EFFECT OF SOME ORGANIC TREATMENTS ON YIELD AND FRUIT QUALITY OF "COSTATA" PERSIMMON TREES.

Soaad A. Mohamed and *Refat A. Youssef
Deciduous fruit Dept., Hort. Res. Inst., ARC, Giza, Egypt
*Soil and Water Department, NRC, Giza, Egypt

ABSTRACT

The aim of this study is to investigate the effect of foliar application of some organic substances (humic acid, fulvic acid and Algae extract) on vegetative growth, yield and fruit quality of "Costata" persimmon trees grown on clay loamy soil under surface irrigation.

This study was conducted during 2011 and 2012 seasons at EL-Kanater, Horticultural Research Station, Kalubeia governorate, Egypt on "Costata" persimmon trees (Diospyros Kaki L.). The trees were 22 years old budded on "Lotus" rootstock and spaced at 4x5 m apart. Twenty one trees were sprayed four times {at full bloom, two weeks after fruit set, after one month of fruit set and at month before harvest} with humic acid at 1 or 2%, seaweed extract at 1 or 2% as well as fulvic acid at 1 or 2%.

The results showed that, humic acid and algae extract gave better vegetative growth {leaf area, shoot length, leaf dry weight}, nutrition status {leaf content of N, P, K, Fe, Mn and Zn}, fruiting {fruit set and yield} as well as fruit characters {weight, size, dimensions, firmness}, {TSS%, acidity% and tannins%} as compared with control in two studied seasons. Also, higher concentration (2%) of all tested substances was more effective than low one.

INTRODUCTION

Persimmon is one of favorable deciduous fruit trees grown in Egypt. Extension of the cultivated area nowadays is due to its highly economic value. The area reached to 2029 feddan **(Ministry of Agriculture, 2013)**. Improving crop yield and fruit quality without adversely affecting the environment could be achieved by replacing chemical fertilizers by some organic materials to crop production.

Fulvic and humic acids have the same source of origin, the main difference is that the molecular size. These substances work in various stages of soil and plant development **(Senn and Kingman, 2000)**. However, supplying "Florda Prince" peach trees with the suitable N through 50 % inorganic form as well as application of humic acid at 80 ml/ tree/ year+25ml *Spirulina platensis* algae is suggested to promote yield quantitively and qualitatively**(El-Khawaga, 2011)**. The beneficial effect of organic fertilization on enhancing soil fertility and the uptake of different nutrients surely reflected on stimulating growth characters and nutritional status of the trees, subsequently producing more fruits **(Davis and Ghabbour, 1998)**. There is growing interest of the use of humic acid and K-humate as a substitute to

chemical fertilizers which have potential polluting effects in the environment **(Senn and Kingman, 2000)**. Also, humic acid promotes soil aggregation, water holding capacity of soils, nutrient availability to plant roots and helps in root development and plant growth **(Ismail *et al.*, 2007)**. Therefore, humic acid can face many problems in calcareous soil, alkaline soil and low organic matter soil such as nutrient availability and chemical reactions that affect the loss or fixation of almost all nutrients without excessive use of chemicals which are considered a menance to environment **(Eissa et al., 2007)**. Moreover, **El-Shall et al. (2010)** revealed the importance of HA treatment for increasing water use efficiency of plum trees. Also, **Grzyb et al. (2012)** stated that, organic fertilizers and amendments induced higher growth of apple and cherry rootstocks than chemical fertilization. Hence, foliar and/or soil application of humic acid had a positive effect on yield, fruit quality, leaf chlorophyll and mineral content of N, P, K of "Florida Prince" peach trees **(Abd El-Razek et al., 2012).**

Algae *(Spirulina platensis)* is a photosynthetic blue green micro alga, it considers an essential fertilizer due to its commercial importance as a source of proteins, vitamins, essential amino acids and fatty acids **(Vonshak, 1986).** In addition, spraying "Keitte" mango trees at full bloom with 2%algae combined with yeast at 0.2% was very effective in improving fruit set, fruit retention, yield, fruit dimentions. Also, enhanced total soluble solids (T.S.S.) and improved nitrogen, potassium and boron leaf content. Moreover, it reduced fruit drop and weight of peel and seed compared with control **(Abd El-Motty et al., 2010)**.

Also, **Fornes *et al.* (2002)** reported that seaweed extract increased the yield of "Clementine" mandarin by 11%. Overall, algae extract as a new fertilizer containing N, P, K, Ca, Mg and S as well as Zn, Fe, Mn, Cu, Mo, and Cobalt, some growth regulators, polyamines and vitamins applied to improve nutritional status, vegetative growth, yield and fruit quality of apple **(Spinelli *et al.*, 2009)**. Also, organic or bio-fertilization is very safe for human, animal and environment to get lower pollution and reduce soil salinity via decrease mineral usage fertilization and saving cost **(Chouliaras et al., 2009 and Abd El-Motty et al., 2010).**

MATERIALS AND METHODS

The present investigation was carried out during two successive seasons, 2011 and 2012 at El-Kanater Horticultural Research Station, Kalubeia governorate, Egypt on "Costata" persimmon trees (Diospyros kaki L). The trees were 22 years old and budded on "Lotus" rootstock, spaced at 4 x 5 meters apart and grown on clay loamy soil under surface irrigation.

Treatments used were as follow:

1- Control sprayed only with water (T1)
2- [1]Humic acid (K-humate) sprayed at 1% (T2). {HA}
3- Humic acid (K-humate) sprayed at 2% (T3). {HA}
4- [2]Algae extract (Alga-plus) sprayed at 1%(T4). {AE}
5- Algae extract (Alga-plus) sprayed at 2%(T5). {AE}
6- [3]Fulvic acid (K-fulvate) sprayed at 1% (T6). {FA}
7- Fulvic acid (K-fulvate) sprayed at 2% (T7). {FA}

[1]Humic Extra contains: 10%humic acid, 2%Fulvic acid, 4%potassium, 5%nitrogen, 0.1%sulpher and 1.5%iron.

[2]Algae-Plus contains: 10%algae extract, 8%amino acids, 5%NPK, 0.1% Fe, Zn, Mn, B, 0.01%Mo and 0.02%Cupper.

[3]Fulvic acid contains: 3%fulvic acid and 4%potassium.

The selected trees received all horticultural practices that are usually applied in the orchard.

Treatments were applied four times: the first at full bloom, the second two weeks after fruit setting, the third after one month of the second spray and the fourth one month before harvest (during fruit maturity). The foliar application was applied directly for the trees with a handheld sprayer until runoff in the early morning.

In this orchard, twenty one trees as uniform as possible were selected for this study. The different treatments were arranged in a complete randomized blocks design.

Four main branches per tree were chosen, all current shoots developed on those branches were used for measuring: leaf area (cm^2) using Li-core 3100 area meter, shoot length (cm). Leaves were dried and weighed to get leaf dry weight (g.). All these samples were taken on August according to **(Westwood, 1978)**.

Leaf mineral content: Sample of mature leaves were collected on August, prepared and determined according to **Cottenie et al. (1982)**. Macro-elements were expressed as percent on dry weight basis while micro-elements as part per million. Final fruit set was estimated after full blooming as percentage.

At harvest time when the control fruits attained maturity at the stage of yellow green colour according to the standard recorded by **(El-Azzouni et al., 1975)**, the yield (Kg/tree) was recorded at the two seasons. In addition, samples of twenty fruits were randomly taken from each replicate to study fruit characters, weight (g), size (cm^3), length (cm), diameter (cm), firmness ($lb/inch^2$) by pressure tester using a 5/16 plunger, two reading were taken on the flesh of each fruit. Also, total soluble solids (TSS%) was determined by hand refractometer, acidity% (as malic acid/100ml juice) and tannins (%) in the juice of the fruits were determined according to **(A. O. A. C., 1985)**.

Statistical analysis:

Data were subjected to analysis of variance according to **Snedecor and Cochran (1982)** and the differences between the conducted treatments separated by Duncan's test at 0.05% **(Duncan, 1955).**

RESULTS AND DISCUSSION

1- Vegetative growth:-

Effect of humic acid, algae extract and fulvic acid on leaf area, leaf dry weight and shoot length:

It is clear from obtained data in Table (1) that organic substances applications improved leaf area, shoot length and leaf dry weight compared to control at both studied seasons. It was obvious that high concentration (2%) of all tested materials were more effective. Generally, humic acid (HA) gave the highest effect as it recorded (83.36&89.00cm^2) for leaf area, (68.92&71.18cm) for shoot length and (8.99&7.61g) for leaf dry weight, while the control recorded (68.22&74.30 cm^2), (55.4&57.5 cm) and (7.02&5.84 g) at both seasons, respectively. It followed by 2% algae extract, 1% humic acid, then 2% fulvic acid. The other treatments gave lowest values.

Table (1): Effect of humic acid, algae extract and fulvic acid on leaf area, shoot length and leaf dry weight of "Costata" persimmon trees during 2011 and 2012 seasons.

Treatments	Leaf area (cm^2)		Shoot length (cm)		Leaf dry weight (g.)	
	2011	2012	2011	2012	2011	2012
Control	68.22g	74.30c	55.40d	57.50g	7.02d	5.84c
HA 1%	78.08c	85.66a	64.60b	65.90c	8.22b	7.04b
HA 2%	83.36a	89.00a	68.92a	71.18a	8.99a	7.61a
AE 1%	73.10e	80.60b	59.60c	61.10e	7.30cd	6.28c
AE 2%	80.02b	87.04a	66.36b	68.59b	8.63a	7.26ab
FA 1%	70.42f	78.40bc	57.20d	59.50f	7.31cd	6.13c
FA 2%	76.04d	79.24b	60.30c	63.40d	7.66c	6.13c

Means having the same letters in each column are not significantly different at 0.05 level.

Similar trend was noticed by **Allam (2008); El-Shall et al. (2010) and Refaai (2011)** who cleared that either soil or foliar application of HA increased vegetative growth of "Kelsy" plum trees. Also, **El-Khawaga (2011)** revealed a promotive effect of organic fertilizers and 50% inorganic N on increasing leaf area of peach comparing with N via inorganic form at 100%.

2- Effect of humic acid, algae extract and fulvic acid on macro-elements leaf content:

Referring to leaf mineral content of NPK in Table (2), all different treatments increased N, P and K leaf content. humic acid at 2% significantly increased NPK content than all treatments and control at both studied seasons. It followed by 2%algae extract in the next order. Spraying at 2% level of all substances resulted in higher content of elements as compared with 1%.

Results pointed out that fulvic acid at 1% gave the lowest insignificant increase in this respect compared to control.

Table (2): Effect of humic acid, algae extract and fulvic acid on N, P and K leaf content (%) of "Costata" persimmon trees during 2011 and 2012 seasons.

Treatments	N (%)		P (%)		K (%)	
	2011	2012	2011	2012	2011	2012
Control	2.16e	2.25d	0.25b	0.23b	1.26d	1.28e
HA 1%	2.34cd	2.46c	0.27ab	0.25ab	1.35bcd	1.40bcd
HA 2%	2.73a	2.81a	0.30a	0.27a	1.47a	1.52a
AE 1%	2.26de	2.36cd	0.26ab	0.24ab	1.32cd	1.35cde
AE 2%	2.57b	2.77a	0.29ab	0.25ab	1.44ab	1.47ab
FA 1%	2.20e	2.33d	0.26ab	0.23b	1.28d	1.32de
FA 2%	2.45c	2.58b	0.28ab	0.25ab	1.39abc	1.43abc

Means having the same letters in each column are not significantly different at 0.05 level.

These results are in harmony with those obtained by **Hegab *et al.* (2005)** on citrus and **Stino *et al.* (2009)** on apricot. Also, **Abd El-Motty et al. (2010)** on mango found that N and K leaf content increased by yeast+algae treatments.

3- Effect of humic acid, algae extract and fulvic acid on micro-elements leaf content:

The obtained results in Table (3) cleared that all treatments improved leaf content of Fe, Mn and Zn compared with control at 1st and 2nd seasons. It was clear that humic acid at 2% followed by ○2% algae extract increased these elements compared with control and the other treatments at both seasons. In addition, fulvic acid at 1% recorded the lowest increase compared with control.

Table (3): Effect of humic acid, algae extract and fulvic acid on Fe, Mn and Zn leaf content (ppm) of "Costata" persimmon trees during 2011 and 2012 seasons.

Treatments	Fe (ppm)		Mn (ppm)		Zn (ppm)	
	2011	2012	2011	2012	2011	2012
Control	118.02d	114.00d	58.30d	61.20g	17.20c	18.00d
HA 1%	129.20bc	121.80bc	62.30c	67.56c	17.80bc	18.30cd
HA 2%	136.30a	128.59a	66.23a	70.62a	19.02a	19.58a
AE 1%	125.31c	118.60cd	61.50c	64.30e	17.40c	18.16cd
AE 2%	132.40ab	125.74ab	64.77ab	69.16b	18.47ab	18.95b
FA 1%	120.20d	115.10d	59.50d	63.60f	17.32c	18.10cd
FA 2%	131.42b	124.64ab	64.42b	65.45d	18.15abc	18.54bc

Means having the same letters in each column are not significantly different at 0.05 level.

These clarifications are supported by many researchers, **(Russo and Berlyn, 1990; Eissa *et al.*, 2007; Ismail *et al.*, 2007; Fathi *et al.*, 2010 and Abd El-Razek et al., 2012).** Additionally, **Naiema (2008)** revealed that aminofert treatments increased N, Fe, Zn and Mn leaf content of pear. At the

same time, it decreased P leaf content. Moreover, Asik **et al. (2009)** worked on wheat, found that foliar application of humic increased the content of P, K, Mg, Na, Cu and Zn in saline soils. Also, **El-Shall et al., (2010)** showed that foliar and soil HA treatments significantly increased N, P, K, Fe, Mn and Zn leaf content. Noticeably, **Havlin and Westfall (1984)** noticed that fulvic and humic organic amendments increased the efficiency of P fertilizers and the availability of soluble calcium phosphates. Also, **Delgado et al. (2002)** cleared that mixture of humic-fulvic acid increased the efficiency of P fertilizers.

Burk et al. (1931) reported that natural humic acid increases the growth through the iron which it contains, also, iron contained in humic acid may promote plant cell processes such as "respiration, nitrification, catalase activity". They also reported that, humic acid may be classified as a stimulant that provides iron for nutrient and growth such that iron is more available when compared to other media.

4- Effect of humic acid, algae extract and fulvic acid on fruit set, yield and fruit weight:

From data presented in Table (4) it is obvious that all these characters were positively affected by all treatments with significant differences compared with control. Algae extract at 2% recorded the highest significant increase fruit set (56.94&58.84%), yield (31.00&29.45kg) and fruit weight (129.0&140.8g) compared with control. It followed by 2%HA. Control recorded the lowest values (40.62&42.80%)fruit set, (23.2&21.70kg) yield and (95.6&105.2g) fruit weight in both seasons, respectively.

Table (4): Effect of humic acid, algae extract and fulvic acid on fruit set, yield and fruit weight of "Costata" persimmon trees during 2011 and 2012 seasons.

Treatments	Fruit set (%)		Yield (kg)		Fruit weight (g.)	
	2011	2012	2011	2012	2011	2012
Control	40.62g	42.80g	23.20d	21.70g	95.60g	105.20g
HA 1%	47.55d	49.50d	26.45c	25.30d	110.25d	124.80d
HA 2%	53.37b	55.43b	29.05b	27.78b	121.60b	134.2b
AE 1%	49.86c	52.43c	27.93b	26.60c	115.30c	127.9c
AE 2%	56.94a	58.84a	31.00a	29.45a	129.00a	140.8a
FA 1%	42.60f	44.52f	24.20d	23.20f	103.20f	114.70f
FA 2%	45.02e	46.55e	25.50c	24.10e	107.10e	119.70e

Means having the same letters in each column are not significantly different at 0.05 level.

The previous results are in agreement with those reported by **Abd El-Wahab (2007)** on grapevine; **Kandil et al. (2009)** on peach; **El- Khawaga (2011)** on peach and **Abd El-Razek et al. (2012)** on peach.

Also, spraying mango trees with algae at 2% and yeast at 0.2% extracts gave the highest values of fruit set, fruit retention and reduced fruit drop (**Abd El-Motty et**

al., 2010). This may be due to the improving effect of such treatments on nutritional status of the trees, which reflected on fruit set and fruit retention increase.

In this respect, **Kulk (1995) and Adam (1999)** reported that the improvement of fruit set percentage could be explained as a result of increasing pollen grains germination.

Humic acid is one of stimulants which are known as an organic material that promote plant growth and help plants to withstand hard environments when applied in small quantities **(Chen et al ., 1994).** It is also highly beneficial for both plant and soil; i.e., it maintains proper plant growth as well as it increases nutrient uptake, tolerance to drought and temperature extremes and activity of beneficial soil microorganisms. Furthermore, humic materials may increase root growth in a similar manner to auxins **(O'Donnell, 1973; Tatini et al., 1991 and Khattab et al., 2012).** In this respect, humic acid has many effects due to increase of cation exchange capacity which affects the retention and availability of nutrients, or due to a hormonal effect, or a combination of both **(Chunhua et al ., 1998).** Moreover, there is growing interest of the use of humic acid and K-humate as a substitute to chemical fertilizers which have potential polluting effects in the environment **(Senn and Kingman, 2000).** In addition, the increment in the yield could be explained as a result of increasing fruit physical characteristics such as fruit weight.

5- Effect of humic acid, algae extract and fulvic acid on physical fruit characters (volume, dimensions and firmness):

It is evident from the data in Table (5) that all spraying treatments caused positive effect in increasing volume, length and diameter of fruits compared with control. It was noticed that the highest significant values were obtained as a result of using 2%algae extract, since it recorded (130.1, 144.7cm^3); (6.57, 6.63cm)and (6.32, 6.35cm) compared with control (96.4, 107.4 cm^3); (5.52, 5.60cm) and (5.5, 5.5cm) for fruit volume, length and diameter at both seasons, respectively. It followed by 2% humic acid, then 1%algae extract. In contrast, there are reflex relationship between all treatments and fruit firmness, since they accelerated fruit maturity (decreased the firmness) than the control in the two investigated seasons. The lowest significant values of firmness were recorded by 2% algae extract.

Table (5): Effect of humic acid, algae extract and fulvic acid on fruit volume, length, diameter and firmness of "Costata" persimmon trees during 2011 and 2012 seasons.

Treatments	F. volume (cm^3)		F. length (cm.)		F. diameter (cm.)		F. firmness (lb/inch^2)	
	2011	2012	2011	2012	2011	2012	2011	2012
Control	96.40g	107.4g	5.52e	5.60f	5.50d	5.50d	16.50a	15.80a
HA 1%	116.5d	120.4d	5.99c	6.12cd	5.82c	6.01bc	15.70abc	14.80d
HA 2%	123.6b	137.1b	6.34b	6.40b	6.11b	6.23a	14.80cd	13.90f
AE 1%	118.3c	126.5c	6.22b	6.25bc	5.88c	6.03b	15.30bc	14.40e
AE 2%	130.1a	144.7a	6.57a	6.63a	6.32a	6.35a	14.20d	13.40g
FA 1%	104.5f	115.8e	5.67de	5.75ef	5.76c	5.85c	16.25a	15.50b
FA 2%	113.2e	113.6f	5.83cd	5.92de	5.80c	5.94bc	16.00ab	15.20c

Means having the same letters in each column are not significantly different at 0.05 level.

These results are in harmony with those obtained by **Allam (2008)** on plum; **Naiema (2008)** on pear; **El-Naggar (2009)** on apricot; **El-Shall et al. (2010)** on plum; **Refaai (2011)** on grapevine **and Mansour et al. (2013)** on peach.

In addition, the same line was noticed when mineral N fertilizer was replaced by using humic acid and algae fertilizer on "Florida Prince" peach **(El-Khawaga, 2011)**, also, when applying humate fertilizers on "Manfalouty" pomegranate trees **(Khattab *et al.*, 2012)**, "Canino" apricot **(Shaddad *et al.*, 2005)**, "Grandnain" banana **(El-Shenawi *et al.*, 2008)** and "Florida Prince" peach **(Abd El-Razek et al., 2012).**

Organic fertilization enhanced the uptake of different nutrients, surely reflected on stimulating growth characters and nutritional status of the trees which produce bigger fruits. **(Davis and Ghabbour, 1998 and Kannaiyan, 2002)** and fruit quality improvement **(Abd El-Razek et al., 2012).**

As for fruit firmness, use of humic acid considered as a good practice for early marketing due to the acceleration of fruit maturity and providing the markets with the fruits earlier than the untreated orchards **(Abd El-Razek et al., 2012).** These results are in conformity with those mentioned by **Ismail et al. (2007)** on pear; **Naiema (2008)** on pear and **Kandil et al. (2009)** on peach.

6- Effect of humic acid, algae extract and fulvic acid on chemical fruit characters (TSS%, Acidity%, TSS/acid ratio and Tannins% fruit content):

Table (6) showed that using organic treatments improved "Costata" fruits quality in terms of increasing TSS and reducing total acidity and tannins fruit content compared with unsprayed trees (control). The highest promotion of TSS was related to 2%humic acid at 1st season and 2%algae extract at 2nd season. In addition, 2%algae extract followed by 1% then 2%HA were the superior in decreasing fruit acid and tannins content. Moreover, 2% algae extract followed by 2%Humic acid significantly stimulated the maturity index (T.S.S/acid ratio) compared with control in two seasons. In this concern, 2%fulvic acid has a significant effect in increasing TSS or TSS/acid ratio in the second season, as well as fulvic acid at 1 or 2% significantly decreased tannins% fruit content at both seasons compared with control.

Table (6): Effect of humic acid, algae extract and fulvic acid on TSS, acidity, TSS/acid ratio and tannins fruit content of "Costata" persimmon trees during 2011 and 2012 seasons.

Treatments	TSS (%)		Acidity (%)		TSS/acid Ratio		Tannins (%)	
	2011	2012	2011	2012	2011	2012	2011	2012
Control	18.40b	19.20e	0.63a	0.57a	29.22c	33.70e	0.82a	0.76a
HA 1%	20.15b	20.70d	0.57abc	0.52bc	35.42abc	39.86cd	0.72bc	0.65cd
HA 2%	24.30a	21.40c	0.55bc	0.49cd	45.04a	46.88b	0.68c	0.62d
AE 1%	21.50ab	22.00b	0.52cd	0.47d	41.44ab	43.69bc	0.61d	0.57e
AE 2%	22.30ab	22.60a	0.48d	0.42e	46.59a	53.93a	0.55e	0.53e
FA 1%	18.80b	19.70e	0.60ab	0.55ab	31.40bc	35.89de	0.77b	0.70b
FA 2%	19.45b	20.30d	0.59ab	0.53abc	33.02bc	38.39d	0.75b	0.68bc

Means having the same letters in each column are not significantly different at 0.05 level.

These results are in conveyable with those achieved by {**Eissa, 2003; Gaser et. al., 2006; Ahmed *et al.*, 2012; Alaam, 2008; El-Khawaga, 2011; Ahmed et. al., 2012 and Mansour et al., 2013**}. Also, are in the line with using organic stimulants which significantly improved T.S.S synthesis and decreased acidity (**Ismaeil *et. al.*, 2003 and Fathi et al., 2010**).

Moreover, the promotive effect of these stimulants in building sugars and plant pigments (**Kannaiyan, 2002**) surely reflected on enhancing fruit quality.

CONCLUSION

This study concluded that, foliar spray of "Costata" persimmon trees in clay loamy soil with humic acid or algae extract at 2% four times, (at full bloom, two weeks after fruit setting, one month later and one month before harvesting time) are considered the best treatments, since they improved the vegetative growth, nutritional status of trees and increased the quantity and quality of the yield. Subsequently, it reflects on persimmon growers income.

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تأثير المعاملة ببعض المركبات العضوية على محصول و جودة ثمار الكاكى صنف "كوستاتا".

سعاد عبدالرحيم محمد و*رفعت أبو يوسف

قسم بحوث الفاكهة متساقطة الأوراق- معهد بحوث البساتين- مركز البحوث الزراعية- جيزة- مصر

*قسم الأراضى والمياة- المركز القومى للبحوث- الدقى-جيزة

الهدف من هذا البحث دراسة تأثير رش بعض المركبات العضوية (حمض الهيوميك، حمض الفولفيك و مستخلص الطحالب) على النمو الخضرى، المحصول و جودة ثمار الكاكى صنف "كوستاتا" تحت ظروف التربة الطينية الطميية والرى بالغمر.

أجريت هذه الدراسة خلال موسمى 2011، 2012 بالقناطر الخيرية- محطة بحوث البساتين- محافظة القليوبية-مصر على أشجار الكاكى صنف "كوستاتا". الأشجار عمر 22 عاما ومطعومة على أصل اللوتس على مسافة 4*5م. تم رش 21 شجرة 4رشات (مرحلة إكتمال التزهير ، بعد إسبوعين من عقد الثمار، بعد شهر من الرشة الثانية و قبل شهر من الحصاد) بحمض الهيوميك وحامض الفولفيك ومستخلص الطحالب منفردين بتركيزى 1 أو 2%. وكانت النتائج كالأتى:

أعطت معاملات رش الهيوميك و مستخلص الطحالب أفضل نمو خضرى (مساحة الأوراق ووزنها الجاف و طوّل الأفرع) ، الحالة الغذائية (محتوى الأوراق من عناصر النيتروجين ، الفوسفور، البوتاسيوم ، الحديد، المنجنيز و الزنك) والإثمار (العقد والمحصول) وأيضا صفات الجودة للثمار (الوزن ، الحجم ، الأبعاد والصلابة)، محتوى العصير من المواد الصلبة الذائبة ، الحموضة والتانينات مقارنة بالكنترول خلال موسمى الدراسة. أيضا كان التركيز الأعلى (2%) أكثر فاعلية عن التركيز الأقل فى كل المواد المستخدمة.