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Do foliar δ^{15}N patterns indicate shifts in the mycorrhizal abundance and function under nutrient load?

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We examined how simulated atmospheric nitrogen (N) deposition changed peatland plant-mycorrhizal relationships. We hypothesized that as N deposition increases, more inorganic N will be available and carbon allocation to mycorrhizal fungi, in exchange for organic N uptake, will decrease. The decrease in mycorrhizal organic N uptake would translate into increased foliar δ^{15}N values in ericoid mycorrhizal shrubs. The rationale is based on fungal discrimination of ^{15}N during synthesis of transfer compounds that depletes plant N in ^{15}N relative to source, and enriches fungal N in ^{15}N. We tested whether foliar δ^{15}N patterns could indicate the degree of mycorrhizal colonization under experimental nutrient additions where other factors influencing δ^{15}N values are constrained. The study was carried out at two of the longest-running nutrient addition experiments on peatlands, Whim Bog, United Kingdom, and Mer Bleue Bog, Canada. The treatments received an additional load of 1.6-6.4 N g m^{-2} y^{-1} either as ammonium (NH_4) nitrate (NO_3) or NH_4NO_3, with and without phosphorus (P) and potassium (K) for 15 years, alongside unfertilized controls. We sampled the leaves of dominant ericoid mycorrhizal shrubs as well as the nonmycorrhizal sedge Eriophorum vaginatum and analyzed their δ^{15}N patterns and nutrient contents under different nutrient addition treatments. The non-mycorrhizal sedge was sampled to determine the effect of fertilizer on plant δ^{15}N signal. We also sampled fine roots from ericoid shrubs and microscopically quantified abundance and morphology of fungal colonization. Overall, long-term fertilization increased foliar δ^{15}N values,less in non-mycorrhizal sedge than in ericoidshrubs. With increasing N additions the foliar δ^{15}N values of mycorrhizal and nonmycorrhizal plants converged, presumably owing to a shift in the N source and diminished role of mycorrhizal fungi in ericoid shrub N uptake. Unexpectedly, mycorrhizal colonization rates did not change significantly, but presence of other root associated fungi in ericoid roots increased under nutrient load. Combined with functional changes in fungal symbionts, e.g., in producing hydrolytic enzymes for degrading organic matter, these data will allow us to further analyze the utility of ^{15}N natural abundance approach to predict the role of mycorrhizal fungi in plant N uptake in peatlands under changing nutrient availability.