

Data and scripts used in the paper entitled “Led Color Gradient As A New Screening Tool For Rapid Phenotyping Of Plant Responses To Light Quality” by Pierre LEJEUNE, Anthony FRATAMICO, Frédéric BOUCHÉ, Samuel HUERGA-FERNÁNDEZ, Pierre TOCQUIN, Claire PÉRILLEUX

Abstract of the manuscript

Background

The increasing demand for local food production is fueling high interest in the development of controlled environment agriculture (CEA). In particular, LED technology brings energy-saving advantages together with the possibility to manipulate plant phenotypes through light quality control. However, optimizing light quality is required for each cultivated plant and specific purpose.

Findings

In this paper, we show that the combination of LED gradient setups with imaging-based non-destructive plant phenotyping constitutes an interesting new screening tool with the potential to improve speed, logistics, and information output. To validate this concept, an experiment was performed to evaluate the effects of a complete range of Red:Blue ratios on seven plant species: *Arabidopsis thaliana*, *Brachypodium distachyon*, *Euphorbia peplus*, *Ocimum basilicum*, *Oryza sativa*, *Solanum lycopersicum*, and *Setaria viridis*. Plants were exposed during four weeks to the light gradient and showed significant, but species-dependent, responses in terms of dimension, shape, and color. A time series analysis of phenotypic descriptors highlighted growth changes but also transient responses of plant shapes to the Red:Blue ratio.

Conclusion

This approach, which generated a large reusable dataset, can be adapted for addressing specific needs in crop production or fundamental questions in photobiology.

Images

Images are stored in independent repositories for each species:

- *Arabidopsis thaliana*: DOI 10.5281/zenodo.5016876
- *Brachypodium distachyon*: DOI 10.5281/zenodo.5016978
- *Euphorbia peplus*: DOI 10.5281/zenodo.5016937

- *Ocimum basilicum*: DOI 10.5281/zenodo.5016647
- *Oryza sativa*: DOI 10.5281/zenodo.5016680
- *Setaria viridis*: DOI 10.5281/zenodo.5016748
- *Solanum lycopersicum*: DOI 10.5281/zenodo.5016808

images_analysis.ijm

images_analysis.ijm is the Macro file used to process images with ImageJ (Fiji distribution).

raw_data.csv

Data in *raw_data.csv* are produced by ImageJ macro available in *images_analysis.ijm* file.

selected_data.csv

Data from *raw_data.csv* have been checked to remove outliers etc. and arranged in an easy to read file.

Data file contains the following columns:

- **species (string)**: plant species
- **treatment (string)**: treatment (gradient or white light)
- **plant_id (string)**: unique plant id
- **room (string)**: culture cabinet used
- **column (integer)**: relative plant position along cabinet width
- **row (integer)**: relative plant position along cabinet depth
- **sowing_date (date)**: date of plant sowing (format %Y-%m-%d)
- **gradient_date (date)**: date of transfer from white light to red-blue gradient light (format %Y-%m-%d)
- **ppfd (float)**: photosynthetically active photon flux density in $\mu\text{mol.m}^{-2}.\text{s}^{-1}$
- **pdf_red (float)**: photon flux density in $\mu\text{mol.m}^{-2}.\text{s}^{-1}$ from 600 to 700 nm
- **pdf_blue (float)**: photon flux density in $\mu\text{mol.m}^{-2}.\text{s}^{-1}$ from 400 to 500 nm
- **img_date (date)**: date of capture (format %Y-%m-%d)
- **das (integer)**: day after sowing
- **dag (integer)**: day after transfer under gradient
- **parameter (string)**: parameter measured by *images_analysis.ijm*
- **value (float)**: measures of parameter
- **unit (string)**: unit of parameter

data_analysis.R

data_analysis.R is the R script used to analyse data and produce raw graphs.

processed_data.csv

processed_data.csv contains summarized data of regressions produced by the R script.

Data file contains the following columns:

- **species (string)**: plant species
- **treatment (string)**: treatment (gradient or white light)
- **das (integer)**: day after sowing
- **dag (integer)**: day after transfer under gradient
- **parameter (string)**: parameter measured by *images_analysis.ijm*
- **nbpts (integer)**: data length used for the regression
- **slope (float)**: slope of the regression
- **intercept (float)**: intercept of the regression
- **rsq (float)**: coefficient of determination, r^2
- **pval_slope (float)**: p-value of the slope of the regression
- **pval_intercept (float)**: p-value of the intercept of the regression
- **signif (string)**: categories of significance of the slope. NS = Not significant (p-val > 0.05), LS = Low significant (p-val ≤ 0.05), MS = Mean significant (p-val ≤ 0.01), HS = High significant (p-val ≤ 0.001).