Plant Pathology Update
UF IFAS Plant Diagnostic Center

2025 FBGA Summer Grower Meetings

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Overview

Today's topics to review

- The UF IFAS Plant Diagnostic Center
  - History, location, services offered
- Common blueberry diseases diagnosed in Florida
  - Plant disease sample report 2020-2025
- Fungicide update for Phytophthora
  - Banded application rates of Ridomil vs Orondis Gold
- Questions

History of the UF IFAS Extension Plant Disease Clinic

Dr. R.S. Mullins founded the UF IFAS Extension Plant Disease Clinic in 1958 on the main campus of UF in Gainesville.

History of the PDC

The Original Plant Disease Clinic on UF campus in 1974

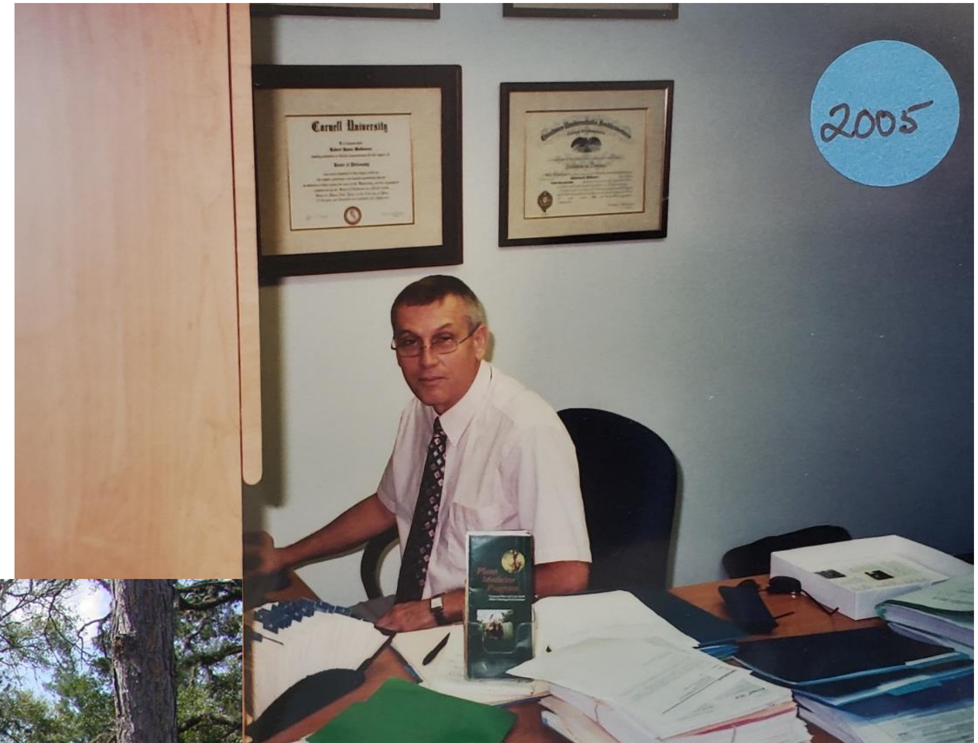
The current building completed in 2012

Dr. Tom Kucharek

Former Plant Disease Clinic Director and Extension Specialist in Plant Pathology

Dr. Bob Mcgovern

- Former Plant Disease Clinic Director and Extension Specialist in Plant Pathology



Groundbreaking for the new PDC in June 2012


UF UNIVERSITY of FLORIDA
IFAS
Plant Diagnosti
Center

Director of NIFA, Sonny Ramaswamy

Director of NIFA, Dr. Majit Misra

Under Secretary For Research, USDA's Chief Scientist: Dr. Chavonda Jacobs-Young

National Impact

Additionally, the training of students and researchers at the PDC has had a nationwide impact, with former trainees going on to establish and manage plant diagnostic labs across the country.

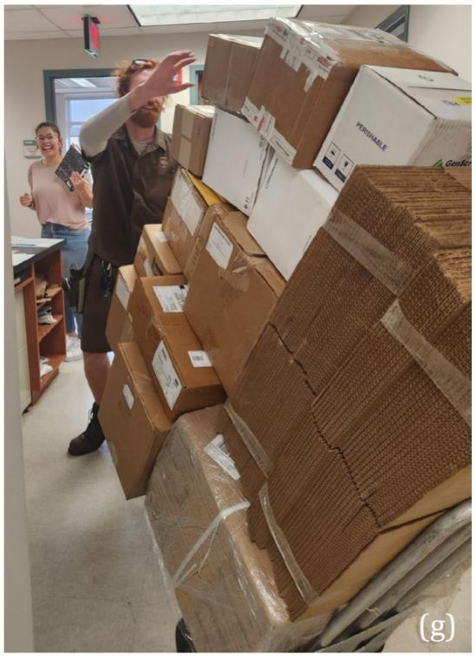
This was demonstrated at the NPDN National Meeting, held in Portland, Maine in 2024 where diagnosticians who received training at the PDC and other UF colleagues gathered with professionals from across the U.S.(j).

“Essential” Personnel

2024 Annual Report

Samples and Growing Demand

The PDC processed 3,152 samples in 2024. This was over 500 more samples in 2024 compared to 2023, often arriving in large batches at a time (g). Despite the number of samples in the center at any time, the PDC staff continues to ensure a range of clientele are well served by our many diagnostic services. Find our up-to-date list of services offered here.



(g)

A Leader in Florida Diagnostics

The PDC has shown its capacity for leadership, providing expertise and support for establishing new diagnostic labs across the state of Florida. Dr. Carrie Harmon serves as a key resource, offering guidance and supplies to institutions setting up lab facilities, such as the new Hastings Triage Lab (h, i).

Distribution

The PDC in Gainesville processed samples for clientele from 57 out of the 67 counties in Florida and 23 other states and territories in 2024 (Figure k). Our international diagnostic service received samples from Dominica, Dominican Republic, and Switzerland.

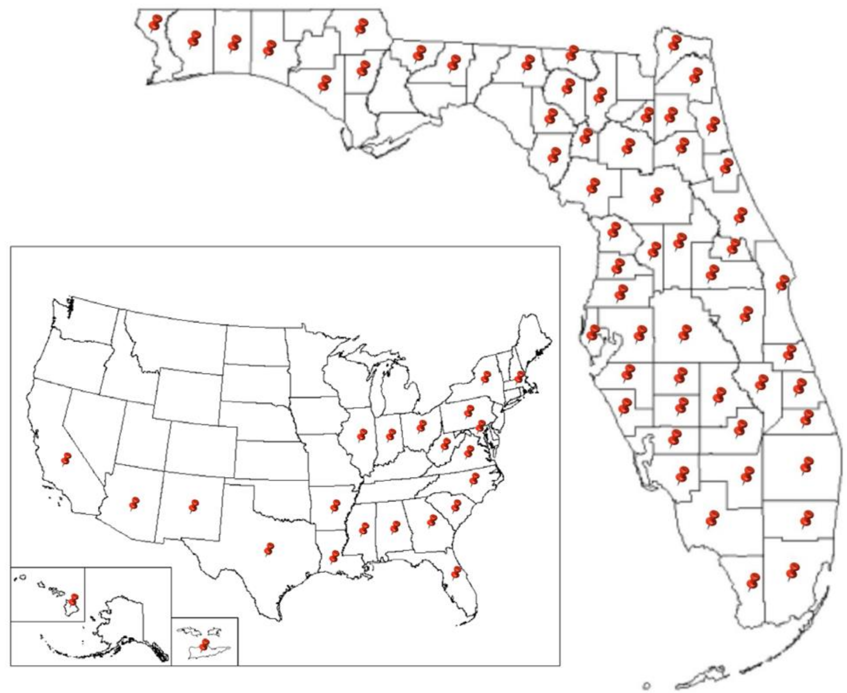


Figure k. Distribution of samples in 2024 by FL county and state.

Sample Submission

Turf and palms continue to represent the majority of PDC samples (Figure l). The number of turf and palm

UF IFAS Large Grant Leadership Award 2024 (>$1m)

PDC Blueberry Data

427 samples 2020 through 7/6/25

County, State	No.	County, State	No.
Alachua, FL	227	Sumter, FL	12
Pasco, FL	77	Citrus, FL	8
Lake, FL	55	Madison, FL	7
Polk, FL	43	Leon, FL	7
Marion, FL	32	Glades, FL	5
Highlands, FL	30	Jefferson, FL	5
Hardee, FL	24	Hernando, FL	5
De Soto, FL	24	Nassau, FL	4
Orange, FL	18	Levy, FL	4
Hillsborough, FL	18	Jackson, FL	4
Clay, FL	18	Miami-Dade, FL	3
Putnam, FL	16	Okaloosa, FL	2
Hendry, FL	15	…	
Manatee, FL	12		

PDC Blueberry Data
2022-2024 (all states)

Variety	No.	Variety	No.	Variety	No.
311	2	GeorgiaDawn	10	Patricia	4
12-279	7	Indigocrisp	6	Preston	10
17-142	20	Jewels	1	Rabbiteye	3
Abundance	5	KeeCrisp	24	SanJoaquin	3
Albus	3	Kestrel	10	Sentinel	31
Arcadia	59	Kira	2	Stellar	13
Avanti	48	Legacy	15	Suziblue	16
Chickadee	4	Mageia	3	SweetCrisp	5
Collosus	8	Meadowlark	6	Vireo	8
Emerald	17	Oneal	7	Winterbelle	7
Farthing	78	Optimus	24	WinterSweet	4

PDC Blueberry Data

427 samples 2020 through 7/6/25

County, State	No.	County, State	No.
Botryosphaeria sp./spp.	116	Botrytis cinerea	4
No Pathogen Found	88	Blueberry Red Ringspot Virus	4
Colletotrichum (anthracnose)	86	Xanthomonas sp./spp.	4
Phytophthora cinnamomi	70	Agrobacterium tumefaciens	3
Arthropods	31	Alternaria sp./spp.	3
Phomopsis sp./spp.	25	Armillaria sp./spp.	2
Rust	24	Blueberry Necrotic Ring Blotch Virus	2
Phyllosticta vaccinii	20	Rhizoctonia sp./spp.	2
Ralstonia solanacearum	20	Septoria albopunctata	2
Pestalotiopsis sp./spp.	18	Calonectria sp./spp.	1
Gloeocercospora inconspicua	16	Exobasidium maculosum	1
Pythium sp./spp.	16	Microsphaera vaccinii	1
Corynespora sp./spp.	14	Monilinia vaccinii-corymbosi	1
Cephaleuros virescens	13	Stemphylium sp./spp.	1
Fusarium sp./spp.	8		

Evolving challenges

- New disease discoveries at UF for the industry
  - Algal stem blotch, *Cephaleuros virescens* 2005
  - Bacterial leaf scorch, *Xylella fastidiosa* 2009
  - New stem blight pathogens, *Lasiodiplodia theobromae* 2009
  - Blueberry necrotic ring blotch, *BNRB* virus 2013
  - Target spot, *Corynespora cassicola* 2015
  - Bacterial wilt, *Ralstonia solanacearum* 2017
  - Fungicide resistance, *Colletotrichum* sp. 2018
  - Cercospora leaf spot, *Psuedocercospora* sp. 2022

Bacterial Wilt

Example: Bacterial Wilt *Ralstonia solanacearum* potentially devastating

Unknown disease killing a promising evergreen variety, 'Arcadia' 2016

Discovered bacterial wilt, published the research in 2017

EDIS extension publication and FBGA presentations with management recommendations 2016-within 12 months

Arcadia is still viable because of this work.

Screening protocols developed with breeding program to help reduce the chances of future releases being as susceptible

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PP332

Bacterial Wilt of Southern Highbush Blueberry Caused by *Ralstonia solanacearum*[1]

Philip F. Harmon, Carrie Harmon, and Dave Norman[2]

Symptoms

Bacterial wilt is a newly discovered disease of blueberry in Florida. Symptoms of the disease are similar to those caused by *Xylella* and bacterial scorch. Plants with bacterial wilt will show signs of water stress such as wilting and marginal leaf burn (Figures 1 and 2). Plants with bacterial wilt may also be prone to developing severe symptoms of other stress diseases, such as stem blight, in the affected patches and thus may show symptoms of both diseases. The crowns of blueberry plants with bacterial wilt have a mottled discoloration or light brown to silvery purple blotches with ill-defined borders (Figure 3). This discoloration is distinct from that which occurs with stem blight disease; stem blight discoloration is typically pie piece-shaped and pecan brown in color. Additionally, wood chips floated in water from the crowns of plants with bacterial wilt will stream bacterial ooze (Figure 4). Stem blight-infected wood chips do not.

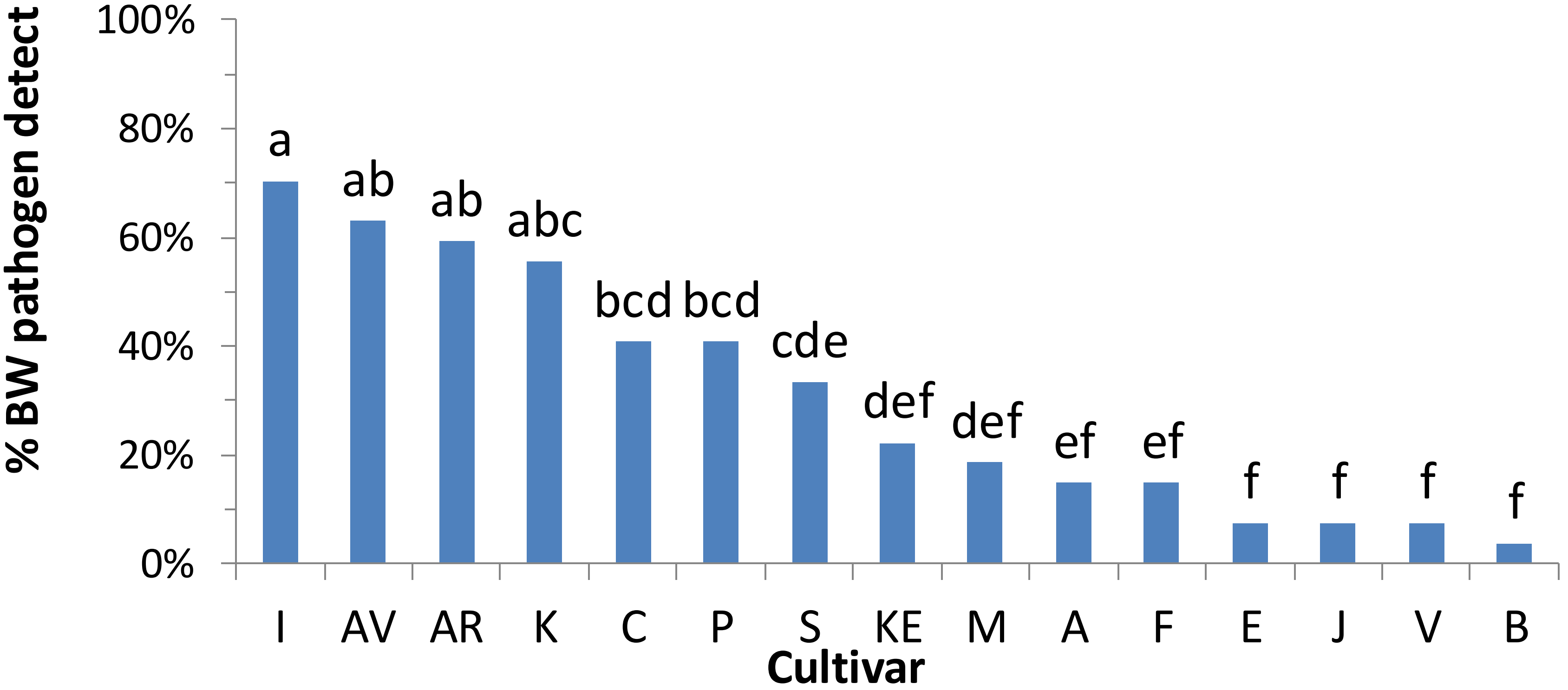
Unlike *Xylella*, which causes bacterial leaf scorch, this *Ralstonia* can be spread easily in water, soil, or through infected plant material. Plants can be infected without showing symptoms. *Ralstonia* can survive for years in soil, slowly spreading down and across rows of blueberry, leaving large circular patches of dead and dying plants (Figures 5 and 6). These symptoms are similar in appearance to Phytophthora root rot-affected areas, but do not necessarily occur only in low-lying and poorly drained soils. Once introduced to a farm or nursery facility, the pathogen is spread most efficiently in recycled irrigation water and ponds used for irrigation. *Ralstonia* can also be moved from plant to plant on pruning and other equipment.

Figure 1. Scorch symptoms caused by bacterial wilt disease on 'Arcadia' blueberry.
Credits: Philip Harmon, UF/IFAS

1. This document is PP332, one of a series of the Plant Pathology Department, UF/IFAS Extension. Original publication date November 2016. Reviewed July 2020. Visit the EDIS website at https://edis.ifas.ufl.edu for the currently supported version of this publication.
2. Philip F. Harmon, professor, Plant Pathology Department; Carrie Harmon, director UF/IFAS Plant Diagnostic Center; and Dave Norman, professor, Plant Pathology Department, UF/IFAS Mid-Florida Research and Education Center; UF/IFAS Extension, Gainesville, FL 32611.

Reviewed: 11/2023

Cultivar Screen Results



- Every cultivar was susceptible, but frequency of disease detection varied significantly among cultivars, and Arcadia was in the most susceptible statistical grouping.
- Mean time to permanent wilt was not a reliable indicator of susceptibility.
- Results from this assay are consistent with other cultivar screens, data from diagnostic clinics, and observations of disease in the field, and would be useful for selecting less susceptible varieties in breeding programs.

Gloeocercospora leaf spot

- Described in 1947
- Found on the Sentinel variety in 2022
- Fungicide screening ongoing

Phytophthora root rot

- Phytes applied as foliar spray
- Fungicides applied to the bed
  - Banded application
  - Through irrigation
- Ridomil Gold SL-3.6 pt per acre broadcast
  - For 10’ centers
  - 18” band
  - 8.64 fl oz/acre
  - $44/acre @ $650/gallon

4.0 APPLICATION DIRECTIONS

4.1 Methods of Application

Applications with Ridomil Gold SL are permitted by ground, by air, and via chem otherwise restricted in **Section 6.1**. Ground application includes broadcast spray applications, as well as soil injections and crown dips. Incorporation includes prep applications.

For band applications, refer to **Section 4.1.1** to calculate the amount of Ridomil furrow applications, refer to **Section 4.1.2** for the amount of product to use with c for details of application by chemigation.

4.1.1 BAND APPLICATION

Application rates in **Section 7.0** are expressed as an amount per acre which refers a banded application, use proportionally less product using the formula below:

$$\frac{\text{band width in inches}}{\text{row spacing in inches}} \times \text{broadcast rate per acre} = \text{amount needed per acre of field}$$

4.1.2 IN-FURROW APPLICATION

The following table provides common row spacing and the amount of Ridomil G Cotton, Peanut, Potato, and Soybean **ONLY**.

Phytophthora root rot

- Orondis does not allow for banded application reduction the way that Ridomil does
  - Broadcast rates are applied to treated area, regardless of banded or not
  - $86/acre low rate @$390/gallon
  - $171/acre high rate

If using banded application to beds, reduce rate to account for treated acres vs total

Example:

Ridomil Gold application to blueberry

width of bed:	18in		
row spacing	10ft		120
label rate	3.6pt/a		57.6fl oz
Banded rate	8.64fl oz	per treated acre	
Acres to treat	140		9.45gallons product

$6,150 @ $650/gallon

Orondis Gold (oxy+mef) application to blueberry

low label rate	28fl oz/a			
high label rate	55fl oz/a			
		Product to use		
Acres to treat:	140	low rate	3920fl oz	30.625gallons product
				$12k @ $390/gallon
		High rate	7700fl oz	60.15625gallons product
				$24k

Any Questions?

Philip Harmon, University of Florida

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2023 Grower Survey

Top 5 Disease problems/causal agent

Disease	Pathogen	Top5
anthracnose ripe rot	*Colletotrichum gloeosporioides*	28
leaf rust	*Thekopsora mimimum*	27
algal stem blotch	*Cephaleuros virescens*	17
root rot	*Phytophthora cinnamomi*	16
stem blight	*Botryosphaeria spp.*	12
bacterial wilt	*Ralstonia solanacearum*	9
target spot	*Corynespora cassiicola*	5
Alternaria fruit rot	*Alternaria spp.*	2
gray mold	*Botrytis cinerea*	1
Septoria leaf spot	*Septoria albopunctata*	1

"Anthracnose"

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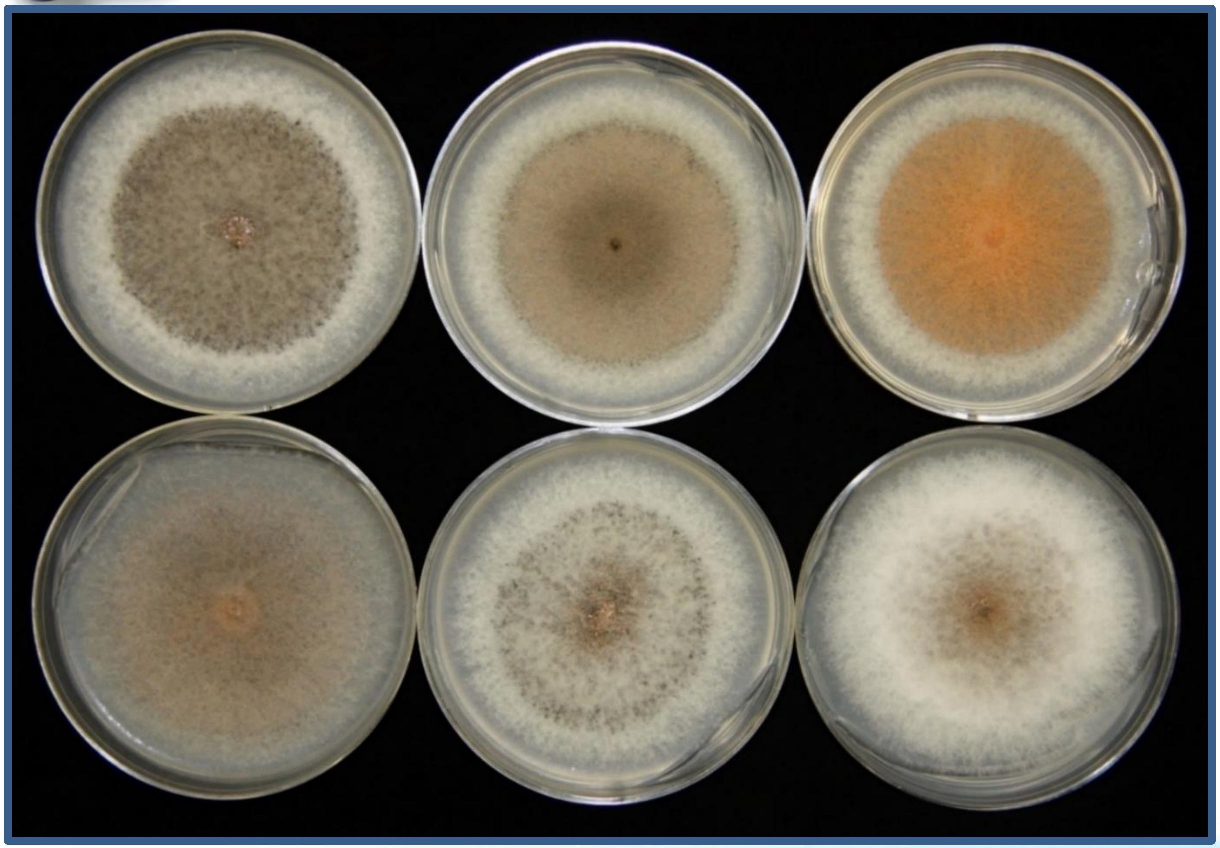
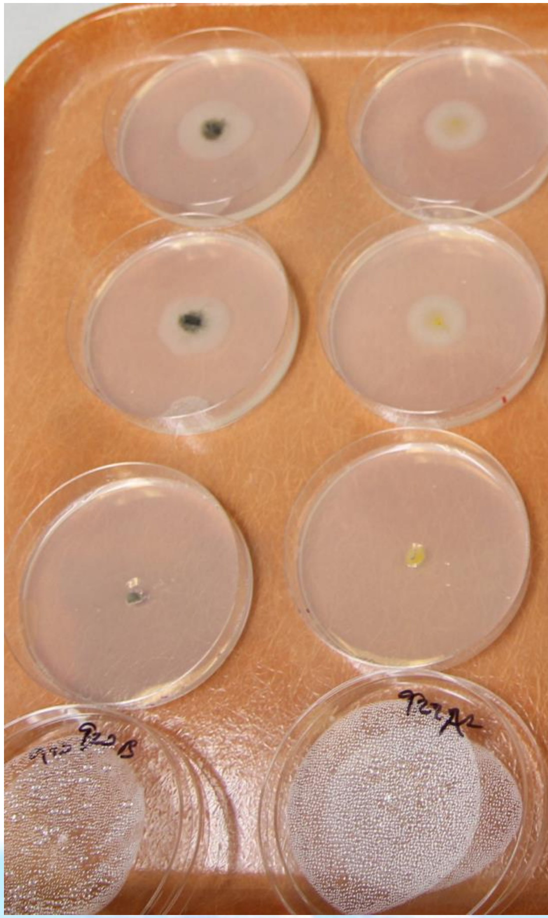
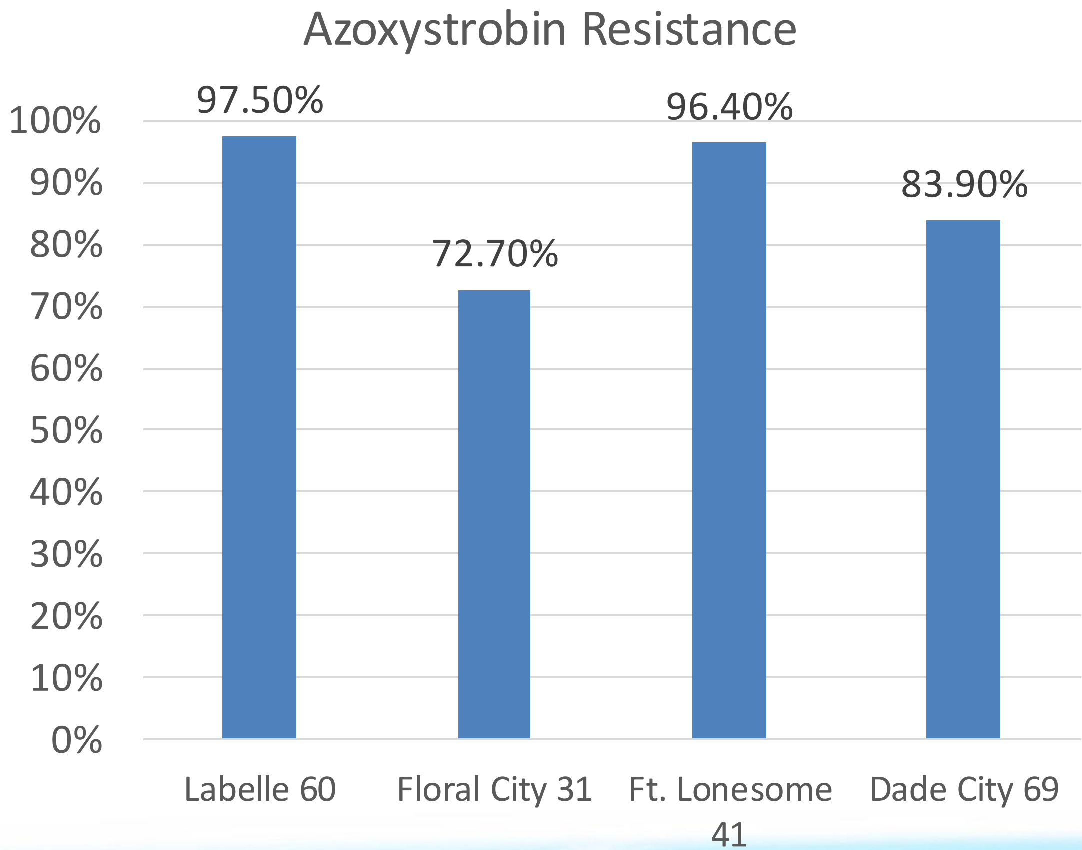




Overlapping colony morphology from berry, stem, and leaf.
Fungicide resistance to our best products

Anthracnose fruit rot

Known Resistance



- Resistance
  - Abound (azoxy)
  - Miravis (pydiflum)
  - Pristine (boscalid)
- Sensitive
  - Switch (fludioxonil)
  - Omega (fluazinam)
  - Fontelis (penthiopy
  - Aprovia (benzovindi (lowbush only)

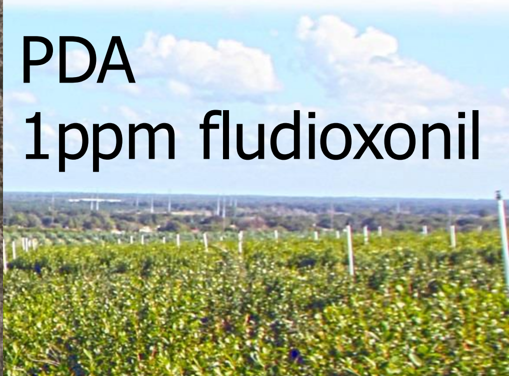
Gama et al 2021

Resistance to fludioxonil (Switch)?

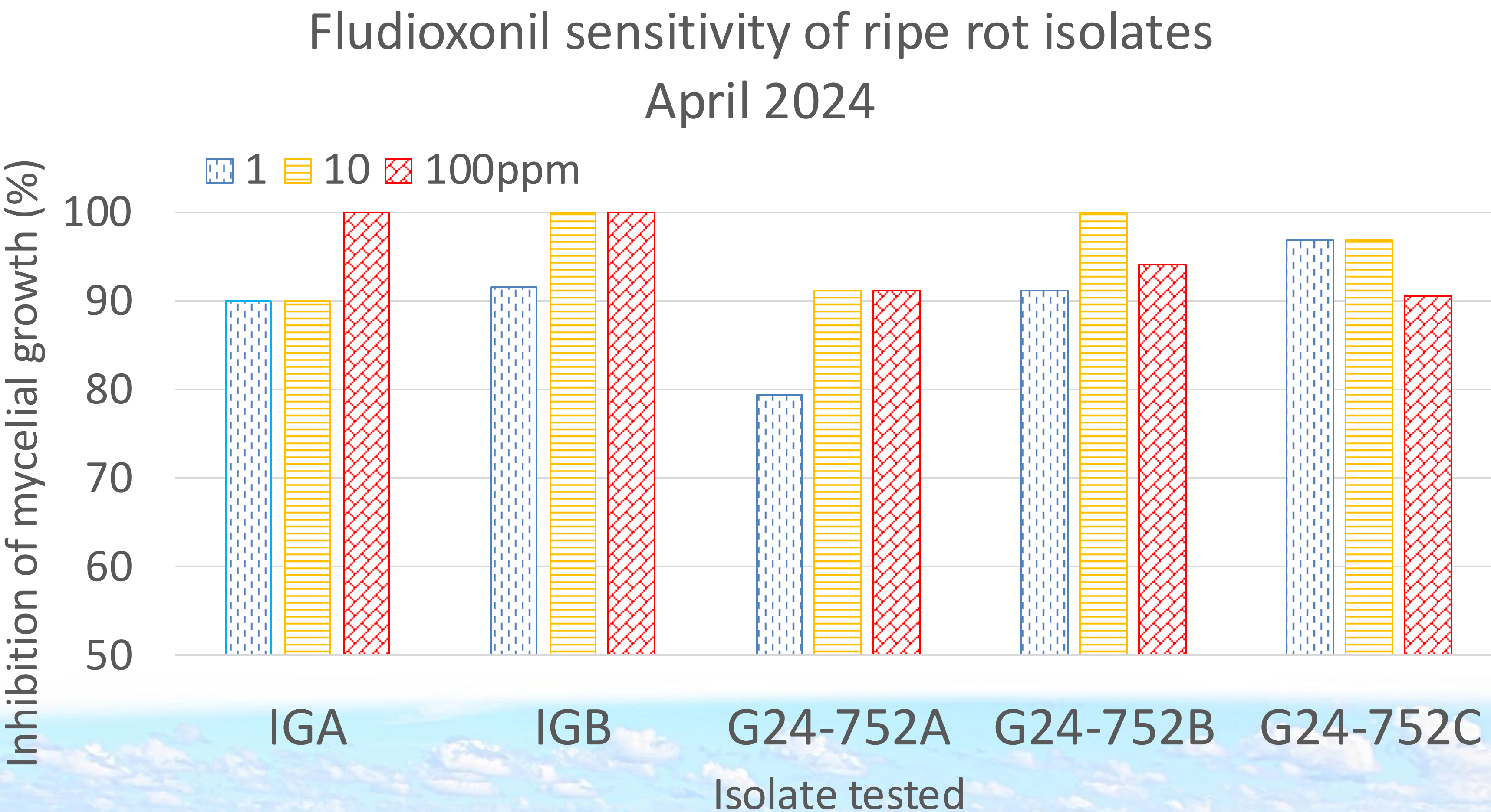
Isolate *Colletotrichum*

PDA

PDA
1ppm fludioxonil



Isolates were sensitive (>90% inhibition at 10ppm)



Resistance is a major concern!

Follow label instructions, do not overuse fludioxonil.

Fungicide resistance modes

- modification of sensitive site
- exclusion of fungicide
- detoxifying the fungicide

Resistance Review

- **Risk factors for fungicide resistance**
  - # of site(s) of action in the targeted microbe
  - fitness of resistant mutants
  - use of repetitive or sustained fungicide treatments
  - extensive areas of use
  - population size and reproductive rate of target pathogen
  - lack of other types of fungicides or cultural controls
  - cross-resistance with existing fungicides (resistance to two or more fungicides mediated by the same genetic factor)

What is resistance?

- Fungicide no longer provides acceptable levels of disease control, because individuals in the pathogen population are not sensitive to the active ingredient
- Sensitivity is the quantifiable toxicity of an active ingredient on a fungus
- Selection is the increase in ratio of individuals in a population with an adaptive advantage to those without it
- Selection pressure is the magnitude of the adaptive advantage applied to a population

How does it occur?

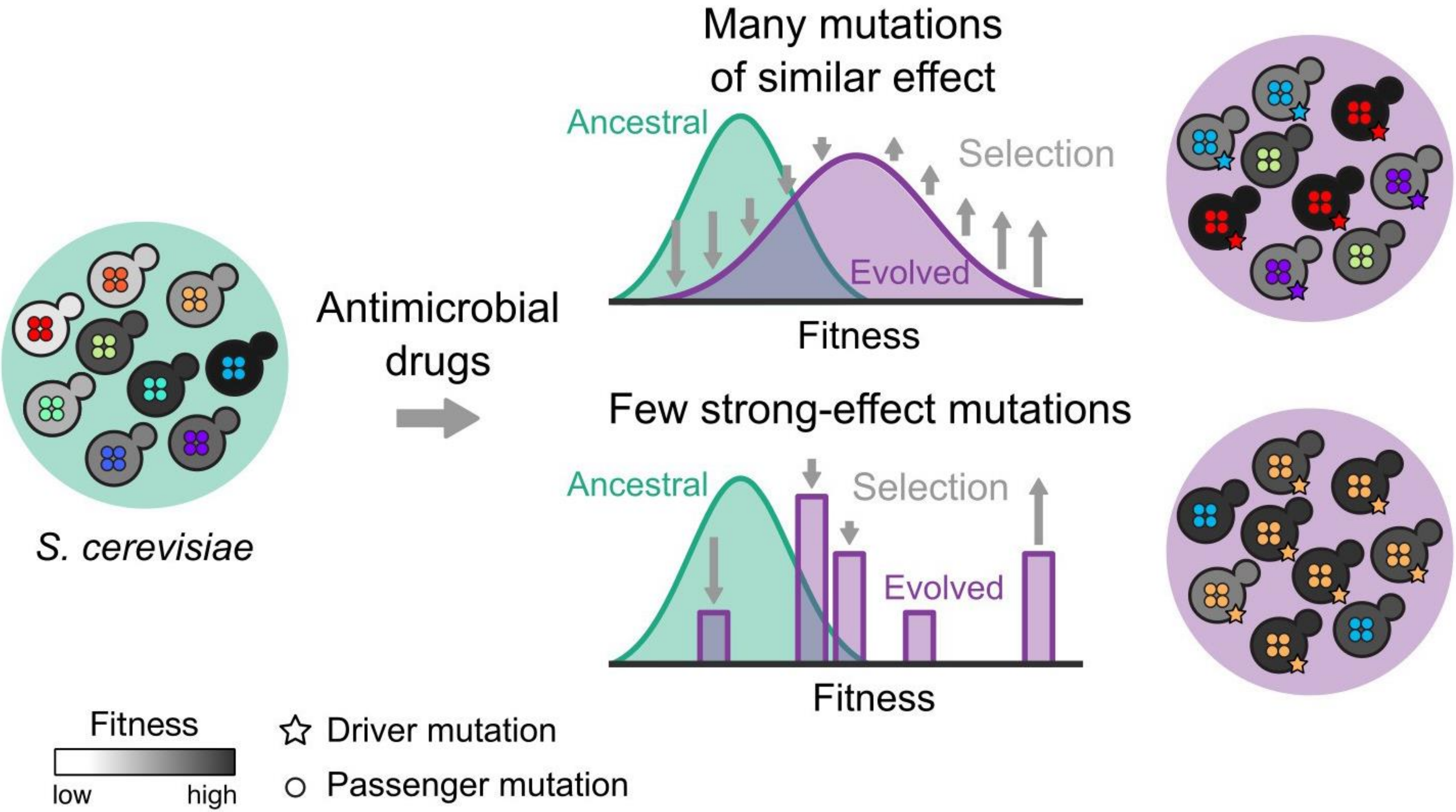
- Mutation is the ultimate source of variation in a population
  - Single site fungicides potentially affect one protein at one binding site defined by one codon
  - Mutation rates are low, but populations can be large
    - *Neurospora crassa* inositol requirement $8x10^{-8}$, Adenine requirement $4x10^{-8}$ per asexual spore
    - 6 out of every 100 million spores
- Resistance does not represent a pathogen's deliberate response to exposure to a fungicide
  - Fungicides do not cause changes in DNA sequence

When does it occur?

- Fungi differ in their likelihood of developing resistance
  - Large populations—prolific spore producers
  - Lower mutation rates? Higher resilience to mutation?
  - Few other sources of genetic variation—transposable elements, sex, etc.
- Persistent, strong, selection pressure applied to large diverse populations are more likely to result in resistance in a given amount of time

What types of resistance?

- Monogenic
  - Qualitative sensitivity distribution likely
  - Changes in the target site of the fungicide
- Polygenic
  - Quantitative sensitivity distribution likely
  - Changes in the ability of the fungus to limit accumulation of the active ingredient in fungal cells
    - Reduced uptake (polyoxin D)
    - Secretion (DMI)
    - Detoxification
    - Alternative pathways (alternative oxidase, QoI)



https://www.sanger.ac.uk/news_item/yeast-spotlights-genetic-variation-s-link-drug-resistance/

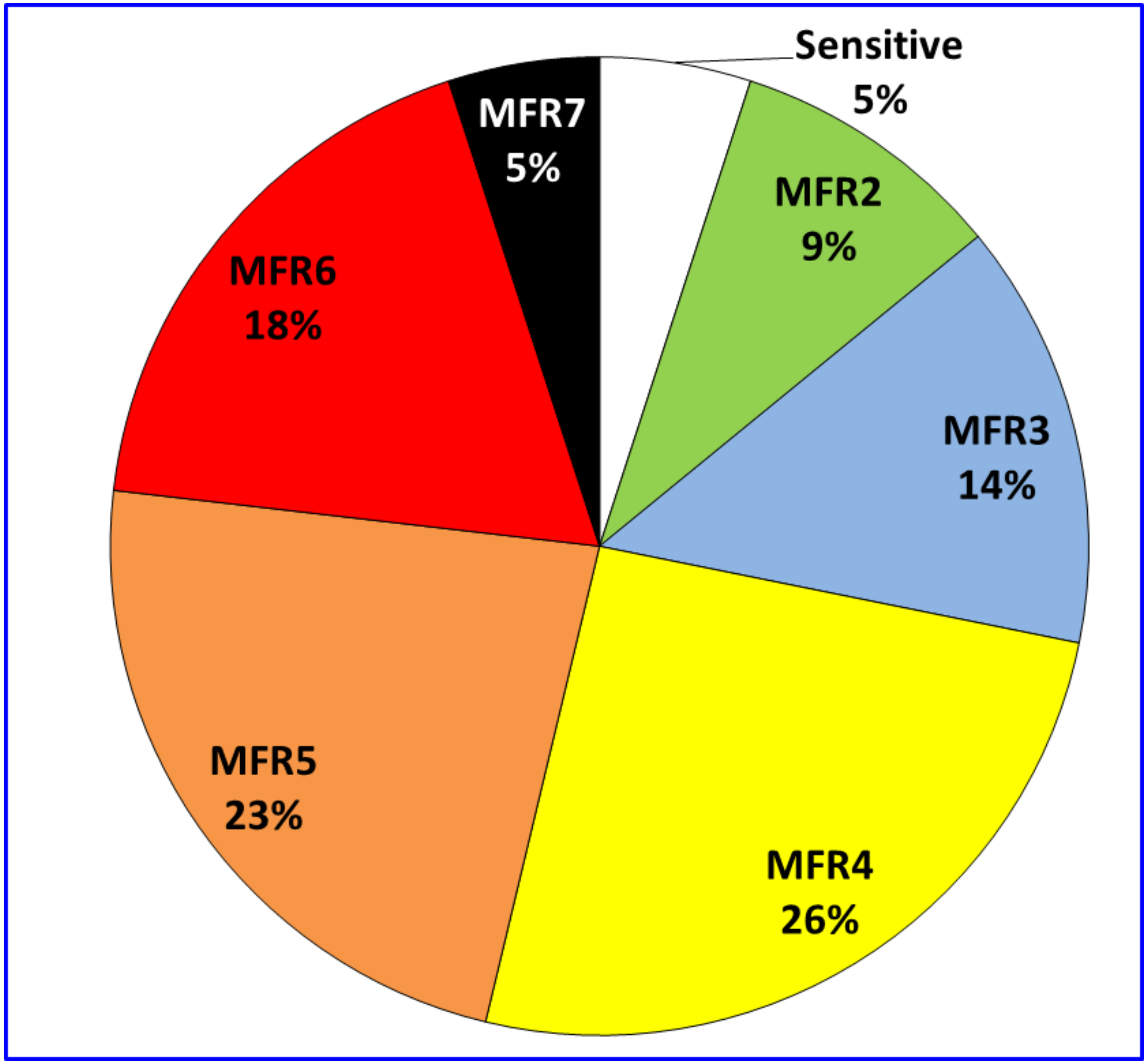
Multiple resistance

- Cross resistance
  - Resistance to multiple active ingredients in a MOA
- Multiple resistance
  - Resistance to multiple MOA groups

- Gray mold caused by *Botrytis*
  - Examples of isolates that are resistant to DMI, benzimadazoles, and 5 other MOA's exist!
- Ripe rot anthracnose caused by *Colletotrichum*


Botrytis blossom blight

Management at risk because of multiple resistance



Phenotype	Resistant to
MFR2	2 fungicides
MFR3	3 "
MFR4	4 "
MFR5	5 "
MFR6	6 "
MFR7	7 "

MFR = The same botrytis isolate may be resistant to 2, 3, 4 or more fungicides, simultaneously.

From Amiri, Harmon, & Peres. Winter BGA meeting, Plant City, FL, 02/20/14

Managing resistance

- Two strategies or goals for preventing resistant populations from becoming predominate
  - Keep population sizes small
  - Reduce selection pressure
- Recommendations
  - <u>Employ nonchemical options of disease control</u>
  - Apply fungicides preventatively
  - Use multi-site compounds as the first line of defense
  - Limit the use of site-specific actives
  - Use multi-site tank mix partners
  - Rotate or tank mix site-specific classes
  - Use the recommended rate

FBGA Research Priorities

- Committee of FBGA Board Members
  - Charge is to formalize a list of prioritized research needs for the Florida Blueberry Industry
  - A draft list of topics has been put together with Board of Directors' input
  - We'd like to get your input!
  - What are the most important research needs for your farm?

FBGA Research Priorities

- Breeding-Cultivar development, improvement
  – Increase yield, firmness, pest and disease resistance, flavor, machine harvestability
- Entomology-Control measure development for:
  – Chili thrips, mites, gall midge, diaprepes
  – Rankings of varieties for tolerance to pests
  – Spray timing, rotations, rates, economic returns
- Nematology-investigate replant disorder
  – Survey, fumigation work
- Weeds-Additional control options for:
  – Sedge, perennial grasses, QuinStar safety for FL
  – Plant safety, specifically when carrying fruit
  – Evaluate combinations, reduce PHI's for glufosinate, organic options
- Pathology-Control options for:
  – Rust, root rot, stem blight, anthracnose, bacterial wilt
  – Refine effectiveness ratings, economic return studies
  – Overhead vs drip irrigation impacts on disease
  – Methods to limit spread of pathogns to limit risk, sanitation efforts
  – Root girdling, sucker removal, stem blight

FBGA Research Priorities

Continued

- Horticultural practices-
  - Variety specific pruning practice effects on yield for machine harvesting
  - Renewal pruning practices vs renovation, economic thresholds for evergreen and deciduous
  - Plant spacing and density multi-year multi variety research
  - Precocious varieties recommendations to maximize yr1 yield, crop insurance implications
  - Phosphorous and other nutrient management impact on fruit quality and yield
  - Nitrogen needs for crop production leading to and through harvest, crop load impacts, slow release tech
  - Fruit drop, red cap, pollination, fert impacts on fruit abortion (Sentinel, Meadowlark, Optimus)
  - Mechanization, fruit toughening practices, new harvest tech
  - Pine bark alternatives, coco,
  - Low temp impact and damage studies at different floral and fruit development stages (water conservation)
- Pollination
  - Flower visitation studies with yield prediction by AI to promote market stability
  - Cross pollination partners, interplant density requirements