



# MYCOTOXINS IN WESTERN CANADIAN DIETS

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Red Deer Swine Technology Workshop  
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# Mycotoxins

- Secondary metabolites produced by moulds and fungi
- Exert toxic effects and adverse physiological responses when ingested
- Over 400 mycotoxins identified

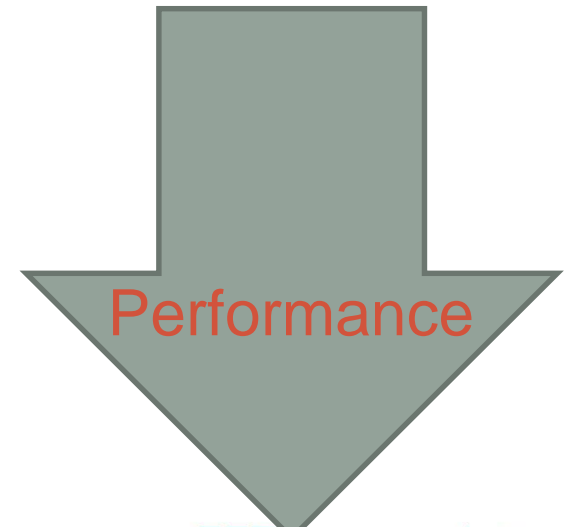
# Mycotoxins

- Grains contaminated with mycotoxins commonly downgraded for animal feed
- Mycotoxins of primary concern in pigs:
  - Aflatoxins
  - Zearalenone
  - Fumonisin
  - Ochratoxin
  - Ergot
  - Deoxynivalenol



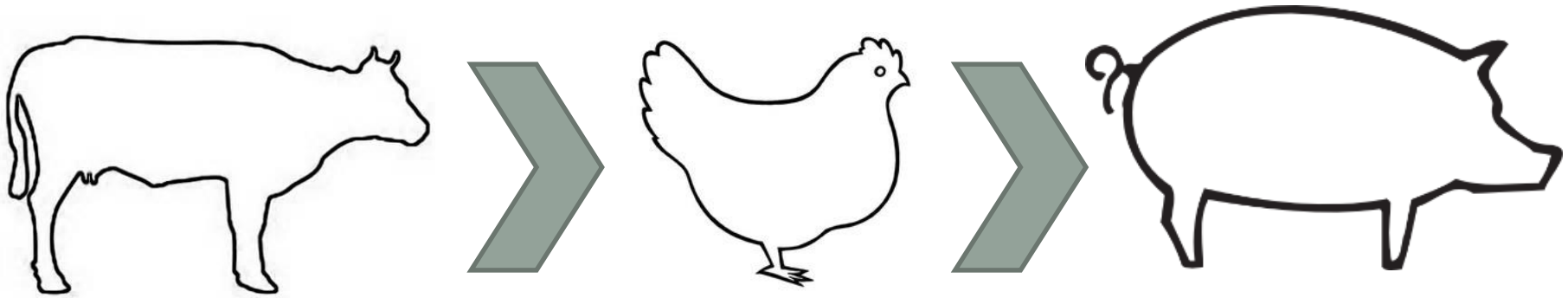
# Effects of Mycotoxins on Health

- Negative effects primarily due to ingestion, but inhalation and skin exposure also problematic
- Effects/symptoms dependent on mycotoxin exposure:
  - Feed refusal and vomiting
  - Impaired reproductive function
  - Kidney, liver damage
  - Compromised immune function
  - Digestive problems



# Pigs Most Susceptible

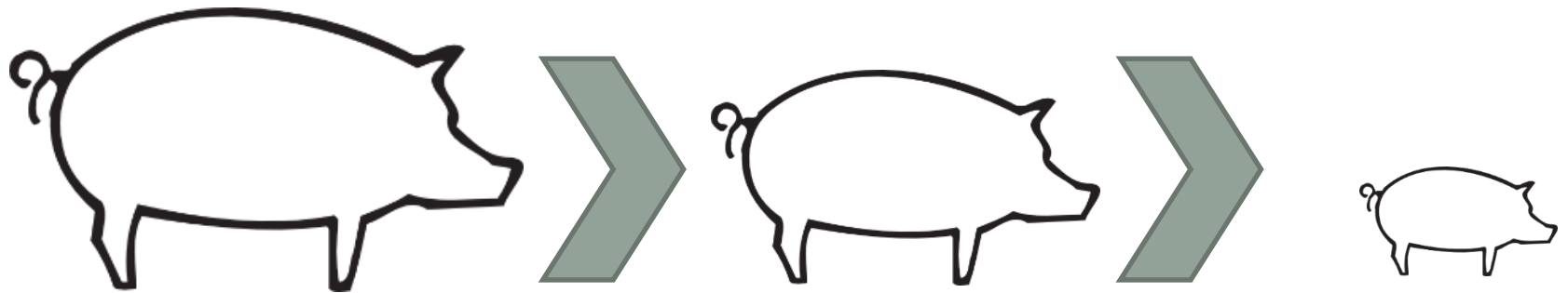
- Species show different tolerance to mycotoxins



- Pre- vs. post-digestion location of major microbial populations?

# Older Animals More Tolerant

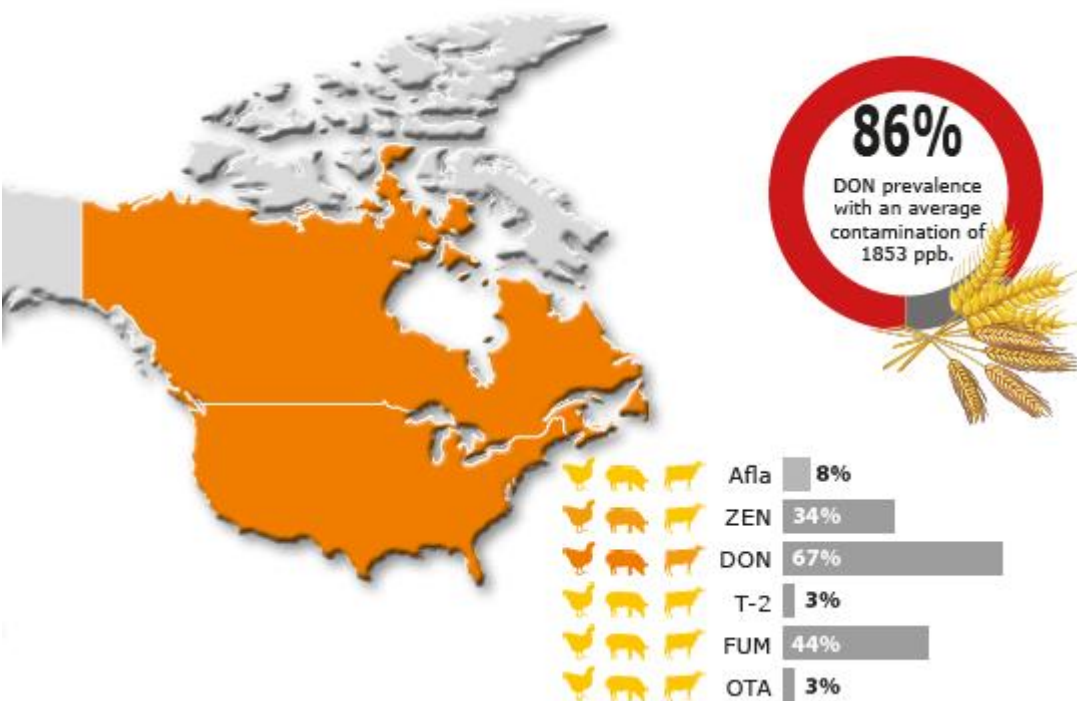
- Avoid feeding to newly-weaned



# Regulations and Guidelines

<b>Mycotoxin</b>	<b>Action Level</b>
	<b>Complete Feed</b>
Aflatoxins	20 ppb
Deoxynivalenol	1 ppm
Fumonisin	NA
Ergot – weaned piglets	4 ppm
Ergot – GF pigs	4 ppm

# Mycotoxin Prevalence



## Mycotoxins in main commodities

	Total samples: 1 780	Afla	ZEN	DON	T-2	FUM	OTA
Finished feed	Number of samples tested	537	578	492	492	563	578
	% Contaminated samples	12%	29%	82%	5%	46%	3%
	Average of positives (ppb)	9	147	579	697	2673	3
	Median of positives (ppb)	4	85	321	664	708	2
	Maximum (ppb)	57	1282	6500	1143	50734	7
Corn	Number of samples tested	478	484	450	450	483	484
	% Contaminated samples	9%	36%	68%	2%	70%	1%
	Average of positives (ppb)	36	297	759	379	3497	8
	Median of positives (ppb)	15	145	428	545	1236	4
	Maximum (ppb)	280	3320	13641	898	76778	18
Cereals*	Number of samples tested	48	51	51	50	51	52
	% Contaminated samples	6%	55%	86%	6%	33%	12%
	Average of positives (ppb)	6	369	1853	67	534	3
	Median of positives (ppb)	7	71	645	2	467	2
	Maximum (ppb)	8	4765	11600	197	1330	4

\*Cereals: wheat, barley, oats, rice, sorghum.

BIOMIN World Mycotoxin Survey 2018



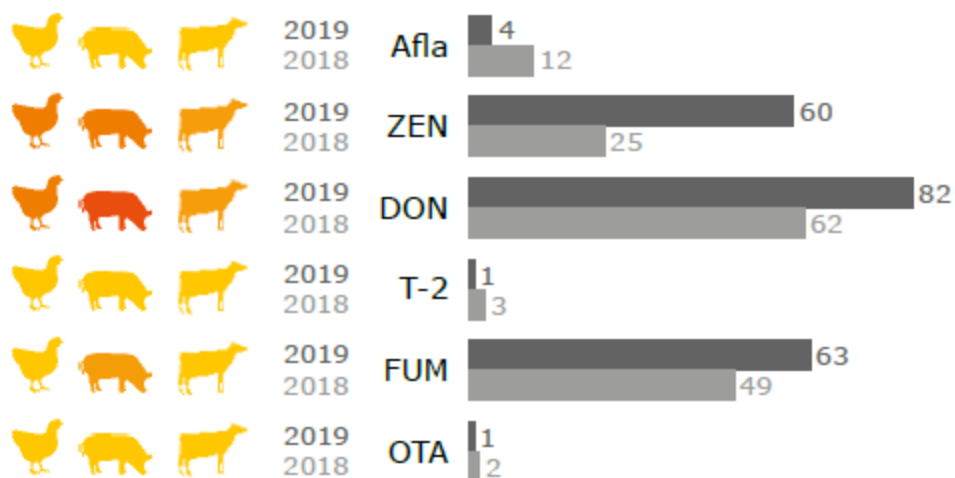


# Mycotoxin Prevalence

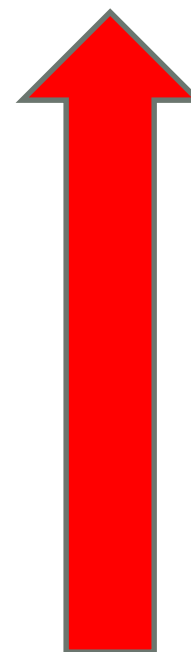
- In a recent survey 42% of wheat and 56% of barley samples from Western Canada contained at least one mycotoxin
- 33% of wheat and 44% of barley samples contained DON

Shi et al. (2019)

# Mycotoxin Prevalence



% Contaminated samples January – March 2019 ■  
and January – March 2018 ■



Prevalence is increasing

BIOMIN World Mycotoxin Survey 2019 Q1

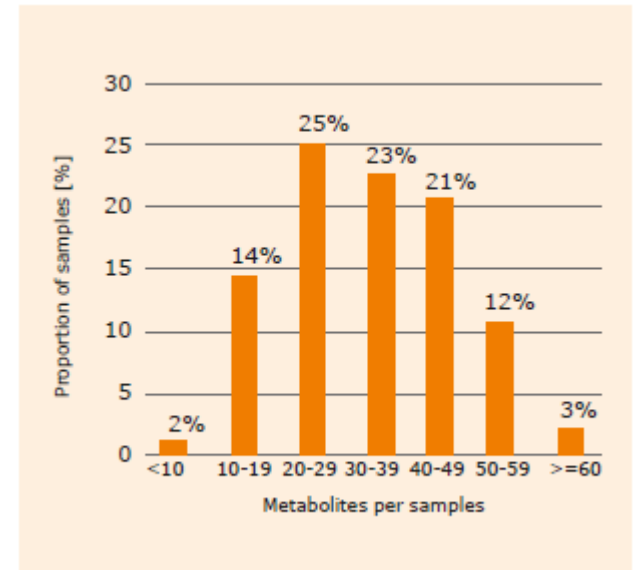


# What's the situation in Alberta?

- From 2001 to 2013, increasing incidence of Fusarium in Southern Alberta
- Since 2013, increasing incidence of Fusarium outside of Southern Alberta
  - 9 counties reported in 2001
  - 13 counties reported in 2010
  - 22 counties reported in 2015
  - 26 counties reported in 2016

# Mycotoxin Co-contamination

- In 2018 survey
  - Average of 34 mycotoxins and metabolites per sample
  - 98% of samples contained 10 or more mycotoxins and metabolites
- May result in greater negative effects



BIOMIN World Mycotoxin Survey 2018

# Economic Impact

- Reduced animal performance
- Crop losses
- Mycotoxin analysis
- Feed additives

**\$5 BILLION**

**COST OF  
MYCOTOXINS IN  
CANADA AND USA  
EACH YEAR**

(FAO)

# What can we do?

- Avoid feeding/reduce consumption
  - Feed to older animals vs. younger
- Physical separation
- Feed additives
  - Mycotoxin adsorbents/binders
  - Yeast products
  - Preservative blends
  - Spray dried animal plasma (SDAP)

# Reducing Consumption

- Avoid feeding contaminated grains
  - Not always viable due to widespread occurrence
- Dilution of contaminated grains\*\*\*
  - Level in final feed below upper tolerable limit
  - Accurate determination of mycotoxin in grain/feedstuff and final feed

# Mycotoxins in Co-products

- Processing does not deactivate mycotoxins
- Mycotoxins often concentrated in co-products (e.g. DON in DDGS 3 × DON in starting corn)





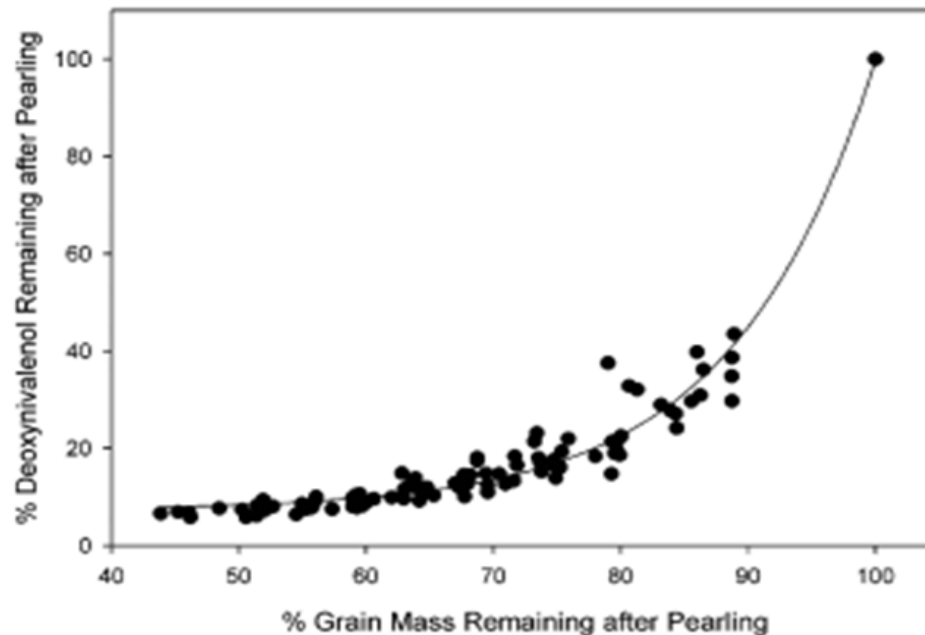


# Adsorbents/Binders

- Non-nutritive feed additives meant to deactivate or reduce absorption of mycotoxins (e.g., bentonite/silicate clays, activated charcoal)
- Effectively bind aflatoxins but generally ineffective against other mycotoxins
  - Yeast products showing some promise
- Unwanted adsorption of other nutrients

# Physical Removal

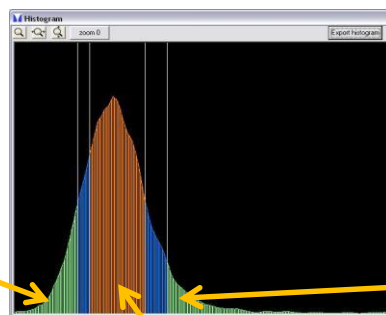
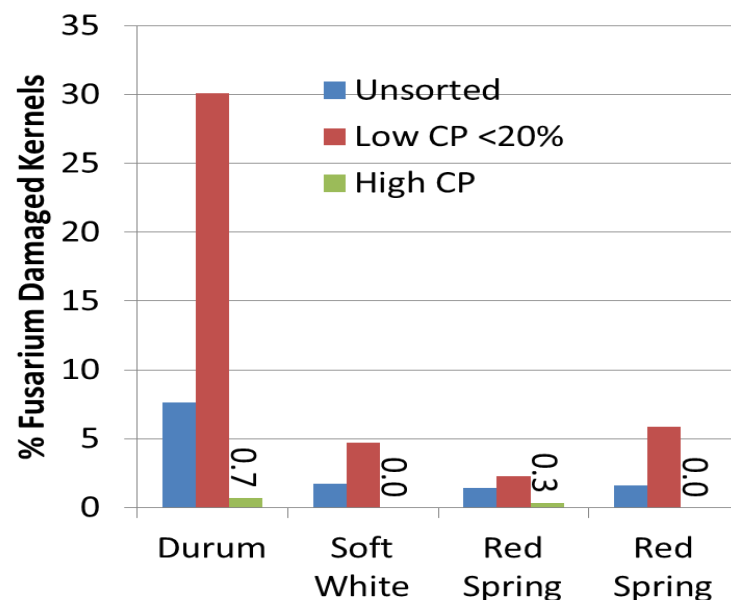
- Physical removal from grain
  - Abrasive pearling, effective but removes significant amount of grain



House et al., (2003)

# Grain Sorting

- Sorting of grain to remove contaminated kernels
- NIR transmittance based on crude protein



DON contaminated

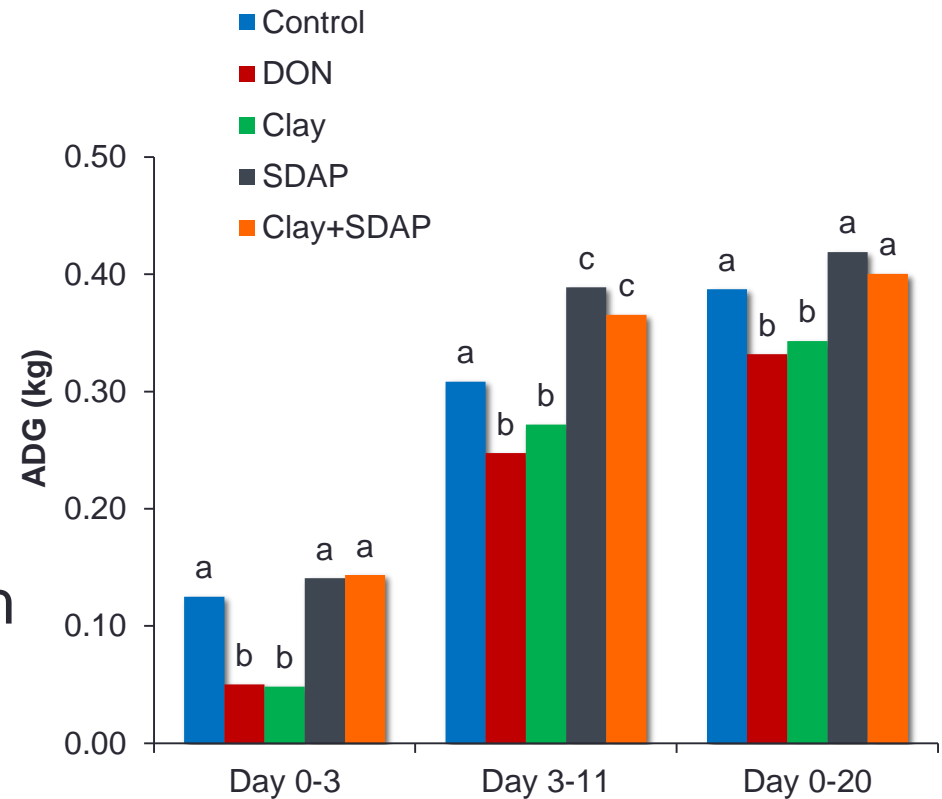
Immature grain

High-quality grain

Barnsley (2016)

# Spray-Dried Animal Plasma

- Inclusion of SDAP increases feed intake, improves gut health, modulates immune response
- In DON-contaminated diet was able to improve growth performance



Barnsley (2016)



# Yeasts Products/Blend Products

- Contain one or more components
  - Antioxidants, amino acids, direct-fed microbials, yeast/yeast products, enzymes, plant extracts, adsorbents
- Multi-pronged approach to mycotoxin mitigation
  - Deactivation, biotransformation, protection of animal, physiological support (e.g., gut health)



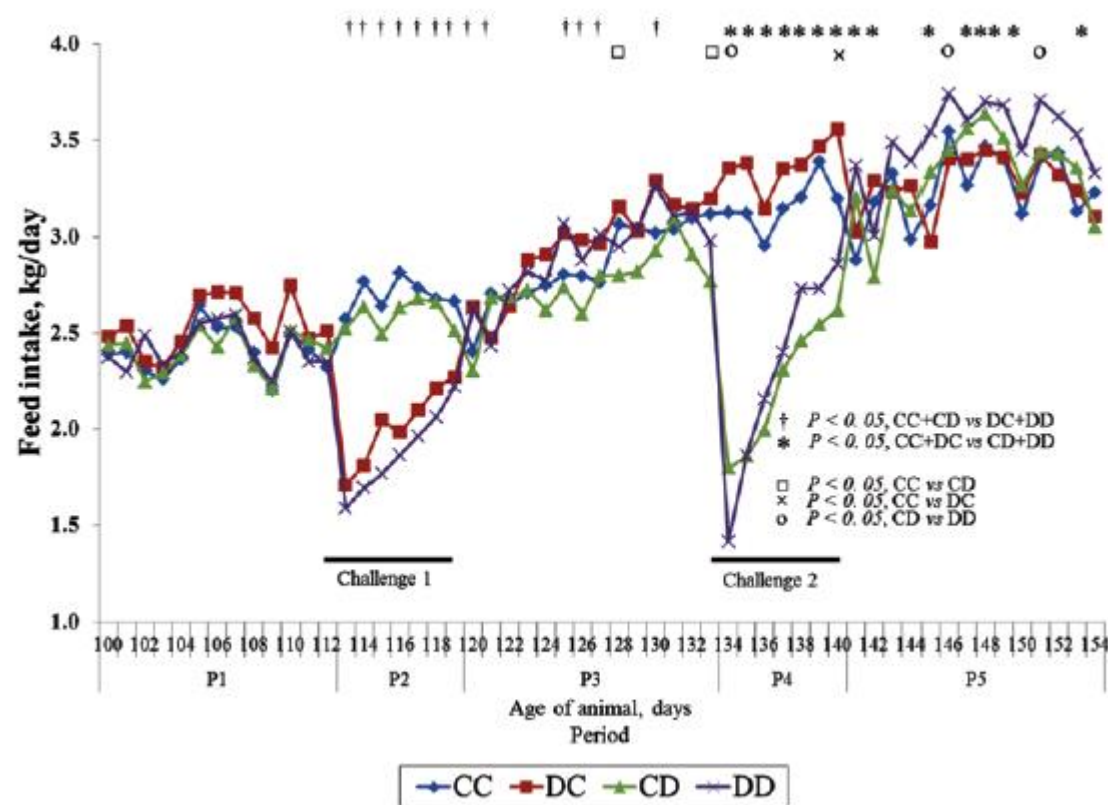
**BEST TO AVOID**

**BUT**

**WHAT IF YOU CAN'T?**

# DON in Grower-Finisher Pigs

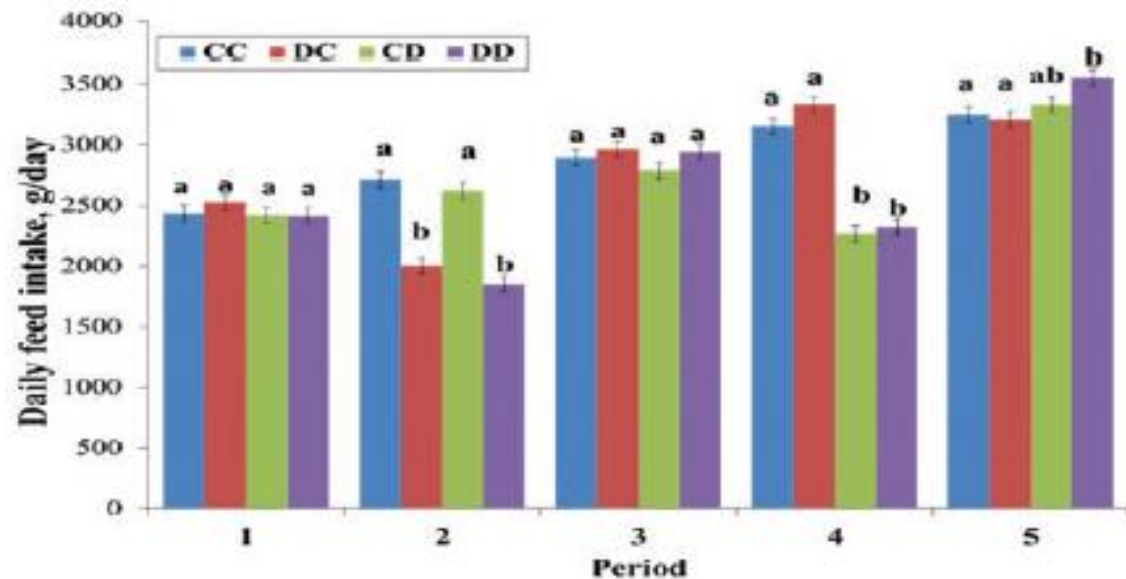
- Performance decreases when provided DON-contaminated diet (3 ppm) for 7 days
- Previous exposure does not protect against negative effects



Serviento et al. (2019)

# DON in Grower-Finisher Pigs

- Response to DON related to feed intake



Serviento et al. (2019)



Is 1 ppm an appropriate maximum inclusion for deoxynivalenol?



# Objectives

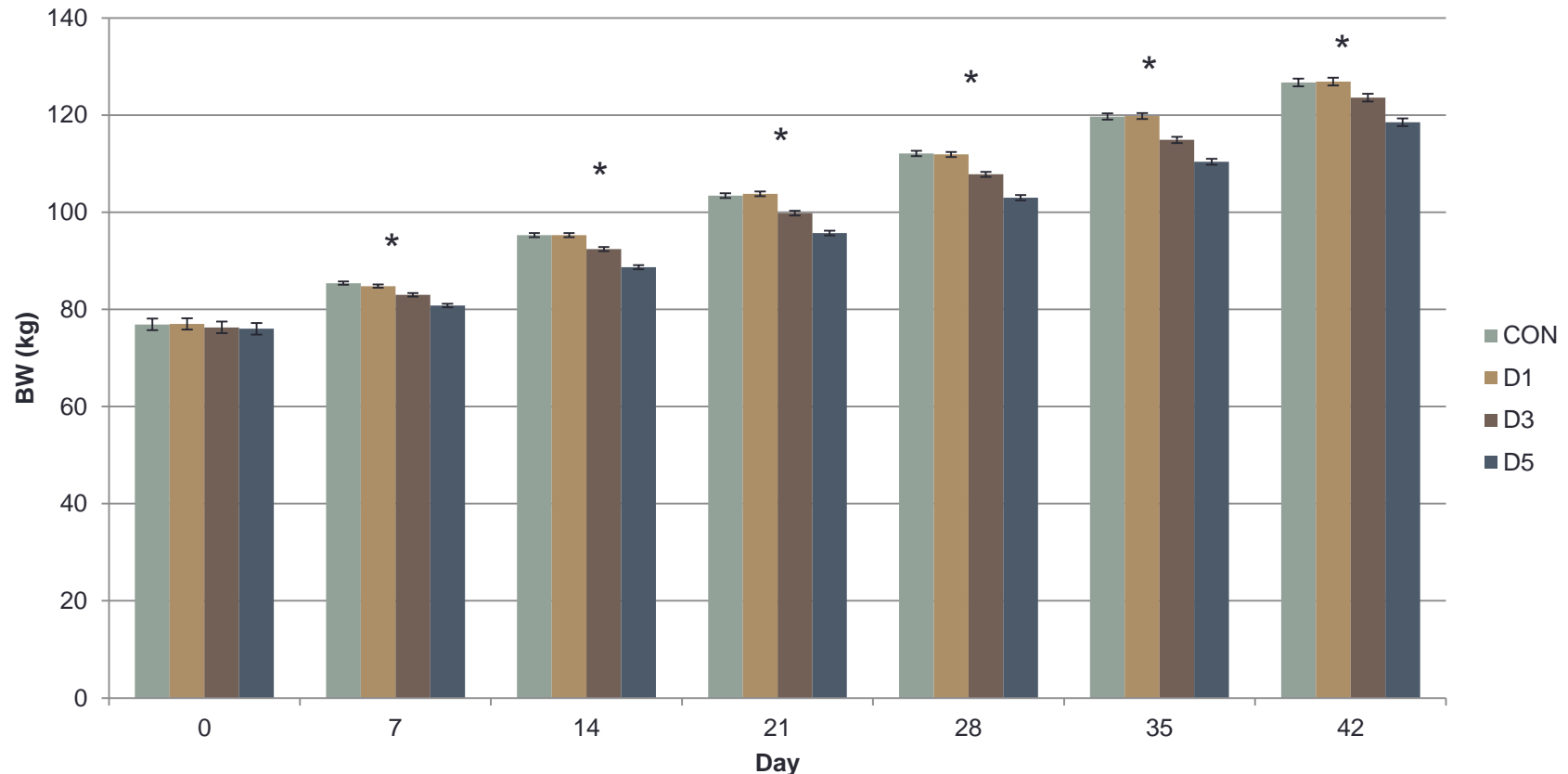
1. Determine effects of long-term exposure of graded levels of DON on growth performance, nutrient utilization, and overall health status of grower-finisher pigs.
2. Determine economic viability of feeding DON-contaminated diets in the grower-finisher period.



# Methodology

- Finisher Study
  - 200 pigs (75 kg BW) fed control diet (CON) or diets containing 1, 3, or 5 ppm DON (DON 1, DON 3, DON 5) for 6 weeks
  - Diet DON levels achieved with naturally contaminated wheat and wheat screenings
- Grower-Finisher Study
  - 240 pigs (35 kg BW) fed same levels for 10 weeks (6 weeks grower, 5 weeks finisher)

# Body weight decreased on D3 and D5

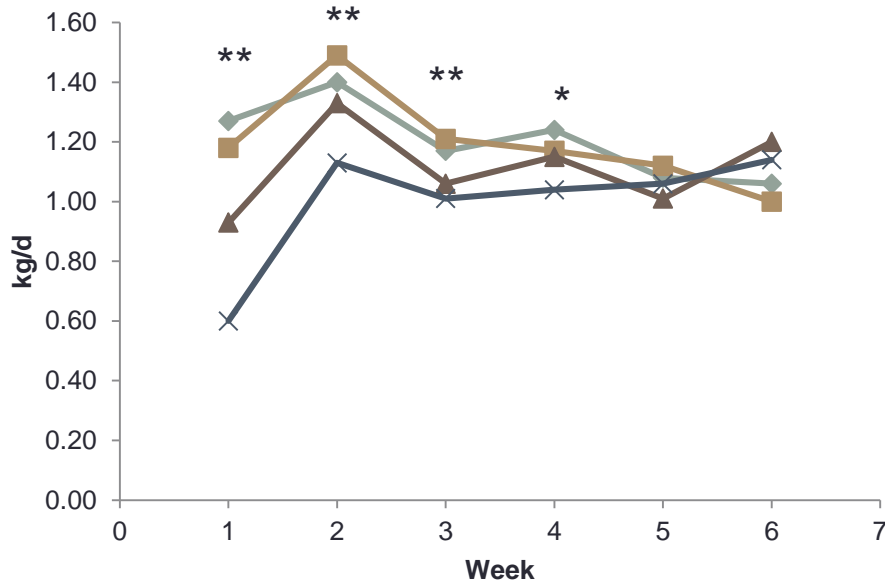


- DON3 and DON5 pigs were ~ 3 and 8 kg lighter at market

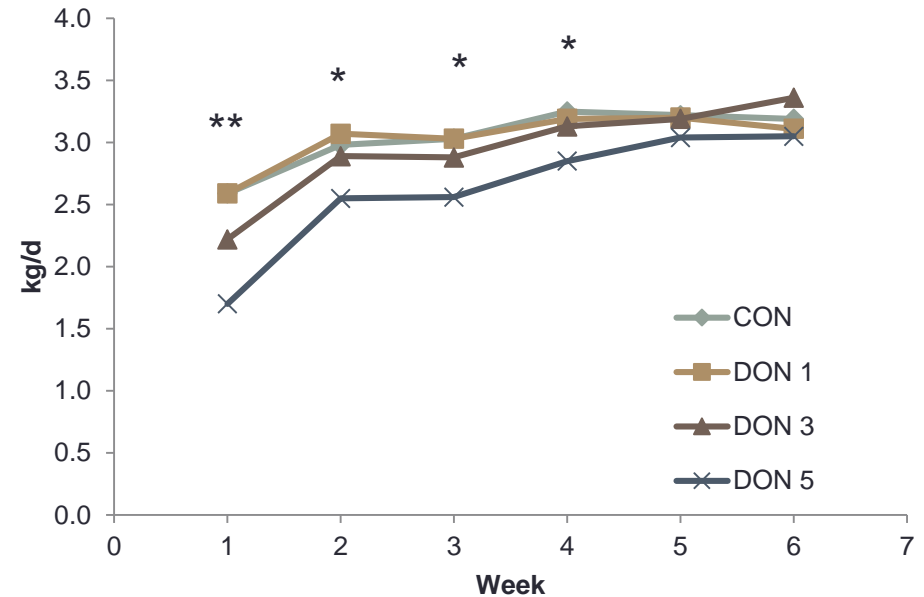
\*indicates significant difference DON3 and DON5  
(compared to CON)  
DON3 different than DON5

# ADG/ADFI decreased but recovered

## Average Daily Gain



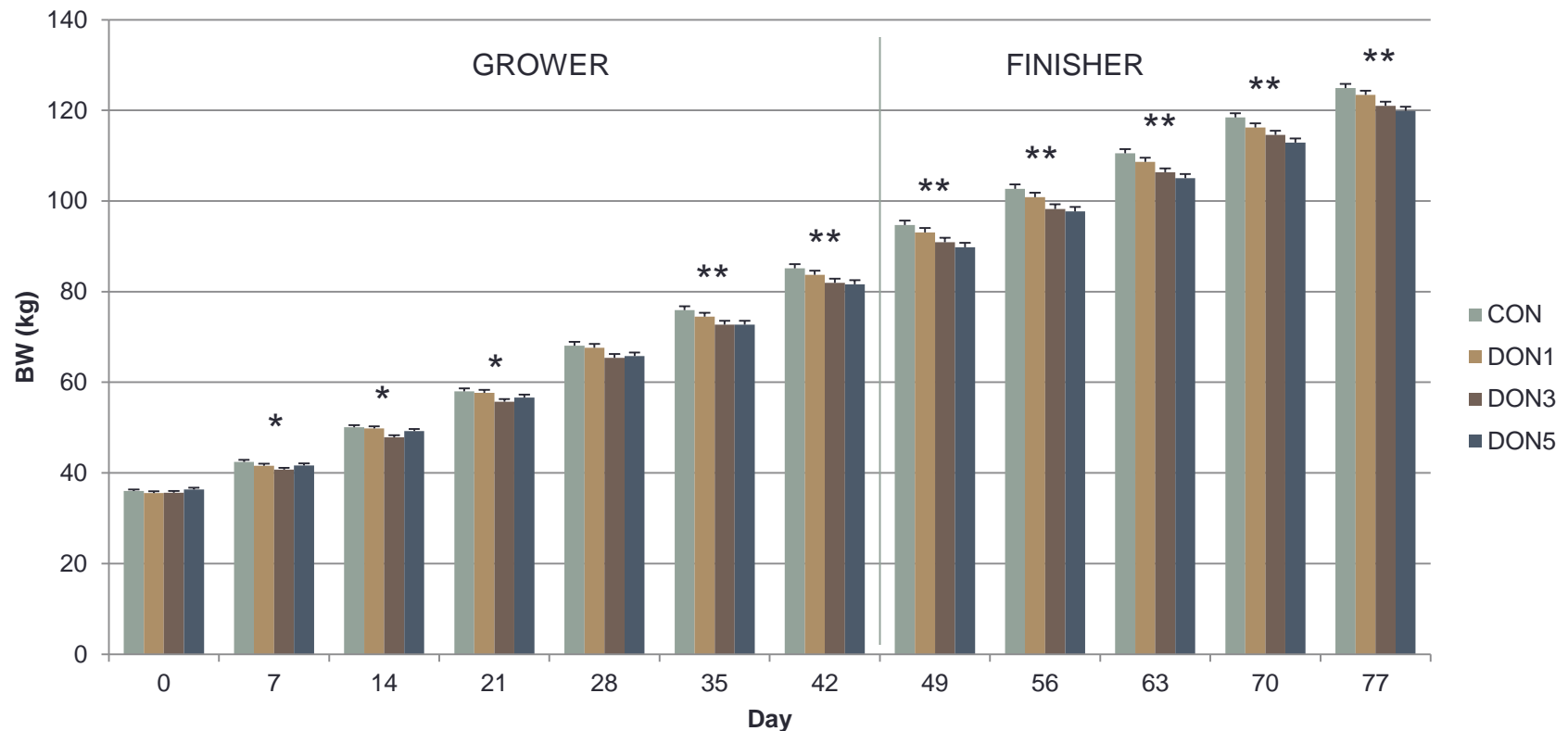
## Average Daily Feed Intake



- Overall ADG reduced on DON3 and DON5 (recovered after 4 weeks)
- Overall ADFI reduced only on DON5 (recovered after 4 weeks)
- Feed efficiency only reduced in first week – effects mostly due to feed intake?

\*indicates significant difference DON5  
\*\*indicates significant difference DON3 and DON5  
(compared to CON)

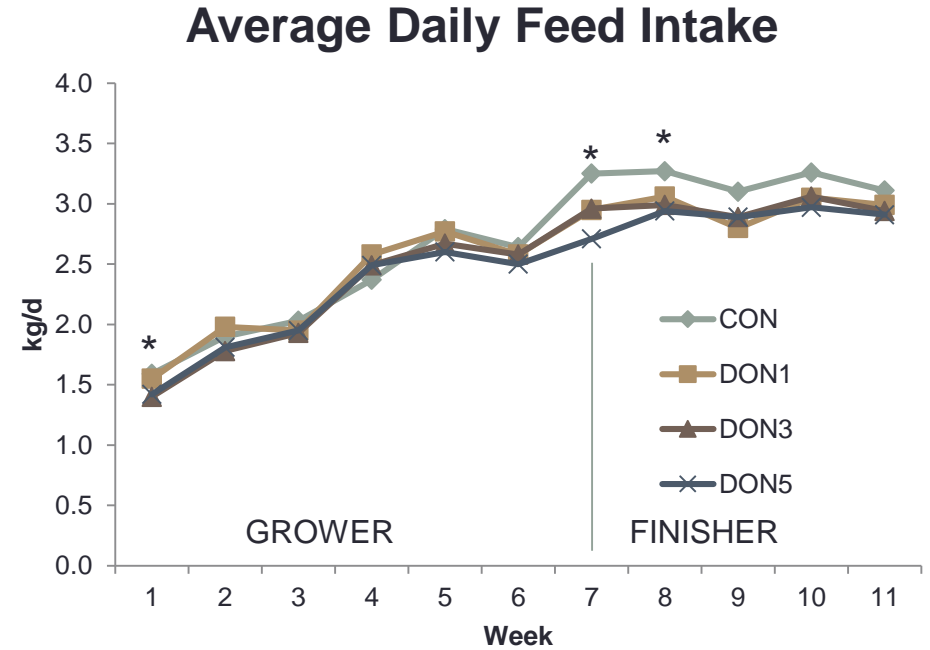
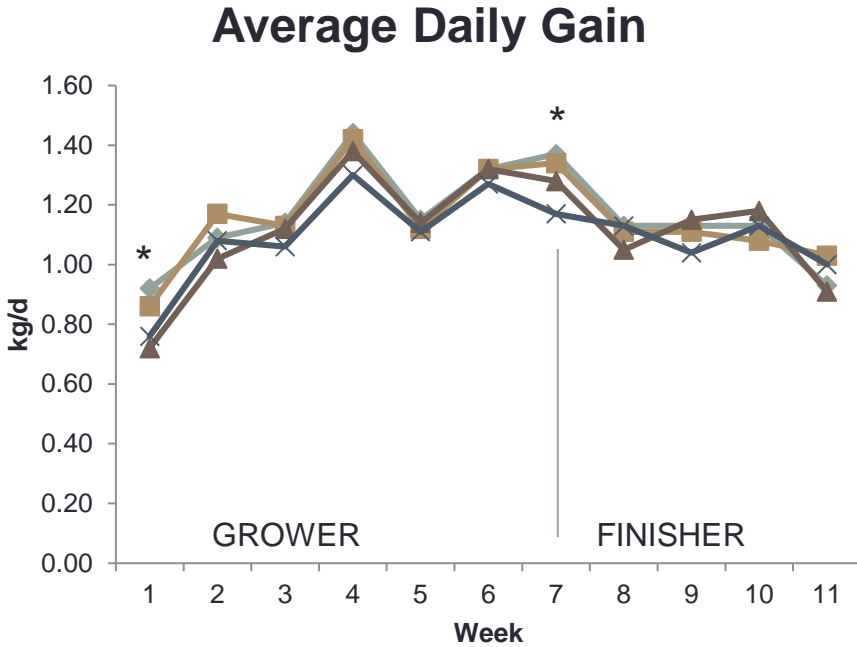
# Body weight decreased on D3 and D5



- DON3 and DON5 pigs were ~ 4 and 5 kg lighter at market

\*indicates significant difference DON5 OR DON3  
\*\*indicates significant difference DON3 and DON5  
(compared to CON)

# ADG/ADFI decreased but recovered



- Grower phase and overall ADG reduced on DON3 and DON5, no effect in finisher phase
- Finisher phase and overall ADFI reduced with DON, no effect in grower phase
- No difference in feed efficiency

\*indicates significant difference

# Summary

- Mycotoxins will continue to be an issue in animal agriculture
- Mitigation strategies available – efficacy dependent on mycotoxin present
- Older animals appear to be more susceptible to DON, some evidence of adaptation
- Effects of DON mostly due to feed intake





# Project Sponsors



# Program Sponsors

