

PHYSIOLOGICAL MODIFICATIONS PRODUCED BY *TAPHRINA DEFORMANS* (BERK.) TUL. IN *PERSICA VULGARIS* MILLER CULTIVATED IN THE CLIMATIC CONDITIONS OF OLTENIA REGION

NICOLAE I.¹, BUȘE-DRAGOMIR LUMINIȚA^{1*}

¹ University of Craiova, Email: ionnicolaebio@yahoo.com

^{1*} Corresponding author, University of Craiova, Email: luminita25dragomir@yahoo.com

Keywords: attacked leaves, healthy leaves, pathogen, photosynthesis, transpiration.

ABSTRACT

The researches regarding physiological modification produced in *Persica vulgaris* Miller due to the attack produced by *Taphrina deformans* (Berk.) Tul. were performed on Champion variety cultivated in the climatic conditions in Oltenia Region.

In the leaves of the peach attacked by the pathogen it is observed that the physiological processes intensity presents specific variations due the damaging action of the pathogen and of the climatic conditions. The photosynthesis and transpiration's intensity in the attacked leaves is similar to that in the healthy leaves, but the recorded values are lower due to the reduction of the assimilation surface of the leaf due to the appearance of reddish-yellow spots and tissue deformation. The attacked leaves present a decrease of chlorophyll and water content, fact manifested by withering and drying of the leaves.

INTRODUCTION

The area is favorable to peach culture in southern, eastern and south western Romania, and the best peach cultivation favors the emergence and evolution of the *Taphrina deformans* (Berk.) Tul. The disease is frequently encountered in the peach crop in our country, the symptoms being developed at the end of April to early May (Nicolae and Bușe-Dragomir, 2012). The peach leaf curl caused by *Taphrina deformans* is an important disease causing quantitative and qualitative yield losses. This is a very widespread in all peach growing areas around the world (Ponti and Spada, 1997).

The phytopathogenic fungus *Taphrina deformans* causing the so called "leaf curl disease" in peach trees leads to severe yield losses due to the development of leaf hypertrophy and subsequent necrosis and scission (Koleva-Valkova et al., 2017).

Taphrina deformans Berk/Tul. is able to affect not only individual leaves, but also systemically infect young shoots, which most often necrotize and die as a result. In some cases the symptoms of the disease manifest at later stages, in the period of June-July, which suggests summer infections with the pathogen (Agris, 2005).

The fungus hyphae are entirely intracellular and obtain nutrients from adjacent cells, which determine the ability for systemic development of the pathogen (Mehrotra and Aggarwal, 2013). The embryonic infection of peach leaves with *Taphrina deformans* causes dramatic cytohistological changes, hypertrophy and hyperplasia, that manifest as chlorosis, thickening and deformation of leaves, shoots and fruit, and ultimate necrosis of the infected organs (Caporali, 1964).

At peach leaves, the photosynthesis maximum is achieved in late April and lasts until the first days of July (Cappelini and Dettori, 1992). The intensity of the process of photosynthesis in peach leaves varies between 8.0 and 15.8 $\mu\text{mol CO}_2 / \text{m}^2 / \text{s}$ (Andersen and Brodbeck, 1988).

Research conducted in peach on chlorophyll content from shaded and sunny leaves showed that shaded leaves have a higher chlorophyll content compared to the sunny ones (Gaudillere and Moing, 1992).

The diurnal dynamics of transpiration has a maximum at noon and a minimum during the night when cuticle transpiration (Burzo et. al., 1999). In hydric conditions of stress, the closing of stomata determines the increase of stomata resistance, the decrease of stomatal conductance and the reduction of photosynthesis intensity (Nicolae, 2010).

MATERIAL AND METHODS

The physiological analyzes were performed in the peach tree - *Champion* variety cultivated in the climatic conditions in Oltenia region. The peach *Champion* variety is a small tree with lanceolate leaves, slightly toothed on the edges. The flowers are light pink. The fruits are large, pubescent, with a slightly flattened spherical shape, in shades of yellow with red spots. The pulp of the fruit is yellow, juicy with a pleasant aromatic taste, non-adherent to the stone. It is a variety with a high fruit productivity.

The photosynthesis and transpiration of the intensity and the physiological parameters (photosynthetic active radiation, leaf temperature, stomatal conductance) were determined with the ultra compact photosynthesis measurement system (LCi).

The water contents and the dry substance content were determined by the gravimetric method and the chlorophyll content were analysed with the help of 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

Taphrina deformans (Berk.) Tul. is common in the culture of peaches in our country, the symptoms being developed in late April to early May. The peach leaf curl produced by *Taphrina deformans* (Berk.) Tul. is manifested through leaf puckering and distortion, acquiring a characteristic downward and inward curl. Leaves will also undergo chlorosis, turning a pale green or yellow, and later show a red or purple tint (Figure 1 and Figure 2).

Fruit can either drop prematurely or show surface distortions. The attacked tree will experience defoliation if the leaves are badly diseased.



Figure 1. The peach tree (*Persica vulgaris* Miller) attacked by the *Taphrina deformans* (Berk.) Tul. (Original).



Figure 2. The leaves of *Persica vulgaris* Miller attacked by the *Taphrina deformans* (Berk.) Tul. (Original).

The peach leaf curl is favored by precipitation, the length of periods with high humidity, temperature and the stage of development of the leaves.

The physiological researches were performed in the attacked leaves of the plants compared to the healthy leaves, according to the climatic conditions on May 6th 2021.

The estimation of the attack (frequency, intensity and degree of attack) produced by *Taphrina deformans* (Berk.) Tul. in the *Persica vulgaris* Miller is presented in Figure 3.

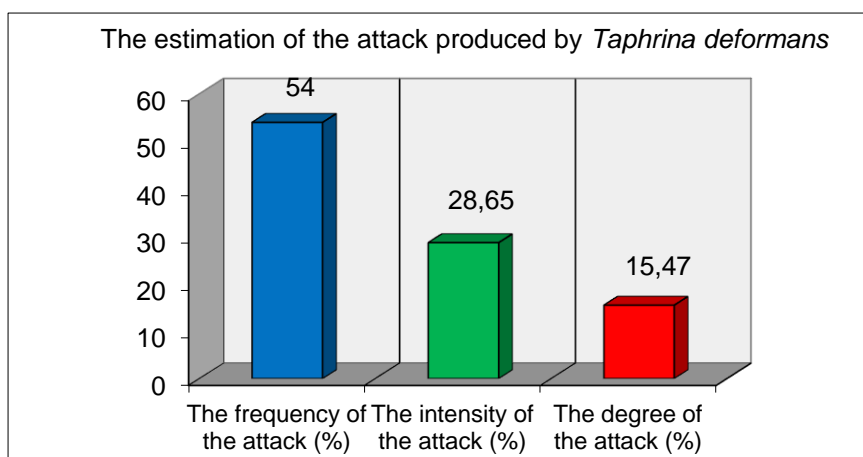


Figure 3. The estimation of the attack produced by *Taphrina deformans* (Berk.) Tul. in the *Persica vulgaris* Miller

The photosynthesis and transpiration intensity is lower value in the attacked leaves by pathogen as a result of the reduction of the assimilation surface, the deterioration of the chlorophyll, but also by malfunctioning of stomata (Figure 4 and Figure 5).

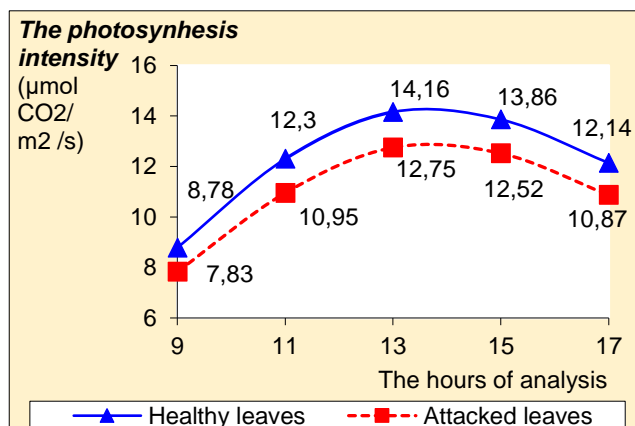


Figure 4. The photosynthesis intensity in the leaves of the *Persica vulgaris* Miller

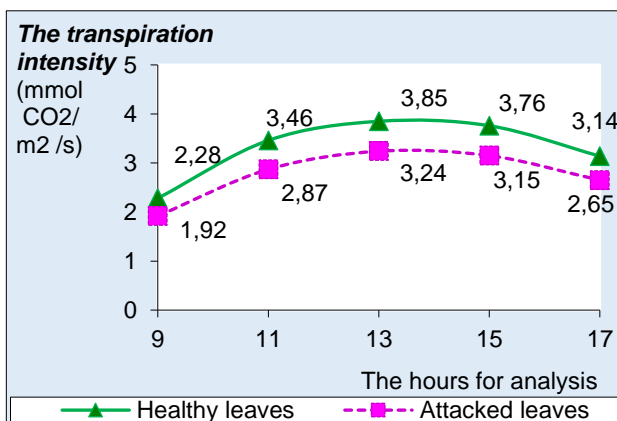


Figure 5. The transpiration intensity in the leaves of the *Persica vulgaris* Miller

The photosynthesis and transpiration's intensity are correlated with the physiological parameters (photosynthetic active radiation, leaf temperature and stomatal conductance), but present different values in the attacked leaves, in comparison with the unattacked leaves, a strong association being established between these. In the peach tree an increase of the photosynthetic active radiations can be observed starting from the morning (9 a.m.), when one can record values of 985 μmol / m² / s for the healthy leaves and of 950 μmol / m² / s for the attacked leaves, values which increase until afternoon (1 p.m.) when one record 1452 μmol / m² / s for the healthy leaves and 1428 μmol / m² / s for the attacked

leaves, and towards the evening (5 p.m.) a decrease is noticed, when values of 1378 $\mu\text{mol} / \text{m}^2 / \text{s}$ are recorded for the healthy leaves and of 1348 $\mu\text{mol} / \text{m}^2 / \text{s}$ for the attacked leaves.

Linear regression shows a positive correlation between the photosynthesis intensity and photosynthetic active radiations were the coefficient of determination (R^2) was 0.91 for the healthy leaves and 0.89 for the attacked leaves and between the transpiration intensity and photosynthetic active radiations were the coefficient of determination was 0.81 for the healthy leaves and 0.79 for the attacked leaves (Figure 6 and Figure 7).

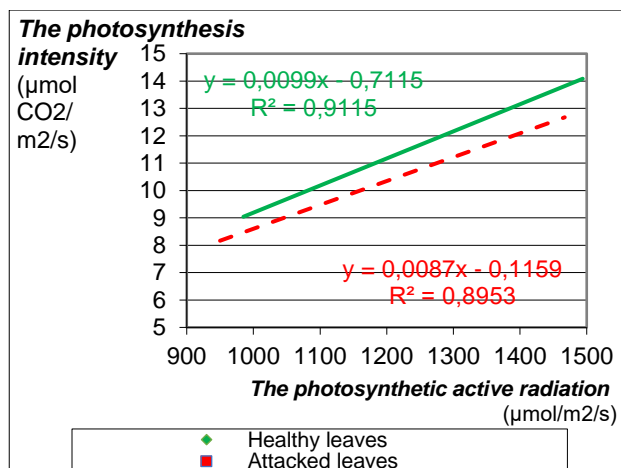


Figure 6. The correlation between the intensity of photosynthesis and the photosynthetic active radiation in the leaves of the *Persica vulgaris* Miller

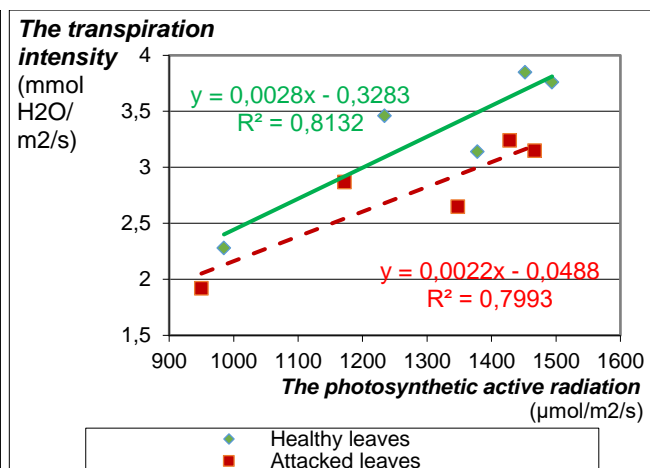


Figure 7. The correlation between the intensity of transpiration and the photosynthetic active radiation in the leaves of the *Persica vulgaris* Miller

The leaf temperature increases starting in the morning (9 a.m.) when the recorded value is 27.7 °C in the healthy leaves and 27.8 °C in the attacked leaves, increases until afternoon (1 p.m.) when value recorded is 32.7 °C in the healthy leaves and 32.9 °C in the attacked leaves and in the evening (5 p.m.) the temperature decreases when the recorded value is 31.5 °C in the healthy leaves and 31.7 °C in the attacked leaves.

The photosynthesis intensity and leaf temperature shows a positive correlation between these, the coefficient of determination (R^2) is 0.91 for the healthy leaves and 0.90 for the attacked leaves and the transpiration intensity and leaf temperature shows a positive correlation, the coefficient of determination is 0.79 for the healthy leaves and 0.81 for the attacked leaves (Figure 8 and Figure 9).

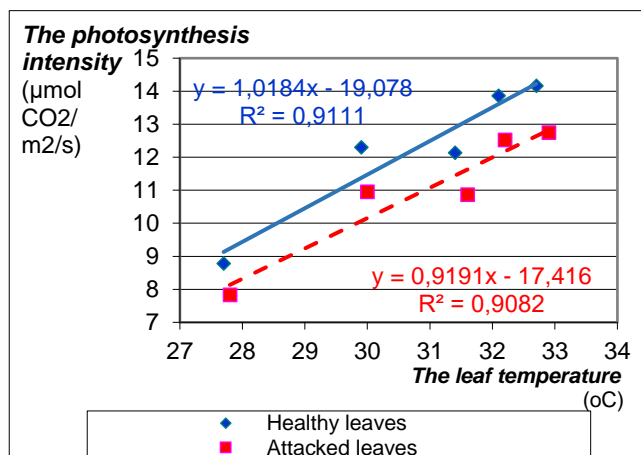


Figure 8. The correlation between the intensity of photosynthesis and the leaf temperature in the *Persica vulgaris* Miller

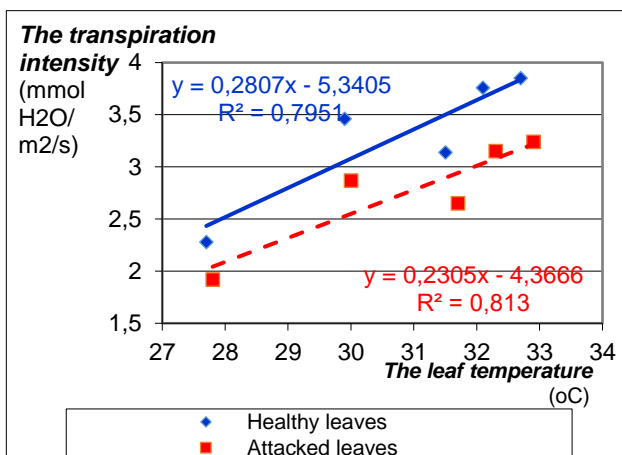


Figure 9. The correlation between the intensity of transpiration and the leaf temperature in the *Persica vulgaris* Miller

The stomatal conductance in the *Persica vulgaris* Miller increases starting in the morning (9 a.m.), when the recorded values are 0.08 mol / m² / s in the healthy leaves and 0.06 mol / m² / s in the attacked leaves, until afternoon (1 p.m.) when the recorded values are 0.14 mol / m² / s in the healthy leaves and 0.12 mol / m² / s in the attacked leaves and towards the evening (5 p.m.) stomatal conductance decreases when the record values are 0.1 mol / m² / s in the healthy leaves and 0.08 mol / m² / s in the attacked leaves.

Linear regression performed shows a positive correlation between the photosynthesis intensity and of the stomatal conductance (the coefficient of determination was 0.87 for the healthy leaves and 0.84 for the attacked leaves) and between the transpiration intensity and of the stomatal conductance (coefficient of determination was 0.88 for the healthy leaves and 0.82 for the attacked leaves) - Figure 10 and Figure 11.

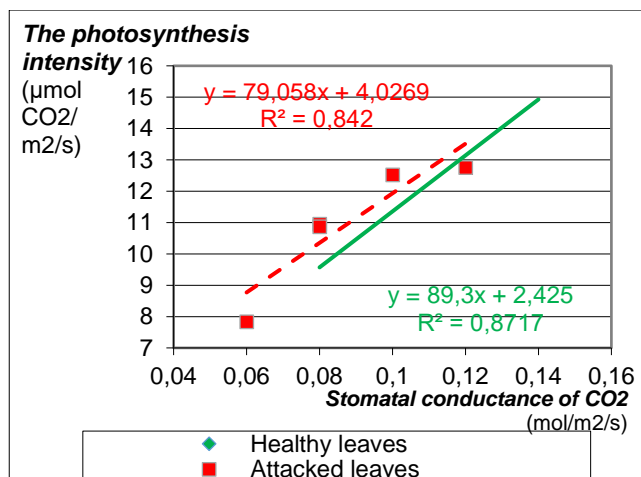


Figure 10. The correlation between the intensity of photosynthesis and the stomatal conductance in the leaves of the *Persica vulgaris* Miller

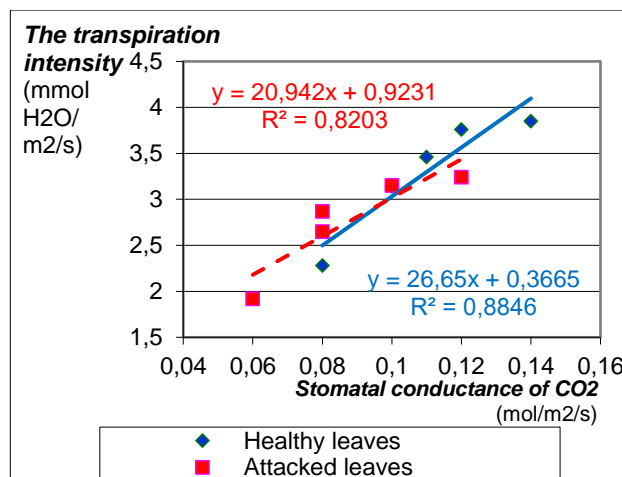


Figure 11. The correlation between the intensity of transpiration and the stomatal conductance in the leaves of the *Persica vulgaris* Miller

The attacked leaves by the *Taphrina deformans* (Berk.) Tul. present a lower water content and a higher of dry substance content, fact manifested by the withering and premature drying of the leaves (Figure 12).

The attacked leaves present a lower chlorophyll content as a result of the distortion leaves and deterioration of the chlorophyll, this correlating with the decrease of the photosynthesis intensity (Figure 13).

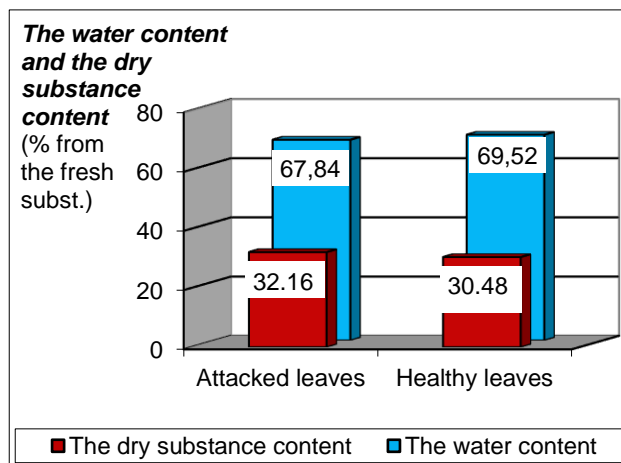


Figure 12. The water content and the dry substance content in the leaves of *Persica vulgaris* Miller

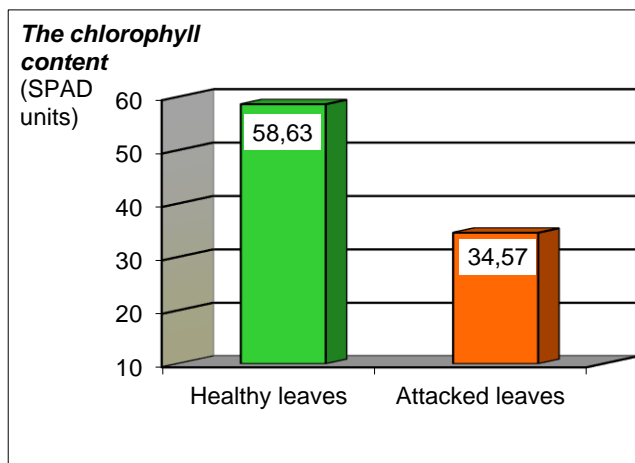


Figure 13. The chlorophyll content in the leaves of the *Persica vulgaris* Miller

CONCLUSIONS

In the *Persica vulgaris* Miller it was observed that photosynthesis and transpiration intensity present minimum values in the morning, maximum values until after noon and minimum values toward the evening, but results obtained in attacked leaves are lower, in comparison with healthy leaves.

The intensity of the physiological processes varies according to the degree of attack, but also by the climatic conditions. The photosynthesis and transpiration's intensity are positively correlated with the photosynthetic active radiation, leaf temperature and stomatal conductance, but present different values in the attacked leaves by pathogen, in comparison with the healthy leaves of the plants.

As a result of the action produced by the pathogen on the attacked leaves one can observe a decrease of the chlorophyll content because of the distortion leaves and deterioration of the chlorophyll and the decrease of the water content, which determines the withering and the early drying of the leaves with consequences on the quality and quantity of peaches.

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