Test Cultivation of Some Genotypes of Tomato Plant in Southern Iraq Under Salt Stress Conditions

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Abstract

The field experiment was conducted in one of the greenhouses of Al-Fares Agricultural Company in Al-Rafidah area of Al-Zubair district during season 2021-2020 with the aim of testing the salt tolerance with three concentrations of 3 dSm-1-NaCl (the comparison treatment) and 6 and 9 DS.m^{-1}-NaCl, for five tomato genotypes (Black de Barra, Chalasanta, Black Prince, Son of the Tiger, and Red Flora) Randomize Complete Block Design (R.C.B.D) was used for a two-factor factorial experiment, a one-time Split Plot Design, and with three replicates. The averages of the treatments were compared according to the least significant difference test at a probability level of 0.05, and the results were as follows: Irrigation at a concentration of 3 DS.m^{-1}NaCl (control treatment) led to a significant increase in most of the traits under study, while irrigation with both concentrations of 6 and 9 dSm1-NaCl led to a significant decrease in stem diameter (cm), total number of leaves and leaves area of the plant (64.73 and 59.08 dm^{2}) And the fresh weight (kg) and dry weight (gm) of the plant, and in each of the total chlorophyll (mg 100 g $^{-1}$ fresh weight), total soluble carbohydrates (mg g $^{-1}$ dry weight), nitrogen, phosphorous and potassium (%) in the leaves, as well as in the number of inflorescences and the total number of flowers plant 89.80 and 82.53 flowers), flower drop (%),In the total number of fruits of the plant (53.60 and 47.74 fruits), the weight of the fruit (65.13 and 50.70 g), the yields of the early plant 1.147) and 0.718 kg), the total (1.147 and 0.718 kg), and in the dry matter (%) and vitamin C (mg 100 g $^{-1}$ fresh weight) with fruits. Irrigation at a concentration of 6 dSm1-NaCl led to a significant increase in the total neutralizing acidity of the fruits (0.496%). Whereas, irrigation with a concentration of 9 dSm-^{1}NaCl led to a significant increase in the concentration of sodium (0.725%), chloride (6.88%) and proline (1865 µg g^{-1} dry weight) in leaves, and total soluble solids in fruits (7.307%).The genotypes differed in their response to saline concentrations, as the plants of the cultivar Black de Para excelled in the fresh weight of the plant (kg), and in each of sodium and chloride (%) in leaves, and in the number of flowers (107.45 flowers) and fruits (72.92 fruits) in total, and the yield of the early plant 1.262 kg), and the dry matter in fruits (%).The plants of the Gala Santa cultivar were excelled in potassium in leaves (%), while the plants of the tiger cultivar were excelled in total chlorophyll (mg 100 g^{-1}-fresh weight) and nitrogen (%) in leaves, and in the weight of the fruit (77.06 g). The total yield of one plant was (4.317 kg), and the hybrid Red Flora plants showed a significant excelled in the concentration of proline in leaves (1243 µg g^{-1}-dry weight) and in the planted fruits (74.67%) and a decrease in the percentage of precipitation in flowers (25.95%). The genotypes under study excelled each other with the exception of the cultivar Black de Barra in plant height (cm), and the genotypes except for the cultivar Ibn al-Nimr showed a significant excel in the dry weight of the plant (gm), while the cultivars of Gala Santa, Ibn al-Nimr and Black de Para were superior in the number of inflorescences of the plant. The plants of the Black Prince cultivar and the hybrid Red Flora were superior in stem diameter (cm), and the hybrid was excelled on the Gala Santa cultivar in the number of leaves and the leaf area of the plant (dm2), and the hybrid excelled with the Ibn Al-Nimr cultivar in phosphorous in leaves (%), Also, plants of the two cultivars, Gala Santa and Black Prince, were superior in total soluble carbohydrates in leaves (mg g^{-1}-dry weight) and in the total neutralizable acidity of fruits (%), the plants of the two cultivars Black de Para and Black Prince were excelled in total soluble solids in fruits (%), and plants of the cultivar Black de para and tiger's son in vitamin C concentration in fruits (mg 100 g $^{-1}$fresh weight). The bi-interaction of salt concentrations and genotypes significantly affected most of the traits under study.

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Introduction

Tomato (*Solanum lycopersicum* L.) is one of the main summer vegetable crops belonging to the Solanaceae family. It is cultivated in various parts of the world, including Iraq, for its high nutritional value and its various uses in the food industry.

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Each 100 g of fresh fruits contains 93.5 g of water, 22 calories, 4.7 g of total carbohydrates, 1.1 g of protein, 13 mg of calcium, 27 mg of phosphorous, 0.5 mg of iron, 244 mg of potassium, 900 mg of vitamin A and 23 mg of ascorbic acid. For dietary fiber, carotene, lycopene and antioxidants (Hassan (1988). The cultivated area of the tomato plant in Iraq reached 31,979 hectares with a productivity of 754,759 tons (FAO 2020), and due to the increasing demand for it, it has received great attention from plant breeders, and efforts at the present time for most breeding programs have focused on developing high-productivity and good-quality hybrids (Ibrahim et al., 2001), Therefore, cultivars are one of the most important factors that determine productivity, as plants must develop different adaptive conditions in response to environmental pressures that affect its growth (Ciobanu and Sumalan, 2009), Also, the recovery of local strains that are locally adapted may play a pivotal role in avoiding or reducing production losses that occur due to genetic diversity, making them more resistant to some genetic environmental factors, as well as improving the quality of fruits at the same time (Massaretto et al. 2018). Among the studies in this field has been between Rasheed et al. (2017) when studying two hybrids of tomato (Royal and Sandra) under greenhouse conditions, Royal plants were excelled in plant height (2.927 m), leaf area (362.42 cm^2), chlorophyll percentage (53.59%), number of fruits (21.18 fruits) and plant yield (2.58 kg) and the early yields (54.25 tons ha-1) (and total) 151.12 tons ha^{-1}) compared to Sandra cultivar, which gave 0.857 m, 313.75 cm2, 9.92 fruits, 2.02 kg, 39.34 tons ha^{-1}, and 118.36 tons ha^{-1}- for each of the mentioned traits, respectively. Which was excelled in fruit weight and total acidity (203.71 g and 6.23%) compared to the Royal hybrid (121.40 g and 5.15%), Guil-Cuerrero and Fuentes, 2009, conducted an experiment on eight cultivars of tomato (Cherry, Cherry Pera, Daniela Larga Vida, Lido, Pera, Racimo, Raf and Rambo) grown in greenhouses to study their nutritional components, and they found a high content of the cultivars of vitamin C and carotenoids. Compared to the prevailing local cultivars, The Cherry cultivar was insignificantly excelled on the other cultivars in vitamin C (82 ± 20 (mg 100 gm^{-1}-fresh weight). All cultivars excelled on Racimo in moisture, Cherry (1.27g), Daniela Larga Vida (1.26g) and Pera (1.16g) and Rambo (1.01g) in carbohydrates. Irrigation water is a controversial topic in many researches, due to the maintenance of the balance between the root and vegetative groups (Heuvel ink, 2005), and on the other hand, it plays an important and fundamental role not only in determining the quantity of production but also in the quality of the crop (Wu and Kubo 2008) Abiotic stress is one of the most important determinants of agricultural production in many countries of the world, and this does not mean that biotic stress is little, but that the greatest decrease in productivity in general causes abiotic stress on plants. Therefore, saline stress is one of the types of environmental stresses that have a negative impact on the life of the developing plant. In a saline environment, whether it is salinity in the soil or in the irrigation water, They cause changes in physiology and metabolism that affect the final yield (Pompeiano et al. 2016) and local tomato cultivars represent a reservoir of genetic traits useful for improving the fruit quality of plants grown under stress conditions (Moles et al. 2019), It was found that salinity causes three main effects, namely that plants suffer from water deficit (osmotic stress) due to reduced water potential in the root zone, Excessively absorbed by plant roots, sodium and chloride ions cause ion toxicity that leads to nutritional imbalance caused by reduced absorption of other essential nutrients or reduced transport and distribution of shoots within the plant. It is difficult to link a specific growth inhibition to one of these three effects because they affect plant organs in different ways and shift according to growth stage, genotype, and environmental conditions (Eckhard et al. 2012). Therefore, many experiments and research were conducted in this field, as studies showed external signs of salt toxicity due to salt water irrigation, such as sclerosis, burning leaves and poor vegetative growth (Munns, 2002), And Hu et al. (2018) In a study by them on four genotypes of tomato and treated with three salt concentrations of 35, 70 and 140 mmol of sodium chloride, treatment with salt in the seedling stage increased the plant's tolerance to salinity with age, and after the formation of the fourth leaf, The 45-day-old plants were the most tolerant of salinity, as well as the mature plants were similarly tolerant of salinity independently of the growth stage at which the NaCl treatments started. However, the yield for all genotypes was higher when treated, The dry weight decreased and the concentration of sodium and chlorine ions increased during the early stages of growth, and the plants exposed to salt before the formation of the fourth leaf were higher in concentration and less in dry weight. It allows it to regulate the internal concentrations of sodium and chlorine and thus to grow under high saline conditions. It was noted by Shin et al. (2020) when they were grown for four cultivars of tomato ("Dafni's", "Maxi fort", "BKO" and "B-blocking") and treated with concentrations of sodium chloride (0, 50, 100, 150, 200, 300 and 400 mmol).) A decrease in growth indicators represented in plant height, stem diameter, fresh and dry weight of the plant, as well as a decrease in the concentration of chlorophyll A and B with an increase in the salt concentration in the treatments, While there was a significant increase in the concentration of proline in the leaves, and the highest increase was observed in seedlings treated with saline concentration 200-100 mM, and Dafni's showed the highest response to saline concentrations compared to the other cultivars. Among Bhattarai et al. (2021) when they studied the response of 43 genotypes to the conditions of the open and protected environment, and then selected 18 genotypes grown in greenhouses under conditions of temperature (26)/20°C. The results showed that the cultivars “Heat Master”, “New Girl” and “HM” - 1823", "Rally", "Valley Girl", "Celebrity" and "Tribeca" are highly resistant to environmental conditions and heat stress, as they gave the highest productivity compared to other cultivars in the experiment. Lade wig et al. (2021) when they studied the response of some Mexican tomato genotypes, namely 'Campeche', 'Oaxaca', 'Puebla' and 'Veracruz' compared to the commercial hybrid 'Vengador' to four levels of NaCl (0, 30, 60 and 90 mM) and the presence of A decrease in the dry weight of stems and leaves with increased salinity stress, The cultivar "Veracruz" showed a decrease in the ratio of root to shoot when exposed to high salt concentrations, which indicates an increased sensitivity to salinity compared to other wild strains and the hybrid 'Vengador' tested in the experiment. The fruits, as the plants of the cultivar “Veracruz” produced the lowest yield of 1.06 tons ha^{-1} for the control plants and 0.59 tons ha^{-1} when irrigated with a saline concentration of 90 mmol of sodium chloride, with a drop rate of 44%,The cultivar "Campeche" showed sensitivity in response to salinity, which caused a decrease in yield by 71.1%, 80.1% and 89.6% for concentrations 30, 60 and 90 mM compared to the control treatment consecutively, although "Veracruz" fruits showed the highest values at each salinity level. Compared to other breeds and domestic hybrids, However, the fruits of "Oaxaca" and "Puebla" increased by a concentration of 90 mmol of sodium chloride by 109.2% and 110.4% for each of them, respectively, and the fruits of "Oaxaca" also recorded the highest decrease in total acidity of 6.1% and the highest increase in total soluble sugars that reached 106.7%, Selda et al. (2021) that salinity is one of the serious abiotic stresses that have harmful effects on plant growth, as the use of 100 mmol of sodium chloride led to a delay of germination by 27.6%, And the seedlings' length and vitality were reduced by 24.33% and germination stress tolerance by 27.6% compared to the control treatment. Salinity also reduced plant growth represented by plant height and leaf area. Due to the importance of the tomato crop, the study was conducted for the purpose of introducing new genotypes and testing their tolerance to salinity of irrigation water under the conditions of Basra Governorate, southern Iraq.

Materials and Methods

The experiment was conducted in season 2019-2020 in the project to develop tomato cultivation with modern technologies of the Basra Agriculture Directorate in Khor Al-Zubair in an unheated greenhouse with an area of 450 m2, in sandy clay soil with electrical conductivity (E.C. 6.11 dSm-1) and pH) 7.21, The interaction between two factors included three planting dates (9/5, 10/5 and 11/5) and nine genotypes (Black de Barra, Chala Santa, Black Prince, Tiger's son, Romovaya Papa, Siberian tiger, Pav gunk, Pav). Flora Vein Bank), Randomized Complete Block Design (R.C.B.D.) was used for a two-factor experiment, so that the number of transactions was 27 factorial treatments with three replicates so that the number of units was 81 experimental units. The averages of the results were statistically analyzed using the statistical program Genstat, V. 10.3 (2011), and the Least Significant Differences Test (L.S.D.) was used to compare the means at the 0.05 probability level (Al-Rawi and Khalaf Allah, (1980).
The soil of the greenhouse was prepared by tillage it twice perpendicular, smoothed and leveled, then divided into seven lines, 48 m long, 0.4 m wide, 0.30 m deep, and 0.75 m between one line and another. The decomposed animal manure was added to the lines before planting at an average of 8 tons of 1 dunum - P2O5 triple superphosphate fertilizer was added at a level of 50 kg of 1 dunums - (Required and others, 1989) then the lines were buried at a height of 15 cm by mixing field soil and

organic fertilizer.Then, subsurface irrigation pipes were installed in the middle of the line, and the lines were buried in the soil of the field. The lines were divided into 81 experimental units for the experiment (three sectors, each containing 27 experimental units) and 84 units for the greenhouse. Each line was divided into 12 experimental units with a length of 4 m. With a distance of 1.15 m between one planting line and another, and with an area of 4.6 m^2, Each experimental unit included 10 plants, so that the number of plants in one line was 120 plants, with a distance of 40 cm between one plant and another. Assuming that the actual area of hectares is 8800 m2 so that the number of plants per square meter is 2.1739 plants, the genotypes seeds were planted according to the mentioned dates. The service operations were conducted identically for all treatments, where is the case for the production of this crop in greenhouses. The seedlings were transferred to the greenhouse at the age of 45 days from planting. Urea fertilizer was added to the plants by irrigating them with irrigation water at a rate of 2 gL^{-1} between one week and another. It was sprayed with N.P.K neutral fertilizer (20-20-20) at an average of 1 $g.L^{-1}$ After three weeks of seedling I sprayed on 15/1/2019 with Polo arachnid pesticide at an average of 65 ml 100 L^{-1} three times a week to control aphids, the harvest started in 2019 11/22 and ended on 6/29/2020.Irrigation was done as needed and weeding was done manually. The plastic house was covered using a transparent polyethylene cover with a thickness of 150 microns on 11/20/2019 and the cover was lifted on 1/4/2020. Table (4) shows the start and end date of the harvest, the number of pounds and the net duration of the season First Agricultural 2020 - 2019. The following measurements were taken randomly for five plants from each experimental unit at the end of the season for each of the vegetative growth indicators and included, plant height (cm), stem diameter (mm), number of leaves, leaf area (dm^2), fresh and dry weight of the plant (gm) and the chemical properties of leaves, which are carotene (mg $100gm^{-1}$ (fresh weight)and total soluble carbohydrates (mg g^{-1} dry weight) and indicators of flowering growth and included the number of days until the first flower opens in 50% of the experimental unit plants (early flowering) (day) and the number of inflorescences (inflorescence.$plant^{-1}$-) The number of flowers in a single inflorescence (inflorescence plant-), the total number of flowers (flower $plant^{1-}$) and the set fruits (%) and the readings included the total number of fruits of a plant $^{-1}$. Fruit weight (gm), early yield (kg m^2), total yield of one plant (kg) and total productivity (ton ha^{-1}) The percentage of dry matter, total soluble solids, total acidity and vitamin C concentration (mg 100 g fresh weight) in fruits.

Results and Discussion

The results in Table (1) showed the effect of saline concentrations on the vegetative growth indicators of five tomato genotypes. The plants irrigated with RO water (control treatment) were significantly excelled to those irrigated with concentrations 6 and 9 dSm^{-1}NaCl. A significant decrease was observed in the increase in the salinity of the irrigation water compared to the control treatment in each of the stem diameter, number of leaves, leaf area, fresh and dry weight of the plant, except for the number of leaves, where there was no significant difference between the concentrations 6 and 9 dSm^{-1}NaCl, Regarding the effect of genotypes, the hybrid Red Flora plants excelled in the mentioned vegetative growth indicators, with the exception of the fresh weight of the plant, where the Black de Para cultivar excelled in this trait. Also, there was no significant difference between the plants of the hybrid Red Flora and the plants of the cultivars Galasanta, the Black Prince and the Son of the Tiger in plant length, the plants of the Black Prince cultivar in stem diameter, and the plants of the cultivar Gala Santa in the number of leaves and leaf area and plants of cultivars Black de Barra, Gala Santa and Black Prince in the plant dry weight, and the bi- interaction between salinity concentrations and genotypes showed the excelled of the plants of Black Prince cultivar and the hybrid Red Flora irrigated with RO water as well as irrigated with a concentration of 6 dSm $^{-1}$ NaCl significantly in stem diameter, each reaching 1.900 cm, The same hybrid plants irrigated with RO water excelled plants in the number of leaves (94.67 leaves) and the dry weight of the plant (352 g), and plants of the cultivar Gala Santa in leaf area (75.60 cm^2) and the Black de Para cultivar in the fresh weight of the plant (1.474 kg). It was also observed that the vegetative growth indicators under study decreased due to the bi-interaction between the treatments by increasing the salinity of the irrigation water, with the exception of plant height. The results in Table (2) show the effect of the two study factors and their interaction on the chemical traits of the leaves. The plants irrigated with RO

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water (control treatment) significantly excelled on those irrigated with 6 and 9 dS.m^{-1}-NaCl. There was a significant decrease in the salinity of the irrigation water compared to the control treatment in both total chlorophyll and total soluble carbohydrates and in the percentage of nitrogen, phosphorous and potassium, except for the percentage of sodium, chloride and proline. It was noticed that there was an increase in each of them with the increase in the salinity of the irrigation water, and the two interactions between saline concentrations and genotypes showed the excelled of the hybrid Red Flora plants irrigated with RO water in both total chlorophyll (10.470 mg 100 g^{-1} fresh weight) and phosphorus (0.224%) and the plants of Ibn al-Nimr cultivar in both nitrogen (0.959%) and potassium (3.074%), and the plants of the cultivar Black de Bara irrigated with a salt concentration of 9 dSm^{1}-NaCl showed a significant increase in sodium (0.887%) and chloride (8.34%) and the plants of the hybrid Red Flora concentration. The same in proline (2329 µg g^{-1} dry weight). The results in Table (3) showed the effect of the salinity of irrigation water on the indicators of flowering growth, where the plants irrigated with RO water excelled in the number of flowering inflorescences, the total number of flowers and the percentage of fruit set, and in the decrease in the percentage of flower drop. A decrease was also observed with an increase in the concentration, with the exception of the last two traits, where it was noted that there was no significant difference between the concentrations 6 and 9 ds m^{1}-NaCl, and on the effect of genotypes. De Barra in the number of total flowers, and hybrid red flora plants in the percentage of fruit set and low percentage of flowering, and between the interaction of the salinity of irrigation water with the genotype, the plants irrigated with RO water of the cultivar Black de Barra were excelled in the number of total flowers (119.67 flower of plant^{-1}) and the plants of the cultivar Gala Santa in the fruit set (79.42%) and the percentage of flower drop (20.58%) compared to the highest percentage Precipitation was observed in plants of Ibn al-Nimr variety (61.16%) irrigated with a saline concentration of 9 dSm^{-1} compared to NaCl. The results in Table (4) indicate the effect of irrigation water salinity and genotypes and their interaction on yield and its quality. A decrease was observed in the number of fruits, fruit weight, early plant yield, per plant yield, dry matter and vitamin C in fruits with an increase in the salinity of the irrigation water. It was also noted that there was no significant difference between plants irrigated with RO water and those irrigated with a concentration of 6 dSm^{1}-NaCl in the concentration of vitamin C, and the percentage of total soluble solids in the fruits increased with the increase in the salinity of the irrigation water, and the fruits of plants irrigated with a concentration of 6 dSm^{-1}-NaCl were excelled to the total acidity, followed by a significant difference between the fruits of plants irrigated with a concentration of 9 dSs m^{1}-NaCl, then the fruits of the control treatment plants irrigated with RO water with an insignificant difference. between them, As for the effect of genotypes, Black de Para plants outperformed in the number of fruits, early plant yield, percentage of dry matter, total soluble solids, and vitamin C in fruits. The yield of one plant, as it was noted that there was no significant difference between the two cultivars Black de Bara and the Black Prince in the percentage of total soluble solids, and between the two cultivars Black de Bara and Ibn El Nimr in vitamin C, and between the two cultivars Gala Santa and the Black Prince in the total acidity of the fruits. The interaction of the concentrations with the genotypes had a significant effect on the yield and its quality, as the interaction of the plants of the cultivar Black de Bara with irrigation with RO water was excelled to the number of fruits (91.33 fruits plant^{-1}), the yield of the early plant (1.704 kg) and the dry matter (9.520%) in the fruits. Whereas, the plants of the tiger cultivar irrigated with the same water outperformed in the weight of the fruit (96.13 g) and the yield of one plant (6.950 kg), and the plants of the tiger cultivar irrigated with a concentration of 6 dsm1-NaCl in the total acidity (0.505%).And vitamin C (29.67 mg 100 g-1 fresh weight), and the hybrid Red Flora plants irrigated at a concentration of 9 dS m^{-1}-NaCl in the total soluble solids in fruits (7.533%). The significant effect of the salinity of irrigation water on the decrease of some indicators of vegetative growth represented by the decrease in the number of leaves and the fresh and dry weight of the plant (Table 1). It may be due to the effect of salinity in inhibiting plant growth and development processes, which leads to a decrease in the value of the water potential and an increase in the osmotic effort, especially the decrease in cell expansion and stomata closure, affecting the efficiency of the photosynthesis process and causing a reduction in the size of the protoplast. As the presence of salt causes hormonal imbalance and reduces the level of plant hormones that encourage growth such as

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auxin and gibberellins, while the level of growth inhibitors such as abscisic acid increases (Taiz and Zeiger, 2006). However, the closure of the stomata and the significant decrease in the level of transpiration in the plant directly leads to an increase in the temperature of the plant, especially the leaves, which affects the plant growth negatively and thus reduces the development of the plant (2011) (Razzaghi et al., This is consistent with Munns (2002) and Chai chi et al. (2017), or that the decrease in the number of leaves as a result of the increase in salinity concentration affects the leaf area and thus the fresh weight of the plant, which in turn is reflected in the decrease in the dry weight of the plant. The low concentration of chlorophyll in leaves (Table 2) may be attributed to membrane damage, which directly affects the photosynthetic pigments, but exposure of the plant to salt stress may lead to the accumulation of free oxygen species, which may cause chlorophyll oxidation (Hassine and Lutts, 2010). This is consistent with the findings of Dogan et al. (2010), or that the decrease in chlorophyll and carbohydrates may be due to the decrease in the number of leaves, which causes a decrease in the concentration of chlorophyll and carbohydrates as a result of the decrease in the leaf area of the plant, and the process of salt transfer from the medium in which the plant grows to the inside of the plant is controlled by a group of genes, This appears through the transfer of the sodium ion more than the chlorine ion due to the negative electrical potential in the cell membranes, thus facilitating the transfer of ions into the plant cells with high concentrations higher than the natural concentrations (Munns, 2005). This agrees with Ahmed et al. (2010), in addition to the fact that the presence of high amounts of sodium concentration may affect the permeability of the plasma membrane and cause the osmotic stress that affects the growth of roots and their efficiency in the ability of the plant to absorb nutrients (Suhayda et al. 1990), The significant increase in the concentration of proline in the leaves of the plant can be explained by the deficiency of the enzyme Proline Oxidase under the conditions of saline stress when the salt concentrations increase or because of the transformation of amino acids into protein (Girija et al. 2002). This is in line with what was found by Dasgan et al. (2009) Or, the increase in the concentration of proline may be due to its role in modulating the osmotic effort and thus increasing the plant's tolerance to different stress conditions. It may also contribute to protecting the plasma membranes and maintaining their permeability and protecting DNA from the harmful effects of free radicals to contribute to their destruction (Ahmed et al. 2010) and this is supported by what Rasheed et al. found. (2017). It is noted from the results that the indicators of flowering growth (Table 3) decreased, and this may be due to the plant's need for small amounts of salts represented by ions and nutrients that improve plant growth and thus increase the indicators of flowering growth represented in the number of flowering inflorescences and the total number of flowers, which is reflected in the increase in the percentage of fruits Al-Aqidah (Shukri, 1994 on the wheat) or it may be due to the fact that high salinity causes a delay in the cell division process of pollen grains (Soliman et al. 1994), or it may be due to genetic factors specific to the cultivars and the sensitivity of their flowers to salinity tolerance (Maga'n, 2005) or that the decrease in the vegetative growth indicators (Table 1) and the chemical traits of the leaves (Table 2) is reflected in the indicators of flowering growth. The discrepancy between the genotypes in the components of the yield represented in the number of fruits, the weight of the fruit, the yield of the early plant and the yield of one plant (Table 4) may be attributed to genetic factors specific to the variety or the extent of its adaptation to environmental conditions (Al-Madi, 2018 on pepper). The increase in yield is related to an increase in the number of fruits and the weight of the fruit, in addition to the decrease in yield and its components may be due to the increase in sodium and chloride ions (Table 2), which greatly affect the nutritional balance and the manufacture of carbohydrates important in the growth of fruits, which leads to an imbalance in the nutritional balance of the plant Or the accumulation of these ions at toxic levels inside cells, and this may directly affect the absorption of potassium and calcium cations (Lade wig et al. 2021). As well as the direct and negative effect of increasing the concentration of Na^+ and Cl^- ions in plant tissues, which shows the inhibitory effect on the enzymatic activity that causes the precipitation of proteins, As the plant expends additional energy to alleviate the increase in the concentration of the sodium ion, which transfers it to the vacuole or outside the cytoplasm through the cell membrane by vectors, which pushes the plant to consume the stores of carbohydrates to release energy and thus reduce the weight of the fruit, which is one of the main yield components as a result of the increase in salt concentrations in the plant. David and Nilsen, 2000), This is consistent with Al-yahyai and Al-Asmaily (2010), or that the decrease in vegetative growth indicators and chemical traits of leaves (Tables 1 and 2) and flower growth indicators (Table 3), the reason for the decrease in yield. Also, the increase in the percentage of total soluble solids in the plant (Table 4), as a result of the increase in the salinity of the irrigation water may be due to the decrease in the water content of the fruit, which leads to an increase in its content of dry matter, including its content of total soluble solids (Lu et al. 2003). This is in line with what was found by Panthee et al. (2012), or the decrease in the quality traits of the fruits under salt stress conditions can be due to the inhibition of the rate of photosynthesis and the disturbance of the metabolism process (Liang et al. 2006), or the decrease in the chemical characteristics of the leaves (Table 2) may be reflected in the specific characteristics of the fruits.

Table 1. Effect of irrigation water salinity and some genotypes of tomato and their overlap on vegetative growth indicators

Plant Dry Weight (gm)	Fresh weight of the plant (kg)	Leaf area (dm²)	The number of leaves	stem diameter(cm)	plant length (cm)	genotypes	Irrigation water salinity NaCl (dsM-1(
351.00	1.474	68.83	77.33	1.067	137.00	Black de Para	RO
345.67	1.438	75.60	92.00	1.300	204.33	Chala Santa	
345.33	1.382	52.50	90.67	1.900	210.33	black prince	
327.33	1.371	68.60	87.33	1.433	198.33	son of tiger	
352.00	1.333	73.03	94.67	1.900	218.67	Red Flora	
306.67	1.179	66.50	73.33	0.933	128.67	Black de Para	6
319.00	1.129	71.63	90.00	1.067	195.33	Chala Santa	
327.33	1.161	48.07	84.67	1.600	201.00	black prince	
307.00	1.169	65.80	72.00	1.100	195.33	son of tiger	
335.00	1.114	71.63	94.00	1.900	200.00	Red Flora	
306.33	1.009	59.97	70.00	0.733	128.00	Black de Para	9
293.00	0.962	67.43	88.67	0.700	187.67	Chala Santa	
276.00	0.855	42.23	79.33	1.267	181.00	black prince	
276.33	0.986	57.63	68.00	0.933	184.00	Ibn al-Nimr	
265.33	0.900	68.13	84.00	0.800	142.33	Red Flora	
8.66	0.062	3.00	7.37	0.347	N.S.	R.L.S.D. 5%	
344.27 a	1.400 a	67.71 a	88.40 a	1.520 a	193.73	RO	Average salinity of irrigation water
319.00 b	1.150 b	64.73 b	82.80 b	1.320 b	184.07	6	
283.40 c	0.942 c	59.08 c	78.00 b	0.887 c	164.60	9	
4.87	0.036	2.42	5.54	0.291	N.S.	R.L.S.D. 5%	
321.33 a	1.221 a	65.10 b	73.56 c	0.911 c	131.22 b	Black de Para	Genotypes average
319.22 a	1.176 b	71.56 a	90.22 a	1.022 bc	195.78 a	Chala Santa	
316.22 a	1.133 c	47.60 c	84.89 b	1.589 a	197.44 a	black prince	
303.56 b	1.175 b	64.01 b	75.78 c	1.156 b	192.55 a	Ibn al-Nimr	
317.44 a	1.116 c	70.93 a	90.89 a	1.533 a	187.00 a	Red Flora	
5.12	0.036	1.52	3.93	0.170	20.81	R.L.S.D. 5%	

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Table 2. Effect of irrigation water salinity and some genotypes of tomato plant and their interaction on the chemical traits of leaves

Proline (µg g-1 dry weight)	Cl (%)	Na (%)	K (%)	P (%)	N (%)	Total Soluble Carbohydrates (mg g-1 dry weight)	Total Chlorophyll (mg 100gm-1 fresh weight)	genotypes	Irrigation water salinity NaCl (dsM-1)
307	3.61	0.379	3.003	0.154	0.874	45.60	7.723	genotypes	RO
414	3.65	0.384	3.004	0.151	0.610	46.47	9.544	Black de Para	
525	3.85	0.404	2.961	0.163	0.634	49.50	10.212	Chala Santa	
445	3.34	0.351	3.074	0.214	0.959	46.37	10.267	black prince	
446	4.05	0.426	2.970	0.224	0.676	47.23	10.470	son of tiger	
719	7.08	0.745	2.934	0.142	0.590	33.40	7.568	Red Flora	6
784	7.01	0.737	2.994	0.153	0.597	41.30	7.576	Black de Para	
873	3.97	0.417	2.910	0.155	0.630	37.33	8.356	Chala Santa	
873	3.95	0.415	2.981	0.210	0.746	33.47	9.008	black prince	
953	6.14	0.645	2.788	0.217	0.669	32.13	9.001	son of tiger	
1217	8.34	0.887	2.844	0.142	0.583	17.27	7.545	Red Flora	9
1615	7.59	0.798	2.928	0.139	0.594	26.03	7.104	Black de Para	
2201	4.65	0.489	2.869	0.146	0.612	23.47	7.497	Chala Santa	
1961	6.50	0.683	2.788	0.211	0.732	20.00	8.177	black prince	
2329 a	7.32	0.769	2.651	0.214	0.648	18.40	7.464	Ibn al-Nimr	
46	0.10	0.006	0.038	0.007	0.012	N.S.	0.300	R.L.S.D. 5%	
427 c	3.70 c	0.389 c	3.002 a	0.181 a	0.751 a	47.03 a	9.643 a	RO	Average salinity of irrigation water
840 b	5.63 b	0.592 b	2.921 b	0.175 b	0.644 b	35.53 b	8.302 b	6	
1865a	6.88 a	0.725 a	2.816 c	0.170 c	0.637 c	21.03 c	7.558 c	9	
26	0.07	0.004	0.029	0.003	0.006	2.812	0.157	R.L.S.D. 5%	
748 e	6.34 a	0.670 a	2.927 c	0.146 c	0.682 b	32.09 b	7.612 d	Black de Para	Genotypes average
938 d	6.08 b	0.640 b	2.975 a	0.148 c	0.600 e	37.93 a	8.075 c	Chala Santa	
1200 b	4.16 e	0.437 e	2.913 c	0.155 b	0.625 d	36.77 a	8.688 b	black prince	
1093 c	4.60 d	0.483 d	2.948 b	0.212 a	0.812 a	33.28 b	9.151 a	Ibn al-Nimr	
1243 a	5.84 c	0.613 c	2.803 d	0.218 a	0.664 c	32.59 b	8.979 ab	Red Flora	
27	0.05	0.003	0.020	0.004	0.007	2.399	0.180	R.L.S.D. 5%	

Table 3. Effect of irrigation water salinity and some genotypes of tomato and their interaction on flowering growth indicators

Set of fruits (%)	Flower drop (%)	Total number of flowers (flower.plant-1)	Number of inflorescences (inflorescence.plant 1-)	genotypes	Irrigation water salinity (NaCl (dsM-1
76.39	23.68	119.67	10.83	genotypes	RO
79.42	20.58	103.33	11.83	Black de Para	
71.67	27.57	86.50	9.17	Chala Santa	
67.13	32.87	108.33	10.83	black prince	
74.94	25.06	76.33	9.83	son of tiger	
62.07	37.93	103.00	10.83	Red Flora	6
61.52	38.48	102.00	10.83	Black de Para	
63.95	36.05	81.00	8.83	Chala Santa	
44.49	55.51	107.00	10.83	black prince	
74.91	25.09	56.00	8.33	son of tiger	
63.70	36.30	99.67	9.17	Red Flora	9
61.83	38.17	92.00	9.50	Black de Para	
58.77	41.23	66.00	8.67	Chala Santa	
39.98	61.16	100.00	9.50	black prince	
74.16	25.84	55.00	8.17	Ibn al-Nimr	
3.92	3.75	2.88	N.S.	R.L.S.D. 5%	
73.91a	25.95 a	98.83 a	10.50 a	RO	Average salinity of irrigation water
61.39 b	38.61 b	89.80 b	9.93 b	6	
59.69 b	40.54 b	82.53 c	9.00 c	9	
3.30	2.94	1.91	0.55	R.L.S.D. 5%	
67.39 b	32.64 b	107.45 a	10.28 a	Black de Para	genotypes average
67.59 b	32.41 b	99.11 c	10.72 a	Chala Santa	
64.80 c	34.95 c	77.83 d	8.89 b	black prince	
50.53 d	49.85 d	105.11 b	10.39 a	Ibn al-Nimr	
74.67 a	25.33 a	62.44 e	8.78 b	Red Flora	
1.91	1.94	1.62	0.59	R.L.S.D. 5%	

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Table 4. Effect of irrigation water salinity and some genotypes of tomato and their interaction on yield and quality

Vitamin C (mg 100gm-(1 soft weight)	**Total acidity (%)**	**Total soluble solids (%)**	**dry matter (%)**	**Yield per plant (kg)**	**early yield (kg)**	**Fruit Weight (gm)**	**Number of fruits (fruit plant 1-)**	**genotypes**	Irrigation water salinity NaCl (dsM-1(
29.23	0.476	6.300	9.520	4.890	1.704	53.54	91.33	genotypes	RO
25.53	0.469	6.400	7.627	5.275	1.351	64.42	82.03	Black de Para	
27.63	0.456	6.500	7.427	4.742	1.649	75.54	62.63	Chala Santa	
29.67	0.431	5.367	8.517	6.950	1.421	96.13	72.73	black prince	
26.47	0.467	5.567	7.367	4.995	1.670	87.51	57.17	son of tiger	
28.57	0.485	7.367	7.427	2.966	1.288	46.40	63.93	Red Flora	6
25.00	0.497	6.433	7.327	3.567	1.081	61.07	62.77	Black de Para	
27.47	0.496	6.667	7.213	3.589	1.071	66.60	51.80	Chala Santa	
29.67	0.505	6.167	7.103	3.550	1.037	74.60	47.57	black prince	
26.73	0.498	6.333	7.293	3.370	1.256	77.00	41.93	son of tiger	
28.43	0.465	7.400	5.423	2.916	0.793	35.91	63.50	Red Flora	9
24.30	0.473	6.600	6.310	3.082	0.805	40.49	56.87	Black de Para	
25.50	0.485	7.500	6.437	2.089	0.673	53.94	38.73	Chala Santa	
26.43	0.464	7.500	6.577	2.452	0.672	60.46	38.83	black prince	
24.83	0.436	7.533	6.787	3.197	0.645	62.70	40.77	Ibn al-Nimr	
0.40	0.005	0.461	0.486	0.417	0.045	1.64	3.23	R.L.S.D. 5%	
27.71 a	0.460 c	6.027 c	8.091 a	5.370 a	1.559 a	75.43 a	73.18 a	RO	Average salinity of irrigation water
27.49 a	0.496 a	6.593 b	7.273 b	3.408 b	1.147 b	65.13 b	53.60 b	6	
25.90 b	0.465 b	7.307 a	6.307 c	2.747c	0.718 c	50.70 c	47.74c	9	
0.25	0.001	0.203	0.379	0.308	0.018	0.52	2.29	R.L.S.D. 5%	
28.74 a	0.475 b	7.022 a	7.457 a	3.591 c	1.262 a	45.28 e	72.92 a	Black de Para	Genotypes average
24.94 d	0.480 a	6.478 b	7.088 c	3.975 b	1.079 d	55.32 d	67.22 b	Chala Santa	
26.87 b	0.479 a	6.889 a	7.026 c	3.473 c	1.131 c	65.36 c	51.06 d	black prince	
28.59 a	0.467 c	6.344 b	7.399 a b	4.317 a	1.043 d	77.06 a	53.04 c	Ibn al-Nimr	
26.01 c	0.467 c	6.478 b	7.149 b c	3.854 b	1.190 b	75.74 b	46.62 e	Red Flora	
0.23	0.003	0.283	0.253	0.224	0.028	1.04	1.77	R.L.S.D. 5%	

Conclusions

It is concluded from the study that irrigation with high salinity water (6 and 9 dSm-1) led to negative results in growth and yield. The hybrid Red Flora, Black de Para, Gala Santa and Son of the Tiger can be adopted because they are more tolerant of salt stress. In the desert lands of southern Iraq.

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