

VARIATION OF PHOTOSYNTHETIC PIGMENTS CONTENT UNDER THE INFLUENCE OF TREATMENTS WITH BIOSTIMULATING SUBSTANCES AT SOME TABLE GRAPE VARIETIES GROWN IN IASSY VINEYARD AREA

VARIAȚIA CONȚINUTULUI ÎN PIGMENȚI FOTOSINTETICI SUB INFLUENȚA TRATAMENTELOR CU SUBSTANȚE BIOSTIMULATOARE LA UNELE SOIURI PENTRU STRUGURI DE MASĂ CULTIVATE ÎN AREALUL PODGORIEI IAȘI

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Abstract. *This study aims to determine the chlorophyll (a and b) and carotenoid content, using spectrophotometric methods, from leaves of Chasselas doré and Gelu table grape varieties (Vitis vinifera L.), grown in Iasi vineyard, treated with two organic fertilization products, Cropmax and Kelpak, in different doses. Physiological role of assimilating pigments is complex, being involved in oxidation-reduction and photosynthesis processes, fructification and protection against ultraviolet radiation. Following the study were observed statistically significant differences between experimental variants, which confirms the suitability of using these products in sustainable viticulture.*

Key words: chlorophyll, carotenoids, *Vitis vinifera* L., organic foliar fertilization.

Rezumat. *Studiul are ca scop determinarea spectrofotometrică a conținutului în clorofile (a și b) și carotenoizi din frunzele soiurilor de viță de vie (Vitis vinifera L.) Chasselas doré și Gelu, cultivate în podgoria Iași, tratate cu două produse ecologice de fertilizare a viței de vie, Kelpak și Cropmax, în diferite doze. Rolul fiziologic al pigmentilor asimilatori este complex, fiind implicați în procesele de oxido-reducere, în procesele de fotosinteză, fructificare și de protecție față de radiațiile ultraviolete. În urma observațiilor efectuate au fost identificate diferențe statistic semnificative între variantele experimentale, fapt ce confirmă preabilitatea folosirii acestor produse în viticultura sustenabilă.*

Cuvinte cheie: clorofilă, carotenoizi, *Vitis vinifera* L., fertilizare foliară organică.

INTRODUCTION

Photosynthetic pigments are represented by green chlorophyll pigments (chlorophylls a and b) and yellow carotenoid pigments (carotenes and xanthophylls), being essential compounds in light energy conversion (Toma and, Jităreanu, 2003).

The quantity of light radiation absorbed by the leaf depends mainly on the amount of photosynthetic pigments that they contain (Steele et al., 2008). *Vitis*

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vinifera L. leaves contain high levels of photosynthetic pigments, their value being dependent on the stage of leaf maturation and the phenophase of vegetation in which the plant is found, the percentage of chlorophyll in leaves increasing, during phenophases, until ripening. Usually, in vines, chlorophyllian and carotenoid pigments content was reported to be in the range of 1.05 mg/g fresh weight (f.w.) and 1.58 mg/g f.w., respectively from 0.33 to 0.65 mg/g f.w. (Burzo et al., 2005, Acatrinei and Andor, 2006).

Ratio between chlorophyll a and b (a/b), at *Vitis vinifera L.*, is maximum at the beginning of the growing season, reaching up to 3/1 and decreases during the grapes ripening, while the ratio chlorophyll/carotenoids can register values till 4/1 (Toma and Jităreanu, 2003, Beceanu, 2011).

Plant growth and development is controlled, in addition to genetic factors, by endogenous substances that are part of the plant hormone group (Davies, 2004). Phytohormones are a class of organic substances that in low concentrations, influences physiological processes of growth, differentiation and development of plants with effect on biosynthesis of assimilating pigment and the relationship between them.

MATERIAL AND METHODS

The study was conducted at the table grape varieties *Gelu*, new romanian creation obtained at Research and Development Station for Viticulture and Vinification Iassy (RDSVV) by free fecundation of the local variety Coarnă neagră, whose hybrid seeds were irradiated with X rays; and *Chasselas Doré*, old cosmopolitan variety, with medium maturation and mixed use, cultivated in Iassy vineyard area, Ampelographic Collection of Faculty of Horticulture, belonging to the University of Agricultural Sciences and Veterinary Medicine (UASVM) "Ion Ionescu de la Brad" Iassy.

Physiological analysis of assimilating pigments were made in berry growth phenophase, at 14 days after foliar treatments with biostimulating substances *Kelpak* in doses of 50 mL (V₁K), 100 mL (V₂K), 150 mL (V₃K) and *Cropmax*, at 10 mL (V₁C), 15 mL (V₂C), 20 mL (V₃C). For analyzes were collected leaves from the middle third of the shoots, which contain the highest amount of chlorophyllian pigments, compared with leaves from upper and lower third of the shoots (Burzo et al., 2005).

Research aimed to emphasize the influence of mentioned treatments on chlorophyllian and carotenoid pigment biosynthesis in leaves of varieties selected for study. Extraction of pigments was achieved with 99% purity acetone, in triplicate.

Chlorophylls and carotenoids were quantitatively determined spectrophotometrically by measuring absorbance at three wavelengths, λ 662 nm, 645 nm and 470 nm, 1 cm optical path, using a UV-vis spectrophotometer T 70 PG Instruments and the calculation of results was performed according to formulas proposed by Lichtenhaler H., 1987, the data being reported in mg pigment/g leaf, with three decimals, to detect small differences that appear at some variants.

Results are average of three determinations having calculated the standard deviation, and for the statistical analysis of data was used application Data Analysis, from Microsoft® Excel software.

RESULTS AND DISCUSSIONS

Chlorophylla content, for the two studied varieties, differed according to the biostimulating substance used and the applied doses. Chlorophyll content value registered was between 1.363 mg/g f.w. (V₁C) and 2.257 mg/g f.w. (V₁K) at the Gelu variety, and between 1.441 mg/g f.w. (V₁C) and 2.351 mg/g f.w. (V₁K) at the Chasselas Doré variety (fig. 1).

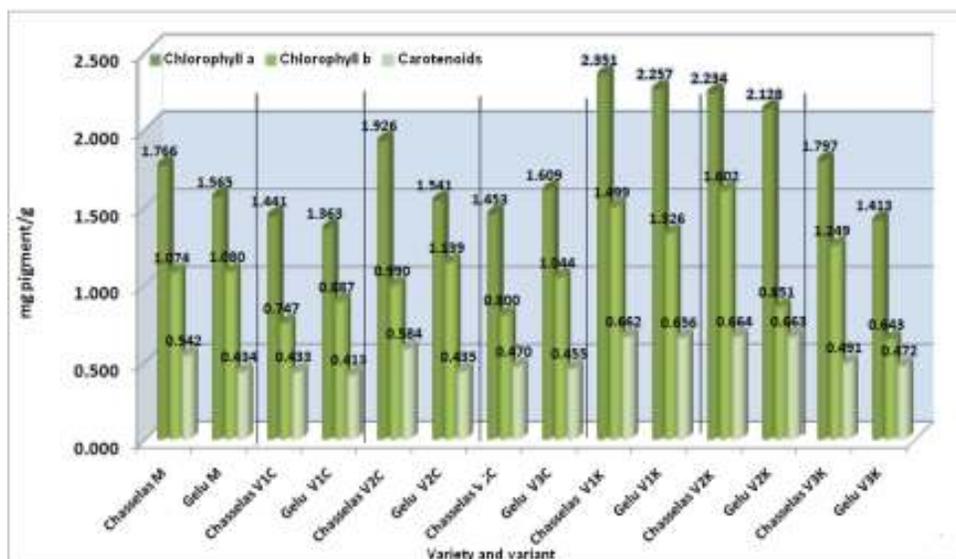


Fig. 1 - The amount of chlorophyll a, chlorophyll b and carotenoids (mg/g f.w.)

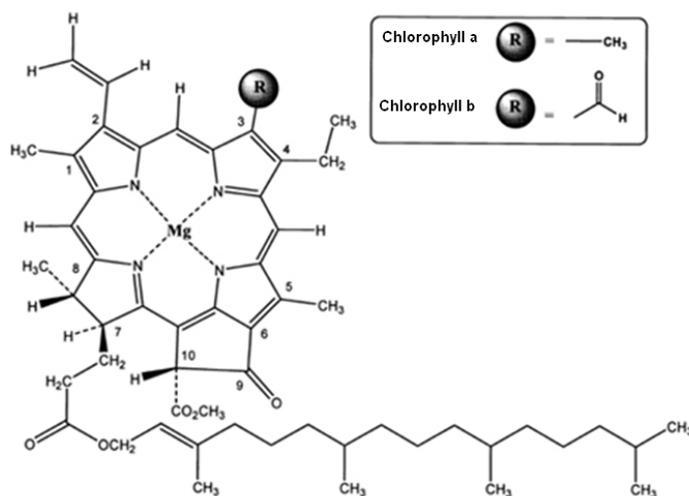


Fig. 2 - Chemical structure of chlorophyll a and b (adaptation after Streit et al., 2005)

Can be noted that low doses of Kelpak product applied to the first samples have positively influenced the content of chlorophyll a, chlorophyll b (fig. 2) and carotenoids compared with control sample, leading to an increase in both varieties in the pigment content. In contrast, low doses Cropmax led to low levels of chlorophyll a, compared to control version. The results of measurements were considered high compared with values found in the literature, presented introductory, fact correlated with the biostimulating treatments application.

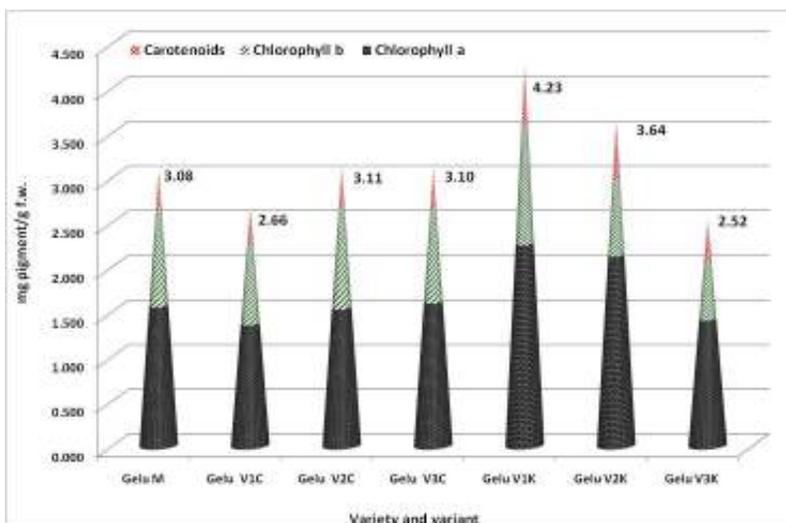


Fig. 3 - The total amount of photosynthetic pigments registered at Gelu variety

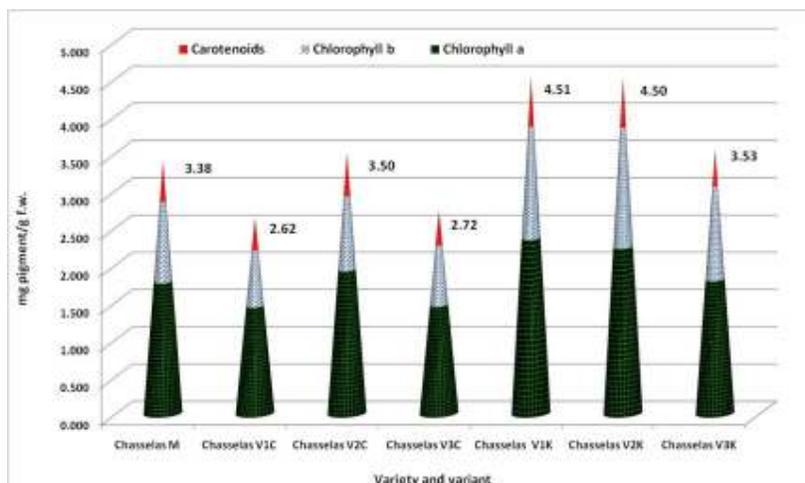


Fig. 4 - The total amount of photosynthetic pigments registered at Chasselas Doré variety

At the local variety Gelu, chlorophyll a and b content was the lowest in the variant treated with 150 mL Kelpak (V₃K), 0.643 mg/g f.w., at the cosmopolitan

variety Chasselas Doré minimum value was identified at the variant treated with 10 mL Cropmax (V₁C) 0.747 mg/g f.w.

Carotenoids content, at Gelu variety, ranged from 0.413 mg/g f.w. at V₁C and 0.663 mg/g f.w. V₂K version, and at the variety Chasselas Doré was found to be ranged from 0.433 mg/g f.w. (V₁C) and 0.664 mg/g f.w. (V₂K).

The total amount of photosynthetic pigments record a minimum of 2.52 mg/g f.w. and a maximum of 4.23 mg/g f.w. Gelu variety (fig. 3), and at Chasselas Doré variety ranged between 2.62 mg/g f.w and 4.51 mg/g f.w. (fig. 4).

Because of increasing values of chlorophyll *a* and chlorophyll *b*, caused by the treatments applied with the stimulant substances and also of the sampling moment, the ratio chlorophyll *a*/ chlorophyll *b* was less than 3/1, normal value given by the literature, and the chlorophylls/carotenoids ratio was much higher than the reference value, 4/1 (Table 1).

Table 1

The content of photosynthetic pigments in leaves at the variety Chasselas Doré

Variety Version	Total chlorophylls (mg/g f.w.)	Chlorophyll a/ Chlorophyll b	Chlorophylls/ Carotenoids	Total photosynthetic pigments (mg/g f.w.)
Chasselas M	2.841 ± 0.11	1.644 ± 0.02	5.239 ± 0.01	3.383± 0.13
Chasselas V1C	2.187 ± 0.89	1.659 ± 0.70	4.266 ± 1.78	2.621± 0.75
Chasselas V2C	2.917 ± 0.14	1.948± 0.07	4.995 ± 0.10	3.500± 0.16
Chasselas V3C	2.253 ± 0.22	1.835 ± 0.18	4.791 ± 0.10	2.723± 0.26
Chasselas V1K	3.850± 0.76	1.557 ± 0.11	5.867 ± 0.31	4.512± 0.93
Chasselas V2K	3.836 ± 0.36	1.403 ± 0.14	5.787 ± 0.39	4.500± 0.41
Chasselas V3K	3.046 ± 0.63	1.456 ± 0.14	6.206± 0.36	3.536±0.73
Gelu M	2.646 ± 0.23	1.455 ± 0.07	6.087 ± 0.14	3.080± 0.26
Gelu V1C	2.250 ± 0.23	1.540 ± 0.07	5.453 ± 0.30	2.663± 0.27
Gelu V2C	2.680 ± 0.12	1.359 ± 0.12	6.180± 0.43	3.115± 0.25
Gelu V3C	3.816± 0.03	1.695 ± 0.04	5.872 ± 0.12	3.108± 0.04
Gelu V1K	3.584 ± 0.22	1.703 ± 0.06	5.466 ± 0.14	4.239± 0.26
Gelu V2K	2.979 ± 0.03	2.518± 0.30	4.494 ± 0.13	3.642± 0.03
Gelu V3K	2.056 ± 0.21	2.200 ± 0.37	4.401 ± 0.39	2.529± 0.30

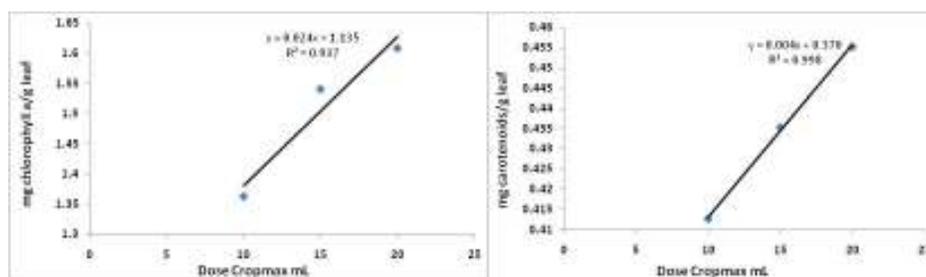


Fig. 5 - Correlation between chlorophyll a and carotenoid content, and applied dose at Gelu variety

Following statistical hypotheses by performing ANOVA test, *p-value* was less than 0.05 alpha (*p-value* calculated $<p=0,05$), and F factor calculated was

higher than F critical ($F_{calc} > F_{crit}$) concluded that differences statistically observed between the variants are caused by the treatments applied not by the experimental errors.

Only at Gelu variety were found positive correlations between the Cropmax doses applied and chlorophylls ($R^2=0.937$) and carotenoids content ($R^2=0.998$), indicating that at higher concentrations of the applied doses appears an increasing of chlorophylls and carotenoids content (fig. 5).

CONCLUSIONS

1. The highest influence on the content of chlorophyll pigments had Kelpak product. The biggest amounts of assimilating pigments were recorded in both varieties at Kelpak with 50 mL and 100 mL concentration of solution. These increased amounts of assimilating pigments may be related to the hormonal substances applied and in a small measure to the microelements found in product composition.

2. Treatments applied had no significant influence on carotenoid content, the values oscillating around control sample value, unrelated with the concentration used.

3. Influence of biostimulating treatment at Chasselas Doré and Gelu varieties led to a reduction of the chlorophyll *a*/chlorophyll *b* ratio, and also to an increased value of chlorophylls/carotenoids ratio.

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