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University of Natural Resources and Life Sciences, Vienna
Department of Integrative Biology and Biodiversity Research

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Short-term effects of cutting and organic fertilizer on species composition in semi-natural meadows

Angeringer, W.[1, 3], Karrer G.-[1], Starz, W.[2], Pfister, R.[2] and Rohrer, H.[2]

Introduction

Managed, semi-natural grassland contribute to about half of agricultural area in Austria (1.38 m. ha^{-1}). Therefrom, 0.25 m. ha^{-1} can be described as traditionally used semi-natural grassland with a maximum of two cuts or grazing terms per year. Due to sozio-economic changes in mountain regions, farmers increase their cutting frequencies as well as rate of organic fertilizing on proper sites. This process strongly alters species assemblages on former traditionally managed permanent grassland and plant species react by increasing or decreasing coverage. However, the rates of change in species cover of traditionally managed non-sown montane hay meadows remain unclear and are tested in an on-farm field experiment. In this poster trends of vegetation change due to cutting frequency and different manuring during three years of investigation are discussed.

Material and methods

Site description: Two meadows in the Upper Styrian Pöls valley (AUT, **Figure 1**), Cambisol of sandy loam, 950 m.a.s., 5.9 °C mean temperature, 850 to 1040mm annual precipitation 2009 – 2011

Soil parameters: pH ($CaCl_2$) 5.7-5.9; P (CAL) 36-71 mg kg-1; K (CAL) 133-271 mg kg-1

Association: *Cardaminopsido halleri-Trisetetum flavescentis* (Bohner 2000)

Design: Balanced incomplete blocks, 2x 30 relevés (N=60, n=10)

Treatment: Cutting frequency (2, 3, 4 times/year), type of organic fertilizer (slurry, manure), see **Table 1**

Variable: Species cover percentages before cutting and 1st-3rd June 2012

Statistics: SAS 9.2 Proc. Mixed, post-hoc Tuckey-Kramer, Principal Components Analysis (PCA) PCOrd 6.0, Graph Sigma Plot v.11

Table 2: Influence of treatments on cover percentage (%) of species with high contiunity (>90%) after three years of experiment.

	Cutting frequency							Organic fertilizer			
	2		*3*		*4*			*Slurry*	*Manure*		
	%		*%*		*%*		*SEM*	*p*	*%*	*%*	*SEM*	*p*
Creeping grass												
Poa angustifolia	22	a	21	a	***16***	b	1.2	***0.0010***	19	21	0.9	0.0479
Poa pratensis	1	a	1	a	2	a	0.4	0.1442	2	1	0.3	0.5621
Poa trivialis	***7***	a	10	a	22	b	1.5	***<0.0001***	14	12	1.3	0.1279
Tussock grass												
Lolium perenne	11	b	14	b	***19***	a	1.3	***0.0008***	15	15	1.1	0.8410
Trisetum flavescens	16	a	12	a	14	a	1.3	0.0899	15	14	1.2	0.3485
Dactylis glomerata	4	a	3	a	4	a	0.4	0.1303	4	4	0.4	0.1067
Festuca pratensis	3	ab	***4***	b	2	a	0.4	***0.0165***	2	***3***	0.3	***0.0345***
Creeping forb/legume												
Achillea millefolium	15	a	16	a	***8***	b	0.9	***<0.0001***	13	13	0.7	0.9473
Trifolium repens	12	a	13	a	15	a	1	0.0938	12	14	0.9	0.0673
Other forbs												
Taraxacum officinale	***7***	a	6	b	6	b	0.4	***0.0096***	6	7	0.3	0.0605
Crepis biennis	***10***	a	7	b	5	b	0.6	***<0.0001***	7	7	0.5	0.4261

Figure 1: Two sites of investigation.

Table 1: Treatment factors and mowing dates

	Main factors		Mowing and observation date			
	Cut-y	**Fertiliser-Nequ ha-1**	**1**	**2**	**3**	**4**
1	2 (zero)	Manure-70kgN ha-1	June 1-8	Aug. 17-20	*Okt. 19-21	–
2	2	Slurry-70kgN ha-1	June 1-8	Aug. 17-20	*Okt. 19-21	–
3	3	Manure-120kgN ha-1	May 16-23	July 18-21	Sept. 13-29	–
4	3	Slurry-120kgN ha-1	May 16-23	July 18-21	Sept. 13-29	–
5	4	Manure-150kgN ha-1	May 9-12	June 27-30	Aug. 1-5	Sept. 13-29
6	4	Slurry-150kgN ha-1	May 9-12	June 27-30	Aug. 1-5	Sept. 13-29
*3rd cut to imitate autumn grazing						

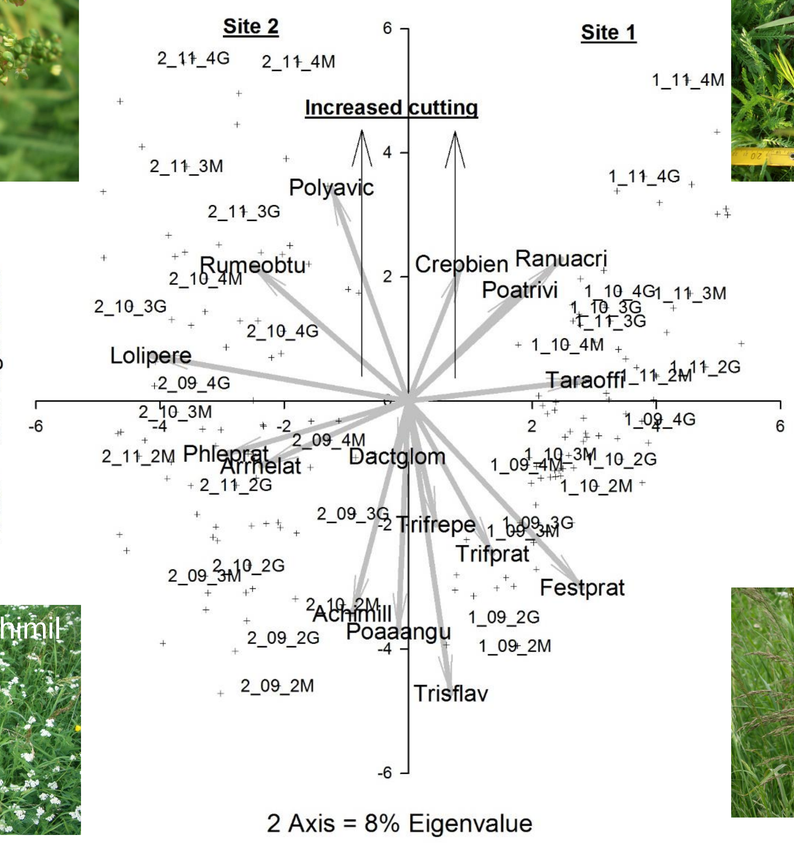

Figure 2: PCA of all species and replicates from 2009 to 2011 (centered, log[10] transformation, annual average species cover), arrows = direction of species within the biplot, marks = relevés, two rep. of every treatment each year with visible code: Site_year_cuts/y; fertilizer type (M=manure; G=slurry). Species codes: first four letters of genus and specific epithet of *Achillea millefolium, Arrhenatherum elatius, Crepis biennis, Dactylis glomerata, Festuca pratensis, Lolium perenne, Phleum pratense, Poa angustifolia, Poa trivialis, Polygonum aviculare, Ranunculus acris, Rumex obtusifolius, Taraxacum officinale agg., Trifolium pratense, Trifolium repens, Trisetum flavescens*

Results

Diversity: 71 vascular plant species – 49 grassland associatecd, 22 ruderals, range 19-30 species per relevé

Cutting frequency: significant influence to majority of species, **Table 2**

- susceptible to early cutting: *Poa trivialis, Lolium perenne*
- adapted to traditional management: *Poa angustifolia, Achillea millefolium, Trisetum flavescens (n.s.), Phleum pratense, Arrhenatherum elatius* **(Figure 2)**
- uninfluenced: *Dactylis glomerata, Trifolium repens*
- high annual fluctuation: forbs with seed reproduction only - *Taraxacum officinale, Crepis biennis* – **(Figure 2)**
- *ruderal species: Polygonum aviculare, Rumex obtusifolius* benefit from intense management **(Figure 2)**

Organic fertilizer: no significant influence to majority of abundant species, except *Festuca pratensis (in combination with three cuts)* and trend of *Trifolium repens* to manure, **Table 2**

Poa species: broad-leafed *Poa pratensis* recognized from *Poa angustifolia* in 2012, performed better to early cutting and slurry application (n.s.)

Conclusion

- **We recorded significant changes in coverage of most frequent meadow species due to cutting regime, but few response to type of organic fertilizer after 3 years of different manangement regime**
- **Of valuable crops only *Lolium perenne* increased coverage after intensification**
- **Occuring gaps are susceptible for settlement of less palatable meadow species as *Poa trivialis* and weeds as *Rumex obtusifolius***
- **Intensification, especially early mowing, leads to a unfavourable change in botanical composition of semi-natural montane hay meadows very soon**
- **Site-specific, well adapted ecotypes of common grassland species decline very soon due to intensification, *eg. Poa angustifolia agg., Achillea millefolium agg., Trisetum flavescens***

[1]University of Natural Resources and Applied Life Sciences
Department of Integrative Biology , Institute of Botany
Gregor-Mendel-Strasse 33, A-1180 Vienna (Austria),
wolfgang.angeringer@boku.ac.at

[2]Agricultural Research and Education Centre (AREC) Raumberg-Gumpenstein
Institute of Organic Farming and Farm Animal Biodiversity
Raumberg 38, A-8952 Irdning (Austria)

[3] Austrian Chamber of Agriculture, District of Styria
Department of Plant Production
Hamerlinggasse 3, A-8010 Graz (Austria)
wolfgang.angeringer@lk-stmk.at