KY-TN Tobacco Agents Training – Tobacco disease management

UK UNIVERSITY OF KENTUCKY College of Agriculture, Food and Environment

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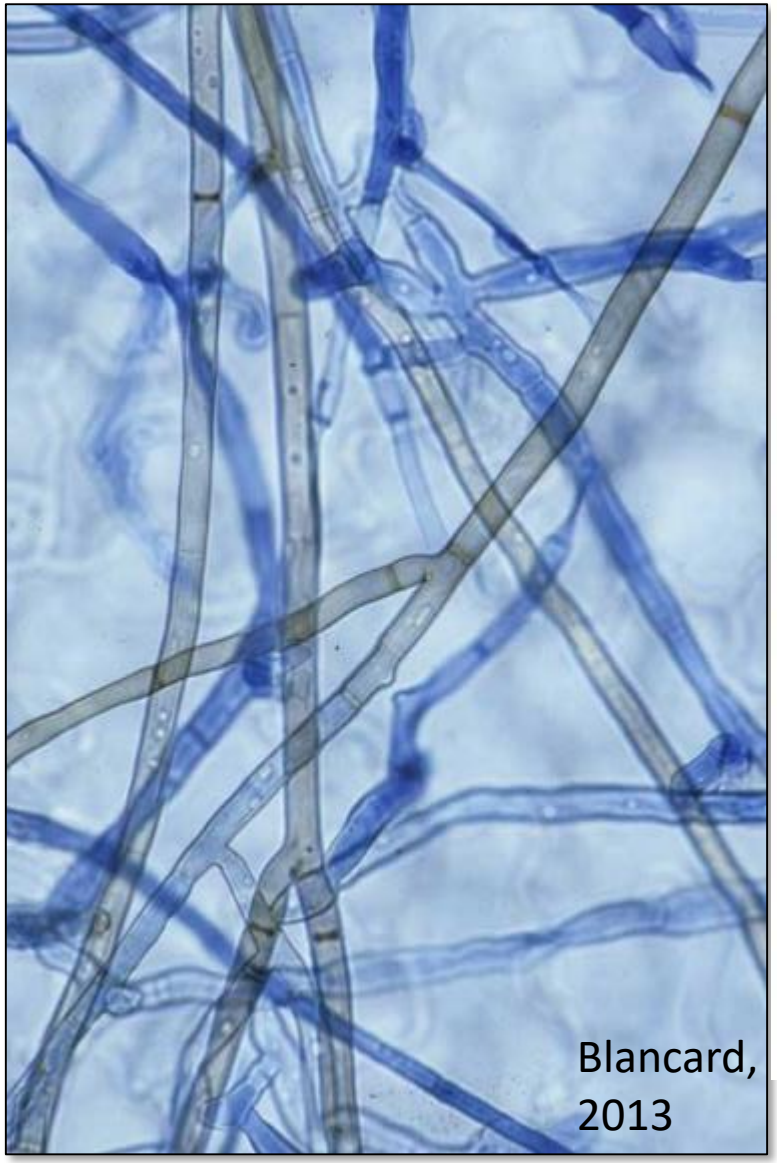
Disease management requires an integrated approach

- Clean materials and equipment + preventative Terramaster + weekly Manzate + azoxystrobin after 1st clipping (transplant diseases)
- Field rotation + preplant N application + reducing plant damage (angular leaf spot)
- Field rotation + resistant varieties + soil-directed fungicides (black shank)
- Field rotation + varieties + foliar fungicides (frogeye leaf spot)

Greenhouse transplant diseases and management plan

Fungal greenhouse tobacco diseases

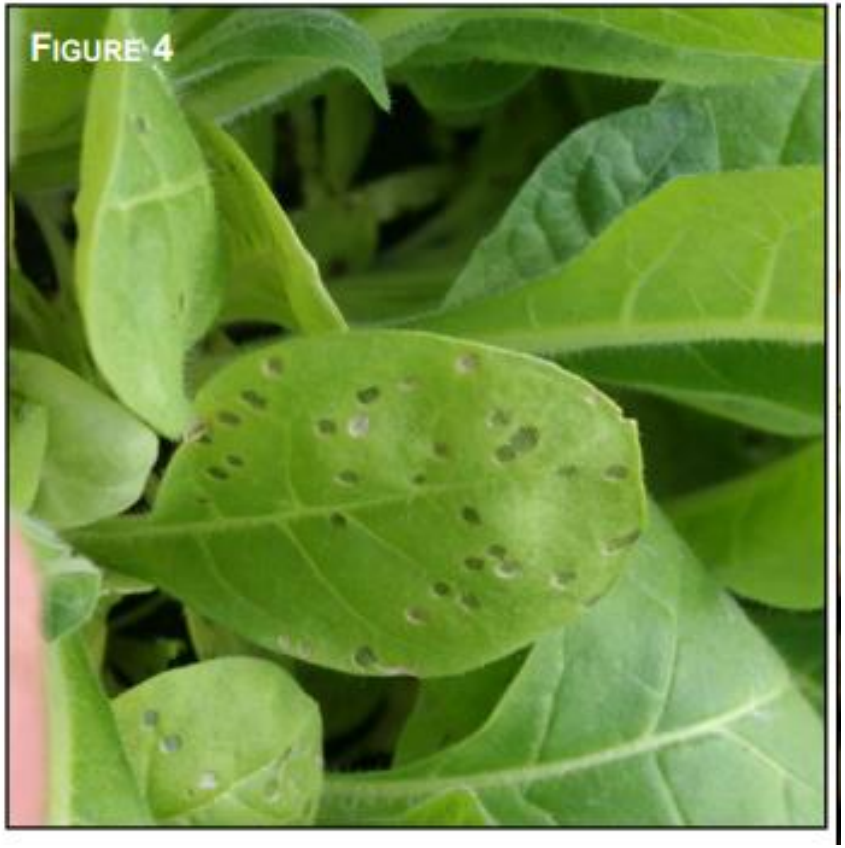
- Damping off, caused by *Rhizoctonia solani*
- Source of pathogen: infested trays
- Disease becomes most apparent as seedlings grow rapidly
- Management is focused on tray sanitization and/or replacement, clean media

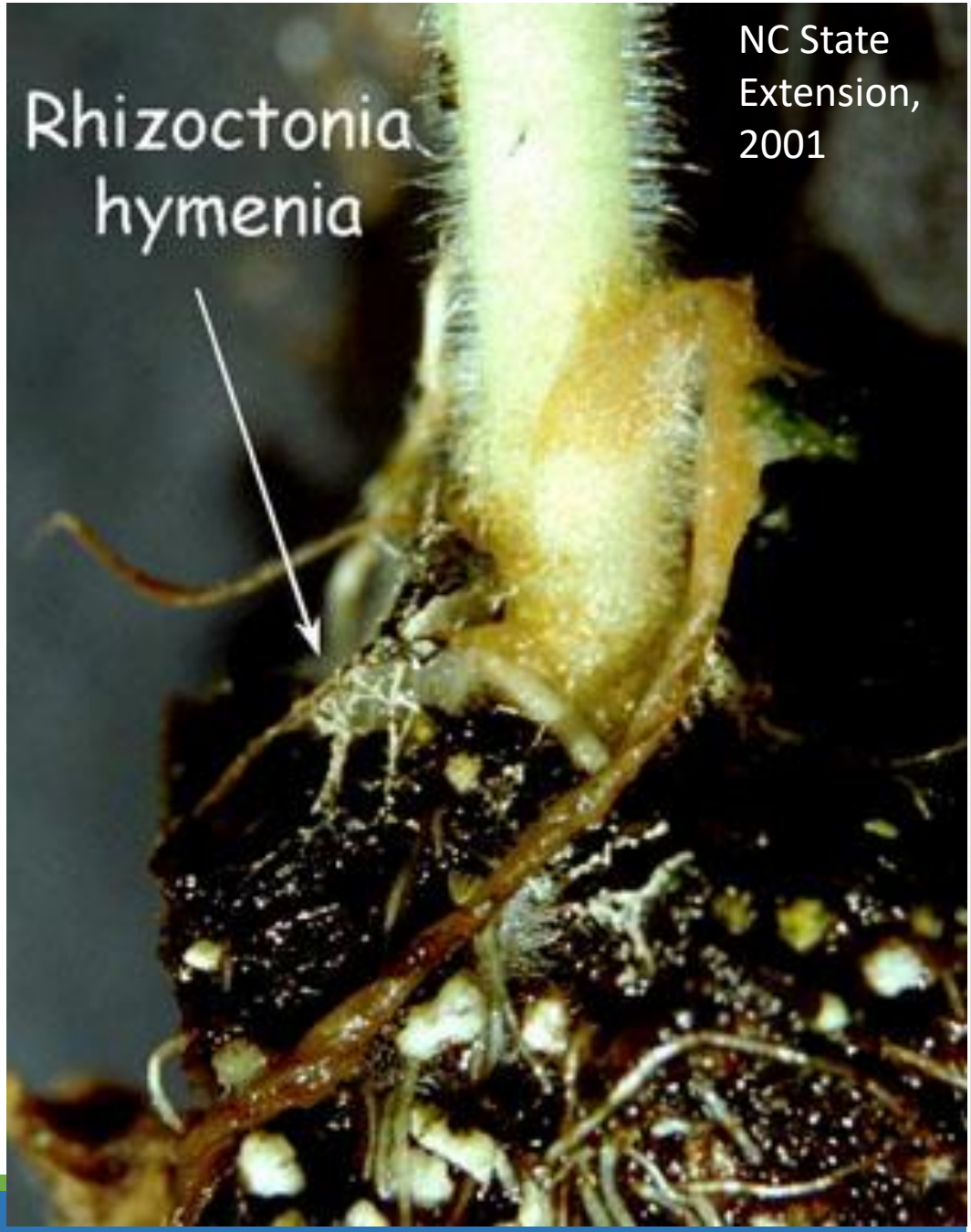


Blancard, 2013

Fungal greenhouse tobacco diseases

- Target spot, caused by *Rhizoctonia solani*
- Source of pathogen: infested trays or spores produced outside of greenhouse
- Disease becomes most apparent in clumps of plants in gh trays
- Management is focused on reducing weedy borders, sanitized trays, and fungicide apps





NC State Extension, 2001

Fungal greenhouse tobacco diseases

- Collar rot, caused by *Sclerotinia sclerotiorum*
- Source of pathogen: apothecia developed from sclerotia outside of gh
- Disease becomes most apparent when canopy closes
- Management is focused on weed management, removal of infected plants and clippings


FIGURE 3

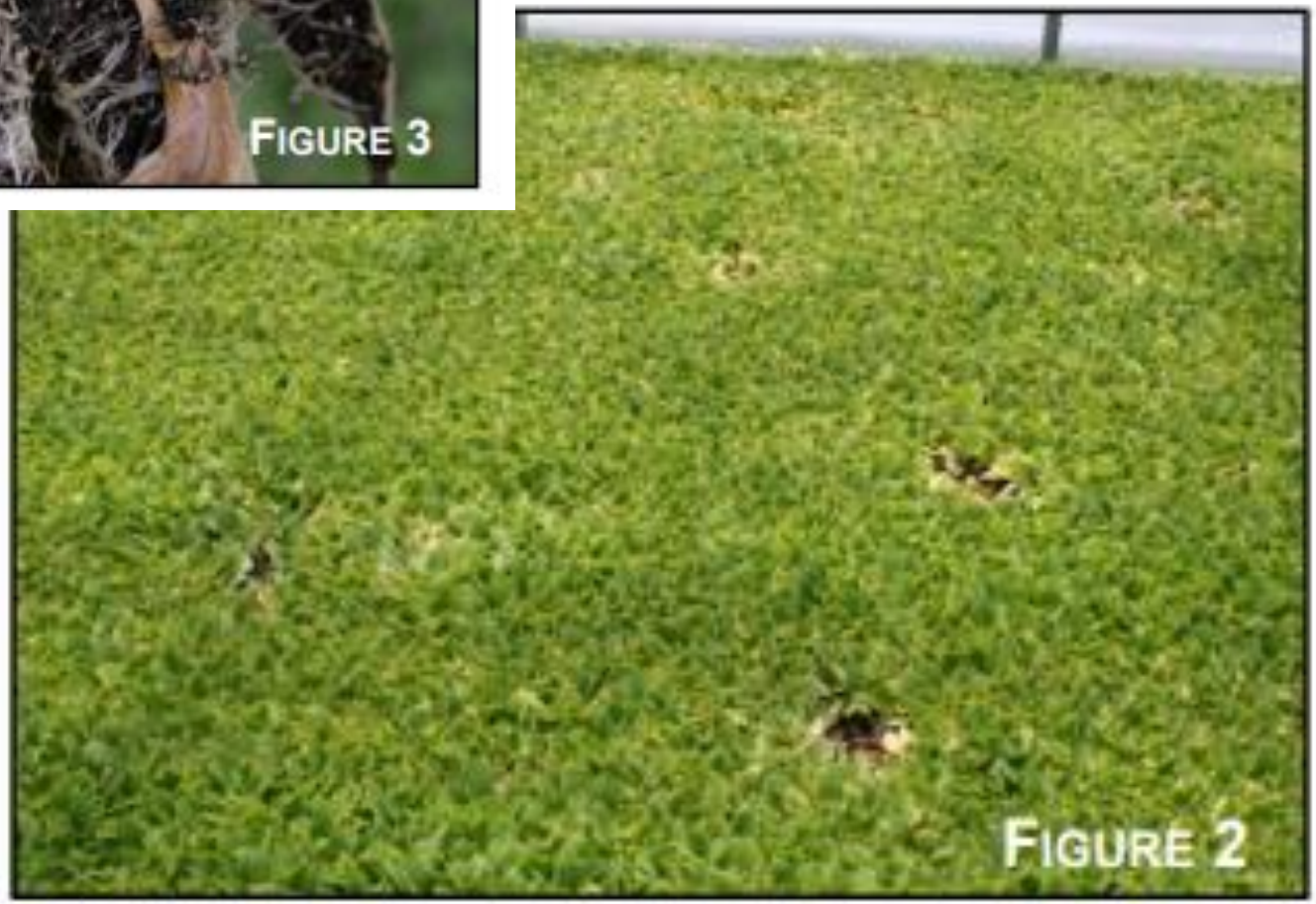


FIGURE 2

Bacterial greenhouse tobacco diseases

- Blackleg, caused by *Pectobacterium carotovorum*
- Source of pathogen: fairly common in environment, found in soils and among other crops
- Requires a wound to infect many plants
- Management is focused on infected tray removal, clipping with sharp, sanitized blade; streptomycin applications?


3

Fungal greenhouse tobacco diseases

- Root rot and damping off, caused by *Pythium* spp.
- Source of pathogen: infested trays, spores introduced from natural soil
- May cause blank cells, macerated, discolored roots, narrowed stems
- Management is focused on preventing introduction of natural soil, sanitizing trays, <u>preventative</u> fungicide

Managing *Pythium* in the tobacco floatbed

Pythium root rot is most common problem

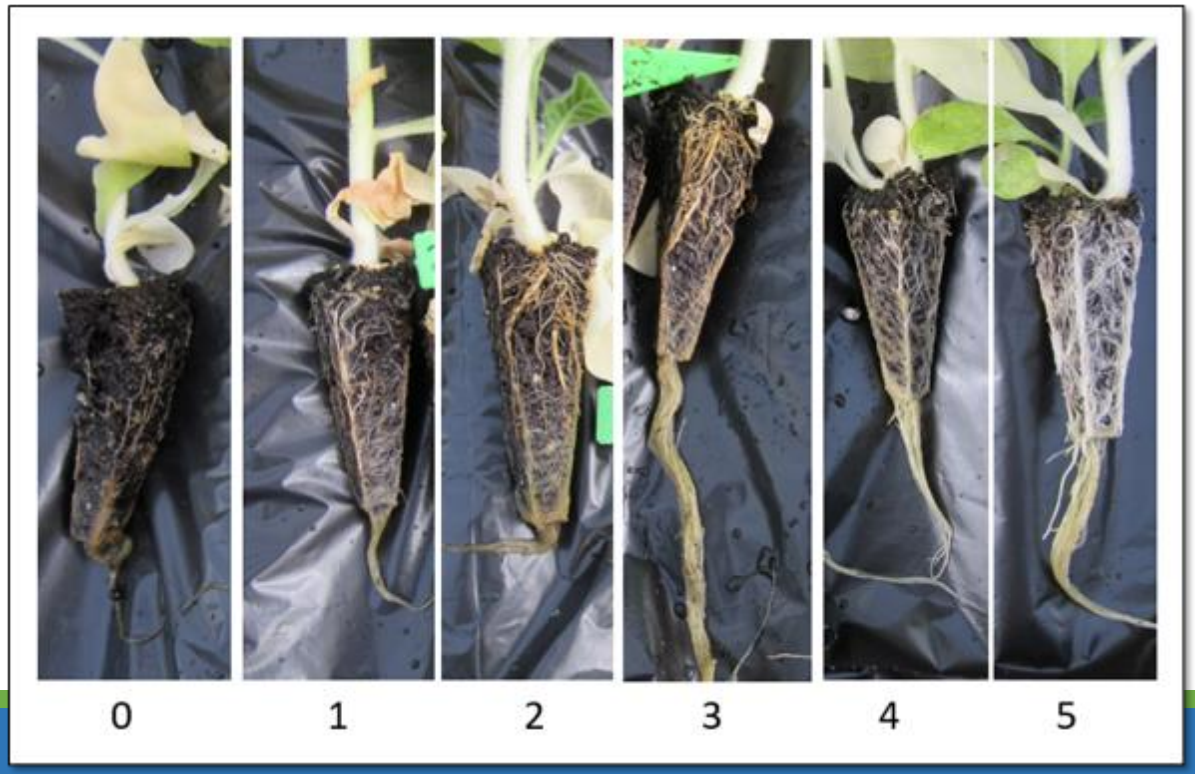
- Replace plastic floatbed liners
- New trays are ideal; trays <3 years old are ok – clean thoroughly
- Terramaster and Oxidate are only labeled products
  - Use preventatively and circulate well

Experimental design

Treatment	Rate
Untreated control	.
Terramaster	0.7 oz / 100 gal
Ridomil	4 ml / 100 gal
Oxidate	2.4 fl. oz / 100 gal

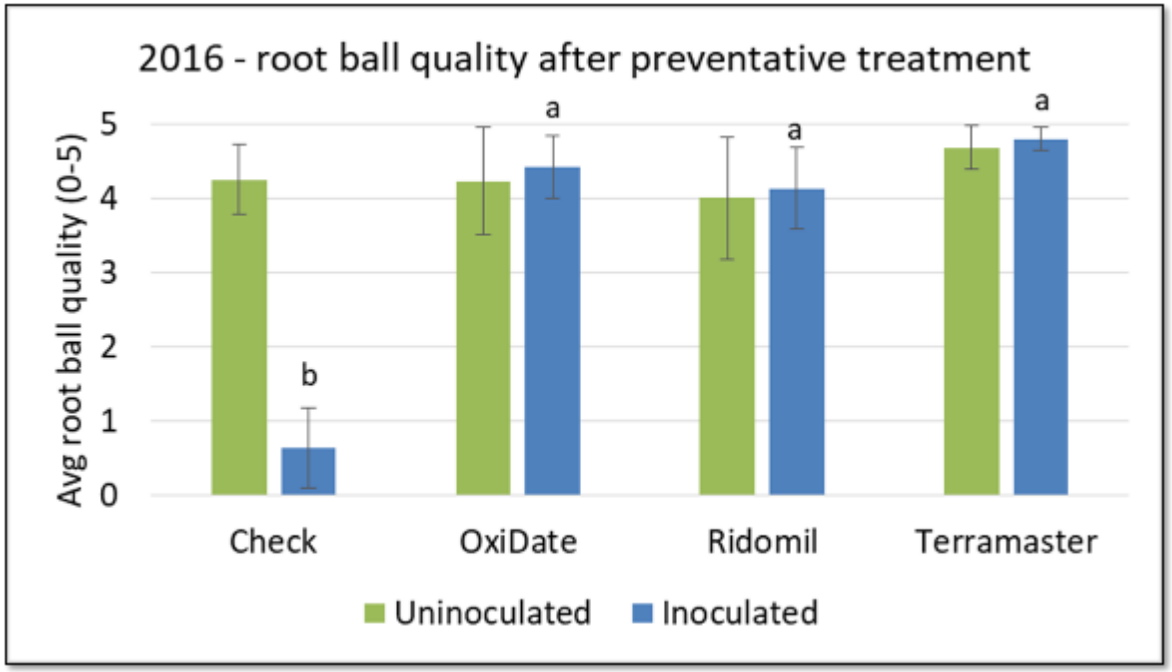
- Transplants grown in mini-float beds
- Inoculated with *Pythium* spp., then treated
  - 2016: treated same day
  - 2017: treated 10 days later

- Plants were rated for root ball quality before setting
- Set in field on UK Woodford Co. farm
- No post-transplant treatments
- Yields recorded at conclusion of season

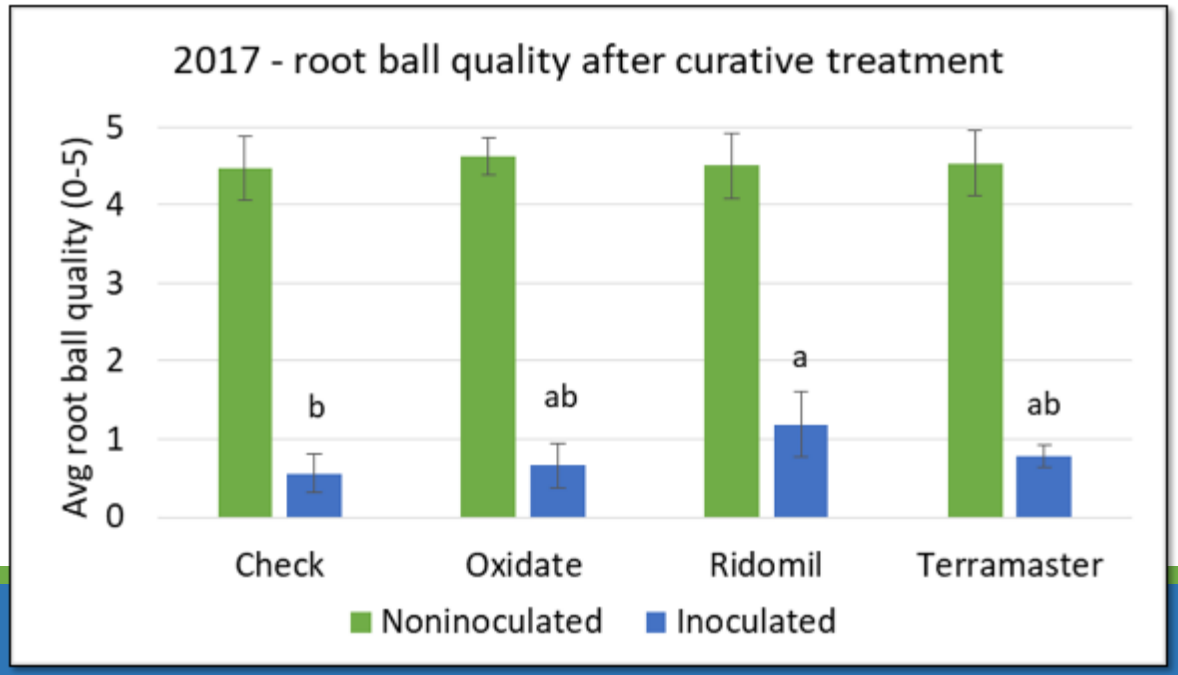


Plants were rated for root ball quality before setting in field

→ In 2016, plants were treated <u>on the same day</u> *Pythium* was introduced to the water

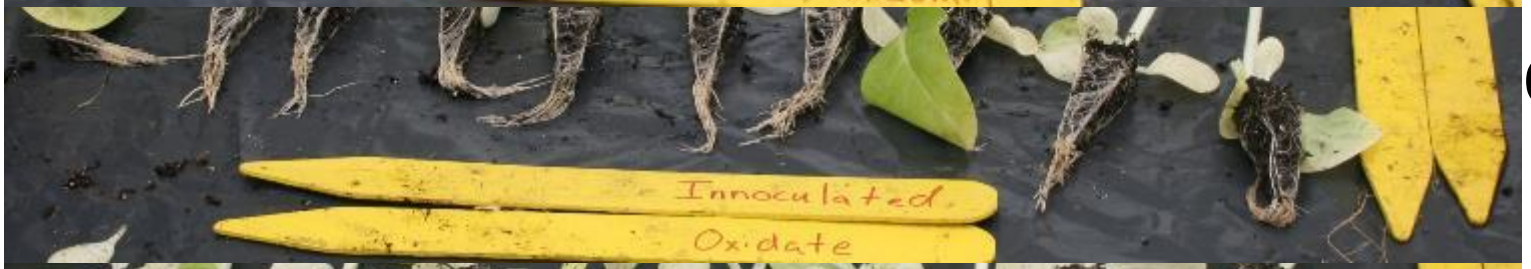


→ In 2017, plants were treated <u>10 days</u> after *Pythium* was introduced to the water



PREVENTATIVE TREATMENTS

Ridomil

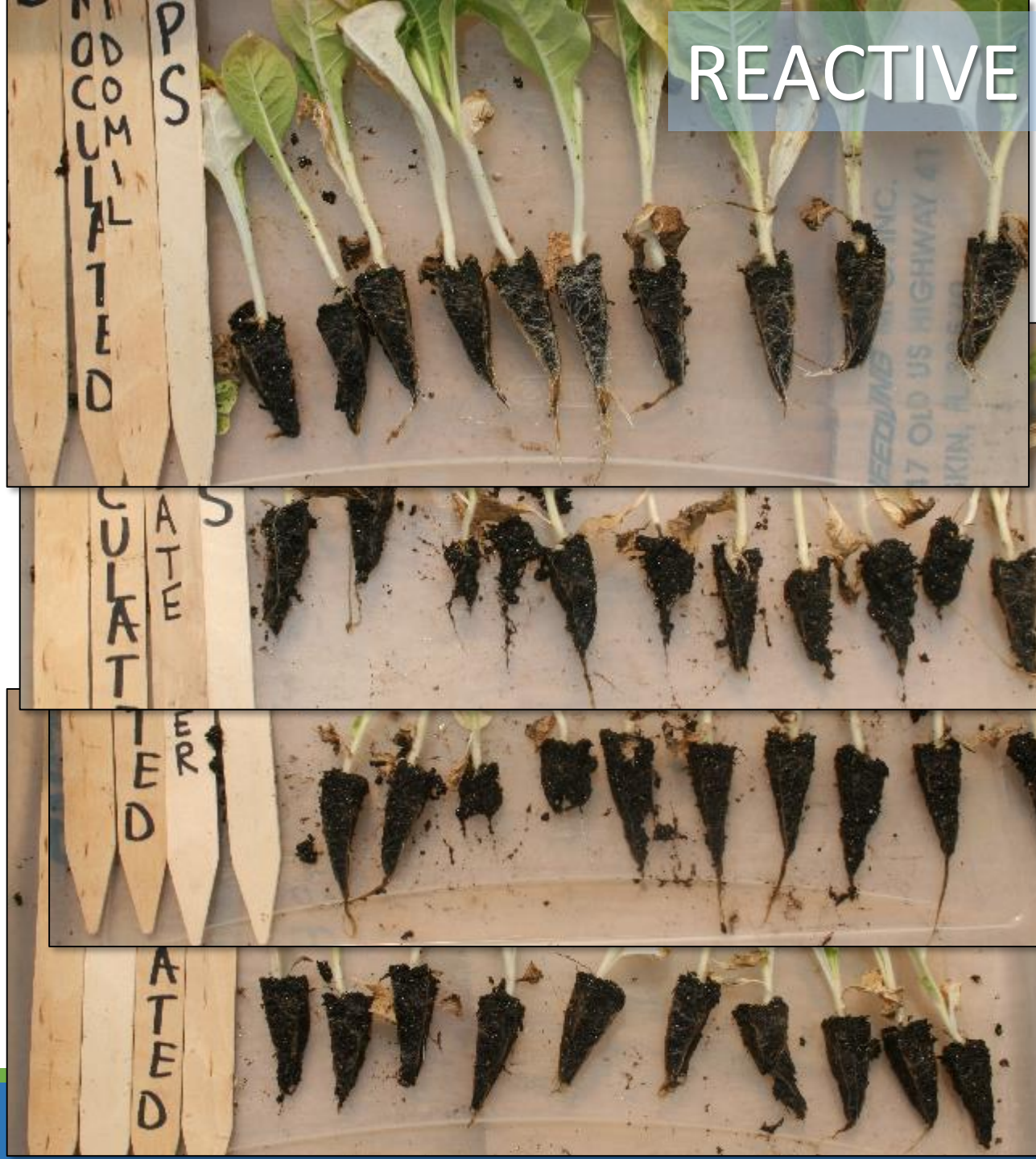


Oxidate

Terramaster

UTC

REACTIVE TREATMENTS



Ridomil

Oxidate

Terramaster

UTC

ucky; funded by Altria

PREVENTATIVE TREATMENTS

Terramaster-treated; no Pythium

UTC; with Pythium

By Pearce and Pfeufer labs at University of Kentucky; funded by Altria

PREVENTATIVE TREATMENTS

Terramaster-treated; no Pythium

Terramaster-treated; with Pythium

By Pearce and Pfeufer labs at University of Kentucky; funded by Altria

PREVENTATIVE TREATMENTS

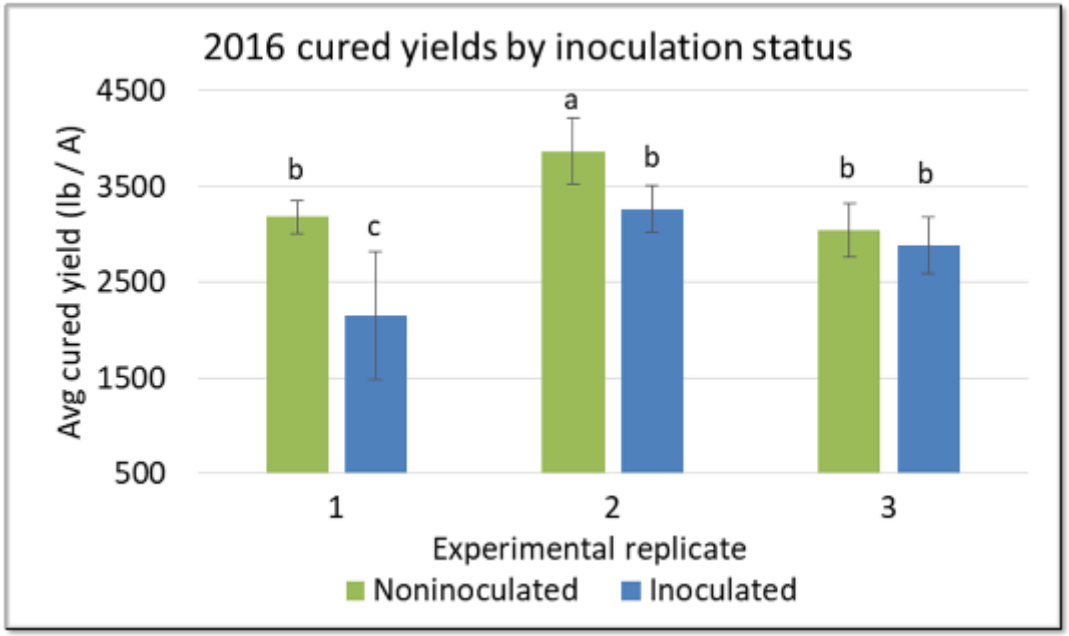
Ridomil-treated; no Pythium

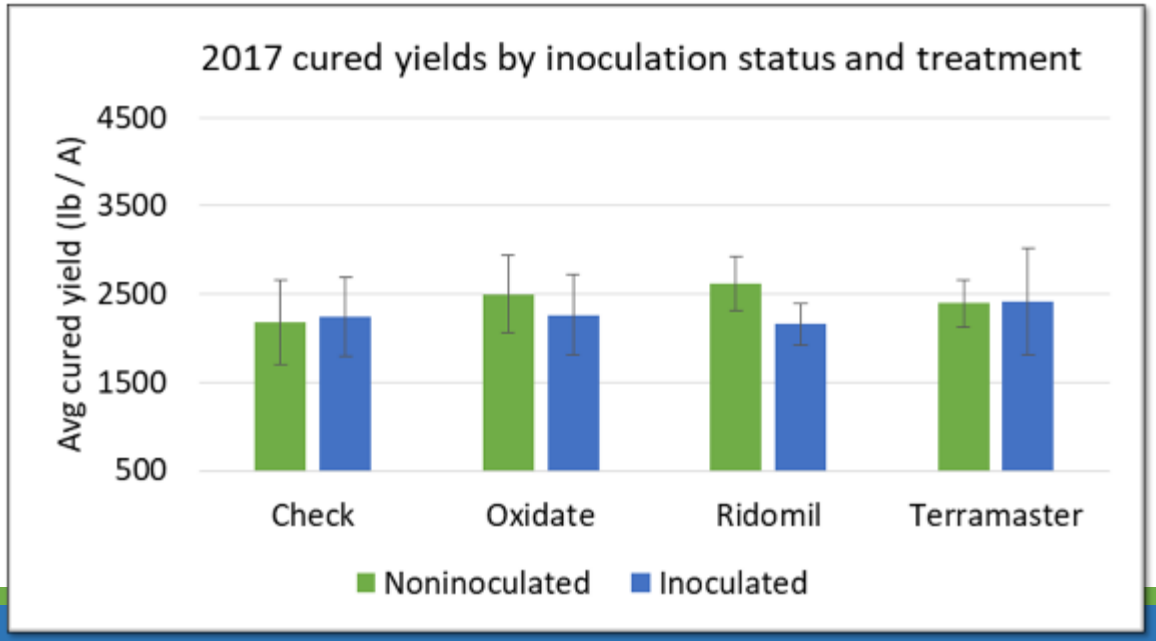
Terramaster-treated; with Pythium

By Pearce and Pfeufer labs at University of Kentucky; funded by Altria

Plants were rated for root ball quality before setting in field

- → No differences in final yields among fungicide treatments in either year
- → *Pythium*-infected plants, regardless of treatment, yielded 602 and 152 lb/A less yield compared to noninoculated plants in 2016 and 2017, respectively
- → Yield loss due to *Pythium* 9 – 17% (assuming $1.90/lb, this means $400 - $1050/A)





Best practices for raising healthy transplants

- New bed plastic, new trays
- Avoid introduction of natural soil
- Preventative fungicide treatment
  - when ½ the cells have water roots, 0.7 oz / 100 gal Terramaster
  - Circulate well
- At quarter-size plants, start Manzate applications on a 7 day schedule (0.5 lb / 100 gal; max 12 gal / 1000 sq ft)
- Monitor for insect damage
- Azoxystrobin app (4 ml / 1000 sq ft in 5 gal) after 1st or 2nd clipping
- Apply Manzate at least once more before going to field

From 2018 Tobacco Fungicide Guide (PPFS-AG-T-08)

Greenhouse disease management program outline

Timing	Product	Rate	Purpose
Dime-sized transplants	Mancozeb	1 tsp / gallon, Apply 3 gallons / 1000 sq ft	Target spot
Approx. 50% of cells with water roots	Terramaster	0.7 oz / 100 gal, circulated well	Pythium root rot
7 - 10 days after 1st mancozeb app	Mancozeb	1 tsp / gallon, Apply 3 – 6 gallons / 1000 sq ft	Target spot, collar rot
Day after first clipping	Azoxystrobin (Quadris, Aframe, AZteroid, Satori, or Azoxyzone)	1 tsp Quadris, Aframe, Satori, or Azoxyzone / 1000 sq ft (1.3 tsp AZteroid / 1000 sq ft)	Target spot
7 – 10 days after azoxystrobin	Mancozeb	1 tsp / gallon, 3 – 6 gallons / 1000 sq ft	Target spot, collar rot
3 weeks after 1st Terramaster treatment, or if roots develop obvious symptoms (not always necessary)	Terramaster	1.0 – 1.4 fl oz / 100 gal, circulated well	Pythium root rot
Every 7 – 10 days if holding plants	Mancozeb	1 tsp / gallon, 3 – 6 gallons / 1000 sq ft	Target spot, collar rot

NOTE:
For blackleg, a bacterial disease, streptomycin can be used to prevent disease development (100 ppm rate) or suppress spread of the disease once it is identified (200 ppm rate). In addition, N fertility should be moderate and steps should be taken to prevent high temperatures in the greenhouse.

Variety trial becomes accidental black shank trial

Black shank trial 2019

Funded by Syngenta, Certis, Drexel

- Conducted in Clark County, KY at black shank "nursery" – field has been in burley tobacco for at least 7 years
- Three varieties with different resistance backgrounds, using several different fungicide programs
- 24 total "treatments" replicated four times = 1 acre with borders

"Keys" to black shank management

1. Crop rotation (we didn't do this)
2. Resistant varieties (KT-215; rated 10 to race 0, 9 to race 1; TN-90; rated 4 to both races; H404; rated 1 to both races)
3. Fungicide applications – up to three among TPW, first cultivation, and layby

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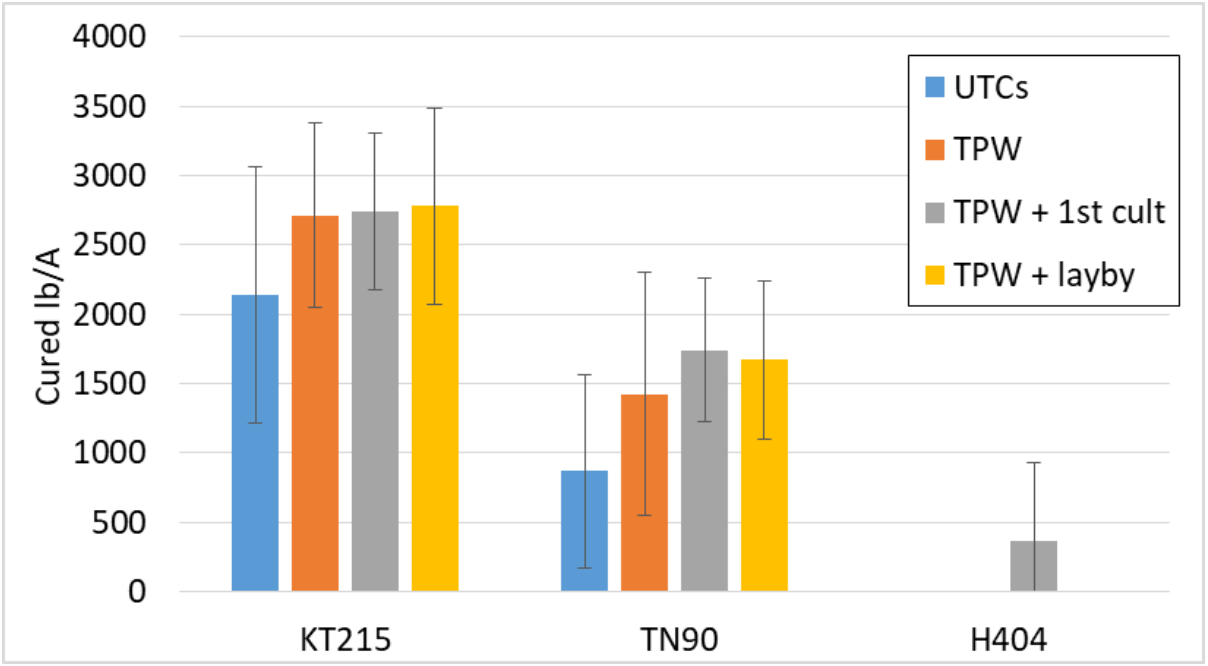
2019 Black shank data



TPW applications were Orondis Gold (4.8 oz) + Ridomil Gold (8.0 oz) administered through transplant water

Both types of post-transplant application were Presidio (4 oz/A) applied to either side of the plant row and cultivated in within 3 hr

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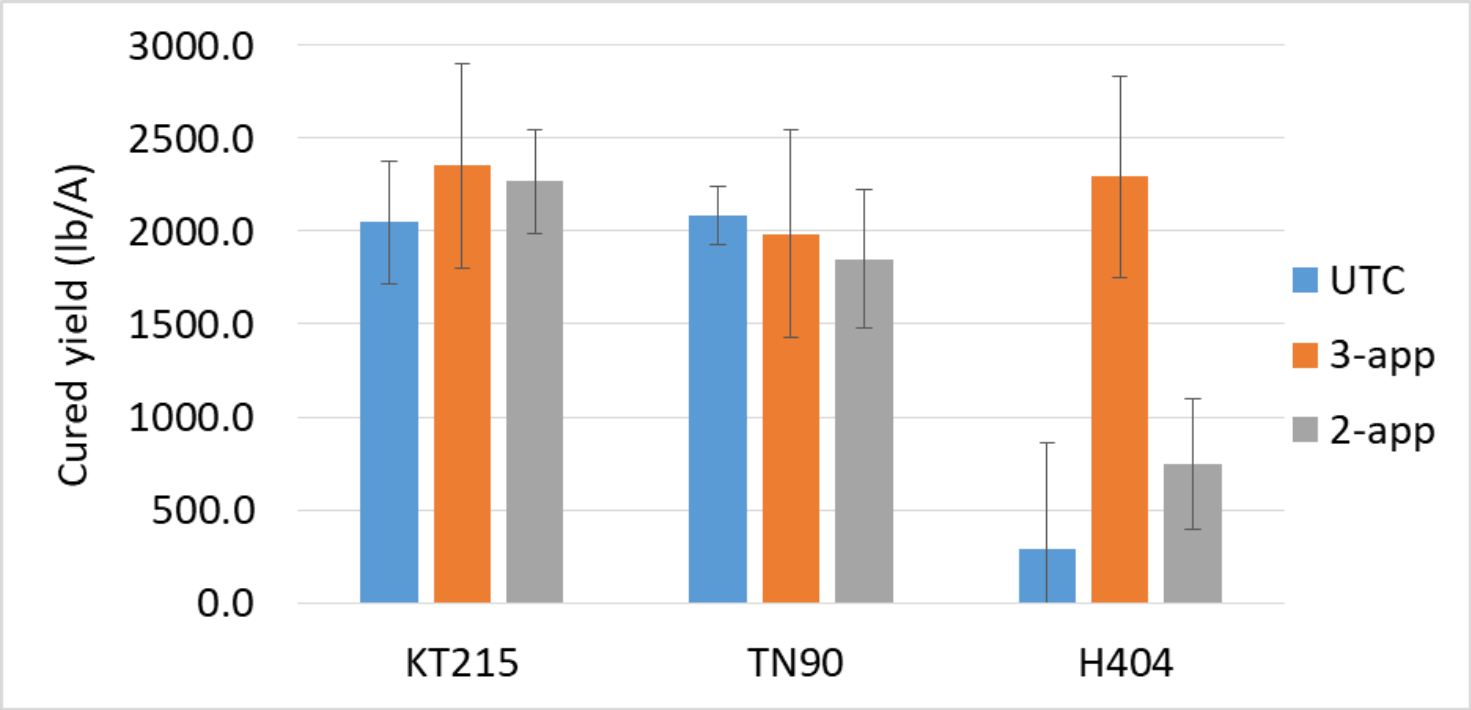
2018 Black shank data

- Low disease pressure across the state, also in this trial
- TPW water treatments were all Orondis Gold
- What the post-transplant treatment was did not matter
- Number of post-transplant treatments was important for the no-resistance variety H404



Black shank trial 2019

Funded by Syngenta, Certis, Drexel

"Keys" to black shank management

1. Crop rotation: 2-3 yrs out of tobacco
2. Resistant varieties: moderate resistance (or more) recommended to both races
3. Fungicide applications
    1. TPW is easiest and cheapest; Orondis Gold or Ridomil Gold
    2. 1st cultivation or layby; above options or Presidio
        1. Use Presidio if coarser soils or rain is forecasted
        2. Use RG on no-till or drier weather

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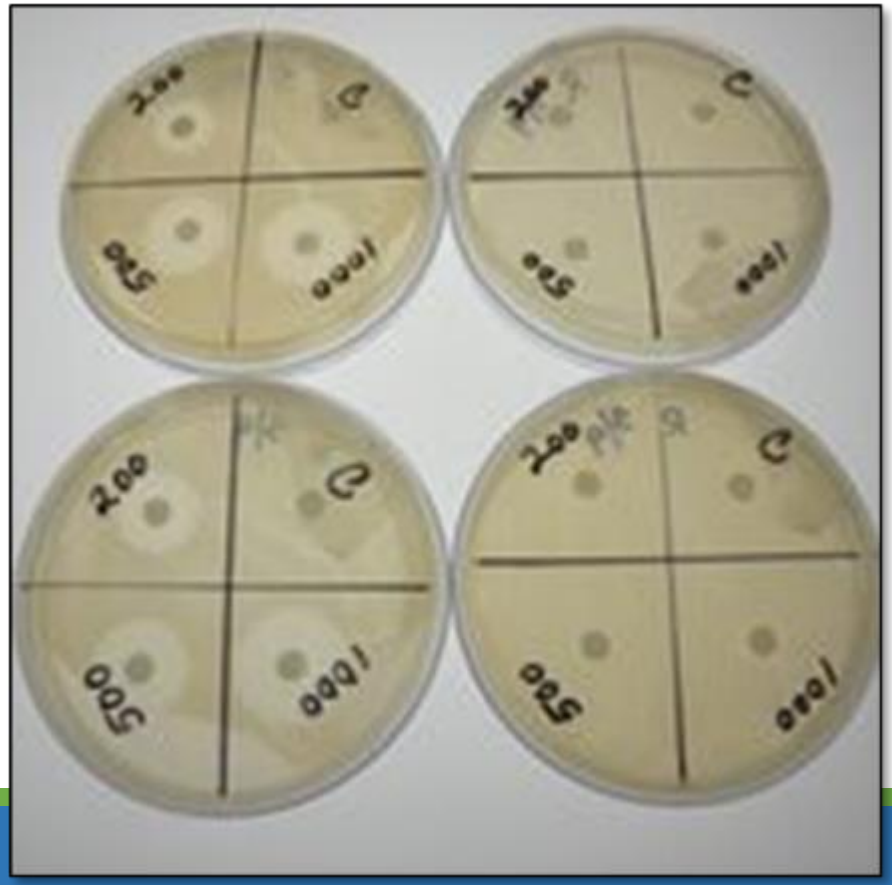
UK Ag EXTENSION

Resistance to streptomycin in *Pseudomonas syringae* pv. *tabaci*

- Simple protocol, typically executed in 7 days
- Resistant isolate results replicated
- Results returned to grower through county agent



A. Bailey, PSS

Supported by Altria Client Services

Resistance to streptomycin in *Pseudomonas syringae* pv. *tabaci*

2016: 1 / 13 isolates tested grew on 5000 ppm strep

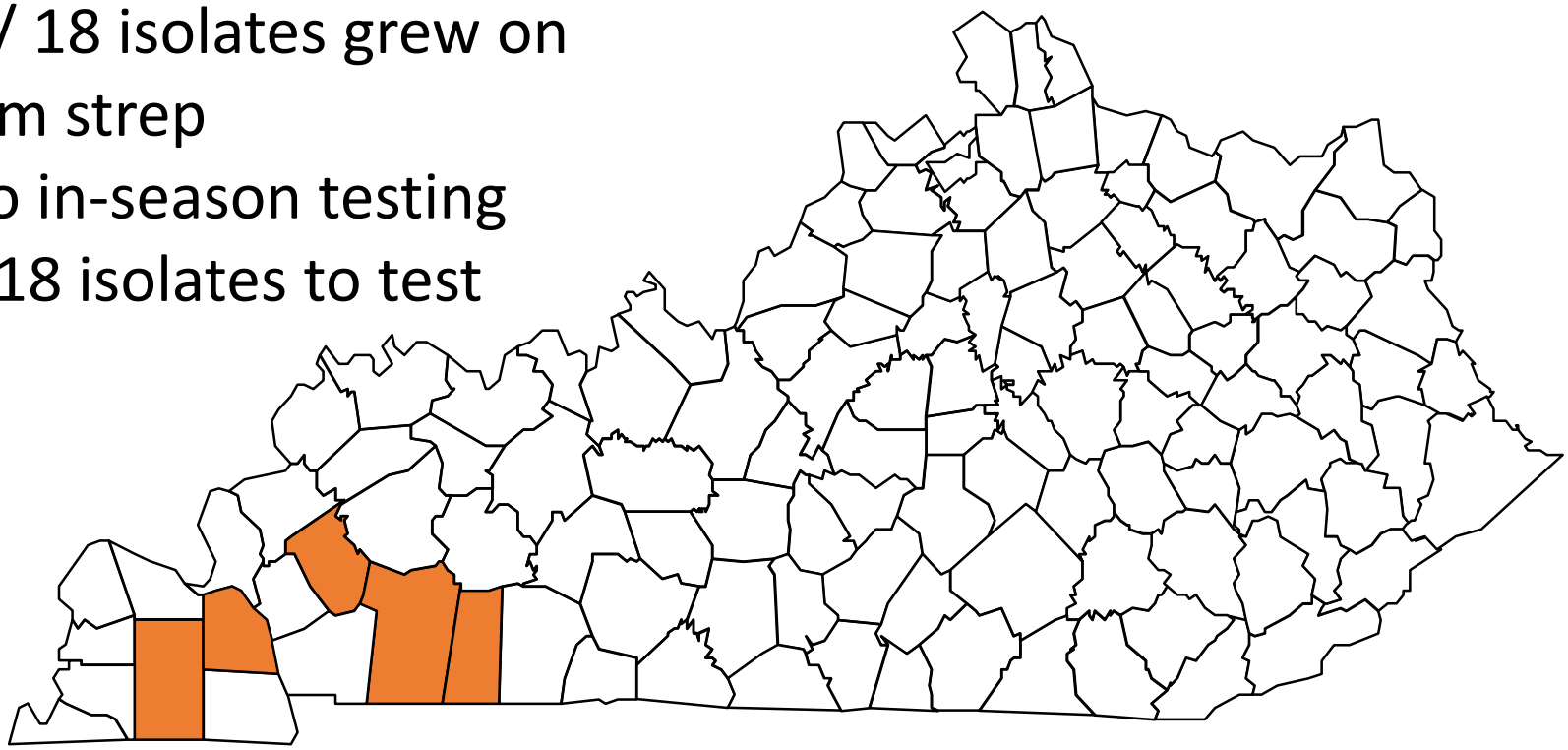
2017: 20/ 62 isolates tested grew on 1000 ppm strep

- 6 farms, 4 different counties

2018: 2 / 18 isolates grew on 1000 ppm strep

2019: No in-season testing

- 18 isolates to test



General recommendations for maximizing the efficacy of biologicals

- Match the biological to the target disease
  Some biologicals will only be effective against certain diseases
- Apply before disease is present
  Many biologicals either “prime” tobacco’s defenses or inhibit disease based on numbers
- Minimize environmental stresses at application time
  Many biologicals are living organisms sensitive to heat and light
- Ensure compatibility
  Don’t tank mix with azoxystrobin (fungi) or streptomycin or copper (bacteria). Check the pH of your mix water.

2019 Angular leaf spot data

Funded by Altria, Valent

- Two trials conducted in Princeton and Murray, KY
- KTD-8LC
- Inoculated with *P. syringae* pv. *tabaci* (the ALS pathogen)

Princeton treatments	7/2	INOCULATED	7/17	7/24	8/1	8/8	8/15
UTC							
Streptomycin 200 ppm			x	x	x	x	x
Regalia 1 gal			x	x	x	x	x
Leap 1 qt + Nordox 4 lb			x	x	x	x	x
Trilogy 2 pt			x	x	x	x	x
Serifel 1 lb			x	x	x	x	x
Kphite 3 qt			x	x	x	x	x
Stargus 4 qt			x	x	x	x	x
Botrystop 2 lb			x	x	x	x	x
Pre-trt strep 200 ppm	x		x	x	x	x	x

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2019 Angular leaf spot data

Treatment Name	AUDPC	Yield (kg ha^{-1})
Leap+Nordox	548.8 a	3933 A
Regalia	716.5 ab	3824 A
Botrystop	771.4 ab	3794 A
Trilogy	778.4 b	3740 A
Streptomycin pretreat	791.9 b	3804 A
Streptomycin	831.4 b	3781 A
Kphite	839.4 b	3834 A
Serifel	845.2 b	3814 A
Stargus	846.1 b	3874 A
Untreated Control	927.8 b	3856 A

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2019 Angular leaf spot data

- Two trials conducted in Princeton and Murray, KY
- KTD-8LC
- Inoculated with *P. syringae* pv. *tabaci* (the ALS pathogen)

Murray treatments	7/15	INOCULATED	7/29	8/5	8/12	8/19
UTC						
Streptomycin 200 ppm	x		x	x	x	x
Milstop 5 lb/100 gal	x		x	x	x	x
Nordox 4 lb	x		x	x	x	x
Lifegard 4.5 oz	x		x	x	x	x
PAA 35 oz/100 gal	x		x	x	x	x
Serifel 1 lb	x		x	x	x	x

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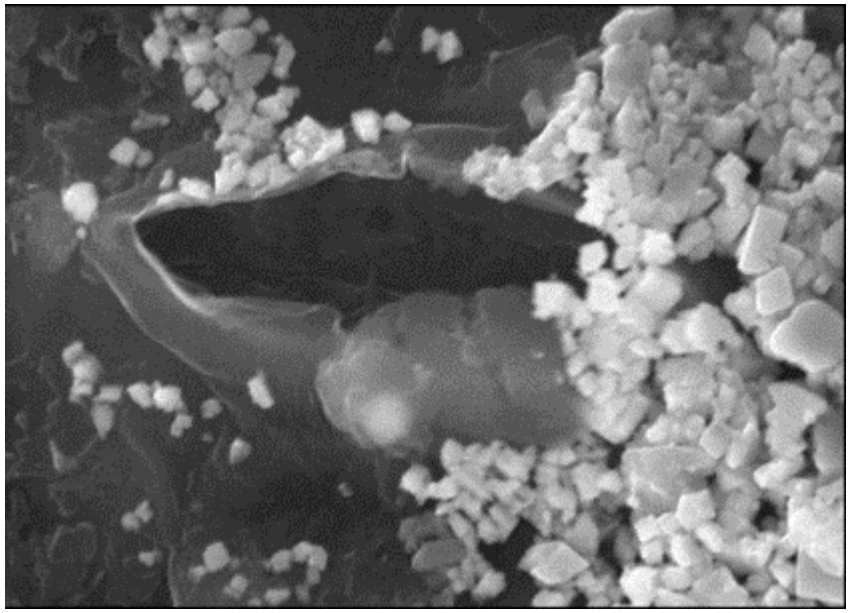
2019 Angular leaf spot data

Treatment Name	Sept 10 rating	Yield (kg ha^{-1})
Nordox	33.1 A	3755 a
Milstop	32.4 A	3054 b
Untreated Control	33.4 A	2843 bc
PAA	31.1 A	2829 c
Serifel	27.6 A	2799 c
Streptomycin	34.0 A	2742 c
Lifegard	35.5 A	2628 c

** Check your contract or with your field rep on copper acceptability

Coppers in bacterial disease mgmt

- Various copper formulations are available
- Particle sizes and shapes vary; inerts?
  - High solubility improves coverage, decreases retention
- Copper must be deposited before pathogen encounters plants
- Cu2++ ions are released with precipitation
- Torr et al.



Deepening our understanding of ALS

Levels of in-field diversity?

Are certain production factors related to higher ALS[2]?

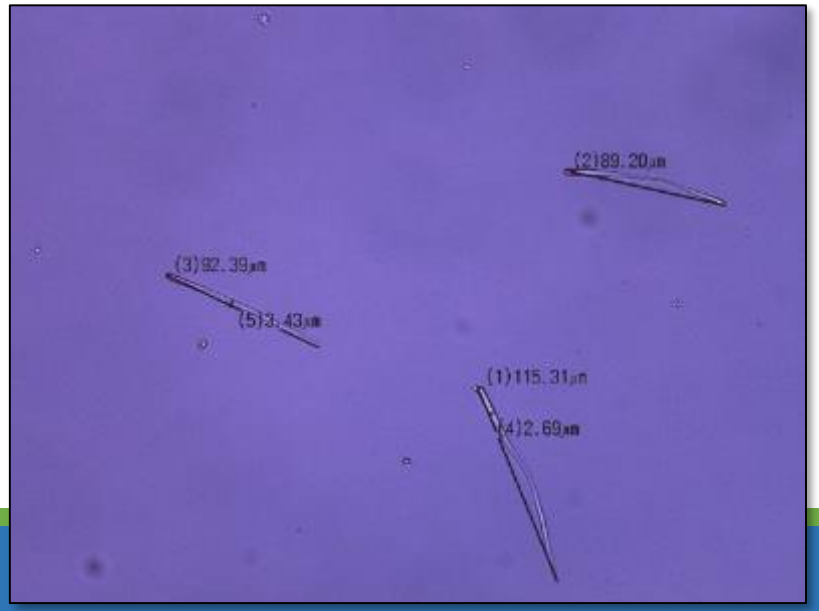
- Preplant fertility
- Varieties grown
- Reduced tillage
- Soil temperatures
- Average rainfall

[2]Pfeufer and Gugino, 2018. Plant Dis. 102:2205-2211

Cercospora nicotianae causes frogeye

- Relatively little published about epidemiology
- No sexual cycle documented
- Host range is Solanaceous plants
  - Nightshades, jimsonweed, groundcherries
  - Soybean?
- Characterized as a “weak parasite,” that only attacks declining plant tissue

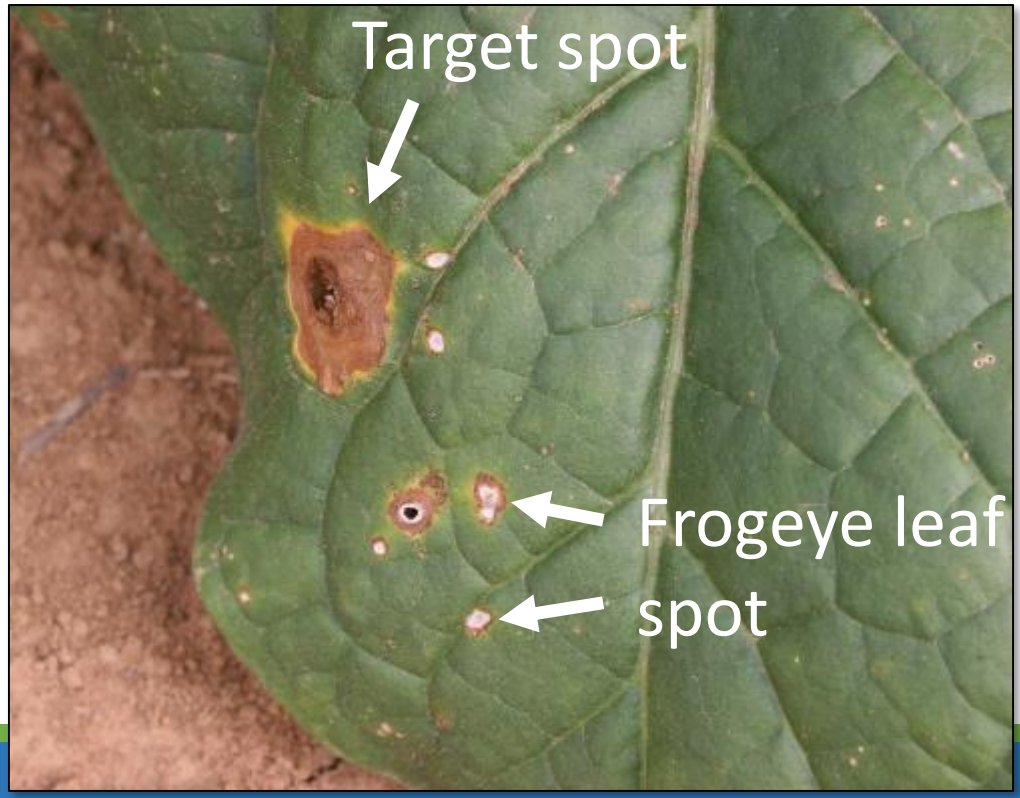

Dixon, 2017



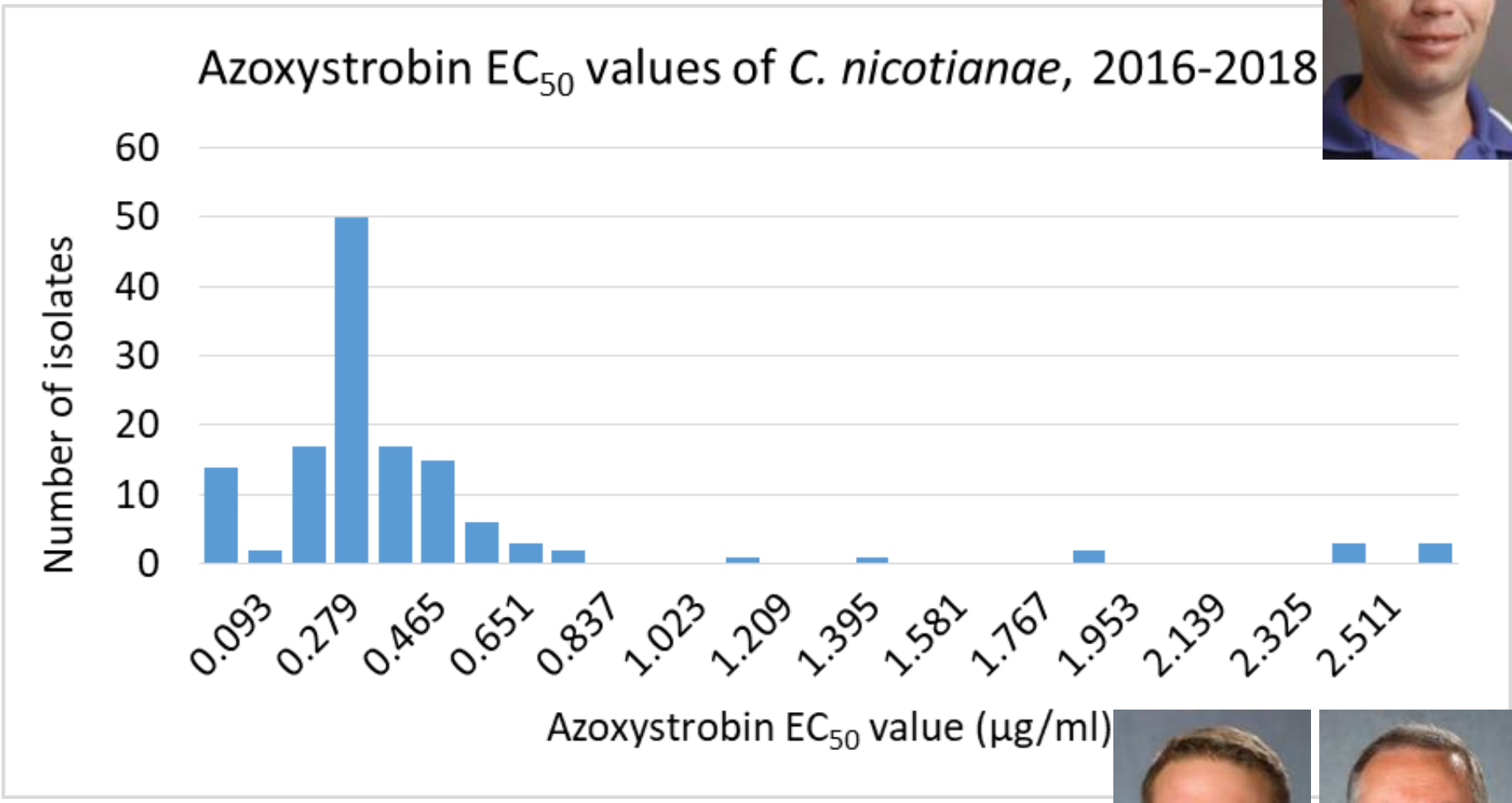
Azoxystrobin fungicide

- Only systemic AI labeled for fungal leaf spots in tobacco
- Prevents fungal respiration by binding to Qo site in cytochrome bc1 complex
  - Three resistance mutations: F129L, G137R, G143A

- Resistance documented in *C. sojina, C. beticola,* many pathogens
  - Vast majority G143A
- Tobacco producers make 2+ apps / crop
  - Fungicide rotations?



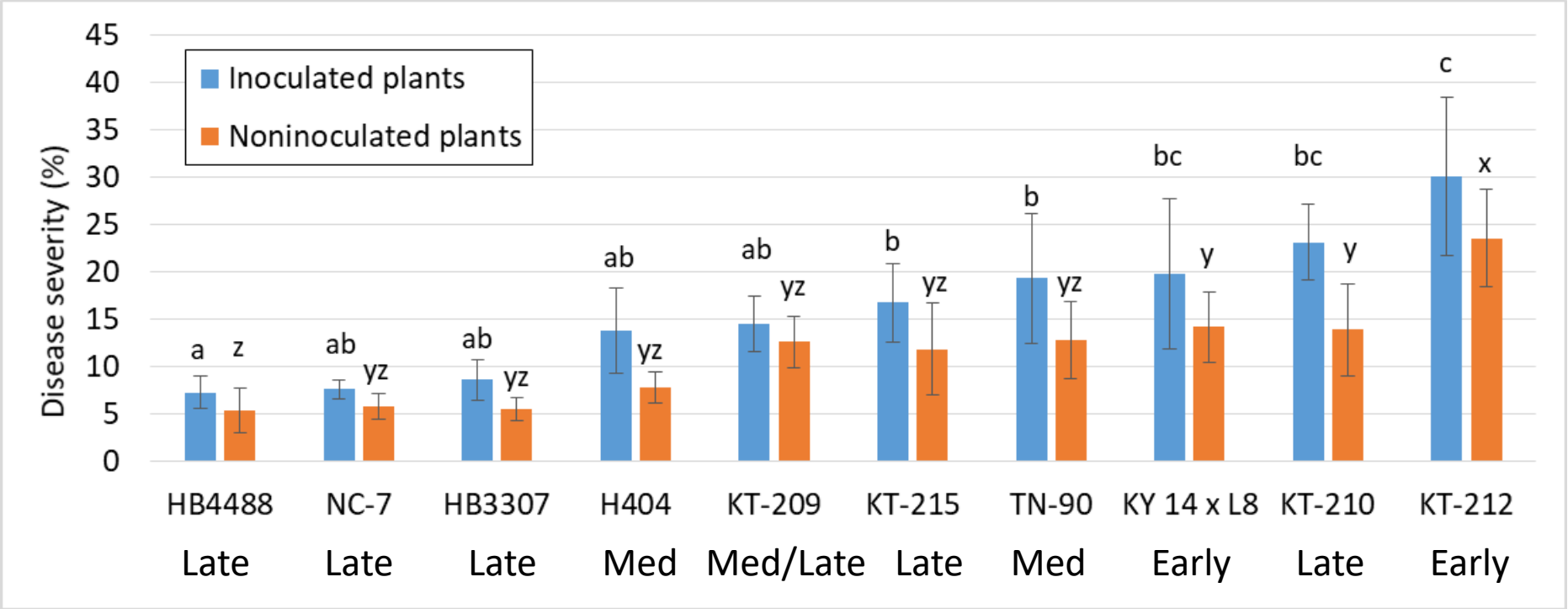
Azoxystrobin fungicide sensitivity



Trimodal distribution

2017 research farm variety trial – frogeye leaf spot

Five most recently, fully expanded leaves rated using Horsfall-Barratt scale

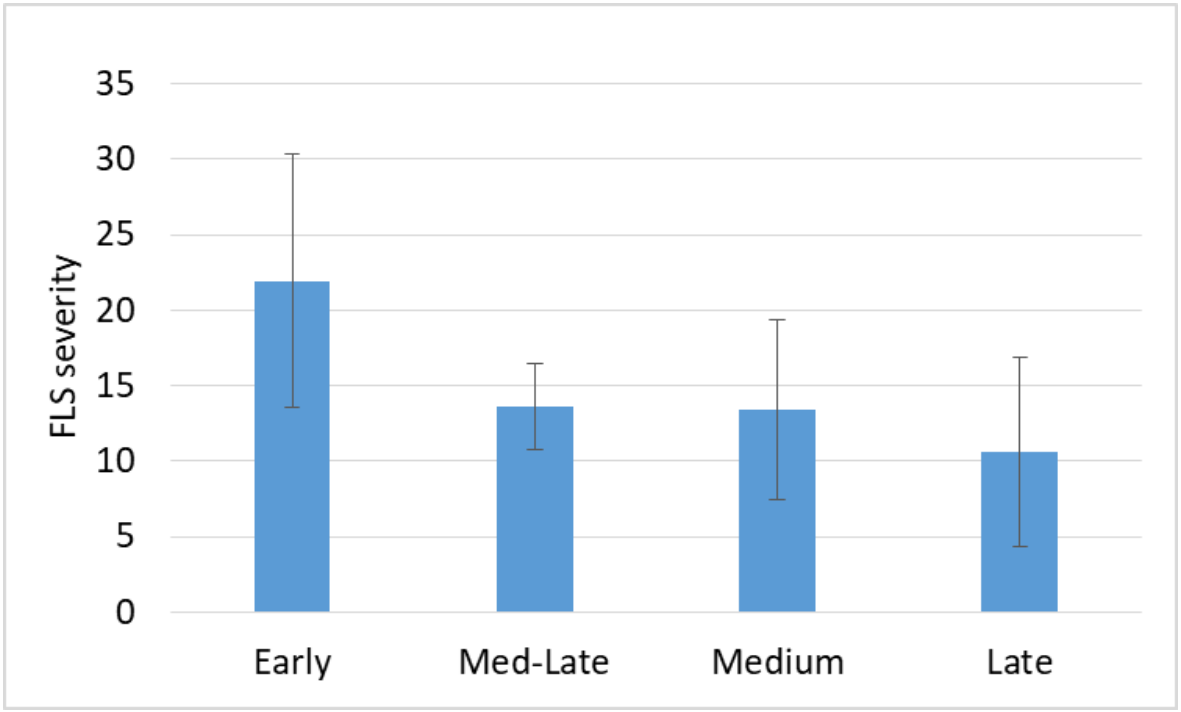


September 26 rating

→ KT-212, KT-210, and KY 14xL8 had highest severities

2017 research farm variety trial – frogeye leaf spot

Summarized by maturity; final FLS disease rating



→ Early maturing varieties significantly worse than medium to late maturing varieties

2019 Frogeye fungicide trial

(funded by Burley Tobacco Growers Cooperative)

- Conducted on Spindletop Farm in Lexington
- Variety KT-212LC (early maturing; early maturing varieties seem to have greater FLS severity)
- Inoculated with a 1:1:1 mixture of isolates based on their sensitivity to azoxystrobin (Quadris) – three levels of sensitivity, equally represented

Treatment	Spray 1	Spray 2	Spray 3
UTC			
Grower std	Quadris 8 oz	Manzate 2 lb/100 gal	Quadris 8 oz
Grower alternative	Quadris 8 oz	Nordox 3 lb	Quadris 8 oz
Increased rate	Quadris 12 oz	Manzate 2 lb/100 gal	Quadris 12 oz
Bio1 (Lifegard)	Quadris 8 oz	Lifegard 4.5 oz	Quadris 8 oz
Bio2 (Double Nickel)	Quadris 8 oz	Double Nickel 3 qt	Quadris 8 oz
Bio Only	Lifegard 4.5 oz	Double Nickel 3 qt	Lifegard 4.5 oz

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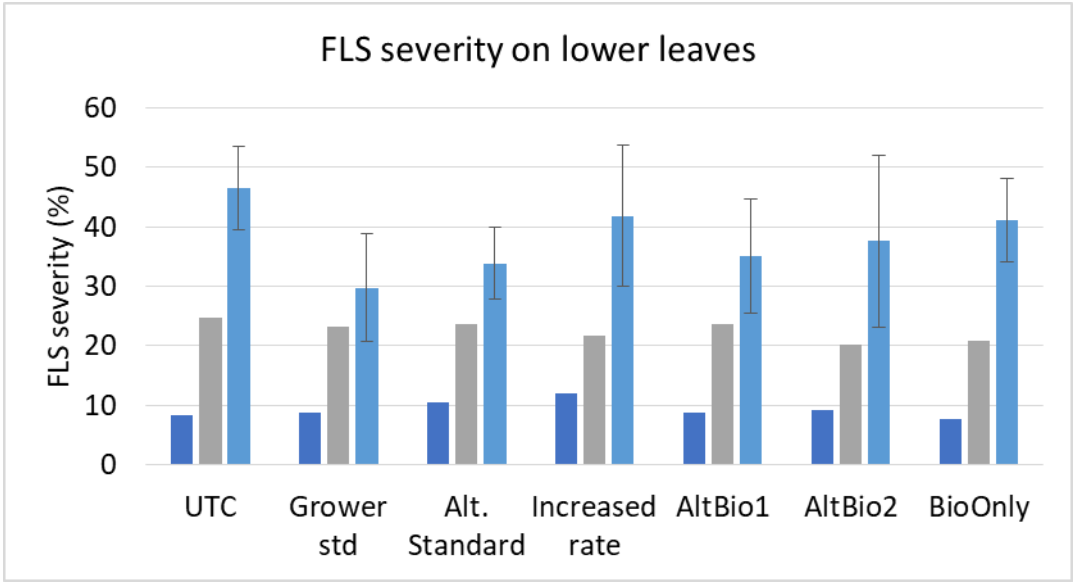
2019 Frogeye fungicide trial

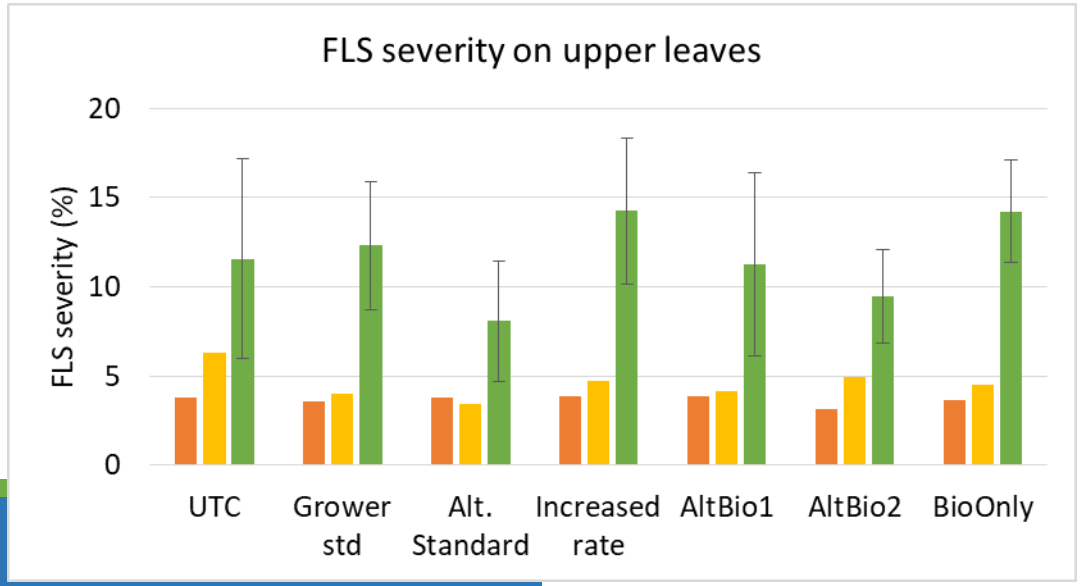
(funded by Burley Tobacco Growers Cooperative)

Lower leaves: only difference is between grower standard and UTC on last rating date
(Quadris 8 oz – Manzate 2 lb – Quadris 8 oz)
*NOTE EXTENDED PHI FOR MANZATE: 30 days
** CHECK YOUR CONTRACT ON YOUR ABILITY TO USE MANZATE

Upper leaves: no statistically significant differences

***No differences in yield (not shown)





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Disease management requires an integrated approach

- Clean materials and equipment + preventative Terramaster + weekly Manzate + azoxystrobin after 1st clipping (transplant diseases)
- Field rotation + preplant N application + reducing plant damage (angular leaf spot)
- Field rotation + resistant varieties + soil- (black shank)
- Field rotation + varieties + foliar fungicides (frogeye leaf spot)

Funding sources: Council for Burley Tobacco, Burley Tobacco Growers Cooperative, Altria, JTI, PMI, Syngenta, Certis, Valent, Drexel