

Post-Harvest Grain Quality

Delivering Biosecure Grains for Maximum Profit

STORED GRAIN MANAGEMENT IN A CHALLENGING NEW CROPPING YEAR

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Presentation Outline

- Working through harvest, Drying and storage
- Drying frost-damaged corn and soybeans
- Proactive stored grain management
- What should I do (WSID)?

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2019 Harvest Update

- US corn harvest is 92% complete and soybean is 96% complete.
- Indiana corn is 96% complete; last year was 100% and 5-year average is 99%
- Indiana soybean is 96% complete; last year was 100% and 5-year average is 100%

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Some Challenges This Year

- Wetter corn and soybean than average
- Corn with less test weight, more breakage
- Immature and frost damaged beans
- Dryer couldn't keep up with wet grain
- Lack of fuel (propane and NG) to dry
- Late harvest and colder temperatures resulting in more energy needed to warm cold air for drying.

Prepare for Late Season Harvest

- **Prepare drying equipment early.**
 - Contact service technician
 - Clean out equipment
 - Purchase enough fuel
- **Plan to harvest early and dry**, rather than leave on the field to dry-down. Don't count on the weather.
- **Handle trash.** Crop will most likely have more trash than normal, so plan to clean out dryer frequently during operation.
- **Dry sufficiently to a safe moisture content** depending on marketing plans.
- **Cool down adequately after drying** to prevent early on-set of heating and subsequent spoilage.

Some important things to note about stored grain management

- Because seasonal patterns of weather could change, it's best to be conservative on moisture. Storing lower moisture grain is better than storing grain on the margins of safe moisture.
- Invest in monitoring technologies and understand what your data means.
- Check your stored grain frequently, especially when it gets warm.
- Should you smell deteriorating grain around your storage bins, investigate to determine active spoilage. Remove spoiled grain from the bin if possible. Turn on aeration fans to slow down spoilage.
- Practice safe bin entry procedures. #1. Never work alone in a bin.
- For grain not dried sufficiently in the fall, cool as soon as possible and dry when weather becomes favorable.

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How much should I dry my grain?

Source: MWPS 13, Grain Drying, Storage and Handling Handbook, Third Edition

	Maximum moisture content, %wb			
		Storage Period		
Grain Type	At Harvest	Up to 6 months	6-12 months	> 1 year
Shelled corn & sorghum	30	15	13	13
Soybeans	18	13	12	11
Wheat, barley oats	20	14	13	12

Grain Moisture Indicator Issues

Check your moisture meter calibration with your grain elevator

- Check calibrations of your field moisture meters with calibrated elevator moisture meters
- Warm up cold grain or cool-down hot grain to room temperature before taking moisture reading.
- If bias occurs in instrument , fix as per manufacturers instructions



Dickey-john GAC-2500



Pertten AM 5200

Drying System Categories

- Low Temperature
 - Natural air or air heated by up to 5-15°F (+3-8°C)
 - In-bin (or in-storage)
- Medium Temperature
 - kernel temps *below 110°F* (43°C) for seed and food grains, and *below 140°F* (60°C) for all others (incl. #2 yellow corn, waxy, HOC)
 - In-bin or column
- High Temperature
 - kernel temps above 140°F (60°C)
 - In-bin or column
- Combination
 - Med temp plus dryeration or in-bin cooling
 - Med-low temp 2-stage drying

Grain Type – End Use – Maximum Kernel Temperature

CORN	Dry Milling & Seed	100-110° F	38-43° C
	Wet Milling	130-140° F	54-60° C
	Feed Use	160-180° F	71-82° C
WHEAT	Seed (> 24%)	110° F	43° C
	Seed (< 24%)	120° F	49° C
	Flour	120-170° F	49-77° C
SOYBEANS	Seed	100° F	38° C
	Oil Crushing	120° F	49° C
SUNFLOWER	Food	140-170° F	60-77° C
	Oil Crushing	170-195° F	77-91° C
RICE	Milling (>20%)	105° F	41° C
	Milling (<20%)	110° F	43° C
BARLEY	Malting	105-120° F	41-49° C
	Feed	165-185° F	74-85° C
EDIBLE BEANS	Food Use	100° F	38° C

Drying Frost-Damaged Corn and Soybeans

- Frost damage is a possibility for late harvest corn and soybeans
- Options on harvesting, drying and storage of frost-damaged corn and soybeans depends on developmental stage.
- Frost damage will impact crop as follows:
 - Reduced yields
 - Increased dockage due to lower test weight or undesirable color
 - Reduced harvest efficiency
 - Wetter grain than normal
 - Increased drying cost



How to dry frost-damaged corn

- Expect slower field moisture dry-down rates late in the fall
- Keep air temperatures below 120-140°F range using medium and low temperature drying systems
- Keep air temperatures below 140-160°F in column dryers
- Grain can be transferred hot and cooled in a bin or dried and cooled in a column dryer
- Dry corn to 14% or below and plan for short storage period
- Because of reduced drying capacities, corn may be in wet holding bins longer, Watch out to make sure blue-eye mold doesn't develop.
- Preferably screen corn to remove fines and core center during binning to ensure good airflow at the center

How to dry frost-damaged soybean

- Late fall harvest, wet and cool conditions may result harvesting soybeans at 16-20% moisture.
- Note that too much heat while drying soybeans causes excessive seed coat cracking.
- The key factor to avoid seed splits is to keep the relative humidity (RH) of the drying air above 40%; this limits heat input and drying capacity.
- For example, 50°F outside air temperature at 80% RH can only be heated to 70°F in order to maintain humidity above 40%.
- If using column or bin dryers, restrict heat input by using short heat-on cycles or changing the burner jets to fire low. Reduce temperature rise of air by reducing the total burner firing ON/OFF cycle (no more than half an hour exposure at a time).
- If splits are not of concern, limit drying air temperatures to 120-140°F.
- It's better to dry frost damaged soybeans to 11-12%

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Basic Concepts of Stored Grain Management

- Grain is a biologically active material and therefore it will deteriorate in storage under favorable conditions
- Stored grain quality cannot be improved but maintained.
- Therefore, knowing the history and initial grain quality is an important first step in managing grain in storage

Grain Quality after Storage = $F(\text{Quality}_{T_s}, \text{Mgt}, ?)$
How can we accurately predict this?

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Your Investment in Storage

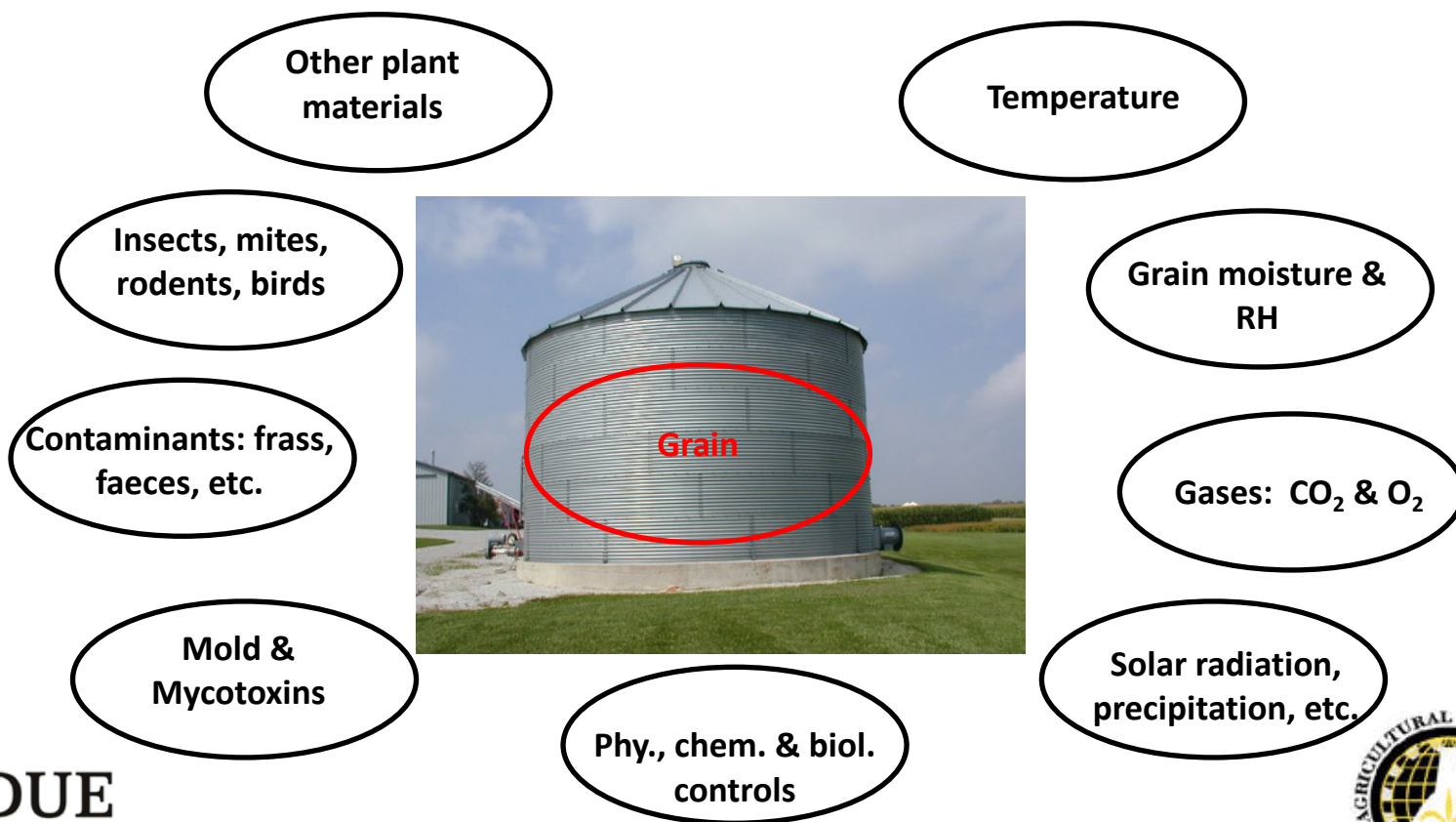


Maintaining Quality is Job # 1 in Stored Grain Management

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The Stored Grain Ecosystem

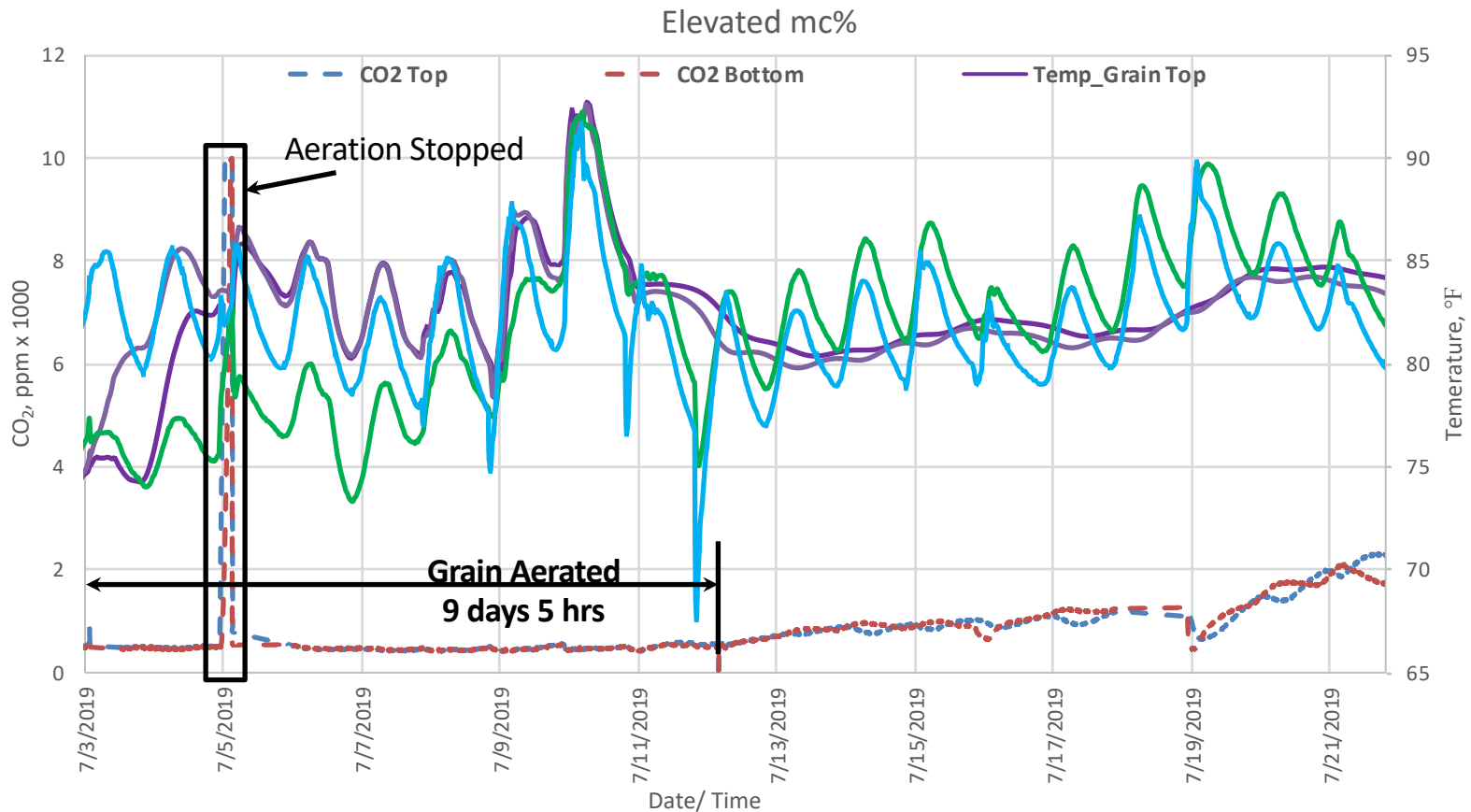


Storage Life of Grain

Maximum storage time (months) for corn and soybean*							
Corn temperature ° F	Moisture Content Corn (top %), Soybean (bottom%)						
	13%, 11%	14%, 12%	15%, 13%	16%, 14%	17%, 15%	18%, 16%	24% N/A
40	150	61	29.0	15.0	9.4	6.1	1.3
50	84	34	16.0	8.9	5.3	3.4	0.5
60	47	19	9.2	5.0	3.0	1.9	0.3
70	26	11	5.2	2.8	1.7	1.1	0.2
80	15	6	2.9	1.6	0.9	0.9	0.06
*Based on 0.5% maximum dry matter loss—calculated on the basis of USDA research at Iowa State University. Corresponds to one grade number loss; 2-3% points in damaged seeds. Soybean approximated at 2% lower moisture than corn.							

Source: <http://www.extension.iastate.edu/CropNews/2009/1015hurburghelmore.htm>

Impact of aeration on grain spoilage (24.6 -> 12.6%)



Always aerate a wet bin to slow down spoilage !

S.L.A.M.

Sanitation

The concept of SLAM for stored grain systems was developed in the 1990s by Purdue University Extension

Engineer and Specialists: **Dr. Dirk Maier** (Agricultural

Loading

Engineer), **Dr. Linda Mason** (Stored-Product

Entomologist) and **Dr. Charles Woloshuk** (Stored-Product Pathologist).

Aeration

Acknowledgements:

Thanks to Dr. Linda Mason, Purdue Entomology

Monitoring

Department and Dr. Dirk Maier, Department Head at

Kansas State University Grain Science Program and Mr.

Dave Crompton, Integris USA, LLC. for providing the contents of this presentation.



Sanitation

Think Insect Clean!



Pest Prevention



Empty Bin Treatment



**Tempo & Malathion are products
certified for use**

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Loading

Eliminate the potential for loading by:

- Cleaning grain to remove fines and foreign material
- Drying grain gently by using appropriate drying techniques to prevent stress cracks
- Handling gently using appropriate grain conveying devices

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Pre-Cleaning



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Cushion Boxes and Flow Retarders



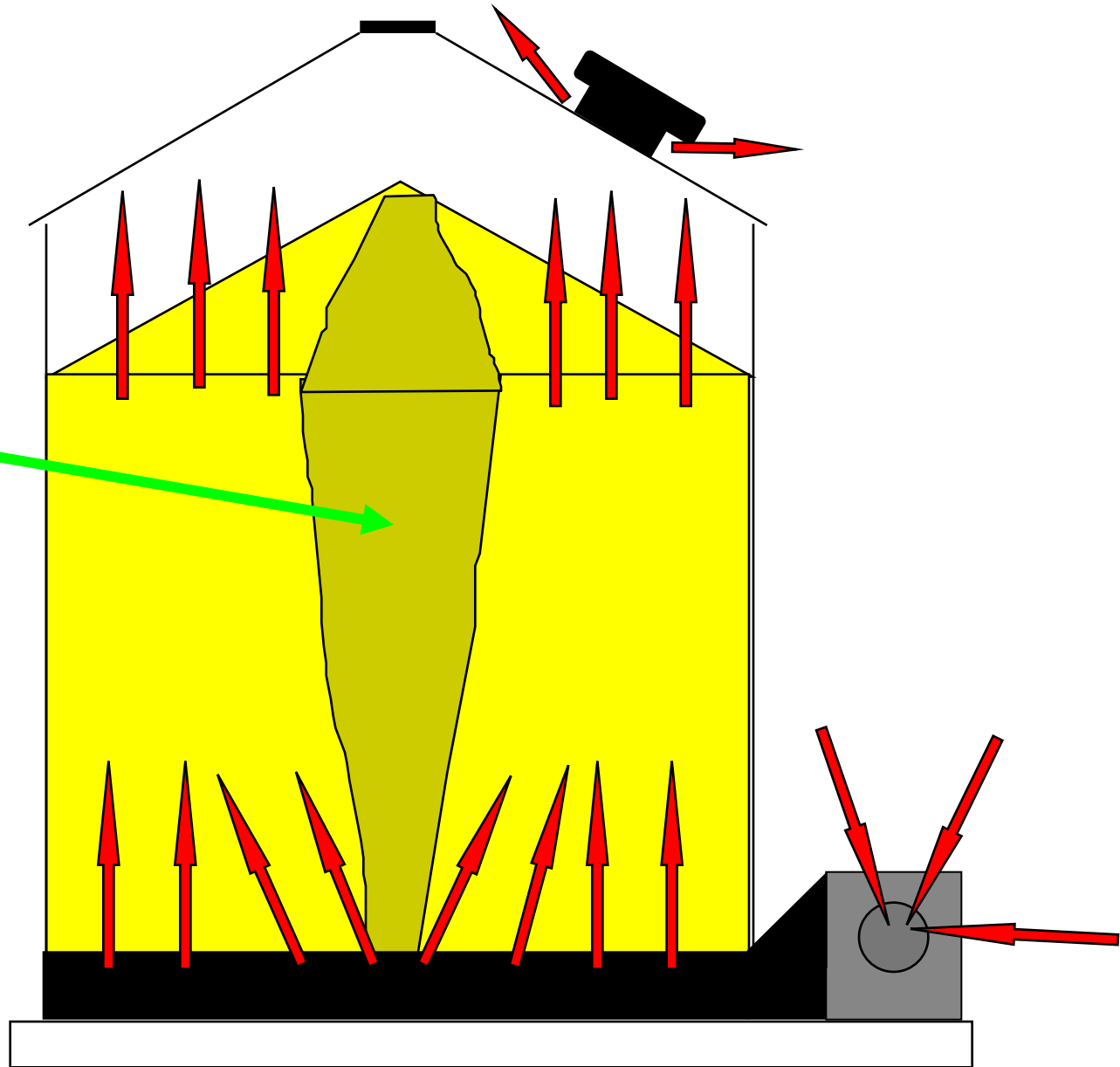
PURDUE
UNIVERSITY

Bin Entrapment Rescue in Spring 2005



What do you think was the cause of this event?

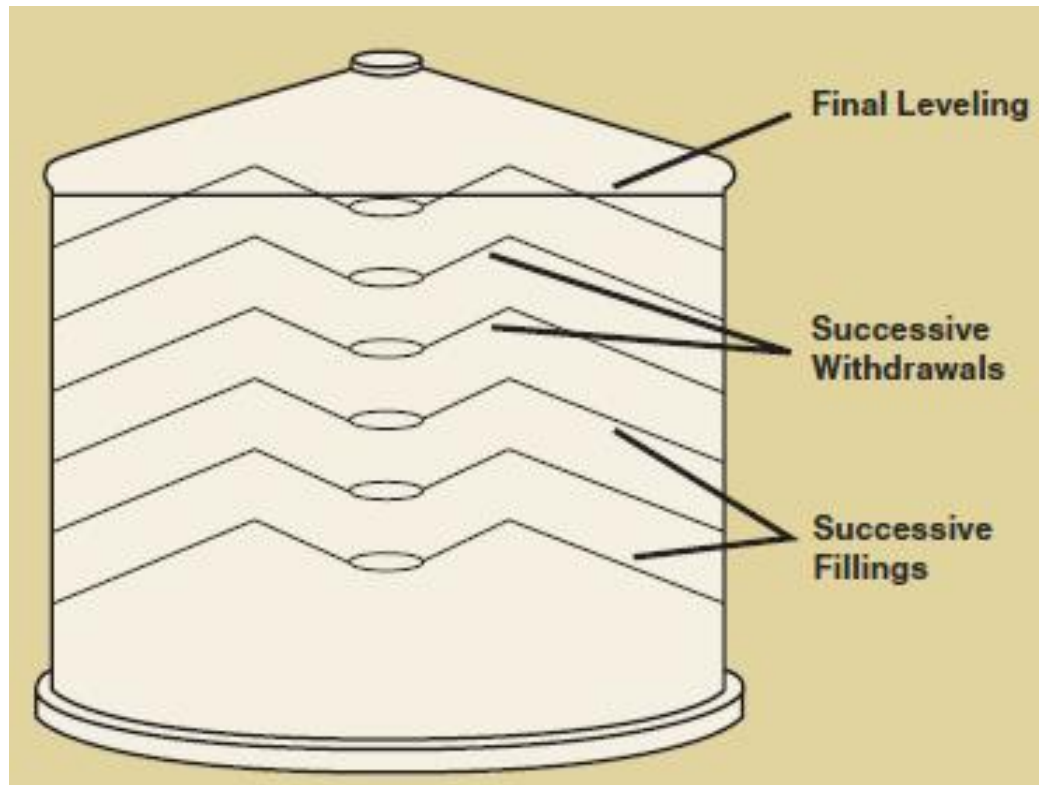
- Core of fines
 - Foreign Material (FM)
 - Broken grain & fines
 - Weed seeds



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Advisable to create core in stored grain , which facilitates airflow and makes aeration more efficient.



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Grain Spreaders

Product Details:

- Will handle up to a 6" Auger.
- 2500 Bushel per Hour Capacity.
- Funnel Type Cone Spreader for bins up to 26'.
- All Galvanized Construction.
- No Moving Parts, No Motor

Source: <https://www.sloanex.com/>



Product Details

- 3600 Bushel per hours capacity
- Will work with up to an 8" auger
- Rotary type cone spreader for up to 30' bins
- Gavlanized construction
- No Motor Required

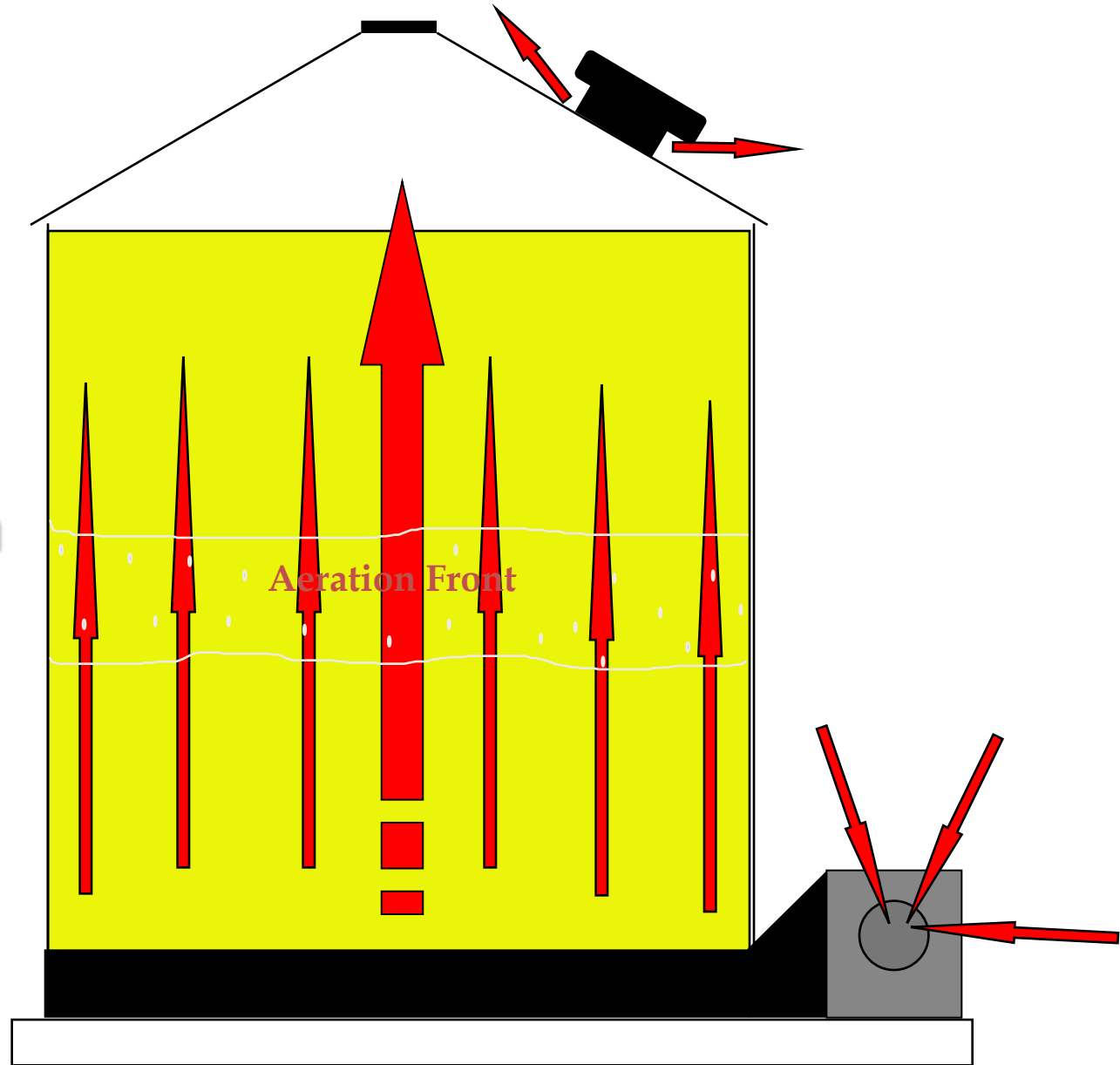
Source: <https://www.sloanex.com/>



Aerate – to slow down bio-activity



Move
Aeration
Front through
grain mass
as quickly as
possible!
Airflow of 1
cfm/bu is
advisable



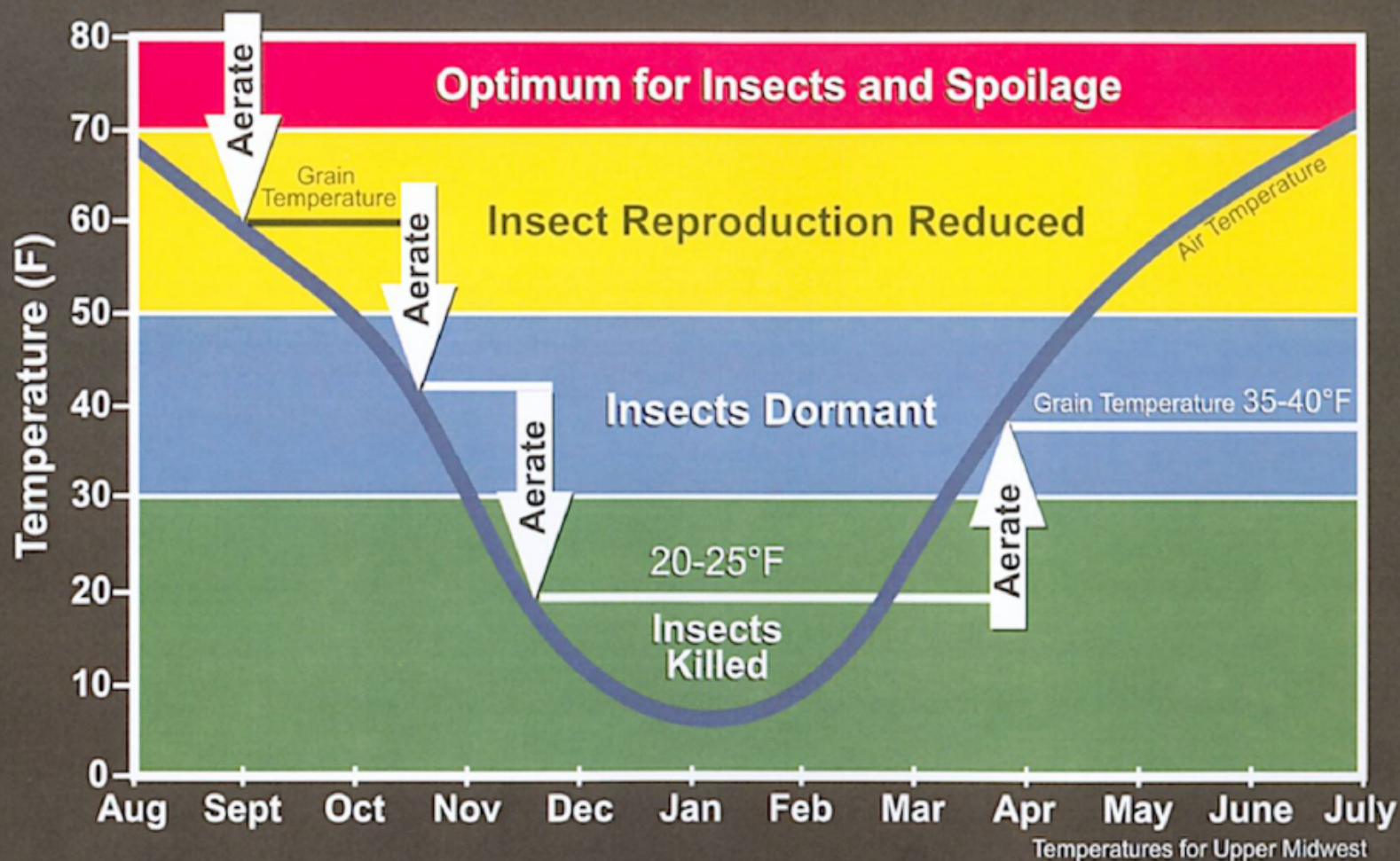
Cooling grain by aeration

Temperature Influence on Insects

Fields, 1992

Temperature (°F)	Effect
122+	Death in minutes
95+	Development stops
77-90	Optimum
66-77	Sub-optimum
41-60	Death in days
0	Death in minutes

Cool Grain to Prevent Storage Problems



* 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

Dr. Kenneth J. Hellevang, F
NDSU Extension Service

Source: Dr. Kenneth Hellevang, North Dakota State University

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 low temperatures with intermittent aeration: January, February- 28-35°F

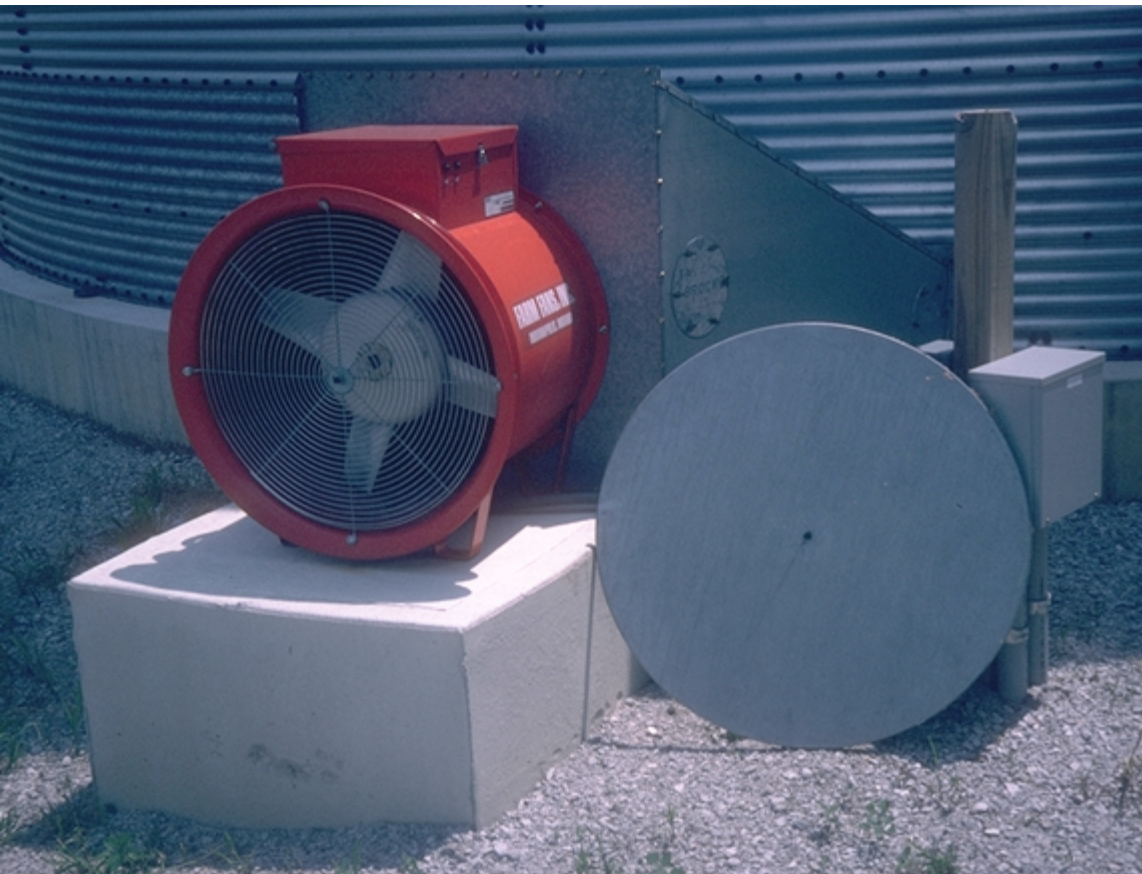
- **Phase 3: Spring Holding**

- Keep grain cold from winter aeration
 - Seal fans
 - Ventilate only headspace intermittently

**No Summer
Aeration to
warm-up grain
to control
bioactivity!**

**Warm-up grain
prior to delivery if
cooler than
ambient to
prevent
condensation!**

Source: Dr. Dirk Maier, Kansas State University

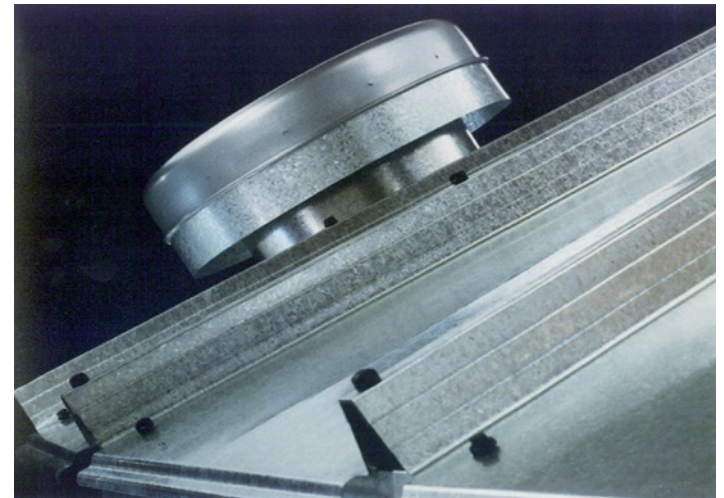
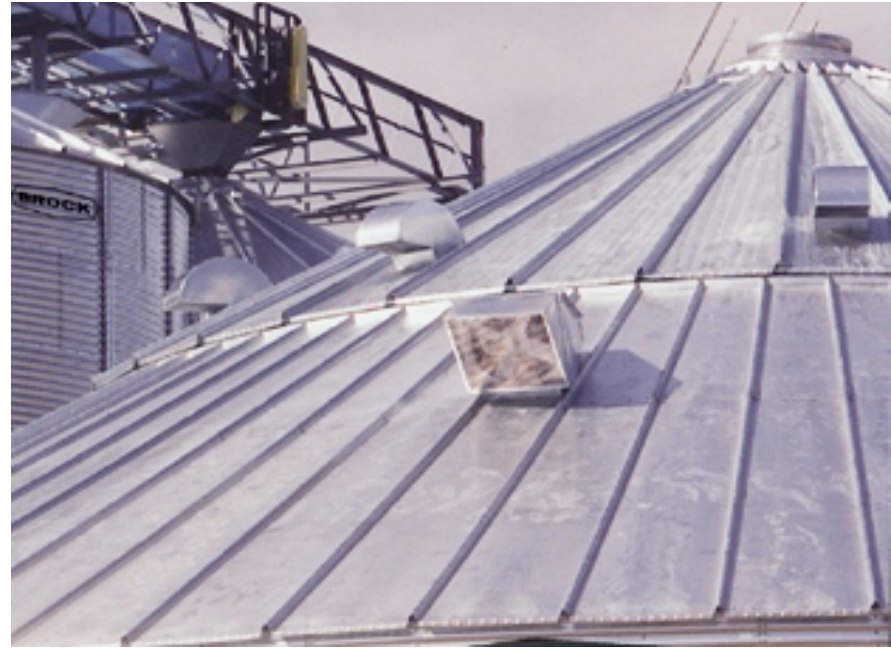


Open Fan

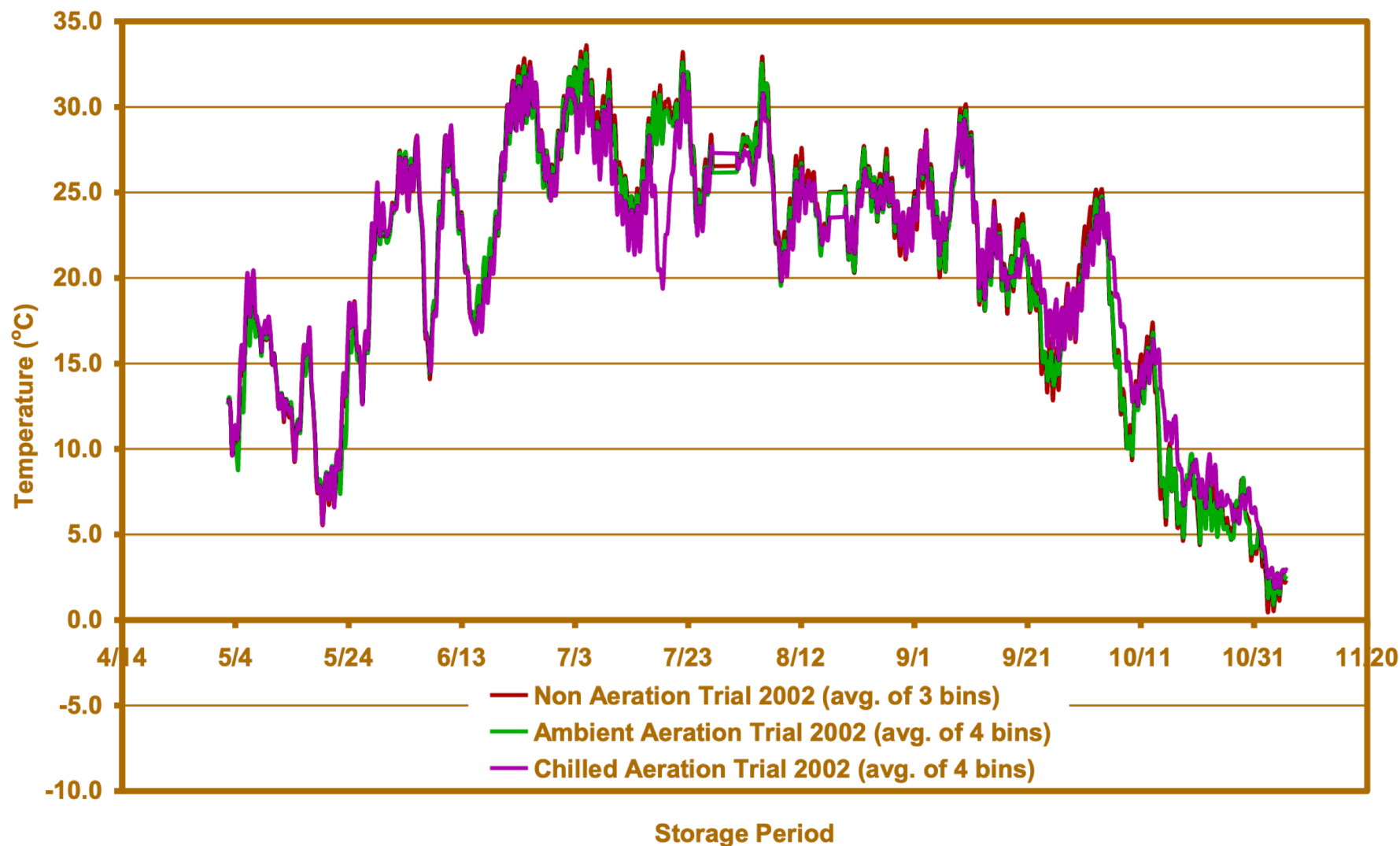


Sealed Fan

Headspace Ventilation



Headspace Temperature - 2002



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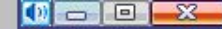
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Monitoring:

You can't manage what you
don't know is there



1 Alarm(s)

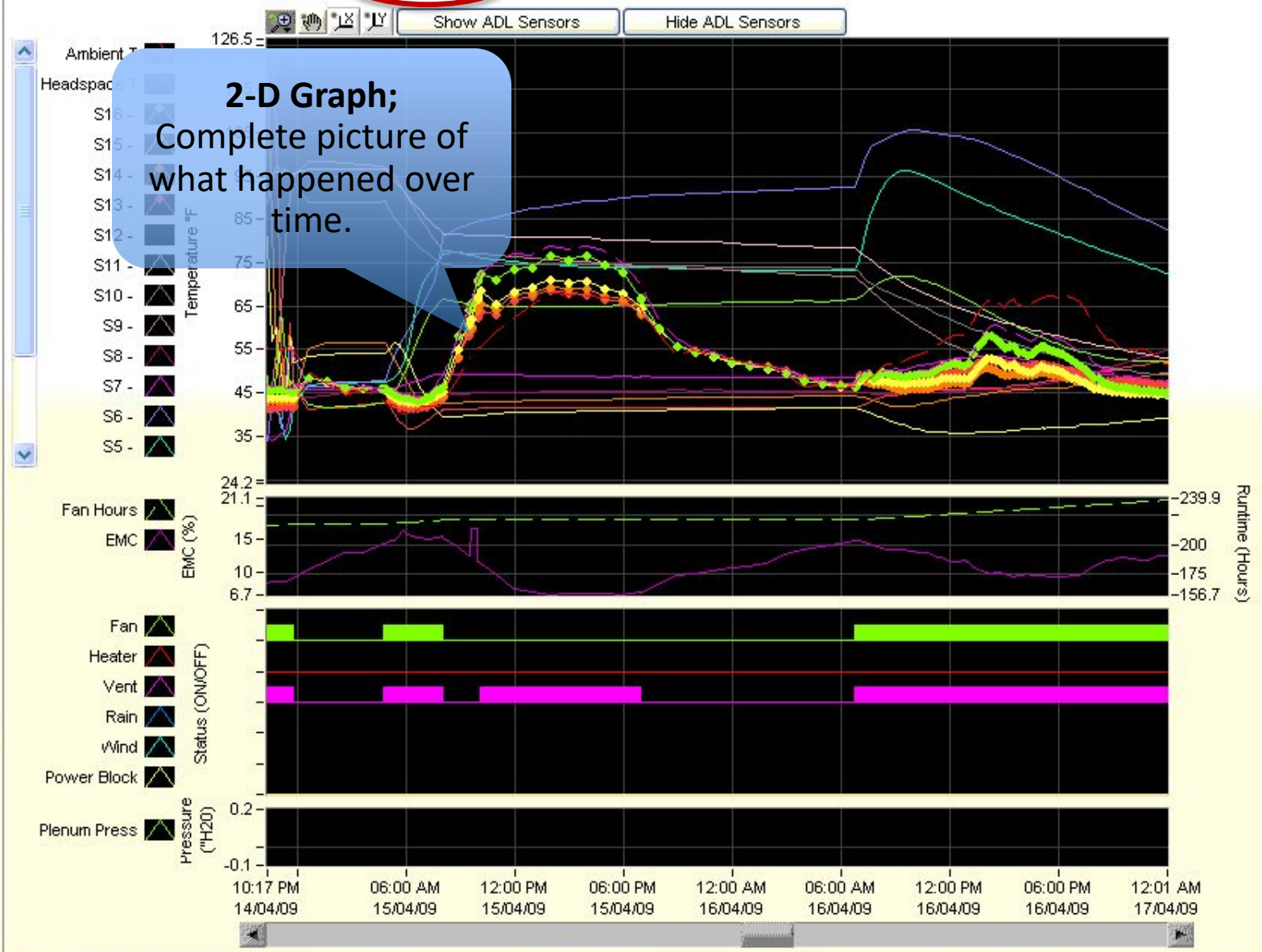
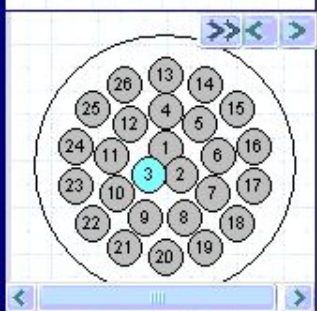
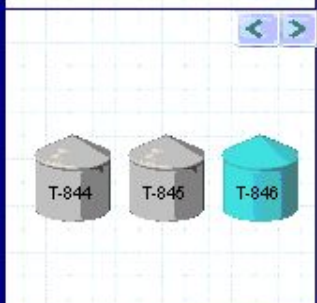
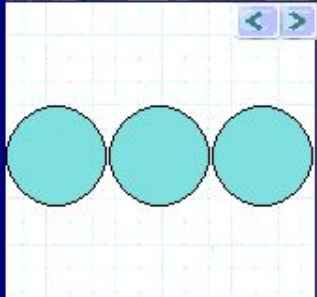


integrus^{PRO}

Site Navigation Structure View Level **2-D Graph** Table Alarms Configuration

5/1/2009 12:00:20 PM

Temperature Data Fan Control Summary **Fan Control Cables** Time Selection: 5.0 Week(s); Fill Date: 11/12/2008 2:35 PM; Display Fan Hours: 21.8



**Monitor
temperature with
temperature cables**



**It takes a while to
detect deterioration
and hot spots using
temperature cables
alone**

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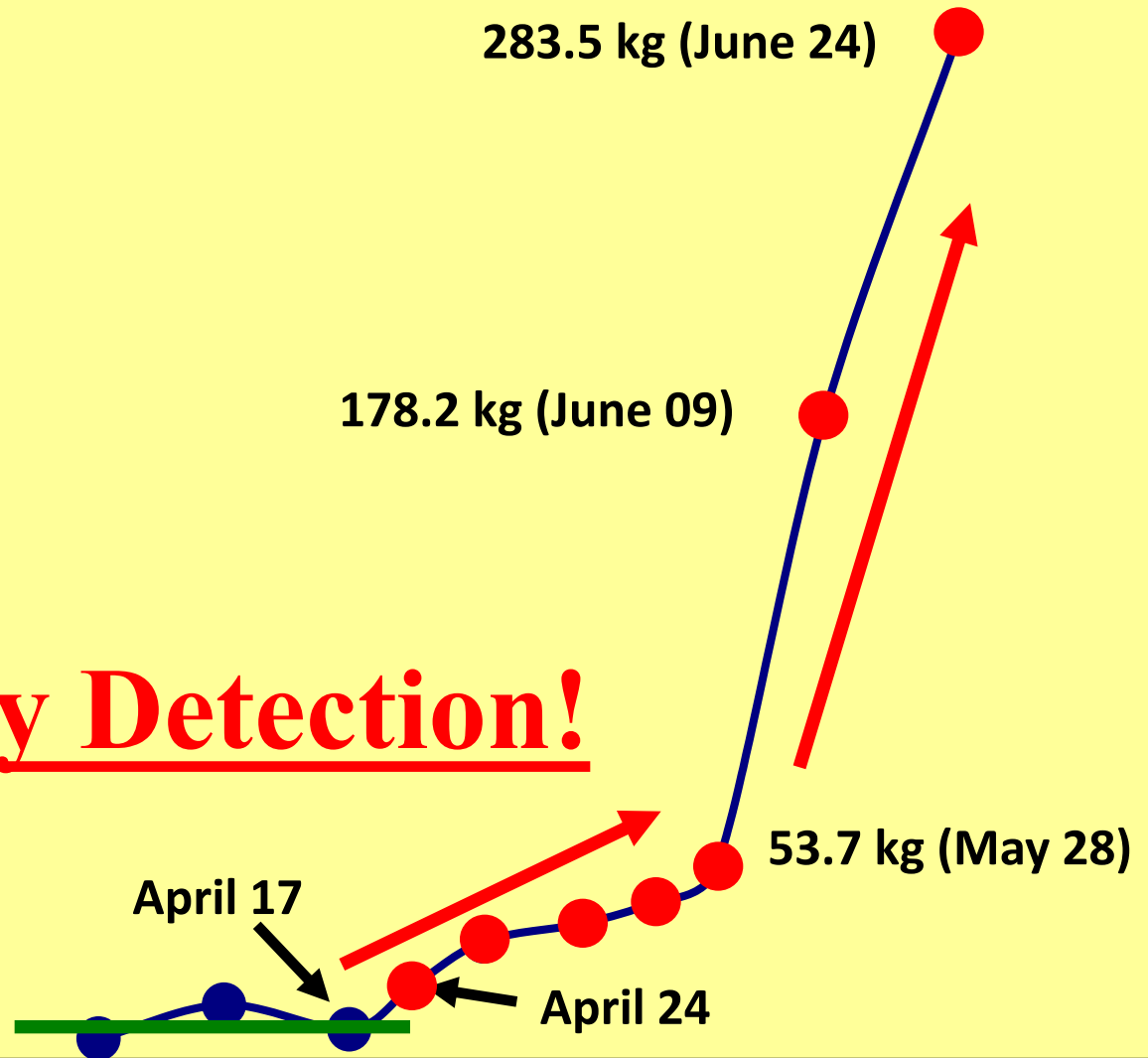
CO₂ Monitors – Early Spoilage Detection



The Andersons, Delphi - Tank 54 (Semi-wet 17.5% MC)
Total CO2 (kg)

Total CO2 (kg)

Early Detection!



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Post-Harvest Management

- Monitor stored grain bin throughout the storage season.
- Increase frequency of monitoring if warm spell passes through.
- Once grain has been cooled to below 30°F in the winter, aerate grain bulk only when grain is suspect to be undergoing deterioration.
- Don't warm up grain in the spring after winter aeration.

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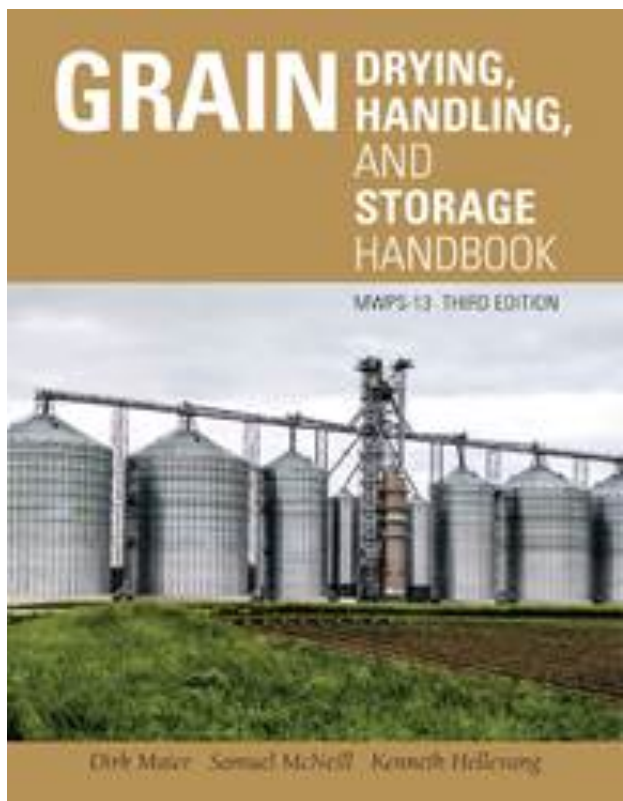
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What Should I Do (WSID)?

- I discover that grain at the surface has begun to sprout.
- I find a load of severely out of condition grain; load in the bin with good grain and aerate?
- Of 200,000 bu corn, I have 150,000 bu dried to 15% and the rest 50,000 bu still wet at 20%.
- I'm alone unloading my bin and the auger stops because of a potential blockage.

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New – Revised Grain Drying, Handling and Storage Handbook, MWPS-13

This handbook was developed to assist farmers, elevator managers, equipment dealers, students, and others interested in developing grain systems.

The price for this new edition is \$74 + shipping. Save 10% if you place an order on-line by July 26, 2017. <https://www-mwps.sws.iastate.edu/catalog/grain-handling-storage/grain-drying-handling-and-storage-handbook>

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Resources

Some Extension websites from U.S. Land-Grant Universities:

- <http://extension.entm.purdue.edu/grainlab/>
- <http://www.extension.iastate.edu/Grain/>
- <http://www.oardc.ohio-state.edu/nc213/>
- <http://uarpp.uark.edu/personnel.htm>
- <http://entopl.okstate.edu/sprec/index.htm>

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Thank You!
Questions?



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<https://extension.entm.purdue.edu/grainlab/index.php?page=home.php>