THE INFLUENCE OF THE TREATMENT WITH FUNGICIDES ON THE PHYSIOLOGICAL PROCESSES IN THE ROSE PLANTS (*ROSA* SP.) ATTACKED BY THE *PHRAGMIDIUM MUCRONATUM* (PERS.) SCHLTDL.

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Abstract
The influence of the treatment with fungicides on the physiological processes were observed in the rose plants (Rosa sp.) cultivated in the climatic conditions in Oltenia region.The physiological researches were performed on August 15th 2021, both for plants treated with Topsin M70 (0,1%) and Dithane M45 (0,2%), in four phases, at 7 days interval and also for the plants attacked by Phragmidium mucronatum (Pers.) Schltdl. in which treatments have not been performed. The photosynthesis intensity and transpiration intensity record lower values as a result of the effects produced by the pathogen manifested by the appearance yellow-orange pustules (urediniospores) and the brown or black pustules (teliospores). In the leaves of the plants analysed after performing treatments with fungicides it was registered a higher water content and clorophyll content, in comparison with the plants in which fungicide treatments have been performed.

Key words: *attacked leaves, fungicide, pathogen, photosynthesis, transpiration.*

INTRODUCTION

The genus *Rosa* L. comprises about 150-200 species widely distributed throughout the temperate and sub-tropical habitats of the northern hemisphere (Gu and Robertson, 2003; Rehder, 1940). Representatives of this family can be found in all regions of Europe, from the Mediterranean to the arctic and from oceanic to tundra and alpine habitats (Helfer, 2005).
Rust fungi in the genus *Phragmidium* are frequent pathogens of both wild and cultivated roses (Ritz et al., 2005). This species produces the disease known as rose rust, as reported on cultivated varieties and hybrids of roses, but also on wild species of the *Rosa* genus (Tănase and Șesan, 2006). *Phragmidium* is characterized by Caeoma-type aecia with catenulate aeciospores, uredo-type or calodion-type uredinia with peripheral paraphyses and dark brown teliospores that are typically festooned with several transverse septa along with 2-3 germ pores per teliospore cell (Cummins and Hiratsuka 2003; Yun et al. 2011).
The 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 through the deterioration of the chlorophyll (Nicolae, 2010). 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 (Nicolae and Buşe-Dragomir, 2012).

MATERIALS AND METHODS

The physiological analyses were performed in rose plants cultivated in the climatic conditions in Oltenia region.
The rose is a plant from the *Rosaceae* family widespread in most regions of the globe. The rose plants come in a range of forms, from traditional shrubs and

climbers to small plants. They flower abundantly from early summer in a choice of colours including shades of pink, peach, cream, white, yellow, orange, crimson or red.

The treatments were carried out starting on July 18th 2021 and consisted of the application of four treatments with fungicides, alternatively (two treatments with *Topsin* M70-0.1% and two treatments with *Dithane* M45-0.2%) at an interval of 7 days (July 18th 2021, July 25th 2021, August 1st 2021, August 8th 2021).

The physiological analyses were carried out according to the climatic conditions in the Oltenia area on August 15th 2021, in rose plants treated with fungicide and rose plants attacked by pathogen in which treatments have not been performed.

The photosynthesis and transpiration's intensity, photosynthetic active radiations, stomatal conductance, leaf temperature were determined with the ultra compact photosynthesis measurement system (LCi). The water content and the dry substance content were determined by the gravimetric method and the chlorophyll content was determined by the Minolta SPAD 502 chlorophyllmeter.

The estimation of the attack was made using the calculation formulae elaborate by Săvescu and Rafailă (1978).

RESULTS AND DISCUSSIONS

Rose rust is caused by the fungus *Phragmidium mucronatum* which attacks all the green parts of the rose, leaves, flowers, shoots (Figure 1).

In spring round spots with yellow or orange centers appear on the upper surface of the leaves. Aggregated aecia with bright orange-yellow, powdery masses of aeciospores are subsequently formed on the lower surface of leaves and petioles. From early summer to autumn, uredinia with bright orange-yellow masses of urediniospores are produced on the lower surface of leaves and branches. The uredinia are quickly replaced by blackish masses of teliospores and the lower surface of attacked leaves may appear blackish and dusty (Figure 2).

The aecial infection cause distortion of the attacked leaves and uredinial infection causes early yellowing of the attacked leaves and premature defoliation.

Figure 1. The rose plants (*Rosa* sp.) attacked by *Phragmidium mucronatum* (Pers.) Schltdl. (Original).

Figure 2. *Phragmidium mucronatum (Pers.) Schltdl.* - teliospores and urediniospores (ob. 20 x oc. 10) - Original.

The physiological analyzes were performed out according to the climatic conditions in the Oltenia area, in the rose plants treated with fungicides (*Topsin*

M70-0.1% and *Dithane* M45-0.2%) and rose plants attacked by pathogen in which treatments have not been performed.

The estimation of the frequency, intensity and degree of attack produced by *Phragmidium mucronatum (Pers.) Schltdl.* in the rose plants is presented in Figure 3.

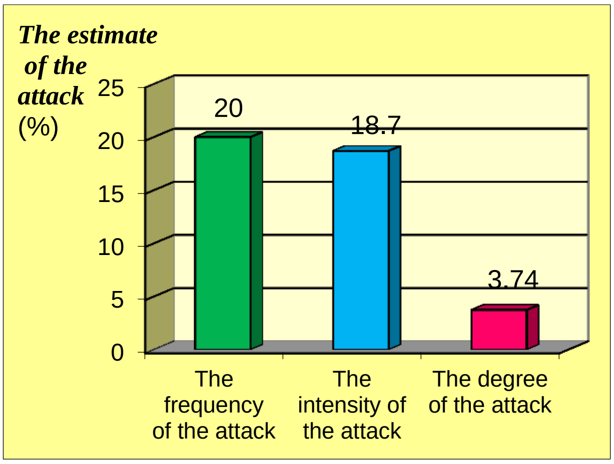

Figure 3. The estimation of the attack produced by *Phragmidium mucronatum* (Pers.) Schltdl. in *Rosa* sp.

The photosynthesis and transpiration's intensity has a lower value in the attacked rose plants as a result of the reduction of the assimilation surface and the malfunctioning of the stomatic apparatus due to the appearance of yellow-orange pustules (urediniospores) and the brown or black pustules (teliospores) - Figure 4 and Figure 5.

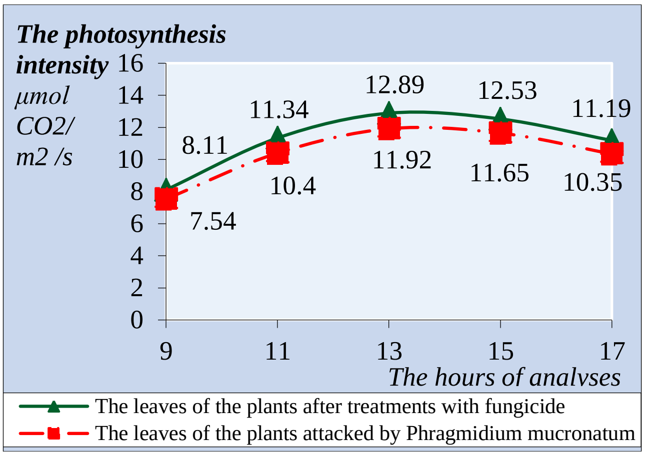

Figure 4. The photosynthesis intensity in the leaves of *Rosa* sp.

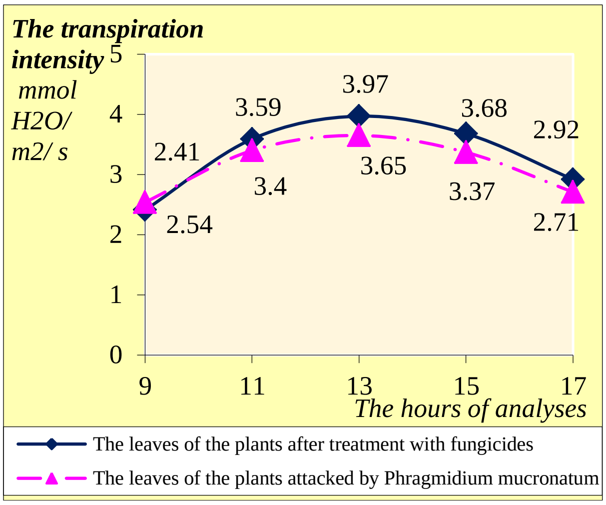

Figure 5. The transpiration intensity in the leaves of *Rosa* sp.

The photosynthesis and transpiration's intensity are correlated with the physiological parameters (photosynthetic active radiation, leaf temperature and stomatal conductance).

In the rose plants an increase of the photosynthetic active radiations can be noticed starting with the morning (9 a.m.) when values are 1329 µmol/m^2/s in the plants treated with fungicides and 1291 µmol/m^2/s in the attacked plants by pathogen, they grow up until afternoon (1 p.m.) when values are 1472 µmol/m^2/s in the treated plants and 1428 µmol/m^2/s in the attacked plants and decrease towards evening (5 p.m.) when values are 1368 µmol/m^2/s in the plants treated with fungicides and 1337 µmol/m^2/s in the attacked plants.

Linear regression made between the photosynthesis intensity and photosynthetic active radiations shows a positive correlation, the coefficient of determination (R^2) was 0.92 for the rose plants (*Rosa* sp.) treated with fungicide and 0.90 for the attacked plants; linear regression made between the transpiration intensity and photosynthetic active radiations shows a positive correlation, the coefficient of determination R^2 was 0.78 for the rose plants treated with fungicide and 0.64 for the rose plants attacked by pathogen (Figure 6 and Figure 7).

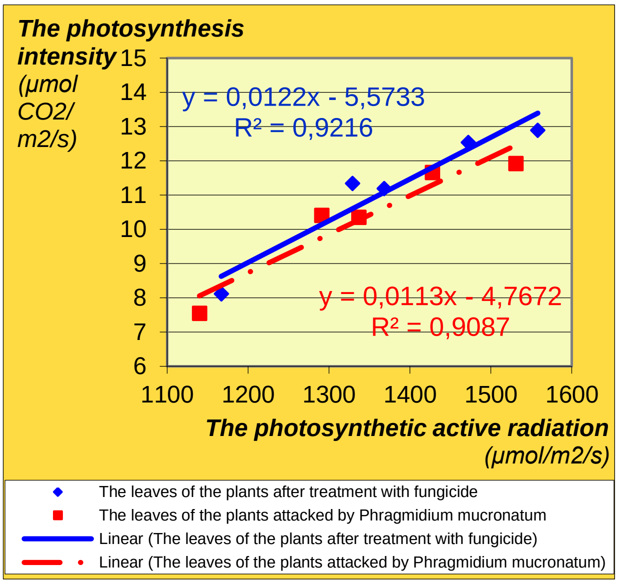

Figure 6. The correlation between the intensity of photosynthesis and the photosynthetic active radiation in *Rosa* sp.

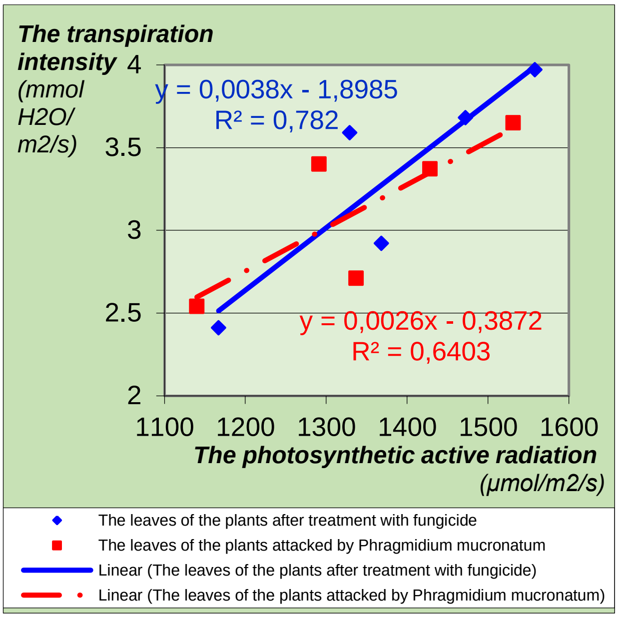

Figure 7. The correlation between the intensity of transpiration and the photosynthetic active radiation in *Rosa* sp.

The leaf temperature in the plants increases starting with the morning (9 a.m.), when values are 29.4 °C in the plants treated with fungicides and 29.6 °C in the attacked plants, they grow up until afternoon (1 p.m.) when values are 34.8 °C in the treated plants and 35 °C in the attacked plants and decrease towards evening (5 p.m.) when values are 32.4 °C in the plants treated with fungicides and 32.5 °C in the attacked plants.

Linear regression made between the photosynthesis intensity and leaf temperature shows a good positive correlation, the coefficient of determination (R^2) was 0.98 for the rose plants after treatments with fungicide and 0.97 for the plants attacked by pathogen; linear regression made between the transpiration intensity and leaf temperature shows a good positive correlation, the coefficient of determination R^2 was 0.90 for the rose plants after treatments with fungicide and 0.81 for the attacked plants (Figure 8 and Figure 9).

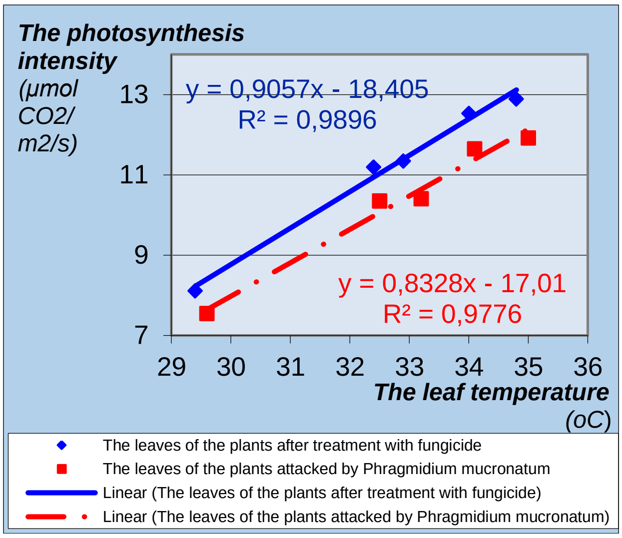

Figure 8. The correlation between the intensity of photosynthesis and the leaf temperature in *Rosa* sp.

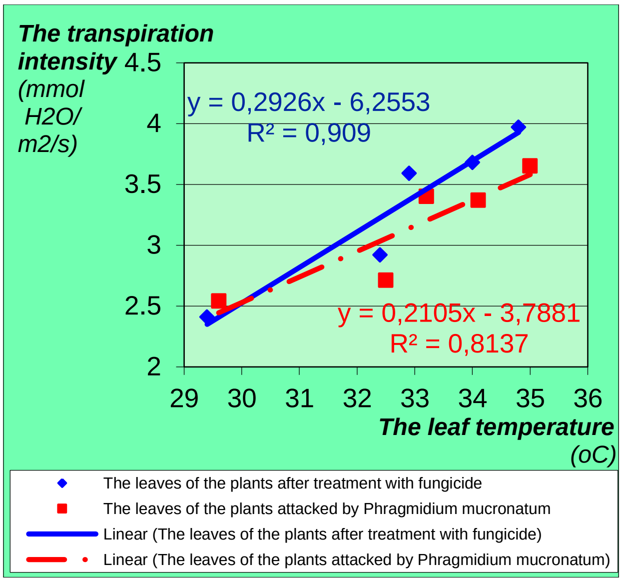

Figure 9. The correlation between the intensity of transpiration and the leaf temperature in *Rosa* sp.

The stomatal conductance in the plants increases starting with the morning (9 a.m.), when values are 0.06 mol/m²/s in the plants treated with fungicides and 0.04 mol/m²/s in the attacked plants by pathogen, they grow up until afternoon (1 p.m.) when values are 0.14 mol/m²/s in the treated plants and 0.11 mol/m²/s in the attacked plants and decrease towards evening (5 p.m.) when values are 0.1 mol/m²/s in the plants treated with fungicides and 0.07 mol/m²/s in the attacked plants.

The photosynthesis intensity and stomatal conductance show a positive correlation, the coefficient of determination (R^2) was 0.95 for the rose plants treated with fungicide and 0.92 for the plants attacked by pathogen; the transpiration intensity and stomatal conductance show a positive correlation, the coefficient of determination R^2 was 0.92 for the rose plants after treated with fungicide and 0.90 for the attacked plants (Figure 10 and Figure 11).

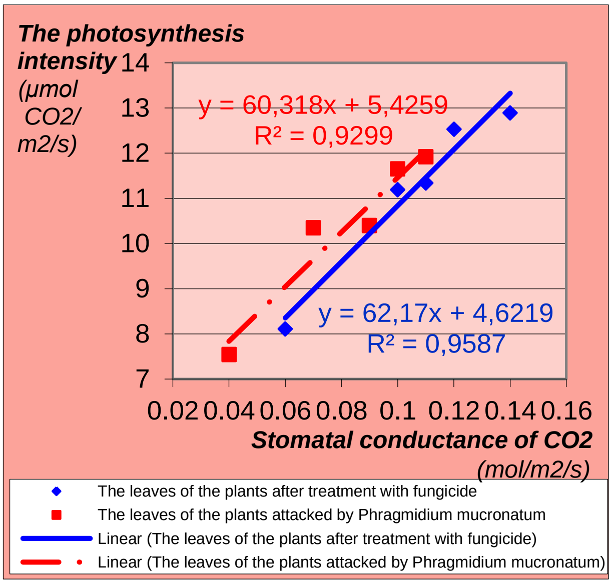

Figure 10. The correlation between the intensity of photosynthesis and the stomatal conductance in *Rosa* sp.

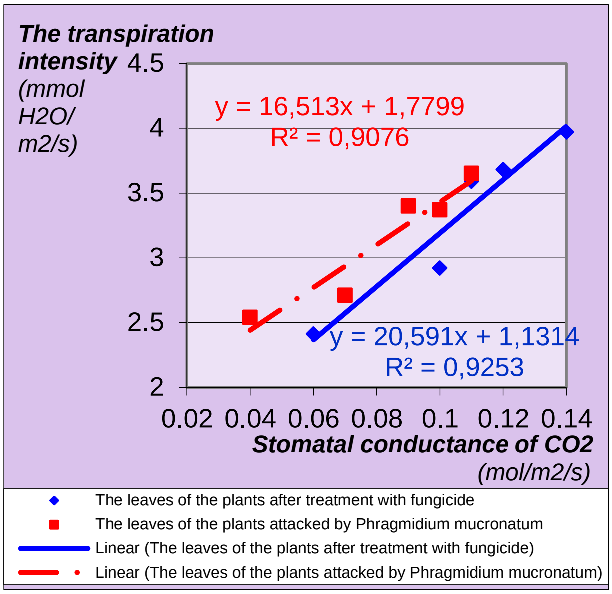

Figure 11. The correlation between the intensity of transpiration and the stomatal conductance in *Rosa* sp.

The attacked rose plants by the pathogen present a lower water content and a higher dry substance content fact that is manifested by the withering and premature drying of the plants (Figure 12).

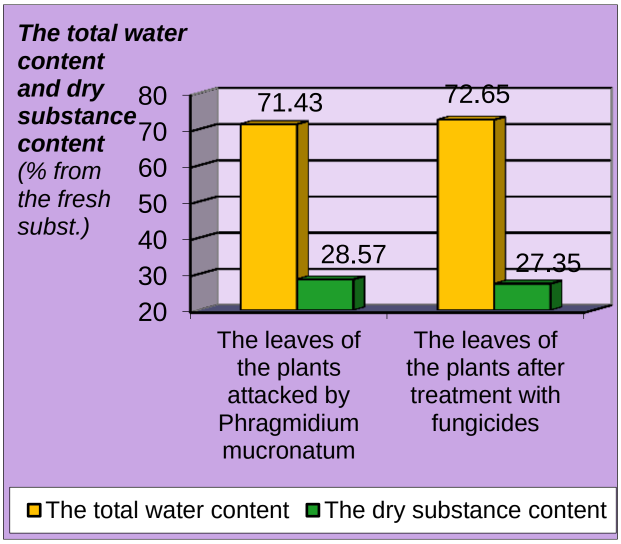

Figure 12. The water content and the dry substance content in *Rosa* sp.

In the plants attacked by the pathogen one can observe a lower chlorophyll content, fact correlated with the photosynthesis intensity (Figure 13).

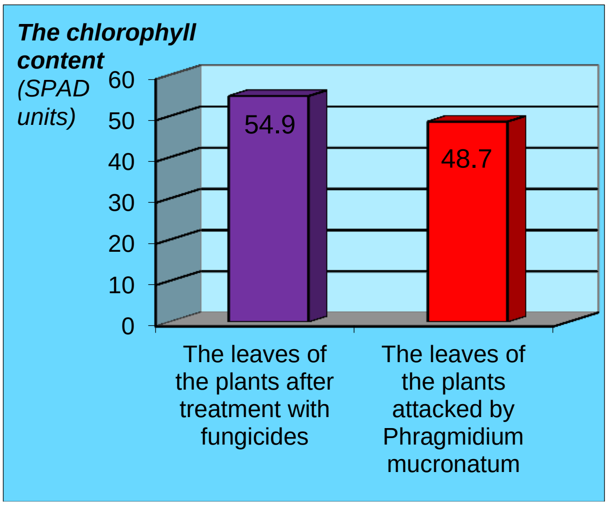

Figure 13. The chlorophyll content in *Rosa* sp.

CONCLUSIONS

In the plants attacked by the pathogen one can observe that the intensity of the physiological processes is lower, in comparison with the plants treated with the fungicides, as a result of the reduction of the assimilation surface and the malfunctioning of the stomatic apparatus.

The photosynthesis and transpiration's intensity are positively correlated with the photosynthetic active radiations, temperature leaf and stomatal conductance, but shows variations in the attacked plants as a result of structural changes produced by pathogen.

In the attacked plants by the pathogen, in comparison with the plants treated with fungicide, one can observe a decrease of the water content and chlorophyll content, which is manifested by the withering and premature drying of the rose plants.

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