Conserving natural enemy population in glasshouse crops

Gerben Messelink, Wageningen UR Greenhouse Horticulture

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Teagasc, Ashtown, Dublin, October 21, 2014

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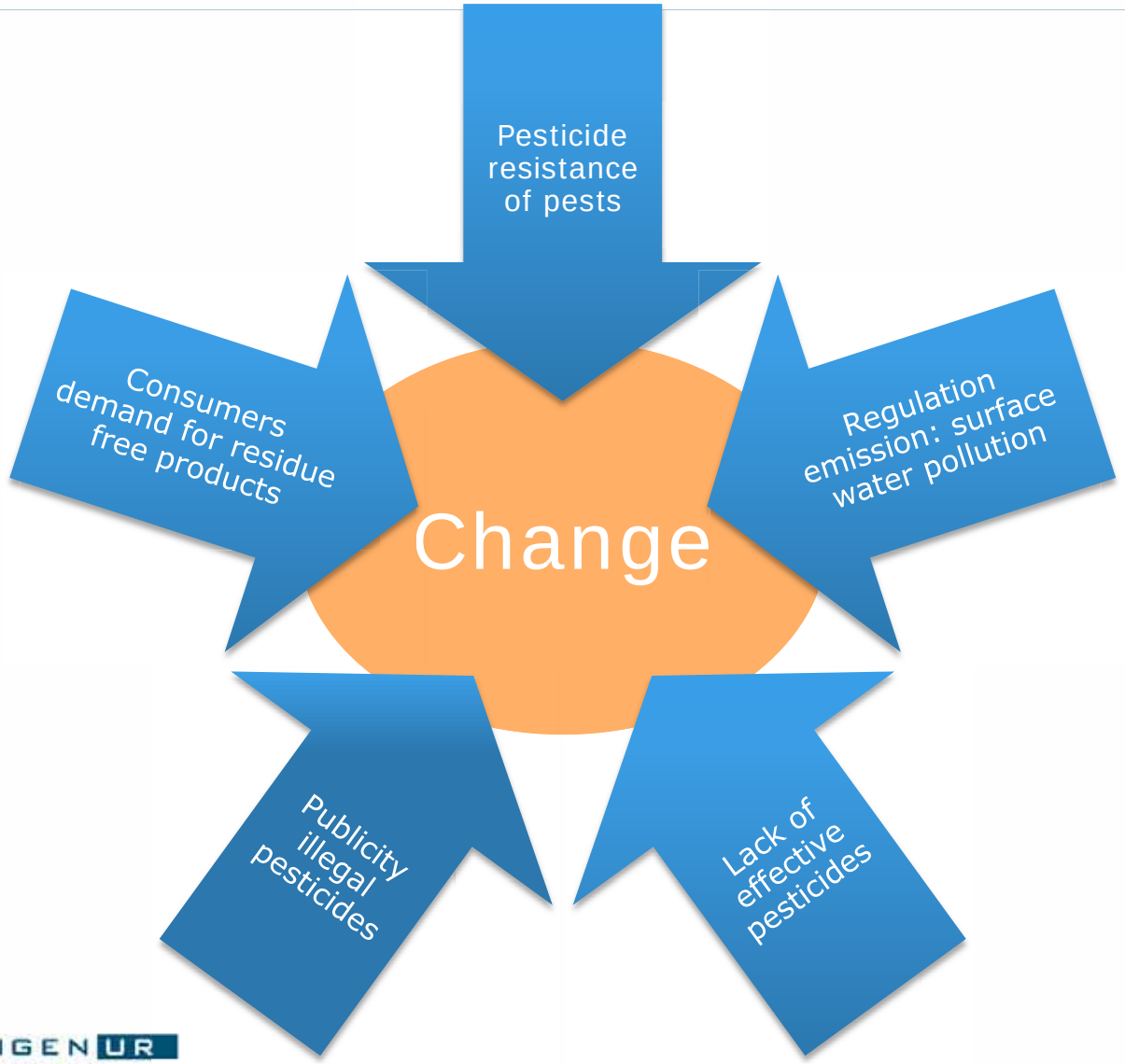
Drivers for change in crop protection:



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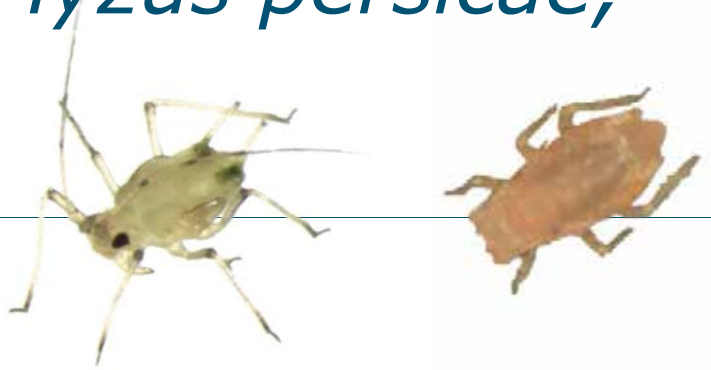
Is biological control with natural enemies always working well?

Nr 1 vegetables: aphids, *Myzus persicae, Aulacortum solani*



Problems:

- Natural enemies not effective enough and too expensive
- Problems with establishment of natural enemies (eg predatory midges)

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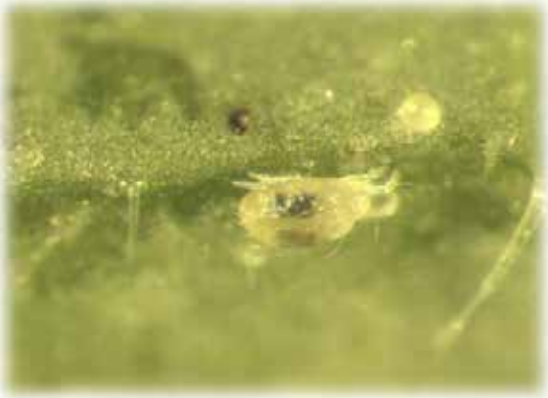
Nr 2 vegetables: spider mites, *Tetranychus urticae*

Problems:

- Side-effects pesticides (e.g. neonicotinoids against Feltiella)
- Poor quality *Phytoseilius persimilis*?
- Interaction with other predatory mites?



Nr 3 vegetables: caterpillars, *Chrysodeixis chalcites, Lacanobia oleracea* etc.

Problems:

- Larval parasitoids not commercially available (too expensive)
- Trichogramma not effective

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Nr 4 vegetables: true bugs, *Lygus rugulipennis, Liocoris tripustulatus, Lygocoris pabulinus*

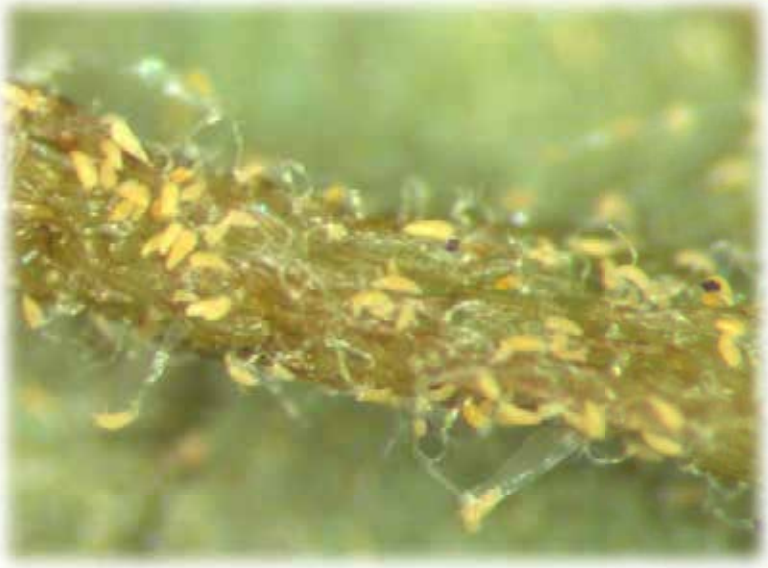
Problems:

- natural enemies against adults not available

Nr 5 vegetables: Tomato russet mite, *Aculops lycopersici*

Problems:

- Predatory mites get entrapped by the type VI glandular trichomes on tomato stems



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Nr 1 ornamentals: western flower thrips, *Frankliniella occidentalis*

Problems:

- Low thresholds for thrips densities
- Poor establishment of effective predators: predatory mites and predatory bugs (lack of food, unsuitable habitat, side-effects pesticides)
- Strong side-effects pesticides (e.g. meltatox in roses)

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Nr 2 ornamentals: mealybugs, *Planococcus citri* (and others..)

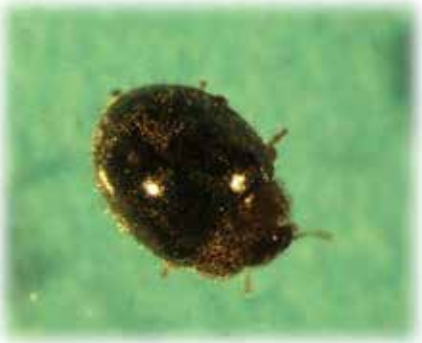
Problems:

- Parasitoids and *Cryptolaemus montrouzieri* often not effective and too expensive

Nr 3 ornamentals: armoured scales, *Aulacaspis rosae, Diaspis boiduvalli*

Problems:

- Natural enemies not available or not always effective.
- Side-effects other pesticides



Nr 4 ornamentals: whiteflies, *Trialeurodes vaporariorum, Bemisia tabaci*

Problems:

- Natural enemies not effective at lower temperatures (gerbera)
- Poor establishment of natural enemies (lack of food, side-effects pesticides)
- Zero-tolerance policy (Poinsettia)

Nr 5 ornamentals: *Echinothrips americanus*

Problems:

- Predatory mites not very effective
- Poor establishment of Orius bugs
- Effective mirid predators cause damage to flowers (gerbera)
- Predatory thrips of lacewing larvae are too expensive and not effective enough

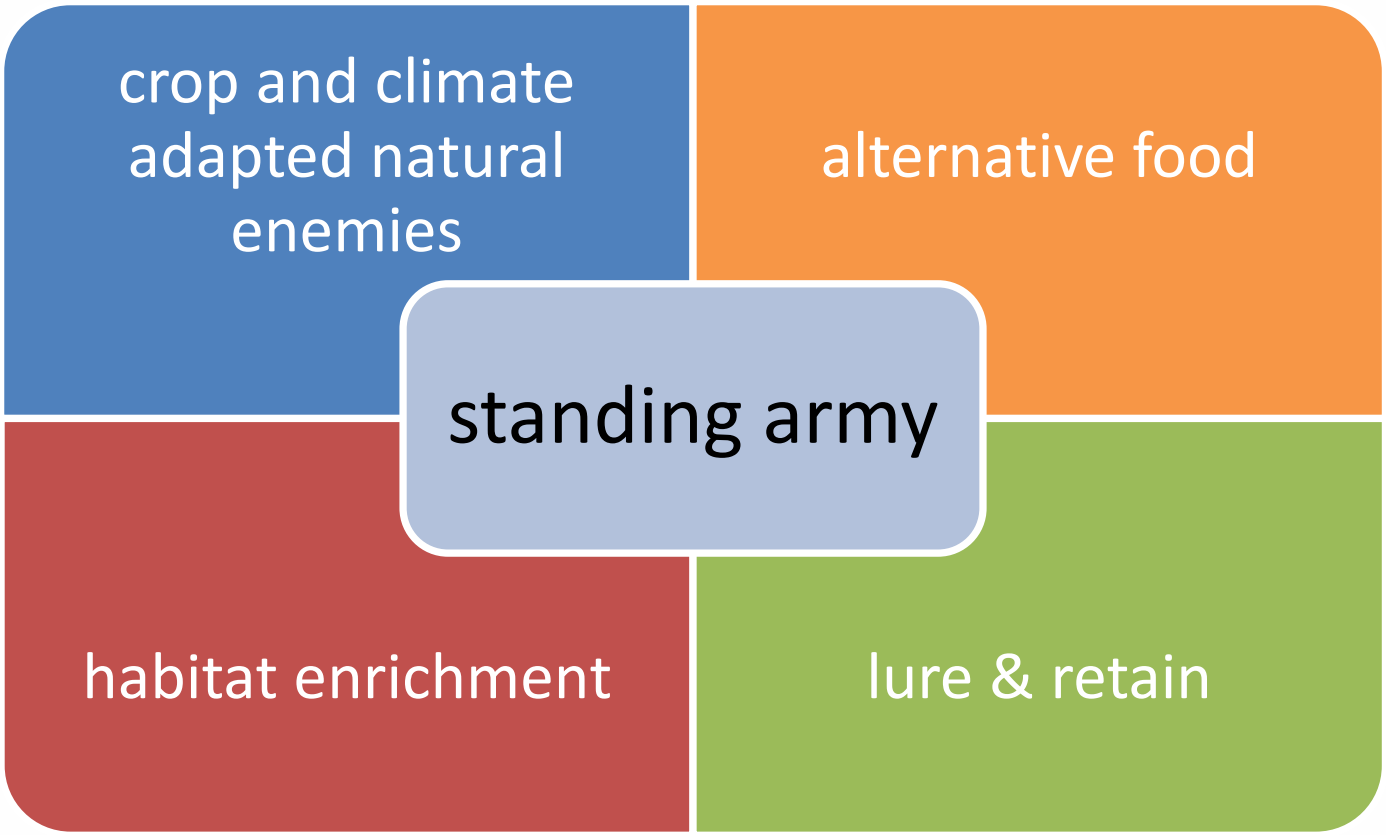
Summarizing: reasons limited use of biocontrol

Not only because of social aspects (attitude industry and government) or regulations but also because:

- Natural enemies are not effective enough
- Natural enemies do not establish well
- Natural enemies are too expensive
- Natural enemies are not available

Enhancing efficacy of natural enemies

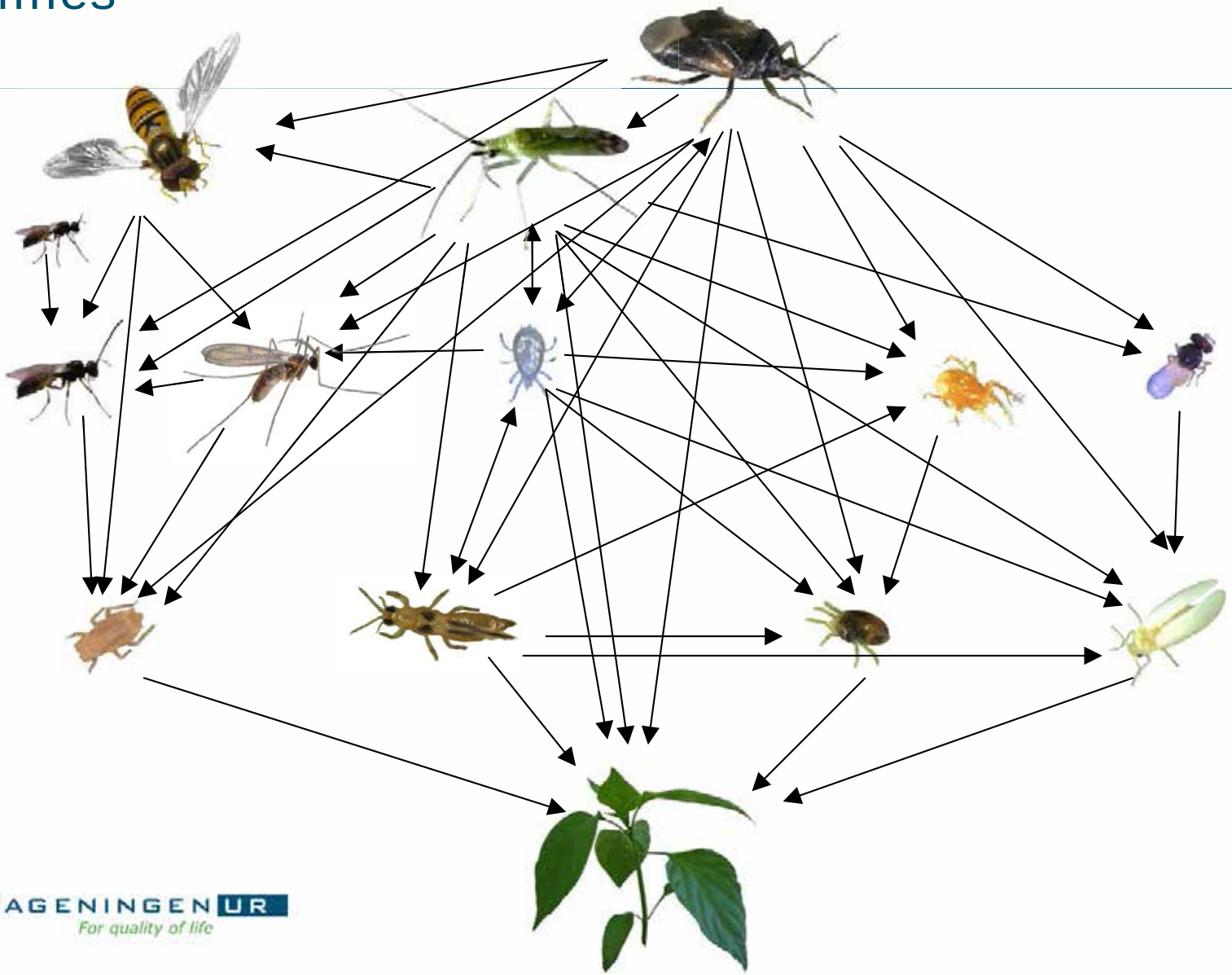
- Enhancing quality of natural enemies:
  - Better rearing methods
  - Selective breeding (pesticide resistance, climate, symbionts)
  - olfactory conditioning
- Enhancing establishment
  - alternative food, prey, hosts
  - oviposition sites or shelters
  - Adapting the greenhouse climate/microclimate
  - avoiding pesticide side-effects
  - The right combinations of natural enemies


crop and climate adapted natural enemies
alternative food
standing army
habitat enrichment
lure & retain

Methods for conserving natural enemy populations: some examples

- The right combinations of natural enemies
- Banker plants
- Insectary plants
- Food sprays
- Mulch layers

A food web with 4 pest species and their natural enemies



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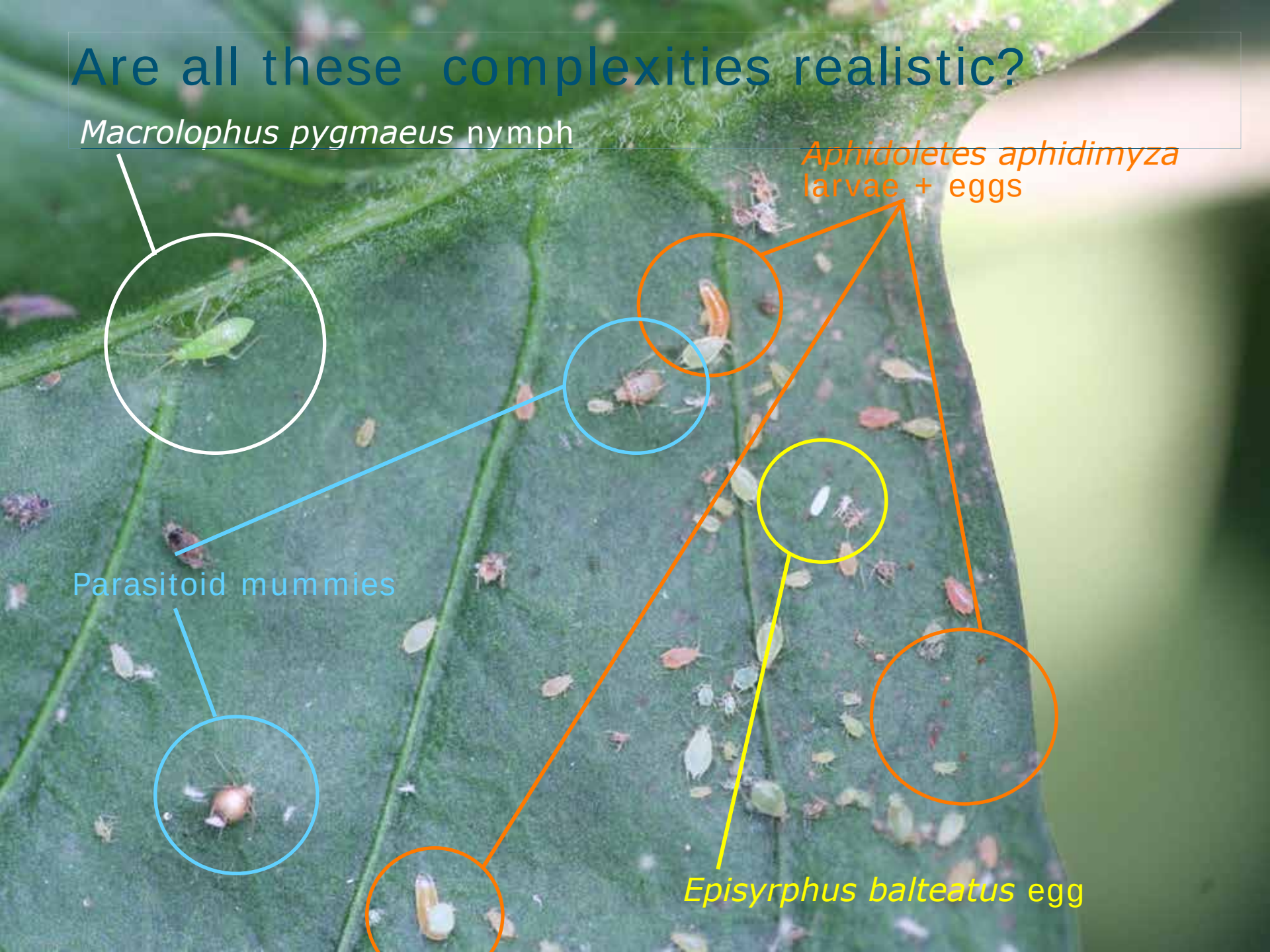
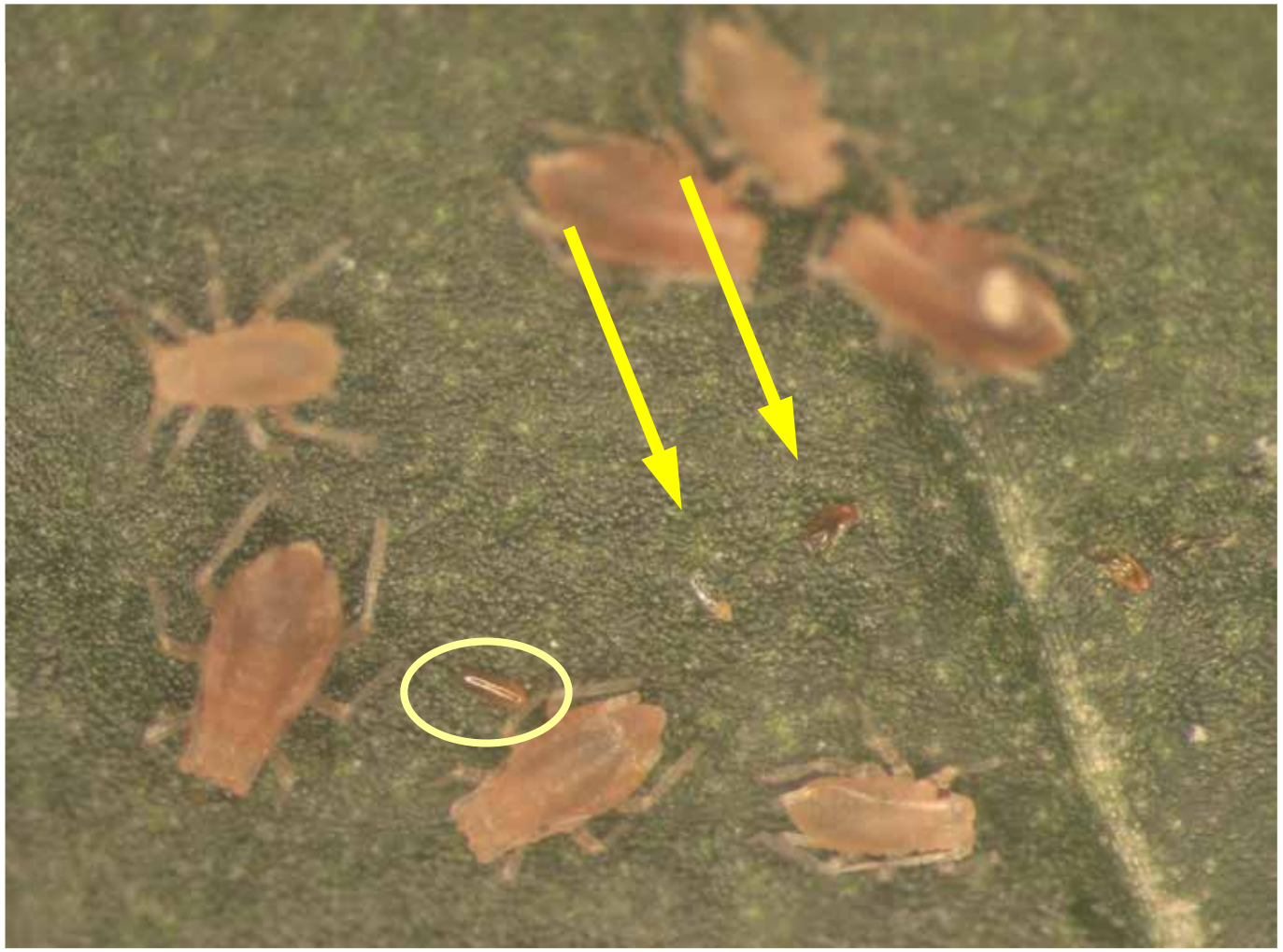
Are all these complexities realistic?



Bad establishment caused by hyperpredation



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- Predatory mites

+ predatory mites

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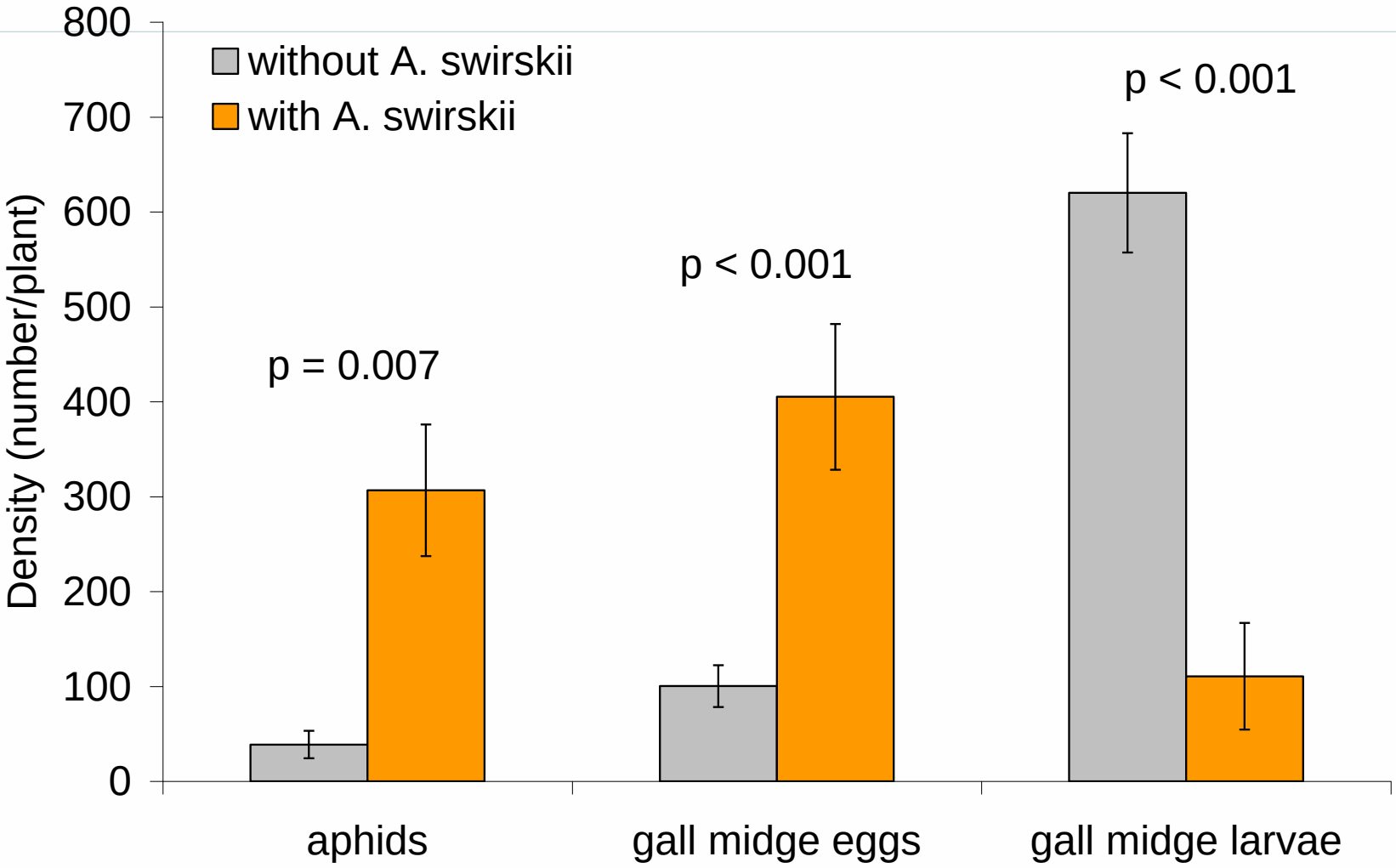
Densities of aphids, midge eggs and midge larvae after 7 days



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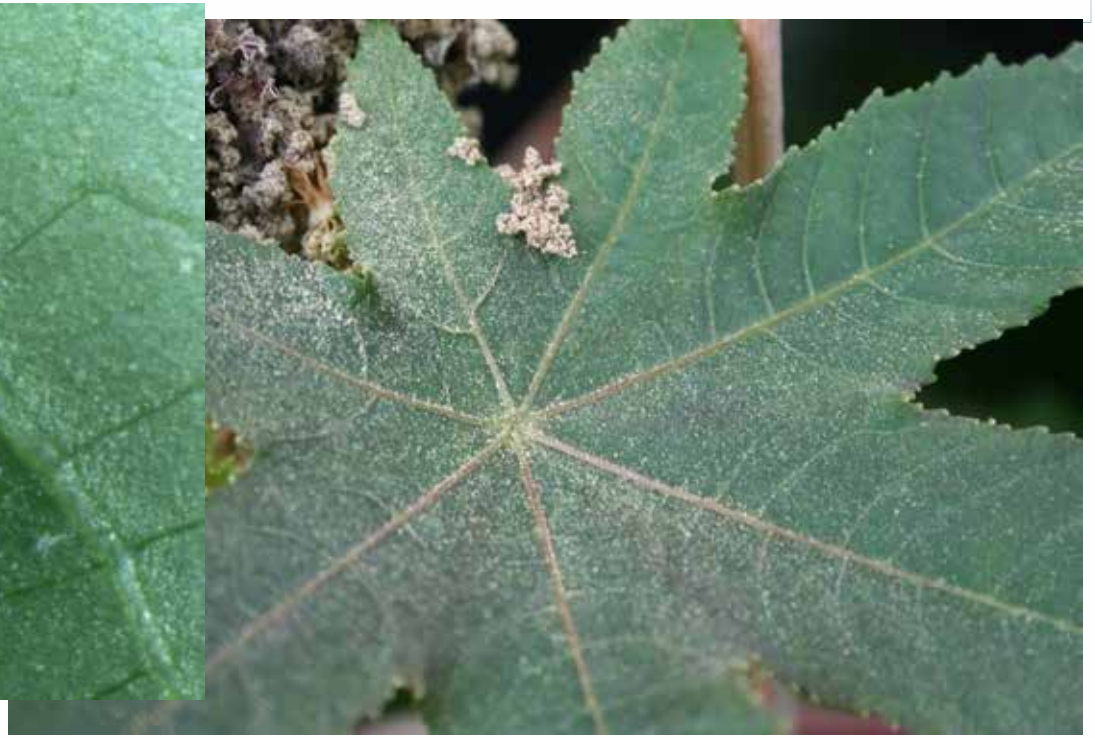
Messelink et al., Biological Control 2011

Banker plant: Castor bean *Ricinus communis*



- *Iphiseius degenerans*
- *Amblyseius swirskii*
- *Euseius ovalis*

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Castor bean plant *Ricinus communis*

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Banker plants for Aphid parasitoids

- Most popular: combination of winter wheat & *Sitobion avenae* for production of *Aphelinus abdominalis* or *Aphidius ervi*
  - Advantages: cheap rearing of parasitoids, “fresh” parasitoids
  - Disadvantages: smaller wasps than on host from mass production, increased risk on hyperparasitism

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Huang et al., Critical Reviews in Plant Sciences 2011

Dominant hyperparasitoid: *Dendrocerus aphidum*

- Related to another common species: *Dendrocerus carpenteri*
- Parasitizes parasitized aphids 4-10 days after parasitism by the primary parasitoids
- Generalist species: most aphid-parasitoid combinations are vulnerable

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Conservation of *Aphidoletes aphidimyza*

- The banker plant method, similar to the parasitoids: combination of winter wheat & *Sitobion avenae*
- Intercropping with kohlrabi (with cabbage aphids)

Banker planmts for Orius









Possible candidates for *Orius laevigatus in* ornamentals

- *Amaranthus cruentes* (red amaranthus)
- Ornamental pepper: *Capsicum* 'Black Pearl'
- Corn flower, *Centaurea cyanus*
- Strawberry + strawberry whitefly, *Aleyrodes lonicerae* (not for roses)

Insectary plants for nectar fuelling:

- conservation of *Episyrphus balteatus*

Alyssum lobularia

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Insectary plants for nectar fuelling:

- conservation of *Episyrphus balteatus*

Buckwheat, *Fagopyrum esculentum*

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Conservation of *Episyrphus balteatus*

- Nectar fuelling with insectary plants

Crambe hispanica

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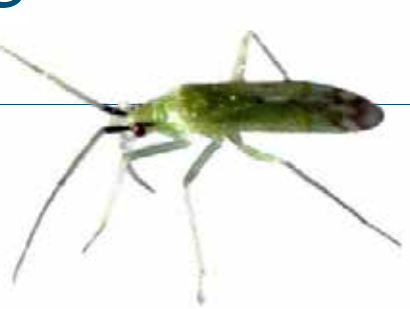
Alternative food sources for the mirid predator *Macrolophus pygmaeus*



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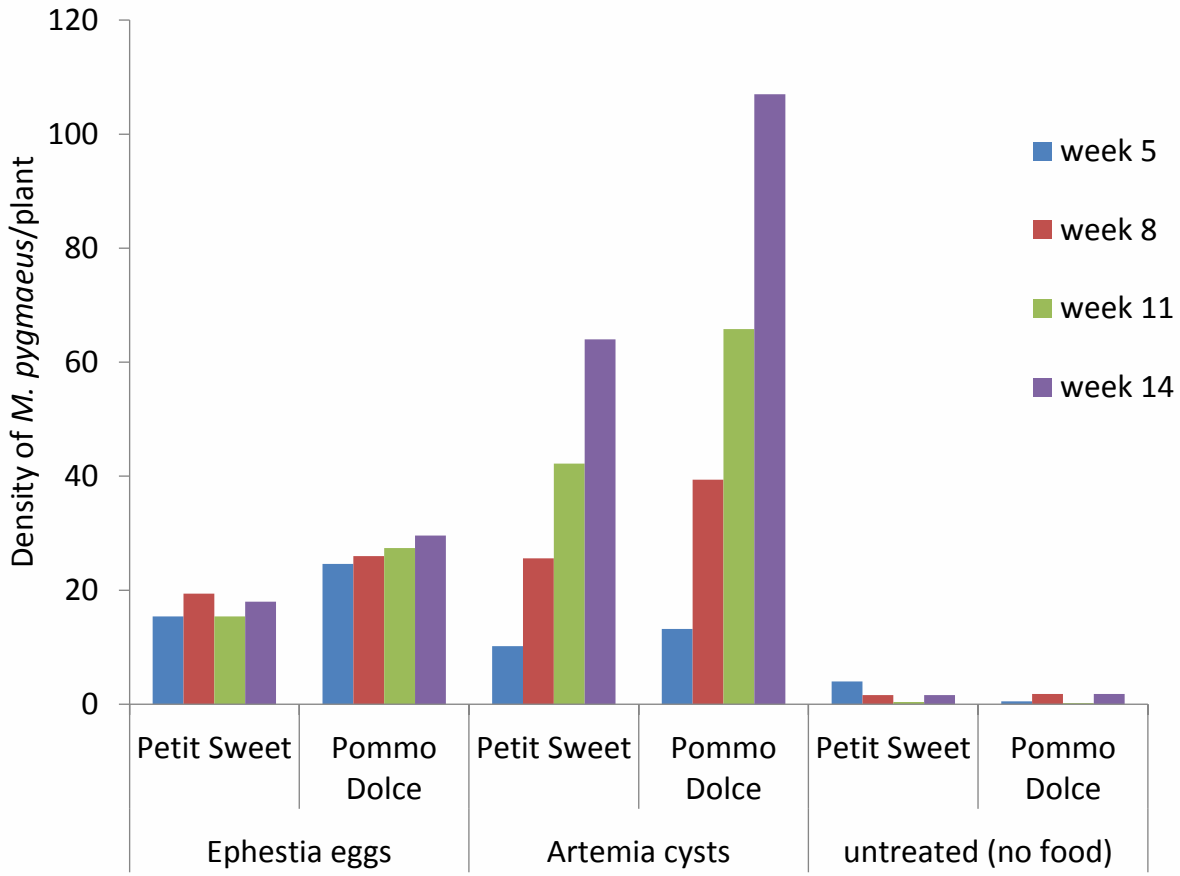
Applying alternative food in practice

Applying alternative food in practice



Weekly application:

Ephestia eggs: 35 g/ha	(€800/kg)
Artemia: 135 g/ha	(€20/kg)

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Food and shelter for predatory mites

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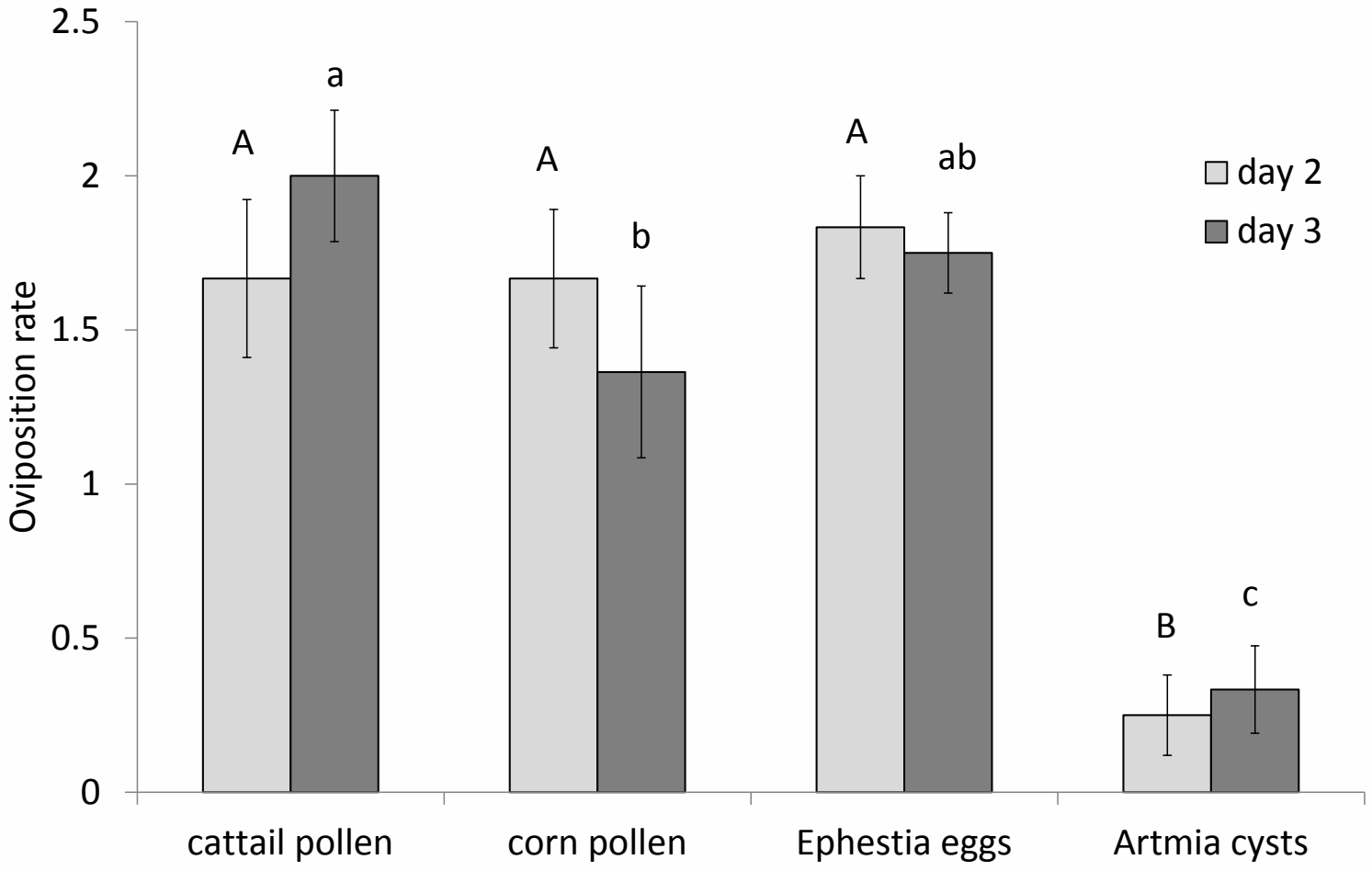
Alternative food for predatory mites



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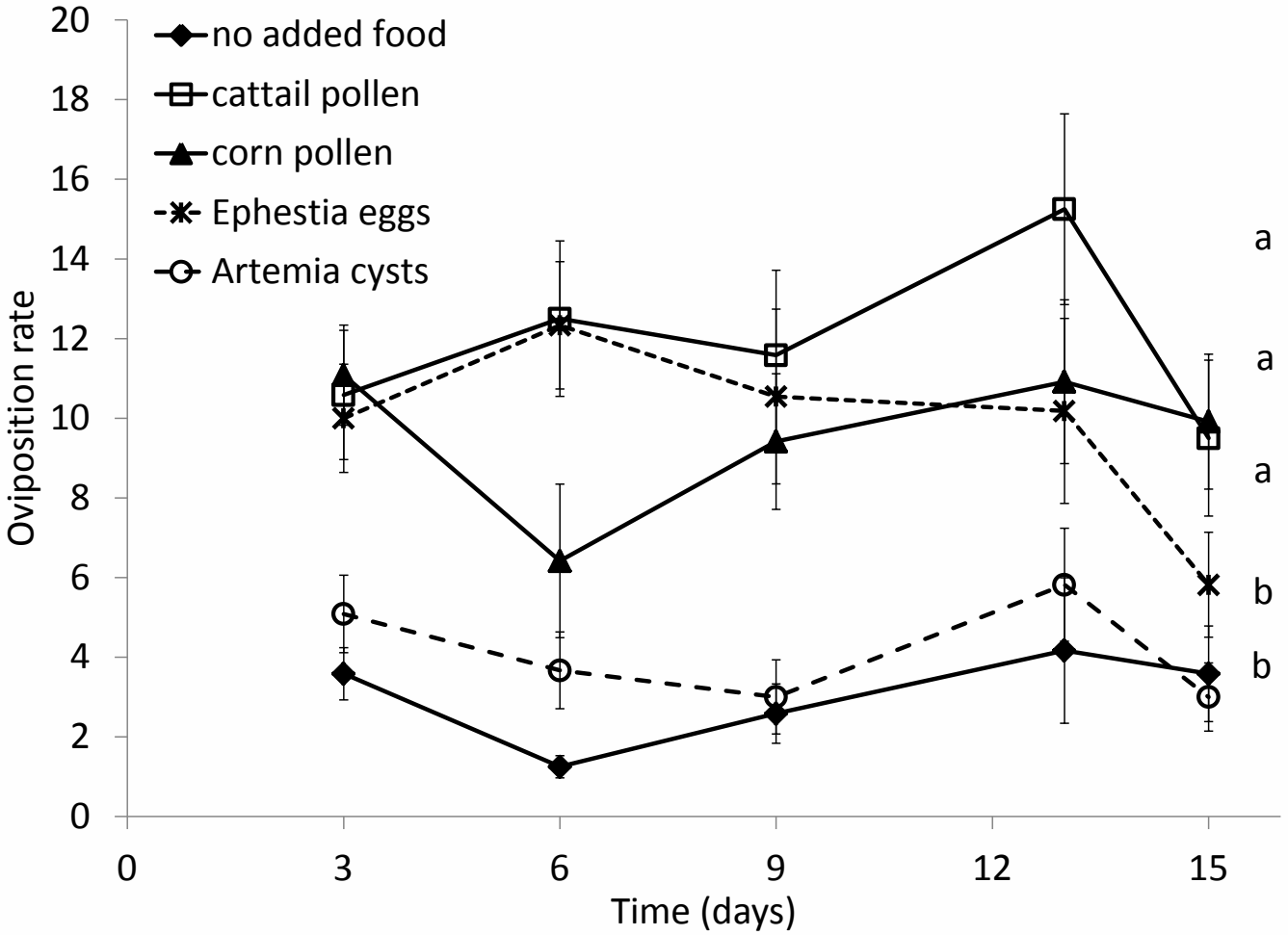
Effects of food on thrips



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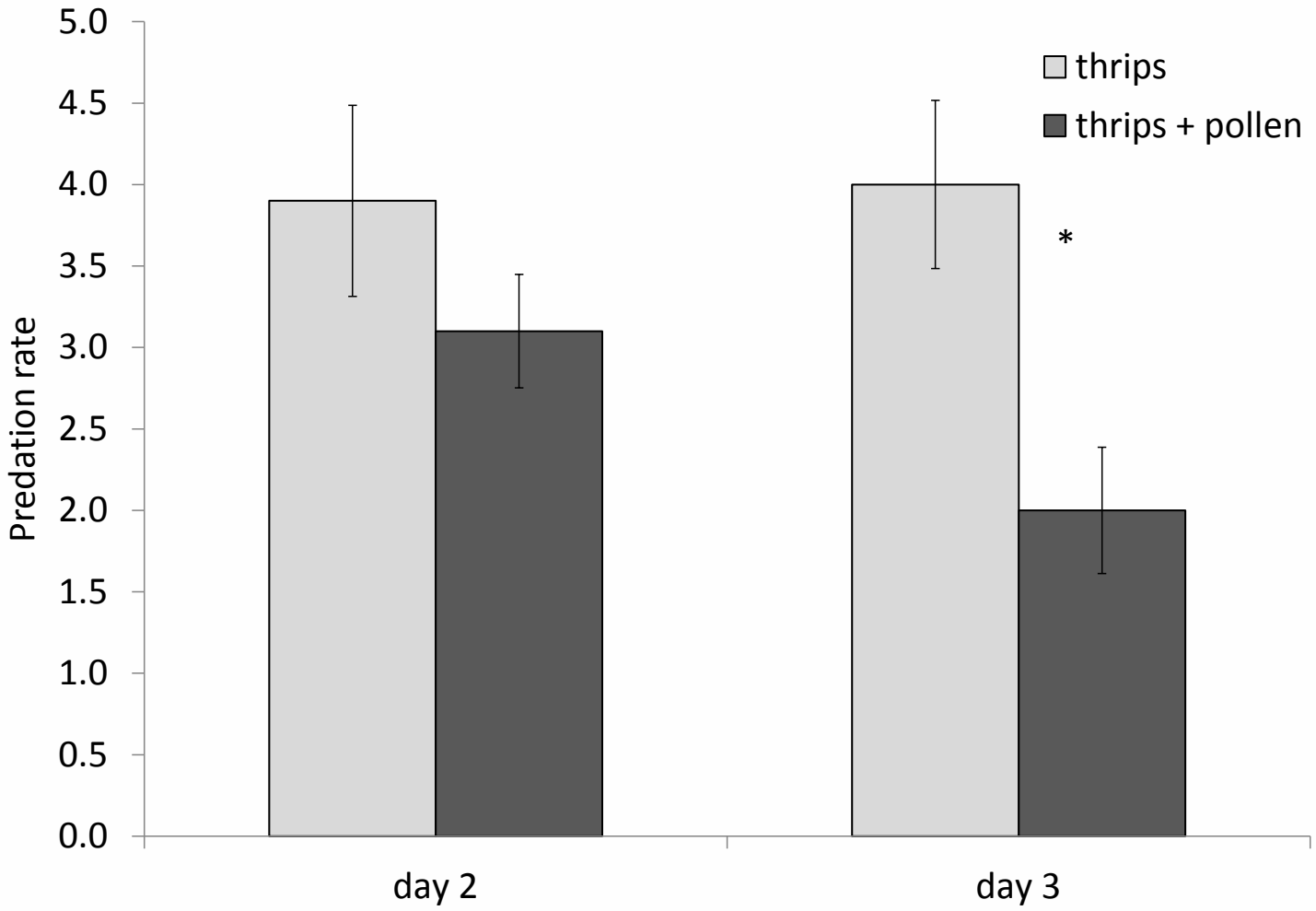
Effects of food on thrips predation



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Effects on biological control of thrips

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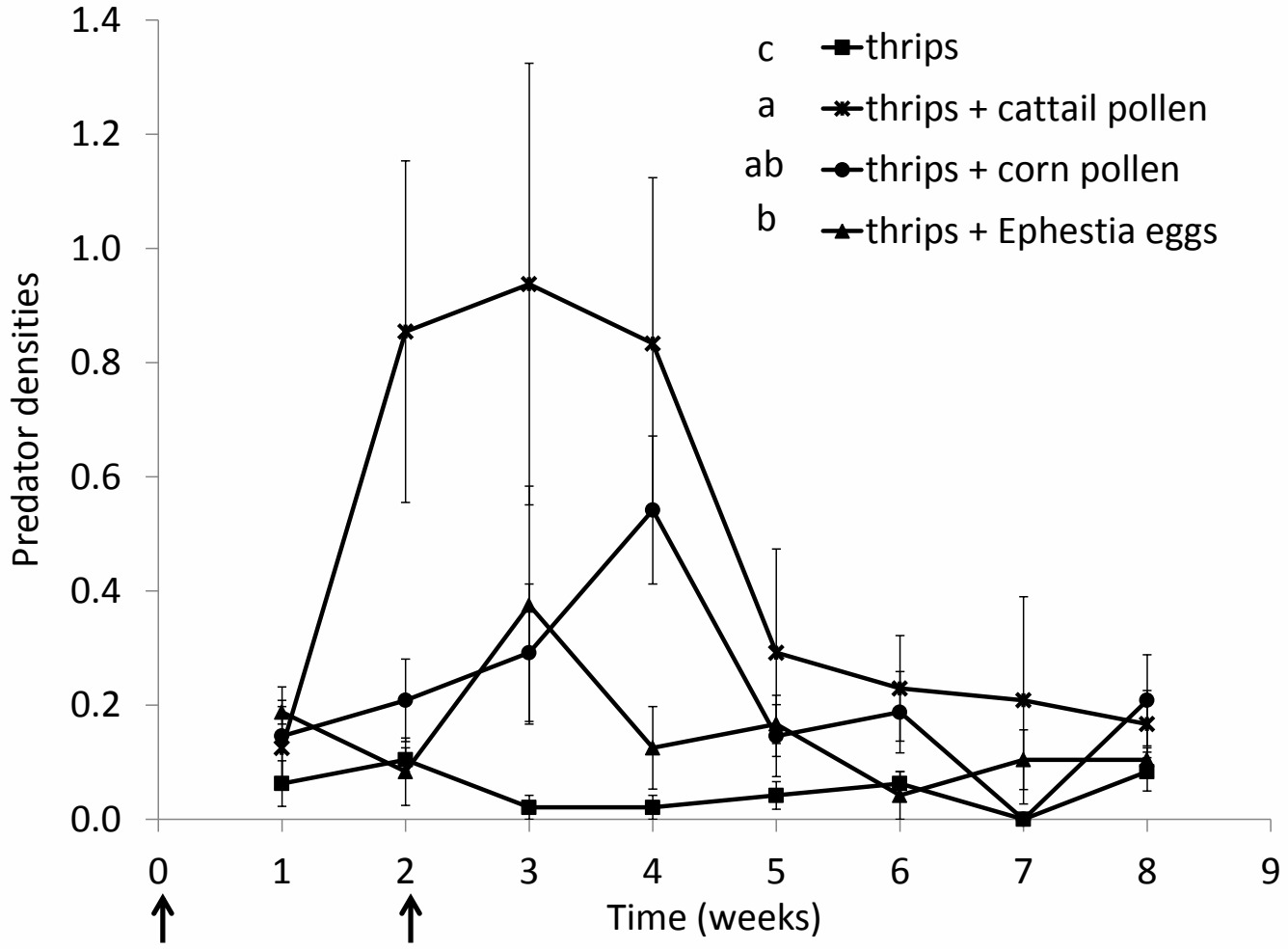

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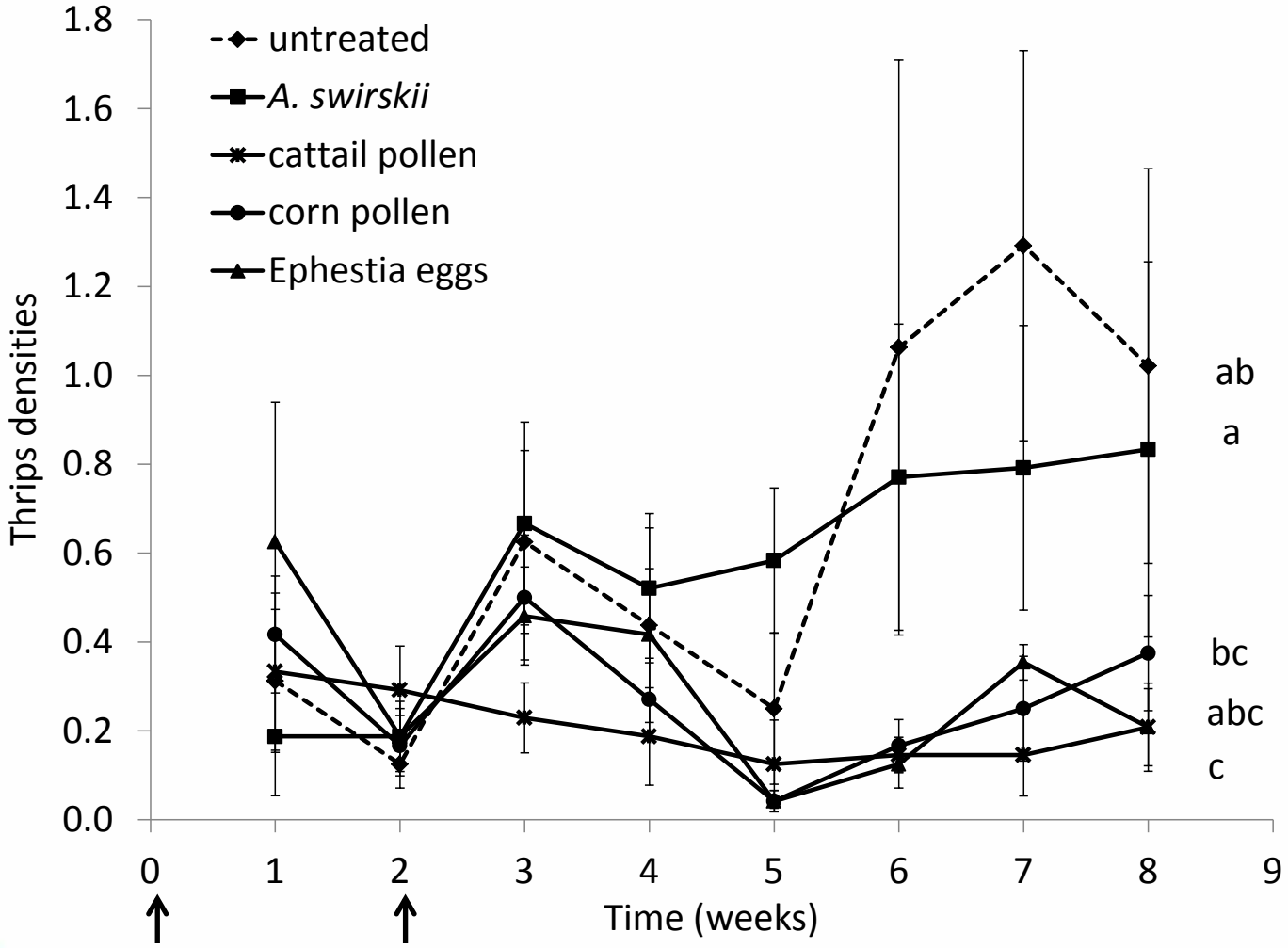
Effects on biological control of thrips



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Mulch layers for enhancing pest control

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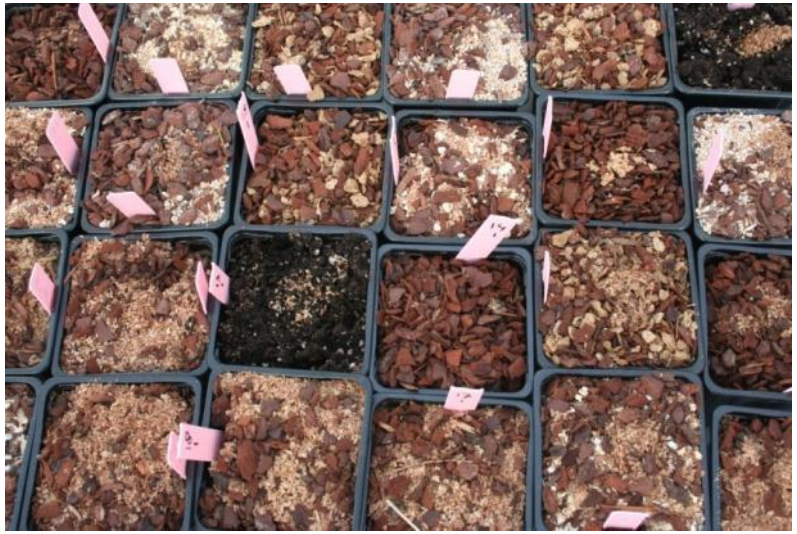
mulch-layer composition

Prey mite population increase

- 9 mulch-layers
- 2 prey-mites:
    - *Acarus siro*
    - *Carpoglyphus lactis*



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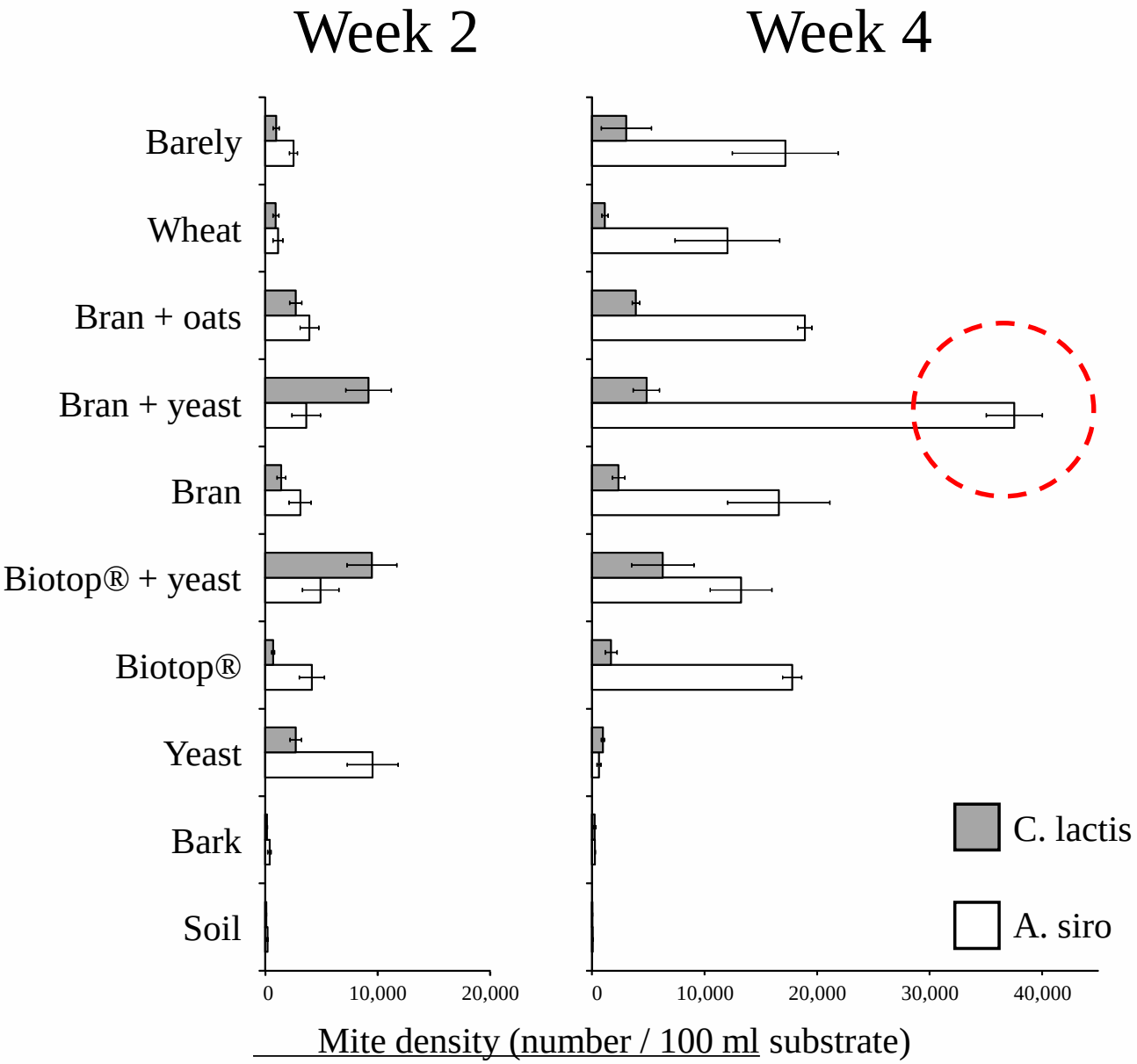

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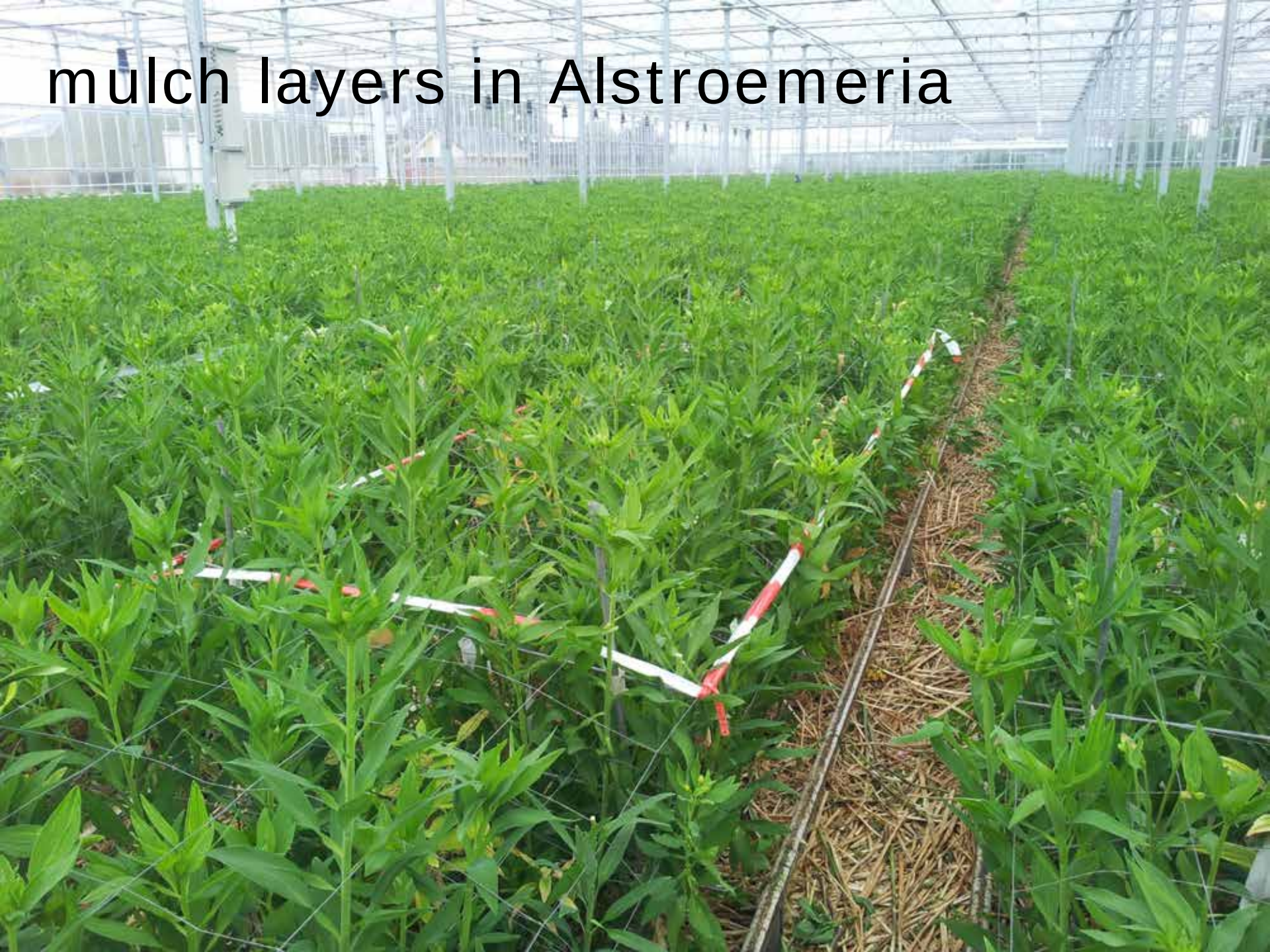
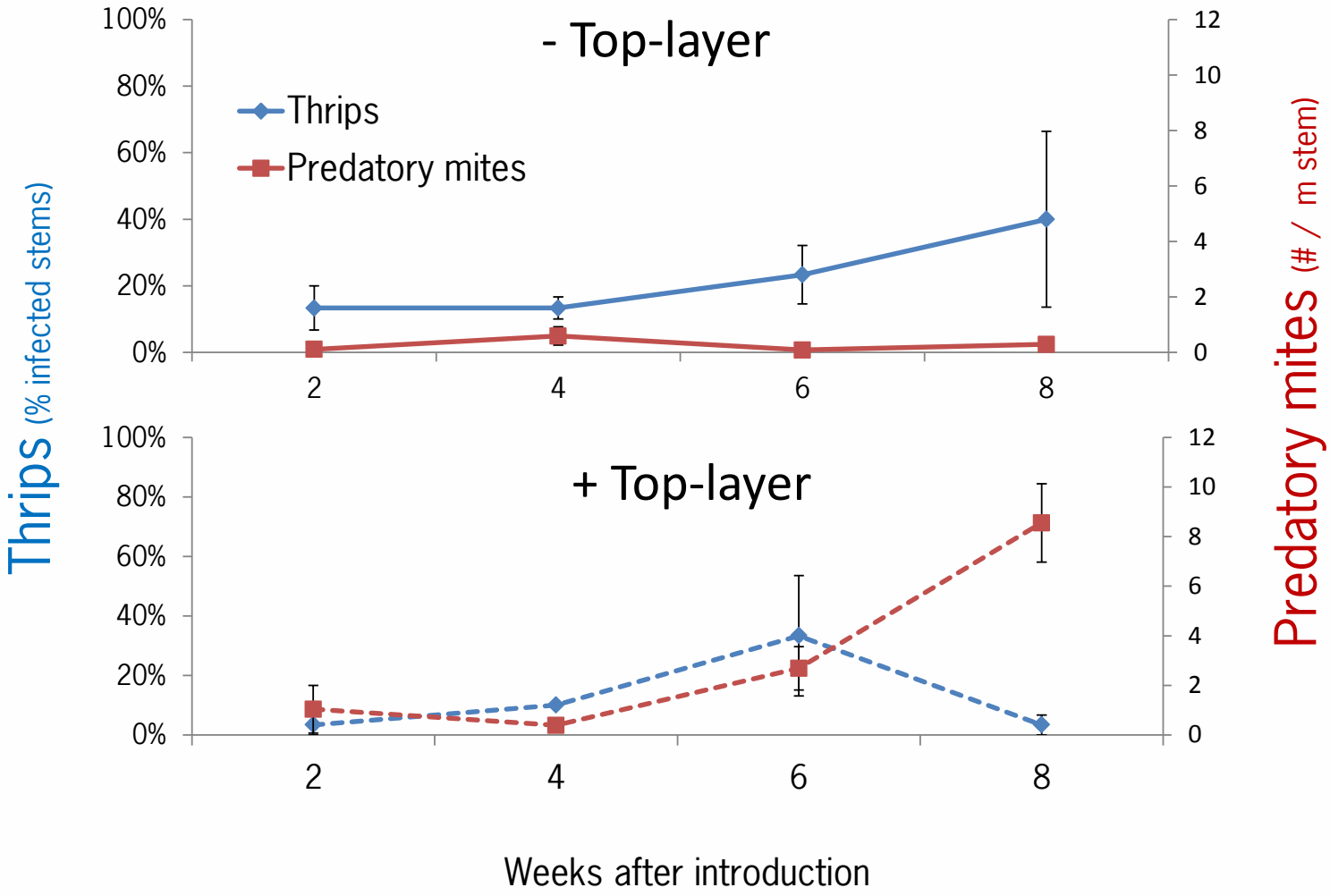
mulch layers in Alstroemeria



Effect on thrips and predatory mites (*N. cucumeris*)



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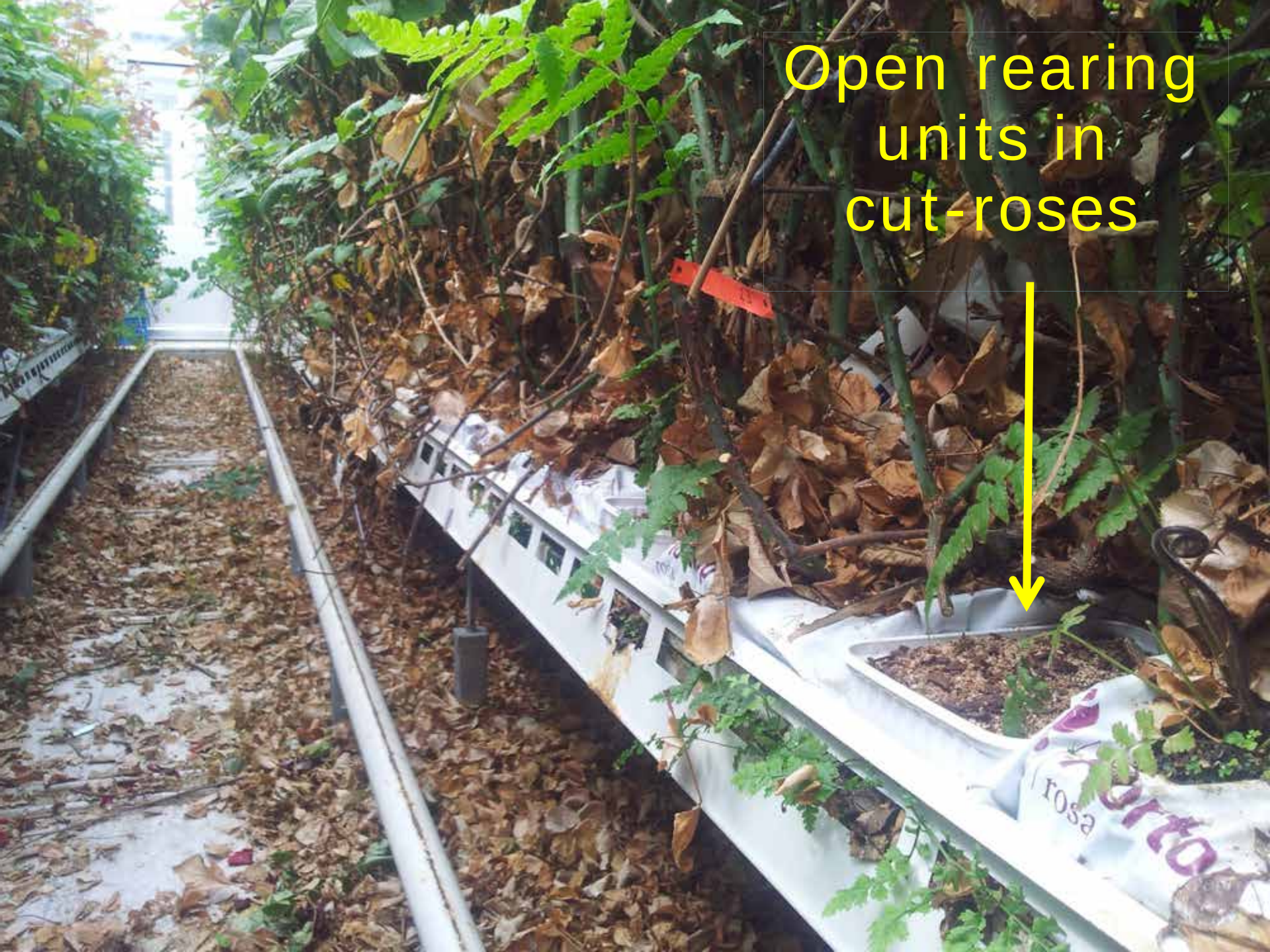
Conclusions

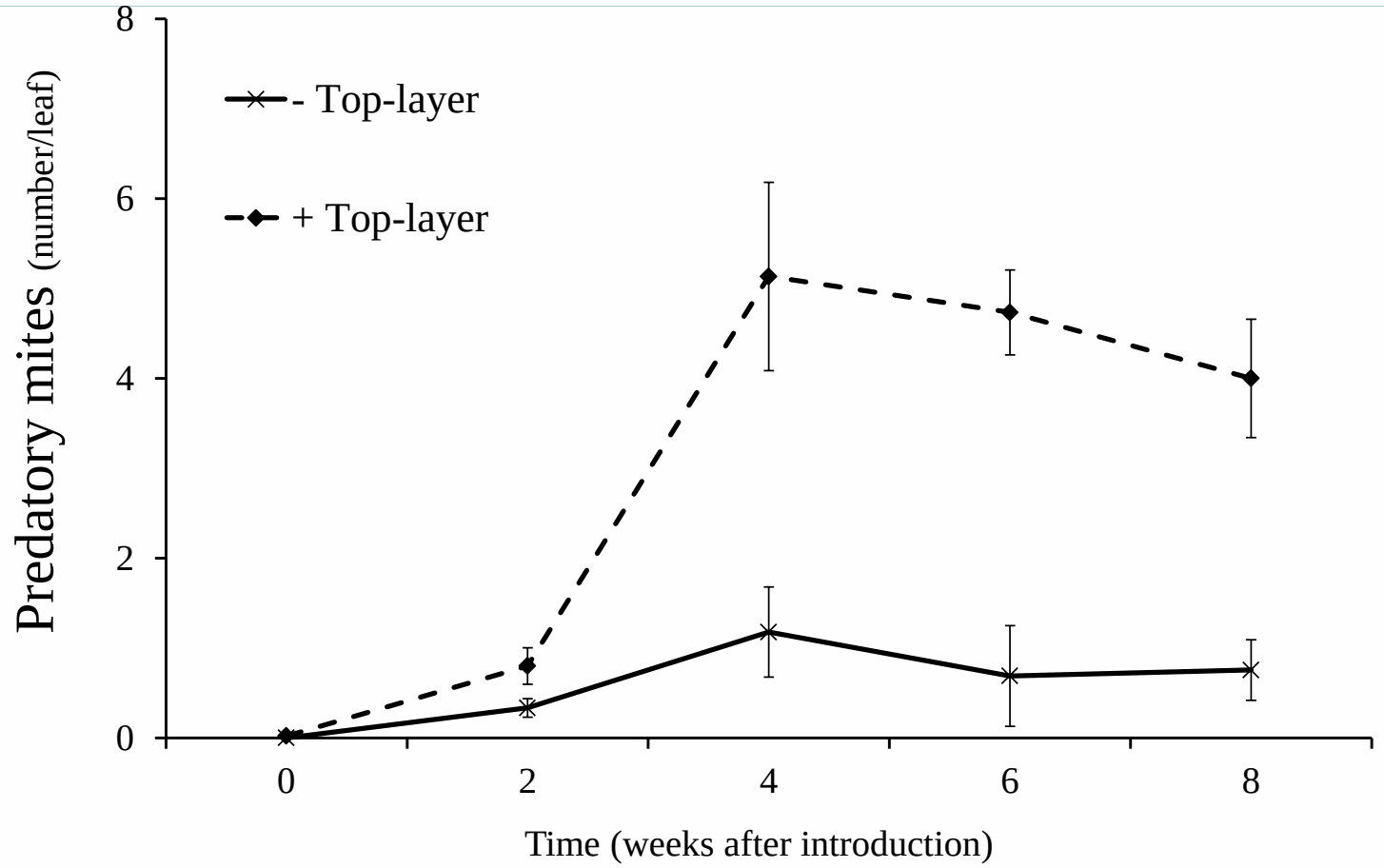
- Mulch layer:
  - Predatory mites do not establish on crop
  - Pest pressure increases gradually

+ mulch layer:
  - Increase in pest-pressure is followed by strong increase in predatory mite density on crop
  - Pest pressure decreases

Better predatory mite establishment and thrips-control due to mulch layer application


Open rearing
units in
cut-roses

Effect on predatory mites (*A. swirskii*)



- Strong increase in predator density due to mulch layer application
- Increased predation rates in treatments with rearing units

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conclusions

- Establishment of natural enemies can be enhanced with banker plants, insectary plants, food sprays and mulch layers
- Be aware of food web complexities through presence of hyperparasitoids and hyperpredators
- Be aware of short-term dynamics when the alternative food is also edible for the pest species

Thanks for your attention!

Ministry of Economic Affairs, Agriculture and Innovation

Productschap Tuinbouw

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