

PHYSIOLOGICAL MODIFICATIONS IN *ROSA CENTIFOLIA* L. AS A RESULT OF THE ATTACK PRODUCED BY *PHRAGMIDIUM MUCRONATUM* (PERS.) SCHLTDL.

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Abstract. The research studies regarding physiological modifications produced by *Phragmidium mucronatum* (PERS.) SCHLTDL. have been made on Kosmos roses variety cultivated in Botanical Garden “Al. Buia” of Craiova. In the attacked plants one can observe the diurnal dynamics of the photosynthesis and of transpiration presents a minimum in the morning, a maximum after lunch and a minimum toward the evening, in connection with the climatic conditions, with pathogen specific variations. At the attacked plants one can also observe a decrease of chlorophyll content as a result of the blockage synthesis of the chlorophyllian pigments. These plants present a decrease of total water content as a result of malfunctioning of closing and opening mechanisms of the stomates, which is manifested by the withering and premature drying of the plants.

Keywords: attacked plants, healthy plants, pathogen, roses variety.

Rezumat. Modificări fiziologice la *Rosa centifolia* L. ca urmare a atacului produs de *Phragmidium mucronatum* (PERS.) SCHLTDL. Cercetările privind modificările fiziologice produse de *Phragmidium mucronatum* (PERS.) SCHLTDL. s-au efectuat la soiul de trandafiri Kosmos cultivat în Grădina Botanică “Al. Buia” din Craiova. În plantele atacate se observă că dinamica diurnă a fotosintezei și transpirației prezintă un minim dimineața, un maxim după prânz și un minim spre seară, în funcție de condițiile climatice, cu variații specifice patogenului. La plantele atacate se observă o scădere a conținutului în clorofilă ca urmare a blocării sintezei pigmentilor clorofilieni. Aceste plante prezintă o scădere a conținutului în apă totală ca urmare a dereglării mecanismelor de închidere și deschidere a stomatelor, fapt manifestat prin ofilirea și uscarea prematură a plantelor.

Cuvinte cheie: plante atacate, plante sănătoase, patogen, soi de trandafiri.

INTRODUCTION

The rose is a plant from the Rosaceae family widespread in most regions of the globe. In the *Rosa* genus there are framed as many as 400 species of shrubs whose ancestors came from Central Asia Plateaus.

Phragmidium mucronatum (PERS.) SCHLTDL. is a truly parasite species. This species produces the disease known as rust rose, as reported on cultivated varieties and hybrids of roses, but also on wild species of the *Rosa* genus (TĂNASE & ȘESAN, 2006).

The intensity of the photosynthesis and of transpiration in the case of flowery plants varies depending on environmental conditions. Thus the *Rosa* genus at a light intensity of 1826 $\mu\text{mol}/\text{m}^2/\text{s}$ has an intensity of photosynthesis of 11.21 $\mu\text{mol CO}_2/\text{m}^2/\text{s}$ and at a temperature of 35.4°C, the transpiration intensity is of 6.03 $\mu\text{mol H}_2\text{O}/\text{m}^2/\text{s}$ (BURZO et al., 2000).

At the attacked plants, there is a decrease in the intensity of photosynthesis as a result of the occurrence of chlorate spots (chlorosis) in leaf and the degradation of chloroplast and the covering of stomatitis stiles by fungus mycelium (NICOLAE, 2008).

MATERIAL AND METHODS

The research studies regarding physiological modifications produced by *Phragmidium mucronatum* (PERS.) SCHLTDL. have been made on Kosmos rose varieties cultivated in the Botanical Garden “Al. Buia” of Craiova.

The variety of Kosmos rose plants presents a height of 80 cm, cream-colored flowers with a diameter of 7 - 8 cm.

The estimation of the attack was made using the calculation formulae (SĂVESCU & RAFAILĂ, 1978).

The intensity of the photosynthesis and transpiration was established by a non-destructive method with the analyzer LCi (Ultra Compact Photosynthesis Measurement System) and the obtained results were graphically represented and statistically interpreted. The total water contents and the dry substance were determined by the help of the gravimetric method. The contents of the chlorophyllian pigments were estimates by the help of the Minolta SPAD 502 chlorophyll meter.

RESULTS AND DISCUSSIONS

The rose rust is evident on the green parts of plants: the tongue of leaves, stems, young branches, peduncle floral buds, and fruit in particular. On the surface of the attacked organs spring dusty orange pustules form, which are aecia with aeciospores (MITREA, 2006).

Pustules which are formed on the leaf nervures, on stems and branches are elongated, while pustules on the tongue of leaves and on floral buds are round and irregular (Fig. 1).

In a more advanced stage of the disease on leaves, spots of discoloration appear; they are well-determined and may conflate. Right to the spots, on the bottom of leaves, small pustules, orange, powdery, are formed, representing the uredinia of the fungus (Fig. 2).

In autumn, on the bottom of the leaves there appear the telia of the fungus in the shape of pustules of dark colour. The strong rust attack causes drying and early fall of leaves, drying of branches, the fall of the non-opening of buds. The disease is favoured by rainy periods combined with higher temperatures during the day and by misty nights.



Figure 1. The leaves of the *Rosa centifolia* attacked by *Phragmidium mucronatum*. / Figura 1. Frunze de *Rosa centifolia* atacate de *Phragmidium mucronatum* (original).



Figure 2. Uredinia at the leaf of the *Rosa centifolia* attacked by *Phragmidium mucronatum*. / Figura 2. Uredosori la frunzele de *Rosa centifolia* atacate de *Phragmidium mucronatum* (original).



Figure 3. *Phragmidium mucronatum* - the microscopic image with teliospores and urediniospores (ob. 20 x oc. 10). / Figura 3. *Phragmidium mucronatum* - imagine microscopică cu teleutospori și uredospori (ob. 20 x oc. 10) – (original).

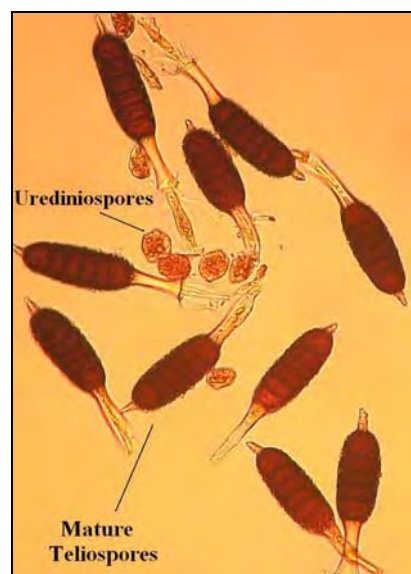


Figure 4. *Phragmidium mucronatum* - the microscopic image with mature teliospores and urediniospores (ob. 20 x oc. 10). / Figura 4. *Phragmidium mucronatum* - imagine microscopică cu teleutospori și uredospori maturi (ob. 20 x oc. 10) – (original).

Phragmidium mucronatum (PERS.) SCHLTDL. presents pycnidia, which is formed on green plant organs, arranged in small groups, within them on sporiferous filaments forming small pinoles having a thin, colourless membrane.

Uredinia are formed only on the underside of leaves and are surrounded by a corena of paraphyze clubbed and curved inwards. The urediniospores are spherical or nearly spherical, ellipsoidal or oval. The telia is formed in the same places with urediniospores, have dark colour and are pulverous (Figs. 3, 4).

The teliospores are oval or spindle elongated, multicellular (6-9 cells) rounded at the basis, and on the apical side they are narrow and finished by a colourless papilla. The membrane is dark brown, and the pedicel is colourless, dilated at the basis.

The germination of the telia results in a promycelium, on which basidiospores are formed and they ensure the first infections on the young leaves of the rose.

The intensity of the physiological processes at rose plants was established, according to the frequency, the intensity and the degree of attack, but also to the climatic conditions, on the 23rd of June 2009.

The estimation of the attack produced by the *Phragmidium mucronatum* (PERS.) SCHLTDL. at rose plants is presented in figure 5.

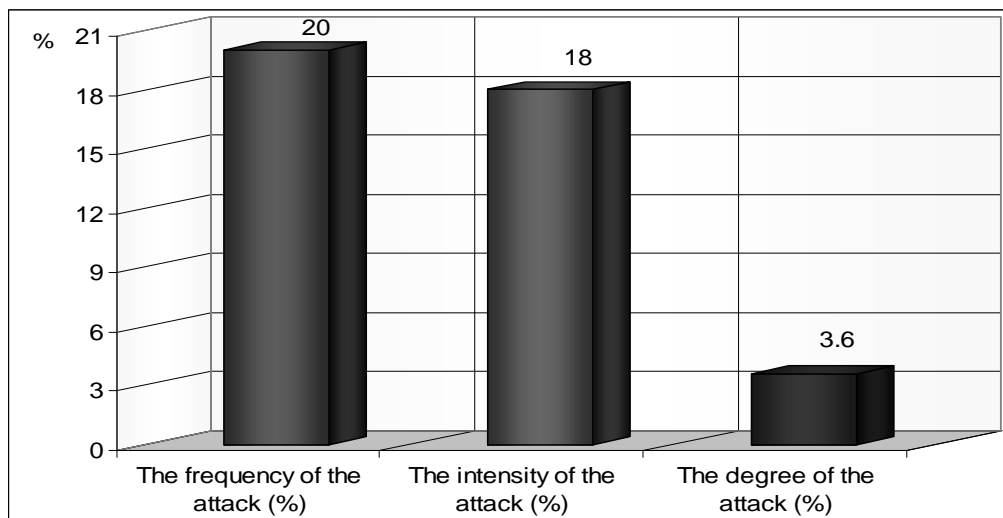


Figure 5. The estimate of the attack produced by *Phragmidium mucronatum* in the Kosmos roses variety.
Figura 5. Estimarea atacului produs de *Phragmidium mucronatum* la soiul de trandafiri Kosmos.

The research regarding physiological modifications produced by *Phragmidium mucronatum* (PERS.) SCHLTDL. shows that diurnal dynamics of photosynthesis in the attacked plants is similar to that in healthy plants but the recorded values are lower in comparison with these as a result of the reduction of the assimilation surface, as well as the inhibition of several biochemical reactions of the photosynthesis (Fig. 6).

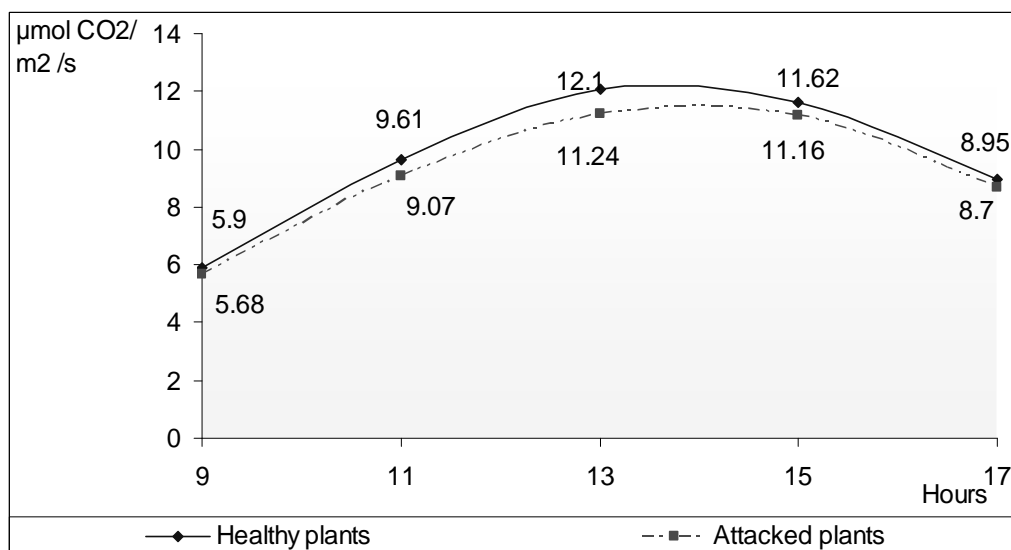


Figure 6. The diurnal dynamics of photosynthesis at the roses leaves - Kosmos variety.
Figura 6. Dinamica diurnă a fotosintezei la frunzele de trandafiri - soiul Kosmos.

The diurnal dynamics of transpiration in the attacked plants is similar to that in healthy plants, but the recorded values are lower on account of the cover of stomata by the mycelium and fructifications of the fungus, but also by malfunctioning of the closing and opening mechanisms of the stomata (Fig. 7).

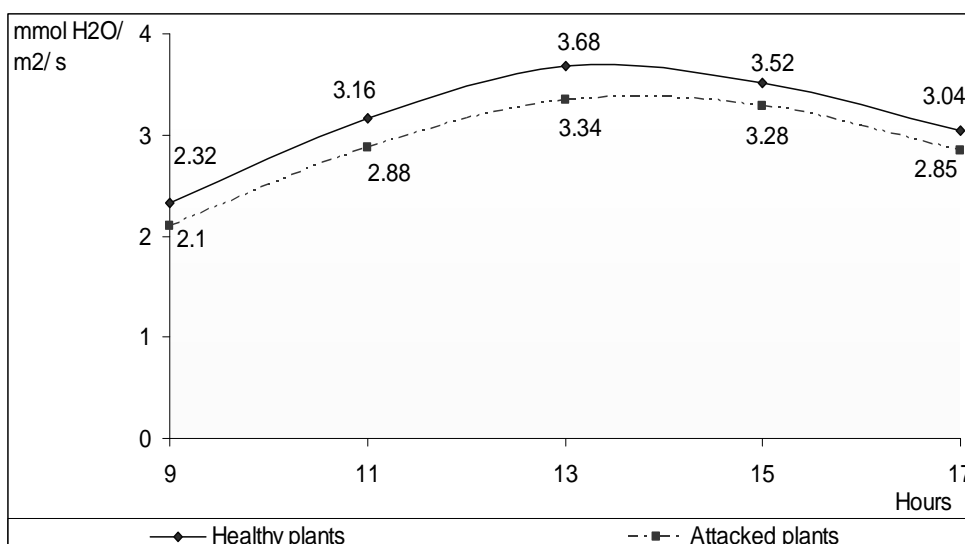


Figure 7. The diurnal dynamics of transpiration at the roses leaves - Kosmos variety.
 Figura 7. Dinamica diurnă a transpirației la frunzele de trandafiri - soiul Kosmos.

The diurnal dynamics of photosynthesis and transpiration depend on the light radiation received by leaves, which are dependent on the position of the leaves on plants.

The diurnal increase of the photosynthetic active radiations starting with the early hours of the morning is correlated with the increase of the photosynthesis and of transpiration, but present different values in the attacked plants as a result of the action of the pathogen.

At the rose plants one can observe an increase of the photosynthetic active radiations presented on the surface of the leaves in the morning (9 a.m.) when one can record values of 1,214 $\mu\text{mol}/\text{m}^2/\text{s}$ for the healthy plants and of 1,187 $\mu\text{mol}/\text{m}^2/\text{s}$ for the attacked plants, their growth up until after lunch (1 p.m.) when one record 1,560 $\mu\text{mol}/\text{m}^2/\text{s}$ for the healthy plants and 1,537 $\mu\text{mol}/\text{m}^2/\text{s}$ for the attacked plants, and towards evening (5 p.m.) one can notice a gradual decrease, recording values of 1,324 $\mu\text{mol}/\text{m}^2/\text{s}$ for the healthy plants and of 1,290 $\mu\text{mol}/\text{m}^2/\text{s}$ for the attacked plants.

Linear regression made between the rate of photosynthesis and photosynthetic active radiations show a positive correlation between the two analyzed factors, the coefficient of determination (R^2) was 0.87 for the healthy plants and 0.81 for the attacked plants (Fig. 8).

Linear regression made between the rate of transpiration and photosynthetic active radiations show a positive correlation, the coefficient of determination (R^2) was 0.88 for the healthy plants and 0.80 for the attacked plants (Fig. 9).

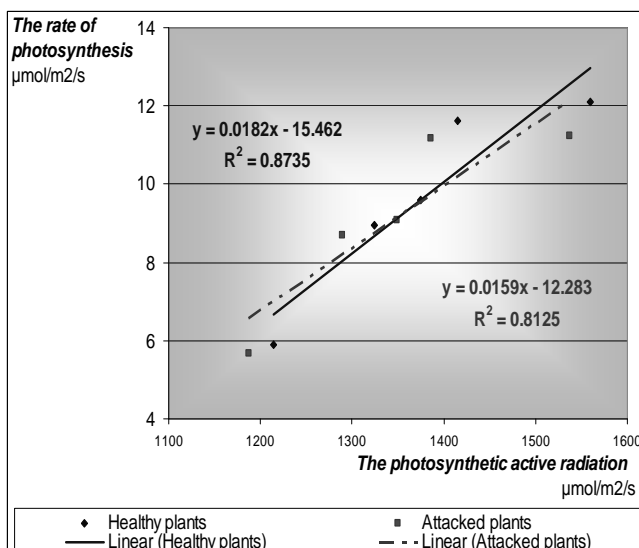


Figure 8. The correlation between the rate of photosynthesis and the photosynthetic active radiation at the roses leaves - Kosmos variety. / Figura 8. Corelații între rata fotosintezei și radiația fotosintetic activă la frunzele de trandafiri - soiul Kosmos.

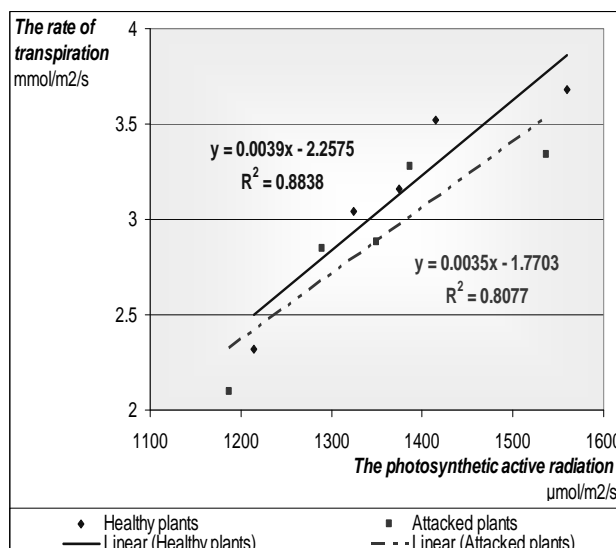


Figure 9. The correlation between the rate of transpiration and the photosynthetic active radiation at the roses leaves - Kosmos variety. / Figura 9. Corelații între rata transpirației și radiația fotosintetic activă la frunzele de trandafiri - soiul Kosmos.

The intensity of photosynthesis and transpiration depend on temperature. At the rose plants one can observe an increase of the leaf temperature in the morning (9 a.m.) when values of 30.6°C are recorded in the healthy plants and 30.9°C in the attacked plants, the increase of the temperature up until after lunch (1 p.m.) when one record 35.3°C in the healthy plants and 35.8°C in the attacked plants and towards the evening (5 p.m.) the gradual decrease of the temperature, recording values of 33.1°C in the healthy plants and 33.5°C in the plants attacked.

The diurnal increase of the temperature starting with the early hours of the morning is correlated with the increase of the photosynthesis and transpiration, but present different values in the attacked plants as a result of several structural modifications appeared in the host plants under the damaging action of the pathogen.

Linear regression made between the rate of photosynthesis and of the leaf temperature show a positive correlation between the two factors analyzed, the coefficient of determination (R^2) was 0.96 for the healthy plants and 0.95 for the attacked plants (Fig. 10).

Linear regression made between the rate of transpiration and of the leaf temperature show a positive correlation, the coefficient of determination (R^2) was 0.97 for the healthy plants and 0.96 for the attacked plants (Fig. 11).

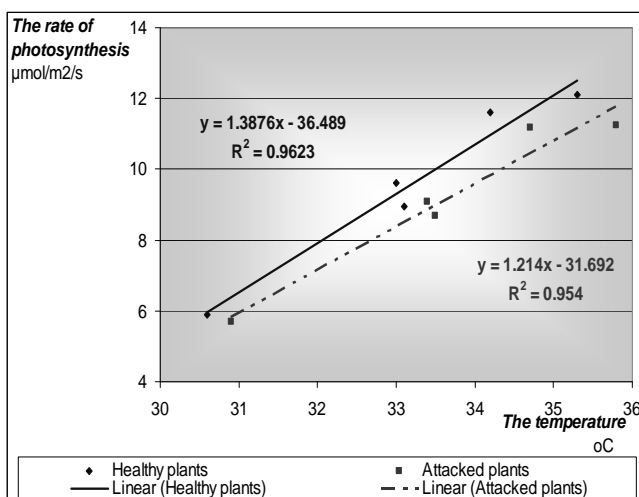


Figure 10. The correlation between the rate of photosynthesis and the leaf temperature at the Kosmos roses variety.

Figura 10. Corelații între rata fotosintezei și temperatura frunzei la soiul de trandafiri Kosmos.

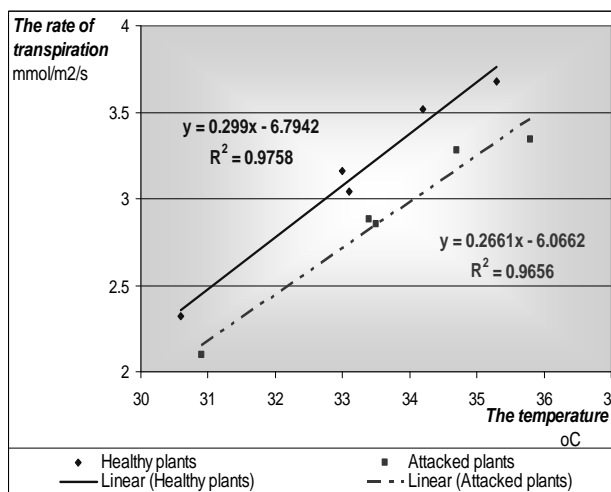


Figure 11. The correlation between the rate of transpiration and the leaf temperature at the Kosmos roses variety.

Figura 11. Corelații între rata transpirației și temperatura frunzei la soiul de trandafiri Kosmos.

At the attacked plants there can be seen a decrease of the water content by 1.18 % and an increase of the dry substance content by 2.69 %, as a result of the action of the pathogen and malfunctioning mechanisms of the stomata, which is manifested by the decrease of the cellular turgor, the withering and premature drying of the plants (Fig. 12).

The plants attacked by the pathogen present a decrease of the chlorophyll content by 4.82 % as a result of the blockage of its biosynthesis and the deterioration of the chlorophyllian pigments (Fig. 13).

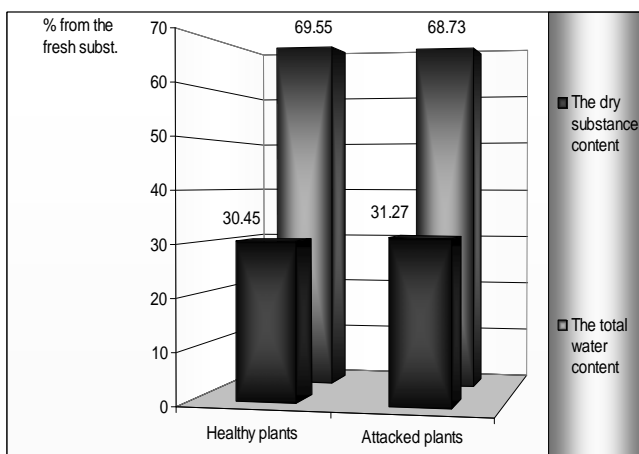


Figure 12. The total water content and the dry substance content at the roses leaves - Kosmos variety. / Figura 12. Conținutul total de apă și conținutul de substanță uscată la frunzele de trandafiri - soiul Kosmos.

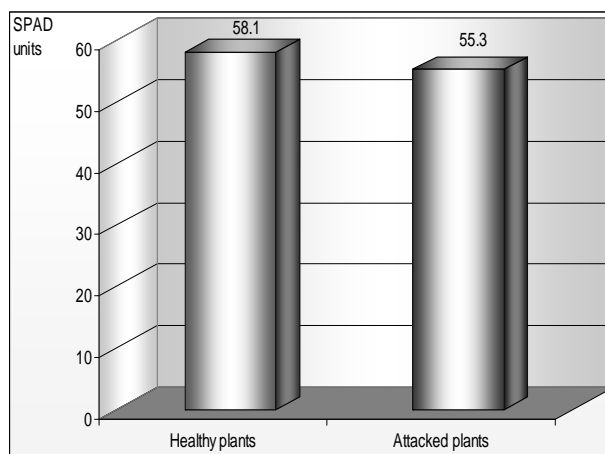


Figure 13. The chlorophyll content at the roses leaves - Kosmos variety. / Figura 13. Conținutul de clorofilă la frunzele de trandafiri - soiul Kosmos.

CONCLUSIONS

The intensity of the physiological processes at the rose plants varies according to the frequency, the intensity and the degree of attack, but also to the climatic conditions. At the analyzed attacked rose plants, one can observe that the intensity of the photosynthesis and of transpiration presents a minimum in the morning, a maximum after lunch and a minimum toward the evening, but the recorded values are smaller in comparison with healthy plants.

The increase of the photosynthetic active radiations and temperature leaf is positively correlated with the increase of the photosynthesis and of the transpiration, but shows variations in the attacked plants as a result of several structural modifications produced by pathogen.

As a result of the pathogen action on the attacked plants, one can observe a decrease of the chlorophyll content because of the intensification of the chlorophylls and deterioration of the chloroplasts and the decrease of the total water content, which determines the withering and premature drying of the plants.

The attacked plants present some physiological modifications with implications on the growth and development rose plants.

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