

Agro-TCR

An instrumented agroforestry site in Lorraine: optimizing productivity and sustainability of intensive cropping systems through symbiotic nitrogen fixation

Issues

- In temperate areas, intensive timber plantations for energy purposes, such as **short rotation coppice (SRC)**, are criticized.
- They are known to **deplete the soil in nutrients** and to **bring no real profit**.
- The combination of **atmospheric nitrogen fixing species** with fast growing species (*i.e.* poplar) may be a sustainable alternative.
- The nitrogen fixing species can be woody (alder) or grass (alfalfa).

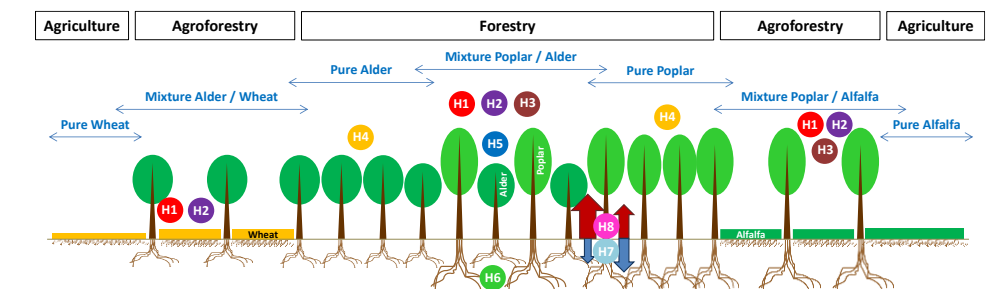
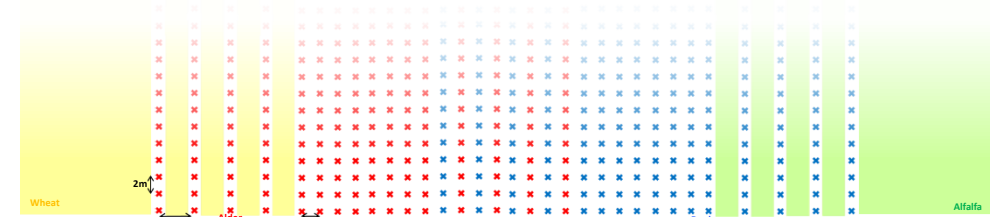


Layout

The plantation is composed of three types of plots:

- Agricultural plots** (pure wheat, pure alfalfa),
- Forest plots** (pure poplar, pure alder, mixture poplar / alder)
- Agroforestry plots** (mixture poplar / alfalfa, mixture alder / wheat)

In addition, two herbaceous mixtures were planted in the forest plots to estimate the ecological impact of the tree plantations on floristic diversity.



Scientific hypotheses

- H1:** The **growth** of the non-nitrogen-fixing species is **stimulated** by fixing species in the mixture ...
- H2:** ... through an **increase of the nitrogen stock** in the soil ...
- H3:** ... resulting in **increased leaf area and photosynthetic assimilation** of non-fixing species
- H4:** In forest plots, the **competition** is more intense in monoculture for poplar; inversely for alder
- H5:** **Canopy stratification** in the mixture allows better capture of the light resource
- H6:** A **stratification of root systems** in the mixture allows better capture of water and nutrients
- H7:** The fraction of assimilated carbon allocated to the underground compartment is lower in the mixture
- H8:** The **aboveground production is improved** in the mixture
- H9:** The ratio "Net Primary Production" / "Carbon flux to the underground compartment" increases in the mixture

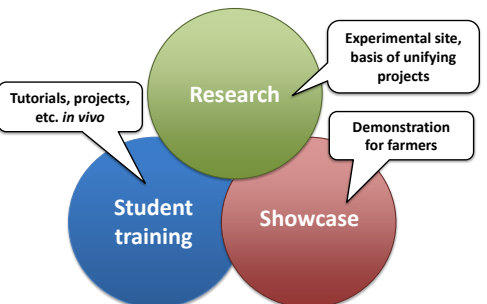
Key persons

- Nicolas Marron (EEF, marron@nancy.inra.fr)
- Séverine Piutti (LAE, Severine.Piutti@univ-lorraine.fr)
- Daniel Epron (EEF, Daniel.Epron@univ-lorraine.fr)
- Bernard Amiaud (EEF, Bernard.Amiaud@univ-lorraine.fr)
- Erwin Dallé (EEF, edalle@nancy.inra.fr)
- Alexandre Laflotte (LAE, Alexandre.Laflotte@univ-lorraine.fr)



Objectives

- Research in **agroforestry** is lacking behind in France and Europe, unlike North America and Asia.
- The agroforestry plantation in Lorraine has the **triple function** of being an experimental research site, an opportunity for students for field courses, and a showcase for farmers.



Partnership

The project is lead by the INRA – Lorraine University Unit, “Forest Ecology and Ecophysiology (EEF)” in close collaboration with the INRA – Lorraine University Unit “Laboratory Agronomy and Environment (LAE)”. The “Trees – Micro-organisms Interactions (IAM)” and “Biogeochemical cycles in Forest Ecosystems (BEF)” Units also contribute.



Site

The field of 5 hectares belongs to the experimental farm of La Bouzule (Meurthe-et-Moselle, 48° 44'N, 6° 18' E). It presents a slight slope to the south where it is bordered by a river. The annual average rainfall is 823 mm and the mean annual temperature is 9.6°C. The soil is composed of two-thirds of clay and one-third of silt.

A station for the continuous monitoring of soil and climatic conditions is currently being installed.

