

EFFECT OF FOLIAR SPRAY WITH SOME SAFETY COMPOUNDS ON GROWTH, PRODUCTIVITY AND QUALITY OF SOME STRAWBERRY CULTIVARS

Shams, A. S.¹; F. A. Abo - Sedera¹; A. Abo El - Yazied²; M. M. El-Nagar¹ and M. S. EL-Badawy

1. Horticulture Department, Faculty of Agriculture Benha University

2. Horticulture Department, Faculty of Agriculture, Ain Shams University

Corresponding Author: E-mail: abdelhakeem.shams@fagr.bu.edu.eg

ABSTRACT

A field experiment was carried out during the two successive seasons of 2011/2012 and 2012/2013 in private farm at El-Dair village, Kalubia governorate in sandy soil, to investigate the effect of foliar spray with some safety compound (Borka vit, Vitamin-X and Chitosan) on growth, productivity and quality of some Strawberry cultivars, i.e., Sweet Charlie, Florida and Festival. This experiments included 12 treatments resulted from the interaction between three cultivars and four safety compound treatments. Obtained results showed that, there were significant differences among the studied strawberry cultivars in all measured vegetative growth traits, fruit yield and its components as well as fruit quality. In this respect, cv. Florida reflected the highest values of early yield. Also, safety compounds-sprayed plants showed its superiority in enhancing the vegetative growth, total produced fruit yield and its components as well as fruit quality. In addition, using Borka vit at 3 g/l followed by Vitamin-X at 0.75cm³/l reflected the highest values in all studied growth and yield traits of tested cultivars. Spraying plants of cv. Festival with Borka vit produced fruits with highest values of TSS and vitamin-c in the two seasons.

Thereby, it could be recommended that foliar application with some safety compounds (Borka vit, Vitamin-X and Chitosan) could be used to improve growth, productivity and quality of some Strawberry cultivars.

Keywords: Strawberry, cv. Sweet Charlie, Festival, Florida, Borka vit, Vitamin-X, Chitosan, Vegetative growth, fruit yield, fruit quality.

INTRODUCTION

Strawberry (*Fragaria X ananassa* Duch.) is one of the most important vegetable crops grown in Egypt for fresh consumption, processing and exportation. It's the unique vegetable crop belong to family Rosaceae. The total area devoted to grow strawberry in Egypt was increased and reached about 13720 fed. from which 7720 fed. for fresh production with an average yield of 18.6 t/fed and 6000fed. for frigo production with an average yield of 12.14 t/fed. Moreover, the total exportable fruit yield was 22 thousand ton according to the statistics of Egyptian Ministry of Agriculture and Land reclamation in 2012-2013season. The growth, production and quality of produced strawberry fruit are depending on the different agricultural treatments done during the growing season. Recently, unconventional efforts are used to minimize the amounts of chemical fertilizers which applied to vegetables and edible plants in order to reduce production cost and environmental pollution without reduction of yield. Therefore, the trend now is

using some safety compound. Nowadays many farmers used to apply organic compounds and growth stimulants either as foliar spray or soil addition to improve growth, productivity and yield quality of produced fruits. Also, within the past few years several materials such as Borka vit, Vitamin-x- and Chitosan, many strawberry growers have used these materials and reported various degree of success. As with most vegetable enterprises, competition is great and strawberry growers are searching for ways to increase fruit yield, size and quality in an economic manner. In this connection, several researches have been conducted on several vegetable crops relating the effect of such compounds on plant response. In this respect, Arancon *et al.* (2003), Singh *et al.* (2009), Abo Sedera *et al.* (2010), Abd El-Mawgoud *et al.* (2010) and Spinelli *et al.* (2010) on strawberry reported positive response for using such organic compounds on productivity and quality of strawberry cultivars.

In addition, many investigators, i.e., Chaiprasart *et al.* (2006), Hernandez *et al.* (2008), Li Hua *et al.* (2010) and Shafshak *et al.* (2011) reported that using organic compounds such as Chitosan and mineral salts ,i.e., potassium either as pre harvest foliar application on plants at flowering and fruiting stage or postharvest as fruit treatment or both of them improved and maintained the fruits quality, especially during cold storage

Therefore, the present study aims to investigate the effect of foliar application for some safety compounds on vegetative growth, productivity, fruit yield and quality of some strawberry cultivars.

MATERIALS AND METHODS

A field experiment was carried out during the two successive seasons of 2011/2012 and 2012/2013 in private farm at El-Dair Village, Kalubia governorate to investigate the response of three strawberry cultivars namely Sweet Charlie, Festival and Florida to foliar application with some safety compounds, i.e., Borka vit, Vitamin-X and Chitosan comparing with the control (without foliar application) on vegetative growth, chemical composition, fruit yield and its components as well as fruit quality of the tested cultivars. Physical and chemical characters of the used soil are shown in Table (a). Physical analysis was estimated according to **Jackson (1973)**, whereas chemical analysis was determined according to **Black et al. (1982)**.

Table (a): Physical and chemical analyses of the used soil.

| Physical analysis | | Chemical analysis | | | |
|---------------------|--------|-------------------|------|-------------------------------|------|
| | | Cations meq/l | | Anions meq/l | |
| Coarse sand | 18 % | Ca ⁺⁺ | 8.9 | CO ₃ ⁻ | Zero |
| Fine sand | 36.6% | Mg ⁺⁺ | 3.15 | HCO ₃ ⁻ | 4.5 |
| Silt | 27.1% | Na ⁺ | 4.20 | Cl ⁻ | 6.35 |
| Clay | 18.3 % | K ⁺ | 1.18 | SO ₄ ⁻ | 8.10 |
| Texture class sandy | | | | | |
| Soil pH | 7.4 | Available N | | 23.3 mg/kg | |
| E.C, dS/m | 1.59 | Available P | | 12.4 mg/kg | |
| Organic matter | 2.1% | Available K | | 181 mg/kg | |

Plant materials:

The fresh transplants of the used cultivars were obtained from Modern Agriculture Company Pico, Egypt. Transplants were dipped in Rhizolex solution at rate of 3g/l for 20 minutes as recommended by Ministry of Agriculture for pathogens disinfection before transplanting.

Experiment layout:

This experiment included twelve treatments at random in a split plot design; where the cultivars occupied the main plot, whereas the sub plot was devoted to foliar application of some safety compounds with four replicates in both seasons of study. The area of the experimental plot was 35.0 m² included four beds each five meters in long and 1.75 meters in width. Each bed included five rows at 25 cm apart and the transplanting was done at 20 cm apart between transplants in the same row. Transplanting was done on 1st of October in 2011/2012 and 2012/2013. Sprinkler irrigation was used in the first month after transplanting, after that the beds were covered with 40 micron black plastic mulch. After that the drip irrigation was used after mulching until the end of the growing season. Foliar application treatments were started after 40 days from transplanting and every 10 days by intervals, four times throughout the growing season.

Experiment treatments:

In each season, the foliage was sprayed four times during the growth period with the following safety compounds at 40, 50, 60 and 70 days after transplanting date of both seasons. A surfactant (Tween 20) at a concentration of 0.01% was added to all tested solutions including the control.

Borka vit: is a commercial product from Union for Agriculture Development (UAD) Egypt contain; K 54% and B 1.2% (registered in malar, Egypt under 7416 number) was used at 3g/l.

Vitamin-X: is a commercial product from Union for Agriculture Development (UAD) Egypt contain: vit.B₁, vit.B₂, vit.C, Biotin, Nicotinic Acid, Byrodeksal, Berdeksen, Byrodeksamen 9%, K₂O 4%, Fe 1%, Zn 0.5% and Mn 0.5% (registered in malar, Egypt under 7010 number) was used at 0.75cm³/l.

Chitosan: It is commercial product by Oxford Laboratory India. It includes chitosan 90-95%. (2-Amino-2-deoxy-beta-D-glucosamine) at 1%.i.e., 10g from Chitosan dissolved in 0.1 NaoH and completed to liter of distilled water was used at 5g/l.

Control treatment: as the plants were sprayed with distilled water.

The agricultural practices concerning cultivation, fertilization, irrigation and pest- and disease control were conducted as commonly followed according to the recommendation of the ministry of Agriculture for the commercial production of fresh strawberry.

Data recorded:

Five plants were taken from each experimental plot as a representative sample in December after 90 days from transplanting and the following data were recorded.

Plant height, fresh weight/plant, number of crowns/plant, number of leaves/plant. Leaf area/plant calculated as relation between area unite and

dry weight of leaves (Koller, 1972). Crown diameter was measured by using vernier caliper.

Early fruit yield: it was determined as weight of all harvested fruits at the ripe stage during December and January. Total fruit yield per plant and feddan. Marketable yield: it was calculated after discarding the infected fruit. Un-marketable yield: it was calculated as weight of infected fruit during the harvesting season.

TSS, Vit.C, acidity and anthocyanin pigment were determined according to AOAC (2000). Total sugars were determined colorimetrically by the method described by Nelson (1974).

Statistical analysis:

The obtained data in both seasons of study were subjected to analysis of variance as a factorial experiment in split plot design. L.S.D. method was used to differentiate between means according to Snedecor and Cochran (1991).

RESULTS AND DISCUSSION

1. Vegetative growth characteristics:-

Effect of cultivars.

Data in Tables 1 and 2 reveal that, irrespective of plant height and number of Leaves per plant during the first season and dry weight of plant during the second one which were not significantly affected, all the measured growth parameter (plant height, fresh weight of plant, leaves and crown number per plant, average leaf area and crown diameter per plant) were significantly differed among the investigated strawberry cultivars during the two seasons of growth. In this connection, cv. Sweet Charlie exhibited the highest number of crowns and values of leaf area during the first season and plant height, number of leaves and crowns per plant during the second one. On the other hand, cv. Festival reflected the highest values of plant height, average fresh weight per plant and average crown diameter and fresh weight per plant during the first season as well as leaf area during the second season. On the contrary, cv. Florida recorded the lowest values in all morphological parameters during the two seasons of study except crown diameter during the second season. Such differences in plant growth traits among the tested cultivars may be attributed to genetic differences in structures of such cultivars. In addition, the variance in measured growth habitation of tested cultivars during the two seasons of study may be due to the difference in cultivars response to different prevalent temperature during the two growing seasons.

Obtained results are in accordance with those reported by El-Miniawy (1991), Paraskevopoulou *et al.* (1995), Ragab *et al.* (2000), Mohamed (2003), Ahmed (2009), Abo Sedera *et al.* (2010) , Ameri *et al.* (2012) and Kumar and Ahmed (2012) all working on strawberry, They reported significant differences in most measured vegetative growth aspects among the tested cultivars.

Table 1: Effect of cultivars and foliar spray with some safety compounds as well as their interaction on vegetative growth characteristics of strawberry.

| Treatments | | 2011/2012 | | | | | |
|-----------------|----------------------------------|-------------------|-------------------------|-------------------------|---------------------|-------------------------|------------------------------------|
| Cultivars | Spray compounds | plant height (cm) | Fresh weight /plant (g) | Number of crowns/ plant | Crown diameter (cm) | Number of Leaves/ plant | Leaf area(cm ²) /plant |
| Sweet Charlie | | 17.91 | 16.03 | 2.00 | 1.31 | 8.00 | 428.67 |
| Florida | | 17.27 | 12.26 | 1.71 | 1.19 | 8.06 | 338.93 |
| Festival | | 18.06 | 16.27 | 1.42 | 1.41 | 8.25 | 416.67 |
| L.S.D .at 0.05% | | NS | 2.93 | 0.39 | 0.14 | NS | 82.55 |
| | Vitamen-x-0.75cm ³ /l | 17.98 | 15.14 | 1.61 | 1.34 | 8.17 | 414.88 |
| | Borkavit 3g/l | 17.68 | 15.92 | 1.89 | 1.29 | 8.33 | 435.86 |
| | Chitosan 5g/l | 17.89 | 14.56 | 1.78 | 1.33 | 8.33 | 419.29 |
| | Control | 17.43 | 13.80 | 1.55 | 1.24 | 7.58 | 308.99 |
| L.S.D .at 0.05% | | NS | 1.32 | NS | 0.09 | 0.34 | 78.77 |
| Sweet Charlie | Vitamen-x-0.75cm ³ /l | 18.29 | 15.91 | 1.66 | 1.35 | 8.00 | 431.90 |
| | Borkavit 3g/l | 18.46 | 16.74 | 2.08 | 1.30 | 8.00 | 485.36 |
| | Chitosan 5g/l | 17.75 | 16.31 | 2.08 | 1.38 | 8.25 | 489.83 |
| | Control | 17.13 | 15.17 | 2.17 | 1.20 | 7.75 | 307.59 |
| Florida | Vitamen-x-0.75cm ³ /l | 17.58 | 12.91 | 1.83 | 1.25 | 8.75 | 381.26 |
| | Borkavit 3g/l | 16.75 | 14.35 | 1.92 | 1.15 | 8.25 | 380.68 |
| | Chitosan 5g/l | 17.67 | 10.77 | 1.75 | 1.13 | 8.25 | 327.51 |
| | Control | 17.08 | 11.00 | 1.33 | 1.23 | 7.00 | 266.26 |
| Festival | Vitamen-x-0.75cm ³ /l | 18.08 | 16.59 | 1.33 | 1.43 | 7.75 | 431.48 |
| | Borkavit 3g/l | 17.83 | 16.67 | 1.67 | 1.43 | 8.75 | 441.55 |
| | Chitosan 5g/l | 18.25 | 16.60 | 1.50 | 1.50 | 8.50 | 440.54 |
| | Control | 18.08 | 15.22 | 1.17 | 1.30 | 7.00 | 353.13 |
| L.S.D .at 0.05% | | NS | 2.29 | 0.68 | 0.16 | 0.60 | 136.44 |

Table 2: Effect of cultivars and foliar spray with some safety compounds as well as their interaction on vegetative growth characteristics of strawberry plants.

| Treatments | | 2012/2013 | | | | | |
|-----------------|-----------------------------------|-------------------|-------------------------|-------------------------|---------------------|-------------------------|------------------------------------|
| Cultivars | Spray compounds | plant height (cm) | Fresh weight /plant (g) | Number of crowns/ plant | Crown diameter (cm) | Number of Leaves/ plant | Leaf area(cm ²) /plant |
| Sweet Charlie | | 29.07 | 17.17 | 2.69 | 1.94 | 17.10 | 482.2 |
| Florida | | 17.25 | 16.12 | 1.38 | 2.33 | 10.10 | 564.2 |
| Festival | | 18.75 | 18.09 | 1.19 | 2.28 | 9.00 | 780.8 |
| L.S.D .at 0.05% | | 2.02 | 1.26 | 0.66 | 0.22 | 1.95 | 246.8 |
| | Vitamen-x- 0.75cm ³ /l | 21.78 | 18.56 | 1.50 | 2.20 | 11.20 | 642.6 |
| | Borkavit 3g/l | 22.17 | 16.88 | 1.75 | 2.04 | 11.90 | 662.1 |
| | Chitosan 5g/l | 21.56 | 16.20 | 2.13 | 2.28 | 13.90 | 630.4 |
| | Control | 21.26 | 16.87 | 1.63 | 2.21 | 11.30 | 501.2 |
| L.S.D .at 0.05% | | NS | 0.89 | 0.49 | NS | 2.35 | NS |
| Sweet Charlie | Vitamen-x- 0.75cm ³ /l | 29.96 | 20.432 | 2.00 | 2.13 | 16.80 | 511.6 |
| | Borkavit 3g/l | 30.57 | 16.46 | 2.25 | 1.58 | 15.70 | 474.4 |
| | Chitosan 5g/l | 27.63 | 16.26 | 3.75 | 2.33 | 19.50 | 485.8 |
| | Control | 28.13 | 15.53 | 2.75 | 1.73 | 16.50 | 457.1 |
| Florida | Vitamen-x- 0.75cm ³ /l | 16.45 | 16.98 | 1.25 | 2.38 | 9.00 | 529.5 |
| | Borkavit 3g/l | 17.50 | 15.86 | 1.63 | 2.45 | 11.50 | 666.1 |
| | Chitosan 5g/l | 18.04 | 15.09 | 1.50 | 1.95 | 11.10 | 527.5 |
| | Control | 17.01 | 16.56 | 1.13 | 2.53 | 8.75 | 533.6 |
| Festival | Vitamen-x- 0.75cm ³ /l | 18.94 | 18.27 | 1.25 | 2.10 | 7.75 | 886.7 |
| | Borkavit 3g/l | 18.45 | 18.32 | 1.38 | 2.10 | 8.50 | 845.9 |
| | Chitosan 5g/l | 18.99 | 17.25 | 1.13 | 2.55 | 11.10 | 877.8 |
| | Control | 18.65 | 18.53 | 1.00 | 2.38 | 8.63 | 512.8 |
| L.S.D .at 0.05% | | 2.59 | 1.56 | 1.56 | 0.85 | 1.56 | 1.56 |

Effect of safety compounds.

It is clear from data in Tables 1 and 2 that spraying strawberry plants with safety compounds i.e., Vitamin x at 0.75 cm³/l, Borka vit at 3 g/l and Chitosan at 5 g/l. significantly enhanced most studied morphological traits of plants especially during the first season of study compared with the control. In this connection, except plant height and number of crown per plant during the first season and plant height and average of crown diameter during the second season which were not significantly affected by spray treatments, using Borka vit at 3 g/l. reflected the highest values for fresh weight of plant, number of leaves and crowns per plant during the first season and plant height and leaf area during the second one, while spraying plants with Chitosan at 5 g/l ranks the second in all studied morphological parameters during the first season and reflected the highest values in number of leaves and crown during the second season.

Meanwhile, spraying the plants with Vitamin-x at 0.75 cm³/l. recorded the highest values of plant height and crown diameter in the first season and fresh weight per plant during the second one. Such enhancement effect of used growth stimulants (Borka vit, Chitosan and Vitamin-x) on all measured growth parameters are attributed to the content of boron and potassium elements in case of Borka vit and group of vitamins B complex in case of Vitamin-x and poly saccharides in case of Chitosan which are necessary and play main role in enhancement plant metabolism phytoprotection and maintain plant health and consequently increase plant growth. In this respect, Abo Sedera *et al.*(2010), Esringu *et al.*(2011), Shafshak *et al.*(2011), Abo El-Yazied and Mady (2012), Eshghi *et al.*(2012) and Kazemi (2013), reported that spraying the plants with potassium and (or) boron salts positively affected the plant growth aspects. In this regard, spraying strawberry plants with Chitosan as growth stimulator, positively affected plant growth expressed as plant height, fresh and dry weight, number of leaves and crown per plant (Ohta *et al.*, 2001, Sukwattanasinitt *et al.*, 2001, Bautista *et al.*, 2003, New *et al.*, 2004, Abdel-Mawgoud *et al.*, 2010, Shafshak *et al.*, 2011). In addition, treated plants with different vitamins compounds enhanced plant growth parameters (Nassar, 2013).

Effect of the interaction.

The effect of the interaction between all tested cultivars and foliar application of safety compounds (Vitamin x, Borka vit and Chitosan) on vegetative growth parameters expressed as plant height, fresh weight of plant, number of leaves and crowns per plant as well as crown diameter and leaf area, data in Tables 1 and 2 indicate that the highest values in most measured growth parameters were recorded as a result of spraying strawberry plants of cv. Sweet Charlie either with Borka vit at 3 g/l or Vitamin – x at 0.75 cm³/l, in the two seasons of study.

2. Fruit yield and its components.

Effect of cultivars.

Data in Table 3 show that there were significant differences among the tested cultivars in total produced fruit yield and its components expressed as early yield, marketable and unmarketable fruit yield as well as total fruit yield plant⁻¹ and feddan⁻¹ during both seasons of study. In this connection, cv.

Florida produced the highest early yield during the two seasons of growth. However, plants of cv. Festival recorded the highest marketable fruit yield and total fruit yield per plant and per feddan during the first season, but it produced the lowest unmarketable yield during the first season. Moreover, plants of cv. Florida exhibited the highest marketable and total fruit yield for both plant and feddan as well as unmarketable fruit yield during the second season. In this respect, cv. Sweet Charlie ranked the last in total produced fruit yield and its components except the early yield it ranks the second after cv. Florida with out significant differences during the two growing seasons. Such differences in total fruit yield and its components among the studied cultivars may be attributed to the differences in genetical structure between such cultivars.

Obtained results are in the same line as those reported by El-Miniawy (1991), Schopplein *et al.* (2002), Gunduz and Ozdemir (2008), Ahmed (2009) and Abo Sedera *et al.* (2010). All working on strawberry they reported great differences in total fruit yield and its components between the tested cultivars.

Effect of safety compounds .

Data in Table 3 indicate that spraying the plants with Borka vit at 3g/l, Vitamin -x at 0.75 cm³/l and Chitosan at 5 g/l significantly increased all the aforementioned yield parameters compared with the control treatment during the two growing seasons. In this respect, the highest values of total produced fruit yield and its components were exhibited by spraying the plants with Borka vit., followed by Vitamin- x and Chitosan in descending order during the two seasons of study. Such increments in total fruit yield and its components are accompanied with the increment in vegetative growth parameters Tables (1 and 2). The highest produced yield in case of using Borka vit may be attributed to the highest content of potassium and boron which play main role in synthesis of protein, carbohydrate and fats, translocation of sugars, enabling their ability to resist pest and disease which in turn increased flowering and fruit set of plants. Obtained result are going with those reported by Pawel and Mariusz (2003), Lanauskas *et al.* (2006), Abo-Sedera *et al.* (2010) and Shafshak *et al.* (2011). In this respect, Abo-Sedera *et al.* (2010) reported that spraying strawberry plants with mineral salts as calcium and potassium significantly increased total produced yield and its components compared with the control treatment. Moreover, Abd El-Mawgoud *et al.* (2010) and Shafshak *et al.* (2011) on strawberry mentioned similar results due to spraying plants with chitosan on yield and its components.

Effect of the interaction.

Concerning the effect of the interaction between the studied cultivars and safety compounds (Borka vit, Vitamin- x and Chitosan). Such data in Table 3 proved that there were significant differences in all measured yield parameters (early yield, marketable, total yield per plant and feddan as well as unmarketable fruit yield) during the two seasons of growth. In this regard, cv. Florida sprayed with Borka vit at 3g/l four times during the growing season reflected the highest values in all studied yield parameters, except the unmarketable fruit yield which was higher in case of the control treatment with the same cultivar.

3. Chemical fruit quality

Effect of cultivars.

Data presented in Tables 4 and 5 show clearly that chemical fruit quality characters expressed as TSS, vitamin-C, total acidity, total sugars and anthocyanin concentration were significantly different among the tested cultivars except vitamin-C and total acidity in the first season only in which the level of differences did not reach the level of significance. In this respect, cv. Festival recorded the highest value of TSS, vitamin-C, total acidity, total sugars and anthocyanin concentration. On the other hand, the highest total sugars content was recorded in case of fruit of cv. Sweet Charlie. In this respect, such differences in fruit chemical quality characters between the studied cultivars may be attributed to the genetic structure of such cultivars. Obtained results are in agreement with those reported by Hakala *et al.*(2002), Zmuda *et al.*(2004) and Ahmed (2009). All working on strawberry.

Table 4: Effect of cultivars and foliar spray with some safety compounds as well as their interaction on chemical fruit quality of strawberry plants.

| Treatments | | 2011/2012 | | | | |
|-----------------|----------------------------------|-------------|----------------------------|-----------------------------|------------------------|---------------------------------|
| Cultivars | Spray compounds | TSS% | Vit .C (mg/100g f.w) | Acidity (mg/100g f.w) | Total sugars (%) | Anthocyanin (mg/100g f.w) |
| Sweet Charlie | | 10.63 | 44.75 | 1.24 | 8.32 | 85.40 |
| Florida | | 9.34 | 45.19 | 1.24 | 8.32 | 84.50 |
| Festival | | 11.66 | 46.50 | 1.25 | 8.30 | 88.90 |
| L.S.D .at 0.05% | | 0.99 | NS | NS | 0.01 | 1.05 |
| | Vitamen-x-0.75cm ³ /l | 10.29 | 48.33 | 1.13 | 8.31 | 90.90 |
| | Borkavit 3g/l | 11.25 | 48.67 | 1.23 | 8.32 | 86.30 |
| | Chitosan 5g/l | 10.33 | 43.83 | 1.28 | 8.33 | 87.10 |
| | Control | 10.29 | 41.08 | 1.34 | 8.30 | 80.80 |
| L.S.D .at 0.05% | | NS | 3.95 | NS | 0.01 | 0.78 |
| Sweet Charlie | Vitamen-x-0.75cm ³ /l | 10.50 | 46.00 | 1.08 | 8.33 | 87.10 |
| | Borkavit 3g/l | 11.50 | 44.25 | 1.25 | 8.34 | 90.00 |
| | Chitosan 5g/l | 10.50 | 46.50 | 1.10 | 8.33 | 84.00 |
| | Control | 10.00 | 42.25 | 1.55 | 8.28 | 80.00 |
| Florida | Vitamen-x-0.75cm ³ /l | 8.57 | 51.25 | 1.18 | 8.31 | 88.00 |
| | Borkavit 3g/l | 9.88 | 50.50 | 1.23 | 8.31 | 87.00 |
| | Chitosan 5g/l | 9.00 | 41.00 | 1.40 | 8.34 | 82.00 |
| | Control | 9.75 | 38.00 | 1.15 | 8.32 | 81.00 |
| Festival | Vitamen-x-0.75cm ³ /l | 11.63 | 47.75 | 1.15 | 8.30 | 98.00 |
| | Borkavit 3g/l | 12.38 | 51.25 | 1.20 | 8.31 | 82.00 |
| | Chitosan 5g/l | 11.50 | 44.00 | 1.33 | 8.31 | 94.00 |
| | Control | 11.13 | 43.00 | 1.33 | 8.30 | 82.00 |
| L.S.D .at 0.05% | | 1.75 | 6.85 | 0.40 | 0.02 | 1.40 |

Effect of safety compounds .

Data in Tables 4 and 5 indicate that spraying strawberry plants with different studied safety compounds four times during the growing seasons, positively enhanced all the assayed chemical constituents of fruit. In this concern, the highest values of TSS and vitamin-C were recorded in case of Borka vit, while the highest values of total sugars were recorded in case of Chitosan, but Vitamin-x recorded the highest values of anthocyanin content in

fruit. However, the highest total acidity values were recorded in case of the control treatment. Such results are true during the two seasons of study. In this concept, Pawel and Mariusz (2003), Singh *et al* (2009), Abo Sedera *et al* (2010), Esringu *et al.*(2011) and Abo El-Yazied and Mady (2012) in case of using mineral salts, Abd El-All (2009) in case of using vitamins and Shafshak *et al.* (2011) in case of using chitosan.

Table 5: Effect of cultivars and foliar spray with some safety compounds as well as their interaction on chemical fruit quality of strawberry plants.

| Treatments | | 2012/2013 | | | | |
|-----------------|-----------------------------------|-------------|----------------------|----------------------|------------------|---------------------------|
| Cultivars | Spray compounds | TSS% | Vit .C (mg/100g f.w) | Acidty (mg/100g f.w) | Total sugars (%) | Anthocyanin (mg/100g f.w) |
| Sweet Charlie | | 7.96 | 50.10 | 1.63 | 6.90 | 84.07 |
| Florida | | 7.60 | 45.00 | 1.62 | 6.86 | 82.15 |
| Festival | | 8.75 | 52.40 | 2.06 | 6.82 | 84.73 |
| L.S.D .at 0.05% | | 0.41 | 3.95 | 0.41 | 0.02 | 1.74 |
| | Vitamen-x- 0.75cm ³ /l | 7.74 | 49.10 | 1.73 | 6.88 | 84.22 |
| | Borkavit 3g/l | 8.46 | 50.90 | 1.81 | 6.86 | 85.61 |
| | Chitosan 5g/l | 8.13 | 49.50 | 1.84 | 6.84 | 83.59 |
| | Control | 8.08 | 47.30 | 1.70 | 6.86 | 81.19 |
| L.S.D .at 0.05% | | NS | NS | NS | 0.02 | 1.67 |
| | Vitamen-x- 0.75cm ³ /l | 7.35 | 48.00 | 1.40 | 6.90 | 85.54 |
| Sweet Charlie | Borkavit 3g/l | 8.15 | 49.60 | 1.47 | 6.90 | 85.02 |
| | Chitosan 5g/l | 8.11 | 53.10 | 2.17 | 6.89 | 84.32 |
| | Control | 8.22 | 49.80 | 1.50 | 6.91 | 81.39 |
| | Vitamen-x- 0.75cm ³ /l | 7.71 | 45.30 | 1.60 | 6.87 | 83.17 |
| Florida | Borkavit 3g/l | 8.00 | 49.10 | 1.77 | 6.86 | 82.66 |
| | Chitosan 5g/l | 7.34 | 43.00 | 1.60 | 6.85 | 83.03 |
| | Control | 7.36 | 42.40 | 1.53 | 6.87 | 79.75 |
| | Vitamen-x- 0.75cm ³ /l | 8.15 | 53.90 | 2.20 | 6.88 | 83.95 |
| Festival | Borkavit 3g/l | 9.22 | 53.90 | 2.20 | 6.81 | 89.16 |
| | Chitosan 5g/l | 8.95 | 52.40 | 1.77 | 6.79 | 83.40 |
| | Control | 8.68 | 49.50 | 2.07 | 6.80 | 82.42 |
| L.S.D .at 0.05% | | 0.79 | 7.45 | 0.59 | 0.04 | 2.89 |

Effect of the interaction.

With regard to the effect of the interaction, the same data in Tables 4 and 5 indicate that generally spraying the plants of different tested cultivars with Borka vit at 3g/l four times during the growing seasons scored the highest values in all assayed chemical constituents of fruits during the two seasons of study.

Consequently, it is preferable from the previous results that treating some strawberry cultivars plants with some safety compound (Borka vit, Vitamin-X and Chitosan) for enhancing growth, quality, chemical composition and productivity of these cultivars. Therefore, the present study strongly admit the use of such treatments to provide good and high exportation characteristics due to its safety role on human health.

CONCLUSION

Under similar conditions of the experiment it could be concluded that spraying strawberry plants with safety compounds (Borka vit at 3g/l or Vitamin-x at 0,75 cm³/l) four times during the growing seasons obtained the highest early yield in case of cv. Florida and highest yield per plant and feddan with the best quality in case of cv. Festival.

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تأثير الرش ببعض المركبات الآمنة على نمو وانتاجه بعض أصناف الفراولة
عبد الحكيم سعد شمس^١، فتحى أبو النصر أبوسديرة^١، أحمد أبو اليزيد عبد الحافظ^٢،
مهران مختار النجار^١ و محمد سعيد البدوي
١. قسم البساتين- كلية الزراعة - جامعة بنها
٢. قسم البساتين - كلية الزراعة-جامعة عين شمس

اجريت تجربة حقلية خلال موسمی الزراعة ٢٠١١- ٢٠١٢ و ٢٠١٢-٢٠١٣م فی مزرعة خاصة بقريه الدير- محافظه القليوبيه في ارض رملية لدراسه استجابته ثلاثة اصناف من الفراولة وهى سویت شارلى وفلوريدا و فيستيفال للرش ببعض المركبات الكيمياءيه المحفزة للنمو (بوركافيت و فيتامين اكس و شيتوسان) وتأثير ذلك على النمو الخضري والتركيب الكيمياءى للمجموع الخضري للنبات والمحصول الثمرى ومكوناته وكذلك ايضا جودة الثمار الناتجه وقد اشتملت التجربة على ١٢ معاملة ناتجه من التفاعل بين ثلاثة اصناف من الفراولة واربعه معاملات من المواد الآمنة المحفزة للنمو.

وقد اظهرت النتائج المتحصل عليها وجود اختلافات في جميع صفات النمو الخضري والمحصول ومكوناته وكذلك جودة الثمار الناتجه بين الاصناف المستخدمه في الدراسه. وفي هذا الشأن اعطي الصنف فلوريدا اعلى محصول مبكر بينما اعطي الصنف فيستيفال اعلى محصول كلي كذلك ادي الرش بالمواد الآمنة المحفزه للنمو المستخدمه الى تحسين في المجموع الخضري والمحصول الثمرى وصفات الجودة للثمار الناتجه وقد ادى استخدام البوركافيت بمعدل ٣ جم/لتر يلية استخدام فيتامين اكس بمعدل ٠,٧٥ سم^٣/لترالى الحصول على افضل النتائج فى النمو الخضري والمحصول والجودة لجميع الاصناف المستخدمه. كما أن رش نباتات الفراولة صنف فيستيفال باستخدام بوركافيت أعطى أعلى محتوى للثمار من المواد الصلبة الكلية و فيتامين سى والحموضة وذلك فى كلا الموسمين.

الكلمات الدالة:

الفراولة- سویت شارلى- فلوريدا- فيستيفال- بوركافيت - فيتامين اكس - شيتوسان - النمو الخضري- المحصول الثمرى- جودة الثمار .

Table 3: Effect of cultivars and foliar spray with some safety compounds as well as their interaction on fruit yield and its component of strawberry.

| Treatments | | 2011 /2012 | | | | | 2012/2013 | | | | |
|-----------------|----------------------------------|-----------------------|------------------------|-----------------------|------------------------------|-----------------------------|-----------------------|------------------------|------------------------|------------------------------|-----------------------------|
| Cultivars | Spray compounds | Early yield (ton/fed) | Total yield (g) /plant | Total yield (ton/fed) | Marketabl e yield (ton/fed) | Unmarketable (kg/fed) yield | Early yield (ton/fed) | Total yield (g) /plant | Total yield (ton /fed) | Marketabl e yield (ton/fed) | Unmarketable yield (kg/fed) |
| Sweet Charlie | | 5.94 | 436.4 | 23.78 | 23.35 | 430.20 | 7.55 | 432.25 | 24.14 | 23.76 | 403.45 |
| Florida | | 7.06 | 509.9 | 28.25 | 27.69 | 564.08 | 7.87 | 522.25 | 29.27 | 28.74 | 528.15 |
| Festival | | 5.66 | 538.7 | 30.49 | 30.12 | 373.62 | 5.48 | 458.50 | 25.74 | 25.32 | 419.38 |
| L.S.D .at 0.05% | | 0.44 | 21.5 | 2.89 | 2.16 | 73.72 | 0.41 | 17.55 | 1.39 | 0.83 | 56.57 |
| | Vitamen-x-0.75cm ³ /l | 6.49 | 510.4 | 28.80 | 28.35 | 452.01 | 7.04 | 481.75 | 26.96 | 26.51 | 446.01 |
| | Borkavit 3g/l | 6.77 | 522.6 | 29.11 | 28.65 | 463.22 | 7.23 | 492.58 | 27.63 | 27.16 | 467.86 |
| | Chitosan 5g/l | 6.16 | 487.6 | 27.32 | 26.95 | 372.57 | 6.95 | 469.75 | 26.36 | 26.02 | 335.10 |
| | Control | 5.46 | 459.3 | 24.79 | 24.26 | 533.66 | 6.66 | 439.92 | 24.64 | 24.09 | 552.35 |
| L.S.D .at 0.05% | | 0.25 | 15.7 | 2.64 | 1.69 | 95.09 | 0.16 | 11.47 | 1.29 | 0.58 | 71.90 |
| | Vitamen-x-0.75cm ³ /l | 6.17 | 443.9 | 24.81 | 24.37 | 440.15 | 7.56 | 443.00 | 24.68 | 24.27 | 405.06 |
| Sweet Charlie | Borkavit 3g/l | 6.40 | 453.6 | 25.43 | 25.00 | 428.85 | 7.66 | 449.00 | 25.10 | 24.72 | 382.90 |
| | Chitosan 5g/l | 5.73 | 438.4 | 24.62 | 24.18 | 443.35 | 7.55 | 432.50 | 24.26 | 23.94 | 315.84 |
| | Control | 5.47 | 409.8 | 20.36 | 19.85 | 508.47 | 7.44 | 404.50 | 22.62 | 22.11 | 510.02 |
| | Vitamen-x-0.75cm ³ /l | 7.38 | 521.5 | 28.78 | 28.23 | 545.17 | 7.99 | 535.50 | 30.01 | 29.5 | 508.76 |
| Florida | Borkavit 3g/l | 7.64 | 542.9 | 29.82 | 29.26 | 560.85 | 8.14 | 553.25 | 31.02 | 30.47 | 549.91 |
| | Chitosan 5g/l | 7.27 | 503.0 | 28.19 | 27.72 | 474.22 | 7.94 | 521.75 | 29.24 | 28.85 | 393.40 |
| | Control | 5.94 | 472.1 | 26.21 | 25.53 | 676.06 | 7.42 | 478.50 | 26.82 | 26.16 | 660.52 |
| | Vitamen-x-0.75cm ³ /l | 5.92 | 565.8 | 31.71 | 31.33 | 377.93 | 5.57 | 466.75 | 26.16 | 25.74 | 424.20 |
| Festival | Borkavit 3g/l | 6.28 | 571.4 | 32.09 | 31.70 | 399.96 | 5.88 | 475.50 | 26.75 | 26.28 | 470.77 |
| | Chitosan 5g/l | 5.46 | 521.5 | 29.25 | 28.95 | 300.14 | 5.35 | 455.00 | 25.55 | 25.25 | 296.05 |
| | Control | 4.98 | 496.0 | 27.81 | 27.39 | 416.43 | 5.13 | 436.75 | 24.49 | 24.00 | 486.50 |
| L.S.D .at 0.05% | | 0.43 | 27.25 | 3.09 | 2.93 | 164.71 | 0.28 | 19.87 | 1.12 | 1.00 | 124.53 |

