

# RESEARCH STUDY ON THE DYNAMICS OF THE CONTENT OF PHOTOSYNTHETIC PIGMENTS AT SOME GRAPEVINE VARIETIES IN THE VEGETATION YEAR 2013

## CERCETĂRI PRIVIND DINAMICA CONȚINUTULUI DE PIGMENTI FOTOSINTETICI LA UNELE SOIURI DE VIȚĂ DE VIE ÎN PERIOADA DE VEGETAȚIE A ANULUI 2013

*JITĂREANU Carmenica Doina*<sup>1</sup>, *SLABU Cristina*<sup>1</sup>, *MARTA Alina Elena*<sup>1</sup>  
e-mail: doinaj@uaiasi.ro

**Abstract:** Grapevine plantations and environmental conditions create an entity in which interdependence and mutual conditioning represent a normal state of things, the higher influence being exerted by the environmental element toward the vegetal organisms. The modifications of environmental conditions lead to modifications in the metabolism, the development of growth and development processes, with positive or negative effects on both plant quality and vitality. Atmospheric and pedological draught perturb the physiological and biochemical processes having significant repercussions on cellular ultrastructure and physiological processes. Climatic changes and their impact on vineyards represent a highly important issue for the researchers of various fields of activity.

**Key words:** vineyard, eco-physiology, photosynthetic pigments

**Rezumat :** Plantația viticolă și condițiile de mediu alcătuiesc o unitate, în cadrul căreia interdependența și condiționarea reciprocă constituie o legitate, cu o influență mai puternică dinspre mediu către organismele vegetale. Modificarea condițiilor de mediu determină schimbări în metabolism, în desfășurarea proceselor de creștere și dezvoltare, cu influențe pozitive sau negative asupra calității și vitalității plantelo. Seceta atmosferică și pedologică determină dereglarea unor procese fiziologice și biochimice care au repercusiuni importante asupra ultrastructurii și proceselor fiziologice din celule. Schimbările climatice și problema impactului acestora asupra podgoriilor reprezintă o problemă de maximă importanță pentru cercetătorii din diferite domenii.

**Cuvinte cheie:** viță de vie, eco-fiziologie, pigmenti fotosintetici

### INTRODUCTION

The particularities of the photosynthesis process for *Vitis* varieties and species are due to the morphological characteristics of the leaf, different from one species to the other, or from one variety to the other, as far as the thickness of the mesophyll, epidermis, cuticle and number of stomas etc. are concerned (Jones, 2006). The photosynthetic activity of the vine is influenced by the request or the need of metabolites, expressed by the production quantity. In general, fertile shoots have a more intense photosynthetic activity than the sterile ones (Bloom, 2009; Schultz, 2008). The level of metabolites the vine can provide through

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<sup>1</sup> University of Agricultural Sciences and Veterinary Medicine of Iași, Romania

photosynthesis is limited, and if the request is excessive it leads to a diminished vegetative growth, slight differentiation of the productive buds, deficitary maturation of grapes and tendril wood (Chavez et al., 2010). The determinations included in the present study are part of a wider one that includes various grapevine varieties ( $V_1$  -Fetească albă,  $V_2$  - Fetească regală,  $V_3$  - Italian Riesling,  $V_4$  - Băbească gri,  $V_5$  - Francușă,  $V_6$  - Grasă de Cotnari,  $V_7$  -Tămâioasă românească) cultivated in three wine regions from Moldavia: Iași, Cotnari and Dealu Bujorului, in the climatic conditions of 2013 (Jitareanu, 2012, 2013).

## MATERIAL AND METHOD

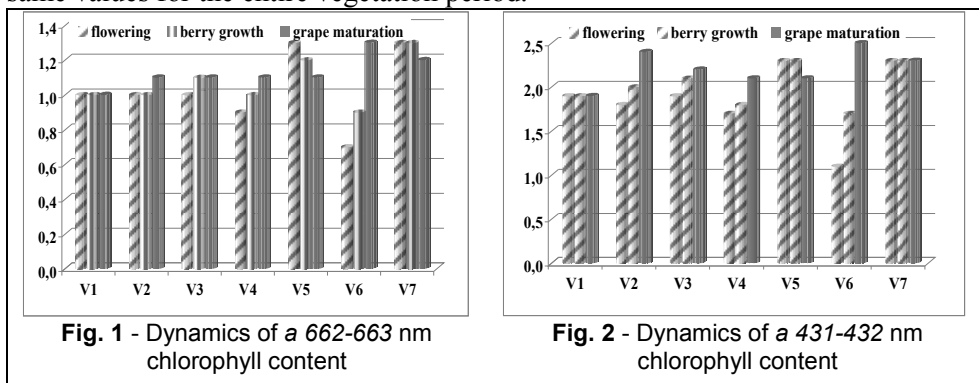
The eco-physiological reaction of the grapevines varieties experimented in the climatic conditions induced by global warming in the wine centres of Iasi, Cotnari and Dealu Bujorului was appreciated based on the dynamics of the content of foliar pigments seen as indicators for photosynthesis processes and plants resistance to stress conditions (Steele M., Gitelson A., Rundquist D. 2008). The analyses of foliar pigments have been performed in June and July – during flowering and berry development and at the beginning of September during grape maturation, on the leaf under the cluster at the fertile shoot and on the leaf from the same level, at the sterile shoot. The leaf pigment content was analyzed spectrophotometrically, its assessment depending of the light absorption capacity of the pigment acetonic extract (1%) in the visible spectrum (400-700 nm) and close UV (320 nm). Chlorophyll *a* 663 can assess photosynthesis intensity in the reaction centre, while chlorophyll *a* 435 and chlorophyll *b* 453 can assess the light absorption capacity in the light absorption centre in photosynthetic systems; flavonoid pigments with close UV (320nm) absorption can evaluate plants reaction to different climatic stress factors.

## RESULTS AND DISCUSSIONS

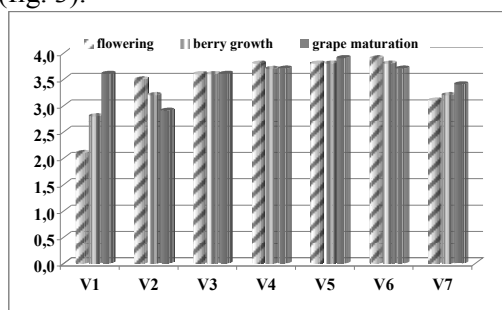
### *The dynamics of the average foliar pigment content*

In 2013 in **Iasi vineyard**, the content of chlorophyll *a* 662 -663 nm recorded similar values at the following varieties in all three phenophases: Fetească regală, Frâncușă, Grasă de Cotnari, Tămâioasă românească and Băbească gri and identical values at Fetească albă. The highest values were recorded at Băbească gri variety, leading to the highest production recorded in this vineyard (15.8 t/ha). The values of the average chlorophyll content *a* 662 – 663 generally ranged between 1.1 – 1.3 u.a. demonstrating the relatively stable character of the synthesis capacity from the reaction centres of the photosynthetic systems. A different behaviour was recorded at the Italian Riesling variety, with the lowest content of chlorophyll *a* 662-663, especially in the berry growth phenophase which, combined with a minimum foliar surface on the shoot, lead to a small quantitative production, but with high sugar content; this was due to the intense accumulation of chlorophyll *a* 662 – 663 in the grape maturation phenophase (fig. 1). As far as the chlorophyll *a* 431- 432 nm content is concerned, the main component of the absorption centre from the photosynthetic systems, from figure 2, we can notice that the following varieties Fetească albă, Frâncușă,

Grasă de Cotnari and Italian Riesling, recorded a progressive growth from the flowering phenophase toward the grape maturation phenophase, while at Fetească albă and Băbească gri varieties the chlorophyll *a* 431 – 432 content was within the same values for the entire vegetation period.

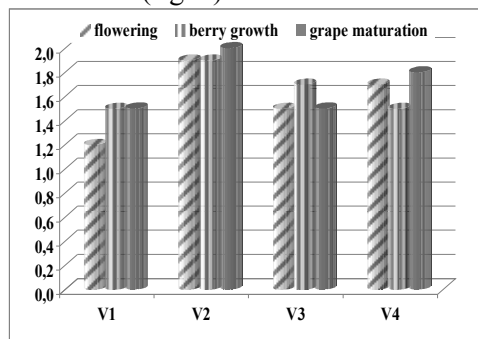


The content of flavonoid pigments, with role in protecting the plants against stress factors, recorded high values at all analyzed varieties, with maximum values of 3.7 – 3.9 ua at the following varieties Italian Riesling, Tămâioasă românească and Grasă de Cotnari which suggests that the vegetation period of 2013 might be characterized as having been normal from thermic and hydric point of view (fig. 3).

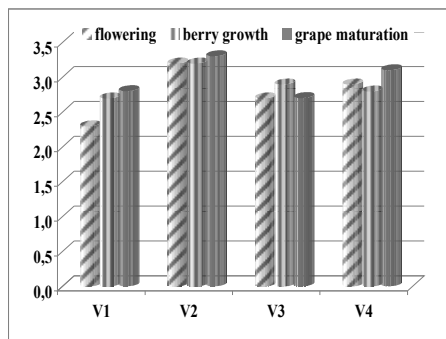


In **Cotnary vineyard** the chlorophyll *a* 662 – 663 content presented itself as a biapical curve for Grasă de Cotnari variety, with maximum values in the flowering and berry maturation phenophases and lower values during growth phenophase, while the Frâncușă variety presented a uniapical curve, with maximum values in the growth phenophase. The varieties Tămâioasă Românească and Fetească albă recorded higher values of the chlorophyll *a* 662 – 663 content toward the berry maturation phenophase (fig. 4). The highest chlorophyll *a* 662 – 663 values were recorded at the following varieties: Tămâioasă Românească and Grasă de Cotnari, which lead to high sugar content in the grapes, with values resembling those of supramaturation. The chlorophyll *a* 431 – 432 content behaved just like the chlorophyll *a* 662 – 663 one at the varieties from Cotnari vineyard. Grasă de Cotnari variety accumulated chlorophyll *a* 431 – 432 as a

biapical curve, with maximum values during flowering and fruit maturation phenophase, while Frâncușă variety presents the model of a uniapical curve, with maximum values during growth and lower values during flowering and fruit maturation (fig. 5).

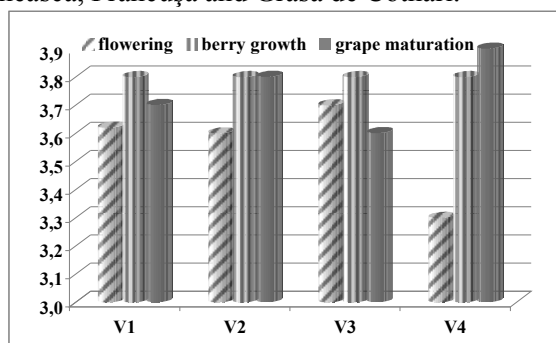


**Fig. 4** - Dynamics of a 662-663 nm chlorophyll content



**Fig. 5** - Dynamics of a 431-432 nm chlorophyll content

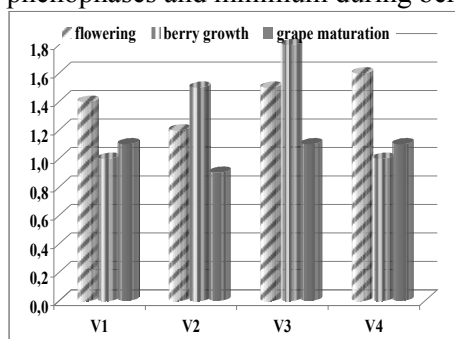
Tămâioasă Românească and Fetească albă varieties recorded growth of the chlorophyll *a* 431 – 432 content during the entire vegetation period, maximum values being recorded in the maturation phenophase. The content of flavonoid pigments (320 – 325 nm) proved to be minimum to all the varieties existent on the Cotnari vineyard during the flowering phenophase, this period being characterized by normal temperatures and excess of precipitations; from this point of view, the plants did not confront themselves with stress conditions (Fig. 6). Most of the varieties analyzed presented the highest quantity of flavonoid pigments during the berry growth phenophase, with the maximum value of 3.8 ua at Fetească albă, Tamâioasă românească, Frâncușă and Grasă de Cotnari.



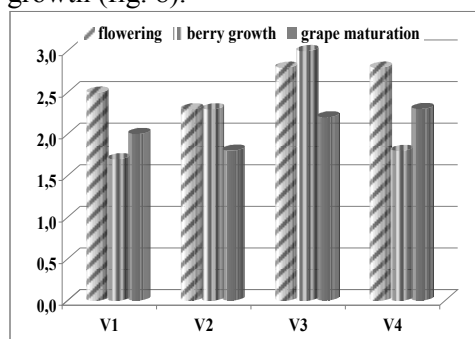
**Fig. 6** - Dynamics of flavonoid pigment content

In Dealu Bujorului vineyard the content of chlorophyll *a* 662 – 663 presented itself as a biapical curve for the varieties Băbească gri and Fetească albă, the higher values being recorded during the flowering and fruit maturation phenophase, and lower in the growth phenophase, while the Italian Riesling and Fetească regală varieties presented an uniapical curve, the maximum values being recorded in the berry growth phenophase (fig. 7). The highest values for chlorophyll *a* 662 – 663 were registered by the Italian Riesling variety, values

reflected by the maximum quantity of sugar in the grapes, with values characteristic to supramaturation, increasing the production quality for this variety. A similar evolution was recorded by chlorophyll *a* 431 – 432 to all the varieties analyzed, the biapical curve being noticed at Fetească albă and Băbească gri varieties, with high values during the flowering and grape maturation phenophases and minimum during berry growth (fig. 8).

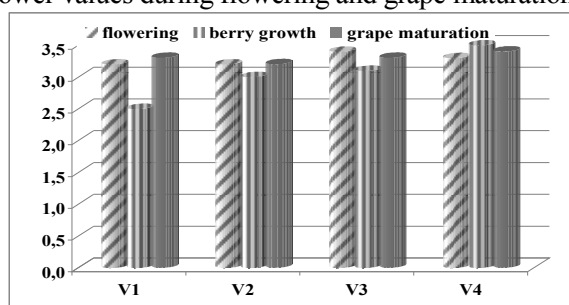


**Fig. 7** - Dynamics of a 662-663 nm chlorophyll content



**Fig. 8** - Dynamics of a 431-432 nm chlorophyll content

In the case of the Italian Riesling variety the same behaviour of the uniapical curve is maintained, with maximum values in the growth phenophase and lower values during flowering and maturation, this variety accumulating the highest quantity of chlorophyll *a* 431 – 432 during the entire vegetation season; this generated supramaturation sugar content in the grapes. The only exception of this vineyard is represented by the Fetească regală variety which presented a linear behaviour during the flowering and growing phenophases and a decrease during the grape maturation phenophase. The flavonoid pigments presented high values at all the varieties from the Dealu Bujorului vineyard, during all the analyzed phenophases, but lower if we compare them to those of the varieties from the other vineyards. As far as Fetească albă, Fetească regală and Italian Riesling varieties are concerned, the flavonoid pigments presented themselves as a biapical curve, with maximum values in the flowering and fruit maturation phenophases and lower during the growth phenophase (fig. 9). A different behaviour, as a uniapical curve was recorded only by the Băbească gri variety, which presented maximum values during the growth phenophase and lower values during flowering and grape maturation phenophases.



**Fig. 9** - Dynamics of flavonoid pigment content

## CONCLUSIONS

1. The research studies undertaken in Iasi vineyard in 2013 on the dynamics of the average content of foliar pigments shows a relatively stable character of the synthesis capacity of the reaction and absorption centres from the photosynthetic systems, and the content of flavonoid pigments with role in plant protection against stress factors recorded high values at all the varieties analyzed during the entire vegetation period that was characterized by thermal and hydric normality.

2. The results obtained in Cotnari vineyard show that Grasa de Cotnari and Tamaioasa romaneasca varieties present the highest light absorption capacity during the berry growth phenophase and the highest photosynthetic efficacy during the fruit maturation period. This feature demonstrates the special adjustment capacity of these varieties to the ecological conditions from the experimented area.

3. In Dealu Bujorului vineyard it stands out the Italian Riesling variety which recorded the maximum content of assimilating pigments both in the absorption and the reaction centres from the photosynthetic centres, the values being reflected in the accumulation of the maximum quantity of sugar in the grapes, with values equal to those of supramaturation, increasing the production quality of this variety.

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