DOI: 10.5281/zenodo.5834333
CZU: 634.86:631.81.095.337(498)

THE USE OF BIOSTIMULANT MATUREX TO INCREASE THE QUALITY OF THE GRAPES IN THE MUSCAT OF HAMBURG VARIETY IN THE CONDITIONS OF CLUJ NAPOCA

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Abstract. To improve the quality of horticultural crops are used a series of biostimulants to accumulate the amount of sugar and increase the intensity of color. The study took a variety of table grapes with medium maturity, Muscat of Hamburg, in the conditions of Cluj Napoca. The vines were planted in the didactic collection of the Faculty of Horticulture, in the USAMV Cluj Napoca campus. The climatic conditions of 2020 (spring with low temperatures) determined the delay of the phenophases of vegetation by 3 weeks, including up to the phenophase of veraison and ripening of the grapes. In this case, the application of the Maturex biostimulant was done only once, on September 7, when the grapes were 5-10% in the veraison. The application was made by spraying, with an atomizer, in a concentration of 30 ml per 10 liters of water. The experience included the control variant (untreated) and the treated variant. The grapes were harvested for analysis 6 weeks after treatment, which consisted in determining the weight of the grape, the sugar and total acidity content in the berries, the mass of 100 berries, the mechanical analysis of the grape composition and the berries sphericity. According to the OIV codes, visually notes were awarded. The results showed signifficant differences between the treated version and the untreated version in terms of sugar content in the berries and unformity in skin color.

Key words: Grapevines; Muscat of Hamburg; Biostimulants; Berries; Sugar; Harvest.

INTRODUCTION

In the last decade, the cultivation of table grapes has spread in areas low light conditions, a high rainfall, and relatively low thermal amplitude during véraison to maturation, which adversely affect fruit maturation indexes, such as color development and biosynthesis of primary or secondary metabolites (Teixeira, A. et al. 2013; Qunxian, D. et al. 2019). Grape growers may occasionally face difficulties in grape skin coloration and low total soluble solids content in growing of table grape cultivars (Kok, D., Bal, E. 2018). To overcome these problems, exogenous hormones can be applied to red-colored table grapes to improve their internal and external appearances (berry color development) and quality, for instance (Conde, A. et al. 2016; Luan, L.Y. et al. 2013).

In recent years, the stimulant has been widely used to horticultural crops as they have plant growth-promoting effects (Qunxian, D. et al. 2019). The biostimulant is "a formulated product of biological origin that improves plant productivity as a consequence of the novel, or emergent properties of the complex of constituents, and not as a sole consequence of the presence of known essential plant nutrients, plant growth regulators, or plant protective compounds (Yakhin, O.I. et al. 2017).

The biostimulants could have in compositons diverse materials which may include bacteria, fungi, seaweeds, higher plants, animals and also humate-containing raw materials (du Jardin, P. 2015). Freeamino acids, seaweed and fruit extracts, effective microorganism, humic substances and chitosan are classified as natural biostimulants (Calvo-Veles, P. et al. 2014). In commercial grape growing, different methods such as canopy management techniques, sprinkler cooling, spraying of various biostimulants and plant growth regulators are used for enhancing quality characteristics of grapes (Kok, D., Bal, E. 2017). There are some studies which investigate the effects of biostimulant on grape quality (Yuan, L. et al. 2018). The purpose of present study was to evaluate effects the use of Maturex biostimulator on yield and table grape quality characteristics of Muscat of Hamburg in cool climate conditions.

MATERIALS AND METHODS

Plant Material and Study Area. This study was performed during the 2020 growing season, located in the Didactic collection of UASVM Cluj-Napoca, Cluj County, Transylvania, Romania. Seven year

Figure 1. *Veraison phenophase – the moment of applying treatment with Maturex (September 7th, 2020)*

old Muscat of Hamburg grapevines (*Vitis vinifera* L.) were used as materials. Vines were planted 1.2 x 1.8 m distance between vines and between rows. The vineyard was established in 2013. The vines are grafted on SO-4 with a planting density of 4629 vines/ha. The trellis system is monoplan with a three-row wire (1- simple, 2- double, 3- double). The same trellis system was used for all training systems in the experiment field.

The vineyard was in charge of local standard viticulture practices for cultivar and region. It was also applied a standard disease control program for fungal diseases.

Biostimulant Treatments and Treatment Times. In current study, effects of Maturex biostimulant on yield and quality characteristics of Muscat of Hamburg table grape cultivar were evaluated. Biostimulant was applied to grapevines at the stage of veraison of 5-10 % of berries, on September 7th. The treatment was made only once due to rainy weather on the following period.

The Maturex biostimulator was applied as follow: 30 ml dissolved in 10 liters of water. The treatment was applied only once by spraying on the surface of leaves and bunches. The treatment was applied on 15 vines (5 vine on replicate). On marked vines for observation (15 treated vines and 15 untreated vines) the number of grapes/vines was around 15-16 bunches.

Measurement of Yield and Quality Parameters. In present study, grape weight (g) and 100 berries weight were measured as yield parameters. Total soluble sugar (g/l) using portable Zeiss refractometer, titratable acidity (g/l tartric acid) by titrimetric method were determined as quality parameters (Bora, F. et al. 2014). The sphericity index was calculated as proposed by Roberto et al., 2017. Appreciation on grape general aspect was made according OIV codes (OIV, 2018).

Harvest Time and Preparation of Grape Sampling. During the 2020 growing season, grapes on the grapevines of Muscat of Hamburg were continuously observed and were harvested after 6 weeks after treatment. After the grapes were harvested, samples of 50 bunch grapes were collected from each variant (not treated and Maturex treated) and were finally used to determine total soluble solids content, total acidity, bunch weight and 100 berries weight.

Statistical analysis. The data were expressed as mean from three replicates for each variant. The statistical interpretation of the data was performed using the Excell Program for the analysis of variance (ANOVA).

RESULTS AND DISCUSSIONS

The town of Cluj-Napoca has an area of 179.5 km² and is located in central Transylvania in the Someş Mic Corridor, situated within three major geographical units: the Transylvanian Plain, the Someş Plateau, and the Apuseni Mountains, wich influence the climatic conditions throughout the year (Boancă, P. et al. 2018). Meteorological data were provided by the meteorological station ADSCON Telemetry of University of Agricultural Sciences and Veterinary Medicine of Cluj-Napoca. According to Micle et al. (2019), in Cluj-Napoca is an average annual temperature of 8.3 °C. Autumns are colder in Cluj-Napoca due to the air front coming from northern Europe. Until midSeptember, summer temperatures can still be recorded, after which it gradually cools down. The transition from summer to autumn is quite fast and most days are recorded with rainfall and windy days. The precipitation regime in Cluj-Napoca city is influenced by the geographical positioning and the circulation of air masses with western predominance. The analysis of the annual values of precipitation and the multiannual average is 590 mm. In experimental plot the soil type is typical preluvosol, with a clay-sandy texture, which ensures a good supply of plants with water (Lung, M.L. 2012).

During 2020, the developing of the phenophases in the Muscat of Hamburg variety was significantly influenced by the climatic conditions. All phenophases were delayed on 2-3 week compared with an average year for Transylania region. If version for Muscat of Hamburg on a normal year was observed at the beginning of August, during 2020 – this phenophase was observed on the third decade of the

Table 1. *Development of phenophases in the Muscat of Hamburg variety, during 2020, in the USAMV Cluj Napoca experimental field*

Phenophases	***2020***
Bleeding sap	March 30th – April 5th
Disbudding/Budding	April 24-30th
Shoots growth	After May 10th
Blooming	June 24-30th
Verasion	Around August 25th
Harvest at full maturity	Around October 13th
Leaves fall	November 15-20th

month, as showed in Table 1. During verasion till ful maturity there are some well-orchestrated coordination of steps, such as accumulation of anthocyanins, responsable for color and sugars, degradation of chlorophyll and organic acids, cell wall softening, and synthesis of volatiles (Kumar et al., 2014). Some studies shown that the application of biostimulants enhances the accumulation of several metabolite. Meanwhile, the degradation of other metabolites involved in fruit ripening was accelerate by this process (Koyama, K. et al. 2010).

From the data in Table 2, it can be seen that, compared to the average experience, the variant to which the treatment with Maturex (VT) was applied had a higher sugar accumulation of 157 g/l, compared to the untreated variant (VN) - 148 g/l. The difference, from a statistical point of view, is significantly positive compared to the average experience. Regarding total acidity and spherity indix, between the experimental variants, there was no statistical difference, the treament had no influence on those two parameters due to late and the number of times of aplication. Our results are comparable with thoose obtain by other researchers. According to R. Koyama et al. (2014), F.J.D. Neto (2017), D. Qunxian et al. (2019), the application of S-ABA to 'Rubi' and 'Isabel' grapevines and Sunred to Cabernet sauvignon and Prosseco showed significant differences in the fresh mass of berries and bunches, soluble solids, titratable acidity, and ratio of soluble solids/acidity.

Table 2. *Synthesis of data on quality and quantity parameters of Muscat of Hamburg*

No.	***Variant***	***Sugar content (g/l)***	***Total acidity (g/l tartric acid)***	***Sphericity index***	***Grape weight (g)***	***100 berries weight (g)***
1	Maturex treated - VT	157*	$5,3^{ns}$	$1,23^{ns}$	502*	278*
2	Untreated variant - VN	148^{o}	$5,8^{ns}$	$1,28^{ns}$	488^{o}	267^{o}
Mean of experience		152,2	5,5	1,25	495	272,5
LSD 5%		2,28	0,50	0,05	2,98	2,48
LSD 1%		5,73	1,15	0,12	6,92	5,76
LSD 0,1 %		7,45	3,65	0,38	21,92	8,24

Regarding the quantity parameters, the weight of one grape and 100 berries were significantly influence by the treatment with Maturex as showed in Table 2. It can be seen that, compared to the average experience, the variant to which the treatment with Maturex (VT) was applied, had an average bunch weight of 502 g/l, compared to the untreated variant (VN) - 488 g/l. Even if, from the statistical point of view, there was a significant difference, we consider that this is due to the sample harvest.

As can be seen from the Figures 2 and 3, in both experimental variants, the color of the berries was not uniform. Thus, for the VT variant - depending on the color, two intensities of color of berries were appreciated: full colored berries and semi-colored berries. In the VN variant, three intensities of color were appreciated – full colored berries, semi-colored berries and non-colored berries.

The mechanical composition of the grapes varies depending on the variety, the limits of variation in this case being large, the specific characteristics of the varieties and their direction of use. The composition also varies depending on the pedooclimatic conditions in different areas or the annual meteorological conditions

in the same area. It also varies with the vigor of the vines, the position of the grapes on the vine and their degree of ripeness. In the Muscat of Hamburg variety, the number of berries in one kg of grapes ranged from 328 berries in the Maturex treatment variant (VT) to 319 berries in the non-treatment variant (VN) (Table 3).

Figure 2. *Appreciation of the intensity of berry color in the Muscat of Hamburg variety to the untreated variant – VN (from left to right - uncoloured berries, semi-colored berries, full colored berries)*

Figura 3. *Appreciation of the intensity of berry color in the Muscat of Hamburg variety to the Maturex treated variant – VT (from left to right - semi-colored berries, full colored berries)*

The health of the grapes particularly influences the data obtained from the mechanical analysis; therefore, it is necessary that in the study of varieties for the knowledge of their qualitative potential, the analyzed grapes be healthy, characteristic of the varieties, and the defective grains to be replaced with normal ones or to compensate their number and weight compared to normal ones. As it is observed from Table 3, for Maturex treament variant there were only 3,35% of diseased berries, compared with non-treatment variant with 9,40%. The Maturex treatment influenced the diseased degree of berries at full maturity.

Table 3. *Mechanical analysis per 1 kg of grapes for the Muscat de Hamburg variety*

Variant	***No. of berries***	***No. of healty berries***	***No. of diseased berries***	***% diseased berries***	***Skin (g)***	***Pulp (g)***	***Seeds (g)***	***Rachis (g)***
VT	328	317	11	3,35	230	676	43	51
VN	319	289	30	9,40	228	669	49	54

VT- Maturex treated variant; VN – untreated variant

Based on the commercial aspect when harvesting the grape samples visible in Figures 4 and 5 and based on the OIV visual assessment criteria, the grades for the experimental variants were established.

Figura 4. *Grapes harvest for analysis and appreciation of the Muscat de Hamburg variety - the variant treated with MATUREX*

Figura 5. *Grapes harvest for analysis and appreciation of the Muscat de Hamburg 0 variety - the variant untreated*

Table 4. *OIV assessment criteria for skin and thigh appearance*

Variant/ Observed character	Berry shape – code OIV 223	Skin color – code OIV 225	Uniformity of skin color – code OIV 226	Intensity of anthocyanin staining in the pulp – code OIV 231	Pulp juiciness – code OIV 232	Skin thickness – code OIV 228
VT	Note 2	Note 6	Note 2	Note 7	Note 3	Note 7
VN	Note 2	Note 5	Note 1	Note 6	Note 3	Note 7

VT- Maturex treated variant; VN – untreated variant

In the table 4, the differences can be observed between the experimental variants to the OIV criteria which refer to the skin color, the uniformity of the skin color and the intensity of the anthocyanin coloration in the pulp. Thus, it can be stated that, as confirmed in the data presented above, that the treatment with Maturex, even with a single treatment, influenced the quality and commercial appearance of Muscat de Hamburg grapes.

CONCLUSIONS

Climatic changes influenced significantly the quality of harvest. The applying of some biostimulants in difficult years and in areas with low heliothermal conditions could rise the quality of the harvest. Our results showed that, the using biostimulant Maturex, increases the quality of grapes of Muscat of Hamburg in an area not-suitable for grape growing and also in a difficult year. Even if the Maturex treatment is applied only once, the influence of the level of sugar content and uniformity of the berry color is observed. Also, the Maturex treatment influenced the degree percentage of diseased berries, with only 3,35% for the treated variant, compared with non-treatment variant with 9,40%. In growing of table grape, problems derived from uneven skin coloration and low total soluble solids content can be encountered by grape growers. The results of present study revealed that the foliage sprayed with biostimulants could improve quality components.

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Data prezentării articolului: 15.10.2021
Data acceptării articolului: 20.11.2021