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SUSTAINABLE PERMANENT GRASSLAND

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Permanent grassland overseeding and slot seeding with diverse species and mixtures

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- **DESCRIPTION:**. Oversowing and slot seeding are two methods of sward improvement by which we introduce seeds of desired species that may be only partially present or entirely missing. The seed can be oversown on the surface of the soil or in slots created by a specially designed slot seeder machine.

Fig.1: Thin grassland suitable for overseeding

Fig.2: Slot seeding into thin pasture sward

- **RATIONALE:**

Cultivated grasses and legumes usually produce higher yields, provide forage of better quality and utilise nutrients more effectively than wild species. In intensively utilised grasslands, the proportion of legumes (e.g. white clover, Trifolium repens, and red clover, Trifolium pratense) and cultivated grasses usually decreases over time. Legumes fix nitrogen (N) from the air (150 – 300 kg N/ha/year) and transfer some of this to accompanying grasses. Unlike manufactured nitrogen fertilisers, this does not involve the burning of fossil fuels, thereby resulting in lower CO2-equivalent greenhouse gas emissions per unit of fixed N. The legumes in grassland swards enhance yields and produce high-quality forage (high crude protein, palatability, digestibility). Deep rooting forbs and legumes can extract water and nutrients from deeper soil layers that may be beyond the reach of fibrous grass roots. The presence of these species in swards can therefore stabilise forage production in dry years.

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Fig.3: Overseeded area, previously damaged by cattle in a winter feeding area

- **MECHANISM OF ACTION:**

Cultivating the soil to at least 40% bare soil creates establishment niches for sown species, while retaining species within the current sward. When oversowing, seed is typically broadcast on the surface and rolled in. The sown species may be grasses, legumes and/or herbs; and, where increasing biodiversity is the main objective, regionally native species and hemiparasitic plants. If successful, the improved sward can increase yield/productivity (more productive species), reduce reliance on manufactured nitrogen fertiliser (more legumes), increase resilience to drought (deep rooting species), improve forage quality (cultivated species) and/or improve biodiversity (diverse seed mixtures and use of hemiparasitic plants). Introducing new plant species into an established sward is more difficult than seeding into a prepared seedbed devoid of vegetation, and weather conditions can strongly affect the outcome. To reduce the impact of drought, oversowing is most effective in late summer, autumn or early spring, although this is highly dependent on weather patterns. It can also be effective during a period of moist weather after a first cut of silage. In most regions, oversowing should be carried out before early September, although in cooler regions (generally further north or at altitude) the 'cut off' is early August. Oversown grasslands must be cut early (once the existing sward has a height of 20-30 cm) so that the seedlings of desired species are not outcompeted for light and water by existing plants and can establish in the new sward. Fertilising grassland before or shortly after over-seeding should be avoided to reduce the growth of the original sward. In some cases, it may be useful to apply a low dose of herbicide (glyphosate 0.5 l/ha a.i.) before sowing to reduce competition of the original sward. In the case of weed infestation (especially of species such as broad-leaved dock, thistles, dandelion) it is essential to apply selective herbicides before oversowing. Thatch and mosses should also be removed by harrowing before oversowing. To ensure good seed to soil contact, either use grazing livestock to trample the seed into the soil or roll immediately after oversowing.

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Fig.4: Emerging legumes after slot seeding

- **POTENTIAL FOR APPLYING THE MANAGEMENT OPTION:**

Overseeding techniques can be used in any biogeographic region and in many situations where soil cultivation is limited by designation, topography and/or soil stoniness, wetness or shallowness. It is applicable on conventional and organic farms. Grasslands with no or negligible legumes presence, but suitable conditions for their growth (e.g., soil pH above 5.0 , gaps in the sward), are suitable for overseeding or slot seeding. Increasing botanical diversity beyond a few species may be challenging on sites with high soil fertility and/or high weed burden. However, on such sites a limited number of species (2-5) can be selected to improve grass yield and quality. The species chosen must be suited to the site conditions.
Should this be 5.5 or even 6.0? We advise an optimum soil pH of 6.0 for grass-clover swards on minreral soils.
In sandy soils and in humid areas, it is challenging to increase soil pH above 5.0. I have experiences that at soil pH 4.9 red and white clover thrive well at our research station.

Fig.5: Machine suitable for slot seeding

Fig.6: Machinery for grassland oversowing equipped with Cambridge roller

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- **POTENTIAL FOR APPLYING THE MANAGEMENT OPTION:**

Red clover (*Trifolium pratense*) can be a useful and reliable species for grassland oversowing, particularly in Continental climatic conditions. Its weight share in the seed mixture should be at least 50%. By contrast, lucerne is usually not a good choice due to its slow initial development (limited ability to compete after emergence). Forage varieties of chicory and ribwort plantain are also available for pastures. They can provide higher production than grasses on less fertile soils, and palatable fodder for grazing animals with high water content. They can also help overcome summer stress as they are drought tolerant thanks to their deep root system. Seed mixture seed rates typically range from 15 to 40 kg per ha. For red clover and ryegrass, it is advisable to prefer tetraploid varieties due to their larger seed size and faster initial growth under competitive conditions. If red fescue (*Festuca rubra*) or common bent (*Agrostis capillaris*) are dominant in the sward, overseeding success is likely to be limited due to their highly competitive traits. If oversown seed is in a thick sward, it is very unlikely to emerge as a seedling. The risk of oversowing failure is even higher in dry and warm years. Examples of potentially beneficial pasture species:

Pastures	Cut swards
Birdsfoot trefoil (Lotus corniculatus)	Red clover (Trifolium pratense)
White clover (Trifolium repens)	Sainfoin (Onobrychis viciifolia)
Perennial ryegrass (Lolium perenne)	Tall oat-grass (Arrhenatherum elatius)
Pasture types of Festulolium	Timothy (Phleum pratense)
Cocksfoot (Dactylis glomerata)	Cocksfoot (Dactylis glomerata)
Chicory (Cichorium intybus)	Tall fescue (Festuca arundinacea)
Ribwort plantain (Plantago lanceolata)	Meadow fescue (Festuca pratensis)

- **SUPPORT:**

No external incentives are needed. The costs associated with incorporating novel species into existing grass swards include the seed and machinery costs. However, there can be significant savings on N fertilisers and both forage production and quality can be significantly increased. The cost of overseeding is 2 – 3 times lower than complete sward renewal. Furthermore, from an environmental point of view, oversowing should be preferred over complete sward renewal as it reduces the risk of soil carbon loss, nitrate leaching and erosion due to tillage.

- **EXAMPLE OF GOOD PRACTICE (Czech Republic):**

Grasslands oversowing is used by many farms in the Bohemian-Moravian Highlands. Seed mixtures tend to be dominated by red clover, which has proven itself to be a productive species for silage production. A high risk of dry spells means that slot seeding is the preferred option, as it places the seeds at an optimal depth of 1-2 cm and ensures good seed to soil contact. Accompanying species are most often Festulolium, meadow fescue, timothy and perennial ryegrass, while a mixture of birdsfoot trefoil and perennial ryegrass with a small mixture of other species is preferred for grazed areas. After successful seeding, the forage yield can typically increase by up to 40% for three to four years, even without nitrogen fertilisation, and forage quality can also increase significantly. In view of the limited persistence of current varieties of red clover, seeding is repeated every 4-5 harvest years.

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