

PHYTOSOCIOLOGICAL DEFINED SEEDINGS RECONCILING NATURAL DIVERSITY AND SOIL PROTECTION ON RIVULETBANKS, PART I

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ZUSAMMENFASSUNG

Im Rahmen von Fließgewässerrenaturierungen werden von Seiten der Landschaftsgestaltung Saatmischungen zum Erosionsschutz eingesetzt. Bei Zusammenstellung und Einsatz dieser Saatmischungen werden bislang nur wenig die besonderen Standortbedingungen berücksichtigt und auch dem Ziel, eine möglichst naturnahe Artenvielfalt mit Hilfe der Saatmischungen zu ermöglichen, wird bislang nur sehr wenig Aufmerksamkeit geschenkt. In diesem Zusammenhang wurden verschiedene Gräser bezüglich ihrer Fähigkeit, wassergesättigten Boden zu durchwurzeln, untersucht. Ausgewählt wurden zum einen Gräser, die häufig in Saatmischungen der Landschaftsgestaltung eingesetzt werden, und zum anderen Gräser, die nur selten oder gar nicht eingesetzt werden, aber natürlicherweise an grundwassernahen Standorten verbreitet sind.

Die Ergebnisse deuten an, daß eine Ausweitung des in Saatmischungen an Fließgewässern eingesetzten Artenspektrums um standortgerechte Arten nicht nur die natürliche Vielfalt sondern auch den Erosionsschutz erhöhen würde.

keywords: *landscape design, seed mixture, natural diversity, soil protection, erosion, root growth pattern, ground water table*

INTRODUCTION

In connection with the so-called "Renaturalisation of Flowing Waters", i.e. the improvement of the ecological state of rivers by measures of landscape design, landscape engineers use sowings to protect the newly modelled streambanks against erosion (DONNER 1983). Until now the composition of those seedings was only chosen with regard to soil protection and merely a couple of common grass species traditionally used in sowings for agriculture and landscape design (FLL 1987; HESA-RASENPRODUKTE 1988), were taken into consideration. The application of phytosociological knowledge in the practise of landscape design at streambanks is still restricted to plantations of big tall reed grasses like *Phragmites communis* Trin. (BITTMANN 1953; BEGEMANN und SCHIECHTL 1986) or woody plants like *Alnus glutinosa* (L.) Gaertn. (LOHMEYER and KRAUSE 1975; KIRWALD 1976; BEGEMANN and SCHIECHTL 1986).

In our investigations we were looking for strategies to integrate ecological aspects (natural diversity) in existing landscape engineering measures (seedings for soil protection against erosion). Thus we examined the succession of vegetation starting on bare soil and with different kinds of seedings in order to find the optimal seeding-composition for streambanks to satisfy both requirements (cf. STOCKEY and BRECKLE 1989). These investigations showed distinct differences in vegetation depending on small changes (about 30 cm) in the mean water table. Following LOHMEYER and KRAUSE (1975), who describe the root growth of different tree species and their importance for preventing erosion on streambanks, we investigated the growth of different grasses at different groundwaterlevels, especially the ability of their roots to penetrate the water saturated soil. We chose three grass species (*Agropyron repens* (L.) PB., *Festuca rubra* L. and *Lolium perenne* L.) which make part of a seed mixture commonly used

for soil protection at newly designed streambanks (cf. FLL 1987; HESA-RASENPRODUKTE 1988; STOCKEY and BRECKLE 1989) and two grass species used rarely (*Phalaris arundinacea* L.) or not at all (*Glyceria fluitans* (L.) R.Br.).

In contrast to *Agropyron repens* (L.) PB., *Festuca rubra* L. and *Lolium perenne* L., the last two mentioned both are typical grasses of natural vegetation on streambanks (cf. LIENEN-BECKER 1971; HILLER 1980). Following ELLENBERG (1986) *Glyceria fluitans* (L.) R.Br. is character species of the *Spargano-Glycerion fluitantis* and *Phalaris arundinacea* L. is character species of the *Phalaridion*.

MATERIAL AND METHODS

The grasses were sown in glass-faced boxes (root growth chambers) placed in inclined position (cf. BÖHM 1979; BERTEL'S et al. 1989) and grown at water tables of -10 and -40 cm. After three months the above-ground biomass and the underground biomass, separated in different soil layers, were determined.

RESULTS AND DISCUSSION

The five grass species show different growth patterns at the two levels of water table (Tab. 1, Fig. 1 and Fig. 2).

Three main types of behaviour can be distinguished:

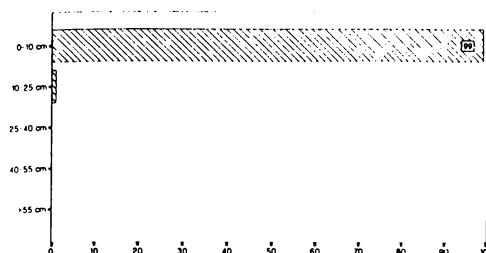
1. *Festuca rubra* L. with a strong decrease of biomass production at high water table and no root growth into the water-saturated soil.
2. *Agropyron repens* (L.) PB. with no remarkable reduction of biomass production but at the same time a strong decrease of rooting into lower soil layers at high water table.
3. *Glyceria fluitans* (L.) R.Br. with a strong increase of biomass production at high water table and a high penetration of the roots into the water-saturated soil.

Similar to *Alnus glutinosa* (L.) Gaertn. (LOHMEYER and KRAUSE 1975), *Glyceria fluitans* (L.) R.Br. provides a good protection against erosion, whereas, similar to *Populus x canadensis* Moench (LOHMEYER and KRAUSE 1975), *Agropyron repens* (L.) PB. increases the danger of undermining the fresh grass sward on stream-sides. It is obvious that *Festuca rubra* L. is not suitable to stands with high groundwater level.

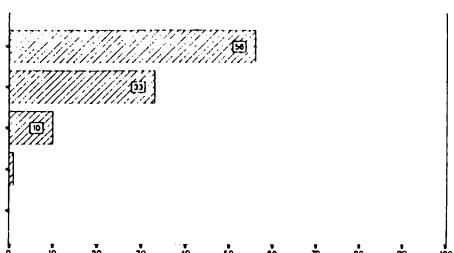
Tab. 1: Above Ground- and Underground Biomass production of the five grass species at two different levels of water table

Species	Fest. rub.		Agr. rep.		Lol. pere.		Phal. ar.		Glyc. fl.	
Water Table (cm)	-10	-40	-10	-40	-10	-40	-10	-40	-10	-40
Total Biomass (g dry weight)	1.69	2.78	7.15	8.47	6.90	4.78	10.60	2.22	6.68	2.37
Total Biomass (% of Total Biomass at Watertable of -10 cm)	100	170	100	118	100	69	100	21	100	35
Underground Biomass (g dry weight)	0.70	0.99	4.82	4.00	2.66	1.34	6.48	0.73	3.71	0.97
Underground Biomass (% of Undergr. Biomass at Watertable of -10 cm)	100	141	100	83	100	51	100	11	100	26
Underground Biomass (% of Total Biomass)	41	36	67	46	38	26	61	29	55	44

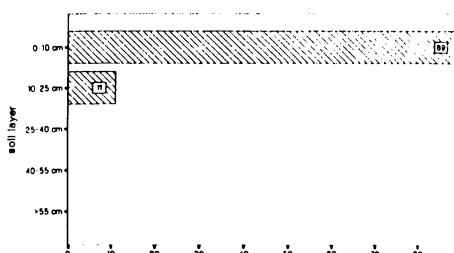
Festuca rubra / water table -10 cm



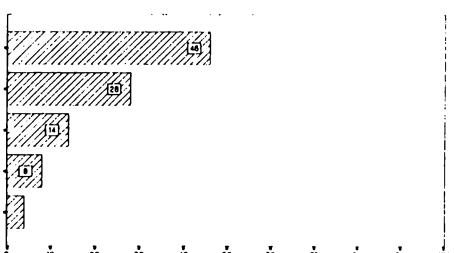
Festuca rubra / water table -40 cm



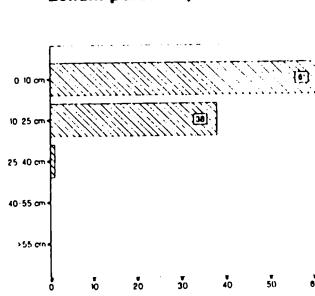
Agropyron repens / water table -10 cm



Agropyron repens / water table -40 cm



Lolium perenne / water table -10 cm



Lolium perenne / water table -40 cm

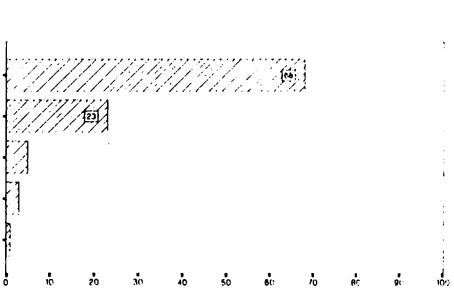


Fig. 1: Underground Biomass distribution of Festuca rubra, Agropyron repens and Lolium perenne on the separated soil layers with a water table of -40 cm and -10 cm.

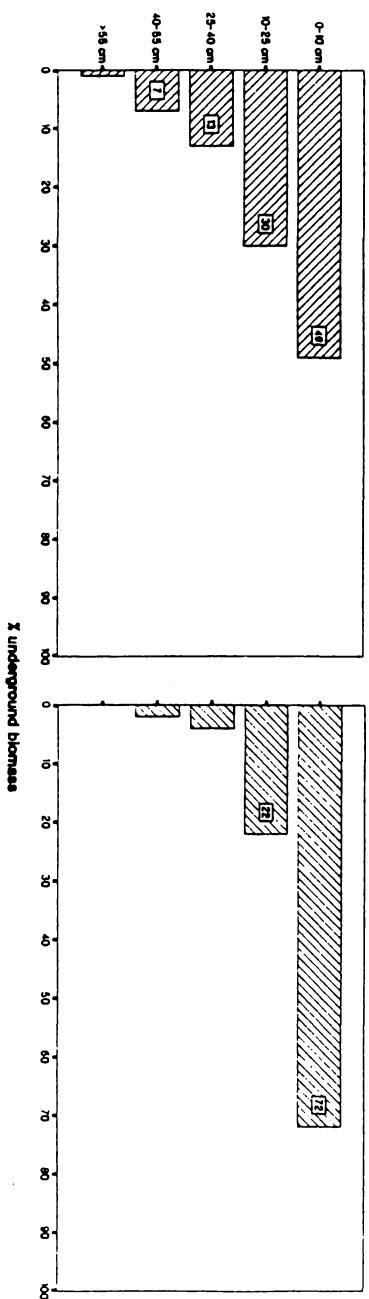
Lolium perenne L. and *Phalaris arundinacea* L. are species lacking one of these distinct growth patterns. The high biomass production (10,6 g of Total biomass and 6,48 g Underground biomass) of *Phalaris arundinacea* L. at high water table (Tab. 1) reveals, that like *Glyceria fluitans* (L.) R.Br. this species is a more suitable grass for streambanks than *Festuca rubra* L., *Agropyron repens* (L.) PB and *Lolium perenne* L..

The results show that similar to phytosociological defined plantations (BEGEMANN and SCHIECHTL 1986) the inclusion of character species of the *Sparganio-Glycerion fluitantis*

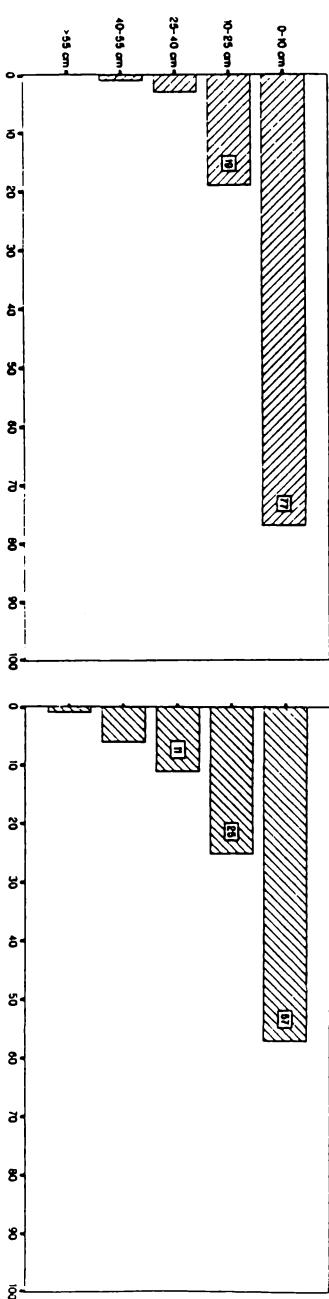
Phalaris arundinacea / water table -10 cm

Phalaris arundinacea / water table -40 cm

soil layer



Glyceria fluitans / water table -10 cm



Glyceria fluitans / water table -40 cm

Fig. 2: Underground Biomass distribution of *Phalaris arundinacea* and *Glyceria fluitans* on the separated soil layers with a water table of -40 cm and -10 cm.

and the *Phalaridion* into seed mixtures for streambanks will improve the soil protection against erosion.

Preliminary results of investigations started in spring 1989 give hints that there are other species (e.g. *Juncus bufonius* L. and *Alisma plantago-aquatica* L.) adapted to distinct ecological conditions like high water table or temporary floods. The use of these species in seed mixtures for streambanks would be advisable.

CONCLUSION

These results suggest that an integration of soil protection and natural diversity can be achieved. Furthermore it seems possible to improve both the natural diversity as well as the function of soil protection on rivulet banks with seed mixtures arranged under phytosociological aspects, if the composition of species is specifically suited to the distinct ecological conditions of the type of location. Thus seed mixtures for "natural" landscape design should be composed on the basis of phytosociological knowledge.

For the application of this demand it is necessary to increase the number of commercially available species in order to provide landscape architects with a variety of suitable seed mixtures.

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