

What is the effect of long-term cutting versus abandonment on the vegetation and chemical properties in the soil and the herbage of a mountain hay meadow (*Polygono-Trisetion*)?

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Introduction

Polygono-Trisetion meadow communities are endangered in Europe. These meadows are common in the Alps, but in the past, such meadows were also common in the western alpine regions of Central Europe. The aim of our experiment was to find a suitable management regime for the maintenance of these *Polygono-Trisetion* grasslands and its effect on the vegetation and chemical properties of the soil and in the herbage.

Methods

The experiment was undertaken from 1999 to 2009 in a mountain hay meadow in the Bukovec Nature Reserve in the Jizera mountains on the border between Czech Republic and Poland. The altitude of this study site was 910 m, the average annual precipitation was 1500 mm and the mean annual temperature was 4.5°C during the study period. Applied treatments were: cutting once a year with removal of biomass in mid July (C) and an unmanaged control (U). The vegetation was monitored in five pairs of permanent 5 m x 5 m plots annually in mid-July before cutting at the same phenological stage in each year. The cover of all vascular plant species on each plot was recorded using a percentage scale. Soil and herbage samples were taken from 2003–2009. Plant-available P, K, Ca and Mg were extracted by Mehlich III (Mehlich 1984) reagent and then determined by inductively coupled plasma–optical emission spectrometry (ICP–OES). Total N was analysed by the Kjeldahl method and organic C by means of colorimetry (AOAC 1984). N, P, K, Ca and Mg concentrations in the herbage were determined by analysis of dry matter herbage yield after digestion in *aqua regia* by ICP–OES. Data were analysed by ANOVA (Statistica 9 software).

Results

Plant species composition

The main effect of abandonment (unmanaged control) on plant species composition was the shift in cover of the dominant species. The cover of *Festuca rubra*, *Agrostis capillaris*, *Anthoxanthum odoratum*, *Briza media* and *Trifolium repens* was significantly increased by cutting ($P < 0.05$). On the other hand, the cover of *Cirsium heterophyllum*, *Geranium sylvaticum*, *Hypericum maculatum*, *Trisetum flavescens* and *Luzula luzuloides* was significantly

higher on the abandoned treatment.

Soil and herbage chemical properties

Potassium was the only nutrient for which the soil concentration significantly decreased under the cutting (C) treatment. Soil K concentration was 175 and 210 mg/kg in the C and U treatments, respectively, in the last year of the experiment.

A significant effect of treatment on the herbage concentrations of P ($P = 0.022$) and K ($P < 0.001$) was recorded. The mean concentration of N in the herbage was 16 and 16.5, P was 1.7 and 1.8 and K was 11.1 and 14.6 g/kg in C and U, respectively.

Discussion

Plant species composition

The positive effect of cutting on the cover of *Festuca rubra* is well documented (Krahulec *et al.* 2001; Hellström *et al.* 2006). *Trifolium repens* also started to increase in the cut treatment after five years. The higher cover of *Trifolium repens* in the cut treatment probably reflected its intolerance of shade (Grime *et al.* 1988). The rapid increase in the proportion of *Hypericum maculatum* in the unmanaged treatment is also consistent with the results from mountain hay meadows in Central Europe (Krahulec *et al.* 2001; Pavlu *et al.* 2007).

Soil and herbage chemical properties

A possible explanation for the decrease in K availability under the regime of regular cutting and biomass removal is that soil with high organic matter and low clay content was not able to release enough K by weathering of clay minerals in order to compensate for the K removed by the harvested herbage (Kayser and Isselstein 2005). The decrease in herbage K concentrations was recorded substantially earlier than the decrease in plant-available K concentrations in the soil. It seems that soil analyses of plant-available K are not as sensitive as analyses of herbage K concentrations, and soil K status can be better predicted by the herbage K analysis.

Conclusion

Ten years of contrasting management resulted in relatively small changes in plant species composition, but these rather

slow changes are still in progress.

In contrast to K, ten years of nutrient depletion by cutting and biomass removal management was too short a period to affect plant-available P, Ca and Mg concentrations, but it was long enough to decrease concentration of P and K in the herbage.

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