4-2015

2015 Pesticide Safety: Fruit rot management

Erika Saalau Rojas
UMass Amherst Cranberry Exp Station, esaalau@umass.edu

Follow this and additional works at: https://scholarworks.umass.edu/cranberry_extension
Part of the Agriculture Commons, and the Horticulture Commons

Recommended Citation
Retrieved from https://scholarworks.umass.edu/cranberry_extension/205

This Article is brought to you for free and open access by the Cranberry Station Outreach and Public Service Activities at ScholarWorks@UMass Amherst. It has been accepted for inclusion in Cranberry Station Extension meetings by an authorized administrator of ScholarWorks@UMass Amherst. For more information, please contact scholarworks@library.umass.edu.
Fruit rot management

Erika Saalau Rojas
Extension Plant Pathologist
UMass Cranberry Station
East Wareham, MA
Bravo – Chlorothalonil  
(F. Caruso 2010 Results)

<table>
<thead>
<tr>
<th>LOC</th>
<th>PHI</th>
<th>PPM</th>
<th># Apps</th>
<th>LAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA</td>
<td>77</td>
<td>0.026</td>
<td>3</td>
<td>06/29/10</td>
</tr>
<tr>
<td>MA</td>
<td>77</td>
<td>0.042</td>
<td>3</td>
<td>06/29/10</td>
</tr>
<tr>
<td>MA</td>
<td>77</td>
<td>&lt;0.01 ppm</td>
<td>3</td>
<td>06/29/10</td>
</tr>
<tr>
<td>MA</td>
<td>77</td>
<td>0.016</td>
<td>3</td>
<td>06/29/10</td>
</tr>
<tr>
<td>MA</td>
<td>77</td>
<td>0.02</td>
<td>2</td>
<td>06/29/10</td>
</tr>
<tr>
<td>MA</td>
<td>77</td>
<td>&lt;0.01 ND</td>
<td>2</td>
<td>06/29/10</td>
</tr>
<tr>
<td>MA</td>
<td>77</td>
<td>0.008</td>
<td>1</td>
<td>06/29/10</td>
</tr>
<tr>
<td>MA</td>
<td>77</td>
<td>0.044</td>
<td>1</td>
<td>06/29/10</td>
</tr>
<tr>
<td>MA</td>
<td>88</td>
<td>&lt;0.01 ppm</td>
<td>2</td>
<td>06/18/10</td>
</tr>
<tr>
<td>MA</td>
<td>88</td>
<td>0.014</td>
<td>2</td>
<td>06/18/10</td>
</tr>
<tr>
<td>MA</td>
<td>88</td>
<td>&lt;0.01 ppm</td>
<td>1</td>
<td>06/18/10</td>
</tr>
<tr>
<td>MA</td>
<td>88</td>
<td>0.008</td>
<td>1</td>
<td>06/18/10</td>
</tr>
<tr>
<td>MA</td>
<td>97</td>
<td>&lt;0.01 ppm</td>
<td>1</td>
<td>06/09/10</td>
</tr>
<tr>
<td>MA</td>
<td>97</td>
<td>0.034</td>
<td>1</td>
<td>06/09/10</td>
</tr>
</tbody>
</table>

50% of detections >0.01 ppm
The new MRL essentially eliminates Bravo for fruit rot control

50% of detections >0.01 ppm
**Efficacy** – the overall effect of a fungicide on the level of disease

In order of efficacy (best to worst):

- Chlorothalonil - Bravo, Equus, Echo
- EBDC’s – Manzate, Dithane, Roper
- Prothioconazole – Proline
- Fenbuconazole - Indar
- Azoxystrobin - Abound
- Ferbam
- Coppers – Champ, Kocide
Fungicides available for fruit rot

**DMI**
- FRAC Code 3
- Indar
- Proline

**QoI**
- FRAC Code 11
- Abound
- Evito

**polyoxins**
- FRAC Code 19
- Tavano

**chloroanilines**
- FRAC Code M5
- Bravo (and many others)

**dithiocarbamates**
- FRAC Code M3
- Mancozeb
- Ferbam

Risk levels:
- **High risk**
- **Medium risk**
- **Low risk**
Fungicides available for fruit rot

**DMI**
- Indar
- Proline

**QoI**
- Abound
- Evito

**polyoxins**
- Tavano/Oso

**chloronitriles**
- Bravo (and many others)

**dithiocarbamates**
- Mancozeb
- Ferbam

Efficacy unknown $$$
Fungicides available for fruit rot

<table>
<thead>
<tr>
<th>DMI</th>
<th>FRAC Code 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indar</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>chloroanilides</th>
<th>FRAC Code M5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bravo (and many others)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>polyoxins</th>
<th>FRAC Code 19</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tavano/Oso</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DMI</th>
<th>FRAC Code 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abound</td>
<td></td>
</tr>
<tr>
<td>Evito</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DMI</th>
<th>FRAC Code 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ferbam</td>
<td></td>
</tr>
</tbody>
</table>

Only 4 effective fungicides against fruit rot

Efficacy unknown $$$
Why do fungicide applications fail?

- Fungicide ineffective against pathogen
- Improper timing
- Poor coverage / application method
- Fungicide resistance
Fungicide resistance

Fungal pathogen = less sensitive to fungicides

Heritable trait = resistant population builds up

Single-site fungicides pose a higher risk

Indar
Abound
Proline
Risk factors

- Pathogen diversity
- Single-site fungicides

**Storage Rot**
- Allantophomopsis lycopodina
- Allantophomopsis cytispora
- Coleophoma empetri
- Fusicoccum putrefaciens
- Phyllosticta elongata
- Phyllosticta vaccinii
- Physalospora vaccinii
- Strasseria geniculata

**Field Rot**
- Coleophoma empetri
- Colletotrichum accutatum
- Colletotrichum gloesporioides
- Fusicoccum putrefaciens
- Phomopsis vaccinii
- Phyllosticta vaccinii
- Physalospora vaccinii
**Efficacy** – the overall effect of a fungicide on the level of disease

**In order of efficacy (best to worst):**

- Chlorothalonil - Bravo, Equus, Echo
- EBDC’s – Manzate, Dithane, Roper
- Prothioconazole – Proline
- Fenbuconazole - Indar
- Azoxystrobin - Abound
- Ferbam
- Coppers – Champ, Kocide
Chlorothalonil and mancozeb
FRAC codes M5 and M3

Multi-site: multiple targets (enzymes, metabolic pathways, spore germination, toxic to cell membranes)
FRAC code

Fungicide Resistance Action Committee
Classifies fungicides by mode of action
Different FRAC codes represent different modes of action.
QoI (Strobilurins)
FRAC code 11

Single-site: target the mitochondrion

Fungal cell
Different trade names, same mode of action
DMI fungicides
FRAC code 3

Single-site: target the cell membrane
Indal
Fungicide

ACTIVE CONSTITUENT: 24%

BAYER

PROLINE®
480 SC Fungicide

Net Contents:
2.5 Gallons

For control of specified diseases on listed crops.

ACTIVE INGREDIENT:
Prothioconazole, 2-{2-(1-Chlorocyclopropyl)-
3-(2-chlorophenyl)-2-hydroxypropyl}-1,
2-dihydro-3H-1,2,4-triazole-3-thione .......... 41.0%
INERT INGREDIENTS: ............... 59.0%
Contains 4 pounds Prothioconazole per gallon.

KEEP OUT OF REACH
OF CHILDREN

FOR ADDITIONAL PRECAUTIONARY
STATEMENTS: See Inside Booklet.
FRAC code
GROUP 3
## Standard fungicide approach

### Applications

<table>
<thead>
<tr>
<th>Early bloom 1</th>
<th>Early bloom 2</th>
<th>Early/mid bloom 1</th>
<th>Mid/out bloom 2</th>
<th>Mid/out bloom 3</th>
</tr>
</thead>
</table>

5 applications
# Standard fungicide approach

## Applications

<table>
<thead>
<tr>
<th></th>
<th>Early bloom 1</th>
<th>Early bloom 2</th>
<th>Early/mid bloom 1</th>
<th>Mid/out bloom 2</th>
<th>Mid/out bloom 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 applications</td>
<td>Indar/Abound</td>
<td>Indar/Abound</td>
<td>Bravo</td>
<td>Bravo</td>
<td>Bravo</td>
</tr>
<tr>
<td>4 applications</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 applications</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Areas with moderate to high fruit rot**

The # of out-of-bloom applications may depend on cultivar

More resistant:
- Early Black
- Howes
- Mullica Queen
# Standard fungicide approach

## Applications

<table>
<thead>
<tr>
<th>Early bloom 1</th>
<th>Early bloom 2</th>
<th>Early/mid bloom 1</th>
<th>Mid/out bloom 2</th>
<th>Mid/out bloom 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indar/Abound</td>
<td>Indar/Abound</td>
<td>Bravo</td>
<td>Bravo</td>
<td>Bravo</td>
</tr>
<tr>
<td>Indar/Abound</td>
<td>Indar/Abound</td>
<td>Bravo</td>
<td>Bravo</td>
<td></td>
</tr>
<tr>
<td>Indar/Abound</td>
<td>Indar/Abound</td>
<td>Bravo</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Single-site fungicides:** Medium-high risk of resistance
- **Multi-site fungicides:** Low risk of resistance ‘cleanup application’
Single-site fungicides (Indar, Abound, Proline)

Medium-high risk of resistance
Single-site fungicides (Indar, Abound, Proline)

Medium-high risk of resistance
Single-site fungicides (Indar, Abound, Proline)

Medium-high risk of resistance

Indar (FRAC 3) + Abound (FRAC 11)
or
Proline (FRAC 3) + Abound (FRAC 11)
Single-site fungicides (Indar, Abound, Proline)

Medium-high risk of resistance

Indar (FRAC 3) + Abound (FRAC 11)
or
Proline (FRAC 3) + Abound (FRAC 11)
Single-site fungicides (Indar, Abound, Proline)

Medium-high risk of resistance

Indar (FRAC 3) + Abound (FRAC 11)
or
Proline (FRAC 3) + Abound (FRAC 11)

Multi-site fungicides

Low risk of resistance
‘cleanup application’

Combine or alternate modes of action
Use FRAC codes for guidance
Single-site fungicides (Indar, Abound, Proline)

Medium-high risk of resistance

Indar (FRAC 3) + Abound (FRAC 11) or Proline (FRAC 3) + Abound (FRAC 11)

Combining or alternating modes of action
Use FRAC codes for guidance

Multi-site fungicides

Low risk of resistance ‘cleanup application’

No carryover of resistant pathogens to next growing season
Single-site fungicides (Indar, Abound, Proline)

Medium-high risk of resistance

Indar (FRAC 3) + Abound (FRAC 11) or Proline (FRAC 3) + Abound (FRAC 11)

Multi-site fungicides

Low risk of resistance

‘cleanup application’

Combine or alternate modes of action

Use FRAC codes for guidance

Last application of the growing season should be a multi-site fungicide (Bravo or Mancozeb)

No carryover of resistant pathogens to next growing season
Standard approach- No Bravo

Early bloom 1  |  Early bloom 2  |  Early/mid bloom 1  |  Mid/out bloom 2  |  Mid/out bloom 3

5 applications

Proline/Abound  Proline/Abound

FRAC 3 and FRAC 11
Standard approach- No Bravo

<table>
<thead>
<tr>
<th>Early bloom 1</th>
<th>Early bloom 2</th>
<th>Early/mid bloom 1</th>
<th>Mid/out bloom 2</th>
<th>Mid/out bloom 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indar/Abound</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Areas with **moderate** to **high** fruit rot

Mancozeb (e.g., Dithane and Manzate) can affect fruit color and fruit size (long-term)
## Standard approach - No Bravo

<table>
<thead>
<tr>
<th>Early bloom 1</th>
<th>Early bloom 2</th>
<th>Early/mid bloom 1</th>
<th>Mid/out bloom 2</th>
<th>Mid/out bloom 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mancozeb</td>
<td>Indar/Abound</td>
<td>Indar/Abound</td>
<td>Mancozeb</td>
<td>Mancozeb</td>
</tr>
<tr>
<td>Indar/Abound</td>
<td>Mancozeb</td>
<td>Indar/Abound</td>
<td>Mancozeb</td>
<td></td>
</tr>
<tr>
<td>Indar/Abound</td>
<td>Indar/Abound</td>
<td>Mancozeb</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If spraying 2 mancozeb~ first application can be In bloom
Next targets?

**Table 2: The potential impact of the new regulation on fungicides as assessed by the UK CRD.**

<table>
<thead>
<tr>
<th>Most likely to be eliminated by hazard criteria</th>
<th>Additional fungicides that may be eliminated depending on definition of cut-off criteria for endocrine disruption</th>
<th>Fungicides likely to be identified as Candidates for Substitution (assuming not already eliminated, and depending on endocrine disruptor definition)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bitertanol</td>
<td>Difenoconazole, Folpet, Fluquinconazole, Fuberidazole, Metiram, Propiconazole, Prothiocarbazole, Tetraconazole, Thiram, Triadimenol, Triticonazole</td>
<td>Chloropicrin, Chlorothalonil, Cyproconazole, Cyprodinil, Dimoxystrobin, Famoxadone, Fenbuconazole, Fluquinconazole, Silthiofam, Tetraconazole, Triazoxide</td>
</tr>
<tr>
<td>Carbendazim</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cyproconazole</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dinocap</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Epoxiconazole</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fenbuconazole</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flusilazole</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ipodione</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maneb</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mancozeb</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>EBDCs</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Indar**

**Bravo**

**Proline**
Opportunities

• Focus on proper timing and coverage of fungicide apps

• Cultural practices
  – Monitor weather conditions (e.g., KQF & scald)
  – Avoid pathogen buildup (e.g., trash flood)
  – Late water(?)

• Plant health and IPM (Integrated Pest Management)
  – Drainage
  – Nutrition
  – Weed/insect control
Summary

• Newer fungicides = higher risk of resistance
• Resistance management = fungicide durability
• Alternate/mix modes of action (use FRAC codes)
• End of season = multi-site fungicide application
• Integrated Pest and Disease Management