Sphagnum-Specific Structural Polysaccharides Play an Important Role in Decay Resistance and Active Depression of Decomposition in Bogs

Tomáš Hájek[1,2], Simon Ballance[3], Juul Limpens[4], Mink Zijlstra[4], and Jos T.A. Verhoeven[5]

[1] Institute of Botany of the Academy of Sciences of the Czech Republic, Dukelská 135, 379 82 Třeboň, Czech Republic (hajek@botany.cas.cz)
[2] Department of Plant Physiology, Faculty of Science, University of South Bohemia, Branišovská 31, 370 05 České Budějovice, Czech Republic
[3] Norwegian Biopolymer Laboratory, Department of Biotechnology, Norwegian University of Science and Technology, N-7491 Trondheim, Norway
[4] Nature Conservation & Plant Ecology Group, Wageningen University, Droevendaalsesteeg 3a, 6708 PB Wageningen, The Netherlands
[5] Landscape Ecology Group, Utrecht University, Prof. dr. F.A.F.C. Wentgebouw. Sorbonnelaan 16. 3584 CA Utrecht, The Netherlands

Introduction

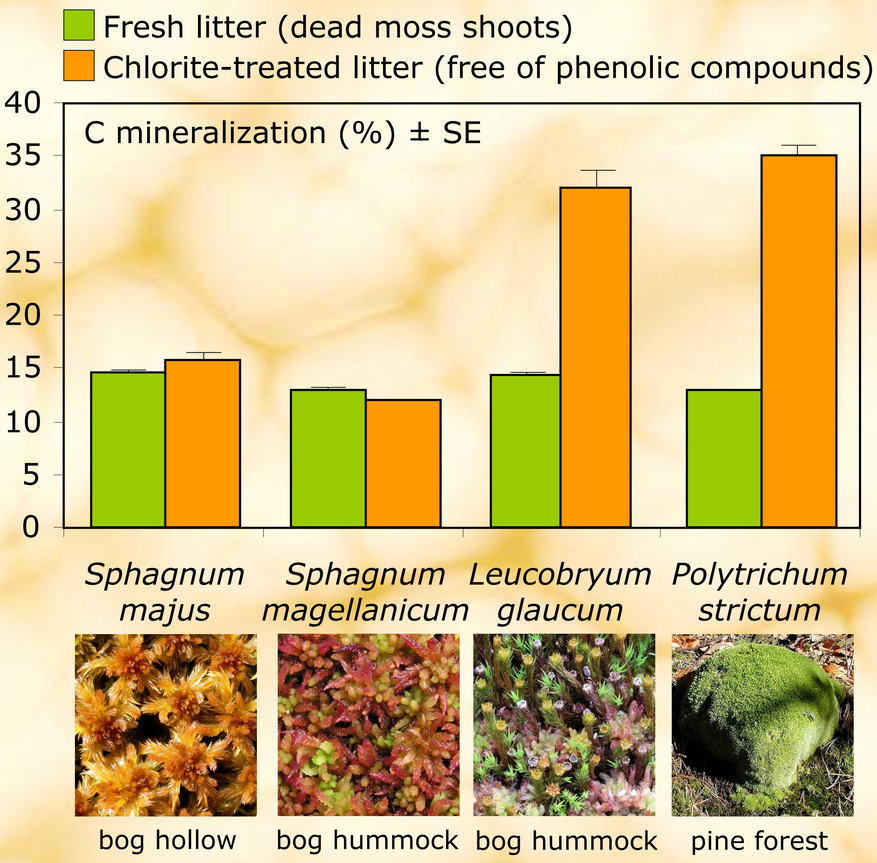
Plant litter chemistry is an important predictor of litter decomposition. Understanding how *Sphagnum* litter chemistry controls carbon (C) mineralization is essential for understanding potential interactions between environmental changes and C mineralization in peatlands.

We aimed to separate the effects of phenolics and structural polysaccharides on decay of *Sphagnum* litter.

Materials & Methods

We measured aerobic microbial respiration of different moss litter types in a lab environment. We used chemical treatments to step-wise remove the chemical compounds thought to be important in decay-resistance in three taxonomically distant moss genera (*Sphagnum*, *Leucobryum* and *Polytrichum*). The last experiment focused on the effect of *Sphagnum*-specific cell-wall pectic polysaccharides on C and N mineralization of cotton grass leaf litter.

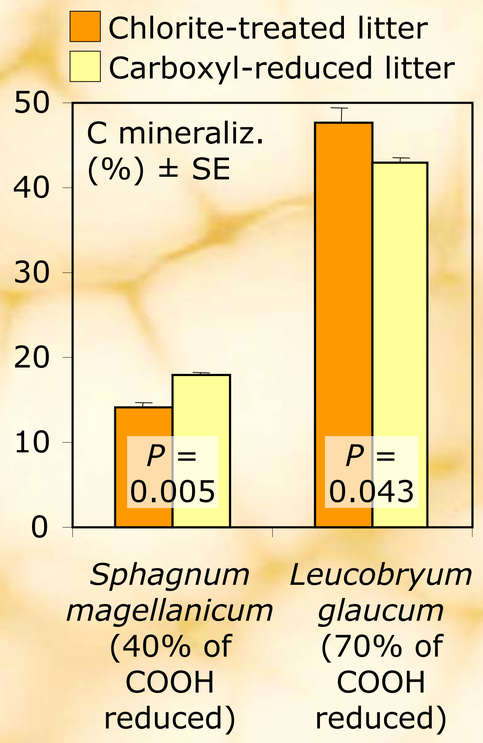
Results



Polymeric lignin-like phenolics, removed by chlorite treatment, play:

- a minor role in decay resistance of *Sphagnum*
- but a great role in *Polytrichum* & *Leucobryum*

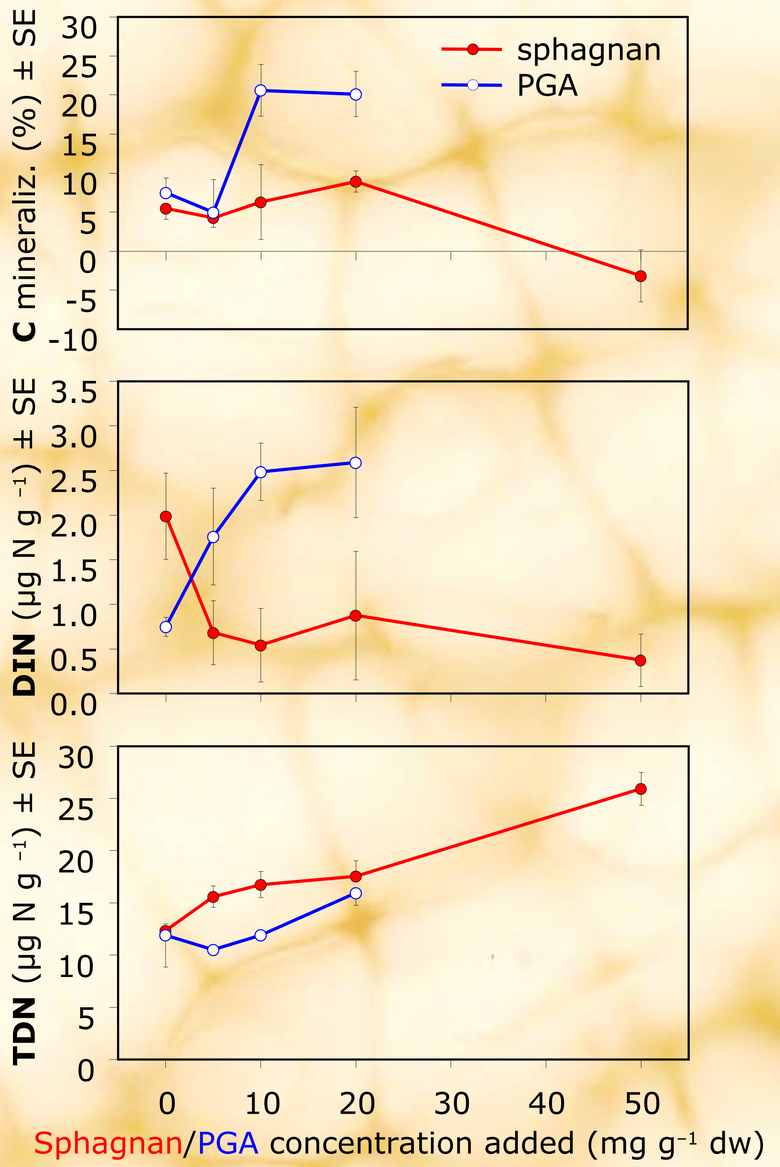
Therefore *Sphagnum* cell-wall polysaccharides (represented by the chlorite-treated litter) resist the microbial decomposition in contrast with the other two mosses.



Carboxyl groups (COOH) of cell-wall-bound pectin-like polysaccharides resisted decay in *Sphagnum* litter but served as a C-source in *Leucobryum* litter.

These negatively-charged pectin-like polysaccharides are easily hydrolysable and release into the solution as so-called "sphagnan".

Effects of adding sphagnan and chemically similar polygalacturonic acid (PGA) to the cotton grass (*Eriophorum*) leaf litter:



Sphagnan, compared to PGA, did not serve as C-source but instead, it inhibited C and N mineralization of cotton grass litter resulting also in accumulation of DON.

Binding of extracellular enzymes by negatively charged and branched molecules of sphagnan is the expected inhibitory mechanism.

Conclusions

Our results emphasize the role of polysaccharides in resistance to, and active inhibition of, microbial mineralization in *Sphagnum*-dominated peatlands.

In plant litters, these properties are usually attributed to phenolics (lignin, polyphenols). An important question arisen: do the quality and the microbial decay rate of the polysaccharides respond differently to environmental processes than phenolics?

Background: leaf structure of *Sphagnum magellanicum* viewed as phenolic fluorescence excited by UV radiation.