Agronomics of Growing “Clean” Forage in the Midwest

Damon L. Smith, Ph.D.
Associate Professor and Field Crops Extension Pathologist
Department of Plant Pathology
University of Wisconsin-Madison
Major Diseases in 2018 and 2019

- Gray leaf spot
- Tar spot
- Northern corn leaf blight
- Gibberella ear rot

**More Mold and Yeast?**

- Also identified Bacterial Leaf Streak for the first time in 2018
The Major Ear Rots in Wisconsin

Fusarium ear rot

- White to pink, cottony mold anywhere on the ear; affected kernels are scattered and kernels discolored or have white streaks
- Airborne conidia infect ears via silks or insect injury; soilborne conidia infect plant roots
- Inoculum survives in infected corn residue

Gibberella ear rot

- Red or pink mold typically beginning at ear tip
- Splashing water and ejection of spores from specialized fungal structures spread inoculum to the ear, infecting through silks or base of the ear
- Inoculum survives in infected corn and wheat residue
Weather Conditions that Promote *Fusarium* spp.

- Warm and excessively wet and humid conditions promote these species

- Ear rot phase especially significant when these conditions occur during silking
  - Temperature range of 65°- 85°F before and during silking
  - Prolonged rain and/or humidity during silking and after
Why Have Fusarium-related Diseases Re-Emerged/Increased in Frequency Recently?

- Short Rotations
  - Corn-Corn and Corn-Soybean are not rotations!
- No-Till Cropping Systems
  - Good for soil conservation
  - Downside = Lots of crop surface residue where pathogens can overwinter
- Wetter Seasons
  - 30-year NOAA precipitation trends increasing During Growing season
  - Especially true for June (Anthesis for Wheat) and August (Silking and ear fill in corn)
  - Drier July adding a stress component?
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)
  - "Wet" corn is a primary means of further increasing mycotoxins in grain storage systems

• 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.
  - DON (vomitoxin), T-2 Toxin, Zearalenone, Fumonisins
Multiple Chemotypes Can be found in Agronomic Landscapes – An example from Wheat

• 2016 Samples
  • Among 195 wheat head samples collected in 2016 in Wisconsin, 145 *Fusarium* spp. were positively chemotyped as 3ADON or 15ADON
  • 90% were of the 15ADON chemotype and 10% of isolates were 3ADON

• 2017 Samples
  • 185 samples were collected and 120 of them were chemotyped
  • 92% of the isolates were identified as 15ADON chemotype and 8% the 3ADON chemotype
Vomitoxins Produced by *Fusarium* spp. Come in Different “Flavors”

- *Fusarium* spp. produce an array of toxins, but their primary secondary metabolites are deoxynivalenol (DON) and nivalenol (NIV).
- There are 3 chemotype classifications of isolates:
  - Acetyldeoxynivalenol 3-ADON, 15-ADON, and NIV (Type B trichothecenes)
  - 3-ADON isolates are typically more aggressive - low levels in population in U.S.
  - 15-ADON isolates more prevalent in U.S.
  - NIV is the most toxic mycotoxin produced by *Fusarium* spp., but is relatively rare in the Midwest.
  - Type A trichothecenes can also be produced (T-2, H-2 toxins)
- *Fusarium graminearum* AND *Fusarium culmorum* main species of importance on corn/wheat in Wisconsin.
FDA Dexoynivalenol Guidelines

- 1 ppm for finished wheat products (e.g. flour, bran, germ, etc) to be consumed by humans
- 10 ppm for total feed ration for ruminating beef cattle over 4 months
- 5 ppm in the total ration for dairy cattle older than 4 months
- 5 ppm for swine as long as the grain products are not more than 20% of the feed ration
- 5 ppm for as long as the grain products are not more than 40% of the feed ration for all other animals
**Mycotoxin Dietary Limit Guidelines**

*Summarized by Dr. John Goeser, PAS & Dipl. ACAN*
*Revised January, 2015*

<table>
<thead>
<tr>
<th>Toxin Type</th>
<th>Dairy</th>
<th>Feedlot</th>
<th>Swine</th>
<th>Poultry</th>
<th>Equine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aflatoxin</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Deoxynivalenol (DON or Vomitoxin)*</td>
<td>0.5 to 1.0</td>
<td>10</td>
<td>1</td>
<td>2</td>
<td>500</td>
</tr>
<tr>
<td>Fumonisin</td>
<td>2</td>
<td>7</td>
<td>10</td>
<td>20</td>
<td>500</td>
</tr>
<tr>
<td>T-2 Toxin</td>
<td>100</td>
<td>500</td>
<td>100</td>
<td>100</td>
<td>NA</td>
</tr>
<tr>
<td>Zearalenone</td>
<td>400</td>
<td>5</td>
<td>300</td>
<td>10</td>
<td>50</td>
</tr>
<tr>
<td>Ochratoxin</td>
<td>5</td>
<td>5</td>
<td>700</td>
<td>700</td>
<td>35</td>
</tr>
<tr>
<td>Ergot Toxins (combined)</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>750</td>
<td>300</td>
</tr>
</tbody>
</table>

Values listed in blue are PPM, all other listed are in PPB.

Note: The table lists maximum concentrations for the total diet. These values were summarized from the literature cited below and conservatively chosen to represent the lowest values recommended without causing animals harm. Measured toxin is likely not the only type of toxin present in a sample; multiple toxins (including those not measured or masked toxins) may interact to further impact health and performance.

*Deoxynivalenol may be used as a marker for further mycotoxin contamination. If DON is detected, 90 to 100% of the time other mycotoxins are present as well (Whitlow, 2014).*

**References**


Whitlow, L.W., 2014. Personal communication.


Management of Ear Rot in Corn

Reducing stress and damage to the corn plant is important

• Choose hybrids rated resistant to the primary pathogen of interest (e.g. Gibberella ear rot, Fusarium ear rot, etc.)
• Choose a hybrid well adapted to your environment (Pushing RM can lead to stress)
• Plant early and allow normal heat unit accumulation (this has been a challenge in recent years, especially 2019!)
• Irrigate, if dry, to reduce stress (irrigation during silking could increase mycotoxin issues)
• Manage insects to minimize insect damage (Bt traits have been useful in this regard for Fusarium ear rot)
• Harvest at optimum moisture to facilitate proper fermentation
• Need to pack bunker quickly and promote rapid fermentation (Mycotoxin-producing fungi don’t grow well at low pH)
• Fungicide applications? – Product and timing are important
The Role of Fungicides in Reducing Vomitoryxin – What We Know From Wheat
**2018 Foliar Fungicide Trial - Arlington**

*Letters represent LSD at $\alpha = 0.05$*
2018 Foliar Fungicide Trial - Arlington

*Letters represent LSD at $\alpha = 0.05$
### 2018 DON Concentrations

<table>
<thead>
<tr>
<th>Treatment</th>
<th>DON Concentration (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headline 6 FL OZ/A + 0.25% N5 Feekes 5</td>
<td>a 1.9</td>
</tr>
<tr>
<td>Absolute MAXX 5.0 FL OZ/A + 0.125% N5 Feekes 8</td>
<td>ab 1.6</td>
</tr>
<tr>
<td>Headline 6 FL OZ/A + 0.25% N5 Feekes 8</td>
<td>ab 1.6</td>
</tr>
<tr>
<td>Prosaro 6.5 FL OZ/A + 0.25% N5 Feekes 10.5.1</td>
<td>b 1.5</td>
</tr>
<tr>
<td>Non-treated check</td>
<td>bc 1.4</td>
</tr>
<tr>
<td>Caramba 13.5 FL OZ/A + 0.25% N5 Feekes 10.5.1</td>
<td>bc 1.4</td>
</tr>
<tr>
<td>Headline 6 FL OZ/A + 0.25% N5 Feekes 5 fb</td>
<td>cd 1.1</td>
</tr>
<tr>
<td>Prosaro 6.5 FL OZ/A + 0.25% N5 Feekes 8 fb</td>
<td>cd 1.0</td>
</tr>
<tr>
<td>Prosaro 6.5 FL OZ/A + 0.25% N5 5 days after</td>
<td>de 0.8</td>
</tr>
<tr>
<td>Caramba 13.5 FL</td>
<td></td>
</tr>
<tr>
<td>Miravis Ace 13.7 FL OZ/A + 0.25% N5 Feekes 10.5.1</td>
<td>de 0.7</td>
</tr>
<tr>
<td>Miravis Ace 13.7 FL OZ/A + 0.25% N5 5 days after Feekes 10.5.1</td>
<td>e 0.5</td>
</tr>
<tr>
<td>Miravis Ace 13.7 FL OZ/A + 0.25% N5 5 days after Feekes 10.5.1</td>
<td>e 0.4</td>
</tr>
</tbody>
</table>

*Letters represent LSD at $\alpha = 0.05$*
Fungicides For Reducing Vomitoxin (DON) in Corn – Is This a Viable Strategy in The Absence of Complete Resistance in Corn Hybrids?
Fungicide Applications on Silage Corn Originally Focused on Improving Digestibility

- Foliar fungicide applications improve silage quality which results in increased feed conversion (Haerr et al., 2015. J. Dairy Sci.)
- Fungicide application on corn may reduce negative impacts by plant pathogens and reduce the fibrous content within plants (Kalebich et al., 2017. Animal Feed Science and Technology)
  - Silage made with fungicide treated corn may reduce the bulk of the corn and enhance quality of the feedstuff.
- Reduced fungal activity might lead to lower mycotoxin levels?
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

<table>
<thead>
<tr>
<th>Fungicide</th>
<th>GPA</th>
<th>Nozzle</th>
<th>% DON of UTC 2011</th>
<th>% DON of UTC 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>.</td>
<td>UTC</td>
<td>.</td>
<td>100a</td>
<td>100a</td>
</tr>
<tr>
<td>Proline</td>
<td>5</td>
<td>Above</td>
<td>58bc</td>
<td>100a</td>
</tr>
<tr>
<td>Proline</td>
<td>10</td>
<td>Above</td>
<td>61bc</td>
<td>75b</td>
</tr>
<tr>
<td>Proline</td>
<td>20</td>
<td>Above</td>
<td>61bc</td>
<td>60ab</td>
</tr>
<tr>
<td>Proline</td>
<td>10</td>
<td>Drop</td>
<td>58bc</td>
<td>65ab</td>
</tr>
<tr>
<td>Proline</td>
<td>20</td>
<td>Drop</td>
<td>52c</td>
<td>70ab</td>
</tr>
<tr>
<td>Proline</td>
<td>10</td>
<td>Above+Drop</td>
<td>66b</td>
<td>70ab</td>
</tr>
<tr>
<td>Proline</td>
<td>20</td>
<td>Above+Drop</td>
<td>56bc</td>
<td>65a</td>
</tr>
<tr>
<td>Headline</td>
<td>10</td>
<td>Above</td>
<td>96a</td>
<td>150a</td>
</tr>
<tr>
<td>Quilt</td>
<td>10</td>
<td>Above</td>
<td>93a</td>
<td>110a</td>
</tr>
</tbody>
</table>

Limay-Ríos, Schaafsma, Hooker, Ridgetown (2011)
Timing of Proline Application on DON 2010-2011

Limay-Rios, Schaafsma, Hooker, Ridgetown (2011)
2017 Wisconsin Silage Corn Fungicide Trials

- 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 TTNDFD

Yield $P = 0.16$

TTNDFD $P = 0.47$
2017 Ear rot and DON

Ear Rot $P = 0.75$
DON $P = 0.02$

Exp 1 + Tilt 3
FL OZ/A (R1)
Miravis Neo
13.7 FL OZ
(R1)
Proline 5.7
FL OZ/A (R1)
Delaro 8.0 FL
OZ/A (R1)
Proline 5.7
FL OZ/A (5
days post R1)
Healine AMP
10.0 FL OZ/A
(R1)
Proline 5.7
FL OZ/A (10
days post R1)
Delaro 4.0 FL
OZ/A (V6)
Quilt Xcel
10.5 FL OZ/A
(R1)
Non-treated
Control

DON Concentration (ppm)
Ear rot (%) DON (ppm)

Products and Timings below this line resulted in 50% or more reduction in DON
2018-2019 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, and DON 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
2018 Yield and TTNDFD

Yield P = 0.41
TTNDFD P = 0.60

P0956AMX

Yield P = 0.74
TTNDFD P = 0.32

F2F627
2018 Ear Rot and DON

Ear Rot P = 0.34
DON P = 0.24

Ear Rot (%)
DON (ppm)
2019 Yield and TTNDFD

**P0956AMX**

Yield $P = 0.43$
TTNDFD $P = 0.94$

**F2F627**

Yield $P = 0.06$
TTNDFD $P = 0.40$
2019 Ear Rot and DON

Ear Rot P = 0.55
DON P = 0.04

Ear Rot P = 0.75
DON P = 0.27
What part of the plant is DON Accumulating?

<table>
<thead>
<tr>
<th>Effect</th>
<th>Num DF</th>
<th>Den DF</th>
<th>F Value</th>
<th>Pr &gt; F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hybrid</td>
<td>1</td>
<td>33</td>
<td>1.16</td>
<td>0.2889</td>
</tr>
<tr>
<td>Part</td>
<td>1</td>
<td>33</td>
<td>10.87</td>
<td>0.0023</td>
</tr>
<tr>
<td>Hybrid*Part</td>
<td>1</td>
<td>33</td>
<td>35.5</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Treatment</td>
<td>2</td>
<td>33</td>
<td>0.6</td>
<td>0.5523</td>
</tr>
<tr>
<td>Hybrid*Treatment</td>
<td>2</td>
<td>33</td>
<td>0.25</td>
<td>0.7766</td>
</tr>
<tr>
<td>Part*Treatment</td>
<td>2</td>
<td>33</td>
<td>0.18</td>
<td>0.8391</td>
</tr>
<tr>
<td>Hybrid<em>Part</em>Treatment</td>
<td>2</td>
<td>33</td>
<td>1.83</td>
<td>0.1764</td>
</tr>
</tbody>
</table>

**Diagram:**

- **PO956AMX**:
  - Ear DON (ppm): 4.2
  - Stalk DON (ppm): 8.5

- **F2F627**:
  - Ear DON (ppm): 27.2
  - Stalk DON (ppm): 2.3

Legend:

- Blue bar: Ear DON (ppm)
- Orange bar: Stalk DON (ppm)
Balance Your Disease Resistance Needs when Choosing a Hybrid

PO956AMX Scores from Technical Data Sheet

<table>
<thead>
<tr>
<th>Characteristic Scores</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silage Yield</td>
<td>5</td>
</tr>
<tr>
<td>Fiber Digestibility</td>
<td>9</td>
</tr>
<tr>
<td>Milk Per Acre</td>
<td>6</td>
</tr>
<tr>
<td>Milk Per Ton</td>
<td>9</td>
</tr>
<tr>
<td>Beef Per Acre</td>
<td>6</td>
</tr>
<tr>
<td>Beef Per Ton</td>
<td>9</td>
</tr>
<tr>
<td>Stalk Strength</td>
<td>3</td>
</tr>
<tr>
<td>Root Strength</td>
<td>4</td>
</tr>
<tr>
<td>Stress Emergence</td>
<td>5</td>
</tr>
<tr>
<td>Drought Tol.</td>
<td>6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Disease Scores</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gray Leaf Spot</td>
<td>3</td>
</tr>
<tr>
<td>* No. Leaf Blight</td>
<td>4</td>
</tr>
<tr>
<td>Goss’s Wilt</td>
<td>5</td>
</tr>
</tbody>
</table>

TRAIT SCORE RATINGS: 9 = Excellent; 1 = Poor; Blank = Insufficient Data.

F2F627 Scores from Technical Data Sheet*

<table>
<thead>
<tr>
<th>CHARACTERISTICS CHART</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>FORAGE YIELD</td>
<td>9</td>
</tr>
<tr>
<td>EARLY VIGOR</td>
<td>8</td>
</tr>
<tr>
<td>ROOT STRENGTH</td>
<td>7</td>
</tr>
<tr>
<td>STALK STRENGTH</td>
<td>7</td>
</tr>
<tr>
<td>DROUGHT TOLERANCE</td>
<td>7</td>
</tr>
<tr>
<td>GREEN SNAP</td>
<td>9</td>
</tr>
<tr>
<td>GRAY LEAF SPOT</td>
<td>4</td>
</tr>
<tr>
<td>* NCLB</td>
<td>4</td>
</tr>
<tr>
<td>SCLB</td>
<td>6</td>
</tr>
</tbody>
</table>

Rating scale: 9 = Excellent; 1 = Poor, NR = Not Rated

* Suggested on technical data sheet to use fungicide for foliar disease control
Is Grain DON Positively Correlated with Straw DON in Wheat?

**Table 3.** Results of a Spearman correlation analysis for the fungicide trial showing the correlation coefficients and probabilities of the correlations between the deoxynivalenol (DON), 3-acetyl-DON, and 15-acetyl-DON concentrations reported in wheat straw with the DON concentrations in the grain, the Fusarium head blight (FHB) index value, and the yield levels in the fungicide study. Correlations between the DON concentrations in the grain and the FHB index and yield are also listed.

<table>
<thead>
<tr>
<th></th>
<th>Deoxynivalenol (DON)</th>
<th>3-acetyl-DON</th>
<th>15-acetyl-DON</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Grain Straw</td>
<td>Straw</td>
<td>Straw</td>
</tr>
<tr>
<td>Grain DON</td>
<td>R (-) 0.55</td>
<td>0.47</td>
<td>0.53</td>
</tr>
<tr>
<td>Prob &gt;</td>
<td>l</td>
<td>&lt;0.0001</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Index(a)</td>
<td>R 0.54</td>
<td>0.08</td>
<td>0.14</td>
</tr>
<tr>
<td>Prob &gt;</td>
<td>l</td>
<td>&lt;0.0001</td>
<td>0.006</td>
</tr>
<tr>
<td>Yield</td>
<td>R (-0.80)</td>
<td>(-0.45)</td>
<td>(-0.36)</td>
</tr>
<tr>
<td>Prob &gt;</td>
<td>l</td>
<td>&lt;0.0001</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

\(a\) Index was calculated by (FHB incidence \times FHB severity) / 100.

Bissonnette et al., 2018
*Plant Disease*

- Grain DON and straw DON are positively correlated
- Possible Explanation: Water leaches DON from Grain to Straw
Is Ear DON Correlated with Stalk DON?

\[ y = -0.1388x + 10.149 \]

\[ R^2 = 0.1277 \]
Foliar Fungicides Can Help Reduce Corn Foliar Diseases That Can Impact Forage Quality – The Case of Tar Spot
Tar spot of corn

Martin Chilvers

Steve Koeman
## Corn silage: quality (observational)

<table>
<thead>
<tr>
<th></th>
<th>“Less affected”</th>
<th>“Severely affected”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture %</td>
<td>52.4</td>
<td>19.0</td>
</tr>
<tr>
<td>Crude Protein %</td>
<td>8.2</td>
<td>7.5</td>
</tr>
<tr>
<td>ADF % (cellulose &amp; lignin)</td>
<td>14.5 (DM)</td>
<td>23.2 (DM)</td>
</tr>
<tr>
<td>aNDF % (cellulose, lignin, hemicellulose)</td>
<td>27.6 (DM)</td>
<td>38.4 (DM)</td>
</tr>
<tr>
<td>Lignin %</td>
<td>1.99 (DM)</td>
<td>3.37 (DM)</td>
</tr>
<tr>
<td>NDF Digestibility (30hr) %</td>
<td>58.1 (NDF)</td>
<td>50.9 (NDF)</td>
</tr>
<tr>
<td>Ethanol Soluble CHO %</td>
<td>7.2 (NFC) 4.2 (DM)</td>
<td>3.5 (NFC) 1.7 (DM)</td>
</tr>
<tr>
<td>Starch %</td>
<td>85.6 (NFC) 49.8 (DM)</td>
<td>89.1 (NFC) 42.8 (DM)</td>
</tr>
<tr>
<td>TDN (% DM)</td>
<td>76.5</td>
<td>71.2</td>
</tr>
<tr>
<td>Net Energy Lactation (Mcal/lb)</td>
<td>0.79</td>
<td>0.73</td>
</tr>
</tbody>
</table>

**Severely affected areas:**
- Too dry to ferment, may catch fire, require 40-60% moisture
- High lignin which is indigestible
- Overall lower quality and energy

In severely affected fields may consider bailing dry stover after ear harvest

M. Chilvers and K. Cassida
What about the Fungicide Efficacy on Tar Spot?

• 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

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

| 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

Delaro
8.0 fl oz (VT)
2ee label

BAS75303F
8.0 fl oz (V12)

Priaxor
4.0 fl oz (V12-14)
2ee label
Summary and Discussion

• DON can accumulate in ears AND stalks
  - Farmers should consider that stalks could be a source of DON

• Some hybrids might be more susceptible to stalk DON accumulation than ear DON accumulation (PO956AMX vs. F2F627)
  - Balance hybrid choice with foliar disease rating AND ear rot rating

• DON accumulation in stalks likely independent from ear DON accumulation
  - Crown, stalk infection, leaf axial infection vs. ear infection by F. graminearum
  - Different than wheat; water-leaching of DON may be leading to straw DON levels

• Fungicide may not always reduce DON or reduce DON to acceptable levels
  - Hard to get fungicide into stalks to reduce stalk infection; Thus, DON still accumulates in stalk portion independent of ear infection control by fungicide applied at R1

• Best all around fungicide timing still likely R1; reduces ear DON levels substantially AND balances foliar disease control
  - Be sure product contains a DMI and not just a sole strobilurin containing product

• Don’t forget plant stress can play a major roll in mycotoxin accumulation, fungicide is just part of the management plan
  - Adjust planting populations
  - Be careful with supplemental irrigation
Questions?

Damon Smith, Ph.D.
Associate Professor and Extension Specialist
Field Crops Pathology

University of Wisconsin-Madison
Department of Plant Pathology
1630 Linden Drive
Madison, WI 53706-1598

Phone: 608-286-9706
Twitter: @badgercropdoc
e-mail: damon.smith@wisc.edu
Website: http://badgercropdoc.com