PHYSIOLOGICAL MODIFICATIONS PRODUCED BY *Stigmina carpophila* (LÉV.) M.B. ELLIS IN *Armeniaca vulgaris* LAM. CULTIVATED IN THE CLIMATIC CONDITIONS OF OLTENIA REGION

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Abstract. Research regarding the physiological modifications produced by *Stigmina carpophila* (LÉV.) M.B. ELLIS were carried out on *Armeniaca vulgaris* LAM., *NJA 19* variety, cultivated in the region of Oltenia (Banu Mărăcine, Dolj). As a result of the research carried out on the leaves attacked by the pathogen it was noticed that the leaves presented lower values of the intensity of photosynthesis and transpiration, in comparison to healthy leaves, due to the reduction of the assimilation surface of the leaf by the appearance of pink-purple spots bounded by a reddish-brown border, necrosis of the tissue corresponding to spots, this causing their gradual drying. 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 correlated with the photosynthesis intensity and a lower water content, which affects the hydric and metabolic imbalances with consequences on the quality and quantity of fruit.

Keywords: apricot tree, attacked leaves, healthy leaves, pathogen, physiological processes.

Rezumat. Modificări fiziologice produse de *Stigmina carpophila* (LÉV.) M.B. ELLIS la *Armeniaca vulgaris* LAM. cultivat în condiţii climatice din Oltenia. Cercetările privind modificările fiziologice produse de *Stigmina carpophila* (LÉV.) M.B. ELLIS au fost efectuate la *Armeniaca vulgaris* LAM., soiul *NJA 19*, cultivat în regiunea Olteniei (Banu Mărăcine, Dolj). În urma cercetărilor efectuate la frunzele atacate de patogen s-a constatat ca acestea prezintă valori mai scăzute ale intensităţii fotosintezei şi transpiraţiei, în comparaţie cu frunzele sănătoase, datorită reducerii suprafeţei de asimilaţie a frunzei prin apariţia petelor roz-violacei, delimitate de un chenar brun-roşietic, necrozarea ţesuturilor corespunzătoare zonei atacate, acestea determinând uscarea treptată a frunzelor. Regresii liniare efectuate între intensitatea proceselor fiziologice şi radiaţia fotosintetic activă, temperatura frunzei şi conductanţa stomatală, evidenţiază corelaţii pozitive între acestea. În frunzele atacate s-a înregistrat un conţinut mai scăzut în clorofilă corelat cu intensitatea fotosintezei şi un conţinut mai scăzut în apă determinând dezechilibre hidrice şi metabolice cu consecinţe asupra calităţii şi cantităţii fructelor.

Cuvinte cheie: cais, frunze atacate, frunze sănătoase, patogen, procese fiziologice.

INTRODUCTION

Apricot (*Armeniaca vulgaris* LAM.) is originally native to Manchuria China but has spread across the world over the past few centuries (RUTHNER et al., 2006).

Stigmina carpophila (LÉV.) M.B. ELLIS is frequent in all species of fruit trees with seed enclosed in a hard, stony shell, causing large losses to the apricot. The attack is on the leaves, young twigs and fruit (MITREA, 2006).

The net photosynthetic activity is subjected to seasonal changes and to diurnal changes, which are mainly influenced by the stage of shoot development, the leaf ageing, the accumulation of hormones and of carbohydrates in the leaves, as well as by the fluctuations of light, the leaf temperature, the air temperature and humidity (LAKSO,1985).

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 in the crown and crown shape (BURZO et al., 1999).

The physiological research regarding photosynthesis intensity in *Armeniaca vulgaris* LAM. shows variations between the values of 5.7 and 9.8 μmol CO_2 / m^2 / s (GUCCI et al., 1990).

The intensity of transpiration process proportionally increases with that of photosynthesis, both processes being dependent on solar radiation intensity (BIGNAMI & NATALI, 1992).

The water content may undergo different modifications, but in most cases, the water content is lower in diseased plants, actually met in the case of fading when plants suffer from hydric imbalances and cells become less turgid (NICOLAE, 2011).

The increase of the photosynthetic active radiations, leaf temperature and stomatal conductance is positively correlated with the increase of the photosynthesis and of the transpiration, but shows variations in the attacked leaves as a result of several structural modifications produced by the pathogen (NICOLAE & CAMEN, 2011).

MATERIAL AND METHODS

Research regarding the physiological modifications produced by *Stigmina carpophila* (LÉV.) M.B. ELLIS were carried out on *Armeniaca vulgaris* LAM. - *NJA 19* variety cultivated in the climatic conditions from the region of Oltenia (Banu Mărăcine, Dolj).

Armeniaca vulgaris LAM. var. *vulgaris* is a small tree, the leaves are ovate, acuminate with a rounded base and serrated margin. The flowers have white to pink petals and the fruit are large and globular or flattened; they have a yellow-orange colour.

The apricot tree - *NJA 19* variety is native from the USA. The crown is large, globular, with high production potential. The fruit is medium to high size (60-80 g), ovoid, with early ripening, yellow-orange in colour with little red-carmine on the sunny side. The pulp of the fruit is yellow-orange colour, flavoured. The maturation period occurs in the second decade of June.

The intensity of the physiological processes and photosynthetic active radiations, leaf temperature and stomatal conductance was established with ultra-compact photosynthesis measurement system (Lci). The obtained results were graphically represented and statistically interpreted. The water contents and dry substance were determined by the help of the drying stove by gravimetric method. The chlorophyll content was estimates by Minolta SPAD 502 chlorophyllmeter.

The estimate of the attack was made with the help of the calculation formulae elaborated by SĂVESCU & RAFAILĂ, 1978.

RESULTS AND DISCUSSIONS

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. During this time, the tissue corresponding to the spots becomes necrotic and falls, so that the leaves appear riddled. The spots can be isolated or are joined together and in this case the perforations are larger, irregular (Figs. 1; 2).

The attack on the fruit is manifested on the part of the fruit, with the emergence of small spots, brown-reddish, with slightly protruding edge.

Stigmina carpophila (LÉV.) M.B. ELLIS presents the mycelium developing within the intercellular spaces of the tissues. Conidiophores are simple, septal, hyaline or yellow-brown, and at the end, they form a single conidia, oval-cylindrical, hyaline and nonseptal at first, then yellow-brown, with transverse walls (Fig. 3).

Filaments of germination of the conidia penetrate the leaf cuticle, mechanically or by stomata. High humidity presents an important role in the development of fungus and rainwater spreads conidia. Fungus winters in the form of mycelium and conidia, in the attacked branches.

Figure 1. The *Armeniaca vulgaris* (*NJA 19* variety) attacked by *Stigmina carpophila.* (original).

Figure 2. Detail of the leaf in *Armeniaca vulgaris* (*NJA 19* variety) attacked by *Stigmina carpophila.* (original).

Figure 3. *Stigmina carpophila* - oval - cylindrical conidia. (original).

The estimation of the attack (the frequency, intensity and degree of attack) produced by the *Stigmina carpophila* (LÉV.) M.B. ELLIS in *Armeniaca vulgaris* LAM. (*NJA 19* variety) is presented in Fig. 4.

Research regarding the physiological modifications produced by the pathogen has been made according to the climatic conditions and the degree of the attack, on May 25th 2011.

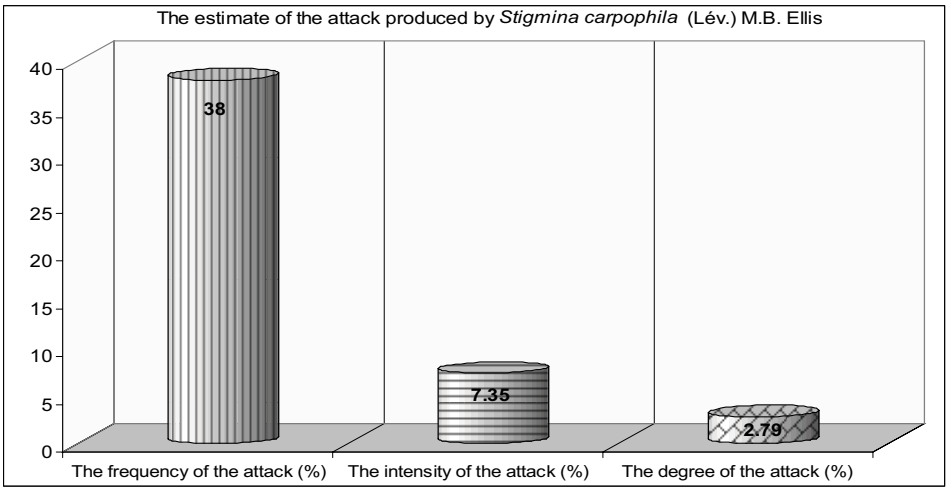

Figure 4. The estimate of the attack produced by *Stigmina carpophila* in the *Armeniaca vulgaris* (*NJA 19* variety).

The photosynthesis during the day increases from early morning due to the increase of light intensity, temperature and the stomata opening level, it maintains itself constant until noon, and then gradually decreases due to the reduction of light intensity and temperature, as well as to the closing of the stomata. The photosynthesis intensity in the attacked leaves presents lower values, in comparison to healthy leaves, as a result of the reduction of the assimilation surface by the appearance of pink-purple spots bounded by a reddish-brown border, necrosis of the tissue corresponding spots and the gradual drying of the attacked leaves (Fig. 5).

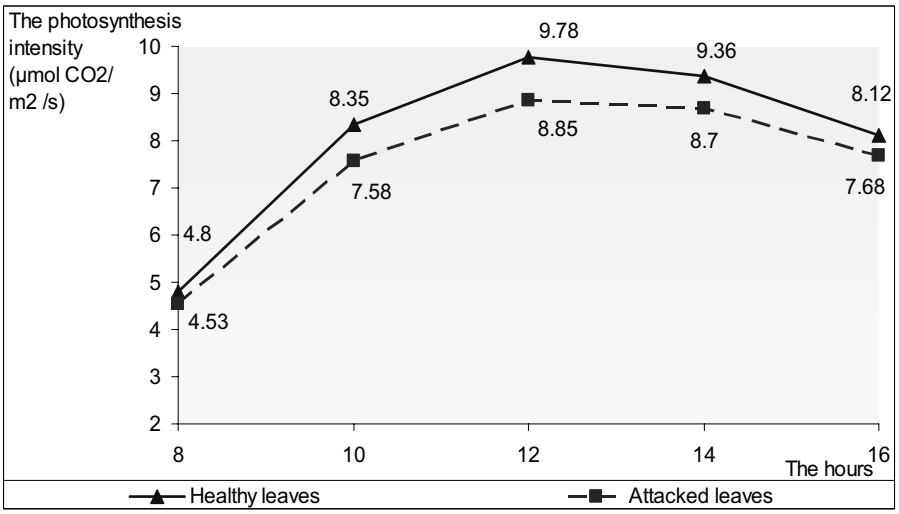

Figure 5. The photosynthesis intensity during the day in the leaves of *Armeniaca vulgaris* (*NJA 19* variety).

The transpiration during the day increases starting in the morning due to the opening of stomata, increase of light intensity and temperature, presents a maximum values after lunch, when light intensity and temperature are high and air relative humidity is lower, and towards the evening, it takes place the reduction of the transpiration intensity. The transpiration intensity in the attacked leaves presents lower values, in comparison with healthy leaves, as a result of the appearance of spots, necrosis of the tissue corresponding to spots and malfunctioning mechanisms of the stomata opening (Fig. 6).

The photosynthesis and transpiration intensity is correlated with the photosynthetic active radiation, leaf temperature and stomatal conductance, but it presents different values in the healthy leaves, in comparison with the attacked leaves.

The *photosynthetic active radiation* increases beginning in the morning (8 a.m.), when it records the values of 987 µmol/m^2/s for the healthy leaves and of 960 µmol/m^2/s for the attacked leaves, their growth after lunch (12 a.m.), when the values are of 1510 µmol/m^2/s for the healthy leaves and of 1475 µmol/m^2/s for the attacked leaves, and decreases in intensity towards evening (4 p.m.), when it records values of 1175 µmol/m^2/s for the healthy leaves and to 1140 µmol/m^2/s for the attacked leaves.

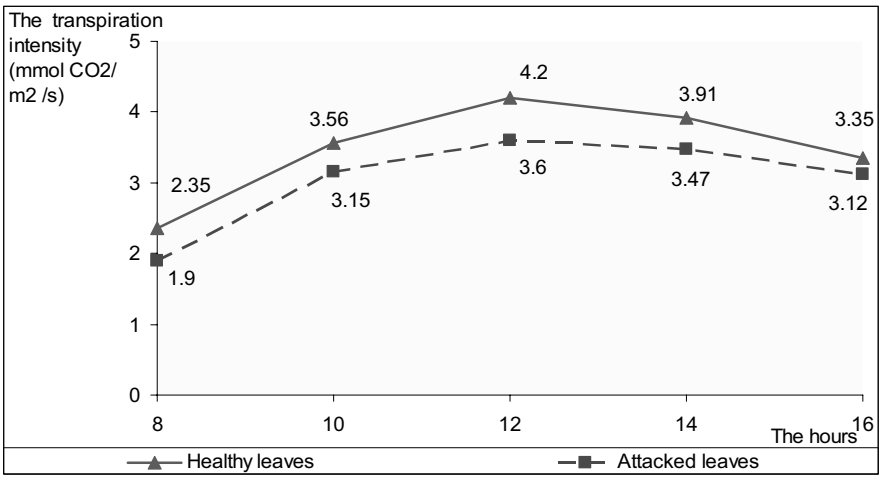

Figure 6. The transpiration intensity during the day in the leaves of *Armeniaca vulgaris* (*NJA 19* variety).

The linear regressions performed between the values of photosynthesis intensity and the photosynthetic active radiation show a good positive correlation, the coefficient of determination (R^2) being of 0.89 for the healthy leaves and 0.85 for the attacked leaves and linear regression made between the transpiration intensity and photosynthetic active radiations shows a good positive correlation between these, the coefficient of determination (R^2) being of 0.95 for the healthy leaves and 0.84 for the attacked leaves (Figs. 7; 8).

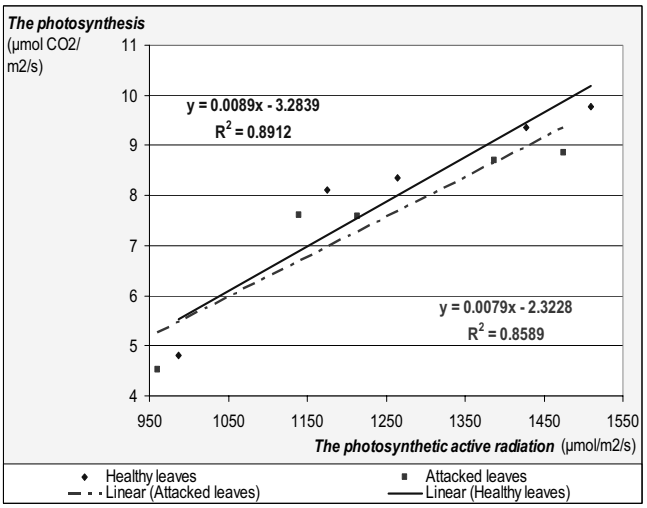

Figure 7. The correlation between the photosynthesis intensity and the photosynthetic active radiation in the leaves of *Armeniaca vulgaris* (*NJA 19* variety).

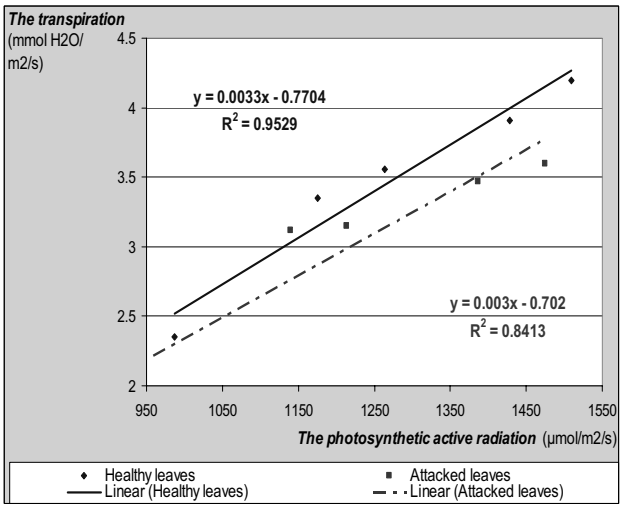

Figure 8. The correlation between the transpiration intensity and the photosynthetic active radiation in the leaves of *Armeniaca vulgaris* (*NJA 19* variety).

At the analysed plant one can observe an increase of the *leaf temperature* beginning in the morning (8 a.m.), when it records the values are of 26.5 ^oC in the healthy leaves and 26.7 ^oC in the attacked leaves, the increase of the temperature after lunch (12 a.m.), when the values are of 32.4 ^oC in the healthy leaves and 32.5 ^oC in the attacked leaves and towards the evening (4 p.m.) the gradual decrease of the temperature, recording values of 29.7 ^oC in the healthy leaves and 29.8 ^oC in the attacked leaves.

The linear regressions performed between the values of photosynthesis intensity and the leaf temperature show a positive correlation, the coefficient of determination (R^2) being 0.83 for the healthy leaves and 0.81 for the attacked leaves and linear regression made between the transpiration intensity and leaf temperature shows a positive correlation between these, the coefficient of determination (R^2) being 0.84 for the healthy leaves and 0.77 for the attacked leaves (Figs. 9; 10).

The *stomatal conductance of* CO_2 increases beginning in the morning (8 a.m.), when recorded the values are 0.07 mol / m^2 / s in the healthy leaves and 0.05 mol / m^2 / s in the attacked leaves, the increase of the stomatal conductance after lunch (12 a.m.), when the values are 0.14 mol / m^2 / s in the healthy leaves and 0.11 mol / m^2 / s in the attacked leaves and decreases in intensity towards evening (4 p.m.), when the record values are 0.1 mol / m^2 / s in the healthy leaves and 0.09 mol / m^2 / s in the attacked leaves.

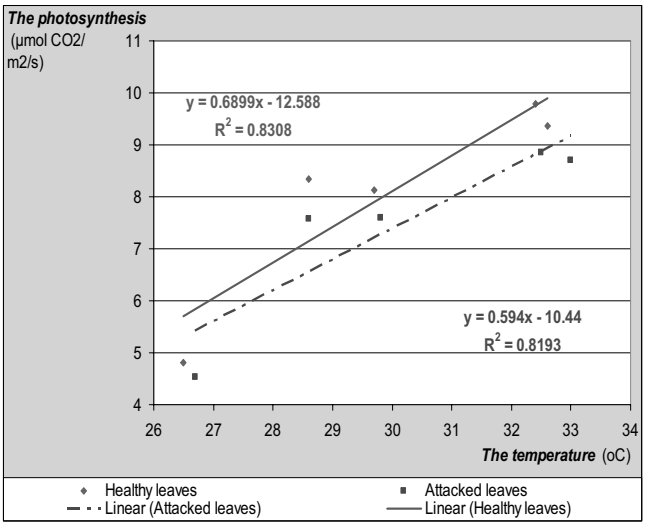

Figure 9. The correlation between the photosynthesis intensity and the leaf temperature in the leaves of *Armeniaca vulgaris* (*NJA 19* variety).

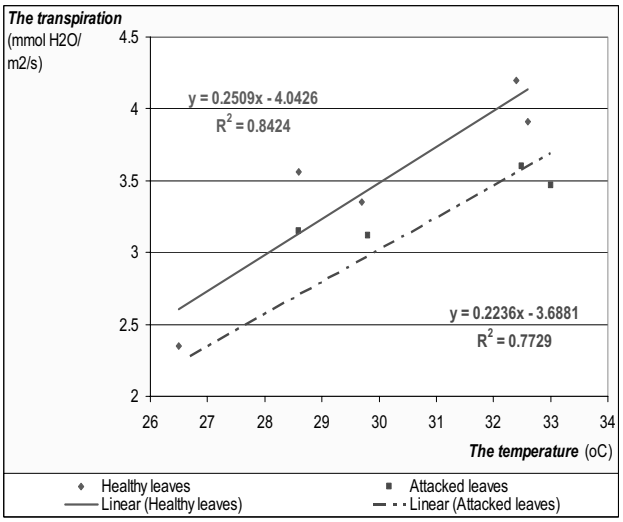

Figure 10. The correlation between the transpiration intensity and the leaf temperature in the leaves of *Armeniaca vulgaris* (*NJA 19* variety).

The linear regressions performed between the photosynthesis intensity and the stomatal conductance show a positive correlation, the coefficient of determination (R^2) being 0.88 for the healthy leaves and 0.85 for the attacked leaves and linear regressions performed between the transpiration intensity and the stomatal conductance show a positive correlation, the coefficient of determination (R^2) being 0.93 for the healthy leaves and 0.83 for the attacked leaves (Figs. 11; 12).

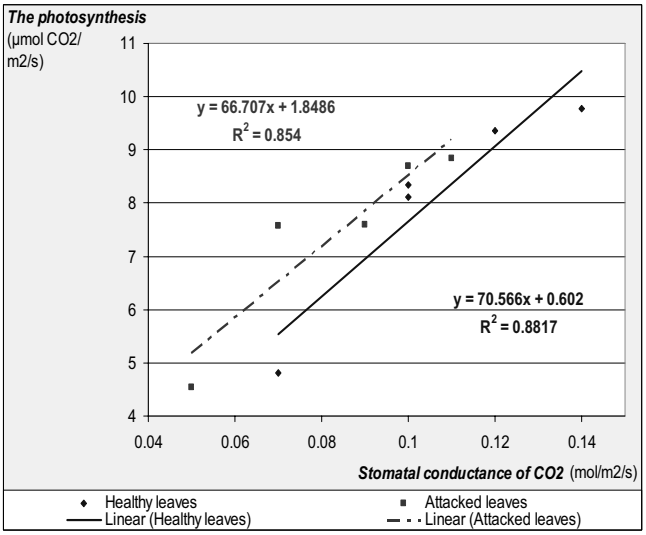

Figure 11. The correlation between the photosynthesis intensity and the stomatal conductance in the leaves of *Armeniaca vulgaris* (*NJA 19* variety).

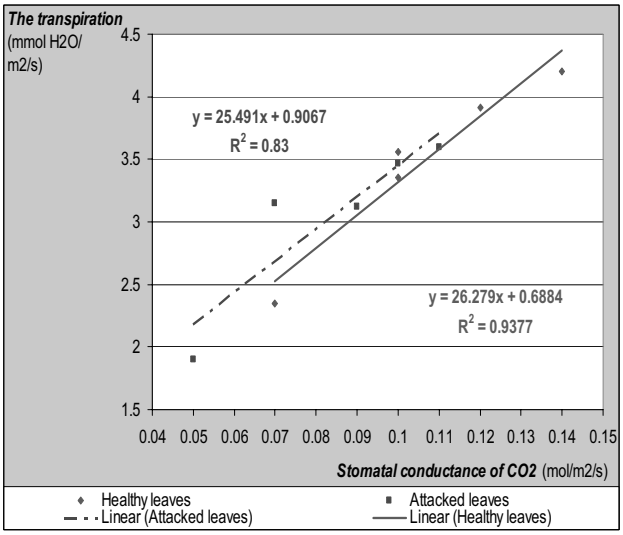

Figure 12. The correlation between the transpiration intensity and the stomatal conductance in the leaves of *Armeniaca vulgaris* (*NJA 19* variety).

The leaves attacked by the pathogen present a decrease of the chlorophyll content by 3.47 %, as a result of the appearance of pink-purple spots and necrosis on the leaves, this correlating with the decrease of the intensity of photosynthesis (Fig. 13).

The leaves attacked by *Stigmina carpophila* (LÉV.) M.B. ELLIS present lower water content by 1.81 % and a higher dry substance content by 3.96 %, in comparison with the healthy leaves and this affects the hydric and metabolic imbalances (Fig. 14).

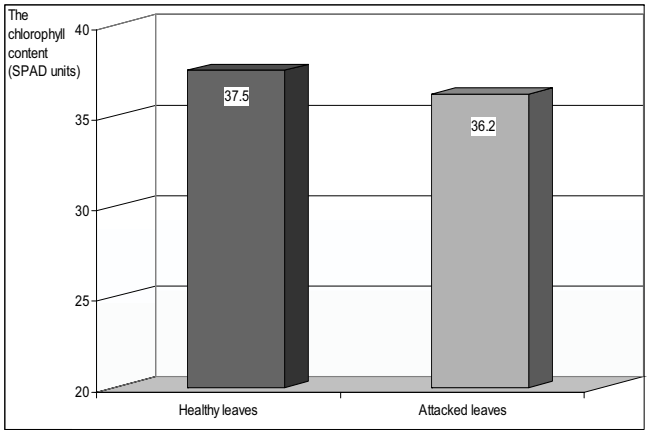

Figure 13. The chlorophyll content in the leaves of *Armeniaca vulgaris* (*NJA 19* variety).

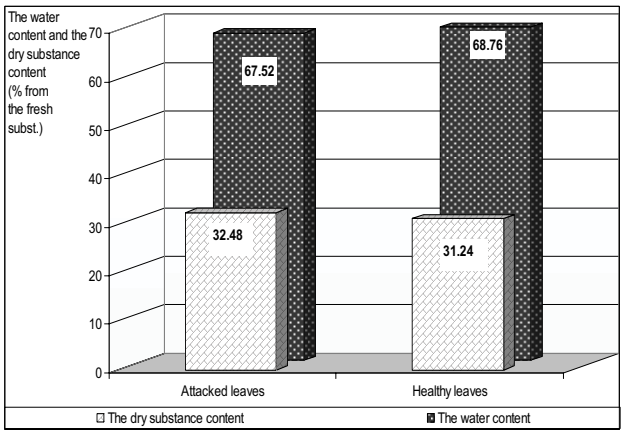

Figure 14. The water contents and the dry substance content in the leaves of *Armeniaca vulgaris* (*NJA 19* variety).

CONCLUSIONS

The photosynthesis intensity and transpiration intensity, during the day, in the leaves of *Armeniaca vulgaris* LAM. (*NJA 19* variety) attacked by *Stigmina carpophila* (LÉV.) M.B. ELLIS present lower values, in comparison with the healthy leaves, as a result of the reduction of the assimilation surface by the appearance of pink-purple spots bounded by a reddish-brown border, necrosis of the tissue corresponding to spots, malfunctioning mechanisms of the stomata opening, this causing the gradual drying of the attacked leaves. The linear regressions performed between these physiological processes and the photosynthetic active radiation, the leaf temperature and the stomatal conductance show a positive correlation, in healthy leaves but also in the attacked leaves. The chlorophyll content presents a lower value in leaves attacked by pathogen as a result of the appearance of spots and necrosis on the leaves, this correlating with the decrease of the intensity of photosynthesis.

The leaves attacked by *Stigmina carpophila* (LÉV.) M.B. ELLIS present a lower water content and a dry substance content, in comparison with the healthy leaves, thus determining the hydric and metabolic imbalances with consequences on the quality and quantity of apricots.

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