CHLOROPHYLL A FLUORESCENCE: A TOOL TO ASSESS THE PHOTOSYNTHETIC APPARATUS BEHAVIOR

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Chlorophyll a fluorescence

The rise of fluorescence following illumination of a dark-adapted chlorophyll containing material, known as the Kautsky effect, has been first detected and described in 1931. The study of the chlorophyll a fluorescence (CAF) kinetics has been widely used to assess environmental impact on the photosynthetic apparatus. The analysis of the CAF enables a phenomenological and biophysical interpretation of the photosynthetic apparatus behavior as well as a quantification of its functional activity.

Fast phase
- Represents the successive reduction of the electron transport chain.
- Gives information about the energy conservation from the photons absorbed in the whole electron transport chain.

Slow phase
- The fluorescence starts to decrease.
- Gives information about photochemical and non-photochemical process leading to the fluorescence quenching.

Imaging
- Imaging of the CAF provides spatial distribution efficiency of photosynthetic activities.

Case study: photosynthetic apparatus response of Lolium perenne L. to climate stress in a temperate grassland (*)
- Photosynthetic activities of the Lolium perenne L. exhibited a seasonal pattern and a diurnal dynamic photo-inhibition.
- This photo-inhibition was caused by down-regulation mechanisms aimed to reduce the over-excitation driven by sun irradiance.
- High light and severe drought episodes increased the sensitivity of the photosynthetic apparatus to increase of air temperature and vapor pressure deficit.
- Ozone was not identified as an important stress-driver in the grassland.

Reference:

(*) CROSTVOC PROJECT – This study is part of the CROSTVOC project which investigates the impact of abiotic stresses on the volatile organic compound fluxes from the grassland at ecosystem-scale by eddy-covariance measurements and at smaller scale with six dynamic chambers with automated lid.