The sustainable management of plant health is one of the main research topics of SFR Quasav (Structure Fédérative de Recherche Qualité et Santé du Végétal). Since 1998, the LEVA group (Legumes, plant ecophysiology, agro-ecology) conducted research in this field. LEVA is a unit of the Ecole Supérieure d’Agricultures of Angers under contract with INRA. Their research is aimed at addressing several major societal challenges: reducing the use of nitrogen fertilizers and greenhouse gas emissions, increasing protein production and improving the resilience of cropping systems. The research done by LEVA laboratory into legume-based intercrops is recognised at a national and international level. Their work aims to improve nitrogen resource management, soil biological fertility and weed control in annual crops.

Looking for partners?

Two contacts to support your projects:

- **Emeline Defossez**: contact to support your R&D projects and to put you through
  emeline.defossez@vegepolys.eu

- **Tanegmart Redjala**: close interface with the laboratories of the Research Federative Structure Quasav.
  tanegmart.redjala@univ-angers.fr
**Legumes are sources of proteins and free nitrogen**

They are plants of the Fabaceae family. They are mainly used for three goals:

- **Grain legumes**
  - Production of protein rich grains
  - *Soya, pea, fava bean, green bean...*
  - Protein rich food or feed

- **Forage legumes**
  - Production of protein rich fodder
  - *Alfalfa, clovers, vetches, trefoil...*
  - Protein rich forage

- **Green manure**
  - Enrichment of the soil with nitrogen
  - *Clovers, black medick, alfalfa...*
  - Nitrogen supply for the following crops, savings in nitrogen fertilizers

**Legumes are ecological biofertilizers**

Legumes have the particularity to draw nitrogen both from soil and air. They are characterised by their symbiotic activity of nitrogen fixation through bacteria lying in their nodules. Legumes fix more nitrogen from the atmosphere when the soil is poor in nitrates.

**Figure**: Root system of legume with its nodules

Legumes roots can bring to the soil 15 % to 30 % of the total nitrogen accumulated by the plant during its growth until grain maturity. This nitrogen is brought as organic molecules that are less harmful for the environment than nitrate. Moreover, intercropping helps to reduce leaching.

After maturity, the residues also bring nitrogen from the atmosphere into the soil. Nitrogen is then transformed by fauna and microorganisms before mobilization by the plants.

**Legumes are a good way to save nitrogen fertilizers**

**Benefits of intercropping when the legume is the main crop:**
Stabilize legumes yields: legumes are very susceptible to weeds, diseases and pests when cultivated on themselves.

Example: pea/cereal, lupine/cereal

**Benefits of intercropping when the crop is associated with a legume:**
Fertilize the soil and limit the pressure of weeds, pests and pathogenic agents

Example: oilseed rape/legume

**INFO**

LEVA research team works on the biological processes that allow for improving the agronomic and environmental performances of cropping systems less dependent on nitrogen fertilizers and herbicides. The investigations also deal with the interactions between crops and soil organisms in order to improve soil fertility. In collaboration with teams from IRHS, the researchers also work on the response of legumes to abiotic stresses and on the selection of varieties adapted to climate change during crop installation. Finally, LEVA team members join their research to that of research groups with other skills to study the conditions for the adoption of innovative intercrops by farmers.
**RESEARCH RESULTS**

The **architecture of the crop cover** influences the partition of the solar radiation between the two species. For pea, varietal traits like the **height** and the **number of ramifications** influence the proportions of each species in the mixture at harvest.

**Partition of solar radiation**

Cereal-legume intercrops are more competitive towards **weeds** than pure legume crops due to a better competition for soil nitrogen.

**Complementarity for nitrogen sources** (air and soil) between the species plays a crucial role in the performances of intercrops. Growth of each species depends on the dynamics of soil nitrate availability.

**Recent Projects**

**APPLIED RESEARCH PROJECTS**

**European project DiverSify** (2017-2020) run by [James Hutton Institute](https://www.jameshuttoninstitute.org) (UK). Choose the best species crop teams to favour synergies and optimize production and other services.

**European project DiverIMPACTS** (2017-2021) run by INRA. Crop diversification through rotation, intercropping, multiple cropping, promoted with actors and value-chains towards sustainability.


**Interregional project Prograilive** (2016-2018). Intercropping lupine with a cereal to control weeds in lupine crops.

**ANR project Légitimes** (2014-2017). Build the conditions for a wider insertion of legumes in agricultural systems and assess the expected effects, for a sustainable management of territories and resources.

**PhD THESES**

**Elana DAYOUB** Competitiveness of different legumes towards weeds, associated traits and interactions with the intercrop design and the services related to nitrogen and weeds provided by legumes in the cropping systems. [g.hellou@groupe-esa.com](mailto:g.hellou@groupe-esa.com)

**Hélène BOBILLÉ** Regulation of root exsudation in Fabaceae and consequences in the response to abiotic stresses. [j.fustec@groupe-esa.com](mailto:j.fustec@groupe-esa.com), [anis.limami@univ-angers.fr](mailto:anis.limami@univ-angers.fr)

**Nicolas CARTON** Trophic interactions induced by lupine intercropped with another specie and consequences on the productivity of both espieces and weed management. [g.hellou@groupe-esa.com](mailto:g.hellou@groupe-esa.com)

**Baptiste DRUT**. Interactions between the crop cover and the soil organisms in relation with the crop diversity in the field: consequences on soil fertility and crop yield. [j.fustec@groupe-esa.com](mailto:j.fustec@groupe-esa.com)
Examples of topics for collaboration

- **Choose the species/varieties** to be intercropped and the intercrop design according to the cropping system and the objectives to reach
- Use and conduct intercrops to **manage weeds**
- Choose the **most appropriate space-time schemes**
- Quantify the **nitrogen flows** in the agrosystems
- Understand the interactions between the vegetation cover and soil; study the consequences on the quality of organic matter and **soil fertility**
- Improve the **diagnostic of soil quality** for a better driving of soil quality

**Strengthen your R&D team** by recruiting a CIFRE PhD student (financial support by ANRT and CIR), a recent PhD graduate (financial support by CIR) or a working student (in contract of professionalization or apprenticeship)

Training for enterprises

- Biological fertility of soils
- Driving of legume-based intercrops

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  - agrocampus-ouest/formation-tout-au-long-de-la-vie

- **Catalogue online of Université d’Angers**
  - universite-angers/formation-continue/Offre-de-formation

or share your needs with us!

Services

- **Diagnostic of soil biological activity**
  Diagnostic in the field of the ability to degrade soil organic matter using the new indicator **LEVAbag<sup>TM</sup>**
  - Contact : LEVAbag@groupe-esa.com