Effect of spraying with seaweed extract and potassium sulfate on some vegetative and fruiting traits of three eggplant cultivars

Ahmed Mohamed Hamid and AL-zubaidi Ali Hassan Ali

Al Mussaib Technical College, Al-Furat Al-Awsat Technical University

Abstract:

An experiment was conducted in Al- Musayyib area Babylon province to study the response of three eggplant cultivars for growing season 2022 to spraying with three levels of seaweed extract and three levels of potassium sulfate . The experiment was conducted according to randomized complete block design (R.C.B.D). Results showed that treatment of spraying seaweed extract B2 at a concentration of 2 $ml.L^{-1}$ significantly excelled and gave the highest average in number of leaves. The number of main branches, number of fruits and leaves area cm (160.103, 8.883, 42.127, 5009. 49), respectively. The study also showed that there were significant differences in the treatment of spraying potassium sulfate C2 at a concentration of 2 $ml.L^{-1}$ in number of leaves. The number of main branches. number of fruits. leaves area cm. (154.052, 8.196, 45.708, 4632 , 989), respectively. The results showed that the interaction between seaweed extract and potassium sulfate had a significant effect on most of the studied traits, where the interaction in the combination (2 ml / L of seaweed extract and 2 ml / L of potassium sulfate) gave the highest mean for all the following traits: in the number of leaves. The number of main branches. number of fruits. Leaves area cm. (161.967, 9.639, 47.500, 5628.47) respectively

Introduction

Eggplant (*Solanum melongena* L.), which belongs to the Solanaceae family, which includes tomato, pepper and potatoe, is native to India and China[1] .It is an important vegetable plant and has a high nutritional value, where its fruits contain proportions of proteins, fats, and fiber and carbohydrates, in addition to containing proportions of vitamins (A, B1, B2, B5, and C) and many important nutrients[2] and it has medical benefits, including reducing blood cholesterol, bronchitis, asthma, diabetes, and others[3] . The eggplant crop is considered one of the stressful crops due to its long growth period, and therefore it needs sufficient amounts of nutrients[4] .It is necessary to take care of it and raise its productivity by knowing the methods and following the easiest and fastest means. Foliar nutrition plays an effective role in plant nutrition due to the rapid absorption of nutrients and evenly in the vegetative system and reduces the use of large quantities of fertilizers, where it is the fastest in processing because it works to add nutrients to the areas of deficiency directly. In addition to saving a lot of effort and time, due to its ability to mix fertilizers and growth regulators[5] and as mentioned by modern sources related to foliar fertilization. Seaweed extract from natural fertilizers and important sources of nutrients and vitamins also contains levels of growth regulators, organic and amino acids[6] confirmed that spraying at concentrations of 0, 1, 2, 3, ml/liter seaweed, at an average of two sprays between the first spray and the second spray, thirty days on the okra plant. The spraying treatment with a concentration of 3 ml/liter was significantly excelled on the control treatment and the rest of the treatments. The other is the number of fruits per plant, the yield per plant, the total yield, and the two seasons of the experiment . [7] showed when studying four levels of ground fertilization in potassium sulfate and foliar fertilization of the same fertilizer at a rate of two sprays, the best vegetative growth

represented in the number of leaves and wet weight of eggplant leaves was achieved when adding 90 kg / dunum with foliar spraying of potassium sulfate fertilizer. Based on the foregoing, the research aimed to study the effect of spraying with three levels of seaweed extract and three levels of potassium sulfate and the interaction between them on the growth and yield of three cultivars of eggplant.

Materials and Methods

A field experiment was conducted in one of the lands of Al- Musayyib area Babylon province during the spring season 2021-2022 to study the effect of spraying seaweed extract and potassium sulfate on plant growth and yield according to the randomized complete block design (R.C.B.D). The experiment included three factors, namely: the first factor, three cultivars of eggplant (Hauser, Queen, and Abd aswd) and its symbol (A1, A2, A3), and the second factor, three concentrations of seaweed extract fertilizer (0,1,2) $ml.L^{-1}$ and symbolized by the symbol (B0, B1, B2) and the third factor is three concentrations of potassium sulfate (0,1.5,2) $ml.L^{-1}$, and it is symbolized by the following symbols (C0, C1, C2). Samples were taken for the studied traits, at the rate of (5) plants for each experimental unit, randomly, for the purpose of extracting the average out of 20 plants. The statistical analysis of the studied traits was carried out according to a randomized complete block design using (Genstat) program. The results were tested using LSD, the least significant difference between the arithmetic means at the level of 0.05 . The soil of the field was prepared by plowing, smoothing and amending, and different samples were taken from the experimental soil for the purpose of conducting chemical and physical analyses. The experimental land was divided into three replicates, each replicate containing 27 experimental units. The dimensions of one experimental unit were 3 * 2 m for three planting lines, and the distance between one line and another was 1 m, between one plant and another 40 cm, and between one experimental unit and another (1) m, and between one sector and another 2 m. The seedlings were planted in the soil on 3/25/2022, after which the seedlings were sprayed with the above-mentioned fertilizer, as the first spray was 15 days after planting, the second spray 15 days after the first spray, and the third spray when flowering.

Studied traits:

vegetative growth five plants randomly selected from each experimental unit were used for all replicates after 150 days of seedling except for dry weight of leaves and stems which were measured after 225 days of seedling.

1- The number of leaves. $plant^{-1}$: The number of leaves for each plant was counted.

2- The number of branches. $plant^{-1}$: Calculated at the end of the season.

3- The number of fruits. $plant^{-1}$: According to the number of fruits from the beginning of the first harvest after 4 months from the date of cultivation until the last harvest at the end of the season by dividing the total fruits in the experimental unit by the number of plants of all the fruits.

4-. Leaf Area (LA) (cm^2 $plant^{-1}$): The leaf area was measured at the end of the experiment, where three leaves were taken from each plant from the upper, middle and lower parts of five plants, then estimated using a Japanese planometer, after that the plant leaf was drawn on a white paper [8] (Mohammed, 1977) and extracted through the following equation

Total leaf area per plant = average area of one leaf x average number of leaves per plant

Results and discussion:

number of leaves. plant $^{-1}$

Table (1) showed that there were significant differences between the levels of the studied factors in their effect on the number of leaves. Plant $^{-1}$cultivar A1 excelled by giving it the highest average of 157,833 leaves. Plant $^{-1}$ while the A3 cultivar gave the lowest average

of 134,722 leaves. Plant $^{-1}$. The reason for the discrepancy between the cultivars is due to the genetic difference between the cultivars resulting from the different genetic factors that control the vegetative buds responsible for the formation of leaves and thus control the number of leaves formed on the plant for each cultivar [9] . The addition of foliar nutrients significantly increased this trait. The treatment of B foliar nutrient gave the highest mean B2 concentration of 160,103 leaves. plant $^{-1}$. While the control treatment, B0, gave the lowest average of 141,052 leaf. Plant $^{-1}$.The increase is due to the role of the foliar nutrient in revitalizing plants and increasing their growth because it is rich in amino acids and is very important in increasing the concentration of chlorophyll in the leaves, which increases the carbon metabolism products, causing an increase in the formation of vegetative tissues and the accumulation of carbohydrates and proteins in them, which increased the area of absorption of nutrients in foliar fertilization[10] While the foliar nutrient C gave the highest average C2 concentration of 154,052 leaf. Plant $^{-1}$ while the control treatment C0 gave the lowest mean of 144,221 leaves. Plant^{-1}. The reason for the excelled of spraying treatments with nutrient solution C is due to the role of potassium, which is essential for plant growth and development.Where it affects many vital processes such as the formation of proteins and the process of photosynthesis, which leads to an increase in the number of branches of the plant and vegetative growth, the effect of which is reflected in the increase in the number of leaves,[11] .The bi-interaction between A and B showed a significantly excelled, where it gave cultivar A1 and foliar nutrient B2 the highest average of 174,320 leaves. plant^{-1}, compared to the A3 cultivar, which gave the lowest mean with nutrient B0, amounting to 131,200 leaves. Plant $^{-1}$.It was found that the bi-interaction between A and C had a significant effect, where the cultivar A1 with concentration C2 gave the highest average of 166,167 leaf. Plant $^{-1}$. Compared to cultivar A3 with control treatment C0, it gave the lowest average of 134,123 leaves. Plant $^{-.1}$The interaction between nutrients and concentrations had a significant effect on this trait, where nutrient B2 and concentration C2 gave the highest mean of 163,667 leaves. plant $^{-1}$, while the interaction between nutrients B0 and C0 gave the lowest mean of 135,987 leaves. Plant $^{-1}$,The interaction between the three studied factors had a significant effect, where the A1 cultivar with the B2 nutrient and the C2 concentration gave the highest mean of 188,330 leaves. plant $^{-1}$, while the A3 cultivar with nutrients B0 and C0 gave the lowest mean of 124,430 leaves. Plant $^{-1}$.

The number of main branches. (branch. plant^{-1})

The results in Table (2) indicated that there are significant differences between the levels of the studied factors in their effect on the number of main branches. Plant $^{-1}$ The A1 cultivar excelled by giving it the highest average of 7.832 branches. Plant $^{-1}$ while the A3 variety gave the lowest average of 7.177 branches. Plant $^{-1}$. The addition of foliar nutrient led to a significant increase in this trait, where the treatment of foliar nutrient B2 gave the highest average B2 concentration of 8.883 branches. Plant $^{-1}$ While the control treatment B0 gave the lowest average of 6.530 branches. Plant $^{-1}$., while the foliar nutrient C gave the highest average C2 concentration of 8.196 branches. Plant $^{-1}$ While the control treatment, C0, gave the lowest average of 6.878 branches. Plant $^{-1}$. The increase in this trait and the rest of the traits when sprayed with nutrient solution B2 .It may be due to the role of the nutrients and organic substances present in this solution and their impact on the process of photosynthesis, respiration and protoplasmic construction, such as the nitrogen element, which is involved in the synthesis of a large number of important organic compounds in the vital processes of the plant, It enters into the synthesis of nuclear amino acids such as RNA and DNA and enters into the synthesis of the chlorophyll molecule and cytochrome enzymes, which are important in the synthesis of many compounds,

including nucleic acids and ATP, and helps in the formation and division of cells, and this is reflected in stimulating the growth and development of branches and plant maturity. This result is agreement with [12] who found that spraying tomato plants with foliar nutrients led to a significant increase in vegetative traits, and that the deficiency of these elements may cause the emergence of many symptoms that negatively affect the nature of plant growth.The bi-interaction between A and B showed a significant superiority, as it gave cultivar A1 and foliar nutrient B2 the highest average of 9,366 branches. Plant $^{-1}$ compared to the A3 cultivar, which gave the lowest average with nutrient B0, reaching 6.312 branches. Plant $^{-1}$.It was found that the bi-interaction between A and C had a significant effect, where the A1 cultivar with C2 concentration gave the highest average of 8.669 branches. Plant^{-1}, compared to the A3 variety with the control treatment C0, gave the lowest average of 6.636 branches. Plant $^{-1}$.The interaction between the nutrients and the concentrations had a significant effect on this trait, as the nutrient B2 and the concentration C2 gave the highest average of 9.639 branches. Plant $^{-1.}$, while the interaction between nutrients B0 and C0 gave the lowest mean of 5.913 branches. Plant $^{1-.}$ The interaction between the three studied factors had a significant effect, where the A1 variety with the nutrient B2 and the concentration C2 gave the highest average of 10.640 branches. plant $^{-1}$, while the A3 cultivar with nutrients B0 and C0 gave the lowest mean of 5.787 branches. Plant $^{1-.}$

Table (1) Effect of cultivars, spraying with seaweed extract and potassium sulfate and the interactions between them on leaf number (leaf. Plant $^{-1}$)

A x B	C			B	A
	2	1.5	0	concentration	
147.200	153.200	145.870	142.530	0	A1
151.980	156.970	151.070	147.900	1	
174.320	188.330	174.200	160.430	2	
144.757	150.370	142.900	141.000	0	A2
149.120	154.630	148.030	144.700	1	
170.157	180.600	171.370	158.500	2	
131.200	141.170	128.000	124.430	0	A3
137.133	144.230	133.770	133.400	1	
145.833	146.970	145.430	145.100	2	
0.935**	1.620**			lsd5%	
A average	A x C			cultivars	
157.833	166.167	157.047	150.287	A1	
154.678	161.867	154.100	148.067	A2	
134.722	134.123	135.733	134.310	A3	
0.540**	0.935**			lsd5%	
B average	XB C			B concentrations	
141.052	148.247	138.923	135.987	0	
146.078	151.943	144.290	142.000	1	
160.103	163.667	161.967	154.677	2	
0.540**	0.935**			lsd5%	
	154.052	148.960	144.221	C average	
	0.540**			lsd5%	

Table (2) Effect of cultivars, spraying with seaweed extract and potassium sulfate and the interactions between them on the number of main branches. Plant $^{1-}$

A x B	C			B	A
	2	1.5	0	concentration	
6.803	7.453	6.973	5.983	0	A1
7.328	7.913	7.093	6.979	1	
9.366	10.640	9.030	8.427	2	
6.475	7.307	6.147	5.970	0	A2
7.062	7.813	6.930	6.443	1	
8.738	9.203	8.813	8.197	2	
6.312	7.053	6.097	5.787	0	A3
6.674	7.313	6.530	6.180	1	
8.545	9.073	8.623	7.940	2	
0.130**	0.226**			lsd5%	
average A	A x C			A	
7.832	8.669	7.699	7.130	A1	
7.425	8.108	7.297	6.870	A2	
7.177	7.813	7.083	6.636	A3	
0.075**	0.130**			lsd5%	
C average	X B C			B concentrations	
6.530	7.271	6.406	5.913	0	
7.022	7.680	6.851	6.534	1	
8.883	9.639	8.822	8.188	2	
0.075**	0.130**			lsd5%	
	8.196	7.360	6.878	C average	
	0.075**			lsd5%	

Number of fruits (fruit. plant $^{-1}$)

The results in Table (3) indicated that there were significant differences between the levels of the studied factors in their effect on the number of fruits. The A1 cultivar excelled by giving the highest average of 42.128 fruits. Plant $^{-1}$ while the A3 cultivar gave the lowest average of 37,277 fruits. Plant $^{-1}$.The addition of foliar nutrients led to a significant increase in this trait, where the treatment of foliar nutrient B gave the highest average B2 concentration of 42.127 fruits. Plant $^{1-}$ while the control treatment B0 gave the lowest mean of 37,940 fruits. Plant $^{-1}$. While the foliar nutrient C gave the highest average C2 concentration of 45.708 fruits. Plant $^{-1}$ while the control treatment C0 gave the lowest mean of 34.464 fruits. Plant $^{-1}$. The increase in the number of fruits is attributed to the role of foliar nutrients in increasing carbon metabolism as a result of improving vegetative growth indicators, which is then associated with stimulating their transfer to fruits as a result of increasing the absorbed amounts of nutrients, especially potassium[13] . This result agrees with the results of [14] when spraying eggplant plants with potassium fertilizer (For max) at a concentration of 6 g. L^{-1} - has led to a significant increase in the number of fruits and the yield of one plant. The bi-interaction between A and B showed a significantly excelled, where cultivar A1 and foliar nutrient B2 gave the highest average of 43.693 fruits. Plant $^{1-}$ compared to cultivar A3, which gave the lowest average with nutrient B0, amounting to 34.887 fruits. Plant $^{1-}$.It was found that the bi-interaction between

A and C had a significant effect, as the A1 cultivar with C2 concentration gave the highest average of 46.990 fruits. Plant $^{-1}$ compared to the A3 cultivar with the control treatment C0, it gave the lowest average of 30.233 fruits. Plant $^{-1}$.The interaction between nutrients and concentrations had a significant effect on this trait, where treatment B2 and concentration C2 gave the highest mean of 47.500 fruits. Plant^{-1}, while the interaction between nutrients B0 and C0 gave the lowest mean of 31.100 fruits. Plant $^{1-}$ The interaction between the three studied factors had a significant effect, where the A1 cultivar with the nutrient B2 and the concentration C2 gave the highest mean of 48.870. While cultivar A3 with treatment B0 and C0 gave the lowest average of 27.630 fruits. Plant $^{-1}$

Table (3) Effect of cultivars, spraying with seaweed extract and potassium sulfate and the interactions between them on the characteristic of the average number of fruits per fruit. Plant $^{1-}$.

A x B	C			B	A
	2	1.5	0	concentration	
40.633	45.600	41.430	34.870	0	
42.057	46.500	42.970	36.700	1	A1
43.693	48.870	43.630	38.580	2	
38.300	44.500	39.600	30.800	0	
41.410	45.070	41.330	37.830	1	A2
43.433	47.100	42.500	40.700	2	
34.887	42.530	34.500	27.630	0	
37.690	44.670	37.530	30.870	1	A3
39.253	46.530	39.030	32.200	2	
ns	2.067**			lsd5%	
average A	A x C			A	
42.128	46.990	42.677	36.717	A1	
41.048	45.557	41.143	36.443	A2	
37.277	44.577	37.020	30.233	A3	
0.689**	1.193**			lsd5%	
B average	X B C			B concentrations	
37.940	44.210	38.510	31.100	0	
40.386	45.413	40.610	35.133	1	
42.127	47.500	41.720	37.160	2	
0.689**	1.193**			lsd5%	
	45.708	40.280	34.464	C average	
	0.689**			lsd5%	

leaf area. cm^2

Table (4)shows that there are significant differences between the levels of the factors studied in their impact on leaf area. The A1 cultivar excelled by giving it the highest average of 4384.011 cm2, while the A3 cultivar gave the lowest average of 4068.100 cm^2.The reason may be due to the response of the cultivar to the used foliar nutrients that behave positively in that, and also the reason may be due to the increase in the relative content of chlorophyll resulting from the effect of spraying with the foliar solution in increasing the available of the nitrogen and magnesium elements, which have a significant impact during their presence in the center of the chlorophyll molecule and thus Its effect on the leaf area of the plant [15] .The addition of foliar nutrients led to a significant increase in

this characteristic, where the foliar nutrient treatment B gave the highest average B2 concentration of 5009.489 cm2, while the control treatment B0 gave the lowest average of 3627.956 cm^2. While the foliar nutrient C gave the highest average C2 concentration of 4632.989 cm^2 While the control treatment, C0, gave the lowest average of 3809.544 cm2. The reason for the excelled of spraying with the nutrient solution is that it contains the necessary nutrients in the process of cell division and expansion, which are important in manufacturing the amino acid tryptophan, which is necessary for the synthesis of IAA, which is important in cell division and then increasing the leaf area,[11] . The bi-interaction between A and B showed a significantly excelled, where cultivar A1 and nutrient B2 gave the highest average amount of 5368.067 cm^2 compared to cultivar A2, which gave the lowest average with nutrient B0 of 3581.833 cm^2.It was found that the bi-interaction between A and C had a significant effect, where the cultivar A1 with concentration C2 gave the highest average of 4953.767 cm^2 compared to cultivar A2 with the control treatment C0, as it gave the lowest average of 3747.333 cm^2.The interaction between the nutrients and the concentrations had a significant effect on this traits, where the nutrient B2 and the concentration C2 gave the highest average of 5628.467 cm^2, while the interaction between the nutrient B0 and C0 gave the lowest average of 3337.967 cm^2.The interaction between the three studied factors had a significant effect, where the cultivar A1 with nutrient B2 and concentration C2 gave the highest average of 6223.000 cm^2, while the cultivar A1 with nutrients B0 and C0 gave the lowest average of 3312.400 cm^2.

Table (4) Effect of cultivars, spraying with seaweed extract and potassium sulfate and the interactions between them in (leaf area.cm^2)

A x B	C			B	A
	2	1.5	0	concentration	
3712.733	4251.300	3574.500	3312.400	0	A1
4071.233	4387.000	3996.200	3830.500	1	
5368.067	6223.000	5229.200	4652.000	2	
3581.833	3934.700	3457.400	3353.400	0	A2
3819.867	4152.500	3772.600	3534.500	1	
4879.067	5439.200	4843.900	4354.100	2	
3589.300	3940.900	3478.900	3348.100	0	A3
3833.667	4145.100	3811.800	3544.100	1	
4781.333	5223.200	4764.000	4356.800	2	
30.370**	52.610**			lsd5%	
average A	A x C			A	
4384.011	4953.767	4266.633	3931.633	A1	
4093.589	4508.800	4024.633	3747.333	A2	
4068.100	4436.400	4018.233	3749.667	A3	
17.540**	30.370**			lsd5%	
B average	X B C			B concentrations	
3627.956	4042.300	3503.600	3337.967	0	
3908.256	4228.200	3860.200	3636.367	1	
5009.489	5628.467	4945.700	4454.300	2	
17.540**	30.370**			lsd5%	
	4632.989	4103.167	3809.544	C average	
	17.540**			lsd5%	

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