Abiotic stress occurs when plants are exposed to high concentrations of sulfur dioxide (SO_2) and its derivative sulfite. Physiological studies suggested sulfite oxidase (SO) as one important component of SO_2 detoxification. However, it is unknown to which extend plant fumigation with SO_2 triggers a specific transcriptional response. To address this question, we compared Arabidopsis wildtype (WT) and SO knock-out lines (SO-KO) facing the impact of 600 nL L^{-1} SO_2 using RNAseq to quantify absolute transcript abundances. These transcriptome data were correlated to sulfur metabolism related enzyme activities and metabolites obtained from the same samples in a physiological study. SO-KO plants showed first symptoms of leaf injury after fumigation that were not detectable in fumigated WT plants. Analogously, SO-KO exhibited remarkable and broad regulative responses at the mRNA level, especially in transcripts related to sulfur metabolism enzymes but also of those related to stress response and senescence. Our data provide evidence for a highly specific co-regulation between SO and sulfur related enzymes like APS reductase. Moreover, we could show that beside of SO a new player comes into business – apoplastic peroxidase (PRX). PRXs known from work of Pfanz and colleagues in the early 1990ies are able to detoxify sulfite. We could show that under SO_2-fumigation the mRNA of *prxcb* is 5fold up-regulated. This result implies that sulfite detoxification is of exceptional importance so that the plants have evolved a complex network of mechanisms and enzymes for controlling its level including regulation of stomata, generation of enzymes like SO and PRX for direct oxidation and use of the sulfur assimilation pathway for reductive detoxification.

12) The arbuscular mycorrhizal symbiosis influences sulfur starvation responses of *Medicago truncatula*

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Arbuscular mycorrhizal (AM) symbiosis is a mutualistic interaction that occurs between most vascular plants and fungi of the phylum Glomeromycota. The main benefit for both organisms in this relationship is an exchange of nutrients to the plant in return for plant-derived carbohydrates. In the past, the primary focus has been on mycorrhizal phosphate transfer, mainly because low phosphate concentrations in soils are often the main growth-limiting factor and known to be necessary to establish symbiosis. Evidence for symbiotic uptake pathways for additional nutrients emerged from the recent identification of a number of other nutrient transporter genes, which are also specifically expressed or induced in mycorrhized roots. In this study we were interested whether *in vivo* sulfate supply from the fungus to the plant does occur under conditions of sulfate starvation in addition to a mild phosphate starvation. Sulfur starvation leads to typical S starvation phenotype in *Medicago truncatula* Gaertn. with reduced thiol, protein and chlorophyll contents and consequently a reduced biomass in *M. truncatula*.

We investigated whether mycorrhizal colonization by the fungus *Rhizophagus irregularis* (previously termed *Glomus intraradices*) influences leaf metabolite composition and the expression of sulfur starvation-related genes when applying different sulfur and phosphate fertilization treatments to *M. truncatula*.

Single amino acids, as well as S-containing metabolites and ions, were analyzed in shoots of mycorrhized and non-mycorrhized plants grown under S starvation (−S) and S repletion (+S) as well as in plants fertilised with 1 mM phosphate (+P), which represents a mild phosphate starvation, and plants grown under strong phosphate starvation (−P). Primary metabolites of the S assimilation pathway like cysteine, methionine, glutathione, gamma-glutamylcysteine, sulfite, and also total protein content were correlated to the sulfate content in shoots. All metabolites displayed strong reductions under −S conditions which were slightly alleviated by mycorrhiza formation. This mainly resulted in increased biomass as additional sulfate was converted into growth. Leaf metabolite concentrations clearly showed that phosphate starvation has a greater impact than sulfur starvation on plant metabolism, with no demand for sulfur at strong phosphate starvation. However, when phosphate nutrition is high enough, mycorrhizal colonization reduces sulfur stress responses, as a result of symbiotic sulfur uptake.

We made use of a two-compartment system in which the plant's roots (in one compartment) were restricted to grow into a compartment, which only the fungus could reach. Application of ^{35}S to this "fungal compartment", confirmed that sulfate was taken up by the fungal hyphae and transported to the plant detected as radioactivity in the plant's leaves.

Similar to other plant species, sulfate deprivation also leads to the induction of sulfate transporters in *M. truncatula*. In this study nine putative sulfate transporter genes, which correspond well to the known classifications in other species were identified in *M. truncatula*. We also investigated mRNA accumulation levels in leaves and roots of mycorrhized and non-mycorrhized plants grown under the two different S concentrations (+S and −S) and at 1mM phosphate. Sulfur starvation leads to the induction of sulfur starvation-related genes and the myccorhizal provision of sulfate resulted in a less strong induction of these genes. Thus, the transcripts of marker genes of the S-assimilation pathway, adenosine-5′-phosphosulfate reductase (APR), and of the OAS-cluster gene of the ChaC-like protein were highly induced under sulfate starvation in sulfur starved non-mycorrhized plants while the induction level was lower in sulfur starved mycorrhized plants. It has to be noted that no additional sulfate source was provided but fungal hyphae mobilized sulfate more efficiently from the substrate than plant roots.

In this study we could show that mycorrhizal colonization of sulfur starved plants led to an increased accumulation of biomass and a shift in the metabolite pattern in the direction of that of sulfur-replete plants. We can assume that mycorrhizal colonization is able to reduce sulfur starvation responses in *M. truncatula*. This demonstrated the importance of mycorrhizal sulfur uptake for plant metabolism, when the plant's phosphate status is high enough for the plant to benefit from increased sulfate nutrition.

13) Compartment-specific changes in glutathione and ascorbate levels during high light stress in Arabidopsis

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Excess light conditions represent a potential danger to the plant as it can lead to the accumulation of reactive oxygen species (ROS) in chloroplasts by overstraining the electron transport chain during photosynthesis and of hydrogen peroxide (H_2O_2) in peroxisomes as a result of glycolate oxidation in the photorespiratory pathway. If not detoxified ROS can leak into the