



Nursery & landscape disease management

Aaron J. Palmateer
Ornamental Plant Pathology
Florida Extension Plant Diagnostic Clinic
Tropical Research & Education Center, UF, IFAS

Disease update

Anthracnose

Bacteria

Dieback & Sphaeropsis

Downy Mildew

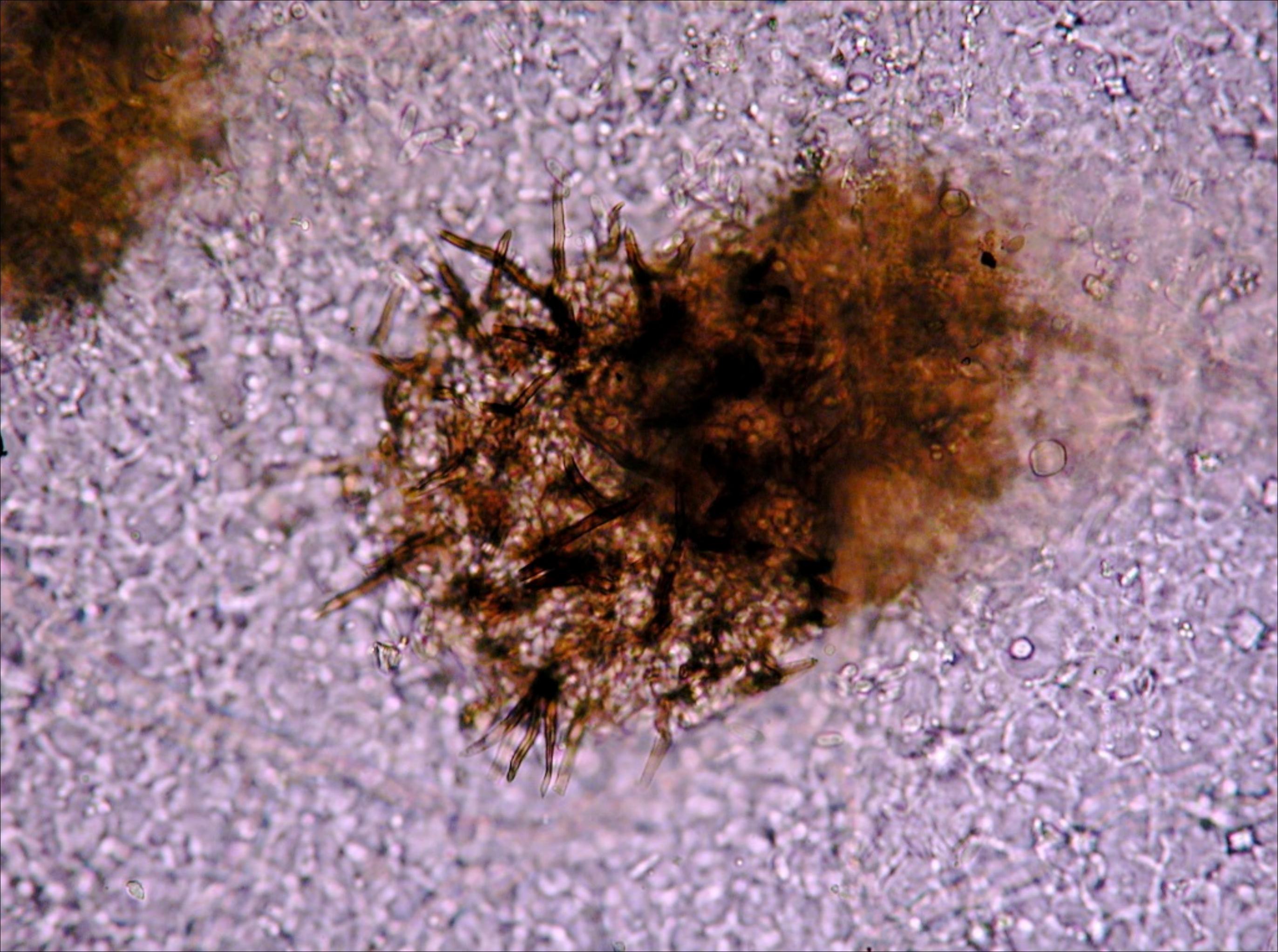
Mushrooms

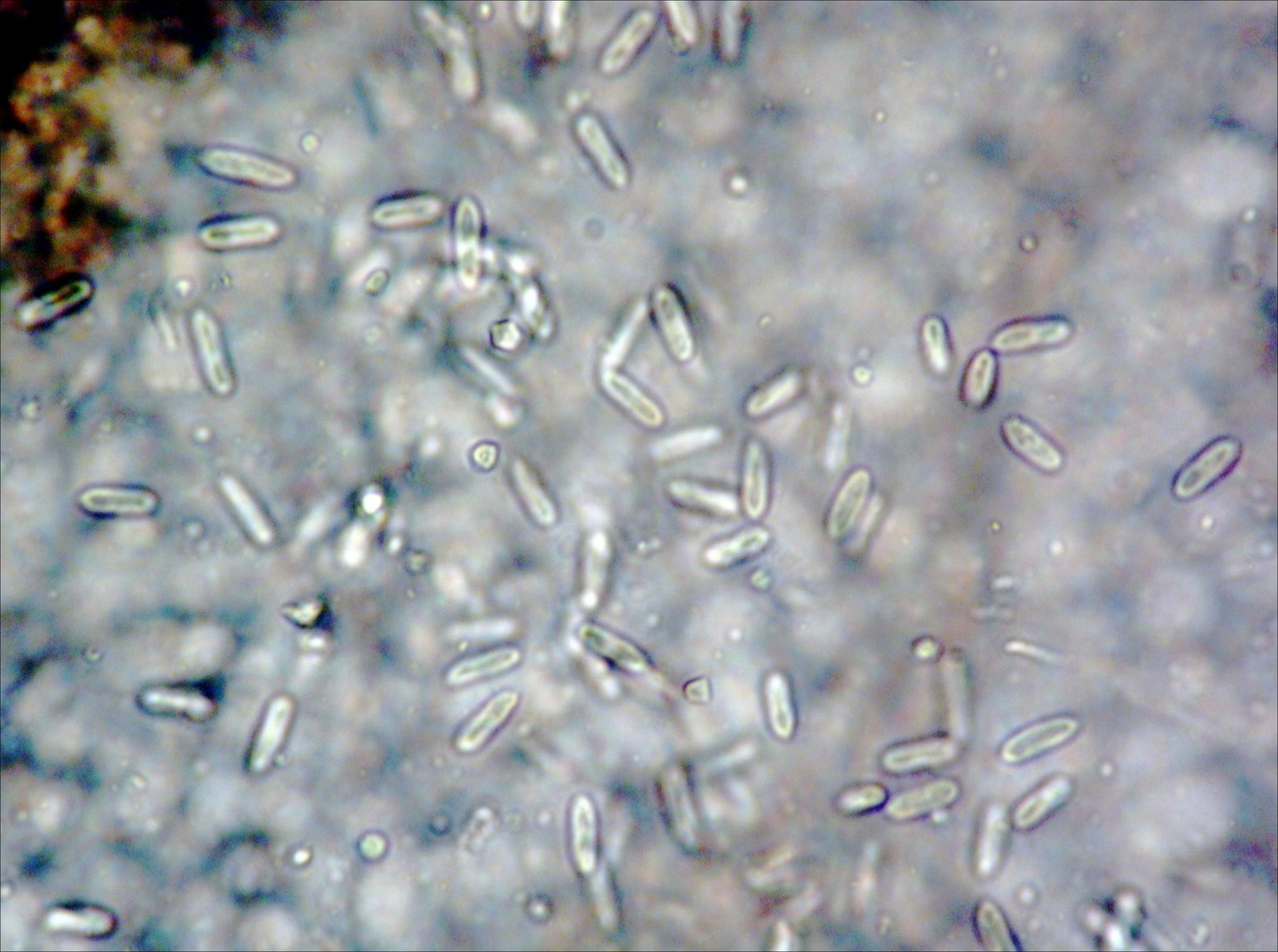
Rust













Ian Maguire UF/IFAS/TREC



Evaluate and compare the efficacy of preventative & curative fungicides for managing anthracnose

Host: *Sansevieria trifasciata* 'Laurentii'

Pathogen: *Colletotrichum sansevieriae*

Plants were grown in 3-gallon containers containing Fafard potting soil amended with Florikan 18-6-8 slow release fertilizer.

Experimental units were a plant treated with a single fungicide treatment, with 6 repetitions in a randomized complete block design with sub-sampling.

Fungicides were mixed in 1.0 gal total volume, and applied as a foliar spray until runoff (approx 16 fl oz per plant). Four applications for each treatment.

Plants were inoculated with a spore suspension of 1×10^5 spores/ml. Inoculum was sprayed on plant foliage until runoff.

Treatments:

1. Non-inoculated control
2. Inoculated control
3. Disarm 480 SC (fluoxastrobin) @ 16 ounces/100 gallons; 14 d
4. Pageant (pyraclostrobin + boscalid) @ 18 ounces/100 gallons; 14 d
5. Heritage (azoxystrobin) @ 6 ounces/100 gallons; 14 d
6. Concert (propiconazole + chlorothalonil) @ 28.5 ounces/100 gallons; 14 d
7. Affirm WDG (polyoxin D zinc salt) @ 0.375 lbs/100 gallons; 7 d
8. Torque (tebuconazole) @ 7 ounces/100 gallons; 14 d
9. Xeroton X3 (hydrogen peroxide + acids) @ a 1:1500 dilution; 7 day spray interval

Curative Trial

Disease levels for 9 treatments to control anthracnose. Disease measures were number of symptomatic leaves, number of lesions, disease severity, and marketability. Values within each column with the same letter do not differ significantly based on means separation using Tukey's Studentized Range (HSD). All treatments were applied as foliar spray. Marketability is the number of marketable plants out of the six experimental units for the given treatment.

Product	Rate	Number of symptomatic leaves	Number of lesions	Severity	Marketability
1-Non-inoculated control	---	27.25 ± 10.14	97.75 ± 52.71	11.63 ± 6.36	0
2-Inoculated control	---	36.00 ± 12.81	103.75 ± 35.69	16.50 ± 6.59	0
3-Disarm 480 SC (fluoxastrobin)	16 fl oz/100 gal	23.75 ± 8.77	72.50 ± 29.21	10.00 ± 3.49	0
4-Pageant (pyraclostrobin + boscalid)	18 fl oz/100 gal	25.75 ± 8.72	74.25 ± 33.27	10.25 ± 4.31	0
5-Heritage (azoxystrobin)	6 fl oz/100 gal	55.50 ± 30.80	74.00 ± 30.46	9.35 ± 3.36	0
6-Concert (propiconazole+chlorothal)	28.5 fl oz/100 gal	33.00 ± 14.22	89.00 ± 42.73	15.00 ± 7.27	0
7-Affirm WDG (polyoxin D zinc salt)	0.375 lbs/100 gal	26.50 ± 4.92	58.00 ± 11.58	12.75 ± 2.39	0
8-Torque (tebuconazole)	7 fl oz/100 gal	32.50 ± 5.33	82.25 ± 19.14	12.00 ± 1.96	0
9-Xeroton X3 (hydrogen peroxide + acids)	1:1500 dilution	37.50 ± 8.05	50.50 ± 9.13	13.75 ± 1.31	0

Preventative Trial

Disease levels for 9 treatments to control anthracnose. Disease measures were number of symptomatic leaves, number of lesions, disease severity, and marketability. Values within each column with the same letter do not differ significantly based on means separation using Tukey's Studentized Range (HSD). All treatments were applied as foliar spray. Marketability is the number of marketable plants out of the six experimental units for the given treatment.

Product	Rate	Number of symptomatic leaves	Number of lesions	Severity	Marketability
1-Non-inoculated control	---	9.25±1.89 ab	18.0±3.42 ab	1.52±0.21 ab	1
2-Inoculated control	---	16.0±5.14 a	50.5±19.5 a	4.45±1.59 a	0
3-Disarm 480 SC (fluoxastrobin)	16 fl oz/100 gal	6.25±0.85 ab	10.75±3.09 b	1.75±0.60 ab	2
4-Pageant (pyraclostrobin + boscalid)	18 fl oz/100 gal	2.0±0.58 b	3.75±1.38 b	0.22±0.08 b	6
5-Heritage (azoxystrobin)	6 fl oz/100 gal	4.75±0.75 ab	7.75±0.85 b	0.62±0.33 b	5
6-Concert (propiconazole+chlorothal)	28.5 fl oz/100 gal	7.0±3.56 ab	8.25±4.17 b	0.67±0.45 b	5
7-Affirm WDG (polyoxin D zinc salt)	0.375 lbs/100 gal	8.75±2.02 ab	17.3±4.17 ab	1.37±0.40 ab	1
8-Torque (tebuconazole)	7 fl oz/100 gal	5.25±1.97 ab	7.25±2.84 b	0.77±0.37 b	5
9-Xeroton X3 (hydrogen peroxide + acids)	1:1500 dilution	9.25±1.05 ab	23.8±10.1 ab	2.05±1.05 ab	0
	<i>P</i> =	0.0022	0.0105	0.0555	---

Sansevieria Recovery Trial

Title: Evaluate the efficacy of dip and sprenc applications for controlling anthracnose

Several local nurseries have Sansevieria plants that have been severely affected by anthracnose. The question has been raised about discarding diseased plants or possibly cutting them back extensively to remove all symptomatic tissue and then treating preventatively with fungicides.

All products will be applied on a 7-day application schedule. All products applied as an initial dip application will continue as a sprenc with the exception of Plant Shield HC, which was applied one time as a dip at planting.

1. Untreated control
2. 3336 @ 24 oz/100 gal- 15 minute dip application; 7 day Sprenc @ 12 oz/100 gal
3. Affirm @ 0.5 lb/100 gal- sprenc after planting; 7-day Sprenc @ 0.25 lbs/100 gal
4. Banner Maxx @ 64 oz/100 gal- sprenc after planting; 7-day Sprenc @ 8 oz./100 gal
5. Copper Count N @ 1 qt/100 gal sprenc after planting; 7-day Sprenc @ 1 qt/100 gal
6. Insignia @ 6 lbs/100 gal- 15 minute dip application; 7-day Sprenc @ 6.1 oz/100 gal
7. Xeroton X3 @ 1:500 dil dip to completely cover; 7-day Sprenc @ 1:500 dilution
8. Milstop @ 2.5 lbs/100 gal- sprenc after planting; 7-day Sprenc @ 2.0 lbs/100 gal
9. Cease @ 5.0 qt/100 gal- sprenc after planting; 7-day Sprenc @ 5 qt/100 gal
10. Plant Shield HC @ 1.5lbs/5 gal- dip to completely cover and then plant

Sansevieria Recovery Trial

Table 1. Disease levels for 9 treatments to control anthracnose on sansevieria. Disease measures were # symptomatic leaves, # of lesions, and % of canopy affected.

Treatment	Rate	# of symptomatic leaves	# of lesions	% disease severity
1- untreated control	----	4.60 <u>abc</u>	10.7 <u>ab</u>	21.3 a
2- 3336	24.0 fl oz/100 gal	2.43 <u>fg</u>	4.80 <u>fg</u>	6.83 <u>cd</u>
3- Affirm	0.5 <u>lbs</u> /100 gal	3.23 <u>def</u>	5.97 <u>ef</u>	8.83 c
4- Banner Maxx	64.0 fl oz/100 gal	2.90 <u>efg</u>	4.43 <u>fg</u>	9.73 c
5- Copper Count N	1 <u>qt</u> /100 gal	4.07 <u>bcd</u>	6.87 <u>def</u>	8.63 c
6- Insignia	6 <u>lbs</u> /100 gal Dip	1.93 g	2.97 g	4.00 d
7- <u>Xerotron X3</u>	1:500 dilution	4.77 <u>ab</u>	9.57 <u>abc</u>	15.1 b
8- <u>Milstop</u>	2.5 <u>lbs</u> /100 gal	3.67 <u>cde</u>	7.97 <u>cde</u>	16.3 b
9- Cease	5 <u>qt</u> / 100 gal	5.40 a	11.9 a	15.2 b
10- Plant Shield	1.5 <u>lbs</u> /5 gal	4.13 <u>bcd</u>	8.60 <u>bcd</u>	14.7 b

Column means indicated with the same letters are not significantly different ($P \leq 0.05$) based on Student Newman Keuls test

Bacterial Diseases

Xanthomonas

Ralstonia

Pseudomonas

Soft rots











Table 1: Effect of ZnTiO₂ (Nano 3) on the incidence of bacterial spot caused by *Xanthomonas* sp. on rose cultivar 'Flower Carpet Red', shown as average area under the disease progress curve (AUDPC). The trials were conducted at Homestead and Quincy, FL during Spring 2011.

Treatment	Rate	AUDPC ^y	
		Homestead, FL	Quincy, FL
ZnTiO ₂ (7 day spray schedule)	X/10 ^x	335.8 b ^z	247.3 ab
	X/25	260.2 b	177.5 b
	X/50	255.3 b	232.6 ab
Ornamental industry standard spray program for management of diseases on roses (14 day spray schedule; given in the order of rotation)		431.1 b	276.5 a
Heritage [®] (Azoxystrobin)	4 oz/ 100 gal H ₂ O		
Dithane-75 DF [®] (Mancozeb)	24 oz/ 100 gal H ₂ O		
T-Methyl (Thiophanate-methyl)	20 oz/ 100 gal H ₂ O		
CuPro (Copper hydroxide)	16 oz/ 100 gal H ₂ O		
Untreated		877.1 a	301.4 a

^xX represents the undiluted formulation of ZnTiO₂

^yDisease severities were rated using the Horsfall-Barratt scale, a non-dimensional 12-point scale, to assess the percentage of canopy affected by bacterial spot. Values were converted to mid-percentages and used to generate AUDPC

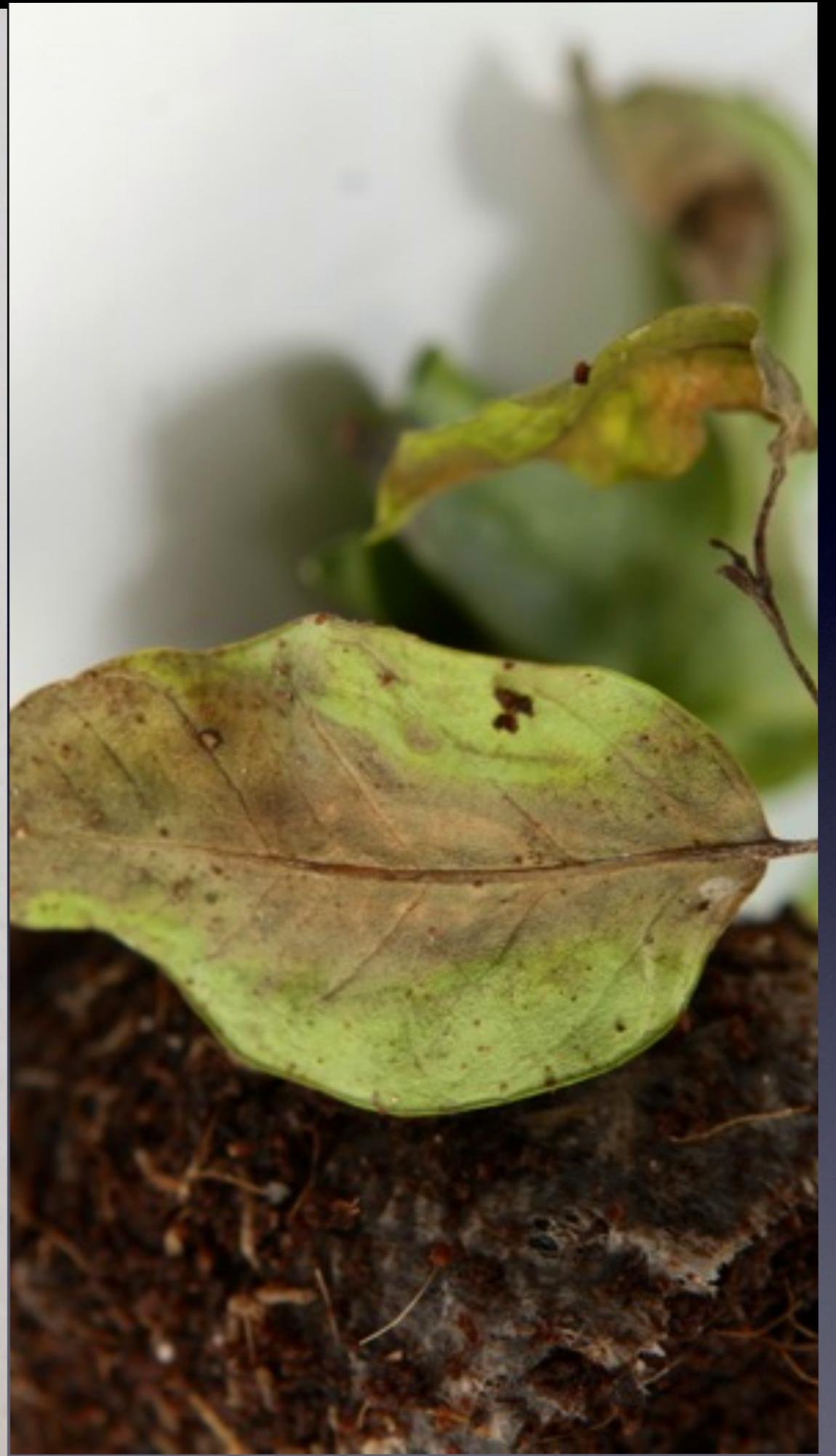
^zColumn means indicated with the same letters are not significantly different ($P \leq 0.05$) based on Student Newman Keuls test

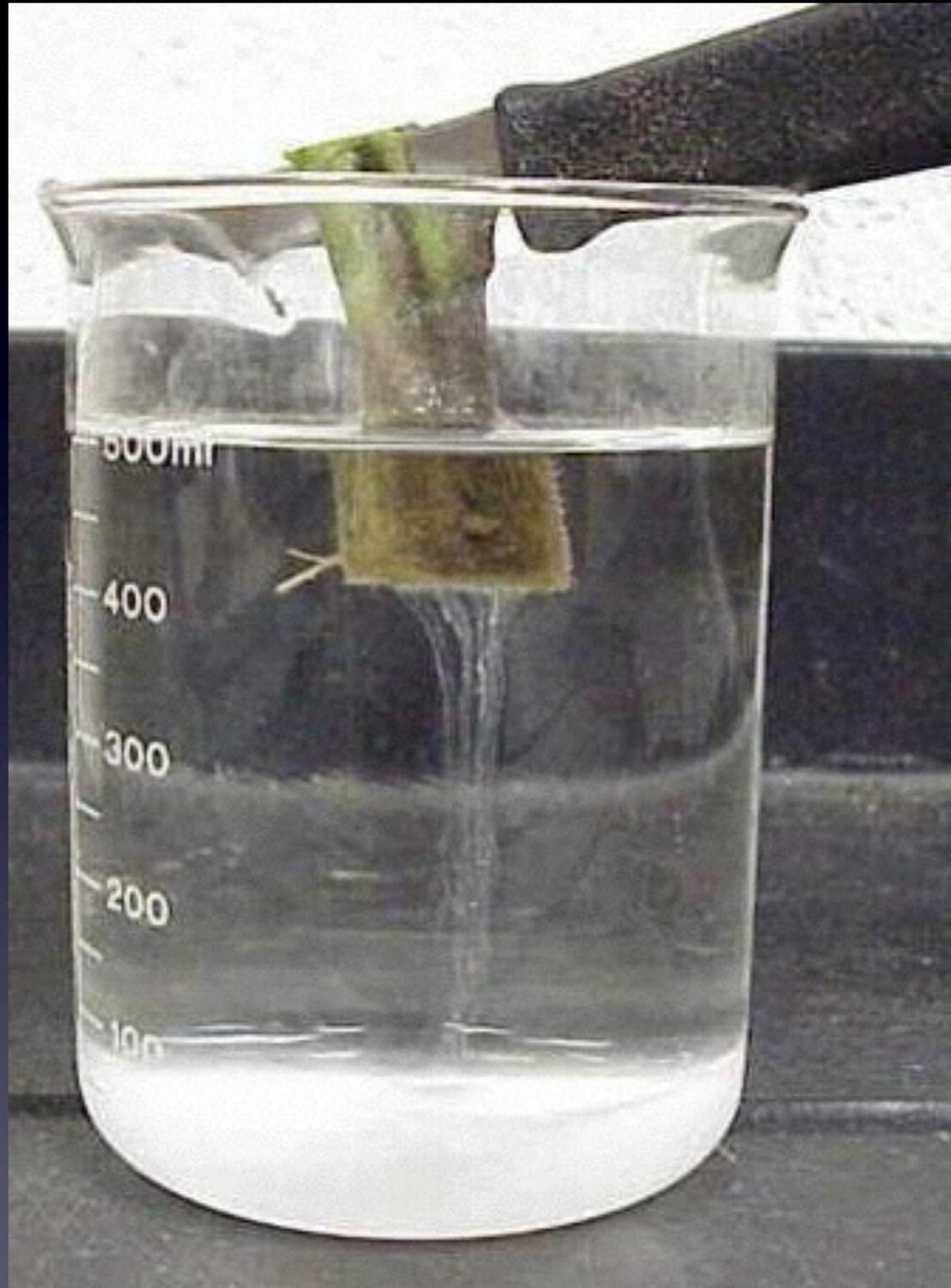
Stem gall at pinch site on Sun Parasol mandevilla



A stem gall with vertical cracks; the surface of the gall was oozing bacteria
A leaf gall and associated necrosis and chlorosis











VOTED
BEST BURGER

OPEN

Our Menu Items
are
Trans Fat Free













How & when dieback develops?

Different inoculation & incubation conditions & pathogenic variation was examined

Test for pathogenicity to determine whether *N. parvum* was the sole causal agent of dieback

Influence of temperature and light intensity was tested to determine whether dieback development would be affected under shade

Conclusion

-light & temp-

Sig differences in disease development were not observed under the wide range of light intensities that were tested, 2,000-300 $\text{mmol s}^{-1} \text{m}^{-2}$

Radial growth rates of all seven *N. parvum* isolates increased significantly over the tested range (15 – 30°C)

Both internal and external disease increased with increasing temp

External and internal symptom development was far greater at 25 and 30°C than at 15 or 20 °C

Temperature appears to be an important factor in the seasonal development of this disease

Conclusion

-disease studies-

All of the fungi that were used in pathogenicity tests colonized eugenia and were easily recovered at the end of an experiment

Only *N. parvum* caused dieback, vascular discoloration & reduced plant growth

Glomerella spp. and *M. terrestris* caused neither sig external or internal symptoms, nor did they reduce host growth

Mycelial flap and toothpick inoculations caused comparable disease development

Table 1. Disease levels for 11 treatments to control dieback of Eugenia. Disease measures were incidence (# total diseased branches), severity (y_{max} , severity), and AUDPC of severity values.

Product	Rate	Reapplication interval	Incidence (# diseased branches)	Severity (y_{max})	AUDPC
1-inoculated control	---	---	7.75±1.93	18.00±6.45	197.40±47.76
2-CuPRO	1.375 <u>lb</u> /100 gal	7 d	5.75±1.80	11.75±5.92	123.25±70.06
3-Banner Maxx	12 <u>fl oz</u> /100 gal	14 d	12.75±3.12	12.75±4.42	147.25±48.35
4-Cease	5 <u>qts</u> /100 gal	7 d	11.75±2.66	14.25±3.15	135.38±41.83
5-Daconil <u>Ultrax</u>	1.4 <u>lbs</u> /100 gal	7 d	7.25±4.59	11.75±6.42	107.81±46.01
6-Dithane DF	2.365 <u>lbs</u> /100 gal	7 d	14.25±2.56	14.50±3.12	108.20±32.85
7-Heritage	5.6 <u>oz</u> /100 gal	7 d	11.50±5.85	15.75±6.86	199.19±81.96
8-Headway	12 <u>fl oz</u> /100 gal	14 d	7.00±1.41	10.50±2.53	157.06±91.28
9-Medallion	3 <u>oz</u> /100 gal	7 d	8.00±2.38	9.00±2.35	151.21±79.25
10-Pageant	15 <u>oz</u> /100 gal	7 d	7.50±2.18	9.75±2.50	54.04±4.21
11-Trinity 2SC	12 <u>fl oz</u> /100 gal	7 d	16.00±2.55	23.75±6.10	202.71±43.40
12-Palladium	4 <u>oz</u> /100 gal	7 d	10.25±2.93	12.75±7.42	139.31±64.82
		<i>P</i> =	0.2491	0.5730	0.6999

Sphaeropsis Gall

fungus disease of woody ornamentals

holly, hawthorn, bottle brush, crape myrtle, ligustrum, oleander and Prunus species

causes swellings, dieback, shoot proliferation and defoliation

major problem from Tampa/Orlando south

Sphaeropsis gall

fungus spreads by spores and hyphae

disease is favored by high humidity and wet conditions

spores spread by wind blown rain and mechanical transmission from plant to plant

pruning tools with plant sap contain spores and hyphae, which can be spread with each subsequent cut

Symptoms are quite noticeable when severe, but low levels of disease are often overlooked



A closer look at this American holly shows galling and shoot proliferation

When environmental conditions are favorable, disease symptoms can progress to a severe dieback that requires removal of some mature trees.







Management options

prune out disease well below symptoms and
remove plant debris

sterilize pruning shears between cuts on
affected plants and between plants where
the disease occurs

use clean plant material

plant species, cultivars not as susceptible



Downy mildew



Primarily cause foliar blights by attacking and spreading rapidly in young, tender green leaf, twig, and flower tissue

They develop and are severe when a film of water is present on the plant tissue and the relative humidity is high during cool or warm, but not hot periods

Downy mildews have caused spectacular and catastrophic epidemics on several crops in the past...most well known is downy mildew of grapes in the mid 1800's almost completely destroyed the industry in France











Impatiens

Gardening impatiens (*Impatiens walleriana*)- the most economically important bedding plant in the U.S.

Approximately 100 Florida producers generate over 20 million impatiens plants annually

The annual economic impact of impatiens to Florida is estimated to be greater than \$50 million



Plasmopara obducens



Causes a destructive foliar disease on *Impatiens walleriana*

Has popped up in various locations throughout the midwest since the first report in 1942

Production greenhouses in Southern California in 2004

Widespread outbreaks in 2011

Devastating on impatiens in the landscape all throughout the U.S.









Management

-cultural practices-

Avoidance of diseased plants

Aggressive management in production

Separate seed grown and vegetative (impatiens)

Limit moisture on the leaves

Provide good horizontal air movement (proper plant spacing)

Management

-chemical control-

Use products that are labeled

Preventative approach is best!

Good coverage of contact fungicides

Proper rotation of fungicide chemistry

Eradicative Phosphorous Acid Landscape Trial - Fall 2012-Spring 2013

Host: *Impatiens walleriana* Cv: Super Elfin Red

Pathogen: *Plasmopara obducens*

Inoculation Date: none – natural inoculum

Treatment List: 6 treatments; 10 plants per treatment; each treatment replicated 3 times RCBD in landscape bed

Transplanted: 11/29

2. Untreated control
3. Rampart, 0.667 fl oz/1 gallon SPRAY
4. Fosphite, 0.667 fl oz/1 gallon SPRAY
5. A14658C, 64 fl oz/100 gallons SPRAY
6. Aliette, 2 lbs/100 gallons SPRAY
7. Affirm 0.5 lbs/100 gallons SPRAY

Spray rate: 0.5 gallon per treatment, or ~189 mL per plant.

Application Dates:

- 1st app: 11/26/12 Trts 3,4,5,6,7
 - 2nd app: 12/3/12 Trts 3,4,5,6,7
 - 3rd app: 12/10/12 Trts 3,4,5,6,7
 - 4th app: 12/17/12 Trts 3,4,5,6,7
-

11/29



12/10



12/17



12/21



12/26



12/31



1/4



AI4658C (Potassium phosphite)

Untreated Control

Affirm (Polyoxin D zinc salt)

Rampart (Phosphorous acid)

Fosphite (Phosphorous acid)

Aliette (Fosetyl Al)

Actaphos 0-28-25: \$74.65/2.5 gallons

\$0.15/1 gallon application (18.92 mL of product) 2 qts/100 gallon rate

Affirm: \$230.00/2.4 lbs

\$0.48/1 gallon application (2.268 g of product) 0.5 lbs/100 gallon rate

Agri-Fos: \$81.95/2.5 gallons

\$0.28/1 gallon application (33.27 mL of product) 1 1/8 fl oz/1 gallon rate

Aliette: \$182.99/5 lbs

\$0.73/1 gallon application (9.072 g of product) 2 lbs/100 gallon rate

Armada: \$145.00/2 lbs

\$0.41/1 gallon application (2.551 g of product) 9 oz/100 gallon rate

FosfiMax Copper: \$15.00/1 quart

\$0.15/1 gallon application (9.46 mL of product) 1 qt/100 gallon rate

Fosphite: \$92.00/2.5 gallons

\$0.19/1 gallon application (19.72 mL of product) 2/3 fl oz/1 gallon rate

MilStop: \$59.99/5 lbs

\$0.30/1 gallon application (11.34 g of product) 2.5 lbs/100 gallon rate

Quanta: \$184.25/2.5 gallons

\$0.43/1 gallon application (22.18 mL of product) 3/4 fl oz/1 gallon rate



Agrocybe Trial 2013 (ZZ) – Trial Details

APPLICATION TIMINGS & DETAILS

Host: *Zamiculcas zamiifolia*

Size of potting container: 10 inch

Growing media: 100% coir

Location of the trial: Shadehouse 83%

Date the trial was initiated: 3/20/13

Quantity of plants and labeling: 10 treatments x 4 reps = 40 plants total.

Spray volumes: Drench volume: 1000ml/Treatment

Rating dates and details about how the plants will be rated: Photographed weekly only

Applications:

: 3/20/13 Trts 2,3,4,5,6,7,8,9,10

: 4/3/13 Trt 9

: 4/10/13 Trts 3,4,10

: 4/18/13 Trts 5,6,7,8,9

: 4/24/13 Trt 2

Treatment list: (all DRENCHES)

1. Untreated Control
2. Chipco 26019 6 oz/100 gal + 1 gal Zerotel/100 gal+ 1 quart Addspray 101/100 gal
3. Medallion 2 oz/ 100 gal
4. Prostar 0.9 oz/5gal+ Silwet L77 0.05% (v/v)
5. Aquiflo 8 fl oz/100 gal
6. Aquiflo 16 fl oz/100 gal
7. Rootshield 5 oz/100 gal
8. Rootshield+ 8 oz/100 gal
9. Cease 6 qts/100 gal
10. Prostar 0.9 oz/5gal

3/14/13



1. Untreated Control

4/29/13



3/14/13



2. Chipco 26019 6 oz/100 gal + 1 gal Zerotel/100 gal+ 1 quart Addspray 101/100 gal

4/29/13



3/14/13



3. Medallion 2 oz/ 100 gal

4/29/13

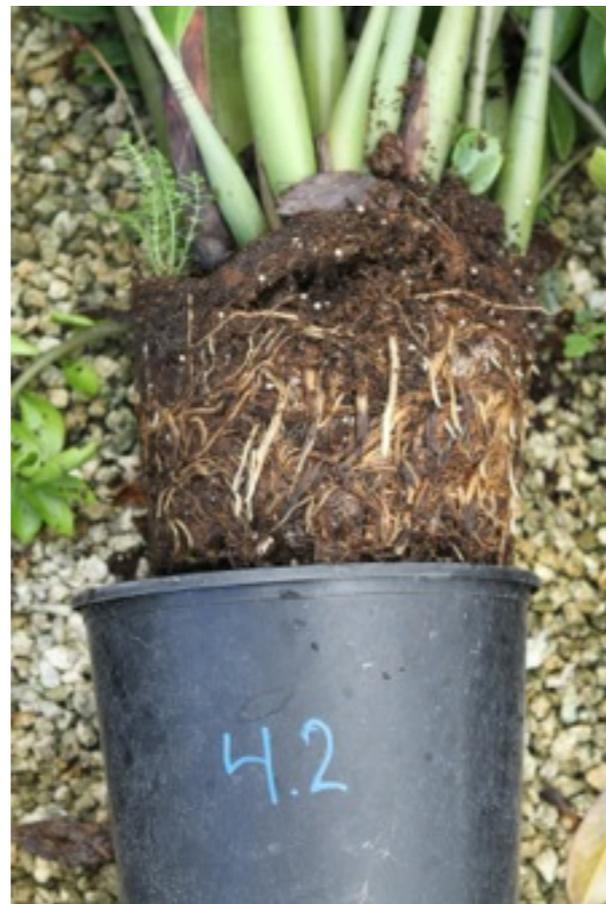


3/14/13



4. Prostar 0.9 oz/5gal+ Silwet L77 0.05% (v/v)

4/29/13

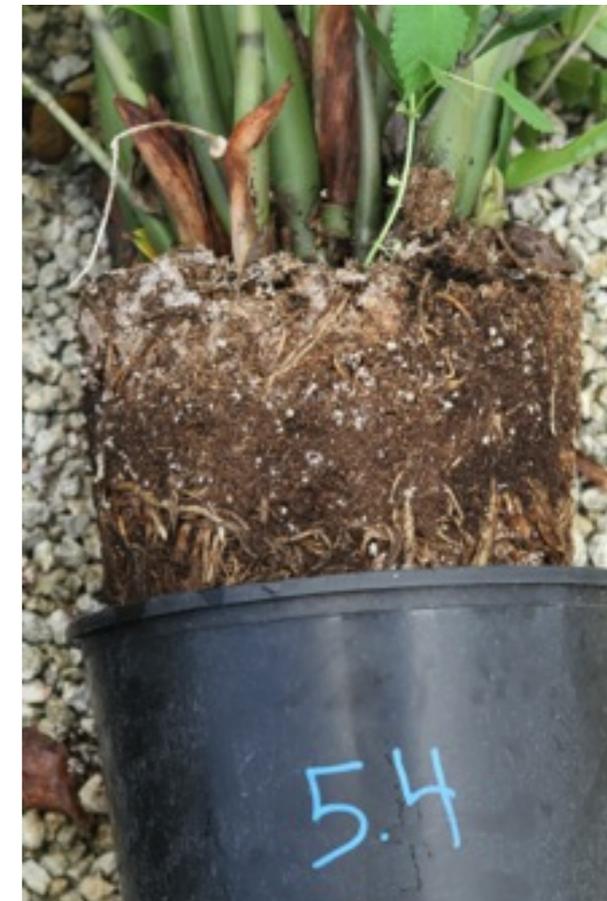
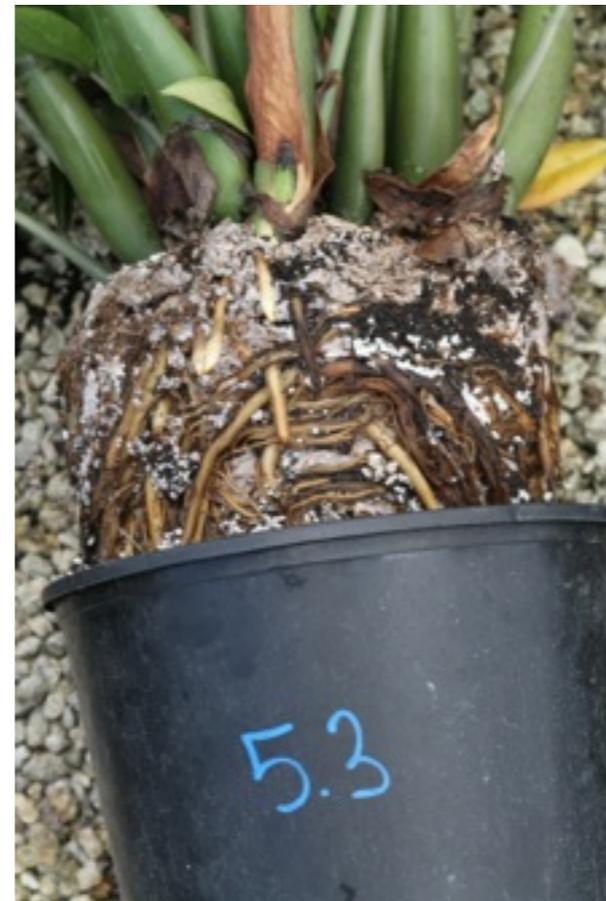


3/14/13



5. Aquiflo 8 fl oz/100 gal

4/29/13

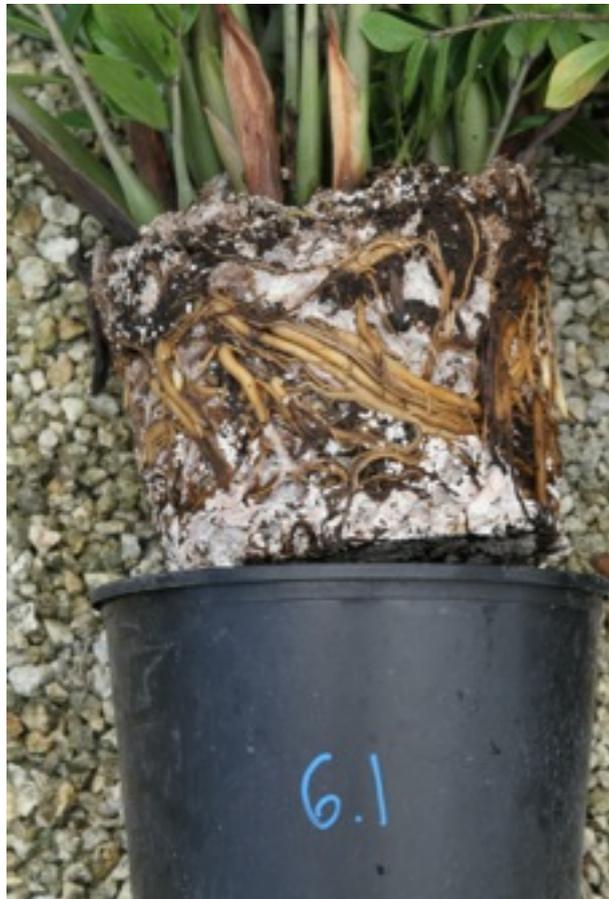


3/14/13



6. Aquiflo 16 fl oz/100 gal

4/29/13



3/14/13



7. Rootshield 5 oz/100 gal

4/29/13

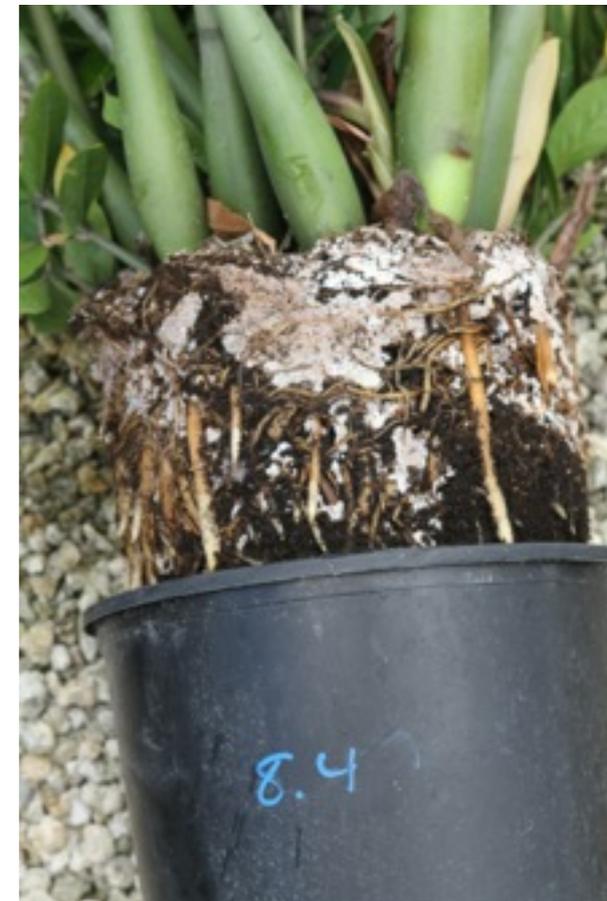


3/14/13



8. Rootshield+ 8 oz/100 gal

4/29/13

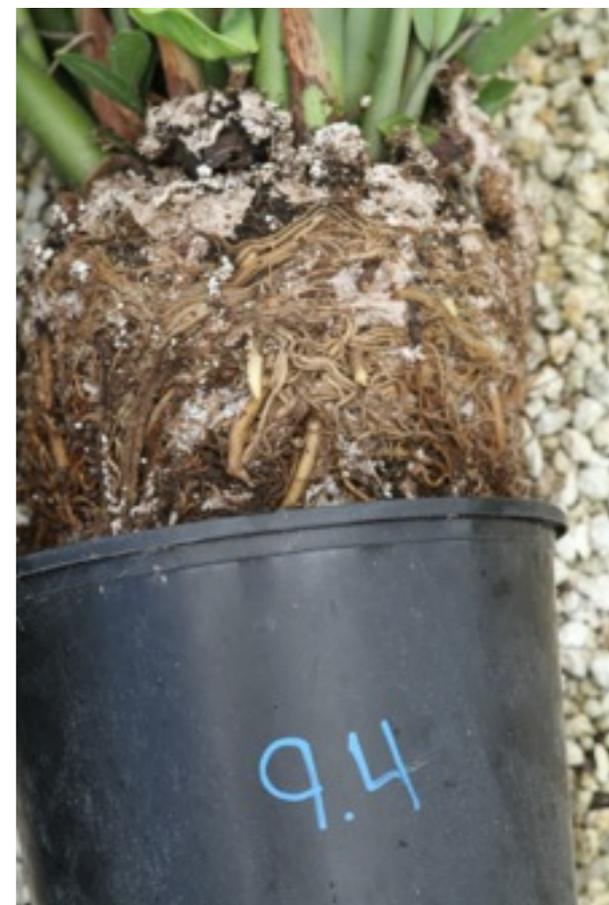


3/14/13



9. Cease 6 qts/100 gal

4/29/13



3/14/13



10. Prostar 0.9 oz/5gal

4/29/13



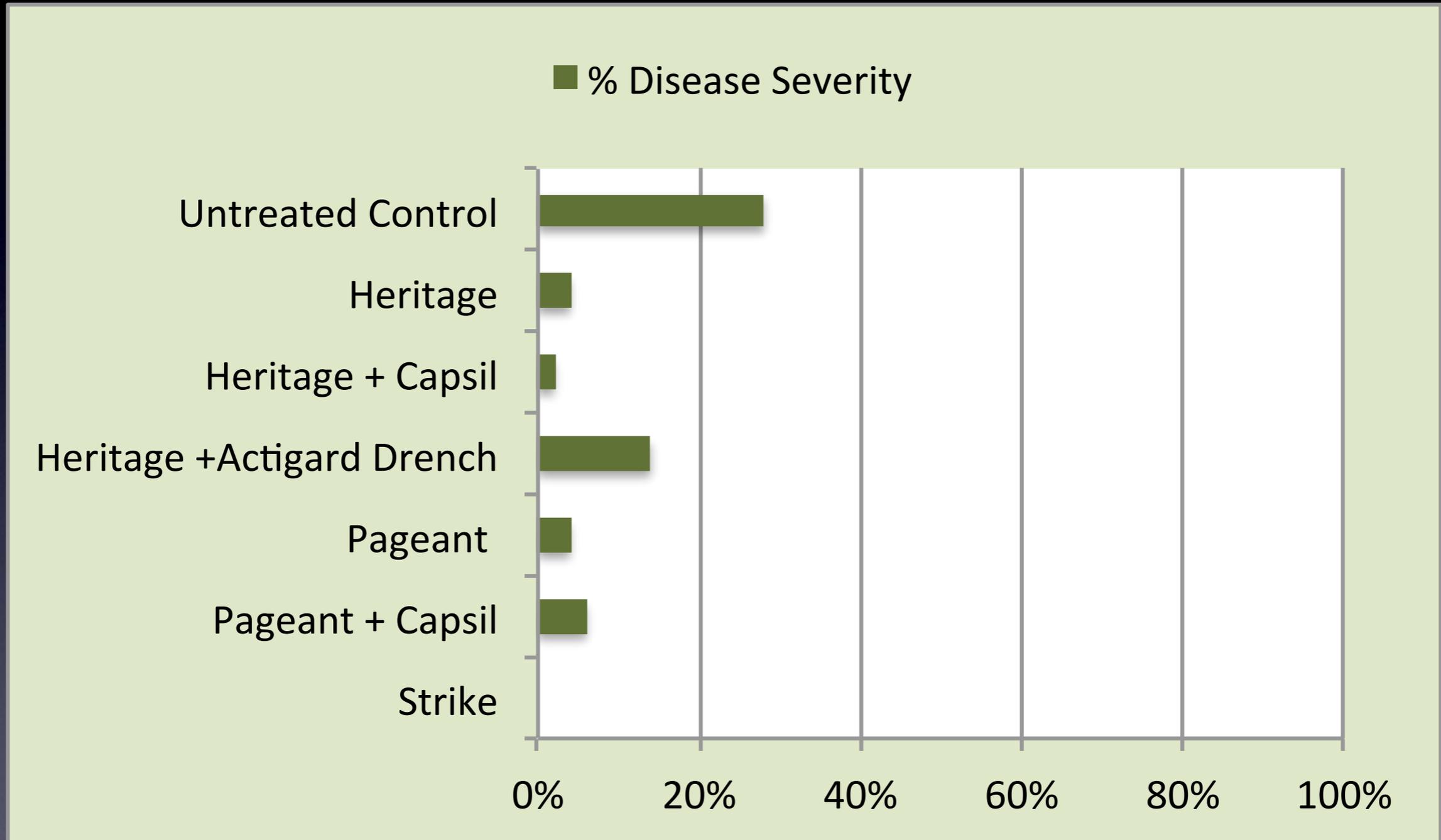








Fungicide efficacy for controlling rust on Plumeria



IPM planning

Educate yourself before planting a new crop

Learn to recognize problems & take steps to prevent before they occur

Determine the objectives of your IPM program i.e. saving \$, improve crop quality, reduce pesticide applications, & switching from broad-spectrum to reduced-risk pesticides

ID your primary objectives first then determine the elements & practices for a successful IPM program

Prepare an IPM summary

Makes decisions easier and quicker when action must be taken

List each pest problem that could be encountered and the scouting & management methods that will be used

List acceptable pesticides & application rates and ID treatment options

Follow pest control action thresholds (if known), make informed decisions, & consult with experts if necessary

Disease prevention

Most plant problems can be anticipated & avoided

Often prevention is the least expensive, most effective, and only control option available

By the time plants appear unhealthy it's too late. Key pathogen prevention techniques include:

- Planning crop production & IPM in advance
- Good sanitation & exclusion
- Properly managing the environment

Sanitation & Exclusion

Make the site as pest free as possible before planting

Remove old plants, crop debris, and weeds

Disinfect containers, tools, & irrigation systems
Before planting:

- Make containers, equipment, growing areas, & growing media pathogen free

- Use high quality, pathogen free planting stock

 - Inspect landscapes regularly

Environmental & cultural practices

Each plant requires specific growing conditions; drastic fluctuations from proper conditions predispose crops to damage

Use proper cultural practices i.e. fertilization, irrigation, temperature, lighting, etc

Be certain area has the aeration, drainage, & salinity necessary for good growth

Good team work among essential employees is a must for a successful IPM program

Scouting or Monitoring

-foundation of IPM program-

Early detection:

Reduce plant damage

Improve plant quality

Reduce replacement costs

Avoid excessive and costly pesticides

Acknowledgements

Ian Maguire, Biological Scientist

Patricia Lopez, Laboratory Technician

Stephanie Suarez, Graduate Student

Support from local growers

Florida Nursery Growers & Landscape Association

IR4 Ornamental Horticulture Project

Support from chemical companies



The screenshot shows the website for Dr. Aaron Palmateer's Lab at the University of Florida IFAS, Ornamental Plant Pathology. The header includes the university logo and the lab name. Below the header is a navigation menu with links for Home, People, Projects, Extension, Publications, Prospective Students, and Contacts & Links. The main content area features a 'RESEARCH PROGRAM' section with a sub-heading 'Bacterial blight of Ficus Caused by Xanthomonas'. This section includes a brief narrative of an ongoing project and a list of four research objectives. A photograph of a Ficus leaf with characteristic yellow and brown necrotic spots is shown next to the text. Below this, another research program is partially visible, titled 'Improved disease diagnosis: Molecular techniques for the detection and identification of plant pathogens in host tissue'.

UF UNIVERSITY of FLORIDA IFAS Dr. Aaron Palmateer's Lab Ornamental Plant Pathology

Home Search GO

▶ People
▶ Projects
▶ Extension
▶ Publications
▶ Prospective Students
▶ Contacts & Links

RESEARCH PROGRAM

Bacterial blight of Ficus Caused by Xanthomonas

Brief Narrative of Ongoing Project:
We are currently conducting research to:

- 1) determine if Xanthomonas isolates from Ficus elastica are different from those previously reported to cause disease on other Ficus species;
- 2) conduct host range trials to see if other (i.e. Strelitzia spp., Ficus spp., Cordyline sp., Anthurium sp., Syngonium sp., and Dieffenbachia) popular foliage plants are susceptible;
- 3) evaluate the impact of temperature and light on disease; and 4) conduct bactericide efficacy trials.

Improved disease diagnosis: Molecular techniques for the detection and identification of plant pathogens in host tissue

Brief Narrative of Ongoing Project: