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EFFECT OF GA_3 ON BERRY SHATTERING AND ANATOMICAL STRUCTURE OF THOMPSON SEEDLESS GRAPE CLUSTERS

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ABSTRACT

This investigation was carried out during two successive seasons of 1990/91 and 1991/92 to study the relationship between the anatomical structure of rachis & pedicels as well as berry shattering of Thomoson Seedless grape clusters during harvest and handling as affected by gibberellic acid.

The study included 5 treatments and the control. Grape clusters were dipped in 10, 20, 30, 40 and 50 ppm GA_3 solutions before flowering and after fruit-set.

All GA_3 treatments induced berry shattering, since the percentage increased with increasing GA_3 concentration. Also GA_3 treatments increased the pedicel diameter and number of secondary xylem cells. The higher levels of GA_3 at 40 and 50 ppm induced more diameter and number of secondary cells along the radial rows. Lignin content in rachis and pedicels also increased significantly specially with GA_3 at 50 ppm.GA_3 at all concentrations used increased cellulouse content in the rachis and pedicels, the increase was proportional to the level of GA_3 applied.

From this study it is concluded that using low concentrations of GA_3 is recommended to avoid berry shattering at harvest and during handling. Thus, lower concentrations of GA_3 at 10-20 ppm can be used for elongation, while 30 ppm is used for increasing berry size.

INTRODUCTION

Grapes are considered the second fruit crop in Egypt, and consumed mainly as table grapes. The area of the vineyards has increased rapidly in the last few years especially in the newly reclamed lands.

Although the majority of Thompson seedless grapes are internationally consumed as raisins, yet it is favored in Egypt for fresh consumption. Thus, it is highly needed to treat the Thompson seedless grapes with GA_3 to increase production and improve the quality . So, buncehes develop with bigger berries that can tolerate handling and increase their shelf-life..

Previous studies were undertaken to improve yield and berry of Thompson seedless grape cv by using some growth regulators such as gibberellic acid (GA_3) . But it is noticed that the berries were easily separated from the pedicels and rachis. Separation happens by physical disorder during transit and handling, and consequently serious losses occuer during masrketing.

The present study was carried out to elucidate the cause of berry shattering as a result of gibberellic acid application and the relationship of berry shattering to lignin and cellulose content of rachis and pedicels through histological studies of the pedicels.

MATERIALS AND METHODS

This investigation was carried out during two successive seasons of1990/91 and 1991/92 in an attempt to study the relationship between the anatomical structure of rachis and pedicels with berry shattering of Thompson Seedless grapes during harvesting and handling as affected by gibberellic acid treatments (GA_3).

This study was performed on 6-years-old Thompson Seedless grape vines growing in a private vineyard near Mahalla el-Kobra, Gharbia Governorate. For the study, 54 vines of almost similar vigor were selected. The soil is clay and the vines were planted at 2.0 X 2.5 meters apart. The vines were trained on three wires using the cane system of pruning. An equal number of 60 buds was maintained on each vine. The number of canes varied from 5-6, and each cane was of 10-12 buds. All vines received the normal orchard management usually practiced in the commercial vineyards in the are particularly fertilization, irrigation, and pest & disease control.

The experiment was laid out in a Randomized Complete Block Design. Each treatment included three vines replicated three times. On each vine, 10 clusters were selected at random to receive one of the following GA_3 treatments. The first application was carried out when the clusters were about 7-10 cm long and the second treatment after fruit-set. The clusters were dipped in there assigned solutions for 5 seconds.

1. Control
2. GA_3 10 ppm before flowering + 10 ppm after fruit-set.
3. GA_3 20 ppm before flowering + 20 ppm after fruit-set.
4. GA_3 30 ppm before flowering + 30 ppm after fruit-set.
5. GA_3 40 ppm before flowering + 40 ppm after fruit-set.
6. GA_3 50 ppm before flowering + 50 ppm after fruit-set.

Harvesting the grapes was carried out when SSC reached about 18 % in the control bunches according to El-Banna *et al.* (1984). Bunch samples were taken to the laboratory for the following determinations:

1. Percentage of berry shattering: Three bunches treatment wise were dropped from a hieght of one meter and the shattered berries were weiged and there percentage to the total weight of berries / bunch was estimated.

2. Cellulouse & lignin determination : Samples of rachis and pedicels were collected, dried at 70 C. ground and kept for chemical analysis. Goering & Van-Soest procedures (1970) were adopted to determine the acid detergent fiber by using Tecator Fiber System.

3. Anatomical investigation : Pedicels from 5 mature bunches were separated , killed and fixed in Formalin-Aceto-Alcohol (FAA), dehydrated with ethyl alcohol series, embedded in paraffin wax (56-58 C m.p.). The pedicels were cross sectioned at 15 u/ using a rotary xylene and finally mounted in Canada balsam. The following characters were determined :

a-Pedicel diameter (u).
b-Vascular cylinder diameter (u).
c-Number of cells along the radial rows of secondary xylem.

The above anatomical characters specified in microns were obtained using calibrated eyepiece micrometer. From each specimen, 5 random sections were measured. Thus, the value of a given anatomical character is the mean of 25 readings.

Statistical analysis: All the obtained data were subjected to statistical analysis as the usual technique of analysis of variance (ANOVA) of the Randomized Complete Block Design according to Gomez & Gomez (1984).

RESULTS AND DISCUSSION

Data presented in Table (1) show that all applied concentrations of GA_3 gave higher values of berry shatter than the control. Berry shattering was also increased as the level of GA_3 was increased.. The shattering is directly proportional to the increase of GA_3 level. The lower levels of GA_3 were of non significant effect on berry shattering, while the increase in GA_3 concentration after fruit-set resulted in significant increases in berry shatter.

Table (1): Effect of GA_3 on berry shattering of Thompson seedless grapes

Treatments	Percentage of Berry shattering	% increase over control
Control	10.40	----
GA_3 at 10 ppm + 10 ppm	12.08	1.94
GA_3 at 20 ppm + 20 ppm	12.36	2.22
GA_3 at 30 ppm + 30 ppm	9.96	9.82
GA_3 at 40 ppm + 40 ppm	19.44	5.30
Ga_3 at 50 ppm + 50 ppm	19.59	9.45
L.S.D. at 5 %	5.41	
L.S.D> at 1 %	3.26	

Some reports indicated that GA_3 had no effect on percentage of berry shatter such as; Singh *et al.* (1978) and Daulta *et al.* (1980). The obtained results are in line with those found by Ahmed (1980), and Nakamura & Hari (1981). They noticed a higher percentage of berry drop, smaller removal force of individual berries and greater hardness of rachis following GA_3 treatments. Other studies by the same workers indicated that post harvest berry drop after GA_3 treatments was caused by rachis hardening rather than advanced berry maturity. When rachis are hard, they were easier to break , and therefore, berry shatter was increased.

Data presented in Table (2) clearly indicate that GA_3 at any level resulted in in a high lignin content in rachis and pedicels than control. The use of GA_3 at 10 ppm before flowering plus 10 ppm after fruit-set resulted in 0.65 5 increase in lignin content over the control againest 3.59% when GA_3 was applied at 50 ppm, as an average of the two seasons under study.

Table (2): Effect of GA_3 on lignin content of pedicels and rachis.

Treatments	Lignin content (%) 1991	1992	Mean	% Increase over over control
Control	16.23	16.72	16.47	-----
GA_3 at 10 ppm + 10 ppm	17.16	17.08	17.12	0.65
GA_3 at 20 ppm + 20 ppm	17.19	17.39	17.29	0.82
GA_3 at 30 ppm + 30 ppm	18.03	18.19	18.11	1.64
GA_3 at 40 ppm + 40 ppm .	18.47	19.22	18.84	2.37
GA_3 at 50 ppm + 50 ppm	19.90	20.23	20.06	3.59
L.S.D. at 5 %	0.83	0.33		
L.S.D. at 1 %	1.43	0.52		

Concerning the effect of GA_3 on cellulose content data in table (3) indicated that GA_3 at any concentration increased cellulose content in both rachis and pedicels compared with the control. Application of GA_3 at 10 ppm before flowering plus 10 ppm after fruit-set produced about 2,27 % increase in cellulose content over the control, while this increase reached about 3.36 %, 4.51 %5.74 % and 6.54 % for Ga_3 at 20, 30, 40 and 50 ppm respectively.

Table (3): Effect of GA_3 on cellulose content of pedicels and rachis

Treatments	Cellulose content (%) 1991	1992	Mean	% increase over control
Control	13.98	14.49	14.23	-----
GA_3 at 10 ppm + 10 ppm	16.71	17.30	17.00	2.77
GA_3 at 20 ppm + 20 ppm	17.41	17.78	17.59	3.36
GA_3 at 30 ppm + 30 ppm	18.84	18.64	18.74	4.51
GA_3 at 40 ppm + 40 ppm	20.13	19.82	19.97	5.74
GA_3 at 50 ppm + 50 ppm	20.80	20.75	20.77	6.54
L.S.D. at 5 %	0.73	0.78		
L.S.D. at 1 %	1.12	1.14		

Table (4) and the plates show that pedicel cross sectional diameter and vascular cylinder diameter were significantly increased as a result of GA_3 treatments. The higher concentrations of GA_3 at 40 and 50 ppm produced more increase in the dimensions. Pedicel diameter reached about 1721 microns with GA_3 at 50 ppm compared to 999 microns for the control. In the same way diameter of the vascular cylinder reached about 1018 microns compared to 626 microns for the control. With regard to the number of secondary xylem cells, it is also seen that all GA_3 levels increased the number of cells along the radial rows. The inreament induced by GA_3 at 50 ppm was highly significant since it reached about 21.8 compared to 12.6 for the control. It is also evident that although all GA_3 levels increased the number of secondary xylem cells, the higher concentration was most effective.

Table (4): Effect of GA_3 on pedicel and vascular cylinder diameter and number of Secondary cells.

Treatments	Pedicel Diameter (micron)	Vascular cylinder diameter (micron)	No.secondry xylem cels
Control	999.2	626.9	12.66
GA_3 at 10 ppm + 10 ppm	1098.2	688.2	14.44
GA_3 at 20 ppm + 20 ppm	1131.2	715.3	15.55
GA_3 at 30 ppm + 30 ppm	1220.7	758.9	16.22
GA_3 at 40 ppm + 40 ppm	1333.9	857.8	17.22
GA_3 at 50 ppm + 50 ppm	1721.6	1018.1	21.87
L.S.D. at 5 %	150.2	101.4	4.63
L.S.D. at 1 %	213.7	144.3	N.S.

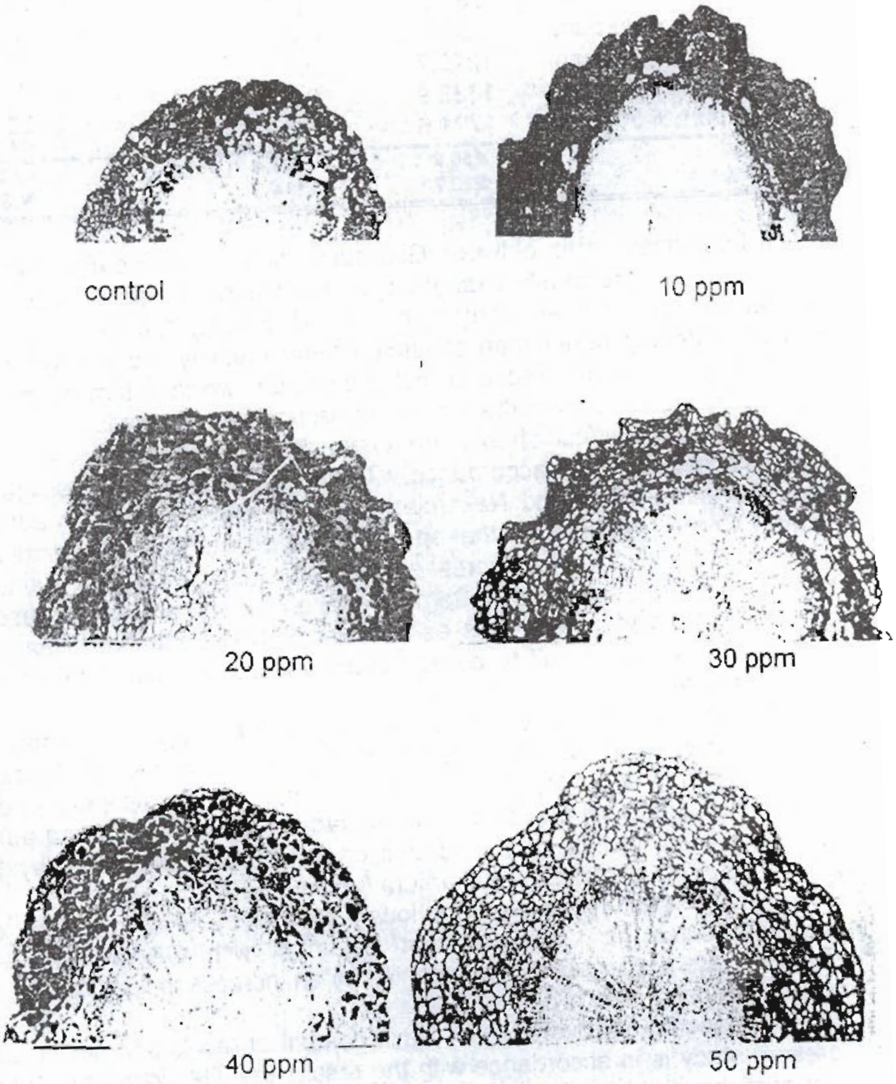
The inter relationship between GA_3 application on rachis diameter and hardening were previously examined by Nakamura & Hari (1983). They concluded that post-harvest berry drop induced by GA_3 treatments was due to rachis hardening rather than advanced berry maturity. Rachis hardening was accompanied with increase in rachis diameter which in turn seemed to be caused by the increase in the number of secondary xylem cells.

The enhancing effect of GA_3 on xylem development as noticed in the present investigation is in accordance with the results of many investigators (Davis & Holms, 1962 and Nakamura & Hari 1984). Working on apricot, Bradley & Crane (1957) found that spraying spur shoots with GA_3 stimulated cambial activity and led to increase xylem development. The work of Nakamura & Hari on Kyoho & Combell grape cvs. showed an increase in number of secondary xylem cells as a result of GA_3 treatment in easy to harden as well as in difficult to harden grape varieties, though with a lower extent in the latter.

The induction of vascular tissues as a result of GA_3 application may be due to enhanced cambial cell division. In this concept, Weaver(1972) found that the application of GA_3 to stems produced a pronounced increase in cell division in the sub apical meristem. The interaction between GA_3 and auxin in the enhancing action of the former on xylem differentiation may be involved as previously stated by Nakamura & Hari (1983).

Lignifications of xylem was previously studied by Shanan (1976) on bean plants since he reported that treatment with GA_3 produced a characteristic stem elongation accompanied by an increase in lignifications of meta and secondary xylem.

The enhancing effect of GA_3 on lignin content of rachis and pedicels in the present study is in accordance with the results that GA_3 increased lignin content of rachis and tendrils. In other study by Nakamura & Hari (1983) they reported that lignifications of the cells seemed to be involved in the hardening of rachis treated with GA_3. Hardening resulted from thickening and increase of the number of the secondary xylem cells as explained earlier.



cross sections showing diameter of vascular cylinder and number of cells along the radial rows of secondary xylem of pedicels from bunches treated with GA_3 compared to control.

The increase in cellulose and hemicelluloses contents in the rachis of Kyoho grape bunches was induced by GA_3 application as reported by Nakamura *et al.*. (1974). The enhancing effect of GA_3 on cellulose content of rachis and pedicels in the present study is also in accordance with the results of Fidan *et al.* (1981). They reported that GA_3 treatments led to increasing proportionally the cellulose content of the pedicels and rachis of seedless grapes with increasing GA_3 concentration

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أثر المعاملة بحمض الجبريلليك على نسبة فرط الحبات والتركيب التشريحى لأعناق حبات العنب البناتى

نبيلة قاسم – عبدالعال حجازى ونجاح النعمانى عاشور
المركز القومي للبحوث وجامعة المنصورة– مصر

اجرى هذا البحث خلال موسمى ٩١/٩٠ و ٩٢/٩١ لدراسة العلاقة بين التركيب التشريحى ونسبة فرط حبات العنب البناتى صنف طومسون سيدلس وذلك خلال الجمع والتداول نتيجة المعاملة بحمض الجبريلليك.

تضمنت الدراسة خمسة معاملات بغمس العناقيد فى محلول حمض الجبريلليك بتركيزات ١٠و٢٠و ٣٠و ٤٠ و ٥٠ جزء فى المليون قبل التزهير وأيضا بعد العقد– هذا بالأضافة الى المقارنة بدون معاملة.

ولقد أوضحت النتائج أن جميع معاملات الجبريللين أدت الى زيادة فى نسبة فرط الحبات وكانت الزيادة طردية مع زيادة التركيزات كما أظهرت معاملات الجبريللين زيادة قطر أعناق الحبات وعدد خلايا الخشب الثانوى الذى أدى بالتالى الى زيادة فرط الحبات. كما أنه حدثت زيادة فى فى محتوى الأعناق من اللجنين مع زيادة تركيز الجبريللين وأيضا زيادة السليلوز وكانت الزيادة متناسبة طرديا مع تركيز الجبريللين.

ويتضح من نتائج هذه الدراسة أن التركيزات المنخفضة من حمض الجبريلليك تقلل من تقصف أعناق حبات العنب الطومسون وبالتالي تقليل فرط الحبات ولذلك يمكن التوصية باستخدام التركيزات المنخفضة ١٠و٢٠ جزء فى المليون لاستطالة العناقيد والتركيزات حتى ٣٠ جزء فى المليون لزيادة حجم الحبات.