PHYSIOLOGICAL RESEARCH REGARDING THE INFLUENCE OF THE PATHOGEN ATTACK PRODUCED BY *Elsinoë rosarum* JENKINS & BITANC. IN THE ROSE PLANTS (*Rosa* sp.)

NICOLAE Ion, BUŞE-DRAGOMIR Luminiţa

Abstract. The physiological research regarding influence of the pathogen attack produced by *Elsinoë rosarum* JENKINS & BITANC. has been made on Pascali rose variety cultivated in the Botanical Garden "Al. Buia" from Craiova, Dolj. In the analysed rose leaves it was observed that the diurnal dynamics of the photosynthesis and of transpiration varies depending on the climate conditions, in the morning with lower values, a maximum values after lunch and lower values toward the evening, but the intensity of these processes has lower values in the attacked leaves. The linear regressions performed between the physiological processes (photosynthesis and transpiration) and the photosynthetic active radiation, the temperature leaf and the stomatal conductance show a positive correlation between these, with specific variations in the attacked leaves, in comparison with healthy leaves. In the attacked leaves it was recorded a lower water and chlorophyllian pigment content, which correlates with the decrease of the photosynthesis intensity. Under the damaging action of the pathogens, in the attacked leaves the hydric and metabolic unbalance appear, with negative consequences on the growth of rose plants.

Keywords: attacked leaves, healthy leaves, pathogen, physiological processes, rose variety.

Rezumat. Cercetări fiziologice privind influenţa atacului patogen produs de *Elsinoë rosarum* JENKINS & BITANC. la plantele de trandafiri (*Rosa* sp.). Cercetările fiziologice privind influenţa atacului patogen produs de *Elsinoë rosarum* JENKINS & BITANC. s-au efectuat la soiul de trandafiri Pascali cultivat în Grădina Botanică „Al. Buia" din Craiova, Dolj. La frunzele de trandafiri analizate s-a constatat că dinamica diurnă a fotosintezei şi transpiraţiei variază în funcţie de condiţiile climatice, prezentând valori scăzute dimineaţa, valori maxime după prânz şi valori scăzute spre seară, dar intensitatea acestor procese are valori mai scăzute în frunzele atacate. Regresii liniare efectuate între procesele fiziologice (fotosinteză şi transpiraţie) şi radiaţia fotosintetic activă, temperatura frunzei şi conductanţa stomatală, evidenţiază corelaţii pozitive între acestea, cu variaţii specifice, la frunzele atacate, comparativ cu frunzele sănătoase. În frunzele atacate s-a înregistrat un conţinut mai scăzut de apă şi pigmenţi clorofilieni, fapt corelat cu scăderea intensităţii fotosintezei. Sub acţiunea dăunătoare a patogenului, în frunzele atacate, apar dezechilibre hidrice şi metabolice, cu consecinţe negative asupra creşterii plantelor de trandafiri.

Cuvinte cheie: frunze atacate, frunze sănătoase, patogen, procese fiziologice, soi de trandafiri.

INTRODUCTION

The rose is a plant from the Rosaceae family spread in most regions of the world. Genus *Rosa* includes around 140 species, widely scattered in Europe, Asia, the Middle East and North America (CAIRNS, 2003).

Anthracnose of the rose produced by the *Elsinoë rosarum* (JENKINS & BITANC. 1957) is found on different *Rosa* species and varieties of cultivated roses. In our country it was first reported in 1952, in Cluj Botanical Gardens (NEGRU 1956, cited in SĂVULESCU *et al*., 1969).

Light intensity and temperature are the main factors with the influence on photosynthesis intensity. In the *Rosa* sp. at a light intensity of 1826 μmol/m^2/s, the intensity of photosynthesis is of 11.21 μmol CO_2/m^2/s. The transpiration intensity of leaf varies according to the characteristics of the species and the environmental conditions. Thus, at a temperature of 35.4^{o}C, the transpiration intensity is of 6.03 μmol H_2O/m^2/s (BURZO *et al*., 2000).

The development of the pathogen agents on the surface of the organs or in the tissues of the attacked plants reduce the assimilation of the foliar surface, which entail a change in the physiological processes with consequences for the quantity and quality of production by flowers (NICOLAE, 2010).

MATERIAL AND METHODS

The physiological research regarding the influence of the pathogen attack produced by *Elsinoë rosarum* JENKINS & BITANC. has been made on rose plants - **Pascali** variety cultivated in the Botanical Garden "Al. Buia" from Craiova, Dolj.

The variety of **Pascali** rose plants presents a height of 80 cm, white flowers and easy perfume.

The intensity of the physiological processes (photosynthesis intensity and transpiration intensity) and photosynthetic active radiations, leaf temperature and stomatal conductance were established with the analyser LCi (The Ultra Compact Photosynthesis Measurement System) and the obtained results were graphically represented and statistically interpreted.

The total water content and the dry substance content were determined by the help of the drying stove - gravimetric method.

The chlorophyll content was estimates by Minolta SPAD 502 chlorophyll meter.

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

RESULTS AND DISCUSSIONS

Anthracnose is found all the over ground organs of the plant, but the first symptoms emerge on the leaves. Light green punctiform spots emerge on the outer leaves, grow bigger and then become surrounded by a brown-purple or crimson ring (Figs. 1; 2).

The tissues corresponding to the spots sometimes get loose and fall and the leaf has empty marks on it. Black dots emerge on the surface of the spots and they are appear in concentric circles made up of conidiophore and conidia. The strongly damaged leaves get yellow, dry out and fall before time.

Similar spots are formed on the leaf, the calyx and even on the petals. Small spots (aprox. 2 mm) are formed on the bark of the twigs and they are circular, deepened into the surface. They may be brown with purple hues and they have a white-grey centre (SĂVULESCU *et. al*., 1969).

Elsinoë rosarum JENKINS & BITANC. presents intercellular mycelium, they are formed on septate conidiophores, hyaline, with conidia, brown in colour, oval or ellipsoidal, unicellular. Under the pressure of coniophores and conidia, the epidermis is to tear and conidia are issued (MARINESCU *et al*., 1988).

Figure 1. The rose plants - **Pascali** variety attacked by *Elsinoë rosarum* / Figura 1. Plante de trandafiri - soiul **Pascali** atacate de *E. rosarum* (original).

Figure 2. The rose leaves - **Pascali** variety attacked by *Elsinoë rosarum.* / Figura 2. Frunze de trandafiri - soiul **Pascali** atacate de *E. Rosarum* (original).

The estimation of the attack (frequency, intensity and degree of attack) produced by the *Elsinoë rosarum* JENKINS & BITANC. at rose plants - **Pascali** variety is presented in figure 3.

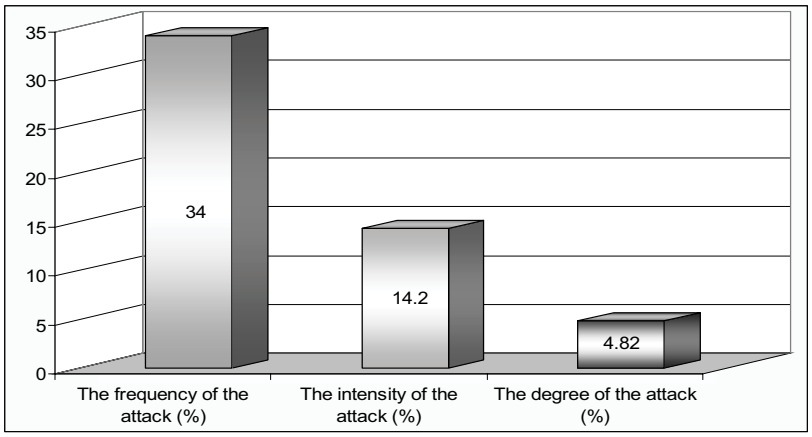

Figure 3. The estimate of the attack produced by *Elsinoë rosarum* in the roses **Pascali** variety.
Figura 3. Estimarea atacului produs de *E. rosarum* la trandafiri - soiul **Pascali**.

The physiological research regarding influence of the pathogen attack produced by *Elsinoë rosarum* JENKINS & BITANC. on roses - **Pascali** variety has been made, according to the climatic conditions, on August 28th 2010.

The photosynthesis intensity increases from early morning due to the increase of light intensity, temperature and the stomata opening level, it maintains itself constant until noon, then gradually decreases due to the decrease of light intensity, the accumulation of organic substances in chloroplasts, the gradual decrease of temperature, as well as the reduction of the opening degree of stomata. The diurnal dynamics of photosynthesis intensity in the attacked leaves is similar to that in healthy leaves but the recorded values are lower as a result of the reduction of the assimilation surface by the appearance of spots and deterioration to chlorophyll pigments, the yellowing of the leaves, and premature drying of the leaves (Fig. 4).

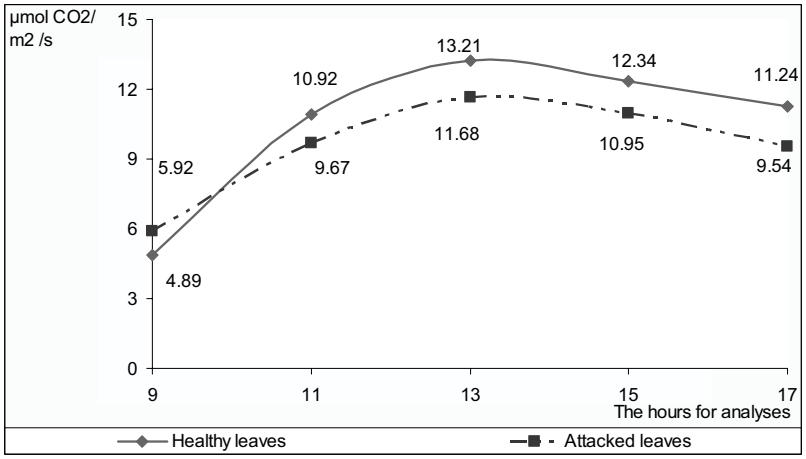

Figure 4. The diurnal dynamics of photosynthesis intensity in the rose leaves - **Pascali** variety.
Figura 4. Dinamica diurnă a intensităţii fotosintezei la frunzele de trandafiri - soiul **Pascali**.

The transpiration intensity increases from dawn when the opening of stomata takes place, presents a maximum value during the afternoon when the temperature is higher and the air relative humidity is lower, and towards evening the reduction of the transpiration process takes place. The dynamics of transpiration intensity in the attacked rose leaves presents lower values, in comparison with healthy leaves, as a result of malfunctioning mechanisms of the stomatic apparatus, of the withering and drying leaves (Fig. 5).

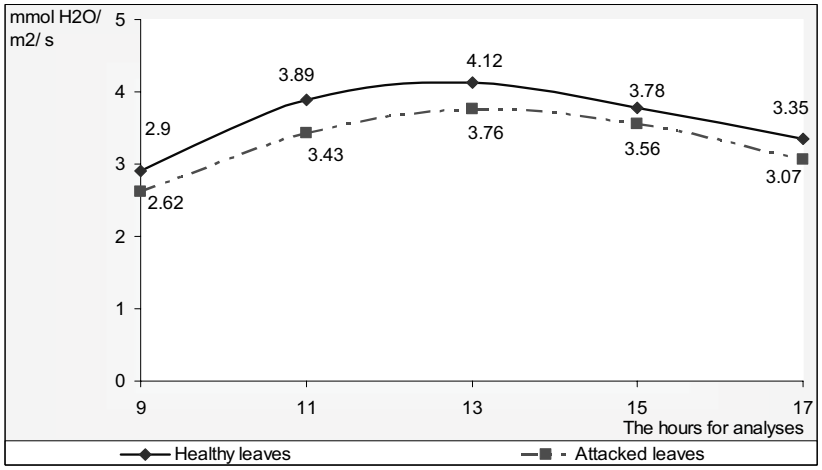

Figure 5. The diurnal dynamics of transpiration intensity in the rose leaves - **Pascali** variety.
Figura 5. Dinamica diurnă a intensităţii transpiraţiei la frunzele de trandafiri - soiul **Pascali**.

The intensity of physiological processes (photosynthesis and transpiration intensity) depend on the photosynthetic active radiation, the temperature leaf and the stomatal conductance and presents specific variations in the attacked leaves, in comparison with healthy leaves.

The rose leaves have an increasing photosynthetic active radiation in the morning (9 a.m.) when the values are of 1020 µmol/m^2/s for the healthy leaves and of 992 µmol/m^2/s for the attacked leaves, they grow until after noon (1 p.m.) when the values are of 1510 µmol/m^2/s for the healthy leaves and of 1468 µmol/m^2/s for the attacked leaves, while towards the evening (5 p.m.) the values decrease gradually to 1365 µmol/m^2/s the healthy leaves and to 1360 µmol/m^2/s for the attacked leaves.

The linear regressions performed between the values of photosynthesis intensity and the photosynthetic active radiation show a good positive correlation, the coefficient of determination (R^2) being of 0.96 for the healthy leaves and 0.93 for the attacked leaves and linear regressions performed between the values of transpiration intensity and the photosynthetic active radiation show a positive correlation, the coefficient of determination (R^2) being of 0.70 for the healthy leaves and 0.73 for the attacked leaves (Figs. 6 and 7).

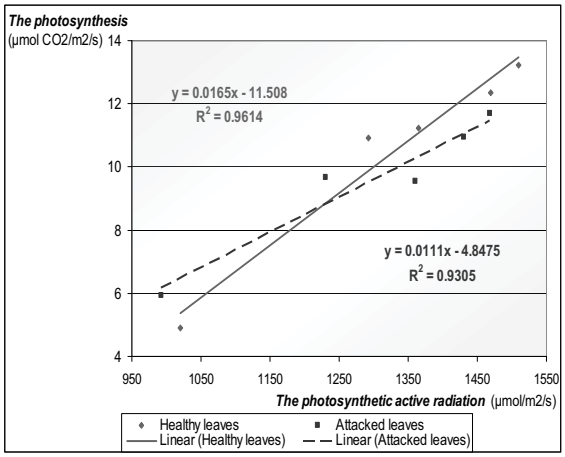

Figure 6. The correlation between the photosynthesis intensity and the photosynthetic active radiation in the rose leaves - **Pascali** variety. / Figura 6. Corelaţii între intensitatea fotosintezei şi **radiaţia** fotosintetic activă la frunzele de trandafiri - soiul **Pascali**.

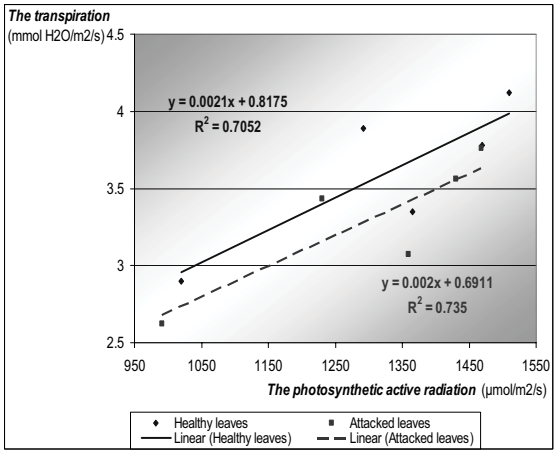

Figure 7. The correlation between the transpiration intensity and the photosynthetic active radiation in the rose leaves - **Pascali** variety. / Figura 6. Corelaţii între intensitatea transpiraţiei şi radiaţia fotosintetic activă la frunzele de trandafiri - soiul **Pascali**.

In the leaves of roses can be seen an increase of the leaf temperature in the morning (9 a.m.), when the values are of 28.4^{o}C in the healthy leaves and 28.5^{o}C in the attacked leaves, the increase of the temperature up until after lunch (1p.m.), when the values are of 34.2^{o}C in the healthy leaves and 34.3^{o}C in the attacked leaves and towards the evening (5 p.m.) the gradual decrease of the temperature, recording values of 32.3^{o}C in the healthy leaves and 32.6^{0}C in the attacked leaves.

The linear regressions performed between the values of photosynthesis intensity and the leaf temperature show a good positive correlation, the coefficient of determination (R^2) being of 0.98 for the healthy leaves and 0.97 for the attacked leaves and linear regressions performed between the values of transpiration intensity and the leaf temperature show a positive correlation, the coefficient of determination (R^2) being of 0.85 for the healthy leaves and 0.89 for the attacked leaves (Figs. 8; 9).

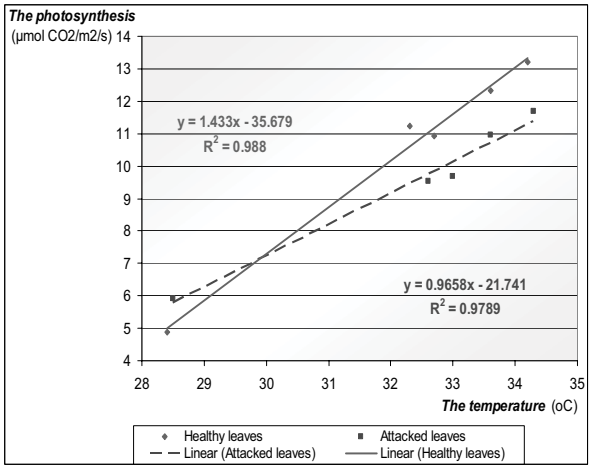

Figure 8. The correlation between the photosynthesis intensity and the temperature in the rose leaves - **Pascali** variety. / Figura 8. Corelaţii între intensitatea fotosintezei şi temperatura frunzelor de trandafiri - soiul **Pascali**.

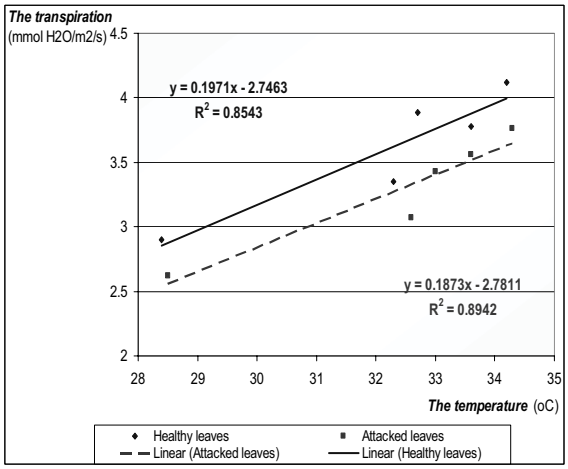

Figure 9. The correlation between the transpiration intensity and the temperature in the rose leaves - **Pascali** variety. / Figura 9. Corelaţii între intensitatea transpiraţiei şi temperatura frunzelor de trandafiri - soiul **Pascali**.

In the leaves of roses it can be seen an increase of the stomatal conductance of CO_2 starting in the morning (9 a.m.), when the recorded values are 0.09 mol/m^2/s in the healthy leaves and 0.07 mol/m^2/s in the attacked leaves, the increase of the stomatal conductance up until after lunch (1 p.m.), when the recorded values are 0.14 mol/m^2/s in the healthy leaves and 0.12 mol/m^2/s in the attacked leaves and towards the evening (5 p.m.) the gradual decrease of the stomatal conductance, when the recorded values are 0.1 mol/m^2/s in the healthy leaves and 0.08 mol/m^2/s in the attacked leaves.

The linear regressions performed between the values of photosynthesis intensity and the stomatal conductance show a positive correlation, the coefficient of determination (R^2) being of 0.80 for the healthy leaves and 0.77 for the attacked leaves and linear regressions performed between the values of transpiration intensity and the stomatal conductance show a positive correlation n, the coefficient of determination (R^2) being of 0.87 for the healthy leaves and 0.78 for the attacked leaves (Figs. 10; 11).

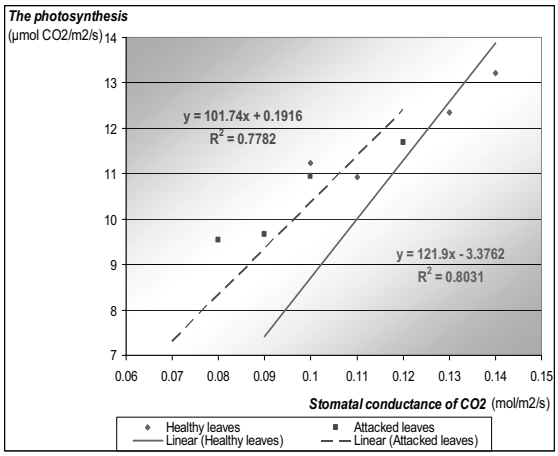

Figure 10. The correlation between the photosynthesis intensity and the stomatal conductance in the rose leaves - **Pascali** variety. / Figura 10. Corelaţii între intensitatea fotosintezei şi conductanţa stomatală la trandafiri - soiul **Pascali**.

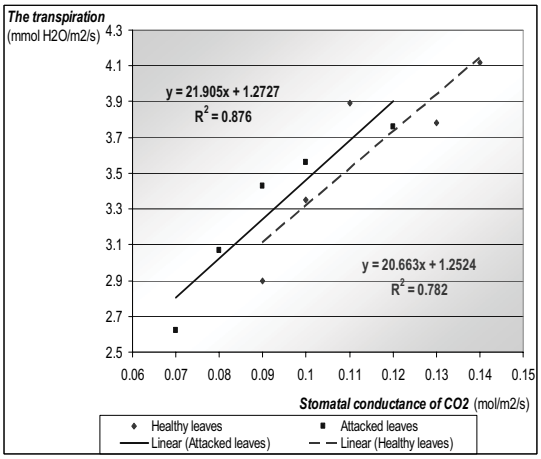

Figure 11. The correlation between the transpiration intensity and the stomatal conductance in the rose leaves - **Pascali** variety. / Figura 11. Corelaţii între intensitatea transpiraţiei şi conductanţa stomatală la trandafiri - soiul **Pascali**.

In the attacked rose leaves it can be seen a decrease of the water content and an increase of the dry substance content, which is manifested by the withering and premature drying of the leaves (Fig. 12).

The attacked leaves present a decrease of the chlorophyll content, manifested by their yellowing as a result of the deterioration of the chlorophyllian pigments; this correlates with the decrease of the intensity of photosynthesis (Fig. 13).

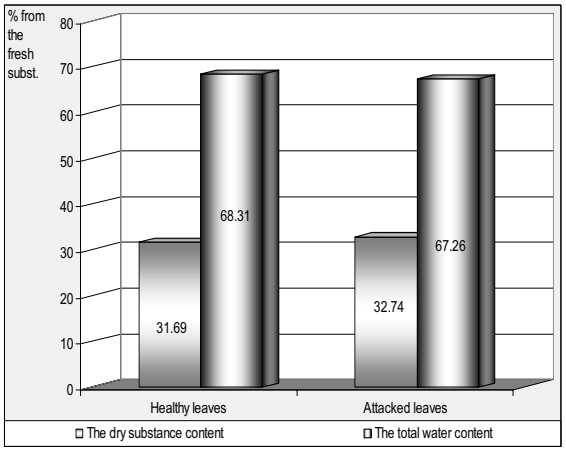

Figure 12. The water contents and the dry substance content in the rose leaves - **Pascali** variety. / Figura 12. Conţinutul de apă şi conţinutul de substanţă uscată la frunzele de trandafiri - soiul **Pascali**.

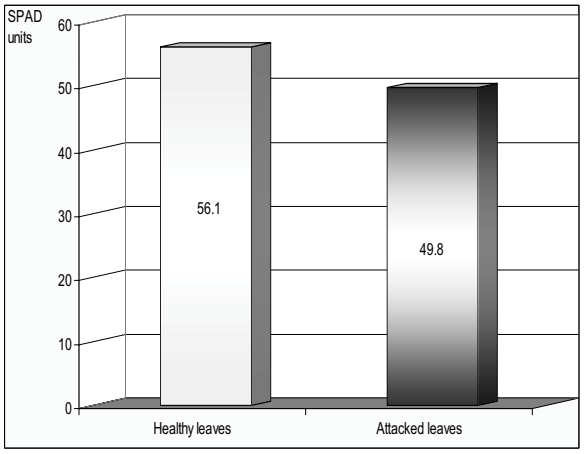

Figure 13. The chlorophyll content in the rose leaves - **Pascali** variety. / Figura 13. Conţinutul de clorofilă la frunzele de trandafiri - soiul **Pascali**.

CONCLUSIONS

In the rose leaves, *Pascali* variety, it was observed that the diurnal dynamics of the photosynthesis and transpiration present a minimum in the morning, a maximum after lunch and a minimum toward the evening, but it presents lower values in the leaves attacked by *Elsinoë rosarum* JENKINS & BITANC, compared with the healthy leaves.

The linear regressions performed between the physiological processes (photosynthesis and transpiration intensity) and the photosynthetic active radiation, the temperature leaf and the stomatal conductance show a positive correlation between them, with specific variations in the attacked leaves.

In the leaves attacked by the pathogen, lower water content and higher dry substance content was recorded, manifested by the withering and drying leaves under the damaging action of the pathogens.

In the attacked leaves a lower chlorophyllian pigments content was recorded, and this correlates with the decrease of the photosynthesis intensity, with implications on the growth and development of the plants.

REFERENCES

BURZO I., TOMA S., VOICAN VIORICA, AMĂRIUŢEI ALEXANDRINA, ŞELARU ELENA, POPESCU V., CRĂCIUN C. 2000. *Fiziologia plantelor de cultură*. Întreprinderea Editorial Poligrafică „Ştiinţa", Chişinău. **4**. 401 pp.

CAIRNS T. 2003. *Horticultural Classification Schemes*. In: Roberts A. V., Debener T., Gudin S. (Eds.) Encyclopedia of Rose Science. Elsevier Science Publishing Co Inc. Academic Press. **1**: 117-124.

MARINESCU G., COSTACHE M., STOENESCU A. 1988. *Bolile plantelor floricole*. Edit. Ceres. Bucureşti. 216 pp.

NICOLAE I. 2010. *Fiziologia plantelor horticole*. Edit. „Sitech", Craiova. 262 pp.

SĂVESCU A. & RAFAILĂ C. 1978. *Prognoza în protectia plantelor*. Edit. „Ceres", Bucureşti. 354 pp.

SĂVULESCU OLGA, BARBU VALERIA, ELIADE EUGENIA, NĂGLER M., TUDOSESCU-BĂNESCU VERONICA. 1969. *Bolile plantelor ornamentale din România.* Edit. Academiei R.S.R. Bucureşti. 604 pp.

Nicolae Ion
University of Craiova
Al. I. Cuza Street, No. 13, 200585, Craiova, Romania
E-mail: ionnicolaebio@yahoo.com

Buşe-Dragomir Luminiţa
University of Craiova
Al. I. Cuza Street, No. 13, 200585, Craiova, Romania
E-mail: luminita25dragomir@yahoo.com

Received: March 27, 2012
Accepted: July 26, 2012