



Conference Abstract

Effects of Nutrient Enrichment on Vegetation Biomass, Soil Properties and Lysimetric Water Chemistry in Temperate Alpine Grassland Ecosystem

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Abstract

Alpine grasslands belong among highly sensitive ecosystems where nutrient deposition can affect significantly soil chemistry, water quality, and vegetation dynamics and structure. To study responsiveness of alpine grassland ecosystems to increased inputs of nitrogen (N) and phosphorus (P) experimental plots were established in 2002 on an eLTER site Jalovecká dolina, Slovakia (<https://deims.org/e13f1146-b97a-4bc5-9bc5-65322379a567>). Since then, experimental plots have been fertilized by solution of 2, 6 and 15 g N.m².year⁻¹ in a form of NH₄NO₃ and by solution of 5 g P. m².year⁻¹ in a form of KH₂PO₄. A control has been sprayed by water of the same amount. Experimental solutions are applied three times per year during summer months. All treatments were established in five replicates. In 2009, all plots were divided on halves, ones are still fertilized and second ones were left for recovery.

Soils at the site are humic ferruginous podzols, derived from biotite granodiorite parent material with very low pH/H₂O around 3.5. Vegetation at the site belongs to the Juncion trifidi Krajina 1933 alliance and it is dominated by graminoid species, including *Oreochloa disticha*, *Festuca supina*, *Agrostis rupestris*, *Carex bigelowii*, *Juncus trifidus*, and *Avenella flexuosa*, with lower cover of forb and dwarf shrub species, but significant

layer of lichens *dominated* by *Cetraria islandica*. After 6 years of experiment we showed (Bowman et al. 2008) that increases in nitrogen deposition in the region result in a depletion of both base cations and soluble aluminium, and an increase in extractable iron concentrations. In conjunction with this, we observe a nitrogen deposition-induced reduction in the biomass of vascular plants, associated with a decrease in shoot calcium and magnesium concentrations. We suggest that this site, and potentially others in central Europe, have reached a new and potentially more toxic level of soil acidification in which aluminium release is superseded by iron release into soil water.

After 20 years of experimental N and P enrichments and 13 years of recovery were done chemical analyses of soil and soil water. Chemical analyses of plant biomass will be done in near future. Soils at the site are humic ferruginous podzols, derived from biotite granodiorite parent material with very low pH/H₂O around 3.5. Comparing fertilized to recovery plots revealed that the soil and soil water pH increased only very little. The pools of NO₃⁻ and NH₄⁺ in soil water decreased in N recovery plots, but remained higher than in P and C plots. Soil exchangeable metals Al³⁺ and Fe²⁺ decreased slightly in N recovery plots, but Mn²⁺ elevated. Content of soil base cations Ca²⁺, Mg²⁺ and K⁺, except Na⁺, elevated in all treatment and control. The effect of increased N and P treatments on vegetation pointed out that herbs and mosses biomass significantly decrease under N15 and P (Kruskal-Wallis $p < 0.001$), while total biomass was notably enhanced under the P treatment ($p < 0.001$). Grass, bushes, mosses and lichens displayed limited responses, reflecting their slower growth rates and nutrient uptake capacities.

In summary, the results demonstrate that N and P nutrient enrichment in acid alpine grasslands enhance plant productivity for fast-growing species like herbs, halt the sensitive species like lichens, and affect soil and water nutrient cycling and quality with potential for long-lasting impacts on ecosystem structure and function.

Keywords

Alpine grassland, Vegetation Biomass, Soil Properties, Lysimetric Water Chemistry, LTER site

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Conflicts of interest

The authors have declared that no competing interests exist.