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Biogenic Volatile Organic Compound (BVOC) emissions from agricultural crop species: is guttation a possible source for methanol emissions following light/dark transition ?

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In the framework of the CROSTVOC (CROp STress VOC) project, the exchange of biogenic volatile organic compounds (BVOCs) between two important agricultural crop species, maize and winter wheat, and the atmosphere has recently been measured during an entire growing season by using the eddy covariance technique. Because of the co-variation of BVOC emission drivers in field conditions, laboratory studies were initiated in an environmental chamber in order to disentangle the responses of the emissions to variations of the individual environmental parameters (such as PPFD and temperature) and to diverse abiotic stress factors. Young plants were enclosed in transparent all-Teflon dynamic enclosures (cuvettes) through which BVOC-free and RH-controlled air was sent. BVOC enriched air was subsequently sampled from the plant cuvettes and an empty cuvette (background) and analyzed for BVOCs in a high sensitivity Proton Transfer Reaction Mass Spectrometer (hs-PTR-MS) and for CO_2 in a LI-7000 non-dispersive IR gas analyzer. Emissions were monitored at constant temperature (25 °C) and at a stepwise varying PPFD pattern (0-650 μmol m-2 s-1).

For maize plants, sudden light/dark transitions at the end of the photoperiod were accompanied by prompt and considerable increases in methanol (m/z 33) and water vapor (m/z 39) emissions. Moreover, guttation droplets appeared on the sides and the tips of the leaves within a few minutes after light/dark transition. Therefore the assumption has been raised that methanol is also coming out with guttation fluid from the leaves. Consequently, guttation fluid was collected from young maize and wheat plants, injected in an empty enclosure and sampled by PTR-MS. Methanol and a large number of other compounds were observed from guttation fluid. Recent studies have shown that guttation from agricultural crops frequently occurs in field conditions. Further research is required to find out the source strength of methanol emissions by this guttation phenomenon in real environmental conditions.