ECOPHYSIOLOGICAL RESEARCH DURING THE ONTOGETENIC CYCLE OF ROSES

CERCETĂRI ECOFIZIOLOGICE ÎN TIMPUL CICLULUI ONTOGENETIC LA TRANDAFIRI

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Abstract. *Rose plant resistance to adverse conditions such as drought and high temperatures changes during ontogenesis, by the appearance of periods of high sensitivity, as the period of vegetative growth and flowering.* The *present study aims to analyse the eco-physiological response of varieties of roses to the climatic conditions of the year 2008 induced by global warming, estimated by the evaluation of the process of photosynthesis, measuring the photosynthetic and flavonoid content of leaf pigments, and by assessing the resistance of varieties in the study to dehydration, during the phenological phases. Leaf pigment content was analyzed spectrophotometrically by determining the ability of light absorption by acetone extract of pigments, in the blue and red areas of the visible spectrum. The study of the leaf pigments content and the rate of dehydration of the leaves to the respective species in the study showed the changes induced by environmental conditions on the quality and vitality of plants.*

Key words: rose**,** drought, leaf pigments, dehydration

Rezumat. *Rezistenţa plantelor de trandafir la condiţiile nefavorabile, cum ar fi seceta şi temperaturile ridicate, se modifică în timpul ontogenezei, prin apariţia unor perioade de sensibilitate ridicată, aşa cum sunt perioada de creştere vegetativă şi înflorirea. În lucrarea de faţă ne-am propus să studiem reacţia eco-fiziologică a unor soiuri de trandafiri, faţă de condiţiile climatice ale anului 2008 induse de încălzirea globală, apreciată prin evaluarea procesului de fotosinteză, determinând conţinutul de pigmenţi clorofilieni şi flavonoizi din frunze, şi prin aprecierea rezistenţei soiurilor luate în studiu la deshidratare în diferite fenofaze. Conţinutul de pigmenţi din frunze a fost analizat spectrofotometric, prin determinarea capacităţii de absorbţie a luminii de către extractul acetonic de pigmenţi, în zonele albastră şi roşie ale spectrului vizibil. Studiul conţinutului de pigmenţi foliari şi a ritmului de deshidratare a frunzelor la soiurile luate în studiu a evidenţiat modificările induse de condiţiile de mediu asupra calităţii şi vitalităţii plantelor.*

Cuvinte cheie: trandafiri, secetă. pigmenţi foliari, deshidratare

INTRODUCTION

The extreme meteorological phenomena that have appeared in the context of global worming have had catastrophic ecological consequences. At the same time, they have also had a negative influence on the normal development of cultivated plants and their vegetation cycle (Gore Al., 2007). The atmospheric and pedological draught has determined the modification of certain physiological and biochemical processes which have had severe repercussions over the

ultrastructure and the physiological activity of plant cells. (Pârvu C., 2005, Jităreanu Carmen Doina, 2007). The visible effects are represented by the withering of leaves, the reduction of the stoma opening, perspiration and also the decrease of the photosynthesis' intensity due to the poor supply of CO_2 (Wagner Şt., 2002). If mankind were capable of limiting the rise of global temperature, agriculture could adjust to the new climatic conditions by differently cultivating the soil and by growing plants that can adapt to the new conditions (Toma Liana Doina, Jităreanu Carmen Doina, 2007). Of extreme importance is the growth of plants with deep roots such as the rose (Şelaru Elena, 1993).

In the present paper we intended to study the eco-physiological reaction of a variety of roses grown in the Copou area of Iaşi to the climatic conditions existent in 2008 that were induced by the global worming. The eco–physiological reaction was estimated after evaluating the process of photosynthesis, determining the content of photosynthetic and flavonoid pigments from the leaves and estimating the dehydration resistance of the species included in the study.

MATERIAL AND METHOD

There were four varieties of roses tested during the present study: *Luchian, Rose Gaujard, Madame Meilland, Emeraude d'Or.* They were grown at the farm of the Experimental Didactic Station of U.S.A.M.V in Iaşi, in the climatic conditions of 2008.

Analysis of climatic conditions. The evolution of the climatic factors in 2008, from the Copou area of Iaşi was submitted to a monthly analysis that made it possible to establish the monthly mean and sum of the air temperature and of the level of precipitations, as well as the deviation from the multi-annual mean.

Analysis of the foliar pigments content. The analyses of the foliar pigments content were made during the following phenophases: *vegetative growth, flowering and the beginning of the repose stage* at the leaves of the vegetative and floriferous shoot. The foliar pigments were extracted by solubilization in acetone and their content was estimated using the *computerized spectrophotometric method,* by determining the light absorption capacity of the acetonic extract in the blue and red areas of the visible spectrum, which characterize the wave lengths with maximum absorption for chlorophyll (431 – 432, 453 – 454 and 662 – 663). The results are presented in absorption units.

Establishing the dehydration rhythm of the rose leaves. The water forms present in the leaves can suggest the different physiological processes within the plants. At a foliar level, the water forms can indicate the intensity of the perspiration process that is represented by the free water content.

RESULTS AND DISCUSSIONS

The evolution of the climatic factors in 2008, in the Copou area in Iaşi was submitted to a monthly analysis and thus establishing the monthly mean and sum of the air temperature and of the precipitations as well as the deviation from the multi-annual mean. The dynamic study of the monthly mean temperatures demonstrates that, during the first three months of 2008 this ranged between -1.3^{o}C in January and 7.1^{o}C in March, the deviations from the multi-annual mean ranging between 1.4^{o}C and 3.6^{o}C. These values had a positive influence over the way the roses managed to get out of winter as it is well known that once the sap

starts circulating, plant freeze at temperatures between -5°C and -10°C (fig. 1). The precipitation level during the period that was analyzed showed a deficit of -12.8mm, respectively 20.2 mm in January and February, while in March there was an excess of 4.6 mm. These conditions did not affect the rose culture, roses having a powerful reaction to the moderate humidity.

In April, the monthly mean temperature was of 11.2°C, the deviation from the multi-annual mean being of only 0.9°C and in May there was a negative deviation (-0.3°C) with a monthly mean of 15.8°C. Given the monthly mean temperature of 20.6°C and the deviation of 1.1°C in respect to the normal one, we can say that these months have favored the growth of vegetative copse and flower development, roses needing daily variations of temperature below 4°C at night and over 16°C during the day. If we consider the hydric conditions, the growth registered in this period was significant, of 46.2mm in April followed by a slight deficit in May (-5.8 mm) and June (-4.2 mm). These results did not affect the roses which, due to their structure and origin, have a deep root system resistant to draught.

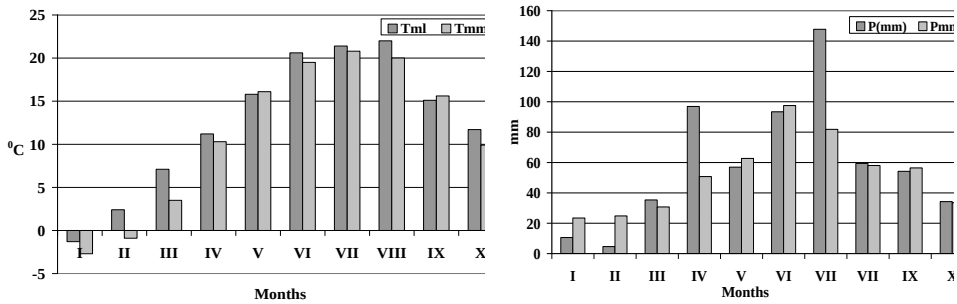

Fig. 1. The evolution of the climatic conditions in 2008

The average temperatures for July and September were close to the multi-annual mean, in August being registered a thermic growth of 2°C. Given the hydric surplus of 65.9 mm in July and the level of precipitation close to the multi-annual mean in August and September, the rose experienced the most propitious conditions during the flowering phenophase, with high temperatures and moderate humidity.

The analysis of the foliar pigments content in the copse's leaves of the four varieties of roses demonstrates a differentiated evolution, according to the phenophase and the variety of pigments.

It was noticed that in June, during the phenophase of shoot's growth, the content of photosynthetic pigments, respectively the *a* chlorophyll 662 – 663 nm, the *b* chlorophyll 453 – 454 nm and the *a* chlorophyll 434 – 435 nm, have minimum values at the *Luchian* variety and maximum values at Emeraude d'Or. The content of flavonoid pigments with absorption at the wave length of 320-322nm is maxim at *Madame Meilland*, but it has registered minimum values at *Emeraude d'Or* (fig. 2). The same results prove a highly efficient photosynthesis in the case of the *Emeraude d'Or* allochthonous, as well as a minimum resistance in case of climatic or biotic stress at the same phenophase. The other varieties, the autochthonous *Luchian* and the French varieties *Rose Gaujard* and *Madame*

Meilland, show a modest capacity of light absorption and biosynthesis of the assimilated as well as a moderate resistance to stress factors.

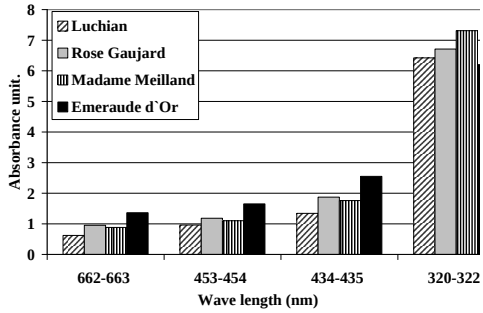

Fig. 2. The content of photosynthetic pigments in the phenophase of vegetative growth

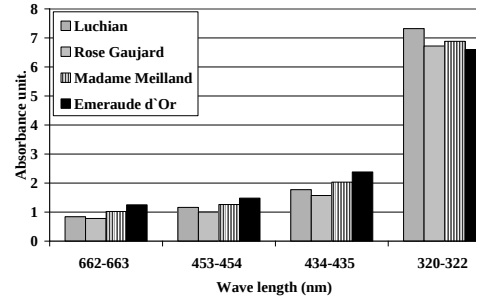

Fig. 3. The content of photosynthetic pigments in the first part of the flowering phenophase

In July, during the first stage of the flowering phenophase, the evolution of the photosynthetic pigments has, in general, a similar dynamic, the ratio between the varieties analyzed being almost the same. Nevertheless, the autochthonous variety *Luchian* presents a maxim content of flavonoid pigments at that can offer it a higher resistance to stress in respect to the French varieties (fig. 3).

This characteristic becomes more intense in August when plants continue their flowering phenophase. In these conditions, the *Luchian* variety makes itself noticed with its capacity to absorb light - represented by the *a* chlorophyll 434-435 nm and *b* chlorophyll 453-454 content - to synthesize the assimilated represented by the *a* chlorophyll 662-663 content and especially with its resistance to stress represented by the flavonoid pigments with maximum absorption at wave lengths of 320-322 nm, all of them being superior to the French varieties (fig. 4).

In October, plants continued flowering but in the same time the assimilated were directed toward depositing the starch in the branches, accomplishing the maximum of autumn. What follows now, is the maturation of the wood that is meant to assure the plants' resistance to low temperatures. In this phenophase it is noticed the high content of photosynthetic pigments at the autochthonous variety *Luchian*, that could suggest a proper preparation to winter when the content of flavonoid pigments is minimum. The allochthonous varieties present moderate values of light absorption capacities and biosynthesis of the assimilated, but a high content of flavonoid pigments; the maximum values were registered in the case of *Madame Meilland*, followed by *Emeraude d'Or* (fig. 5). These results suggest the existence of two different physiological mechanisms of assuring resistance during cold season in the case of two varieties with different origin; for the autochthonous *Luchian* this mechanism is based on the intensification of carbohydrate deposit resulted from photosynthesis while for the allochthonous varieties they are based on biosynthesis and accumulation of flavonoid pigments.

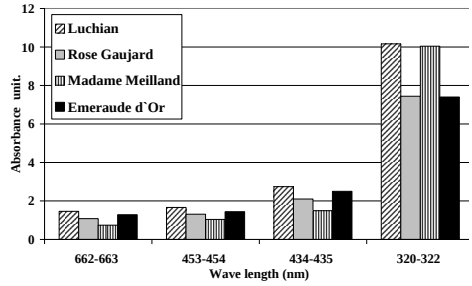

Fig. 4. The content of photosynthetic pigments in the second stage of the flowering phenophase

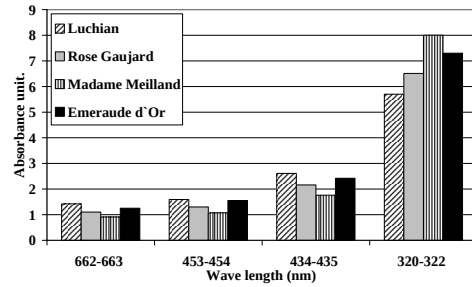

Fig. 5. The content of photosynthetic pigments at the beginning of the repose phenophase

The results of the analysis meant to establish the **dehydration rhythm of the rose leaves** demonstrates that in the phenophase of vegetative growth, *Madame Meilland* presented the lowest level of perspiration that was expressed by the amount of water lost in the first hour and the lowest content of free water, represented by the amount of water lost in 24 hours. We may say that this variety of rose has the highest capacity to retain water during the vegetative growth as well as the highest capacity to deal with hydric stress in this phenophase (fig. 6).

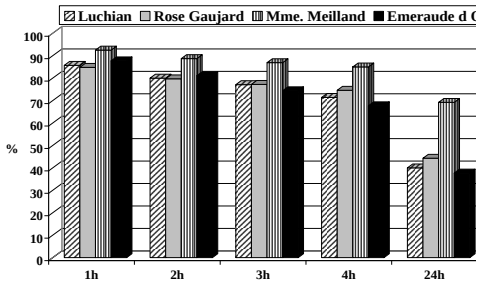

Fig. 6. The dehydration rhythm during the phenophase of vegetative growth.

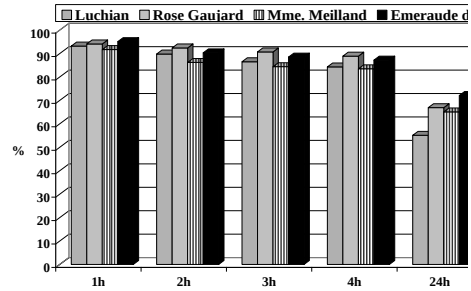

Fig. 7. The dehydration rhythm during the first stage of the flowering phenophase

In July, during the first stage of the flowering phenophase, it was noticed that the values of the intensity of the perspiration process were similar for all the varieties included in the study (fig. 7). The difference between the Romanian variety (*Luchian*) and the French ones (*Madame Meilland*, *Emeraude d'Or*, *Rose Gaujard*) is represented by the free water content that demonstrates a minimum resistance of the foliar system to the hydric stress for the autochthonous variety in relation to the allochthonous varieties.

In August, during the second stage of the flowering phenophase, the values of the perspiration intensity were higher, some French varietys becoming more sensitive to the thermic and hydric stress represented by draught; the content of free water at the level of the leaves is also different, being minimum for the *Rose Gaujard* and *Luchian* and maximum for the *Emeraude d'Or* variety (fig. 8).

In October, at the moment when plants begin their repose phenophase, the differences between the varieties with different origins become clearer. The

autochthonous *Luchian* variety presents the lowest rhythm of foliar dehydration with minimum values for the perspiration intensity and the free water content in the leaves. In the case of the allochthonous varieties included in this study, the highest rhythm of dehydration was registered at *Madame Meilland* and *Rose Gaujard* (fig. 9).

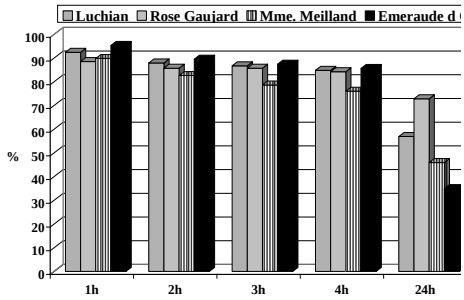

Fig. 8. The dehydration rhythm during the second stage of the flowering phenophase

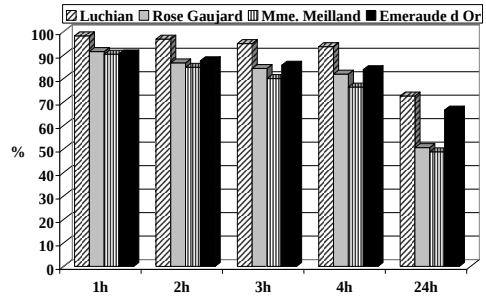

Fig. 9. The dehydration rhythm when plants begin their repose phenophase

These data underline the distinct behavior that varieties with different origins have when preparing to winter; the autochthonous variety makes itself noticed by a metabolic activity of retaining water when preparing to winter.

CONCLUSIONS

1. After the analysis of the eco-physiological conditions of 2008 in the Copou area in Iaşi it resulted that they are auspicious for the ontogenetic cycle of rose plants, for all the varieties that were studied.

2. From the analysis of foliar pigments results that the *Emeraude d'Or* variety is characterized by a maximum photosynthetic efficiency while the autochthonous *Luchian* variety presented a maximum content of flavonoid pigments during the growth and flowering phenophases that offer this variety a higher resistance to stress.

3. From the analysis of the dehydration rhythm the *Madame Meilland* variety presents the highest capacity to retain water and the highest resistance to hydric stress. During the flowering phenophase it was noticed an intensification of the perspiration process to all varieties analyzed, less resistant being the autochthonous *Luchian* variety that intensified its water retaining activity for the wood maturation and wintering while on repose.

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