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Emission of aromatic compounds from poplar

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While unstressed grey poplar (*Populus* x *canescens*) emits mainly isoprene, plants infested with *Pollaccia radiosa* showed strong additional emissions of green leaf volatiles (GLV), terpenoids (mono-, sesqui- and homoterpenes), and aromatic compounds. To obtain more information regarding the mechanisms of stress-induced emissions of aromatic compounds we tried to mimic *Pollaccia radiosa* infestation by ozone- (O_3) or methyl jasmonate- (MeJA) exposures.

Exposing poplar plants to MeJA resulted in strong emissions of terpenoids. Contrary, emissions of aromatic compounds and GLV were low if detectable at all. For O_3 exposures the plants' responses were dependent on O_3 flux densities ($\Phi(O_3)$). O_3 exposures at $\Phi(O_3) \quad < 50$ nmolm^{-2}s^{-1} for up to 90 to 100 minutes did not induce strong GLV emissions but induced a strong release of aromatic compounds. The pattern of aromatic compounds was dominated by methyl salicylate emission and the emission strengths of reduced carbon reached several percent of the carbon uptake via net CO_2 assimilation. Labeling of the emitted volatiles during $^{13}CO_2$ application proved the *de novo* biosynthesis of stress induced emissions of terpenoids and aromatic compounds.

During experiments at $\Phi(O_3) \quad <$ 50 nmolm^{-2}s^{-1} the emission patterns of aromatic compounds differed markedly from those observed following infection by *Pollaccia radiosa*. Enforcing O_3 exposures to levels inducing GLV emissions ($\Phi(O_3)$ up to 200 nmol m^{-2} s^{-1}) led to emission patterns of aromatic compounds, similar to those found after fungal infection. The emission strengths measured for aromatic compounds emitted after such acute ozone stresses were much lower than those found at lower $\Phi(O_3)$. From this observation we presumed that ozone induced membrane-degradation and the resulting formation of jasmonic acid (JA) suppresses the emissions of aromatic compounds from poplar.

Indeed, the ozone-induced emission of aromatic compounds from poplar, namely methyl salicylate, could be suppressed when applying MeJA ($<$ 0.5 ppb) to ozone stressed plants. In parallel the emission pattern of aromatic compounds shifted from a methyl salicylate dominated emission to an emission pattern with indole as main aromatic compound. This switch indicates a strong cross talk between jasmonic acid and shikimate pathway-related biosynthesis of volatile aromatic compounds.

Here we show that oxidative stress to poplar, below the threshold of membrane oxidation can induce a strong *de novo* production of volatile aromatic compounds requiring several percent of intrinsic net CO_2 assimilation. However, the increase of oxidative stress to a level resulting in membrane degradation and accumulation of jasmonic acid diminished the carbon costs for volatile aromatic compounds and increased the carbon costs for terpenoids.