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EFFECT OF SPRAYING WITH DIFFERENT LEVELS OF SEAWEED EXTRACT AND POTASSIUM SULFATE ON THE GROWTH AND YIELD OF EGGPLANT

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Abstract:
An experiment was conducted to study the response of three eggplant cultivars for the 2022 season to spraying with three levels of seaweed extract and three levels of potassium sulfate. The results showed that there were significant differences in the treatment of spraying seaweed extract B2 at a concentration of 2 ml / liter in plant height. cm and weight of the fruit(g) and the proportion of nitrogen N% and phosphorous P% in the leaves (9.943 - 192.077gm - 84.928cm - 0.342) respectively. The study also showed that there were significant differences in the treatment of spraying potassium sulfate C2 at a concentration of 2 ml / liter in plant height cm. The fruit weight (g) and the percentage of nitrogen N% and phosphorus P% in the leaves (0.307 - 9.266 - 184.978gm - 80.504cm), respectively .The results also showed that the interaction between seaweed extract and potassium sulfate had a significant effect on most of the studied traits. The weight of the fruit (g)and the percentage of nitrogen% N and phosphorus % in the leaves (10.484 - 194.557gm - 90.623cm - 0.360), respectively.

Keywords: seaweed extract, potassium sulfate, growth, eggplant

Introduction:

Eggplant (*Solanum melongena* L.), which belongs to the Solanaceae family, which includes tomato, pepper and potatoe, is native to India and China (Ware and McCullum, 1980). 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 (Hussein, etal, 2010), and it has medical benefits, including reducing blood cholesterol, bronchitis, asthma, diabetes, and others (Daunay 2000). The eggplant crop is considered one of the stressful crops due to its long growth period, and therefore it needs sufficient amounts of nutrients (Al-Rikabi and Abdul-Jabbar, 1981). It is necessary to take care of it and raise its productivity by knowing the methods and following the easiest and fastest means. Foliar nutration 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 (Focus, 2003). And as mentioned by modern sources related to foliar fertilization. Seaweed extract from natural fertilizers and important sources of nutrients and vitamins, and also contains levels of growth regulators, organic and amino acids (Hamad et al., 2011)(Al-Akaishi and Al-Sahhaf, 2017) 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 . It was observed (Al-Zubaidi, 2013) that pepper plant was sprayed with seaweed extract for three concentrations (0, 3, 6 ml / L). The concentration exceeded 6 ml / L in plant height, number of branches, dry weight of the vegetative set and root system, where well as the number of fruits and the content of the leaf of chlorophyll, as well as Wajd (Taped and Madkhour, 2018(The foliar fertilization of eggplant plant with seaweed extracts at concentrations of 0, 1.5, 3 ml / L and 4 sprays between the first and second spraying and between the third and fourth respectively, two weeks, had a significant effect, with a concentration of 3 ml / L, which gave the highest average for the number of leaves and leaf area. In addition to natural extracts .Many studies have confirmed the effect of potassium sulfate on the growth and productivity of crops in general and its effect on the eggplant plant in particular . Potassium is essential as an aid to the water balance in the cell, a regulator of the movement of solutes, and resistance to deformation through the important role it plays in the process of vulcanization and thickening of cell walls (Abu Dahi and El-Younes 1988.(As between Fawzy et al (2007) 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 the Musayyib project area 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 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 (Al-Rawi and Khaf Allah, 1980). 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 5 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- Plant height. cm

Plant height was measured from the soil surface to the top of the growing apex using an iron tape measure.

2- Fruit weight (gm)

The average fruit weight was calculated by dividing the weight of the experimental unit yield by the number of fruits of all the fruits during the harvest period. The number of fruits per plant was also calculated by dividing the total number of fruits in the experimental unit by the number of plants of all harvests.

chemical traits

Phosphorus was determined by the method of ammonium molybdate and vitamin C. After the appearance of blue, the color intensity of the solution was measured using a spectrophotometer at a wavelength of 882 nm (Olesen and Somers, 1982). The total nitrogen was estimated using a microcalculator by evaporation and distillation (Jackson, 1958).

Results and discussion:

plant height. cm

Table (1) showed that there were significant differences between the levels of the studied factors in their effect on plant height. The A1 cultivar excelled by giving it the highest average of 77.289 cm, while the A3 cultivar gave the lowest average of 73.628 cm. The addition of foliar nutrition led to a significant increase in this trait, where the treatment of foliar nutration B gave the highest average B2 concentration of 84.928 cm.While the control treatment, B0, gave the lowest mean of 68.709 cm. It may be due to the role of foliar nutrition and their effect on plant growth and yield increase, and this leads to the excelled of the treatments used in this study. The reason may be due to the speed of plant absorption of nutrients and thus affect the development of the vegetative system of the crop. On the other hand, the contents of the used foliar nutrients represent their quality in terms of containing the necessary and important nutrients for growth, such as nitrogen (N) and phosphorous (P).While the foliar nutrition C gave the highest average C2 concentration of 80.504 cm, while the control treatment C0 gave the lowest average of 71.157 cm.The presence of potassium also has a significant relationship in increasing the vegetative growth and thus its effect on the vegetative total of the plant (Torres et al., (2004). The binary interaction between A and B showed a significant excelled. Compared to cultivar A3, which gave the lowest mean with B0, it reached 67.690 cm. 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 83.243 cm, compared to cultivar A3 with the control treatment C0, as it gave the lowest average of 70.123 cm. The interaction between the nutrients and the concentrations had a significant effect on this traits,

as the nutrient B2 and the concentration C2 gave the highest mean of 90.623 cm. While the interaction between B0 and C0 gave the lowest mean of 64.480 cm. The interaction between the three studied factors had a significant effect, as the cultivar A1 with nutrient B2 and concentration C2 gave the highest average of 95.930 cm, while the cultivar A3 with nutrients B0 and C0 gave the lowest average of 64.200 cm.

Table (1) Effect of spraying with seaweed extract and potassium sulfate and the interactions between them on plant height(cm)

A x B	C			B	A
	C2	C1	C0	concentration	
69.857	74.700	68.900	65.970	B0	A1
73.767	79.100	72.070	70.130	B1	
88.243	95.930	86.470	82.330	B2	
68.580	74.600	67.870	63.270	B0	A2
72.213	76.400	71.170	69.070	B1	
84.137	88.870	84.270	79.270	B2	
67.690	72.800	66.070	64.200	B0	A3
70.790	75.070	69.400	67.900	B1	
82.403	87.070	81.870	78.270	B2	
0.865**	1.499**			lsd5%	
average A	A x C			A	
77.289	83.243	75.813	72.810	A1	
74.977	79.957	74.437	70.537	A2	
73.628	78.313	72.447	70.123	A3	
0.500**	0.865**			lsd5%	
average B	X B C			concentration B	
68.709	74.033	67.613	64.480	B0	
72.257	76.857	70.880	69.033	B1	
84.928	90.623	84.203	79.957	B2	
0.500**	0.865**			lsd5%	
	80.504	74.232	71.157	average C	
	0.500**			lsd5%	

Fruit weight (g)

The results in Table (2) indicated that there were significant differences between the levels of the studied factors in their effect on the fruit weight (g). The A1 cultivar excelled by giving it the highest average of 178.197 g, while the A3 cultivar gave the lowest average of 173.609 g. Perhaps the reason for the A1 cultivar excelled on the local cultivar is due to the genetic differences and the suitability of the cultivar to the prevailing environmental conditions in the region (Al-Hayani,

2000).The addition of foliar nutrients led to a significant increase in this traits, where the treatment B gave the highest average B2 concentration of 192.077 gm, while the control treatment B0 gave the lowest average of 162.464 gm.While the treatment C gave the highest average C2 concentration of 184.978 gm, while the control treatment C0 gave the lowest average of 168.573 gm. The reason may be due to the fact that the used foliar nutrients are rich in essential nutrients that contribute to increasing cell division and building and activating the vital activities of the plant, which leads to increased vegetative growth and thus an increase in production. The bi-interaction between A and B showed a significantly excelled, as cultivar A1 and treatment B2 gave the highest average of 195.067 g, compared to cultivar A3, which gave the lowest average with nutrient B0 of 160.763 g. 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 188.320 gm, compared to cultivar A3 with the control treatment C0, as it gave the lowest average of 166.210 gm.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 194.557 gm, while the interaction between the nutrient B0 and C0 gave the lowest average of 150.953 gm. The interaction between the three studied factors did not have any significant effect on this trait

Table (2) Effect of spraying with seaweed extract and potassium sulfate and the interactions between them on Fruit weight(g)

A x B	C			B	A
	2	1.5	0	concentration	
163.150	178.450	160.870	150.130	B0	A1
176.373	187.250	173.770	168.100	B1	
195.067	199.260	194.080	191.860	B2	
163.480	176.440	160.670	153.330	B0	A2
173.450	183.440	171.720	165.190	B1	
192.130	194.200	192.270	189.920	B2	
160.763	174.230	158.660	149.400	B0	A3
171.030	181.320	168.600	163.170	B1	
189.033	190.210	190.830	186.060	B2	
1.596**	ns			lsd5%	
average A	A x C			A	
178.197	188.320	176.240	170.030	A1	
176.353	184.693	174.887	169.480	A2	
173.609	181.920	172.697	166.210	A3	
0.921**	1.596**			lsd5%	
average B	XB C			concentration B	
162.464	176.373	160.067	150.953	0	
173.618	184.003	171.363	165.487	1	

192.077	**194.557**	**192.393**	**189.280**	**2**
0.921**	**1.596****			**lsd5%**
	184.978	**174.608**	**168.573**	**average C**
	0.921**			**lsd5%**

Determination of nitrogen in leaves % .

The results in Table (3) indicated that there were significant differences between the levels of the studied factors in terms of their effect on the nitrogen percentage . The A1 cultivar excelled by giving it the highest average of 8.774%, while the A3 cultivar gave the lowest average of 8.236%.The addition of foliar nutrients led to a significant increase in this traits, where the treatment of foliar nutrient B gave the highest average B2 concentration of 9.943%, while the control treatment B0 gave the lowest average of 7.544%. Abdel-Mouty et al. (2011) and (Salloum, 2012) in eggplant and (Hussein, 2013) in tomato. While the treatment C gave the highest average C2 concentration of 9.266%, while the control treatment C0 gave the lowest average of 7.891%.The bi-interaction between A and B showed a significantly excelled, where cultivar A1 and B2 gave the highest average of 10.350% compared to cultivar A3, which gave the lowest average with nutrient B0 of 7.351%.It was found that the bi-interaction between A and C had a significant effect, where the cultivar A1 with the concentration C2 gave the highest average of 9.608%, compared to the cultivar A3 with the control treatment C0.It gave the lowest average of 7.711%. 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 10.484%. While the interaction between nutrients B0 and C0 gave the least average of 6.932%. The interaction between the three studied factors had a significant effect, as the cultivar A2 with nutrient B2 and concentration C2 gave the highest average of 10.861%, while the cultivar A3 with nutrient B0 and C0 gave the lowest average of 6.753%.

Table (3) Effect of spraying with seaweed extract and potassium sulfate and the interactions between them on nitrogen in leaves %

A x B	**C**			**B**	**A**
	C2	**C1**	**C0**	**concentration**	
7.776	**8.960**	**7.287**	**7.080**	**B0**	**A1**
8.197	**9.180**	**8.233**	**7.179**	**B1**	
10.350	**10.683**	**10.677**	**9.690**	**B2**	
7.506	**8.393**	**7.160**	**6.963**	**B0**	**A2**
8.131	**8.817**	**8.010**	**7.567**	**B1**	
9.982	**10.861**	**9.677**	**9.407**	**B2**	
7.351	**8.227**	**7.073**	**6.753**	**B0**	**A3**
7.860	**8.365**	**7.880**	**7.337**	**B1**	
9.497	**9.907**	**9.540**	**9.043**	**B2**	

0.049**	**0.084****			**lsd5%**
average A	**A x C**			**A**
8.774	**9.608**	**8.732**	**7.983**	**A1**
8.539	**9.357**	**8.282**	**7.979**	**A2**
8.236	**8.833**	**8.164**	**7.711**	**A3**
0.028**	**0.049****			**lsd5%**
average B	**CXB**			**concentration B**
7.544	**8.527**	**7.173**	**6.932**	**0**
8.063	**8.787**	**8.041**	**7.361**	**1**
9.943	**10.484**	**9.965**	**9.380**	**2**
0.028**	**0.049****			**lsd5%**
	9.266	**8.393**	**7.891**	**average C**
	0.028**			**lsd5%**

Determination of the phosphorous in the leaves %

Table (4), by analyzing its results, shows that there are significant differences between the levels of the studied factors in their effect on the trait of the percentage of phosphorus in the leaves. The A1 cultivar excelled by giving it the highest average of 0.291%, while the A3 cultivar gave the lowest average of 0.265%. The addition of foliar nutrients led to a significant increase in this trait, as the foliar nutrient treatment B gave the highest average B2 concentration of 0.342%, while the control treatment B0 gave the lowest average reached 0.230%, The positive role of organic nutrients in absorbing nutrients and then increasing their percentages was also found by Abdel-Mouty et al. (2011) and Salloum (2012) in eggplant and Hussein (2013) in tomatoes. While the treatment C gave the highest average C2 concentration of 0.307%, while the control treatment C0 gave the lowest average of 0.247% .The bi-interaction between A and B showed a significantly excelled, as the cultivar A1 and treatment B2 gave the highest average of 0.370%, compared to cultivar A3, which gave the lowest average with feeder B0, amounting to 0.228%.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 0.323% compared to cultivar A3 with the control treatment C0, which gave the lowest average of 0.244%. The interaction between the nutrients and concentrations had a significant effect on this trait, where the nutrient B2 and the concentration C2 gave the highest average of 0.360%, while the interaction between the nutrient B0 and C0 gave the lowest average of 0.192%.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 0.383%, while the cultivar A2 with nutrient B0 and C0 gave the lowest average of 0.187%

Table (4) Effect of spraying with seaweed extract and potassium sulfate and the interactions between them on phosphorous in leaves %

A x B	**C**			**B**	**A**
	C2	**C1**	**C0**	**concentration**	

0.235	**0.287**	**0.240**	**0.178**	**B0**	**A1**
0.267	**0.300**	**0.256**	**0.247**	**B1**	
0.370	**0.383**	**0.392**	**0.333**	**B2**	
0.229	**0.273**	**0.226**	**0.187**	**B0**	**A2**
0.260	**0.290**	**0.253**	**0.237**	**B1**	
0.334	**0.357**	**0.337**	**0.310**	**B2**	
0.228	**0.253**	**0.219**	**0.210**	**B0**	**A3**
0.247	**0.280**	**0.241**	**0.220**	**B1**	
0.322	**0.340**	**0.323**	**0.302**	**B2**	
0.009**	**0.016****			**lsd5%**	
average A	**A x C**			**A**	
0.291	**0.323**	**0.296**	**0.253**	**A1**	
0.274	**0.307**	**0.272**	**0.244**	**A2**	
0.265	**0.291**	**0.261**	**0.244**	**A3**	
0.005**	**0.009****			**lsd5%**	
average C	**XB C**			**concentration B**	
0.230	**0.271**	**0.229**	**0.192**	**0**	
0.258	**0.290**	**0.250**	**0.234**	**1**	
0.342	**0.360**	**0.351**	**0.315**	**2**	
0.005**	**0.009****			**lsd5%**	
	0.307	**0.276**	**0.247**	**average C**	
	0.005**			**lsd5%**	

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