Effect of Water Quality on Chemical Properties of Two Different Soil Textures and Corn Growth in Erbil Governorate

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Abstract

A pot experiment was carried out to study the role of chemical composition of water, soil texture and their interaction on soil chemical properties and growth of corn plant**,** at Grdarasha Field, College of Agriculture, University of Salahaddin, Erbil. The results indicated to increase in electrical conductivity of the soil extract after harvest and ranged between 1.25 to 9.30 dS m^{-1} with increasing the electrical conductivity of the water from 0.44 to 5.00 dS m^{-1} , the highest value of electrical conductivity of soil extract 9.30 dS m^{-1} was recorded from W_6S_1, while the lowest value 1.25 dS m^{-1} was recorded fromW_1S_1 .The highest value 93.14 g pot^{-1} of dry matter was recorded at treatment combination W_6S_1, generally the role of soil texture was very clear in the weight of dry matter in S1 which was 8 times more than its weight in S2 .The quality of irrigation water affected significantly in the concentration of cations and anions and chlorophyll content of corn plant.

Keywords: Water quality, Soil texture, Corn.

Introduction

Water is a precious natural resource, it is vital for sustaining all kinds of life on the earth, less than 3% of total water on the earth is fresh water and less than0.03%is accessible to mankind.Water is needed for irrigation,food production, drinking and to maintain the natural ecosystem (Sastry and Rama, 2004). Ground water is one of the earth's most widely distributed replenishable resources. Ground water caters to the requirement of the agriculture. Total ground water on the earth is 35 times greater than the surface water the main objective of ground water exploration is to locate aquifers capable of yielding water in sufficient quantity of suitable quality for domestic, industrial and agricultural purposes (Patel *et al*;(2006)).

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Texture is the most important physical property of the soil for plant growing, since it influences water holding capacity and root growth (Rice, 2002).

High-quality crops can be produced only by using high- quality irrigation water. Characteristics of irrigation water that define its quality vary with the source of water. There are regional differences in water characteristics, based mainly on geological formation and climate (Faust, 1999).

Water quality has great effect on soil chemical properties. The normal pH range for irrigation water is from 6.5 to 8.4. High pH,s above 8.5 often caused by high bicarbonate (HCO^{-1}) and carbonate (CO_3^{2-}) concentration, know as alkalinity (Bauder et al, 2005). Calcium carbonate would prevent significant changes in pH of soil solution (Al-busaidi and Cookson, 2003). The water quality did not affected significantly ($p \leq 0.01$) on the soil pH after harvesting due to the high buffer capacity of the soil (Mam Rasul,2000 and Salih ,2008). Ayres and Westcot ;(1976) indicated to an increace in soil salinity in case of using bad water quality, the salinity of soil increases when the water takes by plant from the soil. An increase in water salinity would cause an increase in osmotic pressure of the soil solution, causing reduces in availability of water for plant (Rijtema,1981). The increase in EC_{iw} of irrigation water from 0.37 to 0.94 dS m^{-1} caused an increase in EC_e of soil extract from 0.55 to 2.65 dS m^{-1} (Mam Rasul,2000) .Salih (2008) studied effect of seven water qualities having EC_{iw} 0.42 to 5.65 dS m^{-1} irrigation with these waters caused an increases in (EC_e) from 2.05 to 10.87 dS m^{-1}.

Kelly;(1963) found that if the concentration of Ca^{2+} in irrigation water is equal or more than 35% of total cations, it will replace sodium on the surface of soil particles.The results showed an increase in exchangeable sodium percentage due to increases in sodium percent to calcium in irrigation water(Hamdi *et al*. 1966) .The investigations on the effect of water quality of well water in Erbil plain on some chemical properties of soil under supplementary irrigation condition found the high significant correlation between the concentration of cations and anions in irrigation water and saturated soil extract, the results also showed that the ionic composition of saturated soil extract is similar to the ionic composition of irrigation water (Esmai ; (1986) , Al-Azawi ; (1986) , Esmail ;(1996). Mam Rasul ;(2000), Salih ;(2008) , Abdul Amer *et al*; (1987) found the significant correlation coefficients (r) between the concentration of (Ca^{2+}, Mg^{2+}, K^{+} and Na^{+}) in soil extract and concentration of them in irrigation water. The mean values of (r) were ($o.967^{**}$, $o.951^{**}$, 0.994^{**}, 0.977^{**}) for the above cations respectively.

This investigation was conducted to study:

1. The effect of chemical composition of irrigation water on chemical properties of two different textured soils.
2. The effect of chemical composition of irrigation water on growth and nutrient uptake of corn plant.

Materials and methods

Water sampling:

Water samples were collected from six locations at Arbil plain which included 6 wells (Figure,1) and (Table,1), water samples were taken at each location for chemical analysis according to APHA (1989). The chemical properties of the studied water were shown in (Table, 2).

Water, soil and plant analysis:

Some chemical properties of soil, water and plant were analyzed weekly depending on methods mentioned in APHA;(1989), Black;(1980),Gupta;(2006)

Table (1) The Global Positioning System (GPS) readings for the studied locations of wells and soils.

No.	Well Locations	Elevation (m)	(G.P.S.) Reading	
			N	E
1	Kuchablbas	398	35°03´09´´	44°01´09´´
2	Grdarasha	412	36°06´49´´	44°00´41´´
3	Bakrta	332	35°57´03´´	43°53´58´´
4	Mnara	320	35°57´49´´	43°53´23´´
5	Makhmur	305	35°46´54´´	43°36´05´´
6	Chakhmera	282	35°47´00´´	43°46´32´´
Studied soils locations				
S_1	Grdarasha	407	36°06´49´´	44°00´47´´
S_2	Zurgazraw	396	35°54´19´´	43°49´45´´

and Mostra and Roy ;(2008). Table (2 and 3) show the mean of water properties during the study and initial soil properties respectively.

Pot experiment:

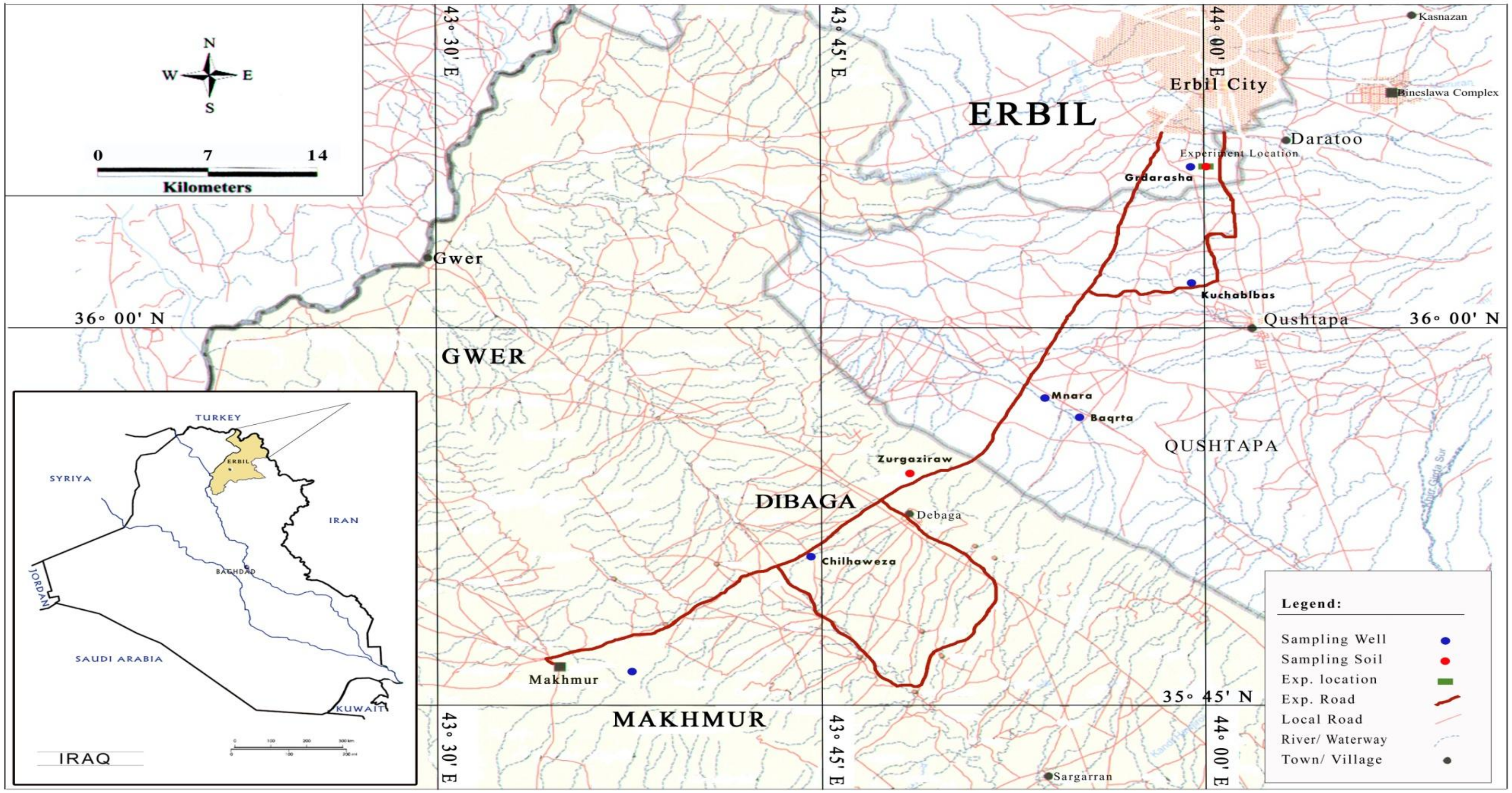
The pot experiment was conducted at the farm of the College of Agriculture, University of Salahaddin at Grdarasha field (G.P.S., N = 36°06´49" , E = 44° 00´ 47"), during (23/7/2009 to 3/10/2009) to study the effect of six water qualities having EC values (0.44, 0.50, 1.30, 1.37, 3.5 and 5 $dS.m^{-1}$), two different textured soils and their combination on some chemical properties of soil and corn growth using factorial CRD with 3 replication.

Results and discussion

1- Effect of water quality, soil texture and their interaction on some chemical properties of the soils

1-1-Hydroge ion potential (pH)

Table (4) shows that the water quality, soil type and their interaction did not affected significantly ($p \leq 0.01$) on the soil pH after harvesting; this may be due to the high buffering capacity of the studied soils. This result agree with those recorded by Mam Rasul;(2000), Salih;(2008), AbdulAmer *et al*;(1987) and Esmail ;(1986).


N
W
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43° 30' E
43° 45' E
44° 00' E
36° 00' N
35° 45' N
Kasnazan
Erbil City
ERBIL
Bineslawa Complex
Daratoo
Experiment Location
Grdarasha
Gwer
Kuchablbas
Qushtapa
GWER
Mnara
Baqrta
QUSHTAPA
Zurgaziraw
DIBAGA
Debaga
Chilhaweza
Makhmur
MAKHMUR
Sargarran
TURKEY
SYRIYA
ERBIL
IRAN
JORDAN
BAGHDAD
SAUDI ARABIA
KUWAIT
IRAQ
Legend:
Sampling Well
Sampling Soil
Exp. location
Exp. Road
Local Road
River/ Waterway
Town/ Village

Table (2) some chemical properties of irrigation water used in pot experiment.

Well No.	Locations	pH	$dS\ m^{-1}$	concentration $mmol_c\ L^{-1}$								SAR	Adj.SAR	Adj.R Na	Ca^{2+}/Mg^{2+}	Mg^{2+}/Ca^{2+}
				Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	Cl^{-}	NO_3^{-1}	SO_4^{2-}	HCO_3^{-}					
W_1	- blba	7.6	0.4	2.35	1.10	0.6	0.0	0.3	0.24	0.57	3.01	0.5	0.9	0.5	2.1	0.4

		0	4			6	2	5				0	8	6	4	7
W_2	Grdarasha	7.45	0.50	2.80	1.45	0.45	0.03	0.30	0.25	1.30	3.13	0.31	0.63	0.34	1.93	0.52
W_3	Bakrta	7.40	1.30	3.85	4.88	3.8	0.18	1.28	0.50	5.43	6.00	1.82	4.62	2.12	0.79	1.27
W_4	Mnara	7.30	1.37	6.01	8.05	4.65	0.05	2.35	0.60	8.04	7.77	1.75	4.93	2.09	0.75	1.34
W_5	Makhmur	7.08	2.50	10.00	8.05	7.02	0.02	4.83	2.60	15.76	4.50	2.34	2.46	2.87	1.24	0.81
W_6	Chakhmera	7.05	5.00	18.55	16.70	18.1	0.14	11.8	3.67	37.49	4.00	4.31	5.99	1.50	1.11	0.90

جدول رقم (2)

Table (3) Some physical and chemical properties of the soils before experiment.

Soil No. (location)	pH	EC ds m^{-1}	organic matter g kg^{-}	total $CaCO_3$ g kg^{-}	CEC mol kg^{-1}	Bulk Density Mg m^{-3}	Soil texture	P.S.D. g kg^{-1}			water content %			total water added / pot (L)	concentration $mmol_c$ L^{-1}								Mg^{2+}/Ca^{2+}	SAR
								clay	Silt	sand	S.P	F.C	W.P		Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	Cl^{-}	HCO_3^{-}	NO_3^{-}	SO_4^{2-}		
S1 Grdarasha	7.65	0.63	8.18	335	23.4	1.27	SiCL	356	546	97	58.45	26.45	17.03	40.25	2.75	1.92	1.39	0.12	1.20	3.32	0.45	1.08	0.70	0.91

S2 zurgazraw	7.70	1.10	8.11	350	19.1	1.36	SL	117	244	637	33.33	17.61	8.67	26.10	5.20	1.30	1.80	0.08	0.70	2.30	0.25	6.25	0.25	1.00

جدول رقم (3)

Table (4) Interaction effect of water quality (w) and soil texture (S) on pH and EC (dS m^{-1}) of soil extract after harvest.

W=water quality	S_1	S_2	Mean	S_1	S_2	Mean
	pH			EC at 25 C°		
W_1	7.60	7.20	7.40	1.25	3.12	2.19
W_2	7.45	7.80	7.63	1.56	1.70	1.63
W_3	7.40	7.30	7.35	2.12	2.50	2.31
W_4	7.30	7.10	7.20	4.05	4.00	4.03
W_5	7.08	7.54	7.31	3.50	4.50	4.00
W_6	7.15	7.30	7.23	9.30	8.50	8.90
Mean	7.33	7.37	7.35	3.63	4.05	3.84
Tukey's W	0.05			0.03		
Tukey's S	0.02			0.01		

	WS	0.08	0.05

1-2Electrical conductivity (EC).

Table (4) shows the significant differences at ($p \leq 0.01$) between all water qualities in their effect on electrical conductivity of soil extract EC_e, the highest mean value 8.90 dS m^{-1} was recorded from W_6 while the lowest value 1.63 dS m^{-1} was obtained from W_2. In general the increase in electrical conductivity of irrigation water EC_{iw} caused an increase in EC_e. The correlation coefficient between EC_{iw} and EC_e was ($r = 0.959$**). This result is agreed with results reported by Mam Rasul (2000).

The soil texture affected significantly at a level of ($p \leq 0.01$) on EC_e, the highest value (4.05 dS m^{-1}) was recorded from S_2 while the lowest value (3.63 dS m^{-1}) was recorded from S_1 , this may be due to the differences in initial EC of studied soils and the differences in their chemical and physical properties (Table 3). The interaction between water quality and soil texture affected significantly ($p \leq 0.01$) on the electrical conductivity of soil extract the highest value 9.30 dS m^{-1} was recorded from the combination treatment W_6S_1 while the lowest value 1.25 dS m^{-1} was recorded from W_1S_1, this may be due to the difference in initial EC of studied soils and the quality of applied water in irrigation (Table 2 and 3).

1-3- Soluble cations.

The water quality affected significantly ($p \leq 0.01$) on the mean concentration of cations (Table,5) the highest concentrations (28.50, 15.61 and 45.00) $mmol_c\ L^{-1}$ of Ca^{2+}, Mg^{2+} and Na^{+} respectively, were recorded in treatment W_6 however the highest concentration 0.45 $mmol_c\ L^{-1}$ of K^{+} was recorded from treatment W_1, while the lowest concentration 8.45 $mmol_c\ L^{-1}$ of Ca^{2+} was obtained from treatment W_1, and the lowest concentrations (2.55, 0.11, 4.38) $mmol_c\ L^{-1}$ of Mg^{2+} , K^{+} , Na^{+}, were recorded from treatment W_2.

Table:(5)Interaction effect of water quality (w) and soil texture (S) on concentration of cations in soil extract ($mmol_c\ L^{-1}$) after harvest.

W	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
	Ca^{2+}			Mg^{2+}			K^{+}			Na^{+}		
W_1	7.50	9.40	8.45	1.42	13.20	7.31	0.13	0.77	0.45	3.35	8.60	5.98
W_2	8.88	10.20	9.54	3.10	2.00	2.55	0.13	0.09	0.11	4.05	4.70	4.38
W_3	11.50	6.40	8.95	3.10	8.00	5.55	0.22	0.12	0.17	5.10	10.00	7.55
W_4	22.50	9.60	16.05	10.50	3.40	6.95	0.17	0.08	0.13	6.12	24.30	15.21

W_5	16.00	14.40	15.20	10.20	11.60	10.90	0.20	0.09	0.15	9.30	19.50	14.40
W_6	27.00	30.00	28.50	17.22	14.00	15.61	0.51	0.30	0.41	50.00	40.00	45.00
Mean	15.56	13.33	14.45	7.59	8.70	8.15	0.23	0.24	0.24	12.99	17.85	15.42
Tukey's Values w	0.18			0.09			5.20			0.07		
Tukey's Values s	0.08			0.04			2.24			0.03		
Tukey's Values ws	0.29			0.15			8.32			0.11		

It means that in general an increase in concentration of cations in irrigation water caused an increase in their concentration in soil extract, these results are similar to those recorded by Esmail ;(1992) and Salih ;(2008). In general the soil texture affected significantly on the mean concentration of cations at ($p \leq 0.01$) the highest value 15.56 $mmol_c\ L^{-1}$ of Ca^{2+} was recorded from treatment S_1, while the highest values (8.70, 0.24, 17.85) $mmol_c\ L^{-1}$ of Mg^{2+} , K^+ and Na^+ were recorded from treatment S_2 , and the lowest concentration of Ca^{2+} (13.33 $mmol_c\ L^{-1}$) was recorded at S_2 and the lowest concentration of Mg^{2+}, K^+ and Na^+ (7.59, 0.23, 12.99) $mmol_c\ L^{-1}$ were recorded from treatment S_1. The highest value of Ca^{2+} was recorded in S_1 in spite of the low initial concentration of Ca^{2+} in this soil comparing with S_2, this may be due to the higher amount of applied water in S_1 comparing with S_2 in additional to the higher $CaCO_3$ content of S_2. while the behavior of Na^+ was differ from Ca^{2+} since the higher Na^+ concentration, SAR, Adj. SAR and Adj. RNa values were recorded in S_1 (Table,3), this explain that the behavior of Na^+ is differ from Ca^{2+}, and may be due to the difference in chemical and physical properties of S_1 and $S_{2,}$ the similar results were recorded by Salih ;(2008).

The interaction between water quality and soil texture affected significantly ($p \leq 0.01$) on concentration of cations in soil extract, the highest concentration 30.00 $mmol_c\ L^{-1}$ of Ca^{2+} was recorded from treatment combination W_6S_2 and the highest concentration (17.22 and 50.00) $mmol_c\ L^{-1}$ of both Mg^{2+} and Na^+ were recorded from W_6S_1,while the lowest concentration (6.40 $mmol_c\ L^{-1}$) of Ca^{2+} was recorded from treatment combination W_3S_2 and the lowest concentration (1.42 and 3.35) $mmol_c\ L^{-1}$ of both Mg^{2+} and Na^+ were recorded at treatment combination W_1S_1, and the lowest concentration (0.08 $mmol_c\ L^{-1}$) of K^+ was recorded from W_4S_2 (Table,5). This may be due to the initial concentration of cations in soil and it 's concentrations in irrigation water (Table, 2 and 3), for example the concentration of Mg^{2+} and Na^+ in each of W_1, W_2 and S_2 were less than the concentration of them in other water quality and soils, for this reason, the interaction between W and S created various conditions for accumulation of cations in low or high concentration, this may be due to the role of the type of clay minerals in the studied soils, in additional to the differences between chemical and physical properties of S_1 and S_2 (Table,3). These results are similar to those recorded by Esmail ;(1986) and Salih ;(2008).

1-4- Soluble anions.

The water quality affected significantly at ($p \leq 0.01$) on the mean concentration of anions (Table,6) the highest concentration (7.78 mmolc L^{-1}) of Cl^- was recorded from treatment W_4, while the highest concentrations (8.28, 78.96 and 0.70) mmolc L^{-1} of HCO_3^-, SO_4^{2-} and NO_3^- were recorded from treatment W6 respectively and the highest concentration (4.44 µg ml^{-1}) of P was recorded from W_3. While the lowest concentration (1.65 and 11.63) mmolc.L^{-1} of both Cl^- and SO_4^{2-} and (3.74 µg ml^{-1}) of P were recorded at treatment W_2, and the lowest concentration (3.05 and 0.45) mmolc L^{-1} of both HCO_3^- and NO_3^- were recorded from W_1, in general the increase in concentration of anions in irrigation water caused an increase in their concentration in soil extract (Table, 2). The similar results were recorded by Mam Rasul ;(2000), Mustafa *et al*;(2004) and Salih ;(2008).

The soil texture affected significantly on the mean concentration of anions at ($p \leq 0.01$) the highest values 4.13 µg ml^{-1} of P , (5.54 , 6.27 and 0.73) $mmol_c\ L^{-1}$ of P, Cl^-, HCO_3^-, NO_3^-, were recorded at treatment S_1 respectively, while the highest value (33.92) $mmol_c\ L^{-1}$ of SO_4^{2-} was recorded from treatment S_2.The lowest concentration 4.01 µg ml^{-1} of P and (3.04 , 3.18, 0.42) $mmol_c\ L^{-1}$ of (Cl^-, HCO^-_3 and NO^-_3) were recorded in treatment S_2 , while the lowest value (24.55) $mmol_c\ L^{-1}$ of SO_4^{2-} was recorded from treatment S_1, this may be due to the initial concentration of anions, and the ratio between the chemical composition of the soil extract in studied soils. The similar results were obtained by Salih ;(2008) , Mam Rasul ;(2000) and Mostra *et al* ;(2008). In additional to the effect of different textured soils on the amount of required water to reach the soil moisture to the field capacity.

The interaction between water quality and soil texture affected significantly ($p \leq 0.01$) on the concentration of anions in soil extract, the highest values (13.35, 0.88) $mmol_cL^{-1}$ of Cl^- and NO_3^- were recorded from treatment combination W_4S_1,while the highest value (8.65 and 85.54)) $mmol_c\ L^{-1}$ of $HCO_3^-$and SO_4^{2-} were recorded at treatment combination W_6S_1 and the highest value 4.78 µg ml^{-1} of P was recorded at treatment combination W_3S_2,while the lowest values (0.51, 1.90, 7.75, 0.32) $mmol_c\ L^{-1}$ and 3.5 µg ml^{-1} of Cl^- , HCO_3^-, SO_4^{2-}, NO^-_3 and P were recorded in treatment combinations W_6S_1 ,W_5S_2 , W_1S_1, W_3S_2, W_5S_2 and W_5S_2 this may be due to initial concentration of anions in different water qualities and textured soils (Table ,2 and 3) similar results were recorded by Mustafa et al.;(2004).

Table (6) Interaction effect of water quality (w) and soil texture (S) on concentration of anions in soil extract after harvest.

W	S_1	S_2	Mean	S_1	S_2	mean	S_1	S_2	mean	S_1	S_2	mean	S_1	S_2	Mean
	Cl^-			HCO_3^-			SO_4^{-2}			NO_3^-					
	mmol$_c$ L^{-1}												P µg ml^{-1}		
W_1	1.30	3.80	2.55	3.35	2.75	3.05	7.75	25.42	16.59	0.49	0.41	0.45	4.06	4.22	4.14
W_2	1.50	1.80	1.65	4.50	2.10	3.30	10.16	13.09	11.63	0.65	0.53	0.59	3.89	3.59	3.74
W_3	4.40	3.40	3.90	6.50	2.10	4.30	9.02	19.02	14.02	0.70	0.32	0.51	4.10	4.78	4.44
W_4	13.35	2.20	7.78	7.10	2.30	4.70	18.84	32.89	25.87	0.88	0.38	0.63	4.20	4.38	4.29
W_5	12.20	3.00	7.60	7.50	1.90	4.70	16.00	40.69	28.35	0.80	0.33	0.57	4.18	3.50	3.84
W_6	0.51	4.02	2.27	8.65	7.90	8.28	85.54	72.38	78.96	0.84	0.56	0.70	4.35	3.59	3.97
mean	5.54	3.04	4.29	6.27	3.18	4.72	24.55	33.92	29.23	0.73	0.42	0.57	4.13	4.01	4.07
Tukey's Values W	0.03			0.11			0.21			0.04			0.03		
Tukey's Values S	0.01			0.05			0.09			0.01			0.01		

	WS	0.04	0.18	0.33	0.04	0.05

جدول رقم (6)

2-Effect of water quality, different soil texture and their interaction on concentration of some ions and chlorophyll content in corn plant:

The water quality affected significantly **(**$p \leq 0.01$**)** on concentration of cations in dry matter as shown in Table (7). The highest mean values 3.62 and 2.45 mg g^{-1} dry matter of both Ca^{2+} and Mg^{2+}, were recorded in W_6, while the lowest values of both of them 1.66 and 1.37 mg g^{-1} dry matter, and were recorded from W_2. This may be due to chemical composition of the irrigation water for example, the highest concentration of Ca^{2+} and Mg^{2+} were recorded in treatment W_6 comparing with most of studied water qualities (Table,2). On the other hand the highest dry weight of plant was recorded from treatment W_6 comparing with most other treatments. This means that the highest concentration of cations were not attributed to the dilution effect. The lowest value of Ca^{2+} and, Na^+ and K^+ may be due to the imbalance among ions in soil media then in the plant (Mustafa et al.;(2004)).

As appear from table (7) the soil texture affected at **(**$p \leq 0.01$**)** the calcium concentration in the plant, the highest mean value 2.59 mg g^{-1} was recorded from S_1, while the lowest mean value 2.44 mg g^{-1} recorded from S_2 and the highest mean value (1.73 mg g^{-1}) of Mg^{2+} recorded from S_2, while the lowest value 1.68 mg g^{-1} recorded from S_1, this is due to the dilution effect, since the concentration of Ca^{2+} in corn after harvest in soil S_1 was higher than S_2, however its concentration in plant grown in S_1 was lower than those grown in S_2. These explain the role of dilution effect; the different behaviors of water qualities in soil and their effect on nutrient concentration in plant.

The interaction between water quality and soil texture affected significantly **(**$p \leq 0.01$**)** on concentration of cations in corn, the highest concentration 3.88 and 2.79 mg g^{-1} for both Ca^{2+} and Mg^{2+} were recorded from treatment combination W_6S_2, while the lowest concentration 1.23 mg g^{1} for Ca^{2+} was recorded from treatment combination W_2S_1 and the lowest concentration 1.05 mg g^{1} for Mg^{2+} recorded from treatment combination W_1S_1.This may be due to the initial concentration of cations in soils and concentration of them in irrigation water (Tables 2 and 3).

Table (7) Interaction effect of water quality and soil texture on cations concentration of corn.

W=Water quality		S_1	S_2	mean	S_1	S_2	Mean
		Ca^{2+}			Mg^{2+}		
		mg g^{-1}					
W_1		2.28	2.51	2.40	1.05	2.20	1.63
W_2		1.23	2.08	1.66	1.27	1.47	1.37
W_3		2.75	2.24	2.50	2.15	1.42	1.79
W_4		3.23	2.12	2.68	2.03	1.21	1.62
W_5		2.68	1.80	2.24	1.49	1.31	1.40
W_6		3.35	3.88	3.62	2.10	2.79	2.45
Mean		2.59	2.44	2.51	1.68	1.73	1.71
Tukey 's Values	W	0.23			0.08		
	S	0.10			0.03		
	WS	0.37			0.12		

Table (8) shows the significant effect ($p \leq 0.01$) of water quality on Cl^- concentration in plant. The highest mean value (3.97mg g^{-1}) of Cl^- was recorded from treatment W_6 and the lowest value of 1.13 mg g^{-1} was recorded from treatment W_2, this may be due to the highest concentration of Cl^- in W_6 (Table,2) similar results recorded by Mam Rasul; (2000) and Salih; (2008).

The soil texture affected significantly at ($p \leq 0.01$) on Cl^- concentration in corn plant and the highest mean value (3.00 mg g^{-1}) of Cl^- found in corn plants grown in treatment S_1, this may be due to the initial Cl^- concentration of S_1 (Table, 3), While the lowest values (1.94 mg g^{-1}) of Cl was recorded in S_2, this is due to the highest Mg^{2+}/Ca^{2+} in treatment S_1 and the balance between Cl^- and SO_4^{2-} (Table, 3), these results agree with those recorded by Salih; (2008) and Esmail; (1992).

The interaction between water quality and soil texture affected significantly **(**$p \leq 0.01$**)** on concentration of anions in corn plants, the highest value (6.93 mg g^{1}) of Cl^- was recorded from treatment combination W_6S_1, while the lowest values (1.02 mg g^{1}) of Cl^- was recorded from treatment combination W_6S_2, This may be due to the initial concentration of anions in soils and concentration of them in irrigation water (Table 2 and 3).

Table (8) shows that the water quality, soil type and their interaction did not affected significantly ($p \leq 0.01$) on concentration of P in the plant this due to high concentration of $CaCO_3$ and pH in the soil that reduced the availability of P in soil.

Table (8) Interaction effect of water quality (W) and soil texture (S) on anions concentration of corn plants.

W=Water quality		S_1	S_2	mean	S_1	S_2	mean	S_1	S_2	Mean
		Cl^-			P			N		
		mg g^{-1}								
W_1		1.05	2.36	1.70	0.30	0.31	0.31	1.89	2.01	1.95
W_2		1.06	1.20	1.13	0.31	0.33	0.32	2.01	2.14	2.08
W_3		1.45	3.06	2.26	0.36	0.40	0.38	1.28	1.86	1.57
W_4		2.73	1.53	2.13	0.33	0.39	0.36	1.16	1.55	1.36
W_5		4.76	2.47	3.61	0.29	0.30	0.30	1.27	1.58	1.43
W_6		6.93	1.02	3.97	0.32	0.31	0.32	1.02	1.43	1.23
Mean		3.00	1.94	2.47	0.32	0.34	0.33	1.44	1.76	1.60
Tukey 's Values	W	0.09			0.03			0.04		
	S	0.04			0.02			0.02		
	WS	0.15			0.06			0.06		

The soil texture affected significantly at ($p \leq 0.01$**)** on the nitrogen concentration in corn plants, the highest mean value (1.76 mg g^{-1})of nitrogen was recorded from treatment S_2 , while the lowest value (1.44) mg g^{1} of nitrogen was recorded from S_1, at the same time the highest mean values of Chlorophyll a, b (7.70 and 5.17) mg.100g^{-1} were recorded in S_2 and the lowest value (6.95 and 2.78) mg/100g were recorded in S_1 (Table,9) this may be due to the differences in NO_3^- concentration in the studied soils and waters (Table, 3) in additional to the variation between chemical composition of water and soil solution, the similar results were recorded by Salih; (2008).

The interaction between water quality and soil texture affected significantly at **(**$p \leq 0.01$**)** on concentration of nitrogen in corn plants, the highest value (2.14 mg g^{1}) of nitrogen was recorded in treatment combination W_2S_2, while the lowest value (1.02 mg g^{-1}) of nitrogen was recorded in treatment combination W_6S_1, This is due to the initial concentration of anions in soils and its concentration in irrigation water.

Table:(9) Interaction effect of water quality (w) and soil textured on chlorophyll content of corn plants.

W=Water quality		Chl. a S_1	Chl. a S_2	Chl. a mean	Chl.b S_1	Chl.b S_2	Chl.b mean	Total Chl. S_1	Total Chl. S_2	Total Chl. Mean
		Mg.100g^{-1}								
W_1		6.80	8.00	7.40	2.70	4.40	3.55	9.50	12.40	10.95
W_2		6.60	8.20	7.40	2.40	6.70	4.55	9.00	14.90	11.95
W_3		7.00	8.50	7.75	2.80	4.40	3.60	9.80	12.90	11.35
W_4		7.70	7.10	7.40	3.00	4.40	3.70	10.70	11.50	11.10
W_5		6.00	6.00	6.00	2.70	4.30	3.50	8.70	10.30	9.50
W_6		7.60	8.40	8.00	3.10	6.80	4.95	10.70	15.20	12.95
Mean		6.95	7.70	7.33	2.78	5.17	3.98	9.73	12.87	11.30
Tukey 's Values	W	0.63			0.41			0.72		
	S	0.27			0.18			0.31		
	WS	1.01			0.66			1.15		

3-Effect of water quality, different soil texture and their interaction on dry weight of corn planta.

Table (10) shows the significant effect of water quality at ($p \leq$ 0.01**)** on the dry weight of plant, the highest values 50.94 mg pot $^{-1}$ was recorded from treatment W_6 and the lowest value 38.27 mg pot $^{-1}$ was recorded from treatment W_4, this due to the chemical composition of irrigation water.

The soil texture affected significantly (p ≤ 0.01**)** on the dry weight of plant, the highest values 78.57 mg pot $^{-1}$ was recorded from S_1, while the lowest values 9.80 mg pot $^{-1}$ was recorded from S_2 this may be due to the differences in the physical and chemical properties of the soils.

The interaction between water quality and soil texture affected significantly at **(**p≤ 0.01**)** on the dry weight of plant , the highest values 93.14 mg pot $^{-1}$ was recorded from treatment combination W_6S_1 , while the lowest values 8.74 mg pot $^{-1}$ was recorded from treatment combination W_6S_2,similar results were obtained by Salih; (2008) and Dohuki; (1997).

Table (10)Interaction effect of water quality (w) and soil texture(s) on dry weight of corn plants.

W=water quality	S_1	S_2	Mean
	dry weight mg Pot^{-1}		
W_1	87.29	9.28	48.28
W_2	74.75	11.58	43.17
W_3	76.67	9.08	42.88
W_4	66.55	9.99	38.27

W_5		73.01	10.11	41.56
W_6		93.14	8.74	50.94
Mean		78.57	9.80	44.18
Tukey 's Values	W	17.15		
	S	7.38		
	WS	27.42		

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تاثير نوعية المياه فى الصفات الكيميائية لنسجتين من التربة ونمو الذرة الصفراء في محافظة اربيل

أكرم عثمان اسماعيل افين صابر كريم

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الخلاصة

اجرى هذا البحث في حقول كلية الزراعة / جامعة صلاح الدين / اربيل لدراسة تاثير ست نوعيات من مياه الري و نسجتين من التربة و التداخل بينهما في الصفات الكيميائية للتربة ونمو الذرة الصفراء و تشير النتائج الى الزيادة في درجة التوصيل الكهربائى للمياه من (0.44 - 5.00) ديسيسيمنز م$^{-1}$ ادت الى زيادة قيمة التوصيل الكهربائى فى مستخلص العجينة المشبعة و بمدى (1.25- 9.30) ديسيسيمنز م$^{-1}$ حيث سجلت اعلى قيمة للتوصيل الكهربائى فى المعاملة العاملية (W_6 S_1) اى مياه ذات درجة التوصيل الكهربائى = 5 ديسيسيمنز م$^{-1}$ وتربة ذات نسجة (مزيجية طينية) فى حين سجلت ادنى قيمة للتوصيل الكهربائى في المعاملة العاملية(W_1 S_1) تم الحصول على اعلى قيمة للمادة الجافة 93.14 غم / سندانة في المعاملة العاملية (W_6 S_1) حيث كانت دور النسجة واضحة جدا فى زيادة المادة الجافة حيث كانت وزن المادة الجافة في تربة S_1 اكثر ب 8 مرات من وزن المادة الجافة للنبات المزروع في تربة (S_2)، كذلك اثرت نوعية المياه معنويا فى تركيز الايونات و الكلوروفيل في الذرة الصفراء.