Reducing harmful water salinity by phytohormones in quinoa plants (Chenopodium quinoa)

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Abstract
With the aim of knowing the extent of the resistance of the quinoa plant to salinity and the extent of the response of this plant to the growth regulator kinetin and the interaction between them, Two varieties of quinoa (yellow and red) were planted in 48 pots, To be irrigated with different concentrations of sodium chloride salt (NaCl) (200, 400, 600) mmol/L, and control with distilled water. This is counteracted by two treatments with the growth regulator kinetin (200 ppm): one by soaking the quinoa seeds in a kinetin solution before planting, and the second by spraying the plant twice with a kinetin solution during the vegetative phase. We took measurements in the vegetative phase, including: average stem length, number of branches, number of leaves, leaf area, chlorophyll a, chlorophyll b, relative water content, wet weight, and dry weight.
The results obtained showed that the two types of quinoa respond to different degrees to changes in salinity concentrations, The effect was negative at high levels of salinity, and on the contrary, the effect was positive at low levels of salinity, We found that treating the two cultivars with a growth regulator led to a reversal of the negative effect of salinity to significant and different degrees between the two cultivars. This difference is due to biological and physiological changes between the two varieties, and to their genetic makeup.
key words: Salt water, growth regulator kinetin, *Chenopodium quinoa*.

Introduction

Salinity is considered one of the most important abiotic factors limiting plant productivity in all regions of the world, especially salt-sensitive crop species. Salinity can lead to physiological stresses that affect various stages of plant growth, reducing crop productivity. In some cases, it can lead to plant death if salt concentrations are high and toxic.
To address this problem, a number of strategies have been adopted in recent years to improve plant performance under salt stress conditions. This has prompted many researchers to propose effective methods to help plants tolerate salinity, either by counteracting or reducing the effects of stress exposure.
In recent years, plant hormones have received significant attention from researchers because they are among the key components that stimulate plant responses to various environmental challenges, including salt stress. Among these growth-regulating plant hormones, cytokinins in general—and kinetin in particular—have demonstrated significant activity.

Materials and Methods:

The seeds were soaked in the growth regulator (kinetin), with a control group left untreated, for 4 hours. Then, sowing was carried out at a rate of 10 quinoa seeds per pot. Treatment was applied at the beginning of the germination stage, after the emergence of 3 to 4 leaves. The plants were treated with salinity concentrations of 200, 400, and 600 mM, with a control group left untreated. After 24 hours, the plants were sprayed with the growth regulator kinetin at a concentration of 75 ppm. This process was repeated after 10 days. Spraying with the growth regulator kinetin was only applied to the plants whose seeds had been soaked in it. Several parameters were applied to the experiment, as shown in the table.

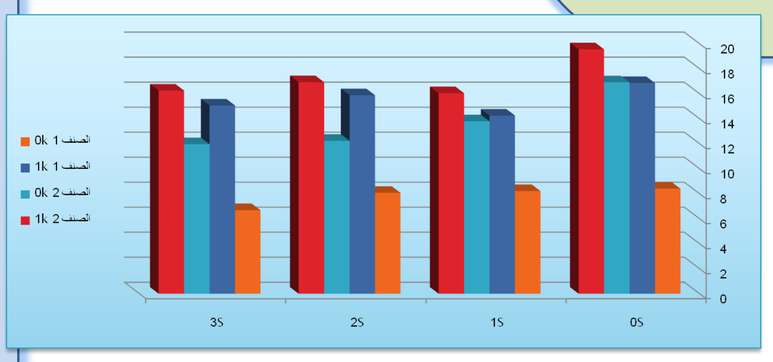
Main leg length (cm)	Hanger length (cm)	Number of branches	Number of leaves
leaf area (cm^2)	Chlorophyll estimation A and B (mg)	Estimation of relative water content	Fresh weight
Fresh weight (g)	dry weight (g)		

the parameters studied

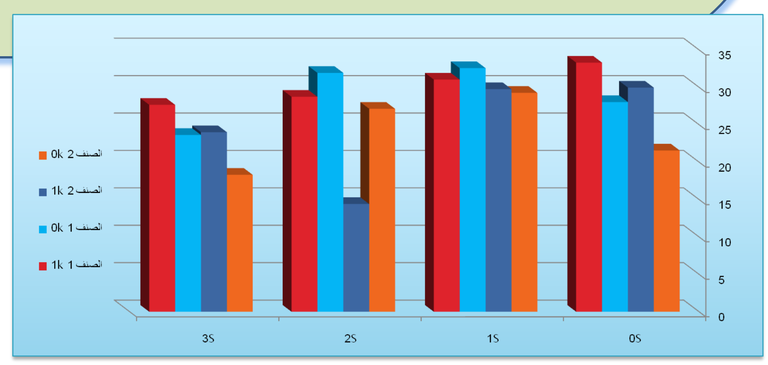
quinoa plant

Results and discussion

The decrease in stem length and leaf area is due to several reasons, including exposure of roots to salt stress, which leads to decreased absorption of water and mineral elements from the soil, thus affecting metabolic processes such as the rate of photosynthesis, carbohydrate deficiency, and the rate of hormone production (M'barek et al., 2001). The causes of decreased growth at high concentrations include decreased meristematic activity, cell elongation at the tips, and inhibition of cell division (Azmi et Alam, 1990).
This study demonstrated that adding the growth regulator kinetin improved growth rates. The effect of the used growth regulator was clear compared to the control and is explained by the plant's adaptation to salinity thanks to the growth regulator kinetin. We also observed through this study and by comparing the two quinoa varieties (yellow and red) that yellow quinoa was more physiologically active in the vegetative stage, which was reflected in its greater resistance than red quinoa to salinity concentrations and its response to the growth regulator kinetin.



The effect of spraying with Kinetin on the chlorophyll a concentration of two quinoa cultivars grown under saline conditions.



The effect of spraying with Kinetin on the main stem length of two quinoa cultivars grown under saline conditions.