Pest management in organic greenhouse horticulture

keynote lecture pest management session, ISOGH

Izmir, Turkey, April 13, 2016

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Pest management in OGH: challenge!

- Control measures are limited:
  - no synthetic pesticides
  - “biopesticides” often not effective
  - Natural enemy releases expensive and not always effective
- Serious crop losses: weak plants vulnerable for pests and diseases
- High “pest pressure” of multiple species
- New invasive pests
- Pest diversity and performance of natural enemies is crop dependent

Number 1 pest in tomato: *Tuta absoluta*

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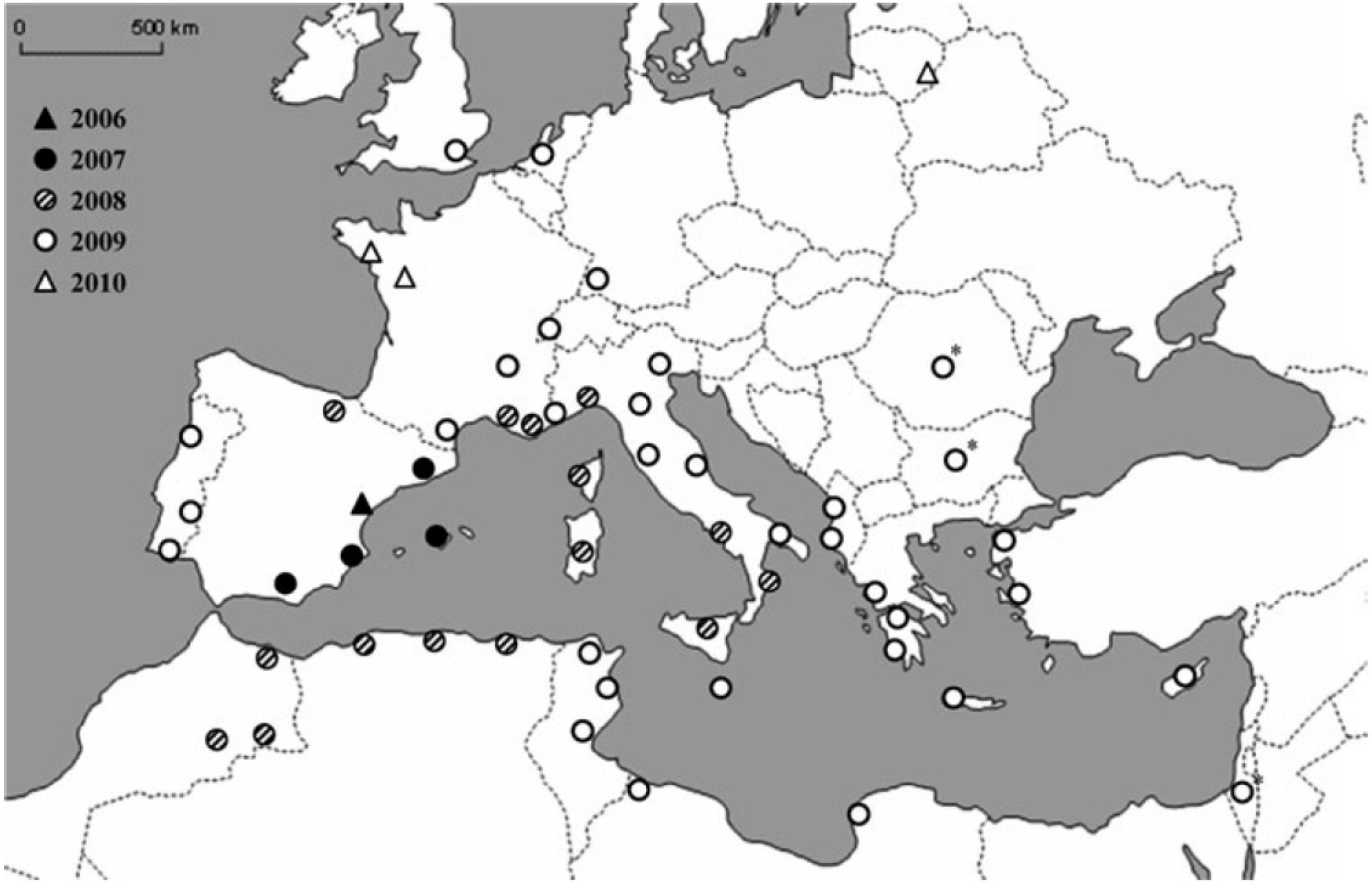
It’s spread and establishment in Europa

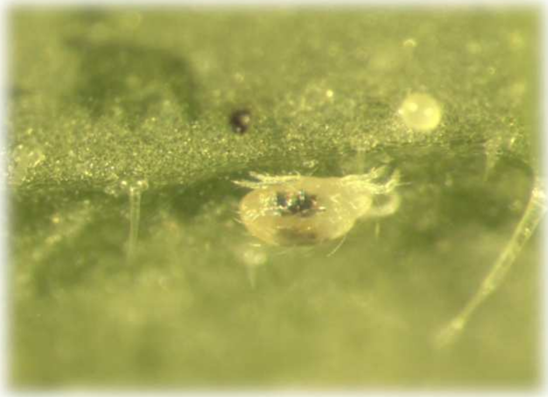


Desneux et al., JPS 2010

Other important pests in tomato

- Whiteflies (Bemisia tabaci and Trialeurodes vaporariorum)
- Tomato russet mite, *Aculops lycopersici*
- *Noctuid* caterpillars
- Leafminers
- Spider mites



Nr 1 pest in sweet pepper: aphids
Myzus persicae, Aulacortum solani

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Some other pest in sweet pepper:

- *Bemisia tabaci*
- Noctuid caterpillars
- Broad mites, spider mites
- Western flower thrips
- *Echinothrips americanus*
- Plant damaging bugs: *Lygus rugulipennis, Liocoris tripustulatus*

Invasive pest in sweet pepper: the pepper weevil *Anthonomus eugenii*

- Appeared in 2012 in The Netherlands
- Q-organism: crops destroyed to eradicate the pest

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types of biological control

- Classical biological control = inoculation of area's with natural enemies in order to obtain a permanent suppression of pests for several years/decades

- Augmentative biological control = frequent releases of commercially mass-produced natural enemies

- Conservation biological control = methods that protect and stimulate the performance of naturally occurring natural enemies

Specialist *Dacnusa sibirica*

Specialist aphid predator: *Aphidoletes aphidimyza*


Specialist predator: *Phytoseiulus persimilis*

Generalist phytoseiid predatory mite *Amblyseius swirskii*

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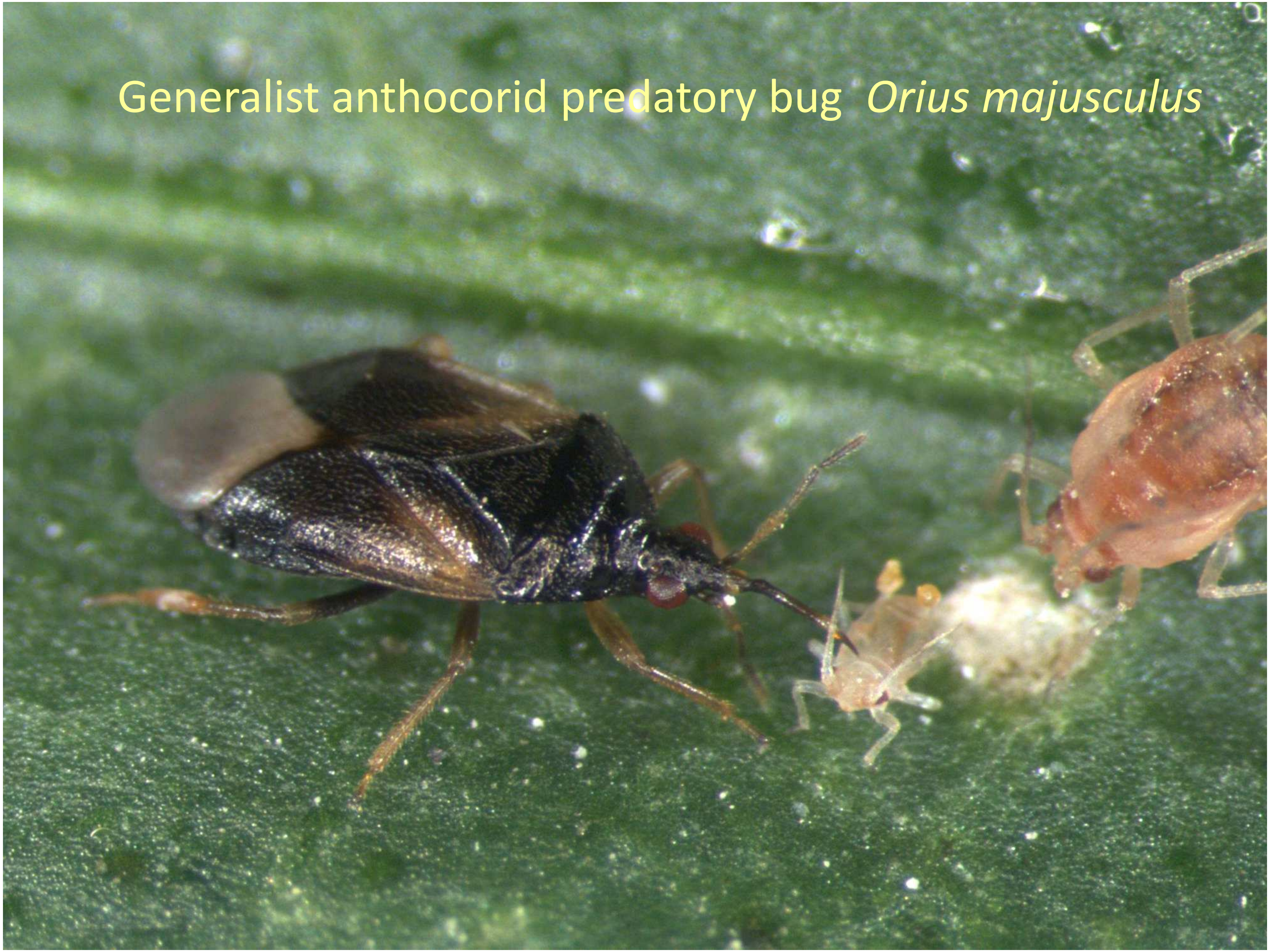
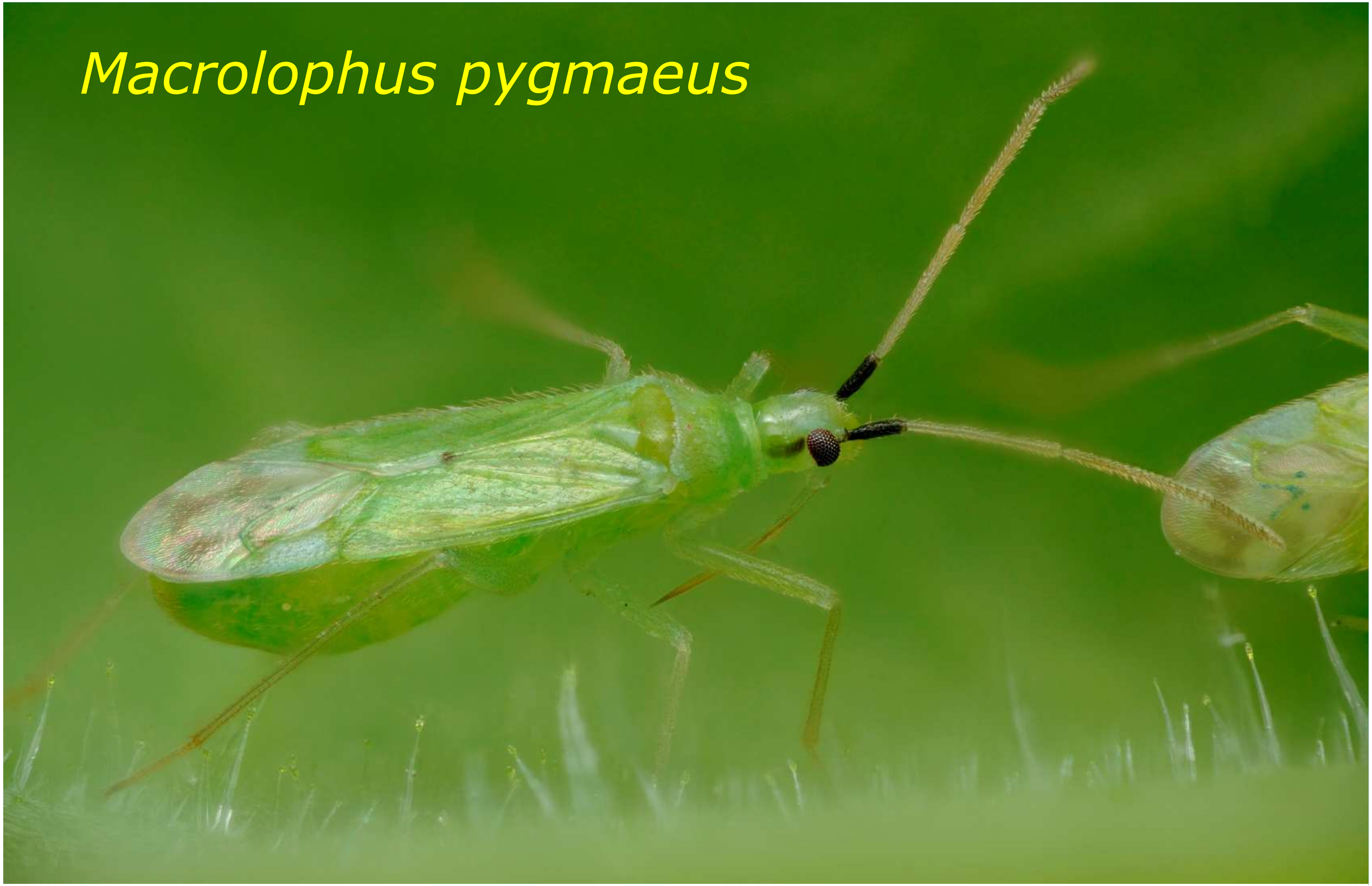
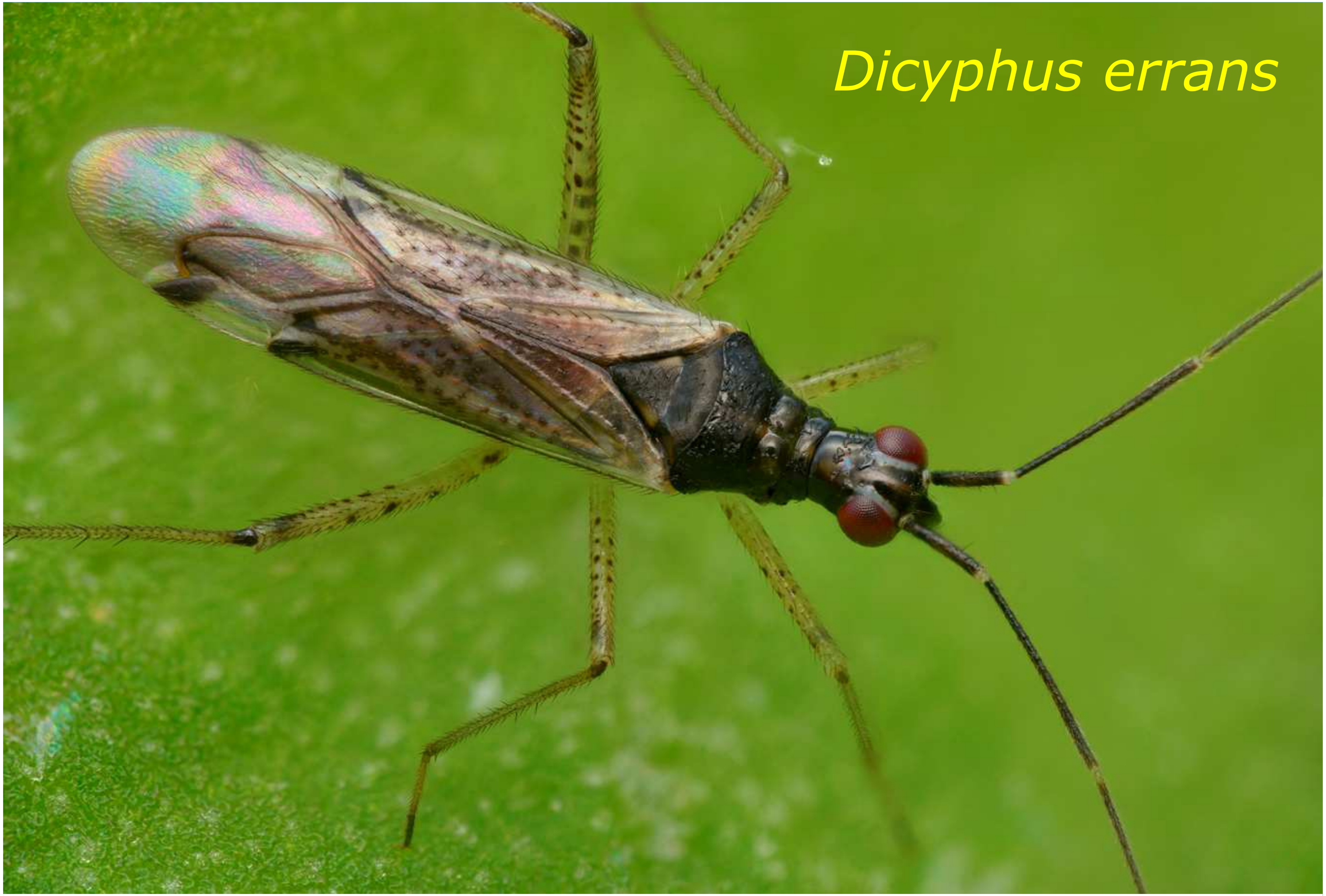

Generalist anthocorid predatory bug *Orius majusculus*

Macrolophus pygmaeus



Dicyphus maroccanus


Dicyphus errans

Developments in biological control

- Best results achieved with preventive control measures: shift from specialists to generalist/omnivorous predators
- Combination of augmentative and conservation biological control
- Increased food web complexities

Review
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Approaches to conserving natural enemy populations in greenhouse crops: current methods and future prospects

Gerben J. Messelink, Jude Bennison, Oscar Alomar, Barbara L. Ingegno, Luciana Tavella, Les Shipp, Eric Palevsky, Felix L. Wäckers

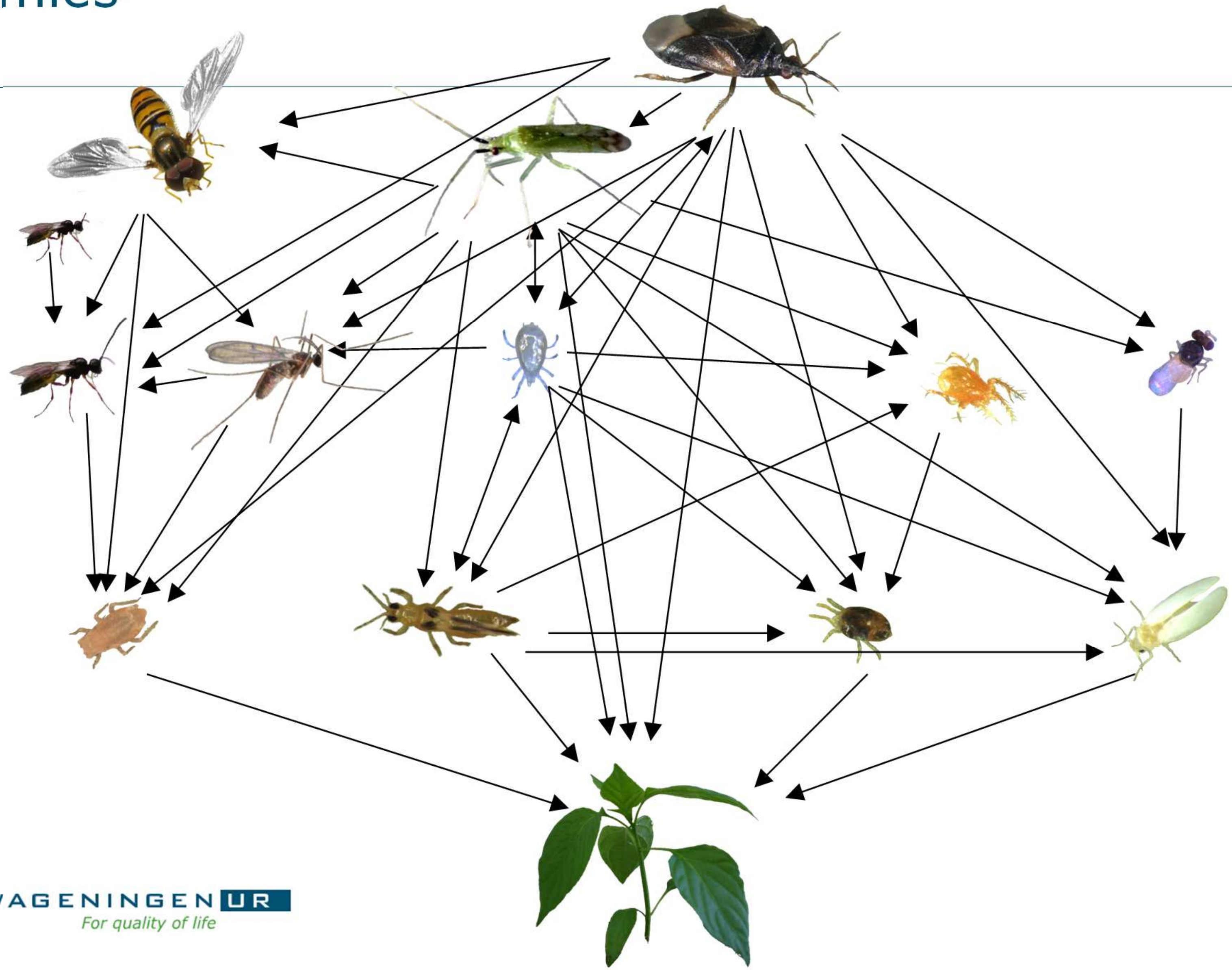
Abstract

Biological pest control in greenhouse crops is usually based on periodical releases of mass-produced natural enemies, and this method has been successfully applied for decades. However, in some cases there are shortcomings in pest control efficacy, which often can be attributed to the poor

Leaflets with more detailed examples

- Supplemental food for generalist predators
- Banker plants for Entomophthorales of aphids
- Banker and companion (flowering) plants for parasitoids and predators
- Conservation methods for lacewings in and around greenhouses
- Conservation of predaceous Coccinellidae species
- The use of omnivorous predators in pest control
- Side-effects of (bio)pesticides and the integration in to organic growing systems

A food web with 4 pest species and their natural enemies



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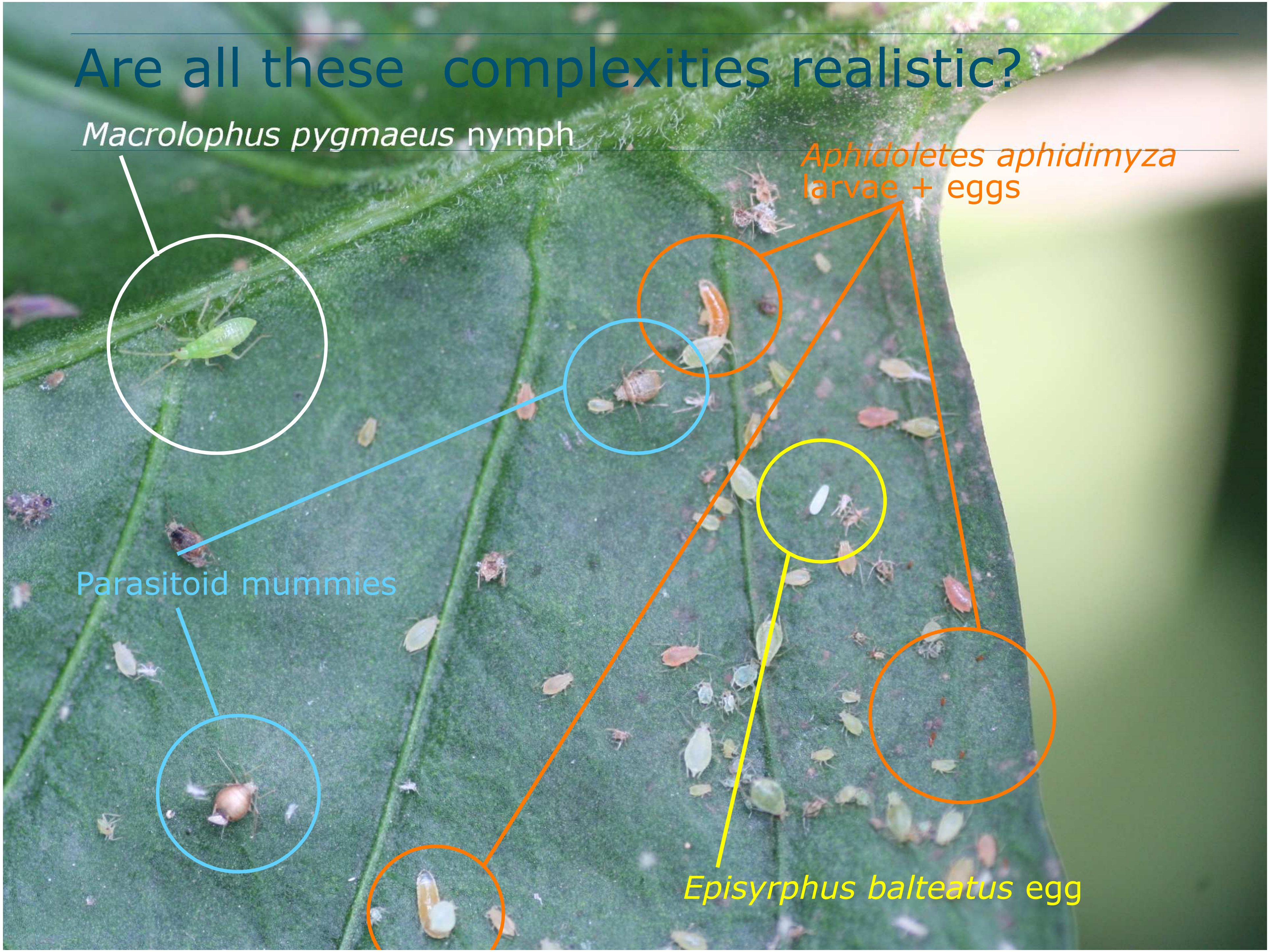
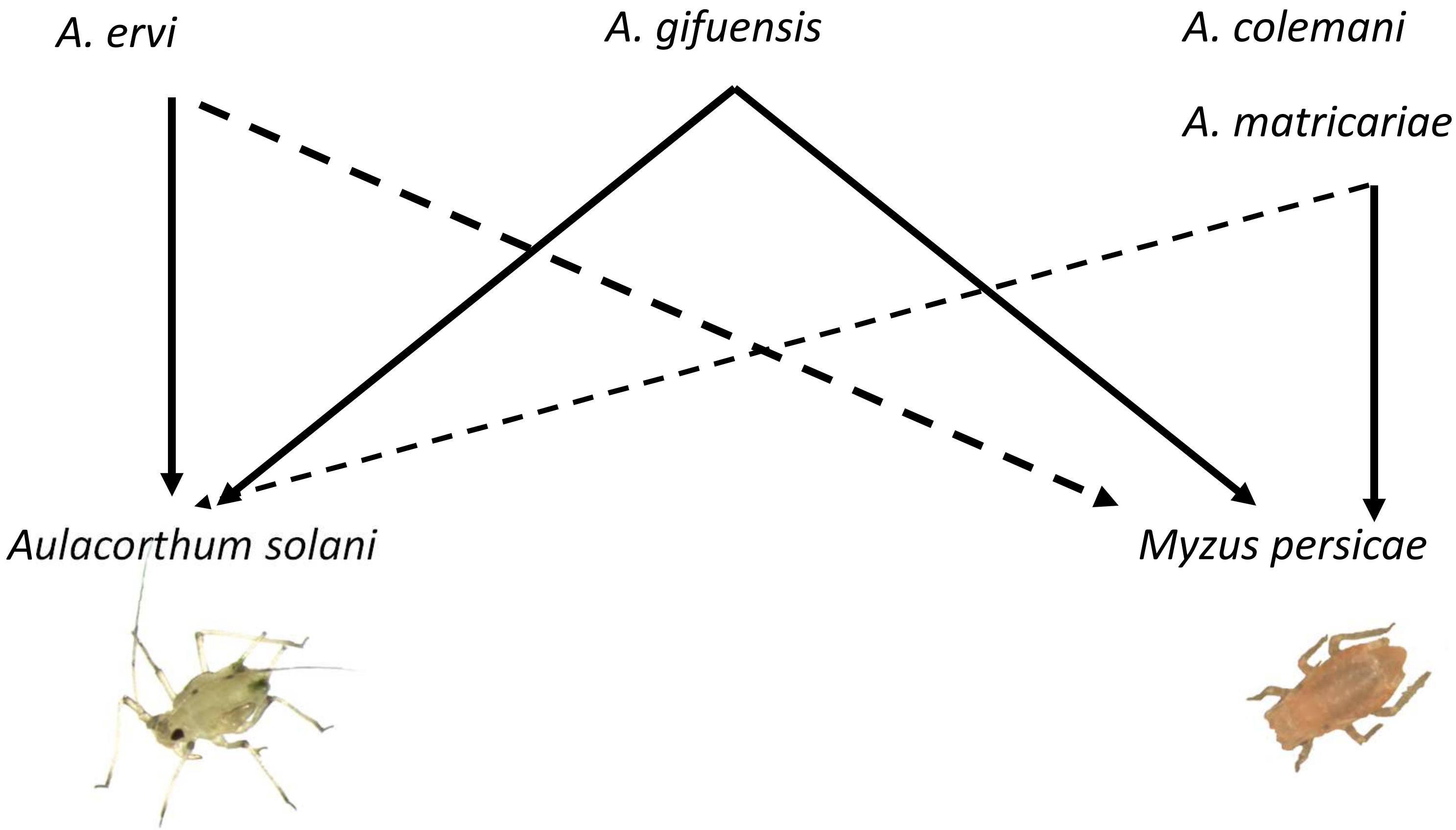
Are all these complexities realistic?

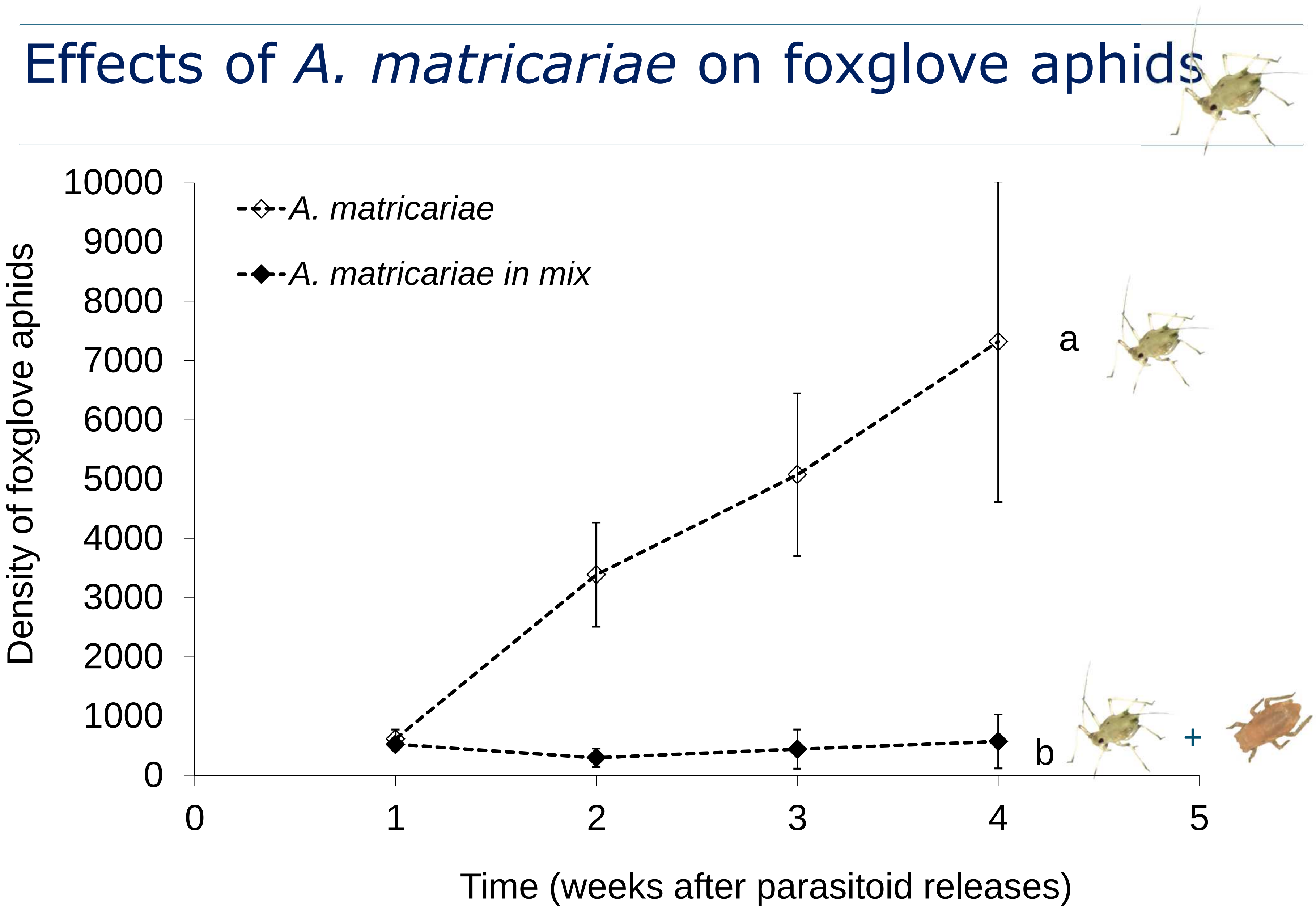


Aphidius matricariae: an effective parasitoid of the red phenotype of *Myzus persicae*

What happens when both *M. persicae* and *A. solani* are present?



Effects of *A. matricariae* on foxglove aphids



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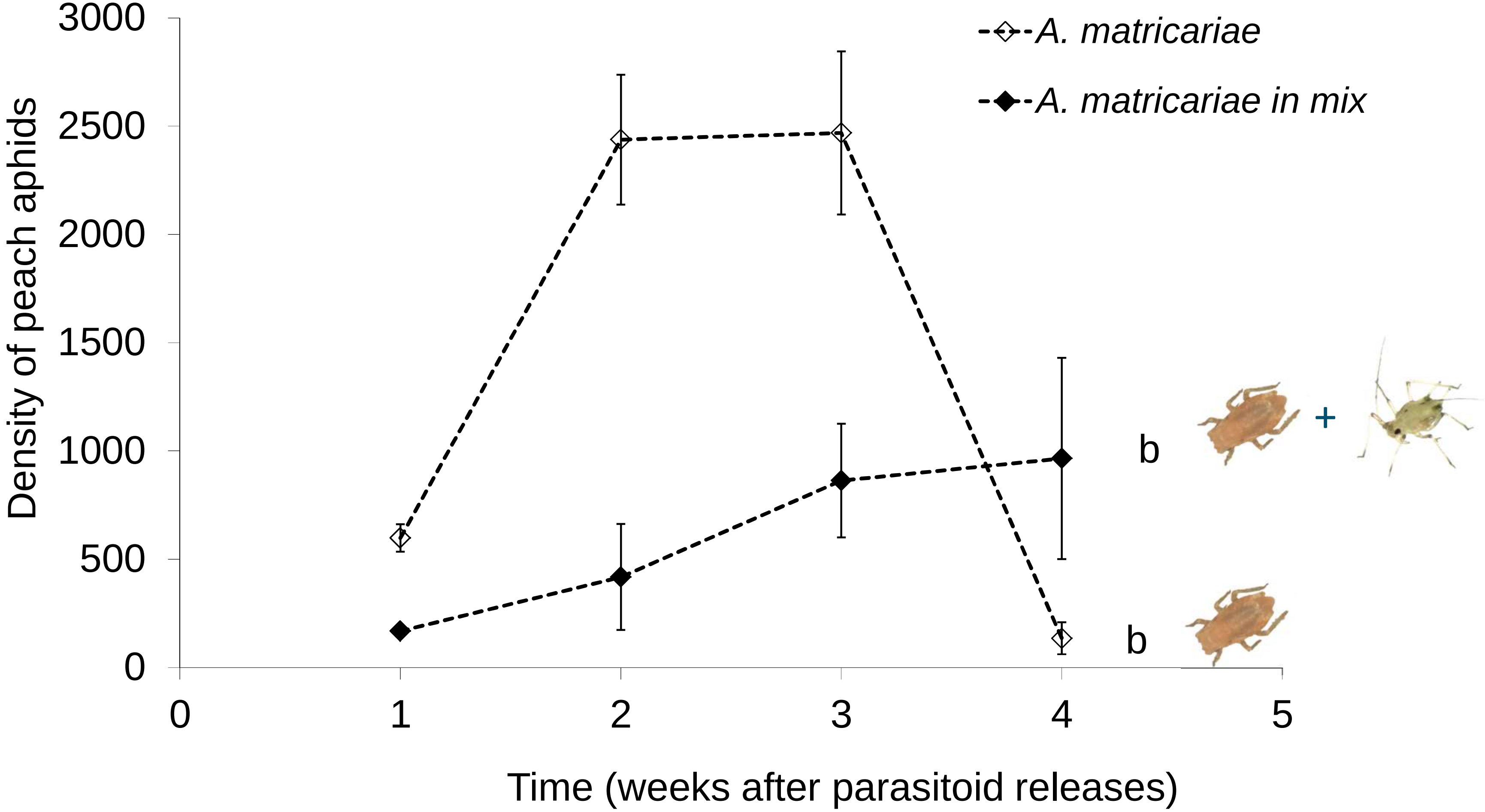
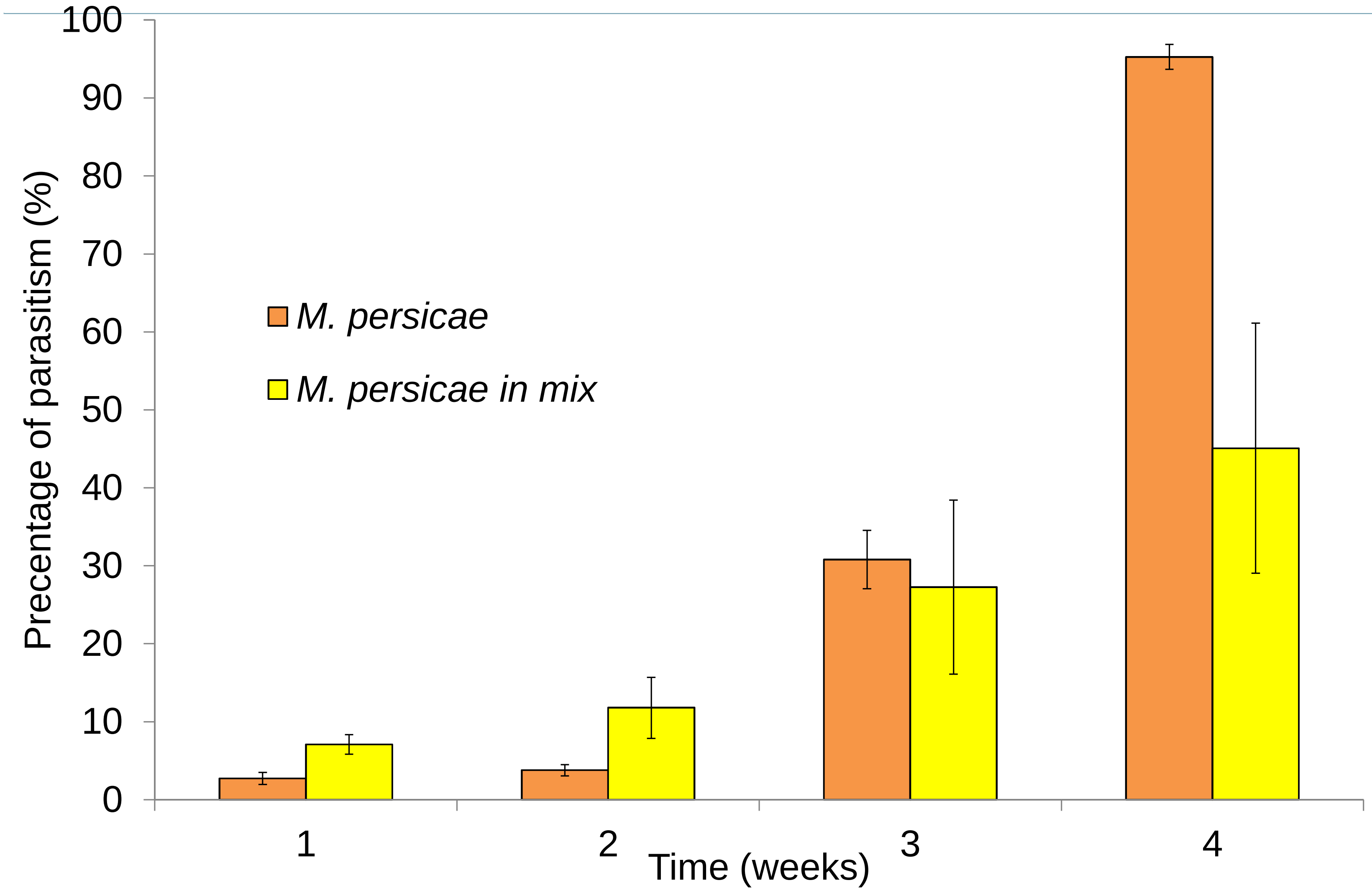
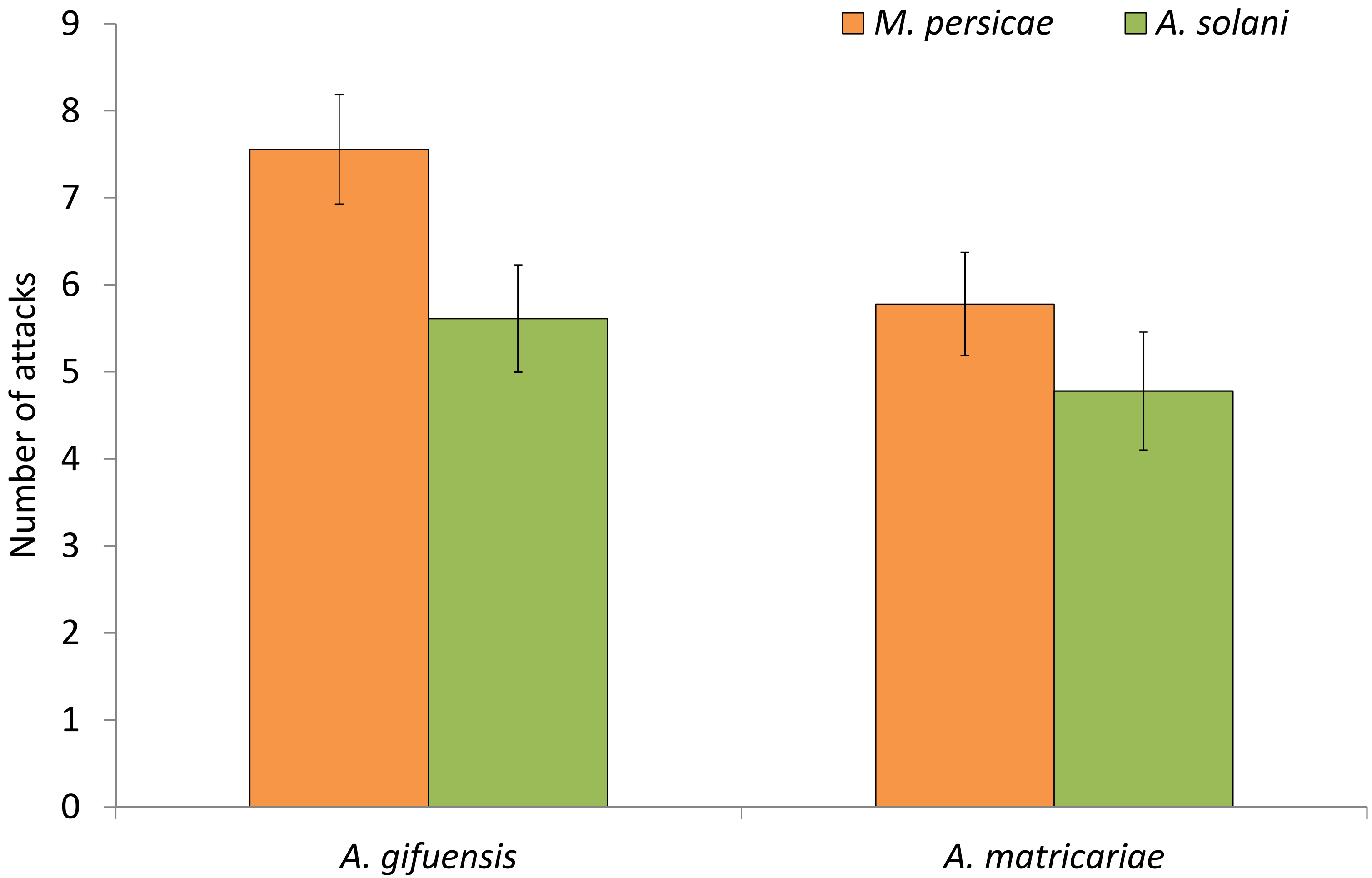
Effects of *A. matricariae* on peach aphids



Rates of parasitism by *A. matricariae*



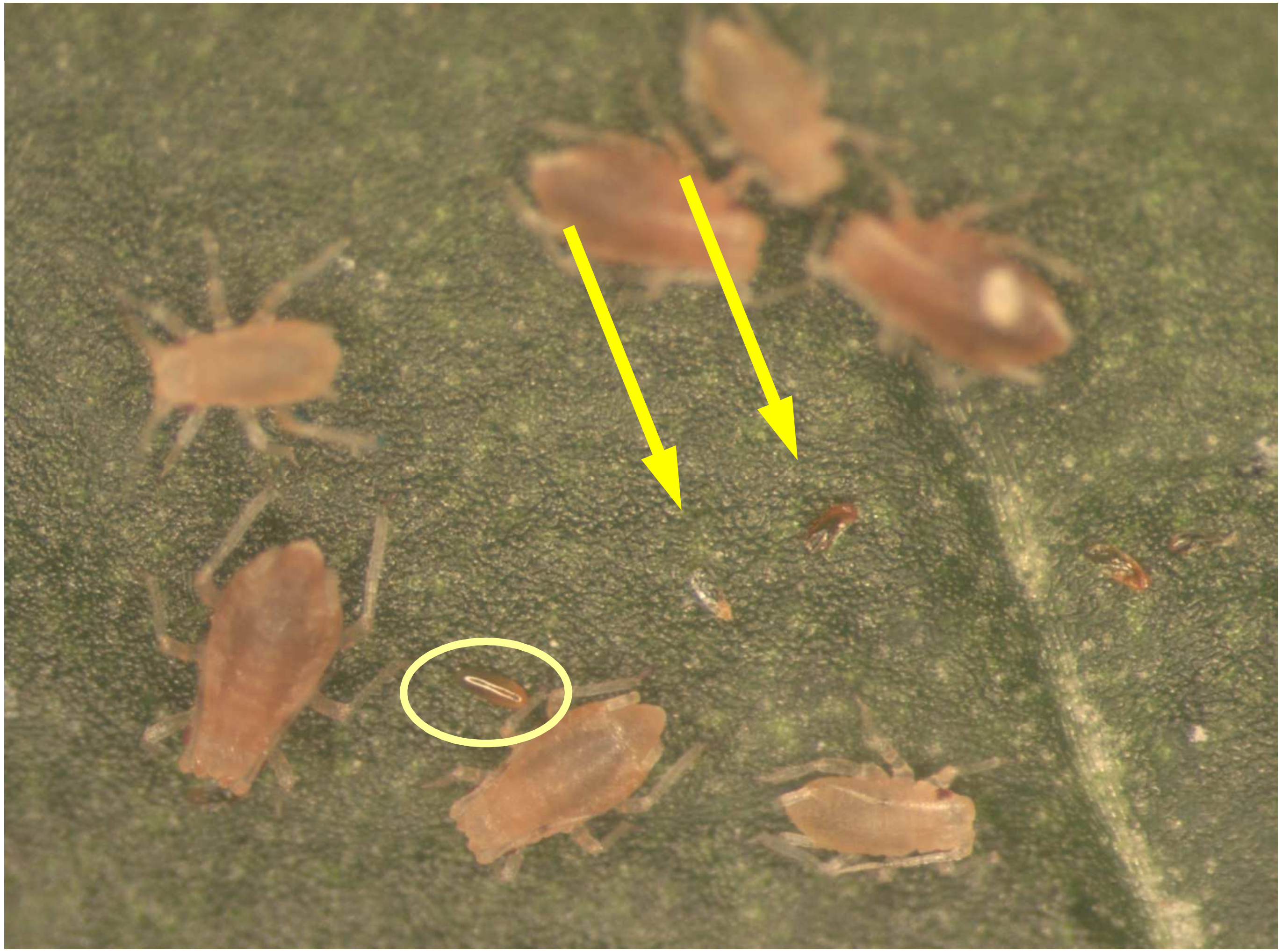
Host preference of *A. matricariae* and *A. gifuensis*



conclusion

- Parasitoids can even contribute to the control of unsuitable aphid hosts without parasitism (aphid dropping as a defence response)
- The presence of an unsuitable host can distract aphid parasitoids from their target host, resulting is reduced control
- Surprising results can happen through pest diversity
- It may be a benefit to use “generalist” parasitoids when multiple species of aphids are present

An example of hyperpredation



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- Predatory mites

+ predatory mites

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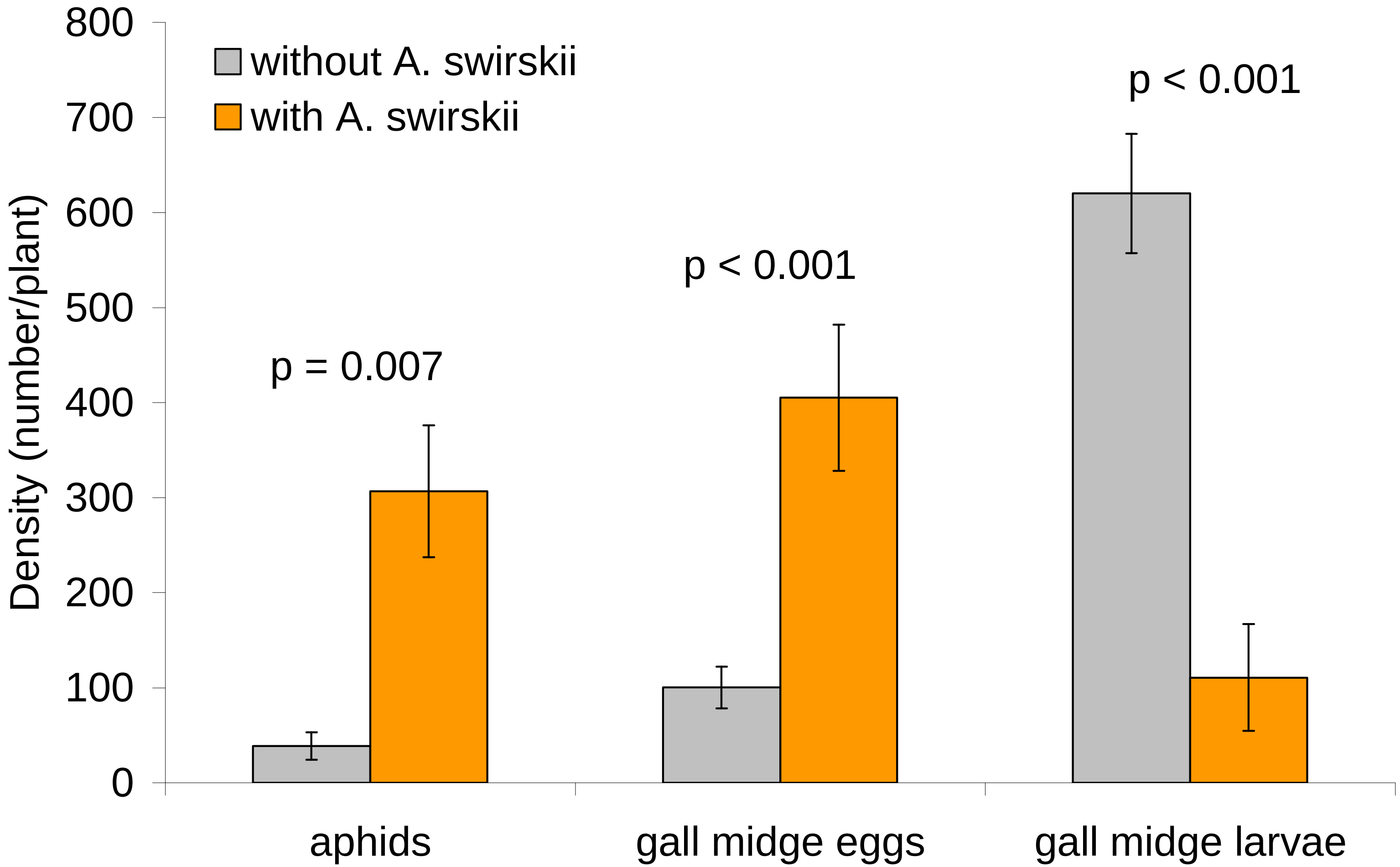
Disruption of aphid control



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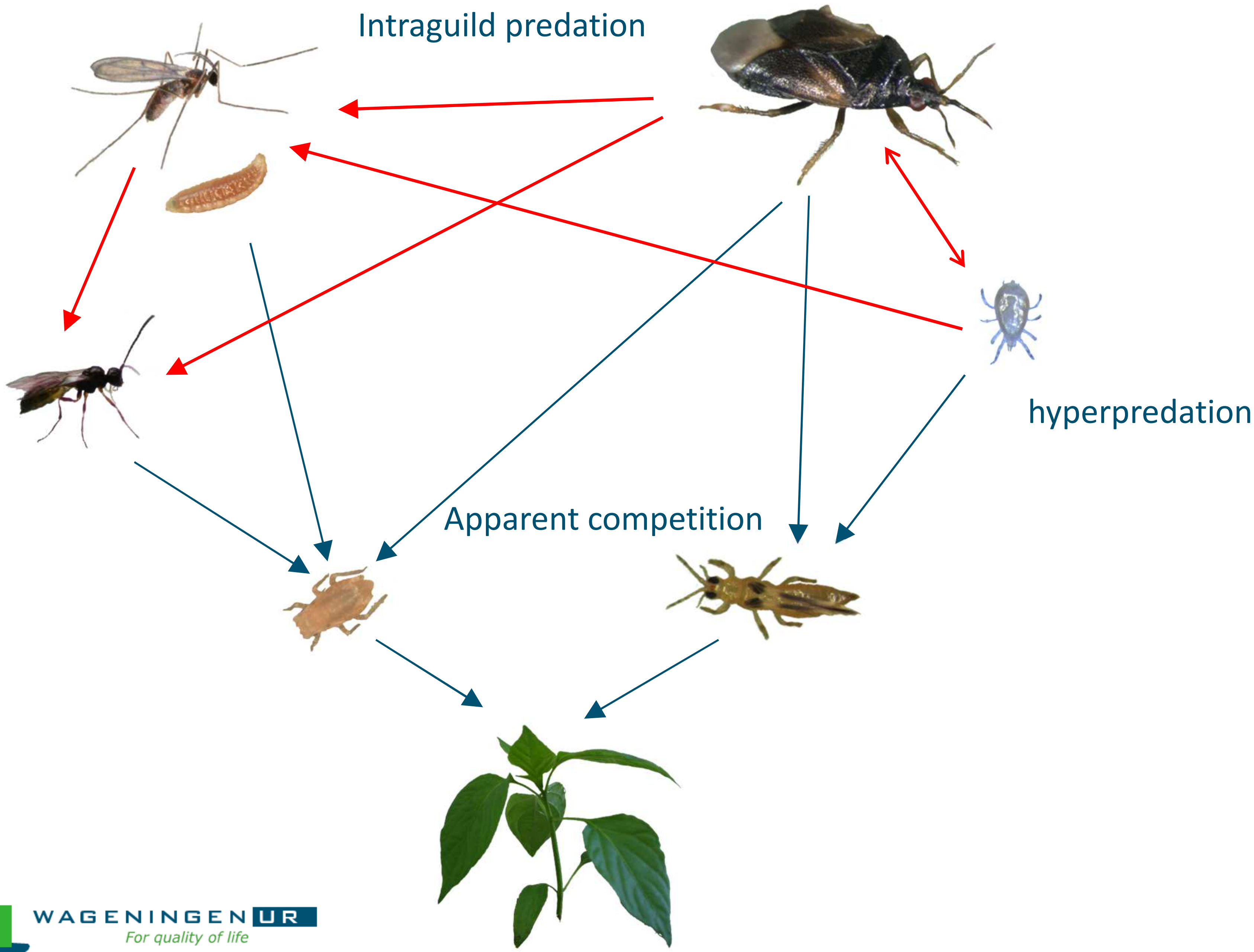
Messelink et al., Biological Control 2011

Food web complexities

What happens when several types
of interactions occur within one food web?



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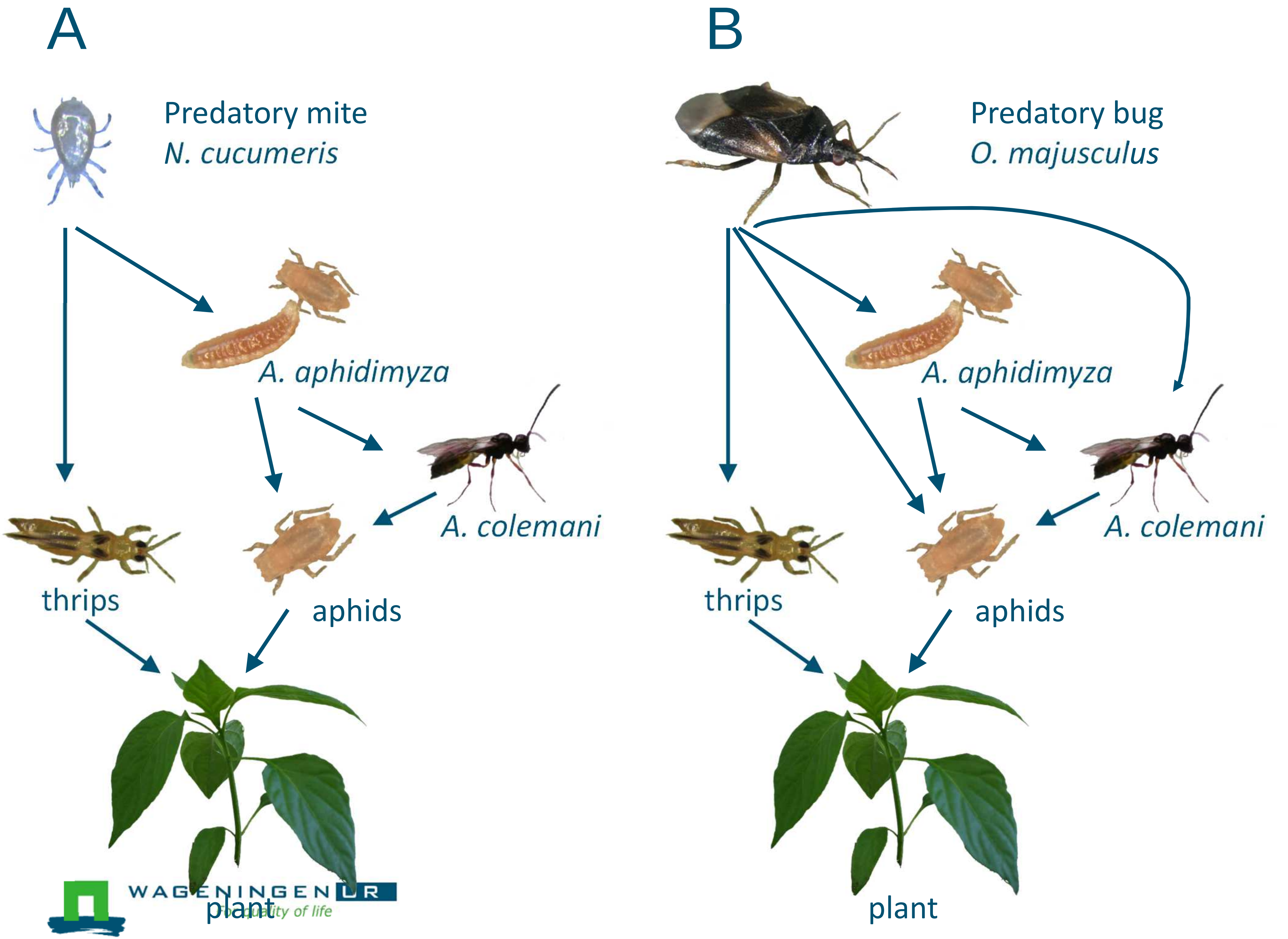

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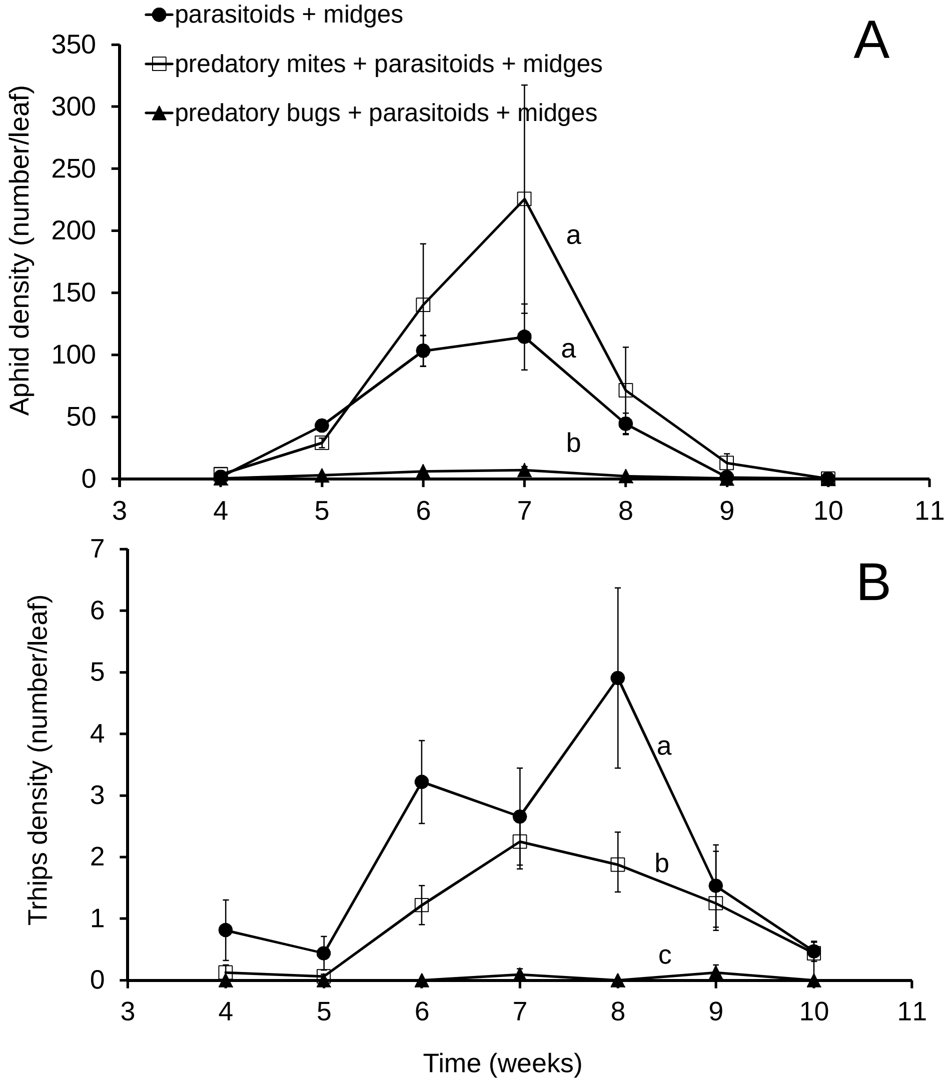
Effects on aphids and thrips



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Messelink et al., BioControl 2013

conclusion

Potentially negative effects of intraguild predation can be compensated by the positive effects of generalist predators (strong effect on shared prey, apparent competition, prior to pest establishment)

Comparing inoculative releases of generalist predators for aphid control

O. laevigatus

O. majusculus

M. pygmaeus

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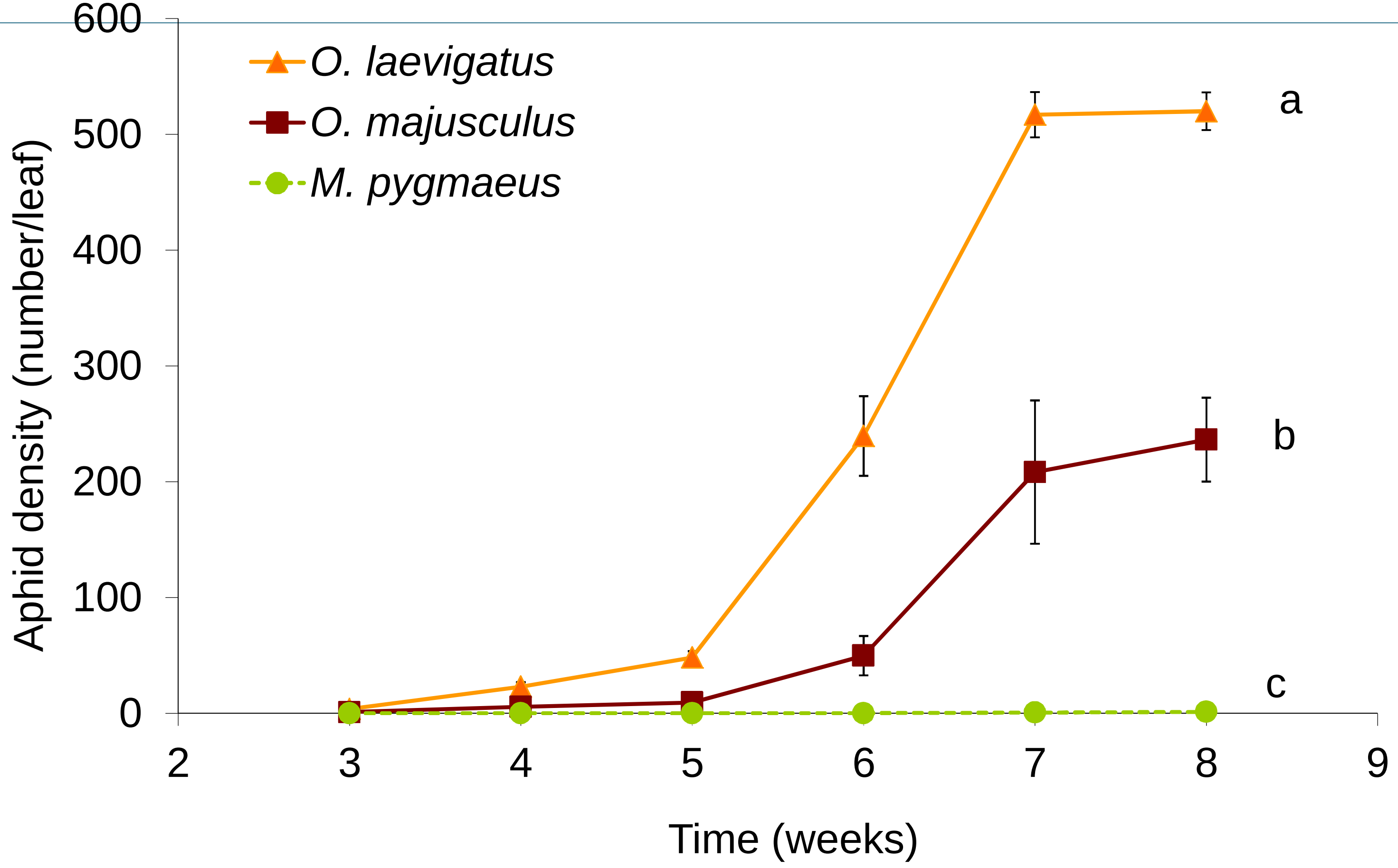
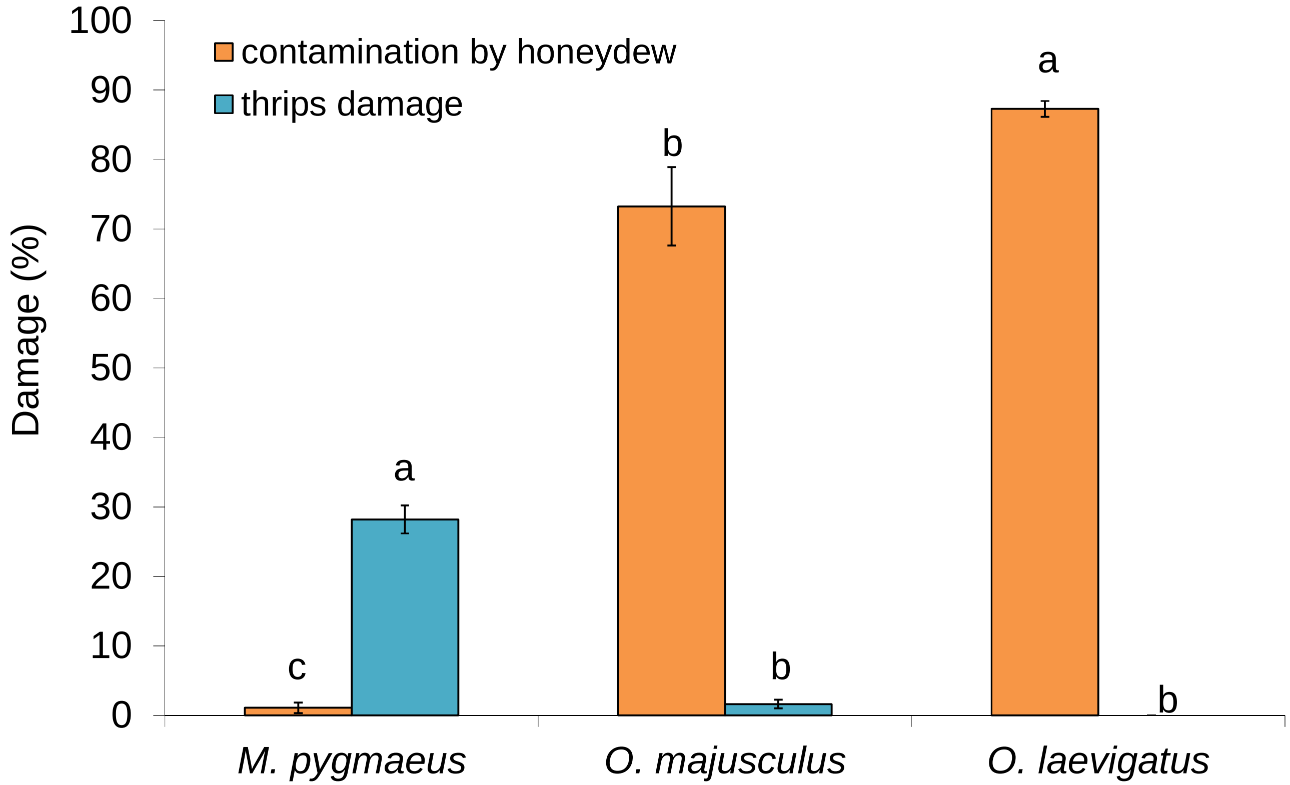
Comparing inoculative releases of generalist predators for aphid control



Fruit damage



What happens when we combine two species of generalist predatory bugs?
(increased IGP, competition, exclusion
or complementary effects?)

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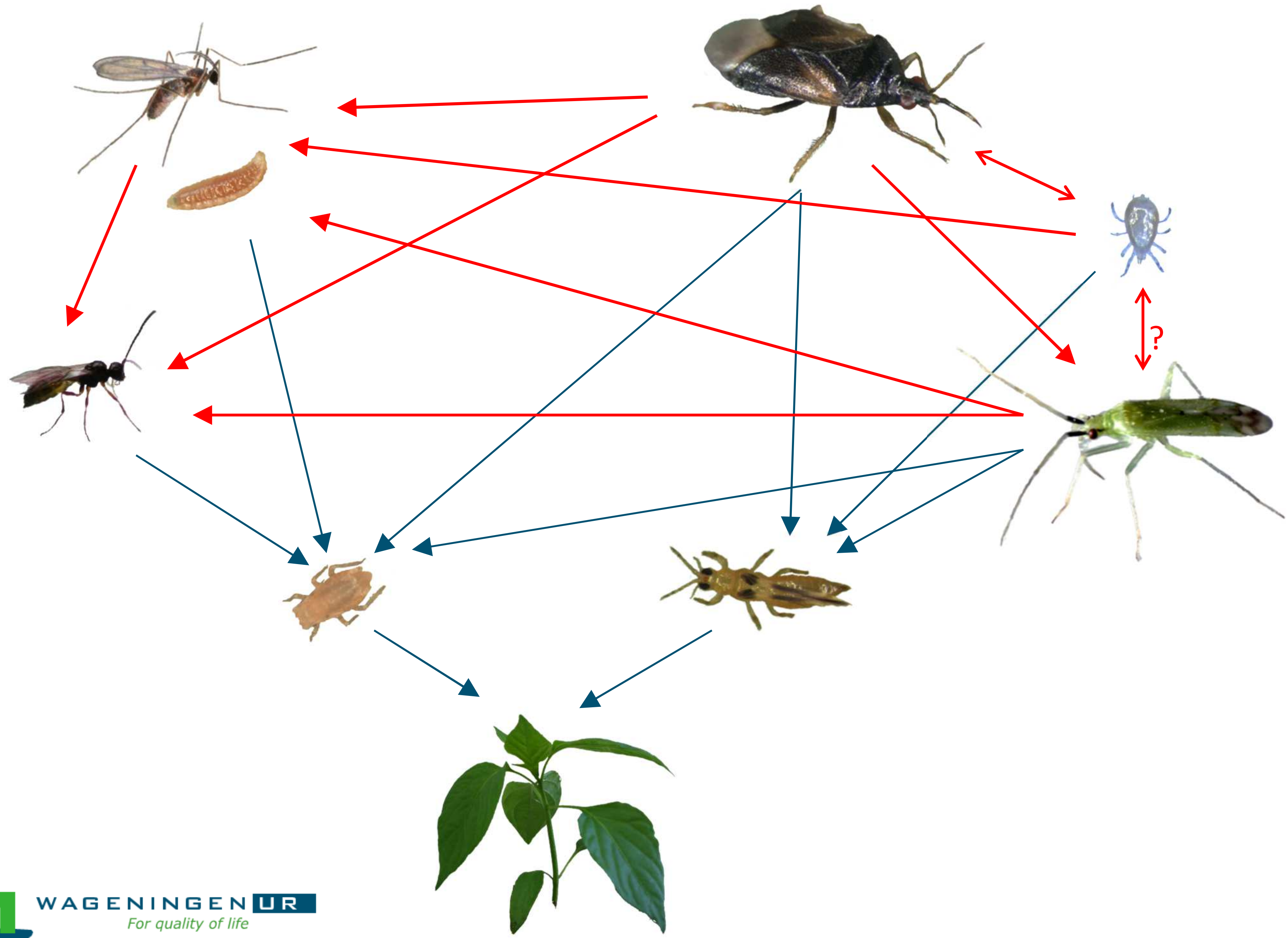

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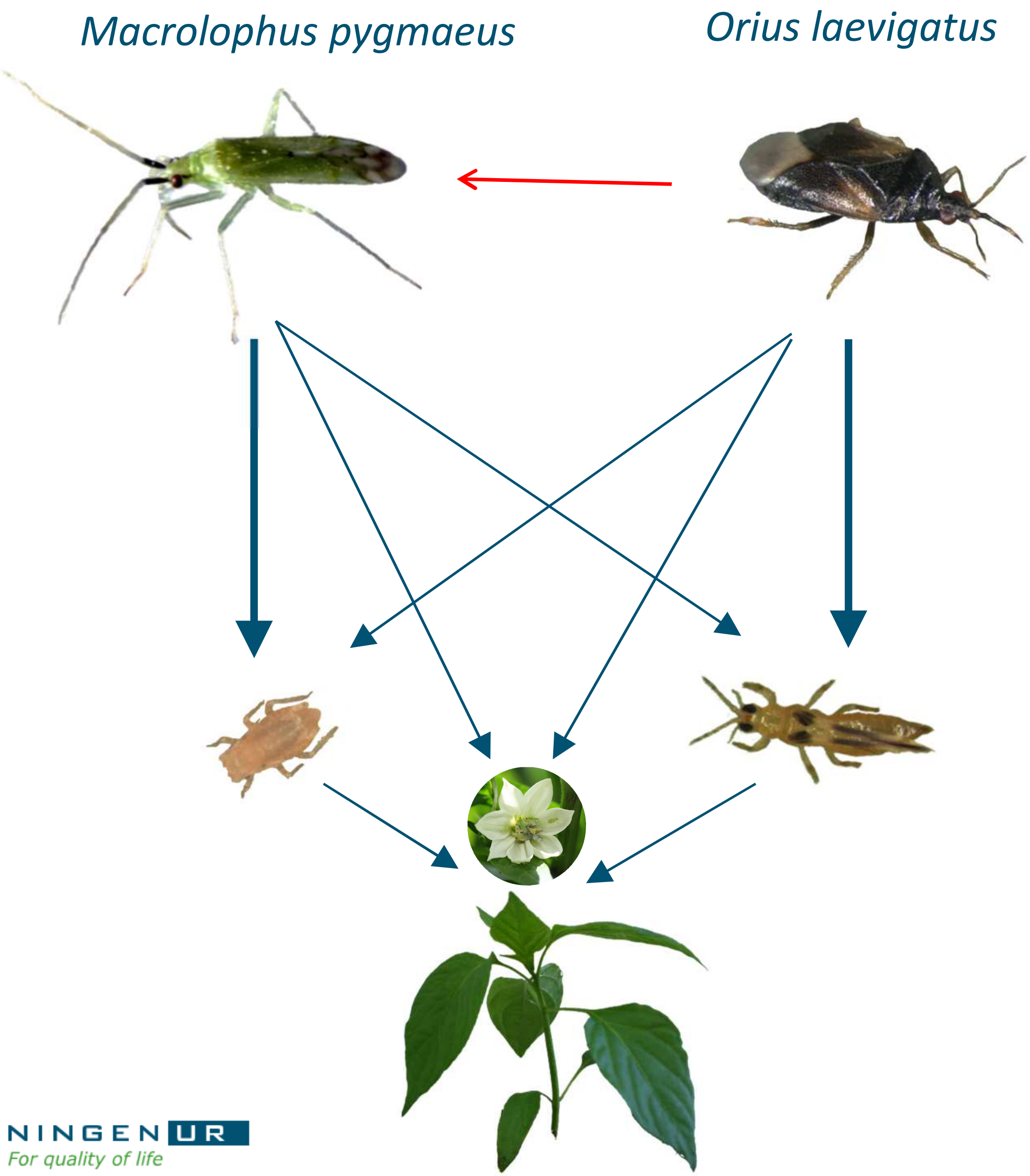

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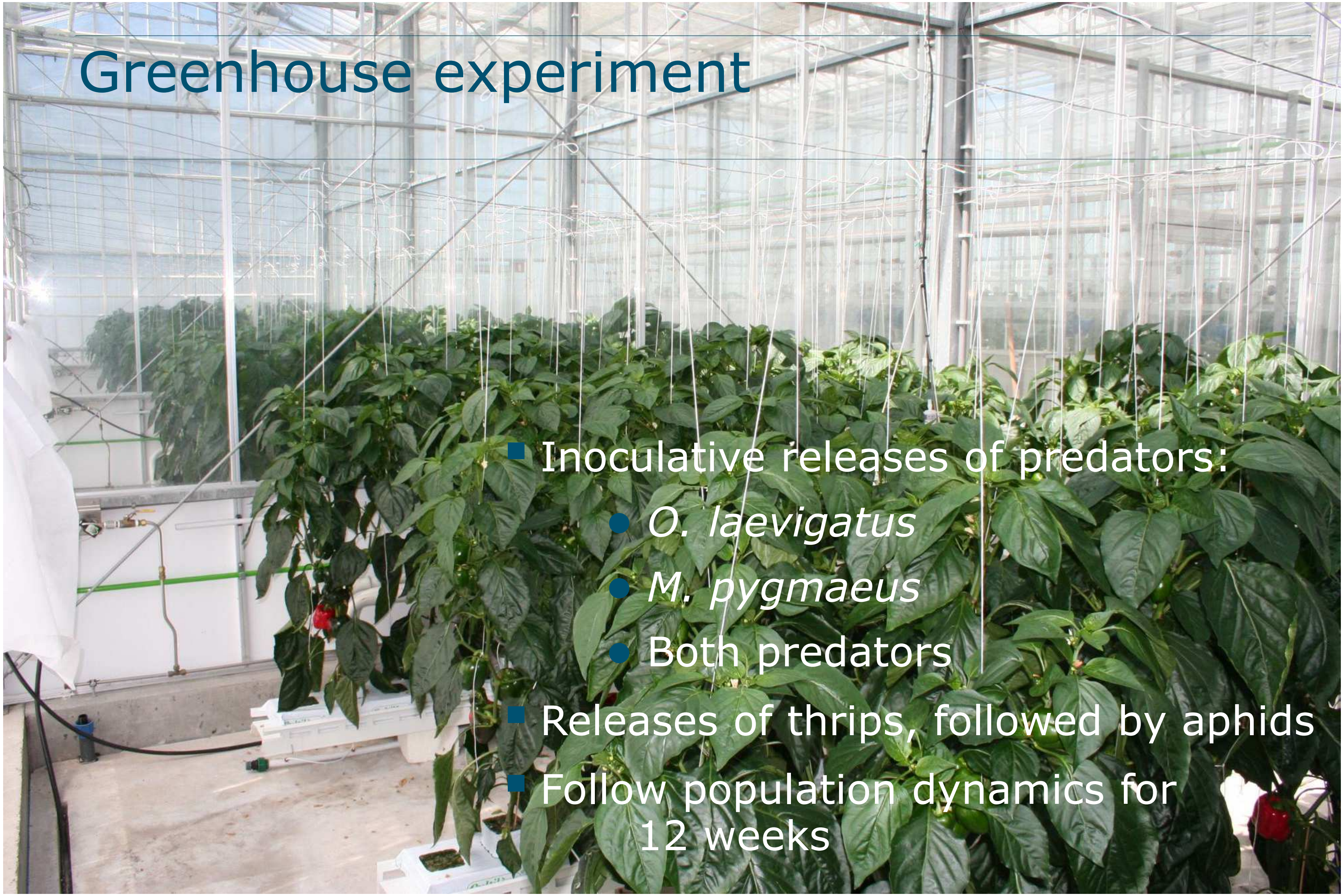
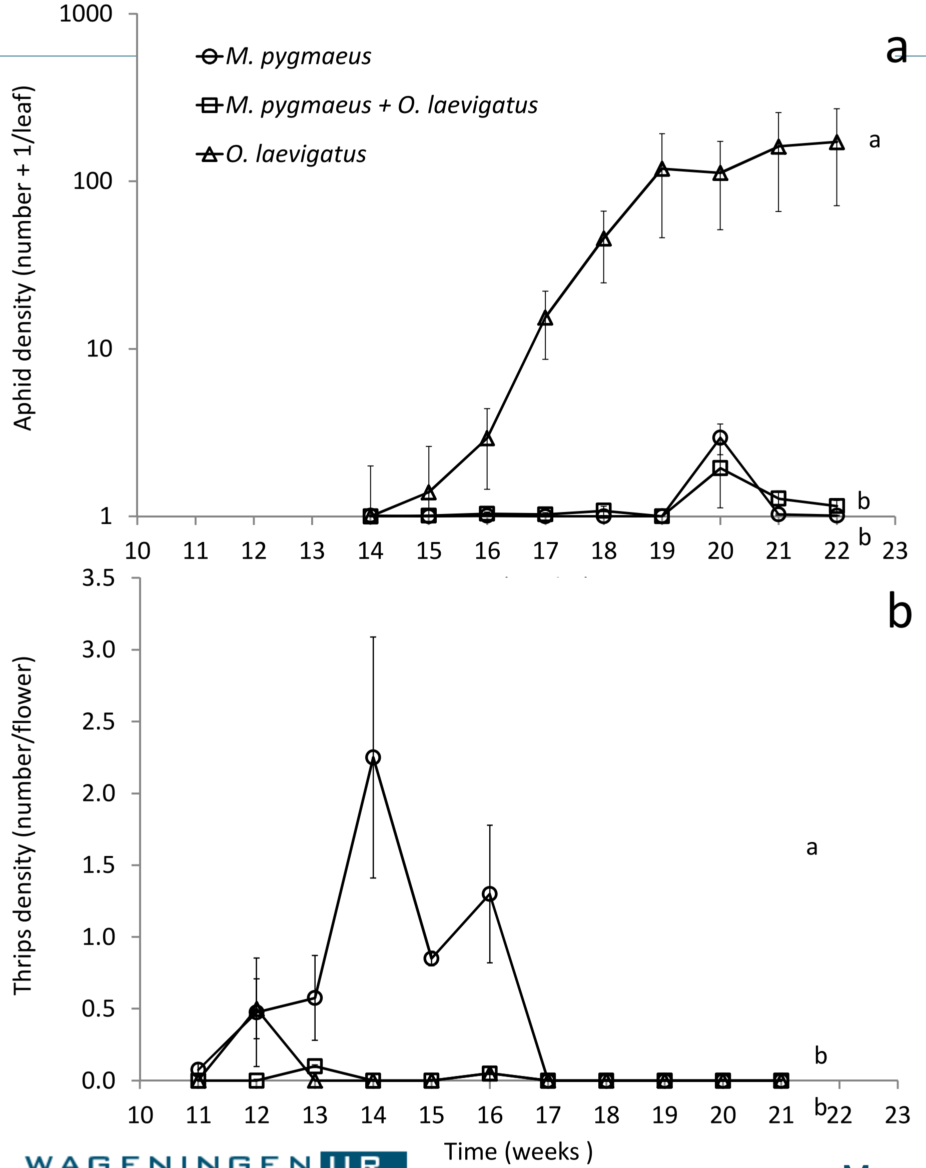
Greenhouse experiment



- Inoculative releases of predators:
  - *O. laevigatus*
  - *M. pygmaeus*
  - Both predators
- Releases of thrips, followed by aphids
- Follow population dynamics for 12 weeks

Effects on aphids and thrips



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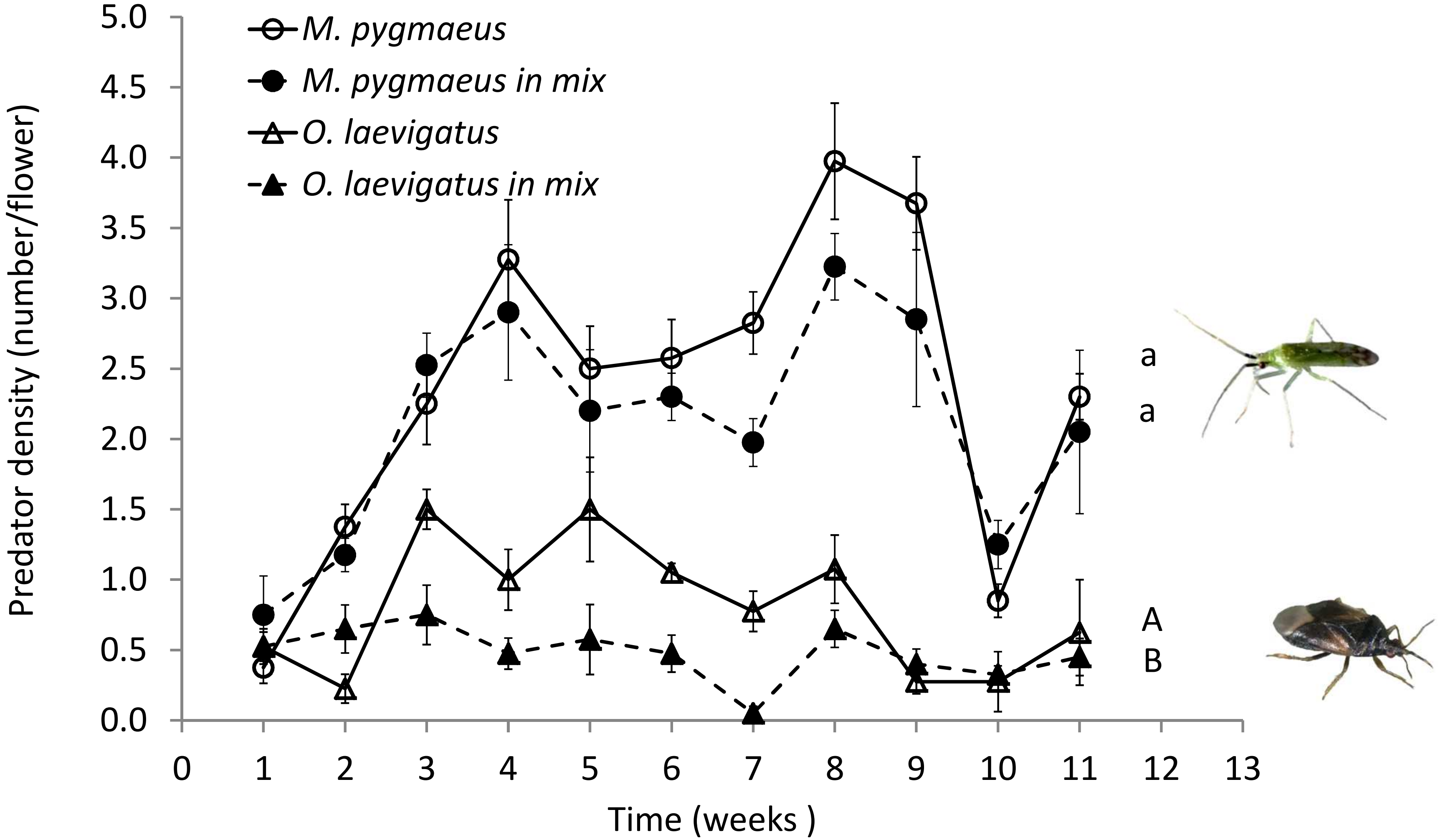
Messelink & Janssen, Biological Control 2014

Predator densities in flowers



Messelink & Janssen, Biological Control 2014

conclusions

- IGP by *O. laevigatus* did not affect coexistence or pest control
- The combined use of the 2 predators gave the best control of both thrips and aphids

Take home message

- Biological control is more than releasing natural enemies, but requires an ecosystem approach to create "standing armies"
- There is still a lot that can be done to enhance biological control systems: learn from nature and be creative!
- Be aware of food web complexities

Thanks for your attention!

Ministry of Economic Affairs, Agriculture and Innovation

Productschap Tuinbouw

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