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# Identification and management of cotton diseases

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# Outline

- **Seedling diseases**
- **Bacterial wilt**
- **Verticillium wilt**
- **Fusarium wilt**
- **Root knot and reniform nematode**
- **Alternaria stem blight**

# 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*

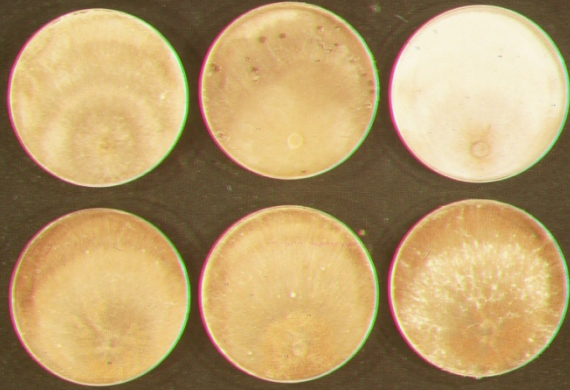


Photo courtesy of Dr. Craig Rothrock  
University of Arkansas Plant Pathologist

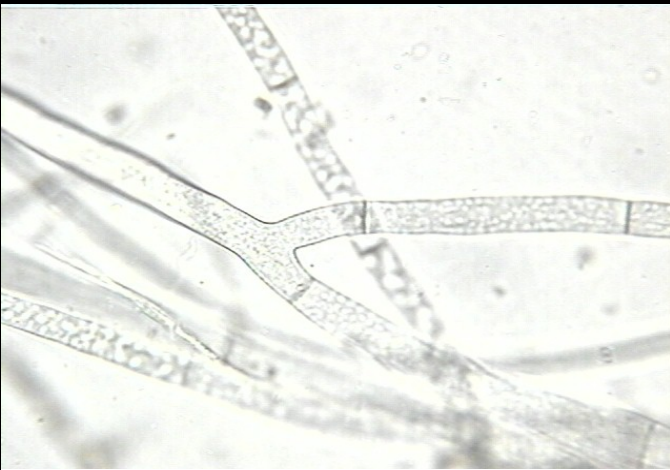


Photo courtesy of Mr. Jason Brock  
University of Georgia Diagnostician

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

# *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





# *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**

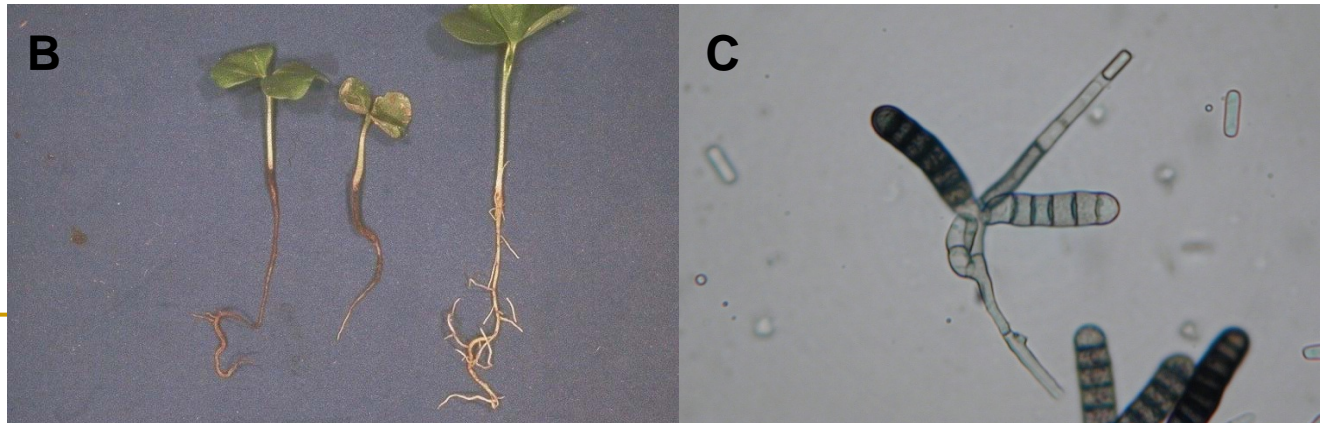
# *Thielaviopsis basicola*



A

- 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)

Photos courtesy of Dr. Craig Rothrock University of Arkansas, Fayetteville



B

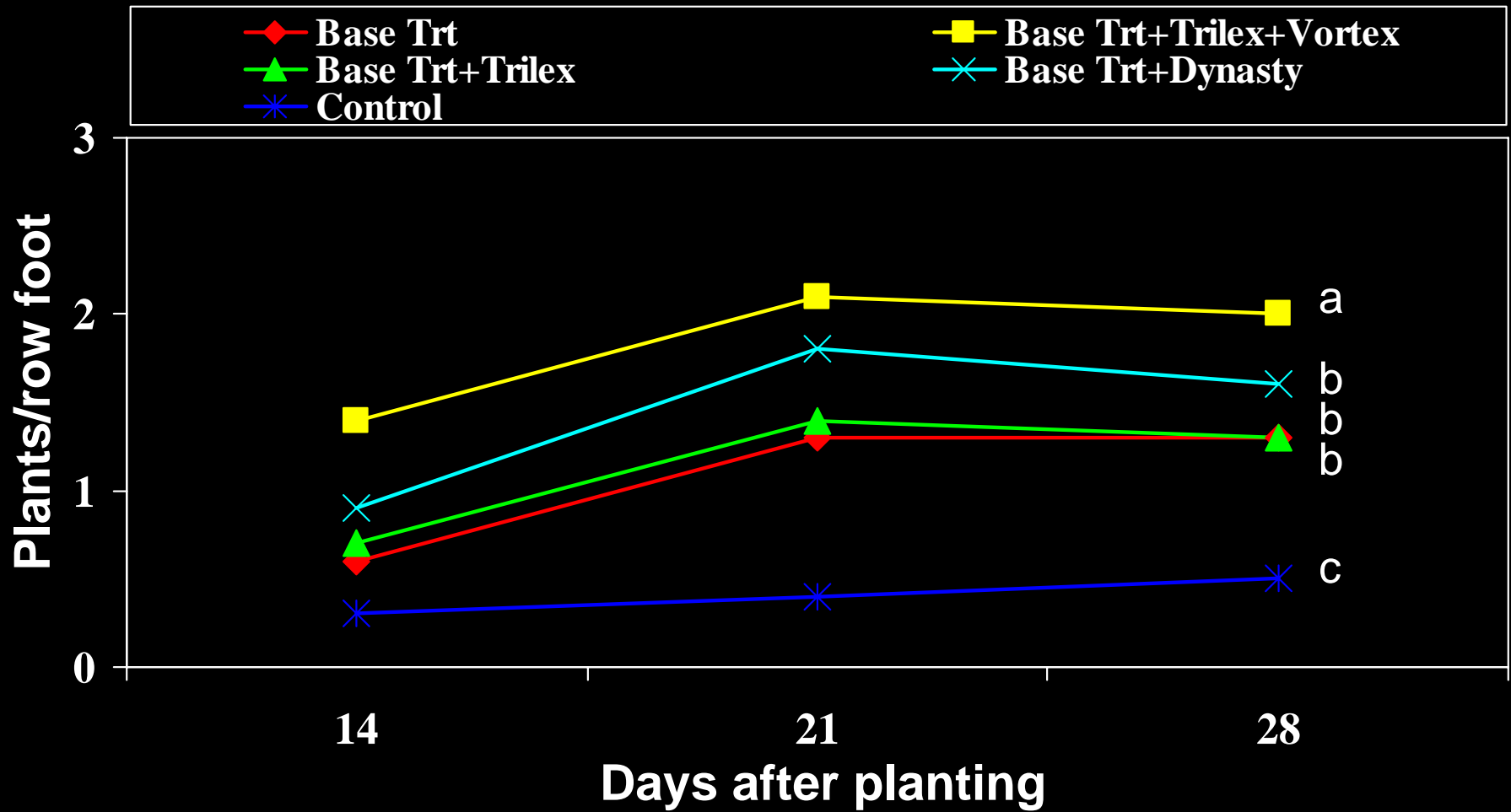
C

Photo: Dr. Terry Wheeler, TAES Lubbock

# Minimizing Seedling Disease Losses

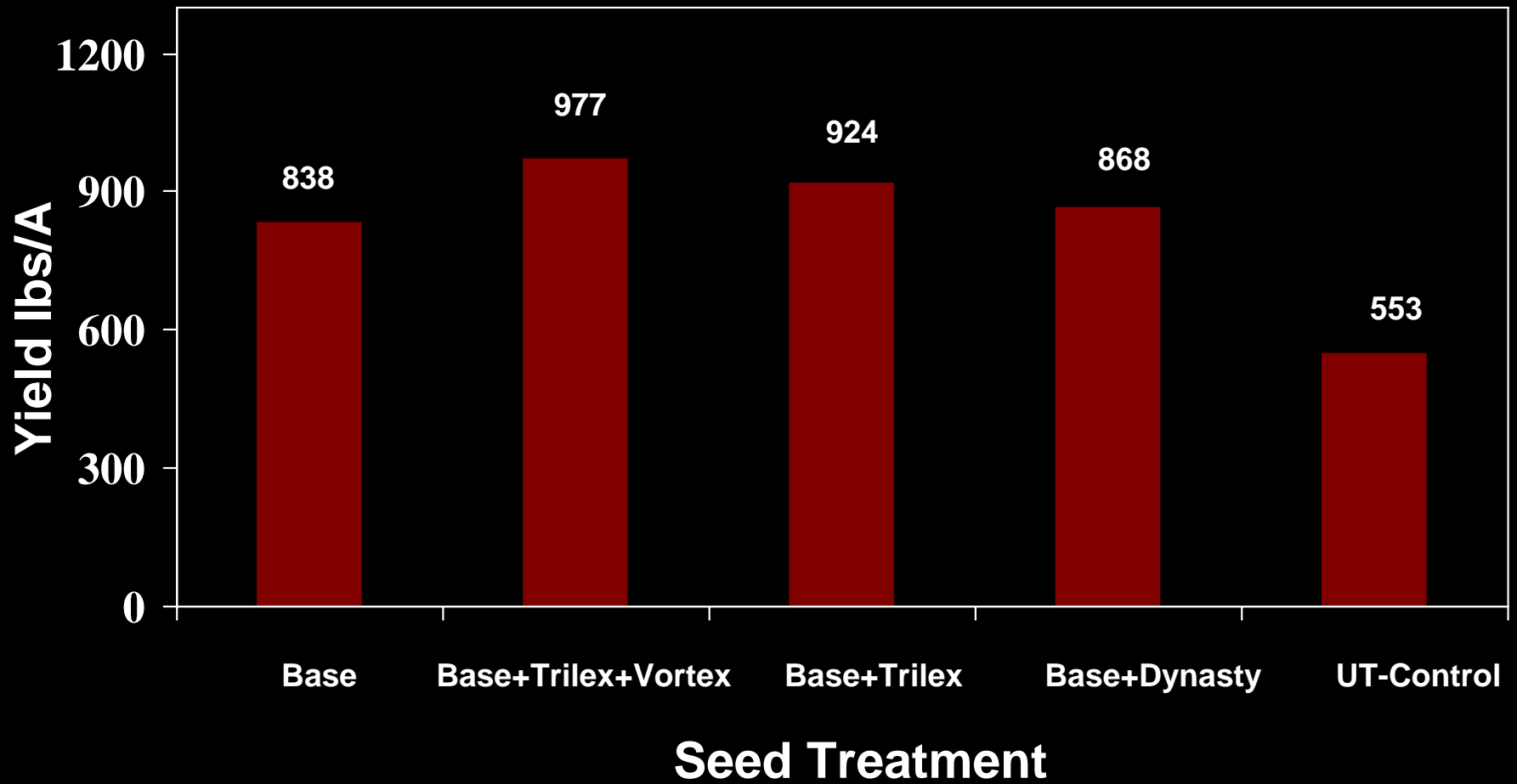
- **Resistant varieties**
  - Difficult to detect, based on nature of pathogens
- **Rotation**
  - Depends on duration and crops in rotation
- **Seed quality**
  - First line of defense (healthy seed = healthy plant)
- **Delayed planting**
  - Plant in warmer soils
- **Fungicide seed treatments**
  -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

# 2006 stand count data (Infested)



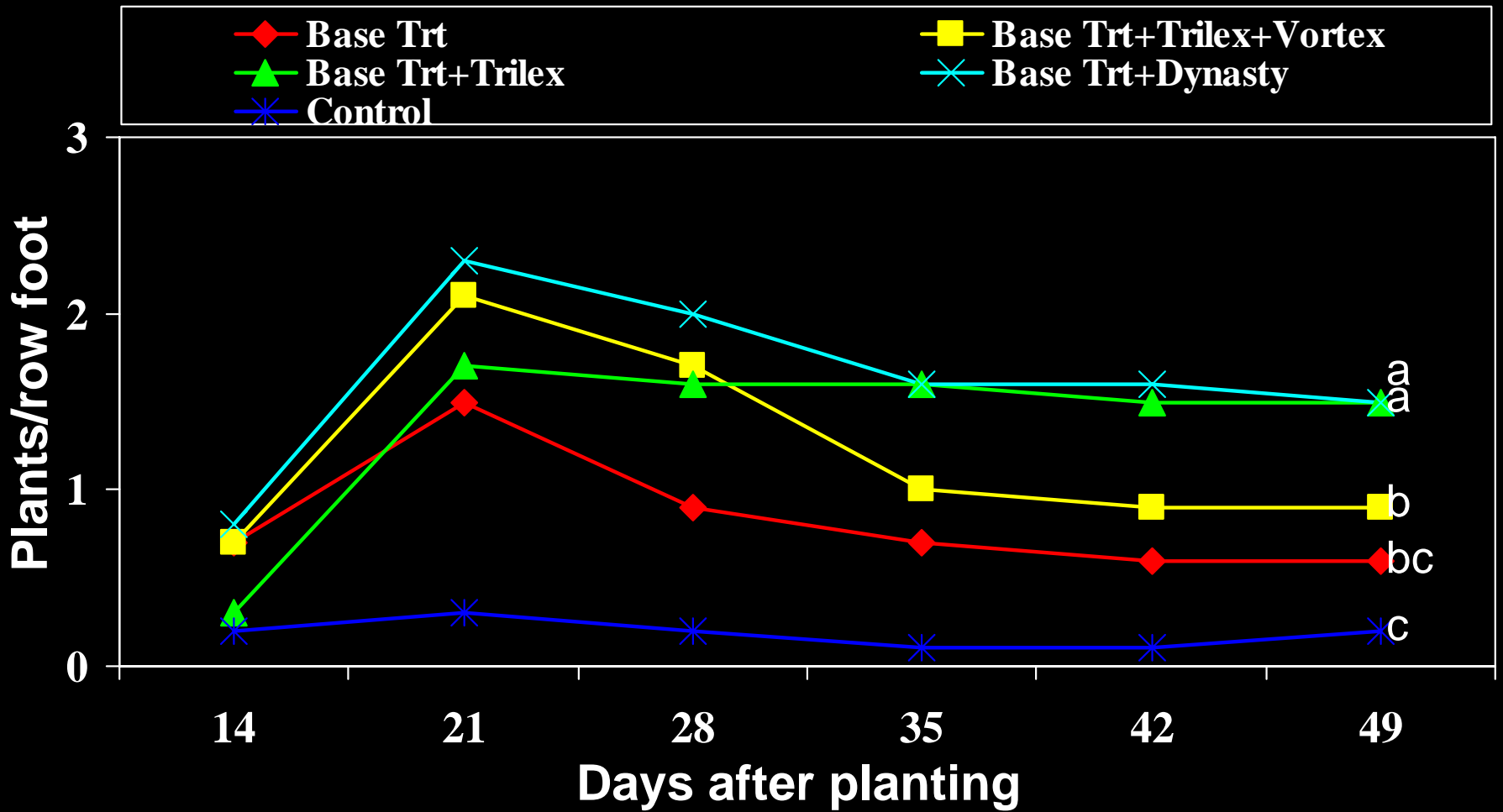
\* Soil artificially infested with *Rhizoctonia solani*

## 2006 yield data (Infested)



\* Soil artificially infested with *Rhizoctonia solani*

# 2007 stand count data (Infested)



\* Soil artificially infested with *Rhizoctonia solani*

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*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

## (Symptoms)

- Symptoms include small dark green 'water-soaked' spots
  - First visible on the underside of leaves
  - Later become present on the upper leaf surface
  - Lesions have an angular appearance and are delimited by the veins



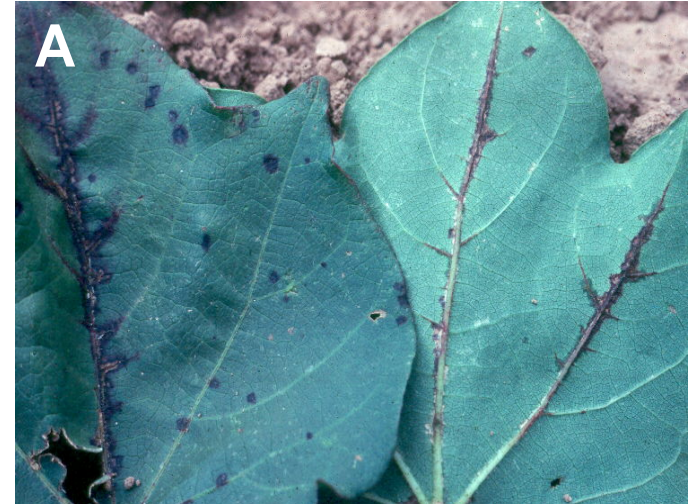
Photos courtesy of Dr. Harold Kaufman  
Retired TCE Extension Plant Pathologist



# Bacterial Blight

## (Symptoms)

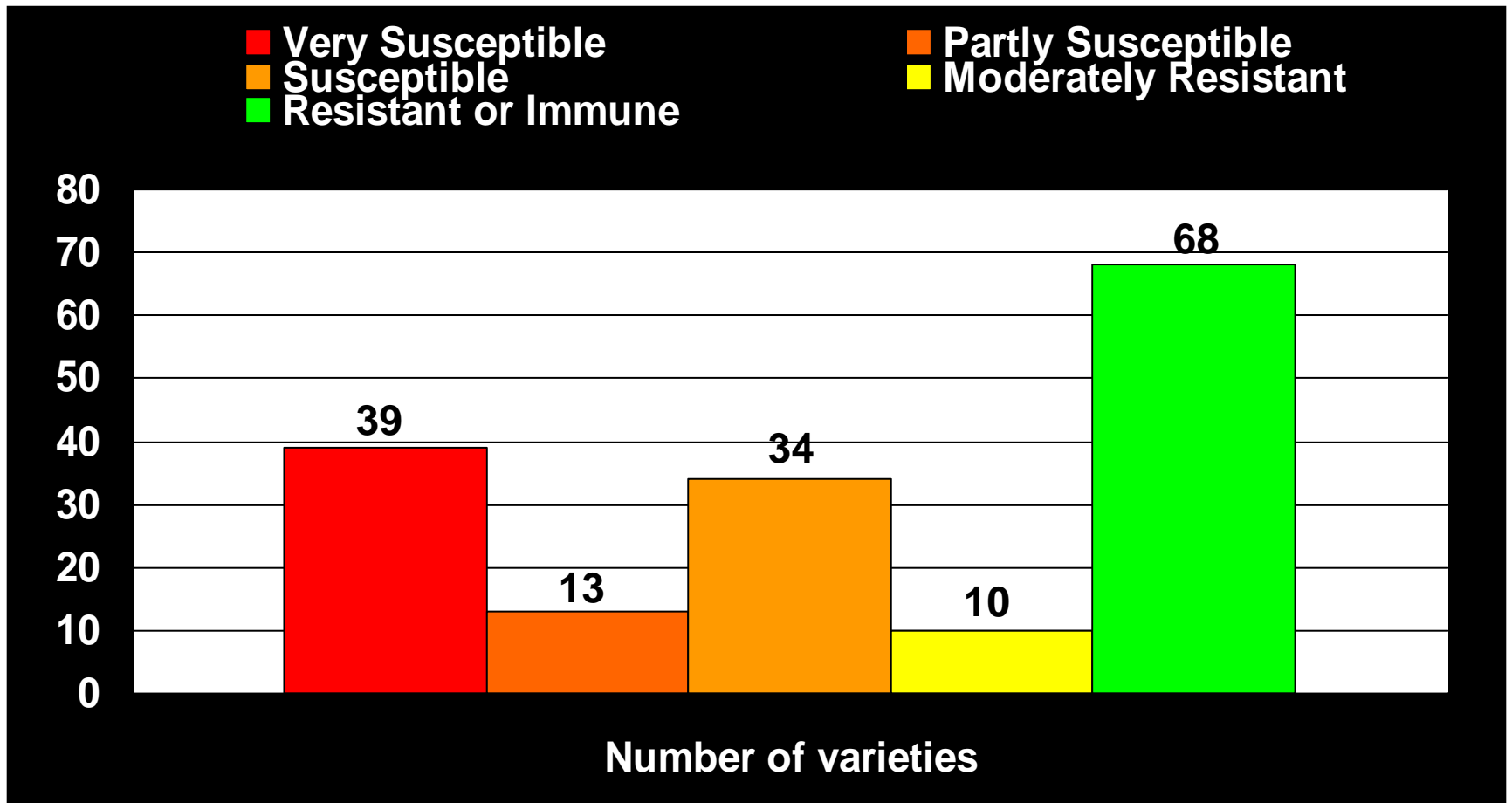
- A second leaf symptom consists of lesions that extend along the main vein (A)
- Individual lesions coalesce and become necrotic
  - Resulting in the leaf drop (B)
- Similar lesions may also occur on bolls (C)



Photos courtesy of Dr. Harold Kaufman  
Retired TCE Extension Plant Pathologist

# Bacterial Blight

Variety Performance 2000-2006 (164 total)



# Verticillium Wilt

(*Verticillium dahliae*)

- **Devastating disease found throughout the High Plains**
  - **Reduced fiber quality and decreased micronaire, fiber length, strength, uniformity and grade**
  - **Propagules long lived in soil**
- **Infections and symptoms 'typically' occur when temperatures are 95°F or less**
- **Symptoms vary depending on variety, fungal isolate, developmental stage, and environmental conditions**



Photo: Dr. Terry Wheeler, TAES Lubbock

# Verticillium Wilt

- **Leaf symptoms are most common**
  - Occur from the beginning of flowering and last through the growing season
  - Early: chlorosis between veins (Top)
  - Late: necrosis and/or defoliation
- **Longitudinal cuts exhibit vascular discoloration (Bottom)**
  - Can be confused with Fusarium, disease identification should be confirmed through isolation

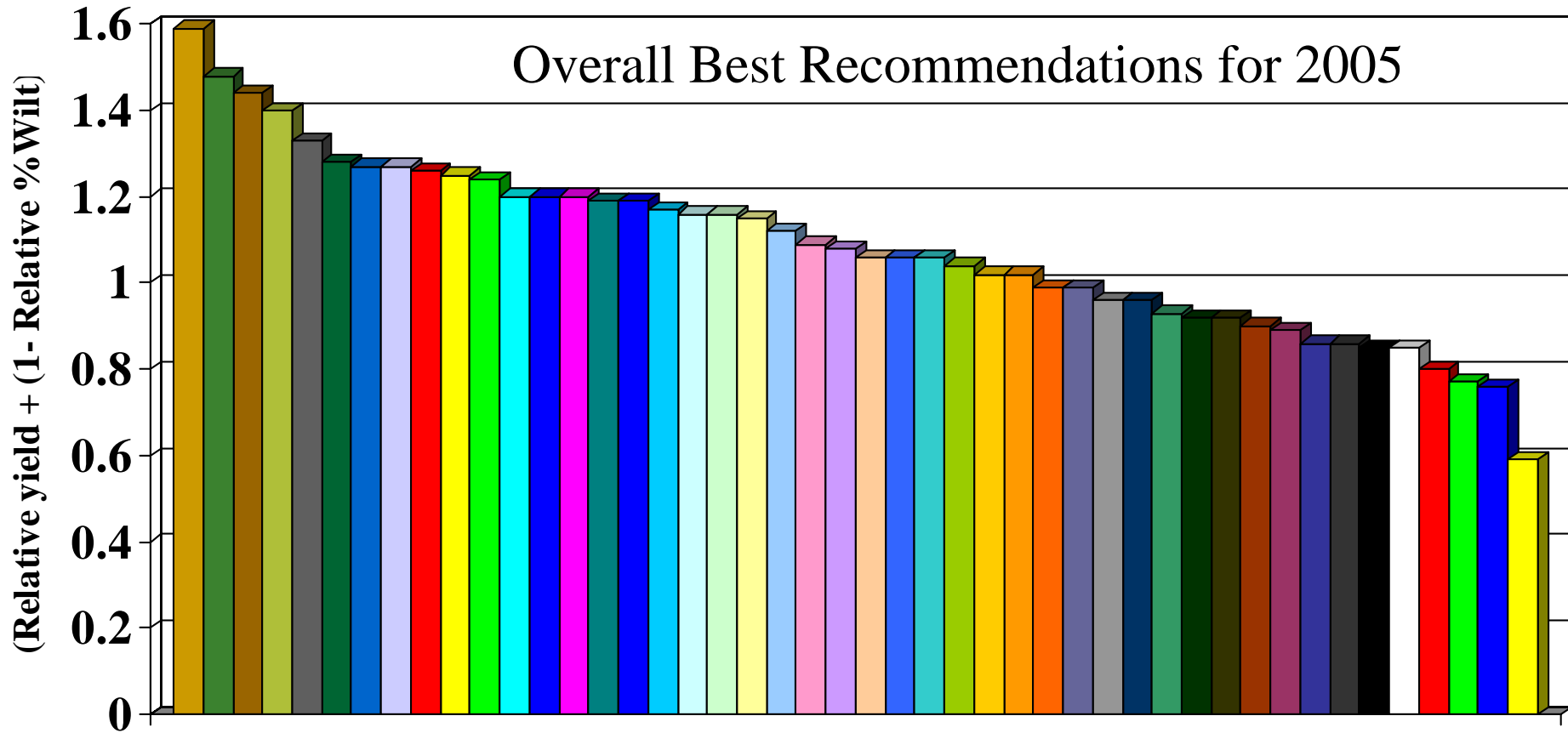


Photos courtesy of Dr. Harold Kaufman  
Retired TCE Extension Plant Pathologist

# Microsclerotia (Survival structures)

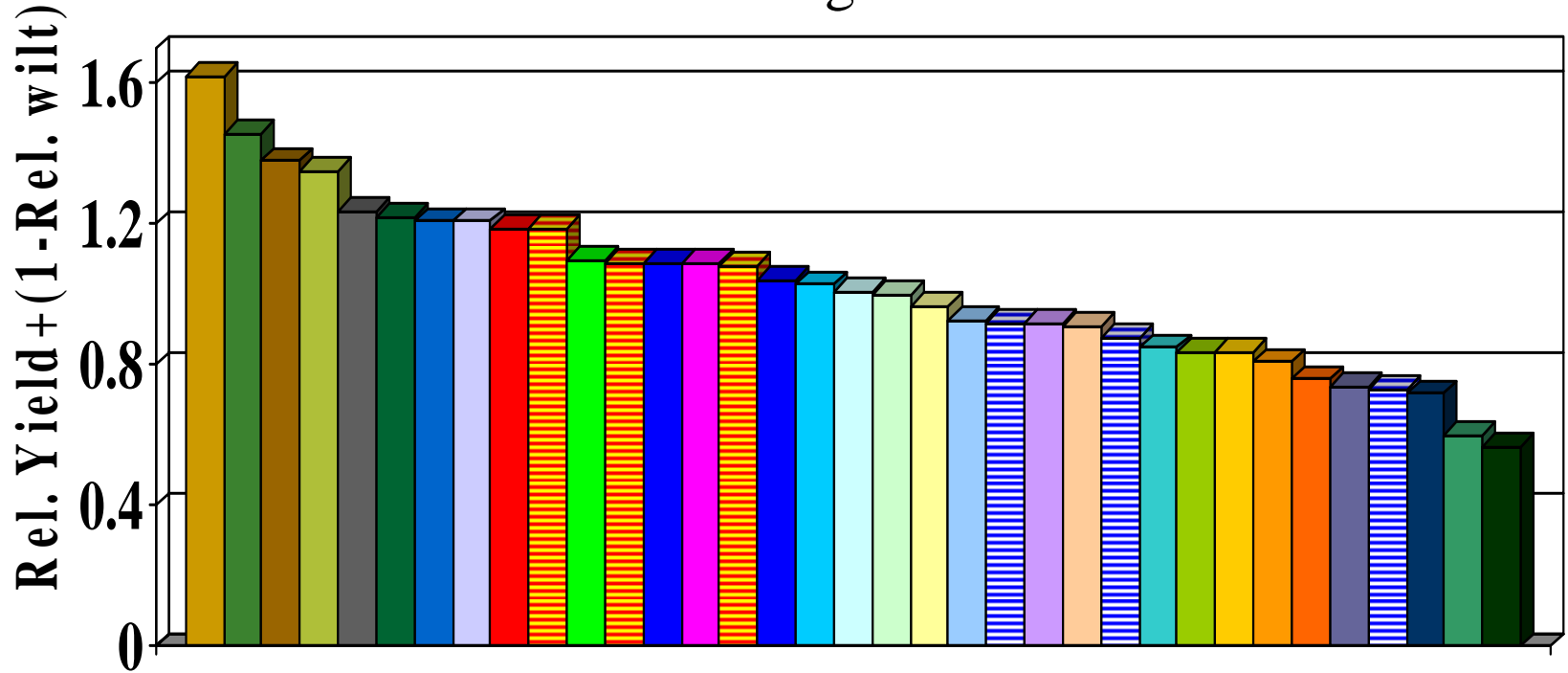
Site	Microsclerotia per cc soil	Incidence of Wilt	Date of Rating
Earth	0.0	0	Sept. 8
Brownfield	5.5	2	Aug. 28
<b>Petersburg</b>	<b>30.8</b>	<b>20</b>	<b>Aug. 18</b>
<b>Slaton</b>	<b>31.5</b>	<b>24</b>	<b>Aug. 24</b>
Levelland	80.0	16	Aug. 8

# Overall Best Recommendations for 2005



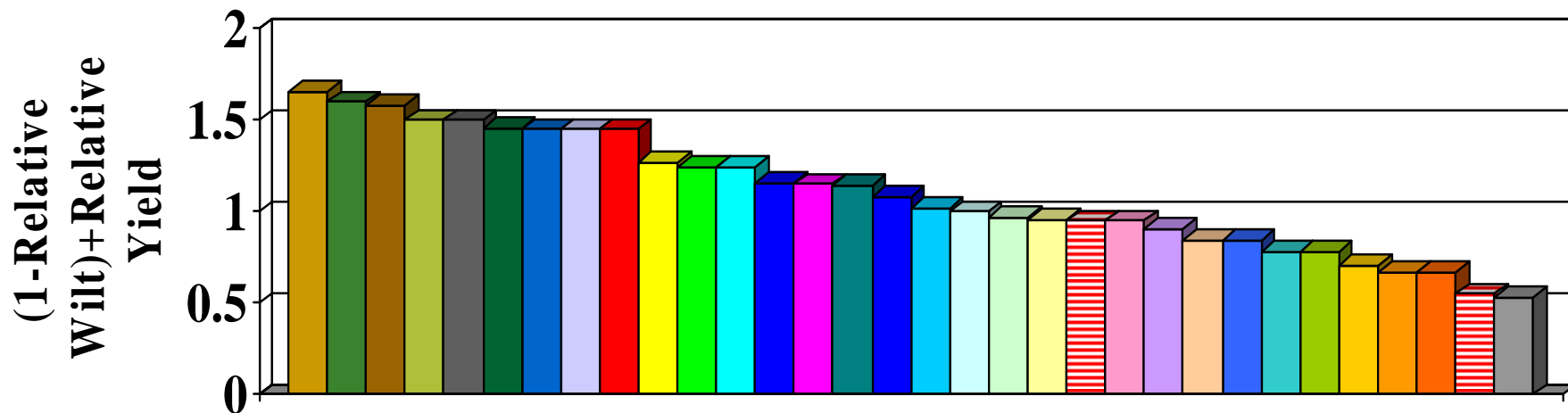
FM 960BR	FM 989B2R	FM 989BR	DP 455BR	FM 960RR	PM 2379RR	DP 5690RR
FM 960B2R	PM 2167RR	AT AtlasRR	Phy 470WR	NG 2448R	PM 2280BR	FM 989RR
AFD 3602R	DP 444BR	ST 5242BR	PM 2266RR	NG 1553R	ST 5303R	AT PatriotRR
DP 424B2R	FM 5045BR	AFD 3511R	ST 6636BR	DP 449BR	Phy 410R	ST 4696R
PM 2145RR	DP 434RR	DP 555BR	NG 3969R	ST 4575BR	AM 262R	Phy 310R
DP 445BR	DP 494RR	ST 5599BR	AT WarriorRR	DP 432RR	BCG 28R	DP 5415RR
AM 821R	BCG 50R	BCG 30R	AT MagnumRR			

# Petersburg 2006



PM 2326RR	AFD 5065B2F	BCG 520R	FM 989RR	NG 2448R	PM 2167R
ST 5242BR	FM 989B2R	PM 2266RR	DG 2100B2F	NG 1553R	BW 3255B2F
PM 2280BR	FM 9063B2F	CG 3020B2F	FM 9060F	ST 4664F	DP 424B2R
FM 960RR	BW 4021B2F	FM 960BR	ST 4700B2F	FM 960B2R	BCG 50R
CG 3520B2F	FM 9058F	AT Atlas RR	ST 4357B2F	AT Summit B2F	DP 117B2F
ST 4554B2F	DG 2242B2F	DP 110F	FM 9068F	BW 2038B2F	

# Slaton 2006 Drip



- |            |           |            |                 |
|------------|-----------|------------|-----------------|
| AFD 5064F  | FM 832LL  | PG 440W    | AFD Raider 271  |
| FM 988LLB2 | FM 958LL  | NG 2448R   | FM 960BR        |
| FM 989BR   | FM 966LL  | DG 2242B2F | PG 125F         |
| FM 981LL   | FM 5035LL | FM 965LLB2 | DP 117B2F       |
| AFD 5062LL | BCG 245   | BCG 50R    | FM 832          |
| AM 1532B2F | DP 448B   | FM 955LLB2 | NG 3550F        |
| DP 393     | AT Atlas  | FM 958     | AT Marathon B2F |
| AM 427R    | AM 8120   | CG 4020B2F | BCG 295         |



# 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 spores (microsclerotia) survive in soil for many years**

# 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

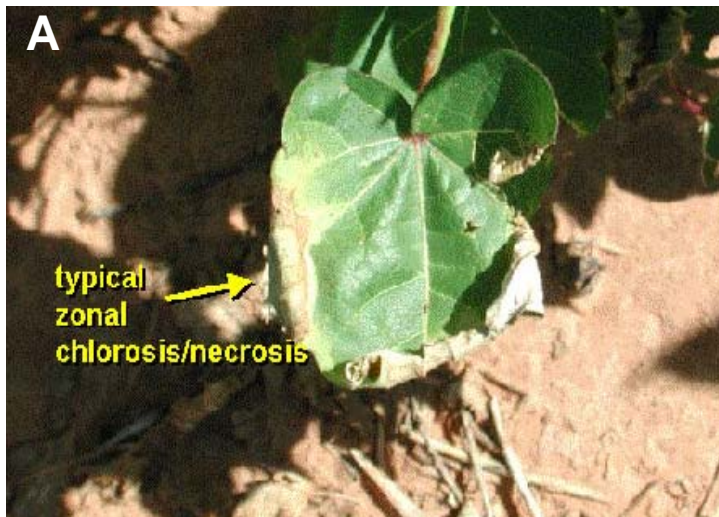


Photo: Dr. Randy Boman, TCE Lubbock

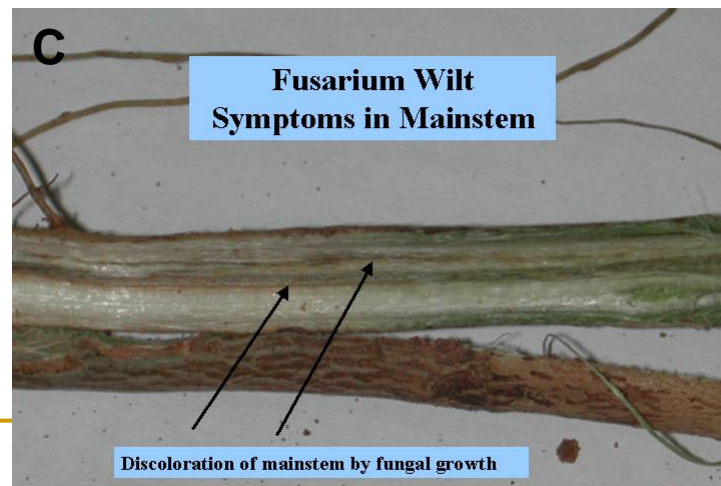
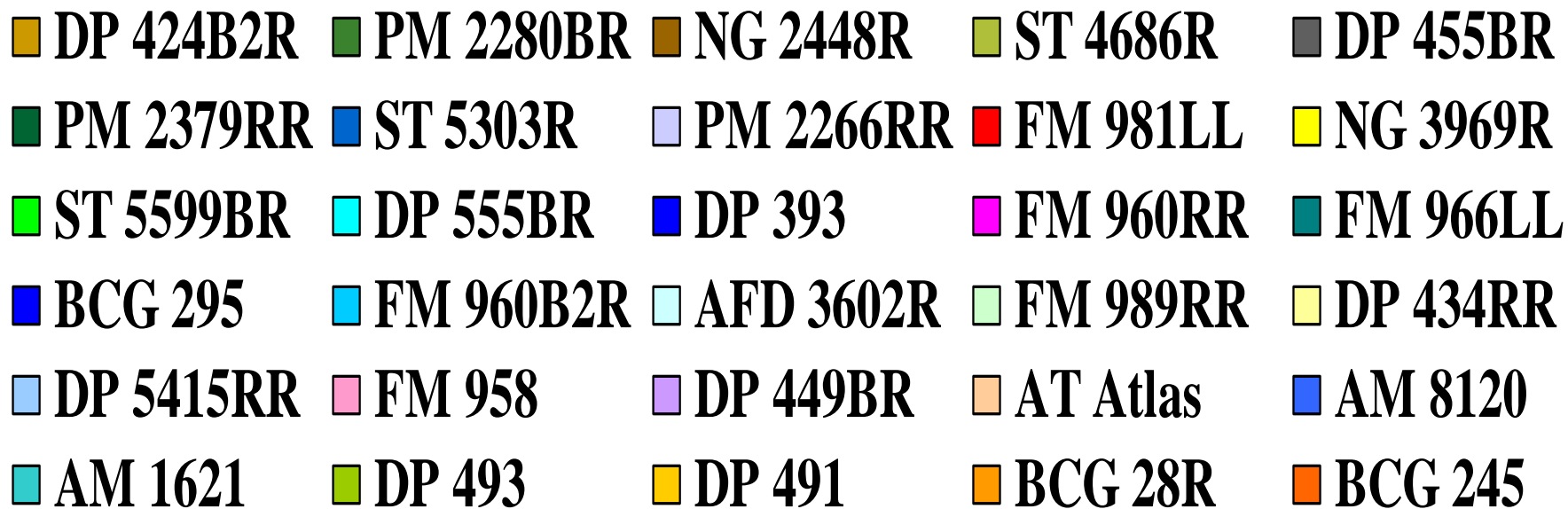
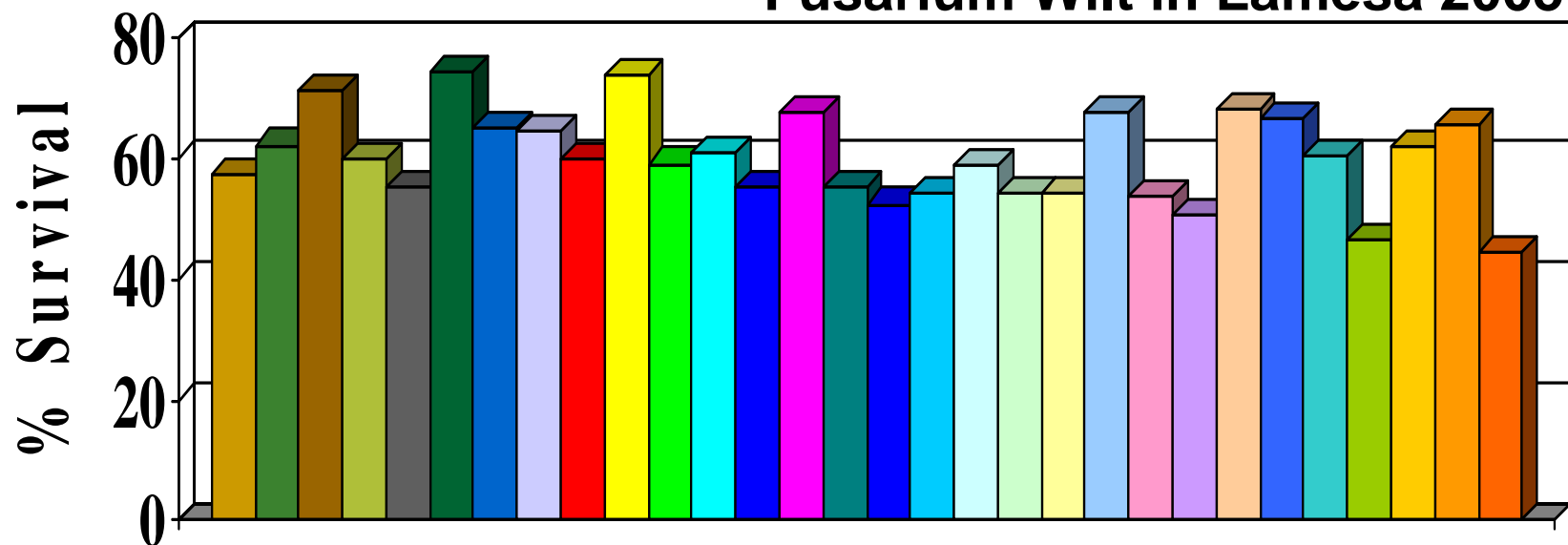
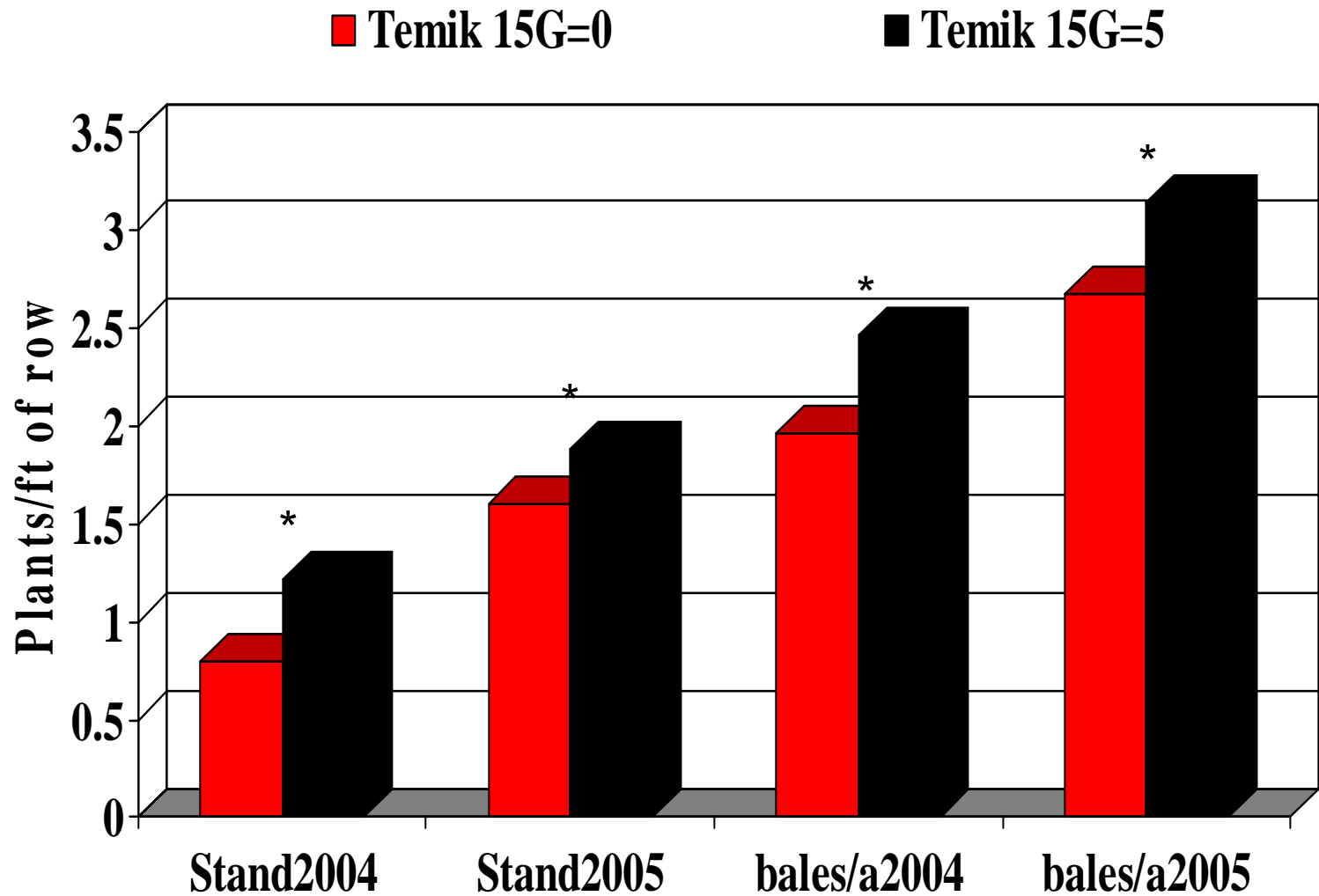


Photo: Dr. Randy Boman, TCE Lubbock

## Fusarium Wilt in Lamesa 2005



Data from Dr. Terry Wheeler



# Management of Fusarium Wilt

- **Plant a less susceptible variety**
  - Increase in Fusarium wilt has resulted from previous use of susceptible varieties
  - Efforts are ongoing to evaluate cotton varieties performance in fields with a history of Fusarium wilt
- **Rotate with non-nematode host**
- **Use Temik 15G at planting (5 lbs/acre) to minimize nematode damage**
- **Minimize wounding of roots by excessive tillage operations (i.e. minimum tillage)**

# 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.

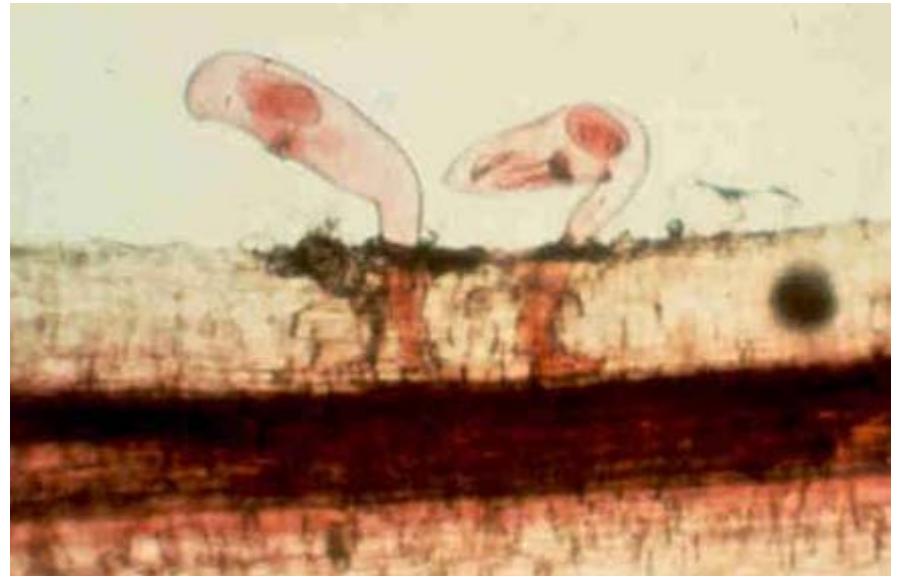


Photo courtesy of Dr. Jim Starr, Nematologist Texas A&M University, College Station

# 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

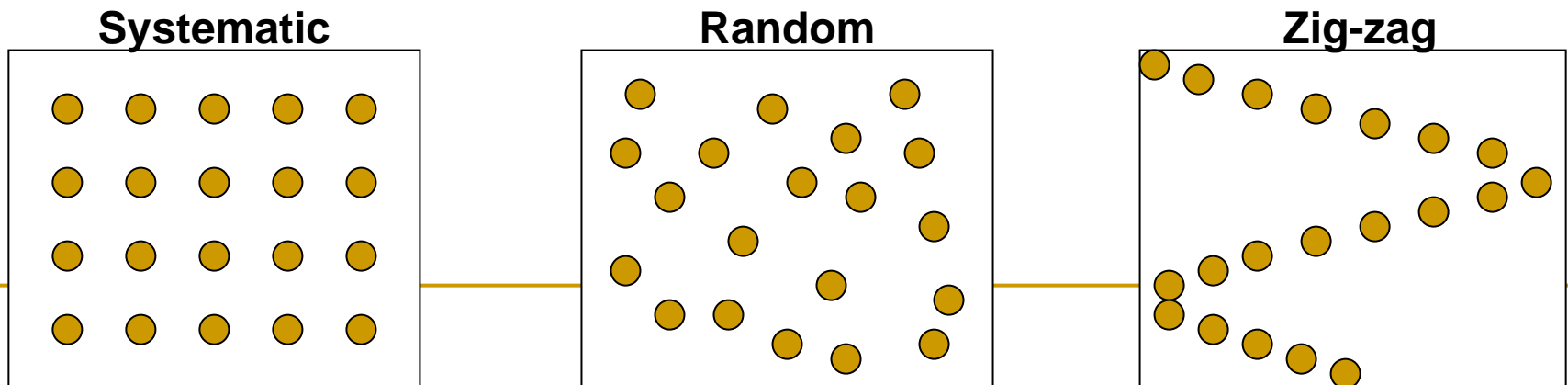


# Reniform nematode

- **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**

# Management of Root Knot With Temik

<b>Population (per 500cc soil)</b>	<b>Risk Level</b>	<b>Rate (lbs/acre)</b>
<b>&lt;250</b>	<b>None</b>	<b>0</b>
<b>250-999</b>	<b>Low</b>	<b>3.5</b>
<b>1000-5000</b>	<b>Mod.</b>	<b>5</b>
<b>&gt;5000</b>	<b>High*</b>	<b>5-7</b>

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# Other nematode management options

- **Additional products available include:**
  - Avicta Complete Pak (Syngenta)
  - Aeris (Bayer)
  - Vydate (Dupont)
  
- **Cultural practices**
  - Crop rotation

# Reniform nematode

- **Not as severe as root knot (but on the increase)**
  - Serious problem where established
  - Lubbock station, New Home, Morton????
- **Not as easily identifiable as root knot**
- **Currently no resistant or tolerant varieties**
- **Crop rotation with grain or peanut**
  - Every other year most effective, two consecutive cotton crops possible
- **Temik (5 lb/acre) at planting, Avicta Complete Pack on seed, or 2 applications of Vydate C-LV (8.5-10.7 oz/a) two weeks apart**
- **Minimize spread of soil within infested fields, and KEEP OUT of clean fields**

# Foliar Diseases

## Field Observations

Leaf Spot



- **Wide spread in 2006**
  - Following heavy rain in Sept.
  - Not commonly seen in region
- **Observed on stressed and earlier maturing cotton**
- **Caused severe defoliation**

Stem Blight



- **First noticed in 1999**
  - Increasing every year
- **Infects leaf margin**
  - Different pathogen
  - Resembles a lightning strike
- **Noted on many varieties**

# Leaf Spot





# Stem Blight



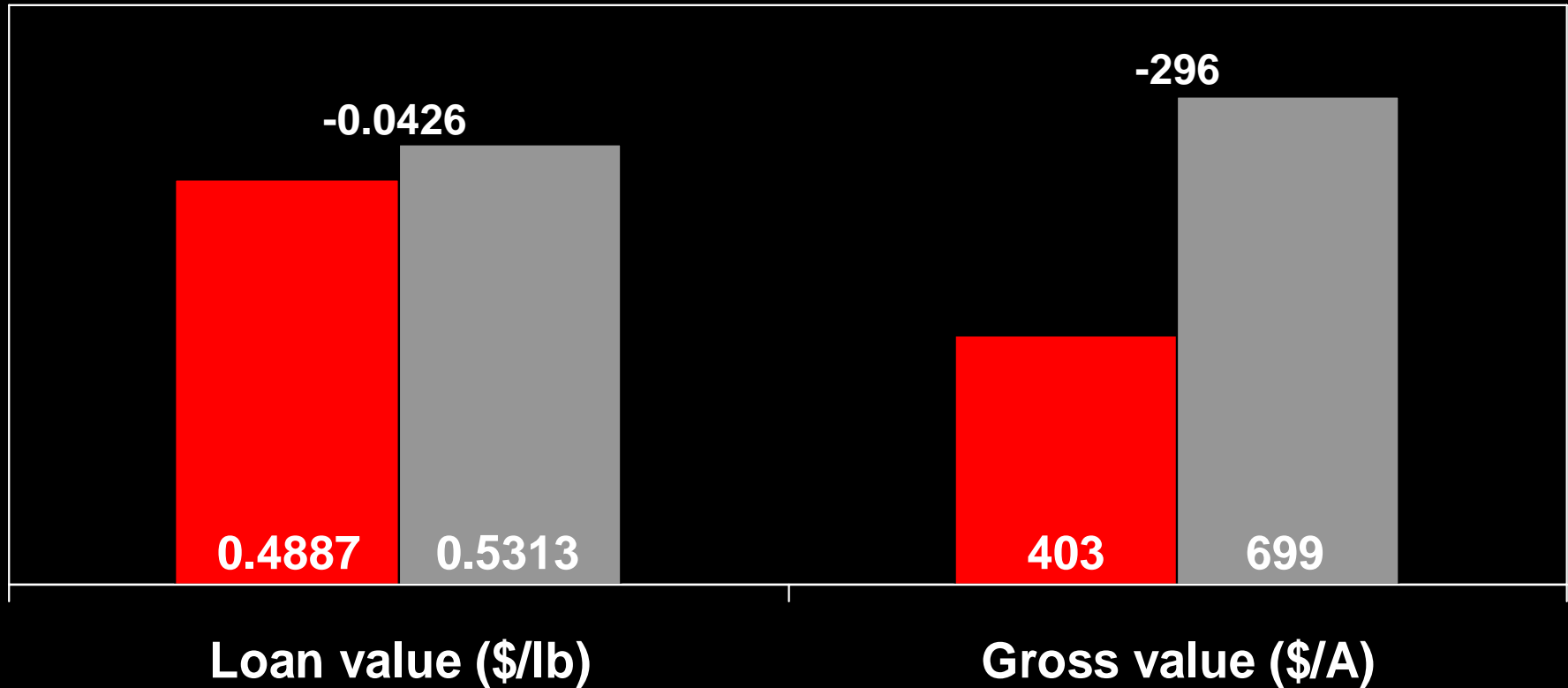
# Effect of stem blight on crop value

## Significant differences in:

Lint yield (-475 lb/A); Seed yield (-758 lb); Micronaire (-0.8);  
Uniformity (-3.3); Leaf grade (+0.39)

■ Inside Hit

■ Outside Hit



# Questions

