

Unique Microbial Solutions for Livestock Challenges



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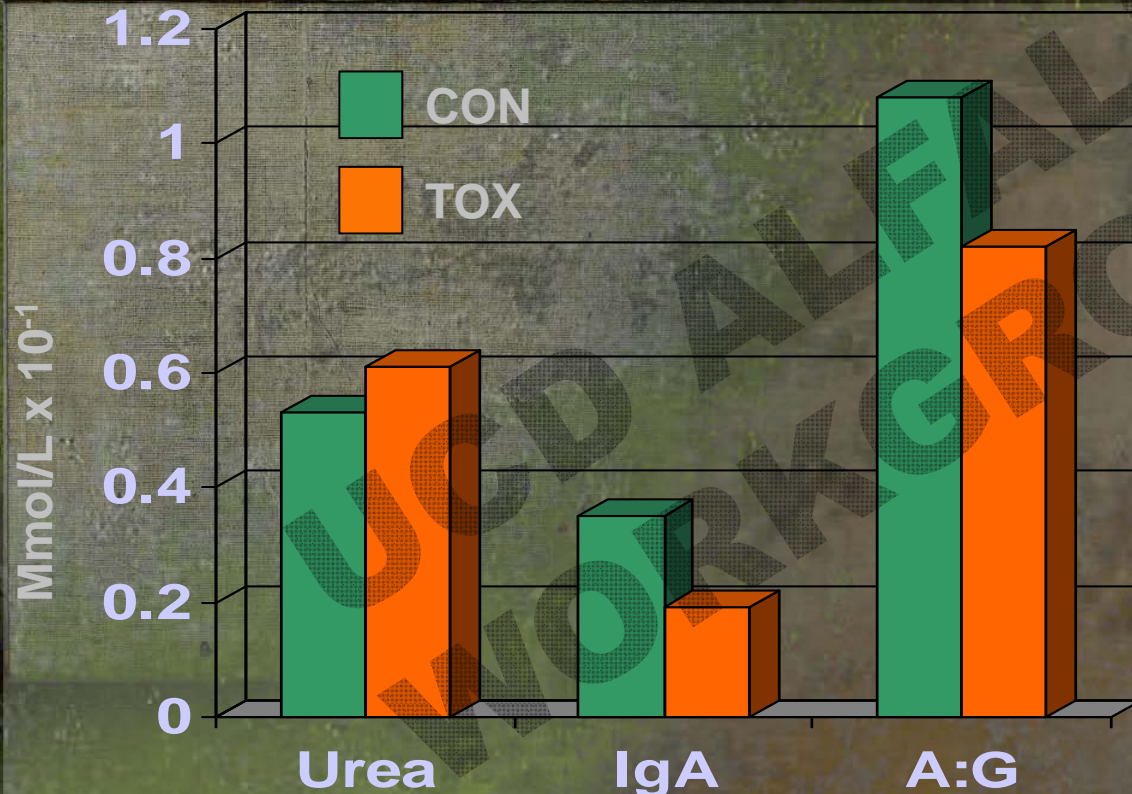
A Little Fresh Air

Fungal Toxins and Silage



Is There A Problem?

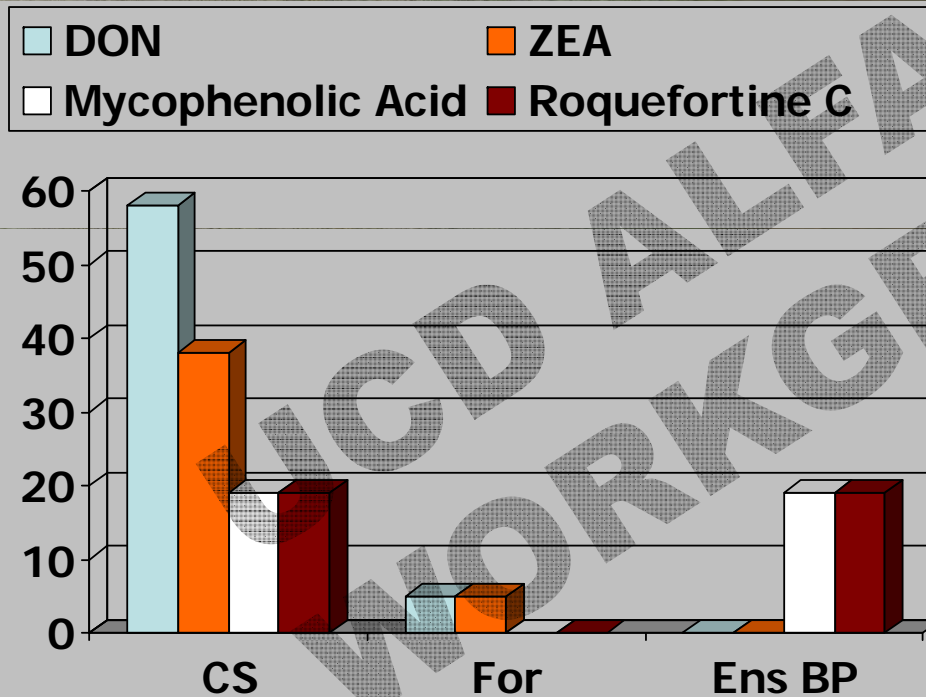
- Protocol
 - DON, 15-ace-DON, ZEA
 - In wheat, corn, hay
 - CON 500 ppb DON in TMR
 - TOX 3.5 ppm DON, 240 ppb ZEA*
- 6 cows/treatment
- Serum variables
 - Urea
 - IgA
 - Album./Glob ratio
- * Zea in hay!



Adapted from Korosteleva, S.N., T.K.Smith, & H.J. Boermans (2007) Effects of feedborne *Fusarium* mycotoxins on the performance, metabolism, and immunity of dairy cows. J. Dairy Sci. 90: 3867-3873.

Is There A Problem?

Recovery of Mycotoxins (% of samples)



CS = corn silage, compound feed, and commodity samples

For = forages

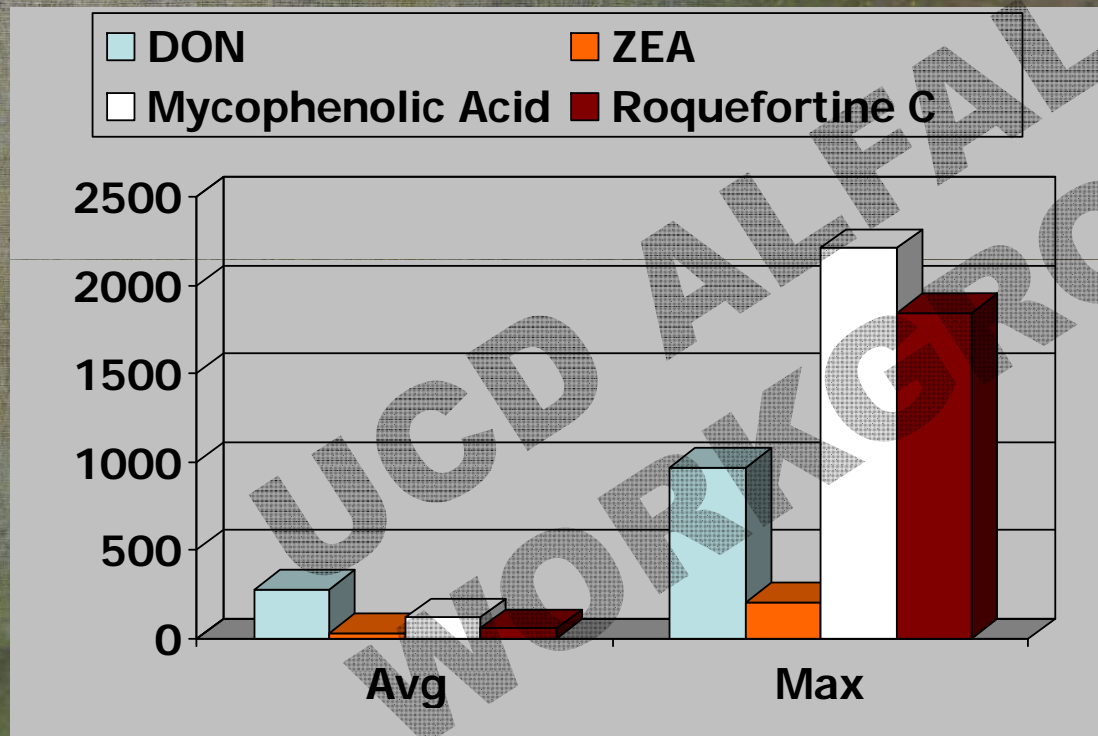
Ens BP = Ensiled by-products

Note: test panel of 20 mycotoxins: AFB1,2,G1,2; OA; T-2; HT-2; 3- and 15-ace-DON; DAS; sterigm; fusar-X; ergotamine; penicillinic acid; fumonisin B1,2

Driehuis, F., Spanier, M.C. Schotten, J.M. and te Giffel, M.C. (2008). Occurrence of mycotoxins in feedstuffs of dairy cows and estimation of total dietary intakes. J. Dairy Sci. 91:4261-4271

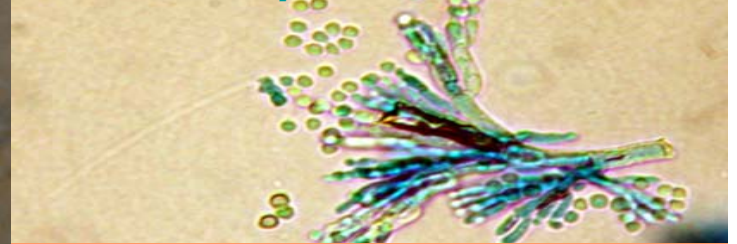
Is There A Problem?

Amounts of Mycotoxins (ppb)



Note: concerns of toxicity to large animals of mycophenolic acid and roquefortine is increasing. The latter is produced by a micro-aerophilic *Penicillium* mold routinely isolated from corn silage

Penicillium roquefortii



http://py.guillaume1.free.fr/site%20microbiologie/page_microscopie/photos%20microscopie/moisissures/penicillium_roquefortii.jpg

Driehuis, F., Spanier, M.C. Schotten, J.M. and te Giffel, M.C. (2008). Occurrence of mycotoxins in feedstuffs of dairy cows and estimation of total dietary intakes. J. Dairy Sci. 91:4261-4271

Silage

- **Regardless of type of container**
 - Ensiling depends upon mechanical action for initial exclusion of oxygen



12/8/2010

Silage

- **Expected sequence**

- Materials for ensiling

- **Chopped at proper time**

- Blown into silo

- **Weight of material and/or of equipment compresses mass and excludes most oxygen**

- Rapid microbial activity

- **Consuming remaining oxygen**

- **Lowering pH (to 3.5-4.3)**

- Temperature 10-20F of ambient

- **Warmer > O₂ penetration**



Molds Isolated From Silage

- **Common molds**

- *Aspergillus* spp.
- *Fusarium* spp.
- *Penicillium* spp.

- **Less common**

- *Absidia*, *Arthrinium*,
Alternaria
- *Bysochlamys*, *Baccharis*
- *Monascus*, *Mucor*,
Myrothecium
- *Scopulariopsis*
- *Trichoderma*

- **Toxins of Interest**

- Aflatoxin, T-2 toxin, DON, zearalenone, fumonisin, ochratoxin A, aflatrem
- DAS, MAS, citrinin, patulin, fusarins, fusaric acid, cyclopiazonic acid
- Pencillinic acid, PR toxin roquefortine C, mycophenolic acid, penetrem, agroclavine, festuclavine, roridins, verrucarins, alternariol
- Unknowns (e.g. *Absidia*)



Real World Dairy Rations

Variable	Result	Units
Yeasts (misc.)	120,000,000	cfu/gm
<i>Mucor racemosus</i>	5,000	cfu/gm
<i>Absidia corymbifera</i>	1,700,000	cfu/gm
<i>Penicillium roquefortii</i>	700,000	cfu/gm
<i>Fusarium</i> spp.	0	cfu/gm
Deoxynivalenol (DON)	2,500 ppb	ng/g
Zearalenone	500 ppb	ng/g

A. corymbifera: Aw 0.90; infection, abortion in cattle

P. roquefortii: Aw 0.82; micro-aerophilic; acid tolerant; 5 toxins, 2 alkaloids

Molds/Toxins in Silage

- **At ensiling**
 - Some toxins are present in the materials ensiled
 - Mold/spores present as well
- **Post-ensiling**
 - Trapped small air pockets...
 - Minor air infiltration into the container
 - Poor cutting or removal technique with additional infiltration
- **24-48 hrs enough for toxic loads to form**

Is CA Different?

- **Why the question?**

- Routine testing yields little in the way of common toxins

- **DON, T-2 toxin, zearalenone, AF**

- But dairy herds experience the same problems that relate to mold toxins as other areas of the US

- **What are the differences?**

- Climate

- Possibly materials used

- Adjacent agriculture

Is CA Different?

- **Climate**

- Lower relative humidity

- **Aw may be lower than for other areas?**

- **Alters mold profile**

- **Constituents**

- Use of “other” ingredients

- **Adjacent agriculture**

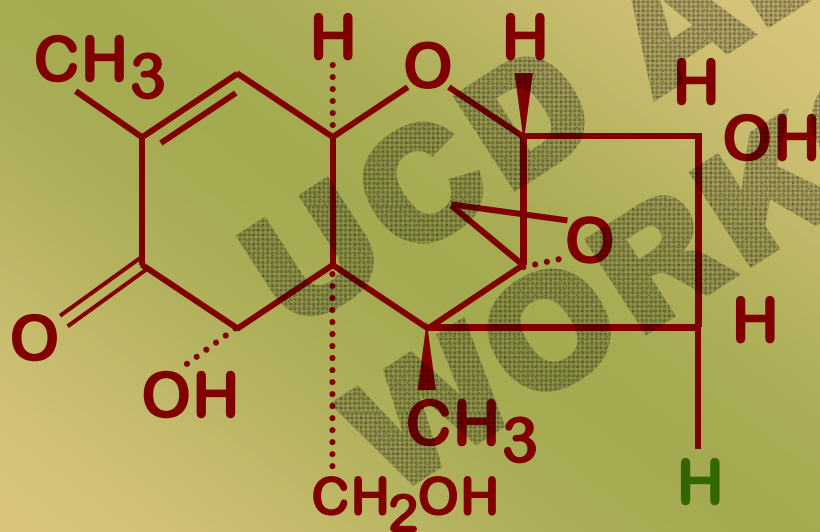
- Fruits, nuts

- Enriched mold flora specific to those commodities



Masked Mycotoxins

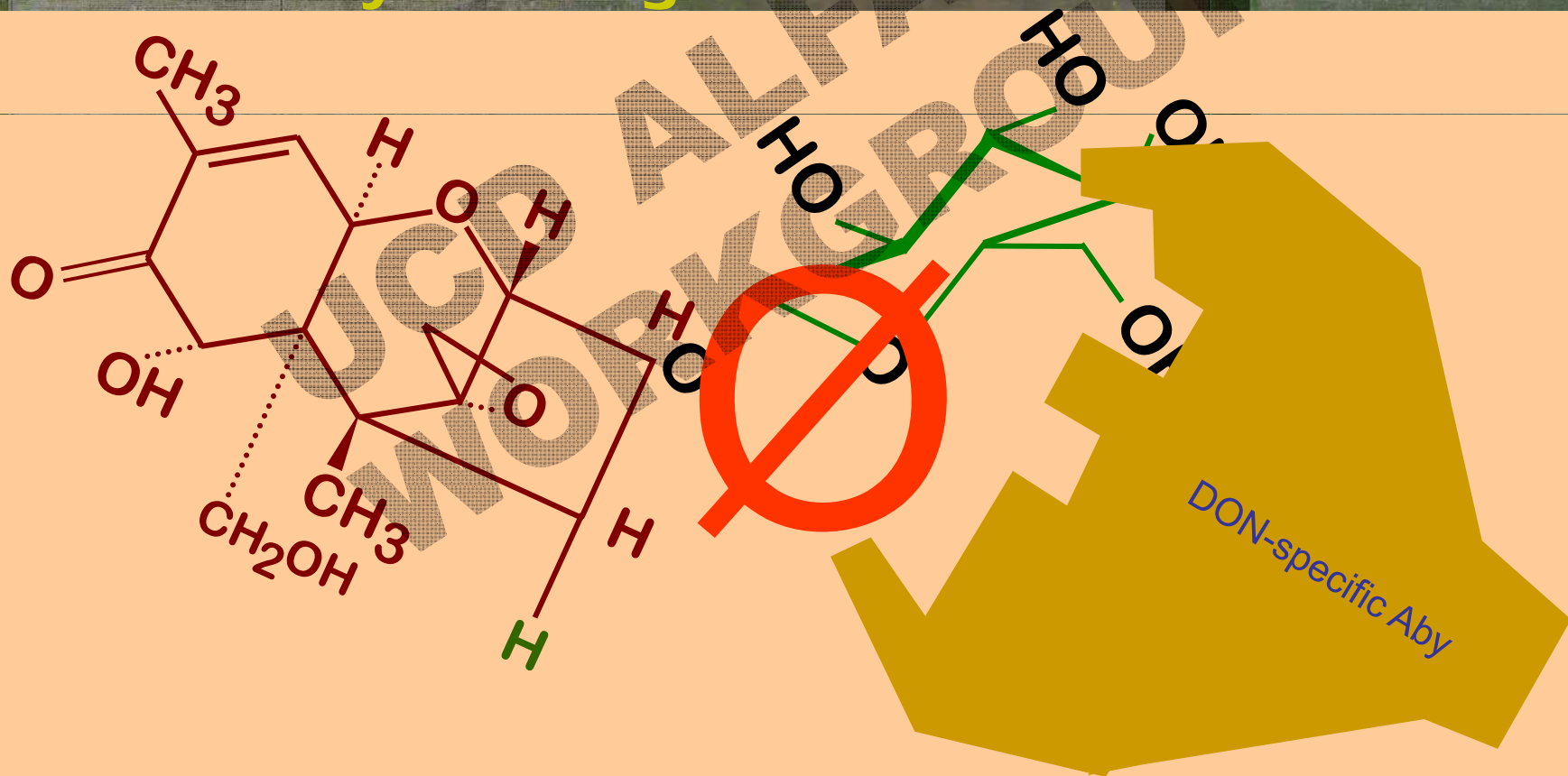
- Antibody in test recognizes a very specific chemistry



DON-specific Aby

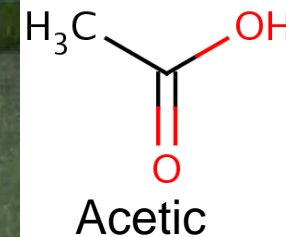
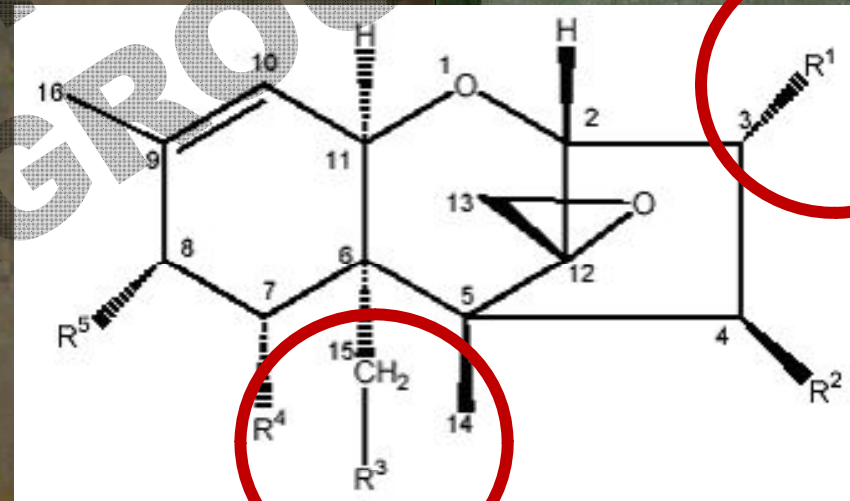
Masked Mycotoxins

- Plants add 'sugar' (e.g., glucose) to detoxify
- Chemistry is changed – toxin is “masked”



Masked Mycotoxins

- **Molds also produce 'alternative' forms**
 - Addition of –OH or other moieties
- **DON congeners, e.g.**
 - 3-acetyl-DON
 - 15-acetyl-DON
- **Also hidden from standard DON antibody**
- **Both (congeners & glycosides) require extra hydrolysis**



Masked Mycotoxins

- Found for most common mycotoxins
- Rapid tests may underestimate total toxin level by 50 – 125%
- A “less than 150 ppb DON” could mean 300 or more effective DON is present



Prevention? Control?

- **Only real solutions open to dairymen on the silage side are**
 - Best ingredients into the ensiling process
 - Best maintenance of silage storage
 - **Bird damage, mechanical, etc.**
 - Best management of silage
 - **Cutting quality**
- **Dairyman's best options are to**
 - Presume presence of toxins
 - Watch cow symptoms carefully
 - Additives which aide the cow in combating toxins

Control: '09 Test

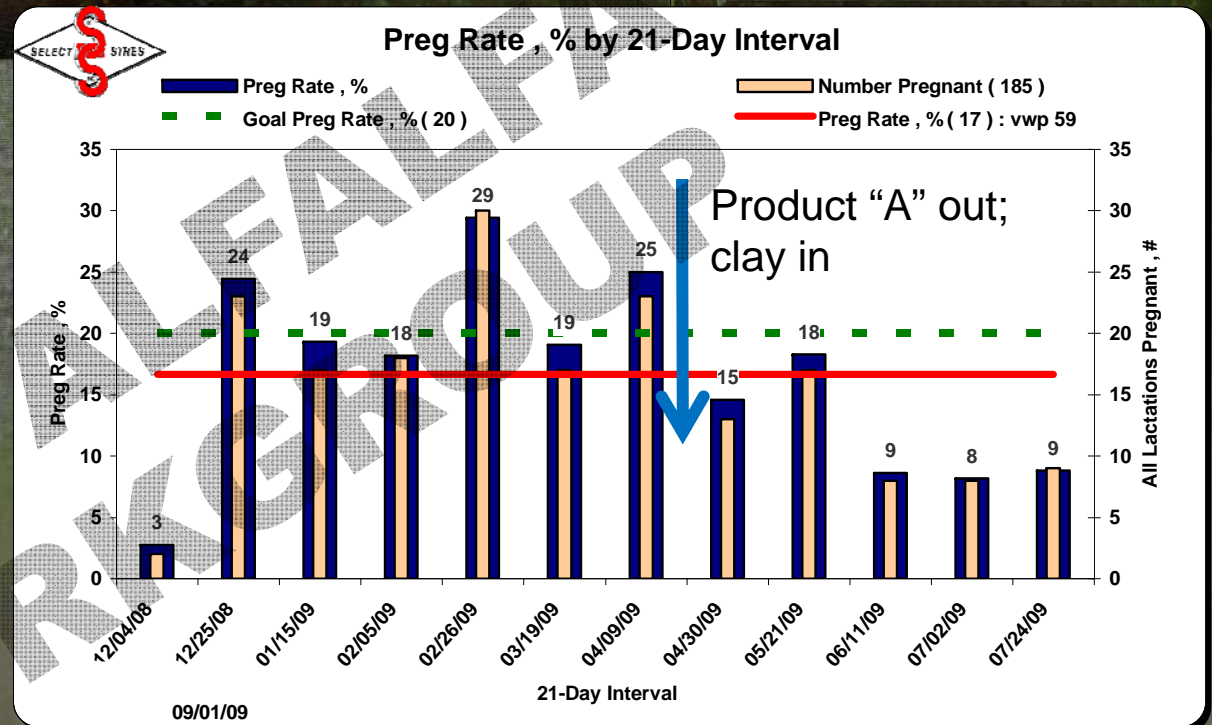
MYCOTOXIN	VALUE	UNITS
Quantitative Results (Dry Matter Basis)		
Aflatoxin		ppb
Vomitoxin (DON)	687.0	ppb
T-2 Toxin	>25	ppb
Zearalenone	>50	ppb
Fumonisin		ppm
Ochratoxin		ppb

Control?

- **Control is with the host animal!**

- Test, but
- Watch the signs in the cows
- use measures appropriate to the issue!

- If you don't have high AF, why use a clay?
- If you don't know that ALL others are low, why use a yeast?
- Use a truly broad spectrum approach



Summary—Just A Little Fresh Air

- Based on mold cultural features, silage should be a toxin-safe feedstuff
- However, complete anaerobiosis is not achieved
- Minor leakage-infiltration of air yields mold 'hot spots' with substantive toxin accumulations
- Best practices for silage and reinforcement of cows' natural defenses are the best control

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Thank You!

