ALTO, orchard redesign towards agroecology to produce without any pesticides

**Context**
- **Sustainability** of current orchards is questioned
- **Strongly reducing pesticide use** in current orchards induces **risk of fruit damage** (BioReCo1, EcoPêche’ and CAP-ReD3 projects)
- Is **plant diversification** a way to reduce pesticide use?

**Aims**
- To **rethink the agroecosystem** to produce fruit in very low pesticide or pesticide-free systems & to build **concrete proposals** for tomorrow
- To **assess** the effect of plant diversification in the agroecosystem on the orchard sustainability and ecosystem services
- To **share** the approach and knowledge with stakeholders

**An agroecological approach**

**A partnership-based dynamic**
- Visits
- Co-design workshops
- Agro Café
- Interdisciplinary actions

**3 experimental sites**

**Resources sharing through time and space**
- Apple (planting year 2016), walnut and leguminous cover plants associated in agroforestry systems
- Organic farming

**Step by step redesign in a highly diversified environment**
- Alternated fruit tree rows: apple (planting year 2019), olive, apricot, kiwi fruit, persimmon, plum, fig and citruses...
- Habitats and infrastructures to foster biodiversity: hedgerows, ponds, shelters, nest-boxes... at landscape scale.
- Organic farming excluding pesticides but biocontrol solutions and low dose copper applications

**Orchard re-design from the ground up**
- Fruit species and cultivars alternated within and between 'rows': apple (planting year 2018), plum, peach, apricot, fig, pomegranate, nut fruits, soft fruits...
- Companion plants and habitats to foster biodiversity at landscape scale
- Organic farming excluding all pesticides (even biocontrol)
Focus - Gotheron site

Experimental system « Unit 1 » in Gotheron

Spatial layout, mix cropping and multilayer design

Compared to its surface, the circle is the shape with the smallest outer edge with the surrounding landscape, a potential source of pests and diseases. The layout of the experimental plot has been designed to reinforce multiple services, through a diversity of plant layers, species and cultivars.

4 Cultivar diversity, cultural control, commercialisation

> To produce pome and stone fruits
> To diversify species and cultivars to limit pests and diseases
> Low-susceptible cultivars
> Legumes cover crops to promote soil fertility
> Same number of trees for each stone fruit species and cultivar, for sales purpose
> Traffic optimization along the 6 fruit spirals

Conservation biological control

Habitats, food resources and breeding habitats for natural predators or parasitoids of the fruit tree pests

3 Plant barrier and production diversification

The « müesli » circle is an additional barrier between outer apple trees and inner fruit trees production circles. It produces diversified fruits, aims at limiting the pest and disease spread and providing resources to natural enemies.
1. Plant barrier and conservation biological control

The outer circle of the plot aims to limit the wind, promote biodiversity and produce nuts. It includes large and indigenous forest species, shrubs hosting a diversity of natural enemies, and also almonds and chestnuts trees.

- **Tall trees**, as wind-break
- **Trees to produce nuts** (almonds, chestnuts)

2. Trap plants and plant barrier

Aphids crossing the outer circle are attracted by the adjacent apple cultivar. This low-susceptibility cultivar limits aphid development with no fruit damage due to infestation. It acts as a trap cultivar pulling aphids in this circle and protecting other inner apple cultivars.

- **BARRIER AND WIND-BREAK HEDGE**
- **APPLE TREES** TRAP CULTIVAR
- **OTHER APPLE TREES CULTIVARS**

**MOSLI CIRCLE**

- **Barrier**: to limit the spread of pest and diseases from one circle to another
- **Production**: a diversity of fruit trees and berries: fig, hazelnut, pomegranate, persimmon, raspberry.
- **Biodiversity**: corridors with shrubs for natural enemies: *Viburnum tinus*, hazelnut, *Arbutus*...
ALTO, an interdisciplinary approach

Biodiversity
- Multi-production systems
- Pest supression

Multi-stakeholders
- Farmers, Advisors, Trainers, Naturalists, Researchers...
  - 14 partners

Redesign
- Agroecosystem & pest suppressive design
- Supra-plot design with production areas & production supporting areas

Expected results

- Co-design methodology
to design more or less breaking systems

- Knowledge about biological processes:
  pest suppression, fruit tree behaviour in multi-crop systems

- Prototypes
  of very low-input orchards

- Multi-criteria assessment
  of multi-production complex systems

- New types of interactions
  between stakeholders

An on-going project...

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2018

2019

2020

... 2023

INRA Gotheron

CTIFL Balandran

INRA Restinclières

Multiple partners, skills and expertises

INRAE Gotheron, UMR System, UR Ecodéveloppement, UR PSH, UMR EMMAH Sols

GRCETA de Basse Durance - Conseil technique en arboriculture fruitière

Centre technique interprofessionnel des fruits et légumes

Agribiodrôme

GRAB

Ligue pour la Protection des Oiseaux - Auvergne Rhône Alpes

Groupe de recherche en agriculture biologique

La Valentin

EPFFA

ADG pour la biodiversité

Chambre d'agriculture de la Drôme

For further information
1 https://www.inra.fr/experimentations-systemes/les-experimentations/Arboriculture/BioRaco
2 https://www6.paca.inra.fr/psh/Contracts-et-Projets/EXPE-DEPHY-EcoPHYto-EcoPeche
4 https://www6.paca.inra.fr/aere/Contracts-et-Projets/EXPE-DEPHY-EcoPHYto-II-ALTO

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