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Oxidative stress as a response to salinity and aluminum

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Reactive oxygen species (ROS), such as the superoxide radicals and hydrogen peroxide, are formed in processes involving electron transfer. In plants, ROS are generated in many cellular compartments, especially in the chloroplasts, mitochondria, and peroxisomes. In legume root nodules, ROS are also produced at high rates during bacteroid respiration. Under physiological conditions, plants are endowed with a great variety and quantity of antioxidant enzymes and metabolites to keep ROS concentrations under tight control. This is important to avoid the potential toxicity of ROS while allowing them to perform useful functions in growth, development and stress signaling. However, in plants exposed to several types of abiotic and biotic stress, an excess of ROS production and/or a decrease in antioxidant protection may lead to oxidative stress. This situation can be diagnosed by the accumulation in plant cells of lipid peroxides and oxidatively-modified proteins, among other biochemical markers. In this talk, I will review what is known on the ensuing of oxidative stress in plants exposed to salt and aluminum stress, with an emphasis on legumes. A summary of main conclusions follows. *Salt stress* causes reduction in plant growth and photosynthesis, and increases of Na and proline (but decreases in K and Ca) in plant tissues. Salinity also leads to increases in the activities of antioxidant enzymes [superoxide dismutases (SOD), ascorbate-glutathione pathway], in the production of ROS, and in the contents of lipid peroxides and oxidized proteins. It is concluded that the there is an integrative effect of salt stress (NaCl concentration x duration of treatment), probably related to the Na concentration in tissues. It is also propose that this parameter, together with proline, lipid peroxidation, and the antioxidant enzymes SOD and dehydroascorbate reductase, are good markers for salt stress tolerance/sensitivity. *Aluminum* is a nonessential metal that causes toxicity to plants in acid soils, where the metal is highly mobile. Very little is known about the effects of Al on the antioxidant systems of plants, and most data are restricted to roots. Also, there are variable results depending on the experimental protocol, plant species, and plant age. A main and general effect of Al (at micromolar levels) is the rapid inhibition of root growth, but treatment of plants with Al also causes an accumulation of lipid peroxides in tissues, which is indicative of oxidative stress. However, much more work will be needed to ascertain whether the toxicity of Al is due, at least in part, to oxidative damage of cellular components and to determine the effects of this metal on antioxidant systems and ROS production.