INFLUENCE OF LEAD ON ORGANO-MINERAL COMPOSITION OF ROOTS, LEAVES AND FRUITS OF MORUS SP.

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Summary

The environment pollution with heavy metals (Pb, Hg, Co, Cu, Ni, Zn etc) is due mainly to the activity of humans.

High quantities of these metals can be toxic for all organisms. Still, some of them, called microelements, are necessary as components of enzymes or other proteins involved in major metabolic pathways.

The entry of heavy metals from the polluted environment in plants is influenced by different factors and stopped through several mechanisms. Their presence in plants can have effects on different physiological processes: photosynthesis, respiration, transpiration, cell membrane permeability, affecting even the whole process of plant growth (if they reach a certain concentration level).

Using heavy metal contaminated vegetal products in alimentation can have important effects on short or long terms, depending on the intensity and action period of the polluting factor.

This study is mainly aimed at highlighting the influence of physical-chemical properties of soil and their relationship with the morus root and translocation of nutrients absorbed by roots in other vegetative and generative organs.

To achieve this objective were collected and analyzed samples of roots, leaves and fruit.

Introduction

Soil contamination with heavy metals became a serious problem both in the high affected industrial areas and in the agriculture. This problem requires obligatory the remediation of polluted soils to keep healthy the environment.

Research conducted on the pollution / soil contamination with heavy metals showed several possibilities to remedy it is part and extraction of these metals in the soil by cultivating plants with high capacity to absorb pollutants including Morus sp.

As a result of pollution and high load of soil with heavy metals and increase awareness of their mobility in soil, plants absorb large quantities of these elements, plus deposit amount with existing polluted air particles on leaves, shoots, etc.

Hyper-accumulator plants, which have ability to extract high concentrations of metals in the soil in their tissues while retaining metabolic functions, are considered primary candidates for phytoremediation process. Plant species that are more efficient in the translocation of lead, should have rapid growth and produce large amounts of biomass while accumulating high concentrations of metal pollutants. It should also be tolerant enough to grow in contaminated soils and be resistant to the action of chelating agents.

The concept of using plants to clean up contaminated environments is not new. About 300 years ago, plants were proposed for use in the treatment of wastewater. At the end of the 19th century, *Thlaspi caerulescens* and *Viola calaminaria* were the first plant species documented to accumulate high levels of metals in leaves. In 1935, Byers reported that plants of the genus *Astragalus* were capable of accumulating up to 0.6 % selenium in dry shoot biomass. One decade later, Minguzzi and Vergnano identified plants able to accumulate up to 1% Ni in shoots. More recently, Rascio reported tolerance and high Zn accumulation in shoots of *Thlaspi caerulescens*.

The idea of using plants to extract metals from contaminated soil was reintroduced and developed by Utsunamyia and Chaney (1983), and the first field trial on Zn and Cd phytoextraction was conducted in 1991 (Baker et al.). In the last decade, extensive research has been conducted to investigate the biology of metal phytoextraction.

Despite significant success, our understanding of the plant mechanisms that allow metal extraction is still emerging. In addition, relevant applied aspects, such as the effect of agronomic practices on metal removal by plants are largely unknown. It is conceivable that maturation of phytoextraction into a commercial technology will ultimately depend on the elucidation of plant mechanisms and application of adequate agronomic practices. Natural occurrence of plant species capable of accumulating extraordinarily high metal levels makes the investigation of this process particularly interesting.

Literature studies have led to the recognition of plant root Morus sp. as essential components of ecosystem productivity and stability, being able to synthesize a remarkable diversity of secondary metabolites and to adjust their metabolic activities in response to abiotic stress factors. High biomass producing plant species, such as *Morus sp*., have potential for removing large amounts of trace metals by harvesting the aboveground biomass if sufficient metal concentrations in their biomass can be achieved.

An important characteristic of ecosystems is the Morus tree biomass production and longevity than their considerable (50-100 years), compared with annual or biennial plant ecosystems of spontaneous and cultivated flora present in the same biotype.

Perennial nature of the Morus tree in time lead to the formation of an environment and ecosystem in which plants are influencing each other.

Romania is situated in an area favorable for Morus culture; it is cultivated in all areas except the alpine and coniferous forest area.

Materials and methods

To highlight the influence of physico-chemical properties of soil in the root system of mulberry correlation with the process of translocation of lead ions and other nutrients absorbed by roots in vegetative and generative organs (leaves, fruit with seeds) used an experimental field was made from mulberry plants (Morus).

The field experiment was carried out on the ground that, after training the natural conditions (climate, rocks, terrain and vegetation) is the type of "brown-red soil" (according to Romanian Soil Classification System), which has changed due to human activity, has undergone changes of the Ao and Bt genetic horizons.

The establishment of plantation of mulberry (Morus) consisted of cleaning the soil to a depth of 50 cm leading to the formation of the sloppy Db horizon and the maintenance works that were performed frequently in the plantation, led to the emergence of the Ap horizon above the Db horizon.

Emphasizing the soil-plant relationship was conducted by collecting and analyzing a large number of samples of root material, leaves and fruit. In the samples was determined major nutrient content and heavy metal content. For major nutrients were determined concentrations of N-NO3-, N-total, P, S, K, Ca, Mg and heavy metals were determined concentrations of Zn, Cu, Fe, Mn, Pb, Ni, Cr, Co, and Cd. Analyses were performed using standard methods for each of the indicators determined by specific laboratory equipment.

The test results were interpreted in comparison with the content of macro and micronutrients provided by the soil.

Fig No.1 – Morus seedlings in vegetation after removal of the polyethylene film

Results and discussions

Major nutrient content in roots, leaves and fruits is presented in Table 1, highlighting their translocation to plant organs mentioned. In Table 2 are the results of tests on heavy metals content in the samples.

Table No. 1 – The content of major nutrients in soil relationship system - plant

No. sample	Nature sample	Sampling horizon	N – NO_3 ppm	N total %	P %	S ppm	K %	Ca %	Mg %
1	Root	Ap	150	0.88	0.08	222	1.38	0.62	0.31
2	Root	Db	100	0.85	0.08	206	1.47	0.58	0.27
3	Root	Bt	180	0.88	0.08	222	1.47	0.53	0.30
4	Leaf	-	-	2.42	0.23	373	0.99	2.48	0.45
5	Reference Values	-	400**	3*	0.7	1.000-5.000	3	3	0.7
6	Fruits	-	150	1.51	0.15	155	3.39	0.80	0.29
7	Reference Values	-	60x	3	0.7	1.000-5.000	3	3	0.7

(*) simple values D. Davidescu quotes, *Agrochemistry* – Romanian Academy Publishing - 1963
(**) values quoted from *Soil Studies Drafting Methodology* - ICPA – Bucharest - 1987
(x) values quoted from the Ministry of Health Order no. 975/1998

Table No. 2 – The content of heavy metals in soil relations system – plant

No sample	Sample nature	Soil horizon	Zn ppm	Cu ppm	Fe ppm	Mn ppm	Pb ppm	Ni ppm	Cr ppm	Co ppm	Cd ppm
1	Root	Ap	23,9	3,1	2282	69,3	3,8	10,0	3,0	1,67	0,23
2	Root	Db	15,0	2,2	1176	43,3	5,0	8,4	3,5	1,67	0,11
3	Root	Bt	18,3	2,1	1116	45,5	3,8	8,4	3,0	2,50	0,19
4	Leaf		24.2	3.9	-	30.5	9.1	10.6	2.1	10.0	0.43
5	Reference values*		20	7	400-1.300	30	3[**]	0.15-2.3	0.04-10	0.15	0.5[**]
6	Fruit sample 1 Fruit sample 2		20,8	2,9	271	22,4	**5,**0 **0,93**	**7,2** **1,6**	1,5	**2,92** **0,09**	0,16
7	Reference values		50[x]	0.05[x]	400-1.300	30	3[x]	0.15-2.3	0.04-10	0.15	0.5[x]

(*) simple values Davidescu quotes, D., *Agrochemistry* – Romanian Academy Publishing - 1963
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The physico-chemical analysis showed to supply organic matter and reflected the degree of mineralization of humus content and C / N. Thus, in the horizons investigated, Ap and Db, the humus content is low of 2.59 % and 2.05 % respectively, while the C / N varies in the normal type of soil from 11.4 to 12.3; the Bt horizon very low humus content is 1.02 % and C / N ratio indicates a sharp mineralization of organic matter with a value of 10.8.

Other natural soil properties that were investigated are:

- total cation exchange capacity denoted by TNH4 %, and degree of base saturation denoted by V%. It shows the following evolution:
- total cation exchange capacity increases from 12.92 % to 20.94 % from horizon worked to the Bt horizon on increasing the clay content, because the organic matter decreases with depth, however, it is small compared with the state investigated the depth of natural soil;
- the degree of saturation in the base-profile varies, but remains within natural boundaries for this type of soil, the minimum value being 76.8 %.

Tests conducted did not indicate significant changes in indicators of soil properties analyzed, except for total cation exchange capacity has fallen sharply, probably due to changes in bulk density. This indicator is particularly important in translocation of elements from soil to plant because it gives property called absorption capacity of soil (ACS).

Chemical analysis data on the supply of major nutrients and translocation, as presented in Table 1, shows that no root system are exceeded normal values for the elements analyzed: N-NO3, Nt, P, K, Ca, Mn, S, , Cr and Cd. In exchange for sample No. 1, according to data presented in Table 2, heavy metals are exceeded for Pb, Ni and Co from mulberry fruit, whether they existed or not exceeding the normal content in the soil.

Thus, Pb and Ni continues its evolution from the soil to overcome the strong, recording values of 5.0 ppm for Pb and 7.2 ppm Ni, while Fe, Zn, Mn and Co in the plant even exceed normal values soil if they qualify as normal. To verify the results obtained in the first sample and mulberry fruit were harvested from the same variety, but another parcel and to review the contents of Pb, Ni and Co, obtaining values below the maximum allowed by legislation for food and certain concentrations of 0.93 ppm for Pb, 1.6 ppm for Ni and 0.09 ppm respectively for Co. Because the soil is slightly acidic reaction to surface and deep neutral pH is not a growth factor that induces mobility elements, the results of the content in Pb, Co and Ni in sample 2 fruit being below the maximum allowed.

One can appreciate that without a well-developed and complex adsorption of this Bt horizon (low permeability), the transition elements in the soil solution is much easier and increase the absorption into the root. It is known that the root system forms a specific named properties microecosistem effect rhizosphere, where root secretions (organic acids) and activity of microorganisms favors the solubilization of poorly soluble elements and their absorption into the root, technology-arbusculare biofertilizer with vesicular mycorrhiza with beneficial effect in stimulating microbiological activity in the rhizosphere.

Translocation of mineral elements in plants is influenced among others by his age and vegetation period (phenophase) is well known that during the life of trees, in the youth, transport is favored by high permeability of the plasma membrane of the cell wall and insufficient development and change both how the annual cycle speed and direction of transport, such as growth in the shoots and leaves forming mineral elements are directed to the vegetative organs.

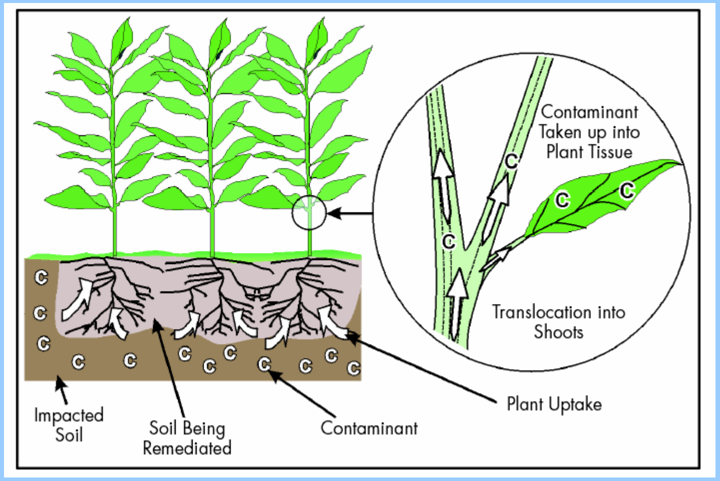

Fig No. 2 – Translocation of contaminants

Conclusions

- In the category of heavy metals, enter a number of chemicals with high toxicity for living organisms. Toxic effect occurs in overcoming a threshold below which some may even be essential components of proteins involved in different metabolic pathways.

- To emphasize the soil-plant relationship were collected and analyzed samples of root, leaves and fruit, the results were compared with macro-and microelements content provided by soil. The root system is not normal values are exceeded for the following items considered: N-NO3, Nt, P, K, Ca, Mn, S, Cu, Cr and Cd. In contrast to other heavy metals are exceeded for Pb, Ni and Co at the morus fruits.

- Translocation of mineral elements in plants is influenced among others by his age and vegetation period (phenophase) is well known that during the life of trees, in the youth, transport is favored by high permeability of the plasma membrane and cell wall development failure.

- Pb content in different organs of plants tends to decline in the following order: roots> leaves> stem> inflorescence> seeds.

- Crops raised on such lands will not be used for human food or animal, but only in order to decontaminate the soil.

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Thank you very much for your attention.