Biology and Management of Diamondback Moth

• Major pest of *brassica* crops world-wide.

• Economic losses = $4-5 billion annually.

• Rapid biological development

• Long history of resistance to insecticides

• Typically, a *minor pest* in the western U.S.
Diamondback Moth Biology

Life cycle

- Egg
- L1
- L2
- L3
- L4
- Pupa
- Adult

M. Pena, UA Yuma
Diamondback moth

Liriomyza leafminer
<table>
<thead>
<tr>
<th>Insect</th>
<th>Lower</th>
<th>Upper</th>
<th>Optimal Temp (°F)</th>
<th>Egg-Adult (Avg. days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cabbage looper</td>
<td>54</td>
<td>95</td>
<td>86</td>
<td>18.5</td>
</tr>
<tr>
<td>Beet armyworm</td>
<td>54</td>
<td>100</td>
<td>86</td>
<td>17.9</td>
</tr>
<tr>
<td>Diamondback moth</td>
<td>39</td>
<td>107</td>
<td>86</td>
<td>11.1</td>
</tr>
</tbody>
</table>
Temperature and Development of DBM on Brassica crops

- Developmental rate (days from egg-adult)

- Average Temperature, °F

- 50°F: ~4 days
- 57°F: ~6 days
- 61°F: ~6 days
- 68°F: ~6 days
- 75°F: ~4 days
- 80°F: ~4 days
- 86°F: ~4 days
- 93°F: ~4 days

* 2nd instar larva to pupa
• Average adult longevity, ~ 15 days
• Females can lay > 250 eggs
• The moths are weak fliers, but can disperse ~ 100 ft within a crop field

* Active during the day, but more active at night.
Diamondback Moth Outbreaks

- Hot, dry weather is conducive to exponential population growth.
- Poor spray coverage and/or spray timing.
- Marginal efficacy with standard insecticide products
Diamondback moth Management

**Sanitation**

- *Prompt* destruction of crop residues following final harvest
- *Clean culture*: control of brassica weeds in and around fields

**Isolation / Crop Placement**

- Avoid sequential plantings in the same field
- Plant susceptible crops distant from sources of insects
Diamondback moth Management

- It starts in the nursery
- Inspect trays prior to transplanting
- *Verimark* transplant drench
- Scout / Monitor Thoroughly
- **Initiate Control Early**
  (prevent establishment)
Diamondback moth Management

Maximize insecticide applications

- Spray Coverage is critical
- Higher spray volumes
- *Tighten spray intervals* (4-5 d)
# Diamondback Moth Management in Desert Produce - 2021

## Relative Efficacy for Diamondback Moth

<table>
<thead>
<tr>
<th>Product</th>
<th>IRAC MOA</th>
<th>Larvae</th>
<th>Adults</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lannate</td>
<td>1A</td>
<td>▶️</td>
<td>▶️</td>
</tr>
<tr>
<td>Dibrom</td>
<td>1B</td>
<td>▶️</td>
<td>▶️</td>
</tr>
<tr>
<td>Malathion</td>
<td>1B</td>
<td>▶️</td>
<td>▶️</td>
</tr>
<tr>
<td>Pyrethroids</td>
<td>3</td>
<td>▶️</td>
<td>▶️</td>
</tr>
<tr>
<td>Assail</td>
<td>4A</td>
<td>▶️</td>
<td>▶️</td>
</tr>
<tr>
<td>Cormoran</td>
<td>4A+15</td>
<td>▶️</td>
<td>▶️</td>
</tr>
<tr>
<td>Radiant, Entrust</td>
<td>5</td>
<td>▶️</td>
<td>▶️</td>
</tr>
<tr>
<td>Proclaim</td>
<td>6</td>
<td>▶️</td>
<td>▶️</td>
</tr>
<tr>
<td>Bt, aizawai</td>
<td>11B</td>
<td>▶️</td>
<td>▶️</td>
</tr>
<tr>
<td>Intrepid</td>
<td>18A</td>
<td>▶️</td>
<td>▶️</td>
</tr>
<tr>
<td>Torac</td>
<td>21</td>
<td>▶️</td>
<td>▶️</td>
</tr>
<tr>
<td>Avaunt</td>
<td>22</td>
<td>▶️</td>
<td>▶️</td>
</tr>
<tr>
<td>Movento</td>
<td>23</td>
<td>▶️</td>
<td>▶️</td>
</tr>
<tr>
<td>Coragen, Besiege</td>
<td>28, 28+3</td>
<td>▶️</td>
<td>▶️</td>
</tr>
<tr>
<td>Exirel, Verimark</td>
<td>28</td>
<td>▶️</td>
<td>▶️</td>
</tr>
<tr>
<td>Harvanta</td>
<td>28</td>
<td>▶️</td>
<td>▶️</td>
</tr>
</tbody>
</table>

* Based on local research and field observations

---

**Efficacy**
- Green: Excellent-Good control
- Yellow: Fair control
- Red: Poor to no control
## Diamondback moth Management

### Larvae
- **Radiant**
- **Proclaim**
- **Coragen**
- **Exirel**
- **Avaunt**
- **Xentari**
- **Cormoran**
- **Intrepid**

### Adults
- **Lannate**
- **Dibrom**
- **Pyrethroids**

---

- It starts in the nursery
- Inspect trays prior to transplanting
- **Verimark** transplant drench
- Scout / Monitor Thoroughly
- Initiate Control Early

**Rotate Modes of Action**  
*(Do not tank mix larvacides)*
Tank-mixtures for DBM control in Cabbage
Yuma Ag Center, Spring 2020

- 3 applications
- 7-14 day spray interval
- 22.5 gpa@50 psi

DBM / 10 plants Plant

- UTC
- Avaunt + Xentari
- Xentari
- Avaunt
- Radiant + Proclaim
- Proclaim
- Radiant

6 DAA1
12 DAA1
6 DAA2
6 DAA3
Alternative Insecticides to Consider

- Movento
- Cormoran
- Harvanta
- Spear-Lep
**Movento – Suppression of DBM in Brassica crops**

Yuma Ag Center, 2017-2021

---

**BRASSICA (COLE) LEAFY VEGETABLES**

Crops of Crop Group 5 Including: Broccoli, Broccoli raab (rap, Cavalo broccolo), Chinese broccoli (gai lon), Chinese cabbage (gai choy), Collards, Kale, Kohlrabi, Rape greens

---

<table>
<thead>
<tr>
<th>PESTS CONTROLLED</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Aphids</td>
<td>Whiteflies</td>
</tr>
<tr>
<td>Swede midge</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PESTS SUPPRESSED</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Diamondback moth</td>
<td></td>
</tr>
<tr>
<td>Onion thrips (larvae)</td>
<td></td>
</tr>
</tbody>
</table>
Movento – Suppression of DBM in Brassica crops
Yuma Ag Center, 2017-2021

7 Trials (2017-2021)
Cabbage or broccoli
2 sprays / trial
Industry Standards:
- Radiant, Exirel, Proclaim
3, 7 & 14 DAA samples

Avg. DBM larvae / 10 plants

- Industry Standards
- Movento 5 oz
- Untreated check

• a
• b
• c
Diamondback Moth in Broccoli with Cormoran

Yuma Ag Center, Fall 2017

DBM / 10 Plants

- Untreated
- Intrepid
- Cormoran, 9 oz
- Cormoran, 12 oz
- Coragen
- Exirel
- Radiant

Trial Average

• 2 applications
• 10 day spray interval
• 23.5 gpa@50 psi
• Sampled: 3, 7 and 14 DAA
Diamondback Moth in Broccoli
Yuma Ag Center, Spring 2018

- 3 applications
- 10 day spray interval
- 23.5 gpa@50 psi
- Sampled: 2, 5 and 8 DAA
Chemistry

Antranillic Diamide, IRAC group

Mode of Action

- Rynaodine receptor modulator

Route of Activity

- Translaminar / ingestion

Harvanta cyclaniliprole, IKI-3106

0.42 lb AI / gal Suspension Liquid

1st Generation Diamides

- Coragen
- Besiege Chlorantraniliprole

2nd Generation Diamides

- Verimark
- Exirel Cyantraniliprole
- Minecto Pro

3rd Generation Diamides

- Harvanta Cyclaniliprole
Harvanta

cyclaniliprole, IKI-3106

Spring Cauliflower 2019

- 25.0 gpa @ 40 psi
- 2 sprays: 8 day intervals
- Sampled at 3 and 7 DAA

Diamondback Moth

Check
Xentari
Avaunt
Proclaim
Exirel
Coragen
Harvanta
Radiant

Mean Larvae / 10 plants

Harvanta

• 25.0 gpa @ 40 psi
• 2 sprays: 8 day intervals
• Sampled at 3 and 7 DAA
Spring Cabbage 2021

- 35 gpa @ 50 psi
- 3 sprays: 10 day intervals
- Sampled at 4 and 8 DAA

Harvanta

cyclaniliprole, IKI-3106

- Untreated
- Coragen, 5 oz
- Avaunt, 3.5 oz
- Xentari, 1.5 lb
- Harvanta, 10.9 oz
- Radiant, 5 oz
- Proclaim, 4.8 oz
- Harvanta, 16.4 oz
- Exirel, 15.0 oz

DBM larvae / 10 plants
Spear-Lep

GS-omega/ kappa-Hxtx-Hv1a, peptide

- Btk crystal proteins damage the gut cells allowing Spear-Lep's active ingredient to access the nervous system.
- The open channel causes persistent depolarization of the nerve cell.
- Caterpillar ingests plant tissue treated with Spear-Lep and a low dose of Btk.

- Peptide-based insecticides
- Affects a specific neuromuscular target.
- Mixed with low dose Bt

- New mode of action (IRAC group 32)
- Potential tool for IRM
Spear-Lep in Spring Cabbage

Yuma Ag Center, spring 2020

- 3 applications
- 7-day spray interval
- 23.5 gpa@50 psi
- Sampled: 6 and 12 DAA

Untreated

Spear Lep + Leprotec, 1 pt

Spear Lep + Leprotec, 2 pt

Dipel, 1.5 lb

Xentari, 1.5 lb

Entrust, 5 oz

• Sampled: 6 and 12 DAA
There are a few more A.I.s in the pipeline.

jpalumbo@ag.arizona.edu
928-920-3387