EVALUATION OF TAR SPOT MANAGEMENT STRATEGIES ON CORN IN THE MIDWEST

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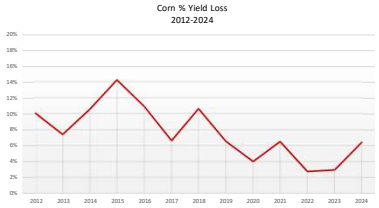
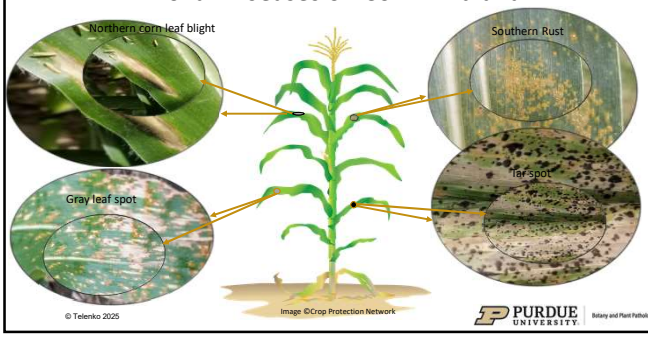
Yield Loss to Disease in U.S. Corn



Data source: Crop Protection Network. 2023. Estimates of crop yield losses due to diseases and invertebrate pests: an online tool. https://loss.cropprotectionnetwork.org/.

CropProtectionNetwork.org | CROP PROTECTION NETWORK | Defending Fields. Protecting Yields.

Foliar Diseases on Corn - Indiana



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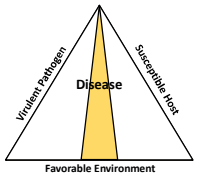
Disease Triangle

Virulent pathogen:
- Overwinter?
- Endemic – already present in soil/debris
- Spore movement



Susceptible host:
- Plant species
- Variety/hybrid susceptibility
- Growth stage

Favorable Environment:
- Temperature
- Moisture
- Leaf wetness

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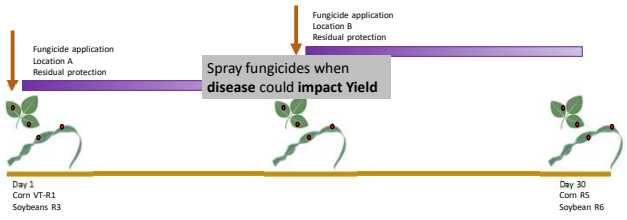
Understanding Fungicide Timing



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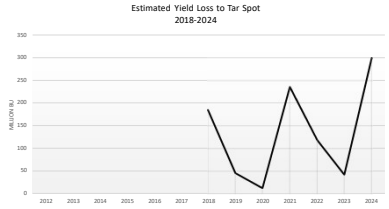
Tar spot of corn

Yield Loss to Tar Spot in U.S. and Canada



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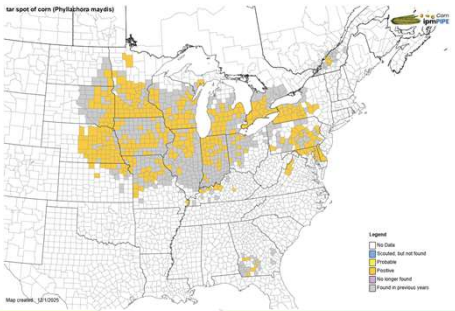
2025 Map

20 U.S. states, Ontario and Quebec Canada



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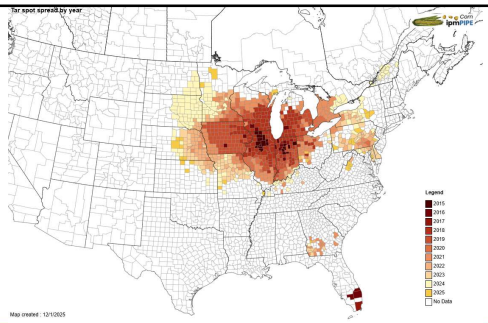

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10 Points after Eight Seasons of Tar Spot

1. Every year has been different – disease triangle!
2. Scouting is critical
3. Host resistance is important
4. Fungicides will work, but tar spot shows limitations
5. Timing is critical – can be too early or too late
6. ROI – understand the numbers on 1x vs. 2x applications
7. Corn will never be 100% clean at the end of the season – see #4
8. Stewardship is important
9. Use the tools
10. Keep asking new questions

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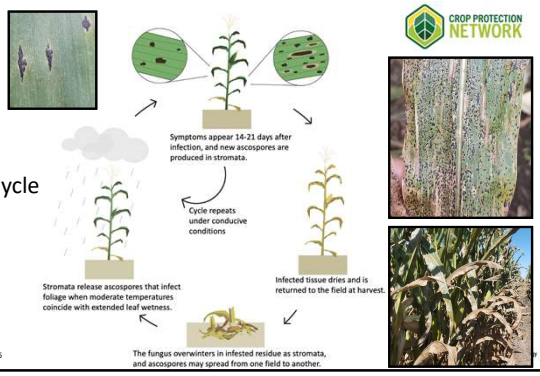
Tar Spot Disease Cycle



Weather Matters for Tar Spot

- Temperature is critical:
  - ✓Optimum conditions when extended periods (30 days) of mild temperature (64-73°F; 18-23°C).
  - ✓Monthly temperatures that exceed 73°F reduce tar spot progression.
- Moisture plays a role:
  - ✓Moisture important in process to aid spore germination
  - ✓Tar spot developed when relative humidity under 90% over 2-3 week span
  - ✓Extended periods of excessive moisture (RH > 90%), especially at high temperatures, can hinder disease progression.
- Use Crop Risk Tool for Tar Spot

Source: Webster, R. W., et al. 2023. Tar spot prediction in corn: The weather matters. Crop Protection Network. CPN-5012. doi.org/10.31274/cpn-20231220-1

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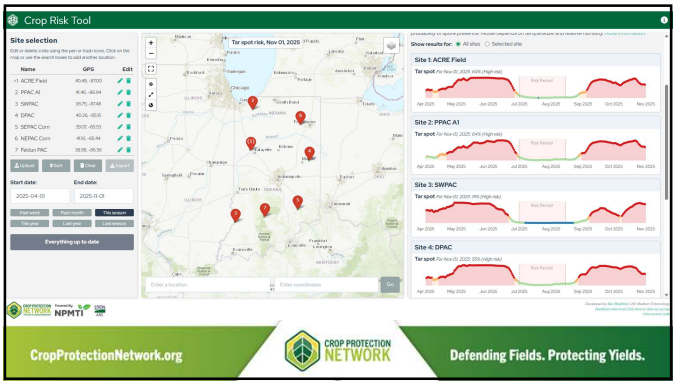

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Tar Spot Epidemiology – Indiana 2021

NPMTI

First pathogen detection
6/6/21 – 6/15/21
Spore detection

V12 VT/R1 R3 R5 R6

Incubation period

Latent period

First symptom observed **8/2/21**

Tar spot probability (%)

Tar spot on ear leaf (%)

31-May 7-Jun 14-Jun 21-Jun 28-Jun 5-Jul 12-Jul 19-Jul 26-Jul 2-Aug 9-Aug 16-Aug 23-Aug 30-Aug 6-Sep 13-Sep 20-Sep 27-Sep

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Tar Spot Epidemiology – Indiana 2022

NPMTI

First pathogen detection
Not detected

V10 VT/R1 R3 R5 R6

First symptom observed **9/12/2022**

Tar spot probability (%)

Tar spot on ear leaf(%)

31-May 7-Jun 14-Jun 21-Jun 28-Jun 5-Jul 12-Jul 19-Jul 26-Jul 2-Aug 9-Aug 16-Aug 23-Aug 30-Aug 6-Sep 13-Sep 20-Sep 27-Sep 4-Oct

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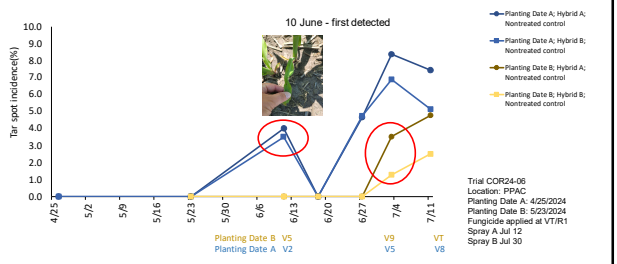
Disease Management Options for Tar Spot

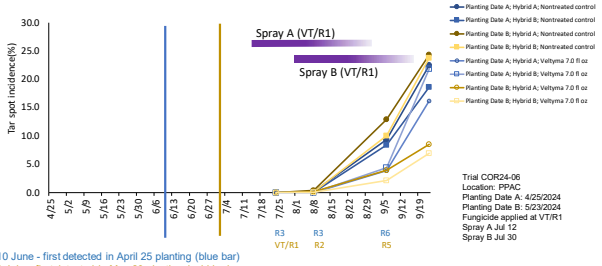
Hybrid by Fungicide Timing Trials on Tar Spot in Indiana – 2024

Planting Date	Dates 2024	Tar spot 1st Detection
Planting Date A	planted 25 April	10 June
Planting Date B	planted 23 May	15 July
Hybrid		
Pioneer 9608Q – 96 day hybrid		
Pioneer 1099Q – 110 day hybrid		
Fungicide		
Nontreated Control		
Veltyma 7.0 fl oz at R1		

Tar Spot Disease Progress Indiana 2024 – Lower Leaves % Incidence

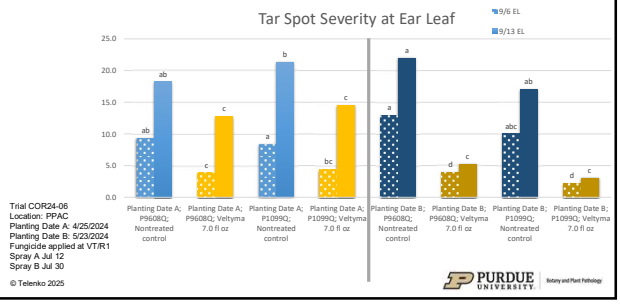


Tar Spot Disease Progress Indiana 2024 – Ear Leaf Severity



10 June - first detected in April 25 planting (blue bar)
3 July – first detected in May 23 planting (gold bar)

Evaluation of Planting Date, Hybrid, and Fungicide for Tar Spot in Northwestern Indiana, 2024 (COR24-06.PPAC)



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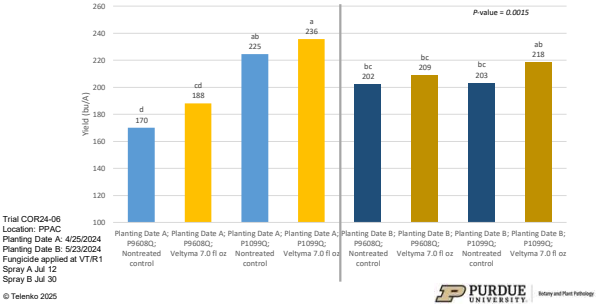

Hybrid reaction to tar spot

susceptible hybrid

moderately resistant hybrid

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Hybrid by Fungicide Timing Trials on Tar Spot

Indiana, Iowa, Michigan, Missouri, Wisconsin, and Ontario, CA
2022, 2023, 2024 (14 site years)

Hybrids	**Dates 2022**
Tar spot susceptible	planted 20 May
Tar spot mod. resistant	planted 20 May
Fungicide Programs	
Nontreated control	
Delaro Complete 8 fl oz/A at V10	21 Jul
Delaro Complete 8 fl oz/A at VT/R1	2 Aug
Delaro Complete 8 fl oz/A at R2	12 Aug
Delaro Complete 8 fl oz/A at R4	23 Aug
Delaro Complete 8 fl oz/A Tarspotter	V8 14 Jul fb VT/R1 2 Aug
Tar spot first detection	1 Sep

USDA NIFA Grant no. 2022-68008-36510

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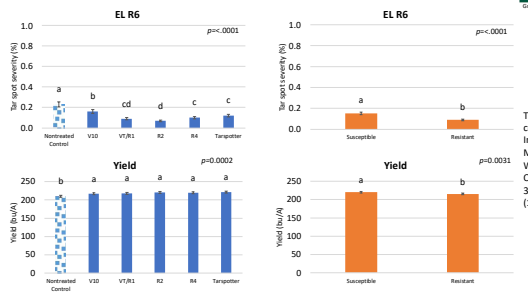
Hybrid by Fungicide – 2022-2024

USDA NIFA Grant no. 2022-68008-36510



Trials were conducted in Indiana, Iowa, Michigan, Missouri, Wisconsin, and Ontario, CA across 3 years (14 site years)

Goodnight 2025

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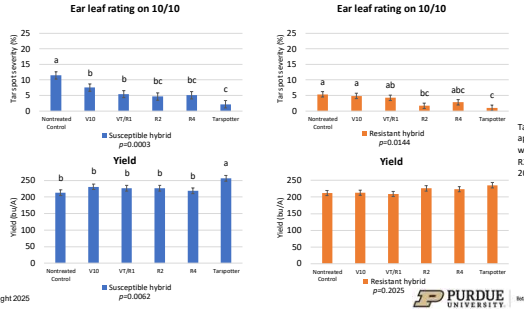
Hybrid by Fungicide – 2023

USDA NIFA Grant no. 2022-68008-36510



Tarspotter applications were applied at R2 and R4 in 2023

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Hybrid by Fungicide – 2024

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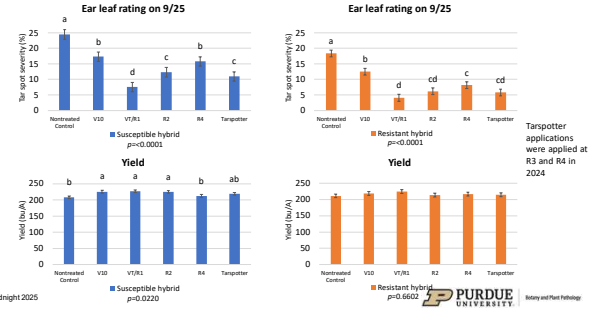

Tarspotter applications were applied at R3 and R4 in 2024

Goodnight 2025

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Uniform Fungicide Efficacy Trials for Tar Spot

Indiana, Illinois, Michigan, Wisconsin, Iowa, and Ontario, Canada

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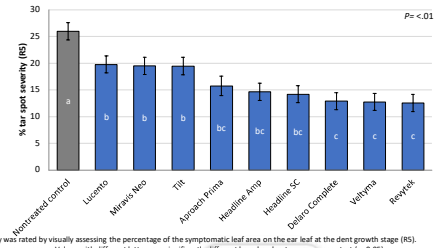
Uniform Fungicide Trials on Tar Spot – 2021

Telenko, D. E. P., Chilvers, M. I., Ames, K., Byrne, A. M., Check, J. C., Da Silva, C. R., Ross†, T. J., Smith, D. L., and Tenuta, A. 2022. Fungicide efficacy during a severe epidemic of tar spot on corn in the United States and Canada. Plant Health Progress. doi.org/10.1094/PHP-02-22-0012-BR.



2021 trials conducted in Illinois, Indiana, Michigan, Wisconsin, and Ontario, CA (5 environments)

† Tar spot severity was rated by visually assessing the percentage of the symptomatic leaf area on the ear leaf at the dent growth stage (R5).
‡ Values are least squares means. Values with different letters are significantly different based on least square means test (α=0.05).

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Uniform Fungicide Trial on Tar Spot – Yield 2021

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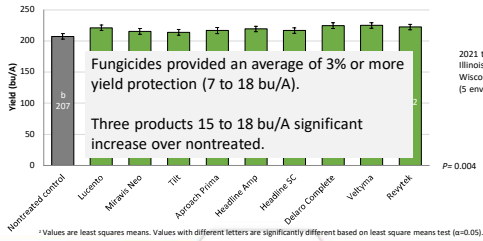

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Coverage Matters!!!

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Large block sprayed with Hylio
Small block (by road) with T10

Fungicide used:
Tigrist Azoxyprop 12 fl oz/A at 2 GPA
(azoxystrobin 13.5% + propiconazole 11.7%)

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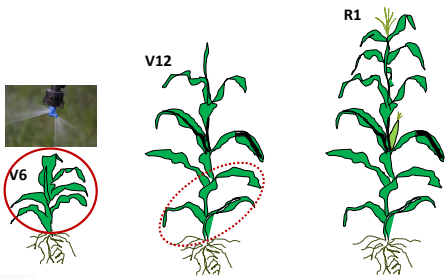
Putting things into perspective: Which leaves are protected?



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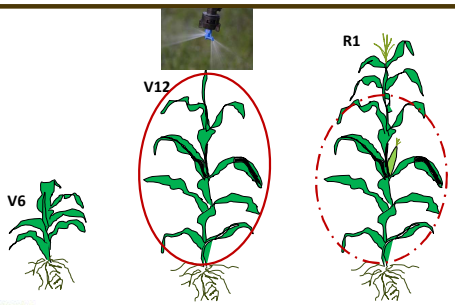
Which leaves are protected?



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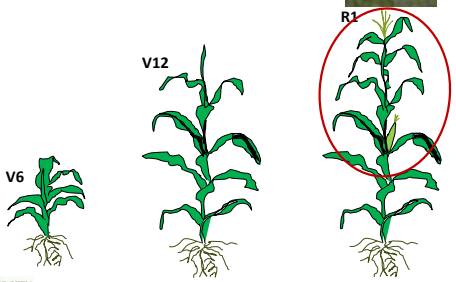

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Does Fungicide Timing Matter?

What about ROI?

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Fungicide Timing – Indiana 2019, 2020, 2021

Fungicide: Trivapro 13.7 fl oz/A (benzovindiflupyr + azoxystrobin + propiconazole)
First detection of tar spot

Trials COR19-05/COR20-05/COR21-03
Location: PPAC
Hybrid: 'W25B5SSRIB'

2019
- V7 – 8 Jul
- V9 – 15 Jul **13 Jul**
- V10 – 19 Jul
- VT/R1 – 7 Aug
- R2 – 23 Aug
- V7 fb VT – 8 Jul, 7 Aug
- Tarspotter – no app

2020
- V8 – 14 Jul
- V10 – 20 Jul **28 Jul**
- VT/R1 – 7 Aug
- R2 – 21 Aug
- R3 – 2 Sep
- R4 – 11 Sep
- R5 – 23 Sep
- V8 fb VT – 14 Jul,7 Aug
- Tarspotter – no app

2021 **3 Jul**
- V8 – 23 Jul
- V12 – 2 Aug
- R1 – 6 Aug
- R2 – 20 Aug
- R3 – 30 Aug
- R4 – 10 Sep
- R5 – 16 Sep
- V8 fb R1 – 23 Jul, 6 Aug
- Tarspotter – 2 Aug

*Photos courtesy of C. Gerber Dept. Agronomy

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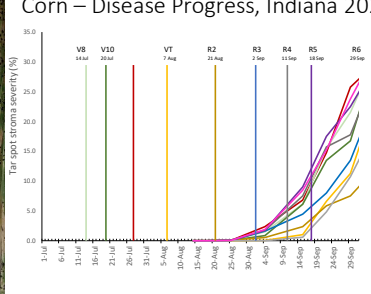
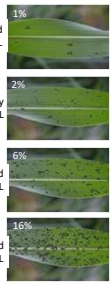
Fungicide Timing and Model Validation for Tar Spot in Corn – Disease Progress, Indiana 2020



Trial COR20-05
Location: PPAC
Hybrid: 'W25B5SSRIB'
Fungicide: Trivapro 13.7 fl oz/A
28 July 2020 tar spot first detected



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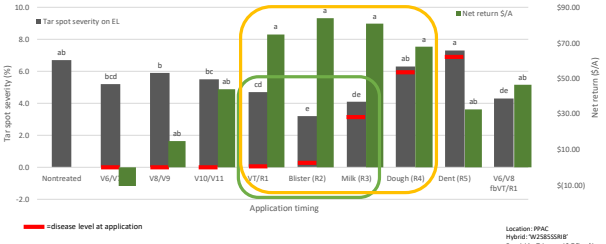
Tar spot severity at end of season on ear leaf and partial net return in Indiana from 2019 to 2021



Location: PPAC
Hybrid: 'W25B5SSRIB'
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Ross, T. J., Allen, T. W., Shim, S., Thompson, N. M., and Telenko, D. E. P. 2023. Investigations into economic returns resulting from foliar fungicides and application timing on management of tar spot in Indiana hybrid corn. Plant Disease. https://doi.org/10.1094/PDIS-05-23-0932-RE

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Break-even scenarios for corn

Bushels per acre needed to pay for application

Corn price ($/bu)	Application cost ($/A)				(Typically for two applications)				
	$20	$25	$30	$35	$40	$45	$50	$55	$60
$3.00	6.7	8.3	10.0	11.7	13.3	15.0	16.7	18.3	20.0
$4.00	5.0	6.3	7.5	8.8	10.0	11.3	12.5	13.8	15.0
$5.00	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0
$6.00	3.3	4.2	5.0	5.8	6.7	7.5	8.3	9.2	10.0
$7.00	2.9	3.6	4.3	5.0	5.7	7.9	7.1	7.9	8.6
$8.00	2.5	3.1	3.8	4.4	5.0	5.6	6.3	6.9	7.5
$9.00	2.2	2.8	3.3	3.9	4.4	5.0	5.6	6.1	6.7
$10.00	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0

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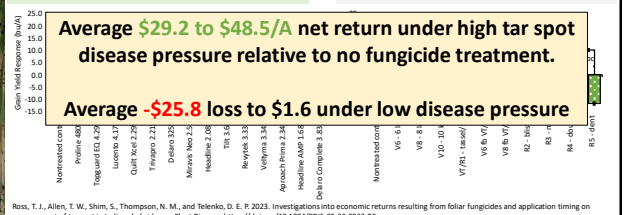
Net returns from foliar fungicides and application timing on tar spot management in Indiana

TS high - average yield increase 9.5 bu/A (range = -1.2 to 18.7 bu/A)
TS low – average yield increase 3.0 bu/A (range = -7.8 to 11.1 bu/A)

TS high - average yield increase 14.6 bu/A (range = 6.2 to 22.2 bu/A)
TS low – average yield increase - 2.7 bu/A (range = -11.9 to 9.3 bu/A)

Average $29.2 to $48.5/A net return under high tar spot disease pressure relative to no fungicide treatment.

Average -$25.8 loss to $1.6 under low disease pressure



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Fungicide Timing for Tar Spot

Crop Stage When Tar Spot is First Detected	Possible Benefit From Spraying	Comment
Late Vegetative	Rarely, consult extension specialists before spraying	Scout fields and monitor disease progress; may need a second spray
VT/R1 (Tasseling/Silking)	Yes	May need a second spray
R2 (blister)	Yes	Less likely to need a second spray
R3 (milk)	Yes	No second spray needed
R4 (dough)	Maybe, with severe disease pressure	No second spray needed
R5 (dent)	No	No second spray needed
R6 (black layer)	No	

https://cropprotectionnetwork.org/maps/tar-spot-of-corn

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My 10 Points after Eight Seasons of Tar Spot

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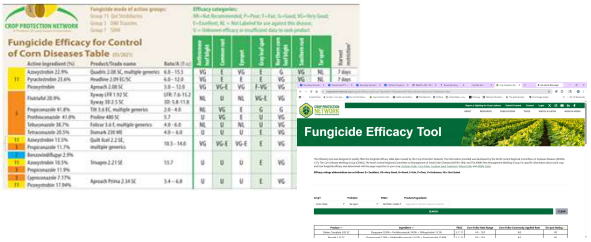
Fungicide Efficacy Resources for Corn



https://cropprotectionnetwork.org/fungicide-efficacy-tool

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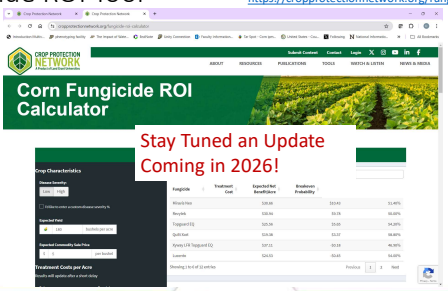
Fungicide ROI Tool

https://cropprotectionnetwork.org/fungicide-roi-calculator



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THANKS TO THE TELENKO LAB

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- Graduate students, Post docs, and Visiting scholars: Mariama Brown, Audrey Conrad, Emily Duncan, Mariela Fernandez Campos, Morgan Goodnight, Natalia Piñeros Guerrero, Emilia Meyers, Ivis Miranda, Monica Mizuno, Mariana Moreano Acevedo, Juan Pena Roncancio, Edward Pena Roncancio, Camila Rocco da Silva, Tiffanna Ross, Kaitlin Waibel, Nileshwari Yewle
- Over 18 undergraduate students






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