



Funded by the European Union



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



API-Tree

[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



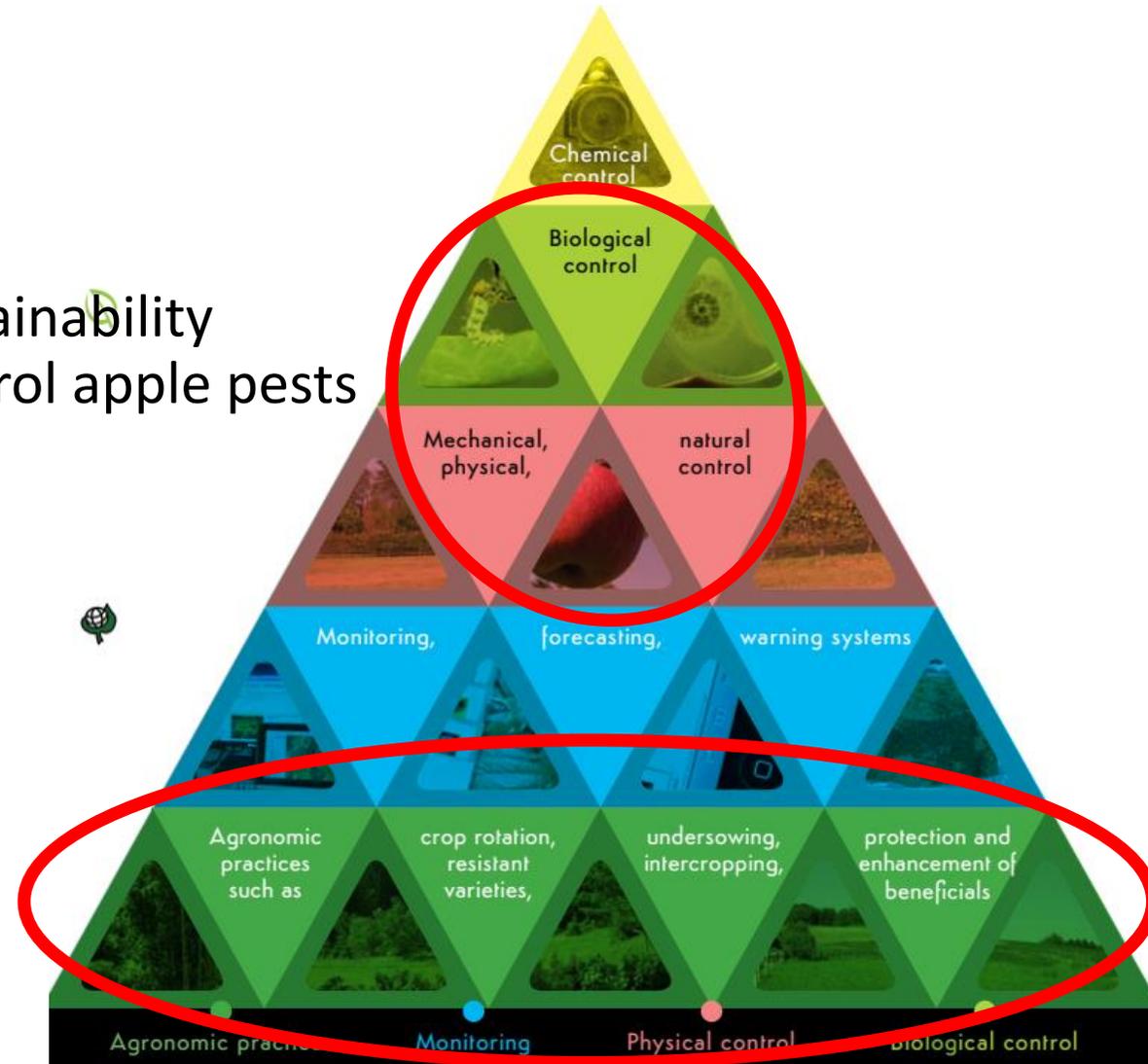
API-Tree project

- Objectives

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

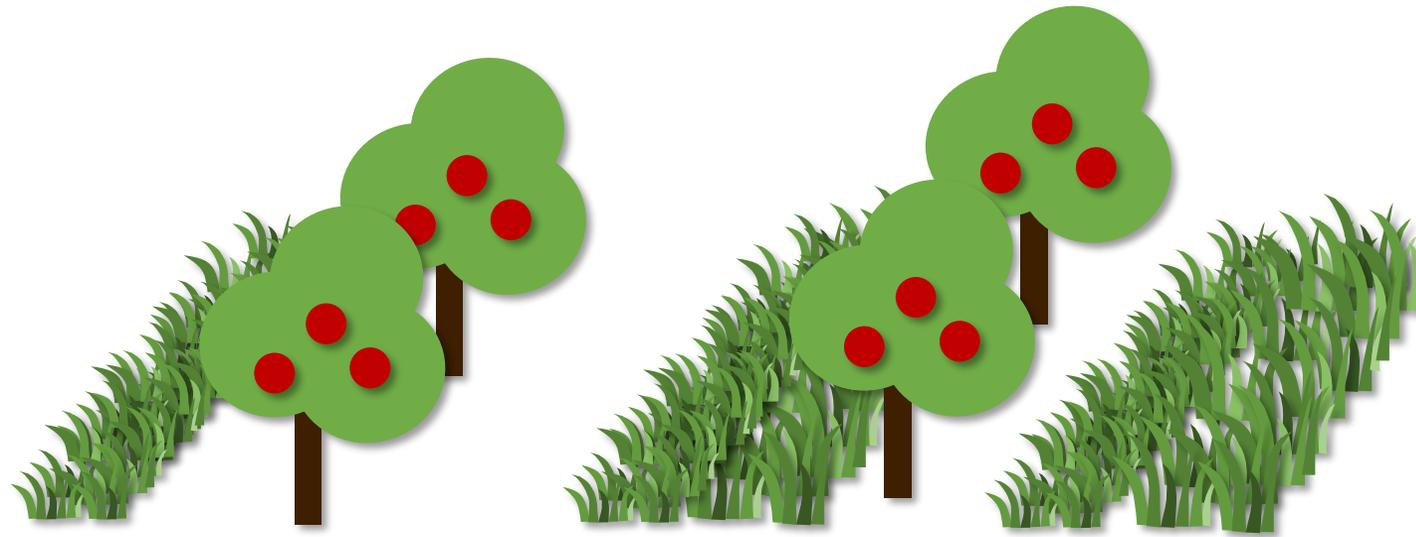
- Outcomes

- 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



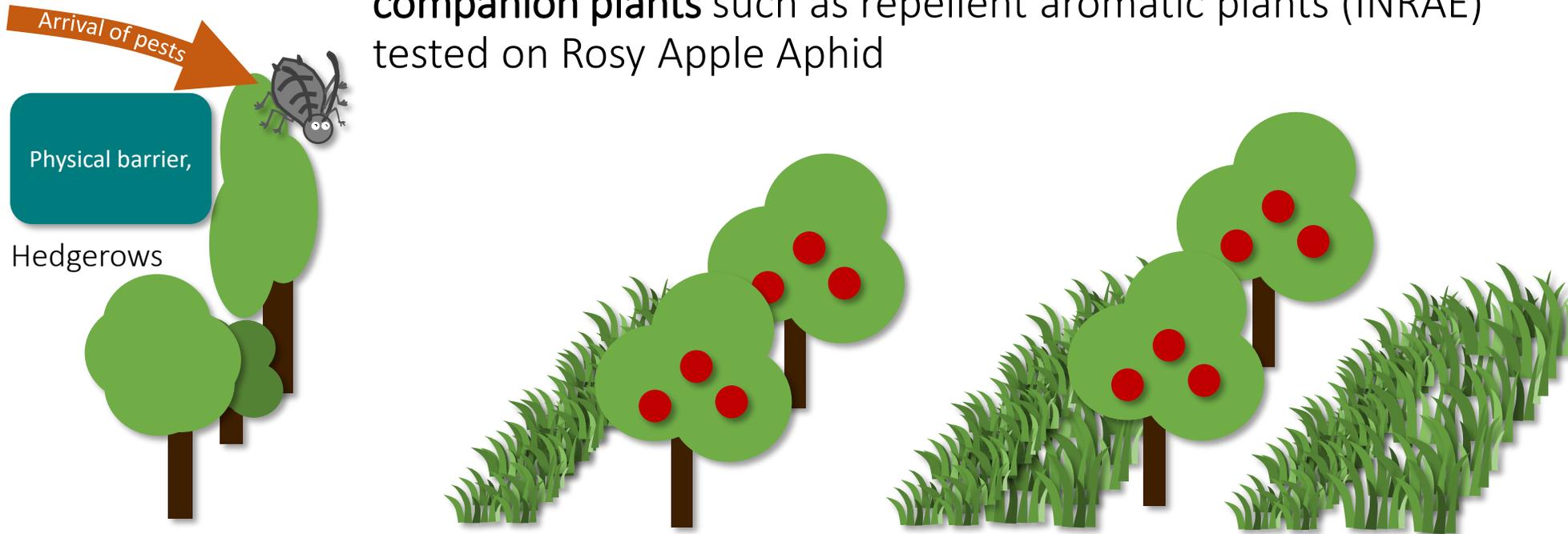
How can we design a pest-suppressive agroecosystem?

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,



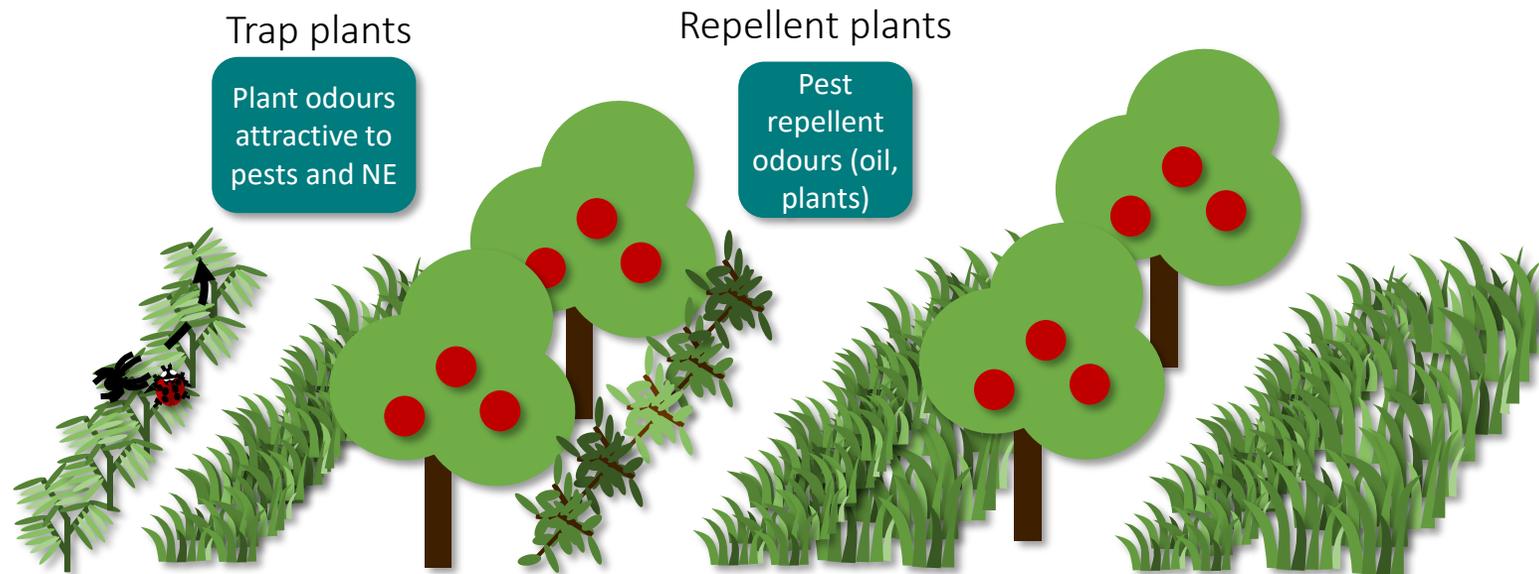
How can we design a pest-suppressive agroecosystem?

1 2

1. To make it difficult for pests

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

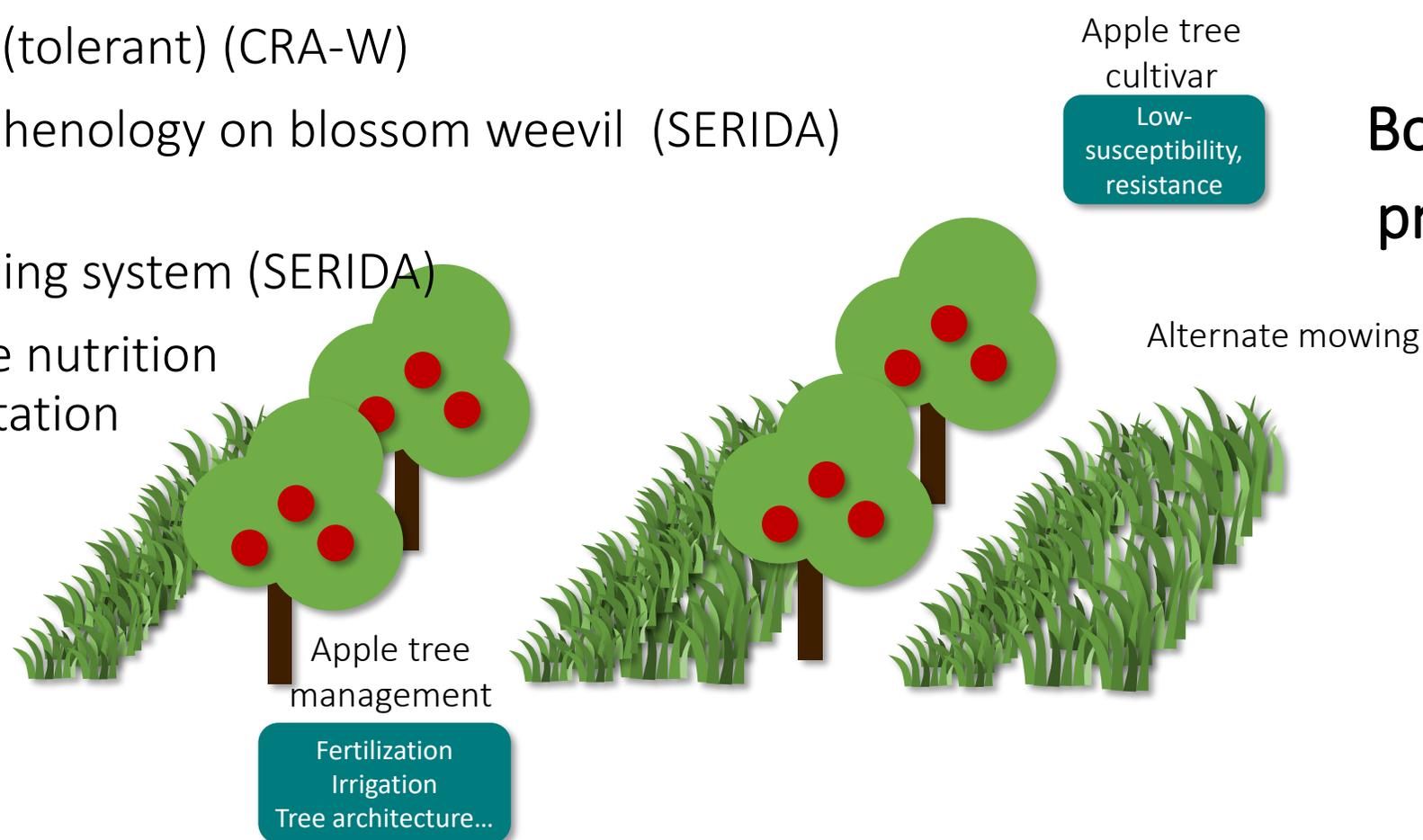
Push Pull,
dilution



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)



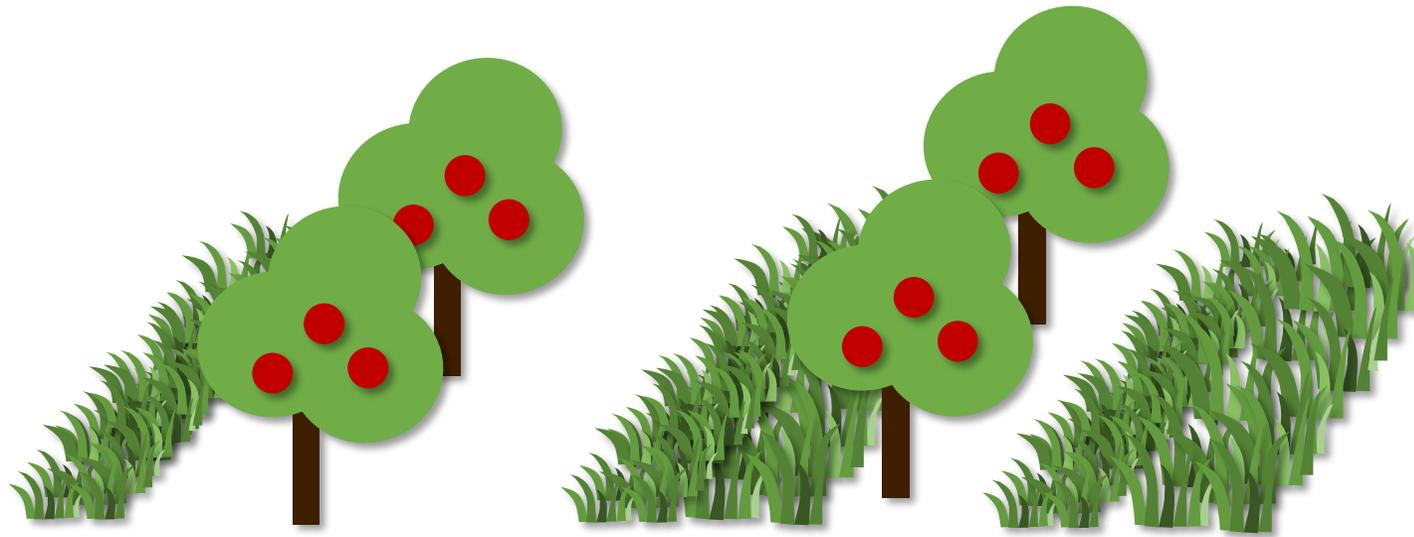
How can we design a pest-suppressive agroecosystem?

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?

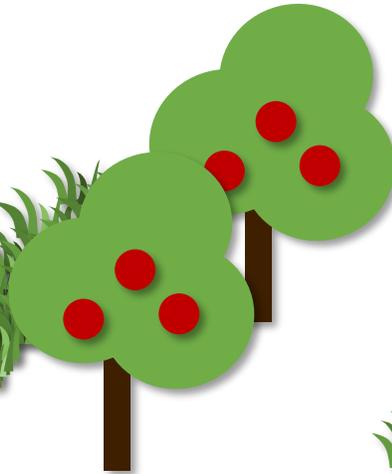
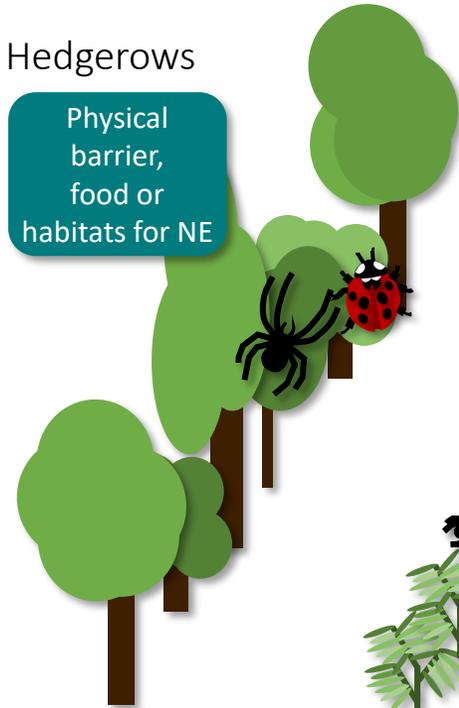
2. To create the conditions that promote pests' natural enemies

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)

Hedgerows

Physical barrier,
food or
habitats for NE



Nest boxes

Habitats or
food
resources for
NE

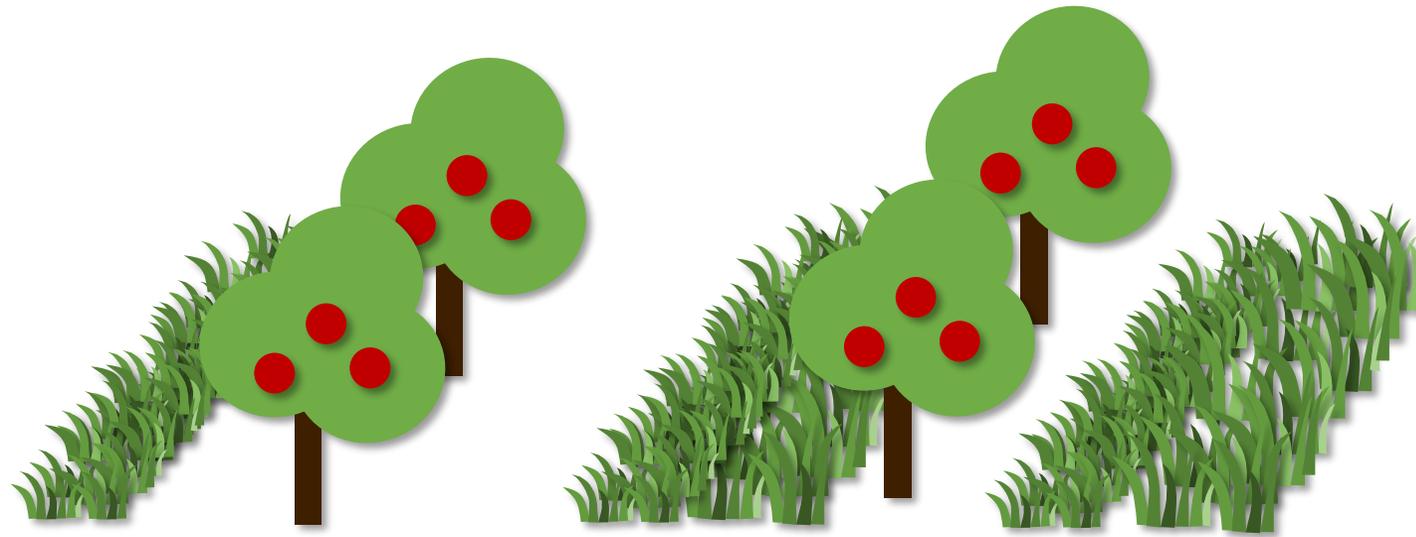
Flower strips



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

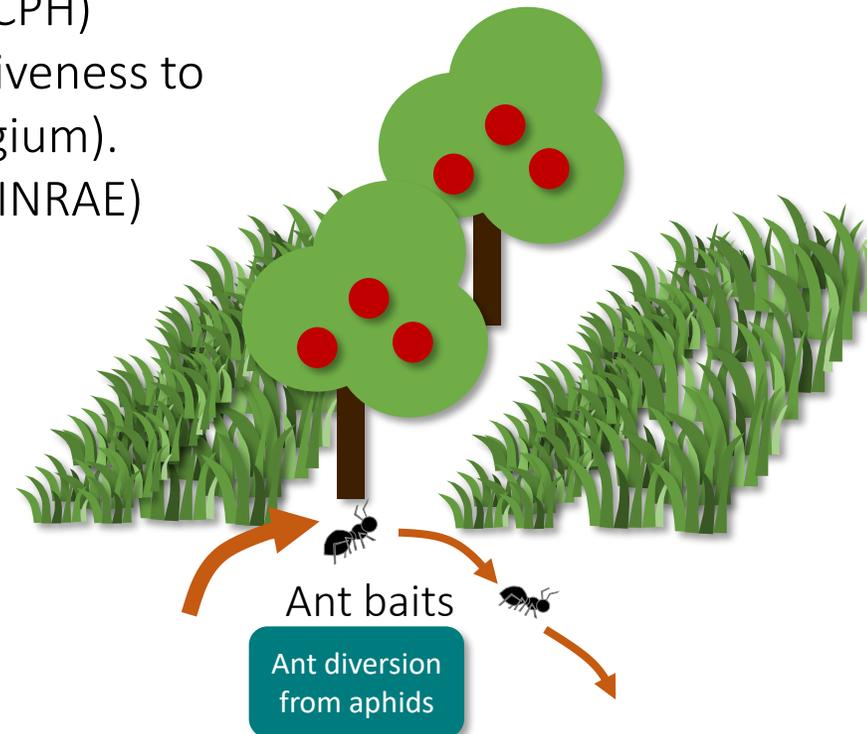
Predictive models
to adjust
pesticides use to
weather risks

Mating
disruption
Mass
trapping

NE
releases

5

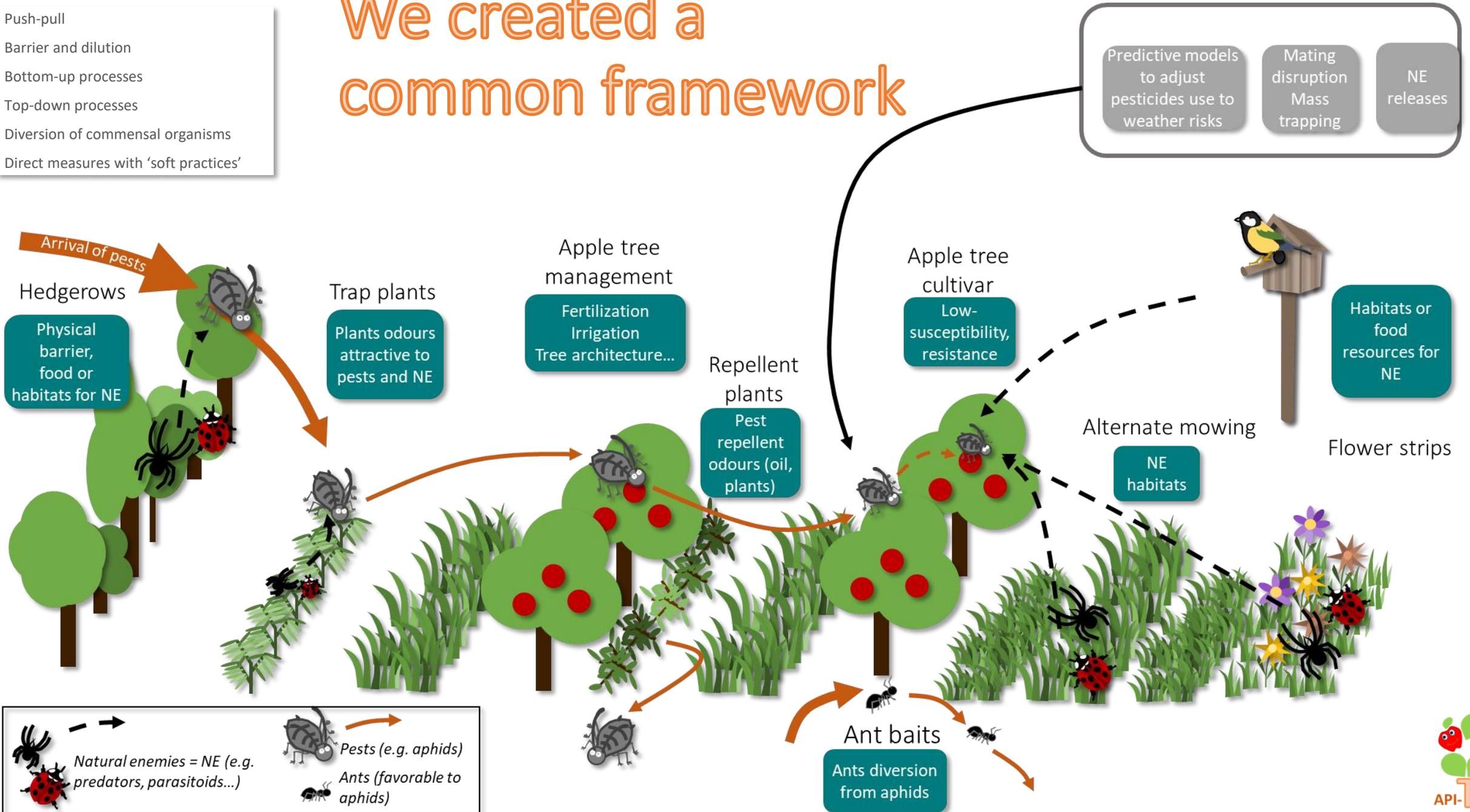
6



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



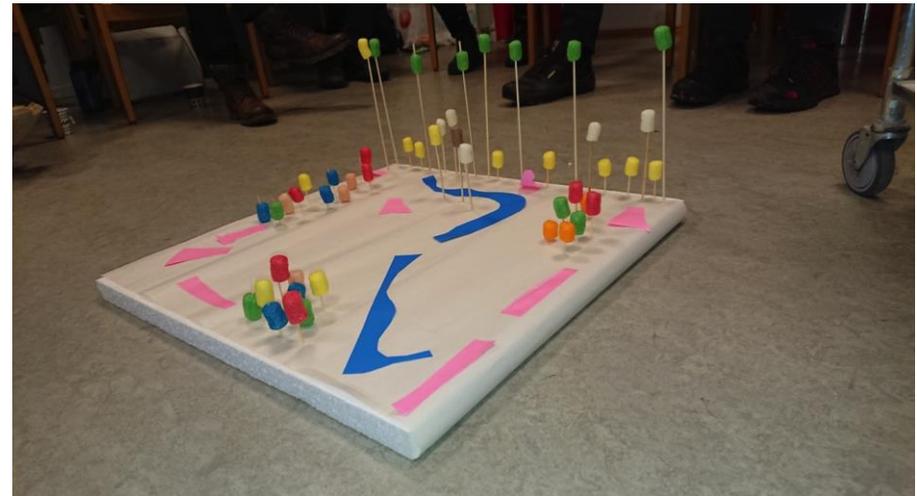
We did co-design workshops

• Workshops

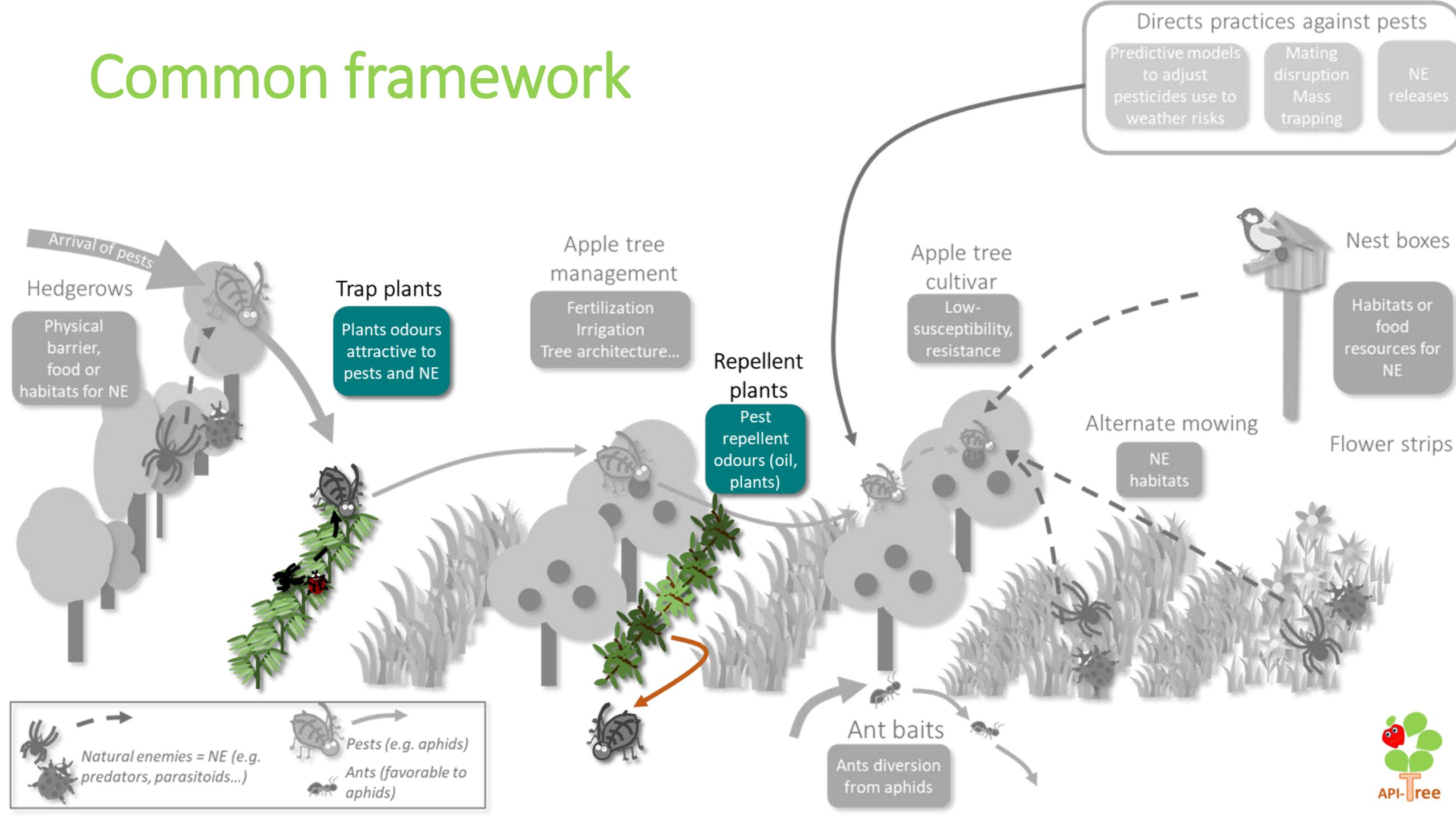
- The API-Tree team (design of sustainable orchard)
- Organisation of workshops with farmers and researchers & other stakeholders (INRAE & SLU & UCPH)

• Objective

- To involve stakeholders
- To go to an integrated solution



Common framework





Effects of intercropping aromatic plants with apple trees on aphid control

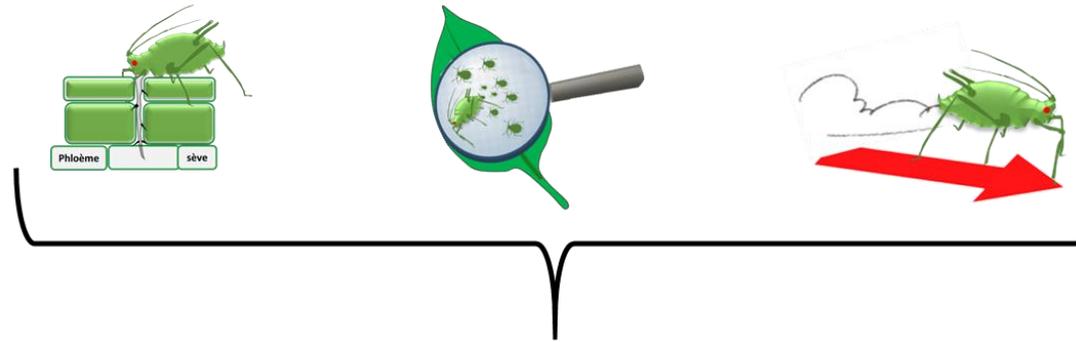
[Art.4.1 (b) - privacy]

¹INRAE UERI Gotheron; ² 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



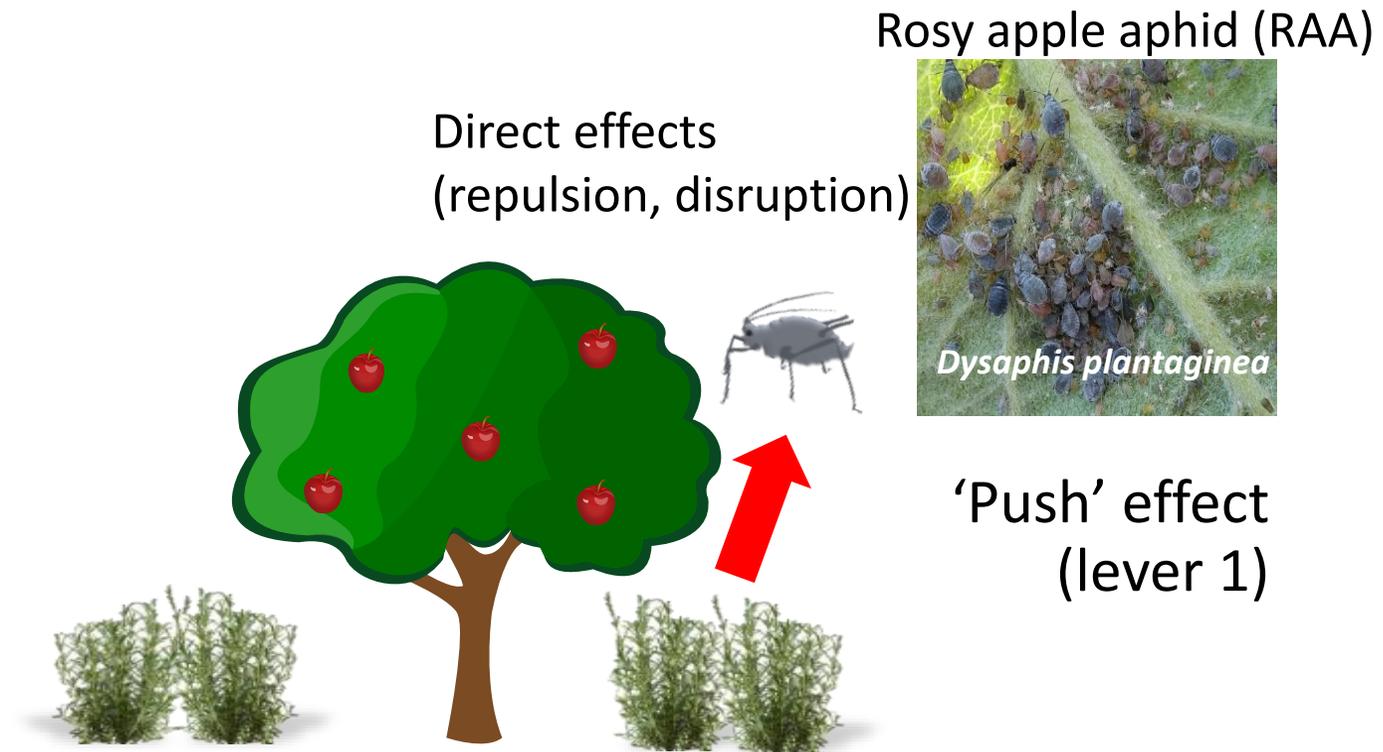
Ocimum basilicum

Marigold

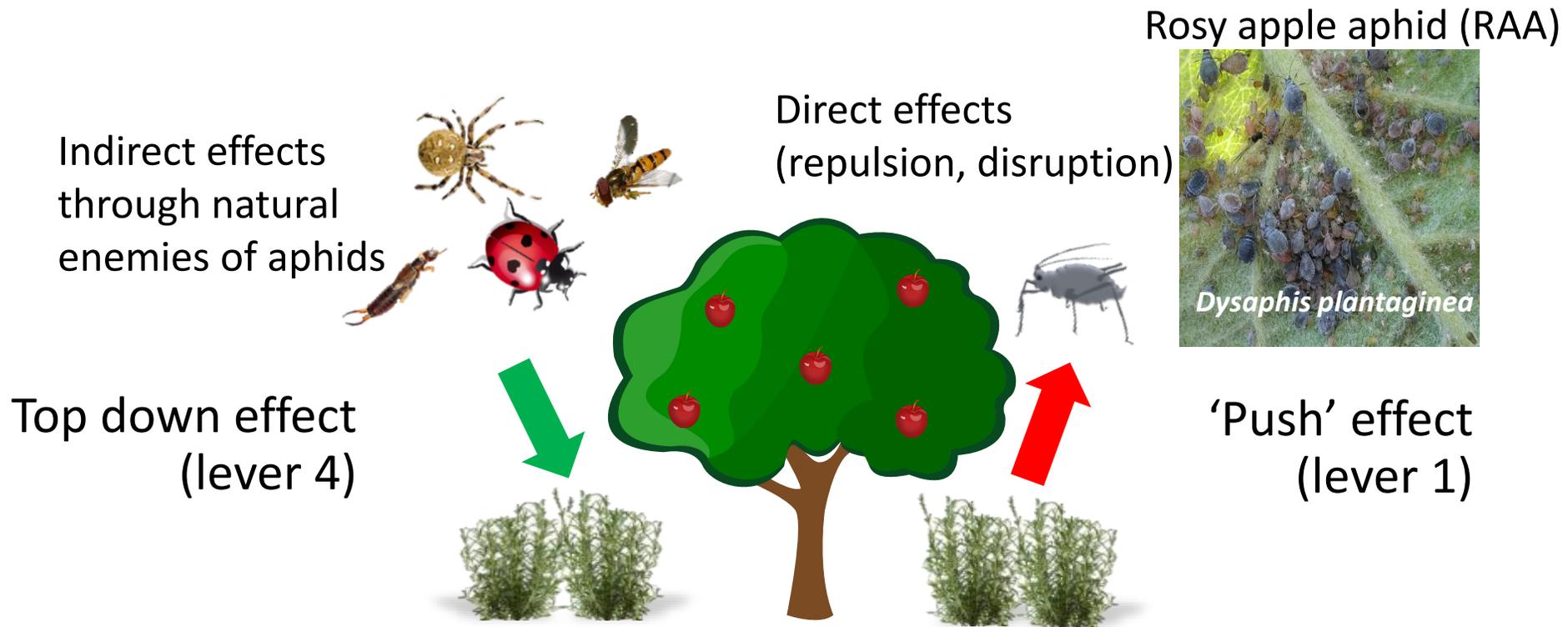


Tagetes patula

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



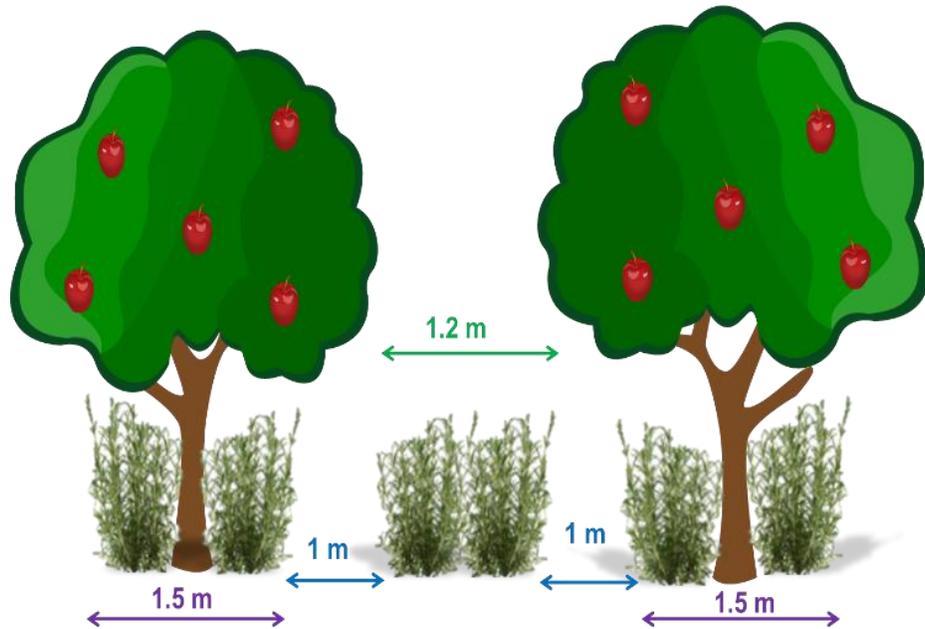
What are the effects of those promising companion plants on the rosy apple aphid in orchards?



Gotheron: experimental design

Two objectives:

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



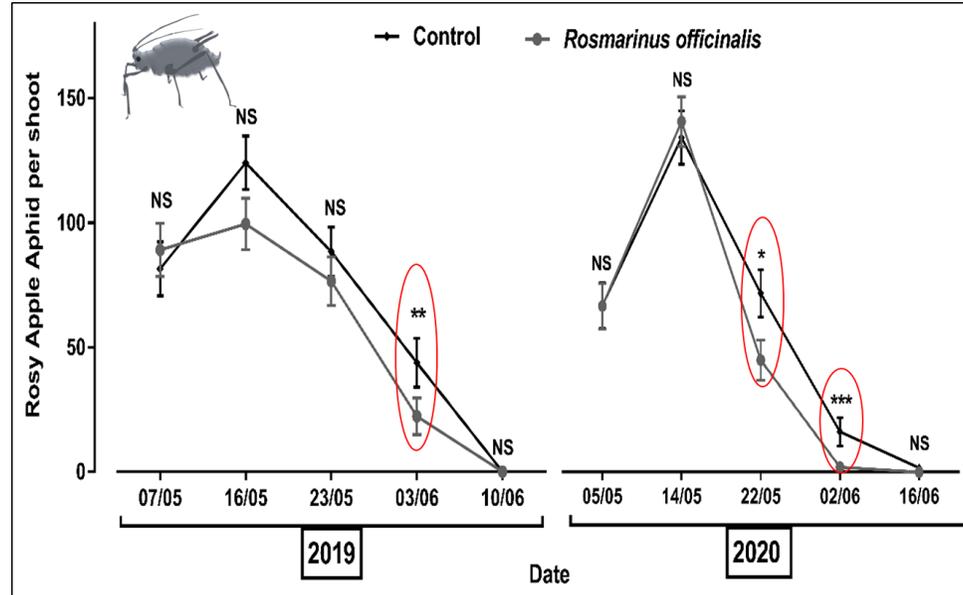
Gotheron: Results (1/2)



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)



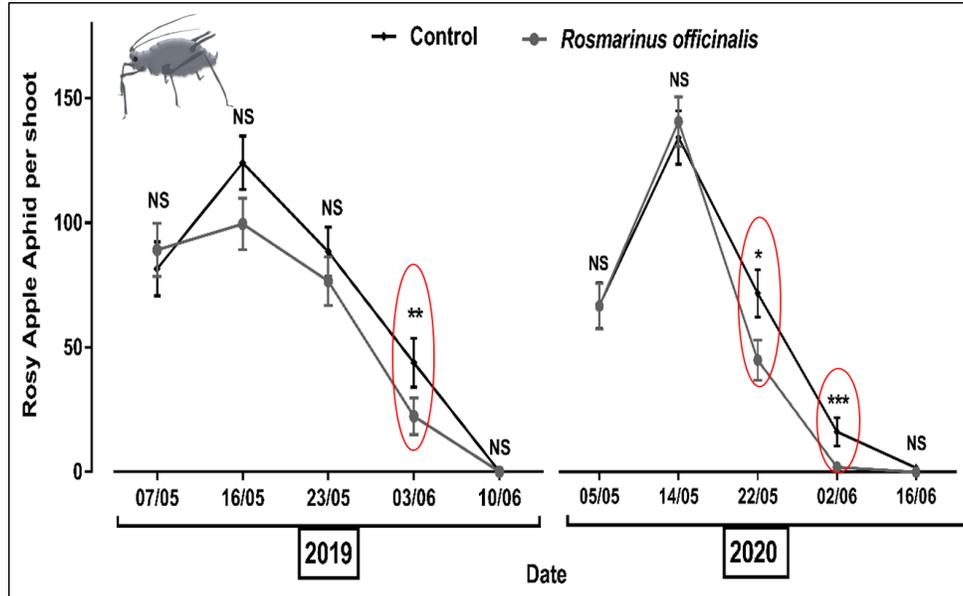
Visual observations of marked infested shoots

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

Gotheron: Results (2/2)



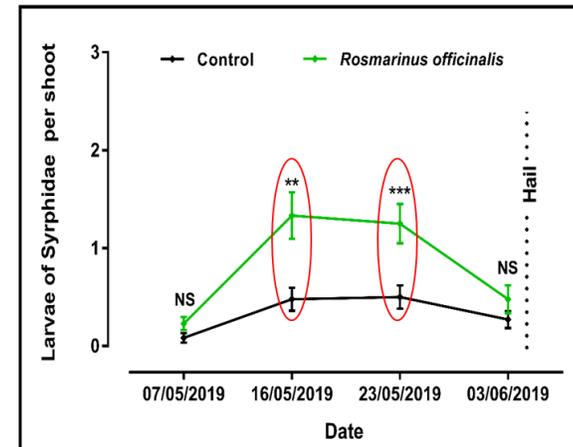
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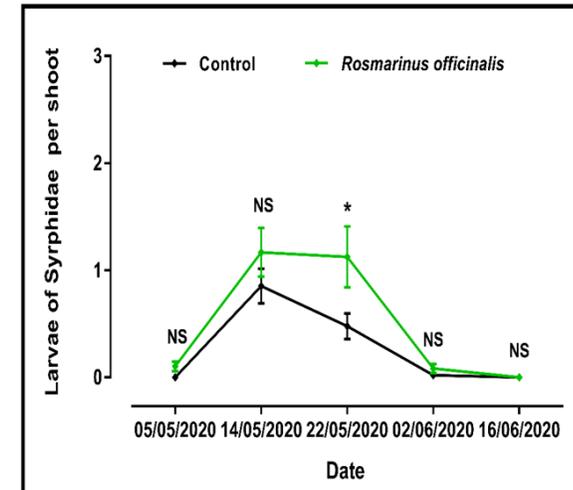
Visual observations of marked infested shoots

- ✓ 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)



2019



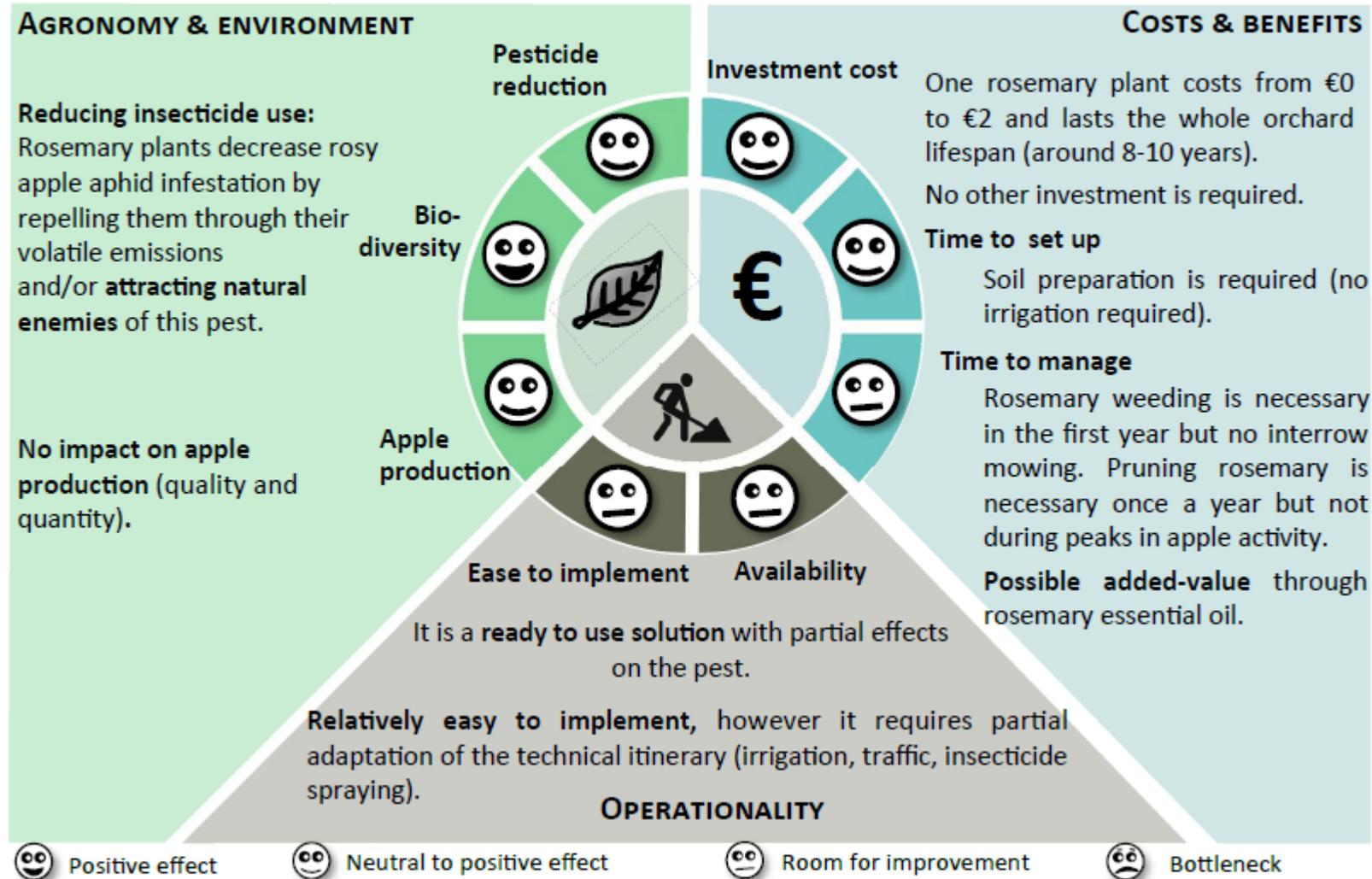
2020

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:

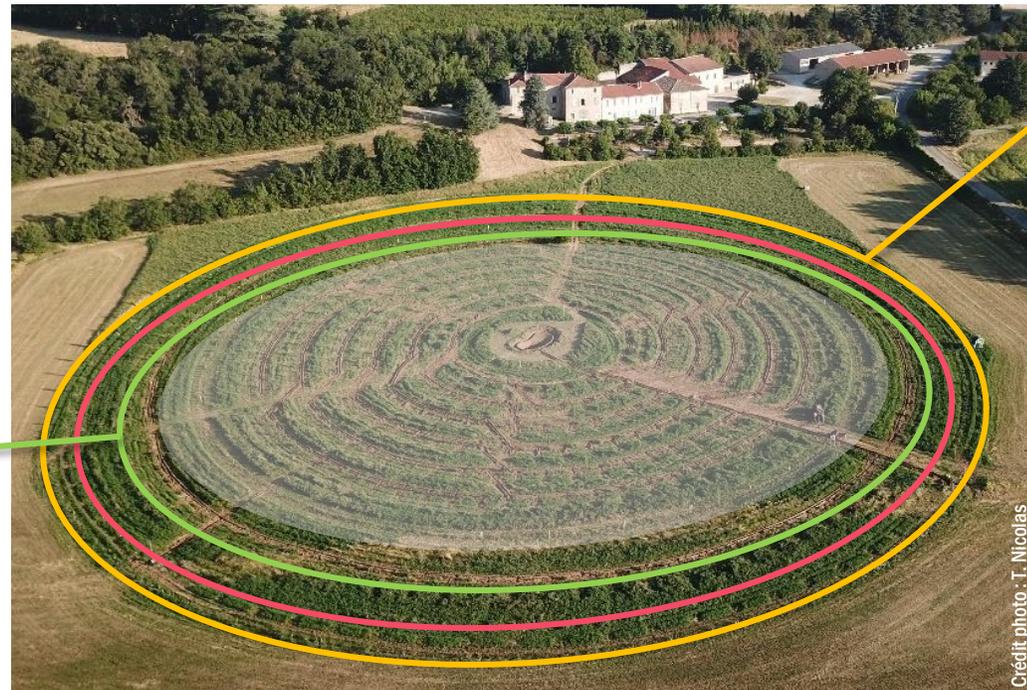
<https://hal.inrae.fr/hal-03352357>

Towards a pesticide free orchard?

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

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

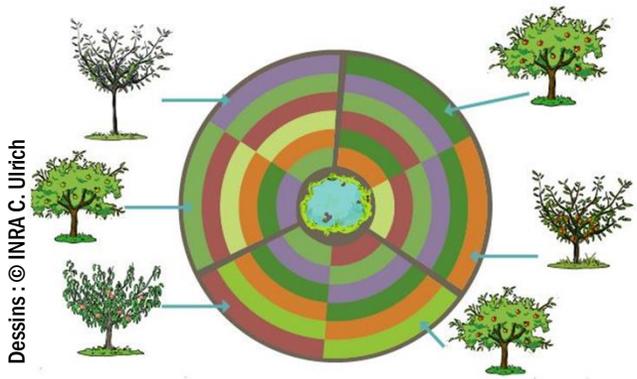
**Barrier: hedgerow
+ windbreak**



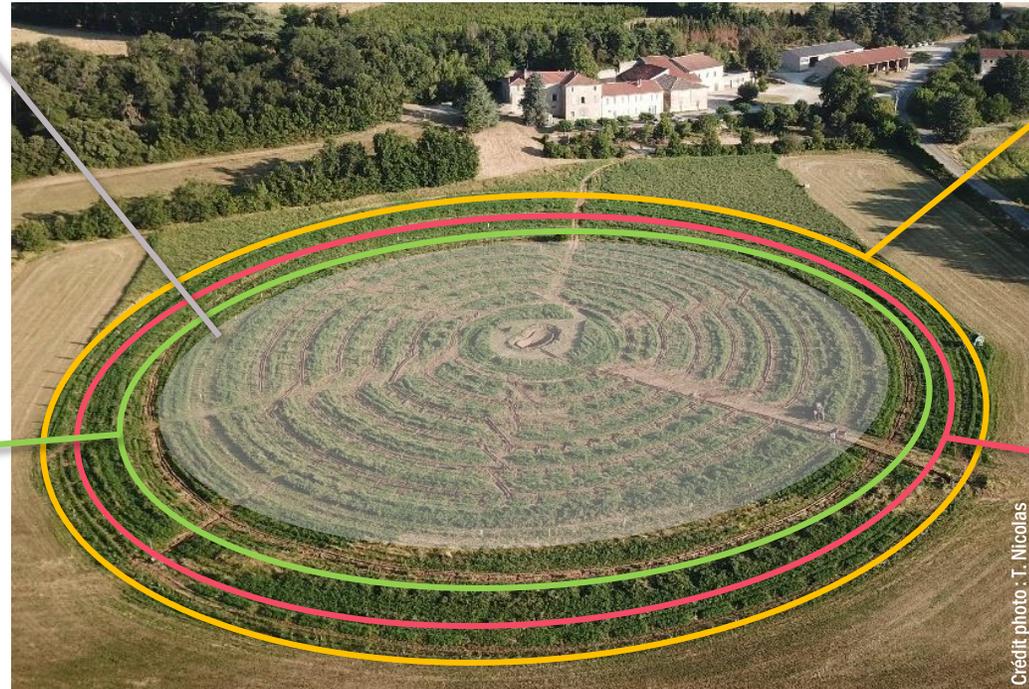
Surface area = 1.7 ha (including hedges)

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...)



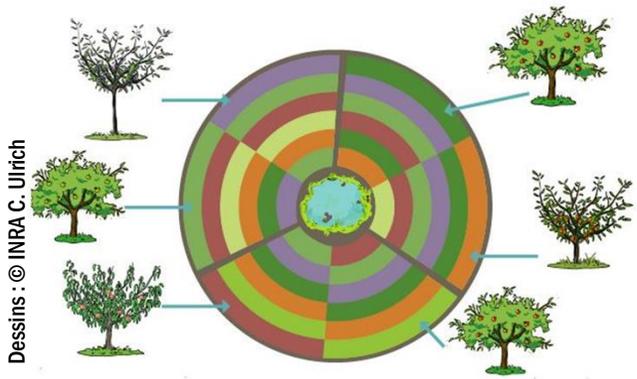
Barrier: hedgerow + windbreak

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

Surface area = 1.7 ha (including hedges)

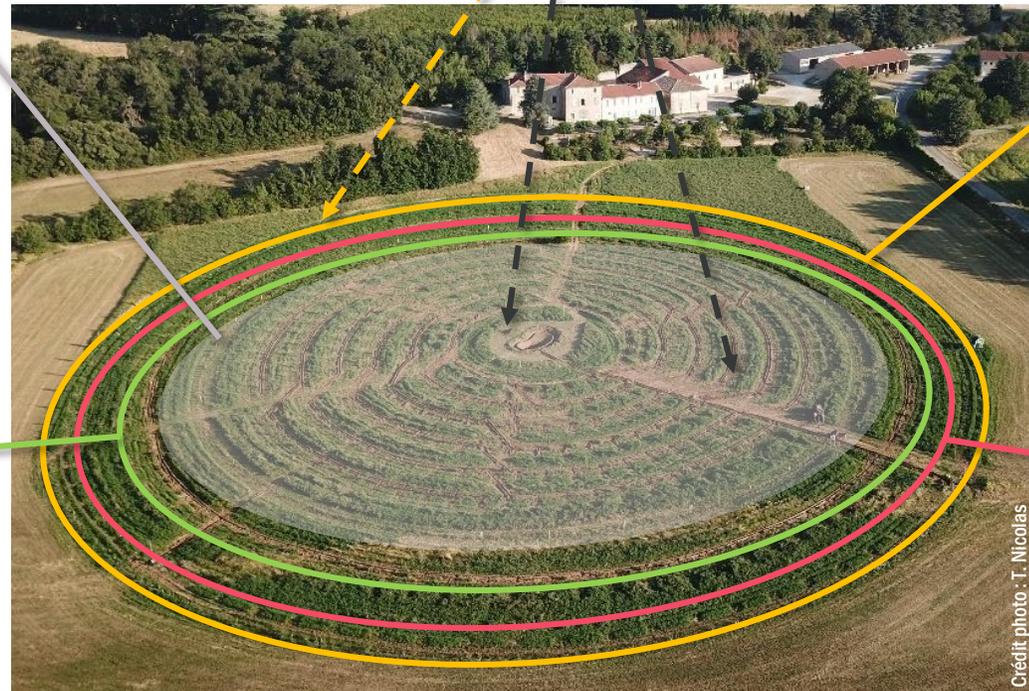
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'Trap' apple cultivars (e.g., aphid low-susceptibility cv)

Surface area = 1.7 ha (including hedges)

Thank you



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

