Sulfur supply improves tomato pathogen resistance

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Abstract

Vascular wilt caused by the soil-borne fungus *Verticillium dahliae* (*V. dahliae*) is a major yield and quality-limiting disease in many crop plants worldwide. Sulfur (S)-enhanced defense (SED) may effectively and environmentally safely constrain wilt disease levels *in planta*. To evaluate the influence of S nutrition on the protective potential of SED mechanisms, two near-isogenic tomato genotypes differing in fungal susceptibility, were treated with low or supra-optimal S supply. Microscopy revealed a significant S-induced decrease in the amount of infected vascular cells in both genotypes. Physiological analyses demonstrated a significant influence on S-containing defense compounds and suggest protective sugar-sensing mechanisms. An absolute qRT-PCR method using species-specific primer was developed for the sensitive measurement of S-induced changes in fungal colonization patterns. High S nutrition had a significant fungicidal effect resulting in reduced fungal spread in the stem of both tomato genotypes. A spatial analysis of the expression of genes which might play a role in SED mechanisms was performed. Laser-microdissection combined with relative qRT-PCR showed a vascular tissue-derived gene-expression in the resistant tomato genotype as affected by fungus and S supply. Genes involved in glutathione and cysteine synthesis were tissue-specific down or upregulated, respectively. This indicates a vascular bundle-localized role of cysteine synthesis-related steps in *V. dahliae*-induced SED mechanisms of tomato. Thus, cysteine seems to be the key player in S-enhanced resistance of tomato against *V. dahliae.*