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European Union



INRAE



IRTA



API-Tree

# Towards an insecticide-free orchard: Agroecological practices to control apple insect pests

[Art.4.1 (b) - privacy]

INRAE UERI Gotheron

[Art.4.1 (b) - privacy]



# API-Tree project



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European Union



- 10 partners across Europe
- 4 years 2017 – 2021
- 44 experiments on agroecological practices
- 6 types of levers for action
- 8 performance criteria



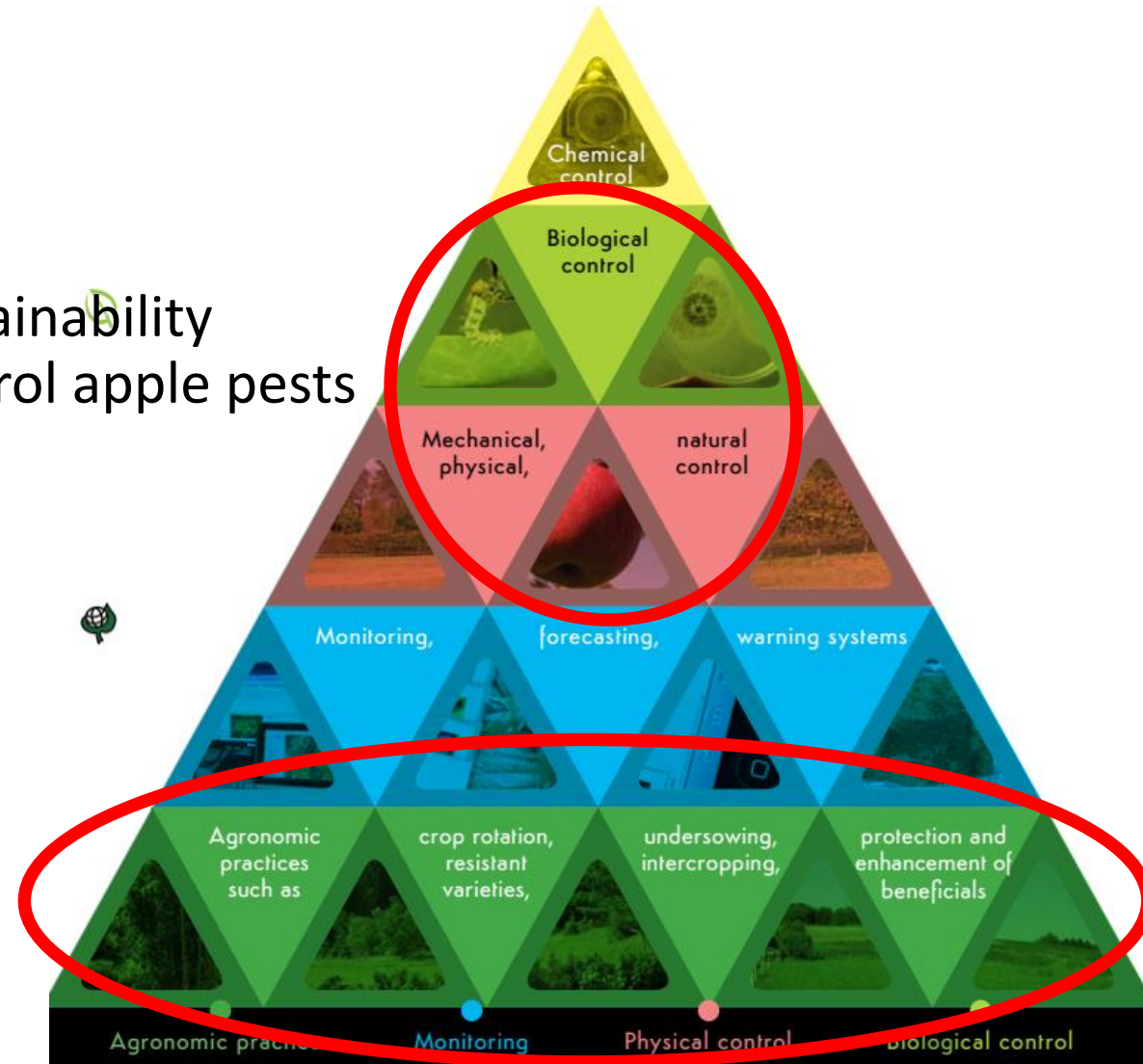
# API-Tree project

- Objectives

- To design and assess the efficiency and sustainability of practices alternative to pesticides to control apple pests
- Practices are related to :

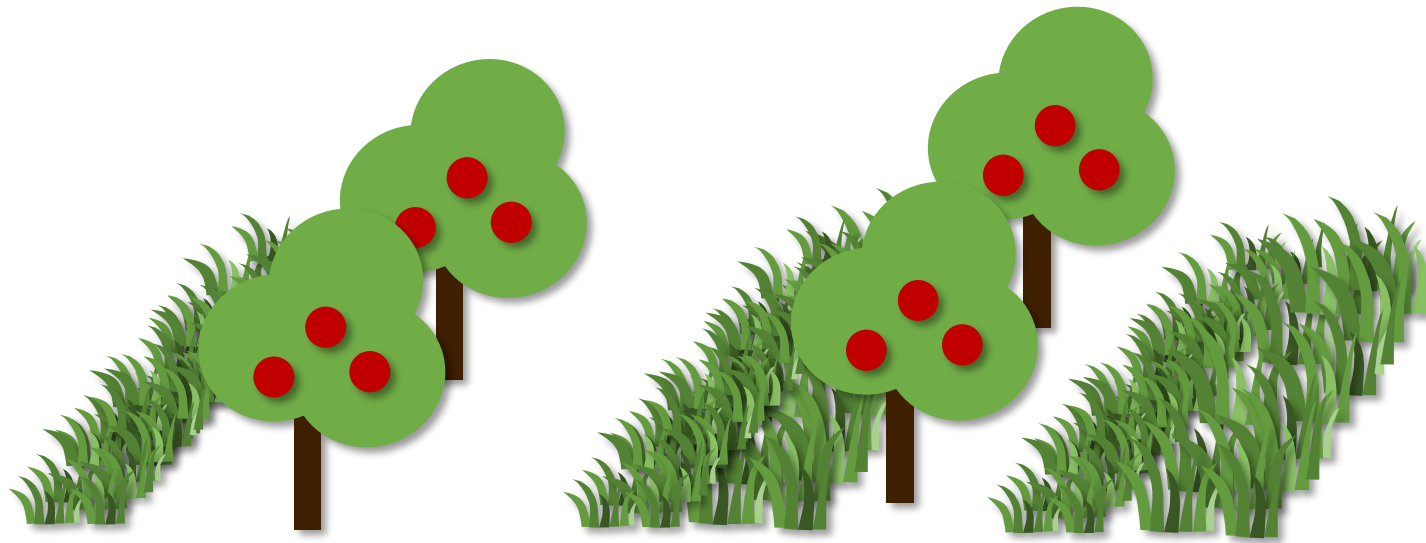
- Outcomes

- IPM solutions with info on implementation, feasibility and costs
- Methods to design (with end-users) and evaluate alternative practices



# How can we design a pest-suppressive agroecosystem?

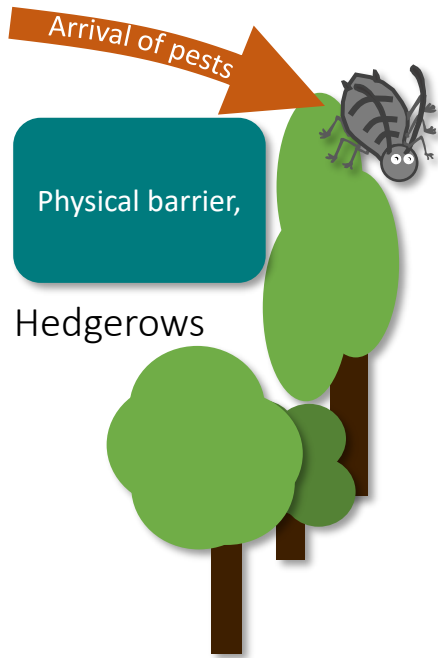
1. To make it difficult for pests



# How can we design a pest-suppressive agroecosystem?

## 1. To make it difficult for pests to find the host plant

- Hedges as physical barrier
- Susceptible cultivars as **trap plants** (CRA-W) and **companion plants** such as repellent aromatic plants (INRAE) tested on Rosy Apple Aphid



① ②

Push Pull,  
barrier,

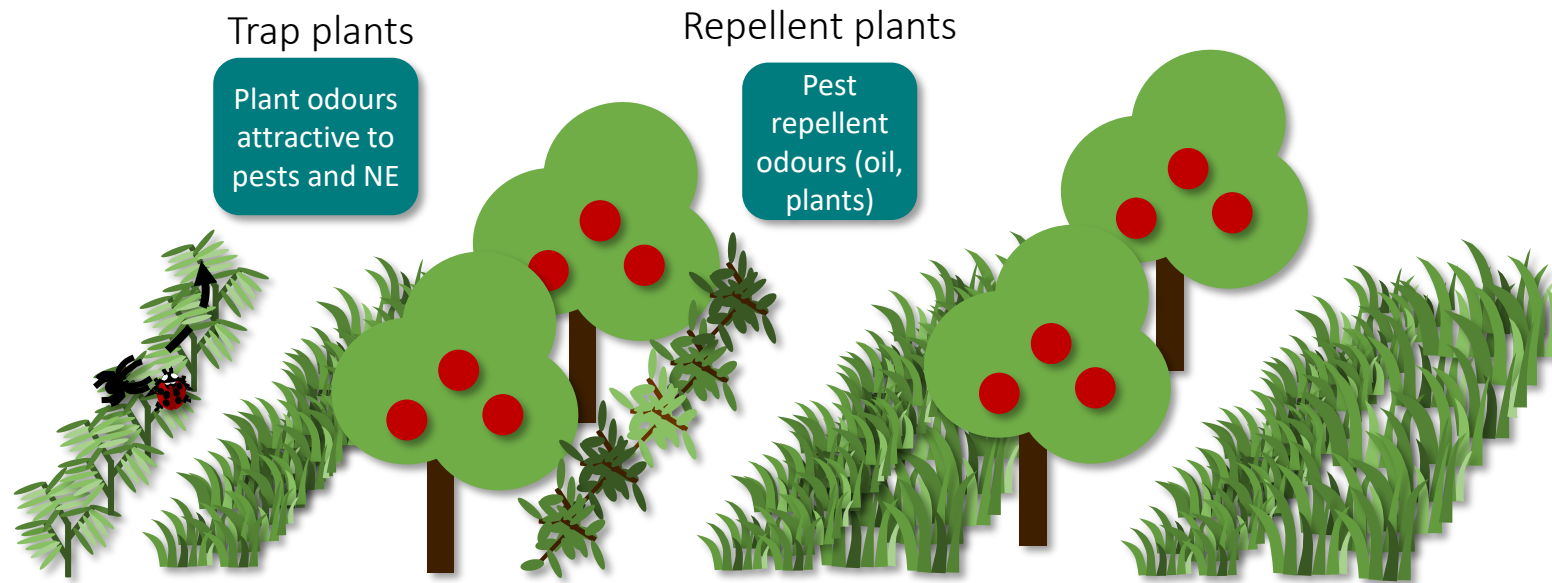
# How can we design a pest-suppressive agroecosystem?

1 2

## 1. To make it difficult for pests

Push Pull,  
dilution

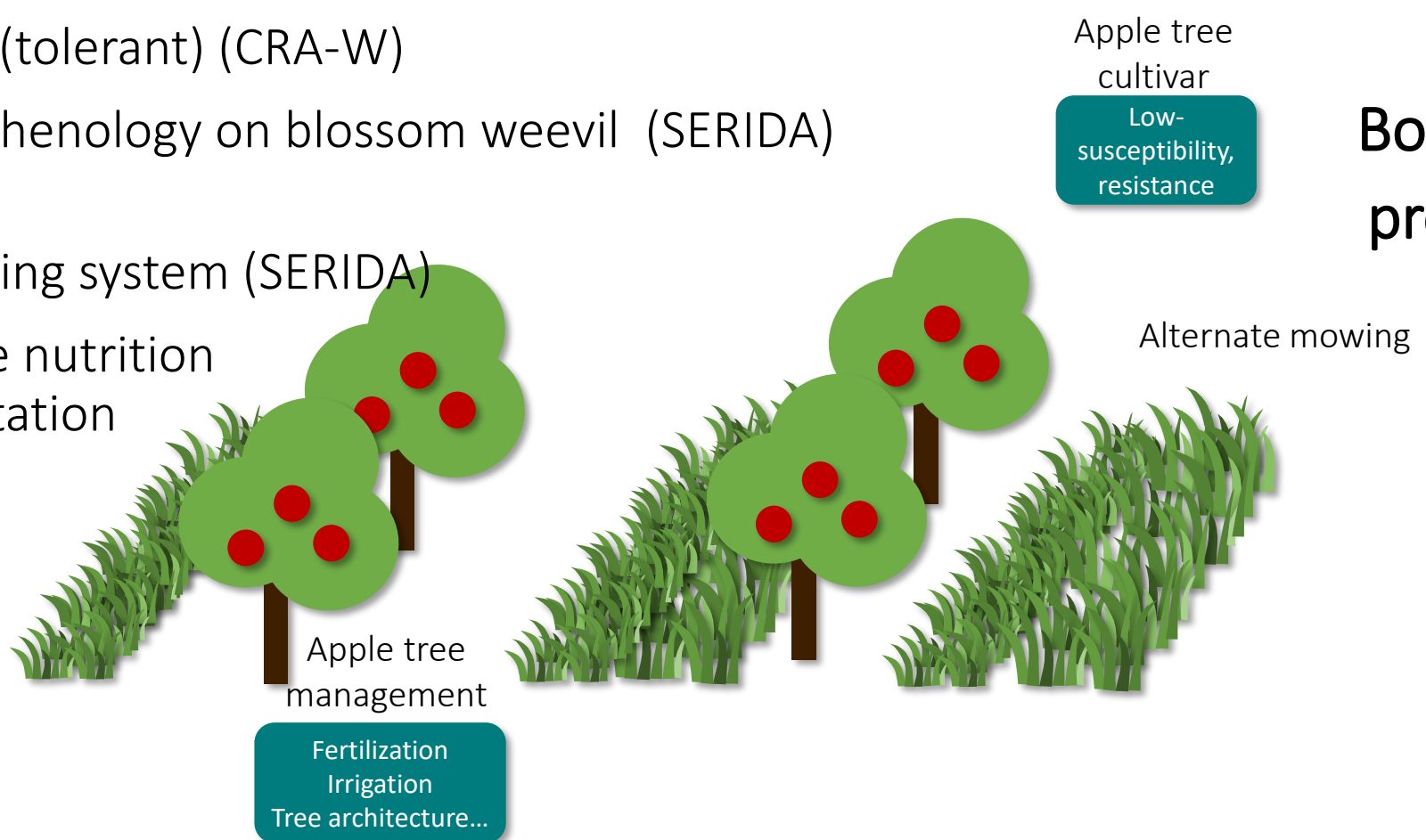
- Diffusion of essential oils in the orchard tested against sawfly (GRAB)
- Spatial and temporal dynamic of plant volatile emission and effects on NE (INRAE)



# How can we design a pest-suppressive agroecosystem?

## 1. To make it difficult for pests to be in the same space and time-frame as pest-susceptible organs

- Plant material (tolerant) (CRA-W)
- Effect of bud phenology on blossom weevil (SERIDA)
- Effect of cropping system (SERIDA)
- Effect of N tree nutrition on aphid infestation (INRAE)



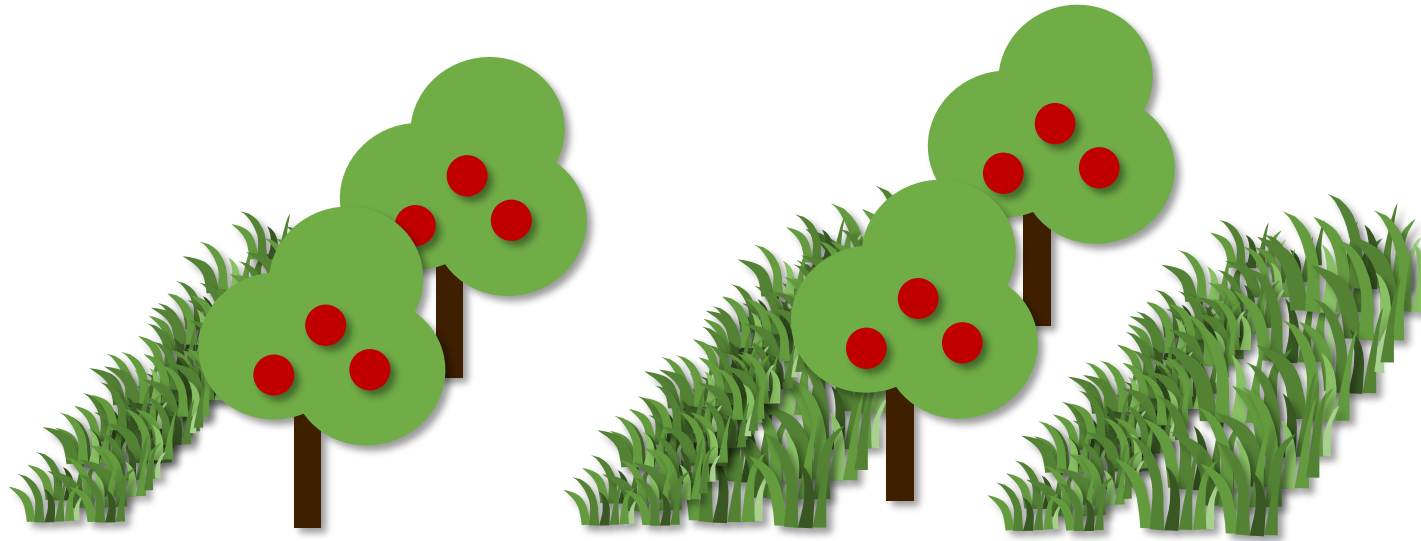
# How can we design a pest-suppressive agroecosystem?

## 2. To create the conditions that promote pests' natural enemies

Agroecological infrastructures encouraging NE

4

Top down  
processes

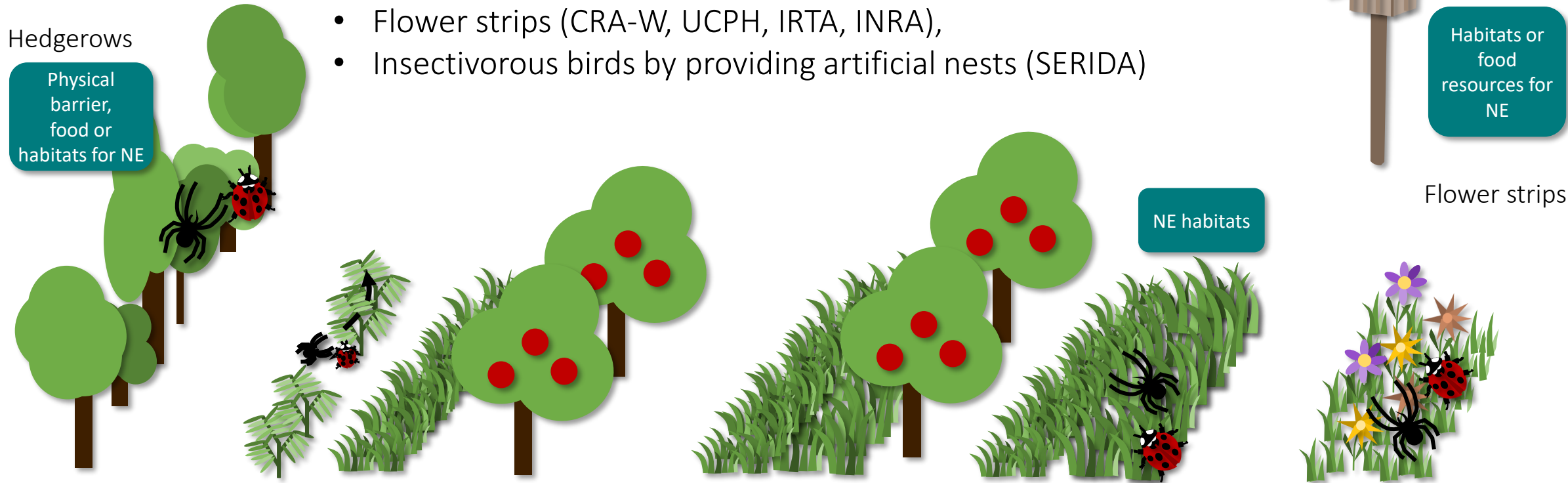


# How can we design a pest-suppressive agroecosystem?

## 2. To create the conditions that promote pests' natural enemies

### Agroecological infrastructure encouraging NE

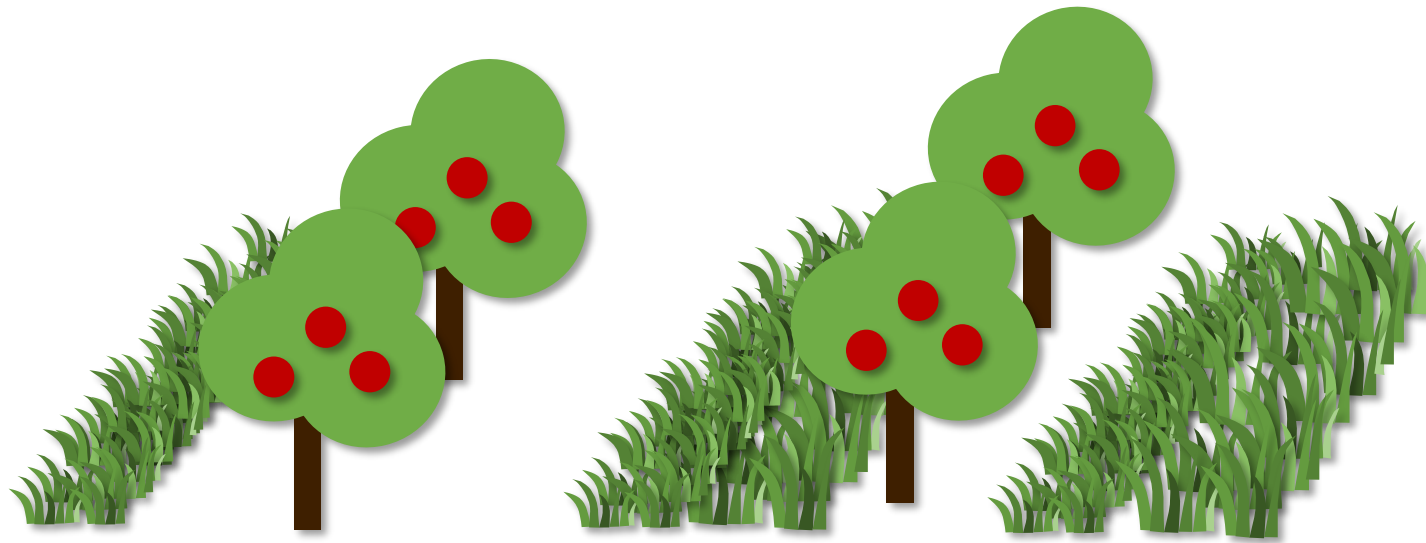
- Effect of groundcover management in alleys (SERIDA)
- Flower strips (CRA-W, UCPH, IRTA, INRA),
- Insectivorous birds by providing artificial nests (SERIDA)



# How can we design a pest-suppressive agroecosystem?

## 2. To create the conditions that promote pests' natural enemies

Direct soft solutions



# How can we design a pest-suppressive agroecosystem?

## 2. To create the conditions that promote pests' natural enemies

### Direct soft solutions

- **Diversion of ants** with sugar baits (SLU)
- **Augmentative releases** of predatory arthropods:
  - Early releases of predatory insects such as earwigs (INRA, IRTA), as well as anthocorids (UCPH)
  - Parasitoid populations and their effectiveness to control RRA by mass release (UCL, Belgium).
- **Inoculative release** of *M. ridens* parasitoid (INRAE)

### Direct practices against pests

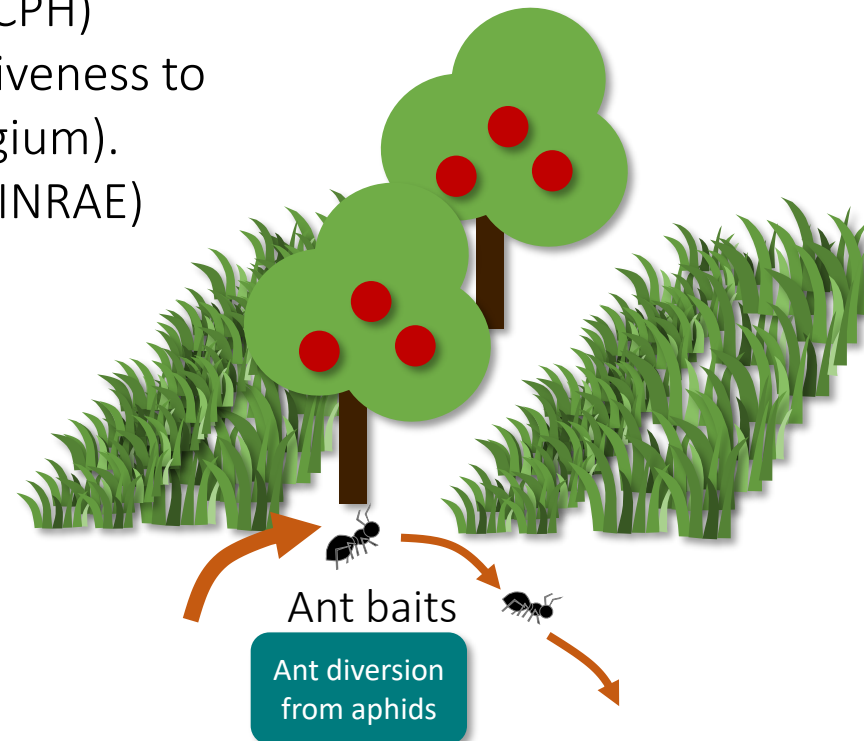
Predictive models  
to adjust  
pesticides use to  
weather risks

Mating  
disruption  
Mass  
trapping

NE  
releases

5

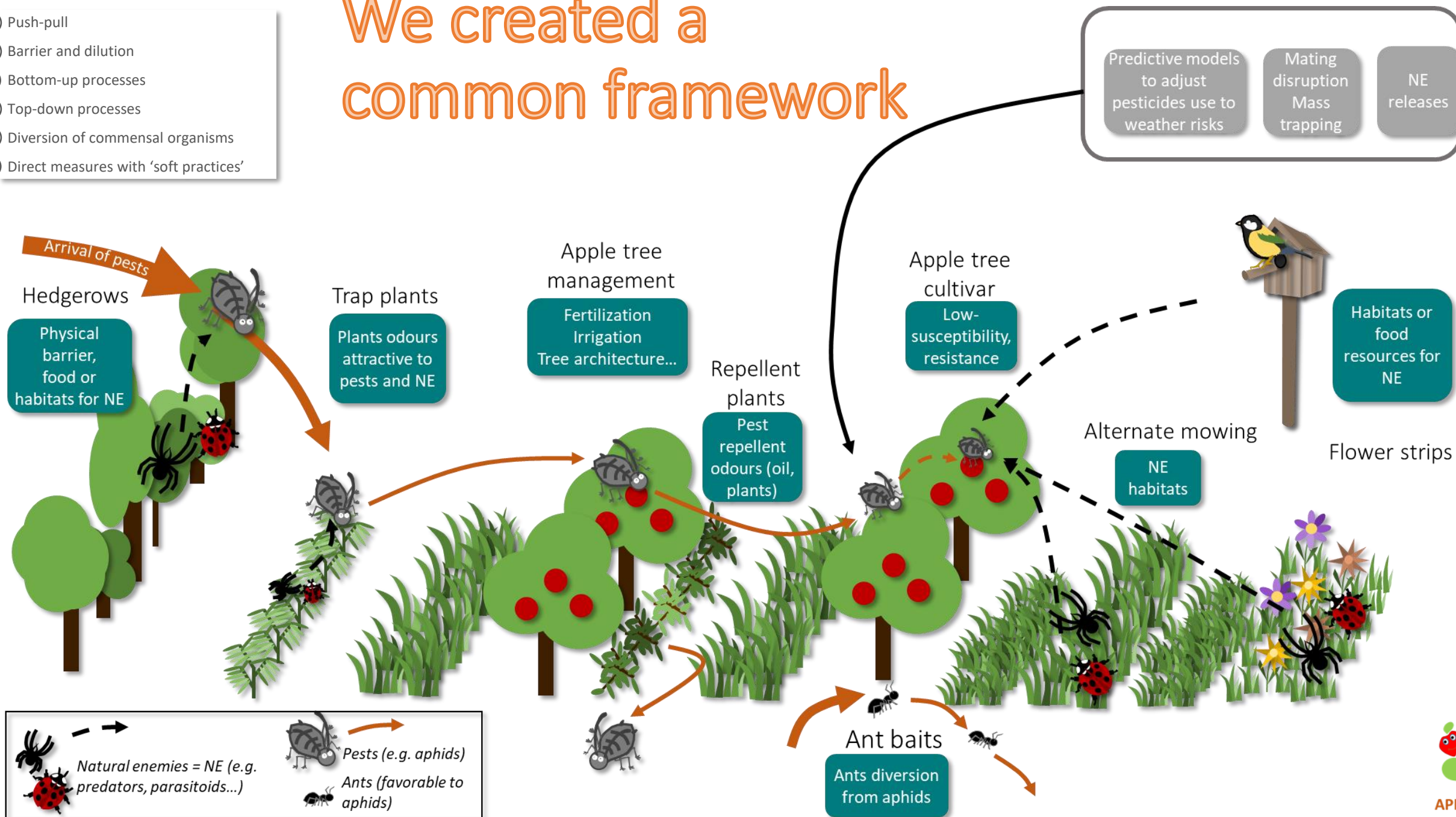
6



## Tested levers for action

- ① Push-pull
- ② Barrier and dilution
- ③ Bottom-up processes
- ④ Top-down processes
- ⑤ Diversion of commensal organisms
- ⑥ Direct measures with 'soft practices'

# We created a common framework



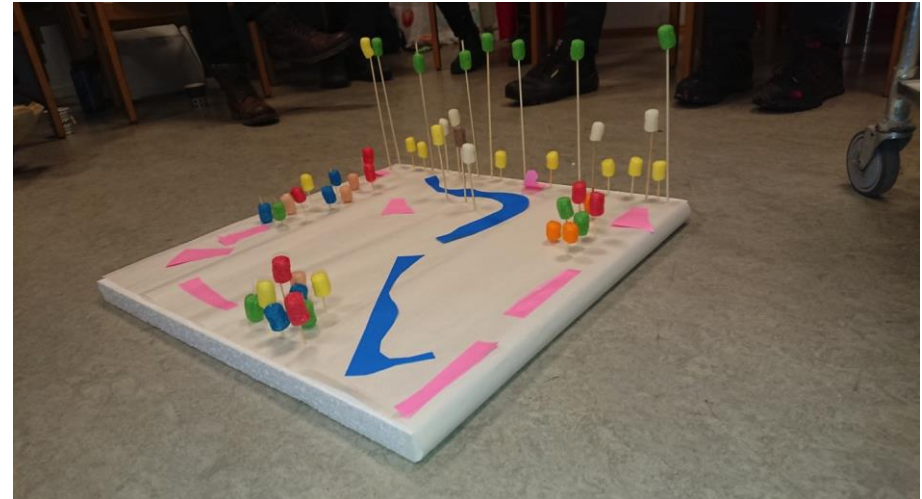
# We did co-design workshops

## • Workshops

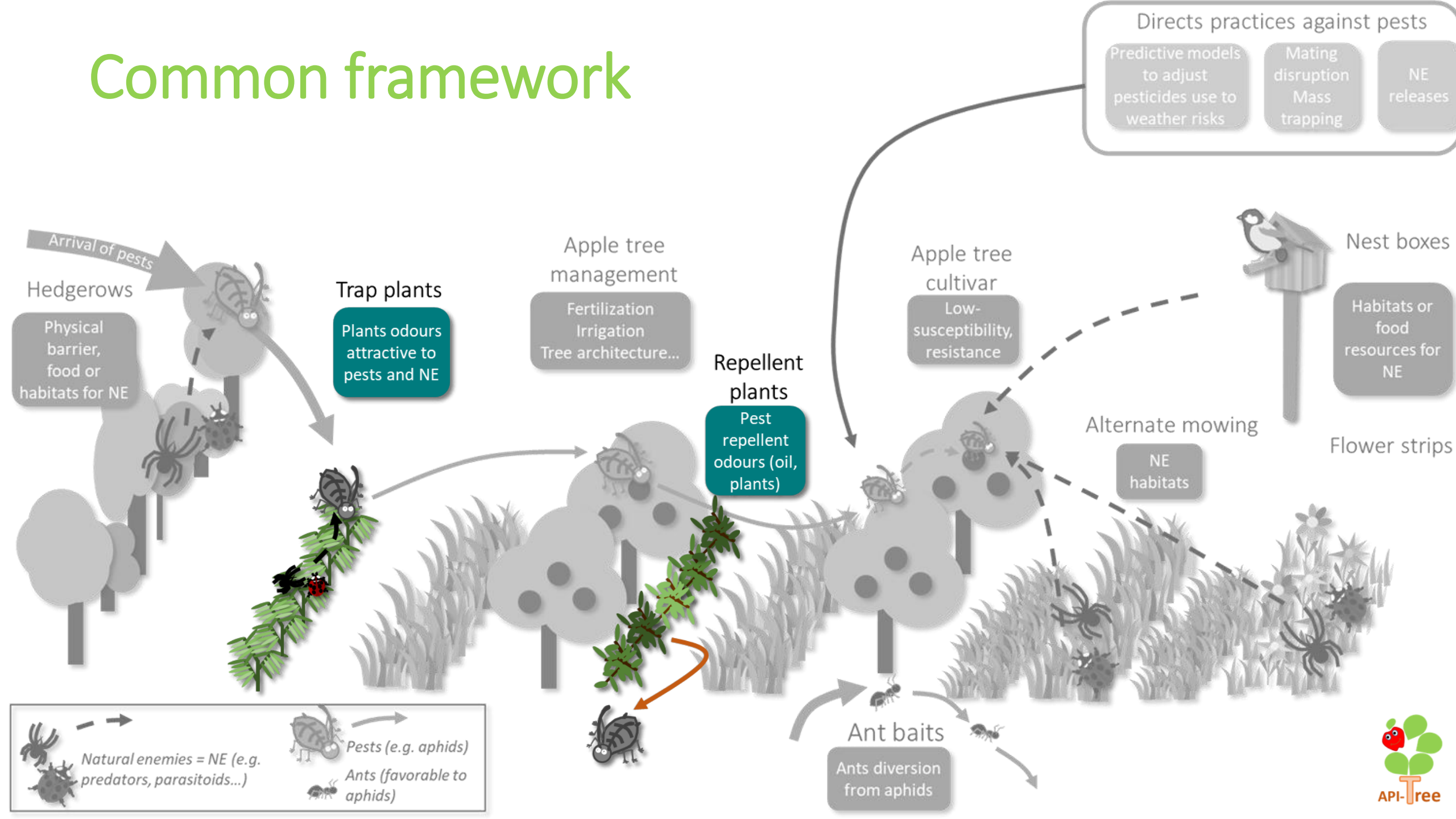
- The API-Tree team (design of sustainable orchard)
- Organisation of workshops with farmers and researchers & other stakeholders (INRAE & SLU & UCPH)

## • Objective

- To involve stakeholders
- To go to an integrated solution



# Common framework





# Effects of intercropping aromatic plants with apple trees on aphid control

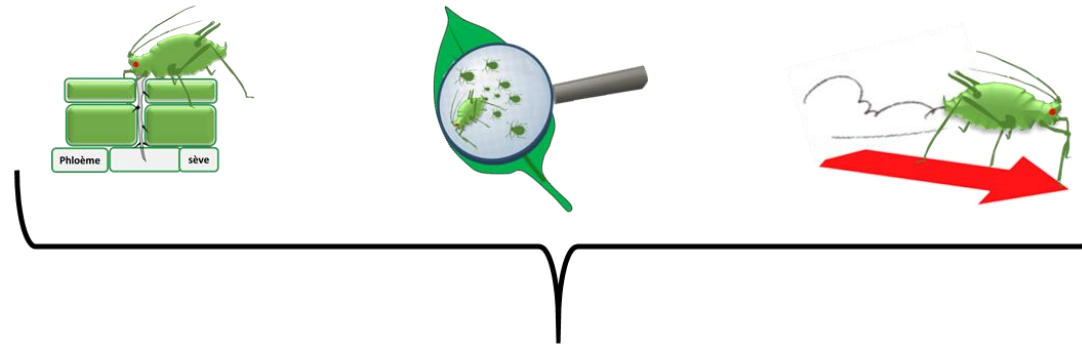
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<sup>1</sup>INRAE UERI Gotheron; <sup>2</sup> INRAE PSH Avignon

# Introduction

Documented effects of companion plants on a fruit tree aphid  
*Myzus persicae* in controlled conditions

(Dardouri et al. 2019; 2020; Ben Issa et al., 2016; 2017)



Rosemary



*Rosmarinus officinalis*

Basil



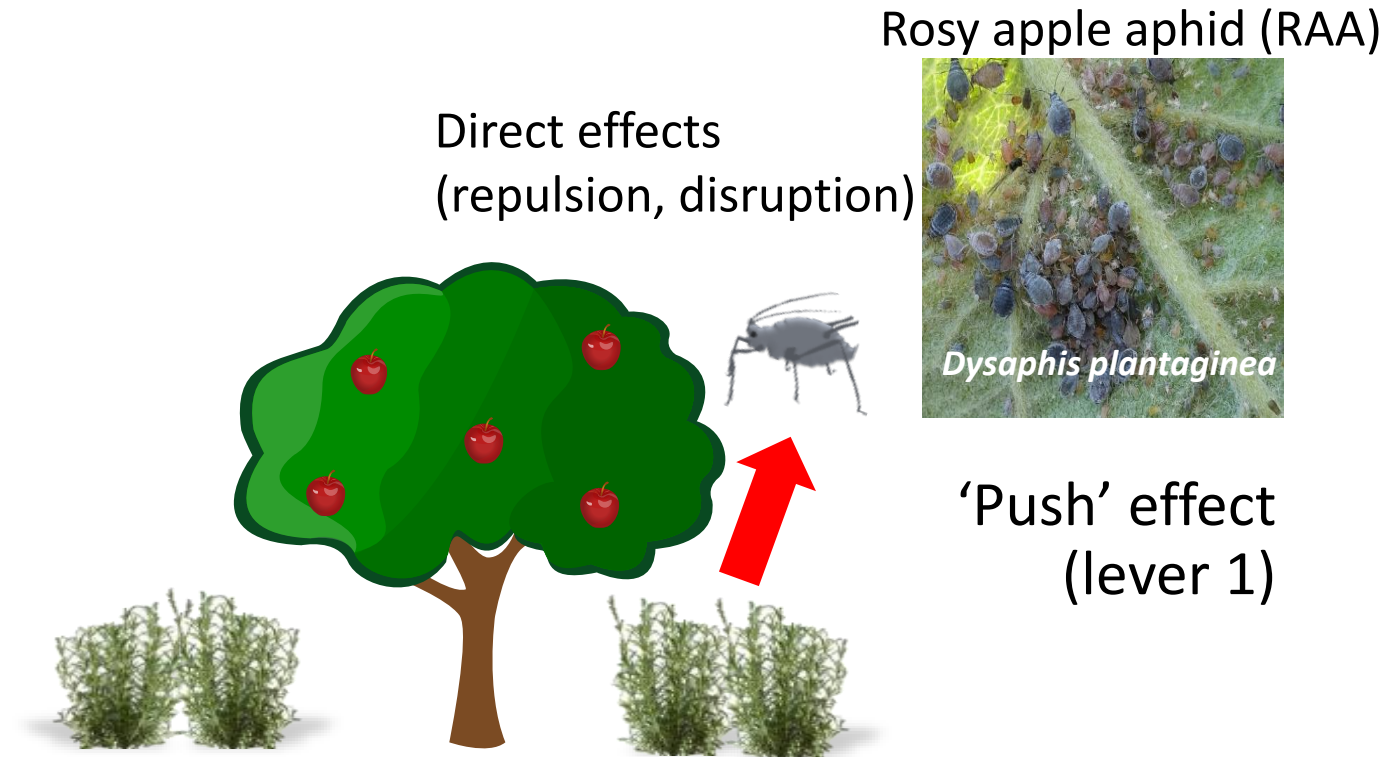
*Ocimum basilicum*

Marigold

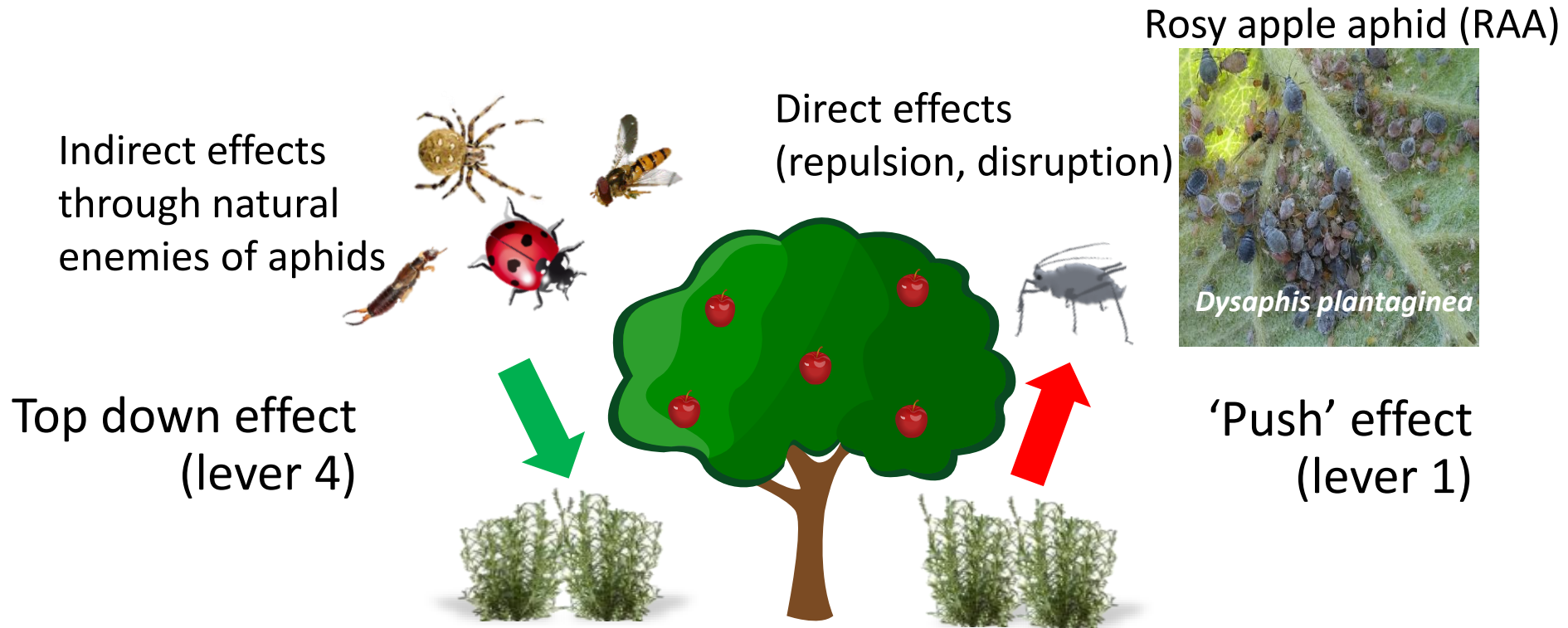


*Tagetes patula*

# What are the effects of those promising companion plants on the rosy apple aphid in orchards?



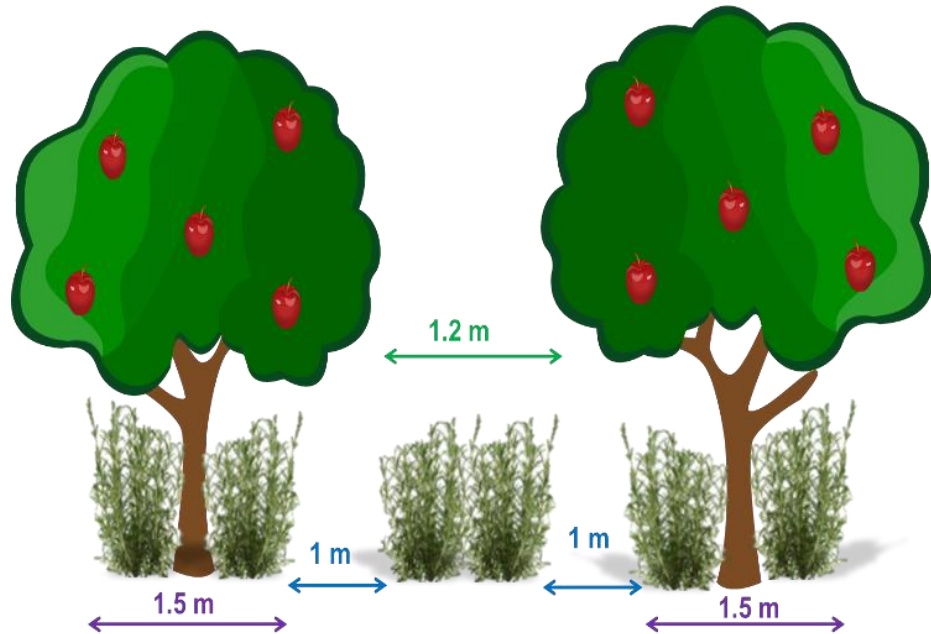
# What are the effects of those promising companion plants on the rosy apple aphid in orchards?



# Gotheron: experimental design

## Two objectives:

- To evaluate effect on RAA and natural enemies
- To design a functional system (machinery)



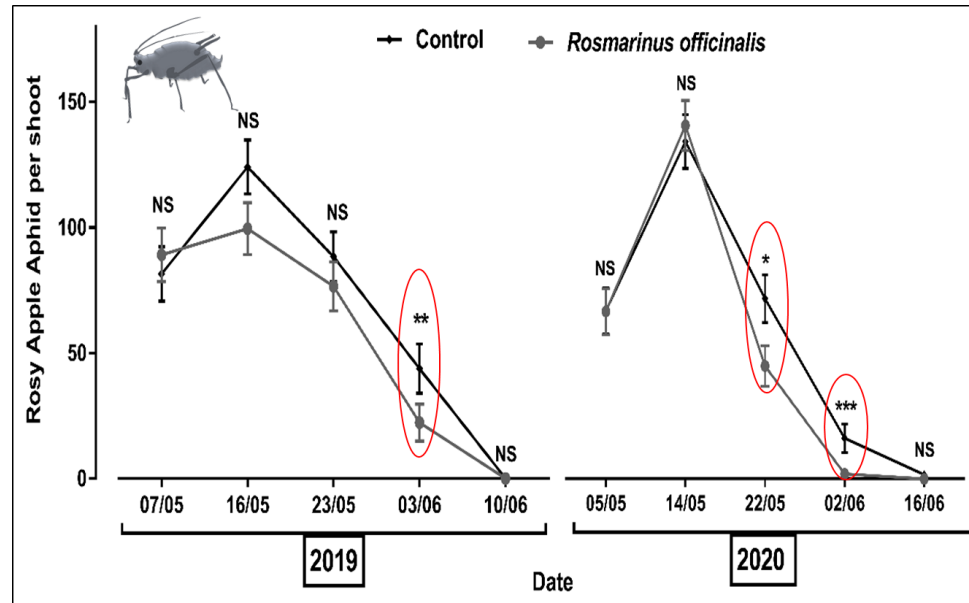
# Gotheron: Results (1/2)



Mortality was 60% higher within the row compared to alley  
(most probably due to watering & light interception by apple trees)

# Gotheron: Results (2/2)

Mean number of RAA per shoot (2019, 2020)

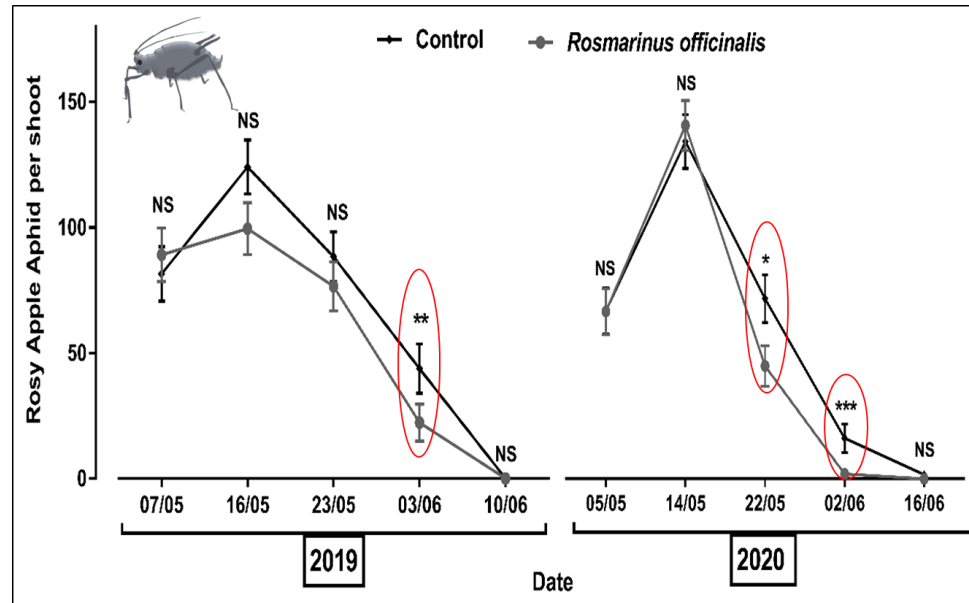


Visual observations of marked infested shoots

- ✓ A decrease of the quantity of aphids/colony at some dates in the presence of rosemary

# Gotheron: Results (2/2)

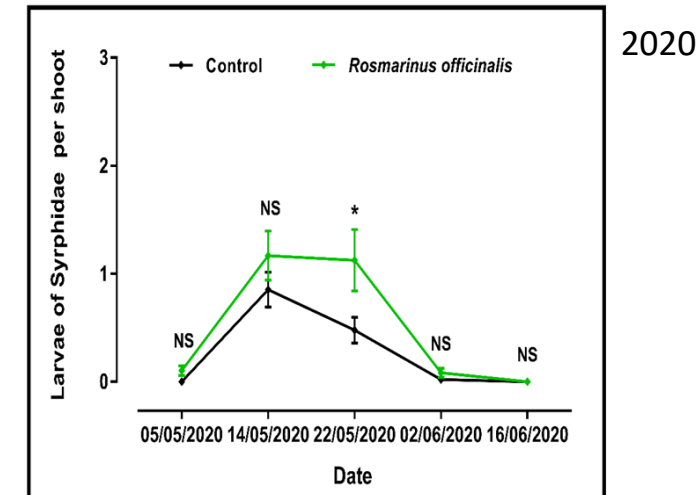
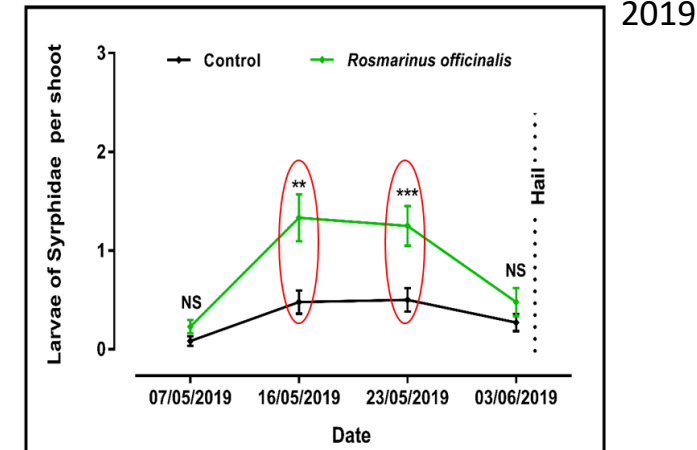
Mean number of RAA per shoot (2019, 2020)



Visual observations of marked infested shoots

- ✓ A decrease of the quantity of aphids/colony at some dates in the presence of rosemary
- ✓ An increase of Syrphidae larvae at some dates with rosemary

Mean number of Syrphidae larvae per shoot (2019, 2020)

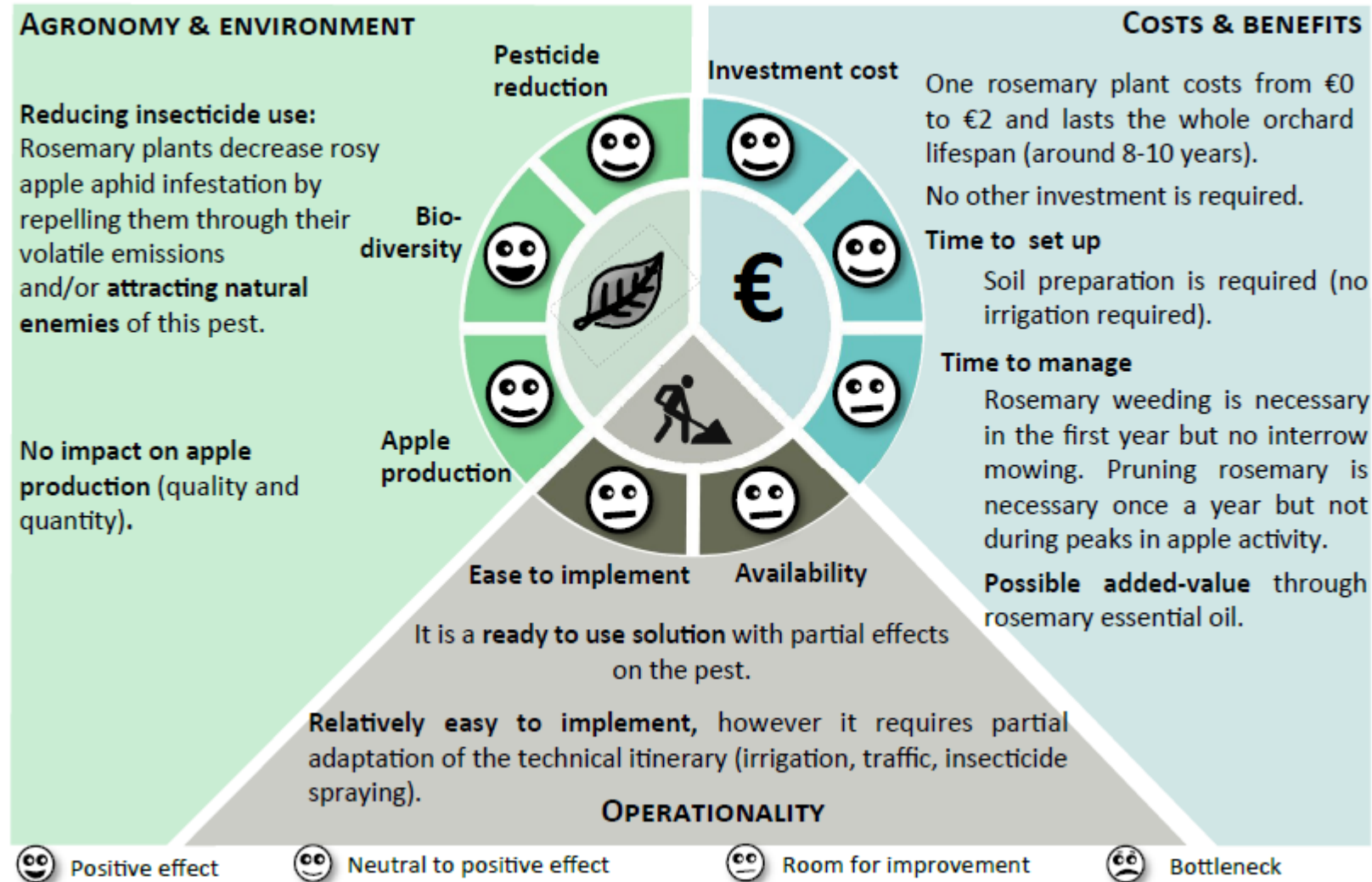


# Performances

In comparison to a conventional orchard.



Rosemary repels aphids and/or attracts natural enemies that will help limit pest outbreaks.





➔ API Tree results are available in a synthetic booklet:

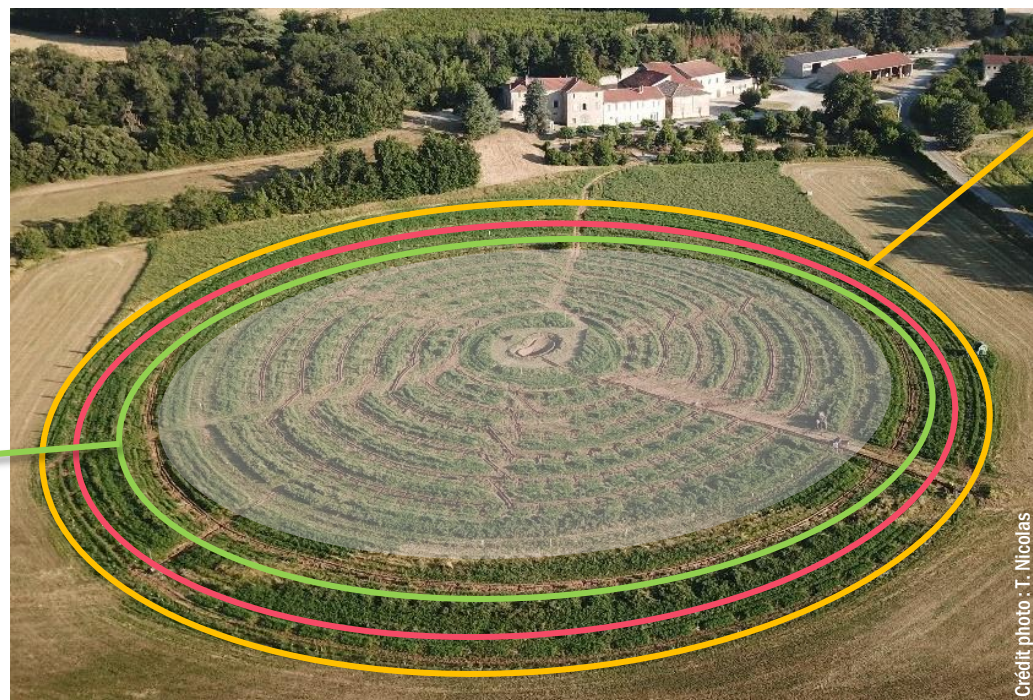
<https://hal.inrae.fr/hal-03352357>

Towards a pesticide free orchard?

# Towards a pesticide free orchard: the Gotheron experience, a diversified system

**Barrier: diversified fruit  
production (fig, hazelnut,  
soft fruit...)**

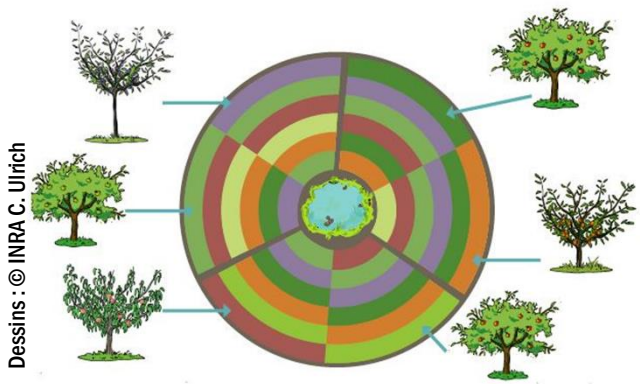
**Barrier: hedgerow  
+ windbreak**



Surface area = 1.7 ha (including hedges)

# Towards a pesticide free orchard:

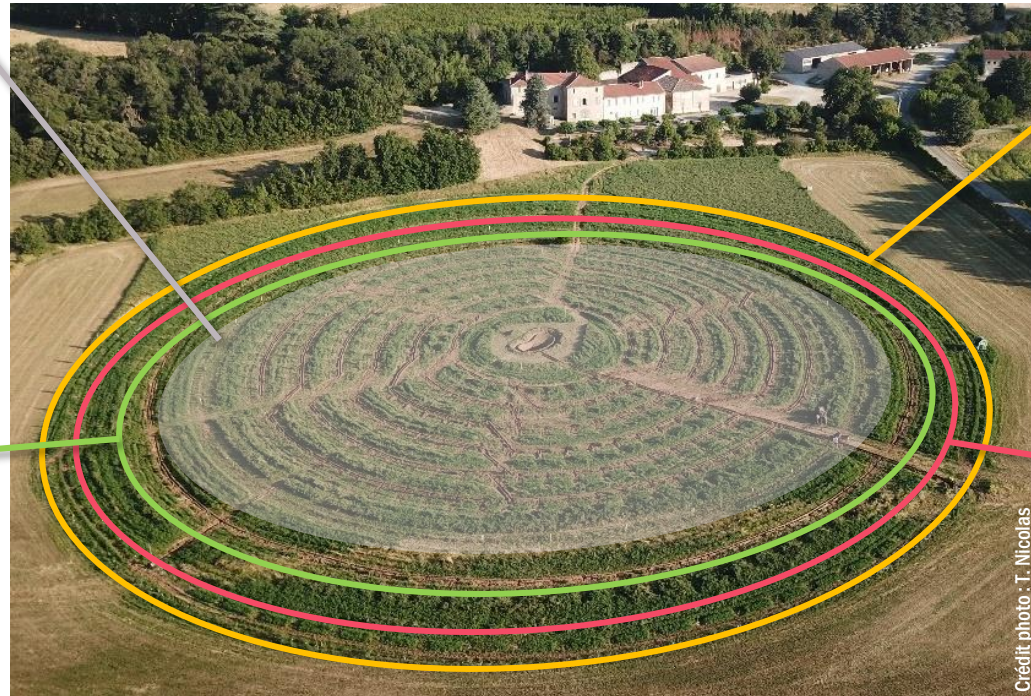
Main fruit species: low pest and disease susceptibility, species and cultivar mixture



Barrier: diversified fruit production (fig, hazelnut, soft fruit...)

Barrier: hedgerow + windbreak

'Trap' apple cultivars (e.g., aphid low-susceptibility cv)



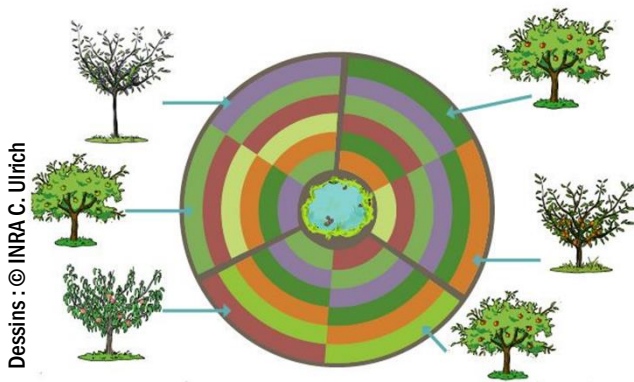
Surface area = 1.7 ha (including hedges)

# Towards a pesticide free orchard:

Main fruit species: low pest and disease susceptibility, species and cultivar mixture



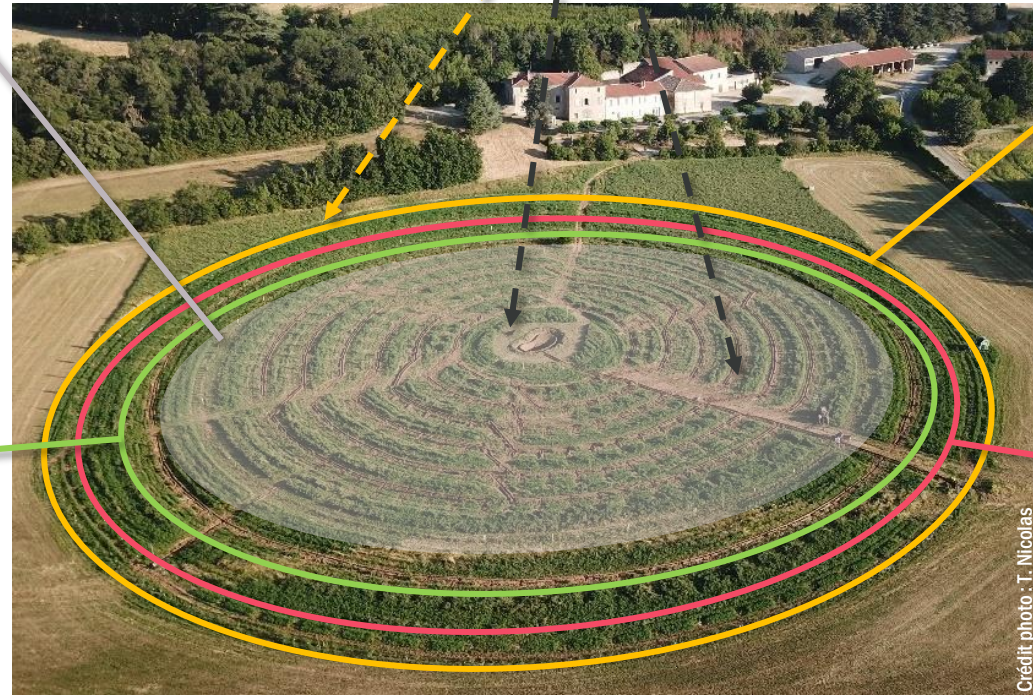
Conservation biocontrol : plant assemblages and habitats



Barrier: hedgerow + windbreak

Barrier: diversified fruit production (fig, hazelnut, soft fruit...)

'Trap' apple cultivars (e.g., aphid low-susceptibility cv)



Surface area = 1.7 ha (including hedges)

# Thank you



<https://www6.paca.inrae.fr/ueri/Contrats-et-projets/Projet-Z>

