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RESPONSE YIELD OF FOUR CULTIVAR KOHLRABI (*BRASSICA OLERACEA VAR. CAULORAPA* L.) TO PLANT DENSITY AND FOLIAR NUTRITION OF SEAWEED

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Abstract

The experiment was conducted at the research station of the Department of Horticulture and Gardening Engineering at the Faculty of Agriculture, Diyala University in the agricultural season-autumn 2018 to study the Response Yield of Four Cultivar Kohlrabi to Plant Density and Foliar Nutrition of Seaweed. The experiment included four varieties of Kohlrabi, namely Green delicacy (V_1), local variety (V_2), Purple delicacy (V_3) and Vienna White (V_4) with two plant densities, 53333 H^{-1} (D_1) and 106666 H^{-1} (D_2). It has three levels of Foliar Nutrition with seaweed extract and it is without spraying (F_0), 3ml $liter^{-1}$ (F_1) and 6ml $liter^{-1}$ (F_2). A global experiment was carried out within the split plot design system within the complete randomized sector design (RCBD), as densities were placed in the main plates and the Foliar Nutrition levels were laid with seaweed extract in the secondary plates, while plant varieties were placed in sub-secondary units, the program was used The SAS statistic in analyzing the results, and the averages were compared to the polynomial Duncan test at a probability level of 0.05, the study showed that there were significant differences between the varieties, as the Green delicacy category exceeded Diameter of enlarged stem and weight of one plant And that amounted to 10.09 cm and 851.3 g Respectively, The local variety significantly increased in size of the enlarged stem, reaching 403.1 cm^3, Whereas, the White Vienna cultivar significantly showed superior characteristics of enlarged leg weight and total score It reached 593.2 g and 47.22 tons h^{-1} Respectively. The plants grown with the first density (D_1) were significantly superior in characteristics The weight, size and diameter of the enlarged stem and the weight of a single plant 525.8 g, 387.7 cm^3, 10.12 cm, 789.8g respectively. While the plants planted with the second density (D_2) were significantly superior in the total yield, with a value of 53.80 tons H^{-1}. Sprinkled plants excelled at a concentration of $6ml^{-1}$ from seaweed extract significantly in traits Weight, size, and diameter of the enlarged stem, and the weight of the single plant and total yield And that amounted to 543.8 g, 383.02 cm^3, 10.42 cm, 817.3 g, and 43.62 tons h^{-1} Respectively, Triple interaction show the four cultivars, plant density and foliar feeding with seaweed extract had a significant effect, The treatment of purple delicacy, first intensity and fertilization of 6ml $liter^{-1}$ ($V_3D_1F_2$) was significantly significant at the highest value For enlarged stem length and total plant weight And that amounted to 8.575 cm and 929.5 g Respectively, While the plants treated the interference of cultivar White Vienna and the first density and fertilization at a concentration of $6ml^{-1}$ ($V_4D_1F_2$) significantly in The diameter of the enlarged leg, which amounted to 11.02 cm.

Keywords: Kohlrabi Cultivars, Plant Density, Foliar Nutrition of Seaweed**.**

Introduction

The Kohlrabi (*Brassica oleracea var. caulorapa* L.) of the plants of the Crusader family Brassicaceae, it is believed that the northern coast of Europe is its original habitat and endures a wide range of temperatures so it can be cultivated early or late, the speech is cultivated mainly in India, Pakistan, Iran and Belarus and is an important crop in Egypt, but In Syria and the countries of Western Europe, North and South America, it is considered a second-class crop, but in Iraq it is grown mainly in Karbala Governorate and in the provinces of Babel and Baghdad on a small scale (Al-Khafaji *et al*., 1989). The part that is eaten is the enlarged stem located above the surface of the soil, has a high nutritional and medicinal value due to its high contents of vitamins such as vitamin A, B1, B2, B5, B6 and E and minerals, such as iron, zinc, magnesium, and antioxidants that prevent the formation of carcinogens, and the enlarged leg contains Carbohydrates increased by 6.7-7.2%, proteins 2.8% and fats 2.0% (Al-Khafaji *et al*., 1989 and Matlob *et al*., 1989).

The environmental diversity has a great role in the performance of plant varieties and affects them directly, as most of the characteristics of economic crops are quantitative qualities which in turn are greatly affected by environmental factors, and for this the selection of suitable varieties for cultivation in a region plays an important role in increasing the yield and comes in the first ranks In the factors affecting the increase in production (Al-Shammari and Saud, 2014). Silatar *et al*. (2018) mentioned in an experiment conducted in India for the purpose of knowing the effect of the varieties White Vienna, Early White Vienna, Palam Tender Knob and Purple Vienna and cultivation distances in the growth and yield of the word, the purple Vienna variety outperformed the thickness of the leg (11.90 cm) and the soft weight of the enlarged leg (277.36 gm) and yield (33.28 tons h^{-1}). Also, this cultivar was found to be the most suitable for cultivating Kohlrabi in the north of Gujarat. Al-Shammari and others (2019) observed in an experiment conducted in Diyala governorate to show the effect of foliar feeding with Grow More product on the growth and yield of three varieties of dishonor, that the Globe Master cultivar significantly outperformed the rest of the cultivars in length, diameter, head weight, plant weight and total yield as values reached (14.84 cm, 14.64 cm, 1.031 kg, 1.596 kg, and 34.29 tons e^{-1}), respectively, while the Red Rose cultivar outperformed the vegetative traits included in the experiment.

Plant density affects the extent to which plants benefit from light, which has a major role in plant growth, and here the role and importance of plant density in distributing light to all parts of plants is highlighted. On the other hand, an increase in the number of plants in a unit area leads to an increase in the yield to a certain extent and this may be At the expense of the quotient quality, Therefore, there must be a balance in the number of cultivated plants per unit area on the one hand and the amount of lighting and nutrients

available to plants on the other hand. Increasing the distance showed plants leads to the spreading of the plant's root system in a wider area which provides it with a wider field for growth, plant fixation and absorption of elements and materials Diet This affects the strength of vegetative growth and the increase in leaf formation, which increases the soft and dry weight of the plant compared to plants grown at a lower distance (Sharma *et al*., 2001). Bhangre *et al*. (2011) studied the effect of the variety and five different cultivated distances on the growth and yield of the speech plant under cultivation conditions in India, if the distance exceeds 60 x 60 cm significantly with the highest values for different traits except for the days required for harvest 50% (59.83 days), while plants gave Cultivated at a distance of (30x45 cm) the lowest values for the same characteristics except for the days of harvest 50% (64.5 days). Show Kumar and Rawat (2002) in an experiment conducted in India that studied the effect of nitrogen and cultivation distances on the quality and yield of degeneration, that plants grown at a distance of 60x60 cm were outperformed in the percentage of TSS (8.77%) and the percentage of dry matter (11.66%) and content Chlorophyll (0.24 mg g^{-1}), head diameter (13.93 cm) and head weight (1184.33 g) compared to plants cultivated at a distance of 30 x 60 cm which gave the lowest values to the listed traits but outperformed the overall yield (303.09 tons e^{-1}).

The effect of seaweed extract is due to the microelements and plant growth regulators such as the cytokinin contained in them. Seaweed extract is used as a leaf mixture added to the soil or the seeds are soaked in before planting. It also encourages seed germination, increases the absorption of plant nutrients, gives resistance to frost diseases and fungi, and seaweed extracts are effective for ripening fruits, increasing the shelf life of the product, and improving production quality. (2001, Zodape), Al-Maliki (2013) noted in his experience when studying The effect of spraying with marine algae extract Biozyme TF on the growth and yield of two cultivar plants in the desert areas of Basra Governorate that there was a significant effect when adding three times as it caused a significant increase in the weight of the coiled head (1.713 kg) and its diameter (16.5 cm), compared to the comparison treatment, While plants outperformed the total plant weight (2. 441 kg)and the coiled head weight (1.837 kg) and the total yield (21.479 tons. $Dunum^{-1}$) when adding the extract four times compared to the comparison treatment. Manea *et al*. (2018) mentioned in an experiment conducted in northern Babil Governorate for the winter agricultural season 2017-2018 to find out The effect of spraying with seaweed extract and its magnetization on the growth and yield of the broccoli plant Paraiso cultivar, that spraying with Alga Al-zuhoor extract at a concentration of 2 ml^{-1} has exceeded the head weight (1239 g) and the total yield (29.07 tons e^{-1}) compared to the comparison plants (without Spray) which gave the lowest values to the mentioned characteristics.

This study aims to know the best variety that can be cultivated in the atmosphere of Diyala Governorate within the appropriate plant density with the best concentration of seaweed extract.

Materials and Methods

The experiment was conducted at the research station of the Department of Horticulture and Gardening Engineering at the Faculty of Agriculture, Diyala University in the fall 2018 agricultural season to study the effect of plant density and foliar feeding on seaweed on the growth and yield of speech. The experiment included four varieties: Green delicacy (V_1), local variety (V_2), Purple delicacy (V_3) and Vienna White (V_4) with two plant densities 53333 E^{-1} (D_1) and 106666 H^{-1} (D_2) at three levels. From fertilizing with seaweed extract, it is without spraying (F_0), 3 ml L^{-1} (F_1) and 6 ml L^{-1} (F_2). The experiment was carried out within the split strip plot design according to the complete random sector design (RCBD). The number of transactions reached 24 transactions and triples. Thus, the number of experimental units became 72 units, the length of the experimental unit reached 3.5 m and width of 4 m, i.e. an area of 14 m^2. Significance of mean differences between the averages was tested according to the Duncan polynomial test with a 0.05 probability level.

The seeds of speech cultivars were planted on 16/8/2018 in a private nursery in the Khan Bani Saad region, where cork dishes were filled with a capacity of 209 eyes with peatmos as an agricultural medium and then one seed was placed in each of the dish openings and service operations were performed until they were transferred to the field on 4/10/2018. The field designated for cultivation has been prepared by conducting the process of cultivating the soil to get rid of the seeds of the bush and facilitating the tillage process that was carried out with the flip-flop plow twice and perpendicular to a depth of 30 cm. In Him (Matlob and Others, 1989).

The seedlings were planted on one side of the irrigation tube in the first density (D_1), and on the sides of the irrigation tube in the second density (D_2) and the distance between the seedlings to another was 25 cm, and the number of seedlings in the experimental unit reached 12 seedlings in the first density and 24 seedlings in the second density, The plants were sprayed with marine algae extract until full wetness three times during the growing season starting (14/10/2018) and with a period of 10 days between sprinkles and the spraying was carried out early in the morning. Harvesting took place on November 22, 2018 and lasted for 15 days.

Thoughtful traits:

1. Adjusted leg weight (kg leg $^{-1}$):

The amplified stem weight and five randomly selected plants were calculated from each experimental unit and then the mean was calculated.

2. Diameter of oversized stem (cm):

Five random plants were chosen from each experimental unit. The diameter of the enlarged stem was measured by the vernir by measuring the distance between the two furthest points on the edges of the enlarged stem passing through its diameter and then calculating the average.

3. Oversized Leg Length (cm):

Five random plants were chosen from each experimental unit. The length of the enlarged stem was measured by the vernir by measuring the distance between the two furthest points on the edges of the enlarged stem and then calculating the average.

4. Size of the enlarged leg (cm^3):

Five random plants were selected from each experimental unit and their volume was measured by displacement water using the included cylinder.

5. Weight of one plant (stem with leaves) gm^{-1}

Five plants were taken from each experimental unit at the end of the season and the whole plants were weighed (stem with leaves). The rate was calculated by adding the plants weights and dividing them by five.

6. The sum total (inflated stems only) ton e^{-1}: calculated according to the following formula:

Total quotient (enlarged stems only) ton ha^{-1} = enlarged stem weight only without leaves and roots (kg stalk $^{-1}$) x number of plants per hectare / 1000

Table 1 : Some chemical and physical characteristics of the soil of the field in which the experiment was carried out

Adjective		the value	Unit
PH		-	7.03
Electrical conductivity (1: 1)		Ds. m^{-1}	6.95
Ready items	Nitrogen	Mg-kg $^{-1}$	59.32
	Phosphorus	Mg-kg $^{-1}$	7.942
	Potassium	Mg-kg $^{-1}$	84.769
Organic matter		G kg^{-1}	8.373
Soil arthropods	the sand	G kg^{-1}	296.2
	Silt	G kg^{-1}	585.7
	Clay	G kg^{-1}	118.1
Soil tissue		Alluvial mixture	Silty loam
Bulk density		G cm^{-3}	1.35

Results

Weight of the enlarged leg

The results presented in Table 2 showed a significant effect of the cultivar on the amplified stem weight attribute, as the V_4 cultivar significantly outperformed the rest of the cultivars in this attribute with the highest average weight of the leg mass reaching 593.2 g, whereas the V_1 class gave the lowest rate of the leg weight to 463.4 g, and it was found that there Significant differences when treating plants with seaweed extract when sprayed on leaves, as treatment F_2 significantly outperformed the highest rate of enlarged stem weight of 543.8 g compared to the coefficients of comparison (F_0) and the second level of spraying (F_1), which gave the lowest rate of enlarged stem weight of 473.6 and 530.3 g on Arrangement: The triple interference between cultivar, plant density, and leafy feeding with seaweed extract had a significant effect on this trait, as treatment $V_4D_1F_2$ was significantly superior to other treatment coefficients with the highest rate of inflated leg weight reaching 629.3 g except for treatment $V_4D_1F_1$ did not differ significantly from it as the average weight of the leg It contained 624.5 g, while the treatment $V_1D_2F_0$ gave the lowest rate of enlarged leg weight of 404.3 g. Diameter of the enlarged leg**.**

Diameter of the enlarged leg

Table 3 shows a significant effect of the cultivar on the diameter of the bulb stem, as the V_1 cultivar significantly outperformed the highest rate of the bulb stem diameter of 10.09 cm, while the lowest diameter of the bulb stem with the variety reached 9.735 cm. It was found that there were significant differences when treating plants with seaweed extract The F_2 fertilization treatment was significantly superior to the highest rate of enlarged stem diameter of 10.42 cm, compared to the comparison parameters (F_0) and the second spray level (F_1), which gave the lowest rate for enlarged stem diameter of 9.29 and 10.11 cm, respectively. The results of the table showed that the factors of triple interference between the variety and the plant density and foliar feeding with seaweed extract had a significant effect on the trait, as treatment $V_4D_1F_2$ was significantly superior to the rest of the other coefficients with the highest rate of inflated stem diameter was 11.02 cm except for the treatment factors $V_1D_1F_1$ and $V_1D_1F_2$ which did not differ significantly from it The average diameter of the stem in them was 10.47 and 10.90 cm, respectively, while the lowest average diameter of the affected leg appeared in treatment $V_3D_2F_0$, as it reached 8.663 cm.

Leg length enlarged

The results shown in Table 4 indicated that there was no significant effect of the variety in this trait, as there is no significant difference between the four classes studied in the length of the amplified stem length. The results in the same table indicate that there were no significant differences between the density D_1 and D_2 in these characteristics. The adjective, while it was found that there were significant differences when treating plants with seaweed extract, as treatment F_2 significantly outperformed the highest rate of enlarged stem length of 8,215 cm compared to the comparison treatment (F_0) in which the rate of enlarged stem length decreased to 6.533 cm. The triple overlap between cultivar, plant density, and leafy feeding with marine algae extract had a significant effect in this characteristic, as treatment $V_3D_1F_2$ was significantly superior with the highest rate of leg length reaching 8.575 cm, while the lowest rate of leg length amplified in treatment $V_2D_2F_0$ reached 5.968 cm.

The size of the enlarged leg

The results presented in Table 5 showed a significant effect of the variety on the size of the enlarged leg, as the V_2 variety significantly outperformed the rest of the varieties in this capacity by the largest size of the enlarged leg reached 403.16 cm^3, while the smallest size of the enlarged leg was found in the V_4 category as it reached 306.7 cm^3, and it was found Results in the same table, there were significant differences between D_1 and D_2 in this capacity, as D1 significantly outperformed the highest rate of enlarged leg size of 387.7 cm^3, while D_2 gave the lowest average size of the enlarged leg reaching 326.1 cm^3. It was found that there were significant differences when treating plants with seaweed extract, as F_2 fertilization treatment outperformed the highest rate of enlarged stem size of 383.03 cm^3 compared to the comparison coefficients (F_0) and the second level of spraying (F_1) as they gave the lowest average size of the enlarged stem reached 322.3 and 364.3 cm^3 over

Arrangement. While the triple interference between the variety and the plant density and foliar feeding with seaweed extract showed a significant effect in this trait, as treatment $V_2D_1F_2$ was significant over all other interference factors with the highest rate of enlarged stem size reached 461.0 cm^3 except for the treatment of interference $V_2D_1F_1$ which did not differ morally from it as the average leg size In it 458.5 cm^3, while the lowest rate for an enlarged leg reached 224.4 cm^3 in the treatment of interference. $V_4D_2F_0$.

Weight of a single plant (stem with leaves)

The results obtained in Table 6 show that there was a significant effect of the variety on the weight of one plant (stem with leaves), as the cultivar V_3 outperformed the rest of the cultivars in this quality with the highest average plant weight rate of 851.5g. While cultivar V_4 gave the lowest average weight of one plant reached 655.3g. The results showed in the same table that there were significant differences between the levels of density D_1 and D_2 in this capacity, as density D_1 significantly outperformed the highest rate of plant weight reached 789.7 g while this weight in density D_2 decreased to the lowest rate of plant weight reached 727.7 g. It was found that there were significant differences when treating plants with seaweed extract, as the F_2 treatment plants significantly outperformed the highest plant weight ratio of 817.2 g, compared to the comparison coefficients (F_0) and the second level of spray (F_1) which gave the lowest average plant weight of 678.6 and 780.2 g, respectively. The above table data showed that the triple interference between the variety and the plant density and foliar feeding with seaweed extract had a significant effect in this trait, as treatment $V_3D_1F_2$ was significant on all interference treatments with the highest rate of plant weight reached 929.5 g, except for the interference factors $V_1D_1F_2$ and $V_3D_1F_1$, which did not differ significantly between them. The weight of a single plant was 914.7 and 916.5 g, respectively, while treatment $V_4D_2F_0$ gave the lowest average plant weight of 602.1g.

The sum total

The results of Table 7 showed that there was a significant effect of the variety, as the V_4 category significantly outperformed the rest of the cultivars with the highest average total weight of 47.21 tons H^{-1}, while the weight of the total yield decreased to 37.01 tons H^{-1} in Class V_1. The results shown in the same table confirmed the presence of significant differences between the levels of density D_1 and D_2 in the trait, as density D2 significantly outperformed the highest average weight of the total yield reached 153.8 tons H^{-1}, while density D_1 gave the lowest rate of total weight of 28.04 tons H^{-1}, It was found that there were significant differences when treating plants with seaweed extract when sprayed on leaves, as treatment F_2 significantly outperformed the highest average total weight of 43.61 tons e^{-1} compared to the comparison factors (F_0) and the second spray level (F_1), which gave the lowest average total weight It reached 37.01 and 42.13 tons. H^{-1}, respectively. The above table data showed that there was a significant effect of triple interference between the variety and the plant density and foliar feeding with seaweed extract in the characteristic of the total yield, as treatment $V_4D_2F_2$ was significantly superior to the rest of the interference factors, with the highest average weight of the total yield reached 165.2 tons e^{-1}, but it did not differ significantly with treatment Interference $V_4D_2F_1$, with an average gross weight of 65.14 tons. H^{-1}, while treatment $V_3D_1F_0$ gave the lowest average total weight of 24.06 tons e^{-1}.

Table 2 : The effect of plant density and spraying with seaweed extract and their interaction on bloated stem weight (gm) for four cultivars of kohlrabi.

Varieties (V)	Plant density (D)	Concentration of marine algae fertilizer			Overlap VxD
		F_0	F_1	F_2	
Green delicacy V_1	D_1	f-h451.5	e498.2	de.510 2	d.486 6
	D_2	i404.3	gh443.2	f473.3	e440.2
Local variety V_2	D_1	fg470.0	c-e.520 9	b-d532.6	c.507 8
	D_2	f-h499.2	de.509 2	de.517 7	d508.7
Purple delicacy V_3	D_1	f-h451.2	c-e522.1	bc.548 9	c507.4
	D_2	hi.429 0	de.514 5	b-d.527 3	d.490 2
White Vienna V_4	D_1	b550.4	a.624 5	a.629 3	a601.4
	D_2	b-d533.4	a.610 7	a.611 2	b.585 1
Marine algae fertilizer averages		C.473 6	B.530 3	A.543 8	
Bilateral interaction between taxa and marine algae					
Varieties	Concentration of marine algae fertilizer			Items averages	
	F_0	F_1	F_2		
V_1	f.427 9	e.470 7	d.491 8	C.463 4	
V_2	e.459 6	c515.0	bc.525 2	B499.9	
V_3	f.440 1	c.518 3	b.538 1	B.498 8	
V_4	b.541 9	a617.6	a.620 2	A.593 2	
Bilateral overlap between the density of cultivation and marine algae fertilizer					
Plant density	F_0	F_1	F_2	Agriculture density averages	
D_1	e.480 7	b541.4	a.555 3	A.525 8	
D_2	f.454 0	d.519 4	c.532 4	B.501 9	

* Note: The symbols in the table indicate the following: V = varieties where V_1 = Green delicacy, V_2 = local variety, V_3 = Purple delicacy, V_4 = White Vienna and D = plant density levels where D_1 = first density and D_2 = second density F = seaweed spray levels, where F_0 = no spray, F_1 = 3 mL^{-1} and F_2 = 6 mL^{-1}.

Table 3 : The effect of plant density and sprinkling with seaweed extract and their interaction on the characteristic stem diameter (cm) for four cultivars of speech.

Varieties (V)	**Plant density (D)**	**Concentration of marine algae fertilizer**			**Overlap VxD**
		F_0	**F_1**	**F_2**	
Green delicacy V_1	D_1	9.546 $^{f-h}$	10.47 $^{a-c}$	10.90 $^{a-b}$	10.30 ^{a}
	D_2	9.327 ^{gh}	10.04 $^{c-e}$	10.30 ^{bc}	9.889 ^{c}
Local variety V_2	D_1	9.322 ^{gh}	10.30 ^{bc}	10.38 ^{bc}	10.00 $^{a-c}$
	D_2	9.225 ^{h}	9.957 $^{c-f}$	10.22 ^{cd}	9.800 ^{c}
Purple delicacy V_3	D_1	9.387 $^{f-h}$	10.16 $^{c-e}$	10.34 ^{bc}	9.962 ^{bc}
	D_2	8.663 ^{i}	9.857 $^{c-g}$	10.01 $^{c-e}$	9.516 ^{d}
White Vienna V_4	D_1	9.588 $^{e-h}$	10.11 $^{c-e}$	11.02 ^{a}	10.23^{ab}
	D_2	9.30 ^{gh}	10.00 ^{ce}	10.21 ^{cd}	9.83 ^{cd}
Marine algae fertilizer averages		9.29 ^{C}	10.42 ^{A}	10.11 ^{B}	
Bilateral interaction between taxa and marine algae					
Varieties	Concentration of marine algae fertilizer			Items averages	
	F_0	F_1	F_2		
V_1	9.43 ^{c}	10.25 ^{ab}	10.59 ^{a}	10.09 ^{A}	
V_2	9.274 ^{cd}	10.12 ^{b}	10.30 ^{ab}	9.898 ^{AB}	
V_3	9.025 ^{a}	10.01 ^{b}	10.17 ^{b}	9.735 ^{B}	
V_4	9.442 ^{c}	10.05 ^{b}	10.61 ^{a}	10.03 ^{A}	
Bilateral overlap between the density of cultivation and marine algae fertilizer					
Plant density	F_0	F_1	F_2	Agriculture density averages	
D_1	9.461 ^{c}	10.26 ^{b}	10.66 ^{a}	10.12 ^{A}	
D_2	9.128 ^{d}	9.967 ^{b}	10.18 ^{b}	9.758 ^{B}	

Table 4 : The effect of plant density and sprinkling with seaweed extract and their overlap on the characteristic length of the stem (cm) for four cultivars of speech.

Varieties (V)	**Plant density (D)**	**Concentration of marine algae fertilizer**			**Overlap VxD**
		F_0	**F_1**	**F_2**	
Green delicacy V_1	D_1	$^{e-g}$.6 703	$^{a-c}$.8 047	8 ab406.	^{a}.7 718
	D_2	$^{e-g}$.6 542	$^{b-d}$.7 499	$^{a-c}$.7 871	^{a}.7 304
Local variety V_2	D_1	^{fg}.6 216	$^{b-d}$7.549	^{ab}8.285	^{a}.7 351
	D_2	^{g}.5 968	$^{a-c}$.7 749	^{ab}.8 183	^{a}7.300
Purple delicacy V_3	D_1	6.527 $^{e-g}$	8.151 $^{a-c}$	8.575 ^{a}	7.751 ^{a}
	D_2	^{fg}.6 418	$^{b-e}$7.446	$^{a-c}$.8 058	^{a}.7 307
White Vienna V_4	D_1	$^{c-f}$.7 157	$^{a-c}$.7 847	^{ab}.8 429	^{a}.7 811
	D_2	e-g.6 739	$^{a-c}$.7 580	$^{a-c}$.7 913	^{a}7.410
Marine algae fertilizer averages		^{B}.6 533	^{A}.7 733	^{A}8.215	
Bilateral interaction between taxa and marine algae					
Varieties	Concentration of marine algae fertilizer			Items averages	
	F_0	F_1	F_2		
V_1	^{bc}.6 622	.7 a773	^{a}.8 139	^{A}.7 511	
V_2	^{c} 092. 6	7.649^{a}	8.234^{a}	7.325^{A}	
V_3	6.473^{bc}	7.798^{a}	8.317^{a}	7.529^{A}	
V_4	6.948^{b}	7.714^{a}	8.171^{a}	7.611^{A}	
Bilateral overlap between the density of cultivation and marine algae fertilizer					
Plant density	F_0	F_1	F_2	Agriculture density averages	
D_1	6.651 ^{c}	7.899 ^{ab}	8.424 ^{a}	7.658 ^{A}	
D_2	6.417 ^{c}	7.568 ^{b}	8.006 ^{ab}	7.330 ^{A}	

Table 5 : Effect of plant density and sprinkling with seaweed extract and their interaction on the size of the enlarged stem (cm 3) for four cultivars of speech.

Varieties (V)	Plant density (D)	Concentration of marine algae fertilizer			Overlap VxD
		F_0	F_1	F_2	
Green delicacy V_1	D_1	386.6 ^{cd}	416.0 ^{c}	419.1 ^{bc}	407.2 ^{b}
	D_2	315.7 $^{e-g}$	374.2 ^{cd}	392.0 ^{cd}	360.6 ^{c}
Local variety V_2	D_1	409.6 ^{c}	458.5 ^{ab}	461.0 ^{a}	443.0^{a}
	D_2	314.4 $^{e-g}$	382.3 ^{cd}	393.2 ^{cd}	363.3 ^{c}
Purple delicacy V_3	D_1	330.7 $^{e-g}$	348.7 $^{d-f}$	383.4 ^{cd}	354.2 ^{c}
	D_2	292.3 ^{hg}	320.6 $^{e-g}$	325.8 $^{e-g}$	312.9 ^{d}
White Vienna V_4	D_1	304.7 ^{fg}	355.7 ^{de}	377.9 ^{cd}	346.1 ^{c}
	D_2	224.4 ^{i}	258.4 ^{hi}	319.9 $^{e-g}$	267.5 ^{e}
Marine algae fertilizer averages		322.3 ^{C}	364.3 ^{B}	383.03 ^{A}	
Bilateral interaction between taxa and marine algae					
Varieties	Concentration of marine algae fertilizer			Items averages	
	F_0	F_1	F_2		
V_1	351.2 ^{c}	395.1 ^{b}	405.5 ^{ab}	383.9 ^{B}	
V_2	363.0 ^{c}	420.4 ^{ab}	427.1 ^{a}	403.16 ^{A}	
V_3	311.5 ^{d}	334.7 ^{cd}	354.6 ^{c}	333.6 ^{C}	
V_4	264.5 ^{e}	307.0 ^{d}	348.8 ^{c}	306.7 ^{D}	
Bilateral overlap between the density of cultivation and marine algae fertilizer					
Plant density	F_0	F_1	F_2	Agriculture density averages	
D_1	357.9 ^{b}	394.8 ^{a}	410.3 ^{a}	387.7 ^{A}	
D_2	286.7 ^{d}	333.9 ^{c}	357.7 ^{b}	326.1 ^{B}	

Table 6 : The effect of plant density and spraying with seaweed extract and their interaction on the weight of a single plant (stem with leaves) (gm) for four cultivars of speech.

Varieties (V)	Plant density (D)	Concentration of marine algae fertilizer			Overlap VxD
		F_0	F_1	F_2	
Green delicacy V_1	D_1	713.7 $^{f-g}$	822.1 ^{bc}	914.7 ^{a}	816.8 ^{b}
	D_2	645.0 0 $^{i-k}$	736.0 ^{de}	836.3 ^{b}	748.1 ^{d}
Local variety V_2	D_1	635.9 ^{ij}	819.5 ^{bc}	862.4 ^{b}	778.6 ^{c}
	D_2	607.7 ^{jk}	746.9 $^{d-f}$	781.6 ^{cd}	712.0 ^{e}
Purple delicacy V_3	D_1	827.6 ^{b}	916.5 ^{a}	929.5 ^{a}	891.2 ^{a}
	D_2	735.0 $^{e-g}$	844.8 ^{b}	855.8 ^{b}	811.8 ^{b}
White Vienna V_4	D_1	644.4 $^{i-k}$	681.9 ^{hi}	690.9 $^{g-i}$	672.4 ^{f}
	D_2	602.1 ^{k}	647.4 $^{i-k}$	667.0 ^{i}	638.8 ^{g}
Marine algae fertilizer averages		678.6 ^{C}	780.2 ^{B}	817.2 ^{A}	
Bilateral interaction between taxa and marine algae					
Varieties	Concentration of marine algae fertilizer			Items averages	
	F_0	F_1	F_2		
V_1	679.3 ^{d}	792.6 ^{bc}	875.5 ^{a}	782.4 ^{A}	
V_2	630.8 ^{e}	783.2 ^{c}	822.0 ^{b}	745.3 ^{B}	
V_3	781.3 ^{c}	880.7 ^{a}	892.6 ^{a}	851.5 ^{c}	
V_4	623.3 ^{e}	664.7 ^{d}	678.1 ^{d}	655.3 ^{d}	
Bilateral overlap between the density of cultivation and marine algae fertilizer					
Plant density	F_0	F_1	F_2	Agriculture density averages	
D_1	709.0 ^{d}	810.0 ^{d}	894.4 ^{a}	789.7 ^{A}	
D_2	647.5 ^{e}	750.5 ^{c}	785.3 ^{b}	727.7 ^{B}	

Table 7: Effect of plant density and sprinkling with seaweed extract and their interference on the total yield weight (tons.e^{-1}) for four cultivars of speech.

Varieties (V)	Plant density (D)	Concentration of marine algae fertilizer			Overlap VxD
		F_0	F_1	F_2	
Green delicacy V_1	D_1	24.07 ^{l}	26.57 ^{jk}	27.21 ^{j}	25.95 ^{f}
	D_2	43.13 ^{g}	47.28 ^{ef}	53.82 ^{d}	48.07 ^{c}
Local variety V_2	D_1	25.06 ^{kl}	27.78 ^{ij}	28.40 ^{ij}	27.08 ^{e}
	D_2	47.89 ^{e}	54.31 ^{d}	55.22 $^{b-d}$	52.47 ^{b}
Purple delicacy V_3	D_1	24.06 ^{l}	27.84 ^{ij}	29.27 ^{i}	27.06 ^{e}
	D_2	45.76 ^{f}	54.88 ^{cd}	56.34 ^{bc}	52.29 ^{b}
White Vienna V_4	D_1	29.35 ^{i}	33.30 ^{h}	33.56 ^{h}	32.07 ^{d}
	D_2	56.76 ^{b}	65.14 ^{a}	65.21 ^{a}	62.37 ^{a}
Marine algae fertilizer averages		37.01 ^{C}	42.14 ^{B}	43.62 A	

Bilateral interaction between taxa and marine algae				
Varieties	Concentration of marine algae fertilizer			Items averages
	F_0	F_1	F_2	
V_1	33.60 ^{f}	36.92 ^{d}	40.51 ^{c}	37.01 ^{A}
V_2	36.47 ^{d}	41.04 ^{c}	41,81 ^{bc}	39.87 ^{B}
V_3	34.91 ^{e}	41.36 ^{c}	42.76 ^{b}	39.68 ^{B}
V_4	34.05 ^{b}	49.22 ^{a}	49.38 a	47.22 ^{A}

Bilateral overlap between the density of cultivation and marine algae fertilizer				
Plant density	F_0	F_1	F_2	Agriculture density averages
D_1	25.46 ^{f}	28.87 ^{e}	29.61 ^{d}	28.04 ^{B}
D_2	48.38 ^{c}	55.40 ^{b}	57.62 ^{a}	53.80 ^{A}

The results in tables 3, 4, 5, 6, and 7 indicate that there is a significant difference between the varieties included in the experiment in most of the characteristics of the outcome, and the difference between the varieties may be due to the genetic variation between them and their ability to respond to environmental conditions and this is consistent with what Abdul and Omer (2014).

While the results in the same tables indicated an increase in the weight, diameter, size of the enlarged stem and the weight of a single plant (stem with leaves) in the first plant density (D_1), the reason for this may be the lack of competition between plants in light, water and nutrients due to the increase in the nutritional area of a single plant This led to an increase in photosynthesis and its results, and this leads to improving the characteristics of vegetative growth in the plant and then increasing the diameter of the inflated stem due to the lack of plant density and providing better environmental conditions, which increases the photosynthesis process as a result of increasing the leaf area and then forming a strong root system that increased from The water absorption and nutrients present in the soil are well absorbed, which increases the vital activities in the plant due to the strength of the vegetative system, as there is a correlation with a highly significant effect between the leafy area and the total plant weight since the higher the leafy area the greater the chlorophyll ratio in the plant and thus the efficiency of the building process Photosynthesis, and as a result of biological and physiological processes in the plant due to the increase in the nutritional area of a single plant, this contributed to the formation of large, enlarged stems. The size and increase in the weight of a single plant, this is consistent with the findings of Moniruzzaman (2011), Bhangre *et al.* (2011), Haque *et al.* (2015) and (Rana *et al.*, 2015), due to the increase in total plant production in the second density (D_2) despite the decrease in the weight of the inflated stems due to the increase in the number of plants per unit area This is consistent with what Hossain *et al.* (2012), Al-Hamdani and Hadi (2017) have found on broccoli.

As for spraying with seaweed extract in the traits of the yield, it was found that the increase in spraying with seaweed extract to 6 ml^{-1} liter led to a significant superiority in all traits of the yield under study. It is one of the major nutrients, especially NPK and smaller ones such as Fe, B, Mg, Zn (Abdel Hafez, 2008). The importance of these elements in the biosynthesis of plants, and therefore the increase of these elements increases the efficiency of photosynthesis due to the increase in chlorophyll due to the increase in the leafy area and the manufacture of carbohydrates in the leaves (Zodape *et al.*, 2008), and the transfer of materials manufactured in the leaves and stored in the enlarged stems, which contributes to In increasing the average weight of the inflated stem, and consequently, there is an increase in the weight of the single plant and the total yield, and these reasons may be the ones that led to an increase in the characteristics of the yield (Al-Saabri, 2005) and these are consistent with the findings of Eris and others (2004) and Jabouri (2009). Al-Shammari (2011).

References

Abdul, H. and Al-Yazid, A. A. (2008). Using seaweed extracts to improve the growth and efficiency of horticultural plants is a good step for a sustainable agricultural system, Arab Publishing, Alexandria University, Arab Republic of Egypt.

Abdul, K.S. and Samal, J.O. (2014). Comparison of Four Cultivars of Broccoli (*Brassica oleracea* var. Italica Plenck) in Sulaimani Governorate. Journal of Kirkuk University For Agricultural Sciences, 5(2): 23-32.

Al-Hamdani, Sabeeh Abdel-Wahab and Hanin, T.H. (2017). The effect of organic and chemical fertilizers and plant

density on some broccoli growth properties *Brassica oleracea* var. botrytis, Diyala Journal of Agricultural Sciences, 9(2): 104-114.

Al-Khafaji, M.A. and Faisal Abdul-Hadi al-Mukhtar (1989). Fruit and vegetable production. Ministry of Higher Education and Scientific Research. House of Wisdom. Baghdad University College of Agriculture. Iraq.

Al-Maliki, A.H.Q. (2013). The effect of Biozyme TF marine algae extract on growth and yield of two cultivar cultivars *Brassica oleracea* var.capitata L. cultivated in desert areas. Basra Research Journal (operations). 39(4): 88-97.

Al-Saabri, M.R.S. (2005). The effect of some agricultural treatments on growth and yield of *Lactuca sativa* L., Master Thesis, Department of Horticulture, College of Agriculture and Forestry, University of Mosul, Ministry of Higher Education and Scientific Research, Republic of Iraq.

Al-Shammari, A.M.A. and Omar, G.S. (2014). The effect of spraying with some organic nutrients and the culture method in obtaining three hybrids of cucumbers under protected cultivation conditions. Diyala Journal of Agricultural Sciences, 6(2): 60-73.

Al-Shammari, A.M.A.; Nashwan, A.H.A.; Saeed, H.M. and Ghassan, J.H. (2019). The effect of foliar nutrition in Grow More product on the growth and yield of three cultivars. Kirkuk University Journal of Agricultural Science, 2018 (special issue), 392-398.

Al-Shammari, W.S.A.H. (2011). The effect of EM1 bio-fertilizer and seaweed extract on the growth and occurrence of cowpea. *Vigna sinensis* L, MA, Horticulture Department, College of Agriculture, Tikrit University, Ministry of Higher Education and Scientific Research, Republic of Iraq.

Bhangre, K.K.; Sonawane, P.C. and Warade, S.D. (2011). Effect of different varieties and spacing on growth and yield parameters of broccoli (*Brassica oleracea* L. var. Italica Plenck) under Pune conditions. Asian Journal of Horticulture, 6(1): 74-76.

Eris, A.; Sivritepe, H.O. and Sivritepe, N. (2004). The effect of seaweed (*Ascophyllum nodosum*) extract on yield and quality criteria in Peppers. Acta Hort. (ISHS) 412: 733-737.

Haque, F.A.; Islam, N.; Islam, M.N.; Ullah, A. and Sarkar, M.D. (2015). Growth, yield and profitability of cabbage (*Brassica oleracea* L.) as influenced by applied nitrogen and plant spacing. The Agriculturists, 13(1): 35-45.

Hossain, M.F.; Ara, N.; Uddin, M.R.; Dey, S. and Islam, M.R. (2012). Effect of time of sowing and plant spacing on broccoli production. Tropical Agricultural Research and Extension, 14(4).

Jubouri, M.A.M. (2009). The effect of humic acid and seaweed on the growth, flowering, and yield of cucumbers. *Cucumis sativus* L. Master Thesis, College of Agriculture, Tikrit University, Ministry of Higher Education and Scientific Research, Republic of Iraq.

Kumar, M. and Rawat, T.S. (2002). Effect of nitrogen and spacing on the quauty and yield of cabbage (*Brassica oleracea* L. Var. capitata). Agricultural Science Digest, 22(2): 90-92.

Manea, A.I.; Ayad, H.K. and Hassanien, M.A.M. (2018). Influenced of Seaweed Extracts and Its Magnetization in Growth and Yield of Broccoli. Euphrates Journal of Agriculture Sciences, 10(2):7-12.

Matlob, A.N.; Muhammad Izz al-Din Sultan and Karim, S.A. (1989). Vegetable production. The second part. Revised second edition. Ministry of Higher Education and Scientific Research. University of Al Mosul. The Republic of Iraq.

Moniruzzaman, M. (2011). Effect of plant spacings on the performance of hybrid cabbage (*Brassica oleracea* var. capitata) varieties. Bangladesh Journal of Agricultural Research, 36(3): 495-506.

Rana, S.; Barholia, A.K.; Lekhi, R.; Singh, V.B.; Pippal, R. and Rana, P. (2015). Response of Cabbage Yield under Variable Spacing and Boron Levels.

Sharma, D.K.; Chaudhary, D.R. and Pandey, D.P. (2001). Growth and yield of lettuce cv. "Alamo-1" as influenced by dates of planting and plant density. Vegetable Science. 28(1): 38-39.

Silatar, P.; Patel, G.S.; Acharya, S.K. and Vadodaria, J.R. (2018). Performance of different varieties and plant spacing on growth and yield of knolkhol (*Brassica oleracea* var.*gongylodes*), International Journal of Agricultural Sciences, 8(7): 1476-1479.

Zodape, S.T. (2001). Seaweeds as abiofertilizer. J.Sci.Ind.Res., 60: 378-382.

Zodape, S.T.; Kawarkhe, V.J.; Patolia, J.S. and Warade, A.D. (2008). Effect of liquid seaweed fertilizer on yield and quality of okra (*Abelmoschus esculentus* L.).Journal of Scientific & Industrial Research, 67: 1115-1117.