



# **Disease Management Practices for Dark Tobacco in Kentucky and Tennessee: Angular Leaf Spot and Black Shank *Angular Leaf Spot and Black Shank***

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# Angular Leaf Spot (ALS) Infection

*Pseudomonas syringae* pv. *tabaci*



- Outbreaks occur after heavy storms
- Normally occurs on lower/mid stalk first from ground
- Can occur in the top of the plant first
  - Bacteria can come in on raindrops or even heavy fog and infect if plant is damaged
- Limited effectiveness from spray programs
  - Low infections can be managed with spray programs with favorable weather
  - Severe infections with unfavorable weather cannot be effectively managed.
- No resistance in current dark tobacco varieties

# Trial Conducted at University of Kentucky and University of Tennessee

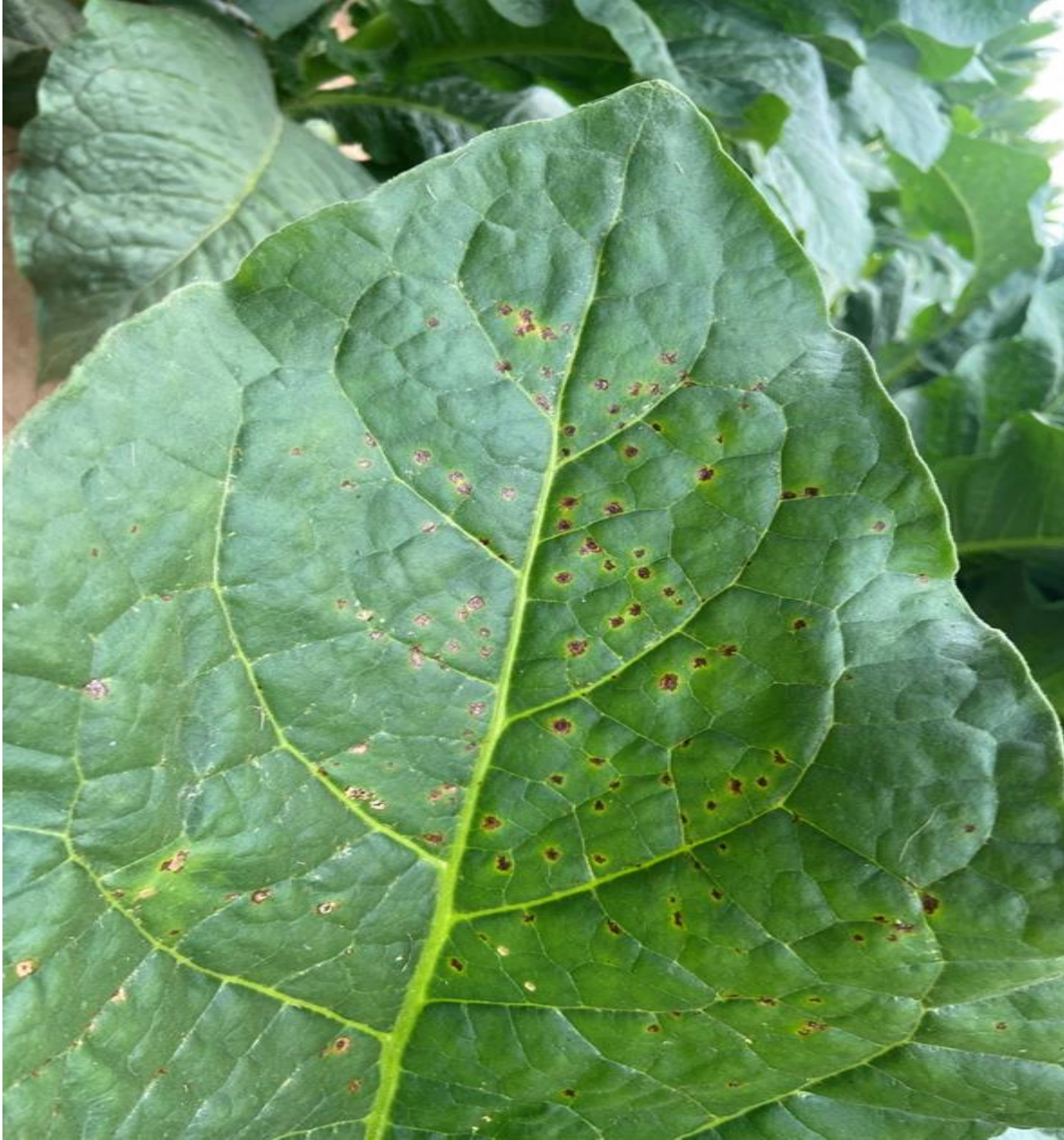
- No dark tobacco varieties have resistance to ALS although some do have resistance to wildfire (Hansen and Zeng, 2023)
- Dark tobacco varieties have varying levels of susceptibility (Keeney et al., 2021)
  - 17 varieties included within this study
    - Two varieties were highly susceptible
    - 11 varieties were moderately susceptible
    - Four varieties were less susceptible

**Table 1.** Characteristics of dark tobacco varieties.

Variety	Maturity	Black Shank (0-10) <sup>a</sup>		Use <sup>b</sup>	Relative Yield Score <sup>c</sup>	Relative Quality Score <sup>c</sup>	Black Root Rot <sup>d</sup>	TMV	Wildfire	Angular leaf spot <sup>e</sup>
		Race 0	Race 1							
NL Mad LC	Med-Late	0	0	F/A	7	9	S	S	S	S
TR Madole	Early-Med	0	0	F	6	6	S	S	S	S
Lit Crit	Med-Late	0	0	A/F	5	9	S	S	S	LS
KY 171 <sup>f</sup>	Medium	0	0	A/F	7	7	R	R	S	S
VA 309	Early-Med	2	2	A/F	6	7	S	S	-	S
VA 359	Medium	1	1	A/F	6	7	S	S	-	-
TN D950	Early	3	3	F	8	6	R	R	R	HS
KT D6LC	Early-Med	3	3	F	8	7	R	R	R	S
KT D8LC	Medium	4	4	F/A	9	5	S	S	S	S
KT D14LC	Medium	10	5	F/A	8	6	R	R	R	S
KT D17LC	Medium	10	6	F/A	9	7	R	S	R	HS
DT 538 LC	Medium	4	4	F/A	8	6	M	-	-	LS
DT 558LC	Medium	4	4	F/A	8	7	M	S	-	S
PD 7302LC <sup>g</sup>	Medium	10	0	F/A	6	7	R	R	-	-
PD 7305LC	Early	10	3	F	8	6	R	R	R	S
PD 7309LC	Medium	10	0	F/A	7	8	S	S	-	LS
PD 7312LC <sup>f</sup>	Medium	0	0	A/F	7	8	R	R	S	S
PD 7318LC	Medium	10	0	F/A	8	7	R	R	-	LS
PD 7319LC	Medium	10	1	F/A	8	7	-	R	-	S

# Disease Symptomology

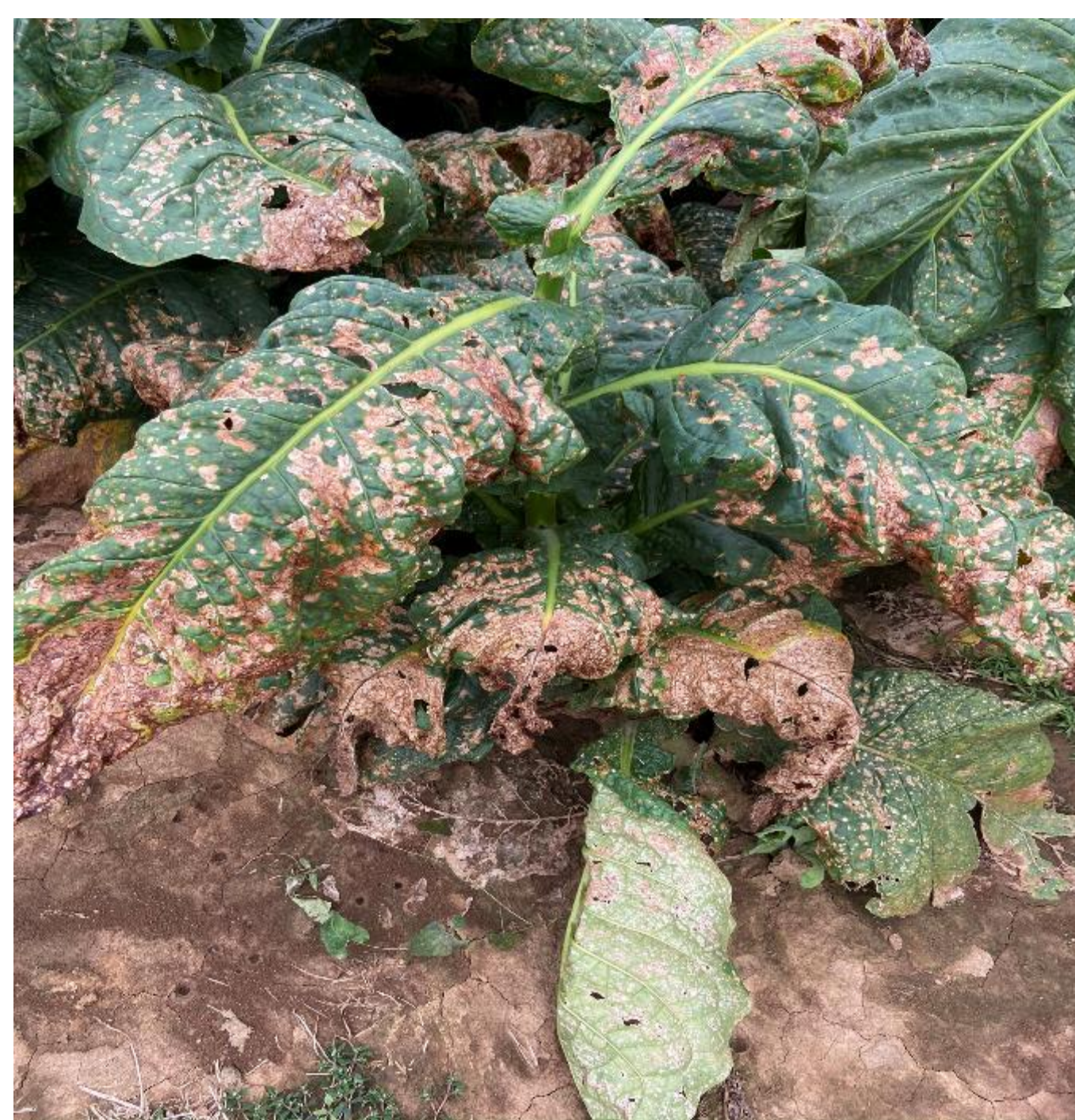
Approximately 2 weeks following infection





# Disease Symptomology

Approximately 5 weeks following  
infection



# Disease Symptomology

Approximately 3 days before  
harvest

# Current Concerns with Angular Leaf Spot

- Currently, angular leaf spot is a significant tobacco disease in several major tobacco producing areas of the world and has become the most significant foliar disease of dark fire-cured tobacco in the Kentucky-Tennessee production area since 2015.
- One main control mechanism---streptomycin
- Since 2015, there have been documented cases of resistance to streptomycin at 200 ppm
- 2015-2022: 120 samples have been confirmed to be ALS, 28 of these samples have been confirmed to have streptomycin resistance (~25%)
- Manufacturers: complaints about yield loss curing processing tobacco in heavily infested crops.

# Recent History of Angular Leaf Spot Research in Kentucky

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- Major research projects initiated since outbreaks in 2015
- Bacteriocide screening field trials:
  - >25 products tested since 2015
    - Compared to streptomycin (standard)
    - Biological products
    - Copper products
    - Systemic Acquired Resistance products (SAR)
    - Surface sterilants
  - Products that show promise are retained from year to year
  - Products that appear ineffective are dropped
- Some products have shown some effect in reducing infection
- No products have been very “effective”





# Severe Outbreaks of ALS in 2023

## Dark Fire-cured Belt of west KY/TN

Heaviest angular leaf spot pressure since 2016



Some severe cases appear to be worse in top of plant

# Cumulative Rainfall and Rainfall Intensity Increases ALS Probability - 2023

County	July 2023 Rainfall (inches)	August 2023 Rainfall (inches)	Total Rainfall (in.) July-August 2023*	Average ALS Incidence**
Caldwell	11.2	8.9	20.1	High
Trigg	3.0	8.0	11.0	Low
Calloway	10.7	10.0	20.7	High
Graves	12.8	10.9	23.7	High
Christian	5.5	5.8	11.3	Low
Todd	4.7	8.3	13.0	Moderate
Logan	3.8	6.7	10.5	Low

\*Average annual rainfall ~50 in. \*\*Individual rain events of 6 to 10 in. in counties with high incidence.

# 2023 Angular Leaf Spot Field Trial

## Murray, KY

Trt	Treatment	Rate
1	Untreated Control	-
2	Streptomycin (4 apps.)	1 lb/100 gal (200 ppm)
3	Copper Oxide (Nordox) (2 apps.) Copper Octanoate (Cueva) (2 apps.)	4 lb/A 1.5 gal/A
4	<i>Ulocladium uudemansii</i> U3 (Botrystop) (4 apps.)	2 lb/A
5	Acibenzolar-S-methyl (Actigard) (3 apps.)	0.5 oz/A
6	Actigard Streptomycin Nordox Cueva	0.5 oz/A 1 lb/100 gal (200 ppm) 4 lb/A 1.5 gal/A

- KTD8 transplanted May 31, 2023 (4900 plants/A)
- RCBD with 4 replications
- All plots inoculated at 5 wks after transplanting
  - 16P-475 Strep-sensitive, Natalia Martinez

### Application Timings and spray volumes:

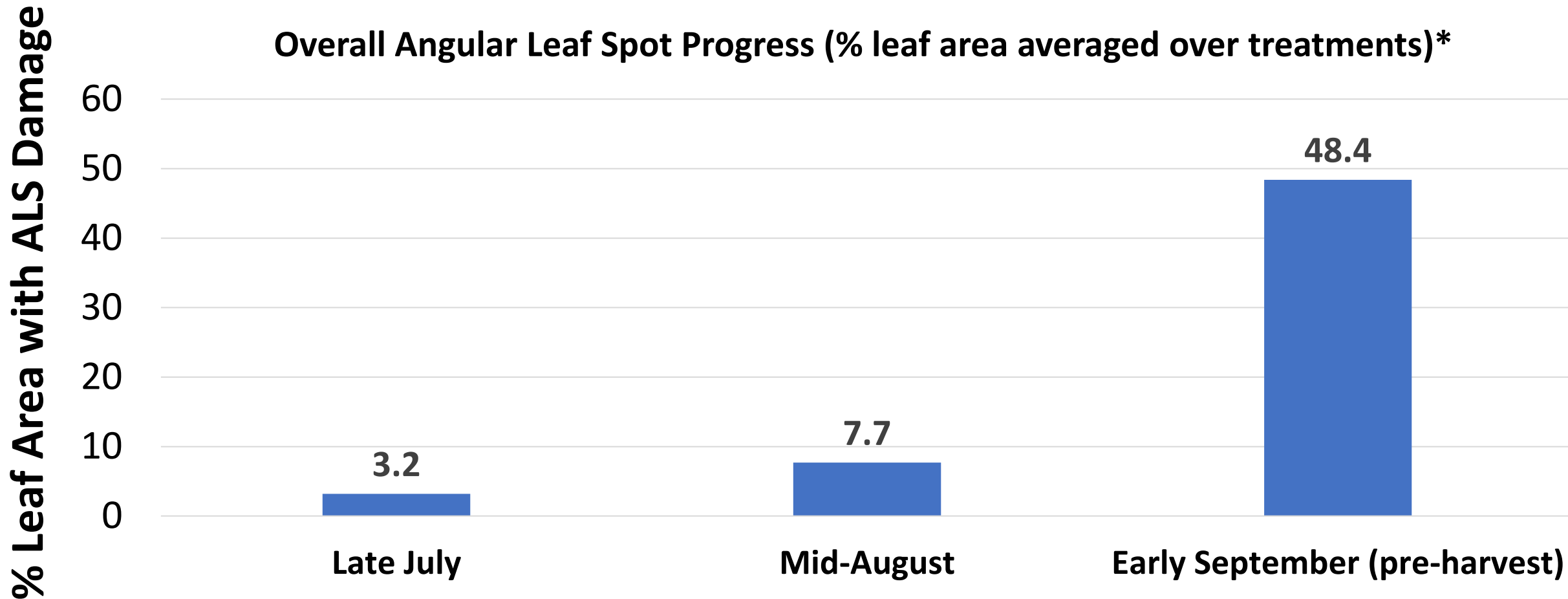
- Pre-inoculation (4 wks) – 15 gal/A
- Post-inoculation (6 wks) – 25 gal/A
- Topping (8 wks) – 40 gal/A
- Pre-harvest (10 wks) – 50 gal/A

# 2023 Angular Leaf Spot Field Trial

## Average Disease Progress

### Murray, KY

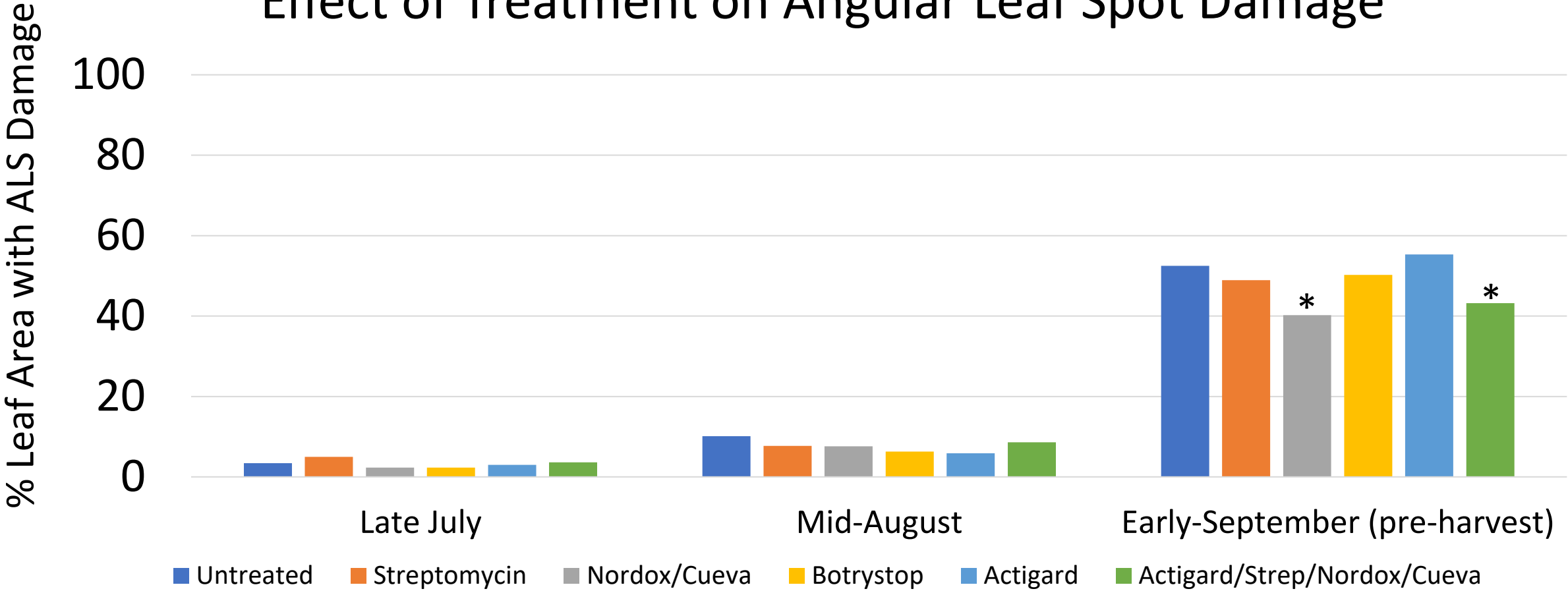
Overall Angular Leaf Spot Progress (% leaf area averaged over treatments)\*



\*Significant increases in ALS disease progress during the 2023 season.

# 2023 Angular Leaf Spot Field Trial Murray, KY

## Effect of Treatment on Angular Leaf Spot Damage



# Angular Leaf Spot Spray Programs – 2023 Field Trial

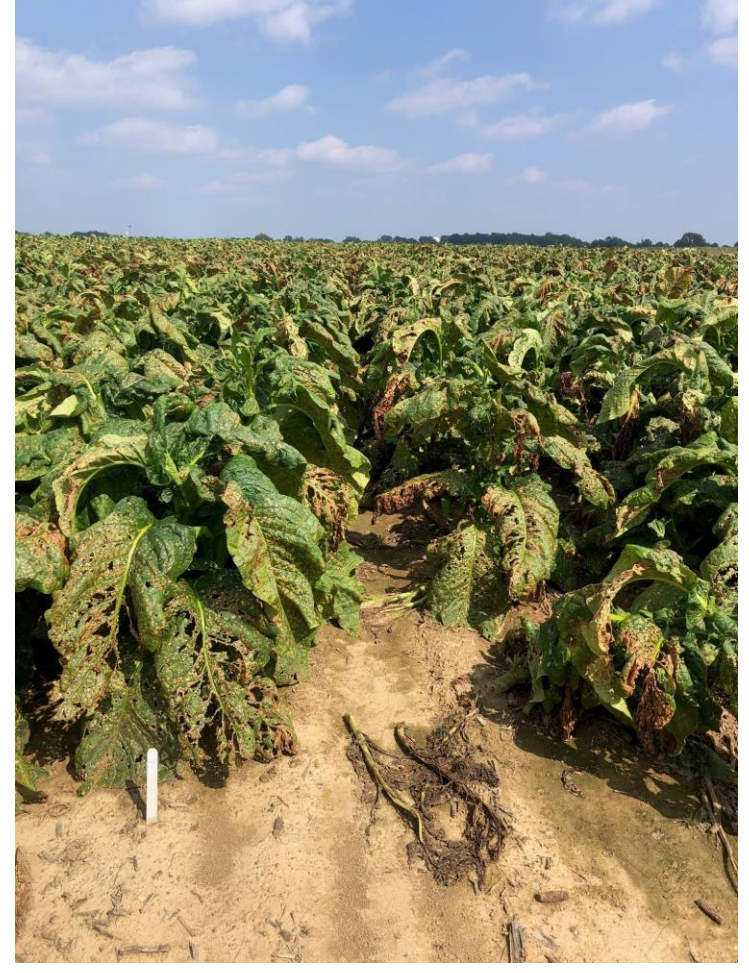
*Very Limited Effectiveness in High Disease Pressure*



**Untreated**  
**56% leaf area**



**Streptomycin**  
**51% leaf area**



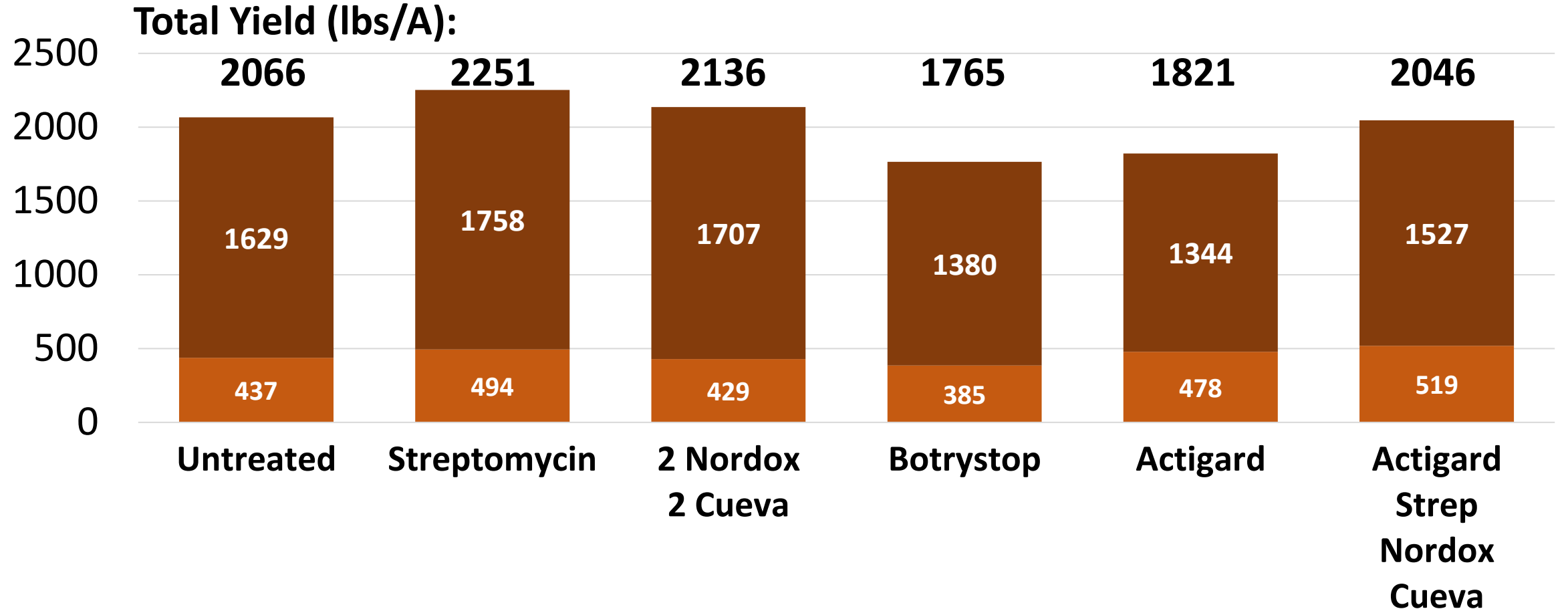
**Nordox-Cueva**  
**40% leaf area**

# 2023 Angular Leaf Spot Field Trial

## Dark-Fired Yield

### Murray, KY

Dark-Fired Yield (lbs/A)



**Severe infections of ALS  
in weather conditions  
favorable for infection  
cannot be controlled  
with current products.**







# Black Shank

- Destructive soil-borne disease caused by *Phytophthora nicotianae*
- First identified in Kentucky in 1934 (Todd Co.)
- Much less resistance in dark tobacco than in burley.
- Little or no resistance in cigar wrapper types

# Black Shank 2023

- Attacks root system
- Plants can survive with infected root system with adequate rainfall
- Sudden crash when conditions get dry



# Fungicides Registered for Black Shank Control

- Ridomil Gold SL (mefenoxam)
  - Pre transplant broadcast or Post transplant directed – 1 to 2 qt/A up to Layby
  - Transplant water: 4 to 8 oz/A
- Orondis Gold (mefenoxam + oxathiapiprolin)
  - Transplant water: 24 to 27.8 oz/A
- Presidio (fluopicolide)
  - 4 oz/A after transplanting

# Dark Tobacco Black Shank Fungicide Trial

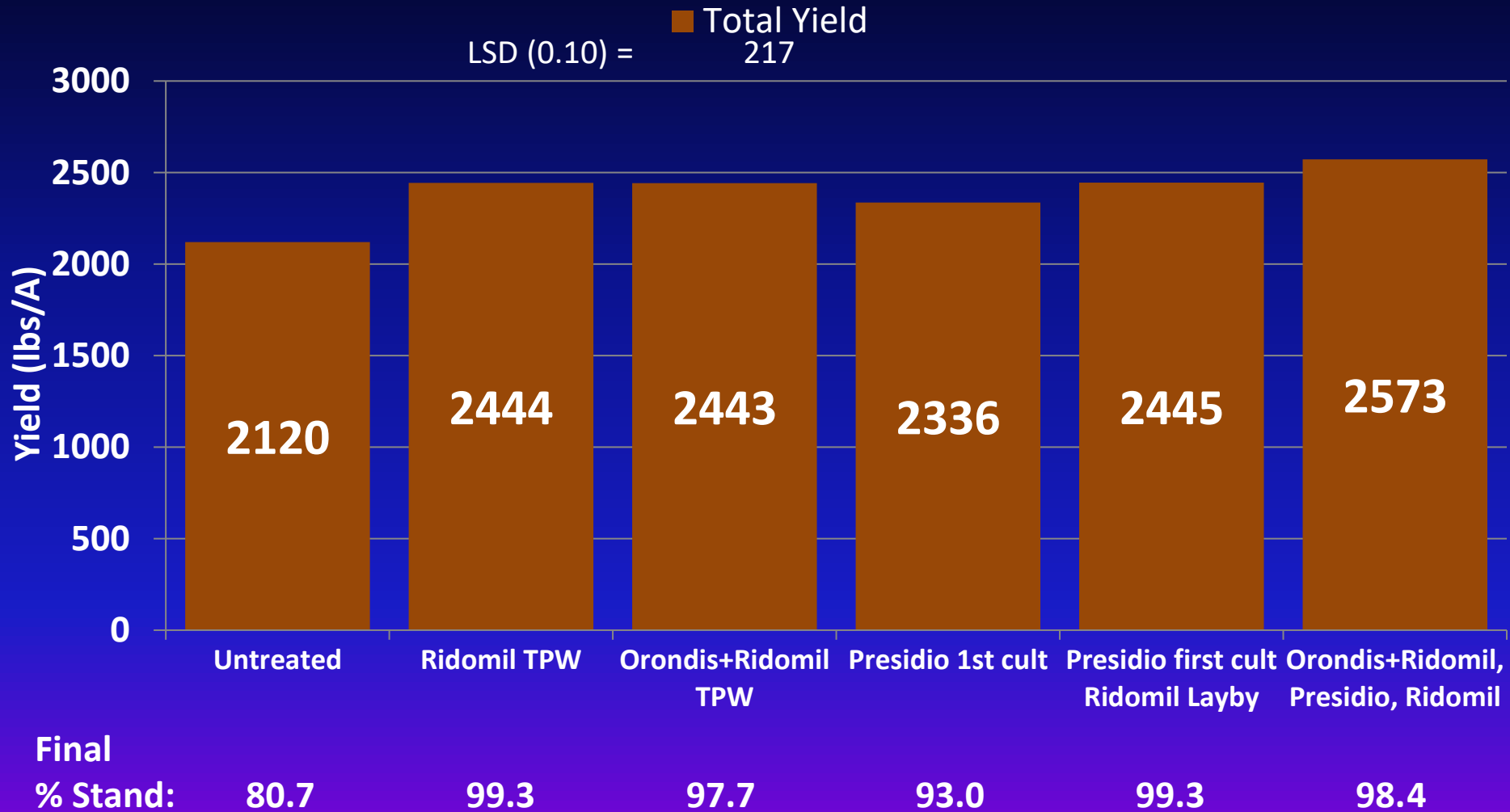
## Kent Boyd Farm – Hopkinsville KY - 2018

- KT D6 set June 18
  - 40” x 32” = 4900 plants/A
- Transplant water (TPW) applications made June 18
- 1<sup>st</sup> cultivation applications made July 2
- Layby applications made July 18

Treatments:		
1	Ridomil Gold TPW	8 oz/A
2	Orondis + Ridomil Gold TPW	4.8 oz/A + 8 oz/A
3	Presidio 1 <sup>st</sup> Cultivation	4 oz/A
4	Presidio 1 <sup>st</sup> cult Ridomil Gold Layby	4 oz/A 16 oz/A
5	Orondis + Ridomil Gold TPW Presidio 1 <sup>st</sup> cult Ridomil Gold Layby	4.8 oz/A + 8 oz/A 4 oz/A 16 oz/A

# 2018 Dark-Fired Black Shank Fungicide Trial

## Kent Boyd Farm – Hopkinsville KY – Final Stand and Yield



LSD<sub>0.10</sub> (stand) = 6

# Dark Tobacco Black Shank Fungicide Trial

## Kent Boyd Farm – Hopkinsville KY - 2018

- More fungicide applications = more yield
- Earlier applications (TPW) better than later applications
- But will these increases in yield pay for costs of fungicides?

# Cost and Benefit of Fungicides for Black Shank Control 2018 Trial, Hopkinsville KY

Fungicide Treatment	Yield (lbs/A)	Yield Increase from Fungicide	Increase \$/A	Cost of Fungicide	Increase \$/A
Untreated	2120	-	-		-
Ridomil Gold TPW	2444	+ 324 lbs	+ \$648	\$50/A	+ \$598
Orondis Gold TPW	2443	+ 323 lbs	+ \$646	\$58/A	+ \$588
Presidio 1 <sup>st</sup> cult	2336	+ 216 lbs	+ \$432	\$36/A	+ \$396
Presidio 1 <sup>st</sup> cult Ridomil Layby	2445	+ 325 lbs	+ \$650	\$136/A	+ \$514
Orondis TPW Presidio 1 <sup>st</sup> Cult Ridomil Layby	2573	+ 453 lbs	+ \$906	\$194/A	+ \$712

# 2022 Black Shank Fungicide Trial for Dark Tobacco

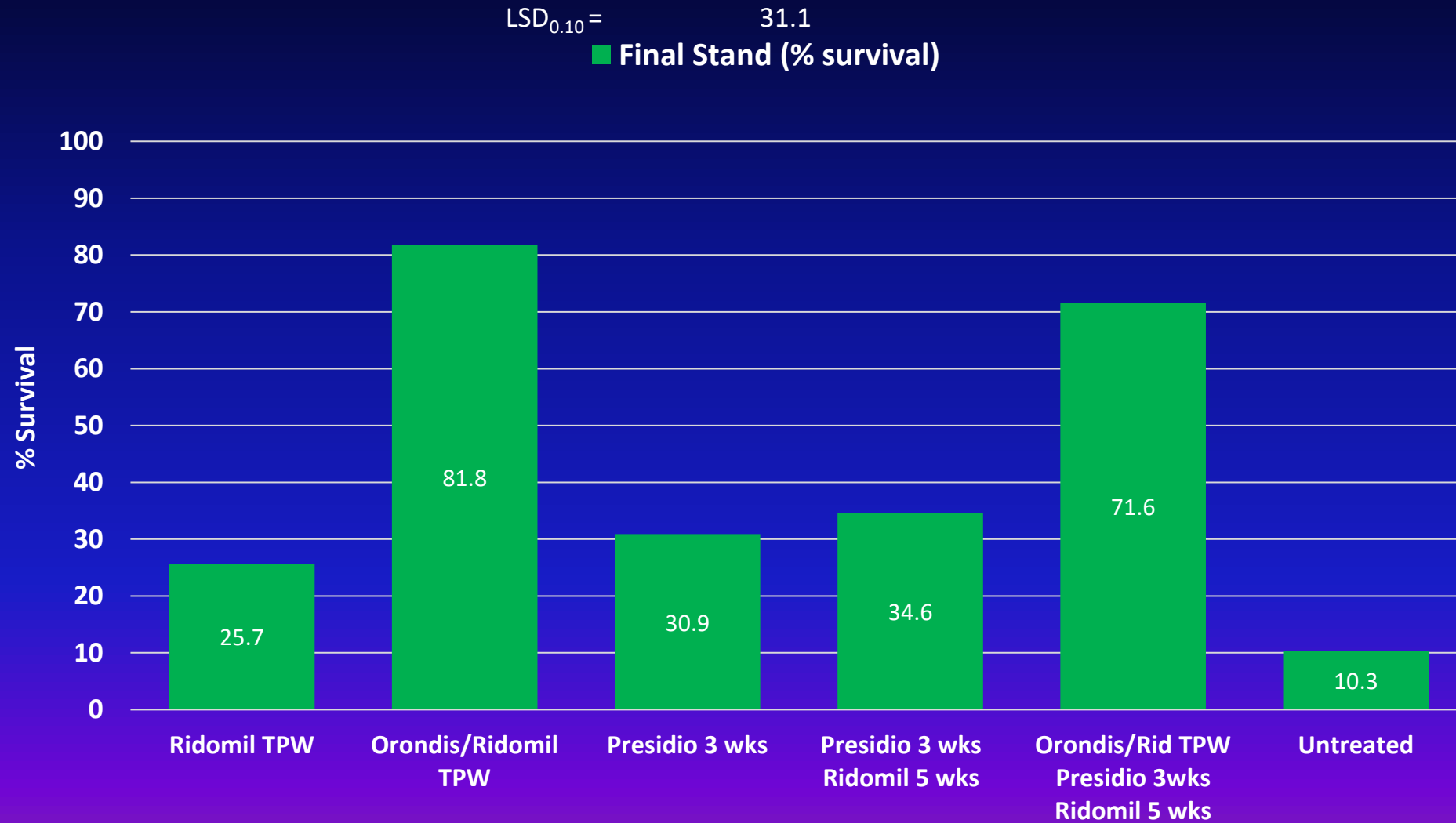
## Kent Boyd Farm – Hopkinsville KY

- KTD6 transplanted June 3
  - Moderate black shank resistance (3-3).
- Fungicide applications:
  - Transplant Water (TPW, 200 gal/A)
  - 3 weeks after transplanting
    - Banded spray at 15 gal/A
  - 5 weeks after transplanting
    - Banded spray at 15 gal/A
- Tobacco harvested late September, fire-cured.
- Treatments:
  - 1) Ridomil Gold (8 oz/A) TPW
  - 2) Orondis Gold (4.8 oz/A) + Ridomil Gold (8 oz/A) TPW
  - 3) Presidio (4 oz/A) at 3 wks
  - 4) Presidio (4 oz/A) at 3 wks, Ridomil Gold (16 oz/A) at 5 wks
  - 5) Orondis Gold (4.8 oz/A) + Ridomil Gold (8 oz/A) TPW, Presidio (4 oz/A) at 3 wks, Ridomil Gold (16 oz/A) at 5 wks
  - 6) Untreated Control



# 2022 Black Shank Fungicide Trial for Dark Tobacco

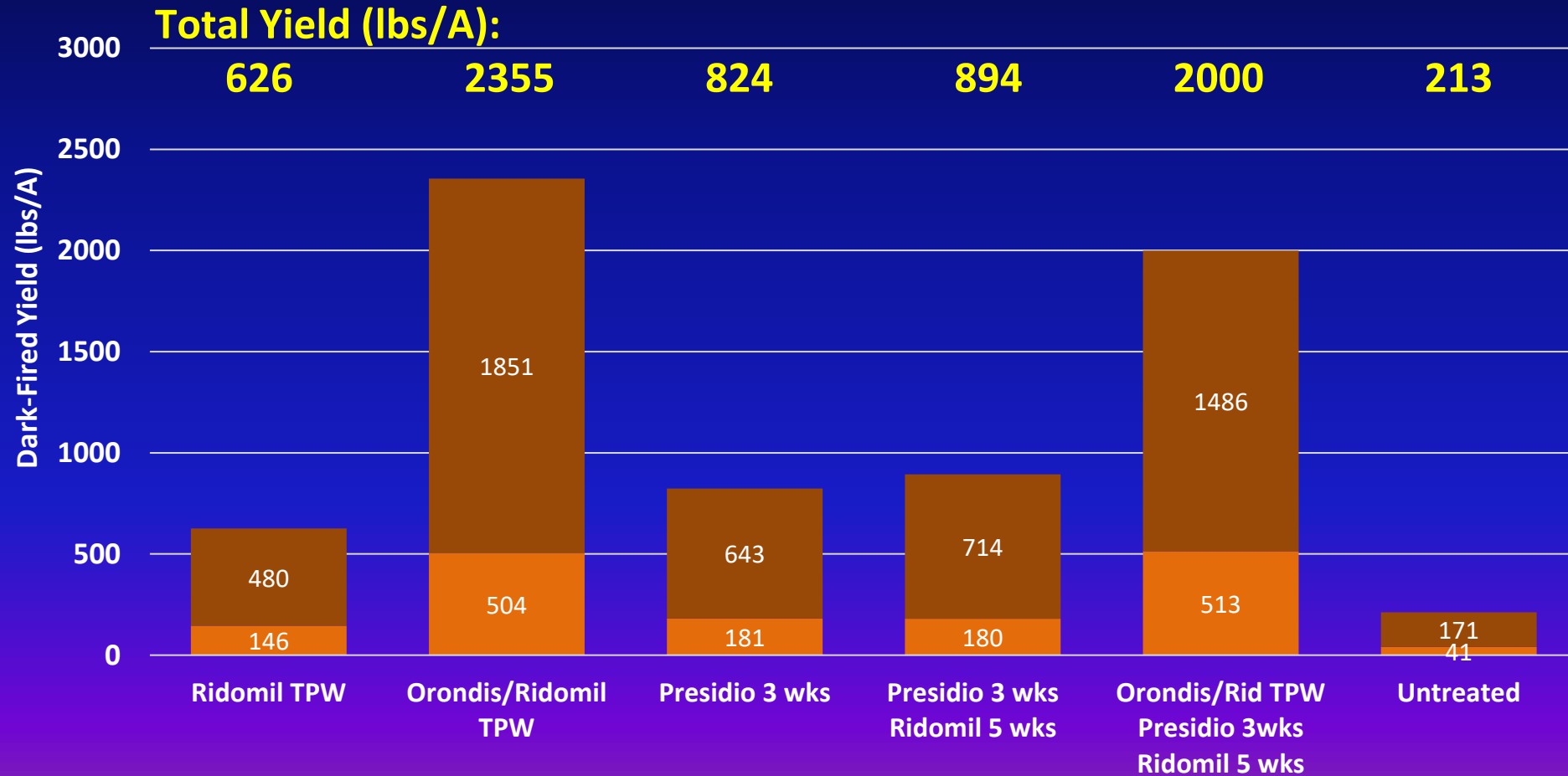
## Kent Boyd Farm – Hopkinsville KY



# 2022 Black Shank Fungicide Trial for Dark Tobacco

## Kent Boyd Farm – Hopkinsville KY

LSD<sub>0.10</sub> =      189      807      980 (total)  
■ Lug   ■ Leaf



# Summary

- Angular leaf spot:
  - Varieties differ in level of susceptibility, but inverse relationship with black shank resistance
  - No effective bacteriacides for managing heavy infestations when weather favors the disease (2016 and 2023).
  - Low infestations may be managed in programs with copper products
- Black shank:
  - Good resistance in some varieties, although best resistance = lower quality
  - Most meaningful fungicide application is that made in transplant water
    - Orondis Gold

# Acknowledgments

- Altria
- Natalia Martinez (KY Tobacco Res. & Dev. Ctr)