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Carbon dynamics differences between Sphagnum and peatland invading vascular plants litters assessed by laboratory experiments and modelling.

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Sphagnum peatland invasion by vascular plants, such as Molinia caerulea and Betula spp, may be accelerated under anthropogenic perturbations because of changes of water regime, and even more drastically because of increased nutrient loading. Such a vegetation change may alter the C cycle of peatlands by (i) producing litter that decompose faster, (ii) increasing heterotrophic respiration through root exudation, (iii) increasing CH4 emission through root exudation and efflux pathway through vascular tissues, (iv) affecting moisture content of the substrate.

Accordingly, the objective here was to determine the C dynamics in autochthonous and invading species litters from la Guette peatland (France), a site dominated by Sphagnum spp, and invaded by Molinia caerulea and Betula spp.To do so, we used experimental and modelling tools to study decomposition kinetics of organic matter (OM) in litters with different chemical characteristics. OM decomposition was assessed in laboratory experiment by both measuring the remaining mass and estimating CO2 production from in vitro decomposing Sphagnum cuspidatum, Molinia caerulea and Betula spp litters. The Water Extractable Organic Carbon (WEOC) and the Specific UV Absorbance at 280 (SUVA 280), an index of aromaticity, of the water extract were also measured. The remaining mass, the WEOC and the CO2 production were used in a model of C dynamics. It was hypothesised that two pools of OM (labile and recalcitrant) compose the litter and are catalysed at two different rates. The exo-enzymes release soluble compounds that are then taken by the microorganisms up and respired. The model outputs were labile and recalcitrant catalysis rate and WEOC respiration rate. Two models were compared: in the first one the flux rates were constant whereas in the second one, they were allowed to decrease in a negative exponential manner.

The model results showed that the data were best described when catalysis and respiration rates were allowed to decrease with time, suggesting that these processes were gradually constrained. The Betula litter lost mass faster and respired more than the two other litters. Soluble C accumulation was also lower in Betula litter than in the two others. Furthermore, as the Betula litter is the richest in N, such a fast decomposition could increase the N cycling in the peatland, further promoting the establishment of vascular species. Molinia and S. cuspidatum litters lost mass and respired at the same rate. However, the C substrate quality was lower in the Molinia litter (higher aromaticity of the WEOC) than that in the S. cuspidatum litter suggesting that low C substrate quality may explain low respiration in Molinia litter. Furthermore, the results of the model showed that the catalysis rate decreases faster in the S. cuspidatum litter than in the Molinia litter (efficient enzymatic inhibition). It is suggested that the sphagnan, through its binding capacity, could be at the origin of both low catalysis and respiration rate in S. cuspidatum litter. The WEOC content was the highest in the Molinia litter. This implies that increased percentage cover of Molinia may increase DOC content in the peatland water and its export.