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The Effect of Spraying with Kinetin and Nano-Zinc on the Tolerance of Maize Plants to Salt Stress

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Abstract*: *The pot experiment was conducted under field conditions in Karbala governorate - Al-Hussainiya area to study the effect of spraying with kinetin and nano-zinc on some plant traits for the tolerance of maize plant Zea mays to salt stress in sandy soil during the 2022 agricultural season. The experiment included three factors, the first factor represented by foliar spraying of two concentrations of zinc (Zn) is (0 and 1) mmol during the two phases of plant growth (before elongation and endowment), and the second factor (S) represented by two levels of salinity in irrigation water (2 and 4) decimens. M-1, and the third factor (H) included foliar spraying with two concentrations of kinetin (0 and 2) mg L-1 A completely randomized CRD design was used with three replications, and the experiment included 24 experimental units. The results showed a significant effect of the hormone kinetin and potassium on the traits (nutrients N, p, K and K/Na). The results also indicate the possibility of using saline water within the study levels to irrigate the maize plant when spraying with the hormone Kinetin and potassium.

Key words: kinetin, nano-zinc, maize, salt stress

1. INTRODUCTION

Several studies have been conducted to find out the possibility of coexistence with the possibility of replacing water from sewage and wells with relatively high levels of salinity in agricultural fields compared to river water. Which will affect its growth and productivity. In Iraq, water from cesspools and wells was used as a source of irrigation water, but it is characterized by a high percentage of salinity in it, which has negative effects on plant production and even on the physical and chemical properties of the soil (Kubba, 2008).Note the results reached by Al-Sharifi (2018) on maize plant when using four levels of salinity (1.2, 2, 4, 6) dSiemens m-1, that the salinity levels of irrigation water significantly affected the phenotypic traits and yield characteristics. Al-Asadi (2019) noticed that the salinity of the irrigation water significantly affected the maize plant when irrigated, it significantly affected most of the phenotypic characteristics and yield characteristics (plant height, leaf area, weight of 500 grains and dry weight). Perhaps the presence of some methods of selection, genetic modification, growth regulators and osmotic organizations enabled an increase in the tolerance of crops to different stresses, and these organizations are kinetin and nano-zinc. Kinetin is one of the growth regulators known as cytokines, which has the ability to improve the growth of growing crops under different salt stress conditions (Salama and Awadalla, 1987), and which regulates several physiological processes necessary in the growth and

detection of plants, such as stimulating cellular and mitotic division, mitotic and mitotic divisions. Aging of papers. Between Kaya et al (2009) Treating maize with kinetin improved production, reduced the effect of salt stress, and enhanced essential nutrients by maintaining membrane permeability. Which was reached by Al-Taei (2013) noted that the increase in the salinity levels of the irrigation water led to a significant decrease in the content of the leaves of (N, P, K) due to salt stress, but treatment with kinetin has a significant effect under the conditions of salt stress. This is similar to what was found by (Mohammed and Ahmed, 2017) that spraying with kinetin led to an increase in the grain yield of corn plants Zinc has an important role in the process of hormonal balance and increasing the efficiency of plant growth regulators. Recently, fertilizers coated with nanoparticles have been used to reduce the added quantity and increase the efficiency of their use (Guo (2011). The addition of nano-fertilizers increases the efficiency of the use of nutrients, reduces their toxicity in the soil, and reduces the frequency of application (Al-Shami, 2019). Studies indicate that the use of nano-fertilizers causes a threefold increase in the efficiency of nutrient use and reduces the potential negative effects associated with overdose compared to non-nano-fertilizers as well as providing additional stress tolerance. Less, as its use reduces the excessive consumption of conventional chemical fertilizers (Manjunatha et al., 2016). . Nano-fertilizers are considered effective materials at low prices compared to conventional fertilizers (Shawki et al., 2017). Nano-fertilizers are used in biological, physical or chemical ways, and the negative and toxic effects that can occur as a result of adding nano-fertilizers are less compared to traditional fertilizers if they are added at a moderate rate (Walpola and Yoon, 2012).
From the above, this study aims to find out the effect of spraying with kinetin and nano-zinc in increasing the tolerance of maize plants to salt stress caused by irrigation with salt water through:
1- Knowing the extent of response of maize crop to spraying with kinetin for the growth and productivity of the growing crop under different levels of salinity of irrigation water.
2- Determining the role of added zinc, which may give important results in the growth and productivity of the growing maize crop under the conditions of the study.
3- Studying the binary and triple interactions of the study factors to obtain the best treatments in improving the growth and productivity of the growing yellow corn under different salinity levels.

2. MATERIALS AND METHODS:

A pot experiment was conducted at the College of Agriculture - University of Karbala by planting yellow maize seeds (mays (Zea) type 106 Research) during the 2022 agricultural season. A sandy soil with little salinity was used and after drying it air it passed through a sieve with holes diameter (2) mm and it was homogenized well and then filled in plastic pots with a diameter of 42 cm and a height of 55 cm and with a value of 40 kg of soil -1 for each pot. The experiment was designed as a factorial experiment using a Compeletely Randomized Design (C.R.D) for three factors with three replications, thus the number of experimental units used in the study became 24 experimental units. The first factor (zn) is represented by two levels of foliar spraying with nano-zinc are (0 and 2) mmol. K from a source of nano and ordinary potassium sulfate fertilizer (K2S04) in two equal batches, according to the treatment when 6 leaves and 12 leaves appear (that is, 21 days and 70 days after planting), The second factor (S) is represented by two levels of salinity of irrigation water (2 and 4) decimens. M-1 was obtained by using well water that was mixed with river water to obtain the levels required for the study, and the third factor (H) included spraying plants with two concentrations of kinetin (0 and 2) mg.l-1. It was added in the two phases of plant growth when 6 leaves and 12 leaves appeared. A diffuser (Tween 20) was added to increase the efficiency of plant uptake of kinetin and nano-zinc. The seeds were sown on 10/3/2022 for the spring season, at a rate of 10 seeds per pot. Then the seedlings were reduced to three plants in each pot. The nitrogen fertilization process was carried out at a rate of 320 kg N.H-1 from the source of urea fertilizer (46% nitrogen) in four batches, and phosphorous was added at a rate of 200 kg P2O5. E-1 from the source of calcium superphosphate fertilizer, according to the guidance bulletin (Peter and Postel, 2008) issued by the Ministry of Agriculture (Jdoea, et al. 2013). All necessary agricultural measures were taken to control insects and maintain moisture content within the field capacity of all experimental units throughout the plant growth period.

- The phenotypic characteristics of the spring lobe.

1- Average plant height (cm):

Plant height was measured for two plants from each experimental unit, Sahoki (1990). Then the average was taken and measured from the surface of the soil to the bottom of the male inflorescence using a tape measure.

2- Average leaf area (cm2 plant-1):

The leaf area of the experimental plants was measured at the stage of female flowering (100%) according to Elsahookie's method, 1985) according to the following equation:

Paper area (cm2) = Maximum length x Max width x 0.75

3- The weight of the dry vegetative part (gm plant-1): It was calculated from the weight of three plants with the sum of their parts (leaves, stems and male inflorescences) and dried in the oven at a temperature of 70oC for three days until the weight is stable.

4- Weight of 500 tablets (g):

500 grains were weighed with a Sartorius scale, measured in grams of coriander grains

Plants of each experimental unit were dried in an electric oven at a temperature of 65°C until the weight was stable (Al-Sahoki, 1990).

3. RESULTS AND DISCUSSION:

1- Plant height:

The results presented in Table (1) indicate a significant increase in the plant height characteristic of yellow corn when spraying with levels of kinetin, as the highest plant height when spraying with kinetin (H1) was 100.25 m. The results in the table indicated that there was a significant effect of spraying levels with nano-zinc, which led to a significant increase in plant height, and the highest height of maize plant when spraying with nano-zinc (Zn1) was 99.66 m, with an increase of 2.51% compared to the lowest height of its amount 97.16 When zinc (Zn0) was not sprayed. The results shown in Table (1) indicated the effect of levels. The salinity of the moral irrigation water in the characteristic of plant height, as the plant height decreased with the increase in the levels of salinity of the irrigation water. It is noticeable that the height decreased from 102 m at the level of salinity of irrigation water S1 to 94.33 at the level of irrigation (S2) with a decrease of 8.13% compared to the comparison treatment S1. The results showed in the indicated table that there was a significant effect of the bilateral interaction between spraying with zinc (Zn) and spraying with the hormone kinetin (H) a significant effect on the plant height, as the highest height of the plant when spraying kinetin and spraying with nano-zinc treated ((Zn1H1) by 101.66 m, which It did not differ significantly from the treatments (Zn0H1). While the lowest plant height at the two levels (Zn0H0) was 95.50 m, which did not differ significantly from the treatment (Zn1H0). .

The bilateral interaction between the two factors of spraying with kinetin and the salinity of the irrigation water showed a significant effect in this trait, and the highest plant height at the two levels (S1H1) was 103.66, which did not differ significantly from the treatment (S1H0), while the lowest plant height was at the two levels (S2H0 by 91.83 m). As for the bilateral interaction between the levels of irrigation with saline water and spraying with zinc, it also had a significant effect on the plant height, and the highest concentration reached at the two levels (S1Zn1) by 103.33 m and the lowest at the two levels by S2Zn0), which amounted to 92.66 m. The triple interaction of the study factors had a significant effect on the plant height, and the highest height in the treatment (1S1Zn1H) was 105 m, while the lowest plant height was achieved when the treatment (0S2Zn0H) was 90 m.

Table (1) the effect of spraying with kinetin and nano-zinc and the interaction between them on the height of maize plant (Bahut class 106) under saline levels.

Kinetin spray level H mg.l-1	**zinc level Zn mmol**	**Irrigation water salinity levels S Desi Siemens M-1**		**Kinetin rate mg.l-1**
		S1 2	**S2 4**	
H0 without adding	**Zn 0 without addition**	90.00	101.00	96.58
	Zn 1 mmol2	93.66	101.66	
H1	**Zn 0 without addition**	95.33	102.33	100.25
	Zn 1 mmol2	98.33	105.00	
Irrigation water salinity rate		94.33	102.00	
zinc rate		**Zn0**	**Zn1**	
		99.66	97.16	
Kinetin*Zinc		**Zn0**	**Zn1**	
		97.66	95.50	
		101.66	98.83	
Kinetin*Salt		**S1**	**S2**	
		91.83	101.33	
		96.83	103.66	
Zinc*Salt		**S1**	**S2**	
		101.66	92.66	
		103.33	96.00	

L.S.D 0.05	**H**	**Zn**	**S**	**Zn*H**	**S*H**	**S*Zn**	**S*H*Zn**
	1.2861	1.2861	1.2861	2.7317	2.4137	2.5722	3.0705

2- Plant leaf area (cm2.plant-1).

The results presented in Table (2) indicate the effect of spraying with kinetin and nano-zinc and the interaction between them on the leaf area characteristic of plants irrigated with two salinity levels of irrigation water. The highest value of it was (263.21 cm2 plant-1) when spraying with kinetene (H1), and the lowest value for this trait was 250.92 cm2 plant-1 when not spraying with kineten (H0). The results shown in the table showed that there was a significant effect of spraying with potassium, which led to a significant increase in the leaf area, as it reached the highest value of 366.51 cm2 plant-1 when spraying with nano potassium (K2) with an increase of 9.37% compared to the lowest value of 332.17 cm2 plant-1 When not spraying with potassium K0. The results shown in the mentioned table showed a significant effect of the salinity levels of irrigation water on the leaf area of the plant, as the leaf area decreased with the increase in the salinity levels of the irrigation water, and the leaf area decreased from 277.60 cm2 plant-1 at the level of salinity of irrigation water S1 to 236.53 cm2 plant -1 When irrigating at the level (S2), with a decrease of 17.36% compared to it. The binary interaction between spraying with nano-zinc (Zn) and spraying with kinetin (H) was significant in the characteristics of leaf area of maize plant. And its highest value was reached when spraying with kinetin and spraying with nano-zinc (Zn1H1), which amounted to 94268.cm2 plant-1, while the lowest value for leaf area when not spraying with zinc and kinetin (Zn0H0) was 242.78cm2 plant-1. The results also showed a significant effect of the bilateral interaction between the quality of the used irrigation water and spraying with kinetin in the characteristic of leaf area, and the treatment (S1H1) achieved the highest value for this trait, which amounted to 282.64 cm2 plant-1, and the treatment ((S2H0) gave the lowest value for this trait amounted to 229.28 cm2 plant -1 . The results also showed a significant bilateral interaction between the quality of the used irrigation water and spraying with nano-zinc, and the treatment (S1Zn1) achieved the highest value of 287.47 cm2 plant-1, while the lowest value of leaf area when treatment (S2Zn0), which amounted to 232.53 cm2 plant-1, which It did not differ significantly from treatment (S2Zn1). The triple interaction of the study factors had a significant effect on this trait. Treatment (S1Zn1H1) achieved the highest value for leaf area, which was 291.99 cm2 plant-1, which did not differ significantly from treatments S1Zn0H1) (S1Zn1H0), while the lowest value when treatment S2Zn0H0) was 223.37 cm2 plant-1.

Table (2) The effect of spraying with kinetin and nano-zinc and the interaction between them on the average leaf area (cm2.plant-1) of maize plant (Bahut class 106) under saline levels.

Kinetin spray level H mg.l-1	**zinc level Zn mmol**	**Irrigation water salinity levels S Desi Siemens M-1**		**Kinetin rate mg.l-1**
		S1 2	**S2 4**	
H0 without adding	**Zn 0 without addition**	262.19	223.37	250.92
	Zn 1 mmol2	282.94	235.19	

H1	**Zn 0 without addition**	273.29	241.70	263.21
	Zn 1 mmol2	291.99	245.87	
Irrigation water salinity rate		277.60	236.53	
zinc rate		**Zn0**	**Zn1**	
		250.00	264.14	
Kinetin*Zinc		**Zn0**	**Zn1**	
		242.78	259.07	
		257.50	268.94	
Kinetin*Salt		**S1**	**S2**	
		272.56	229.28	
		282.64	243.78	
Zinc*Salt		**S1**	**S2**	
		267.74	232.53	
		287.47	240.53	

L.S.D 0.05	**H**	**Zn**	**S**	**Zn*H**	**S*H**	**S*Zn**	**S*H*Zn**
	10.55	10.55	10.55	15.42	16.565	15.61	21.1

3- Average dry weight (gm.plant-1):-

The results presented in Table (3) indicate the effect of adding kinetin and nano-zinc levels and their interaction on the weight of the dry vegetative part of the plant under salinity levels, through which it is noted that there is a significant increase in the dry vegetative weight when spraying with kinetin (H), and the highest value of this trait was when treated (H1) amounted to (69.60 g. plant-1), and the lowest value was 54.81 g. plant-1 when treated without spraying with kinetin (H0). It was shown in the above table that there was an effect of spraying with nano-zinc, which led to a significant decrease in the vegetative dry weight of the plant, as the highest value reached 65.97 gm plant-1 when treated without spraying with nano-zinc (Zn0), while the lowest value reached 58.44 gm plant 1- When spraying with zinc (Zn1).The results shown in the aforementioned table showed the effect of the significant levels of salinity of irrigation water on the dry vegetative weight of the plant. If the dry vegetative weight decreased with the increase in salinity levels of the irrigation water, a decrease was noticed from 64.09 g of plant-1 at the level of salinity of irrigation water S1 to (60.33) g Plant-1 when irrigated at the level of S2 with a decrease of 6.23% compared to treatment S1. The results in the indicated table showed a significant effect of the bilateral interaction between spraying with zinc (Zn) and spraying with kinetin (H) on dry vegetative weight. While the lowest vegetative dry weight at the two levels (Zn0H1) was 52.24 g plant-1 The results showed a significant bilateral interaction between the quality of the used irrigation water and spraying with nano-zinc in the vegetative dry weight. The highest value was 69.26 gm plant-1 when treated (S1Zn1), and the lowest dry weight was 53.97gm plant-1 when treated (S2Zn0), which It was not significantly different from the treatment (S1Zn0).. The triple interaction had a significant effect of the factors under study in this trait. Treatment

(S1Zn1H1) achieved the highest value of dry vegetative weight, which amounted to 79.70 gm plant-1, which did not differ significantly from treatment (S2Zn1H1), and the lowest value when treatment (S2Zn0H1) reached 51.57 gm plant-1, which did not differ significantly from treatment (S1Zn0H1).

Table (3) The effect of spraying with kinetin and nano-zinc and the interaction between them on the average dry weight (gm.plant-1) of maize plant (Bahut class 106) under saline lev

Kinetin spray level H mg.l-1	**zinc level Zn mmol**	**Irrigation water salinity levels S Desi Siemens M-1**		**Kinetin rate mg.l-1**
		S1 2	**S2 4**	
H0 without adding	**Zn 0 without addition**	52.97	51.57	96.58
	Zn 1 mmol2	58.73	55.98	
H1	**Zn 0 without addition**	64.95	64.28	100.25
	Zn 1 mmol2	79.70	69.47	
Irrigation water salinity rate		64.09	60.33	
zinc rate		**Zn0**	**Zn1**	
		65.97	58.44	
Kinetin*Zinc		**Zn0**	**Zn1**	
		52.27	57.36	
		64.62	74.58	
Kinetin*Salt		**S1**	**S2**	
		55.85	53.85	
		72.32	66.88	
Zinc*Salt		**S1**	**S2**	
		58.96	57.93	
		69.21	62.73	

L.S.D 0.05	**H**	**Zn**	**S**	**Zn*H**	**S*H**	**S*Zn**	**S*H*Zn**
	1.4149	1.4149	1.4149	3.9444	4.9508	3.19	2.8298

4--. Weight 500 tablets (gm)

The results presented in Table (4) indicate the effect of adding kinetin and nano-zinc and their interaction on the character of weight of 500 grains under the salinity of irrigation water. It was noticed that there was a significant increase of spraying with kinetin (H) in the character of weight of 500 grains. The treatment of spraying with kinetin (H1) gave the highest value of 97 83 g, with an increase of 9.75%, compared to the lowest value for this characteristic, which is 88.29 g when treated without spraying with kinetin(H0). It is noted that there is a significant effect of spraying with zinc that led to a significant increase in the characteristic of the weight of 500 tablets, as the highest value of this characteristic was 95.64 g when spraying with nano-zinc (Zn1) and with an increase of 5.40% compared to the lowest value of 90.48 g when treated with no zinc spray (Zn0). The results showed the moral effect of the salinity of the irrigation water used in this trait, as the trait of weight of 500 grains decreased when treatment (S2) amounted to 87.19 g, while treatment S1 gave the highest value of this trait amounted to 98.00 g. The results indicate a significant effect of the bilateral interaction between spraying with nano-zinc (Zn) and spraying with kinetin (H) in this trait. by 86.74 g, which did not differ significantly from (Zn1H0) treatment. The dual interaction between the two factors of kinetin spray and the salinity of the irrigation water also had a significant effect on the weight characteristic of 500 grains, and the highest grain weight at the two levels (S1H1) was 107.10 g, while the lowest grain weight was 85.83 g when spraying with two levels (S2H0), which did not Significantly different from treatment (S2H1) (S1H0). The results also showed a significant bilateral interaction between the quality of the used irrigation water and zinc spraying, and the treatment (S1Zn1) achieved the highest value of 101.53 g, and the lowest value was in the weight of 500 grains when treatment (S2Zn0), which amounted to 84.64 g. The triple interaction of the study factors had a significant effect on this trait. Treatment (S1Zn1H1) achieved the highest value for the weight of 500 grains, which amounted to 111.00 g, while the lowest value for treatment (S2Zn0H0) was 84.03 g, which did not differ significantly from the treatments (S2Zn1H0) and (S2Zn0H1).

Table (4) The effect of spraying with kinetin and nano-zinc and the interaction between them on the average weight of 500 grams of maize plant (Bahut class 106) under saline levels.

Kinetin spray level H mg.l-1	**zinc level Zn mmol**	**Irrigation water salinity levels S Desi Siemens M-1**		**Kinetin rate mg.l-1**
		S1 2	**S2 4**	
H0 without adding	**Zn 0 without addition**	84.03	89.45	88.29
	Zn 1 mmol2	87.62	92.07	
H1	**Zn 0 without addition**	85.24	103.21	97.83
	Zn 1 mmol2	91.80	111.00	
Irrigation water salinity rate		87.19	98.00	
zinc rate		**Zn0**	**Zn1**	
		90. 48	95.64	
Kinetin*Zinc		**Zn0**	**Zn1**	
		86.74	89.85	

	94.22	101.44	
Kinetin*Salt	**S1**	**S2**	
	90.76	85.83	
	107.10	88.56	
Zinc*Salt	**S1**	**S2**	
	96.33	84.64	
	101.53	89.75	

L.S.D 0.05	**H**	**Zn**	**S**	**Zn*H**	**S*H**	**S*Zn**	**S*H*Zn**
	3.9991	3.9991	3.9991	9.2450	6.1911	9.2976	7.9983

4. DISCUSSION

The effect of the added hormone kinetin was significant in the studied traits. As the results presented in those tables indicated, with regard to the increase in the rates of leaf area and dry weight when treated with kinetin, the reason may be attributed to the ability of kinetin to reduce membrane damage due to high salt concentrations through activating the anti-oxidation system for lipids in cell membranes (Chakrabarti and Mukherji, 2003) The treatment with kinetin may have compensated for the deficiency in the endogenous cytokinins of the plant. It is known that the sites for the manufacture of cytokinins are the tops of the roots and as a result the root growth is affected by the salt stress, which negatively affects its functional performance in the manufacture of cytokinins (Javid and others, 2011), Kinetin increases cell division, increases RNA building, and prevents or obstructs leaf aging by inhibiting degrading enzymes such as cellulase and pectinase, as well as increasing the construction of chlorophyll pigments, thus increasing the efficiency of the photosynthesis process (Tiaz and Zeiger, 2002). Significant in the trait of weight of 500 grains, in plants treated with H2 level compared to untreated plants H0. The reason is that kinetin works on regulating growth and increasing it and raising productivity (Grosha, 2003). They noticed when spraying kinetin hormone on wheat plants growing under saline conditions, it had a significant effect. Spraying kinetin gave the highest weight of seeds in the spike, and this is similar to the study (Al-Zwaini, 2021).) on the maize plant. The effect of nano-zinc was positive and clear, as it caused a significant superiority in some of the studied traits such as plant height and leaf area. (Shukla et al., 2017), and because of its ultra-fine particle size with large reactive surface area, as well as the fact that nano-fertilizers have a higher efficiency in plant nutrient uptake due to their high ability to penetrate plant tissues, which provides the best growth of internode cells and thus their elongation (Panwar et al., 2012). Tiwari, 2017). The increase in plant height as a result of the increase in the level of zinc addition is attributed to its active role in the plant, as it contributes to the activity and formation of a number of enzymes, nucleic acids and amino acids necessary for stem elongation (Havlin et al., 2009). Paper Space (Al-Sahhaf, 1989). These results agree with what was found by (Al-Aboudi, 2002) and (Al-Esawy, 2004), who noticed an increase in the leaf area of rice when sprayed with microelements, including zinc, due to the role of zinc in maintaining the integrity of cellular membranes and maintaining the systemic system. Ion transport and the transport of macromolecules across membranes (Dang et al., 2010). These results are consistent with what was indicated by (Al-Masoudi, 2021). The results obtained in this study indicated an effect of irrigation water salinity levels on the growth of maize plant, as a decrease was observed in each of the studied traits. The reason for this may be due to the increase in the osmotic pressure of the soil solution around the root, which reduces water absorption and increased From the absorption of salt, which in turn led to the inhibition of the growth, expansion and elongation of cells (Boursier et al., 1987; Attia and El Kayar, 2000). The effect of osmosis and nutritional imbalance caused by salinity is what affected the lack of absorption of water and nutrients and increased sodium absorption and thus ionic imbalance and increased toxicity in the leaves, which leads to inhibition of growth, expansion and elongation of cells, which reduced the leaf area, and thus affect the rate of division Cellular in the developing tops and elongation of cells, which leads to a decrease in plant height and a decrease in the emergence of new leaves, thus reducing the number of leaves and thus a decrease in the dry weight of the vegetative part (Shukri, 2002), and these results are consistent with what Al-Sharifi (2018). One of the reasons that led to the decrease in yield is due to the decrease in the weight of 500 grains, due to the decrease in the fertilization process caused by the effect of irrigation with saline water S2, these results are identical with the results of Al-Asadi (2019), where a significant decrease in maize yield was noticed with an increase in the salinity levels of irrigation water. The bilateral interactions between the levels of the hormone kinetin and the salinity of the irrigation water in general indicated an effect on the studied traits in maize plant. That salinity causes an imbalance in plant hormones, as Hubick and others (1986) noticed that salinity causes an imbalance in plant hormones and that spraying with kinetin restores this hormonal balance in the plant. A number of researchers showed that plant hormones improve the salinity tolerance of Barakat plants (2013), Salinity-induced decline in crop plant growth can be reduced by spraying with plant growth regulators (Ghorbani et al., 2011). In view of the many modifications in plant development in response to salt stress conditions, cytokinins play a key role in several physiological processes necessary in plant growth and development, as well as increase the plant's ability to tolerate salt stress and cytokines. Kinetin (Javid; et al., 2011). The triple interactions of the study factors in general showed a significant effect for most of the studied traits in the maize plant, as the addition of nutrients and growth regulators, whether it was spraying, fertilizing the ground or soaking the seeds, all worked to increase the tolerance of agricultural crops to salt stress, and this is consistent with what was stated by Al-Ta'i (2013) And the zinc nanoparticles and the hormone kinetin played a key role in improving the growth and increasing its productivity by reducing the negative effects caused by salt stress (Al-Zouini, 2021).

5. CONCLUSIONS AND RECOMMENDATIONS:

The levels of spraying with kinetin had a significant positive effect, while spraying with nano-zinc led to a significant increase, while the levels of salinity of the irrigation water led to a significant decrease in . The harmful effect of irrigation with salt water can be reduced by spraying with nano-zinc fertilizer and spraying the maize plant with the hormone kinetin at a concentration of 2 mg.L-1.

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