Spring Dead Spot of Bermudagrass: Biology and Management

Dr. Nathan R. Walker

Department of Entomology and Plant Pathology

Oklahoma State University

Bermudagrasses

Bermudagrass (*Cynodon dactylon*), African bermudagrass *Cynodon transvaalensis*, and interspecific hybrids (*C. dactylon* x *C. transvaalensis*)

C4, stolon/rhizome growth habit, and a plant that is used for both forage and turf

Tolerance to high temperatures, drought, and salt but intolerant to shade or low temperatures

Clonally propagated elite varieties
- interspecific hybrids

Seed propagated varieties
- common and improved bermudagrass

Historical Aspect

- Spring dead spot was first described in a 1959 report from Oklahoma – dated to 1936 – questionable
- Most reliable is from 1954 in Stillwater
- In 1960, Australian researchers working with a similar disease determined it was a caused by a fungus
- Wadsworth and Young (OSU) coined the name “Spring Dead Spot”
- Most important and devastating disease of bermudagrass where it goes dormant in the winter

What causes Spring Dead Spot?

Caused by several closely related root infecting fungi

In Oklahoma the most important is:

Ophiosphaerella herpotricha

Found through out Oklahoma, south into North Texas, west to Texas pan handle, North into southern Kansas and east to Tennessee

Throughout the United States

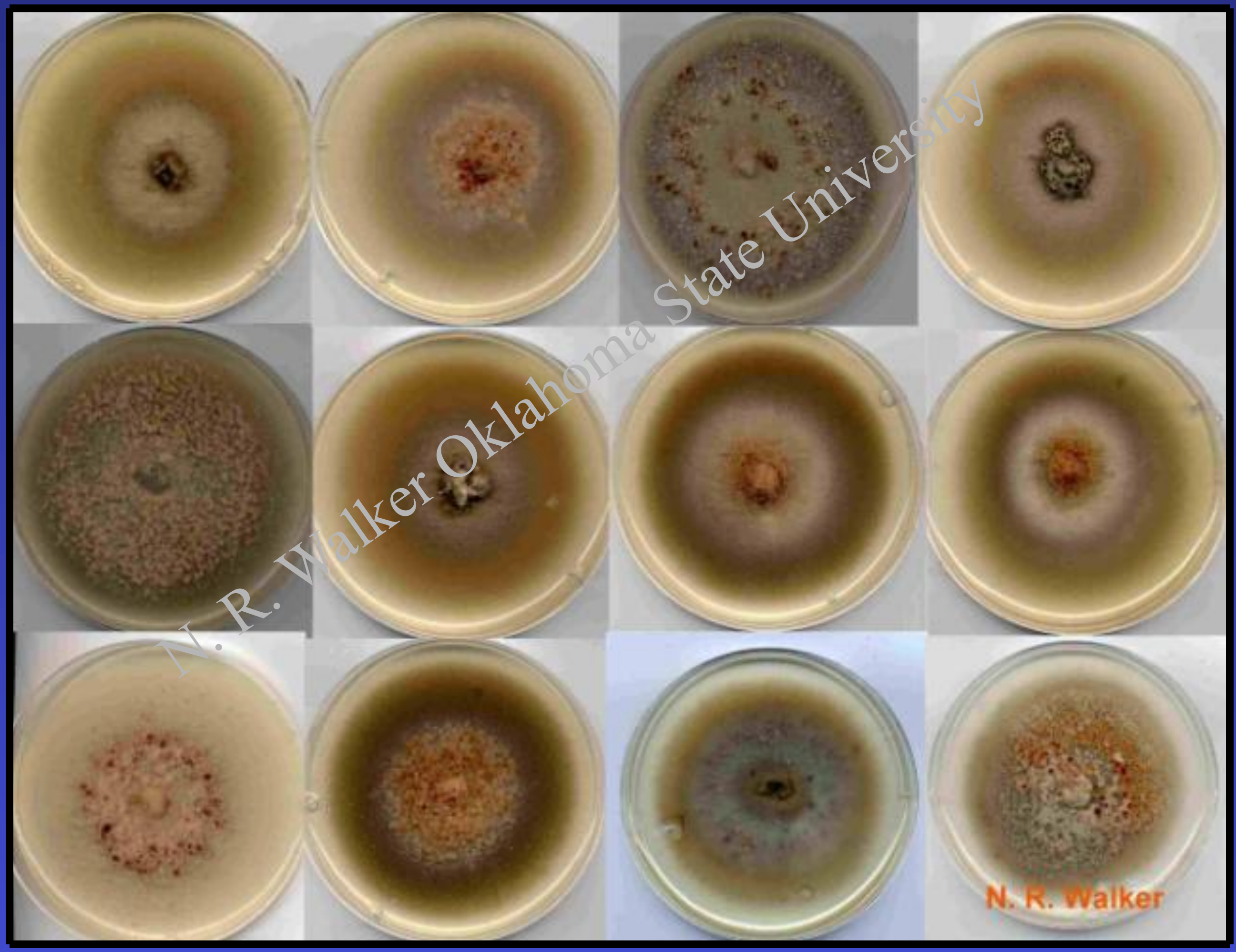
Ophiosphaerella korrae

Found in eastern Oklahoma, throughout eastern states (AL, MS, NC, SC, VA)

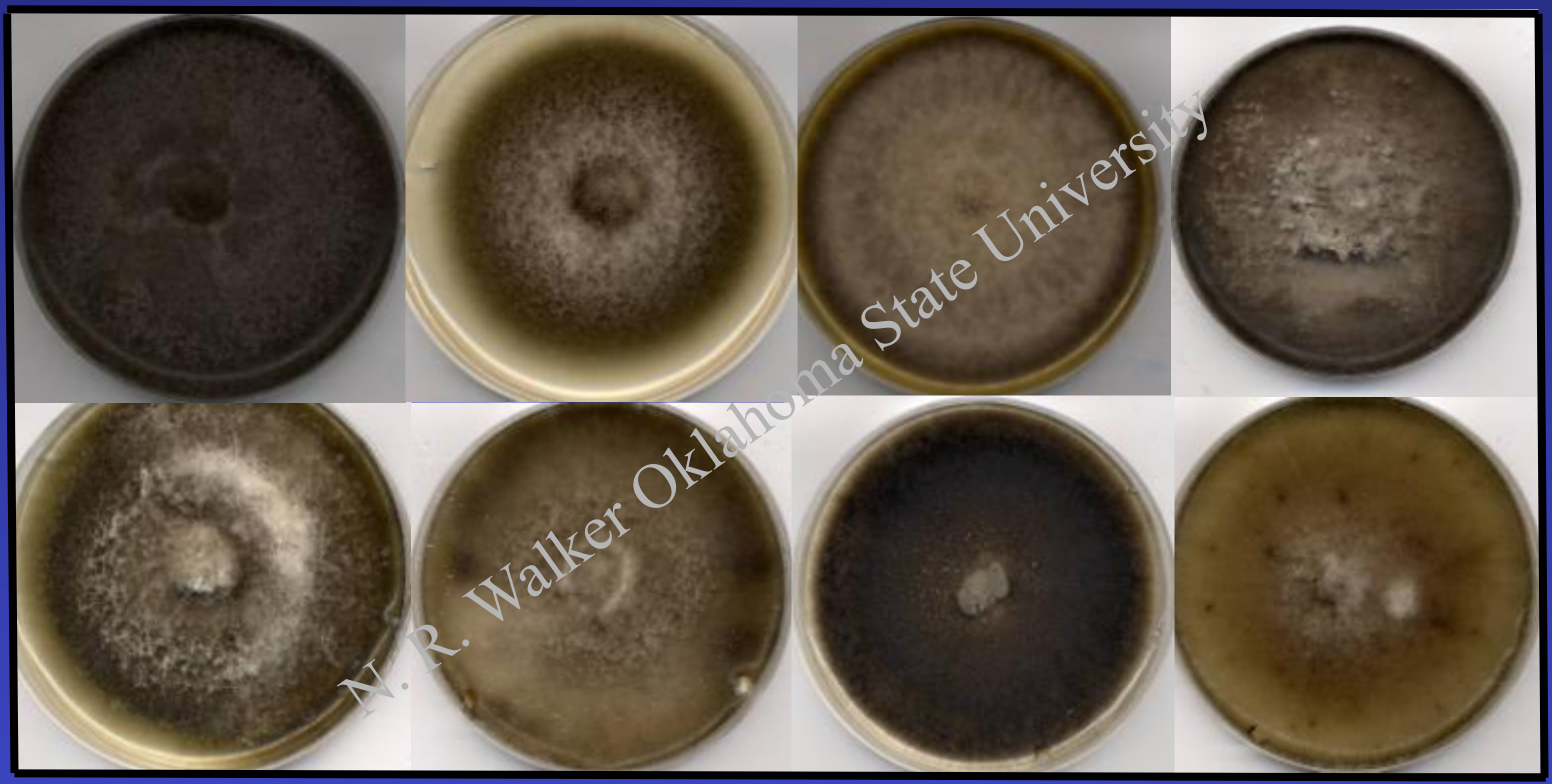
Ophiosphaerella narmari

Primarily found on the west coast (CA)

Ophiosphaerella herpotricha

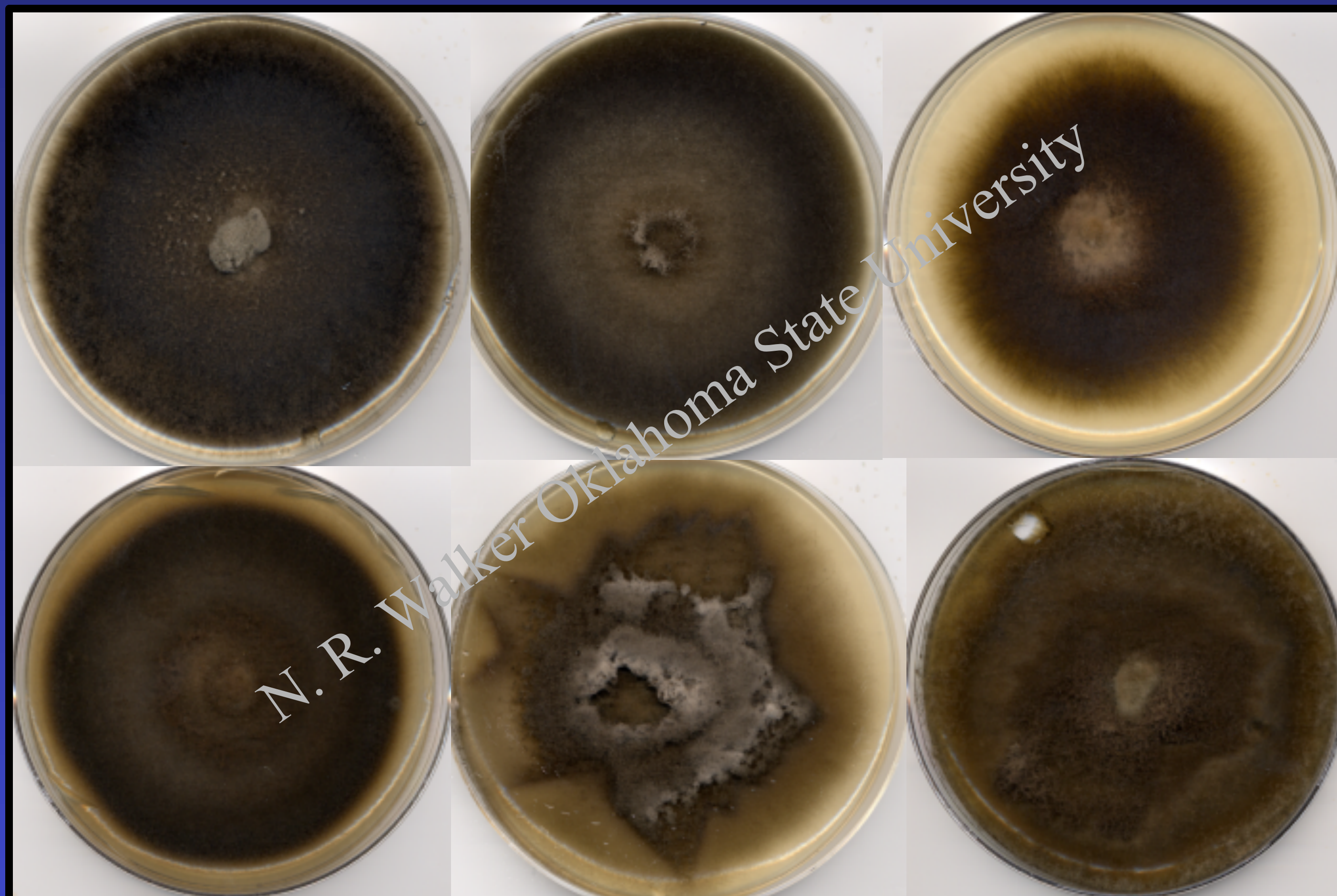


Ophiosphaerella korrae



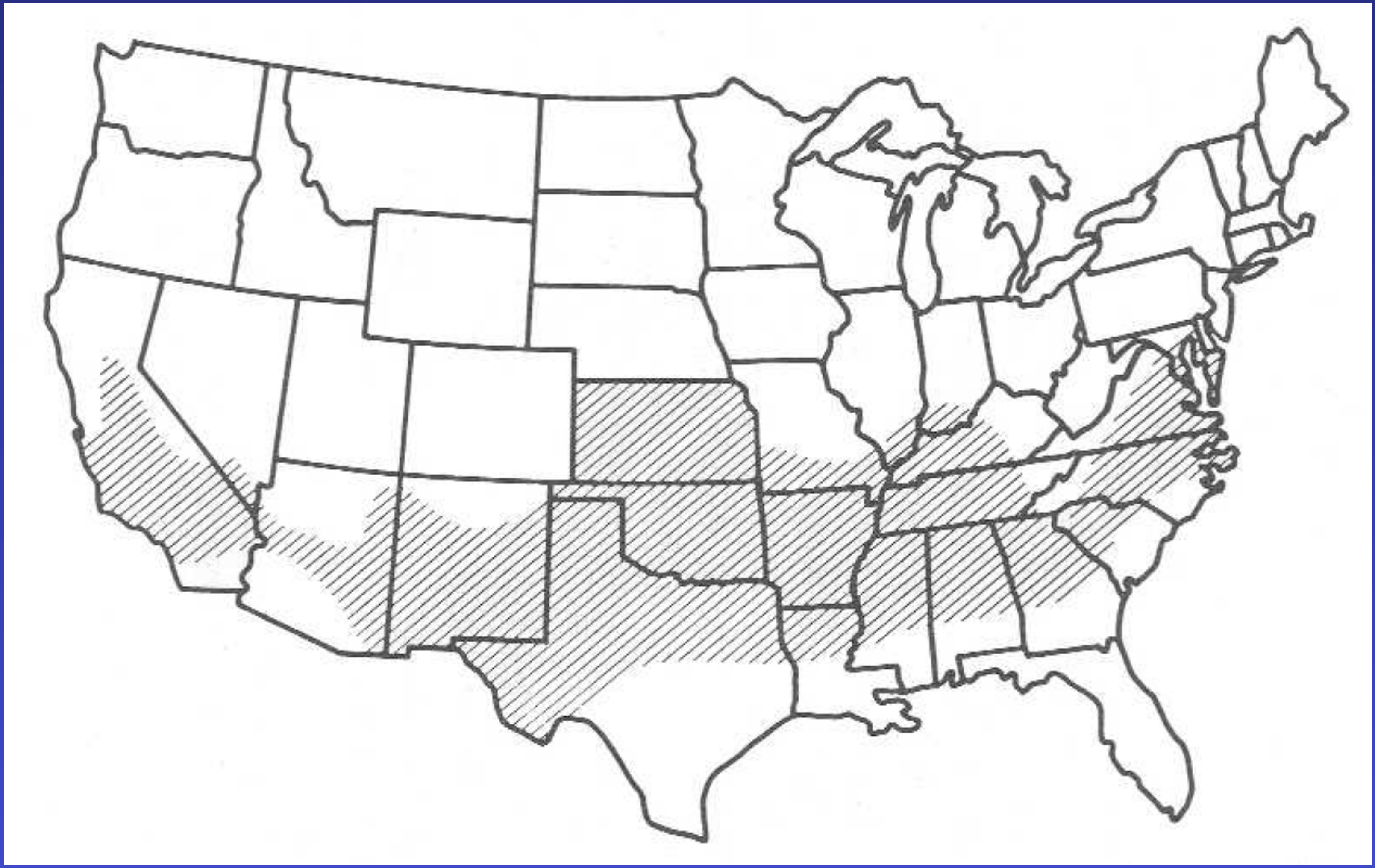
Similar but darker

Ophiosphaerella narmari



Similar to *O. korrae*

Distribution of Spring Dead Spot



From: Turfgrass Patch Diseases Caused by Ectotrophic Root-infecting Fungi, eds:B. Clarke and A. Gould. 1993. APS Press St. Paul, MN

Symptoms of Spring Dead Spot

- Clearly defined circular patches of dead grass apparent in early spring (April in OK)

- Most prevalent on intensively managed bermudagrass
  - Fairways, athletic field, home lawns, and commercial landscapes
  - Bermudagrass putting greens (farther south) a different story

- Most important and devastating disease of bermudagrass *where it enters dormancy in the winter*
  - Appearance
  - Weed encroachment
  - Golf play
  - Tournament scheduling

Late March
Patches begin to appear

Serpentine or Doughnut appearance

Patches will enlarge in the *same* location each year

Spring Dead Spot

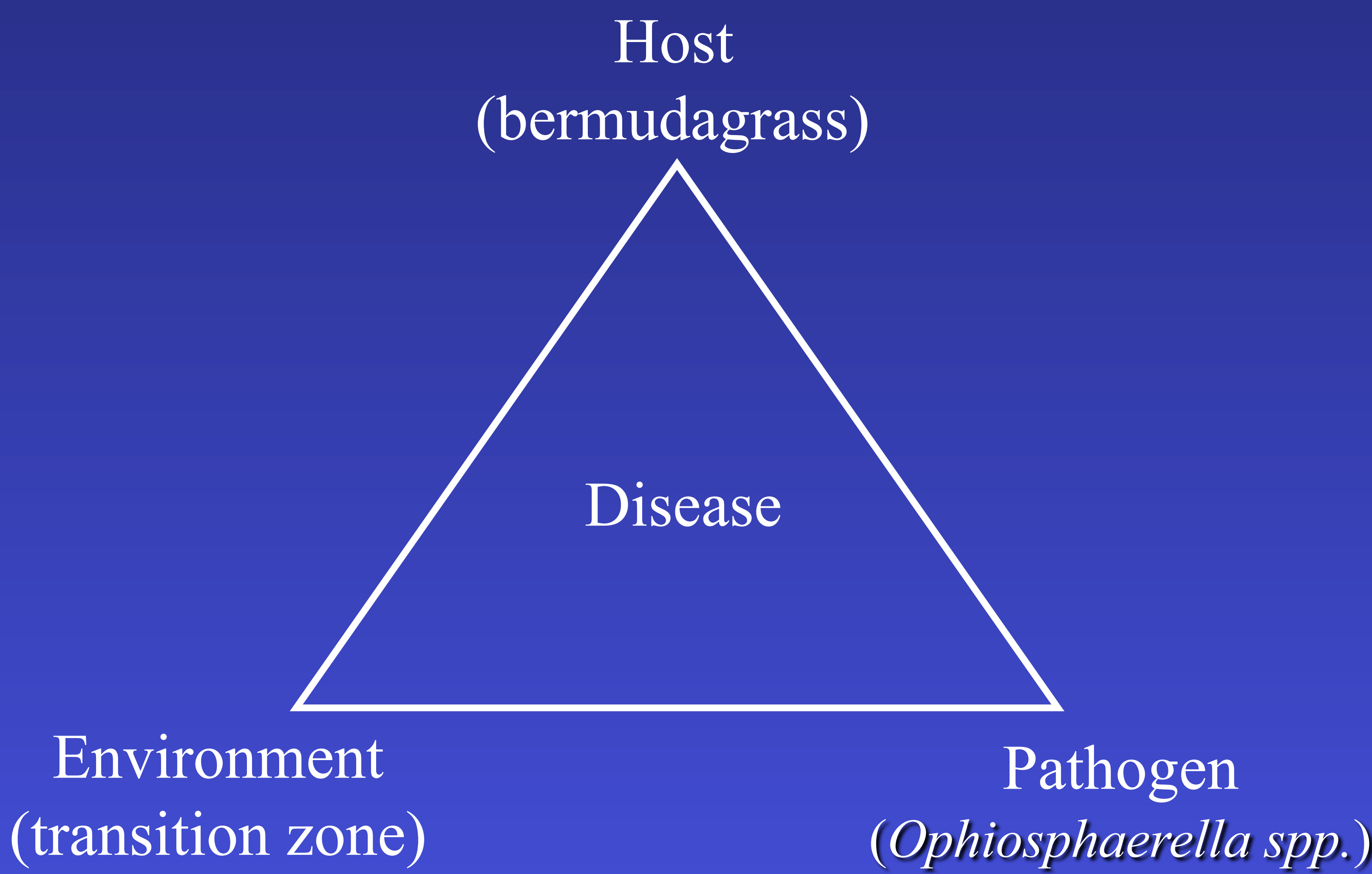
- In the spring, if you excavate diseased plants, dark, discolored roots, crowns, and stolons are visible to the naked eye
- Leaves are straw colored or bleached in contrast to the dark, black roots

Spring Dead Spot
Winter injury versus disease

- In most cases, the patches will recover in one season; however, in severe situations more than one year might be necessary
  - However, this can be slowed due to the establishment of weeds

The Biology of Spring Dead Spot

Disease triangle



Spring Dead Spot Disease Development

- Local and long distant movement
  - *O. herpotricha* - infested soil and plant materials
  - *O. korrae* - infested soil, plant materials, and possibly spores
- Optimal infection and colonization occurs when soil temperatures are cool
  - less than 70 F (Walker et al. 2006)
  - up to 77 F (Tisserat et al. 1989)
- Wet or near saturated soils may aid in infection (Walker et al. 2006)
  - disease may be more severe in heavy soils (Young and Sturgeon, 1973)
- Typically symptoms do not appear on a newly established planting (< 3 years old)
- Symptoms will first appear as small spots
  - Often overlooked

The influence of temperature on the colonization of bermudagrass roots by *Ophiosphaerella herpotricha*

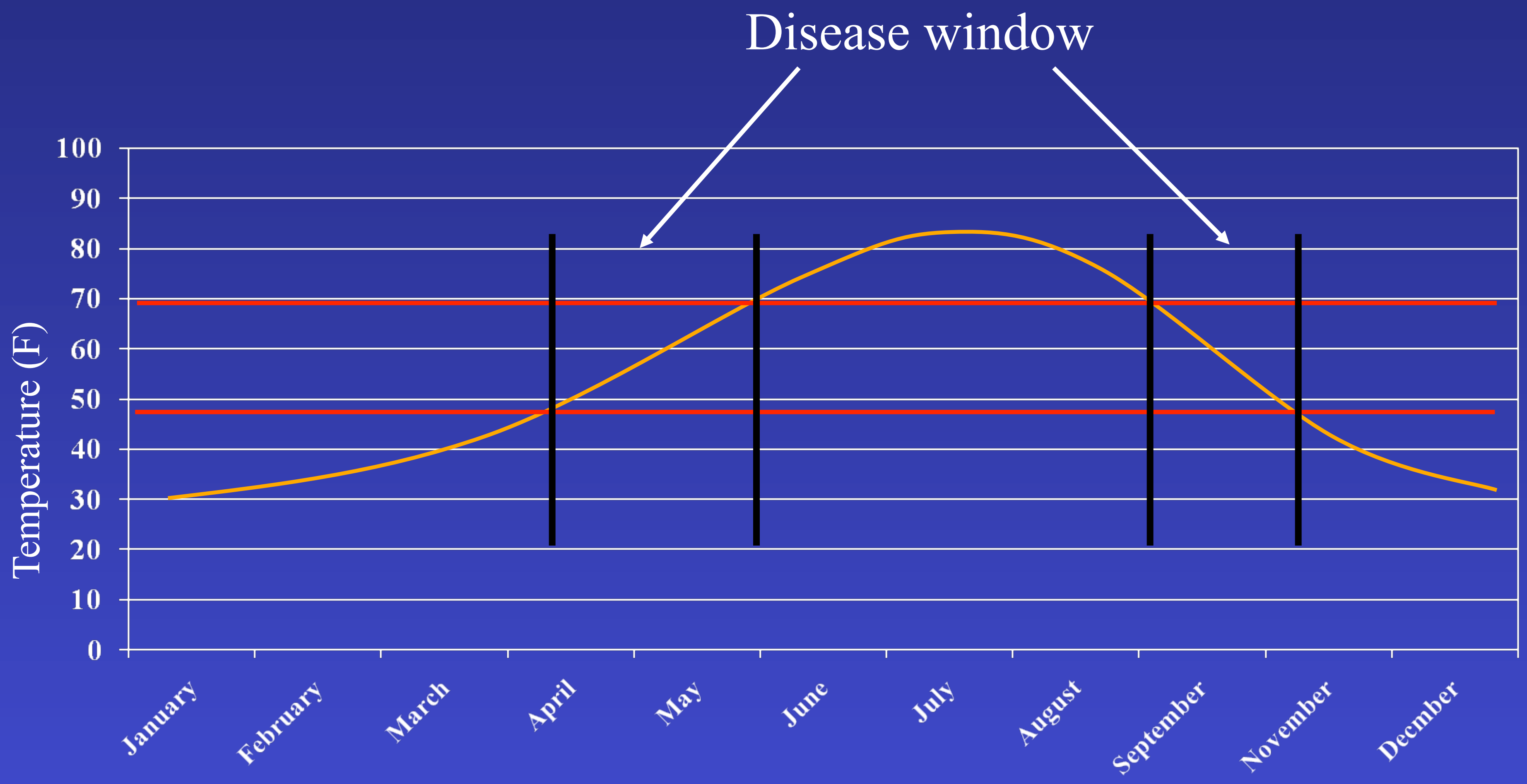
	Colonization (mm)	
Temperature (f)	Measurement 1[x]	Measurement 2[y]
54	9.1 b[z]	10.0 bc
61	7.8 bc	9.8 bc
63	12.0 a	13.1 a
66	6.5 c	8.6 c
70	9.6 b	11.1 b
77	2.9 d	2.6 d
86	2.7 d	3.0 d

[x] Length determined 8 days after inoculation for 54, 61, 66, 77, and 86 C and 7 days after inoculation for 63 and 70 f

[y] Length determined 10 days after inoculation for 54, 61, 66, 77, and 86 C and 7 days after inoculation for 63 and 70 f

[z] Means in the same column followed by the same letter are not significantly different according to Duncan's multiple range test ($P \leq 0.05$)

Soil Temperatures and Disease Activity



Generalized schematic for soil temperatures at 4”

Spring Dead Spot

Roots versus Stolons

- The fungus directly infects the root surface, begins to grow on and into the root
- Cooler temperatures in autumn and spring favors fungal activity over plant root growth
- Cooler temperatures = shorter roots with a higher percentage of root length colonized
- Warmer temperatures = longer roots with a much smaller percentage of root length colonized

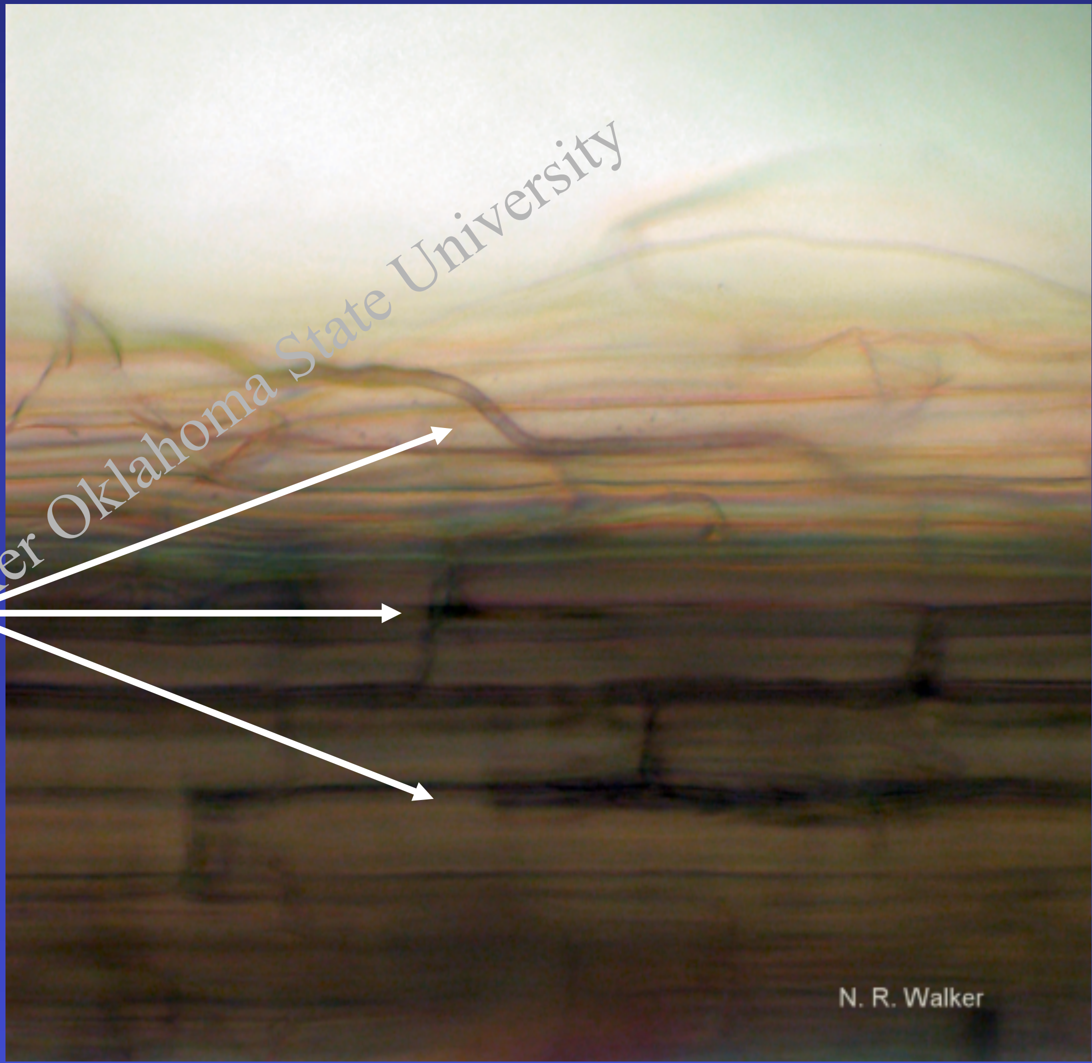
Spring Dead Spot Disease Development

- Root infection, discoloration and fungal growth

Spring Dead Spot

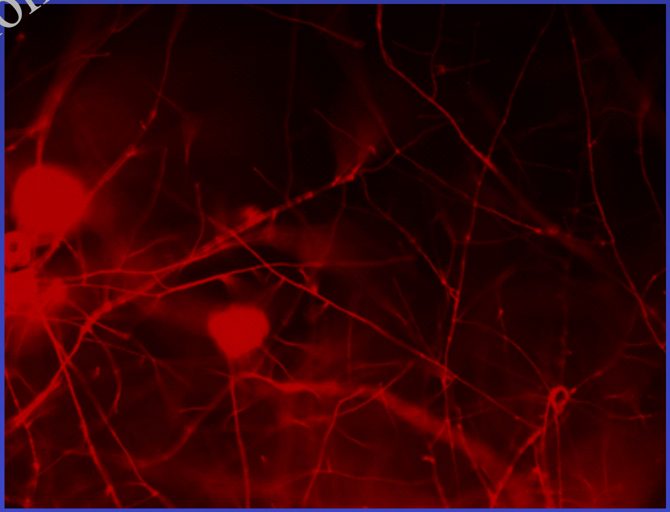
To this point it has been difficult to say much more

Here is the fungus, but what it is doing ?



Transgenic isolates of *O. herpotricha*

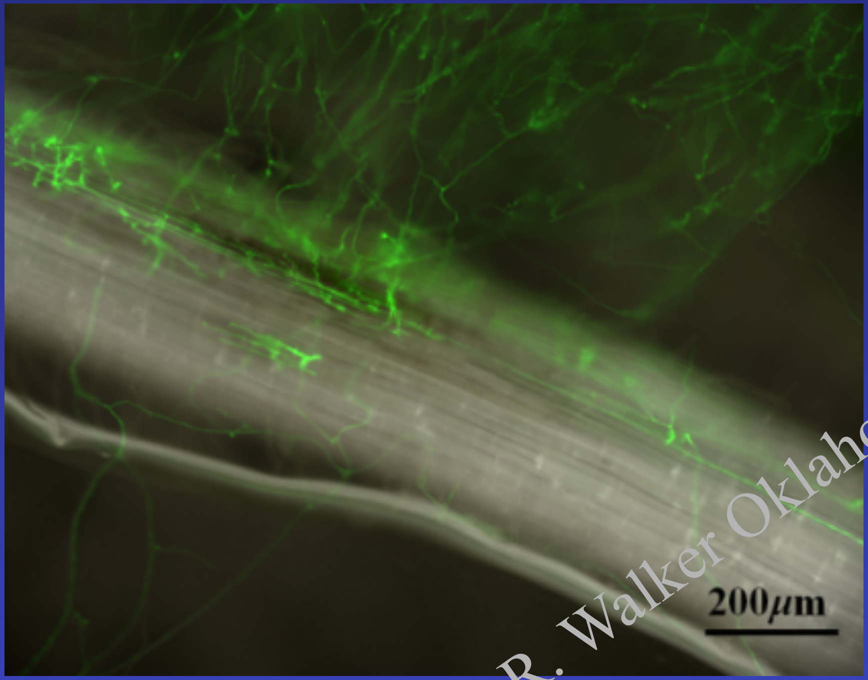


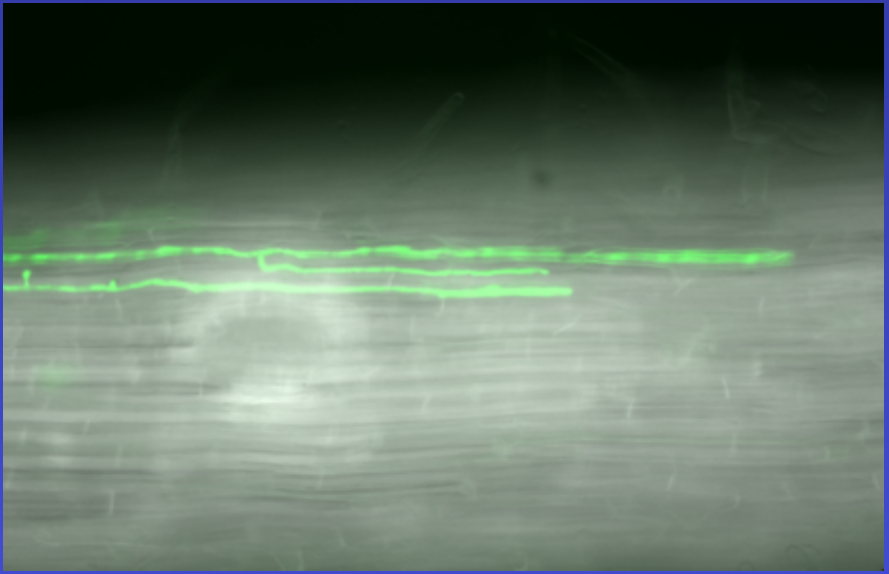
GFP
(green)

tdTom
(red)

Disease Progression
Infection of roots after 4 days

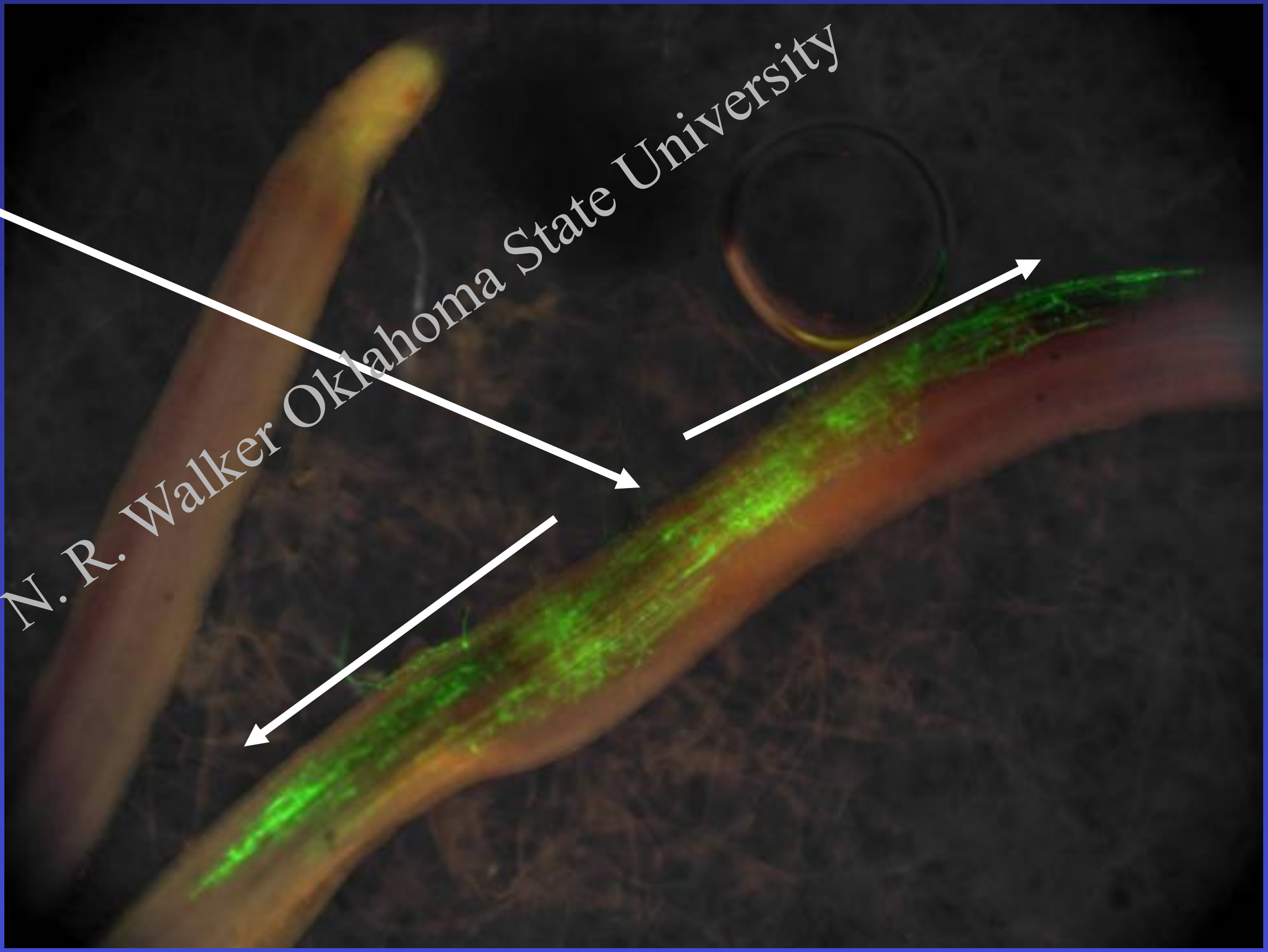


Tifway 419



Rapid infection and colonization when conditions are ideal

- Infection started here and moved outward

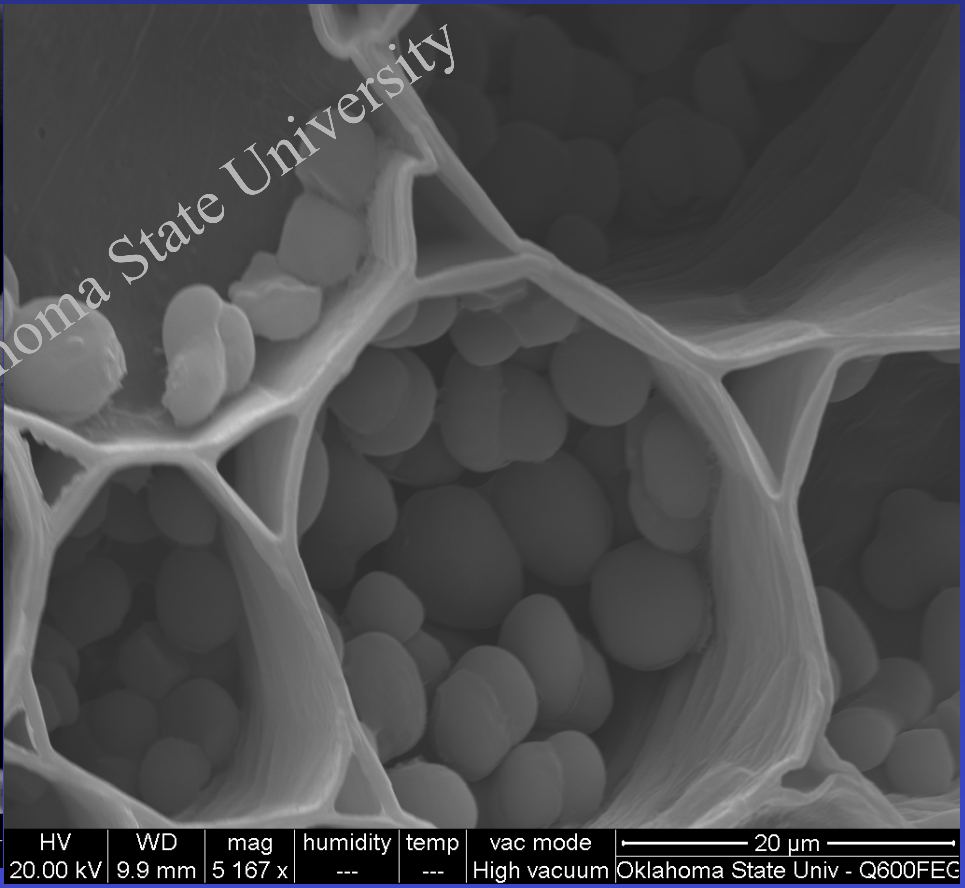


Spring Dead Spot

Roots versus Stolons

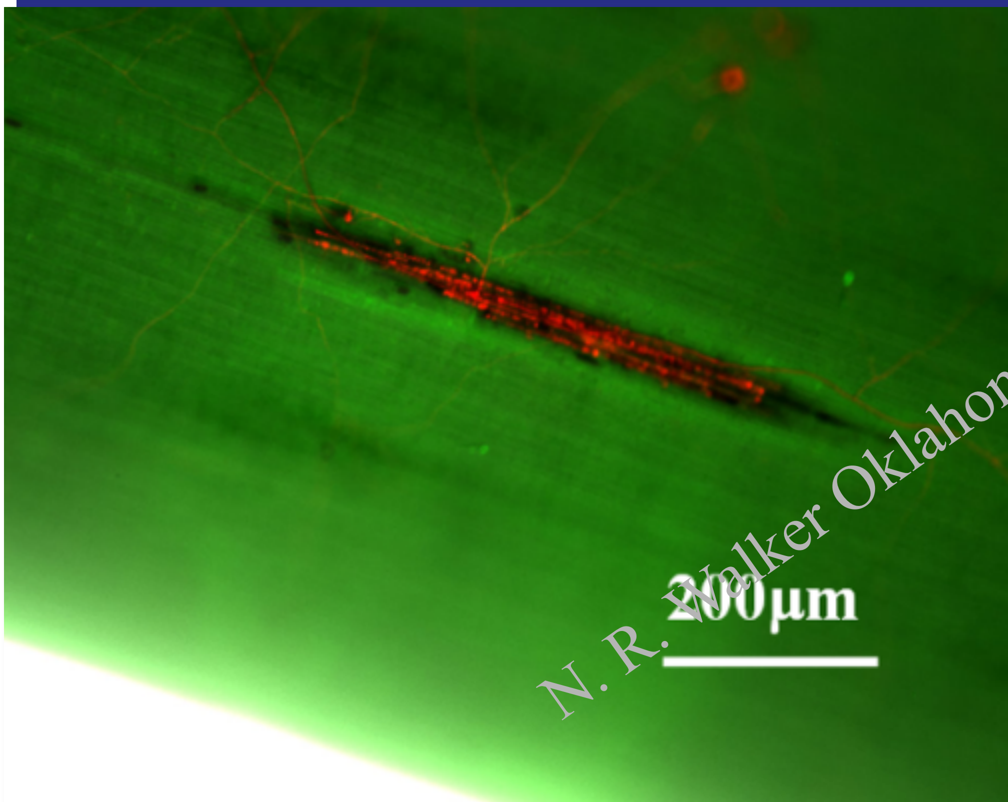
- Primary overwintering structure
- Nodes are the growing points (meristem) for new roots, stolons/rhizomes, and shoots
- Storage organ for starches (food reserves) for plant to utilize when it begins regrowth in the spring

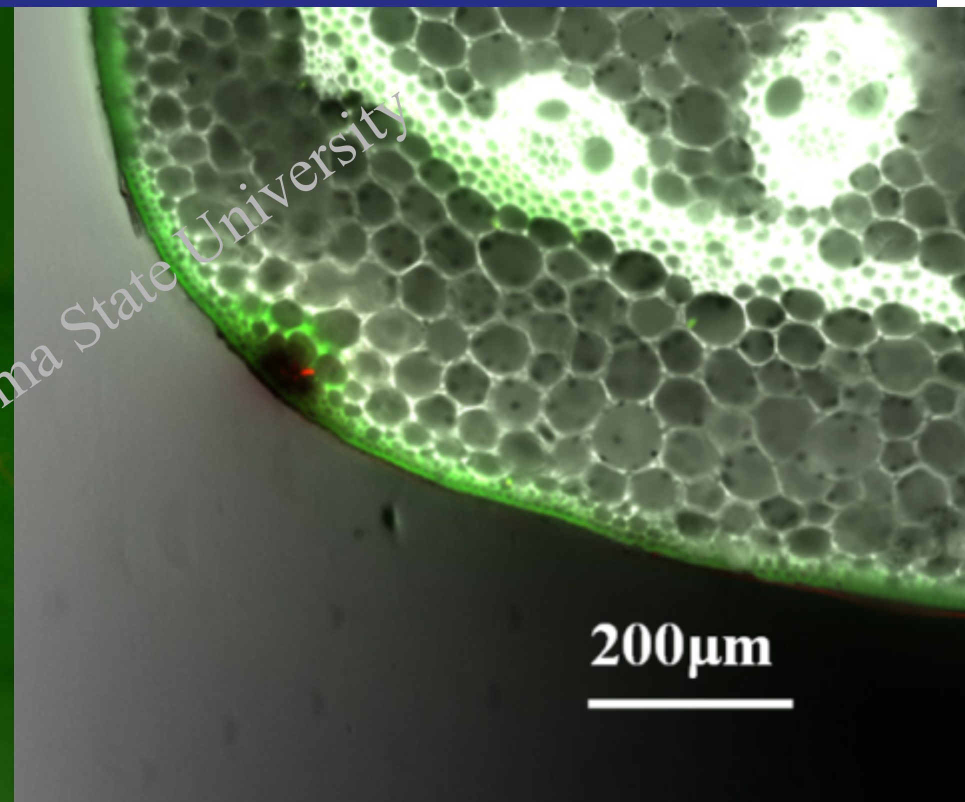
Stolons are storage organs for starches



Disease Progression on stolons

after 1 month

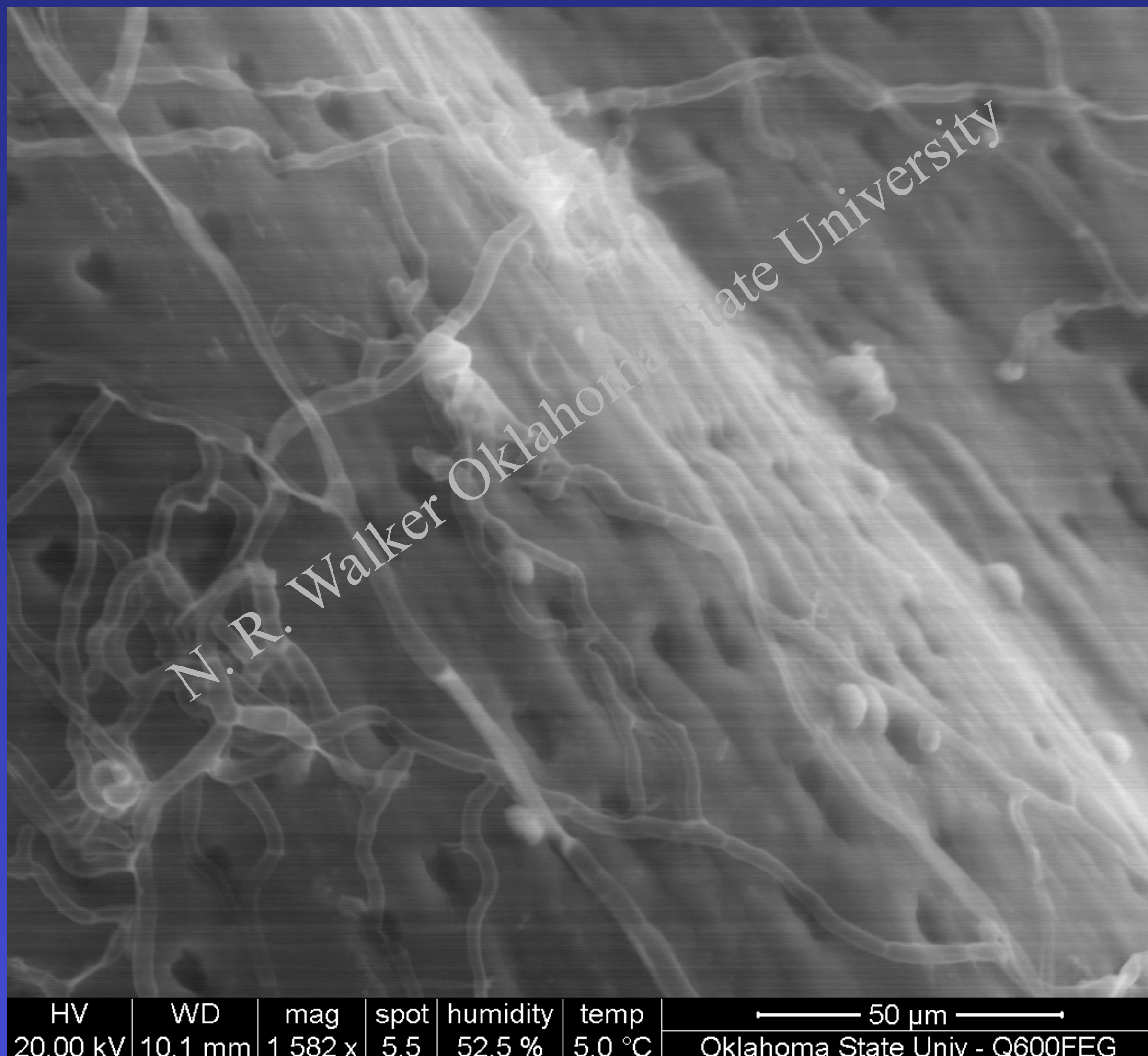




stolon surface

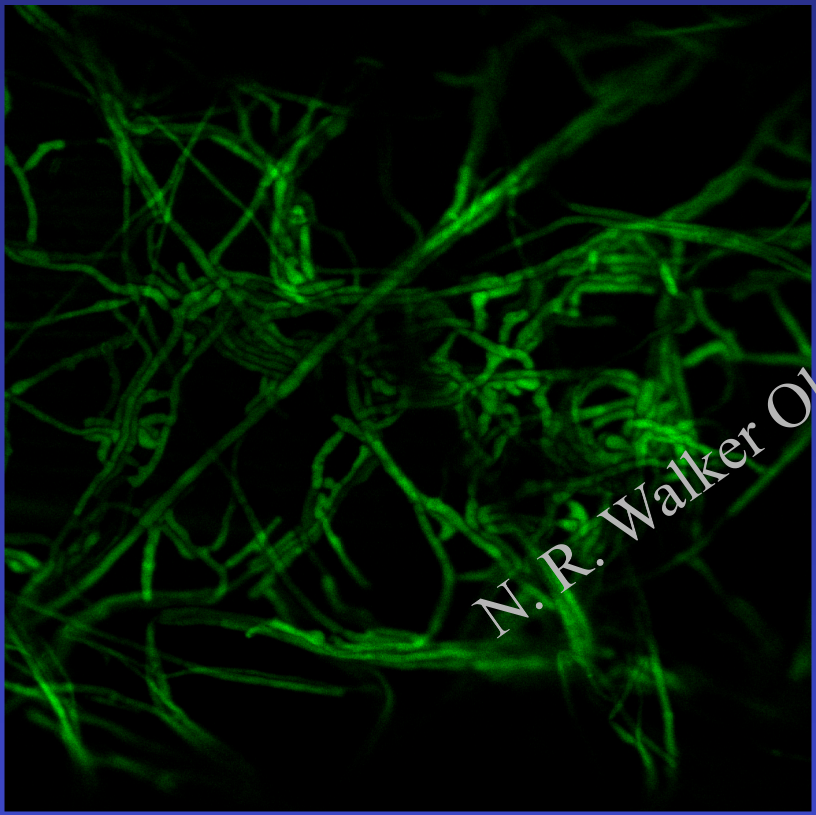
transverse section

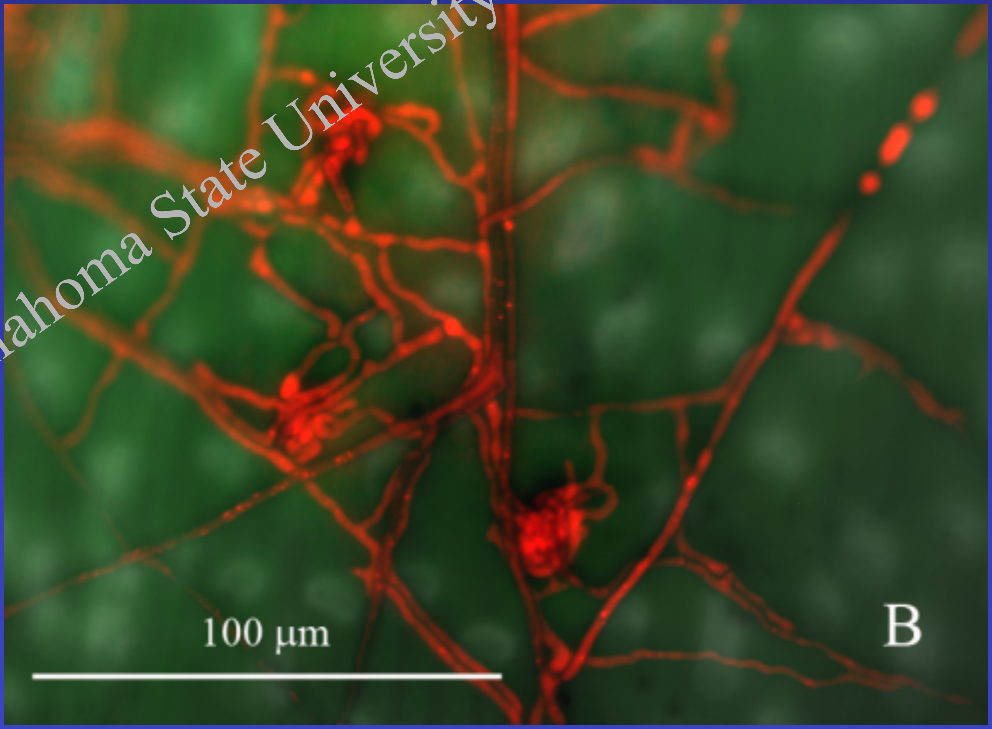
ESEM of stolon surface



Disease Progression on stolons

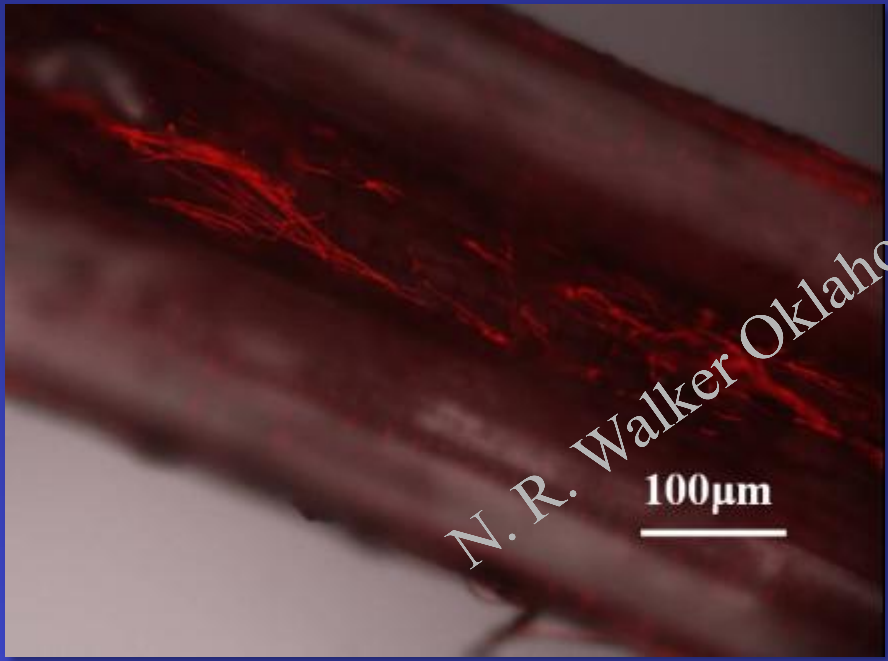
after 1 month

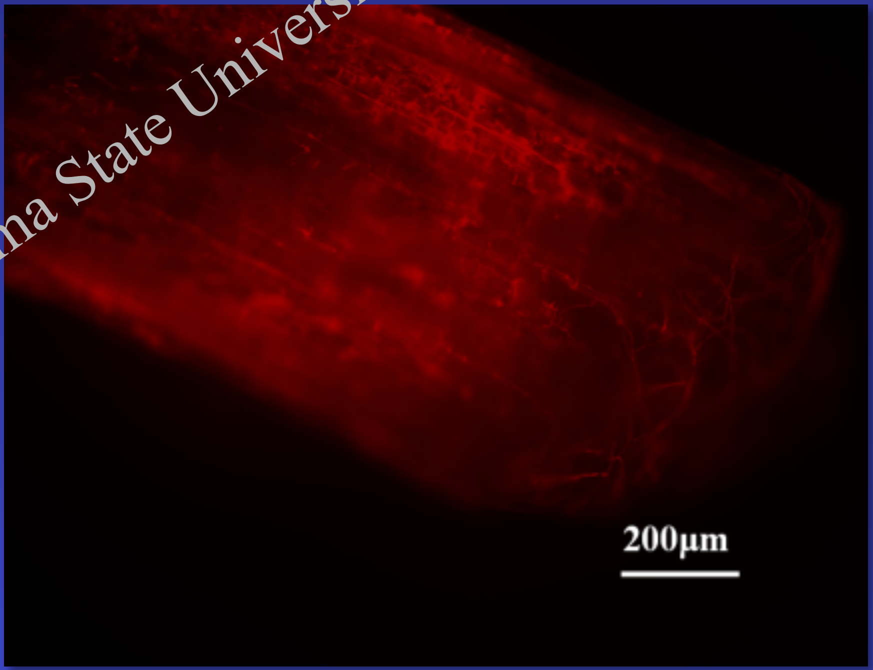




Disease Progression on stolons

after 6 weeks





longitudinal sections

The Biology of Spring Dead Spot

Fungal diversity (percent) recovered from *O. herpotricha* inoculated and non-inoculated bermudagrass roots and stolons/rhizomes.

	Ophiosphaerella herpotricha		Non-inoculated Control	
Fungal genera	Stolons/rhizomes	Roots	Stolons/rhizomes	Roots
Bipolaris spp.	14.3	11.8	55.6	6.3
Fusarium spp.	35.7	40.8	11.1	68.8
O. herpotricha	7.1	15.8	-	-
Macrophomina spp.	-	3.9	-	12.5
Microdiplodia spp.	3.6	1.3	-	-
Microsphaeropsis spp.	-	-	5.6	-
Mortierella spp.	-	1.3	5.6	-
Nectria spp.	-	1.3	-	6.3

Populations obtained from two samples collected on 30 October 2006 twice from Tifway bermudagrass inoculated with *O. herpotricha*, or once from a non-inoculated site.
Values in the same column are expressed as percent of total fungal isolates cultured from either stolons/rhizomes or roots.

The Biology of Spring Dead Spot

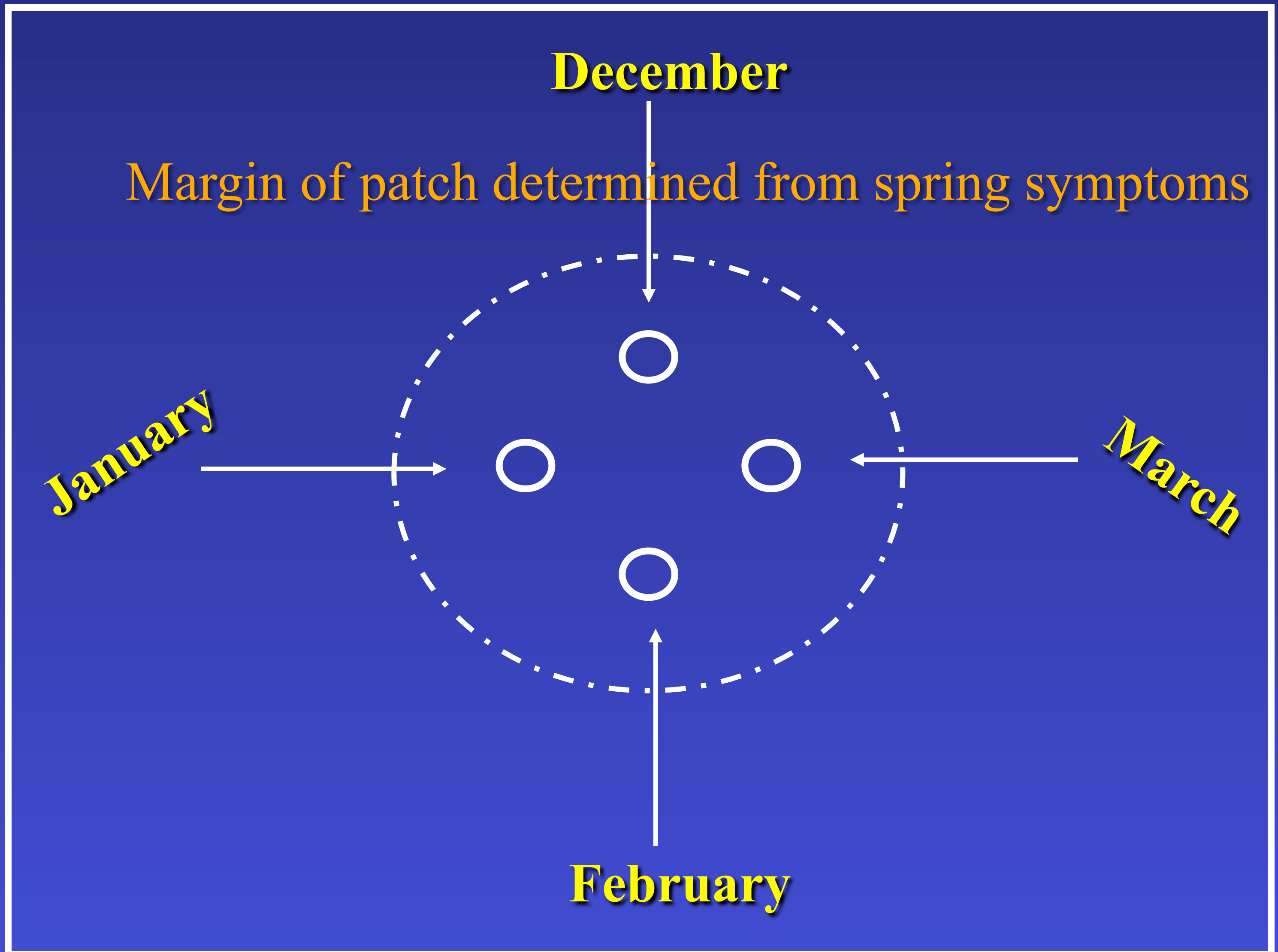
- Plant death
  - When does it occur during cold temperature induced dormancy?

- Only 20% to 50% infection of the total root system is required to cause plant death (Walker et al., 2006)

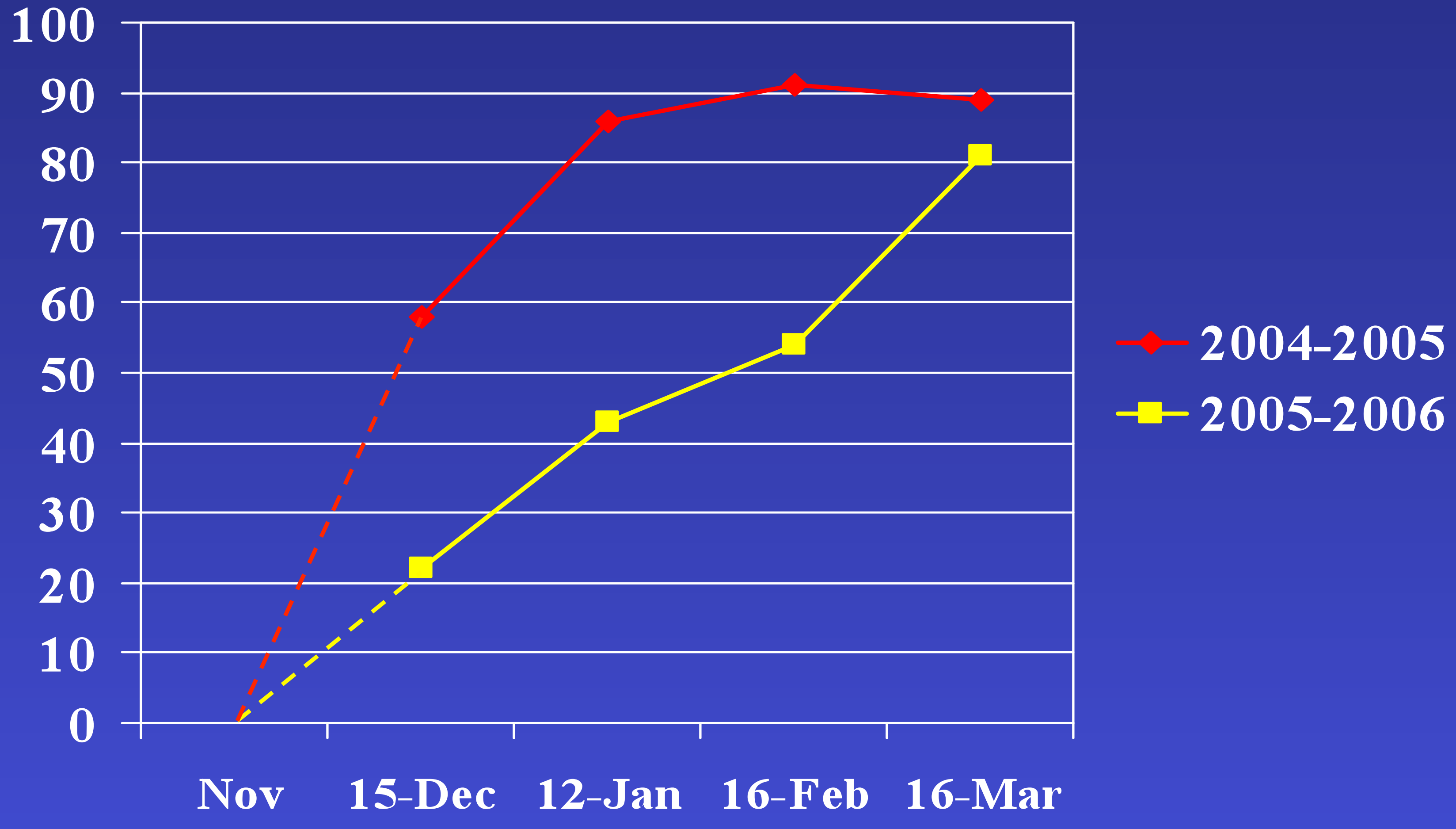
- Plants can tolerate a low level of infection/damage and survive

- Severity of disease may largely depend on Fall conditions – rain and temperatures

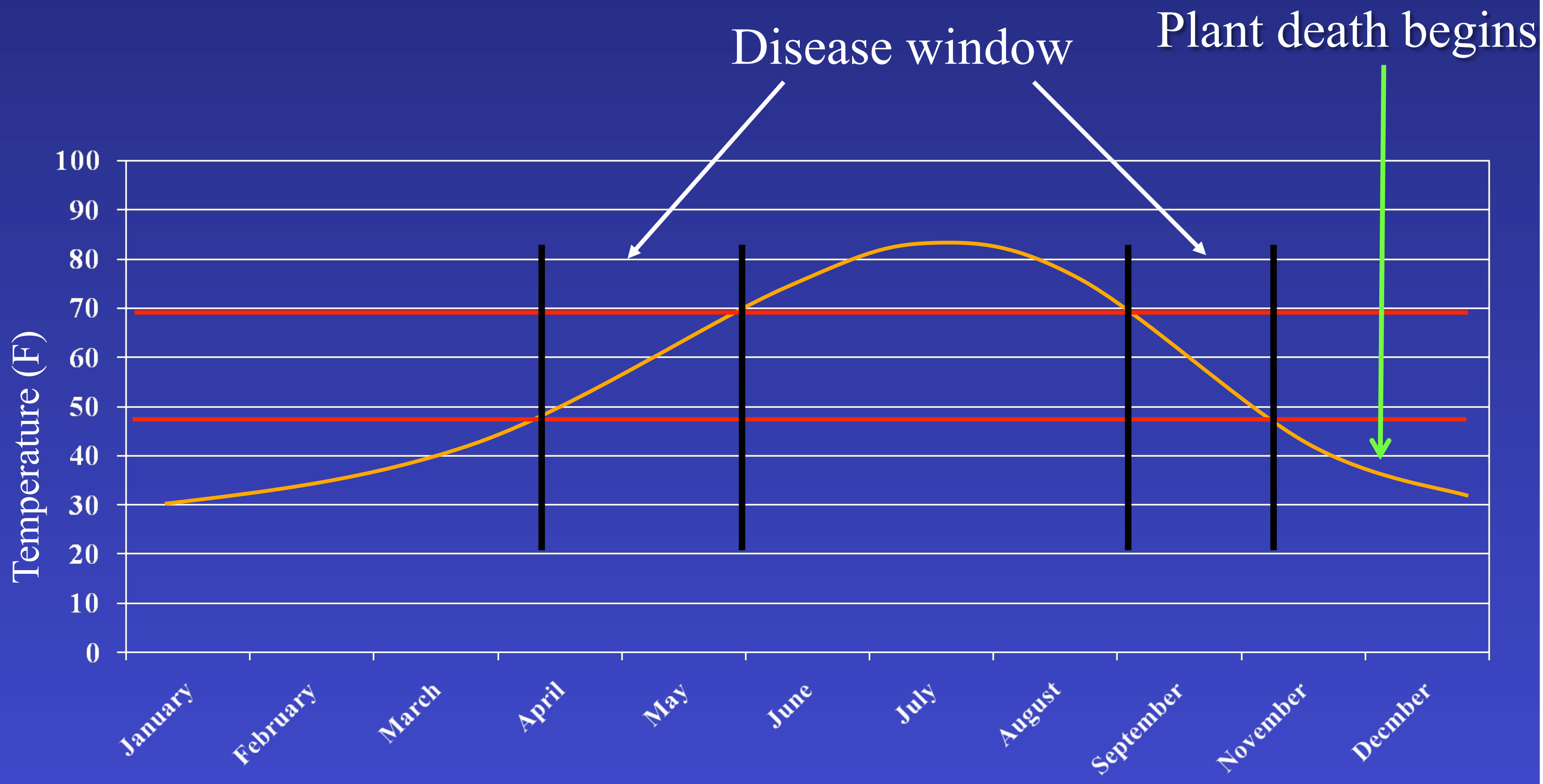
Sampling procedure



O. herpotricha induced death of bermudagrass



Soil Temperatures and Disease Activity



Generalized schematic for soil temperatures at 4”

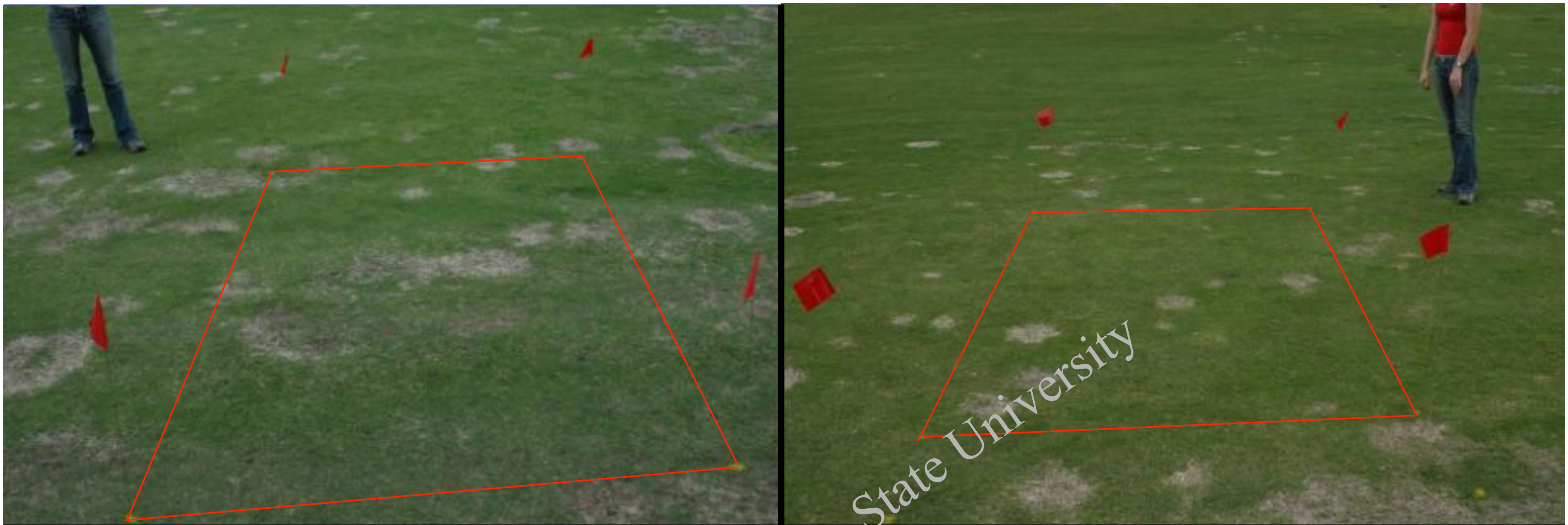
The Biology of Spring Dead Spot

- Recovery in dead patches can be initiated from:
  - Surviving bermudagrass in the affected area
  - From grass around the affected area

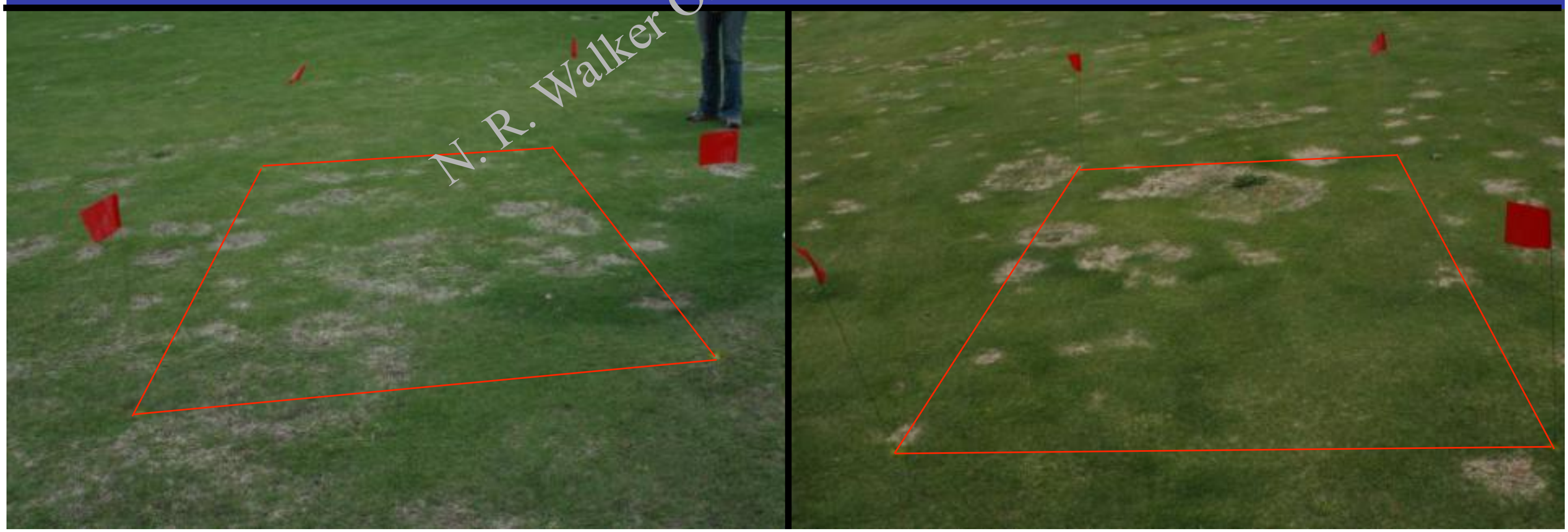
- However, this can be slowed due to the establishment of weeds

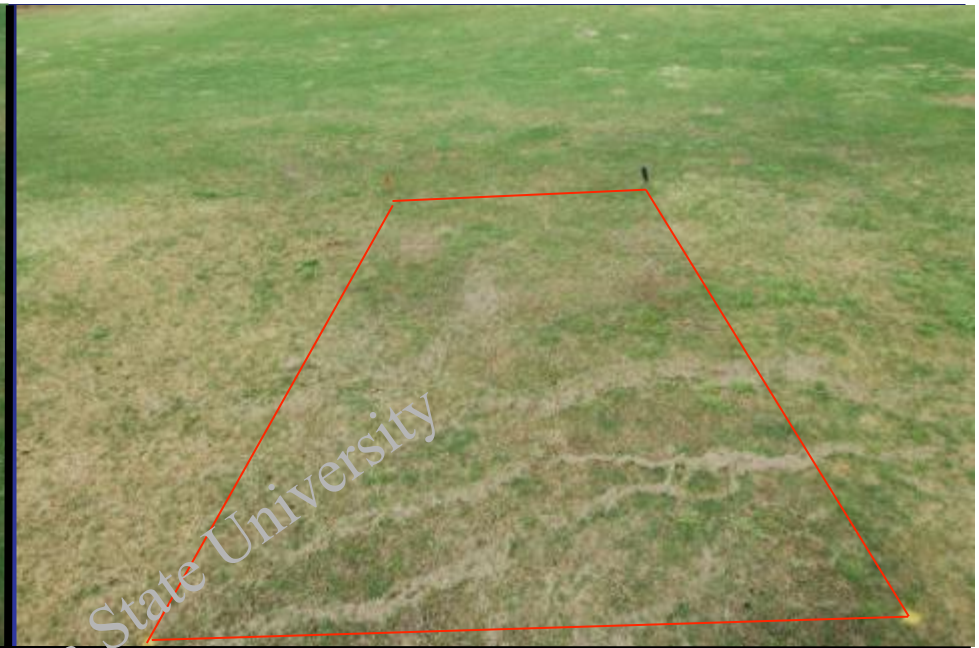
- Toxins? – slow turf growth in the spring, recovery, and stunted roots
  - Active disease
  - Root pruning pre-emergent herbicides

- After many years (> 6) symptoms at the same location can decline or even disappear
  - It is not known why this happens - antagonists



Non-treated Control plots on May 9, 2006





Non-treated Control on March 28, 2007

Non-treated Control on May 2, 2007

Managing Spring Dead Spot

- Host plant resistance
  - Use resistant varieties
- Avoid late season applications of nitrogen
  - Or practices that delay normal dormancy
- Organic soil amendments/fertilizers?
  - trends
- Cultural management
  - Reduce soil compaction
    - Aeration
  - Disease tends to be more severe with increasing thatch
    - Vertical mowing
- For Oklahoma, soil pH has not been a good predictor of disease incidence or severity

NTEP Spring Dead Spot Evaluations 2006, Stillwater

Cultivar	Patch size (cm^2)
CELEBRATION	2842.7
SUNDEVIL II	2562.0
TIFT NO. 1	2511.0
SOUTHERN STAR	2241.7
PRINCESS 77	2234.3
NUMEX SAHARA	2062.7

Cultivar	Patch size (cm^2)
ARIZONA COMMON	1756.7
GN-1	1720.7
CONTESSA (SWI-1045)	1646.0
SWI-1012	1471.7
RIVIERA	1311.7
MS-CHOICE	1250.3

Cultivar	Patch size (cm^2)
PATRIOT	940.0
YUKON	763.7
SWI-1014	745.7
TIFWAY	178.0
MIDLAWN	41.0
OKC 70-18	8.3
TIFSPORT	6.3

Managing Spring Dead Spot

- Host plant resistance
  - Use resistant varieties
- Avoid late season applications of nitrogen
  - Or practices that delay normal dormancy
- Organic soil amendments/fertilizers
  - N or K
  - trends
- Cultural management
  - Reduce soil compaction
    - Aeration
  - Disease tends to be more severe with increasing thatch
    - Vertical mowing
- For Oklahoma, soil pH has not been a good predictor of disease incidence or severity

Fungicide Management

- Expensive: expect $400 per acre per treatment
- Historically variable results
  - Which fungicides were used
  - Where fungicides were applied (Was there disease there before?)
  - Fungicide application timing
  - Expectations of product performance
- Repeated applications must be made (fall easiest to plan)
  - First application when soil temperatures are in the mid to low 70's
  - Second 4 weeks later, often when soil temperatures are conducive for disease
- Not appropriate for the entire site/location
  - High value areas
  - Sites with a history of severe problems
- Consider using those inexpensive digital cameras
  - Document disease, do not rely on memory alone

Now knowing a little more, can we obtain better disease control?

- Can spring fungicide applications reduce the severity of spring dead spot?
- Many Universities do not recommend fungicides for spring dead spot control
- First fungicide trial was conducted over three years
- Documented the size of patches in the Spring of each year

Can this new information be used to optimize fungicide applications?

- Fungicide (tebuconazole @ 2.22 oz) was applied with a CO^2 pressurized plot sprayer @ 87 gal/acre or 2 gal/1000 sq ft

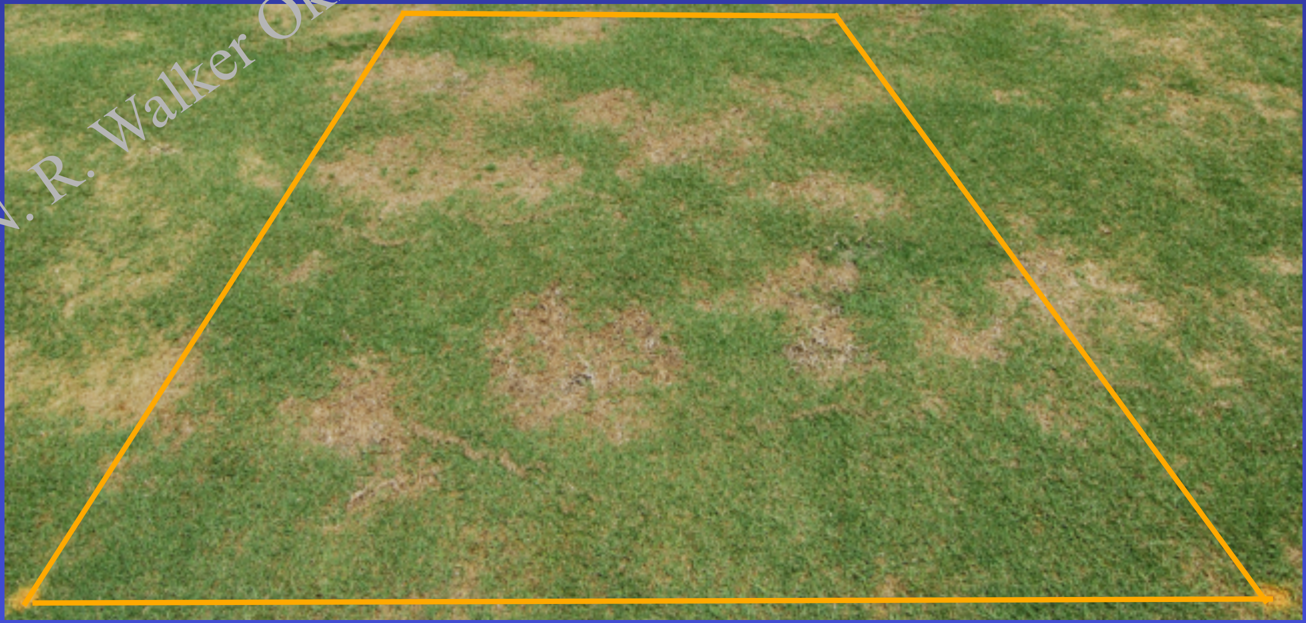
- Treatments
  - 1 Spring, 2 Fall
  - 2 Spring, 2 Fall
  - 2 Fall
  - 3 Fall
  - 4 Fall

- All plots irrigated with 1/4 – 1/2 inch of water immediately after application

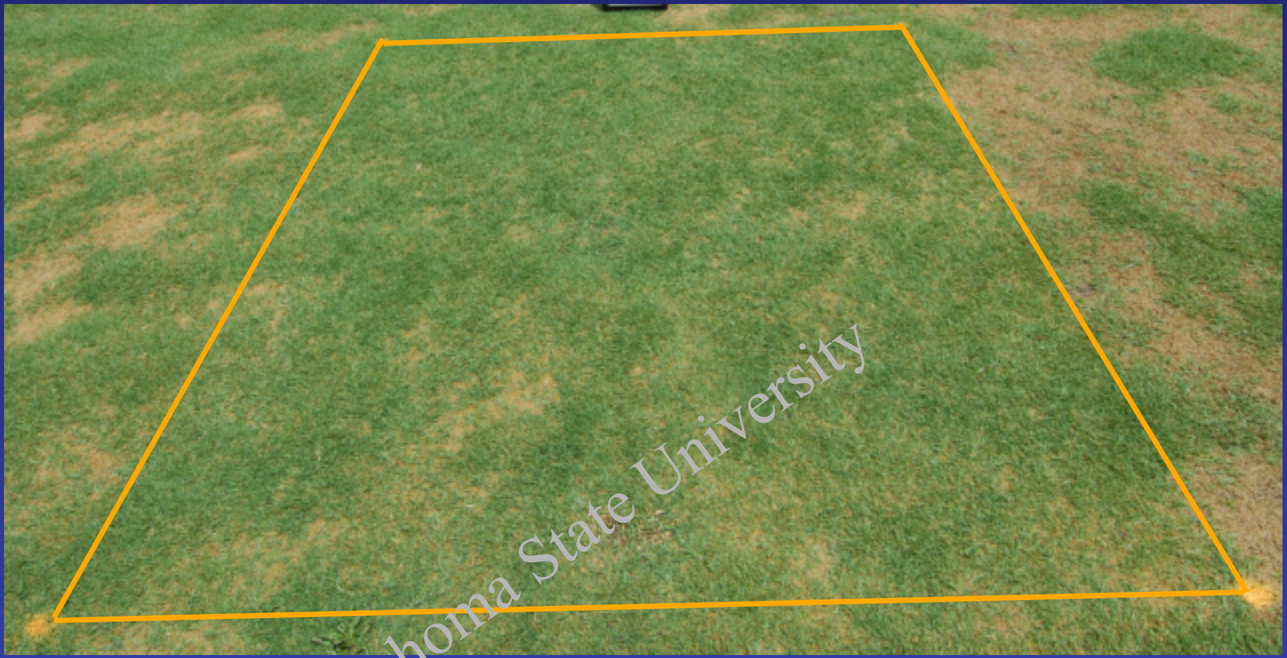
More Fungicide Evaluations

- Various fungicides were applied with a CO^2 pressurized plot sprayer @ 87 gal/acre or 2 gal/1000 sq ft
- Treatment schedule
  - September 21, 2007
  - October 24, 2007
- Soil temperatures at application was 76 F for first and 55 F for second
- All plots were irrigated with 1/4 – ½ in of water immediately after application
- Tifway 419 Bermudagrass (0.5 in height)

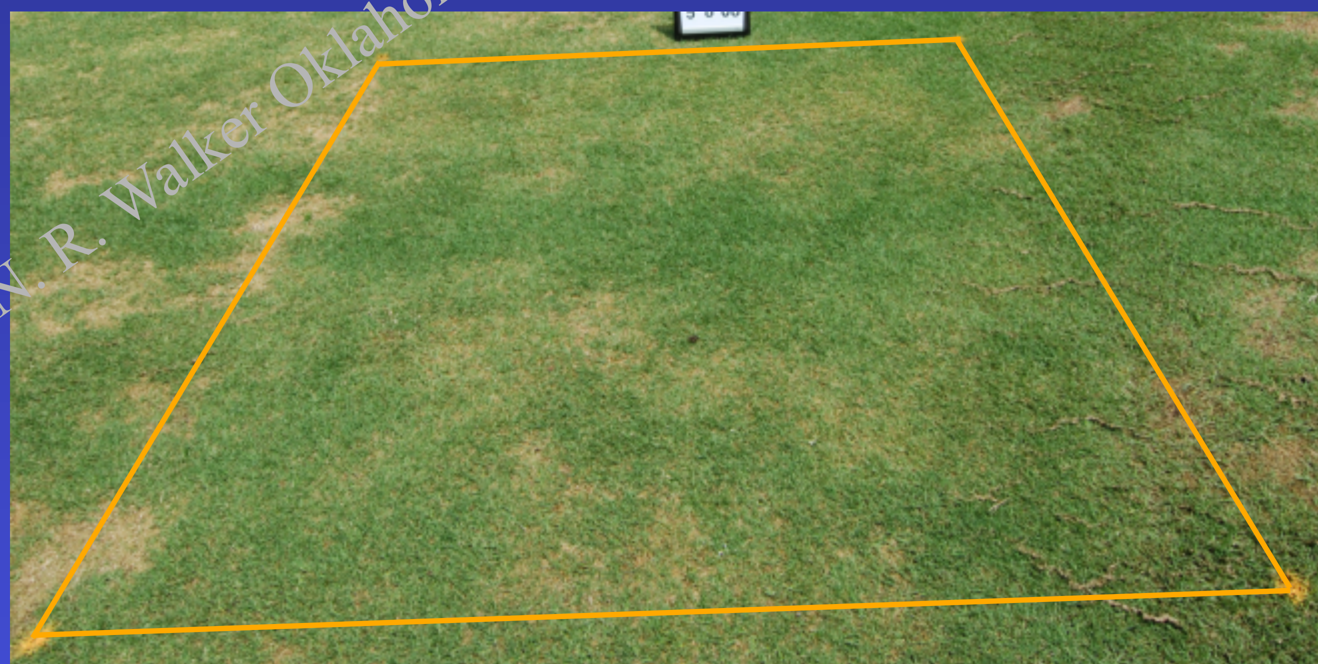
Non-treated
Control plots



Tebuconazole
2 fl oz (twice)



Rubigan
(fernarimol)
6 fl oz
then
Cleary's 3336
(thiophanate-methyl)
5.4 fl oz



Managing Spring Dead Spot

- Use an integrated approach
  - Disease triangle
- Nothing is 100% effective
- Have realistic expectations
  - and document visually/digitally

Spring Dead Spot of Bermudagrass: Biology and Management

Questions?