology, College of Science, University of Babylon,Iraq. ORCID:0005-6562-2753

***Corresponding Author : batool_aladily@yahoo.com**

To cite this article:

Hassan B. M. and Subhi, I. A., **Some ecological impacts of eastern Euphrates drainage water on Olerace *(Spinacia oleracea)*** ,*Mesop. environ. j*., Vol. 7, No.1, pp. 55-60. 2023,

Received date: 16/04/2023 accepted date: 11/06/2023 published date: 15/06/2023

Abstract:

Climate change effect many countries and Iraq is one of them, which affects water resources. Olerace*(Spinacia oleracea*) was grown well when using water of drainage by increasing content of MDA, GSH, ROS and proline as a biochemical adaptation, their concentrations increased to : 18.08 (mmol/l), 4.59 (µmol/l).,12.05 µg/g and 4.14, respectively.The concentrations of Zn , Fe and Cu in eastern daring water were : 0.001, 0.001 and o.111 Mg/L, respectively Although it was having higher amounts of total hardness, drainage water was within irrigated water's limitations. The results of current study showed possibility utilize the drainage water from the eastern Euphrates which is not polluted with studied heavy metals and not saline and it is suitable for irrigation of plants.

Keywords: drainage water, heavy metals, biochemical responses, *Spinacia oleracea*

Introduction

On earth, water is a crucial liquid for all living forms, including prokaryotes and humans. Availability of water resource are decreasing continuously from a long time ago [1]. Climate changes effects many countries and Iraq is of them, which important effect is reducing water resources [2], thus many studies were done on to use alternative water sources including the use the drainage water. One of them was done in 2015 on eastern Euphrates drainage which focused on the concentration of some pollutants in water and sediments. The properties of drainage water are keys that limiting its usage for irrigation if it is within the acceptable parameters [3]. There are many limits for drainage in agriculture, including salinity, high levels of Na and containing pollutant which effect plants, [4]. Using of Drainage water can increase area of lands [5].

Agriculture is dependent on water, hence it's important to maintain that sector, to increase supply of food; under continues changes in the climate [6,7]. *Spinacia oleracea* is a plant that is sensitive to polluted water, so it used to study possibility of using eastern Euphrates in AL kful (130 KM southern Baghdad) as irrigation source. All previous studies focused on concentration of pollutants in water or biota of drainage and almost all of them concluded that Eastern Euphrates drainage was not polluted with heavy metals but don't explained possibility of using its water in the irrigation, thus this work tend to explain the possibility of using it as a water resource in irrigation.

Material and Methods

Planting of plant

Seeds of *Spinacia oleracea* were planted in ten plastic pots (each contain about two kilograms of sandy soil), divided pots in two groups, first was irrigated with drainage water, while second with tab water(control). Irrigation was a half litter each three days.

Water parameters Analysis:

Standard water analytical methods [8] were used to investigate each of concentrations of each of the following parameters: electrical conductivity, total alkalinity, Calcium, Magnesium, total hardness, chlorides and pH were studied as described in standard methods in both the tab and drainage water.

Soil parameters Analysis:

Sandy soil was used for planting the seeds of olerasea , pH , EC , Cl , Ca , organic matter and heavy metals (Fe, Pb, Cu, Cd and Zn) calculate depending soil analyses methods [9].

Biochemical responses:

Fresh leaves samples were extracted by aceton 80% to determine amount of chlorophyll A, chlorophyll B, and Carotenoids [10]. Proline concentration was evaluated using the method of ninhydrin extraction [11]. The total amount of protein was assessed utilizing Bovine Serum Albumin and a (UV/VIS) Spectrophotometer at 650nm [12]., and total soluble

sugar, MDA, ROS and vitamin C were evaluated using methods from biochemistry facility, and the phosphomolybdenum procedure was used to measure the total antioxidant activity. [13,14], respectively.

Statistical Analysis

One factorial treatment experiment design was done to study effect of drainage water on *Spinacia oleracea*, and (LSD) was calculated to study the significant differences between means at $p<0.05$.

Results and Discussion

In particular, soil characteristics and climate conditions have a significant impact on the quality of drainage water, which is typically saline water. Although the Zn, Fe, and Cu pollution in the studied eastern Euphrates drainage water was lower and it wasn't salty, Total hardness presented in Tables 1 and 2 both showed higher values. In accordance with the requirements for maintaining Iraqi rivers, [15] and the US limits for drinking water [16], the eastern Euphrates drainage water is not saline, and may be used to irrigate fields, and is not contaminated with heavy metals.

These findings concur with that of Al- Saadi et al.,[17] that looked at the same drainage system in a different area, it also agrees with results of Habeebe's study [18]. Who explained that concentrations of heavy metals and TDS as well as other some parameters were within limits, indicating that it is secure to use as a reliable source of water, heavy metals levels are still within acceptable limits. As plants differ, so do their adaptations to avoid or tolerate the same environmental influences [19], and some of them do so by upping their antioxidant levels as evidenced by the findings in table (3). By making many biochemical adjustments, such as raising the levels of Basil received good increase in MDA, proline, GSH, and ROS when grown in drainage water. To combat the stress of elevated ions, several plant species increase antioxidant enzymes and the substances that feed them [20].

This study showed non - signi ficant decrease in Chlorophyll a in *S.oleracea* when irrigated with drainage water , as explain in table 3.Higher value(7.5) mg/g.f.w recorded in *S.olerscea* that irrigated with tab water .Drainage water caused a significant decrease (Pvalue<0.05 =0.025) in Chlorophyll b content when used, The decrease in chlorophyll in plants irrigated with drainage water is attributed to the high chlorides in it (Table 1), as chlorides inhibit calcium absorption, which in turn collects in the cell wall [21]. Plant need carotenoid as a antioxidant substance, the decrease in carotenoid content due to stress of chloride, calcium and total alkalinity in drainage water, and the significant decrease in *S. oleracea* may due to the physiological pattern of this species which is more depend on carotenes than other antioxidant [22]. In this study, noted significant decrease in protein concentration in *S. oleracea* when used tab water (6.96) mg/g .f. w. P<0.05=0.

A huge studies and data indicate a positive relationship between proline accumulation and plant stress. Proline, an amino acid, plays a very beneficial role in plants exposed to various stress conditions. In addition to being an excellent Osmolality[23]. Results showed non - significant increase in concentration of proline when used drainage water when comber with that irrigation with tab water .

Table 1: Various water properties that were investigated for their impact on *Spinacia oleracea.*

Parameter	Unit	Drainage water	Tab water (control)
pH	-	8.08	8.99
EC	Ms/cm	1560	1465
Total alkalinity	Mg/L	280	240
Chloride	Mg/L	689.3	639.4

Total hardness	Mg/L	880	680
Calcium	Mg/L	144.3	96.19
Magnesium	Mg/L	191.25	130.72

Table 2: Heavy metals concentrations in drainage water, soil and plants.

	Soil after irrigation				Soil before irrigation	Tab water	Drainage water
	Tap water		Drainage water				
	Soil	Plant	Soil	plant			
Zn	0.199	0.220	0.171	0.1133	0.163	0.057	0.001
Cd	0.050	0.050	0.001	0.001	0.001	0.080	0.183
Fe	0.053	0.051	0.047	0.050	0.062	0.001	0.001
Cu	0.496	0.471	0.496	0.511	0.630	0.144	0.111
Pb	0.028	0.0025	0.024	0.020	0.024	0.001	0.003

Vitamin C (ascorbic acid) is very popular for its antioxidant properties [24]. The results record (31.82) when used tab water but it decreased significantly when irrigated with drainage water (P <0.05=0.01). Decreasing vitamin C concentration in both species due to the rule of this vitamin in cell plant which used in a antioxidant system then its concentration will decrease[25].

The *Spinacia oleracea* was able to withstand high levels of both Cd and Pb. Because of these elements have ' harmful effects, protein and photosynthetic pigments in the plant were reduced, because these metals inhibit protein synthesis which inhibit plant's activity in photosynthesis and other activities [26]. All studied heavy metal concentration in plant were within the stander limits of them except Cd, and this results are agree with study of Habeeb [18] who explained that heavy metals concentration were within Iraq standard of drainage water .

Table 3: Biochemical responses of *Spinacia oleracea* to irrigation .

Parameter	Unit	Control (tap water)	Drainage water
protein	(mg/g.F.W)	13.04	6.96
Carotenoids	(mg/g.F.W)	4.86	2.27
CHL.B	(mg/g.F.W)	9.87	9.31
CHL.A	(mg/g.F.W)	7.5	7.13
MDA	(mmol/l)	8.81	18.08
TAO	(mg AEE/g.F.W)	49.96	44.66
vitamin C	(mg/g.F.W)	31.82	28.84
Proline	(mole/g.F.W)	3.63	4.14
GSH	(µmol/l).	3.54	4.59
ROS	µg/g	12.27	12.5

Conclusions

Drainage water (at studied area) can used in irrigation, and *Spinacia oleracea* adapted to some elevated ions by increasing generation of MDA. *Spinacia oleracea* loss some its nutritional value like protein, anti-oxidants under Cd stress.

Author Contributions Statement

Both authors collected samples, prepare soil and planting the plant. So, they cooperated in all analysis data.

Declaration of competing interest

The author declares that there is no competing interest

Acknowledgment

We are glad to thank the staff of biology department /collage of science in Babylon university specially those who helped us in this work.

References

[1] Niruban, C & Balakrishnan ,T., Water Scarcity- Challenging the Future , International Journal of Agriculture, Environment and Biotechnologyvol.Vol.12, No.3,pp. 187-193. 2019.

[2] Mendy, M.. Impact of climate change on Arab countries , J. Europe ,Vol.22, No.22.2008.pp.8.

[3] Hoorn, V. Quality of irrigation water, limits of use and prediction of long term effects, salinity seminar Baghdad,, irrigation and drainage no.7 Pp. 117-135. FAO, 1970.

[4] Yurtseven E, Öztürk H S & Avcı S . Mass balance criteria in soil salinity management: journal of Agriculture Science, Vol.20, No.2014, pp:103-111. 2014.

[5] Ritzema, H. Main drainage systems. MSc programme land and water development for food security, UNESCO-IHE.2014.

[6] Sojca, M; Kozlowski, M.; Staski, R.; Napierala, M.; K ¸Kesicka, B.; Wró˙zy´nski, R.; Jaskuła, J.; Liberacki, D. and Bykowski, J. Sustainable Water Management in Agriculture—The Impact of Drainage Water Management on Groundwater Table Dynamics and Subsurface Outflow, Sustainability, Vol.11, 4201. doi:10.3390/su11154201. ; 2019.

[7] Döll, P.; Jiménez-Cisneros, B.; Oki, T.; Arnell, N.W.; Benito, G.; Cogley, J.G.; Jiang, T.; Kundzewicz, Z.W.; Mwakalila, S.; Nishijima, A. Integrating risks of climate change into water management. Hydrol. Sci. J. Vol. 60. ,pp. 4–13. 2015.

[8] APHA (American Public Health Association). Standard method for examination of water and waste water, 21th Ed. Washington DC, USA.2005.

[9] ICARDA (International Center for Agricultural Research in drier areas). Soil and Plant Analysis Laboratory Manual, 2nd Ed. Pages 177.2001.

[10] Lichtenthaler H.K., Wellburn A.R. Determinations of total carotenoids and chlorophylls a and b of leaf extracts in different solvents Biochem. Soc Trans. Vol.11, No.5, pp. 591-592.1983.

[11] Bates L.S., Waldren R.P., Teare I.D. Rapid determination of free proline for water-stress studies. Plant and Soil. Vol.39, No.1,pp. 205-207. 1973.

[12] Lowry O.H., Rosebrough N.J., Farr A.L., Randall R.J. Protein measurement with the Folin phenol reagent. Journal of Biological Chemistry. Vol.193, pp:265-275. 1951

[13] Sadasivam S., Manickam A.,. Phenolics. Biochemical Methods for Agricultural Sciences. Wiley Eastern Ltd., New Delhi. pp. 187-188. 1992 .

[14] Dubois M., Gilles K.A., Hamilton J.K., Rebers P.T., Smith F. Colorimetric method for determination of sugars and related substances. Analytical Chemistry. Vol. 28, No.3. pp. 350-356. 1956.

[15] Iraqi standards limits . Standards Iraqi limits of rivers, Minister of water resources. irrigation water qualities and leaching ratio. Journal of Agricultural Sciences, Vol.20, pp:103-111. 1986

[16] US- Environmental protection agency. Drinking water standards and health advisories, Washington, DC,. PP:8-11. 1996.
[17] Al- Saadi,H.A.; Al-Lami, A.A. ; Hassan, F.A. and Al- Dulaymi A.A., heavy metals in water , suspended, particles , sediments and aquatic plants of Habbania lake, Iraq. International journal of environmental studies, Vol. 59, No. 5 .. pp:589-598. 2002.
[18] Habeeb, M. A. some ecological and anatomical study on hydrophytes of eastern Euphrates drainage, Babylon- Iraq, MSC. Thesis, Collage of Science Babylon University. 2015.
[19] Al-Mamoori S. ,O, H, and Batool, M, H, AL-Adily . Some effects of treated waste water of hillatextile factory on four species of cultivated plants . Plant Archives Vol. 18, No. 2, pp:2379-2382, 2018.
[20] Foroozesh, Peyman, Bahmani Ramin, PazoukiAlireza, asgharzadeh Ahmad, Rahimdabbagh Sepideh and Ahmadvand Solmaz . Effect of Cadmium stress on antioxidant enzymes activity in different bean Genotypes. ARPN. Journal of Agricultural and Biological Science. Vol. 7, No.5.2012.
[21] Hepler, Peter & Winship, Lawrence. Calcium at the Cell Wall-Cytoplast Interface. Journal of integrative plant biology. Vo.52. pp: 147-60. 2019. DOI: 10.1111/j.1744-7909.2010.00923.x.
[22] Mcelroy, J. S., & Kopsell, D. A. Physiological role of carotenoids and other antioxidants in plants and application to turfgrass stress management. New Zealand Journal of Crop and Horticultural Science, Vol. 37, No. 4, pp: 327-333. 2009
[23] Meena, M, Divyanshu, K, Kumar, S, Swapnil, P, Zehra, A, Shukla, V, ... and Upadhyay, R. S. Regulation of L-proline biosynthesis, signal transduction, transport, accumulation and its vital role in plants during variable environmental conditions. Heliyon, Vol.5, No.12, e02952. 2019
[24] Arrigoni, O, and De Tullio, M. C. Ascorbic acid: much more than just an antioxidant. Biochimica et Biophysica Acta (BBA)-General Subjects, Vol.1569, No.1-3, 1-9. 2002
[25] **Paciolla, Costantino & Fortunato, Stefania & Dipierro, Nunzio & Paradiso, Annalisa & de leonardis, Silvana & Mastropasqua, Linda & de Pinto, Maria**. Vitamin C in Plants: From Functions to Biofortification. Antioxidants. 8. 519. 10.3390/antiox8110519. 2019
[26] Kumar, Indrajeet & Kumar, Umesh & Singh, Prince & Sharma, Rajesh. Salt-Induced Effects on Crop Plants and Counteract Mitigating Strategy by Antioxidants System. 10.1002/9781119700517.ch9. 2021