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THE USE OF PAULOWNIA AS A PLANT TEST PECIMEN FOR PHYTOINDICATION OF THE ECOLOGICAL CONDITION OF THE STUDIED SITE

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Phytoindication is a method for assessing the state of the environment, ecological factors, and anthropogenic pressure [2–4] by studying the species composition, structure, and responses of plants or plant communities. The method is based on the ability of plants to respond to air, soil, or water pollution, as well as to changes in climatic conditions. This method does not require expensive laboratory equipment, complex chemical reagents, or ongoing financial costs. It reflects the entire set of ecological factors (the combined impact of various pollutants), rather than just individual chemical elements. Visible changes (leaf necrosis, discoloration, stunted growth, etc.) allow for a rapid assessment of the scale of an ecological problem directly in the field [1].

Paulownia (Paulownia) shows great potential as a plant for phytomonitoring and phytoremediation due to its unique ability to accumulate pollutants and rapidly increase its biomass. Research into its phytoindication properties is a relevant area of study in ecology, as the tree’s large leaves and deep root system actively respond to anthropogenic stress, and thanks to its unusually rapid growth, the results of ecological assessments of a site’s condition are visible within a single growing season [5].

With this in mind, the goal of our study was to investigate the possibility of using paulownia as a plant indicator for assessing the ecological condition of the study site.

The results of the analytical study indicate that paulownia is a fast-growing deciduous tree with unique biological and morphological characteristics. Annual height growth ranges from 3 to 5 meters per year under optimal conditions. In their first year, young plants can reach the height of an adult human. Paulownia grows approximately 10 times faster than pine or poplar and 6 times faster than oak [5].

Experimental studies conducted at the Bila Tserkva National Agrarian University revealed a significant difference in the growth and development rates of Paulownia trees at different locations within the study area (Table 1).

Table 1.

Growth intensity indicators for Paulownia

Sample No.	Plant weight (kg)	Leaf weight (kg)	Height (cm)	Weight of a 5x5 cm die-cut (g)
1	0,035	0,015	34,5	0,77
2	0,11	0,04	48	0,945
3	0,025	0,01	37	0,79
4	2,27	1,105	270	1,02

Based on the data presented in Table 1, it is possible to conduct an ecological assessment of plant growth and development and establish correlations between the parameters.

Samples No. 1, No. 2, and No. 3 exhibited relatively low indicators of early growth and development: their height ranged from 34.5 to 48 cm, their total weight ranged from 0.025 to 0.11 kg, and their leaf mass ranged from 0.01 to 0.04 kg.

Sample No. 4 stood out sharply in terms of its parameters: its height reached 270 cm, its total weight was 2.27 kg, and its leaf mass was 1.105 kg.

During the experiments, a clear correlation was established between soil acidity (pH) and the intensity of the plants' biometric indicators. The best wood growth was observed at a pH of 6.8, where nutrient availability was optimal (Fig. 1).



Figure 1. Growth rate of Paulownia under environmental conditions with a pH of 6.8
Source of the figure: photo taken by the authors

In contrast, under alkaline conditions (pH 8.5), young paulownia plants lagged significantly behind in growth, indicating inhibited root uptake of micronutrients and physiological stress in the plants.

Conclusion. Experimental studies have confirmed the significant potential of Paulownia as an effective test species for the phytomonitoring of anthropogenic stress. Experimental data revealed differences in the plants' biometric parameters across various locations within the study site. In particular, sample No. 4 exhibited the highest values for height (270 cm) and total plant mass (2.27 kg). A pronounced dependence of growth rate on soil acidity was established: optimal plant development was observed at a pH of 6.8, whereas an alkaline soil reaction (pH 8.5) caused physiological stress and inhibited plant growth. The results obtained are of significant practical importance for agroecological planning and the optimization of Paulownia cultivation. Taking soil and climatic factors into account, along with a preliminary pH analysis, allows not only for predicting the productivity of plantations but also for minimizing resource consumption while ensuring maximum ecological and economic benefits.

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