IMPACTS OF THE CHERRY-MARKET TRENDS ON ON-FARM BEHAVIOUR AND IPM OF R. cerasi

From Pest Ethology, through Modelling, to Pest Management

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The **PESTonFARM** model

What it does:

Emulates behaviour of large cohorts of individual insects within seasonally changing mosaics of farming landscape, under the challenge of IPM actions

How it works?

- It simulates **only** daily behaviours of individual insects
- Locally fluctuating patterns of pest densities, crop infestations, IPM effects are NOT programmed (determined)
- Alike in nature - they ‘emerge’ as a consequence of the independent actions undertaken by individual ‘virtual insects’
The purpose

• The model was developed as a tool for:
  – Research – ‘virtual eco-lab’ to evaluate hypotheses
  – Tool for site-specific ‘precision IPM’
  – Training

• It emulates a ‘virtual IPM experiment’ - pest development, crop infestation and IPM effects, both biological and economic.

• Like a replicate of a real on-farm experiment, upon each run, the model generates stochastically equivalent, but unique set of results, presented in a format usually collected during ‘real’ on-farm experiments.
Reflects the key spatiotemporal features of the terrain ...
Landscape example: JKI experimental farm, Dosenheim, GE

Satellite picture of the farm, with selected area of interest

Simplified farm diagrams (created by the program)
Reflects the key features of pest biology ...
Main ecological factors

Age-dependant **SURVIVAL**

Age-dependant **FECUNDITY**

Age-dependant **MIGRATION** propensity

Spring **EMERGENCE** patterns
‘Multi-pattern’ spatial features determining behaviour of each individual insect, examples of: farm features ‘insect created’ features IPM

Time - Season days
- Host phenology (attractiveness, fruits)
- Insect age (fecundity, mortality, mobility)
- IPM effectiveness
- Natural enemies
Trends in cherry production ...

**Producer driven:**

- Plant phenology - varieties covering extended season (staggered fruit maturation)
- Reduction of tree canopy size and structure

**Consumer driven:**

- Increase in fruit size
- Enhancement of fruit colouration
Plant phenology

what to consider ....
Seasonal profile of host attractiveness - Host Phenology

Pest emergence, *ca.* 40-45 days after flowering

Cherry pictures from: Heidrun Vogt

Fruit susceptibility window

- Fruit harvest
Seasonal profile of host attractiveness & ’fruit suitability windows’

- Fruit harvest

Total No of insects / ZONE

season [days]

HOST 1
HOST 2
HOST 4
OW-1
OW-2
Oviposition window 4
Simulated fecundity potential
(assuming unlimited fruit availability)

Factors:
- Intrinsic fecundity
- Intrinsic mortality
- Staggered emergence
- Natural enemies

Fruit infestation - 97.5%

Fruit infestation – 49.8%
Narrowing the fruit susceptibility window for a late variety

Host Phenology & 'Oviposition Windows' - OW

Total No of insects / ZONE

Host 1

Host 2
Effects on pest distribution and fruit infestation

<table>
<thead>
<tr>
<th>Host 1 (long window)</th>
<th>Host 2 (short window)</th>
<th>Host 1 (long window)</th>
<th>Host 2 (short window)</th>
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Infest. = 13.0%  
Infest. = 7.7%

Differences in egg laying patterns

- Host 1
- Host 2
Conclusion:

*If possible, shorten the fruit susceptibility window, especially for late varieties*
Canopy structure

what to consider ....
The pest evolved in such landscape ....
Trends in orchard structure - traditional
Trends in orchard structure - current
Trends in orchard structure – future?
Effects of difference in canopy size (NO IPM)

canopy diam. in field A = 1m,  field B = 6m, same late variety [8 HW], same fruit availability

Yr. 1
- Total = 8,000
  - Field A = 50%
  - Infestation: 8.7% vs. 14.2%

Yr. 2
- Total = 8,015
  - Field A = 37.5%

Yr. 3
- Total = 7,914
  - Field A = 32.1%
  - Infestation: 7.2% vs. 15.4%

Yr. 4
- Total = 7,567
  - Field A = 27.2%
  - Infestation: 5.8% vs. 15.8%

Yr. 5
- Total = 7,712
  - Field A = 23.4%
  - Infestation: 5.2% vs. 16.9%

Yr. 6
- Total = 7,242
  - Field A = 19.9%
  - Infestation: 4.1% vs. 16.6%
Timing of pesticide appl. according to age structure of field population

Host Phenology & 'Oviposition Windows' - OW

Age Structure - total numbers

Age Structure - %
Thank you for your attention