



**UNIVERSITY OF  
GEORGIA**

College of Agricultural &  
Environmental Sciences

*Department of Plant Pathology*

**ALMA BLUEBERRY UPDATE MEETING**



# Georgia Blueberry Disease Update

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**January 13<sup>th</sup>, 2021**



# Outline

- 2020 Disease Diagnostic Summary
- Specific Blueberry Issues During 2020
  - Yeast Rot Problems on Rabbiteye
  - First Identification of Bacterial Wilt of Blueberry in Georgia
  - Phytotoxicity on Blueberry Fruit – Spray Injuries
- Management Updates
  - Ripe Rot of Blueberry (Fungicide Resistant Anthracnose)
  - Mummy Berry
- Seasonal Spray Schedule



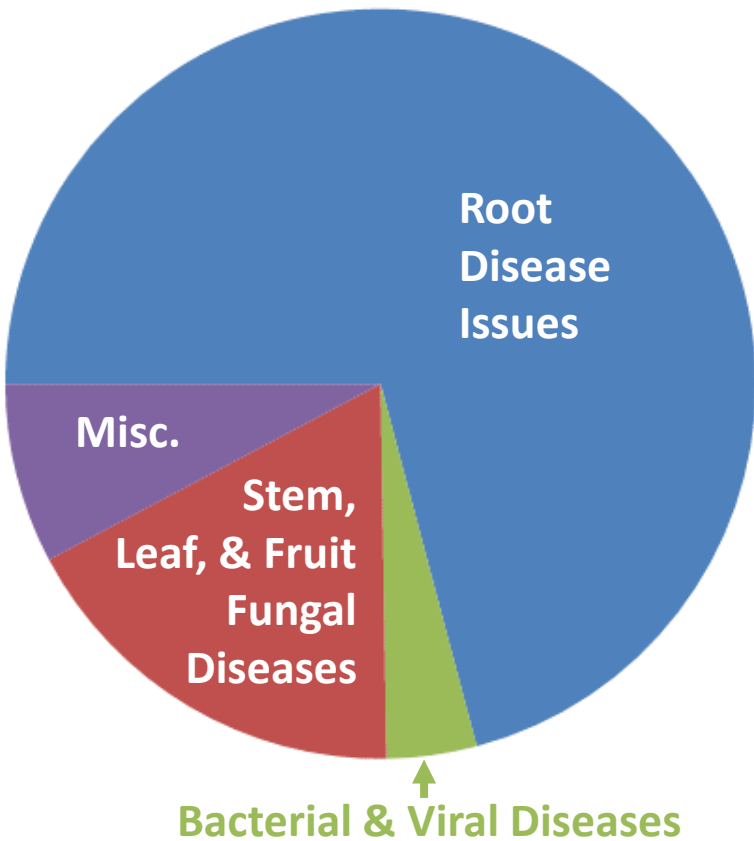
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## Disease Diagnoses on Blueberry Samples by UGA Plant Disease Clinic: [samples submitted in 2020]

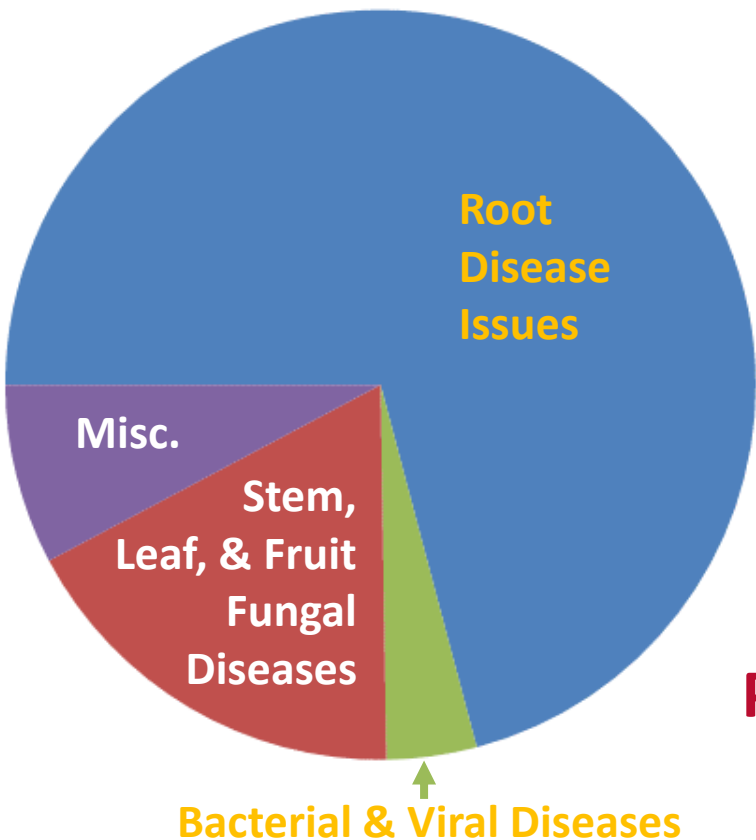
**103 Diagnosed Issues**





## Disease Diagnoses on Blueberry Samples by UGA Plant Disease Clinic: [samples submitted in 2020]

103 Diagnosed Issues



### Root Disease Issues:

*Phytophthora cinnamomi*: 40

Rhizoctonia: 26

Root problem (unknown cause): 7

### Bacterial and Viral Diseases:

Bacterial Wilt (*Ralstonia*): 2

Bacterial Leaf Scorch (*Xylella*): 1

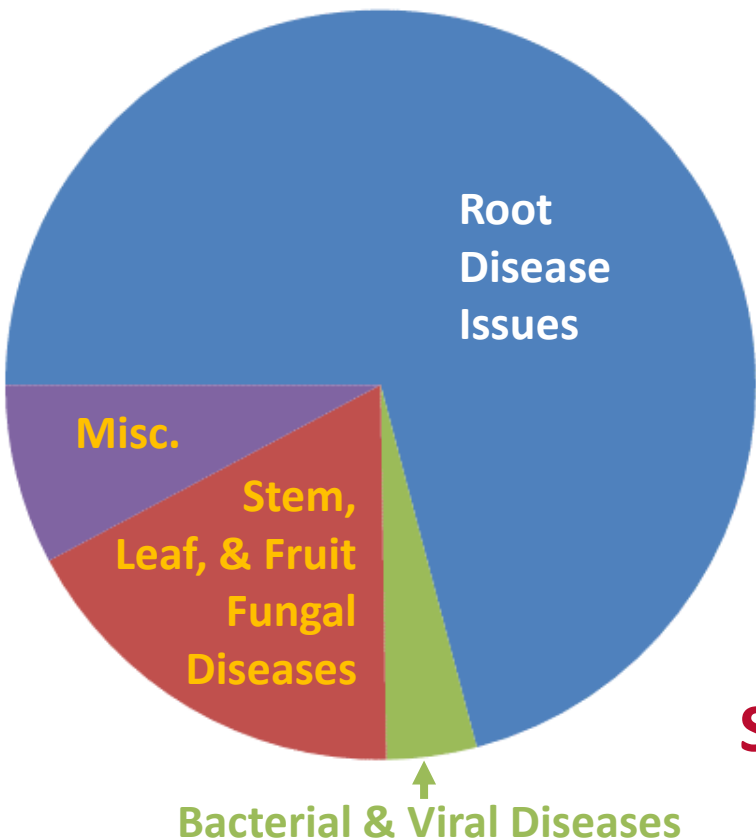
*Blueberry red ringspot virus*: 1

**Phytophthora continues to be our most frequently diagnosed disease issue**



## Disease Diagnoses on Blueberry Samples by UGA Plant Disease Clinic: [samples submitted in 2020]

103 Diagnosed Issues



### Stem, Leaf, and Fruit Fungal Diseases:

*Pucciniastrum* sp. (Rust): 4

Botryosphaeria Stem Blight: 4

*Fusicoccum* sp.: 4

*Pestalotia* sp. (Fruit Rot): 3

*Phyllosticta* sp. (Leaf Spot): 2

*Colletotrichum* sp. (Anthracnose): 1

### Misc. Issues:

Insect or mite damage: 3

Sooty mold: 2

Unknown: 2

Environmental stresses: 1

**Spring rust epidemics continue to be an  
issue following warm winters**





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# Yeast Rot Problems on Rabbiteyes

- In late May 2020, several growers and packing houses in Georgia began reporting severe problems with fruit quality.
- Soft, splitting fruit were common, and diagnostic samples were noted to be heavily infested with yeasts.
- As a result of these issues, packing houses in Georgia were forced to reject numerous loads of harvested fruit, many blueberry packing lines shut down early, and many harvests were abandoned completely.
- Economic losses were significant.



J. Jacobs

**Fruit splits on 'rabbiteye' blueberry**





# Yeast Rot Problems on Rabbiteyes

- Yeast rot is a typically sporadic post-harvest rot of blueberries caused by the fungus *Aureobasidium pullulans*.
- This fungus is considered a secondary or weak pathogen that colonizes fruit surfaces & wounds, causing fruit to rapidly collapse and take on a wet, slimy appearance.
- Warm, wet and/or humid conditions likely favor the growth of this fungus.
- With how sudden & widespread this issue was in GA in 2020, it's likely that environmental conditions were key.



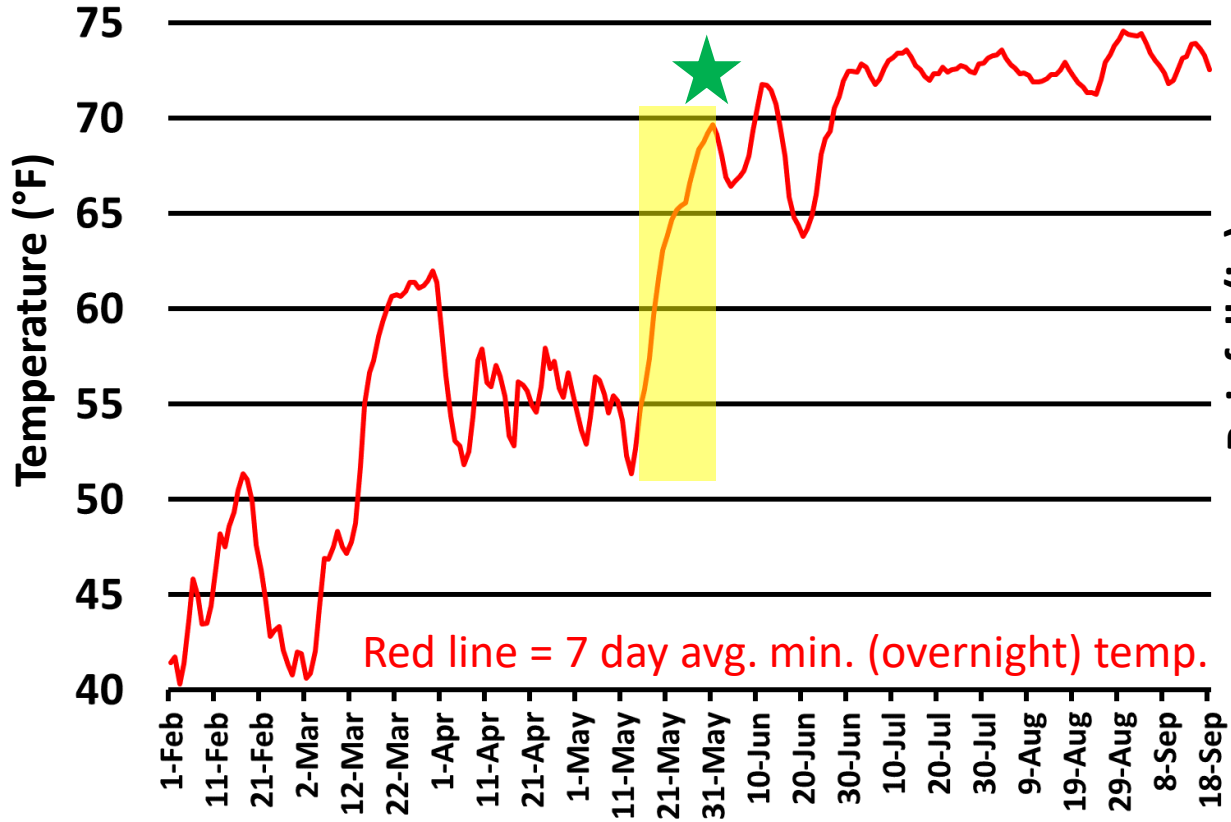
**Progression of Yeast Rot on Blueberry Fruit**



# Yeast Rot Problems on Rabbiteyes

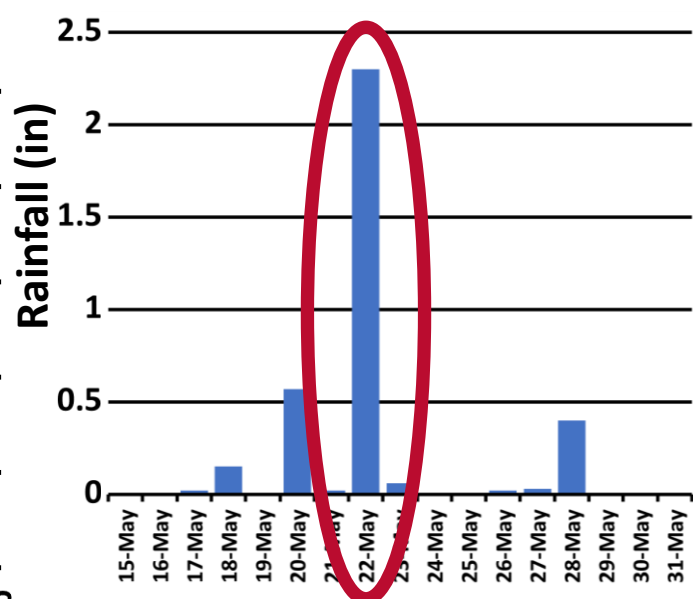
- Rapid shift to warmer overnight temps in mid/late May

2020 Overnight Temperature in Alma, Georgia



- Heavy rainfall event

Daily Rainfall in Alma, Georgia



**2.3" on May 22<sup>nd</sup>**

Reports of Yeast Rot Begin = ★



# Yeast Rot Problems on Rabbiteyes

- Yeast rot issues are typically sporadic and infrequent.
- As a result, no management options are available for yeast rot, beyond timely harvesting & handling of ripe fruit.
- The exact causes of the observed issues with the rabbiteye harvest in 2020 are unclear, but environmental conditions likely factored heavily.
- **Fruit splits** (resulting from an extreme rainfall event in late May) and **rapidly warming nighttime temperatures** (after a prolonged period of cool temps during berry development) likely provided ideal conditions for yeast growth on berries.



# First ID of Bacterial Wilt in Georgia

- Bacterial wilt, caused by *Ralstonia solanacearum* (Rs) was first identified on 3 Florida farms in 2016.
- Since 2016, it has since been found in multiple locations through Florida.
- Over the last three years, samples from 18 sites in eight counties in southern Georgia have been tested for Rs.
- In 2020, bacterial wilt was identified for the first time on blueberries in Georgia at two sites in Clinch County.



Marginal leaf scorch, an initial symptoms of bacterial wilt disease





# First ID of Bacterial Wilt in Georgia



**'Indigocrisp' Blueberry Planting in Clinch County, Georgia**





# First ID of Bacterial Wilt in Georgia

- Symptoms include marginal leaf necrosis, wilting, & plant death in as little as 3 weeks after infection

Highly susceptible cultivars: 'Arcadia', 'Indigocrisp', & 'Keekrisp'

Moderately susceptible cultivars: 'Emerald', 'Farthing', & 'Meadowlark'



Leaves showing marginal leaf scorch



Affected plants showing wilting and plant decline



**Symptoms can resemble Bacterial Leaf Scorch or Phytophthora Root Rot**





# First ID of Bacterial Wilt in Georgia

- *R. solanacearum* is easily spread through water, soil, or infected plant material; often spreads down rows.
- Management largely relies on prevention (limiting the movement of plants, equipment and soil between farms) & burning infected plant materials.
- **Efficacy data is scarce for bacterial wilt chemical controls.** Routine soil drenches with phosphonate fungicides (K-Phite) *may* have some efficacy to protect nearby plants from infection. Prior to replanting into infected fields, potted plants can be drenched with phosphate products.



# Phytotoxicity on Blueberry Fruit

- Oils and/or EC (emulsifiable concentrate) formulations of pesticides can damage plants when applied improperly
  - Such as in hot weather or in (improper) tank mixes





# Phytotoxicity on Blueberry Fruit

- Solo and tank mixes of captan are crucial for fungicide resistance management, however, DON'T apply captan in combo with or in close proximity to oil sprays. Likewise, captan and EC fungicide combos are NOT recommended.



T. Price

Blueberry fruit damage observed in 2020 following application of Captan, Sniper, and Malathion 57 EC

**Applying captan with oils or EC formulations can allow for captan to penetrate into the plant and cause damage**



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  - **Mummy Berry**
- Seasonal Spray Schedule





# Anthracnose Fruit Rot (Ripe Rot)

- Anthracnose fruit rot is caused by two different fungi: *Colletotrichum gloeosporioides* and *C. acutatum*
- Fruit infections begin at bloom, remain latent until ripening.
  - Can be major issue postharvest
- Warm, wet weather during bloom and just before harvest favors disease development.



Sabaratham 2016

**Shriveling Ripe berries**



Miles and Schilder 2008

**Sporulation on infected berry**



MyIPM App

**Orange spore masses on berries**



# Fungicide Resistance

- Ripe rot fungi (*Colletotrichum sp.*) are known to develop fungicide resistance.
- Anthracnose resistance to QoI fungicides (Abound and Pristine) has been documented previously in Florida, and in 2019 three isolates of *C. gloeosporioides* **highly resistant** to Pristine were isolated from blueberries near Blackshear, GA.
- These isolates possessed a mutation known to confer resistance in *Colletotrichum sp.* to all QoI fungicides.
- Survey work ~~was~~ is anticipated in ~~2020~~ 2021 to determine if this resistance is widespread within the Georgia blueberry production region.





# Managing Fungicide Resistant Ripe Rot

- For ripe rot management, fungicides should be applied during bloom and cover sprays

Recommendations below are based on the 2020 SE Regional Blueberry Integrated Management Guide

Trade Name	Active Ingredient	FRAC MoA	PHI	Efficacy	
QoI	Quilt Xcel	azoxystrobin+propiconazole	11+3	30 days	+++++
	Abound	azoxystrobin	11	0 days	+++++
	Pristine	pyraclostrobin+boscalid	11+7	0 days	+++++
Switch	cyprodinil+fludioxonil	9+12	0 days	+++++	
Omega	fluazinam	29	30 days	+++	
Captan	captan	M4	0 days	+++	
Ziram	ziram	M3	*do not apply later than 3 weeks after full bloom*	++	



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Ziram	ziram	M3	*do not apply later than 3 weeks after full bloom*	++

- Rotate/alternate available modes of action.
  - Note extended Omega PHI and Ziram precautions.
- Tank mix with a “low risk” fungicide such as Captan.



# Managing Fungicide Resistant Ripe Rot

- During 2020, two field trials were conducted to evaluate spray programs and new materials for fruit rot control

Program	Treatment/Timings <sup>z</sup>					Fruit rots (%) <sup>y</sup>			
	30% Bloom	Petal Fall	10 days after Petal Fall	3 weeks after Petal Fall	Pre-harvest	Ripe Rot (%) <sup>x</sup>		All Rots (%) <sup>w</sup>	
						'Star'	'Farthing'	'Star'	'Farthing'
Control	n/a	n/a	n/a	n/a	n/a	2.0 a	7.1 a	17.3 a	15.7 a
1	Switch	Captan	Switch	Captan	Switch	0.4 b	1.9 b	11.7 ab	7.0 b
2	Switch	Captan	Miravis Prime	Captan	Miravis Prime	0.1 b	3.3 b	4.1 b	8.1 b
3	Switch	Captan	Luna Tranquility	Captan	Luna Tranquility	1.1 ab	6.7 a	11.2 ab	15.6 a
4	Switch	Ziram	Switch	Omega	Switch	0.1 b	1.4 b	13.4 ab	4.8 b
5	Switch	Ziram	Miravis Prime	Omega	Luna Tranquility	0.3 b	1.7 b	6.9 ab	5.7 b

<sup>z</sup>Treatments were applied at (1) 30% bloom (5 Feb), (2) petal fall (19 Feb), (3) 10 days after petal fall (6 Mar), (4) ~3 weeks after petal fall (17 Mar), and (5) pre-harvest (25 Mar).

<sup>y</sup>Recorded for ~150-200 fruit per plot.

<sup>x</sup>Rot caused by *Colletotrichum sp.* ID'd based upon visual observations. Means in each column followed by the same letter are not significantly different according to the least significant difference test (LSD)( $\alpha=0.05$ ).

<sup>w</sup>Rots caused by *Colletotrichum sp.*, *Phomopsis vaccinii*, *Alternaria tenuissima*, and other unidentified fungi. Means in each column followed by the same letter are not significantly different according to the least significant difference test (LSD)( $\alpha=0.05$ ).

**Green = Significantly less disease vs. control**      **Yellow = Not significantly different vs. control**

**Switch, Captan, Omega, & Ziram are effective vs. ripe rot;  
Miravis Prime provides control that is comparable to Switch**



# Mummy Berry

- Disease caused by the fungus *Monilinia vaccinii-corymbosi*
- Symptoms include shoot blight, flower cluster blight, and fruit mummification



Shoot blight

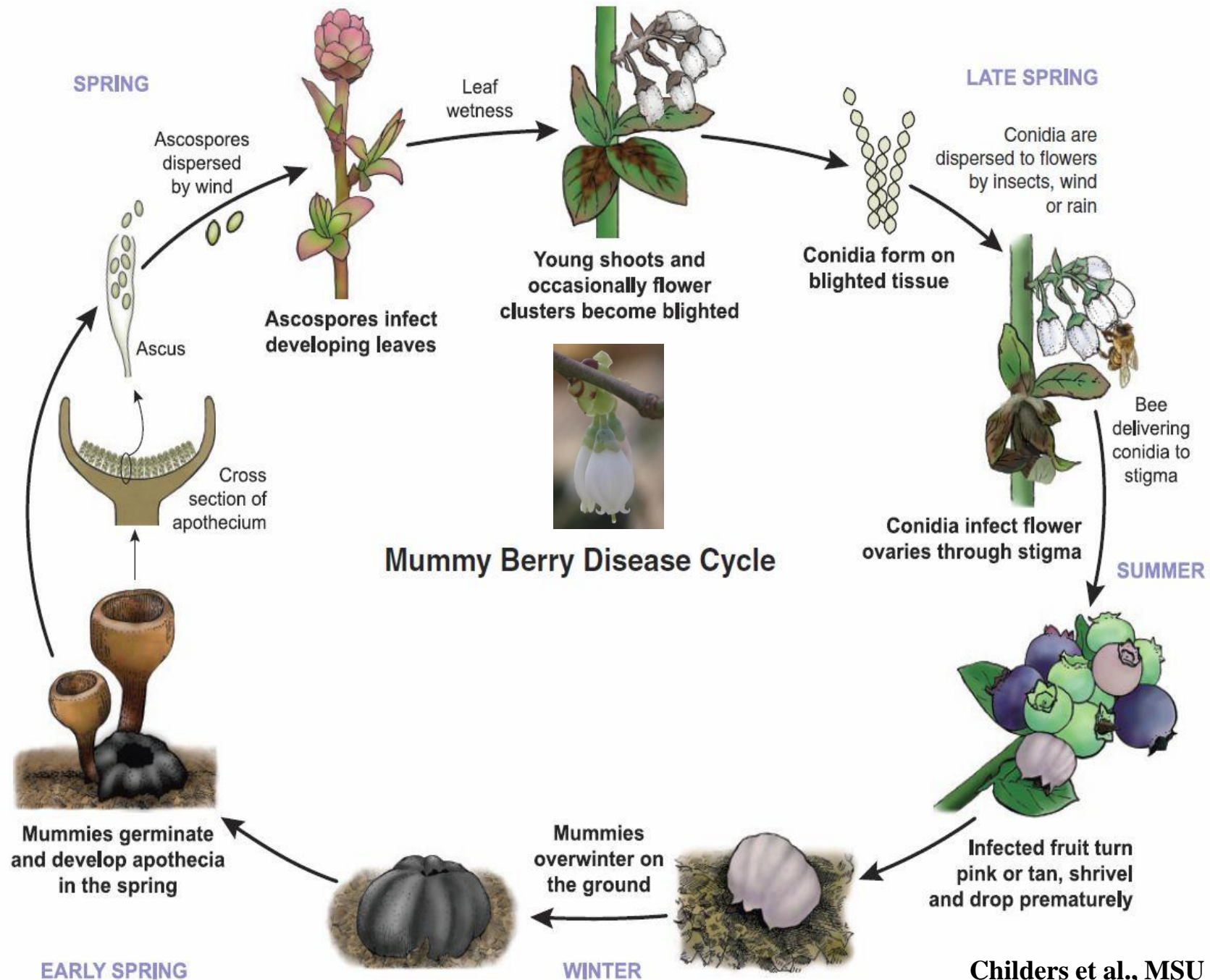


Infected immature fruit



Ripe fruit (mummies)

- On GA rabbiteye, fruit mummification can cause significant yield losses
- SHB often escape due to earlier bud break and bloom



Childers et al., MSU





# Management

- **Cultural controls** include sanitation practices such as burying (>1”) mummies to reduce initial inoculum
  - This alone is not sufficient for control
- **Chemical controls** are very effective.
  - Fungicide applications from green tip through bloom
  - Pristine and DMI fungicides (Indar, Tilt, Bumper, Propimax, Quash, Quilt Xcel, or Proline) are recommended
    - Captan should be tank mixed with DMI fungicides to prevent issues with ripe rot





# DMI fungicides (Indar, Proline, Propulse, Tilt) as well as Luna Tranquility were very effective in 2020 mummy berry trials

Treatments/Timing <sup>z</sup>				Blighted shoots per bush <sup>y</sup>		Mummy incidence (%) <sup>x</sup>	
Green tip	20% Bloom	Full Bloom	Late Bloom	'Powderblue'	'Tifblue'	'Powderblue'	'Tifblue'
Untreated Control				33.6 a	30.8 a	23.2 a	36.8 a
Proline	Luna Tranquility	Proline	Luna Tranquility	4.6 b	6.4 c	1.1 b	4.9 b
Propulse	Luna Tranquility	Propulse	Luna Tranquility	6.4 b	5.2 c	3.9 b	9.6 b
Indar	Fontelis	Indar	Fontelis	9.8 b	14.4 b	3.5 b	12.0 b
Indar	Indar	Fontelis	Fontelis	10.4 b	n.t.	6.1 b	n.t.
Indar	Indar	Indar	Indar	9.0 b	15.2 b	1.0 b	7.4 b

Treatments	Application timing <sup>z</sup>	Mummy incidence (%) <sup>y</sup> 'Ochlockonee'
Untreated control	n/a	14.9 a
Tilt	Green tip, 20% Bloom, Full Bloom (x2), Late Bloom, Green Fruit	1.3 b
Luna Tranquility	Green tip, 20% Bloom, Full Bloom (x2), Late Bloom, Green Fruit	0.0 b
Propulse	Green tip, 20% Bloom, Full Bloom (x2), Late Bloom, Green Fruit	0.0 b
Miravis	Green tip, 20% Bloom, Full Bloom (x2), Late Bloom, Green Fruit	0.0 b
Cannonball 50WG	Green tip, 20% Bloom, Full Bloom (x2), Late Bloom, Green Fruit	0.4 b
Miravis Prime	Green tip, 20% Bloom, Full Bloom (x2), Late Bloom, Green Fruit	0.5 b

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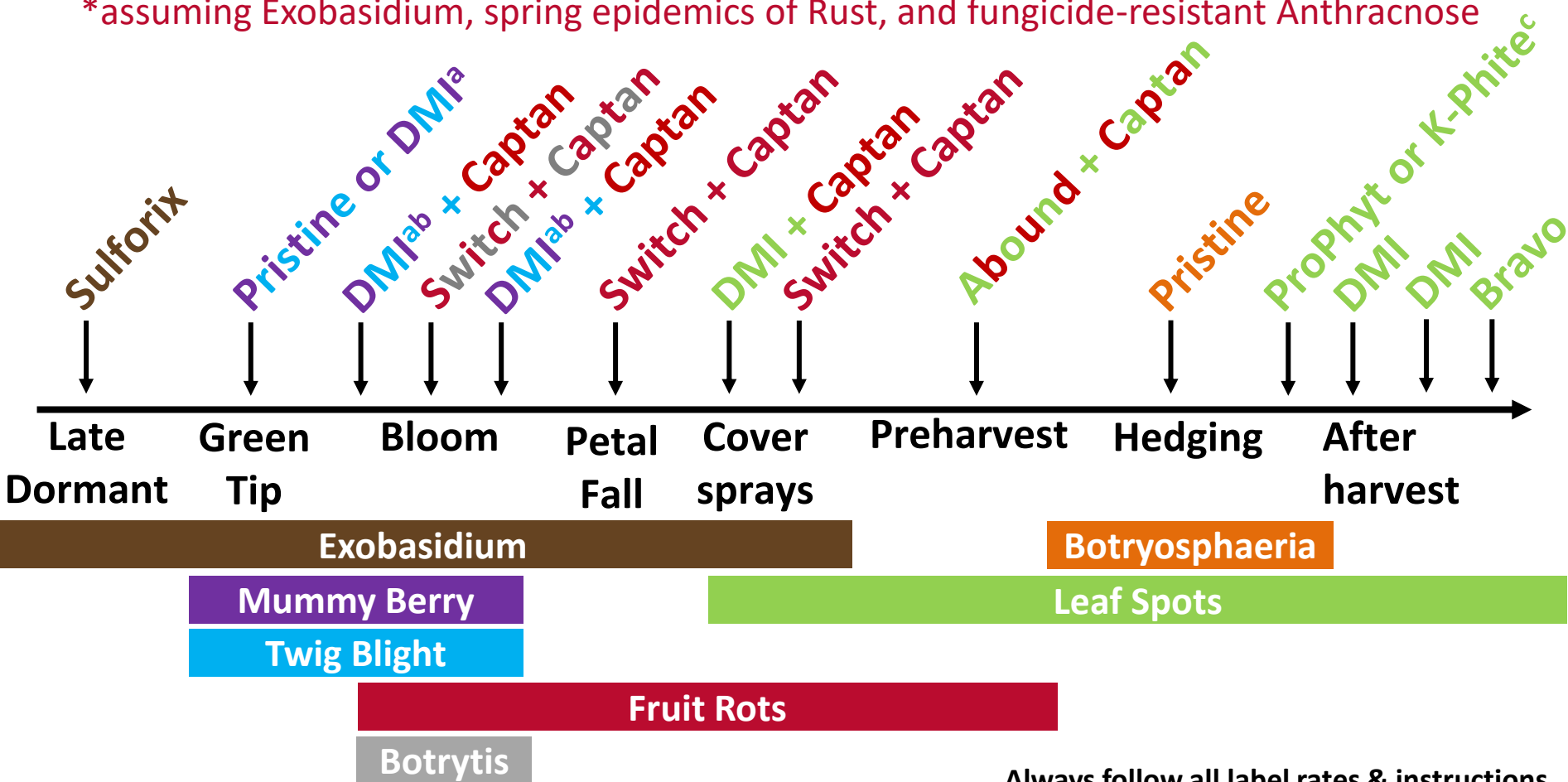
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# Example Seasonal Spray Schedule

\*assuming Exobasidium, spring epidemics of Rust, and fungicide-resistant Anthracnose



Always follow all label rates & instructions.

<sup>a</sup>DMIs include Indar, Tilt/generics, Quash, and Proline.

<sup>b</sup>Elevate can be added for additional Botrytis control, if resistance is not an issue.

<sup>c</sup>Phosphonate fungicides (ProPhyt, K-Phite, Reliant) are also effective for Phytophthora control



# Southeast Regional Blueberry Guide



<http://www.smallfruits.org/ipm-guides.html>

- Home
- SRSFC Activities
- Crops
- Regional Experts
- IPM/Production Guides
- County Agent Training
- Weather

## IPM/Production Guides

Last updated Monday 21 August 2017 7:59 GMT

### Blueberries

- Southeast Regional Blueberry Integrated Management Guide**
- Southeast Regional Blueberry Horticulture and Growth Regulator Guide
- Southeast Regional Organic Blueberry Pest Management Guide

### Bunch Grapes

- Southeast Regional Bunch Grape Integrated Management Guide

### Caneberries

- Southeast Regional Caneberries Integrated Management Guide
- Southeast Regional Caneberry Production Guide (PDF)
- Southeast Regional Caneberry Production Guide (Online Version)

### Muscadines

- Southeast Regional Muscadine Grape Integrated Management Guide

### Strawberries

- Southeast Regional Strawberry Integrated Pest Management Guide
- Southeast Regional Strawberry Plasticulture Production Guide
- Fungicide Selection for Botrytis and Anthracnose Fruit Rot Management 2017



### 2020 Southeast Regional Blueberry Integrated Management Guide

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Bill Cline (North Carolina State University)

Recommendations are based on information from the manufacturer's label and performance data from research and extension field tests. Because environmental conditions and grower application methods vary widely, suggested use does not imply that performance of the pesticide will always conform to the safety and pest control standards indicated by experimental data.

This publication is intended for use only as a guide. Specific rates and application methods are on the pesticide label, and these are subject to change at any time. Always refer to and read the pesticide label before making any application! The pesticide label supersedes any information contained in this guide, and it is the law.



Recommendations below are from the 2020 SE Regional Blueberry Integrated Management Guide

**Seasonal ‘at a glance’ fungicidal spray schedule options for blueberry**

Developmental Stage	Late Dormant	Green tip	Bloom (2-3 applications) <sup>b</sup>	Petal Fall	10-14 Days after Petal Fall	20-24 Days after Petal Fall	Pre-Harvest <sup>c</sup>	After Harvest Foliage Management
<b>Disease Controlled (Fungicides)</b>	<b>Exobasidium</b> (lime sulfur [NC]) <sup>a</sup>	<b>Mummy Berry</b> (Pristine [11+7] or Indar [3] or Tilt or Bumper or PropiMax or Quash [3] or Proline [3])  <b>Twig blight</b> (Pristine [11+7] or Indar [3])  <b>If Exobasidium</b> has been a problem, add Captan [M4]	<b>Mummy Berry and Twig blight</b> (Pristine [11+7] or Indar <sup>c</sup> [3] + Captan [M4] or Tilt or Bumper or PropiMax or Quash [3] or Quilt Xcel [11+3] or Proline [3])  For serious <b>Botrytis</b> problems, add (CaptEvote [17+M4] or Elevate [17] or Pristine [11+7] or Switch [9+12])  <b>If Alternaria and Ripe Rot</b> have been a problem, add (Abound [11] or Pristine [11+7] or Switch [9+12] or Omega [29]) <sup>d</sup>  <b>If Exobasidium</b> has been a problem, add Captan [M4]	<b>Alternaria and Ripe Rots</b> (Abound [11] or Pristine [11+7] or Switch [9+12] or Captan [M4] or Omega [29] or Quilt Xcel [11+3])  <b>Septoria Leaf Spot</b> (Abound [11] or Aliette [33] or Pristine [11+7] or Switch [9+12] or Quash [3] or Quilt Xcel [11+3] or Proline [3]) <sup>f</sup>  <b>If Exobasidium</b> has been a problem, add Captan [M4]	<b>Alternaria and Ripe Rots</b> (Abound [11] or Pristine [11+7] or Switch [9+12] or Captan [M4] or Omega [29] or Quilt Xcel [11+3])  <b>Septoria Leaf Spot</b> (Abound [11] or Aliette [P07] or Pristine [11+7] or Switch [9+12] or Quash [3] or Quilt Xcel [11+3] or Proline [3]) <sup>f</sup>  <b>If Exobasidium</b> has been a problem, add Captan [M4]	<b>Alternaria and Ripe Rots</b> (Abound [11] or Pristine [11+7] or Switch [9+12] or Captan [M4] or Omega [29] or Quilt Xcel [11+3])  <b>Septoria Leaf Spot</b> (Abound [11] or Aliette [P07] or Pristine [11+7] or Switch [9+12] or Quash [3] or Quilt Xcel [11+3] or Proline [3]) <sup>f</sup>  <b>If Exobasidium</b> has been a problem, add Captan [M4]	<b>Alternaria and Ripe Rots</b> (Abound [11] or Pristine [11+7] or Switch [9+12] or Captan [M4])	<b>Septoria Leaf Spot</b> (Abound [11] or Tilt or Bumper or PropiMax or Quash [3] or Aliette or ProPhyt [P07] or Bravo [M5] or Pristine [11+7] or Switch [9+12] or Indar [3] or Quilt Xcel [11+3] or Proline [3])  <b>Anthraxnose</b> (K-Phite or Aliette or ProPhyt [P07] or Pristine [11+7] or Quilt Xcel [11+3] or Quash [3])  <b>Rust</b> (Bravo [M5] or Tilt or Bumper or PropiMax [3] or Pristine [11+7] or Indar or Quash [3] or Proline [3]) <sup>g</sup>

<sup>a</sup> Exobasidium is not specifically on the label. However, when applied for other diseases, suppression of Exobasidium has been observed.  
<sup>b</sup> Bloom times vary, due to varietal differences and the environment. Bloom sprays should provide protection against the primary pathogens of blooms for the entire bloom period. The number of applications required for bloom may vary from 1-3, depending on the season and the variety.  
<sup>c</sup> When using Indar during bloom, always tank-mix with Captan. Captan provides additional control of mummy berry, and it has some activity against twig blight, Botrytis and fruit rots. However, it is mainly of value to prevent increased rots with the use of Indar, as well as providing resistance management.  
<sup>d</sup> Many of the fungicides which are registered for rot control may also have activity against twig dieback organisms, such as *Phomopsis* species.  
<sup>e</sup> In wet years, pre-harvest and post-harvest rots may be a potential problem. Under these conditions, 1-2 applications of a pre-harvest material may be necessary for rot control.  
<sup>f</sup> Septoria leaf spot is generally controlled with 2-4 fungicide applications. This disease is more problematic on highbush blueberry varieties, but some rabbiteye varieties may experience premature defoliation from Septoria as well. For leaf spot, Aliette and other phosphites (ProPhyt, K-Phite, etc.) are best utilized after harvest, since they are not as efficacious against the fruit rots, and they serve as a resistance management tool.  
<sup>g</sup> Rust is problematic on some blueberry varieties, especially in far southern areas such as south Georgia, and it can result in complete, premature defoliation on susceptible varieties. Scout for rust in mid to late July. Applications of fungicides (2-3) from August to mid-September will generally result in good rust management. Some varieties may require yearly rust control.



# MyIPM App

## MyIPM App

- Contains basic disease (and pest) info for Apple, Blackberry, **Blueberry**, Cherry, Cranberry, Grape, Peach, Pear, & Strawberry
- Includes management and pesticide efficacy info
- Available for **free download**







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**THANK YOU!**



**Thank you for your attention!**