Effect of water content components on desiccation and recovery in *Sphagnum* mosses

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Abstract

• *Background and Aims* We measured the basic parameters of water relations in *Sphagnum* mosses. We then tested the relationship of these parameters to the photosynthetic response to desiccation, and the ecology of these mosses.

• *Methods* The water relations parameters of five *Sphagnum* species (mosses typical of wet habitats) and *Atrichum androgynum* (a typical, more mesophytic, moss) were calculated from pressure–volume isotherms. Photosynthetic properties during and after moderate desiccation were monitored by chlorophyll fluorescence.

• *Key Results* When desiccated, the hummock forming species *S. fuscum* and *S. magellanicum* lost more water before turgor started dropping than other sphagna inhabiting less exposed habitats (73 % compared to 56 % on average). Osmotic potentials at full turgor were similar in all species with an average value of –1.1 MPa. Hummock sphagna had clearly more rigid cell walls than species of wet habitats (ε = 3.55 compared to 1.93 MPa). As a result, their chlorophyllous cells lost turgor at higher relative water contents (RWC) than species of wet habitats (0.61 compared to 0.46) and at less negative osmotic potentials (–2.28 compared to –3.00 MPa). During drying, Φ_{PSII} started declining earlier in hummock species (at RWC of 0.65 compared to 0.44), and F_v/F_m behaved similarly. Compared to other species, hummock sphagna desiccated to –20 MPa or –40 MPa recovered more completely after rehydration. *A. androgynum* responded to desiccation similarly to hummock sphagna suggesting that their desiccation tolerance may have a similar physiological basis.

• *Conclusion* Assuming a fixed rate of desiccation, the higher water holding capacities of hummock sphagna will allow them to continue metabolism for longer than other species. While this could be viewed as a form of "desiccation avoidance", hummock species also recover faster than other species during rehydration, suggesting that they have higher inherent tolerance. This may help them to persist in drought-exposed hummocks. By contrast, species growing in wet habitats lack such strong avoidance and tolerance mechanisms. However, their turgor maintenance mechanisms, for example more elastic cell walls, enable them to continue metabolizing longer as their water contents fall to the turgor loss point.