Building an Integrated Codling Moth Program

Jay Brunner
Mike Doerr
Keith Granger

Tree Fruit Research and Extension Center
Wenatchee, WA
Integrated Management Approach

CM Control

- Mating Disrupt
- Larvicides
- Ovicides
- Cultural

Monitoring | Models | Biology
Biology

• Increase knowledge of key pest

• Life cycle
  ▪ Overwintering stage
  ▪ Damaging stage
  ▪ When susceptible to insecticides or biological control
  ▪ Number of generations

• Cause of outbreaks
  ▪ Hot, dry summers
  ▪ Borders, top of slopes, hotspots
Degree-Day Model

- Predict events difficult to see
  - Egg hatch
- Predict size of third generation
- Important for timing insecticides
Monitoring

• Understand model predictions
• Consistent trapping program
  ▪ Measure relative densities
  ▪ Monitor adult movement
• Visual inspections
  ▪ Locate hot-spots
  ▪ Assess need for retreatment
Potential Problem With Models

**Trap Catch**

**DD from biofix**

- **Basin**
- **Prediction**
Potential Problem With Models

Trap Catch

DD from biofix

Basin
Prediction
Potential Problem With Models

Codling Moth Damage Evaluations

Insecticide Applications

250DD  +21 d  1250DD


Total % CM damage
History Will Repeat Itself

Do you have a plan?

2nd Generation Flight

Degree-Days

CM/Trap

Prediction
2002
2001
Cultural Practices

Very few reports of control failures

“Guthion doesn’t work as well as it used to!”
Sprayer Calibration

How important is coverage?

![Graph showing % mortality versus days after treatment for different sprays: Guthion Dilute (dashed black line), Assail Dilute (dashed magenta line), Guthion Concentrate (solid black line), and Assail Concentrate (solid magenta line). The graph illustrates the residual control of insects over time.](image-url)

Days After Treatment

% Mortality

Residual control
Standard Insecticide-based Program

- Egg hatch
- Bloom
- DD from biofix

Guthion
- May
- June
- July

Imidan
- Aug.
- Sept.
Standard Insecticide-based Program

- **Egg hatch**

- **Neonicotinyl**

- **Guthion**

- **Imidan**

**DD from biofix:**
- May: 0-100
- June: 300-500
- July: 1100-1300
- August: 1900-2100
- September: 2300

**Bloom**
- May
- June
- July
- August
- September
Neonicotinyls

- Assail/Calypso - viable alternatives
- Clutch - shows little promise at this time
Standard Insecticide-based Program

- Guthion
- Neonic.
- Guthion
- Imidan

Egg hatch

DD from biofix

May, June, July, Aug., Sept.
CM Damage Increasing

What is the next step?

DD from biofix

- Egg hatch
- Guthion
- Neonic.
- Asana?
- Guthion?
- Imidan
- Neonic.?
CM Damage Increasing

Mating Disruption as the foundation

Egg hatch

Guthion

Neonic.

Guthion

Imidan

May  June  July  Aug.  Sept.

DD from biofix
Mating Disruption
CAMP and AWII Success Stories

- Avg. moth capture per trap per year
- Avg. percent traps capturing moths
- Avg. percent codling moth damage
- Avg. codling moth insecticides appl./acre

Howard Flat, WA
Hand Applied Pheromone

*Release rate and longevity*

mg codlemone remaining in dispenser

![Graph showing the release rate and longevity of different pheromone types](image)

- **CheckMate**: Green line
- **Isomate CTT**: Blue dashed line
- **Isomate C+**: Red line
- **NoMate**: Orange line

*Age in days: 0, 28, 56, 84, 112, 140*
NoMate Fibers and Disrupt Flakes

Point Sources

Hand Applied < Fibers < Sprayable

Release Rate

Hand Applied > Fibers > Sprayable
NoMate Fibers and Disrupt Flakes
Attractiveness and Longevity

![Graph showing attractiveness and longevity of NoMate Fibers and Disrupt Flakes over 60 days. The x-axis represents days after trap placement, ranging from 12 to 60. The y-axis represents proportion relative to L2 septa. The graph includes lines for Female, Fiber, and Flake, with the Female line showing a steep decline in attractiveness followed by a recovery, while the Fiber and Flake lines show a more gradual decline.]
CM Damage Increasing
*Mating Disruption as the Foundation*

**Bloom**

**Mating Disruption**

- Guthion
- Neonic.
- Guthion
- Imidan

**DD from biofix**

- May
- June
- July
- Aug.
- Sept.

**Egg hatch**
MD and Moderate Pressure
Need for Ovicidal Supplements

Mating Disruption

Bloom

IGR Guthion Neonic. Guthion Imidan

May June July Aug. Sept.

DD from biofix:

Egg hatch
Ovicidal IGRs

CM Management with Ovicides Only

% Reduction From Control (Range)

Intrepid

Esteem

Rimon
Ovicidal IGRs

Opportunity for LR Control

% Reduction From Control (Range)

Intrepid

Esteem

Control at 2nd generation

Rimon
MD and Moderate Pressure

Need for Ovicidal Supplements

Bloom

Mating Disruption

IGR  Guthion  Neonic.  Guthion  Imidan

May  June  July  Aug.  Sept.

0 100 300 500 700 900 1100 1300 1500 1700 1900 2100 2300

DD from biofix

Egg hatch
MD and High Pressure
Need for Ovicidal Supplements

Mating Disruption

DD from biofix

Egg hatch

Bloom

May June July Aug. Sept.

Guthion
IGR +IGR
Neonic.
Guthion
Imidan

0 100 300 500 700 900 1100 1300 1500 1700 1900 2100 2300
MD and Highest Pressure
Need for Ovicidal Supplements

Bloom

Mating Disruption

DD from biofix

- Egg hatch

- Guthion
- Guthion + IGR
- Neonic.
- Guthion + iGR
- Imidan

May June July Aug. Sept.
Stabilizing CM Management  
*Lower Pressure/Reducing Inputs*

![Diagram showing the timeline of Mating Disruption and chemical applications.]

- Bloom
- Mating Disruption
- DD from biofix

Chemical Applications:
- Guthion
- IGR
- Neonic
- Guthion + IGR
- Imidan

Timeline:
- May
- June
- July
- Aug.
- Sept.

Egg hatch graph indicating peak activity periods.
Stabilizing CM Management
Lower Pressure/Reducing Inputs

Mating Disruption

Bloom

Egg hatch

May June July Aug. Sept.

Guthion

IGR

Guthion

IGR

Imidan

DD from biofix
Stabilizing CM Management

Lower Pressure/Reducing Inputs

- Bloom
- Mating Disruption
- IGR Guthion
- Neonic.
- Guthion

DD from biofix

May June July Aug. Sept.
Stabilizing CM Management

Lower Pressure/Reducing Inputs

Mating Disruption

IGR: Guthion, Neonic.

Egg hatch

DD from biofix
Stabilizing CM Management

**AWI Program with no OPs**

**Mating Disruption (Reduced Rates)**

- **Egg hatch**
- **Bloom**
- **Neonic. or IGR**
- **Neonic. or IGR**

DD from biofix:

- May
- June
- July
- Aug.
- Sept.
## Cost of CM and LR Control?

<table>
<thead>
<tr>
<th>Program</th>
<th>CM</th>
<th>LR</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000 Avg</td>
<td>$75</td>
<td>$53</td>
<td>$127</td>
</tr>
<tr>
<td>Most Intensive</td>
<td>$363</td>
<td>$0</td>
<td>$363</td>
</tr>
<tr>
<td>AWII Conv</td>
<td>$107</td>
<td>$44</td>
<td>$151</td>
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<tr>
<td>AWII Soft</td>
<td>$145</td>
<td>$0</td>
<td>$145</td>
</tr>
</tbody>
</table>
Organic CM Management

High Pressure Clean-up

Mating Disruption (400 d/a)

Oil

DD from biofix

Bloom

May June July Aug. Sept.
Organic CM Management
High Pressure Clean-up

Mating Disruption (400 d/a)

Entrust + oil

Entrust + oil

Entrust + oil

Entrust + oil

Oil

Oil

Oil

DD from biofix

May

June

July

Aug.

Sept.
Organic CM Management

High Pressure Clean-up

Mating Disruption (400 d/a)

- Entrust + oil
- Virus
- Oil

DD from biofix

May June July Aug. Sept.
Organic CM Management

High Pressure Clean-up

Mating Disruption (400 d/a)

Oil

Entrust + oil

virus

Entrust + oil

Entrust + oil

Entrust + oil

Entrust + oil

Bloom

DD from biofix

0 100 500 700 900 1100 1300 1500 1700 1900 2100 2300

$450
Organic CM Management

Maintenance program

Mating Disruption (300 d/a)

DD from biofix

Oil

Bloom

May June July Aug. Sept.
Organic CM Management

Maintenance program

Bloom

Mating Disruption (300 d/a)

Entrust + oil

Oil

Oil

Oil

Oil

DD from biofix

May

June

July

Aug.

Sept.

0 100 300 500 700 900 1100 1300 1500 1700 1900 2100 2300
Organic CM Management
Maintenance program

Mating Disruption (300 d/a)

- Virus
- Entrust + oil
- Oil

May June July Aug. Sept.

DD from biofix

0 100 300 500 700 900 1100 1300 1500 1700 1900 2100 2300
Organic CM Management

Maintenance program

$300

Bloom

Mating Disruption (300 d/a)

Oil

Entrust + oil

Virus

Maintenance program

DD from biofix
Organic CM Management

*How low can you go??*

**Mating Disruption (300 d/a)**

- **Entrust + oil**
- **virus**

**DD from biofix**

- **May**
- **June**
- **July**
- **Aug.**
- **Sept.**
Organic CM Management

How low can you go???

Mating Disruption (300 d/a)

DD from biofix

Bloom

virus

virus

virus

virus

Entrust + oil

Oil

Oil

Oil

Oil

May

June

July

Aug.

Sept.
Organic CM Management
*How low can you go??*

Bloom

Mating Disruption (300 d/a)

- Virus
- Entrust + oil
- Oil

May June July Aug. Sept.

DD from biofix
Organic CM Management

How low can you go???

Mating Disruption (300 d/a)

DD from biofix

Bloom

May June July Aug. Sept.

virus virus virus virus

Entrust + oil Entrust + oil

Oil Oil Oil Oil

Oil Oil Oil Oil
Best Chance for Success

• Be creative, don’t keep doing the same thing if it is not working!
• Establish a consistent monitoring program
• Use mating disruption as a base to your CM control program
• Use new products correctly - rates and timing
Lessons learned from AWII

• Cost of CM control increases with softer programs
  • Less toxic, shorter residual = more apps
• Overall cost and control of soft and conventional programs are equal
  • IGRs, chloronicotinyls control multiple pests
  • Biocontrol likely reducing need for some sprays
• Use oil whenever possible (CM control)