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Isoprene biosynthesis in hybrid poplar impacts ozone tolerance

K. Behnke (1), E. Kleist (2), R. Uerlings (2), J. Wildt (2), H. Rennenberg (3), and J. P. Schnitzler (1)

(1) Research Centre Karlsruhe, Institute for Meteorology and Climate Research, 82467 Garmisch-Partenkirchen, Germany, (2) Forschungszentrum Jülich, ICG-3: Institute Phytosphere, 52425 Jülich, Germany (j.wildt@fz-juelich.de), (3) Institute for Forest Botany and Tree Physiology, Albert-Ludwigs-University Freiburg, 79110 Freiburg, Germany

Isoprene is the most abundant volatile compound emitted by vegetation. It influences air chemistry and is thought to take part in plant defense reactions against abiotic stress such as high temperature or ozone. However, whether or not isoprene emission interacts with ozone tolerance of plants is still in discussion. We exploited transgenic non-isoprene emitting Grey poplar (Populus x canescens) in a biochemical and physiological model study to investigate the effect of acute ozone stress on the elicitation of defense-related emissions of plant volatiles, photosynthesis and the antioxidative system. We recorded that non-isoprene emitting poplars are more resistant to ozone as indicated by less damaged leaf area and higher assimilation rates compared to ozone-exposed wild type plants. The integral of green leaf volatile (GLV) emissions was different between the two poplar phenotypes and a reliable early marker for subsequent leaf damage. For other stress-induced volatiles like mono-, homo-, and sesquiterpenes, and methyl salicylate similar time profiles, pattern and emission intensities were observed in both transgenic and wild type plants. However, un-stressed non-isoprene emitting poplars are characterized by elevated levels of ascorbate and -tocopherol as well as a more effective de-epoxidation ratio of xanthophylls than in wild type plants. Since ozone quenching properties of ascorbate are much higher than those of isoprene and furthermore -tocopherol also is an essential antioxidant, non-isoprene emitting poplars might benefit from changes within the antioxidative system by providing them with enhanced ozone tolerance.