THE EFFECT OF SOME FUNGICIDES ON THE PHYSIOLOGICAL PROCESSES IN *VITIS VINIFERA* L. PLANTS ATTACKED BY *GUIGNARDIA BIDWELLII* (ELLIS) VIALA & RAVAZ

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 effect of some fungicides on the physiological processes were performed on Vitis vinifera L., Cardinal variety, cultivated in the Oltenia region. The physiological analyses were carried out according to the climatic conditions on July 14th 2023 in the treated plants with the fungicide and in the attacked plants by Guignardia bidwellii (Ellis) Viala & Ravaz in which treatments with fungicide have not been performed. In the leaves of the Vitis vinifera L. plants attacked by the pathogen it was observed that the physiological processes' intensity is lower as a result of the effects produced by the pathogen manifested by the appearance of circular spots, light brown with darker edges and then necrosis of the central portion of these spots. In the leaves of the attacked plants there were recorded lower values of chlorophyll content, compared to the leaves of the plants treated with fungicide, thus there is a positive correlation between the chlorophyll content and the intensity of photosynthesis.

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

INTRODUCTION

The researches undertaken has the aim of presenting the influence of some fungicides on the physiological processes in *Vitis vinifera* L. attacked by black rot (*Guignardia bidwellii* (Ellis) Viala & Ravaz). *Vitis vinifera* L. is a species originating from the Mediterranean region, central Europe and southwestern Asia.

The fungal pathogen *Guignardia bidwellii* (Ellis) Viala & Ravaz originates from North America. The disease appeared in southern Europe (France and Italy) more than 100 years ago (in 1885) and gradually spread to the northern wine growing regions (Besselat and Bouchet, 1984; Mauri and Kobel, 1988). European grapevine cultivars are susceptible to black rot (Hausmann et al., 2017) and without adequate crop protection and under warm and humid conditions, emergence of black rot can be expected. In heavily infected vineyards, sometimes up to 100% yield loss can occur (Rinaldi et al., 2013).

Under the conditions of climate change, a change in the dynamics of this pathogen, as well as other plant pathogens, can be observed. There are a number of pesticides that can be used to control this pathogen, but they must be applied at set periods and used within the integrated protection of the vines (Lixandru and Fendrihan, 2023). Much research has been done over time, but physiological studies of the true interactions between grapevine and *Guignardia bidwellii* are still rarity (Szabó et al., 2023). It has been ascertained that 70 % of the photosynthesis activity of palisate grapevines is accomplished by the leaves with direct light exposure, although they represent only 1/5 of the total leaves (Champagnol, 1994). The photosynthesis intensity process varies between 13.8 µmol CO_2/ m^2 / s in August and 7.5 µmol CO_2/ m^2 / s in September (Williams and Biscay, 1991).

The young leaves have the highest intensity of the transpiration process and as they get older, the transpiration intensity decreases, the lower values being recorded at senescent leaves (Burzo et al.,1999).

The chlorophyll content was higher in plant leaves analyzed after made treatments with fungicide, compared with the attacked leaves by pathogen, being a positive correlation between the pigments chlorophyll content and the photosynthetis intensity (Nicolae and Camen, 2012).

MATERIALS AND METHODS

The physiological researches were performed in *Vitis vinifera* L., *Cardinal* variety cultivated in the Oltenia region.

The *Cardinal* variety originates from the USA (California) and was created in 1939. It was introduced in Europe after the Second World War and in Romania after 1962. It is a variety of great vigor, with a short-medium vegetation period (150-160 days). The leaves are large, slightly embossed, pentalobed. The grape is large cylindrical-conical, the grain is spherical with a thin red-violet skin.

Guignardia bidwellii (Ellis) Viala & Ravaz (black rot) can attack all the herbaceous expanding organs of the plant (leaves, shoots, tendrils, petioles and berries), with young shoots and fruits being extremely sensitive (Kuo and Hoch, 1996). At 1-2 weeks after infection, small, round or slightly segmented, brownish-reddish spots with dark edges become visible on the leaves. The black pycnidia are sometimes arranged in concentric circles and appear at the edges of the leaf spots and if the susceptibility of the host plant is high, hundreds or even thousands of pycnidia may be found on the spots (Szabó et al., 2023). On the petioles and pedicels, they appear as small, darkened depressions, which soon turn black. Occasionally, lesions girdle the petiole and kill the entire leaf. Shoot infections appear as larger, darker, oval and slightly sunken elongated black cankers ranging in length from 1 mm to 20 mm (Wilcox and Hoffmann, 2015).

The treatments were carried out starting on May 31th 2023 and consisted of the application of three treatments with *Cabrio Top* fungicide at an interval of 14 days. The physiological analyses were carried out according to the climatic conditions on July 14th 2023, in the leaves treated with the fungicide and in the attacked leaves by *Guignardia bidwellii* (Ellis) Viala & Ravaz in which treatments with fungicide have not been performed.

Cabrio Top fungicide can be used during the entire period of sensitivity of the vines, but with increased efficiency during the flowering period until the grape growth period. Administration dose 1.5-2 kg/ha. *Cabrio Top* fungicide has a vitalizing physiological effect on grapevine plants, the leaves become healthier, have a more intense assimilation, with a positive influence on quantitative and qualitative production. It has a strong preventive action and a long duration of protection.

The intensity of physiological processes was established with the ultra compact photosynthesis measurement 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. The chlorophyll content were analysed with the Minolta SPAD 502 chlorophyllmeter. SPAD values quickly express the chlorophyll index, an indicator that allows to quickly interpret if the plant presents some type of stress (Kumar and Sharma, 2019). The results obtained were expressed in SPAD units.

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

RESULTS AND DISCUSSIONS

The black rot infections (*Guignardia bidwellii* (Ellis) Viala & Ravaz) is characterized by a first symptomless phase and a second necrotic and damaging phase (Kuo and Hoch, 1996). On the adaxial surface of the leaves, the fungus causes the appearance of circular spots that evolve into light brown lesions with darker borders (Figure 1).

Figure 1. The leaves of the grapevine, *Cardinal* variety, attacked by *Guignardia bidwellii* (Ellis) Viala & Ravaz (Original).

The central portion of the spot turns necrotic and pycnidia become visible as small black dots. On the fruits, the first occurrence is the appearance of small whitish dots that rapidly expand concentrically around the berry, forming a brown patch (Figure 2).

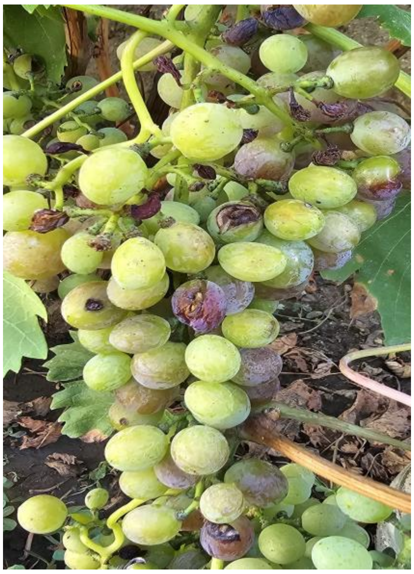


Figure 2. The grapes, *Cardinal* variety, attacked by *Guignardia bidwellii* (Ellis) Viala & Ravaz (Original).

In spring, pycnidia produce conidia and pseudothecia produce ascospores that, under favourable conditions, infect all young green tissues. The fungus can persist on infected plant debris for up to 2 years (Sosnowski et al., 2012).

The evaluation of the attack (frequency, intensity and degree of attack) produced by the pathogen is presented in Figure 3.

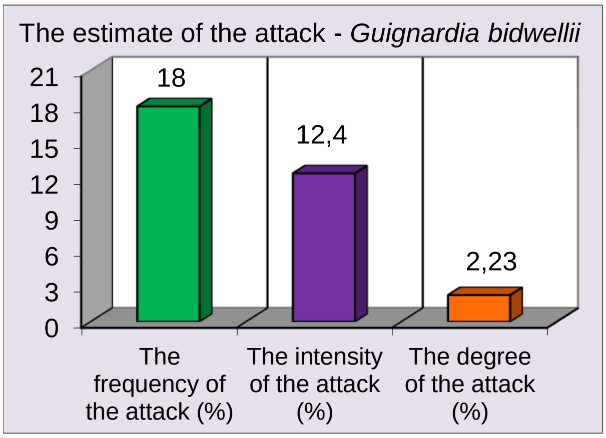


Figure 3. The estimation of the attack produced by *Guignardia bidwellii* (Ellis) Viala & Ravaz in the *Vitis vinifera* L.

In the leaves of grapevine plants, there is a decrease in the intensity of photosynthesis and transpiration as a result of the attack produced by the pathogen, manifested at first by the appearance of light brown circular spots with dark edges and then by the necrosis of these spots (Figure 4 and Figure 5).

The intensity of photosynthesis and transpiration depends on the photosynthetic active radiation, leaf temperature, stomatal conductance.

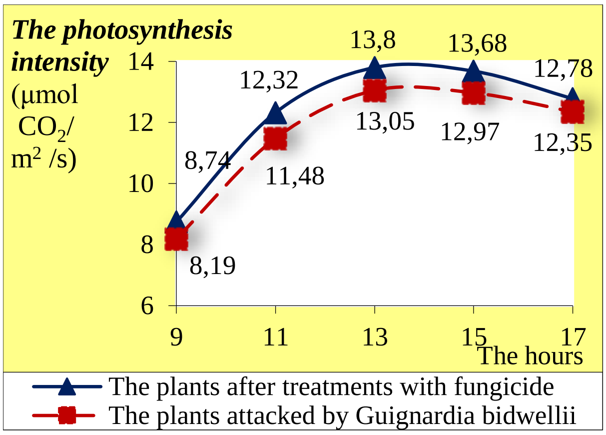


Figure 4. The photosynthesis intensity in the leaves of *Vitis vinifera* L.

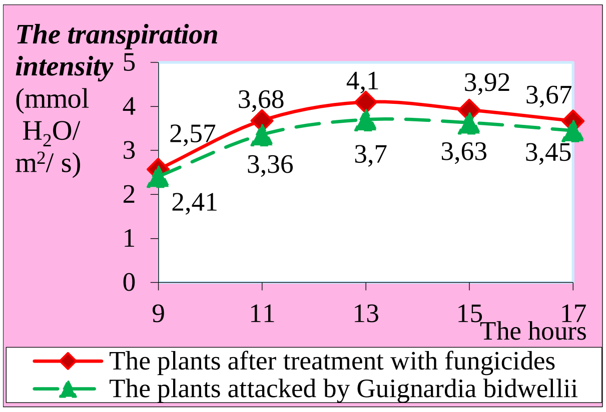


Figure 5. The transpiration intensity in the leaves of *Vitis vinifera* L.

In the grapevine the photosynthetic active radiation in the morning (9 a.m.) has values of the 1235 μmol/m²/s in the treated plants with fungicide and 1183 μmol/m²/s in the attacked plants, they increase until afternoon (1 p.m.) when it has maximum values of the 1589 μmol/m²/s in the treated plants and 1546 μmol/m²/s in the attacked plants and decrease towards evening (5 p.m.) when it has values of the 1476 μmol/m²/s in the treated plants and 1420 μmol/m²/s in the attacked plants. Linear regression made between the photosynthesis intensity and photosynthetic active radiations shows a positive correlation, the coefficient of determination (R^2) was 0.98 for the treated plants with fungicide and 0.96 for the attacked plants; linear regression made between the transpiration intensity and photosynthetic active radiations shows a positive correlation, R^2 was 0.98 for the treated plants and 0.97 for the attacked plants (Figure 6 and Figure 7).

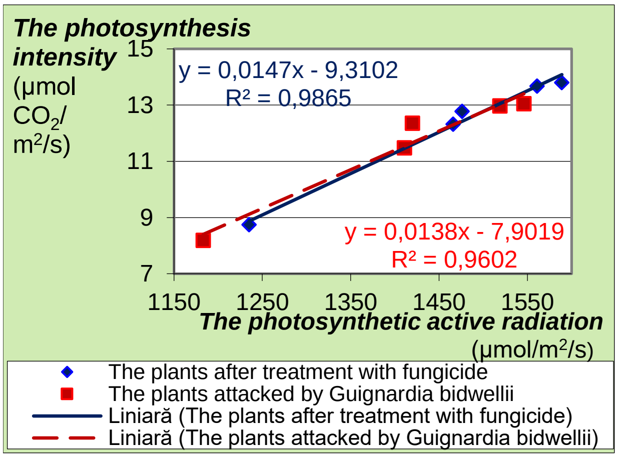


Figure 6. The correlation between the intensity of photosynthesis and the photosynthetic active radiation in *Vitis vinifera* L.

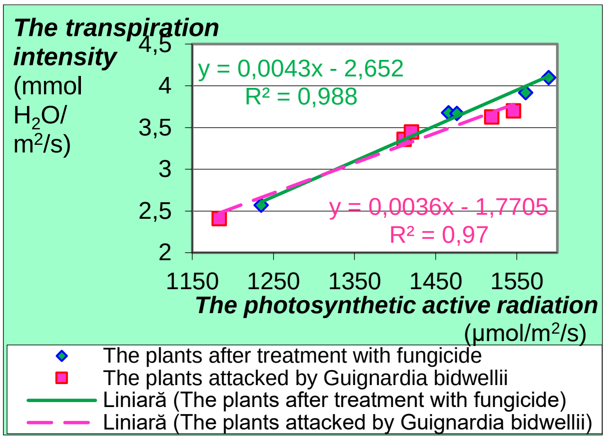


Figure 7. The correlation between the intensity of transpiration and the photosynthetic active radiation in in *Vitis vinifera* L.

The leaf temperature increases starting in the morning (9 a.m.) when it has values of the 27.1 °C in the plants treated with fungicide and 27.3 °C in the attacked plants, they grow up until afternoon (1 p.m.) when values are 33.6 °C in the treated plants and 33.8 °C in the attacked plants and decrease towards evening (5 p.m.) when values are 31.2 °C in the treated plants and 31.4 °C in the attacked plants. Linear regression made between the photosynthesis intensity and leaf temperature shows a positive correlation, the coefficient of determination (R^2) was 0.94 for the treated plants with fungicide and 0.93 for the attacked plants; linear regression between the transpiration intensity and leaf temperature shows a positive correlation, the coefficient R^2 was 0.93 for the treated plants and 0.92 for the attacked plants (Figure 8 and Figure 9).

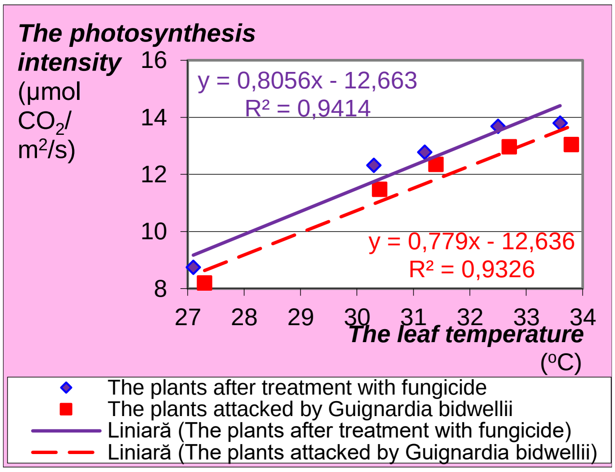


Figure 8. The correlation between the intensity of photosynthesis and the leaf temperature in *Vitis vinifera* L.

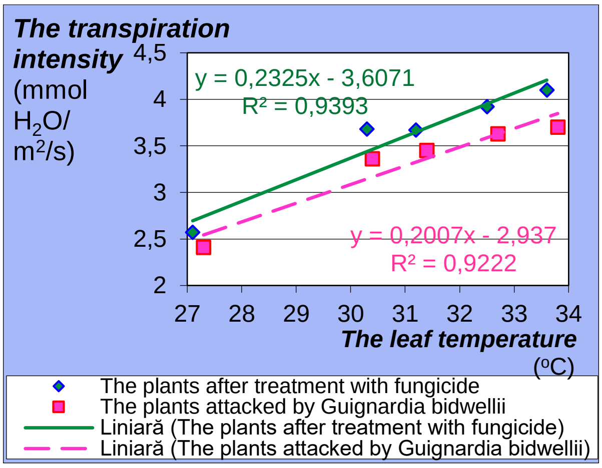


Figure 9. The correlation between the intensity of transpiration and the leaf temperature in *Vitis vinifera* L.

The stomatal conductance increases starting with the morning (9 a.m.) when it has values of 0.08 mol/m^2/s in the treated plants with fungicide and 0.06 mol/m^2/s in the attacked plants, they grow up until afternoon (3 p.m.) when maximum values are 0.18 mol/m^2/s in the treated plants and 0.17 mol/m^2/s in the attacked plants and decrease towards evening (5 p.m.) when values are 0.17 mol/m^2/s in the treated plants and 0.15 mol/m^2/s in the attacked plants. The photosynthesis intensity and stomatal conductance show a positive correlation, the coefficient of determination (R^2) was 0.83 for the treated plants with fungicide and 0.80 for the attacked plants; the transpiration intensity and stomatal conductance show a positive correlation, the coefficient R^2 was 0.74 for the treated plants and 0.72 for the attacked plants (Figure 10 and Figure 11).

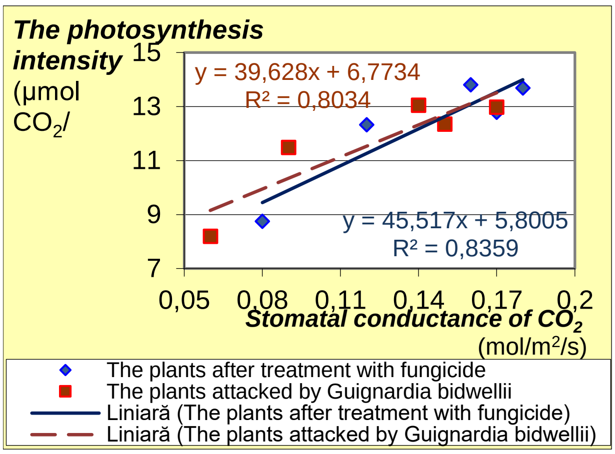
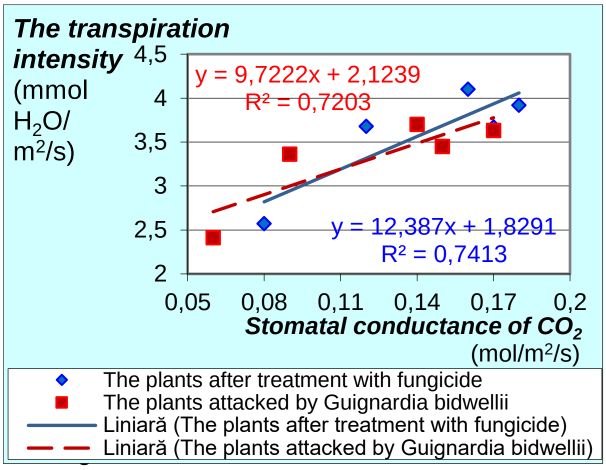


Figure 10. The correlation between the intensity of photosynthesis and the stomatal conductance in *Vitis vinifera* L.



intensity of transpiration and the stomatal conductance in *Vitis vinifera* L.

In the attacked plants it was registered a lower water content and a higher dry substance content, fact which caused water imbalances in these attacked plants (Figure 12).

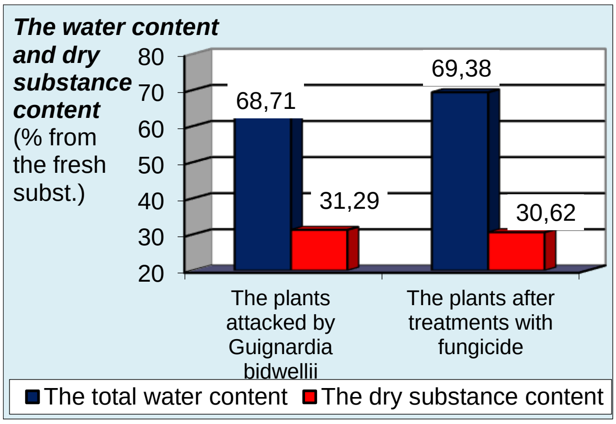


Figure 12. The water content and the dry substance content in *Vitis vinifera* L.

The chlorophyll content recorded lower values in attacked plants by the pathogen, there being a positive correlation with the intensity of photosynthesis (Figure 13).

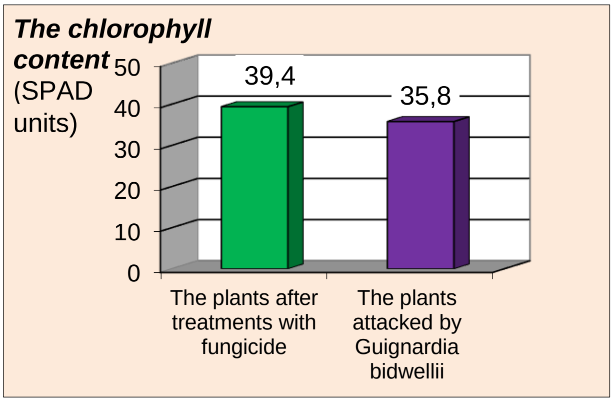


Figure 13. The chlorophyll content in *Vitis vinifera* L.

CONCLUSIONS

In the *Vitis vinifera* L. plants it was observed that the physiological processes' intensity is lower as a result of the effects produced by the pathogen, in comparison with the treated plants with fungicide. 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 plants. In the attacked plants lower values of the water content were recorded, fact that caused hydric imbalances, with consequences on the quality and quantity of the grapes. In the attacked plants there were recorded lower values of chlorophyll content, there being a positive correlation between the chlorophyll content and the intensity of photosynthesis.

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