AtoZ

mycotoxins

Mycotoxins & Mycotoxicosis

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In 1928, Dr. Alexander Fleming, a Scottish microbiologist discovered that a colony of Penicillium mold inhibited the growth of bacteria on a petri dish.

As a result the antibiotic Penicillin was isolated, tested and produced prior to WWII, saving many lives.

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Turkey X Disease

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Toxinogenic moulds could be divided in 4 groups:

1. Pathogenic for plants - Aw > 0,90
   (i.e. *F. graminareum*, producing **Zearalenone**)

2. Moulds growing and producing mycotoxins on old or stressed plants - Aw > 0,90
   (*F. moniliforme* producing fumonisin and *A. flavus* producing **Aflatoxins**)

3. Moulds growing on plants and enhancing mycotoxins contamination during harvest – Aw > 0,90
   (i.e. *F. roseum* producing Trichothecens – **DON, T2, HT2**)

4. Moulds living in ground and decaying materials which will grow during storage - Aw > 0,60
   (i.e. *A. ochraceus* and *P. viridicatum* producing Ochratoxin A).

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Major Mycotoxins

- Well known
  - Aflatoxin
  - Zearalenone
  - Fumonisins
  - Tricothecenes
    - (DON and T-2 toxin)
- Least known
  - Fusaric Acid
  - Ochratoxin A

MYCOTOXIN	FOODSTUFF	MOLDS
Aflatoxin B_1, B_2, G_1, G_2	Corn, peanuts, pistachios Small grains	*Aspergillus flavus, A. parasiticus*
Aflatoxin M_1	Milk and milk products, eggs	
Ochratoxin A	wheat, corn, sorghum, coffee, wine, beer, meats	*A. ochraceus, A.carbonarius, A. niger, Penicillium verrucosum*
Tricothecenes	Corn, wheat, barley	*Fusarium graminearum, F. culmorum,*
Fumonisin	Corn and corn products	*F. verticillioides, F. proliferatum*

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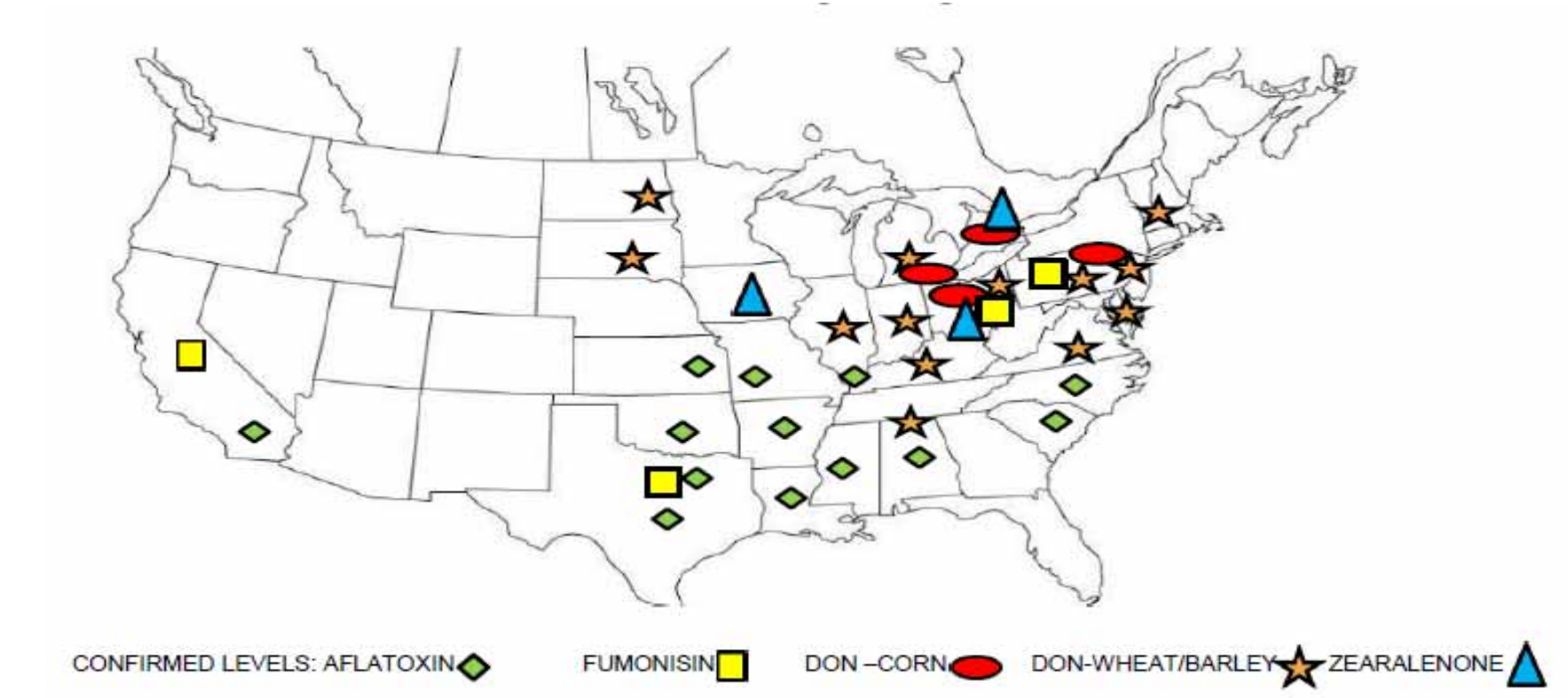
2011 Harvest Mycotoxin Map Report

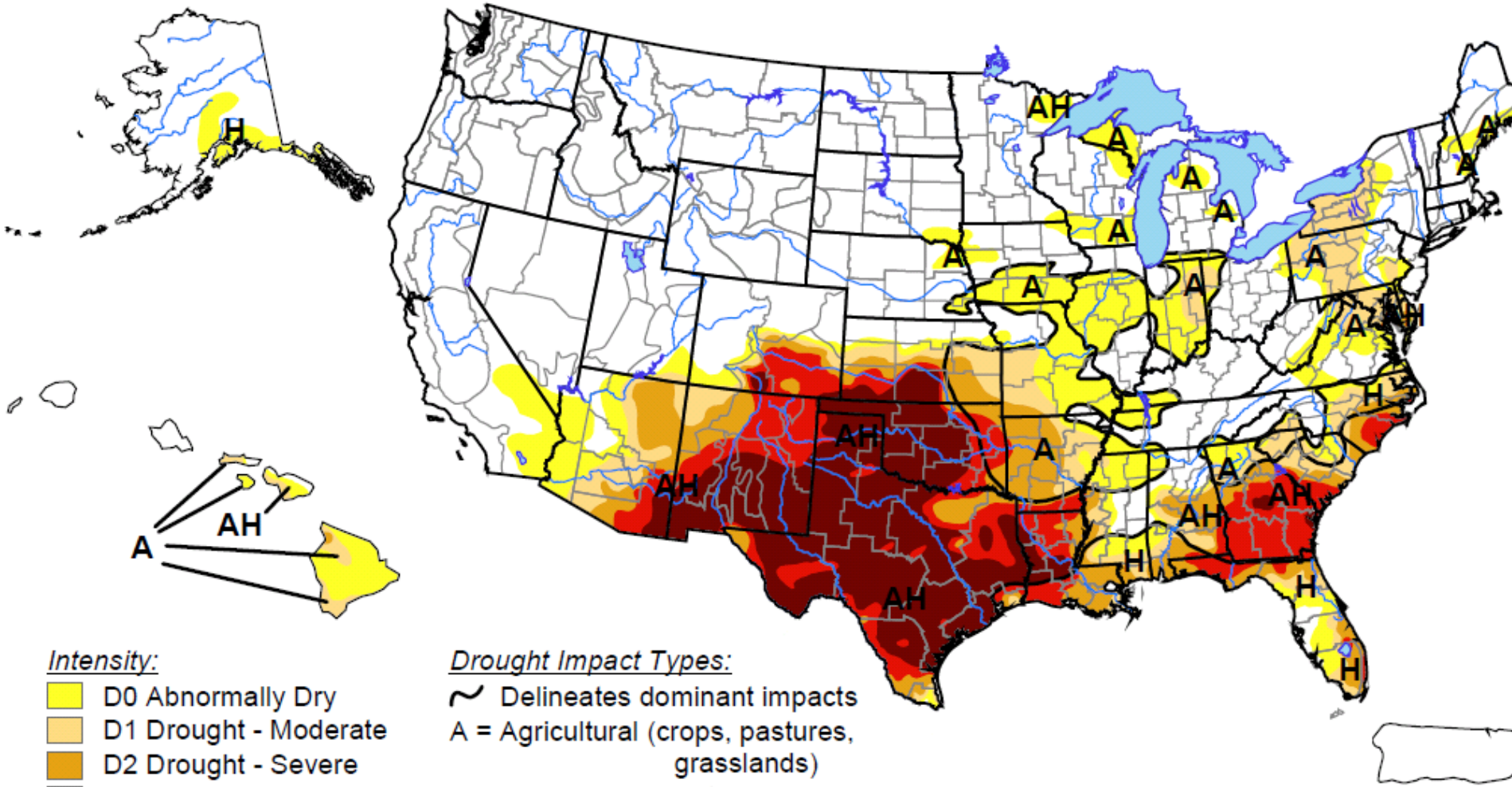


If you have questions please contact our office and speak with our staff. This report is brought to you by the Pet Food Department at Neogen. Reports are compiled from various sources and are subject to variability. For further details on the map or assistance with on-site mycotoxin monitoring please contact us at (800) 234-5333 or email us at foodsafety@neogen.Com or visit our website at www.Neogen.Com

NEOGEN CORPORATION

U.S. Drought Monitor

August 2, 2011
Valid 7 a.m. EDT



Intensity:
- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

Drought Impact Types:
- ~ Delineates dominant impacts
- A = Agricultural (crops, pastures, grasslands)
- H = Hydrological (water)

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://drought.unl.edu/dm

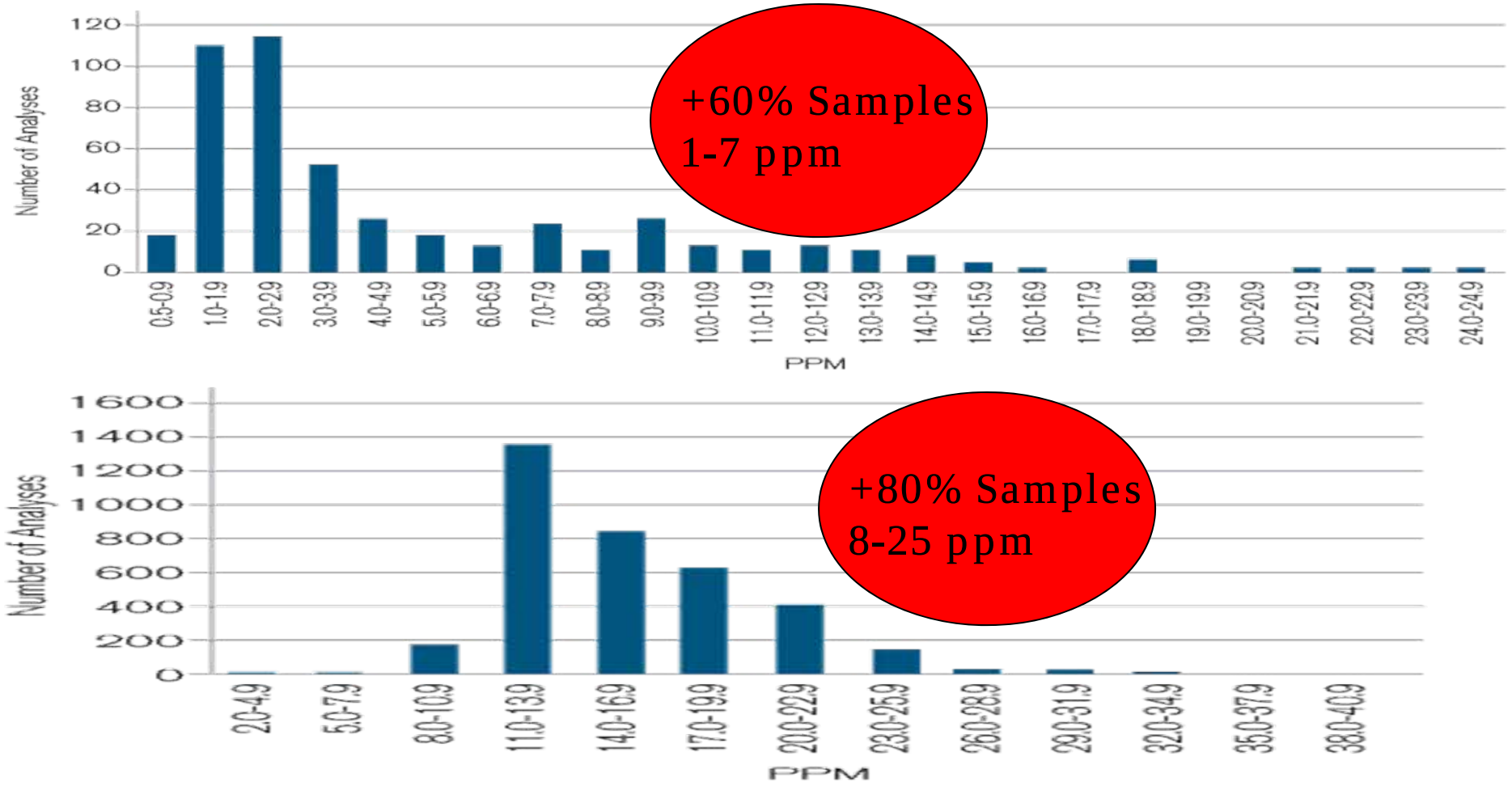
Released Thursday, August 4, 2011

Author: Brad Rippey, U.S. Department of Agriculture

2009 Growing Season "A Perfect Storm of Events"

- A wet spring delayed planting in many areas. Cool temperatures and increased rainfall throughout the corn growing regions were noted during the 2009 season.
- Due to the cool conditions crop maturation was extremely slow.
- Corn was harvested at a much higher moisture level than desired. Therefore storage conditions were harder to meet and maintain at less than 14% moisture.
- High levels of DON in corn were found in Western Pennsylvania, Ohio, Indiana and Southern Michigan. In many areas zearalenone was also present.

DON Results in 2009
Ohio/Indiana Corn



Courtesy of Trilogy Labs

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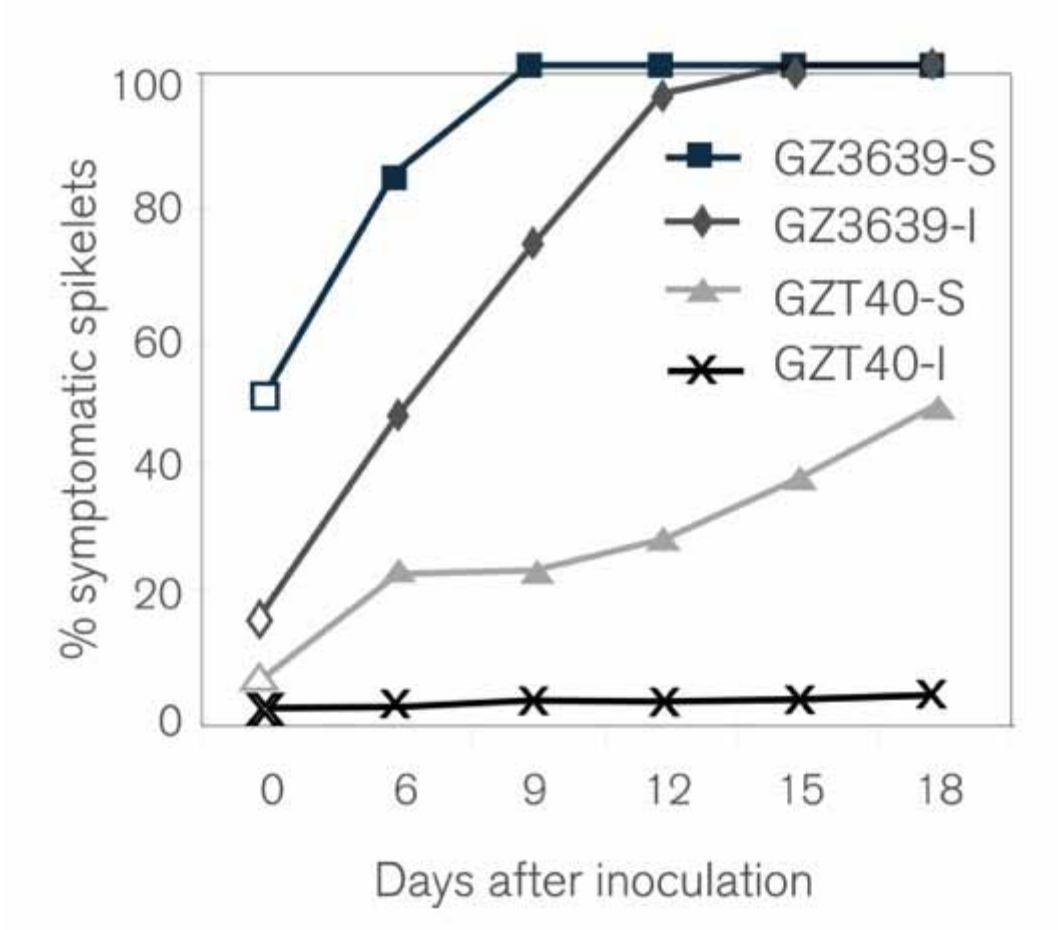
Biological Significance

- Response to stress
- Competitive advantage (ecological)
- Mechanisms for propagation



Bai et. al Mycopathologia 2001

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Environmental Factors Affecting Mold Growth

- Suitable Substrate - Feed
- pH 4 to 8, depending on mold
- Temperature 5ºC to 44ºC (40ºF to 110ºF)
- Moisture > 13%, variable requirements
- Relative humidity > 70%
- Water activity above a_w of 0.75

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Why have mycotoxin concerns increased?

- Better analytical methods




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Mycotoxin Analysis

Analytical Method

- Fully quantitative

- Semi-quantitative

- Rapid monitoring

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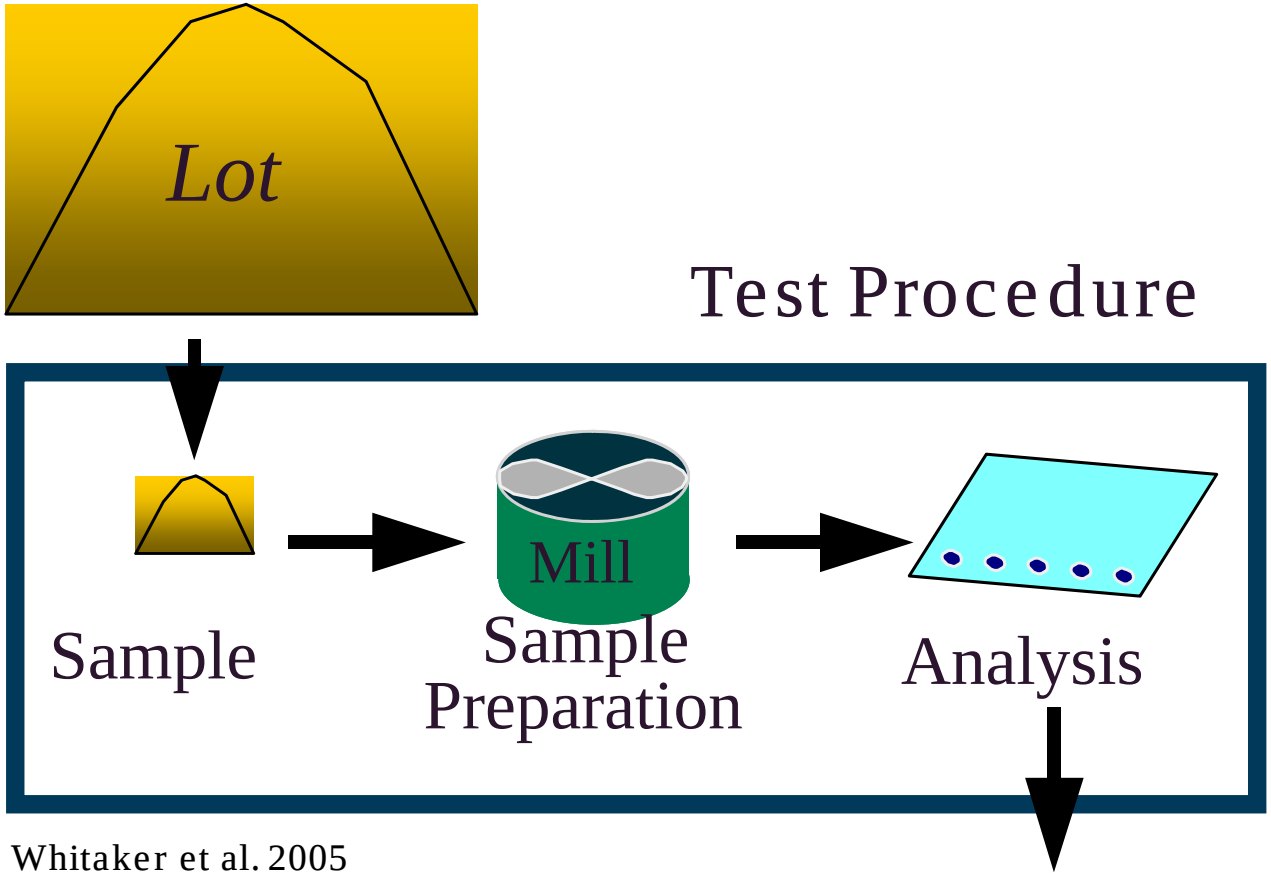
Mycotoxin Specific Sampling Protocols



Whitaker et al. 2005

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Error Associated with the Analytical Procedure

The variability measured by the variance associated with a 0.91 kg sample, 50 g subsample, measuring aflatoxin in 1 aliquot of shelled corn at 20 ppb aflatoxin

	Variance	Ratio %
Sample = 0.91 kg	268.1	75.5
Sub S^2, 50g	56.3	15.9
Immunoassay, 1 aliquot	30.4	8.6
Total	354.8	100

Sampling, sample preparation, and analysis errors account for about 75.5, 15.9, and 8.6% of the total error, respectively

Whitaker et al. 2005

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Mold and Toxin Distribution

Protein

12	13	12	14
13	13	14	12
15	11	12	12
13	14	11	9
13	12	12	13

Mean Protein Concentration 13%

(USDA)

Aflatoxin

0	0	0	0
0	0	200	0
0	0	0	0
0	**0**	0	0
0	0	0	0

Mean Aflatoxin Concentration 10ppb

(USDA)

Analytical Biases

Reference Materials

- Daily Quality Checks
- Training
- Proficiency Samples

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Sampling biases

DON – 7.0 ppm
ZONE – 0.0 ppm

DON – 0.0 ppm
ZONE – 0.0 ppm

DON – 2.1 ppm
ZONE – 4.4 ppm

DON – 263.2 ppm
ZONE – 82.8 ppm

Courtesy of Trilogy labs

DON – 1.8 ppm
ZONE – 0.3 ppm

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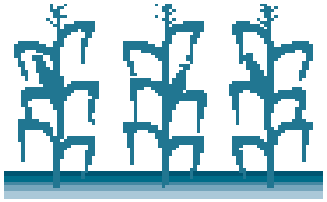
Why have mycotoxin concerns increased?

- Better analytical methods
- Understanding of their occurrence and effects
- Higher production levels (animals)
  - More general stress
  - Marginal nutrient deficiencies
  - Genetic vulnerability
  - Animal production changes
- Increased incidence in some years

Factors affecting Mycotoxin occurrence in the food chain



Biological factors

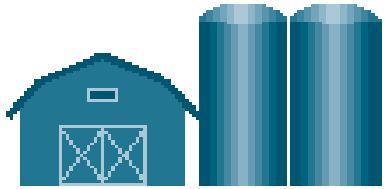
- Susceptible crop
- Compatible toxigenic fungus

Environmental factors

- Temperature
- Moisture
- Mechanical injury
- Insect/bird damage
- Fungus

Harvesting

- Crop maturity
- Temperature
- Moisture
- Detection/Diversion



Storage

- Temperature
- Moisture
- Detection/Diversion

Distribution - Processing

- Detection/Diversion

Humans

Animal products

Animals

(Pestka and Casale 1989)

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Strategies to reduce the risk of Mycotoxin Contamination

- ✓ PREVENTION OF THE MYCOTOXIN FORMATION IN THE FIELD
  - Good Hygienic Practice
  - Good Agricultural Practice
- ✓ INPROVEMENT IF THE POST-HARVEST TECHNIQUES
  - Good Storage Practice
  - Good Manufacturing Practice
- ✓ DEVELOPMENT OF CP ON ALL POINTS OF PRODUCTION AND PORCESSING
  - Capable of monitoring the health and promote safe and fare commerce
- ✓ CHEMICHAL, PHYSICAL OR BIOLOGICAL METHODS TO DETOX/DECON
  - Losses Associated with their consumption

HACCP - Hazard Analysis and Critical Control Point

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Water Activity

- Water is probably the most important factor affecting microorganisms growth
- Water activity (Aw) is the most used measure of the availability of water to microorganisms
- Aw is the ratio of the vapor pressure of the water above the substrate to that of pure water at the same temperature and pressure

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Water Activity Values Affecting the Range of Micro-Organisms Growth

1.00 Represents the Aw of pure water

0.90 Moulds responsible for fields mycotoxins production

0.60 Minimal Aw for mould growth

0.45 Minimal Aw for yeast growth

0 No water available for growth

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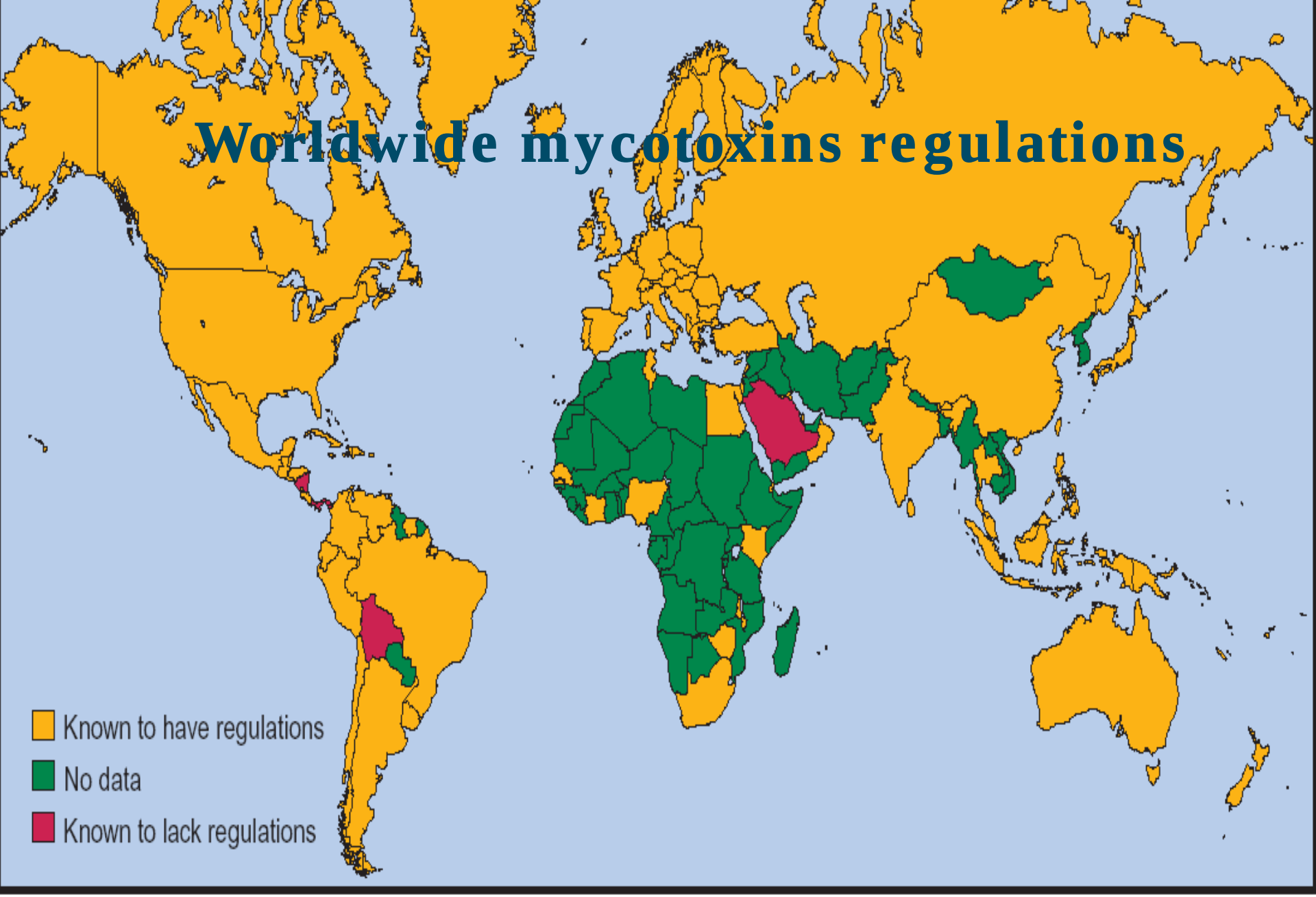
Conclusions

- The unpredictability of the environmental conditions that grains are exposed to make it difficult to predict toxin contamination from year to year
- Improper storage could greatly influence mycotoxin contamination
- Therefore any complete feed management program should always include mycotoxin analysis

Worldwide mycotoxins regulations



(FAO 2004)