Sown Biodiverse Permanent Pastures Rich in Legumes (SBPPRL)

Goal	Installation of Sown Biodiverse Permanent Pastures Rich in Legumes (SBPPRL).
Target group	Farmers or advisors managing cattle or other ruminants in extensive systems with pastures.
Description of the measure	Sown Biodiverse Permanent Pastures Rich in Legumes (SBPPRL) are based on diverse mixtures of about twenty different species, including species and varieties originated from the Mediterranean which may be, in some cases, absent or in lower proportions in spontaneous grasslands (for example, species and/or varieties of legumes) (Teixeira et al., 2011). These species or varieties help to establish a functioning ecosystem with complementary ecological functions and niches. In this manner, the increased biodiversity also allows for increased productivity (Dias, 2017; Teixeira et al., 2015). There is no exact, representative mixture of species as this ultimately depends on the soil physical and chemical characteristics besides local climate conditions. However, some common species are: *Trifolium subterraneum*, *Trifolium incarnatum*, *Trifolium resupinatum*, *Ornithopus* spp., *Biserrula pelecinus*, annual *Medicago* spp., and grass species of the genera *Lolium*, *Dactylis* and *Phalaris*. Sown species are frequently complemented with seeds from spontaneous plants such as: *Plantago spp.*, *Vulpia spp.* and *Bromus spp.*. Legumes cover more than 50 % of first-year sown pastures and are thus very common (Teixeira, 2008). After the first year, legumes increase and eventually dominate. Mature sown pastures (after 5 years) may include 25 % to 30 % of legumes in plant cover. Regarding nitrogen, SBPPRL are self-sufficient because legumes are inoculated with bacteria of the genus *Rhizobium* which results in the development of nitrogen-fixing nodules in the roots. The grass species can then use the nitrogen that has been fixated from the atmosphere. However, during the first years after the installation of SBPPRL there is a need for phosphorus fertilization – a potentially non-renewable resource – for the nitrogen cycle to be effective (Teixeira et al., 2015). The installation of SBPPRL must be timely performed, i.e., when the soil is still relatively warm, and in well prepared and fertilized plots. No mobilization or fertilization with nitrogen should take place after installation. During the first winter, grazing is possible and may help to control undesired species, allowing for generous seed production, as long as the soil is able to accommodate cattle treading with no risk of compaction and the plants already have at least 5 to 7 leaves. A high stocking rate may be used for 3 – 5 days and grazing must cease when the first flowers bloom. On irrigated sown pastures, as long the soil allows it, grazing is also possible, throughout the year, preferably in a rotational manner. During the Autumn and Winter, grazing must be highly reduced or absent. During the Summer, the dried grass must be grazed, as long as seed formation is complete and no flowers are visible anymore. All the dried grass should be grazed before the first

	rains of Autumn takes place. After all the dried grass is removed and before the rain, it is important to fertilize the soil with phosphorous and eventually potassium and other soil improvers in poorer soils and/or with very low pH.
Suitable sites	▪ Semi-arid and sub-humid regions in the Mediterranean or elsewhere (with modifications); ▪ Farms with natural, permanent, semi-natural and sown pastures where cattle or other ruminants are kept and reared (in extensive systems).
How a good implementation looks like	▪ After the first year, legumes should be the most predominant species; ▪ In mature sown pastures (after 5 years) legumes should take up from 25 % to 30 % of plant cover area; ▪ Legumes should exhibit nitrogen-fixing nodules in the roots; ▪ A variety of species should bloom every year (not necessarily the same combination every year) (Figure 1).  Figure 1 – A blooming sown biodiverse permanent pasture, rich in legumes. Photo credits: © Terraprima

Effects on biodiversity
(ecosystems, species, soil biodiversity)
	▪ The effects of SBPPRL on wild biodiversity are unclear (Teixeira et al., 2015);
	▪ Soil and insect biodiversity may increase due to:
	  ▪ Well managed presence of livestock reduces the need for operations dedicated to controlling shrubs (e.g., tillage);
	  ▪ Higher root productivity;

	 ▪ Higher Soil Organic Matter (SOM); ▪ Higher water retention; ▪ Lower soil erosion.
Other positive effects/benefits for the farmer	▪ Higher genetic diversity and richness in the pasture; ▪ Higher adaptability to climatic, environmental and micro-topographic variations; ▪ Higher photosynthetic capacity; ▪ Higher yields of quality pasture; ▪ Higher stocking rates without comprising the sustainability of the system; ▪ Reduced need for concentrated animal feed; ▪ Significantly increased of replenished stable SOM (reducing erosion and preventing desertification); ▪ Improved soil structure; ▪ Potential for the pasture to perform as a carbon sink; ▪ Climate change mitigation and adaptation; ▪ Decreased surface water runoff; ▪ Higher water retention capacity; ▪ Decreased pyrophyte shrub vegetation.
Indicator/key data	▪ Presence of SBPPRL common species, including legumes; ▪ Predominance of legumes; ▪ Diverse number of flowering species blooming every year; ▪ Nitrogen concentration measured in the soil; ▪ SOM measured in the soil; ▪ Soil biodiversity.
Risk and further recommendations	▪ The indications given in the description of the measure, regarding implementation, and particularly regarding the management of livestock and grazing regimes, must be rigorously followed; ▪ Excessive and/or untimely grazing may be detrimental to SBPPRL and their positive effects.
Timeframe (When to start a measure and anticipated time for implementation)	The installation of SBPPRL must be performed when the soil is still warm from the Summer and after it has been prepared. Grazing must follow an adequate regime. No further seeding should be necessary for about 10 years.
Additional special resources/ equipment/ skills needed	▪ The adequate mixture of seeds should be procured before installation, and this may require technical assistance given that different soil and climatic conditions (besides other relevant regional environmental aspects) require different seed mixtures;

	▪ The necessary logistics for direct seeding is advisable.
References	▪ Dias, N.F.A., 2017. Sown biodiverse permanent pastures rich in legumes as an adaptation tool against climate change. Faculdade de Ciências da Universidade de Lisboa, Lisboa, Portugal. ▪ Teixeira, R.F. de M., 2008. Economic incentives for carbon sequestration in grassland soils: an offer you cannot refuse. Instituto Superior de Economia e Gestão, Universidade Técnica de Lisboa, Lisboa, Portugal. ▪ Teixeira, R.F. de M., Domingos, T., Costa, A., Oliveira, R., Farropas, L., Calouro, F., Barradas, A., Carneiro, J., 2011. Soil organic matter dynamics in Portuguese natural and sown rainfed grasslands. Ecol. Modell. 222, 993–1001. ▪ Teixeira, R.F. de M., Proença, V., Crespo, D., Valada, T., 2015. A conceptual framework for the analysis of engineered biodiverse pastures. Ecol. Eng. 1, 85–97.

Further information: Knowledge pool

This Action Fact Sheet belongs to the training package for advisors of standard organisations and companies and was developed within the project: “Biodiversity in Standards and Labels of for the Food Industry”. The main objective of the project is to improve the biodiversity performance of standards and sourcing requirements in the food industry by helping standard organisations to integrate efficient biodiversity criteria into their schemes and motivating food processing companies and retailers to include comprehensive biodiversity criteria into their sourcing guidelines.

Editor: “Biodiversity in Standards and Labels of for the Food Industry”; Instituto Superior Técnico (IST) / University of Lisbon

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