

## New services from perennial legumes in agroecological farming systems\*

Christian Huyghe<sup>1</sup>, Philippe Gate<sup>2</sup>

<sup>1</sup> Scientific Director Agriculture, Inra, Paris, France, <sup>2</sup> Scientific Director, Arvalis, Paris, France

**KEYWORDS:** alfalfa, ecosystem services, living mulches

Ecosystem services have been defined in the Millenium Ecosystem Assessment and include provisioning, supporting, regulating and cultural services. Considering this broad analysis, it is possible to identify new uses for alfalfa and other perennial forage legumes in farming systems, based upon agroecology to reach sustainable agri-food systems.

In the present paper, we will present how alfalfa and forage legumes may be used as living mulches in cereal production systems.

Such living mulches make it possible to reach Land Equivalent Ratio higher than 1, through higher biomass production and more regulating services. By avoidance of environmental debt, such new production systems could contribute to a better adequacy between society and farmers expectations regarding production systems. New paradigms such as agroecology, microbioms and chemical ecology offer new prospects for very contrasting production systems such as cereal production with living mulches.

A large dataset of results will be presented, both in experimental conditions and in real farms, on small grains, on maize and in water-limited environments. These French situations are supported by examples from the international literature. On average, the yields of small grain crops are similar when sown in a legume living mulch, with a key attention to be paid to the control of the legume growth in order to avoid competition. There is a slight mean benefit on cereal quality. The economic returns are similar.

In coherence with the ecosystem services approach, a multicriteria evaluation is necessary to document all services. This will enlighten the variability among the various experiments, but also the convergences among all situations. Environmental impacts are clearly improved with less use of nitrogen and pesticides, less consumption of energy, improved soil structure and water management. One peculiar feature will be documented regarding the work load for the farmers and the possibility to drill over larger periods of time due to improved soil structure and soil loading capacity. This offers prospects for larger changes in the evaluation of farming systems.

The physiological and biological mechanisms explaining the observed benefits and some failures will be documented. They include the control of competition between crops and living mulches, and the use of complementarity as species in the swards explore different soil horizons and have different nitrogen sources. The agroecological mechanisms and especially the biological regulations are obtained thanks to an increasing functional diversity of swards, with a special attention paid to water cycle and N and P fertility cycles.

These very contrasting production systems raise many scientific and technical issues. Some will be discussed, such as plant breeding both for the sale crops and the service crops, machinery or decision tool kits. It also raises clear challenges for training and advisory systems as well as for research where more participatory research or new research designs such as Living Labs may be implemented.

---

\* **CITATION:** Christian H., Philippe G. 2018. New services from perennial legumes in agroecological farming systems. IN Proceedings. Second World Alfalfa Congress, Cordoba, Argentina. 11-14 November, 2018. Instituto Nacional de Tecnología Agropecuaria (INTA), <http://www.worldalfalfacongress.org/>