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Field capacity changes by irrigation with domestic wastewater

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Abstract

There is accumulating demand to use the water in different countries due to global water crisis, population growth and industrialization. Under these conditions, we have to use uncommon waters including wastewater in agriculture. Before the use of wastewater in agriculture irrigation, we have to conduct vast studies about the effects of wastewater on agricultural soils and also on different crops. The present study conducted for investigation of the effect of irrigation with domestic wastewater and first and second drainage water using the method of lysimeter on changes of field capacity. The results showed that the field capacity while being irrigated with domestic wastewater was increased 8.5 percent in comparison with control. Also, field capacity while being with first drainage water was increased 7.5 percent in comparison with agronomical water and field capacity while being irrigated with second drainage water was increased 1 percent.

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Introduction

Arid and semiarid regions of the world are confronted by an ever increasing shortage of water and also freshwater is not available for irrigation in these regions (Gatica and Cytryn, 2013). If we will not apply special management in Arid and semiarid regions of the world that are confronted by an ever increasing shortage of water, using wastewater in agriculture, it may cause damage to structure of soil. Soils contain of mineral and organic materials, water, air, microorganisms and are generally under physical-chemical changes. On the other hand domestic wastewaters are free from heavy materials and poisonous and harmful elements including Cadmium and Zinc, but since some parts of vitamins and nutritious materials which human daily consumes are finally saved in wastewater and soil. It may be effective in qualitative and quantitative changes of soil structure. The use of domestic wastewater instead of common irrigation water in agriculture will improve most of characteristics of soil including penetration, porosity and creation of sponge structure on soil (Aliabadi Farahani *et al.*, 2009). Irrigation of cultivation lands with urban and domestic wastewater will destroy physical characteristics of soil. In long term these dangers also will have higher destructive effects on soil. In this study the consequences of using wastewaters in agriculture and cultivation soils with decrease of soil hydraulic guide, watching soil seeds, soil crust, running water and decrease in aeration of soil are referred (Bernstein *et al.*, 2009). Stevens *et al.* (2003) in order to study long term effect of irrigation with wastewater on cultivation soil used from wastewater with saline of 1.7 times higher than well water and SAR double times of well water for 28 years in agriculture. They reported that changes in salinity of soil and its density by using urban wastewaters will not result in decreasing product (Dudai, 2005). This study was carried out in a CRBD with three replications with 17 treatments for investigation of refined wastewater effects on chemical characteristics of cultivation soils. The main treatment include four levels of irrigation with wastewater (25, 50, 75 and 100 percent accessible water for cultivation soils) and four levels of nitrogen with shape (0, 150, 300 and 450 kg/ha) with treatment supplying 100 percent accessible water for cultivation soils and increasing 300 kg/ha of nitrogen as control. In this research the effect of refined wastewater depth on EC and density of chloride was not significant statistically, but these two items were not significant on parameters of SAR and density of sodium (Fine *et al.*, 2006). Another study revealed that after irrigation with domestic wastewater the sodium of soil will increased up to 90 percent also sodium that is present in surface of soil will increased up to 89-117 percent (Khalid, 2006). By observing all aforesaid items and results that are gained due to studying effect of irrigation with domestic and urban wastewater on physical, chemical and biological characteristics of cultivation soils, the importance and necessity of conducting broad researches in this field will be revealed for us. Meanwhile under conditions of shortage and severe crisis of water resources, most of world's countries are moving toward using from wastewaters in agriculture. Therefore we have offered some part of our researches in relation to effect of irrigation with domestic wastewater (refined) and its drainage water on cultivation soil and plants with method of lysimeter in this article (Kidder, 2001). The main objective of this research was the effect of irrigation with domestic wastewater and it drainage water with method of lysimeter on field capacity changes.

Materials and methods

This study was conducted on experimental lysimeters of Islamic Azad University, Shahr-e-Qods Branch of Tehran at Iran in 2011, The volume of each lysimeter was 150 lit (Height = 100 cm and Radius = 60 cm) filled by soil and in order to prevent water influx from field to lysimeters, those placed on metal legs (height = 40 cm). After filling lysimeters by clay loam soil, plants seeds were planted and were irrigated with agronomical water rapeseed *(Brassica napus* L.), alfalfa (*Medicago sativa* L.) and basil (*Ocimum basilicum* L.) were used in this experiment. In this experiment, we had 15 lysimeters, that were planted rapeseed in 1 to 5 lysimeters and were irrigated by domestic wastewater with BOD_5 about 150 mg/lit and primary drainage water were accumulated. In the 6 to 9 lysimeters was planted alfalfa and were irrigated by primary drainage water and then, were accumulated secondary drainage water. We have irrigation 10, 11 and 12 lysimeters by secondary drainage water that was planted inside the basil. In order to compare plants characteristics, in 13, 14 and 15 lysimeters were planted rapeseed, alfalfa and basil respectively and were irrigated by agronomical water (Fig. 1). It shall be noted that in order to compare FC in our experiment for lysimeters No. 13, 14, 15 that were containing *Brassica napus* L., alfalfa and basil respectively we have used from usual well water as control.

Results and discussion

Physical and chemical characteristics of agronomical water (control) are shown in Tables 1, 2 and 3. Since in this study we attempt to study changes of field capacity before and after irrigation with domestic wastewater and first and second drainage water, thus in this section we have studied the changes of this important parameter. After fulfilling irrigation of lysimeters No. 1-5 with refined domestic wastewater a sample by using Oger drill was extracted from soil insides of *Brassica napus* L. lysimeter and FC parameter was treated by 1/3 atmosphere suction using PF Meter machine. After weighting the sample soils were treated for 24 hours in oven under temperature of 105°c and their percentage of humidity was calculated. Of course at this stage from each lysimeter a sample from depth of 0-15 was received. The same measurement was performed for 4 alfalfa lysimeters with same method but with this difference that 4 alfalfa lysimeters with exit drainage water from 5 *Brassica napus* L. lysimeters were irrigated and the same experiment was performed for 3 basil lysimeters that were irrigated from exit of 4 alfalfa lysimeters.

Table 1. Physical and Chemical Characteristics of Soil inside of Lysimeters before Irrigation with Refined Domestic Wastewater.

Soil Texture	Soil Humidity FC PWP	Bulk Density	Total Porosity %	EC	PH	SAR
Clay=30% Silt= 28% Sand=42%	FC=13.7 PWP=6.14	1.52	38	5.68	7.2	8.72

Ca =12.01(meq/lit)

Mg =14.12(meq/lit) *K =201.41(mg/kg)*

Na =30.21(meq/lit) *P = 5.12(mg/kg).*

Table 2. Analysis of Refined domestic Wastewater before Irrigation of Lysimeters.

Parameter	BOD_5	COD	EC	PH	CL	SAR	Na	Mg	Ca
	ppm	ppm	ds/m	-	mg/lit	-	meq/lit		
Amount	150	232	4.8	7.2	1.82	5.81	24	15.01	14.7

Table 3. Analysis of agronomical water (Control) for Irrigating Lysimeters No.13, 14, 15.

Parameter	BOD_5	COD	EC	PH	CL	SAR	Na	Mg	Ca
	ppm	ppm	ds/m	-	mg/lit	-	meq/lit		
Amount	2.42	18.01	1.62	7.60	7.42	5.01	9.40	2.81	5.02

The results showed that the soil that was irrigated with agronomic water (control) had lower humidity percentage in comparison with lysimeter soils that were irrigated with domestic wastewater and drainage water. The ratio of increasing FC in irrigation with domestic wastewater and first drainage water and second drainage water gradually decreased (Tables 4, 5 and 6). In other words, when irrigation was performed with second drainage water only FC was increased 1 percent and this second drainage water was act as agronomic water. Domestic wastewater is refined after being passed from soil profile for 2 times inside of lysimeters and its effect on field capacity is the same effect of agronomic water on field capacity inside of lysimeters (Mittler, 2002; Rodgers *et al.*, 2008).

Table 4. Comparison of FC in irrigated Soil Lysimeter with domestic Wastewater.

FC1	FC2	FC3	FC2/FC1	FC2/FC3
13.7%	15.21%	14.01%	+1.10	+1.08

FC1= FC Percentage in Lysimeter Soil before Irrigation

FC2= FC Percentage in Lysimeters Soil that are Irrigated with Refined domestic Waste Water Rapeseed

FC3= FC Percentage of Rapeseed Lysimeter that is Irrigated with agronomical water.

Table 5. Comparison of FC in Lysimeter Soil that are Irrigated with primary drainage Water in Comparison with agronomical water (Alfalfa Lysimeter).

FC1	FC2	FC3	FC2/FC1	FC2/FC3
13.7%	15.07%	14.01%	+1.10	+1.07

FC1= Percentage in Lysimeter Soil before Irrigation

FC2= Percentage in Alfalfa Lysimeter Soil that are Irrigated with primary drainage Water

FC3= Percentage of Alfalfa Lysimeter that is Irrigated with agronomical water.

Table 6. Comparison of FC in Lysimeter Soil that are Irrigated with Secondary drainage Water in Comparison to agronomical water (Basil Lysimeter).

FC1	FC2	FC3	FC2/FC1	FC2/FC3
13.7%	14.18%	14.01%	+1.01	+1.01

FC1= Percentage in Lysimeter Soil before Irrigation

FC2= Percentage in Basil Lysimeter Soil that are Irrigated with Secondary drainage Water

FC3= Percentage of Basil Lysimeter that is Irrigated with agronomical water.

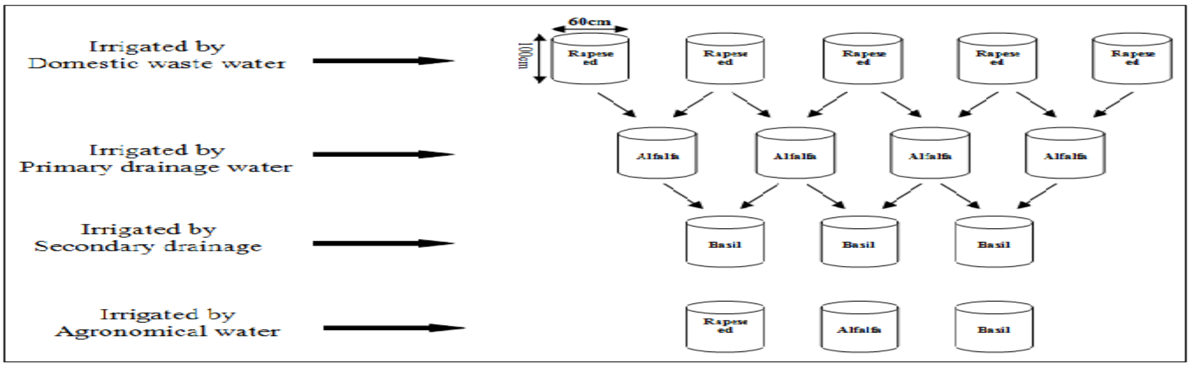

Fig. 1. Characteristics of lysimeters for irrigation of the studied plants.

Conclusion

Most of processes of wastewater including initial drainage water and second drainage water in view of FC were higher than well water. Level of useful and nutritious elements in soil that is irrigated with domestic wastewater is higher in comparison with irrigation with agronomic water. Processes for domestic wastewater were effective in improving physical and chemical characteristics of soil and they will not cause any problem in view of the soil destruct and structure. In using from domestic wastewater as irrigation we shall apply special management for having maximum efficiency.

References

Aliabadi Farahani H, Valadabadi SAR, Daneshian J, Khalvati MA. 2009. Evaluation changing of essential oil of balm (*Melissa officinalis* L.) under water deficit stress conditions. Journal of Medicinal Plants Research **3,** 329–333.

Gatica J, Cytryn E. 2013. Impact of treated wastewater irrigation on antibiotic resistance in the soil microbiome. Environmental Science and Pollution Research **20,** 3529-38.

Bernstein N, Chaimovitch D, Dudai N. 2009. Effect of irrigation with secondary treated effluent on essential oil, antioxidant activity, and phenolic compounds in oregano and rosemary. Agronomy Journal **101,** 1-10.

Dudai N. 2005. Factors affecting content and composition of essential oils in aromatic plants. p. 77–90. In R. Dris (ed.) Crops growth, quality and biotechnology. III. Quality management of food crops for processing technology. WFL Publ., Helsinki, Finland.

Fine P, Halperin R, Hadas H. 2006. Economic considerations for wastewater upgrading alternatives: An Israeli test case. Journal of Environmental Management **78,** 163–169.

Khalid KA. 2006. Influence of water stress on growth, essential oil, and chemical composition of herbs (*Ocimum* sp.). International agrophysics **20,** 289-296.

Kidder G. 2001. Using waste products in forage production. Florida Coop. Ext. Service SL 179. Univ. of Florida, Gainesville.

Mittler R. 2002. Oxidative stress, antioxidants and stress tolerance. Trends Plant Science **7,** 405–410.

Oregani KE, Kazemi Esfeh Z, Gholami A, Lari Yazdi H. 2014. Impact of wastewater irrigation on germination, growth seedling and concentration of heavy metals in soil and Canola (*Brassica napus* L.). International Journal of Biosciences **4(10),** 89-98.

Rodgers M, Wu G, Zhan X. 2008. Nitrogen and phosphorus removal from domestic strength synthetic wastewater using an alternating pumped flow sequencing batch biofilm reactor. Journal of Environmental Quality **37,** 977-982.

Stevens DP, McLaughlin MJ, Smart MJ. 2003. Effects of long-term irrigation with reclaimed water on soils of the Northern Adelaide Plains, South Australia. Australian Journal of Soil Research **41,** 933–948.

Vasudevan P, Thapliyal A, Srivastava RK, Pandey A, Dastidar MG, Davies P. 2010. Fertigation potential of domestic wastewater for tree plantations. Journal of Scientific and Industrial Research **69,** 146-150.

Wahid A, Nasir MGA, Ahmad SS. 2000. Effects of water pollution on growth and yield of soybean. Acta Scientia **10,** 51-58.