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Nicotiana tabacum as model for ozone - plant surface reactions

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Elevated tropospheric ozone concentrations are considered a toxic threat to plants, responsible for global crop losses with associated economic costs of several billion dollars per year. The ensuing injuries have been related to the uptake of ozone through the stomatal pores and oxidative effects damaging the internal leaf tissue. A striking question of current research is the environment and plant specific partitioning of ozone loss between gas phase, stomatal or plant surface sink terms.

Here we show results from ozone fumigation experiments using various *Nicotiana Tabacum* varieties, whose surfaces are covered with different amounts of unsaturated diterpenoids exuded by their glandular trichomes. Exposure to elevated ozone levels (50 to 150 $ppbv$) for 5 to 15 hours in an exceptionally clean cuvette system did neither result in a reduction of photosynthesis nor caused any visible leaf damage. Both these ozone induced stress effects have been observed previously in ozone fumigation experiments with the ozone sensitive tobacco line *Bel-W3*.

In our case ozone fumigation was accompanied by a continuous release of oxygenated volatile organic compounds, which could be clearly associated to their condensed phase precursors for the first time. Gas phase reactions of ozone were avoided by choosing a high enough gas exchange rate of the plant cuvette system. In the case of the *Ambalema* variety, that is known to exude only the diterpenoid cis-abienol, ozone fumigation experiments yield the volatiles formaldehyde and methyl vinyl ketone (MVK). The latter could be unequivocally separated from isomeric methacrolein (MACR) by the aid of a Selective Reagent Ion Time-of-Flight Mass Spectrometer (SRI-ToF-MS), which was switched every six minutes from H_3O^+ to NO^+ primary ion mode and vice versa.

Consistent with the picture of an ozone protection mechanism caused by reactive diterpenoids at the leaf surface are the results from dark-light experiments. The ozone loss obtained from the difference of ozone measured before and after the plant cuvette was investigated as a function of stomatal opening. Switching from dark to light conditions and thus opening the stomata only a small increase in ozone loss was observed for the *Ambalema* variety (25%). In the case of the *3H02* variety, a line known to emit almost no diterpenoids, the ozone loss increased by more than 100% when changing from dark to light conditions.

It is anticipated that the described effect is of importance also for other plant species emitting low-volatility unsaturated organic compounds (e.g. in form of exudates or resins).