



# Annual Refresher on Apple Scab, Fire Blight and Rot Management

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**Assistant Professor of Tree Fruit and Specialty Crop  
Pathology**

**Virginia Polytechnic Institute and State University**

***Annual Vermont Tree Fruit Growers Association Meeting  
Middlebury, VT  
17 February 2023***

# Careers at Virginia Tech

## Research Specialist II

**Job no:** 524378

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**Work type:** Staff

**Senior management:** Agriculture & Life Sciences

**Department:** Alson H. Smith, Jr. AREC

**Location:** Winchester, Virginia

**Categories:** Agriculture / Life Science, Research / Scientific

### Job

### Description

This is an off-campus position located at the Virginia Tech's Alson H. Smith Jr Agricultural Research and Extension Center (AREC) in Winchester, Virginia. It supports research and extension program in plant pathology and requires research and diagnostic skills applicable to conducting field and closed-space efficacy trials with pesticides on tree fruit, and to conducting laboratory procedures and experiments. Responsibilities include but are not limited to: independently applying experimental and maintenance pesticide treatments dictated by weather and crop growth stage conditions (leading design, modification, application, timing decision); records management in the greenhouse, lab, and field; managing day to

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## Filter Results

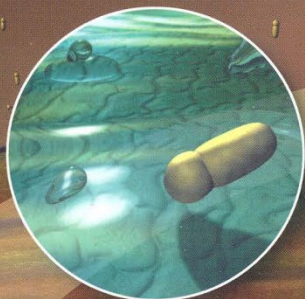
Work type

☐ Staff (1)

[acimovic@vt.edu](mailto:acimovic@vt.edu)  
517 449 0905



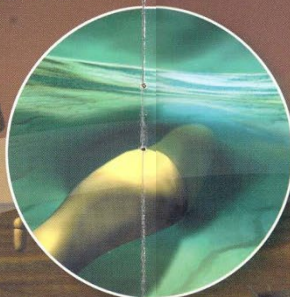
Jedna askospora dospeva na vlažan list. Naročito su osetljivi mladi listovi.



Zrele askospore se pod uticajem kapi kiše izbacuju u visinu i nošene vetrom dospevaju na list jabuke. Izbacivanje askospora traje tokom čitavog proleća.



"Klijanjem" askospore gljivica dospeva ispod površine lista gde formira "stromu".



Iz strome izbijaju "konidiofore" na kojima se formiraju letnje forme spora i konidije.



Uz pomoć kišnih kapi se ove letnje spore šire po zasađu do kraja vegetacije.



Presek jedne "Peritecijije" u kojoj se nalaze "askusi", svaki sa osam zimskih spora (askospore) koje čekaju proleće da nastave infekcije.



Gljivica *Venturia sp.*, prezimjava u inficiranim opalim listovima na tlu zasađa.



Simptomi na plodu



Stalno formiranje novih spora donosi nove infekcije



Simptomi na listu

Pozadina slike: Površina opalog lista u jesen sa brojnim "peritecijijama" u kojima prezimjava gljivica (uvećano 500x)

# Apple Scab GT - FC



# Scab Leaf litter degradations

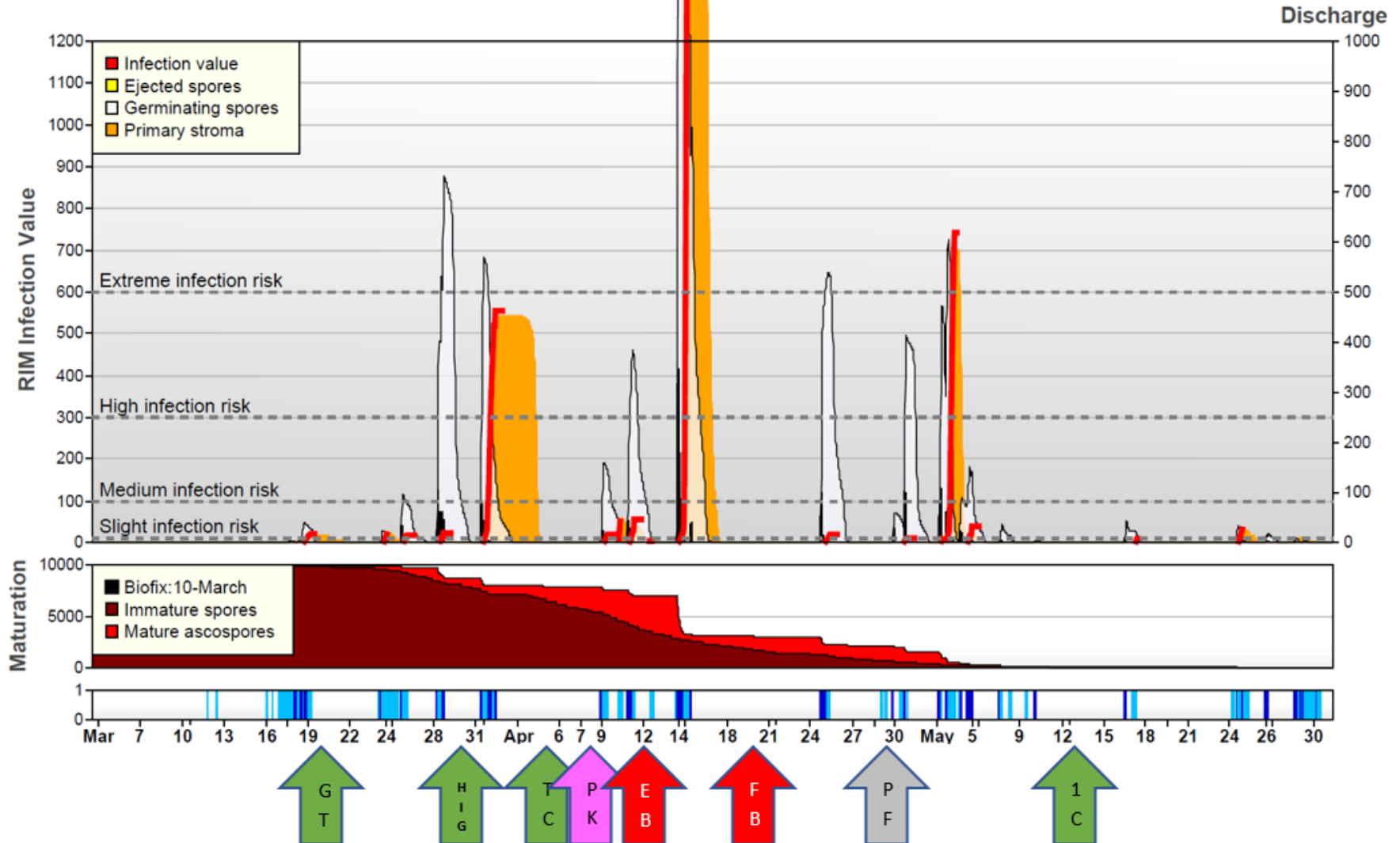
- Eliminate fallen leaves by Urea or Lime spray to reduce ascospore dose 50-70%
- Urea 40 lb / A in 100 gal
- Dolomitic lime 2.5 t/A)
- Prune for good air circulation
- Use flail mower to shred leaves the to smaller pieces
- Rake the leaves from under the trees into row middles and remove leaf piles with flail mower's mode for scalping the sod
- Lime increases the pH or basicity (opposite to acidity) of soil surface promoting microbial activity
- Helps leaf litter breakdown
- Powdered lime spreader



# Partnership on RIMpro Apple Scab Model: Virginia

- Developed for Organic Producers, Netherlands -

Venturia 3.0 Winchester AREC - 2021



# Delayed Dormant Copper for *Ea* from Cankers

- Kill bacteria on surface of bark and buds
- Cuprofix, COCS, NuCop (fixed coppers, 40 to 50% metallic copper equivalent)
- 6 to 8 lb. rate of finished product
- If you had bitter rot or fire blight: Basic Copper 53 (8.0 – 15.0 lb/A of product = 4.24 - 8.0 lbs Copper /A)



Dormant



Silver Tip



Green Tip



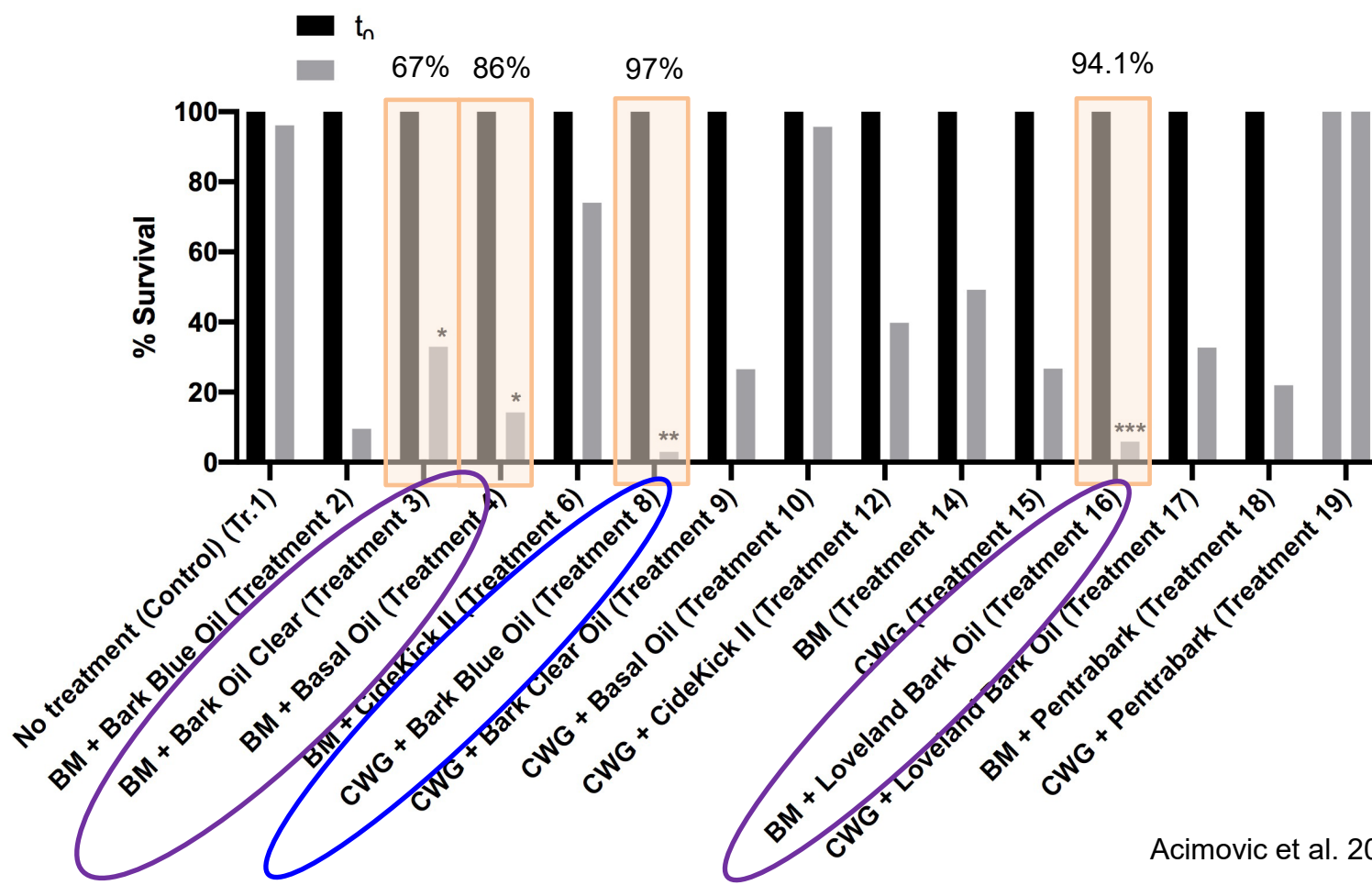
1/4 to 1/2 -inch green



# Copper Reduces Live *Ea* Cells in Cankers

## - Research -

- Fall application, N = 3, n = 3
- B. Mix (13 lb), Champ WG (8 lb) + Oils
- Cortland, natural cankers
- Sampled: 0, 15 days after





# In Season Use: New vs. Old Copper Formulations

Traditional vs. new formulations - Maximize Cu ion effectiveness

- **Reduce the particle size** - micronization of the A.I. to improve coverage of treated surfaces: High surface/volume ratio gives better uniformity in coverage, distribution and adhesion, increased resistance to run-off.
- **Copper microencapsulation** - control the release of A.I.-s and improve product adhesiveness, rainfastness.
- **Combining with zeolites, clay-like bentonite** - Zeolites adhere firmly to leaves – metal has different modes of action and release (release one Cu part fast, second slow).
  - Release Cu at foliar wetting, hold it in low humidity
  - Clay absorbs water, keeps leaves dry, reduces risk of infections
- **SAR materials** - strengthen plant defenses against pathogens or environment stress reducing copper requirements over long period
- **Terpenic alcohols** of coniferous oils
  - Improve leaf coverage
  - Increase copper efficacy, reduce drainage

# 1. Apple Scab Trial 2020

3/22/2020 – GT  
 4/6/2020 – HIG  
 4/14/2020 – TC  
 4/23/2020 – TC2  
 4/29/2020 – PK  
 4/29/2020 – EB  
 5/4/2020 – MB  
 5/16/2020 – PF  
 5/26/2020 – 1C  
 6/13/2020 – 2C  
 7/7/2020 – 3C

- **Spur leaf scab**  
Jul 10 – 14
- **Fruit scab**  
Jul 14 – 15
- **Shoot leaf scab**  
Jul 17 – Aug 4

Mefentrifluconazole Group 3 Fungicide

**Cevya**<sup>®</sup>  
Fungicide

**EXCALIA**<sup>™</sup>  
FUNGICIDE

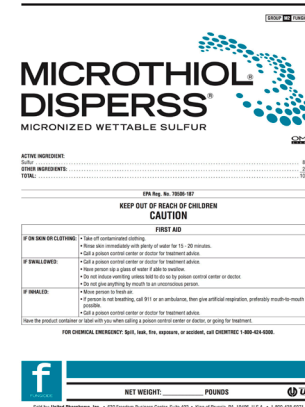
Indiflin, FRAC 7

PYDIFLUMETOFEN GROUP 7 FUNGICIDE

 **Miravis**<sup>®</sup>

**Indar**<sup>™</sup>  
75 WSP  
AGRICULTURAL FUNGICIDE

  
**Luna**<sup>®</sup>  
**SENSATION**



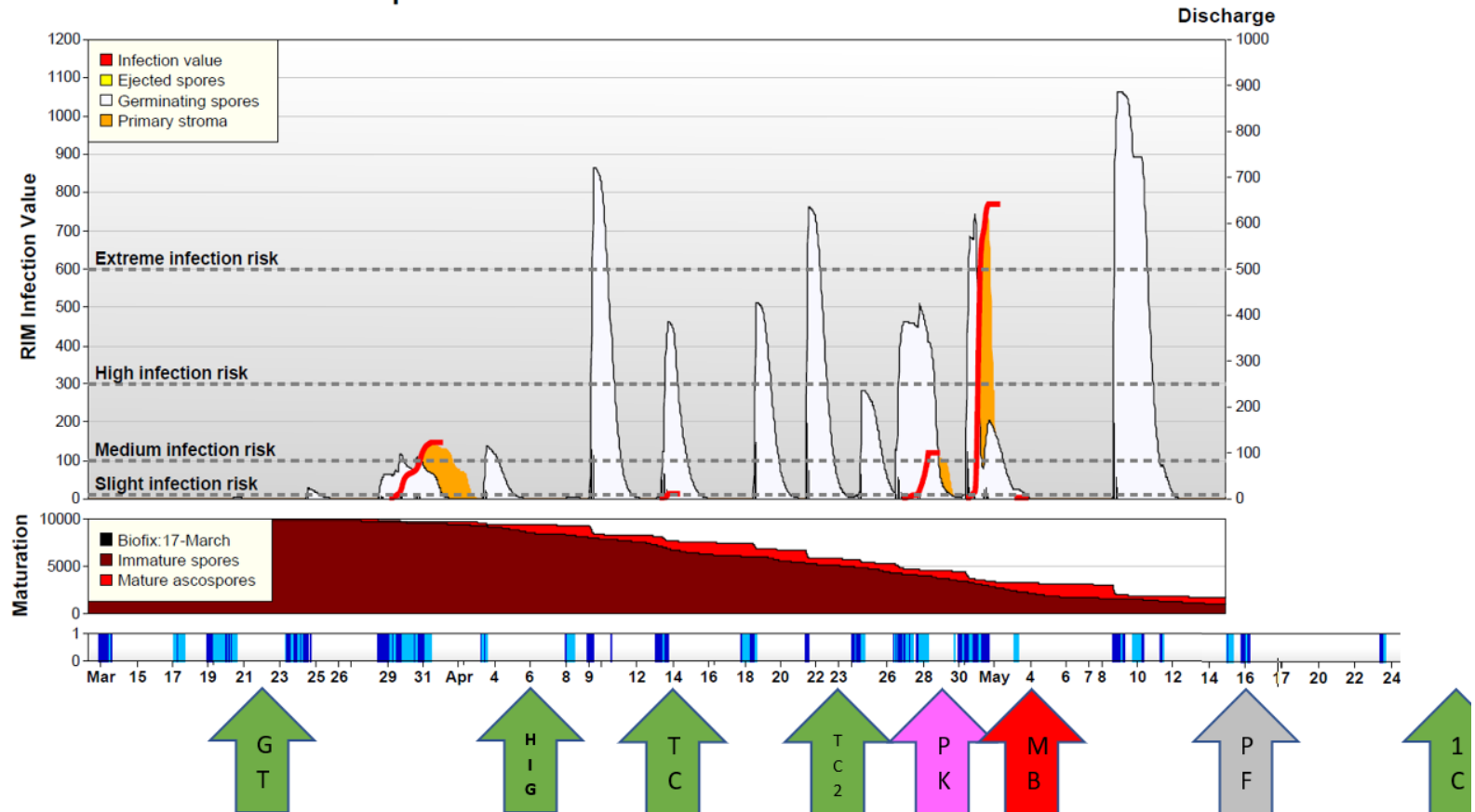
Stargus - 1 × 10<sup>9</sup> CFU  
*B. amyloliquefaciens*  
 F727, FRAC BM02

**Nu-Film P**  
Spreader Sticker

**Vacciplant**<sup>®</sup>  
plant defense stimulant

# 1. Apple Scab Trial 2020

RIMpro-Venturia location: New Paltz - 2020



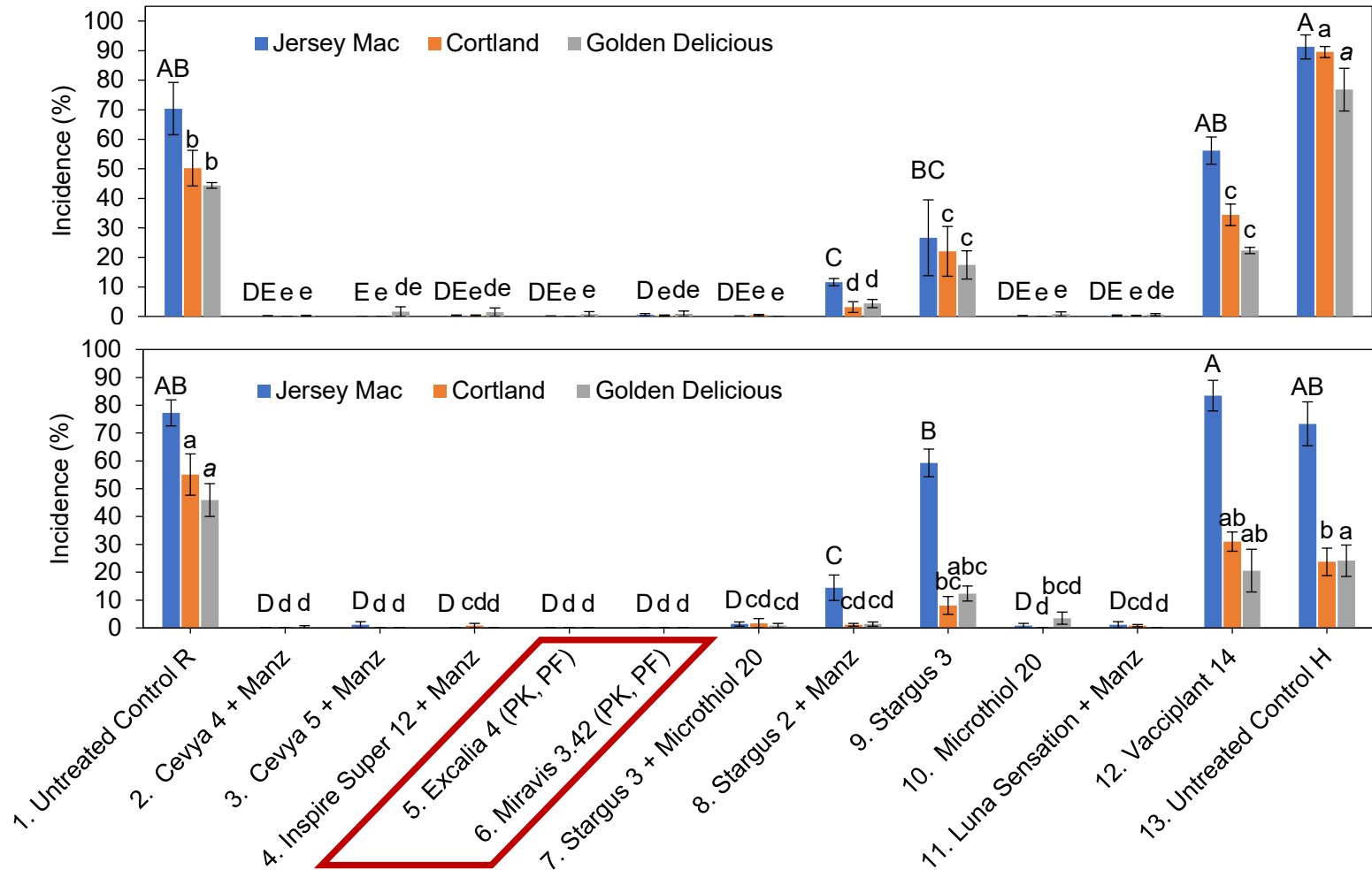


# Spray Timing of Fungicides

1 Untreated control regular	/
2 Manzate Pro-stick 75 WG 3lb	HIG
Manzate Pro-stick 75 WG 3lb	TC
Manzate Pro-stick 75 WG 3lb	TC
Cevya 4 fl oz + Manzate Pro-stick 75 WG 3lb	PK, MB, PF
Manzate Pro-stick 75 WG 3lb	1C
Captan 80 WDG 3 lb	2C, 3C
3 Manzate Pro-stick 75 WG 3lb	HIG
Manzate Pro-stick 75 WG 3lb	TC
Manzate Pro-stick 75 WG 3lb	TC
Cevya 5 fl oz + Manzate Pro-stick 75 WG 3lb	PK, MB, PF
Manzate Pro-stick 75 WG 3lb	1C
Captan 80 WDG 3 lb	2C, 3C
4 Manzate Pro-stick 75 WG 3lb	HIG
Manzate Pro-stick 75 WG 3lb	TC
Manzate Pro-stick 75 WG 3lb	TC
Inspire Super 12 fl oz + Manzate Pro-stick 75 WG 3lb	PK, MB, PF
Manzate Pro-stick 75 WG 3lb	1C
Captan 80 WDG 3 lb	2C, 3C
5 Manzate Pro-stick 75 WG 3lb	GT
-	HIG
Manzate Pro-stick 75 WG 3lb	TC
Manzate Pro-stick 75 WG 3lb	TC
Excalia 4 fl oz	PK
Inspire Super 12 fl oz	MB
Excalia 4 fl oz	PF
Manzate Pro-stick 75 WG 3lb	1C
Captan 80 WDG 3 lb	2C, 3C

6 Manzate Pro-stick 75 WG 3lb	GT
-	HIG
Manzate Pro-stick 75 WG 3lb	TC
Manzate Pro-stick 75 WG 3lb	TC
Miravis 3.42 fl oz	PK
Inspire Super 12 fl oz	MB
Miravis 3.42 fl oz	PF
Manzate Pro-stick 75 WG 3lb	1C
Captan 80 WDG 3 lb	2C, 3C
7 Stargus 3 qts + Microthiol Disperss 20 lbs	GT
-	HIG
Stargus 3 qts + Microthiol Disperss 20 lbs + NuFilm P 32 fl oz/100 gal	TC, TC, PK, MB, PF, 1C
8 Stargus 2 qts + Manzate Pro-stick 75 WG 3lb	HIG
Stargus 2 qts + Manzate Pro-stick 75 WG 3lb	TC, TC
-	PK, MB,
Stargus 2 qts + Manzate Pro-stick 75 WG 3lb	PF, 1C
9 Stargus 3 qts	GT
-	HIG
Stargus 3 qts + NuFilm P 32 fl oz/100 gal	TC, TC, PK, MB, PF, 1C
10 Microthiol Disperss 20 lbs	GT
-	HIG
Microthiol Disperss 20 lbs + NuFilm P 32 fl oz/100 gal	TC, TC, PK, MB, PF, 1C
11 Indar 8 fl oz + Manzate Pro-stick 75 WG 3lb	TC, TC
Rally 8 oz + Manzate Pro-stick 75 WG 3lb	PK
Luna Sensation 4.17SC 5 fl oz + Manzate Pro-stick 75 WG 3lb	MB, PF
Manzate Pro-stick 75 WG 3lb	1C
Captan 80 WDG 2.5 lb	2C, 3C
12 Vacciplant 14 fl oz	TC, TC, PK, MB, PF, 1C
13 Untreated control high	/

# 1. Apple Scab Trial 2020



# Scab Control in Organic Apples

## - Recommendations -

### Choices:

- Scab-resistant cv-s: *Vf* gene: Williams' Pride, Jonafree, Liberty, Enterprise, Prima, Pristine, GoldRush
- **First 4-5 years grow trees using conventional pesticides first (!)**
- Orchard isolated from woodlots, hedgerows, meadows – source of rust, SBFS, bitter rot
- Sites with excellent air drainage so leaves dry quickly, planting design
- Sulfur, liquid lime sulfur (LLS), potassium bicarbonate (PB), copper on susceptible cultivars
- Spray before rain i.e. infection periods & **use disease prediction models**
- Arrest scab development: PB @ 4.3 lb a.i./A + Sulfur 4.3 lb a.i./A
- After PK bud: PB @ 2.15 lb a.i./A + Sulfur 2.15 lb a.i./A (PB against germinating scab spores)

### Problems:

- No antibiotics, fertilizers, synthetic pesticides, plant growth regulators
- 8-10 Sulfur and LLS sprays/year lower productivity 25 to 35% – photosynthesis, thinning
- Copper GT to Pre-PK only at low rates - fruit russetting when slow drying!
- Scab-resistant cultivars still need some sulfur, LLS sprays (mildew and *Vf* gene preservation)
- Sulfur, LLS, and copper not very effective for rusts (LLS burns wet leaves & fruit)
- Scab-resistant cultivars highly susceptible to cedar apple rust
- All apple cultivars susceptible to quince rust
- PB timed precisely to 200 - 540 DH (base 32°F) after criteria for a Mills infection are met



# New Zealand Organic Apple Orchard

- IFTA tour 2018: Visit to Bostoc NZ -

- Avoid planting M.9
- Use fire blight resistant G202 (*M.27* x *Robusta* 5) slightly larger than M.26
- **Grow trees with conventional pesticides first 4-5 years (!)**
- **Reach full tree size, then switch orchard to organic protection**
- Sheep in winter eat scab leaves
- Ground cultivation - helps degrade leaf litter
- **Early scab:** Lime sulfur - scab sprays, thins fruit a little
  - They are careful to not reduce photosynthesis
  - 1.9 gal of lime + 1.1 lb Kumulus (sulfur)/A
  - At 10 mm fruit size switch to copper
- **Later scab:** Copper Hydroxide 35% @ 1.1 lb/A
- Higher rate for fire blight when model shows risk
- **Year limit: 2.64 lb/A/year**
- Blossom Bless® (*Pantoea agglomerans* flowable powder)
  - Respiratory and skin sensitizer - toxicant
- Problem are *Botryosphaeria* - black & white rot

# Apple Disease Recommendation

- 5 to 7 Days, Rain, Tissue Expansion -

QIG, HIG, TC	Advantage	Disadvantage
Scala 5 fl oz or Vanguard 3 oz or Syllit 1.5 pt or Luna Tranquility 16 fl oz + Manzate 3 lb	Scab Scab Scab Scab, Mildew  Scab, Rust	not effective on mildew & rust not effective on mildew & rust not effective on mildew & rust
Rally, Sonoma 7.7 oz or Procure 12 oz or Indar 8 fl oz or Rhyme, Topguard 13 fl oz + Manzate 3 lb	Scab, Mildew, Rust Scab, Mildew, Rust Scab, Mildew, Rust  Scab, Rust	
PINK BUD	Advantage	Disadvantage
Inspire Super 12 fl oz or Fontelis 20 fl oz or Sercadis 4.5 fl or Excalia 4 fl oz or Miravis + Widespread Max 4 to 8 fl oz/100 + Manzate 3 lb	Scab, Rust Scab, Mildew Scab, Mildew Scab, Mildew  -  Scab, Rust	not best on rust not best on rust not best on rust   *Should not use Aprovia **Should not use Luna Sensation, Flint Extra, Merivon, Pristine

PINK BUD	Advantage	Disadvantage
Inspire Super 12 fl oz or Cevya 5 oz or <u>Fontelis 20 fl oz or</u> <u>Sercadis 4.5 fl or</u> <u>Excalia 4 fl oz or</u> <u>Miravis 3.4 fl oz</u> + Widespread Max 4 to 8 fl oz/100 + Manzate 3 lb or Ziram 6 lb	Scab, Rust Scab, Rust Scab, Mildew Scab, Mildew Scab, Mildew Scab, Mildew, Rust  -  Scab, Rust	<div data-bbox="1232 182 1493 304">             not best on rust              not best on rust              not best on rust           </div> <div data-bbox="1534 82 1760 321">  </div> <div data-bbox="1232 358 1694 525">             *Should not use Aprovia              **Should not use Luna              Sensation, Flint Extra,              Merivon, Pristine (no rust)           </div>
BLOOM	Advantage	Disadvantage
Rally, Sonoma 7.7 oz or Procure 12 oz or Indar 8 fl oz or Rhyme, Topguard 13 fl oz + Manzate 3 lb or Ziram 6 lb	Scab, Mildew, Rust Scab, Mildew, Rust Scab, Mildew, Rust Scab, Mildew, Rust  Scab, Rust	
PETAL FALL	Advantage	Disadvantage
Inspire Super 12 fl oz or Cevya 5 oz or <u>Fontelis 20 fl oz or</u> <u>Sercadis 4.5 fl or</u> <u>Excalia 4 fl oz or</u> <u>Miravis 3.4 fl oz/A</u> + Widespread Max 4 to 8 fl oz/100 + Manzate 3 lb or Ziram 6 lb	Scab, Rust Scab, Rust Scab, Mildew Scab, Mildew Scab, Mildew Scab, Mildew, Rust  -  Scab, Rust	<div data-bbox="1232 1058 1493 1179">             not best on rust              not best on rust              not best on rust           </div> <div data-bbox="1534 953 1760 1192">  </div> <div data-bbox="1232 1230 1694 1398">             *Should not use Aprovia              **Should not use Luna              Sensation, Flint Extra,              Merivon, Pristine (no rust)           </div>

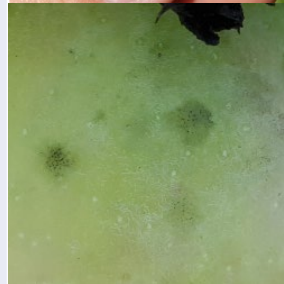
FIRST COVER	Advantage	Disadvantage
Inspire Super 12 fl oz or Cevya 5 oz or Rally, Sonoma 7.7 oz or Procure 12 oz or Indar 8 fl oz or Rhyme, Topguard 13 fl oz + Manzate 3 lb or Ziram 6 lb	Scab, Mildew, Rust Scab, Mildew, Rust Scab, Mildew, Rust Scab, Mildew, Rust Scab, Mildew, Rust Scab, Mildew, Rust  Scab, Rust	*Should not use Aprovia **Should not use Luna Sensation, Flint Extra, Merivon, Pristine (no rust) ***Should not use Omega



SECOND COVER	Advantage	Disadvantage
Captan 3 LB/A + <u>Prophyt**</u> 64 fl.oz./A or Captan 3 LB/A + <u>Topsin M**</u> 1 lb/A + <u>Fontelis</u> 20 fl oz or <u>Sercadis</u> 4.5 fl or <u>Excalia</u> 4 fl oz or <u>Miravis</u> 3.4 fl oz/A + Ziram 6 lb + <u>Microthiol Disperss</u> 12 lb/A	SBFS, Bitter Rot SBFS, Bitter Rot  Mildew, Rust Mildew, Rust Mildew, Rust SBFS, Mildew, Rust  SBFS, Rust, Bitter Rot Mildew	Not Excellent for BR Not Excellent for BR,  not best on rust not best on rust not best on rust  *Should not use Aprovia **Should not use Luna Sensation, Flint Extra, Merivon, Pristine (no rust)



SECOND / THIRD COVER	Advantage	Disadvantage
Inspire Super 12 fl oz or Captan 3 LB/A + Prophyt** 64 fl.oz./A Captan 3 LB/A + Topsin M** 1 lb/A Captan 2.5 LB/A + Ziram 6 lbs/A Captan 3 LB/A + Ziram 6 lb	SBFS SBFS SBFS SBFS, Rust SBFS  SBFS, Rust, Bitter Rot	*Should not use Aprovia **Should not use Luna Sensation, Flint Extra, Merivon, Pristine (no rust)







# KENJA<sup>®</sup> 400SC

## FUNGICIDE

ACTIVE INGREDIENT: Isofetamid*	36.0%
OTHER INGREDIENTS:	64.0%
Total	100.0%

\*N-[1,1-dimethyl-2-[2-methyl-4-(1-methylethoxy)phenyl]-2-oxoethyl]-3-methyl-2-thiophenecarboxamide

Contains 3.33 pounds Isofetamid Per Gallon (400 grams per liter)

### KEEP OUT OF REACH OF CHILDREN

### CAUTION

See side panel for additional precautionary statements.  
Read entire label carefully and use only as directed.

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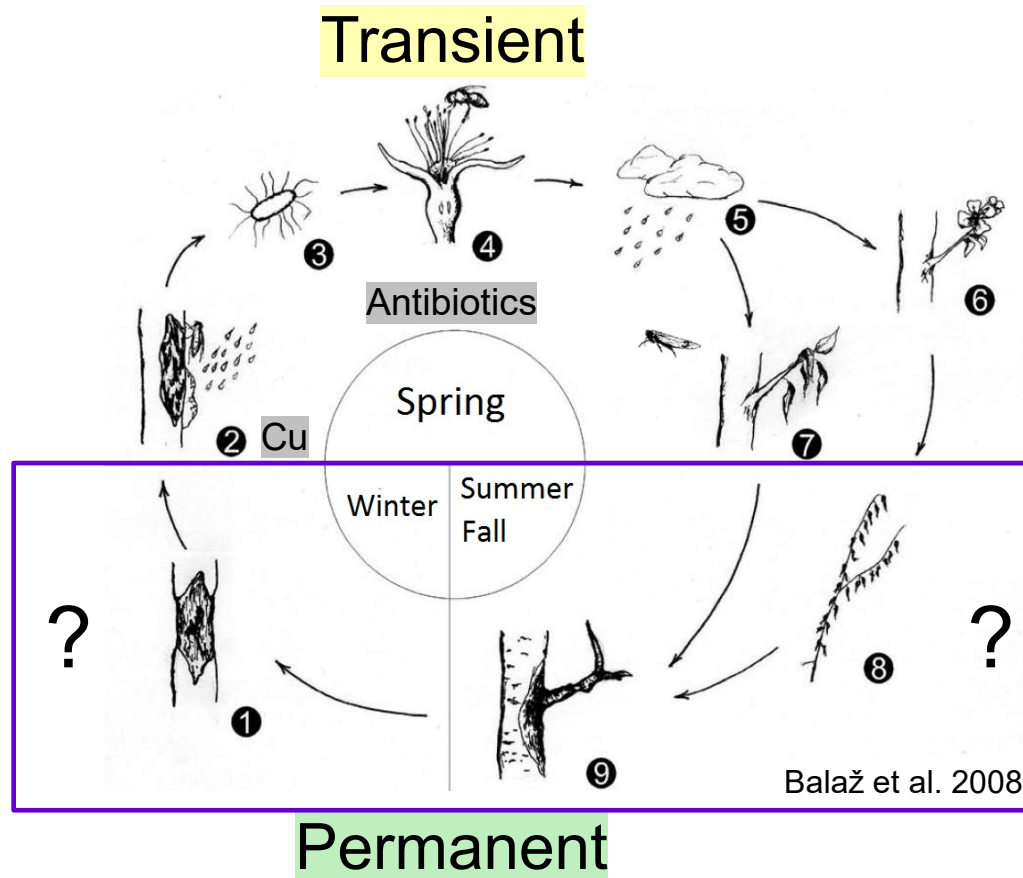
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# Kenja Uses

DIRECTIONS FOR USE			
Crop	Diseases	Use Rate Fl. Oz. Product Per Acre	Instructions
Pome Fruit, Crop Group 11-10	Apple scab ( <i>Venturia inaequalis</i> ) Pear scab ( <i>Venturia pirina</i> ) Suppression: Powdery mildew ( <i>Podosphaera leucotricha</i> )	12.5 fl oz (0.326 lb. a.i./A)	<p><b>Application Instructions:</b> Initiate applications prior to disease development and continue on a 10 to 14-day interval.</p> <p>Apply KENJA 400SC in sufficient water to obtain adequate coverage of the foliage. Spray volume will usually be 100 to 200 gallons per acre.</p> <p><b>Resistance Management:</b> Do not make more than 2 sequential applications of KENJA 400SC FUNGICIDE or other Group 7 containing fungicides before rotating to a fungicide with a different mode of action.</p> <p><b>Restrictions:</b> Do not apply more than 6 applications/A/year (75 fl oz/A/year (1.956 lb. a.i./A/year)) In the State of New York, do not apply more than 5 applications/A/year at 0.326 lb. a.i./application (1.63 lb. a.i./A/year).</p> <p>The Pre-Harvest Interval (PHI) for this crop group is 20 days</p>
Includes all members of the Pome Fruit Crop Group 11-10: Apple; azarole; crabapple; loquat; mayhaw; medlar; pear; pear, Asian; quince; quince, Chinese; quince, Japanese; tejocote; and cultivars, varieties, and/or hybrids of these.			
Stone Fruit, Crop Group 12-12	Blossom blight, Brown rot ( <i>Monilinia spp.</i> )	12.5 fl oz (0.326 lb. a.i. /A)	<p><b>Application Instructions:</b> Initiate applications prior to disease development and continue on a 7 to 14-day interval.</p> <p>Apply KENJA 400SC in sufficient water to obtain adequate coverage of the foliage. Spray volume will usually be 100 to 200 gallons per acre.</p> <p><b>Resistance Management:</b> Do not make more than 2 sequential applications of KENJA 400SC FUNGICIDE or other Group 7 containing fungicides before rotating to a fungicide with a different mode of action.</p> <p><b>Restrictions:</b> Do not apply more than 3 applications/A/year (37.5 fl oz/A/year (0.978 lb. a.i./A/year))</p> <p>The Pre-Harvest Interval (PHI) for this crop group is 1 day.</p>
Includes all members of the Stone Fruit Crop Group 12-12: Apricot; apricot, Japanese; capulin; cherry, black; cherry, Nanking; cherry, sweet; cherry, tart; Jujube, Chinese; nectarine; peach; plum; plum, American; plum, beach; plum, Canada; plum, cherry; plum, Chickasaw; plum, Damson; plum, Japanese; plum, Klamath; plum, prune; plumcot; sloe; and cultivars, varieties, and/or hybrids of these.			

# *Erwinia amylovora* Survives in Cankers



# Fire Blight Predictions (MaryBlyt)

## - Model, Flowers Still Open -

WATCH TUTORIAL [↗](#)

All Stations

● Winchester (VT AHS AREC), VA | [▼](#)

First Blossom Open Date

[📅](#) 04/11/2022 [clear](#)

The [first blossom open](#) above is estimated based on degree day accumulations. Enter the actual first blossom open date for your orchard block of interest and the tool will calculate the protection period during bloom more accurately.

Accumulated degree days (base 43°F BE) through 2022-05-04: **741**

1. Open flowers
  2. Accumulate heat units in bloom for inoculum to reach threshold
  3. Wetting event after this point to wash bacteria flower down in flower (spray water)
  4. Average temperature above 60F.
- EIP (Epiphytic Infection Potential) - index for infection risk for enough heat
  - Threshold for infection is  $EIP \geq 100$

### Results Table

[Download CSV](#)

[Forecast Details](#)

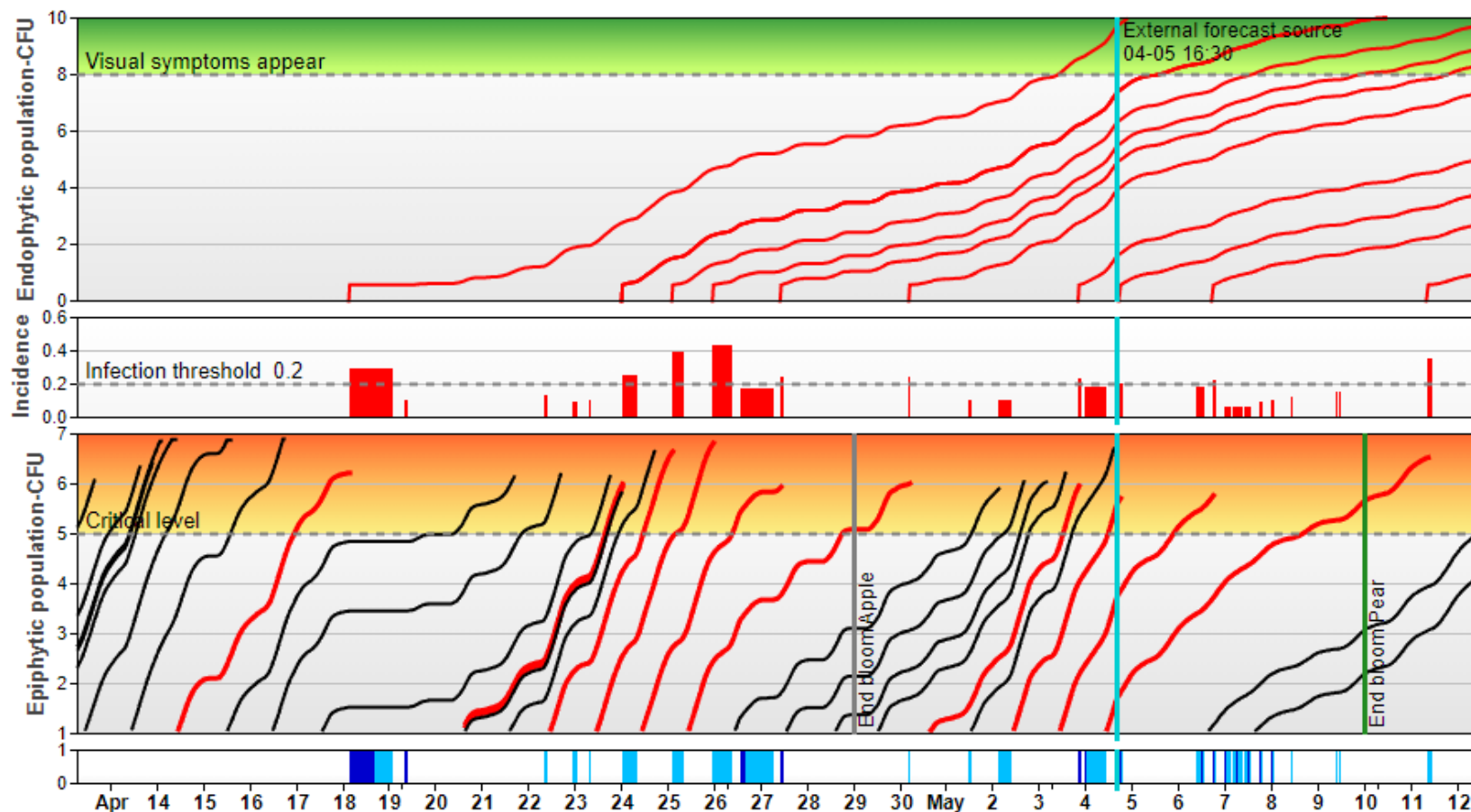
Date (2022)	Cougar Blight 4-Day DH	Infection Potential EIP value
	Risk Levels: <a href="#">Low</a> <a href="#">Caution</a> <a href="#">High</a> <a href="#">Extreme</a>	Risk Levels: <a href="#">Low</a> <a href="#">Moderate</a> <a href="#">High</a> <a href="#">Infection</a>
May 2	257	56
May 3	297	66
May 4 Forecast	419	103
May 5 Forecast	458	110
May 6 Forecast	254	38
May 7 Forecast	195	19
May 8 Forecast	50	0
May 9 Forecast	4	0

# Fire Blight RIMpro Model



## Fire Blight (Erwinia) - Rustburg (Bryant) - 2022

Indicated potential infection events only relevant for trees in bloom.



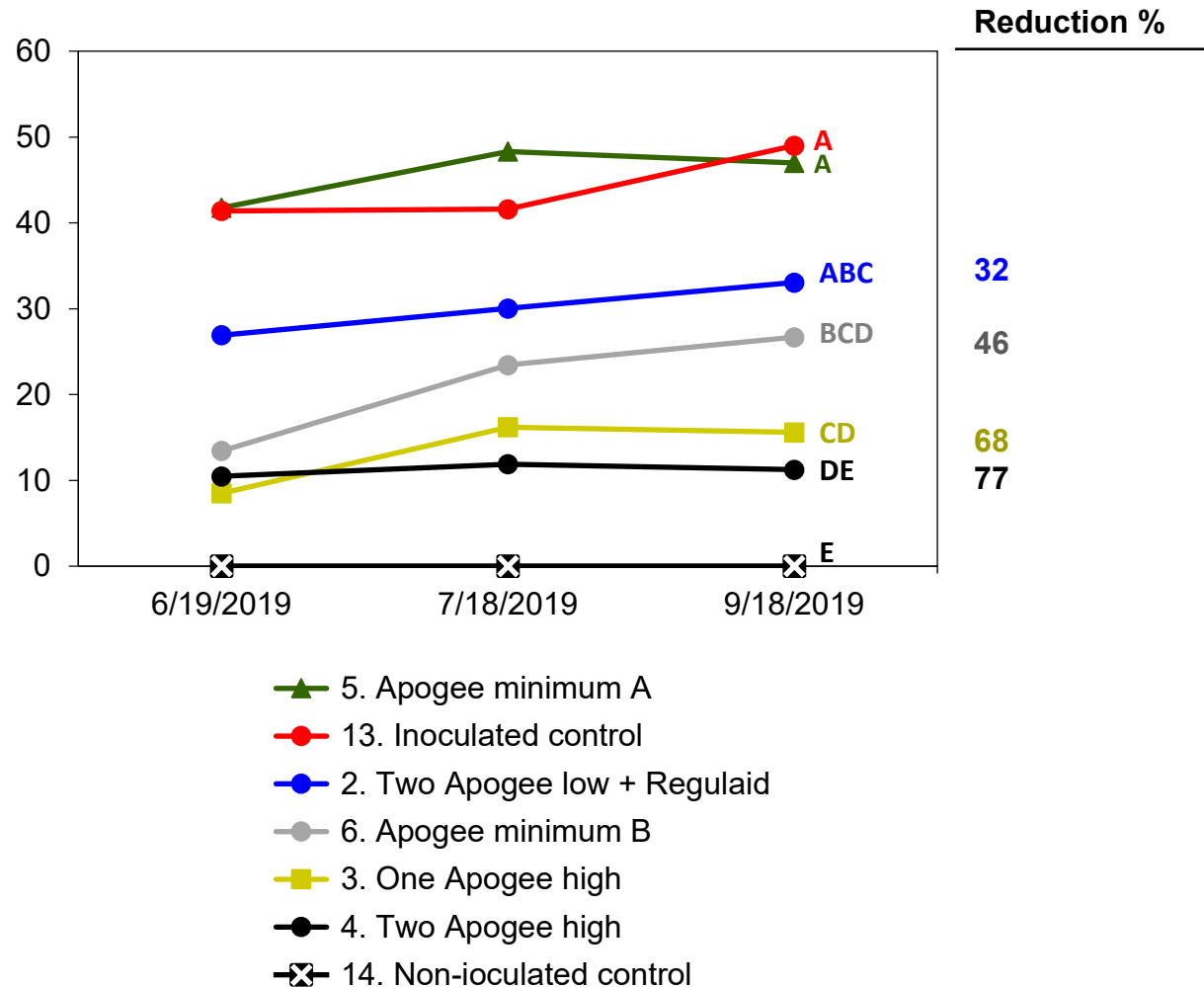


## Cankers Can Kill Spindle-shaped Apple Trees



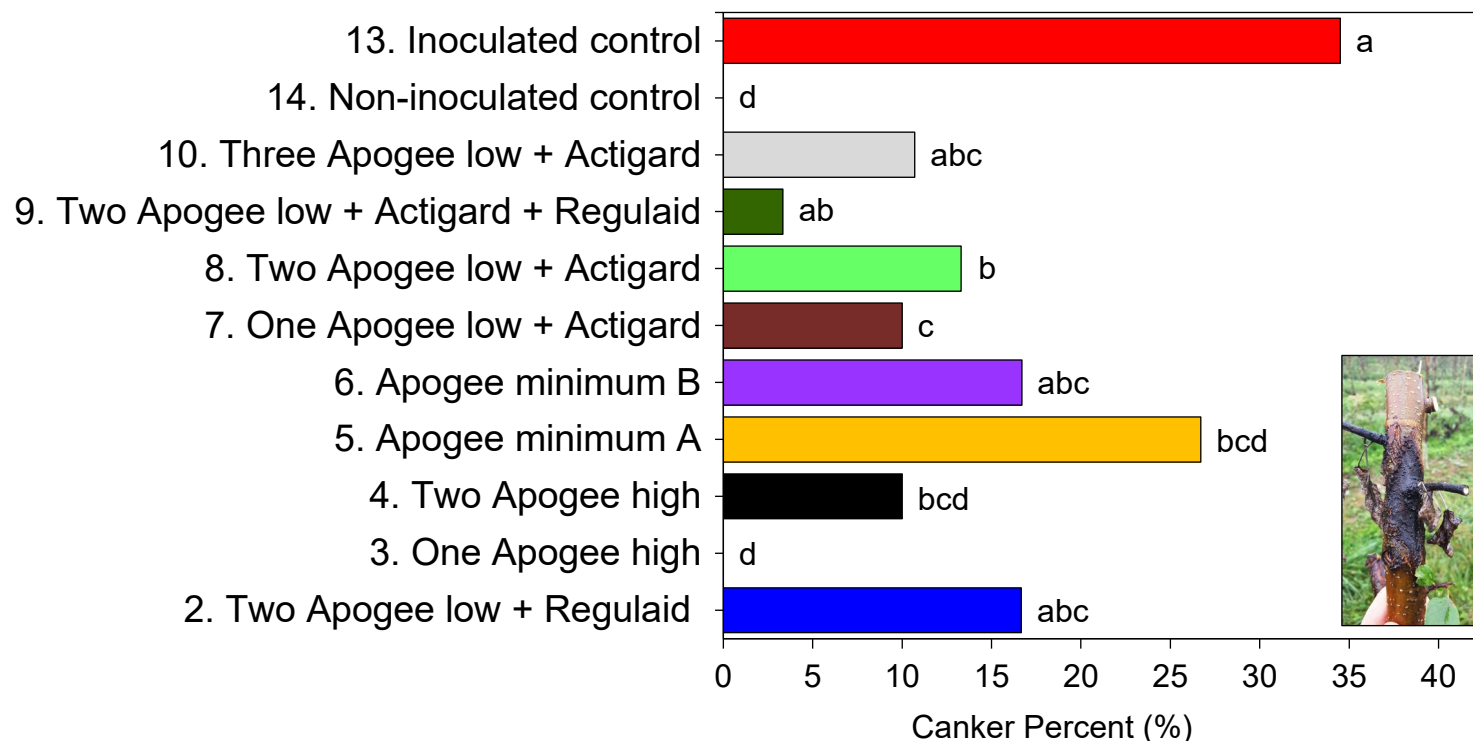
# Post-Infection Regalis Programs

## - Severity Reduction -



# Post-Infection Regalis Programs

## - Canker Prevention 9/18 -



H: Different application methods could improve efficacy of Regalia as an SAR activator candidate on apple and pear.



# PEARS EXTINCT



**Serbia – Backo Dobro  
Polje**

**October – November 2006**







# 1. Pear Fire Blight Experiment 2019

- On 'Bartlett' -

Gerber Nestle funded project - Treatments:

1. **Regalia @ 2 X 76.8 fl oz/A (2 X 5.6 L/ha) – trunk injection in fall 2018**
2. **Regalia @ 5 X 30.72 fl oz/A (5 X 2.24 L/ha) – five foliar sprays in Spring, Bud burst, Green cluster, White bud, Petal fall, Fruit set.**
3. **Arbor-OTC @ 1 X 0.31 g / 2.5 cm trunk – trunk injection at bud burst (36.7% oxytetracycline, 10% water solution).**
4. **FireLine @ 16 oz/A (1.1 kg/ha) + Regulaid @32 fl oz/100 (0.25 %) X 2 Bloom spray, at least twice before inoculation (17% oxytetracycline)**
5. **Agri-mycin @16 oz/A (1.1 kg/ha) + Regulaid @32 fl oz/100 gal (0.25%) X 2, bloom spray, at least twice before inoculation (17% streptomycin)**
6. Untreated control injected with Water, spring 2019
  - 100 Gal/A
  - **Three** replicate trees per treatment
  - Shoot inoculation: 10 shoots / tree
  - Rate shoot blight severity
  - Canker incidence and severity on wood



**FireLine**<sup>TM</sup>  
17 WP

**Agri-Mycin® 17**

# 1. Application Timing

- New York 2019 -

- FALL - PRIOR LEAF DROP
- BUD BURST
- GREEN CLUSTER
- WHITE BUD
- BLOOM
- PETAL FALL
- FRUIT SET
- 25 May 2019
- SHOOT INOCULATION

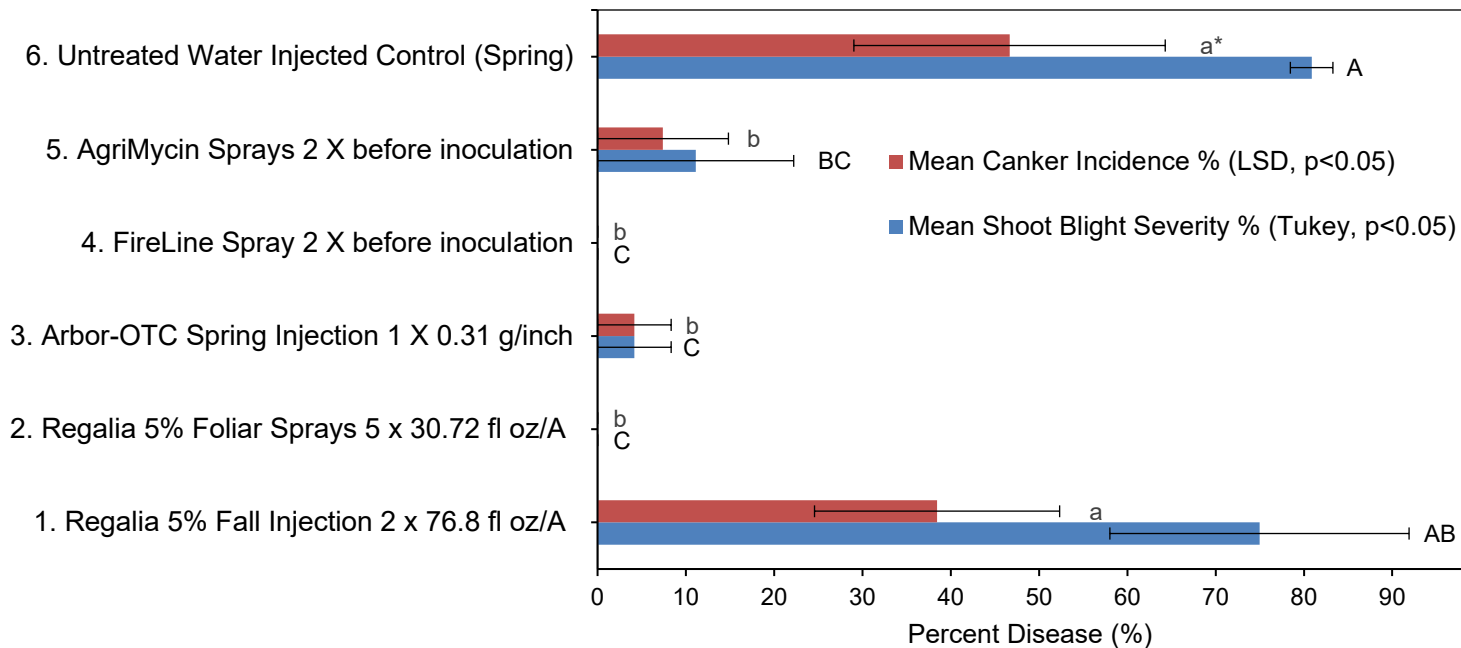


ulation

0<sup>8</sup> CFU

# 1. Pear Shoot Blight & Canker Control

- 23 June 2019 -



# Apple Bitter Rot

## 16 *Colletotrichum* spp. Infect Pome Fruit

### *Colletotrichum acutatum* species complex - cooler regions:

- *C. fioriniae* (Clade 2)
- *C. nymphaeae* (Clade 3)
- *C. acutatum* (Clade 4)
- *C. paranaense*, *C. melonis*, *C. acerbum*,  
*C. godetiae*, *C. pyricola*, *C. rhombiforme*,  
*C. salicis*, *C. piri*

### *C. gloeosporioides* species complex - warmer regions:

- *C. gloeosporioides* (*G. cingulata*)
- *C. siamense*
- *C. theobromicola*
- *C. fructicola*
- *C. alienum*
- *C. aenigma*

### *C. boninense* complex

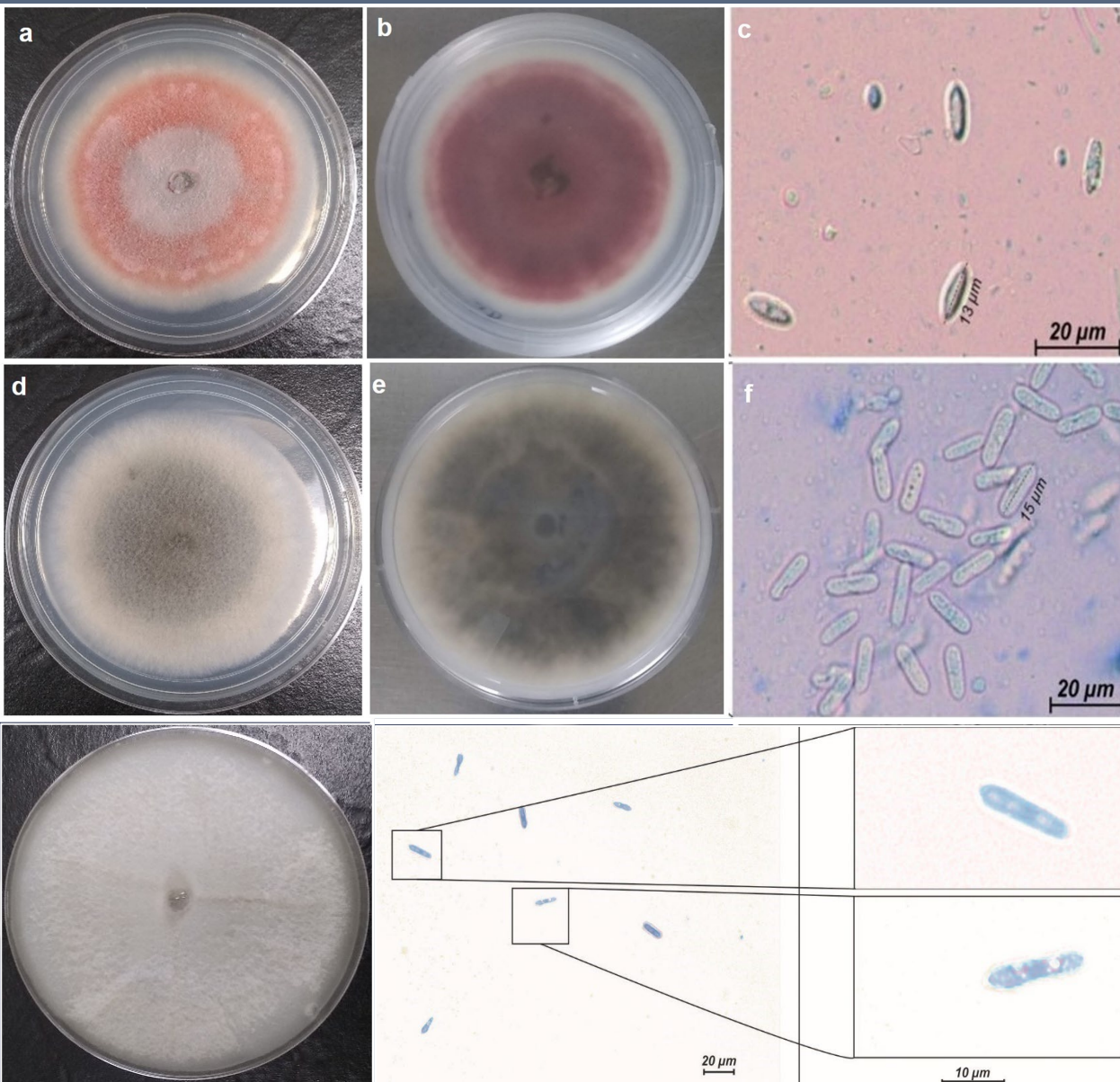
- *C. karstii*



*Glomerella* leaf spot  
Fuji, Jonagold,  
defoliation



# Northeastern *Colletotrichum* spp.



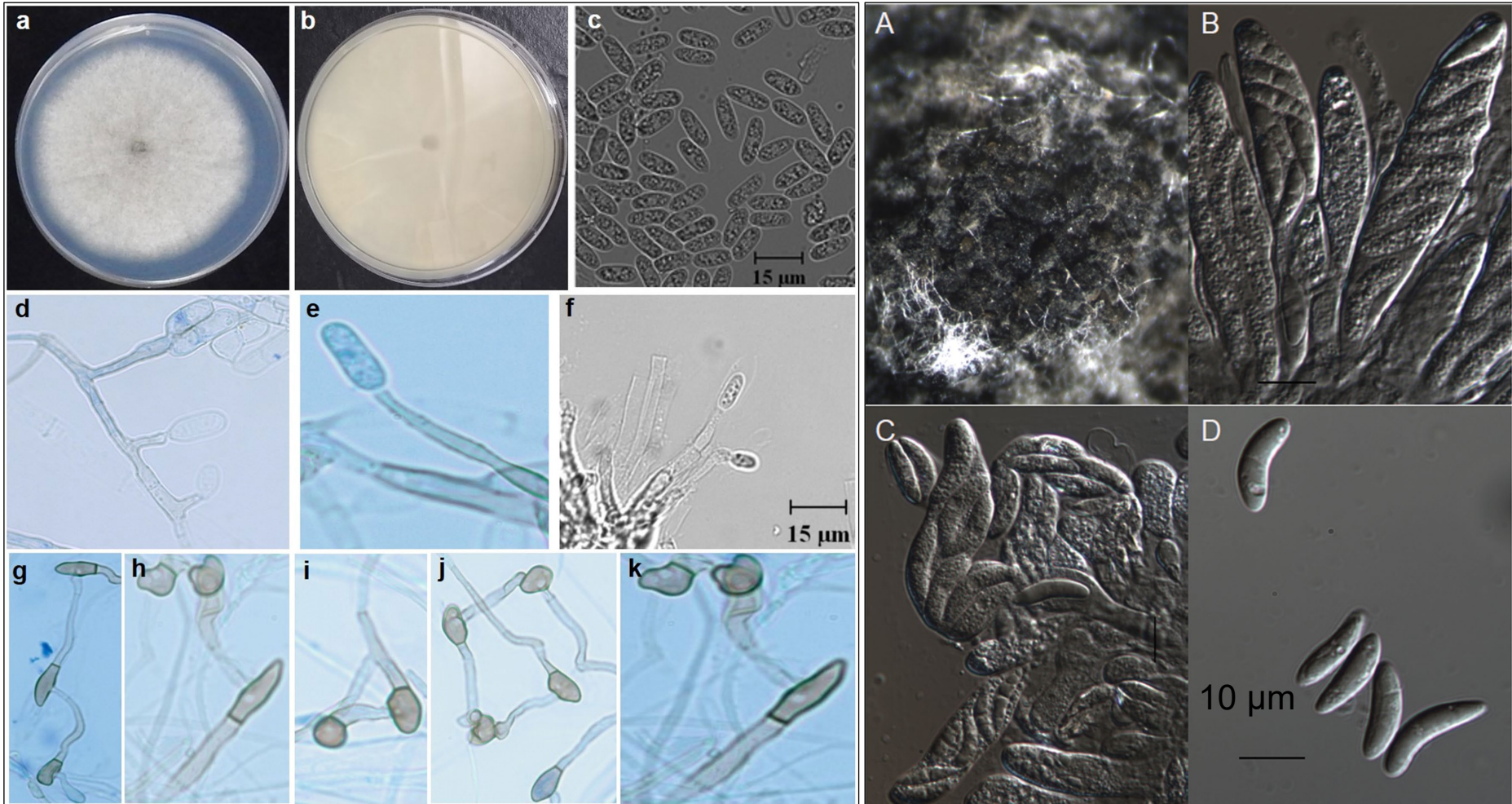
60% *C. fioriniae* in CASC  
in cooler regions (~ 77°F)  
(ITS, *TUB2* and *GAPDH*)

25% *C. chrysophilum* in  
CGS complex (~ 86°F)

12.5% *C. noveboracense*  
sp. nov. CGS complex (~  
86°F)

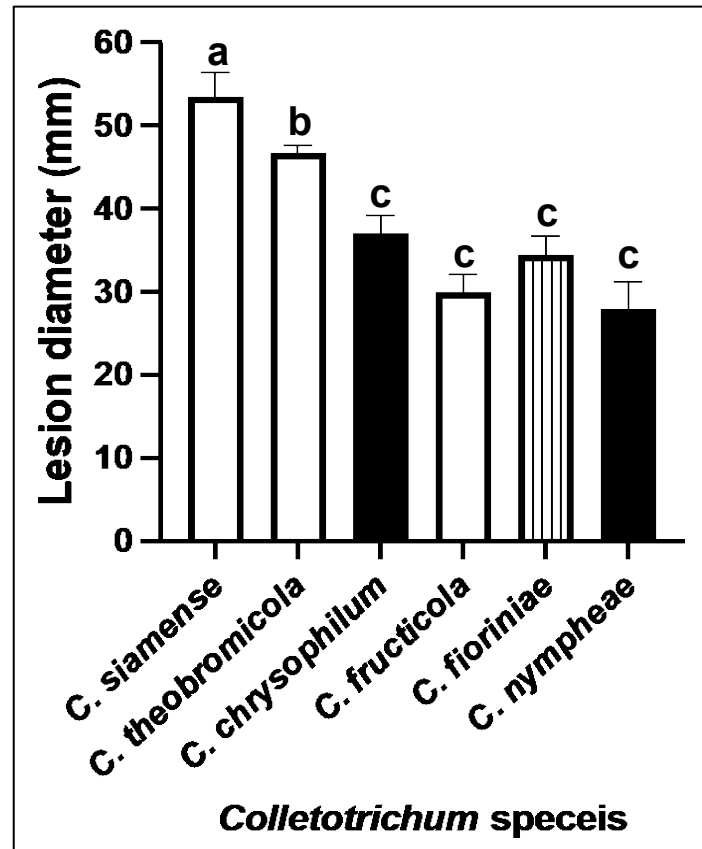
# *C. noveboracense* sp. nov.

## - Morphology -



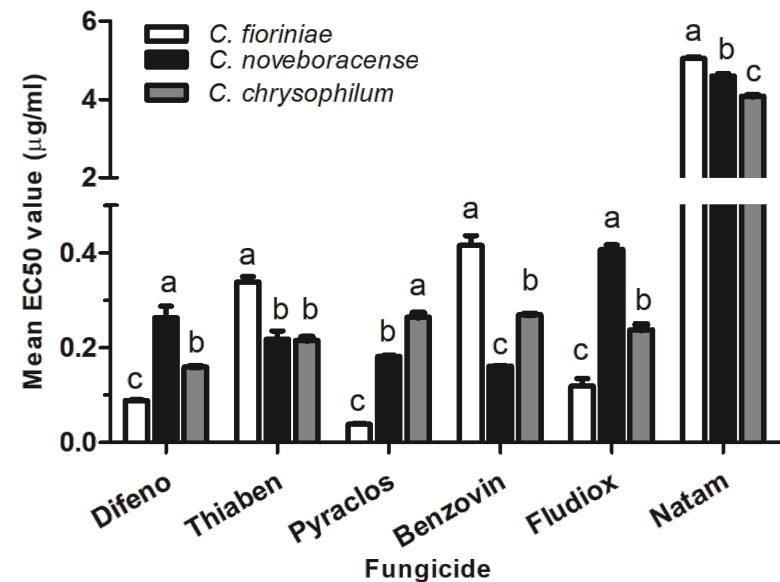
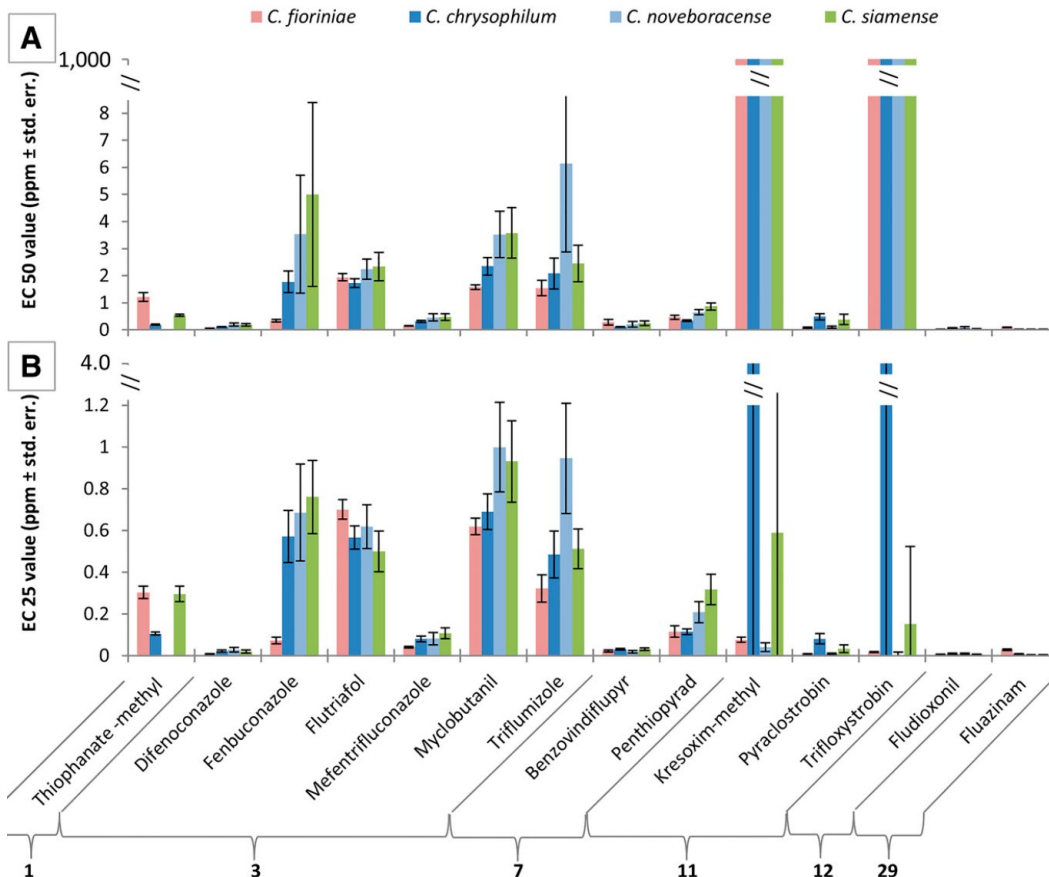


## *Colletotrichum* Species Differ in Pathogenicity



# *Colletotrichum* spp. Differ in Sensitivity to Fungicides

## - Resistance Mechanisms -



# Effective Fungicides in the Orchard?

- *C. fioriniae* Trial 2020 -

# 2022 Fungicide Efficacy Trial for Bitter Rot in Virginia

#	Spray materials and rate	Active ingredient (FRAC code, Mode of Action)	Appl. Time	Spray interval	
1	Regalia 64 fl oz/A + JMS Stylet-Oil 1 gal/100 gal	extract from Reynoutria sachalinensis (P05, anthraquinone elicitor)	3 <sup>rd</sup> to 9 <sup>th</sup> cover spray*	14 days or 2 inches of rain, whichever comes first, but if no rain occurred for 14 days, extend spray interval to 21 days, under the condition that we do not get rain during the 7 additional days.	
2	Regalia 128 fl oz/A + JMS Stylet-Oil 1 gal/100 gal				
3	Actigard 2 oz/A	acibenzolar-S-methyl (P01, SAR activator)			
4	Reliant 2.5 quarts/A	(P07, phosphonates)			
5	Prophyt 64 fl oz/A				
6	EcoSwing 0.5 Gal/A	extract of Swinglea glutinosa (BM01, affects fungal spores and germ tubes, induced plant defense)			
7	Vacciplant 60 fl oz/A	laminarin (P04, polysaccharide elicitor)			
8	FungOUT 3.75 gal/A	1.07% citric acid (NA**)			
9	Flint Extra 2.9 fl oz/A	trifloxystrobin (11, QoI)			
10	Sovran 6.4 oz/A	kresoxim-methyl (11, QoI)			
11	Cabrio 11.84 oz/A	pyraclostrobin (11, QoI)			
12	Aprovia 5.5 fl oz/A	benzovindiflupyr (7, SDHI)			
13	Omega 500 13.8 fl oz	fluazinam (29, UOPP)			
14	Omega 500 6.9 fl oz	fluazinam (29, UOPP)			
15	Ziram 6 lb/A	ziram (M03, multisite)			
16	Captan 80 WDG 3 lb/A	captan (M04, multisite)			
17	Ferbam Granuflo 4.6 lbs/A)	ferbam (M03, multisite)			
18	Grower Standard	difenoconazole (3, DMI) + cyprodinil (9, AP) + captan (M04)			If any rain event occurs between 14 and 21 days, apply fungicide before that rain regardless was 21 days reached or not.
	• Inspire Super 12 fl oz/A + Captan 80 WDG 2.5 LB/A				
	• Topsin M 1 lb + Captan 80 WDG 2.5 lb				
	• Topsin M 1 lb + Captan 80 WDG 2.5 lb				
	• Prophyt 64 fl oz + Captan 80 WDG 2.5 lb				
	• Flint Extra 2.9 oz + Captan 80 WDG 2.5 lb				
	Flint Extra 2.9 oz + Captan 80 WDG 2.5 lb	trifloxystrobin (11, QoI) + captan (M04)			
19	Untreated inoculated control	-	-	-	
20	Untreated non-inoculated control	-	-	-	

# 2022 Fungicide Efficacy for Bitter Rot in Virginia

## - 26 July 2022 -

% Incidence of Bitter Rot on apple fruit

1. Reg. 64 fl oz/A + St.Oil 1 gal/100
2. Reg. 128 fl oz/A + St.Oil 1 gal/100
3. Actigard 2 oz/A
4. Reliant 2.5 qts/A
5. Prophyt 64 fl oz/A
6. EcoSwing 0.5 Gal/A
7. Vacciplant 60 fl oz/A
8. Flint Extra 3.75 gal/A
9. Sovran 6.4 oz/A
10. Cabrio 11.84 oz/A
11. Aprovia 5.5 fl oz/A
12. Omega 500 13.8 fl oz/A
13. Omega 500 6.9 fl oz
14. Captan 80 WDG 3 lb/A
15. Ferbam 4.6 lb/A
16. GrowerSTD
17. Untreated Inoculated Control
18. Non-Inoculated Control

# Your Goal: Preserve Efficacy of Group 11 Fungicides

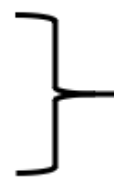
- **Limit strobilurins (Group 11) to 4 spray applications per season**
- **Reduce risk for bitter rot fungicide resistance**
- **Apply Group 11 before warm wetting events (favor bitter rot)**
- **Alternate Group 11 with SDHI, UOP, Multisite fungicides**
- One cover spray lasts: 14 days or 2 inches of rain, whichever comes first (single or many summed events),
- If no rain falls for 14 days, extend the spray interval to 21 days, under the condition that no rain occurs during the 7 additional days.
- If rain event occurs during additional 7 days, apply fungicide before that rain regardless if reached 21 days or not.



# My Recommendations for Bitter Rot

## 13 cover spray options:

- 1C: Inspire Super 12 fl oz/A + Captan 80 WDG 3 lb/A
- 2C: Topsin M 1 lb + Captan 80 WDG 3 lb
- 3C: Prophyt 64 fl oz + Captan 80 WDG 3 lb
- +C: **Aprovia 5.5 fl oz (30 PHI)** + Captan 80 WDG 3 lb
- +C: **Aprovia 5.5 fl oz (30 PHI)** + Captan 80 WDG 3 lb
- 4C: Flint Extra 2.9 oz + Captan 80 WDG 3 lb
- +C: **Omega 13.8 fl oz (28 PHI)** + Captan 80 WDG 3 lb
- +C: **Omega 13.8 fl oz (28 PHI)** + Captan 80 WDG 3 lb
- 5C: Pristine 14.5 oz + Captan 80 WDG 3 lb
- 6C: Captan 80 WDG 3 lb
- 7C: Merivon 5.5 fl oz + Captan 80 WDG 3 lb
- 8C: Captan 80 WDG 3 lb
- 9C: Merivon 5.5 fl oz + Captan 80 WDG 3 lb



Not effective

**2 X SDHI (group 7)**

**QOI (group 11)**

**2 X UOP (group 29)**

**QOI (group 11)**

**Multisite**

**QOI (group 11)**

**Multisite**

**QOI (group 11)**

**Multisite**

# Timing and Other Considerations

- Assume fruit are susceptible at all stages of growth
- Irrigate well ahead of heat waves = Prevent tree drought/heat stress
- Weather conducive to infection and bitter rot development
  - Start 1-2 weeks after petal fall **until harvest**
  - In Pennsylvania start effective fungicides **15 June**
  - In Virginia start effective fungicides **1st June**
  - Spray before warm wetting events (warm nights)
  - **Late cultivars = more sprays, October, November**
    - Flint, Pristine, Captan, Merivon, **Sovran**, Luna Sensation (blossom end rot)
    - Ziram high rate (dithiocarbamate)
    - Ferbam granuflo (dithiocarbamate)
    - Captan alone (full rate): 4.0 lb / A (50 WP),  
2.5 - 5.0 lb / A (80 WDG)  
1.0 pt/100 gal (4L)
  - **Sovran** / Flint / Pristine / Topsin + Captan / Ziram, Effective on Sooty Blotch & Flyspeck

# 1. Black Rot

- *Botryosphaeria obtusa* -

Red Delicious



Cortland - Frogeye leaf spot



Gala





# 1. Black Rot

- Symptoms -



# 1. *B. obtusa* Life Cycle

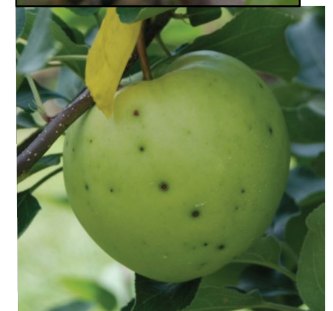
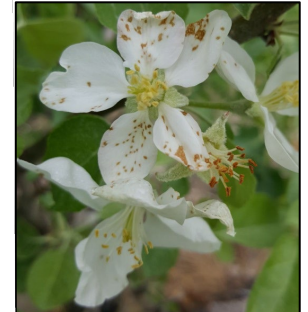
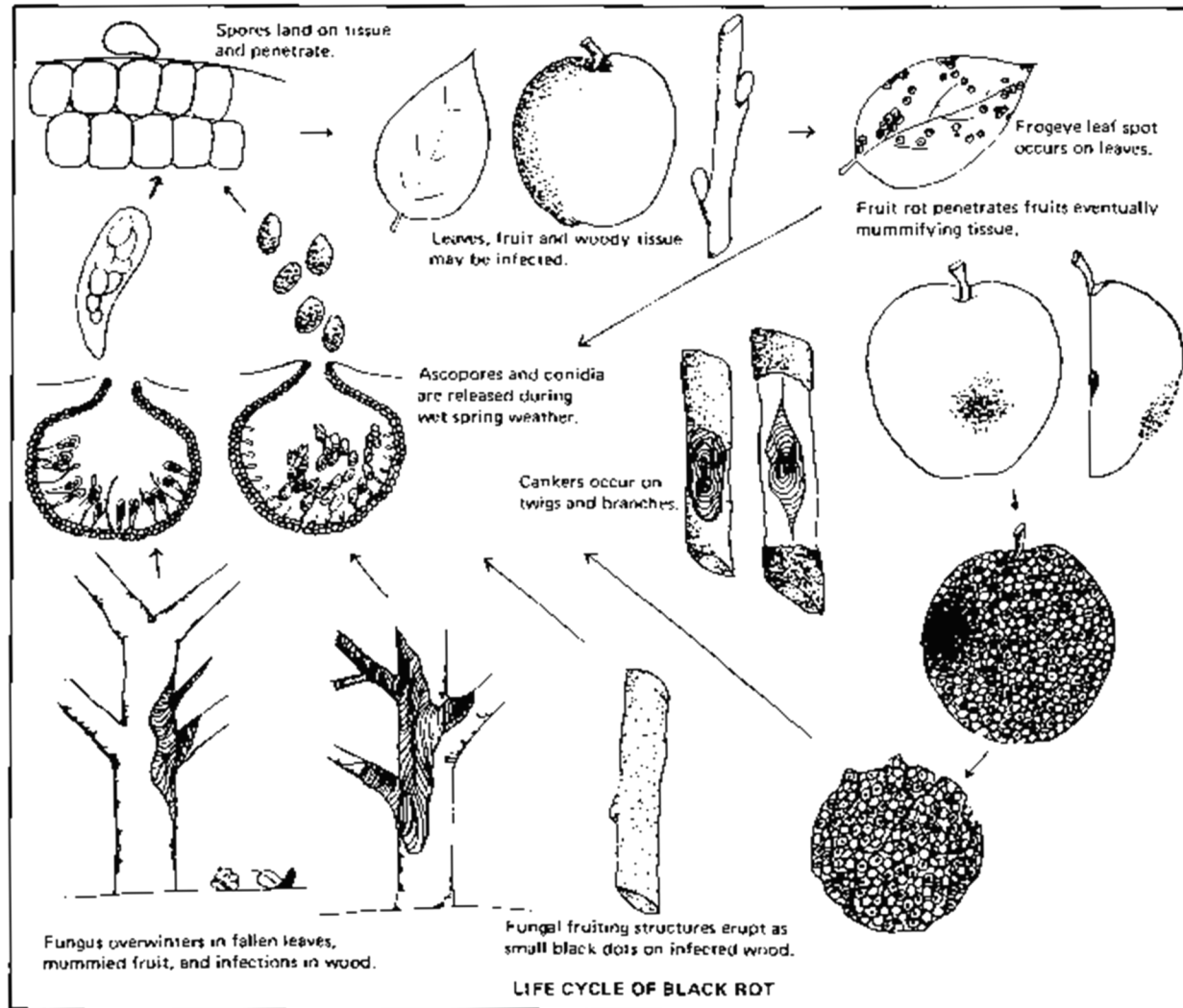


Photo by D. Rosenberger

Figure 84



## 2. White rot

- *Botryosphaeria dothidea* -



Soft, soggy, drippy rot  
Irregular margins



## 2. White rot

- *B. dothidea* -

- Overwintering same as black rot
- Causes infections in hot summer days
- **Soft rot (soggy, drippy fruit)**
- **Has irregular margins**
- **White rot on fruit in fall is firm ~ to black rot**
- It causes shallow bark cankers (trunk, branches)
- Typical sign is flaky bark on the trunk
- Drought stress helps trunk and branch infections (Schoeneweiss 1981)
- Do herbicides that hit trunk drought-stress the tree allowing *B. dothidea* in?



# Top Choice Products

## Good orchard sanitation:

- Prune, remove, burn, cankers & mummies
  - Brush should not be left flail mowed
  - Avoid pruning stubs
  - Prevent fruit bruising
  - Topsin-M / Thiophanate Methyl + Captan (8 - 16 oz + 2.5 lb)



- **Topsin - no bitter rot control**
- Flint + Captan (1.5 - 2.5 oz + 2.5 lb, also SBFS, bitter rot)
- Luna Sensation 4 - 5.8 oz (also SBFS, bitter rot)
- Merivon 4 - 5.5 oz (also SBFS, bitter rot)
- Sovran (3.2 - 6.4 oz + 2.5 lb, also SBFS, bitter rot)
- Pristine 14.5 - 18.5 oz (also SBFS, bitter rot)
- **Do not miss starting fungicides 10 July (based on Hudson Valley)**
- **You must re-cover after >2-inch rain**
- **Make sure the residue is maintained on the fruit until harvest**
- Problem in organic : liquid-lime sulfur for SBFS, oil (~1%), damage fruit skin
- Therefore fruit surface injury worsens rots in organic orchards





# ***Diplocarpon coronariae* - Marssonina Leaf & Fruit Blotch**

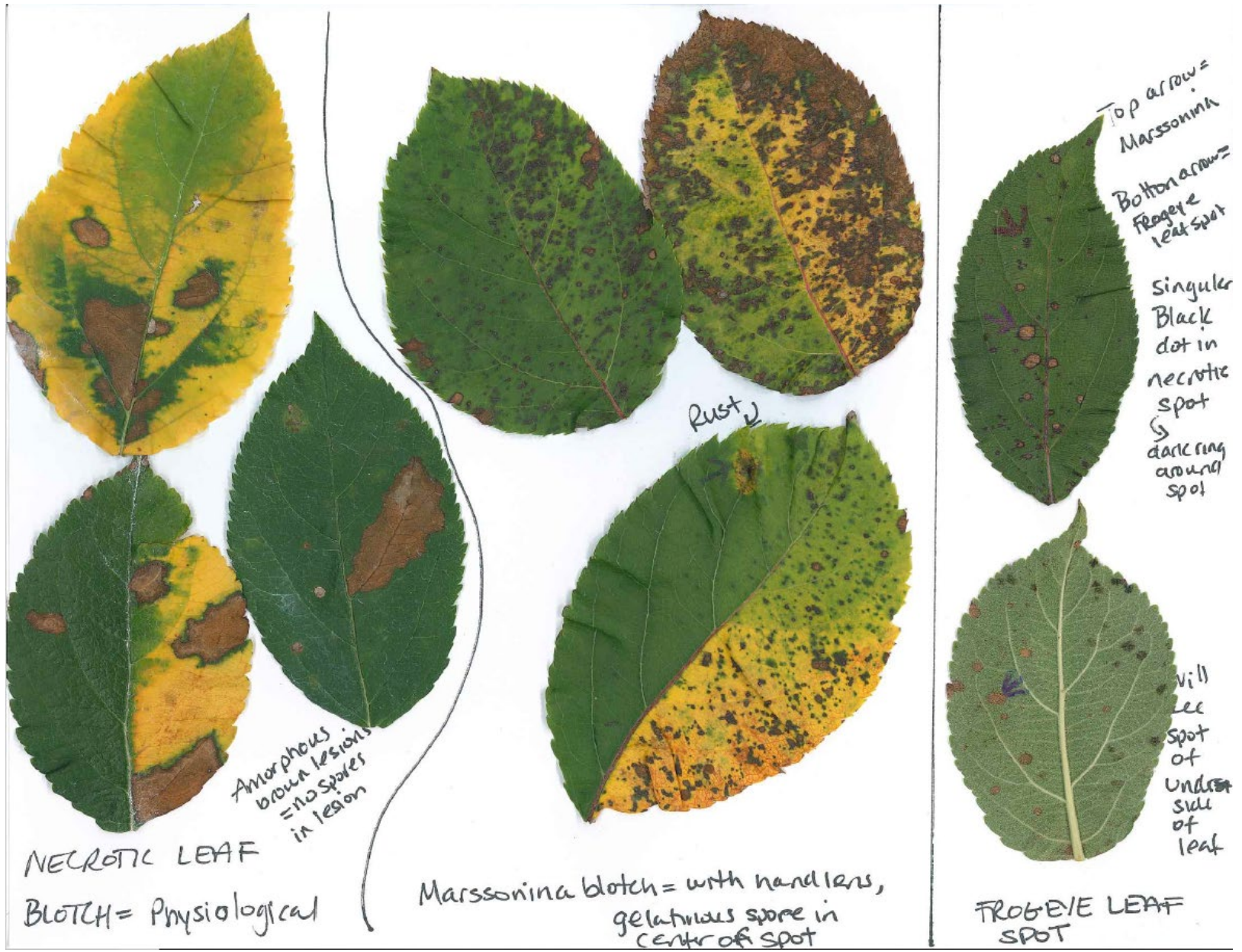
*Marssonina coronaria* ?





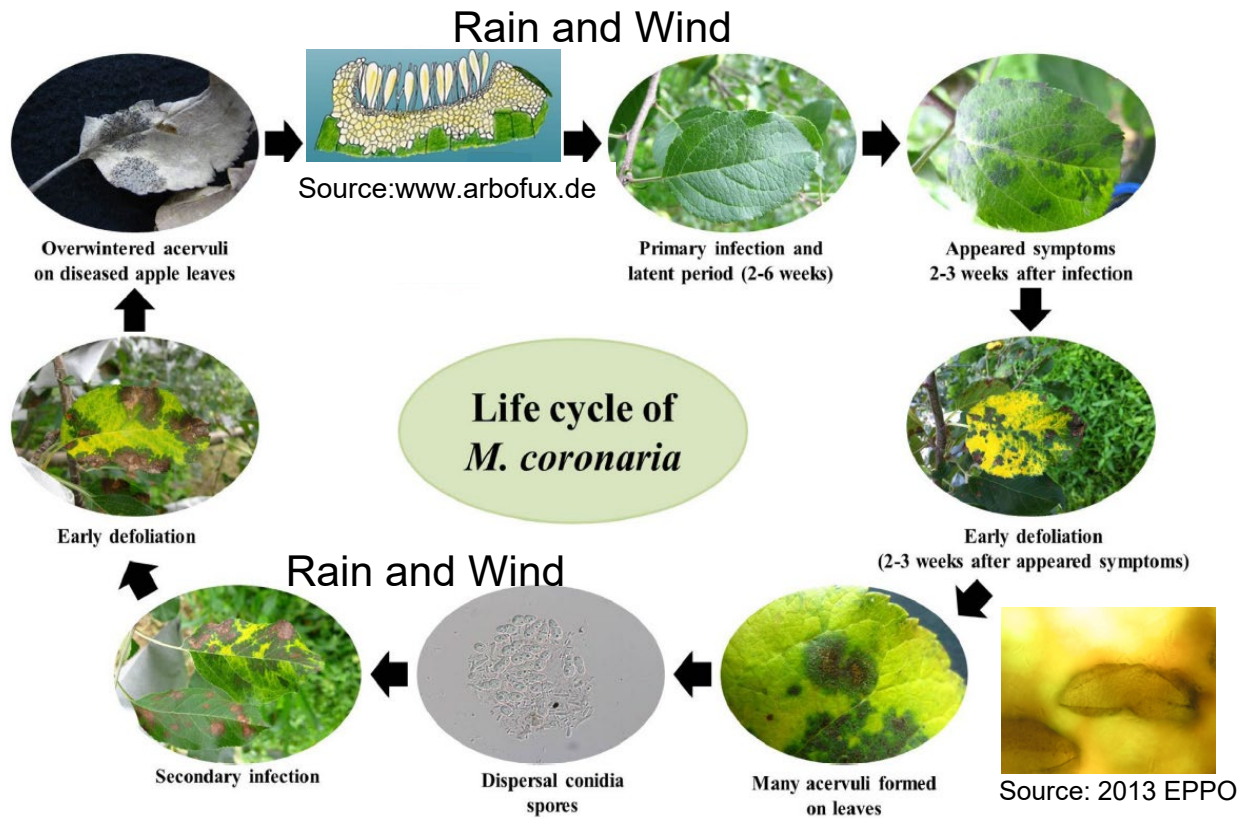
# What's the Difference?

- Kari Peter – Penn State -



# Different Leaf Spots - Marssonina Leaf Blotch

- *Marssonina* fungus -



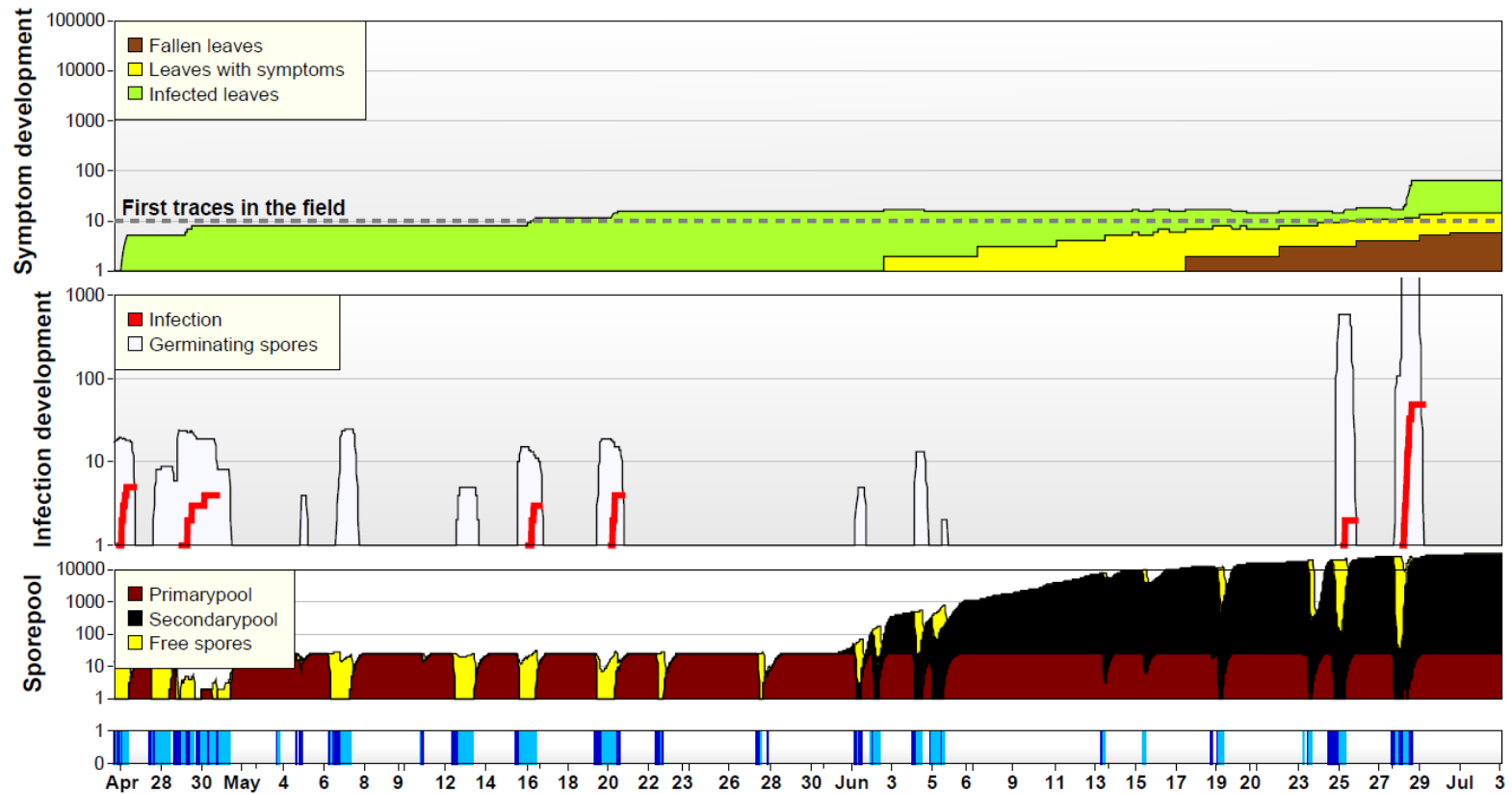
Adapted from: Back & Jung 2014, Journal of Medical Mycology 42(3):183-190

# - *Marssonina* Prediction Model -

## - Use Models -

RIMpro-Marssonina

- 2018



## FIFRA Sec. 2(ee) Recommendation

# Cevya® Fungicide

### For control of Marssonina leaf blotch in pome fruit

For use in: Connecticut, Delaware, Georgia, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, North Carolina, Ohio, Pennsylvania, Rhode Island, South Carolina, Virginia, Vermont, and West Virginia.

This Section 2(ee) Recommendation expires on December 31, 2023.

**EPA Reg. No. 7969-407**

**This recommendation is made as permitted under FIFRA Section 2(ee) and has not been submitted to or approved by the EPA.**

**All applicable directions, restrictions, precautions, and Conditions of Sale and Warranty on the EPA registered container label are to be followed.**

Information contained in this Section 2(ee) Recommendation is not intended to replace or amend any product labeling. Always read and follow all label directions when using any pesticide alone or in tank mix combinations.

The user must have this recommendation in their possession at the time of use.

---

### Directions For Use

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Apply 5 fl ozs/A of **Cevya® Fungicide** to control Marssonina leaf blotch caused by *Marssonina coronaria* in pome fruit. See pome fruit use labeling for all application instructions and restrictions.



# Dr. Kari Peter, Penn State, 2020:

**Management: Avoiding premature defoliation (can be severe) and avoiding build up of pathogen**

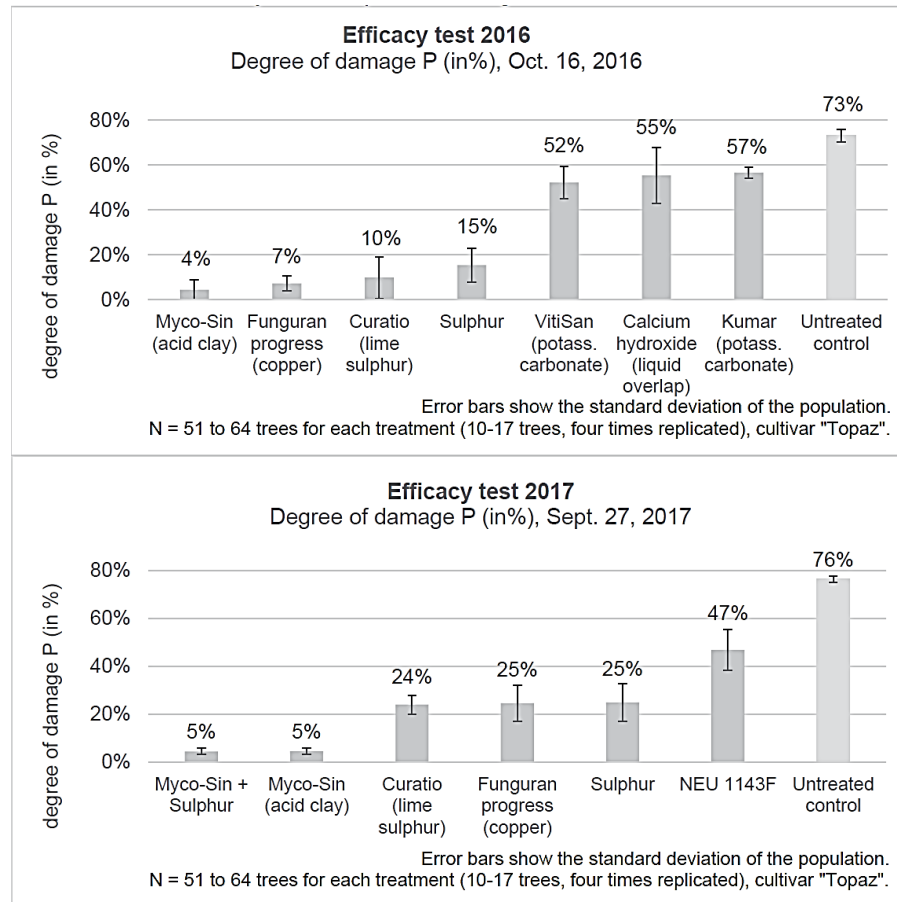


- Sanitation is key to limit disease: Overwinters in infected fallen leaves
  - Uncertain of timing of first spores
- Early season = important

Product	Marssonina control efficacy (preliminary)*
Captan	Excellent
Ziram 76 DF*	Good - Excellent
Mancozeb	Excellent
Sulfur	Good
Omega	Fair – Excellent (high rate)
Cevya, Trionic	Good - Excellent
Inspire Super	Fair – Excellent* (suppresses?)
Luna Sensation, Merivon	Excellent
Flint Extra	Fair – Excellent* (suppresses?)
Luna Tranquility	Excellent
Aprovia*, Fontelis*, Miravis, Excalia, Sercadis	Good - Excellent
Topsin M	Good
Cueva + DN, Regalia* + Stargus, Regalia+ Badge SC, Kaligreen	Poor - Fair

# Bohr et al. 2018 - Germany

From: [www.ecofruit.net/2018/12\\_Bohr\\_36-42.pdf](http://www.ecofruit.net/2018/12_Bohr_36-42.pdf)



10-12 spray applications of each from 10 or 12 Jun - 30 Aug

# Acknowledgements



Phillip Martin  
PSU



Kari Peter  
PSU



Matheus Borba

**VARP – VSHS**  
**ARDP – NYS Ag & Markets**



Thank you for attention ...

Questions?

<https://treefruitpathology.spes.vt.edu/>

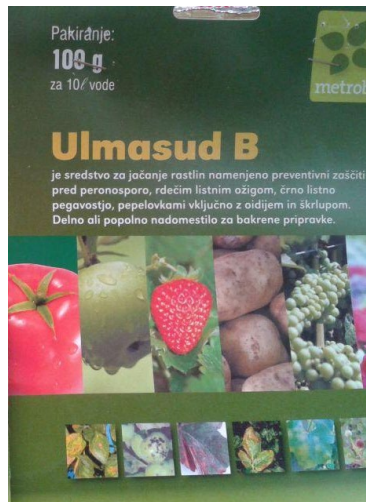




# Acid Clays in Apple Scab Control

## - Research -

- Clays control plant diseases by increasing aluminum on plant surfaces (Enkelmann and Wohlfarth, 1994).
- Aluminium ions inhibit spore germination of fungal pathogens (Andrivon, 1995; Van Zwieten et al., 2007).
- Clay keeps leaves dry, reducing the risk of pathogen infections (La Torre et al. 2018).



Mycosin



Copper Oxychloride



# Organic Scab Control - Serbia

- Balaz et al. 2010, AGES Austria visit -

Product	A. I.-s	*Conc. (%)
Acid Clay (Ulmasud B)	Aluminium-oxide 8.7% Silicon dioxide 13.7% Titanium-oxide 0.047% Sulfur 11.8%	1
Acid Clay (Ulmasud B) + Sulfur (Thiovit Jet)	- as above -  Inorganic sulfur 80%	0.8 + 0.3
Copper (Funguran OH) + Sulfur (Thiovit Jet)	Copper oxychloride 50%  Inorganic sulfur 80%	0.05 + 0.3
Spray standard	Cu, EBDC, dodine dithianon, cyprodinil, difenoconazole, hexaconazole, pirimetanil, fluquinconazol	Label

\*Sprays during primary infections: 16, 23, 29 April, 6, 13, 19, 25 May

# Acid Clay in Scab Control – Low Pressure

- 10 June 2009 (Balaz et al, 2010) -

Alone on leaves: 52-58 %; Combo 71-77%

Alone on fruit: 88%; Combo: 87%

