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Influence of Garbage Leachate on Soil Reaction, Salinity and Soil Organic Matter in East of Isfahan

Ebrahim Panahpour, Ali Gholami, Amir Hossein Davami

***Abstract*—**During this day a considerable amount of Leachate is produced with high amounts of organic material and nutrients needed plants. This study has done in order to scrutinize the effect of Leachate compost on the pH, EC and organic matter percentage in the form of statistical Factorial plan through randomizing block design with three main and two minor treatments and also three replications during three six month periods. Major treatments include N: Irrigation with the region's well water as a control, I: Frequent irrigation with well water and Leachate, C: Mixing Leachate and water well (25 percent leachate + 75 percent ordinary well water) and secondary treatments, include DI: surface drip irrigation and SDI: sub surface drip irrigation. Results of this study indicated significant differences between treatments and also there were mixing up with the control treatment in the reduction of pH, increasing soluble salts and also increasing the organic matter percentage. This increase is proportional to the amount of added Leachate and in the treatment also proportional to higher mixture of frequent treatment. Therefore, since creating an acidic pH increases the ability to absorb some nutrient elements such as phosphorus, iron, zinc, copper and manganese are increased and the other hand, organic materials also improve many physical and chemical properties of soil are used in Leachate trash Consider health issues as refined in the green belts around cities as a liquid fertilizer recommended.

***Keywords*—**Leachate, Compost, Drip Irrigation, Liquid Fertilizer, Soil Reaction

I. Introduction

POPULATION growth, irregular development of cities, unsuitable current consumption pattern and many other factors cause problem in human society especially in under developing countries. One of most obvious problems is waste. Lack of control of it affects on the health and environment in the bad way (2). One of the important kinds of waste is urban waste. Compost production is a current method for waste controlling. There is much water in urban waste that induces to compost leachate production. It is the minor problem of compost production.Besides considerable organic matter content in leachate causing structure improvement and infiltration increase, they include a lot of micro and micro elements such as N, P, K, Fe, Zn, Cu, Mn and Mo that affects on soil fertility and also they involve infrequent elements causing environmental pollution so waste usage needs to be assessed(1,4,13).

F. A. Department of Soil Science, Science and Research Branch, Islamic Azad University, khouzestan, Iran(phone: 0098-913-129-5342; fax: 0098-611-4435288;e-mail:(e.panahpour@khouzestan.srbiau.ac.ir).

S. B. Department of Soil Science, Science and Research Branch, Islamic Azad University, khouzestan, Iran(phone: 0098-611-4457612; fax: 0098-611-4435288; e-mail: (a.gholami@khouzestan.srbiau.ac.ir).

T. C. Department of Environmental Management, Science and Research Branch, Islamic Azad University, khouzestan, Iran(phone: 0098-916-311-5402;fax:00986114435288e-mail:(davami.ah1352@khouzestan.srbiau.ac.ir).

The percentage of moisture content and dry organic matter in leachate is respectively 84%-96% and 30%-85%. Other leachate properties such as pH and EC are respectively 4.3-6.8 and 16-40ds/m . Leachate reaction is acidic so its dissolution power is high. This factor enhances the general solids (dissolved and suspense). Wastes usually stay at houses and places for some days. During this period, because of high organic matter, in leachate, suitable moisture and temperature, biological decomposition process can be done and the reaction of leachate gets acidic so leachate pH at transportation station is more acidic than it is at houses and places. The leachate is so saline and it can increase soil salinity (1,9). One research showed the salinity and sodium adsorption ratio in soils under sewage irrigation has more significant increment than the soils irrigated with well water. Leachate addition to the diverse soils shows different effects. For example, soil salinity that increases under this condition is tied to initial soil salinity, soil texture and irrigation water salinity and the amount of leachate consumption. Alexander and et, al. Adjusted sewage sludge and waste compost to soil in volume ratio of 1:1. The results show the organic matter consumption enhanced from 1.5% to 5.3% and 9.3%. Organic matter decomposition by micro-organisms that are involved main or minor oxidation supplying carbon dioxide, water and intermediate production(such as soluble organic acid) start by adding the leachate to soil(14,19).

Mohammadi Nia reported, by addition the leachate to soil, organic matter increases and by passing the time, organic matter be decomposed and the microbial composition be reduced, but in treatment 100%, high salinity that is due to leachate add to soil, halts the microbial growth and leaching cause high decrease in organic matter amount of this soil sample.

II. Materials and Methods

Properties of Research Place

This research was done at Gavart region of Isfahan with longitude 32º 39´ and latitude 51º 48´. The height of sea level is 1555meter and based on the suggested divide that has done by Karimi for Iran, the climate of region is arid with warm summers and rather cold winters (10). Average rainfall in this region is 120mm and the annual average temperature is 16ºC. Region soil is of Golshahr series and the soil order of region was Aridisols (8). Soil texture was loam, the EC and pH of water irrigation was respectively, 4.19ds/m and 7.01ds/m.

Based on Irez Wescat guidelines, for assessing the water irrigation quality, the water of this region was determined as average (8). First the suitable site was selected for piloting. The test was done in the form of statistical factorial plan through randomizing block design with three main and two

minor treatments and also three replications during three six month periods. Major treatments include N: Irrigation with the region's well water as a control, I: Frequent irrigation with well water and Leachate, C: Mixing Leachate and water well (25 percent leachate + 75 percent ordinary well water) and secondary treatments, include DI: surface drip irrigation and SDI: sub surface drip irrigation. Besides two biennial species of trees (Acacia and Plane tree) was planted and irrigated by these treatments during 3periods that every period lasted 6months.

As the same time as planting, leachate was transmitted to place and was supplied in the poly ethilen tank and the imposed incubation time on them was 4months.

For describing the fault that were due to the leachate properties changes during the time, about 200liter of leachate was transferred to a tank with the volume 1000liter and then it was diluted with the field well water. It was done to decrease the leachate EC to 6ds/m. After that prepared leachate was used as a supply for different treatments.

The droppers of subsurface drip irrigation were located into holes that were digging by uger and for restrain of their preclusion were filled by silicate. Average output discharge of droppers was 10lit/hr and irrigation period was once in two days based on soil texture. During every period about 20lit leachate was consumed for every tree, so this content was 300lit/month for mixing treatment and 150lit/month for frequent treatment. Irrigation time for every period was 2hours and its discharge was 0.17lit/min. pH and EC of soil samples were measured in saturated mud respectively by pH meter (Metrohm 632model) and electric conduct meter (Consort K620model).Soil organic matter measurement was done by cold oxidation method. Data analysis and correlation coefficient determination was done by SAS software. Dancan's test was used for determining the significant level and the diagrams were drawn by EXCEL software.

III. Results and Discussion

Variance analysis results of the effect of treatments on pH, EC and soil organic matters. The table 1 shows that the effect of time passing, irrigation type and different irrigation treatments on pH, EC and soil organic matter is significant. The opposing effects of time and depth on pH and EC was significant but the insignificant results has achieved for soil organic matters while the opposing effects time×depth×irrigation was significant only for EC. The mean comparisons of different treatments significant effect on soil chemical properties are assessed as bellow.

A. Treatments Effects on Soil Salinity

Waste leachate involves much solute that causes the soil salinity. Mean comparison of the different treatments significant effect on soil electrical conductivity is shown at the figures of 1-4 to 3-4. By using waste leachate, the salinity in soil surface and sub-surface soil increased respectively of 8.9ds/m and 7.8ds/m to 11.96ds/m and 10.89ds/m.

TABLE I
VARIANCE ANALYSIS RESULTS OF TREATMENTS EFFECT ON SOIL CHEMICAL PROPERTIES

Changes Resources	Free Degree	Mean Square		
		pH	EC	O.M
Model	17	0.3149**	13.353**	0.5476**
Time	2	**0.1562	**10.759	0.8197**
Depth	1	**1.1645	**15.435	0.1956**
Irrigation	2	**1.8101	**91.961	**3.3288
Time×Depth	2	0.0075**	0.0975**	0.03838ns
Time×Irrigation	4	0.0563**	1.2079**	0.15247**
Depth×Irrigation	2	0.0049*	0.0037**	0.04144*
Time×Irrigation×Depth	4	0.0018ns	0.04249**	0.1196ns
Error	36	0.0013	0.00114	0.01268

**,* Respectively, are significant at the 0.01and 0.05 levels.
ns : Non- significant

General trend of sil salinity changes was the same in both surface and depth, however, the soil salinity in all treatments of the soil surface was higher than the sub-surface soil. This subject shows the effective infiltration of leachate into the soil depth(22,24). By passing the time, in different periods, the soil salinity increased of the average 10.7ds/m at the end of last period to 12.23ds/m of the end of third period. Different irrigation treatments showed the significant increase than the blank treatment, so much that blank treatment EC increased of the average 9.15ds/m to 11.44ds/m in frequent treatment and 13.68ds/m in mixing treatment. The mean comparison of opposing effects of the different treatments is given at the figures of 1 to 6.Waste leachate increased the soil salinity in both depths. Between two planted species in the experimental site, plane tree was more sensible to salinity so they be destroyed at the beginning of the leachate using. It was probably related to the physiological drought, but under this condition, the Acacia trees survived, so that it is important to be attention to the allowable level of leachate consumption

with irrigation water especially in the green space that has Acacia species (5, 7).

Mean comparison of the opposing effects of leachate using method and time in different treatments (figure4) shows that soil salinity increased significantly by passing the time in mixing treatments than the other treatments.

Mean comparison of the opposing effects of leachate using method and depth in different treatments (figure5) shows that soil surface salinity increased significantly in mixing treatments than the other treatments.

Mean comparison of the opposing effects of depth and time in different treatments (figure6) shows that soil salinity significantly increased at the soil surface than the other treatments.

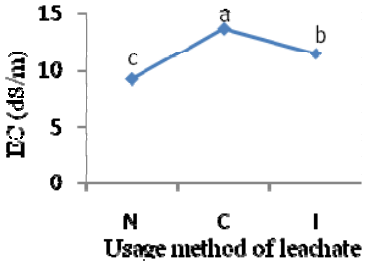

Fig. 1 Mean comparison of different treatment effect of leachate usage type on EC in soil saturated extraction

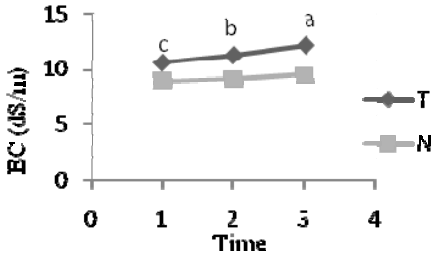

Fig. 2 Mean comparison of time effect on EC in soil saturated extraction

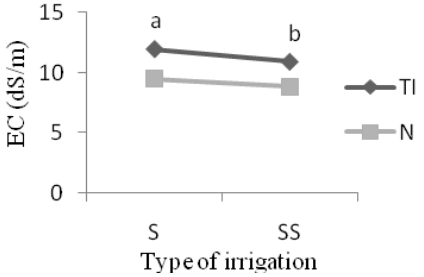

Fig. 3 Mean Comparison of irrigation type and leachate effect on EC in soil saturated extraction

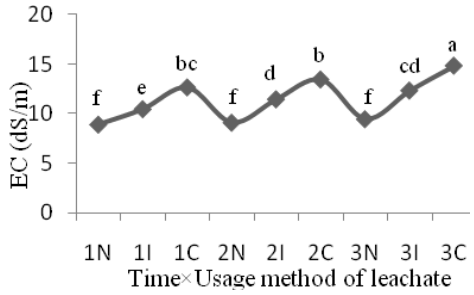

Fig. 4 Mean comparison of different treatments opposing effects of leachate using type and time on EC in soil saturated extraction

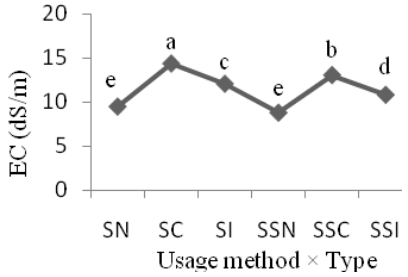

Fig. 5 Mean comparison of different tretments opposing efects of leachate using type and irrigation type by leachate on EC in soil saturated extraction

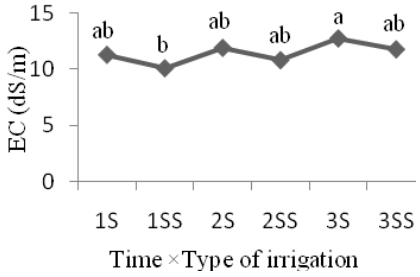

Fig. 6 Mean comparison of different treatments opposing effects of irrigation type with leachate and time on EC in soil saturated extraction

B. The Effect of Treatments on Soil pH

The figures 7-9 show the significant effect of different leachate treatments on soil pH in different times and depths. Leachate using reduced the soil pH in both depths 0-30cm and 30-60cm. Soil pH reduced in subsurface and surface soil, respectively from 7.89 and 7.95 to 7.43 and 7.72, so pH decreasing changes trend were more in subsurface soil than surface soil(18). By passing the time, average pH was decreased from 7.68 to 7.56 at the end of second period and at the end of third period, the average pH was 7.49, however, time and the amount of leachate consumption was the same as the former time (It decreases 0.07 unit than the former period) that maybe it is due to much calcareous amount (59%) and high buffer capacity in experimental soils. By contuning irrigation with more leachate, the pH decreasing could be stopped at one point and after that the pH begins to increase. This point is ZPC. Different irrigation treatments showed

significantly the pH decrease than the blank treatment. So much that pH decreased of the average 7.94 in blank treatment to 7.47 in frequent treatment and 7.33 in mixing treatment so pH decreasing is relevant with leachate consumption amount. Mean comparison of different opposing treatments effects of irrigation and time (figure10) show that mixing treatment decrease significantly the soil pH than the other treatments.

Mean comparison of different opposing treatments effects of irrigation and depth (figure11) show that soil pH decreased significantly by mixing treatment during the time.Mean comparison of different opposing treatments effects of time and depth (figure 12) show that by passing the time and using the waste leachate , pH was decreased significantly at the soil surface layer than the subsurface layer (figure 12,17). Soil pH changes under race planting are dependent on the initial soil pH. Under wetting condition calcareous soils pH get decreased and acidic soils pH get increased. Calcareous soils have high buffer capacity, so soil PH changes to the first condition after adding the leachate to soil.

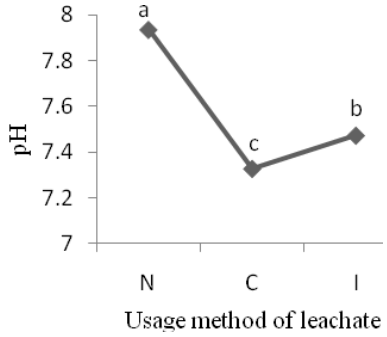

Fig. 7 Different treatments effect of leachate usage type on soil PH

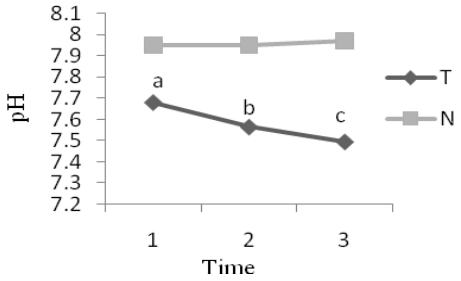

Fig. 8 Time effect on soil pH

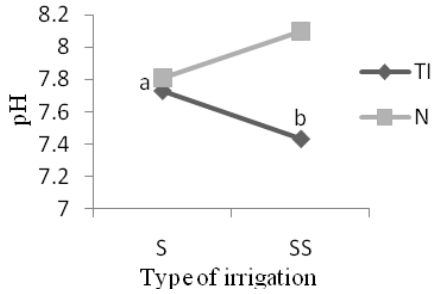

Fig. 9 Irrigation type effect with leachate on soil pH

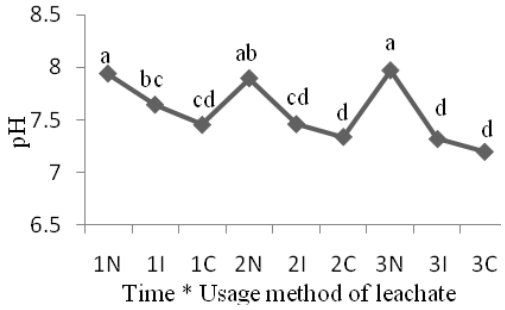

Fig. 10 Different treatments opposing effects of leachate usage type and time on soil pH

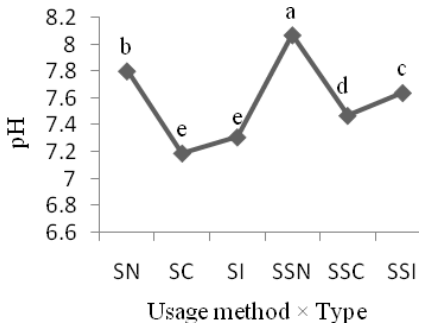

Fig. 11 Different treatments opposing effects of leachate usage type and irrigation type with leachate on soil pH

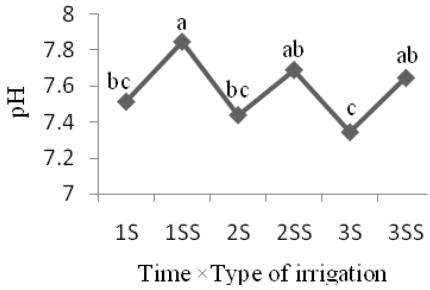

Fig. 12 The opposing effects of irrigation type with leachate and time on soil pH

C. The Effect of Treatments on Soil Organic Matter

Figures 13-15 show the significant mean of comparison treatment effects of different times and depths on soil organic matter. Waste leachate usage causes the soil organic matter increasement in both depth of 0-30cm and 30-60cm.

Organic matter in surface soil and subsurface soil was respectively increased with the average of 0.2% and 0.134% to 0.73% and 0.6%. General organic matter changes trend was more at the subsurface soil than the surface soil.

By passing the time, average amount of organic matter was increased from 0.47% to 0.64% at the end of second period and at the end of third period, it got to 0.89%(is that it showed 0.25unite increment than the former period). Different irrigation treatments showed the significant increase than the blank treatment. It was while the average amount of organic matter was increased of 0.19% to 1.04% in frequent treatment and to 0.75% in mixing treatment, that is, organic matter increase was relevant with leachate consumption amount. Mean comparison of different treatments opposing effects of irrigation and depth (figure 17), showed that the mixing treatment is more effective on surface soil organic matter than the other treatments, therefore, these are due to leachate usage, improvement of the aggrigation, soil structure, and decrease the surface crust formation and simplify the media preparing practice.

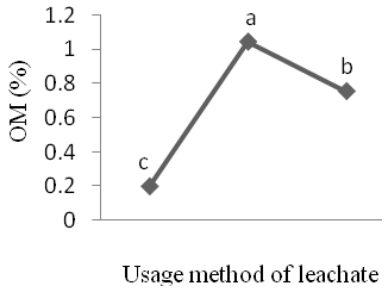

Fig. 13 Different treatment effects of leachate usage on soil organic matter

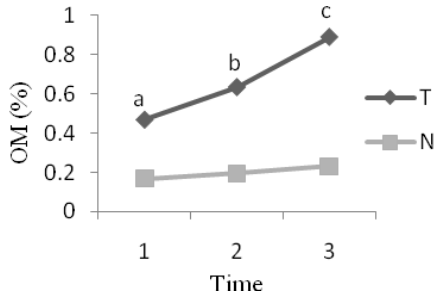

Fig. 14 The time effect on soil organic matter

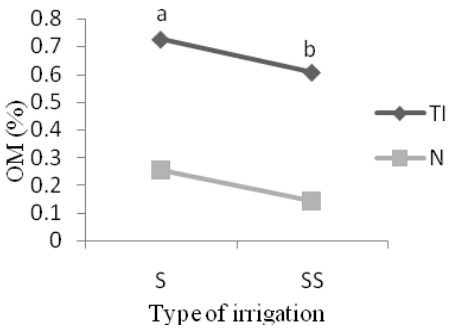

Fig. 15 The irrigation type effect with leachate on soil organic matter

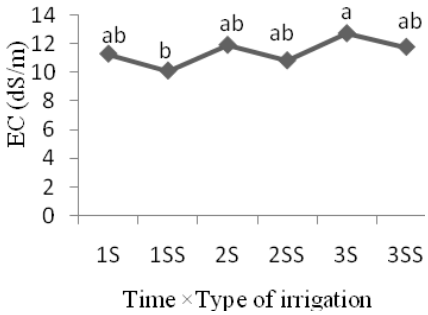

Fig. 16 Different treatments opposing effects of leachate usage type and time on soil organic matter

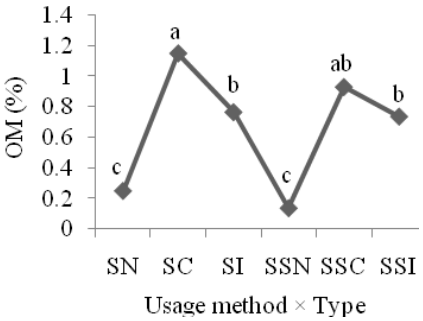

Fig. 17 Different treatments opposing effects of leachate usage type and irrigation type with leachate on soil organic matter

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Dr. Ebrahim Panahpour (4 April 1977) born in city of Borojen - Iran. He was graduated with bachelor degree in Agriculture Engineering-soil science on 2002 and in Master of Science in soil science on 2005 from Islamic Azad University, Science and Research Branch, Tehran, Iran He was accepted as PhD student in Faculty of Agriculture and Natural Resources, Department of soil science, Islamic Azad university, science and research Branch in Tehran on 2005and academic member of Islamic Azad university, Khuzestan Science and Research Branch in Ahwaz city of Khuzestan province) on 2005 and he studied his dissertation in field of " Assessment of compost leachate effect on soil fertility and distribution elements in soil profile under drip irrigation ". He has studied 7 university research design, and 30 printed papers in national and international conferences and journals.