EXTENDING MARKETING WINDOW OF THOMPSON SEEDLESS GRAPES BY SYNTHETIC CYTOKININ AND NAPHTHALENE ACETIC ACID PREHARVEST SPRAY TREATMENTS AND COLD STORAGE.

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ABSTRACT

This experiment was conducted during the 2002 and 2003 seasons on seven-year old Thompson seedless grapevines, head-trained and cane pruned, located in a vineyard at El-Santa, Gharbia governorate. Clusters at 4-6 mm berry diameter were sprayed with 5 ppm CPPU [N-(2-chloro-4-pyridinl)-N-phenylurea], known as sitofex and /or 10 ppm Naphthalene acetic acid . The clusters were stored at 0 °C and 90-95 % RH.

Sitofex (CPPU) spray treatment decreased all of soluble solid content, SSC: acid ratio, marketable cluster and overall quality index, whereas increased the decayed berries. Naphthalene acetic acid (NAA) spray treatment decreased both of shattering percentage and berry firmness.

It can be extending the marketing window of Thompson seedless grapes to the forth week of October, because of holding its marketable and overall quality index, through 10 ppm NAA preharvest spray treatment, delaying the harvest date to the forth week of August and cold storage (0 °C & 90-95 % RH) for eight weeks.

Key words: Sitofex [N-(2-chloro-4-pyridinl)-N-phenylurea], NAA, *Vitis Venefera*, cold storage, fruit quality, harvest date.

INTRODUCTION

Thompson seedless grapes is one of the most popular fruits in Egypt and its commercial maturity occurs in July and the first week of August. Producing high quality garpes is becoming an inescapable necessity for entering and sustaining business in the fresh market. Berry size, cluster conformation and yield of seedless grapes could be improved through the application of growth regulators (El-Morsy, 2001; Farooq and Hulamani 2001 and Fawzi and Hafez, 2004). CPPU [N-(2-chloro-4-pyridinl)-N-phenylurea] application was found to be effective in increasing total yield, cluster weight, berry size, berry firmness, induce greener grapes, thicker pedicels, improve rachis appearance and delay fruit maturity (El-Hammady *et al.*, 2000; Mervet *et al.*, 2001 and Fawzi and Hafez, 2004).

Foliar application of naphthalene acetic acid (NAA) delay fruit maturity through reducing soluble solid content and increasing titratable acidity, increased berry weight, maximized yield, lowered cracking of berries, improved cluster general appearance and prolonged shelf life (Kumar *et al.*, 2000; El-Morsy, 2001 and El-Abbasy and El-Morsy, 2002).

This work was carried to improve Thompson seedless grapes quality and delay fruit maturity to shift the marketing window, from August to September – October, through cold storage and evaluate the effect of CPPU and NAA on the storability of Thompson seedless at cold storage (0 °C) followed by 7 days at 20 °C.

MATERIALS AND METHODS

This work was conducted during two successive seasons (2002/03) on seven-year old Thompson seedless vines in a vineyard at El-Santa, Gharbia governorate. Vines were as uniform as possible, and cane-pruned at 50 eyes /vine. Solutions of all combinations of CPPU [N-(2-chloro-4-pyridinl)-N-phenylurea], known as sitofex, from SKW Trostberg Aktiengeselleschaft, Germany (0 and 5 ppm) and NAA (0 and 10 ppm) were prepared just before application.

Each treatment was represented by three vine plot in three replicates arranged in a randomized complete block design. Clusters (4-6 mm berry diameter) of the assigned vines for each treatment were sprayed using a hand sprayer. Guard rows separated all treatments. The treated clusters were harvested at the second and the forth week of August in the two studied seasons. Soluble solid content of the control treatment at harvest was 18.67 & 19.47 during the two experimental seasons, respectively. The harvested clusters were transported, at ambient temperature (25 °C) within two hours, to the Hort.Dpt. Fac. Agric. Kafer El-sheikh, Tanta Univ., where proposed for packaging.

Trimmed clusters were packed in plastic boxes (50 X 35 X 15 cm) with proliferated polyethylene liners and slow release SO_2 pads (pads were changed every two weeks during the storage period) and stored at 0 ° C and 90--95 % RH for two months. Thereafter they were transferred and stored at 20 °C for 7 days (as shelf life).

The following parameters were determined at each harvest date as well as after storage period (8 weeks at 0 °C plus7 days at 20 °C).

Cluster general appearance was visually evaluated and given a score 5, 4, 3, 2, 1 which corresponds to a rating of very good, good, fair, bad and very bad, respectively. Shuttering was determined by shaking the individual clusters in the sample two light shakes by hand, and then weights of the shattered berries per every sample were recorded and expressed as percentage in relation to the weight before shaking. Decayed berries were separated, weighted and expressed as percentage in relation to the weight of each sample.

Berry firmness was measured in the equatorial zone of 20 sound berries for each replicate per every treatment and expressed as Newton, using a dynamometer with Gr 7 accessory plunger.

Marketable cluster was recorded and expressed as the percentage of the sound cluster weight, without any decayed berries, related to the initial fresh weight before the storage period. The rachis condition was evaluated by determining the moisture content, as a percentage, and color of both the main and lateral branches of the rachis. The color of the branches was evaluated by applying 5 parameters and scores as flows: green : 4, yellowish green :3, yellow : 2, brownish yellow : 1 and brown : 0.

To get a general meaningful value of the determined quality parameters, cluster overall quality index (OQI) was calculated. This was calculated as a sum of the absolute unites for the values of SSC: acid ratio, marketable cluster (MC), cluster general appearance (GA), berry firmness (F) and non shattered berries cluster weight percentage (NSC). The absolute unit of the value was calculated by dividing the measured parameter value by the highest recorded value for the same parameter in the same season.

The author supposed that the cluster overall quality index equal: 20% SSC: acid ratio + 20% MC + 20 % GA + 20 % F + 20% NSC.

One hundred and fifty grams of sound berries per replicate of each treatment was juiced to determine soluble solid content (SSC), by hand refractometer (ATAGO N-1E), titratable acidity (TA) as tartaric acid by NaOH 0.1 N. SSC: acid ratio was calculated. The juice pH was measured by using pH meter (HANNA, model 8519).

The obtained data was statistically analyzed as a randomized complete block design with factorial arrangement of treatments according to Byrkit (1987). Data calculated as percentage was transformed to arcsine of square root before analysis. Means were separated using Duncan's multiple range test (DMRT). Irristat program was used.

RESULTS AND DISCUSSION

As shown in Table (1), CPPU treatment significantly increased both of weight and size of 100 berries with 30 & 29 % and 53 & 58 % compared with the control in the two seasons, respectively. While NAA treatment decreased berry weight and berry size with 8.5 & 10 % and 25 & 28 % compared with the control treatment in the two seasons, respectively. The interaction between CPPU and NAA showed significant increase in both of berry weight and berry size in the two seasons.

Table (1). Effect of CPPU and NAA spray treatments on weight and size of 100 berries of Thompson Seedless grapes

	Weight of 100 berries (g)		Size of 100 berries (ml)	
	2002	2003	2002	2003
Control	173.57 b	187.83 b	140.00 b	145.00 b
5 ppm CPPU	230. 17 a	242.27 a	223.33 a	230.00 a
10 ppm NAA	129.30 c	133.40 c	128.33 b	130.00 c
5 ppm CPPU + 10 ppm NAA	224.47 a	228.73 a	216.67 a	218.33 a

In a column, means in each group followed by a common letter are not significantly different at 5% level according to DMRT.

Soluble solid content (SSC) was not significantly affected by delaying the harvest date (Table, 2). Whereas, it was significantly affected by the used chemical treatments. The lowest SSC (16.30 & 16.99 %) was obtained by 5 ppm CPPU treatment followed by 5 ppm CPPU + 10 NAA treatment (17.63 & 17.25 %) in the two seasons, respectively. NAA treatment had the highest SSC values (20.53 & 20.17 %) in the two seasons, respectively. These results are in harmony with Kumar *et al*, 2000 and Farooq and Hulamami, 2001 where they found that NAA increased grapes SSC compared to the control treatment.

Titratable acidity (TA) showed reduction by delaying the harvest date especially in the first season, which might be as a result of ripening progress. All the chemical treatments had no significant effect on TA in the two seasons.

SSC: acid ratio (Table, 2) was significantly increased by delaying the harvest date. CPPU treatment had the lowest SSC: acid ratio (30.22 & 37.14) in the two seasons, respectively. The present data reveals that SSC: acid ratio was highly significant correlated to TA (r = - 0.68) than SSC (r = 0.55).

Juice pH was significantly increased by delaying the harvest date. CPPU treatment significantly decreased juice pH and had the lowest value (2.47 & 2.49) compared with the control (2.67 & 2.68) in the two seasons, respectively. There was a highly significant negative correlation between juice pH and TA (r = - 0.52).

Berry firmness (Table,3) showed no significant difference by delaying the harvest date. The highest berry firmness (1.88 and 2.00 N) was obtained by 5 ppm CPPU + 10 ppm NAA treatment. Whereas the lowest one (1.51 & 1.51 N) was obtained by 10 ppm NAA treatment in the two seasons, respectively. The increase in berry firmness might be due to maintaining the total pectin and calcium content at higher concentrations and increasing the number of flesh cell layers (Yang-Yau Shiang *et al.*, 1997). This result is in harmony with EL-Morsy (2001).

Shattering (Table, 3) was significantly increased by delaying the harvest date. NAA treatment showed the lowest shattering percentage (4.96 & 5.87) in the two seasons, respectively. This reduction in shattering might be due to decreasing ABA content, by

Table (2). Effect of CPPU and NAA preharvest sprays and harvest date on some chemical parameters of Thompson seedless grapes after eight weeks cold storage (0 °C) plus 7 days at 20 °C

	SSC (%)		#Acidity (%)		SSC: acid ratio		Juice pH	
	2002	2003	2002	2003	2002	2003	2002	2003
Harvest date (D)*								
I	18.63 a	18.45 a	0.57 a	0.57 a	32.37 b	32.11 b	2.37 b	2.33 b
II	18.39 a	18.96 a	0.53 b	0.56 a	34.53 a	36.95 a	2.86 a	2.87 a
Sig.	NS	NS	**	NS	*	**	**	**
Treatments (T)								
Control	18.95 b	19.90 a	0.57 a	0.55 a	33.37 b	35.78 a	2.67 ab	2.68 a
5 ppm CPPU	16.30 d	16.99 b	0.54 a	0.53 a	30.22 d	31.93 b	2.47 c	2.49 b
10 ppm NAA	20.53 a	20.67 a	0.55 a	0.56 a	37.47 a	37.14 a	2.59 b	2.59 ab
5 ppm CPPU + 10 ppm NAA	17.63 c	17.25 b	0.54 a	0.61 a	32.76 c	33.26 b	2.73 a	2.64 a
Interactions (D*T)	NS	NS	**	**	**	**	*	**

In a column, means in each group followed by a common letter are not significantly different at 5% level according to DMRT.

* I : second week of August, II : forth week of August. # Determined as tartaric acid.

Table (3). Effect of CPPU and NAA preharvest sprays and harvest date on some physical parameters of Thompson seedless grapes after eight weeks cold storage (0 °C) plus 7 days at 20 °C

	Berry firmness (N)		Shattering (%)		Decayed berries (%)		# # General appearance (3-0)	
	2002	2003	2002	2003	2002	2003	2002	2003
Harvest date (D)*								
I	1.60 a	1.68 a	7.13 b	7.03 b	6.25 a	6.45 a	2.17 a	2.17 a
II	1.79 a	1.82 a	9.25 a	10.79 a	4.44 a	5.10 a	2.33 a	2.08 a
Sig.	NS	NS	*	*	NS	NS	NS	NS
Treatments (T)								
Control	1.71 ab	1.83 b	8.32 b	8.59 bc	3.85 b	3.18 b	2.17 a	2.83 a
5 ppm CPPU	1.73 a	1.65 c	12.50 a	12.42 a	9.09 a	9.32 a	2.17 a	1.83 bc
10 ppm NAA	1.51 b	1.51 c	4.96 c	5.87 c	3.32 b	2.81 b	2.67 a	2.50 ab
5 ppm CPPU + 10 ppm NAA	1.83 a	2.00 a	6.98 b	8.75 ab	5.11 ab	7.79 a	2.00 a	1.33 c
Interactions (D*T)	*	NS	NS	NS	NS	NS	*	NS

In a column means in each group followed by a common letter are not significantly different at 5% level according to DMRT.

I : second week of August, II : forth week of August.

evaluated by applying 4 parameters and scores: 3= very good, 2 = good, 1 = fair and 0 = bad.

NAA treatment, which in turn decrease berry drop (Youlin *et al.*, 2000 and Jeong *et al.*, 2004). These results are in harmony with El-Abbasy and El-Morsy, 2002.

Decayed berries (Table 3) were not significantly reduced by delaying the harvest date. CPPU treatment at 5 ppm significantly increased the decayed berries (9.09 & 9.32 %) followed by 5 ppm CPPU + 10 NAA treatment (5.11 & 7.79 %) in the two seasons, respectively. This increase in decayed berries might be due to increased cluster compactness in CPPU treatment, as a result of increased berries length and diameter (El-Morsy, 2001). Decayed berries showed highly significant correlations with SSC (r = - 0.57), SSC: acid ratio (r = - 0.40) and cluster general appearance (r = - 0.57).

Cluster general appearance (GA) was not affected by the harvest date, and showed different responses by the studied chemical treatments in the two seasons. The lowest GA was obtained by 5 ppm CPU + 10 ppm NAA treatment (2.00 & 1.33) in the two seasons, respectively. GA showed high significant correlation with SSC (r = 0.47) followed by MF (r = 0.40) and DF (r = - 0.37).

Marketable clusters percentage (MC) showed no significant difference by delaying the harvest date. CPPU treatment (Fig.1) showed the lowest MC (88.41 & 88.30 %) in the two seasons, respectively compared with the other chemical treatments. Marketable clusters showed highly significant correlations with decayed berries percentage (r = - 0.87), SSC (r = 0.49), SSC: Acid ratio (r = 0.39) and cluster general appearance (r = 0.40).

The overall quality index (OQI), (Fig.1), showed that the harvest date had no significant effect in this respect. CPPU treatment at 5 ppm decreased OQI (83.67 & 78.15 %), in the two seasons, respectively. The highest OQI values were obtained by the control (85.36 & 91.15%) and 10 ppm NAA (88.94 & 85.12 %) treatments in the two seasons, respectively.

The linear regression for the present data clears the following standardized coefficients:

OQI = 0.63 GA + 0.47 NSC + 0.23 SSC: acid + 0.26 F + 0.11 MF

Rachis prosperities (Table, 4), showed non significant responses by delaying the harvest date, whereas it showed different trends by the used chemical treatments in the two seasons. The present data confirm the negative highly significant correlations (r = - 0.56 & - 0.38) between shattering and both of the lateral branches general appearance and the main branches general appearance, respectively and negative highly significant correlation between lateral branches moisture content and marketable cluster (r = - 0.30). The changes in the rachis prosperities might be as a result of rachis water loss which reflected the visible symptoms of stem browning (Hernandez *et al.*, 2004).

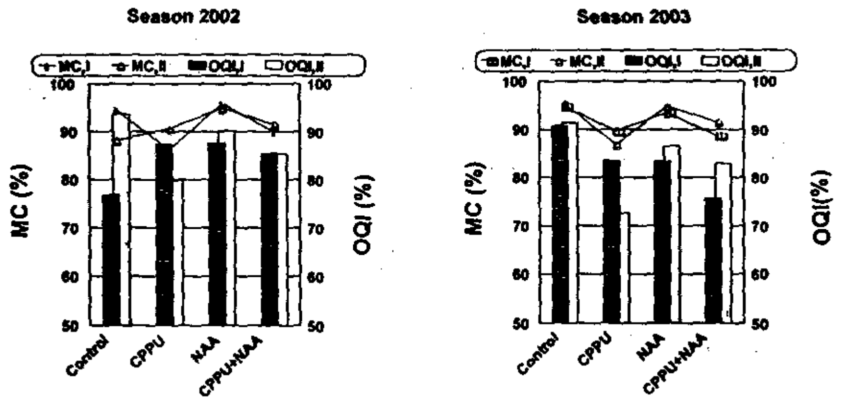

Fig. (1): Effect of CPPU, NAA preharvest spray treatments and harvest date on marketable cluster and overall quality index of Thompson seedless grapes after cold storage (0 °C) plus 7 days at 20 °C.

Further studies are required to assess the effect of the different CPPU concentrations combined with cluster thinning on additional maturity stages to prolong the marketing window though the cold storage.

Table (4). Effect of CPPU and NAA preharvest sprays and harvest date on rachis properties of Thompson seedless grapes after eight weeks cold storage (0 °C) plus 7 days at 20 °C

	** Rachis color (5-0)				Moisture content (%)			
	Main Branch		Lateral branches		Main Branch		Lateral branches	
	2002	2003	2002	2003	2002	2003	2002	2003
Harvest date (D)*								
I	1.17 a	1.08 a	1.00 a	1.00 a	72.67 a	71.82 a	57.97 a	56.72 a
II	0.92 a	1.00 a	0.83 a	0.75 a	74.04 a	70.89 a	57.40 a	52.74 a
Sig.	NS	NS	NS	NS	NS	NS	NS	NS
Treatments (T)								
Control	1.00 ab	1.00 a	1.00 a	0.83 a	73.20 ab	70.89 b	55.16 b	51.96 b
5 ppm CPPU	0.83 b	1.00 a	0.83 a	0.83 a	74.56 a	73.01 a	60.72 a	56.57 a
10 ppm NAA	1.00 ab	1.17 a	1.00 a	1.00 a	75.22 a	72.72 a	55.71 b	57.60 a
5 ppm CPPU + 10 ppm NAA	1.33 a	1.00 a	0.83 a	0.83 a	70.44 b	68.72 a	57.16 ab	52.80 b
Interactions(D*T)	NS	NS	NS	NS	NS	NS	**	*

In a column means in each group followed by a common letter are not significantly different at 5% level according to DMRT.

* I : second week of August, II : forth week of August.

** Evaluated by applying 5 parameters and scores: green = 4, yellowish green =3, yellow =2, brownish yellow = 1 and brown = 0.

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الملخص العربي

إطالة النافذة التسويقية للعنب البناتي طومسون سيدلس بالرش قبل الجمع بسيتوكينين صناعى (سيتوفكس) ونفثالين حمض الخليك والتخزين المبرد

أسامة كمال العباسي
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أجريت هذه الدراسة خلال موسمي ٢٠٠٢ & ٢٠٠٣ على كرمات عنب بناتي طومسون سيدلس ذات عمر ٧ سنوات ومرباة تربية قصبية بمزرعة كروم خاصة بمركز السنطة – محافظة الغربية. تم رش العناقيد الثمرية عند وصول قطر الحبات الى ٤ – ٦ مم وذلك بـــمحلول ٥ جزء في المليون سيتوفكس و / أو محلول ١٠ جزء في المليون نفثالين حامض الخليك. تم تخزين العناقيد الثمرية للعنب البناتي طومسون سيدلس تحت ظروف التخزين المبرد (صفر °م & ٩٠ – ٩٥ % رطوبة نسبية) لمدة ثماني أسابيع.

أدت المعاملة بالسيتوفكس الى انخفاض كل من محتوى المواد الصلبة الذائبة الكلية ونسبة المواد الصلة الذائبة الكلية الى الحموضة والعناقيد القابلة للتسويق والدليل العام للجودة. كما أدت المعاملة بنفثالين حامض الخليك الى إنخفاض كل من نسبة الفرط وصلابة الحبات.

كما إنه يمكن إطالة النافذة التسويقية للعنب البناتي طومسون سيدلس إلى الأسبوع الأخير من شهر أكتوبر حيث أنه قد احتفظ بقيمته التسويقية وكذلك الدليل العام للجودة وذلك من خلال الرش بنفثالين حمض الخليك ، بتركيز ١٠ جزء في المليون عند قطر الحبات ٤–٦ مم ، وتأخير الجمع إلى الأسبوع الرابع من شهر أغسطس ثم التخزين المبرد على درجة الصفر المئوي ورطوبة نسبية ٩٠ – ٩٥ % لمدة ثماني أسابيع .