

## THE STUDY OF PHOTOSYNTHETIC PIGMENTS CONTENT AT SOME VINE FOR TABLE GRAPES UNDER THE INFLUENCE OF BIOSTIMULANT SUBSTANCES APPLICATION

STUDIUL ASUPRA CONȚINUTULUI ÎN PIGMENȚI FOTOSINTETICI LA  
UNELE SOIURI DE VIȚĂ DE VIE PENTRU STRUGURI DE MASĂ SUB  
INFLUENȚA APLICĂRII SUBSTANȚELOR CU ROL BIOSTIMULATOR

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**Abstract.** Assimilatory photosynthetic pigments (chlorophyll a and b) have an important role in plant growth, in the processes of photosynthesis, oxidation-reduction and fruiting, the variation of these parameters being an indicator of the growth or damage of the leaf apparatus. This study aims to establish the influence of the application of substances with a biostimulating role on the content of chlorophyll pigments in the leaves of the vine varieties 'Paula', 'Aromat de Iași', and 'Chasselas doré'. The treatments were carried out with two organic vine fertilization products, applied in three concentrations 'Ecklomar'® (3.5 L/ha-V1, 4.5 L/ha-V2, 5.5 L/ha -V3) and 'Kaishi'® (2.5 L/ha-V1, 3.5 L/ha-V2, 4.5 L/ha-V3) in different growth phenophases. Following the study were identified differences between the experimental variants in carotenoid content. The highest values were observed on Paula variety with 'Ecklomar'® treatments.

**Key words:** chlorophyll, carotenoids, foliar fertilization

**Rezumat.** Pigmenții fotosintetici asimilatori (clorofila a și b) au un rol important în creșterea plantelor, în procesele de fotosinteză, oxidoreducere și fructificare, variația acestor parametri fiind un indicator al sresului sau deteriorării aparatului foliar. Lucrarea de față are ca scop stabilirea influenței aplicării unor substanțe cu rol biostimulator asupra conținutului în pigmenți clorofilieni din frunzele soiurilor de viță-de-vie 'Paula', 'Aromat de Iași', și 'Chasselas doré'. Tratamentele au fost efectuate cu două produse ecologice de fertilizare a viței-de-vie, aplicate în trei concentrații 'Ecklomar'® (3,5 L/ha-V1, 4,5 L/ha-V2, 5,5 L/ha-V3) și 'Kaishi'® (2,5 L/ha-V1, 3,5 L/ha-V2, 4,5 L/ha-V3) în diferite fenofaze de creștere. În urma determinărilor efectuate s-au constatat diferențe între variantele experimentale în cazul conținutului de carotenoizi. Cele mai ridicate valori s-au observat la soiul Paul, în urma tratamentelor cu 'Ecklomar'®.

**Cuvinte cheie:** clorofilă, carotenoizi, fertilizare foliară

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## INTRODUCTION

Chlorophyll is a natural green pigment found in all plants that carry out photosynthesis, allowing them to absorb energy from light (Hörtensteiner and Kräutler, 2011).

Chlorophyll pigments, especially chlorophyll a and b, are essential compounds for the conversion of light energy into chemical energy. The importance of the chlorophyll content of the leaves is reflected in its role on the nutritional status of the plants, since a large part of the nitrogen in the leaves is incorporated into the chlorophylls. Moreover, the chlorophyll content is closely related to plant stress and senescence (Merzlyak *et al.*, 1999).

Carotenoids are a group of red or yellow pigments (Pfander, 1992). They are an essential component of all photosynthetic organisms due to their photoprotective and antioxidant properties (Lohr, 2009).

At vine, the maximum photosynthetic intensity is recorded during the period when the solar radiation is higher, in the months of May and June. In July, photosynthesis is maximum for all plant leaves, and in October the intensity of this process is reduced due to the installation of the senescence process (Burzo *et al.*, 2005).

## MATERIAL AND METHOD

The biological material used in the study was represented by two vine varieties for table grapes, Paula and Aromat de Iasi, created at the Research and Development Station for Viticulture and Winemaking Iasi, compared with the control Chasselas doré, cosmopolitan variety, with medium ripening and mixed use. Treatments with biostimulating substances were carried out in three different concentrations, as follows: Ecklomar® 3.5 L/ha-V1, 4.5 L/ha-V2, 5.5 L/ha -V3 and 'Kaishi'® 2.5 L/ha-V1, 3.5 L/ha-V2, 4.5 L/ha-V3, with untreated variant within each variety.

The analyzes on the variation of chlorophyll and carotenoid content pigments were carried out at the beginning of flowering, during the period of berry formation and in the phenophase of grape ripening.

For the quantitative determination of the assimilatory pigments in the leaves of the studied varieties, the solvent extraction method was used.

The content in assimilatory pigments was calculated in mg/g fresh substance, using the equations proposed by Lichtenthaler and Buschmann and completed by the Carnegie Institute of Science by Spectranomis Protocol.

$$\text{Chl a } (\mu\text{g mL}^{-1}) = 11,24 \times (A662 - A710) - 2,04 \times (A645 - A710);$$

$$\text{Chl b } (\mu\text{g mL}^{-1}) = 20,13 \times (A645 - A710) - 4,19 \times (A662 - A710);$$

$$\text{Carotenoids } (\mu\text{g mL}^{-1}) = (1000 \times (A470 - A710) - 1,90 \times \text{Chl a} - 63,14 \times \text{Chl b})/214.$$

Simultaneously with the determination of the content in photosynthetic pigments in the leaves, the humidity of the leaves was determined, by drying for four hours in an oven, at a temperature of 105 °C.

The results presented in the paper are the average of three determinations, and the Data Analysis application, from the Microsoft® Excel software, was used for the statistical analysis of the data.

## RESULTS AND DISCUSSIONS

After the determination of the content in photosynthetic pigments, the humidity of the leaves of the grape varieties studied was also determined. According to the data in table 1, the humidity recorded the highest values in June, for all studied varieties, followed by a gradual decrease in July and August. In June, the highest value was recorded for the Paula variety, the untreated variant (73.97%), followed by the V-2E treatment variant, also for the Paula variety (73.02%). In the months of July and August, there is an increased humidity in the Aromat de Iasi variety, the V-2E (72.02%) and V-1E (65.36%) variants.

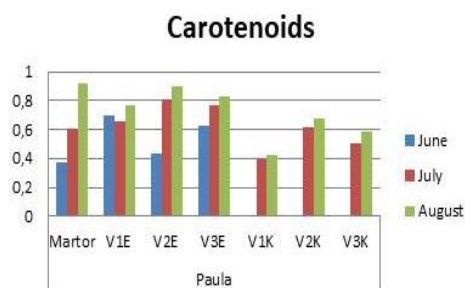
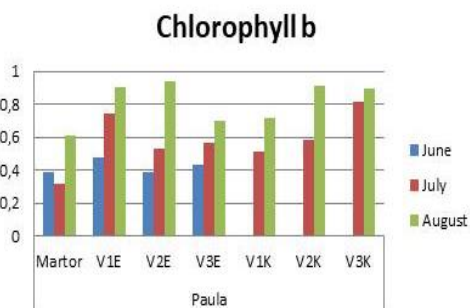
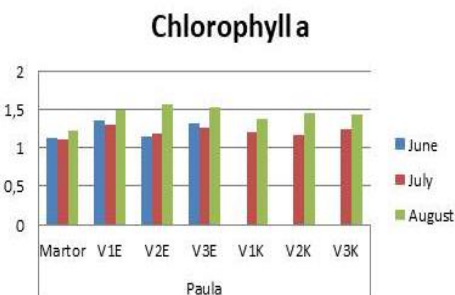
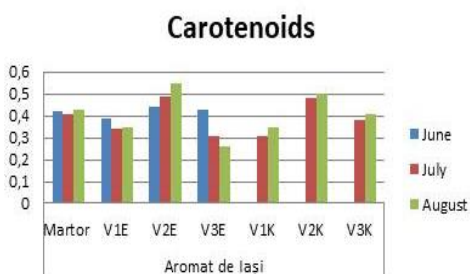
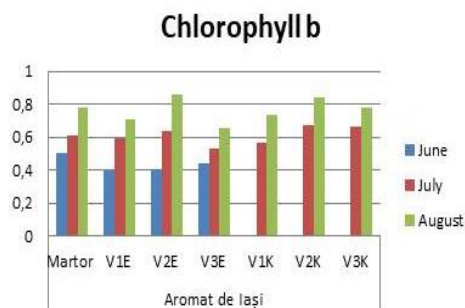
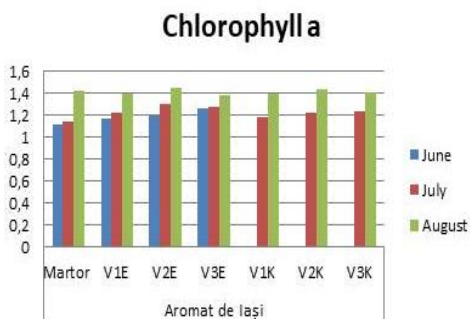
Table 1

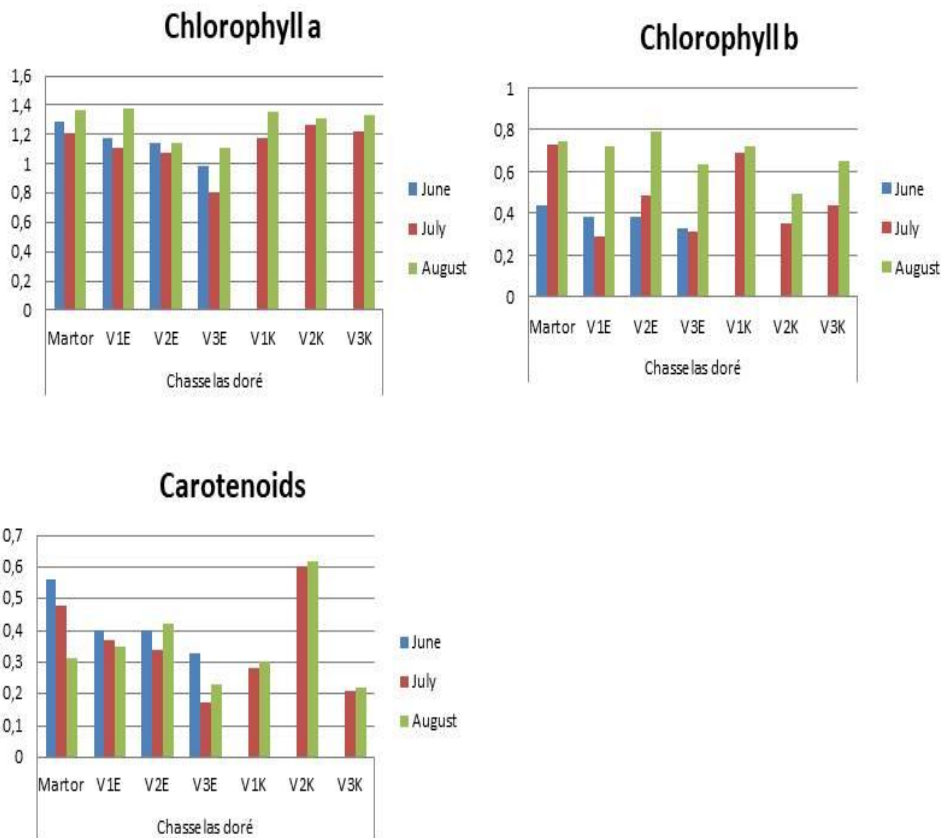
Leaves moisture (%)								
Humidity (%)								
Variety	Month	Untreated variety	V-1E	V-2E	V-3E	V-1K	V-2K	V-3K
Aromat de Iași	June	71.27	72.82	73.23	72.53	-	-	-
	July	70.12	71.40	72.02	70.12	69.43	70.34	68.46
	August	62.95	65.36	63.85	63.50	65.81	62.78	63.06
Paula	June	73.97	69.12	73.02	70.48	-	-	-
	July	71.98	68.09	71.52	69.25	68.78	67.14	68.83
	August	62.49	63.16	61.81	62.86	63.13	63.16	61.09
Chasselas doré	June	70.17	70.89	69.15	70.12	-	-	-
	July	69.14	69.11	68.46	68.43	65.46	66.87	68.43
	August	63.03	63.36	62.98	62.53	59.19	60.60	61.24

According to the data in figure 1, in June, chlorophyll a obtained the highest value in the Paula variety. variant V-1E, with a value of 1.36 mg/g dry matter, followed by the variant V-3E of the same variety (1.31 mg/g). The Chasselas doré variety obtained the highest value of chlorophyll a content in the untreated variant (1.29 mg/g), all others having lower values compared to the control. In the case of the content in chlorophyll b, in June all studied varieties recorded the highest values in the untreated variants. all others being lower than the control. The carotenoses in the leaves of the varieties studied had the highest value in the Paula variety, the V-1E variant (0.7 mg/g), followed by the V-3E variant of the same variety (0.63 mg/g) and the lowest value in the variety Chasserlas doré V-3E (0.33%), followed by V-2E and V-1E (0.4 mg/g).

In July. the highest value of the chlorophyll a content was obtained at the variants V-2E at Aromat de Iasi and V-1E at the variety Paula (1.29 mg/g). The lowest values of this month were on the control variety

Chasserlas doré variants V-3E (0.81 mg/g) and V-2E (1.08 mg/g). Chlorophyll b had the highest values in the variety Paula, V-3K (0.81 mg/g) and V-1E (0.74 mg/g) and the lowest values in the variety Chasselas doré, treatment variants V-3E (0.31 mg/g) and V-1E (0.29 mg/g). Carotenoids had the highest values in the Paula variety, variants V-3E (0.77 mg/g) and V-2E (0.81 mg/g) and the lowest values in Chasselas doré, variants V-3E (0.17 mg/g) and V-3K (0.21 mg/g).





**Fig. 1.** The content of photosynthetic pigments

The last determination of the assimilatory pigments was carried out in August. the values obtained being increased compared to those of the previous months for all experimental variants. The highest values of the content in assimilatory pigments were recorded in the Paula variety, in which chlorophyll a obtained the highest values in the variants V-2E (1.56 mg/g). V-3E and the control (1.52 mg /g) and the lowest values in Chasselas doré V-2K (1.31 mg/g). Chlorophyll b recorded increased values in the Paula variety V-1E (0.98 mg/g) and V-2E (0.94 mg/g) and low values in the treatment variant V-3E (0.3 mg/g). Carotenoids in August recorded increased values in the untreated variant of the Paula variety (0.92 mg/g), followed by the treatment variant V-2E (0.9 mg/g) and the lowest values in the Chasselas doré variety. V-3K (0.22 mg/g) and V-3E (0.23 mg/g).

According to the study carried out by Toma and Jitareanu (2007). the ratio of chlorophyll a/b, in the species *Vitis vinifera* L., is maximum at the

beginning of the vegetation period. reaching up to 3/1 and decreases during the ripening period of the grapes. while the ratio chlorophyll/carotenoids can reach up to 4/1.

At Aromat de Iasi variety. in June, the chlorophyll a/b ratio has the highest value in the V-1E and V-2E treatment variants (2.90 mg/g). At Paula variety. the V-3E variant (3.05 mg/g) stands out, and in the Chasselas dore variety the highest value of the chlorophyll a/b ratio was recorded at the V-1E variant. In all varieties. the values obtained in the treated variants were higher compared to the untreated ones, except of the Paula V-1E. where the value obtained was lower.

In July. at Aromat de Iasi, the highest value of the chlorophyll a/b ratio was obtained in the V-3E variant (2.40 mg/g), close to the highest value of the Paula variety. V-1K (2.37 mg/g). In Chasselas doré. the highest value in July was 3.60 mg/g recorded for the V-2K variant.

In August, a decrease in the chlorophyll a/b ratio is observed compared to the previous months, at Aromat de Iasi the highest value was 1.96 mg/g for the V-1E variant. at Paula 2.17 mg/g for the treatment with V-3E. and at Chasselas doré 2.67 mg/g with the V-2K variant.

For the second type of ratio analyzed. chlorophyll (a + b)/carotenoids, in June highlighted the V-1E treatment for Aromat de Iasi and V-3E for the Chasselas doré variety (4.00 mg/g), followed by 3.58 mg/g at V-2E Paula in which the treated variants obtained low values compared to the untreated variant (4.11 mg/g). In July. the highest value was recorded at Chasselas doré. V-2K (7.90 mg/g), followed by Aromat de Iasi V-3E (5.81 mg/g) and Paula V-1K (4.41 mg/g). In August. the values obtained increased compared to the previous months. Among the varieties analyzed. the control variety Chasselas doré, the treatment variant V-3K with 9.00 mg/g, Aromat de Iasi V-3E with 7.77 mg/g. and Paula the highest value was 5.00 mg/g at V-1K.

Table 2

The content of photosynthetic pigments

Variety	Treatment variant	Chlorophyll a / b ratio			Chlorophyll (a + b) / carotenoids ratio		
		June	July	August	June	July	Aug
Aromat de Iași	Untreated V	2.22	1.85	1.81	3.83	4.24	5.09
	V-1E	2.90	2.05	1.96	4.00	5.29	6.00
	V-2E	2.90	2.02	1.67	3.64	3.94	4.18
	V-3E	2.84	2.40	2.11	3.93	5.81	7.77
	V-1K	-	2.05	1.90	-	5.61	6.06
	V-2K	-	1.81	1.70	-	3.92	4.54
	V-3K	-	1.86	1.79	-	4.97	5.32
Paula	Untreated V	2.90	3.44	2.00	4.11	2.33	2.10

	V-1E	2.83	1.74	1.51	2.63	3.08	3.19
	V-2E	2.95	2.23	1.66	3.58	2.11	2.78
	V-3E	3.05	2.19	2.17	2.76	2.36	2.19
	V-1K	-	2.37	1.92	-	4.41	5.00
	V-2K	-	2.02	1.59	-	2.82	3.47
	V-3K	-	1.53	1.62	-	4.02	3.95
Chasselas doré	Untreated V	2.93	1.66	1.85	3.09	4.04	6.81
	V-1E	3.11	3.83	1.92	3.90	3.78	6.00
	V-2E	3.00	2.25	1.44	3.80	4.59	4.60
	V-3E	3.00	2.61	1.76	4.00	6.59	7.57
	V-1K	-	1.71	1.88	-	6.68	6.90
	V-2K	-	3.60	2.67	-	2.68	2.90
	V-3K	-	2.77	2.05	-	7.90	9.00

Following the application of the ANOVA test, where  $p\text{-value} = 0.05$ . it was observed that there are no significant differences between the values of the assimilatory pigments in the leaves of the vine varieties studied. which proves that the biostimulating substances applied in the experiment did not influence the normal physiological processes of plants.

## CONCLUSIONS

1. Humidity in the leaves of the vine varieties studied decreases as they move towards the senescence phase, but remains within normal physiological limits. The highest moisture value was recorded in the Paula variety, the untreated variant. in June. and the lowest value was recorded in the control variety Paula, Kaishi® 4.5 L/ha. in August.

2. The content in *chlorophyll a* and *b* was increased in the variants treated with biostimulating substances compared to the untreated ones. Among the biostimulators applied. Ecklomar® had the greatest influence on the content of assimilatory pigments, in all analyzed varieties.

3. Following the static analysis. it is found that the differences between the treatment variants are insignificant. a fact that confirms that the biostimulators substances applied do not affect the normal physiological processes of the plants.

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