SHADE TOLERANT GRASSES AND LEGUMES

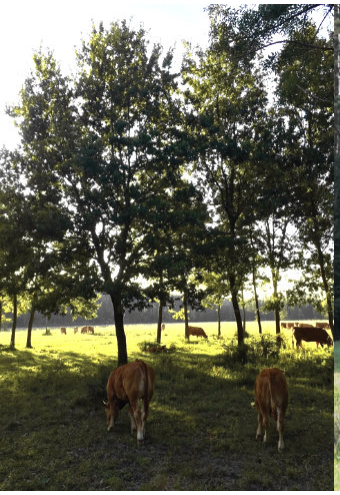
Forage use

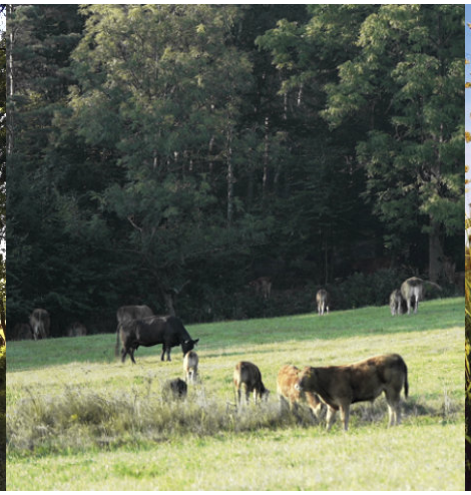
AFINET
AGROFORESTRY INNOVATION NETWORKS

THE WHAT AND WHY

How you could improve understorey forage production in silvopastoral systems?

Silvopastoral systems are designed to simultaneously produce timber/fruit/wood biomass in the long term and high-quality forage resources and efficient livestock production thus ensuring short-term and continuous cash flow. These current income sources should be explored by careful selection and management of livestock and forage components to be developed under the trees. The choice of appropriate forages will depend on particular characteristics of the site and the aim. Locally adapted perennial crop species, productive under shade stress and tree competition conditions must be considered by farmers operating in Atlantic and Continental European climates. Farmers may want to choose grass genotypes/species or mixtures of grasses and legumes to provide feed with improved palatability, nitrogen content, protein yield and digestibility. There are several promising species for Atlantic and Continental climate silvopastoral systems that could be recommended as a forage.





Agroforestry systems of the Mozsi Ranch. Ref : Mozsi Ranch, Sellye, Hungary

Cattle grazing at a silvopastoral farm, Poland, Ref: OIKOS Farm, Krzywa, Poland

Orchardgrass (Dactylis glomerata), an ideal grass to be used in silvopastoral systems

Caucasian clover (Trifolium ambiguum) has developed many adaptations to shade conditions.

HOW IS THE CHALLENGE ADDRESSED

Discover the best forage species for your system

Agroforestry farmers in Atlantic and Continental climates should focus on shade-tolerant forage species with higher palatability and percent of crude protein, protein yield and feed value but also plant species with higher performance under shaded conditions compared to sunny open places. Such species are more likely to maintain biomass and quality as trees grow and canopies close (Pang et al. 2017). Many of the top shade-tolerant species described for North America have been found to be adapted to shade in Continental Europe as well and some of them are recommended as forage shade-tolerant species by extension services or seed companies. The most promising cool season forage grass species are to be: orchardgrass (Dactylis glomerata) (also tested as an excellent shade-tolerant species in Galicia); tall fescue (Festuca arundinacea); red fescue (Festuca rubra) and reed canary grass (Phalaris arundinacea) (the last one is considered an invasive plant, be careful). Among leguminous crops, Caucasian/kura clover (Trifolium ambiguum), crimson clover (Trifolium incarnatum) and red clover (Trifolium pratense) were recommended. Some cultivars of perennial ryegrass (Lolium perenne) (Prończuk and Prończuk 2008) and Kentucky bluegrass (Poa pratensis) show satisfactory adaptability to shade. However, typically a species/cultivars mixture is used in order to ensure stability and optimal quality of the sward. This means that grass and leguminous species, varieties and cultivars have enough plasticity to grow under shade and in open sites. Usually, grass species are better adapted to shade than leguminous species that are generally more temperature and light demanding than grasses. Therefore, it is very important to evaluate the varieties/cultivars better adapted to local conditions.

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Keywords: Silvopasture; shade tolerance; feed value; crude protein; yield; site adaptation

HIGHLIGHTS

- Appropriate legume and grass species, varieties and cultivars should be selected to be sown under shade under given conditions
- Shade delays the best moment for grass/legumes to be harvested extending the growing season
- Grasses are usually better adapted to shade than leguminous species

Experimental plots in a silvopastoral system established in Galicia (NW Spain).

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FURTHER INFORMATION

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ADVANTAGES AND DISADVANTAGES

Optimize forage quantity and quality

Interaction of agroforestry components

Trees can protect forages against winds, frosts and summer drought by reducing evapotranspiration, allowing an extended grass growing season. Increased botanical diversity is observed when both underneath and far away from tree canopy habitats are considered, compared to open grasslands. Impact of tree shade on forages may be negative in soils with strong water restrictions, as trees can consume large amounts of water, which might limit the growth of the forages, particularly on sandy soils; they can delay maturity of understorey plants and have an impact on general resistance of plants against stress conditions as well. Moreover, in some cases, with high humidity, shade may improve conditions for the growth of shade-tolerant weeds and fungi infecting crops, and this can lead to severe yield losses under wet climate conditions. Some of these fungi are able to produce alkaloids that may cause animal poisoning. For instance, tall fescue has a mutualistic association with an endophytic fungus being a source of the ergovaline toxin. In this regard, although top performing shade-tolerant species should be planted under the trees, a mix of site-appropriate high-protein and disease-resistant species including legumes is recommended.

Shade-tolerant grass species recommended for mixtures in silvopastoral systems

Orchardgrass (*Dactylis glomerata*)
Highly competitive under shade conditions. Very resistant to cold. Tolerant of acid and poor fertility soils but not growing on wet areas. Very valuable forage plant for beef and sheep.

Tall fescue (*Festuca arundinacea*)
Grows well on acid soils. Adapted to wet areas and does not tolerate dry soils. Resistant to cold temperatures and droughts. Due to deep roots, may be used in eroded areas.

Red fescue (*Festuca rubra*)
It prefers well-drained soils but tolerates poor fertility and periodically dry stands. Good winter hardiness. Resistant to animal trampling. Good plant for controlling erosion.

Shade-tolerant leguminous species recommended for mixtures in silvopastoral system

Caucasian clover (*Trifolium ambiguum*)
Persistent perennial plant. Tolerates continuous heavy grazing. Adapted to acid soils and soils where phosphorous is limiting. Resistant to pests and diseases. It is very tolerant of cold conditions and drought.

Crimson clover (*Trifolium incarnatum*)
Annual plant. Continuous grazing pressure at a moderate stocking rate may be beneficial to the plant as it limits fungal diseases. Deep rooting. Not tolerant of heavy acid and alkaline soils.

Red clover (*Trifolium pratense*)
Short-lived perennial plant (2-4 years). Recommended light rotation grazing since trampling destroys crowns. Deep rooting. Grows on a wide variety of soils, optimal soil pH above 6 with adequate Ca. Drought tolerant.

Fertilization

Fertilization of grasslands should be carefully considered, and phosphorous and potassium should be provided in sufficient amounts to cover the demands of the grassland mixture. Leguminous are especially dependent on phosphorous and potassium as this family is considered a “luxurious consumer” of potassium. Moreover, nitrogen inputs should be restricted if an adequate proportion of leguminous is expected. A high nitrogen level in soil is associated with legume development, while in grass dominant swards soil nitrogen is low.

Protein yield and digestibility

Digestibility of grasslands is usually negatively associated with the ageing of grasses and generally positively associated when the legume proportion in the grassland is increased. However, some dramatic problems may appear when an excess of legumes appears in the grassland due to the delay of the flowering caused by the shade. On the other hand, flowering delay could increase the intake of protein by livestock reducing the needs of external inputs such as concentrates. Digestibility is depending as well on the share of individual grass species in grassland and selection of best yielding and quality cultivars mix under given conditions.