Conditioning and Storing High-Moisture Grain

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Safe Grain Moisture Content (ERH = 65%)

Temperature (°F)

- Winter Storage
  - 50°F
  - 60°F
  - 70°F
  - 80°F

- Summer Storage

EMC (%)

- Corn
- Soybeans

Temperature (°C)

-1 2 4 7 10 13 16 18 21 24 27 30 33 36 39
Growth of *Aspergillus glaucus* in Corn
32°C (90°F), 15 % Moisture Content
Mycotoxins of Concern

- Deoxynivalenol (DON; Vomitoxin)
- Aflatoxin
- Fumonisins
- Ochratoxin
- Zearalenone

Gibberella zeae Ear Rot
Fusarium graminearum
S.L.A.M. Step 1: Sanitation

- Handling equipment
- Transportation vehicles
- Storage structures
  - inside and outside
- Pest prevention
  - “Sanitation is pest control!”
  - Residual protectants
S.L.A.M. Step 2: Loading

- Screening/Pre-cleaning
- Coring
  - single vs. multiple withdrawals
- Leveling
  - spreading (mechanical, gravity)
- Sealing
  - fans, leaks, cracks
Over-Filling

- Poor head space ventilation
- Spoiled grain on silo wall
- Impossible to monitor grain surface
Gravity Cleaner

Aspirated Cleaner

Pre-Cleaning

Rotary Cleaner

Grain Cleaning
Core of fines

- Foreign Material (FM)
- Broken grain
- Weed seeds
Non-uniform Airflow Effect - Peaked Grain Mass
Aeration Cooling Effect - Peaked Grain Mass

Day 7
Aeration Cooling Effect - Cored Grain Mass

Day 7
Coring

One time coring
- Eliminate grain peak
- Remove core of BCFM
- Improve airflow through center
- Better monitor grain surface

1/3-1/2 bin dia.

Grain bulk

Core
S.L.A.M. Step 3: Aeration
Cool Grain to Prevent Storage Problems

- Optimum for Insects and Spoilage
  - Grain Temperature
- Insect Reproduction Reduced
- Insects Dormant
- Insects Killed
  - Grain Temperature 35-40°F
  - 20-25°F

* Prevent crusting due to moisture migration by cooling grain to within 15°F of average outdoor temperatures.
* Cooling grain by 10°F doubles its allowable storage time.
**Aeration Phases**

- **Phase 1: Fall Cool Down**
  - Lower grain temperatures stepwise
    - October 40-45 F
    - November 35-40 F
    - December 28-35 F

- **Phase 2: Winter Maintenance**
  - Maintain temperatures with intermittent aeration
    - January, February 28-35 F

- **Phase 3: Spring Holding**
  - Keep cold grain cold
    - Seal fans
    - Ventilate headspace intermittently
Headspace Ventilation
135,000 bu Bin of Corn during Summer Storage in Indiana – Non-aerated on 7/28/89
Insect Cage Emergence - Field

- **80-85°F**: Control (Month 1), Ambient (Month 2), Chilled (Month 3)
- **70-75°F**: Control (Month 2), Ambient (Month 3), Chilled (Month 4)
- **60-65°F**: Control (Month 3), Ambient (Month 4), Chilled (Month 1)
Summer Aeration

Should cooled grain be warmed up again?

NO!
S.L.A.M. Step 4: Monitoring

- Temperature
- Moisture
- Molds
- Insects
  - present or absent
  - population growth
  - pest control (fumigation)
- Rodents
Use of handheld CO$_2$ sensor (Outdoor pile)

Handheld CO$_2$ sensor
Telaire 7001  ~$400
www.telaire.com
The Andersons, Delphi - Tank 54 (Semi-wet 17.5% MC)
Total CO2 (kg)

- 53.7 kg (May 28)
- 178.2 kg (June 09)
- 283.5 kg (June 24)

**Early Detection!**

- April 17
- April 24
- 53.7 kg (May 28)
- 178.2 kg (June 09)
- 283.5 kg (June 24)
Spoilage in Tank 54
Detection of increased CO\textsubscript{2} concentrations from self-heating corn by a CO2 sensor installed in the headspace of a bin (150,000 BU) located near St. Mary, Kansas during Fall 2009 and Winter 2010.
Pitfall Probe Traps
Granary Weevil

Rice Weevil

Internal Feeders

Angoumois Grain Moth

Lesser Grain Borer
Stored Grain Management

Implications

- Store grain at safe moisture content
- Core & level grain after loading bins
- Cool grain then seal fans
- Manage headspace conditions with intermittent ventilation
- Monitor grain regularly for insect activity and mold development
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