Vegetable Bioindicators of Heavy Metal Pollution

Monica Butnariu*

Chemistry and Vegetal Biochemistry, Banat’s University of Agricultural Sciences and Veterinary Medicine from Timisoara, Romania

Vegetable bio indicators define the term and characterize the plant species tested experimentally.

After realizing the danger of heavy metals pollution and the consequences on the ecosystems that sustain life on the planet, new ways of controlling and monitoring these pollution had to be found, besides the instrumental ones.

This indicates that of these surveillance is to detect possible functional and composition modifications of biological systems, also, followed by registering the reactions and the responses to the environmental changes [1].

This monitoring system through plants, named biological monitoring, can replace or complement the instrumental one, being much less expensive especially when big areas are monitored. The advantage of bio-monitoring system compared with instrumental one, comes from the fact that can provide information’s about the variations in time, the accumulation and the interaction of some abiotic factors and the response of the living organisms at the individual or group levels, to the changes in the environment [2].

The biological indicators are species, polluting agents or groups of species which due to their biochemical, physiological, ethological and ecological variations can allow the characterization of an ecosystem and bring to light as early as possible, natural and anthrop cal modifications of the studied ecosystem.

In case of heavy metals pollution the bio indicators can be:
- sensitive species, which indicate the pollution agents presence by injuries and malformations;
- the accumulating species, which deposits the heavy metals in their body;
- Species which can divide and proliferate in the polluting areas.

The vegetable bio indicators can offer answers to the combined effect of some heavy metals (comparing with instrumental system which can monitor one at each time) and can provide information’s about tissue analysis about small quantities of polluting agents and also the evolution in time of this agent [3].

The vegetable bio indicators can be classified in 2 groups:
- Introductive species, with accelerated growth, genetically uniform and are called “guarding species”. Their utilization is named–active bio monitoring. They respond immediately when concentration increases and are used for early heavy metal presence signalling.
- Species which grow only in some areas, perennial species of trees, slowly growing and with slow motion reaction to the polluting agent. They are named–detector species-because the effects of the pollution are seen late in the development. The method is called passive bio monitoring.

The guarding species have a rapid reaction in the early stages of development. For this reason they have to be periodically introduced and also cultivated in normal conditions as control samples [4].

The soil resistance to polluting agents like heavy metals depends on the stopper capacity. The soils with higher adsorption capacity (high content of clay and organic matter) retain these elements in the superior horizons. In these soils the toxic compound content of heavy metal which can be adsorbed by the plants or washed in the underground waters is much higher in the acid or dusty soils [5-7].

The dusty soils have a weak retention capacity for the majority of heavy metals. Each of this heavy metal penetrates the tropics chain and is subjected to specific processes. In the tropics circle the heavy metals encounter different biological barriers, due to which a bio selective accumulation takes place focused on organism protection against these elements. The biological barriers effects still limited, because in most cases a high concentration and accumulation can be observed [8-11].

To prevent these toxic effects of heavy metals accumulation some steps can be taken:
- blocking the heavy metals in the soil by adjusting the pH around 6.5 value (the majority of metals are insoluble at this stage except Mo) with amendment;
- deep plough by which clean soil is brought to the surface, and the combination of these with superficial layer can lead to heavy metal content reduction;
- elimination of the soil polluted layer;
- addition of some compound which can inactivate or precipitated the heavy metal content;
- bioremediation by cultivation with tolerant plant species which are not used for food production;
- cultivation of species which have a lower consummation for metals;
- recalculations of the compound dosage used to maintain soil fertility/

As a result of performed determination we can say that the heavy metals content in the soils is much higher than the maximum limit, but polluted areas were not pointed out 12].

The bio indicators can open a new and large research field,
regarding the heavy metal pollution. This kind of research is much more convenient than instrumental monitoring, but there are still more to be to clarify and optimal monitoring methods for the environment to be found. Also its necessary to develop efficient steps for environment protection and for biodiversity conservation If we consider the budget problems with which all countries is confronted these days and other problems, the bio monitoring programs is for sure a successful and interesting alternative to classical methods.

References
1. Käffer MI, Lemos AT, Apel MA, Rocha JV, Martins SM, et al. (2012) Use of bioindicators to evaluate air quality and genotoxic compounds in an urban environment in Southern Brazil. Environmental Pollution 163: 24-31.
2. Essumang DK, Adokoh CK, Boamponsem L (2010) Levels of platinum group metals in selected species (Sarotherodon melanotheron, Chonophorus lateristriga, Macrobrachium vollenhovenii and Crassostrea tulipa) in some estuaries and lagoons along the coast of Ghana. Scientific World Journal 10: 1971-87.
3. Krystofova O, Shestivska V, Galiova M, Novotny K, Kaiser J, et al. (2009) Sunflower Plants as Bioindicators of Environmental Pollution with Lead (II) Ions. Sensors (Basel) 9: 5040-58.
4. Sanders AP, Flood K, Chiang S, Herring AH, Wolf L, et al. (2012) Towards prenatal biomonitoring in North Carolina: assessing arsenic, cadmium, mercury, and lead levels in pregnant women. Public Library of Science 7: e31354.
5. Amado-Filho GM, Salgado LT, Rebelo MF, Rezende CE, Karez CS, et al. (2008) Heavy metals in benthic organisms from Todos os Santos Bay, Brazil. Brazilian Journal of Biology 68: 96-100.
6. Wolff G, Pereira GC, Castro EM, Louzada J, Coelho FF (2012) The use of Salvinia auriculata as a bioindicator in aquatic ecosystems: biomass and structure dependent on the cadmium concentration. Brazilian Journal of Biology 72: 71-7.
7. Cheng Q, Wang W, Wang H, Wang, Zhao Z (2012) Investigation of the heavy metal contamination of the sediments from the yellow river wetland nature reserve of zhengzhou, china. Iranian Journal of Public Health 41:26-35.
8. Chen Y, Li TQ, Han X, Ding ZL, Yang XE, et al. (2012) Cadmium accumulation in different pakchoi cultivars and screening for pollution-safe cultivars. Journal of Zhejiang University Science B Zhejiang da xue 13: 494-502.
9. Malizia D, Giuliano A, Ortaggi G, Masotti A (2012) Common plants as alternative analytical tools to monitor heavy metals in soil. Chemistry Central Journal 2: 56.
10. Bhargava A, Carmona FF, Bhargava M, Srivastava S (2012) Approaches for enhanced phytoextraction of heavy metals. Journal of environmental management 105: 103-20.
11. Lo Gullo MA, Glatzel G, Devkota M, Raimondo F, Trifiló P, et al. (2012) Mistletoes and mutant albino shoots on woody plants as mineral nutrient traps. Annales botanici 109: 1101-9.
12. Wu C, Ye Z, Li H, Wu S, Deng D, et al. (2012) Do radial oxygen loss and external aeration affect iron plaque formation and arsenic accumulation and speciation in rice? Journal of experimental botany 63: 2961-70.