

EFFECT OF SEAWEED EXTRACT AND PLANT SPACING ON GROWTH AND YIELD OF TWO EGGPLANT HYBRIDS (*SOLANUM MELONGENA* L.)

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ABSTRACT

The experiment was conducted at the vegetable research farm, College of Agricultural Engineering Sciences, University of Duhok, Iraq, in the growing season (2018) to study the effect of seaweed extract at four concentrations (0, 0.5, 1.0, and 1.5 ml/L) and plant spacing at three levels (30, 45 and 60 cm) on growth and yield of two eggplant (*Solanum melongena* L.) cultivars. The seaweed extract (Tecamin algae) sprayed at three times during growing season, 15 days between each spraying and another. The experiment were designed in a factorial experiment within Split-Split-Plot Design in (RCBD), with three replication. The results showed that the seaweed extract at concentration (1 ml.l⁻¹) significantly increases leaf area (cm²), leaf chlorophyll content, average fruit weight, plant yield (Kg.plant⁻¹) and total yield (ton.ha⁻¹) compared with control plants, but not affected on plant height. Plant spacing at level (30 cm) significantly increased plant height and total yield, whereas at level (60 cm) significantly improved leaf area, chlorophyll content in leave and plant yield. Also, the Kyme cultivar significantly affected in average fruit weight, plant yield and total yield, while Anamur RZ cultivars increased plant height. The binary and triple interaction revealed that the combination between Kyme cultivars, plant spacing at level (60 cm) and seaweed extract at level (1 ml.l⁻¹) significantly increased almost all characteristics.

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1. INTRODUCTION

Eggplant (*Solanum melongena* L.), is a popular vegetable also known as Brinjal (India), Aubergine (United Kingdom), or Guinea squash (Southern of United States) and it is one of the commonly grown species in the family *Solanaceae* (Kantharajah and Golegaonkar, 2004). It is one of the major crop an economically in Africa, Asia and in almost all sub-tropics and is also grown in some warm temperate regions of the South America and Mediterranean (Das *et al.*, 2010). Eggplant is intolerant to frost, and the growth of small plants will be slow down when night temperatures are less than 16°C (Chen And Li, 2000).

The yield production depends on several factors, from these proper and balanced nutrition plays an effective role (Bozorgi, 2012). One of the most effective nutrition ways is the use of seaweed extract. Seaweeds include the multicellular and macroscopic marine algae that usually lived in the coastal regions of the world's oceans where suitable habitat exist (El-Miniawy *et al.*, 2014). Seaweed extract application for various crops has a considerable

benefits as a results to its content with high amounts of organic matter, micro elements (Cu, Fe, Co, Zn, Mn, Mo, and Ni), amino acids and vitamins and also, it is a good sources of growth regulators such as auxins, gibberellins and cytokinins (Khan *et al.*, 2009). In general, seaweed extracts, at low concentrations, are able to induce a group of physiological plant responses, such as encourage of plant growth and improvement of flowering and yield (Battacharyya *et al.*, 2015).

Plant spacing is a significant agronomic factor that is supposed to have an effects on light interception to plant for photosynthesis which is the medium for energy producing by using green parts of the plant (Ndereyimana *et al.*, 2014). Also the plant spacing per hectare is an important to receive higher yields in brinjal. It can be achieved by using different spacing between the rows and plants (Arun, 2013). The knowledge of crop response to plants spacing provides the basis for accessing the influences of intraspecific competition (Adani *et al.*, 1998).

In the last years, the farmers trend to use F1 hybrids varieties for cultivation in open field. The reasons behind the use of F1 hybrids varieties in open field are their capability to

highly increase yield and more uniformity as compared to local seeds and non-hybrid varieties (**Muñoz-Falcón *et al.*, 2008**). Therefore, this research was aimed to study the effect of planting densities and foliar spraying by seaweed extract on growth and yield production of two eggplants cultivars.

2. MATERIALS & METHODS

The experiment was conducted in open field conditions at the growing season 2018, at the vegetable research farm, college of Agriculture Engineering Sciences, Sumil, Duhok, Iraqi Kurdistan region. Seeds of two hybrid cultivars of eggplant were chosen during the study which are (Anamur RZ F1 and Kyme F1). Sowing of seeds started in March, 5th 2018 for both cultivars. After 49 days from sowing seeds the seedling transplanted to the permanent place in farm in April, 23rd 2018. The seedling planted according to plant spacing factor which are (30, 45 and 60 cm) between plants and (0.75 cm) between rows. The plants was irrigated by drip irrigation. The experiment consist of the effect of two eggplant hybrid cultivars (A1 = Anamur RZ F1 and A2 = Kyme F1), three levels of plant spacing (B1= 30, B2= 45 and B3=60 cm) and four levels of foliar sprayings with seaweed extract (C1= 0, C2= 0.5, C3= 1.0 and C4= 1.5 ml.l⁻¹), which mean treatment with their interaction. Anamur RZ F1 is produced in Holland by Rijk Zwaan company and Kyme F1 is produced in Barcelona, Spain by Fito company. The seaweed extract that used is Tecamin algae, which depended on algae from the genus (*Ascophyllum nodosum*). Foliar sprayings with seaweed extract were applied three times within 15 days intervals, starting after 15 days from transplanting. The surfactant agent Tween-80 was added to spraying solution at rate 2-3 drops per liter.

The treatments of experiment were arranged in a factorial experiment within Split-Split-Plot Design in (RCBD), including three factors . The main plot was represented by two hybrid cultivars, three planting density in sub plot and four levels of seaweed extract in sub-sub-plot. The treatments were randomly distributed by

using completely randomized blocks design (RCBD). Each experimental units involves one line, with 10 plants/line as observation. The comparison between means was carried out according to Duncan's multiple range test at (0.05) level, using a SAS computerized program (SAS, 2003).

Experimental Measurements:

Vegetative Growth characteristics:

1. Plant Height (cm)
2. Leaf Area (cm²)
3. Leaf chlorophyll content (SPAD)

Fruit and Yield characteristics:

1. Average weight of fruit (g. fruit⁻¹)
2. Plant yield (Kg. plant⁻¹)
3. Total yield (ton. ha⁻¹)

3. RESULTS

Vegetative growth characteristics:

1. Plant height (cm):

Data presented in table (1) shows that a highly significant differences between cultivars in plant height, Anamur RZ cultivars overcame Kyme cultivar in plant height which record (80.38 cm). Also the plant spacing significantly affected in plant height and the highest value (76.87 cm) was recorded in (30 cm) spacing. But seaweed extract recorded no significant differences on plant height.

The interaction between cultivars and plant spacing showed a significant variation among them, which was superior in Anamur RZ cultivars and (45 cm) plant spacing. Interaction between cultivars and seaweed extract gives superior in plant height (81.40 cm) in Anamur RZ cultivars and (0.5 ml.l⁻¹) of seaweed extract. Interaction between plant spacing and seaweed extract recorded a significant differences on plant height, where (30 cm) plant spacing and (0.5 ml.l⁻¹) of seaweed extract (gave the best result). Interaction among three factors resulted in a significant differences on eggplant height. The maximum plant height was determined among Anamur RZ cultivar, (45 cm) plant spacing and (1.5 ml.l⁻¹) of seaweed extract which was (86.46 cm), when compared to other plants.

Table (1): Effect of cultivars, plant spacing, seaweed extract and their interaction on plant height (cm) of eggplant. *

Cultivar	Plant Spacing	Seaweed Extract				Cultivar * Plant spacing	Mean effect of cultivars
		0	0.5	1	1.5		
Anamur RZ	30	85.14 ab	81.70 a-c	80.51 a-c	76.55 cd	80.98 a	80.38 a
	45	79.88 bc	80.93 a-c	81.90 a-c	86.46 a	82.29 a	
	60	76.05 cd	81.57 a-c	77.28 cd	76.63 cd	77.88 b	
Kyme	30	76.17 cd	73.50 de	73.12 d-f	68.27 e-g	72.76 c	67.63 b
	45	68.87 e-g	68.60 e-g	67.53 fg	66.87 g	67.97 d	
	60	60.23 h	60.07 h	63.35 gh	65.05 gh	62.17 e	
Cultivar * Seaweed Extract	Anamur RZ	80.36 a	81.40 a	79.90 a	79.88 a	Mean effect of Plant spacing	
	Kyme	68.42 b	67.39 b	68.00 b	66.73 b		
	30	80.65 a	77.60 ab	76.81 ab	72.41 cd	76.87 a	
	45	74.37 b-d	74.76 bc	74.71 bc	76.66 ab	75.13 b	
	60	68.14 e	70.82 c-e	70.32 de	70.84 c-e	70.03 c	
	Mean effect of Seaweed Extract	74.39 a	74.39 a	73.95 a	73.30 a		

*Means within a rows, columns and their interaction written with the same letters are not significantly different from each other according to Duncan's multiple range test at 5% level.

2. Leaf Area (cm²):

Data in table (2) reported that the cultivars don't have any significant influence on leaf area of eggplant. Plants spacing significantly influenced leaf area, the maximum value obtained in (60 cm) spacing which was (88.24 cm²). Also seaweed extract significantly affected on leaf area, recorded the highest number (87.70 cm²) when sprayed by (1 ml.l⁻¹) compared to the other plants.

In case of the interaction between cultivars and plant spacing, there were a significant variation between them, superior interaction was between Anamur RZ cultivars and (60 cm)

spacing. The interaction between cultivars and seaweed extract gave the highest value in the combination between the Kyme cultivars and (1 ml.l⁻¹) of seaweed extract. Interaction between plant spacing and seaweed extract gave a significant impact on leaf area, the best data was obtained from interaction of (60 cm) spacing and (0 ml.l⁻¹) of seaweed extract. Triple interaction among the factors showed a significant variation on leaf area in eggplant, the superiority was found in the interaction among Kyme cultivars, (60 cm) plant spacing and (0 ml.l⁻¹) of seaweed extract.

Table (2): Effect of cultivars, plant spacing, seaweed extract and their interaction in leaf area (cm²) on eggplant.*

Cultivars	Plant spacing	Seaweed Extract				Cultivar * Plant spacing	Mean effect of cultivars
		0	0.5	1	1.5		
Anamur RZ	30	81.59 ef	78.80 f	85.3 c-e	78.50 f	81.05 c	85.88 a
	45	88.25 b-d	89.3 a-c	87.81 b-d	84.50 c-e	87.47 ab	
	60	84.92 c-e	92.95 ab	86.1 c-e	92.57 ab	89.13 a	

Kyme	30	82.98 d-f	88.44 b-d	93.20 ab	78.69 f	85.83 ab	85.50 a
	45	88.37 b-d	80.78 ef	81.32 ef	82.88 d-f	83.34 bc	
	60	94.37 a	81.15 ef	92.45 ab	81.44 ef	87.35 ab	
Cultivar * Seaweed Extract	Anamur RZ	84.92 bc	87.02 ab	86.40 a-c	85.19 bc	Mean effect of Plant spacing	
	Kyme	88.57 a	83.46 cd	88.99 a	81.00 d		
Plant spacing * Seaweed Extract	30	82.28 d	83.62 cd	89.25 a	78.59 e	83.44	b
	45	88.31 ab	85.04 b-d	84.56 b-d	83.69 cd	85.40	ab
	60	89.64 a	87.05 a-c	89.27 a	87.00 a-c	88.24	a
Mean effect of Seaweed Extract		86.75 ab	85.24 b	87.70 a	83.10 c		

*Means within a rows, columns and their interaction written with the same letters are not significantly different from each other according to Duncan's multiple range test at 5% level.

3. Chlorophyll content in leaves (SPAD):

Results in the table (3) showed that the cultivars not affected on the chlorophyll content in leaves. The plant spacing significantly influenced on the chlorophyll in leaves, at level (60 cm) spacing the plants gave the highest value (55.83). Also the chlorophyll content in leaves significantly affected by seaweed extract and the maximum results was achieved by applying (1 ml.l⁻¹) of seaweed extract which was (54.00).

Interaction between cultivars and plant spacing was superior in Kyme cultivars and (60 cm) spacing. Also interaction between cultivars and seaweed extract significantly improved

chlorophyll in leaves, the highest result was recorded in the Kyme cultivars and (1 ml.l⁻¹) of seaweed extract (56.47). Interaction between plant spacing and seaweed extract gave a significant impact on chlorophyll in leaves, the maximum value was measured in the combination between (60 cm) spacing and (1 ml.l⁻¹) of seaweed extract. The interaction among all factors (cultivars, plant spacing and seaweed extract) was found significantly enhanced chlorophyll content in leaves. The highest value was achieved in the interaction among Kyme cultivar, (60 cm) spacing and spraying (1 ml.l⁻¹) of seaweed extract.

Table (3): Effect of cultivars, planting spacing, seaweed extract and their interaction on Chlorophyll content (SPAD) in leaves of eggplant.*

Cultivars	Plant spacing	Seaweed Extract				Cultivar * Plant spacing	Mean effect of cultivars
		0	0.5	1	1.5		
Anamur RZ	30	51.52 f-h	50.19 gh	51.61 f-h	50.21 gh	50.88 cd	51.23 a
	45	50.31 gh	51.12 f-h	49.65 gh	49.59 gh	50.17 d	
	60	52.85 d-h	52.47 e-h	53.30 d-g	51.97 e-h	52.65 bc	
Kyme	30	51.35 f-h	51.93 e-h	53.22 d-g	48.75 h	51.31 cd	54.94 a
	45	55.77 c-e	53.77 d-g	54.95 c-f	53.49 d-g	54.49 b	
	60	58.40 a-c	59.58 ab	61.24 a	56.82 b-d	59.01 a	
Cultivar * Seaweed Extract	Anamur RZ	51.56 bc	51.26 bc	51.52 bc	50.59 c	Mean effect of Plant spacing	
	Kyme	55.17 a	55.09 a	56.47 a	53.02 b		
Plant spacing	30	51.44 ef	51.06 ef	52.42 de	49.48 f	51.10	b

* Seaweed Extract	45	53.04 c-e	52.45 de	52.30 de	51.54 ef	52.33 b
	60	55.63 a-c	56.02 ab	57.27 a	54.40 b-d	55.83 a
Mean effect of Seaweed Extract		53.37 a	53.18 ab	54.00 a	51.81 b	

*Means within a rows, columns and their interaction written with the same letters are not significantly different from each other according to Duncan's multiple range test at 5% level.

Fruit and Yield characteristics:

1. Average Fruits Weight (g. fruit⁻¹):

Table (4) revealed that the average fruit weight are significantly variant in the two cultivars and the Kyme cultivars was superior by (126.45 g. fruit⁻¹). The effect of plant spacing shows that there were no significant differences between treatment in average fruit weight. The influences of seaweed extract recorded a significant improved in concentration (0.5 ml.l⁻¹) and (1 ml.l⁻¹) at rate (114.56 g. fruit⁻¹ and 113.15 g. fruit⁻¹) respectively. Interaction between cultivars and plant spacing, there were a significant differences between them, the highest value was recorded in Kyme cultivars and (45

cm) spacing. The interaction between cultivars and seaweed extract the best value was recorded in the interaction between the Kyme cultivars and (0.5 ml.l⁻¹) of seaweed extract. The influence of plant spacing and seaweed extract significantly enhanced average fruit weight at level (45 cm) spacing and (0.5 ml.l⁻¹) seaweed extract, with the maximum weight (118.70 g. fruit⁻¹). The interaction among the three factors shows a significant differences between them, the highest number was recorded in interaction among Kyme cultivars, (45 cm) spacing and (0.5 ml.l⁻¹) of seaweed extract in comparison to all other treatments.

Table (4): Effect of cultivars, plant spacing, seaweed extract and their interaction on average fruit weight (g. fruit⁻¹) of eggplant.*

Cultivars	Plant spacing	Seaweed Extract				Cultivar * Plant spacing	Mean effect of cultivars
		0	0.5	1	1.5		
Anamur RZ	30	88.42 f	94.84 f	97.88 ef	96.12 f	94.31 b	94.52 b
	45	86.26 f	98.78 ef	97.30 ef	95.10 f	94.36 b	
	60	88.04 f	98.46 ef	99.74 ef	93.31 f	94.89 b	
Kyme	30	117.31 cd	129.20a-c	126.03a-d	124.04 a-d	124.16 a	126.45 a
	45	134.68 ab	138.62 a	125.33a-d	122.86 b-d	130.37 a	
	60	111.97 de	127.42a-d	132.62a-c	127.32 a-d	124.83 a	
Cultivar * Seaweed Extract	Anamur RZ	87.57 d	97.36 c	98.31 c	94.84 cd	Mean effect of Plant spacing	
	Kyme	121.32 b	131.77 a	127.99 ab	124.74 ab		
Plant spacing * Seaweed Extract	30	102.86 bc	112.05 ab	111.95 ab	110.08 a-c	109.24 a	
	45	110.47 a-c	118.70 a	111.31 ab	108.98 a-c	112.37 a	
	60	100.01 c	112.94 ab	116.18 a	110.31 a-c	109.86 a	
Mean effect of Seaweed Extract		104.45 b	114.56 a	113.15 a	109.79 ab		

*Means within a rows, columns and their interaction written with the same letters are not significantly different from each other according to Duncan's multiple range test at 5% level.

2.Plant Yield (kg. Plant⁻¹):

Data in table (5) indicated that there was a significant difference between the two cultivars on plant yield, the best value was obtained in Kyme cultivar (3.43 kg. Plant⁻¹). The plant spacing significantly influenced in plant yield, the highest number recorded in (60 cm) spacing at (3.96 kg. Plant⁻¹). Spraying with seaweed extract showed a significant effect on plant yield, the level (1 ml/L) gave the highest results, when comparing with concentration (0.5 ml.l⁻¹) which was (3.31 kg. Plant⁻¹).

Interaction between cultivars and plant spacing showed a significant differences among them, the superior interaction was recorded in Kyme cultivar and (60 cm) spacing. Also

interaction between cultivars and seaweed extract recorded a significant influences on plant yield, the concentration (1 ml.l⁻¹) of seaweed extract and Kyme cultivar had the highest value. The interaction between plant spacing and seaweed extract resulted in significant impact between them, the maximum value was measured in the combination between (60 cm) spacing and (0.5 ml.l⁻¹) of seaweed ,also (60 cm) spacing and (1 ml.l⁻¹) of seaweed extract respectively.

In the triple interaction results revealed that there were a significant differences among the three factors in plant yield, the Kyme cultivar, (60 cm) spacing and (1 ml.l⁻¹) of seaweed extract positively improved plant yield.

Table (5): Effect of cultivars, planting spacing, seaweed extract and their interaction on plant yield (kg. Plant⁻¹) of eggplant.*

Cultivars	Plant spacing	Seaweed Extract				Cultivar * Plant spacing	Mean effect of cultivars
		0	0.5	1	1.5		
Anamur RZ	30	1.91 m	2.06 m	2.49 k	2.07 m	2.13 e	2.99 b
	45	2.62 jk	3.11 i	3.04 i	2.97 i	2.93 c	
	60	3.89 de	4.28 b	3.80 ef	3.62 g	3.90 b	
Kyme	30	2.51 k	2.47 k	2.68 j	2.30 l	2.49 d	3.43 a
	45	3.99 cd	3.85 de	3.68 fg	3.59 g	3.78 b	
	60	3.36 h	4.09 c	4.48 a	4.15 bc	4.02 a	
Cultivar * Seaweed Extract	Anamur RZ	2.80 e	3.15 d	3.11 d	2.89 e	Mean effect of Plant spacing	
	Kyme	3.29 c	3.47 b	3.61 a	3.35 c		
Plant spacing * Seaweed Extract	30	2.21 g	2.27 g	2.58 f	2.18 g	2.31 c	
	45	3.30 e	3.48 d	3.36 e	3.28 e	3.36 b	
	60	3.62 c	4.19 a	4.14 a	3.88 b	3.96 a	
Mean effect of Seaweed Extract		3.05 c	3.31 a	3.36 a	3.12 b		

*Means within a rows, columns and their interaction written with the same letters are not significantly different from each other according to Duncan's multiple range test at 5% level.

3.Total Yield (ton. ha⁻¹):

Table (6) revealed that there were significant variation between the cultivars in the total yield, the Kyme cultivar gave the superior value (77.95 ton. ha⁻¹). The influence of plant spacing significantly improved plant yield with (30 cm) spacing by (77.02 ton. hectare⁻¹). The seaweed extract significantly affected on total yield, obvious that the concentration (1 ml.l⁻¹) of seaweed extract promoted total yield by(76.53 ton. hectare⁻¹).

Binary interaction refers that the interaction between Kyme cultivars and (45 cm) plant

spacing obtained the best value. The combination between Kyme cultivars and (1 ml/L) of seaweed extract gave the highest result. Also the interaction between plant spacing and seaweed extract shows a significant differences between them, the highest value was recorded from (30 cm) spacing and (1 ml.l⁻¹) of seaweed. Regarding the interaction among the three factors, there were a significant differences between them. The best results were recorded in combination of Kyme cultivar, (30 cm) spacing and (1 ml.l⁻¹) of seaweed extract.

Table (6): Effect of cultivars, plant spacing, seaweed extract and their interaction on total yield (ton. ha⁻¹) of eggplant. *

Cultivars	Plant spacing	Seaweed Extract				Cultivar * Plant spacing	Mean effect of cultivars
		0	0.5	1	1.5		
Anamur RZ	30	63.72 kl	68.80 hi	82.84 cd	69.13 hi	71.12 b	67.09 b
	45	58.12 mn	69.16 hi	67.46 ij	66.08 i-k	65.20 c	
	60	64.77 jk	71.38 gh	63.33 kl	60.34 lm	64.95 c	
Kyme	30	83.60 cd	82.28 cd	89.25 a	76.50 ef	82.91 a	77.95 a
	45	88.65 ab	85.63 bc	81.67 d	79.86 de	83.95 a	
	60	56.04 n	68.21 h-j	74.62 fg	69.13 hi	67.00 c	
Cultivar * Seaweed Extract	Anamur RZ	62.21 f	69.78 d	71.21 d	65.18 e	Mean effect of Plant spacing	
	Kyme	76.10 c	78.71 b	81.85 a	75.16 c		
Plant spacing * Seaweed Extract	30	73.66 c	75.54 bc	86.05 a	72.82 c	77.02 a	
	45	73.39 c	77.39 b	74.56 c	72.97 c	74.58 b	
	60	60.41 f	69.80 d	68.98 d	64.73 e	65.98 c	
Mean effect of Seaweed Extract		69.15 c	74.24 b	76.53 a	70.17 c		

*Means within a rows, columns and their interaction written with the same letters are not significantly different from each other according to Duncan's multiple range test at 5% level.

4- DISCUSSION**1. Effect of cultivars, plant spacing and seaweed extract on vegetative characteristics:**

The results from table (1, 2 and 3) revealed that the studied factors (cultivars, plant spacing

and seaweed extract) and their interaction have a significant influences on most parameters. Cultivars has a significant effect on plant height, but it not affected on leaf area and chlorophyll in leaves. The variation in plant height between the two cultivars may be due to the increases in

nutrient absorption in the soil by Anamur RZ cultivars rather than Kyme cultivars or may be due to the variation in the root system or the genetic differences between the two cultivars, the same results were reported by **(Ibraheim and Mohsen, 2016; Rasheed et al, 2017 ; Rasheed, 2013 and Olaniyi et al, 2010).**

The using of plant spacing in the studies showed the pervious results in table (1,2 and 3) which indicated that there were a significant differences among treatment in plant height, leaf area and chlorophyll in leaves. The positive effect of plant spacing may be due to various factors. The plants with wider plant spacing take more resources like light, water and nutrients from soil as compared to the lower planting density, as a result to competition among them. These results are acceptable with that reported by **(Alabi et al., 2014)** which said that could be attributed to the competition among plants to the available water, nutrients from soil and photosynthetically active radiation in the lowest planting density. Also the data obtained are agreed with **(Ibraheim and Mohsen, 2016; Ndereyimana et al. 2014).**

The enhancement of vegetative growth by application of seaweed extract resulted in significant effect in some parameters like leaf area and chlorophyll content in leaves. This significant effect may be returned to the positive effect of seaweed extract on plant growth which contain major macronutrients, plant growth hormones (auxin, Gibberellins and cytokines), also the plant biostimulants such as vitamins and amino acids, as well as improve plants resistances and delay plant senescence. These results are acceptable with that reported by **(Abd El-Gawad and Osman, 2014; Hegazi, et al, 2015; and Mohammed, 2013).** However, the growth-enhancing of seaweed application may be attributed to the presence of carbohydrate and of micro and macro nutrient **(Sangeetha and Thevanathan, 2010).** Also seaweed extracts enhance the growth of vegetables and other crops as they contain plant growth regulators such as auxins (IAA and IBA), cytokinins, gibberellins and betaines **(Kumar and Sahoo, 2011).**

Vegetative growth improvement by seaweed extracts may be as a results of its components like macro and micro elements, vitamins, amino acids, auxins, cytokinins, and abssisic acid

(ABA) like growth regulators which influences in cellular metabolism in treated plants due to improve growth and yield, these results agreed with **(Ordog et al. 2004 and Durand et al. 2003).**

2. Effect of cultivars, plant spacing and seaweed extract on yield characteristics:

It obvious from tables (4, 5 and 6) that all factors (cultivars, planting density and seaweed extract) individually and combined increased the most studied parameter significantly, which are average fruit weight, plant yield and total yield.

The cultivars influences on eggplant crop may be due to the environmental conditions or genotypes. The same results was approved by **(Shewfeld, 1999 and Maniutiu et al., 2008)** which are revealed that Genetic factors and environmental conditions, including nutrients content in the soil are the major factors affecting on vegetable crops. Various cultivars of eggplant have different growth habit which reflect on yield productivity **(Mohammed, 2015).** The results are in acceptable with **(Ibraheim and Mohsen, 2016)** which are showed that the variability between the cultivars could be as a result of the different genetic factors among them. So in this research Kyme cultivar gave the highest value in all yield characteristics.

It is clear from the tables (4, 5 and 6) that plant spacing significantly Increases the plant yield and total yields in the term of yield characteristics, but not affected on average fruit weight. The plant spacing at rate (60 cm) significantly increased the plant yield, while the plant spacing (30 cm) increases the total yield, that results are obtained as a results of competition between plants for the recourses like nutrient, water and light. These results are agreed with **(Rasheed, 2013; Ibraheim and Mohsen, 2016; and Islam et al., 2011).** However, the highest plant yield was obtained with maximum plant spacing and thus increases the number of plants per unit area, which increase the numbers of fruits per hectare which may lead to the increase in production **(Cavero et al, 2001).**

Seaweed extract significantly affected in the yield characteristics like average fruit weight, plant yield and total yield, which are mentioned in the results in table (4,5 and 6). The

improvements in yields may be associated with the increase in vegetative growth parameters which previously mentioned in table (1,2 and 3), these results are agreed with (El-Miniawy *et al*, 2014; Mohammed, 2013 and Al-Saaberi, 2005). Also the enhancement of yield may be due to the presence of plant growth regulators in the seaweeds extract, especially Cytokinins. Cytokinins in vegetative plant parts are related with nutrient apportionment, while in reproductive organs, high percent of cytokinins may be associated with nutrient mobilization (Abd El-Gawad and Osman, 2014).

5. Conclusion:

According the pervious results the three factors (Cultivars, Plant spacing and Seaweed extract) have positive effect on plant growth and yield parameters. The Kyme cultivar has a superiority over Anamur RZ cultivar in almost all parameters. The spacing have significant effect on plant growth and yield parameters. The spraying of seaweed extract at concentration (1 ml.l⁻¹) gave the best results.

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کارتیکرنا گفاشتی رووه کین ده ریایی و بوشایی چاندنی ل سهر گه شه و به رهه می دوو جورین باجان رهشکان (*Solanum melongena* L).

پوخته

ئهف قه کولینه یا هاتیبه نه نجام دان ل زه قیین قه کری یین کولیژا زانستین نه ندازیاریا چاندنی , زانکویا دهوک, هه ریما کوردستانی , عیراق. دوهرزی چاندنی یی هافینی دا ل سالا (2018). ب نارمانجا تاقیکرنا کارتیکرنا گفاشتی رووه کین ده ریایی (Seaweed Extract) ب چار تیراتیا (0, 0.5, 1.0, 1.5) مل.لتر-1 و ههروه سا بوشایی چاندنی ب سی ئاستا (30, 45, 60) سم ل سهر گه شه کرن و به رهه می دوو جورین باجان رهشکان (*Solanum melongena* L). گفاشتی رووه کین ده ریایی (Tecamin algae) سی جارا هاته ره شاندن ل ده می وه رزی چاندنی , 15 روژ دنابه را هه ره شانده کی دا بون. قه کولین هاتیبه نه خشه کرن وهک قه کولینه کا فره هوکار (Factorial) ل ژیر سیسته می (Split-Split-Plot) ب کارئینانا نه خشی (RCBD) دگه ل سی دووباره کرنا. د نه نجامدا دیار بوو کو ره شاندا گفاشتی رووه کین ده ریایی ب تیراتیا (1 مل.لتر-1) ب شیوه کی بهرچاف نهف ساخله ته زیده کرن (روهری ری به لگی, ریژا کلوروفیلی د به لگا دا , تیکرای کیشا بهری , به رهه می ئیک رووهک , و تیکرای به رهه می د هیکتاره کی دا) ب به راوردی دگه ل رووه کین نه ره شاندی , به لی گفاشتی رووه کین ده ریایی چ کارتیکرن ل سهر بلندیا رووه کی نه بو. بوشایی چاندنی ب ئاستی (30 سم) ب شیوه کی بهرچاف بلندیا رووه کی و تیکرای به رهه می د هیکتاره کی دا زیده کرن , و ش لایه کی دیقه ل ئاستی (60 سم) ب شیوه کی بهرچاف نهف ساخله ته باشر لیکن (روهری ری به لگی, ریژا کلوروفیلی د به لگا دا , به رهه می ئیک رووهک). ههروه سا جوری باجان رهشکی (Kyme) کارتیکرنا بهرچاف هه بو ل سهر تیکرای کیشا بهری و به رهه می ئیک رووهک و تیکرای به رهه می د هیکتاره کی دا , به لی جوری (Anamur RZ) بلندیا رووه کی زیده کر. د تیکه ل بونا دوو قولی و سی قولی دا دیار بو کو تیکه ل بون دنابه را جوری باجان رهشکی (Kyme) و بوشایی چاندنی ب ئاستی (60 سم) و ره شاندن ب گفاشتی رووه کین ده ریایی ب تیراتیا (1 مل.لتر-1) ب شیوه کی بهرچاف پتیرا ساخله تا زیده کر.

تأثیر مستخلص الأعشاب البحرية و المسافات الزراعية على نمو و حاصل صنفين من البادنجان (*Solanum melongena* L.)

الخلاصة

نفذت الدراسة في الحقل المكشوف في حقول الخضراوات/كلية علوم الهندسة الزراعية /جامعة دهوك / العراق. في موسم النمو (2018) بهدف دراسة تأثير المستخلص البحري ب

بأربعة تراكيز (0 , 0.5 , 1.0 , 1.5 مل.لتر⁻¹) و المسافات الزراعية بثلاث مستويات (30 , 45 , 60 سم) على نمو و حاصل صنفين من البادنجان (*Solanum melongena* L.) و الصنفن هما (Anamur RZ F1) و (Kyme F1). تم رش المستخلص البحري (Tecamin algae) بثلاث دفعات خلال موسم النمو و كانت الفترة بين رشة و أخرى (15) يوم. صممت التجربة العملية بنظام الألواح المنشقة (Split-Split-Plot) ضمن تصميم القطاعات العشوائية الكاملة (RCBD) و بثلاث مكررات. أظهرت النتائج أن مستخلص الأعشاب البحرية بتركيز (1 مل.لتر⁻¹) أدى الى زيادة معنوية في (المساحة الورقية سم² , محتوى الكلوروفيل في الأوراق , معدل وزن الثمرة الواحدة , حاصل النبات الواحد , الحاصل الكلي طن.هكتار⁻¹) و مقارنة مع النباتات الغير معاملة , لكن لم يؤثر على طول النبات. المسافات الزراعية بمستوى (30 سم) أدت الى زيادة معنوية في طول النبات و الحاصل الكلي , بينما بمستوى (60 سم) زادت بشكل معنوي كلاً من المساحة الورقية و محتوى الكلوروفيل في الأوراق و حاصل النبات الواحد , الحاصل الكلي , بينما صنف (Kyme) أثر معنوياً في زيادة (معدل وزن الثمرة الواحدة , حاصل النبات الواحد , الحاصل الكلي) , بينما صنف (Anamur RZ) زاد بشكل معنوي طول النبات. التداخل الثنائي و الثلاثي أظهر أن التداخل مابين صنف (Kyme) و المسافات الزراعية بمستوى (60 سم) و مستخلص الأعشاب البحرية بتركيز (1 مل.لتر⁻¹) أدت الى زيادة معنوية في أغلب الصفات.