Evaluation of four commercial products that promote growth in strawberry farming in macrotunnel

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Abstract

This research was carried out in the community of Hermosillo, belonging to the municipality of Santiago Maravatio, Guanajuato, during January-September 2016. Four commercial products were evaluated: Fitobolic, Kelpak, Xtra-alga y Algamar, that have a direct impact on the quality of strawberry fruits (*Fragaria vesca* L). An experimental design was established in randomized comparative strips, with twelve treatments and three replicates, the experimental unit were beds of 1,000 plants, evaluating ten plants per repetition. It was analyzed polar and equatorial diameter of the fruits, root length, number of flowers per plant, number of fruits, plant height and production per bed. According to the results obtained and to the statistical analysis in the Xtra-alga treatment at 2 L / ha, a difference was obtained between polar diameter, equatorial and number of small fruits. Fitobolic at 2 L / ha affected the height of the plant and number of flowers surpassing the other treatments; While Xtra-algae at 1 L / ha stood out in the production of number of red and large fruits. Kelpak at 3 L / ha showed an increase in root length. Xtra-alga treatment at 2 L / ha was higher in production, obtaining 9.9 kg/m^e and a shelf life of 6 days.

Growth regulators, amino acids, algae

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Introduction

The strawberry is the strawberry of greater production and export in Mexico. Strawberry exports increased by 21.2 percent at the end of 2016, compared to 2015, which represented revenues of 650.8 million dollars, which represents an average annual growth rate of 11.7 percent, as well as an average sales for 524.7 million dollars (SAGARPA, 2017).

Strawberry cultivation in the country is very important due to the quantity of labor that it demands, which translates into job creation. Generally the strawberry has a production period of five months and between 40 to 50 tons are obtained, obtaining the best selling prices during the months of December to February (SIAP, 2013). However, to obtain 80 tons per hectare in macro-tunnel or 120 tons / ha in the greenhouse, a large amount of synthetic fertilizers is required. However, the excessive use of chemical fertilizers in the production of strawberries and the misuse of manures derived from livestock activities, has generated a series of environmental problems worldwide, contaminating surface and groundwater due to the effect of Elements such as nitrogen, in the form of nitrate, phosphorus as phosphate, as well as potassium (K +) and magnesium (Mg ++) cations that waterproof and impoverish agricultural soils generate the loss of organic matter and the reduction of soil biota (Romero- Romano et al., 2011).

In strawberry fruits, the most important factors to ensure their quality start from the field with the selection of cultivars, which vary in quality, defined mainly by the firmness, sugar content and acidity of the fruits; as well as the susceptibility of them to diseases. Other factors that influence the quality of strawberry fruits, because they have a very short shelf life, are: meteorological factors, as well as management and storage conditions such as temperature and humidity.

The main aspects considered to determine the quality of the strawberry are the appearance, firmness, flavor, degree of maturity, brightness and absence of damage in the fruits (Martínez-Bolaños et al., 2008).

The physical and morphological resistance of a plant is a determining factor to achieve good yields and quality of harvested products. These characteristics will depend, among other factors, on the nutrients and hormones that are applied to the plant (Romero-Romano et al., 2012).

In the last ten years, the use of biostimulants of natural origin enriched with amino acids, growth regulators, seaweed extracts and micronutrients has increased, which induces defense mechanisms in strawberry, activating their physiological functions, promoting the development of healthy plants, facilitate the absorption of nutrients and generate more vigorous plants (Hernández, 2014).

Justification

Strawberry cultivation is highly profitable for producers who mostly export their products to the United States and Canada; In addition to having a social impact, by generating more than 500 jobs in the southern region of the state of Guanajuato derived from cultural practices that are made to the crop during its different phenological stages. This research is aimed at supporting producers in the municipality of Santiago Maravatio to reduce losses in production and post-harvest handling, through the correct use of growth regulators and crop nutrition.

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Problem

The strawberry is one of the crops most susceptible to the attack of postharvest pathogens that limit its shelf life, which is directly related to the nutrition applied in the different phenological stages of the crop. In addition, markets such as the United States and Canada are more demanding in their quality and safety policies with very high standards for the marketing of fresh fruits.

Hypotesis

In the market there are products that are regulators of growth, however, not all have the same effect on the fruits, some may affect the development of the plants, the size of the fruits and others may lengthen the shelf life of the strawberries by increasing its turgor.

Objectives

General objevtives

Evaluate four commercial products used as growth regulators on yield, fruit quality with respect to shelf life.

Specific objectives

Identify the product with the highest performance and the optimum dose of application.

To evaluate the quality of the fruit based on the established scales of the total content of soluble solids, pH, titratable acidity, firmness, colorimetry and size of the fruits.

Theoretical framework

The strawberry is cultivated in practically all the world, reaches a production of 2.5 million tons; of which Mexico contributes 228,900 T that place it as the fourth producer.

One of the main agronomic management problems that it faces is nutrition, so evaluating the total nutrient demand of the plants and their absorption dynamics is important to determine the fertilization plans that allow the synchronization between the supply and demand of the crop. culture (Avitia et al., 2014).

The genetic expression of any species to grow vegetables or fruit trees, as well as the growth and development of these are controlled especially by the hormones that are synthesized in the interior of plants. Plant hormones are compounds that are synthesized by plants in micro-molar or lower concentrations, which cause specific physiological responses either locally or are translocated to other regions of the plant to modify their growth and development (Yáñez, 2002).

Hormones can also be considered essential in plant physiology because if these are not produced, in balance between these and / or used appropriately in the corresponding site of action, causes the plant to unbalance in its growth and development causing alterations in the phenology of the crops, as well as drastic changes in the production, quality of the same, as well as in the possibility of preserving the species (Salisbury, 1994).

According to their physiological structure and function, the hormones have been classified into several groups that include auxins, cytokinins (CK), abscisic acid (ABA), gibberellins (GA), ethylene, jasmonatos (JA), salicylic acid (SA)), brassinosteroids, polyamines (According to Cruz et al, 2010).

Among the technologies used to improve the quality and increase the size of the fruit are the use of growth regulators such as gibberellins and cytokinins. Gibberellins (AG) promote cell growth because they increase the hydrolysis of starch, fructans and sucrose, causing fructose and glucose.

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These hexoses contribute to the formation of the cell wall and decrease the water potential of the cell, which favors the entry of water and causes cell expansion (Salisbury and Ross, 2000). In this regard, some positive effects of the applications of gibberellic acid (AG3) on strawberry production are reported, among which the shortening of the period between sowing and the first fruiting, the increase in the number of fruits and the duration of the harvest period, although this gibberellin can also reduce the mass of the fruit (Tehranifar and Battey, 1997).

Methodology

Establishment of the experiment. The project was carried out in facilities of the Sociedad de Productores Agrícolas of Santiago Maravatio SPR de RL, located in the community of Hermosillo belonging to the municipality of Santiago Maravatio, Guanajuato.

The surface planted with strawberry was 1.9 hectares in macrotúnel with mulch and with a drip irrigation system. The transplant was performed on August 21, 2016, with a planting density of 75,000 plants per hectare.

Experimental design. An experimental design was established in random comparative bands, with twelve treatments and three repetitions. Ten plants were evaluated per repetition. The data was analyzed in the statistical Statistic Analytic System (SAS, 1990).

Treatments 12 treatments were established and an absolute control, three repetitions were made. For each repetition 10 plants were sampled.

Variables to be evaluated. The variables were: plant height, number of flowers, number of fruits, equatorial and polar diameter of the fruit, size of the root, Production (kg per m2) and determination of soluble solids.

A vernier was used for fruit measurements, while a 30 cm transparent rule was used for plant height and root size. The weight of the fruits was quantified in an electronic scale. Ten strawberry plants were measured, in each treatment and repetition. The shelf life was determined by leaving fruits cut in clams for 10 days.

Agronomic management. Soil sampling was carried out at the beginning of the crop cycle to define the nutrient content and fertility of the same and thus design the fertilization demanded by the crop. The analyzes were sent to the soil fertility laboratory at INIFAP Bajío. Irrigation and fertilization and were applied according to the water and nutritional demands of the crop. Relieving tensiometers, recording daily temperatures and nutritional requirements in each phenological stage of the crop. The control of pests and diseases present in the crop was done manually with the application of chemical and organic products, as well as through cultural management.

Results

Phenological variables. According to the statistical analysis and the Tukey P test ≤ 0.05 of the results obtained, for the height variable, no differences were found between the treatments (Graph 1).

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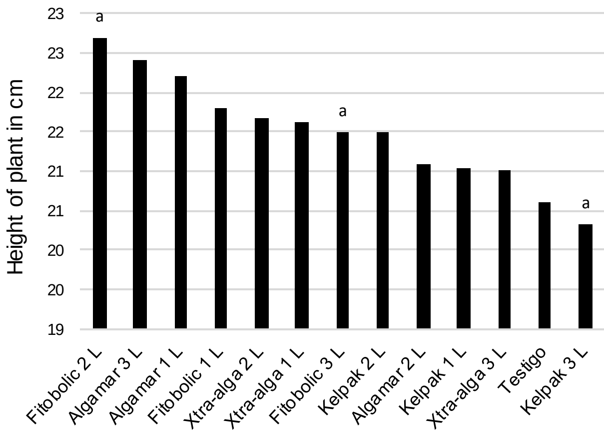
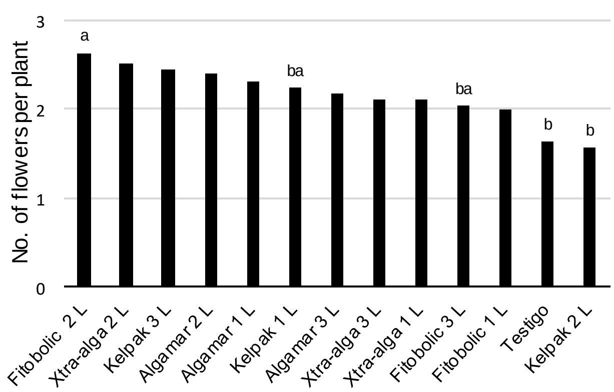
Article
RINOE Journal
December 2017 Vol.1 No.1 1-8

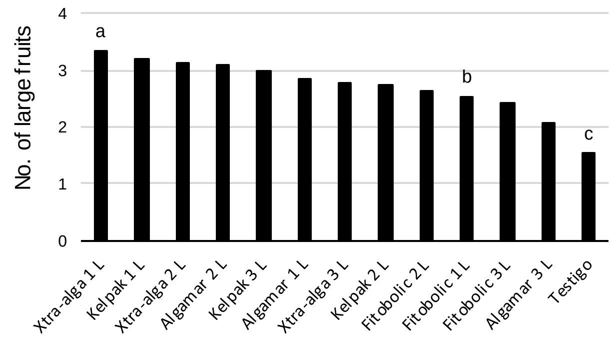


Graph 1 Behavior of the plant height variable.

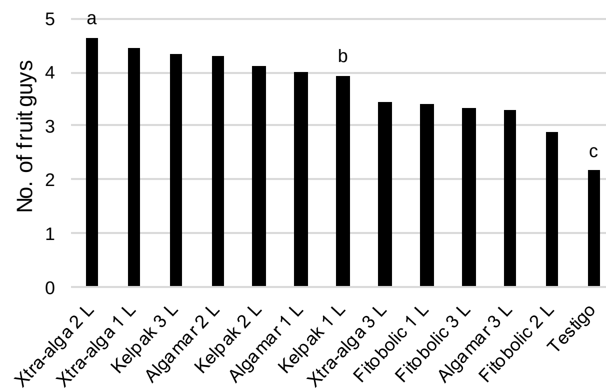
For the variables of the number of flowers, the treatment that stood out was Fitobolic at 2 L (Graph 2). Xtra-alga 1 L and Xtra-alga at 2 L affected the variables for large and small fruits (Graph 3 and 4). With respect to the polar and equatorial diameter, it was Xtra-alga 2 L (Graphics 5).



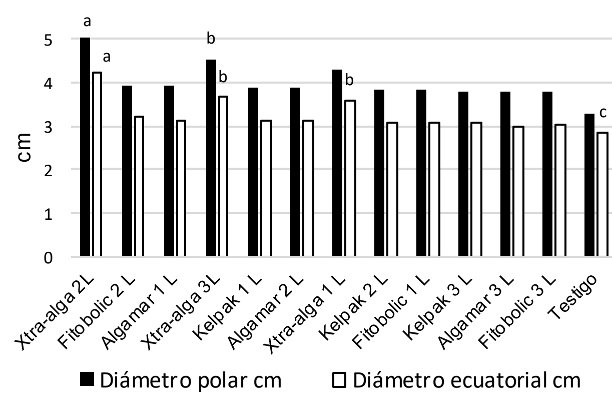
Graph 2 Comparison of means with respect to the number of flowers.



Graph 3 Comparison of means of the number of large fruits.



Graph 4 Comparison of means of number of small fruits.



Graph 5 Polar and equatorial diameters of strawberry fruits.

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RINOE Journal
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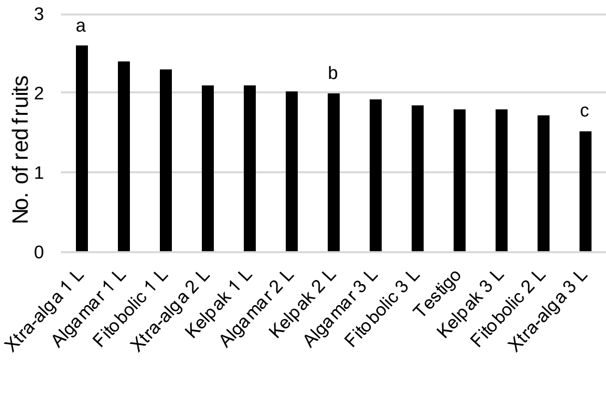
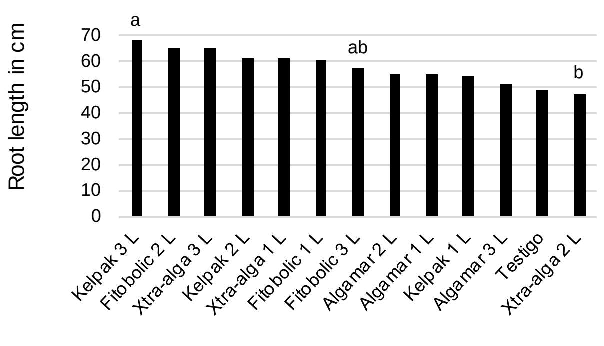
For red fruits, the product that affected this quality parameter was Xtra-alga at 1 L, while Xtra-alga at 3 L was the one with the lowest number of red fruits (Figure 6).



Graph 6 Polar and equatorial diameters of strawberry fruits.

With regard to root length in the Tukey test (P≤0.05), differences are shown where Kelpak at 3 L reached a higher development than the other treatments (Graph 7).

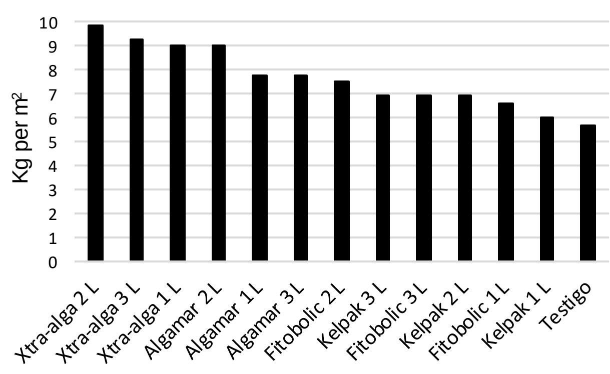


Graph 7 Polar and equatorial diameters of strawberry fruits.

It is probable that edaphoclimatic factors influence the assimilation and translocation of nutrients towards the demanding parts of the strawberry plant directly affecting the height variable in the plant in which no differences were found between the treatments (P≤0.05) the average more high was 22.7 and the lowest was 20.3.

The products evaluated in this study contain gibberellins, auxins and cytokinins, which are plant growth promoters that modify the normal growth characteristics of plants which caused various physiological responses in flowering and root proliferation (Ackerman and Hamemik, 1996). The results obtained in this study determined that the product that affected the number of flowers was Fitobolic at 2L / ha. However, there are reports that marine algae also induce physiological responses of plants, increasing the production of crops such as strawberry and blueberries because they contain a wide variety of plant growth promoting substances such as auxins, cytokinins, betaines, gibberellins and organic substances such as amino acids, macronutrients and trace elements that improve the yield and quality of crops, which was proven with the Xtra-alga product (Sathya et al., 2010).

Harvest. The total kilograms harvested per treatment is shown in the following chart.



Graph 8 Harvest yields by treatment.

The highest yield was obtained with Xtra-alga at 2 L, achieving a production of 9.9 kg / m2. This is consistent with what was reported by (Hernández-Herrera et al. (2014) mentioning that the application of seaweed to the soil and foliage induces greater absorption of nutrients, increases the chlorophyll content, the size of the leaves, which result in greater yield and quality of crops.

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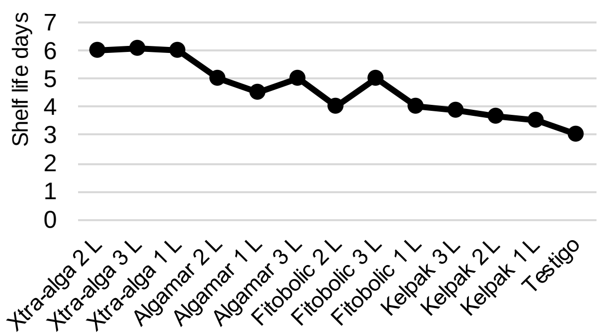
Fruit shelf life. There were no differences between the doses of Xtra-alga in the shelf life of the fruits, which reached an average of six days, while the treatment with a shorter time was three days.



Graph 9 Shelf life of fruits stored at room temperature.

Regarding the flavor and coloration of the fruits, there were no differences between treatments, but the Xtra-alga fruits were the sweetest on the palate, but not due to the determination of Brix degrees.

Aknowledgement

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Conclusions

The use of growth regulators based on marine algae in strawberry production is a success that should be practiced by the producers of macro-tunnels. The commercial product recommended to lengthen the shelf life and preserve the quality characteristics is Xtra-alga at 2 L / ha.

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