EFFECT OF SOME NUTRIENTS MANAGEMENT PRACTICES AND LEACHING REQUIREMENTS ON SOIL QUALITY AND PRODUCTIVITY OF SORGHUM GROWN IN A SALT -AFFECTED SOIL

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ABSTRACT

A field experiment was conducted at the research station of the Ministry of Agriculture in Abu Ghraib area –Baghdad, Iraq, to study the effect of applying some nutrients management practices and leaching requirements on some soil quality indicators and sorghum productivity under saline soil conditions. The experiment was laid out in randomized complete block design (RCBD) with split split plot arrangement and three replicates. Treatments included 7 nutrients combinations :(Control” F_0”, NPK” F_1”, NPKS” F_2”, NPKS + micronutrients”F_3”, NPKS+ micronutrients+ Nano silicon” F_4”, NPKS+ micronutrients + Nano silicon + calcium and magnesium nitrate” F_5”, NPKS + micronutrients + Nano silicon + potassium humates” F_6”, two leaching requirements: standard leaching requirements (L_1) and doubled leaching requirements (L_2)) and two sorghum varieties: Al-Khair synthetic variety (C_1) and Rabeh synthetic variety(C_2). The results showed that fertilizer treatments had a very important role in the availability of nutrients in the soil, where treatment F_6 exceeded other treatments in flowering stage in increase the availability of (N,P and Si) (48.0, 32.43and 17.45 mg Kg^{-1}) respectively, as well as in after harvest stage treatment F_6 exceeded the other treatments in increase the availability of (N,K,Fe and Si) (26.9, 293.8, 3.21 and 15.49 mg Kg^{-1}) respectively. Doubled leaching requirements (L_2) exceeded (L_1), which led to reducing the amount of NaCl salts in the soil for the depth of (25-50 cm). Proper nutrients management practices could improve soil properties, increase the availability of nutrients, and improve plant tolerance to abiotic stress such as soil salinity.

Keywords : soil chemical properties , available soil nutrients ,(*Sorghum bicolor* L.), grain yield
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تأثير بعض عمليات أدارة المغذيات المختلفة ومتطلبات الغسل في نوعية التربة وانتاجية الذرة البيضاء المزروعة في تربة متأثرة بالملوحة

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المستخلص

تم أجراء تجربة حقلية في محطة البحوث التابعة لوزارة الزراعة في منطقة أبي غريب– بغداد، العراق لدراسة تأثير تطبيق بعض عمليات أدارة المغذيات ومتطلبات الغسل في بعض مؤشرات نوعية التربة وإنتاجيه الذرة البيضاء تحت ظروف تربة ملحية. نفذت التجربة وفق تصميم القطاعات التامة التعشية RCBD بترتيب الألواح المنشقة المنشقة (Split split plot arraignment) وبثلاثة مكررات. تضمنت المعاملات 7 توليفات سماديه: (المقارنة'' F_0'' و NPK '' F_1''و NPKS'' F_2 '' وNPKS+ مغذيات صغرى F_3 وNPKS+ مغذيات صغرى + سيليكون نانو F_4 وNPKS+ مغذيات صغرى + نترات الكالسيوم والمغنسيوم'' F_5 '' وNPKS+ مغذيات صغرى + هيومات البوتاسيوم F_6 ، ومستويين من متطلبات الغسل: متطلبات غسل اعتياديه (L_1) ومتطلبات غسل مضاعفة (L_2)، وصنفين من الذرة البيضاء: الصنف التركيبين الخير (C_1) و رابح (C_2). أظهرت النتائج أن لعمليات إدارة المغذيات دور مهم في جاهزية المغذيات في التربة، ففي مرحلة التزهير تفوقت المعاملة F_6 على بقية المعاملات في زيادة جاهزية كل من (N,P,Si) بمتوسط (48.00 و32.43 و17.45 ملغم كغم$^{-1}$) على التوالي ، كذلك في مرحلة بعد الحصاد فقد تفوقت المعاملة F_6 على بقية المعاملات في زيادة جاهزية كل من (N,K,Fe,Si) بمتوسط (26.9 و293.8 و3.21 و15.49 ملغم كغم$^{-1}$) على التوالي. تفوقت معاملة متطلبات الغسل المضاعفة (L_2) على متطلبات الغسل الاعتيادية (L_1)، أذ أدت الى خفض كمية أملاح كلوريد الصوديوم (NaCl) في التربة للعمق (25– 50 سم). أن عمليات إدارة المغذيات المناسبة يمكن أن تحسّن صفات التربة وتزيد من جاهزية المغذيات فيها وتحسن من تحمل النبات للإجهادات غير الحيوية كملوحة التربة.

الكلمات المفتاحية: صفات التربة الكيميائية، مغذيات التربة الجاهزة، الذرة البيضاء ، حاصل الحبوب.
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INTRODUCTION

Crop plants are subject to many different biotic and abiotic stresses, which can be natural or as a result of human intervention. Soil salinity is one of the abiotic stress and a global threat to food security, and one of the causes of land desertification, especially in arid and semi-arid regions. More than 20% of agricultural lands around the world are adversely affected by high concentrations of salts as a result of natural factors and human activities (34). Soil salinity can be consider as the most factor limiting the agricultural production in Iraq especially for strategic crops production (29). The high concentration of salts in the root zone significantly limits agricultural production in most regions of the world, this coincide with the increase in population around the world which causes high pressure on fertile agricultural lands. Therefore , an urgent action needed for good management practices in order to sustain and improve agricultural production, especially when reclamation projects are not available or expensive. In general, most field and horticultural crop plants grow better and have better tolerance to various stresses if they have certain nutrient management (25). Nutrients play a vital role in all stages of plant growth, and this means that low-fertility soils will be subjected to nutritional stress associated with other stresses and thus impaired growth and a decrease in productivity both quantitatively and qualitatively (14). Iraq is one of the countries that suffer from a lack and deficiency of macro (N & P) and micronutrients due to high carbonates and pH and low soil organic matter, and a harsh environment (4, 29) found that micronutrient fertilization has an important role in improving plant growth and metabolic processes, as well as improving the quantitative and qualitative yield. Several fertilizer management methods can be used to reduce the negative impact of various stresses, including salt stress (14, 20). Among these methods are the addition of organic fertilizers, fertilizers containing calcium and magnesium, as well as the addition of fertilizers containing silicon. The addition of silicon (to the soil or by foliar) from good and safe sources and at the right concentration can increase the plant's tolerance to salt stress, by inhibiting the absorption of sodium and chloride, regulating water relations and the balance of nutrients in the plant and improving the photosynthesis process (17, 43). The addition of organic fertilizers and Humic acids also has an important role in improving various soil qualities, especially water qualities, and increasing the tolerance of plants to moisture and salt stresses (3, 13, 26). Sorghum is the 5th most important cereal crop in the world after wheat, barley, rice, and maize, and it is characterized by its need for less water and its tolerance to climate changes compared to other cereal crops (9) .Sorghum plays a leading role in ensuring food security for more than half a billion people in Asia and Africa. This crop is mainly cultivated for fodder or for seed production (22). Sorghum can withstand abiotic stress fairly well (39). Although sorghum has the ability to produce under suboptimal climatic conditions, it is not immune to biotic and abiotic stresses. In order to increase the amount of production per unit area of this crop, there must be balanced additions of plant nutrients, because the balanced addition of macronutrients and micronutrients led to a significant increase in the yield of sorghum and improved the absorption of nitrogen, phosphorus and potassium and the fertilizer use efficiency (38). Therefore this experiment was aimed to study the effect of some Nutrients Management Practices and Leaching Requirements on Soil Quality and Productivity of Sorghum under saline conditions.

MATERIALS AND METHODS

A field experiment was conducted at the Ministry of Agriculture research station in Abu Ghraib area located within the latitude 33^{o}19'30.61" north and longitude 44^{o}12'45.75" east, to investigate tolerance of two sorghum (*Sorghum bicolor* L.) varieties to salinity using different nutritional practices and two leaching requirements during the spring season 2022 in sedimentary loam soil . The design of the field experiment was randomized complete block design RCBD with split split plot arrangement with three replicates (2). The sorghum varieties placed at the main plots and leaching requirements placed at the sub-plots and the fertilization treatments placed at the sub-sub plots. Some physical, chemical and fertility properties of the studied soil before planting and after harvest were determined in the laboratories of soil research department of office of agricultural researches/ Ministry of Agriculture, according to the methods described by researchers (8, 17, 28, 31, 35). Results of soil properties before planting presented in (Table 1).

Treatments:

1- Main plots represents sorghum variety (**C**) (Al-Khair synthetic variety (C_1) and Rabeh synthetic variety (C_2).

2- sub-plots represents the leaching requirements(**LR**) (normal leaching requirements (L_1) and double leaching requirements (L_2).

3-sub-sub-plots represents the fertilization treatments (**F**) which were (Control, NPK, NPKS, NPKS +micronutrients, NPKS+ micronutrients+ Nano silicon, NPKS+ micronutrients + Nano silicon + calcium and magnesium nitrate, NPKS + micronutrients + Nano silicon + potassium Humate) which were given the codes (F_0, F_1, F_2, F_3, F_4, F_5 and F_6), respectively.

Table 1. some physical, chemical and fertility properties of the study soil

property		Value	Unit
pH		7.3	-
ECe		7.0	dS m^{-1}
CEC		13.9	C mol $_+$ Kg^{-1} soil
SOM		9.4	g Kg^{-1} Soil
Dissolved ions			
CO_3^{2-}		Nill	mmol L^{-1}
HCO_3^-		2.0	
SO_4^{2-}		11.1	
Cl^-		50.0	
Ca^{2+}		18.75	
Mg^{2+}		11.0	
Na^+		13.21	
Available Nutrients			
N		30.0	mg Kg^{-1}Soil
P		11.5	
K		267.0	
Fe		2.6	
Mn		2.1	
Cu		0.85	
Zn		0.93	
B		1.1	
Si		16.55	
Particle size distribution (PSD)	sand	384	g Kg^{-1}soil
	Silt	452	
	Clay	164	
Texture		Loam	

Sorghum seeds were sown according to sowing quantity of 16 kg ha^{-1} on 20/3/2022 and the planting was carried out on lines with 75cm between lines and in holes with 20 cm within lines. Sorghum seeds were sown according to sowing quantity of 16 kg ha^{-1} on 20/3/2022 and the planting was carried out on lines with 75cm between lines and in holes with 20 cm within lines. The irrigation was carried out by drip irrigation, and the leaching requirements were calculated using the equation given in (32):

$$LR = \frac{ECW}{5(ECe) - ECW}$$

LR: leaching requirements, ECW: salinity of irrigation water (dS m^{-1}),ECe: electrical conductivity of the saturated paste extract(which leads to a loss of 10% of the yield for a particular crop). Mineral fertilizers, at the recommended rates, for Sorghum plants were used. Di-ammonium phosphate (23% P) was added at a rate of 50 Kg P ha^{-1} one time after 20 days from germination, Urea (46% N) was added at a rate of 140 kg N ha^{-1} , Potassium sulfate (42% K) was added at rates of 100 kg K ha^{-1} three times after 20, 50 days after germination “DAG”and at flowering stage (4). 20 kg S ha^{-1} was added in the form of a compound fertilizer containing 20% S in one batch after 20 days after germination “DAG”, calcium nitrate was added at 20 kg ha^{-1} and magnesium nitrate at 20 kg ha^{-1} in three splits (10, 25 and 40 days DAG), these fertilizers were added on lines 10 cm away from the planting line and 10 cm depth. Silicon Nano-fertilizer of 16 liters ha^{-1} was also added in three batches (30, 50 and 70 DAG). Micronutrients fertilizers were added at 10 kg Fe ha^{-1} (Fe-EDDHA 3.5% Fe), 5 kg Zn ha^{-1}(Zn-EDTA 3.9% Zn), 1 kg B ha^{-1} (B-EDTA 3% B), 8 kg Mn ha^{-1} (Mn-HEEDTA 13% Mn) and 2.5 kg Cu ha^{-1} (Cu-EDTA 14% Cu) in two batches during vegetative growth and at the beginning of the flowering phase. Potassium Humates (12% K_2O) was added by 40 kg ha^{-1} in two batches during vegetative growth and at the beginning of the flowering phase, the addition was with irrigation water (5, 34). Crop harvest was carried out on 18/07/2022 when the crop was fully ripened. Five plants were taken randomly from the midline for each treatment to determine the grain yield. All management practices for crops and water were done as required using standard methods.

Soil samples were collected to determine soil quality indicators : soil salinity and NaCl in root zone for the depth of (0-25 & 25-50 cm) and nutrients availability in soil at flowering stage and after harvest.

RESULTS AND DISCUSSION

Table.2. shows that the application of some managements practices of plant nutrients (ferti lizing treatments and leaching requirements) reduced soil salinity at the end of the agricultural season (post-harvest stage) than the beginning of the agricultural season, but this effect was not significant, where the treatment (L_1F_5) of (C_2) variety followed by the treatment (L_1F_5) of (C_1) variety, exceeded in the reduction of soil salinity after harvest, which amounted to 3.08 and 3.68 dS m^{-1}, respectively compared to the beginning of the agricultural season. Obviously, the decrease was obvious between the two leaching treatments, as the increase in the amount of water reduced the salinity. The effect of leaching was obvious at the post-harvest stage as a result of the absorption of nutrients or their loss by the processes of loss and continuous leaching. The F_5 treatment seems to have a lower salinity (electrical conductivity EC) than others, especially in the treatment $L_1F_5C_1$ and $L_1F_5C_2$, which indicates the importance of adding calcium and magnesium nitrate in reducing soil salinity by balancing and replacing sodium with calcium and magnesium and improving plant growth through the addition of nitrates (27,1).

Table 2. Effect of different nutrients management practices and leaching requirements on soil salinity (EC, dS m^{-1}) after harvest

C	L	F0	F1	F2	F3	F4	F5	F6	C * L	
C1	L1	5.36	6.30	6.11	5.46	5.49	3.68	4.69	5.30	
	L2	4.04	3.84	3.67	4.89	5.16	5.24	4.17	4.43	
C2	L1	4.74	4.91	4.18	4.92	4.52	3.08	4.35	4.39	
	L2	4.61	4.40	4.43	4.15	5.85	4.50	5.21	4.74	
LSD $_{C*L*F}$					N.S				LSD $_{C*L}$	N.S
					C * F					
C		F0	F1	F2	F3	F4	F5	F6	Mean (C)	
C1		4.70	5.07	4.89	5.17	5.33	4.46	4.43	4.86	
C2		4.67	4.66	4.30	4.53	5.18	3.79	4.78	4.56	
LSD $_{C*F}$					N.S				LSD $_C$	N.S
					L * F					
L		F0	F1	F2	F3	F4	F5	F6	Mean(L)	
L1		5.05	5.61	5.14	5.19	5.00	3.38	4.52	4.84	
L2		4.32	4.12	4.05	4.52	5.51	4.87	4.69	4.58	
LSD $_{L*F}$					N.S				LSD $_L$	N.S
					F					
F		F0	F1	F2	F3	F4	F5	F6		
Mean (F)		4.69	4.86	4.60	4.85	5.26	4.13	4.61		
LSD $_F$					N.S					

Table 3 and 4, shows that the treatment of leaching requirements has significantly affected the amount of sodium chloride salts in the soil at a depth of (25-50 cm) only, where the Level (L_2) exceeded the level (L_1) in reducing the amount of sodium chloride salts, which were 7.81 and 12.71 mmol L^{-1} for levels (L_2) and (L_1) respectively, this may be due to the role of leaching requirements, which are one of the main means of controlling soil salinity, which leaching salts down of the root zone (37). While (Tables 3-4) show that the rest of the treatments and their interactions did not significantly affect the amount of sodium chloride salts in soil. Tables 5 - 22 indicate that fertilization treatment significantly affected the availability of all nutrients in the soil at both stages. This increase can be because all these nutrients were included in most treatments in addition to Humic acids, silicon in regulating soil fertility (17, 21), and the role of potassium Humates (which contains Humic and fulvic acids), in improving the physical, chemical and fertility qualities of soils, which is reflected in increasing the availability of all nutrients (33, 3, 7). Also, the leaching requirements play a role in reducing soil salinity (Tables 1-3) and improving nutrients in soil, especially nitrogen (30). It can be clear that values were higher at the flowering stage compared to harvest and this can be attributed to crop plant uptake. Other treatments such as leaching and variety did not have a clear effect on nutrient availability in soil. From these results, one can see the effect of mineral and organic fertilizers applications on increasing nutrient availability in soil especially at a flowering stage which is very important for good crop productivity. These effects were due to using good and proper fertilizers sources especially micronutrients that are most convenient to soil conditions (i.e. chelates) (8, 18). Values of available N, P, and K at the flowering stage reached 48.40 mg N kg^{-1},32.43 mg P kg^{-1} Soil, and >300 mg K kg^{-1} soil which can be considered as good to ensure high productivity (5).

Table 3. Effect of different nutrients management practices and leaching requirements on NaCl (m mol L^{-1}) in root zone for the depth of (0-25 cm)

C	L	F0	F1	F2	F3	F4	F5	F6	C * L
C1	L1	7.00	10.00	8.33	6.00	8.00	4.00	4.00	6.76
	L2	4.67	5.00	6.67	7.67	5.33	4.00	5.33	5.52
C2	L1	6.33	6.33	5.67	8.67	7.67	6.33	9.33	7.19
	L2	7.67	6.00	7.33	6.67	9.33	8.67	7.33	7.57
LSD $_{C*L*F}$					N.S				LSD $_{C*L}$ N.S
					C * F				
C		F0	F1	F2	F3	F4	F5	F6	Mean (C)
C1		5.83	7.50	7.50	6.83	6.67	4.00	4.67	6.14
C2		7.00	6.17	6.50	7.67	8.50	7.50	8.33	7.38
LSD $_{C*F}$					N.S				LSD $_{C}$ N.S
					L * F				
L		F0	F1	F2	F3	F4	F5	F6	Mean (L)
L1		6.67	8.17	7.00	7.33	7.83	5.17	6.67	6.98
L2		6.17	5.50	7.00	7.17	7.33	6.33	6.33	6.55
LSD $_{L*F}$					N.S				LSD $_{L}$ N.S
					F				
F		F0	F1	F2	F3	F4	F5	F6	
Mean (F)		6.42	6.83	7.00	7.25	7.58	5.75	6.50	
LSD $_{F}$					N.S				

Table 4. Effect of different nutrients management practices and leaching requirements on NaCl (m mol L^{-1}) in root zone for the depth of (25-50 cm)

C	L	F0	F1	F2	F3	F4	F5	F6	C * L
C1	L1	20.67	12.00	17.67	10.33	13.00	10.67	12.33	13.81
	L2	4.00	6.67	6.33	9.33	14.33	8.33	7.33	8.05
C2	L1	11.33	11.33	9.33	14.00	11.33	10.00	14.00	11.62
	L2	7.67	5.67	8.33	8.00	12.67	4.67	6.00	7.57
LSD $_{C*L*F}$					N.S				LSD $_{C*L}$ N.S
					C * F				
C		F0	F1	F2	F3	F4	F5	F6	Mean (C)
C1		12.33	9.33	12.00	9.83	13.67	9.50	9.83	10.93
C2		9.50	8.50	8.83	11.00	12.00	7.33	10.00	9.60
LSD $_{C*F}$					N.S				LSD $_{C}$ N.S
					L * F				
L		F0	F1	F2	F3	F4	F5	F6	Mean (L)
L1		16.00	11.67	13.50	12.17	12.17	10.33	13.17	12.71
L2		5.83	6.17	7.33	8.67	13.50	6.50	6.67	7.81
LSD $_{L*F}$					N.S				LSD $_{L}$ 2.44
					F				
F		F0	F1	F2	F3	F4	F5	F6	
Mean (F)		10.92	8.92	10.42	10.42	12.83	8.42	9.92	
LSD $_{F}$					N.S				

Table 5. Effect of different nutrients management practices on available soil (N) at flowering stage (mg N kg^{-1})

C	L	F0	F1	F2	F3	F4	F5	F6	C * L
C1	L1	22.10	51.50	49.10	41.60	53.10	47.90	48.10	44.80
	L2	23.90	43.90	50.60	44.40	30.70	31.90	46.40	38.80
C2	L1	24.20	47.70	43.80	34.40	44.90	48.30	56.90	42.90
	L2	24.60	50.60	46.70	36.70	42.20	47.70	40.80	41.30
LSD $_{C*L*F}$					N.S				LSD $_{C*L}$ N.S
					C * F				
C		F0	F1	F2	F3	F4	F5	F6	Mean (C)
C1		23.00	47.70	49.80	43.00	41.90	39.90	47.20	41.80
C2		24.40	49.20	45.30	35.60	43.60	48.00	48.90	42.10
LSD $_{C*F}$					N.S				LSD $_C$ N.S
					L * F				
L		F0	F1	F2	F3	F4	F5	F6	Mean (L)
L1		23.10	49.60	46.40	38.00	49.00	48.10	52.50	43.80
L2		24.20	47.30	48.70	40.50	36.40	39.80	43.60	40.10
LSD $_{L*F}$					N.S				LSD $_L$ N.S
					F				
F		F0	F1	F2	F3	F4	F5	F6	LSD $_F$ 8.27
Mean (F)		23.70	48.40	47.50	39.30	42.70	44.00	48.00	

Table 6. Effect of different nutrients management practices on available soil (N) after harvest (mg N kg^{-1})

C	L	F0	F1	F2	F3	F4	F5	F6	C * L
C1	L1	10.52	26.42	24.73	24.36	26.88	25.61	26.25	23.54
	L2	16.07	25.11	26.90	23.99	19.80	19.37	24.09	22.19
C2	L1	15.98	25.14	22.84	18.54	21.16	27.54	30.22	23.06
	L2	15.17	27.50	24.92	18.76	20.90	24.40	27.05	22.67
LSD $_{C*L*F}$					4.38				LSD $_{C*L}$ N.S
					C * F				
C		F0	F1	F2	F3	F4	F5	F6	Mean (C)
C1		13.29	25.76	25.82	24.18	23.34	22.49	25.17	22.86
C2		15.57	26.32	23.88	18.65	21.03	25.97	28.63	22.86
LSD $_{C*F}$					3.42				LSD $_C$ N.S
					L * F				
L		F0	F1	F2	F3	F4	F5	F6	Mean (L)
L1		13.25	25.78	23.79	21.45	24.02	26.58	28.24	23.30
L2		15.62	26.31	25.91	21.38	20.35	21.88	25.57	22.43
LSD $_{L*F}$					2.92				LSD $_L$ N.S
					F				
F		F0	F1	F2	F3	F4	F5	F6	LSD $_F$ 1.96
Mean (F)		14.43	26.04	24.85	21.41	22.19	24.23	26.90	

Table 7. Effect of different nutrients management practices on available soil (P) at flowering stage (mg P kg^{-1})

C	L	F0	F1	F2	F3	F4	F5	F6	C * L
C1	L1	12.20	34.17	31.90	30.13	27.50	32.22	31.40	28.50
	L2	12.10	29.24	30.53	33.63	29.03	27.23	33.47	27.89
C2	L1	10.41	30.37	28.67	30.77	30.45	34.83	30.17	27.95
	L2	12.90	32.80	30.80	31.23	31.10	33.20	34.70	29.53
LSD $_{C*L*F}$					N.S				LSD $_{C*L}$ N.S
					C * F				
C		F0	F1	F2	F3	F4	F5	F6	Mean (C)
C1		12.15	31.70	31.22	31.88	28.27	29.72	32.43	28.20
C2		11.65	31.58	29.73	31.00	30.77	34.02	32.43	28.74
LSD $_{C*F}$					N.S				LSD $_C$ N.S
					L * F				
L		F0	F1	F2	F3	F4	F5	F6	Mean (L)
L1		11.30	32.27	30.28	30.45	28.97	33.52	30.78	28.23
L2		12.50	31.02	30.67	32.43	30.07	30.22	34.08	28.71
LSD $_{L*F}$					2.76				LSD $_L$ N.S
					F				
F		F0	F1	F2	F3	F4	F5	F6	LSD $_F$ 1.97
Mean (F)		11.90	31.64	30.47	31.44	29.52	31.87	32.43	

Table 8. Effect of different nutrients management practices on available soil (P) after harvest (mg P kg^{-1})

C	L	F0	F1	F2	F3	F4	F5	F6	C * L
C1	L1	7.57	20.53	21.93	21.77	17.60	20.17	20.67	18.60
	L2	8.75	21.10	22.30	24.37	21.23	18.53	21.03	19.62
C2	L1	8.65	19.57	20.17	21.70	21.53	21.85	21.20	19.24
	L2	8.50	22.93	19.07	22.63	20.80	20.73	22.80	19.64
LSD C*L*F					N.S				LSD C*L N.S
					C * F				
C		F0	F1	F2	F3	F4	F5	F6	Mean (C)
C1		8.16	20.82	22.12	23.07	19.42	19.35	20.85	19.11
C2		8.58	21.25	19.62	22.17	21.17	21.29	22.00	19.44
LSD C*F					2.10				LSD C N.S
					L * F				
L		F0	F1	F2	F3	F4	F5	F6	Mean (L)
L1		8.11	20.05	21.05	21.73	19.57	21.01	20.93	18.92
L2		8.63	22.02	20.68	23.50	21.02	19.63	21.92	19.63
LSD L*F					1.69				LSD L N.S
					F				
F		F0	F1	F2	F3	F4	F5	F6	LSD F 1.13
Mean (F)		8.37	21.03	20.87	22.62	20.29	20.32	21.43	

Table 9. Effect of different nutrients management practices on available soil (K) at flowering stage (mg K kg^{-1})

C	L	F0	F1	F2	F3	F4	F5	F6	C * L
C1	L1	276.3	300.3	295.7	287.3	309.0	317.0	318.0	300.5
	L2	261.0	325.0	330.3	340.0	346.3	295.7	322.3	317.2
C2	L1	263.7	315.0	318.3	367.0	319.3	307.3	327.0	316.8
	L2	273.3	333.3	331.3	336.0	313.7	351.7	335.3	325.0
LSD C*L*F					37.6				LSD C*L N.S
					C * F				
C		F0	F1	F2	F3	F4	F5	F6	Mean (C)
C1		268.7	312.7	313.0	313.7	327.7	306.3	320.2	308.9
C2		268.5	324.2	324.8	351.5	316.5	329.5	331.2	320.9
LSD C*F					N.S				LSD C N.S
					L * F				
L		F0	F1	F2	F3	F4	F5	F6	Mean (L)
L1		270.0	307.7	307.0	327.2	314.2	312.2	322.5	308.7
L2		267.2	329.2	330.8	338.0	330.0	323.7	328.8	321.1
LSD L*F					N.S				LSD L 8.6
					F				
F		F0	F1	F2	F3	F4	F5	F6	LSD F 18.8
Mean (F)		268.6	318.4	318.9	332.6	322.1	317.9	325.7	

Table 10. Effect of different nutrients management practices on available soil (K) after harvest (mg K kg^{-1})

C	L	F0	F1	F2	F3	F4	F5	F6	C * L
C1	L1	234.0	245.7	243.0	240.0	258.3	267.3	283.3	253.1
	L2	232.0	272.7	283.0	298.3	291.7	276.3	297.7	278.8
C2	L1	235.3	284.0	287.3	297.0	288.7	272.3	295.7	280.0
	L2	248.3	293.0	287.7	293.3	292.0	298.7	298.7	287.4
LSD C*L*F					N.S				LSD C*L 22.8
					C * F				
C		F0	F1	F2	F3	F4	F5	F6	Mean (C)
C1		233.0	259.2	263.0	269.2	275.0	271.8	290.5	266.0
C2		241.8	288.5	287.5	295.2	290.3	285.5	297.2	283.7
LSD C*F					N.S				LSD C N.S
					L * F				
L		F0	F1	F2	F3	F4	F5	F6	Mean (L)
L1		234.7	264.8	265.2	268.5	273.5	269.8	289.5	266.6
L2		240.2	282.8	285.3	295.8	291.8	287.5	298.2	283.1
LSD L*F					N.S				LSD L 6.2
					F				
F		F0	F1	F2	F3	F4	F5	F6	LSD F 14.6
Mean (F)		237.4	273.8	275.2	282.2	282.7	278.7	293.8	

Table 11. Effect of different nutrients management practices on available soil (Fe) at flowering stage (mg Fe kg^{-1})

C	L	F0	F1	F2	F3	F4	F5	F6	C * L	
C1	L1	1.42	1.42	1.43	5.14	4.56	4.92	5.17	3.44	
	L2	1.78	2.07	1.96	5.15	5.13	5.29	4.78	3.74	
C2	L1	2.23	1.97	2.07	4.99	4.94	4.36	4.73	3.61	
	L2	2.33	2.19	2.08	4.57	4.91	4.39	4.50	3.57	
LSD C*L*F					N.S				LSD C*L	N.S
					C * F					
C		F0	F1	F2	F3	F4	F5	F6	Mean (C)	
C1		1.60	1.75	1.70	5.15	4.85	5.11	4.98	3.59	
C2		2.28	2.08	2.08	4.78	4.92	4.37	4.62	3.59	
LSD C*F					0.37				LSD C	N.S
					L * F					
L		F0	F1	F2	F3	F4	F5	F6	Mean (L)	
L1		1.83	1.70	1.75	5.06	4.75	4.64	4.95	3.53	
L2		2.06	2.13	2.02	4.86	5.02	4.84	4.64	3.65	
LSD L*F					0.39				LSD L	N.S
					F					
F		F0	F1	F2	F3	F4	F5	F6	LSD F	0.26
Mean (F)		1.94	1.91	1.89	4.96	4.88	4.74	4.80		

Table 12. Effect of different nutrients management practices on available soil (Fe) after harvest (mg Fe kg^{-1})

C	L	F0	F1	F2	F3	F4	F5	F6	C * L	
C1	L1	1.09	1.67	0.71	3.47	2.77	3.36	3.13	2.32	
	L2	1.24	1.44	1.22	3.07	3.30	3.50	3.25	2.43	
C2	L1	1.40	0.97	0.93	2.96	3.01	2.56	3.15	2.14	
	L2	1.08	0.95	0.97	2.56	2.73	2.80	3.31	2.06	
LSD C*L*F					N.S				LSD $_{C*L}$	N.S
					C * F					
C		F0	F1	F2	F3	F4	F5	F6	Mean (C)	
C1		1.17	1.55	0.97	3.27	3.03	3.43	3.19	2.37	
C2		1.24	0.96	0.95	2.76	2.87	2.68	3.23	2.10	
LSD C*F					0.39				LSD $_{C}$	N.S
					L * F					
L		F0	F1	F2	F3	F4	F5	F6	Mean (L)	
L1		1.24	1.32	0.82	3.22	2.89	2.96	3.14	2.23	
L2		1.16	1.19	1.09	2.81	3.02	3.15	3.28	2.24	
LSD L*F					N.S				LSD L	N.S
					F					
F		F0	F1	F2	F3	F4	F5	F6	LSD F	0.26
Mean (F)		1.20	1.26	0.96	3.01	2.95	3.06	3.21		

Table 13. Effect of different nutrients management practices on available soil (Mn) at flowering stage (mg Mn kg^{-1})

C	L	F0	F1	F2	F3	F4	F5	F6	C * L	
C1	L1	1.29	1.28	1.12	2.51	2.60	2.52	2.25	1.94	
	L2	1.19	1.15	1.04	2.20	2.55	2.56	2.78	1.92	
C2	L1	0.87	1.20	1.07	2.78	2.91	2.49	2.05	1.91	
	L2	1.07	1.27	1.18	2.85	2.91	3.05	2.87	2.17	
LSD $_{C*L*F}$					N.S				LSD $_{C*L}$	N.S
					C * F					
C		F0	F1	F2	F3	F4	F5	F6	Mean (C)	
C1		1.24	1.22	1.08	2.35	2.57	2.54	2.52	1.93	
C2		0.97	1.23	1.12	2.82	2.91	2.77	2.46	2.04	
LSD $_{C*F}$					N.S				LSD $_{C}$	N.S
					L * F					
L		F0	F1	F2	F3	F4	F5	F6	Mean (L)	
L1		1.08	1.24	1.10	2.65	2.75	2.51	2.15	1.93	
L2		1.13	1.21	1.11	2.53	2.73	2.81	2.82	2.05	
LSD $_{L*F}$					N.S				LSD $_{L}$	N.S
					F					
F		F0	F1	F2	F3	F4	F5	F6	LSD $_{F}$	0.26
Mean (F)		1.10	1.23	1.10	2.59	2.74	2.66	2.49		

Table 14. Effect of different nutrients management practices on available soil (Mn) after harvest (mg Mn kg^{-1})

C	L				F				C * L	
		F0	F1	F2	F3	F4	F5	F6		
C1	L1	0.84	0.71	0.61	1.43	1.53	1.44	1.27	1.12	
	L2	0.54	0.46	0.47	1.07	1.65	1.67	1.72	1.08	
C2	L1	0.55	0.57	0.67	1.80	2.31	1.73	1.35	1.28	
	L2	0.52	0.70	0.54	2.58	1.56	2.00	1.73	1.38	
LSD_{C*L*F}					N.S				LSD_{C*L}	N.S
					C * F					
C		F0	F1	F2	F3	F4	F5	F6	Mean (C)	
C1		0.69	0.59	0.54	1.25	1.59	1.56	1.50	1.10	
C2		0.54	0.64	0.61	2.19	1.93	1.87	1.54	1.33	
LSD_{C*F}					N.S				LSD_{C}	N.S
					L * F					
L		F0	F1	F2	F3	F4	F5	F6	Mean (L)	
L1		0.70	0.64	0.64	1.61	1.92	1.59	1.31	1.20	
L2		0.53	0.58	0.51	1.83	1.60	1.83	1.73	1.23	
LSD_{L*F}					N.S				LSD_{L}	N.S
					F					
F		F0	F1	F2	F3	F4	F5	F6	LSD_{F}	0.42
Mean (F)		0.61	0.61	0.58	1.72	1.76	1.71	1.52		

Table 15. Effect of different nutrients management practices on available soil (Zn) at flowering stage (mg Zn kg^{-1})

C	L				F				C * L	
		F0	F1	F2	F3	F4	F5	F6		
C1	L1	0.55	0.53	0.60	2.95	3.13	2.96	2.58	1.90	
	L2	0.70	0.40	0.73	3.10	3.15	3.37	2.98	2.06	
C2	L1	0.85	0.81	0.42	2.93	2.85	2.98	3.16	2.00	
	L2	0.67	0.56	0.73	2.74	2.84	2.73	2.24	1.78	
LSD_{C*L*F}					0.454				LSD_{C*L}	0.274
					C * F					
C		F0	F1	F2	F3	F4	F5	F6	Mean (C)	
C1		0.63	0.47	0.66	3.03	3.14	3.17	2.78	1.981	
C2		0.76	0.69	0.58	2.84	2.85	2.86	2.70	1.894	
LSD_{C*F}					N.S				LSD_{C}	N.S
					L * F					
L		F0	F1	F2	F3	F4	F5	F6	Mean (L)	
L1		0.70	0.67	0.51	2.94	2.99	2.97	2.87	1.951	
L2		0.68	0.48	0.73	2.92	2.99	3.05	2.61	1.923	
LSD_{L*F}					N.S				LSD_{L}	N.S
					F					
F		F0	F1	F2	F3	F4	F5	F6	LSD_{F}	0.219
Mean (F)		0.69	0.58	0.62	2.93	2.99	3.01	2.74		

Table 16. Effect of different nutrients management practices on available soil (Zn) after harvest (mg Zn kg^{-1})

C	L				F				C * L	
		F0	F1	F2	F3	F4	F5	F6		
C1	L1	0.48	0.43	0.48	1.02	1.10	1.20	1.04	0.82	
	L2	0.56	0.30	0.45	1.34	1.30	1.55	1.28	0.97	
C2	L1	0.57	0.57	0.33	1.38	1.22	1.28	1.33	0.96	
	L2	0.44	0.36	0.42	1.15	1.06	1.21	0.84	0.78	
LSD_{C*L*F}					N.S				LSD_{C*L}	0.11
					C * F					
C		F0	F1	F2	F3	F4	F5	F6	Mean (C)	
C1		0.52	0.36	0.47	1.18	1.20	1.38	1.16	0.90	
C2		0.51	0.47	0.38	1.27	1.14	1.25	1.09	0.87	
LSD_{C*F}					N.S				LSD_{C}	N.S
					L * F					
L		F0	F1	F2	F3	F4	F5	F6	Mean (L)	
L1		0.53	0.50	0.41	1.20	1.16	1.24	1.18	0.89	
L2		0.50	0.33	0.43	1.25	1.18	1.38	1.06	0.88	
LSD_{L*F}					N.S				LSD_{L}	N.S
					F					
F		F0	F1	F2	F3	F4	F5	F6	LSD_{F}	0.17
Mean (F)		0.51	0.42	0.42	1.22	1.17	1.31	1.12		

Table 17. Effect of different nutrients management practices on available soil (Cu) at flowering stage (mg Cu kg^{-1})

C	L				F				C * L	
		F0	F1	F2	F3	F4	F5	F6		
C1	L1	0.403	0.433	0.433	1.387	1.387	1.593	1.363	1.000	
	L2	0.383	0.380	0.380	1.370	1.320	1.440	1.350	0.946	
C2	L1	0.427	0.513	0.327	1.287	1.347	1.327	1.417	0.949	
	L2	0.500	0.383	0.570	1.233	1.300	1.333	1.477	0.971	
LSD_{C*L*F}					N.S				LSD_{C*L}	N.S
					C * F					
C		F0	F1	F2	F3	F4	F5	F6	Mean (C)	
C1		0.393	0.407	0.407	1.378	1.353	1.517	1.357	0.973	
C2		0.463	0.448	0.448	1.260	1.323	1.330	1.447	0.960	
LSD_{C*F}					0.129				LSD_{C}	N.S
					L * F					
L		F0	F1	F2	F3	F4	F5	F6	Mean (L)	
L1		0.415	0.473	0.380	1.337	1.367	1.460	1.390	0.975	
L2		0.442	0.382	0.475	1.302	1.310	1.387	1.413	0.959	
LSD_{L*F}					N.S				LSD_{L}	N.S
					F					
F		F0	F1	F2	F3	F4	F5	F6	LSD_{F}	0.097
Mean (F)		0.428	0.427	0.427	1.319	1.338	1.423	1.402		

Table 18. Effect of different nutrients management practices on available soil (Cu) after harvest (mg Cu kg^{-1})

C	L				F				C * L	
		F0	F1	F2	F3	F4	F5	F6		
C1	L1	0.117	0.180	0.127	0.403	0.447	0.680	0.430	0.340	
	L2	0.110	0.109	0.173	0.540	0.437	0.570	0.413	0.336	
C2	L1	0.177	0.226	0.150	0.360	0.440	0.354	0.494	0.314	
	L2	0.063	0.127	0.132	0.300	0.297	0.299	0.441	0.237	
LSD_{C*L*F}					N.S				LSD_{C*L}	N.S
					C * F					
C		F0	F1	F2	F3	F4	F5	F6	Mean (C)	
C1		0.113	0.145	0.150	0.472	0.442	0.625	0.422	0.338	
C2		0.120	0.176	0.141	0.330	0.368	0.326	0.467	0.276	
LSD_{C*F}					N.S				LSD_{C}	N.S
					L * F					
L		F0	F1	F2	F3	F4	F5	F6	Mean (L)	
L1		0.147	0.203	0.138	0.381	0.443	0.517	0.462	0.327	
L2		0.087	0.118	0.152	0.420	0.367	0.435	0.427	0.287	
LSD_{L*F}					N.S				LSD_{L}	N.S
					F					
F		F0	F1	F2	F3	F4	F5	F6	LSD_{F}	0.120
Mean (F)		0.117	0.160	0.145	0.401	0.405	0.476	0.445		

Table 19. Effect of different nutrients management practices on available soil (B) at flowering stage (mg B kg^{-1})

C	L				F				C * L	
		F0	F1	F2	F3	F4	F5	F6		
C1	L1	0.81	0.83	0.89	1.42	1.62	1.13	1.27	1.14	
	L2	0.57	0.66	0.62	1.28	1.18	1.15	1.59	1.01	
C2	L1	0.77	0.89	1.23	1.54	1.42	1.44	1.49	1.26	
	L2	0.68	0.71	0.78	1.67	1.61	1.63	1.54	1.23	
LSD_{C*L*F}					0.13				LSD_{C*L}	N.S
					C * F					
C		F0	F1	F2	F3	F4	F5	F6	Mean (C)	
C1		0.69	0.74	0.75	1.35	1.40	1.14	1.43	1.07	
C2		0.73	0.80	1.01	1.60	1.52	1.54	1.52	1.24	
LSD_{C*F}					0.08				LSD_{C}	0.05
					L * F					
L		F0	F1	F2	F3	F4	F5	F6	Mean (L)	
L1		0.79	0.86	1.06	1.48	1.52	1.28	1.38	1.20	
L2		0.63	0.68	0.70	1.48	1.40	1.39	1.56	1.12	
LSD_{L*F}					0.10				LSD_{L}	N.S
					F					
F		F0	F1	F2	F3	F4	F5	F6	LSD_{F}	0.06
Mean (F)		0.71	0.77	0.88	1.48	1.46	1.34	1.47		

Table 20. Effect of different nutrients management practices on available soil (B) after harvest (mg B kg^{-1})

C	L	F0	F1	F2	F3	F4	F5	F6	C * L
C1	L1	0.659	0.734	0.598	1.120	1.194	0.821	1.034	0.880
	L2	0.430	0.424	0.434	1.088	0.853	0.557	1.223	0.716
C2	L1	0.368	0.504	0.534	1.483	0.943	1.120	1.070	0.860
	L2	0.517	0.604	0.675	1.347	1.280	1.446	1.257	1.018
LSD $_{C*L*F}$					0.223				LSD $_{C*L}$ 0.089
					C * F				
C		F0	F1	F2	F3	F4	F5	F6	Mean (C)
C1		0.544	0.579	0.516	1.104	1.024	0.689	1.129	0.798
C2		0.442	0.554	0.604	1.415	1.111	1.283	1.163	0.939
LSD $_{C*F}$					0.161				LSD $_C$ 0.107
					L * F				
L		F0	F1	F2	F3	F4	F5	F6	Mean (L)
L1		0.513	0.619	0.566	1.302	1.069	0.971	1.052	0.870
L2		0.473	0.514	0.554	1.217	1.066	1.001	1.240	0.867
LSD $_{L*F}$					N.S				LSD $_L$ N.S
					F				
F		F0	F1	F2	F3	F4	F5	F6	LSD $_F$ 0.117
Mean (F)		0.493	0.566	0.560	1.260	1.068	0.986	1.146	

Table 21. Effect of different nutrients management practices on available soil (Si) at flowering stage (mg Si kg^{-1})

C	L	F0	F1	F2	F3	F4	F5	F6	C * L
C1	L1	10.98	12.08	13.32	12.61	17.34	19.20	19.29	14.98
	L2	13.78	13.46	14.75	12.59	18.28	17.73	15.99	15.23
C2	L1	11.44	13.07	11.58	12.91	15.25	15.78	15.76	13.68
	L2	12.38	14.13	13.46	13.30	14.79	16.58	18.76	14.77
LSD $_{C*L*F}$					2.14				LSD $_{C*L}$ N.S
					C * F				
C		F0	F1	F2	F3	F4	F5	F6	Mean (C)
C1		12.38	12.77	14.04	12.60	17.81	18.47	17.64	15.10
C2		11.91	13.60	12.52	13.11	15.02	16.18	17.26	14.23
LSD $_{C*F}$					1.53				LSD $_C$ N.S
					L * F				
L		F0	F1	F2	F3	F4	F5	F6	Mean (L)
L1		11.21	12.58	12.45	12.76	16.30	17.49	17.53	14.33
L2		13.08	13.79	14.10	12.95	16.54	17.16	17.38	15.00
LSD $_{L*F}$					N.S				LSD $_L$ 0.61
					F				
F		F0	F1	F2	F3	F4	F5	F6	LSD $_F$ 1.10
Mean (F)		12.15	13.19	13.28	12.85	16.42	17.32	17.45	

Table 22. Effect of different nutrients management practices on available soil (Si) after harvest (mg kg^{-1})

C	L	F0	F1	F2	F3	F4	F5	F6	C * L
C1	L1	10.16	10.25	10.22	10.13	15.23	14.86	16.35	12.46
	L2	10.25	10.25	10.55	10.36	15.55	13.67	14.95	12.23
C2	L1	10.16	10.55	10.16	10.32	13.74	12.52	15.09	11.79
	L2	10.32	10.29	10.20	10.29	12.04	13.48	15.55	11.74
LSD $_{C*L*F}$					N.S				LSD $_{C*L}$ N.S
					C * F				
C		F0	F1	F2	F3	F4	F5	F6	Mean (C)
C1		10.20	10.25	10.39	10.25	15.39	14.27	15.65	12.34
C2		10.24	10.42	10.18	10.31	12.89	13.00	15.32	11.76
LSD $_{C*F}$					1.11				LSD $_C$ N.S
					L * F				
L		F0	F1	F2	F3	F4	F5	F6	Mean (L)
L1		10.16	10.40	10.19	10.22	14.48	13.69	15.72	12.12
L2		10.28	10.27	10.37	10.33	13.79	13.58	15.25	11.98
LSD $_{L*F}$					N.S				LSD $_L$ N.S
					F				
F		F0	F1	F2	F3	F4	F5	F6	LSD $_F$ 0.81
Mean (F)		10.22	10.33	10.28	10.28	14.14	13.63	15.49	

The different fertilization treatment and sources affected the grain yield compared to the control treatment (Table -23). The results of Table 23. indicate the highest mean grain yield of 5191.6 kg ha^{-1} for the treatment (F_6), while the lowest mean was 1719.5 kg ha^{-1} for the treatment (F0), and this is certainly a result of fertilizing with macro, micro and beneficial nutrients and the addition of potassium Humates and Silicon. this result confirms the results of plant nutrient concentrations in the soil, plant and also confirms the positive role of fertilization in mitigating the salinity effect of the soil and Irrigation Water. In addition to the possibility of improving the activity of soil microorganisms as a result of fertilizing with Potassium Humates has a role in increasing the grain yield of sorghum(15). Calcium nitrate can also have a role in increasing grain yield by reducing the negative impact of soil salinity on the plant (3). Silicon may also have a role in increasing the grain yield of Sorghum by improving growth and increasing plant resistance to biotic and abiotic stressors (12,24) .Micronutrient fertilizers may have a role in increasing the grains yield of sorghum, (11,10). The results of (Table -23) indicated that high amount of leaching (L_2), gave better results with mean of 4303.9 kg ha^{-1}, compared to 3580. 9 kg ha^{-1} for (L_1) . This can be due to the role of leaching in reducing soil salinity (16,25). The results of (Table 23) also indicate that the interaction between the treatment of leaching requirements and fertilization treatment has significantly affected the grain yield, the highest mean for the grain yield was 5666.6 kg ha^{-1} for the treatment (L_2F_6) and the lowest mean was 1711.2 kg ha^{-1} for (L_2F_0). This may be due to the good balance between soil salinity and nutrients (3,6,24,36,40). The results of (Table 23) also indicate that the interaction between sorghum variety and fertilization treatment had a significant impact on the grain yield, with the highest mean for the grain yield of 5527.7 kg ha^{-1} for the treatment (C_2F_6) and the lowest mean was 1666.6 kg ha^{-1} for (C_2F_0), which could be due to the difference of the two varieties of sorghum in their genetic traits, in addition to the effect of fertilization (3, 12, 36).

Table 23. Effect of different nutritional management practices and leaching requirements on grain yield (kg ha^{-1})

C	LR				F				C * L
		F0	F1	F2	F3	F4	F5	F6	
C1	L1	1855.5	2211.1	3411.1	4044.4	3755.5	3955.5	4233.3	3352.4
	L2	1689.1	3522.2	4277.7	5399.9	5500.0	4833.3	5477.7	4385.7
C2	L1	1600.0	3611.1	3922.2	3733.3	4544.4	4055.5	5199.9	3809.5
	L2	1733.3	3077.8	4222.2	4722.2	4188.9	5755.5	5855.5	4222.2
LSD $_{C*L*F}$					872.8				LSD $_{C*L}$ N.S
					C * F				
C		F0	F1	F2	F3	F4	F5	F6	Mean (C)
C1		1772.3	2866.6	3844.4	4722.2	4627.7	4394.4	4855.5	3869.0
C2		1666.6	3344.4	4072.2	4227.7	4366.6	4905.5	5527.7	4015.8
LSD $_{C*F}$					713.4				LSD $_C$ N.S
					L * F				
(LR)		F0	F1	F2	F3	F4	F5	F6	Mean (L)
L1		1727.8	2911.1	3666.6	3888.9	4150.0	4005.5	4716.6	3580.9
L2		1711.2	3300.0	4250.0	5061.1	4844.4	5294.4	5666.6	4303.9
LSD $_{L*F}$					568.6				LSD $_L$ 424.6
					F				
F		F0	F1	F2	F3	F4	F5	F6	LSD $_F$ 357.5
Mean (F)		1719.5	3105.5	3958.3	4475.0	4497.2	4650.0	5191.6	

The effect of the triple interaction was significant in the grain yield, with the highest value of 5855.5 kg ha^{-1} for ($C_2L_2F_6$) with an increment of 266% compared to 1600.0 kg ha^{-1} of ($C_2L_1F_0$). This can be due to presence of all nutrients, humic acid, Si and calcium and magnesium nitrate together with good leaching for salinity and relatively more tolerant verity (3, 16, 19, 21, 36, 38, 40). Finally and despite the fact that the sorghum crop grown in saline soil and irrigated with well water differ in quality according to occasional scarcity, the application of good management practices of fertilizing, leaching requirements and selection of relatively tolerant variety can achieve good results . The results of the current study is within the good production levels indicated by others (22, 23, 29) where they found that the production rate of sorghum for different varieties is between 3000-6000 Kg ha[1]. As well as production efficiency (field efficiency) increased about ten times as a result of fertilization with various nutrient.

CONCLUSION

Fertilizer treatments had a very important role in the availability of nutrients in the soil, where treatment F6 exceeded other treatments in flowering stage in increase the availability of (N,P and Si), as well as in after harvest stage treatment F6 exceeded the other treatments in increase the availability of (N,K,Fe and Si). Doubled leaching requirements (L2) exceeded (L1), which led to reducing the amount of NaCl salts in the soil for the depth of (25-50cm).

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

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