



BEESPOKE

Benefitting Ecosystems through Evaluation of food Supplies for Pollination to Open up Knowledge for End users

Seed Mix Recommendations for Grasslands

The intensification of grasslands over the past century caused a major decline in biodiversity in pastures as well as meadows. In the BEESPOKE project, we aimed to develop more diverse seed mixtures for dairy cows under an intensive cutting regime. This kind of management is common in the intensively managed grassland regions of Northwest Germany and the North Sea region. Therefore, they offer great potential to provide resources also for insects.

COMPOSITION

When designing seed mixtures, regional requirements must be considered. Species and varieties should be selected with regard to the recommendations of the agricultural institutions of the respective country or region (e.g., for Lower Saxony, Germany). We recommend using a combination of grasses, legumes, and forbs as the different characteristics of those groups can complement each other which can increase yield and resilience. Cutting and grazing managements differ in their demands to the plant composition as some species may be more sensitive to either one management type. The BEESPOKE grassland mixtures were cultivated with cutting only.

For good biomass and roughage production, a highly productive grass species must be the base for the mixture. Combining different varieties of *Lolium perenne* (perennial ryegrass) ensures good spring growth and season-long quality by mixing different flowering times. More grass species can be added to compensate for weaknesses of *L. perenne* like its vulnerability to drought conditions. Deeper rooting grass species that may not be as productive as *L. perenne* under ideal conditions but during dry spells can be of value (e.g., *Phleum pratense* or *Dactylis glomerata*). Grass species with early spring and long autumn growth like *Festuca arundinacea* can expand the growth period. This species is, however, more difficult to establish in mixture due to its slow germination.

Legumes in general increase dry matter intake of dairy cows because of good taste and fast breakdown in digestion. Their protein content is high resulting in fast and efficient energy conversion. Furthermore, their symbiosis with nitrogen fixing bacteria reduces on the need for fertilisers. The nitrogen can even be utilised by surrounding plant species through nitrogen transfer. Exploiting this process reduces costs for mineral fertilisers. Most legumes show a strong summer growth while grasses are stronger in spring. Their biomass productions are therefore not of a competitive nature but can complement one another. Strong fertilisation with manure can weaken and decrease the legume proportion in a meadow. Recommendations concerning the ideal proportion of legumes in the fields range from 30 to 60 %. As clovers usually weaken over the years, a high legume coverage after establishment decreases naturally over time.

Two species are essential: white clover (*Trifolium repens*) and red clover (*T. pratense*). White clover has a very long blooming period that pollinators can profit from. It grows stolons that creep into the open soil spots between grasses, reducing the amount of open soil in newly established grasslands. Due to its rather low growth, it does not compete with grasses strongly but is still persistent. Red clover is of high importance as food for several bumblebee species. It grows deeper roots than grasses and can therefore withstand drought periods. It is of greater height but only grows strongly in July and August, so the competition to grasses remains acceptable. It is more sensitive to grazing than white clover. In newly sown grasslands, *Trifolium resupinatum* can be included to produce abundant flowers for pollinators already in the first year when other legumes are still establishing but it will not last to the second year as it cannot withstand below-zero temperatures.





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There are several other legumes (e.g., *Lotus corniculatus*, *Trifolium hybridum*) that can be included in the mix, but their success depends on the soil conditions. In the German field trial, *Lotus corniculatus* did not establish successfully, probably due to the acidic soils while it was much more successful in a trial in Belgium. There is less experience with breeding varieties for agriculture for legumes other than red clover, white clover, and alfalfa but more species may be profitable in the future. Alfalfa seems to be a valuable species for fodder but is not tolerant to the frequent cutting in intensive grassland.

There are only few forbs that can withstand the frequent cutting in intensively managed grasslands. One of them is *Plantago lanceolata* (riparwort plantain). It is well

established in the pastures of New Zealand already and currently gains more relevance in Europe. It roots very deep, making it drought resistant (FIGURE 1). It produces most biomass in summer, so the competition with grasses is reduced. Furthermore, plantain contains secondary metabolites with positive effects on dairy cows. The inflorescences are accessible to hoverflies that cannot feed on many legumes due to their deep corollas. Wild bees can also profit from the flowers. Other forbs that can be used under intensive regime are chicory and yarrow. They are drought resistant, tasteful for cattle, and a great resource for wild pollinators. *Crepis biennis* and *C. capillaris* could also be considered in more diverse seed mixes in grassland. However, these species were not tested in the BEESPOKE project.



FIGURE 1

After a long drought the clovers and plantain still look fresh and green while the perennial ryegrass stopped growing.



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ESTABLISHMENT

In general, diverse grassland mixes can be sown like other grasslands but some aspects should be considered for a successful establishment. Grassland seeds are best sown in late Summer (late August to late September). The presence of legumes and herbs makes it essential to control weeds vigorously beforehand as herbicides are not an option after establishment. Further, it is important to account for the local soil conditions. There is no one-size-fits-all-solution when it comes to grassland. The seed bed preparation may include different steps on marsh soil compared to bog soil. If the soil is acidic, species depending on higher pH-values like *Lotus corniculatus* will not establish. Sandy soils prone to drought can be more productive if a higher percentage of drought-resistant species is included and less *Lolium perenne*. If grasslands are not newly established but oversown, the seed mixture composition may need to be adjusted to complement the already established plant community.

MANAGEMENT

The management is the same as in other intensive grasslands. The mix as described is optimised for cutting, not for grazing. Dairy cows require very high fodder

qualities. If the ideal cutting time for great fodder quality can allow full flowering of the mixture species, insects are well taken care of. However, it may not be possible to account for the requirements of insect pollinators at every cutting event. Insect communities can be harmed greatly not only by cutting their resources, but by the cutting process itself. It is therefore recommended to start mowing in the middle of the field and proceed outward or to mow in strips from one side to the other. These techniques allow insects to flee away from the machinery and not be trapped. The clovers may allow to reduce the use of nitrogen fertilisers. It is recommended to pay attention to the sulphur and potassium levels in the soil as non-grasses often use higher quantities of these elements. Clovers also reduce the need for herbicides since they cover open soil in grassland that would allow the establishment of weeds. An intensive mowing regime with three to five cuts per year is a very harsh environment for plants as well as insects, which only few species can handle. Including flowering species other than grasses is certainly a win for insects like bumblebees that can use the resources as food. However, this also requires spaces where these insects nest. The value that diverse grasslands can have for biodiversity depends greatly on the surrounding landscape matrix. The importance of extensively managed or semi-natural habitats like hedges, buffer strips, and ditches cannot be overstated.



FIGURE 2
clovers, grasses and herbs combined show good growth in the BEESPOKE test sites.



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