Chronic photoinhibition plays only a minor role in the world's most successful bryophyte genus

Tomáš Hájek[1,2], Eeva-Stiina Tuittila[3], Raija Laiho[3] and Mati Ilomets[4]

[1] *Institute of Botany of ASCR, Dukelská 135, 379 82 Třeboň, CZ,* ✉ *hajek@butbn.cas.cz*
[2] *Faculty of Biological Sciences, Branišovská 31, 370 05 České Budějovice, CZ*
[3] *Department of Forest Ecology, University of Helsinki, P.O. Box 27, 00014 Helsinki, FIN*
[4] *Institute of Ecology, Tallinn University, Kevade tn. 2, Tallinn 10 137, EST*

Introduction and Methods

Peat mosses (*Sphagnum*) cover vast areas of earth's land surface. They often induce water-saturated unfavourable soil conditions for vascular plants and so form treeless, sun-exposed habitats.

This evokes the hypothesis that they show a long-term adaptation to full sun irradiance. When pristine mires are drained and their tree cover increases, bryophyte species composition changes only partially, thus indicating that some species are able to acclimate to shade conditions.

To test the mosses' ability to adapt/acclimate to sun and shade habitats, we measured:

- light response of CO_2 assimilation (IRGA)
- chlorophyll fluorescence (photochemical parameters)
- contents of chlorophylls and total carotenoids

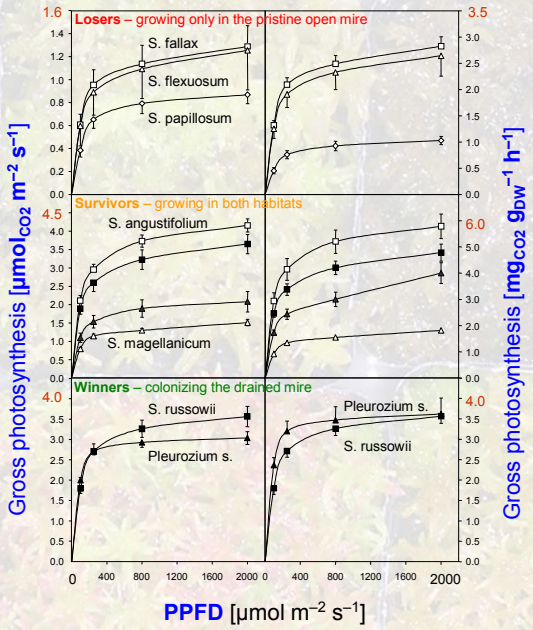
in:

- six *Sphagnum* species and *Pleurozium schreberi*
- growing in open and/or forested mire

The mosses were collected in central Finland and kept under mild irradiation for 10 days before experiments.

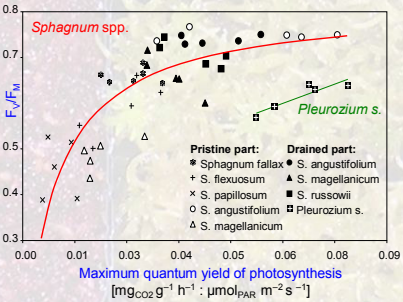
Results & Discussion

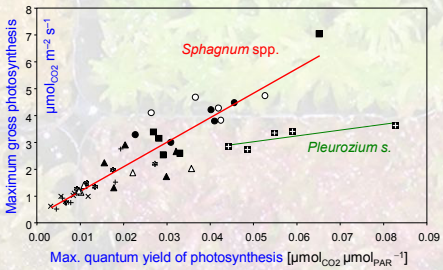
Light curves of *Sphagnum* spp. and *Pleurozium:*



Chlorophyll fluorescence:

- the maximum quantum yield of photosynthesis correlated well with that of Φ_{PSII} (F_V/F_M, $r = 0.82$) ↓
  = support for the gas-exchange data





- F_V/F_M correlated closely with Φ_{PSII} (at PPFD of 220 µmol.m^{-2}.s^{-1}, $r = 0.94$) and less with qP ($r = 0.74$)

Pigment content results:

- no clear correlation between chlorophyll content or Chl a/b ratio and gas exchange and any chlorophyll fluorescence parameter
- carotenoid content is (slightly) inversely proportional to Φ_{PSII} or F_V/F_M ($r = 0.50$)

➢ sun-grown plants are richer in carotenoids but their photoprotective function is insufficient

➢ we postulate that the long-lasting photoinhibition in sun-grown *Sphagna* can be ascribed to the ambient levels of both PPDF and/or UV-B radiation

Light curves in *Sphagnum* mosses showed:

- large differences in maximum rate of photosynthesis,
- large span of max. quantum yield of photosynthesis (α) = indication of strong photoinhibition in species low in α
- high PPFD saturation point (~ 2000 µmol m^{-2} s^{-1})
- ← maximum quantum yield of photosynthesis determined the photosynthetic rate in *Sphagnum* = indication of reduced amount of PS2 reaction centres

Conclusions

➢ losers, sun-grown *Sphagna* of open mires, are very inefficient in utilizing any light level

➢ losers suffer from chronic photoinhibition (due to photodamage to photosystem II), which is unrecoverable on a time scale of weeks

➢ a survivor, *Sphagnum angustifolium*, was the most photosynthetically active and less photoinhibited species in both habitats why ?