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BVOC emissions of Quercus robur L. induced by Tortrix viridana L. differs between susceptible and tolerant trees to insect defoliation

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Defoliation of oaks by insect feeding is an urgent problem for forestry in Central Europe. During the last outbreak of the green oak leaf roller moths (Tortrix viridana L.) in 2003-2005, fundamental differences in the defoliation level of individual Quercus robur L. trees in Germany were observed. Some of the trees seem to be somehow "tolerant" (T oaks) against the insects grub while some seem to be conspicuously "susceptible" (S oaks). We aim to identify the underlying molecular and biochemical mechanisms in oaks responsible for the behavioral preference of Tortrix viridana.
We hypothesized that BVOC emission can play an important role in defense/ susceptibility of Oaks, thus we performed enclosed cuvette experiments before and after feeding plants with caterpillars of moths, followed by feeding choice experiments of adult moth females.

We found that the two T and S oak phenotypes emit different quantity of mono- and sesqui- terpene. In particularly S oaks can emit significant higher amount of (E)-β-ocimene, β-myrcene, linalool, (E)-4,8-dimethyl-1,3,7-nonatriene (DMNT) and (E,E)-α-farnesene after being fed with the caterpillar of Tortrix viridana. Constitutively low-emitted monoterpenes were not significantly different in plants before insects feeding. Also, biochemical analysis show higher monoterpene synthase (monoTPS) activities of β-myrcene, linalool and (E)-β-ocimene in S oaks than T oaks after insect feeding, with a systemic response of the entire tree leaves, but enhanced on the same leaf which was directly damaged. Finally, olfactometer experiments reveal that 89% of adult female moths chose S oaks.

Thus, our results suggest that the ability of S oaks to enhance specific BVOC emissions was the key element of attracting the pest Tortrix viridana.