

**Large-scale grassland restoration: high diversity
seeding and knowledge transfer of regional seed
propagation to Hungary**

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Motivation & Aim

Within the Pro-SEED DBU project, a cooperation of Hungarian and German partners intended to develop an innovative concept for alkali- and loess grassland restoration in the Hortobágy National Park (East-Hungary). We used a two-phase restoration approach that is especially feasible for large-scale restoration. In the first phase within the frame of the Grassland restoration and marsh protection in Egyek-Pusztakócs (LIFE04 NAT/HU/000119) LIFE project, arable weeds were suppressed by sowing of a low diversity seed mixture of competitive grasses. In the second phase in the present DBU project species-rich target forb seed mixtures were sown in so-called establishment windows, which act as seed sources for further colonisation. At the moment, there are open questions concerning the size of the establishment windows and the influence of grazing on the establishment rate and seed production of sown species.



Project site in the Hortobágy National Park. [1]

In Egyek-Pusztakócs (Hortobágy National Park) altogether 760 ha alkali- and loess grasslands were restored on former arable lands by sowing low diversity seed mixtures between 2005 and 2008. Due to the restoration efforts species-poor grasslands characterised by competitor grass species were formed within three years. However immigration of typical grassland species to the restored grasslands was hindered in many sites, where the proportion of loess grasslands (which could act as seed sources) was low. More information of the LIFE project can be found at <http://biodiversity.unideb.hu>.



Species-rich dry loess grassland in the Hortobágy National Park. [2]

In Hungary, wild plant seeds of regional provenance have not been available commercially till now. Therefore, the project consortium supports the Salvia Environmental and Nature Protection Association to start seed propagation to produce seeds of local provenance available for restoration projects in the future. The project also helps to establish a donor site register of the Hortobágy National Park to identify species-rich grasslands. The donor site register supports the selection of sites suitable for the collection of seed material for propagation.

Seed propagation of wild plants in Hungary

Seed propagation of wild plants is a rather difficult task. Species have various requirements for germination, growing, harvesting, cleaning and seed storing. Seed producers have to find innovative solutions to cope with drawbacks caused by climate, pests, weeds, and bridge knowledge gaps concerning wild plant growing. In Germany, there are seed companies regionally producing and selling seeds of 450 wild plants in eight geographical seed production zones. Conversely, in Hungary, even regionally produced seeds of common grasses are unavailable.

Supported by a German seed producer, the project team selected target plant species suitable for agricultural propagation and restoration, compiling their specific requirements for germination, establishment, seed harvest and processing. During a project workshop in Bernburg in May 2014, the Hungarian team had the opportunity to become acquainted with the whole process of agricultural seed propagation of wild plants. During the yearly meeting of the German Association of Wild Seed and Plant Producers, they were able to discuss questions with the members.



Visiting the German propagation sites and greenhouses. [3–4]

Parent seed material was collected in the Hortobágy National Park in summer 2013 and seeds were sown in a greenhouse in spring 2014. The Hortobágy National Park administration selected suitable sites for agricultural seed propagation. The Salvia Environmental and Nature Protection Association planted and/or sown the following target species on arable land between September and mid of October 2014.

- *Achillea collina* (transplants and seed sowing)
- *Agropyron pectinatum* (seed sowing)
- *Centaurea scabiosa* (transplants and seed sowing)
- *Dianthus ponederae* (transplants and seed sowing)
- *Festuca rupicola* (seed sowing)
- *Filipendula vulgaris* (transplants and seed sowing)
- *Hypericum perforatum* (transplants and seed sowing)
- *Melandrium viscosum* (transplants and seed sowing)
- *Phlomis tuberosa* (transplants and seed sowing)
- *Salvia austriaca* (transplants and seed sowing)
- *Salvia nemorosa* (transplants and seed sowing)
- *Silene vulgaris* (transplants and seed sowing)



From left: planting in rows, and propagation site. [5–6]

Donor site register for species-rich grasslands

In restoration projects, it is important to use seeds from local provenance as these ecotypes are better adapted to the local environmental and climatic conditions than other ecotypes or commercial cultivars. In Germany, there is a well-developed network containing information on grasslands (donor sites) for eight seed zones and provenance regions (characterised by similar terrain, edaphic and climatic conditions). Donor site registers and sorted lists of target species of the provenance regions are a great help for NGOs, nature conservation authorities and stakeholders to obtain seeds of grassland species for restoration and conservation actions from local provenance.

In many parts of the Great Hungarian Plain, the area of former species-rich grasslands decreased considerably, because grassland stands were ploughed due to their fertile chernozemic soil. In our region, most stands of the remaining species-rich loess grasslands are managed by the Hortobágy National Park Directorate.

A data base about still existing grasslands can support conservation actions as well as restoration projects, because these stands can act as donor sites of seed material. The data base of potential donor sites will encompass ecological as well as economical data. The knowledge about valuable donor sites will support also their proper management. Grasslands listed in the database can be used for the collection of basis seed for seed propagation in frame of the project but also for small-scale on-site harvesting via threshing, mowing, or raking.

Restoration of species-rich grasslands

In the Hortobágy National Park, 32 establishment windows (sized 16 m², 4 m² and 1 m²) were established in October 2013 on restored grasslands (restored by alkali or loess seed mixtures sowing in 2005). After tilling and seed bed preparation, the windows were sown with 35 regionally collected target species in a seed density of 10 g/m². The selected target species are characteristic species of loess and alkali grasslands and originated locally from the Hortobágy and Nagykunság region.

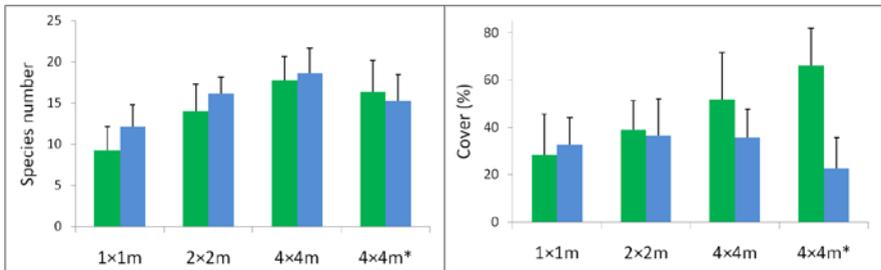
Our study focuses on the following questions: (1) Is soil preparation positive for the establishment of sown target species? (2) Which size of establishment windows is the most proper for the establishment and dispersal of sown target species? (3) How does the management regime (with or without grazing) influences the establishment rate and seed production of sown species?



From left: cleaned seeds before mixing; fenced 16 m²-establishment window during soil preparation. [7–8]

First results: establishment windows

In the first year, 33 out of 35 sown species were established in the windows. In different window sizes the following establishment rates were reached: 1 m² 66 %, 4 m² 86 %, 16 m² (unfenced) 89 % and 16 m² (fenced) 80 % of the target species were successfully established.

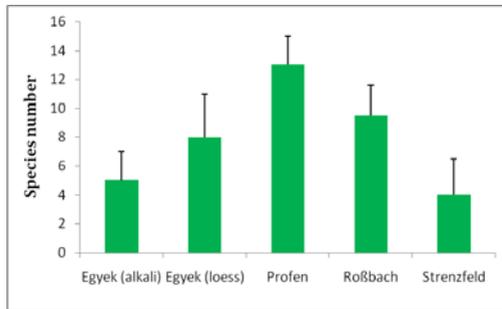


Mean species number (A) and mean cover of species (B) in the establishment windows. Green = sown; blue = spontaneously immigrated; * = fenced sites.

In the 16 m²-sized establishment windows, sown target species reached the highest mean species numbers and mean cover. In fenced windows, species numbers were slightly lower than in unfenced ones. In contrast, in fenced windows sown species reached the highest and spontaneously immigrated species the lowest cover compared to all other windows.

Immigration of target species

To answer the question, which factors are decisive for the successful colonization of species-poor sites, we studied the migration of sown target species into control sites without direct species introduction in old restoration sites in Germany and Hungary. In a comparative study in summer 2014, we recorded the number and cover of successfully immigrated target species, migrating from adjacent sites with species introduction.



Immigrated target species in old restoration trials.

In the Hortobágy National Park, 9 years ago, alkali- and loess grasslands were restored with seed mixture sowing (containing 2 or 3 native grass species). Until 2014, more target species immigrated into loess sites than to alkali sites probably due to the lower salinity. On both sites, the sown grasses still dominated the vegetation. In Germany, 3 sites were studied: (1) a 10-year-old grass margin in Strenzfeld, (2) a 14-year-old slope sown with 3 commercial grasses in the mine Profen, (3) a 4-year-old slope spontaneously vegetated in the mined site Roßbach. Here, the number of immigrated target species is highest on older sites with lower grass cover.



Top: fenced establishment window; bottom: seedling of the sown *Centaurea solstitialis*, *Silene vulgaris*, *Trifolium striatum* and *Galium verum*. [9-10]

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