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The Effect of Gibberellins on the Production Increase and Quality Improvements of Grape

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Abstract

The influence of gibberellin acid $(GA)_3$ on production and quality of the grapevine cultivar *Vlosh* was studied during the 2011-2012 period. Different doses (75-100-125 mg / l^{-1}) of GA_3 were applied and the effects on the percentage of sugar, acceleration of ripening and berry size were analyzed. Results confirmed that all treatments showed an acceleration of the flowering and maturation compared to controls. Simultaneously, commercial appearance and performance were improved, and sugar content was increased 0.6 - 4.2 % compared to control and ripening was accelerated 18 days. Gibberellins affected biometric indicators such as the growth of the berry, size and weight, as a result of development biosynthesic processes. Treatment of this cultivar with phytohormone GA3 during affected in some extent reducing the seed number per fruit of the grapevine. Biosynthetic processes are of enzymatic and biochemic nature and developed with vitamine and phytohormons contribute. Application of phytohormone with concentration 125 mg /l-1 induced ripening of grapes about 10 days before control.

Keywords: Gibberellic acid, cv Vlosh, biometric indicators, ripening, production, quality.

1. Introduction

Rhythms of development of viticulture besides increasing the planted were associated with scientific research to improve varietal structures and implementation of new methods [1] . Recent years, is widely used, stimulativ effect of synthetic hormones, to increase productivity and product quality. [2] The mechanism of action gibberellins in physiological processes is not fully explained and relates to the metabolism of nucleic acids.

Gibberellins induce synthesis of ARNs a specific information that participates in growth. Gibberellins increase the permeability of membranes of the cell organelles causing an increased diffusion of the enzymes [6].

According to Van Overbeek, [7] gibberellins hormonal effect, indirect effect is attributed to auxins. Various plant organs are capable to synthesize gibberellins, embryo during seed development, upward peaks stemand root, floral reproductive organs, new leaves, in some species of trees, fruits that grow. Gibberellin show big impact plant growth, height, size and shape of leaves, formation of large parthenocarpic fruit (without seeds), suspend period of buds resting, speeding flowering and frutification [4].

Numerous papers were published during 1950s and 1960s presenting results of such treatments [11] Treatment of clusters with 100 ppm Gibberellins resulted in longer and heavier clusters, heavier and longer berries, and an increase in sugar content of the berries. Following the successes with "Thompson Seedless", gibberellin treatments were used on other cultivars. Pratt and Shaulis (1961) increased fruit set and induced parthenocarpy on "Fredonia" treated with 100 ppm gibberellic acid (GA_3). Dipping "Delaware" clusters in 100 ppm GA_3 also caused up to 96% seedless berries and led to earlier ripening and lower sugar-acid ratios in the seedless berries (Clore, 1965). Christodoulou et al (1968) reconfirmed typical GA_3 effects when the compound was applied at bloom: looser, elongated clusters and significant berry elongation.

Gibberellins compounds are isoprenoides of which the most important is gibberellic acid of GA_3.

Girdling grapevines resulted in both an increase in carbohydrate concentration above girdle, and an increase in weight per unit leaf area . Otherwise, root

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carbohydrate concentrations were less for the girdled vines when compared to the control vines [10].

Experience has shown the degree of elongation of the main cluster (rachis) stem rather than cluster length or shoot length is a more precise determinant for scheduling gibberellin application[8].

2. Material and Method

This experiment took place in Manza of Durres, during e period of two years 2011-2012, where the solution of GA_3 with 3 different treatments: 75 mg / l^{-1}, 100 mg / l^{-1} and 125 mg /l^{-1} were applied, in cultivar Vlosh of grapevine aged 20 years. Treatments were applied on 10 plants for each replication, and each variant had 40 plants together with control). Spraying is performed on the floral onset and the full flowering stage, early in the morning with some days different from each other. For each treatment was used 6 litra solutions of GA_3.

The quantity and timing of application are important for gibberellin, since grape clusters respond better to the concentration of active ingredient in the solution rather than the active ingredient per acre. Varieties differ in their sensitivity to gibberellin, and as a result the appropriate application concentration varies accordingly. [9]

The solution was prepared 1 hour before sprays. The quantity of weighted of GA3, was preliminarily dissolved in alcohol 96 %, (10 mg GA3 in 5 ml alcohol). Solvates brought to proper volume of distilled water.[5] Agrotechnique been the same for all treatments performed. Indicators of the study were:

Phenological: (i) the date of the beginning of flowering; (ii) the date of fruit set; (iii) the date of verasion initiation; (iv) technical ripeness, (v) number of new sprouts (10-20 cm length) that emerges from winter buds; (vi) the number of nodes, internodes and their length, when spurs, reaches maturation [3].

The biometric cluster: the average bunch weight in grams; number and weight of berries per fruit cluster; grape bunch weight in gram; the percentage of berries by weight per clusters; cluster length and width in cm and their ratio.

Berry: weight and volume of 100 berries; the average berry weight; hulls weight; seeds weight and the number of seeds per berry.

Chemical Analysis: the sugar content; acidity using titration method.

Statistical analysis: Multivariate Principal Components, correlation, ANOVA with JMP statistical software from SAS.

3. Results and Discussion

Phenological developments: the process of sap exudation started at the end of February and the assimilative movement finished in the first days of March.

The opening of buds was observed with 4-6 April. Flowering began in early June and lasted up to mid June, while equal number of days (6-7 days) during two years were needed for the completion of this stage.

Fruit set was observed at 18 June and the ripening started with veraison from 22 July to 10 August.

Ripening of berry started in mid-September and lasted 15 days. Third treatment accelerate the ripening about 10 days compared with 1 and 2 treatments.

Influence of GA_3 on key indicators: Average of two years data has shown the influence of GA_3 in increasing the grapes production, the effectiveness and the quality improvement on all treatments with 75 mg / l^{-1} , 100 mg / l^{-1} and with 125 mg / l^{-1} . Besides this there was observed an increase sugar content in percentage in a range from 1.3 to 3 g/liters, which accelerates ripening up to 10 days and increased the quality of wine.

Tables 1. Data on some key indicators performed under the influence of phytoregulator

Treatment	*Sugar (%)*	*Weight of 100 berries*	*Volumetric Weight*	*Number of seed/100 berries*	*∑ day of Flowering-ripening*
Co	19.0 ±1.10 c	286 ±2.08 c	279 c	158 a	117 a
75 ppm	20.6 ±0.40 b	308 ±2.64 b	280 b	150 b	109 b
100 ppm	21.2 ±0.68 b	329 ±3.21 a	306 b	150 b	107 b
125 ppm	22.1 ±0.65 a	327 ±3.60 a	294 a	144 c	107 b

Levels having different letters are significantly different.

In dendograma (figure 2) , the percentage of sugar has shown variability versus control (untreatment grapevine of cv .Vlosh). The percentage of sugar is presented, in parallel with the addition of increasing dose GA_3.

The phytohormone have the ability to affect cell elongation and enlargement and as results also in internodes of sprouts.

The effect of the phytoregulator in biometric indicators: Volumetric weight of 100 berries treated specifically with 100 mg / l-1 – 125 mg / l-1 is 306.3 and 282, respectively versus control 279.

The weight of 100 berries on control was 283 grams, while for the treatments was: T 1 -305 grams, T 2-329 and T 3 -283 grams respectively (Figure 2) LSD 2,03 p=0,05). Treatment of this cultivar with phytohormone GA3 affected in some extent also in reducing the seeds numbers of the fruit of the grapevine:

The number of seeds on the control was 158 for 100 berries, while the treatments with 75,100 and 125 mg / l-1, had respectively 150 and 144 seeds per 100 berries. Good indicator for treatments with gibberellins has been also the clusters size and the their average weight. These biometric indicators together with those of production and high percentage of sugar must affect the efficiency that according to the treatments is shown below. Physiological indicators such as leaf area growth are important impact of phytohormone since that is the basis of photosynthesis. It is expressed in dm ^{2} and showed a gradual increase from1.61 in control to the1.67 and 1.99 on treated with GA_3 variants.

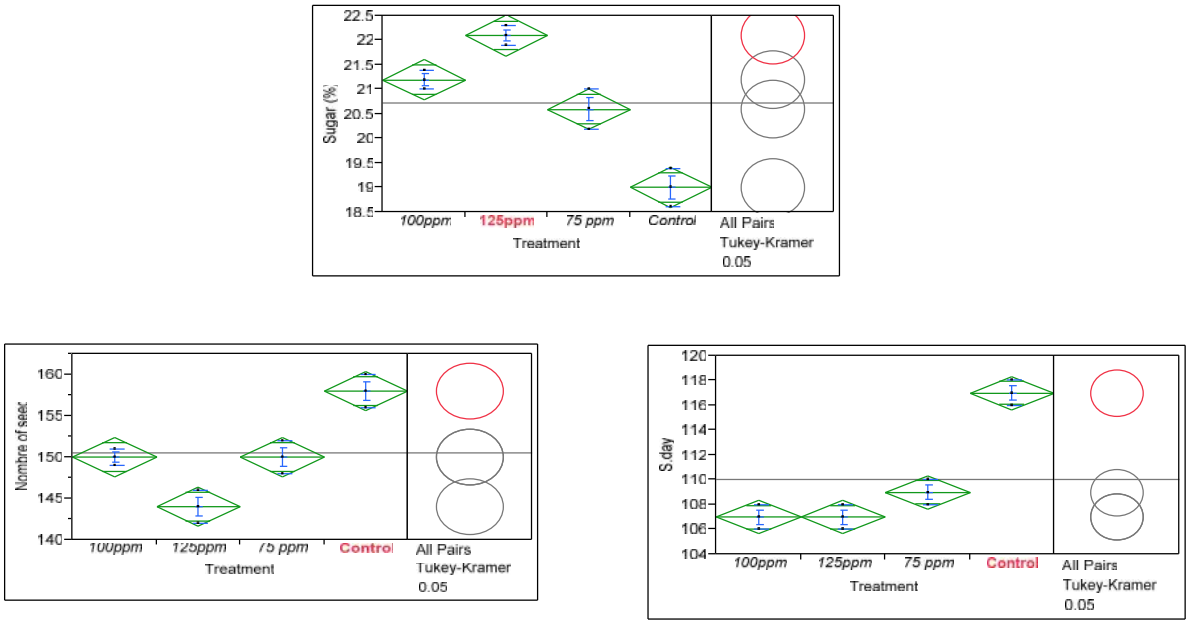

Figure 2. Analysis of Variance for Means for OnewayAnova Comparisons for all pairs using Tukey-Kramer HSD for q*1.12 Alpha 0.05 of S.day By Treatment, of Number of seed By Treatment, of Sugar (%) and ∑ day of Flowering-ripening

The intensity of photosynthesis was measured exept the second treatmentand it was 268.2 ppm CO2/ hour for other treatments and 222.3 ppm CO2 /hour for the control.

The flowers fertility was also affected by the application of the phytoregulator resulting to an increase of the fruit set, and intensity of physiological processes. Treatments of GA3 have accelerated multiplication processes of tissue cells, helping in the synthesis of sugars and reducing the number of days for ripening bunch. Vlosh cultivar is a late cultivar and this time reduction is a positive effect on ripening.

It seems that the low number of seeds is shifted from the high concentrations GA3 (Figure 2). The number of days required for ripening bunches were 117 for the control, 109 for the first treatment and 107 for other two treatments of GA3 (Figure 2).

Treatment of cv.Vlosh with gibberellins resulted on production growth, quality improvement and demonstred better economic efficiency in all treatments. Berries were colorful and the bunch showed an uniformity with color. There have been some changes that are observed form year to year due to the fluctuations of the temperature and air humidity.

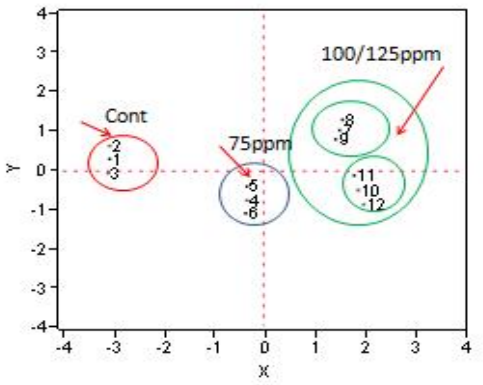

Figure 3. Multivariate Principal Components / Factor Analysis on Correlations, score plot with Eigen value and Eigen vectors for 8 principal research indices

According to figure 3, assessing of the main factors under the effect of treatments is resulted the variability reflected the position in coordinative the axis x and y. Indicators achieved in the first treatment and control are positioned in the negative parts of axes x, y, while the treatments with 100 and 125 mg / l^{-1} are positioned in the positive parts of axes showing the positive effect of those treatments on the integrity of indicators. Variation between treatments was tested for probability < 0001*, and in general confirmed the positive impact of 100 and 125 mg / l^{-1} concentrations versus control having lower impact.

4. Conclusions

- Treatment with the gibberellins Vlosh cv, causes the increase of production, quality and economic efficiency
- Better concentration results is 100 mg / l^{-1} with an additional 17.4% of the control
- The sugar content was higher on treated plants with 125 mg / l^{-1} and the ripening of grapes was shortened in about 10 days.
- This precociousness ripening of this cv, which later ripening, is a great advantage in terms of ecoclimate of Tirana region, because rain fall in early autumn can damage the production and quality of grapes.
- Biometric highest indicators in the three treatments can increase the commercial value of production.

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