ARTICLE / INVESTIGACIÓN

Effect of adding antisaline and marine algae on the vegetative growth characteristics of Cauliflower, Mica Cultivar

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Abstract: In the agricultural season 2019-2020 in one of the farming fields in Muqdadiya district, Haruniya region Kilo 21, 40 km north-east of Baquba district of Diyala governorate, order to study the effect of adding anticline and marine algae on the vegetative growth characteristics of broccoli, mica cultivar. The results showed the superiority of anti-salinity treatment in most of the studied traits, including(Plant height, number of leaves, leaf area, stem diameter, chlorophyll b,a concentration and carotene percentage in leaves) which achieved (69.10 cm, 29.08 leaf^{-1}, 235.16 dm^2 plant^{-1}, 29.01 mm, 0.68 mg g^{-1}, 0.51 mg g^{-1}, 0.58%) respectively also the spray of marine algae superiority at most of the studied traits, including in some characteristics (Plant height, number of leaves, leaf area, stem diameter, chlorophyll b,a and carotene percentage in leaves) (69.53 cm, 31.83 leaf^{-1}, 272.71 dm^2 plant^{-1}, 33.88 mm, 0.70 mg g^{-1}, 0.53 mg g^{-1},0.62%) respectively and the interaction between the two factors was reatment ignificant and superiority at in most of the traits, including (Plant height, number of leaves, leaf area, stem diameter, chlorophyll b,a concentration and carotene percentage in leaves) in some traits (76.30 cm, 33.86 leaf^{-1}, 301.17 dm^2 plant^{-1}, 35.50 mm, 0.80 mg g^{-1}, 0.56 mg g^{-1}, 0.70%) respectively.

Key words: Anti-saline, foliar nutrition, Marine Algae extract, Cauliflower.

Introduction

The phenomenon of salinity is added to soils with a salt concentration near the ground's surface to prevent it from moving upwards, which may lead to crop damage. It ends the problem of the accumulated salt without forming impermeable layers. The effect of the anticline in protecting saline lands to increase agricultural production influences the reduction of water evaporation in the soil and the groundwater level, and they also found that it reduces the entry of salt water from the sea added by the wind into the ground. By conserving available water in the soil[1], Foliar feeding provides the plant with nutrients in the vegetative system, which can absorb the elements. Foliar fertilization is one of the easiest ways to deliver nutrients to the plant and is considered a supplement to organic fertilizers in the soil[2]. Marine algae is one of the most essential and best organic sources used in agricultural production, and it is a supplement to, and not a substitute for, fertilizers[3]. Marine algae contain nutrients and growth regulators such as auxins, gibberellins and amino acids that improve vegetative and root growth. Marine algae also contribute to increasing the plant's strength and ability to absorb elements, thus increasing its resistance to diseases, which leads to its productivity and improvement of its quality[4]. These algae increase the efficiency of nutrient absorption as well as increase the activity of the respiration process. Over 15 million tons are used annually in the agricultural field and contain more than a group of growth promoters such as auxins, vitamins, amino and organic acids, and polysaccharides[5]. The results are superior and direct in seaweed, extraction method, concentration, addition method, and addition time (6) found that this extract increases most of the plant's studied vegetative properties and leaf content. (7) obtained a significant increase in the number of leaves and seedlings when spraying seaweed on the plant Cauliflower, and the scientific name is *Brassica tolerance var botrytis* L. It belongs to the cruciferous family Brassicaceae. It is one of the most essential winter vegetables. The area planted with Cauliflower reached 3.955 dunams, with productivity of 7.187 tons[8]; therefore, this study aims to know the effect of adding antisaline and marine algae to their best concentration.

Materials and methods

A field experiment was carried out within the design of randomized complete sectors and with a factorial investigation in the agricultural season 2019-2020 in one of the farming fields in the district of Muqdadiya, Harouniyah area Kilo 21 It is 40 km north-east of Baquba district of Diyala governorate, to study the effect of adding antisaline and marine algae on the vegetative growth characteristics of Cauliflower, Mica type.

Study factors

The experiment included two factors; the first factor is anti-salinity, symbolized by (S_0, S_1, S_2) and at a concentration (0, 1, 2 ml L^{-1}) sequentially added to the soil and the second factor is marine algae and symbolized by the

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symbol (T_0, T_1, T_2) and at a concentration of (0, 2, 4 ml L^{-1}), sequentially sprayed on the leaves. The seedlings were planted on 10/10/2019, and the crop was harvested on 25/12/2019. Ten samples were taken randomly from the soil and mixed well, and homogeneously, a representative sample of the field was taken for analysis before planting from 0-30 cm depth. They were pneumatically dried, ground with a wooden hammer, sieved with holes diameter (2 mm), divided into several sections to prevent the sample from being damaged or lost, and kept in different known places until analysis. The following traits were taken: plant height, number of leaves, leaf area, stem diameter, chlorophyll a, b and the percentage of carotene in leaves, as shown in Table 1.

Statistical analysis

The data were analyzed using the statistical program (SAS), and the significant differences between the means were tested according to the (Duncan) polynomial test at the probability level of 0.05[9].

Results

Plant height (cm)

Table (2) shows a significant difference when adding antisaline to treatment S_2, which amounted to 69.10 cm. In comparison, treatment S_0 amounted to 59.64 cm, and adding marine algae was superior to treatment T_2 when it reached 69.53 cm. On the comparison treatment, T_0 amounted to 58.45 cm, and the interaction between the two factors was the highest value in treatment S_2 T_2, which amounted to 76.30 cm. On the comparison treatment, S_0 T_0 amounted to 53.96 cm.

Number of leaves (leaf plant^{-1})

Table 3 shows a significant difference when adding anticline when treatment S_2 was 29.08 leaf plant^{-1} on the comparison treatment S_0. It reached 26.36 leaf plant^{-1}, and the addition of marine algae was superior to treatment T_2 when

Soil Properties	Values	Unit
Electrical conductivity $EC_{1:1}$	1.92	ds m^{-1}
Soil $pH_{1:1}$	7.57	
Organic matter	19.6	g kg^{-1}
Available nutrients		
available nitrogen	45.18	mg kg^{-1}
available phosphorous	12.24	
available- potassium	192.92	
Available iron	3.47	
Bulk density	1.4	Mg m^{-3}
Soil Separators		
clay	524	g kg^{-1}
silt	88	
sand	388	
	clay	soil texture

Table 1. Shows the analysis results of the chemical and physical properties of the study soil before planting. In the Laboratory of Soil and Water Resources Sciences, College of Agriculture, Diyala University.

	T_0	T_1	T_2	antisaline average
S_0	53.96	60.46	64.5	59.64
	d	cd	Bc	B
S_1	59.73	63.66	67.8	63.73
	cd	bc	bc	B
S_2	61.66	69.33	76.3	69.1
	bc	ab	a	A
Marine algae average	58.45	64.48	69.53	
	C	B	A	

*According to Duncan's polynomial test, The coefficients with similar letters do not differ significantly at the probability level of 0.05.

Table 2. The effect of adding antisaline and marine algae on plant height (cm).

	T_0	T_1	T_2	Antisaline average
S_0	22.2	26.53	30.36	26.36
	f	cdef	Abc	B
S_1	24	27.53	31.26	27.6
	ef	bcde	Ab	AB
S_2	24.56	28.83	33.86	29.08
	def	bcd	a	A
Marine algae average	23.58	27.63	31.83	
	C	B	A	

*According to Duncan's polynomial test, The coefficients with similar letters do not differ significantly at the probability level of 0.05.

Table 3. The effect of adding antisaline and marine algae on the number of leaves (leaf^{-1}).

it went 31.83 leaf plant^{-1} over the control treatment T_0. It got 23.58 leaf plant^{-1}, while the interaction between the two factors was the highest value when treatment S_2T_2 arrived at 33.86 leaf plant^{-1} and compared to treatment S_0T_0, which amounted to 22.20 leaf plant^{-1}.

Leaf area (dm^{-1})

Table (4) shows a significant difference when adding anticline when treatment S_2 reached 235.16 dm^{-1} over the comparison treatment S_0. It got 217.33 dm^{-1}, and adding marine algae was superior to treatment T_2 when it came to 272.71 dm^{-1} over the control treatment T_0. It reached 174.31 dm^{-1}, while the interaction between the two factors was the highest value in treatment S_2T_2, which amounted to 301.17 dm^{-1}, and in comparison treatment S_0T_0, which amounted to 189.77 dm^{-1}.

Diamater of the stem (mm)

Table (5) shows a significant difference when adding anticline in treatment S_2, which amounted to 29.01 mm compared to treatment S_0. It reached 28.56 mm, and adding marine algae when it was T_2, which amounted to 33.88 mm, was superior to the control treatment T_0, which amounted to 23.64 mm. As for the interaction between the two factors, the highest value was in the treatment S_2T_2, which amounted to 35.50 mm, and in the comparison treatment S_0T_0, which amounted to 23.40 mm.

The concentration of chlorophyll an in leaves (mg g^{-1})

Table 6 shows a significant difference when adding antisaline when treatment S_2 was 0.68 mg g^{-1} over the comparison treatment S_0. It reached 0.55 mg g^{-1}, and the addition of marine algae was superior to treatment T_2, which amounted to 0.70 mg g^{-1}, over the control treatment T_0, which amounted to 0.45 mg g^{-1} As for the interaction between the two factors, the highest value was in treatment S_2T_2, which amounted to 0.80 mg g^{-1}, and in comparison treatment S_0T_0, which amounted to 0.46 mg g^{-1}.

The concentration of chlorophyll b in leaves (mg g^{-1})

It appears from Table 7 that there is a significant difference when adding antisaline in treatment S_2, which amounted to 0.51 mg g^{-1} in the comparison treatment S_0. It reached 0.44 mg g^{-1}, and adding marine algae was superior to treatment T_2 when it arrived at 0.53 mg g^{-1} over the control treatment T_0. It got 0.40 mg g^{-1}, while the interaction between the two factors was the highest value in treatment S_2T_2, which amounted to 0.56 mg g^{-1}, and in comparison, treatment S_0T_0, which amounted to 0.40 mg g^{-1}.

Carotene content in leaves (mg g^{-1})

Table 8 shows a significant difference when adding antisaline when treatment S_2 was 0.58 mg g^{-1} on the comparison treatment S_0. It reached 0.47 mg g^{-1}, and adding marine algae was superior to treatment T_2 when it reached 0.62 mg g^{-1} over the control treatment T_0. It amounted to 0.45 mg g^{-1}, while the interaction between the two factors was the highest value in treatment S_2T_2, which amounted to 0.70 mg g^{-1}, and in comparison treatment S_0T_0, which amounted to 0.43 mg g^{-1}.

Discussion

The results of Tables 8, 7, 6, 5, 4, 3 and 2 show a significant difference when adding antisaline. The reason for

	T_0	T_1	T_2	antisaline average
S_0	198.77	203.53	249.7	217.33
	bcd	bcd	abc	AB
S_1	124.43	168.13	267.27	186.61
	d	cd	ab	B

*According to Duncan's polynomial test, The coefficients with similar letters do not differ significantly at the probability level of 0.05.

Table 4. The effect of adding antisaline and marine algae to the leaf area (dm2 plant^{-1}).

	T_0	T_1	T_2	antisaline average
S_0	23.4	28.43	33.86	28.56
	d	c	ab	B
S_1	23.86	28.56	32.3	28.23
	d	c	b	B

*According to Duncan's polynomial test, The coefficients with similar letters do not differ significantly at the 0.05 probability level.

Table 5. Effect of adding antisaline and marine algae on stem diameter (mm).

	T_0	T_1	T_2	antisaline average
S_0	0.46	0.53	0.66	0.55
	cd	bcd	abc	B
S_1	0.33	0.53	0.63	0.5
	d	bcd	abc	B
S_2	0.56	0.7	0.8	0.68
	bc	ab	a	A
Marine algae average	0.45	0.58	0.7	
	C	B	A	

*According to Duncan's polynomial test, The coefficients with similar letters do not differ significantly at the 0.05 probability level.

Table 6. The effect of adding antisaline and marine algae on the concentration of chlorophyll a in leaves (mg g^{-1}).

	T_0	T_1	T_2	antisaline average
S_0	0.4	0.4	0.53	0.44
	cd	cd	ab	B
S_1	0.36	0.43	0.5	0.43
	d	bcd	abc	B

*According to Duncan's polynomial test, The coefficients with similar letters do not differ significantly at the 0.05 probability level.

Table 7. The effect of adding antisaline and marine algae on the concentration of chlorophyll b in leaves (mg^{-1}).

	T_0	T_1	T_2	antisaline average
S_0	0.43	0.46	0.53	0.47
	e	de	cd	C
S_1	0.46	0.5	0.63	0.53
	de	de	ab	B

*According to Duncan's polynomial test, The coefficients with similar letters do not differ significantly at the 0.05 probability level.

Table 8. Effect of adding antisaline and marine algae on the percentage of carotene in leaves (mg g^{-1}).

reducing salinity in the study soil is attributed to the role of anti-salinity in reducing salinity stresses that cause high salinity by the capillary property through permanent moisture. (10) is believed that anticline reduces the water stress of crops and achieves the highest production, reduces the costs of delivering irrigation water to agricultural fields and increases the utilization of soil moisture storage. It reduces fertilizer losses because it reduces surface run-off and deep seepage and increases net production by increasing crop yield and quality. It reduces waterlogging problems by reducing excessive amounts of water. It helps control root zone salinization problems by reducing excessive amounts of water that cause the water level to rise in the ground.

Also, irrigation water contains salts; increasing irrigation means adding salts to the soil. This leads to achieving additional returns by using the water stored in the soil for irrigation during the short periods when the crop is not irrigated, consistent with (11). Water stress occurs due to low water content in the soil due to constant water loss. Also, water stress causes many physiological and chemical changes in the plant, reducing plant growth, leaf size, stem elongation, root expansion and reduced water use efficiency[12]. It is believed that the antisaline expels the salts from the root area, thus increasing plant growth and giving the plant a greater chance of growth and expansion through cell elongation and division and leading to the closing of the stomata due to changing hormone levels in the plant by decreasing levels of cytokinin in the roots and increasing levels of abscisic acid in the leaf and decreasing Transpiration rates and water stress in plant tissues, especially in the soil of saline and salinity-affected areas[13]. Some theories state how to overcome the problem of salinity and activate the anti-salinity action in its explicit form, and that is through spraying with potassium sulfate fertilizer by reducing the osmotic effort of the leaves or improving the nutrition of the host and then improving the tolerance of plants to drought The importance of potassium comes from its role in many physiological processes, especially the transport and storage of represented substances and water relations inside plants affected by salinity, and this is consistent with (14,15). The results of the same tables show the superiority of the addition of marine algae. The reason is due to the role of algae in that these algae contain many major and minor elements and plant hormones such as auxins and gibberellins, which leads to fossilization, division, elongation of cells and growth of meiotic tissues. It also regulates biological and physiological processes, which stimulates and increases the efficiency of carbon metabolism, thus improving the plant's vegetative growth, and this agrees with the results reached by Spinelli[4]. It is believed that the reason for adding marine algae is because it contains many macro and micronutrients and plant hormones, especially auxins and cytokines, which have an influential role in increasing plant height, number of leaves, leaf area and chlorophyll concentrations as they encourage the process of cell division and cell elongation, as well as the effect of nutrients such as nitrogen, phosphorous and potassium. Moreover, amino acids have a wide range in preparing vital plant activities. These results are in agreement.

Conclusions

The application of antisaline to the soil with a concentration of 2 ml L^{-1} gave the best results in most of the studied traits in the vegetative growth characteristics of the cauliflower cultivar Mica. The addition of marine algae by spraying it on the vegetative, the treatment with concentration (4 ml L^{-1}) gave the best results in most of the studied traits in the vegetative growth characteristics of cauliflower cultivar Mica. As for the interaction between the factors, the treatment (2 and 4 ml L^{-1} for antisaline and marine algae, respectively) gave the best results in most of the studied traits in the vegetative growth characteristics of cauliflower cultivar Mica.

Conflicts of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this manuscript.

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