THE EFFECT OF FUNGICIDES ON THE PHYSIOLOGICAL PROCESSES IN *PRUNUS ARMENIACA* L. ATTACKED BY *STIGMINA CARPOPHILA* (LÉV.) M.B. ELLIS

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Abstract

These researches aim of presenting the effect of fungicides on the physiological processes in Prunus armeniaca L. (Litoral variety) *attacked by Stigmina carpophila (Lév.) M.B.Ellis., in Oltenia region. Shot hole disease appears in intensified cool and wet conditions of spring, but can occur and cause damage at any time during prolonged wet weather. The physiological researches were carried out in the leaves of plants after treatments with fungicide and the leaves of plants attacked by the pathogen in which treatments with fungicide have not been performed. In the leaves of the Prunus armeniaca L. plants attacked by the pathogen, in comparison with the leaves of plants after treatments with fungicide, it was found that the physiological processes' intensity during the day has low values as a result of the harmful action of the pathogen which is manifested by the small reddish or purplish, with yellow halo bordered spots, the centre of which drops out as the spot ages. In the leaves of the plants attacked by the pathogen lower values of water content were recorded, which produces water imbalances, but also lower values of chlorophyll content, which correlates with the intensity of photosynthesis.*

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

INTRODUCTION

Apricot (*Prunus armeniaca* L.) is a widely cultivated and significant fruit crop worldwide, serving as a key agricultural product of local economies, with numerous health benefits (Hussain et al., 2025).

The apricot has been used in medicines as a remedy for various diseases (Gilani et al., 2010). Apricot oil is used in cosmetics industry specially to protect the skin from ultra violet radiations and also as laxative and expectorant. Apricots are tasty even eaten fresh or when added in desserts, poached, stewed or pureed in jams, chutneys, pickles, compotes, salads or sorbets. Baby foods from pulp of apricot are a good source of calcium, phosphorus and iron. It is also reported to be used in asthma, constipation and cough (Ghasemhezhad et al., 2010).

Prunus armeniaca L. (apricots) is a tree with trunk with out spread canopy comprising of twisted branches. The leaves has oval shaped and the surface of the leaves is dark green in colour while having a ting of yellow on the underside. Flowers, 2-4 cm broad, consists of 5 petals and blossom in the month of April and May depending on cultivar and environmental conditions. The fruit requires 3-6 months for complete development and ripening (Singh, 2009). The surface of the fruit is yellow or reddish-orange in colour and is either smooth (glabrous) or velvety (pubescent).

However, apricots are susceptible to several diseases and pests that cause lower yields and significant financial losses, including apricot shot hole disease brought on by *Stigmina carpophila (Lév.) M.B. Ellis* (syn. *Wilsonomyces carpophilus*), a polyphagous fungus, creates a serious threat to stone fruits, particularly the apricot tree (Muhammad et al., 2022).

Shot hole disease produced by *Stigmina carpophila* (Lév.) M.B. Ellis is found in stone fruit trees including peach, nectarine, apricot, plum, cherry and almond. Stone fruit trees are economically important land- scape plants. The most limiting factor to their production is shot-hole disease (Woodward, 1999). Disease manifests as spots on apricot fruit and leaves in spring (April to June), with severe cases leading to leaf drop. Fruit symptoms include light brown lesions with dark purple margins, often clustered on the upper side of the fruit (Saleem et al., 2020).

MATERIALS AND METHODS

The physiological researches were performed in *Prunus armeniaca* L., *Litoral* variety, cultivated in the Oltenia region.

The *Litoral* variety (Romanian variety) has low vigor, the trunk is straight or twisted, with a voluminous crown. The fruit is medium to large in size, elongated-ovoid in shape, lemon-yellow in color, with carmine-red spots and streaks on the sunny side. The fruit pulp is light yellow, not adhering to the seed, aromatic. The ripening period is late (August), and the production potential is high.

The treatments with fungicide spraying were carried out starting on May 23th 2024 and consisted of the application of three treatments with *Dithane* M-45 (0.2%) fungicide at an interval of 14 days. The physiological research was carried out, according to the climatic conditions, on July 4th 2024, in the leaves of *Prunus armeniaca* L**.** after treatments with fungicide and in the attacked leaves by *Stigmina carpophila* (Lév.) M.B. Ellis in which treatments with fungicide have not been performed.

Dithane M-45 fungicide is a contact fungicide, based on the active substance mancozeb 80%. This fungicide combats a wide range of pathogens by inhibiting the germination of spores in various crops (vegetables, flowers, fruit trees, vines).

Dithane M-45 is applied preventively in conditions favorable to attack or can be used during the period with risk of attack.

The physiological processes (photosynthesis intensity and transpiration intensity) was established with the ultra compact photosynthesis system (LCi) which enables recording and other parameters (photosynthetic active radiations, leaf temperature, stomatal conductance). The water content and the dry substance content were determined by the gravimetric method by drying the plant material using an oven.

The chlorophyll content were determined with the Minolta SPAD 502 chlorophyllmeter. The estimate of the attack produced by the pathogen was calculation with formulae elaborate by Săvescu and Rafailă (Săvescu and Rafailă, 1978).

RESULTS AND DISCUSSIONS

Shot hole disease produced by *Stigmina carpophila (Lév.) M.B. Ellis* is manifested on buds, branches, blossoms, leaves and fruits of *Prunus armeniaca* L. Disease appears in the form of spots on fruit and leaves in spring. On leaves, the symptoms of shot-hole disease range from small reddish or purplish, with yellow halo bordered spots, the centre of which drops out as the spot ages, to larger, irregular, reddish brown spots occurring usually along the leaf margin - where the affected area also drops out (Woodward, 1999) - Figure 1.

On plants twigs the symptoms is manifested are small black spots which later enlarge and become sunken. Symptoms on fruit present lesions that are light brown with dark purple margins. Fruit spotting can be severe and as fruits mature, the spots become crusty, leaving roughened areas beneath.

Leaf infection leading to defoliation in the most serious aspect of shot hole diseases, because severe defoliation during early fruit development can cause the young fruits to fall, and repeated defoliation weakens the trees and reduces their yield (Teviotdale et al., 1999).

Figure 1. The leaves of the *Prunus armeniaca* L. attacked by *Stigmina carpophila* (central necrotic area gradually gives way and drop out) - (Original).

The disease is the most harmful in intensified cool and wet conditions of spring, although it can occur and cause damage at any time during prolonged wet weather (Evans et al., 2008).

Stigmina carpophila (Lév.) M. B. Ellis presents intercellular mycelium, septated. Conidiophores are simple, filamentous, septa, hyaline or yellow-brown, at the end of which a single conidia is formed, oval-cylindrical (Nicolae and Bușe-Dragomir, 2023) - Figure 2.

Figure 2. *Stigmina carpophila (Lév.) M.B. Ellis* - oval cylindrical conidia (Original).

The pathogen overwinters as hyphae and conidia inside the scales of infected buds and on the cankers on twigs. Conidia begin germinating in the early spring when favorable environmental circumstances are favorable (Highberg and Ogawa, 1986). The estimate of the attack produced by *Stigmina carpophila* in *Prunus armeniaca* L. is presented in Figure 3.

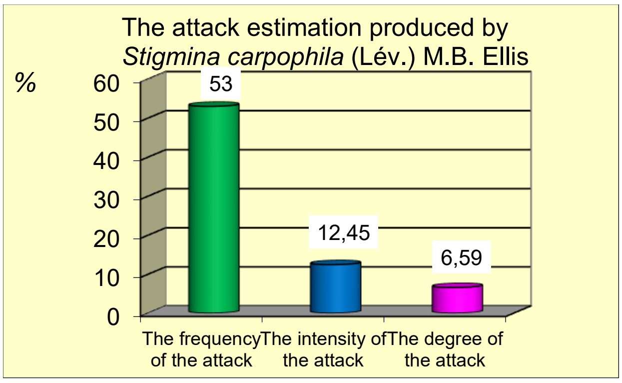

Figure 3. The attack estimation produced by *Stigmina carpophila* in *Prunus armeniaca* L.

The photosynthesis intensity and transpiration intensity, during the day, in the leaves of the plants attacked by the pathogen shows lower values, in comparison with leaves of the plants after treatment with fungicide, as a result of the harmful action of the pathogen which is manifested by the small reddish or purplish, with yellow halo bordered spots, the centre of which drops out as the spot ages (Figure 4 and Figure 5).

The physiological processes' intensity (photosynthesis and transpiration intensity) depends on the photosynthetic active radiation, leaf temperature, stomatal conductance.

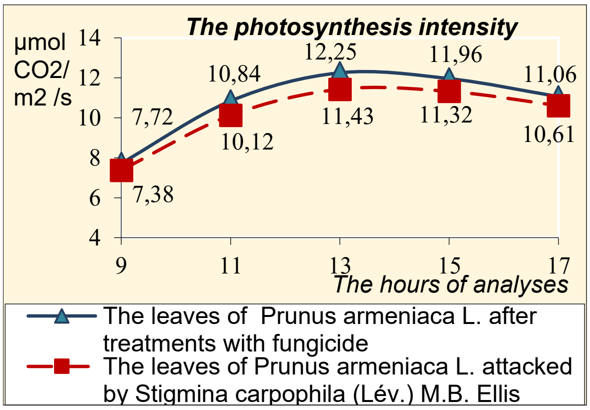

Figure 4. The photosynthesis intensity during the day in the leaves of *Prunus armeniaca* L.

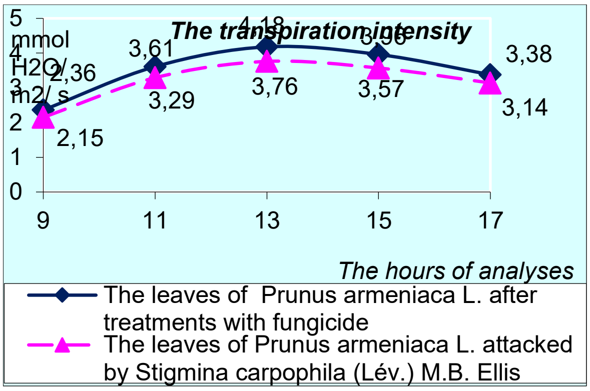

Figure 5. The transpiration intensity during the day in the leaves of *Prunus armeniaca* L.

The photosynthetic active radiation in the morning (9 a.m.) has values of the 1237 μmol/m^2/s in the leaves of the plants after treatment with fungicide and 1206 μmol/m^2/s in the attacked leaves, these values increase in the middle of the day (1 p.m.) when 1673 μmol/m^2/s are recorded in the treated leaves and 1635 μmol/m^2/s in the attacked leaves and decrease towards the evening (5 p.m.) when 1552 μmol/m^2/s are recorded in the leaves of the plants after treatment with fungicide and 1528 μmol/m^2/s in the attacked leaves. Linear regression shows a positive correlation between the photosynthesis intensity and photosynthetic active radiations, the coefficient of determination (R^2) was 0.97 for the treated leaves and 0.96 for the leaves of the attacked plants and linear regression made between the transpiration intensity and photosynthetic active radiations shows a positive correlation, the coefficient of R^2 was 0.91 for the treated leaves and 0.90 for the attacked leaves (Figure 6 and Figure 7).

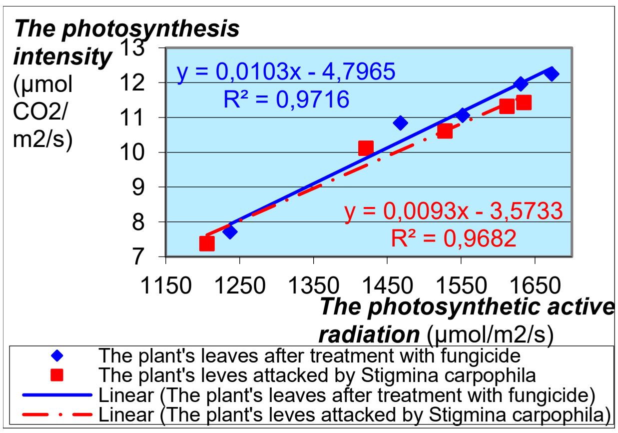

Figure 6. The correlation between the intensity of photosynthesis and the photosynthetic active radiation in *Prunus armeniaca* L.

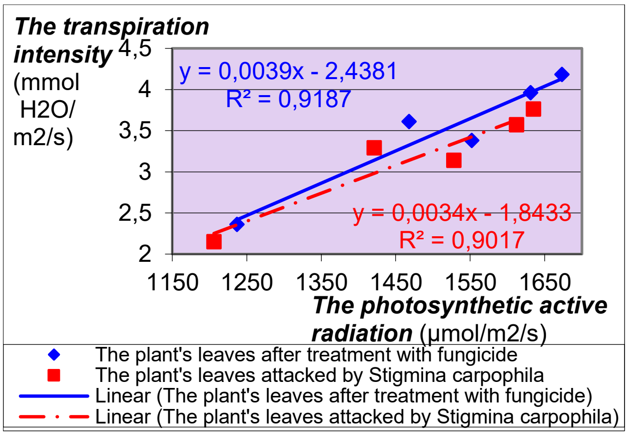

Figure 7. The correlation between the intensity of transpiration and the photosynthetic active radiation in *Prunus armeniaca* L.

The leaf temperature in the morning (9 a.m.) has values of the 25.2 ºC in the leaves of the plants after treatment with fungicide and 25.3 ºC in the leaves of the plants attacked by the pathogen, then increases until after lunch (1 p.m.) when it has values of the 35.1 ºC in the treated leaves and 35.3 ºC in the attacked leaves and gradually decreases towards the evening (5 p.m.) when values of the 29.2 ºC in the leaves of the plants after treatment and 29.3 ºC in the attacked leaves. The photosynthesis intensity and leaf temperature show a positive correlation, the coefficient of determination (R^2) was 0.86 for the treated plants with fungicide and 0.82 for the leaves of the plants attacked by the pathogen and the transpiration intensity and leaf temperature shows a positive correlation, the coefficient R^2 was 0.95 for the treated plants and 0.93 for the attacked leaves of the plants (Figure 8 and Figure 9).

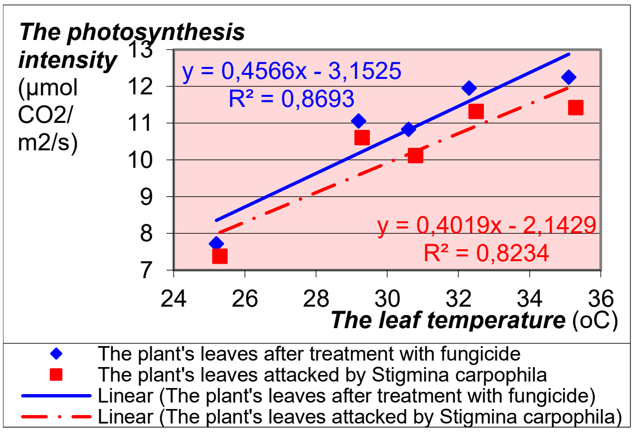

Figure 8. The correlation between the intensity of photosynthesis and the leaf temperature in *Prunus armeniaca* L.

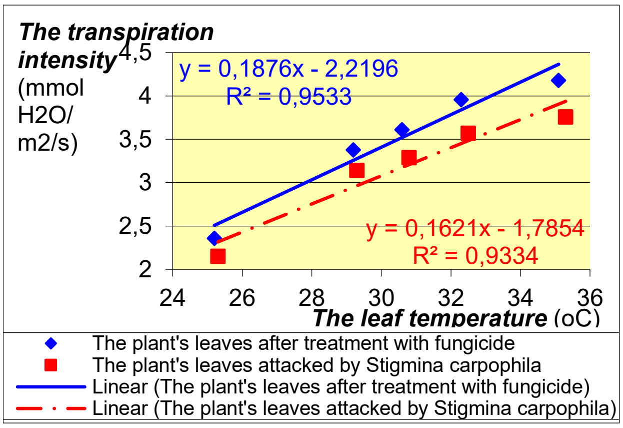

Figure 9. The correlation between the intensity of transpiration and the leaf temperature in *Prunus armeniaca* L.

The stomatal conductance in the morning (9 a.m.) has values of the 0.07mol/m^2/s in the treated leaves and 0.05 mol/m^2/s in the attacked leaves, then increases until after lunch (1 p.m.) when it has values of the 0.18 mol/m^2/s in the treated and 0.17 mol/m^2/s in the attacked leaves and gradually decreases towards the evening (5 p.m.) when values of the 0.15 mol/m^2/s in the treated leaves and 0.13 mol/m^2/s in the attacked leaves. Linear regression shows a positive correlation between the photosynthesis intensity and stomatal conductance show a positive correlation, the coefficient of determination (R^2) was 0.99 for the treated leaves and 0.97 for the attacked leaves and the linear regression shows a positive correlation between the transpiration intensity and stomatal conductance, R^2 was 0.95 in the treated leaves and 0.98 in the attacked leaves (Figure 10 and Figure 11).

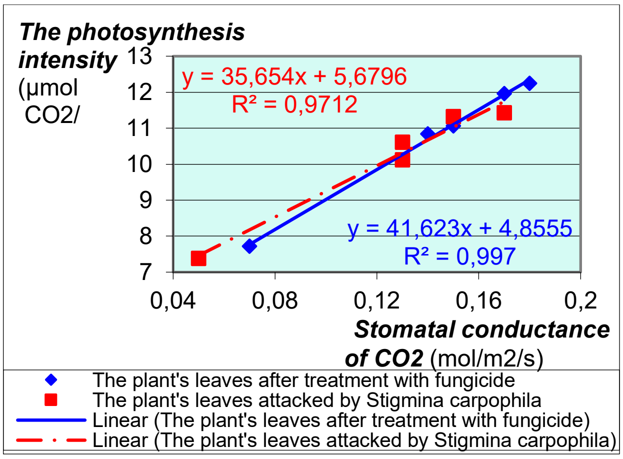

Figure 10. The correlation between the intensity of photosynthesis and the stomatal conductance in *Prunus armeniaca* L.

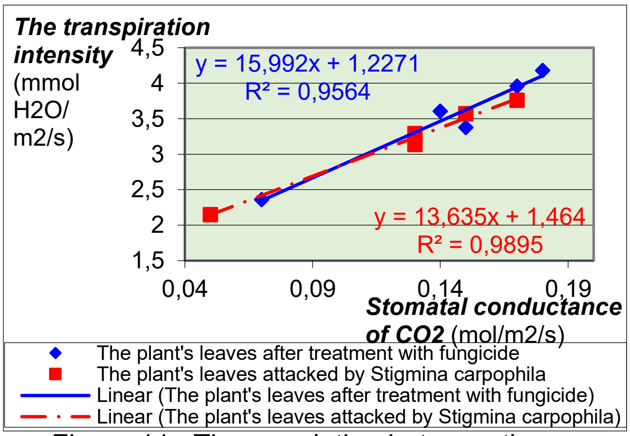

Figure 11. The correlation between the intensity of transpiration and the stomatal conductance in *Prunus armeniaca* L.

In the attacked leaves a lower values of water content and a higher values dry substance content were recorded, fact which caused water and metabolic imbalances (Figure 12).

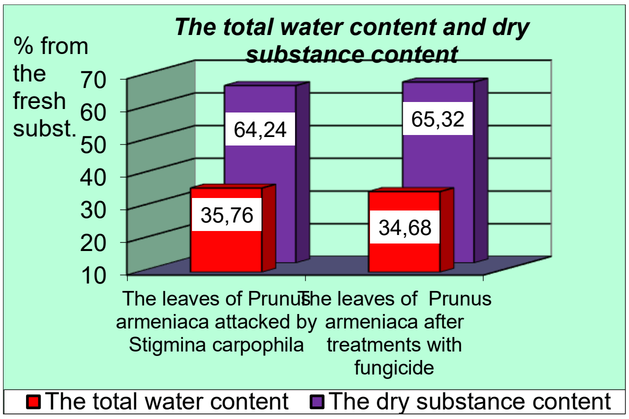

Figure 12. The water content and the dry substance content in leaves of *Prunus armeniaca*

In the attacked leaves, in comparison with the treated leaves, it is observed a lower values of chlorophyll content, which correlates with the intensity of photosynthesis (Figure 13).

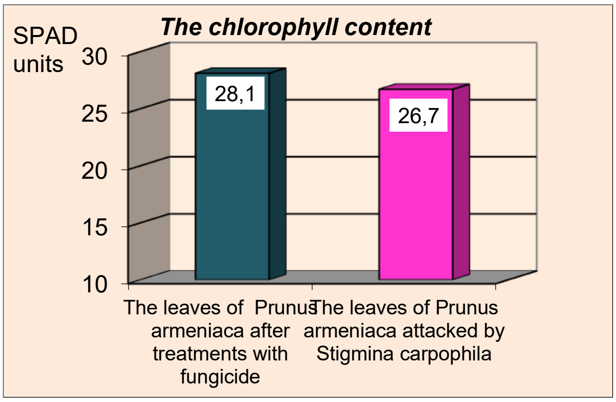

Figure 13. The chlorophyll content leaves of *Prunus armeniaca* L.

CONCLUSIONS

In the leaves of the *Prunus armeniaca* L. attacked by pathogen, during the day, one can observe that the physiological processes' intensity is lower, in comparison with leaves of the plants after treatment with fungicide, as a result of the harmful action of the pathogen which is manifested by the small reddish or purplish, with yellow halo bordered spots whose center disappears with the evolution of the disease.

The photosynthesis and transpiration's intensity depend on the photosynthetic active radiation, leaf temperature and stomatal conductance, with which it positively correlates. One can observe that in the plant's leaves attacked by pathogen there is a lower water content and chlorophyll content, fact that has a consequences on plant growth and apricot production.

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