Comparison of three Revegetation Methods on a Dike of the River Rhine (Sod Transplantation, Heudrusch™-Sowing, Commercial Seed), regarding Biodiversity, Ecological Value and Erosion Control

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Problem situation and study target

Alarming worldwide loss of species and biocoenoses call for revegetation methods using autochtonous plant material. With regard to flood protection, riverside vegetation has to meet bioengineering requirements besides its ecological function. Until agricultural land use changed to an industrialized farming in the middle of the last century, river dikes in the lower Rhine area were commonly grown with thermophilic, species-rich meadows and dry grassland. Intensive land use, fertilizing and herbicide use led to a considerable loss of these plant communities. A relocated dike of the River Rhine near Monheim (county Mettmann, Germany) was revegetated by three different methods: 1. Transplantation of meadow sods taken from the old dike (autochthonous plants), 2. the Heudrusch™-Method (autochthonous seed harvested on suitable donor areas (fig. 4), and 3. sowing a commercial culture seed blend ("Emscher-blend"). The respective vegetation was surveyed by permanent plots. The examination objective was the evaluation and comparison of cover increase, cover density, species diversity, and bioengineering function.

Method

Three permanent plots were installed in 2003 on each dike section having been revegetated by sod transplantation, by Heudrusch sowing, and by sowing the Emscher-blend. In 2004, five more plots were installed on the Heudrusch section. The plot size varied from 9 to 25 m². The respective vegetation was surveyed once a year in May/June according to Braun-Blanquet.

Results

Cover Increase and Cover Density

Evaluation of the permanent plots showed considerable differences in the density of the vegetation cover. The densest vegetation, showing a constant or even increasing cover of 92-100%, could be found on the sod plots and the Heudrusch plots. By contrast, the Emscher-blend plots showed a decreasing vegetation density, resulting in covers of only 70-75% in the third year of observation (fig. 1).

Fig. 1: Comparison of vegetation cover on the permanent plots.

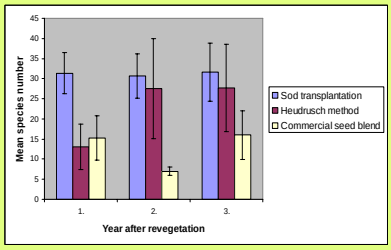

Fig. 2: Comparison of mean species number on the permanent plots.

Species Diversity

The highest species diversity could be found on the sod plots showing an average species number of 30 already in the first year after transplantation, closely followed by the Heudrusch plots which showed almost the same diversity in the second year. The lowest number of species grew on the Emscher-blend plots, which showed only about 50 % of the species number of the other plots (fig. 2).

Plant Sociology

The sod and Heudrusch plots contained a comparatively high number (45-58 %) of plant species being character- and differential species of meadows and dry grassland, and 42-55 % of accessory species. The Emscher-blend plots contained only 33-42 % of meadow species, but 58-67 % of accessory species. The sod plots showed a relative high continuity and abundance of *Bromus erectus* and *Salvia pratensis* and a bigger amount of rare species and species prefering poor soil nutrient conditions. From a plant sociological point of view, the sod section can be described as a dry grassland vegetation (Mesobromion) with a high value for nature conservation. The Heudrusch plots showed an initial stage of a meadow vegetation (Arrhenatheretum) with an increasing tendency towards dry grassland vegetation. Apart from sporadically growing *Bromus erectus*, several species indicating poor nutrient provision and ecological valuable vegetation could be found on these plots. The Emscher-blend plots showed only few species of dry grassland vegetation even three years after revegetation (fig. 3). These species predominantly derived from the seed blend. Dominating species were *Festuca rubra* and *Lolium perenne*, which were also part of the seed blend.

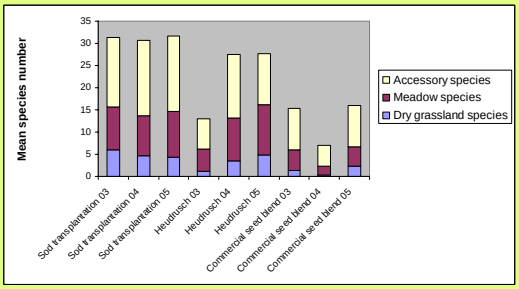

Fig. 3: Comparison of mean species number related to sociological affiliation.

Bioengineering Effect

Due to cover density, the best erosion control effect was achieved by autochthonous plant material supplied by sod transplantation and Heudrusch sowing. Moreover, a high species diversity leads to a diversified root system which additionally enhances bioengineering effects.

Esthetic Aspects

Compared to the Emscher-blend plots, the sod plots and the Heudrusch plots bear a considerable manifold flower aspect due to a bigger species diversity (fig. 5-7).

Fig. 4: View of the donor area harvested for Heudrusch sowing.

Conclusions and Outlook

With regard to soil bioengineering, several authors could show that the best erosion control effect is generally achieved through species-rich grassland with a high value for nature conservation. Taking into account also the vegetation cover, it can be postulated that sod transplantation and Heudrusch sowing are suitable procedures to attain successful bioengineering results. Sowing of the commercial Emscher seed blend led to a lower cover density and to a vegetation with less species. It must be concluded that the latter method is less suited for a safe erosion control.

As to biodiversity and plant sociology, sod transplantation will generate ripe and stable, species-rich phytocenoses with a high value for nature conservation. Heudrusch sowing offers the opportunity to transfer a sizeable big share of species growing on the donor area, including the potential to develop to dry grassland vegetation with a high value for nature conservation. The lowest value was achieved by the Emscher-blend plots.

As sod transplantation is time and cost intensive, Heudrusch sowing is a more reasonable method for transfering species-rich grassland. Therefore, a combination of both procedures should be recommended with regard to economical as well as phytosociological aspects. Some small spots of transferred sods within areas revegetated with Heudrusch seed would be suitable to work as start spots for soil fauna, for spore plants, and for species which are difficult to get established via Heudrusch sowing. This recommendation is not reduced to dike construction, but should be extended to any kind of civil engineering and landscaping in order to conserve local plant and phytocenosis diversity and to prevent the expansion of culture species designed by man.

Fig. 5: Species-rich Mesobromion society with *Salvia pratensis* established by sod transplantation showing a high value for nature conservation.

Fig. 6: Vegetation established by Heudrusch sowing showing an increasing tendency towards dry grassland vegetation.

Fig. 7: *Festuca*- and *Lolium*-dominated vegetation of dike sections sown with commercial seed (Emscher-blend) show only few species and thus a comparatively monotonous cover.

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