Long term plant adaptation to changes in light quality.

Thesis about adaptation to changes in light quality at the Laboratory of Biophysics, as part of a BSc/MSc in the programs of Molecular Life Sciences or Plant Sciences.

Photosynthesis relies on sunlight, but as light filters through leaves, red and blue wavelengths are absorbed more, creating a gradient in light intensity and spectrum within plant canopies. The spectral shift affects plants on the molecular level, as the two protein complexes that absorb light, Photosystem I & II, do so at slightly different wavelengths. Changes in light spectrum can thus lead to unbalanced excitation and a decreased photosynthetic efficiency. It is known that in the long-term plants change the stoichiometry of PSI and PSII to restore the balance. However, there is little quantitative information about this process and making predictions on the degree of adaptation is as of yet impossible.

Recently, we developed an extension of an often used photosynthesis model, the Farquhar, Von Caemmerer and Berry model. The original model can predict photosynthesis rates based solely on light intensity. The new model can also take the spectrum of light into account and takes the PSI/PSII stoichiometry as a parameter. Initial model analysis indicates that there is a PSI/PSII stoichiometry where the photosynthesis rate is maximal for a given incident light spectrum. This begs the question whether plants are able to and 'want' to adapt their PSI/PSII stoichiometry to reach this optimum. Therefore, we want to test the following hypothesis:

"Plants regulate the PSI/PSII stoichiometry to optimize carbon assimilation rate under a given growth light spectrum."

Methods and expectation:

This project will involve experimental and modelling/theoretical work:

- Grow pea/tomato plants under various light spectra.
- Measure several photosynthetic parameters such as gas exchange, chlorophyll fluorescence and photosystem content.
- Use the newly developed photosynthetic model to determine the theoretical optimal PSI/PSII stoichiometry.

Extensive experience with plant experimental work and/or modelling is not required. However, affinity and willingness to learn with both areas is important.

Period

Starting in the first period of 2025-2026 or later.

Further information:

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