PHYSIOLOGICAL RESEARCHES IN *CORYLUS AVELLANA* L. VAR. *PURPUREA* GROWN IN THE CLIMATIC CONDITIONS IN THE OLTENIA REGION

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ABSTRACT

Researches regarding the intensity of some physiological processes were performed in the Corylus avellana L. var. purpurea grown in the climatic conditions in the Oltenia region.

It is noticed that photosynthesis and transpiration intensity varies depending on climatic conditions, presenting lowvalues in the morning, high values until after noon and low values towards the evening, but results obtained at mature leaves are higher, in comparison with young leaves.The linear regressions performed between the physiological processes intensity and the photosynthetic active radiation, leaf temperature and stomatal conductance at Corylus avellana L. highlights a positive correlations with specifical variations in the young leaves and mature leaves. The chlorophyll content in mature leaves increases by 17.89 %, in comparison with young leaves, between the content of chlorophyll and the photosynthesis intensity being a good correlation. The mature leaves present a decrease of the total water content by 1.43 % and an increase of the dry substance content by 5.44 %, with implications in the processes of growth and development of the plants.

INTRODUCTION

Hazelnut (*Corylus avellana* L.) belongs to the *Betulaceae* family and is native to Europe and Asia Minor. In the last years the interest for hazelnut breeding and its growth extension increased, the hazelnut culture expanded in several European countries increased the acreage and production due to new cultivars and modern technology of culture. More and more countries are recorded as hazelnut producers and in the last 15 years the world production increased from 697,681 t to 831,653 t (Fideghelli et al. 2009).

Hazelnut usually grows as a shrub with straight stems, little branched, having a height of 5-6 m. Buds are covered with fine hairs. The leaves are serrated on the edge, they have a rounded shape is sharp peak. Flowers are divided, the femininine of the male.The fruits are covered by the hard shell, which contains a core rich in vitamins A, B, C and E as well as calcium, iron, phosphorus and potassium (Teleuță et al. 2008).

Hazelnut belongs to the group of nut tree species that bear highly nutritious fruits. Edible kernels, protected with lignified shells, have a mild, sophisticated flavor that is sweet, rich, buttery, and smoky. They provide a good balance of protein, carbohydrates, and fats, and are also a healthy source of vitamin E, folate, B vitamins, lowdensity lipoprotein (LDL) cholesterollowering unsaturated fatty acids, and blood pressure-lowering minerals (Solar and Stampar 2009).

Hazelnut fruits are different in morphologic characteristics and mineral composition with an extremely high variability among genotypes of different origins (Ferreira et al. 2010; Rovira et al. 2005). They are a rich source of main nutritive matter that seem to have positive effect on human health (Cristofori et al. 2008; Oliveira et al. 2008; Schmitzer et al. 2011; Silva et al. 2007). Regarding mineral composition, Alasalvar et al. 2003, considered

that the major minerals in hazelnut were potassium, phosphorus, calcium, magnesium, selenium.

The results obtained by Cosmulescu et al. (2013) showed that an important part of daily K, P, Mg, Ca, Mn, Fe, Zn, Cu, Rb, Sr, Na, Cr, and Al requirement for human nutrition can be supplied by the daily consumption of 100 g hazelnut. According to the daily micro-element requirements and results of the present study, the amount of 100 g hazelnut has supplied about 13% for K, 55% for P, 70% for Mg, 10% for Ca, 94% for Fe, 22% for Zn and 5.6% for Cr of the RDA. For Mn and Cu, the levels of 100 g hazelnuts are higher than the respective daily requirements.

In its native habitat, hazelnut is usually an understory species, and although its requirement for water is not high, this species is very sensitive to drought stress (Mingeau et al. 1994), high temperatures, and vapor pressure deficits (Girona et al. 1994; Hogg et al. 2000). Water shortage in hazelnut can cause reduction in shoot growth and a drop in fruit production and quality (Tasias and Girona 1983).

The photosynthesis intensity rises until 1 p.m. at the plants that grow in low light, plants for which light and temperature do not show excessive variations. After 1 p.m. there is a decrease in the process and it stops at night. As far as the plants that grow in bright light, plants are concerned the stomates close and there is a rise in water shortage in leaves because of the high temperature and relative low air humidity during the day. This process leads to the diminution in the photosynthesis intensity(Burzo et al. 1999).

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

Positive correlations were established between the intensity of the physiological processes and the photosynthetic active radiation, the leaf temperature and stomatal conductance of CO_2 (Nicolae 2010).

MATERIALS AND METHODS

The physiological research were performed in *Corylus avellana* L. var. *purpurea*grown in the Oltenia Region,according to the climatic conditions (on 10th of July 2015).

The photosynthesis and transpiration intensity, photosynthetic active radiation, leaf temperature and stomatal conductance had been established with the analyzer LCi (Ultra Compact Photosynthesis Measurement System). The contents in total water and in dry substance were determined by the help of the drying stove - gravimetric method. The chlorophyll content was estimated by Minolta SPAD 502 chlorophyll meter.

RESEARCH RESULTS

The leaves of *Corylus avellana* L. var. *purpurea*are softly hairy on both surfaces, double-serrate on the edge. Leaves are brownish-red to dull purple(Figure1).The flowers are produced very early in spring, before the leaves, and are monoecious(separate male and female flowers on the same plant). Male flowers are pale yellow and 5-12 cm long, while female flowers are very small. The fruit is a nut and has a roughly spherical to oval shape, yellow-brown color (Figure2).

Fig. 1. Serrated leaves on the edge at *Corylus avellana* L.

Fig. 2. The spherical to oval shape fruits at *Corylus avellana*

The photosynthesis and transpiration intensity in the leaves of *Corylus avellana* L. increases from early morning due to the increase of light intensity, temperature and the stomata opening level until after noon, and then gradually decreases due to the reduction of light intensity and temperature, as well as to the closing of the stomata (Figure 3 and 4).

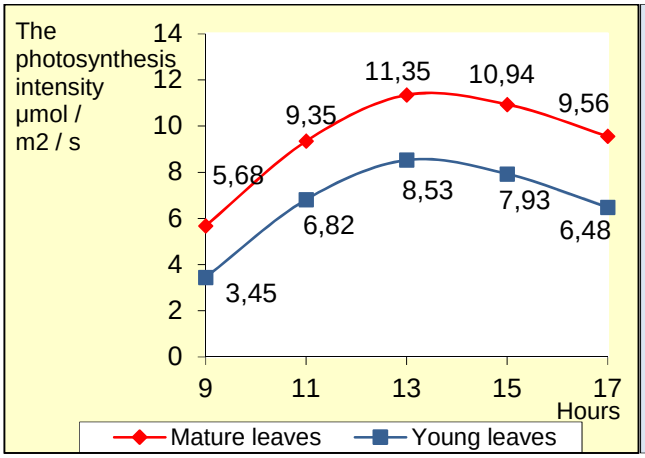

Figure 3. The photosynthesis intensity in the leaves of *Corylus avellana* L.

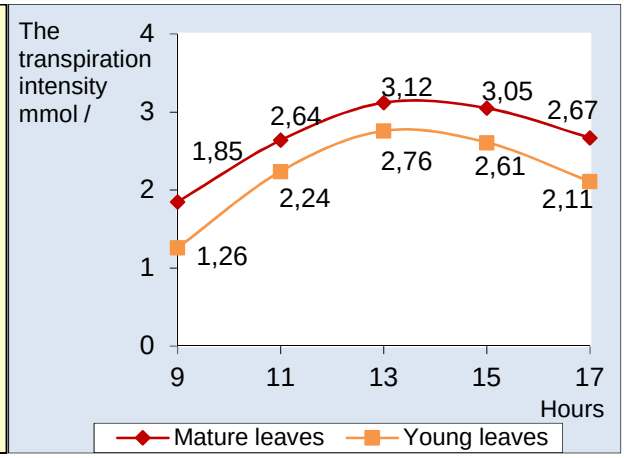

Figure 4. The transpiration intensity in the leaves of *Corylus avellana* L.

Light intensity and temperature are the main factors in the influence of physiological processes intensity.The physiological processes are correlated with the photosynthetic active radiation, but it presents different values at mature leaves, in comparison with young leaves. In the leaves of *Corylus avellana* L. can be noticedthat photosynthetic active radiation increases starting in the morning (9 a.m.) when the values are of 1291 µmol/m^2/s at young leaves and 1320 µmol/m^2/s at mature leaves, their growth until after noon (1 p.m.) when the values are of 1590 µmol/m^2/s at young leaves and 1624 µmol/m^2/s at mature leaves and towards the evening (5 p.m.) the values decrease gradually to 1458 µmol/m^2/s at young leaves and 1475 µmol/m^2/s at mature leaves.

The linear regressions performed between photosynthesis intensity and the photosynthetic active radiation show a good positive correlation - the coefficient of determination (R^2) being of 0.86 at young leaves and 0.88 at mature leavesand the linear regressions performed between transpiration intensity and the photosynthetic active

radiation show a good positive correlation - the coefficient of determination (R^2) being of 0.87 at young leaves and 0.90 at mature leaves (Figure 5 and 6).

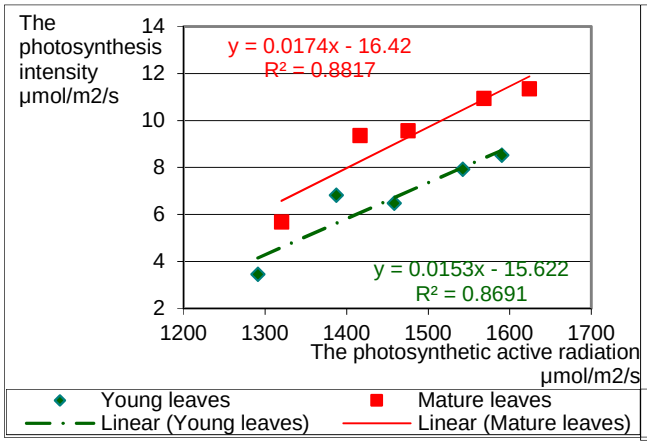

Figure 5. The correlation between the photosynthesis intensity and the photosynthetic active radiation at *Corylus avellana* L.

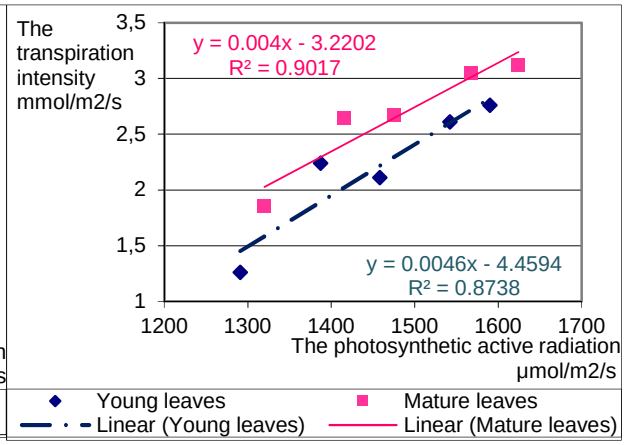

Figure 6. The correlation between the transpiration intensity and the photosynthetic active radiation at *Corylus avellana* L.

The leaf temperature increase beginning in the morning (9 a.m.) when values of 29.4 ^oC at young leaves and of 29.6 ^oC at mature leaves are recorded, their growth until after noon (1 p.m.) when the values of 34.5 ^oC at young leaves and 34.7 ^oC at mature leavesare recorded and decreases towards the evening (5 p.m.) when the values of 32.7 ^oC at young leaves and of 32.8 ^oC in the mature leaves are recorded.

Linear regression performed between the photosynthesis intensity and leaf temperature show a good positive correlation between these, the coefficient of determination (R^2) is 0.94 for the young leaves and 0.96 for the mature leaves and linear regression made between the transpiration intensity and leaf temperature show a good positive correlation - $R^2$is 0.93 for the young leaves and 0.96 for the mature leaves (Figure 7 and 8).

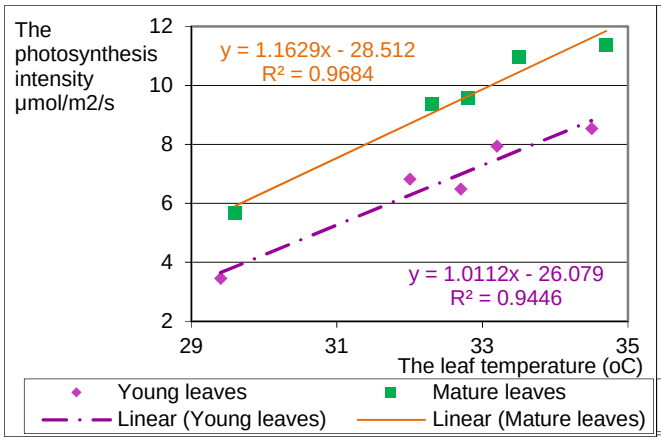

Figure 7. The correlation between the photosynthesis intensity and the leaf temperature at *Corylus avellana* L.

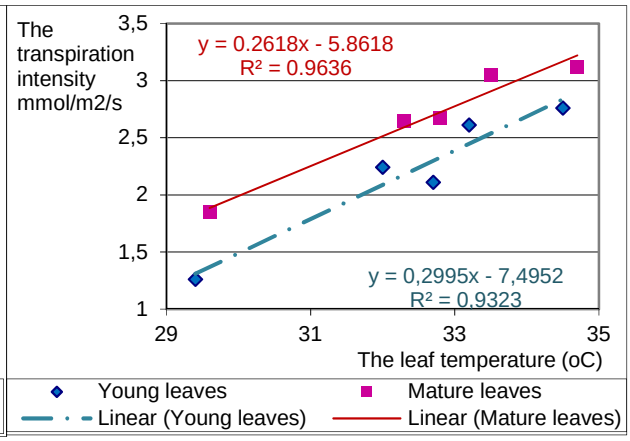

Figure 8. The correlation between the transpiration intensity and the leaf temperature at *Corylus avellana* L.

The stomatal conductance increase beginning in the morning (9 a.m.) when it records the values of 0.05 mol / m^2 / s at young leaves and 0.07 mol / m^2 / s at mature leaves, their growth until after noon (1 p.m.) when it records the values of 0.12 mol / m^2 / s young leaves and 0.15 mol / m^2 / s at mature leaves and decreases towards the evening

(5 p.m.) when it records the values of 0.09 mol/ m^2 / s at young leaves and 0.12 mol/ m^2 / s at mature leaves.

Linear regression performed between the photosynthesis intensity and stomatal conductance show a good positive correlation, the coefficient of determination (R^2) is 0.92 for the young leaves and 0.88 for the mature leaves and linear regression made between the transpiration intensity and stomatal conductance show a good positive correlation - R^2 is 0.88 for the young leaves and 0.91 for the mature leaves (Figure 9 and 10).

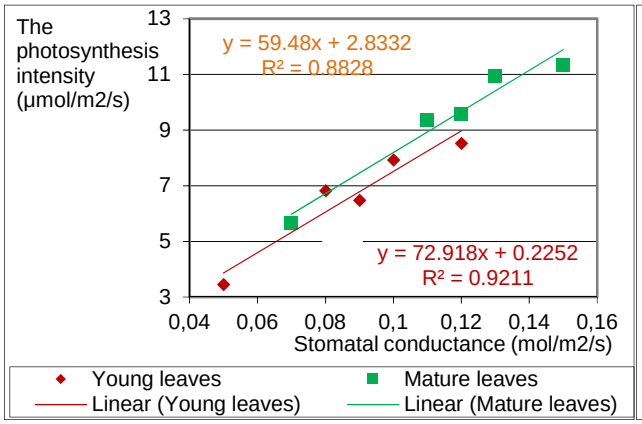

Figure 9. The correlation between the photosynthesis intensity and the stomatal conductance at *Corylus avellana* L.

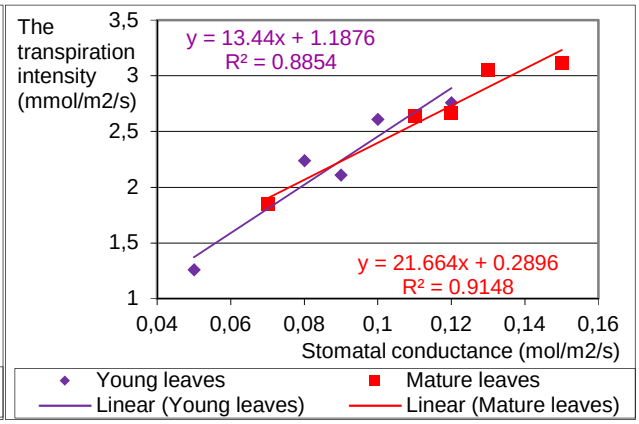

Figure 10. The correlation between the transpiration intensity and the stomatal conductance at *Corylus avellana* L.

The mature leaves present a increase of the chlorophyll content by 17.89 %, in comparison with young leaves, this correlating with the increase of the photosynthesis intensity (Fig. 11).

Corylus avelana var. *purpurea*, compared to other varieties, show a lower content in chlorophyll pigments and a higher content in anthocyanin pigments, this evidenced by red-purple leaves.

The mature leaves, in comparison with young leaves, present a decrease of the total water content by 1.43 %, and an increase of the dry substance content by 5.44 %, fact highlighted through the decreased of the cellular turgor (Fig. 12).

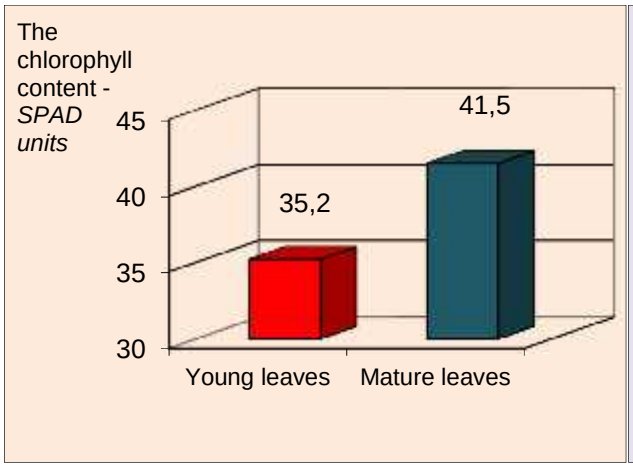

Figure 11. The chlorophyll content at the leaves of *Corylus avellana* L.

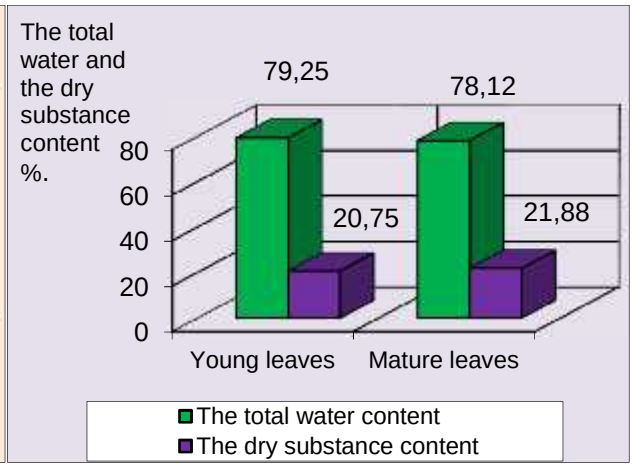

Figure 12. The total water and the dry substance content at the leaves of *Corylus avellana* L.

CONCLUSIONS

At*Corylus avellana* L. var. *purpurea*was observed thatphotosynthesis and transpiration intensity presents a minimum values in the morning, a maximum values until after noon and a minimum values toward the evening,but resultsobtained at mature leaves are higher, in comparison with young leaves.

The linear regressions performed between these physilological processes intensity (photosynthesis and transpiration)and the photosynthetic active radiation, the temperature leaf and the stomatal conductance show apositive correlation, with specifical variations in the mature leaves, in comparison with the young leaves.

The mature leavespresent a increase of the chlorophyll content, in comparison with young leaves. The mature leaves present a decrease of the total water and a increase of the dry substance content, with implications in the processes of growth and developmentof the plants.

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