Research regarding some physiological modifications in *Prunus domestica* L. as a result of the attack produced by *Polystigma rubrum* (pers.) Dc.

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**Abstract**  The research regarding physiological modifications produced by *Polystigma rubrum* (Pers.) DC. has been carried in *Prunus domestica* L. - *Diana* variety cultivated in the climatic conditions in Oltenia region (Banu Mărăcine, Dolj).

As a result of research carried out on the leaves attacked by the pathogen, in comparison to healthy leaves, notice that these presents lower values of photosynthesis and transpiration intensity, due to the reduction of the assimilation surface of leaf and the malfunctioning of stomata mechanisms, as a result of e spots at the beginning of yellow-cream color, then of red-brown and necrosis of the tissue corresponding to spots. In the leaves attacked by the pathogen it can be observed a decrease of chlorophyll content and the decrease of the total water content which is manifested by the gradual drying of the leaves.

European plum (*Prunus domestica* L.) is an economically important fruit crop and is widely grown across the world [3; 4]. *Prunus domestica* L. has moderate requirements for the temperature and light and higher requirements for water, and can grow on all types of soil. Due to moderate requirements for environmental factors the plum of Romania is spread in the subcarpathian hills area, occupying land unsuitable for other crops and this is the main source of existence of the population in these areas.

The physiological research regarding photosynthesis intensity in *Prunus domestica* L. shows variations between values of 13.6 - 14.4 μmol CO₂ / m² / s [2].

The pigment chlorophyll content was higher in the plant leaves analyzed in the fruits growth phase, being a positive correlation between the pigment chlorophyll content and the photosynthesis intensity. In the fruit maturation phase it can be observed a decrease in chlorophyllian pigment content due to the gradual decline of their biosynthesis [7].

The phytopathogenic fungus infections are accompanied by structural changes and some changes in the metabolism of host plant. This is necessary for the coexistence of two partners involved, for a long time and given the fact that they need to grow and to reproduce, the parasite requires a constant supply with nutrients from the tissues of the host plant [5].

In Romania there were made numerous research concerning the physiology and biochemistry of diseased plants. Antohe Anca & collab. carried out a series of ecophysiological research in some sorts of plum in the conditions of pesticides applications and of the attack of *Polystigma rubrum* [1].

The increase of the photosynthetic active radiations, temperature leaf and conductance stomatal is positive correlated with the increase of the photosynthesis and of the transpiration, but shows variations in the attacked leaves as a result of several structural modifications produced by pathogen [8].

The water content of diseased plants undergo different modifications, but in most cases the water content is lower in diseased plants, actually met in the case of fading when plants suffer from imbalance and cells become less turgid [9].

**Material and Method**

Research regarding physiological modifications produced by *Polystigma rubrum* (Pers.) DC. in *Prunus domestica* L. has been carried at plum tree *Diana* variety cultivated in Oltenia region (Banu Mărăcine, Dolj).

*Prunus domestica* L. presents in most varieties the right trunk, ritidom smooth or cracked in form of poliedric boards. It can be have a high natural increase of 8-10 m, if the plantation is not more than 5-6 m. The root system growth is dependent on the rootstock.

The plum tree - *Diana* variety is originally from Romania. The tree of medium, globular crown force, semi-late, early blooms, productive environment, resistant to frost and disease. The fruit is large (50-60
of spherical type, colored in red-purple, the pulp is yellowish-green, dense, juicy, with pleasant taste. The period of maturation is the beginning of July.

The intensity of the photosynthesis and transpiration was carried out using ultra compact photosynthesis measurement system (LCi) which enables automatic recording and other parameters (photosynthetic active radiations, leaf temperature, stomatal conductance etc.). The results obtained were graphically represented and statistically interpreted.

The water contents and dry substance were determined by the help of the drying stove - gravimetric method. The chlorophyll content was estimates by Minolta SPAD 502 chlorophyllimeter.

The estimation of the attack (the frequency, the intensity and the degree of the attack) was made using the calculation formulae elaborate by Săvescu & Rafailă [10].

Results

Polystigma rubrum (Pers.) DC. shows the mycelium with intercellular development which forms colored stroma corresponding to the colored spots on the leaves. It differentiates the fungus asexuate fructifications of the pathogen (picnidia with picnospores hyaline, unicellular, filaments). In autumn perithecia are formed which contains asci with ascospores ellipsoidal, hyaline, unicellular.

The disease (red leaf spot) occurs in late May, early June, when on the attacked leaves approximately circular spots make their appearance, at first creamy yellow, then orange and finally turning into red-brown (Fig. 1 and Fig. 2).

The tissue corresponding to spots, is prominent, waxed and on the underside of the leaf there are punctiform formations that represent ostioles of the picnidia [6].

In the favourable disease, as a result of intense attacks, the dry leaves and fall; this causes a low resistance of trees during the winter.

The research regarding physiological modifications produced by Polystigma rubrum (Pers.) DC. in leaves of plum - Diana variety were performed according to the degree of the attack and the climatic conditions on July 8th 2011.
The physiological processes intensity (photosynthesis and transpiration) of the analyzed leaves plant shows lower values in the morning due to low light intensity and temperature, higher values at lunch due to the increasing light intensity and temperature which determine the opening of degree of the stomata and lower values towards the evening due to the decreasing light intensity and temperature and to the decreasing opening degree of the stomata.

The photosynthesis and transpiration intensity during the day in the attacked leaves shows lower values as a result of the reduction of the assimilation surface and malfunctioning of stomata closing and opening mechanisms by the appearance of the yellow-cream spots, then red-brown and in finally a necrosis of the tissue corresponding spots (Fig. 4 and Fig. 5).

The physiological processes intensity (photosynthesis and transpiration) is correlate with the the physiological parameters (photosynthetic active radiation, leaf temperature, stomatal conductance), but presents different values in the attacked leaves, in comparison with the healthy leaves, a strong was establishing association between these.

The physiological parameters, during the day, increase starting in the morning; they present higher values at lunch and a gradually decrease towards evening (Table. 1).
The linear regressions performed between the values of photosynthesis intensity and the photosynthetic active radiation show a good positive correlation, the coefficient of determination ($R^2$) is 0.92 for the healthy leaves and 0.90 for attacked leaves and linear regression made between the transpiration intensity and photosynthetic active radiations show a good positive correlation between these, the coefficient of determination ($R^2$) is 0.88 for the healthy leaves and 0.87 for attacked leaves (Figs. 6 and Fig. 7).

![Graph 1](image1)

**The physiological parameters in the leaves of Prunus domestica L.**

<table>
<thead>
<tr>
<th>The photosynthetic active radiation ($\mu$mol / m$^2$ / s)</th>
<th>Healthy leaves</th>
<th>Attacked leaves</th>
</tr>
</thead>
<tbody>
<tr>
<td>1145</td>
<td>1362</td>
<td>1576</td>
</tr>
<tr>
<td>1124</td>
<td>1352</td>
<td>1358</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The leaf temperature ($^\circ$C)</th>
<th>Healthy leaves</th>
<th>Attacked leaves</th>
</tr>
</thead>
<tbody>
<tr>
<td>26.4</td>
<td>30.9</td>
<td>35.3</td>
</tr>
<tr>
<td>26.6</td>
<td>31.1</td>
<td>35.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The stomatal conductance of CO$_2$ ($\text{mol} / \text{m}^2 / \text{s}$)</th>
<th>Healthy leaves</th>
<th>Attacked leaves</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.08</td>
<td>0.11</td>
<td>0.13</td>
</tr>
<tr>
<td>0.06</td>
<td>0.1</td>
<td>0.12</td>
</tr>
</tbody>
</table>

The linear regressions performed between the values of photosynthesis intensity and the leaf temperature show a positive correlation, the coefficient of determination ($R^2$) is 0.95 for the healthy leaves and 0.96 for attacked leaves and linear regression made between the transpiration intensity and leaf temperature show a positive correlation between these, the coefficient of determination ($R^2$) is 0.88 for the healthy leaves and 0.87 for attacked leaves (Figs. 8 and Fig. 9).

![Graph 2](image2)

**Table 1**

<table>
<thead>
<tr>
<th>The hours of performed analyses</th>
<th>8$^{\text{th}}$</th>
<th>10$^{\text{th}}$</th>
<th>12$^{\text{th}}$</th>
<th>14$^{\text{th}}$</th>
<th>16$^{\text{th}}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy leaves</td>
<td>1145</td>
<td>1362</td>
<td>1576</td>
<td>1480</td>
<td>1384</td>
</tr>
<tr>
<td>Attacked leaves</td>
<td>1124</td>
<td>1352</td>
<td>1358</td>
<td>1456</td>
<td>1345</td>
</tr>
<tr>
<td>Healthy leaves</td>
<td>26.4</td>
<td>30.9</td>
<td>35.3</td>
<td>34.7</td>
<td>33.4</td>
</tr>
<tr>
<td>Attacked leaves</td>
<td>26.6</td>
<td>31.1</td>
<td>35.5</td>
<td>34.8</td>
<td>33.5</td>
</tr>
<tr>
<td>Healthy leaves</td>
<td>0.08</td>
<td>0.11</td>
<td>0.13</td>
<td>0.12</td>
<td>0.1</td>
</tr>
<tr>
<td>Attacked leaves</td>
<td>0.06</td>
<td>0.1</td>
<td>0.12</td>
<td>0.1</td>
<td>0.09</td>
</tr>
</tbody>
</table>

Fig. 6. The correlation between the photosynthesis intensity and the photosynthetic active radiation at the Prunus domestica L. - Diana variety.

The linear regressions performed between the values of photosynthesis intensity and the leaf temperature show a positive correlation, the coefficient of determination ($R^2$) is 0.95 for the healthy leaves and 0.96 for attacked leaves and linear regression made between the transpiration intensity and photosynthetic active radiations show a good positive correlation between these, the coefficient of determination ($R^2$) is 0.88 for the healthy leaves and 0.87 for attacked leaves (Figs. 6 and Fig. 7).

Fig. 7. The correlation between the transpiration intensity and the photosynthetic active radiation at the Prunus domestica L. - Diana variety.

between the transpiration intensity and leaf temperature show a positive correlation between these, the coefficient of determination ($R^2$) is 0.97 for the healthy leaves and 0.96 for attacked leaves (Fig. 8 and Fig. 9).
Linear regression shows a positive correlation between the photosynthesis intensity and the stomatal conductance (the coefficient of determination R² was 0.85 for the healthy leaves and 0.79 for the attacked leaves) and between the transpiration intensity and the stomatal conductance (the coefficient of determination R² was 0.77 for the healthy leaves and 0.73 for the attacked leaves) - Fig. 10 and Fig. 11.

The attacked leaves by *Polystigma rubrum* (Pers.) DC. present a decrease of the chlorophyll content by 6.80% as a result of the deterioration of the chlorophyll, appearance of spots and necrosis on the leaves, this correlating with the decrease of the photosynthesis intensity (Fig. 12).

The leaves of *Prunus domestica* L. (*Diana* variety) attacked by the pathogen present a decrease of the total water content by 1.70%, and an increase of the dry substance content by 3.65%; this fact is manifested by the decrease of the cellular turgor and gradual drying of the leaves (Fig. 13).
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-67.08

Attacked leaves

% from the

substance

fresh

The chlorophyll content

Healthy leaves

48.6

45.3

Attacked leaves

Healthy leaves

48.6

45.3

The total water content and the dry substance content

The dry

substance content

% from the fresh substance

The total water content

Healthy leaves

67.08

68.24

Attacked leaves

32.92

31.76

Fig. 12. The chlorophyll content at the Prunus domestica L. - Diana variety.

Fig. 13. The water content and the dry substance content at the Prunus domestica L. - Diana variety.

Conclusions

The photosynthesis and transpiration intensity during the day in the leaves of Prunus domestica L. (Diana variety) attacked by Polystigma rubrum (Pers.) DC. present lower values, in comparison with healthy leaves, as a result of the reduction of the assimilation surface by the appearance of the yellow-cream spots, then red-brown and finally a necrosis of the tissue corresponding to spots. The linear regressions performed between these physiological processes and the photosynthetic active radiation, the temperature leaf and the stomatal conductance show a positive correlation, in healthy leaves but also in attacked leaves.

As a result of the action of pathogen on the attacked leaves one can notice a decrease of chlorophyll content, but also a decrease of the total water content which is manifested in withering and gradual drying of leaves.

References