IMPACT OF ABIOTIC STRESSES ON VOLATILE ORGANIC COMPOUND PRODUCTION OF FIELD CROPS AND GRASSLANDS

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INTRODUCTION

Abiotic and biotic stresses are known to alter biogenic volatile organic compound (BVOC) emission from plants[1,2]. With the climate and global change, BVOC emissions are likely to increase[3]. This increase on BVOC emissions could be driven by many environmental parameters like temperature, ozone and light availability for photosynthesis although it is still difficult to predict the impact of some environmental parameters, environmental controls on BVOC emission being species and BVOC-dependent[4,5]. These BVOC are involved in a wide range of interactions of plants with their environment[6] and these interactions could be affected by the global change[5]. Moreover, BVOC also play a key role in the atmospheric chemistry[7] and may contribute to ozone formation and an increase in methane lifetime, strengthening the global change[5]. Yet, due to technical limitation, there are few studies examining the impact of multiple co-occurring stresses on BVOC emission at the ecosystem level although stress combination is probably more ecologically realistic in field.

GOALS

In the CROSTVOC (for CROp STress VOC) project, the impact of abiotic stresses (e.g. heat, drought, ozone and grazing) on BVOC emission will be investigated for field crops (maize and wheat) and grassland both at the ecosystem and plant scale.

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

Hypothesis → Link between ecophysiological dataset and altered BVOC emissions

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

In The Field

Environmental data collection

- Meteorological data (precipitations, radiation, total and diffuse PPFD, air temperature, air humidity, atmospheric pressure, ozone)
- Soil humidity, soil temperature
- CO_2, H_2O, ozone sensible heat fluxes by eddy-covariance measurements

Stress markers

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

BVOC measurements

- BVOC fluxes measurements at the ecosystem scale by eddy-covariance and proton transfer reaction-mass spectrometry (PTR-MS)
- BVOC fluxes measurements at the plant scale by PTR-MS in six 22-44 L field cuvettes (Sampling Duration , SD : 10 min/h)
- BVOC identification by gas chromatography-mass spectrometry (GC-MS) with dynamic headspace sampling in six field cuvettes (SD : 4 h/week)

Equipment for environmental and BVOC eddy-covariance data collection (UBP/BISA)

Field cuvette (22L) for PTR-MS and GC-MS measurements (BISA)

In Growth Chamber

Growth condition

- In 22-44 L chamber cuvettes
- Temperature, PPFD, HR and soil water content controlled
- Realistic soil substrate
- Reproduction of stress episodes

BVOC measurements

- BVOC fluxes measurements by PTR-MS in cuvette (SD : 10 min/h)
- BVOC identification by GC-MS with dynamic headspace sampling in cuvette (SD : 4 h/week)

Chamber cuvette (44L) for PTR-MS and GC-MS measurements (BISA)

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