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EFFECT OF IRRIGATION WATER QUALITY, ORGANIC MATTER AND SPRAYING WITH ZINC NANO-FERTILIZERS ON SOME SOIL PROPERTIES AND SUNFLOWER GROWTH

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Abstract

A field experiment was conducted in Al-Mahaweel district, Al-Imam hand, Al-Birawi region, in a soil with a texture of Silty Clay Loam classified into the major typic torrifluvent group according to the randomized complete block design (RCBD), Split plot experiment with three replications, to study the effect of irrigation water quality, organic matter, and the level of zinc nano-fertilizer applied as a spray on plants, and the effect of their interaction on some soil properties, which include EC, PH, SAR, and soil organic matter, and growth traits such as plant height and percentage of chlorophyll in sunflower leaves, the experiment included three variables: irrigation with four types of different electrical conductivity 2, 4, 6, and 8 dSiemens, three levels of organic fertilizer (zero) without addition, 20 tons.ha^{-1} of cow manure and sheep manure, and three levels of zinc nanofertilizer 0, 1.5, and 3 g.L^{-1}, the organic matter showed a significant increase in the chlorophyll content of the leaves of the sunflower plant, while spraying nanoparticles of zinc did not affect the SAR, pH and OM, The effect of the interaction between the three factors was significant on soil properties. The seeds were sown on 5/3/2022 by the method of midwives and in cork dishes, and the seed variety was luleo from a French originator. The midwives were transferred after thirty days to the permanent site, and the results showed an increase in the salinity of the irrigation water. It led to a significant increase in the values of electrical conductivity, the percentage of adsorbed sodium, and soil content of organic matter, and to a significant decrease in the pH of soil and plant height, with the addition of organic residues to the soil. It led to a significant decrease in the values of electrical conductivity, the percentage of adsorbed sodium, and the pH of the soil, and increased the soil content of organic matter, and mitigated the harmful effect of salinity of irrigation water, in addition to that, nano fertilizer and zinc did not have a significant effect on the chemical properties of the studied soil, and the interaction between The three factors influence the chemical properties of the soil. Plant height and chlorophyll percentage in sunflower plants.

Keywords: Irrigation water quality, organic fertilizer, zinc nano-fertilizer, sunflower.

Introduction

The problem of water scarcity is a global problem, as the world witnessed, especially in the past two decades and in many countries, a large and sharp decrease in precipitation, which led to a major problem in the amount of fresh water, as the problem of water scarcity is considered one of the most important problems that Iraq faces due to the drought that has been exposed in recent years, in addition to the continuous storage of water in neighboring countries where the sources of rivers are located, population density has increased and the need for food has increased, so there has been a significant expansion of the agricultural area and the amount of water consumed by the agricultural sector in Iraq is estimated at more than 90% of the total consumed water [2]. This led to an increase in the demand for water, which led to the use of alternative sources of poor quality such as puncture water and wells to compensate for the shortage of fresh water and adding organic fertilizers increases the soil's ketogenic exchange capacity, as well as increases the soil's organic matter content, and it helps reduce soil pH [11]. The concentration of ions in the irrigation water is the main factor determining the amount of added salts, which are responsible for determining the salinity of the soil and the concentration of positive and negative ions in it. The ionic composition of the irrigation water affects the quality of the ions prevailing in the soil solution depending on their concentration in the irrigation water, as the use of water with a high concentration Of a particular ion can lead to the dominance of that ion on the surfaces of the exchange complex and then affect the availability and absorption of other nutrients [9,5].

The soil properties most affected by the irrigation water quality and the fastest change are the chemical properties of the soil such as the electrical conductivity EC, the pH of soil, and the sodium adsorption ratio SAR [13].

Found [17] increasing the salinity of the irrigation water led to a significant increase in the values of electrical conductivity and the percentage of adsorbed sodium, and to a significant decrease in the degree of soil reaction and plant characteristics. In order to mitigate the negative effects of using salt water, organic residues are added that improve the physical and chemical properties of the soil, and then increase the availability of nutrients and water for the plant. It prevents the accumulation of salts in the soil. It was found [25] that the addition of organic matter by 5% of the weight of the soil in the potting and irrigation experiment with diluted seawater with electrical conductivity of 4.8 and 8.6 D Siemens led to a decrease in the harmful effect of irrigation with saline water, as the addition of organic matter improved the soil structure and increased the porosity, Which helps to increase the movement of water through the soil, prevent salt build-up, increase the available water, and increase the growth and production of the sunflower crop. The quality of irrigation water and organic fertilizers are among the important factors that greatly affect the efficiency of zinc fertilizer, especially saline water, as well as the quality of the dominant ions in the water, especially monomers such as chloride and sodium, which work to dissolve calcium carbonate and release more calcium, which accelerates the mechanism of zinc precipitation and leads to a decrease in In the readiness of zinc for the plant with an increase in the concentration of salts [3].

This study was conducted to investigate the effect of irrigation water quality, organic matter, zinc nano-fertilizer level, and the effect of their interaction on some soil chemical properties and sunflower plant growth.

Materials and Methods

A field experiment was conducted during the spring season of 2022 in one of the private peasant farms within Al-Shahwaniya boycott 31 of Al-Imam hand/ Al-Mahaweel district / Babil Governorate (30 km north of Babil Governorate) from March 2022 until June 2022. With an area of (18 m × 128 m= 2304 m^2) In order to know the effect of irrigation water quality, organic fertilization, and nano-fertilizers on soil properties and sunflower growth. Silty Clay Loam texture. The experiment was applied according to a split-plot arrangement using a randomized complete block design (RCBD) and with three replications, where the main plots occupied the irrigation water salinity levels They are (2, 4, 6, 8) de Siemens.m^{-1} and denoted by the symbols (a1, a2, a3, a4), respectively, while the type of organic waste occupied the sub-blocks and denoted by the symbols (b0.b1, b2) respectively, while the processors occupied Zinc nano-fertilizers contain sub-plots and denoted by (c0, c1, c2).

The treatments were distributed in the field according to the design of the randomized complete blocks into 108 treatments and with three replicates planted using the Marouz method, and 1.5 m intervals were left between the main units into each sector and 1 m intervals between the secondary and sub-secondary panels.The area of one board was ($3m \times 4m$ = $12m^2$) separated by shoulder width of 1m.

The studied factors:

The first factor: the quality of the irrigation water, which represents the main factor, the Main-Plot, which has four types and a symbol for them.

a1: Irrigation with river water of electrical conductivity (EC= 2 dSiemens.m^{-1})

a2: Irrigation with water of electrical conductivity (EC= 4 dSiemens.m^{-1})

a3: Irrigation with water of electrical conductivity (EC= 6 dSiemens.m^{-1})

a4: Irrigation with water of electrical conductivity (EC= 8 dSiemens.m^{-1})

Table 1. Some chemical properties of the water used in the experiment

Unit	**Irrigation water quality**				**Adj**
	a4	a3	a2	a1	
dSiemens.m^{-1}	8	6	4	2	Ec
mmol.L^{-1}	7.03	7.18	7.69	7.82	Ph
	9.89	7.52	6.63	4.76	Ca
	7.06	6.04	5.75	3.49	Mg
	21.38	16.44	12.33	7.84	Na
	0.35	0.28	0.16	0.12	K
	22.63	13.65	12.54	8.48	Cl
	9.45	7.34	6.78	5.57	SO_4
	3.15	2.42	2.92	1.25	CO_3
	6.21	4.88	5.43	2.51	HCO_3
mho's	5.19	4.47	3.5	2.73	SAR
	C_4S1	C_4S1	C_4S_1	C_3S_1	**water quality**

The water has been classified according to the classification of the American Salinity Laboratory (USDA) mentioned in [20].

The second factor: the levels of organic fertilizer represent the secondary factor SUB- PLOT, which has three levels and their symbol:

B0: comparison treatment (without adding organic fertilizer)
B1: It represents the addition of 20 tons.h^{-1} of cow manure
B2: It represents the addition of 20 tons.h^{-1} of sheep manure
The third factor: the levels of ZN nanofertilizer, and it represents the sub-secondary factor (SUB-SUB-PLOT)), which has three levels and their symbol:
C0: Comparative treatment (without adding zinc nanofertilizer)
C1: represents an addition of 1.5 g.L^{-1} (Zinc Nano Fertilizer)
C2: represents an addition of 3 g. L^{-1} (Zinc Nano Fertilizer)
For the purpose of knowing the physical and chemical properties of the soil before planting, random samples were taken from different places of the soil of the experiment field at a depth of 0 - 30 cm, and the required tests were conducted on them. Table (1) shows some characteristics of the study soil. methods) and according to the method presented (22) for the purpose of estimating soil texture.
The bulk density of the soil was estimated using the core method, as in [22]. The electrical conductivity (EC) and the pH (pH) of the saturated soil paste extract were measured with the (EC-meter) and the (pH meter) device as mentioned in [24], the amount of calcium and magnesium dissolved by agitation with Na2-EDTA as reported in Richards, 1954, the amount of potassium and sodium dissolved using a flame photometer as stated in Richards 1954. Carbonates and bicarbonates were estimated by saturation with sulfuric acid (0.01 N) as in [23]. The chloride was estimated by litheation with silver nitrate (0.05 N) as mentioned in [20]. Sulfates were estimated by precipitation method with barium chloride and as stated in [23] sodium adsorption ratio SAR according to the equation.

$$\mathbf{SAR} = \frac{Na^+}{\sqrt{Ca^{+2} + Mg^{+2}}} \text{ (mmol.L}^{-1}\text{)}$$

The organic matter was determined by the method of dry digestion, Black, Walkly, as mentioned in [24].
Determine the available zinc (mg.kg^{-1} soil) according to the method (Lindsay and Norvel, 1978) after extraction with the chelated compound DTPA using an atomic absorption spectrophotometer (Model. Shimadzu AA-6200), and the available nitrogen (mg.kg^{-1} soil) extracted with a KCL 2N solution using a microcaldal apparatus, the pH was raised using MgO and the nitrate ion was reduced using Devarda alloy according to method [24].
The available phosphorus (mg. kg^{-1} soil) was estimated by extracting it from the soil by (Olsen and Sommers, 1982) using sodium bicarbonate at a half-molar concentration (0.5M-NaHCO3) and the color phase was determined using a method using ammonium molybdate and ascorbic acid, and it was estimated using a spectrophotometer. At a wavelength of 882 nm according to (24). The prepared potassium (mg.kg-1 soil) was extracted by ammonium acetate (1N-NH4OAC) at pH = 7 and estimated using a flame retardant device [24].

Table 2. Chemical and physical characteristics and properties of the study soil before planting

Unit	value	Adjective	
	7.8	The pH of the soil pH suspended 1-1	
desi siemens.m^{-1}	3.23	Electrical conductivity EC 1-1	
Cmol	35	Cation-exchange capacity CEC	
mmol.l^{-1}	10.22	Calcium	dissolved Cations
	7.66	Magnesium	
	15.28	Sodium	
	0.59	Potassium	
	Nil	Carbonate	dissolved Anions
	3.35	Bicarbonate	
	10.63	Sulfites	
	20	Chloride	
%	1,7	Organic Matter	
PPM	40	Available Nitrogen	
	8,9	Available Phosphorous	
	180	Available Potassium	
%	49	Sand	soil separates
	20	Silt	
	31	Clay	
Silty Clay Loam		Soil Texture	
1.27 mcg.m^{-3}		Bulk Density	
2.84 $(mmol.l^{-1})^{-1/2}$		Sodium adsorption ratio SAR	

Sunflower seeds of the luleo cultivar produced by the French company Panam were used. The seeds were sown on 5/3/2022 in cork dishes after filling them with (German) peptmus, where one seed was placed in each sample to produce single seedlings, respectively. The plates were placed in a nursery in the study area of Al-Imam district, Babylon Governorate, and after 30 days they were ready for cultivation. On 4/4/2022, the plants were transferred to the experimental site after watering them with irrigation, where they were planted in the lower third of the field. Two days after planting, it was irrigated in a nearby wilderness to activate the root, then the irrigation process continued according to the recommended water quality (2, 4, 6, 8 dSiemens.m^{-1}) which is denoted (a4, a3, a2, a1) in the experiment and to flowering stage. Zinc nano-fertilizer from the Green Iranian Company (chelated zinc fertilizer 12%) was used (1 kg package) using the foliar spray method for the purpose of fertilizing with zinc nano-fertilizer. high temperatures, and the number of sprays was 3 times during the growth stages, starting from the height of the plant 25 cm until the flowering stage. Due to the occurrence of dust storms during the season of implementation of the experiment, the washing process was carried out continuously, especially before spraying the nano-zinc fertilizer, to make sure that the plants benefit from the fertilizer and for the purpose of conducting irrigation operations in the experimental area, four salinity levels for irrigation water were prepared by mixing puncture water Ec = 10 dSiemens.m^{-1} with river water Ec = 2 dSiemens.m^{-1}. The puncture water was obtained from one of the drains available in the study area, and the salinity levels of irrigation water used in each irrigation were measured by an Ec-meter.

The process of decomposing the two organic fertilizers (sheep and cows) was completed on 7/3/2022 by placing them in two basins (a basin for each fertilizer) with dimensions (2 x 3 x 1) m3. The pit was filled with organic fertilizer in layers and moistened with water until the appropriate humidity was reached, and 2 kg of fertilizer was added. Urea fertilizer to increase the activity of microorganisms and the speed of decomposition of the organic fertilizer, then it was covered with transparent nylon for the purpose of encouraging anaerobic reactions and reducing the loss of nitrogen during the decomposition process, and they were stirred from time to time, after which they were extracted from the hole and spread in the form of a light layer to dry aerobically, and it was added to the experimental soil after the leveling process Before the milling process, and according to the quantities recommended in the experiment, a sample was taken from both fertilizers for post-decomposition analysis [25].

Table 4. Some chemical properties of the organic waste used in the experiment

Organic waste		**Measuring unit**	**Properties**
Cows	Sheep		
4.3	**4.51**	**desi siemens.m^{-1}**	**electrical conductivity**
7.4	**6.50**		**pH**
345.06	**455.01**	**g.Kg^{-1}**	**organic carbon**
17.50	**18.10**		**N total**
6.36	**6.86**		**P total**
4.50	**5.00**		**K total**
20	**17**		**C/N Ratio**

Characteristics of vegetative growth:

Plant height (cm) was measured by measuring tape starting from the point of contact of the plant with the soil to the base of the flower disc. The leaf chlorophyll content (µg) was estimated by a SPAD Meter.

The data were analyzed statistically using the Excel statistical analysis program according to the design used, and the averages were compared with the least significant difference (LSD) at a significant level of 0.05 to determine the difference between the averages [23].

Results and discussion

electrical conductivity

It is noted from the results in Table (5) that the increase in the salinity of the irrigation water led to a significant increase in the values of the electrical conductivity of the soil, as the average values of the electrical conductivity of the soil were 3.08, 5.37, 7.22, and 8.54 dSiemens M-1 for the treatments irrigated with electrically conductive water. 2, 4, 6 and 8 dSiemens M-1, respectively. The reason for this is attributed to the accumulation of salts with the increase in the salinity of the irrigation water, as a result of the difference in the ionic composition of the used irrigation water, as shown in Table No. (3). This result agrees with what was obtained [12, 23 and 25].

As for the effect of the levels of organic fertilizer, it had a significant effect on reducing the electrical conductivity values, as the rates of the electrical conductivity values of the saturated soil paste extract were 6.35, 6.05, and 5.75 dSiemens.m^{-1} at the application levels of 0 and 20 tons.ha^{-1} of cow and sheep manure on respectively. The reason for the decrease in the electrical conductivity values of the soil when treated with organic waste is attributed to the improvement of the physical properties of the soil, and then the improvement of soil structure, the increase in the stability of its aggregates, its permeability, and the increase in porosity. Which helps in the high movement of water through the soil and reduces the movement of salts upwards, and increases the speed of leaching in it, which leads to mitigating the harmful effect of the salinity of irrigation water and preventing the movement of salts to the surface of the soil, as well as diluting the soil solution resulting from increasing the ability of the soil to retain water when it is treated with organic residues It chelates the nutrients and makes them not loose in the soil solution. This result agrees with the findings of [19 and 25], who found that adding organic fertilizer to the soil leads to mitigating the harmful effect of salinity of irrigation water and preventing the accumulation of salts in the soil. As for the effect of zinc nano-fertilizer levels, the results indicate that increasing the fertilizer level led to a non-significant increase in the electrical conductivity values, reaching 6.012, 6.02, and 6.01 dSiemens.m^{-1}, respectively.

The results of the same table indicate that there are significant differences between the binary interference of organic matter and nano-zinc fertilizer (sheep manure and spraying at the third level of nano-zinc fertilizer) in reducing the electrical conductivity values and amounted to 5.61 dSiemens.m^{-1} compared to the comparison treatment, which gave the highest rate of 6.36 dSiemens.m^{-1} The reason may be attributed to the effect of the interaction between the factors and the effect of the organic matter on the soil properties. [4 and 1]. As for the triple overlap, the results showed that there were significant differences in raising the electrical conductivity values, and the treatment excelled (the second level of irrigation water quality and sheep manure and the third level of nano-zinc fertilizer) and gave the highest rate of 9.01 dSiemens m-1 compared to the treatment (2 dSiemens.m^{-1}, sheep manure and 3 g.L^{-1} of zinc nano-fertilizer), which gave the lowest rate of 2.88 dSiemens.m^{-1}. The reason may be attributed to the interaction of the experimental factors.

Table 5. The effect of irrigation water quality, organic matter and levels of zinc nano-fertilizer on electrical conductivity, dSiemens.m^{-1} .

A*B	Zinc nano fertilizer gm.L^{-1}			Compost 20 tons.ha^{-1}	Irrigation water quality
	3	1.5	without spraying		
3.20	3.14	3.17	3.28	without addition	a1 2ds.m^{-1}
3.12	3.04	3.08	3.23	Cow compost	
2.93	2.88	2.93	2.98	Sheep compost	
5.71	5.89	5.73	5.50	without addition	a2 4ds.m^{-1}
5.36	5.21	5.37	5.49	Cow compost	
5.04	4.81	5.09	5.23	Sheep compost	
8.11	8.32	7.68	8.32	without addition	a3 6ds.m^{-1}
6.94	7.05	6.99	6.77	Cow compost	
6.62	6.43	6.58	6.84	Sheep compost	
8.41	8.47	8.43	8.33	without addition	a4 8ds.m^{-1}
8.80	8.57	8.82	9.01	Cow compost	
8.41	8.33	8.40	8.48	Sheep compost	
0.795	**0.342**			**LSD 0.05**	
A * C					
3.08	3.02	3.06	3.16	**a1 2ds.m^{-1}**	
5.37	5.30	5.40	5.41	**a2 4ds.m^{-1}**	
7.22	7.27	7.09	7.31	**a3 6ds.m^{-1}**	
8.54	8.46	8.55	8.61	**a4 8ds.m^{-1}**	
0.599	**0.197**			**LSD 0.05**	
B * C					
6.35	6.45	6.25	6.36	**without addition**	
6.05	5.97	6.07	6.13	**Cow compost**	
5.75	5.61	5.75	5.88	**Sheep compost**	
0.397	**0.171**			**LSD 0.05**	
	6.01	6.02	6.12	**Average**	
	0.099			**LSD 0.05**	

pH of Soil

The results in Table 6 showed a significant decrease in the pH of soil with an increase in the salinity of the irrigation water, as the average values were 7.82, 7.80, 7.83, and 7.78 for the irrigated treatments with electrical conductivity water of 2, 4, 6, and 8 dSi m-1, respectively, and the reason for this is The increase in the salinity of the irrigation water leads to the accumulation of neutral salts, which caused a decrease in the degree of soil reaction towards neutralization [9].

Table 6 Effect of irrigation water quality, organic matter and levels of zinc nano-fertilizer on the pH of soil

A*B	**Zinc nano fertilizer gm.L^{-1}**			**Compost 20 tons.ha^{-1}**	**Irrigation water quality**
	without spraying	**without spraying**	**without spraying**		
7.87	7.84	7.87	7.89	**without addition**	**a1 2ds.m^{-1}**
7.85	7.81	7.87	7.88	**Cow compost**	
7.73	7.53	7.83	7.84	**Sheep compost**	
7.84	8.15	7.68	7.68	**without addition**	**a2 4ds.m^{-1}**
7.95	7.87	7.90	8.08	**Cow compost**	
7.62	7.47	7.65	7.74	**Sheep compost**	
7.99	8.06	8.03	7.87	**without addition**	**a3 6ds.m^{-1}**
7.86	7.80	7.87	7.93	**Cow compost**	
7.62	7.61	7.58	7.69	**Sheep compost**	
7.96	7.98	8.00	7.90	**without addition**	**a4 8ds.m^{-1}**
7.80	7.67	7.83	7.89	**Cow compost**	
7.58	7.54	7.58	7.62	**Sheep compost**	
0.109	**0.170**			**LSD 0.05**	
A * C					
7.82	7.73	7.86	7.87	**a1 2ds.m^{-1}**	
7.80	7.83	7.74	7.84	**a2 4ds.m^{-1}**	
7.83	7.82	7.83	7.83	**a3 6ds.m^{-1}**	
7.78	7.73	7.80	7.80	**a4 8ds.m^{-1}**	
0.093	**0.098**			**LSD 0.05**	
B * C					

7.91	8.01	7.90	7.84	**without addition**
7.87	7.79	7.87	7.95	**Cow compost**
7.64	7.54	7.66	7.72	**Sheep compost**
0.054	**0.085**			**LSD 0.05**
	7.78	7.81	7.84	**Average**
	0.049			**LSD 0.05**

As for the effect of adding organic waste on the pH values, the results showed a non-significant decrease in the values of the pH of soil by adding organic waste, as the average values were 7.91, 7.87, and 7.64 at the levels of addition of 20 $tons.ha^{-1}$ of cow and sheep manure, respectively.
As for the levels of nano-zinc fertilizer, it did not significantly affect the values of the pH of soil . The results of the statistical analysis showed an almost negligible effect of the levels of spraying in reducing the values of the pH of soil , as they reached 7.84, 7.81, and 7.78 at the levels of 0, 1.5, and 3 $g.L^{-1}$, respectively. This result agrees with what was reached by [3], which found that increasing the levels of adding nano-zinc fertilizer did not significantly affect the values of the pH of soil . As for the effect of the triple interaction between irrigation water quality, levels of organic matter, and nano-zinc fertilizer, the effect was non-significant, as it reached the highest value 8.15 when irrigating with water with a conductivity of 4 mm bananas and the level of 0 $tons.ha^{-1}$ of organic fertilizer and 3 $g.L^{-1}$ of nano-zinc fertilizer and the lowest value 7.47 when irrigating with water with an electrical conductivity of 4 $dSiemens.m^{-1}$ and the level of 20 $tons.ha^{-1}$ of organic cow manure And at the level of 3 $g.L^{-1}$ of nano fertilizer.

Organic Matter

The results are shown in Table 7. A significant effect of the quality of irrigation water on the soil content of organic matter, as the soil content of organic matter increased with the increase in the salinity of the irrigation water, as the soil content of organic matter was 0.91, 1.06, 1.21, and 1.29 $g.kg^{-1}$ for the treatments irrigated with water With electrical conductivity of 2, 4, 6, and 8 $dSiemens.m^{-1}$, respectively, the reason for the increase in the soil content of organic matter with the increase in the salinity of irrigation water may be attributed to the decrease in biological activity in such conditions, and then the organic residues remain for a longer period in the soil, causing an increase in soil content. of organic matter, in addition to that salinity may cause higher erroneous values of organic matter to be given due to the consumption of chlorite ions for the part of potassium dichromate used in the determination of organic matter, and this result agrees with what was obtained (19) in that an increase in the salinity of the medium leads to an increase in the soil content of Organic matter As for the effect of organic waste on the soil content of organic matter, the results showed a significant effect of adding organic waste on increasing the soil content of organic matter, as the average values were 1.07, 1.11, and 1.17 at levels The addition of 0 and 20 $tons.ha^{-1}$ of cow and sheep manure, respectively. As for the effect of nano-zinc fertilizer levels on the soil content of organic matter, the results of the statistical analysis showed that there was no significant effect on the soil content of organic matter, as the rates of soil content of organic matter were 1.11 and 1.11. and 1.13 at the application levels of 0 and 20 tons.ha^{-1} of cow and sheep manure, respectively, and Table 7 shows this

Table 7. Effect of irrigation water quality, organic matter and zinc nano-fertilizer levels on soil organic matter content

A*B	Zinc nano fertilizer gm.L^{-1}			Compost 20 tons.ha^{-1}	Irrigation water quality
	without spraying	without spraying	without spraying		
0.84	0.88	0.85	0.81	**without addition**	**a1 2ds.m^{-1}**
0.92	0.89	0.90	0.98	**Cow compost**	
0.95	0.94	0.95	0.96	**Sheep compost**	
1.00	0.98	1.00	1.01	**without addition**	**a2 4ds.m^{-1}**
1.05	1.09	1.07	1.00	**Cow compost**	
1.14	1.23	1.18	1.01	**Sheep compost**	
1.19	1.27	1.13	1.17	**without addition**	**a3 6ds.m^{-1}**
1.22	1.25	1.15	1.25	**Cow compost**	
1.23	1.17	1.25	1.26	**Sheep compost**	
1.24	1.24	1.20	1.26	**without addition**	**a4 8ds.m^{-1}**
1.25	1.22	1.28	1.25	**Cow compost**	
1.38	1.40	1.39	1.33	**Sheep compost**	
0.057	**0.072**			**LSD 0.05**	
A * C					
0.91	0.90	0.90	0.92	**a1 2ds.m^{-1}**	
1.06	1.10	1.08	1.01	**a2 4ds.m^{-1}**	
1.21	1.23	1.17	1.23	**a3 6ds.m^{-1}**	
1.29	1.29	1.29	1.28	**a4 8ds.m^{-1}**	
0.034	**0.042**			**LSD 0.05**	
B * C					
1.07	1.09	1.05	1.06	**without addition**	

1.11	1.11	1.10	1.12	**Cow compost**
1.17	1.19	1.19	1.14	**Sheep compost**
0.028	**0.036**			**LSD 0.05**
	1.13	1.11	1.11	**Average**
	0.021			**LSD 0.05**

Sodium Adsorbent Rate (SAR)

The results showed in Table 8, a significant effect of the quality of the irrigation water on the sodium adsorption rate, as the adsorptive sodium percentage increased in the soil with the increase in the salinity of the irrigation water, as the values reached 3.43, 3.74, 5.19, and 7.35 mmol. L-1 for the treatments irrigated with water with electrical conductivity 2 and 4, 6 and 8 dSiemens M-1, respectively, and the reason for this is due to the possibility of sedimentation of the calcium and magnesium ions, as their competition with the sodium ion decreases, and thus the percentage of sodium adsorbed in the soil increases, and this result agrees with what was obtained (6 and 27). As for the effect of organic residues on the percentage of sodium adsorption in the soil, its addition had a significant effect in reducing the percentage of adsorbed sodium, as the SAR rates in the soil were 5.30, 4.97, and 4.51 mmol.L-1 at the application levels of 0 and 20 tons.ha^{-1} of cow and sheep manure. Respectively, the reason for the low SAR values in the soil when treated with organic waste is due to the liberation of organic acids during the decomposition of organic fertilizer, which has an effect on dissolving some carbonate minerals, especially calcite and machinite, which carry magnesium, and leads to the liberation of quantities of calcium and magnesium, in addition to improving the physical properties of the soil. And then improve the structure of the soil and its permeability and increase the speed of leaching in it, which reduces the accumulation of salts in the soil, especially the sodium ion compared to the calcium and magnesium ions, which works to reduce the value of the numerator in the equation for calculating SAR equation (1) and these results agree with what was obtained [20 and 25] either the effect The levels of zinc nano-fertilizer, the results of the statistical analysis showed that there was no significant effect on the SAR values in the soil. As for the effect of the triple overlap, the results of the statistical analysis showed a significant effect of these factors on the SAR values, as it reached the highest value of 7.74 mmose.l^{-1} when irrigating with water with electrical conductivity of 8 dSi m-1 and level 0 kg of organic fertilizer and at level 3g. . liters of nano-zinc fertilizer, and the lowest value was 3.15 mmol.l when irrigating with water with electrical conductivity of 2 dSiemens.m^{-1} and the level of 20 tons.ha^{-1} of sheep manure, and at the level of 3 g. liters of zinc nano-fertilizer, and these results agree with what was obtained [19 and 14] who found an increase in SAR values with increasing irrigation water salinity, noting the role of organic matter in mitigating the harmful effect of irrigation water salinity.

Table 8. Effect of irrigation water quality, organic matter and levels of zinc nano-fertilizer on the percentage of adsorbed sodium (mmose.l^{-1})

A*B	Zinc nano fertilizer gm.L^{-1}			Compost 20 tons.ha^{-1}	Irrigation water quality
	without spraying	without spraying	without spraying		
3.67	3.76	3.74	3.52	**without addition**	**a1 2ds.m^{-1}**
3.39	3.39	3.41	3.37	**Cow compost**	
3.22	3.15	3.25	3.27	**Sheep compost**	
4.20	4.33	4.16	4.10	**without addition**	**a2 4ds.m^{-1}**
3.67	3.64	3.76	3.60	**Cow compost**	
3.35	3.16	3.39	3.50	**Sheep compost**	
5.63	6.10	5.22	5.56	**without addition**	**a3 6ds.m^{-1}**
5.53	5.65	5.85	5.09	**Cow compost**	
4.41	3.87	4.71	4.65	**Sheep compost**	
7.68	7.74	7.62	7.69	**without addition**	**a4 8ds.m^{-1}**
7.29	7.10	7.45	7.32	**Cow compost**	
7.08	7.27	7.14	6.82	**Sheep compost**	
0.204	**0.549**			**LSD 0.05**	
A * C					
3.43	3.43	3.47	3.39	**a1 2ds.m^{-1}**	
3.74	3.71	3.77	3.73	**a2 4ds.m^{-1}**	
5.19	5.21	5.26	5.10	**a3 6ds.m^{-1}**	
7.35	7.37	7.40	7.27	**a4 8ds.m^{-1}**	
0.277	**0.317**			**LSD 0.05**	
B * C					
5.30	5.48	5.19	5.22	**without addition**	
4.97	4.95	5.12	4.85	**Cow compost**	
4.51	4.36	4.62	4.56	**Sheep compost**	
0.102	**0.274**			**LSD 0.05**	

	4.93	4.98	4.87	**Average**
	0.158			**LSD 0.05**

Plant Height

The results shown in Table 9 showed a significant effect on plant height by increasing the salinity of the irrigation water, as the plant height rates reached 90.46, 83.81, 79.23 and 76.94 cm for the treatments irrigated with water of electrical conductivity 2, 4, 6 and 8 dSi m-1, respectively. The reason for the decrease can be attributed to height The plant, with the increase in the salinity of the irrigation water, leads to the accumulation of salts that cause osmotic and toxic effects on the plant, and then decreases its absorption of water and the nutrients it needs to carry out its vital activities. As for the effect of adding organic waste, it had a significant effect on increasing the plant's height, as it reached rates of 74.68, 82.24, and 90.91. Toxin at application levels of 0 and 20 tons.ha^{-1} of cow and sheep manure, respectively. The reason for the increase in plant height when the soil is treated with organic waste can be attributed to the improvement of the soil's physical, chemical and fertility properties, an increase in the absorption of some nutrients necessary for the plant, and a reduction in the harmful effect of the salinity of irrigation water, and then an increase in plant height. This result is consistent with what was reached by (15 and 10). As for the effect of the levels of nano-zinc added spraying on the leaves, the results of the analysis showed that the rates of plant height increased significantly with the increase in the levels of nano-zinc fertilizer, reaching 78.98, 82.95, and 85.90 cm at nano-zinc levels of 0.1.5 and 3 g.L^{-1}, respectively. This refers to the role of zinc in increasing plant growth, increasing vital activities, the enzymatic system in the plant, starch formation, regulating sugar consumption and producing energy needed for vital activities in the plant. This result agrees with what was obtained (27 10). The height was 98.50 cm when irrigating with water with a conductivity of 2 dSiemens.m^{-1} and level 20 tons.ha^{-1} of organic sheep manure and level 3 g.L^{-1} of nano-zinc fertilizer. The lowest height was 66.33 cm when irrigating with water with a conductivity of 8 dSiemens.m^{-1} and levels 0 of Organic fertilizer and nano-zinc. The reason for this may be attributed to the role of each of the organic matter and zinc in reducing the harmful effect of the salinity of irrigation water, and thus an increase in plant height.

Table 9. Effect of irrigation water quality, organic matter and zinc nano-fertilizer levels on sunflower plant height.

Mean	**Zinc nano fertilizer gm.L^{-1}**			**Compost 20 tons.ha^{-1}**	**Irrigation water quality**
	without spraying	**without spraying**	**without spraying**		
83.48	86.53	86.00	77.92	**without addition**	**a1 2ds.m^{-1}**
90.75	92.33	91.67	88.25	**Cow compost**	
97.14	98.50	96.50	96.42	**Sheep compost**	

73.72	76.42	75.67	69.08	**without addition**	**a2 4ds.m^{-1}**
83.86	90.17	84.08	77.33	**Cow compost**	
93.86	98.42	92.17	91.00	**Sheep compost**	
72.50	75.58	71.67	70.25	**without addition**	**a3 6ds.m^{-1}**
79.25	82.75	78.00	77.00	**Cow compost**	
85.94	89.83	85.00	83.00	**Sheep compost**	
69.03	71.08	69.67	66.33	**without addition**	**a4 8ds.m^{-1}**
75.08	77.42	75.08	72.75	**Cow compost**	
86.69	91.75	89.92	78.42	**Sheep compost**	
0.993		**1.669**		**LSD*0.05***	
		A * C			
90.46	92.46	91.39	87.53	**a1 2ds.m^{-1}**	
83.81	88.33	83.97	79.14	**a2 4ds.m^{-1}**	
79.23	82.72	78.22	76.75	**a3 6ds.m^{-1}**	
76.94	80.08	78.22	72.50	**a4 8ds.m^{-1}**	
0.718		**0.963**		**LSD*0.05***	
		B * C			
74.68	77.40	75.75	70.90	**without addition**	
82.24	85.67	82.21	78.83	**Cow compost**	
90.91	94.63	90.90	87.21	**Sheep compost**	
0.496		**0.834**		**LSD*0.05***	
	85.90	82.95	78.98	**Average**	
		0.482		**LSD*0.05***	

Percentage Of Chlorophyll

The results in Table 10 showed a significant decrease in the chlorophyll percentage with an increase in the salinity of the irrigation water, as the rates reached 48.74, 47.02, 44.74, and 42.25 cm for the irrigated treatments with electrical conductivity waters of 2, 4, 6, and 8 dSi M-1, respectively. Irrigation water leads to the accumulation of salts that cause osmotic effects on the plant, which reduce water absorption, as well as affect surface tension and stop elongation of cells, which affects the lack of transfer of nutrients and growth hormones from the roots to the rest of the plant parts due to the lack of absorbed water. As for the effect of adding organic waste It had a significant effect on increasing the percentage of chlorophyll in the leaves, as the chlorophyll levels reached 42.13, 45.24, and 49.69 mg.e at the application levels of 0 and 20 tons.ha^{-1} of cow and sheep manure, respectively. The reason for the increase in chlorophyll when treating the soil with organic waste can be attributed to the improvement of the soil's physical, chemical and fertility properties, an increase in the absorption of some nutrients necessary for the plant, and a reduction in the harmful effect of the salinity of irrigation water, and then an increase in chlorophyll.). As for the effect of the levels of zinc nano-fertilizer applied as a spray on the leaves, the results of the analysis showed that the percentage of chlorophyll increased significantly with the increase of the levels of zinc nano-fertilizer, reaching 43.15, 46.08, and 47.84 at the levels of nano-zinc 0.1.5 and 3 g.L^{-1}. In succession, this is due to the role of zinc nanoparticles in increasing the activity of catalyst enzymes to inhibit the effectiveness and stop the production of ethylene, which has a role in the activity of the chlorophyll oxidation enzyme, which destroys chloroplasts, as it leads to the division of chlorophyll and the survival of chloroplasts for a longer period, as well as stimulating metabolism enzymes. The photosynthesis showed that the small size of the nanoparticles, the increase in the effective surface area, and its high efficiency to contribute to the chemical reactions that take place inside the plant, as it improves the plant response to absorb the largest amount of nutrients, which leads to an increase in vegetative growth. As for the effect of the triple interaction, it was significant in the percentage of chlorophyll, as it reached the highest percentage of 56.83 when irrigating with water with a conductivity of 2 dSiemens.m^{-1}and the level of 20 tons.ha^{-1} of organic sheep manure, and at level 3 of zinc nanofertilizer, and it reached the lowest percentage of 36.83 when irrigating with water of high quality. Conductivity of 8 dSiemens.m^{-1} and the two levels 0 of organic fertilizer and nano-zinc, and the reason for this may be attributed to the role of each of the organic matter and zinc in reducing the harmful effect of the salinity of the irrigation water and then the increase in the percentage of chlorophyll.

Table 10. Effect of irrigation water quality, organic matter and zinc nano-fertilizer levels on chlorophyll content

Mean	**Zinc nano fertilizer gm.L^{-1}**			**Compost 20 tons.ha^{-1}**	**Irrigation water quality**
	without spraying	**without spraying**	**without spraying**		
44.64	48.00	43.37	42.57	**without addition**	**a1 2ds.m^{-1}**
48.83	47.23	50.67	48.60	**Cow compost**	
52.76	56.83	56.40	45.03	**Sheep compost**	
42.81	44.47	41.77	42.20	**without addition**	**a2 4ds.m^{-1}**
45.64	47.63	45.37	43.93	**Cow compost**	
52.61	55.80	54.00	48.03	**Sheep compost**	
42.13	43.27	41.40	41.73	**without addition**	**a3 6ds.m^{-1}**

44.97	46.63	46.47	41.80	**Cow compost**	
47.09	49.57	46.87	44.83	**Sheep compost**	
38.92	42.37	37.57	36.83	**without addition**	**a4 8ds.m^{-1}**
41.51	42.77	42.30	39.47	**Cow compost**	
46.32	49.50	46.73	42.73	**Sheep compost**	
2.021		**3.589**		**LSD*0.05***	
		A * C			
48.74	50.69	50.14	45.40	**a1 2ds.m^{-1}**	
47.02	49.30	47.04	44.72	**a2 4ds.m^{-1}**	
44.73	46.49	44.91	42.79	**a3 6ds.m^{-1}**	
42.25	44.88	42.20	39.68	**a4 8ds.m^{-1}**	
2.195		**2.072**		**LSD*0.05***	
		B * C			
42.13	44.53	41.03	40.83	**without addition**	
45.24	46.07	46.20	43.45	**Cow compost**	
49.69	52.93	51.00	45.16	**Sheep compost**	
1.011		**1.795**		**LSD*0.05***	
	47.84	46.08	43.15	**Average**	
		1.036		**LSD*0.05***	

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