Evaluation of site-specific and commercial seed mixtures for alpine pastures

Krautzer B.[1], Graiss W.[1], Peratoner G.[2] and Partl C.[3]
[1]*Institute of Plant Production and Cultural Landscape, Federal Research Institute Gumpenstein, 8952 Irdning, Austria*
[2]*Department of Forage Production and Grassland Ecology, University of Kassel, 37213 Witzenhausen, Germany*
[3]*Amt der Tiroler Landesregierung, Fachbereich Landwirtschaftliches Versuchswesen, 6020 Innsbruck, Austria*

Abstract

In most cases commercial seed mixtures containing varieties of lowland species are used for reseeding at high altitudes. However, in recent years, special seed mixtures containing a high percentage of site-specific species have become available on the market. Using data of the EU research project ALPEROS, commercial (SM1) compared to site-specific seed mixtures (SM2) were assessed on three sites at increasing altitude. Their suitability for reseeding alpine pastures was tested from an ecological as well as from an agricultural point of view. The use of site-specific species led to significantly better soil cover. Only the coverage achieved by SM2 could guarantee sufficient protection against erosion. Calculating the average energy yield of harvests in 2001 and 2002, the results showed a significant influence of altitude, but not of the seed mixture, on energy yield. Even though the concentration of metabolizable energy (ME) differed significantly between mixtures, only a slightly better forage quality was achieved by SM1.

Keywords: alpine pasture, seed mixture, restoration, site- specific species, energy yield

Introduction

Thousands of hectares are still machine-graded each year in the Alpine area for intensive road building, torrent and avalanche barriers as well as ski slopes and infrastructural measures. At increasing altitude, successful reseeding becomes increasingly more difficult due to the rapidly worsening climatic conditions. The first target function of restoration or reseeding in high zones is usually the achievement of stable grassland. This is particularly true in Austria, Switzerland and Bavaria, where most of those areas are used as pastures during summertime. For this reason, farmers' expectations for forage quality and yield are also valid for such reseeded areas. In this study, vegetation cover, dry matter yield, metabolizable energy and energy yield were assessed on three re-vegetated ski runs, comparing a widely used commercial seed mixture with site-specific seed mixtures containing species adapted to the prevailing climatic conditions, but also considered suitable for agricultural use (Krautzer *et al.*, 2001).

Materials and methods

For four years, an international research project has been carried out by various institutes. At three sites, the pros and cons of site-specific compared to commercial seed mixtures were tested. At the locations Sudelfeld (SU, Bavaria, 1,245 m), Hochwurzen (HW, Styria, 1,830 m) and Gerlos (GE, Tyrol, 2,280 m), similar trials arranged as two factorial split-plot designs with plots of 21 m², replicated three times, were carried out from 1999 to 2002. As factor 1, two application techniques were used (AT1 = hydro seeding, 15 g m^{-2} seeds, AT2 = hydro seeding, with vesicular-arbuscular mycorrhiza inoculum, 15 g m^{-2} seeds). Factor 2 was the seed mixture (SM1 = usual seed mixture; SM2 = site-specific seed mixture, containing site-specific grasses, leguminosae and herbs, see table 1). For more detailed information on locations, application techniques and seed mixtures see *www.alperos.org*. Plots were fertilised only once in the establishment year. Vegetation cover, botanical composition and subsequent yield and forage quality were assessed at the stage of flowering of *Festuca nigrescens*, in order to guarantee comparable conditions. Plots were harvested in 2001 and 2002 (two cuts at Sudelfeld, once a year at the other locations). Digestibility was estimated using the in vitro method of Tilley and Terry (1963). ANOVA was carried out for all comparisons. An F-ratio of $P < 0.05$ was regarded as significant. No significant differences between application techniques were found in 2001 and 2002, so these results are not reported.

Table 1. Composition of seed mixtures.

Grasses	SM 1 SU, HW, GE	SM 2 SU	SM 2 HW	SM 2 GE	Leguminosae and herbs	SM 1 SU, HW, GE	SM 2 SU	SM 2 HW	SM 2 GE
Agrostis capillaris	4,6		4	6	*Anthyllis vulneraria*		3	5	
Avenella flexuosa				6	*Lotus corniculatus*	5	3	3	6
Festuca nigrescens		28	35	22	*Trifolium badium*		1	5	2
Festuca ovina	2,5				*Trifolium hybridum*	2,4			6
Festuca rubra	31				*Trifolium nivale*			7	
Festuca supina				5	*Triolium repens*	4,2	6		6
Lolium perenne	15,7		3		*Vicia sativa*	3,4			
Phleum alpinum		5	10	6	*Achillea millefolium*	0,7		1	2
Phleum hirsutum		10			*Campanula barbarta*			0,22	
Phleum pratense	19,9				*Crepis aurea*		0,1	0,5	
Poa alpina		25	15	27	*Leontodon hispidus*		2	1	1
Poa pratensis	10,6				*Melandrium rubrum*			0,03	
Poa supina		5	5	4	*Plantago lanceolata*		1,9		
Poa violacea		10	5		*Silene vulgaris*			0,25	1

Results and discussion

Alpine ecosystems are characterised by unfavourable climatic conditions, with limiting effects on the growth and biomass production of plants. Such effects increase with altitude. Only sufficient vegetation cover can stabilise the topsoil and minimise soil erosion to an acceptable degree. Results of several assessments indicate that at altitudes between 1,200-2,400 metres, a minimum vegetation cover of 70-80 % is required to avoid erosion (Tasser *et al.*, 2003). Figure 1 shows a comparison of vegetation cover between sites, years and seed mixtures. In general, it was obvious that in high zones, seed mixtures need at least two growing seasons to achieve sufficient vegetation cover. At the Gerlos site, no sufficient cover could be established during the investigation period. Only the vegetation obtained with site- specific seed mixtures enabled sufficient protection against erosion at the Sudelfeld and Hochwurzen sites. A significantly lower mean cover value was obtained for SM1(60.5) than for SM2 (66.8). In accordance with previous results (Gruber *et al.*, 1998), dry matter yield (DMY kg ha^{-1}) decreased significantly with altitude but no differences between mixtures were observed, while the concentration of metabolizable energy (ME) differed significantly between seed mixtures. For SM1, a mean concentration of 9.2 MJ ME kg^{-1} DM was measured, whereas SM2 only achieved 8.6 MJ ME kg^{-1} DM. This can be partly explained by the faster development and growth of site-specific species at high altitudes, and therefore with earlier phenological development of commercial species at the time of cutting. Considering changes in the botanical composition of the trials during the first four years, a decreasing proportion of poorly-adapted, high quality species was observed in the commercial seed mixture. Thus, an adjustment of ME values can be expected at all locations. The energy yield (DMY x MJ ME) is a useful parameter to compare the three locations (Figure 2). As observed for DMY, the energy yield also showed a significant decline with increasing altitude. The highest value was found for SM1 at Sudelfeld (24.9 GJ ha^{-1} y^{-1}) and the lowest for SM2 at Gerlos (2.5 GJ $ha^{-1}y^{-1}$). In contrast to what was found for energy concentration, only slightly higher values, but no significant differences, in energy yield could be found between the different mixture types.

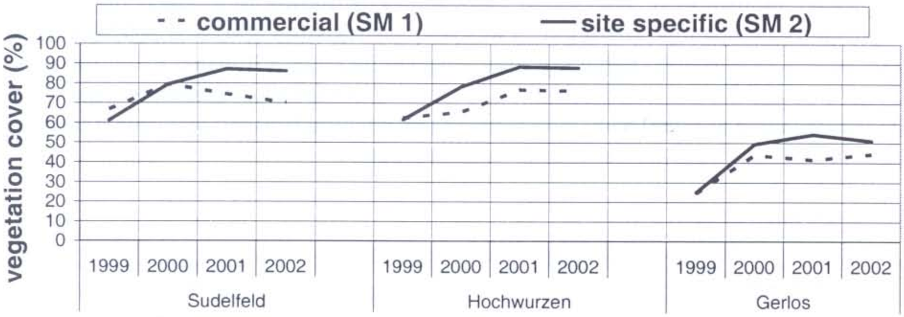

Figure 1. Development of vegetation cover in %, 1999-2002, comparison of three sites.

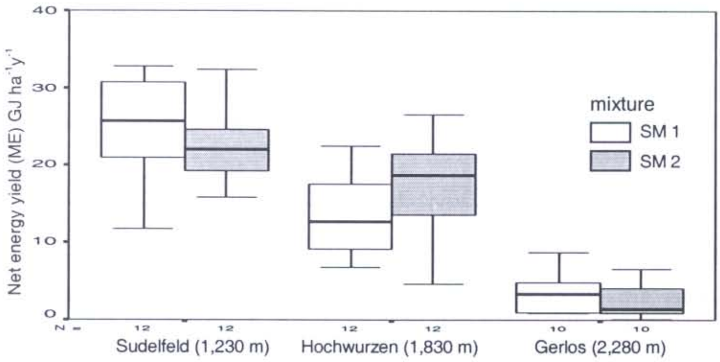

Figure 2. Average Net energy yield (Nel) in GJ ha^{-1} y^{-1} at the experimental sites (Ø 2000, 2001), comparison between commercial (SM1) and site specific (SM 2) seed mixtures.

Conclusions

On soils of low nutrient contents, significantly better vegetation cover and comparable energy yield can be expected if site-specific, instead of commercial seed mixtures, are used.

Acknowledgments

The project was supported by the European Commission (FAIR CT98-4024).

References

Gruber L., Guggenberger T., Steinwidder A., Schauer A., Häusler J., Steinwender R. and Sobotik M. (1998) Ertrag und Futterqualität des Höhenprofils Johnsbach in Abhängigkeit von den Standortsfaktoren. *Bericht 4. Alpenländisches Expertenforum* BAL Gumpenstein, pp. 63-95.

Krautzer B., Bohner A., Partl C., Venerus S. and Parente G. (2001) New approaches to restoration of ski slopes. *Grassland Science in Europe*, 6, 193-196.

Tilley J.M.A. and Terry R.A. (1963) A two stage technique for the in vitro digestion of forage crops. *Journal of the British Grassland Society*, 18, 104-111.

Tasser E., Mader M. and Tappeiner U. (2003) Effects of land use in alpine grasslands on the probability of landslides. *Basic and Applied Ecology*, 4, 271-280.