Le Corps professoral de

Gembloux Agro-Bio Tech - Université de Liège vous prie

de lui faire l'honneur d'assister à la défense publique de la dissertation originale que

Monsieur DIGRADO Anthony,

Titulaire d'un diplôme de master bioingénieur : sciences agrononomiques, à finalité spécialisée,

présentera en vue de l'obtention du grade et du diplôme de

DOCTEUR EN SCIENCES AGRONOMIQUES ET INGENIERIE BIOLOGIQUE,

le 28 mars 2018, à 14 heures précises (personne ne sera admis après cette heure),

en l'auditorium PhV (Physiologie Végétale, bât. 48),

Avenue Maréchal Juin,13 à 5030 GEMBLOUX.

Cette dissertation originale a pour titre :

« Influence of combined environmental constraints on photochemical capacity and CO_2 fluxes in a temperate managed grassland ».

Le jury est composé comme suit :

Présidente : Prof. M.-L. FAUCONNIER, Présidente du Département AGROBIOCHEM,
Membres : Prof. P. DELAPLACE (Promoteur), Prof. P. du JARDIN (Copromoteur), Prof. B. HEINESCH, Dr F. FRANCK, Pr F. BUSSOTTI (University of Florence - Italie), Dr S. LUTTS (UCL).

Abstract

Increase in agricultural production to insure food security and energy demand by 2050 might result in higher greenhouse gas emissions (GHG) from the agricultural sector. Managed grasslands, however, offer the opportunity to offset some of the GHG emission through the storage of carbon in terrestrial systems by photosynthesis. Photosynthesis, however, is highly sensitive to environmental conditions. Especially, plant ability to harvest and use light energy for photochemistry can be impaired by abiotic stresses. While numerous studies have focused on the impact of environmental constraints on ecosystem carbon fluxes, the influence on ecosystem photochemical capacity is understudied. The main goals of this thesis was to evaluate how environmental constraints impacted the grassland photochemical capacity and how variations in processes involved in light reactions of photosynthesis influenced ecosystem carbon fluxes.

Frequent chlorophyll fluorescence measurements were conducted over a two-year period, on three grassland species (*Lolium perenne* L., *Taraxacum* sp., and *Trifolium repens* L.). The ecosystem photochemical capacity was estimated from measurements performed on the three grassland species. In addition, monitoring CO_2 fluxes was performed by eddy covariance. Our results showed that photochemical capacity of the primary grasslands species exhibited diurnal and seasonal variations. The monocot *L. perenne* and the dicots (*Taraxacum* and *T. repens*) exhibited different acclimation strategies. All species exhibited the onset of energy dissipation mechanisms within the photosystem II but expressed contrasted response in the photosystem I efficiency. As a result, the ecosystem also exhibited variations in its ability to harvest and use photon energy. The strongest declines in photochemical capacity were observed in summer when abiotic stresses such as high light and high air temperature were combined. However, decrease in photochemical capacity did not result in a decreased ability to fix carbon in the grassland. The maintenance of carbon assimilation despite the onset of energy dissipation mechanisms can be explained by the higher availability of light energy under these conditions.

In the final section of this PhD thesis, we discuss how future experiments can improve our knowledge in plants functional ecology and in the relationship between the photochemical capacity and ecosystem carbon fluxes. We also discuss how these results can benefit GHG mitigation strategies and how plants influence GHG balance through other routes than photosynthesis.