REUSE OF GREYWATER IN YUCCA PLANT IRRIGATION UNDER PHYTOREMEDIATION STRESS CONDITION

Mustafa M. Kafay [1]; Sami A. Metwally [2]; Hesham I El-Kassas,.[1] and Hussein I. Abdel-Shafy [3]

1) Department of Environmental Agricultural Sciences, Faculty of Graduate Studies and Environmental Research, Ain Shams university, Egypt. 2) Department of Ornamental plants and Woody Trees, Agricultural and Biological Institute, National Research Centre, Dokki, Cairo, Egypt 3) Water Research & Polluted Control Dept, National Research Centre, Dokki, Cairo, Egypt.

ABSTRACT

Over the past few years, concerns regarding water scarcity and pollution have become more prominent. In many regions, water supply management requires support. This study aimed to determine the effect of greywater on vegetative parameters and chemical content on the yucca plant by using pots studies under greywater stress. This study was carried out in pilot plant of the experimental area, National Research Centre, Dokki, Cairo, Egypt, during the two successive seasons of 2021-2022. Yucca plants were irrigated with greywater at different dilutions by tap fresh water at the following percentage of greywater: 50%:50% (50%greywater,50% tap water); 67%: 33% (67% greywater, 33% tap water); 75%:25% (75% greywater, 25% tap water);100% (100% greywater, 0% tap water) while the control samples were irrigated with tap water only. It was found that irrigation of yucca plant with raw grey wastewater recorded the highest values in the proline content, protein and chlorophyll a, b in the plants, while all the vegetative parameters were decreased. By irrigation with 75:25 greywater (i.e., 75 % greywater: 25% freshwater), higher values in cell carbohydrates content were recorded compared to the control (i.e.,100% tap water) and other treatments. On the other hand, irrigation with 67% greywater recorded the highest values in vegetative parameters, followed by irrigation with 75% greywater in comparison with the control one (tap water). From this study, it was concluded that long-term irrigation with greywater exhibited a beneficiary effect on Yucca plant.

Keywords: Greywater, ornamental plants, phytoremediation, water treatment and Yucca plants

INTRODUCTION

Greywater management is gaining importance, particularly, in the low and middle-income countries where inadequate treated wastewater should be considered to avoid the negative impact on both public health and the environment (Abdel-Shafy and Al-Sulaiman, 2014). Recently, greywater has been identified as a valuable and adequate source of water for irrigation to reduce the consumption of fresh water while increasing the food security (Assayed *et al*., 2010; Abdel-Shafy *et al*., 2015). The treatment of wastewater using phytoremediation is one of the desirable treatment technologies in many parts of the world (George and Gabriel, 2017; Abdel-Shafy and Mansour, 2018).

It is well documented that, wastewater discharge to the environment causes serious eutrophication and water borne diseases(Mansour and Abdel-Shafy, 2021, Abdel-Shafy and El-Khateeb, 2019). Separation of wastewater into grey and black has gain an interest in several countries for purpose of reuse or recycling particularly in the remote areas and decentralized wastewater treatment (Abdel-Shafy *et al*., 2014 a).

The greywater can be obtained by separating of the household wastewater into black, and grey wastewaters (Abdel-Shafy, and Al-Sulaiman, 2014). The later was obtained by excluding the wastewater from the toilets by separating piping system. Greywater includes wastewater from washbasins, kitchen sinks, laundries, washing machines, and dishwashers(Maimon *et al.*, 2010, Abdel-Shafy and Al-Sulaiman, 2014). Generally, generally; accounts for 70% to 73% of the combined residential municipal wastewater. While blackwater is about 90% vacuum toilets(Abed and Scholz, 2016; Avery *et al*., 2007). Therefore, greywater is not contaminated by human excrete.

On the other hand, ornamental plants have the characteristics of fast growth, huge biomass production, faster propagation, a large root system, and high tolerance. These characteristics are considered excellent for multifunctional phytoremediation (Ayala-Hernandez *et al.*, 2022).

Yucca gloriosa L. belongs to the family Asparagaceae, subfamily Agavoideae. Yuccas are economically important; they are used as living fences and windbreaks. Fibers are extracted from their leaves including wines, baskets, and other useful utensils. The roots, stems, leaves, shoots, flowers, and seeds of several Yuccas species contain antioxidant, antimicrobial, anti-inflammatory, antidiabetic, and hypocholesterolemic compounds, among others(Ayala-Hernandez *et al.,* 2022).

This study aimed to determining the effect of greywater on the yucca plant in terms of growth and phytoremediation plant under such stress condition. Therefore, greywater was employed at variable dilution factors as source of irrigation.

MATERIALS AND METHODS

Sources of Raw greywater: Real household wastewater was separated into three types of water; namely: Grey (G), Black (B), and Yellow (Y) water. These types of wastewaters were segregated and collected from one house across a “Training Demonstration Center” (TDC) site constructed in the National Research Centre (NRC), Cairo, Egypt. This concerned house composed of two separated sides. Each one of these sides composed of five apartments. One of these sides is presently connected to the TDC center as separated G, B, and Y water constructed manholes. The collected greywater (GW) was used in the present study. It includes wastewater from showers, baths, hand wash basins, dishwashers, washing machines, and kitchen sinks.

Pots experiment was carried out at the greenhouse of National Research Centre, Dokki, Cairo, Egypt, during the seasons of 2021-2022. The study was conducted using Yucca plant in pot experiments by cultivating in plastic pots of 30 cm in diameter and 50 cm in depth field with 6 kg soil the pots were filled with media containing a mixture of sand and clay soil as 1:1 by volume. The experiment included 4 treatments of greywater with various dilutions of gray water at the following percentage of greywater: tap water 50:50%, 67:33%, 75:25%, and 100:0% while the control samples were irrigated with tap water only.

For chemical analyses, soil samples were collected from different locations in the plantation at 0- 30 cm depth and analyzed for chemical characters according to the standard procedures described by (Wilde *et al.*, 1985) (Table 1). One homogenous terminal cutting of Yucca plants (10 cm) in length was obtained from nursery of private company. The seedlings were planted at the second week of May in both seasons 2021-2022 as one seedlings/pot 30 cm diameter.

Vol. (51); Iss. (12); No. (7); Dec. 2022
ISSN 1110-0826
ONLINE ISSN 2636 - 3178

Phosphorus fertilizers were added before transplanting. Moreover, N and K were added to the media according to the recommended dose of Ministry of Agriculture after 30 days from transplanting.

The irrigation regime was applied after 45 days from transplanting and the quantity of water was adjusted to reach the field capacity. After 30 days from the transplantation, the plants were irrigated with the various dilutions of greywater during all the experimental periods. These experiments were set in a completely randomized design with 5 replicates.

The following data were recorded:

1- Plant height (cm). 2- Stem diameter (mm). 3- Leaf area index (cm2) 4-Number of branches / plants.5-Number of leaves / plants. 6-Fresh and dry weight of leaves (g). 7- Fresh and dry weight of stems (g). and 8-Fresh and dry weight of roots (g).

hemical constituents:

Pigments contents (chlorophyll a, b and carotenoids (mg / g) Fresh weight(F.W.) were determined according to(Metzner et al., 1965). Total carbohydrates (% Dry weight (D.W)) were determined according to the method described by (Herbert et al., 1971). Proline content (ug / g) was determined according to the method mentioned by (Bates et al., 1973). Protein content as (mg / g F.W.) was determined according to the method described by (Alsmeyer et al., 1974).

The experimental design. was randomized Complete block design. Each treatment was Contained five replicates. The recorded date (the average of two seasons) were subjected to one-way analysis of variance (ANOVA) according to (Snedecor and Cochran, 1980) by using costate program. The values of least significant difference (L.S.D) and the means were Compared using L.S.D. test at 5% levels probability.

RESULTS AND DISCUSSIONS

Physical and Chemical Characteristics of the raw greywater:

The physical and chemical characteristics of the employed raw greywater are given in Table (2). The given data reveal that the given greywater is within a low strength wastewater. The determined Biological Oxygen Demand (BOD)/ Chemical Oxygen Demand (COD) ratio indicated a good bio-degradable type of greywater (Abdel-Shafy *et al.,* 2014 b) The recorded level of Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), and Total Suspended Solid (TSS) are less than that employed by other investigators (Regelsberger *et al.,* 2007)

Table 1: Physical, soluble cations, and soluble anions of pot soil before agriculture.

Physical characteristics		Soluble Cations (ppm)				Soluble anions (ppm)			
P^H	EC(ms/cm)	Ca	Mg	Na	K	$CO3^{--}$	HCO_3^-	Cl^-	$SO4^{--}$
7.64	0.93	3.5	1.5	3.6	0.8	-	0.9	4.8	3.7

Table 2: Physical and Chemical Characteristics of the employed raw greywater in the present study.

Parameter	Number of samples	Unit	Min.	Max.	Average
P^H	22	---	5.92	7.80	6.83
Temperature	22	C^0	26.33	28.87	28.01
Electrical Conductivity (EC)	22	ms/cm	517	895	678
(TSS)	22	mg/l	62	166	115
(COD)	22	mg O_2/l	303	542	402
(BOD_5)	22	mg O_2/l	179	332	289
BOD/COD ratio	22	---	0.58	0.63	0.60
Oil & Grease	22	mg/l	88	221	149
Sodium Absorption Ratio (SAR)	18	%	21	28.8	24

Vegetative growth:

The given results in Fig (1) show no significant increase in the vegetative characteristics of yucca plant. The treatment of 67% greywater recorded the highest values in the vegetative parameters, followed by irrigation with 75% greywater compared to the control (tap water) and the other conducted treatment. On the other hand, the irrigation with 100% greywater recorded a significant decrease in plant height, the fresh and dry weight of leaves, and the total dry weight of the plant. Meanwhile, a significant decrease was recorded in leaf area, number of leaves, root length, stem diameter and total fresh weight of the yucca plant.

Table 3: the effect of greywater on soil characteristics after agriculture

	Analyses type		**Soluble Cations (ppm)**				**Soluble Anions (ppm)**			
Percentage of greywater: fresh water	P^H	EC (ms/cm)	Ca	Mg	Na	K	CO_3^{--}	HCO_3^-	Cl^-	SO_4^-
Control	7.3	0.53	2	1.5	1.3	0.8	-	2.4	2	1.2
50%:50%	7.8	0.73	2.5	1	2.60	1.32	-	2.92	2.8	1.6
67%:33%	7.9	0.7	3	1.5	1.90	0.95	-	3.75	2.4	1.2
75%:25%	7.9	0.63	2.5	1	2.10	0.83	-	3.63	2	0.8
100% greywater	7.8	0.74	2.5	1.5	2.30	1.2	-	4.3	2	1.2

***Control**: (tap water); **50%:50% (**50%-greywater,50% tap water); **67%: 33%** (67% greywater, 33% tap water); **75%:25%** (75% greywater, 25% tap water);**100%** (100% greywater, 0% tap water)

Table3 shows that, irrigated yucca plants with 100% graywater recorded the highest values in Na, K, Cl^- elements and So4. That means, it has the ability to tolerate irrigation with gray water without mixing it with water.

From Table (1) and (3) it was found that, soil characteristics after planting of yucca plants recorded the lower values in Soluble Cations and Soluble anions while, soil characteristics before planting of yucca plants recorded the higher values in Soluble Cations and Soluble anions, it means that yucca plants uptake Soluble Cations and Soluble anions form soil and irrigation water in the cells to decrease the toxicity from soil.

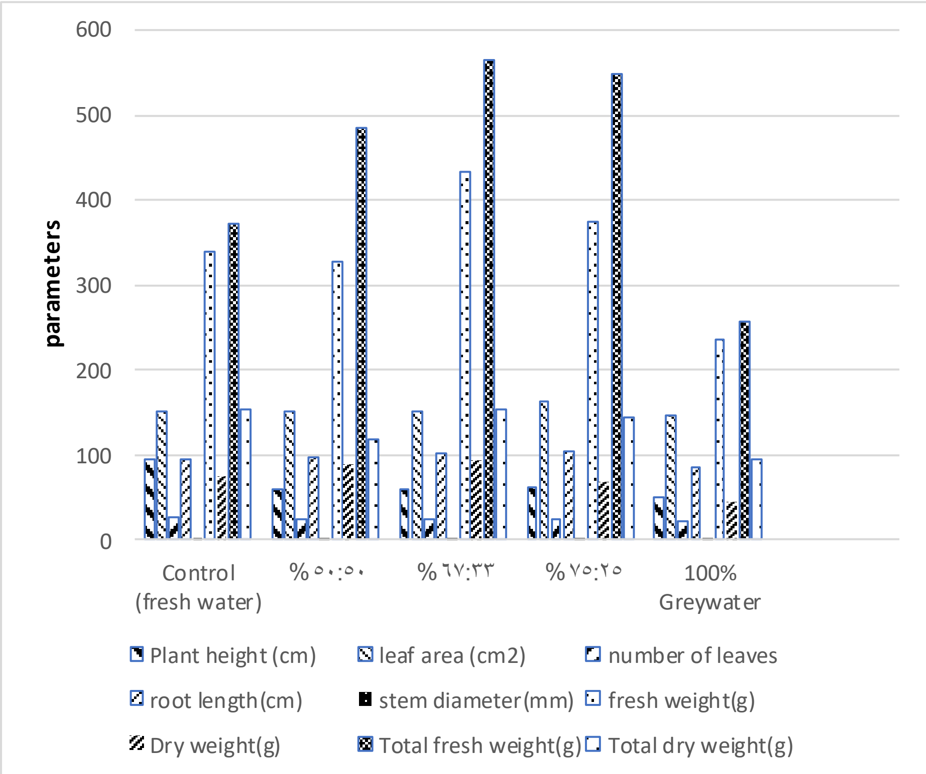

Figure (1): the effect of greywater on growth plant ***Control**: (tap water); **50%:50%** (50%-greywater,50% tap water); **67%: 33%** (67% greywater, 33% tap water); **75%:25%** (75% greywater, 25% tap water);**100%** (100% greywater, 0% tap water).

These results hold true work with (Ikhajiagbe *et al.*, 2020). They reported that, there was a general decrease in leaves numbers of *Vigna unguiculata* L plants under greywater treatments compared with the control plants.

The present results showed there was no significant difference in growth parameters between seedlings irrigated with greywater and those irrigated with tap water. The response of plants to greywater depends on the specific Ion toxicity (due to the presence of Na, Boron, and chloride in greywater), which induce changes in soil properties in terms of elements accumulation and p^H levels. it could be suggested that greywater have no a difference effect on plant in the short period but may be observed in long term (Ikhajiagbe *et al.*, 2020).

The reduction of growth parameters of plants treated with gray water observed in the present study could have consequently been due to chemical constituents and/or gray water parameters which affect directly or indirectly reduce the bioavailability of plant nutrients. These results were in agreement with the results of (Ali *et al.,* 2004), who mentioned that the decrease in plant growth may be due to decrease water uptake toxicity of Na and chloride (Cl^-) in the cells and reduced photosynthesis. The gray water hazard affect may be due to the contain of greywater from toxic elements such as Chlorides, phosphates and Sodium that can harmful the vegetative growth and chemical constituents of the plants (Ayers and Westcot, 1985).

Chemical content:

From Table (4) and Fig. (2) it was found that, irrigation of yucca plant with 75% and 100% gray water recorded the highest values in proline, chlorophyll a, b content compared with control plant while, Irrigation with 75% gray water recorded the higher values in carbohydrates content compared with the control (i.e., tap water and other treatments).On the other hand, irrigation with

Vol. (51); Iss. (12); No. (7); Dec. 2022
ISSN 1110-0826
ONLINE ISSN 2636 - 3178

75 % graywater recorded the higher values in cell carbohydrates content compared to the control (i.e., tap water and other treatments). However, there is no significant decrease on protein and proline under irrigation with 50% and 67% greywater.

Table (4): the effect of greywater on Chemical content

Treatments /Parameters	Proline (ug /g)	Protein (mg / g F.W.)	Chlorophyll a (mg / g)	Chlorophyll b (mg / g)	Carbohydrate (mg / g)
Control	9.54	0.062	0.17	0.05	4.66
50%	7.73	0.071	0.36	0.18	10.26
67%	4.42	0.0432	0.26	0.09	5.20
75%	11.57	0.042	0.46	0.23	10.26
100%	11.46	0.061	0.52	0.20	4.60
L.S. D	1.90	0.016	0.15	0.07	2.17

* **Control**: (tap water); **50%:50%** (50%-greywater,50% tap water); **67%: 33%** (67% greywater, 33% tap water); **75%:25%** (75% greywater, 25% tap water);**100%** (100% greywater, 0% tap water.

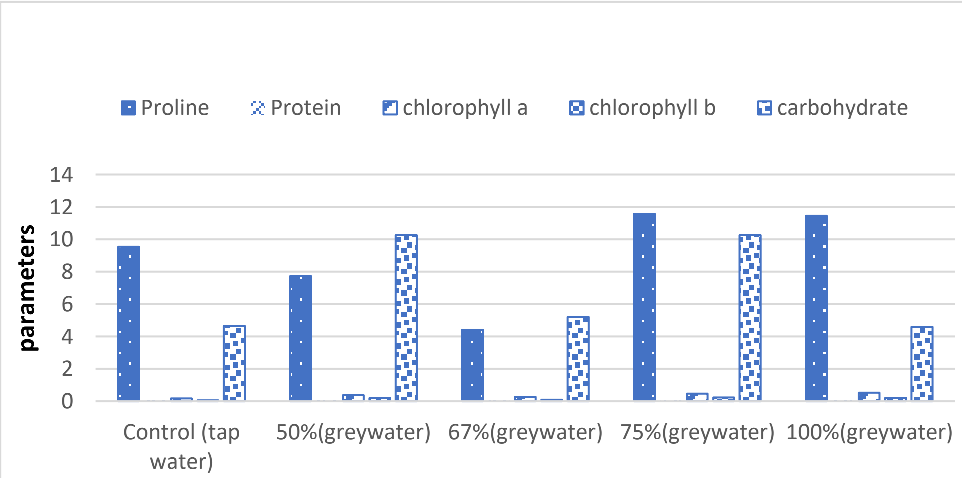

Figure (2): The effect of greywater on Chemical content *Control- tap water; 50%-greywater,50% tap water; 67% greywater, 33% tap water; 75% greywater, 25% tap water; 100% greywater, 0% tap water.

This study shows that the application of greywater increases the chlorophyll content of yucca plant compared with control, these results may be due to correlated with the metal induced inhibition of photosynthetic process and respiration of shoot systems and synthesis protein in the root.

Based on the effect of natural and gray water, its element content and its continued use for irrigation affect the vegetative growth of plants, protein, carbohydrate, and proline content. (Hatata and ABDEL, 2008; Kabir *et al*., 2010; Khalilzadeh *et al.*, 2020).

Previous studies revealed that there was a marked decrease in the protein content based on greywater treatments (Chen e*t al.*, 2003; Khosravinejad *et al*., 2009). The presence of sodium chloride in irrigation water reduced the protein content in the plant(Chao *et al.*, 1999). Other investigators mentioned that the increase in protein content of the tomato plant is due to the presence of salts in the irrigation water (Nyagatare et al., 2021).

CONCLUSIONS AND RECOMMENDATIONS

Irrigation with 67% greywater recorded the highest values in vegetative parameters, followed by irrigation with 75% greywater compared with the control (tap water). From this study, it was concluded that long term irrigation with greywater exhibited a beneficiary effect on Yucca plant in terms of vegetation. Nevertheless, it is recommended that greywater should receive adequate treatment to be safely reused as a reliable source of restricted irrigation. Consequently, further studied should be fully carried out to insure the given recommendation.

Acknowledgements:

The authors are in debt to the facilities provided by the following projects:

1. Titled “Towards Innovative and Green Water Reuse with Integrated Constructed Wetlands and Ferrate (VI) Treatment”- number (42688)- supported in whole or part by NAS and USAID, USA-Egypt Science Technology Joint Fund-(Cycle.19), and the (STDF-Egypt).
2. Titled “Development of the frame conditions for the establishment of an innovative water technology which couple’s anaerobic wastewater treatment and biomass production in a bioreactor in the Mediterranean region”- number (31319)-FRAME, ERANETMED3-75, Fund (STDF-Egypt).

REFERENCES

Abdel-Shafy, H. I., El-Khateeb, M. A., & Shehata, M. (2014a). Greywater treatment using different designs of sand filters. *Desalination and Water Treatment*, *52*(28-30), 5237-5242.

Abdel-Shafy, H., & El-Khateeb, M. A. (2019). Fate of heavy metals in selective vegetable plants irrigated with primary treated sewage water at slightly alkaline medium. *Egyptian Journal of Chemistry*, *62*(12), 2303-2312.

Abdel-Shafy, H. I., Al-Sulaiman, A. M., & Mansour, M. S. (2014b). Greywater treatment via hybrid integrated systems for unrestricted reuse in Egypt. *Journal of Water Process Engineering*, *1*, 101-107.

Abdel-Shafy, H. I., & Al-Sulaiman, A. M. (2014). Assessment of physico-chemical processes for treatment and reuse of greywater. *Egyptian Journal of Chemistry*, *57*(3), 215-231.

Abdel-Shafy, H. I., & Al-Sulaiman, A. M. (2014). Effeciency of degreasing/settling tank followed by constructed wetland for greywater treatment. *Egyptian Journal of Chemistry*, *57*(5), 435-446.

Abdel-Shafy, H. I., Al-Sulaiman, A. M., & Mansour, M. S. (2015). Anaerobic/aerobic treatment of greywater via UASB and MBR for unrestricted reuse. *Water Science and Technology*, *71*(4), 630-637.

Abdel-Shafy, H. I., & Mansour, M. S. (2018). Phytoremediation for the elimination of metals, pesticides, PAHs, and other pollutants from wastewater and soil. In *Phytobiont and ecosystem restitution* (pp. 101-136). Springer, Singapore.

Abdel-Shafy, H. I., Mansour, M. S., & Al-Sulaiman, A. M. (2019). Anaerobic/aerobic integration via UASB/enhanced aeration for greywater treatment and unrestricted reuse. *Water Practice and Technology*, *14*(4), 837-850.

Abed, S. N., & Scholz, M. (2016). Chemical simulation of greywater. *Environmental Technology*, *37*(13), 1631-1646.

Ali, Y., Aslam, Z., Ashraf, M. Y., & Tahir, G. R. (2004). Effect of salinity on chlorophyll concentration, leaf area, yield and yield components of rice genotypes grown under saline environment. *International Journal of Environmental Science & Technology*, *1*(3), 221-225.

Alsmeyer, R. H., RH, A., AE, C., & ML, H. (1974). Equations predict PER from amino acid analysis.

Assayed, A. K., Dalahmeh, S. S., & Suleiman, W. T. (2010). Onsite greywater treatment using septic tank followed by intermittent sand filter-A case study of Abu Al Farth Village in Jordan. *Royal Scientific Society-Environmental Research Centre Al-Jubaiha Jorda, 1*(1International).

Avery, L. M., Frazer-Williams, R. A., Winward, G., Shirley-Smith, C., Liu, S., Memon, F. A., & Jefferson, B. (2007). Constructed wetlands for grey water treatment. *Ecohydrology & Hydrobiology*, *7*(3-4), 191-200.

Ayala-Hernandez, M. M., Rios-Gomez, R., Solano, E., & Garcia-Mendoza, A. (2022). Yucca muscipula (Asparagaceae, Agavoideae), a new species from central Mexico. *Phytotaxa*, *543*(2), 103-112.

Ayers, R. S., & Westcot, D. W. (1985). *Water quality for agriculture* (Vol. 29, p. 174). Rome: Food and Agriculture Organization of the United Nations.

Bates, L. S., Waldren, R. P., & Teare, I. D. (1973). Rapid determination of free proline for water-stress studies. *Plant and soil*, *39*(1), 205-207.

Chao, W. S., Gu, Y. Q., Pautot, V., Bray, E. A., & Walling, L. L. (1999). Leucine aminopeptidase RNAs, proteins, and activities increase in response to water deficit, salinity, and the wound signals systemin, methyl jasmonate, and abscisic acid. *Plant Physiology*, *120*(4), 979-992.

Chen, Y., Lerner, O., & Tarchitzky, J. (2003). Hydraulic conductivity and soil hydrophobicity: effect of irrigation with reclaimed wastewater. In *9th Nordic IHSS symposium on abundance and functions of natural organic matter species in soil and water* (Vol. 19). Sundsvall, Sweden: Mid-Sweden University.

Eid, E. M., Hussain, A. A., Taher, M. A., Galal, T. M., Shaltout, K. H., & Sewelam, N. (2020). Sewage sludge application enhances the growth of Corchorus olitorius plants and provides a sustainable practice for nutrient recirculation in agricultural soils. *Journal of Soil Science and Plant Nutrition*, *20*(1), 149-159.

George, G. T., & Gabriel, J. J. (2017). Phytoremediation of heavy metals from municipal waste water by Salvinia molesta Mitchell. *Haya: The Saudi Journal of Life Sciences*, *2*, 108-115.

Hatata, M. M., & ABDEL, A. E. (2008). Oxidative stress and antioxidant defense mechanisms in response to cadmium treatments.

Herbert, D., Phipps, P. J., & Strange, R. E. (1971). Methods in microbiology. *JR Norris, DW Ribbons (Eds.)*, 324.

Ikhajiagbe, B., Ohanmu, E. O., Ekhator, P. O., & Victor, P. A. (2020). The effect of laundry grey water irrigation on the growth response of selected local bean species in Nigeria. *Agricultural Science & Technology (1313-8820)*, *12*(1).

Kabir, M., Iqbal, M. Z., Shafiq, M., & Farooqi, Z. R. (2010). Effects of lead on seedling growth of spesia populnea. *Plant, Soil and Environment*, *56*(4), 194-199.

Khalilzadeh, R., Pirzad, A., Sepehr, E., Khan, S., & Anwar, S. (2020). Long-Term Effect of Heavy Metal–Polluted Wastewater Irrigation on Physiological and Ecological Parameters of Salicornia europaea L. *Journal of Soil Science and Plant Nutrition*, *20*(3), 1574-1587.

Khosravinejad, F., Heydari, R., & Farboodnia, T. (2009). Growth and inorganic solute accumulation of two barley varieties in salinity. *Pakistan Journal of Biological Sciences: PJBS*, *12*(2), 168-172.

Liu, W. H., Zhao, J. Z., Ouyang, Z. Y., Söderlund, L., & Liu, G. H. (2005). Impacts of sewage irrigation on heavy metal distribution and contamination in Beijing, China. *Environment international*, *31*(6), 805-812.

Maimon, A., Tal, A., Friedler, E., & Gross, A. (2010). Safe on-site reuse of greywater for irrigation-a critical review of current guidelines. *Environmental science & technology*, *44*(9), 3213-3220.

Mansour, M ., & Abdel-Shafy, H. I. (2022). Land Infiltration for Wastewater Treatment As Efficient, Simple, And Low Techniques: An Overview. *Egyptian Journal of Chemistry*, *65*(4), 617-631.

Metzner, H., Rau, H., & Senger, H. (1965). Untersuchungen zur synchronisierbarkeit einzelner pigmentmangel-mutanten von Chlorella. *Planta*, *65*(2), 186-194.

Mojid, M. A., Hossain, A. B. M. Z., & Wyseure, G. C. L. (2019). Impacts of municipal wastewater on basic soil properties as evaluated by soil column leaching experiment in laboratory. *Journal of Soil Science and Plant Nutrition*, *19*(2), 402-412.

Nyagatare, G., Shingiro, C., & Nyiranziringirimana, C. (2021). Effect of domestic greywater reuse for irrigation on soil physical and chemical characteristics and tomatoes growth. *Journal of Agriculture and Environment for International Development (JAEID)*, *115*(2), 51-63.

Regelsberger, M., Baban, A., Bouselmi, L., Shafy, H. A., & El Hamouri, B. (2007). Zer0-M, sustainable concepts towards a zero outflow municipality. *Desalination*, *215*(1-3), 64-72.

Snedecor, G. W., & Cochran, W. G. (1980). Statistical Methods 7th Edition Iow State Univ. *Press. Ames. Iowa, USA.*

Wilde, S. A., Corey, R. B., Lyer, J. G., & Voight, G. K. (1985). Soil and plant analysis for Tree Culture P. 93-106. *Oxford and IBM. puplishingCo., New Delhi. 0 0 0 0*, *2*(2.5), 2-5.

Vol. (51); Iss. (12); No. (7); Dec. 2022
ISSN 1110-0826
ONLINE ISSN 2636 - 3178

إعادة استخدام المياه الرمادية في ري نباتات اليوكا
تحت ظروف إجهاد المعالجة بالنباتات

مصطفى محمدي كفافي[١]– سامي متولي[٢]– هشام ابراهيم القصاص[١]– حسين إبراهيم عبد الشافي[٢]
١) كلية الدراسات والبحوث البيئية، جامعة عين شمس ٢) المركز القومي للبحوث

المستخلص

على مدى السنوات القليلة الماضية، أصبحت المخاوف بشأن ندرة المياه والتلوث أكثر بروزًا. في العديد من المناطق فإن إدارة إمدادات المياه تتطلب الدعم بشكل واسع. ولقد هدفت هذه الدراسة إلى تحديد تأثير المياه الرمادية على الصفات النباتية والمحتوى الكيميائي في نبات اليوكا باستخدام دراسات الاصص. أجريت هذه الدراسة بالمركز القومي للبحوث، الدقي، القاهرة، مصر، خلال موسمي ٢٠٢١–٢٠٢٢ المتتاليين. تم ري نباتات اليوكا بالمياه الرمادية بتخفيفات مختلفة بمياه الصنبور العذبة بالنسبة المئوية التالية من المياه الرمادية: **٥٠٪: ٥٠٪** (٥٠٪ ماء رمادى ، ٥٠٪ ماء عذبة)؛ **٦٧٪: ٣٣٪** (٦٧٪ مياه رمادية، ٣٣٪ ماء عذبة) ؛ **٧٥٪: ٢٥٪** (٧٥٪ مياه رمادية ، ٢٥٪ ماء حنفية) ؛ **١٠٠٪** (١٠٠٪ مياه رمادية ، ٠٪ ماء عذبة) بينما تم ري عينات الكنترول بماء عذبة فقط. وجد أن ري نبات اليوكا بالمياه الرمادي الخام(١٠٠%) سجل أعلى القيم في محتوى البرولين والبروتين والكلوروفيل أ ، ب في النباتات ، بينما انخفضت جميع المتغيرات الخضرية. عن طريق الري باستخدام التخفيف (٧٥:٢٥) من المياه الرمادية (أي ٧٥٪ مياه رمادية: ٢٥٪ مياه عذبة)، وكذلك تم تسجيل قيم أعلى في محتوى الكربوهيدرات مقارنةً بالكنترول (أي ١٠٠٪ ماء عذبة) ومعالجات أخرى. ومن ناحية أخرى، سجل الري باستخدام ٦٧٪ من المياه الرمادية أعلى القيم في المتغيرات الخضرية ، يليه الري بنسبة ٧٥٪ من المياه الرمادية مقارنة بالكنترول (مياه عذبة). ومن هذه الدراسة، نستنتج أن الري طويل الأمد بالمياه الرمادية كان له تأثير مفيد على نبات اليوكا.
الكلمات المفتاحية: المياه الرمادية، نباتات الزينة، المعالجة النباتية، معالجة المياه، نبات اليوكا.