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Effect of sprinkler irrigation method and addition urea fertilizer on wheat plant

ABSTRACT

Originality/Value: Farmers must use sprinkler irrigation and avoid surface irrigation because it harms the soil and increases its salinity, also represents a waste of water resources.

Research limitations: Limited availability of sufficient numbers of sprinkler irrigation devices in Iraq, their high prices, and the lack of experience of farmers to use them.

The Purpose of the research is to evaluate the effect of the appropriate irrigation method and the amount of fertilizer specified for urea fertilizer that achieves the best growth for the plant and increase its productivity while avoiding a negative impact on soil properties.

Research Method: Two types of irrigation: spraying and flooding, and four mineral fertilization treatments (0. 50.100. 150) kg.ha-1 were used in the work to study the apparent characteristics of wheat and the amount of productivity, using statistical analysis (Gen Stat) and simple correlation coefficient to find strength of association between variables. The experiment was carried out in 2023 at Al-Khatib Farm, located in Al-Numaniyah District, it is bordered to the south by Wasit Governorate, 50 km away, and to the north by Baghdad Governorate,160 km away (Iraq).

Results and Discussion. Sprinkler irrigation showed significant differences with the surface irrigation in the length of the spike, number of seed per spike,1000 seed weight, number of spikes per square meter, grain yield kg .ha-1 and the harvest index, while the plant height was not significant. The study also showed that the correlation coefficient between the apparent characteristics of the plants was stronger in the case of using sprinkler irrigation compared to the surface irrigation.

KEYWORDS:
Fertilizer, Irrigation, Sprinkler, Significant, Wheat

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Влияние метода спринклерного орошения (дождевания) и внесения карбамидного удобрения (мочевины) на растения пшеницы

РЕЗЮМЕ

Актуальность. В засушливых условиях рекомендуется использовать орошение с.-х. культур дождеванием и избегать поверхностного орошения, поскольку оно наносит вред почве и увеличивает ее засоление, а также растрачивает водные ресурсы. Однако в Ираке существует ограниченная возможность спринклерного орошения по ряду причин: доступность достаточного количества спринклерных оросительных устройств, их высокие цены и отсутствие у фермеров опыта их использования.

Цель исследования – оценить эффект от соответствующего метода орошения и дозу внесения азотного удобрения (¬мочевины), что позволит добиться наилучшего роста растений и повысить продуктивность, избегая при этом негативного воздействия на свойства почвы.

Методы исследования. Для изучения характеристик пшеницы и величины урожайности были использованы два вида полива: дождевание и поверхностное орошение, а также четыре дозы минеральных удобрений (0, 50, 100, 150) кг/га. Проводили статистический анализ ¬ (Gen Stat) и рассчитывали простой коэффициент корреляции, чтобы определить силу связи между переменными. Эксперимент проводился в 2023 году на ферме Аль-Хатиб, расположенной в районе Ан-Нумания, граничащей на юге с провинцией Васит – в 50 км, а на севере с провинцией Багдад – в 160 км (Ирак).

Результаты. Спринклерное орошение (дождевание) показало существенные различия с поверхностным орошением по длине колоса, количеству семян в колосе, массе 1000 семян, количеству колосков на квадратный метр, урожайности зерна кг/га и индексу урожая, в то время как высота растений не имела существенного значения. Исследование также показало, что коэффициент корреляции между характеристиками растений был сильнее в случае использования дождевания по сравнению с поверхностным поливом.

КЛЮЧЕВЫЕ СЛОВА:
удобрение, орошение, разбрызгиватель, пшеница

Introduction

Wheat is the dominant crop in temperate countries being used for human food and livestock feed. Success in its growth depends partly on its adaptability and high yield potential [1]. The farmer believes that adding chemical fertilizers and quantities of irrigation water to the field will increase production, so this is wasted and overloaded with irrigation water until this leads to be one of the reasons for salinization of the soil, which has become the most important problem facing us, today as a specific constraint to agriculture, Due to drought, irrigation water decreases annually, so the alternative to surface irrigation is sprinkler irrigation. This research aims to find the appropriate dose of urea fertilizer using sprinkler irrigation to reduce water losses. 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 Mousa and Ulas [2].

Experiments in wheat fields showed that sprinkler irrigation gave an efficiency of 89% compared to surface irrigation, which achieved 64%. This result was reached by Ali & et al. [3].

The length of the Spike encourages it to contain more grains, and this is what happened with sprinkler irrigation, which increases the dry weight and the yield. Also, the increase in the number of Spikes comes from an increase in the number of branches and thus an increase in the total yield and an increase in the weight of the grain) [4].

Al-Dairi et al. [5] concluded that wheat and barley fields using sprinkler irrigation gave a productivity of 1.78 and 1.18 kg§m2 while in surface irrigation it was 0.88 and 0.60 kg§m2 respectively.

The aim of the research is to evaluate the effect of the appropriate irrigation method and the amount of fertilizer allocated to urea fertilizer, which achieves the best growth of the plant and increases its productivity while avoiding a negative impact on soil properties.

Material and Methods

The experiment was carried out in 2023 at Al-Khatib Farm, located in Al-Numaniyah District, at longitude 45.5° and latitude 32.3°. It is bordered to the south by Wasit Governorate, 50 km away, and to the north by Baghdad Governorate,160 km away.

It is bordered to the east by Diyala Governorate,70 km away, and to the west by Babil Governorate, 60 km away.

A map showing the study location and indicated by arrows.

The climate of the city of Numaniyah, where the experiment was carried out, is suitable for agriculture. In summer, the temperature reaches 44 degrees Celsius, while in winter it reaches zero or below. Also, Numaniyah is characterized by a lack of rain, not exceeding 50 mm.

Within Field to grow wheat crop (Dana) with an area of 2000 hectare under the linear sprinkler irrigation system, and part of the field is the subject to surface irrigation, In sandy, silt soil, the experiment was divided into two parts, one of which was under irrigation with linear sprinkling and the second half was by surface irrigation system.

The experiment ground was plowed with disks, then adjusted by the two rates, and plowed with disks again and added to it 600 kg.ha-1 with 150 kg.ha-1 of urea, the seed rate for wheat was 300 kg.ha-1.

The first irrigation was given to the two parts of the experiment by spraying and surface irrigation, the ger-

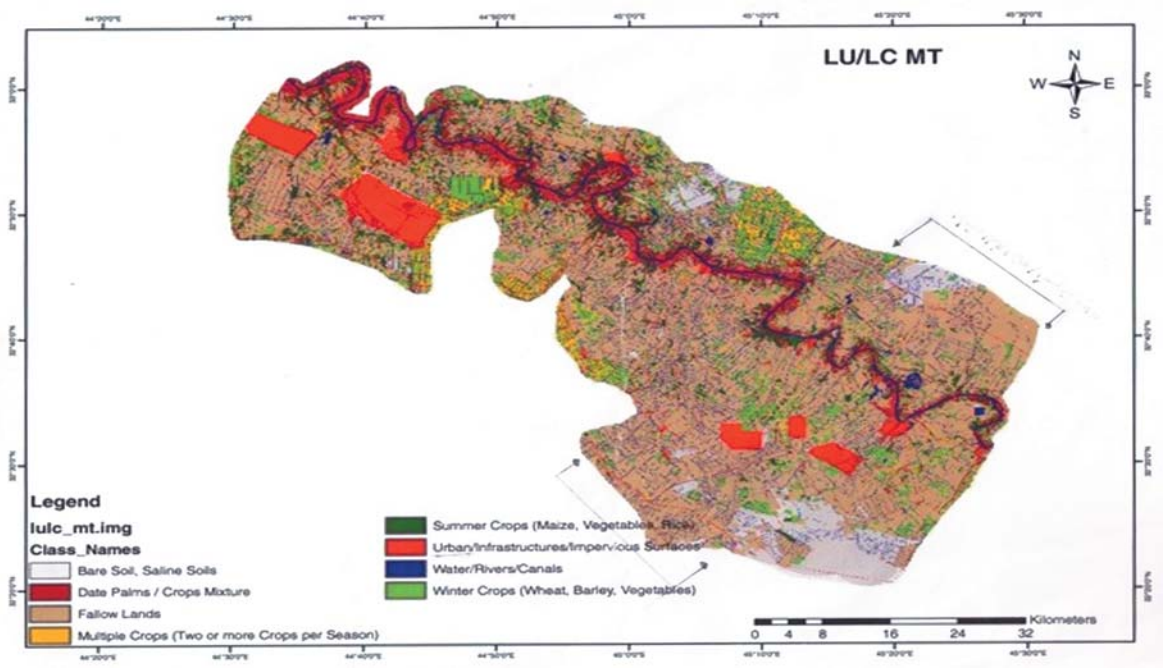

Figure 1.

mination percentage for the experiment site under sprinkler irrigation was 80% and 70% for the surface irrigation. the second batch of urea fertilizer was given according to the proposed quantities, for both sections of the experiment, and the field was combated with a Venture pesticide for thin leaves in quantity and Crane Star for broad papers in quantity.

The experiment required 180 days from the planting until the harvest.

The experiment was designed by Randomized Complete Block Design (RCBD) with two blocks with four treatments of urea fertilizer (0, 50, 100, 150) kg.ha-1 and four iterations for each treatment for both sprinkler and surface irrigation.

Statistical analysis

Two methods were used in statistical analysis. The first one is **(Gen Stat)** when the level of 0.05 table No. 3. The second is **(simple correlation coefficient)** at level 0.05 level, table No. 4.

Results and Discussion

The results showed the significant differences achieved by the sprinkler irrigation method in all apparent characteristics of wheat plants except plant height.

Table 1. Some physical and chemical characteristics of the soil used in the study

Adjective		Value
pH		7.70
EC Dsm^{-1}		2.31
The dissolved ions Mmol L^{-1}	Ca^{++}	4.10
	Mg^{++}	3.69
	Na^{+}	4.31
	K^{+}	0.35
	Cl^{-}	4.24
	SO_4^{--}	4.26
	HCO_3^{-}	3.93
Soil separators g kg^{-1}	sand	302
	silt	463
	clay	235

Plant length (cm)

Surface irrigation was superior to sprinkler irrigation in terms of plant height: it gave an average plant height of 92.82 cm compared to sprinkler irrigation of 82.15 cm. This result was in agreement with the data published by Hussain et al [6]. The reason is that surface irrigation provided a greater reserve of water in the soil than sprinkler irrigation and the results showed that increased nitrogen levels had significant effect on plant height. Data presented (Table 1) showed that there were significant differences in the length of the spike with the superiority of the sprinkler irrigation method over the irrigation method, where the average spike length reached 10.37 cm and 9.17 cm, respectively (i.e. a very small difference), and the least significant difference was at the least significant difference (L.S.D) 1.058 cm. As for the interaction between the irrigation method and fertilizer doses, it was also statistically significant, the L.S.D was 1.662 cm.

Number of grains per spike

The average grain number in a spike when irrigated by sprinkler reached 36.5 compared to the number of seeds in a spike, 34, in surface irrigation the reason is due to the improvement of the soil's physical, chemical and biological properness and the increase in the percentage of organic matter.

This result was consistent with the published data of Shao-Yang Li., et al. [7]. 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 [8].

1000 seeds weight (g)

The weight of a thousand seeds is one of the most important indicators of the yield. Nicou et al. [9] 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. Elevated levels of nitrogen fertilizer increased the average weight of 1000 seeds (g) and this is due to the increase in the weight of spike seeds.

Number of spikes per square meter

Although there is no difference in the average number of spikes per square meter between surface irrigation (33.25 spikes) and sprinkler irrigation (35.5 spikes,

Table 2. Mineral composition, pH and electrical (EC) conductivity of irrigation water before planting

	HCO_3 Mmol L^{-}	SO_4^{-} Mmol L^{-1}	Cl^{-} Mmol L^{-1}	Na^{+} Mmol L^{-}	Mg^{++} Mmol L^{-1}	Ca^{++} Mmol L^{-1}	pH	EC DSm^{-1}
Irrigation water	2.8	3.7	3.6	4.3	2.1	3.4	7.6	1.2

Table 3. Plant and spike length, number of seeds per spike, 1000 seed weight, number of spikes |m2 , Grain yield Kg.ha-1 % Harvest index, values of wheat subjected different urea factorization doses (0, 50, 100, 150) kg.ha-1 in surface irrigation and sprinkler irrigation conditions. Statistical analysis through Gen stat at the level of the least significant difference of L.S.D) 0.05

Dose of urea Fertilization (kg.ha-1)	Plant length (cm)			Spike length (cm)			Number of seeds per spike			1000 seeds weight (g)		
	surface Irrigation	sprinkler irrigation	Means	surface Irrigation	sprinkler irrigation	Means	surface Irrigation	sprinkler irrigation	Means	surface Irrigation	sprinkler irrigation	Means
0	89.4	78.3	83.85	8.6	9.3	8.95	32	33	32.5	31	30	30.5
50	94.7	79. 8	87.25	9.3	10.6	9.95	36	36	36	32	32	32
100	91.9	83.3	87.6	9.4	10.8	10.1	33	37	35	32	38	35
150	95.3	87.2	91.25	9.4	10.8	10.1	35	40	37.5	35	40	37.5
Average	92.82	82.15		9.17	10.37		34	36.5		32.5	35	
L.S.D 0.05 R			0.036			1.306			1.793			1.792
L.S.D 0.05 F			1.294			1.058			1.601			1.059
L.S.D 0.05 F*R			1.585			1.662			1.601			1.602

Dose of urea Fertilization (kg.ha-1)	Number of spikes in (m^2)			Grain yield ($kg.ha^{-1}$)			% Harvest index		
	surface Irrigation	sprinkler irrigation	Means	surface Irrigation	sprinkler irrigation	Means	surface Irrigation	sprinkler irrigation	Means
0	30	32	31	2440	2970	2705	13.3	18.3	15.8
50	35	35	35	2850	4510	368 0	23.1	36.9	30.0
100	33	35	34	3830	5060	4445	22.2	38.8	30.5
150	35	40	37.5	4030	5700	4865	25.6	39.0	32.3
Average	33.25	35.5		3280	4560		21.0	33.3	
L.S.D 0.05 R			2.351			1374.3			0.524
L.S.D 0.05 F			1.148			1036.9			0.467
L.S.D 0.05 F*R			1.192			1434.0			0.622

the latter gave a significant difference, as L.S.D 0.05=2.351.

The cause sprinkler irrigation gives more regular water to the plant than surface irrigation, which prevents soil dryness. Drought accompanied by high temperatures reduces the number of ears per square meter and accelerates, causing decrease in grain productivity [10].

Grain yield (kg.ha-1)

Grain yield irrigation with spraying was superior to a rate of 456 kg.ha-1 compared to surface irrigation of 328.7, and the L.S.D was 1374.3 kg.ha-1and for the overlap was 1434.0 kg.ha-1 meaning the productivity of wheat with irrigation with spraying was higher, this consistent with what was found.

Al-Jubouri et al. [11] indicated that the production of wheat variety Aba gave an optimal production of 10390 kg.ha-1.

% The harvest index

- In the harvest index, sprinkler irrigation was superior to surface irrigation with a significant difference of 0.524. Wnuk [12] found that the harvest index increased with increasing grain weight.

Statistical analysis

Simple correlation coefficient (Table 4) shows the simple correlation coefficient between the studied traits in an experiment using two types of irrigation methods (spraying – surface irrigation) and four levels of nitrogen fertilization (0, 50, 100, 150) kg.ha-1.

The correlation coefficient showed that the relationships between the phenotypic traits of wheat plants shown in the following table are all positive, and the difference in their strength depends on the irrigation method and the fertilizer dose of urea. Sprinkler irrigation was superior to surface irrigation.

Conclusion

The study showed that increasing the levels of nitrogen fertilizer increased the average plant height, the number of ears per m2, the weight of grains in m2, and the weight of 1000 seeds (g).

The reason is attributed to increasing the efficiency of photosynthesis by increasing the manufactured materials, which had a positive effect and increased their weight.

This means that nitrogen is the nutritional element.

The first determines the production of agricultural crops Nitrogen is the first nutrient fertilizer that wheat requires.

Table 4. The phenotypic correlation between the studied traits of wheat plants is at the level of the least significant difference P<0.05

Correlation coefficient value	Plant length cm		Spike length cm		Number of grains in spike		1000 seeds weight g		Spike number per square meter		Grain yield (kg.ha^{-1})		Harvest index %	
	Surface .irr	Sprinkler .irr	urface .irr	Sprinkler .irr	Surface .irr	Sprinkler .irr	Surface .irr	Sprinkler .irr	Surface .irr	Sprinkler .irr	Surface .irr	Sprinkler .irr	Surface .irr	Sprinkler irr
Plant length (cm)	1													
Spike length (cm	0.81	0.72	1											
Number of grains in spike	0.93	0.95	0.66	0.85	1									
Spike number per square meter	0.37	0.80	0.59	0.28	0.03	0.53	1							
1000 seeds weight g	0.52	0.93	0.78	0.89	0.23	0.99	0.96	0.99	1					
Grain yield kg.ha^{-1}	0.61	0.93	0.84	0.92	0.32	0.98	0.93	0.99	0.99	0.99	1			
% Harvest index	0.89	0.68	0.98	0.99	0.76	0.90	0.54	0.07	0.75	0.68	0.75	0.98	1	

It is noted that there are significant differences between the levels of nitrogen. fertilizer, and there are also differences according to the irrigation method.

The sprinkler irrigation system gave the highest rate of grains yield characteristic compared to surface irrigation.

Recommendations

- We recommend using the sprinkler irrigation method instead of surface irrigation to treat the water shortage because of its results in increasing production quantitatively and qualitatively.

- The need to use the fertilizer dose of urea150 (kg.ha-1) because it was the best.

- Avoid using sprinkler irrigation in case of strong wind speeds greater than 15-20 km per/hour that hinder the regular distribution of water on the ground. also, the water used in irrigation is of high salinity.

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