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Effect of the Diyala River irrigation water in the accumulation of cadmium and lead in the soil and plant and some of the chemical Properties of the soil

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ABSTRACT

Biological pot experiment was conducted in the plastic house return to the Department of Soil Science and Wate Resources / College of Agriculture University of Baghdad. Using the soil , silt loam texture (SiL) take from one agricultural fields for the Jadiriyah / Baghdad province to study the concentration of some heavy elements lead, cadmium pb, Cd in the waters of the Diyala River and its impact on some of the chemical characteristics of the soil and the extent of soil contamination Accumulation Heavy elements pb, Cd in the soil and plants. It was planted (Millet) domestic product (Panicum miliaceum L.) in a way prose in a plastic pot capacity of 10 kg in autumn2016 season. Written by fertilizer NPK fertilizer recommendation were two types of irrigation water are the Diyala river water and tap water after draining 50% of water field capacity. Implemented a global experience as full design of randomization CRD with three replications and six transactions are: irrigation tap water only (compared) with the addition of fertilizer NPK and its code symbol C_1 and irrigation tap water only without adding fertilizer NPK and its code symbol C_2 and irrigation water tap and water Diyala River at 1: 1 with the addition of fertilizer NPK and a symbol by the symbol T_1 and irrigation water tap and water Diyala River ratio of 1: 2 with fertilizer NPK and a symbol by the symbol T_2 and irrigation water Diyala River, only with the addition of fertilizer NPK and its code symbol T_3 and irrigation tap water once the waters of the Diyala river again (alternating) code and by the symbol T_4 .It took plant samples of whole plants before flowering stage and at harvest and as the concentration of the elements pb, Cd and as the focus of the two elements above were also taking dust samples in the two periods as above and in which the concentration of the above elements with some of the chemical characteristics of the soil .The results indicated the Diyala River water pollution elements lead, cadmium and high concentrations than permitted by the (World Health Organization ‹2003) Borders and poor water quality as the classified C_4S_1few sodic and very high salinity. The results showed the superiority of the tow treatment T_2 and T_3 increase the concentration and accumulation of lead and cadmium in the tissues of the plant at harvest stage as it stood at 51.55 and 70.30 mg pb. Kg^{-1} dry matter exceeding the permitted by the (World Health Organization ‹2003) Border, amounting to 0.3 mg pb. Kg^{-1} dry matter.Also excelled treatments T_2 and T_3 in increasing the uptake of lead at the the harvest stage was all of the significant effect transactions in increasing the quantity of lead absorbed in the plant, but the treatment T_3 overtook the lead and reached the concentration of 0.0800 mg pb. plant $^{-1}$.As for cadmium concentrations it has increased significantly in the shoot at the harvest reached 4.920 and 5.970 7.170 mg Cd values. Kg^{-1} dry matter for transactions above alternately, all the above values exceeded the permissible limits by the (World Health Organization ‹2003), amounting to 0.1 mg Cd. Kg^{-1} dry matter. The concentrations of the element cadmium absorbed by the plant at the harvest has been very high all were exceeding the permitted limits and international transactions T_1 and T_2 and T_3 amounting to 0.0059 and 0.0070 and 0.081 mg Cd. Kg^{-1} dry matter harvest and for transactions above the sequencers. The remaining lead in the soil increased concentrations morally and internationally T_1 and T_2 and T_3 and T_4 exceeding the allowable limits as well as cadmium. amounting to 0.056 and 0.061 and 0.073 and 0.053 mg pb. Kg^{-1} soil. and 0.0068 and 0.0093 and 0.181 and 0.064 mg Cd. Kg^{-1}soil alternately.The results indicated a low dry weight of plants and grains yield when flowering and harvest phases with increasing quantity irrigated by water from the Diyala River.Led the Diyala River irrigation water to the process to increase the electrical conductivity of the soil after the harvest increase was proportional with the increase in quantity irrigated by water from the Diyala River, with 3.81 and 4.12 and 4.83 and 3.12 values reached $dS.m^{-1}$ transactions T_1 and T_2 and T_3 and T_4 respectively in comparison with the comparison, which amounted to1.00 $dS.m^{-1}$. Also increased the percentage of land degradation is directly proportional to increase the amount of irrigation water from the Diyala River as it stood at 34.32% and 39.33% and 48.24% and 19.87% for transactions above the sequencers.

Keywords: Pollution of Soil and Plant, Diyala River,Lead and Cadimum.

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INTRODUCTION

Pollution is considered as one of the most important challenges that face human being nowadays, it became a threat of human lives after all natural disasters being occurring. It is simply defined as a change in basic element of environment soil, water, and plant to a limit that leads to deterioration of different properties due to different activity of human beings. Using unsuitable irrigation water in agriculture is one of the provoking factors in pollution the matter that lead to salt accumulation on the surface in addition to the accumulation of some toxic elements with it. Diyala River represents the vital artery water stream of Baquba city where this river water considered as an important in the industrial and agricultural uses, where the ratio of pollution was increased due to the interaction of different factors such as industrial waste and sewage water increase that affected the hydrological environment in a negative way, and led to the increase in the environmental balance damage due to the increase in the environment to limitations above the recommended ones (1,2,3). Heavy metals are considered as the most important pollutant in the environment recently (23) and their risks increase with their availability in soil and under some chemical changes, they might contaminate plant, fruits and vegetables that used for human consumption that reflect on health issues (18). Car exhausts, wastes landfills, factories chimneys, and factory solid wastes are considered the main source of these pollutants in the ecosystem (17). These elements have dangerous effects such as food poisoning, carcinogenic diseases, genes mutations, birth defects, and effects on the nerve system, digestive system besides damaging brain cells (19). The potential risks of heavy metals lie in the cumulative characteristics in human bodies (13). Human or even animal need a specific ratio of these elements that possibly gained from plant throughout food chain (6,16), so that the increase in these elements concentrations in plant above the limits might jeopardize consumers lives (8,22). This increase is resulted from plant growth in polluted soils with these elements due to contaminated irrigation water with waste of factories or Sewage water (6). Diyala River is considered as the main source of irrigation water of land extended from west of Iran up to the east of Iraq (3), and as long as this river is suffering from high rates of pollution, these pollutants will transfer to plants especially vegetables that in another way transfer to human throughout the food chain. Heavy elements are of important contaminants of Diyala River, thus the main objective of this paper is to study the effect of the irrigation water coming from Diyala River on the pollution of soil and accumulation of lead and cadmium in soil and plant.

MATERIALS AND METHODS

A greenhouse experiment was conducted in the department of soil and water resources college of agriculture university of Baghdad Al-jadiriya campus and spring season of 2015- 2016 using silt clay loam texture collected from one of this campus Fields.

Some chemical and physical soil properties where measured according to procedure is mentioned in (15) and (11) table 1.

Soil samples were collected, air dried, grounded and passed through 4 mm opening sieve then packed in 10 kg pots. millet (Panicum Millacenum) was broadcasted on March 8^{th}, 2016 at 20 kg per Hectare seeds and 2 cm depth of seeding (used as plant Indicator). Chemical fertilizers of macronutrients NPK where added due to the fertilizeers recommendation (5) at a rate of 28 kg nitrogen.Ha^{-1}, 30 kg P.Ha^{-1} and 20 kg potassium.Ha^{-1} at one level of 28 kgN.Ha^{-1} (0.152 gm.pot^{-1}) at two doses, the first one at planting and the second one before flowering stage. Phosphorus was added as TSP trisuperphosphate (P_2O_5 21%) at one level of 30 kg.Ha^{-1} at one dose at planting 0.339 gm.pot^{-1}), potassium was added as potassium sulfate K_2SO_4 at one level of 20 kg.Ha^{-1} as one dose of 0.10 gm.pot^{-1} at planting. Two types of irrigation water were used. Diyala river water and tap water at 50% of gravimetrically measured field capacity consumption, where applied as:

1- Tap water irrigation control with NPK application C_1
2- tap water irrigation without application of NPK C_2
3- Tap water and Diyala river water irrigation at 1:1 ratio with NPK application T_1
4- Tap water and Diyala River water irrigation at 1:2 with NPK application T_2
5- Irrigation with Diyala River water only with NPK application T_3
6- Irrigation with tap water and Diyala River water alternately with the application of NPK, T_4

The used Diyala River water were of areas adjacent to the main check point of the bridge sides. Some chemical properties were measured. table 2. The experimental design was CRD of six treatments at three replicates in a total experimental units of (18).

Table 1 . some physical and chemical properties of soil

Property	Unit	Value
EC 1:1	$dS .m^{-1}$	2.50
pH	-	7.01
Carbonate minerals	$gm.kg^{-1}$	155.50
CEC	$C.mol.c.kg^{-1}soil$	23.19
OM	$gm.kg^{-1}$	8.91
Cations	$mmol.l^{-1}$	-
Ca++	$mmol.l^{-1}$	22.42
Mg++	$mmol.l^{-1}$	16.76
Na+	$mmol.l^{-1}$	6.34
K+	$mmol.l^{-1}$	0.84
Anions	$mmol.l^{-1}$	-
Cl-	$mmol.l^{-1}$	15.91
HCO3-	$mmol.l^{-1}$	2.50
CO3--	$mmol.l^{-1}$	Nil
SO4--	$mmol.l^{-1}$	13.76
Available N	$mg.kg^{-1}soil$	30.01
Available P	$mg.kg^{-1}soil$	15.73
Available K	$mg.kg^{-1}soil$	82.11
Available Pb	$mg.kg^{-1}soil$	0.020
Available Cd	$mg.kg^{-1}soil$	0.009

Sand%	Silt%	Clay%	Texture class
28.20	**60.00**	**11.80**	Silt Loam

Least significant differences where are used for comparison among averages of treatments at 5% level of significance. Total plant samples (roots, stem and leaves) were collected after harvest, air dried, grounded, sieved then cadmium and lead were measured, soil samples were also collected, electrical conductivity of soil was measured then degradation percentage was calculated.

Concentration of cadmium and lead was measured in soil by using 1 gm of air dried grounded and 2 mm opening sieved soils. Soil samples then were put in to 50 mL capacity Pyrex bottles. 5 mL of nitric acid HNO_3 were added and left for 24 hours. Samples then were put on a hot plate at 80 C° for an hour. Samples later air cooled for an hour and 5 mL of perchloric acid HClO3 was added heat turned on a hot plate up to 180 C° for 2-3 hours until the dark brown color has developed to a colorless one. Samples where filtered after being air cooled, using Whatman 42 filter paper, volume was completed up to 25 mL with distilled water. Cadmium and lead then were measured using atomic absorption spectrophotometer (shimatzo AA=7000). Cadmium and lead where also determined in plants after dry plant samples were wet digested using HNO_3-$HClO_4$ mixture adding 2.5 mL of nitric acid to the plant samples (0.5gm), left for 24 hours, and heated on a hot plate to 80 C° for one hour, air cooled, then 2.5 mL of perchloric Acid were added, heated on a hotplate to 180 C° for 2-3 hours until brown color developed to a clear colorless aliquot, they were air cooled, filtered through Whatman

42 filter paper, then volume was completed with distilled water up to 25 mL. Cadmium and lead where determined using atomic absorption spectrophotometer (12). Grain yields were measured then the uptake and concentration of element was also calculated by multiplying dry weight by element concentration. Results were compared to the recommended international limits of cadmium and lead. The accumulated concentrations in plant were also determined.

Table 2. Some Diyala River water chemical properties.

Property	Unit	Value	limitations
EC	$dS.m^{-1}$	2.30	
pH	-	7.35	
Cations	$mmol.l^{-1}$	-	
Ca++	$mmol.l^{-1}$	20.80	
Mg++	$mmol.l^{-1}$	15.66	
Na+	$mmol.l^{-1}$	5.93	
K+	$mmol.l^{-1}$	0.46	
Anions	$mmol.l^{-1}$	-	
Cl-	$mmol.l^{-1}$	13.84	
HCO3-	$mmol.l^{-1}$	1.93	
CO3--	$mmol.l^{-1}$	Nil	
SO4--	$mmol.l^{-1}$	13.52	
Pb	$mg.l^{-1}$	1.03	5.00
Cd	$mg.l^{-1}$	0.031	0.01
Ni	$mg.l^{-1}$	Nil	0.20
Cr	$mg.l^{-1}$	Nil	0.10
Zn	$mg.l^{-1}$	0.002	2.00
Mn	$mg.l^{-1}$	0.094	0.20
Water quality class	**C_4S_1**	**Low sodicity, highly saline**	

RESULTS AND DISCUSSION

Concentration of lead in plant tissues at harvest stage results are shown in table 3, where there was some significant differences in lead concentrations in plant tissues at harvest stage due to irrigation with Diyala River water. All treatments of Diyala River water were significantly increased in lead concentration in plant tissues at harvest while the highest values were in T_3 treatment of Diyala River water irrigated at 70.30 $mgPb.kg^{-1}$ dry weight as compared to control treatment C_1 of 0.24 $mgPb.kg^{-1}$ dry weight. Also T_2 treatment of 1:2 tap water to Diyala River water irrigated treatment at 51.55 $mgPb.kg^{-1}$ dry weight was at the second place followed by T_1 of 1:1 tap water irrigated treatment at 43.75 $mgPb.kg^{-1}$ dry weight.

The increase in lead concentration in plant tissues at flowering stage is related to the availability of lead in soil irrigated with Diyala river water the matter that led to increase uptake in a plant grown in this soil. Also we can see a positive increase in concentration of lead and accumulation in plant tissues with the increase of irrigation water. That came convenient to what (6) referred to, where they showed the increase of heavy element in soil due to using polluted irrigation water or even using water contaminated with sewage waste and drainage water for irrigation the matter that leads to an increase in heavy elements in plant grown in these polluted soils and accumulation in plant tissues. alternate irrigation treatment T_4 had a big role in decreasing lead concentration in shoots at harvest where it was 37.5 $mg.Pb.kg^{-1}$ dry weight compared to Diyala River water irrigation T_3, and that related to alternate irrigation role and leaching pollutants and salt in soil accumulated by Diyala River water where that was agreed to what (4) referred to, where they showed that alternate irrigation with freshwater and saline water leads to lighten the effect of saline water. Results above also showed that there was a clear increase in lead concentration in plants grown in soils irrigated with lead polluted water of Diyala River. That exceeded the recommended limit (22) which is 0.3 $mgPb.Kg^{-1}$ dry weight, and as long as lead is considered as dangerous element that transfers from plants to consumers as a human or animal throughout the food chain where its toxicity potentials in the cumulative feature that causes physiological damages such as retardation and biofunctional failure (14). So that these elements are considered as pollutants themselves and cannot be used by human or animal in one side, but they could be used in phytoremdiation in another side to get rid of the exceeded concentrations of available lead in soil.

Table 3. lead concentrations in plant tissue at harvest .

Treatment	Value
C_1	0.24
C_2	0.10
T_1	43.75
T_2	51.55
T_3	70.30
T_4	37.50
$L.S.D_{0.05}$	10.18

Plant dry weight at harvest :

Results in table 4 show the averages of one plant dry weight of different treatments at harvest. There was a significant decrease in one plat dry weight at harvest In all three treatments irrigated with the Diyala River water. Weights were 1.21, 1.18, 1.14 gm per plant in T_1, T_2 and T_3 treatments Respectively, when compared to control treatment C_1 that was 1.64 $gm.plant^{-1}$. Previous results showed that there were no significant differences among T_1, T_2, and T_3 treatments. The decrease in average dry weight per one plant at harvest is related to the effect of Diyala River water polluted with heavy elements and their effects on planted plants in soils irrigated with such water. That was coincided with the results of (7) where they showed that heavy metals polluted soils reduce plat growth due to changes in biophysiological processes and plant.

Alternate irrigation of T_4 lead to and none significant increase in one plant dry weight at 1.30 $gm.plant^{-1}$ as compared toT_1, T_2, and T_3 Treatments and that's related to the use of tap water and removing the damage effect of irrigation with polluted Diyala River water that positively reflected in one plant average dry weight.

Table 4. Average of one plant dry weight at harvest gm

Treatments	**Weight (gm)**
C_1	1.64
C_2	0.94
T_1	1.21
T_2	1.18
T_3	1.14
T_4	1.30
$L.S.D_{0.05}$	0.32

Concentrations of lead uptak at harvest :

5 shows concentrations of lead uptaken by plants at harvest, where results showed significant differences in different treatments. All treatments led to a significant increase in uptaken concentrations by plant but the highest values Where in T_3 that was irrigated by Diyala river water only. That is resulted in accumulation of lead and contaminating soil because of irrigation and the increased availability of lead the matter that lead to increase uptake and accumulation in plant tissues. Lead concentrations in the three treatments were 0.081 mg $Pb.Plant^{-1}$. T_2 treatments came into second place where lead concentrations was 0.061 $mgPb.plant^{-1}$, Then T_1 treatment of 0.053 mg $Pb.plant^{-1}$ and T_4 treatments at 0.048 $mgPb.plant^{-1}$ When compared to C_1 Control that was 0.00039 $mgPb.plant^{-1}$. These results assured that there was a positive relationship between lead concentrations uptaken by plant and the amount of Water used for irrigation especially Diyala River water. Concentrations ranked in Their content as T_4-T_1-T_2-T_3 With the increase of Diyala

river water used for irrigation, where that is related to the increase of quantity and concentration of lead in soil with the increase of irrigation water, then the increase of the uptaken lead in plant, and that was convenient to what (7, 11) referred to, where they explained the positive increase of lead as a pollutant and plant with their increase in the media of plant growth. To observe the impact of NPK application in lead uptake, we found that C_1 Control treatment had higher uptake of lead concentrations as compared to C_2 Treatment of no application of NPK Where it was $3.9 * 10^{-4}$ mg $Pb.plant^{-1}$ And first and $9.4 * 10^{-5}$ mg $Pb.plant^{-1}$. That could be related to the effect of the applied fertilizers On the biomass increase and the increase of root group of plant That contributes actively in increasing the uptake in lead by plant.

Table 5 . concentration of lead up taken by plant mgm Pb.plant at harvest.

Treatment	Value
C_1	0.00039
C_2	0.000094
T_1	0.0530
T_2	0.0610
T_3	0.0800
T_4	0.0480
$L.S.D_{0.05}$	0.0190

Concentration of cadmium and plant tissues at harvest:

Table 6 shows concentrations of cadmium and plant tissues of different treatments, Where there were significant differences in cadmium concentration due to irrigation water Of polluted Diyala river Water, where the highest value was found inT_3 treatments that irrigated with Diyala river water only at 7.17mg $Cd.kg^{-1}$ dry weight Followed byT_2 treatment at 5.97mg $Cd.kg^{-1}$ dry weight andT_1 at 4.92mg $Cd.kg^{-1}$ dry weight and T_4 at 3.87mg $Cd.kg^{-1}$ dry weight. We can see that most treatments had a significant effect in increasing the cadmium concentration in plant tissues, But some treatments where even similar in their significant effect , where T_1 and T_4 treatments where not significantly different, Also T_1 and T_2 treatments where the same, while T_3 treatment stayed significantly different Than all other treatments in plant shoots . These values show that all treatments exceeded the recommended limits Of that element 23 which is 0.1 mg $Cd.kg^{-1}$ dry weight, thus all plants where considered to the polluted with cadmium and they Are inedible by human or animals

Application of NPK led to an increase of cadmium in plant tissues at harvest where it was 0.05 mg $Cd.kg^{-1}$ dry weight in C_1 While it was 0.009 mg $Cd.kg^{-1}$ dry weight of none fertilized C_2 treatment, and that could be related to the role of fertilizers In increasing growth and uptake of this element from soil. The increase of cadmium and cadmium polluted Diyala River water irrigated soils where convenient to what (10) found Where soil and water of Diyala river where contaminated due to the waste discharge of Al-Rustumiya Waste station.

Table 6. Cadmium $mgCd.kg^{-1}$ dry weight and plant tissues at harvest stage.

Treatment	Value
C_1	0.050
C_2	0.009
T_1	4.920
T_2	5.970
T_3	7.170
T_4	3.870
$L.S.D_{0.05}$	1.852

Concentration of uptake and cadmium and plant at harvest:

Table 7 shows different uptake in concentrations of cadmium in plant and in different treatments. Results showed that there are significant increases of all treatments due to the use of Diyala River water but they wear different due to their ratio of application used in each treatment for plant irrigation, Where the highest concentration where in highest amount of Diyala River water used for irrigation in T_3 treatment at $8.1*10^{-3}$ mg $Cd.plant^{-1}$ Then T_2, T_1, and T_4 treatments at $7.0*10^{-1}$ mg $Cd.plant^{-1}$, $5.9*10^{-5}$ mg $Cd.plant^{-1}$, and $5.0*10^{-5}$ $mgCd.plant^{-1}$ respectively, When compared to control C_1 treatment of $8.2*10^{-5}$ mg $Cd.plant^{-1}$ in the shoot group . All the previous values of cadmium concentration where above the recommended limits of that element (23) which it is 0.1 mg $Cd.kg^{-1}$ Dry weight , So that all treatments where considered to be polluted with cadmium (6) . Applied fertilizers had an important impact in increasing the uptake and amount of cadmium due to the increase of plant biomass That's reflected in comparing cadmium concentrations of C_1, C_2 where they were $8.2 *10^{-5}$ and $8.4 * 10^{-5}$ mg $Cd.plant^{-1}$ Respectively.

Table 7. uptake and cadmium concentration in plant mg $Cd.plant^{-1}$ at harvest.

Treatment	Concentration
C_1	0.000082
C_2	0.0000084
T_1	0.0059
T_2	0.0070
T_3	0.0081
T_4	0.0050
$L.S.D_{0.05}$	0.0072

Grain yields:

Table 8 shows grain yields ($kg.ha^{-1}$) results of different treatments, they showed a significant decrease of fields and all treatments, irrigated with Diyala River water at 1280, 1180, 1100, 1352 $kg.ha^{-1}$ of T_1, T_2, T_3, and T_4 Treatments respectively as compared to control treatment C1 of 1932$kg.ha^{-1}$. The decrease in grain yield was due to using Diyala River water in irrigation because thw water was saline (2.3 $dS.m^{-1}$) as in table 2, That came confirmable to what (21) found where she showed that using saline water in irrigation (EC 4.4 $dS.m^{-1}$) Leads to a decrease of wheat yield.

Table 8 . grain yield $kg.ha^{-1}$ of different treatments.

Treatment	Yield $kg.ha^{-1}$
C_1	1932
C_2	1040
T_1	1280
T_2	1180
T_3	1100
T_4	1352
$L.S.D_{0.05}$	141.35

When comparing treatments, we can find that T_4 treatment of alternate irrigation was superior in giving highest yield And that could be related to the fresh water role eliminating the bad effect of saline Diyala River water as it was corresponding to what (4) referred to, Where they started using three kinds of irrigation water quality, River, well, and alternate rather well irrigation water, where the alternate irrigation gave highest grain yield And foliage after river water treatments. Application of NPK fertilizers gave a significant increase in yield of grain, where yield was 1932kg.ha-1 in control C_1 as compared to no application treatment of 1040kg.ha-1 grain yield.

Electrical conductivity of soil after harvest:

Results in table 9 show values of electrical conductivity (EC) of soil after harvest in all treatments, They also show that there was significant differences among treatments Due to using Diyala River water for irrigation, Where there was a positive relationship between Diyala River water used for irrigation and electrical conductivity values of soil at 3.81, 4.12, 4.83 $dS.m^{-1}$ of T_1, T_2. T_3 treatments respectively, as compared to control treatment C1 of 1.00$dS.m^{-1}$. The increase in EC values of soil after harvest related to the effect of Diyala River saline water (EC=2.30 dS.m-1, table 6) And the accumulation of salts in soil, in addition to the increase in heavy elements accumulation such as lead and cadmium in soil that led to an increase in EC of soil, where that was conformable to results of (25) that they showed that the use of bad water quality in irrigation will lead to an increase in electrical conductivity of soil. Alternate irrigation treatmentsT_4 led to a significant decrease in soil electrical conductivity after harvest at 3.12$dS.m^{-1}$ when compared to T_1, T_2 and T_3 Treatments and that is related to the effect of fresh water added alternately and leaching salts in soil irrigated with Diyala River water. Application of NPK fertilizers decreased values of soil electrical conductivity of 1.00 $dS.m^{-1}$ when compared to control treatment of no application of fertilizers C_2 Where EC was 1.90$dS.m^{-1}$ and that is related to the influence of fertilizers in increasing plant growth and specially the root system the matter that increases uptake of salts from soil and decreasing EC values.

Table 9. EC of soils of different treatments after harvest $dS.m^{-1}$.

Treatment	Value
C_1	1.00
C_2	1.90
T_1	3.81
T_2	4.12
T_3	4.83
T_4	3.12
$L.S.D_{0.05}$	0.84

Degradation percentage of soil :

So the rotation percentage was calculated due to: % Soil Degradation= (EC of soil after planting – EC of soil before planting)/EC of soil after planting)*100

Results of table 10 show the percentages of soil degradation Of different treatments, results show the steady increase Of the percentages in soil due to the increase of Diyala river water And irrigation, where degradation percentage is where the 24.38 %, the 29.32 %, 48.24% of all T_1, T_2, and T_3 treatments respectively. The reason of increasing degradation of soil related to the increase of EC values of soil and salt accumulation resulted from Diyala river water, that was in line with what (21) found, where irrigation using saline water leads to increase both Salt concentrations in soil and the British and percentages. T_4 treatment of the alternate irrigation led to a decrease in degradation percentage is at 19.87% Compared to T_1, T_2, and T_3 treatments and that was related to the leaching of salts from soil By using fresh water for irrigation after saline water of Diyala River water leading to reduce soil EC values.

Table 10. Soil degradation percentage in different treatments .

Treatment	Value
C1	%-150.00
C2	%-31.57
T1	%34.32
T2	%39.33
T3	%48.24
T4	%19.87

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CONCLUSIONS

1- The laboratory results of Diyala River water showed a pollution levels of cadmium reached up to 0.031 mg.l^{-1} Over doing the recommended limits of WHO which is 0.01 mg.l^{-1}, the whole amount of sled was not overdoing the Recommended limits of That element (5mg.l^{-1}) of WHO Where it was 1.03 mg.l^{-1}. Thus, precautions should be taken When using such quality of arrogation water due to their transfer throughout the food chain of human beings and animals
2- Plant sample analysis showed that lead has overdone the recommended limits of concentrations in plant (22), therefore all plants Where considered to be polluted with cadmium and lead and cannot be used for human and animal consumption.
3- Due to the previous parameters, we can say that Diyala River water used for irrigation is polluted with heavy elements and has a bad quality class the matter that lead to accumulate lead and cadmium in a plant tissues and jeopardized lives of consumers for the bad damages they cause.

RECOMMENDATION

1- Paying attention to Diyala River water pollution problem and finding suitable solutions
2- Treating Al-Rustumiya sewage water station using scientific methods before discharging them to Diyala River.
3- Eliminating wastes of factories to Diyala River.
4- Top varying wastes in agricultural fields randomly.
5- Stop using Diyala River water for irrigation for that time being.

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