**The physiological network regulating sulfite detoxification in plants**

Project description

Previously, we have discovered the enzyme sulfite oxidase (SO) in plants, cloned its gene, and provided knowledge about its biochemistry (atomic structure, spectroscopy, reaction mechanism), localization and function. The substrate of SO - sulfite - is highly reactive and highly toxic for the plant cell. Sulfite can be produced endogenously during sulfur metabolism and can also derive from external sources like the air pollutant sulfur dioxide. We showed that SO is essential for detoxifying excessive amounts of sulfite (safety-valve function) in *Arabidopsis* and poplar. The aim of the present project is (a) to analyze transcriptional and posttranslational regulation of SO-activity and (b) to decipher further basic metabolic functions of SO. For transcriptional regulation specific transcription factors for activation/inactivation of the SO promoter are of particular importance: specific DNA-binding-sites strongly suggest a control by RAV1. Moreover, posttranslational modifications of SO protein (SUMOylation, ubiquitinilation and phosphorylation) will be studied. RNAseq will help to clarify the function of SO for catabolic degradation of reduced sulfur compounds, and indicate other pathways influenced by SO2 treatment or knock-out of SO gene function. So far, mRNA deep-sequencing revealed a second sulfite detoxification mechanism in plants: Apoplastic peroxidase also known from work of Pfanz and colleagues (1990). Induction of the apoplastic peroxidases by SO2 in SO-KO plants indicates independent apoplastic and symplastic detoxification mechanisms. We have to investigate the apoplastic peroxidases on molecular, cell-biological and biochemical level (reaction mechanism for sulfite detoxification) and plan to study the importance of these apoplastic peroxidases and their co-regulation with peroxisomal SO. In addition, we intend to study plant adaptations to increased levels of SO2 both, in natural habitats and in controlled fumigation experiments to decipher the threshold level of SO2 for different plant species below which SO2 is still beneficial as gaseous nutrient and beyond which SO2 becomes toxic. We plan to collect plant material at Volcano Island (Aeolian Archipelago, Italy) known for SO2-concentration in the µL L-1-level. We want to answer the question, how do plants react to higher SO2-concentrations in natural environments. Do we find a long-term adaptation of plants to SO2 achieved in nature by higher SO protein amounts (transcriptional or post-transcriptional modification) or by an adapted post-translational regulation.

Contact:

Prof. Dr. Heinz Rennenberg

Phone: +49 761 203 8300 / 8303

Email: [heinz.rennenberg@ctp.uni-freiburg.de](mailto:heinz.rennenberg@ctp.uni-freiburg.de)

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Project leader:

Heinz Rennenberg

Chair of Tree Physiology

Institute of Forest Sciences

Georges-Köhler-Allee 53/54

79110 Freiburg i. Br., Germany

Phone: +49 (0)761 203 8300

Fax: +49 (0)761 203 8302

Email: [heinz.rennenberg@ctp.uni-freiburg.de](mailto:heinz.rennenberg@ctp.uni-freiburg.de)