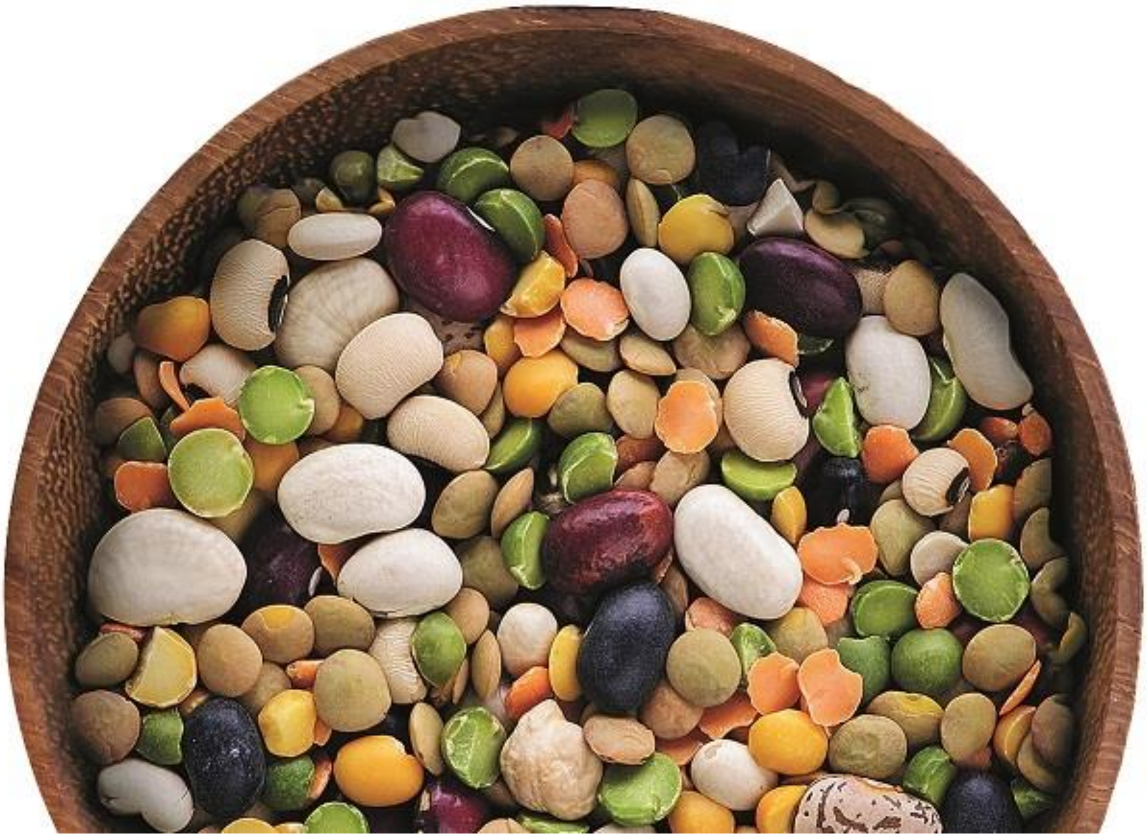
TRansition paths to sUstainable legume-based systems in Europe

Chlorophyll Fluorescence

Date: September, 30th 2018



This Project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement No 727973

Content

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1 Summary Information

1.1 Partner Summary

SOP Code	EU_TRUE_SOP_034
TRUE Partner Acronym	AUA
Primary Author	Ntatsi, Georgia (*ntatsi@aua.gr*)
Other Authors	Savvas, Dimitrios
Linked Reference and Hyperlink (if available)	Yong He, Zhujun Zhu Jing Yang, Xiaolei Ni and Biao Zhu, 2009. Grafting increases the salt tolerance of tomato by improvement of photosynthesis and enhancement of antioxidant enzymes activity. Environmental and Experimental Botany Volume 66, Issue 2: 270-278 *http://dx.doi.org/10.1016/j.envexpbot.2009.02.007*
Associated files to use with the SOP [and function]	*Not applicable*

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1.2 SOP Summary

Title

Chlorophyll fluorescence

Brief description

Light energy absorbed by chlorophyll molecules in a leaf can undergo one of three fates:

used to drive photosynthesis (photochemistry);
excess energy can be dissipated as heat;
re-emitted as light—chlorophyll fluorescence.

By measuring the yield of chlorophyll fluorescence, information about changes in the efficiency of photochemistry and heat dissipation can be gained. This is due to the fact that light energy absorbed by chlorophyll molecules can either used to drive photosynthesis or the excess energy can be dissipated as heat or it can be re-emitted as chlorophyll fluorescence (taken from Maxwell *et al.*, 2000).

Non-photochemical quenching is the quenching of chlorophyll fluorescence and is thought to be involved in protecting the photosynthetic machinery against over-excitation and subsequent damage.

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2 Protocol Steps

Light-adapted and dark-adapted measurements of chlorophyll fluorescence are conducted using a pulse amplitude modulated leaf chamber fluorometer (Li-6400, Li-Cor, Inc., Lincoln, NE, USA).

- Randomly select four plants from each treatment for chlorophyll fluorescence measurements. Use the most recently fully expanded leaf for measurement.
- Calibrate the system prior to measurement.

- To obtain minimal fluorescence values in the dark-adapted state (F_o), apply a low-intensity red measuring light source (630 nm).
- To obtain maximal fluorescence values (F_m), apply a saturating light pulse of 8000 µmol m^{-2} s^{-1}.
- Calculate maximum quantum use efficiency of PSII in the dark-adapted state using the following equation:

$$F_v/F_m = (F_m - F_o) / F_m$$

- The leaf area assayed is dark-adapted for at least 15 min prior to F_v/F_m measurements.

- In a similar manner, obtain minimum (F''_o) and maximum (F''_m) values of fluorescence in the light-adapted state at 800 µmol m^{-2} s^{-1}.
- After continuously illuminating leaves with actinic light for 6 min, record the steady-state fluorescence (F_s).
- Using these parameters, calculate the following ratios:

Effective quantum use efficiency of PSII in the light-adapted state:

$$F''_v/F''_m=(F''_m-F''_o)/F''_m$$

Effective quantum yield:

$$\Phi_{PSII}=(F''_m-F_s)/F''_m$$

Photochemical quenching:

$$q_P=(F''_m-F_s)/F''_m-F''_o$$

Non-photochemical quenching

$$\mathbf{NPQ=(}\boldsymbol{F}_{\mathbf{m}}\mathbf{-}\boldsymbol{F}''_{\mathbf{m}}\mathbf{)/}\boldsymbol{F}''_{\mathbf{m}}$$

Additional Reference

Kate Maxwell, Giles N. Johnson 2000. Chlorophyll fluorescence - a practical guide, Journal of Experimental Botany, Volume 51, Issue 345, 659–668, https://doi.org/10.1093/jexbot/51.345.659

3 Linked SOPs

SOP Code	SOP Function
EU_TRUE_SOP_009	Gas exchange measurement: Net photosynthetic rate (A), Stomatal conductance (Gs), Intercellular CO_2 concentration (Ci) and Transpiration rate

4 Disclaimer

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