UNIVERSITY OF COPENHAGEN

Project on fruits and berries in Denmark

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IMBICONT kick-off meeting, Piracicaba, Brazil 10-14 August 20

Background

Denmark: 43.000 km^2

67% of the area is cultivated, ca 60% with cereals

Strawberry is the major fresh berry crop with an area of ca. 13000 ha of which ca 63 ha organic (2009)

Apple is the major fruit crop with an area of 1700 ha of which 16% in 2010 organic (highest in Europe)

Other important fruit and berry crops include black currant and sour cherry

New (upcoming) fruits include raspberry

Research fields

ecological aspects of biological control

- natural occurrence,
- predator interaction with prey and plant/ habitat/landscape)

application of biological control agents with a focus on predators.

Integration –synergies / antagonisms between natural enemies

Present research projects

Research in orchards

Fruitgrowth - Novel organic solutions securing future growth - (3 y) 2011-14 (**several Danish partners)**

Research in berries

Softpest Multitrap (3 y) 2012-14 CORE Organic II, EU

Mass-trappping of insect pests in strawberry and raspberry

Biological control of tortricids and aphids in strawberry (3 y) 2009-12, Danish EPA

Inbiosoil (3 y) 2012-15, EU FP7 project

Pest control in organic black currant (2 y) 2011-12

Other

ProGrOV 2011-15 WP -IPM in organic -tomato/ pineapple

Projects continued

PhD student Erica Juel Ahrenfeldt

Strawberry pollinators –effect of cropping practice (organic/ conventional), landscape and geographical region on wild bees



FruitGrowth

Novel organic solutions securing future growth

AARHUS UNIVERSITY

UNIVERSITY OF SOUTHERN DENMARK

DET BIOVIDENSKABELIGE FAKULTET
KØBENHAVNS UNIVERSITET

Supported by
The Organic RDD programme, GUDP

Challenges for Danish organic apple production

The production is small and unstable due to yield and quality loss from key pest and diseases

Lack of suitable cultivars for producers

Lack of suitable weed control strategies

Lack of suitable storage strategies

In market competition with imported organic apples

Aim and objectives of the Fruitgrowth project

- To increase the Danish production of high quality organic apples through delivering:
- New robust cultivars
- Storage solutions to extend seasonality
- Implement novel mechanical/biological technologies and compounds to optimally manage weed, diseases, pests and beneficials during production

FruitGrowth partners

AU, Department of Food Science and Department of Agroecology

KU-LIFE, Department of Agriculture and Ecology

SDU, Department of Chemical Engineering, Biotechnology and Environmental Technology

GartneriRådgivningen

- **Landboforeningen Gefion**
- **ENVO-DAN**
- **Danske Frugtavlere**
- **Ventegodtgaard (organic grower)**
- **Strandegaard (organic grower)**

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

In same WP

Plant extracts to control *Operophtera brumata*

Mechnical control of apple scab

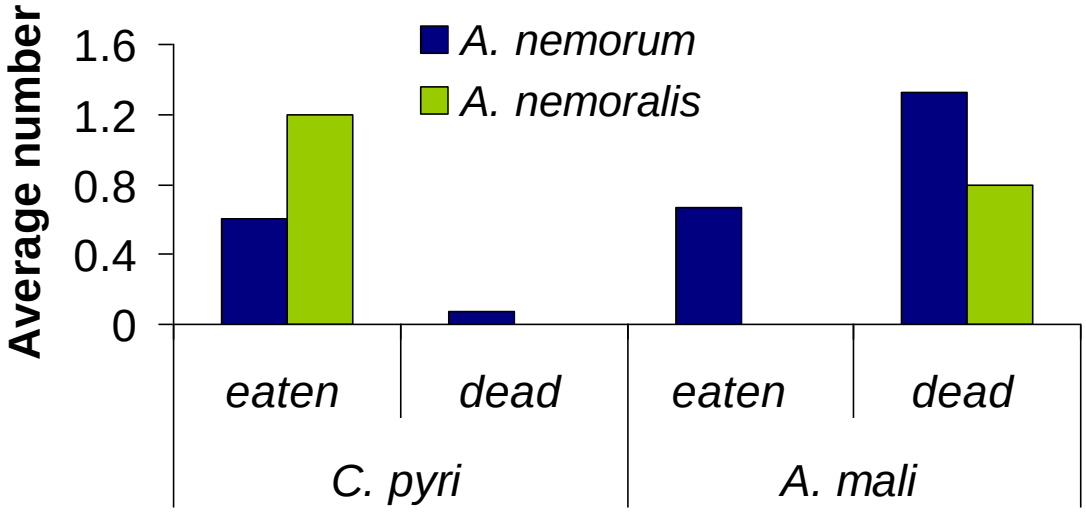
Previous research in pome fruit system

Influence of abiotic factors on Anthocorids
Prey preference and behaviour of Anthocorids
Field ecology of Anthocorids

Mass release of *A. nemoralis* against pear psyllid *Psylla pyri*

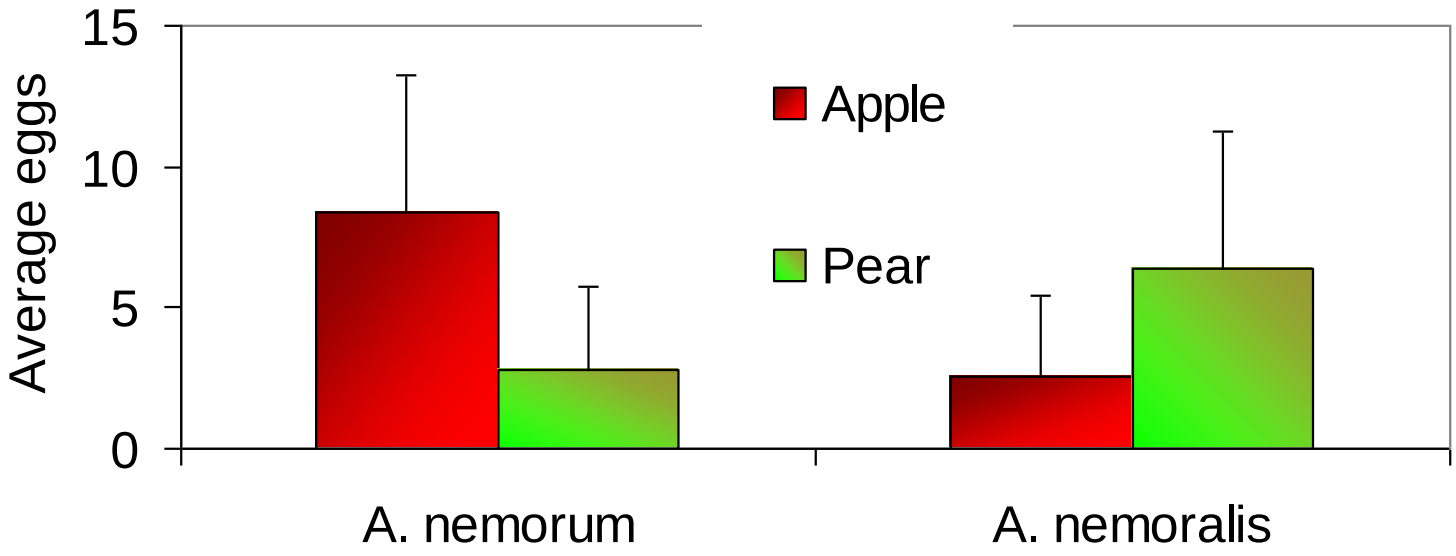
Simonsen et al 2009

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



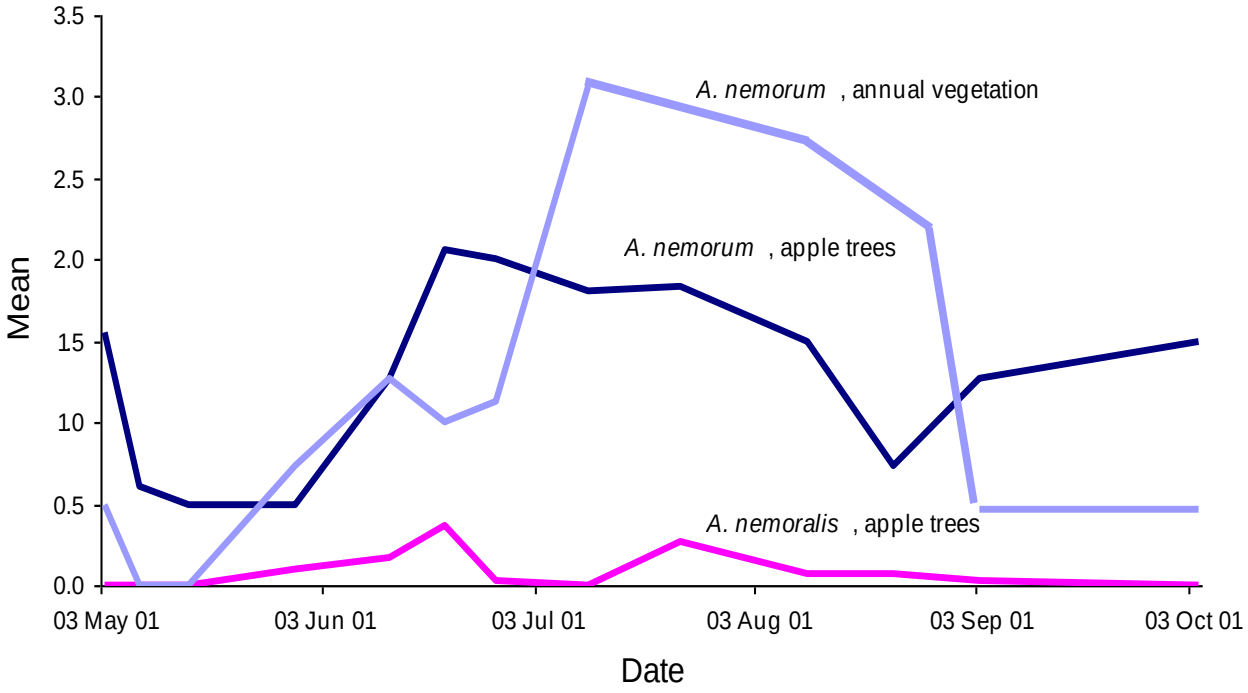
Sigsgaard, 2010

Interactions with plant



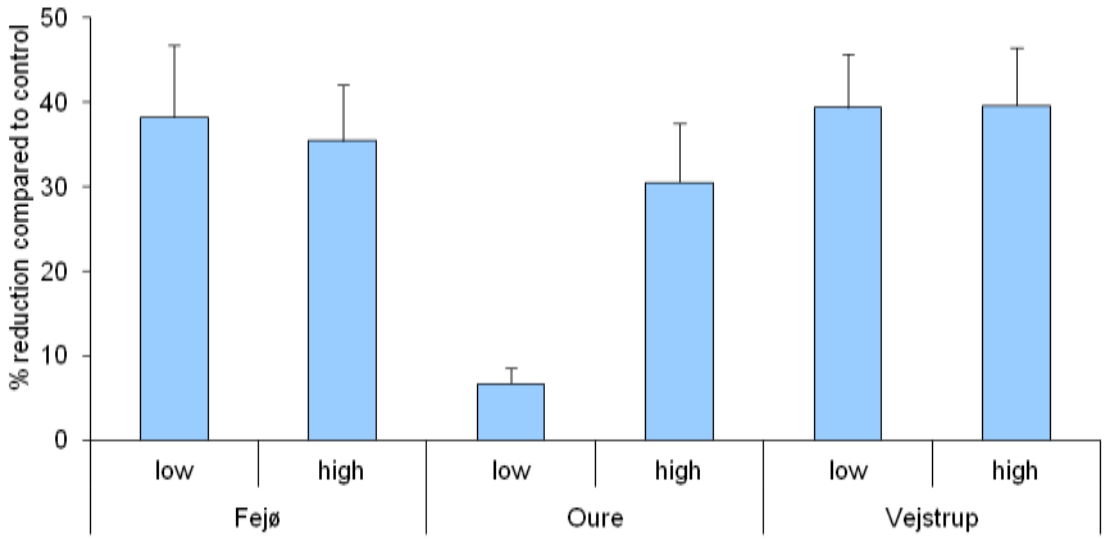
Sigsgaard, 2010

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



Sigsgaard, 2010

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



Sigsgaard et al 2006

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)

The aim: To develop knowledge about how to manage populations of strawberry blossom weevil (*Anthonomus rubi*), European tarnished plant bug (*Lygus rugulipennis*) and the raspberry beetle (*Byturus tomentosus)* in organic strawberry and raspberry so that these two soft fruit crops can be grown without significant economic losses by these pests

Partners:

Bioforsk

KTH VETENSKAP OCH KONST

emr east malling research

FACULTY OF LIFE SCIENCES
UNIVERSITY OF COPENHAGEN

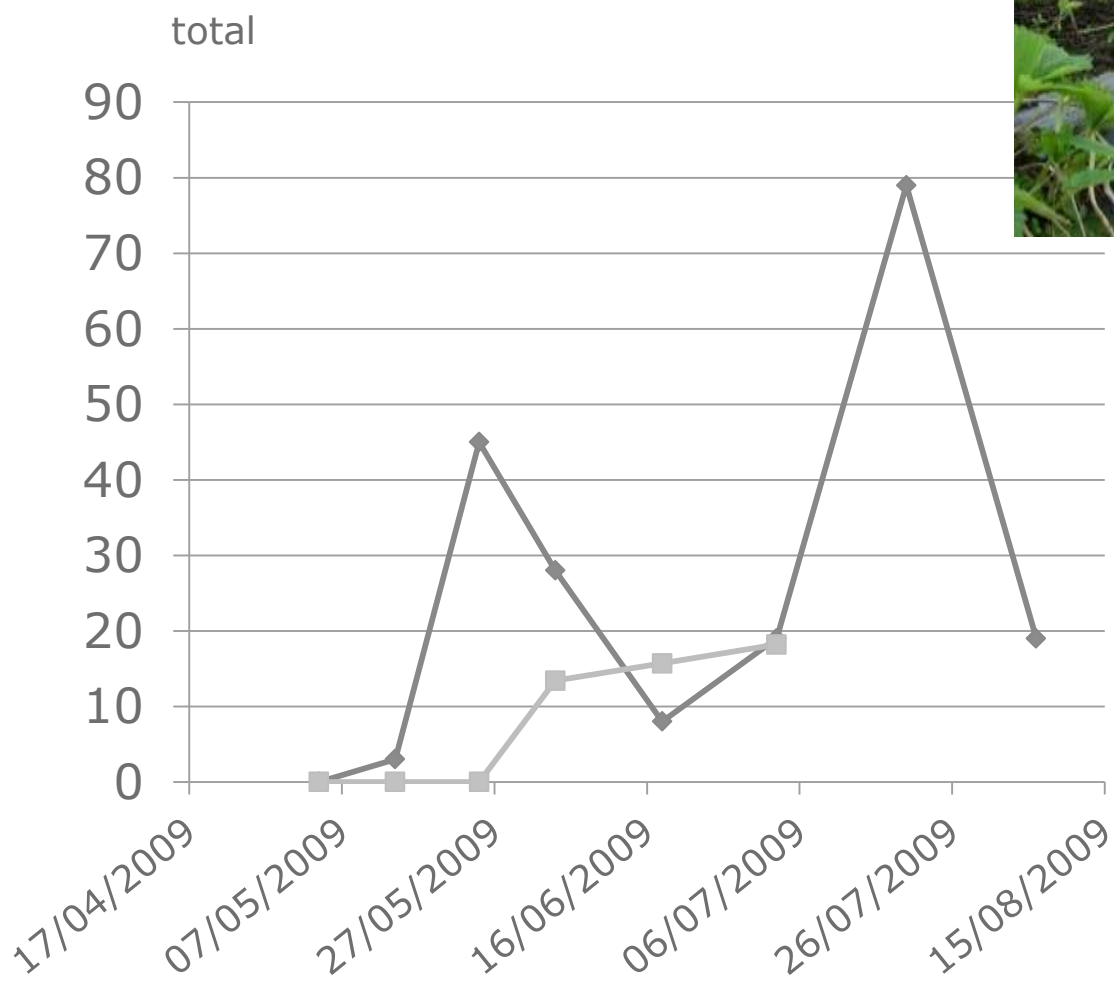
UNIVERSITY of GREENWICH | Natural Resources Institute

Latvian Plant Protection
rch
e Ltd

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Federal Department
of Economic Affairs FDEA
Agroscope Changins-Wädenswil
Research Station ACW

A. rubi numbers in 2009



Early warning/
Mass trapping

A. rubi
damage

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

Biological control of tortricids and aphids in strawberry

Conservation biological control
- Effect of cropping practice on pest and natural enemies (parasitoids and fungi)
 –dietary value of flowers for parasitoid and tortricid + floral strips

Inundative biological control
 -bioassays of predators and parasitoids against *Myzus ascalonicus*

Strategic paper on biological control in strawberry with advisory service

INBIOSOIL -EU FP7

innovative formulations and novel eco-efficient technologies using sustainable, environmentally friendly biological control agents (**BCAs**) to control soil borne crop pests as an alternative to conventional chemical pesticides.

WP3 Assessment of the effects of new biocontrol products on the environment and the food chain

Objectives

1.Verification of the RAFBCA-REBECA metabolite risk assessment decision scheme.

2.Validation of procedures for isolation of metabolites from crops and that metabolites are not entering the food chain.

3.Evaluation and development of novel molecular genetic tools analyzing direct and indirect effects of formulations.

4.**Assessment of direct and indirect non-target effects of formulations on beneficial non-target invertebrates, microbial communities and indigenous BCA populations.**

Landscape effects on wild bees – strawberry pollination

Ahrenfeldt et al., 2012

Biological and other control of key pests in apple

Homoptera: aphids

conservation biocontrol

biocontrol with immature anthocorids of potential

Cf publication list

Insecticides

Lepidoptera: Tortricidae, Geometridae

Codling moth pheromone disruption, virus,

Trichogramma biological control,

conservation biocontrol (flowerstrips)

Insecticides
Pheromone disruption
Virus

Hymenoptera

Operopthera brumata major pest in organic - plant extracts

Insecticides

(Mites not a problem)

Ca 20 annual pesticide treatments.

Insecticides 1-2 treatments.

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

Biological and other control in strawberry

- *Spider mites and strawberry mites (Phytonemus pallidus)*

-predatory mites

(P. persimilus, N. cucumeris, N. andersoni) *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

Biological control in Denmark 2010

	Insecta		
	Anthocoris nemoralis (Hem.)	*Trichogramma spp. (Hym.) #*	
	Macrolophus caliginosus (Hem.)	*Harmonia axyridis (Col.) #*	out
	Orius insidiosus (Hem) #	*Hippadamia canvergens (Col.) #*	
	Orius laevigatus (Hem) #	*Lindarus laphanthae (Col.)*	
	Orius majusculus (Hem) #	*Adalia bipunctata*	
	Podisus maculiventris (Hem.)	**Acari**	
	Franklinothrips vespiformis (Thys.)	*Amblyseiulus barkeri*	
	Chrysoperla carnea (Neu.)	*Amblyseiulus californicus*	
	Aphidoletes aphidimyza (Dipt.)	*Amblyseiulus cucumeris #*	
	Coenosia attenuata / humilis (Dipt.)	*Amblyseiulus degenerans*	
	Feltiella acarisuga (Dipt.)	*Hypoaspis aculeifer / miles #*	
	Episyrphus baltealus (Dipt.)	*Metaseiulus occidentalis*	
	Therodiplosis persicae (Dipt.)	*Phytoseiulus persimilis #*	
	Anagyrus juscivenlris (Hym.)	*Typhlodromus pyri*	
	Aphelinus abdominalis (Hym.)	*Amblyseius andersoni*	
	Aphidius colemani (Hym.) #	**Nematoda**	
2 more	*Aphidius ervi (Hym.) #*	*Heterorhabditis megidis sp. #*	
	Aphytis melinus (Hym.)	*Phasmarhabditis hermaphrodita*	
	Coccophagus lycimnia (Hym.)	*Steinernema carpocapsae #*	
	Dacnusa sibirica (Hym.) #	*Steinernema feltiae #*	
	Diglyphus isaea (Hym.) #	*S. kraussei*	
	Encarsia formosa (Hym.) #	**Bacteria**	
	Encyrtus infelix (Hym.)	*Bacillus thuringiensis* var. israelensis #	
	Eretmocerus spp. (Hym.)	*Bacillus thuringiensis* var kurstaki	
	Leptomastidea abnormis (Hym.)		
	Leptomastix dactylopii (Hym.)	**Fungi**	
	Leptomastix epona (Hym.)	*Isaria fumosorosae*	out
	Lysiphlebus testaceipes (Hym.)	*Lecanicilium lecanii #*	
	Metaphycus helvolus (Hym.)	*Beauveria bassiana*	
	Microterys flavus (Hym.)	**Viruses**	
	Opius pallipes (Hym.)	Agrotis segetum granulovirus	
	Thripobius semiluteus (Hym.)		

Outdoor

Nursery

#=most used

New outdoor

List from Eilenberg et al. 2000

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

Thankyou

Foto Rasmus Nimgaard