Effect of different types of saline water on some chemical properties of gypsiferous soil

Ameer A. Jafaar[*], Rafal J. Mohammed[**] Diaa F. Hassan[***]
[*,] Coll. of Agriculture, [*,*,*]Water Recourses Engineering College**
AlQasim Green University
diaafliah87@gmail.com

ABSTRACT

This study selected a soil with a high gypsum content of 590 g.kg^{-1}. Different types of water were used: distilled water, river water and well water. The soil was leached by water at different levels as far as (WHC) Water Holding Capacity. It was leached once and twice and thrice taking into consideration the amount of the field capacity. Then the cations were measure the rate of leaching speed. The rate of leaching of ions for distilled water is higher than that of the river, which is higher than the well water.

The effect of leaching was studied with different saline water types and their different quantities In the leaching of saline gypsum Soil salinity was 11.6 ds.m^{-1} after leaching with the types of water, the salinity were 3.73, 4.95 and 9.01 ds.m^{-1} for distilled water, river water and Well water respectively, As for the effect of amount of water was found the salainity 7.83, 5.99 and 3.88 ds.m^{-1} when leaching in three W.H.C, two W.H.C and one W.H.C respectively.

Also we show the effect water quality and quantity on gypsum amount so we found that the amount of gypsum were 460, 503.3 and 533.3 g.kg^{-1} for distilled water, river water and well water respectively. As for the effect the amount of gypsum were 523.3, 500.0 and 473.3 g. kg^{-1} for one W.H.C, two W.H.C and three W.H.C respectively. As for the speed of leaching the ions it was found that the largest ions be magnesium, followed by calcium and sulfate, then bicarbonate, sodium and chloride, at 0.55, 0.50, 0.50, 0.52, 0.40 and 0.43) meq.l^{-1} respectively This is due to the bonding of these ions to make salts of different solubility.

Key wards: gypsum, chemical soil properties, Solubility gypsum, leaching soil.

تأثير انواع مختلفة من المياه المالحة على بعض الصفات الكيميائية للترب الجبسية

امير عدنان جعفر[*]، رفل جاسم محمد[**]، ضياء فليح حسن[***]
[*،]كليـــــة الزراعـــــة، [***]هندسة الموارد المائية**
جامعة القاسم الخضراء

الخلاصة

شملت الدراسة اختيار تربة ذات محتوى جبسي عالي يبلغ 590 غم.كغم$^{-1}$ كما استخدمت انواع مختلفة من المياه هي ماء مقطر وماء نهر وماء بئر وقد تم الغسل لهذه التربة بمستويات مختلفة بقدر قابلية التربة العظمى على مسك الماء (W.H.C) اذ غسلت بمقدار مره واحده ومرتين وثلاث مرات مع مراعاة مقدار السعة الحقلية بعد ذلك تم تقدير الايونات لقياس معدل سرعه غسلها اذ يتبين ان معدل سرعة غسل الايونات للماء المقطر اعلى من ماء النهر والذي بدوره اعلى من ماء البئر .

تم دراسة تأثير الغسل بنوعيات مياه مختلفة الملوحة وكمياتها المختلفة في غسل ملوحة الترب الجبسية اذ كانت ملوحة التربة الاصلية 11.6 ديسيسيمنز.م$^{-1}$ اما بعد غسل التربة فقد وجد ان كمية الملوحة انخفضت اذ بلغت 3.75 , 4.95 و 9.01 ديسيسيمنز.م$^{-1}$ عند الغسل بماء مقطر وماء نهر وبئر على التوالي كما بلغت كمية الملوحة 7.83 , 5.99 و 3.88

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ديسيسيمنز.م$^{-1}$ عند الغسل بمقدار مره واحده ومرتين وثلاث مرات من كمية (W.H.C) . اما كمية الجبس فقد كانت تقل ذوبانياتها مع زيادة ملوخة مياه الغسل اذ كانت كمياتها 460 , 503.3 و 533.3 غم.كغم$^{-1}$ عند الغسل بماء مقطر وماء نهر وبئر على التوالي كما بلغت كمية الجبس 523.3 , 500 و 473.3 غم.كغم$^{-1}$ عند الغسل بمقدار مره واحده ومرتين وثلاث مرات من كمية (W.H.C) .

اما بالنسبة لسرعة غسل الايون وجد ان اكبر الايونات غسلا هو المغنيسيوم يليه الكالسيوم والكبريتات ثم البيكاربونات بعدها الصوديوم واخرها الكلورايد اذ تم الغسل بمعدلات (0,55 , 0,50 , 0,50 , 0,52 , 0,40 , 0,43) مليمكافئ.لتر$^{-1}$ على التوالي ويعود السبب في هذا الترتيب الى ارتباط هذه الايونات لتكون املاح مختلفة الذوبان .

INTRODUCTION:

According to (12), gypsiferous soils are widespread in arid areas with an annual . precipitation less than about 400 mm and where sources of calcium sulfate exist. Globally they occupy about 85 million ha, 54.6% in Africa, 44.9% in Asia, 0.4% in Europe, and 0.1% in North America (22).

Understanding of the nature of transfer water and the soluable of gypsum soils is necessary, especially as these soils occupy a large area of Iraq, estimated at 88 thousand km^2 and cover about 20% of the total area of Iraq (4,20).

Gypsum soils with their gypsum content have a negative impact on plant's growth. Gypsum soils are defined as soils containing 2% gypsum or more in the surface layer, the subterranean layer should contain 14% or more of gypsum (25). (26 and 2) found that gypsum has an effect on the physical properties of soil, such as changing the types of soil Texture. In their study of some gypsum soils in the use of water types in the central area of Iraq, (24) revealed that the fresh water increases the gypsum solubility and the formation of sinks. (14), (6) and (10) ascertained that the water which contains salts which contain ion pairs with gypsum reduces the Solubility of gypsum. (26) found that Solubility of gypsum increases with high temperature, and a number of studies that have been carried out have shown that sprinkler irrigation has reduced the Solubility of gypsum compared to surface irrigation (9). Thus, several treatments for gypsum soil problems were found; The first is the quality of irrigation water and is determined by the presence of ion pairs($so4^{-2}$ or Ca^{+2}) as the Solubility of gypsum is inversely proportional to their percentage in this water. Noting the leaching of gypsum will be accompanied by leaching of the salts which are existing in these soils.The second And the quantities of this leaching are directly proportional with the increase of irrigation water salinity. As for the amount of irrigation water, the extravagance leads to the accumulation of salts in the soil (19). The amount of salts that will be removed from the soil by leaching depends mainly on the type of salt found in the soil and the speed of its solubility (5).

A study (1) shows that soil content of salts decreased from 75.50 $mmoh/cm^{-1}$ to 16.75$mmoh/cm^{-1}$ decreased at percentage 78%, and the soil content of the gypsum was significantly decreased from 14.75% to 6.65% with increasing water addition . As (3) explained during a discussion of several previous studies found that increasing the filtration of water inside the soil by increasing its content of gypsum because of its high solubility

The amount of soluble gypsum depends on a number of factors: first, the quantity of water and the speed of its flow, where (16) shows that the amount of soluble gypsum depends on the speed and quantity of running water wherein the amount of soluble gypsum within a certain period of

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time increases when the speed and quantity of water increase. Secondly the concentration of gypsum materials in water. The third factor is the form and distribution of gypsum in the soil, where (23) explained that the amount of soluble gypsum depends on the concentration of gypsum materials in the soil and the distribution method.

Generally, the amount of soluble gypsum increases with the increase of the surface area of the gypsum material exposed to running water currents (16) .

The current study aims at showing which ions are fastest leaching when leaching gypsum soil with different water types and different amount, as well as the extent of the impact of gypsum solubility when leaching with different types of water. Also we study effect water on salt leaching.

MATERALS AND METHODS: -

A laboratory experiment was carried out at the Faculty of Agriculture / Al-Qassim Green University. The soil of the study was selected on the basis of its gypsum content. It was selected from a site in the province of Najaf. The amount of gypsum was 590 $g.kg^{-1}$ and at a depth of 20 cm, this soil was transferred to the laboratory and dried and grinded by a 2 mm sieve. Some chemical and physical properties where measured for it.

As shown in a table (1), this soil was distributed in plastic columns with a length of 35 cm and a diameter of 5 cm in which 500 g of soil. The column was treated with three quantities of water (once as much as the maximum water holding capacity, twice as much as the maximum water holding capacity and thrice as much as the water holding capacity). With regard to getting the soil to the limits of field capacity. These quantities were selected from three types of water (distilled water, river water and well water), whose characteristics are shown in table (1).

Table (1) some properties of water and soil under the study.

Adjective	measuring unit	Soil of the study	Water River	Water well
Electrical conductivity	ds. m^{-1}	11.6	1.93	6.29
pH		8.14	7.8	8.1
Sand	g / kg	360		
Clay	g / kg	510		
Silt	g / kg	130		
Texure		Silt clay loam		
Calcium	Meq/L^{-1}	48.1	8.8	25.6
Magnesium	Meq/L^{-1}	31.6	7.4	20.4
Sodium	Meq/L^{-1}	57.5	6.7	27.3
Bicarbonates	Meq/L^{-1}	1.70	0.7	3.5
Chloride	Meq/L^{-1}	59.6	8.5	29.5
Sulfates	Meq/L^{-1}	69.7	11.7	33.6
Gypsum	$g.kg^{-1}$	590		

We used many factors in this study = three water quantities × three types of water × three replicates = 27 plastic columns. Statistical analysis was used CRD and the

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statistical program was used SPSS to find values LSD.

After the process of adding the water with its three different coefficients, the leachates were collected and some chemical properties were measured. The soil was removed from the column and the rates of gypsum, salinity, calcium, magnesium, sulfur, sodium, chloride and bicarbonate were measured. Soil salinity was calculated and discussed. By measuring the electrical conductivity (salinity) and the percentage of what was melted from gypsum by the types of water used for the study, and the speed of leaching the ions was calculated by equation:

Speed average of leaching ions = $\frac{\textit{concentration of ions after leaching}}{\text{concentration of ions before leaching}}$ **…..(1)**

3- RESULTS AND DESCUSSION

3-1 Effect of water quality in leaching salts: -

The water quality has a significant effect on the leaching of salts, as shown in the table (2) for all treatments . The salinity of the soil used in the study was 11.6. $ds.m^{-1}$. we found the significant effect for interaction between type of water and amount of water . After leaching the soil with one W.H.C it was 5.89 , 7.32 and 10.30 $ds.m^{-1}$ for distilled water , river water and well water respectively. But when leaching the soil with two W.H.C it was 3.89 , 4.86 and 9.24 $ds.m^{-1}$ for distilled water , river water and Well water respectively . also we leaching with three W.H.C it was 1.48 , 2.68 and 7.50 $ds.m^{-1}$ for distilled water , river water and Well water respectively this reason due to the impact by increasing the amount of leaching water, so available the leaching requirements for leaching the salts from the soil by leaching the repaid and slowly salt from soil by increasing water amount As he found it(14 , 27) .

As for the effect the amount of leached salts increases whenever the salinity of irrigation water decrease, we find that after leaching with the types of water, the salinity were 3.73 , 4.95 and 9.01 $ds.m^{-1}$ for distilled water , river water and Well water respectively That is Due to the different salts in their capacity to solubility and leaching. (5). As for the effect of amount of water was found the salinity 7.83, 5.99 and 3.88 $ds.m^{-1}$ when leaching in three W.H.C, two W.H.C and one W.H.C respectively , Highly saline soils should be leached using several applications so that the water can drain well. with increase water amount for leaching requirement to decrease salinity (18 and 11)

Table (2) Values of electrical conductivity (EC) according to the type of water and quantity of leaching.($ds.m^{-1}$).

nn	Wash with one W.H.C	Wash with two W.H.C	Wash in three W.H.C	Average
Distilled water	5.89	3.89	1.48	3.75
Water River	7.32	4.86	2.68	4.95
Water well	10.3	9.24	7.5	9.01
Average	7.83	5.99	3.88	
L.S.D WATER AMOUNT	1.75			
L.S.D (WATER TYPE)	1.35			
L.S.D	1.90			

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3-2 Effect of leaching by water types on gypsum content of soil

Table (3) shows the amount of gypsum for the studied soil was 590 g. kg^{-1}, which is very high. it was found that leaching with one W.H.C reduced the amount of gypsum to 490 g. kg^{-1} when leaching with distilled water, and 530 g. kg^{-1} when leaching with river water, and 550 g. kg^{-1} when leaching with well water. The amount of washed gypsum is increased when leaching with the in turn dissolved the amount of gypsum, was less than that of the distilled water so we found that the amount of gypsum were 460 , 503.3 and 533.3 $g.kg^{-1}$ for distilled water , river water and Well water respectively. It was also found a significant effect that increasing the amount of leaching water increases the amount of dissolved gypsum As for the effect the amount of second amount of W.H.C. After leaching with the third W.H.C, the amount of gypsum reached (420 g. kg^{-1}) when leaching with distilled water, (480 g. kg^{-1}) when leaching with river water and (520 g. kg^{-1}) when leaching with well water. It is clear from the above the amount of gypsum dissolved in the well water was less than the amount of gypsum dissolved by the river water, which

gypsum were 523.3 , 500.0 and 473.3 g. kg^{-1} for one W.H.C, two W.H.C and three W.H.C respectively (21) and (17).

This is due to the effect of the ion pairs . Since leaching water contain some salts which have a ion pairs(calcium and sulfur), it reduces the soluable of gypsum. These results are compatible with what had been reached by (6 and 10 and 14).

Table (3) the values of gypsum and its impact on the types of water used for leaching with its different quantities.

nn	Wash with one W.H.C	Wash with two W.H.C	Wash in three W.H.C	Average
Distilled water	490	470	420	460.0
River Water	530	500	480	503.3
well Water	550	530	520	533.3
Average	523.3	500.0	473.3	
L.S.D WATER AMOUNT	20			
L.S.D (WATER TYPE)	28			
L.S.D	22			

3-3 -Speed average of leaching ions by using the leaching water

Show in table (4) the speed average of leaching an ion in general, and for all ions, was reduced with the increase in the amount of leaching W.H.C. with increase amount of W.H.C added to the leach, quantities of Concentrations reached , 0.62 , 0.62 , 0.79 0.67 , 0.73 , 0.59 For ions Ca^{+2}, Mg^{+2}, Na^{+}, HCO_3 , Cl^{-} , SO_4^{-2} respectively When leaching one time of W.H.C, As has been reached 0.40, 0.40, 0.53, 0.37, 0.52, 0.53 for ions Ca^{+2}, Mg^{+2}, Na^{+} , HCO_3 , Cl^{-} , SO_4^{-2} respectively When leaching tow time of W.H.C, and reached 0.32 , 0.42 , 0.25 , 0.41, 0.27, 0.31 For ions Ca^{+2}, Mg^{+2}, Na^{+} , HCO_3 , Cl^{-} , SO_4^{-2} respectively When leaching three time of W.H.C.

Such as found that the salinity of leaching water effect in leaching and speeding ions,as

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it was found there was a significant effect where the amount of Calcium element were 0.50, 0.69, 0.84 while the amount of Magnesium element were 0.65, 0.73, 0.83 while the amount of Sodium element were 0.34, 0.46, 0.99, Carbonate were 0.29, 0.65, 0.94 while Cloride amount were 0.13, 0.39, 0.35 and Sulfate amount were 0.57, 0.81, 0.99 when leached with distilled water - river - well, respectively and leaching by W.H.C once also is for leaching twice and three times of W.H.C.when comparing the ions, the largest washed ions are found to be magnesium, followed by calcium and sulfate, then bicarbonate, sodium and chloride, at (0.55, 0.50, 0.50, 0.52, 0.40 and 0.43) respectively. This is due to the bonding of these ions to make salts of different solubility, thus the fastest solubility is the fastest leaching with irrigation water. The high capacity of the gypsum, the largest component of these soils, releases the calcium and magnesium ions. It was noted that the leaching was done by 0.79 when leaching with one W.H.C of sulfate and 0.67 for calcium. These results were similar to those of (5), (8) and (7), ions of calcium and sulfate showed different behavior for those of chloride and sodium. Concentration of calcium and sulfate increased with the increase of gypsum content, due to the soluable of gypsum (15).

Table (4) the effect of quantities and types of water in its capacity to affect the speed average of leaching ions.(meq.l^{-1}).

Used water quality	Ca^{+2}	Mg^{+2}	Na^{+}	Hco_3^{-}	Cl^{-}	SO_4^{-2}	
	Leaching with one W.H.C						
Distilled water	0.50	0.65	0.34	0.29	0.13	0.57	0.41
River water	0.69	0.73	0.46	0.65	0.39	0.81	0.62
Well water	0.84	0.83	0.99	0.94	1.35	0.99	0.99
Average	0.67	0.73	0.59	0.62	0.62	0.79	
	Leaching with two W.H.C						
Distilled water	0.33	0.41	0.19	0.24	0.11	0.31	0.26
River water	0.61	0.52	0.20	0.53	0.26	0.35	0.41
well water	0.65	0.64	0.74	0.82	0.85	0.75	0.74
Average	0.53	0.52	0.37	0.53	0.40	0.40	
	Leaching with three W.H.C						
Distilled water	0.14	0.32	0.04	0.12	0.08	0.09	0.13
River water	0.22	0.40	0.17	0.47	0.19	0.28	0.28
well water	0.60	0.55	0.56	0.65	0.55	0.58	0.58
Average	0.32	0.42	0.25	0.41	0.27	0.31	
Average of three leachings	0.50	0.55	0.40	0.52	0.43	0.50	
L.S.D	0.90						

CONCLUSION:

this study shows that the best quality of water is the river water in the leaching of ions. In the soluble of gypsum, the well water was less effective in soluble gypsum so it is possible to use the well water with a leaching requirements to avoid leaching the ions the necessary for plant such as magnesium. There is also an advantage in the use of water wells to reduce the sink hole when leaching these soils.

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