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NON-INVASIVE ANTHOCYANIN AND CHLOROPHYLL DETERMINATIONS ON IVY FROM DIFFERENT HABITATS

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Abstract: This aim of this paper was to analyze behavior of ivy leaves from different habitats in 2023. Ivy is an evergreen climbing plant, which tends to grow on multiple surfaces, gardens, wild areas, walls. For this reason, *Hedera helix* became a universally used species in air pollution biomonitoring. Measurements on ivy leaves are cheap and do not require a long time to be done. The studied indices were anthocyanin and chlorophyll contents. These parameters were analyzed using a non-invasive approach, with OPTI-SCIENCES CCM-300 Chlorophyll Content Meter for chlorophyll determinations, the results being presented in mg m^{-2}, and with OPTI-SCICENCES ACM-200 Plus Anthocyanin Content Meter for anthocyanin contents, where the results were presented in ACI. A total of 240 samples were taken from the foliar system. These were divided in six sets, from three different locations. The first set was collected from the tree trunk of Deva fortress hill (Green area) and the second one from the leaves situated on the soil surface. The same procedure was applied as well for third and fourth set, but were taken from a park (Urban Green area). The last two data set was obtained from an urban area (U) within Deva. In the end, six data sets were assessed. Readings were taken from multiple types of leaves, healthy and those that showed signs of chlorosis. Anthocyanin levels illustrate the air quality, being pigments involved in stress management. Chlorophyll content is highly correlated with an efficient photosynthesis, due to the fact that a wider mesophyll accumulates a bigger quantity of photosynthetic pigments. From the data collected, it was observed that the tested leaves from Deva fortress hill and from the park are healthier than those from the urban area.

• Introduction

Hedera helix is a perennial, evergreen plant known for its biological properties. It has been used in traditional medicine to alleviate coughs with infusions made from its young leaves, and for bronchitis due to its expectorant action. Scientific research has been conducted to justify the use of this plant for medicinal purposes. Biomonitoring includes communities, species, and biological processes that are used to assess the level of **pollution of the air**, as well as to monitor a specific region over a longer period of time. The composition and content of pigments in leaves can provide very important information about the health status of plants. **Chlorophyll** has the ability to absorb sunlight and use it in mechanisms and photosynthetic reaction. The content of **anthocyanins** can provide important information about the health status of a plant. This pigment is genetically biosynthesized in different quantities, and the ability of leaves to secrete anthocyanin varies from species to species. Chlorophyll together with anthocyanins plays an extremely important role in assessing the consequences of atmospheric pollutants on plants. Therefore, the content of these two **pigments** can provide useful information about the degradation status of plants that have been exposed to atmospheric pollutants. When these pollutants are absorbed by the leaves, they cause a decrease in chlorophyll production, which means that plant **productivity decreases** or may even stop.

• Material and method

The study was conducted in the **spring of 2023**, on **March**. Samples were taken from **Deva**, Romania, three areas: Deva fortress hill, Citadel Park and an urban area. The urban area is represented by the area located nearly an intense circulated street.
The studied species was *Hedera helix*. This can be found in investigated areas.
Using OPTI-SCIENCES CCM-300 Chlorophyll Content Meter was analyzed the chlorophyll content, presented in mg m^{-2} and with OPTI-SCIENCES ACM-200 Plus Anthocyanin Content Meter for antochyan contents, where the results were in ACI.
In every location, the samples was collected from the **three trunk** and from the **leaves situated on the soil surface**. For example, the first location marked on the photo above with the number 1 coloured in red was on **Deva fortress hill** and the samples was taken from A - tree trunk, B – the leaves on the ground. The second location with number 2 coloured in red too was in the **park near the fortress** and the same procedure was applied, C – tree trunk, D- the leaves on the ground. The last two data set was determined from the **urban area** within Deva. As a result, a total of **240 samples** were taken from the foliar system.
Statistical analysis was done using PAST v4.03 and data processing was done using Microsoft Office Excel 2016 and Shapiro-Wilk test was utilized to test the normality of datac .

• Results and discussions

This research aimed to determine the values of anthocyanins and chlorophyll contents for *Hedera helix* from some various sites. This evergreen species is a good biomonitoring tool due to the fact that its leaves are capable to accumulate various compounds in all vegetation s

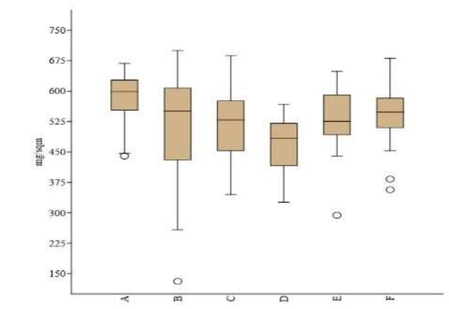

Figure 2. Leaves chlorophyll levels (mean ± SE) depending on studied area and plant position

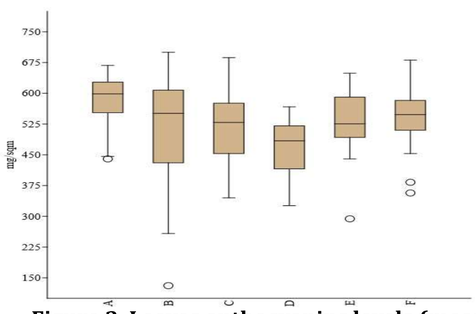

Figure 3. Leaves anthocyanins levels (mean ± SE) depending on studied area and plant position

Table 1. Minimum and maximum levels of chlorophyll and anthocyanins found in the studied plants species, for all variants

Variant	Chl (mg m^{-2})		ACI	
	min	max	min	max
A	440	668	9	30.4
B	131	700	12.2	24.5
C	345	687	4.6	23.5
D	326	567	12.9	24.5
E	294	649	12.2	30.9
F	357	681	5.5	42.7

• Conclusions

Chlorophyll and anthocyanin samples were collected from ivy leaves in all three areas, both from the ground and from ivy on tree trunks. Differences were observed following the tests and averages performed on the samples.
The chlorophyll content was significantly higher in ivy on tree trunks in the green areas as well as in the green urban areas, indicating more efficient photosynthesis. In the urban area, the levels were roughly equal for samples collected from the ground and from tree trunks. At D, the chlorophyll content was lower, possibly due to weaker lighting, with the ivy leaves being exposed to the sun for less time.
The anthocyanin content was within normal limits in the green area as well as in the green urban area on tree trunks.
The highest investment in anthocyanin production was observed in the urban area, especially for ivy located on the ground, which is constantly exposed to the pollutants created by the vehicles that continuously pass through the heavily trafficked nearby street.

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