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Effect of Spraying Seaweed Extract on Improving the Vegetative Growth and Productivity of Jujube Trees

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Abstract: This study was conducted in one of the orchards of Al-Hartha region, north of Basra province, to demonstrate the importance of seaweed extract for two cultivars of jujube Al-Tufahi and Al-Bambawi trees. Three concentrations of the extract were used, and a complete random block design was used. The results showed that Al-Bambawi cultivar had a significantly excelled in the length and size of the fruit at the maturity stage, as it recorded 37.21 mm and 12.44 cm^3, respectively, compared to the Al-Tufahi cultivar, which recorded 35.98 mm and 11.75 cm^3 .It also shows the Al-Tufahi cultivar in the fresh and dry weight of the fruit at the ripening stage was excelled, as it recorded (15.539 and 12.22) g, in addition to the percentage of vitamin C, total soluble solids, and total acidity. The values were (163.24 $mg.100g^{-1}$, 19.38, and 0.3932) and giving it the best values, in a significant way, for each of the percentage of maturity and set, with yields of 95.83%, 13.91%, and 46.18 kg. The results of the study also showed that the concentration of 8 $ml.L^{-1}$ was excelled in most of studies traits. The results also showed a clear significant effect of the bi-interaction on studies traits.

Keywords: Jujube Trees, Seaweed Extract, Al-Tufahi , Al-Bambawi

1. Introduction

Ziziphus Mauritiana LAM. It is known as the English or Ber. The problems facing agriculture in general and jujube in particular are salinity, which means increasing the concentration of salts represented by the sodium chopper located in the root area of the plant, so considering the salinity can be a hurdle of the main obstacles facing agriculture in the center and southern Iraq,This makes salinity a specific factor for the cultivation and success of many fruit trees, including jujube , where it affects the product and productivity, that the use of antioxidants extracted from seaweed extract . Positive results in reducing the damages of salinity on the date palm plant, Al-Hatimi class, showed that it has an effective role in improving the tolerance of salinity or reducing its damage and also works to regulate the fellowship voltage of the cells and thus leads to regulating and encouraging growth under the conditions of saline stress and improving productivity and fruits (Al-Juburi & Maroff, 2007). jujube has antioxidants that consist naturally in the plant, but sometimes they are not sufficient to withstand saline stress, and to overcome this problem, it is possible to use antioxidants manufactured from natural ingredients extracted from seaweed (Shi et al., 2018). Abdel-Sattar et al.(2021).A study of the fruits of jujube trees was conducted for 15 items to explain the physical qualities of the fruits. The percentage of length, diameter and weight in the fruits reached about 18.11-40.69 mm, 16.66-566.60 mm and 2.52-19.37 g respectively (Ivanišová et al., 2017)Gündüz & saraçoğlu (2014) was created by studying on the fruits of Jujube trees within four stages of the growth of the fruits, as he noticed that the percentage of the total materials in the fruits reached their climax in the four stages of the stages of the maturity of fruits and reached about 18.3% compared to the fruits at the beginning of growth, which reached 12.8 % and Singh & Pathak (2015) stated that the total content of the total solid solids in the fruits of jujube trees varies according to the types and cultivars, where a percentage in the fruits ranged about 12.50-16.40 %.Given the lack of studies on knowing the importance of antioxidants in treating stress for Jujube trees, the study took up:Knowing the role of seaweed extract in tackling stresses and its impact on improving the vegetative, fruit and productive reality of jujube trees.

2. Materiel and Methods:

This study was conducted during the growth season 2020-2021 in the NATO groves located in the Al -Hartha region, which is 30 km north of Basra provainc .As the effect of seaweed extract was studied on the treatment of saline stress and the knowledge of some physical and chemical characteristics on the fruits of jujube for Al -

Tafahi and Al -Bambawi and the productive traits(maturity, set and yield) All agricultural service operations, which are well -tied to the soil and fertilizing it with nitrogen chemical fertilizer (N), phosphorus (P) and potassium (K) in a 3 kg of per tree at the end of October in three batches between one payment and 25 days. This was done by following the method of digging a trench around the trees under the branch projections of 1.5 meters, and also removed the weeds, jungle and trimming trees by removing the dry, injured and intertwined branches. The concentrations of the user solution, its method and the date of spraying:The trees were treated with seaweed extract (Equilibrium) and the transactions were prepared in fabricated proportions to know the extent of resistance to the trees when exposed to saline stress. The first treatment was prepared by dissolving 100 ml of the solution in 25 liters of water to get a concentration of 4 ml. As for the second treatment, it was prepared by dissolving 200 ml of the solution in 25 liters of water to get a concentration of 8 ml.The trees were sprayed until wet with a hydraulic pump with a capacity of 15 m3, with the addition of a little diffuser (Tween 20). The first spraying took place on 9/15/2020, before the flowering date, and the fruit set began on 10/30/2020. it continued spraying until March 2021.Where the number of sprays reached 6 and the period between one spray and another was 30 days, while the control treatment 0 was prepared from distilled water only.

The studied traits:
Samples of 5 fruits were taken for each experimental unit, from both Al-Tufahi and Al-Tufahi cultivars, in a random manner, and the physical and some chemical traits were measured at the maturity stage.

The physical traits of jujube fruits:
The method of measuring the trait of volume (cm^3):
The volume was measured by the amount of displaced water, and each of them was placed in a known amount of water inside a graduated cylinder with a capacity of 500 ml. The displaced water resulting from placing the fruits represents the volume.

Method for measuring the traits of the total fresh and dry weight of fruits (g):
The fresh weight of the fruit was calculated using a sensitive electric balance of Sartorius type, and then the seed was separated from the flesh of the fruit. Each of them was calculated separately, and the dry weight was calculated for each of the above, by drying the fruits and seeds in an electric oven at a temperature of 65 °C for two days until the weight was confirmed, and then the fruits were weighed in the same scale for both pulp and seeds.

Chemical traits :
Percentage of water content and dry matter of fruits (%):
Water content and dry matter were estimated at each stage of fruit maturity, as fresh fruit pulp was weighed Then it was dried in a vacuum oven at a temperature of 65 °C for 48 hours until stable weight. The water content and dry matter in the pulp and seeds were calculated based on the method of (George & Latimer, 2016).According to the following equations:
Percentage of water content = (weight of wet sample - weight of dry sample / weight of wet sample) * 100
The percentage of dry matter = (dry weight of the sample / wet sample weight) * 100

Estimation of the percentage of total neutralizable acidity (%):
The total acidity was estimated at each sampling date by following the method of (George & Latimer, 2016) by mashing 5g of fresh fruit pulp with 100ml of distilled water, then the sample was filtered through gauze.10 ml of the filtered juice was taken and pulverized with 0.1 M sodium hydroxide by two drops of phenolphthalein index until reaching the neutralization point (the appearance of the pink color).the percentage of total acidity was calculated through the following equation:
Percentage of total acidity in fruit pulp = Maturity of the base * its quantity * 0.064 * final volume of the solution / volume of the anointed solution * weight of the sample * 100.

Total soluble Solids (TSS):
The total soluble solids were measured at the final maturity of the fruits, by mashing 5 gm of the pulp of fresh fruits with 15 ml of distilled water, and after filtering the extract.Where the percentage of total soluble solids was estimated using the Hand Refractometer (Al-Miksar) by following the method of Howrtiz (1975), then the reading was corrected at the laboratory temperature of 27 °C and according to specific schedules.

Ascorbic acid Vitamin C ($mg.100g^{-1}$ based on fresh weight of fruit pulp):-
Vitamin C was determined by the direct denaturation method using 2-6 dye, Dichlorophenolindophenols. As 10 gm of fresh fruit pulp was mashed using an electric blender with the addition of 10 ml of oxalic acid, its concentration is 6% and swabbed against the pigment, which had a strength of 0.2 mg vitamin C before the swabbing process. The acid was estimated on the basis of the number of milligrams per 100 gm of fresh weight and according to the equation described in George & Latimer (2016).
Vitamin C = H * P * Dilutions / Sample Weight (g) * 100
As it represents:
h: the number of milligrams of pigment needed for neutralization.
P: The strength of the dye or the number of milligrams of vitamin C measurement that equals one ml of the pigment.

3-7: Determination of the physiological characteristics of the fruits of Jujube trees:
3-7-1: Percentage of fruit set (%):
Depending on the method of Ream & Furr (1970), the percentage of fruit set was determined by taking random samples of flowers before spraying and after spraying at different times, then calculating the percentage of set, according to the following equation:
Percentage of fruit set (%) = (number of fruits set in the sample / number of flowers in the total sample) * 100.

3-7-3: The date and percentage of the final maturity of the fruits (%):
The percentage of the final maturity of the fruits was calculated when the fruits entered the stage of final maturity and with different dates during the period.Random samples were selected in each replicate. The number of ripe fruits and the number of unripe fruits were calculated according to the following equation:
Percentage of maturity fruits = (number of maturity fruits / total number of fruits) * 100.

3-7-4: Quantitative traits
The total yield in the tree was measured after the completion of harvesting all the fruits of the trees, and they were weighed with a two-pan scale after collection directly from the field.

Statistical design and used parameters
The experiment was conducted as a Factorial Experiment with a Factorial Experiment in Randomized Complete Block Design with three replicate to demonstrate the effect of the spraying agent. It was sprayed (with seaweed extract in addition to the control treatment, which was sprayed with distilled water only) and the cultivar (Al-Bambawi and Al-Tufahi)The data used in the study were analyzed statistically using the statistical program GenStat 2007. The averages were tested using the method of the least significant difference test (R.L.S.D) at the level of probability (0.05) based on (Mardia et al., 1979).

3. Results and Discussion:

The results in Table 1 show that the Al-Bambawi cultivar was significantly excelled in fruit length and size at the maturity stage, as it recorded 37.21 mm and 12.44 cm^3, respectively, compared to the Al-Tufahi cultivar, which recorded 35.98 mm and 11.75 cm^3.The concentration of 8 $ml.L^{-1}$ was significantly excelled in the same capacity, compared with the other concentrations included in the study, where it recorded 39.35 mm and 12.86 cm^3 for the two traits of length and volume, and the lowest values, with a significant difference recorded when the control treatment was 34.11 mm and 11.22. The table also shows the effect of the bi-interaction significantly on trait of the fruit length at the maturity stage, where the cultivar Al-Bambawi recorded a concentration of 8 $ml.\ L^{-1}$ had a volume of 40.13 mm and 13.32 cm^3 and the lowest values with a significant difference when compared to the Al-Tufahi cultivar with 33.54 mm and 10.81 cm^3.

size (cm^3)		length (mm)		concentrations/cultivars
Al-Bambawi	Al-Tufahi	Al-Bambawi	Al-Tufahi	
11.63	10.81	34.67	33.54	$0ml.L^{-1}$
12.36	12.06	36.81	35.84	$5ml.L^{-1}$
13.32	12.40	40.13	38.58	$8ml.L^{-1}$
12.44	11.75	37.21	35.98	average cultivar
	0.469		0.822	RLSD Cultivar

11.22	34.11	0ml.L-1	concentration average
12.21	36.32	5ml.L-1	
12.86	39.35	8ml.L-1	
0.574	**1.007**		**RLSD Concentrate**
0.812	**1.424**		**RLSD Interaction**

Table 1 Effect of cultivar and spraying with seaweed extract on fruit length and size at maturity

The results of Table 2 show the Al-Tufahi cultivar excelled in the fresh and dry weight of the fruit at the maturity stage, where it recorded (15.539 and 12.22) gm, significantly. As for the effect of spraying with the extract, the concentration was superior to 8 ml.L^{-1} in both fresh and dry weight As it recorded (16.323 and 12.41) gm. The results were taken the same aloe and concentration 8 ml. An overlap curve, by excelled of the Bambawi cultivar, with a concentration of 8 ml. L^{-1}, where the values were (16.433 and 13.22) gm for the fresh and dry weight, respectively.

Table 2 Effect of cultivar and spraying with seaweed extract on the fresh and dry weight of the fruit at the maturity stage

Fruit dry weight (g)		**Fruit fresh weight (g)**			**concentrations/cultivars**
Al-Bambawi	**Al-Tufahi**	**Al-Bambawi**	**Al-Tufahi**		
11.40	9.35	14.380	13.937		**0ml.L-1**
11.74	10.69	15.803	15.210		**5ml.L-1**
13.22	11.60	16.433	16.210		**8ml.L-1**
10.55	12.22	15.119	15.539		**average cultivar**
0.490		**0.413**			**RLSD Cultivar**
10.38		14.158		**0ml.L-1**	**concentration average**
11.21		15.507		**5ml.L-1**	
12.41		16.322		**8ml.L-1**	
0.600		**0.506**			**RLSD Concentrate**
0.849		**0.716**			**RLSD INTERACTION**

It is noted from Table 3 that the Al-Tufahi cultivar was significantly excelled in the studied traits. Table 3 shows the percentage of vitamin C, total soluble solids, and total acidity. The values were (163.24 mg.100g^{-1}, 19.38, and 0.3932)%. The concentration was higher than 8 ml. L^{-1} in terms of vitamin C and total soluble solids, as it recorded (163.98 mg.100g^{-1}, 19.38)%The control treatment excelled by giving the highest values with a significant difference for the percentage of total acidity 0.4470%. The results of vitamin C and total soluble solids were also consistent with cultivar Bimbawi and concentration 8 ml. L^{-1} excelled and giving the highest values 166.85 mg.100g^{-1} and 19.94%, and significantly.The control treatment with the Al-Tufahi cultivar excelled by giving the highest values for the percentage of total acidity, as it recorded 0.4363%. Note that acidity was not significant among the studied cultivars.

Table 3 Effect of cultivar and spraying with seaweed extract on the percentage of vitamin C, total soluble solids and total acidity of the fruit at the maturity stage

Acidity (%)		**(%) TSS**		**Vitamin C (mg.100g-1)**			**concentrations/cultivars**
Al-Bambawi	**Al-Tufahi**	**Al-Bambawi**	**Al-Tufahi**	**Al-Bambawi**	**Al-Tufahi**		
0.4577	0.4363	18.96	17.44	158.25	156.22		**0ml.L-1**
0.3703	0.3617	19.25	18.37	164.62	158.04		**5ml.L-1**
0.3517	0.3407	19.94	18.82	166.85	161		**8ml.L-1**
0.3796	**0.3932**	18.21	19.38	158.46	163.24		**average cultivar**
N.S		**0.561**		**0.920**			**RLSD Cultivar**
0.4470		18.20		157.23		**0ml.L-1**	**concentration average**
0.3660		18.81		161.33		**5ml.L-1**	
0.3462		19.38		163.98		**8ml.L-1**	
0.0479		**0.687**		**1.118**			**RLSD Concentrate**
0.0677		**0.972**		**2.024**			**RLSD Interaction**

The results in Table 4 show the superiority of the Al-Tufahi cultivar in the studied characteristics of the mentioned table, giving it the best values, with significant values of 95.83%, 13.91%, and 46.18 kg. and the concentration is 8 ml. L^{-1} was excelled in all the traits referred to in Table 4, as it scored 96.64%, 14.36%, and 46.53 kg. It is also noted that the Al-Tufahi cultivar with a concentration of 8 ml.l^{-1} gave the best values with clear significance for the above trait 98.37%, 14.95% and 46.40 kg. It is worth noting that the total yield was not significant between cultivars, concentrations and binary interactions.

Table 4 Effect of cultivar and spraying with seaweed extract on the percentage of maturity, set and total yield at maturity stage

total yield (kg)		set percentage (%)		Maturity percentage (%)		concentrations/cultivars
Al-Bambawi	Al-Tufahi	Al-Bambawi	Al-Tufahi	Al-Bambawi	Al-Tufahi	
47.14	43.12	11.88	12.82	92.11	93.67	0ml.L^{-1}
44.73	43.82	12.66	13.96	92.84	95.47	5ml.L^{-1}
46.66	46.40	13.77	14.95	94.92	98.37	8ml.L^{-1}
44.45	46.18	13.91	12.77	95.83	93.29	average cultivar
N.S		0.458		0.644		RLSD Cultivar
45.13		12.35		92.89	0ml.L^{-1}	concentration average
44.27		13.31		94.15	5ml.L^{-1}	
46.53		14.36		96.64	8ml.L^{-1}	
N.S		0.561		0.789		RLSD Concentrate
N.S		0.793		1.115		RLSD Interaction

The difference in proportions between the cultivars may be due to the differences in the nature of the genetic structure between the studied cultivars. The difference may be related to the decrease in the process of photosynthesis and the deepening of the roots and their ability to reduce the permeability of heavy ions represented by the element sodium, which causes salt stress in the root zone, and thus increase the readiness for the absorption of nutrients represented by the microelements and their transfer to the leaves and improve the osmotic pressure of the cells and reach a state of hormonal and nutritional balance.This leads to good nutrition and ease of photosynthesis, and thus the production of fruits with good physical properties, as well as maintaining a high percentage of potassium to sodium ions, which is an important factor in salinity resistance (Gorai et al., 2019).As for the effect of spraying concentrations of antioxidants on the growth curve of the fruits of jujube trees under stress conditions, where the concentration 8 ml.l^{-1} excelled in most traits, this may be due to the fact that the antioxidant used in the experiment works at high concentrations.As 8 ml. L^{1} was superior in most of the physical trait of the fruits compared to the two concentrations of 5 and 0 ml. L^{-1} and that the role of the antioxidant provides protection for plant cells from oxidative free radicals, which deteriorate the growth curve of fruits (Merwad et al., 2015).The reason may also be due to what this solution contains of plant hormones, which in turn stimulate growth by increasing divisions and elongation of meristematic tissue cells and the ease of transmission, movement and representation of nutrients towards the treated tissues, in addition to hindering the process of protein decomposition as well as an increase in the efficiency of the photosynthesis process in the plant Which leads to good nutrition for the tree and absorbing enough water to reduce the damage of salt stress on the trees. This is accompanied by its role in increasing the length of the cells and thus increasing the fruit length in increasing the size of the succulent vacuoles inside the cells through the osmotic flow of water from outside the cell to the vacuoles, which leads to expansion. The lateral cells of the cells in the fruits, and thus the increase in the diameter of the fruits and the fleshy layer, which is reflected positively on the size of the fruits, as well as the role of plant hormones to prevent or inhibit inhibitors or the growth impediments represented by ethylene, Cycocel, and Alar Ozaga &. As for the increase in the dry weight of the fruit during the ripening stages, the reason may be due to the role of the antioxidant in increasing the content of dry matter, carbohydrates, and sugars, which led to an increase in the dry weight of the fruit, especially at maturity (Ram et al. .,2005).As for the effect of concentrations of spraying antioxidants on the chemical properties of the fruits, the reason may be due to the mineral elements that the antioxidant solution contains (Bo, Zn, Cu, Mn, Mo).These elements play a role in improving salt stress tolerance. As salt stress results from an increase in sodium, which works to block the process of building chlorophyll pigment in the peel of fruits due to a lack of nutrients and carbohydrates (Arndt et al., 2001).The accumulation of Cl and Na ions in the cytoplasm leads to an increase in the salt concentration and thus stops or reduces the activity of enzymes. If they are present in the cell walls, they cause dryness and curling of the cells. Salt stress also affects the cessation of cell division and elongation, or the stomata may close, which leads to a reduction in the process of photosynthesis and protein degradation. In the end, plant growth is weak, and the stems are the organs that accumulate the most Na and Cl compared to the leaves, in addition to that the accumulation of Cl increases by a degree more compared to the Na and thus hinders the absorption of nutrients and thus destroys the cell organelles and their membranes (Ali, et al,.2021) Perhaps the reason is due to the role of the antioxidant in raising the percentage of acids gradually at the beginning of growth, and then working to reduce its content in the fruits of treated trees compared to the fruits of untreated trees, with the gradual increase in sweetness in the fruits and culminates in the ripening of the fruits, while the percentage of total soluble solids increased in the ripe fruits in treated trees compared to the fruits of untreated trees Ishaq et al.,2021; Altemimi et al, 2019) or the reason may be due to the role of the amino acids present in the antioxidant, which contributed to the process of opening and closing stomata, the transfer of ions, the reduction or removal of ROS toxicity, and the regulation of the pH number between cells, thus reducing the damage of salt stress on the plant or the reason can be attributed to the low water content in the fruits and the high amount of total soluble solids in the fruits, or due to the accumulation of sugars, which leads to a high percentage of total soluble solids in the ripe fruits (Smirnoff & Wheeler, 2000).As for the high chemical content in the ripe fruits represented by vitamin C, the reason may be due to the role of the antioxidant in regulating the physiological and vital characteristics of the plant and reducing the osmotic stress by removing or reducing the concentration of sodium and chlorine ions, thus increasing the absorption of water and nutrients. or the reason may be due to the fact that the antioxidant used sweeps away the ROS that cause a decrease in the chemical content in the fruits, as the antioxidant can enhance the accumulation of solutes such as amino acids and protein sugars, and those solutes that accumulate under salt stress may participate in the removal of the ROS as well. Non-structural carbohydrates such as (sucrose, hexose, and sugar alcohols) accumulateThese sugars play a protective role, as they contribute to maintaining the stability of the membrane. One of the important amino acids that increases during stress is proline, where it plays the role of protecting the integrity of the plasma membrane and energy production or the reason may be due to the effect of the solution used in adjusting the pH and thus reducing the toxicity of heavy metals by isolating metal ions and not involving them in the vital reactions of the cell and excluding sodium and chlorine (El-Gamal, 2000; Abd et al, 2020). increased sugars in ripe fruits,The reason may be due to the fact that antioxidants increase sugars, especially glucose, and this is due to an increase in the efficiency of the photosynthesis process as well as protection of the cell membrane and the ability to scavenge free radicals ROS (Ibrahim et al., 2019) or the reason may be due to what the solution contains of zinc, which is one of the essential microelements in the plant, as it participates in the process of photosynthesis and enzymes and that this element is considered important in chloroplasts because of its effects on water-splitting in the second photosynthesis PSII, which supplies the necessary electrons for photosynthesis and is involved in the synthesis of proteins In addition, the antioxidant used increases sugars, which scavenge ROS and reduce toxic damage to cell membranes and other compounds, and thus plant resistance to salt stress (Ismael, et al, 2021).

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