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Is the mineralisation response to root exudation controlled by the microbial stoichiometric demand in subarctic soils?

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Climate change will expose arctic and subarctic systems to warming and a shift towards plant communities with more rhizosphere labile C input. Labile C can also increase the rate of loss of native soil organic matter (SOM); a phenomenon termed 'priming'. We investigated how warming (+1.1˚C over ambient using open top chambers) and the addition of plant litter (90 g m^{-2} y^{-1}) or organic nitrogen (N) (fungal fruit bodies; 90 g m^{-2} y^{-1}) in the Subarctic influenced the susceptibility of SOM mineralisation to priming, and its microbial underpinnings. Root exudation were simulated with the addition of labile organic matter both in the form of only labile C (^{13}C-glucose) or in the form of labile C and N (^{13}C-alanine). We hypothesized that labile C would induce a higher mineralization of N than C sourced from SOM ("N mining"); a response unrelated to microbial growth responses. We also hypothesized that the N mining effect would be more pronounced in climate change simulation treatments of higher C/N (plant litter) than treatments with lower C/N (fungal fruitbodies and warming), with the control treatments intermediate. We also hypothesized that the addition of labile C and N would not result in selective N mining, but instead coupled responses of C and N mineralisation sourced from SOM; a response that would coincide with stimulated microbial growth responses.

Labile C appeared to inhibit the mineralisation of C from SOM by up to 60% within hours. In contrast, the mineralisation of N from SOM was stimulated by up to 300%. These responses occurred rapidly and were unrelated to microbial successional dynamics, suggesting catabolic responses. Considered separately, the labile-C inhibited C mineralisation is compatible with previously reported findings termed 'preferential substrate utilisation' or 'negative apparent priming', while the stimulated N mineralisation responses echo recent reports of 'real priming' of SOM mineralisation. However, C and N mineralisation responses derived from the same SOM source must be interpreted together: This suggested that the microbial SOM-use decreased in magnitude and shifted to components richer in N.

This finding highlights that only considering SOM in terms of C may be simplistic, and will not capture all changes in SOM decomposition. The selective mining for N increased in climate change treatments with higher fungal dominance. In conclusion, labile C appeared to trigger catabolic responses of the resident microbial community that shifted the SOM mining to N-rich components; an effect that increased with higher fungal dominance. Extrapolating from these findings, the predicted shrub expansion in the Subarctic could result in an altered microbial use of SOM, selectively mining it for N-rich components, and leading to a reduced total SOM-use.