Effect of Zeolite and biofertilizers on the growth and flowering of *Rosa hybrid* L

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Abstract

The experiment was conducted in the lathhouse of the Department of Plant Production Techniques / Al-Mussaib Technical College for the autumn season of 2021 and the spring season of 2022 to study the effect of Zeolite and bio- inoculum on the growth and flowering of Rosa hybrid . It used plastic pots with a capacity of 27 cm filled with an agricultural medium consisting of (river soil + Zeolite at different levels). The experiment included two factors, the first factor included four levels of Zeolite without addition (the control treatment), adding (3 , 6 9)g.kg^{-1}.soil. As for the second factor, it included two levels of (Bio-healthWSG) water-soluble, organic vaccine without addition, adding 0.02 ml/liter. The results showed that the addition of Zeolite had a significant effect on the studied traits . The addition treatment (9 mg. kg-1) significantly excelled on the rest of the treatments and gave the highest values for the studied traits, plant height (82.9 cm), , intensity of chlorophyll pigment (44.1 spad unit). The percentage of dry matter in the leaves (0.5%), Number of flowers 7.7 (flower.plant-1), vase life 21.2 day, total carotenoid pigment in flowers 2.7 mg.100 g dry weight.Also, the addition of the Bio-health had a clear effect on the traits of vegetative and flowering traits. The addition treatment (0.02 ml/L) was significantly excelled on the non-addition (0) and gave the highest values for the studied traits, plant height (74.5 cm). intensity of chlorophyll pigment (39.9 spad unit), The percentage of dry matter in the leaves 0.5%), Number of flowers 6.5 (flower.plant^{-1}), vase life 18.6 day, total carotenoid pigment in flowers 2.6 mg.100 g dry weight.The results also indicated that the interaction treatment (Zeolite 9 g/kg + bio-fertilizer 0.02 ml/L) was significantly excelled on all studied traits, plant height (91.6 cm)., intensity of chlorophyll pigment (47.4 spad unit), The percentage of dry matter in the leaves (0.6%) Number of flowers 8.7 (flower.plant^{-1}), vase life 22.0 day, total carotenoid pigment in flowers 2.7 mg.100 g dry weight

Introduction

The Rosa hybrid belongs to the Rosaceae family, and the genus Rosa contains 310 species and more than 30,000 commercial cultivars. Its flowers are among the most desirable species and these Rosa hybrid have been at the fore in the gardens of kings and greats for thousands of years until the present time due to their beauty, the multiplicity of colours, fragrant smell and suitability for picking, as well as their entry into the pharmaceutical and cosmetics industry. It is also used to treat mental disorders and skin diseases. (Yashaswini) et al., 2011. The modern trend includes gradual dispensing completely or partially from chemical fertilizers and relying on vital sources that supply plants with their nutritional needs. Bacillus bacteria dissolve organic phosphates and convert them from the complex form to the form absorbable by the plant, where they release acids such as formic and lactic (Formic-Lacetic) that lead to a decrease in the degree of soil interaction and thus increase the availability of phosphorus (Sharma et al. 2012,) (Etesami et al. 2020,).Seaweed extracts are one of the most popular organic biostimulants in recent years .It contains many important compounds such as vitamins, plant hormones and some organic compounds that contribute to the increase and growth of the plant (Ali et al., 2015). As well as containing betaine, which is a source of nitrogen in its low concentrations and a regulator of osmosis in its high concentrations, as well as improving the physical, chemical and biological properties of soil (Kageyama et al., 2017). As for Zeolite , it is an aluminium silicate formed naturally or artificially that has been introduced in many agricultural applications, as it includes 50 types of important minerals (Ramesh et al., 2015). It is

considered a soil fertiliser that increases production and helps in the slow release of adsorbed mineral elements and prevents their loss in the washing process, in addition to its great role in increasing the efficiency of nitrogen use and thus mitigating the harmful effects of nitrogen fertilizers on the environment, and what encourages its use in agriculture is its cheap price and free from Harmful Substances (Rehakova),2004(

Materials and method

Experiment location:

The experiment was conducted in the canopy of the Department of Plant Production , Al-Mussaib Technical College, Middle Euphrates University / for the autumn season of 2021 and the spring season of 2022. To study the effect of Zeolite and inoculation with microorganisms on the growth and flowering of shrub Rosa hybrid . The seedlings of the two cultivars of V. Preciouy Moment Rosa hybrid , with a dark pink to violet color, and V. Rosa Pascal, with a snow-white color, were cultivated. It was purchased at the age of one year, which was dated 10/15/2021, and kept in the lathhose of the department until it was planted in pots designated for the experiment. The seedlings of the two cultivars of shrub Rosa hybrid were transferred to pots of 9 kg of soil and 27 cm in diameter, filled with river soil medium + Zeolite , according to the experimental parameters, + 3% decomposed sheep manure for all agricultural medium .A week after planting, the lengths of the seedlings were standardized by trimming them to 20 cm and keeping three branches for each plant. Samples were taken from different agricultural media, according to the experiment parameters, and the analyses were conducted in Al-Mussaib Technical Institute, Soil and Water Department laboratories, as shown in Table (1)

Table (1) Analysis of the cultivation medium for the experimental treatments(river soil + 3% decomposed sheep manure + Zeolite)

units	values				Traits
	Z3	Z2	Z1	Z0	
	6.6	6.7	6.9	7.20	pH
g/kg soil	3.45	3.30	3.29	3.25	Organic matter
dsm-1	1.09	1.45	1.52	1.86	Electrical conductivity (Ec)
	6.70	6.45	6.23	6.14	total nitrogen
g/kg soil	17.34	17.12	16.65	16.40	Available phosphorous
	35.45	33.21	30.23	29	soluble potassium
	Z3	Z2	Z1	Z0	Soil Separators
	756	742	740	738	sand
	182	180	179	177	silt
$g.kg^{-1}$	70	68	66	62	Clay
Sandy loam					Texture

Bio-health WSG preparation

The bio-inoculation(Bio-health WSG) was used table (2). The process of adding the bio-inoculation began 21 days after transferring the seedlings to the pots and was added according to the manufacturer's recommendation, which is 1,250 kg. dunums, i.e. 0.02 gm. every 21 days.The addition was made after weighing the desired amount and dissolving it with distilled water, taking into account that the soil of the pots is semi-moist, with an emphasis on stirring it before adding in a simple way so that the bio-inoculation reaches the root area of the plants

Table (2) shows the components of the bio-health WSG.

Contents	percentage
Trichoderma harzianum + Bacillus subtilis	10%
humic acid	75%
sea algae	5%
Humidity	10 -20%
water soluble potassium (k20)	11%
Boron	15%
Cation exchange capacity	400 / /meq 100g
Organic materials	65%
The percentage of water-insoluble substances with alkaline percentage	0.1>%

Service and controlling operations

With the beginning of the process of preparing lathhouse, it was spread with polyethylene to prevent the growth of weeds. The plants were covered with polyethylene in the cold days, and the covering process continued until the time of flowering of the plant and moderate temperatures. Plant service operations were followed up, including weeding and control whenever needed, until the end of the experiment. As for the watering operations, they were conducted by means of an irrigation and drip system.

Setting up the drip irrigation system

The drip irrigation system was used in the irrigation process, where it was equipped with a plastic tank with a capacity of 5000 liters to ensure reserve water storage connected to the main pipe feeding the branch pipes. The system included a mechanical pump and a main pipe with a diameter of 3 inches. The system was equipped with a main control switch, and the sub-pipes were connected to the main, and the sub-pipes were plastic tubes with a diameter of 0.5 inch, and the distance between one droplet and another was 25 cm. The sub-pipes were equipped with a control switch to control irrigation

experiment factors

The experiment included three factors:

The first factor: Zeolite

The Zeolite was obtained from the green lightning Zeolite manufacturer, Amman, Jordan

It included four levels: treatments of the first factor

1-Soil +3% (decomposed sheep manure) of the weight of the potting soil (control treatment) and symbolized by Z0

2-Soil + Zeolite 3 g. kg^{-1} Soil + 3% decomposed sheep manure and symbolized by Z1

3-Soil + Zeolite 6 g. kg^{-1} Soil + 3% decomposed sheep manure and symbolized by Z2

4- Soil + Zeolite 9 g. kg^{-1} soil + 3% decomposed sheep manure and symbolized by Z3

The second factor: the bio inoculum (Bio-healthWSG)

It included the addition of the BiohealthWSG vaccine on two levels:

1-Without addition (B0)

2- Add the vaccine at a concentration of 0.02 g. Pot and symbolizes (B1)

experimental design

The experiment was implemented as a Factorial Experiment according to a Completely Randomized Design (C.R.D) and with three replicates. The Genstat program was used to conduct the statistical analysis. The means were compared for all study indicators according to the least significant difference (L.S.D) under the probability level of 5% (Al-Rawi and Khalaf Allah (2000)

Studied traits:

plant height cm

The plant height was measured from the soil surface to the highest plant height using a metric tape measure for three plants for each experimental unit, then the averages were calculated for each treatment.

Intensity of chlorophyll pigment in leaves (Spad unit)

Three leaves were collected from each of the bottom, middle and top of the plant for two branches for each plant and it was estimated using the SPAD-502 Model chlorophyll meter) and for three plants and the averages were extracted for each treatment.

percentage of dry matter in leaves %

The leaves of the second and third pair were collected at the bottom of the growing apex at the beginning of the plant reaching the flowering stage of each experimental unit and measured after taking its fresh weight first and then dried in an electric oven at a temperature of 70 °C for 48 hours and until the weight was stable and the percentage of dry matter of the plant was calculated (Al-Sahaf, 1989).) According to the following equation:

$$\text{Dry matter percentage\%} = \frac{dry\ weight\ of\ leaves}{fresh\ weight} \times 100$$

Number of flowers. Plant^{-1}

The number of flowers formed on the plant was calculated and the rate was calculated for each treatment

Vase life (day):

Three flowers were selected in the bud stage, the beginning of flowering, the curvature of 1 or 2 calyx leaves to the bottom, and the beginning of the release of 1 or 2 outer petals (Reid, 2008).The flowers were placed in the water immediately after picking and then transferred to a room where the temperature ranged from 25-23 degrees Celsius, the flower stems were shortened to 20 cm (Cevallos and Reid, 2001).It was placed in distilled water with a height of 15 cm and according to field treatments, and the time period for the survival of the flowers was calculated until the appearance of one of the following symptoms: the loss of the petals or the flower carrier to its erection (signs of wilting), the falling of the petals (Ichimura and Ueyama, 1998) or their drying up (Cevallos) and Reid, 2001)

Determination of the total carotenoid pigment in flowers (mg. 100 g dry weight^{-1}):

The total carotenoid content of Rosa hybrid plant was determined according to (Ranganna, 1999) method by immersing 0.5 of dry flower petals in |20 ml of RA grade acetone for 2 hours.The layer of carotenoids was separated using Petroleum Ether through a separating funnel and then the volume was completed to 50 ml by adding Petroleum Ether. Then pass the layer of carotenoids through sodium sulfate over the funnel to remove any moisture from it. Then the optical density was measured at a wavelength of 452 nm using a spectrophotometer .Petroleum Ether was used as a blank material, Blank. The content of carotenoids was measured in the laboratories of the Plant Production Techniques Department / Al-Musayyib Technical College.The total carotenoid content was calculated according to the following equation:

Total carotenoids mg.100 g dry weight = (100 x mL 50 complement volume x optical spectrophotometer reading x 3.856)/(1000 x sample weight)

Results and discussion

plant height (m):

The results in Table 3 showed that the Zeolite added to the agricultural medium had a significant effect on the plant height trait, where The adding Zeolite at a level 9 g. kg^{-1} treatment significantly excelled on the rest of the levels by recording the highest values of 82.9 cm, followed by the treatment of 6 $g.kg^{-1}$ and it gave 71.40 cm compared to the treatment of no addition, which recorded 61.3 cm. The table also shows the bio-inoculum treatment with a concentration of (0.02 ml/L) and it gave the highest value of 74.5 cm compared to the control treatment which recorded 67.1 cm. Also, the interaction treatment (Zeolite 9 g/kg + bio-fertilizer 0.02 ml/L) significantly excelled and gave the highest average of plant height, which was 91.6 cm. It was followed by treatment (Zeolite 6 g/kg + bio-fertilizer 0.02 ml/l) and it gave 73.60 cm compared to the control treatment, which recorded the lowest average of plant height of 59.2 cm.

Table 3. Effect of Zeolite , bio-inoculum and their interactions on plant height (cm) of Rosa hybrid plant

average	Bio-fertilizer		Zeolite (g/kg)
	Add 0.02 ml/L	without adding	
61.3	63.3	59.2	0
67.6	69.6	65.7	3
71.4	73.6	69.3	6
82.9	91.6	74.2	9
	74.5	67.1	average
interaction	Bio-fertilizer	Zeolite	LSD
4.81	2.41	3.40	

2- Intensity of chlorophyll pigment in leaves (Spad unit)

Table 4, we notice that the addition of Zeolite has a significant effect in increasing the intensity of chlorophyll pigment in the leaves, where the treatment of 9 g. kg^{-1} recorded the highest average of intensity of chlorophyll pigment in the leaves amounting to 44.1 spad unit, It was followed by a treatment of 6 $g.kg^{-1}$ and it gave an average of the intensity of chlorophyll pigment in the leaves that amounted to 38.8 spad unit compared to the control treatment that recorded the lowest average of the intensity of chlorophyll pigment in the leaves of 35.00 spadunit. The addition of the bio-inoculum at an average of 0.02 ml/L had a significant effect on increasing the intensity of chlorophyll pigment in the leaves and it gave 39.90 spad unit, while the non-addition treatment recorded the lowest average of the intensity of chlorophyll pigment in the leaves, which amounted to 37.4 spadunit. Also, the treatment of the interaction (Zeolite 9 g/kg + bio-fertilizer 0.02 ml/L) excelled and gave a higher intensity of chlorophyll pigment in the leaves, and gave 37.4 spadunit Compared to the control treatment, which recorded the lowest average of chlorophyll pigment intensity in the leaves, it was 34.0 spadunit

Table 4. Effect of Zeolite , bio-inoculum and their interaction on the intensity of chlorophyll pigment spadunit of Rosa hybrid leaves

average	Bio-fertilizer		Zeolite) g/kg(
	Add 0.02 ml/L	without adding	
35.0	36.0	34.0	0
36.5	37.0	36.0	3
38.8	39.1	38.6	6
44.1	47.4	40.9	9
	39.9	37.4	average
interaction	Bio-fertilizer	Zeolite	LSD
2.02	1.01	1.43	

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3Percentage of dry matter of leaves(%)

The results in Table 5 showed the significant effect of adding Zeolite in increasing the percentage of dry matter of leaves (%),The treatment of 9 $g.kg^{-1}$ was significantly excelled on the rest of the other treatments and gave the highest percentage of dry matter percentage of leaves that was 0.5%, followed by treatment of 6 $g.kg^{-1}$ and it gave an average of the percentage of dry matter of leaves amounted to 0.4% Compared to the control treatment, which recorded the lowest percentage of leaf dry matter percentage of 0.3%, and the addition of bio-inoculum at a rate of 0.02 ml/L had a significant effect in increasing the percentage of leaf dry matter (%) and gave the highest average of 0.5% While the non-addition treatment recorded the lowest percentage of dry matter percentage of the leaves amounted to 0.4%. Also, the interaction treatment (Zeolite 9 g/kg + bio-fertilizer 0.02 ml/L) was excelled and gave the highest percentage of dry matter of leaves which was 0.6%.Compared to the comparison treatment, which recorded the lowest percentage of dry matter for leaves, it was 0.3%.

Table 5. Effect of Zeolite ,bio inoculum and their interaction on the percentage of leaf dry matter (%) of Rosa hybrid plant

average	Bio-fertilizer		Zeolite) g/kg(
	Add 0.02 ml/L	without adding	
0.3	0.4	0.3	0
0.4	0.4	0.3	3
0.4	0.4	0.4	6
0.5	0.6	0.4	9
	0.5	0.4	average
interaction	Bio-fertilizer	Zeolite	LSD
0.06	0.03	0.04	

Number of flowers (flower.plant^{-1})

The results in Table 6 showed the significant effect of adding Zeolite in increasing the number of flowers (flower.plant^{-1}). The treatment of 9 g. kg $^{-1}$ was significantly excelled on the rest of the other treatments and gave the highest average of the number of flowers reached 7.7 flower.plant $^{-1}$, followed by treatment of 6 g. kg $^{-1}$ and gave an average number of flowers reached 7.7 flower.plant -1 compared to the control treatment that was recorded The lowest average number of flowers was 3.8 flowers. Plant^{-1}, The addition of the bio-inoculum at an average of 0.02 ml / liter had a significant effect on an increase in the number of flowers and gave the highest average of 6.5 flowers.plant-1, while the non-addition treatment recorded the lowest average of the number of flowers reached 5.5 flowers.plant-1 Also, the interaction treatment (Zyols 9 g/kg + bio-fertilizer 0.02 ml/L) was excelled and gave the highest average of the number of flowers reached 8.7 flower.plant-1 compared to the control treatment which recorded less flowers of 3.0 flower.plant-1

Table 6. Effect of Zeolite and bio-inoculum and their interaction on the number of flowers (flower.plant-1) of Rosa hybrid plant

average	Bio-fertilizer		Zeolite (g/kg(
	Add 0.02 ml/L	without adding	
3.8	4.7	3.0	0
5.8	6.0	5.7	3
6.7	6.7	6.7	6
7.7	8.7	6.7	9
	6.5	5.5	average
interaction	Bio-fertilizer	Zeolite	LSD
0.94	0.47	0.66	

vase life(day)

The results in Table 7 showed the significant effect of adding Zeolite in increasing the vase life (day), where the treatment of 9 g.kg-1 was significantly excelled the rest of the other treatments and gave the highest average of vase life of 21.2 days, It was followed by a treatment of 6 g.kg-1, which gave an average vase life of 7.7 flower.plant-1, compared to the control treatment, which recorded the lowest average vase life of 18.0 days. The addition of the bio-inoculum at an average of 0.02 ml/L had a significant effect on an increase in vase life and gave the highest average of 18.6 days, while the non-addition treatment recorded the lowest average of vase life of 16.8 days.Also, the interaction treatment (Zyols 9 g/kg + bio-fertilizer 0.02 ml/L) was excelled and gave the highest average of vase life of 22.0 days compared to the control treatment, which recorded less flowers of 13.7 days.

Table 7. Effect of Zeolite and bio-inoculum and their interaction on vase life (day) of Rosa hybrid plants

average	Bio-fertilizer		Zeolite (g/kg(
	Add 0.02 ml/L	without adding	
15.0	16.2	13.7	0
16.7	17.4	16.1	3
18.0	19.0	17.0	6
21.2	22.0	20.4	9
	18.6	16.8	average
interaction	Bio-fertilizer	Zeolite	LSD
2.05	1.03	1.45	

Determination of total carotenoid pigment in flowers (mg.100 g dry weight):

The results in Table 8 showed the significant effect of adding Zeolite in increasing the total carotenoid pigment in flowers (mg.100 g dry weight),The treatment of 9 g.kg-1 was significantly excelled on the rest of the other treatments and it gave the highest rate of carotenoid pigment which was 2.7 mg.100 gm dry weight.Followed by the treatment of 6 g. kg-1 and it gave the average carotenoid pigment was 2.6 mg. 100 g dry weight Compared to the control treatment, which recorded the lowest average of carotenoid dye amounted to 2.4 mg.100 g dry weight, the addition of the bio inoculum at an average of 0.02 ml/L had a significant effect on an increase in carotenoid pigment and gave the highest average of 2.7 mg.100 g dry weight.While the non-additive treatment recorded the lowest averageof carotenoids dye amounted to 2.5 mg.100 gm dry weight, the interaction treatment (Zolols 9 g/kg + bio-fertilizer 0.02 ml/L)) and gave the highest average of carotenoids dye amounted to 2.7 mg.100 gm dry weight.Compared to the control treatment, which recorded less for flowers, it was 2.4 mg. 100 g dry weight

Table 8. Effect of Zeolite , bio inoculum and their interaction on total carotenoid pigment in flowers (mg.100 g dry weight) of Rosa hybrid plant

average	Bio-fertilizer		Zeolite (g/kg(
	Add 0.02 ml/L	without adding	
2.4	2.4	2.4	0
2.5	2.6	2.5	3
2.6	2.7	2.6	6
2.7	2.7	2.6	9
	2.6	2.5	average
interaction	Bio-fertilizer	Zeolite	LSD
0.04	0.02	0.03	

The increase in vegetative and flowering growth is due to the effect of adding Zeolite to the growth medium of the Rosa hybrid plant, and this was shown by the results in Table (3,8). The reason for this may be due to the high ability of the plant to absorb water and nutrients and their role in metabolism. As the leaf area develops in the stage of vegetative growth, which in turn is affected by the good preparation of water and nutrients, and the Zeolite works to provide the ammonium sorbent element on the surfaces of Zeolite , which is one of the forms of nitrogen that increases cell division and increases meristematic activity (Ayan et al., 2005). Phosphorous also contributes to cell division and an increase in the vegetative growth, which leads to increased absorption. In addition, potassium activates many enzymes, which improves plant metabolism and delays senescence . It increases the efficiency of chlorophyll and photosynthesis and thus leads to an increase in the rates of production and representation of dry matter and encourages vegetative growth (Al-Maamouri, 2016). The results also indicated that Zeolite improved the growth indicators studied, represented by plant height (Table 3), the percentage of chlorophyll (4), and the carbohydrate content of leaves .Whereas, the addition of Zeolite has improved soil aeration and the physical and chemical properties of the soil due to the abundance of its pores and the slow release of nutrients to the plant due to its high ability to cation exchange (Altemymy, 2019). It also leads to an increase in metabolic activities and an increase in the speed of transfer of metabolic products, and as a result of the increase in the readiness of nutrients and carbon-building processes, a positive impact on the percentage of carbohydrates and their transfer from the places of manufacture to the

rest of the plant parts, including flowers, which increased the flowering age (table (7) and the carotenoid pigment (table 8). Also, the bio-fertilizers had a significant effect on the vegetative growth traits , the results showed the excelled of the treatment (0.02 ml/L) of adding the bio-fertilizer represented by (Bio-health WSG).The reason for this increase may be due to its role in improving the physical and chemical properties of the soil, as well as increasing the surface area of the roots and stimulating the root hairs to absorb the nutrients in the soil as a result of releasing plant hormones in the growth medium such as auxins and gibberellins, which work on cell division and increase their numbers (Wu et al., 2015).The reason for the increase in these traits may be due to the fact that the bio-fertilizer contains a fungus Trichodermassp, which played an important role in the decomposition of organic matter and the formation of organic-mineral complexes with micro-elements (Zn-Mn-Fe), which increased its readiness due to the reduction of the degree of soil interaction (ph) This fungus also works to produce stimuli and regulators of growth and the formation of mechanisms to defend the plant, which contributes significantly to increasing the readiness of nutrients in the root area and then easy absorption by the plant (Sharma et al., 2012) These fungi also extend several centimetres from the surface of the roots and work to withdraw nutrients from the outer area of the infected roots (Demir 2004, Al-Wahaibi, 2008). Bacillus bacteria also had an important role in increasing the growth parameters mentioned above, as it is part of the biological fertilizer and is characterized by its ability to increase the solubility of phosphorus in the soil. Converting unready images into ready-to-sorption images by producing different types of organic acids such as oxalic and citric, which dissolve insoluble phosphate compounds and thus increase their readiness, and this is consistent with (Dawwan et al., 2013). Studies indicate that there is a close relationship between the amount of chlorophyll in the leaves and the accumulation of nitrogen in the dry matter, as the content of chlorophyll is an indicator of the extent of nitrogen absorption from the soil (Ruiz et al., 2000) and the increase in the fresh weight of the plant may be due to the added biofertilizer containing humic acid, which increases the permeability of nutrients by increasing the permeability of the living membranes in the roots, which improves their absorption of nutrients (Arancon et al., 2006). It also works to reduce Fe + 3 to Fe + 2 and chelate iron. In addition, the increase in atmospheric nitrogen fixation has become clear in the treatment of bio-fertilizer. As the percentage of nitrogen increased, and this led to an increase in the process of carbonization, as nitrogen leads to an increase in the speed of plant growth by increasing the speed of cell division, which increases the biomass of the plant (Taha, 2007).The increase in nitrogen was reflected in the increase in the building of chlorophyll (table 5), which led to an increase in the number of leaves in the plant and thus reflected in the leaf area of the plant, and the increase in the leaf area led to an increase in the accumulation of carbon-building products, which was reflected in the increase in the height of the plant (Table 3)and the increase of dry matter in table (7) and carbohydrates in the leaves table (8) The number of flowers and the carotene content of the flowers The aforementioned bio-fertilizer also contains marine algae extracts, which contain Betaines (Ali et al.,2015).It is one of the important catalysts for building chlorophyll, and this is reflected in an increase in the proportion of carbon metabolism and thus the production of different compounds in the plant, and this is what was agreed upon (Sumengala et al., 2019, Alhamzawi-2019). Also, biofertilizers played an important role in increasing the readiness, movement and solubility of nutrients, and then their absorption (Hayat et al., 2010). These beneficial microorganisms work to settle the roots in the rhizosphere, which leads to the stimulation of enzymes such as (protease-phosphatase) (Shaharan and Nehra), 2011), which increases the availability of the elements as a result of the mineralization process and prevents their fixation through the formation of complexes with them (Agbede et al., 2008).

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