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SOME MORPHOLOGICAL TRAITS OF TOMATO PLANTS UNDER THE INFLUENCE OF THE ADDITION OF PHOSPHATE ROCK AND SODIUM CHLORIDE AND THEIR INTERACTIONS

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Abstract:

A (Factorial experiment), Expermant design was Completely Randomized (C.R.D.),2 × 4 × 3, which included 24 experimental units. It was carried out, during the growing season 2017-2018, in one fieldes of the Botanical Garden of the (Department of biology), in the College (Education for Pure Sciences - Ibn Al-Haytham), University of Baghdad. The research aimed to find out the effect of phosphate rock added to the plant growth medium, at the level of 5 grams, and the zero level that is adding phosphate rock (as a source of the element phosphorus) on some vegetative characteristics of the tomato plant, namely plant height, root length, wet and dry weight of the root and shoot group, Tomato plants grown in medium to which sodium chloride solution was added, and at concentrations of 50, 100 and 150 (mM.L-1), as well as the control treatment, which is the zero concentration of NaCl. The study confirmed the positive effect of adding phosphate rock, increasing the averages and values of the studied traits, increasing the plant's ability to withstand the stress of sodium chloride when adding phosphate rock, and reducing the effect of sodium chloride, which causes a significant decrease in the studied plant traits.

Keywords: *Sodium Chloride, Phosphate Rock, Tomatoes* .

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Introduction

The tomato plant has many varieties, different from each other, its original homeland is South America, it was planted in Mexico, and it was transferred to Europe, it belongs to the Solanaceae family, it needs moderate heat and it thrives in sandy lands, free of diseases, it is grown in several ways in greenhouses, the field or home gardens by relying on hydroponics technology, Tomatoes contain very important chemical compounds, the most important of which is lycopene, which is included in many medicines and other compounds that treat and protect against many diseases and cancers. The plant also contains many vitamins and minerals, which makes it an essential element in the diet, not to mention It has a delicious taste, which is why it is widely consumed by humans, and is an important ingredient in many dishes and [1]. Among the environmental stresses that have a significant and negative impact on plant growth, development and productivity is salt stress, which is an increase in salinity in irrigation water or in the soil, which is a problem that causes a decrease in the area of agricultural land in most countries of the world. , in its arid and semi-arid regions, especially those characterized by high temperature and lack of rain ,high rate of transpiration and evaporation, What increases this problem is the mismanagement of the fields of those lands [2]. Large areas of Iraqi arable agricultural land have been dropped due to the problem of salinity in the water or the soil [3]. Salinity affects plant growth adversely, causing deterioration in growth and productivity, because high salinity affects the osmotic potential, the balance of transport and absorption of mineral elements and water, and the increase of toxic ions[4] .Salinity causes an imbalance in the physiological processes within the plant, especially the process of carbon metabolism, and accordingly, vegetative growth indicators such as plant height, leaf area, and shoot dry weight decrease[2] .Salinity also affects plant hormones and their transfer from the roots to the parts of the plant, as the lack of water absorbed, the lack of water entering the plant, the lack of water potential in the cells, the lack of breadth of the leaf cells and the lack of their area, and stimulates the production of growth inhibitors (absic acid and ethylene) that inhibit the growth of the leaf, so it decreases area, and that abscisic acid reduces the width of stomata, which reduces the amount of CO2 released, which affects the efficiency of photosynthesis and the manufacture of carbohydrates [5] .The use of natural resources to fertilize the soil is one of the clean agricultural techniques that reduce pollution, including the use of phosphate rock as a low-cost source, reduces the costs of agricultural production, and reduces environmental pollution[6]. Iraq possesses approximately 300 million tons of phosphate rock reserves in the Akashat mines (western Iraq) [7] .The use of phosphate rock is the reason for increasing the dry weight of the shoot and root , the percentage of nitrogen, phosphorus, potassium in the leaves and phosphorus in the roots) in citrus seedlings, and the reason for phosphate rock is the increase in the readiness of phosphorus, which increases its absorption, and that the readiness of the mineral elements is reflected in the improvement of vegetative growth. [8]. Phosphorus is of great importance to nucleic acids and enzymatic reactions, as it is involved in the synthesis of many nucleic acids, the synthesis of various energy reactions enzymes such as respiration enzymes, photosynthetic enzymes, the synthesis of energy-rich phosphorus compounds (such as ATP), and the enzyme conjugates NADP, NAD, which are important in Oxidation and reduction reactions, and in the synthesis of some fats (phospholipids), and therefore phosphorus is an essential element in plants[9]. Confirmed, a study conducted on pepper plants when treated with rock manure containing (15.2 - 17.4) grams. Kg-1 of phosphorus grown under conditions of salt stress is the reason for improving plant growth, and the reason for increasing the chlorophyll content, leaf area, and absorption of mineral elements, which leads to an increase in plant height and growth, and thus an increase in the dry weight of shoots [10].

Materials and Methods

A factorial experiment was conducted using (5) kg plastic pots Soil.. Pots،s soil have prepared by drying the soil, grinding it, sieving it with a sieve, homogenizing it and weighing it, and placing 5 kg in each pot. Expermant design was Completely Randomized (C.R.D.),2 × 4 × 3, which included 24 experimental units. The experiment includes two factors. The first factor is phosphate rock F26(PO4)Ca10, concentration is 12%, an addition level of 5 grams and a non-additive level, As 5 grams of phosphate rock were added to each pot of the treatment of adding phosphate rock on 3/22/2017. and it was dried in a dryer at a temperature of (105) C for a period of (24) hours in order to get rid of moisture, and then grinded and passed through a sieve The diameter of its openings is (2) mm), and the second agent is sodium chloride, at concentrations of 50, 100, and 150 (mM.L-1), in addition to the control treatment. On 3/23/2017, the pots were planted with (12) seeds of tomato seeds, and they were irrigated with 50% of the field capacity. The experiment was followed up and the necessary agricultural operations were carried out for the growth of the seedlings. On the date of 4/1/2017, the seedlings thinned out and only two seedlings were left for each pot. A solution of one molar concentration was prepared as the main solution by dissolving a gram molecular weight of 58.54 of salt in one liter of distilled water and through the relationship:

(M1*V1) = (M2*V2)

M1:(the concentration of the standard solution)

V1:(the volume taken from the standard solution)

M2: (desired concentration)

V2: (The desired volume)

Concentrations (50, 100, and 150) ($mM.L^{-1}$) were prepared from the main solution. On 13/5/2017, they were irrigated with saline water. Irrigation of the saline concentrations continued until the end of the experiment, according to the concentrations used in the experiment, which are (50, 100, and 150) $mM.L^{-1}$, and according to the plant's need for watering Two months after planting, plant height was measured (using a graduated ruler), root length (using a graduated ruler), wet and dry weight. For the root and vegetative total, as the plants were extracted from pots (one plant per experimental unit), and the vegetative total was separated from the root total, and the length and weight of each was measured, Plant length and root length (using a scaled ruler), and the wet weight of the shoot mass and the wet weight of the root (Using a sensitive balance), then it was placed in an oven at a temperature of 60-75 degrees Celsius for drying, and after the weight was confirmed, it was weighed (using a sensitive balance), and its weights were recorded as dry weights for the shoot and root. A statistical analysis of the results was conducted according to method [11]. Using the SAS program and according to the design of the experiment Completely Randomized Design (C.R.D.) by using the least significant difference LSD test at the probability level of 0.05 to compare between the arithmetic means of the coefficients.

Results and discussion

1- Plant height: The results indicated in Table (1), that the addition of phosphate rock led to a significant increase in the average plant height. The highest average was 26.06 cm at the level of phosphate rock addition (5 gm), compared with 23.40 cm at the control treatment.

(Tab: 1) Effect Sodium chloride and the rock phosphate in height of tomata plant

concentrations of Rock phosphate(gm)	concentrations of NaCl (mM.L^{-1})				average rock phosphate
	Control	50	100	150	
Control	25.90	24.00	23.25	20.45	23.40
5	32.25	25.10	24.14	22.75	26.06
aavrage sodium chloride	29.08	24.55	23.70	21.60	
LSD)(0.05	rock phosphate: 0.050 Sodium chloride: 0.04 The interaction0.120				

As for the effect of sodium chloride concentration in this trait, it was significant, as the plant height decreased from 29.08 to 21.60 cm, with a decrease rate of (25.72)%, when raising the sodium chloride concentration from zero to 150 (mM.L^{-1}).

As for the effect of the bilateral interaction between phosphate rock and sodium chloride in this characteristic, it was significant by giving it the highest average of the plant height characteristic, which is 32.25 cm at the level of 5 grams of phosphate rock and zero concentration of salt, compared with 20.45 when not adding fertilizer and concentration of 150 of salt, with an increase rate of (57.70).)%.

2- Root length: The results indicated in Table (2) that the concentration of phosphate rock had a positive and significant effect on the average of this characteristic, which is the root length, as the treatment of adding fertilizer was significantly superior by giving it the highest mean, which is 12.72 cm, compared with the absence of addition, which is 11. 50, but when increasing the concentration of sodium chloride, there was a significant decrease in the trait, with a decrease of 50.88%, compared with the control treatment. The results indicated that there were significant differences for the effect of the interaction between phosphate rock and the concentration of sodium chloride. The treatment of fertilization and zero concentration of sodium chloride excelled, and gave the highest value for the trait, which is 16.90, while the lowest.

(Tab: 2) Effect Sodium chloride and the rock phosphate in root long tomata plant

concentrations of Rock phosphate(gm)	concentrations of NaCl (mM.L-1)				average rock phosphate
	Control	50	100	150	
Control	14.78	13.22	10.57	7.42	11.50
5	16.90	14.12	11.73	8.13	12.72
aavrage sodium chloride	15.84	13.67	11.15	7.78	
LSD)(0.05	rock phosphate: 0.072 Sodium chloride: 0.051 The interaction: 0.110				

3- Wet weight of the shoot: The results in Table (3) showed that there were significant differences in the wet weight of the vegetative group between the two levels of addition of phosphate rock, as the addition of phosphate rock showed a significant superiority, as it gave 17.69 g, compared to not adding phosphate rock, which gave 15.61 g. There is also a significant effect of the concentration of sodium chloride on the fresh weight of the shoot, as the results showed a decrease in the fresh weight, with a decrease rate (45.43)%, when the concentration of sodium chloride in the nutrient solution was raised from zero to 150 mM.L-1.

The results of the bilateral interaction between the addition of phosphate rock and the concentration of sodium chloride showed that there was a significant difference in the average fresh weight of the shoot, as the highest value for this characteristic was 22.87 when adding fertilizer and zero concentration of salt, compared with the concentration is zero of salt compared to the lowest value, which is 10.94 at the lowest level of fertilizer and the concentration of 150150 mM.L-1 of sodium chloride.

4- Wet weight of the root : As confirmed by the results in Tables (4), the addition of phosphate rock has a significant effect on the average wet weight of the root . The highest average wet weight when adding phosphate rock at the level of 5 g was 9.90 g, compared with 8.05 when the control treatment. The results also confirmed that the concentrations of sodium chloride gave significant differences in the average wet weight of the root system, as the wet weight decreased by a rate decrease of (56.18%) when raising the concentration of sodium chloride from zero to 150 mM.L-1. The results also showed that the effect of the interaction between the addition of phosphate rock and the concentration of sodium chloride in this characteristic was significant, as the phosphate rock treatment used excelled and was the best at zero concentration of sodium chloride by giving it the highest average fresh weight of the root system, which is 15.90 g, compared with 5.50 g when not fertilizing. and a high concentration of sodium chloride.

(Tab: 4) Effect Sodium chloride and the rock phosphate in root fresh weight tomata plant					
concentrations of Rock phosphate(gm)	concentrations of NaCl (mM.L-1)				average rock phosphate
	Control	50	100	150	
Control	10.80	9.00	6.90	5.50	8.05
5	15.90	10.00	7.50	6.20	9.90
aavrage sodium chloride	13.35	9.50	7.20	5.85	
LSD)(0.05	rock phosphate: 0.013 Sodium chloride: 0.039 The interaction: 0.054				

5- The dry weight of the shoot: The results in Table (5) showed a significant increase in the average dry weight of the shoot under the influence of adding phosphate rock,

(Tab: 5) Effect Sodium chloride and the rock phosphate in shoot dry weight tomata plant					
concentrations of Rock phosphate(gm)	concentrations of NaCl (mM.L-1)				average rock phosphate
	Control	50	100	150	
Control	2.13	1.81	1.43	1.13	1.63
5	2.32	1.90	1.65	1.19	1.77
aavrage sodium chloride	2.23	2.86	1.54	1.16	
LSD)(0.05	rock phosphate: 0.015 Sodium chloride: 0.059 The interaction: 0.077				

as the average reached 1.77 at the level of addition compared to 1.63 at the level of no addition. The results indicated that the concentration of sodium chloride had a significant effect on the average of this trait, as the dry weight of the root system decreased by (47.98)% compared with the control treatment. The results of Table (5) confirmed that the bilateral interaction was significant between the addition of phosphate rock and the concentration of sodium chloride. The treatment of adding phosphate fertilizer and zero concentration of sodium chloride excelled by giving it the highest value for the dry weight of the shoot group, which is 2.32. As for the lowest mean of the trait, it was when no fertilizer was added and the concentration was 150 mmol.l-1 of salt.

6- Dry weight of the root system: The results indicated in Table (6) that there were significant differences in the average dry weight of the root system as a result of adding phosphate rock, as the average trait increased from 0.82 g when the control treatment to 1.01 g when adding phosphate rock.

(Tab: 6) Effect Sodium chloride and the rock phosphate in root dry weight tomata plant

concentrations of Rock phosphate(gm)	concentrations of NaCl (mM.L^{-1})				average rock phosphate
	Control	50	100	150	
Control	1.11	0.95	0.68	0.54	0.82
5	1.62	1.04	0.76	0.61	1.01
aavrage sodium chloride	1.37	1.00	0.72	0.58	
LSD)(0.05	rock phosphate: 0.014 Sodium chloride: 0.034 The interaction: 0.051				

Also, the differences are significant in reducing the mean of this trait under the influence of sodium chloride concentration, with a decrease of (57.66)%, at a concentration of 150 mM.L^{-1}of sodium chloride in the growth medium compared to a zero concentration of salt. The interference was significant as shown in Results of Table (6) The highest value of the trait when adding phosphate fertilizer and zero concentration of sodium chloride was 1.62, compared with 0.54 at the zero level of phosphate fertilizer and the high concentration of 150 mM.L^{-1}of sodium chloride.

The results of tables (1, 2, 3, 4, 5, and 6) indicated a significant decrease as a result of the treatment with sodium chloride, because sodium chloride reduces plant growth and elongation, because it reduces the content of chlorophyll, (essential in the photosynthesis process), or because it reduces cytokinins that stimulate cell division and elongation [12] , or because it reduces Auxin Content [13] (Abu al-Taman), which is important in the work and activity of plant meristems for the growth and formation of plant parts [14], or because it reduces the concentration of gibberellin hormone that stimulates the elongation of the internodes

The reason for the decrease in plant growth characteristics may be due to the fact that sodium chloride reduces the rate of protein synthesis, by reducing the cell content of nucleic acids[15]. Nitratereductase, which reduces nitrate absorbed by plants to nitrite, which is converted to ammonia, then to amino acids, and then to protein[16. [

However, the concentration of proline increases (which is one of the important amino acids that accumulate in low and high plants exposed to salt stress, due to its effective osmotic protective role, as it accumulates in osmotically stressed plants) [17].

As for the increase in the indicators of the study with the effect of adding phosphate fertilizer, it is due to the impact of phosphate rock on plant growth and development because it works to increase the concentration of phosphorus available in the soil, [8]،

and the importance of this element in the construction of cellular membranes (phospholipids) and in the construction of nuclear proteins and nucleic acids (RNA and DNA) [18], And in the construction of important energy compounds and enzymatic accompaniments that participate in respiration, carbohydrate metabolism, photosynthesis, and fatty acids, and in improving the phenotypical characteristics of the plant, as phosphorus helps the plant to grow vigorously and increase the number of branches and root system[9] .

Conclusions:

It can be concluded from this experiment: Phosphate rock has a positive and significant effect on all studied traits, improving plant growth and reducing the negative effect of sodium chloride.

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