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Influence of Bioregulator Gibberellic Acid on Some Technological Characteristics of Cluster and Berry from Some Seedless Grape Varieties

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Abstract: Solutions of gibberellic acid prepared at three concentration levels including 5, 10 and 20 mg/L, were applied at two seedless grape varieties, *Thompson* and *Belgrade*, by spraying, during the three different periods of the vine growing: before blooming, after blooming and before veraison, in order to study their influence on some cultural technological characteristics. Dimension and shape of the cluster and berry, mechanical characteristics of the berries and chemical content of the must (sugar and total acids) has been also investigated. It was noticed that the concentration of gibberellic acid had influence on the technological characteristics of the berries in all grape growing periods tested. The addition of gibberellic acid at concentration of 20 mg/L increased the weight of the cluster and berry, and increased the transportability of the berries belonging to the two seedless varieties.

Key words: Gibberellic acid, grape cluster, berry, *Thompson, Belgrade* seedless varieties.

1. Introduction

The basic characteristic of the modern table grape production is its adaptation to the requirements of the market in order to improve the grape quality, such as: equal cluster size, equal size and chape of the berry, equal coloration of all the berries in the cluster and higher resistance of transportation. Furthermore, important attribute of the grape berry quality is the seedlessness. Seedless cultivars are characterized with small grains and require management for improvement of their size.

In order to improve the grape quality and to increase the berry size, plant growth regulators are usually applied [1]. Among the compounds used as plant regulators, gibberellic acid (GA_3) (Fig. 1) has been extensively used to increase the berry size of seedless cultivars [2]. Gibberellic acid promotes cell division, stimulates the earlier flowering, increases the size and yield of fruits and induce seedlessness in the seedless cultivars. The effect of gibberellc acid depends on variety, concentration and time of application [3, 4]. In general, gibberellic acid affects the increasing of the grape berries mass when the plants are treated at 10-14 days after blooming, while for the seedless cultivars, the same effect is achieved when the treatment starts before the blooming phenophase [5].

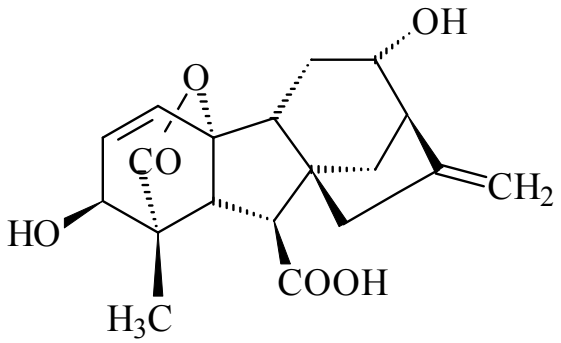

Fig. 1 Structure of gibberellic acid.

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Republic of Macedonia has a Mediterranean and continental climate with a high number of completely dry days. The Vardar region is the most famous for production of a high quality table grape varieties, such as: *Cardinal, Afus ali, Italija, Palieri, Muscat hamburg, Agadaj, Victotija, Valandovski drenak* and some seedlless grape varieties, such as *Belgrade, Thompson, Flame, Rubi and Perletta*. Even there are a large number of seedless grape varieties, no previous research has been performed on the effect of gibberellic acid on the growth of the Macedonian grape cultivars. Therefore, the aim of this study was to examine the effect of gibberellic acid on the fruit development and the quality of seedless grapes *Thompson* (international variety) and *Belgrade* (regional variety) grown in the Vardar region, R. Macedonia. The correlation of berry size, resistance, sugar and acids content provided information about the effect of the applied gibberellic acid on the vine plants.

2. Materials and Methods

2.1 Grape Cultivars

Two seedless grape cultivars, *Thompson* and *Belgrade*, were grown at the Veles vineyards in the Vardar region, R. Macedonia. The grapevines were grafted to the rootstock Berlandieri × Riparia Teleci 8B, and the training system was pergola. The distance between the vines was 1.5 m and the distance between the rows was 3 m. *Thompson* and *Belgrade* grapes were collected from 15-year-old vineyards. 21 clusters were collected from 30 vines. The samples were analyzed in duplicated, immediately after the harvest.

2.2 Experimental Procedure

Experiments were performed during the 3 consecutive years (from 2000 to 2003). Gibberellic acid (GA_3) was prepared at three concentration levels: 5 mg/L (C1), 10 mg/L (C2) and 20 mg/L (C3) and applied by spraying the grapevines from both varieties, *Thomson* and *Belgrade*. The application of GA was performed as following:

Treatment 1 (G1): Three rows of vines were selected and each of them was treated at same period of blooming, but with different concentrations of GA_3. Thus, the first row was treated with 5 mg/L GA_3, the second with 10 mg/L GA_3, and the third row was treated with 20 mg/L GA_3. The application was performed at 7-10 days before blooming and 7-10 days after blooming, for each concentration level of GA_3.

Treatment 2 (G2): Another three rows of vines were also treated at same periods of blooming, applying different concentration of GA_3, 5, 10 and 20 mg/L GA_3. In this treatment, the different concentrations of GA_3 were applied at 7-10 days before blooming, after blooming and before veraison for each row of the selected plants.

Treatment C: Control, included untreated plants.

The method of Prostoserdov [6] has been used to measure the weight and size of the cluster and berries. The mechanical characteristics of the berry were determined on the technical scales. The content of the sugar was determined using the Exlo's device, and the total amount of acids was determined by volumetric method, using 0.025 mol/L solution of NaOH.

3. Results and Discussion

Table 1 shows the fruit cluster and the berry characteristics of the *Thomson* and *Belgrade* varieties, as affected by GA_3 application. As stated in the literature [4, 7-9], higher concentrations of gibberellic acid and increased number of treatments with GA_3, increase the mass of the berry, the mass of the cluster and the number of fertilized berries, improving in that way the grape quality. Almost all GA_3 applications in this study were effective in increasing of the berry and cluster weight, as well as of the number of fertilized berries from both varieties, *Thompson* and *Belgrade*. Thus, the number of berry mass and fertilized berries was increasing with increased concentration of the applied GA_3 in both treatments, (T1—before blooming and after blooming; and T2 before blooming, after blooming and before veraison). The increased

Table 1 Influence of gibberellic acid on the weight, dimension and form of cluster and berry of *Thompson* and *Belgrade* seedless grape varieties.

Thompson

Treatment	GA_3	Cluster						Berry			
		Mass (g)	Index	L/w	Number of berries			Mass (g)	Index	L/w	Average diameter
					Fertilized	Index	Unfertilized				
C	/	364	100	2.21	163	100	22.4	2.06	100	1.04	13.8
G1	C1	218	87	1.98	188	115	58.1	2.32	113	1.19	14.5
	C2	227	62	2.13	172	105	64.4	1.92	93	1.08	11.8
	C3	427	117	2.08	193	118	10.4	2.31	112	1.16	14.7
G2	C1	325	89	2.05	217	133	38.5	2.54	123	1.22	15.3
	C2	272	75	1.78	169	104	96.3	2.15	104	1.19	13.3
	C3	435	119	2.24	199	122	7.14	2.58	126	1.11	14.7

Belgrade

Treatment	GA_3	Cluster						Berry			
		Mass (g)	Index	L/w	Number of berries			Mass (g)	Index	L/w	Average diameter
					Fertilized	Index	Unfertilized				
C		306	100	1.95	112	100	6.31	2.40	100	1.30	15.31
G1	C1	309	102	1.78	62.3	55	47.4	4.06	169	1.64	19.28
	C2	311	101	1.95	98.6	88	21.4	3.87	161	1.41	18.68
	C3	389	127	1.83	109	97	/	4.00	167	1.24	18.20
G2	C1	325	106	1.62	64.8	58	41.1	4.07	169	1.58	19.10
	C2	318	104	1.61	102	91	19.4	3.89	162	1.32	18.96
	C3	402	131	1.60	110	98	/	4.12	172	1.30	18.12

C1: 5 mg/L GA_3; C2: 10 mg/L GA_3, C3: 20 mg/L GA_3, L/w: length/width.

berry mass is a result of the enhanced cell division and cell expansion. Furthermore, the increased berry mass affected the mass of the cluster, so the cluster weight of the *Thompson* variety significantly increased (compared to the control) when highest concentration of GA_3 has been applied, observed in both treatments (T1 and T2). With regard to the *Belgrade* variety, the mass of the cluster was increasing gradually, with increasing of the concentration of applied GA_3 on the plants from both treatments.

With regard to the form of the cluster, no significant changes were observed for both varieties. On the other hand, the shape of the berries from *Thompson* variety was changed from oval to ellipsoid, which has been noticed in T1 and T2 treatments. As a result of the applied treatments, the grapes from *Belgrade* variety were also increasing in length and width, keeping the basic cycle-conic form of the cluster (characteristic for this variety). As a sum, the size of the treated berries in both treatments was changed, but the berry shape remained unchanged, compared to the control.

Table 2 shows the results for the resistance of pressure and breaking resistance of the *Thompson* and *Belgrade* variety. In general, the increased concentration of GA_3 and the increased number of treatments improved the mechanical properties of the berries. Thus, increasing of the pressure and breaking resistance was noticed with increasing of the concentration of the applied gibberellic acid. Furthermore, the best results in improving of the berry properties have been provided in the treatment when the highest concentration of gibberellic acid (20 mg/L) has been applied at the vines from both varieties. This effect was especially evident in the second treatment (T2), when GA_3 was applied three times on the vines, *Thompson* and *Belgrade*. The resistance of pressure and the breaking resistance of *Thompson* cultivar was a significantly higher when plants were treated three

Table 2 Influence of gibberellic acid on the mechanical function of the berries form *Thompson* and *Belgrade* seedless varieties.

Treatment	GA_3	*Thompson*				*Belgrade*			
		Resistance of pressure (g)	Index	Breaking resistance (g)	Index	Resistance of pressure (g)	Index	Breaking resistance (g)	Index
C		1,410	100	182	100	1,359	100	112	100
G1	C1	1,769	125	221	121	1,520	112	126	113
	C2	1,936	137	228	125	1,638	121	133	119
	C3	2,050	145	268	146	1,848	136	150	140
G2	C1	1,725	122	220	121	1,850	136	133	119
	C2	1,837	130	261	145	1,810	133	137	122
	C3	2,280	161	265	146	1,870	138	168	150

C1: 5 mg/L GA_3; C2: 10 mg/L GA_3; C3: 20 mg/L GA_3.

Table 3 Influence of gibberellic acid on the content of sugar and total acids in the must Dimovska, Ivanova, Ilieva, Sofijanova.

Treatment	GA_3	*Thompson*				*Belgrade*			
		Sugar (g/L)	Index	TA (g/L)	Index	Sugar (g/L)	Index	TA (g/L)	Index
C		284	100	4.8	100	162	100	5.8	100
G1	C1	268	94	5.0	104	144	89	7.2	124
	C2	284	100	4.9	102	150	83	6.8	117
	C3	278	96	3.6	75	151	93	5.3	91
G2	C1	271	95	4.9	102	141	87	7.0	121
	C2	278	98	5.3	110	147	91	6.0	103
	C3	270	95	3.6	75	151	93	5.3	91

C1: 5 mg/L GA_3; C2: 10 mg/L GA_3; C3: 20 mg/L GA_3; TA: total acids, expressed as tartaric acid equivalent.

times (before blooming, after blooming and before veraison) with the highest concentration of GA_3 (20 mg/L). As a sum, in fact, the best mechanical characteristics of the berries from both grape varieties were achieved in the second treatment (G2), when a highest content of GA_3 has been applied during the three periods of the vines growing.

Other important parameters that influence the grape quality are the content of sugar and the content of total acids (TA). Results from the influence of the GA_3 on the content of sugar and TA in the must are presented in Table 3. Comparing the grapes from both untreated varieties, *Thompson* and *Belgrade*, generally higher levels of sugar and total acids were determined in the *Thompson* grapes. These differences could be attributed to the cultivar-related characteristics. Concerning the effect of gibberellic acid on the vines applied at different concentrations, similar amounts of sugar have been found in the grapes from both varieties, regardless the concentration of GA_3 and the period of the vine growing. The content of total acids (TA) determined in the *Thompson* grapes, treated with the lowest concentration of GA_3 (in both treatments) was similar to that one found in the control grapes. Decreasing of the TA was observed when a highest concentration of gibberellic acid has been applied at the plants from both varieties. The obtained results were in accordance with previous published data about the effect of gibberellic acid on the grape characteristics [2, 4, 8-10].

4. Conclusion

As a conclusion, the gibberellic acid applied at the vines in a higher concentration increased the berry mass and thus, the mass of the cluster. In addition, the increased number of fertilized berries has been also noticed when GA_3 has been applied in a highest level. The resistance of pressure and breaking resistance was

improved when plants were treated three times (before blooming, after blooming and before verasion) with the highest content of GA_3. It was noticed that gibberellic acid had no significant influence on the content of sugar and content of total acids in the grape must. In general, the best results, in terms of a highest mass of the cluster, highest number of fertilized berries, as well as pressure and breaking resistance, were obtained with the T2-treatment, when the gibberellic acid was applied at highest concentration.

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