Introduction to cotton diseases

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Seedling Diseases (Fungi)

- **Fifteen different fungi cause seedling diseases (complex)**
- **Three major pathogens in West Texas:**
  - ***Rhizoctonia solani***
  - ***Pythium* spp.**
  - ***Thielaviopsis basicola***

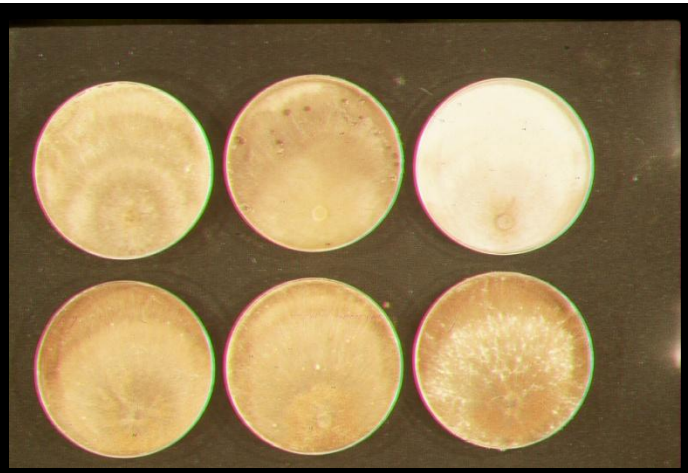
Rhizoctonia solani

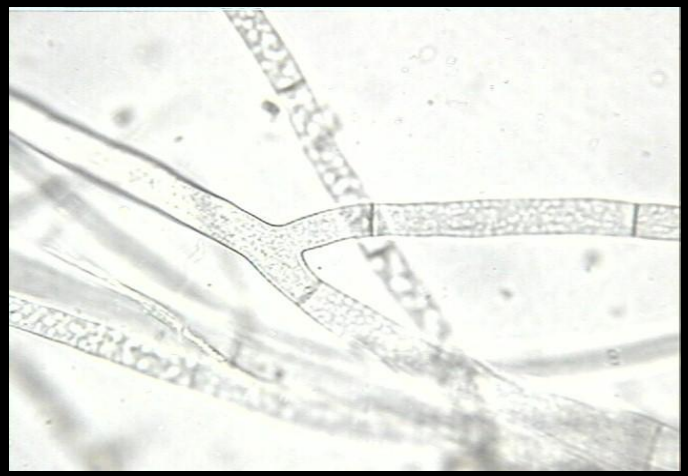
- **May cause seed decay, pre-, and post-emergence damping-off (d.o.)**
- **Environmental conditions: 75 to 90 F with moderate moisture**
  - **Seed decay and pre-emergence d.o. when planted into cool soil**
  - **Post-emergence d.o. occurs via infection of young tissues of the hypocotyl**

Rhizoctonia solani

- **Symptoms:**
  - **Sunken lesions at the soil level, resulting in girdled hypocotyl and collapse**
- **Fungal mycelium may be growing from lesions in wet conditions**
- **Mature plants rarely killed, but weakened**
  - **Stem girdling of older plants (Soreshin)**

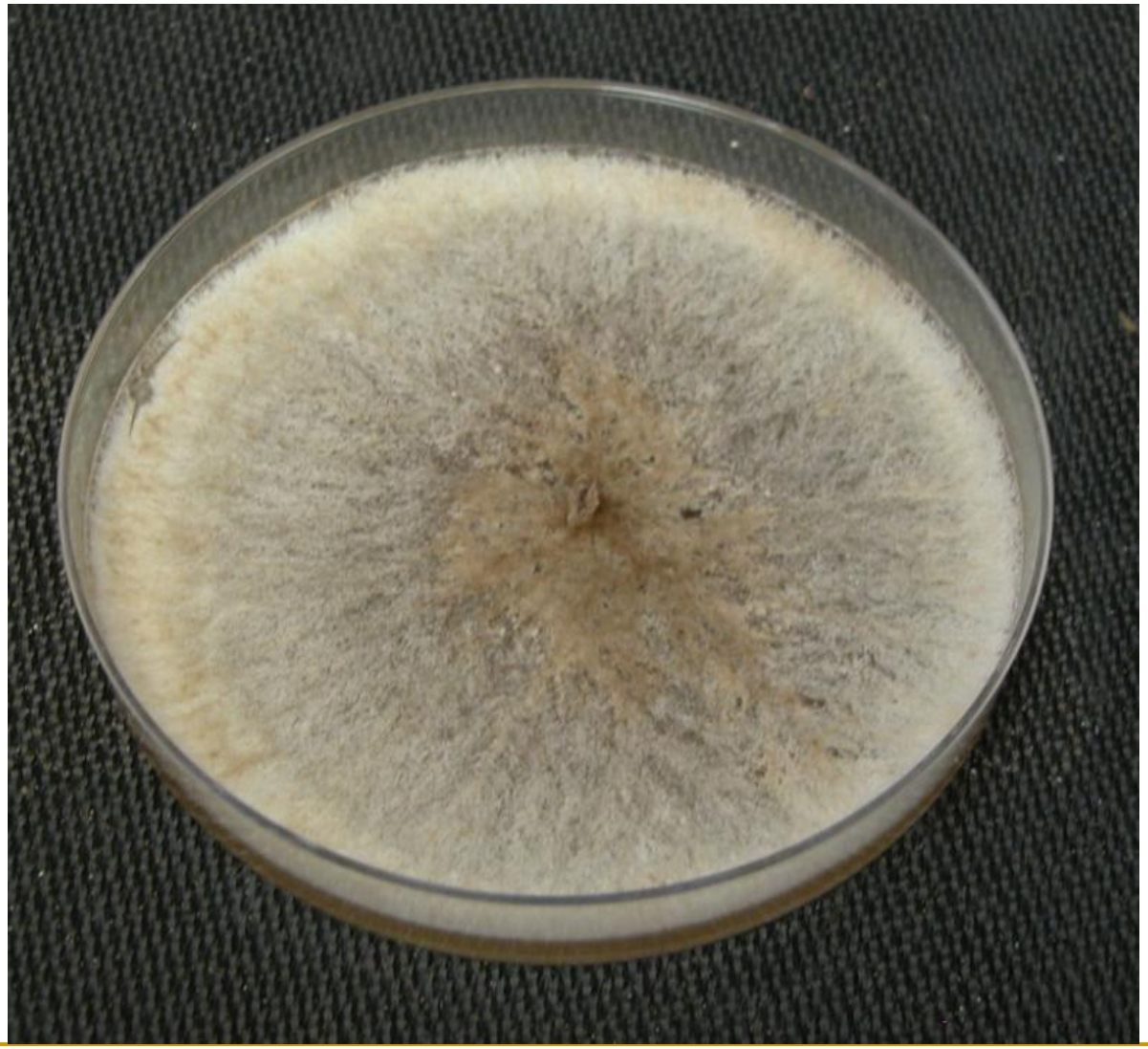
Rhizoctonia solani





- **Morphological characteristics:**
  - **Brown pigmented hyphae in culture (Top)**
  - **Which branch at right angles (Bottom)**
    - **Distinguishes from Pythium**

Rhizoctonia solani



Rhizoctonia solani

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Post emergence damping-off due to *Rhizoctonia solani*

Pythium spp.

- **Environmental conditions: 65 to 70 F with high moisture**
- **Young tissue (seed and radical) are very susceptible to infection**
- **Seedling hypocotyl can also be infected (resembles Rhizoctonia)**
- **Infection is restricted to feeder roots in older plants**

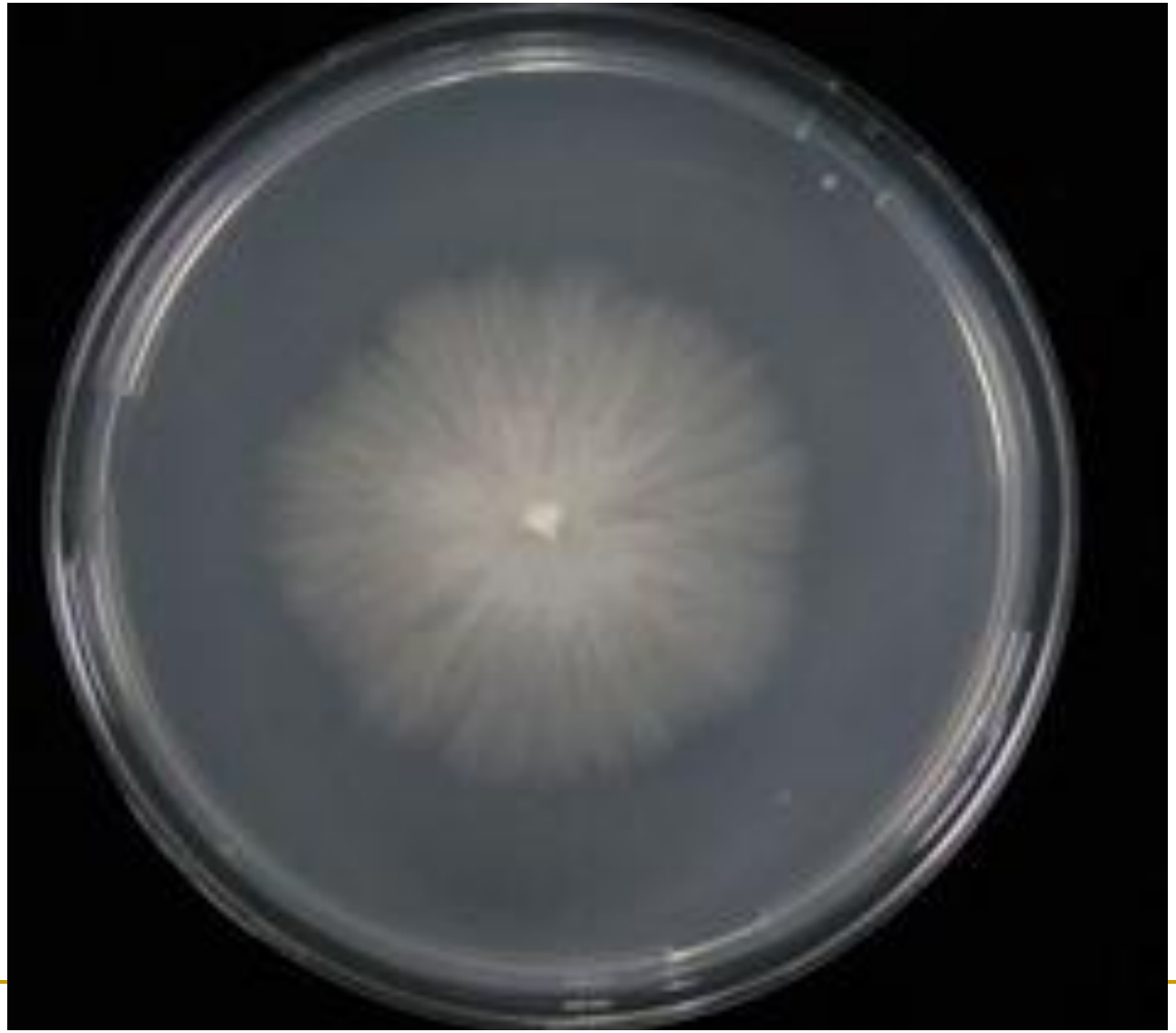
Pythium spp.

- **Symptoms are variable and differ with age:**
  - **Range from pinpoint discolored spots to large sunken necrotic lesions**
  - **If damage is severe, hypocotyls appear girdled with soft, water soaked lesions and necrosis**

***Pythium* or Rhizoctonia**

Photo courtesy Dr. Terry Wheeler, TAES Lubbock

Pythium spp.



Thielaviopsis basicola
(Black Root Rot)

- **Environmental conditions: 60 to 70 F with variable moisture**
- **Attacks roots and lower stems**
- **Seedling hypocotyl can also be infected (resembles Rhizoctonia)**
- **Infection is restricted to feeder root in older plants**

Thielaviopsis basicola

- **Infected plants exhibit stunting (B) and a severe cortical rot (A)**
- **Swelling of the cortex may also be observed**
- **Microscopic evaluations reveal distinct barrel-shaped spores (C)**

Minimizing Seedling Disease Losses

- **Resistant varieties**
  - **Difficult to detect, based on nature of pathogens**
- **Rotation**
  - **Depends on duration and crops in rotation**
- **Seed quality**
  - **First line of defense (healthy seed = healthy plant)**
- **Delayed planting**
  - **Plant in warmer soils**
- **Fungicide seed treatments**
  - **Over-treatments and in-furrow treatments**

Effect of seed treatment on seedling disease (cool wet conditions, inoculated)


"Big shank" of cotton
(poor emergence under hot, dry conditions)
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“Big shank” of cotton
(poor emergence under hot, dry conditions)

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Symptoms of seedling disease (note water-soaked appearance)

Xanthomonas campestris pv. *malvacearum* (Bacterial Blight)

- **Populations of the bacterium in soil serve as initial inoculum**
  - **Seed may also be infested**
  - **Acid delinting lowers populations on seed**
- **Environmental conditions: 25 to 30 C**
- **Susceptible to infection at all developmental stages**
- **Can cause stand losses and loss of vigor at the seedling stage**

Bacterial blight

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Bacterial blight

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Bacterial blight

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Bacterial blight

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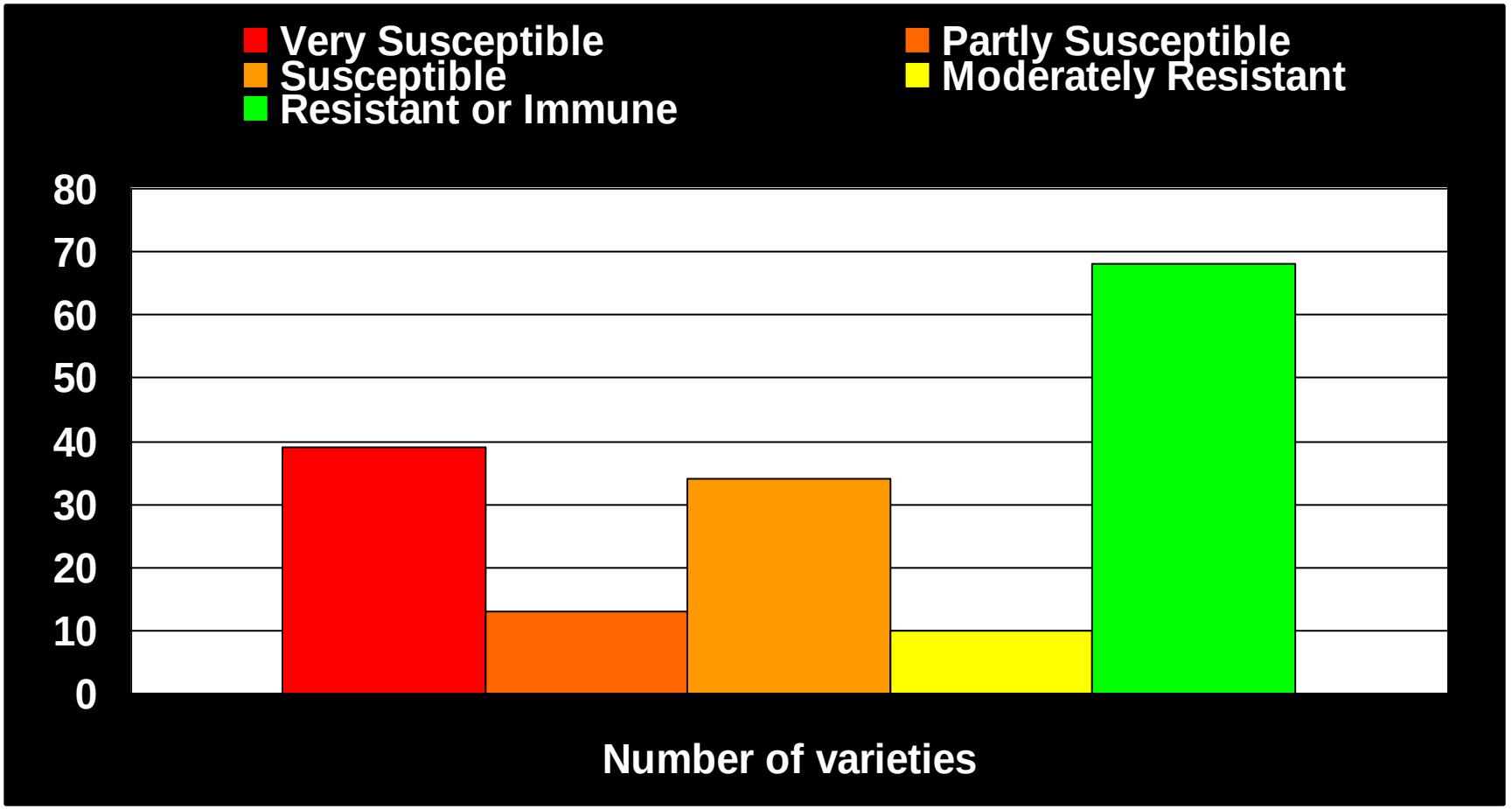
Screening for Bacterial blight resistance

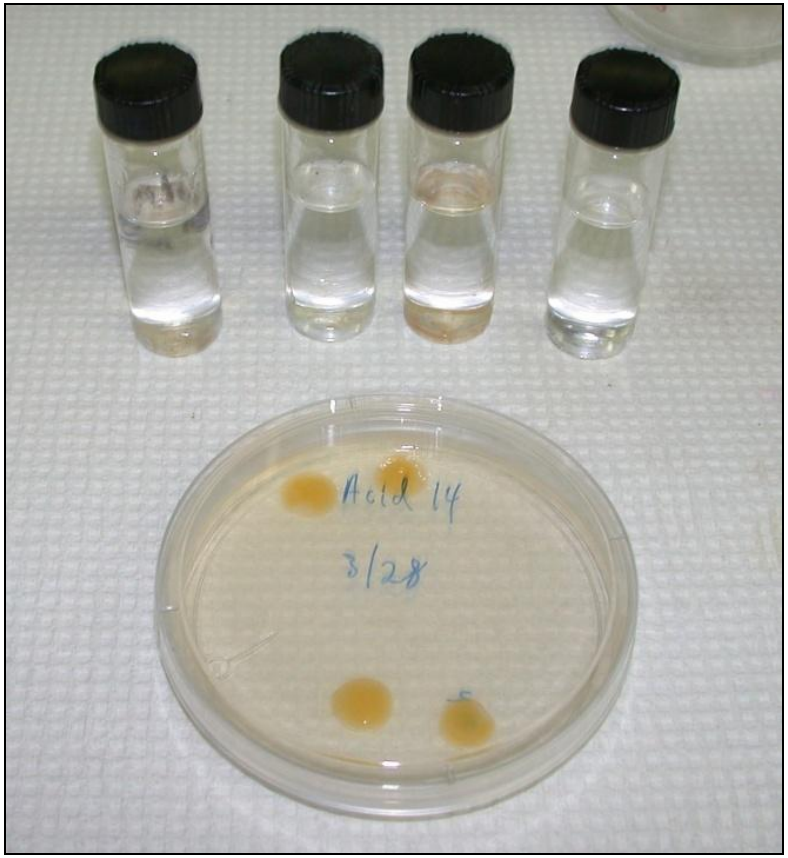
- **Evaluation of commercial varieties and breeding lines**
- **Inoculation with bacterial suspension**
- **Evaluation of plots based on disease reaction**
  - **Susceptible → Resistant → Immune**

Bacterial Blight

Variety Ratings



Bacterial blight
(isolation and pathogenicity)



Crown gall

Crown gall

Isolation of crown gall pathogen

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Verticillium wilt

- Caused by the soilborne fungus *Verticillium dahliae*
- Economically important disease of cotton on southern High Plains
  - Fungus infects plants early in the season
  - Systemic infections lead to the clogging of the vascular system
  - Resulting in foliar symptoms

Verticillium wilt

- **Severe stunting and defoliation can occur**
  - **Significant yield losses**
  - **Reduction in fiber quality**
- ***V. dahliae* is capable of surviving long periods of time microsclerotia**
  - **Relationship exists between soil populations of the fungus and disease incidence**

Foliar symptoms of Verticillium wilt

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Foliar symptoms of Verticillium wilt

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Foliar symptoms
of Verticillium wilt
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Stunting and defoliation due to Verticillium wilt
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Vascular discoloration of plant infected with *Verticillium dahliae*
note speckled appearance
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Ariel image of large plot field trial illustrating differences in defoliation levels among varieties evaluated

Photo credit: Manda Catteneo, Texas AgriLife Extension Service, Seminole, TX

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Management of Verticillium Wilt

- **There are no corrective materials that can be applied to symptomatic plants**
  - **Management decisions prior to planting**
  - **Plant varieties with resistance or tolerance**
  - **DO NOT OVERWATER, use raised beds to improve drainage**
  - **Maintain adequate fertility levels**
  - **Verticillium microsclerotia survive in soil for many years in the absence of a host**

Fusarium Wilt

(*Fusarium oxysporum f.sp. vasinfectum*)

- **Found primarily in Dawson, Terry, and Gaines counties**
- **Confused with Verticillium or wind damage**
- **Hypocotyl lesions resemble Rhizoctonia**
- **Disease severity = inoculum density**
  - **Interaction with root-knot nematode (~10X increase)**

Photo: Dr. Randy Boman, TCE, Lubbock

Fusarium Wilt

(Symptoms)

- Starts at seedling phase 30-40 DAP and continues through season (B)
- Chlorosis/necrosis on leaf margin (A)
- Wilt results from loss of turgor pressure
- Defoliation starts at bottom
- Discoloration of vascular tissue (C)

Photo: Dr. Terry Wheeler, TAES Lubbock

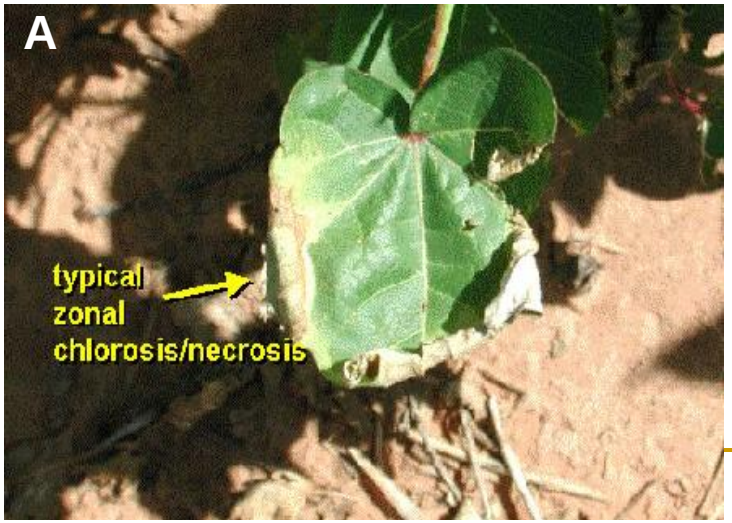

Photo: Dr. Randy Boman, TCE Lubbock

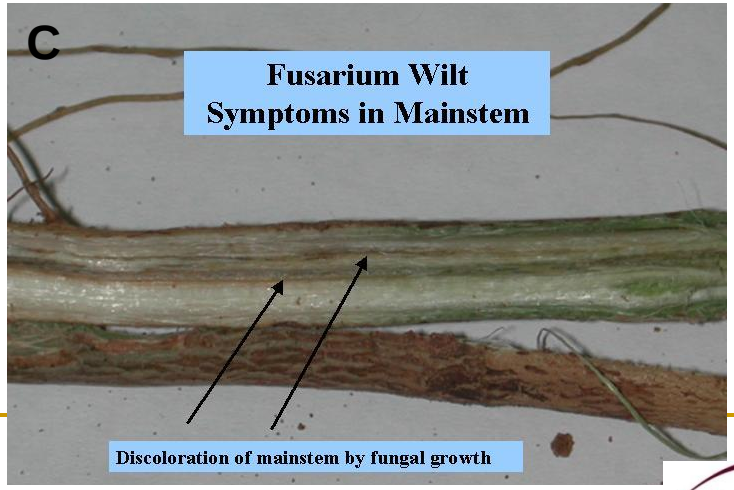

Photo: Dr. Randy Boman, TCE Lubbock

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Initial foliar symptoms of Fusarium wilt

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Initial foliar symptoms of Fusarium wilt

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Advanced foliar symptoms of Fusarium wilt

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Marginal necrosis associated with Fusarium wilt

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Cross section of stems exhibiting discoloration of vascular tissue

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Vascular discoloration of plant infected with
Fusarium oxysporum f. sp. *vasinfectum*
note continuous appearance
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Mortality of cotton plants caused by Fusarium wilt

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Poor stands as a result of Fusarium wilt

note wide spread occurrence

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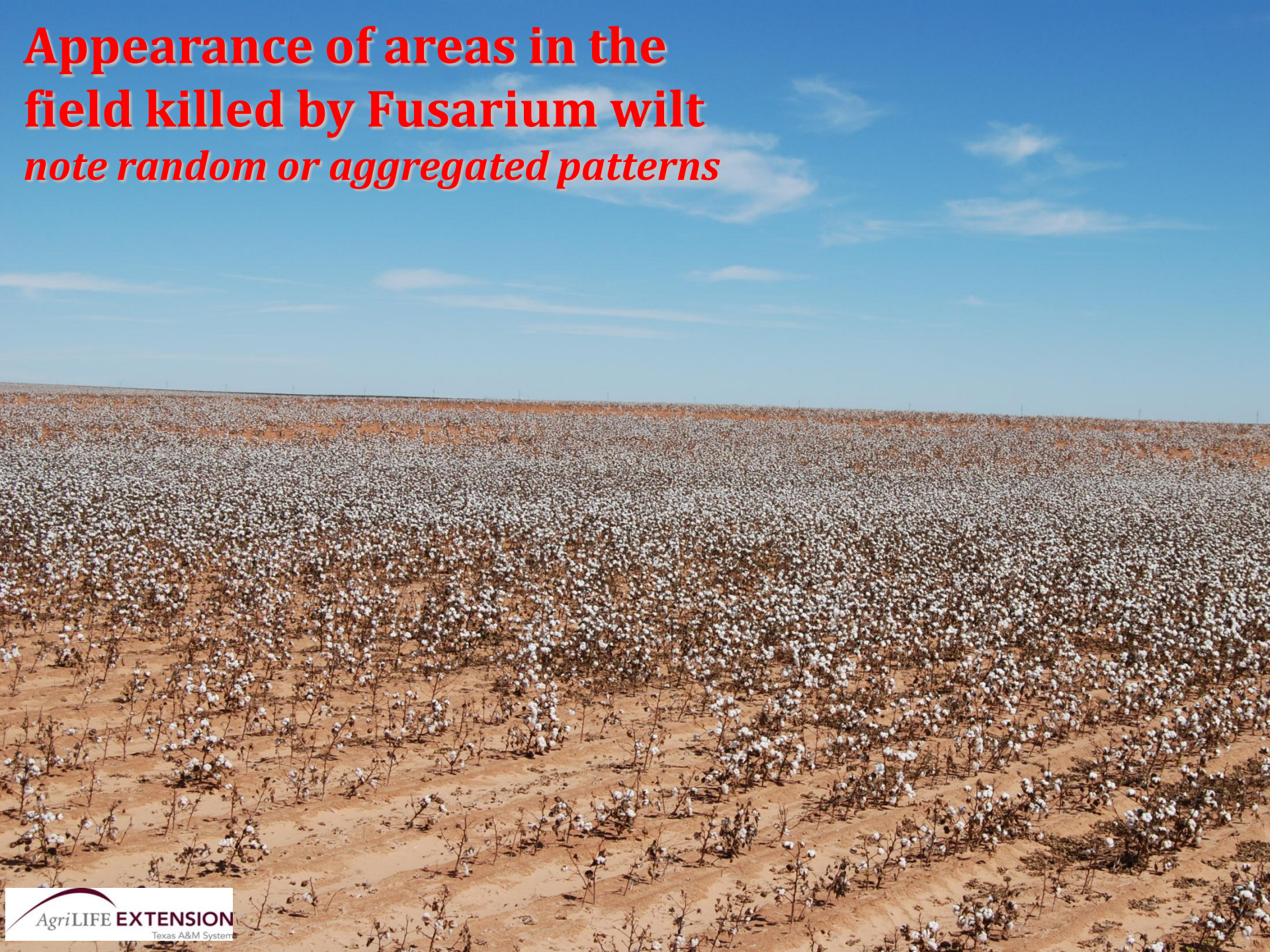
Appearance of areas in the field killed by Fusarium wilt

note random or aggregated patterns



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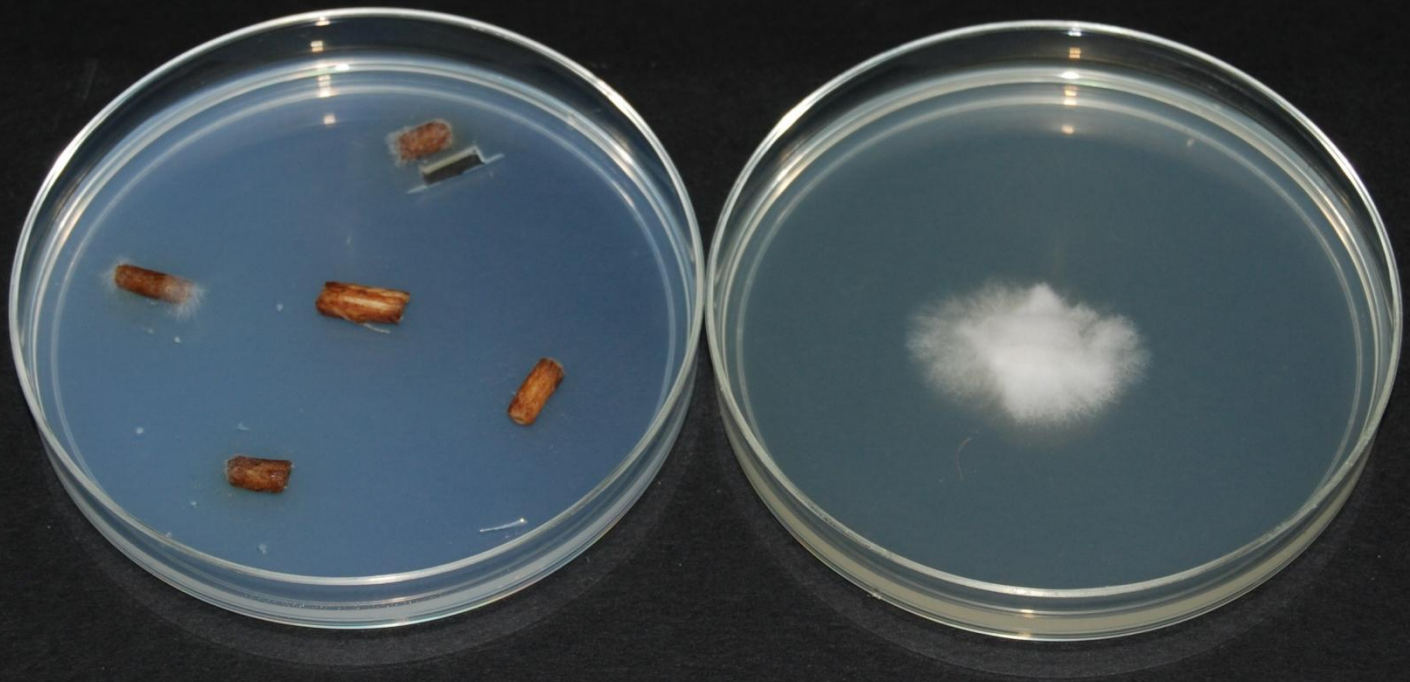
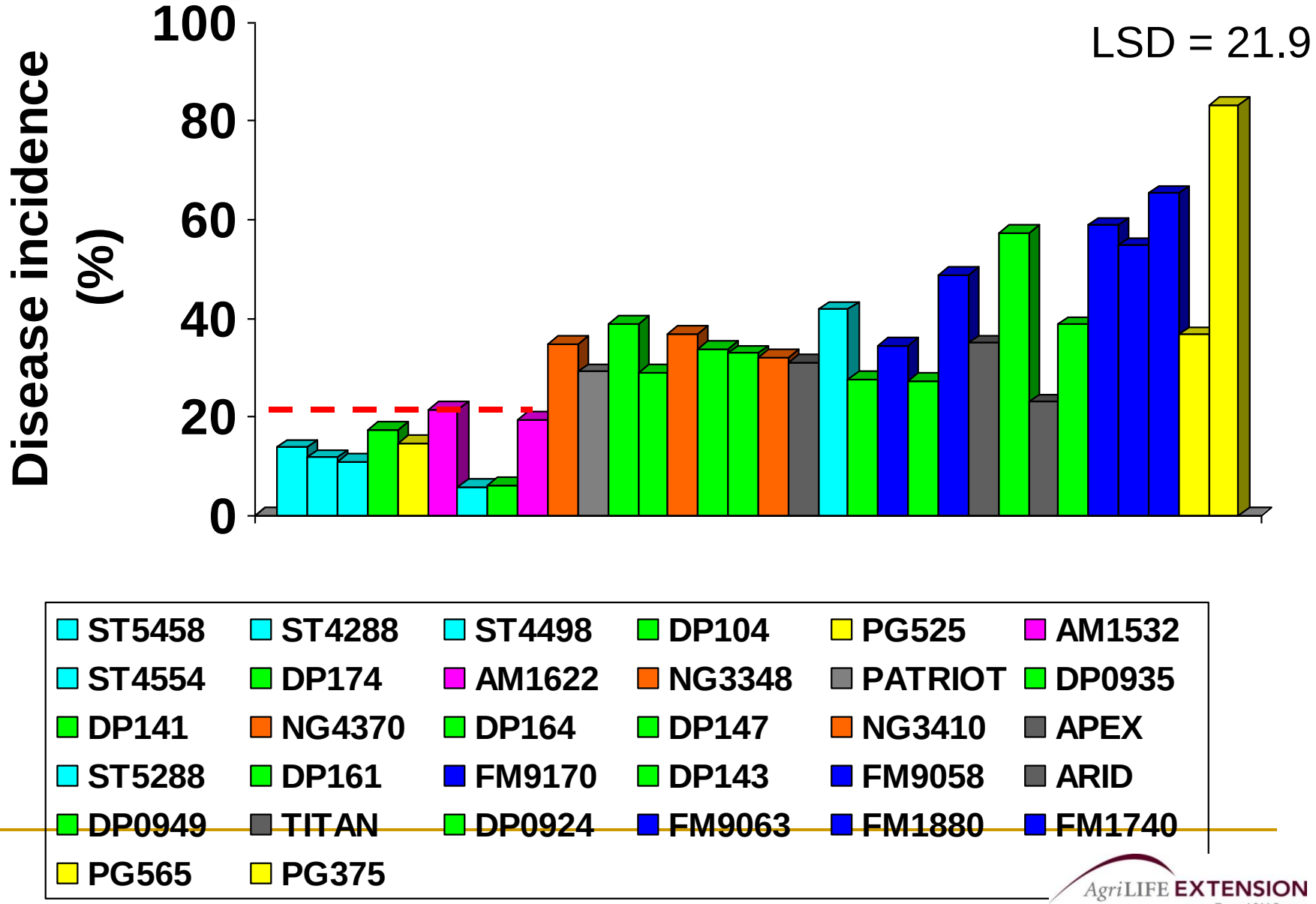
Culture characteristics of the Fusarium wilt pathogen isolated from cotton stems



Management of Fusarium Wilt

- **Plant a less susceptible variety**
  - **Increase in Fusarium wilt has resulted from previous use of susceptible varieties**
- **Rotate with non-nematode host**
- **Use available nematicide to reduce damage caused by root-knot nematodes**
- **Minimize wounding of roots by excessive tillage operations (i.e. minimum tillage)**

Variety performance (disease incidence)



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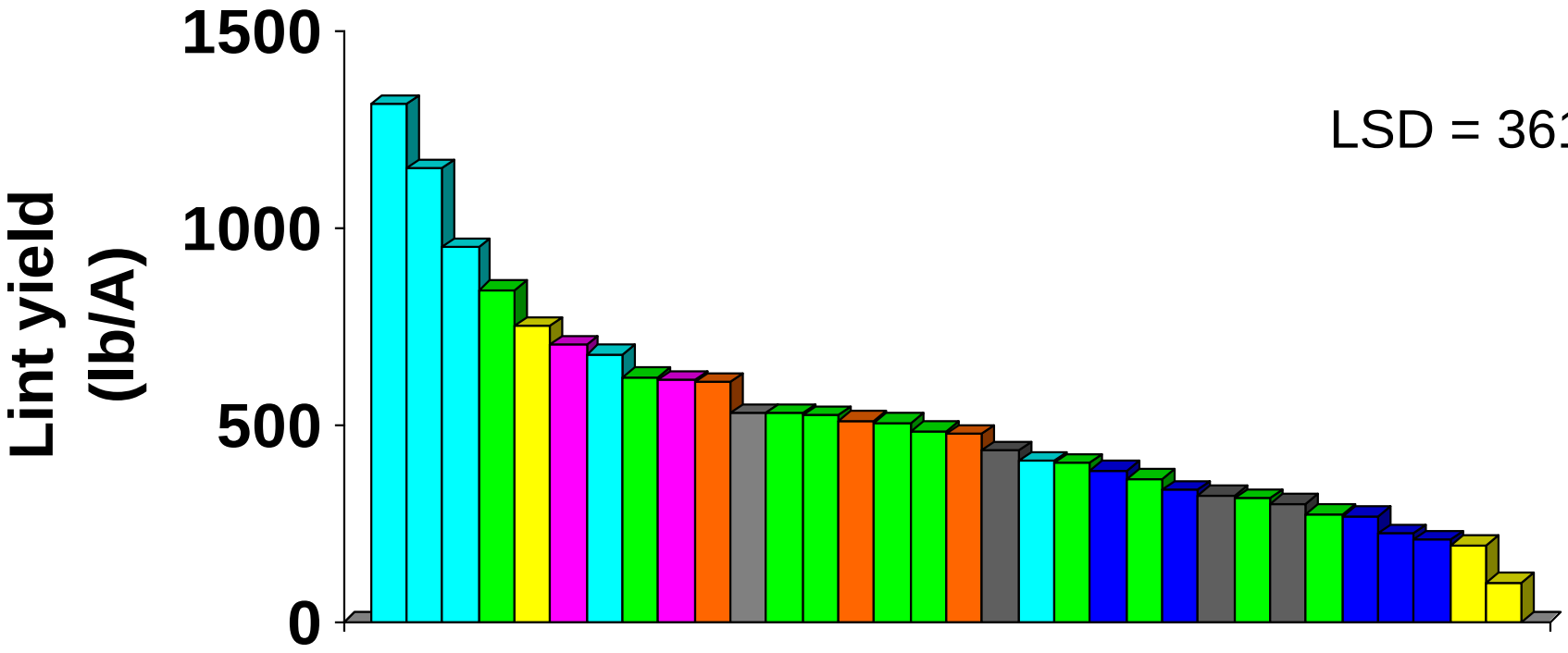
Variety performance (yield)



ST5458 ST4288 ST4498 DP104 PG525 AM1532
ST4554 DP174 AM1622 NG3348 PATRIOT DP0935
DP141 NG4370 DP164 DP147 NG3410 APEX
ST5288 DP161 FM9170 DP143 FM9058 ARID
DP0949 TITAN DP0924 FM9063 FM1880 FM1740
PG565 PG375

Nematodes

- **Two important species:**
  - **Left- Root knot (*Meloidogyne incognita*)**
  - **Right- Reniform (*Rotylenchulus reniformis*)**

Photo credit: California Dept. of Food & Agriculture, Plant Pest Diagnostics Center - Nematology Laboratory, Sacramento, CA.

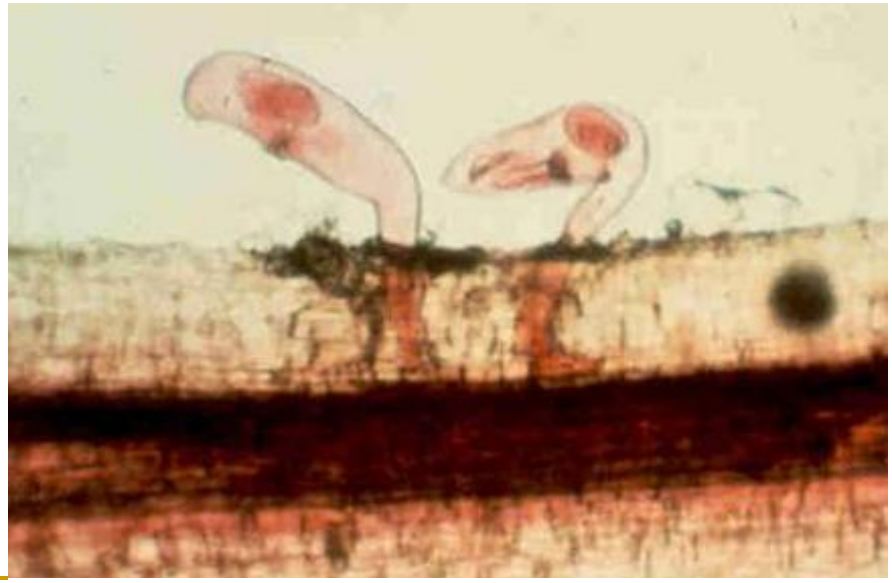


Photo courtesy of Dr. Jim Starr, Nematologist Texas A&M University, College Station

Root knot nematode

- **Symptoms:**
  - **Stunted plants (Top) with chlorotic leaves and fewer bolls**
  - **Resembles nutrient or water deficiency**
- **Sedentary endoparasite**
  - **Females modify cells to establish feeding sites (Bottom)**
  - **Formation of galls for egg production (500+ eggs/female)**
  - **Soil may adhere to egg mass**
  - **Life-cycle: egg to egg 30 days**

Photo courtesy of Dr. Jim Starr, Nematologist Texas A&M University, College Station

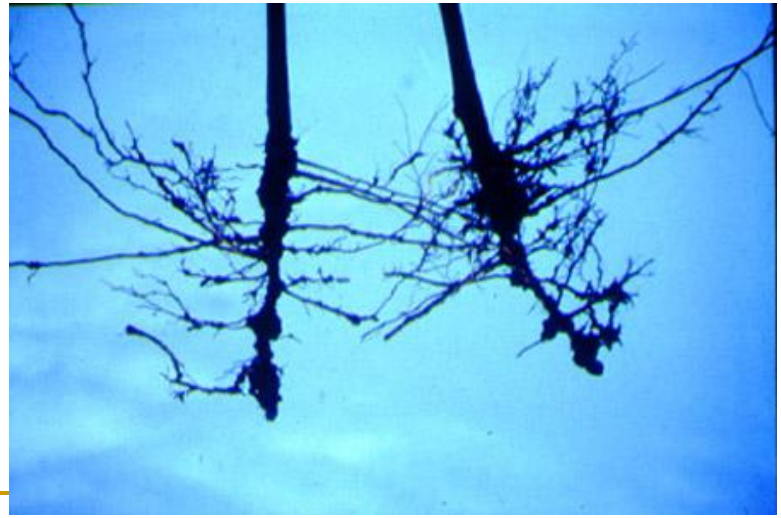
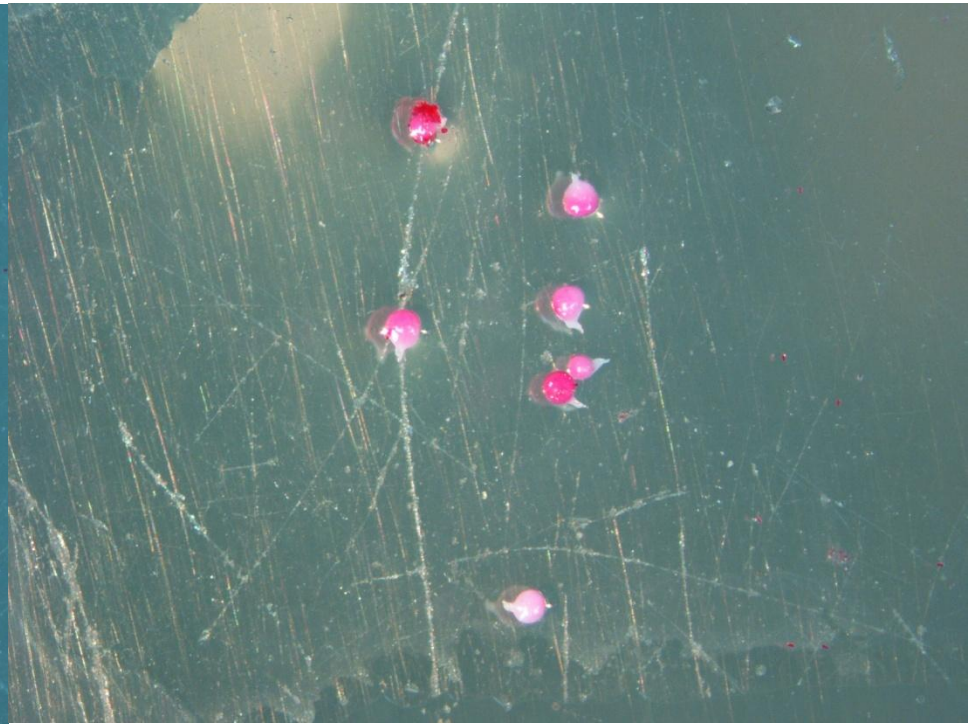


Photo: Dr. Terry Wheeler, TAES Lubbock

Severe galling on roots caused by Root-knot nematodes

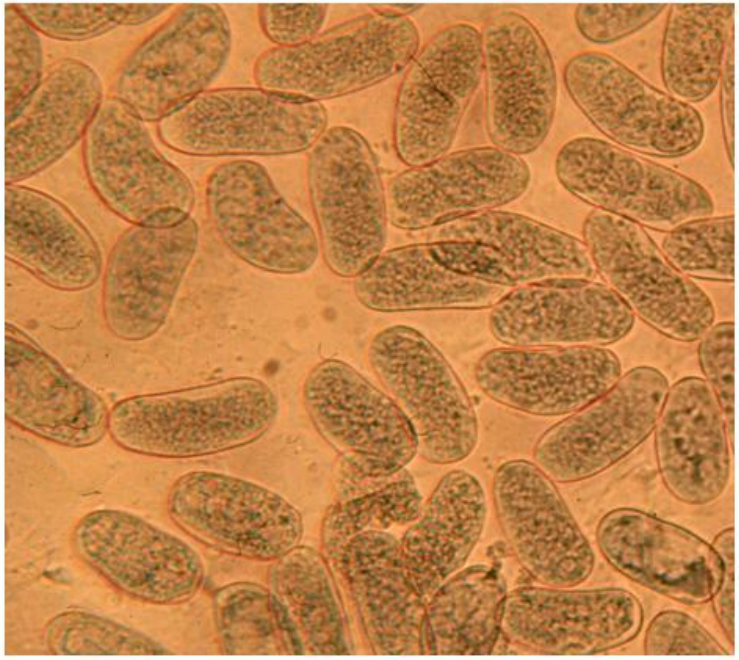
Severe (right) and light (left) calling of roots infected with Root-knot nematodes

Magnification of stained female root-knot nematodes in the root (left) and excised (right)



High power magnification of root-knot nematode eggs and 2nd stage juveniles

Eggs



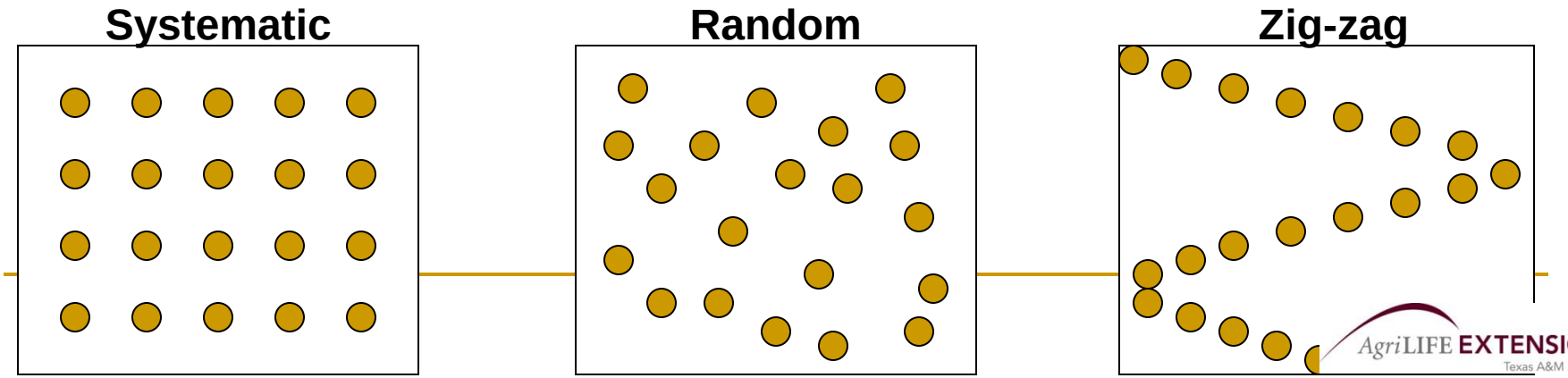
Second-stage juveniles

Reniform nematode

- **Symptoms (similar to root knot):**
  - **Plants are stunted, chlorotic and may wilt**
  - **Reduced root growth**
- **Sedentary semi-endoparasite**
  - **Females invade roots (head)**
  - **Body protrudes from root becoming swollen (kidney-shaped)**
  - **Life-cycle: egg to egg in 20-30 days**

Nematode Sampling

- **Three composite soil samples per field**
  - **Twenty core samples per composite sample (~10 acres)**
  - **Patterns (systematic, random, zig-zag)**
  - **Each core from 12 inch depth**
- **One sample for each 1/3 of field**
  - **More if dealing with different soil types**
- **Start in September- Cost $12.50**



Nematode Sampling

- **For in-season sampling:**
  - **Sampling in the middle of the season gives most representative picture**
  - **Collect individual root or soil samples**
  - **Selective sampling (diseased plants) is most appropriate**
  - **Populations are highest near the root system**
  - **Sampling of healthy plants around the area may be useful for comparisons**

Nematode Management

- **Temik 15G has had consistent results**
  - **Commercial standard for years; higher yields and lower gall ratings**
  - **NO LONGER COMMERCIALLY AVAILABLE**
- **Avicta Complete Pak more variable performance**
  - **Valid option in fields with low to moderate pressure**
- **Aeris Seed Applied System**
  - **Comparable to Avicta Complete Pak**
- **Seed treatments are convenient**
  - **Increased level of consumer risk may be associated**
  - **Sacrifice little yield for convenience**
- **Emphasis on resistant varieties (root-knot)**
  - **DP 174RF, ST 5458B2F, ST 4288 B2F, PG 367WRF, etc.**
- **Efforts at introducing resistance genes for reniform**
  - **Breeding effort underway, currently no commercially available varieties**

Nematode Management

- **In high risk situations:**
  - **Vydate at pinhead square and again 14 days later**
    - **Only material that can be applied over the top**
  - **Fumigation with Telone II or Vapam**
    - **Costly (increased interest with loss of Temik)**
  - **Rotate with non-host**
    - **Peanut, sorghum, etc.**
    - **Yield reductions may not be evident with corn; however, does support nematode reproduction**
  - **Cover crop selection <u>may</u> impact nematode populations**

Performance of susceptible (left) and partially resistant cotton varieties

Performance of susceptible (left) and partially resistant cotton varieties

Photo credit: Manda Anderson, Gaines Co. IPM-EA

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Performance of susceptible (left) and partially resistant cotton varieties

Photo credit: Manda Anderson, Gaines Co. IPM-EA

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Root-knot nematode galling on a susceptible (left) and a partially resistant cotton variety

Photo credit: Manda Anderson, Gaines Co. IPM-EA

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Appearance of field exhibiting symptoms of charcoal rot (under extremely hot, dry conditions)

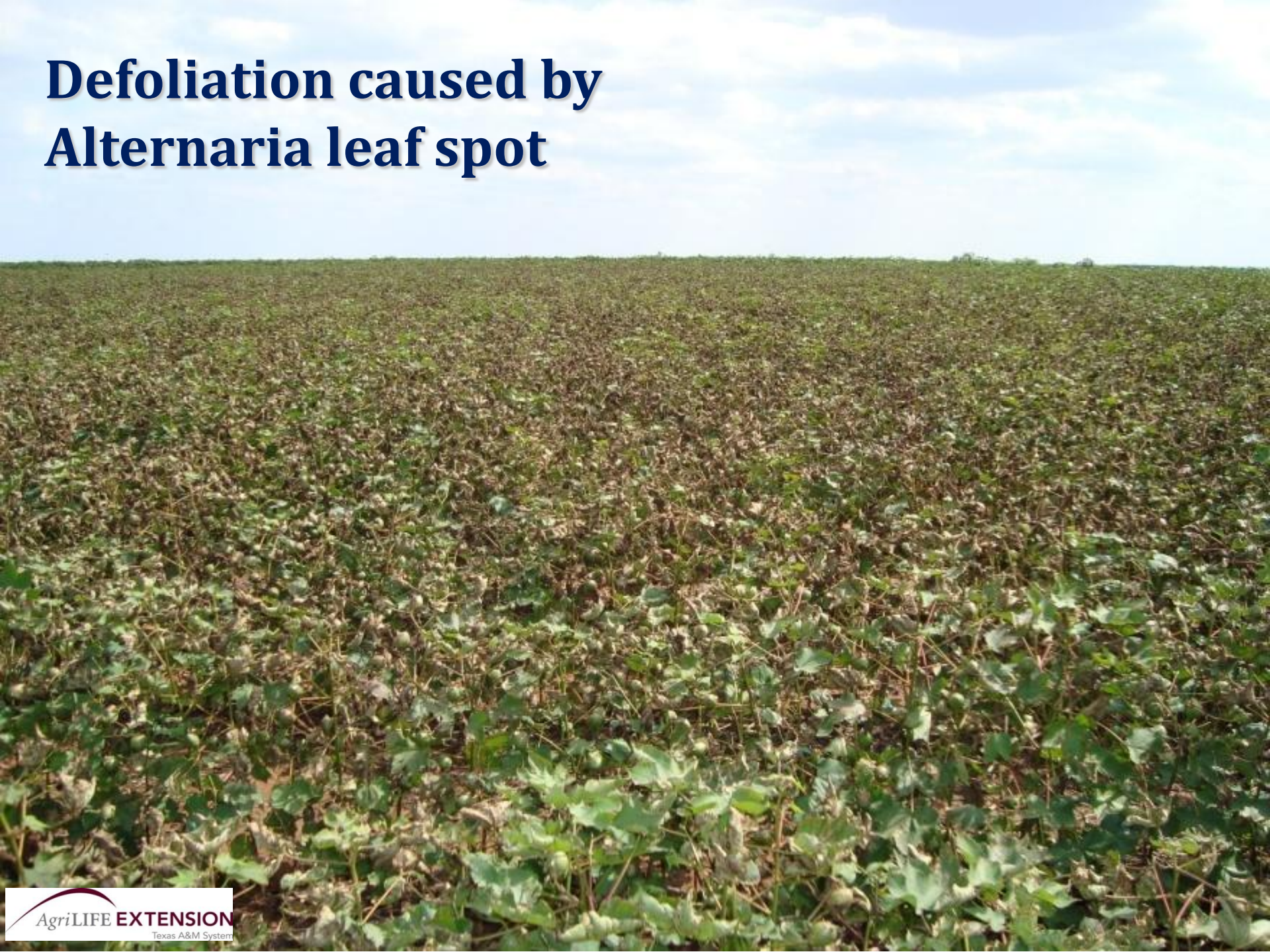
Symptoms of charcoal rot
(under extremely hot, dry conditions)

Symptoms of charcoal rot on roots (under extremely hot, dry conditions)

Symptoms of charcoal rot on roots (under extremely hot, dry conditions)

Alternaria leaf spot

Defoliation caused by Alternaria leaf spot



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Defoliation caused by
Alternaria leaf spot
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Defoliation caused by Alternaria leaf spot
(note level of open cotton bolls)

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Symptoms of Alternaria stem blight
(note purple coloration and circular pattern)

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Initial symptom of Alternaria stem blight
(note lesion developing on the leaf margin)
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Sheppard's crook symptom associated with Alternaria stem blight
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Sporulation of fungus causing
Alternaria stem blight
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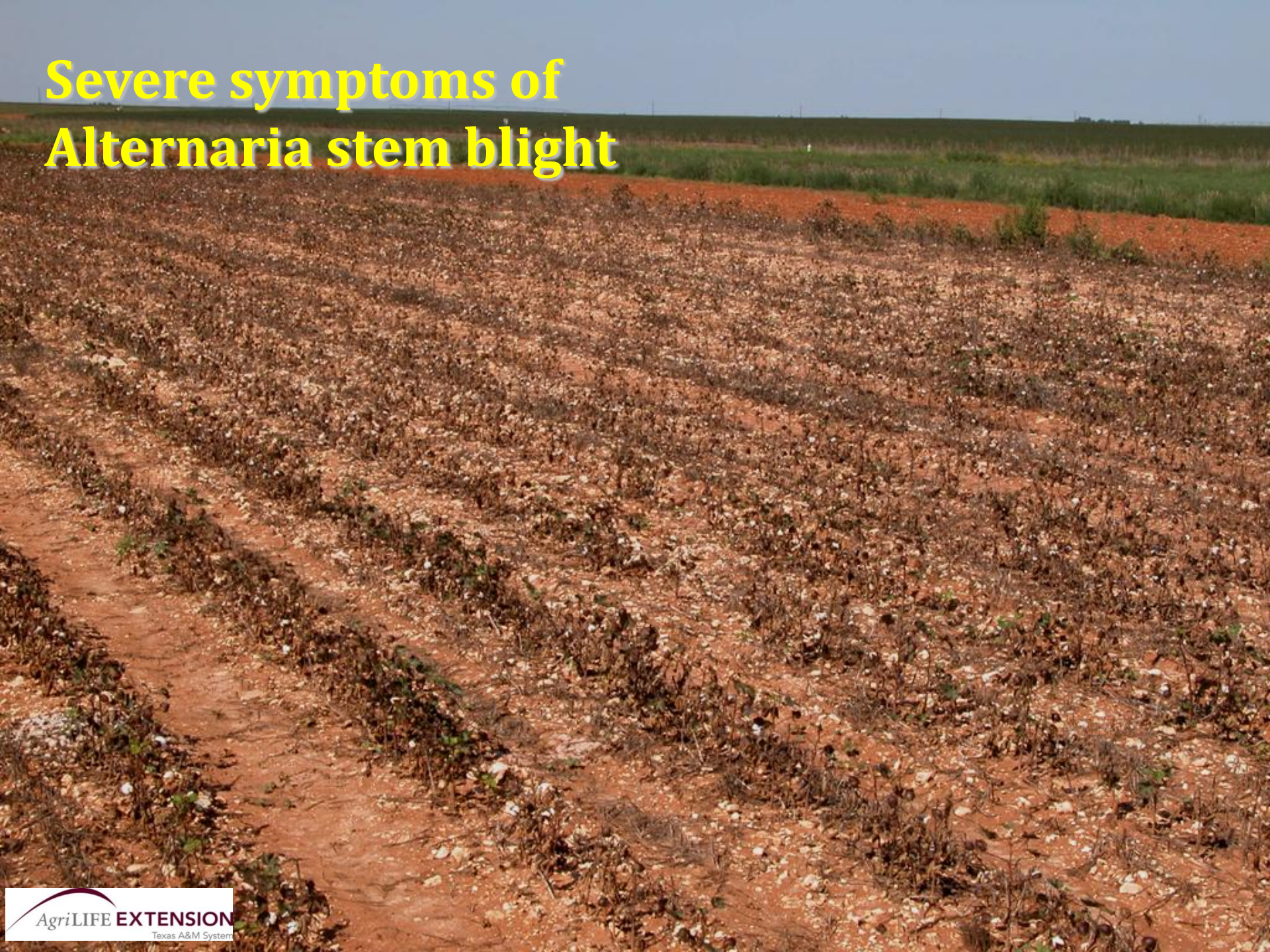
Severe symptoms of
Alternaria stem blight
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Comparison Alternaria leaf spot (left) and stem blight (right) on cotton leaves

Symptoms of southwestern rust on the upper leaf surface

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Pustules of southwestern rust on the lower leaf surface (minor)

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Pustules of southwestern rust on the lower leaf surface (severe)

Photo credit: Kenny Melton, Bayer CropScience

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Damage to seedling cotton caused by hail

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