PLANT RESPONSES TO HEAVY METALS STRESS

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In the last years, human activities have contributed enormously to the environmental pollution by allowing the uncontrolled increment of waste products in the atmosphere and soil. Heavy metals, like cadmium and copper, are directly implicated in the generation of oxidative stress in the plant-surrounding environment. Cadmium is one of the major industrial pollutants that show phytotoxicity even at low doses, inhibiting growth and causing plant death. On the other hand, copper is an essential element for plants, but it is strongly phytotoxic at high concentrations. Both metals induce oxidative damage to different plant species, like sunflower, maize or wheat, though to different extents depending to the tissues or organs and the exposure time. This effect is evidenced by an increase in lipid and protein oxidation due to an alteration of the activity of some of the antioxidant enzymes like ascorbate peroxidase, superoxide dismutase or catalase, or the modification of glutathione levels or chlorophyll content. Catalase is one of the proteins that modify its expression under cadmium stress in sunflower plants. Although CAT protein abundance remained similar to control in Cd-treated seedlings, the metal produced CAT protein oxidation, indicating that the mechanism of CAT inactivation by Cd^{2+} involves oxidation of the protein structure. Both cadmium and copper have shown to alter the proteasome system through oxidative modification of the proteasome itself, which prevents accumulation of oxidatively damaged proteins in the cell. However, under severe Cd stress, sunflower proteasome activity is reduced and this results in accumulation of oxidized proteins. Both metals also have an effect on the metabolism of important nitrogen compounds, as polyamines or nitric oxide, modifying the relationship between these essential compounds and, consequently, plant development. Data related to the involvement of particular aspects of nitrogen metabolism and/or the oxidative status of the cell with plant growth will be presented and discussed.