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Find out more

<http://umr-system.cirad.fr/en/les-agrosystemes-etudes/systemes-agroforestiers-simples>

Design: Cirad, Martine Duportal, May 2019 – © photos UMR System

An ongoing dialogue between field experiments and numerical simulation

- Agroforestry systems are inter-generational systems, taking 20 to 80 years for trees to reach a harvestable age. Exploring all agroforestry aspects (design, management, extreme events, climate change) would require many large experiments all over France. This is not an option, for financial and time reasons. A numerical simulation approach enables virtual experiments to be performed on computers, saving time and money. But the models must first be validated on actual plots. This is where our experimental network comes into play.



Working with farmers

- All our experiments are on-farm. We work with actual farmers who make a living from the agroforestry plots. While this is a constraint for elaborate protocols, it also provides security: even when we are not taking measurements, the plots are managed and maintained. In addition, each day farmers create the agroforestry routine of the future. Furthermore, farmers believe what they see, so seeing farmers involved in agroforestry is the key for agroforestry demonstration.



RAP for national and international projects

PIRAT (1999-2019) is the exclusive long-term research programme on RAP funded by the local authority (www.agroof.net/PIRAT)

SAFE (2000-2005) was the flagship European project on silvoarable agro-forestry that paved the way to agroforestry recognition in Europe (www1.montpellier.inra.fr/safe).

AGFORWARD (2014-2017) is a participative research project on agroforestry. The project aims at identifying innovative management practices among pioneering farmers, test them in replicated scientific experiments and disseminate them at European level. (www.agforward.eu)

ECOSFIX (2011-2014): A French national project assessing the ecosystem services of tree roots (www.agroof.net/agroof_dev/agroof_ecosfix_1.html)

INTENSIFIX (2011-2015): A French project exploring the value of N-fixing species in agroforestry systems (<http://intens-fix.cirad.fr/>)

AGROCOP (2012-2015): A European project on energy biomass production in agroforestry (<http://www.agrocop.com/>)

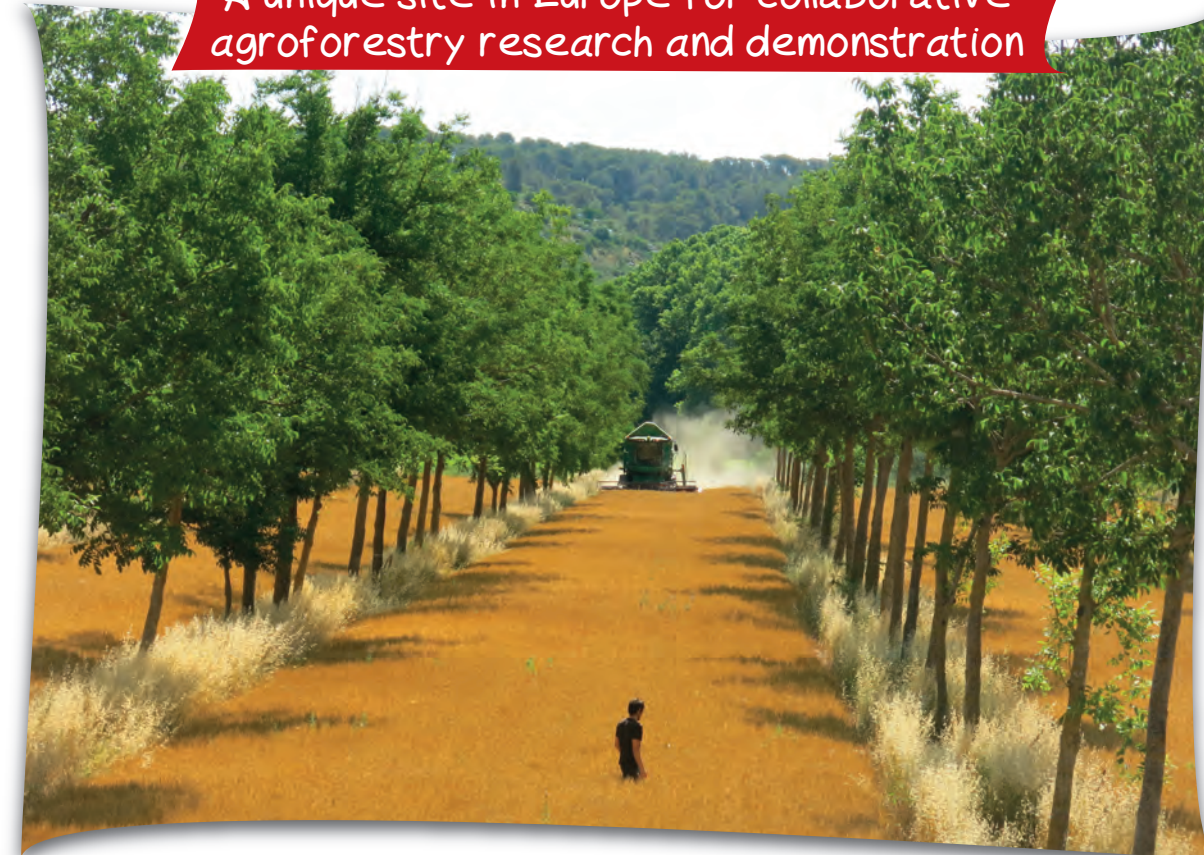
AGRIPSOL (2012-2015): A French project to explore the impact of trees on soils in agroforestry including C sequestration (www.agroof.net/agroof_dev/agroof_agripsol.html)

- RAP is also the support for many students' M. Sc. and Ph.D. theses on:
 - yields of intercrops and trees in agroforestry
 - competition and facilitation processes between trees and crops, including plasticity
 - ecosystem services of agroforestry systems (carbon sequestration, nitrate leaching control, biodiversity)
 - modelling of agroforestry systems



RAP ! THE RESTINCLIERES AGROFORESTRY PLATFORM

A unique site in Europe for collaborative agroforestry research and demonstration



- Managed by the joint research unit



Functioning and Management
of Tropical and Mediterranean Cropping Systems

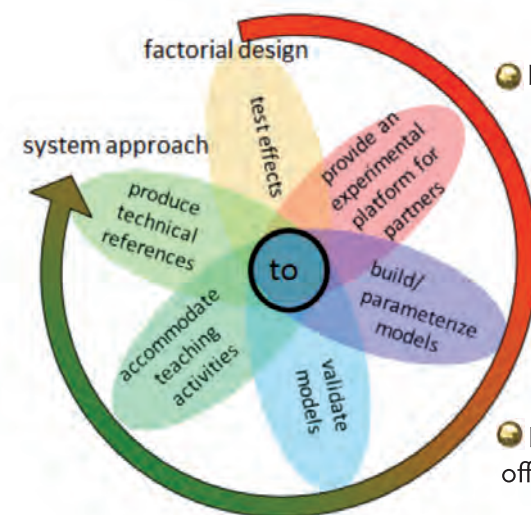
- In cooperation with



RAP: an open-air long-term laboratory for interdisciplinary research

RAP is one of the oldest agroforestry experiments in Europe with continuous monitoring since the trees were planted

- more than 40 ha under agroforestry
- trees planted in 1995 with about 30 different tree species
- several understorey crops:
 - arable crops (wheat, oilseed rape, pea, barley, etc.)
 - grapevine
 - energy crops (alder, poplar)
 - fodder crops (alfalfa, fescue)
 - vegetable growing planned in the future
- landlord and tree owner: *Conseil Départemental de l'Hérault*
- crops managed by local tenant farmers
- experiments managed by INRA and CA 34 with the financial support of the *Conseil Départemental de l'Hérault*
- permanent call for tenders allowing new research teams to join the project each year



RAP features a rare and demanding experimental design that allows the measurement of the true productivity of agroforestry systems thanks to forestry and monocrop controls. This allows the measurement of the LER (Land Equivalent Ratio) for several systems including walnut-cereal, poplar-cereal, Sorbus-cereal, Sorbus-grapevine and pine-grapevine mixtures.

RAP allows factorial experiments focused on processes (e.g. competition for light and soil resources, biodiversity) and provides crucial data for modelling agroforestry systems dynamics.

RAP also provides teaching support and demonstration for extension officers and farmers and welcomes thousands of visitors annually.



RAP is the core of a network of on-farm agroforestry research and demonstration plots that extends all over France and is rapidly increasing

On a regional scale: about 10 sites established by UMR System since 1988



On a national scale: about 70 sites managed by a national network called "RMT AgroforesterieS"



- About 90 members from 48 research, extension or education organisations
- Creation: 2014
- Activities: sharing expertise, databases, and experimental sites
- to promote a collective dynamic for agroforestry adoption
- to develop technical and methodological tools for agroforestry projects design and management
- to support collectively designed agroforestry R&D projects

website: <http://rmt.agroforesterie.fr/>



Some results...

How agroforestry works

- Soil carbon increase under agroforestry systems: Cardinaël R. *et al.*, 2014. Plant and Soil. doi: 10.1007/s11104-015-2422-8.
- Shade impacts on cereal yields and protein content/ Dufour L. *et al.*, 2013. J. Agronomy and Crop Science. doi: 10.1111/jac.12008.
- Nitrate leaching reduction under agroforestry systems: Andrianarisoa K.S. *et al.*, 2015. Agroforestry Systems. doi: 10.1007/s10457-015-9845-3.

Agroforestry productivity

- Economical profitability of agroforestry: Graves A.R. *et al.*, 2007. Ecological Engineering. doi:10.1016/j.ecoeng.2006.09.01.
- 20 to 50% increase in productivity in agroforestry systems as compared to monocropping and afforestation: Dupraz C. and Liagre F., 2008.
- Chickpea yield is higher in the middle of the agroforestry alley than in the sole crop control. Mahieu S. *et al.*, 2015.
- Biological Nitrogen fixation of alfalfa was stimulated close to the trees. Querné A. *et al.*, 2017. European Journal of Agronomy. doi: 10.1016/j.eja.2016.12.001.
- Agroforestry induces spatial heterogeneity in soil microbial response to drought and heat stresses. Guillot E. *et al.*, 2019. Soil Biology and biochemistry. doi: 10.1016/.

