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EFFECT OF SITOFEX (CPPU) ON YIELD AND BUNCH QUALITY OF THOMPSON SEEDLESS GRAPEVINES

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Abstract

The effect of Sitofex (CPPU) and its combination with Gibberellic acid (GA_3) on yield and bunch quality of Thompson Seedless grape cultivar grown at Senhera, *Kalubia* Governorate was studied during both 1997 and 1998 seasons. All the experimental vines were treated with GA_3 at 10 ppm when cluster reached about 8-10 mm length, 20 ppm at full bloom in addition to hand thinning at 6 mm of berry diameter. Eight treatments were applied at 1997season, six treatments were applied at 1998 season using CPPU in combination with GA_3 or each alone in addition to control. All the previous treatments were applied when berry diameter reached about 6 mm. Results showed that sitofex alone or in combination with GA_3 delayed ripening by reducing TSS and increasing acidity for both seasons. The Sitofex treatments in combination with GA_3 or alone significantly increased the total yield, cluster weight, berry weight, size, length, width, bunch compactness and rachis weight, berry shape become global at both seasons of 1997 and 1998. Whereas the bunch Index, and berry Index decreased. Percentage of berry shattering was decreased by applying Sitofex alone or combined with GA_3 at 1998 season. Obtained results proved that Sitofex (CPPU) application at 5ppm + GA_3 at 40 ppm gave the best bunch and berry quality, which are required for exportation.

INTRODUCTION

Thompson Seedless grape cultivar ranking as the most important table grape variety grown in Egypt. GA_3 applications are currently used to increase the berry size of Thompson Seedless grapes. As well as, to solve the defects of this grape variety such as small as uneven berry size, berry compactness and abscission which cause major losses in production. While GA_3 significantly improved berry size and rachis cell elongation, it could cause problems such as a decrease in fruitfulness, corckiness of stems and delayed ripening, (*Jawanda et al.*, 1974 and *Singh et al.*, 1978.

In an attempt to eliminate the quality problems associated with this grape cultivar the efficiency of other growth regulators which can be used without a health environmental hazard, was investigated. Although Cytokinins have shown some potential in improving bunch quality by increasing berry set they have not been widely used in viticulture. (*Weaver et al.*, 1966) (CPPU) (farchlorfenuron or N-2chloro-4-pyridyl-N-

phenylurea) is a new plant growth substances; which has significant physiological activity by increasing berry set and berry size in the Tompson Seedless grapes (*Diaz* and *Maldonado* 1992, *Dokoozlian et al.*, 1994, *Oswald* 1994. CPPU compounds had a mode of action similar to that of cytokinins (*Nickell*, 1985).

The purpose of this study was to study the interaction between CPPU and GA_3 applications and hand thinning on yield, berry shape and berry composition of Thompson seedless table grapes.

MATERIALS AND METHODS

Thompson seedless grapevins that were used in this study for both successive seasons 1997 and 1998 are grown at Senhera Kalubia Governorate. All vines were 14 years old and "T" trellis-trained according to the cane pruning system, vines were spaced 2x3 meters apart, the soil is well-drained sandy loam. It was irrigated by flood system Six canes each bearing 12 buds and approximately five spurs were retained on each vine at pruning time in January of 1997 and 1998 seasons. Cultural practices were performed in accordance with standard commercial production practices for Thompson seedless tablegrapes cultivar. Twelve vines were selected for each treatment, several weeks prior to anthesis on the basis of uniformity of foliage and cluster development. Vines bearing about 20 clusters were selected. Gebberellic acid (GA_3) at 10 and 20 ppm was applied to the vines by hand sprayer when the clusters were 8-10 mm length, for elongating and at fullbloom for thinning flowers according to *Wolf et al.*, (1991). In addition hand thinning, for the above mentioned applications were done to all clusters in all treatments. When berry diameter reached about "6mm". using special pruning scissors as follows. The first basal laterals were left and after the alternatively and the tip of the cluster were removed, to get clusters of 17-20 cm in length. The application of GA_3 at 40 ppm and CPPU at 3.5 or 7 ppm were carried at the pea size (6-8mm) to increase berry size. At season 1998 the CPPU treatments at 7 ppm did not carried because there was no significant difference between (CPPU) at 5 and 7 ppm according to the results of the first seasons (1997). The treatments that were used in this study could summarized as follow:-

No. of treatment	1997 season	1998 season
1	GA_3 at 40 ppm	GA_3 at 40 ppm
2	GA_3 at 40 ppm + 3ppm Sitofex	GA_3 at 40 ppm + 3 ppm sitofex
3	GA_3 at 40 ppm + 5ppm Sitofex	GA_3 at 40 ppm + 5 ppm sitofex
4	GA_3 at 40ppm + 7ppm Sitofex	Sitofex at 3 ppm
5	Sitofex at 3ppm	Sitofex at 5 ppm
6	Sitofex at 5ppm	Control (untreated vines)
7	Sitofex at 7ppm	
8	Control (untreated vines)	

All treatments were applied to clusters with hand sprayer. Each treatment was replicated four times using three vines plots arranged in randomized complete block design.

At harvest date, clusters were picked when TSS of untreated clusters reached about 16-18 (*Tourky et al.*, 1995). As for other tested treatments, the harvest date was later two weeks than the control. Clusters were removed from vine, counted and weighted to determine the mean of total yield for each treatment. Then clusters were transported to the laboratory to determine the following parameters:

- Shattering (%) of berries for each cluster after carefully shaken 10 times (by the same person) was recorded. This was calculated at the second season only (1998), as follows :

$$\frac{\text{weight of shattered berries}}{\text{weight of the grape bunch}} \times 100$$

- Bunch weight and length.
- Bunch compactness as calculated by dividing No. of berries per bunch/length Huglin (1958).
- Bunch Index as determined by average weight of berries/weight of rachis.
- Rachis weight (gm) and length (cm).
- Three samples each contains 100 berries were picked form each treatment for physical and chemical determinations i.e, berry weight, size and dimension, berry-shape (length/diameter) and berry Index (No of berries /100 gm).

The Juice of berries was filtered, clear juice was used to determine total soluble solids content by using handy refractometer, acidity as tertaric acid (by using titration against NaOH 0.1 N).

The obtained results were statistically analyzed according to *Sendecor* and *Cochran*, 1967.

RESULTS AND DISCUSSION

Bunch quality and Compactness coefficient :

It is evident from the data of Tables (1 and 2) and (Fig. 1) that bunch weight increased significantly as affected with GA_3 treatment alone and combined with different concentration of CPPU during both 1997 and 1998 seasons as compared with the control (untreated vines). The most pronounced increase in bunch weight was obtained when GA_3 was used in combination with Sitofex (CPPU) at the first season, data recorded in this regard were (445.7, 466.7 and 482.7 gm) respectively. At the second season it recorded (445.0 and 452.0 gm) for (Treatments 2 and 3) using CPPU at 3 ppm+GA_3 at 40 ppm and CPPU at 5 ppm+GA_3 at 40 ppm.

Treatments numbers (5,6,7) using (CPPU) alone at 3,5 or 7 ppm at the first season gave closed results to the untreated vines (control) but with significant differences at the two seasons (1997 and 1998). These results were in agreement with those obtained by *Nickell* 1986, *Intrieri et al.*, 1995, *Retamales et al.*, 1995 and *Rizk* 1998 who mentioned that Sitofex treatments in combination with GA_3 or without GA_3 significantly increased bunch weight of Thompson seedless grapes. These are due to the effect of GA_3 and CPPU on increasing cell division and elongation.

Tables 1 and 2 as well as Fig. 2 show clearly the influence of GA_3 and CPPU each alone or combined togather on compactness coefficient and length of Thompson seedless table grape bunches. Data indicaed that bunch length is reduced by all treatments. This is due to the hand thinning application as a result of removing the tip of the cluster after fruit set. Bunch compactness coefficient parameter was significantly increased within the treatments as compared with the untreated clusters (control). This increment in compactness may be regard to the increase in size of berries by using the all above mentioned treatments, at the two seasons. The percentage of these increments recorded comparing with the control were 17.11, 17.5, 17.16 and 17.50% using (Treatments 2,3,4 and 5 respectively) in the 1^{st} season. In the second season the highest. In percentages of compactness were by using treatments 2 and 3 which recorded (22.05 and 25.14% respectively). These results are in agreement with *Intrieri et al.*, 1995 and *Rizk*, 1998 who suggested that bunch density increased as berry size increase and to some extend due to increasing berry shattering for the untreated (control) clusters.

Table 1. Effect of Sitofex (CPPU) and GA_3 on bunch quality of Thompson Seedless grapevines at 1997 season.

Treatment	1997					
	Bunch wt. (gm)	Bunch length (cm)	Rachis wt. (gm)	Bunch Index •	Compactness coefficient •	Difference than the control %
GA_3 at 40 ppm	375.0	25.50	13.12	27.43	7.24	14.73
GA_3 at 40 ppm + 3ppm Sitofex	445.7	24.17	14.63	29.78	7.39	17.11
GA3 at 40 ppm+ 5 ppm Sitofex	466.7	25.00	14.87	30.31	7.43	17.75
GA_3 at 40ppm + 7ppm Sitofex	482.7	23.67	13.64	34.45	7.39	17.16
Sitofex at 3ppm	376.7	26.30	10.59	34.46	7.42	17.50
Sitofex at 5ppm	395.0	23.00	11.36	33.45	7.17	13.63
Sitofex at 7ppm	382.7	24.30	12.05	31.12	7.19	13.94
Control (untreated vines)	325.0	26.33	10.00	32.50	6.31	
L.S. D at 5%	33.5	N.S	0.32	1.20	1.00	

Table 2. Effect of Sitofex (CPPU) and GA_3 on bunch quality of Thompson Seedless grapevines at 1998 season.

Treatment	1998					
	Bunch wt. (gm)	Bunch length (cm)	Rachis wt. (gm)	Bunch Index •	Compactness coefficient •	Difference than the control %
GA_3 at 40 ppm	420	24.0	12.57	31.82	7.80	17.70
GA_3 at 40 ppm + 3 ppm Sitofex	445	22.3	12.90	32.94	8.30	22.05
GA_3 at 40 ppm + 5 ppm Sitofex	452	21.0	12.93	43.02	8.51	25.14
Sitofex at 3 ppm	415	25.0	10.33	38.72	7.60	11.76
Sitofex at 5 ppm	430	24.5	10.87	38.63	7.75	13.97
Control (untreated vines)	360	25.1	9.27	38.77	6.80	
L.S. D at 5%	**22.0**	**N.S**	**0.25**	**1.61**	**0.17**	

Fig. 1. Effect of Sitofex (CPPU) and GA_3 on bunch weight of Thompson Seedless grapevines at 1997 and 1998 seasons.

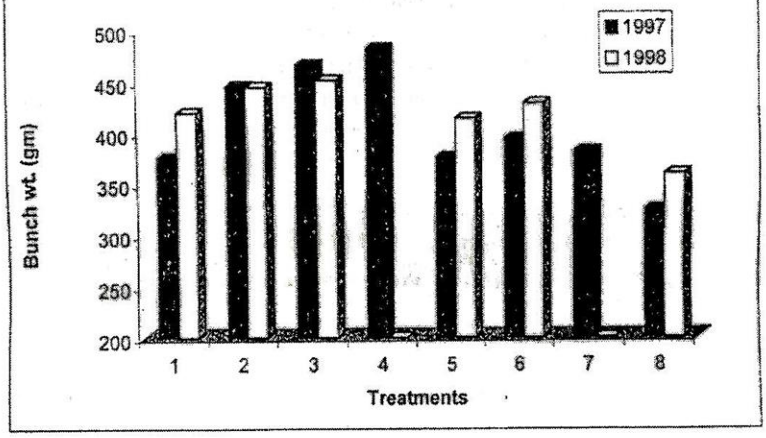
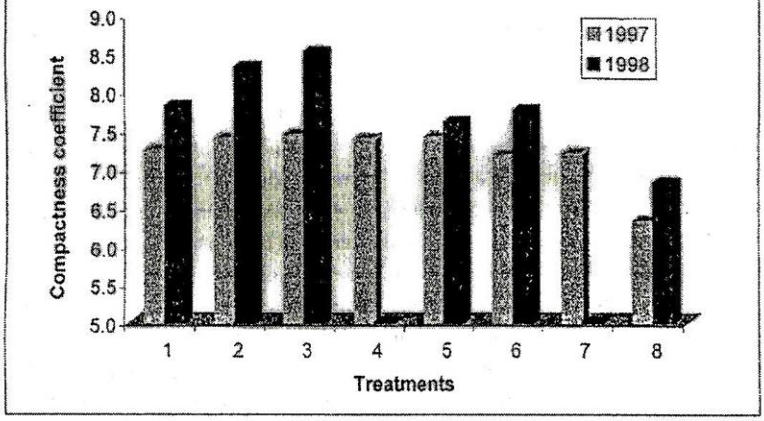


Fig. 2. Effect of Sitofex (CPPU) and GA_3 on Compactness coefficient of Thompson Seedless grapevines at 1997 and 1998 seasons.



CPPU applied after fruit set significantly increased the rachis weight of Thompson Seedless in this study. The same result has been reported for Perlette and Flame Seedless table grapes (*Diaz*, and *Maldanda* 1992). Data clearfied at (Table 1 and 2) showed that the highest Rachis weight was related to treatments (2,3 and 4) which recorded (14.63, 14.87 and 13.64 gms respectively) at 1997 season, and (12.90 and 12.93 gms) for treatments (2 and 3 respectively) in 1998 season. This increments in rachis weight affected in the bunch index parameter as shown in (Table 1 and 2). The highest bunch index values recorded for the control were 39.50 and 48.77 in the two season of 1997 and 1998 respectively.

Total yield and berry characteristics:

As regard to the effect of the above mentioned treatments on total yield, data at Table (3 and 4 and Fig. 3) showed that all treatments significantly increased the total yield per vine than the untreated vines (control). It is clear evident that the combined treatments using CPPU Sitofex at 3,5,7 ppm + GA_3 at 40 ppm at the first season 1997 gave the highest total yield than treatment GA_3 and CPPU alone, this increase about 37.07, 48.46 and 44.46 in comparison by the control. As for the second season 1998 the increase of total yield were about 41.88 and 44.05 for (Treatments 2 and 3) using CPPU at 3 ppm + GA_3 and CPPU at 5 ppm + GA_3, in comparison to the control. These results showed that the combined effect of Sitofex (CPPU) + GA_3 at 40 ppm sprayed at diameter of 6 mm were better than those obtained when each compound was used separately. Obtained results are in the same line with those reported by *Retamales et al.*, 1995 and *Rizk*, 1998 who found that Sitofex (CPPU) alone or in combination with GA_3 at 40 ppm increased berry diameter, length and improved the total yield of Thompson Seedless grapes.

The effect of GA_3 either applied alone or in combination with CPPU on the berry characteristics of Thompson Seedless table grapes are presented in Table (3 and 4 and Fig4) at the two seasons 1997 and 1998. The results showed that significant increases in berry weight and size were obtained for either GA_3 treatment or GA_3 combined with CPPU at 3, 5 or 7 ppm for the 1^{st} season and at 3 or 5 ppm for the 2^{nd} season in comparison with the untreated berries. The percentage of berry weight at the combined treatment GA_3 at 40 ppm + Sitofex at 5 ppm approximately was 81.81% at the first season (1997), while the combined treatment GA_3 at 40 ppm + Sitofex at 3 ppm at the second season (1998) was 49.35% comparing with the control. Berry weight was 2.60 gm against 1.43 gm for the control at the first season (1997) and 2.30 gm against 1.54 gm for the control at the second season (1998) respectively as shown in

Table 3. Effect of Sitofex (CPPU) and GA_3 on Total yield and berry characteristics of Thompson Seedless grapevines at 1997 season.

Treatment	1997								
	Total yield (k gm)	Difference than control %	Berry Wt. (gm)	Difference than control %	Berry size	Berry width (cm)	Berry length (cm)	Berry shape	Berry Index
GA_3 at 40 ppm	8.50	30.76	1.70	18.88	1.59	1.25	1.81	1.44	0.514
GA_3 at 40 ppm + 3ppm Sitofex	8.91	37.07	2.33	62.93	2.20	1.44	1.66	1.15	0.390
GA_3 at 40 ppm+ 5 ppm Sitofex	9.33	48.46	2.60	81.81	2.50	1.48	1.73	1.17	0.355
GA_3 at 40ppm + 7ppm Sitofex	9.65	44.46	2.20	53.84	2.03	1.50	1.79	1.19	0.393
Sitofex at 3ppm	8.53	31.23	2.12	48.25	1.90	1.34	1.59	1.19	0.416
Sitofex at 5ppm	7.90	21.53	2.17	51.74	1.96	1.35	1.54	1.14	0.418
Sitofex at 7ppm	7.17	18.46	1.97	3.76	1.86	1.40	1.50	1.07	0.458
Control (untreated vines)	6.50		1.43		1.32	1.18	1.44	1.22	0.657
L.S.D at 5%	**1.11**		**0.13**		**0.11**	**0.02**	**0.014**	**0.02**	**0.023**

Table 4. Effect of Sitofex (CPPU) and GA_3 on Total yield and berry characteristics of Thompson Seedless grapevines at 1998 season.

Treatment	1998								
	Total yield (k gm)	Difference than control %	Berry Wt. (gm)	Difference than control %	Berry Size	Berry width (cm)	Berry length (cm)	Berry shape	Berry Index
GA_3 at 40 ppm	8.60	24.63	1.88	22.07	1.72	1.41	2.00	1.42	0.472
GA_3 at 40 ppm + 3 ppm Sitofex	9.79	41.88	2.30	49.35	1.98	1.81	2.01	1.11	0.401
GA_3 at 40 ppm + 5 ppm Sitofex	9.94	44.05	2.18	41.55	1.93	1.99	2.26	1.14	0.457
Sitofex at 3 ppm	9.01	30.57	1.80	16.88	1.62	1.62	1.72	1.06	0.527
Sitofex at 5 ppm	8.76	26.95	1.85	20.12	1.70	1.86	1.71	0.92	0.510
Control (untreated vines)	6.90		1.54		1.27	1.34	1.42	1.06	0.699
L.S.D at 5%	**07.0**		**0.18**		**0.24**	**0.14**	**0.26**	**0.08**	**0.124**

Fig. 3. Effect of Sitofex (CPPU) and GA_3 on Total yield of Thompson Seedless grapevines at 1997 and 1998 seasons.

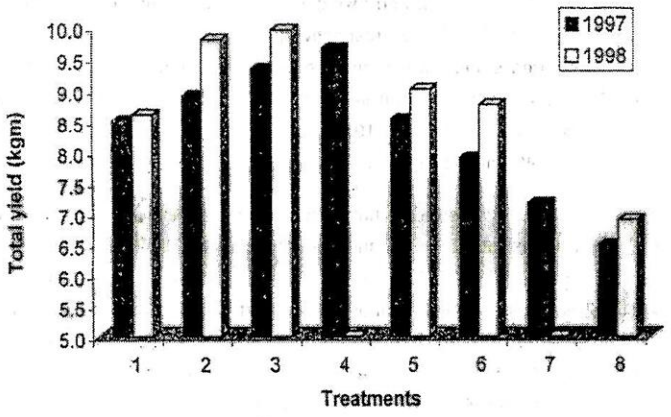
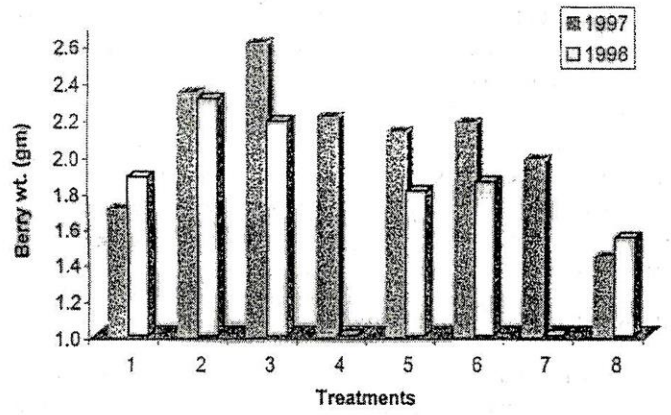


Fig. 4. Effect of Sitofex (CPPU) and GA_3 on berry weight of Thompson Seedless grapevines at 1997 and 1998 seasons.



(Fig 4). Berry size was also increased by using the same treatments (combined GA_3 at 40 ppm + CPPU at 3 ppm, GA_3 at 40 ppm + CPPU at 5 ppm and GA_3 at 40 ppm + CPPU at 7 ppm). As already mentioned at Tables (3 and 4) the application of CPPU alone or GA_3 alone significantly increased, berry weight and size as compared with the control for the two seasons 1997 and 1998 respectively. These results are in harmony with the previouse reported studies which indicated that combined applications of Sitofex (CPPU) and GA_3 at 40 ppm after fruit set had synergistic effects on berry growth of Thompson Seedless grapes (*Nechell*, 1985 and 1986; *Dokoozlin et al* 1994; *Oswald 1994*, *Retamales* 1995 and *Rizk* 1998).

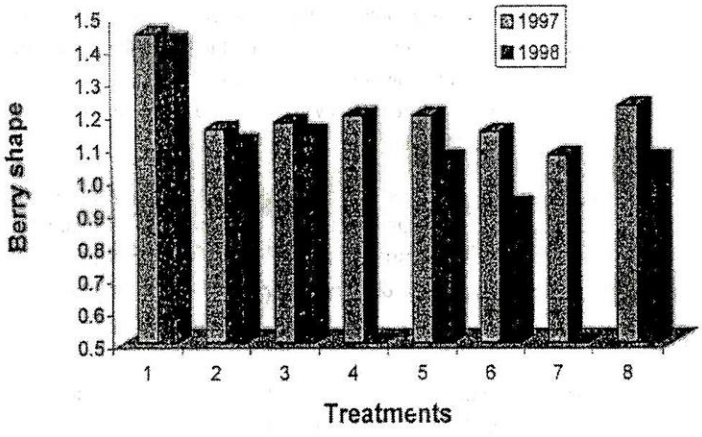
Tables (3,4 and Fig 5) showed that berry dimensions were significantly increased by both CPPU (Sitofex) at 3,5,7 ppm and GA_3 at 40 ppm after fruit set. This may be due to the promotive effect of GA_3 on cell elongation, and CPPU in cell division. The berry width increased significantly in those treated with CPPU + GA_3 after fruit set. It was approximately increased from (1.18) for the control to (1.48 and 1.50) for (CPPU at 5 and 7 ppm + GA_3) at the first season 1997 while it increased from (1.34 to 1.99) for the control and (CPPU at 5 ppm + GA_3) treatment at the second season 1998. Berry length was significantly increased at GA_3 treatment alone (treatment No. 1) it recorded (1.81) at the first season and 3.00) for the same treatment at the second season 1998.

Berry shape is significantly increased by using. GA_3 alone comparing with other treatments followed by the control (untreated berries). These results may be due to the stimulation of CPPU to periclinol berry growth resulting in proportionately greater increase in berry diameter than berry length. In contrast, GA_3 treatments stimulate anticlinal growth, resulting in elongated berries. CPPU treated berries of Thompson Seedless are more spherical than GA_3, treated berries alone. The shape of berries becomes more global rounder when it was treated with cytokinins, (*Ferrara et al.*, 1990; *Dokoozlian et al.*, 1994; *Wolf et al.*, 1994, *Retamales et al.*, 1995 and *Rizk* 1998). The results of the berry index shown in Tables, (3 and 4) indicated that the untreated (control) berries gave the greatest value as compared with the other treatments with a significant differences in the two seasons of 1997 and 1998.

Total Soluble Solids and Acidity:

Combined applications of Sitofex (CPPU) + GA_3 delayed fruit maturity to a greater extent than CPPU alone at the two season of 1997 and 1998. Sugar accumulation rate was reduced. The reduction in Total soluble solids imputed by applying Sitofex

Fig. 5. Effect of Sitofex (CPPU) and GA_3 on berry shape of Thompson Seedless grapevines at 1997 and 1998 seasons.



(CPPU) + GA_3 was more pronounced. Data at Table (5) show that the highest values were (18.33 and 17.07%) in both 1997 and 1998 seasons respectively, for the untreated vines.

Concerning the effect of these treatments on acidity, data of Table (5) revealed that all treatments tended to increase total acidity in the berry juice. Data showed a significant difference between all treatments as compared to the control, they recorded, (0.69 and 0.69) for treatments number (2 and 3) in the two seasons (1997 and 1998) respectively while the control treatment were recorded (0.38 and 0.49%) in the two seasons. Data represented T.S.S and acidity are shown in (Fig 6 and 7).

These results are in the same line with those obtained by *Nickell., 1986, Dokoozlian et al.*, 1994, *Retamale et al.*, 1995 and *Rizk* 1998 who reported that Sitofex (CPPU) application resulted in lower TSS content of Thompson seedless grapes. However, *Ferrara et al.*, 1990 and *Weaver* 1966 reported that cytokinins delayed maturity.

Shattering

At 1998 season the number of berries dropped per bunch in all treatments were recorded, the application of CPPU (Sitofex) + GA_3 at 40 ppm gave the least number. of dropped berries. The greatest number of dropped berries were obtained by using untreated clusters treatment (control), as shown in Fig. number(8).

The results of this study indicate that CPPU (Sitofex) dosage higher than 5 ppm. can not be recommended. High export quality of bunches can be obtained with lower application of growth regulators using combined treatment (CPPU at 5 ppm + GA_3 at 40ppm) when the berry size reached about 6 mm^3. in addiction to hand thinning. (*Orth*, 1990, *Vander Merwe et al.*, 1991 and *Wolf et al.*, 1991).

Table 5. Effect of Sitofex (CPPU) and GA_3 on Total Soluble Solids, Acidity and Shattering of Thompson Seedless grapevines at 1997, 1998 seasons .

Treatment	1997		1998		
	TSS%	Acidity %	TSS%	Acidity %	No. of Shattering %
GA_3 at 40 ppm	16.07	0.43	14.40	0.66	7.74
GA_3 at 40 ppm + 3ppm Sitofex	14.67	0.69	14.00	0.68	5.46
GA_3 at 40 ppm + 5ppm Sitofex	15.00	0.64	13.87	0.69	5.28
GA_3 at 40ppm + 7ppm Sitofex	15.40	0.62	--	--	--
Sitofex at 3ppm	15.53	0.59	14.33	0.66	6.66
Sitofex at 5ppm	15.67	0.57	14.73	0.64	6.05
Sitofex at 7ppm	15.93	0.54	--	--	--
Control (untreated vines)	18.33	0.38	17.07	0.49	14.87
L.S.D at 5%	**0.39**	**0.02**	**0.40**	**0.03**	--

Fig. 6. Effect of Sitofex (CPPU) and GA_3 on Total Soluble Solids and Acidity of Thompson Seedless grapevines at 1997 season.

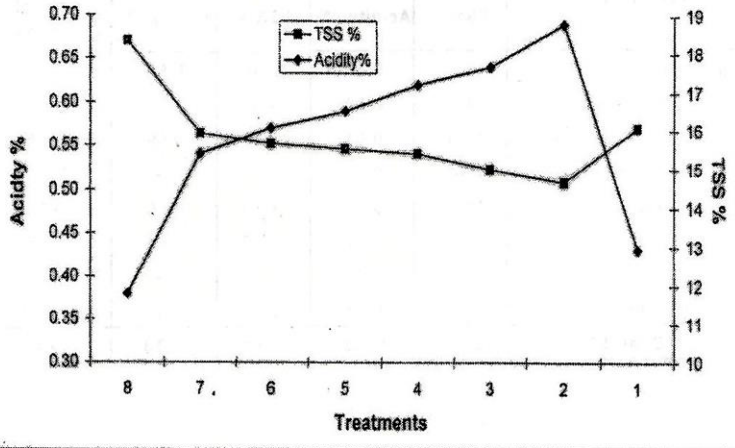


Fig. 7. Effect of Sitofex (CPPU) and GA_3 on Total Soluble Solids and Acidity of Thompson Seedless grapevines at 1998 season.

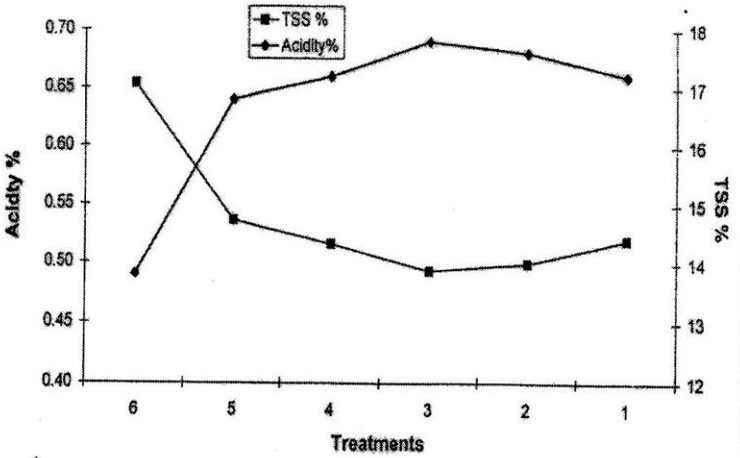
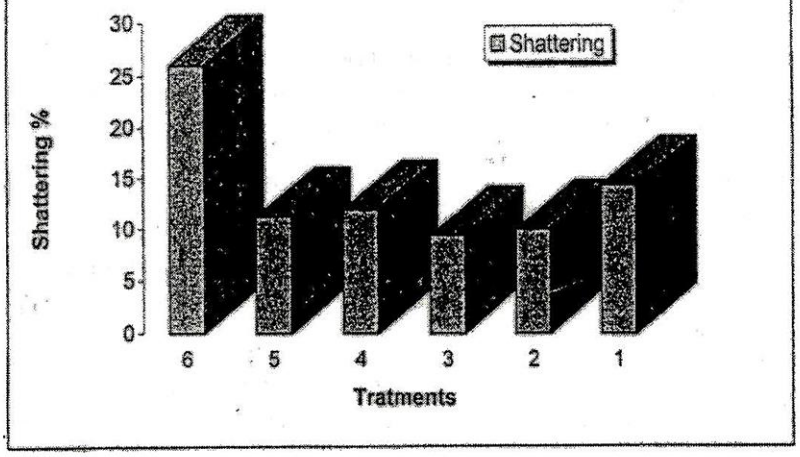


Fig. 8. Effect of Sitofex (CPPU) and GA_3 on Shattering of Thompson Seedless grapevines at 1998 season.



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تأثير السيتوفكس على المحصول وصفات العناقيد فى العنب البناتى

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أجريت المعاملة بمادة السيتوفكس بمفردة أو بالاشتراك مع حمض الجبريليك على العنب طومسون سيدلس فى سنهرة بمحافظة القليوبية خلال موسمي ١٩٩٧ ، ١٩٩٨ كل أشجار التجربة عوملت بحمض الجبريليك بتركيز ١٠ جزء فى المليون عندما وصل طول الشمراخ الزهرى حوالى ٨-١٠مم وكذلك عوملت بتركيز ٢٠ جزء فى المليون فى مرحلة قمة التزهير بالإضافة إلى الخف اليدوى للحبات عند قطر ٦مم للحبة تم إجراء ٨ معاملات فى الموسم الأول ١٩٩٧ و ٦ معاملات فى الموسم الثانى ١٩٩٨ من السيتوفكس وبالاشتراك مع حمض الجبريليك أو كلاً بمفرده بالإضافة إلى المقارنة وأوضحت النتائج المتحصل عليها أن السيتوفكس سواء كان بمفرده أو بالاشتراك مع حمض الجبريليك أخر النضج حيث قلت نسبة المواد الصلبة الذائبة وزادت الحموضة معنوياً فى كلا الموسمين و كذلك أدت نفس المعاملات إلى زيادة معنوية فى كل من المحصول الكلى ، وزن العنقود ، وزن الحبة ، حجم الحبة ، طول الحبة ، عرض الحبة ، تزاحم العنقود ، وزن الشمراخ بينما قل كلاً من معامل الحبة والعنقود وأصبح شكل الحبة مستديراً فى كلا الموسمين ١٩٩٧ ، ١٩٩٨ .

قلل استخدام السيتوفكس سواء بمفرده أو بالاشتراك مع حمض الجبريليك من نسبة التساقط فى موسم ١٩٩٨ ، هذه النتائج المتحصل عليها أكدت أن استخدام السيتوفكس بتركيز ٥ جزء فى المليون بالإضافة لحمض الجبريليك بتركيز ٤٠ جزء فى المليون أعطى احسن الصفات المطلوبة للتصدير سواء للحبة أو العنقود .