FAGUS SYLVATICA - SPECIES INDICATING ENVIRONMENTAL POLLUTION

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ABSTRACT: Antropogenic environmental and a large amount of other chemical elements, which are not necessary for growth and development may be absorbed by trees in different locations and under certain condition and may lead to: an inadequate or excess supply of one or more trees nutrients known to be essential (so-called macronutrients: nitrogen -N, phosphorus-P, potassium-K, calcium-Ca, magnesium-Mg and sulphur-S, and so-called micronutrients: manganese-Mn, iron-Fe, copper-Cu, zinc-Zn, chlorine -Cl)), disturbances in trees metabolism, growth and development to damaging symptoms. Analytical foliar diagnosis has made evident the following: nutritional state of trees (N, P, K, Ca, Mg, S, Mn, Fe, Cu, Zn, Cl) compared to threshold values proposed in the European literature (nutritional intensity and balance; synergism, antagonism and accumulation between essential nutrient elements in trees metabolism and other chemical elements; the capacity of sulphur, chlorine, calcium, magnesium, manganese, iron, copper and zinc metabolisation.

KEY WORDS: trees, foliar synthetic diagnosis, nutritional disorders, damaging symptoms, capacity of metabolisation.

1. INTRODUCTION

The leaves of the plants take from the soil mineral substances selectively absorbed, depending on the ecological requirements of the species and from the atmosphere the carbon dioxide necessary for photosynthesis, together with all the noxious substances contained in the air.

The effects of toxins on plants are more expressive on the leaf, the organ with maximum susceptibility, both to air and soil pollution, due to the more intense physiological activity of the large surface in contact with the environment. External manifestations of intoxications with different toxins are symptoms, which differ depending on: plant species, environmental conditions (primarily nutrition), nature and concentration and time of action of the toxins, distance from the source.

In general, noxious substances influence the growth and development of trees, the process of photosynthesis and the water regime. Changes in the whole set of functions are the reaction of plants to the toxic action of pollutants, which becomes visible (in the form of: chlorosis, necrosis, permanent leaf fall, growth retardation) at a certain concentration threshold, characteristic of the nature of the pollutant. Pollution detection is done by simple observations of morphological changes or specific chlorosis and leaf necrosis caused very quickly by physiological disturbances.

Bioaccumulation is the phenomenon by which a substance present in the air enters the body, even if it has no metabolic role, or even if it is toxic to that body. It is the result of a dynamic balance between air and plant, depending on the properties of the plant, its biomass, its ability to metabolize pollutants, its rate of metabolism of sulfur (sulfur, nitrogen, chlorine are rapidly metabolized), or the rate of deposition on the surface of the leaves.

Tree information is perennial, because as long as it lives, bioindicators and bioaccumulators reveal with fidelity and consistency, through foliar analyzes. - air quality and foliar symptoms - effects of toxins on trees.

The discolored, or necrotic, leaves of the bioindicator trees, highlight the surface of the forests exposed to the effects of the pollutant and the evolution in time and space of these effects. (table1.)

Table1. The ability of chlorine and sulfur to be metabolized by different tree species

Species	Metabolism (ppm)	
	Chlorine	Sulful.
Populus x *canadensis*	31.320	8.230
Populus tremula		5.650
Fraxinus americana	20.460	
Tilia cordata	20.240	
Acer platanoides	17.650	
Acer pseudoplatanus	16.420	
Ulmus glabra	15.340	
Fagus sylvatica	7.900	4.891
Carpinus betulus	6.010	
Picea abies	4.220	1.890
Quercus petraea	3.940	4.891
Tilia pubescens	2.330	
Thuja plicata	1.900	678
Thuja occidentalis	1.530	929
Chamaecyparis lawsoniana	1.510	2.991
Taxus baccata	1.050	614
Pinus strobus	900	1.859
Juniperus sabina	680	2.066
Picea pungens	540	949
Abies concolor	470	794
Pinus nigra	340	
Pinus sylvestris		2.200
Abies alba	330	1.233
Betula pendula	250	8.724
Quercus robur	210	3.719
Quercus rubra		3.627
Quercus cerris		2.198

Pollution indicator flora, whether it is trees in parks, alignments and forests, ornamental shrubs in gardens and hedges, fruit trees, vines, vegetables and flowers in gardens, or weeds on the streets and roads, show symptoms of intoxication, which perpetuate and materialize the presence of toxins, transferring pollution from the theoretical level to the visible field.

In order to reduce pollution and the negative effects of pollution on green areas, it is necessary to make the population aware of the close correlation between the foliar symptoms of bioindicators, the high level of pollution and the negative effects of pollution on human health.

2. *FAGUS SYLVATICA* - SPECIES INDICATING ENVIRONMENTAL POLLUTION

The trees accumulate in the leaves, in addition to the mineral substances absorbed from the soil and the pollutants from the atmosphere, from the beginning of the vegetation season until the moment of sampling. Thus, the foliar analyzes give, depending on the climatic, pedological and biotic factors, a synthesis of the last vegetation season, in the case of deciduous or last years (those of one year, two years, three years, etc.), in the case of softwoods, concerning:

- nutritional status of trees (N, P, K, Ca, Mg, S, Mn, Fe, Cu, Zn, etc.) in relation to deficiency levels, critical or optimal;
- nutritional balance N, P, K;
- nutrition intensity;
- the synergistic, antagonistic or cumulative relationship between the mineral elements, such as N / S;
- metabolic capacity and toxicity threshold with S, Cl, F, Pb, Cu, Zn, Fe, etc .;

As bioindicators, the trees show on the leaves specific symptoms of malnutrition, when the nutrients descend to the level of deficiency at: N, P, K, Ca, Mg etc., or rise to the toxicity threshold with S, Cl, F, O3, Pb etc. .

These foliar symptoms indicate not only the toxic substance or the deficiency but also the intensity of the toxicity or deficiency process, which allows useful predictions to prevent the spread of adverse effects. Fagus sylvatica is one of the most representative species in the forests of western, central and southern Europe, being the most widespread species, especially in the mountains, but also in the hills.

As a bioindicator, beech clearly reveals, through specific foliar symptoms, the presence of sulfur dioxide, fluorine, chlorine, sodium, lead and nitrogen in the air.

Leaves elliptical to ovate, 5-10 cm long, acute at the apex, narrowed or rounded at the base, sinuous, denticulate edges show specific discolorations and necrosis:

-internervation in case of SO2 pollution;

-perimetric or marginal in case of FH pollution

Fig.1. Symptoms characteristic of SO2 pollution in beech

Fluoride enters the cells of the foliar parenchyma through stomata in the form of gas and initially inhibits the synthesis of foliar pigments.

Fluoride, absorbed at the surface of the leaves, is transported by the activity of parenchymal tissues to the edges or tip of the tongue which, intoxicated, chlorinate, necrosis and then die. Fluoride transported and stored at the ends and edges of the leaves produces a ripple.

Necrosis spreads from outside to inside, progressively during the growing season in proportion to its leaf content. Fluoride is revealed by leaves through small apical or marginal necrosis, which gradually spreads around the entire perimeter of the leaf.

Sulfur dioxide is indicated, from the beginning of summer, by internal yellowing, which gradually become obvious brown-reddish-blackish necrosis.

Fig. 2. Characteristic symptoms of beech fluoride pollution

Fluoride affects fundamental physiological processes, such as photosynthesis and respiration. Excess nitrogen from nitrogen oxides emitted by motor vehicles, thermal power plants and industry is manifested in the following symptoms:

-large leaves, infected primarily by lower fungi or bacteria and preferred by insects;

-dark green leaves with chlorosis and peripheral necrosis with chlorotic stripes between the dark green fibers (nitrates), or with necrosis on the entire surface of the leaf;

-abundant shoots.

Ozone arises from the reaction with oxygen of nitrogen oxides, emitted through the exhaust pipe. Ozone has the following symptoms specific to *Fagus sylvatica:* diffuse spots, light green, internervation and then staining of the entire leaf in light green or yellow-green, with tan shades on the top of the leaf. (Fig. 3)

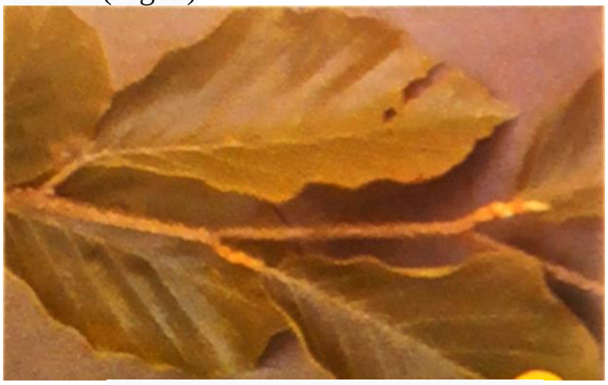

Fig.3 Characteristic symptoms of ozone pollution in beech

Penetrating leaves through the stomata, ozone alters the structure and permeability of plasma membranes and causes discoloration of palisade tissue. In the exterior of the leaf there are white dots with silver iridescence. In large quantities, ozone affects the enzymatic activity causing the loss of leaf turgidity and closure of the stomata.

This inhibits: photosynthesis, respiration and metabolism of carbohydrates, proteins and especially unsaturated fatty acids.

Excess manganese on acidic soils, the following symptoms on mature leaves: (fig.4)

• brown spots on leaves and brown spots on ribs through manganese dioxide deposits;

• the spots and points extend over the entire surface of the leaf, from the tip and from the periphery to its interior;

• leaf rolling.

Fig. 4. Characteristic symptoms of manganese pollution in beech

Lead is recognized after deposition on the leaf, in the form of narrow, purple strips along the ribs.(fig.5.)

Fig. 5.Characteristic symptoms of lead beech pollution

Lead compounds, like some of the components of exhaust gases, block enzymatic activity and disrupt cell divisin and cause a decrease in the content of organic acids in the roots. Lead blocks the absorption of microelements from the soil and inhibits seed germination and seedling growth.

2. CONCLUSIONS

- Pollution detection is done by simple observations of morphological changes or specific chlorosis and leaf necrosis caused very quickly by physiological disturbances.
- Bioindicators and bioaccumulators reveal with fidelity and consistency, through foliar analyzes the air quality and through the foliar symptoms as well as the effects of the toxins on the trees

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