The role of conservation agriculture and priming with some nutrients in tolerance of *Helianthus annuus* L. to salt stress

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Abstract
A laboratory experiment was conducted during autumn season 2023 in the laboratories of the College of Agriculture , University of Wasit located to the southeast of Baghdad provainc at latitude 32° 29-49= north and longitude 45° 50-33= east and an altitude of 35 meters above sea level, with the aim of demonstrating the role of Soaking seeds with some nutrients and treatment of levels of salt concentrations in the germination and growth of sunflower The completely randomized design (CRD) was used in the form of a factorial experiment that included two factors: the first was the use of Soaking seeds with three nutrients: iron, zinc and potassium at a concentration of 5 g of the element in 1 liter of distilled water for 12 hours, while the second factor included four levels of salt water: 1, 4, 8 and 12 dS m-1. The results showed that the treatment of soaking seeds with zinc recorded the highest germination percentage of 85.83%, the highest average radical length of 3.18 cm and the highest average radical weight of 0.18 g, while the soaking seeds with distilled water treatment recorded the lowest germination percentage of 54.17%, the lowest average radical length of 2.04 cm and the lowest average radical weight of 0.13 g. The treatment of soaking seeds with potassium recorded the highest average plumule length of 4.15 cm and the highest average plumule weight of 0.50 g, while the treatment of soaking seeds with distilled water recorded the lowest average plumule length of 2.05 cm and the lowest average plumule weight of 0.32 g.

Keyword: conservation agriculture, Helianthus annuus, salt stress, soaking seeds

Introduction

Abiotic stresses are always a major concern for agricultural crops in terms of reducing yields. Plants are susceptible to abiotic stresses, which include drought, salinity, and heavy metal accumulation. Where crop reduction reaches 70% due to abiotic stresses, which is considered the main factor that limits crop productivity [15] Salt stress is an abiotic stress and is one of the most important agricultural problems facing the world, as it limits the growth and productivity of plants in many regions of the world due to the increased use of poor water quality for irrigation and soil salinization. Salinity poses a global threat to field crop plants, negatively affecting many aspects in particular and reducing their production. According to estimates by the Food and Agriculture Organization, more than 6% of agricultural land areas in the world are affected by salinity, and the effects of salinity on crops are inhibition of growth, followed by the cessation of physiological and biochemical processes, and ultimately death in general [9] According to the Food and Agriculture Organization, more than 423 million hectares, or 3% of the surface soil, and 833 million hectares, or 6% of the subsoil, are salinized in 118 countries, representing 85% of the land area worldwide [14.[

Soaking seeds is a pre-planting method that involves partial hydration of seeds for a specified period in a specific environment followed by drying; this technique is commonly known as seed priming. Seed priming is a fundamental and effective strategy that provides a biotic defense mechanism and tolerance to abiotic stress. Seed priming allows the physical and chemical processes (metabolic activities) to occur before germination in treated seeds while maintaining optimal hydration before planting and preventing root emergence [1,8,19] The priming process allows the required germination processes to occur before germination occurs. Seed activation in water contributes to metabolic changes necessary for germination such as breaking seed dormancy, activating enzymes and absorbing water[5,13] demonstrated that zinc increases the total phenolic content of sunflower plants. This suggests that zinc plays a role in enhancing the production of phenolic compounds which may have various physiological functions in plants. [6] in an experiment using two hybrids of sunflower FH-612 and FH-621 and treating them with different levels of ZnCl2 and CuSO4 found that copper and zinc affected the morphological, physiological and productive traits of sunflower when applied at higher concentrations. [7] found that zinc plays a major role in energy transfer, protein synthesis, protein structure protection and maintaining cell membrane integrity. Zinc had no significant effect on the levels of sucrose, fructose and starch in rice leaves under non-salt stress conditions. When exposed to salinity and alkalinity stress, a significant increase in the carbohydrate content in the leaves was observed. Salinity and alkalinity stress affect the production, transport, distribution and utilization of sucrose, leading to the accumulation of soluble sugars and starches in the leaves [17,20]. showed that zinc can alleviate these harmful effects of salt stress by reducing the levels of sucrose, fructose and starch in leaves. Zinc can help alleviate the effects of alkaline salt stress, reduce the presence of oxygen free radicals in leaves and enhance the production of triose phosphate during photosynthesis, which contributes to facilitating the carbon cycle. In light of this, a laboratory study was conducted on nutrient soaking and cultivation in different saline media to demonstrate the role of nutrient soaking (iron Fe++, zinc Zn, potassium K) in increasing seed germination under salinity levels and to study the interaction between nutrient treatments (iron Fe++, zinc Zn, potassium K) and salt levels on sunflower growth indicators .

Materials and Methods

In order to demonstrate the role of Soaking seeds with some nutrients and treatments of levels of salt concentrations in the germination and growth of sunflower crop " Helianthus annuus L.", a laboratory experiment was conducted during the fall semester of 2023 in the laboratories of the College of Agriculture / University of Wasit located to the southeast of Baghdad province at latitude 32° 29-49 = north and longitude 45° 50-33 = east and at an altitude of 35 meters above sea level.

Implementation of the experiment

This experiment was conducted to test the effect of some trace elements on the germination of sunflower seeds under different salinity levels. The experiment was conducted in a completely randomized design CRD in the form of a factorial experiment that included two factors: the first was the use of three nutrients at the recommended concentration: distilled water, iron, zinc and potassium, while the second factor included four levels of salt water: 1, 4, 8 and 12 dS m-1.

Sunflower seeds were sterilized in 2% sodium hypochlorite solution for one minute, then washed well with distilled water, then soaked according to the previously prepared concentrations of nutrient solutions at a dilution rate of 3 g of nutrient element per 1 liter of water for 12 hours. After soaking, the seeds were germinated on blotting paper after spreading them in a row on two layers of blotting papers at an average of 10 seeds per treatment and with four replicates, then wrapped and moistened with 10 ml of the previously prepared salinity levels. The seeds were then placed in a nylon bag to maintain moisture and then transferred to the incubator at 30°C. The hybrid cultivar FLAMI 001 of sunflower produced by BIOTEK SEED Turkey was used, and the following solutions were used for soaking seeds according to Table 1 below :

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Table 1: Nutrients in which the seeds were soaked

Origin	Concentration	Nutrient type	No.
Spain	**6%**	**DISPER Fer HASA**	**1**
Spain	**19%**	**DISPER Zn Sinergy**	**2**
Egyptian	**50%**	**Hyber - K**	**3**

Drainage water with a salinity of 86 dS m-1 was used as a source of salinity, diluted with distilled water according to the required concentrations. To obtain the salinity levels for the laboratory experiment, the following equation was applied [9[

Concentration of mixing water dS m-1 = (concentration of distilled water × fraction of distilled water used) + (concentration of drainage water × fraction of drainage water used.(

Germination percentage(%)

The germination percentage was calculated after 10 days of planting, when the wraps were opened and the laboratory germination percentages, the length of the shoot and the root, and the total dry weight of the seedlings were calculated as follows:

The germination percentage was calculated according to (Mahmoud A. A. Kh., 2004) and as in the following equation:

Germination percentage (%) = (number of germinated seeds) / (total number of seeds) × 100

plumule length (cm): It was measured using a graduated ruler from the point of its contact with the seed to the top of the seedling [3.[

radical length (cm): It was measured using a ruler from the point of contact of the root to the seed to the end of the root hair [3.[

plumule dry weight (g): The weight was measured using a sensitive electronic balance [4,11[

radical dry weight (g) Weight was measured using a sensitive electronic balance [4;11 [

.7.2.3Statistical analysis: The data were statistically analyzed using the analysis of variance method using the statistical program Genstat 2.1, and the significant differences of the means were tested using the least significant difference (LSD) test at a probability level of 0.05 [2.[

Result and desiccation

Laboratory germination percentage:(%)

The results of Table (3) showed that salinity levels at 8 and 12 dS.m-1 significantly decreased the seed germination percentage by 71.67 and 60.83% compared to lower salinity levels at 1 and 4 dS.m-1, which recorded 84.17 and 77.50% as a result of salt stress on plants, weak seed germination, inhibition of photosynthesis, nutrient imbalance, oxidative stress, and membrane disturbance [12].The results of the same table showed that the treatment of soaking with zinc at an average of 3 g L-1 recorded the highest germination rate of 85.83% compared to the two treatments of soaking with iron at an average of 3 g L-1 with a germination rate of 80% and soaking with potassium at an average of 3 g L-1 with a germination rate of 74.17%, while the treatment of soaking with distilled water (control treatment) recorded the lowest germination rate of 54.17%. This is a statement of the role of zinc Zn in encouraging germination and growth of crop seeds, which is considered one of the essential micronutrients for living components in the plant and helps in protein synthesis, sugar formation, synthesis of plant hormones such as auxin, membrane function, seedling activity, photosynthesis, and also to provide protection from biotic and abiotic stress. This is also consistent with what was reached by [18] as soaking sunflower seeds in zinc sulfate $ZnSO_4$ can alleviate the harmful effects of salinity stress and increase sunflower productivity .

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Table 3. Effect of salinity levels and Soaking seeds treatments with nutrients for sunflower crop on the laboratory germination percentage(%)

average	Soaking seeds treatments				Salinity levels
	potassium	Zinc	iron	control	
84.17	80.00	96.67	86.67	73.33	1ds
77.50	80.00	86.67	83.33	60.00	4 ds
71.67	73.33	86.67	83.33	43.33	8 ds
60.83	63.33	73.33	66.67	40.00	12 ds
5.5	NS				L.S.D
	74.17	85.83	80.00	54.17	average
	5.5				L.S.D 0.05

Plumule length (cm(

The results of Table (4) showed that the salinity levels of 4 and 8 dS.m-1 recorded a significant decrease in the average plumule length of (3.45 and 3.00) cm compared to the salinity level of 1 dS.m-1, which recorded the highest average plumule length of (3.94) cm, while the salinity level of 12 dS.m-1 recorded the lowest average plumule length of (2.17) cm. The results of the same table showed that the potassium soaking treatment at an average of 3 g/L-1 was superior, which recorded the highest rate of plumule length of (4.15) cm compared to the zinc soaking and iron soaking treatments, which reached (3.10 and 3.25) cm, while the distilled water soaking treatment (control treatment) recorded the lowest rate of (2.05) cm. This is consistent with [10] on what they reached in their research on treating sunflower seeds with a potassium chloride solution, which helped stimulate the embryo to grow in the best way as a result of activating the vital roles during germination, especially the activity of sugars and enzymes and increasing the concentration of RNA and phosphatase enzymes, which helped increase the size and thickness of cells in the embryonic axes .

Table 4. Effect of salinity levels and Soaking seeds with nutrients on plumule length of sunflower seedlings (cm(

average	Soaking seeds treatments				Salinity levels
	potassium	Zinc	iron	control	
3.94	4.87	3.93	4.18	2.76	1ds
3.45	4.53	3.41	3.49	2.36	4 ds
3.00	4.09	2.97	3.15	1.81	8 ds
2.17	3.10	2.10	2.20	1.27	12 ds
0.28	NS				L.S.D
	4.15	3.10	3.25	2.05	average
	0.28				L.S.D 0.05

Radical length (cm(

The results of Table No. (5) showed that the salinity levels of 4 and 8 dS.m-1 showed a significant decrease in the average radical length of (2.85 and 2.28) cm compared to the salinity level of 1 dS.m-1, which recorded the highest average radical length of (3.47) cm, while the

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salinity level of 12 dS.m-1 recorded the lowest average radical length of (1.66) cm. The results of the same table showed that the treatment of soaking with zinc at an average of 3 g L-1 was excelled in the average length of the radical, which reached (3.18) cm, compared to the treatments of soaking with iron at an average of 3 g L-1, which reached (2.40) cm, and soaking with potassium at an average of 3 g L-1, which reached (2.63) cm, while the treatment of soaking with distilled water (control treatment) recorded the lowest rate, which reached (2.04) cm, as [16] indicated in his study on wheat seeds that soaking wheat seeds with zinc increases the plant's resistance to salinity by reducing the concentration of chloride and sodium in wheat roots, and also increased the concentration of potassium and the ratio of potassium to sodium in the roots.

Table 5. Effect of treatments of salinity levels and soaking seeds with nutrients on the radical length of sunflower seedlings (cm(

average	Soaking seeds treatments				Salinity levels
	potassium	Zinc	iron	control	
3.47	3.67	4.11	3.20	2.89	1ds
2.85	2.91	3.55	2.68	2.24	4 ds
2.28	2.29	2.88	2.14	1.80	8 ds
1.66	1.64	2.18	1.58	1.24	12 ds
0.21	NS				L.S.D
	2.63	3.18	2.40	2.04	average
	0.21				L.S.D 0.05

Plumule weight (g(

The results of Table (6) showed that the salinity levels of 4 and 8 dS.m-1 showed a significant decrease in the average plumule weight of (0.45 and 0.35) g compared to the salinity level of 1 dS.m-1, which recorded the highest average plumule weight of (0.53) g, while the salinity level of 12 dS.m-1 recorded the lowest average plumule weight of (0.25) g. The results of the same table showed that the potassium soaking treatment at an average of 3 g/L-1 was superior in the average plumule weight of (0.50) g compared to the iron soaking and zinc soaking treatments, which amounted to (0.40 and 0.37) g, while the distilled water soaking treatment (control treatment) recorded the lowest rate of (0.32) g. The reason for the superiority of the potassium soaking treatment is attributed to the length of the plumule and the strength of the seedling in germination, which was directly reflected in the plumule weight [10 .[

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Table 6. Effect of salinity levels and Soaking seeds treatments with nutrients on the plumule weight of sunflower seedlings (g(

average	Soaking seeds treatments				Salinity levels
	potassium	Zinc	iron	control	
0.53	0.62	0.51	0.54	0.44	1ds
0.45	0.56	0.43	0.45	0.37	4 ds
0.35	0.44	0.33	0.34	0.30	8 ds
0.25	0.37	0.23	0.26	0.16	12 ds
0.04	NS				L.S.D
	0.50	0.37	0.40	0.32	average
	0.04				L.S.D 0.05

Radical weight (g(

The results of Table No. (7) showed that the salinity levels of 8 and 12 dS.m-1 showed a significant decrease in the average radical weight of (0.13 and 0.12) g compared to the salinity levels of 1 and 4 dS.m-1, which reached (0.23 and 0.17) g. The results of the same table showed that the treatment of soaking with zinc at an average of 3 g L-1 was excelled in the radical weight rate of (0.18) g compared to the treatments of soaking with iron and soaking with potassium at an average of (0.16 and 0.17) g, while the treatment of soaking with distilled water (control treatment) recorded the lowest rate of (0.13) g as a result of the increase in the radical length rate for the treatment of soaking with zinc. This is consistent with [16] who concluded that soaking wheat seeds in a zinc solution helps prevent the absorption of sodium and reduce its concentration in the plant and prevent its harmful effect, thus increasing root growth.

Table 7. Effect of treatments of salinity levels and soaking seeds with nutrients on the radical weight of sunflower seedlings (g(

average	Soaking seeds treatments				Salinity levels
	potassium	Zinc	iron	control	
0.23	0.24	0.25	0.23	0.20	1ds
0.17	0.18	0.20	0.17	0.13	4 ds
0.13	0.14	0.15	0.13	0.11	8 ds
0.12	0.12	0.13	0.12	0.10	12 ds
0.02	NS				L.S.D
	0.17	0.18	0.16	0.13	average
	0.02				L.S.D 0.05

Conclusions

Soaking seeds with nutrients is not limited to improving laboratory germination only, but it also has a positive effect on crop growth and productivity in the field. The possibility of improving the germination of sunflower seeds in saline soils by soaking them for 12 hours in a zinc solution, especially high concentrations.

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