Changes in Field Capacity (FC) by Irrigation with Domestic Wastewater (DWW)

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ABSTRACT
According to water crisis at most of the countries of world, population growth and industrialization of life, there is urgent need to use from water resources at different societies. Under such conditions that we are facing with limitation of water resources inevitably we have to use from uncommon waters including wastewater in agriculture. Before using irrigation with wastewater in agriculture, we shall conduct vast studies about effects of wastewater on agricultural soils and even different agricultural plants. In this relation we have studied the effect of irrigation with domestic wastewater and first and second drainage water by method of lysimeter on changes of field capacity. Therefore we had used from comparison of averages with presence of witness. 15 lysimeters were installed in farm. In the first 5 lysimeters Brassica napus l which is an industrial plant was cultivated. On the floor of exit lysimeters drainage water was installed for discharging water. In the lysimeters No.5 to 9 alfalfa was cultivated which can be used by farm animals. In third 5 lysimeters basil that is both edible and pharmaceutical plant was cultivated. At the end of pilot 3 lysimeters containing aforesaid plants was installed and irrigated with well water. Before conducting experiment the field capacity inside of lysimeters was measured. Then irrigation with domestic wastewater and first and second drainage water was started and process of cultivation, storage and harvest of aforesaid plants was terminated. The field capacity of Brassica napus l lysimeters that were irrigated with domestic waste water was compared with of 4 alfalfa lysimeters and 3 basil lysimeters and finally their average was compared with field capacity of 5 lysimeters that were irrigated with well water. From this comparison we concluded that the field capacity while being irrigated with domestic wastewater was increased 8.5% in comparison to witness and field capacity while being with first drainage water was increased 7.5% in comparison to well water and field capacity while being irrigated with second drainage water was increased 1% in comparison to well water.

Key words: Field Capacity (FC), Irrigation, Domestic Wastewater (DWW).

INTRODUCTION
In dry and semi-dry regions that because of limitation of water resources inevitably we have to use from uncommon water resources including wastewaters, it is necessary to have scientific and research view point to agricultural soils. This issue will become very important when we know that after irrigation with wastewater some of ions of these wastewaters beside nutritious materials, useful elements and even useless elements will be entered into soil and if we will not apply special management in using wastewater at agriculture it may cause damage to structure of soil. Soils consist of mineral and organic materials, water, air, micro-organisms 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's structure. The use from domestic wastewater instead of usual well water in agriculture it will improve most of characteristics of soil including penetration, porosity and creation of sponge structure on soil [1]. Irrigation of cultivation lands with urban and domestic wastewater will destroy physical characteristics of soil. Of course in long term these dangers

will have higher destructive effects on soil. In this research 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 [2]. Stevens and Coworkers 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 found out that changes in saline of soil and its density by using urban wastewaters will not result in decreasing product [3]. Effect of refined wastewater on chemical characteristics of cultivation soils. This experiment was repeated 3 times within plan of completely random block with 17 attendances. The main attendance include 4 levels of irrigation with wastewater as (25, 50, 75 and 100% accessible water for cultivation soils) and 4 levels of nitrogen with shape of (0, 150, 300 and 450kg in each hectare) with attendance supplying 100% accessible water for cultivation soils and increasing 300kg at each hectare of nitrogen as witness. In this research the effect of depth of refined wastewater on EC and density of chloride was not meaningful at level of 1% but these two items were not meaningful on parameters of SAR and density of sodium [4]. Another research that was conducted was revealed that after irrigation with domestic wastewater the sodium of soil will increased up to 90% also sodium that is present in surface of soil will increased up to nearly 89% to 117% [5]. 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 [6]. The aim 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

In order to study effect of irrigation with domestic wastewater on changes of field capacity we have used from 15 pieces of 5 plastic lysimeters (cultivation container) with altitude of 100cm and diameter of 60cm. Lysimeters were installed on metal legs with powerful floor that is fastened in farm land. The distance of lysimeters is 2m from each other. Inside of lysimeters was filled with farm soil with structure of Clay Loam. Physical and chemical characteristics of soil inside of lysimeters include:

Tab 1: Physical and Chemical Characteristics of Soil inside of Lysimeters before Irrigation with Refined Domestic Wastewater

Percentage of Soil Seeds	Weight Percentage of Soil Humidity FC PWP	Special Mass for Appearance of Soil	Total Porosity Percentage	EC(ds/m)	PH	SAR

Clay=30% Silt= 28% Sand=42%	FC=13.7 PWP=6.14	1.52	38	5.68	7.2 8.72

Ca (meq/lit) =12.01
Mg (meq/lit) =14.12 K (mg/kg) =201.41
Na (meq/lit) =30.21 P (mg/kg) = 5.12

Inside of lysimeters No.1, 2,3,4,5 Brassica napus L. was cultivated and these lysimeters have been irrigated with refined domestic wastewater BOD_5= 150mg/lit. At floor of all lysimeters a hole with diameter of 5cm was dug that this hole can be used as drainage water. In other 5 lysimeters No.6, 7, 8, 9 alfalfa that is a fodder plant was cultivated. In order irrigate these 4 lysimeters we have used from drainage water of first 5 lysimeters that its process is as follows: first lysimeters containing Brassica napus L. were irrigated with refined domestic wastewater and drainage water that were collected in graded buckets was poured into lysimeters containing alfalfa; then drainage water as a result of lysimeters containing alfalfa was collected and poured into 3 lysimeters No.10, 11, 12 containing basil that is both edible and pharmaceutical drug. At the end three 5 lysimeters were installed in experimental pilot that inside them were Brassica napus L., alfalfa and basil was cultivated and all of them were irrigated with usual well water. Before irrigation of lysimeters a sample of refined domestic wastewater was sent to laboratory and result of analysis of wastewater is as follows:

Tab 2: Analysis of Refined domestic Wastewater before Irrigation of Lysimeters

Parameter	**BOD_5 PPm**	**COD PPm**	**EC ds/m**	**PH -**	**CL Mg/lit**	**SAR -**	**TSS Mg/lit**	**NaMgCa/meglit Meq/lit**
Amount	150	232	4.8	7.2	1.82	5.81	208.81	24 15.01 14.7

It shall be noted that in order to compare farm capacity 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 witness. Table for physical and chemical characteristics of well water (witness) is as follows:

Tab 3: Analysis of Well Water (Witness) for Irrigating Lysimeters No.13, 14, 15

Parameter	**BOD_5 PPm**	**COD PPm**	**EC Ds/m**	**PH -**	**CL Mg/lit**	**SAR -**	**Muddiness N.T.U**	**NaMgCa Meg/lit**
Amount	2.42	18.01	1.62	7.60	7.42	5.01	16.5	9.40 2.81 5.02

Since in this article 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 to 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 by using PF Meter machine. After weighting the sample soils were treated for 24 hours in oven under temperature of 105c 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.

Tab 4: Comparison of FC in Irrigated Soil Lysimeter with domestic Wastewater

FC Percentage in Lysimeter Soil before Irrigation	FC Percentage in Lysimeters Soil that are Irrigated with Refined domestic Waste Water(Brassica napus l)	FC Percentage of Brassica napus l Lysimeter that is Irrigated with Well Water	Change Percentage in Comparison to Witness	Change Percentage in Comparison Initial Sample
13.7%	15.21%	14.01%	+8.5%	11%

Tab 5: Comparison of FC in Lysimeter Soil that are Irrigated with Initial drainage Water in Comparison to Well Water (Alfalfa Lysimeter)

FC Percentage in Lysimeter Soil before Irrigation	FC Percentage in Alfalfa Lysimeter Soil that are Irrigated with Initial drainage Water	FC Percentage of Alfalfa Lysimeter that is Irrigated with Well Water	Change Percentage in Comparison to Witness	Change Percentage in Comparison to First Soil Sample
13.7%	15.07%	14.01%	7.5%	10%

Tab 6: Comparison of FC in Lysimeter Soil that are Irrigated with Second drainage Water in Comparison to Well Water (Basil Lysimeter)

FC Percentage in Lysimeter Soil before Irrigation	FC Percentage in Basil Lysimeter Soil that are Irrigated with Second drainage Water	FC Percentage of Basil Lysimeter that is Irrigated with Well Water	Change Percentage	Change Percentage in Comparison to First Soil Sample
13.7%	14.18%	14.01%	1%	3.5%

RESULTS AND DISCUSSION

The issues that are offered in aforesaid tables show that soil which is irrigated with usual well water as witness has lower humidity percentage in comparison to lysimeter soils that are irrigated with domestic wastewater and drainage water. By careful studying the tables 4, 5, 6 we find out that the ratio of increasing FC in irrigation with domestic wastewater and first drainage water and second drainage water will be gradually decreased i.e. when irrigation is performed with second drainage water only FC is increased 1% and this second drainage water will act as well water. Of course these results are compatible with reports of any researchers i.e. 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 well water on field capacity inside of lysimeters [7] and [8].

CALCULATION

1- Most of processes of wastewater including initial drainage water and second drainage water from view point of FC are higher than well water.

2- Level of useful and nutritious elements in soil that is irrigated with domestic wastewater is higher in comparison to irrigation with well water.

3- Processes for domestic wastewater are effective in improving physical and chemical characteristics of soil and they will not cause any problem from view point of destructing soil and soil's structure.

4- In using from domestic wastewater as irrigation we shall apply special management for having maximum efficiency.

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