THE IMPACT OF WASTE WATER FROM TREATMENT PLANT OF ORADEA ON GERMINATION OF *LYCOPERSICON ESCULENTUM*

Pantea Emilia*, Romocea Tamara*, Ghergheleş Carmen*, Cărbunaru M.*

** University of Oradea, Faculty of Environmental Protection, 26 Gen. Magheru St., 410048,Oradea, Romania, e- mail: panteaemilia@yahoo.com*

Abstract

The study was conducted to evaluate the impact of the effluent of aerobic biological treatment (0, 25, 50, 75, 100% concentration) on germination of tomatoes, Lycopersicon Esculentum Heinz 2274 variety. Samples of waste water were collected from biological treatment plant from Oradea county city and as control was used tap water (B1). The samples of effluent were diluted with tap water at concentration: 100%(B2), 25%(B3), 50%(B4) and 75%(B5). The highest germination of 85,71% was found in the 50% mix effluent activated sludge basin and 50% tap water, The rate of seed germination for tomatoes increases with increasing concentration of effluent activated sludge basin up to 50% and thereafter it decreases.

Key words: germination, waste water, effluent of aerobic treatment, irigation

INTRODUCTION

The growth and development of land plants is largely limited by water shortage. Application of wastewater in irrigation is an ancient practice and implemented to a pretty large scale worldwide. There are indicators that wastewater was used back for irrigation in ancient Greece and the Minoan civilization (ca 3000 – 1000 BC) (Angelidaki et.al, 1999).

Wastewater use in areas with water scarcity in arid and semiarid area ensure the protection and the conservation of water available and their efficient management (Takashi Assano and Levine Audrey D., 1996). The conservation of water resource is realized through pricing reforms, wastewater treatment technologies and wastewater reuse (Kretschmer, N., et al.).

The wastewater used in irrigation can be from different sources. It can be completely untreated municipal or industrial wastewater, mechanically treated wastewater or particularly or fully wastewater treated biologically (Donta, Antonia Alkistis, 1997).

The amount of wastewater produced depends on the population of a city or town. Industrial and domestic waste water are frequently channeled either into the same sewerage system (if a sewerage system exists) or into the same open drains. The wastewater is either released untreated, after partial treatment, or after more complete treatment (to the secondary or tertiary levels), into drains, into channels, and then frequently into rivers.

There are many advantages in using waste water in agriculture: conservation of water, recycling of nutrients (waste water from different sources contains considerable amount of organic matter and plant nutrients (N, P, K, Ca, S, Cu, Mn, Zn)) and provision of a reliable water supply to farmers; prevention of pollution of rivers, canals and other surface water, the disposal of municipal wastewater in a low –cost and hygienic way. (Aditya Kishore Dash, 2012, Lubelo et al., 2004; Nath at.al., 2009).

The value of sewage effluents for crop irrigation has been recognized as a potential water resource, an auxiliary supply for plant nutrients and soil structure improvement (Abd-Elfattah *et al*., 2002).

The transition between dormancy and germination represents a critical stage in the life cycle of crop plants which controls population dynamics and productivity (Radosevich et al., 1997; Keller, M., J. Kollmann, 1999, Ogunwenmo, K.O et al., 2010)

MATERIAL AND METHOD

Plant materials

In the study we used tomatoes, *Lycopersicon Esculentum*, Heinz 2274 variety.

Growth conditions

The experiments were located in Laboratory of the Department of Environmental Engineering. The soil is characterized by a slightly acidic reaction, with a pH between 5.5 to 6. Heinz 2274 variety of tomatoes were studied.

The wastewater was supplied from wastewater treatment plant from Oradea city: effluent from biological waste water treatment (activated sludge basin). The experiment was conducted in the period 27.03.2012 - 16.04.2012, were irrigated at 2-day interval throughout the experimental period. In the room that made the experience the average temperature was 23.5^{o}C.

In the laboratory were prepared the following types of water needed for the experiment, as follows:

B1. tap water
B2. effluent from biological waste water treatment
B3. mixture 25% effluent from biological waste water treatment and 75% tap water
B4. mixture 50% effluent from biological waste water treatment and 50% tap water
B5. mixture 75% effluent from biological waste water treatment and 25% tap water

In order to identify quality of water were made the following measurements using the following equipment and working methods:

1. Determination of pH. This parameter was determined electrochemically using a WTW pH meter.
2. Cadmium, chromium, copper, lead were determined by atomic absorption spectrometry (AAS) with atomization furnace (Cd, Pb), flame (Cu, Cr) according to the following standards: EN ISO 15586-2004 (Cr), ISO 8288-2001 (Cu), EN ISO 15586 -2004 (Pb).
3. Determination of chlorides was achieved by Mohr method.
4. Biochemical oxygen demand 5 days was determined by the difference between the amount of dissolved oxygen found immediately in water samples and after 5 days of collection.
5. Sulphates were determined by turbidimetric method.
6. Total nitrogen, total phosphorus, were determined using Hanna Photocolorimeters.

The characteristics of effluent from biological waste water treatment are presented in Table 1.

Table 1.

The characteristics of secondary treated wastewater

Parameter	**U.M**	**B2**
BOD_5	mg/l	22,9
COD	mg/l	43,4
Total nitrogen,	mg/l	9,28
Total phosphorus	mg/l	0,380
Chloride	mg/l	73,6
Sulphate	mg/l	73,8
Copper	mg/l	0,0052
Chromium,	mg/l	0,0036
Cadmium	mg/l	-*
Iron	mg/l	0,423
Nickel	mg/l	-*
Lead	mg/l	-*
pH	unit. pH	6,86

** - Below the detection limit of the device (by AAS detection limits for Pb 0.0001 mg / l for Cr of 0.008 mg / l for Cu and 0.001 for Cd, Ni of 0.0002 mg / l) .*

The physico-chemical quality of the water used is in accordance with FAO recommendation, but the most important for human health is the microbiological quality of waste water but also this can be solved by disinfection.

RESULTS AND DISSCUSION

To determine the germination of of tomatoes according to optimal water quality, the experience was bifactorial:
Factor A - *Lycopersicon esculentum* HEINZ 2274
Factor B – varietes of water :
B1. tap water
B2. effluent from biological waste water treatment
B3. mixture 25% effluent from biological waste water treatment and 75% tap water
B4. mixture 50% effluent from biological waste water treatment and 50% tap water
B5. mixture 75% effluent from biological waste water treatment and 25% tap water

The results obtained from practical observations made in the laboratory are presented in the following table which highlights the influence of quality of water on germination of tomatoes.

Tabel 2.

Germination of of tomatoes according to water quality

Tips water	*01.04.*	*03.04.*	*04.04.*	*06.04.*	*09.04.*	*10.04.*	*16.04.*
B1	-	*4*	*4*	*4*	*5*	*5*	*5*
B2	*1*	*2*	*2*	*2*	*2*	*2*	*2*
B3	-	*3*	*3*	*4*	*4*	*4*	*4*
B4	-	*4*	*5*	*5*	*6*	*6*	*6*
B5	*2*	*3*	*3*	*3*	*3*	*3*	*3*

The highest number of plants obtained in the same period of time was obtained for 50% dilution of effluent.

Fig.1 Tomato seedlings, the variety Heinz produced in the laboratory

Seed germination (%) was observed by providing optimum conditions for each experiment. The germination percentage was recorded following the criteria and standard seed germination (ISTA,1993; Sarwar Abu Kausar Mohammed, et al., 2011).

$$\% \text{ germination} = \frac{\text{number of seed germination}}{\text{total number of seeds}} \times 100$$

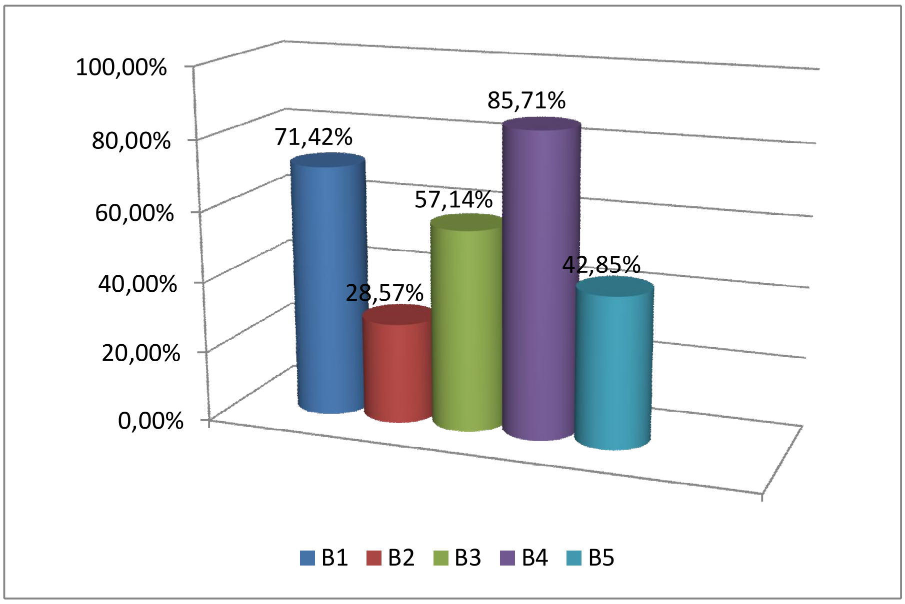

Fig. 2 Germination of tomatoes (%) according to water quality

Highest germination 85.71% was found in the mix 50% effluent from biological waste water treatment and 50% tap water. The similar result, 71.42% for seed germination was obtained for tap water, but using mix waste water and tap water we could protect the water resources.

The rate of seed germination for tomatoes with increasing concentration of domestic waste water up to 50% and thereafter it decreases. Germination the lowest concentration we observed to effluent from biological waste water treatment (100% concentration) and this is explainable because the nutrient reduction takes place in activated sludge basins.

Aditya and al.(2012) has obtained same results for rice and wheat cultivars for domestic waste water. Khan at al. (2011) in study on impact of textile wastewater on seed germination found that higher concentration the germination is affected. Nagda et.al.(2006) found that, the seed germination efficiency decreases for higher concentration of industrial effluent. Ogunwenmo, K.O., et.al. was obtained the highest percentage (95%) of germination for *A. hybridus* with 50% diluted brewery effluent. Ali Abdullah Alderfasi, (2009) shows that irrigation with secondary treated waste water was more efficient than irrigation with underground water in grain yield as well as component characters; grain yield was increased by 16.81 and 21.32% .

Some researchers suggest that other types of waste water (urban waste water, industrial waste water etc.) may be discharged into irrigation system after removing physical and chemical constituents through proper treatment.

CONCLUSIONS

Waste water (raw, diluted or treated) is a resource of increasing global importance, in urban and peri-urban agriculture. The use of waste water would be an alternative resources to protection fresh water. So, domestic waste water could be used for irigation after proper dilution. The use of treated waste water for irigation purposes has emerged an important way to utilize its nutrients, but it must be chosen carefully, taking into account the type of culture and their impact on health and environment protection.

It is also suggested that, treatment of waste water is necessary to minimise the polution effects before it is disharged into the land. With proper management, waste water use contributes significantly to sustaining livelihoods, food security and the quality of the environment.

We were suggested that effluent from biological waste water treatment could be utilized for irrigation purposes after proper dilution. However, such recommendation needs some more extensive work to minimize the risk regarding health (microbiological quality).

Acknowledgments

The autors wish to express their appreciation for efforts made possible the production of the article, Mr. ROBERT JUDEA, manager of WWTP Oradea.

REFERENCES

1. Abd-Elfattah, A., S.M. Shehata and A.S. Talab, 2002 - Evaluation of irrigation with either raw municipal sewage or river water on elements uptake and yield of lettuce and potato plants. Egyptian J. Soil Sci., 42: 705–14
2. Ali Abdullah Alderfasi, 2009 - Agronomic and Economic Impacts of Reuse Secondary Treated Wastewater in Irrigation under Arid and Semi-Arid Regions World Journal of Agricultural Sciences 5 (3): 369-374, ISSN 1817-3047
3. Aditya Kishore Dash, 2012 - Impact of domestic waste water on seed germination and physiological parameters of rice and wheat www.arpapress.com/Volumes/Vol12Issue2/IJRRAS_12_2_15.pdf(Accesed 07.10.2012)
4. Angelakis, A. N., Marecos Do Monte, M.H.F., Bontoux, L., Asano,T., 1999 - The Status of wastewater reuse practices in the Mediterranean basin: need for guidelines – Wat. Res. 33, No.10, pp.2201-2217, Elsevier Science
5. Domuța C, 2009 – Irigarea culturilor, Editura Universității din Oradea.
6. Donta, Antonia Alkistis, 1997 - Der Boden als Bioreaktor bei der Aufbringung von Abwaser auf landwirtschaftich genutzte Flächen, Veröffentlichungen des Institutes für Siedlungswasser – wirtschaft und Abfalltechnik der Universität Hannover,Heft 100
7. Ensink, J. H. J., T. Mahmood and A. Dalsgaard., 2007 - Wastewater-irrigated vegetables: market handling versus irrigation water quality, Tropical Medicine and International Health 12(2): 2–7.
8. ISTA, 1993 – International rules for seed testing rules. Proc. Intl., Seed Testing Assoc. Seed Sci. & Tech. 21(Supplement): 25 – 30 and 141 -186
9. Khan, M. G, G. Daniel, M. Konjit, A.Thomas, S.S. Eyasu and G. Awoke, 2011 - Impact of Textile waste Water on Seed Germination and Some Physological Parameters in Pea (Pisum sativum L.), Lentil (Lens esculentem L.) and Gram (Cicer arientum L.), Asian Journal of Plant Sciences, Volume 10, Issue: 4, page no.: 269-273.
10. Keller, M., J. Kollmann, 1999 – Effects of seed provenance on germination of herbs for agricultural compensation sites. Agric. Ecosyst. Environ., 72: 87 - 99.
11. Kretschmer, N., Ribbe,L., Gaese, H., - Wastewater reuse for agriculture, Technology Ressource Management & Development – Scientific Contributions for Sistainable Development, vol. 2
12. Lubelo, C., Gori, R., Paolo, N.F., Ferrini, F., 2004 – Municipal – treated waste water reuse for plant nurseries irrigation, Water Research 38, 2939 – 2947.

13. Ogunwenmo, K.O., O.A. Oyelana, O. Ibidunmoye, G. Anyasor and A.A. Ogunnowo, 2010 – Effects of Brewery, Textile and Paint Effluent on Seed Germination of Leafy Vegetables – *Amaranthus hybridus* and *Celosia argentea*(Amaranthaceae), Journal of Biological Sciences 10(2): 151 -156, ISSN 1727 – 3048.
14. Nagda G, K., Diwan,A. M., Ghole, V.S., 2006 – Seed germination bioassay to assess toxicity of molasses fermentation besed bulk drug industry effluent. Electonic Journal of Environmental, Agricultural and food Chemistry 5(6), 1598 -1603.
15. Sofia Nawaz, Syeda Maria Ali and Azra Yasmin, 2006 - Effect of Industrial Effluents on Seed Germination and Early Growth of Cicer arientum,Journal of Biological Sciences, volume 6 Issue 1,page no.49-54
16. Radosevich, S., J. Holt and C. Ghersa, 1997 – Weed Ecology: Implications for Management., 2nd Edn, John Wiley and Sons, New York, ISBN: 978 – 0 – 471 – 11606 – 6.
17. Sarwar Abu Kausar Mohammed, Md Akhter Hossain Chowdhury, Gokul Chandra Biswas, Animesh Sarkar, 2011 – Irrigation Potentiality of Industrial Waste Water on Seed Germination of *Amaranthus tricolor* L, Journal of Environment, vol 8, no.1: 13-18.
18. NADIA EL-SAWAF, 2005 - Response of *Sorghum* spp. to Sewage Waste-water Irrigation International Journal of Agriculture & Biology *Vol. 7, No. 6*, 1560–8530/2005/07–6–869–874; http://www.ijab.org
19. Shuval H.I., Adin A., Fattal B., Rawitz E., Yekutiel P., 1986 - Wastewater irrigation in developing countries: health effects and technical solutions. Technical Paper No. 51. World Bank, Washington DC.
20. Takashi Assano, Levine Audrey D., 1996 – Wastewater reclamation, Recycling and Reuse: Past, Present and Future, Water Science and Tehnology, vol 33, no.10 – 11, pp. 1-14