

The Great Outdoors

Opportunities and Challenges in Open Field Biocontrol

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Biological control in outdoor crops





Biological control in outdoor crops



Different conditions
require
Different approaches





Biological control in outdoor crops



- **Crop value lower**
- **Predators/parasitoids free to leave the crop**
- **Higher mortality risks due to exposure to varying climatic conditions & natural enemies**





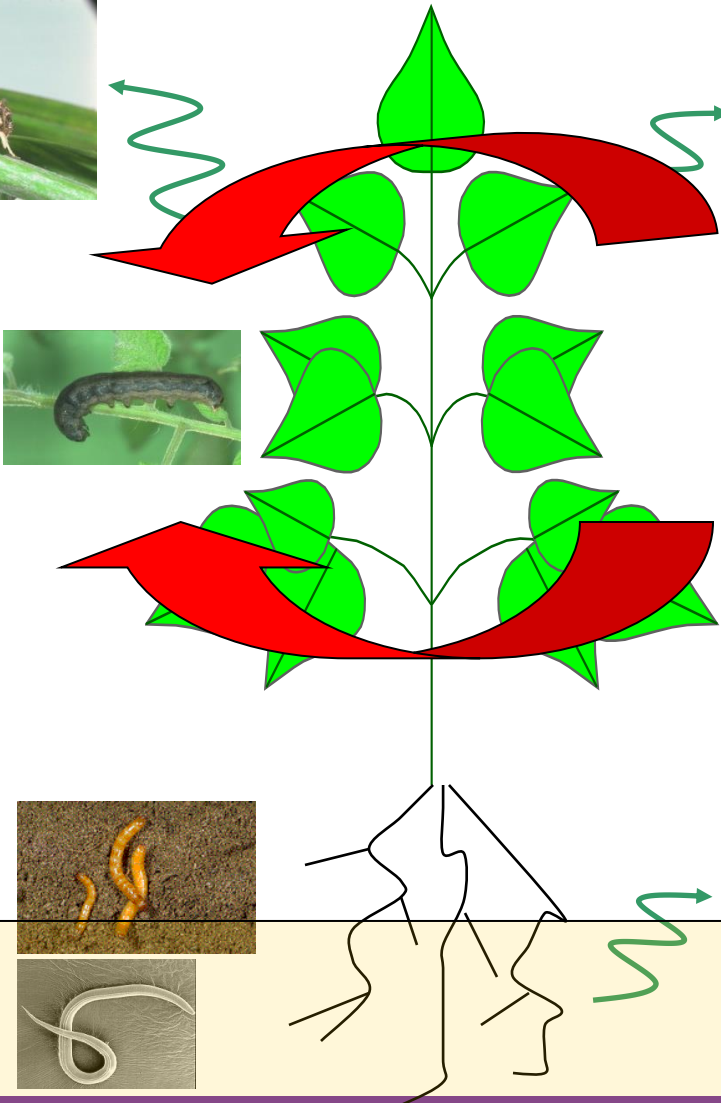
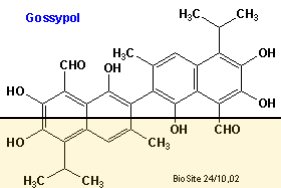
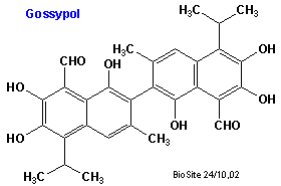
Biological control in outdoor crops



- **Crop value lower**
 - Economical solutions: food supplements, induced resistance
 - Conservation biocontrol, along with / instead of inundative BC
 - Adapted release technologies
- **Predators/parasitoids can leave the crop**
 - Use of semiochemicals to attract/retain beneficials
 - Provide essential resources (food, shelter, alternative prey, oviposition substrates) to support macrobial BCA's
 - Release MBA's with limited mobility (e.g. predatory mites)
- **Higher mortality risks due to exposure to varying climatic conditions & natural enemies**
 - Provide shelter / Banker plants
 - Modify predator-predator interactions (ant distraction)

Induced Resistance

Direct resistance



Indirect resistance

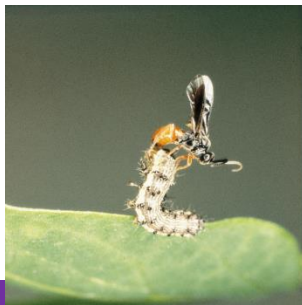




Induced Resistance

Synergies between (induced) plant resistance and BCA's

- Retarded pest development increases window of opportunity for predator/parasitoid attack
- Increased herbivore mobility in response to (locally induced) secondary metabolites increases susceptibility to predation



The right support



Support strategies:

- Infochemicals
- Alternative prey
- Non-prey food supplements
- Oviposition substrates

The right support semiochemicals



Pest control

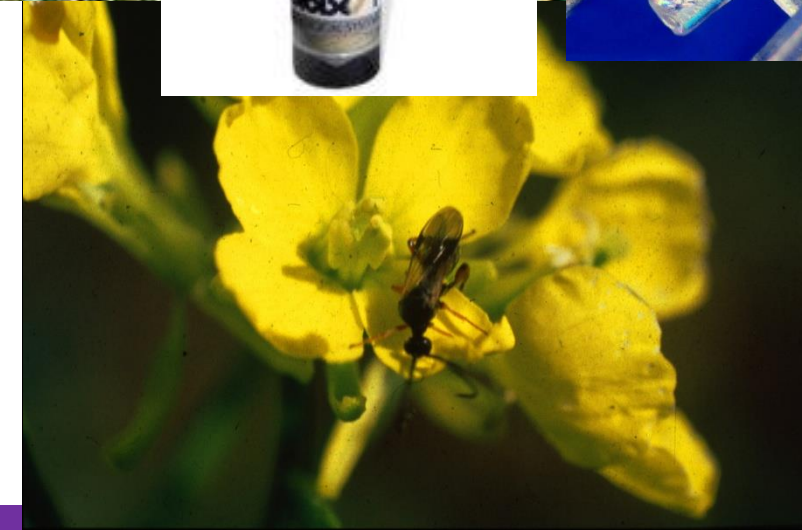
- Monitoring
- Mass trapping
- Pheromone disruption technique
- Attract and kill



Biocontrol support

- Push-pull
- Attraction/retention of BCA's in open field
- Enhancing herbivore induced plant volatiles
- Oviposition stimulants

The right support food supplements





Sugar sprays in citrus to support *Aphytis melinus*

Tena et al (2015) J. Appl. Ecol. 52(3): 795–804

- Parasitoid releases?
- Sugar supplements?

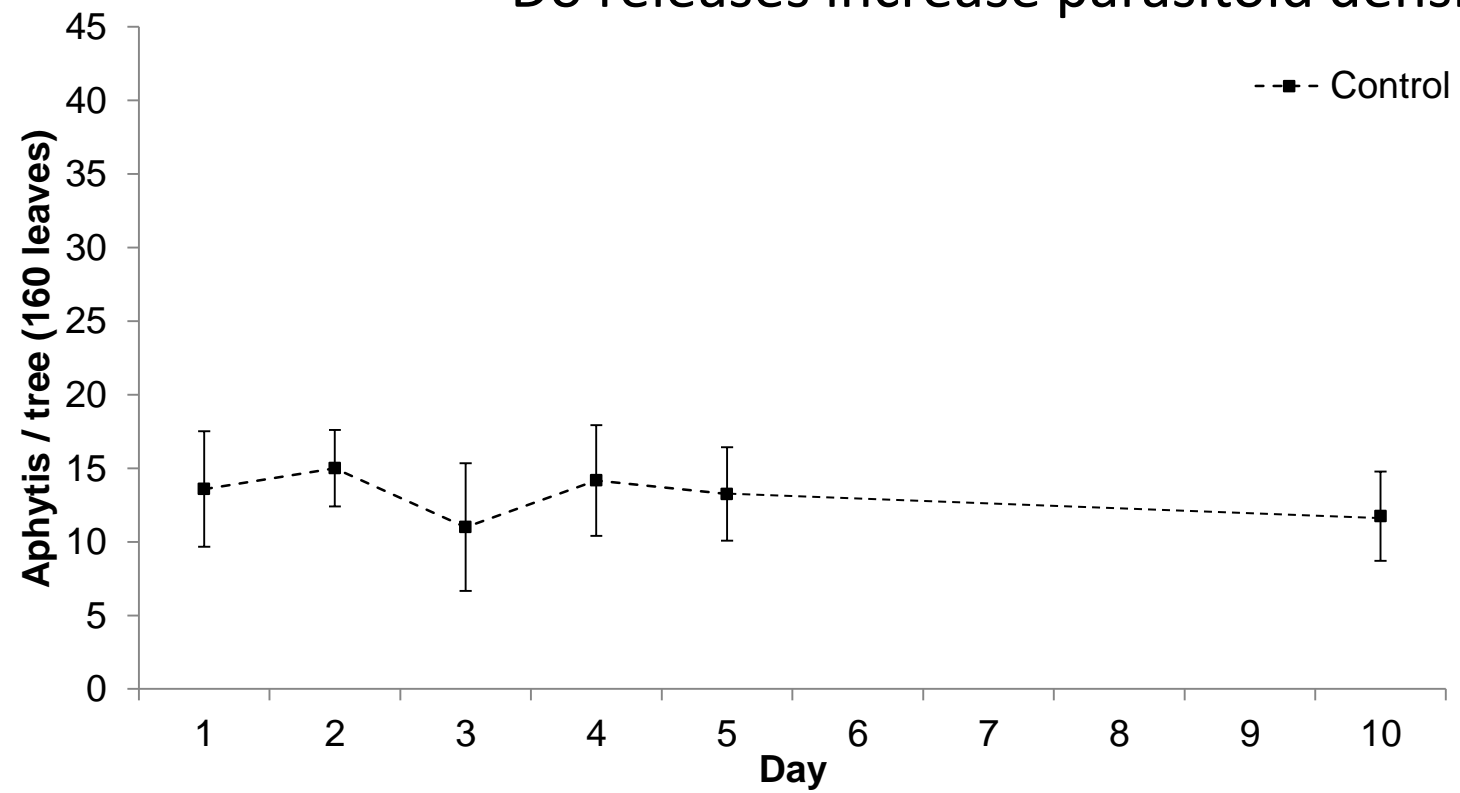




Sugar sprays in citrus to support *Aphytis melinus*

Tena et al (2015) J. Appl. Ecol. 52(3): 795–804

Do releases increase parasitoid density?

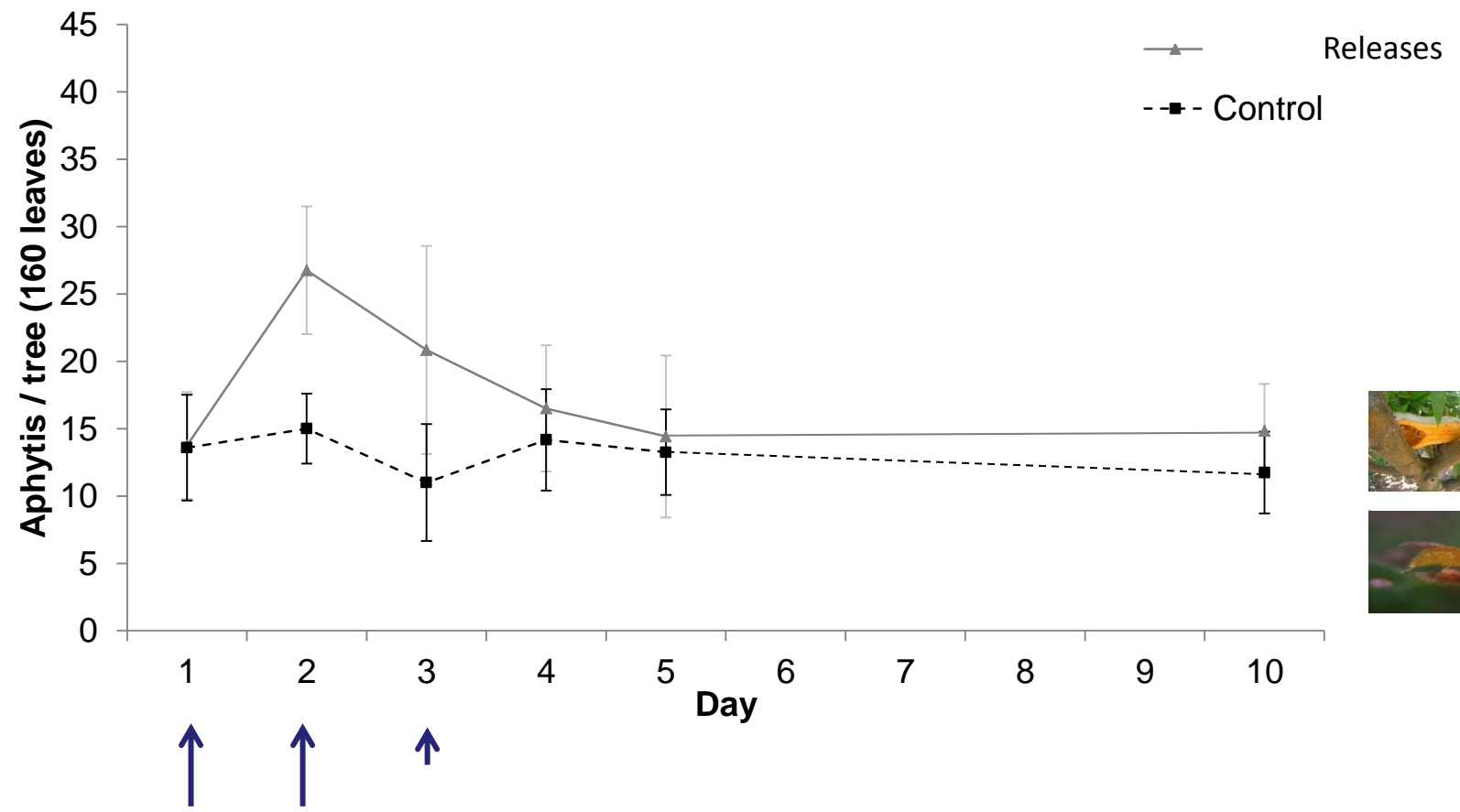




Sugar sprays in citrus to support *Aphytis melinus*

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Do releases increase parasitoid density?



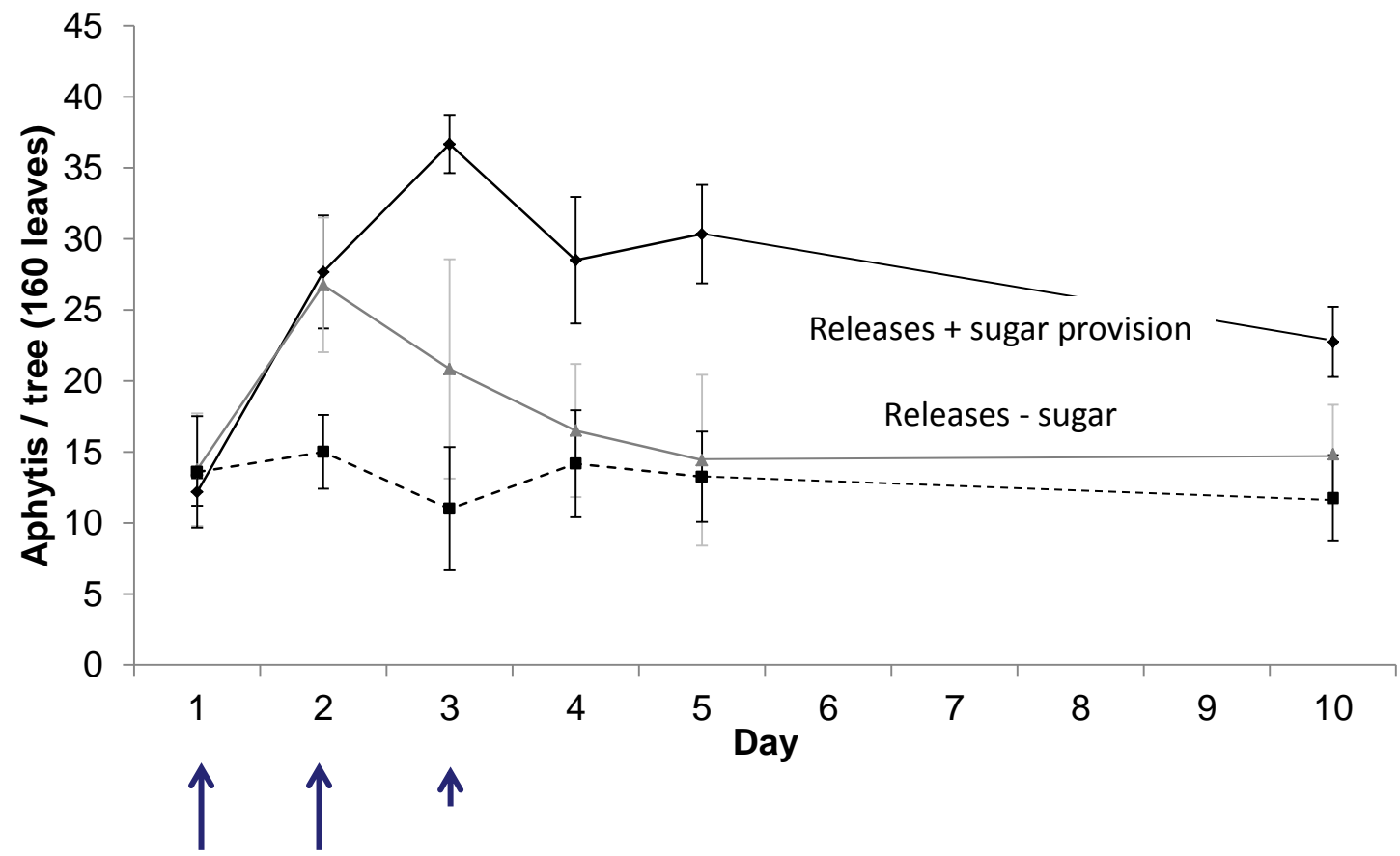
parasitoid emergence



Sugar sprays in citrus to support *Aphytis melinus*

Tena et al (2015) J. Appl. Ecol. 52(3): 795–804

Do releases + *sugar* increase parasitoid density?



↑
↑
↑
parasitoid emergence

Pollen Supplements



Nutrimite



- Nutrimite has a well balanced nutrient profile

Protein	Starch	Other Carbs
20.6	30.6	18.9

- It is relatively resistant to mould/high humidity
- It is not collected by bees
- Nutrimite is based on Typha pollen, so no issues with pesticide residues
- After application, Nutrimite keeps its nutritional value for two weeks
- Nutrimite is relatively unsuitable for thrips
- As the pollen grains are large, Nutrimite settles quickly and causes little allergy problems



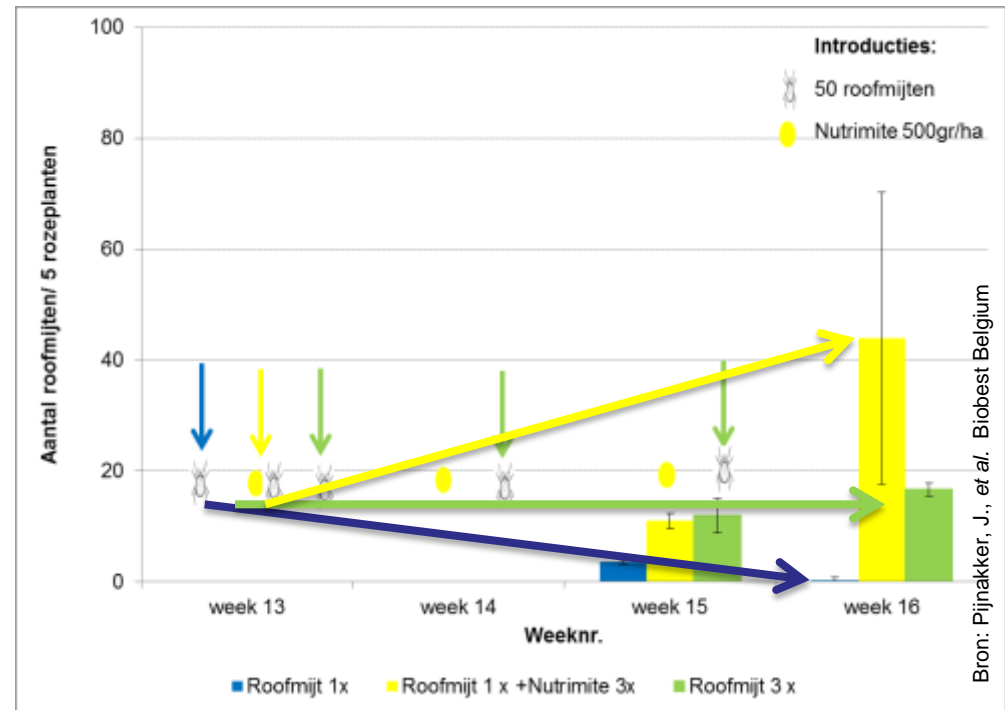


Nutrimite *A. swirskii*

Juliette Pijnakker, Biobest

Result:

- **2,5 times more** predatory mites after **1 introduction & 3 Nutrimite applications** as compared to 3 introductions!



Paradigm shift:

Establishment and rapid population growth
even before pests arrive!





Potential for food supplements

- Use in combination with predator releases
- Use by itself to enhance naturally occurring predators





Optimizing predator-predator interactions

- Intraguild predation
- Hyperpredation, -parasitism
- Competition
- Ant guarding



Ants: Foes or Friends?





Problem of Ant Tending





Ants: Foes or Friends?

Increasing plant damage by protecting honeydew producing plant feeders

Protecting plants by removing

- plant feeders
- pathogens

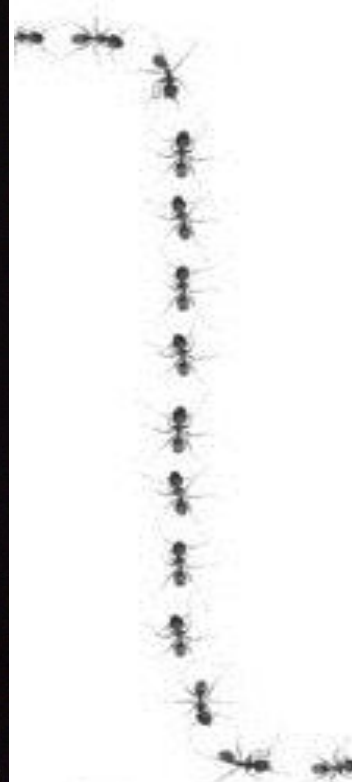




The ant diet



Ant Distraction

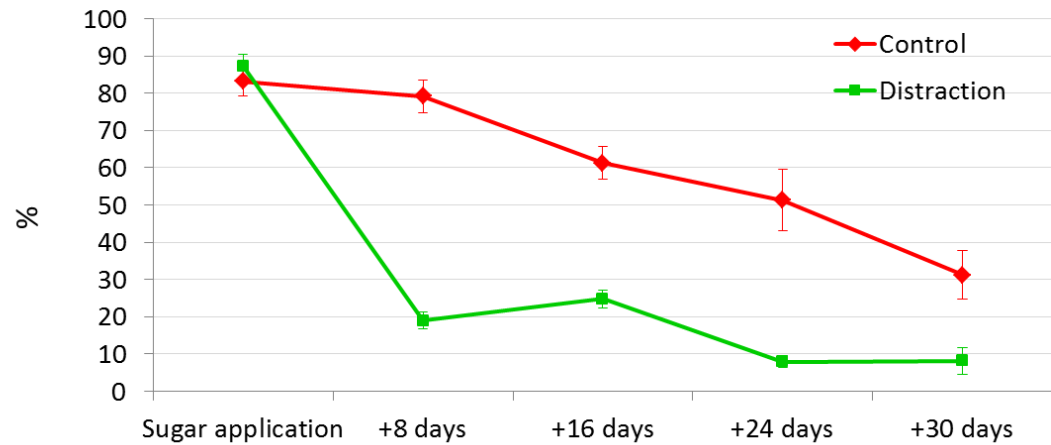


Citrus Trials

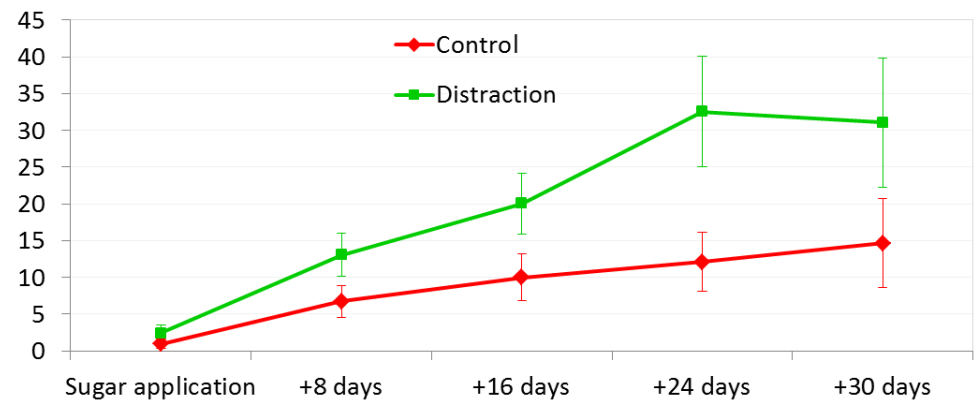
Wäckers et al(2017). Agriculture Ecosystems & Environment 246:168-174



% mealybug colonies occupied by ants



% parasitized mealybugs per colony

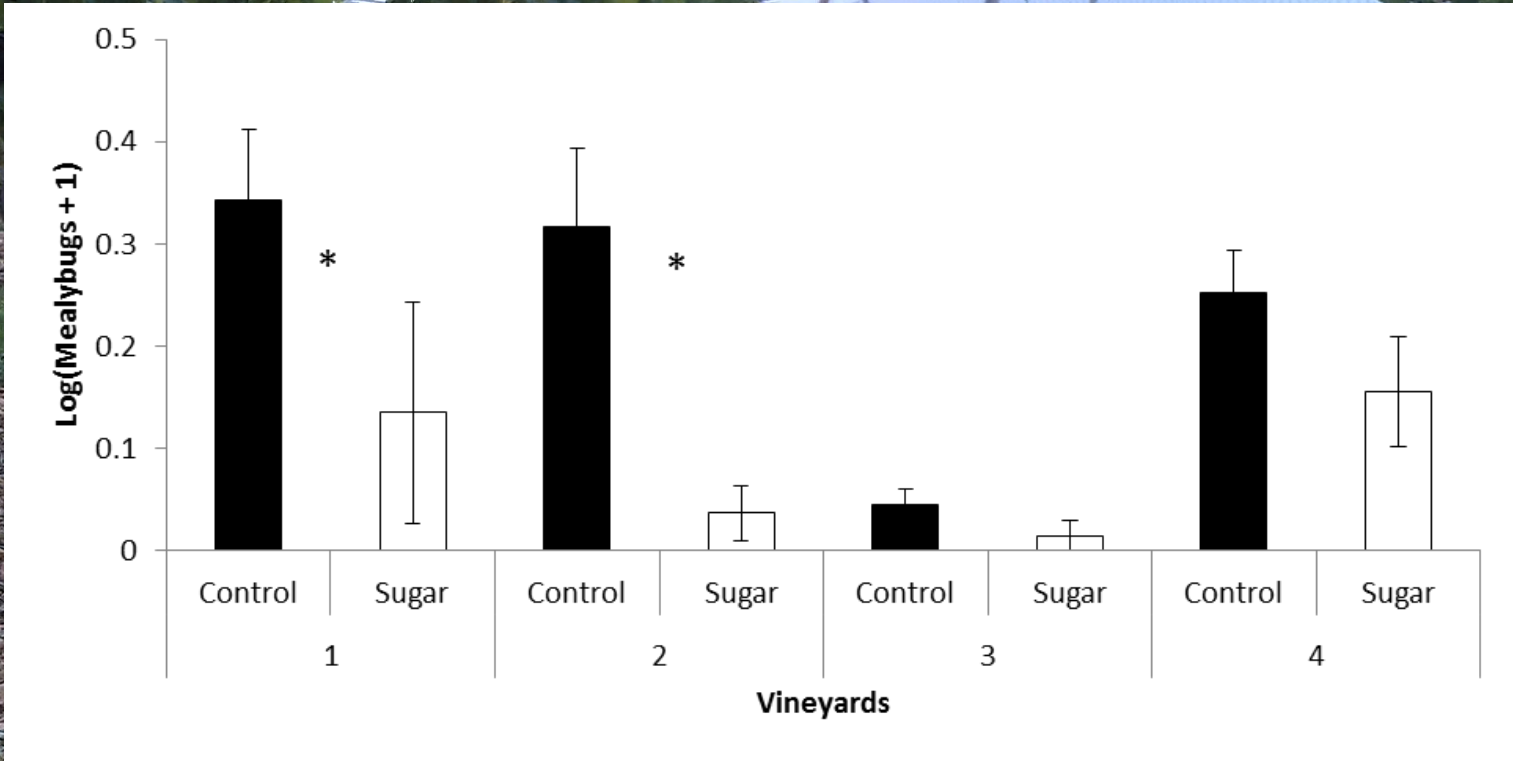




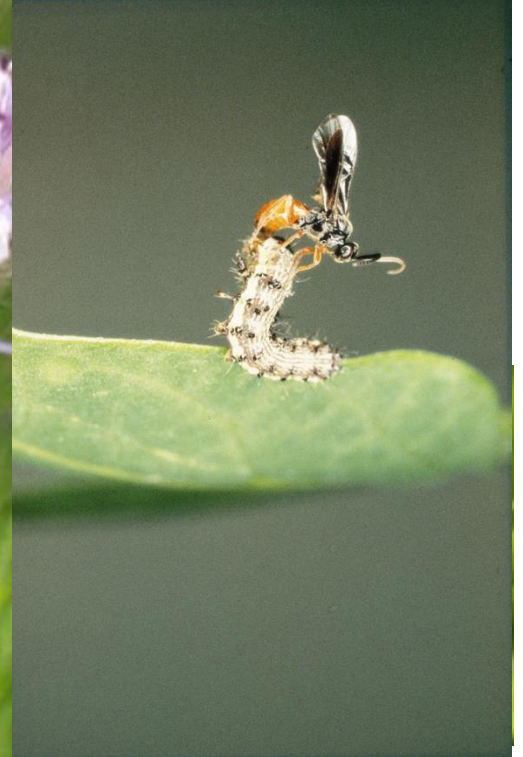
Enhanced parasitism by *Anagyrus pseudococci*



Ant distraction in vineyards (mealybugs)



Thanks



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