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Grass species influence on plant N uptake – Determination of atmospheric N deposition to a semi-natural peat bog site using a 15N labelling approach

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Large areas of natural peat bogs in Northwestern Germany have been converted to arable land and were subjected to draining and peat cutting in the past. The few protected peatland areas remaining are affected by high nitrogen (N) deposition. Our study site – a moderately drained raised bog – is surrounded by highly fertilized agricultural land and livestock production.

In this study, we used a 15N pool dilution technique called 'Integrated Total Nitrogen Input' (ITNI) to quantify annual deposition of atmospheric N into biomonitoring pots over a two-year period. Since it considers direct N uptake by plants, it was expected to result in higher N input than conventional methods for determination of N deposition (e.g. micrometeorological approaches, bulk N samplers).

Using Lolium multiflorum and Eriophorum vaginatum as monitor plants and low, medium and high levels of fertilization, we aimed to simulate increasing N deposition to planted pots and to allocate airborne N after its uptake by the soil-plant system in aboveground biomass, roots and soil. Increasing N fertilization was positively correlated with biomass production of Eriophorum vaginatum, whereas atmospheric plant N uptake decreased and highest airborne N input of 899.8 ± 67.4 μg N d-1 pot-1 was found for low N fertilization. In contrast, Lolium multiflorum showed a clear dependency of N supply on plant N uptake and was highest (688.7 ± 41.4 μg N d-1 pot-1) for highly fertilized vegetation pots. Our results suggest that grass species respond differently to increasing N input. While crop grasses such as Lolium multiflorum take up N according to N availability, species adopted to nutrient-limited conditions like Eriophorum vaginatum show N saturation effects with increasing N supply.

Total airborne N input ranged from about 24 to 66 kg N ha-1 yr-1 dependent on the used indicator plant and the amount of added fertilizer. Parallel determination of atmospheric N deposition using a micrometeorological approach complemented with bulk samplers was about 24 kg N ha-1 yr-1 during both years of experiments and was thus at the lower range of results obtained by the ITNI method. The low 15N recovery rate of about 50 % during some experiments indicated an underestimation of the applied ITNI approach, resulting in a maximum possible N uptake of twice as high as the determined N input.

Most likely, the intensive agricultural land management of the surrounding areas leads to this high N deposition into the protected peatland area. As a result, increasing sensitivity of ombrotrophic vegetation with a subsequent change in plant species composition and a decline in bog-specific vegetation cannot be excluded.