

1-2015

2015 Update Mtg: Fruit Rot Management

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Emerging Challenges in Fruit Rot Management

and opportunities

Erika Saalau Rojas

Extension Plant Pathologist
UMass Cranberry Station
East Wareham, MA

The European Commission sets a new MRL for Bravo...

Maximum Residue Levels (MRLs) for chlorothalonil

Chemical	Trade Name	U.S.A	Canada	European Union
Chlorothalonil	Bravo	5 ppm	2 ppm	2 ppm



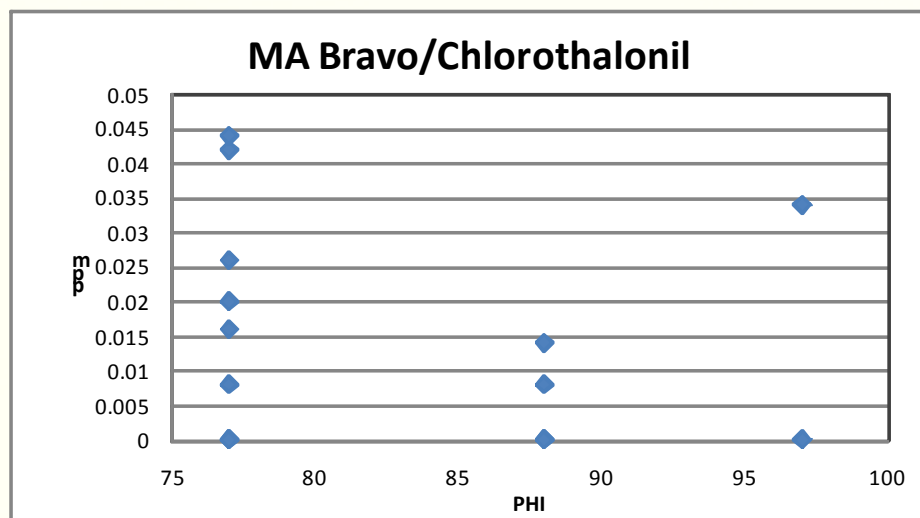
0.01 ppm

Lower limit of detection

Bravo – Chlorothalonil

(F. Caruso 2010 Results)

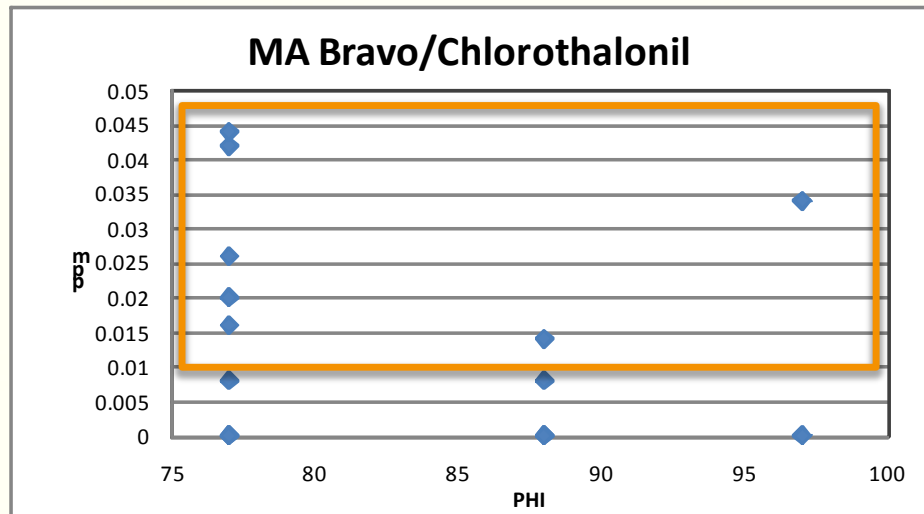
LOC	PHI	PPM	# Apps	LAD
MA	77	0.026	3	06/29/10
MA	77	0.042	3	06/29/10
MA	77	<0.01 ppm	3	06/29/10
MA	77	0.016	3	06/29/10
MA	77	0.02	2	06/29/10
MA	77	<0.01 ND	2	06/29/10
MA	77	0.008	1	06/29/10
MA	77	0.044	1	06/29/10
MA	88	<0.01 ppm	2	06/18/10
MA	88	0.014	2	06/18/10
MA	88	<0.01 ppm	1	06/18/10
MA	88	0.008	1	06/18/10
MA	97	<0.01 ppm	1	06/09/10
MA	97	0.034	1	06/09/10



Bravo – Chlorothalonil

(F. Caruso 2010 Results)

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50% of detections >0.01 ppm

Cranberry Fruit Rot Working Group

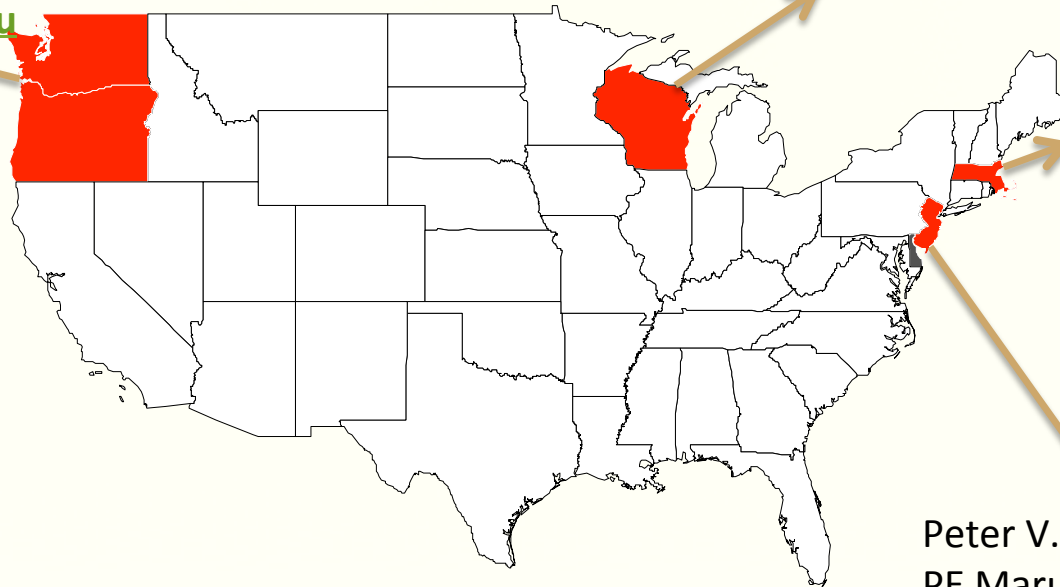
- Address short- and long-term disease management challenges
- Enhance communication and collaboration

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Fungicides Available

DMI
FRAC Code 3

Indar
Proline
Quadris Top
Orbit

QoI
FRAC Code 11

Abound
Evito

polyoxins
FRAC Code 19

Tavano

chloronitriles
FRAC Code M5

Bravo (and
many others)

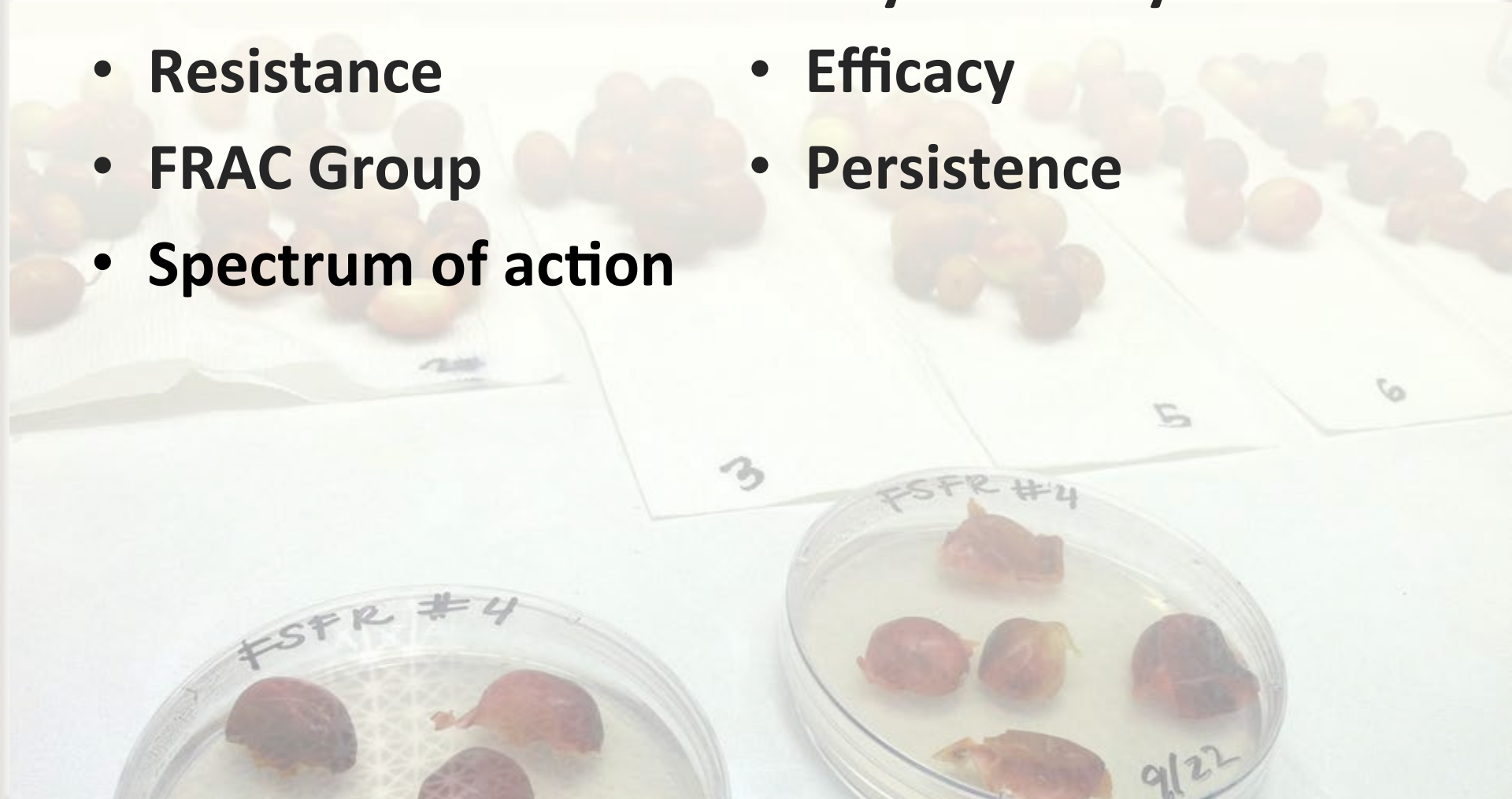
dithiocarbamates
FRAC Code M3

Mancozeb
Ferbam

Rot

Aspects used to compare fungicides

- Mode of action
- Resistance
- FRAC Group
- Spectrum of action
- Phytotoxicity
- Efficacy
- Persistence



Comparison of fungicides available

- **Mode of action** – the mechanism by which a chemical or class of chemicals are toxic to fungi

For more information and examples of different modes of action, please visit:

http://www.frac.info/publication/anhang/FRAC_Mono1_2007_100dpi.pdf

<http://cals.arizona.edu/crop/diseases/papers/dischemistry.html>

- **FRAC Group** – are groups based on mode of action. Each group is assigned a risk for fungicide resistance.

Quadris®
Flowable Fungicide
Broad spectrum fungicide for control of plant diseases

GROUP 11 FUNGICIDES

Active Ingredient:	
Azoxystrobin: methyl (E)-2-{{2-[6-(2-cyano-4-pyrimidin-4-yloxy)phenyl]-3-methoxyacrylate}}	22.9%
Other Ingredients:	77.1%
Total:	100.0%

Group 11

Group 11

Abound®
Flowable Fungicide

GROUP 11 FUNGICIDES

Fungicide Resistance Risk

DMI
FRAC Code 3

Indar
Proline
Quadris Top
Orbit

QoI
FRAC Code 11

Abound
Evito

polyoxins
FRAC Code 19

Tavano

chloronitriles
FRAC Code M5

Bravo (and
many others)

dithiocarbamates
FRAC Code M3

Mancozeb
Ferbam

High risk

Medium risk

Low risk

Fungicide Resistance Risk

DMI
FRAC Code 3

Indar
Proline
Quadris Top
Orbit

QoI
FRAC Code 11

Abound
Evito

polyoxins
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Bravo (and
many others)

dithiocarbamates
FRAC Code M3

Mancozeb
Ferbam

High risk

Medium risk

Low risk

Fungicide Resistance Risk

DMI
FRAC Code 3

Indar
Proline

chloronitriles
FRAC Code M5

Bravo (and
many others)

**Fungicide resistance is a very
real and serious threat!**

QoI
FRAC Code 11

Abound
Evito

polyoxins
FRAC Code 19

Tavano

Ferbam

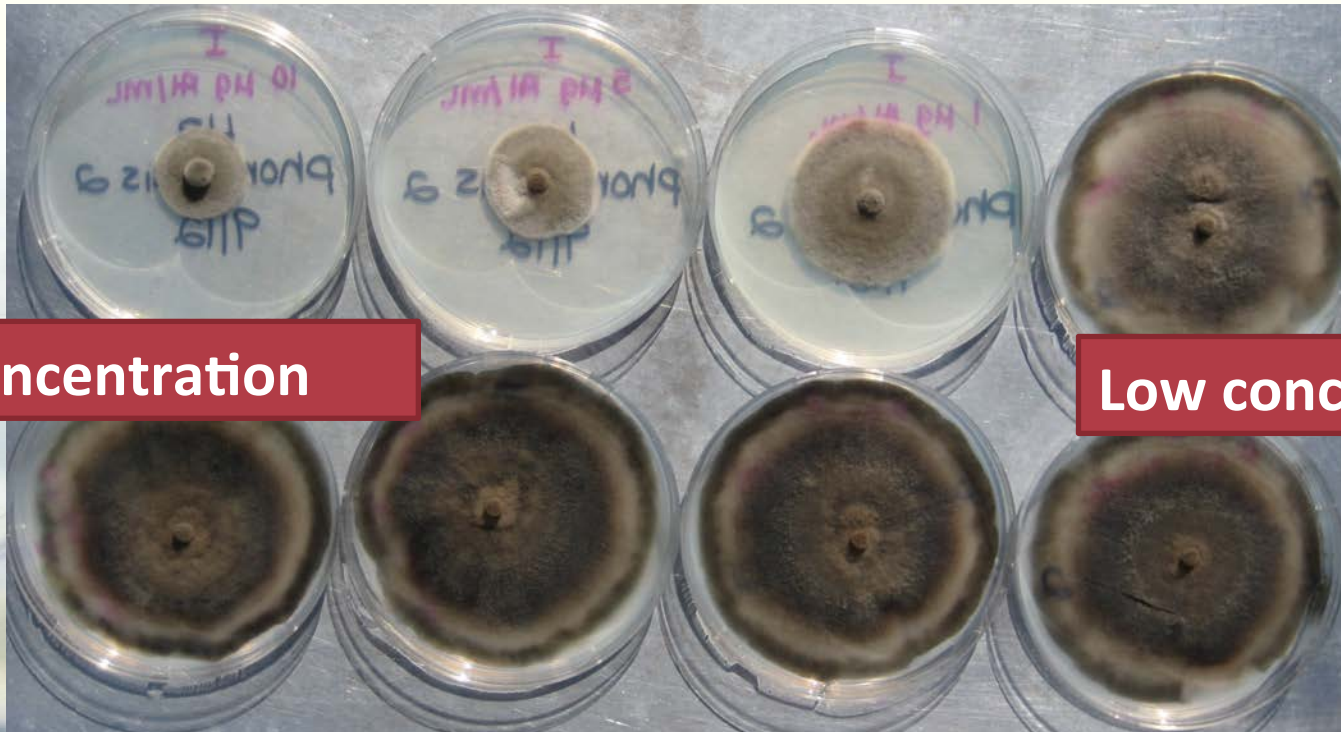
High risk

Medium risk

Low risk

***In vitro* assays by F. Caruso in 2012**

- 2 different locations in MA
- Indar and Abound
- High to low concentrations of fungicide



High concentration

Low concentration

***In vitro* assays by F. Caruso in 2012**

- Reduced sensitivity to Indar and Abound
- 4 fruit rot pathogens
- 2 locations
- Cross-resistance (Indar & Proline)?
 - Same FRAC group



- **Spectrum of action** – the range of fungal species affected by each fungicide

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



- **Phytotoxicity** – damage to the plant caused by a fungicide



Bravo injury

- **Efficacy** – The overall effect of a particular 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

Summary of Fungicide Groups

Group	FRAC	R	Spectrum	Phyto	Efficacy
DMI	3	M	Gaps	0	H
Qol	11	H	Gaps	0	H
Polyoxins	19	M	Unk	0	L
chloronitriles	M5	L	Broad	1	H
dithiocarbamates	M3	L	Broad	2	H/M

Summary of Fungicide Groups

Group	FRAC	R	Spectrum	Phyto	Efficacy
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chloronitriles	M5	L	Broad	1	H
dithiocarbamates	M3	L	Broad	2	H/M

Fungicide scenarios

Fungicide program overview
Timing and # of applications

Bravo and w/o Bravo
Based on efficacy and
fungicide resistance
management

Cranberry Fruit Rot Fungicide Scenarios

When should you time your sprays?

Cranberry main bloom stages

Fungicide application overview

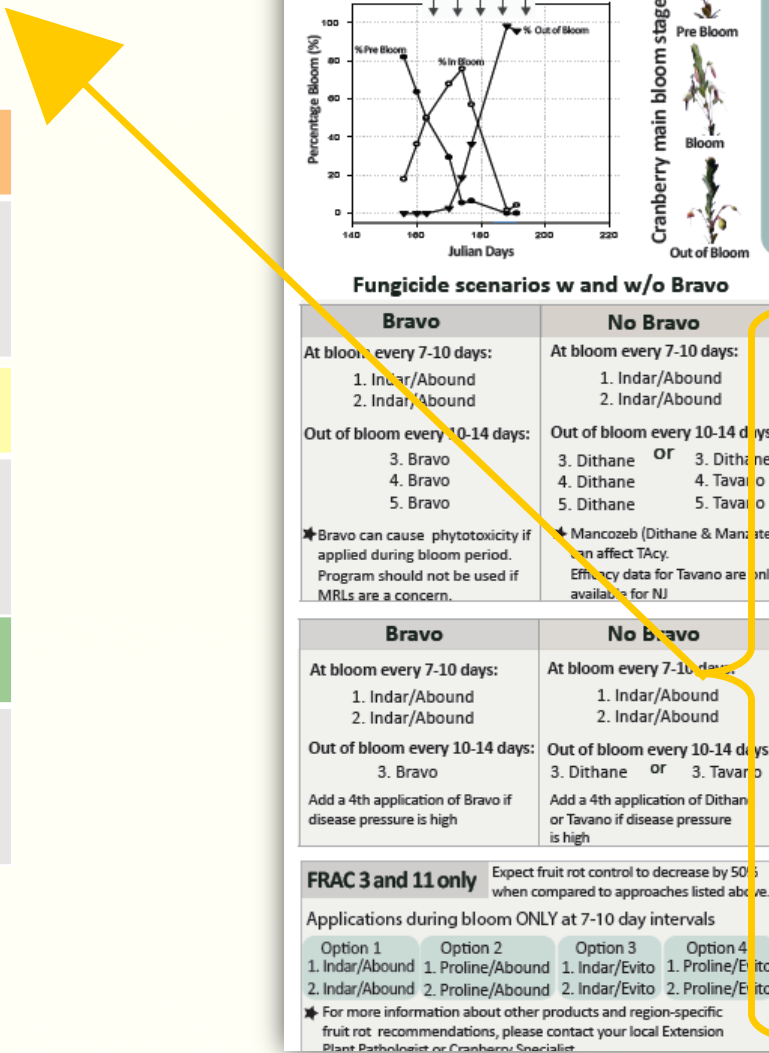
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- ★ Fungicide applications 1-3 are considered critical for adequate fruit rot control, whereas additional applications (4-5) will depend on disease pressure and risk factors.
- ★ The scenarios below were developed considering fungicide restrictions, efficacy, phytotoxicity, and fungicide resistance management.

Fungicide scenarios w and w/o Bravo		Risk factors	Questions?												
<p>Bravo</p> <p>At bloom every 7-10 days:</p> <ol style="list-style-type: none"> 1. Indar/Abound 2. Indar/Abound <p>Out of bloom every 10-14 days:</p> <ol style="list-style-type: none"> 3. Bravo 4. Bravo 5. Bravo <p>★ Bravo can cause phytotoxicity if applied during bloom period. Program should not be used if MRLs are a concern.</p>	<p>No Bravo</p> <p>At bloom every 7-10 days:</p> <ol style="list-style-type: none"> 1. Indar/Abound 2. Indar/Abound <p>Out of bloom every 10-14 days:</p> <ol style="list-style-type: none"> 3. Dithane OR 3. Dithane 4. Dithane 4. Tavano 5. Dithane 5. Tavano <p>★ Mancozeb (Dithane & Manzate) can affect TAcY. Efficacy data for Tavano are only available for NJ</p>	<p>High- Moderate</p> <p>Region (NJ and MA) High fruit rot incidence Newly established bed Susceptible varieties Fresh fruit market High yield (>350 bbl/acre) Frequent scald conditions</p>	<p>New Jersey</p> <p>Peter V. Oudemans Marucci Center for Research Rutgers University oudemans@aesop.rutgers.edu Phone: 609-204-2371</p>												
<p>Bravo</p> <p>At bloom every 7-10 days:</p> <ol style="list-style-type: none"> 1. Indar/Abound 2. Indar/Abound <p>Out of bloom every 10-14 days:</p> <ol style="list-style-type: none"> 3. Bravo <p>Add a 4th application of Bravo if disease pressure is high</p>	<p>No Bravo</p> <p>At bloom every 7-10 days:</p> <ol style="list-style-type: none"> 1. Indar/Abound 2. Indar/Abound <p>Out of bloom every 10-14 days:</p> <ol style="list-style-type: none"> 3. Dithane OR 3. Tavano <p>Add a 4th application of Dithane or Tavano if disease pressure is high</p>	<p>Moderate</p> <p>Region (NJ, MA, OR, WA, WI, and BC) Moderate fruit rot incidence Resistant varieties Sporadic scald conditions</p>	<p>Wisconsin</p> <p>Patricia McManus University of Wisconsin-Madison psm@plantpath.wisc.edu Phone: 608-265-2047</p>												
<p>FRAC 3 and 11 only Expect fruit rot control to decrease by 50% when compared to approaches listed above.</p> <p>Applications during bloom ONLY at 7-10 day intervals</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="background-color: #e0f2f1;">Option 1</td> <td style="background-color: #e0f2f1;">Option 2</td> <td style="background-color: #e0f2f1;">Option 3</td> <td style="background-color: #e0f2f1;">Option 4</td> </tr> <tr> <td>1. Indar/Abound</td> <td>1. Proline/Abound</td> <td>1. Indar/Evito</td> <td>1. Proline/Evito</td> </tr> <tr> <td>2. Indar/Abound</td> <td>2. Proline/Abound</td> <td>2. Indar/Evito</td> <td>2. Proline/Evito</td> </tr> </table> <p>★ For more information about other products and region-specific fruit rot recommendations, please contact your local Extension Plant Pathologist or Cranberry Specialist</p>		Option 1	Option 2	Option 3	Option 4	1. Indar/Abound	1. Proline/Abound	1. Indar/Evito	1. Proline/Evito	2. Indar/Abound	2. Proline/Abound	2. Indar/Evito	2. Proline/Evito	<p>Low</p> <p>Region (WI and QC) Low fruit rot incidence Resistant varieties Rare scald conditions</p>	<p>Washington</p> <p>Kim Patten Washington State University Extension pattenk@wsu.edu Phone: 360-642-2031</p>
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Fungicide scenarios

Risk factors

High- Moderate
4 to 5 applications
Moderate
3 to 4 applications
Low
0 to 2 applications



Cranberry Fruit Rot Fungicide Scenarios

When should you time your sprays?

Fungicide applications

Cranberry main bloom stages

Pre Bloom
Bloom
Out of Bloom

Fungicide application overview

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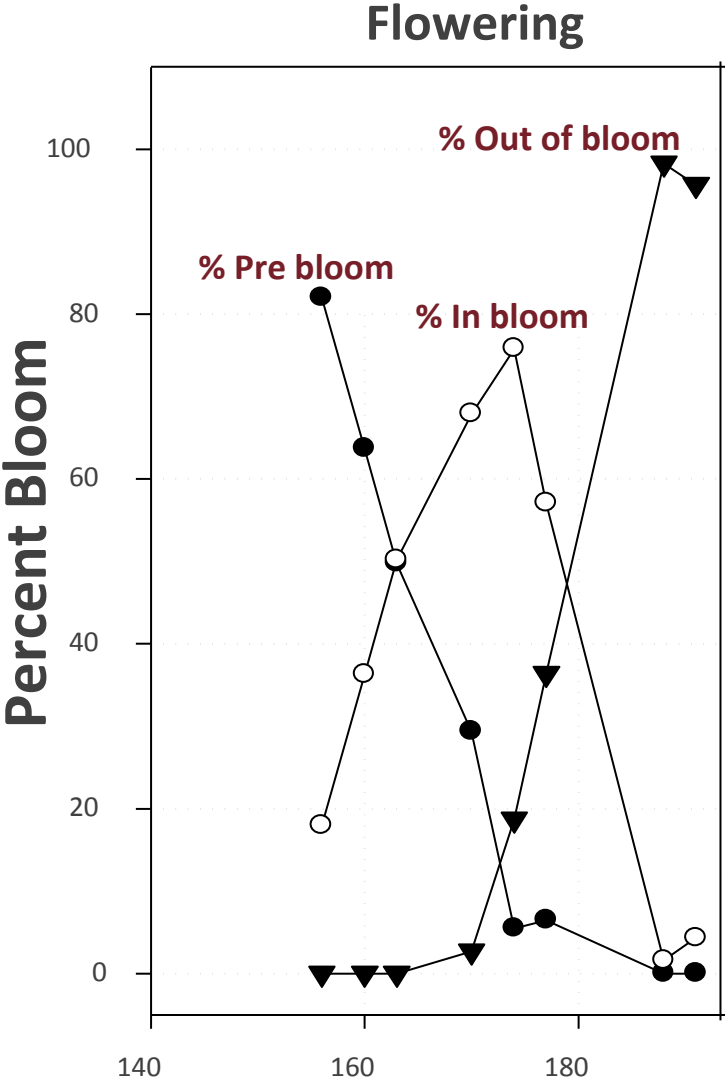
Fungicide scenarios w and w/o Bravo

Bravo	No Bravo	Risk factors	Questions?												
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Timing of application



Impact of timing fungicide applications



Pre bloom

In bloom

Out of bloom

Most fungi infect during this stage

First fungicide application:

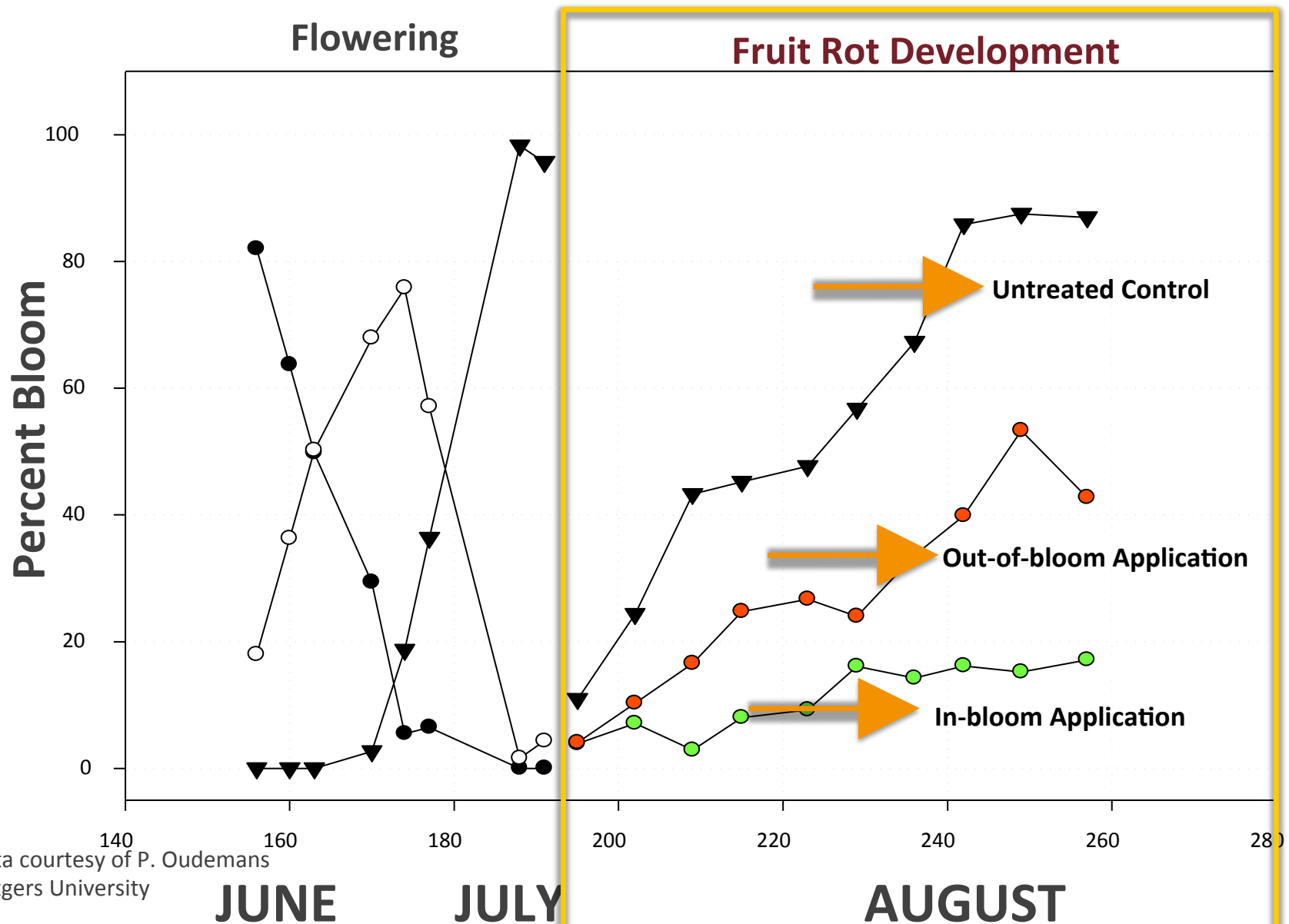
~ 50% bloom

Data courtesy of P. Oudemans
Rutgers University

JUNE

JULY

Impact of timing fungicide applications



Data courtesy of P. Oudemans
Rutgers University

Standard fungicide approach

Applications

	In bloom 1	In bloom 2	Out of bloom 1	Out of bloom 2	Out of bloom 3
5 applications	Indar/Abound	Indar/Abound	Bravo	Bravo	Bravo
4 applications	Indar/Abound	Indar/Abound	Bravo	Bravo	
3 applications	Indar/Abound	Indar/Abound	Bravo		

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

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

More resistant:

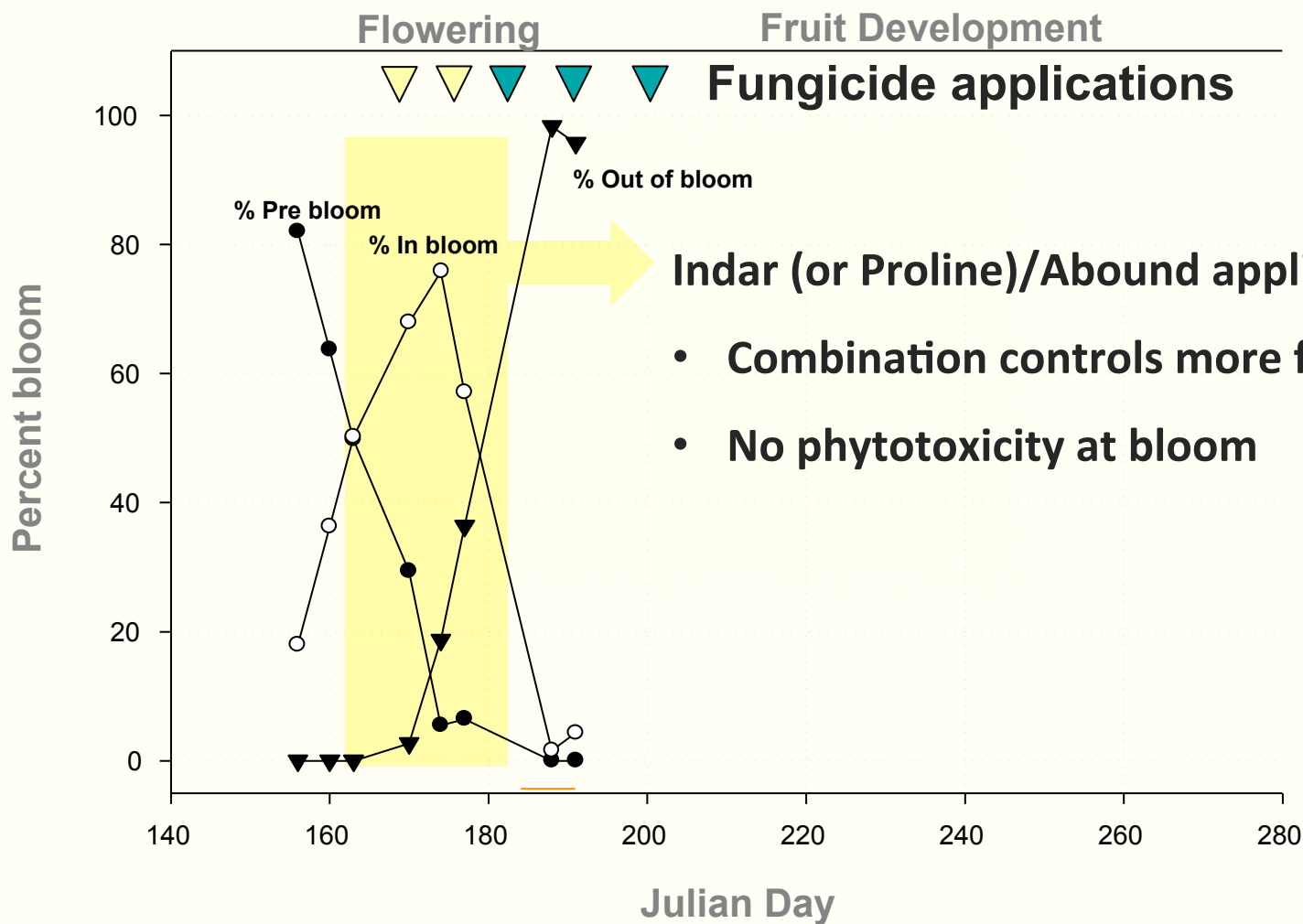
Early Black

Howes

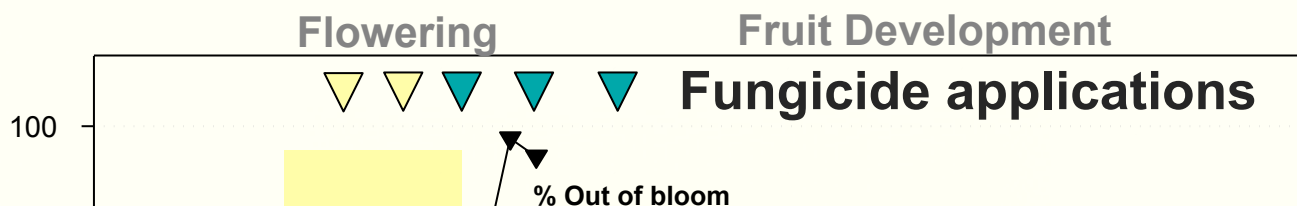
Mullica Queen



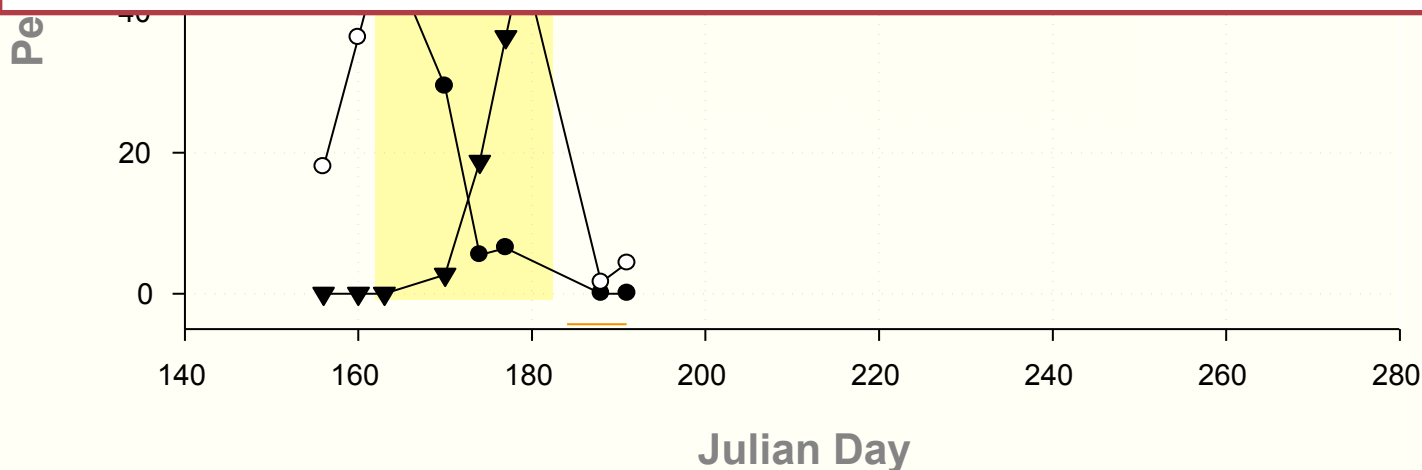
Standard approach- In bloom



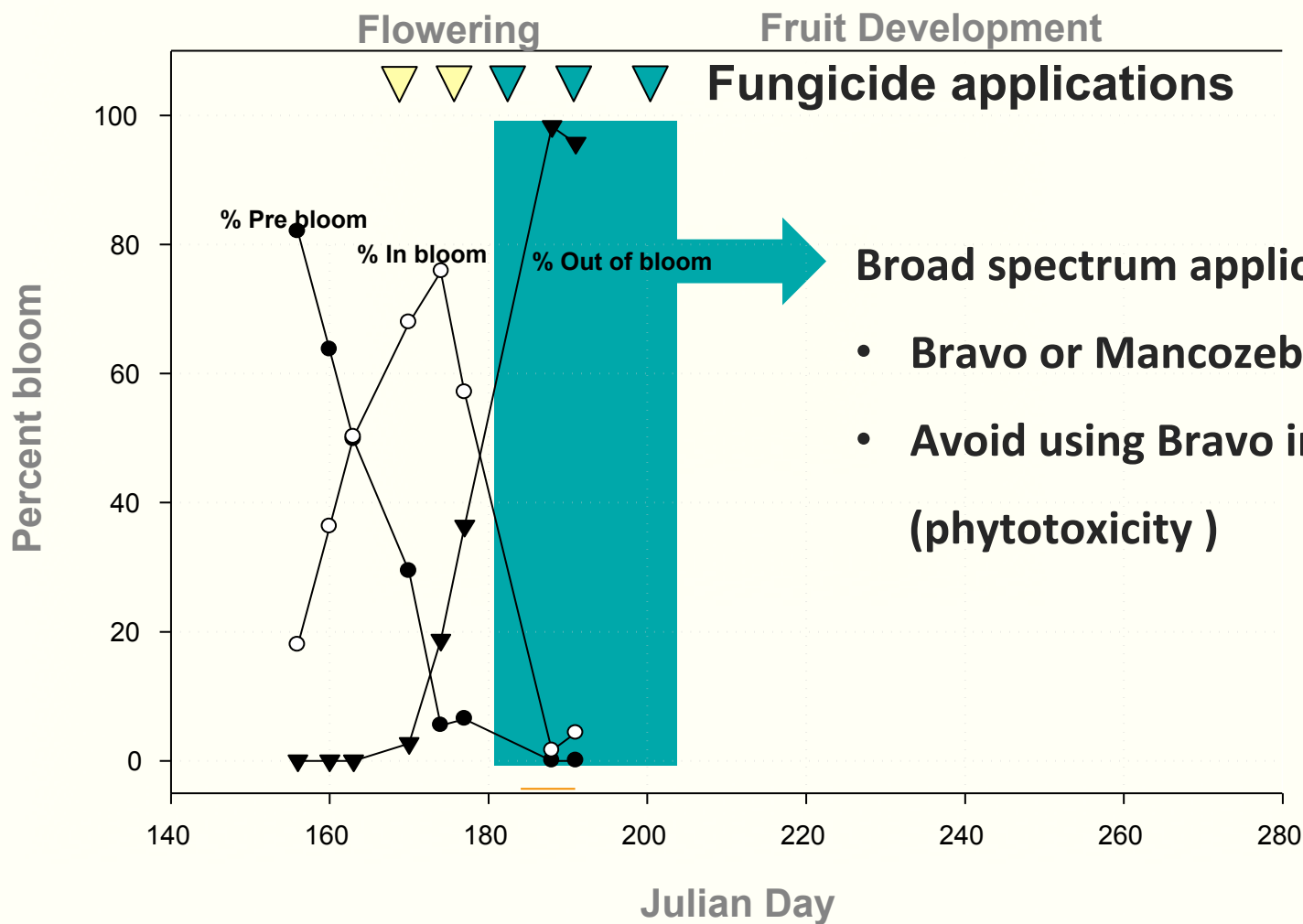
Standard approach- In bloom



**Timing of this application during bloom
reduces risk of resistance**

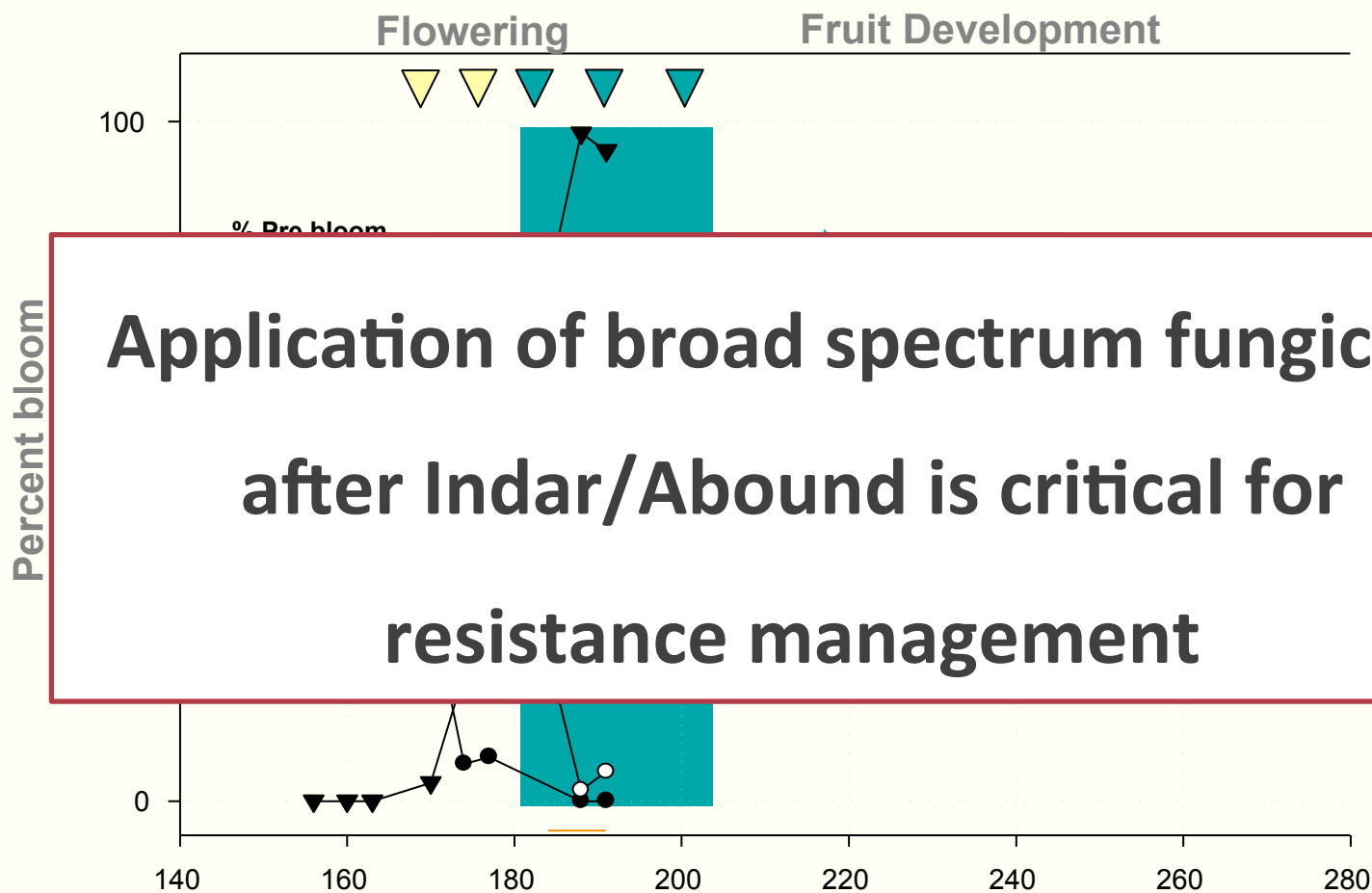


Standard approach- Out of bloom



- Broad spectrum applications:**
- Bravo or Mancozeb
 - Avoid using Bravo in bloom (phytotoxicity)

Standard approach- Out of bloom



**Application of broad spectrum fungicide
after Indar/Abound is critical for
resistance management**

Coming soon...

In bloom 1	In bloom 2	Out of bloom 1	Out of bloom 2	Out of bloom 3
Indar/Abound	Indar/Abound	Dithane	Dithane	Tavano (Oso)
Indar/Abound	Indar/Abound	Dithane	Tavano (Oso)	Tavano (Oso)

- Tavano/ Oso™ is a polyoxin D zinc salt
- Not tested in MA
- Broad spectrum, FRAC group 19



Decisions, decisions, decisions...

Each bog is unique!

High- Moderate

4 to 5 applications

New bed
Poor drainage
Fresh market
Scald

Moderate

3 to 4 applications

Fruit rot history
Weather
Varieties

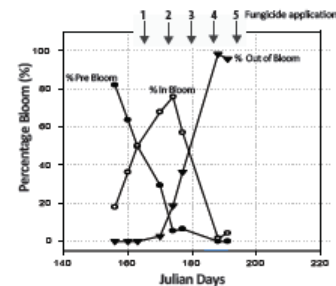
Low

0 to 2 applications

Region
Varieties

Cranberry Fruit Rot Fungicide Scenarios

When should you time your sprays?



Fungicide application overview

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Fungicide scenarios w and w/o Bravo

Bravo	No Bravo
At bloom every 7-10 days: 1. Indar/Abound 2. Indar/Abound	At bloom every 7-10 days: 1. Indar/Abound 2. Indar/Abound
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Risk factors

High- Moderate
Region (NJ and MA)
High fruit rot incidence
Newly established bed
Susceptible varieties
Fresh fruit market
High yield (>350 bbl/acre)
Frequent scald conditions

Questions?

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Massachusetts

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Cranberry Station
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Wisconsin

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Add a 4th application of Bravo if disease pressure is high	Add a 4th application of Dithane or Tavano if disease pressure is high

Moderate
Region (NJ, MA, OR, WA, WI, and BC)
Moderate fruit rot incidence
Resistant varieties
Sporadic scald conditions

FRAC 3 and 11 only Expect fruit rot control to decrease by 50% when compared to approaches listed above.

Applications during bloom ONLY at 7-10 day intervals			
Option 1	Option 2	Option 3	Option 4
1. Indar/Abound	1. Proline/Abound	1. Indar/Evito	1. Proline/Evito
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★ For more information about other products and region-specific fruit rot recommendations, please contact your local Extension Plant Pathologist or Cranberry Specialist

Low
Region (WI and QC)
Low fruit rot incidence
Resistant varieties
Rare scald conditions

Washington

Kim Patten
Washington State University Extension
pattenk@wsu.edu
Phone: 360-642-2031

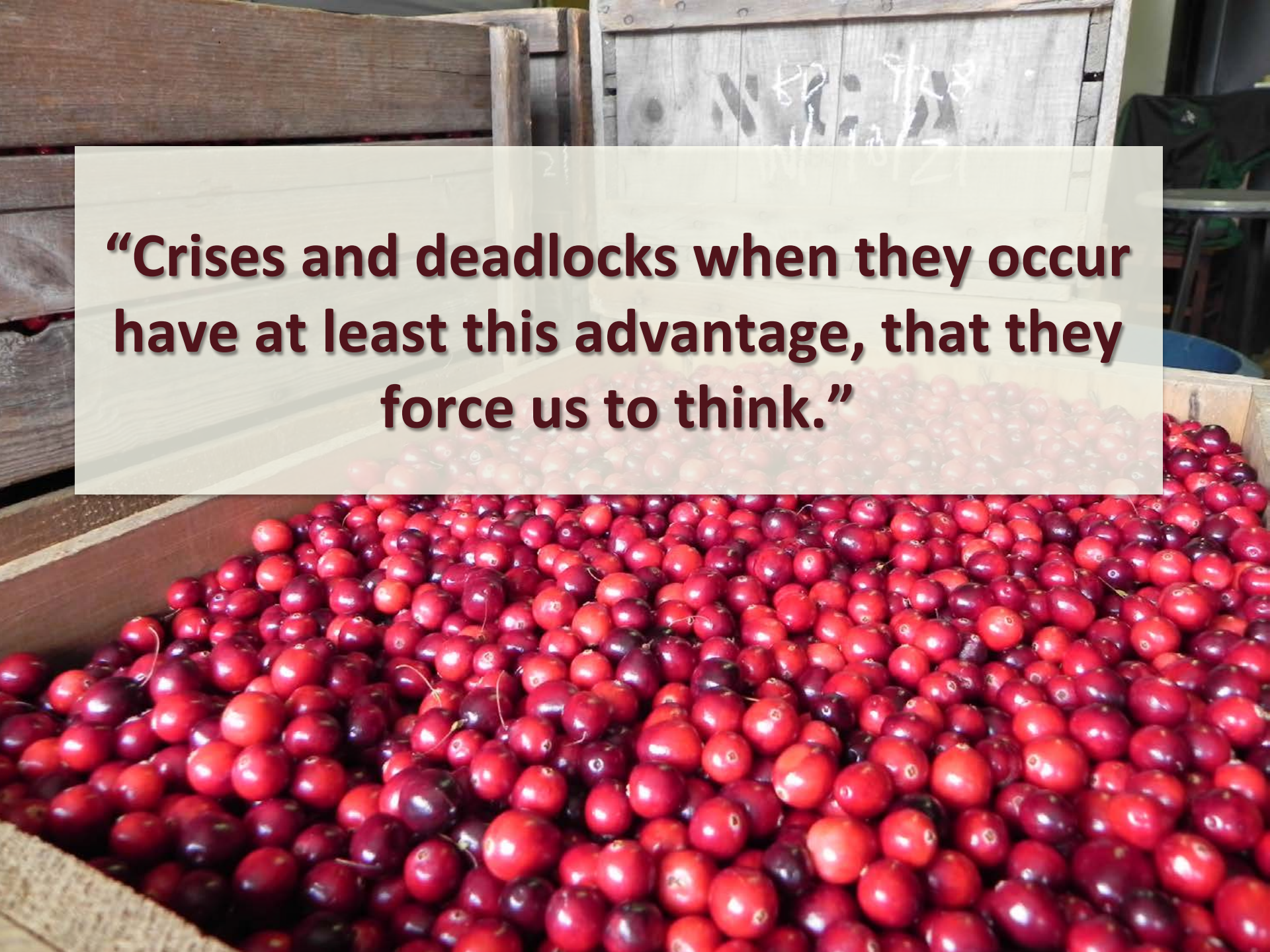
Next targets?

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

Most likely to be eliminated by hazard criteria	Additional fungicides that may be eliminated depending on definition of cut-off criteria for endocrine disruption	Fungicides likely to be identified as Candidates for Substitution (assuming not already eliminated, and depending on endocrine disruptor definition)
Bitertanol	Difenoconazole	Chloropicrin
Carbendazim	Folpet	Chlorothalonil → Bravo
Cyproconazole	Fluquinconazole	Cyproconazole
Dinocap	Fuberidazole	Cyprodinil
Epoxiconazole	Metiram	Dimoxystrobin
Fenbuconazole → Indar		
Flusilazole	Penconazole	Famoxadone
Iprodione	Prochloraz	Fenbuconazole → Indar
Maneb	Propiconazole	Fluquinconazole
Mancozeb → Proline	Prothioconazole → Proline	
	Tetraconazole	Propiconazole
	Thiram	Silthiofam
	Triadimenol	Tetraconazole
	Triticonazole	Triazoxide

EBDCs



A wooden crate filled with a large quantity of small, round berries. The berries are in various stages of ripeness, ranging from bright red to dark, almost black. A semi-transparent white text box is overlaid on the upper portion of the image, containing a quote in a bold, dark red font. The background shows the wooden structure of the crate and some faint white markings on the wood.

“Crises and deadlocks when they occur have at least this advantage, that they force us to think.”

Opportunities

Short- term:

- Re-testing chemical products
- Focus on plant health & cultural practices
- Explore biological control options
- Collaboration & Funding
- Improve existing weather models

Medium- and long- term:

- Manage canopy structure & architecture
 - Nutrition
 - Weather data
- Disease forecasting models
- Focus on pathogen biology
- Integrated Plant Disease Management Program