

Managing High Moisture Grain in Storage

Much of the grain harvested in fall is placed directly in storage. Grain storage management is crucial to maintain excellent grain quality until the grain is delivered or used. Grain storage problems can start with harvest and occur due to poor grain quality and/or poor storage practices. If grain storage is not managed correctly, severe quality and financial losses can occur.

Causes of Storage Problems

Removing fines and damaged grain

When the bin is being filled, poor quality grain and fines accumulate in the center of the bin. The accumulation of the poor-quality grain can result in less air flow increasing the risk of spoilage.

By coring the bin, it results in removal of poor-quality grain from the top of the pile to bottom of the bin. Use the unloading auger until about 1/2 of the grain peak is removed. The number of bushels that need to be removed is equal to the bin diameter (feet) cubed, divided by 90. For a bin with sidewall height roughly equal to diameter, coring bushels equals about 1.5 percent of bin capacity. If sidewall height is only 3/4 of bin diameter, coring would remove about 2 percent, and if sidewall height is 1.5 times diameter, coring would remove about 1 percent.¹

High Moisture Content

Grain should be dried to the proper moisture content before storage, either short or long term. The recommended moisture contents for corn and soybean at various storage periods are shown in Table 1. According to the University of Nebraska, corn at 19% moisture content and a starting temperature of 75° F can lose a market grade in approximately five days if aeration is not working and grain temperature rises.²



Table 1. Maximum percent moisture content for grain storage.

| Grain type and Storage time | Maximum percent moisture content for safe storage |
|-----------------------------|---|
| Corn | |
| Sold by spring | 15.5 |
| 6-to-12-month storage | 14 |
| Stored longer than a year | 13 |
| Soybean | |
| Sold by spring | 14 |
| 6-to-12-month storage | 12 |
| Stored longer than a year | 11 |

*Moisture percentages for good quality grain, for poor quality grain reduce percentages by 1. McKenzie, B. and Van Fussen, L. 1995. Purdue University.³

Inadequate 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 resulting in grain spoilage, referred to as hot spots. Spoilage from moisture migration can occur at any time temperatures vary in the bin but is more common when the warm grain is stored, and outside

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temperatures are cold. Inside the bin, the grain is well insulated and without proper temperature management, the grain and surrounding air can hold the initial temperature when putting into the bin (50 - 80° F). Regardless of the time of year, grain should be maintained within 15 - 20° F of the average monthly temperature.

Aeration is used to control grain temperature by moving air through the grain. In general, aeration should not be used to dry grain, although the moisture content may slightly change. Aeration is used to cool grain in the fall or help to warm it in the spring. Grain that is cooled in 10-30° F increments for winter storage should be less subject to mold growth and insect reproduction. In areas, with lower humidity at harvest, aeration may be used to dry grain, but to do this successfully requires a significant increase in cfm (cubic feet of air per minute) over what would be used to cool grain.

The area of the grain that follows the temperature change through the bin during aeration is known as the cooling or warming zone. One cooling/warming cycle is the amount of time needed to move a cooling/warming 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 /bushel to over 1 cfm/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 figured with following formulas by season:

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

Fluctuating Temperatures in the late Fall and Winter.

Be aware of the major daily temperature fluctuations in the area. It's typical during the fall and winter to have cooler, moist morning with temperatures in the 30 °F range that rise to 50 °F, 60 °F even 70 °F during the afternoon hours. The disadvantages of running the fans continuously during this type of temperature variation are over drying or rewetting the grain from the fluctuations in temperature and dewpoint. A controlled and automated grain management system constantly measures and assesses these conditions and only pushes air in the bin during the periods of the day when the air is at its desirable period: not too moist and not too dry. Trying to do this manually is a very difficult task. As a result, automated systems may run the fans for a few hours in the morning and again in the late afternoon. This avoids the cost of over-drying and rewetting that would take place if fans were running all day. Some growers may have their grain come in at optimal moisture but need to cool it to increase its storage life. Warm and dry air may not be the optimal fix, but an automated system can help run through cool air at certain times of the day to cool the grain down to the desired temperature and maintain moisture content.

Grain Checks and Observations

Taking multiple grain samples when filling the bin and during storage can help account for variable moistures and reduce the risk of storage molds. Use the highest moisture content value to determine management options that can 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. This can be reduced to every two or three weeks when temperatures are more consistent and tend to be colder throughout the winter. Keep an eye on the surface conditions, temperatures, grain condition, and be mindful of different smells, both in the grain and exhaust air. Grain that is crusting, wet, or slimy as well as has ice or frost accumulation and/or heating

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can be a sign of poor conditions and spoilage. 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 beginning to spoil. 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.

Insect Management

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, observations for insect activity should be conducted. Some preventive measures that may help prevent insect issues in stored grain 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 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 aeration ducts.

Safety First

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.

Sources:

- ¹ Shouse, S. and TeBockhorst, K. 2020. Core each grain bin this fall. Iowa State University Extension. <https://crops.extension.iastate.edu/blog/kristina-tebockhorst-shawn-shouse/core-each-grain-bin-fall>.
- ² Dom. T. 2010. Ensure quality grain storage by starting with clean equipment bins. The University of Nebraska-Lincoln. <http://cropwatch.unl.edu>.
- ³ McKenzie, B. and Van Fossen, L. 1995. Managing dry grain in storage. Midwest Plan Service. AED-20. Purdue University. www.extension.purdue.edu.

Additional sources used:

- Cloud. H. and Morey R. 1991. Management of stored grain with aeration. The University of Minnesota Extension. <http://www.extension.umn.edu>.
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- MacKellar, B. 2020. Using bin aeration to dry corn and soybeans with natural air. Michigan State University Extension. <https://www.canr.msu.edu/news/using-bin-aeration-to-dry-corn-and-soybeans-with-natural-air>.
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Legal Statement

ALWAYS READ AND FOLLOW PESTICIDE LABEL DIRECTIONS. Performance may vary, from location to location and from year to year, as local growing, soil and weather conditions may vary. Growers should evaluate data from multiple locations and years whenever possible and should consider the impacts of these conditions on the grower's fields.

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