



UNIVERSITY OF COPENHAGEN



# Present practice, on-going research and future potential for non-chemical pest management in fruit and berry production in Denmark

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Chinese-Danish networking on Systemic approaches to pest management  
L. Sigsgaard, Slide 1



## Background

Denmark: 43.000 km<sup>2</sup>

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

Strawberry is the major fresh berry crop with an area of ca. 1300 ha of which ca 63 ha organic (2009)

Apple is the major fresh 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 (1900 ha, 32 ha organic)  
sour cherry (1400 ha, ca 10 ha organic)  
Pear ca 400 ha

Red currant

Raspberry (30 ha, 2 ha organic)

blueberry



## Strawberry cultivation

- 6 -15 tons/ha. Tunnels 15-22 tons/ha.
- Cultivated as a 2-3 y crop
- Crop rotation
- Main harvest 20. June - 20. July
  - Can be ca. 2 weeks earlier w. fibre/plastic covering
  - Tunnels can prolong the cultivation period



## Pests in strawberry –present practice

- *Spider mites and strawberry mites*                      *predatory mites / lower N level?*
- *Strawberry weevil –Anthonomus rubi*                      *na (variety) - pyrethrum*
  
- *Strawberry tortricids –Acleris comariana*                      *B. thuringiensis - pyrethrum*
  
- Mirids –*Lygus rugulipennis*                      *na*
- Black vine weevil *Otiorhynchus* sp.                      Nematodes (but expensive)  
Entomopathenic nematodes (use?)

Pests found more in protected production /

Whiteflies

biocontrol agents available

Thrips

Mites

Aphids



## Apple and pear

### Pests

*Aphids*

*Cydia pomonella*

Other Tortricids

Geometrids

Noctuids

Fruit tree rsm *Panonychus ulmi*

*In Pear*

Pear psyllid

### Practice

*na*

*Pheromone disruption*

*Virus*

pheromone disruption (*Adox. orana*, *P. heparana*)

(*B. thuringiensis*)

( )

*conserve pred mite*

*conserve +A. nemoralis*



## Response to abiotic factors

Effect of temperature / climate change on insects -pest and beneficials

Temperature effect on predators and parasitoids and EPF

*Effect of winter conditions on pests & beneficials incl. codling moth -  
PhD project /Vucasinovic et al*

Sigsgaard 2001, Simonsen et al 2009, 2010, Esbjerg & sigsgaard, subm.,



## Response to biotic factors

Insect plant interactions

Prey preference and behaviour of natural enemies

Field ecology of natural enemies

Interactions between natural enemies and effect on herbivore

Mass release of *predators/ parasitoids/ microbial control*



Sigsgaard et al 2006, Sigsgaard 2010



## Fruitgrowth - Novel organic solutions securing future growth.

UCPH, AU, SDU, Adv. Services, growers, industry

WP on pests and disease management

- Ecological infrastructures -codling moth control
- Inundative releases of *Trichogramma* spp to reduce codling moth
- Plant extracts to control apple sawfly (Klaus Paaske)
- Control of apple scab (Maren Korsgaard)



-24 August 2012





## *Biological control of tortricids and aphids in strawberry* UCPH, AU, Adv. service

### Cropping practice

- Effect of cropping practice on pest and natural enemies (parasitoids and fungi)

Sigsgaard et al *submitted*

### Conservation biological control -floral strips

*Sigsgaard et al. revision*

### Inundative biological control

- bioassays of predators and parasitoids against *Myzus ascalonicus*

*Enkegaard et al revision*

### Strategic paper on BC in strawberry w. advisory service





EU FP7 project 2012-15

New formulations and technologies using microbiological control agents to control soil borne crop pests

Example in strawberry : Vine weevil

UCPH: Effect on environment, interaction/ side-effects with other BCA



# **IMBICONT**

Improved biological control  
for IPM in fruits and berries

Collaboration UCPH, Denmark- ESALQ-USP University, Brazil  
2012-15

Focus crops : Strawberry, Apple, Citrus







The ecology of entomopathogenic fungi and predators and their  
role and use in

- conservation biological control
- inundation biological control
- inoculation biological control



## CORE ORGANIC II: Softpest Multitrap 2012-14

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

| Strawberry blossom weevil, SBW<br>( <i>Anthonomus rubi</i> )  | European tarnished plant bug,<br>ETB ( <i>Lygus rugulipennis</i> )                  | Raspberry beetle, RB<br>( <i>Byturus tomentosus</i> )                                |
|---|---|--|
|    |   |   |
|   |  |  |
| <p>The pest insects damage to be managed with traps are in <u>left</u>: <i>Anthonomus rubi</i>, a small weevil severing flower buds in strawberry and raspberry, <u>middle</u>: <i>Lygus rugulipennis</i>, a mirid bug causing misshapen strawberries, and <u>right</u>: <i>Byturus tomentosus</i>, a beetle with larvae feeding in raspberries. (Photos: N. Trandem)</p> |   |  |

## Ecosystem services - landscape ecology

Biological control and pollination

Landscape effects on wild bees – strawberry pollination



Ahrenfeldt et al., 2012

Porter et al 2009



## Pests in strawberry, -Ongoing research summary

- *Spider mites and strawberry mites*
  - -predatory mites -
  - *EPF diversity and bioassay + trophic interactions*

### *Strawberry weevil –Anthonomus rubi*

- -entomopathogenic fungi,
- -early warning/ mass trapping

### • *Strawberry tortricids –Acleris comariana*

- -*Bacillus thuringiensis*,
- -mechanical control
- -conservation biological control

### • *Aphids*

*mass-release of beneficial insects*

*EPF diversity and bioassay + trophic interactions + conservation BC*

### • *Mirids –Lygus rugulipennis*

- *Mass-trapping*

### • *Black vine weevil Otiorhynchus sp.*

- *Entomopathogenic fungi*

### • *Ecosystem services / landscape/ pollination*



## Pests in apple –ongoing research summary

### Aphids

conservation biocontrol -biocontrol with immature anthocorids of potential  
Ecology and bioassay EPF, predators, parasitoids

### Lepidoptera: *Codling moth*

*Trichogramma* biological control,  
conservation biocontrol (flowerstrips, hedgerows)  
Ecology, biocontrol predators

### Hymenoptera

*Operopthera brumata* a major pest in organic - plant extracts

Mites : Ecology and bioassay EPF

Conservation BC, ecology of pests and natural enemies

Ecosystem service/ landscape



## Ongoing research other fruit and berry crops

### Black currant

use of microbiological control/ oil/ soap/ pyrethrum/  
mechanical control against lepidopteran pests  
winter moth, tortricids, *Lampronia capitella*

### Raspberry

mass trapping





## Future potential

- Ecology / cropping system
- Basic ecological knowledge of organisms
- interactions between crops/ field/ landscape and herbivores and their natural enemies for bioprospecting and for design of cropping systems
- Scales from organism → field → landscape
- *we see that pest problems can be less in organic (tortricid) – knowing mechanisms behind can be a tool for improvement*

- Prevention
- Variety / intercropping
- Conservation biological control –flower strip
- Distance between crops in time and space –crop rotation (strawberry)
- Other (ex. Sanitation)

- Biological control

identification of potential biocontrol agents

Further development of rearing, application and use of BCA

Use of multiple beneficials in combinations



## Future potential continued

- How to handle complex systems
- How to use beneficials together with other strategies
  
- Other control
  - Mechanical control
  - plant extracts
  - mass trapping
  
- In cool climates not all years give problems (challenge). Mostly growers rely on naturally occurring beneficials
  
- BC control in autumn targeting next year as a preventive treatment - further assessment required -could be promising

Control strategies need to be adopted to degree of cropping intensity  
open field ---- temporary protection (tunnel) -- permanent protection  
(tunnel) ---glasshouse

