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Original Article

Testing Biomonitoring Capacity of Trees from Urban Areas. A Case Study: Cu, Cd, Pb, Zn Pollution in Cluj - Napoca, Reflected by Foliar Accumulation of Five Species Located within Intense Traffic Area. Note 1. Results Recorded in 2010

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Abstract

The identification of tree species used in urban areas as ornamental trees, that have particular behaviour against different heavy metal pollution is of great importance. The aim of our study was to identify the biomonitoring capacity of five tree species used in a heavy traffic area of Cluj - Napoca, Aurel Vlaicu street, by quantification of foliar bioaccumulation of Cu, Cd, Pb and Zn. In the present paper are emphasized and discussed the results obtained in 2010. The leaves were collected weekly from five tree species: *Pinus nigra, Aesculus hippocastanum, Betula pendula, Picea pungens* var. *glauca* and *Tilia cordata*, and heavy metals quantified in the Laboratories of the Department of Environmental and Plant Protection from the Faculty of Agriculture of the UASVM Cluj - Napoca, with Perkin - Elmer Atomic Absorption Spectrometer with flame and graphite furnace, Analyst 800. All analyzed trees have the biggest accumulation capacity for zinc, meaning that all can be used as biomonitoring agents for this element. is *Aescullum hippocastanum* is the most suitable biomonitoring agent for lead and copper pollution while, *Betula pendula* have the biggest bioaccumulation capacity for cadmium.

Keywords: linkage distance, dendrogram, Boxplot diagram, *Pinus nigra, Aesculus hippocastanum, Betula pendula, Picea pungens* var. *glauca*, *Tilia cordata*

1. Introduction

Air pollution in populated areas, big towns with heavy traffic, especially, is a continuous problem for both authorities and population. In this context, the importance of using tree species for pollution reducing is an ambitious project [1, 3].

A first step in this study may be the identification of those tree species used in urban areas as ornamental trees, that have particular behaviour against different heavy metal pollution [2, 4, 5]. The aim of our study was to identify the biomonitoring capacity of five tree species used in a heavy traffic area of Cluj - Napoca, Aurel Vlaicu street, by quantification of foliar bioaccumulation of copper (Cu), cadmium (Cd), lead (Pb) and zinc (Zn).

2. Material and Method

The study was conducted during two successive years, 2010 and 2011. In the present

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paper are emphasized and discussed the results obtained in 2010. The monitoring point was located in Cluj - Napoca, on Aurel Vlaicu Street, an intense traffic urban area. The leaves were collected weekly from five tree species, frequently used as green protection factors in municipal areas: *Pinus nigra, Aesculus hippocastanum, Betula pendula, Picea pungens* var. *glauca* and *Tilia cordata*.

The heavy metal accumulation capacity was quantified in the Laboratories of the Department of Environmental and Plant Protection from the Faculty of Agriculture of the University of Agricultural Sciences and Veterinary Medicine Cluj - Napoca, with Perkin - Elmer Atomic Absorption Spectrometer with flame and graphite furnace, Analyst 800.

The data processing was performed with programme Statistica v.7.0 for Windows. The Boxplot graphic representation and dendrogram analysis was performed to emphasize the bioaccumulation capacity of the concerned trees.

3.Results and Discussions

The analyze of the dendrograms for Cu, Pb, Cd, Zn accumulation in studied trees emphasizes that their accumulation capacity is differentiated by two categories of heavy metals, weak and/or moderate accumulation and strong/very strong accumulation (fig. 1).

In *Pinus nigra* we recorded moderate accumulation of cadmium and lead, and very high accumulation, even over the maximum allowed limit, of zinc.

In the mean time, this specie exhibits very low affinity for copper accumulation, demonstrated by the lack of this element in the foliar tissue of the tree.

The small distances between Cd and Pb indicate a tight grouping between these elements who are at long distance from zinc, which is the most accumulated heavy metal (fig. 1).

In *Aesculus hippocastanum* low copper and cadmium accumulation was recorded, but big lead and zinc accumulations. The small distances between Cu and Cd indicate a tight grouping between these elements who are at long distance from lead and zinc, which are the most accumulated heavy metals (fig. 1).

In *Betula pendula* low copper, lead and cadmium accumulation was recorded, and big zinc accumulations. The small distances between Cu, Pb and Cd indicate a tight grouping between these elements who are at long distance from zinc, which is the most accumulated heavy metal (fig. 1).

In *Picea pungens* var. *glauca* moderate cadmium and lead accumulations were recorded, while zinc was accumulated at a larger rate. Similarly with *Pinus nigra* this specie exhibits very low affinity for copper accumulation, demonstrated by the lack of this element in the foliar tissue of the tree. The small distances between Cd and Pb indicate a tight grouping between these elements who are at long distance from zinc, which is the most accumulated heavy metal (fig. 1).

In *Tilia cordata* small cadmium and lead accumulations and big zinc capture may be emphasized. This specie, too, had low capacity of copper accumulation, underlined by the lack of this element in foliar cover of the tree.

The small linkage distances between Cd and Pb indicate a tight grouping between these elements who are at long distance from zinc, which is the most accumulated heavy metal (fig. 1).

The Boxplot analysis shows that copper is accumulated in large amount by *Aesculus hippocastanum*, in moderate quantity by *Betula pendula*, and lacks in *Pinus nigra, Picea pungens* var. *glauca* and *Tilia cordata* (fig. 2).

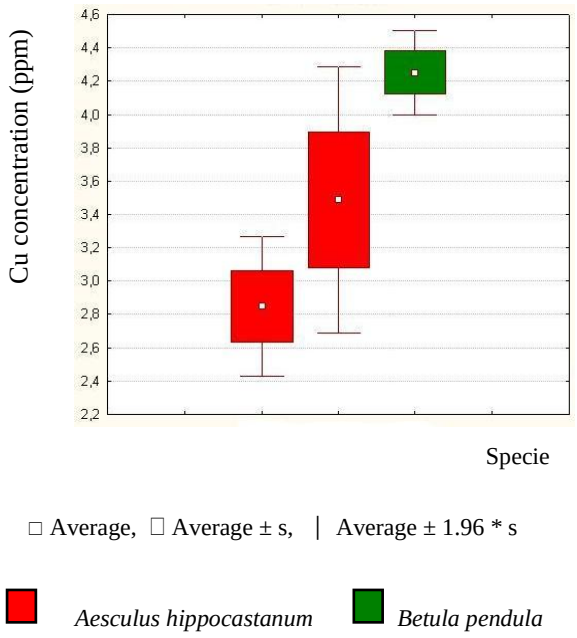

Figure 2. The distribution of Cu in leaves of the studied tree species from monitoring point located on Aurel Vlaicu St. in Cluj - Napoca

The lead accumulation follows a normal distribution and it was moderate accumulated in *Aesculus hippocastanum*, *Pinus nigra*, and *Betula pendula* leaves, and in higher amounts in *Picea pungens* var. *glauca* and *Tilia cordata* (fig. 3).

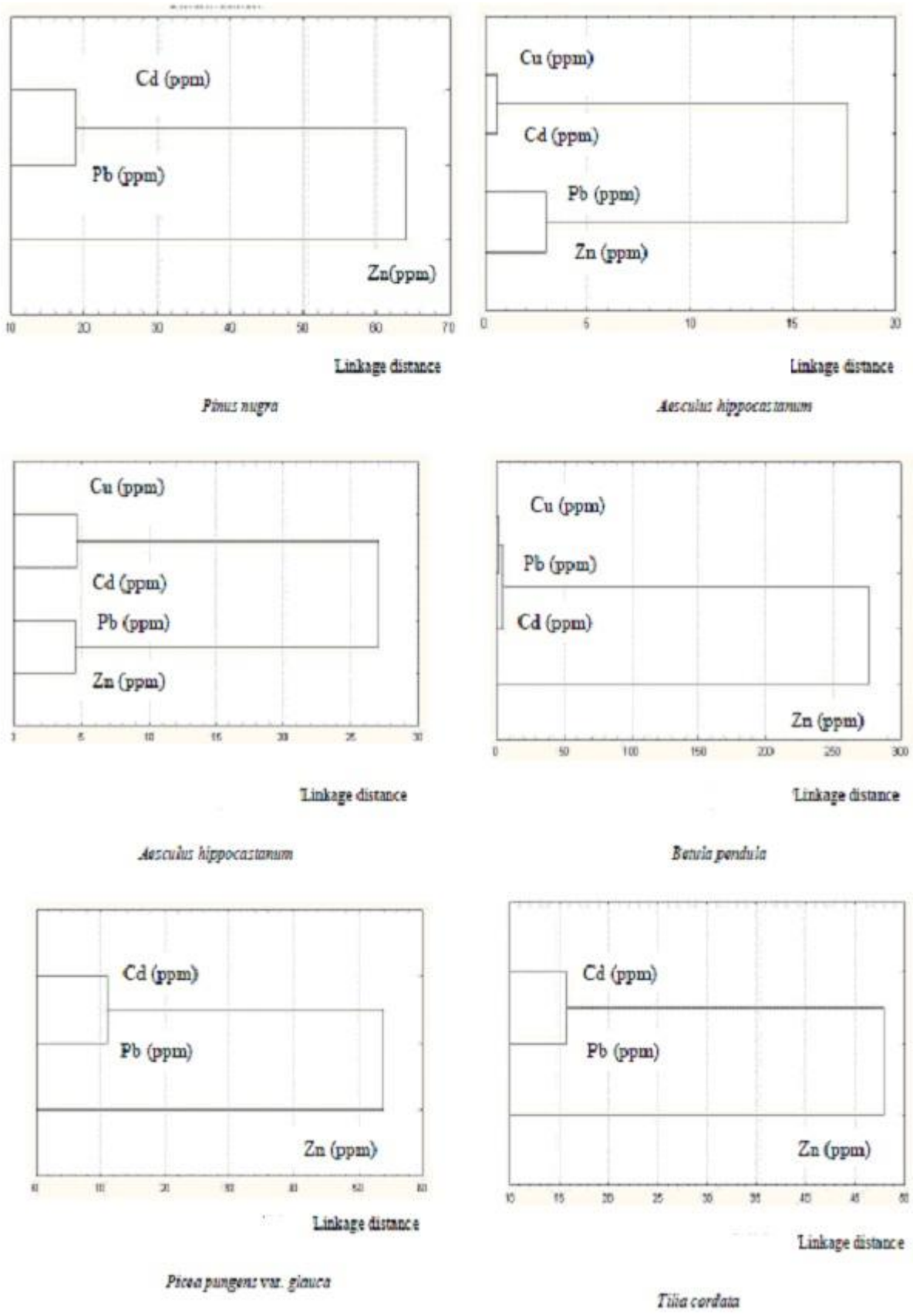

Figure 1. Dendrograms concerning the Cu, Pb, Cd, Zn content in monitoring point located on Aurel Vlaicu St. in Cluj - Napoca

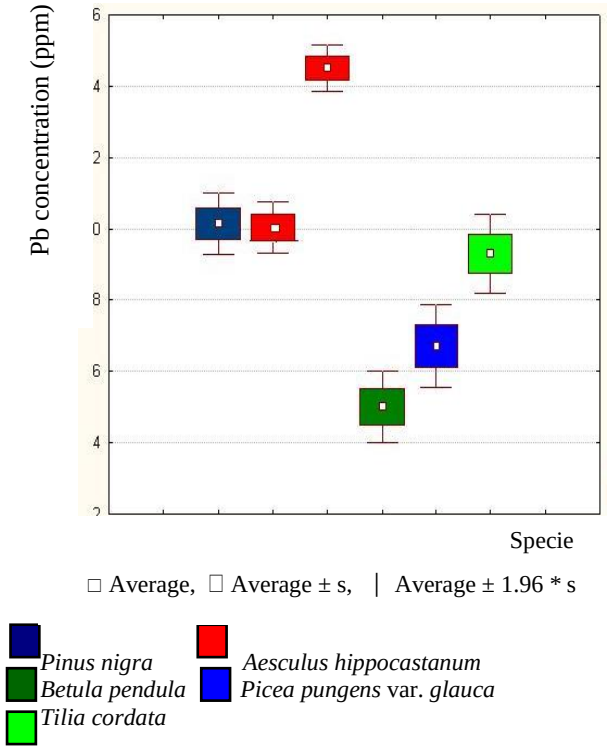

Figure 3. The distribution of Pb in leaves of the studied tree species from monitoring point located on Aurel Vlaicu St. in Cluj - Napoca

The analized tree species exhibited low accumulation capacity for cadmium, except Betula pendula (fig. 4).

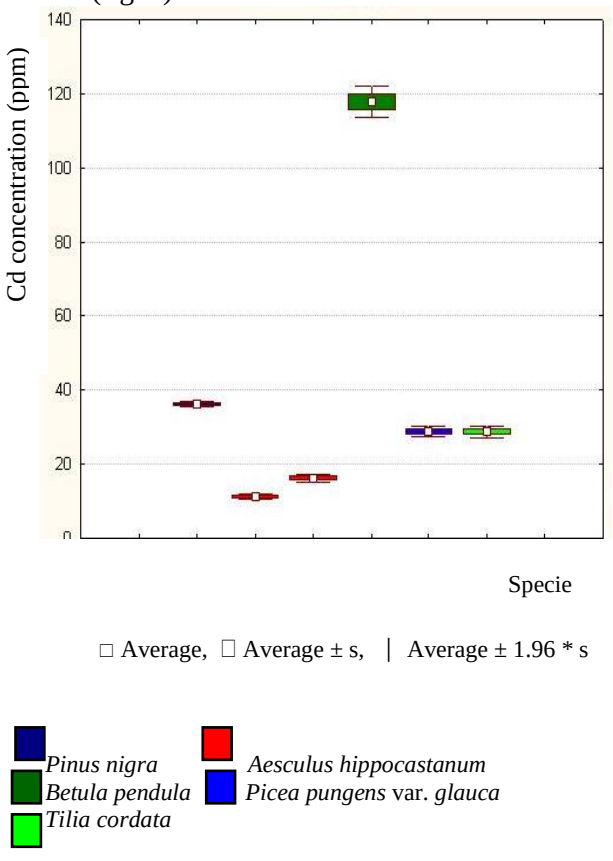

Figure 4. The distribution of Cd in leaves of the studied tree species from monitoring point located on Aurel Vlaicu St. in Cluj - Napoca

The capacity for zinc accumulation was biggest in *Pinus nigra*, moderate in *Aesculus hippocastanum* , *Betula pendula*, *Picea pungens* var. *glauca* and small in *Tilia cordata* (fig. 5).

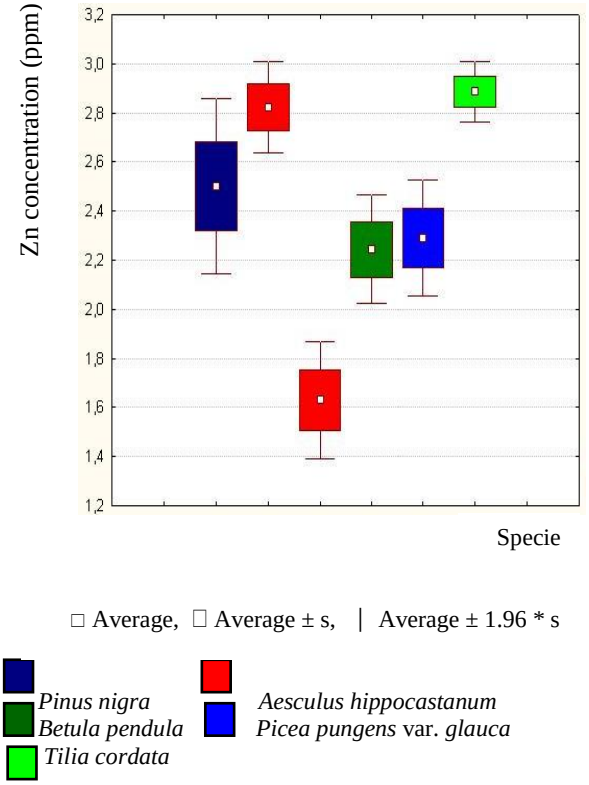

Figure 5. The distribution of Zn in leaves of the studied tree species from monitoring point located on Aurel Vlaicu St. in Cluj - Napoca

4. Conclusions

The quantification of foliar bioaccumulation of copper, cadmium, lead and zinc in all five tree species located a heavy traffic area of Cluj - Napoca, Aurel Vlaicu street, respectively, shows that all analyzed trees have the biggest accumulation capacity for zinc, meaning that all can be used as biomonitoring agents for this element.

The most suitable biomonitoring agent for lead pollution is *Aescullum hippocastanum*, while for cadmium is *Betula pendula*.

The smallest biomonitoring capacity was recorded for copper. Only in *Aescullum hippocastanum*, and *Betula pendula* were recorded copper accumulations, with biggest values in *Aescullum hippocastanum*, while in coniferous species and *Tilia cordata* it lacks.

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