Post Harvest Grain Storage Management

- Grain storage problems can start with harvest and occur due to poor grain quality and poor storage practices. If grain storage is not managed correctly, a severe quality reduction and financial loss can occur.
- Lack of grain temperature management is the main cause of grain spoilage.
- Stored grain should be checked routinely for changes in surface conditions, temperature, grain condition, insects, and smells.
- Safety precautions and emergency plans should be in place before handling grain or entering any grain storage bin.

Causes of Storage Problems

First and foremost, grain should be dried to the proper moisture content before storage to help avoid grain quality issues. The recommended moisture contents for corn and soybean at various storage periods are shown in Table 1. Corn stored at 19% moisture content and a starting temperature of 75 °F can lose a market grade in approximately five days if the aeriation in the storage facility is not working and the temperature of the grain increases.[2]

Table 1. Maximum percent moisture content for safe corn and soybean grain storage.[1]

Grain and storage time	Maximum moisture content for safe storage
Shelled Corn:	
Sold by Spring	15.5%
Stored 6-12 months	14%
Stored > 1 year	13%
Soybeans:	
Sold by spring	14%
Stored up to 1 year	12%
Stored > 1 year	11%

Moisture percentages for good quality grain. Reduce 1% for poor quality grain (drought, disease, frost, harvest damage, etc.) [1]McKenzie, B. and Van Fossen, L. 1995. Managing dry grain in storage. Midwest Plan Service. AED-20. Purdue University.

Other causes of grain quality issues during storage involve storage management, and include:

- Inadequate grain cooling and aeration.
- Improper grain checks.
- Poor initial grain quality.
- Improper insect control.[1]

Grain Cooling and Aeration

If the grain has dried to the proper moisture content, improper temperature management is the primary reason for spoilage. When the grain temperature in the bin does not remain consistent, moisture in the bin can migrate and accumulate in areas and result in grain spoilage. Spoilage from moisture migration can occur whenever temperatures vary in the bin, but it is more common when the grain is stored warm and outside temperatures are cold. Without proper temperature management, the well-insulated grain and surrounding air inside the bin can retain the initial storage temperature (50 to 80 °F) and consequently lead to large discrepancies between the outside temperature and the temperature of the stored grain. Regardless of the time of year, grain should be maintained within 15 to 20 °F of the average monthly temperature.

Post Harvest Grain Storage Management

Aeration is used to control grain temperature by moving air through the grain. In general, aeration should not be used to dry grain even if using it may cause the moisture content of the stored grain to change slightly. Aeration is used to cool grain in the fall or to help warm it in the spring. Cooling grain in 10 to 30 °F increments for winter storage should reduce the likelihood of mold growth and insect reproduction.

The cooling or warming zone, the area of the grain that changes temperature, follows the aeration through the bin. One cooling/warming cycle is the amount of time needed to move a cooling/warming zone completely through the bin. Once a cycle has begun, the fan should operate continuously until the zone moves completely through the bin.

On-farm storage systems may be equipped to move air between 1/10 cfm (cubic feet of air per minute)/bu to over 1 cfm/bu (0.003 cubic meter of air per minute to over 0.03 cmm/bu). The rate depends on the bin type, air distribution system, desired storage moisture percentage, and proper management procedures. The time it takes to complete a full cycle depends on the aeration rate and time of year, and can be calculated with following formulas by season:

- Fall hours = 15/(air movement rate cfm/bu)
- Winter hours = 20 /(air movement rate cfm/bu)
- Spring hours = 12/(air movement rate cfm/bu)

Grain Checks and Observations

Taking multiple grain samples when filling the bin and during storage can help account for variable moistures throughout the bin and reduces the risk of storage molds. Use the highest moisture content value to determine management options that can further reduce the risk for storage molds, hot spots, and spoilage. Averaging sample values may not adequately address pockets of grain with higher moisture content.

When temperatures are quickly changing in the fall and spring, stored grain should be checked weekly. Checks can be reduced to every two or three weeks when temperatures are more consistent and lower throughout the winter.

Keep an eye on the surface conditions, temperatures, and grain condition, and be mindful of different smells both in the grain and exhaust air. Grain that is crusting, wet, slimy, icy or frosty, or warming could be spoiling. Condensation or frost on the underside of the roof, hatches, and vents on a cold day almost always indicate a moisture migration problem. If crusting occurs, stir the surface to break up the crust or, if severe, remove the spoiled grain.

Once the grain is cooled, continue checking exhaust air for smells to help identify grain that could be spoiling. Regardless of the season or weather, if signs of heating or hot spots are detected, run the fan continuously until no further issues can be detected. If hot spots can't be remedied with aeration, grain may have to be removed, cleaned, dried, or even sold. It may be better to sell at a lower price than to allow an entire bin to go out of condition.

Post Harvest Grain Storage Management

Managing Stored Grain During Fluctuating Temperatures in the late Fall and Winter

Be aware of the major daily temperature fluctuations in your area. Cool (30 °F), moist mornings are typical during the fall and winter, and temperatures can rise throughout the day into the 50's, 60's or even 70's °F. Parts of the country experience these temperature fluctuations on a regular basis. Continuously running fans during this type of temperature variation can lead to over drying or rewetting the grain due to the fluctuations in temperature and dewpoint.

A controlled and automated grain management system constantly measures and assesses these conditions, and only pushes air through the bin when the air is the appropriate humidity. Trying to do this manually is a very difficult task. As a result, you may notice your automated system running for a few hours in the morning and again in the late afternoon. This avoids the over-drying and rewetting that would occur if the fans were running all day.

Another important thing to consider is that automated systems can also cool grain. Some growers may have their grain come in at optimal moisture but will still need to cool it in order to increase its storage life. The warm and dry air available at certain times of the day may not accomplish this, but an automated system can run cool air through the bin when it is available to cool the grain to the desired temperature and maintain moisture content.

Insect Control

Insect infestations can arise from residue in combines, handling equipment, and old grain left in storage.[2] In addition to all the other management precautions, the grain should be observed for signs of insect activity. Some preventive measures that may help include:

- Clean debris from harvesting, handling, and drying equipment, and from the inside and outside bins before putting in new grain.
- Repair any areas in the bin that may cause leakage.
- Apply an approved insecticide to the surfaces of clean, empty bins before filling.
- New grain should NOT be put on top of old grain. Just a few insects in the old grain can infest the entire bin.
- If insects had infested the previously stored crop, fumigate the empty bin to kill insects under the floor and in the aeriation ducts.

Safety

The dangers of grain handling cannot be stressed heavily enough. NEVER enter a bin when the grain is flowing and be extremely cautious around all grain handling structures and equipment. Be sure to have safety precautions and emergency plans in place and make them known to all workers and bystanders on the farm.

Post Harvest Grain Storage Management

Sources:

[1]McKenzie, B. and Van Fossen, L. 1995, Managing dry grain in storage. Midwest Plan Service. AED-20. Purdue University. https://www.extension.purdue.edu/extmedia/aed/aed-20.html

[2] Dorn, T. 2010. Ensure quality grain storage by starting with clean equipment, bins. The University of Nebraska-Lincoln. https://cropwatch.unl.edu/ensure-quality-grain-storage-starting-clean-equipment-bins

Additional sources used:

Cloud, H. and Morey, R. 1991. Managing stored grain with aeration. The University of Minnesota Extension. https://extension.umn.edu/corn-harvest/managing-stored-grain-aeration

Hurburgh, Jr., C.R. 2005. Grain quality and grain handling issues in drought areas. Iowa State University Extension. Integrated Crop Management. IC-494(23): 184-186. https://www.extension.iastate.edu/pages/eccrops/transfer/hurburghrobertson.pdf

Hurburgh, C. 2008. Soybean drying and storage. Iowa State University Extension. Pm-1636. https://dr.lib.iastate.edu/entities/publication/753b5d08-4db4-41a7-a959-cbb3e58339be

Beck, R., Bauder, S., Edwards, L., Edwards, N., Bly, A., Karki, D. and Davis, J. 2018. Grain storage: It starts with harvest. South Dakota State University. https://www.farmprogress.com/harvest/grain-storage-it-starts-with-harvest

Legal Statements