Investigation Of Micro Element Intake Of Potassium (K +) And Salt Stress Applied Pepper Plants

Fikret YASAR, Ozlem UZAL, Ozlem YASAR

Abstract: This study was carried out in order to determine whether the element of potassium would be effective in the intake of micronutrients of the papper plants under salt stress. In the study, Demre long pepper type was used as material. The study was carried out in 16/8 hour light / dark photoperiod, 25 0C and 70% humid climate room in controlled conditions. After germinating the seeds planted in the pumice, the seedlings formed in 2 real leaves were cultured in hydroponics. Hoagland nutrient solution was used in culture in hydroponic solution. The current Hoagland solution K^{+} was calculated as 136 ppm and was used as the control. Other doses were K1 = 116 ppm, K2 = 136ppm, K3 = 156 ppm, K4 = 176 ppm. In addition, 100 mM NaCl salt was applied to the plants. Sampling for measurements and analyzes was performed on the 20th day of salt administration. In these samples, iron (Fe^{+2}), zinc (Zn^{+2}), copper (Cu^{+2}), manganese (Mn^{+}) and magnesium (Mg^{+}) contents were determined from micro nutrients by total plant weight. In the results obtained, K3 = 156 ppm and K4 = 176 ppm doses were effective in salvaging the plant from the detrimental effect of salt.

Key words: Ion accumulation, Pepper, Potassium doses, Salt stress

1 Introduction

Stress, plant production, abiotic (low and high temperatures, deficiency or excess of nutrients, air pollution, heavy metals, drought, salinity and radiation) and biotic (virus, bacteria, fungus, etc.) it may cause growth, development and decrease in yield depending on them [1]. Natural and culture-shaped plants can remain under the influence of various stress factors throughout their lives. Salinity is an important problem that negatively affects product yield and quality. In saline conditions, with the decrease in the osmotic potential of the soil solution, the water potential also decreases, thus reducing the water intake of the plant. The decrease in yield in salt stressed plants is due to the direct toxin effect of sodium (Na) and similar cations in medium, but another reason is the deterioration of the ion balance. n soils with high levels of salt stress, Na and Cl ion may lead to deterioration of the ion balance of plants by reducing K, Ca and N intake [2], [3], [1] [4], [5],[6]. There is a positive effect between the amount of K on the leaf of the plant and the increase in resistance of the plant in salty conditions and the high K + / Na + ratio is proportional to salt [7], [1]. In the case of potassium or calcium deficiency, ozmoregulation in the plant is impaired and enzyme activation is inhibited and metabolism is negatively affected. In such a case, it was stated that the negative effect of the salt was removed and less affected by stress by making potassium supplementation from the outside [8]. This study was carried out with the aim of trying to determine whether potassium (K) element in different doses with salt stress and whether potassium would be effective in the intake of micronutrients in plants.

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2 Materials and Methods

2.1 Material

2.1.1 Plant material

In the study, Demre pointed pepper type was used as material.

2.2 Method

The experiment was conducted in a split air-conditioned climate room and water culture, where the normal atmosphere was achieved. For this purpose, the pepper seeds were sown in 40x25x5 cm foamy germination pots filled with small-grain pumice sieved. The germination containers were placed in a climate chamber with a temperature of 25 ± 2°C and a humidity of 70-80%. The first real leaves of the cotyledon leaves to be horizontal and begin to be seen in the seedlings of irrigation, seedlings to be developed with the Hoagland nutrient solution to be developed better [9]. In the pumice medium, the second real leaves were seeded in water trays in 25x25x18 cm plastic tubs filled with Hoagland nutrient solution. In the pumice environment, the growing seedlings were taken into the water culture in 25x25x18 cm plastic tubs filled with Hoagland nutrient solution. Seedlings were grown in water culture for 14 days and started to be applied when they have 4-5 real leaves. NaCl was added to the Hoagland nutrient solution to provide a 100 mM salt concentration. During the replenishment of the repeated solutions every week, the salt application was maintained at the same concentration. In addition to the salt application, different doses of K were applied in addition to the Hoagland nutrient solution. The amount of K used in the normal Hoagland nutrient solution is 136 ppm. However, in our application, starting from 20 ppm lower dose, Control = 136 ppm, K1 = 116 ppm, K2 = 136 ppm, K3 = 156 PPM, K4 = 176 ppm was applied. Table 1 shows the ppm values of all nutrients in the nutrient solution.

Table 1. *Nutrient solution contents (ppm)*

Elem.	App.1 Cont. (ppm)	App. 2 K1+Salt (ppm)	App. 3 K2+Salt (ppm)	App. 4 K3+Salt (ppm)	App. 5 K4+Salt ppm)
N	186	186	186	186	186
P	31	31	31	31	31
K	136	116	136	156	176
Mg	49,28	49,28	49,28	49,28	49,28
Ca	200	200	200	200	200
S	66	66	66	66	66
Fe	3.3	3.3	3.3	3.3	3.3
Mn	0.031	0.031	0.031	0.031	0.031
B	0.205	0.205	0.205	0.205	0.205
Cu	0.015	0.015	0.015	0.015	0.015
Zn	0.023	0.023	0.023	0.023	0.023

Elem: Elements, App: Application, N:Nitrogen, P: Phosphorus, K: Potassium, Mg: Magnesium, Ca: Calcium, S: Sulfur, Fe: Iron, Mn: Manganese, B: Boron, Cu: Copper, Zn: Zinc.

Sampling for measurements and analyzes was performed on the 20th day of salt aplication. In these samples, total plant weight (g) and Fe, Zn, Cu, Mn and Mg accumulation in plant leaves were determined.

2.2.1 Determination of some basic growth parameters
The determination of the total plant weight was weighed with 4 replications with 1 / 10.000 precision digital scales.

2.2.2 Mineral Element Analysis
Samples were taken from the plants and stored in –84oC deep freezer. Weighing between 150 and 200 mg from each leaf sample stored for ion analysis and adding 10 ml of 0,1 N HNO3 (nitric acid) to the samples. with 1 (day) shaken. Fe, Zn, Cu, Mn and Mg contents were read on Atomic Absorption device according to Kacar [10].

2.2.3 Assessments
According to the experiment, randomized plots based on the chance of the experiment were 3 replications and each plant was established as 15 plants. Statistical analysis of the data obtained as a result of biochemical analysis of the plant growth parameters were performed by using the SAS Insitue [11] package program according to Duncan multiple comparison test (P <005).

3 Results

The total plant weight of the leaves of the pepper plants of Demre which are subjected to salt stress, Fe, Cu, Zn, Mg and Mn accumulation of the micro nutrients were measured and the obtained values are given in Table 2. When the plants were examined in terms of total plant weight, the highest value was found in the control group. However, this decrease was not the same in all groups. As the dose of K^+ administered increased, the difference between their control was decreased. In summary, the highest decrease was observed in K1+Salt application while the lowest decrease was obtained from K4 + Salt application.

Table 2. *Fe, Cu, Zn, Mg and Mn ion accumulations determined in the leaves of the plant after the applications (µ g/g F.W.)*

Aplication	Total Plant Weight (g)	Fe	Cu	Zn	Mg	Mn
Kontrol	14,75 A	71.088 B	3.048 AB	4.822 C	25.159 B	26.670 D
K1+Salt	4,94 E	88.730 A	3.555 AB	9.678 A	13.782 C	24.337 D
K2+ Salt	7,52 D	68.318 B	3.496 AB	10.567 A	14.500 C	34.909 C
K3+ Salt	8,64 C	68.407 B	3.919 A	7.137 B	26.188 B	48.421 A
K4+ Salt	10,75 B	62.934 C	2.703 B	7.435 B	28.927A	39.634 B

The difference between the averages of the same capital in the same column is not significant compared to P≤0.05. The difference between the averages with the same lowercase in the same row is not significant compared to P≤0.05.

Table 2 shows the amount of ions in the leaves of pepper plants. It was observed that there were differences between the K applications in the leaves of the plants where salt was applied. Fe accumulation in the leaves of plants in K1 + salt application increased compared to the control, while K4 + salt application decreased and the other applications were found in the same statistical range as the salt not applied control. In the accumulation of copper, while K4 + Salt application decreased compared to the control, it was seen that the other applications were in the same range as the control. There was a significant increase in Zn accumulation compared to control in all applications. The highest increase was observed in K1 + Salt and K2 + Salt applications. In terms of Mg accumulation, increase and decrease was observed according to control application, K3 + Salt application was found to be the same as control, whereas K4 + Salt was the highest in accumulation. Mg accumulation of K1 + Salt and K2 + salt applications was found in half of other applications. In the Mn accumulation in the leaves of plants, control and K1 + Salt application were found to be similar, while others were found to be increased. The highest Mn accumulation was found in K3 + Salt application.

4 Discussion

On the 20th day of administration of different K doses with 100 mM NaCl, the highest decrease in the total plant weight of the pepper plants compared to the control was at the 1st dose of potassium. In terms of total plant weight, there are significant differences between the potassium doses. Yasar [1], Yasar et al. [4], [5], [6] found that total plant weights were an important parameter in determining the response to salt stress in their salinity studies. While the 1st dose of potassium did not eliminate the negative effect of salt stress, doses 2, 3 and 4 were positively effective doses respectively. ur results show that the growth and development of plants decrease in salt environments due to slowing of respiration of plants. As a result of disturbances in the respiratory system and decreased stoma mobility, hormonal disturbances occur in the plant resulting in a decrease in the photosynthesis of the plant, consequently a reduction in carbohydrate formation and a decrease in plant growth and development. When this state in the outside plant K^+ suitable dose administered, the plant can be seen as an effect in reducing the negative effects of stress [12], [1], [5]. The different potassium doses applied to the pepper plants under salinity stress were found different from the Cu deposits in the leaves of the plants. K1 dose was found in the same value range as the control in the leaf. However, K3 and K4 doses decreased compared to control. Deficiencies of micro (Fe, Zn, Mn, and Cu) nutrients in salty soils are found to be difficult because of their solubility and difficult to transport. However, these deficiencies vary according to plant species, plant tissue, salinity level and environmental conditions. Thus, depending on the type of plants due to salt stress, micro element uptake increases or decreases [13]. In response to salt stress, some researchers have reported increases in micronutrients such as Fe, Zn, Cu, Mn and Mg in some plants [14], [15]. Zn uptake of pepper plants was different than copper. Zn uptake decreased as K doses increased. Under the stress of salt, as indicated by the researchers mentioned above, there is an increase in intake compared to the control in order to react to salt, but as the K doses increase, the osmotic balance of the plant in the cell is not impaired and the intake of some micro elements is decreased as K intake is more active [13]. In our study, as seen from the total plant weight values, plant groups where high K doses were applied were both less affected by salt and decreased in micro elements (Fe, Zn, Mn, Cu and Mg). Fe accumulation in leaves of pepper plants under salt stress varied according to the dose of K application. As in the case of other microelements, there was an increase in Fe intake in response to salt stress at low K dose with salt, but when K dose increased, Fe decreased again. In addition, it can be said that when applied to salt stressed plants, K may also be effective in increasing upward transport of Fe in plant due to increase in potassium dose. Villora et al. [16] reported that the intake of Fe, Mn, Zn and Cu increased under salt stress. In the bean plant, Fe and Mn from nutrients were found in high amounts in roots, leaves and fruits with the effect of salt. Amal et al. [17] in their work by applying GA3 to barley plants under salt stress, salt reduction in the application of Zn, Fe, Co, Pb, Cr, Cd and Mn ions stated that the reduction in the accumulation. They also reported that there was an increase in the intake of these ions by reducing the effect of salt stress on the administration of GA3. Similarly, Akman [18] in their study on wheat, Fe, Zn and Cu ions have obtained similar results in the accumulation.

5 Conclusion

In the application of 100 mM NaCl salt stress in pepper plants, the data obtained in our study with different doses of 116, 136, 156 and 176 ppm in nutrient solution contribute to the clarification of salt stress metabolism and how important it is in the intake of micronutrients of potassium ion and especially in stress metabolism. we understood that there was a nutrient element. In our study, as seen from the total plant weight, plant groups where high K doses are applied are less affected by salt and decrease in micro element (Fe, Zn, Mn, Cu and Mg) accumulations. According to this result, the pepper plant can be the element of K, which is the most needed nutrient element in stress. As seen in our study, the proper doses of potassium, even under salt stress, provide the ion balance in the cell and protect the plant from the toxic effect of salt.

6 Resources

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