

## **Abstract**

Heavy metal contamination significantly reduces crop yields, causing serious problems in agriculture and having a major impact on human health if these contaminants enter the food chain. Understanding the mechanisms of plant responses could help to increase their resistance to heavy metals as well as their potential use in phytoremediation. Carbohydrates play an important role in plant growth and development as well as in defense reactions. This work summarizes the results of four publications focused on the effects of arsenic and thorium on antioxidant mechanisms in tobacco plants and horseradish root crops. Attention is paid, among other things, to the dynamics of sugar contents, which are potentially important molecules involved in the fight against oxidative stress.

The first publication summarizes arsenic effects on plant physiological parameters, focusing on arsenic tolerance-enhancing mechanisms as well as summarizing the ability of plants to cope with arsenic-induced oxidative and nitrosative stress. Emphasis was placed on, among other things, a topic that was unjustly neglected in previous publications – i.e. carbohydrate metabolism. Further work was already experimental and dealt with the study of arsenic as a trigger of oxidative stress in the root culture of horseradish and characterization of the involvement of the various parts of the antioxidant system. Attention was paid to the role of carbohydrates in reducing arsenic side effects. Our results have shown that horseradish can maintain stable carbohydrate levels even at high arsenic concentrations, which, together with an effective antioxidant system, help this culture fight oxidative stress. Carbohydrates are also likely to be an integral part of defensive responses in the resistant *Nicotiana tabacum* genotype. cv. 'Wisconsin' when exposed to arsenic. In contrast, *N. sylvestris* susceptible tobacco genotype failed to maintain stable carbohydrate metabolism at higher arsenic concentrations. Our third publication deals with the comparison of responses of sensitive and tolerant tobacco to arsenic. It shows how essential it is for a plant to maintain its robust carbohydrate metabolism together with the early involvement of antioxidant mechanisms and especially in the right organs / tissues or at the correct site. The last work dealt with radioactive heavy metal - thorium and possible increase in its accumulation in hydroponically grown *Nicotiana glutinosa*. Exogenously applied putrescine has been shown to have a promising potential to increase thorium accumulation in tobacco shoots. Likewise, a lack of phosphate promotes thorium intake. In contrast, tartaric acid, also applied exogenously, had no effect on thorium intake.

**Keywords:** arsenic, reactive oxygen species, oxidative stress, carbohydrates, thorium, tobacco, hairy roots, horseradish