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The effect of some irrigation systems and the reduction of mineral fertilizers on soil salinity and the growth and yield of wheat crop

Raji Ali Mousa

Abdullah Ulas

Faculty of Agriculture || Erciyes University || Turkish

Abstract: An experiment was carried out in Iraq, Wasit Governorate, Numaniyah city in 2021 in clay soil with a salinity of more than 4 decimeters- 1, pH 7. To find out the effect of reducing irrigation water and reducing the amount of mineral fertilizer on soil salinity and some growth characteristics and yield of wheat crop.

The experiment included On two factors, the first factor included two irrigation systems, namely surface irrigation and sprinkler irrigation, while the second factor included four levels of fertilization p1, p2, p3, p4 in quantities of 200, 250, 350, 450 kg | hectares respectively

P4 (450) kg | hectares

The results and statistical analysis showed Show irrigation by spraying r2 and fertilizing p4 at a dose of 450 kg | Hectares outperformed in surface irrigation and lower fertilizer doses in the number of spike grains and the weight of 1000, Grain weight in square meters and harvest index.

The experiment was carried out in a splat- plot design with three replicates, and the study included eight treatments in each replicate.

Keywords: Salinity, Sprinkler irrigation, surface irrigation, Fertilizer NPK, Wheat, Significant.

تأثير طريقة الري وتقليل الأسمدة المعدنية على ملوحة التربة ونمو وإنتاج محصول الحنطة

راجي علي موسى

عبد الله اولاش

كلية الزراعة || جامعة ارجس || تركيا

المستخلص: أجريت تجربة في العراق، محافظة واسط، مدينة النعمانية عام 2021 في تربة طينية ذات ملوحة تزيد عن 4 ديسيمتر- 1 ، الرقم الهيدروجيني لها 7 لمعرفة تأثير تقليل مياه الري وتقليل كمية السماد المعدني على ملوحة التربة ونمو وحاصل محصول القمح.

اشتملت التجربة على عاملين، العامل الأول شمل نظامين للري وهما الري السطحي والري بالرش، بينما اشتمل العامل الثاني على أربعة مستويات تسميد معدني بكميات 200، 250، 350، 450 كجم | هكتار على التوالي.

أظهرت نتائج التحليل الإحصائي أن الري بالرش أعطى فروقا معنوية في عدد حبات السنبلة ووزن 1000 حبة ووزن الحبوب بالمتر المربع ومؤشر الحصاد، خاصة عند مستوى تسميد 450 كغم | هكتار.

نفذت التجربة بتصميم القطع المنشقة بثلاث مكررات، واشتملت الدراسة على ثماني معالجات

الكلمات المفتاحية: الملوحة، الري بالرش، الري السطحي، سماد الداب، القمح، المعنوية.

Introduction.

One of the problems facing the agricultural sector in Iraq is soil degradation due to salinity and lack of water, one of the main causes of salinity is adding quantities of water to the field and giving mineral fertilizer more than the need of the plant, so the start of serious thinking about adopting saline agriculture (coexistence with salinity) by reducing fertilizer doses and using irrigation methods Modern and the cultivation of plants sensitive to salt such as wheat, which has a direct relationship with people's food.

In Iraq, studies referred that about 25%of its area are saline[Altay2012] specially in the middle and south parts of Iraq this area is increasing about 2500 hectares every year (Qadir., et al 2012)

Increasing the irrigation water above the plant's need by a great deal leads to flood the soil and increase its salinity.

Fertilizers, especially nitrogen fertilizers, are considered among the important factors that lead to an increase in the yield, provided that the fertilizers are added in the specified quantities and within the recommended dates (Bushra. A. Gaber Mohammed and Ayad H.Ali, 2011)

high productivity of wheat which is a basic food for all people and to reduce the negative impact on the soil that is salinized by increased fertilizer and water.

Therefore, some techniques have been introduced that reduce the effect of salinity in this water, increase the penetration of roots into the soil and their absorption of nutrients and reduce the harmful effect of salts.

The mineral fertilizer is 400 kg Hectares were the best in most of the characteristics of the wheat plant, such as the number of spike kernels, the weight of 1000 grains and the weight of the grains per square meter (Mustafa Sobhi Abdul- Jabbar and Abdul- Wahhab Khudair Al- Obaid, 2016)

Sprinkler irrigation was superior to surface irrigation because it makes the moisture permanent in the root system and reduces the air temperature, and these results are consistent with what previous research has reached.

Finally, the goal of the research seeks to study the possibility of coexisting with salinity by using an appropriate fertilizer dose under modern irrigation that reduces water, as the problem of salinization of agricultural lands is one of the biggest problems facing countries in dry and semi- arid areas as a result of an increase in the concentrations of dissolved salts in the soil.

This research aims to reduce water waste and Using modern irrigation methods, such as sprinkler and drip irrigation, to according to the needs of agricultural crops, in order to avoid soil salinity problems.

The problem and its causes

Saline soils that contain salts that are Dissolved salts in their deep layers or in groundwater and may saline in the future as long as the salts rise in the upper layers causing damage to field crops Or that

saline soils are soils in which the degree of electrical conductivity is more than 4 mm / cm at a degree of 25 °C and the percentage of exchangeable sodium is less than 15% of the total cations and the degree of reaction of the soil is less than 8.5 (Amin I. Ismayilov, et al., 2021)

Literature Review

It is important to determine the effect of the sprinkler irrigation method on soil salinity and verify this effect by referring to the research and studies carried out by researchers.

In this way, how can we reduce irrigation water and soil salinity?

The Sprinkler Irrigation Provided 12% of surface irrigation water, and improving of physical properties soil (Ani1998)

The Sprinkler irrigation reduced the wheat irrigation water from 27- 33%, and the productivity increased from 49- 200%, compared to surface irrigation.

At the same time this type of irrigation, as shown by (Al- Zubaidi et al 2009) led to an increase in the soil's moisture content.

It is necessary to know, does sprinkler irrigation increase productivity?

(Al- Dairi., et al 2011) Explained an experience in Syria was that the yield of irrigation by sprinkler was 1.78 kg |m2 wheat and for barley 1.18 kg |m2 while for surface irrigation it was 0.88 for wheat and 0.60 barely.

(Al- Awadi 2020) has tested that sprinkler irrigation is better than surface irrigation in the following characteristics of wheat:

The number of spikes per square meter, the number of spike grains, the harvest index, the weight of the grains and the weight of 1000 grains, but although the sprinkler irrigation method is good, it is not suitable in very windy days, as the salts are concentrated on the surface of the soil and the problem can be not irrigation during high winds and washing the surface layer of the soil after harvest.

Material and methods.

Location, sources, kind, whole properties of materials

The experiment will be carried out in **IRAQ** the lands of the city of **Nu'maniyah** for the agricultural season 2021- 2022 within a soil whose characteristics will be knew through analysis of soil samples

EC1:1 Ms | cm		3.0
pH		6.5
Dissolved ions Meq | L	Ca^{++}	10.0
	Mg^{++}	9.7
	Na^{+}	5.3
	Cl^{-}	13.0

EC1:1 Ms | cm							3.0	
				SO_4^-			9.6	
				HCO_3			1.5	
% Soil texture				clay			11.6	
				silt			47.4	
				sand			41.0	
Irrigation water analysis	HCO_3^-	SO_4^-	Cl	Na^+	Mg^{++}	Ca^{++}	pH	EC dSm- 1
	ppm							
	2.9	4.6	3.7	4.3	2.7	5.1	7.8	1.5

land will be planted with wheat part of it under the system of linear sprinkler irrigation, and the other part is subject to flood irrigation... The land of the experiment will be well plowed and fertilizer added (200- 250- 350- 450 kg | hectare) and

Wheat seeds are added at a rate of 120 kg| hectare after 50 days of sowing the second half of the fertilizer is given. according to recommendation of Iraqi ministry of agriculture

The experiment was carried out by Split- Plot Designs.

Experiment factors

1- The first factor: irrigation methods, including two levels

r1 Surface irrigation ..... r2 Sprinkler irrigation

2- The second factor: It includes four levels of NPK

F1: 200 kg | hectare ..... F2: 250 kg | hectare

F3: 350 kg | hectare ..... F4: 400 kg | hectare

Note: The length of the plant is measured using a ruler from the surface of the soil to the end of the spike

Spike length| cm by a ruler after harvesting.

number of spike grains after harvesting.

Weight 1000 g..taking 1000 seeds from several spikes and to weight seeds by a sensitive balance after harvesting.

Production g|m2..taking Square meter of experience of wheat and seed extraction from spikes, and knowing their weight

Harvest index %.. Harvest index% = grain yield / biological yield x 100

This information, whether for surface irrigation or sprinkler irrigation, we enter it in tables as follows for the purpose of statistical analysis..

SPSS statistical analysis was used, where significant differences appeared according to Duncan's test the practical results showed the success of growing wheat in saline soils after reducing irrigation water and mineral fertilizers by using sprinkler irrigation.

The effect on the plant, the statistical analysis showed that there were significant differences in the phenotypic characteristics of the wheat plant (plant length | cm, number of grains of spike, weight 1000 grains, grain yield g.m2- % harvest index, While the spike length was insignificant.

Effects on soil:

After the end of the experiment, an increase in the concentration of Na+, Ca+2 and Mg+2 ions on the surface of the soil was observed in sprinkler irrigation compared to surface irrigation because the first gives high irrigation efficiency and does not occur in the washing process of the soil so that the cations move to the second depth.

- There were no significant differences in the pH before planting due to the absence of carbonates in most soils and their low content of bicarbonate and organic matter (Mohamed A.R., et al., 2017)
- The high electrical conductivity values of the soil in the surface layer due to the movement of salts upwards and the high level of evaporation.
- The predominance of chloride salts, especially sodium chloride, where the chlorine ion was> sulfate> bicarbonate (district, Haryana Sanjay Kumar, et al., 2011).
- On the soil, the electrical conductivity increased slightly in the surface layer only, without the area of deepening the roots, and the magnesium ions were concentrated.

Results.

We conclude that there were significant differences in some phenotypic characteristics of wheat except for the length of the spike as a result of fertilization and the irrigation method in which sprinkler irrigation was superior to surface irrigation on all plant characteristics except for the length of the plant.

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Plant lenth	F1R1	3	80.33	.577	.333	78.90	81.77	80	81
	F2R1	3	101.00	1.000	.577	98.52	103.48	100	102
	F3R1	3	91.90	1.868	1.079	87.26	96.54	90	94
	F4R1	3	111.33	1.528	.882	107.54	115.13	110	113
	F1R2	3	78.30	1.000	.577	75.82	80.78	77	79
	F2R2	3	81.20	1.217	.702	78.18	84.22	80	82
	F3R2	3	76.33	3.055	1.764	68.74	83.92	73	79
	F4R2	3	87.20	2.762	1.595	80.34	94.06	85	90
	Total	24	88.45	11.872	2.423	83.44	93.46	73	113
spike lenth	F1R1	3	8.60	1.136	.656	5.78	11.42	8	10
	F2R1	3	9.30	1.473	.850	5.64	12.96	8	11

Descriptives									
	F3R1	3	9.40	1.637	.945	5.33	13.47	8	11
	F4R1	3	9.40	2.254	1.301	3.80	15.00	8	12
	F1R2	3	9.37	1.290	.745	6.16	12.57	8	11
	F2R2	3	10.20	1.000	.577	7.72	12.68	9	11
	F3R2	3	10.80	2.166	1.250	5.42	16.18	8	12
	F4R2	3	10.80	1.311	.757	7.54	14.06	9	12
	Total	24	9.73	1.526	.311	9.09	10.38	8	12
number of grain in spike	F1R1	3	19.00	1.000	.577	16.52	21.48	18	20
	F2R1	3	30.00	1.000	.577	27.52	32.48	29	31
	F3R1	3	24.00	2.646	1.528	17.43	30.57	22	27
	F4R1	3	32.67	2.082	1.202	27.50	37.84	31	35
	F1R2	3	15.33	.577	.333	13.90	16.77	15	16
	F2R2	3	22.33	2.517	1.453	16.08	28.58	20	25
	F3R2	3	37.00	1.000	.577	34.52	39.48	36	38
	F4R2	3	45.00	2.646	1.528	38.43	51.57	43	48
	Total	24	28.17	9.581	1.956	24.12	32.21	15	48
weight 1000grains	F1R1	3	300.00	30.000	17.321	225.48	374.52	270	330
	F2R1	3	290.00	21.794	12.583	235.86	344.14	275	315
	F3R1	3	338.67	43.132	24.902	231.52	445.81	291	375
	F4R1	3	444.67	67.929	39.219	275.92	613.41	402	523
	F1R2	3	399.67	164.895	95.202	- 9.96	809.29	300	590
	F2R2	3	479.33	50.807	29.333	353.12	605.54	450	538
	F3R2	3	446.67	164.613	95.039	37.75	855.59	262	578
	F4R2	3	614.67	13.051	7.535	582.25	647.09	600	625
	Total	24	414.21	127.205	25.966	360.49	467.92	262	625
weight of grain in m2	F1R1	3	244.00	14.422	8.327	208.17	279.83	232	260
	F2R1	3	244.00	14.422	8.327	208.17	279.83	232	260
	F3R1	3	285.00	30.414	17.559	209.45	360.55	250	305
	F4R1	3	392.67	74.272	42.881	208.16	577.17	313	460
	F1R2	3	395.33	96.671	55.813	155.19	635.48	290	480
	F2R2	3	308.00	24.269	14.012	247.71	368.29	280	323
	F3R2	3	476.00	69.195	39.950	304.11	647.89	398	530
	F4R2	3	646.67	155.349	89.691	260.76	1032.58	520	820
	Total	24	373.96	145.411	29.682	312.56	435.36	232	820
%harvest index	F1R1	3	13.33	1.528	.882	9.54	17.13	12	15
	F2R1	3	23.00	8.888	5.132	.92	45.08	13	30
	F3R1	3	22.00	8.544	4.933	.78	43.22	14	31
	F4R1	3	25.67	6.429	3.712	9.70	41.64	21	33
	F1R2	3	18.33	2.082	1.202	13.16	23.50	16	20

Descriptives									
	F2R2	3	37.00	2.000	1.155	32.03	41.97	35	39
	F3R2	3	38.67	1.528	.882	34.87	42.46	37	40
	F4R2	3	39.00	2.646	1.528	32.43	45.57	36	41
	Total	24	27.13	10.385	2.120	22.74	31.51	12	41

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
Plant lenth	Between Groups	3188.680	7	455.526	137.000	.000
	Within Groups	53.200	16	3.325		
	Total	3241.880	23			
spike lenth	Between Groups	12.967	7	1.852	.730	.650
	Within Groups	40.587	16	2.537		
	Total	53.553	23			
number of grain in spike	Between Groups	2055.333	7	293.619	83.891	.000
	Within Groups	56.000	16	3.500		
	Total	2111.333	23			
weight 1000grains	Between Groups	242385.958	7	34626.565	4.269	.008
	Within Groups	129778.000	16	8111.125		
	Total	372163.958	23			
weight og grain in m2	Between Groups	394894.958	7	56413.565	9.873	.000
	Within Groups	91426.000	16	5714.125		
	Total	486320.958	23			
%harvest index	Between Groups	2053.958	7	293.423	11.003	.000
	Within Groups	426.667	16	26.667		
	Total	2480.625	23			

Effects on wheat plant

Plant length cm

There were significant differences in fertilizer application and irrigation method.

The treatment (p4r1) gave an average plant height 111.33 cm compared to the treatment (p4r2) that was given83.20 cm and the rate of 78.3% with a significant difference, and this means that surface irrigation affects plant height more than sprinkler irrigation, a well as the role of nitrogen in the process of cell division and increase its growth, as a result of raising the efficiency of the roots in absorbing nutrients (Hussain., et al 2006) who found an increase in the length of the wheat plant by increasing the addition of nitrogen by surface irrigation.

Plant lenth							
Fertilizers	N	Subset for alpha = 0.05					
		1	2	3	4	5	6
F3R2	3	76.33					
F1R2	3	78.30	78.30				
F1R1	3		80.33				
F2R2	3		81.20				
F4R2	3			87.20			
F3R1	3				91.90		
F2R1	3					101.00	
F4R1	3						111.33
Sig.		.205	.082	1.000	1.000	1.000	1.000
Means for groups in homogeneous subsets are displayed.							
a. Uses Harmonic Mean Sample Size = 3.000.							

Spikes length cm:

That the length of spikes in the wheat crop is for all wheat, the transactions were not affected morally and the statistical analysis did not show any significant differences in 0.05 between the levels of nitrogen fertilizer application nor the method of irrigation all transactions, and this is with what he found (Al- Omari., 2003) despite the fact that the amount of fertilizer phosphorous did not change the length of the wheat spikes.

Breeding novel wheat genotypes with reduced plant height has increased genetic gains in wheat and significantly contributed to increased wheat productivity globally (Beche et al., 2014)

spike length		
Fertilizers	N	Subset for alpha = 0.05
		1
F1R1	3	8.60
F2R1	3	9.30
F1R2	3	9.37
F3R1	3	9.40
F4R1	3	9.40
F2R2	3	10.20
F3R2	3	10.80
F4R2	3	10.80
Sig.		.155
Means for groups in homogeneous subsets are displayed.		
a. Uses Harmonic Mean Sample Size = 3.000.		

The number of spike grains:

The number of seeds in a spike is considered one of the important components of the yield and it is affected significantly by the irrigation system used.

The average grain in a spike when irrigated by sprinkler reached 45 grains, compared to the number of seeds in a spike, 32 grains, in surface irrigation in the rate 72.4% of making a significant difference 0.05 in favor of the first, and the reason is due to the improvement of the soil's physical, chemical and biological properties and the increase in the percentage of organic matter.

the spike increased by increasing the levels of nitrogen fertilizer, as well as the nitrogen fertilization has the effect of filling grains (Pandey., et al 2001) this result was consistent with what he reached (Saleem., et al 2010)

In a previous study it was shown that the number of wheat spikes in surface irrigation was 38 grains and 47 grains in sprinkler irrigation (Abdul- Jabbar., et al 2016)

number of grain in spike							
Duncan[a]							
Fertilizers	N	Subset for alpha = 0.05					
		1	2	3	4	5	6
F1R2	3	15.33					
F1R1	3		19.00				
F2R2	3			22.33			
F3R1	3			24.00			
F2R1	3				30.00		
F4R1	3				32.67		
F3R2	3					37.00	
F4R2	3						45.00
Sig.		1.000	1.000	.291	.100	1.000	1.000
Means for groups in homogeneous subsets are displayed.							
a. Uses Harmonic Mean Sample Size = 3.000.							

Weight of grain per m2:

The difference in the irrigation system contributed to a difference in production.

The treatment of sprinkler irrigation was achieved significant differences for the average wheat crop 646.7 g

While it reached the highest average yield of the crop when surface irrigation 392, 7 g in rate of 60.7%

The reason may be due to the provision of moisture when.

The root zone, increased vegetative growth, which led to an increase.The total production of the wheat crop

This is consistent with (Saleh search 2001)

Grains (g / m2) = the number of spikes per square meter x the number of grains spike x the grain weight (g)

The weight of the kernels per square meter depends on the number of spikes and the weight of 1000 (Solomons., et al 2003)

weight of grain in m2					
Duncan[a]					
Fertilizers	N	Subset for alpha = 0.05			
		1	2	3	4
F1R1	3	244.00			
F2R1	3	244.00			
F3R1	3	285.00	285.00		
F2R2	3	308.00	308.00		
F4R1	3		392.67	392.67	
F1R2	3		395.33	395.33	
F3R2	3			476.00	
F4R2	3				646.67
Sig.		.354	.118	.219	1.000
Means for groups in homogeneous subsets are displayed.					
a. Uses Harmonic Mean Sample Size = 3.000.					

1000 grain spike weight

The weight of a thousand grains is one of the most important indicators of the yield components associated with the number and weight of the grains per spike and the number of spikes per unit area.

The irrigation method had an effect, the average of the treatment (f4r2) was 615 kg which the treatment (f4r1) was 445 gm, because Sprinkler irrigation reduces transpiration on wheat plants and lowers the temperature compared to surface irrigation

(Nicou., et al 1990) Showed that the use of modern irrigation of agricultural crops will increase the capacity of the soil by retaining water, increasing its permeability, and reducing water by surface runoff, and this will increase production in quantity and quality.

weight 1000grains				
Duncan[a]				
Fertilizers	N	Subset for alpha = 0.05		
		1	2	3
F2R1	3	290.00		

weight 1000grains				
F1R1	3	300.00		
F3R1	3	338.67	338.67	
F1R2	3	399.67	399.67	
F4R1	3	444.67	444.67	
F3R2	3	446.67	446.67	
F2R2	3		479.33	479.33
F4R2	3			614.67
Sig.		.074	.102	.084
Means for groups in homogeneous subsets are displayed.				
a. Uses Harmonic Mean Sample Size = 3.000.				

harvest index%:

It gives an idea of the efficiency of grain production in the plant

% Harvest index = grain yield / biology yield x 100

Roots, leaves, stems, grains, grains are all called biological quotient while economic quotient is only grains

The harvest yield gave a significant difference 0.05 to the preference for sprinkler

irrigation compared to surface irrigation according to the mean values in rate of 65.6%

%harvest index				
Duncan[a]				
Fertilizers	N	Subset for alpha = 0.05		
		1	2	3
F1R1	3	13.33		
F1R2	3	18.33	18.33	
F3R1	3	22.00	22.00	
F2R1	3		23.00	
F4R1	3		25.67	
F2R2	3			37.00
F3R2	3			38.67
F4R2	3			39.00
Sig.		.068	.128	.660
Means for groups in homogeneous subsets are displayed.				
a. Uses Harmonic Mean Sample Size = 3.000.				

Discussion of results according to the Duncan method.

It is noted from the tables that the transactions are divided into homogeneous groups 1 2 3 4... etc. The transactions that do not fall into one group have a significant difference between them and those that fall into one group have no significant difference

CONCLUSION.

We recommend using the p4 fertilizer sample and using sprinkler irrigation due to the achieved results, which gave significant differences in the statistical analysis.

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