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PRODUCTION OF HIGH-QUALITY THOMPSON SEEDLESS GRAPES

Omar, A.h. and F. M. El-Morsy
Viticulture Research Department, Horticulture Research Institute, Agricultural Research Center, Giza, Egypt.

ABSTRACT

During two successive years 1997 and 1998, clusters of Thompson Seedless grapevines were subjected to sitofex and/or GA3 spray when berry diameter reached 4-6 mm. Sitofex treatments were 0, 3, 5 and 7 ppm where GA3 was sprayed with 0 or 40 ppm once or twice. Sitofex and/or GA3 significantly increased berry length, diameter, weight, size, firmness, adherence strength, cluster weight, yield, acidity and Ca in berry skin where TSS and TSS/acid ratio were significantly decreased. Sitofex delayed grape maturation more than GA3 and the combined application delayed maturation more than sitofex or GA3 alone. It is recommended to spray clusters when berry diameter reaches 4-6 mm with 40 ppm GA3 + 5 ppm sitofex + 40 ppm GA3 (after 5 days), to produce high quality Thompson Seedless grapes.

INTRODUCTION

Sitofex (Forchlorfenuron) is a plant growth regulator of cytokinin type, has shown marked physiological effects. It increased fruit set in grapes when applied at pre-bloom and increased berry size when applied at post-bloom (Nickell, 1985). It was reported that sitofex tended to increase cluster and berry weight linearly while reducing Brix, pH and increasing titratable acidity of four seedless grape selections (Reynolds et al., 1992).

GA3 is widely used in vineyards, allover the World to increase cluster length, weight, looseness and berry weight and size (Salvador and Manzo, 1984 and Ezzahouani *et al*., 1985).

The minimum tolerance for Thompson Seedless grapes to compete in the international market from horticultural point of view are : bunch weight range of 250 to 700 g., berry diameter 16mm and TSS 16.5% (El-Ansary, 1999).

Exports of Egyptian grapes amounted to 2532 tons in 1998. (El-Saied, 1999). The main cause of unexportable bunches is berry diameter under 16 mm (El-Ansary, 1999). Starting from 15th of July till the end of October, the Europian markets imposed high taxes on the imported grapes; so Egyptian exporters should avoid this period (El-Saied, 1999).

This work aimed to produce high-quality Thompson Seedless grapes to meet the exportation demands in terms of berry diameter, cluster weight, firmness, adherence strength, TSS, acidity and TSS/acid ratio through sitofex and gebberellic acid treatments.

MATERIALS AND METHODS

This work was conducted during the seasons of 1997 and 1998 in a private vineyard located in Wadi Elfaregh, Giza governorate. One hundred

and sixty eight Thompson Seedless grapevines of almost similar vigour grown in sandy soil were chosen. In the first week of January the vines were peruned to five canes of 12 buds each then dormex, a breaking dormancy agent, was applied at 5%. The vines received routine care. A week after fruit set, the clusters were adjusted to 15 clusters/vine.

GA3 and sitofex were applied to clusters as follows :

1-GA3 application :

- Elongation spray : GA3 at 15 ppm (clusters were 10 cm length)
- Thinning spray : GA3 at 20 ppm twice at
  1- 20% bloom stage
  2- 70% bloom stage

1- Sitofex and/or GA3 application for sizing :

Sitofex and/or GA3 were sprayed when berry diameter reached 4-6 mm as follows:

1- Control
2- Sitofex at 3 ppm
at 5 ppm
at 7 ppm
3- GA3 at 40 ppm + 0 sitofex
at 40 ppm + 3 ppm sitofex
at 40 ppm + 5 ppm sitofex
at 40 ppm + 7 ppm sitofex

4- GA3 at 40 ppm was repeated 5 days to treatments which received the first GA3 at 40 ppm; to form the following treatments:

GA3 40 ppm + GA3 40 ppm
GA3 40 ppm + 3 ppm sitofex + GA3 40 ppm
GA3 40 ppm + 5 ppm sitofex + GA3 40 ppm
GA3 40 ppm + 7 ppm sitofex + GA3 40 ppm

Clusters of all treatments were berry thinned after the first GA3 spray for sizing as follows:

- Leaving the first five laterals.
- Removing the subsequent three laterals.
- Leaving the subsequent three laterals.
- Removing the rest of the cluster.

The design of the experiment was randomized complete block with three replicates of four vine each.

When TSS for the control reached 16-17 (23rd June for both seasons) the following data were recorded: berry length and diameter, 100 berry weight and size, berry firmness and adherence strength, cluster weight, yield per vine, TSS (with hand refractometer), acidity (according to A.O.A.C, 1970), TSS/acid ratio and percent of Ca in dry mater of berry skin. In addition, another two vines were kept to record days needed for each treatment to reach TSS 16.5 after control.

Duncan multiple range test was used to compare the average of treatments according to Snedecor and Cochran (1967).

RESULTS AND DISCUSSION

1-Berry length and diameter :

It is clear from Table (1) that sitofex significantly increased berry length and dameter than control. The application of GA3 once or twice followed the same trend. In the first year, there was no significant differences between the application of GA3 once or twice, while in the second year, GA3 applied twice was significantly effective than GA3 applied once. The combination between GA3, applied once, or twice, and sitofex induced a significant increase than control in both seasons. In the second year, GA3 induced the same effect in both berry length and diameter than sitofex alone, while in the first year GA3 induced an increase but without significancy with exception of 5ppm sitofex + 40 ppm GA3 (twice). GA3 applied twice plus sitofex significantly increased berry length and diameter than control in both seasons of the experiment. In the first year, there was no significant differences between GA3 treatments when applied alone or in combination with sitofex. In the second year, GA3 applied twice in combination with sitofex achieved the best results. These treatments induced a significant increase than the other treatments concerning berry length and diameter. The second GA3 spray assure the action of GA3 in increasing berry elongation. Sitofex increased berry diameter because it stimulates periclinal berry growth, where GA3 stimulate anticlinal growth resulting in elongated berries (Dokoozlian, 1994). The combination of these two growth regulators, increased both berry length and diameter depending upon the rate of sitofex + GA3 used.

Similar results were obtained by Wolf *et al*., 1994 and Retamales *et al*., 1995.

2-Berry weight and size :

All treatments of sitofex and/or GA3 significantly increased berry weight than control in both seasons of the experiment. The differences between the treatments of sitofex and/or GA3 (sprayed once) was not significant. The more effective treatment was GA3 (sprayed twice) with different concentrations of sitofex. It generally induced a significant increase in berry weight than control and other treatments in both seasons.

Sitofex and/or GA3 significantly increased berry size than control in both seasons. In the first season, there were no significant differences between sitofex (S7) and/or GA3 treatments in most cases. While in the second season, the increments induced by stofex and GA3 treatments were more evident than those induced by sitofex alone. The highest values were recorded as a result of sitofex + GA3 (sprayed twice). The increase induced in berry weight is mainly due to the increase in berry size induced by GA3 and/or sitofex. Increasing berry size is related to the increase in berry length and diameter (Table 1).

The results are in agreement with those of Singh et al., (1978) for GA3 and Dokoozlian *et al*., (1994); Wolf *et al*., (1994) and Rizk (1998) for sitofex and GA3.

3-Firmness and adherence strength of the berries :

Berry firmness was significantly increased by the application of sitofex, GA3 (applied twice) and their combined application in the first and the second seasons than control. GA3 40 ppm applied twice + sitofex were more effective than GA3 applied once (Table 1). The increase of berry firmness induced by sitofex and/or GA3 could be related to the increase in Ca percentage in berry skin (Table 2).

Berry adherence strength was significantly increased by sitofex and/or GA3 application than control in both seasons. The combined application of sitofex + GA3 (twice) was more effective than the other treatments. It significantly increased the adherence strength of berries. This result is quite useful to reduce shattering.

The increase in berry firmness and adherence as a result of using GA3 was reported by Singh *et al*., 1978 and Abdel-Kawi, 1984. Where Yaushiang *et al.,* 1997 observed that the application of sitofex increased berry firmness.

4-Cluster weight :

Theapplication of sitofex and/or GA3 induced a significant increase in cluster weight in both seasons of the experiment compared to control (Table 1). It is noticeable that there were significant differences between sitofex and GA3 treatments in both seasons. The combined application of sitofex and GA3 showed no significant differences between the treatments in the first season, nevertheless, sitofex + GA3 (40 ppm twice) was more effective than sitofex + GA3 (40 ppm once) and showed significancy in both seasons.

The increase in cluster weight is attributed to the increase in berry weight and size. Similar results were reported by Retamales *et al*., 1995 and Rizk, 1998.

5-Yield :

Yield per vine of Thompson Seedless clusters showed a dramatic response to sitofex and/or GA3 (Table 1). All treatments revealed significant increases than control. The combined application showed no significancy. Sitofex + GA3 (40 ppm twice) showed a pronounced increase than sitofex + GA3 (40 ppm once) treatments. Table (2) illustrate the increment percentages than control for the promising treatments.

Table (2): Effect of GA3 and sitofex on yield

Treatments	1997		1998	
	Kg / vine	Over control	Kg / vine	Over control
Control	6.9	---	7.2	---
GA3 (40 ppm once)	9.2	33%	9	25%
GA3 (40 ppm twice)	10.0	45%	10.3	43%
Sitofex (7 ppm) + GA3 (40 ppm once)	9.8	42%	9.9	38%
Sitofex (5 ppm) + GA3 (40 ppm twice)	10.7	56%	11.2	56%
Sitofex (7 ppm) + GA3 (40 ppm twice)	10.8	57%	11.5	60%

From tables 1 and 2, the application of sitofex 5 ppm + GA3 (40 ppm twice) at berry diameter 4-6 mm could be recommended.

Our results are in accordance with those of Nickel, 1986; Diaze and Maldonado, 1992; Dokoozliian *et al*., 1994; Retamales *et al*., 1995 and Rizk, 1998.

6-TSS, acidity and TSS/acid ratio :

The application of sitofex and/or GA3 significantly reduced TSS than control in both seasons (Table 3). The application of sitofex (S7) was more effective than GA3. The combined application showed significant effect compared to sitofex or GA3. On the contrary, sitofex and/or GA3 significantly increased acidity than control. No significant differences were observed between sitofex and GA3 treatments alone or together. TSS/acid ratio showed a significant decrease as a result of sitofex and /or GA3 treatments compared to control.

The decrease in TSS is related to the increase in berry size caused by siitofex and/or GA3, consequently, the accumulation of sugars needs more time. At the same time, it seems that the applcation of stofex and/or GA3 slow down the degradation rate of acids which explain the high acidity of berries. Accordingly, TSS/acidity was lowered. Similar results were reported by Nickell, 1986; Dokoozlian *et al.,* 1994; Retamales *et al.,* 1995 and Rizk, 1998.

Calcium percentage in berry skin :

It is obvious from Table (3) that the high concentration of sitofex or GA3 (twice) significantly increased Ca percentage in berry skin. The same trend was observed in the combined application and was more effective than sitofex or GA3. This result interpret the increase in berry firmness induced by sitofex and/or GA3. Yaushiang *et al*., (1997) suggested that the application of sitofex increased berry firmness by maintaining the total pectin and Ca contents at a higher concentration and increasing the number of flesh cell layers compared to the control.

The ability of sitofex + GA3 to improve grape quality including berry weight, volume, TSS, adherence and firmness is promising although this combination delayed grape maturation up to 13 days (Table 3) compared to the control which was of low quality (Tables 1 and 3), and consequently unacceptable for export. The chance to export sitofex + GA3 treated clusters is good especially for sitofex (5ppm) + GA3 (40ppm, twice). This treatment achieved high quality Thompson Seedless grape with 14 days chance for export. In spite of the delaying effect of this treatment, high prices could be achieved as illustrated in the following table.

The prices * (American dollar) of grapes in the international markets in 1998 were :

Date	UK market	German market
1-7	3.53	3.64
6-7	3.00	3.49
8-7	2.50	3.29
15-7	2.08	2.59
24-7	1.75	2.13

*** Web site : http: // www.atut.gov.eg**

The above prices reveal the importance to produce grapes with high quality to be exported before 15-7 as mentioned by El-Saied, 1999.

Hence, it could be concluded that optimum concentrations of sitofex 5 or 7 ppm + GA3 40 ppm (twice) could be used to produce high-quality Thompson Seedless grapes in terms of berry diameter, bunch weight, berry firmness, adherence and finally TSS to increase the exportable amount of Thompson Seedless.

REFERENCES

Abdel-Kawi, A.A. (1984). Effect of GA3 sprays, berry thinning and gridling treatments on yield and fruit quality of Thompson Seedless grapes. Agric. Res. Rev. 62 (3A): 29-35.

A.O.A.C. 1970. Association of Official Agriculture Chemists. Official method for analysis. Washington D.C., USA.

Diaze, D.H. and L.A. Maldonado, (1992). Forchlorfenuron effect on berry size and maturity of Perlette and Flame Seedless grapes. Proc. Plant Growth Reg. Soc. Am. 19: 124-128.

Dokoozlian, N.K.; M.M. Moriyama and N.C. Ebisuda. (1994). Forchlorfenthuron (CPPU) increases the berry size and delays the maturity of Thompson Seedless table grapes. International Symposium On Table Grapes Production, 63-68, Anaheim, CA, USA.

El-Ansary, M. (1999). Waste and losses during table grape export. Agricultural technology utilization and transfer project (ATUT). Pub. No. 68. Egypt.

El-Saied, A. (1999). Table grape export quantities, markets and prices for 1998. In the second table grape workshop. Edited by Antonio Lizana. Agricultural technology utilization and transfer project (ATUT). Pub. No. 80. Egypt.

Ezzahouani, A; A.M. Lashen and L.Walali. (1985). Effect of gibberellic and gridling on Thompson Seedless table grapes in Morocco. Hortscience, 20 (3): 393-394.

Nickell, L.G. (1985). New plant growth regulator increases grape size, Pro. Plant Growth Reg. Soc. Am., 12: 1-7.

Nickell, L.G. (1986). The effect of N-(2-Chloro-4 pyridyl)-N-Phenylurea and the 3-chlorobenzyl ester of dicamba on growth and sugar content of grapes. Acta Hort. No. 179, Vol. 11: 805-806..

Retamales, J.; F. Bangertti; T. Cooper and R. Calleias, (1995). Effects of CPPU and GA3 on fruit quality of Sultanina table grape. Acta Hort. No. 394, 149-157.

Reynolds, A.G.; D.A. Wardle; C. Zurowski and N.E. Looney. (1992). Phenylureas CPPU and thidiazuron affected yield components, fruit composition and storage potential of four seedless selections. J.Am. Soc. Hort. Sci. 117 (1): 85-89.

Rizk, M.H. (1998). Effect of CPPU, GA3 and hand thinning on yield and fruit quality of Thompson Seedless grapes. J. Agric. Sci. Mansoura Univ. 23 (1): 397-404.

Salvador, F.R. DE. And Manzo, A. (1984). A study on the use of gibberellins on seedless grape cultivars. Annali dell'Istituto Sperimentale per la Frutticoltura. 15: 159-166. Hort. Abstr. Vol. 57: 1063.

Singh, K.; R.J. Weaver and J.O. Johnson, 1979. Effect of application of gibberellic acid on berry size, shatter and texture of Thompson Seedless grapes. Am. J. Enol. Vitic. 29 (4): 258-268.

Snedecore, C.W. and G.W. Cochran. (1967). Statistical methods. 6th ed. Iowa State Unv. Press Ames. Iowa, USA.

Wolf, E.E.H. and J.A. Vilyoen; A. Nieuwenhuys and J.T. Loubser, (1994). The effect of Forchlorfenuron on bunch quality in table grapes. International symposium on table grape production, 50-53, Anaheim, CA, USA.

Yaushiang, Y.; W. Yihru and K. Yinkang, (1997). Effects of cytokinins and calcium application on the fruit firmness of Honey Red grapes. In proceedings of a symposium on enhancing competitiveness of fruit industry. Taichung district Agric. Improvement Station, special Pub. No. 38, 151-168. Hort. Abstr. Vol. 68: 6555.

إنتاج عنب طومسون سيدلس عالي الجودة

أحمد حسين عمر – فرج محمد المرسي

قسم بحوث العنب – معهد بحوث البساتين – مركز البحوث الزراعية

في تجربة لمدة سنتين رشت عناقيد العنب طومسون سيدلس (البناتي) بالسيتوفكس بتركيز صفر ، 3 ، 5 ، 7 جزء في المليون و / أو GA3 بتركيز صفر أو 40 جزء في المليون رشة واحدة أو رشتان عندما وصل قطر الحبات إلي 4-6 ملليمتر. كانت نتيجة هذه المعاملات زيادة طول ، قطر ، وزن ، حجم الحبة ، الصلابة ، قوة الشد وكذلك وزن العناقيد والمحصول ، الحموضة والنسبة المئوية للكالسيوم في جلد الحبات ، بينما إنخفضت TSS ، TSS/acidity معنوياً. وقد أدي رش السيتوفكس إلي تأخير نضج العنب بدرجة أكبر من GA3 وكانت المعاملات المحتوية علي المركبين أكثر تأخيراً لنضج الحبات.

كانت أفضل المعاملات هي رش العناقيد بـ 40 جزء في المليون من GA3 + 5 جزء في المليون سيتوفكس + 40 جزء في المليون GA3 (بعد خمسة أيام من الرشة الأولي) لإنتاج عنب ذو مواصفات عالية الجودة صالح للتصدير ذات أسعار مرتفعة.

Table (1): Effect of sitofex and/or GA3 on physical characteristics of Thompson Seedless grapes

Treatments	Berry length (mm)		Berry diameter(mm)		Weight of 100 berries (g)		Size of 100 berries (cm^3)		Berry firmness(g)		Adherence strength(g)		Cluster Weight(g)		Yield / vine (Kg)	
	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998
Control	17 c	14.5 f	14 c	14.3 f	213 d	173 f	193 d	160 h	890 e	860 g	354 f	361 f	360 f	377 f	5.4 e	5.7 f
S3	18 bc	15.1 e	15 bc	15.1 e	291 c	220 e	267 c	180 g	920 d	950 f	369 e	372 e	417 e	417 e	6.3 d	6.3 e
S5	18 bc	15.2 e	16 b	16.0 c	305 bc	229 e	280 c	187 g	960 d	970 f	378 de	380 c	416 e	447 d	6.2 d	6.7 d
S7	19 b	15.8 d	16 b	16.3 c	336 bc	278 d	313 b	220 f	1060 c	1000 e	390 cd	391 cd	459 d	460 d	6.9 d	6.9 d
GA3 (40 ppm once)	20 ab	18.8 b	16 b	15.7 d	330 bc	313 c	320 b	240 de	990 d	1010 e	384 c	380 e	512 c	503 c	7.7 c	7.5 c
GA3 (40 ppm twice)	22 a	19.7 a	16 b	16.2 c	350 b	323 c	333 ab	273 c	1150 b	1120 d	377 de	383 de	566 b	587 b	8.5 b	8.8 b
GA3 (40 ppm once)																
+ S3	20 ab	18.2 c	16 b	16.7 b	320 bc	322 c	313 b	253 de	1030 c	1010 e	387 c	388 de	530bc	540 b	8.0 bc	8.1 bc
+ S5	20 ab	18.6bc	16 b	16.9 b	350 b	333 bc	339 ab	263 cd	1150 b	1140 cd	388 c	391 cd	540 b	557 b	8.1 bc	8.4 b
+ S7	20 ab	18.4bc	16 b	17.0 b	335 b	364 ab	320 b	267 cd	1170 b	1170 bc	393 c	393 cd	555 b	557 b	8.3 bc	8.4 b
GA3 (40 ppm twice)																
+ S3	20 ab	19.7 a	16 b	17.6 a	369 a	377 a	340 ab	287 bc	1180 b	1160 b-d	412 b	399 c	607 a	633 a	9.1 a	9.5 a
+ S5	22 a	19.7 a	18 a	18.0 a	382 a	387 a	357 a	307 a	1230 a	1200 a	421 ab	405 b	615 a	644 a	9.2 a	9.7 a
+ S7	21 a	19.7ab	17 a	17.6 a	379 a	387 a	353 a	320 a	1220 a	1250 a	425 a	413 a	620 a	665 a	9.3 a	10.0 a

Values with the same letter (s) are not differ significantly at 5% level S3 = Sitofex 3ppm S5 = Sitofex 5ppm S7 = Sitofex 7ppm

Table (3): Effect of sitofex and/or GA3 on TSS, acidity, TSS/acid ratio, Ca in berry skin, days needed to reach TSS 16.5 after control and period left to export for Thompson Seedless grapes

Treatments	TSS		Acidity		TSS/Acidity		Ca% in berry skin		Days needed to reach 16.5 for TSS after control		Period left to export (days)	
	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998
Control	16.5 a	16.7 a	0.60 d	0.65 c	27.5 a	25.7 a	0.55 g	0.51 f	---	---	23	22
S3	14.8 b	14.9 b	0.80 c	0.85 b	18.5 b	17.5 c	0.56 fg	0.54 e	4	3	19	20
S5	14.0 bc	14.2 bc	0.87 ab	0.92 a	16.1 c	15.4 d	0.57 f	0.55 e	6	6	17	17
S7	13.9 c	13.8 c	0.90 ab	0.95 a	15.4 d	14.5 e	0.61 e	0.57 d	8	7	15	16
GA3 (40 ppm once)	16.5 a	15.2 b	0.87 ab	0.80 b	18.4 b	19.0 b	0.57 f	0.55 e	---	3	22	20
GA3 (40 ppm twice)	15.0 b	15.0 b	0.90 ab	0.88 ab	16.7 c	17.0 c	0.62 de	0.60 c	3	3	16	16
GA3 (40 ppm once)												
+ S3	13.4 cd	13.5 cd	0.90 ab	0.98 a	14.9 d	13.8 ef	0.65 bcd	0.64 b	7	7	16	16
+ S5	13.3 d	13.0 d	0.87 ab	0.98 a	15.3 d	13.3 fg	0.66 abc	0.66 ab	7	7	16	16
+ S7	13.0 de	13.0 d	0.90 ab	0.98 a	14.4 e	13.3 fg	0.67 ab	0.66 ab	9	9	14	14
GA3(40ppm twice)												
+ S3	13.2 d	13.0 d	0.90 ab	0.98 a	14.7 e	13.3 fg	0.64 bc	0.64 b	9	9	14	14
+ S5	13.0 de	13.0 d	1.03 a	0.99 a	12.6 f	13.1 fg	0.67 ab	0.68 a	9	9	14	14
+ S7	12.8 e	12.7 e	1.07 a	0.99 a	11.9 g	12.8 g	0.69 a	0.68 a	12	13	11	10

S3 = Sitofex 3ppm S5 = Sitofex 5ppm S7 = Sitofex 7ppm