

Integrating fodder tree hedgerows in permanent grasslands to produce supplementary forage during summer drought

Pierre Mariotte¹, Edwige Dereuder¹, Charlotte Grossiord², Sonja Kay¹, Elisa Manzocchi¹, Silvia Ampuero Kragten¹, Sébastien Dubois¹, Paolo Silacci¹, Massimiliano Probo¹

¹ Agroscope, Switzerland ; ² EPFL-WSL, Switzerland

 #AgroForageTreeProject

Context

Climate change is an important driver of losses in **forage yield and quality** in permanent grasslands, especially due to increasing **summer drought** events. Agroforestry for forage production could be a promising solution to provide additional **tree-based forage**, since tree species can be more resistant to drought due to their **larger root system** that can access water in deeper soil layers. Furthermore, leaves of specific fodder tree species can have **excellent digestibility** and **nutritional value** for livestock.

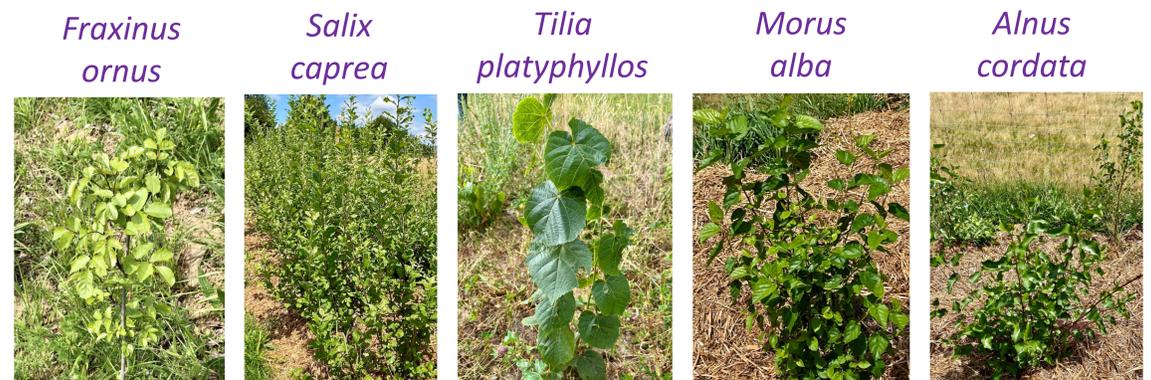
Aims of the project

The **AgroForageTree** project aims at evaluating the potential of fodder tree species to provide supplementary tree-based forage in summer and is organized according to **five main objectives**:

- 1 Monitoring the survival and growth of fodder tree species along a climatic and altitudinal gradient
- 2 Determining leaf production, leaf nutrient content and digestibility of these fodder tree species
- 3 Investigating the impacts of fodder tree hedgerows on ecosystem biodiversity and services
- 4 Assessing the palatability and selection of the tree species by different livestock categories
- 5 Economic evaluation at plot and farm scale according to different climatic scenarios

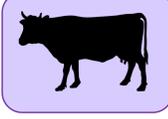
Experimental design

Five tree species were identified as the most interesting fodder tree species in terms of **yield and forage quality**:



Seven on-farm sites along an **altitudinal** (from 450 to 800 m) and climatic gradient (mean annual **temperature** from 11 to 5°C and **precipitation** from 900 to 1600 mm) in **Western Switzerland**. Six hedgerows per site (including five species) planted in the middle of permanent grasslands (**Figure 1**). **Grazing** will start from year 4 or 5 with **different livestock categories** depending on site (cows, goats and horses).

Measurements

- Fodder tree diameter and branches number, leaf-level carbon uptake and water use efficiency for the five fodder tree species at each site. 
- Leaves number, plant functional traits (SLA, LDMC), proximate composition, phenols and condensed tannins. 
- Soil moisture, soil organic carbon and inorganic nitrogen under and around hedgerows, biodiversity (birds, bats, grasshoppers, pollinators) and grass-based forage biomass. 
- Digestibility of leaves and methane emissions (*in vitro*), leaves consumption (count of leaves before and after grazing), GPS tracking of animals (tree species preferences). 
- Plantation and maintenance costs (irrigation, mulching, labour) and benefits (forage yields, biochar made with pruned branches, milk production) 

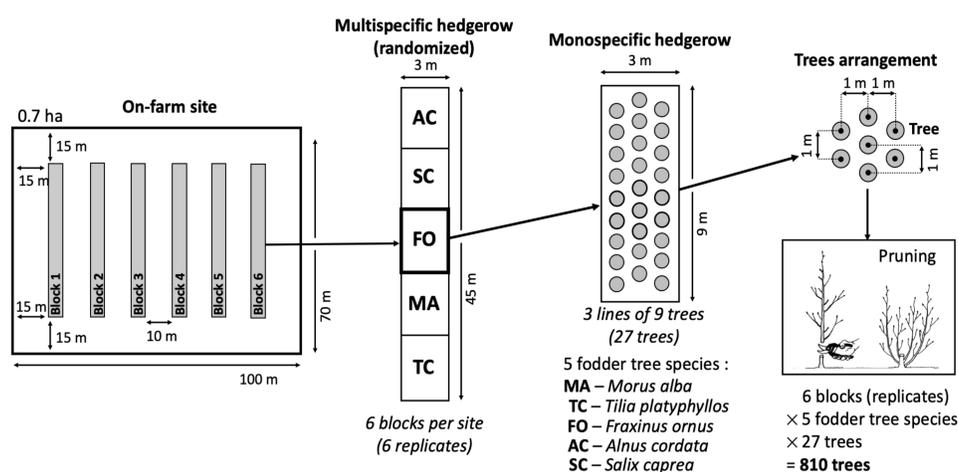


Figure 1: Experimental design of the AgroForageTree project. Each multispecific hedgerow (45 m with 3 parallel lines) is composed out of five randomly arranged monospecific hedgerows of 9 m each, corresponding to the five selected tree species. Tree lines are 1 m apart and trees are separated by 1 m from each other within lines.

Knowledge outcomes

- ✓ **Optimal climatic conditions** for five fodder tree species in Western Switzerland.
- ✓ **Seasonal and interannual variability in forage yield and quality** for the five fodder tree species.
- ✓ Impact of fodder tree hedgerows on **ecosystem biodiversity and services** despite intensive use for forage production.
- ✓ **Appetence and preference** for some fodder tree species rather than others depending on **livestock categories**.
- ✓ **Economic assessment** of forage hedgerows.