Effects of Cultivars and the Spraying with seaweed extract (Tecamin Algae) in the growth and yield of eggplant (*Solanum melongena* L.)

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ABSTRACT

The experiment was conducted in one of the plastic houses belonging to Department of Horticulture and Landscaper Gardening, College of Agriculture, University of Diyala during the cultivation season of (2015, 2016) to study the effect of the cultivars (Paris, ashbilia, Barshelona), the spraying with different concentrations of seaweed extract (0, 0.75, 1 ml.L^{-1}) and the interaction between them on the growth and yield of eggplant. A factorial experiment was conducted according to the Randomized Complete Block Design (R.C.B.D), with three replicates. The results showed that the Paris cultivar was significantly excelled in all traits of the vegetative growth and yield, which included plant height (52.99 cm), number of leaves(40.57 leaf.$plant^{-1}$), leaf area (292.49 cm^2), plant stem diameter (1.21 cm), the percentage of chlorophyll (49.64 %), as well as the yield traits which included the length of fruit (13.85 cm), Fruit diameter (5.7), weight of fruit (151.14) and the early yield for the plant (4460.30 g). The spraying with seaweed extract at concentration of (1 ml.L^{-1}) achieved the highest averages for the traits of the vegetative growth which included Plant height (60.07 cm), number of leaves (43.08), leaves area (303.41 cm^2), plant stem diameter (1.32), the percentage of Chlorophyll (50.77 %), as well as the yield traits which included fruit length (14.24 cm), Fruit diameter (6.10 cm), the weight of fruit (162.25 g) and the early yield for the plant (4666.30 g). As for the interaction between the spraying treatment with seaweed extract at a concentration of (1 ml.L^{-1}) and Barshelona cultivar, this interaction had excelled in all the studied traits that mentioned above.

Keywords: eggplant, seaweed extract, spraying of the plants, extract, vegetative growth.

تأثير الصنف ورش مستخلص الطحالب البحرية Tecamin Algae في نمو وحاصل نبات الباذنجان *Solanum melongena* L.

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الملخص

نفذت التجربة في احد البيوت البلاستيكية التابعة لقسم البستنة وهندسة الحدائق/ كلية الزراعة-جامعة ديالى للموسم الزراعي 2015-2016 لدراسة تأثير الاصناف (باريس ، اشبيليا ، برشلونة) والرش بتراكيز مختلفة من مستخلص الطحالب البحرية (0.0، 0.75، 1) مل.لتر$^{-1}$ و التداخل بينهما في نمو وحاصل نبات الباذنجان . نفذت تجربة عاملية بتصميم القطاعات العشوائية الكاملة R.C.B.D عند مستوى احتمال 5% وبثلاث مكررات .اظهرت النتائج ان الصنف باريس تفوق معنويا في جميع صفات النمو الخضري والحاصل التي شملت ارتفاع النبات(52.99) سم ، عدد الاوراق (40.57)ورقة.نبات$^{-1}$، المساحة الورقية (292.49)سم^2,قطر الساق(1.21)سم و نسبة الكلوروفيل (49.64) وصفات الحاصل التي تشمل طول الثمرة(13.85)سم، قطر الثمرة (5.7) سم و وزن الثمرة(151.14) غم والحاصل المبكر للنبات (4460.30) غم اما الرش بمستخلص الطحالب البحرية بتركيز 1مل .لتر$^{-1}$ فقد اثر معنويا في الحصول على اعلى المتوسطات لصفات النمو الخضري والتي شملت ارتفاع النبات (60.07) سم ، عدد الاوراق(43.08) ورقة لكل نبات $^{-1}$ ، المساحة الورقية (303.41) سم ، قطر الساق(1.32) سم و نسبة الكلوروفيل(50.77) وكذلك صفات الحاصل التي شملت طول الثمرة(14.24) سم، قطر الثمرة (6.10) سم، وزن الثمرة(162.25)غم والحاصل المبكر للنبات(4666.30) غم. اما التداخل بين معاملة الرش بتركيز 1مل.لتر$^{-1}$ والصنف برشلونة فقد تفوقت في جميع الصفات المدروسة .

كلمات مفتاحية : نبات الباذنجان ، طحالب بحرية ، رش النباتات ، مستخلص ، نمو خضري .

1. INTRODUCTION

Eggplant (*Solanum melongena* L.) is a vegetable crop from *Solanaceae* family, which is considered one of the most economically important plant families, Its importance represented by using its fruits as food in most countries of the world, including Iraq, as well as its medical uses. Where each100 g of fresh fruits containing about 24 calories,(92.7 %) water, (4.0 g) carbohydrates, (1.4 g) protein, (0.3 g) fat, (1.3 g) fiber, (0.124 IU) vitamin A), (0.4 mg) Vitamin B1, (0.11 mg) Vitamin B2 (34.0 mg) Vitamin B9, (12.0 mg) Vitamin C (18.0 mg) oxalic acid, as well as mineral salts (potassium, phosphorus, magnesium, calcium, iron, zinc, sodium, sulfur and copper), with percentages amounting of (47.0, 15.0, 18.0, 0.38, 0.22, 3.0, 44.0, 0.12 mg), respectively, (Salunkhe and Kadam (17); Gopalan et al., (8). Modern studies have tended to raise the efficiency of production through the cultivation of high-yielding cultivars and with non-traditional methods of cultivation, which are represented by using the mineral elements in plant nutrition in order to obtain balanced nutrition and the efficiency of giving the highest production and the best quality (Lotfi, 12). Foliar nutrition that represented by spraying the total vegetative for the plant with Dilute solutions of nutrient elements and Repeatedly is considered important and successful to treating the decrease in micronutrients and macronutrient. So foliar nutrition is considered a successful and complementary method for root-based fertilization. Youssef, (18) found that the spraying of the King live solution with a concentration of (4.0 $g.L^{-1}$) contributed to improve the traits of vegetative growth and this was reflected significantly in the increase of the total yield. Althafe, (2) found that spraying the eggplant plant with nutritious solution at a concentration of (2 $ml.L^{-1}$) gave a significant increase in plant height, number of leaves, leaf area, the weight of fruit and total yield for the plant. Mohammed, (14) showed when foliar spraying with nutritious solution (Agro leaf) at a concentration of (1 $g.L^{-1}$) on the eggplant plant with a significant increase in both traits of vegetative growth and total yield. This result agrees with (Althafe et al., (3) on eggplant plant. Based on the above, this study aims to compare the growth and yield of three cultivars of eggplant plant, determining the appropriate cultivar for cultivating, knowing the effect of spraying with seaweed extract and determining the appropriate concentration for plant growth and the quantity of yield.

2. MATERIALS AND METHODS

The experiment was conducted in one of the plastic houses belonging to Department of Horticulture and Landscaper Gardening, College of Agriculture, University of Diyala during the cultivation season of (2015, 2016) on the eggplant plant where the land was prepared for the plastic house from plowing, settling and smoothing and taking a number of random samples from the plastic house dedicated to cultivation at a depth of (0-30 cm) that analyzed in a laboratory of Soil and Water Resources Department, College of Agriculture, University of Diyala as shown in Table (1). And then add the organic fertilizer represented by animal manure (poultry) (AL-Mohammedi 6). The plastic house was divided into 6 plots with width of (1 m), the distance between one plot and another is 50 cm. The seedlings were cultivated after the emergence of (3-4) real leaves inside the plastic house on 25/10/2015. A factorial experiment was conducted, with two factors, the first factor is the eggplant cultivars (Paris, ashbilia, Barshelona), which is symbolized by (Z1, Z2, Z3), respectively. The second factor is the levels of the seaweed extract (0.0, 75.0, 1ml.L-1) as shown in table (2), which is symbolized by (H1, H2, H3), respectively, thus the experiment included 9 factorial treatments, with three replicates. The experimental units became 27 experimental units, with 12 plants per experimental unit and according to the RCBD design, the results were analyzed and the averages were compared according to the least significant difference test at 5% probability level (Al-Rawi and khalf

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allah, 4). Spraying was conducted periodically after four weeks from cultivating, with rate of 15 days between one spraying and another after mixing the spraying solution with the spreading material and spraying the plant until full wet, The control treatment was sprayed with distilled water only. The measurements were taken from six plants from the experimental unit and the average was calculated.

The studied traits

1- The traits of vegetative growth

The vegetative growth was measured at the end of the growing season. The height of the plant was measured from the contact point of the plant with soil to the highest point in the total vegetative, the number of leaves was also calculated. The leaf area is calculated by a scanner device. The plant stem diameter (cm) was measured by Vernier, The percentage of total chlorophyll in the leaves was estimated by Spad Chlorophyll Meter by taking two readings from each plant (Minnotti et al., (13).

2- The traits of the yield

It is took from the Harvesting Frequency and for the end of the season, The fruit diameter of the fruit and the length of the fruit were measured by Verneir and the weight of the fruit was measured by dividing the total yield for the plant on the number of fruits and the early yield of the first four Harvestings.

Table 1: Some physical and chemical properties of the soil of plastic house.

PH	Electrical conductivity E.C ($ds.m^{-1}$)	Nitrogen ($mg.kg^{-1}$)	Phosphorus ($mg.kg^{-1}$)	Potassium ($mg.kg^{-1}$)	Soil separates		
					Clay (%)	Silt (%)	Sand (%)
7.32	8.99	21.3	11.	16.7	22.8	47	30.2

Table 2: Chemical Composition for the seaweed Extract (Tecamin Algae).

Seaweed Extract (Tecamin Algae)	16% weight / weight
Organic matter	7% weight / weight
Fat	0.1% weight / weight
Phosphorus	0.15 weight / weight
Potassium	2.5% weight / weight

3. RESULTS AND DISCUSSION

Effect of cultivars and seaweed extract and their interaction in the traits of vegetative growth

Table (3) shows that the Paris cultivar was significantly excelled in all traits of the vegetative growth: plant height, number of leaves, leaf area (cm^2), plant stem diameter (cm) and the percentage of chlorophyll in plant, which amounted of (52.99 cm, 40.57 $leaf.plant^{-1}$, 292.49 cm^2, 1.21 cm, 49.64 %), respectively. This may be due to the genetic variation between cultivars and the result of genetic variation responsible for the quantitative traits for the plant (Hassan et al., 10; Saha et al., 16). This result agrees with (AL-zbede (5) in its study on eggplant cultivars. The spraying plants with seaweed extract at a concentration of (1 $ml.L^{-1}$) led to a significant increase in the average of plant height amounted of (60.07 cm), the number of leaves (43.08 $leaf.plant^{-1}$, leaf area (303.41 cm^2), plant stem diameter (32.1 cm) and the percentage of chlorophyll amounted of (50.77 %). The superiority of nutrient solution concentrations is due to the role of nutrient elements in the synthesis of the nutrient solution, which enters into nucleic acid synthesis, such as DNA and RNA, in the

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process of cell division. These results agree with (Hassan, 9; Youssef, 18) in their study on eggplant. As for the interaction between the cultivars and the spraying treatments with seaweed, the interaction treatment between the spraying with (1 ml.L^{-1}) concentration and the Barshelona cultivar has excelled in all the above mentioned traits, which amounted of (63.25 cm) plant height, (44.51 leaf.$plant^{-1}$) total number of leaves per plant, (41 cm^2) leaf area, (1.4 cm) plant stem diameter and (51.45 %) for the percentage of chlorophyll.

Table 3: The Effects of Cultivars and Spraying with seaweed extract (Tecamin Algae) and the interaction between them in the traits of the vegetative growth for the eggplant plant.

Treatments	Plant height (cm)	Number of leaves (leaf.$plant^{-1}$)	Leaf area (cm^2)	plant stem diameter (cm)	The percentage of chlorophyll (%)
Paris	52.99	40.57	292.49	1.21	49.64
Ashbilia	51.30	36.95	285.47	1.14	47.29
Barshelona	52.14	38.49	285.52	1.17	48.33
L.S.D for cultivars	**0.17**	**0.18**	**3.12**	**0.02**	**0.11**
0	44.15	34.33	276.32	1.08	45.94
0.75	52.20	38.61	283.75	1.12	48.55
1	60.07	43.08	303.41	1.32	50.77
L.S.D for spraying levels	**0.17**	**0.18**	**3.12**	**0.02**	**0.11**
Interaction between cultivars and levels of spraying with seaweed	45.29	39.47	286.13	1.16	48.28
	55.36	40.12	291.15	1.2	50.31
	58.33	42.17	300.19	1.28	50.35
	42.15	30.09	271.42	1.01	43.15
	53.10	38.17	284.34	1.12	48.21
	58.65	42.61	300.66	1.3	50.52
	45.03	33.43	271.43	1.07	46.39
	48.14	37.55	275.76	1.05	47.15
	63.25	44.51	309.41	1.4	51.45
L.S.D for interaction	**0.3**	**0.31**	**5.42**	**0.04**	**0.11**

Effect of cultivars and spraying with seaweed extract in the yield traits

Table (4) shows that the Paris cultivar was significantly excelled in the yield traits by giving the highest averages for the fruit length (13.85 cm), the fruit diameter (5.7 cm), the weight of the fruit (151.14 g) and the quantity of the early yield (4460.30 g). This may be due to the genetic nature for the Paris cultivar, which is characterized by strong and intense vegetative growth compared with the other two cultivars, which led to an increase in the number of set flowers and thus increase the quantitative traits for the fruits, which was reflected in the increase of early yield. This result agrees with (Kumar and Ram, 11) through their genetic studies on eggplant crop. The foliar spraying treatment with seaweed extract at (1 ml.L^{-1}) concentration showed a significant excelling for the traits: Fruit length (14.24 cm), Fruit diameter (6.10 cm), the weight of fruit (162.25 g) and the early yield for the plant (4666.30 g). The reason may be attributed to the significant superiority of the spraying treatments of the nutritious solution to the positive effect of these elements in the biological processes that conducted within the plant tissues, the vegetative growth of the plant and the improvement of the photosynthesis process in the manufacture of carbohydrates and their transfer to the fruits to meet the requirements of growth and increase their number (Barooah and Ahmed, 7), Thus

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increasing the quantitative traits for plant yield. These results agree with (Althafe et al., (1); Hassan (9); Radi (15) in their study on eggplant. As for the interaction between the cultivars and the spraying treatments with seaweed, the interaction treatment between the spraying with (1 ml.L^{-1}) concentration and the Barshelona cultivar has excelled in all the quantitative traits that mentioned above, This may be due to Barshelona's response to fertilization, which amounted of (14.48 cm) the length of the fruit, (6.07 cm) Fruit diameter, (165.81 g) the weight of the fruit and (4740.30 g) the early yield for the plant.

Table 3: The Effects of Cultivars and Spraying with seaweed extract (Tecamin Algae) and the interaction between them in the yield traits for the eggplant plant.

Treatments	The length of the fruit (cm)	Fruit diameter (cm)	The weight of the fruit (g)	The early yield for the plant (g)
Paris	13.85	5.7	151.14	4460.30
Ashbilia	13.11	5.55	141.30	3909.86
Barshelona	13.17	5.62	149.20	3967.23
L.S.D for cultivars	**0.2**	**0.21**	**0.18**	**12.2**
0	12.65	5.34	134.27	3600.33
0.75	13.24	5.52	145.10	4070.76
1	14.24	6.10	162.25	4666.30
L.S.D for spraying levels	**0.21**	**0.20**	**0.18**	**12.2**
Interaction between cultivars and levels of spraying with seaweed	13.49	5.54	146.16	4226.30
	14.01	5.60	148.03	4546.30
	14.07	5.98	159.23	4608.30
	12.01	5.16	118.24	3033.00
	13.15	5.50	143.93	4046.30
	14.19	5.99	161.73	4650.30
	12.47	5.34	138.43	3541.70
	12.58	5.46	143.36	3619.70
	14.48	6.07	165.81	4740.30
L.S.D for interaction	**0.34**	**0.37**	**0.32**	**21.130**

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