Grassland renovation by natural self-seeding

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Abstract

To meet the increasing demand for forage quality from grassland, different strategies of re-seeding are used in practice. Commercial seed mixtures are usually sown with different over-seeding techniques such as slot-drill machines or combined harrows. Natural self-seeding could be an interesting alternative to improve grassland stands without any technical effort. Two field trials have been carried out by AREC Raumberg-Gumpenstein to investigate different methods of grassland renovation in mountainous regions with consideration of technique, frequency, seed mixtures and also natural self-seeding. The efficiency of natural self-seeding was studied by quantifying the total seed-amount, the species spectrum, and by testing the germination capacity of the seeds. Yield and forage quality were considered as well as the botanical composition of the treated plots.

Keywords: grassland re-seeding, seed mixtures, germination capacity, forage quality

Introduction

For most Austrian grassland and dairy farmers, the use of home-grown forage from meadows and pastures is seen as a substantial element of their farm management system. Different methods that aim to improve forage quality are therefore of great interest. In addition to aspects of fertilization, weed control and forage conservation, grassland renovation is one of the basic keys to success. Due to the specific climatic and topographical conditions, renovation of mountainous and alpine grassland presents special challenges, both from a technical and an ecological point of view. Simple over-seeding, slot row seeding and band rotavator seeding are the mostly used methods for grassland renovation in Austria. Natural self-seeding of grassland, which was the common method for grassland renovation in the past, has become less important through the significant increase of cutting and grazing frequency. This paper deals with the potential of natural self-seeding on grassland, concerning seed amount, species spectrum and germination capacity, and it also considers the preconditions that have to be met for a successful implementation of this method in practice.

Materials and methods

Field experiments were established at two different sites. These were, (i) established in 2005, Gumpenstein (700 m a.s.l; 1000 mm yearly precipitation; 6.8°C average temperature) and (ii) established in 2006, Piber (450 m a.s.l.; 880 mm yearly precipitation; 8.2°C average temperature). In addition to various reseeding techniques and different seed mixtures, a focus was also given to natural self-seeding (singular = only once in the first year, and regular = every two years). Once the dominating plants reached the optimal stage of maturity the plots (28 m^2 each) were cut and threshed with a combine harvester. The threshing material was then dried, cleaned, separated for species and tested for their germination capacity. Yield, forage quality and the botanical composition of the experimental plots was determined to assess the effect of this natural method of grassland renovation.

Results and discussion

The total yield of cleaned seeds ranged between 20 and 92 kg ha^{-1} yr^{-1} of which in all years of observation the highest proportions were dominated by grasses, followed by herbs and clover (Table 1). For technical grassland reseeding measures, 5 to 20 kg of quality seed mixtures ha^{-1} are normally used in practice, which is considerably less than the seed amount obtained by natural self-seeding. There were great differences in the total seed yield both between years and sites, which indicates that the outcome of natural self-seeding is difficult to predict. Key factors concerning the achieved seed yield, and its species spectrum, are the botanical composition of grassland and also the vegetation stage and the maturity scheme of the different plant species.

Table 1. Seed production by natural self-seeding of permanent grassland (kg pure seeds ha^{-1} yr^{-1}; data based on 6 replications, mean values and standard deviations).

Site	Year	Grass seeds		Clover seeds		Herb seeds		Total seeds	
		x̄	σ	x̄	σ	x̄	σ	x̄	σ
	2005	12.8	4.1	6.0	1.0	2.3	0.9	21.0	4.9
Gumpenstein	2007	38.9	10.5	1.5	1.2	3.6	2.3	44.0	10.9
	2009	67.2	42.1	-	-	24.8	13.7	92.0	52.1
	x̄	39.6		2.5		10.2		52.4	
	2006	26.8	18.8	0.6	0.5	3.7	1.9	31.1	18.6
Piber	2008	13.7	8.5	-	-	6.5	6.1	20.1	7.9
	2010	28.5	24.5	-	-	7.7	6.1	36.2	22.7
	x̄	23.0		0.2		6.0		29.1	

About 20 different grassland species could be identified in the threshing material at both sites, which is much more than the average number of species in commercial seed mixtures. *Poa pratensis* and *Dactylis glomerata* were the dominating grass species in the seed material at Gumpenstein but their proportions differed strongly over the years. *Trifolium repens* was the dominating clover species, whereas *Lamium album*, *Ranunculus acris*, *Pimpinella major* and *Chaerophyllum hirsutum* were the main herbs in the harvested seed mixtures. At Piber *Dactylis glomerata*, *Lolium perenne*, *Poa pratensis* and *Phleum pratense* showed the highest proportion of total grass seeds; the dominating herbs were *Plantago lanceolata*, *Prunella vulgaris*, *Veronica chamaedrys* and *Galium album*, whereas legumes played a minor role.

Table 2. Germination capacity (according to ISTA, 2011) of selected species gathered by natural self-seeding at two different sites in Austria.

	Poa pratensis			*Dactylis glomerata*			*Festuca pratensis*			*Trifolium repens*		
	GCA*	x̄	σ	GCA*	x̄	σ	GCA*	x̄	σ	GCA*	x̄	σ
Gumpen-stein	80	87	9.8	80	56	14.2	85	78	27.7	85	39	8.7
	Poa pratensis			*Dactylis glomerata*			*Lolium perenne*			*Phleum pratense*		
	GCA*	x̄	σ	GCA*	x̄	σ	GCA*	x̄	σ	GCA*	x̄	σ
Piber	80	88	5.4	80	74.8	4.6	85	89	4.5	85	85	3.6

GCA* = required minimum germination capacity for species of quality seed mixtures in Austria, followed by mean value and standard deviation

The most relevant species were tested for their germination capacity (Table 2). Compared with the official Austrian seed quality guidelines (Krautzer *et al*., 2010) *Poa pratensis*, *Lolium perenne* and *Phleum pratense* partly even exceeded the required values, whereas *Dactylis glomerata*, *Festuca pratensis* and *Trifolium repens* failed. In the case of *Trifolium repens* a high proportion of hard seeds were responsible for the unusual low level of germination capacity. Compared with normal harvesting times in agricultural practice the plots of the natural self-seeding variants were harvested 6 to 8 weeks later to achieve sufficient yield of ripe seeds. This time lag negatively influenced both yield and forage quality of the particular growth and was resulting in partly significant lower average values of regular natural self-seeding for the total observation period compared to the untreated control and the technical re-seeding treatments at both sites (Table 3). Overall, singular self-seeding performed much better than regular self-seeding. At Gumpenstein the technical reseeding treatments performed slightly better than the untreated variant, whereas at Piber no positive effect could be observed.

Table 3. Yield and forage quality data of two reseeding experiments in Austria.

	Gumpenstein (average of 2005–10)			Piber (average of 2006–10)		
Parameters	DM[1]	CP[2]	GJ NEL[3]	DM	CP	GJ NEL
Treatments	t ha^{-1}	g kg DM^{-1}	ha^{-1}	t ha^{-1}	g kg DM^{-1}	ha^{-1}
Control	101.0[ab]	132.2[a]	51.3[a]	70.9[a]	115.4[a]	39.2[a]
Singular natural self-seeding[4]	95.4[b]	131.5[a]	46.8[ab]	71.9[a]	106.6[a]	36.7[a]
Regular natural self-seeding[5]	79.8[c]	114.8[b]	36.7[b]	65.5[a]	106.1[a]	28.7[b]
Technical seeding	106.6[a]	135.4[a]	53.9[a]	69.4[a]	112.8[a]	36.6[a]

[1]Dry Matter, [2]Crude Protein, [3]Gigajoule Net Energy Lactation, [4]natural self-seeding only once in the first year, [5]natural self-seeding every two years, [a, b, c] treatments with different letters are significantly different (P<0.05)

Concerning the impact of natural self-seeding on the botanical composition an increase of grasses could be noticed at both sites within the observation period. The proportion of legumes declined whereas that of herbs remained stable.

Conclusions

Natural self-seeding of grassland provides remarkable amounts of seeds with a mostly acceptable germination capacity. The species composition of seeds is depending on the floristic diversity of the vegetation but also on the time of self-seeding. A basic assumption to accept natural self-seeding of grassland is the absence of problematic weeds, as far as possible, to avoid a degradation of the vegetation. It has to be taken into account that this alternative method of grassland re-seeding causes both a significant yield reduction and low forage quality of the concerned growth. Regarding the increasing requirements for yield and forage quality in modern grassland farming, natural self-seeding can be regarded as a method primarily recommended for farming systems that follow a low intensity strategy.

References

ISTA (2011) International Rules for Seed Testing, Edition 2011/1, ISBN 13-978-3-906549-63-7.

Conijn J.G. and Taube F. (2004) Grassland resowing and grass-arable crop rotations. Consequences for performance and environment. Second workshop of the EGF-Working Group *Grassland Resowing and Grass-arable Rotations* at Kiel, Plant Research International, Wageningen UR, Report 80, 82 pp.

Krautzer B., Buchgraber K., Egger H., Frank P., Frühwirth P., Hietz M., Humer J., Leonhardt C., Luftensteiner H., Mechtler K., Meusburger C., Peratoner G., Pötsch E.M. and Starz W. (2010) *Handbuch für ÖAG-Empfehlungen von ÖAG-kontrollierten Qualitätssaatgutmischungen für das Dauergrünland und den Feldfutterbau 2011-2013*, Österreichische Arbeitsgemeinschaft für Grünland und Futterbau, c/o LFZ Raumberg-Gumpenstein, Irdning, 25 pp.