Management of New and Re-Emerging Corn Diseases

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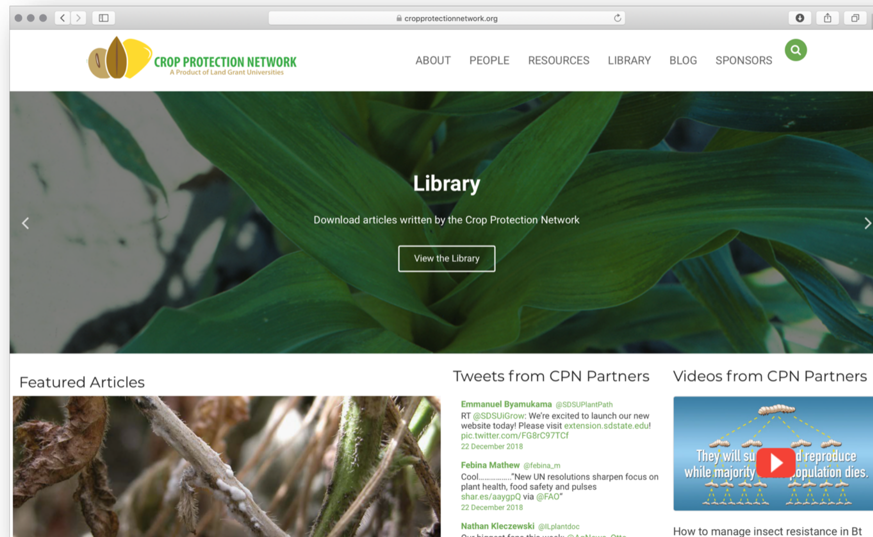
The Outline for Today

1) Discuss the important corn diseases of 2018
2) Talk about the pathogens that cause corn diseases
3) Cover general information about the major corn diseases of the upper Midwest
4) Fungicide mode-of-action and phytomobility
5) Fungicide efficacy data for grain corn
6) Fungicide efficacy data for silage corn – if we have time!

Additional Resources

http://badgercropdoc.com



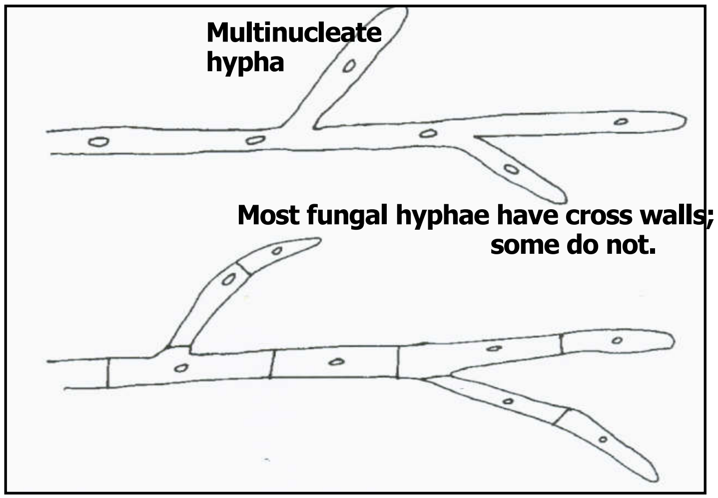
http://cropprotectionnetwork.org

Major Diseases in Midwest Corn - 2018

- Gray leaf spot
- Tar spot
- Northern corn leaf blight
- Gibberella ear rot
- Bacterial Leaf Streak – Just to add insult to injury
- Other diseases of varying importance (anthracnose, eye spot, Goss's Wilt)

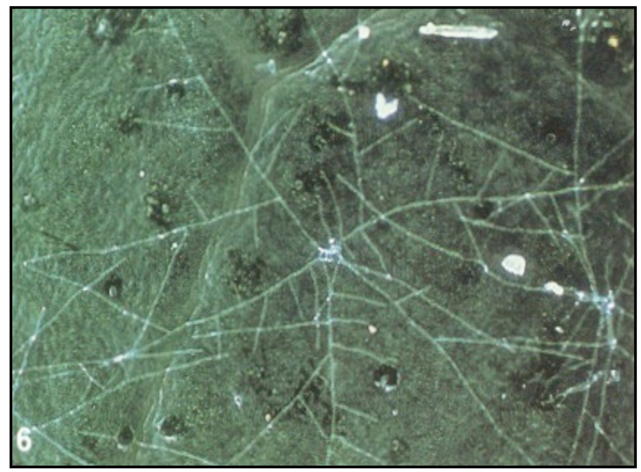
Fungi vs. Bacteria

Fungi



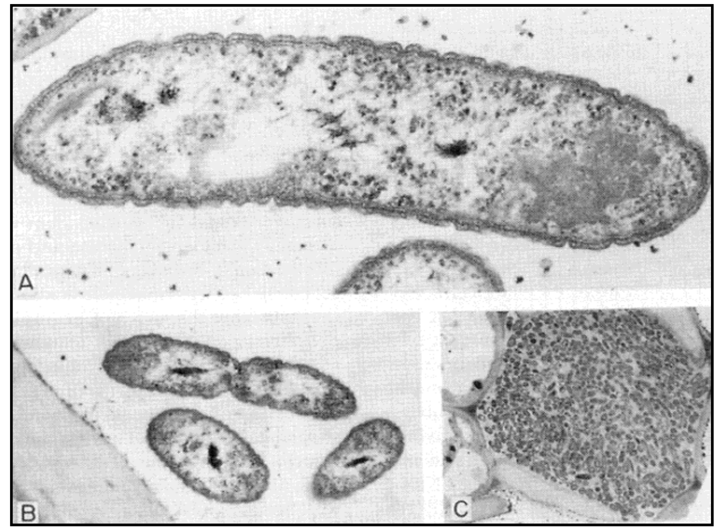
- Many produce spores that are wind or rain dispersed
- Examples: Sclerotinia stem rot, Ear rots of corn, Fusarium head scab

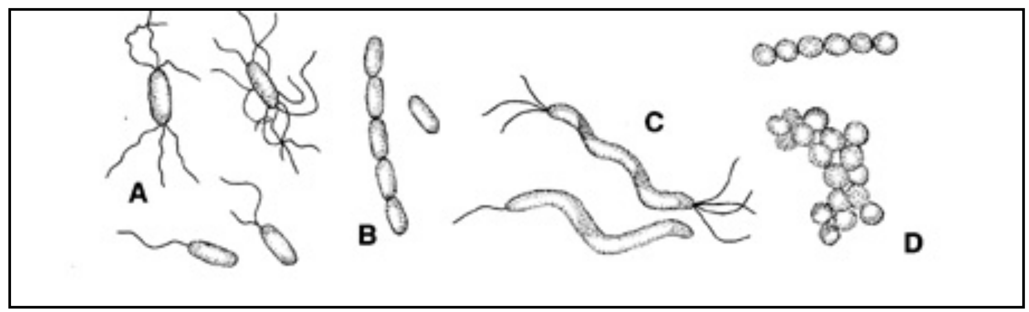
- Many grow microscopically – invest in a good hand lens
- Others will produce visible signs/growth and result in distinct symptoms



Bacteria

- Quite small and single celled
- Spread by water, contaminated seed, and insects
- Enter wounds or natural openings
- E.g., Goss' wilt and Bacterial leaf streak

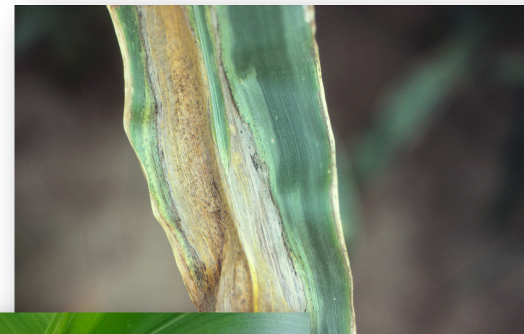


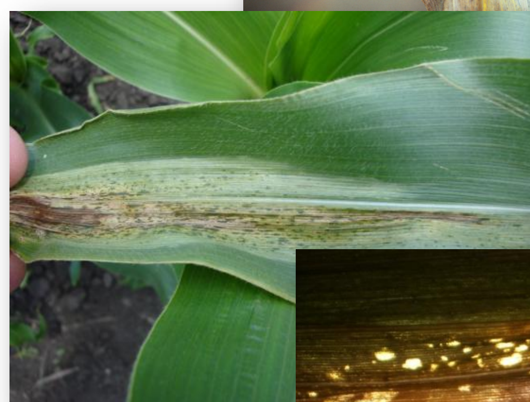


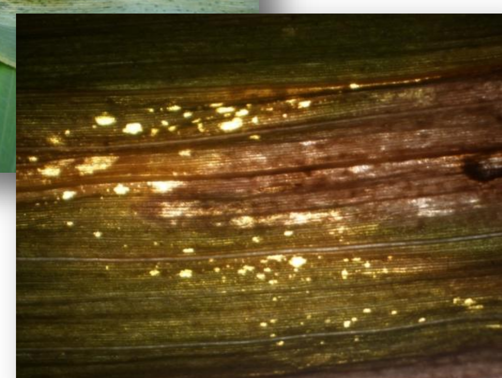
Some Important Midwest Corn Diseases

Goss's Wilt

- Caused by *Clavibacter michiganensis* subsp. *Nebraskensis*
- Often confused with NCLB
- Causes both a wilt and **<u>leaf blight</u>**
- Found throughout much of the Midwest and Southern corn producing states





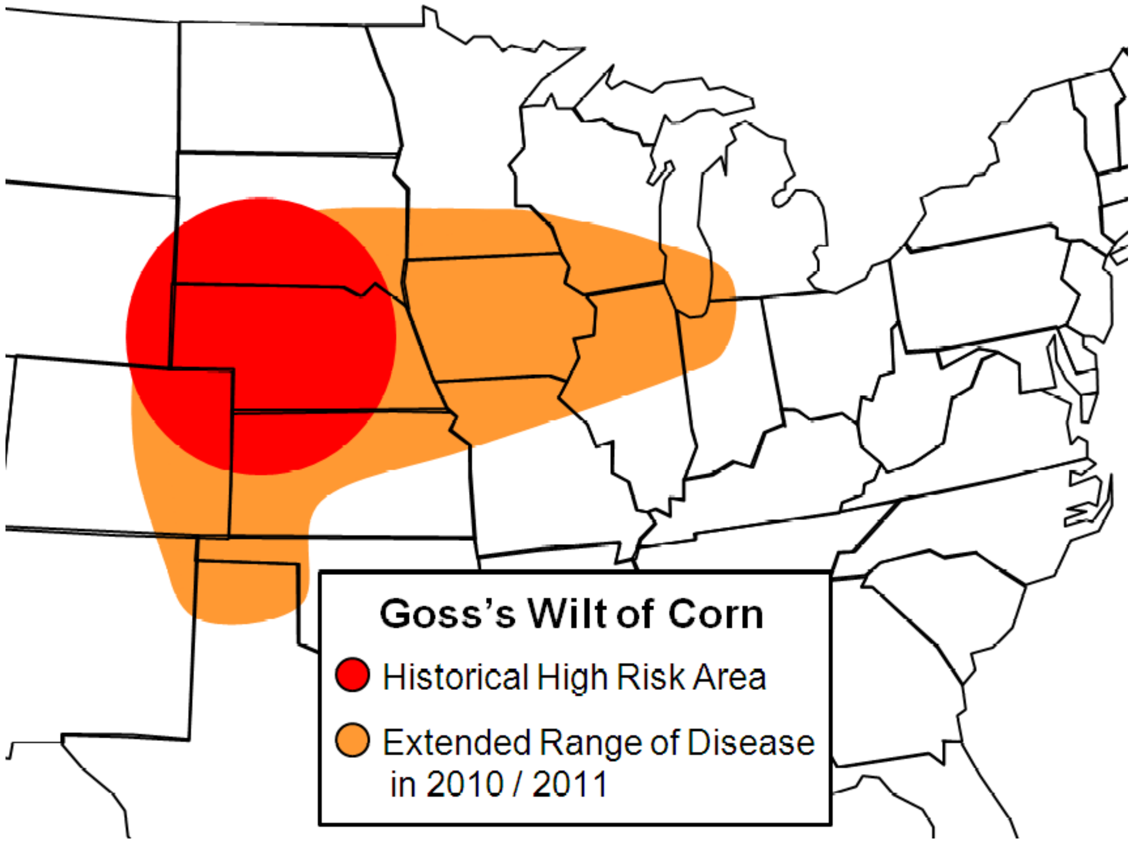


Goss's leaf blight symptoms

IOWA STATE UNIVERSITY
Extension and Outreach

Alison Robertson, ISU

Goss's wilt distribution



Slide Courtesy of Martin Chilvers, MSU

Why the increase in Goss's wilt?

- Change in production systems
- Corn on corn
- Minimum or no-till systems
- Susceptible hybrids
- Change in virulence of the Cmn pathogen

Management

- Plant the most resistant hybrid you can find, which is appropriate for your area
- Tillage and residue management important in high-risk fields
- Longer rotations away from corn will be useful in high-risk fields
- Good weed management recommended – Grassy weed species can serve as alternative hosts
- Fungicides are not effective against Goss's wilt

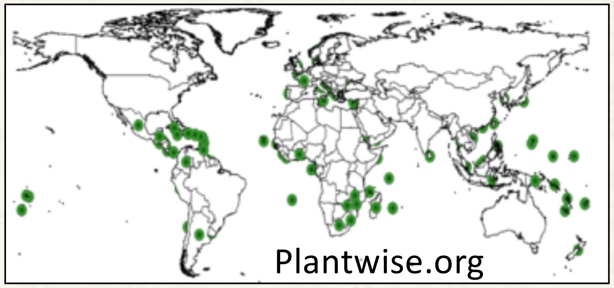
Bacterial Leaf Streak

First report in Wisconsin in 2018

- Pierce Co.
- Relegated to that field
- Not identified in other fields in Wisconsin in 2018
- Do not know if this disease can cause significant yield loss

Bacterial Leaf Streak (BLS) of Corn

- Reported Nebraska July 2016
  - First time reported in the United States
  - Reported in 8 additional states
- Symptoms observed in Nebraska for a few years prior.
- Also in South Africa corn
- Causes gumming disease of sugarcane worldwide



Korus, K., Lang, J., Adesemoye, A., Block, C., Pal, N., Leach, J., and Jackson-Ziems, T. 2016. First report of *Xanthomonas vasicola* causing bacterial leaf streak of corn in the United States. Plant Dis . 101:1030.

Slide Courtesy of Tamra Jackson-Ziems, University of Nebraska-Lincoln

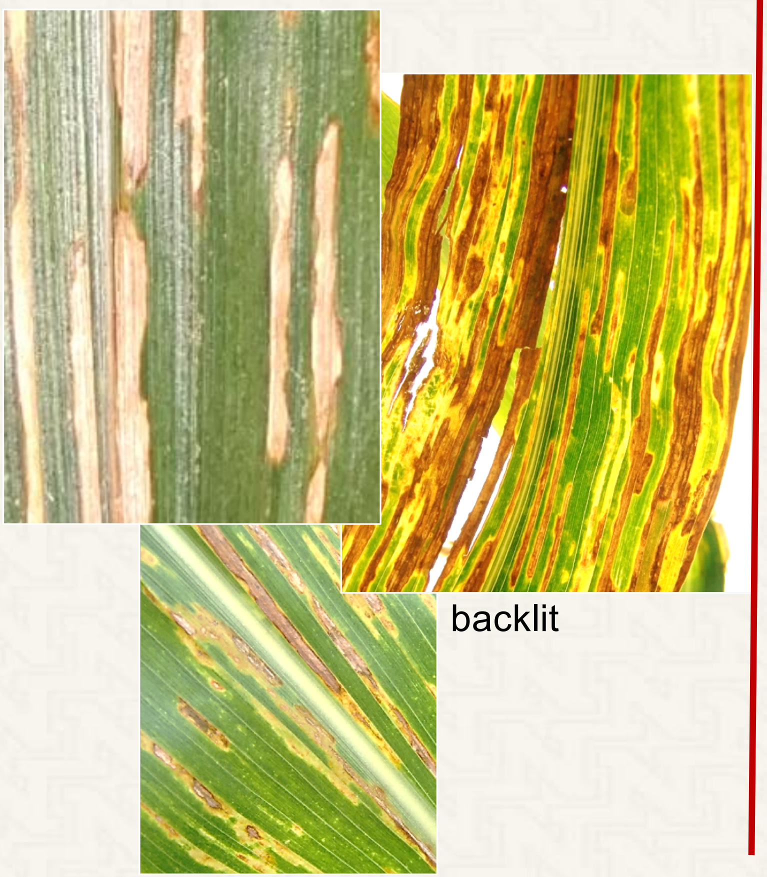
Bacterial Leaf Streak (BLS) of Corn

- Caused by *Xanthomonas vasicola* pv. *vasculorum*
- Other reported hosts:
  - Several palm and grass species
  - Coconut
  - Sorghum species
  - Grain sorghum
  - Johnson- and Sudan grass

Lang, J.M., E. DuCharme, J. Ibarra Caballero, E. Luna, T. Hartman, M. Ortiz-Castro, K. Korus, J. Rascoe, T.A. Jackson-Ziems, K. Broders, and J.E. Leach. 2017. Detection and characterization of *Xanthomonas vasicola* pv. *vasculorum* nov. causing bacterial leaf streak of corn in the United States. Phytopathology 11:1312-1321.

Slide Courtesy of Tamra Jackson-Ziems, University of Nebraska-Lincoln

Bacterial Leaf Streak



Gray Leaf Spot

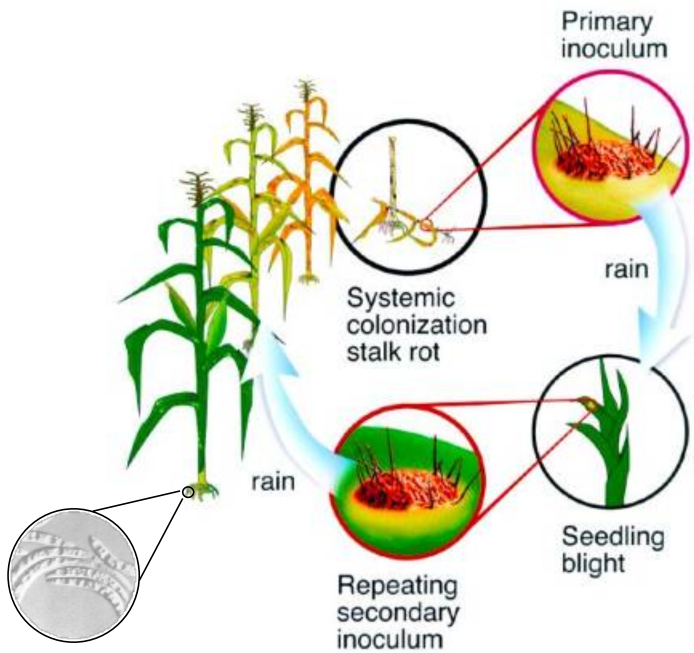
Slide Courtesy of Tamra Jackson-Ziems, University of Nebraska-Lincoln

Anthracnose

- *Colletotrichum graminicola*
- Leaf blight, Top dieback, Stalk rot
  - Leaf disease is not directly related to stalk rot and dieback
- Yield losses of 3-16% reported

Residue-Borne Pathogen

- Overwintering survival: primarily in corn residue
- Rain-splash disseminated
- Poor competitor outside of corn residue



Conidia infect through roots
(Sukno et al. 2008)

Bergstrom and Nicholson, 1999

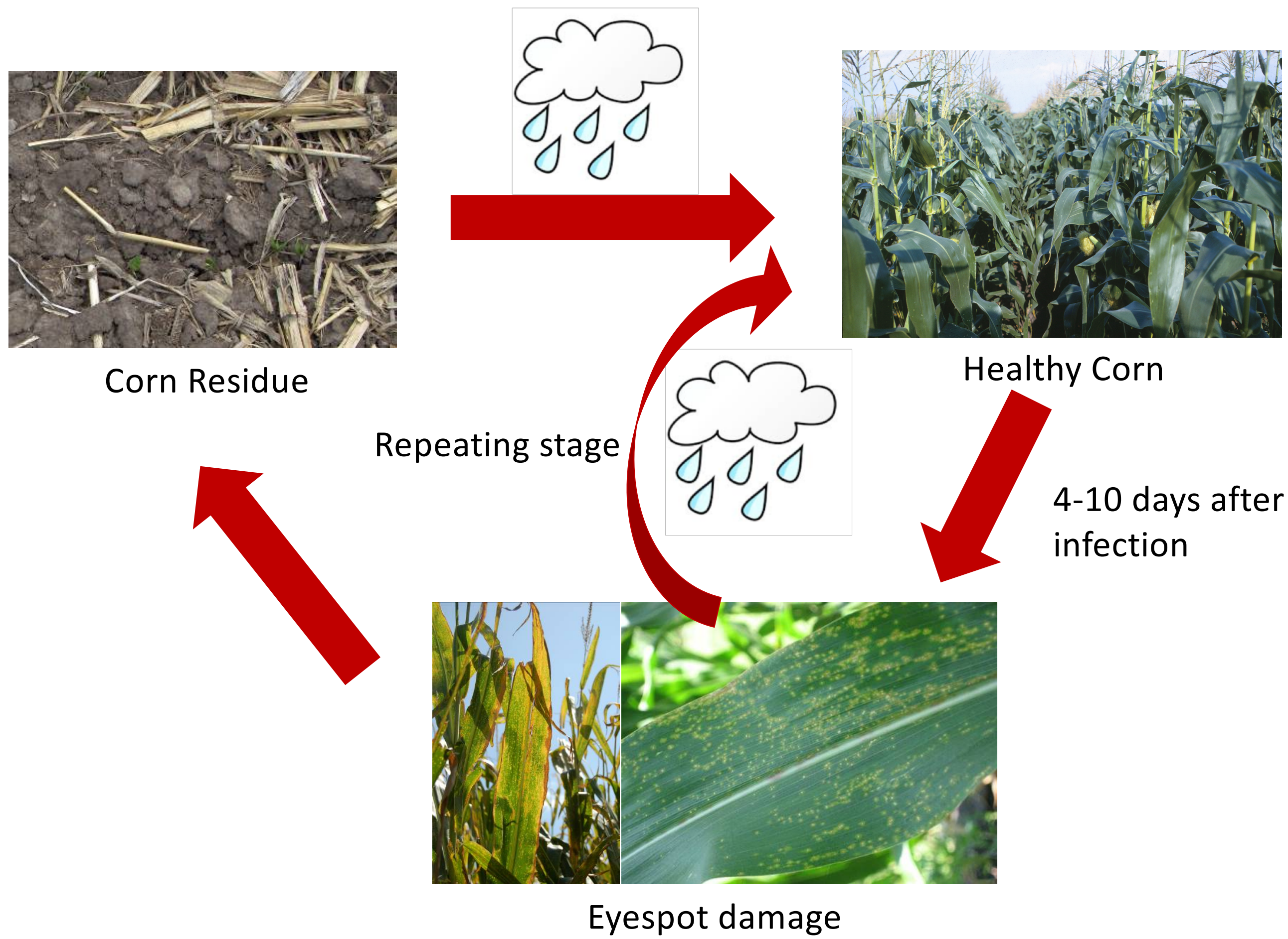
Management

- Tillage
- Rotation
- Chemical control
    - Seed treatment
    - Foliar fungicide
- Host resistance

Eyespot

- Caused by a fungus
  - *Aureobasidium zeae*
  - Old name = *Kabatiella zeae*
- Found throughout the Northern Corn Belt of U.S. and Canada

Eyespot Disease Cycle



Conditions that Favor Eyespot

- Continuous corn rotation
- Minimal tillage = excessive soil-surface residue
- Frequent rains/dew events
- Cool temperatures (68-70 F)

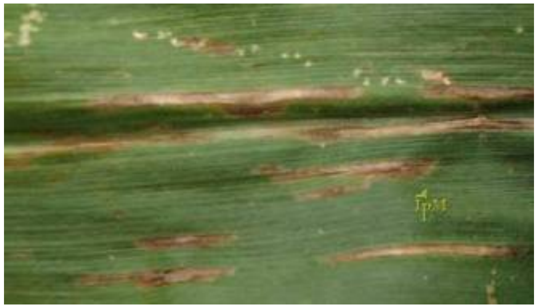
Photo Credit, Alison Robertson, Iowa State University

Management

- Tillage to bury residue/reduce amount of surface residue
- Rotate away form corn – corn is the only known host
- Fungicide application – numerous products labeled, may not be needed

Gray Leaf Spot (GLS)

- *Cercospora zeae-maydis*
- Yield losses can range from 5 to 40 bu/A
  - Even total field losses reported
- Increased under reduced and no-tillage systems
- Early infection = higher yield loss
- Environment: high humidity (leaf wetness); warm temperatures
- Management includes: rotation, resistance, fungicides



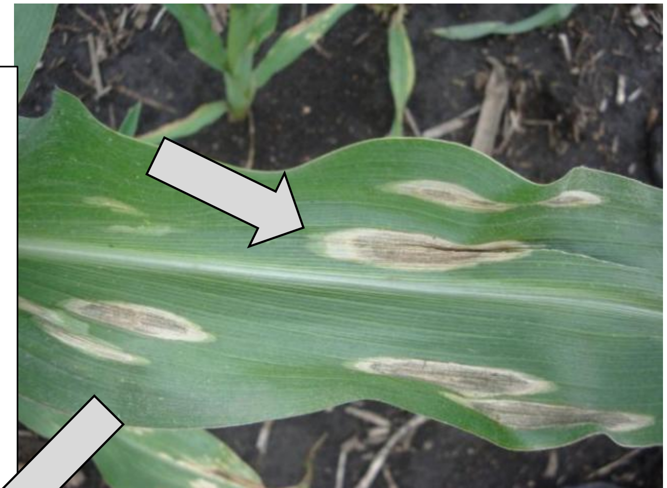
Northern Corn Leaf Blight

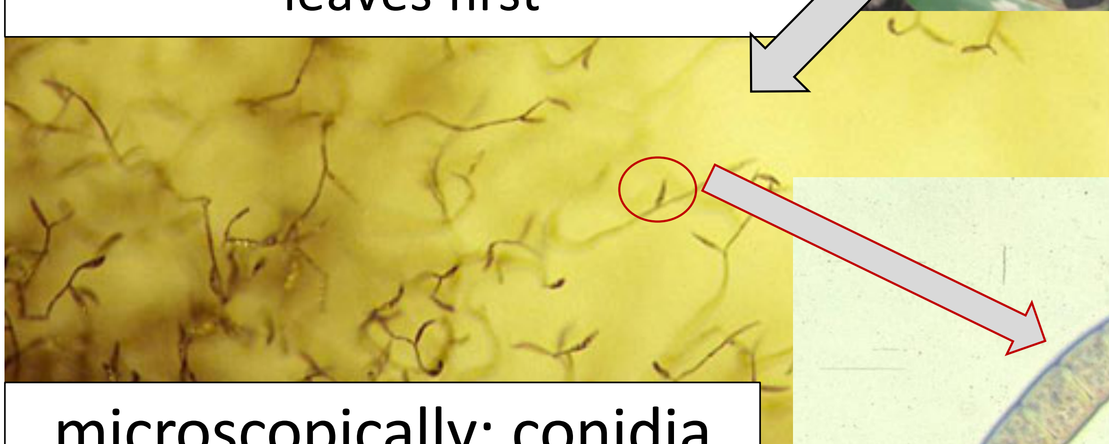
- Fungus: *Setosphaeria turcica* (syn. *Exserohilum turcicum)*
- Found throughout the Midwest
- Can be worse in cool wet years

Symptoms and Signs

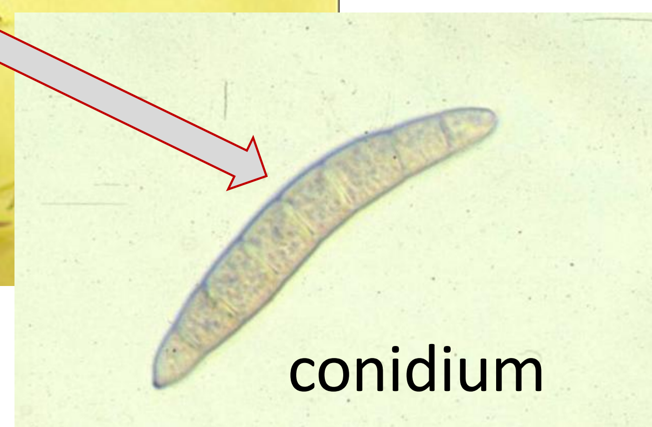
Black fuzzy growth in lesions are conidia forming on conidiophores

Lesions often appear on lower leaves first





microscopically: conidia forming on conidiophores



Factors that Promote NCLB

- Environment that favors: moderate temperatures (65-80°F) and prolonged periods of dew
- Large amounts of surface residue
- Susceptible hybrids
  -New races are likely emerging in the Midwest
- Lack of rotation

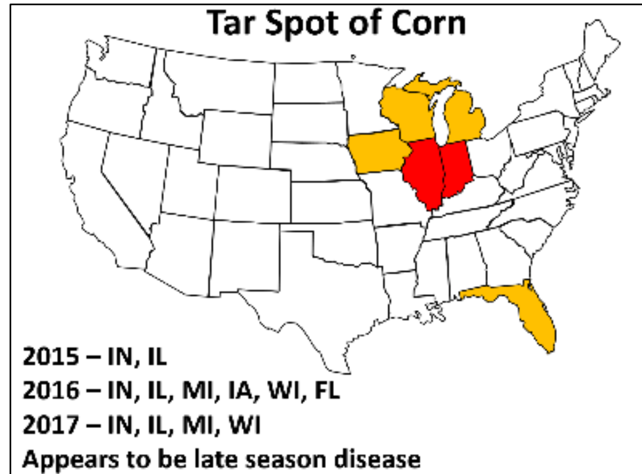
Management

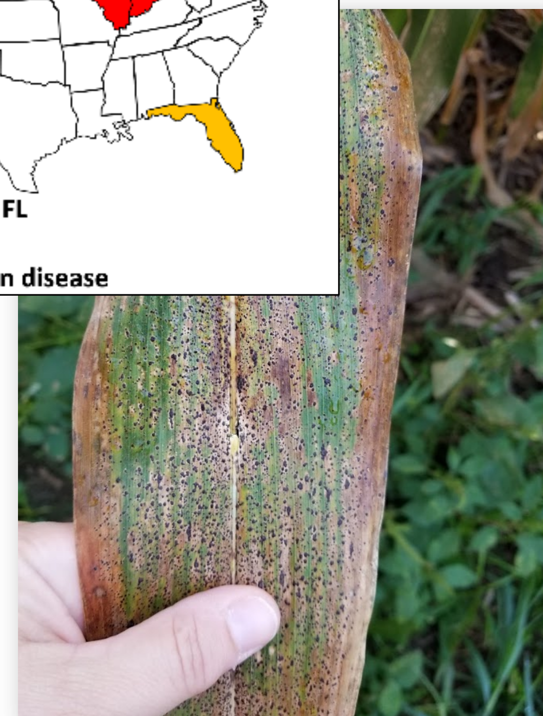
- Choose a resistant hybrid appropriate for your location
- Manage corn residue
- Rotate
- Fungicide application
  - Best chance for economic return = VT/R1 growth stage
  - Scout prior to VT to asses severity of NCLB on lower leaves
  - Goal is to protect ear leaves at VT

Tar spot of corn

Tar Spot

- First confirmed in US in Indiana and Illinois in 2015
- Tar spot complex – *Phyllachora maydis; Monographella maydis*
- Yield-limiting, production issue in the region this year
- Limited knowledge about this disease – most from native range in Latin America





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What to look for

- Small, black raised spots (circular to oval) on infected plants
- These spots may appear on both sides of leaves, leaf sheaths and husks
- Present on both healthy green tissue and dying (brown) tissue
- Sometimes spots may be surrounded by a tan or brown halo

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Why Was Tar Spot so Bad in 2018?

Figure From Mottaleb et al., 2018

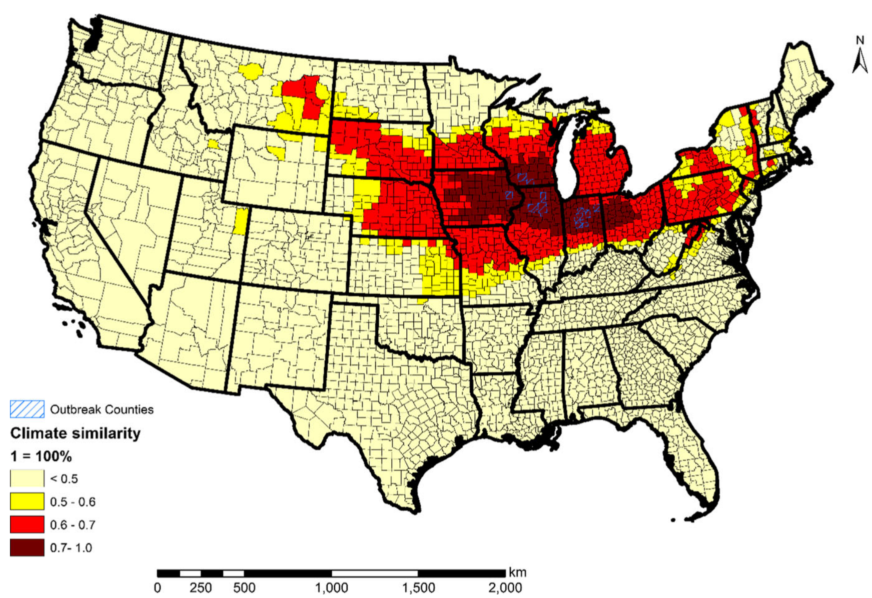
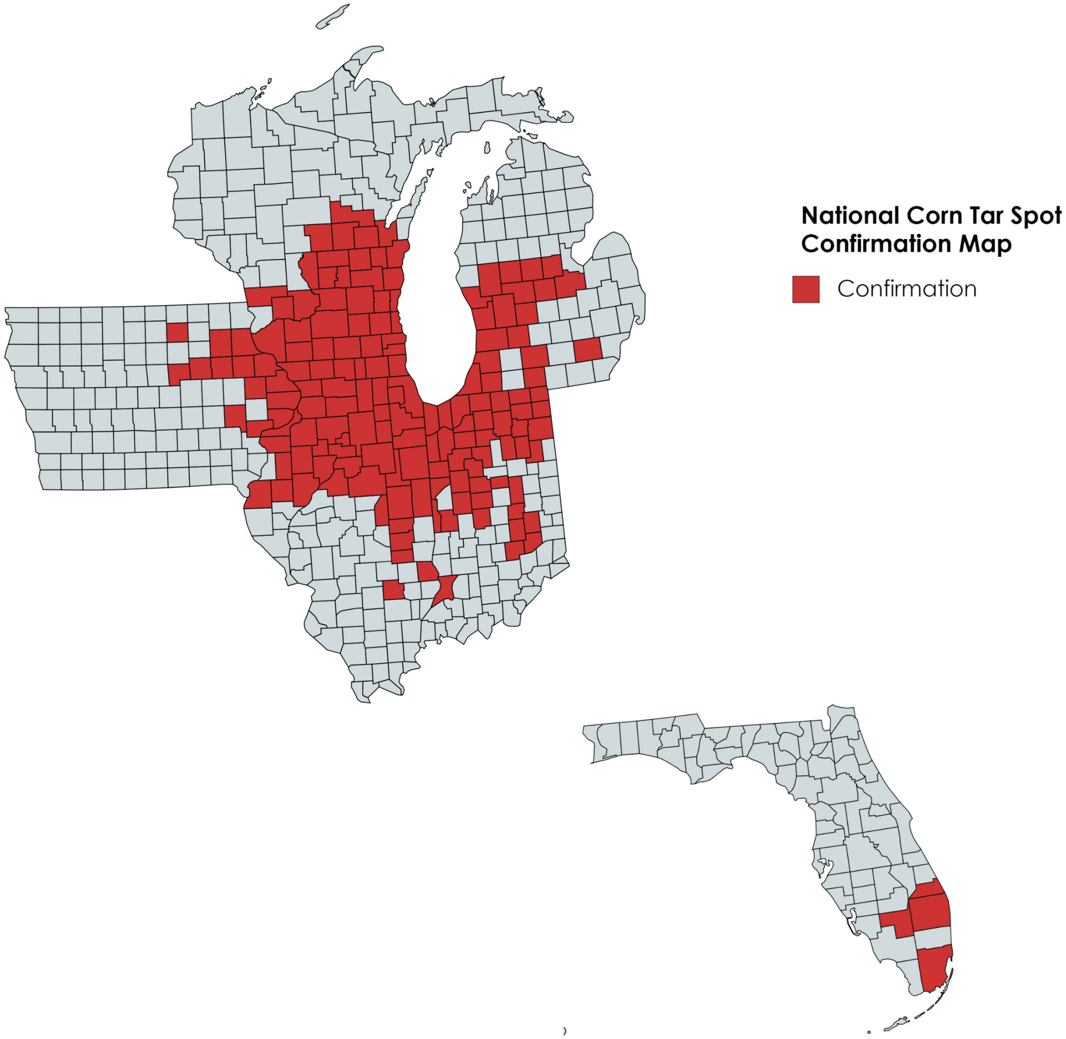


Fig. 4 Maize-producing counties vulnerable to tar spot complex (TSC) calculated based on climate similarity indices using historic climatic data from the counties where TSC has been detected. Source: developed by authors

Hock et al. 1995

- Monthly average temp of 63 F – 72 F
- Average RH greater than 75%
- Average of 7h/night of leaf wetness
- 10-20 foggy days per month
- Monthly rainfall total of at least 5.9 inches



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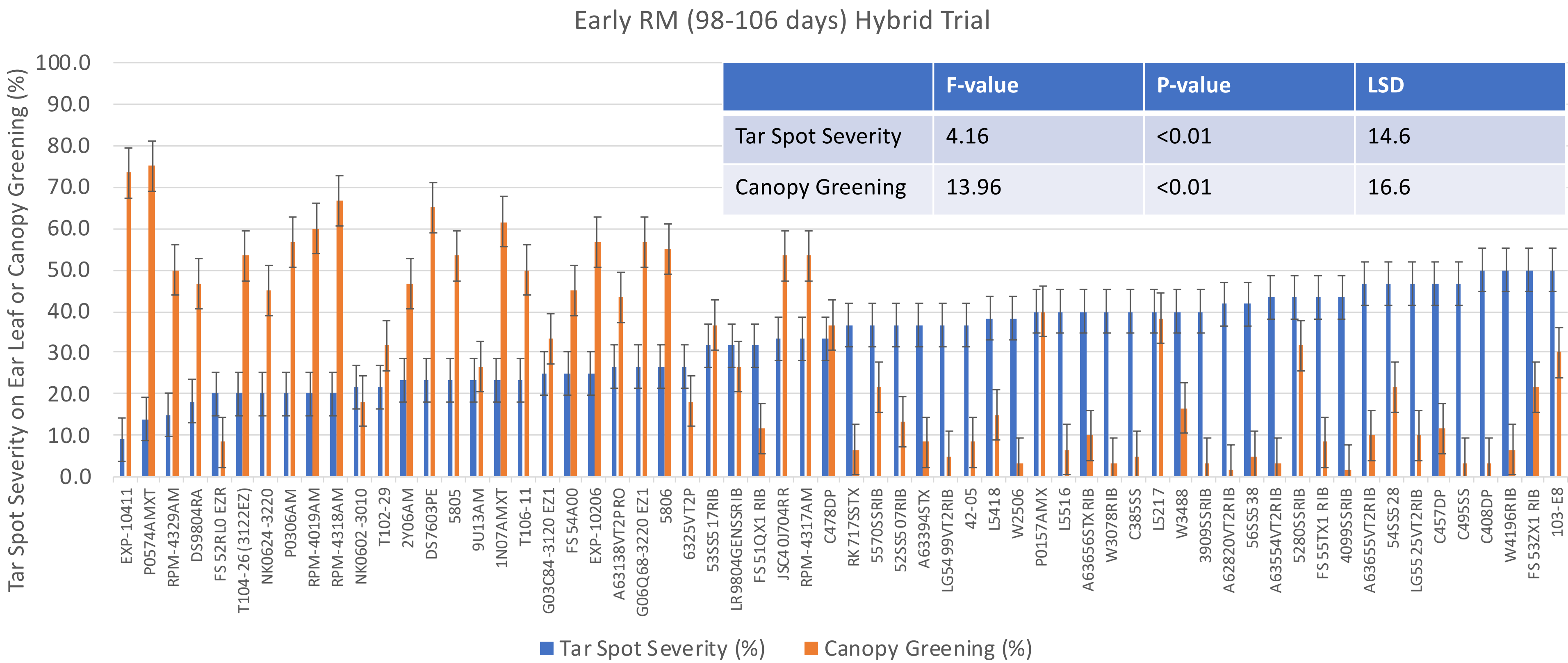
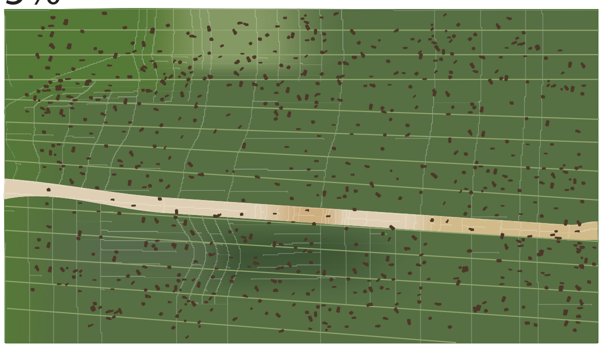
Early RM Hybrid Trial - Montfort, WI (8/31/2018)



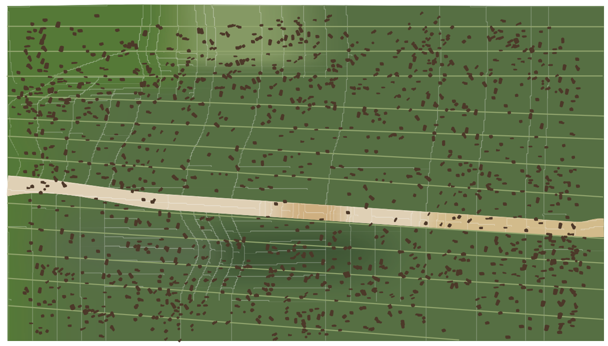
	F-value	P-value	LSD
Tar Spot Severity	4.16	<0.01	14.6
Canopy Greening	13.96	<0.01	16.6

What Does 50% Severity Mean?

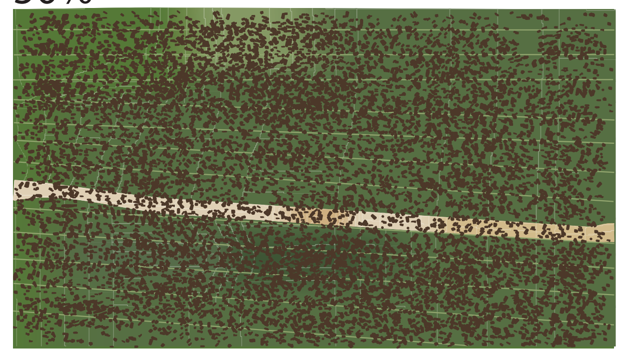
5%



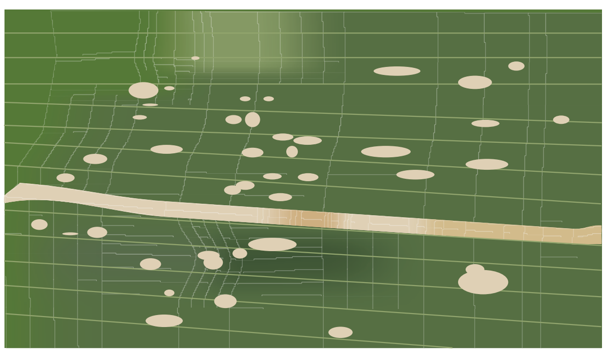
10%



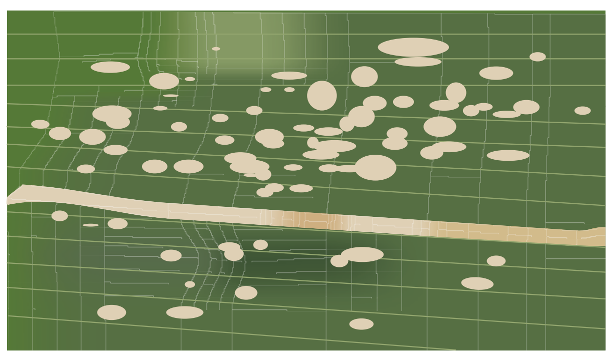
50%



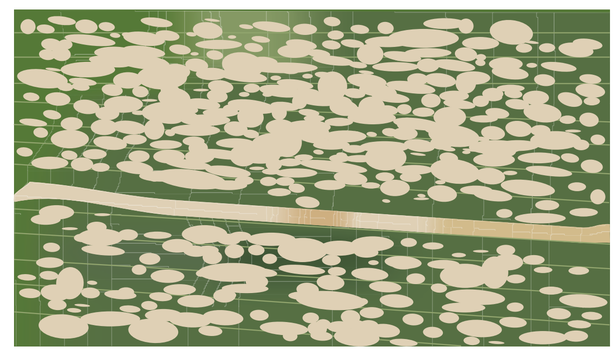
5%



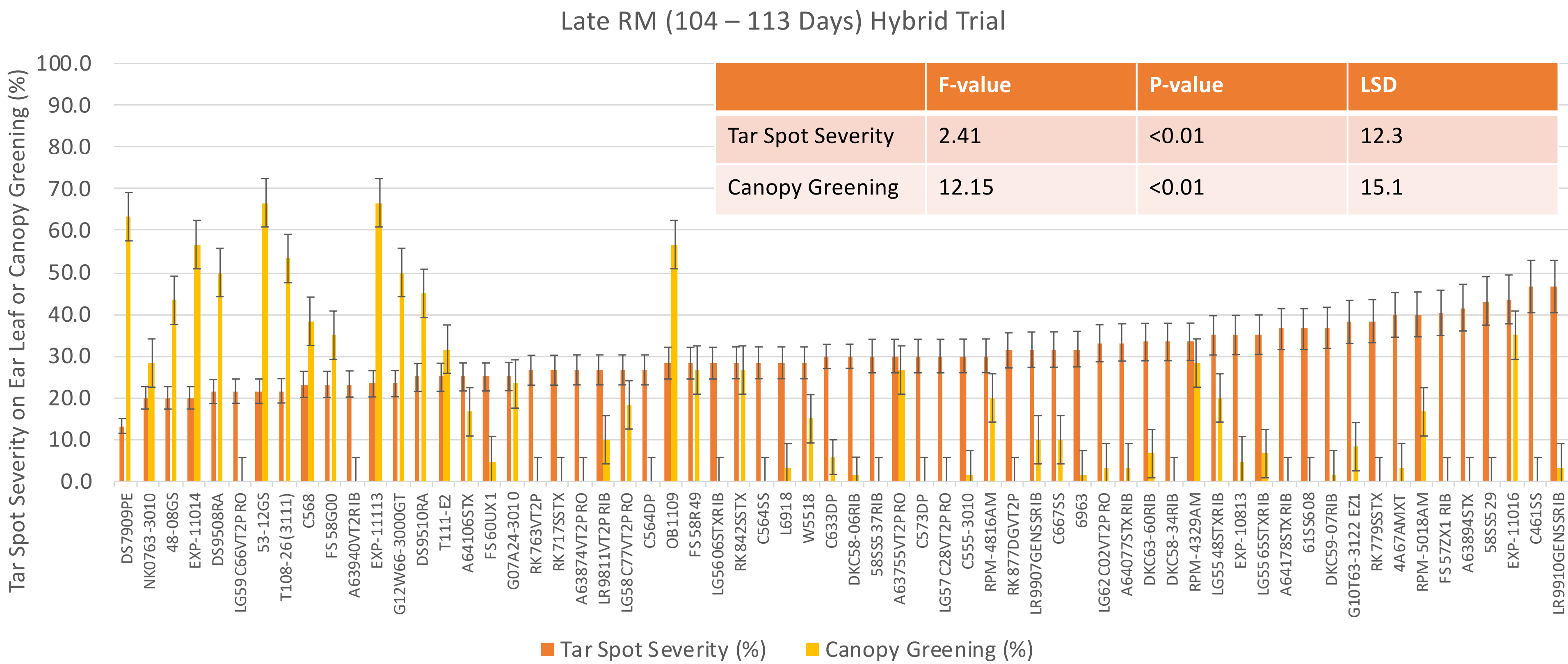
10%



50%

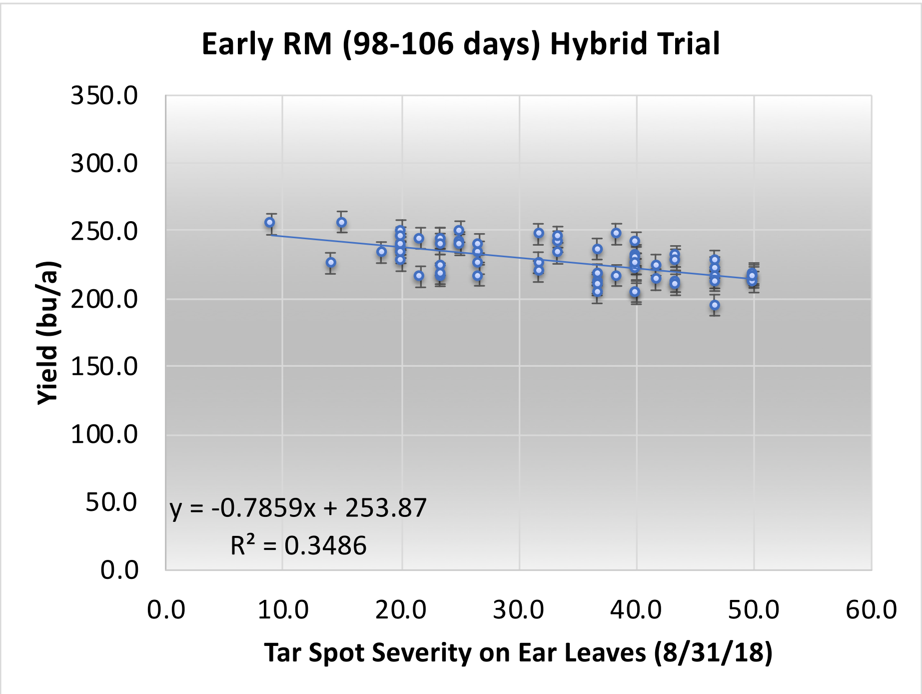


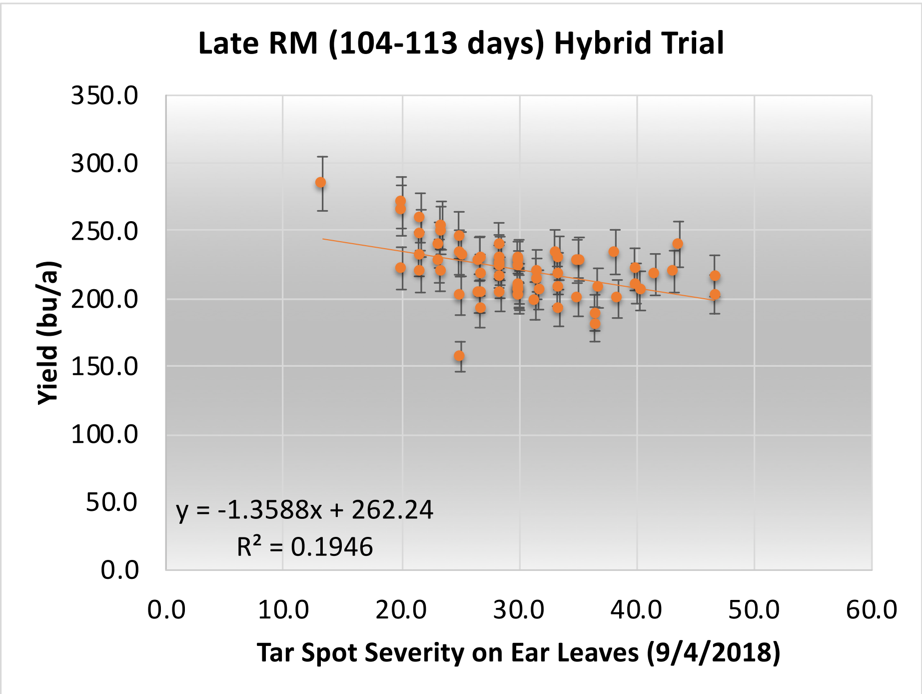
Late RM Hybrid Trial - Montfort, WI (9/4/2018)



	F-value	P-value	LSD
Tar Spot Severity	2.41	<0.01	12.3
Canopy Greening	12.15	<0.01	15.1

Yield Loss – Montfort, WI Hybrid Evaluation





*High severity (45-50% ear leaf severity) led to estimated yield reductions of 40—60 bu/a

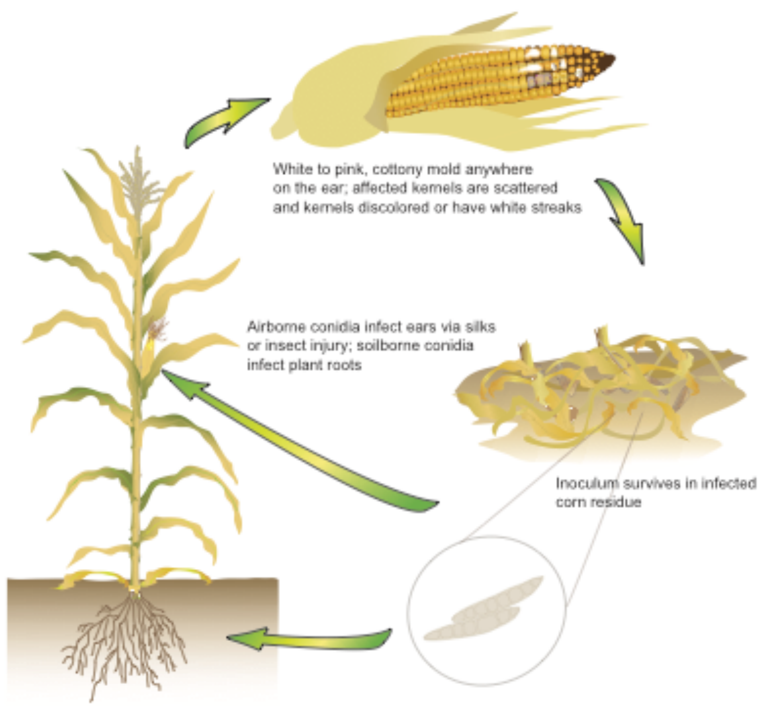
Tar Spot Management

- There will likely be some tar spot in 2019
  - -Level a function of the hybrid planted, weather conditions, and if epidemic initiates earlier vs. later in the season
  - -The 2018 epidemic was so problematic, because tar spot started in some fields before tasseling
- Some hybrids are more resistant than others
  - -Resistance not tied to brand – Every hybrid stands on its own
  - -Strong hybrid resistance isn't common – will need an integrated approach
- Fungicide application can reduce tar spot severity
  - -Product important (QoI + DMI or QoI + DMI + SDHI)
  - -Timing very important
  - -Application needs to occur close to the onset of the epidemic
- Need for a prediction model
  - -Tarspotter? – Needs validation in 2019 and beyond
  - -Have infrastructure in place to launch as a research smartphone application
  - -Will push predictions via newsletters, blogs, and Twitter in 2019
- Need More Crop Management Data
  - -Rotation
  - -Tillage

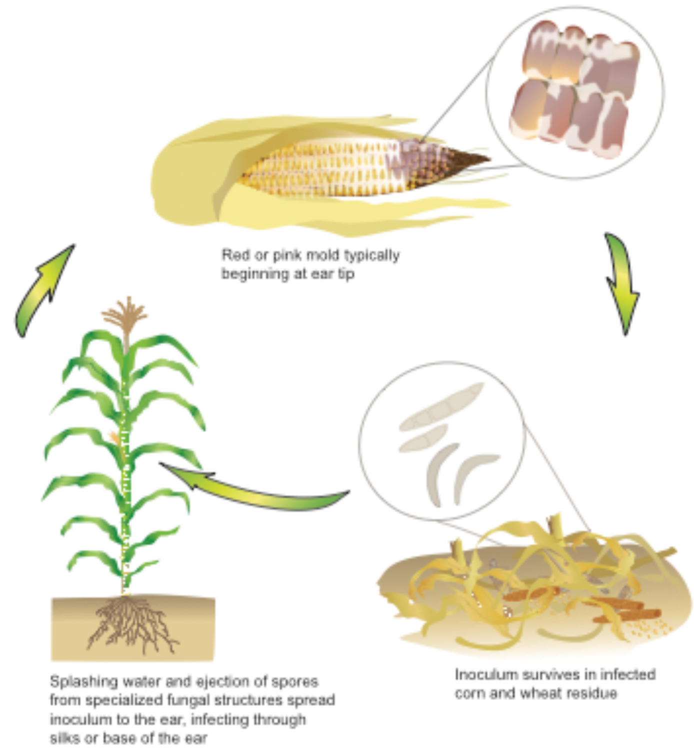
Ear Rots

The Major Ear Rots in the Upper Midwest

Fusarium ear rot



Gibberrella ear rot



Mycotoxins

- Toxic, metabolic by-products produced by fungi (molds) growing on grain, feed, or food in the field or in storage
- 400-500 known mycotoxins
- Production of mycotoxins is highly dependent on
  - Environment
  - Factors that may cause wounding on plants (e.g. hail, insect feeding)
  - Situations where resource demand is high or resources are limiting (e.g. plant stress)
- Kernel moisture >18-20% does favor growth of all ear molds (including those that produce toxins)
- Presence of mold on an ear **DOES NOT EQUAL** mycotoxins are present
- Similarly, no mold **DOES NOT EQUAL NO** mycotoxins are present
- Most important organisms in Wisconsin = *Fusarium* spp.

Management of Mycotoxins

Anything that reduces stress in corn plants will help to reduce infection

- Balanced soil fertility program
- Choose hybrids that are not only resistant to these fungi; but also **WELL ADAPTED** to your location
- Plant early and allow normal heat units to accumulate
- If possible, irrigate to reduce stress
- Minimize insect damage
- Harvest in a timely manner and don't let corn stand late into fall promoting damage from Fusarium ear mold
- Minimize kernel damage at harvest
- Dry corn properly (12% or less)
- Keep storage facilities clean
- Fungicide applications – product and timing are important

Using Fungicides Effectively in Field Crops

Fungicide Mode of Action

Mode of Action – defines how the product actually affects the fungus

Separate from fungicide mobility – how the fungicide moves in plants

Examples

Demethylation inhibitor (DMI) or FRAC 3 compounds – inhibits a specific enzyme in fungi that is important in sterol production

- Sterols are necessary in fungal cell membranes
- Lack of Sterols result in abnormal fungal growth

Quinone outside inhibitors (QoI) or FRAC 11 (Strobilurins) & Succinate dehydrogenase inhibitors (SDHI) or FRAC 7 – inhibit mitochondrial respiration, stopping energy production, and resulting in fungal death

- Effective on germinating spores and early fungal growth

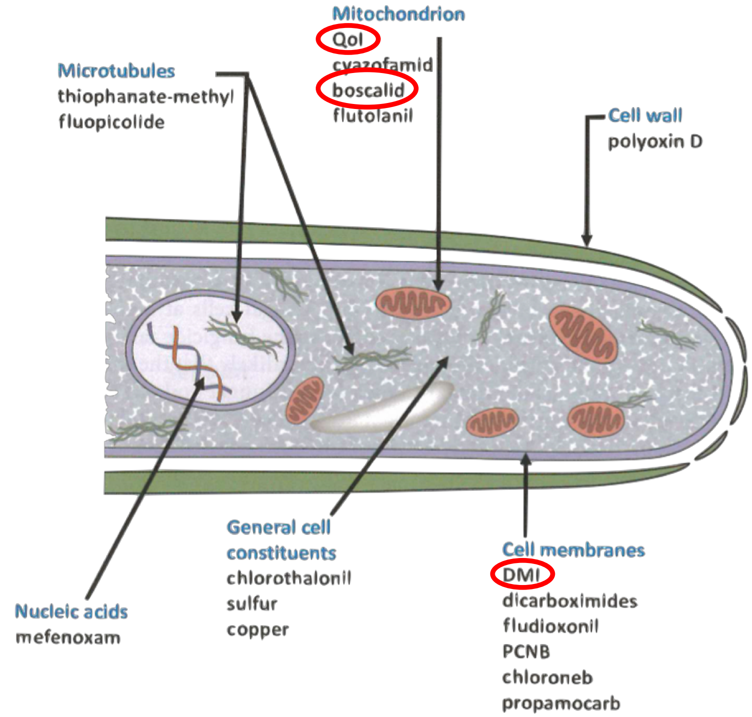


Image Credit: Fig. 2.4 from "A Practical Guide to Turfgrass Fungicides" by Richard Latin, Purdue University

Fungicide Mobility (Phytomobility)

- Contacts (ex. Bravo or Dithane)
  - Applied to the surface of a plant
  - Do not move on the surface or into the plant
  - Can be readily washed from the plant surface
  - New plant growth must be protected
  - Used preventatively only
- Penetrants (ex. Headline or Tilt)
  - *Local (Translaminar) penetrant;* can move from one side of the leaf to the other
  - *Acropetal penetrant;* move only upwards in a plant in a water potential gradient
  - *Systemic penetrant;* move upwards and downwards in a plant; very few fungicides actually move systemically

Contacts

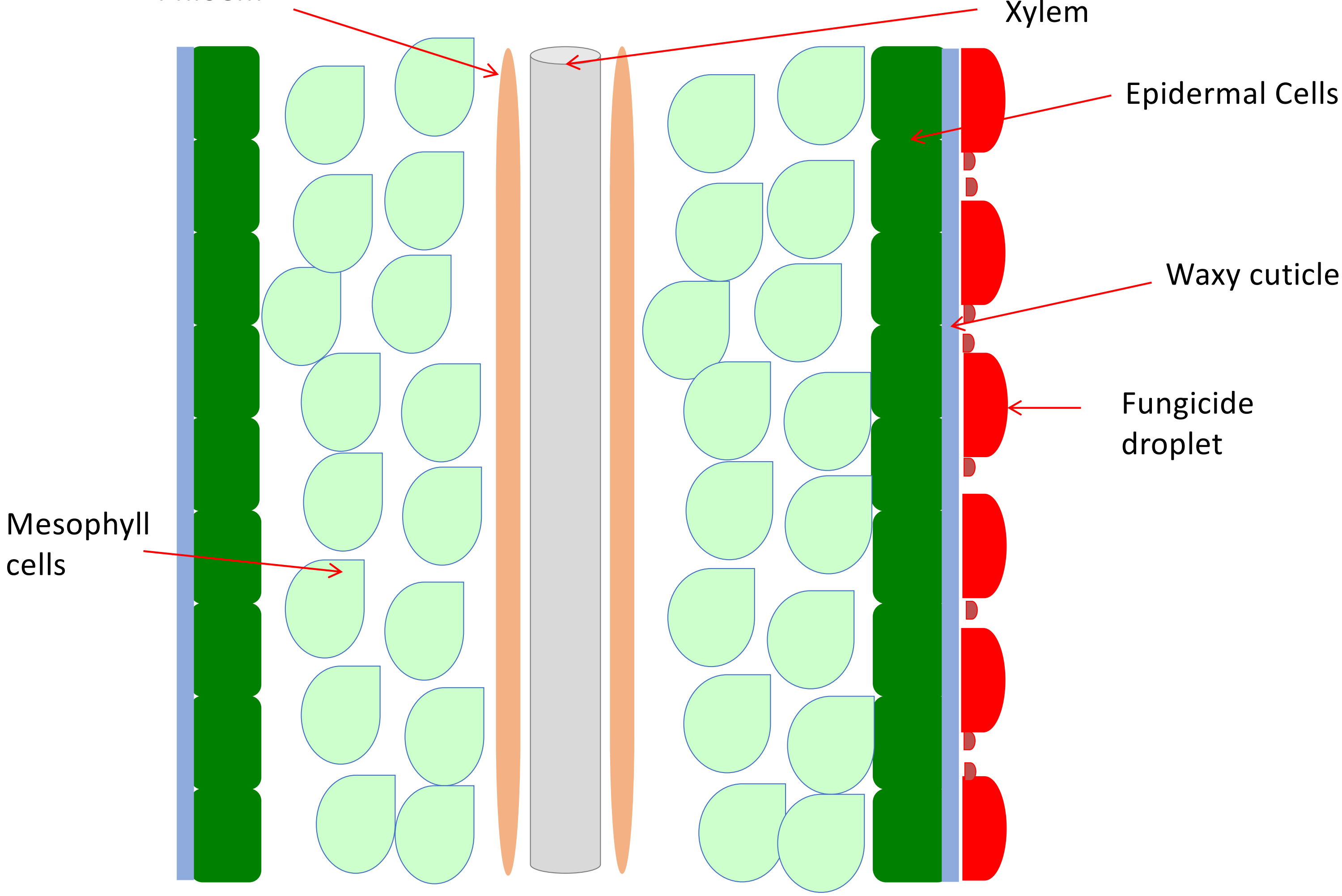


Image Credit: "A Practical Guide to Turfgrass Fungicides" by Richard Latin, Purdue University

Localized (Translaminar) Penetrant (Some Strobilurins)

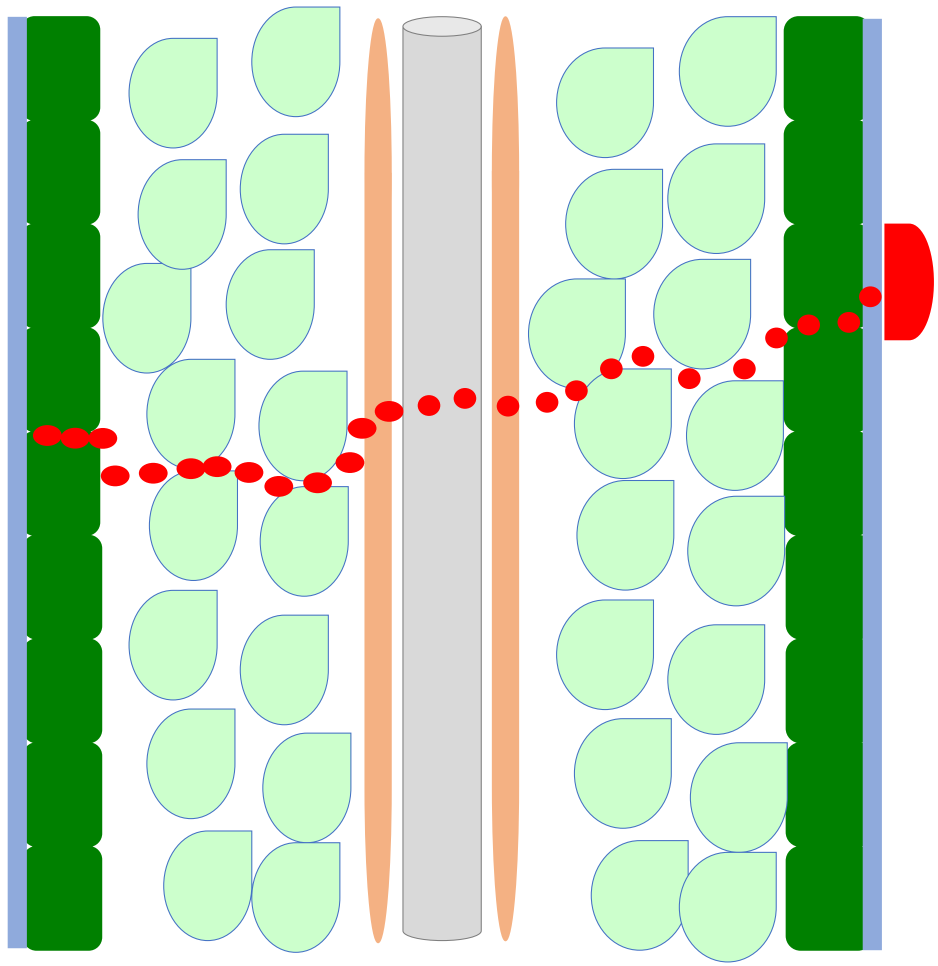


Image Credit: “A Practical Guide to Turfgrass Fungicides” by Richard Latin, Purdue University

Acropetal Penetrant (DMI's, QoI's, SDHI's)

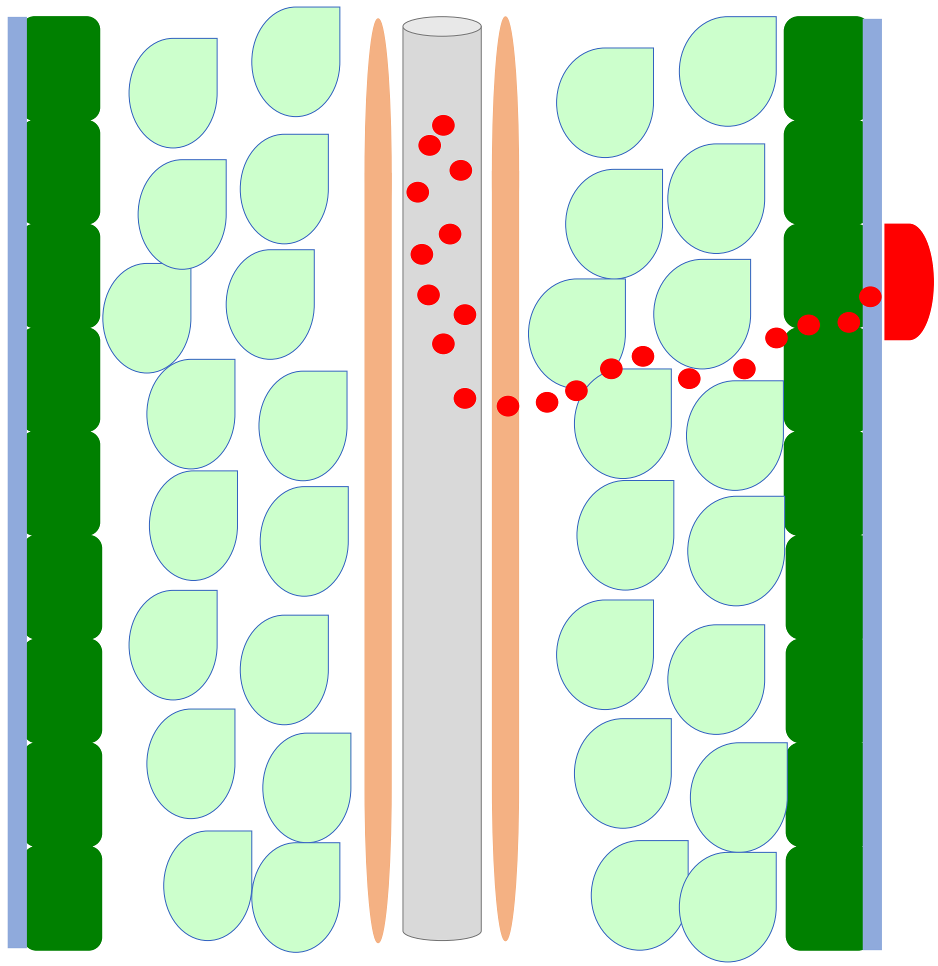


Image Credit: "A Practical Guide to Turfgrass Fungicides" by Richard Latin, Purdue University

Acropetal penetrant (xylem mobile)

1
2
3
4
5

Bartlett et al., 2002 Pest Management Science 58:649-662

Localized penetrant (translaminar)

Using Fungicides to Manage NCLB and Gray Leaf Spot

Foliar Disease Levels Matter!


Ecology and Epidemiology

Meta-Analysis of Yield Response of Hybrid Field Corn to Foliar Fungicides in the U.S. Corn Belt

P. A. Paul, L. V. Madden, C. A. Bradley, A. E. Robertson, G. P. Munkvold, G. Shaner, K. A. Wise, D. K. Malvick, T. W. Allen, A. Grybauskas, P. Vincelli, and P. Esker

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ABSTRACT

Paul, P. A., Madden, L. V., Bradley, C. A., Robertson, A. E., Munkvold, G. P., Shaner, G., Wise, K. A., Malvick, D. K., Allen, T. W., Grybauskas, A., Vincelli, P., and Esker, P. 2011. Meta-analysis of yield response of hybrid field corn to foliar fungicides in the U.S. Corn Belt. Phytopathology 101:1122-1132.

Corresponding author: P. A. Paul; E-mail: paul.661@osu.edu

doi:10.1094/PHYTO-03-11-0091

- Trials over multiple locations and years
- Investigated the effect of fungicide on yield in High vs. Low Disease situations
- Calculated probability of offsetting the cost of fungicide

Field Crops Pathology

BADGER CropDoc

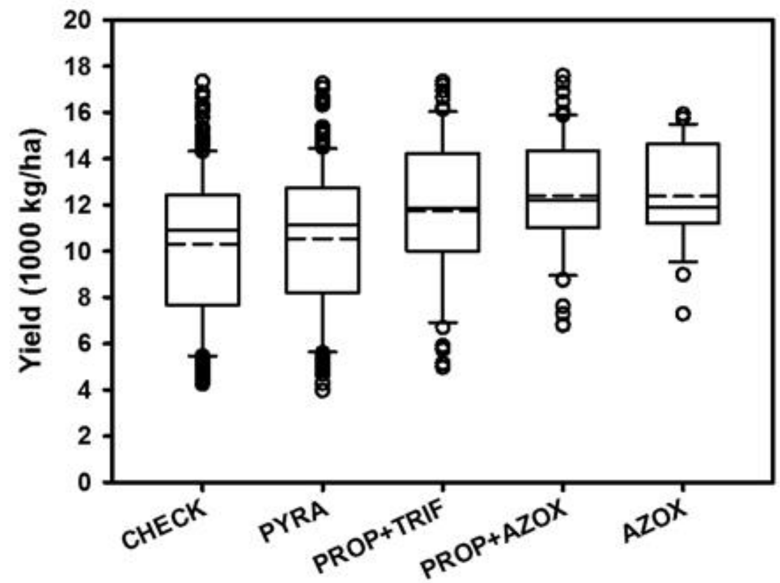
Box Plots Summarizing Grain Yield

PYRA = 23.6% pyraclostrobin (Headline; BASF Corporation Agricultural Products)

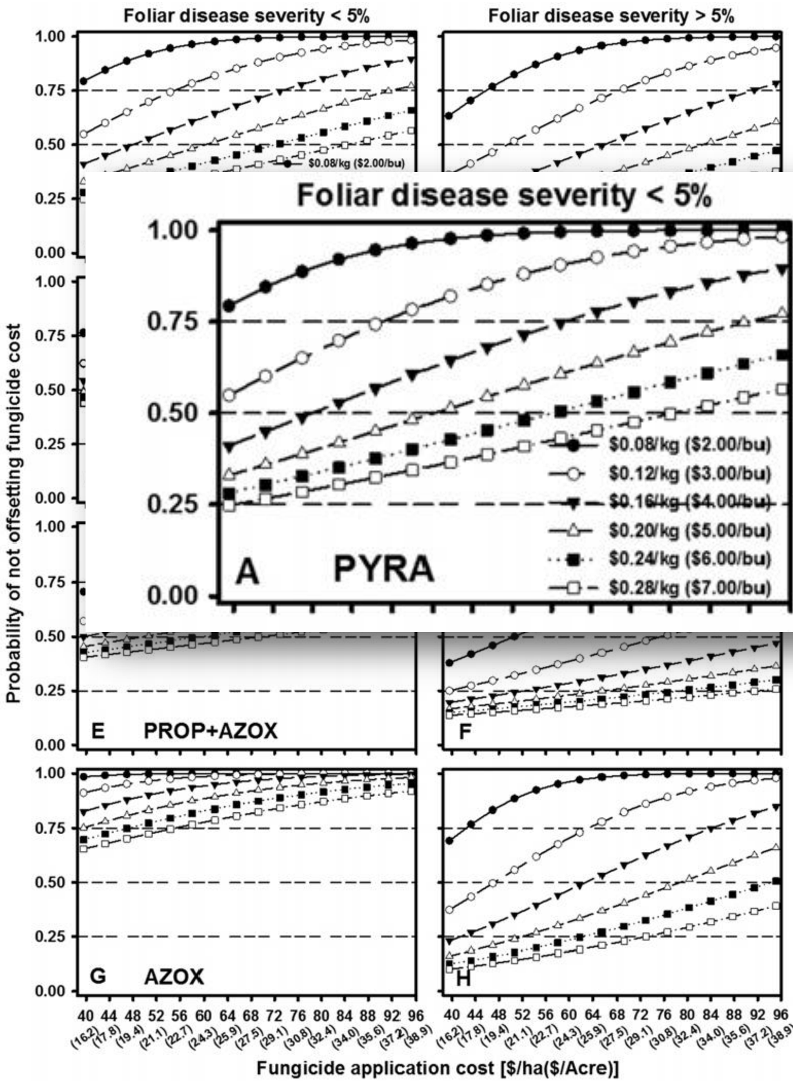
PROP+TRIF = 11.4% propiconazole + 11.4% trifloxystrobin (Stratego; Bayer CropScience, Research Triangle Park, NC)

PROP+AZOX = 7% azoxystrobin + 11.7% propiconazole (Quilt; Syngenta Crop Protection Inc., Greensboro, NC)

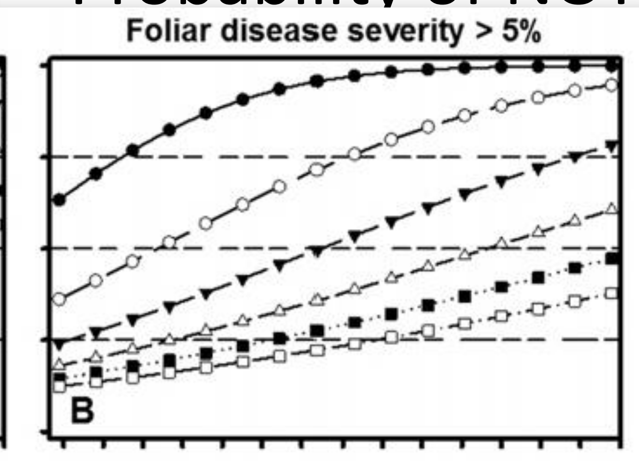
AZOX = 22.9% azoxystrobin (Quadris; Syngenta Crop Protection Inc.)



Paul, P. A., Madden, L. V., Bradley, C. A., Robertson, A. E., Munkvold, G. P., Shaner, G., Wise, K. A., Malvick, D. K., Allen, T. W., Grybauskas, A., Vincelli, P., and Esker, P. 2011. Meta-analysis of yield response of hybrid field corn to foliar fungicides in the U.S. Corn Belt. Phytopathology 101:1122-1132.



Probability of NOT



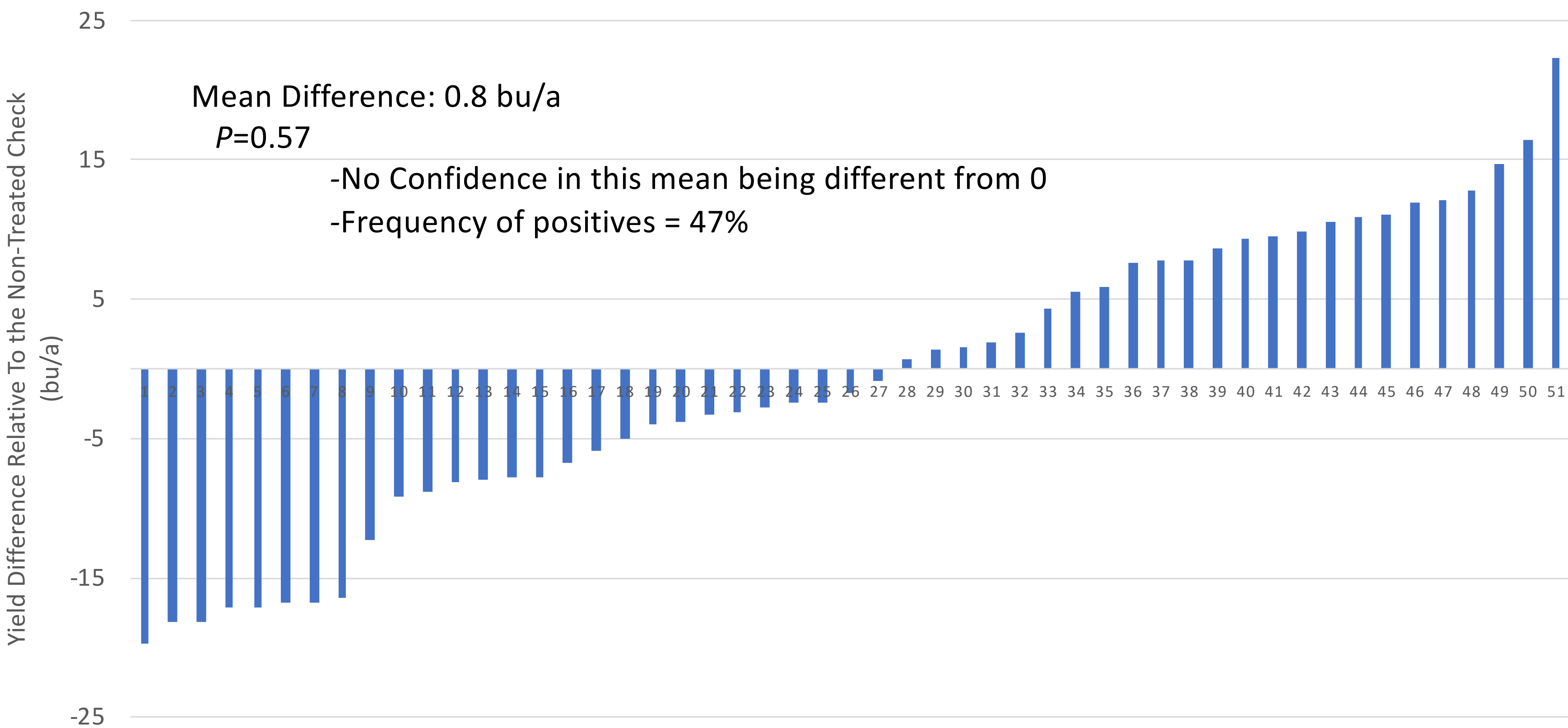
grain

- Cost of fungicide application

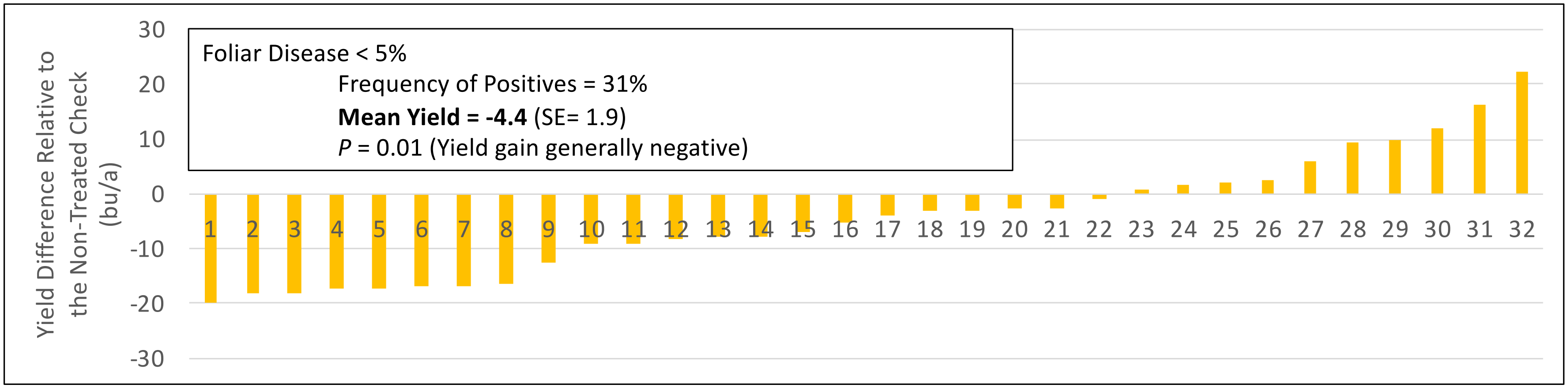
Wisconsin Dataset

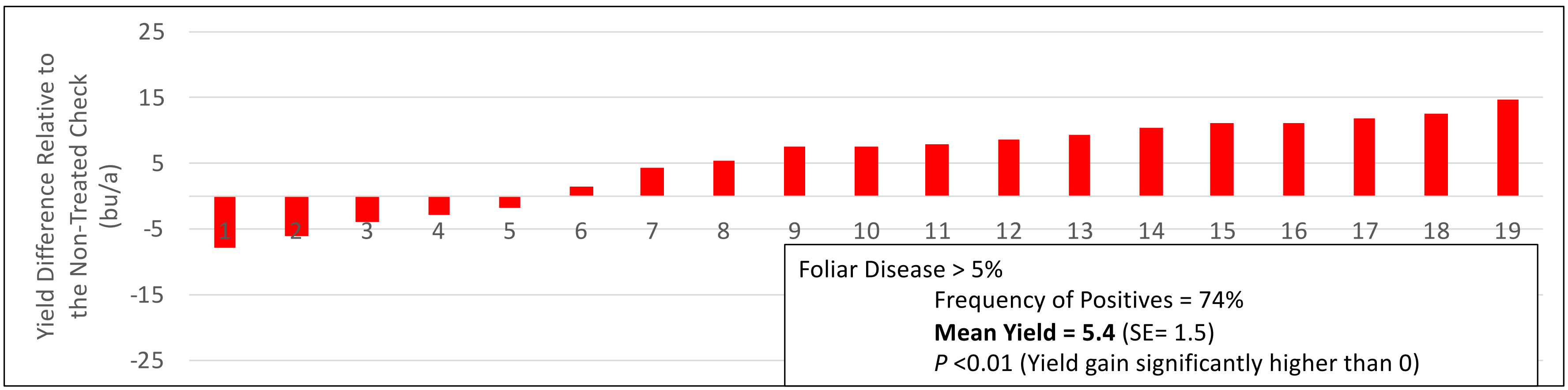
- 4 years of field data at Arlington Wisconsin (2013-2016)
- Used observations for Pre-Mix Fungicide Products Only (DMI + Strobilurins)
  - Most popular products being sprayed on corn
  - Had the largest number of observations over the three-year period
- Used Single-Application Trials Only
  - V6, V8, or VT (No computed difference in chance of yield increase at the various timings)
  - Total of 51 replicated treatment observations
- Looked at
  - Frequency distributions
  - Mean yield advantage
  - Considered variation across a field
  - Calculated Odds of a Positive ROI

Yield Difference Compared to Not-Treating for 51 Treatments

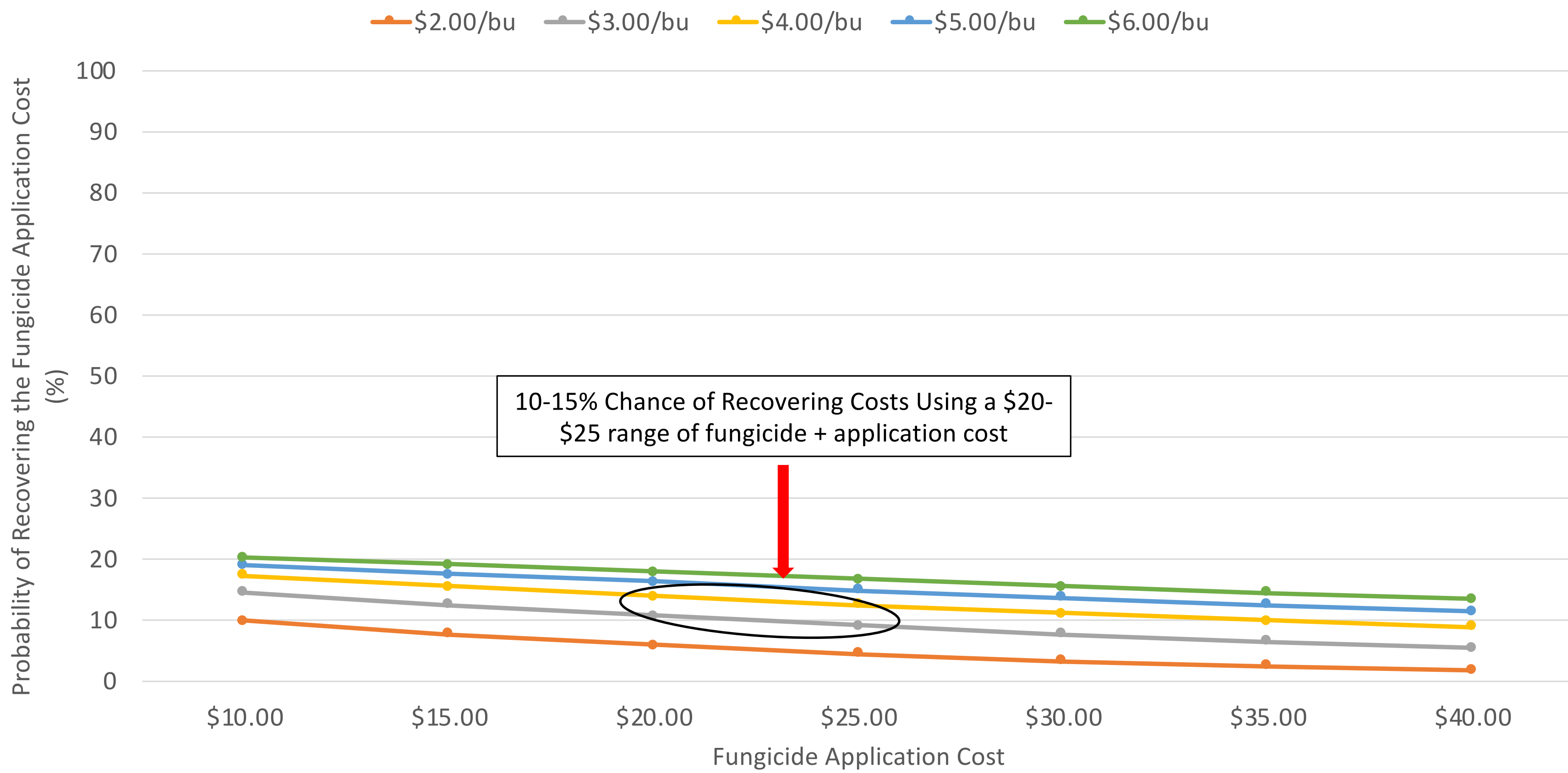


Effect of Disease Level Highly Significant on Yield Response to Fungicide

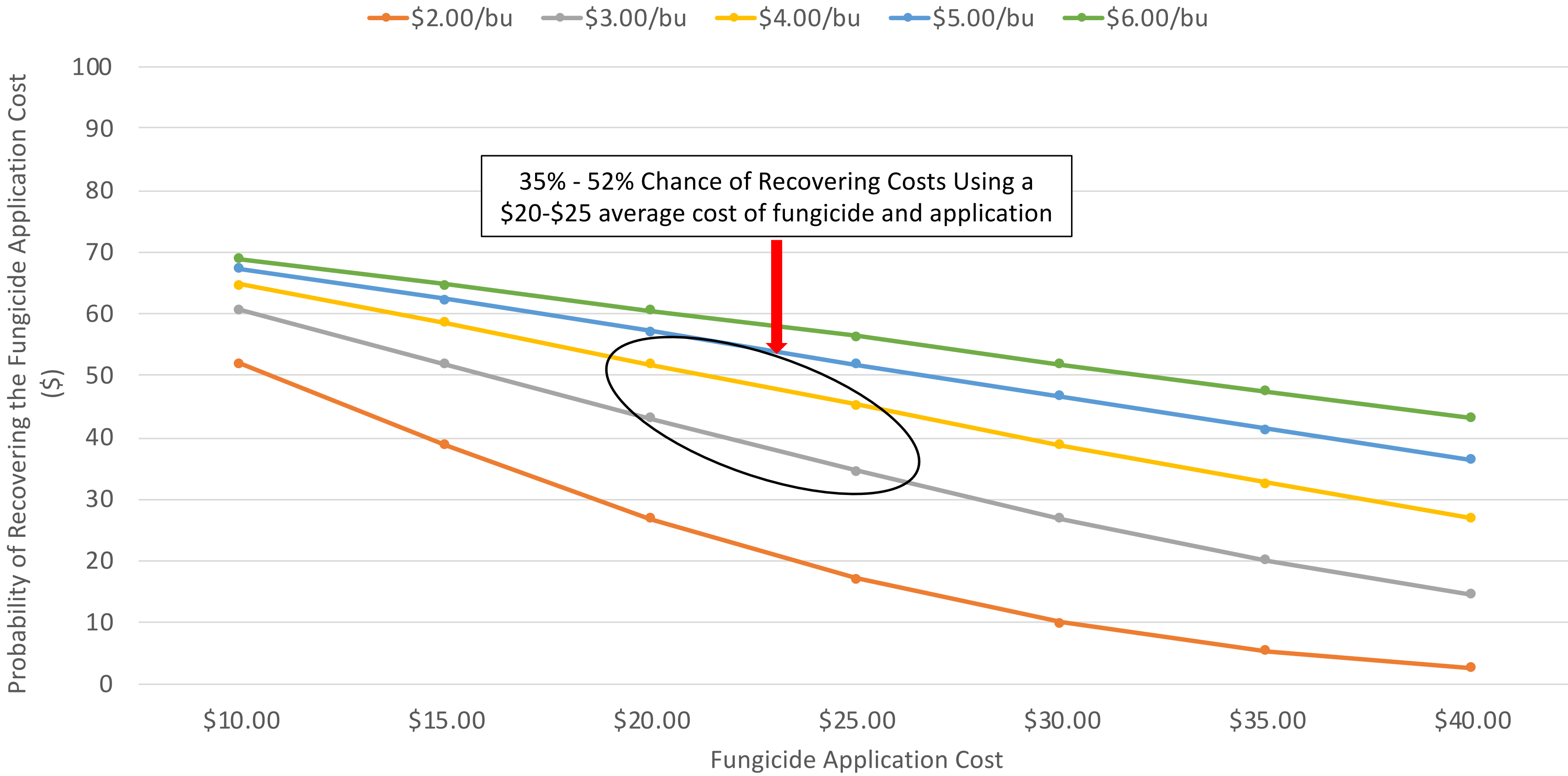




Probability Of Recovering the Cost of A Fungicide Application Under **Low** Foliar Disease Pressure



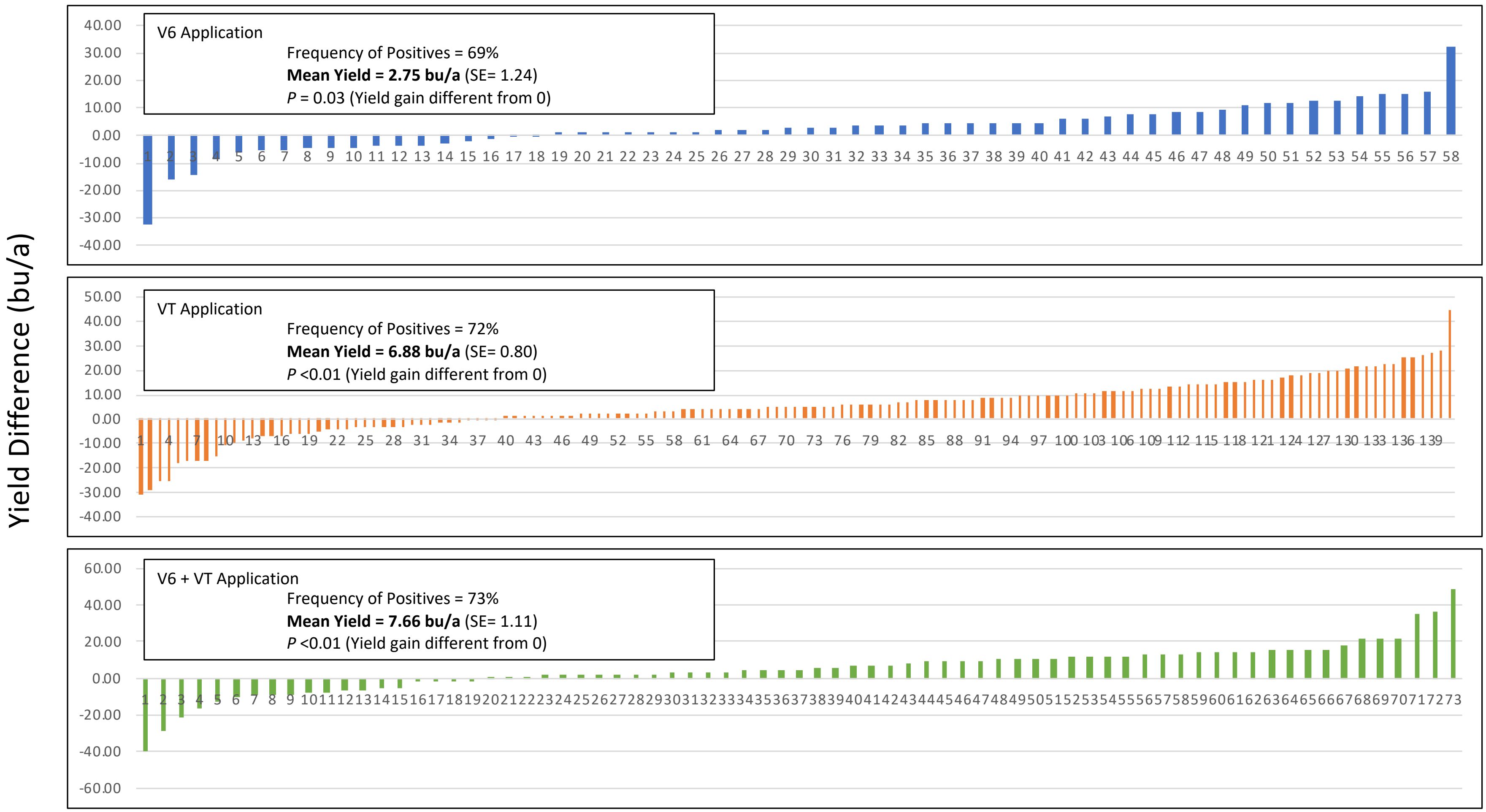
Probability Of Recovering the Cost of A Fungicide Application Under **High** Foliar Disease Pressure



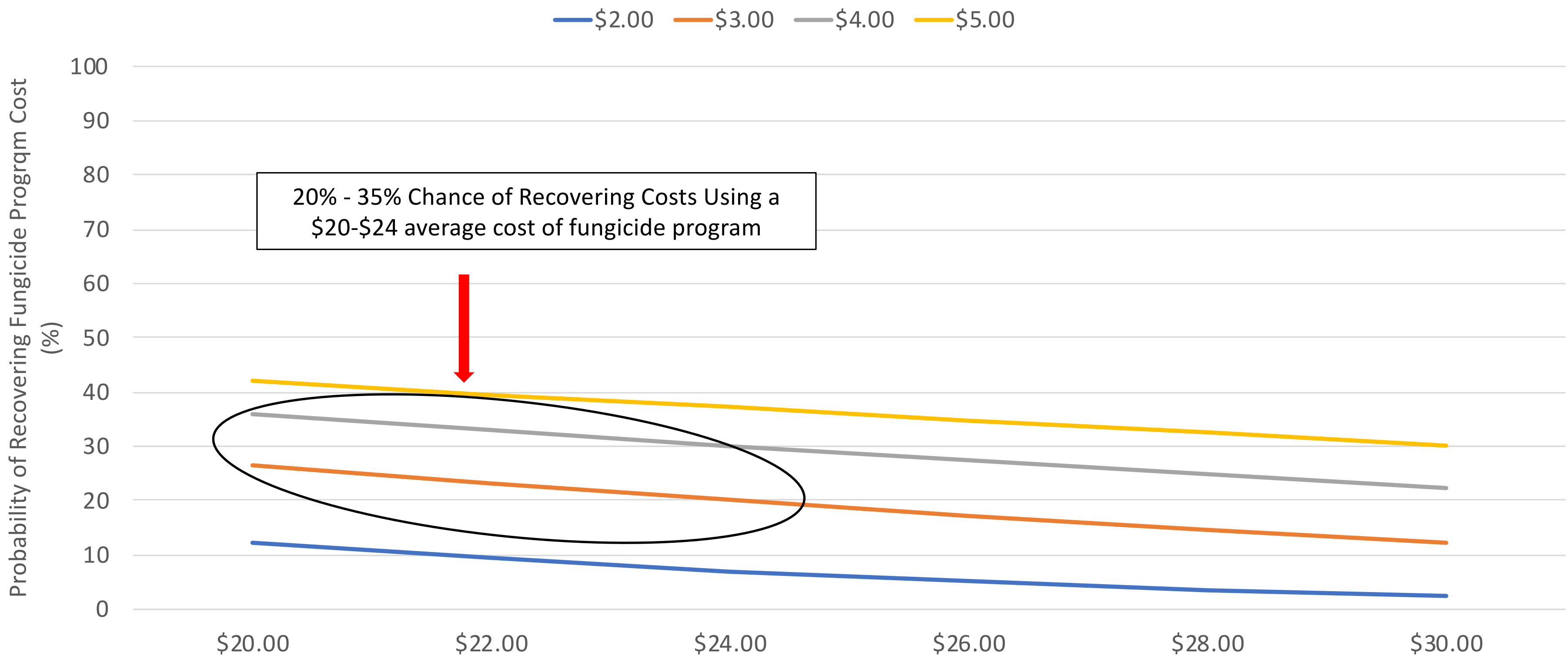
What about timing of application based on results across the United States Corn Belt?

Wise and Smith et al., 2019 Plos One. *Submitted*.

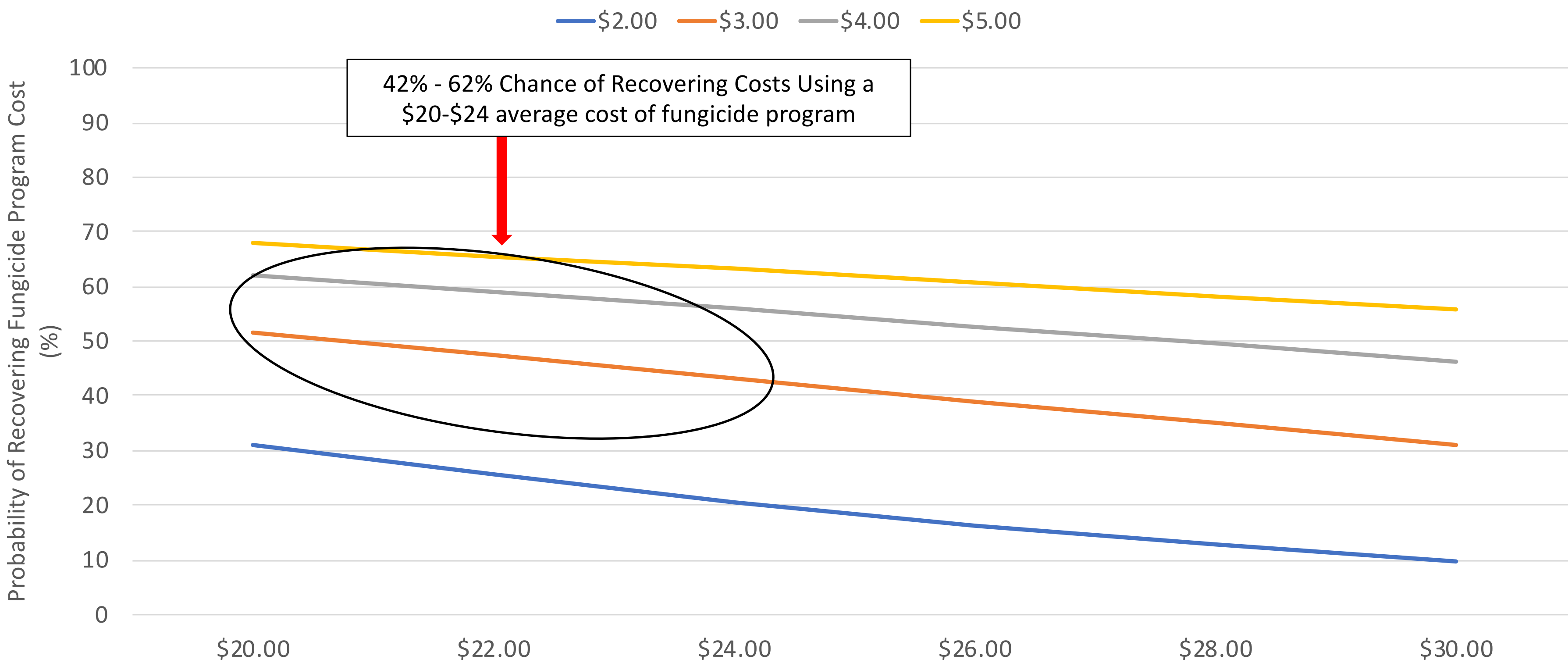
DMI + Strobilurin Results Across the U.S.



Probability of Breaking Even Based on Data from Across the U.S.
(V6 Application Timing)



Probability of Breaking Even Based on Data from Across the U.S.
(VT Application Timing)



Fungicides for Emerging Diseases like Tar Spot

What about the Fungicide Response?

- Single mode-of-action products seemed a bit inconsistent between trials (e.g. WI vs. MI)
- 2- and 3-way modes-of-action were more consistent at reducing tar spot severity and improving canopy greening score
- No fungicide "cured" tar spot

2018 Foliar Fungicide Corn Grain Trial

- Arlington, WI
- Deep Prairie soils
- Hybrid: DKC45-65RIB
- Planted: May 1, 2018
- V6 Application: June 15, 2018
- V12-V14: Application: July 11, 2018
- VT-R1 Application: July 16, 2018
- Later tar spot epidemic relative to Southwest WI – Early-to-Mid August onset in adjacent studies
- Harvested: October 4, 2018

2018 Grain-Corn Fungicide Trial – Arlington, WI

	Tar Spot Severity (%)	Canopy Greening (%)	Stalk Rot Severity (%)	Yield (bu/a)
Experimental (VT-R1)	2.1 d	61.3 ab	27.5 ef	254.4
Experimental (V12-14)	2.1 d	45.0 bc	50.0 cde	245.8
★ **Delaro 8 FL OZ/A + NIS (VT-R1)**	2.8 cd	47.5 bc	30.0 def	256.4
★ **TrivaPro 13.7 FL OZ/A (VT-R1)**	2.8 cd	56.3 ab	30.0 def	251.8
★ **Headline AMP 10 FL OZ/A + NIS (VT-R1)**	3.4 bcd	72.5 a	17.5 f	251.6
★ **Quilt Xcel 10.5 FL OZ/A (VT-R1)**	3.4 bcd	48.8 bc	27.5 ef	250.7
TrivaPro 13.7 FL OZ/A (V12-14)	3.8 bcd	35.0 c	37.5 def	258.4
Proline 5.7 FL OZ/A (VT-R1)	4.9 bcd	33.8 c	37.5 def	250.9
Miravis Neo 13.7 FL OZ/A (V12-14)	4.9 bcd	33.8 c	65.0 abc	241.4
★ **Priaxor 4 FL OZ/A (V12-14)**	4.9 bcd	43.8 bc	52.5 bcd	240.6
★ **Miravis Neo 13.7 FL OZ/A (VT-R1)**	5.4 bc	47.5 bc	27.5 ef	262.8
Quadris 6 FL OZ/A (VT-R1)	5.6 bc	45.0 bc	32.5 def	249.7
Delaro 4 FL OZ/A + NIS (V6)	6.1 b	32.5 cd	75.0 ab	248.0
Non-Treated Check	11.3 a	12.5	87.5 a	239.7
F-value	5.1	3.9	6.0	1.6
P-value	<0.01	<0.01	<0.01	0.12

The Visual – September 27, 2018

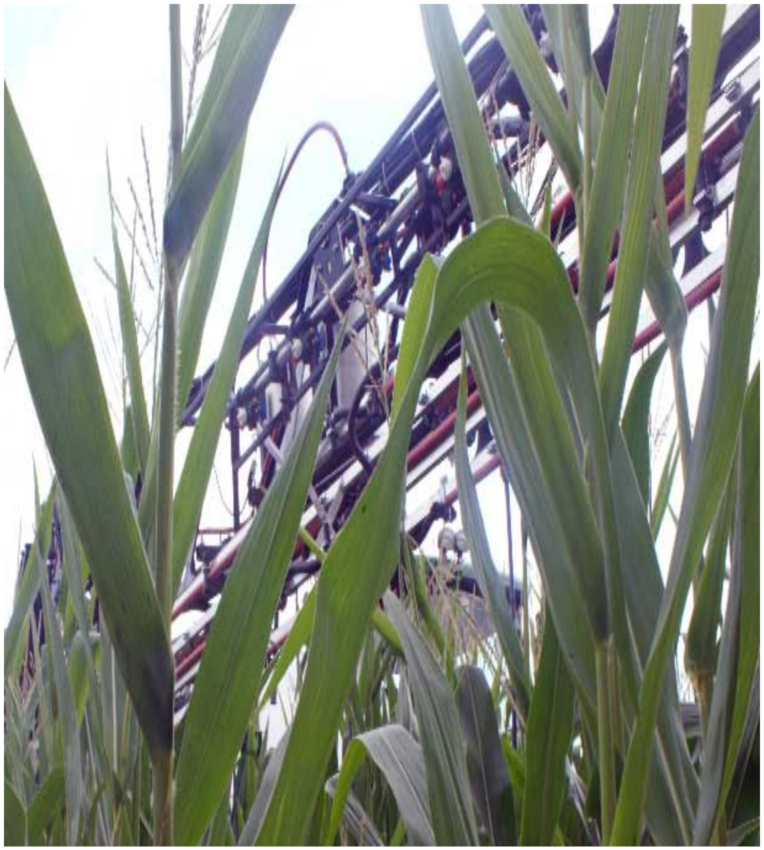
The Visual – September 27, 2018

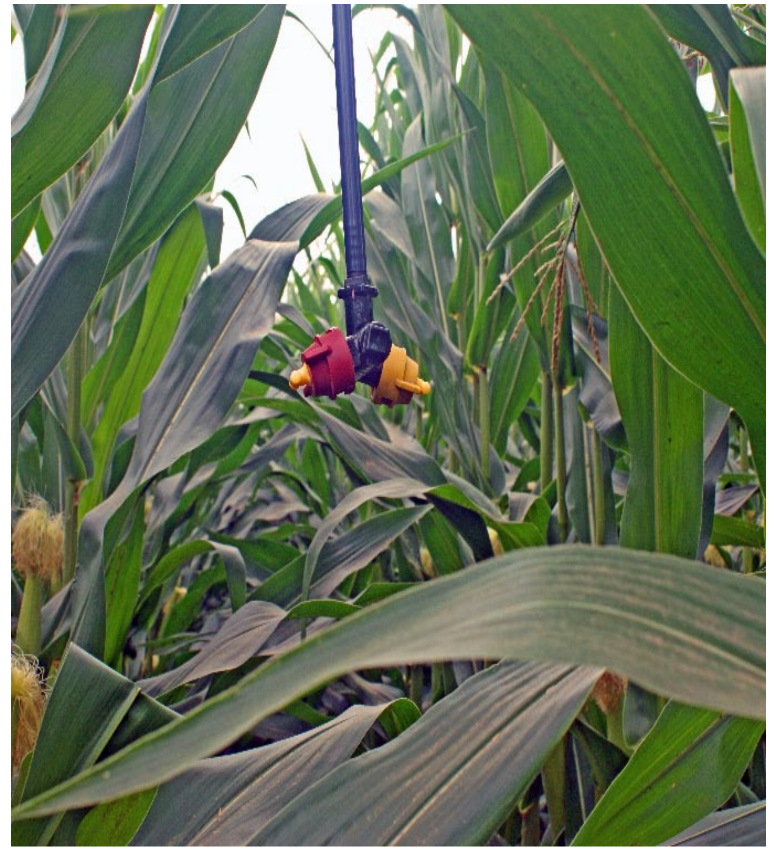
The Visual – September 27, 2018

Fungicides For Reducing Vomitoxin in Grain and Silage


Corn Fungicide Update
Victor Limay-Rios (UG Ridgetown)
Dave Hooker (UG Ridgetown)
Art Schaafsma (UG Ridgetown)
Albert Tenuta (OMAFRA Ridgetown)

High-clearance sprayer equipped with drop nozzles





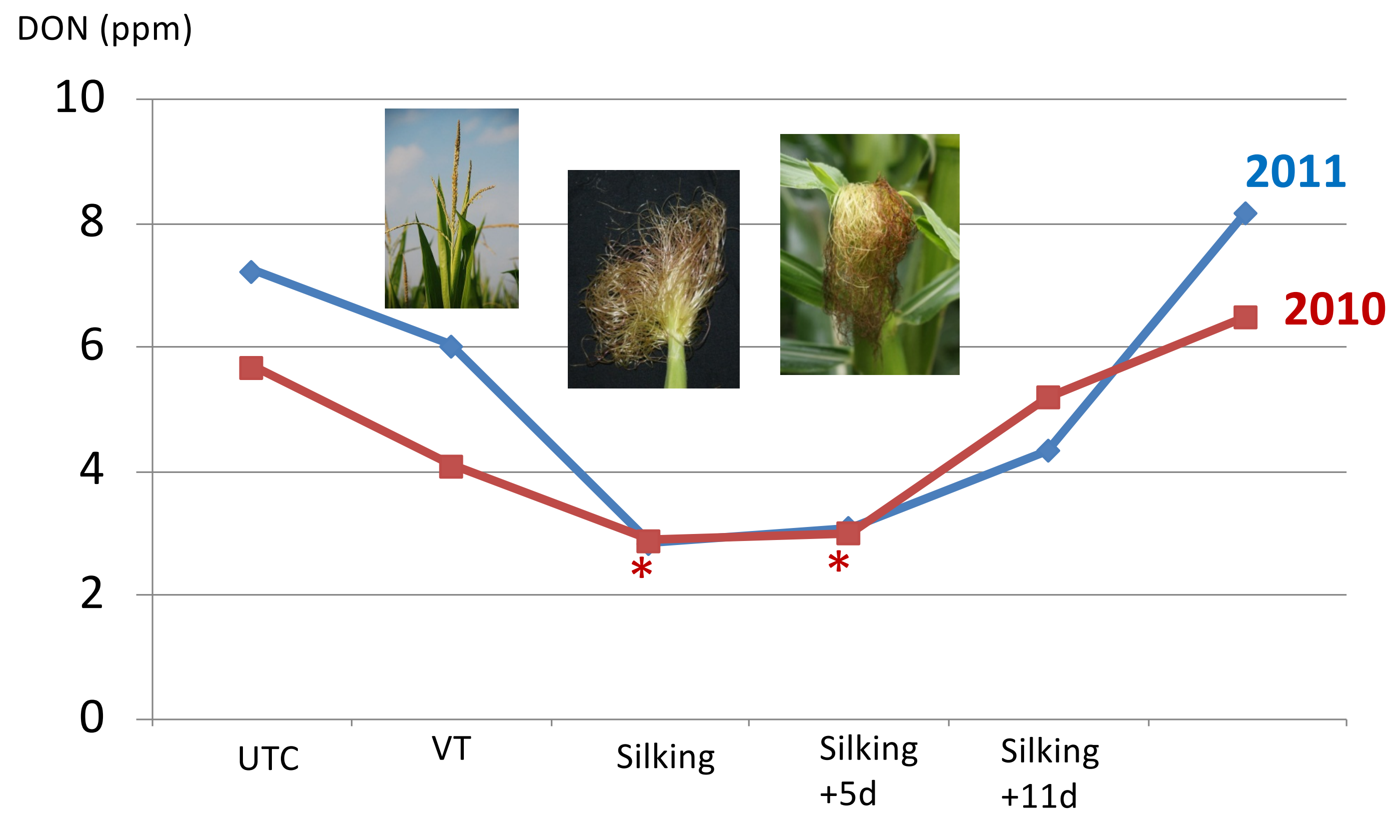
Limay-Rios and Schaafsma (Ridgetown, 2011)

Application technology and product for managing DON

Fungicide	GPA	Nozzle	% DON of UTC 2011		% DON of UTC 2010	
.	UTC	.	100	a	100	a
Proline	5	Above	58	bc	100	a
Proline	10	Above	61	bc	75	b
Proline	20	Above	61	bc	60	ab
Proline	10	Drop	58	bc	65	ab
Proline	20	Drop	52	c	70	ab
Proline	10	Above+Drop	66	b	70	ab
Proline	20	Above+Drop	56	bc	65	a
Headline	10	Above	96	a	150	a
Quilt	10	Above	93	a	110	a
			2 locations 3.5 ppm		3 locations 1.0 ppm	

Limay-Rios, Schaafsma, Hooker, Ridgetown (2011)

Timing of Proline Application on DON 2010-2011

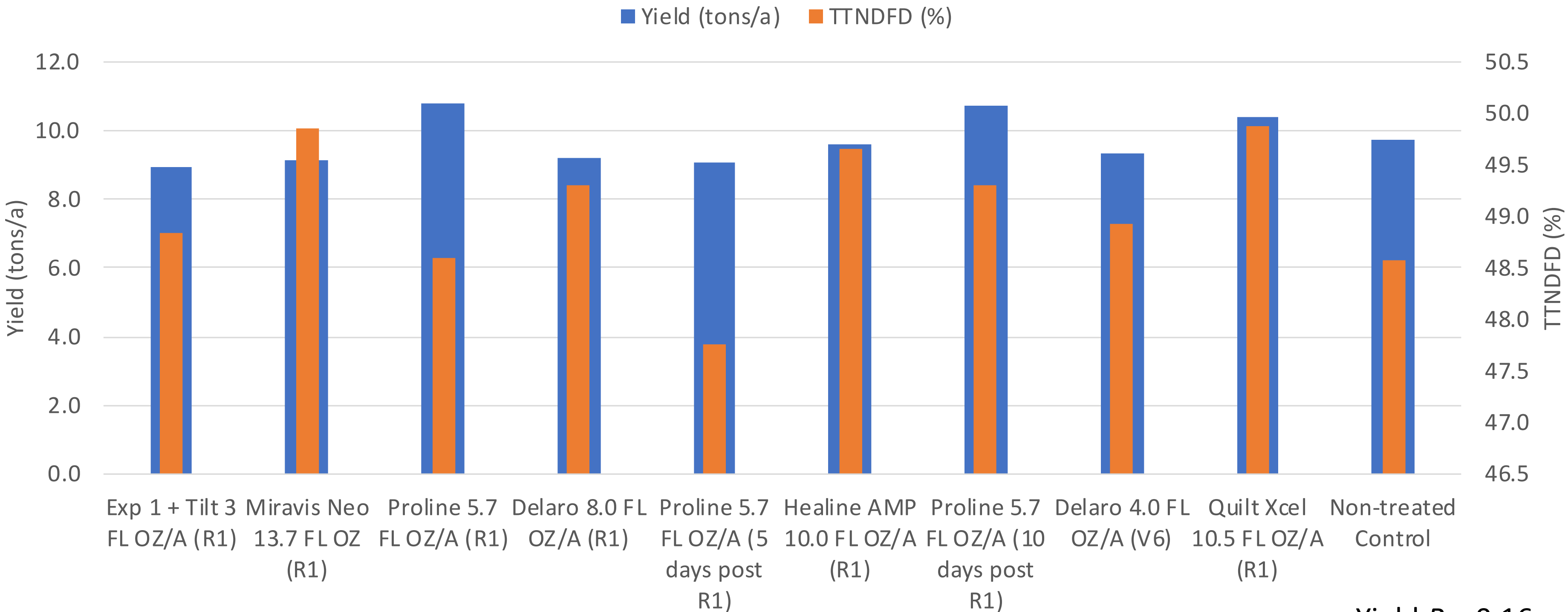


Limay-Rios, Schaafsma, Hooker, Ridgetown (2011)

2017 Wisconsin Silage Corn Fungicide Trials, Revisited

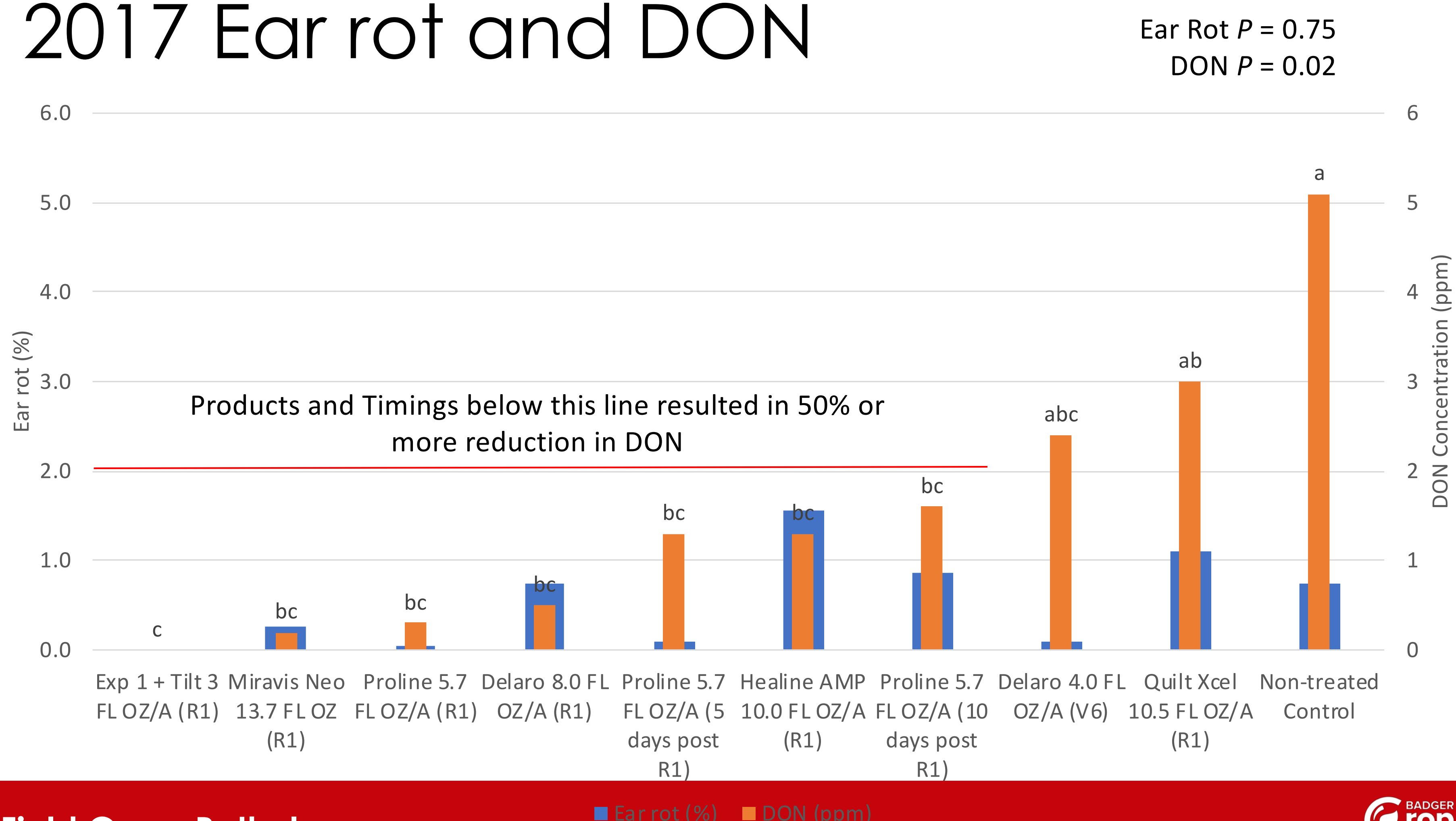
- Arlington ARS - Arlington, Wisconsin
- Small Plots (10 x 20 ft)
- BMR Hybrid – P0956AMX
- Seeding rate: 35,000 seeds per acre
- Fungicide apps of various products x application timings (V6, R1, R1+5, R1+10)
- Harvested with a small plot silage chopper
- Sub-samples of silage taken for forage and DON analysis

2017 Yield and Forage Quality



Yield *P* = 0.16
TTNDFD *P* = 0.47

2017 Ear rot and DON



2018 Wisconsin Silage Corn Trials

- Arlington ARS - Arlington, Wisconsin
- Small Plots (15 x 20 ft)
- 2 BMR Hybrids – P0956AMX (109 RM) and F2F627 (109 RM)
- Seeding rate: 35,000 seeds per acre
- Fungicide apps of various products x application timings (V6, V12, R1, R2)
- Harvested with a small plot silage chopper
- Sub-samples of silage taken for forage, DON, and FUM analysis (center 2 rows)
- Hand harvested and chopped partition-samples from rows 2 and 5 (separated ear portion from stalk portion)** and tested for DON and FUM

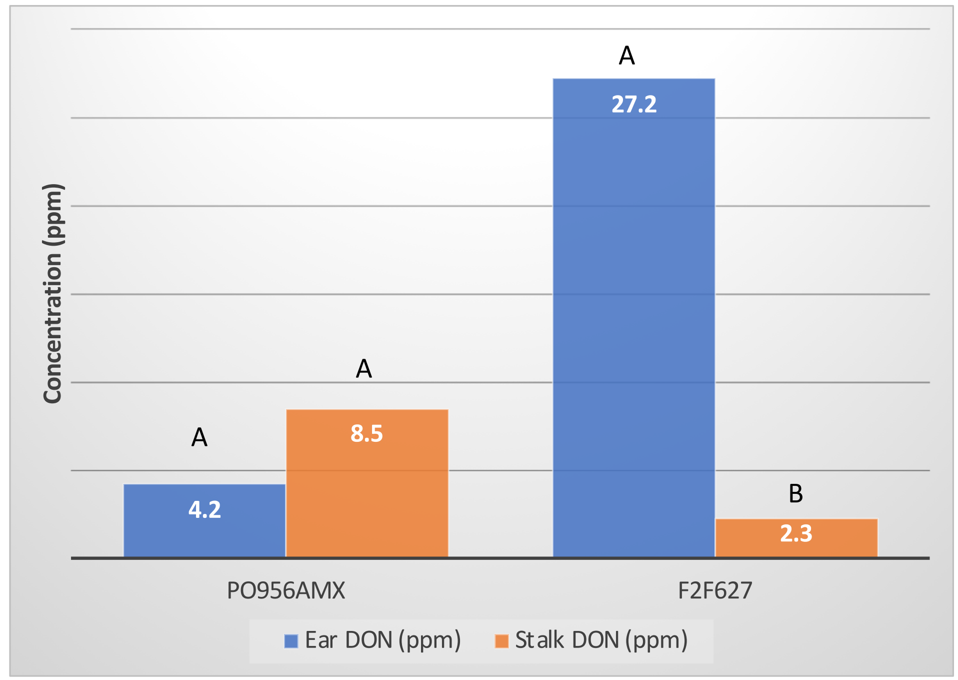
Results - Sorted by DON Level

PO956AMX	GLS Severity (%)	NCLB Severity (%)	Tar Spot Severity (%)	Ear Rot (%)	DM Yield (Tons/a)	TTNDFD (%)	DON (ppm)
Miravis Neo 13.7 FL OZ/A (V12-V14)	0.0 c	16.3 bc	2.1 bcd	2.9	13.6	36.2	7.7
Delaro 8 FL OZ/A (R2)	0.3 bc	10.5 cde	0.6 d	2.1	11.7	38.5	8.2
Miravis Neo 13.7 FL OZ/A + NIS (V6)	0.5 ab	17.5 cde	1.8 bcd	1.4	12.6	37.3	8.4
Lucento 5 FL OZ/A (R1)	0.0 c	8.0 de	0.8 cd	1.5	11.8	37.1	8.5
Proline 5.7 FL OZ/A (R1)	0.0 c	14.3 bcd	1.2 bcd	3.1	11.8	36.8	8.5
Non-Treated	0.8 a	25.0 a	3.8 a	2.1	12.9	34.9	9.4
Miravis Neo 13.7 FL OZ/A (R2)	0.3 bc	8.1 de	1.2 bcd	1.6	12.1	36.7	9.8
Experimental 1	0.0 c	11.3 cde	1.0 cd	3.3	12.2	37.8	9.8
Proline 5.7 FL OZ/A (R2)	0.5 ab	11.3 cde	1.0 cd	1.4	12.8	36.3	10.0
Delaro 8 FL OZ/A (R1)	0.0 c	11.8 cde	1.0 cd	2.1	11.9	36.7	10.5
Headline AMP 14.4 FL OZ/A (R2)	0.3 bc	13.0 cde	0.6 d	1.0	12.0	37.1	11.9
Headline AMP 14.4 FL OZ/A (R1)	0.0 c	14.3 bcd	0.8 cd	1.4	13.0	35.9	11.9
Topguard 10 FL OZ/A (R1)	0.0 c	6.1 e	1.4 bcd	4.9	11.9	38.5	12.9
Miravis Neo 13.7 FL OZ/A (R1)	0.0 c	9.8 b-e	0.6 d	1.0	12.5	36.4	17.9
F-value	**2.08**	**3.44**	**5.35**	**1.17**	**1.06**	**0.86**	**1.32**
P-value	**0.0393**	**0.0014**	**<.0001**	**0.3383**	**0.4166**	**0.5977**	**0.2414**

F2F627	GLS Severity (%)	NCLB Severity (%)	Tar Spot Severity (%)	Ear Rot (%)	DM Yield (Tons/a)	TTNDFD (%)	DON (ppm)
Proline 5.7 FL OZ/A (R2)	6.1 b	27.5 cde	8.6 abc	6.5 b-e	10.4	39.4	10.7 d
Miravis Neo 13.7 FL OZ/A + NIS (V6)	10.5 a	50.0 ab	4.9 cde	10.0 abc	11.0	37.0	12.0 cd
Delaro 8 FL OZ/A (R2)	3.8 bc	28.8 cde	2.0 ef	9.7 b-e	10.5	37.1	12.7 cd
Proline 5.7 FL OZ/A (R1)	2.1 c	31.3 c-f	7.4 a-d	10.4 b-e	11.0	38.5	13.2 cd
Headline AMP 14.4 FL OZ/A (R2)	2.4 c	17.5 ef	1.4 e	18.4 a	11.5	40.9	14.9 bcd
Topguard 10 FL OZ/A (R1)	2.4 c	23.8 de	5.6 cde	4.8 cde	10.7	38.1	15.1 bcd
Experimental 1	1.4 c	42.5 bc	6.3 b-f	7.7 b-e	11.7	39.7	15.7 bcd
Miravis Neo 13.7 FL OZ/A (R1)	1.0 c	21.3 de	6.9 a-d	11.1 ab	11.1	39.5	17.2 bc
Delaro 8 FL OZ/A (R1)	2.1 c	22.5 de	4.3 cde	12.9 ab	11.2	37.8	17.7 bc
Lucento 5 FL OZ/A (R1)	1.0 c	18.8 ef	5.8 bce	4.5 de	12.2	37.5	18.0 bc
Miravis Neo 13.7 FL OZ/A (V12-V14)	1.4 c	27.5 cde	11.3 a	4.6 e	11.6	36.2	18.6 bc
Headline AMP 14.4 FL OZ/A (R1)	1.8 c	36.3 bcd	2.8 def	14.2 ab	10.6	38.7	18.7 bc
Non-Treated	10.5 a	62.5 a	10.5 ab	8.8 a-d	11.0	38.7	21.2 ab
Miravis Neo 13.7 FL OZ/A (R2)	2.4 c	15.0 e	5.5 cde	7.8 b-e	10.7	39.9	30.3 ab
F-value	**8.89**	**5.86**	**2.97**	**1.74**	**0.71**	**1.19**	**1.75**
P-value	**<.0001**	**<.0001**	**0.0043**	**0.0901***	**0.7395**	**0.3247**	**0.0880***

What part of the plant is DON Accumulating?

Type III Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Hybrid	1	33	1.16	0.2889
Part	1	33	10.87	0.0023
Hybrid*Part	1	33	35.5	<.0001
Treatment	2	33	0.6	0.5523
Hybrid*Treatment	2	33	0.25	0.7766
Part*Treatment	2	33	0.18	0.8391
Hybrid*Part*Treatment	2	33	1.83	0.1764



Summary

- DON can accumulate in ears AND stalks
- Some hybrids might be more susceptible to stalk DON accumulation than ear DON accumulation (PO956AMX vs. F2F627)
- DON accumulation in stalks likely independent from ear DON accumulation
- Fungicide may not always reduce DON
  - -Best all around fungicide timing still likely R1 using Proline fungicide; reduces ear DON levels substantially

Questions?

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