DIVISION OF AGRICULTURE
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Bacterial Blight of Cotton: Return of a historically important disease

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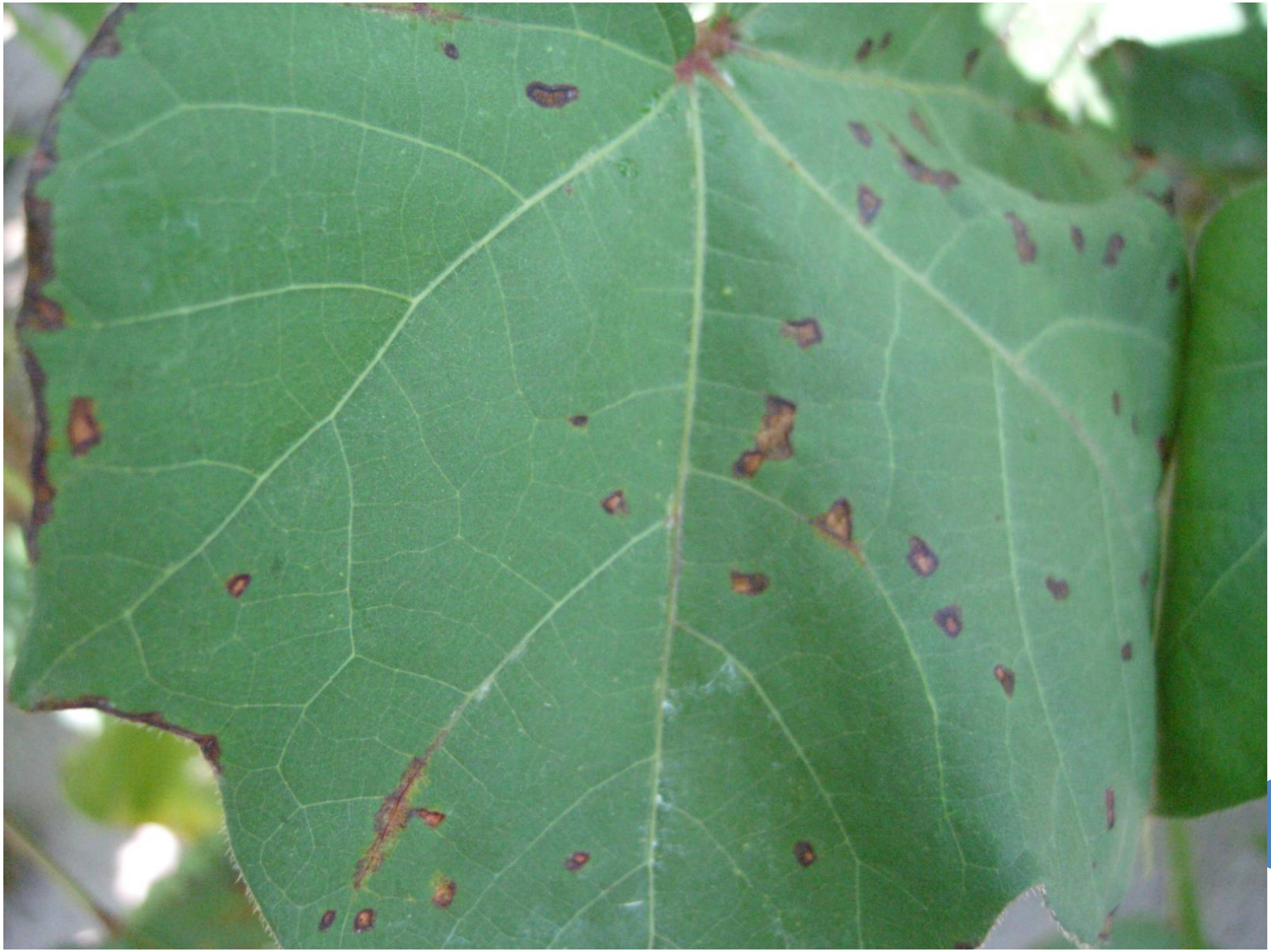
Bacterial blight in Arkansas, 2011

- **Reported in Arkansas in 2011 the week of July 11 (MS Co.)**
- **Most prominent in NE Arkansas – ca. 40,000 acres were affected on farms in MS and Craighead counties.**
- **Possibly somewhere around 60,000 acres statewide. Counties include: Mississippi, Craighead, Crittenden, St. Francis, Lee, Desha.**
- **Several thousand acres in Missouri and Mississippi were also affected.**

Bacterial blight on cotton



Bacterial blight on cotton

Bacterial blight on cotton

Leachville (MS Co.), AR
June 13, 2011

Photo courtesy of Dale Wells

Photo courtesy of Dale Wells

Producer questions

1. How serious is the disease going to get?
2. How do we manage the disease, crop?
3. What should we expect next year?
4. Where did the disease (pathogen) come from?

Bacterial Blight of cotton

Xanthomonas citri subsp. malvacearum

Xanthomonas axonopodis pv. *malvacearum*

- First reported in 1891 by Atkinson
  - Angular leaf spot
  - Blackarm
  - Bacterial boll rot

- Became a serious problem in the 1950’s
- 1946 first breeding effort in the Sudan

Occurrence and Importance
National Cotton Council Disease Database: 1952-2009

- Last reported in Arkansas in 1983
- Consistently reported in Arkansas prior to 1978
- Greatest estimated losses of 1% in 1967
- Losses nationally prior to this; 0.71% to 3.42% (1952 to 1964, high in 1958)

Cultivars with bacterial blight symptoms in the field

- **DP 0912 B2RF – highly susceptible**
  - **More in this variety than others**
  - **Variety was the number one planted in AR in 2011**
  - **Disease found in this variety in all counties**
- **AM 1550 B2RF – highly susceptible**
  - **Several fields in Mississippi County**
- **PHY 367 WRF – highly susceptible**
  - **Several fields in Mississippi county**
- **ST 5458 B2RF– moderately susceptible**
  - **showed symptoms but disease did not seem to progress in this variety like others**

Tom Barber

Bacterial Blight of cotton

- **Boll rot phase**

Bacterial blight on cotton

Bacterial blight on cotton

Where did the inoculum come from?

- Survives poorly in soil in absence of plant debris – probably won't overwinter in soil alone
- Crop residue and seed
  - Pathogen survives between crops in dry leaf trash and infected seed

Survival in crop debris in the field

- Cotton debris on the soil surface still contained the bacterium for 217 days (Perkins OK)
- Cotton debris lost infectivity in 40 to 107 days in moist soil. Bacterium not present after tissue decomposed.
- No disease developed if residue was buried
  - (Brinkerhoff and Fink, 1964)

Seed transmission

- Six to 24% of discolored cottonseed from bacterial blight infected bolls were internally infected (Brinkerhoff and Hunter, 1963)
  - Sulfuric acid delinted and disinfested in Clorox
- Field evaluations of seed lots 0 to 3.9% transmission based on diseased seedlings (Brinkerhoff and Hunter, 1963)

So how many seed need to be infected?

- 1 in 6000 seed was sufficient to initiate an epidemic under Sudanese conditions (Tarr,1961)
- <1 for 4800 Mehta et al, 2005

Was it present in the seed planted in Arkansas?

- Seed assays
  - Shake seed in sterilized phosphate saline for 20 minutes
    - Plate 10 plates PSA with 1ml of suspension.
  - Drain seed
  - Disinfest seed with 70% EtOH for 1 minute
  - 4 min in 2.5% NaOCl
  - 3 rinses in sterile deionized water
  - Plate 10 seed/plate on PSA
- PSA = Peptone sucrose agar

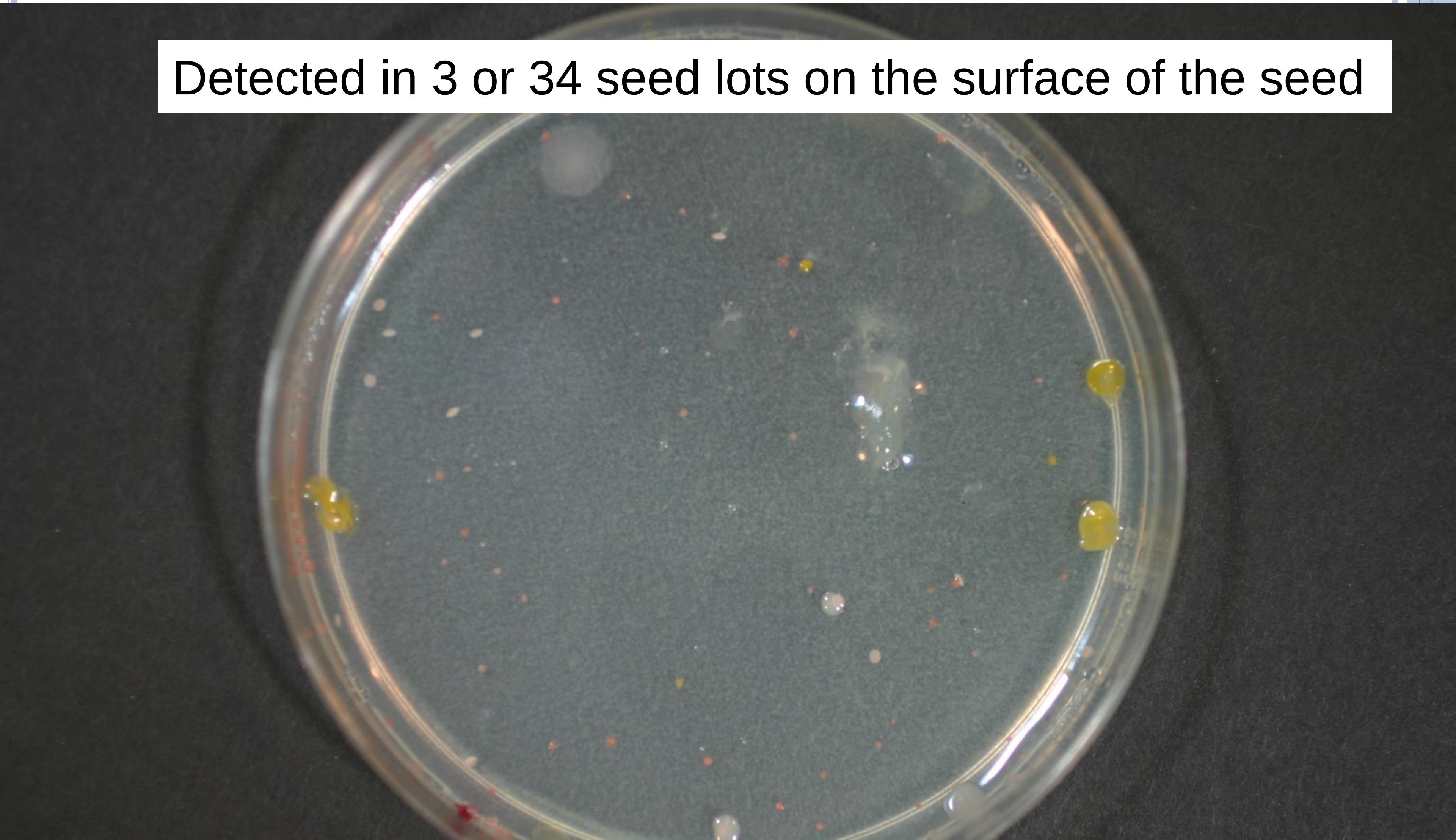
Mehta et al 2005

Was it present in the seed?

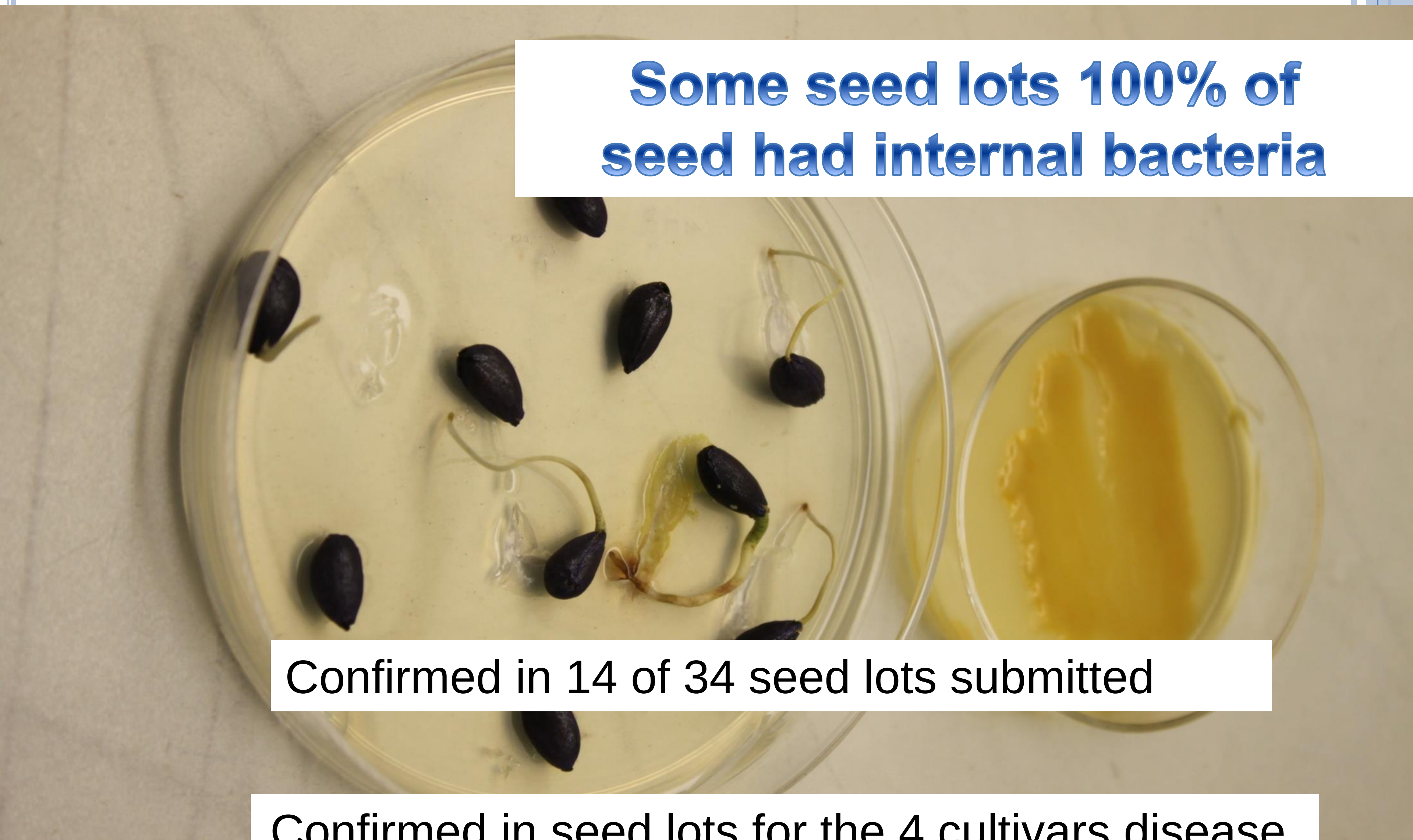
- 34 seed lots submitted by producers or consultants to the
  Plant Disease Diagnostic Clinic
- Plated between 220 and 675 seed per sample

Seed assay results
Seed infestation – on surface

Detected in 3 or 34 seed lots on the surface of the seed



Seed assay results
Seed infection - internal

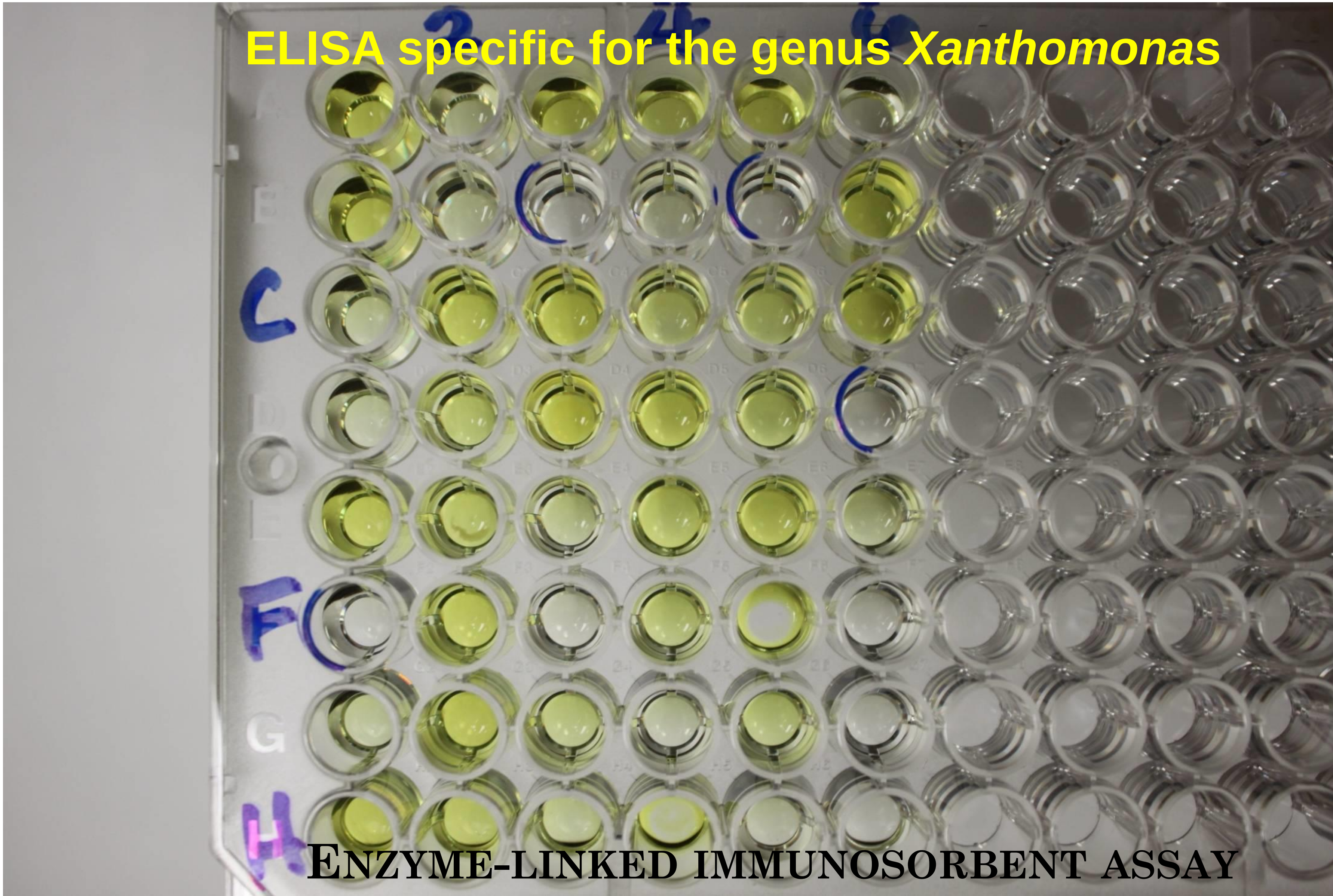


Some seed lots 100% of seed had internal bacteria

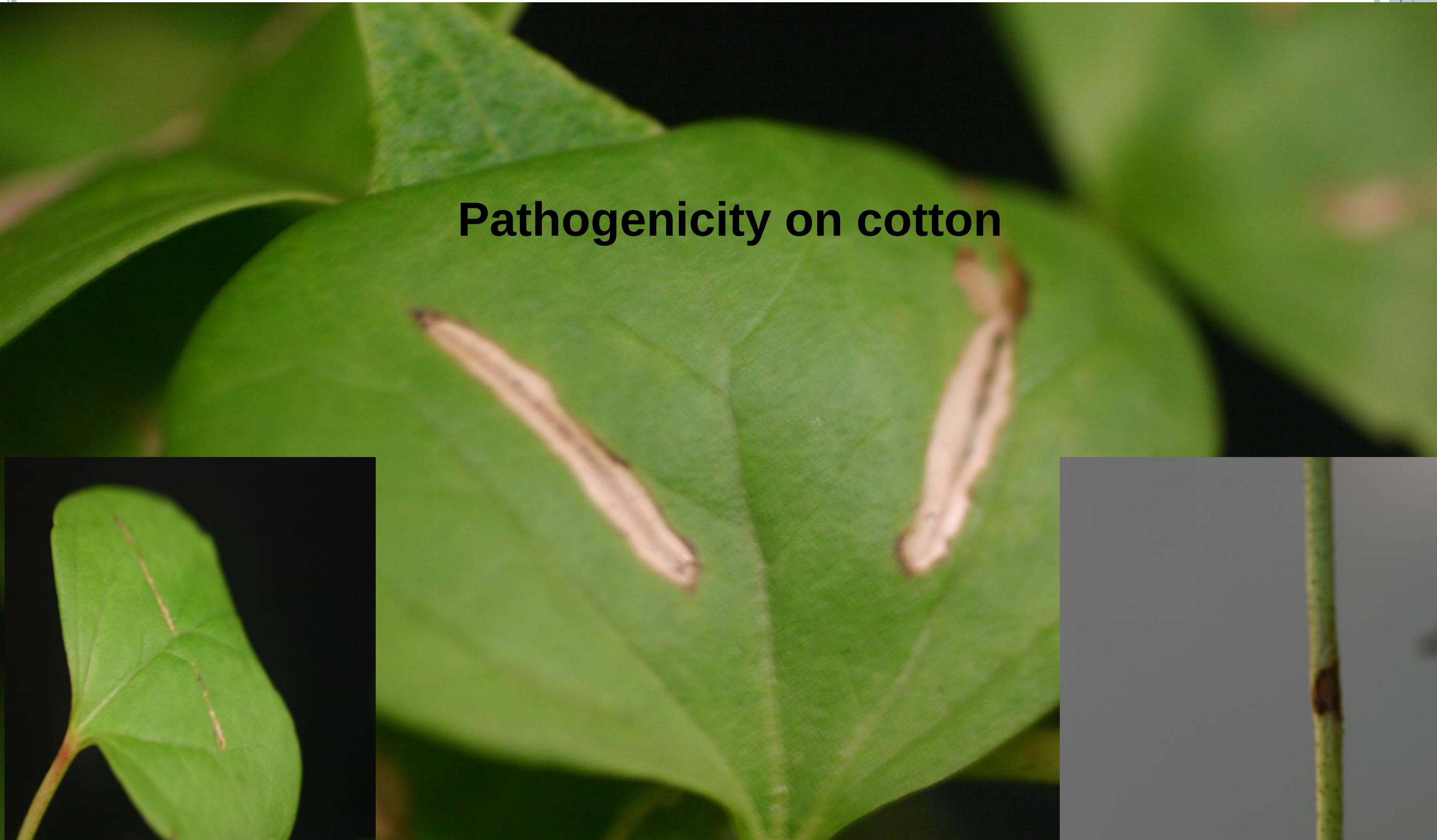
Confirmed in 14 of 34 seed lots submitted

Confirmed in seed lots for the 4 cultivars disease

Isolates identified as *Xanthomonas*



ISOLATES IDENTIFIED AS *XANTHOMONAS CITRI SUBSP. MALVACEARUM*



How does the pathogen spread?

- Maximum air temperatures 97°F (36°C)
- Wind driven rain (Binkerhoff and Hunter 1963)
  - More severe in sandy soils
- Irrigation (King and Brinkerhoff, 1949)
  - Furrow (flood)
  - Sprinkler
    - Schnahorst (1968)
    - Avoid in seed production,CA (Schnahorst 1966)

How important is the disease?

- Losses ranged from 9 to 34% in susceptible varieties compared to resistant varieties after artificial inoculations in the field, only foliar symptoms present (Bird,1959)

Optimal conditions for a bacterial blight epidemic

- Establishing primary infection at the seedling stage
- Early rainfall to distribute the disease through the crop by 6 weeks after planting
- Periods of heavy wind-driven rain after canopy has formed with periods of sunshine to raise the RH to >85%
- High temperature during the secondary phase of the disease 32-38^{o}C and 17-20^{o}C nights

Hillocks, Cotton Diseases

Citrus canker – *Xanthomonas citri subsp. citri*

Dissemination – Spread

1900 ft over a 30 day period

What has changed?

- Seed treatments
  - Acid delinting?
  - Seed treatment chemistries
    - TCMTB
    - Carboxin

Where do we go from here? Bacterial blight management for 2012

- 1. Pathogen-free seed – out of the growers' hands

  2. Sanitation
  - Incorporate plant debris
  - Crop rotation for severe fields – rotate to anything other than cotton for a year

- 3. Disease resistance

Are there resistant cultivars for Arkansas?

- **PHY 375 WRF –resistant, a good option for North AR**
- **UA 48 – Conventional but resistant**
- **DP 0920 B2RF –resistant**
- **DP 1133 B2F – resistant**
- **ST 5288 B2F –resistant**
- **The Fibermax lines are generally resistant,**
  - **FM 1740 B2F**

- **ST 5458 B2RF – Not resistant but symptoms did not progress**
- **ST 4145 LLB2 –no symptoms when planted in fields that had symptoms**

Table 1. Response[1] of entries in the 2011 Arkansas Main Cotton Variety Test to bacterial blight at Keiser, AR, in 2011.(Fred Bourland)

Entry	No. of susceptible plants per plot[2] rep1	rep2	rep3	rep4	Avg. rating[2]	Blight Response	2011 MS[3] Rating	2011 MS[3] Res.	2010 TX Agri-Life[4]
AM 1511 B2RF	bb	bb	bb	bb	9.0	S			
AM 1550 B2RF	bb	bb	bb	bb	9.0	S	4.7	S	S
Ark 0219-15	2	bb	bb	2	5.5	S			
Ark 0222-12	3	0	0	0	0.8	R			
UA48	0	0	0	2	0.5	R			
FM 1740 B2F	0	0	1	0	0.3	R	0.2	R	R
ST 4288B2F	bb	1	bb	bb	7.0	S	3.8	S	S
ST 5288B2F	0	0	0	2	0.5	R	0.1	R	R
ST 5458 B2RF	bb	bb	bb	bb	9.0	S	4.5	S	S
CG 3220 B2RF	bb	bb	bb	2	7.3	S			S
CT 10624	bb	0	bb	2	5.0	S			
DG 2450 B2RF	bb	2	4	bb	6.0	S	4.6	S	
DG 2570	bb	bb	bb	bb	9.0	S	4.6	S	
10R052B2R2	bb	3	bb	bb	7.5	S			
DP 0912 B2RF	bb	bb	bb	0	6.8	S	3.9	S	
DP 0920 B2RF	0	0	0	0	0.0	R			
DP 1028 B2RF	bb	bb	bb	bb	9.0	S	4.5	S	S
DP 1133 B2RF	0	0	0	0	0.0	R	0.1	R	
PHY 367 WRF	bb	bb	bb	bb	9.0	S	4.8	S	S
PHY 375 WRF	0	0	0	0	0.0	R	0.2	R	
PHY 499 WRF	bb	bb	bb	bb	9.0	S	5.2	S	
PHY 565 WRF	bb	bb	bb	bb	9.0	S	4.4	S	S
SSG HQ210CT	bb	bb	bb	bb	9.0	S	4.2	S	
SST HQ110CT	4	4	3	0	2.8	I			

Disease Control Principles

- 1. Exclusion - exclude pathogen from area where it does not occur

- Consequences
  - Weighing pros and cons for agricultural trade and production
    - Must be a significant problem
    - What is the importance of inoculum from seed?
    - What is the feasibility of limiting inoculum on seed?

Strategies for producing pathogen-free seed

- Selecting seed production fields
- Scouting seed production fields for disease
- Seed assays
- Disinfesting and disinfecting seed

- As a result of a centralized seed production infrastructure, opportunities exist to provide pathogen-free seed