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EFFECT OF SPRAYING WITH SEAWEED EXTRACT AND LICORICE EXTRACT IN THE GROWTH AND YIELD TRAITS OF BROAD BEAN (*VICIA FABA* L.)

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Abstract

A field experiment was conducted in the research fields belonging to Department of Plant Production, Al-Musaib Technical College during the agricultural season 2017/2018 to study the effect of spraying two types of foliar nutrients in the growth and yield of two cultivars of the broad bean plant. A factorial experiment was applied according to the ordered of split-split plots within the Randomized Completely Block Design (RCBD) which included three factors, The first is using of two cultivars of broad bean: Spanish cultivar (Luz de Otono) and American cultivar (Basic), and The third factor included the spraying of seaweed extract with three concentrations of (0.00, 4.00, 8.00 ml.L^{-1}), with four spraying, The difference between one spraying and another is 14 days after one month of cultivating seeds of the two cultivars. The results of the study were summarized as follows:

1- Spanish cultivar was excelled on American cultivar in the traits of vegetative growth and yield, which included: leaf area, weight of dry plant, weight of 100 seed and yield of one plant which gave (113.78 cm^2, 24.23 g, 320.95 g, 268.26 g), respectively.

2- The results of the experiment showed that the plants that were sprayed with licorice extract at concentration of (5.00 mg.L^{-1}) was significantly excelled on the other treatments in most studied traits by giving it the highest average in leaf area, dry weight, weight of 100 seeds and yield of one plant (106.71 cm^2, 23.52 g, 322.40 g, 246.31 g), respectively.

3- The concentration of (8.00 mg.L^{-1}) from seaweed extract was significantly excelled in all vegetative and yield traits. The highest average was given in leaf area, dry weight, weight of 100 seeds and yield of one plant (111.88 cm^2, 24.37 g, 332.25 g, 288.42 g), respectively.

4- The bi-interaction between the higher concentration of both licorice and seaweed extracts has recorded a significant response in all the traits studied in the research experiment.

The of triple interaction between the three experimental factors (Spanish cultivar, Luz de Otono and the higher concentrations of licorice extract 5.00 mg.L^{-1} and seaweed extract 8.00 mg.L^{-1}) was significantly affected in all studied traits.

Key words: seaweed, licorice, concentration, foliar spraying, broad bean

Introduction

Broad bean (*Viciafaba* L.) is a winter crop belonging to the fabaceae family, whose seeds contain a high protein content ranging from 23-37%, It is a cheap source of protein compared with high-priced animal protein in addition to its carbohydrate content, which may reach In most cultivars to 56% in addition to mineral elements, vitamins, fiber and other substances (Alghamdi, 2009). The licorice extract contains many chemical compounds, the most important of which is Glycyrrhizin (Al-Ajili, 2005). It is similar in function to the Effectiveness of Steroid hormones, which are important hormones in increasing the formation of proteins that increase plant growth rates (Al-Mohammadi, 2010). The seaweed extract is considered one of the most important sources of organic matter and nutrient elements, and it contains many growth regulators, amino acids, and amino acids, which are used to reduce or limit the use of chemical fertilizers, which have a direct effect on improving production in quantity and quality (Khan *et al.*, 2009). It is considered one of the most important sources of organic matter and nutrient

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elements, and contains many growth regulators, amino acids and mineral elements that affect the various plant activities (Sharma *et al.*, 2013) and have an important role in increasing vegetative growth and early flowering of the plant and thus increase the yield (Battacharrya *et al.*, 2015; Elansary *et al.*, (2016). This study was conducted for the following objective:

1. Determine the best cultivar in response to the factors of study.
2. Determination of the best spraying level of seaweed and licorice extract in the traits of growth and yield.
3. Study the interaction between the factors of the study to know the best combination in the traits of growth and yield for the two cultivars.

Materials and Methods

Location of the study:

The study was conducted in the research fields belonging to Department of Plant Production, Al-Mussaib Technical College during the agricultural season 2017/ 2018 using two cultivars of seeds, the first: American (Basic) produced at 2016 by the Bluefield Iraq company and the second cultivar: Spanish (Luz de Otono) produced by Semillas Fito company.

Preparing the soil for cultivation and conducting experiment treatments:

The soil was plowed by the plow in a perpendicular manner. The soil was then smoothed and settled. The soil of the experiment was divided to furrows, a distance between each other are 0.75 cm, between plant and another 25 cm. Random samples were taken from six different locations of the experiment soil with a depth of 0-30 cm. The samples were then mixed together and the physical and chemical traits of the soil were analyzed as shown in Table 1 at Kufa University, College of Agriculture, Soil Chemistry Laboratory. It was then divided into experimental units of 54 units. Each experimental unit included 4 furrows, the length of one furrow is 3 m, one meter was left between the main plots and one meter between experimental units. Dab fertilizer was added before cultivating in a single batch at (25kg/ dunum), then the soil was irrigated for the purpose of calibration prior to cultivating in a period allowing the soil to retain the appropriate amount of moisture. The seeds were cultivated on 17/10/2017 after being soaked in water for 12 hours, with rate of (2 seeds/pit). The seeds were covered with a thin layer of soil to ensure obtain a good germination rate for seed. The cultivars were randomly distributed within each replicate and sprayed with licorice and seaweed extract after one month of cultivating between one spraying and other is 14 days on (17/11, 2/ 12, 16/12, 31/12). The licorice extract and seaweed extract for both cultivars were sprayed with a 20L Backpack Sprayer until the total wetness of the total vegetative, taking into consideration that spraying should be at early morning to avoid high temperatures and drying of the solution on the plant. The diffuser material Al-Zahi was used with ratio of (3 $cm^3.L^{-1}$) to reduce the surface tension of the water and increase the plant's ability to absorb the solution and take into account the full distribution on all plant leaves (Kamal *et al.*, 2016). The treatments were separated by a piece of agricultural nylon as a barrier to avoid the effect of spraying extracts on the Contiguous treatments during the spraying process, and then cut to one plant in the pit after three weeks of germination.

Table 1: Physical and chemical traits of the field soil at depth of (0 - 30) cm.

Soil traits		Season of 2017-2018
		Soil
Electrical conductivity EC ($ds.m^{-1}$)		1.71
pH		8.1
Soil separates ($g.kg^{-1}$)	Clay	308
	Silt	360
	Sand	332

* Soil Chemistry Laboratory, University of Kufa, College of Agriculture.

The experiment was completed in the second week of April 2018 after the emergence of the final harvest stages on the broad bean plant, namely blackening the stems, leaves and pods on the plant.

Preparation of treatments:

Preparation of seaweed extract:

Seaweed extract (Alga) was used produced by Al-Zohour Agricultural Investment and Development Company, with three concentrates (0.00, 4.00, 8.00 $ml.L^{-1}$) containing some natural growth stimulants such as Auxins, cytokinin, Gibberellins, amino acids and Carbohydrates on 1/ 3 / 2017.

Preparation of licorice extract:

The licorice root powder was obtained from the local markets. In the water extraction method, it was obtained the compounds from the licorice roots, by weighing 5 g of licorice root after drying, grinding well and placed in 50 ml of hot water 90- 100°C for 3 hours, Filter the extract using filter paper and save the extract in a tightly sealed glass flasks until it is used (Weerachai and Duang, 1998). In this way, a concentrated solution is obtained, the resulting solutions are sprayed according to treatments (Al-Marsoumi, 1999). The licorice extract contains the

Table 2: shows the concentration of macro and micronutrient elements in seaweed extract.

Elements	Cu ppm	Zn ppm	Mn ppm	Fe ppm	Mg ppm	K_2O%	P_2O_5%	N%
Concentration	12.6	17.5	31	30	32	4	4	4

* The concentrations are fixed on the box used in the search.

Table 3: Concentration of the macro and micronutrient elements in the licorice extract based on dry weight.

Ingredients (%)		Elements (µ $g.g^{-1}$)									
Total ash	Protein	K	Na	Ca	Mg	P	Mn	Fe	Zn	Cu	Co
7.85	5.20	1230	700	520	230	350	5	35	2.5	5	0.07

* (23)

macro and micronutrient elements as shown in the following table:

Studied traits:

Ten plants were randomly selected in each treatment with the exclusion of the Terminal Plants to study the following traits:

Leaf area (cm^2): The leaf area was measured according to method (Zaynal, 2014).

Dry weightof the total vegetative ($g.plant^{-1}$): (Abu Dahi, 1989).

Weight of 100 seeds (g)

The yield of one plant (g)

Statistical Analysis: The results were analyzed by the statistical program (GenState) according to the variance analysis. The statistical averages were compared to the basis of the least significant difference (L.S.D) at the probability level of 0.05 to find the differences between the statistical averages of the treatments.

Table 4: Effect of seaweed extract and licorice and their interaction in the leaf area.$Plants^{-1}$ (cm^2) for two cultivars.

Cultivar	Licorice extract	Seaweed extract			Cultivar × Licorice extract
		0.00	4.00	8.00	
Basic	0.00	72.67	88.60	98.27	86.51
	2.50	83.03	91.37	98.90	91.10
	5.00	85.37	95.50	101.63	94.17
Luz de Otono	0.00	102.23	107.97	115.00	108.40
	2.50	104.23	115.17	121.67	113.69
	5.00	104.93	117.00	135.80	119.24
L.S.D 0.05		2.26			1.33
Cultivar					Average
Licorice extract		0.00	4.00	8.00	of Cultivar
Basic		80.36	91.82	99.60	90.59
Luz de Otono		103.80	113.38	124.16	113.78
L.S.D 0.05		1.48			1.71
Seaweed extract					Licorice
Licorice extract		0.00	4.00	8.00	extract
0.00		87.45	98.28	106.63	97.46
2.50		93.63	103.27	110.28	102.39
5.00		95.15	106.25	118.72	106.71
L.S.D 0.05		1.53			0.71
Seaweed extract		92.08	102.60	111.88	
L.S.D 0.05		0.10			

Results and Discussion

Leaf area (cm^2)

Table 4 indicates that the two cultivars used in the experiment were significantly different in the leaf area. Luz de Otono cultivar achieved a significant superiority in the above trait by giving it the highest average of (113.78 cm^2), while the Basic cultivar gave an average of (90.59 cm^2). This can be explained by the different genetic factors of both cultivars. The leaf area was significantly affected in this study by increasing the concentration of the used licorice extract. The concentration of (5 $mg.L^{-1}$) was significantly excelled on the other two concentrations by achieving it the highest average of (106.71 cm^2) compared to the spraying with distilled water which gave the lowest average of (97.46 cm^2). The effect of excelling may be due to the fact that the extract contains the Mevalonic acid, the initiator of Gibberellic acid, which increases the elongation of cells that increase the content of the plant tissue and thus increase the leaf area (Musa *et al.*, 2002; Taha, 2007). The behavior of some substances in the licorice extract is similar to the work of Gibberellin through the stimulation of static vegetative growth on the one hand and its effect on the enzymes for the conversion of complex compounds to a simple on the other hand to be invested by the plant in the construction of proteins and thus lead to large vegetative growths caused increased leaf area of plants that treated with licorice extract (Ghaloom *et al.*, 2012). Spraying with seaweed extract has achieved a significant increase with increase the used concentration "by spraying" on the total vegetative, The highest concentration of (8 $mg.L^{-1}$) has achieved a significant excelling on the rest of the treatments in the above traits, where

recorded the highest average of (111.88 cm^2) while the control treatment gave the lowest average of (92.08 cm^2). The significant superiority of the seaweed extract can be explained by its containment of essential elements such as nitrogen, phosphorus and potassium as shown in Table 2 and its containment of amino acids, all of which lead to an increase in plant growth by increasing the activation of cell division process and its expansion. This is reflected in the increase in leaf area in addition to the necessary nutrient elements, especially zinc, which is an encouraging element in the elongation of vegetative branches and increase the size of leaves for its effective role in the construction of amino acid (Tryptophan), which is the starting compound for the construction of internal oxygen, which increases the cells division and their extension (Sheekh and Saied, 2000; Gollan and Wright, 2006). It is possible that the extract has provided enough nutrient elements in the plant to help it to carry out its various activities and thus obtain a good vegetative growth, including the leaf area or the extract may be a catalyst for these activities.

This results agree with Hussein (2011), Jasim and QaisLamy (2014), Al-Bawi (2016). Table 4 shows that the bi-interaction between the cultivar and the licorice extract was significantly excelled in the leaf area. The interaction (Luz de Otono cultivar and the concentration of 5 $mg.L^{-1}$) achieved a significant increase on all interaction by giving it the highest average of (119.24 cm^2), while the interaction treatment (Basic and distilled water) recorded the lowest average for trait which amounted of (86.51 cm^2). The interaction between the cultivar and the seaweed extract was significantly excelled in the leaf area. The interaction (Luz de Otono cultivar and concentration of (8 $mg.L^{-1}$) had achieved a significant effect on the other interactions by giving it the highest average of (124.16 cm^2) compared to the interaction treatment (Basic cultivar and distilled water) which gave the lowest average of (80.36 cm^2).The leaf area was significantly affected by the bi-interaction between spraying with licorice and seaweed as shown in Table 4. The interaction (Concentration of (5 $mg.L^{-1}$) for licorice extract and concentration of (8 $mg.L^{-1}$) for seaweed extract) was significantly excelled in this trait by recording it the highest average of (118.72 cm^2), while the control treatment gave the lowest average of the above trait of (87.45 cm^2). The triple interaction between the three factors significantly increased the averages of leaf area. The triple interaction treatment (Luz de Otono cultivar and spraying with the highest concentration of licorice and seaweed extract) gave a significant superiority over all the treatment used in the experiments, which recorded the highest average of (135.8 cm^2), while the triple interaction treatment (Basic cultivar and spraying with distilled water only) recorded the lowest average of (72.67 cm^2).

Table 5: Effect of seaweed extract and licorice and their interaction in the dry weight of the plant (g) for two cultivars.

Cultivar	Licorice extract	Seaweed extract			Cultivar × Licorice extract
		0.00	4.00	8.00	
Basic	0.00	18.88	19.45	20.47	19.60
	2.50	19.10	20.27	23.03	20.80
	5.00	19.32	21.45	24.14	21.64
Luz de Otono	0.00	20.25	23.40	25.28	22.97
	2.50	22.19	24.60	26.18	24.32
	5.00	23.49	25.49	27.22	25.40
L.S.D 0.05		0.53			0.29
Cultivar					Average of Cultivar
Licorice extract		0.00	4.00	8.00	
Basic		19.10	20.39	22.55	20.68
Luz de Otono		21.98	24.49	26.22	24.23
L.S.D 0.05		0.29			0.23
Seaweed extract					Licorice extract
Licorice extract		0.00	4.00	8.00	
0.00		19.57	21.42	22.87	21.29
2.50		20.65	22.43	24.61	22.56
5.00		21.41	23.47	25.68	23.52
L.S.D 0.05		0.39			0.24
Seaweed extract		20.54	22.44	24.37	
L.S.D 0.05		0.23			

Dry weight of plant (g)

Table 5 shows that the cultivar had a significant effect on the dry weight of the plant. Luz de Otono cultivar achieved a significant increase of (24.23 g) While the Basic cultivar gave the lowest average of (20.68 g), this may be due to genetic differences that distinguish cultivar. The dry weight of the plant was increased by the effect of spraying with different concentrations of licorice, the concentration of (5 $mg.L^{-1}$) was significantly excelled on the rest of the concentrations by giving it the highest average of (23.52 g) compared to the lowest treatment of 21.29 g. The reason for the superiority may be due to the containment of licorice on growth-promoting substances and sugary compounds absorbed by the leaves and accumulate in the cell membranes, which contribute to increased vegetative growth and increase the dry matter of the plant Mousa *et al.*, (2003) or the fact that the extract has a similar behavior to the Gibberellin because it contains the Mevalonic and the Glycyrrhizic acid. This increases the photosynthesis products, as well as contains the

elements that have a catalytic role in improving the growth indicators. Its containment of the zinc element as shown in Table 3, which is incorporated into the production of Tryptophanacid, is the base material in the building of the internal growth enzyme (IAA), all of which is reflected in the weight of the dry matter in the plant (Mahmood and Mohammed, 2013). The spraying of seaweed extract with different concentrations led to a significant effect on dry weight. The increase was positive by increasing the used concentration. The concentration of (8 mg.L^{-1}) achieved the highest average of (24.37 g) which significantly excelling on the other two concentrations, while the control treatment achieved the lowest average of (20.54 g). The causes of excelling can be attributed to what the extracts containing from Auxins and cytokinines that Working to promote physiological events. The nutrient elements produced by the extract also increase growth, such as plant height, number of vegetative branches, and leaf area. This results in the accumulation of carbohydrate, which eventually leads to increase dry weight. This results agree with (Hussein, 2011; Aziz, (2016). The interaction between the cultivar and the licorice extract gave a significant increase, the interaction (Luz de Otono cultivar and spraying with concentration of (5 mg.L^{-1}) recorded a significantly excelling on the other interaction by giving it the highest average of (25.40 g) compared to the interaction (Basic cultivar and spraying with distilled water only) which recorded the lowest average was (19.60 g).

As for the interaction between the cultivar and the seaweed extract, the data in Table 5 showed there is a significant differences. The interaction (Luz de Otono) cultivar and a concentration of (8 mg.L^{-1}) excelled on all interaction by recording it the highest average of (26.22 g) compared to the interaction (Basic cultivar and distilled water), which recorded the lowest average of (19.10 g). The bi-interaction between spraying with different concentrations of licorice and seaweed extract achieved a significant differences in the above trait, where the interaction (concentration of (5 mg.L^{-1}) for licorice and concentration of (8 mg.L^{-1}) of seaweed extract) recorded a significant increase on all interactions by giving it the highest average 25.68 g, while the control treatment gave the lowest average of (19.57 g). The triple interaction between the used factors had a significant effect on the dry weight of the plant. Where the interaction (Luz de Otono cultivar and spraying with concentration of (5 mg.L^{-1}) of licorice and concentration of (8 mg.L^{-1}) of seaweed extract) achieved a significant excelling on all interactions by giving it the highest average for this trait of (27.22 g), while the interaction treatment (Basic cultivar and spraying with distilled water only) recorded the lowest average of this trait of (18.88 g).

Weight of 100 seed (g)

Table 6 shows that there was a significant effect for the cultivar, Luz de Otono cultivar achieved a significant excelling by giving it the highest average of (320.95 g) while Basic cultivar gave the lowest average of (313.25 g). While the Basic cultivar gave the lowest average of (313.25 g). This superiority may be due to genetic differences that distinguish cultivars between them. The results agree with Al-Musawi, (2017). The spraying with licorice extract achieved a significant increase, The concentration of (5 mg.L^{-1}) gave a significant effect on the rest of the concentrations by recording it the highest average of (322.40 g) compared to the control treatment which gave the lowest average of (312.48 g). This may be due to the fact that the increase in the indicators of annual growth achieved significantly contributed in the increase the weight of 100 seeds in the plant, it is a natural reflection of the amount of produced nutrient materials in the plant as a result of stimulation of vegetative growth indicators.

The spraying with seaweed extract led to a significant effect, the concentration of (8 mg.L^{-1}) achieved the highest average of (332.25 g) with significantly excelling on the other two

Table 6: Effect of seaweed extract and licorice and their interaction in the weight of 100 grains (g) of two cultivars of plant.

Cultivar	Licorice extract	Seaweed extract			Cultivar × Licorice extract
		0.00	4.00	8.00	
Basic	0.00	303.60	308.83	319.10	310.51
	2.50	306.01	312.67	321.28	313.32
	5.00	306.57	313.37	327.80	315.91
Luz de Otono	0.00	305.71	310.14	327.51	314.45
	2.50	306.82	313.27	338.43	319.51
	5.00	308.57	318.73	359.37	328.89
L.S.D 0.05		2.61	1.08		
Cultivar					Average of Cultivar
Licorice extract		0.00	4.00	8.00	
Basic		305.39	311.62	322.73	313.25
Luz de Otono		307.03	314.05	341.77	320.95
L.S.D 0.05			1.46	0.80	
Seaweed extract					Licorice extract
Licorice extract		0.00	4.00	8.00	
0.00		304.65	309.49	323.30	312.48
2.50		306.41	312.97	329.85	316.41
5.00		307.57	316.05	343.58	322.40
L.S.D 0.05			1.88		0.89
Seaweed extract		306.21	312.83	332.25	
L.S.D 0.05			1.22		

concentrations, while the control treatment achieved the lowest average of (306.21 g). This can be due to the role of the extract in increasing the permeability of cellular membranes, which accelerates nutrient absorption by the plant which led to increases photosynthetic materials and their transition to sink (Shafeek *et al.*,2013). This results agree with Al-bawe (Al-Bawi, 2016), which obtained a significant increase in the weight of 100 seeds when spraying the broad bean plants (the Luz de Otono cultivar) by different concentrations of foliar nutrients (Battacharrya *et al.*, 2015). The interaction treatment (Luz de Otono cultivar and spraying with (5 $mg.L^{-1}$)) was significantly excelled on the rest of the interactions by recording the highest average of 328.89 g compared to the interaction treatment (Basic cultivar and distilled water), which recorded the lowest average of 310.51 g. As for the interaction between the cultivar and the seaweed extract, Table 6 showed significant differences between the treatments, the interaction (Luz de Otono cultivar and concentration of (8 $mg.L^{-1}$)) excelled on all interactions by recording it the highest average of 341.77 g compared to the interaction (Basic cultivar and distilled water)), which recorded the lowest average of 305.39 g. The results showed that the bi-interaction between spraying with different concentrations of licorice and seaweed extracts had a significant effect on the weight of 100 seeds. The interaction between concentration of (5 mgL^{-1}) from licorice extract and a concentration of (8 $mg.L^{-1}$) from seaweed extract had a significant effect on all interactions by giving it the highest average of 343.58 g, while the control treatment gave the lowest average of 304.65 g. The effect of the triple interaction between the factors was significantly affected in the weight of 100 seeds. The interaction treatment (Luz de Otono cultivar and the concentration of (5 $mg.L^{-1}$)) from the licorice extract and the concentration of (8 $mg.L^{-1}$) from seaweed extract) was significantly excelled on all the interactions by giving it the highest average of this trait of 359.37 g, while the interaction treatment (Basic cultivar and spraying with distilled water only) which gave the lowest average of this trait of 303.60 g.

Yield of one plant (g)

Table 7 shows that the cultivar used in the experiment had a significant effect on the yield of one plant. Luz de Otono cultivar was significantly excelled by giving it the highest average of the yield of one plant was (268.26 g) while Basic cultivar gave the lowest average of 178.55 g. The significant difference between the two cultivars can be returned to genetic differences that distinguish one from the other. The results agree with (Aziz, 2016; Al-Musawi, 2017), which obtained significant differences between the cultivars in the trait of the yield of one plant. The concentration of licorice extract used for spraying on the total vegetative showed significant differences in the total yield of one plant as shown in Table 7 where a concentration of (5 $mg.L^{-1}$) gave the highest average of this trait of (246.31 g) superior to the rest of the concentration, while the control treatment recorded the lowest average of this trait was (204.34 g). This increase may be due to the effect of the nitrogen component provided by the extract from the activation of enzymes and its direct involvement in the synthesis of amino acids needed to build proteins that help in tissue growth as well as its effect in increasing the process of photosynthesis by increasing the leaf area which reaches to equilibrium state between nitrogen and carbohydrates, which promotes growth of flowers and fruit for plant. A significant increase in the yield components of the number of pods per plant and the number of seeds in the pod naturally reflected in the Increase total plant yield. The spraying of total vegetative of plants with different concentrations of seaweed extract has a significant effect on the yield of one plant. The concentration treatment of 98 $mg.L^{-1}$) gave a significant effect on the other two treatments by giving it the highest average of 288.42 g compared to 147.42 g for the

Table 7: Effect of seaweed extract and licorice and their interaction in the yield of one plant (g) of two cultivars of plant.

Cultivar	Licorice extract	Seaweed extract			Cultivar × Licorice extract
		0.00	4.00	8.00	
Basic	0.00	105.95	168.58	200.53	158.36
	2.50	117.69	184.83	217.08	173.20
	5.00	141.65	197.04	273.59	204.09
Luz de Otono	0.00	159.70	256.72	334.55	250.32
	2.50	167.08	288.67	342.05	265.94
	5.00	192.44	310.47	362.70	288.53
L.S.D 0.05		8.25			3.63
Cultivar					Average of Cultivar
Licorice extract		0.00	4.00	8.00	
Basic		121.76	183.48	230.40	178.55
Luz de Otono		173.07	285.29	346.43	268.26
L.S.D 0.05		5.02			4.63
Seaweed extract					Licorice extract
Licorice extract		0.00	4.00	8.00	
0.00		132.83	212.65	267.54	204.34
2.50		142.39	236.75	279.57	219.57
5.00		167.04	253.75	318.14	246.31
L.S.D 0.05		5.72			2.02
Seaweed extract		147.42	234.38	288.42	
L.S.D 0.05		3.87			

control treatment. The increase in the total yield of plants can be returned to the increase of vegetative growth resulting from the increase of the direct concentration of the extract used as spraying on the total vegetative, including the increase of the plant height, number of branches and leaf area, all of this was reflected in the led to increase in the yield components including the trait of the number of pods per plant and the number of seeds per pod and the weight of 100 seeds so all this increase the yield of one plant, in addition to the fact that the seaweed extract is considered a foliar fertilizers that rich in potassium as shown in Table 2 Which stimulates the growth and control of the important physiological functions performed by the plant during its growth as well as regulating the water balance within the leaves, which increased the yield of one plant (Battacharrya *et al.*, 2015; Naeem and Khan, 2009). This results agree with (Hussein, 2011; Jasim and QaisLamy, (2014). Table 7 shows that the bi-interaction between the cultivar and the licorice extract.

Showed a significant increase in the yield of plant. The bi-interaction treatment (Luz de Otono cultivar and spraying with concentration of (5 mg.L^{-1})) recorded a significant excelling on the other interactions, While the interaction (Basic cultivar and distilled water) achieved the lowest average of 158.36 g. As for the bi-interaction between the cultivar and the seaweed extract, The results of Table 7 showed that the superiority of the interaction (Luz de Otono cultivar and spraying with concentration of (8 mg.L^{-1}) significantly on the rest of the mixtures by giving the highest average of 346.43 g while the interaction (Basic cultivar and distilled water) gave the lowest average of 121.76 g. The interaction between the spraying of the total vegetative with the licorice extract and seaweed extract gave significant excelling in the yield of one plant. The highest concentration of the two extracts was significantly excelled on the rest of interaction with an average of 318.14 g compared to the distilled water of both extracts which gave the lowest average of 132.83 g. The interaction of the three factor was significant in the trait of the yield of one plant, The results of Table 7 showed that the interaction treatment (Luz de Otono cultivar and spraying with the highest concentration of licorice and seaweed extract) was significantly excelled by giving it the highest average of 362.70 g compared to the triple interaction treatment (Basic cultivar and spraying with distilled water only for both extracts) which recorded the lowest average of 105.95 g.

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