Nat. Volatiles & Essent. Oils, 2021; 8(6):1948-1961

# Effect Of Sea Water Salinity And Salicylic Acid Treatment On The Growth Of Tissue-Grown Short-Stem Banana Plant Under Greenhouse Conditions

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**Abstract**:

The current study was conducted at the Agricultural Research and Experiment Station / College of Agriculture / University of Basra for the period from 2/1/2018 to 30/6/2018, the tissue-propagated Indian short-stem banana plants M.Caredishii were used in the tissue culture laboratory of the Palm Research Center Adapted at six months old,and it was grown in a greenhouse equipped with a desert cooling system, the banana plants were irrigated with five concentrations of sea water (0, 5, 10, 15, 20) and two concentrations of SA acid are (0, 5) mg $L^{-1}$, sea water was brought From the deep port at the head of the Arabian Gulf, the results obtained are summarized as the concentration of 5% sea water showed a significant increase in the studied traits (average plant height of 12.33 cm and in leaf area it was 150.50 cm 2 and the lowest amount of proline accumulated 4.18 µg $g^{-1}$ dry weight and gave the highest value of total chlorophyll where it reached 1.88 mg $g^{-1}$ fresh weight He accumulated the highest amount of k, which amounted to 3.17 mg $g^{-1}$ dry weight, and the ratio of K:Na in it was 1.74, compared to the other studied concentrations of 10%, 15% and 20%. The results showed that SA acid had an effect on improving the studied traits of banana plant, and the concentration of 5 mg $L^{-1}$ significantly exceeded the concentration 0 mg $L^{-1}$ of it in (the average plant height, which reached 11.40 cm and in the foliar reinforcement, which amounted to 142.40 cm 2 and led to a decrease in the amount of proline In leaves to 4.48 µg $g^{-1}$ dry weight and total soluble carbohydrates to 19.69 mg $g^{-1}$ fresh weight, which led to an increase in the concentrations of total chlorophyll and K ion in leaves to 151 mg $g^{-1}$ fresh weight and 3.01 mg $g^{-1}$ dry weight, respectively, and led to a reduction in Ionic Na and Cl to 2.02 and 1.78 mg $g^{-1}$ dry weight, respectively. The results of the study showed that the interaction of SA with salt concentrations of sea water improved the studied characteristics, and the interaction of the concentration of 5 mg $L^{-1}$ SA with the salt concentration of 5% of sea water improved significantly in improving the studied characteristics.

**Keywords: Sea Water, Sal Salic acid, Banana, Tissue Culture, stress**

## Introduction:

The banana plant is Musa SP. It is an important tropical fruit crop that belongs to the banana family Musaceae, and its original home is Southeast Asia, specifically Malaysia and the Philippines. It is cultivated in many regions of the world and is considered one of the economic tributaries of many countries of the world India, China, the Philippines and Brazil are among the world's largest producers of bananas, as global production of bananas amounted to about 18.2 million metric tons in 2008, and the most exporting countries for bananas are Latin American countries, with exports amounting to 13 million metric tons (FAO, 2014). The banana plant is one of the large and perennial herbaceous monocotyledonous plants. The banana has a rhizome stem located below the surface of the soil from which roots, leaves and large sheaths are spirally coiled around themselves to form the false leg. mother and plant it directly in the soil (Nair et al., 2005). The technique of plant tissue culture is one of the modern technologies that have been used in the propagation of plants, and the banana plant is one of the plants that have been vegetatively propagated in this way, as through it, many plants are obtained that are free of viral diseases and genetically identical to the mother plant The salinity of irrigation water and soil is one of the environmental stresses that lead to disturbing the biological processes that take place inside the plant (Ebed and Muhsen, 2020).Iraq is considered one of the Middle Eastern countries affected by salinity, especially the central and southern regions. The banana plant is considered one of the highly sensitive plants to salinity, as the maximum salinity tolerance of the banana plant reached 2.5 dsm-1 . Banana cultivation began in the fifties of the last century in Basra Governorate, under palm trees, depending on the shade provided by palm fronds. Its cultivation did not show positive results, as it gradually receded due to the high salinity of soil and water and high temperatures (Al-Qatrani, 2016). Currently, short-stemmed bananas are grown inside greenhouses on a limited scale, as the high temperatures can be controlled through the desert cooling system. As for the treatment of the problem of soil salinity and irrigation water, studies have focused on several means to improve the salt tolerance of plants, including the use of plant tissue culture technology In which plant cells and tissues are exposed to different levels of salt concentrations, then select cells and tissues that are resistant to salt stress and follow their growth (Al-Sumaidaie, 2017). The plant tissue culture technique was used to select salt-tolerant plants for many plant species, including local orange (Al-Taha, 2008), date palm (Al-Asadi, 2014) ., sugar cane (Al-Aradi, 2013) and rice (Obeid, 2016 ). Muhammad ,2015 showed that adding salt to chloride in concentrations (0, 20, 50, 80 and 120) mmol to the MS medium of banana plant multiplication negatively affected the number of vegetative branches by increasing salt concentrations, and to reduce the effects of salt stress, some researchers used salicylic acid in agricultural circles, where Khadary ,2004 mentioned that the use of SA acid caused an increase in the fresh weight of seedlings of maize exposed to salt stress, and Murad et al., 2013 stated that the use of low concentrations of SA acid led to an increase in the growth of seedlings of wheat exposed to salt stress and came as a result of Asadi , 2014 on date palms in accordance with the above study. Darwish (2019) found that adding SA at a concentration of 1 mg L-1 to the nutrient medium for multiplication of vegetative buds of date palm cultivar Barhi improved the growth of those buds and increased the content of its leaves from chlorophyll, carbohydrates and nitrogen, and also reduced the accumulation of Na+ in the leaves. A study

(Muhsen et al. al., 2020b) is identical to the above study.Due to the absence of studies on the propagation of banana plants in greenhouses in Basra Governorate, the current study aimed to produce banana plants resistant to salt stress conditions by cultivating short-stemmed and tissue-grown Indian banana plants in the greenhouse and treating them with two concentrations of salicylic acid and five concentrations of sea water. Sea water is a naturally homogeneous brine that contains Na+, Cl- and other ions that were used to implement the current study.

**Materials and Methods**:

The current study was carried out at the Agricultural Research and Experiment Station of the College of Agriculture / University of Basra for the period from 2/1/2018 to 30/6/2018. Indian short-stemmed banana plants, M.Caredishii cultivar were used, as 30 tissue-accumulated banana plants at the age of six months were planted ( Panel 1) Inside the greenhouse and plants were planted on three lines, the distance between one line and another is 1.5 m and between one plant and another 2 m by making a digging of the soil with dimensions of 60 x 60 cm. Root carefully plate (2) and watered with water.


**Pane** **nt**

**Experiment execution plan:**

Watering banana plants with five concentrations of sea water (0, 5, 10, 15, 20)% and two concentrations of SA acid are (0, 5) mg $L^{-1}$, sea water was brought from the deep port at the head of the Arabian Gulf, and the conductivity was estimated Electrical Conductivity (EC) in the Biotechnology Laboratory at the Palm Research Center using the Portable Kit EC model NPC360D. The EC value of sea water was 43 and when multiplied by the factor (800), the salinity reading became 34.400 mg l-1, and the acidity was measured Sea water using a pH-Meter type HACH model HQ411d, where the pH value was 7.98.

Table (1) shows the amount of Na and K elements present in sea water, which were estimated .As for Ca, Mg and Cl, which were estimated according to what was described in Jackson (1958) and HCO3 and SO4 the plants were watered with the above treatments for a period of four months and by one irrigation every ten days, three replicates were used for each treatment (concentration) (each plant represents one replicate), and through the follow-up of the experiment the following characteristics were studied:

1- T
The rate of increase in plant height according to the following:
Plant height at the end of the experiment - Plant height at the beginning of the experiment

2- T
The leaf area of the plant was calculated according to the following equation, according to A= 0.75*L*W Where A represents the leaf area in cm 2 and represents a constant 0.75, L represents the length of the leaf, and W represents the maximum width of the leaf.

3- P
Proline content of leaves: The content of leaf tissue of proline was estimated in the laboratories of the College of Agriculture / University of Basra,

4- L
Leaves content of total soluble carbohydrates: The total soluble carbohydrate content of leaves was estimated in the laboratories of the College of Agriculture / University of Basra

5- T
The total chlorophyll content of leaves was estimated in the laboratories of the Palm Research Center,

6- L
Leaf tissue content of Na+, K+, CL- ions: The content of leaf tissue of Na+, K+ and Cl- ions was estimated in the laboratories of the College of Agriculture / University of Basra

7- C
Calculating the ratio between K+ and Na+ in the tissue of the leaf

**Table 1 : concentration of elements in sea water, its salinity is 34.400 mg $L^{-1}$**

| Element name | chemical symbol | Concentration mg $L^{-1}$ | % |
|---|---|---|---|
| chloride | $Cl^-$ | 18.20 | 52.90 |
| Sodium | $Na^+$ | 11.32 | 32.91 |
| Sulfates | $SO_4^{-2}$ | 2.66 | 7.73 |
| magnesium | $Mg^{+2}$ | 1.19 | 3.46 |
| Calcium | $Ca^{+2}$ | 0.41 | 0.94 |
| potassium | $K^+$ | 0.53 | 1.54 |
| Carbonate | $HCO_3^-$ | 0.11 | 0.25 |

**Design: Experimental**
The experiment was carried out as a factorial experiment according to the Randomized Complete Block Design (RCBD) with three replications for each treatment. The significance of the averages was tested according to the Revised Least

Significant Difference (RLSD) test at a probability level of 5% Genestate 2007 was used to analyze the results

**Results and Discussion:**

The results in Table (1) showed that the increase in the concentration of sea water salinity had a significant effect in reducing the plant height. It is noted from the results that the 20% concentration gave the least increase in plant height and reached 5.5 cm, recording a significant decrease from the rest of the concentrations, and the concentration recorded 5% increase in the height The plant was 12.33 with a significant difference from the two concentrations (10, 15) %, which recorded (10.66 and 8.16) cm respectively, while the zero % concentration (the comparison) recorded the highest increase in the height of the plant amounted to 14.33 cm, the reason for the decrease in the height of the plant when watered with water The sea compared to the salt-free comparison treatment to the osmotic and ionic effects .When the concentration of sodium salts increases, cell growth is affected as a result of a decrease in the rate and quantity of water entering the cells, and the effect of salts is directly proportional to the increase in external osmotic pressure, and the high ability to dissolve calcium chloride is considered one of the salts most involved in raising the osmotic pressure of the growth medium. As for the reason for the increase in growth in the low concentrations of sea water, it may be due to the fact that these concentrations were ideal for stimulating the vital activities necessary for growth and stimulating hormones. Or, this increase in growth may be due to the increased absorption of nutrients by cells as a means of adapting to stress conditions (Kadim and Khalaf, 2020).

**Table (1) Effect of seawater salinity concentration and SA and the interaction between them on the growth rate of banana plants (cm) grown in the greenhouse**

| Mean of SA | S.W % | | | | | SA mgL$^{-1}$ |
|---|---|---|---|---|---|---|
| | 20 | 15 | 10 | 5 | 0 | |
| 9.00 | 5.33 | 7.33 | 9.0 | 10.67 | 12.67 | 0 |
| 11.40 | 5.67 | 9.00 | 12.33 | 14.00 | 16.00 | 5 |
| | 5.50 | 8.16 | 10.66 | 12.33 | 14.33 | Mean of S.W |
| Interaction (1.86) | | | | S.W(1.32) | SA(0.83) | LSD (0.05) |

The table also shows the moral superiority of the treatment with SA in increasing the rate of plant height, as the concentration of 5 mg L$^{-1}$ of SA was superior to the concentration 0 mg L$^{-1}$ with a significant difference, as the rate of increase in plant height was 11.4 and 9 cm, respectively. The superiority of the concentration of 5 mg L$^{-1}$ SA over the concentration 0 mg L$^{-1}$ in the characteristic of an increase in plant height is in line with the physiological role of SA, as it works to accelerate the formation of chlorophyll and carotene pigments, and as a result accelerate the process of photosynthesis and increase the activity of some important enzymes in the growth process; This is consistent with the findings of AL-khallal et al. (2009), on the maize plant, ( Muhsen et al ;2020a) on the date palm plant. From the table, it is also noted that the interaction was significant, as the interaction treatment of 5 mg L$^{-1}$ SA with sea water at concentrations 0, 5 and 10% had the highest increase in plant height and reached 16.0, 14.0 and 10.66 cm, respectively, with a difference Significant among the treatments. While the interaction treatment 20% sea water with two concentrations of SA 0, 5 mg $L^{-1}$ had the least increase in the plant height rate and reached5.33 and 5.67 cm with no significant difference between them. The results of Table (2) indicate that the increase in the concentration of sea water negatively affected the average leaf area of banana plants, as we note the moral superiority of the concentration 5% over the concentrations 10, 15, 20% in the average leaf area, which amounted to 150.50, 140.50, 122.00 , 108.00 $cm^2$ respectively, and the leaf area in the comparison treatment was 164.33 $cm^2$, which was significantly superior to all studied seawater concentrations. We note from the table also the moral superiority of the concentration of 5 mg $L^{-1}$ SA on the concentration of 0 and the leaf area in them reached 142.40 and 131.73 $cm^2$ respectively.

**Table 2: Effect of sea water and SA and the interaction between them on average leaf area $cm^2$**

| Mean of SA | S.W % | | | | | SA $mgL^{-1}$ |
|---|---|---|---|---|---|---|
| | 20 | 15 | 10 | 5 | 0 | |
| 131.73 | 101.33 | 116 | 135 | 146 | 160.33 | 0 |
| 142.40 | 114.67 | 128 | 146 | 155 | 168.33 | 5 |
| | 108.00 | 122.00 | 140.50 | 150.50 | 164.33 | Mean of S.W |
| Interaction (7.45) | | | | S.W(3.33) | SA(2.70) | LSD (0.05) |

As for the interaction, it was significant, and the interaction of concentration 20% sea water with two concentrations of SA 5 and 0 mg.$L^{-1}$ recorded a significant decrease than the other interactions, as the average leaf area in them reached 101.33 and 114.67 $cm^2$, respectively, while the interaction of the comparison treatment recorded zero% with my concentration. SA 0 and 5 mg $L^{-1}$ was significantly superior to all interactions, as the average leaf area in them reached 160.33 and 168.33 $cm^2$ respectively with a significant difference between them. The reason for the effect of high concentrations of sea water in reducing the leaf area in them is due to the fact that sodium chloride salt, especially at its high concentrations, affected the water absorption process, causing a disturbance in the ionic balance, which led to a reduction in cell division and as a result inhibiting the natural growth of the plant, which in turn was reflected in the leaf area. (Al-Kaabi, 2004)pointed out that the effect of salinity on plant growth is not due to the osmotic effect, which is related to the difficulty of absorbing water in the growth medium only, but that salinity affects the vitality of the protoplasm in plant cells and tissues due to the high concentrations of ions such as sodium and chloride, which increase their absorption at the expense of ions. Others needed by the plant, and high salinity concentrations affect the various metabolic processes that occur within plant tissues, as the absorption of ions and their accumulation in the protoplasm or vacuoles can affect the level of protein inside the cell, resulting in an increase in the breakdown of proteins (Abd AL-Hseen and Manea,2020 ). Or it causes changes in the activity of many enzymes, such as hydrolytic enzymes and oxidation enzymes (Mittal & Dubey, 1991). The reason for the superiority of the leaf area in the concentration of 5 mg $L^{-1}$ of SA acid to the concentration 0 mg $L^{-1}$ of it may be due to the fact that SA is one of the plant hormones whose physiological effects depend on the concentration used Hayat and Ahmed, 2007 and SA is considered one of the antioxidants because it has a high ability to scavenge free radicals and as a result increases the activity of metabolic processes inside the plant, which is positively reflected on growth rates (Obeid, 2016).It is noted from Table (3) that the accumulation of proline in the leaves increased with an increase in the concentration of salinity of sea water in the irrigation solution. In the accumulation of proline, which amounted to 3.36 µg $g^{-1}$ dry weight. It is noted from the table that SA at a concentration of 5 mg $L^{-1}$ caused a significant decrease in the accumulation of proline compared to a concentration of 0 mg $L^{-1}$ of it, as the average amount of proline in them was 4.48 and 5.28 µg $g^{-1}$ dry weight, respectively.

**Table (3) Effect of irrigation with sea water and SA and the interaction between them on the accumulation of proline in leaves**

| Mean of SA | S.W % | | | | | SA mg$L^{-1}$ |
|---|---|---|---|---|---|---|
| | 20 | 15 | 10 | 5 | 0 | |
| 5.28 | 6.82 | 5.73 | 5.26 | 4.63 | 3.96 | 0 |
| 4.48 | 5.93 | 5.13 | 4.83 | 3.73 | 2.76 | 5 |
| | 6.37 | 5.43 | 5.04 | 4.18 | 3.36 | Mean of S.W |
| Interaction(0.180) | | | | S.W(0.063) | SA(0.044) | LSD (0.05) |

As for the interaction effect, it was significant, and the interaction treatment of 20% sea water and 0 mg $L^{-1}$ SA was significantly superior to all interactions, as the amount of proline in it was 6.82 µg g-1 dry weight, while the interaction treatment was 0% sea water and 5 mg. $L^{-1}$ SA recorded the lowest value for the amount of proline in its leaves and it was 2.76 µg $g^{-1}$. The reason for the increase in the accumulation of proline in the leaves of the banana plant exposed to salt stress is due to the cells subjected to osmotic stress the accumulation of proline in the cytoplasm of the cells to create a state of physiological balance between the gap and the cytoplasm or the outer periphery And that proline, in addition to its action as an osmotic protector, also works to protect the plasma membrane (Mansour etal 1998). Proline also helps maintain vital energy in cells and protects enzymes and cellular strands by scavenging free radicals (Muhsen et al; 1996). The reason for the decrease in the accumulation of proline in the leaves of banana plants treated with 5 mg.$L^{-1}$ SA and its increase in treatment 0 of it is due to the fact that SA reduced the vital stresses of the cells and thus increased the consumption of proline, as proline is an amino acid that contains organic nitrogen, which is considered It is more available than inorganic nitrogen and is also considered a source of energy through its contribution to the respiration process, which leads to the production of energy compounds Adensoine Triposphate (ATP), which in turn is used for all vital processes (Muhsen et al 2020b). The results of Table (4) indicate that the treatment with sea water at the concentration of 10% recorded a significant superiority in the leaves content of total soluble carbohydrates over the rest of the other concentrations, which amounted to 24.53 mg $g^{-1}$ fresh weight, while the treatment with concentration 20% sea water recorded the lowest amount of carbohydrates It reached 17.96 mg $g^{-1}$ fresh weight,It is also noted from the table that the treatment with concentration 5 mg $L^{-1}$ SA recorded a significant decrease from treatment 0 mg $L^{-1}$ of it, which amounted to 19.69 and 23.12 mg $g^{-1}$ fresh weight.

**Table 4: Effect of irrigation with S.water and SA and the interaction between them on the accumulation of total soluble carbohydrates in banana leaves**

| Mean of SA | S.W % | | | | | SA $mgL^{-1}$ |
|---|---|---|---|---|---|---|
| | 20 | 15 | 10 | 5 | 0 | |
| 23.12 | 19.32 | 25.45 | 26.70 | 23.60 | 20.52 | 0 |
| 19.69 | 16.60 | 21.51 | 22.36 | 20.84 | 17.16 | 5 |
| | 17.96 | 23.43 | 24.53 | 22.22 | 18.84 | Mean of S.W |
| Interaction.(0.173) | | | | S.W(0.121) | SA(0.076) | LSD (0.05) |

The presence of SA acid with sea water led to a decrease in the accumulation of soluble carbohydrates compared to not adding SA to sea water concentrations in watering plants, and an interaction treatment (concentration 10% seawater with 5 mg.$L^{-1}$SA) was recorded at 26.70 mg.$g^{-1}$ fresh weight. And with a significant difference from the rest of the interactions, while the treatment of the interaction 20% sea water with 5 $mg^{-1}$ SA recorded a significant decrease in the accumulation of carbohydrates in the leaves as it reached 16.60 mg.$gm^{-1}$ fresh weight, which is one of the mechanisms of cells to control salt stress conditions It is osmoregulation, which breaks down carbohydrates complex is converted into simple sugars in order to increase the osmotic concentration and reduce the water effort inside the cells .The reason for the decrease in the accumulation of carbohydrates when using SA in watering plants may be due to the fact that SA acid is one of the plant hormones that works to reduce the stress to which the plant is exposed and works to regulate growth, physiological processes, nutrient absorption, protein synthesis, inhibition of ethylene biosynthesis, respiration and protection of cellular organelles, and this in turn It induces plant tissues to grow and consume carbohydrates to provide vital energy for growth compared to the absence of SA in the irrigation solution that accumulated the largest amount of carbohydrates.

It is clear from the results in Table (5) that the treatment with concentration 5% sea water recorded a significant superiority in the average amount of total chlorophyll in leaves compared to other concentrations, which reached 1.88 mg $g^{-1}$ fresh weight, and the concentration 20% sea water showed a significant decrease in the content of leaves from Chlorophyll compared to the rest of the other concentrations, which amounted to 1.28 mg.$gm^{-1}$ fresh weight. It is noted from the table that the treatment with SA at a concentration of 5 mg $L^{-1}$ recorded a significant superiority over the concentration 0 mg L-1 of it in the chlorophyll content of leaves, where it reached (1.51 and 1.41) mg $g^{-1}$ fresh weight, respectively.

**Table5:Effect of S.W and SA and the interaction between them on the total chlorophyll content of banana plants**

| Mean of SA | S.W % | | | | | SA mgL$^{-1}$ |
|---|---|---|---|---|---|---|
| | 20 | 15 | 10 | 5 | 0 | |
| 1.41 | 1.25 | 1.36 | 1.41 | 1.64 | 1.40 | 0 |
| 1.51 | 1.31 | 1.50 | 1.93 | 2.12 | 1.76 | 5 |
| | 1.28 | 1.43 | 1.67 | 1.88 | 1.58 | Mean of S.W |
| Interaction (0.133) | | | | S.W(0.094) | SA(0.059) | LSD (0.05) |

The results of the table indicate that the interaction was significant, and the interaction treatment (5% sea water and 5 mg L$^{-1}$ SA) was significantly superior to the other interactions and recorded 2.12 mg L-1 fresh weight, while the interaction treatment was recorded (20% sea water and 0 mg L-1 SA). The results were the lowest, amounting to 1.25 mg g$^{-1}$ fresh weight. The reason for the increase in the total chlorophyll content of leaves at a concentration of 5% sea water may be due to the fact that exposing the plant to a moderate concentration of tensile material (sea water) improved the ability of cells to divide and grow, and as a result increased the production of photosynthetic pigments compared to high concentrations that inhibited cell growth and production. Optical pigments (Mushsen etal 2020 b). The reason for the superiority of the concentration of 5 mg L-1 SA over the concentration 0 mg L-1 of it in increasing the amount of chlorophyll in the leaves is in line with the physiological role of SA that works to accelerate the formation of chlorophyll and carotene pigments, and as a result, the process of photosynthesis is accelerated and the largest amount of chlorophyll is accumulated in the leaves. The results are consistent with (Muhsen et al., 2020a). From the results in Table (6) it is clear that watering banana plants with different concentrations of sea water led to an increase in the content of plant leaves of $Na^+$ ions, and the increase was significant with an increase in the concentration of sea water, and the concentration exceeded 20% significantly over other concentrations, including the control, and the amount of $Na^+$ in it was 3.11 mg. g$^{-1}$ dry weight, while the control treatment recorded the lowest amount of $Na^+$ which was 1.42 mg g$^{-1}$ dry weight.

**Table 6: Effect of SW and SA and the interaction between them on the accumulation of $Na^+$ ion in banana leaves**

| Mean of SA | S.W % | | | | | SA mgL$^{-1}$ |
|---|---|---|---|---|---|---|
| | 20 | 15 | 10 | 5 | 0 | |
| 2.34 | 3.32 | 2.72 | 2.14 | 1.92 | 1.61 | 0 |
| 2.02 | 2.91 | 2.60 | 1.80 | 1.54 | 1.23 | 5 |
| | 3.11 | 2.67 | 1.98 | 1.73 | 1.42 | Mean of S.W |
| Interaction(0.062) | | | | S.W(0.044) | SA(0.027) | LSD (0.05) |

The results of the table indicated that the use of SA at a concentration of 5 mg $L^{-1}$ in watering plants led to a significant decrease in the $Na^+$ content of leaves compared to the zero concentration of it, and the amount of Na+ in them was 0.02 and 0.034 mg $g^{-1}$ dry weight, respectively.The interaction was also significant, as the table shows that the interaction treatment (S.W. 5% and 0 mg.$L^{-1}$ SA) recorded a significant decrease compared to the rest of the other interactions, where the amount of $Na^+$ reached 1.23 mg.$L^{-1}$ dry weight. From Table (7), we notice that the accumulation of $K^+$ in the leaves decreased with an increase in the concentration of sea water salinity, and the concentration showed 20% less accumulation of $K^+$ ions, which amounted to 1.95 mg g-1 dry weight with a significant difference from the other concentrations, and the concentration 5% sea water recorded the highest amount of $K^+$ Which differed significantly from the control treatment, where it reached 3.17 and 3.12 mg $g^{-1}$ dry weight, respectively.The results of the table indicate that watering plants with SA at a concentration of 5 mg $L^{-1}$ led to a significant increase in the amount of $K^+$ in leaves, which amounted to 3.01 mg.g.w.d. compared to the control treatment, which was 2.19 mg.g.$^{-1}$ dry weight. The results of the table indicate that watering plants with SA at a concentration of 5 mg $L^{-1}$ led to a significant increase in the amount of K+ in leaves, which amounted to 3.01 mg.$g^{-1}$ compared to the control treatment, which was 2.19 mg.$g^{-1}$ dry weight.

**Table 7: Effect of S and SA and the interaction between them on the accumulation of $K^+$ in banana leaves**

| Mean of SA | S.W % | | | | | SA $mgL^{-1}$ |
|---|---|---|---|---|---|---|
| | 20 | 15 | 10 | 5 | 0 | |
| 2.19 | 1.40 | 1.77 | 2.13 | 2.63 | 3.00 | 0 |
| 3.01 | 2.50 | 2.71 | 2.87 | 3.72 | 3.25 | 5 |
| | 1.95 | 2.24 | 2.50 | 3.17 | 3.12 | Mean of S.W |
| Interaction(0.082) | | | | S.W(0.060) | SA(0.030) | LSD (0.05) |

The results showed that the interaction was significant, and the interaction treatment (5% seawater and 5 mg $g^{-1}$ SA) was significantly superior to all the interactions in the $K^+$ ions content of leaves, which amounted to 3.72 mg $g^{-1}$ dry weight, while the interaction treatment showed (20% water). sea and 0 mg $L^{-1}$ SA) the lowest accumulation of $K^+$ in leaves, which was 1.40 mg $g^{-1}$ dry weight. From table (8), it was clear that watering plants with sea water led to an increase in the accumulation of $Cl^-$ ions, and the concentration recorded 20%, the highest accumulation of $Cl^-$ ions in leaves, which amounted to 2.28 mg $g^{-1}$ dry weight, with a significant difference from the rest of the concentrations, and the control treatment recorded 0% less The accumulation of Cl- ions amounted to 1.43 mg g-1 dry weight. The results of the table indicate that the use of SA in the watering solution of banana plants led to a decrease in the accumulation of $Cl^-$ and the concentration of 5 mg g-1SA recorded a significant decrease from the concentration of zero mg l-1 of it and that the accumulation of Cl - They were (1.75 and 2.00) mg $g^{-1}$ dry weight, respectively.

**Table 8: Effect of S.W and SA and the interaction between them on the accumulation of $Cl^-$ in banana leaves**

| Mean of SA | S.W % | | | | | SA $mgL^{-1}$ |
|---|---|---|---|---|---|---|
| | 20 | 15 | 10 | 5 | 0 | |
| 2.00 | 2.46 | 1.36 | 2.23 | 1.90 | 1.56 | 0 |
| 1.78 | 1.75 | 2.10 | 2.03 | 1.72 | 1.30 | 5 |
| | 2.10 | 2.28 | 2.13 | 1.81 | 1.43 | Mean of S.W |
| Interaction (0.070) | | | | S.W(0.050) | SA(0.030) | LSD (0.05) |

As for the interaction (5 mg.l SA and 0% sea water), it was significantly lower than the rest of the other interactions, and the amount of $Cl^-$ 1.3 $mg.g^{-1}$ dry weight showed the interaction of concentration (20% sea water and SA 0 $mg.L^{-1}$) higher Accumulation of Cl-ions was significantly superior to all interactions, as it reached 2.46 mg $g^{-1}$ dry weight. The results of Table (9) show that increasing the concentration of sea water in watering banana plants led to a significant decrease in the ratio of $Na^+$: $K^+$ compared to the control treatment. There are significant differences between all studied concentrations.

**Table 9: Effect of S.W and SA and the interaction between them on the ratio of $Na^+$:$K^+$ in banana leaves**

| Mean of SA | S.W % | | | | | SA $mgL^{-1}$ |
|---|---|---|---|---|---|---|
| | 20 | 15 | 10 | 5 | 0 | |
| 1.06 | 0.42 | 0.64 | 0.99 | 1.37 | 1.86 | 0 |
| 1.72 | 0.86 | 1.04 | 1.58 | 2.11 | 3.02 | 5 |
| | 0.64 | 0.84 | 1.28 | 1.74 | 2.44 | Mean of S.W |
| Interaction(0.082) | | | | S.W(0.060) | SA(0.030) | LSD (0.05) |

The results of the table show that the addition of SA caused an increase in this ratio at a concentration of 5 mg $L^{-1}$ compared to a concentration of 0 mg $L^{-1}$, and the ratio in them was 1.72 and 1.06, respectively. The table showed that the overlap at concentration (0% sea water and 5 mg. $L^{-1}$ SA) led to a significant increase in the ratio of $Na^+$:$K^+$ for all the studied interactions, and a ratio of 3.02 was recorded. The table also shows that the interaction of SA with seawater concentrations recorded a significant increase compared to the concentrations of seawater free of SA. The results of Table 6, 7, 8, and 9 indicated that watering banana plants with different concentrations of sea water led to an increase in the element $Na^+$ and $Cl^-$ and a decrease in the $K^+$ ion and the $Na^+$:$K^+$ ratio. In the soil, thus increasing its absorption by cells exposed to salt stress (kadim et al,2021) and that the proteins in the cell membrane are in the form of channels that allow Na+ to enter the cells and thus Na takes another path in entering the cell, which is the $K^+$ channels themselves because the membranes are incompletely selective Which leads to its accumulation in high concentrations compared to $K^+$ . The reason for the decrease of the K ion is due to the intense competition that occurs between the $Na^+$ and $K^+$ ion for the active sites on the plasma membrane, and since the $K^+$ ions are dominant, which affects the absorption of the $K^+$ element as a competing element (Rubio etal, 1995). As for the reason for reducing the accumulation of Na+ and Cl- and increasing the accumulation of $K^+$ and the ratio of $Na^+$:$K^+$ in banana leaves when using SA, it may be due to the fact that SA reduced the vital stresses of cells, which stimulated plants to absorb large amounts of $K^+$. indicated That watering wheat plants with sea water at concentrations (10 and 20%) led to an increase in the accumulation of $Na^+$ ions in the tissues of the plant and when spraying it with one of the dilute stress solutions led to a decrease in the accumulation of $Na^+$ and the accumulation of $K^+$ and thus an increase in the ratio of $Na^+$: $K^+$. Hayat and Ahmed ,2007mentioned that SA works to reduce the stress to which the plant is exposed and works to regulate growth and all physiological processes because of its role in providing protection for the plant against the types of stress resulting from the accumulation of nutrients. From the study, we conclude that watering the banana plants grown in the greenhouse with sea water at high concentrations inhibited growth through the studied characteristics, and that the concentration of 5% of sea water improved the studied characteristics and that the interaction of salicylic acid at a concentration of 5 mg $L^{-1}$ with sea water improved the studied characteristics, so it is recommended The study using salicylic acid with sea water in watering banana plants grown in the greenhouse and conducting more studies using sea water and salicylic acid with different concentrations and on other plants.

**References:**

Abd AL-Hseen, Z. E., & Manea, A. I. (2020). EFFECT OF BIOFERTILIZER AND ORGANIC EXTRACTS IN TWO HYBRIDS OF CAULIFLOWER (BRASSICA OLERACEA VAR. BOTRYTIS). International Journal of Agricultural and Statistical Sciences. Vol, 16(1), 1651-1659.

Al-Aradi, H. A. (2013). Effect of some stress factors and gamma rays on selection of salt-tolerant sugarcane plants (Saccharum officinarum L.) ex vivo, PhD thesis, College of Agriculture - University of Basrah.

Al-Qatrani, M. K. J. (2016). Effect of acclimatization and fertilization with two types of compound fertilizer NPK on the growth of banana plant (Musa sp.) Indian variety tissue-propagated. Master's thesis, College of Agriculture, University of Basra.

Al-Sumaidaie, K. M. I. 2017. Applications in plant biotechnology. First edition, first part. Addar Al-Jamiya for Printing, Publishing and Translation. Al-Nahrain University, Ministry of Higher Education and Scientific Research. The Republic of Iraq. 364

Al-Taha, H. A.-K. (2008). Use of plant tissue culture technique for propagation of salt-tolerant plants from Citrus sinensis L. Osbeck local orange trees. Cv. Local Orange, PhD thesis - College of Agriculture, University of Basra - Iraq.

Al-Zubaidi, Batoul Hanoun. (2000). Effect of salinity of irrigation water and cycocel on growth and some chemical components of tomato plant. Master Thesis - College of Agriculture - University of Basra - Iraq.

Darwish, M. A. (2019). The effect of some chemical treatments in improving the development of vegetative branches of the date palm variety Barhi ex vivo, Master's Thesis, College of Agriculture - University of Basra.

FAO. (2014) .Banana Market Review and Banana S, 2012-2013. http://www.fao.org/economic/est/est-commodities/bananas/banana exports/en.

Kadim,M.,M .& Khalaf,R.T.,(2020) THE EFFECT OF IRRIGATION WITH DIFFERENT CONCENTRATIONS OF ALGAZONE ON THE CHEMICAL PROPERTIES OF TWO OKRA CULTIVARS (ABELMOSCHUS ESCLENTUS L.) CULTIVATED IN GREENHOUSES. Int. J. Agricult. Stat. Sci. Vol. 16, Supplement( 1) :. 1997-2005

Kadim,M.M., Hamed.N.N and Jaafar,H.S.(2021).EFFECT OF SEED SOAKING AND ORGANIC AND MINERAL FERTILIZERS ON GROWTH AND YIELD OF OKRA Abelmoschus esclentus L. UNDER UNHEATED GREENHOUSES. Plant Cell Biotechnology and Molecular Biology 22(19&20):31-40.

Khodary. S.E.A.(2004). Effects of salicylic acid on the growth photosynthesis and carbohydrate metabolism in salt stressed maize plant . International J. of Agric. And Biol. 6:5-8.

Mansour, M. (1998). Protection of plasma membrance of onion epidermal cells by glycinebetaine and proline against NaCl stress. Plant Physiol. Biochem. 36: 767-772.

Mittal, R. and R.S. Dubey. (1991). Behaviour of peroxidases in rice: changes in enzyme activity and isoforms in relation to salt tolerance. Plant Physiol. Biochem. 24: 31-36.

Mohammad, M. J. (2015).The effect of some treatments on increasing tolerance of banana plant (Musa acuminata L.) Indian cultivar of salt and water stresses by using plant tissue culture technique, PhD thesis, College of Education, Pure Sciences, Department of Biology.

Morad , M. ; Sara , S. ; Mohammad , D. ; Javad , R. M. and Majid , R.Muhsen, K. A. ; Hamza A. H. and Mohammad, M. J. (2020b). Influence of ascorbic acid and tocopherol on the vegetative, physiological and chemical traits of dates palm tissue, Barhi cultivar, irrigated from the Shatt Al- Arab water.

Muhsen, K. A. ; Hantosh, E. A. and Darweash, M. A. (2020a). The effect of puterscine and salsalic acid and their interaction on the multiplication of vegetative buds and their characteristics for date palm cultivars Al-barhi in vitro. Plant Cell Biotechnology and Molecular Biology, 21(19-20), 112-125.

Obaid, Abdul Amir Rahim (2015). Biochemical changes associated with salt stress and evaluation of the role of Cladophora crispata extract in Oryza sativa L. cultured Sensicia. PhD thesis, College of Education for Pure Sciences - University of Basrah.

On Proline Oxidation. Plant Physiol. 61:654-657.

Queiros, F. ; F. Fidalgo ; I. Santos and R. Salema (2007). In vitro selection of salt tolerant cell lines in Solanum tuberosum L., Biologia Plantarum 51 (4): 728-734, 2007.

Rubio.F.;Gassman,W. and Scroecler,.J.(1995). Sodium driven potassium uptake by the plant Potassium transporter and mutations conferring salt tolerance .Asian J.Plant Sci., 270:1660-1663.