THE INFLUENCE OF THE TREATMENT WITH FUNGICIDES ON THE PHYSIOLOGICAL PROCESSES IN *PRUNUS PERSICA* (L.) BATSCH ATTACKED BY *MONILINIA FRUCTIGENA* (ADERH. & RUHL.) HONEY

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Abstract

Researches regarding the influence of the treatment with fungicides on the physiological processes were carried out on Prunus persica (L.) Batsch, Redhaven variety, cultivated in the climatic conditions in Oltenia region. The physiological researches were performed on July 20th 2022, both for peach trees treated with Dithane M-45 (0,2%) fungicide and also for the peach trees attacked by Monilinia fructigena (Aderh. & Ruhl.) Honey, in which treatments have not been performed. In the leaves of the plants attacked by the pathogen it was observed that the physiological processes' intensity (photosynthesis and transpiration intensity) is lower as a result of the effects produced by the pathogen manifested by drying young shoots with the convexity of their top, the presence of brown spots on the fruits and the appearance of the fructifications of the pathogen. In the attacked leaves there were recorded lower values of chlorophyll content, in comparison with the leaves of plants treated with fungicide, thus existing a positive correlation between this content and the photosynthesis intensity.

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

INTRODUCTION

The present study been undertaken with the objective to determine the influence some fungicides on the phisyological processes in *Prunus persica* L. (Persica vulgaris Miller) attacked by the *Monilinia fructigena* (Aderh.& Ruhl.) Honey.

The most important *Monilinia* species on pome and stone fruits worldwide are *Monilinia laxa*, *Monilinia fructigena* and *Monilinia fructicola*. Brown rot (caused by all three *Monilinia species*) is a serious problem primarily in stone fruits. In some cases, even a single fruit can be infected by different *Monilinia* species (Mercier et al., 2009). The fungus survives the winter in mummified fruits (Casals et al., 2015), in canopy or in the ground (Hrustić et al., 2013).The risk of fungicide resistance development is a complex interaction between the risk of the pathogen, the risk of the fungicide and the agronomic risk (the agronomic measures such as cropping system, varieties, fungicide) – (Kuck and Russell, 2006).

In the literature there is little information available on susceptibility by the pathogen during phenological stages. A better knowledge of fruit susceptibility during phenological stages would permit more careful control of the pathogen and reduction in cost of fruit production and environmental risks (Gheorghe et al., 2020).

The intensity of the process of photosynthesis in peach leaves varies between 8.0 and 15.8 µmol CO_2/ m^2/ s (Andersen and Brodbeck, 1988). The diurnal dynamics of photosynthesis in the attacked leaves is similar to that in the plant leaves analysed one month after attack, time in which there were made treatments with foliar fungicide, but the recorded values are lower in comparison with these as a result of the reduction of the assimilation surface, as well as the of the

inhibition of several biochemical reactions of the photosynthesis (Nicolae and Buşe-Dragomir, 2012).The intensity of the photosynthetic active radiation received by the tree leaves is higher near the edge of the crown and near the stem axis and decreases from the higher to the lower levels. It was discovered that shaded leaves have lower transpiration intensity compared to the sunny ones (Chalmers et al., 1983). 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 (Nicolae and Bușe-Dragomir, 2021). Research conducted in peach on chlorophyllic content from shaded and sunny leaves showed that shaded leaves have a higher chlorophyllic content compared to the sunny ones (Gaudillere and Moing, 1992). At the peach tree, the leaves formed at various distances from the centre of the tree did not have high differences of chlorophyll content, but the inner ones have a higher content as compared to the leaves in the outer branches (Marini and Marini, 1983).

MATERIALS AND METHODS

The physiological analyses were performed in *Prunus persica* (L.) Batsch, *Redhaven* variety cultivated in the climatic conditions in Oltenia region.

Prunus persica (L.) Batsch is a small tree with bark grey-brown. Leaves are lanceolate-elliptic to oblong-lanceolate, glabrous above. Flowers are pink to red, or sometimes white. The fruits are usually greenish-white to orange-yellow with form elliptic to round. The *Redhaven* peach variety is moderately lush. The flowers are pink in colour and the fruit is medium to large, round, and the skin is intensely yellow, and bright red on the sunny side. The treatments were carried out starting on June 11th 2022 and consisted of the application of four treatments with *Dithane* M-45 fungicide at an interval of 10 days (June 11th 2022, June 21th 2022 , July 1st 2022, July 10th 2022). The physiological analyses were carried out according to the climatic conditions on July 20th 2022, in the leaves treated with fungicide and in the attacked leaves in which treatments have not been performed.

The intensity of the photosynthesis and transpiration was established with the ultra compact photosynthesis measurement system (LCi) which enables automatic recording and other parameters (photosynthetic active radiations, leaf temperature, stomatal conductance etc.). The water content and the dry substance content were determined by the gravimetric method and the chlorophyll content were analysed with the Minolta SPAD 502 chlorophyllmeter.

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

RESULTS AND DISCUSSIONS

The *Monilinia fructigena (*Aderh. & Ruhl.) Honey can attack the branches, leaves, fruits and flowers. Young branches wither, dry from the top and hang down. The flowers at the top of the young branches wither, turn brown, but remain attached to the tree. The young leaves turn brown, dry and twist. Brown spots appear on the fruit that extend and cover the entire pulp, where the spores of the fungus appear. Rotted fruits may either fall to the ground or dry out on the tree, leaving a hard, shriveled "mummy".

The attack produced by the pathogen was manifested by drying young shoots with the convexity of their top, the presence of brown spots on the tissue softened fruit and the appearance of the fructifications (conidiophores with conidia) in the form of gray-white mold arranged concentrically (Figure 1).

Tufts of mycelium and conidia (ellipsoidal, cream-white colored) sprout from the skin of the infected fruit, arranged in concentric rings (Figure 2).

Figure 1. The fruit of *Prunus persica* (L.) Batsch attacked by *Monilinia fructigena* (Aderh. & Ruhl.) Honey (Original).

Figure 2. *Monilinia fructigena* (Aderh. & Ruhl.) Honey - the ellipsoidal conidia (oc. 10 x ob. 20) - Original.

The physiological analyses were performed out according to the climatic conditions, in leaves of peach tree treated with fungicide and leaves of peach tree attacked by pathogen in which treatments have not been performed.

The estimation of the attack (frequency, intensity and degree of attack) produced by *Monilinia fructigena* (Aderh. & Ruhl.) Honey in the peach tree is presented in Figure 3.

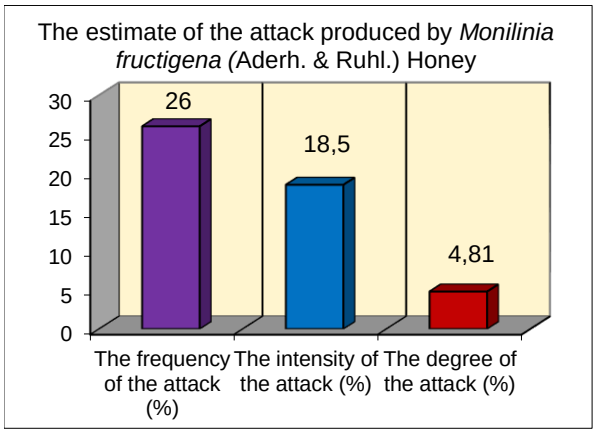

Figure 3. The estimation of the attack produced by *Monilinia fructigena* (Aderh. & Ruhl.) Honey in *Prunus persica* (L.) Batsch.

The photosynthesis and transpiration's intensity has a lower value in the attacked leaves as a result of the effects produced by the pathogen manifested by the drying young shoots with the convexity of their top, the presence of brown spots on the fruits and the appearance of the fructifications in the form of gray-white mold arranged concentrically (Figure 4 and Figure 5).

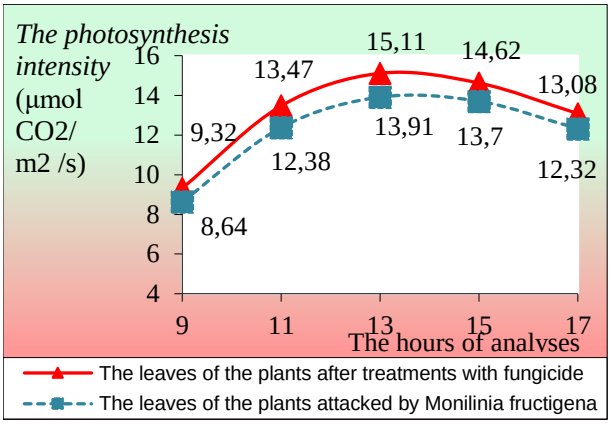

Figure 4. The photosynthesis intensity in the leaves of *Prunus persica* (L.) Batsch.

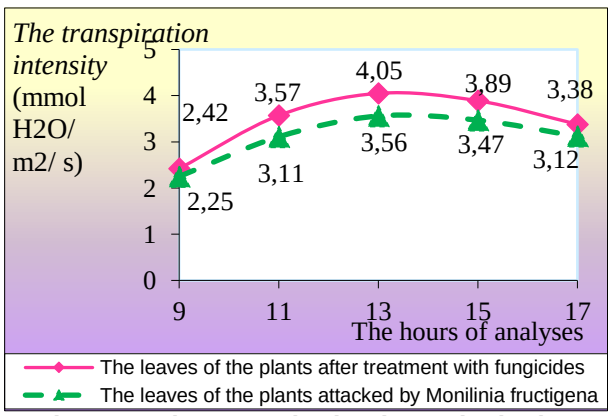

Figure 5. The transpiration intensity in the leaves of *Prunus persica* (L.) Batsch.

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

The photosynthetic active radiation in the peach tree increases starting with the morning (9 a.m.) when values are 1121 µmol/m^2/s in the leaves treated with fungicides and 987 µmol/m^2/s in the attacked leaves by pathogen, they grow up until afternoon (1 p.m.) when values are 1487 µmol/m^2/s in the treated leaves and 1438 µmol/m^2/s in the attacked leaves and decrease towards evening (5 p.m.) when values are 1343 µmol/m^2/s in the leaves treated with fungicides and 1321 µmol/m^2/s in the attacked leaves. Linear regression made between the photosynthesis intensity and photosynthetic active radiations shows a positive correlation between these, the coefficient of determination (R^2) was 0.98 for the peach tree after treatments with fungicide and 0.97 for the attacked peach tree; linear regression made between the transpiration intensity and photosynthetic active radiations shows a positive correlation, the coefficient of determination R^2 was 0.98 for the peach tree after treatments with fungicide and 0.96 for the peach tree attacked by pathogen (Figure 6 and Figure 7).

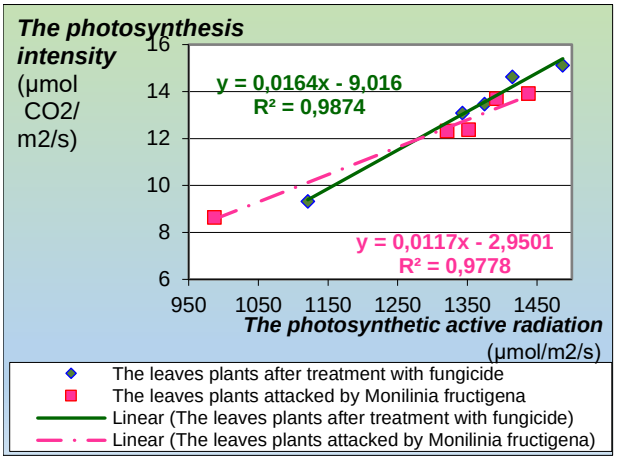

Figure 6. The correlation between the intensity of photosynthesis and the photosynthetic active radiation in *Prunus persica* (L.) Batsch.

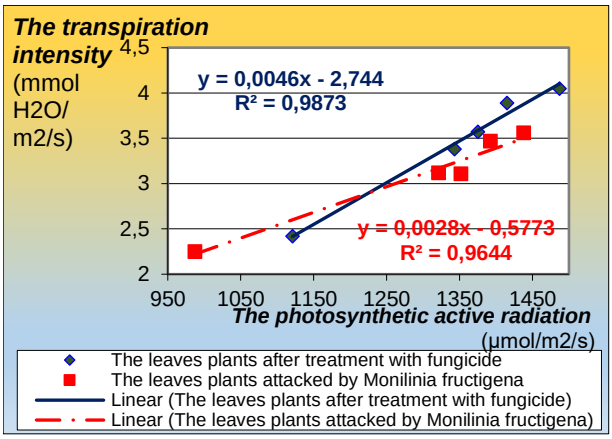

Figure 7. The correlation between the intensity of transpiration and the photosynthetic active radiation in *Prunus persica* (L.) Batsch.

In peach tree an increase of the leaf temperature can be noticed starting in the morning (9 a.m.) when values are 28.3 ^{o}C in the treated leaves and 28.5 ^{o}C in the attacked leaves, they grow up until afternoon (1 p.m.) when values are 33.9 ^{o}C in the treated leaves and 34.2 ^{o}C in the attacked leaves and decrease towards evening (5 p.m.) when values are 31.9 ^{o}C in the treated leaves and 32.1 ^{o}C in the attacked leaves. Linear regression made between the photosynthesis intensity and leaf temperature shows a positive correlation, the coefficient of determination (R^2) was 0.98 for the peach tree after treatments and 0.97 for the attacked peach tree; linear regression between the transpiration intensity and leaf temperature shows a positive correlation, the coefficient R^2 was 0.97 for the peach tree after treatments and 0.98 for the attacked peach (Figure 8 and Figure 9).

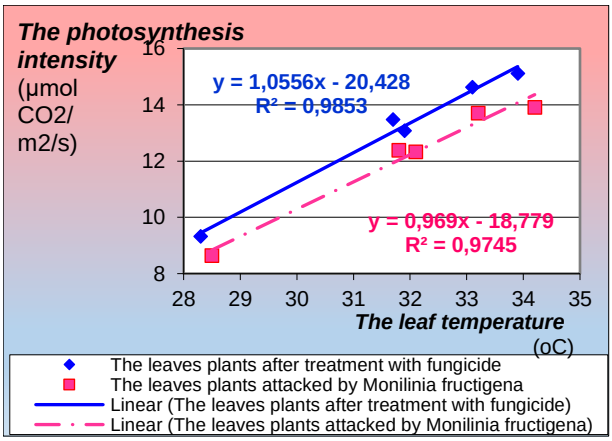

Figure 8. The correlation between the intensity of photosynthesis and the leaf temperature in *Prunus persica* (L.) Batsch.

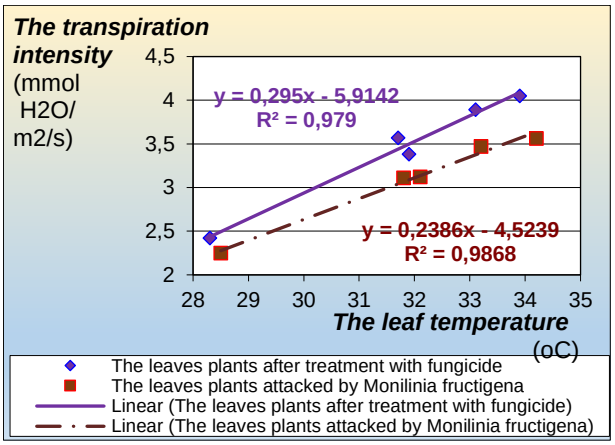

Figure 9. The correlation between the intensity of transpiration and the leaf temperature in *Prunus persica* (L.) Batsch.

The stomatal conductance in the peach tree increases starting with the morning (9 a.m.) when values are 0.07 mol/m^2/s in the treated leaves and 0.05 mol/m^2/s in the attacked leaves, they grow up until afternoon (1 p.m.) when values are 0.15 mol/m^2/s in the treated leaves with fungicide and 0.13 mol/m^2/s in the attacked leaves and decrease towards evening (5 p.m.) when values are 0.11 mol/m^2/s in the treated leaves and 0.10 mol/m^2/s in the attacked leaves. The photosynthesis intensity and stomatal conductance show a positive correlation, the coefficient of determination (R^2) was 0.96 for the peach tree after treatments and 0.93 for the attacked peach tree; the transpiration intensity and stomatal conductance show a positive correlation, the coefficient R^2 was 0.97 for the peach tree after treatments and 0.95 for the attacked peach (Figure 10 and Figure 11).

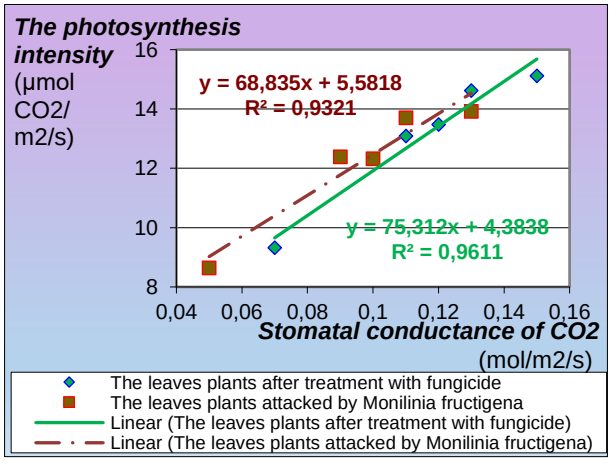

Figure 10. The correlation between the intensity of photosynthesis and the stomatal conductance in *Prunus persica* (L.) Batsch.

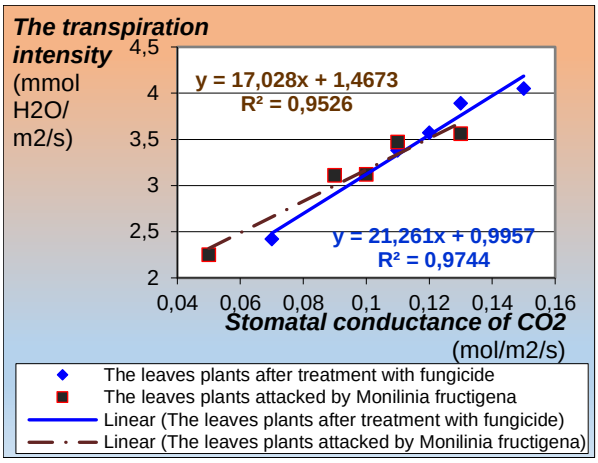

Figure 11. The correlation between the intensity of transpiration and the stomatal conductance in *Prunus persica* (L.) Batsch.

In the attacked leaves it was registered a lower water content and a higher dry substance content in comparison with the leaves of peach after performing treatments with fungicide (Figure 12).

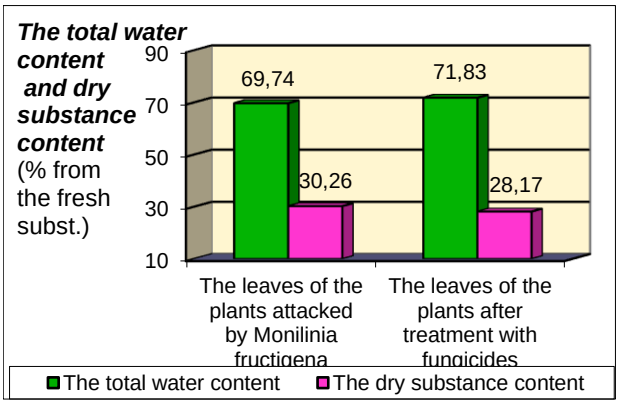

Figure 12. The water content and the dry substance content in *Prunus persica* (L.) Batsch.

In the attacked leaves of peach tree by the pathogen a lower chlorophyll content is recorded in comparison with the leaves treated with fungicide, fact is correlates with photosynthesis intensity (Figure 13).

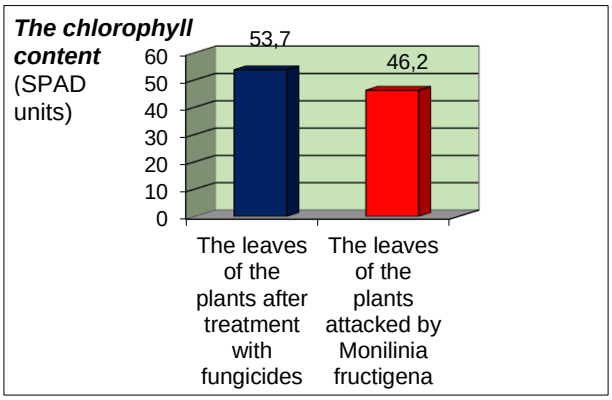

Figure 13. The chlorophyll content in *Prunus persica* (L.) Batsch.

CONCLUSIONS

In leaves of the peach tree attacked by the *Monilinia fructigena (*Aderh. & Ruhl.) Honey one can observe that the intensity of the physiological processes is lower as a result of the effects produced by the pathogen manifested by the drying young shoots with the convexity of their top, the presence of brown spots and the fructifications of the pathogen on the fruits. 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 leaves of peach tree attacked by pathogen.

In the attacked leaves were recorded lower values of the water content and chlorophyll content correlated with the photosynthesis intensity, fact that causes withering and drying of the leaves, with consequences on the quality and quantity of fruit.

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