THE EFFECTS OF THE TREATMENT WITH FUNGICIDES ON THE PHYSIOLOGICAL PROCESSES IN *PRUNUS AVIUM* L. ATTACKED BY *STIGMINA CARPOPHILA (LÉV.) M.B. ELLIS*

NICOLAE Ion[1], BUȘE-DRAGOMIR Luminița[2]

[1]University of Craiova, email:ionnicolaebio@yahoo.com
[2] University of Craiova, email: luminita25dragomir@yahoo.com

Corresponding author email: *luminita25dragomir@yahoo.com*

Abstract

Researches regarding the effects of the treatment with fungicides on the physiological processes were carried out on Prunus avium L.,Carmen variety, cultivated in the climatic conditions in Oltenia region. Physiological research was carried out on June 26 th 2022, on cherry trees treated with the fungicide Dithane M45 (0.2%), in comparison with cherry trees attacked by Stigmina carpophila (Lév.) M.B. Ellis in which no treatments were performed. In the leaves attacked by the pathogen it was noticed that the photosynthesis intensity and transpiration intensity record lower values as a result of the effects produced by the pathogen manifested by the emergence of small pink-purple spots, bounded by a reddish-brown border, that gradually enlarges and become necrotic at the centre. The linear regressions performed between the physiological processes intensity and the photosynthetic active radiation, the leaf temperature and the stomatal conductance show a positive correlation between these. In the attacked leaves there were recorded lower values of chlorophyll content, in comparison with the leaves of plants in which fungicide treatments have been performed.

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

INTRODUCTION

Shot hole blight or shot hole disease is a fungal disease of stone fruit trees including peach, nectarine, apricot, plum, cherry and almond. The most commonly affected are apricot, peach and nectarine, and to lesser degree cherries (Ivanová et al., 2012).

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). Disease development is mostly governed by certain weather parameters, such as temperature fluctuations, as well as averages of maximum and minimum temperatures, relative humidity and average of rainfall. If control measures are, inadequate and conditions for leaf disease development favorable, infection will occur at much higher intensity, resulting in premature defoliation inadequate and conditions for leaf disease development favorable, infection will occur at much higher intensity, resulting in premature defoliation (Iličić et al., 2019). The research regarding photosynthesis intensity in *Cerasus avium* shows values of 10.2-11.7 μmol $CO_2/m^2/s$ (Gucci et al., 1990).

Photosynthetic active radiation intensity is a limiting factor in the process of photosynthesis. Reception of photosynthetic active radiation by tree leaves and bushes is dependent on height, distance of planting, position of the crown shape (Burzo et al.,1999).

The intensity of transpiration process proportionally increases with that of photosynthesis, both processes being dependent on solar radiation intensity (Bignami and Natali, 1992).

MATERIALS AND METHODS

The physiological analyses were performed in *Prunus avium* L. cultivated in the climatic conditions in Oltenia region.

The cherry tree is a species originating from the area between the Black Sea and the Caspian Sea, from where it spread to Europe and Asia. This presents a straight trunk with conical crown and bark smooth purplish-brown. The leaves are alternate, simple ovoid-acute with a serrated margin. The flowers are hermaphroditic with five white petals. The fruit is a drupe, bright red to dark purple when mature.

The *Carmen* variety is a tree of low-medium vigor with high productivity. It is a self-fertile variety. The fruits are large, with a bright red epicarp. The pulp is crispy, juicy, with a sweet taste.

Stigmina carpophila (Lév.) M. B. Ellis is a fungal plant pathogen causing shot hole disease in stone fruits (*Prunus* spp.).

The physiological analyses were carried out according to the climatic conditions in the Oltenia area on June 26th 2022, in leaves of cherry tree treated with fungicide and leaves of cherry tree attacked by *Stigmina carpophila* (Lév.) M.B. Ellis in which treatments have not been performed.

The treatments were carried out starting on May 17th 2022 and consisted of the application of four treatments with *Dithane* M45 (0.2%) fungicide, at an interval of 10 days (May 17th 2022, May 27th 2022, June 6th 2022, June 16th 2022).

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

RESULTS AND DISCUSSIONS

Stigmina carpophila (Lév.) M.B. Ellis can infect buds, branches, blossoms, leaves and fruits. The pathogen mainly affects the leaves, thus compromising photosynthetic ability, causing early defoliation, decreasing yields and reducing fruit quality (Minkov et. al., 2022).

The attack produced by the *Stigmina carpophila* Lév.) M.B. Ellis in the leaves manifests with the emergence of small pink-purple spots, bounded by a reddish-brown border (Nicolae and Bușe-Dragomir, 2013). The disease appear as small circular purple lesion with pale centre that gradually enlarges and become necrotic at the centre that ultimately fall down leaving a shot hole appearance (Shukla et al., 1984)-Figure 1.

Figure 1. The leaves of cherry tree (*Prunus avium* L.) attacked by *Stigmina carpophila* (Lév.) M.B. Ellis (Original).

Stigmina carpophila (Lév.) M. B. Ellis presents mycelium in the form of cylindrical, septate, yellow-brown filaments. Conidiophores and conidia formed, tear the epidermis and come to the surface (Nicolae and Bușe-Dragomir, 2020).

Conidiophores are simple, filamentous, septa, hyaline or yellow-brown, at the end of which a single conidia is

formed, oval-cylindrical, at first hyaline and unsept, then yellow-brown (Figure 2).

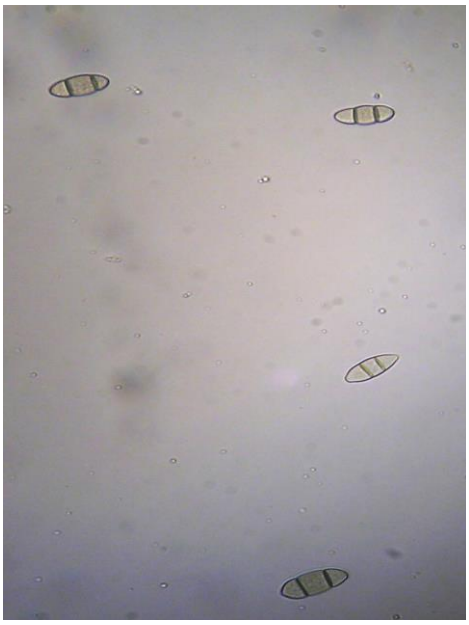

Figure 2. *Stigmina carpophila* (Lév.) M.B. Ellis - the conidia fusoid with transverse septa (oc. 10 x ob. 20) - Original.

The estimation of the attack (frequency, intensity and degree of attack) produced by the *Stigmina carpophila* in the cherry tree is presented in Figure 3.

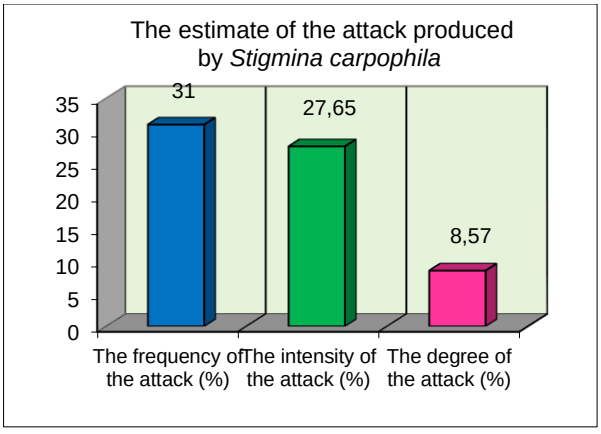

Figure 3. The estimation of the attack produced by *Stigmina carpophila* in *Prunus avium* L.

The photosynthesis and transpiration's intensity has a lower value in the attacked leaves, compared to the leaves treated with fungicide as a result of the reduction of the assimilation surface due to necrosis of the spots on the leaves (Figure 4 and Figure 5).

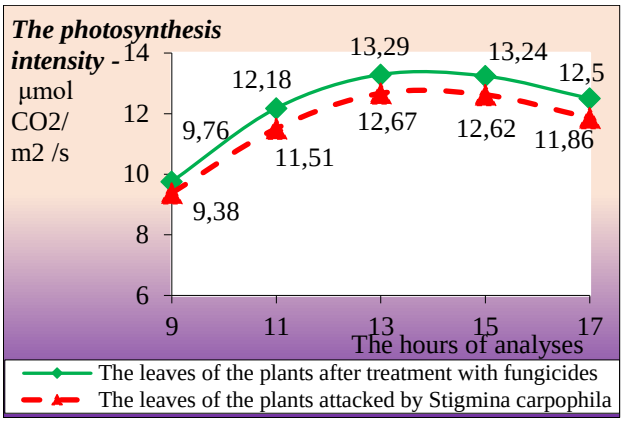

Figure 4. The photosynthesis intensity in the leaves of *Prunus avium* L.

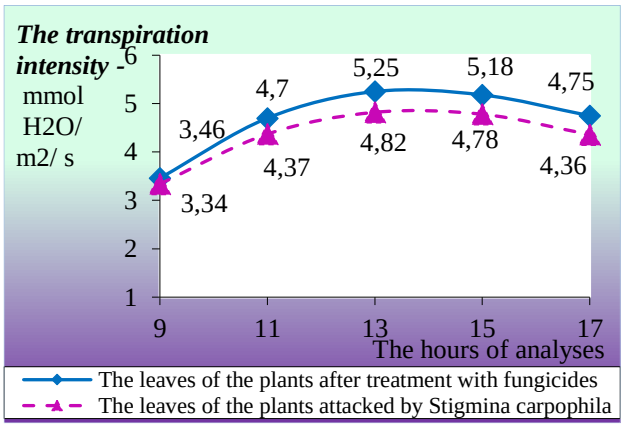

Figure 5. The transpiration intensity in the leaves of *Prunus avium* L.

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

In the cherry tree an increase of the photosynthetic active radiations can be noticed starting with the morning (9 a.m.) when values are 1225 µmol/m^2/s in the leaves treated with fungicides and 1196 µmol/m^2/s in the attacked leaves, they grow up until afternoon (1 p.m.) when values are 1570 µmol/m^2/s in the treated leaves and 1549 µmol/m^2/s in the attacked leaves and decrease towards evening (5 p.m.) when values are 1468 µmol/m^2/s in the treated leaves with fungicides and 1432 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 leaves of cherry tree after treatments with fungicide and 0.96 for the attacked leaves; linear regression made between the transpiration intensity and photosynthetic active radiations shows a positive correlation, the coefficient of determination R^2 was 0.97 for the leaves of the cherry tree after treatments with fungicide and 0.95 for the attacked leaves by pathogen (Figure 6 and Figure 7).

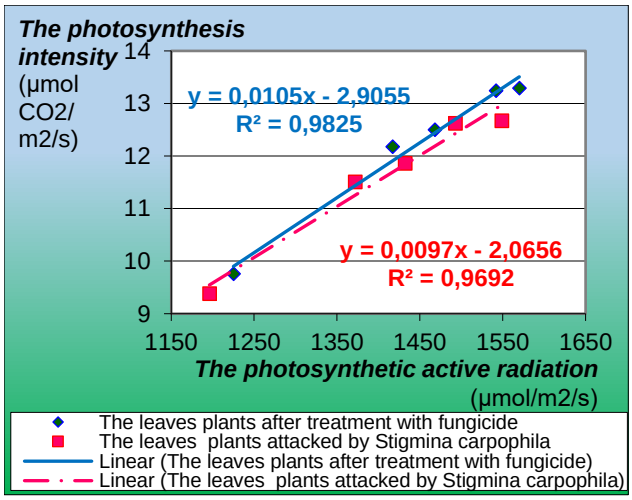

Figure 6. The correlation between the intensity of photosynthesis and the photosynthetic active radiation in *Prunus avium* L.

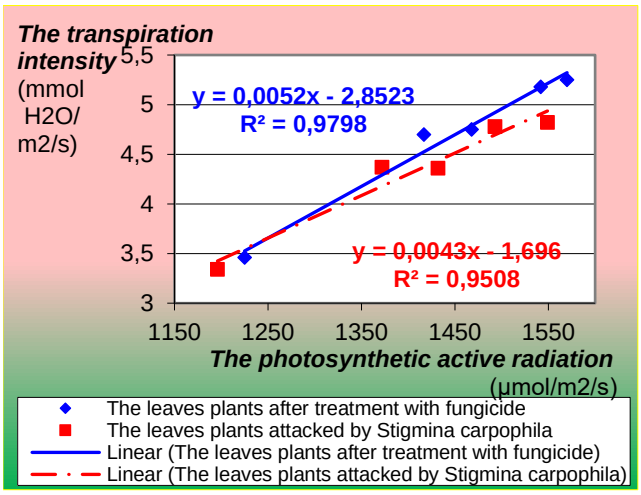

Figure 7. The correlation between the intensity of transpiration and the photosynthetic active radiation in *Prunus avium* L.

The leaf temperature in the cherry tree increases starting with the morning (9 a.m.), when values are 28.2 ^oC in the leaves treated with fungicides and 28.4^oC in the attacked leaves, they grow up until afternoon (1 p.m.) when values are 33.7 ^oC in the treated leaves and 33.9 ^oC in the attacked leaves and decrease towards evening (5 p.m.) when values are 32 ^oC in the leaves treated with fungicides and 32.3 ^oC in the attacked leaves.

The photosynthesis intensity and leaf temperature shows a positive correlation, the coefficient of determination (R^2) was 0.98 for the leaves after treatments with fungicide and 0.97 for the attacked leaves; the transpiration intensity and leaf temperature shows a positive correlation, the coefficient of determination R^2 was 0.98 for the leaves after treatments with fungicide and 0.96 for the attacked leaves (Figure 8 and Figure 9).

The stomatal conductance 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 0.13 mol/m^2/s in the treated leaves and 0.12 mol/m^2/s in the attacked leaves and decrease towards evening (5 p.m.) when values are 0.10 mol/m^2/s in the treated leaves and 0.09 mol/m^2/s in the attacked leaves.

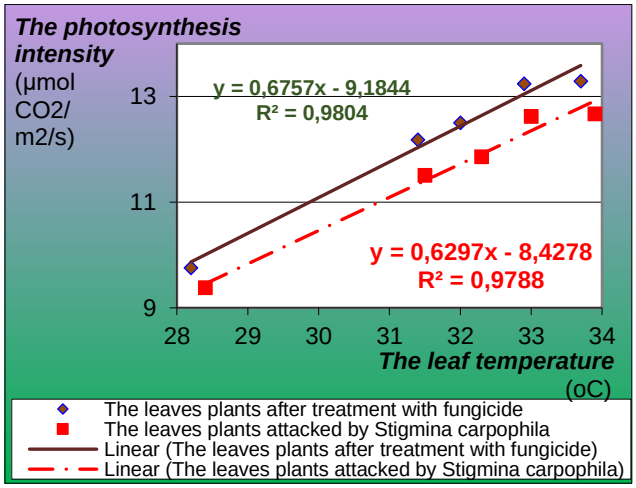

Figure 8. The correlation between the intensity of photosynthesis and the leaf temperature in *Prunus avium* L.

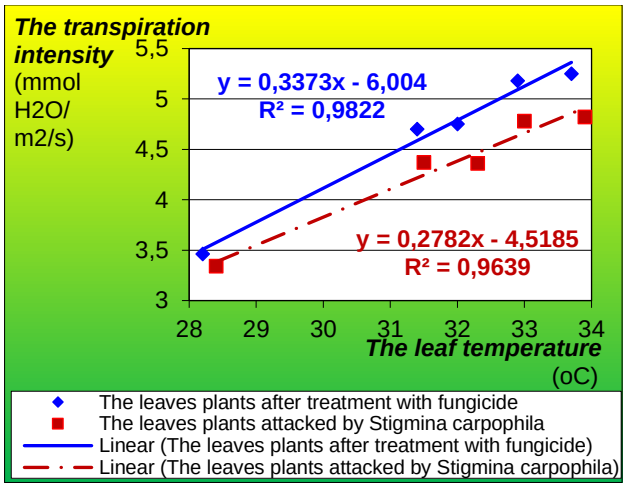

Figure 9. The correlation between the intensity of transpiration and the leaf temperature in *Prunus avium* L.

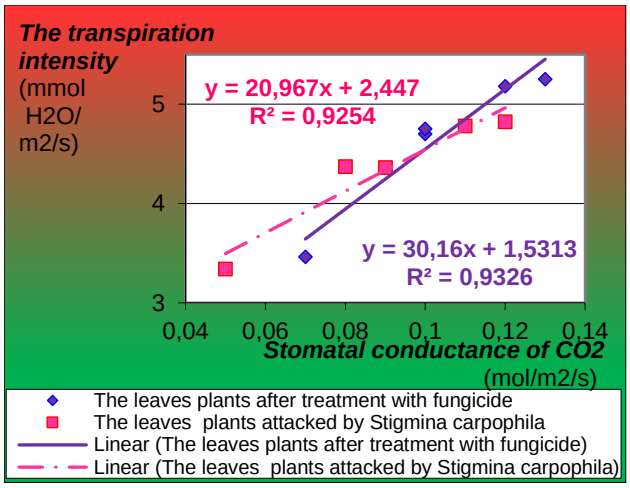

Figure 11. The correlation between the intensity of transpiration and the stomatal conductance in *Prunus avium* L.

Linear regression performed between photosynthesis intensity and stomatal conductance shows a positive correlation, the coefficient of determination (R^2) was 0.91 for the leaves after treatments with fungicide and 0.93 for the attacked leaves; linear regression made between the transpiration intensity and stomatal conductance shows a positive correlation, the coefficient of determination R^2 was 0.93 for the leaves after treatments with fungicide and 0.92 for the attacked leaves (Figure 10 and Figure 11).

In the attacked leaves it was registered a lower water content and a higher dry substance content compared with the treated leaves (Figure 12).

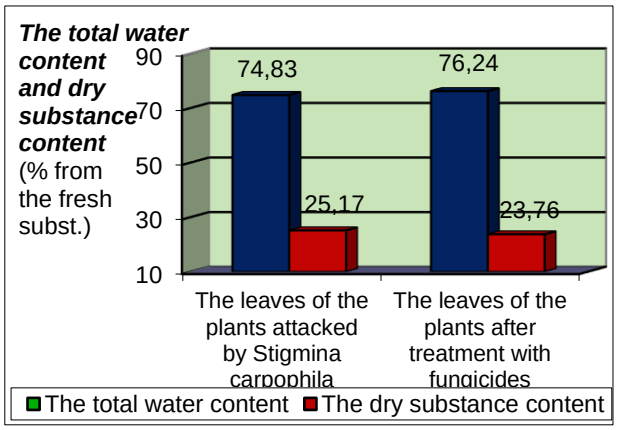

Figure 12. The water content and the dry substance content in *Prunus avium* L.

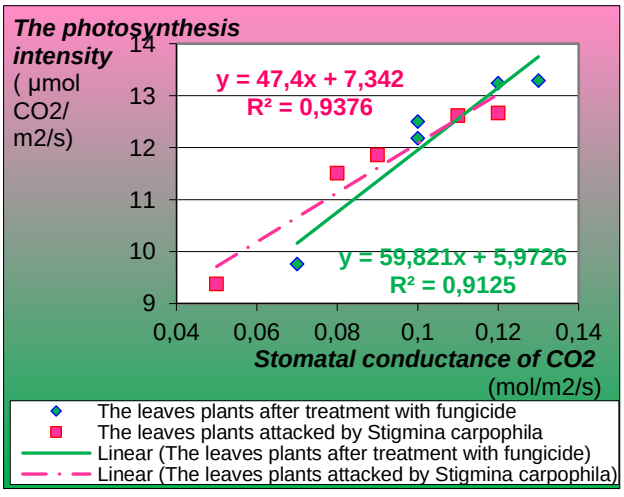

Figure 10. The correlation between the intensity of photosynthesis and the stomatal conductance in *Prunus avium* L.

In the attacked leaves a lower chlorophyll content is recorded, compared with the leaves after performing treatments with fungicide (Figure 13).

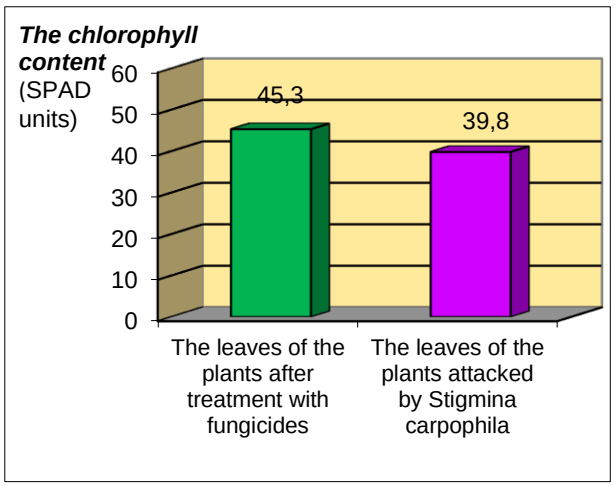

Figure 13. The chlorophyll content in *Prunus avium* L.

CONCLUSIONS

In the *Prunus avium* L. it was observed that the physiological processes intensity (the photosynthesis and transpiration's intensity) is lower in the attacked leaves, in comparison with the leaves treated with fungicide, as a result of the effects produced by the pathogen manifested by the small pink-purple spots, bounded by a reddish-brown border, that gradually enlarges and becomes necrotic at the centre.

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 attacked by pathogen, in comparison with the treated leaves with fungicide.

In the attacked leaves one can observe a decrease of chlorophyll content and the water content, which is manifested by withering and drying of the leaves.

REFERENCES

Bignami C., Natali S. (1992). *Relazioni idriche e fotosintesi di alcune specie da frutto*, Giornate Scientifiche Società Orticola Italiana (S.O.I.). Ravello (Salerno), 174-175.

Burzo I., Toma S., Olteanu I., Dejeu L., Delian Elena, Hoza D. (1999). *Fiziologia plantelor de cultură*, Întreprinderea Editorial Poligrafică Știința, Chișinău, 3, 440.

Gucci R., Grappadelli L.C., Neri D., Piccotino D. (1990). *Field measurement of photosynthesis. 3. Net leaf photosynthetic rate and response curves of tree fruit crops to environmental factors*, Rivista di Frutticoltura e di Ortofloricultura, 52 (8-9), 75-78.

Iličić Renata, Popović Tatjana, Vlajić S., Ognjanov V. (2019). *Foliar pathogens of sweet and sour cherry in Serbia*, Acta Agriculturae Serbica, XXIV, 48,107-118.

Ivanová Helena, Kaločaiová Monika, Bolvanský M. (2012). *Shot-hole disease on Prunus persica - the morphology and biology of Stigmina carpophila*, Folia oecologica, 39(1), 21-27.

Minkov Petko, Stefanova Boryana, Popski Georgi, Todorova Silvena (2022). *Behaviour of sour cherry cultivars to the causes of cylindrosporiosis and shot hole disease*, Scientific Papers, Series B, Horticulture, 66(1), 139-145.

Nicolae I., Buşe-Dragomir Luminiţa, (2013). *Physiological modifications produced by Stigmina carpophila (Lév.) M.B. Ellis in Armeniaca vulgaris Lam. cultivated in the climatic conditions of Oltenia region*, Oltenia. Studii şi comunicări. Ştiinţele Naturii, 29, (2), 84-89.

Nicolae I., Buşe-Dragomir Luminita (2020). *Physiological modifications in Prunus avium L. as a result of the attack produced by Stigmina carpophila (Lév.) M.B. Ellis*, Annals of the University of Craiova-Agriculture, Montanology, Cadastre Series, 50(2), 110-115.

Săvescu A., Rafailă C. (1978). *Prognoza în protectia plantelor*, Editura Ceres, Bucureşti, 103.

Shukla H., Bhat Gjijo M. (1984). *Morphology and physiology of Stigmina carpophylla causing shot hole disease of almond,* Indian J. Mycol. Plant Pathology, 14(2), 178.

Teviotdale B. L., Goodell N., Harper D. (1999). *Shot hole encourages almond drop, doesn´t harm kernels*, California Agriculture, 53, 16-18.