MORPHOLOGICAL AND BIOCHEMICAL CHANGES AT FOLIAR LEVEL INDUCED BY ATMOSPHERIC POLLUTANTS ON SAMPLES OF *AESCULUS HIPPOCASTANUM* L. FROM IAŞI CITY AREA

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Abstract : We present in this paper some morphological changes (presence and size of the surface both normal and necrotic) and biochemical (water content and dry matter) induced at foliar level by some pollutants in samples of *Aesculus hippocastanum* L. cultivated for ornamental purposes across the five air quality monitoring stations in Iasi city area . These stations monitor the presence of gaseous pollutants (sulphur dioxide, carbon dioxide, nitrogen dioxide, ozone) and solids (powders prone to sedimentation). Measurements were made *in vivo*, as well on fresh material covering vegetation periods of years 2012 and 2013. The results are supporting the fact that the increased values of dry matter content do not correlate directly with the degree of necrosis of the leaves, which entitles us to believe that the biochemical and physiological modifications made by pollutants at this level are fast followed by defoliation events. The most critical situation is found at the samples of *Aesculus hippocastanum* L. grown at the site of the traffic station Podul de Piatră, where SO_2 and particulate solids in suspension are the predominating pollutants.

INTRODUCTION

The air quality from urban areas affects our way of life (Perloff, 1969). If by the 80 major sources of air pollution were domestic heating and industries with high emissions of sulphur dioxide (SO_2), now the main source of pollution in city areas is represented by cars that emit oxides of nitrogen, carbon dioxide , hydrocarbons, particles of dust and heavy metals. On hot summer days, these substances contribute to formation of ozone, a pollutant that is more phytotoxic (Garrec and Rose 1988). Numerous studies have shown that woody plants have a high capacity to reduce the quantities of pollutants in the atmosphere acting as true biological filters. Therefore, their presence in heavily polluted urban areas, proved to be necessary not only aesthetically but also in terms of their decontaminating action. However, air pollution is one of the major stressors of woody plants, which can cause acute damage that is immediately visible, but also chronic damage that can sometimes be asymptomatic thus hindering the ability to determine the cause of their decline. Pollutants are factors with phytotoxic effects in all plant’s organs. The symptoms of pollution impact upon trees are investigated in physiological, biochemical, morphological and cytogenetic aspects (Nabais et al. 1999). In this paper we present some morphological changes (presence and size of the surface both normal and necrotic), biochemical (water content and dry matter content of photo-assimilating pigments) and physiological (photosynthetic and transpiration processes intensity) induced at foliar level by some pollutants in samples of *Aesculus hippocastanum* L. cultivated for ornamental purposes across the five air quality monitoring stations in Iasi city area. These stations monitor the presence of gaseous (sulphur dioxide, carbon dioxide, nitrogen dioxide, ozone) and solid (powder prone to sedimentation).

MATERIALS AND METHODS

The biological material represented by leaves of *Aesculus Hippocastanum* L. species was collected from Iaşi city, from the air quality monitoring stations area. The plant material was collected in the years 2012 and 2013 in May, July and September performing alongside field observations. Control species were selected from the Botanical Garden of "Alexandru Ioan Cuza" University. Collection and measurement "in vivo" were made on leaves situated at the edge of the canopy, of the four cardinal points of each individual, at a distance of 4-5 m above the ground. It was taken into account the height above ground at which were mounted the air quality monitoring station’s analyzers and the extent to which measurements of this analysis are relevant.

Determination of leaf area was done with the portable leaf area meter (AM300 apparatus). Optical measurements were made using a simple scanning process.

Water content and dry weight of plant material were determined by gravimetric method (Boldor et al, 1983).

RESULTS AND DISCUSSIONS

Aesculus hippocastanum L. individuals in the five areas studied showed severe foliar symptoms, being a very sensitive to pollutants species.

In Copou-Sadoveanu, Decebal-Cantemir and Tomeşti *Aesculus hippocastanum* L. individuals showed no significant defoliation but showed foliar chlorosis and necrosis since July. (Fig. 1, 2).

Fig. 1 Foliar detail of *Aesculus hippocastanum* L. individual from Decebal-Cantemir (July 2013)

Fig. 2 Foliar detail of *Aesculus hippocastanum* L.individual from Tomeşti (July 2013)

It was found, however, that in Decebal-Cantemir and Tomeşti areas these chlorosis and necrosis widened in late September, occupying significant areas of foliar device (Fig. 3).

Fig. 3 Foliar detail of *Aesculus hippocastanum* L.individual from Tomeşti (September 2013)

In Podul de Piatră and Tătăraşi-Oancea areas *Aesculus hippocastanum* L. individuals showed significant episodes of defoliation in July. Leaflets showed reddish brown marginal necrosis and, at the end of July, their tops were twisted (Fig. 4). Roadside trees are, to a greater extent, to pollution caused by vehicle emissions (Jităreanu et al., 2010).

Fig 4. Foliar detail of *Aesculus hippocastanum* L. individual from Podul de Piatră (July 2013)

Pollutants can cause foliar injury, stomata damage, premature senescence, reduced photosynthetic activity, disrupts membrane permeability and thus the normal growth and development (Tiwari et al. , 2006). Reducing leaf area and number of leaves may be due to the rate of foliar productivity and early senescence induced by pollutants. Dineva (2004) and Tiwari et al. (2006) recorded reduced leaf area and petiole length under stress due to pollution. Some studies showed changes in leaf area and petiole size in polluted air (Jahan and Iqbal, 1992). Significant reduction in the length of the stem and leaf area was also observed in pollution conditions caused artificially. Reduction in leaf area was observed in five species of trees near areas contaminated with solid particulates and SO_2 (Jahan and Iqbal, 1992). Significant effects of automobile exhaust on phenology, morphology and productivity of tree species on the roadside was also reported (Bhatti and Iqbal, 1988).

Leaf area of all investigated individuals showed lower values compared with the control, in all investigated areas, in both years of study, with minimum values at the individuals from Podu de Piatră area (traffic station) (Fig. 5, 6). Chlorosis and necrosis appearance since early developmental stages of leaves, physiological stress due to pollutants aggression is consequential harm to the degree of development of the plant’s leaves. Reduced leaf surface from Podul de Piatră, an intense traffic area, is due to heavy deposits on the leaves or chlorosis and necrosis.

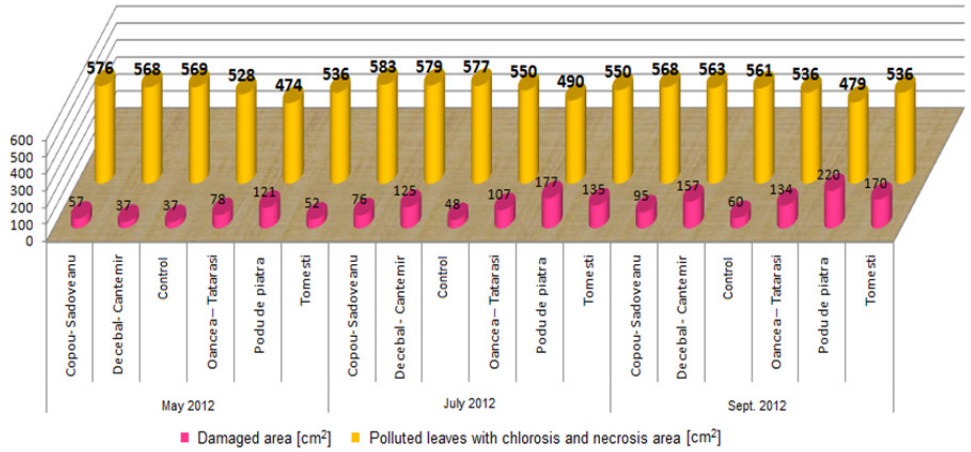

Fig.5 Variation of leaf area at *Aesculus hippocastanum* L. individuals derived from the five areas of investigations (May, July and September 2012)

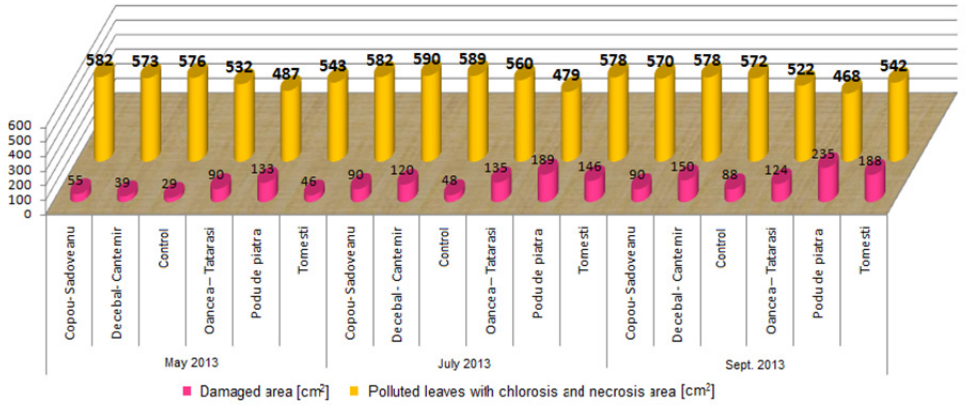

Fig.6 Variation of leaf area at *Aesculus hippocastanum* L. individuals derived from the five areas of investigations (May, July and September 2013)

The dry weight content increased compared to control, in all five areas subject to investigation. Maximum values of dry matter content were recorded in *Aesculus hippocastanum* L. individuals from Tomeşti area (suburban station) (Fig. 7, 8). It should be noted that high dry weight content isn't directly correlated with macroscopically visible necrosis, which means that in some cases disruption of physiological functions is directly followed by defoliation (Ivănescu and Toma, 1999). The decrease of the water amount, combined with the increase of dry substance amount, can be correlated to the close-open stomata mechanism. The solid deposits, the chlorosis and necrosis affect the cuticle perspiration and this affects perspiration, respiration and photosynthesis (Şoltuzu et al., 2012).

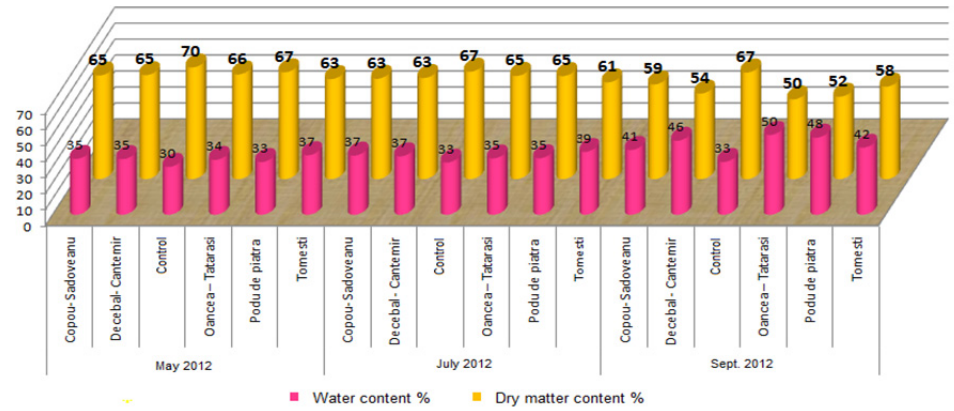

Fig.7 Variation of water content and dry matter at *Aesculus hippocastanum* L. individuals derived from the five areas of investigations (May, July and September 2012)

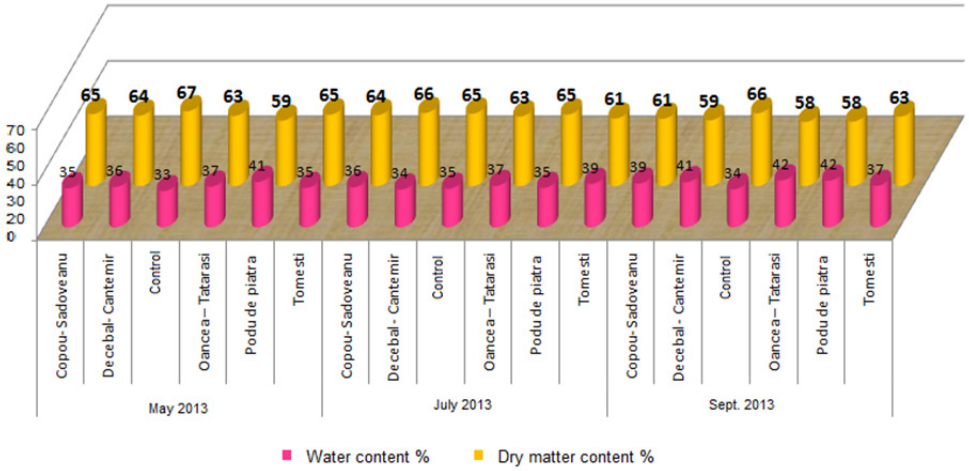

Fig.8 Variation of water content and dry matter at *Aesculus hippocastanum* L. individuals derived from the five areas of investigations (May, July and September 2013)

CONCLUSIONS

On the investigated biological material, due to vegetation condition for the year 2012, following conclusions can be drawn:

At pollution aggression, the responses can be very different even at the individuals from the same species. The foliar chlorosis resulted from deep physiological alterations affect the water and dry substance contents. A large number of chlorosis of the leaf unit accompanied by necrosis of the limb edges were found at the individuals investigated from Podu de Piatră area (traffic station). The lowest values of foliar surface and physiological processes compared to the control, were recorded at the individuals of *Aesculus Hioppocastanum* L. species from Podu de Piatră area (traffic station).

We outline the fact that not always the high dry substance content is related to necrotic leaf surface, which means that in certain cases the disturbance of some physiological functions is straightly followed by defoliation.

Considering all this, we can conclude that there is no uniformity regarding the foliar response to pollutants, not even for individuals from the same species. Because of that, the pollution impact studies on the vegetation should consist of a large range of investigations for each individual in an investigated perimeter.

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