UNIVERSITY OF COPENHAGEN

Systemic Approaches to Pest Management without Pesticides

-Biological control of insect pests with predators and parasitoids

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Trophic interactions

Research needed to understand biological mechanisms guiding outcome of pest management

Interactions of beneficial arthropods with plant and pests

Scales from organism → field → landscape.

Response to abiotic factors

Effect of climate change on insects –example *Agrotis segetum*

Temperature -dependent development and activity

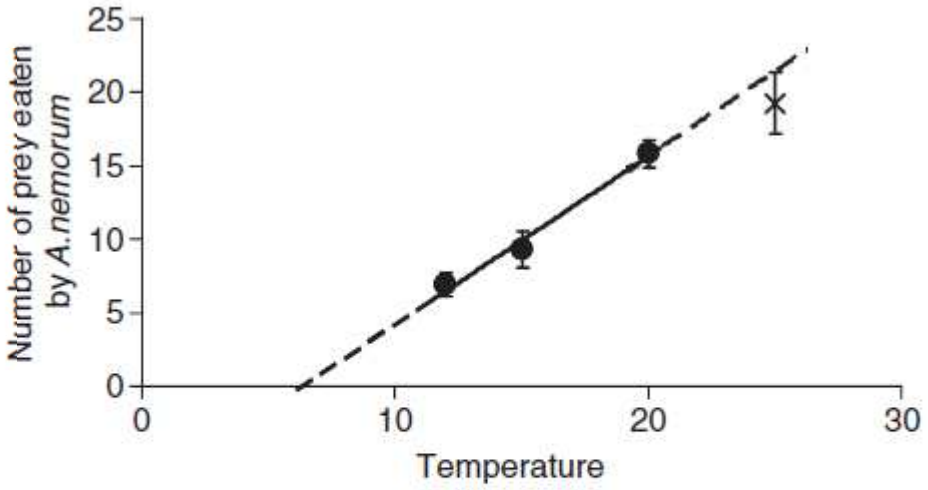
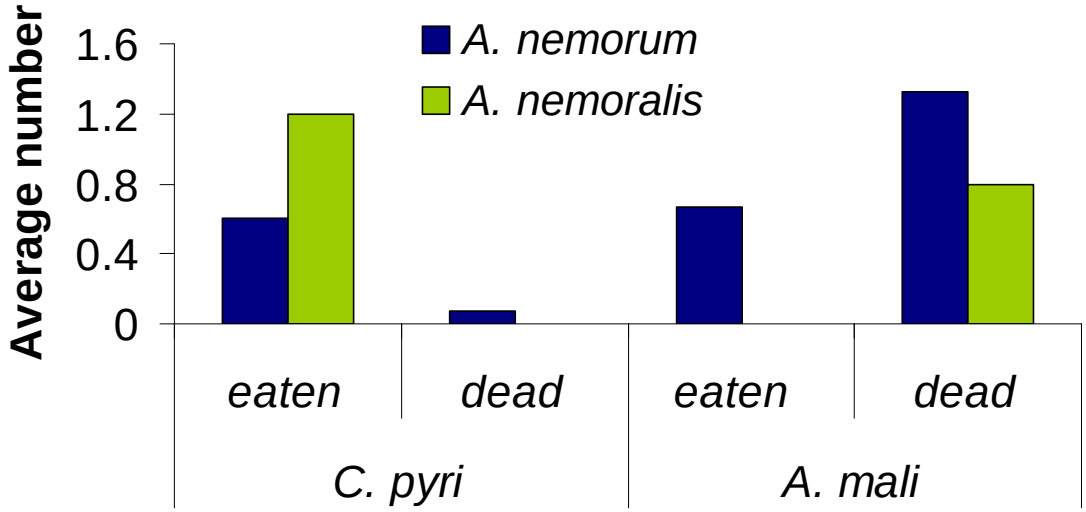


Fig. 1 Temperature-dependent predation of *Anthocoris nemorum* on second instar *Brevicoryne brassicae* (mean number eaten ± SE) during 24 h. •: observed predation at a prey density of 25 *B. brassicae*; ×: observed predation at a prey density of 30 *B. brassicae*. Line: linear regression based on predation at 12–20°C.

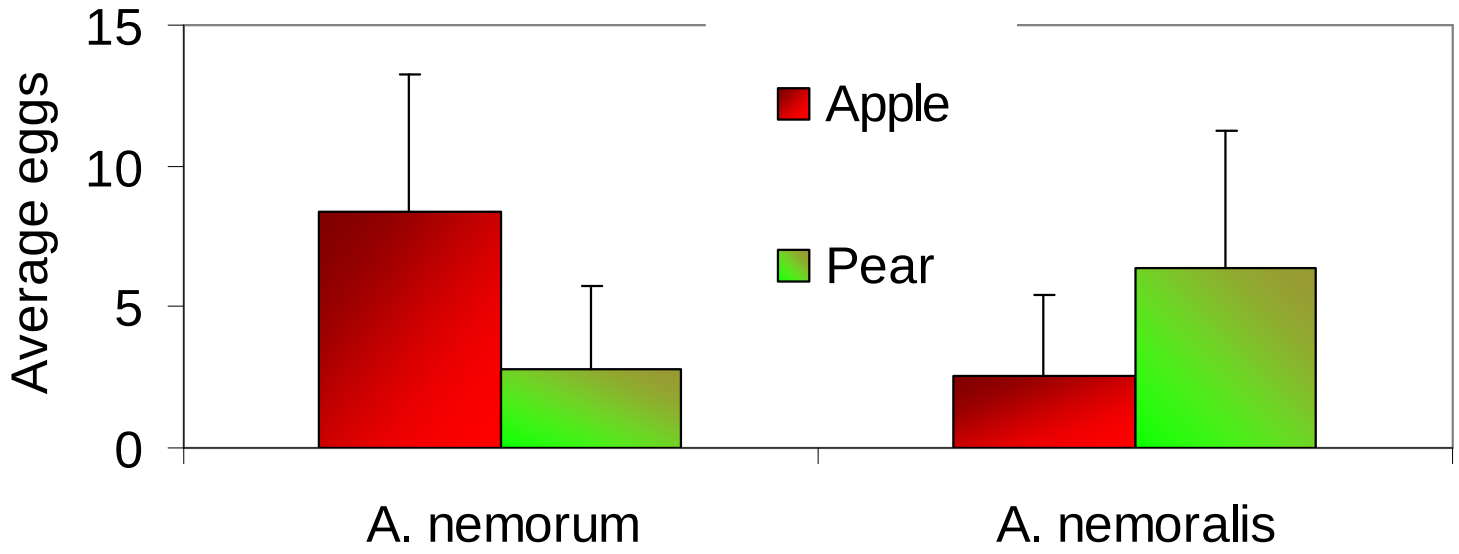
Simonsen et al 2009

Interactions with prey –example two predators –*Anthocoris nemorum* and *A. nemoralis*



Sigsgaard, 2010

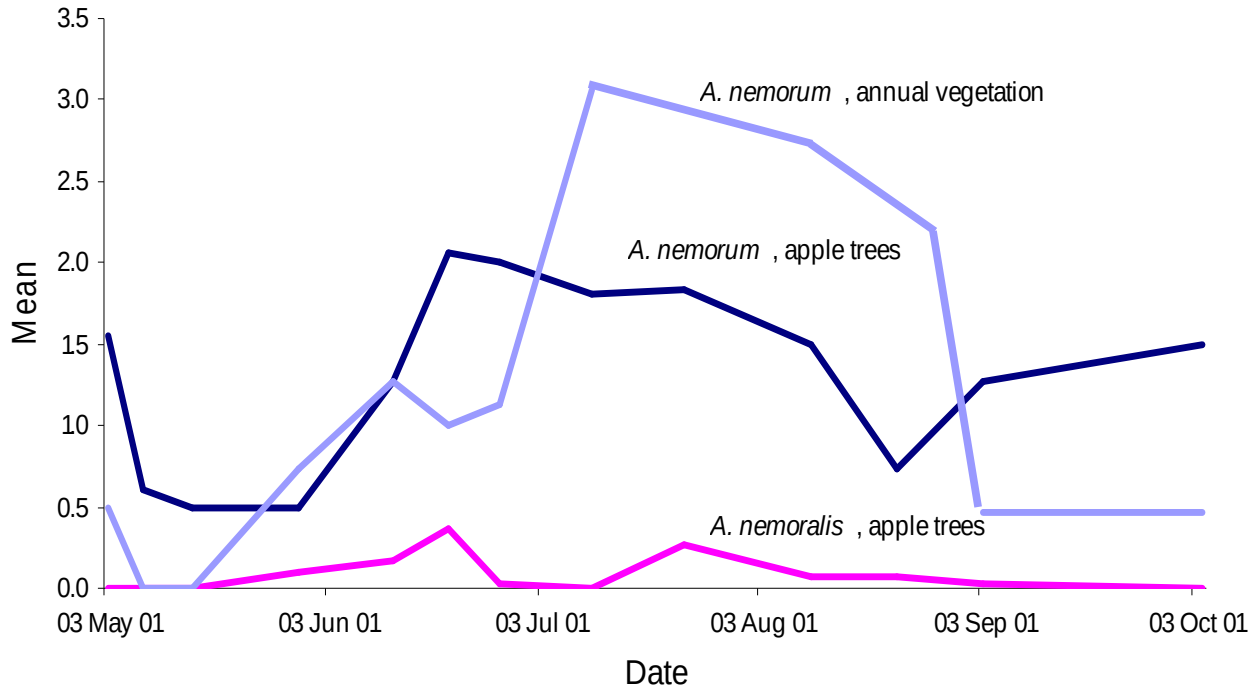
Interactions with plant



Sigsgaard, 2010

Field ecology -

Seasonal distribution of predators - and the role of vegetation in the orchard

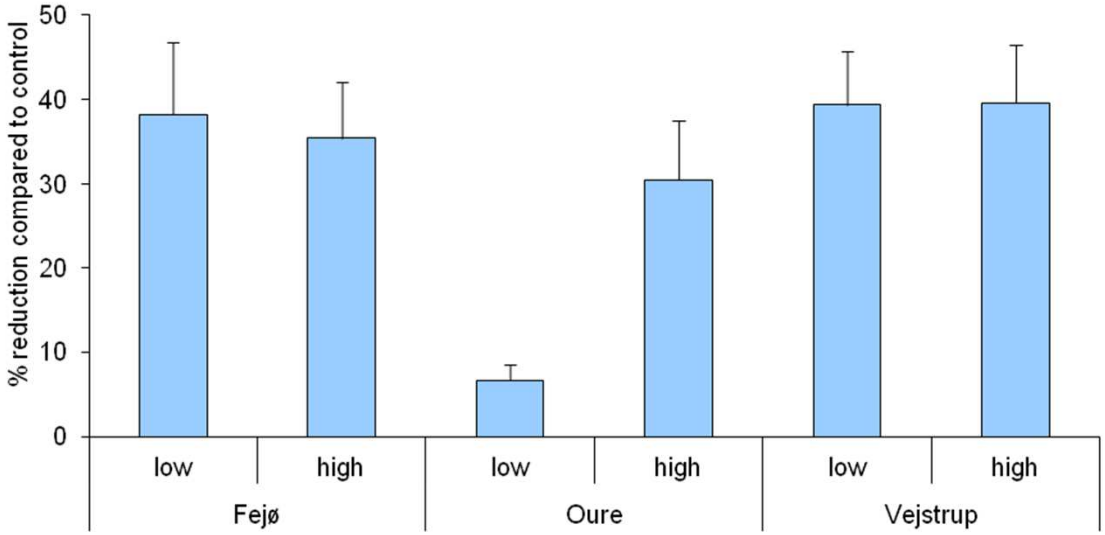


Sigsgaard, 2010

Inundative releases –why?

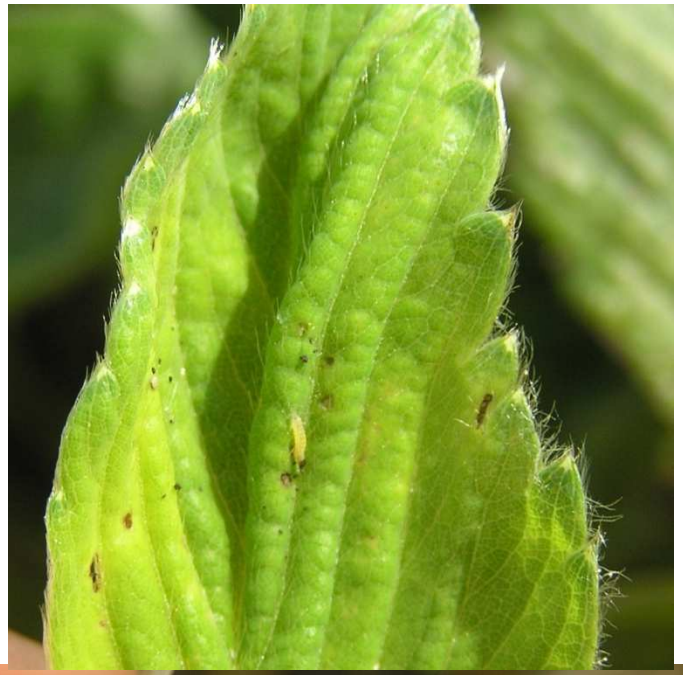
Can supplement conservation biological control
Lack of / failure of insecticides

Demonstrated that mass-release of *A. nemoralis* nymphs consistently could reduce *Cacopsylla pyri* infestation



Sigsgaard et al 2006

Acleris comariana



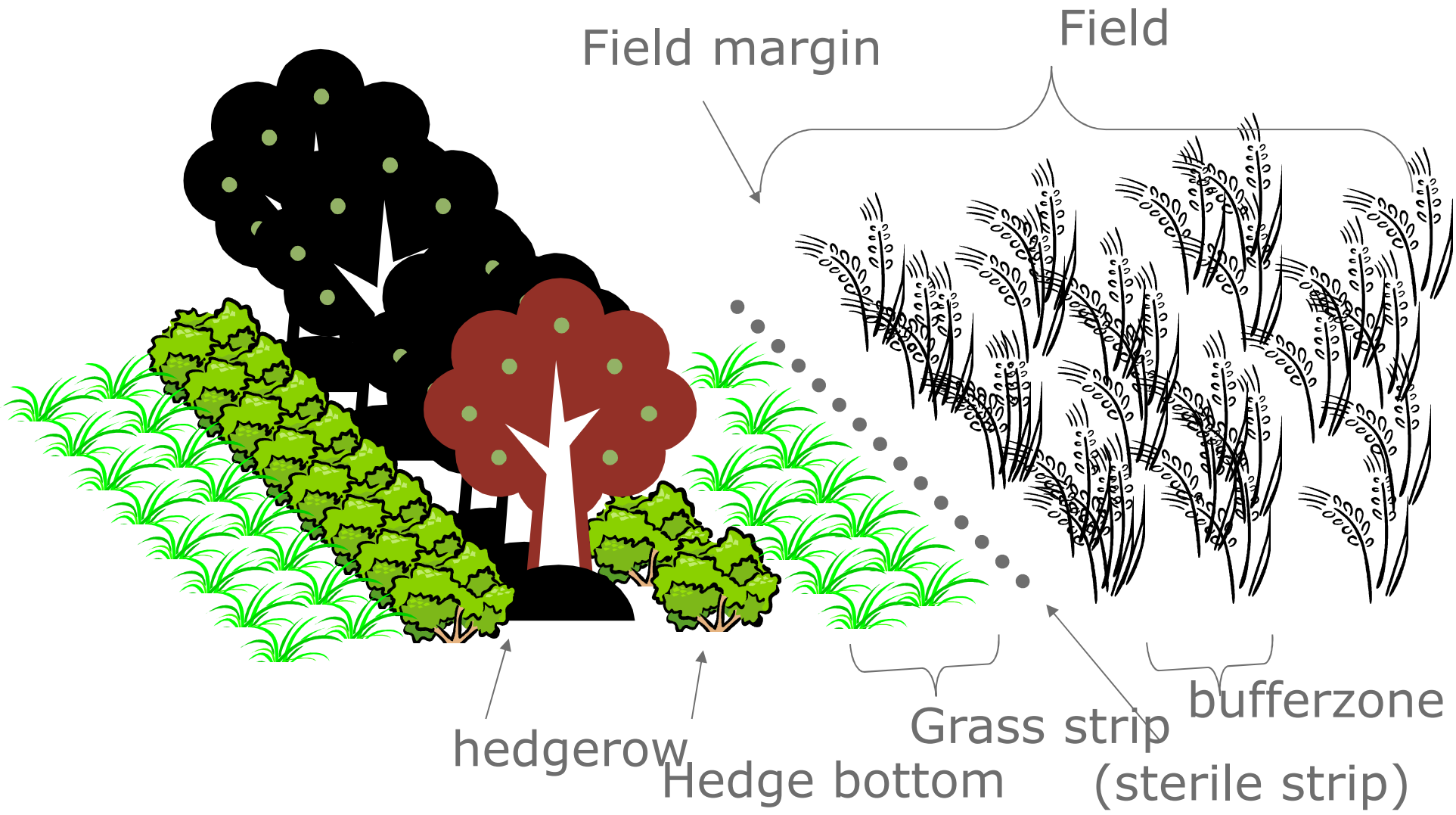
Experiences from strawberry –integrated biological control of key pests

- *Spider mites and strawberry mites*
  - *-predatory mites* — *biocontrol in some use*
- *Strawberry weevil –Anthonomus rubi* — *pyrethroids*
  - *-entomopathogenic fungi,*
  - *-early warning/ mass trapping*
- *Strawberry tortricids –Acleris comariana* — *pyrethroids*
  - *-Bacillus thuringiensis,*
  - *-mechanical control*
  - *-conservation biological control*

- Availability of biocontrol agents can help take-up in small market
- Control in autumn is targeting next year

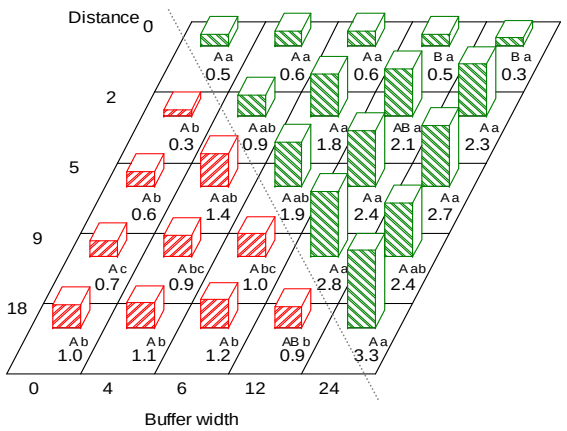
–preventive treament -but not all years give problems

Field and field surroundings

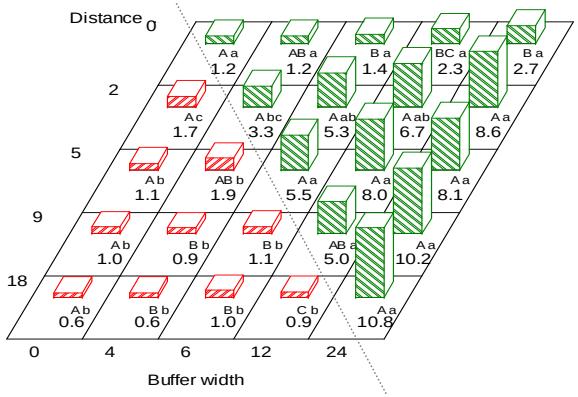


At a landscape scale -increased biodiversity by providing pesticide free buffer zones

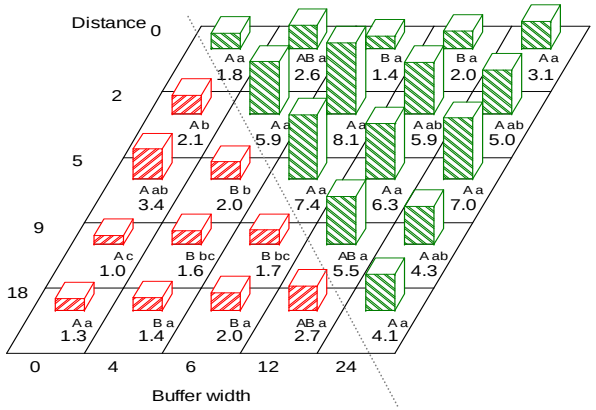
a. Syrphids



b. Spiders



c. Carabids



Navntoft, Sigsgaard, Esbjerg 2012

Landscape effects on wild bees – strawberry pollination

Ahrenfeldt et al., 2012

Ecosystem services

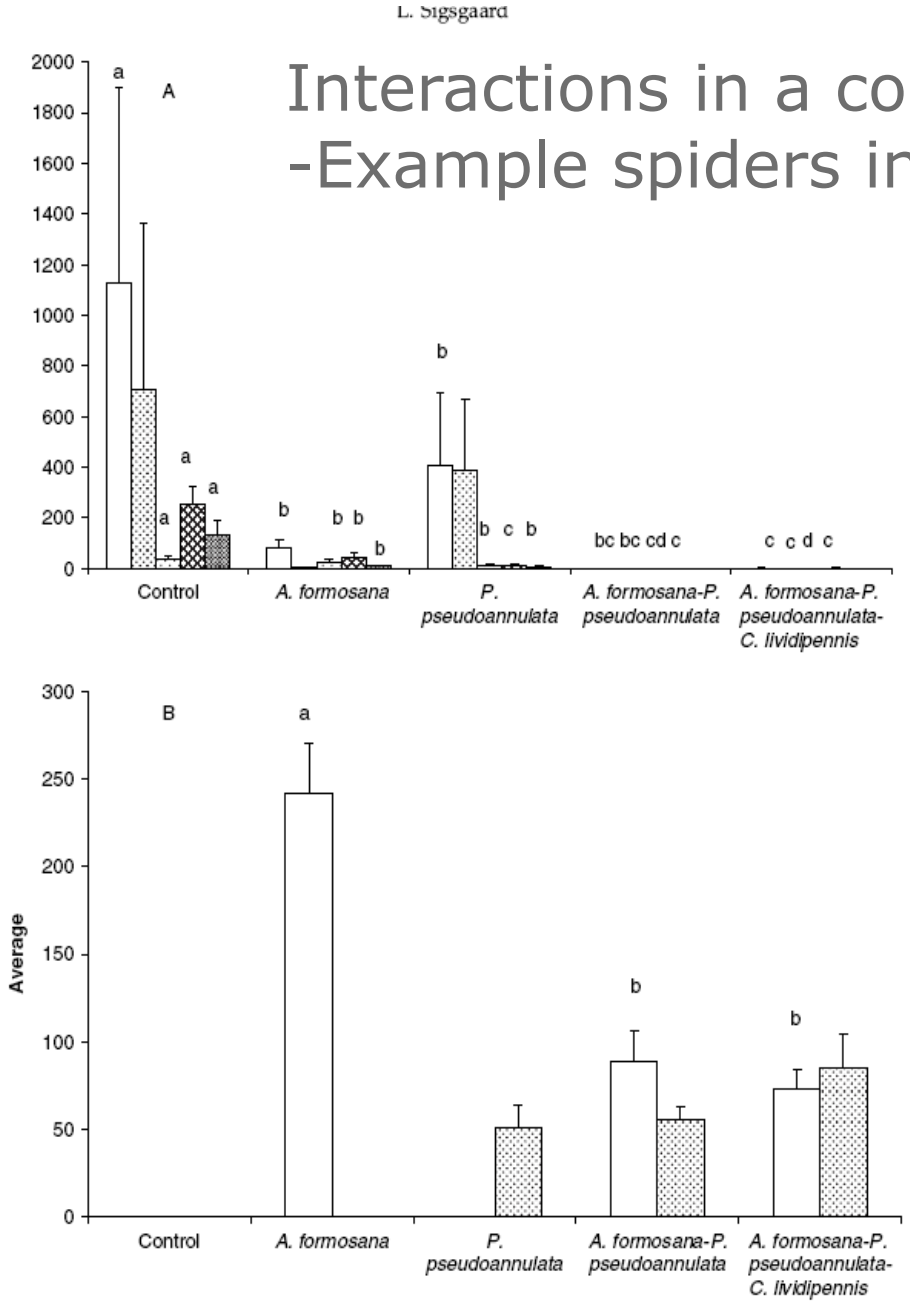
Putting figures on the value of biological control
-and the value of pollination

CFE system –combined food energy system

- Biomass hedges and crops
- Crop rotation
- Organic management
- Energy neutral

Porter et al 2009

Interactions in a complex of predators -Example spiders in rice



ean numbers (±SE) by the conclusion of the experiment with adult spiders of (A) BPH across instars (white) and small, ized and large BPH nymphs and of adult BPH (increasing shades of grey); and (B) *A. formosana* (white) and *P. pseudoannulata*). Letters above columns indicate significant ($P < 0.05$) differences among treatments.

As diversity increases biocontrol also increases

Sigsgaard 2007

Ongoing and new research activities -Systemic approaches to pest management without pesticides

Fruitgrowth 2011-14 – **Novel organic solutions securing future growth -several Danish partners**

Softpest Multitrap 2012-14 -Core Organic II

Mass-trappping of insect pests in strawberry and raspberry

Imbicont 2012-15

Inbiosoil 2012-15 -EU FP7

ProGrOV 2011-15

Fruitgrowth -Ecological infrastructures

- Can functional biodiversity contribute to codling moth control?
  - In orchards with or without flower strips assess level of predation and parasitism on codling moth egg cohorts May-June 2012 and May-June 2013
  - Spatial aspects –effect of flower strip and landscape parametres on pest, predator and parasitoid densities (GIS-analysis)

Fruitgrowth -New mass-release methods of Trichogramma

- Can inundative releases with *Trichogramma* spp reduce codling moth density and crop lossess

Cydia pomonella eggs

Trichogramma female

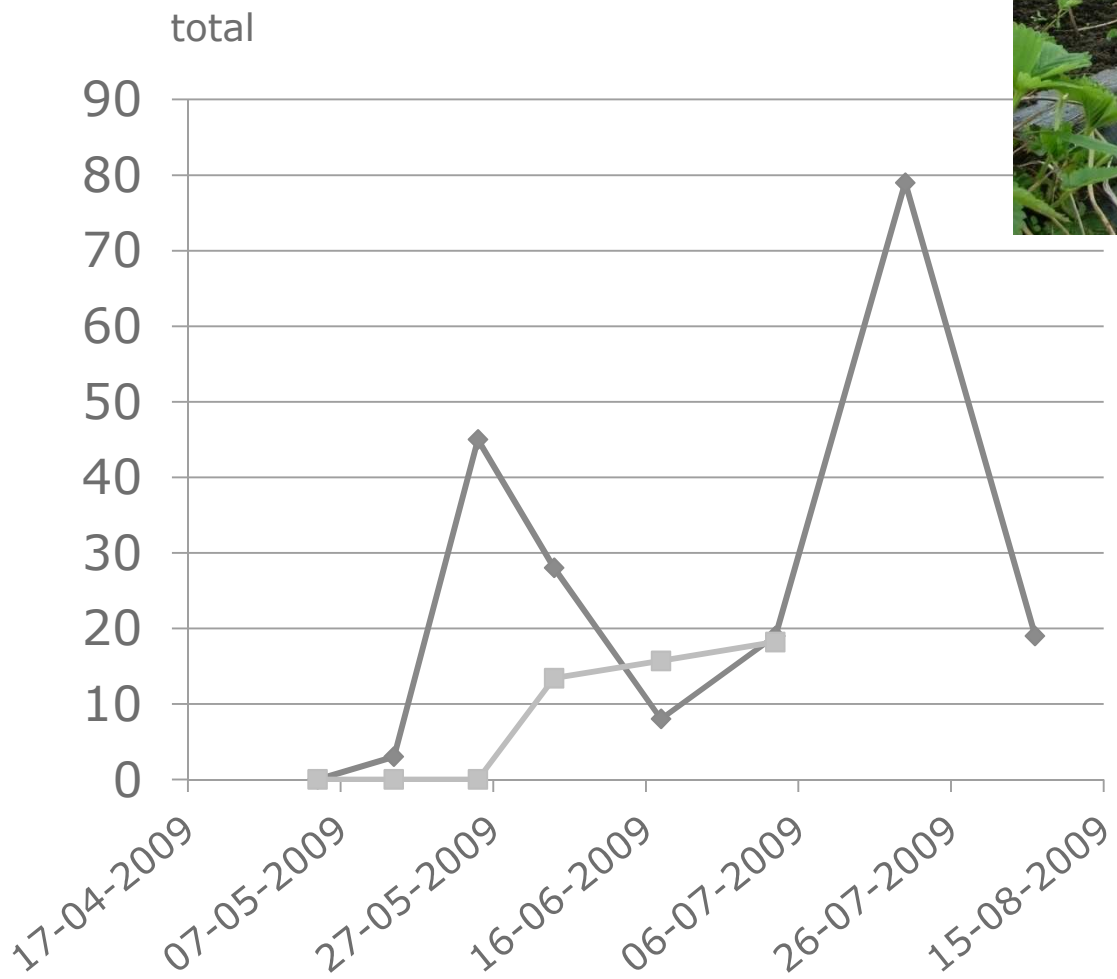
CORE ORGANIC II: Softpest Multitrap 2012-14

Bioforsk Norway, KTH Sweden, KU-LIFE Denmark, EMR + U. Greewich, UK, Agroscope, CH, Latvian Plant Protection Res. C.

Strawberry blossom weevil, SBW (*Anthonomus rubi*)	European tarnished plant bug, ETB (*Lygus rugulipennis*)	Raspberry beetle, RB (*Byturus tomentosus*)
		
		

The pest insects damage to be managed with traps are in *left:* *Anthonomus rubi*, a small weevil severing flower buds in strawberry and raspberry, *middle:* *Lygus rugulipennis*, a mirid bug causing misshapen strawberries, and *right:* *Byturus tomentosus*, a beetle with larvae feeding in raspberries. (Photos: N. Trandem)

A. rubi numbers in 2009



Early warning/
Mass trapping

A. rubi
damage

Weevils are observed over 2 weeks before damage (mid May –Early June)

Experiences with pear psyllid

- Pesticide resistance -growers wish to avoid pesticides

- In small and scattered orchards as the Danish, mass-release of immature *A. nemoralis* yielded consistently good results

- Immature *A. nemoralis* not for sale -a few use release of adults

- Mostly growers rely on naturally occurring beneficials also since damaging years cannot be predicted

Conclusion

Use of biological control has been guided by:

- Lack of pesticides
- Lack of effect of pesticides due to resistance
- Economy
- Societies wishes for better environment and health

To move BC to outdoor crops –what can we do

- Basic knowledge needed
- How to handle complex systems
- Use of multiple beneficials in combinations also with other strategies--
- Contribute to new mindset: no silver bullet