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The Effect of Using Compost Leachate on Absorption of Soil Zinc

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Abstract: The best way to recycle the litter is to produce Compost which releases a great amount of compost leachat which contains a high amount of nutrients and other minerals necessary for the plants. This study in order to evaluate the effect of using Compost leachate on the concentration of soil Zinc in form of a statistical pattern called "Split Plot " by using two main treatments, one subsidiary treatment and three repetitions of the pattern in a three month period. The main B treatments include: irrigation using well water as a blank treatment and the main R treatments include: irrigation using leachate and well water concurrently. Some subsidiary treatments were S (Drop Irrigation) and SS (Sub Drop Irrigation). Then in the established plots, 36 biannual pine and cypress shrubs were randomly grown. Two months later the treatment begins. The results revealed that there is a significant difference between blank treatments and rotation treatments regarding the pH in the first level of Duncan test. Also there was an increase in zinc absorbency of the soil which was in regard to the added amount of Leachate. Later on after using leachate the average pH was decreased equal to 0.46 and also the average of Zn in the soil show an increase in the range of 5.43 mg/kg. Anyway the density of soil Zn in each period was more than past periods. By using leachate and a decrease in the soil pH, there was a significant increase in the soil zinc absorbency relation to blank treatment.

Key words: Rotation and the type of irrigation, Compost leachate, Zinc absorbency in soil.

INTRODUCTION

Since finding and using new water resources entails a huge expenditure, recycling it is of a great concern. Based on the other countries policies, it can be predicted that our country needs to walk in the same path because there is a need to recycle the water to be used in farming. Using sewage has several advantages as follow;

- It is a good substitute for high quality waters in farming.
- It would decrease the need for manure since it is rich in nutrients necessary for the plants.
- In most of the big industrial cities, sewage is an economical source, but due to the existence of the pollutants and other consequences, its usage is not as simple as using ordinary water and it needs a series of precautions *(Joharzade, 1380).*

Another factor which necessitates using sewage and leachat in agriculture is that Iran is a dry or semi dry land. The rate of water consumption is very high compared to other usages. It is now in a very critical state in some areas. It has made the people in charge do some planning. On the other hand, the soil in the central parts of Iran which is a dry or semi dry land contains less than 1 percent of organic substances. It would be best to use other organic manures like ooze, and leachat instead of animal manures *(Efyouni, etal, 1377).*Leachat would turn into Compost after going through several processes and if is not disposed of very well, it would lead in to some dire consequences for the environment *(Panahpour, 1388).*Besides, watering using the sewage from organic manure companies is potentially both good and bad for the soil, plant, and underground water resources due to the existence of the nutrients within. So the leachat needs to be purified before the usage *(Aghali, etal, 1381).*Using such water resources dates back to many years ago. It was first used in the end of the 19^{th} century. It has developed very fast and now China with 1.33 million hectare farming land is using it with the least important consequences *(Ghoreishi, 1385).*The chemical and physical processes which lead to the leachat are dependent on the litter delivered to the factory. So it is normal if its ingredients change in relation with the seasons and the months *(Panahpour, 1388).*This study seeks to shade some light on the irrigation using leachat and also on water considering the substances concentration within the soil.

MATERIALS AND METHODS

Study Area:

This study was conducted on a field in the eastern part of Isfahan on the longitude of 32°, 38' and latitude of 51°, 48'. The height from the sea level was 1555 meters. The average rainfall is about 120 ml and the average temperature is +16°^{c}. The soil is from Golshahr series and belonged to Aridisols order. The soil texture is loamy,

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based on the Ayers and Wescat guidelines the water quality in this area is considered to be of the average type *(Sharifianpour, 1387).*

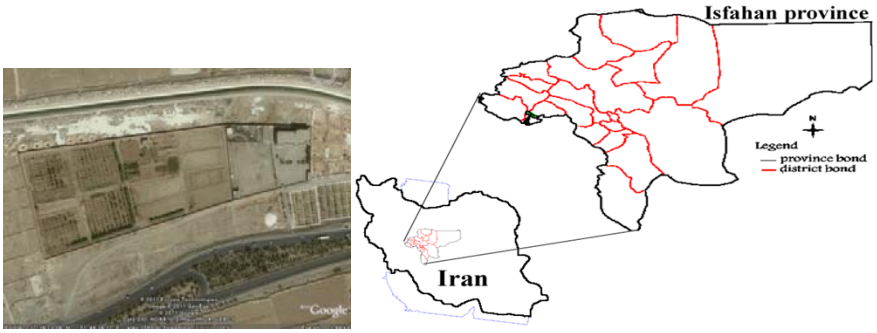

Fig.1: Position of study area in Isfahan province and Iran.

Methods:

First a suitable part of the farm was chosen for doing the Selection Pilot. The study was done based on the Split Plat design. Two main and subsidiary treatments of planting the two year old cypress and pine shrubs were conducted as shown in Table 1. About 200 liters of leachate was transferred to a 1000 liters tank and was diluted by the well water after that the EC reached 4 ds/m. This leachate was the main one used in the treatments. The average output from the dropping tube was 10 liters per hour and the irrigation was performed every two days. In each round about 20 liters of leachate was injected to the tree. So the amount of the consumed leachate for the rotation treatment (R) was 150 liters per month. The irrigation period lasted 2 hours and it was 0.17 liter per minute. The major treatments were irrigation using the water from the wells as instance (B) and rotation irrigation in which EC reached to 4 ds/m. there was also one round using well water (R). The subsidiary treatments were drop irrigation, sub surface drop irrigation in which the dropping tubes were located in the depth of 30 cm.

Table 1: The statistical design.

R	B	R	B	R	B	B	R	R	R	B	B
S	SS	SS	S	SS	SS	SS	SS	S	S	S	S
Δ	Δ	Δ	Δ	o	o	o	Δ	o	o	Δ	o
Δ	Δ	Δ	o	o	Δ	o	Δ	Δ	Δ	o	Δ
Δ	o	o	Δ	Δ	Δ	o	Δ	Δ	Δ	Δ	Δ

S(stands for the drop irrigation), SS (sub surface drop irrigation), B(stands for using well water as a instance), R(stands for the rotation irrigation using the leachate)
o stands for the pine shrubs, Δ stands for the cypress shrubs.

The Analysis Procedures:

The Electrical Conductivity (EC) of the leachate was measured by a conductivity evaluating device (Consort K620) and its Soil Reaction was measured using a pH calculator (Metrohm632*)* (APHA, 1998)**.**The density of zinc in the leachate was measured by an atomic absorption device known as Perkin – Elmer type model 3030 which did it using specific waves. (Nelson, and Sommers, 1987). pH in the mud was calculated using a pH calculator and its electrical conductivity was measured by a conductivity evaluating device called Consort K620 (Page and Keeney, 1986)**.**The zinc absorbency of the soil was measured by extracting using DTPA (0.005 M) which was read by the atomic absorbency device known as Perkin - Elmer type model 3030 in specific waves. (Lindsay, and Norvell, 1978)**.**

Data Analysis:

This statistical analysis of the data and the correlation ratios were gained using MSTATC software.

Duncan test was also conducted to show the meaningful variations and the Excel software was used to sketch the diagrams.

RESULTS AND DISCUSSION

The present study seeks to evaluate the impact of using leachate on zinc absorbency in the soil under the drop like irrigation. By using a well-balanced formula, leachate can be regarded as organic manure in farming, especially in dry and semi-dry regions suffering from the lack of the organic materials. The results showed that the electrical conductivity was 24 ds/m which shows the high amount of salt in the area. pH in the leachate was 5 due to the presence of the organic and mineral acids. The zinc concentration was 17.23 mg/liter.

Table 2: The Variance Analysis to Determine the Effect of Treatments on Soil Zinc Absorbency.

Total	Error	× depth × Irrigation Time	× depth Irrigation	× depth Time	depth	×Time Irrigation	Irrigation	Error	time	Replication	Variation	
35	18	2	1	2	1	2	1	4	2	2	DF	
	0/006	0/063**	0/124**	0/051**	0/535**	2/955**	163/797**	0/002**	0/011ns	0/011ns	zn	Mean square
	0.002	0.001ns	0.05**	0.002ns	0.027**	0.016**	0.902**	0.001ns	0.07**	0.016*	pH	

The Effect of the Treatments on Zinc Concentration and Soil pH:

The comparison between the effects of using litter leachat on the absorbable concentration indifferent experimental treatments and their mutual interactions are shown in figures 2 – 8. It is clear that gradually the average zinc concentration increased from 1.58 ml/kg at the beginning to 3.26 ml/kg at the end of the first period (as much as 1.68 unit increase), and at the end of the second period it was 3.77 ml/kg (as much as 0.51 unit increase) and finally at the end of the 3rd period it reached 4.43 ml/kg (as much as 0.66 unit increase). Time and using leachat are two reasons for this increase.

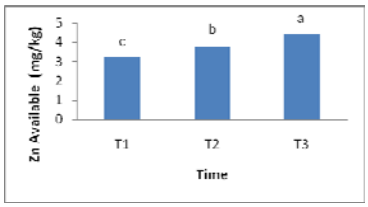

Fig. 2: The effect of time on zinc absorbency of the soil.

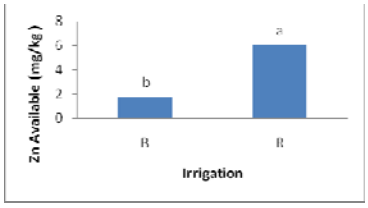

Fig. 3: The impact of different irrigation treatments on zinc absorbency of the soil.

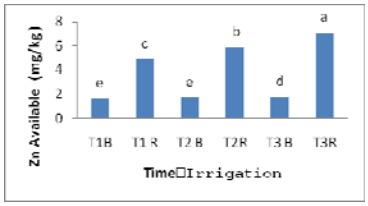

Fig. 4: The mutual interaction between different irrigation treatments and time and their possible effects on zinc absorbency of the soil.

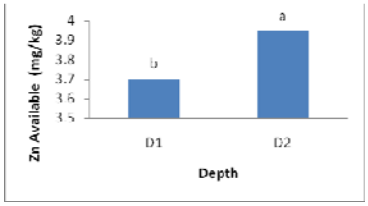

Fig. 5: The effect of using leachate in different depths on zinc absorbency.

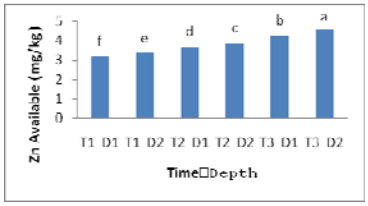

Fig. 6: The effect of different treatments of time and depth on the zinc.

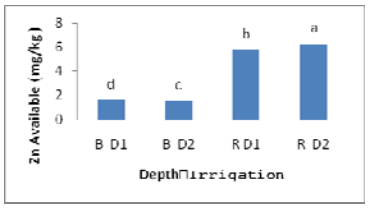

Fig. 7: The mutual interaction between depth and irrigation treatments on zinc absorbency of the soil.

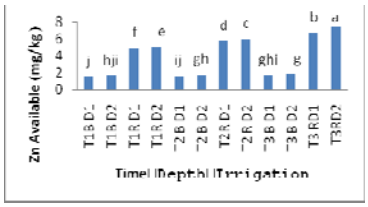

Fig. 8: The effect of different treatments of time, depth, and irrigation on zinc absorbency in soil.

This is more obvious in the underneath than on the surface. The treatments enjoy a meaningful difference at 1 percent level in a way that zincs concentration average increased from 1.69 ml/kg to 5.96 ml/kg in the placebo. So as the acceptable level for zinc is in the range of 2 – 6 ml/kg, both treatments could meet the need. Comparing the mutual effects of different treatments of time and watering (figure 4) revealed that the alternation treatment increased zinc concentration more. Comparing the mutual effects of different treatments of depth and irrigation showed that the alternating treatment increased the concentration on both surface and the underneath layers more than other ones (figure 7).Comparison between the time, depth, and the irrigation patterns (figure 8) showed that the alternation treatment increased zinc density on the soil surface very significantly. Litter leachat decreased pH and organic minerals in the soil and consequently increased zinc concentration on the soil surface (Malekout, and Homaie, 1383). Reports by Mohammadinia (1374) and Gandomkar (1375) showed that leachat can increase the zinc concentration. Some other reports claimed that there is a trade – off between soil PH and zinc concentration and as PH falls, zinc concentration increases *(Rezaie Mirgaed, 1389).*

Conclution And Recommendations:

Maintaining the soil fertility and protecting it from pollution is an essential matter for the long term crop productions. So a right usage of sewages like litter leachat and Compost can keep the soil fertile because it contains 35 – 85 percent of dry materials and a rich existence of other nutrients which are important for soil productivity. Leachat has a great acid power which increases the absorption of minute nutrients like zinc. It is essential that the leachat chemical composition be inspected closely before using it as manure in farming because their ingredients change over the time. By using leachate from the household waste materials, pH in the soil will decrease; as a result the zinc absorbency would increase. As the time goes by, the density of the absorbable zinc increased accidentally. Generally, the high evaporation and other environmental conditions in the region under the study, the salt concentration and other elements at the height of 0-30 cm and 30-60 cm were the main reasons for this to happen. Due to the acceptable density of zinc within the soil as a result of the employed treatment, the researcher arrives at this conclusion that using the alternation treatment was the best beneficial one. The leachate from the household waste materials is presently a waste extracted from Compost which in turn leads to the pollution of the air and other water resources. As it is a vital element for the plants, it is suggested that more research be conducted to use this substance as natural manure in farming. It is recommended that other irrigation methods be used in the prospective studies and be compared with this study. In the present study, the leachate which was diluted by the ratio of 1 to 4 was employed. Other leachate

densities in the soil should be evaluated as well as other types of plants to determine the best ratio between water and leachate. It is suggested that the same study be done for other plant species.

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