

Pomegranate - Specialty Crop Block Grant

FL Pomegranate Association 4th
Annual Meeting, Lake Alfred
October 23, 2015

Gary Vallad & Achala KC
GCREC, Wimauma, FL

Pomegranate - Specialty Crop Block Grant

Overview of Disease Research

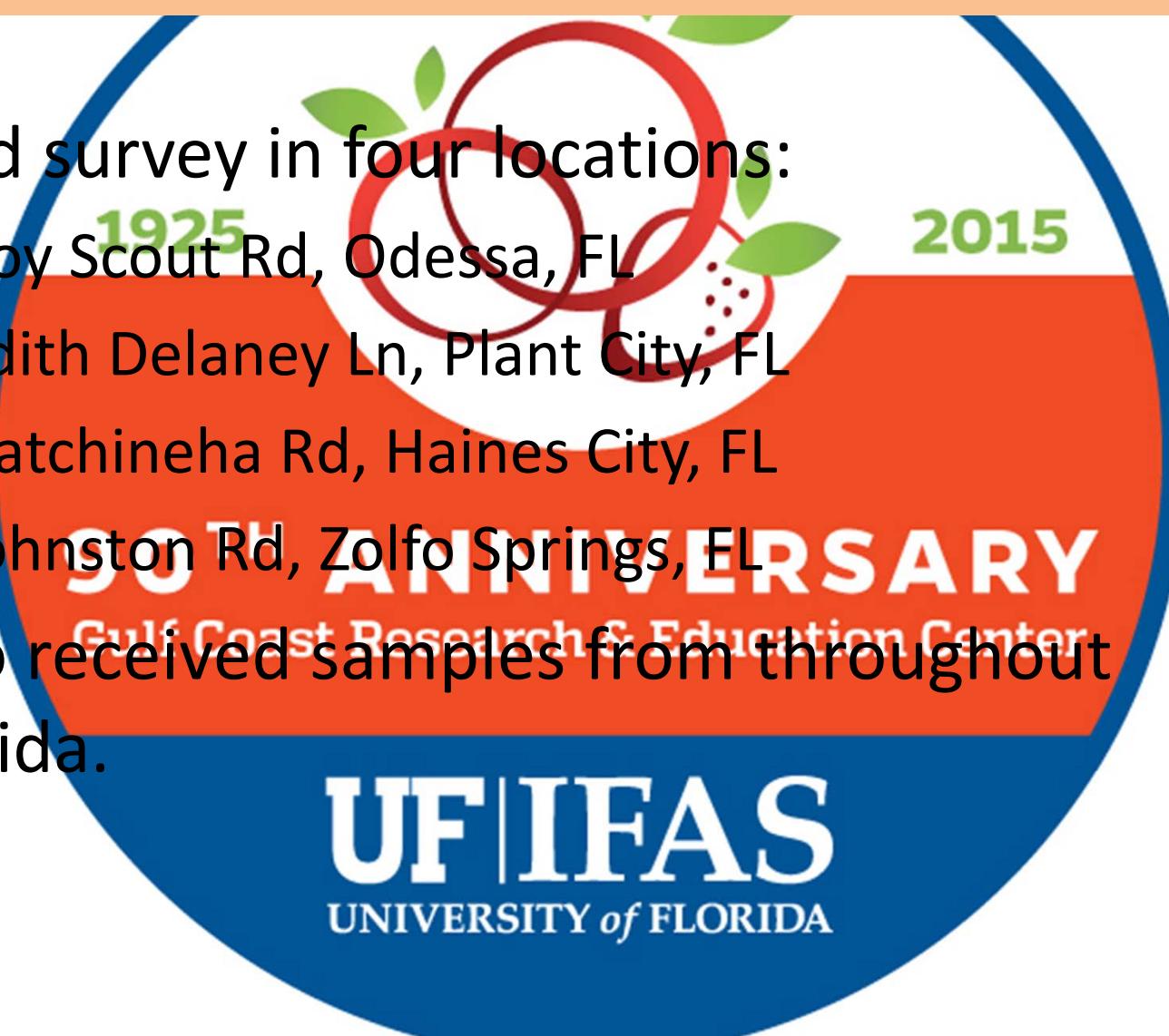
- Initial Disease Survey - 2014
- Pathogen Identification
- Subsequent Disease Survey - 2015
- Chemical Control Studies
 - In vitro assays
 - Field tests
- Future...



KC and Vallad, 2015. University of Florida, GCREC

Initial 2014 Disease Survey

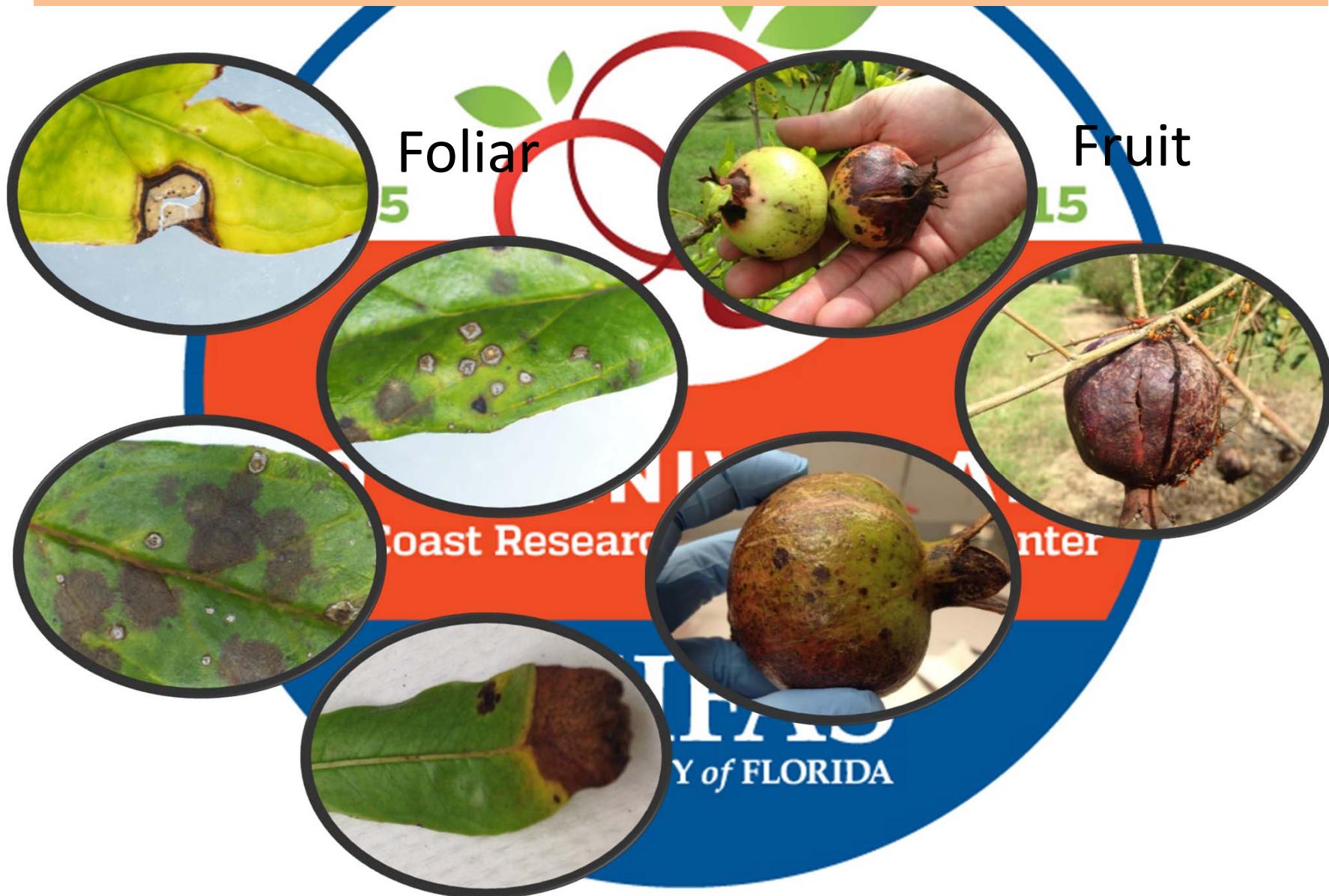
- Field survey in four locations:
 - Boy Scout Rd, Odessa, FL
 - Edith Delaney Ln, Plant City, FL
 - Hatchineha Rd, Haines City, FL
 - Johnston Rd, Zolfo Springs, FL
- Also received samples from throughout Florida.



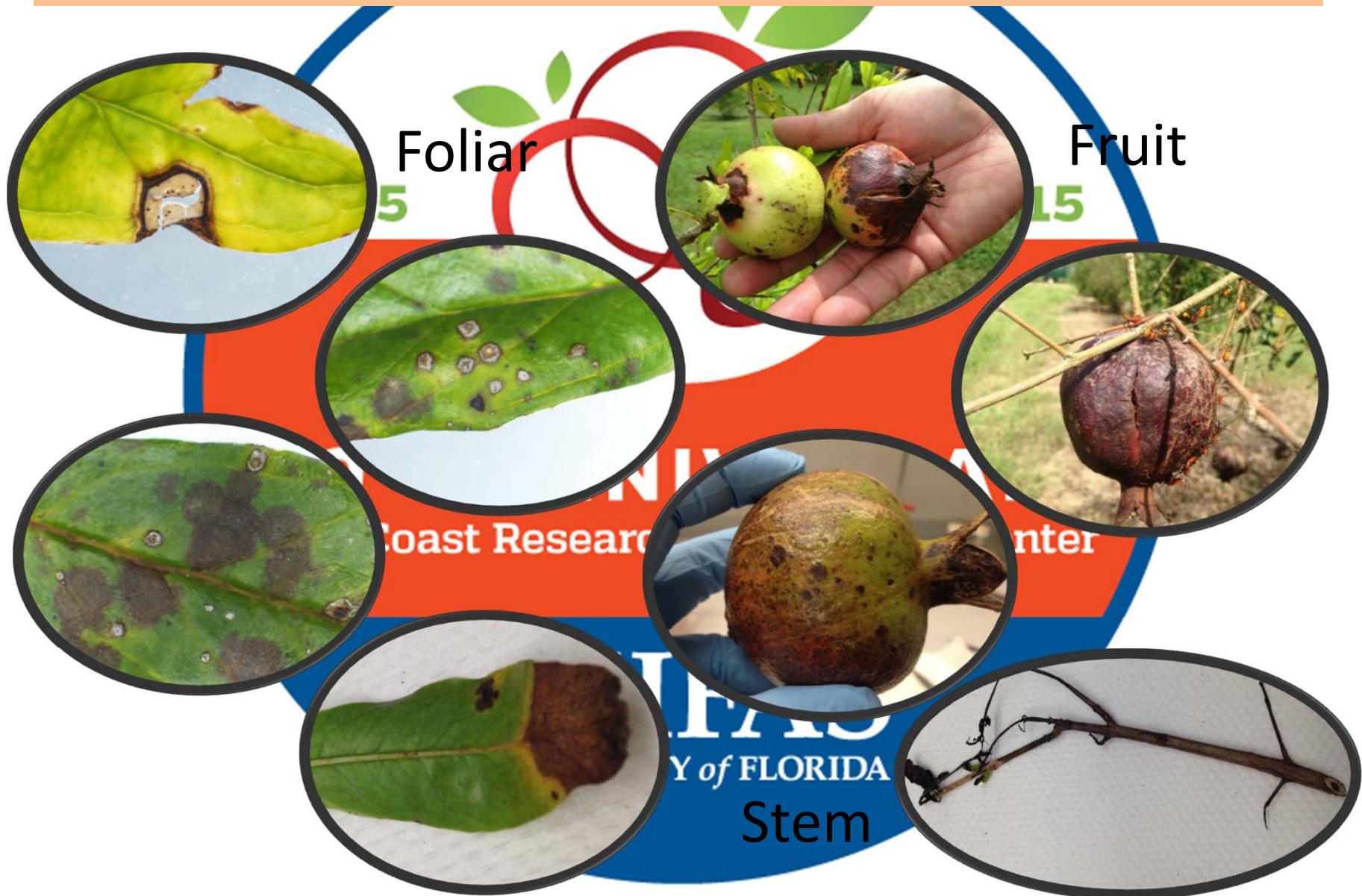
Disease Survey



Disease Survey



Disease Survey



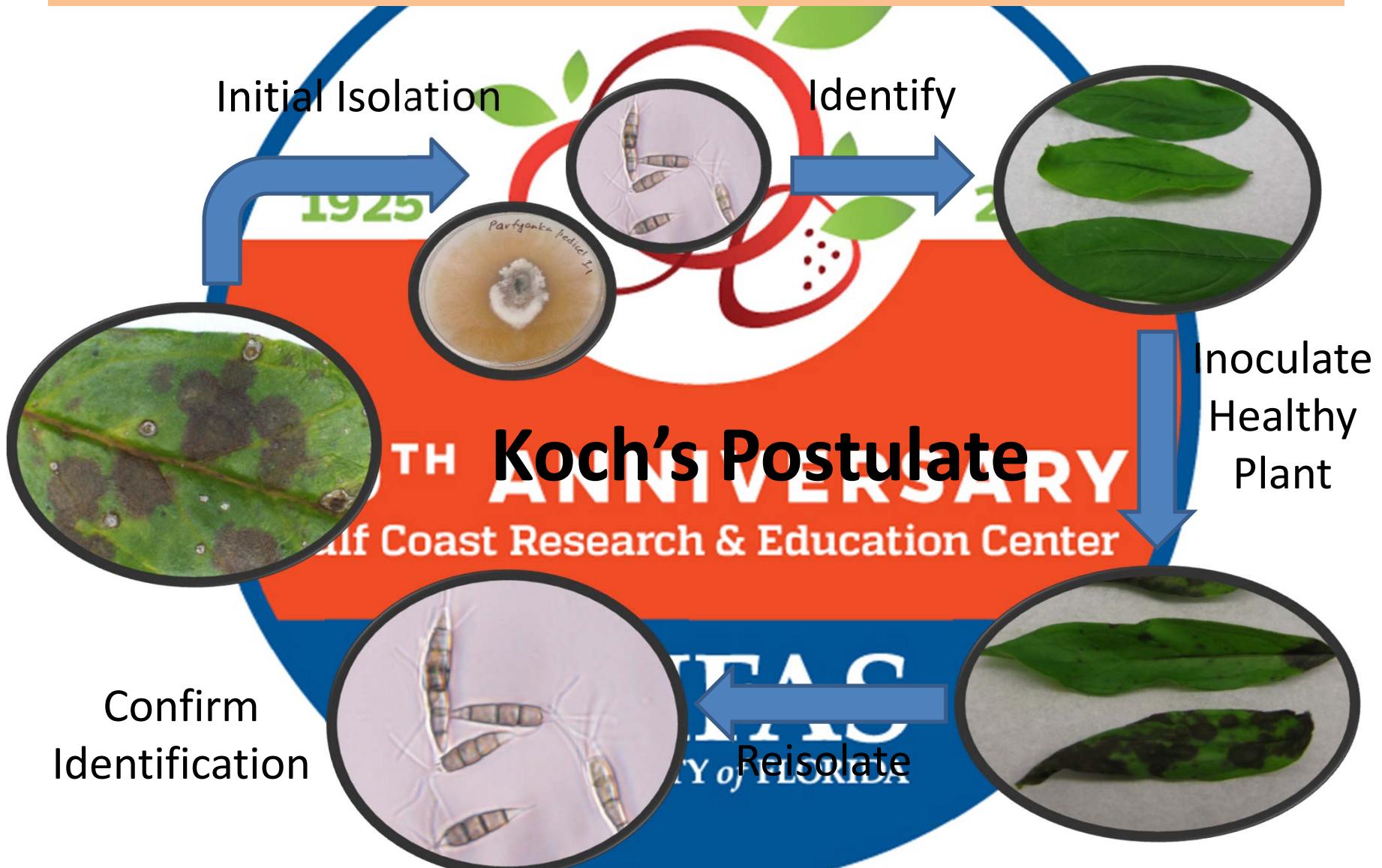
Pathogen Identification



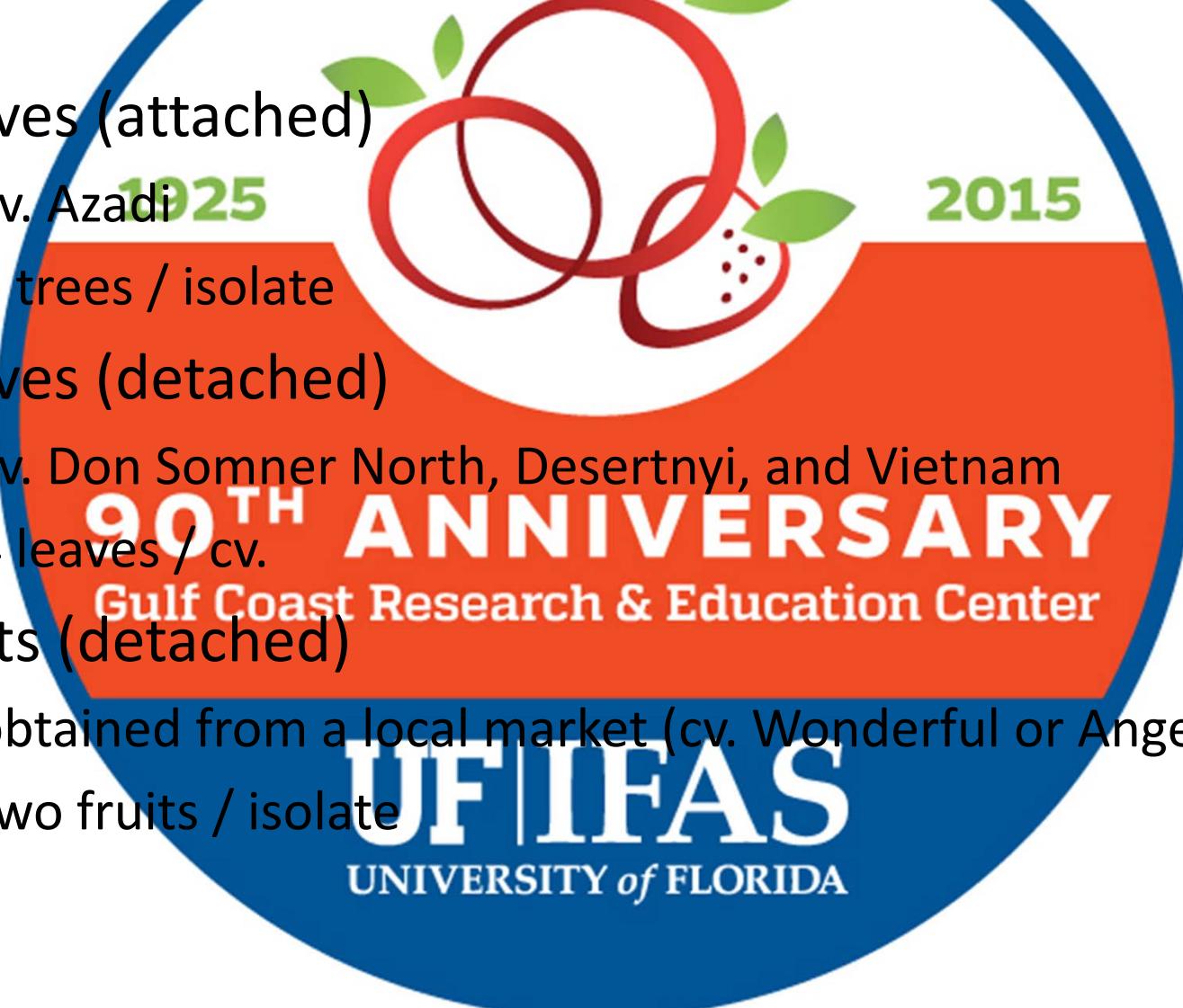
Initial Identification (Results)

Pathogen	Plant Part	% Isolation
<i>Colletotrichum</i> sp.	Leaf, Stem, Flower, Fruit	29
<i>Neofusicoccum parvum</i>	Leaf, Stem, Pedicel	6
<i>Amphilogia</i> sp.	Leaf, Stem, Flower	6
<i>Pilidiella granati</i>	Stem	3
<i>Lasiodiplodia</i> sp.	Leaf, Stem, Pedicel, Fruit	9
<i>Alternaria</i> sp.	Leaf	3
<i>Nigrospora sphaerica</i>	Leaf, Fruit	6
<i>Corynespora cassiicola</i>	Leaf	3
<i>Epicoccum nigrum</i>	Stem	6
<i>Phyllosticta</i> sp.	Leaf	3
<i>Pestalotiopsis clavispore</i>	Leaf	18
<i>Fusarium</i> sp.	Fruit	6
<i>Nectria mauritiicola</i>	Stem	3

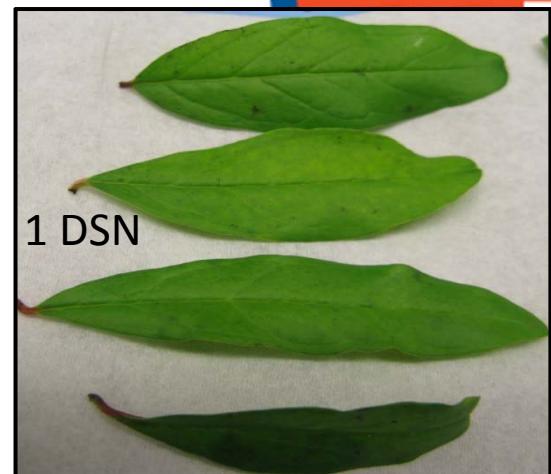
Pathogen Identification



Pathogenicity tests

- Leaves (attached)
 - cv. Azadi
 - 3 trees / isolate
 - Leaves (detached)
 - cv. Don Somner North, Desertnyi, and Vietnam
 - 4 leaves / cv.
 - fruits (detached)
 - obtained from a local market (cv. Wonderful or Angel Red)
 - two fruits / isolate
- 
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Gulf Coast Research & Education Center
- UF IFAS**
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Pathogenicity test (Detached leaf assays)



3- *Amphilogia* sp; 11- *Neofusicoccum parvum*; 2- *Colletotrichum* sp.; 1- *Phyllosticta elongata* ;
8- *Pestalotiopsis clavispora*

Pathogenicity test (Detached fruit assays)



Pathogenicity tests on fruits; fruits inoculated with A) *Amphilogia* sp B) *Pilidiella granati*, C) *Colletotrichum* sp.1 D) *Colletotrichum* sp. 2, E) *Lasiodiplodia* sp., and F) *Neofusicoccum parvum*

Pathogen Identification (Results)

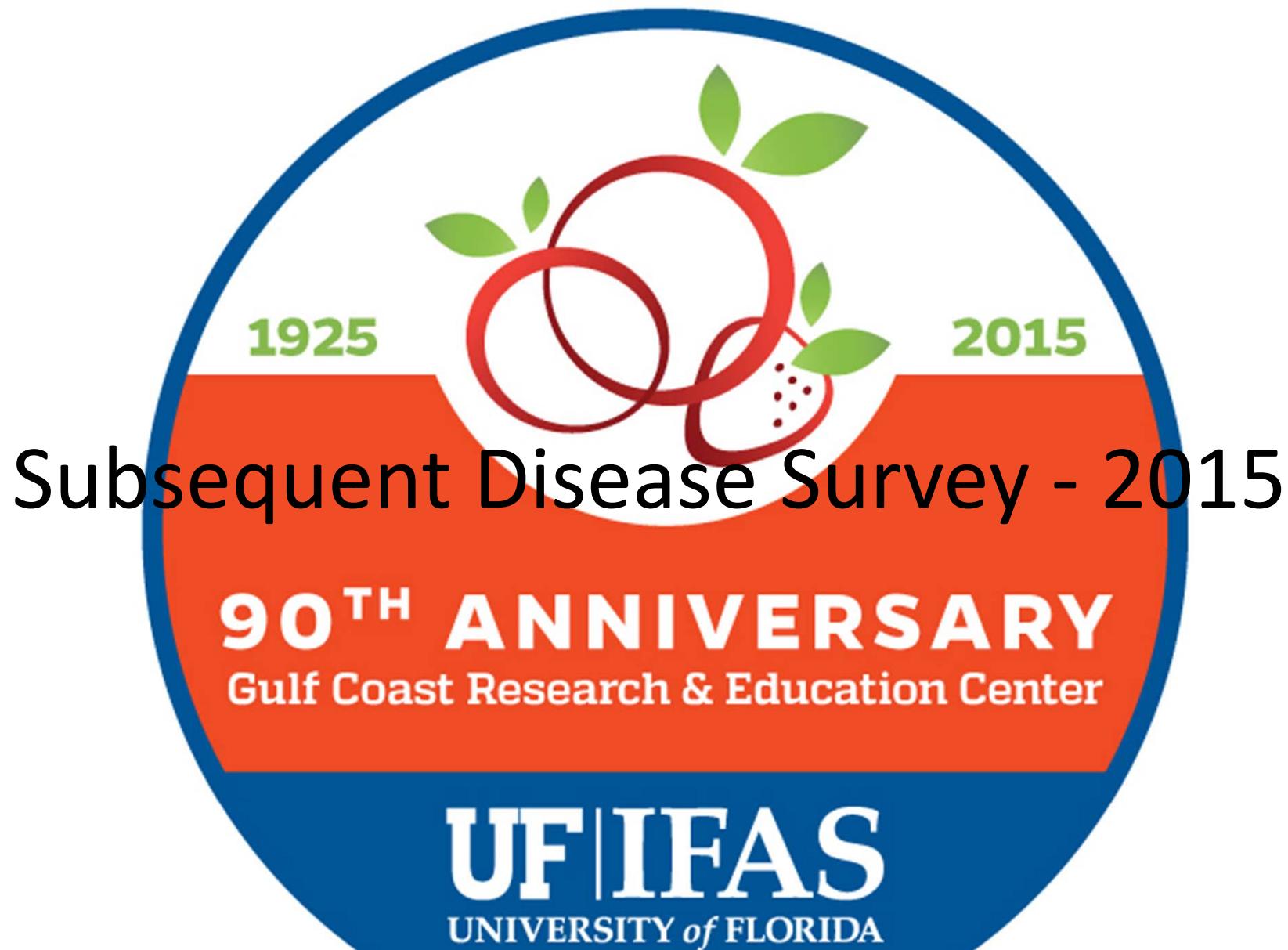
Pathogen	Plant Tissues	% Isolation	Pathogenicity ^a
<i>Colletotrichum</i> sp.	Leaf, Stem, Flower, Fruit	29	+ + **
<i>Neofusicoccum parvum</i>	Leaf, Stem, Pedicel	6	+ + **
<i>Amphilogia</i> sp.	Leaf, Stem, Flower	6	+ + **
<i>Pilidiella granati</i>	Stem, Fruit	3	+ + **
<i>Lasiodiplodia</i> sp.	Leaf, Stem, Pedicel, Fruit	9	+ + **
<i>Alternaria</i> sp.	Leaf	3	+ -
<i>Nigrospora sphaerica</i>	Leaf, Fruit	6	+ -
<i>Corynespora casiciola</i>	Leaf	3	+ -
<i>Epicoccum nigrum</i>	Stem	6	- -
<i>Phyllosticta</i> sp.	Leaf	3	- -
<i>Pestalotiopsis clavispora</i>	Leaf	18	- -
<i>Fusarium</i> sp.	Fruit	6	- -
<i>Nectria mauritiicola</i>	Stem	3	- -

^a + positive on leaves; + red positive on fruits; ** aggressive

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<i>Epicoccum nigrum</i>	Stem	6	- -
<i>Phyllosticta</i> sp.	Leaf	3	- -
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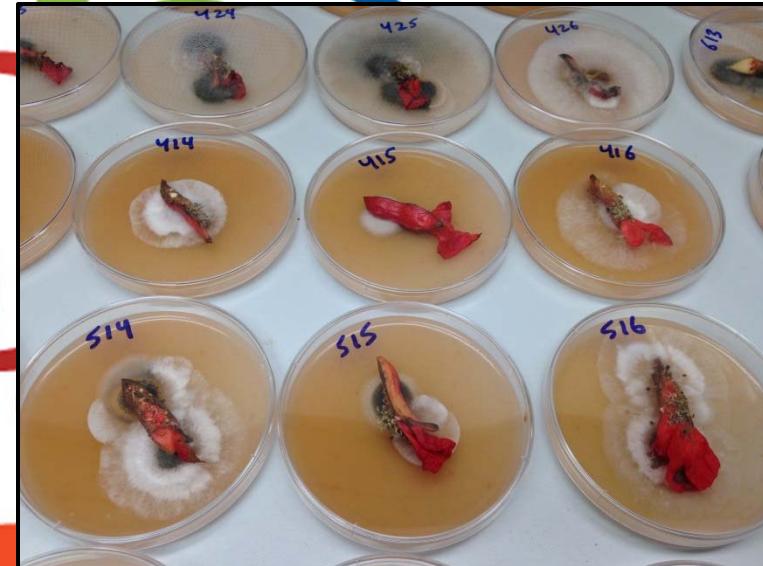
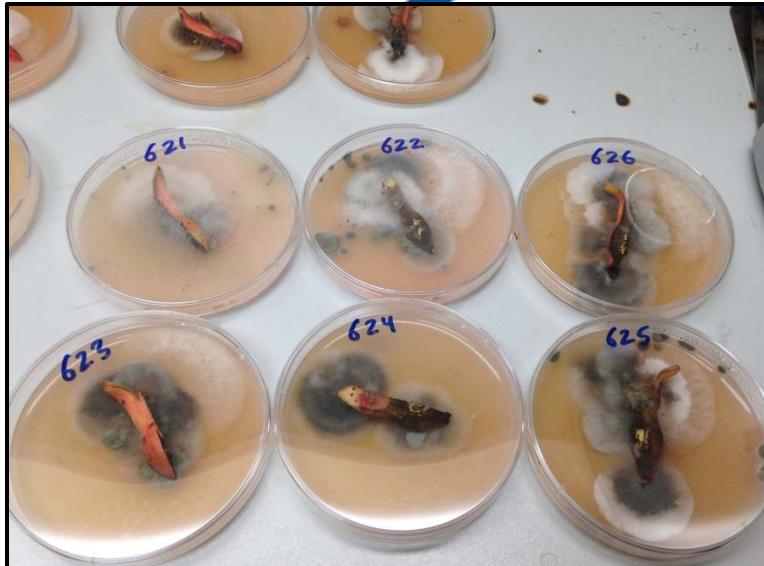
Early Bud Collection

- Flower buds were collected from late January through March 2015
- Buds collected from
 - Haines City, Zolfo Springs, Suwanee Valley, FL
 - Alma, Tifton, GA
 - Ridgeville, SC
- Buds on six different stages of flowering were tested for presence of pathogen

Pathogen Isolation



Results



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Results

Pomegranate pathogen status on flower buds (Suwanee Valley, FL)

Pathogen	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6
Diaporthales	++	++				
<i>Colletotrichum</i> sp.	+++	++				
Botryosphaeriaceae	+	+				
<i>Pilidiella granati</i>	1925				2015	

Pomegranate pathogen status on flower buds (Zolfo Springs, FL)

Pathogen	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6
Diaporthales	++++	+++	+++++	++	+	+
<i>Colletotrichum</i> sp.	++	+++	+++	++		
Botryosphaeriaceae						
<i>Pilidiella granati</i>						

Pomegranate pathogen status on flower buds (Haines City, FL)

Pathogen	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6
Diaporthales	++	+	+	+	++	+
<i>Colletotrichum</i> sp.		+	+	+	+	+
Botryosphaeriaceae				+		
<i>Pilidiella granati</i>				+		+

Results

Pomegranate pathogen status on flower buds (Alma, GA)

Pathogen	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6
Diaporthales	+++++	+++	+++	+++	++++	+++
<i>Colletotrichum</i> sp.	+	+	+		++	++
Botryosphaeriaceae	++++	+++	+++	+++	+++	+++
<i>Pilidiella granati</i>	1925				2015	

Pomegranate pathogen status on flower buds (Tifton, GA)

Pathogen	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6
Diaporthales	+	+++++ + + + +	+++++ + + + +			
<i>Colletotrichum</i> sp.						
Botryosphaeriaceae		+++++ + + + +	+++++ + + + +			
<i>Pilidiella granati</i>	90 TH ANNIVERSARY Gulf Coast Research & Education Center					

Pomegranate pathogen status on flower buds (Ridgeville, SC)

Pathogen	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6
Diaporthales						+
<i>Colletotrichum</i> sp.	+	++	+	+		+++
Botryosphaeriaceae	+	+	+			++
<i>Pilidiella granati</i>	+					+++

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Disease monitoring (Early May 2015)



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Disease monitoring (Early May 2015)



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Figure: Anthracnose of pomegranate caused by *Colletotrichum* sp.

Disease monitoring (Early to Late June)



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Figure: Leaf and fruit spots caused by
Colletotrichum sp., *Cercospora* like
pathogen, Diaporthales, and
Botryosphaeriaceae

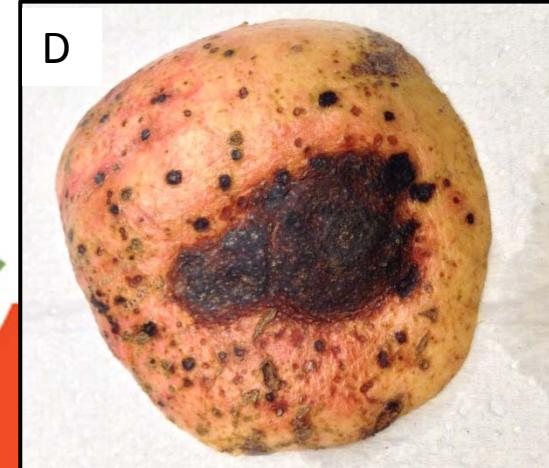
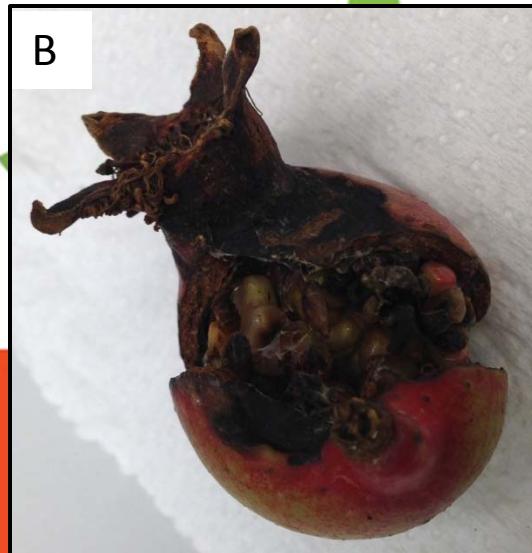
Disease monitoring (Early to Late June)



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Figure: Leaf and fruit spots (A and B), leaf blight (C-E), and shoot blight (F) caused by *Colletotrichum* sp., *Cercospora* like pathogen, Diaporthales, and Botryosphaeriaceae

Disease monitoring (Mid July)



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Figure: Anthracnose
progressed to internal tissues
(A-C) and scars on fruit surface
by *Colletotrichum* sp. and
Botryosphaeriaceae (D)

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Disease monitoring (Mid August)



Figure: Severe defoliation and fruit drop

Disease monitoring (Mid August)

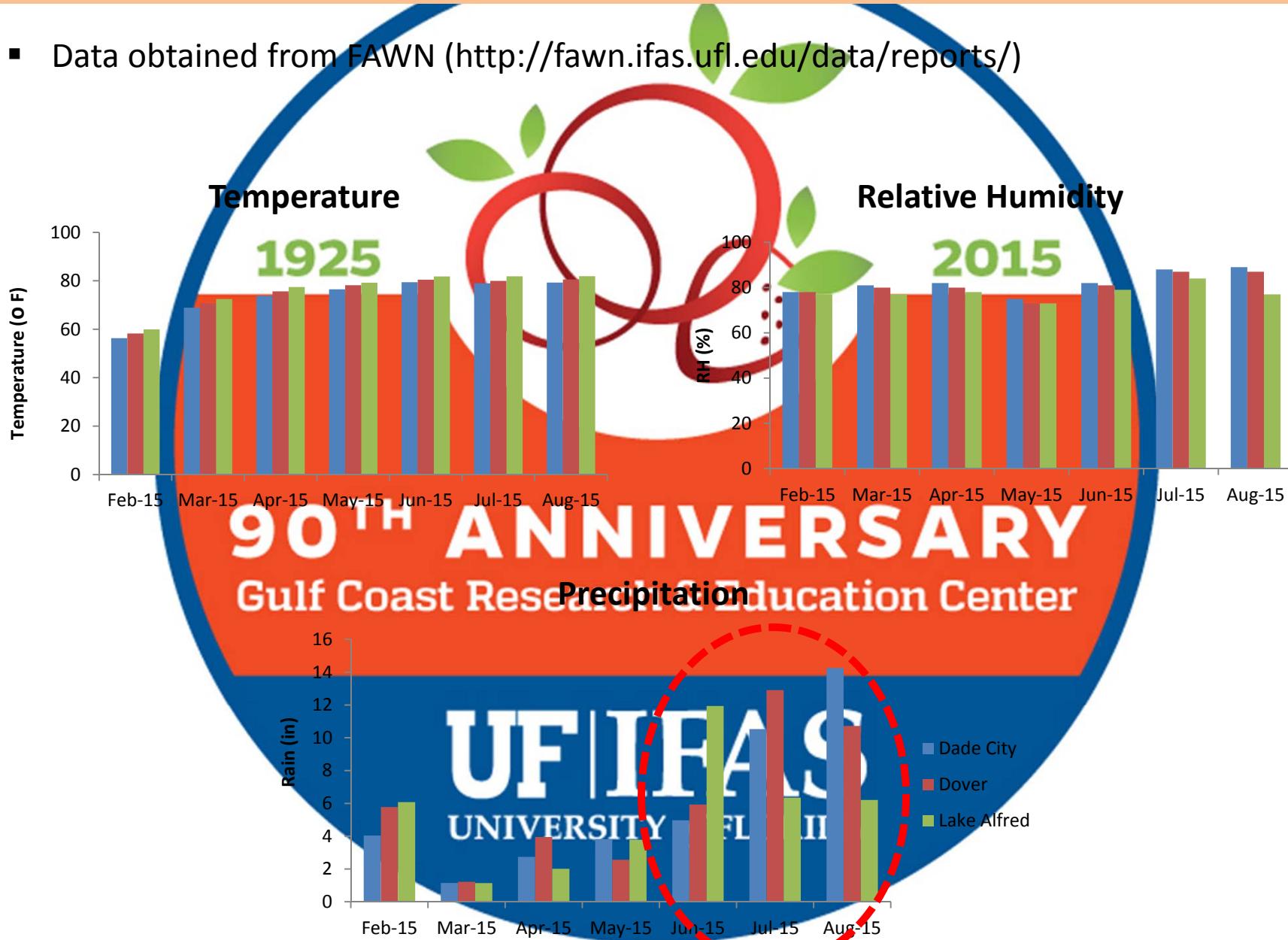


- Symptoms of sunburn, fruit cracking, and mummification became more prevalent

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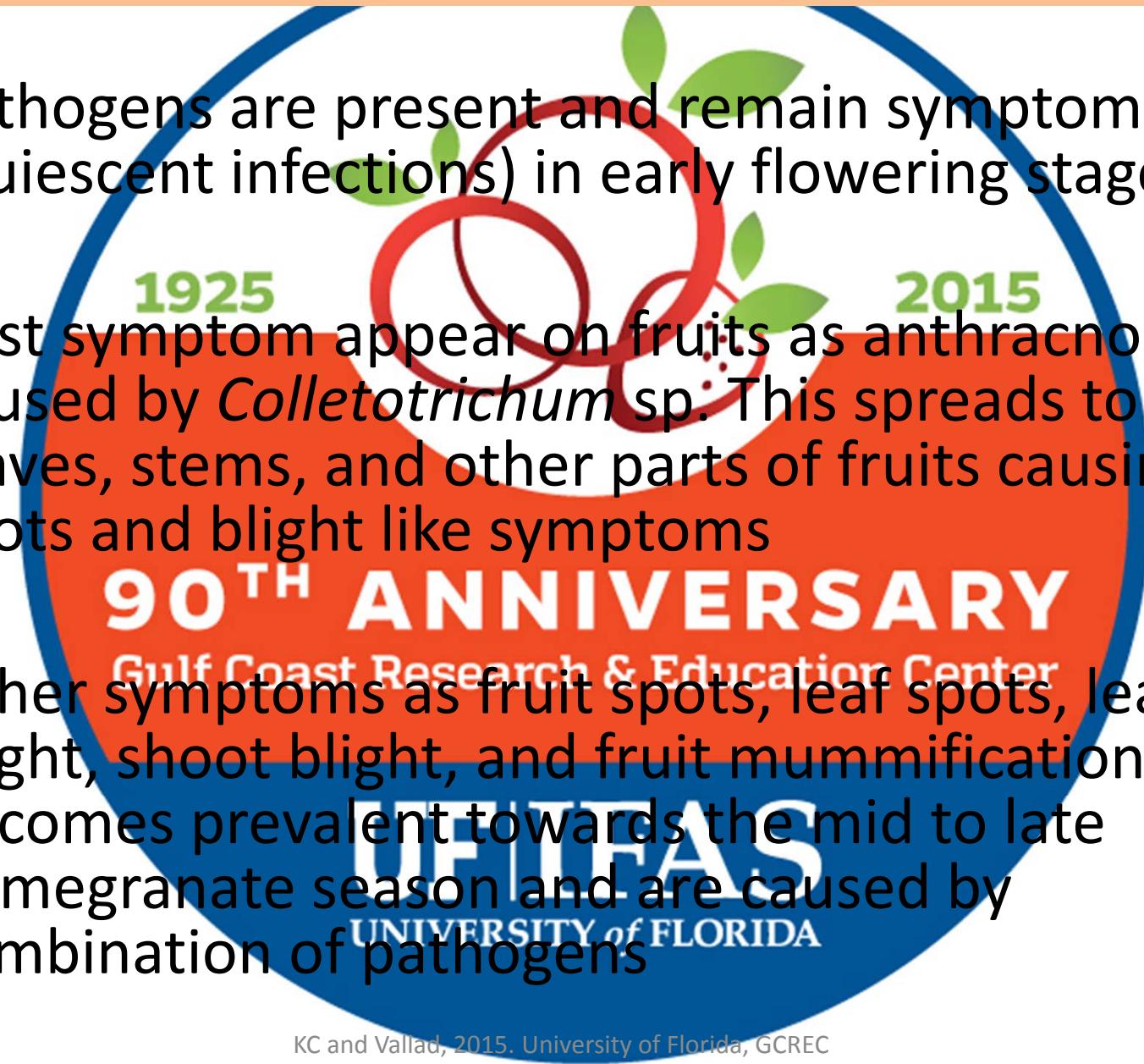
Weather pattern

- Data obtained from FAWN (<http://fawn.ifas.ufl.edu/data/reports/>)



Summary

- Pathogens are present and remain symptomless (quiescent infections) in early flowering stages
- First symptom appear on fruits as anthracnose caused by *Colletotrichum* sp. This spreads to leaves, stems, and other parts of fruits causing spots and blight like symptoms
- Other symptoms as fruit spots, leaf spots, leaf blight, shoot blight, and fruit mummification becomes prevalent towards the mid to late pomegranate season and are caused by combination of pathogens





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Fungicides tested in plate assays and field trials

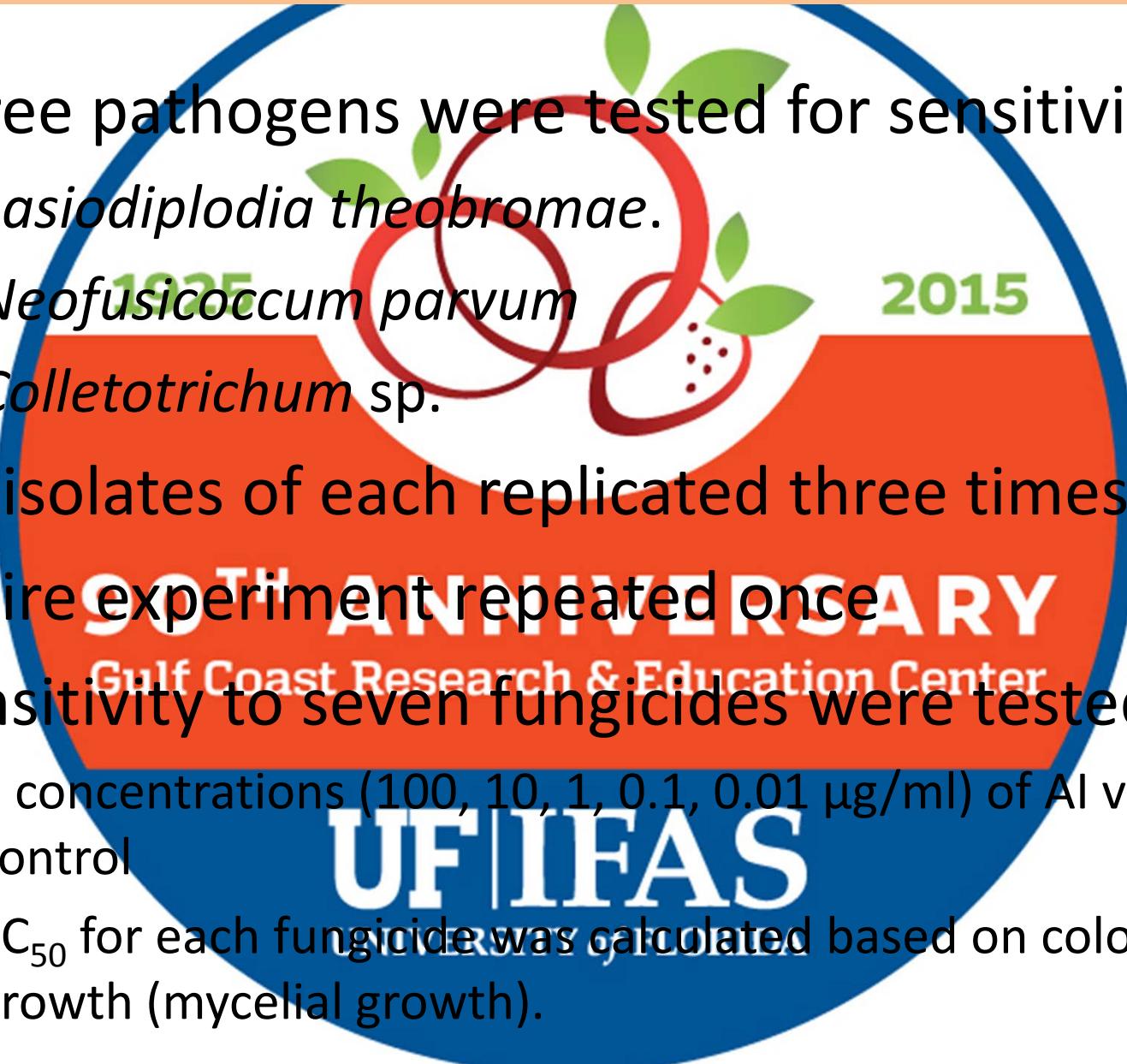
Active ingredient (%)	Group name	FRAC	Product	Manufacturer
Copper Sulfate (71.1%)	Multisite activity	M	Cuprofix	United Phosphorus Inc
Boscalid (70%)	Succinate dehydrogenase inhibitors (SDHI)	7	Endura	BASF
Tebuconazole (38.7%)	Demethylation inhibitors (DMI)	3	Folicur	Bayer CropScience
Thiophanate-Methyl (45%)	Methyl benzimidazole carbamates (MBC)	1	Topsin	United Phosphorus Inc
Pyraclostrobin (20%)	Quinone outside inhibitors (QoI)	11	Cabrio	BASF
Mancozeb (80%)	Multisite activity	M	Penncozeb	United Phosphorus Inc
Pyrimethanil (54.6%)	Anilino-pyrimidines (AP)	9	Scala	Bayer CropScience
Cyprodinil/Fludioxonil	AP/Phenylpyrrole	9/12	Switch	Syngenta Crop Protection
Fluopyram/Tebuconazole	SDHI/DMI	7/3	Luna Experience	Bayer CropScience

Fungicides tested in plate assays and field trials

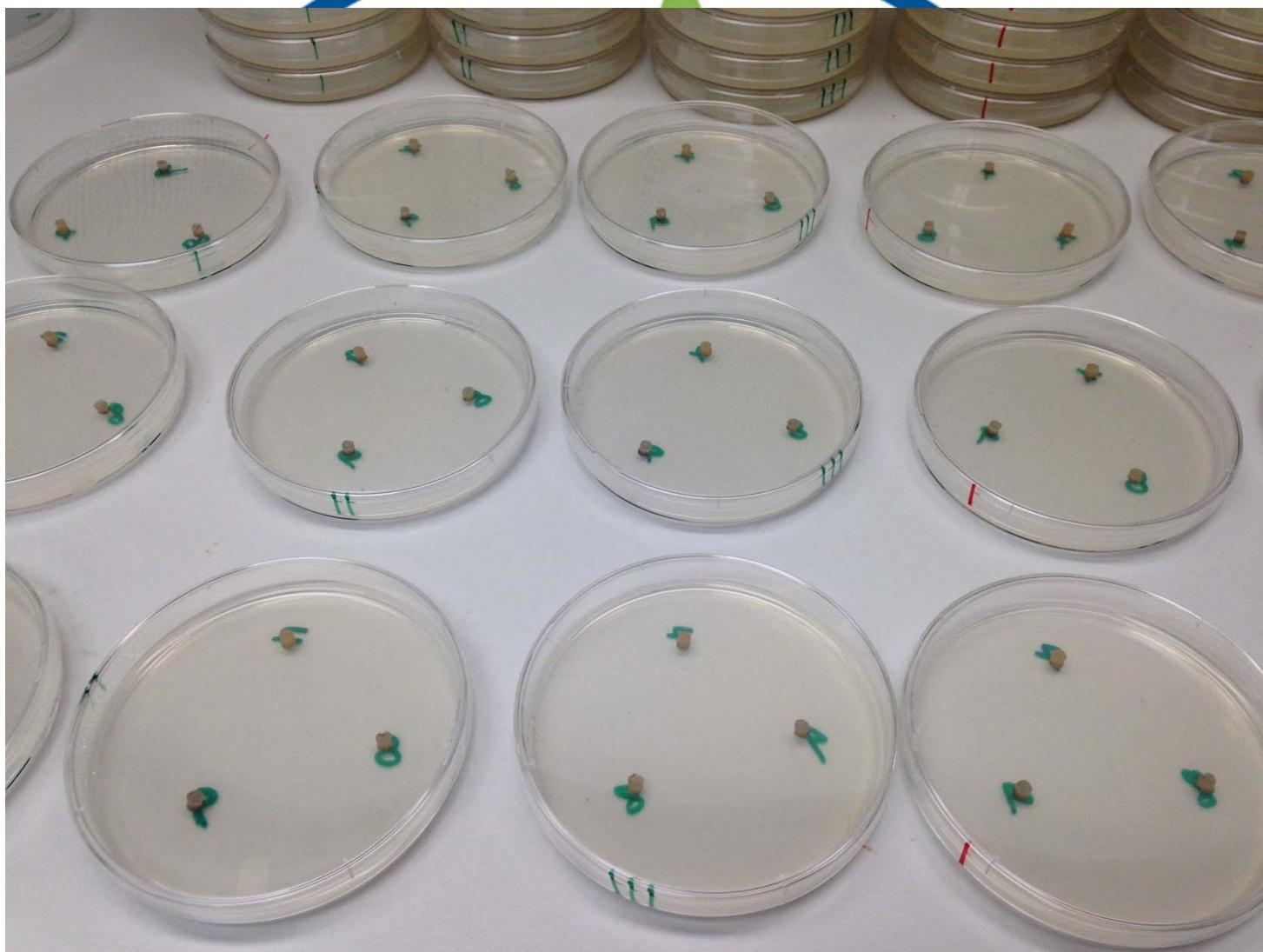
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Thiophanate-Methyl (45%)	Methyl benzimidazole carbamates (MBC)	1	Topsin	United Phosphorus Inc
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Cyprodinil/Fludioxonil	AP/Phenylpyrrole	9/12	Switch	Syngenta Crop Protection
Fluopyram/Tebuconazole	SDHI/DMI	7/3	Luna Experience	Bayer CropScience

Fungicide sensitivity tests (Plate assays)

- Three pathogens were tested for sensitivity
 - *Lasiodiplodia theobromae*.
 - *Neofusicoccum parvum*
 - *Colletotrichum* sp.
- Six isolates of each replicated three times
- Entire experiment repeated once
- Sensitivity to seven fungicides were tested
 - 5 concentrations (100, 10, 1, 0.1, 0.01 µg/ml) of AI vs control
 - EC₅₀ for each fungicide was calculated based on colony growth (mycelial growth).



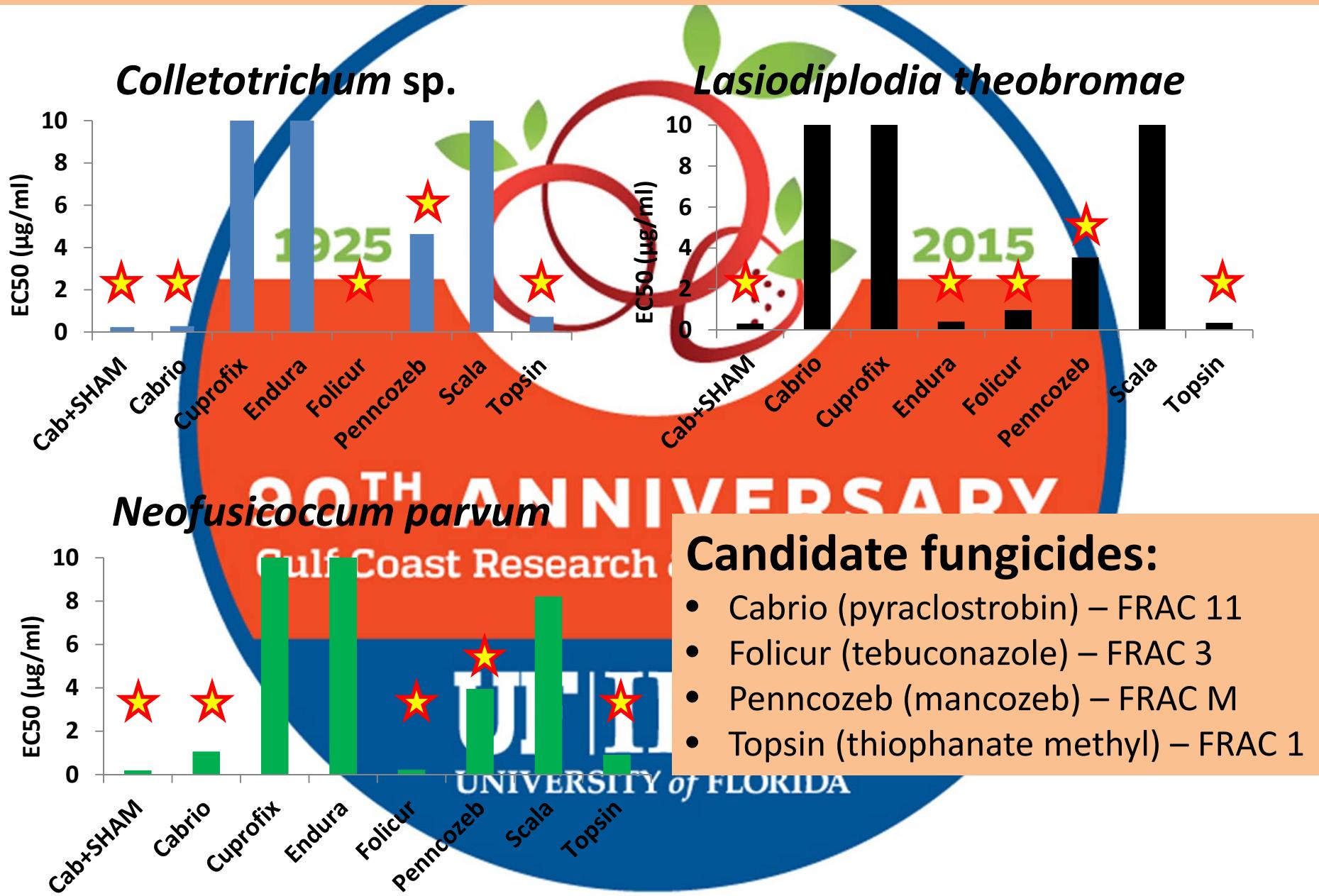
Fungicide sensitivity tests (Plate assays)



Just examining fungicide sensitivity based on mycelial growth!

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Results (Plate Assay)



Candidate fungicides:

- Cabrio (pyraclostrobin) – FRAC 11
- Folicur (tebuconazole) – FRAC 3
- Penncozeb (mancozeb) – FRAC M
- Topsin (thiophanate methyl) – FRAC 1

Fungicide field trial

- Field trials established in three locations
 - Odessa, FL
 - Plant City, FL
 - Haines City, FL
- Application started from
 - 10 Feb until 21 July 2015 in Odessa and Plant City
 - 12 Feb until 23 July 2015 in Haines City

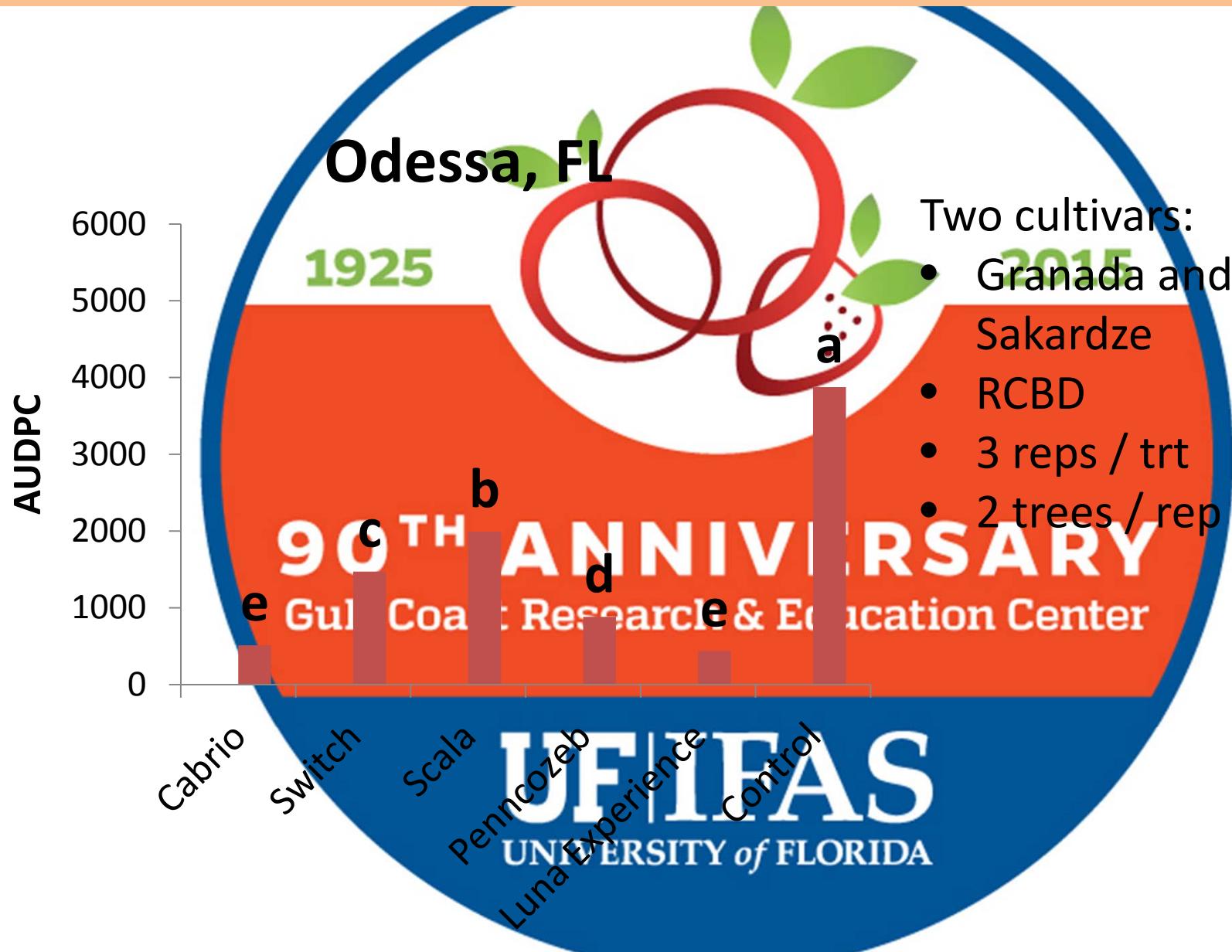


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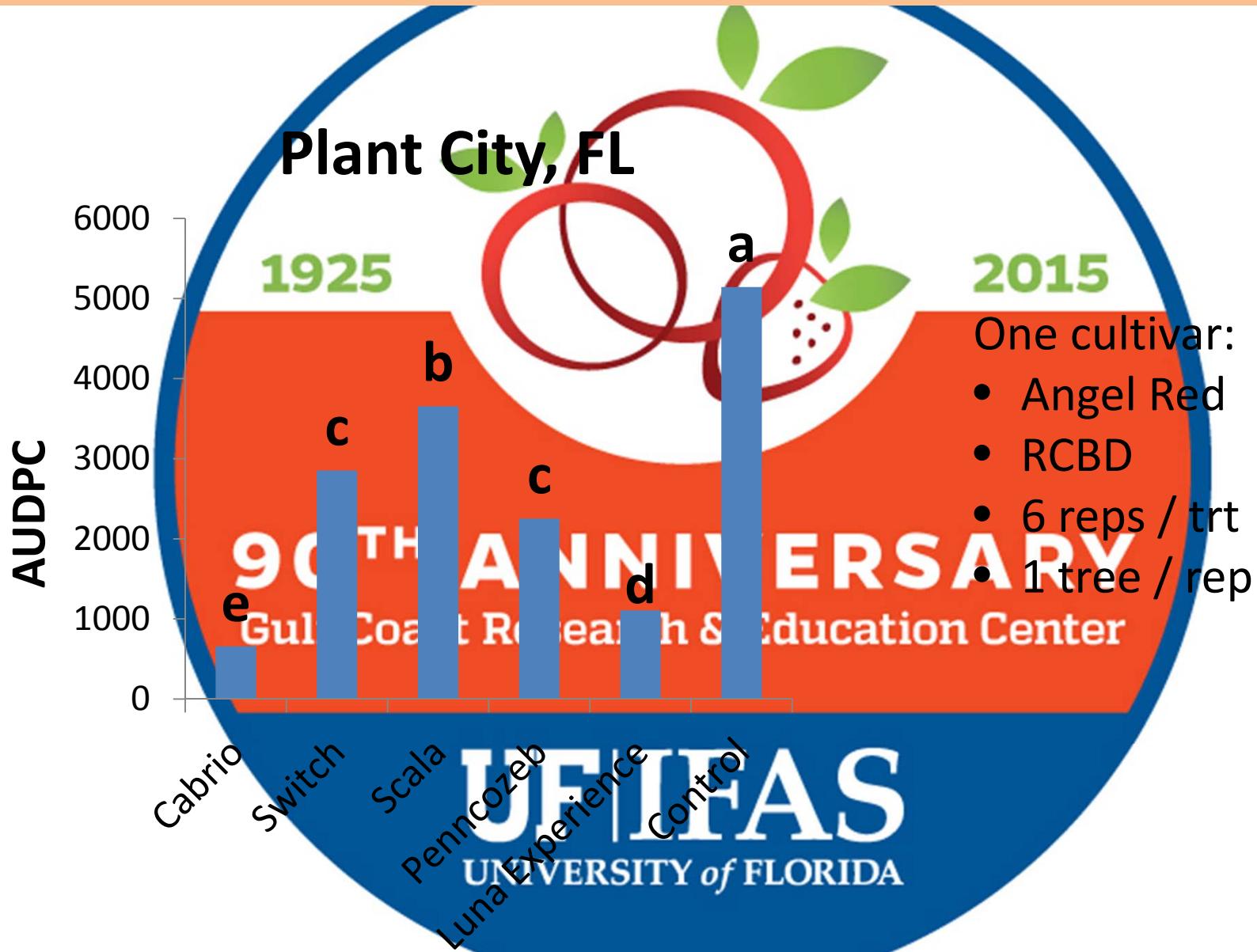
Fungicide field trial

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 - Odessa, FL
 - Plant City, FL
 - Haines City, FL
- Application started from
 - 10 Feb until 21 July 2015 in Odessa and Plant City
 - 12 Feb until 23 July 2015 in Haines City
- Sprayed in every three weeks for first three applications and every two weeks thereafter
- Five fungicides tested for their efficacy to reduce foliar and fruit disease severity
- Sprayed with CO₂ back pack sprayer calibrated to deliver 30 gal/A at 40 psi in Odessa and Plant City and with a handheld sprayer in Haines City

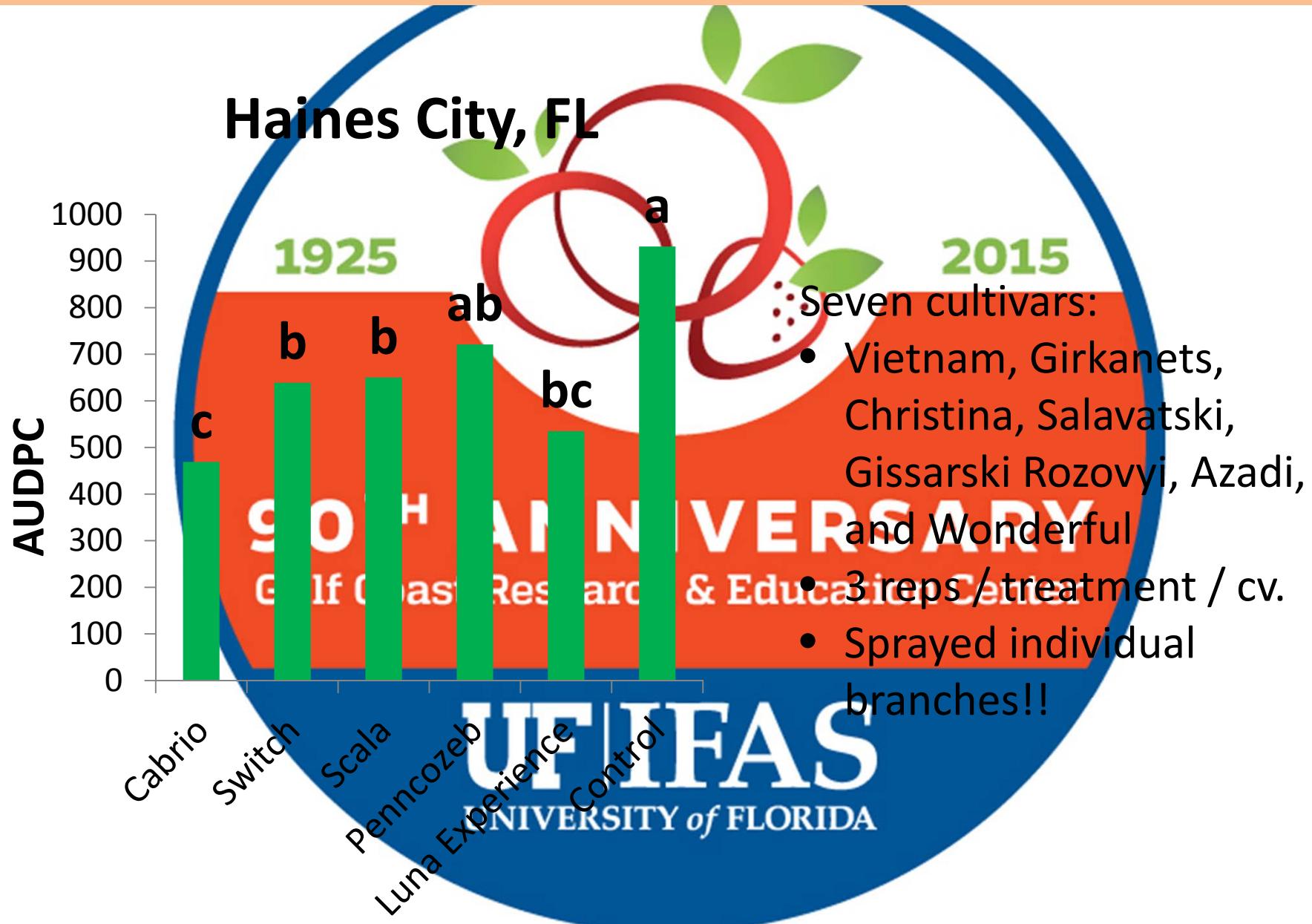
Results (Field Trials)



Results (Field Trials)



Results (Field Trials)





Summary

- *Colletotrichum* sp., *Lasiodiplodia theobromae*, and *Neofusicoccum parvum* were sensitive to Cabrio, Folicur, and Topsin and moderately sensitive to Penncozeb in laboratory assays
- *Lasiodiplodia theobromae* was sensitive to Endura
- In field trials, Cabrio and Luna Experience was highly effective and Penncoxeb was moderately effective in reducing foliar and fruit diseases.
- Combination of cultural practices and rotation of effective fungicides is crucial in sustainable disease management of pomegranate

Disease control is CRITICAL to Pom production!



Plant City, FL



Disease control is CRITICAL to Pom production!



Plant City, FL



University of Florida

Alma, GA

Disease control is CRITICAL to Pom production!



Diseased fruit
collected from
treated plots.



**Not out of the
woods yet!**

Future

- Screening Pom. cultivars & germplasm
 - Dr. Deng's crosses
- IR4 – 'A' priority for Luna Experience, tebuconazole + fluopyram (FRAC 3 + 7)
- Regional PUP upgrade for mancozeb (FRAC M)
 - Support from UPI & IR4, but EPA may be a challenge
- EPA regrouping of sub-tropical fruits –
Pomegranate now a Rep crop in 24B with
avocado, banana, papaya and mango – all have
azoxystrobin (FRAC 11) labels.
- New Specialty Crop Block Grant
 - Vallad & Deng
 - Continuation of disease management & breeding

Acknowledgement

- Dr. Bill Castle
- Mc Teer Farms
 - Haines City, FL
- Cee Bee's Citrus
 - Odessa, FL
- Sutherland's Pomegranate Field
 - Plant City, FL
- Florida Pomegranate Association
- FDACS Specialty Crop Block Grant Program
- GCREC Staff and Team Vallad



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