Scientific Journal of Agricultural Sciences

Print (ISSN 2535-1796) / Online (ISSN 2535-180X)

SJAS

Impact of GA3 on The Behavior of Superior Grapevine

Abdel Hameed M. Wassel[1], Faissal F. Ahmed[1], Mohamed M.A. Abada[2] and Dina A.M. Nagy[2]*

[1]Hort. Dept. Fac. of Agric. Minia Univ. Minia. Egypt
[2]Viticulture Dept. Hort. Res. Instit. ARC, Giza, Egypt

Citation: Abdel Hameed M. Wassel, Faissal F. Ahmed, Mohamed M.A. Abada and Dina A.M. Nagy. (2023). Impact of GA3 on The Behavior of Superior Grapevine. Scientific Journal of Agricultural Sciences, 5 (2): 1-7. https://doi.org/10.21608/SJAS.2023.204498.1291.

Publisher :
Beni-Suef University, Faculty of Agriculture

Received: 6 / 4 / 2023
Accepted: 27 / 5 / 2023

Corresponding author:
Dina Nagy

Email: dinanagy554@yahoo.com

ABSTRACT

The fusion of developmental events depends heavily on phytohormones. The physiological consequences of active gibberellins vary based on the gibberellin GA3 type found in the grapevine plant.
During the 2018/2019, 2019/2020, and 2020/2021 seasons superior grapevines were sprayed with GA3 at concentrations (0, 10, 20, and 40 ppm) at the pea stage “6 mm” to study its effect on vegetative growth and yield. All treatments had a positive impact on increasing the studied vegetative growth while at the same time increasing yield/treatment and cluster weight, improve the berry quality, and other parameters. The main objectives of the research are delaying the ripening of grapevine clusters, and thus prolonging the period of harvesting the crop and obtaining it for long periods, which brings great economic benefit, and obtaining a grape crop with export specifications in terms of the quality of grape clusters and berries. This is a natural storage of the fruits for a date later than the normal date, which brings a profitable economic return to the farmer.

KEYWORDS: grapes, GA3, and ripening

1. INTRODUCTION

Grapevine (*Vitis vinifera* L.) is the second largest crop after citrus in Egypt. The fruiting area is estimated at 157380 feddan produced 1472418 tonnes according to the (Ministry of Agriculture's annual statistics for 2018).

Funt and Tukey (1977) referred to the use (50 and 100 ppm) of gibberellic acid (GA3) in berry breakage on mature vines of *Vitis labrusca* L. cv. Initially, flowering appears to reduce cluster compactness by elongating the spindle, increasing berry size, reducing the number of shoot berries, and further increasing the number of mature berries, cluster weight, and yield.

Gibberellic acid (GA3) is frequently used to increase the berry size of seedless grapes. It is administered at a concentration of 20 ppm to fruit-setting ruby seedless vines when the berry diameter reaches 2-3 mm. It primarily affects growth by regulating cell elongation and division, which is evident in the production of various grape varieties as well as in their makeup and fruit quality (Omar and Girgis, 2005).

Dimovska *et al.,* (2011) found that three concentrations of gibberellic acid solutions (5, 10, and 20 mg/L) were sprayed on two seedless grape varieties, Thompson and Belgrade, at three different times for viticulturer flowering, post-flowering, and metamorphosis to study their influence on specific cultural technical traits. Gibberellic acid was added at a dosage of 20 mg/L, which enhanced the weight of the grapes and berries and improved the transportability of two seedless types of berries.

Abu-Zahra and Salameh (2012) mentioned that the application of GA3 on black magic fruit increased berry diameter and produced heavier clusters with an increased number of berries per cluster compared to control vines. The Percentage of berry breakage was increased in all vine treatments, otherwise berry quality was improved by GA3.

El-Halaby *et al.,* (2015) revealed that GA3 was sprayed seven times: once (5 ppm) before blooming, three (2, 5, and 7.5 ppm) at full bloom, and three more (3 ppm) when the berries were at the (6 mm) pea stage (30, 30 and 20 ppm). In addition, to combat the negative effects of GA3, particularly on colored types, joint spraying of GA3 four times before blooming and three times during the whole flowering stage.

Al-Atrushy (2016) found the effect of four concentrations (0, 10, 20 and 30 ppm) and three frequencies (single, double and triple) of GA3 on the yield and quality of "Zark" concentrations and frequencies- Grapes had a significant effect on most of the traits examined. Increasing GA3 concentration and abundance tended to increase yield per grape, including cluster number, cluster weight, berries per cluster, and 100-berry size. Increased juice percentage and density, total soluble solids and total sugars

Arashdy *et al.,* (2017) found that addition (GA3 30 mg/L) in the “El-Bayadi cultivar” increased berry weight, length and width compared to the control treatment. Both cluster weight and length were increased in GA3 compared to controls.

Radwan *et al.,* (2019) found that this was done over two seasons. superior seedless grapes were sprayed with GA3 seven times in 2016 and 2017, once before flowering (5 ppm), three times at full bloom (5 and 10 ppm), and three more times (30 ppm) when the berries were in the (6 mm) pea stage. Obtains heavy, compact bunches and accelerated ripening with very good seedless berry quality.

Ibrahim *et al.,* (2021) examined the impact of various GA3 concentrations (10, 20, 40 ppm, and 10 + 20 + 40 ppm) on the Thompson seedless grape variety's output and fruit quality. The findings demonstrated that spraying grapes with 10 + 20 + 40 ppm of GA3 raised percentages of total acidity and produced the highest levels of yield components while lowering fruit quality.

Tyagi *et al.,* (2021) phenylpropanoid pathway and ripening, and that processing (GA) treatment is understood to Increased fruit size delayed sugar accumulation and acid breakdown but not GA, and decreased berry colour and anthocyanin levels. Gibberellic acid (GA), a growth regulator used to increase fruit size in seedless grapes, has been reported to have interesting effects on these processes.

The main objectives of the research are to delay the ripening of grape clusters, and thus prolonging the period of harvesting the crop and obtaining it for long periods, which brings great economic benefit, obtaining a grape crop with export specifications in terms of the quality of grape clusters and berries and this treatment with gibberellic acid is prepared and classified as a post-harvest treatment for the grape crop, where the grapes are stored on trees, making them fresh and at the same time suitable for generating money from an economic point of view.

2. MATERIALS AND METHODS

Throughout the 2018/2019, 2019/2020, and 2020/2021 seasons, this study was conducted on exceptional 7-year-old vines. The experimental vines that were chosen were robust and in good health. The spacing between the chosen vines was 2.0 x 3.0 m. The crop was gathered in the third week of June from vines that were planted on a gable system and cultivated in clay soil with flood irrigation.

At pea stage "6 mm," GA3 was sprayed on all vines at concentrations of 0, 10, 20, and 40 ppm. Each year, the following variables were examined. The main stem, leaf area, cane thickness, wood weight, and leaf pigment, including chlorophyll A, B, total chlorophylls, and carotenoids, were all used to express vegetative growth. (Ahmed and Morsy, 1999 & Von-Wettstein, 1957 & Hiscox and Israelstam, 1979). Percentage (%) of N, P and K based on dry weight (Piper, 1950 & Chapman and Pratt, 1965 & Summer, 1985 & Wilde *et al.,* 1985). Berry weight (g) and dimensions (longitudinal and equatorial, cm). TSS%, total acidity % (in g tartaric acid/100 ml juice), % reducing sugars and TSS/acidity. (A.O.A.C., 2000).

2.1.Statistical Analysis:

The experiment was set in a completely randomized block design with 4 treatments each with three replicates. Analysis of variance (ANOVA) was performed on the obtained data. The values obtained were compared individually using a concentration of 5 % new LSD (Mead et al., 1993).

3. RESULTS AND DISCUSSION

3.1. Effect of (GA3) on some vegetative growth aspects of Superior grapevines during 2018/2019, 2019/2020 and 2020/2021

In comparison to the control treatment, the acquired data showed that (GA3) considerably stimulated four growth parameters, including main stem length, leaf area, wood weight, and wood maturity coefficient. The data presented in Table (1) showed that the GA3 concentration was raising the vegetative parameters. All GA3 treatments had a beneficial effect in enhancing vegetative growth. The difference between them and the control was substantial at the same time. The results shown are consistent with those attained by (Dimovska et al., 2014).

Table 1. Effect of (GA3) on some vegetative growth aspects of Superior grapevines during 2018/ 2019, 2019/ 2020 and 2020/2021 seasons

Characters / Treatments	Main shoot length (cm.)			Leaf area $(cm)^2$		
	2018/2019	2019/2020	2020/2021	2018/2019	2019/2020	2020/2021
Control	111.0	111.5	112.0	107.0	108.0	108.5
Spraying (GA3) at 10 ppm	112.0	113.0	113.0	107.5	109.0	109.5
Spraying (GA3) at 20 ppm	113.5	114.0	114.5	109.0	110.5	111.0
Spraying (GA3) at 40 ppm	115.5	116.0	117.0	111.0	111.0	111.5
New L.S.D. at 5%	1.7	1.9	2.0	1.2	1.3	1.4
	Wood ripening coefficient			**Pruning wood weight /vine (kg.)**		
	2018/2019	**2019/2020**	**2020/2021**	**2018/2019**	**2019/2020**	**2020/2021**
Control	0.76	0.75	0.76	1.88	1.85	1.88
Spraying (GA3) at 10 ppm	0.78	0.78	0.79	1.93	1.94	1.96
Spraying (GA3) at 20 ppm	0.79	0.80	0.81	1.96	1.97	1.99
Spraying (GA3) at 40 ppm	0.80	0.81	0.82	2.10	2.15	2.20
New L.S.D. at 5%	0.02	0.02	0.03	0.02	0.03	0.04

3.2. Effect of (GA3) on the yield and cluster aspects of Superior grapevines during 2018/2019, 2019/2020 and 2020/2021 seasons

Data presented in Table (2) show the influence of spraying GA3. Results in Table (2) also indicated that in the first experimental season, all treatments were of meaningless effect on the number of clusters per vine compared with the control. The trend existed in the second and third experimental seasons Table (2). The untreated vines recorded the least values of the number of cluster/vines, cluster weight and yield. The yield of the untreated vines reached (8.2 - 8.3 - 8.4 kg) during 2018/2019, 2019/2020 and 2020/2021 seasons, respectively. The behavior result had been confirmed by the result obtained by Malladi and Jacqueline, (2007).

Table 2. Effect of (GA3) on the yield and cluster aspects of Superior grapevines during 2018/2019, 2019/2020 and 2020/2021 seasons

Characters / Treatments	No. of clusters per vine			Av. Cluster weight			Yield/ vine (kg.)		
	2018/2019	2019/2020	2020/2021	2018/2019	2019/2020	2020/2021	2018/2019	2019/2020	2020/2021
Control	21.0	21.0	21.0	390.0	395.0	400.0	8.2	8.3	8.4
Spraying (GA3) at 10 ppm	22.0	23.0	24.0	415.0	420.0	425.0	9.1	9.7	10.2
Spraying (GA3) at 20 ppm	22.0	24.0	24.0	430.0	435.0	440.0	9.5	10.4	10.6
Spraying (GA3) at 40 ppm	22.0	24.0	25.0	440.0	445.0	450.0	9.7	10.7	11.2
New L.S.D. at 5%	NS	1.2	1.4	0.9	1.1	1.2	0.9	1.00	1.05

3.3. Effect of (GA3) on the cluster aspects and percentage of shot berries of Superior grapevines during 2018/ 2019, 2019/ 2020 and 2020/2021 seasons

Table (3)'s findings show that the usage of GA3 at the vineyard dramatically decreased the shot berries percentage of Superior grapevines (10, 20, and 40 ppm). Shot berries in the clusters might be controlled greatly by spraying the plants with GA3 in descending sequence. The plants sprayed with GA3 at a concentration of 40 ppm had the lowest shot berry values, which were (4.0), (3.8), and (3.5%) respectively during the three seasons. In the untreated vines, the percentage of shot berries was (5.2), (5.3), and (5.3%) over the seasons of 2018/2019, 2019/2020, and 2020/2021, respectively. When they applied superior grapevines GA3 at 40 ppm throughout the 2018/2019, 2019/2020, and 2020/2021 seasons, respectively, the maximum values of the cluster's length (26.5, 27.8, and 29.0 cm) and width (19.6, 19.8, and 20 cm) were noted. The control was set to register minimum values. These findings, which held throuhout three seasons, are consistent with those of (Casanova *et al.*, 2009), demonstrating that the positive effects of GA3 on promoting protein biosynthesis, a natural hormone, as well as cell division and elongation, may be responsible for the stimulation of growth aspects in response to an increase in the number of GA3 applications.

Table 3. Effect of (GA3) on the cluster aspects and percentage of shit berries of Superior grapevines during 2018/ 2019, 2019/ 2020 and 2020/2021 seasons.

Characters / Treatments	Length of the cluster (cm)			Width of the cluster (cm)			Shot berries %		
	2018/2019	2019/2020	2020/2021	2018/2019	2019/2020	2020/2021	2018/2019	2019/2020	2020/2021
Control	20.2	20.4	20.5	14.5	14.7	14.9	5.2	5.3	5.3
Spraying (GA3) at 10 ppm	23.0	23.2	23.5	17.0	17.2	17.4	4.8	4.7	4.6
Spraying (GA3) at 20 ppm	25.0	25.5	26.0	19.0	19.2	19.5	4.2	4.0	3.8
Spraying (GA3) at 40 ppm	26.5	27.8	29.0	19.6	19.8	20.0	4.0	3.8	3.5
New L.S.D. at 5%	0.4	0.5	0.6	0.3	0.4	0.4	0.3	0.3	0.4

3.4. Effect of (GA3) on the berry weight (g.), height and diameter of Superior grapevines during 2018/2019, 2019/2020 and 2020/2021 seasons

Data in Table (4) showed the berry weight (g.), height and diameter of Superior grapevines was positively affected only by the treatment included GA3 at (10, 20 and 40) ppm sprayed at mid of April. GA3 at 40 ppm is the maximum value. These above results are true and existed in the three experimental seasons. Concerning the effect of different treatments on the Berry weight (g) and Berry longitudinal (cm) and Berry equatorial (cm) of superior grape cv. during the three experimental seasons results showed that the highest positive effect of treatments on berry weight (g) and berry longitudinal (cm) and berry equatorial (cm) was obtained from spraying superior vines by GA3 at 40 ppm sprayed at pea stage "6mm" the maximum value. The effect of this treatment was positively higher than any other treatment including the control. One can be stated that most of the treatments used were not differ statistically from the control (Casanova *et al.*, 2009).

Table 4. Effect of (GA3) on the berry weight (g.), height and diameter of Superior grapevines during 2018/2019, 2019/2020 and 2020/2021 seasons.

Characters / Treatments	Berry weight (g,)			Berry longitudinal (cm)			Berry equatorial (cm)		
	2018/ 2019	2019/ 2020	2020/ 2021	2018/ 2019	2019/ 2020	2020/ 2021	2018/ 2019	2019/ 2020	2020/ 2021
Control	3.30	3.30	3.35	2.15	2.15	2.18	2.03	2.05	2.05
Spraying (GA3) at 10 ppm	3.45	3.50	3.55	2.55	2.65	2.70	2.35	2.40	2.45
Spraying (GA3) at 20 ppm	3.55	3.60	3.65	2.65	2.70	2.75	2.40	2.40	2.50
Spraying (GA3) at 40 ppm	3.70	3.80	3.85	2.70	2.75	2.80	2.45	2.45	2.55
New L.S.D. at 5%	0.07	0.08	0.09	0.03	0.04	0.04	0.02	0.02	0.02

3.5. Effect of (GA3) on the percentage of TSS, acidity, reducing sugars and the ratio of Superior grapevines during the 2018/ 2019, 2019/ 2020 and 2020/2021 seasons

It is clear from Table (5) that superior grapevine spraying with (GA3) showed that GA3 spraying had a positive effect in increasing the total soluble solids, significantly as compared with the control. Results in the same table (2) showed that total soluble solids increased by decreasing the total acidity in the juice. This was declared in the three experimental seasons. The highest effect in this concern was due to spraying the vines with (GA3) at 40 ppm in the three experimental seasons. as suggested by (Pérez *et al.*, 2000) and (Göktürk and Harmankaya, 2005).

In the light of behavior results one can state that GA3 was effective in increasing the cluster weight and yield, delaying the ripening of grape clusters, and thus prolonging the period of harvesting the crop and obtaining it for long periods.

Table 5. Effect of (GA3) on the percentage of TSS, acidity, reducing sugars and TSS/acid ratio of Superior grapevines during 2018/ 2019, 2019/ 2020 and 2020/2021 seasons

Characters / Treatments	TSS%			Acidity %		
	2018/2019	2019/2020	2020/2021	2018/2019	2019/2020	2020/2021
Control	17.5	17.8	18.0	0.630	0.620	0.610
Spraying (GA3) at 10 ppm	17.4	17.7	17.8	0.635	0.630	0.625
Spraying (GA3) at 20 ppm	17.3	17.4	17.5	0.645	0.640	0.635
Spraying (GA3) at 40 ppm	17.2	17.4	17.5	0.660	0.650	0.650
New L.S.D. at 5%	0.3	0.4	0.4	0.019	0.022	0.024
	TSS/ acid ratio			**Reducing sugars %**		
	2018/2019	2019/2020	2020/2021	2018/2019	2019/2020	2020/2021
Control	27.8	28.7	29.6	15.5	15.8	15.9
Spraying (GA3) at 10 ppm	27.4	28.1	28.5	15.4	15.6	15.8
Spraying (GA3) at 20 ppm	26.8	27.2	27.6	15.3	15.4	15.5
Spraying (GA3) at 40 ppm	26.1	26.8	26.9	15.1	15.3	15.4
New L.S.D. at 5%	0.9	1.0	1.1	0.06	0.06	0.07

4. REFERENCES

Abu-Zahra TR and Salameh NM (2012). Influence of Gibberellic Acid and Cane Girdling on Berry Size of Black Magic Grape Cultivar. Middle-East Journal of Scientific Research 11 (6): 718-722.

Ahmed FF and Morsy MH (1999). A new method for measuring leaf area in different fruit species. Minia. 1. of Agric. Rec. & Dev.19: 97- 105.

Al-Atrushy, Sh. M.M., (2016): Effect of GA3 Concentration and Frequency on Yield and Quality of 'Zark' Grape. Jordan Journal of Agricultural Sciences, 12, No.4 -1183

Alrashdy AMA, Al-Qurashi DA, Awad MA, Mohamed SA and Al-rashdi AA (2017). Quality, antioxidant compounds, antioxidant capacity and enzymes activity of ‘El-Bayadi’ table grapes at harvest as affected by preharvest salicylic acid and gibberellic acid spray. Scientia Horticulturae. 220- 243–249.

AOAC (2000). Published by the P.O. Box 540 Washington 4 D.C.

Casanova L, Casanova R, Moret A and Agustí M (2009). The application of gibberellic acid increases berry size of Imperatriz seedless grape Plant production. Field and horticultural crops. 7(4), 919-927.

Chapman HD and Pratt PE (1965). Methods of Analysis for Soil, Plant and Water. Univ. of Calif. Division of Agric. Sci. 172-173.

Dimovska V, Ivanova V, Ilieva F and Sofijanova E (2011). Influence of bioregulator gibberellic acid on some technological characteristics of cluster and berry from some seedless grape varieties Journal of Agricultural Science and Technology B, 1(7): 1054-1058.

Dimovska V, Salamovska IP and Ilieva FA (2014). Flame seedless grape variety (Vitis vinifera L.) and different concentrations of gibberellic acid (GA3). Bulgarian Journal of Agricultural Science, 20 (1): 127-132.

El-Halaby EHS, El-Salhy AM, Al-Wasfy MM and Ibrahim RA (2015). Effect of GA3, Urea and Yeast Spraying on Fruiting of Flame Seedless Grapevines under Sandy Soil Conditions. Assiut J. Agric. Sci. 95-106.

Funt RC and Tukey LD (1977). Influence of Exogenous Daminozide and Gibberellic Acid on Cluster Development and Yield of the ‘Concord’ Grape. J. Amer. Soc. Hort. Sci. 102(4):509-514.

Göktürk N, Harmankaya N (2005). Changes in endogenous hormone levels during the ripening of grape cultivars having different berry set mechanisms. Turkish Journal of Agriculture & Forestry. 29, 205-210.

Hiscox A and Isralstam B (1979). Method for the extraction of chlorophyll from leaf tissue without maceration. Can. J. Bot. 57:1332-1334.

Ibrahim RA, El-Akad MM and Rizkalla MK (2021). Effect of spraying gibberellic acid and caffeic acid on yield and fruit quality of White Banaty (Thompson Seedless) grape cultivar. SVU-International Journal of Agricultural Sciences. 132-140.

Malladi A and Jacqueline BK (2007). Communication by plant growth regulators in roots and shoots of horticultural crops. HortScience, 42: 1113 -1117.

Mead R, Currow RN and Harted AM (1993). Statistical Methods in Agricultural and Experimental Biology. Second Ed. Chapman & Hall. London, pp.10-44.

Omar AH and Girgis VH (2005). Some treatments affecting fruit quality of Crimson Seedless grapevine. J. Agric. Sci., Mansoura Univ., 30 (8), 4665-4673.

Pérez EJP Terra MMCC Pommer ISOV and Pssos IRS (2000). Improvement of cluster and berry quality of centennial seedless grapes through gibberellic acid. Acta Horticulture (ISHS), 526: 293-302.

Piper GS (1950). Soil and Plant Analysis. Inter. Sci. New York. pp. 48-110.

Radwan EMA, Khodair OA and Silem AAEM (2019). Effect of some Compounds Spraying on Fruiting of Superior Seedless Grapevines under Assiut Conditions**.** J. Plant Production, Mansoura Univ., Vol. 10 (1): 59 – 64.

Summer ME (1985). Diagnosis and Recommendation Integrated System (DRIS) as a guide to orchard fertilization. Hort. Abs. 55(8): 7502.

Tyagi K, Maoz I, Kochanek K, Sela N, Lerno L, Ebeler SE and Lichter A (2021). Cytokinin but not gibberellin application had major impact on the phenylpropanoid pathway in grape. Horticulture Research (2021) 8 :51.

Von-Wettstein DVC (1957). Clatale under Sumbmikro Skopisne Formwechsel de Plastids. Experimental Cell Research, 12:427.

Wilde SA, Corey RB, Layer J and Voigt GK (1985). Soils and Plant Analysis for Tree Culture. 3rd Ed. Oxford and IBH publishing Co., New Delhi, India, pp. 490-510.

الملخص العربي

تأثير الجبريلين على السلوك لصنف العنب السوبريور

عبد الحميد محمد مرسى واصل[١]، فيصل فاضل أحمد[١]، محمد على مجاور عباده[٢] و دينا عاطف محمد ناجى[٢]

[١]قسم البساتين (فاكهة) – كلية الزراعة – جامعة المنيا

[٢]قسم بحوث العنب – معهد بحوث البساتين – مركز البحوث الزراعية – الجيزة

تعتمد نظرية استطالة وتطور النبات بشكل أساسى على الهرمونات النباتية. حيث يوجد أكثر من نوع للجبريلينات ومنها GA3 والذي يكون له تأثيرات فيسيولوجية كبيرة داخل النبات.

تم تطبيق الرش بالجبريلين خلال المواسم ٢٠١٩/٢٠١٨ – ٢٠٢٠/٢٠١٩ – ٢٠٢١/٢٠٢٠ لكرمات العنب السوبريور بتركيزات (٠، ١٠، ٢٠، ٤٠ جزء في المليون) في مرحلة حجم الحمصة "٦ مم" لدراسة تأثيرها على النمو الخضري والمحصول. كان لجميع المعاملات تأثير إيجابي في زيادة النمو الخضري محل الدراسة وفي نفس الوقت زيادة المحصول / المعاملة ووزن العناقيد. وتحسين صفات الجودة ، وغيرها من العوامل. تتمثل الأهداف الرئيسية للبحث في تأخير إنضاج عناقيد العنب، وبالتالي إطالة فترة حصاد المحصول والحصول عليه لفترات طويلة، الأمر الذي يعود بفائدة اقتصادية كبيرة، في الحصول على محصول عنب بمواصفات تصديرية من حيث جودة العنب العناقيد والحبات .