

PHYSIOLOGICAL MODIFICATIONS IN *DAHLIA VARIABILIS* WILLD. AS A RESULT OF THE ATTACK PRODUCED BY *ERYSIPHE COMMUNIS* (WALLR.) FR.

NICOLAE Mariana

Abstract. The research materialized in the presentation of some physiological modifications produced by *Erysiphe communis* (WALLR.) FR. at *Dahlia variabilis* WILLD. plants cultivated in N. Romanescu Park of Craiova (Dolj County, România). The diurnal dynamics of the photosynthesis and transpiration in the plants attacked by pathogen is similar to that in healthy plants, but the recorded values are lower in comparison with these as a result of the reduction of the assimilation surface, the coverage of the stomata by the mycelium of the fungus and the malfunctioning of the stomatic apparatus. On the attacked plants, one can observe a decrease of the total water content, which is manifested by the withering and premature drying of the plants and a decrease of chlorophyll content as result of the blockage of its biosynthesis and the deterioration of the chlorophyllian pigments.

Keywords: attacked plant, healthy plants, pathogen, photosynthesis, transpiration.

Rezumat. Modificări fiziologice la *Dahlia variabilis* WILLD. ca urmare a atacului produs de *Erysiphe communis* (WALLR.) FR. Cercetările s-au concretizat în prezentarea unor modificări fiziologice produse de *Erysiphe communis* (WALLR.) FR. la plantele de *Dahlia variabilis* WILLD. cultivate în Parcul N. Romanescu din Craiova (județul Dolj, România). Dinamica diurnă a fotosintezei și transpirației în plantele atacate de patogen este asemănătoare cu cea de la plantele sănătoase, dar valorile înregistrate sunt mai mici în comparație cu acestea datorită reducerii suprafeței de asimilație, acoperirii stomatelor de către miceliul ciupercii și dereglării aparatului stomatic. La plantele atacate se constată o scădere a conținutului în apă totală fapt manifestat prin ofilirea și uscarea prematură a plantelor și o scădere a conținutului în clorofilă datorită blocării biosintezei acesteia și deteriorării pigmentilor clorofilieni.

Cuvinte cheie: plante atacate, plante sănătoase, patogen, fotosinteza, transpirația.

INTRODUCTION

Dahlia variabilis WILLD. is a plant originating in Mexico. Although its flowers are highly perishable and have a short-term shortage in water, variety and brilliance of colour, composition and size, length of bloom, and also the high capacity of production are undeniable qualities, which are at the foundation of its extend in culture.

It prefers sunny places, away from wind, and a healthy soil, sandy-loamy, rich in humus. It vegetates and blooms beautifully in hills and submountainous regions, with moderate temperatures in summer.

The powdery mildew disease of the *Dahlia* was observed in Iasi in October 1960 by SANDU-VILLE et al., 1962, being assigned to the *Sphaerotheca fuliginea* (SCHLECHT.) SALM pathogen.

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

The intensity of physiological processes varies according to the characteristics of the species and due to the climatic conditions. At the flowery plants, the intensity of photosynthesis is particularly influenced by light intensity and temperature. Determinations made at *Dahlia* show that the light intensity of 1.778 $\mu\text{mol}/\text{m}^2/\text{s}$ has a photosynthesis intensity of 11.67 $\mu\text{mol CO}_2/\text{m}^2/\text{s}$. With regard to the process of transpiration, research conducted at a temperature of 34.4°C indicates the intensity of transpiration of 5.75 $\mu\text{mol H}_2\text{O}/\text{m}^2/\text{s}$ (BURZO et al., 2000).

MATERIAL AND METHODS

The research studies regarding the physiological changes produced by the *Erysiphe communis* (WALLR.) FR. were performed in the *Dahlia variabilis* WILLD. (variety of small plants with purple flowers) cultivated in N. Romanescu Park of Craiova, in 2009.

D. variabilis WILLD. is a plant with fistulous stems, herbaceous, branched, slightly wooden at the basis. The leaves are large and lobed with pinnate sectors. The flowers differ in size, shape and colour from white, shades of yellow, red, pink, and purple. *Dahlia* blooming takes place in stages, from June to October.

The physiological processes were established with the ultra compact photosynthesis measurement system LCI and the obtained results were graphically represented and statistically interpreted. The water contents and dry substance were determined by the gravimetric method. The chlorophyll content was estimated by SPAD 502 chlorophyll meter.

The estimation of the attack was made using the calculation formulae (SĂVESCU & RAFAILĂ, 1978).

RESULTS AND DISCUSSIONS

The attack produced by *Erysiphe communis* (WALLR.) FR. occurs on leaves and stems, which starting with August, appears as a mist-fine, whitish-gray spotted, arranged in the form of different sizes, which sometimes cover

much of the attacked organs. In a more advanced stage of the disease the affected areas become powdery in appearance, with the formation of conidiophores and conidia of the fungus (Figs. 1; 2).

In the mycelium mist on the leaves, spherical cleistothecii are formed with simple appendix, numerous hyaline, brown at the basis and top. In cleistothecium there is a single asca with 8 hyaline ascospores (MITREA, 2006).



Figure 1. *Dahlia variabilis* attacked by the *Erysiphe communis*.

Figura 1. *Dahlia variabilis* atacată de *Erysiphe communis* (original).



Figure 2. The leaf of the *Dahlia variabilis* attacked by the *Erysiphe communis*.

Figura 2. Frunza de *Dahlia variabilis* atacată de *Erysiphe communis* (original).

Towards the end of the vegetation period, on the surface of the stains, there appears cleistothecium in mycelium mist. From the mycelium the ectoparasite differs itself by conidiophores with conidia. The conidia are chained, unicellular, hyaline, ellipsoidal, the conidia from the top of the chain being the biggest because it is the first that reaches maturity (Figs. 3; 4).



Figure 3. The microscopic image with conidiophores and conidia at *Dahlia variabilis* attacked by *Erysiphe communis* (ob. 40 x oc. 10).

Figura 3. Imagine microscopică cu conidiofori și conidii la *Dahlia variabilis* atacată de *Erysiphe communis* (ob. 40 x oc. 10). (original).



Figure 4. The microscopic image with mature conidia at *Dahlia variabilis* attacked by *Erysiphe communis* (ob. 40 x oc. 10)

Figura 4. Imagine microscopică cu conidii mature la *Dahlia variabilis* atacată de *Erysiphe communis* (ob. 40 x oc. 10). (original).

The intensity of physiological processes at the analyzed plants was established, according to the frequency, the intensity and the degree of attack, but also to the climatic conditions, on September 28, 2009.

The estimation of the attack caused by the *Erysiphe communis* (WALLR.) FR. at the *Dahlia variabilis* WILLD. is presented in Figure 5.

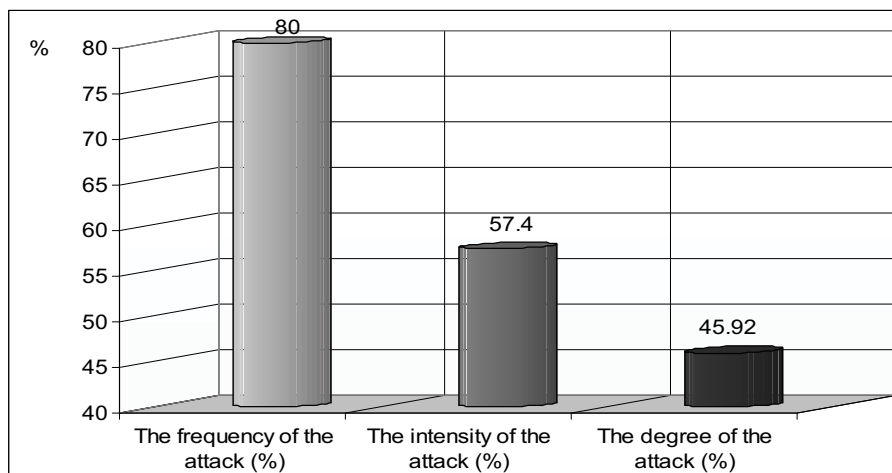


Figure 5. The estimate of the attack produced by *Erysiphe communis* at the leaves of *Dahlia variabilis*.

Figura 5. Estimarea atacului produs de *Erysiphe communis* la frunze de *Dahlia variabilis*.

The diurnal dynamics of photosynthesis in the attacked plants is similar to that in healthy plants, but the recorded values are lower in comparison with these as a result of the reduction of the assimilation surface through the deterioration of the chlorophyll, as well as the inhibition of several biochemical reactions of the photosynthesis (Fig. 6).

The diurnal dynamics of transpiration in the attacked plants is similar to that in healthy plants, but the recorded values are lower in comparison with these as a result of the reduction of the transpiration surface, the coverage of the stomata by the mycelium of the fungus and the malfunctioning of the stomatic apparatus (Fig. 7).

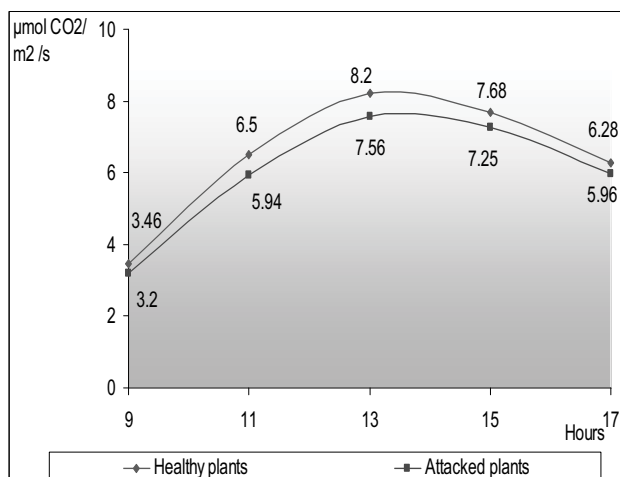


Figure 6. The diurnal dynamics of photosynthesis in the leaves of *Dahlia variabilis*.

Figura 6. Dinamica diurnă a fotosintezei la frunze de *Dahlia variabilis*.

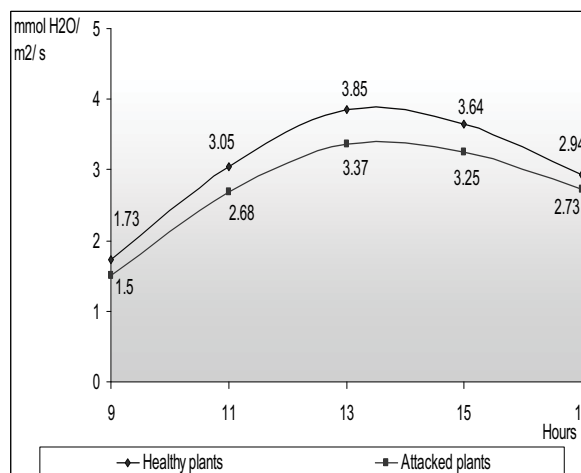


Figure 7. The diurnal dynamics of transpiration in the leaves of *Dahlia variabilis*.

Figura 7. Dinamica diurnă a transpirației la frunze de *Dahlia variabilis*.

The intensity of photosynthesis and the intensity of transpiration depend on the light radiation received by leaves, which is dependent on the position of the leaves on plants. At the analyzed plants, one can notice an intensification of the photosynthetic active radiations that is present on the surface of the leaves starting morning (9 a.m.), when one can record values of 1,105 $\mu\text{mol}/\text{m}^2/\text{s}$ for the healthy plants and of 1,068 $\mu\text{mol}/\text{m}^2/\text{s}$ for the attacked plants, their growth up until after lunch (1 p.m.), when one record 1,410 $\mu\text{mol}/\text{m}^2/\text{s}$ for the healthy plants and 1,386 $\mu\text{mol}/\text{m}^2/\text{s}$ for the attacked plants and towards evening (5 p.m.), one can notice a gradual decrease, recording values of 1,280 $\mu\text{mol}/\text{m}^2/\text{s}$ for the healthy plants and of 1,265 $\mu\text{mol}/\text{m}^2/\text{s}$ for the plants attacked.

The increase of the photosynthetic active radiations correlates with the increase of the photosynthesis and transpiration, but presents different values in the attacked plants, in comparison with the healthy ones, as a result of several structural modifications appeared in the host plants under the damaging action of the pathogen.

Linear regression made between the rate of photosynthesis and photosynthetic active radiations shows a good correlation between the two analyzed factors; the coefficient of determination (R^2) was 0.90 for the healthy plants and 0.89 for the attacked plants (Fig. 8).

Linear regression made between the rate of transpiration and photosynthetic active radiations shows a good correlation; the coefficient of determination (R^2) was 0.91 for the healthy plants and 0.89 for the attacked plants (Fig. 9).

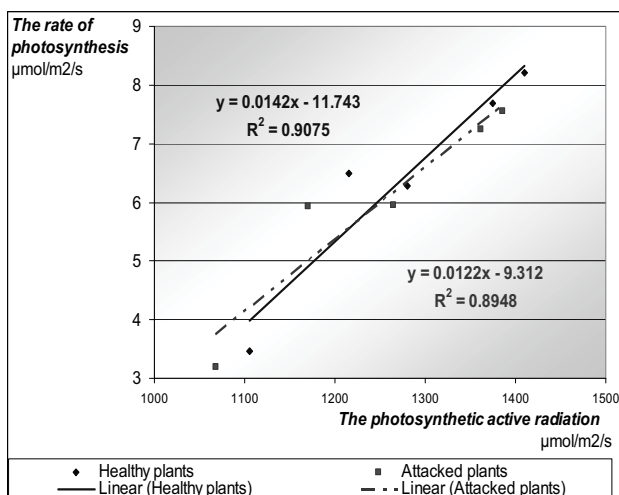


Figure 8. The correlation between the rate of photosynthesis and the photosynthetic active radiation at the leaves of *Dahlia variabilis*.

Figura 8. Corelații între rata fotosintezei și radiația fotosintetic activă la frunze de *Dahlia variabilis*.

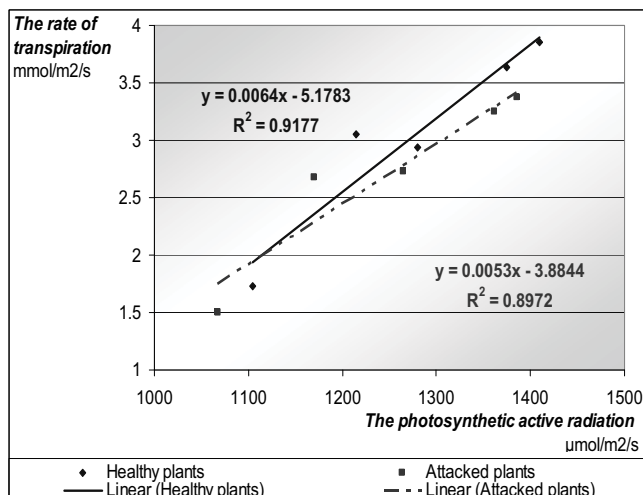


Figure 9. The correlation between the rate of transpiration and the photosynthetic active radiation at the leaves of *Dahlia variabilis*.

Figura 9. Corelații între rata transpirației și radiația fotosintetic activă la frunze de *Dahlia variabilis*.

The intensity of physiological processes depends on the temperature. At the analyzed plants one can observe an increase of the leaf temperature starting morning (9 a.m.), when values of 28.4°C are recorded in the healthy plants and 28.6°C in the plants attacked, the increase of the temperature up until after lunch (1 p.m.), when one record 33.8°C in the healthy plants and 34.2°C in the attacked plants, and towards the evening (5 p.m.) the gradual decrease of the temperature, recording values of 29.8°C in the healthy plants and 30.1°C in the plants attacked.

The diurnal increase of the temperature starting with the early hours of the morning is correlated with the increase of the photosynthesis and transpiration.

Linear regression made between the rate of photosynthesis and of the leaf temperature shows a good correlation between the two analyzed factors; the coefficient of determination (R^2) was 0.83 for the healthy plants and 0.80 for the attacked plants (Fig. 10).

Linear regression made between the rate of transpiration and of the leaf temperature shows a good correlation between the 2 analyzed factors; the coefficient of determination (R^2) was 0.84 for the healthy plants and 0.78 for the attacked plants (Fig. 11).

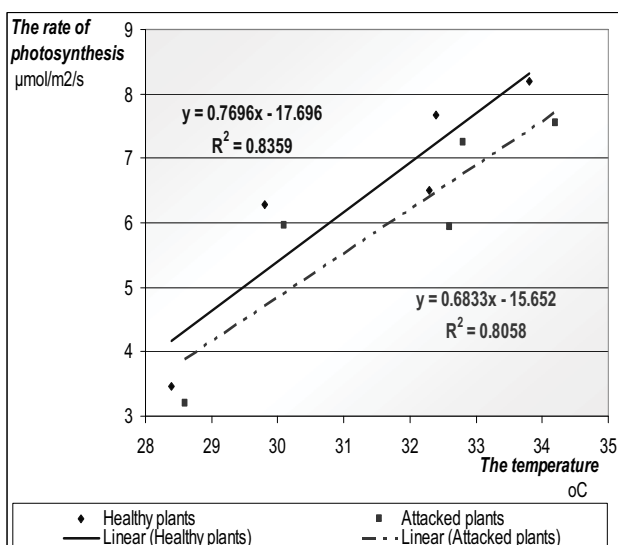


Figure 10. The correlation between the rate of photosynthesis and the leaf temperature at the *Dahlia variabilis*.

Figura 10. Corelații între rata fotosintezei și temperatura frunzei la *Dahlia variabilis*.

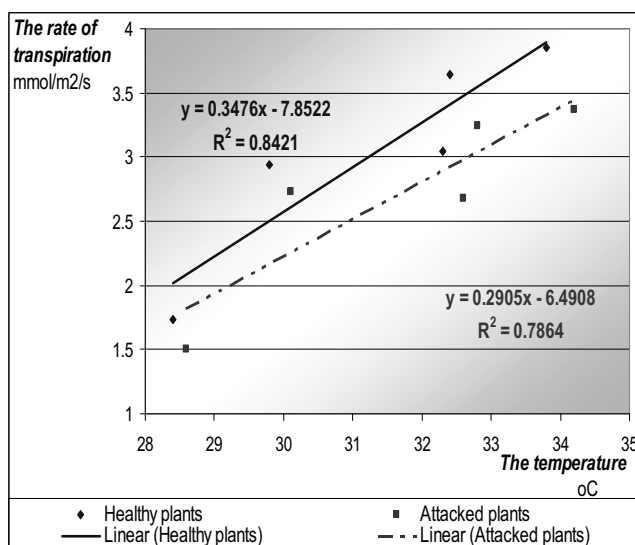


Figure 11. The correlation between the rate of transpiration and the leaf temperature at the *Dahlia variabilis*.

Figura 11. Corelații între rata transpirației și temperatura frunzei la *Dahlia variabilis*.

At the attacked plants, there can be seen a decrease of the total water content by 1.22% and an increase of the dry substance content by 3.32%, which is manifested by the decrease of the cellular turgor, the withering and premature drying of the plants (Fig. 12).

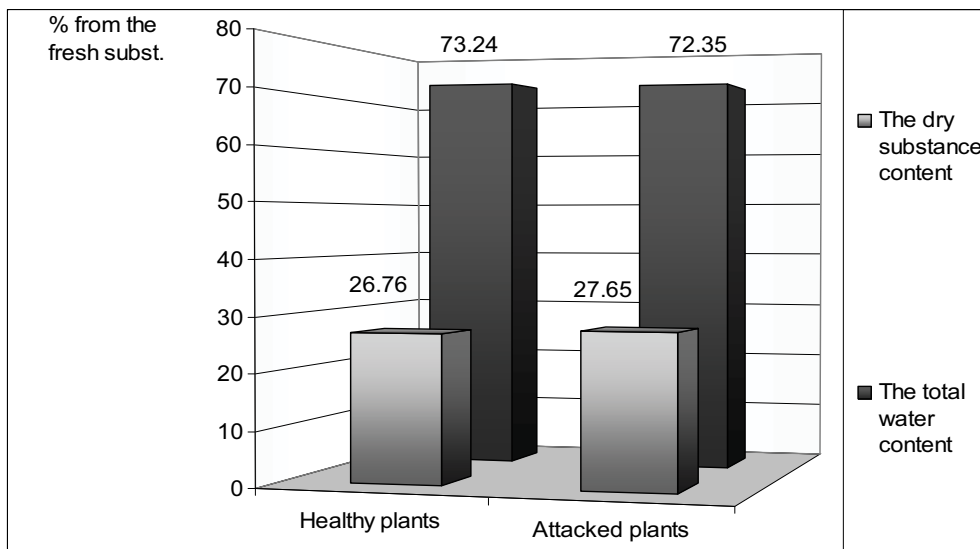


Figure 12. The total water content and the dry substance content at the leaves of *Dahlia variabilis*.
Figura 12. Conținutul total de apă și conținutul de substanță uscată la frunze de *Dahlia variabilis*.

The attacked plants present a decrease of the chlorophyll content by 8.25% as a result of the blockage of its biosynthesis chlorophyll and the deterioration of the chlorophyllian pigments (Fig. 13).

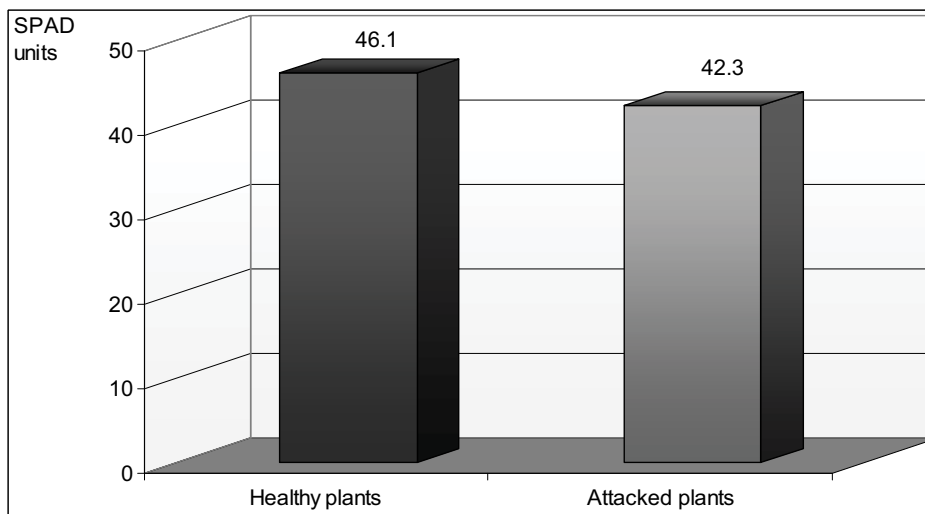


Figure 13. The chlorophyll content in the leaves of *Dahlia variabilis*.
Figura 13. Conținutul de clorofilă în frunzele de *Dahlia variabilis*.

CONCLUSIONS

The intensity of the physiological processes at the analyzed plants presents variations according to the frequency, the intensity and the degree of attack, but also to climatic conditions.

At the analyzed plants, it can be observed that the diurnal dynamics of the photosynthesis and transpiration in the attacked plants is similar to that in healthy plants, but the recorded values are lower in comparison with these as a result of the reduction of the assimilation surface, the coverage of the stomata by the mycelium of the fungus and the malfunctioning of the stomatic apparatus.

In the attacked plants, one can also observe a decrease of the total water content which determines of the withering and premature drying of the plants and the decrease of the chlorophyll content on account of the intensification of the chlorophylls and deterioration of the chloroplasts.

The action of the pathogen produced in the attacked plants physiological modification with implications on the growth of the plants.

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Nicolae Mariana

"Transporturi Auto" Scholar Group, Craiova
99, Nicolae Romanescu Street, 200738, Craiova, România
E-mail: nicomariana2006@yahoo.com

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