ABSTRACT

„Effect of cadmium and zinc on physicochemical and biochemical properties of roots and cell walls of *Apiaceae* L. plants"

Soil acidity is important factor that increases heavy metals mobility, which in turn can increase their bioaccumulation in plants. The resistance to environmental stress, including heavy metals toxicity markedly vary among different plants. The explanation of plants reaction on the stress and mechanisms determining their resistance has been up to date a focus of intensive research. However, very little is known on the effects of heavy metals on physicochemical properties of roots. Also we found no literature results on heavy metals influence on physicochemical behavior of the root's cell wall. We hypothesized that especially pectins playing a crucial role in determining the physicochemical properties of the cell wall will be stress sensitive.

To explain the above processes the effect of phytotoxic concentrations of zinc (micronutrient) and cadmium (ballast element) on roots and cell walls of two plant species (parsnip and celery) was studied. Both stressors are among the group of heavy metals with a high degree of potential environmental contamination. Changes in physicochemical, chemical, biochemical and morphometric properties were analyzed.

It was demonstrated that the structure of pectins, the degree of esterification and PME activity in the cell walls of both tested species changed in different way under the applied stresses. The observed changes in cell wall pectins had an undoubted impact on the cell walls properties, which in turn resulted in changes of the roots physicochemical properties.

Two main quantities: apparent specific surface area (S) and cation exchange capacity (CEC) are used in physiology and plant physical chemistry to describe the ability of the roots to collect water and cations were determined basing on water vapor adsorption isotherms and back-titration curves. Additionally surface charge density (SCD), total variable surface charge and average value of apparent surface dissociation constants were calculated.

The above physicochemical quantities for roots of both plants decreased under the stresses. The same behavior was noted for root cell walls of the celery, however for the parsnip's they increased, which was correlated with modification of cell wall pectin of this plant.

Changes in the cell walls occurring under the stress affected to a large extent the parameters characterizing the ion binding capacity of the whole roots. Despite the physicochemical parameters of the celery cell walls and roots were largely correlated with the observed modi-

fications of roots cell wall pectins, most probably, the pectins do not directly govern physicochemical properties of the cell walls and of the roots, which is seen for the parsnip roots. The effect of pectins on cell walls and roots physicochemical parameters can depend on the genetic determinants of plants.

The results obtained in this paper can provide valuable information on plant response to stress and also on physical chemistry of plants. Physicochemical studies of cell walls physicochemistry in relation to the pectins content and quality presented in this paper for the first time, may open a field of a further studies on plant response on environmental stresses.

The results reaffirmed a hypothesis that was adopted at the beginning of these studies, that changes in the morphological, biochemical and physiological properties occurring in the roots under the influence of stressors are related to changes in physicochemical properties of roots surface, and that these changes shell correlate with the modification of pectin cell walls.

Keywords: root, cell wall, pectin, DM, PME, surface area, CEC, surface charge density, cadmium, zinc