



Blackberry Disease Management Update

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Outline

- 2021 Disease Diagnostic Summary
- Blame it on the rain: Major Blackberry Disease Issues During 2021
 - Cane Blight and Cane Dieback
 - Orange Cane Blotch
- Pseudocercospora Leaf Spot and Fungicide Resistance
- Seasonal Spray Schedule & IPM Guide



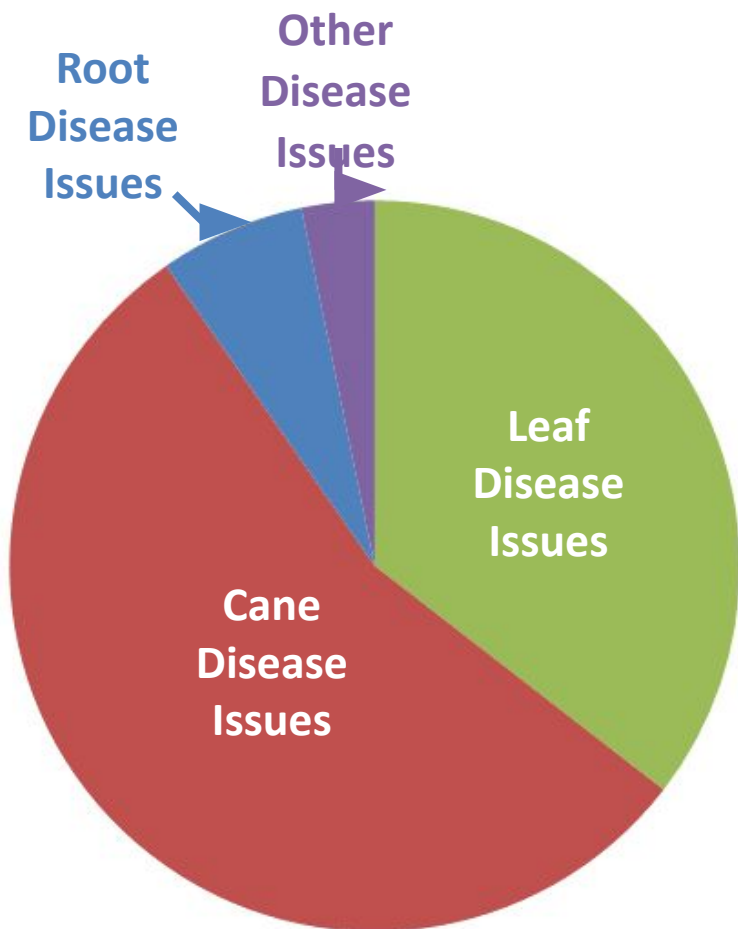
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Disease Diagnoses on Blackberry Samples by UGA Plant Disease Clinic: [samples submitted in 2021]

31 Diagnosed Issues



Cane Disease Issues:

- Cane Blight (*Leptosphaeria sp.*): 8
- Orange Cane Blotch: 7
- Phomopsis sp.*: 1
- Sphaeropsis*: 1

Leaf Disease Issues:

- Pseudocercospora sp.* (Leaf spot): 6
- Cane and leaf rust: 5

Root Disease Issues:

- Rhizoctonia*: 1
- Root Problem, Unknown Cause: 1

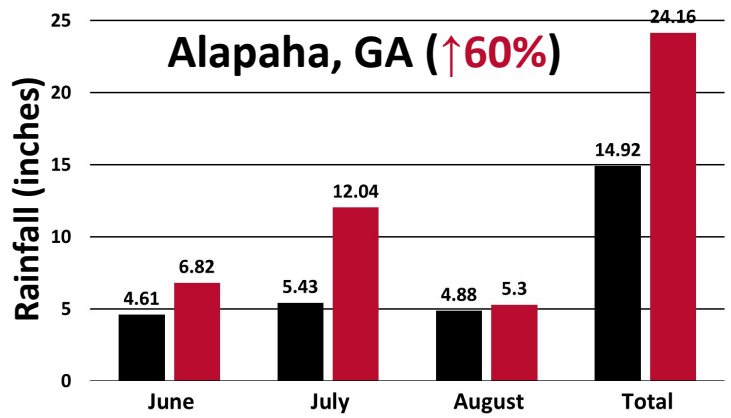
Other Disease Issues:

- Mites: 1

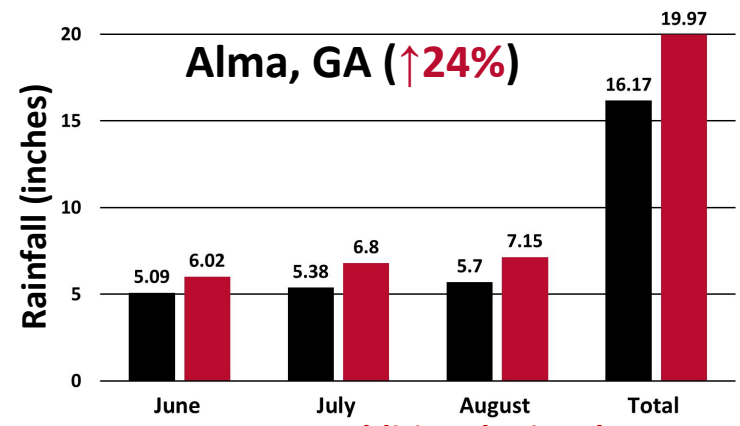


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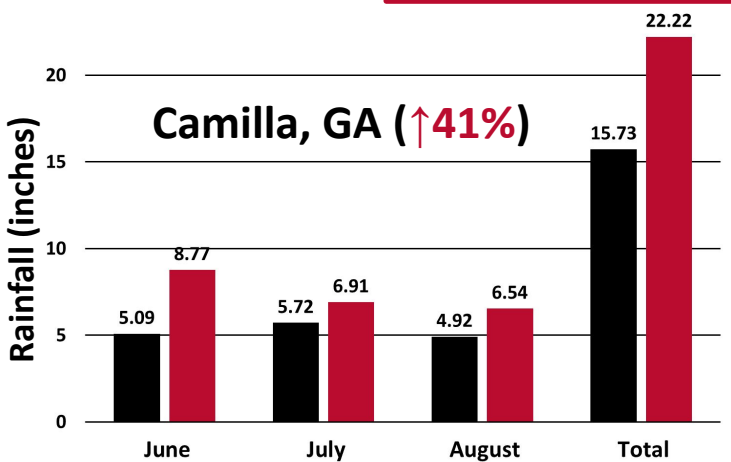


19 additional rainy days vs. average

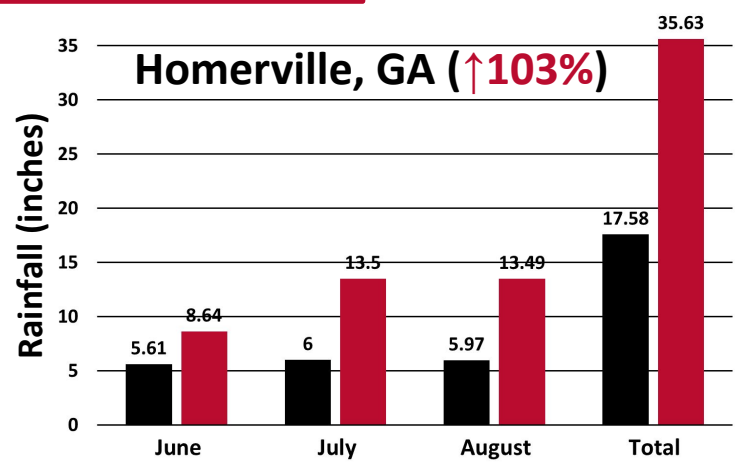


9 additional rainy days vs. average

Average Rainfall vs. Summer 2021



22 additional rainy days vs. average



13 additional rainy days vs. average

Summer 2021 was very wet (more rainfall AND more rainy days)



Impact of Summer Rain on Diseases

- Rain, high humidity, & high soil moisture promote disease.
 - Rainfall/splashing water spreads fungal spores.
 - High humidity or free water (droplets) on plant leaves/stems triggers spore germination.
 - High soil moisture stresses the plant host and promotes spread of additional soilborne pathogens.
- Warm conditions also favor the growth of many pathogens.
- Rainfall can also prevent and/or complicate spraying and other seasonal maintenance activities (for blackberries summer includes harvest, removal of old floricanes after harvest, and primocane growth, development, and pruning activities)



Impact of Summer Rain on Diseases

- Likely due to the excessive rainfall during Summer and Fall 2021, cane diseases (including cane dieback, cane blight, and orange cane blotch) were especially problematic.



Cane Dieback



<https://ohioline.osu.edu/factsheet/plpath-fru-10>

Cane Blight



Tim Flanders, UGA
Extension

Orange Cane Blotch





Cane Dieback

- Frequently observed issue in established blackberry fields in southern Georgia
- Individual canes and whole plants decline, collapse, and die
- The leading contributor to dieback of blackberry in the southeastern US is believed to be cane blight



Blighted blackberry canes in southern Georgia

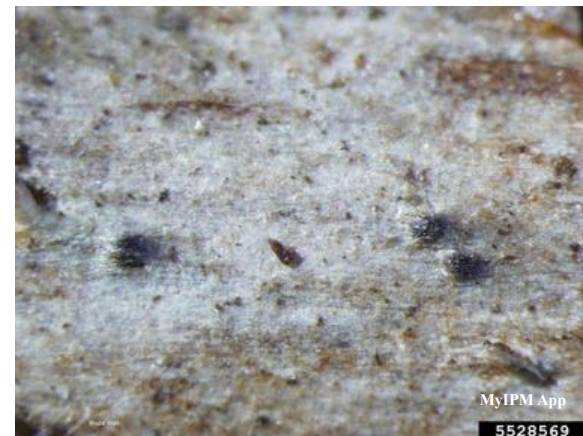


Cane Blight

- Caused by the fungus *Leptosphaeria coniothyrium*
- Fungal spores (conidia) are spread by rainsplash and infect canes through wounds.
- Lesions appear on primocanes in summer, fall, and winter.
- Cane death results when lesions girdle the vascular tissue.



Blighted canes often appear to be grey/silver



Fungal pycnidia on cane surface



Cane Blight Management

- **Cultural control** recommendations include:
 - Avoid wounding of primocanes whenever possible
 - Pinch-off/tip primocanes at desired heights (3-4 ft)
 - Remove infected canes and old floricanes after harvest
 - Promote quick drying of the canopy via weed free strip
 - Avoid nutrition and water stress to plants
- **Chemical controls** recommendations include:
 - Apply fungicides such as Rally or Pristine after each day of pruning to protect wound site from fungal entry
 - Whenever possible, avoid pruning prior to rainfall events



Cane Blight vs. “Cane Blight”

- Reports of “cane blight” in southern Georgia blackberry plantings in recent years in have led to investigations of the causal agents
- *L. coniothyrium* often isn't identified in affected plants
- Other fungal organisms capable of causing dieback have been identified from infected plants (including *Fusarium oxysporum*, *Pestalotiopsis microspore*, *Neofusicoccum parvum*, *N. kwambonambiense*, *Colletotrichum siamense*, *Lasiodiplodia theobromae*, *L. pseudotheobromae*)



Unexplained blackberry dieback



Cane Dieback Management

Less Disease → Moderate Disease → More Disease

Treatment	Rate/A	Fungal Isolates				<i>F.o.</i> ^z	Control	
		<i>L.t.</i> ^z	<i>N.k.</i> ^z	<i>N.p.</i> ^z	<i>P.m.</i> ^z		Cut Only ^z	w/Agar Plug ^z
Untreated control		2515	2245	961	587	28	25	73
Captan Gold 4L	2 qt	1122	2097	1231	742	57	19	26
Rally 40WSP	3 oz	1906	1050	639	702	215	42	23
ProPhyt	4 pt	996	1293	1554	404	144	19	65
Tilt	6 fl oz	1045	1662	1721	251	139	20	24
Abound	15.5 fl oz	809*	1268	537	1033	169	21	19
Switch 62.5WG	14 oz	382*	578*	506	189	34	20	22
Pristine	23 oz	448*	446*	491	541	425	23	35
Incognito 85WDG	0.8 lb	242*	488*	377	398	58	32	33

^zArea under the disease progress curve (AUDPC) for each isolate or uninoculated control. AUDPC calculated as accumulated dieback over time. Means in each column followed by * are significantly lower than the untreated control according to Fisher's test (LSD)($\alpha=0.05$).

**Switch, Incognito, & Pristine applications
after pruning reduced dieback**

(Note: Incognito is not labelled for use on blackberry)

Isolate Key

L.t. = *Lasiodiplodia theobromae*

N.k. = *N. kwambonambiense*

N.p. = *Neofusicoccum parvum*

P.m. = *Pestalotiopsis microspora*

F.o. = *Fusarium oxysporum*



Cane Dieback Management

- Fungicide trial results suggest that the application of Switch and Pristine may be effective **chemical controls** for cane dieback if used after pruning events.
- **Cultural controls** for dieback are likely to be similar to those recommended for cane blight:
 - Avoid wounding of primocanes whenever possible
 - Pinch-off/tip primocanes once at desired height (3-4 ft)
 - Remove infected canes and old floricanes after harvest
 - Promote quick drying of the canopy via weed free strip
 - Avoid nutrition and water stress to plants



Orange Cane Blotch (OCB)

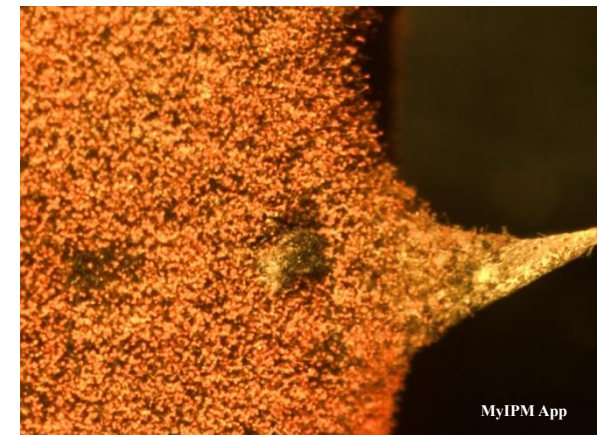
- Caused by the parasitic alga species *Cephaleuros virescens*
- Algal sporangiophores form an orange felt-like material on blackberry stems; release zoospores under wet conditions.
- Blotches crack canes and may provide entry for pathogens.
- Orange blotches formed on canes can be mistaken for rust.



Blotches on canes



Cracking blotches

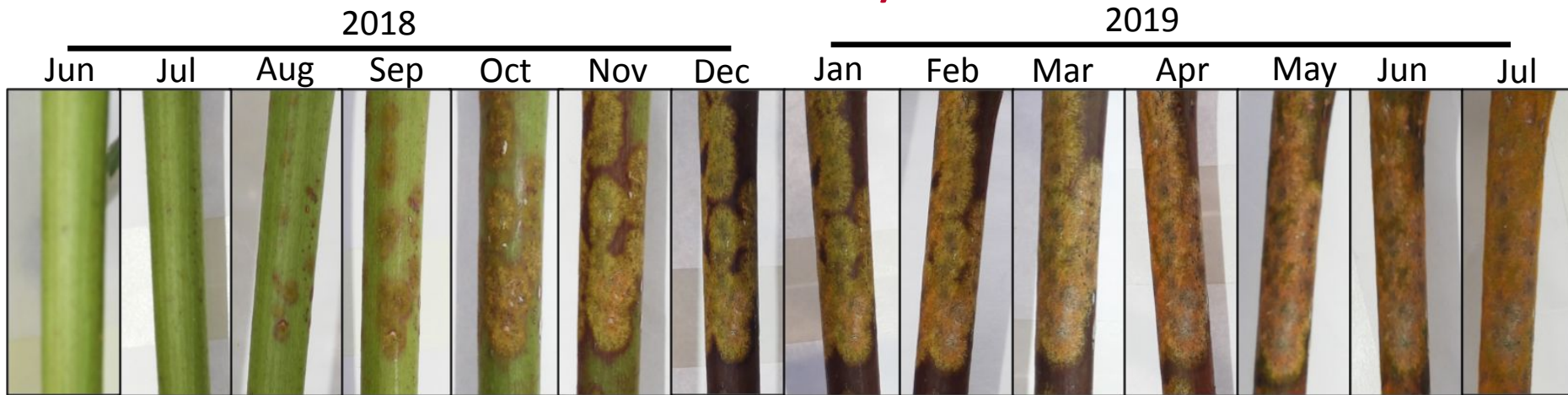


Sporangiophores within blotch



Orange Cane Blotch (OCB)

- UGA research suggests that infection of new primocanes only occurs during one period each year (late May- July).
- New infections of floricanes likely do not occur.



- Management practices for OCB are most likely to be effective at preventing primocane infection during the late spring-early summer (late May-July).



Management

- **Cultural controls** include:
 - Removal of old floricanes immediately after harvest
 - Promoting rapid drying of the canopy through the use of weed free strips, black plastic, and drip-tape irrigation
 - Avoiding nutrient and water stresses
 - Avoiding planting in poorly drained sites

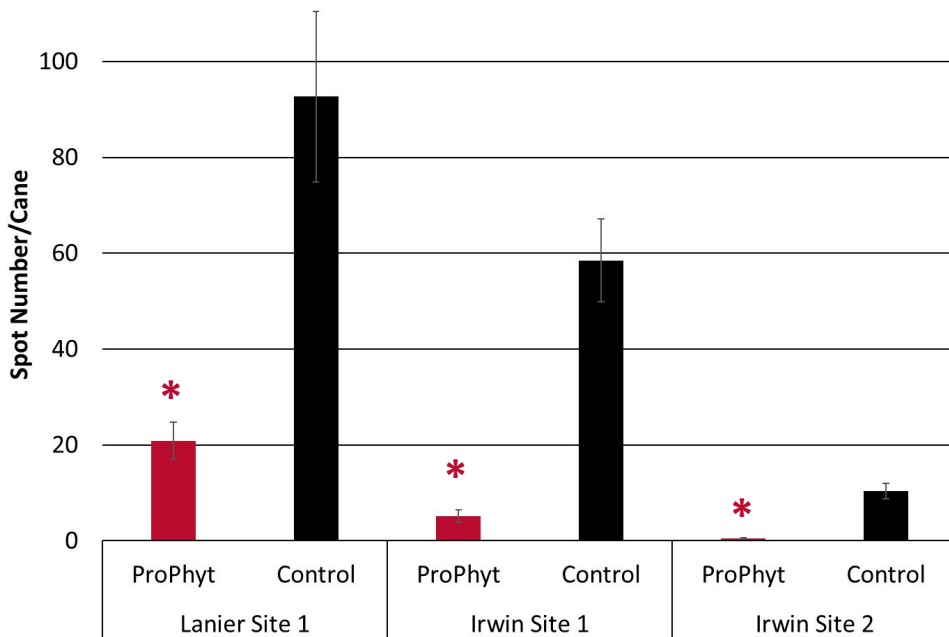
Anecdotal evidence suggests that limiting ground contact by primocanes (by tying them up earlier) may also somewhat reduce infections



Management

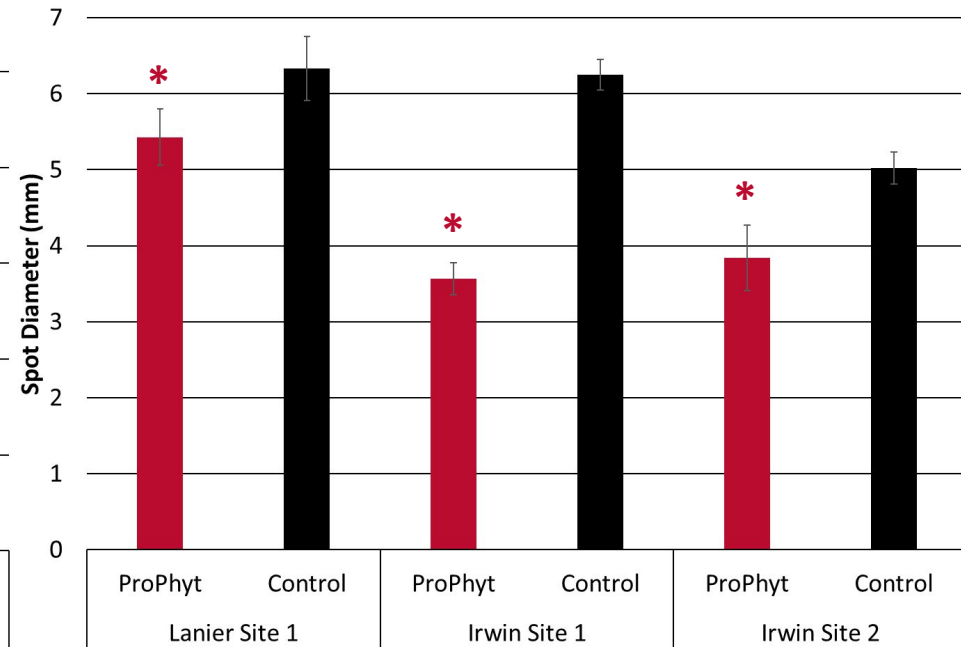
- Chemical controls** include phosphonate fungicides (ProPhyt). Applications dramatically reduce the number of spots on primocanes and also reduce spot size.

Spot Number



*significant reduction vs. untreated control (P≤0.05)

Spot Diameter



*significant reduction vs. untreated control (P≤0.05)

Comparisons between multiple applications of **ProPhyt** (June-November) vs. **Untreated Control**



Management

- **Chemical controls** include phosphonate fungicides (ProPhyt). Applications dramatically reduce the number of spots on primocanes and also reduce spot size.
- Therefore, for optimal control, ProPhyt applications should be focused on preventing infection of primocanes.
- Applications should be initiated after the emergence of new primocanes (during the “Preharvest” period) and repeated every 3-4 weeks for up to 6 applications in total.



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Pseudocercospora Leaf Spot

- Pseudocercospora leaf spot is one of two major leaf spots on blackberries in the SE U.S. (along with Septoria leaf spot)
- Leaf spots can lead to significant defoliation of blackberries in warm, humid conditions; heavily infected plants may produce less fruit, lack vitality, and suffer more cold injury.



Pseudocercospora Leaf Spot caused by the fungus *Pseudocercospora rubi*



Septoria Leaf Spot caused by the fungus *Mycosphaerella rubi*



Leaf Spot Management

- **Cultural controls** include:
 - Increasing air circulation to promote faster drying of the foliage (thinning canes and reducing weeds)
 - Removal of dead or damaged canes as soon as possible after harvest
- **Chemical controls** include:
 - Application of fungicides such as Tilt or QoI fungicides (Cabrio, Quilt Xcel, and Pristine) for all leaf spots; and Abound and Luna Tranquility for Septoria only
 - Note: Isolates of *Pseudocercospora sp.* with resistance to azoxystrobin (Abound) have been identified in the Southeastern U.S.



Fungicide-Resistant Pseudocercospora?

- In 2020-21, research was carried out at UGA to examine the prevalence and management of QoI-resistant *Pseudocercospora sp.* in Georgia blackberry*

(*funded by a 2020 North American Bramble Growers Research Foundation Grant)

- Field Survey:

- Determine whether *Pseudocercospora sp. isolates* from Georgia blackberry are resistant to QoI fungicides

- Fungicide Trial:

- Determine whether additional fungicides (not currently utilized for leaf spot control) could be effective for *Pseudocercospora* leaf spot management



Pseudocercospora Field Survey

Methods and Results:

- During 2020, isolates of *Pseudocercospora* were collected from SE Georgia blackberry plantings.
- Isolate ID was confirmed using morphology and ITS sequencing



Pseudocercospora Leaf Spot in Lanier County – September 2020

Summary of Pseudocercospora isolates collected and identified in 2020.

Site	County	Collection Date	Host	# of Isolates
Site 1	Lanier	9/2/2020	Blackberry cv. 'Ouachita'	4
Site 2	Lanier	9/2/2020	Blackberry cv. 'Osage'	4
Site 3	Lanier	9/2/2020	Blackberry cv. 'Caddo'	3
Site 4	Bacon	9/3/2020	Blackberry cv. 'Ouachita'	4
Site 5	Pierce	9/10/2020	Blackberry cv. 'Ouachita'	3



Pseudocercospora Field Survey

Methods and Results:

- Isolates were subsequently screened for resistance to the QoI-fungicide pyraclostrobin (in Cabrio and Pristine) using a mycelial growth inhibition assay*.

QoI-resistance testing results for Pseudocercospora isolates.

Site	County	QoI Resistant Isolates/Total Isolates Tested (%)
Site 1	Lanier	2/4 (50%)
Site 2	Lanier	0/3 (0%)
Site 3	Lanier	2/2 (100%)
Site 4	Bacon	3/3 (100%)
Site 5	Pierce	0/1 (0%)
		Total: 7/13 (54%)

*Genetic testing implicated the G143A mutation within *cytochrome b* to be behind this resistance. This mutation confers resistance to all QoI fungicides. Additional testing efforts underway.

- Pyraclostrobin resistance was identified in the majority of tested isolates (7 of 13) and locations (3 of 5).**



Pseudocercospora Fungicide Trial

Methods:

- During 2021, fungicides were evaluated for control of Pseudocercospora leaf spot in the field at two commercial blackberry sites in SE Georgia (cv. Ouachita).

Fungicides Utilized in 2021 Pseudocercospora Leaf Spot Field Trials

Fungicide (Rate/Acre)	Active Ingredients	FRAC MoA	Application Dates
Tilt (6 fl oz)	propiconazole	3	7/30, 8/18, 9/9, 9/24
Luna Tranquility (16 fl oz)	fluopyram+pyrimethanil	7+9	7/30, 8/18, 9/9, 9/24
Kenja (15.5 fl oz)	isofetamid	7	7/30, 8/18, 9/9, 9/24
Switch 62.5WG (14 oz)	cyprodinil+fludioxonil	9+12	7/30, 8/18, 9/9, 9/24
Howler (5 lb)	<i>Pseudomonas chlororaphis</i> (AFS009)	BM02	7/30, 8/18, 9/9, 9/24
Theia (3 lb)	<i>Bacillus subtilis</i> (AFS032321)	BM02	7/30, 8/18, 9/9, 9/24
Untreated	n/a	n/a	n/a

- Leaf spots were assessed on October 13th and 14th



Pseudocercospora Fungicide Trial

Results:

- Treatments with **Tilt** resulted in the lowest disease incidence (% spotted leaves) and severity (spots per leaf). However, **NONE** of the treatments significantly reduced disease relative to the untreated control.

Means followed by the same letter are not significantly different [Tukey's HSD ($\alpha=0.05$)].

Results from 2021 Pseudocercospora Leaf Spot Field Trials

Fungicide	Bacon County Site		Pierce County Site	
	Spots per leaf	Spotted leaves (%)	Spots per leaf	Spotted leaves (%)
Untreated	34.8 a	84.0 a	11.3 a	81.1 a
Theia	37.6 a	90.1 a	15.6 a	87.8 a
Luna Tranquility	31.3 a	85.6 a	12.6 a	83.3 a
Kenja	30.5 a	83.8 a	13.3 a	76.1 a
Switch 62.5WG	28.5 a	80.0 a	12.6 a	75.7 a
Howler	26.8 a	80.5 a	12.4 a	82.1 a
Tilt	12.9 a	78.3 a	7.7 a	66.9 a

Less Disease → Moderate Disease → More Disease



Conclusions

- Testing of isolates collected during the 2020 field survey suggested that **QoI-resistant Pseudocercospora is prevalent in Georgia blackberries**
 - Growers should be on the lookout for control failures
- None of the fungicides tested during the 2021 fungicide trials resulted in a significant reduction in leaf spot disease.
 - A bad year for disease. Summer rains may have swamped the efficacy of the tested chemicals. (Tilt has previously rated “Very Good”, but not sig. different here)
 - **No additional products can be recommended for leaf spot control based on these results.**



Managing QoI-Resistant Leaf Spot

- If resistance to QoI fungicides is present, few chemical control options for Pseudocercospora management remain

Recommendations below are based on the 2022 SE Regional Blackberry Integrated Management Guide

Trade Name	Active Ingredient	FRAC MoA	PHI	Efficacy		
				Septoria	Pseudocercospora	
Luna Tranquility	fluopyram + pyrimethanil	7+9	0 days	+++++	Not recommended	
QoI	Abound	azoxystrobin	11	0 days	++++	Not recommended
	Quilt Xcel	azoxystrobin+propiconazole	11+3	30 days	+++++	++++
	Cabrio	pyraclostrobin	11	0 days	++++	++++
	Pristine	pyraclostrobin+boscalid	11+7	0 days	++++	++++
Tilt	propiconazole	3	30 days	++++	++++	

- These circumstances put more pressure on **remaining effective materials** and **cultural controls** (timely weeding, pruning, and removal of floricanes) for management.



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	Cabrio	pyraclostrobin	11	0 days	++++	++++
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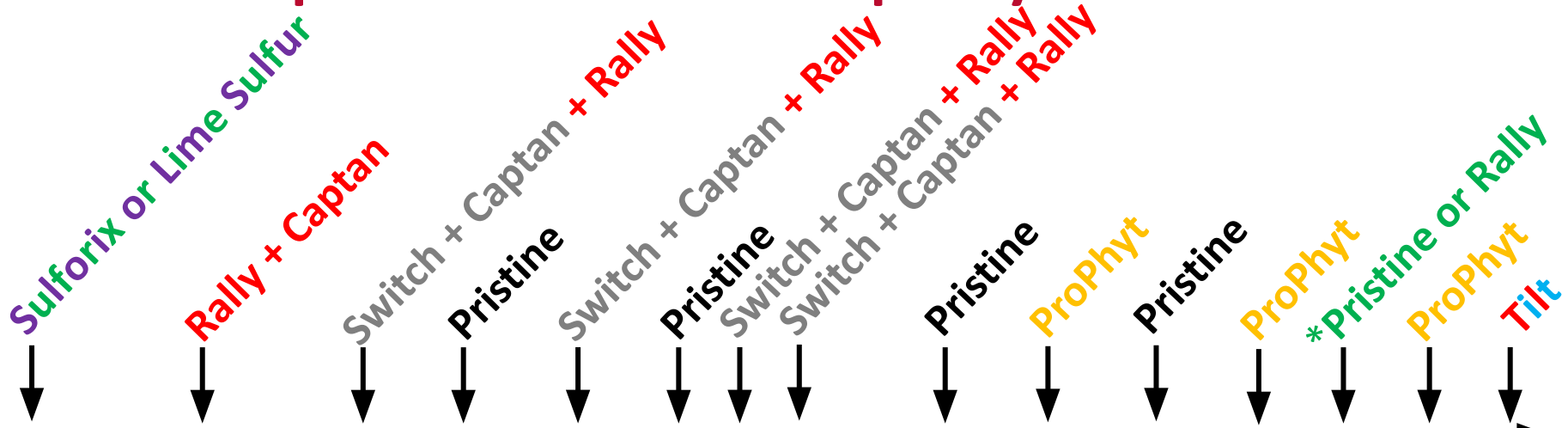


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Example Seasonal Spray Schedule



Delayed Dormant **Shoots 6" long** **Bloom** **Petal Fall** **Cover Sprays** **Preharvest** **Harvest** **After harvest**

Anthracnose & Spur Blight
Cane Blight
Leaf Spots
Rusts & Powdery Mildew
Botrytis & Rosette
Orange Cane Blotch

*Apply after each pruning IF applications remain.

Always follow all label rates & instructions.



Caneberry IPM Guide

the Southern Region
small fruit consortium

- 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

2022 Southeast Regional Caneberry Integrated Management Guide

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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 applications methods are on the pesticide label, and these are subject to change at any time. Registrations also vary between states and are subject to change at any time, please check with your state department of agriculture or regulatory agency concerning current registration status within your state. 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 legal document referenced for application standards.





Seasonal ‘at a glance’ fungicide spray schedule options for caneberries

Developmental Stage	Delayed Dormant	Shoots 6” long till Pre-Bloom	Early bloom (5-10%)	Full Bloom ^a	Petal Fall	Cover Sprays	Pre-Harvest	Harvest	After Harvest	
Disease (Registered fungicide)	Anthracnose, Cane Blight, Spur Blight (Lime Sulfur or Copper)	Anthracnose, Cane Blight, Spur Blight (Cabrio, Abound, Pristine, Quilt Xcel, Captan)	Anthracnose, Cane Blight, Spur Blight (Cabrio, Abound, Pristine, Quilt Xcel, Captan)	Anthracnose, Cane Blight, Spur Blight (Cabrio, Abound, Pristine, Quilt Xcel, Captan)	Anthracnose, Cane Blight, Spur Blight (Cabrio, Abound, Pristine, Quilt Xcel, Captan)	Anthracnose, Cane Blight, Spur Blight (Cabrio, Abound, Pristine, Quilt Xcel, Captan)	Anthracnose, Cane Blight, Spur Blight (Cabrio, Abound, Pristine, Captan)	Anthracnose, Cane Blight, Spur Blight (Cabrio, Abound, Pristine, Captan)	Cane Blight (see notes)	
		Powdery Mildew (Sulfur, Rally, Cabrio, Abound, Pristine, Quilt Xcel, Luna Tranquility)	Powdery Mildew (Rally, Cabrio, Abound, Pristine, Quilt Xcel, Luna Tranquility)	Powdery Mildew (Rally, Cabrio, Abound, Pristine, Quilt Xcel, Luna Tranquility)	Powdery Mildew (Rally, Cabrio, Abound, Pristine, Quilt Xcel, Luna Tranquility)	Powdery Mildew (Rally, Cabrio, Abound, Pristine, Quilt Xcel, Luna Tranquility)	Powdery Mildew (Rally, Cabrio, Abound, Pristine, Quilt Xcel, Luna Tranquility)	Powdery Mildew (Rally, Cabrio, Abound, Pristine, Luna Tranquility)	Powdery Mildew (Rally, Cabrio, Abound, Pristine, Luna Tranquility)	Powdery Mildew (Rally, Cabrio, Abound, Pristine, Quilt Xcel, Luna Tranquility)
		Rusts (Rally, Abound, Cabrio, Pristine, Tilt, Quilt Xcel)	Rusts (Rally, Abound, Cabrio, Pristine, Tilt, Quilt Xcel)	Rusts (Rally, Abound, Cabrio, Pristine, Tilt, Quilt Xcel)	Rusts (Rally, Abound, Cabrio, Pristine, Tilt, Quilt Xcel)	Rusts (Rally, Abound, Cabrio, Pristine, Tilt, Quilt Xcel)	Rusts (Rally, Abound, Cabrio, Pristine, Tilt, Quilt Xcel)	Rusts (Rally, Abound, Cabrio, Pristine)	Rusts (Rally, Abound, Cabrio, Pristine)	Rusts (Rally, Abound, Cabrio, Pristine, Tilt, Quilt Xcel)
		Leaf Spots (Tilt, Cabrio, Quilt Xcel, Pristine)	Leaf Spots (Tilt, Cabrio, Quilt Xcel, Pristine)	Leaf Spots (Tilt, Cabrio, Quilt Xcel, Pristine)	Leaf Spots (Tilt, Cabrio, Quilt Xcel, Pristine)	Leaf Spots (Tilt, Cabrio, Quilt Xcel, Pristine)	Leaf Spots (Tilt, Cabrio, Quilt Xcel, Pristine)	Leaf Spots (Cabrio and Pristine)	Leaf Spots (Cabrio and Pristine)	Leaf Spots (Tilt, Cabrio, Quilt Xcel, Pristine)
		Septoria Leaf Spot Only (Abound, Luna Tranquility)	Septoria Leaf Spot Only (Abound, Luna Tranquility)	Septoria Leaf Spot Only (Abound, Luna Tranquility)	Septoria Leaf Spot Only (Abound, Luna Tranquility)	Septoria Leaf Spot Only (Abound, Luna Tranquility)	Septoria Leaf Spot Only (Abound, Luna Tranquility)	Septoria Leaf Spot Only (Abound, Luna Tranquility)	Septoria Leaf Spot Only (Abound, Luna Tranquility)	Septoria Leaf Spot Only (Abound, Luna Tranquility)
Phytophthora Root Rot (Ridomil, Orondis Gold 200, ProPhyt, K-phite, Aliette)	Botrytis (Rovral, Nevado, Elevate, Switch, Pristine, Luna Tranquility, Ph-D, Kenja, Captan) Rosette (Switch, Abound, Pristine, Quilt Xcel)	Botrytis (Rovral, Nevado, Elevate, Switch, Pristine, Luna Tranquility, Ph-D, Kenja, Captan) Rosette (Switch, Abound, Pristine, Quilt Xcel)	Botrytis (Rovral, Nevado, Elevate, Switch, Pristine, Luna Tranquility, Ph-D, Kenja, Captan) Rosette (Switch, Abound, Pristine, Quilt Xcel)	Botrytis (Rovral, Nevado, Elevate, Switch, Pristine, Luna Tranquility, Ph-D, Kenja, Captan) Rosette (Switch, Abound, Pristine, Quilt Xcel)	Botrytis (Rovral, Nevado, Elevate, Switch, Pristine, Luna Tranquility, Ph-D, Kenja, Captan) Rosette (Switch, Abound, Pristine, Quilt Xcel)	Botrytis (Rovral, Nevado, Elevate, Switch, Pristine, Luna Tranquility, Ph-D, Kenja, Captan) Rosette (Switch, Abound, Pristine)	Botrytis (Rovral, Nevado, Elevate, Switch, Pristine, Luna Tranquility, Ph-D, Kenja, Captan) Rosette (Switch, Abound, Pristine)	Botrytis (Rovral, Nevado, Elevate, Switch, Pristine, Luna Tranquility, Ph-D, Kenja, Captan) Rosette (Switch, Abound, Pristine)	Phytophthora Root Rot (Ridomil, Orondis Gold 200, ProPhyt, K-phite, Aliette) Orange Cane Blotch (ProPhyt)	
							Orange Cane Blotch (ProPhyt)	Orange Cane Blotch (ProPhyt)	Orange Cane Blotch (ProPhyt)	

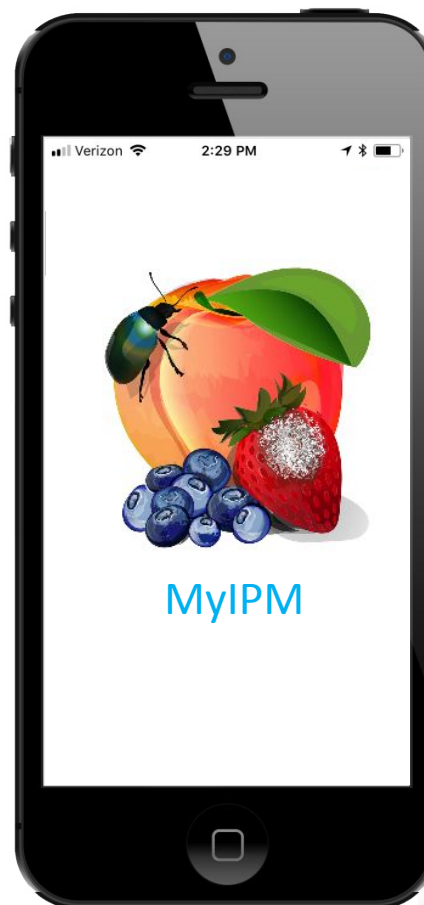
^aCaneberry bloom periods are protracted, so bloom and cover spray can be difficult to define clearly. Do not exceed label rates or spray intervals, but make sure that the pathogens indicated above are addressed with a thorough fungicide program as defined by the cultivar.



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**



Thank you for your attention!

