

Abstract

PLANTS AS BIOINDICATORS OF AIR POLLUTION

DOI: 10.5937/EcoTER26650D

Student: Nataša Đorđević¹

Mentors: Jelena Kalinović^{1*,a}, Tanja Kalinović^{1,b}

¹ University of Belgrade, Technical Faculty in Bor, Vojske Jugoslavije 12, 19210 Bor, SERBIA

^a <https://orcid.org/0000-0003-0088-2683>

^b <https://orcid.org/0000-0003-0161-0065>

Abstract

Air pollution represents one of the most critical environmental issues of the contemporary era. Air pollution is commonly defined as the presence of particulate matter and gaseous pollutants in the atmosphere at concentrations that pose risks to living organisms and ecosystem functionality. Some of the most significant atmospheric pollutants are particulate matter (PM_{2.5} and PM₁₀), nitrogen oxides (NO_x), sulfur dioxide (SO₂), and tropospheric ozone (O₃). These substances contribute to environmental degradation and various health-related issues.

In recent years, considerable attention has been directed toward the use of plants as effective biomarkers and bioindicators of atmospheric pollution, owing to their inherent capacity to accumulate contaminants and exhibit measurable physiological and morphological responses. Plants are especially valuable in this context due to their ability to directly interact with atmospheric pollutants and respond through measurable physiological, biochemical, and morphological changes.

This paper provides a literature review of the applicability of selected plant species as biomarkers of air pollution, with particular emphasis on dandelion (*Taraxacum officinale*), pear (*Pyrus communis* L.), and horse chestnut (*Aesculus hippocastanum* L.). The obtained findings indicate species-specific responses including heavy metal accumulation and structural leaf alterations. *Taraxacum officinale* efficiently accumulates Pb, Cd, and Zn in its roots and leaves, making it a reliable indicator of urban environmental pollution. *Pyrus communis* L. was used to assess the impact of gaseous pollutants on plant physiological condition, and the results showed that exposure to NO_x and SO₂ leads to chlorosis, reduced photosynthetic activity, and increased accumulation of trace heavy metals in leaves. *Aesculus hippocastanum* L. was used for biomonitoring of urban air pollution, and the results showed that this species accumulates Pb, Cd, and Zn in leaf tissues, accompanied by necrosis, chlorotic spots, and premature leaf fall under elevated pollutant concentrations.

The analyzed species demonstrate complementary biomonitoring roles, where *Taraxacum officinale* primarily reflects heavy metal accumulation in soil and air, *Pyrus communis*

*jkalinovic@tfbor.bg.ac.rs

indicates physiological stress caused by gaseous pollutants, and *Aesculus hippocastanum* integrates both chemical accumulation and visible foliar damage, making them collectively effective indicators of urban air quality gradients.

Based on the obtained results, the authors concluded that plants could be suitable as a cost-effective and an environmentally friendly tool for air quality monitoring.

Keywords: air pollution, biomarkers, bioindicators, plants

ACKNOWLEDGEMENT

The authors are grateful to the Ministry of Education, Technological development, and Innovations of the Republic of Serbia for financial support, within the funding of the scientific research at the University of Belgrade – Technical Faculty in Bor (No. 451-03-34/2026-03/200131).

REFERENCES

1. World Health Organization (WHO). Air Quality Guidelines. 2005.
2. Markert, B., Breure, A.M., Zechmeister, H.G. Bioindicators and Biomonitoring Principles, Concepts and Applications. Amsterdam: Elsevier; 2003.
3. Gill, S.S., Tuteja, N. Plant Physiol. Biochem. 2010, 48, 909–930.
4. Vuković, G., Aničić Urošević, M., Škrivanj, S., *et al.* Sci. Total Environ. 2016, 542, 394–403.
5. Petrova, S., Yurukova, L., Velcheva, I. J. Bio. Sci. Biotech. 2012, 1(3), 241–247.