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# EFFECT OF SPRAYING COCONUT LIQUID AND MARINE ALGAE EXTRACT ON VEGETATIVE AND PRODUCTION PROPERTIES OF TWO TYPES OF STRAWBERRY *FRAGARIA ANANASSA* DUCH

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## Abstract

An experiment was carried out to study the effect of spraying liquid coconut and marine algae extract on vegetative and yield characteristics of two types of strawberry for the season 2019 at the Faculty of Agricultural Science Engineering, University of Baghdad. The experiment was Random Complete Block Design (RCBD) within the split-plot, where varieties are the main factor and the spraying parameters were the secondary factor. The experiment included using two types of strawberry: Albion (V1) and Rubygems (V2) and two types of fertilizers, coconut liquid (0, 10, 20%) and marine algae extract (0, 5, 10 ml.l$^{-1}$). The results showed the superiority of Rubygems in the increase of the number of leaves and leaf area compared to Albion, while there was no significant difference between the two varieties in the other qualities. The obtained results showed that spraying liquid coconut has a significant effect on vegetative and yield characteristics where C2 was superior with the highest plant height, the highest number of leaves, the largest leaf area, the highest content of chlorophyll in leaves, and the highest dry weight compared to C0. Spraying marine algae extract resulted in a superiority in K2 where the highest plant height, the highest number of leaves, the largest leaf area, the highest relative chlorophyll content in leaves and the highest dry weight compared to K0.

***Keywords*:** Strawberry, Coconut Liquid, Leaf Algae Extract, Varieties.

## Introduction

Strawberry (*Fragaria ananassa* Duch.) is a member of the Rosaceae family of small-scale fruit that is widespread in the world, native to America and extends from tropical and subtropical regions to cold areas (Darnell *et al*., 2003). It is name has been derived from the Latin word Fragrans and relatively short-lived, herbivorous plant adapted to a wide range of climatic conditions (Al-Ibrahim, 2002). The fruits are characterized by the beautiful red color, delicious taste and high nutritional value as an important source of vitamins A, B, C and minerals such as iron, calcium, potassium, phosphorus and zinc as well as their distinctive medical properties that are related to the nutrition and health of the human. The dipped strawberry leaves and plant roots was used as a treatment for tuberculosis, pulmonary infections, as a purifier for blood and gargle for sore throat in addition to that boiling leaves is useful for in the alleviation of asthma attacks, as well as fruits contain antioxidants that help to prevent diseases, especially cancer (Morgan, 2006, Shnikat *et al*., 2007, Margaret *et al*., 2007). The growth and development of the plant and the improvement of its productivity are controlled by several factors, including fertilization, which is one of the important and fundamental means of forming a plant capable of growing in a balanced manner and thus obtaining a good total vegetative and root yield. As a result of the increased use of chemical fertilizers and pesticides in recent years, and the emergence of many damage to human health through the accumulation of toxins and minerals in the body, which drew attention to the need to change these practices and the trend to the use of correct and balanced fertilization programs that provide the plant needs of nutrients in planting including the use of liquid coconut and marine algae extract as leaf fertilizers spray on plant vegetation as natural substances that do not have adverse effects on the environment and humans. Studies have shown that liquid coconut is an important source of vitamins and minerals such as potassium, sodium, calcium, magnesium, phosphorus, iron, zinc and copper, as well as containing amino acids and amides (Gupta, 1996, Crouch and Vanstaden, 2005). Attia *et al*. (2010) showed that spraying liquid coconut on the black bean plant gave positive results in improving vegetative growth of the plant, especially the use of 10% concentration, which gave a significant increase in stem diameter, number of branches, roots, dry weight of vegetative and root group. Mukhtar, (2008) found that spraying three concentrates of liquid coconut (0, 100, 200 ml.l$^{-1}$) on roselle plant (*Hibiscus sabdariffa L.*) improved plant growth, especially the 200 ml.l$^{-1}$ concentration, which was characterized by giving the highest plant height, the highest number of leaves, the highest content of chlorophyll in leaves. Furthermore, spraying date palm trees (type Al-Sayer) with coconut extract at concentration of 0, 100, 200, and 300 ml.l$^{-1}$ gave superiority in the increase of weight, length, diameter and size of fruit as well as the weight of the fleshy layer of the fruit, for both stages ripe and dry dates (Abbas and Lafta, 2014).

The marine algae extracts have been characterized by the presence of many nutrients and some growth regulators such as oxinates, gibberellins and amino acids, which improve vegetative and vegetative growth in the plant and increase its strength and thus increase the absorption of elements, which leads to increased productivity and improved quality (Spinelli *et al*., 2009, Spann and Little, 2011). Spinelli *et al*. (2010) indicated that spraying the Actiwave marine extract on strawberry plant had a positive effect on vegetative growth, with increase percentage of 10%, leaf content of chlorophyll 11%, photosynthesis rate, and significant increase in dry weight of branches by 27% and roots by 76 %. In a study conducted by Salih and Taha (2012) on two types of Celonca and Tethis to investigate the effect of spraying the marine-matrix extract (Matrix-15) at four levels (0, 1, 1.5, 2 ml.l$^{-1}$), the results showed that the spray treatment at concentration of 2 ml.l$^{-1}$ was superior in all vegetative growth characteristics and for both types. Taha,

(2008) have studied two varieties of strawberry plant, Hapil and Samling Kaiser's and demonstrated that a significant improvement in Hapil class in the total number of flowers per plant, the proportion of flowering flowers and the percentage of the fruit nodules.

## Materials and Methods

A field experiment was carried out during the winter season 2018-2019 at the Faculty of Agriculture, University of Baghdad, to study the effect of spraying on liquid coconut and marine algae extracts and their interaction in improving the vegetative growth characteristics of two different types of strawberry plant. The split plot design was used to divide the varieties in the main plots and the treatments in the secondary plots randomly within the RCBD design and with three replicates per treatment and three seedlings per experimental unit with a total of 162 seedlings. (Al-Sahuki and Wahib, 1990), the experiment included the use of two varieties of strawberry: Albion (V1) and Rubygems (V2) and the seedlings were planted on 15 of November 2018 in pots (5 kg) filled with loamy soil added to the peat moss by 2: 1 (2 soil -1 peat moss). The experiment also included the use of two types of fertilizer treatments: spray with liquid coconut at concentrations of 0, 10 and 20% and spray with marine algae extract at concentrations of 0, 5 and 10 ml.l$^{-1}$, as shown below:

$T_1$. Comparative control ($C_0K_0$).
$T_2$. Liquid Coconut (0%) + 5 ml.L$^{-1}$ of algae extract ($C_0K_1$).
$T_3$. Liquid Coconut liquid (0%) + 10 ml.L$^{-1}$ of algae extract ($C_0K_2$).
$T_4$. Liquid Coconut (10%) + 0 ml.L$^{-1}$ of algae extract at ($C_1K_0$).
$T_5$. Liquid Coconut (10%) + 5 ml.L$^{-1}$ of algae extract ($C_1K_1$).
$T_6$. Liquid Coconut (10%) + 10 ml.L$^{-1}$ of algae extract ($C_1K_2$).
$T_7$. Liquid Coconut (20%) + 0 ml.L$^{-1}$ of algae extract ($C_2K_0$).
$T_8$. Liquid Coconut (20%) + 5 ml.L$^{-1}$ of algae extract ($C_2K_1$).
$T_9$. Liquid Coconut (20%) + 10 ml.L$^{-1}$ of algae extract ($C_2K_2$).

The experimental treatments were randomly distributed to the seedlings. The spraying procedure was done every two weeks and for three months using a 10 liter hand spray until full wetness with the addition of a diffuser (liquid soap 0.1 ml.l$^{-1}$) to reduce the surface tension of the water molecules. Measurements were taken for experimental unit plants and included plant height (cm): Measured by using a metric bar from the contact area between stem and soil to the highest plant height, the total number of leaves per plant (leaf.plant$^{-1}$) was calculated and the average was recorded and the leaf area (dsm$^2$.plant$^{-1}$), which was calculated by taking 10 tablets (known area) of three leaves and dried in an oven at 65 °C until the stability of weight, then calculated the leaf area according to the following equation (Watson and Watson, 1953).

Leaf area (dsm$^2$) = (Leaf size of tablets × Dry weight of plant leaves)/Dry weight of tablets

The relative content of chlorophyll in SPAD UNIT was estimated by a chlorophyll meter by reading 6 leaves of plants per experimental unit and then averaged (Minnotti et al., 1994) and measured in SPAD UNIT units (Jemison and Williams, 2006). The samples were selected for the fifth and sixth leaves of the three plants and for each experimental unit. The leaves were then washed to remove the dust and dried in an electric oven at 70 °C until the weight was stable (Sahaf, 1989). The samples were then sampled and 0.2 g of the sample was minced and digested with 4 ml of acid (2%) of concentrated pyrochloric acid according to the method of Jones and Steyn, (1973). Nitrogen (N %) was estimated using the Micro Kjeldahl method according to the method of Jackson 1958. Phosphorus (P%) was estimated using ammonium polysaccharides and ascorbic acid with a spectrophotometer and 662 nanometers (Olsen and Sommers, 1982). Potassium (K %) was estimated by the Flame photometer as proposed by Haynes, (1980).

## Results and Discussion

**Plant height (cm):** The results in Table 1 showed that there was no significant differences between the varieties although Rubygems gave the highest plant height of 6.38 cm compared to Albion (6.28 cm). It was also observed that spraying the liquid coconut with different concentrations had a positive and significant effect on plant height. Spray treatment $C_2$ showed the highest plant height of 7.03 cm compared with $C_0$ which recorded the lowest plant height with mean of 5.59 cm. Similarly, spraying on algae extract had a significant effect on the increase in plant height where $K_2$ was superior by giving the highest plant height of 6.53 cm while $K_0$ gave the lowest height of the plant (6.12 cm). The interaction between the coconut and marine algae extracts had a significant effect on this increase. It was observed that the $C_2K_2$ increased the plant height by 7.28 cm compared to the lowest plant height at $C_0K_0$ (5.38 cm). The triple interaction had a significant effect on plant height where $V_2C_2K_2$ gave the highest plant height of 7.42 cm compared to the treatment of $V_1C_0K_0$ which gave the lowest height of 5.28 cm.

**Number of leaves (leaf. plant$^{-1}$):** The results of Table 2 showed that Rubygems type was significantly higher than Albion in the number of leaves in the plant which reached 26.45 leaf.plant$^{-1}$ while Albion type gave the lowest number of leaves (23.83 leaf.plant$^{-1}$). The results of the same table showed that spraying liquid coconut with different concentrations had a positive and significant effect on the increase in the number of leaves in the plant. Treatment $C_2$ was superior by giving the highest number of leaves with mean of 30.77 leaf.plant$^{-1}$. It was found that the spray of marine algae extract had a significant effect on the increase in the number of leaves where $K_2$ recorded the highest number of leaves with 28.14 leaf.plant$^{-1}$ compared to $K_0$ which gave the lowest number of leaves was 22.12 leaf.plant$^{-1}$. The interaction between the spray treatments (coconut and marine algae extracts) had a significant effect on this trait. It was observed that $C_2K_2$ treatment increased the number of leaves (35.27 leaf.plant$^{-1}$) compared to $C_0K_0$ (17.18 leaf.plant$^{-1}$). Furthermore, triple interaction had a positive significant effect on the increase of the number of leaves where $V_2C_2K_2$ detected the highest number of leaves amounted to 37.77 leaf.plant$^{-1}$ compared to $V_1C_0K_0$, which gave the lowest values amounted to 15.70 leaf.plant$^{-1}$.

**Leaf area (dsm$^2$.plant$^{-1}$):** The difference in the varieties had a significant effect on the leafy area of the strawberry plant. The obtained results showed that Rubygems type resulted in an increase in leaf area in the plant reached to 20.28 dsm$^2$.plant$^{-1}$ compared to Albion, which gave the lowest leaf area 18.24 dsm$^2$.plant$^{-1}$. Moreover, the results showed that spray liquid coconut had a significant effect in increasing the leaf area where $C_2$ gave the highest leaf area (22.96 dsm$^2$.plant$^{-1}$) compared to $C_0$ which recorded the lowest leaf area (16.07 dsm$^2$.plant$^{-1}$) as well as the spraying of leaves with marine algae extract has significantly affected the increase in leaf area whereas $K_2$ was superior by giving an

area of 20.61 $dsm^2.plant^{-1}$ while $K_0$ recorded the lowest leaf area (17.96 $dsm^2.plant^{-1}$). Regarding the interaction between the spray treatments with coconut and marine algae extracts, there was a significant effect on this trait where $C_2K_2$ treatment has increased the leaf area to reach 25.73 $dsm^2.plant^{-1}$ compared to 14.95 $dsm^2.plant^{-1}$ for $C_0K_0$. The triple interaction was significantly affected the increase of leaf area where $V_1C_0K_0$ gave the highest leaf area of 27.40 $dsm^2.plant^{-1}$ compared to $V_1C_0K_0$ which gave the lowest values with mean of 13.77 $dsm^2.plant^{-1}$.

**Relative content of chlorophyll in leaves (SPAD UNIT):** The results of Table 4 showed no significant differences between Rubygems and Albion in the relative content of chlorophyll in leaves. Although Rubygems gave the highest values (50.01 SPAD units) while Albion gave the lowest content of chlorophyll in leaves (48.94 SPAD units). As shown in the same table, the spray of liquid coconut gave a significant effect on the increase in leaf content of chlorophyll. It was observed that $C_2$ gave the highest content of chlorophyll at 52.64 SPAD units while C0 (without spray) gave the lowest content with mean of 46.14 SPAD unit. Spraying strawberry plant with marine algae extract had a significant effect on the increase in leaf content of chlorophyll. Treatment $K_2$ gave the highest content of the leaves at 50.96 SPAD units compared with $K_0$ which gave the lowest content of chlorophyll (48.11 SPAD unit). The interaction between spray treatments with coconut and marine algae extracts had a significant effect on the increase of chlorophyll content. It was observed that $C_2K_2$ has exceeded the other treatments in increasing the chlorophyll content to reach 54.42 SPAD units compared to $C_0K_0$ which gave the lowest values (44.65 SPAD units). As for the triple interaction, the treatment of $V_2C_2K_2$ was significantly superior by giving the highest chlorophyll content of 55.53 SPAD units compared to the $V_1C_0K_0$ which gave the lowest values (43.00 SPAD units).

**Vegetative dry weight ($plant^{-1}$):** The results in Table 5 showed that there was no significant differences between the cultivars, although Rubygems gave the highest dry vegetable weight of 3.47 $g.plant^{-1}$ compared to the Albion (3.20 $g.plant^{-1}$). It was also observed that spraying with liquid coconut at different concentrations had a positive significant effect on the vegetative dry weight of the plant where $C_2$ was superior in the highest plant weight with mean of 4.04 $g.plant^{-1}$ compared to the lowest dry weight of the plant at $C_0$. Furthermore, the results showed that spraying the marine algae extract had a significant effect on the vegetative dry weight of the plant. The treatment of $K_2$ spray was higher by giving the highest dry weight of the plant and reached 3.46 $g.plant^{-1}$ while $K_0$ recorded the lowest weight (3.28 $g.plant^{-1}$). The interaction of the spray treatments with coconut and marine algae extracts had a significant effect on this increase. It was observed that $C_2K_2$ treatment resulted in a dry vegetable weight of 4.21 $g.plant^{-1}$ compared to the lowest dry weight at $C_0K_0$ (2.81 $g.plant^{-1}$). In terms of the triple interaction, $V_2C_2K_2$ was significantly superior by giving the highest dry vegetable weight of 4.37 $g.plant^{-1}$ while $V_1C_0K_0$ gave the lowest values with mean of 2.20 $g.plant^{-1}$.

**Fruit length (cm):** The results in Table 6 showed that Rubygems type was superior in the highest yield with mean of 3.96 cm compared to the Albion which recorded mean of 3.78 cm. It was also observed that spraying the liquid coconut with different concentrations had a positive significant effect on the length of the fruit where $C_2$ gave the highest fruit length of 4.28 cm compared to the lowest length of the fruit at $C_0$ (3.39 cm). Marine algae extract had a significant effect on the length of the fruit whereas $K_2$ was superior with a higher length (4.01 cm) while $K_0$ gave the lowest values (3.63 cm). The interaction between spray treatments had a significant effect on the fruit length trait. It was observed that the $C_2K_2$ increased the fruit length to reach 4.27 cm compared to the lowest length at $C_0K_0$ (2.86 cm). As for the triple interaction effect, $V_2C_2K_1$ was superior by giving the highest length of the fruit (4.39 cm) while $V_1C_0K_0$ recorded the lowest values (2.88 cm).

**Fruit diameter (cm):** The results of Table 7 showed that Rubygems type were distinguished by giving the largest diameter of the fruit (2.97 cm) compared to the Albion type which gave the lowest diameter of the fruit of 2.88 cm. Also, the results of the table showed that liquid coconut spray had a significant effect on the increase of fruit diameter. The spraying treatment $C_2$ gave the highest value at 3.31 cm compared to $C_0$ which recorded the lowest value (2.58 cm). The spraying of leaves with algae extract has significantly affected the increase of the fruit diameter where $K_2$ treatment recorded the largest diameter of 3.00 cm while $K_0$ gave the lowest diameter of the fruit (2.82 cm). The interaction between the spray treatments with coconut and marine algae extracts had a significant effect on this trait. It was observed that the $C_2K_2$ treatment increased the diameter of the fruit to 3.42 cm compared to the lowest diameter of the fruit at $C_0K_0$ (2.44 cm). The triple interaction had a significant effect on the increase in the fruit diameter where $V_1C_0K_0$ gave the highest value of 3.54 cm compared to the treatment $V_1C_0K_0$, which gave the lowest values (2.43 cm).

The obtained results indicated that the spraying treatments with coconut and marine algae extract was superior in the increase of the measured vegetable growth indicators, especially the $C_2K_2$ treatment (20% for coconut spray + 10 $ml.l^{-1}$ of marine algae extract) which can be attributed to their role in improving growth traits (Table 2), leaf area (Table 3), leaf content of chlorophyll (Table 4) and dry vegetable weight (Table 5) due to its richness in many nutrients and which have an important role in stimulating the processes of the physical and biological functions within the plant such as the increase in the formation of proteins, amino acids and increase the composition of DNA and RNA necessary for the division of cells as well as their role in the metabolism of carbon and provide the necessary energy to form new cells, which increases the growth and development of the plant as well as stimulate the division of cells and the extension and increase in size, which leads to an increase in the number of leaves and their area, which reflected positively on the increase of vegetative growth, length and fruit diameter (Arnout, 2001; Taiz and Zeiger, 2006). These results are in line with Devlin and Witham, (2001) as well as Crouch and Vanstaden, (2005), who noted that plants supplied with abundant amounts of nutrients tend to increase the number of leaf cells and increase their size and thus increase the leaf area. The improvement in vegetative growth of the plant may also be attributed to spraying of liquid coconut and marine algae extracts due to their content of the major and micro nutrients and plant hormones, which are absorbed directly when sprayed on the leaves. The absorbed nitrogen then indirectly increases the absorption and transfer of other elements by entering the composition of chlorophyll

pigments as well as the composition of amino acids that are involved in the formation of green plastids, which is positively reflected in increasing the chlorophyll content in the leaves (Table 4) and then increase the carbonate metabolism and build proteins which are of great importance to activate plant growth and increase the efficiency of absorption and accumulation of the rest of the elements and thus an increase in the plant resulted in an increasing of plant activity and growth (Yassin, 2001; Crouch and Vanstaden, 2005; Spinelli *et al*., 2009). These results are consistent with Mukhtar (2008), Attia *et al.* (2010), Spinelli *et al*. (2010) and Saleh and Taha (2012).

**Table 1 :** Effect of Spraying liquid Coconuts and Marine Algae Extract and their interaction on Plant Height of Two Types of strawberry for the Season 2017-2018.

| **Season 2018-2019** | | | | | | |
|---|---|---|---|---|---|---|
| **Varieties V** | **Liquid coconut** | **Marine Algae Extract** | | | **V × C** | **Average V** |
| | | **$K_0$** | **$K_1$** | **$K_2$** | | |
| Albion $V_1$ | $C_0$ | 5.28 | 5.89 | 5.76 | 5.54 | 6.28 |
| | $C_1$ | 6.11 | 6.42 | 6.51 | 6.35 | |
| | $C_2$ | 6.77 | 6.91 | 7.13 | 6.94 | |
| Rubygems $V_2$ | $C_0$ | 5.49 | 5.62 | 5.78 | 5.63 | 6.38 |
| | $C_1$ | 6.18 | 6.37 | 6.57 | 6.37 | |
| | $C_2$ | 6.88 | 7.08 | 7.42 | 7.13 | |
| L.S.D 0.05 | | 0.269 | | | 0.159 | N.S |
| | | | | | | |
| V × K | Albion | 6.05 | 6.31 | 6.47 | L.S.D 0.05 | **0.15** |
| | Rubygems | 6.18 | 3.36 | 6.59 | | |
| | | | | | | |
| C × K | $C_0$ | 5.38 | 5.61 | 5.77 | 5.59 | |
| | $C_1$ | 6.14 | 6.40 | 6.54 | 6.36 | |
| | $C_2$ | 6.83 | 7.00 | 7.28 | 7.03 | |
| | Average K | 6.12 | 6.33 | 6.53 | | |
| L.S.D 0.05 | | | | | | |
| C × K | | K | | | C | |
| **0.192** | | 0.111 | | | 0.111 | |

**Table 2 :** Effect of spraying coconuts and marine algae extract and their interaction on the leaf number (leaf-plant$^{-1}$) of two types of strawberry plant for the Season 2018-2019.

| **Season 2018-2019** | | | | | | |
|---|---|---|---|---|---|---|
| **Varieties V** | **Liquid coconut** | **Marine Algae Extract** | | | **V × C** | **Average V** |
| | | **$K_0$** | **$K_1$** | **$K_2$** | | |
| Albion $V_1$ | $C_0$ | 15.70 | 19.70 | 21.47 | 18.96 | 23.83 |
| | $C_1$ | 21.70 | 23.90 | 25.17 | 23.59 | |
| | $C_2$ | 25.30 | 28.77 | 32.77 | 28.94 | |
| Rubygems $V_2$ | $C_0$ | 18.67 | 20.73 | 22.73 | 20.71 | 26.45 |
| | $C_1$ | 22.80 | 26.43 | 28.93 | 26.06 | |
| | $C_2$ | 28.57 | 31.43 | 37.77 | 32.59 | |
| L.S.D 0.05 | | 1.586 | | | 1.073 | 1.368 |
| | | | | | | |
| V × K | Albion | 20.90 | 24.12 | 26.47 | L.S.D 0.05 | 1.073 |
| | Rubygems | 23.34 | 26.20 | 29.81 | | |
| | | | | | | |
| C × K | $C_0$ | 17.18 | 20.22 | 22.10 | 19.83 | |
| | $C_1$ | 22.25 | 25.17 | 27.05 | 24.82 | |
| | $C_2$ | 26.93 | 30.10 | 35.27 | 30.77 | |
| | Average K | 22.12 | 25.16 | 28.14 | | |
| L.S.D 0.05 | | | | | | |
| C × K | | K | | | C | |
| **1.078** | | 0.623 | | | 0.623 | |

**Table 3 :** Effect of Spraying Coconut and Marine Algae Extract and their Interaction in the leaf area ($dsm^2.plant^{-1}$) of Two Types of strawberry plant for the Season 2018-2019

| Season 2018-2019 | | | | | | |
|---|---|---|---|---|---|---|
| **Varieties V** | **Liquid coconut** | **Marine Algae Extract** | | | **V × C** | **Average V** |
| | | **$K_0$** | **$K_1$** | **$K_2$** | | |
| Albion $V_1$ | $C_0$ | 13.77 | 16.17 | 16.23 | 15.39 | 18.24 |
| | $C_1$ | 17.27 | 17.73 | 18.10 | 17.70 | |
| | $C_2$ | 19.73 | 21.07 | 24.07 | 21.62 | |
| Rubygems $V_2$ | $C_0$ | 16.13 | 16.57 | 17.53 | 16.74 | 20.28 |
| | $C_1$ | 18.80 | 20.27 | 20.30 | 19.79 | |
| | $C_2$ | 22.03 | 23.47 | 27.40 | 24.30 | |
| L.S.D 0.05 | | 1.689 | | | 0.908 | 0.771 |
| | | | | | | |
| V × K | Albion | 16.92 | 18.32 | 19.47 | L.S.D 0.05 | 0.908 |
| | Rubygems | 18.99 | 20.10 | 21.74 | | |
| | | | | | | |
| C × K | $C_0$ | 14.95 | 16.37 | 16.88 | 16.07 | |
| | $C_1$ | 18.03 | 19.00 | 19.20 | 18.74 | |
| | $C_2$ | 20.88 | 22.27 | 25.73 | 22.96 | |
| | Average K | 17.96 | 19.21 | 20.61 | | |
| L.S.D 0.05 | | | | | | |
| C × K | | K | | | C | |
| **1.240** | | 0.716 | | | 0.716 | |

**Table 4 :** Effect of Spraying on Coconut and Marine Algae Extract and their Interaction in the Relative Content of Chlorophyll in the Leaves (SPAD UNIT) of Two Types of strawberry plant for the Season 2018-2019

| Season 2018-2019 | | | | | | |
|---|---|---|---|---|---|---|
| **Varieties V** | **Liquid coconut** | **Marine Algae Extract** | | | **V × C** | **Average V** |
| | | **$K_0$** | **$K_1$** | **$K_2$** | | |
| Albion $V_1$ | $C_0$ | 43.00 | 45.17 | 47.63 | 45.27 | 48.94 |
| | $C_1$ | 48.33 | 49.50 | 50.50 | 49.44 | |
| | $C_2$ | 50.93 | 51.87 | 53.50 | 52.10 | |
| Rubygems $V_2$ | $C_0$ | 46.30 | 46.80 | 47.97 | 47.02 | 50.01 |
| | $C_1$ | 48.93 | 49.90 | 50.63 | 49.82 | |
| | $C_2$ | 51.13 | 52.87 | 55.53 | 53.18 | |
| L.S.D 0.05 | | 1.380 | | | 1.025 | N.S |
| | | | | | | |
| V × K | Albion | 47.42 | 48.84 | 50.54 | L.S.D 0.05 | 1.025 |
| | Rubygems | 48.79 | 49.86 | 51.38 | | |
| | | | | | | |
| C × K | $C_0$ | 44.65 | 45.98 | 47.80 | 46.14 | |
| | $C_1$ | 48.63 | 49.70 | 50.57 | 49.63 | |
| | $C_2$ | 51.03 | 52.37 | 54.52 | 52.64 | |
| | Average K | 48.11 | 49.35 | 50.96 | | |
| L.S.D 0.05 | | | | | | |
| C × K | | K | | | C | |
| **0.899** | | 0.519 | | | 0.519 | |

**Table 5 :** Effect of Spraying on Coconut and Marine Algae Extract and their Interaction on Plant Dry Vegetative Weight (g.plant$^{-1}$) of Two Categories of strawberry plant for the Season 2018-2019

| Season 2018-2019 | | | | | | |
|---|---|---|---|---|---|---|
| **Varieties V** | **Liquid coconut** | **Marine Algae Extract** | | | **V × C** | **Average V** |
| | | **$K_0$** | **$K_1$** | **$K_2$** | | |
| Albion $V_1$ | $C_0$ | 2.20 | 2.29 | 2.41 | 2.30 | 3.20 |
| | $C_1$ | 3.26 | 3.36 | 3.56 | 3.39 | |
| | $C_2$ | 3.82 | 3.88 | 4.04 | 3.91 | |
| Rubygems $V_2$ | $C_0$ | 3.42 | 2.47 | 2.53 | 2.81 | 3.47 |
| | $C_1$ | 2.97 | 3.51 | 3.85 | 3.44 | |
| | $C_2$ | 3.99 | 4.13 | 4.37 | 4.16 | |
| L.S.D 0.05 | | 0.691 | | | 0.433 | N.S |
| | | | | | | |
| V × K | Albion | 3.09 | 3.18 | 3.34 | L.S.D 0.05 0.433 | |
| | Rubygems | 3.46 | 3.37 | 3.58 | | |
| | | | | | | |
| C × K | $C_0$ | 2.81 | 2.38 | 2.47 | 2.55 | |
| | $C_1$ | 3.12 | 3.44 | 3.71 | 3.42 | |
| | $C_2$ | 3.91 | 4.01 | 4.21 | 4.04 | |
| | Average K | 3.28 | 3.28 | 3.46 | | |
| L.S.D 0.05 | | | | | | |
| C × K | | K | | | C | |
| **0.484** | | 0.280 | | | 0.280 | |

**Table 6 :** Effect of Spraying on Coconut and Marine Algae Extract and their Interaction in Fruit Length (cm) for Two Types of strawberry for the Season 2018-2019.

| Season 2018-2019 | | | | | | |
|---|---|---|---|---|---|---|
| **Varieties V** | **Liquid coconut** | **Marine Algae Extract** | | | **V × C** | **Average V** |
| | | **$K_0$** | **$K_1$** | **$K_2$** | | |
| Albion $V_1$ | $C_0$ | 2.88 | 3.62 | 3.67 | 3.39 | 3.78 |
| | $C_1$ | 3.69 | 3.75 | 3.90 | 3.78 | |
| | $C_2$ | 4.09 | 4.27 | 4.15 | 4.17 | |
| Rubygems $V_2$ | $C_0$ | 2.84 | 3.64 | 3.71 | 3.40 | 3.96 |
| | $C_1$ | 3.88 | 4.12 | 4.21 | 4.07 | |
| | $C_2$ | 4.13 | 4.39 | 4.38 | 4.30 | |
| L.S.D 0.05 | | 0.243 | | | 0.147 | 0.169 |
| | | | | | | |
| V × K | Albion | 3.55 | 3.88 | 3.91 | L.S.D 0.05 0.147 | |
| | Rubygems | 3.62 | 4.05 | 4.10 | | |
| تـداخل C × K | $C_0$ | 2.86 | 3.63 | 3.69 | 3.39 | |
| | $C_1$ | 3.79 | 3.93 | 4.06 | 3.93 | |
| | $C_2$ | 4.11 | 4.33 | 4.27 | 4.24 | |
| | Average K | 3.59 | 3.96 | 4.01 | | |
| L.S.D 0.05 | | | | | | |
| C × K | | K | | | C | |
| **0.172** | | 0.099 | | | 0.099 | |

**Table 7 :** Effect of Spraying on Coconut and Marine Algae Extract and their Interaction in Fruit Diameter (cm) of Two Classes of strawberry plant for the Season 2018-2019

| Season 2018-2019 | | | | | | |
|---|---|---|---|---|---|---|
| **Varieties V** | **liquid coconut** | **Marine Algae Extract** | | | **V × C** | **Average V** |
| | | **$K_0$** | **$K_1$** | **$K_2$** | | |
| Albion $V_1$ | $C_0$ | 2.43 | 2.61 | 2.64 | 2.56 | 2.88 |
| | $C_1$ | 2.83 | 2.86 | 2.82 | 2.84 | |
| | $C_2$ | 3.13 | 3.25 | 3.31 | 3.23 | |
| Rubygems $V_2$ | $C_0$ | 2.45 | 2.62 | 2.71 | 2.59 | 2.97 |
| | $C_1$ | 2.85 | 2.93 | 2.99 | 2.92 | |
| | $C_2$ | 3.19 | 3.44 | 3.54 | 3.39 | |
| L.S.D 0.05 | | 0.140 | | | 0.074 | 0.061 |
| | | | | | | |
| V × K | Albion | 2.80 | 2.91 | 2.92 | L.S.D 0.05 0.074 | |
| | Rubygems | 2.83 | 3.00 | 3.08 | | |
| | | | | | | |
| C × K | $C_0$ | 2.44 | 2.62 | 2.68 | 2.58 | |
| | $C_1$ | 2.84 | 2.90 | 2.90 | 2.88 | |
| | $C_2$ | 3.16 | 3.35 | 3.42 | 3.31 | |
| | K Average | 2.82 | 2.95 | 3.00 | | |
| L.S.D 0.05 | | | | | | |
| C × K | | K | | | C | |
| **0.103** | | 0.059 | | | 0.059 | |

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