Effect of the number of sprays with different concentrations of seaweed extract Algazone on the qualitative traits of two okra cultivars *Abelmoschus esculentus L. Moench* grown in greenhouses.

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Abstract

The study was conducted during the agricultural season 2019-2020 in one of the unheated greenhouses in one of the private farms affiliated to Al-Faris Agricultural Company located in Al-Zubair district, southwest of Basrah region To study the effect of spraying with different concentrations of seaweed extract Algazone and the number of irrigation times on the chemical properties of two cultivars of the local okra plant Al-Khanisariah and Batira .The experiment included 54 treatments, which is the combination of three concentrations of seaweed extract 8.4,0 ml L^{-1} and a spray average of 4.3 times during the duration of the experiment for two okra cultivars . The factorial experiment was conducted as split split plot experiment according to the Randomized Complete Block Design and with three replicates. The results showed the cultivar Khneisri excelled in trait of specific yield such as vitamin C, T.S.S. percentage of total soluble solids in fruits, and percentage of dry matter in fruits.The study also showed the excelled treatment of the number of times of spraying, especially spraying by an average of four times, a significant effect with regard to the percentage of dry matter in the leaves. The extract concentration treatment was also excelled for all the studied traits, especially the concentration (8.4) ml.L^{-1}, while the percentage of total soluble solids and the percentage of dry matter in the fruits.The concentration of 8 ml L^{-1} spray showed a significant effect with regard to the content of the fruits of vitamin C and the percentage of total soluble solids (T.S.S). As for the bi-interactions, they were significant for some of the studied traits. The triple interaction between the experimental factors also showed a significant effect, especially with regard to the percentage of dry matter

Introduction

Okra Moench L. Ablmoschus esculentus belongs to the family Malvaceae. In Iraq, it is one of the important and widespread summer vegetable crops. It is grown in all regions of the country and is considered a vegetable crop with a high nutritional value. Each 100 g of fresh okra fruits contains 88.988.9 g of water, 2.4 g of fat, 7.6 g of carbohydrates, 1 g of fiber, 92 mg of calcium, 51 mg of phosphorous and 0.6 mg Iron, 3 mg sodium, 41 mg magnesium, 249 mg potassium, 31 mg riboflavin, 1 and a small amount of carotene and vitamin A (5)It is worth noting that okra contains pectin, which is a resinous substance similar to wax (4), which reduces moisture loss and the percentage of fiber in the fruits is a determining factor to a large extent in determining the quality of the fruits. The lower the percentage of fiber, the higher the quality of the fruits and vice versa (6) Okra is also famous for its high content of antioxidants, as it has many potential beneficial health effects on some important diseases such as cardiovascular diseases, diabetes, and some types of cancer (11) Okra plays an important role in the diet because the soft, immature pods contain a sticky substance that is used as a thickener for soups. It is also a good source of minerals, protein, carbohydrates, and fats. It is also rich in fibers that can enhance the digestion of food (15) Varieties are among the most important factors that determine the success of the Cultivation of plants in a specific area by interaction with the environmental conditions prevailing in that area (16) The environment and genetic material of the cultivated okra cultivar greatly affect the quantity and quality of the yield. In a study conducted by Zaidan et al (11) in one of the greenhouses in Najaf

province, to evaluate seven cultivars of okra plant, Samara, Sultani, Clemson, Spinless80, and Clemson. The cultivar Sultani in all the traits of the quantitative and qualitative yield. The use of organic fertilizers in the form of seaweed extracts is a modern application to achieve sustainable agriculture as well as stimulate plant growth (8)Seaweed is a new generation of natural organic fertilizer that contains highly effective nutrients and liquid fertilizer extracted from seaweed is an effective environmentally friendly fertilizer for increasing the growth and yield of many crops and preserving natural resources. Seaweed extracts are an integral part of organic farming due to their various benefits in agricultural fields including nutrient management and crop growth (9) The use of garlic extract led to an increase in the number of fruits, fruit length, diameter, weight, and early yield (Jassim et al., 2006).It was reported (Al-Shuili, 2013) that spraying with seaweed extract at a concentration of 4 ml per liter led to a significant increase in all vegetative and flowering traits.Of them, more than 31 million tons are used annually in agricultural fields around the world. They are non-fertilizer materials that stimulate plant growth in low concentrations and contain macro and micronutrients and contain more than one group of growth-stimulating substances such as cytokinins, auxins, vitamins, amino and organic acids, and compounds similar to auxins. (14) and due to the lack of a study on the use of irrigation seaweed extract (Algazon) produced locally and the use of cultivars that are characterized by their high level of production due to the different cultivars among them in terms of quality, so this study was prepared to find out its reflection in improving the quality properties of two cultivars of the local okra plant grown in greenhouses in the desert areas of southern Iraq.

Materials and methods

The study was conducted during the agricultural season 2019-2020 in one of the unheated greenhouses, with dimensions of 9 * 50 m, in one of the private farms affiliated with Al-Faris Agricultural Company, located in Al-Zubair district, southwest of Basra region, located at latitude 15 7 30 north and longitude 52◦ 42◦ 47◦ To the west, in silty clay soil. The soil of the plastic house was analyzed before planting by taking random samples from different places with a depth of 0-30 cm. Table (1) shows some physical and chemical properties of the soil. The land of the plastic house was plowed at a depth of 30 cm, then the soil was smoothed and leveled, then the house was divided into 6 lines, 45 m long, 0.5 wide, 1.2 m between one line and another, with a distance of 1.25 between each side of the house. (3) . Then the Radwell 5G pesticide was added at an average of 3 kg to the house, where the addition of urea fertilization to the soil at different levels (Haji, 2016) then divided each line into 9 experimental units with a length of 5 m for each experimental unit, leaving a distance of 2.5 m at the entrance and end of each line. Drip irrigation system to irrigate plants, and the planting lines were covered with black plastic.The treatments were randomly distributed to the experimental units, where the experiment was designed according to the Randomized Complete Block Design R.C.B.D as a split-factor experiment twice as a split-plot system, where the cultivars represent the main factor, the number of watering orders the secondary factor, and the concentrations of the organic extract the sub-secondary factor. The seeds of the two local cultivars of okra, Batira and Khanisiriya, which were prepared under the supervision of the Basra Agriculture Directorate, were sown on 1/1/2020. The soil of the greenhouse was moistened two days before planting using the drip irrigation system. Three seeds were placed in each pit and the seeds were planted alternately on both sides of the dotted line between each seed and another. After germination, the plants were thinned by leaving one plant in each hole. All agricultural operations used to produce this crop were conducted in greenhouses. Then start spraying the plants with the first dose of Algazone extract twenty days after planting. Table (2) shows the components of Algazone seaweed extract.The cultivation was sprayed

with the second spray 15 days after the first spray, the third spray 15 days after the second spray, and the fourth spray 15 days after the third spray.The structure of the plastic house was covered with transparent white plastic for the winter agricultural season on 1/1/2020 and lifted on 1/4/2020, then the house was covered with a lathhouse (saran). The harvest started on 3/15/2020 and the harvest ended on 1/7/2020 The results were analyzed using the analysis of variance and the least significant difference (L.S.D) test was chosen to compare the averages at the probability level (0.05) (2)

Table (1) Some physical and chemical properties of irrigation soil and water for the 2019-2020 growing season

traits		values	units
pH		7.80	_
electrical conductivity (EC)		2.12	$ds.m^{-1}$
Dissolved positive ions	Ca^{+2}	31.14	$mmo.l^{-1}$
	Mg^{+2}	25.65	$mmo.l^{-1}$
	Na^{+1}	2.13	$mmo.l^{-1}$
	K^{+1}	1.15	$mmo.l^{-1}$
Organic matter		0.63	%
Dissolved negative ions	HCO_3	22.22	mmo.l-1
	CO_3	_	mmo.l-1
	$SO4^{-2}$	25.54	mmo.l-1
	CL^-	9.65	mmo.l-1
Total nitrogen (N)		20.2	$g.kg^{-1}$
available phosphorus (P)		0.015	$g.kg^{-1}$
cation exchange capacity (CEC)		17.43	$g.kg^{-1}$
Soil Separators	sand	12.21	%
	silt	42.6	%
	clay	45.13	%
texture		silty clay	
Humidity at field capacity		30.13	%
Irrigation water properties			

electrical conductivity (EC)	**0.50**	**ds.m^{-1}**
pH	**8.20**	

The analysis was conducted in the central laboratory / College of Agriculture, University of Basra

Experimental Measurements:

Indicators of the qualitative content of fruits

1: Ascorbic Acid Vitamin C (mg 100g^{-1} fresh weight.)

Take 50 g of fruit pulp for each sample and cut it into small pieces and add to it 50 ml of oxalic acid at a concentration of 6% It was mixed in an electric mixer for five minutes until the solution became homogeneous. The juice was filtered with a piece of gauze and 10 ml was taken from it and placed in a 50 ml beaker the volume was completed to the mark with 3% oxalic acid, then 10 ml was taken from it and placed in a beaker and smeared with 2,6-Dichloro dye. phenol indophenol and as shown in (7)

Amount of ascorbic acid = burette reading x pigment strength x 100/(sample weight)

2: The percentage of total soluble solids (T.S.S)

The percentage of total soluble solids was calculated by taking 5 g of fruits with 20 ml of distilled water It was placed in the electric mixer and filtered and a drop was taken and placed on the Hand Refrectometer to read the percentage of total dissolved solids as described (7).

3: Percentage of dry matter in fruits (%)

The percentage of dry matter was estimated by taking 100 g of fruits at random from each experimental unit and then drying them in an electric oven at 70 °C for 72 hours. The percentage of dry matter was calculated from the equation

Table (2) Algazone seaweed extract content

Components	Values
natural compounds	**30%**
K20	**43**
natural growth stimulants	**20%**
(auxins, gibberellins, cytokinins)	**5%**
Minor elements	**2%**

* The bulletin is issued by the producing company, the Iraqi Al-Joud Company

Results and discussion

Table (3)showed that the study factors and their interactions had a significant effect on ascorbic acid and vitamin C, where the Khenaisri cultivar significantly excelled the cultivar in traits of vitamin C, with an increase of 20.34%. The same table showed that the bi-interaction between the cultivar and the concentrations of seaweed extract Algazone had a significant effect, whereby the plants treated for the cultivar Khneisari and the concentration of 4 ml L^{-1} showed the highest values of 31.69 mg.The same table also shows that the number of spraying times treated with seaweed extract Algazone had a significant effect on ascorbic acid and vitamin C, especially when spraying 3 and 4 times 10.55% and 13.13%, respectively, compared

to spraying twice during the experiment period.The same table showed that the treatment with extract concentrations had a significant effect, especially at concentrations 4 and 8 ml L^{-1}, with an increase of 3.34% and 3.67%, respectively, compared to the comparison treatment, and there were no significant differences between the two concentrations. The table also shows that the bi-interaction between the number of spraying times and the concentration of the extract was significant, as the treated plants gave the highest values of 30.47 mg $100g^{-1}$. Compared to the control treatment, the triple interaction between the experimental factors was not significant. Table (2) showed that the study factors and their interactions had a significant effect on the percentage of soluble solid matter in the fruits, where the Khenaisri cultivar significantly excelled on the cultivar in the percentage of soluble solid matter in the fruits, with an increase of 33.95% The same table also shows that the bi-interaction between the cultivar and the number of irrigation times was significant, where the plants treated Khenaisri and the watered 4 times gave the highest values, amounting to 5.65%. The same table also shows that the treatment of the number of times sprayed with seaweed extract Algazone had a significant effect on the percentage of soluble solid matter in the fruits, especially when watered 3, 4 times, with an increase of 9.52% and 9.21%, respectively, compared to spraying twice. Table (2) also showed that the concentrations of seaweed extract Algazone had a significant effect, especially at concentrations 4 and 8 ml L^{-1}, which showed an increase of 9.50%, respectively, compared to the control treatment, and there are no significant differences between the two concentrations. Also, the bi-interactions did not show a significant effect, where the triple interaction between the experimental factors, it was also not significant .It is evident from Table (3) that the study factors and their interactions had a significant effect on the percentage of dry matter in the fruits, whereas the Khunaisri variety significantly excelled on the cultivar in the percentage of dry matter in the fruits that amounted to 26.61%. The same table also shows that the treatment the number of times spraying with seaweed extract Algazone had a significant effect on the percentage of dry matter in the fruits, especially when spraying 4 times, with an increase of 4.72% compared to irrigation for two to three times during the experiment period. The same table also showed that the concentrations of Algazone seaweed extract had a significant effect on the dry matter percentage of the fruits, especially at the concentration of 8 ml. L^{-1} showed an increase of 2.89% in a row compared to the control treatment As it is clear from the table that the triple interaction between the experimental factors was also significant, where the treatment plants of the cultivar Khneisri + and spraying 4 times + concentration 8 ml L^{-1} appeared the highest values of the percentage of dry matter in the fruits amounted to 12.34% compared to the lowest value produced from the plants treated for the variety Batira + The spray 2 + and the concentration of 0 ml L^{-1} amounted to 8.65.It is clear from the tables (1,2,3) that the Khenaisri cultivar excelled on the Batira cultivar in a frequency in all traits of the specific yield and this is attributed to the genetic factors specific to the cultivar due to its growth under the same environmental conditions (14).This is consistent with what was found (12). It is clear that spraying at an average of three and four times gave the highest values. As shown by the tables, the exelled of seaweed extract in increasing all the traits of the specific yield is attributed to the physiological role of irrigation with seaweed extract in increasing the traits of vegetative growth because it contains Amino acids that are in the formation of proteins, RNA, DNA, which are an indicator of plant growth, as they contain substances that encourage plant growth.This is due to the fact that the repeated irrigation of the extract led to an increase in the concentration of the elements present in the extract and an increase in their content in the plant, thus increasing the trait of the specific yield. It contains biologically active substances such as sugars, fatty acids, and natural growth hormones such as auxin and cytokinin that lead to improving the quality

traits of the fruits.Also, the absorption of these nutrients through the roots and their access to the leaves plays an important role in activating the enzymes involved in the process of carbon metabolism and increasing the processed carbohydrates that are stored in the fruits (1), which are necessary for the formation of ascorbic acid and soluble solids (10) and these results are consistent with what was found (11) on the okra plant.

Table (1). Effect of variety, number of spray times, and concentrations of seaweed extract and their interactions on ascorbic acid, vitamin C (mg $100g^{-1}$ fresh weight)

seaweed extract $ml.L^{-1}$	number of sprays	Cultivars		number of sprays *Extract concentrations
		Batira	Khanisiriya	
0	2	20.91	30.35	25.63
	3	25.88	30.54	28.21
	4	26.99	32.02	29.50
4	2	23.46	30.91	27.18
	3	26.69	32.83	29.76
	4	27.59	31.33	29.46
8	2	25.23	27.25	26.24
	3	26.89	31.98	29.43
	4	28.62	32.33	30.47
L.S.D (0.05)		n.s		2.13
average cultivar		25.81	31.06	
L.S.D (0.05)		1.15		
Average extract concentrations				
Cultivar *Extract concentrations	0	24.59	30.97	27.78
	4	25,91	31.69	28.80
	8	26.91	30.52	28.71
L.S.D (0.05)		1.63		0.14
number of sprays average				
Cultivar* number of sprays	2	23.20	29.50	26.35
	3	26.49	31.78	29.13
	4	27.73	31.89	29.81
L.S.D (0.05)		n.s		1.78

Table (2). Effect of cultivar, number of sprays and seaweed extract concentrations and their interactions on the percentage of total soluble solids (T.S.S) (%)

seaweed extract $ml.L^{-1}$	number of sprays	Cultivars		number of sprays *Extract concentrations
		Batira	Khanisiriya	
0	2	3.26	4.977	4.12
	3	3.81	4.113	3.96
	4	3.94	5.17	4.56
4	2	3.58	4.04	3.81
	3	3.76	5.32	4.54
	4	3.92	5.87	4.89
8	2	3.62	4.66	4.14

	3	3.95	5.42	4.69
	4	4.07	5.90	4.99
L.S.D (0.05)		n.s		n.s
average cultivar		3.77	5.05	
L.S.D (0.05)		**0.18**		
Average extract concentrations				
Cultivar *Extract concentrations	**0**	3.67	4.75	4.21
	4	3.75	5.07	4.41
	8	3.88	5.33	4.61
L.S.D (0.05)		n.s		0.37
number of sprays average				
Cultivar* number of sprays	**2**	3.49	4.56	4.02
	3	3.84	4.95	4.39
	4	3.98	5.65	4.81
L.S.D (0.05)		0.27		0.22

Table (3). Effect of cultivar, number of sprays and seaweed extract concentrations and their interactions on the percentage of dry matter in fruits (%)

seaweed extract ml.L^{-1}	**number of sprays**	**Cultivars**		**number of sprays *Extract concentrations**
		Batira	**Khanisiriya**	
0	**2**	8.653	9.23	8.94
	3	8.76	11.80	10.28
	4	9.48	12.68	11.08
4	**2**	8.65	12.23	10.44
	3	8.47	10.98	9.73
	4	9.29	11.07	10.18
8	**2**	8.32	10.69	9.50
	3	9.88	11.60	10.74
	4	9.54	12.34	10.94
L.S.D (0.05)		0.67		n.s
average cultivar		9.00	11.40	
L.S.D (0.05)		**0.48**		
Average extract concentrations				
Cultivar *Extract concentrations	**0**	8.96	11.24	10.104
	4	8.81	11.43	10.121
	8	9. 24	11.54	10.397
L.S.D (0.05)		n.s		0.46
number of sprays average				
Cultivar* number of sprays	**2**	8.54	10.72	9.63
	3	9.04	11.46	10.25
	4	9.44	12.03	10.73
L.S.D (0.05)		n.s		0.70

Conclusions:-

1- The study showed that the Khenaisri cultivar significantly excelled on the Batira

cultivar in trait of the qualitative traits of the fruits.

2- Spraying with Algazon extract showed a significant effect on all qualitative traits of fruits, especially at levels 4 and 8 ml L^{-1}

3- Significantly excelled in the average number of spraying times with the extract, where the plants sprayed with an average of three and four times excelled in all the qualitative trait of the fruits

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