CROSTVOC : AN INTEGRATED PROJECT FOR STUDYING THE IMPACT OF ABIOTIC STRESSES ON BVOC PRODUCTION OF FIELD CROPS AND GRASSLANDS

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CONTEXT

CROSTVOC ?

In addition to a lack of data on biogenic volatile organic compound (BVOC) emissions from important agricultural lands, large uncertainties in BVOC emission inventories are attributed to stress, which can drastically alter the emission capacities of plants and change their BVOC emission patterns. With "CROSTVOC" (for CROp STress VOC, 2013-2017), we will study the effects of abiotic stress (**heat, drought, ozone and grazing**) on BVOC emissions, both at the ecosystem and plant scale, for three specific model systems (maize/wheat/grassland) representing together about 75% of the agricultural land-use in Wallonia (Belgium).

Parallel investigations under field natural conditions and growth-chamber controlled conditions will help to understand to which extent knowledge coming from laboratory measurements can be extrapolated to real conditions.

SCIENTIFIC QUESTIONS TO BE INVESTIGATED

- Which BVOCs are emitted by these under-studied agricultural crops in non-stressed conditions, in which amount and when? Which environmental (light, temperature, humidity,…) or phenological conditions are driving these exchanges?
- How frequently and when are these ecosystems subjected to (a)biotic stress?
- What is the quantitative and qualitative (compound speciation) impact of those stress events on BVOC emissions?
- What is the relative impact of phenology, plant type and stress level on BVOC stress-induced emissions?
- What is the impact of combined stress on BVOC emissions and biosynthesis pathways?

STRATEGY

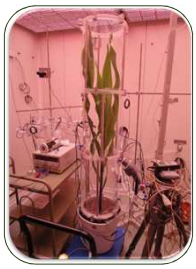
Field campaigns
- Environmental data collection
- ecophysiological measurements
- BVOC measurements in field enclosures and at the ecosystem level

Hypothesis
Link between ecophysiological dataset and altered BVOC emissions

Laboratory validation
Simulation of the environmental constraints linked to altered BVOC emissions in growth chamber and measure of the resulting BVOC emissions

Equipment for environmental and BVOC eddy-covariance data collection at Lonzée (top) and Dorinne (bottom) sites

Field cuvette for PTR-MS and GC-MS measurements



Chamber cuvette (whole plant on the left and hanging leaf cuvette on the right) for PTR-MS and GC-MS measurements

TOOLS

Experimental sites
- Lonzée (crop, ICOS site) and Dorinne (grazed grassland) terrestrial observatories
- Growth chamber at the Belgian Institute for Space Aeronomy: 18 m^3, temperature (15-35 °C) and PAR (0-600 µmol m^{-2} s^{-1}) control, realistic soil substrate
- Six automated field cuvettes and several 22-44 L growth-chamber cuvettes with RH control and O_3 fumigation capacities

Environmental data (field/lab)
- Meteorological data (precipitation, radiation, air temperature, air humidity, O_3 conc)
- Soil humidity, soil temperature
- Field CO_2, H_2O, O_3 and sensible heat fluxes by eddy-covariance

Phenology (field/lab)
- Biomass growth follow-up using destructive samplings and LAI measurements
- Crop management activities follow-up (fertilizer, pesticides, grazing intensity for the grassland)

Stress markers (field/lab)
- Chlorophyll content and chlorophyll fluorescence kinetics
- Stomatal conductance
- Destructive sampling for antioxidant measurement
- Monitoring of biotic stresses (controlled to avoid them to settle in the field and mask abiotic stresses)

BVOC measurements (field/lab)
- Ecosystem scale BVOC fluxes measurements by eddy-covariance using proton transfer reaction-mass spectrometry (PTR-MS)
- Plant scale BVOC fluxes measurements by PTR-MS in field cuvettes (Sampling Duration , SD : 10 min/h) and in growth chamber cuvettes
- BVOC identification by gas chromatography-mass spectrometry (GC-MS) with dynamic headspace sampling in all types of cuvettes (SD : 4 h/week)

Keywords : GC-MS, PTR-MS, eddy covariance, BVOC, field crop, grassland, abiotic stress, chlorophyll fluorescence, chlorophyll content, stomatal conductance

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