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Effect of Spraying with Seaweed Extract (Algae 600) and Cal-Boron on Some Vegetative Growth and Yield Characteristics of Two Strawberry Cultivars (Rubygem and Albion)

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ABSTRACT

This study was conducted in a plastic house at the Horticulture Department of the College of Agricultural Engineering Science, University of Raparin in Qaladze/Iraq. During the growing season of 2024–2025.In this experiment, two strawberry cultivars (Rubygem and Albion) are used to test the effects of three different dosages of seaweed extract (Algae 600) (0, 4, 8) g/L and Cal-Boron (0, 0.5, 1.5) ml/L as a foliar spray on growth, blooming, and yield as well as their interactions on strawberry growth, chemical composition, production, and quality. Six spraying during the experiment after transplanting in 1 November 2024, first spraying of Alga 600 was done in 21 November 2024 after (20) day of the transplanting. In addition, second spraying in 12 December 2024 and third spraying in 2 January 2024. The first spraying of Cal-Boron was done in 2 December 2024, 40 days after of transplanting, second spraying done after flowering and third spraying done during fruit development. The fertilizers (Cal-Boron and Algae 600) had a major impact, according to the data. Specifically, they significantly influenced leaf area, reaching a value of 78.45 cm^2 in the Rubygem cultivar with a treatment of (8 g/L algae and 1.0 ml/L Cal-Boron). They also significantly affected fruit size, with Rubygem producing a fruit size of 13.28 cm^3 under the same treatment. Moreover, the same treatment recorded a significant anthocyanin content of 42.31 mg/100 g F.W. Additionally, the interaction between (Cultivars + Fertilizers + Concentration) significantly affected leaf area, with the highest value of 88.41 cm^2 observed in (Rubygem + 8 g/L algae + 1.0 ml/L Cal-Boron). It also significantly influenced fruit size, reaching 19.50 cm^3 in the same treatment. In comparison to untreated strawberries, the interaction of (Rubygem + 8 g/L algae + 1.0 ml/L Cal-Boron) yielded an anthocyanin value of 31.49 mg/100 g F.W., while (Albion + 0.0 algae + 0.0 Cal-Boron) served as the control.

***Keywords*:** Strawberry, Fragaria x ananassa Duch., Rubygem, Albion, Algae 600, Cal-Boron.

INTRODUCTION

The strawberry belongs to the Rosaceae family (*Fragaria* x *ananassa* Duch.). Fruit from the Fragaria genus can have a beautiful look, a wonderful flavor, and a high nutritional value. Strawberries contain anthocyanins, ellagic acid, and vitamin C, a potent natural antioxidant. They are high in B-complex vitamins and contain trace levels of lutein, beta-carotene, and zea-xanthin, all of which are helpful to health. They include a high concentration of folic acid, fiber, and numerous minerals such as potassium, manganese, fluorine, copper, iron, and iodine. Strawberries' bright red color is due to their high levels of phytonutrients and flavonoids **[1].** Strawberries can be cultivated anywhere in the world under a range of conditions. Because of its sweetness, fragrance, and perfume, this berry-like fruit is consumed by everybody. Globally, strawberries are grown mostly in temperate climates and come in a variety of forms. The strawberry, one of the most significant berry plants, is grown all over the world and is essential to the natural ecosystem **[2**]. Strawberries are now one of the most desired and popular fruits in Iraq, having first been grown in private gardens. Its quick proliferation makes it unique **[3].** The strawberry plant produces fruit early because the first fresh harvest appears in marketplaces in the spring. Because they are potent inhibitors of cardiovascular, vascular, and malignant disorders, their fruits are also rich in vital components **[4].**

The use of commercial seaweed products in agriculture and horticulture has significantly increased during the last 20 years **[5].** An algal-rich organic fertilizer can be diluted and applied to larger plants and to transplants and sensitive

seedlings **[6**]. However, it has been found that algae can give enough trace elements to make up for peripheral deficiencies. Also, the combination of nutrients and trace elements with other components in seaweed extract is extremely probable to cause a yield increase **[7].** The use of seaweed extract reportedly enhanced the chlorophyll content and leaf vegetative development properties of the peach plants. Compared to other plants, algae are an excellent source of fiber, minerals, proteins, vitamins, and fatty acids, among other components that are vital for nutrition. Algae contain a number of compounds that encourage plant growth, such as cytokinin's, auxins, and betaines **[8].** Applying extracts from seaweed (Alga 600) at levels of 2 to 8 g/L increased fruit production and fruit quality in strawberries (cv. 'Albion') **[9].**

Cal-Boron, a combination calcium and boron fertilizer, increases strawberry plant growth, fruit productivity, quality, and post-harvest shelf life when applied foliar **[10].** Ca+B treatments lead to firmer fruits with reduced total soluble solids, increased acidity, and more ascorbic acid **[11].** Calcium is one of the most important macronutrients for growing strawberries. Because it can enhance fruit quality and yield, calcium is regarded as a vital vitamin for plants. It also promotes photosynthesis and the movement and absorption of nitrate within the plant **[12].** The most significant physiological effects of boron in plants include its structural function in cell walls, stimulation or inhibition of particular metabolic pathways, involvement in the transport of calcium into the plant, production and retention of flowers, elongation and germination of pollen tubes, development of seeds and fruit, transport of sugar, and hormonal regulation **[13].** While Ca+B foliar sprays enhance marketable products by 20% above controls by lowering deformities, boron alone raises fruit yield per plant by 45.7%. Low boron causes fruit set and pollen tube growth to be disrupted, resulting in deformed fruit. Strawberry seedling root length, leaf SPAD value, biomass, and general growth are all increased by foliar boron spraying at 0.1% H3BO3. Applications of both Ca and B together promote cell division and the metabolism of carbohydrates **[14].**

The aim of this study was to assess how two strawberry cultivars, algae 600 and Cal-Boron, responded to these nutrients in terms of growth and yield: Rubygem and Albion. The study aimed to determine whether these fertilizers, applied as a foliar spray, and to identify the cultivar that would respond positively to each fertilizer to aid in plant management. The findings from this research could significantly contribute to reducing the use of fertilizers and promote the sustainable production of strawberries while enhancing the plant's quality and productivity.

Materials and Method

This study was conducted during the growing season of 2024–2025 at the College of Agricultural Engineering Sciences/University of Raparin in Qaladze/Iraq. It examined the effects of spraying three concentrations of algae 600 (0, 4 and 8 gm L-1) and Cal-Boron (0, 0.5 and 1 ml.L-1) on the growth, flowering, yield, and qualitative characteristics of two strawberries, CV. Rubegym and Albion. The experiment was conducted in the morning due to the lower temperatures; foliar spring was finished.

Algae were sprayed three times during the experiment. The first application of Alga 600 was carried out on November 21, 2024, twenty days after the transplanting. The second application was carried out on December 12, 2024, and the third application took place on January 2, 2024. Cal-Boron was initially sprayed on December 2, 2024, forty days after transplanting; it was then sprayed again during flowering and a third time during fruit development.

strawberry cultivars were transplanted into pots from a nursery in Peramagrun. In order to achieve a balance between roots and vegetative development, all transplants were trimmed by removing any excess or damaged leaves, and each plant's remaining three leaves were also sterilized with fungicide (Topsin Wp). The transplants were positioned 30 cm apart from plants and 40 cm apart from culture rows.

From November 1, 2024, to May 1, 2025, the greenhouse was planted using a drip watering system. Plants were repeatedly stripped of their flowers throughout the first mouth following transplanting. In the trial, eighteen therapies were used, with three replications. Using Randomized Complete Block Design (RCBD) in a factorial experiment, six seedlings were selected from each treatment and measurements were made. At the 5% level, means were compared using the Duncan 0.5 Multiple Ranges test. After that, a split plot design was employed to use plants in a factorial experiment (2*3*3). For the following properties, strawberry fruit was harvested from March 15 to April 20, for the following properties:

Leaf area (cm2)

Leaf area was measured non-destructively using the easy leaf area mobile app (Samsung android A70 plus 2018 mobile).

Total Chlorophyll content (mg. 100g-1 fresh weight)

Weigh 0.2-0.5 g of fresh strawberry leaves. Cut or grind the leaves into small pieces. Place the leaf tissue in a test tube or small flask with 10 mL of 95% ethanol. Place the tube in a hot water bath at ~65-70°C for 5-10 minutes. The solution should turn green as chlorophyll dissolves into the ethanol. Avoid prolonged heating to prevent degradation. Cool the solution to room temperature. Filter or centrifuge to obtain a clear extract. Use the extract to measure

absorbance at:
664 nm (Chlorophyll a)
649 nm (Chlorophyll b)
Calculations
Chlorophyll a (ug/mL) = 13.36 × A664 - 5.19× A649
Chlorophyll b (ug/mL) = 27.43 × A649 - 8.12× A664
Total chlorophyll = Chlorophyll a + Chlorophyll b

Leaf Mineral Contents (N, P and Ca)

Mineral contents of leaves (N, P, Ca). Following harvest, leaves were taken at random from each plant receiving treatment. The leaves were promptly transported to the lab by being placed in plastic bags. To get rid of any spray residue, the leaves were cleaned and repeatedly washed with tap water, followed by another wash with HCl 0.01 N and a rinse with distilled water. After air drying, the leaf samples were placed in an oven set at 70 C until their weight remained constant. The concentration of minerals in leaves was measured using their dry matter. The concentration of minerals in leaves was measured using their dry matter. Additionally, concentrated sulfuric (H2SO4) and percloric (HCIO4) acids were used to digest 0.5 g samples of leaves from each treatment. After that, unambiguous extracts for mineral assessment were obtained. The percentage of nitrogen was estimated by the use of Microkjeldhal apparatus. phosphorous was estimated by the use of ammonium vanadium. After the developing of the color, the sample reading was recorded by Spectrophotometer apparatus at the wave length of (410 nm) nanometer. Calcium (Ca) determined by atomic absorption spectroscopy (AAS) or inductively coupled plasma optical emission spectrometry (ICP-OES).

Fruit weight (g)

The average weight of one fresh fruit for each of the six plants randomly selected for each experimental unit at the first harvest to the end of the last harvest was calculated using a Balance

Fruit size (cm3)

The average size was obtained by taking five fruits from each plant. For determining the size of fruit, numerical cylinder, filled with water, was utilized. The size of fruit equivalent to the amount of displaced water

Total yield per plant (g)

Plant yield was calculated according to the following equation:
No. of fruit in plant x Mean weight of fruit

Total Soluble Solids/ Total Treatable Acidity Ratio (TSS/TTA)

The percentage of total soluble solids and the percentage of total titrable acidity were calculated by dividing TSS/TTA.

Anthocyanin Content (mg.100g-1 F.W.)

Anthocyanin (mg. 100g-1 fresh weight) was determined by taking (2.5g) of fruit juice, then added 50 ml mixture of 85% Alcohol + 15% HCl (1.5 N), and left for 24 hours at 4°C, then filtered through filter paper (0.1N) then it estimated by using Spectrophotometer at a wavelength of 535nm.

$$\text{Anthocyanin content} = \frac{\text{Abs } 535 * \text{Ve}}{\text{Vu} * \text{Wts}} \times 100$$

Abs = Reading of spectrophotometer
Ve = Volume of extracts
Vu = Volume of extracts use for spectrophotometer reading
Wts = Weight of the sample

Statistical Analysis

An RCBD design was used to conduct the experiment. Three replications of each treatment were used, with four plants in each replication. Analysis of variance (ANOVA) was performed on the collected data, and the Duncan test was used to determine the mean values at $P < 0.05$ using the SAS program.

Results

Leaf area (cm^2):

Data in Table (1) illustrates that the effects of Strawberry cultivars, Alga 600, and Cal-Boron on the leaf area were significantly influenced by cultivars, the differences were significant, and the highest value of leaf area was obtained on Rubygem, which was (78.45 cm^2 /plant). The lowest values were obtained on Albion, (53.72 cm^2 /plant). The Alga 600 showed significant results, with 8gm.L^{-1}, the recording values of (72.38 cm^2 /plant) compared with the control were (58.62 cm^2 /plant).

Regarding the effect of the foliar spray Cal-Boron, foliar plants with a concentration of 1.0 ml. L-1 resulted significant increase in leaf area per plant. Plants treated recorded higher values of leaf area per plant, (70.38 cm^2 /plant), compared to the control was recorded as (61.01cm^2 /plant).

Concerning the bilateral interaction between (cultivars and Algae 600), the effects were The results from the same tables indicated that the interaction between (Algae 600 and Cal-Boron) showed a significant difference in leaf area per plant, the highest mean value was obtained from the interaction between 8gm.L^{-1} and 1.0ml. L^{-1} was (76.68 cm^2 /plant) compared with the lowest value of (54.41 cm^2 /plant) from 0.0 gm. L^{-1} Algae 600 and 0.0ml. L^{-1} Cal-Boron.
The triple interaction among (cultivars, Algae 600and Cal-Boron) significantly affected plant leaf area. The maximum plant leaf area of (88.41 cm2 /plant) was obtained as a result of interaction among Rubygem, 8gm.L^{-1} Algae 600-, and 1.0-ml. L^{-1} Cal-Boron. The lowest values were recorded (43.83) significant as obtained from the interaction between Rubygem and 8gm. $L^{-1,}$ which recorded the highest value, (84.37 cm^2 /plant), compared with the Albion and 0.0 gm. L^{-1}, of Algae 600 was recorded as (46.24 cm^2 /plant).
The interaction between the Cultivars and Cal-Boron had a significant effect. The results indicated that the interaction of Rubygem and 1.0 ml. L^{-1} appeared to be the most operative treatment as it gave the highest leaf area per plant, (83.41cm^2 /plant), compared with the lowest (49.28cm^2 /plant). m^2 /plant) with Albion, 0.0 gm. L^{-1} Algae 600, and 0. 0ml.L^{-1} Cal-Boron.

Table (1): Effectiveness of Alga 600, Cal-Boron and their interaction on leaf area (cm^2) of Two Strawberry cultivars

Cultivars	Algae gm.L^{-1}	Three-way interaction cultivars × Cal-boron × Algae			Two-way effect of Cultivars × Algae
		CalBoron ml.L^{-1}			
		0	0.5ml.L^{-1}	1.0ml.L^{-1}	
Rubygem	0	64.99 ef	71.45 de	76.61 cd	71.02 c
	4gm.L^{-1}	73.99 cd	80.78 bc	85.20 ab	79.99 b
	8gm.L-1	79.23 bc	85.45 ab	88.40 a	84.36 a
Albion	0	43.82 g	45.74 g	49.14 ig	46.23 f
	4gm.L-1	50.14 ig	55.51 g-i	57.91 f-h	54.52 e
	8gm.L-1	53.85 hi	62.39 fg	64.95 ef	60.39 d
Two-way interaction Cultivars ×Cal-Boron	Cultivars	Cal-Boron ml.L^{-1}			Main effect of Cultivars
	Rubygem	72.73 c	79.22 b	83.40 a	78.45 a
	Albion	49.27 f	54.55 e	57.33 d	53.72 b
Two-way interaction Cal-Boron × Algae	Algae gm.L^{-1}	Cal-Boron ml.L^{-1}			Main effect of Algae
		0	0.5ml.L^{-1}	1.0ml.L^{-1}	
	0	54.41 c	58.59 bc	62.88 a-c	58.62 c
	4gm.L-1	62.06 a-c	68.14 a-c	71.56 ab	67.25 b
	8gm.L-1	66.54 a-c	73.92 ab	76.68 a	72.38 a
Main effect of Cal-Boron		61.006 c	66.88 b	70.37 a	

Means of each factor and their interactions, followed by different letters, are significantly different from each other according to Duncan's multiple range test at 5%.

Total Chlorophyll content (mg. 100g-1)

Results in table (2) illustrates that the effects of Strawberry cultivars, Alga 600, and Cal-Boron on the total chlorophyll content were significantly influenced by cultivars, the differences were significant, and the highest value of total chlorophyll content was obtained on Rubygem, which was (44.14 mg. $100g^{-1}$). The lowest values were obtained on Albion, (42.57 mg. $100g^{-1}$). The Alga 600 showed significant results, with 8gm.L^{-1}, the recording values of (44.66 mg. $100g^{-1}$) compared with the control were (41.45 mg. $100g^{-1}$). Regarding the effect of the foliar spray Cal-Boron, foliar plants with a concentration of 1.0 ml. L-1 resulted significant increase in total chlorophyll content. Plants treated recorded higher values of total chlorophyll content, (45.97 mg. $100g^{-1}$), compared to the control was recorded as (40.99 mg. $100g^{-1}$). Concerning the bilateral interaction between (cultivars and Algae 600), the effects were significant as obtained from the interaction between Rubygem and 8gm. $L^{-1,}$ which recorded the highest value (44.92

mg. $100g^{-1}$), compared with the Albion and 0.0 gm. L^{-1}, of Algae 600 was recorded as (40.21 mg. $100g^{-1}$). The interaction between the Cultivars and Cal-Boron had a significant effect. The results indicated that the interaction of Rubygem and 1.0 ml**.** L^{-1} appeared to be the most operative treatment as it gave the highest total chlorophyll content, (46.88 mg. $100g^{-1}$), compared with the lowest (39.92 mg. $100g^{-1}$). The results from the same tables indicated that the interaction between (Algae 600 and Cal-Boron) showed a significant difference in total chlorophyll content, the highest mean value was obtained from the interaction between 8gm.L^{-1} and 1.0ml. L^{-1} was (47.45 mg. $100g^{-1}$) compared with the lowest value of (38.37 mg. $100g^{-1}$) from 0.0 gm. L^{-1} Algae 600 and 0.0ml. L^{-1} Cal-Boron. The triple interaction among (cultivars, Algae 600and Cal-Boron) significantly affected total chlorophyll content. The maximum total chlorophyll content of (47.89 mg. $100g^{-1}$) was obtained as a result of interaction among Rubygem, 8gm.L^{-1} Algae 600-, and 1.0-ml. L^{-1} Cal-Boron. The lowest values were recorded (36.92 mg. $100g^{-1}$) with Albion**,** 0.0 gm. L^{-1} Algae 600, and 0. 0ml.L^{-1} Cal-Boron.

Table (2): Effectiveness of Alga 600, Cal-Boron and their interaction on Total Chlorophyll Content of Two Strawberry cultivars

Cultivars	Algae gm.L^{-1}	Three-way interaction cultivars × Cal-boron × Algae			Two-way effect of Cultivars × Algae
		Cal-Boron ml.L^{-1}			
		0	0.5ml.L^{-1}	1.0ml.L^{-1}	
Rubygem	0	39.82 g	42.32 d-g	45.93 a-c	42.69 a
	4gm.L^{-1}	44.75 b-e	43.27 c-f	46.74 ab	44.81 a
	8gm.L-1	41.62 e-g	44.83 a-e	47.98 a	44.92 a
Albion	0	36.92 h	40.84 fg	42.87 c-g	40.21 b
	4gm.L-1	40.53 fg	43.06 c-f	45.38 a-d	42.99 a
	8gm.L-1	42.31 d-g	44.33 b-e	46.93 ab	44.52 a
Two-way interaction Cultivars ×Cal-Boron	Cultivars		CalBoron ml.L^{-1}		Main effect of Cultivars
	Rubygem	42.06 c	43.47 bc	46.88 a	44.14 a
	Albion	39.92 d	42.74 c	45.06 ab	42.57 b
Two-way interaction Cal-Boron × Algae	Algae gm.L^{-1}		Cal-Boron ml.L^{-1}		Main effect of Algae
		0	0.5ml.L^{-1}	1.0ml.L^{-1}	
	0	38.37 e	41.58 d	44.40 bc	41.45 b
	4gm.L-1	42.64 cd	43.17 cd	46.06 ab	43.96 a
	8gm.L-1	41.96 d	44.58 bc	47.45 a	44.66 a
Main effect of CalBoron		40.99 c	43.11 b	45.97 a	

Means of each factor and their interactions, followed by different letters, are significantly different from each other according to Duncan's multiple range test at 5%.

3. Leaf nitrogen percentage %

Table (3) displays that the effects of Strawberry cultivars, Alga 600, and Cal-Boron on the leaf nitrogen percentage were significantly influenced by cultivars, the differences were significant, and the highest value of leaf nitrogen percentage was obtained on Albion, which was (2.11%). The lowest values were obtained on Rubygem, (1.92%). The Alga 600 showed significant results, with 8gm.L^{-1}, the recording values of (2.20%) compared with the control were (1.83 %). Regarding the effect of the foliar spray Cal-Boron, had non-significantly result. The results from the same tables indicated that the interaction between (Algae 600 and Cal-Boron) showed a significant difference in leaf nitrogen percentage, the highest mean value was obtained from the interaction between 8gm.L^{-1} and 1.0ml. L^{-1} was (2.36%) compared with the lowest value of (1.74%) from 0.0 gm. L^{-1} Algae 600 and 1.0ml. L^{-1} Cal-Boron.

The triple interaction among (cultivars, Algae 600and Cal-Boron) significantly affected leaf nitrogen percentage. The maximum plant leaf nitrogen percentage of (2.53%) was obtained as Concerning the bilateral interaction between (cultivars and Algae 600), the effects were significant as obtained from the interaction between Albion and 8gm. L^{-1},

which recorded the highest value, (2.30%), compared with the Rubygem and 0.0 gm. L^{-1}, of Algae 600 was recorded as (1.81%).The interaction between the Cultivars and Cal-Boron had a significant effect. The results indicated that the interaction of Albion and 1.0 ml**.** L^{-1} appeared to be the most operative treatment as it gave the highest leaf nitrogen percentage, (2.17%), compared with the lowest (1.89%). a result of interaction among Albion, 8gm.L^{-1} Algae 600-, and 1.0-ml. L^{-1} Cal-Boron. The lowest values were recorded (1.73) with Albion**,** 0.0 gm. L^{-1} Algae 600, and 1. 0ml.L^{-1} Cal-Boron.

Table (3): Effectiveness of Alga 600, Cal-Boron and their interaction on Leaf Nitrogen Percentage % of Two Strawberry cultivars

Cultivars	Algae gm.L^{-1}	Three-way interaction cultivars × Cal-Boron × Algae			Two-way effect of Cultivars × Algae
		Cal-Boron ml.L^{-1}			
		0	0.5ml.L^{-1}	1.0ml.L^{-1}	
Rubygem	0	1.86 e-h	1.82 e-h	1.76 gh	1.81 c
	4gm.L^{-1}	1.90 e-h	1.79 f-h	1.88 e-h	1.85 c
	8gm.L-1	1.92 e-g	2.22 c	2.19 c	2.11 b
Albion	0	1.97 d-f	1.88 e-h	1.73 h	1.86 c
	4gm.L-1	2.11 e	2.18 c	2.25 bc	2.18 ab
	8gm.L-1	1.99 de	2.39 ab	2.53 a	2.30 a
Two-way interaction Cultivars × Cal-Boron	Cultivars		Cal-Boron ml.L^{-1}		Main effect of Cultivars
	Rubygem	1.89 b	1.94 b	1.94 b	1.92 b
	Albion	2.02 ab	2.15 a	2.17 a	2.11 a
Two-way interaction Cal-Boron× Algae	Algae gm.L^{-1}	Cal-Boron ml.L^{-1}			Main effect of Algae
		0	0.5ml.L^{-1}	1.0ml.L^{-1}	
	0	1.91 b-d	1.85 cd	1.74 d	1.83 c
	4gm.L-1	2.00 bc	1.98 bc	2.06 b	2.02 b
	8gm.L-1	1.95 bc	2.30 a	2.36 a	2.20 a
Main effect of CalBoron		1.95 a	2.04 a	2.05 a	

Means of each factor and their interactions, followed by different letters, are significantly different from each other according to Duncan's multiple range test at 5%.

Leaf phosphorus percentage %

Data in Table 4 illustrates that the effects of the interaction between the Cultivars and Cal-Boron had a significant effect. The results indicated that the interaction of Albion and 0.5 ml**.** L^{-1} appeared to be the most operative treatment as it gave the highest leaf phosphorus percentage, (0.222%), compared with the lowest (0.162%).Strawberry cultivars, Alga 600, and Cal-Boron on the leaf phosphorus percentage were significantly influenced by cultivars, the differences were significant, and the highest value of leaf phosphorus percentage was obtained on Albion, which was (0.214%). The lowest values were obtained on Rubygem, (0.165%). The Alga 600 showed significant results, with 8gm.L^{-1}, the recording values of (0.214%) compared with the control were (0.168). Regarding the effect of the foliar spray Cal-Boron, foliar plants with a concentration of 0.5 ml. L-1 resulted significant increase in leaf phosphorus percentage. Plants treated recorded higher values of leaf phosphorus percentage, (0.192%), compared to the control was recorded as (0.186). Concerning the bilateral interaction between (cultivars and Algae 600), the effects were significant as obtained from the interaction between Albion and 8gm. L^{-1}, which recorded the highest value, (0.236%), compared with the Rubygem and 0.0 gm. L^{-1}, of Algae 600 was recorded as (0.142%). The results from the same tables indicated that the interaction between (Algae 600 and Cal-Boron) showed a significant difference in leaf phosphorus percentage, the highest mean value was obtained from the interaction between 8gm.L^{-1} and 0.5ml. L^{-1} was (0.225%) compared with the lowest value of (0.165%) from 0.0 gm. L^{-1} Algae 600 and 0.5ml. L^{-1}Cal-Boron. The triple interaction among (cultivars, Algae 600and Cal-Boron) significantly affected plant leaf phosphorus percentage. The maximum plant leaf

phosphorus percentage of (0.254%) was obtained as a result of interaction among Albion, 8gm.L^{-1} Algae 600-, and 0.5-ml. L^{-1} Cal-Boron. The lowest values were recorded (0.140%) with Rubygem**,** 0.0 gm. L^{-1} Algae 600, and 0. 5ml.L^{-1} Cal-Boron.

Table (4): Effectiveness of Alga 600, Cal-Boron and their interaction on Leaf Phosphorus Percentage% of Two Strawberry cultivars

Cultivars	Algae gm.L^{-1}	Three-way interaction cultivars × Cal-Boron × Algae			Two-way effect of Cultivars × Algae
		Cal-Boron ml.L^{-1}			
		0	0.5ml.L^{-1}	1.0ml.L^{-1}	
Rubygem	0	0.141 f	0.140 f	0.146 f	0.142 e
	4gm.L^{-1}	0.164 d-f	0.152 ef	0.169 d-f	0.162 d
	8gm.L-1	0.185 c-e	0.195 cd	0.193 cd	0.191 c
Albion	0	0.192 cd	0.191 cd	0.199 b-d	0.194 c
	4gm.L-1	0.200 b-d	0.222 a-c	0.218 a-c	0.213 b
	8gm.L-1	0.236 ab	0.254 a	0.219 a-c	0.236 a
Two-way interaction Cultivars × Cal-Boron	Cultivars	CalBoron ml.L^{-1}			Main effect of Cultivars
	Rubygem	0.163 c	0.162 c	0.169 c	0.165 b
	Albion	0.210 b	0.222 a	0.212 b	0.214 a
Two-way interaction Cal-Boron× Algae	Algae gm.L^{-1}	Cal-Boron ml.L^{-1}			Main effect of Algae
		0	0.5ml.L^{-1}	1.0ml.L^{-1}	
	0	0.166 cd	0.165 d	0.172 b-d	0.168 c
	4gm.L-1	0.182 b-d	0.187 a-d	0.194 a-d	0.187 b
	8gm.L-1	0.211 ab	0.225 a	0.206 a-c	0.214 a
Main effect of CalBoron		0.186 b	0.192 a	0.191 a	

Means of each factor and their interactions, followed by different letters, are significantly different from each other according to Duncan's multiple range test at 5%.

Leaf Calcium Percentage %

Results in table (5) illustrated that the effects of Strawberry cultivars, Alga 600, and Cal-Boron on the leaf calcium percentage were significantly influenced by cultivars, the differences were significant, and the highest value of leaf calcium percentage was obtained on Albion, which was (2.48%). The lowest values were obtained on Rubygem, (2.26%). The Alga 600 showed significant results, with 8gm.L^{-1}, the recording values of (2.64%) compared with the control were (2.06%). Regarding the effect of the foliar spray Cal-Boron, foliar plants with a concentration of 1.0 ml. L-1 resulted significant increase in leaf calcium percentage. Plants treated recorded higher values of leaf calcium percentage, (2.48%), compared to the control was recorded as (2.25%).

Concerning the bilateral interaction between (cultivars and Algae 600), the effects were significant as obtained from the interaction between Albion and 8gm. $L^{-1,}$ which recorded the highest value, (2.76%), compared with the Rubygem and 0.0 gm. L^{-1}, of Algae 600 was recorded as (2%). The interaction between the Cultivars and Cal-Boron had a significant effect. The results indicated that the interaction of Albion and 1.0 ml**.** L^{-1} appeared to be the most operative treatment as it gave the highest leaf calcium percentage, (2.58%), compared with the lowest (2.14%). The results from the same tables indicated that the interaction between (Algae 600 and Cal-Boron) showed a significant difference in leaf calcium percentage, the highest mean value was obtained from the interaction between 8gm.L^{-1} and 1.0ml. L^{-1} was (2.72%) compared with the lowest value of (1.93%) from 0.0 gm. L^{-1} Algae 600 and 0.0ml. L^{-1} Cal-Boron. The triple interaction among (cultivars, Algae 600and Cal-Boron) significantly affected plant leaf calcium percentage. The maximum plant leaf calcium percentage of (2.83%) was obtained as a result of interaction among Albion, 8gm.L^{-1} Algae 600-, and 1.0-ml. L^{-1} Cal-Boron. The lowest values were recorded (1.87%) with Rubygem**,** 0.0 gm. L^{-1} Algae 600, and 0. 0ml.L^{-1} Cal-Boron.

Table (5): Effectiveness of Alga 600, Cal-Boron and their interaction on Leaf Calcium Percentage % of Two Strawberry cultivars

Cultivars	Algae gm.L^{-1}	Three-way interaction cultivars × Cal-Boron × Algae			Two-way effect of Cultivars × Algae
		Cal-Boron ml.L^{-1}			
		0	0.5ml.L^{-1}	1.0ml.L^{-1}	
Rubygem	0	1.87 g	1.97 fg	2.17 c-g	2.00 d
	4gm.L^{-1}	2.12 e-g	2.25 c-f	2.37 c-e	2.24 c
	8gm.L-1	2.43 b-d	2.56 ab	2.61 ab	2.53 b
Albion	0	1.99 e-g	2.12 d-g	2.24 c-f	2.11 cd
	4gm.L-1	2.44 bc	2.56 ab	2.67 ab	2.56 b
	8gm.L-1	2.68 ab	2.77 a	2.83 a	2.76 a
Two-way interaction Cultivars × Cal-Boron	Cultivars		Cal-Boron ml.L^{-1}		Main effect of Cultivars
	Rubygem	2.14 c	2.26 bc	2.38 a-c	2.26 b
	Albion	2.37 a-c	2.48 ab	2.58 a	2.48 a
Two-way interaction Cal-Boron× Algae	Algae gm.L^{-1}	Cal-Boron ml.L^{-1}			Main effect of Algae
		0	0.5ml.L^{-1}	1.0ml.L^{-1}	
	0	1.93 e	2.04 de	2.20 cd	2.06 c
	4gm.L-1	2.28 c	2.41 bc	2.52 ab	2.40 b
	8gm.L-1	2.55 ab	2.66 a	2.72 a	2.64 a
Main effect of CalBoron		2.25 b	2.37 ab	2.48 a	

Means of each factor and their interactions, followed by different letters, are significantly different from each other according to Duncan's multiple range test at 5%.

Fruit weight (g)

The table (6) explains that the effects of Strawberry cultivars, Alga 600, and Cal-Boron on the fruit weight were significantly influenced by cultivars, the differences were significant, and the highest value of fruit weight was obtained on Rubygem, which was (16.16 g). The lowest values were obtained on Albion, (13.89 g). The Alga 600 showed significant results, with 8gm.L^{-1}, the recording values of (17.70 g) compared with the control were (13.02 g). Regarding the effect of the foliar spray Cal-Boron, foliar plants with a concentration of 1.0 ml. L-1 resulted significant increase in fruit weight. Plants treated recorded higher values of fruit weight, (17.34g), compared to the control was recorded as (12.72 g). Concerning the bilateral interaction between (cultivars and Algae 600), the effects were significant as obtained from the interaction between Rubygem and 8gm. $L^{-1,}$ which recorded the highest value, (18.76 g), compared with the Albion and 0.0 gm. L^{-1}, of Algae 600 was recorded as (11.66 g). The interaction between the Cultivars and Cal-Boron had a significant effect.

The results indicated that the interaction of Rubygem and 1.0 ml**.** L^{-1} appeared to be the most operative treatment as it gave the highest fruit weight, (18.82 g), compared with the lowest (12.15 g). The results from the same tables indicated that the interaction between (Algae 600 and Cal-Boron) showed a significant difference in fruit weight, the highest mean value was obtained from the interaction between 8gm.L^{-1} and 1.0ml. L^{-1} was (20.79 g) compared with the lowest value of (10.97 g) from 0.0 gm. L^{-1} Algae 600 and 0.0ml. L^{-1} Cal-Boron. The triple interaction among (cultivars, Algae 600and Cal-Boron) significantly affected fruit weight. The maximum fruit weight of (22.65 g) was obtained as a result of interaction among Rubygem, 8gm.L^{-1} Algae 600-, and 1.0-ml. L^{-1} Cal-Boron. The lowest values were recorded (10.29 g) with Albion**,** 0.0 gm. L^{-1} Algae 600, and 0. 0ml.L^{-1} Cal-Boron.

Table (6): Effectiveness of Alga 600, Cal-Boron and their interaction on Fruit Weight (g) of Two Strawberry cultivars

Cultivars	Algae gm.L^{-1}	Three-way interaction cultivars × Cal-Boron × Algae			Two-way effect of Cultivars × Algae
		Cal-Boron ml.L^{-1}			
		0	0.5ml.L^{-1}	1.0ml.L^{-1}	
Rubygem	0	11.66 ef	14.70 b-e	16.79 b-d	14.38 cd
	4gm.L^{-1}	13.41 d-f	15.58 b-e	17.03 b-d	15.34 bc
	8gm.L-1	14.81 b-e	18.80 a-c	22.65 a	18.76 a
Albion	0	10.29 f	11.59 ef	13.11 d-f	11.66 d
	4gm.L-1	11.73 ef	12.80 d-f	15.55 b-e	13.36 cd
	8gm.L-1	14.43 c-f	16.55 b-d	18.93 ab	16.64 ab
Two-way interaction Cultivars ×Cal-Boron	Cultivars		CalBoron ml.L^{-1}		Main effect of Cultivars
	Rubygem	13.29 cd	16.36 ab	18.82 a	16.16 a
	Albion	12.15 d	13.65 cd	15.86 bc	13.89 b
Two-way interaction Cal-Boron × Algae	Algae gm.L^{-1}	Cal-Boron ml.L^{-1}			Main effect of Algae
		0	0.5ml.L^{-1}	1.0ml.L^{-1}	
	0	10.97 e	13.15 de	14.95 b-d	13.02 c
	4gm.L-1	12.57 de	14.19 cd	16.29 bc	14.35 b
	8gm.L-1	14.62 cd	17.68 b	20.79 a	17.70 a
Main effect of CalBoron		12.72 c	15.00 b	17.34 a	

Means of each factor and their interactions, followed by different letters, are significantly different from each other according to Duncan's multiple range test at 5%.

Fruit size (cm^3)

Data in Table 7 illustrates that the effects of Strawberry cultivars, Alga 600, and Cal-Boron on the fruit size were significantly influenced by cultivars, the differences were significant, and the highest value of fruit size was obtained on Rubygem, which was (13.28 cm^3). The lowest values were obtained on Albion, (12.36 cm^3). The Alga 600 showed significant results, with 8gm.L^{-1}, the recording values of (15.60 cm^3) compared with the control were (10.69 cm^3). Regarding the effect of the foliar spray Cal-Boron, foliar plants with a concentration of 1.0 ml. L-1 resulted significant increase in fruit size. Plants treated recorded higher values of fruit size, (13.88 cm^3), compared to the control was recorded as (11.82 cm^3). Concerning the bilateral interaction between (cultivars and Algae 600), the effects were significant as obtained from the interaction between Rubygem and 8gm. L$^{-1,}$ which recorded the highest value, (16.36 cm^3), compared with the Albion and 0.0 gm. L^{-1}, of Algae 600 was recorded as (10.02 cm^3). The interaction between the Cultivars and Cal-Boron had a significant effect. The results indicated that the interaction of Rubygem and 1.0 ml**.** L-**1** appeared to be the most operative treatment as it gave the highest fruit size, (14.71 cm^3), compared with the lowest (11.65 cm^3). The results from the same tables indicated that the interaction between (Algae 600 and Cal-Boron) showed a significant difference in fruit size, the highest mean value was obtained from the interaction between 8gm.L^{-1} and 1.0ml. L^{-1} was (17.36 cm^3) compared with the lowest value of (11.65 cm^3) from 0.0 gm. L^{-1} Algae 600 and 0.0ml. L^{-1} Cal-Boron. The triple interaction among (cultivars, Algae 600and Cal-Boron) significantly affected fruit size. The maximum fruit size of (19.50 cm^3) was obtained as a result of interaction among Rubygem, 8gm.L^{-1} Algae 600-, and 1.0-ml. L^{-1} Cal-Boron. The lowest values were recorded (9.41 cm^3) with Albion**,** 0.0 gm. L^{-1} Algae 600, and 0. 0ml.L^{-1} Cal-Boron.

Table (7): Effectiveness of Alga 600, Cal-Boron and their interaction on Fruit Size (cm3) of Two Strawberry cultivars

Cultivars	Algae gm.L^{-1}	Three-way interaction cultivars × Cal-Boron × Algae			Two-way effect of Cultivars × Algae
		Cal-Boron ml.L^{-1}			
		0	0.5ml.L^{-1}	1.0ml.L^{-1}	
Rubygem	0	10.75 g-i	11.40 e-i	11.95 e-h	11.36 cd
	4gm.L^{-1}	11.57 e-i	12.05 e-h	12.69 d-g	12.10 c
	8gm.L-1	13.65 c-e	15.94 b	19.50 a	16.36 a
Albion	0	9.41 i	10.01 hi	10.63 g-i	10.02 d
	4gm.L-1	11.15 f-i	12.26 d-h	13.29 c-f	12.23 c
	8gm.L-1	14.39 b-d	14.92 bc	15.22 bc	14.84 b
Two-way interaction Cultivars ×Cal-Boron	Cultivars		Cal-Boron ml.L^{-1}		Main effect of Cultivars
	Rubygem	11.99 b	13.13 ab	14.71 a	13.28 a
	Albion	11.65 b	12.40 ab	13.05 ab	12.36 b
Two-way interaction Cal-Boron × Algae	Algae gm.L^{-1}		Cal-Boron ml.L^{-1}		Main effect of Algae
		0	0.5ml.L^{-1}	1.0ml.L^{-1}	
	0	10.08 f	10.70 ef	11.29 d-f	10.69 c
	4gm.L-1	11.36 d-f	12.15 de	12.99 cd	12.17 b
	8gm.L-1	14.02 bc	15.43 b	17.36 a	15.60 a
Main effect of CalBoron		11.82 b	12.76 ab	13.88 a	

Means of each factor and their interactions, followed by different letters, are significantly different from each other according to Duncan's multiple range test at 5%.

Total yield per plant (g)

According to the table (8) illustrates that the effects of Strawberry cultivars, Alga 600, and Cal-Boron on the yield of the plant were significantly influenced by cultivars, the differences were significant, and the highest value of yield of the plant was obtained on Rubygem, which was (234.18 g). The lowest values were obtained on Albion, (206.26 g). The Alga 600 showed significant results, with 8gm.L^{-1}, the recording values of (295.46 g) compared with the control were (169.42 g). Regarding the effect of the foliar spray Cal-Boron, foliar plants with a concentration of 1.0 ml. L-1 resulted significant increase in yield of the plant. Plants treated recorded higher values of yield of the plant, (260.17 g), compared to the control was recorded as (168.32 g). Concerning the bilateral interaction between (cultivars and Algae 600), the effects were significant as obtained from the interaction between Rubygem and 8gm. L$^{-1,}$ which recorded the highest value, (315.95 g), compared with the Albion and 0.0 gm. L^{-1}, of Algae 600 was recorded as (149.17 g). The interaction between the Cultivars and Cal-Boron had a significant effect. The results indicated that the interaction of Albion and 1.0 ml**.** L-**1** appeared to be the most operative treatment as it gave the highest yield of the plant, (263.88 g), compared with the lowest (145.25 g). The results from the same tables indicated that the interaction between (Algae 600 and Cal-Boron) showed a significant difference in yield of the plant, the highest mean value was obtained from the interaction between 8gm.L^{-1} and 1.0ml. L^{-1} was (361.40 g) compared with the lowest value of (125.60 g) from 0.0 gm. L^{-1} Algae 600 and 0.0ml. L^{-1} Cal-Boron. The triple interaction among (cultivars, Algae 600and Cal-Boron) significantly affected yield of the plant. The maximum yield of the plant of (375.30 g) was obtained as a result of interaction among Rubygem, 8gm.L^{-1} Algae 600-, and 1.0-ml. L^{-1} Cal-Boron. The lowest values were recorded (94.02 g) with Albion**,** 0.0 gm. L^{-1} Algae 600, and 0. 0ml.L^{-1} Cal-Boron.

Table (8): Effectiveness of Alga 600, Cal-Boron and their interaction on Yield of the Plant (g) of Two Strawberry cultivars

Cultivars	Algae gm.L^{-1}	Three-way interaction cultivars × Cal-Boron × Algae			Two-way effect of Cultivars × Algae
		Cal-Boron ml.L^{-1}			
		0	0.5ml.L^{-1}	1.0ml.L^{-1}	
Rubygem	0	157.18 g	222.06 d-f	189.79 d-g	189.68 c
	4gm.L^{-1}	172.73 fg	213.69 d-f	204.29 d-g	196.90 c
	8gm.L-1	244.28 cd	328.29 ab	375.30 a	315.95 a
Albion	0	94.02 h	152.69 g	200.80 d-g	149.17 d
	4gm.L-1	152.07 g	188.46 f-h	243.35 c-e	194.63 c
	8gm.L-1	189.65 d-g	287.75 bc	347.50 ab	274.97 b
Two-way interaction Cultivars × Cal-Boron	Cultivars		CalBoron ml.L^{-1}		Main effect of Cultivars
	Rubygem	191.40 b	254.68 ab	256.46 ab	234.18 a
	Albion	145.25 c	209.63 b	263.88 a	206.26 b
Two-way interaction Cal-Boron× Algae	Algae gm.L^{-1}		Cal-Boron ml.L^{-1}		Main effect of Algae
		0	0.5ml.L^{-1}	1.0ml.L^{-1}	
	0	125.60 e	187.37 cd	195.30 cd	169.42 c
	4gm.L-1	162.40 de	201.07 cd	223.82 c	195.76 b
	8gm.L-1	216.97 c	308.02 b	361.40 a	295.46 a
Main effect of CalBoron		168.32 c	232.16 b	260.17 a	

Means of each factor and their interactions, followed by different letters, are significantly different from each other according to Duncan's multiple range test at 5%.

Total Soluble Solids/ Total Treatable Acidity Ratio (TSS/TTA)

Results in table (9) illustrates that the effects of Strawberry cultivars, Alga 600, and Cal-Boron on the TSS\TAA were significantly influenced by cultivars, the differences were significant, and the highest value of TSS\TAA was obtained on Rubygem, which was (15.05 %). The lowest values were obtained on Albion, (13.24 %). The Alga 600 showed significant results, with 4gm.L^{-1}, the recording values of (16.53 %) compared with the control were (11.16 %). Regarding the effect of the foliar spray Cal-Boron, foliar plants with a concentration of 0.5 ml. L-1 resulted significant increase in TSS\TAA. Plants treated recorded higher values of TSS\TAA, (15.23 %), compared to the control was recorded as (12.85 %). Concerning the bilateral interaction between (cultivars and Algae 600), the effects were significant as obtained from the interaction between Rubygem and 8gm. L$^{-1,}$ which recorded the highest value, (16.69 %), compared with the Albion and 0.0 gm. L^{-1}, of Algae 600 was recorded as (10.43 %). The interaction between the Cultivars and Cal-Boron had a significant effect. The results indicated that the interaction of Rubygem and 0.5 ml**.** L-**1** appeared to be the most operative treatment as it gave the highest TSS\TAA, (15.90 %), compared with the lowest (12.07 %). The results from the same tables indicated that the interaction between (Algae 600 and Cal-Boron) showed a significant difference in TSS\TAA, the highest mean value was obtained from the interaction between 4gm.L^{-1} and 0.5ml. L^{-1} was (17.95 %) compared with the lowest value of (9.67 %) from 0.0 gm. L^{-1} Algae 600 and 0.0ml. L^{-1} Cal-Boron. The triple interaction among (cultivars, Algae 600and Cal-Boron) significantly affected TSS\TAA. The maximum TSS\TAA of (18.30 %) was obtained as a result of interaction among Albion, 4gm.L^{-1} Algae 600-, and 0.5-ml. L^{-1} Cal-Boron. The lowest values were recorded (8.92 %) with Albion**,** 0.0 gm. L^{-1} Algae 600, and 0. 0ml.L^{-1} Cal-Boron.

Table (9): Effectiveness of Alga 600, Cal-Boron and their interaction on Fruit Total Soluble Solids/ Total Titratable Acidity (TSS/TTA) of Two Strawberry cultivars

Cultivars	Algae gm.L^{-1}	Three-way interaction cultivars × Cal-Boron × Algae			Two-way effect of Cultivars × Algae
		Cal-Boron ml.L^{-1}			
		0	0.5ml.L^{-1}	1.0ml.L^{-1}	
Rubygem	0	10.41 gh	12.76 e-g	12.49 e-g	11.89 bc
	4gm.L^{-1}	14.72 c-e	17.60 ab	17.41 a-c	16.58 a
	8gm.L-1	15.74 a-d	17.32 a-c	17.02 a-d	16.69 a
Albion	0	8.92 h	11.08 gh	11.29 gh	10.43 c
	4gm.L-1	14.79 b-e	18.30 a	16.34 a-d	16.47 a
	8gm.L-1	12.50 e-g	14.29 d-f	11.66 f-h	12.82 b
Two-way interaction Cultivars × Cal-Boron	Cultivars		Cal-Boron ml.L^{-1}		Main effect of Cultivars
	Rubygem	13.62 a-c	15.90 a	15.64 ab	15.05 a
	Albion	12.07 c	14.56 a-c	13.10 bc	13.24 b
Two-way interaction Cal-Boron× Algae	Algae gm.L^{-1}	Cal-Boron ml.L^{-1}			Main effect of Algae
		0	0.5ml.L^{-1}	1.0ml.L^{-1}	
	0	9.67 e	11.92 d	11.89 d	11.16 c
	4gm.L-1	14.76 bc	17.95 a	16.87 ab	16.53 a
	8gm.L-1	14.12 c	15.81 a-c	14.34 c	14.75 b
Main effect of CalBoron		12.85 c	15.23 a	14.37 b	

Means of each factor and their interactions, followed by different letters, are significantly different from each other according to Duncan's multiple range test at 5%.

Anthocyanin Content (mg.100g-1 F.W.) According to the table (10) illustrates that the effects of Strawberry cultivars, Alga 600, and Cal-Boron on the fruit anthocyanin were significantly influenced by cultivars, the differences were significant, and the highest value of fruit anthocyanin was obtained on Rubygem, which was (42.31 mg.100g^{-1} F. Wt). The lowest values were obtained on Albion, (40.24 mg.100g^{-1} F. Wt). The Alga 600 showed significant results, with 8gm.L^{-1}, the recording values of (44.76 mg.100g^{-1} F. Wt) compared with the control were (38.82 mg.100g^{-1} F. Wt). Regarding the effect of the foliar spray Cal-Boron, foliar plants with a concentration of 0.5 ml. L-1 resulted significant increase in fruit anthocyanin. Plants treated recorded higher values of fruit anthocyanin, (45.32 mg.100g^{-1} F. Wt), compared to the control was recorded as (35.17 mg.100g^{-1} F. Wt).Concerning the bilateral interaction between (cultivars and Algae 600), the effects were significant as obtained from the interaction between Rubygem and 8gm. L^{-1}, which recorded the highest value, (46.27 mg.100g^{-1} F. Wt), compared with the Albion and 0.0 gm. L^{-1}, of Algae 600 was recorded as (38.17 mg.100g^{-1} F. Wt). The interaction between the Cultivars and Cal-Boron had a significant effect. The results indicated that the interaction of Rubygem and 0.5 ml**.** L-**1** appeared to be the most operative treatment as it gave the highest fruit anthocyanin, (46.27 mg.100g^{-1} F. Wt), compared with the lowest (33.84 mg.100g^{-1} F. Wt). The results from the same tables indicated that the interaction between (Algae 600 and Cal-Boron) showed a significant difference in fruit anthocyanin, the highest mean value was obtained from the interaction between 8gm.L^{-1} and 0.5ml. L^{-1} was (48.63 mg.100g^{-1} F. Wt) compared with the lowest value of (32.11 mg.100g^{-1} F. Wt) from 0.0 gm. L^{-1} Algae 600 and 0.0ml. L^{-1} Cal-Boron. The triple interaction among (cultivars, Algae 600and Cal-Boron) significantly affected fruit anthocyanin. The maximum fruit anthocyanin of (49.89 mg.100g^{-1} F. Wt) was obtained as a result of interaction among Rubygem, 8gm.L^{-1} Algae 600-, and 0.5-ml. L^{-1} Cal-Boron. The lowest values were recorded (31.49 mg.100g^{-1} F. Wt) with Albion**,** 0.0 gm. L^{-1} Algae 600, and 0. 0ml.L^{-1} Cal-Boron.

Table (10): Effectiveness of Alga 600, Cal-Boron and their interaction on fruit anthocyanin content (mg.100g-1 F.Wt.) of Two Strawberry cultivars

Cultivars	Algae gm.L^{-1}	Three-way interaction cultivars × Cal-Boron × Algae			Two-way effect of Cultivars × Algae
		Cal-Boron ml.L^{-1}			
		0	0.5ml.L^{-1}	1.0ml.L^{-1}	
Rubygem	0	32.73 h	43.90 cd	41.75 de	39.46 bc
	4gm.L^{-1}	35.03 g	45.02 bc	43.58 cd	41.21 bc
	8gm.L-1	41.72 de	49.89 a	47.21 b	46.27 a
Albion	0	31.49 h	43.14 cd	39.89 e	38.17 c
	4gm.L-1	32.67 h	42.58 cd	42.67 cd	39.31 bc
	8gm.L-1	37.37 g	47.38 b	44.99 bc	43.24 ab
Two-way interaction Cultivars × Cal-Boron	Cultivars		Cal-Boron ml.L^{-1}		Main effect of Cultivars
	Rubygem	36.49 c	46.27 a	44.18 ab	42.31 a
	Albion	33.84 d	44.36 ab	42.51 b	40.24 b
Two-way interaction Cal-Boron× Algae	Algae gm.L^{-1}	Cal-Boron ml.L^{-1}			Main effect of Algae
		0	0.5ml.L^{-1}	1.0ml.L^{-1}	
	0	32.11 e	43.52 c	40.82 d	38.82 c
	4gm.L-1	33.85 e	43.80 c	43.13 c	40.26 b
	8gm.L-1	39.54 d	48.63 a	46.10 b	44.76 a
Main effect of CalBoron		35.17 c	45.32 a	43.35 b	

Means of each factor and their interactions, followed by different letters, are significantly different from each other according to Duncan's multiple range test at 5%.

Discussion

The cultivar Rubygem exceeded the cultivar Albion in terms of leaf area (cm^2) and leaf calcium content, as well as fruit size (cm^3), TSS/TTA, and anthocyanin concentration (mg.100g-1 F.W). This is because the two cultivars have different genetics. The tables clearly indicate this**.** (1–10) Fruit size (cm3), yield per plant (g/plant), total chlorophyll content (mg. 100g-1), leaf nitrogen percentage, leaf phosphorus percentage, leaf calcium percentage, leaf area (cm2), yield per plant (g/plant), (TSS/TTA), and anthocyanin content (mg. 100g-1 F.W.) all significantly improved after the strawberry plant was sprayed with three doses of algae and Cal-Boron.

These results are in agreement with those of the current findings about the impact of foliar spraying two strawberry cultivars (Rubygem and Albion) with three concentrations of Algae 600 on their vegetative development characteristics may be related to the application of Algae 600, which improved internal plant metabolism, due to the presence of major and minor elements, and organic substances that include plant growth regulators such as cytokines, auxins, and gibberellins, which improved vegetative growth, leaf area, and Furthermore, foliar spray of Algae 600 could provide adequate levels of growth-promoting chemicals, which stimulate cell division and cell expansion, resulting in a better yield **[15] and [13].**

Seaweed extract has been reported to improve the chlorophyll content and leaf vegetative growth of peach plants. More so than other plants, algae are a rich source of nutrients that are vital to health, such as fiber, minerals, proteins, vitamins, and fatty acids. By spraying twice, algae can promote root and vegetative growth. The effect of algae in promoting growth and strengthening crop stress resistance may be linked to strawberry cultivars by algae at varying concentrations **[16].** Microalgae that promote plant growth, such as prokaryotic cyanobacteria and eukaryotic microalgae, produce phytohormones, which are primarily composed of natural hormones that influence plant growth and development, such as auxin, cytokinin, gibberellin, and abscisic acid, as well as other active substances like polysaccharides, sugar alcohol, betaine, and phenolic compounds **[17].**

These results are consistent with those found [18] using the data shown in tables (1–10). Leaf area (cm2), total chlorophyll content (mg. 100g-1), leaf nitrogen percentage, leaf phosphorus percentage, leaf calcium percentage, fruit

size (cm3), yield per plant (g/plant), (TSS/TTA), and anthocyanin content (mg.100g-1 F.W) were all clearly increased by the foliar application with three concentrations Alga 600. These findings are consistent with those of **[19] and [17].** Using calcium and boron to improve vegetative growth characteristics may be advantageous for nearly all living things. A vital macronutrient, calcium is required for numerous plant metabolic functions, including respiration, cell division, and photosynthesis. Maintaining the stability of the membrane, the cell wall's structure, and the regulation of enzyme activity all depend on it. Additionally, calcium aids in the plant's absorption and transfer of nutrients, enhancing fruit development and quality **[20].** Boron is an essential micronutrient since it is required for various plant metabolic activities, including cell division, elongation, and differentiation. In addition to respiration and photosynthesis, it is required for the synthesis of proteins, carbohydrates, and nucleic acids. Because it plays an important function in the cross-linking of pectic polysaccharides **[21].**

According our results the data unambiguously determines that foliar application of Cal-Boron, particularly at high concentration (1.0 ml. L-1), significantly enhanced the quantity of fruit per plant, fruit weight, fruit size, yield per plant, and yield per area unit.

These findings are consistent found that the foliar application of three calcium-boron concentrations (0.0, 0.5%, and 1.0%) had an impact on the yield and quality of strawberry fruit. increased the leaves' chlorophyll and mineral content, which enhanced the fruit's quality when it was harvested. In particular, the treatment improved fruit firmness, boosted total soluble solids (TSS), and increased the contents of anthocyanin and ascorbic acid in the fruits **[22].**

Using algae 600 as a foliar fertilizer can help plants grow by increasing hormonal responses and nutrient uptake. We also examined at how Algae 600 and other nutrients, both essential and non-essential, affected plant growth. The world's agricultural economy depends heavily on vegetable plants, which are extensively grown in organic environments. Thus, natural materials such as Algae 600 are used extensively in plant cultivation over the globe. Due to their numerous functions in these domains, these compounds are utilized in roughly 65–70% of organic matter on arable land in different regions, impacting plant physiology and the environment **[23].**

Conclusion

The study showed that foliar application of Algae 600 and Cal-boron, Strawberry vegetative growth, production, and fruit quality were all considerably increased. Using (8 g L^{-1} Algae 600) and (1.0-mL L^{-1} Cal-boron) resulted in improved leaf area, chlorophyll content, leaf N, P, and Ca concentrations, as well as fruit weight, size, yield, and quality attributes. The Rubygem cultivar outperformed untreated plants in terms of yields. These enhancements are related to the synergistic benefits of Algae 600 as a bio-stimulant, as well as the critical functions of calcium and boron in plant growth, fruit development, and quality improvement.

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تأثير الرش بمستخلص الطحالب البحرية والكالبورون في بعض صفات النمو الخضري والحاصل لصنفين من الشليك (Albion ,Rubygem)

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الخلاصة

نفذت هذه الدراسة خلال موسم النمو 2024-2025، داخل البيت البلاستيكي التابع لقسم البستنة، الهندسة الحدائق، جامعة رابرين فى قلادزة العراق. لدراسة تأثير الرش مستخلص الطحالب البحرية و كال-بورون فى نمو وحاصل لصنفين من الشليك) و ابتداء من 1 نوفمبر 2024 إلى 1 مايو 2025 فى الصباح باستخدام الرش ست مرات أثناء إجارء التجربة بثلاثة مستويات مستخلص الطحالب البحرية) 0 و 4 و 8 (غم.لتر و ثلاثة مستويات كال-بورون) 0 و 0.5 و 1 (مل. لتر. الصنفين من الشليك (***Rubygem*** و ***Albion).*** نفذت التجربة وفقاً لتصميم القطاعات العشوائية الكاملة (***R.C.B.D)*** للتجارب العاملية و بثلاث مكررات و بواقع ست شتلات لكل وحدة تجريبية. أظهرت النتائج الرش الورقى (مستخلص الطحالب البحرية و كال-بورون) معنويا على مساحة الورقة ، حيث بلغت القيمة (78.45) من ***Rubygem*** باستخدام (8 غم/لتر مستخلص الطحالب البحرية و 1 مل/لتر كال-بورون). و كذلك لديهم تأثير معنوي على حجم الثمار، سجلت قيمة حجم الثمرة وهي (13.28) باستخدام (8) غم/لتر مستخلص الطحالب البحرية و 1 مل/لتر كال-بورون). و أيضا باستخدام (8 غم/لتر مستخلص الطحالب البحرية و 1 مل/لتر كال-بورون) تأثيرها معنوية على الأنثوسيانين و سجلت قيمة (42.31). بالإضافة إلى ذلك، فإن العلاقة بين (الصنف+ الأسمدة+التركيز) تأثرت معنويا على مساحة الورقة، حيث سجلت القيمة في ***Rubygem (88.41)*** سم٢ من خلال استخدام (8 غم/لتر مستخلص الطحالب البحرية و 1 مل/لتر كال-بورون). كما تأثرت معنويا على حجم الثمار وسجلت القيمة (19.50) في ***Rubygem*** ايضا مم خلال استخدام (8 غم/لتر مستخلص الطحالب البحرية و 1 مل/لتر كال-بورون). ولديها تأثير معنوي من خلال استخدام(0غم/لتر مستخلص الطحالب البحرية و 0 مل/لتر كال-بورون). في ***Albion*** حصل عله قيمة (31.49).

الكلمات المفتاحية: Rubygem، Albion، مستخلص الطحالب البحرية ، كال- بورون.