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OBSERVATIONS ON THE FOLIAR ASSIMILATING PIGMENTS CONTENT FOR WILD AND GARDEN ROSES

ADUMITRESEI LIDIA[1], ZAMFIRACHE MARIA MAGDALENA[2], OLTEANU ZENOVIA[2], BOZ IRINA[2]

Abstract: The study of foliar assimilating pigments (chlorophyll a and b, carotenoid pigments) during the ontogenetic development for the wild and the cultivar species of roses indicate from interesting aspects on the ratio chlorophyll a and b, which is more than a unit in the case of species and in most cases, less than a unit for the cultivars. The ratio chlorophyll and carotenoid pigments, reaches thousands in the case of species and units (tenths) for cultivars.
We mention here that the cultivars are the result of multiple and introgressive hybridizations conducted for hundreds of years [ADUMITRESEI & STĂNESCU, 2009; KRÜSMAN, 1986].

Key words: wild and cultivated roses, chlorophyll, carotenoids from the leaf

Introduction

The *Rosa* genus represents, through the spontaneous species spread in the holarctic region, a botanical entity of wide scientific, fundamental and applied interest; despite all this, information about the fundamental research on its biology is still scarce [BURZO & al. 2005; JITĂREANU, 2007; SIHNA, 2004; ZAMFIRACHE, 2005, 2006].

As far as its behaviour towards sunlight is concerned, the speciality literature mentions that the species of the *Rosa* genus are mostly heliosciophyte having a transition character between the sun and the shade species [KRÜSSMAN, 1986].

From a physiological point of view, for the representatives of the *Rosa* genus the more intensely studied under a functional aspect are the two distinct photo systems and less other characteristics of photo assimilating pigments [TAIZ, 2002].

Material and methods

The study of assimilating pigments content from 9 spontaneous species of the *Rosa* genus, 5 aboriginal ones (*R. canina* L., *R. gallica* L., *R. glauca* Pourr., *R. pimpinellifolia* L., *R. rubiginosa* L.) and 4 alochtonous ones (*R. damascena* Mill., *R. multibracteata* Hemsl. et Wills., *R. multiflora* Thunb. and *R. rugosa* Thunb.) was conducted during vegetation period, observing chlorophyll and carotenoid pigments content at vegetative status, blooming fructification and fruit ripening. In order to emphasize the same compounds 8 types of garden roses ('Cocktail', 'Laminuette', 'Luchian', 'M-me A. Meilland', 'Perla d'Alcanada', 'Président Briand', 'Pristine' and 'Rose Gaujard') were observed.

[1] "Anastasie Fătu" Botanic Garden, "Alexandru Ioan Cuza" University of Iaşi, Dumbrava Roşie, no. 7-9, 700487, Iaşi – Romania, e-mail: lidia.adumitresei@yahoo.com
[2] "Alexandru Ioan Cuza" University of Iaşi, Bd. Carol I, no. 11, 700 506, Iaşi – Romania

The fresh material of foliar assimilating pigments determinations was done in the Vegetal Physiology Laboratory of the Biology Faculty, "Alexandru Ioan Cuza" University of Iaşi by spectrophotometric method.

Results and discussions

In the case of species, during the vegetative stage, there can be observed a higher chlorophyll a content compared to chlorophyll b, of a ratio ranging around the value of 3/1 in all the cases.

Slightly higher values of chlorophyll were registered for the species *R. damascena* (1.897 mg), *R. glauca* (1.576 mg) and *R. pimpinellifolia* (1.448 mg), with a minimum value for the *R. multibracteata* (1.016 mg) species (Fig. 1).

High values of chlorophyll b are present in the species *R. damascena* (0.617 mg), followed by *R. glauca* (0.538 mg) and *R. canina* (0.516 mg), while the lowest quantities are to be found in *R. rubiginosa* (0.319 mg) and *R. multibracteata* (0.306 mg).

The minimum values of the chlorophyll a : chlorophyll b ratio are observed in *R. pimpinellifolia* (2.998/1), *R. glauca* (2.929/1), while *R. rubiginosa* and *R. multibracteata* have ratios that are superior to the values 3.3/1.

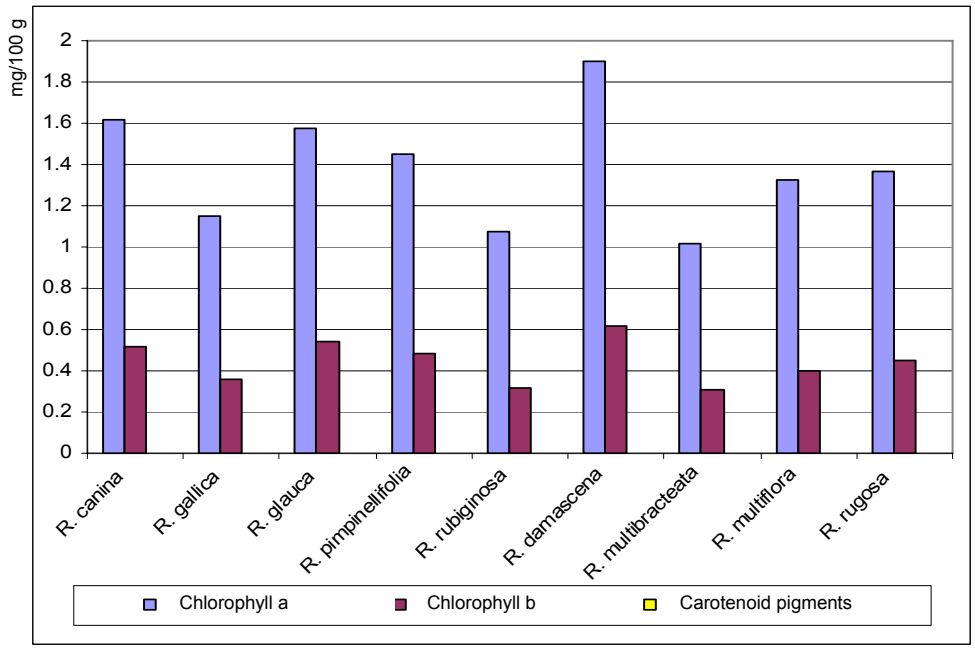

Fig. 1. The assimilating pigments content variation for the investigated species of *Rosa*, vegetative stage

Carotenoid pigments have comparable values for all the taxons, varying between 0.0004 mg (*R. multibracteata* and *R. gallica*) and 0.0006 mg (*R. damascena*).

One must notice that the relatively high content of chrolophyll pigments in the *R. glauca* species, which are macroscopically shielded by antocianic pigments, giving it the colour naming the species.

The carotenoid pigments content is extermely low in all the species, and the ratio of chlorophyll and carotenoid pigments varies between 3305/1 in the case of the *R. multibracteata* species and 4266 for the *R. canina* species.

It is possible, that the usual role of protective screen of the carotenoid pigments may be taken over by the antocianic pigments present in large quantities in the leaves as well as in the young *Rosa* shoots

The already mentioned observations for the vegetative development fenophase are generally true for the **blooming fenophase**, with the sole observation that there is a decreasing tendency of the chlorophyll content (a and b) for the majority of species, except for *R. pimpinellifolia*, where chlorophyll a content (2.215 mg compared to 1.448 mg in the previous stage), as well as chlorophyll b (0.772 mg compared to 0.483 mg) is going up, while for the exotic species *R. multibtracteata* and *R. multiflora* there is only a significant increase in chlorophyll a content (2.361 mg compared to 1.016 mg and 2.083 mg respectively, compared to 1.328 mg).

In this fenophase, the ratio of these two types of chlorophyll slightly modifies its values, slightly superior to the 4/1 level in *R. gallica* among all the other aboriginal species and *R. damascena* among the alochtonous species. Most the species have a ratio between 3 and 4/1. *R. rubiginosa* clearly distinguishes itself with a 1/0.141 ratio of chlorophyll a and b, where we can also notice on the one side a reduction in the total content of assimilating pigments (0.525 mg compared to 1.396 mg in the previous stage). On the other side, there is also a reverse in the ratio of the two types of chlorophyll in favour of chlorophyll b (Fig. 2).

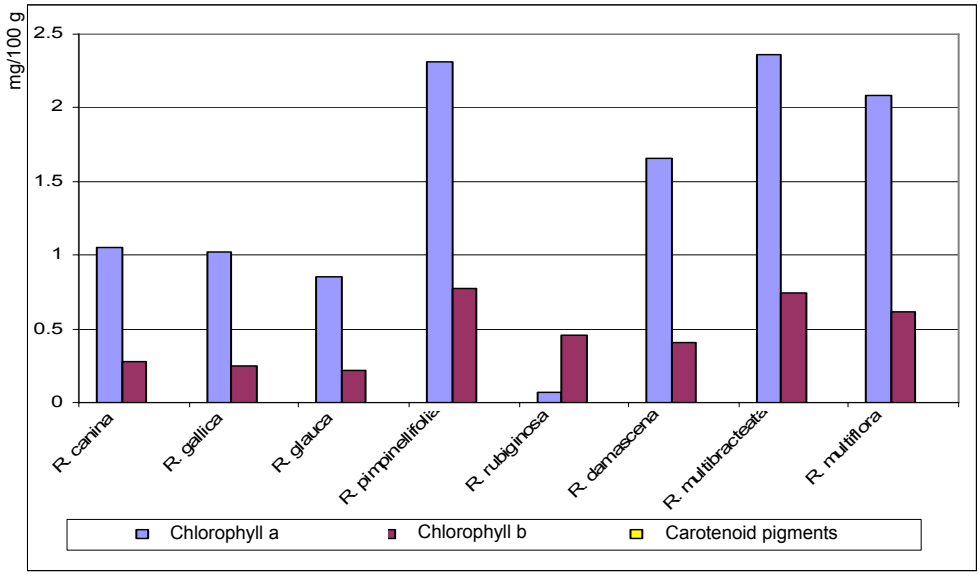

Fig. 2. The assimilating pigments content variation for the investigated species of *Rosa* at the blooming fenophase stage

We must mention that during this fenophase the volatile substances content in the *R. rubiginosa* leaf is at its peak.

At the start of the fructification one can notice an increase in the assimilating pigments content for the majority of the species combined with a decrease of the clorophyll a and b ratio under the 3/1 value. The value remains superior to this level only for *R. canina* (3.043/1). The content of carotenoid pigments slightly increases, reaching values between 0.0006 and 0.0007 mg for the species *R. pimpinellifolia*, *R. rubiginosa*, *R. glauca* and *R. rugosa* (Fig. 3).

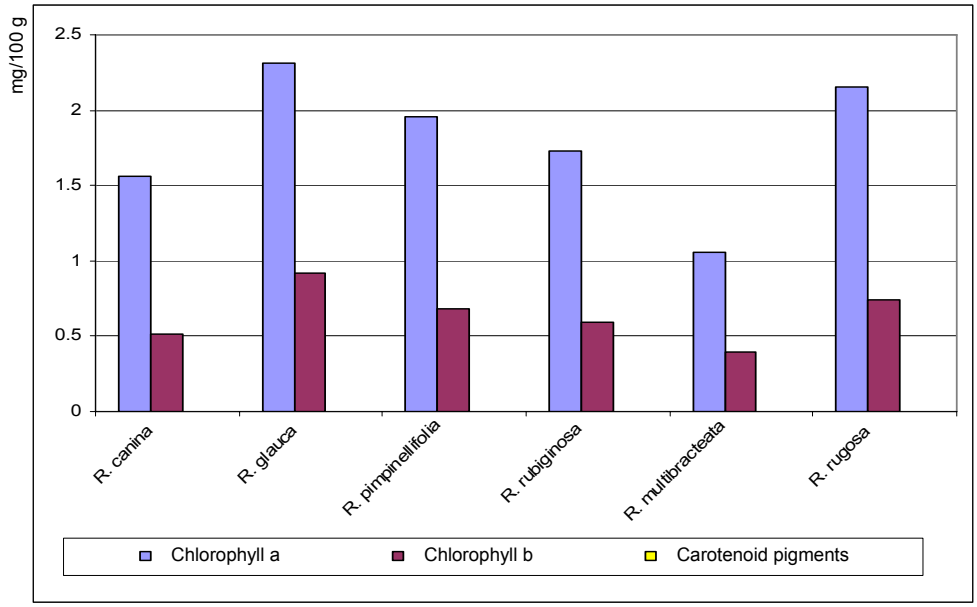

Fig. 3. The assimilating pigments content variation for the investigated species of *Rosa* at the start of the fructification stage

The ratio of assimilating and carotenoid pigments also displays extremely high values ranging from 3873/1 for *R. rubiginosa* and 6913/1 for *R. canina*.

At the **ripening of the fruits** we notice a decrease in the content of assimilating pigments, with a ratio of assimilating pigments varying between 1.612/1 for *R. multibracteata* and 2.820/1 for *R. rubiginosa*. The ratio of assimilating pigments and carotenoid ones register high values between 3644/1 for *R. gallica* and 4411/1 for *R. multibracteata* (Fig. 4).

The analysis of foliar assimilating pigments for cultivars at vegetative and generative stage (blooming) reveals a series of significant differences compared to the spontaneous species.

First of all, there is a much higher chlorophyll b content than chlorophyll a at the majority of the taxons, at both harvestings. Secondly, the cultivars display larger quantities of carotenoid pigments compared to other species.

The chlorophyll a and chlorophyll b ratio, as well as the one for assimilating and carotenoid pigments presents itself as having totally different limits.

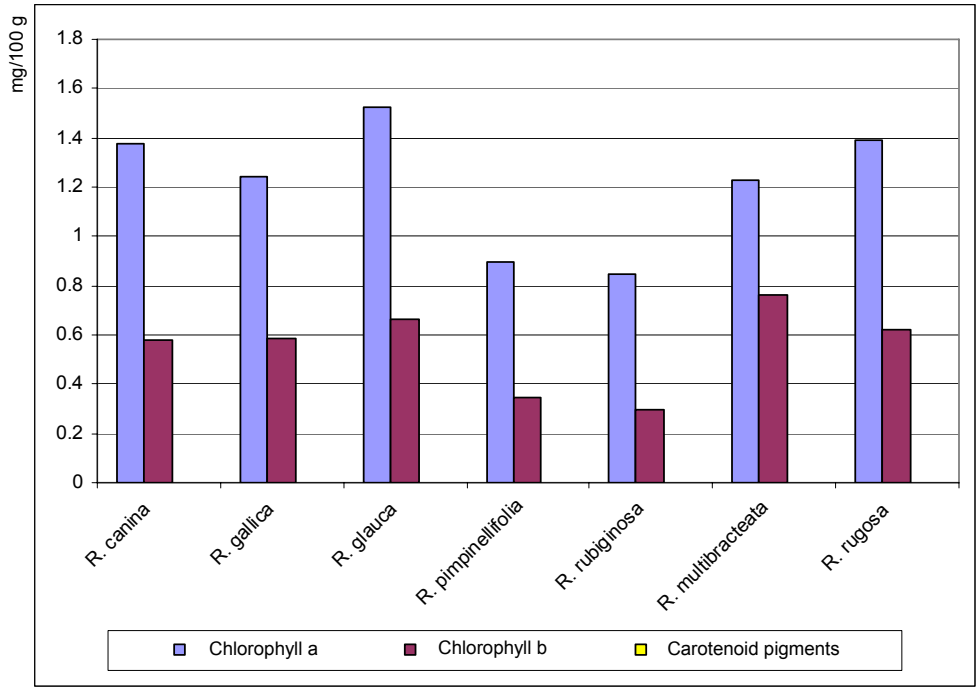

Fig. 4. The assimilating pigments content variation for the investigated species of *Rosa* at the ripening stage

For the **cultivars at vegetative stage** there is a low content in chlorophyll a varying between 0.048 mg for the cultivar 'Cocktail' and 'M-me A. Meilland' as well as 'President Briand' (0.076 mg), with values closer to 0.1 mg for cultivars 'Laminuette', 'Rose Gaujard' and 'Pristine', raising over 0.2 and 0.3 mg respectively for cultivars 'Perla d'Alcanada' (0.202 mg) and 'Luchian' (0.0308 mg). As far the chlorophyll b content is concerned, small quantities in absolute values (in these cases lower than in chlorophyll a) can be observed in the cultivars 'Perla d'Alcanada' (cu 0.016 mg), 'Rose Gaujard' (0.054 mg) and 'Luchian' (0.225 mg). The other cultivars contain between 1.265 mg in the case of the cultivar 'M-me A. Meilland' and 1.691 mg in the case of cultivar 'Pristine' (Fig. 5).

The chlorophyll a and chlorophyll b ratio diplays less than a unit values in the case of most cultivars, ranging from 0.038/1 for the cultivars 'M-me A. Meilland' and 'Cocktail' and 0.071/1 for the cultivars 'Laminuette' and 'Pristine'. Ratios over the unit can be seen in the cultivars 'Luchian' (1.369/1), 'Rose Gaujard' (2/1) and a much higher value for 'Perla d'Alcanada' (12.625/1).

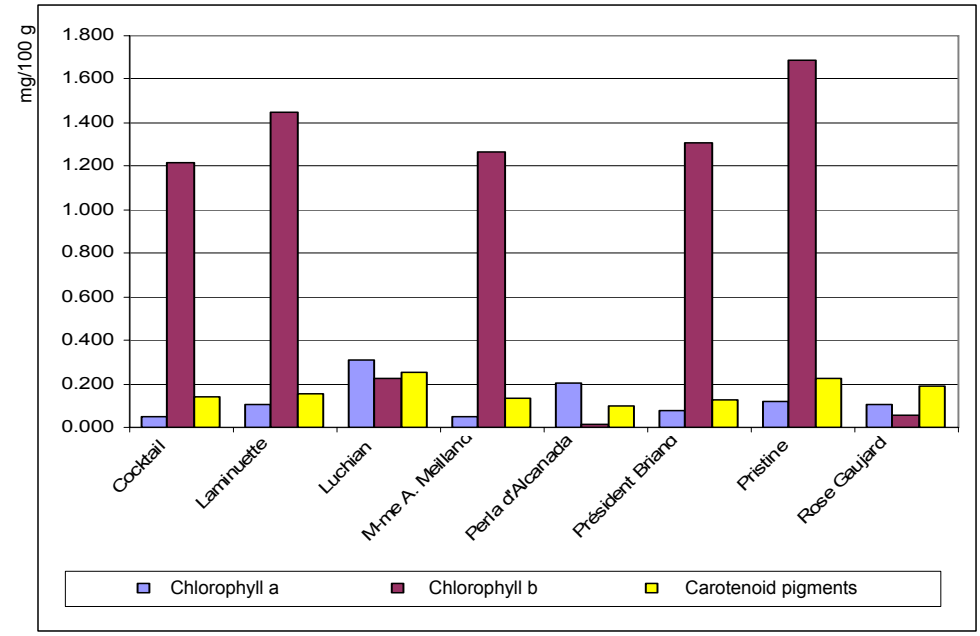

Fig. 5. The assimilating pigments content variation for the investigated species of *Rosa* at the vegetative stage

The ratio of assimilating and carotenoid pigments comes in the case of cultivars close to the values mentioned by classic physiology, varying between (0.866/1) for the 'Rose Gaujard' cultivar and 10.836/1 for the 'Président Briand' cultivar, while the other cultivars are aiming at one of these two poles: 'Luchian' (2.098/1) and 'Perla d'Alcanada' (2.247/1) and between 8 and 9/1 respectively, in the case of the cultivars 'Pristine', 'M-me A. Meilland', 'Laminuette' and 'Cocktail'.

At the **blooming fenophase** there is, first of all, a high clorophyll b content, which varies between 1.297 mg for the 'Perla d'Alcanada' cultivar and 2.264 mg for the 'Rose Gaujard' cultivar.

Secondly, there is a low chlorophyll a content in all the examined cultivars, between the limits: 0.050 mg for 'Perla d'Alcanada', 0.075 mg for the 'Pristine' cultivar and 0.272 mg for the 'Cocktail' cultivar.

Finally, there is a remarkable carotenoid pigments content, which in most cases overpasses the chlorophyll a content with two exceptions, the 'Cocktail' (with 0.272 mg chlorophyll a compared to 1.1 mg of carotenoid pigments) and 'Rose Gaujard' cultivars (chlorophyll a 0.216 mg, and carotenoid pigments 0,196 mg), but even in these cases the differences are small [TĂMAȘ & NEAMȚU, 1986].

As a consequence, the chlorophyll a and b ratio is places less than a unit with extremely low values (between 0.039 for the 'Perla d'Alcanada' cultivar and 0.198 for the 'Cocktail' cultivar).

As it in vegetative stage, the ratio of chlorophyll and carotenoid pigments has values close to those mentioned in classic physiology textbooks (between 9.258 for the

'Cocktail' and 'Laminuette' cultivars and 12.713 mg for the 'M-me A. Meilland' cultivar) (Fig. 6).

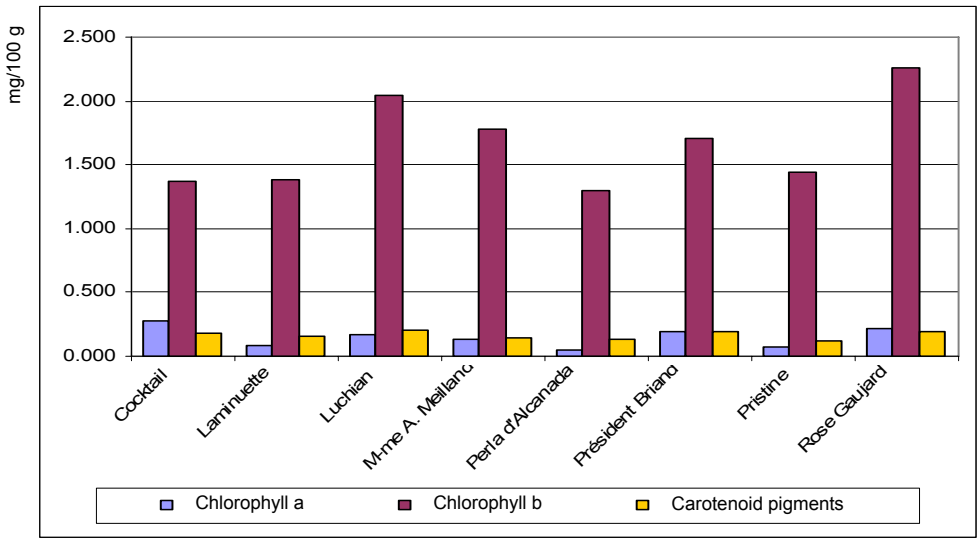

Fig. 6. The assimilating pigments content variation for the investigated cultivars of *Rosa* at the blooming fenophase stage

The higher content of chlorophyll b compared to chlorophyll a is, according to concepts of the classic physiology, something particular of the shade plants, but the roses planted vegetated really well in full sunlight. It is possible that the cultivated roses need a much consistent protection screen since they bloomed better there than in the shade [ARGATU, 1989; WAGNER, 1978; KRÜSSMAN, 1986].

According to the modern physiology concepts the chlorophyll and carotenoid pigments selectively absorb the radiations of light. Chlorophyll a presents a maximum absorption of the radiations with a wavelength of 700 and 435 nm respectively. Chlorophyll b has a maximum absorption of the radiations with the wavelength of 644 and 453 nm respectively, while the carotenoid pigments have a maximum absorption of the radiations within the wavelengths 400-480 nm. With this reality as a starting point, one may observe that the current roses cultivars have a more intense absorption of blue radiation [JITĂREANU, 2007 according to AUDERIRK & AUDERIRK, 1993].

Conclusions

In the case of spontaneous species chlorophyll a is predominant, the chlorophyll a and b ratio varying between 1.6-4/1, similar to the one described by classic physiology as being specific to plants that love sunlight.

For the hybrid origin cultivars, chlorophyll b is predominant with an a/b ratio varying between 0.37-2/1, which would suggest that, according to classic physiology, these cultivars love shade. However, the field observations contradict it. According to the modern physiology concepts [JITĂREANU, 2007 according to AUDERIRK & AUDERIRK, 1993]

the chlorophyll and carotenoid pigments selectively absorb the light radiations. This is how the garden roses display a more intense absorbtion of blue radiations.

The carotenoid pigments content is extremely low for spontaneous species (under ppm per mg/100 g fresh material), while for the cultivars it ranges within normal limits, with the values of 0.1-0.2 mg/100 g per fresh material.

Most probably, together with the carotenoid pigments acting as protectors of the chlorophylls, there are other anthocyanic pigments present in large quantities in species and cultivars as well in all of the ontogenesis stages.

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