Evaluating The Effects Of Fungicide On Silage Corn Quality And Hygiene

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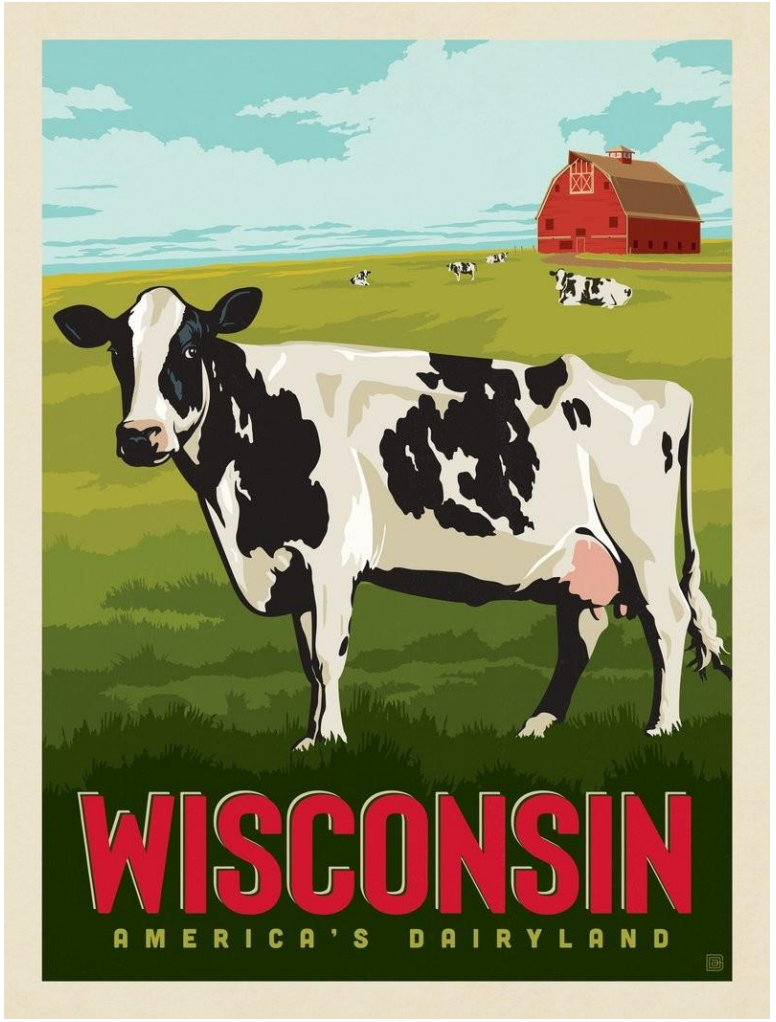
Why Silage Corn?

- **Wisconsin**
  - Number 1 silage producing state in the country – over 1 million acres and 18 million tons harvested in 2019 (USDA)
- **Dairy**
  - 1.3 million dairy cows
  - 30 billion pounds of milk produced in 2018
  - Dairy contributes $45.6 billion dollars to the Wisconsin economy annually. (2019 Dairy Farmers of Wisconsin)
- **Silage**
  - Dairy cows eat on average 100 pounds of feed a day
  - Corn silage makes up about **half** of a dairy cow's daily diet
  - Corn silage yields more digestible energy per acre than any other feed crop (Staples, UF)

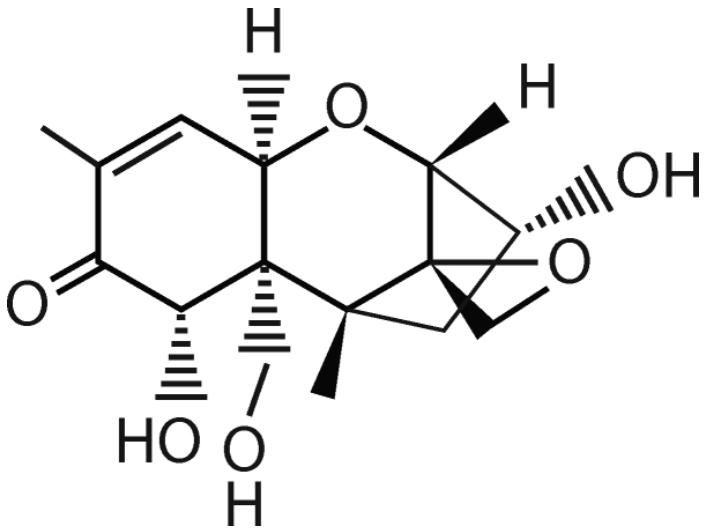


Silage Feed Quality and Fermentation

- Ensiling preserves nutritional content of feed through fermentation
  - Anaerobic with pH below 5 to inhibit growth of spoilage microbes
- Silage quality and nutrition may be lowered if bunker not packed correctly
  - Non-optimal moisture (60-70% moisture)
  - Greater time before fermentation
  - Spoilage organisms and pathogens continue to consume
- Silage quality parameters:
  - Dry Matter Yield
  - Moisture Content
  - TTNDFD= total track neutral detergent fiber digestion
    - (Combs, 2015, UW Dairy Science)
  - Mycotoxin Contamination

Dairyherd.com

Deoxynivalenol - DON



- Most common mycotoxin
- Member of the trichothecene family
- Protein synthesis inhibitor
- Symptoms include nausea, vomiting, diarrhea, abdominal pain, headache, dizziness, and fever
- Extremely heat-stable and water soluble- problem for processed foods.

Mycotoxin Dietary Limit Guidelines

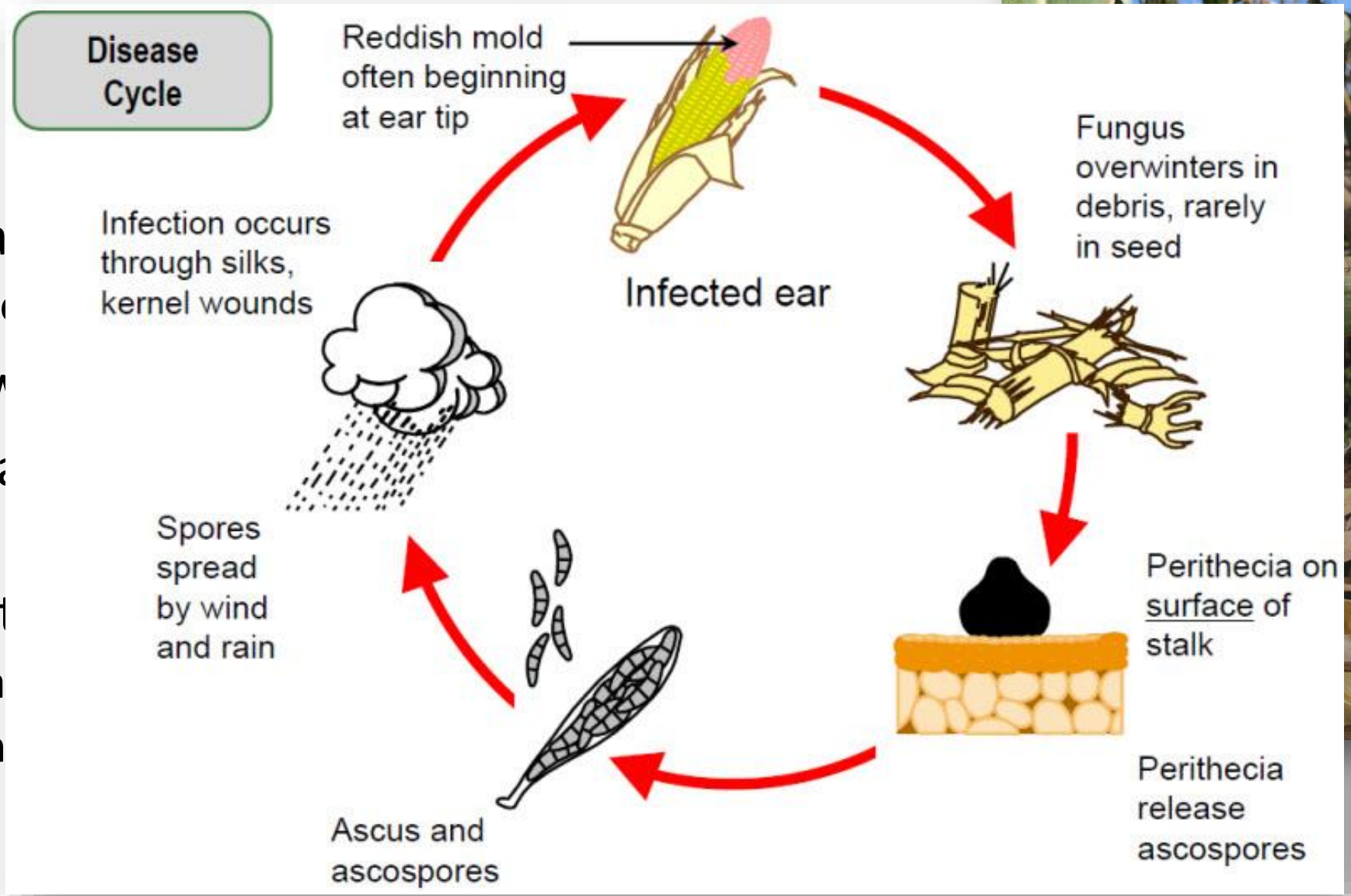
Summarized by Dr. John Goeser, PAS & Dipl. ACAN
Revised January, 2015

Potentially Harmful Toxin Levels for a Total Diet (DM)					
	Dairy	**Feedlot**	**Swine**	**Poultry**	**Equine**
Toxin Type	Values listed in blue are PPM, all other listed are in PPB				
Aflaoxi n	20	20	20	20	20
Deoxynivalenol (DON or Vomitoxin)*	0.5 to 1.0	10	1	2	500
Fumonisin	2	7	10	20	500
T-2 Toxin	100	500	100	100	NA
Zearalenone	400	5	300	10	50
Ochratoxin	5	5	700	700	35
Ergot Toxins (combined)	500	500	500	750	300

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.

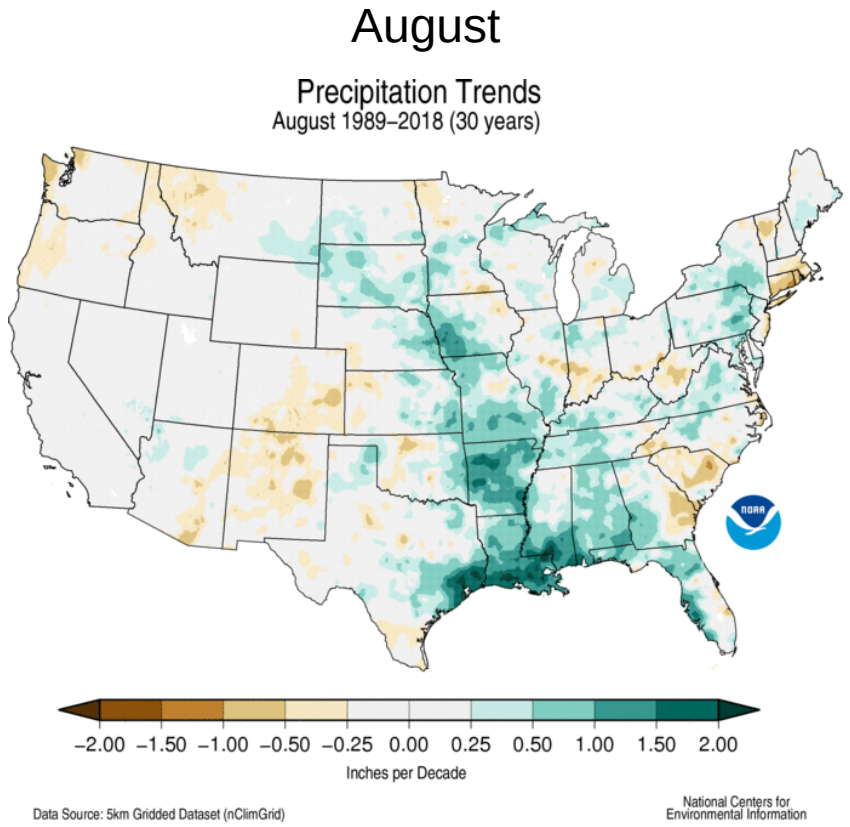
Gibb

- Causa
  - Tel
- Overw
- Favora
  wet d
- Sympt
  - Sta
  - Pin



Recent Increase in Fusarium Diseases

- Short Rotations
- No-Till Cropping System
  - Good for soil conservation
  - Crop residue allow pathogens to overwinter
- Wetter Seasons
  - 30-year NOAA precipitation trends increasing during growing season
  - Especially true for August during silking and ear fill



Research Questions

- What is the effect of fungicides on Gibberella ear rot and stalk rot in silage corn?
- What is the effect of fungicides on DON levels in silage corn?
- Where is DON accumulating within the corn plant?

Projects

1. Fungicide Trial
2. Partitioned Sample Experiment

1. Fungicide Trial

- Foliar fungicide applications improve silage quality which results in increased feed conversion (Haerr et al., 2015. J. Dairy Sci.)
- Known in wheat that QoI fungicides can increase DON concentrations (Zhang et al. 2005).
  - FRAC Group 11- Headline®, Quadris®.

Question: How do fungicides affect DON accumulation, disease severity, and quality of silage corn?

2018-2019 Wisconsin Silage Corn Trials

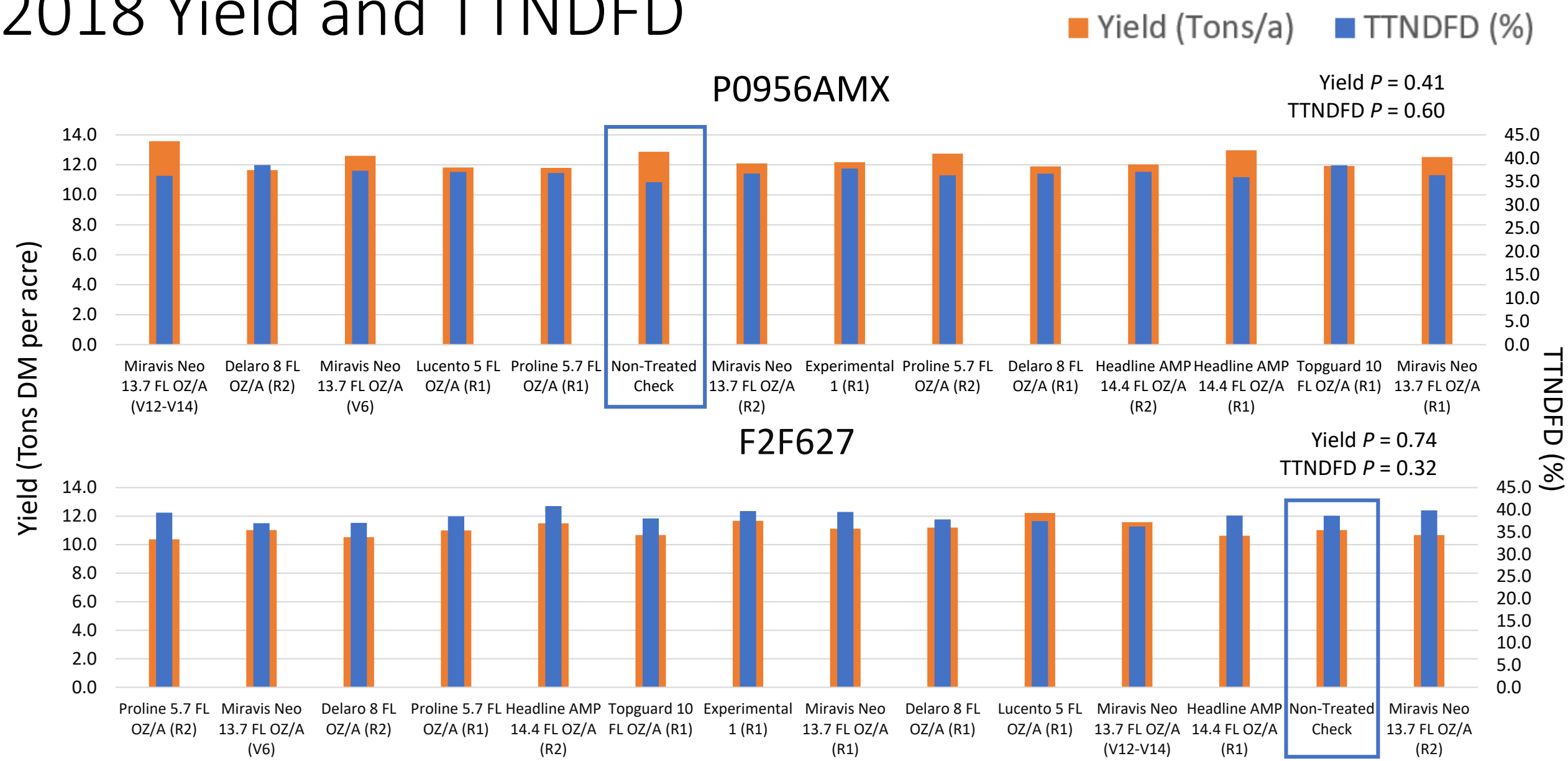
- Arlington ARS - Arlington, Wisconsin
- Small Plots (15 x 20 ft)
- 2 Brown Midrib Hybrids – P0956AMX (Pioneer) and F2F627 (Mycogen)
- Relative Maturity: 109 day
- Seeding rate: 35,000 seeds per acre
- Fungicide apps of various products and application timings (V6, V12, R1, R2)
- Harvested with a small plot silage chopper
- Sub-samples of silage taken for forage quality and DON analysis

Fungicide Treatments

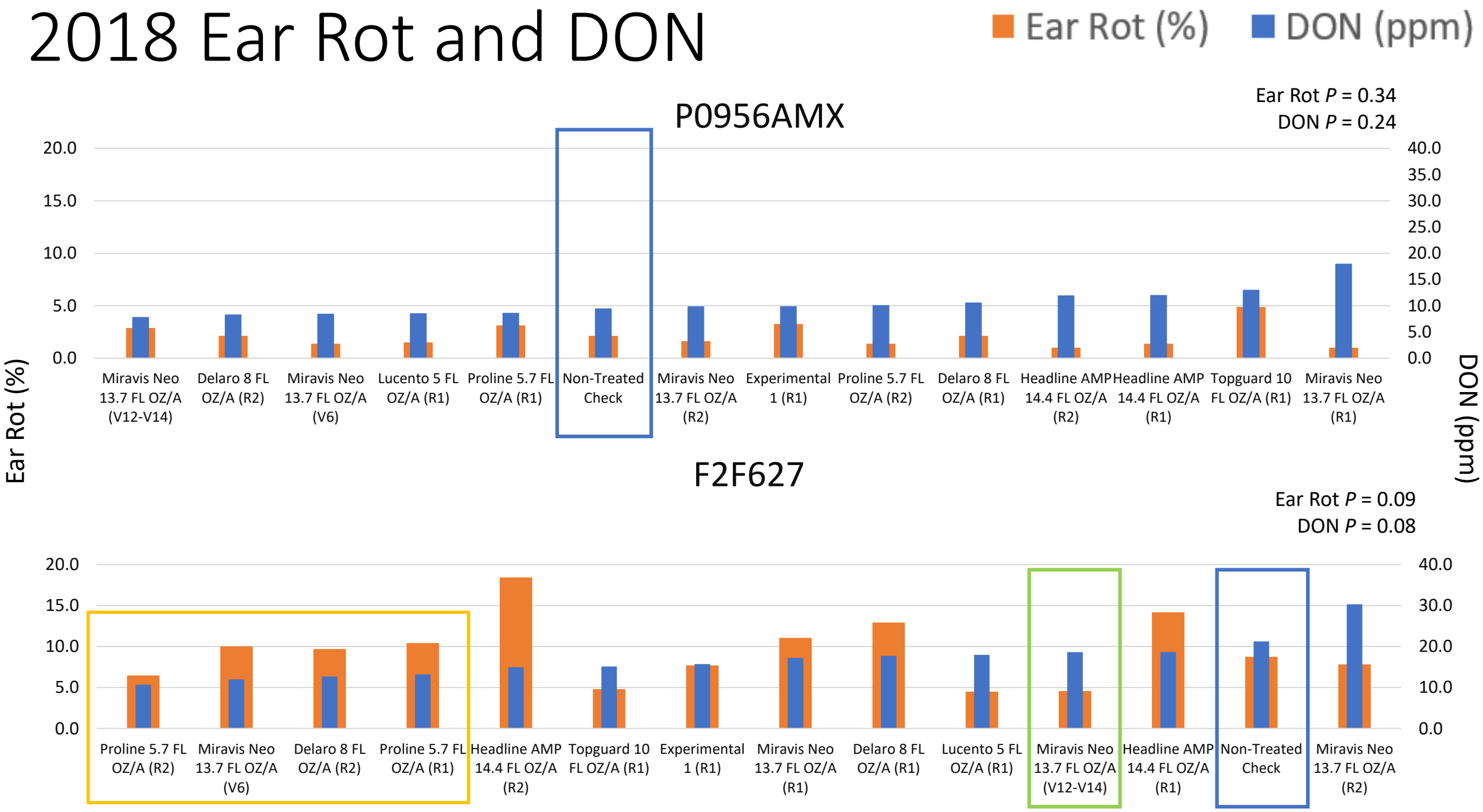
Application Time	Treatment	Year	
		2018	2019
	Non-Treated Check	x	x
V6	Miravis Neo 13.7 FL OZ/A;NIS 0.25%	x	x
V6 R1	Miravis Neo 13.7 FL OZ/A V6;NIS 0.25 % V/V V6 Miravis Neo 13.7 FL OZ/A R1		x
V14	Miravis Neo 13.7 FL OZ/A V12-V14	x	x
R1	Proline 5.7 FL OZ/A	x	x
	Headline AMP 14.4 FL OZ/A	x	x
	Delaro 8 FL OZ/A	x	x
	Miravis Neo 13.7 FL OZ/A	x	x
	Miravis Ace 13.7 FL OZ/A	x	x
	Topguard 10 FL OZ/A	x	x
	Lucento 5 FL OZ/A	x	x
R2	Miravis Neo 13.7 FL OZ/A	x	x
	Proline 5.7 FL OZ/A	x	
	Headline AMP 14.4 FL OZ/A	x	
	Delaro 8 FL OZ/A	x	

R1 Sprays - 07/30/2019

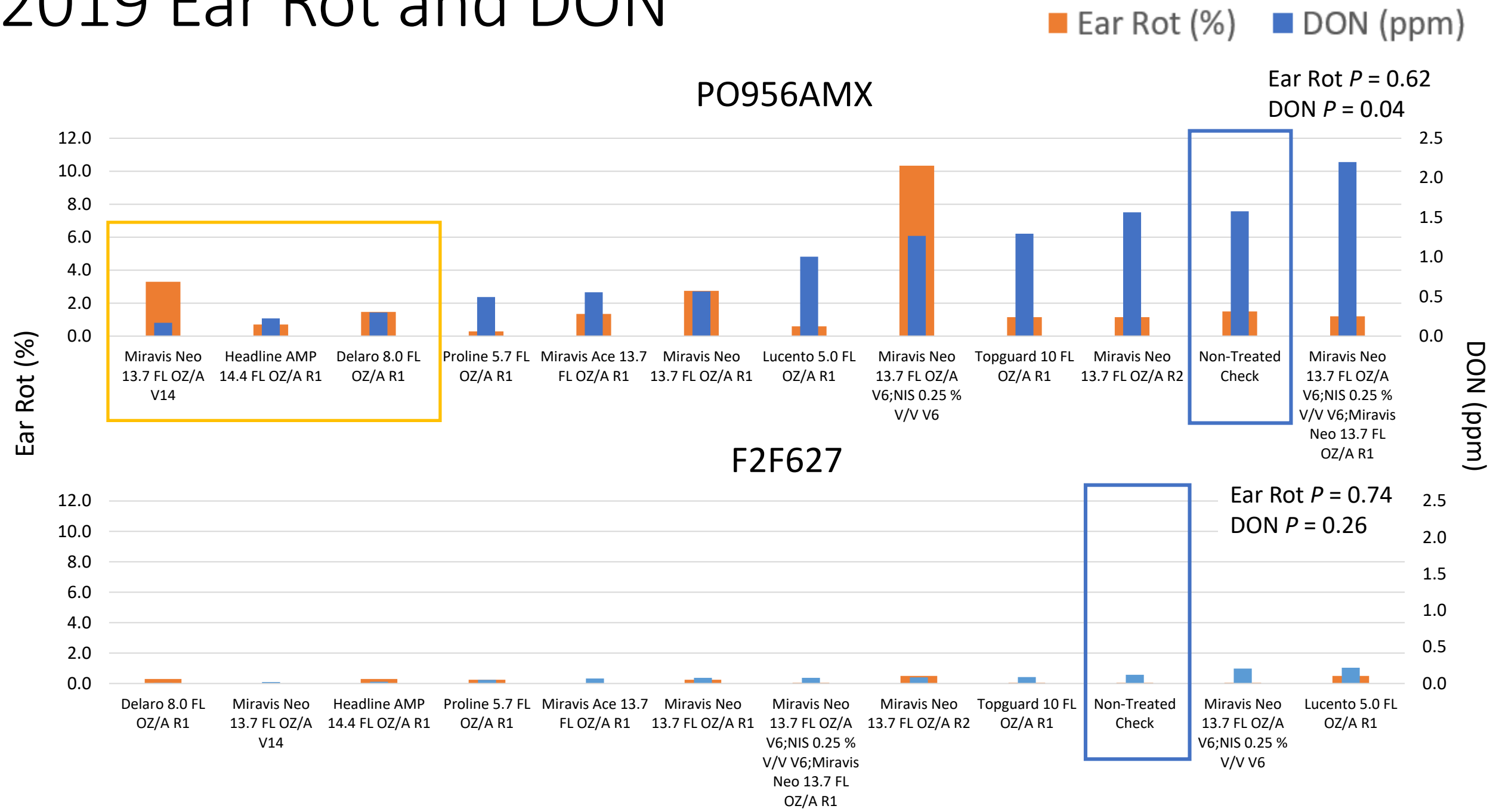
2018 Yield and TTNDFD



2018 Ear Rot and DON



2019 Ear Rot and DON



Summary of Fungicide Trial

- Only two years of data, very different environmental conditions each year
- Yield and TTNDFD not significantly impacted by treatments
- Some treatments decreased DON levels- not consistent
- No findings of increased DON levels
- No correlation between ear rot and DON levels

2. Partitioned Sample Experiment

- 2018 paper found strong correlation between straw DON and grain DON in wheat
- If DON is accumulating in corn stalks- important for silage growers to know this.

Question: How does the accumulation of DON and *Fusarium graminearum* vary between corn stalks and ears?

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.

		Deoxynivalenol (DON)		3-acetyl-DON	15-acetyl-DON
		Grain	Straw	Straw	Straw
Grain DON	R	–	0.55	0.47	0.53
	Prob > |r|	–	<0.0001	<0.0001	<0.0001
Index[a]	R	0.54	0.16	0.08	0.14
	Prob > |r|	<0.0001	0.006	0.16	0.01
Yield	R	–0.80	–0.45	–0.36	–0.37
	Prob > |r|	<0.0001	<0.0001	<0.0001	<0.0001

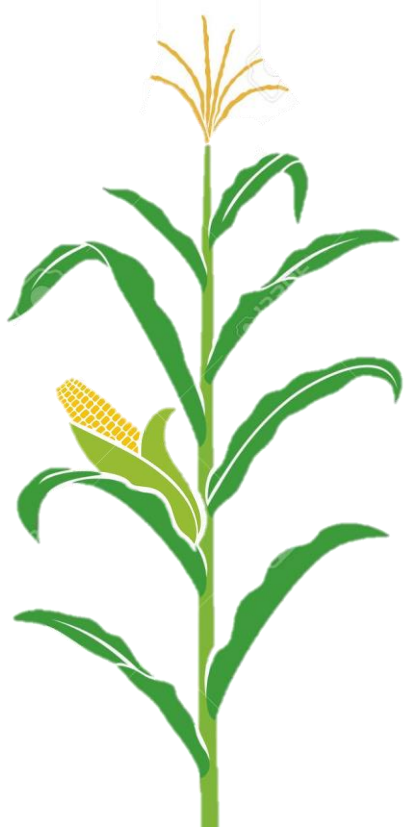
[a] Index was calculated by (FHB incidence × FHB severity) / 100.

Bissonnette et al., 2018 *Plant Disease*

Partitioned Sample Experimental Design

Treatments:

1. Non-Treated Check
2. Headline AMP 14.4 FL OZ/A R1
3. Proline 5.7 FL OZ/A R1

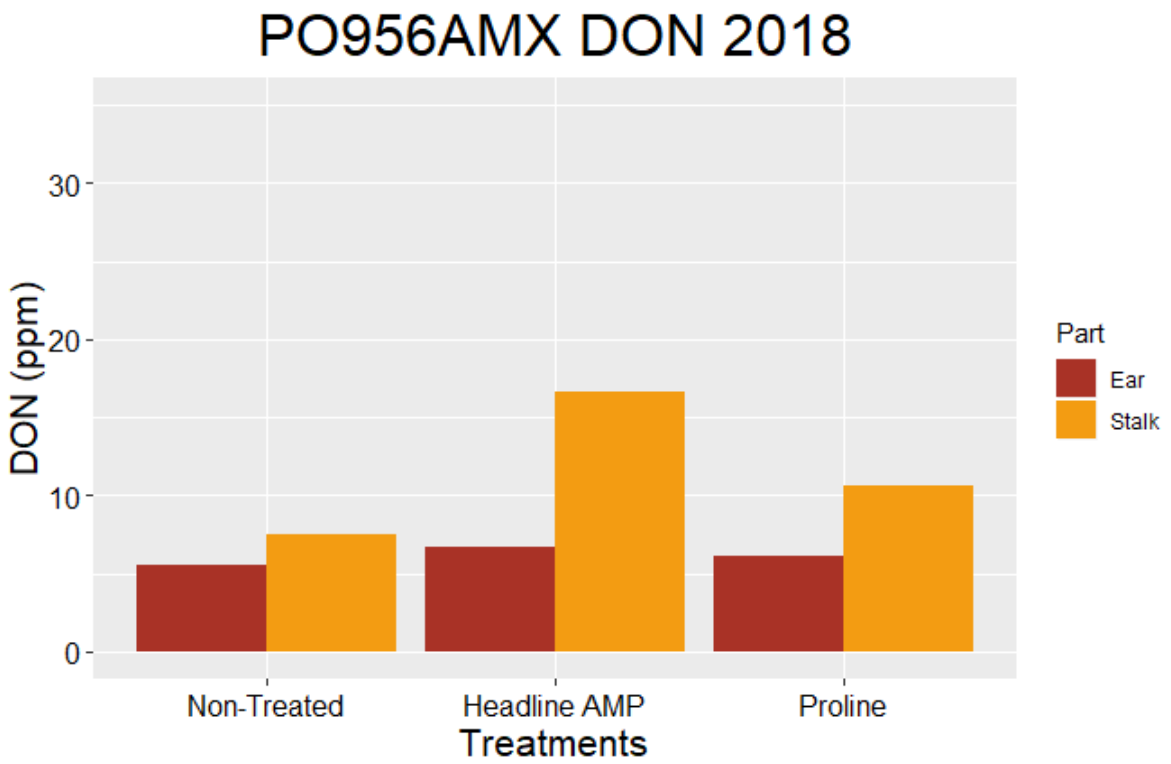


- Samples hand-harvested from fungicide trial rows 2 and 5
- 5 plants per plot, separated stalk and ear
- Chopped and then dried

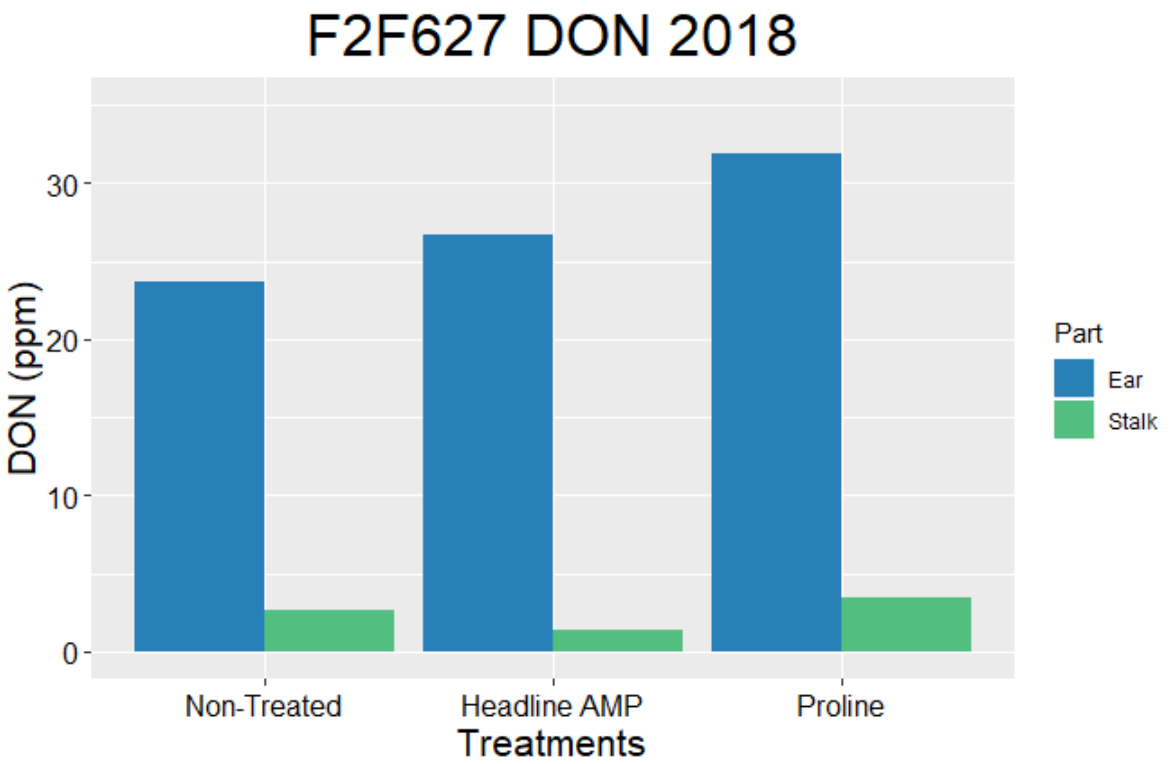
Testing Procedures:

- DON concentration determined using ELISA kit
  R-Biopharm RIDASCREEN ® DON
- *Fusarium graminearum* content quantified using qPCR.

2018 DON Concentrations

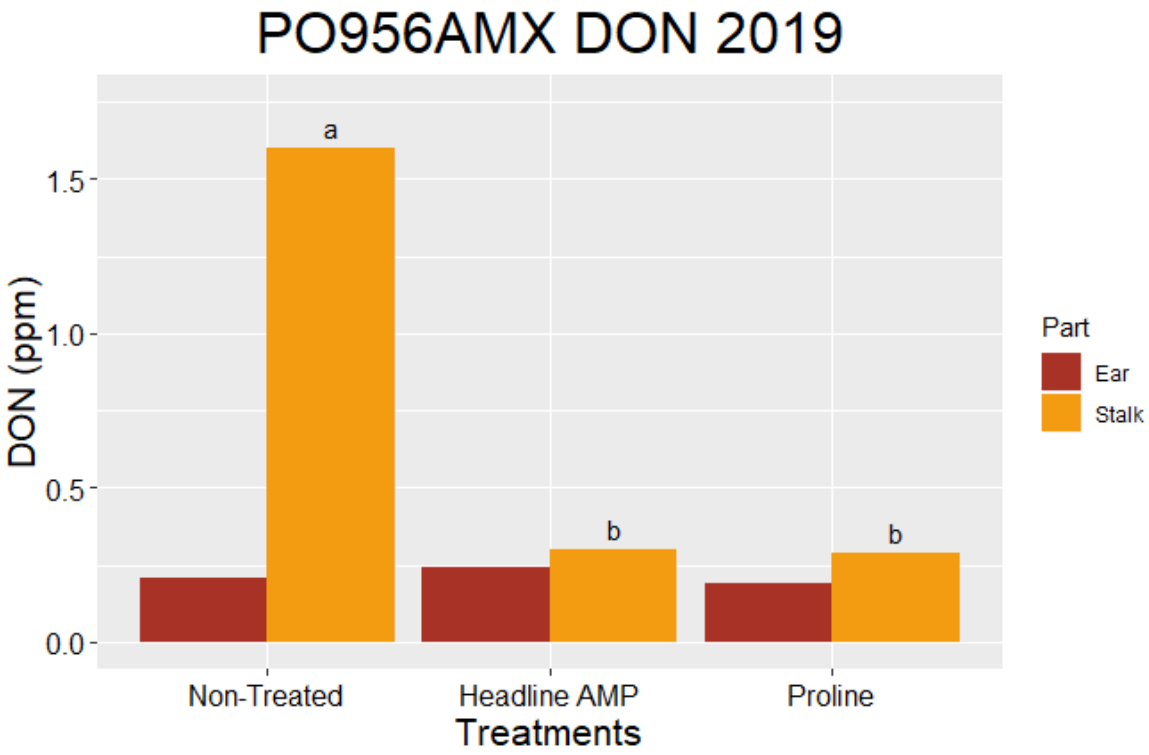


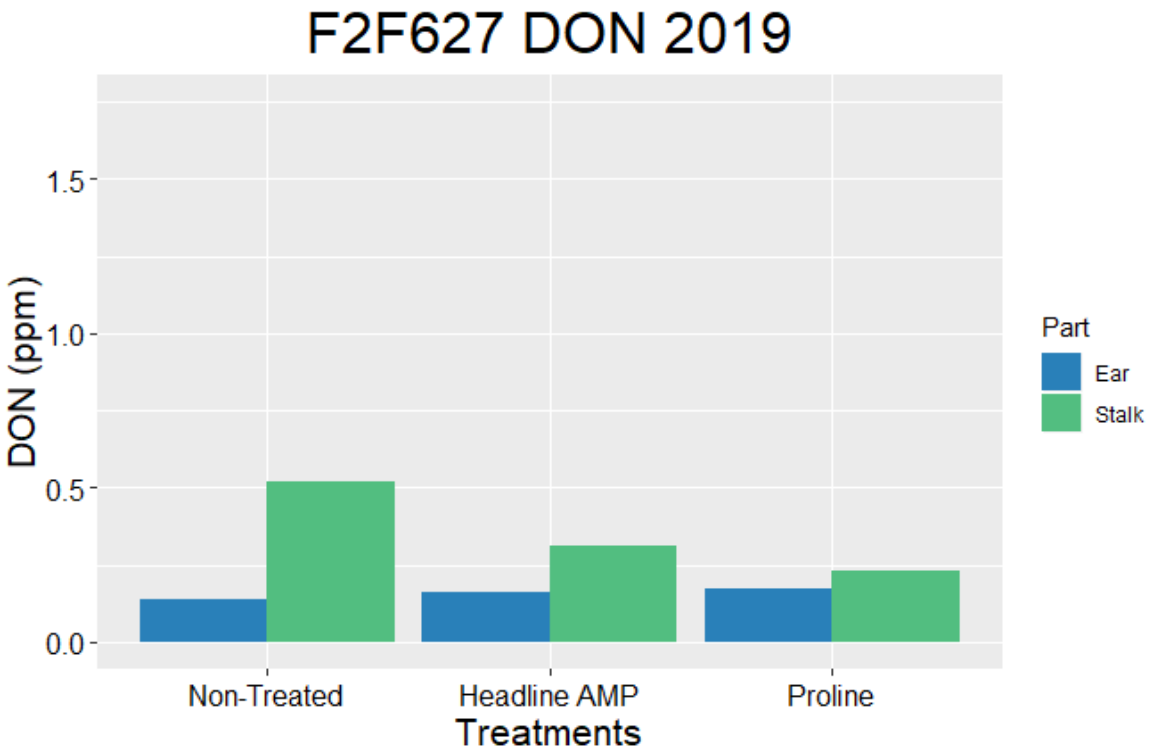
Pioneer 2018 DON	
Treatment	ns
Part	ns
Treatment*Part	ns



Mycogen 2018 DON	
Treatment	ns
Part	****
Treatment*Part	ns

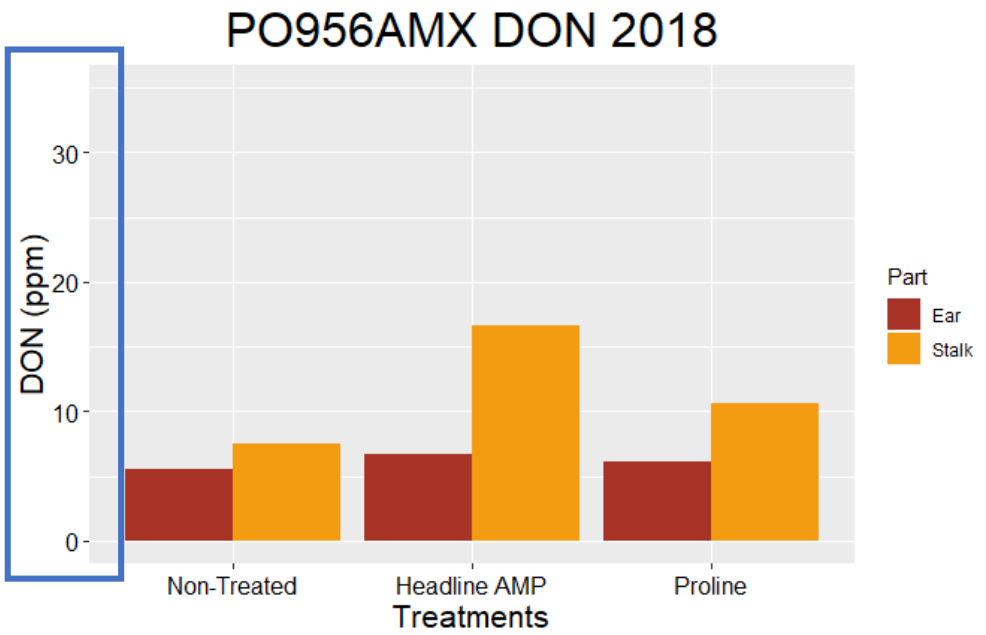
2019 DON Concentrations

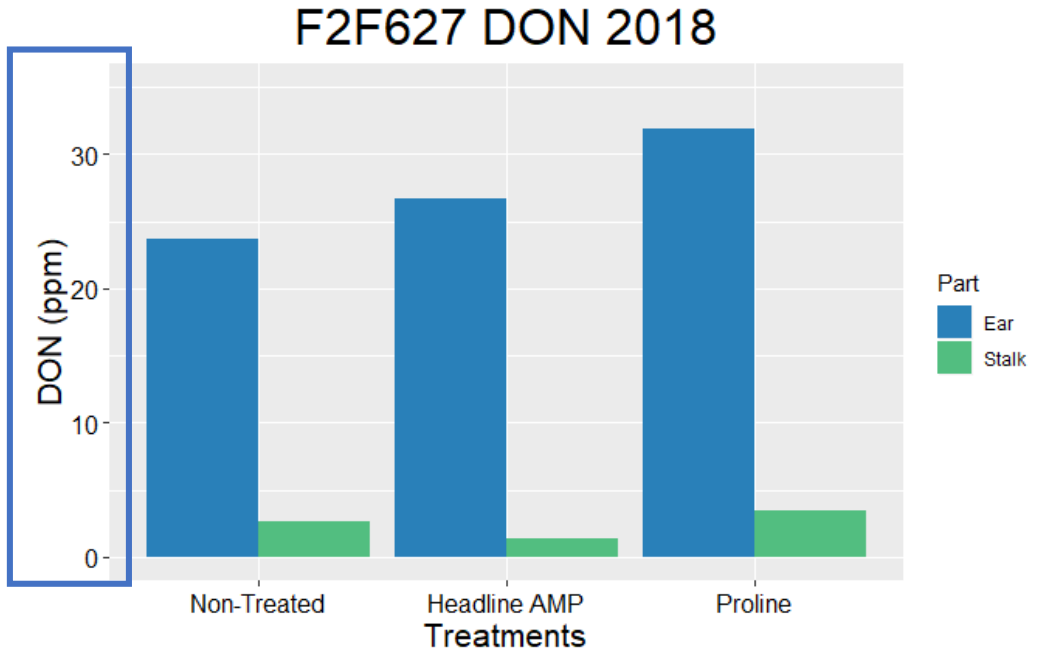


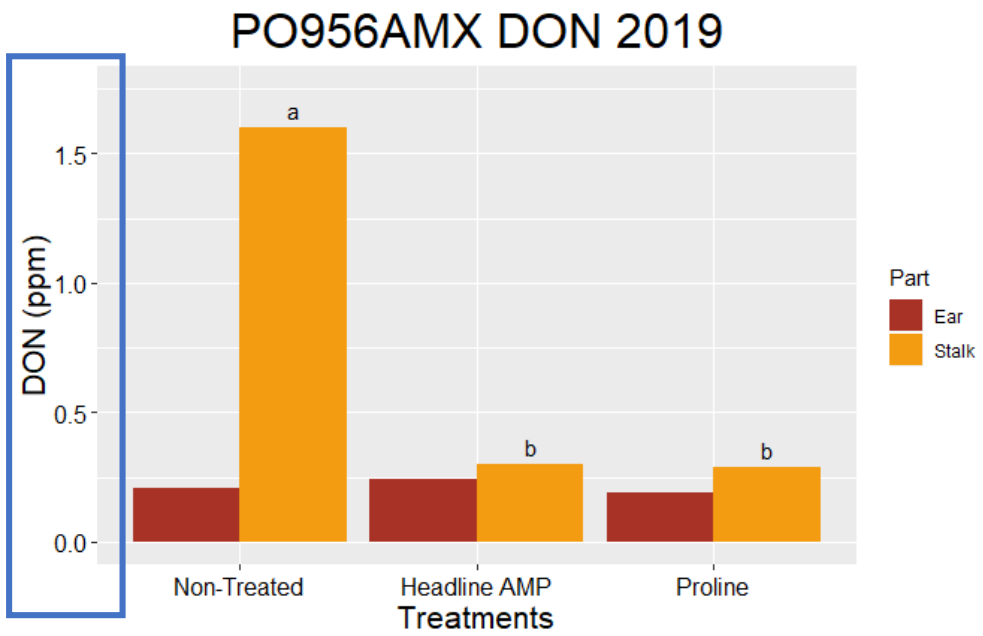


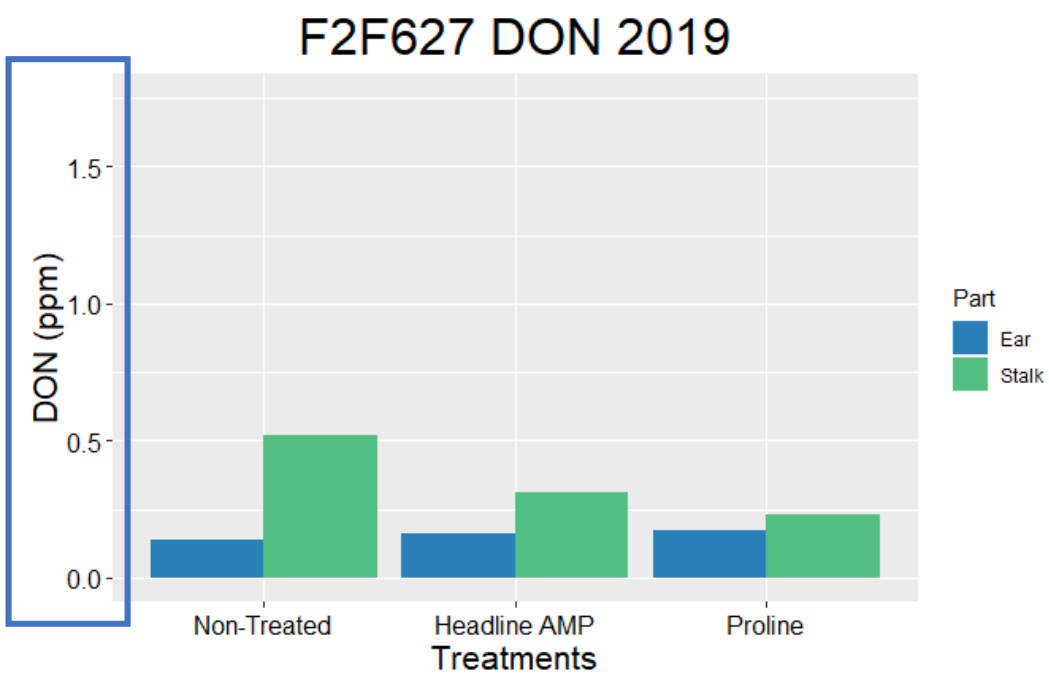
Pioneer 2019 DON	
Treatment	*
Part	**
Treatment*Part	*

Mycogen 2019 DON	
Treatment	ns
Part	**
Treatment*Part	ns

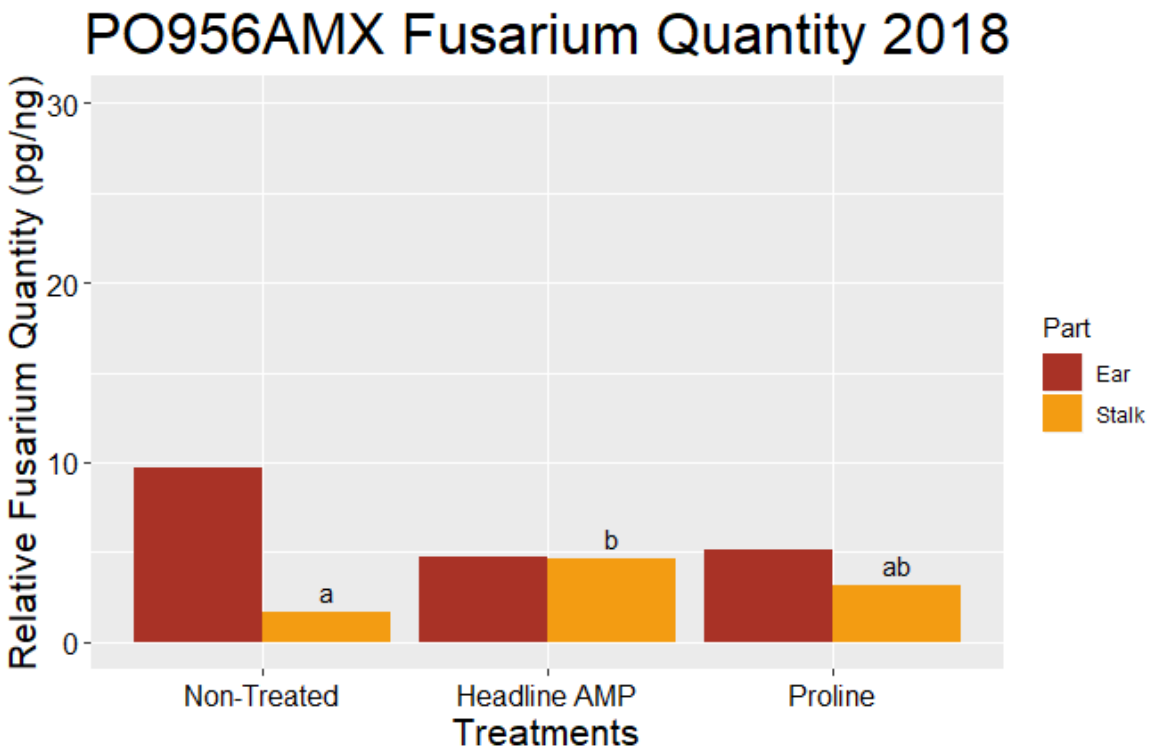

PO956AMX DON 2018
DON (ppm)
30
20
10
0
Non-Treated
Headline AMP
Proline
Treatments
Part
Ear
Stalk


F2F627 DON 2018
DON (ppm)
30
20
10
0
Non-Treated
Headline AMP
Proline
Treatments
Part
Ear
Stalk

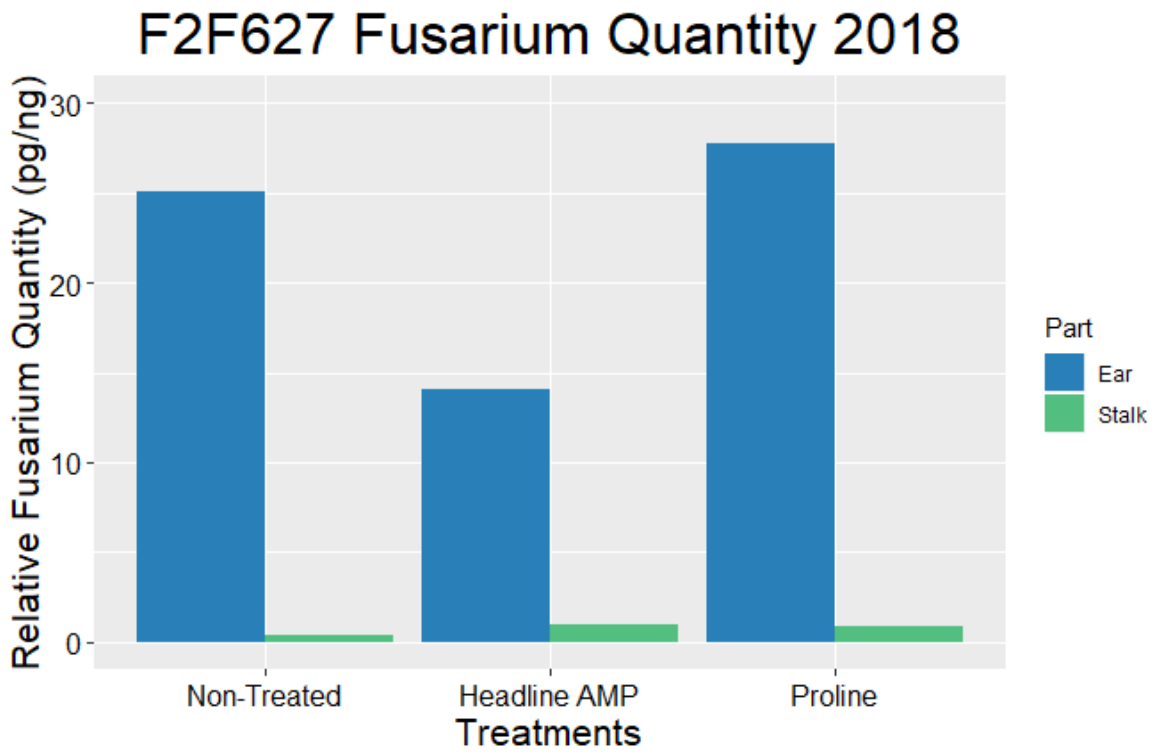

PO956AMX DON 2019
DON (ppm)
1.5
1.0
0.5
0.0
a
b
b
Non-Treated
Headline AMP
Proline
Treatments
Part
Ear
Stalk


F2F627 DON 2019
DON (ppm)
1.5
1.0
0.5
0.0
Non-Treated
Headline AMP
Proline
Treatments
Part
Ear
Stalk

2018 *Fusarium graminearum* in plant material

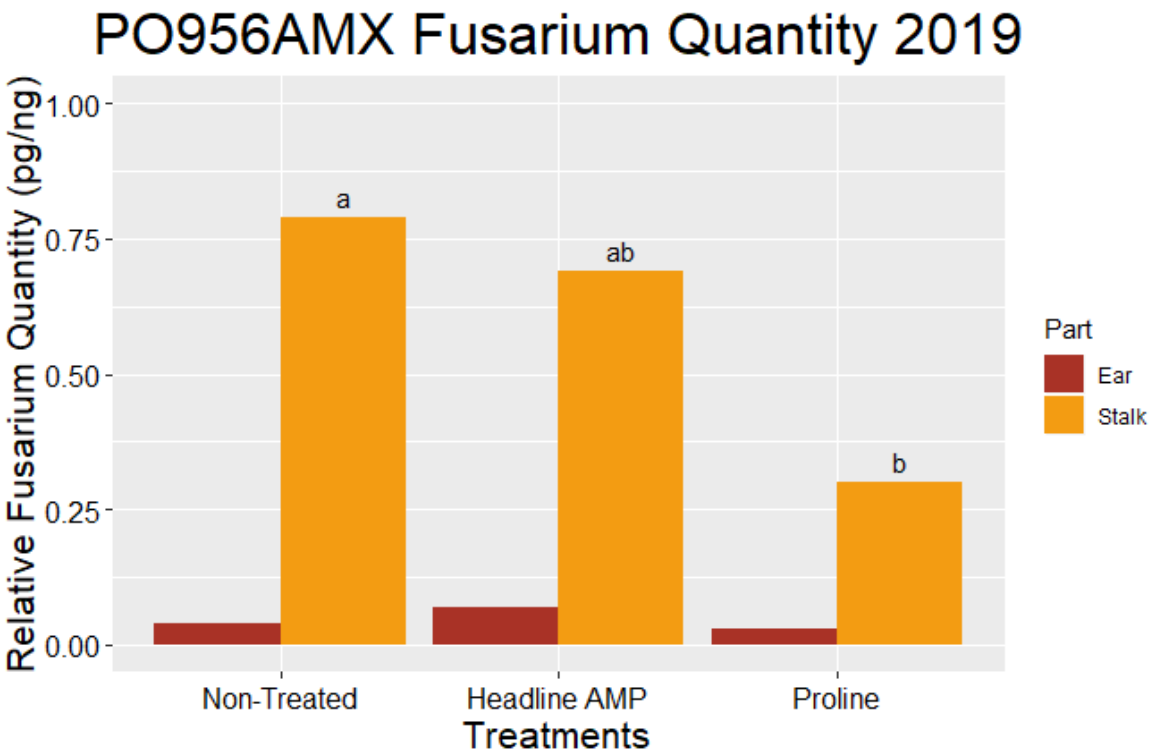


Pioneer 2018 Fusarium	
Treatment	ns
Part	**
Treatment*Part	*

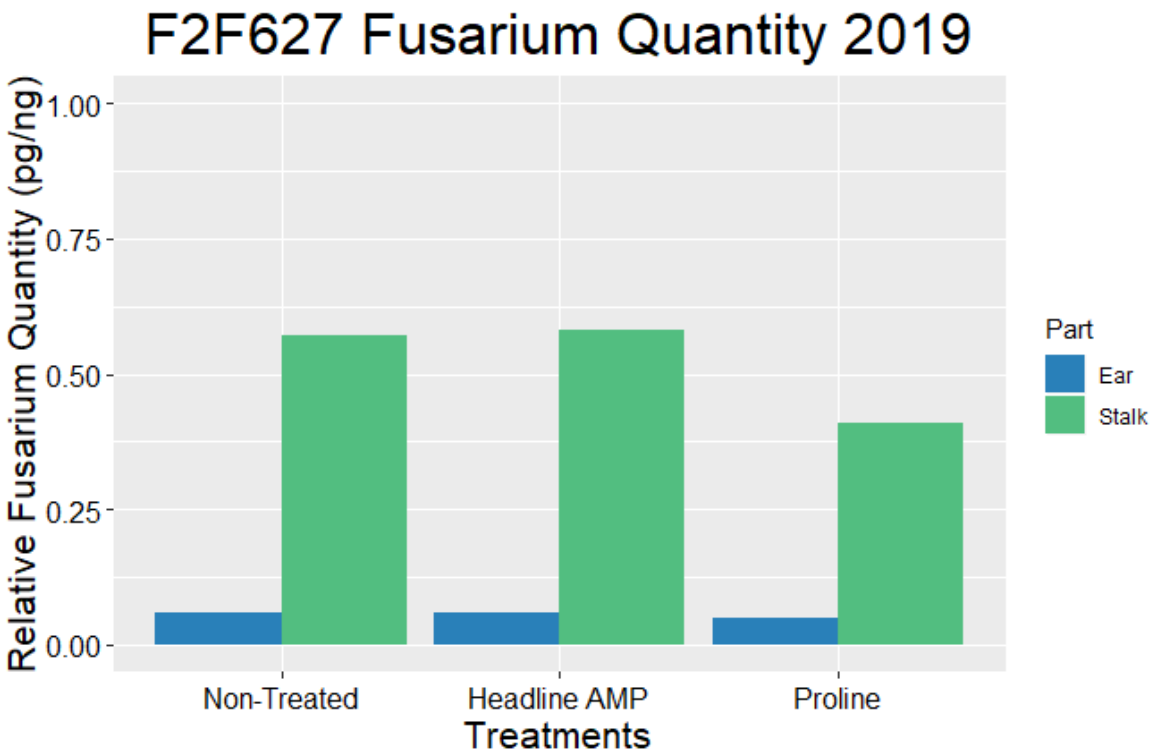


Mycogen 2018 Fusarium	
Treatment	ns
Part	****
Treatment*Part	ns

2019 *Fusarium graminearum* in plant material

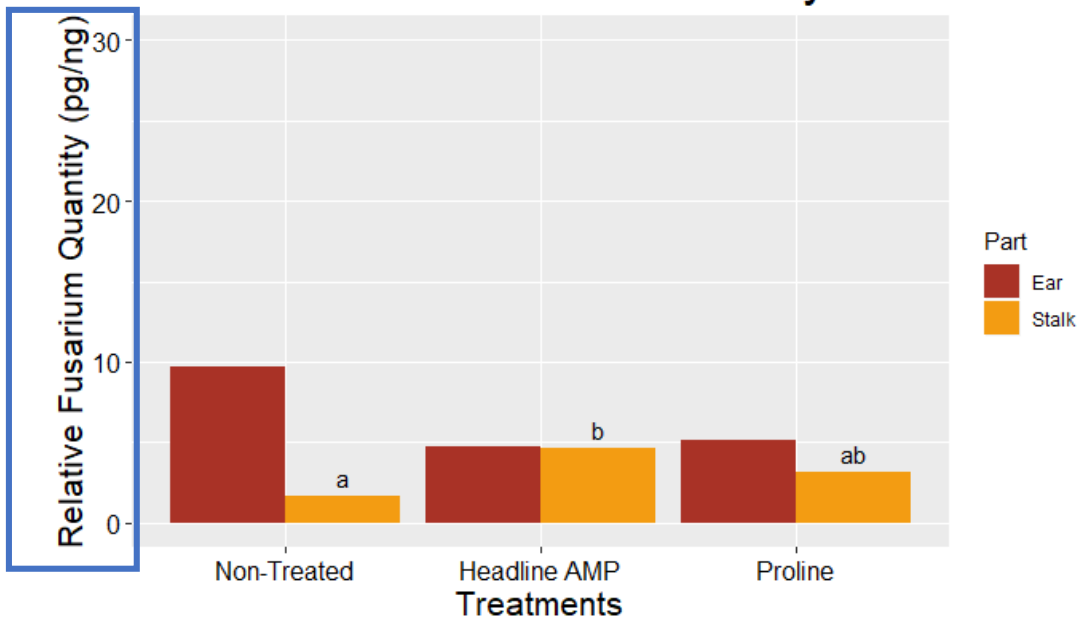


Pioneer 2019 Fusarium	
Treatment	*
Part	****
Treatment*Part	ns

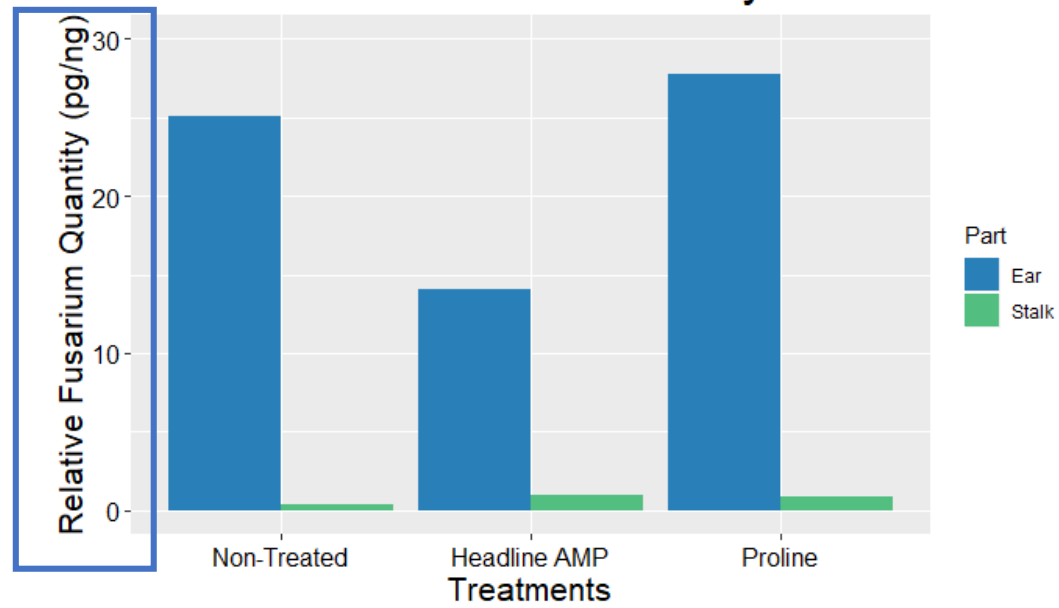


Mycogen 2019 Fusarium	
Treatment	ns
Part	****
Treatment*Part	ns

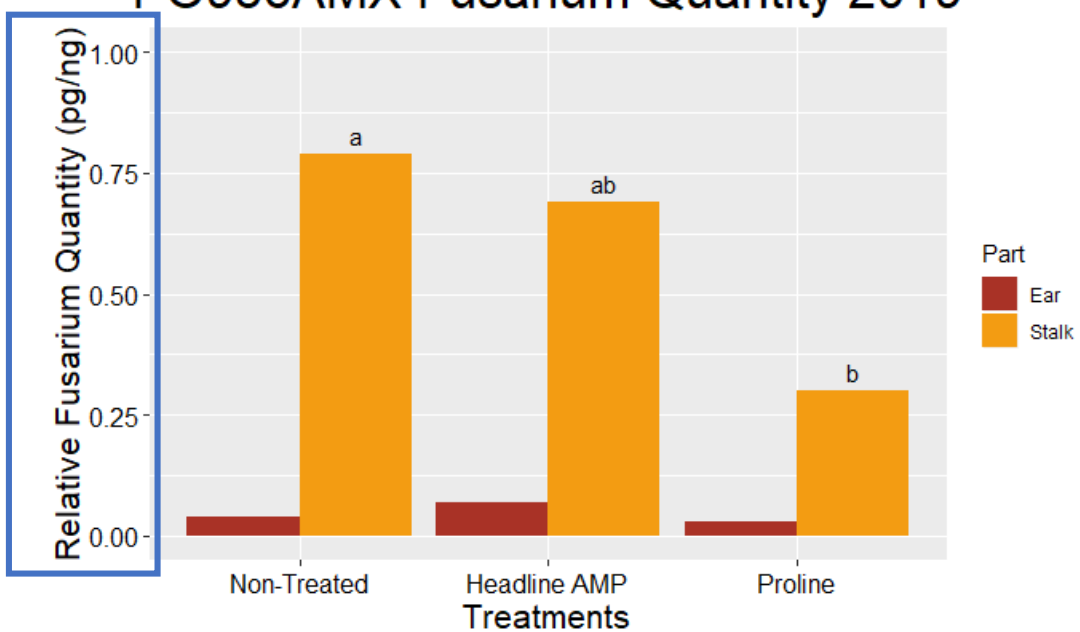
PO956AMX Fusarium Quantity 2018



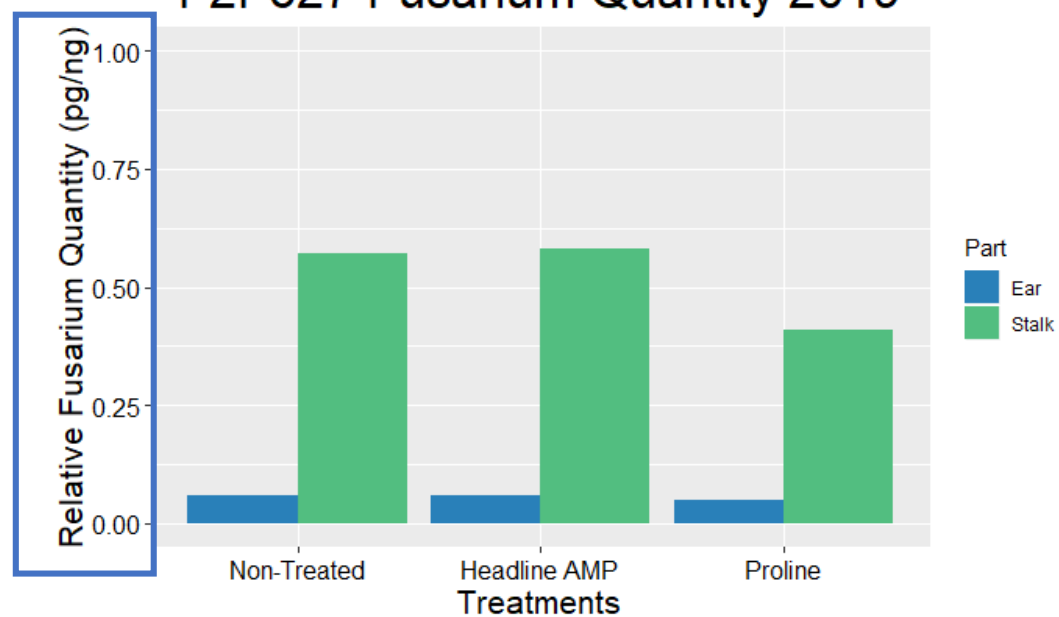
F2F627 Fusarium Quantity 2018



PO956AMX Fusarium Quantity 2019

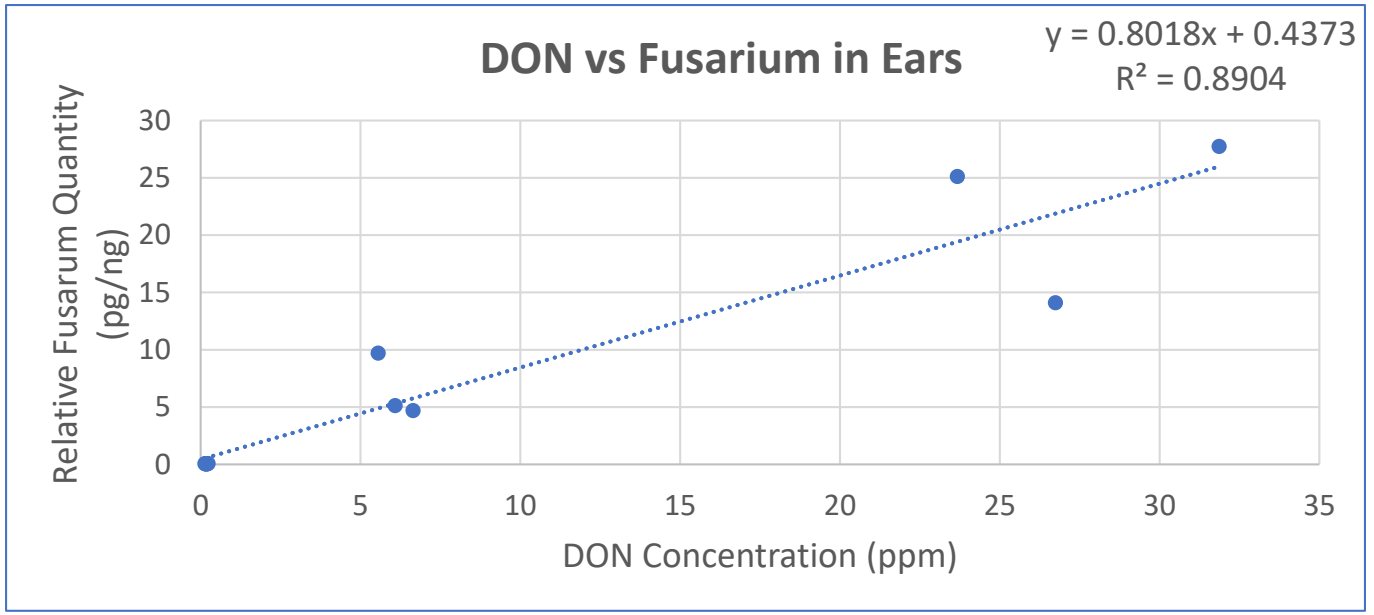


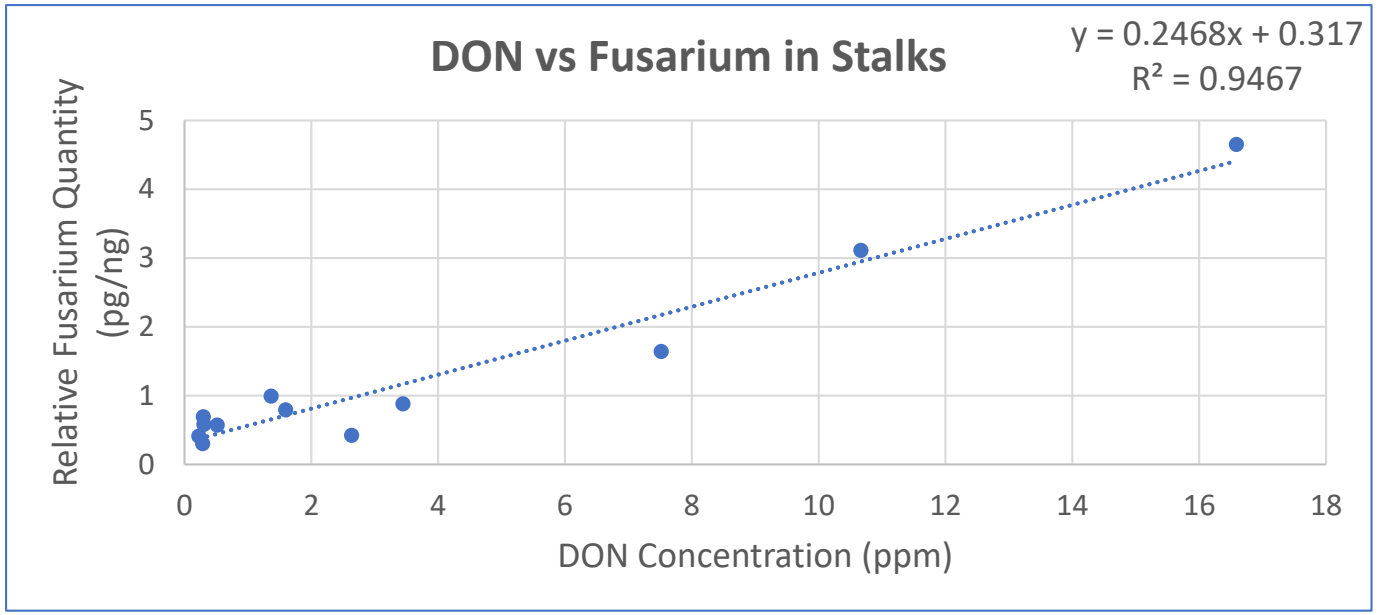
F2F627 Fusarium Quantity 2019



Correlation between DON and Fusarium

- **Strong correlation between DON and fusarium within plant part.**
- No correlation between ear DON and stalk DON (r=0.06)
- No correlation between ear fusarium and stalk fusarium (r=0.04)
- **Evidence suggests separate infection for stalk rots and ear rots.**





Summary of Partitioned Sample Experiment

- DON can accumulate in both stalks and ears
  - Growers should test entire plant DON level if planning to ensile and feed to livestock
- Location of accumulation varies depending on annual disease pressure and hybrid variety
- DON accumulation in stalks likely independent from ear DON accumulation
  - No correlation between stalk DON and ear DON
  - Suggestion of secondary infection
  - Different than wheat

Recommendations

- Focus on ear rots and stalk rots separately
  - Foliar fungicides will likely not impact stalk infections
- Select a resistant hybrid
  - High stalk strength
- Lower inoculum levels
  - Manage soil residue
  - Increase rotation schedule
- Test for DON
  - Likely present even if ear rot symptoms are not
- Harvest and ensile ASAP
  - Fungal contamination and DON levels will continue to increase

Acknowledgements

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Nancy Keller Ph.D.

Questions?