The Effect of Tillage and Cover Cropping Systems on Yield, Quality, and Angular Leaf Spot (ALS) Occurrence in Dark Tobacco in Tennessee

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TWC 2024

Importance to Tennessee

$92 million in 2023

Dark Tobacco

- TN total harvested
  - 10,000 acres
  - 36.6 million pounds
- ~3,033 lbs/ac
- 37.7% of national production

[USDA-NASS]. (2022). https://nass.usda.gov.

Why are we doing this research?

To maintain grower profitability

- Preserve yield
- Maintain higher profit margins
- Current gross revenue: $8903/ac ($22,000/ha)
  - -$3052/ac ($7,542/ha) return over variable cost

Galloway et. al. (2022). W 1075 - 2022
Tennessee Kentucky Dark Fired Tobacco Budget.

Why are we doing this research?

Limited knowledge of Angular Leaf Spot

- Widespread problem since 2015
- Devastated tobacco yields

How bad can it get?

- 27-49% yield reduction (under inoculated conditions)

Keeney et. al. (2021). Differential susceptibility to angular leaf spot (Pseudomonas syringae pv. tabaci) in dark tobacco varieties. Proceeding of the CORESTA Meeting, USA.

Pseudomonas syringae

Many pathovars

Over 60 unique pathovars identified

Two growth phases

Epiphytic & Endophytic

Plant Entry

Through tissue wounds and/or stomata

Pv. tabaci

Causes Angular Leaf Spot and Wildfire

Lydon et. al. (2001). Detection of tabtoxin-producing strains of Pseudomonas syringae by PCR. Letters in Applied Microbiology, 32, 166–170.
Xin et. al.(2018). Pseudomonas syringae: What it takes to be a pathogen. Nature Reviews Microbiology. 16(5), 316–328.
Young et. al. (1978) A proposed nomenclature and classification for plant pathogenic bacteria. New Zealand Journal of Agricultural Research, 21(1), 153-177.

ALS Disease

Source

- Infected plant material
- Naturally infected weeds

Spread

- Water movement
- Splashing of contaminated soil
- Wind-driven rainfall
- Handling wet, infected plants

Prevention

- Sanitary practices
- low susceptibility

Collins et. al. (2013). Disease management. Principles of Flue-Cured Tobacco Production. (pp. 97-109).
Daub et. al.(1991). Infectious diseases. Compendium of Tobacco Diseases. (pp. 30-32)
Davis et. al. (1999). Major tobacco diseases: Fungal and bacterial diseases. Tobacco Production, Chemistry, and Technology. (pp. 183-197).

Current Research for Disease Control

Crop Rotation

Improve disease management

Decrease resistance to fungicides and antibiotics

Hansen et. al. (2022). Dark tobacco variety evaluations for susceptibility to angular leaf spot. TWC.

Cover Crops

Beneficial for disease suppression

Reduce disease severity and pathogen recovery

Dawadi et. al. (2019). Impact of cover crop usage on soilborne diseases in field nursery production. Agronomy, 9(753).

Tillage

Varying results

KY- did not impact

TN- did impact

Keeney-Webb et. al. (2022). Field monitoring and management practices associated with angular leaf spot of dark tobacco. TWC. Richmond, M. (2022). Personal Communication

Chemical

~20 products studied by Univ. KY

ALS moderately controlled by streptomycin

Keeney et. al. (2021). Differential susceptibility to angular leaf spot (Pseudomonas syringae pv. tabaci) in dark tobacco varieties. CORESTA.

Cover Crops

Why use cover crops?

- Reduces weeds
- Improves soil health
- Reduces soil borne diseases

National Cover Crops Survey

- Producer motivations
- Cereal rye, radish, oats

Cover Crops and Tobacco

- Potential weed control

Smith et. al. (2020). CTIC. Funded by USDA SARE.

Objective

To determine the impact of cover crop and tillage type in tobacco production systems

- Yield and leaf quality parameters
- Angular Leaf Spot (*Pseudomonas syringae pv. tabaci*) occurrence

Materials and Methods

Variety	Maturity	Black Shank (0-10)[a]		Use[b]	Relative Yield Score[c]	Relative Quality Score[c]	Black Root Rot[de]	TMV	Wildfire	Angular leaf spot[f]
		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 160	Medium	0	0	A	3	9	S	R	S	-
KY 171[f]	Medium	0	0	A/F	7	7	R	R	S	S
DF 911	Medium	0	0	F	8	6	R	R	R	-
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[g]	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[f]	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

Bailey et. al. (2021). Selecting dark tobacco varieties. Burley and dark tobacco production guide (pp. 7-11).

ALS Inoculum

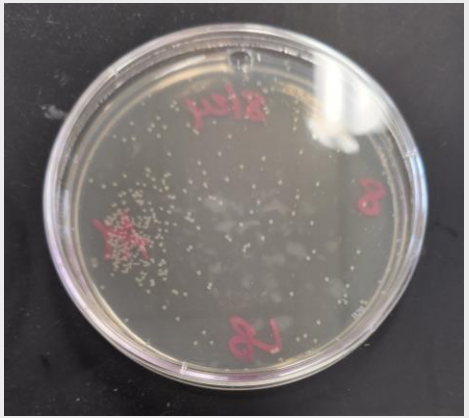
- Lab Procedure
  - P.syringae collected from collaborators at UK
  - – N. Martinez-Seebold, A. Keeney-Webb, A. Bailey
  - Colonies extracted from plates and suspended in 1L KB media
  - Flasks were shaken for 20 hours @ 200rpm and room temperature

- Field Procedure
  - Stages 1108 to 1110
  - 456 mL of suspension per three-gallon spray tank
  - 25 GPA

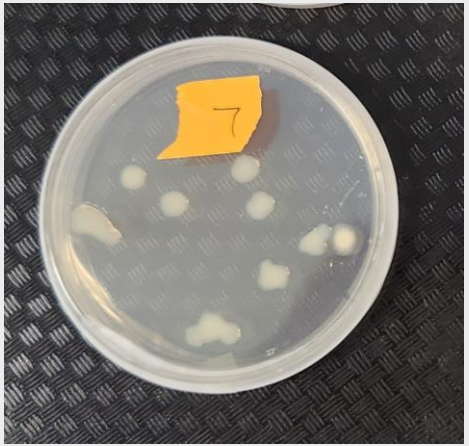
Papenfus, H., & Billenkamp, N. (2019). Guide N° 7 a scale for coding growth stages in tobacco

Serial Dilution

- 10-fold serial dilution made from stock
- 8 dilutions (2022) and 12 dilutions (2023)
- 1.3 x 10^10 CFUs/mL (2022)
- 2.8 x 10^6 CFUs/mL (2023)



8x dilution;
Aug. 24, 2022



7x dilution;
July 11, 2023

Disease Rating and Symptoms

- Incedence: visual percent of the center two rows showing symptoms
- Severity: average leaf area of imfected plants covered by symptoms

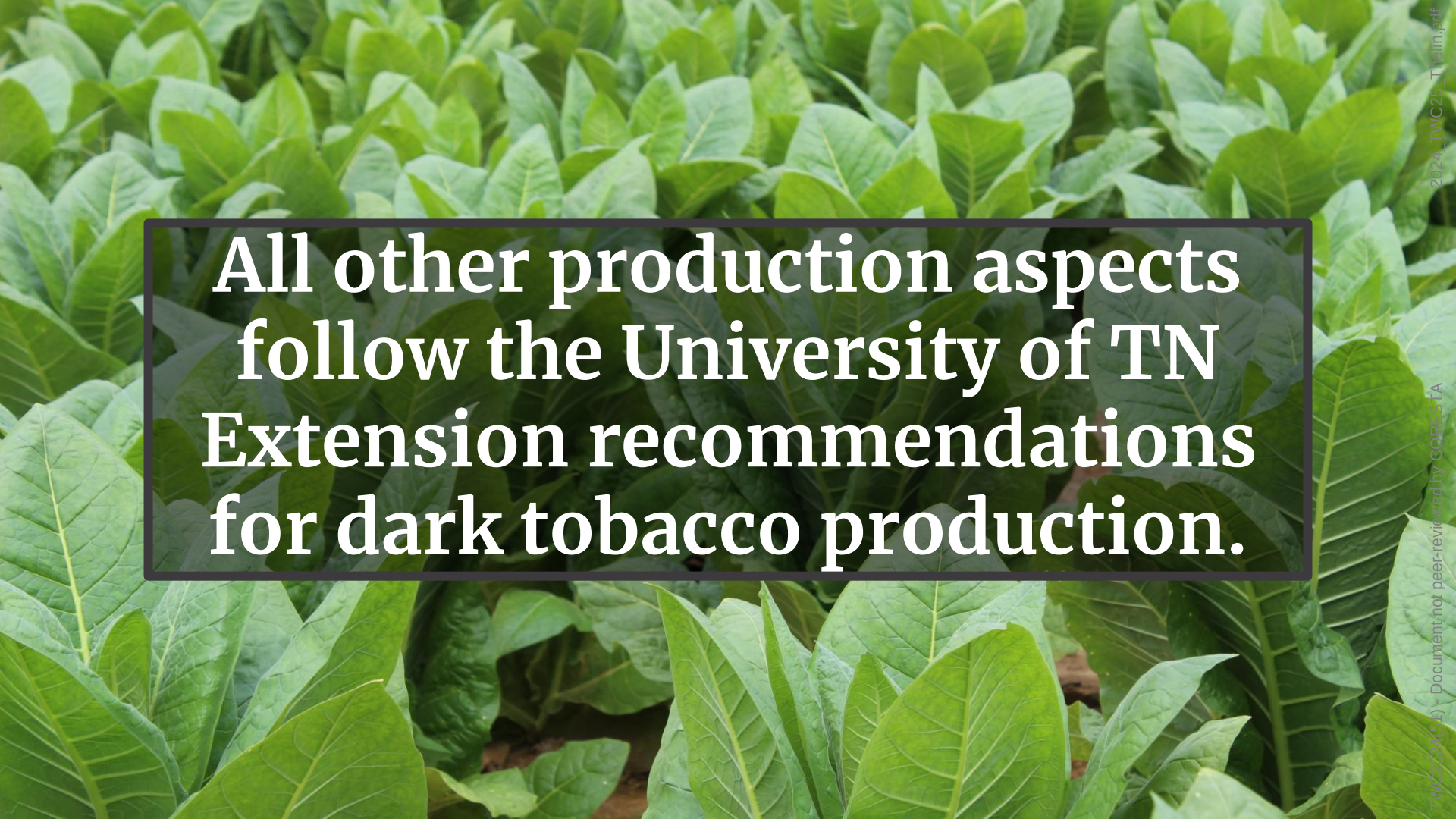
Cover Crops and Tillage

Four Cover Treatments

- Fallow
- Cereal Rye
- Crimson Clover
- Hairy Vetch

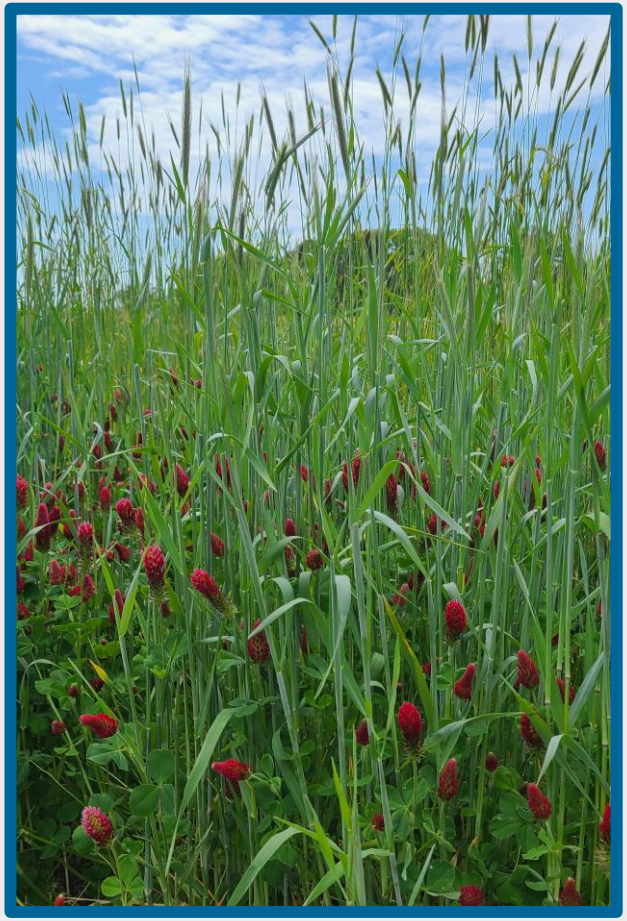
Two Tillage Treatments

- Conventional
- No tillage
- Applied after cover crop harvest

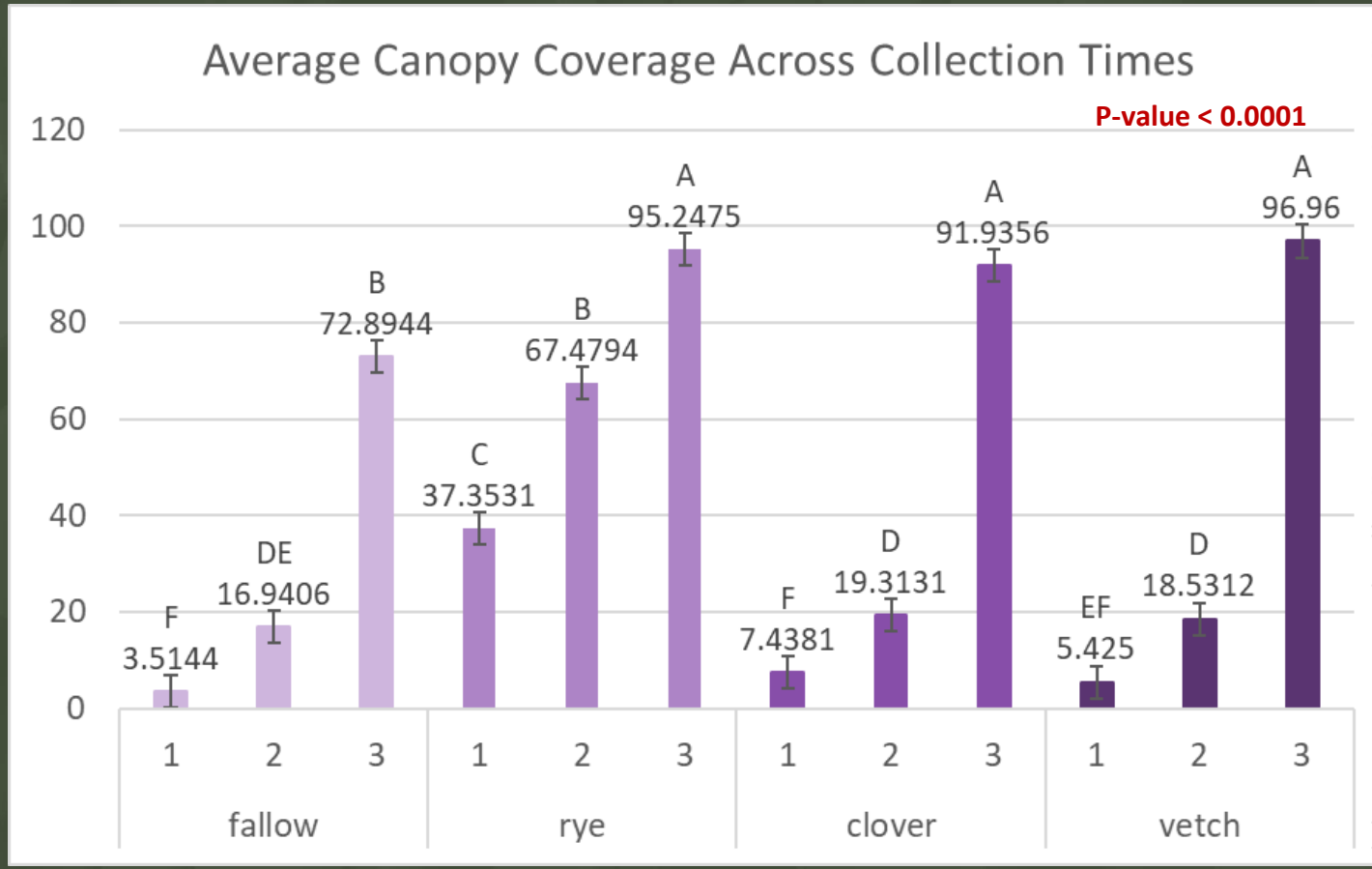


Results

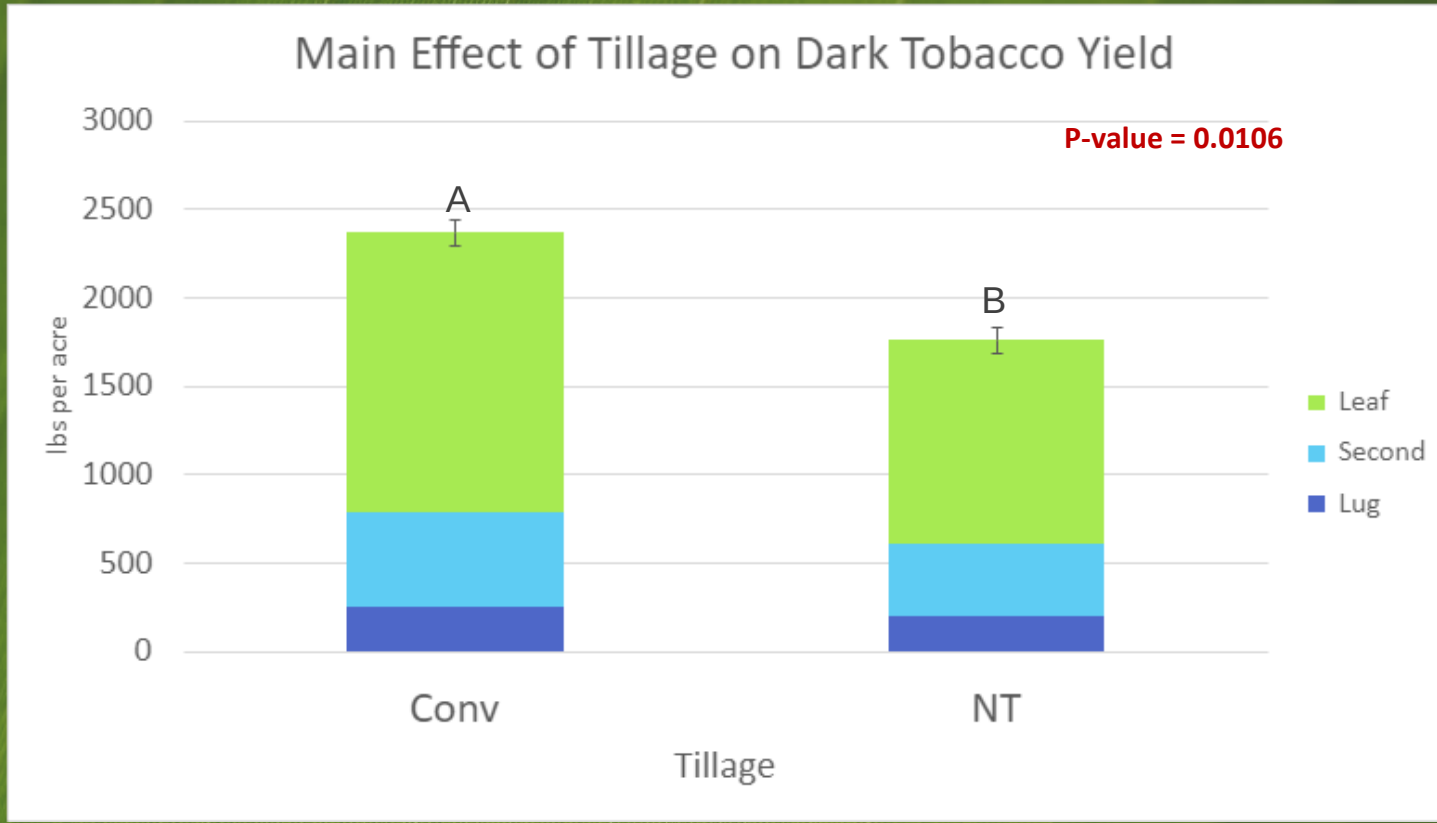
- Tillage and cover crop impact on yield and ALS occurrence



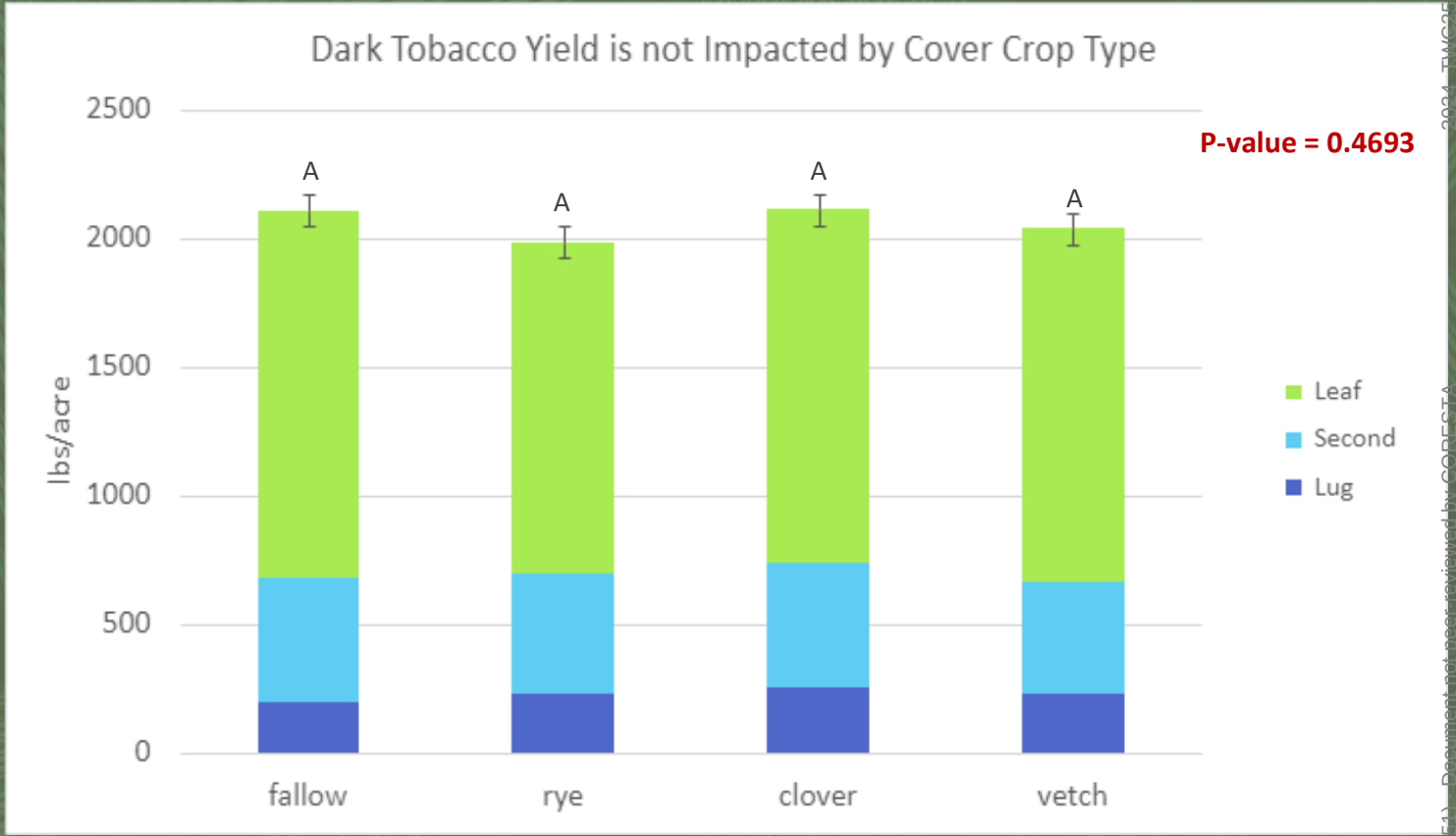
Significant differences were observed among collection times for average canopy coverage.



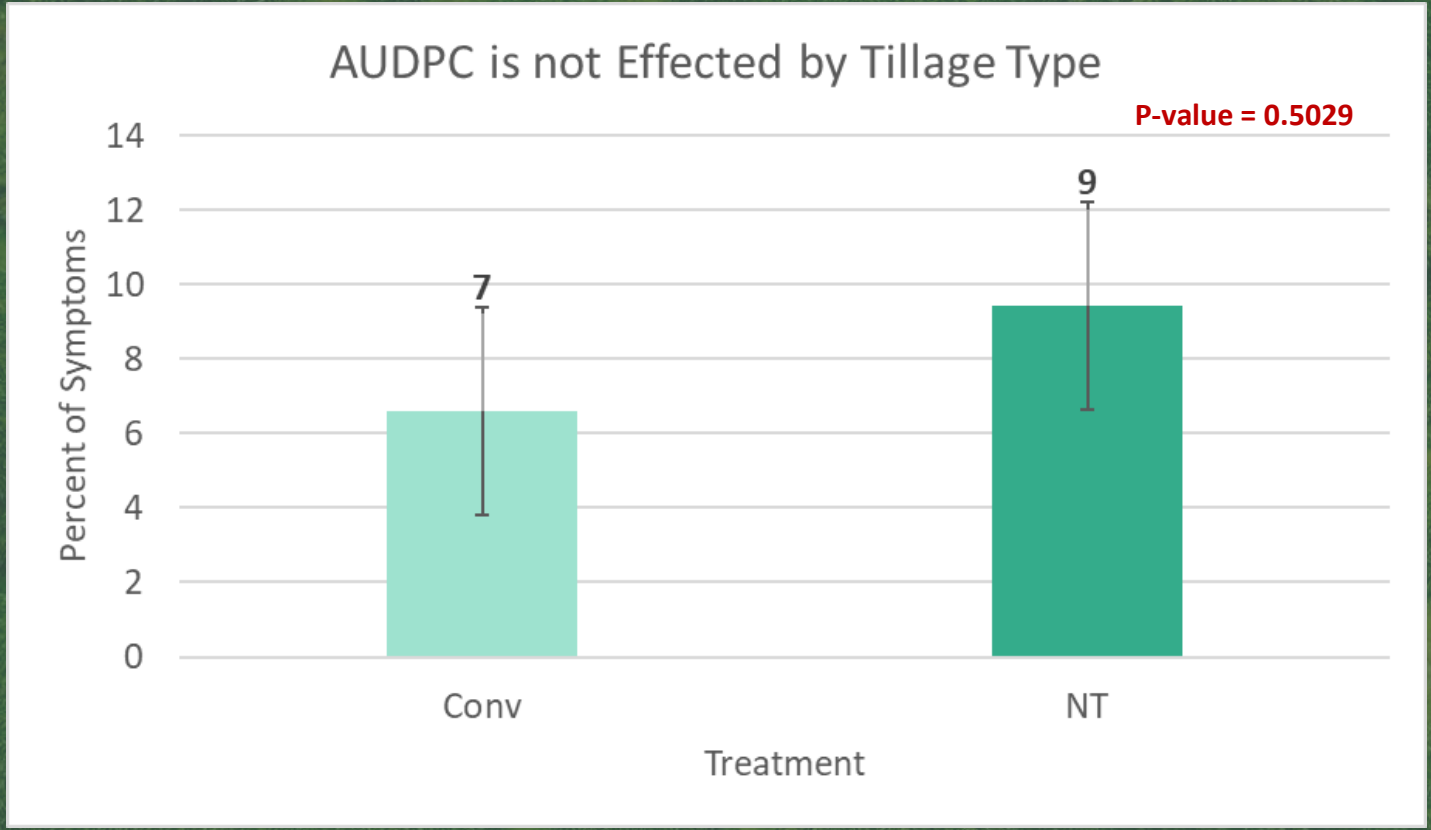
Significant differences were observed among tillage treatments



Significant differences were not observed among cover crop treatments



Significant differences were not observed among tillage types for disease progress.



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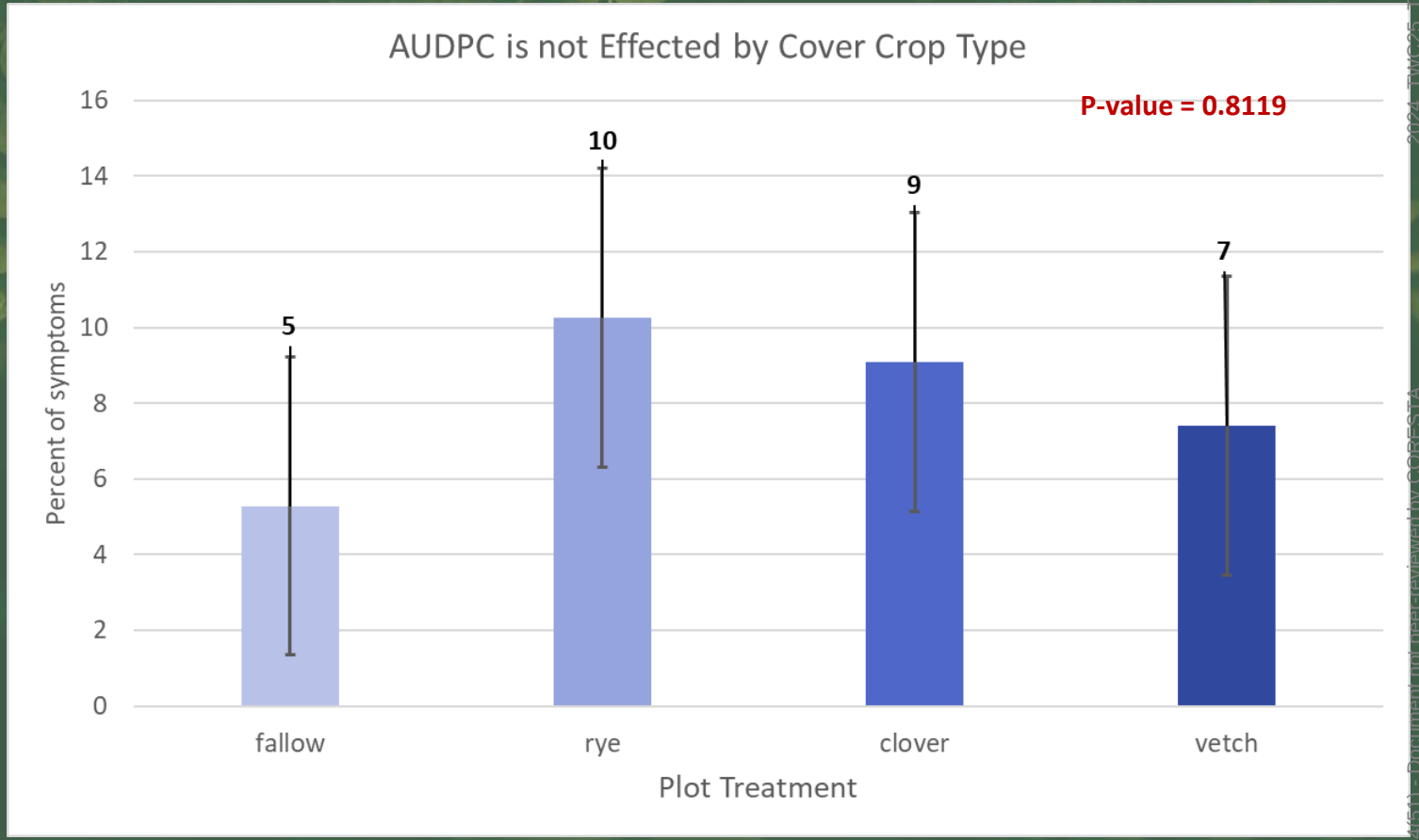

Preliminary Conclusions

- No-tillage observed a decrease in yield compared to conventional tillage.
- Year 1 data suggest there was not a direct impact on tobacco yield or ALS occurrence from cover crop type.

Future work with this project

- To be continued for the 2023-2024 season
- More research on the control of ALS, chemically or culturally, should be conducted to further expand on available solutions.

Acknowledgments

I would like to say thank you to my advisors, committee members, lab mates, and Altria Client Services.

Questions?