Grain Storage Basics

Storage problems can occur with the storage of poor quality grain or can be a result of poor management of good quality grain. Proper aeration, insect control, and regular, thorough observation are all necessary to maintain grain quality. If grain is stored at the proper moisture, issues that arise can usually be attributed to improper grain cooling, inadequate observation, poor grain quality, or lack of insect control measures. Refer to Table 1 for the proper moisture content at which to store corn and soybeans. If grain coming out of the field is too wet, be sure to consider your options for drying to reach the desirable moisture content for storage. The primary reason that dry grain goes out of condition is due to poor temperature control allowing moisture to migrate through the grain, accumulate, and cause spoilage.

Temperature Control and Moisture Migration

During late fall and early winter throughout the Corn Belt, temperatures cool significantly. Falling temperatures cause grain and air along bin walls to cool. The insulated grain and air in the middle remains at around the same temperature as when it was binned. Temperature variances in different areas of the grain bin cause convection currents, the slow, natural flow of moisture and air. Convection currents occur because the cool outer air becomes heavier and settles. As it moves downward and inward, it becomes warmer and lighter causing air to rise through the center column of grain further warming the warm grain. The warmer air has increased moisture-holding capacity and it begins to absorb small amounts of moisture. As it moves upward, it again enters cool grain and some of the moisture from the air is left with the grain through condensation and diffusion. This process is called moisture migration – the most common cause of problems in stored grain. Check for crusting, wet, slimy grain, ice or frost accumulation and/or heating. Condensation or frost on the underside of roof, hatches, and vents on cold days almost always indicates a moisture migration problem. If crusting occurs, you should stir the surface to break up the crust or if severe, remove the spoiled grain.

Aeration Management

Regardless of the time of year, grain temperatures should be within 15-20 degrees of the average monthly temperature. Aeration is a process of forcing air through the grain either continuously or intermittently to affect the grain temperatures. While some minor moisture changes can occur with changing temperatures, aeration is not the same as drying grain. Aeration is used to cool grain in the fall, or help to warm it in the spring. Negative pressure systems move air down through the grain by suction from the bottom. Positive pressure systems force air upward through the grain. The area along which the temperature change follows through the grain mass is known as the cooling or warming zone. As the cooling/warming zone moves up through the bin in a positive pressure system, or down through the bin in a negative pressure system, the grain temperature within the zone is changing and the grain behind the zone has been tempered.

One cooling/warming cycle is the amount of time needed to move a cooling/warming zone completely through the bin (top to bottom in negative or bottom to top in positive). Once a cycle has begun, the fan should operate continuously until the zone moves completely through the bin. The time required for one full cycle depends on aeration airflow rate. Generally, two to three full cycles are needed to cool or warm grain to desired storage temperatures.

On-farm storage systems may be equipped to move air at between 1/10 cfm (cubic feet of air per minute)/bu to over 1 cfm/bu. The rate depends on bin type, air distribution system, desired storage moisture percentage, and proper

<table>
<thead>
<tr>
<th>Grain type &amp; storage time</th>
<th>Maximum moisture content for safe storage</th>
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</thead>
<tbody>
<tr>
<td>Shelled corn</td>
<td></td>
</tr>
<tr>
<td>Sold by spring</td>
<td>15.5%</td>
</tr>
<tr>
<td>Stored 6-12 months</td>
<td>14%</td>
</tr>
<tr>
<td>Stored more than 1 yr</td>
<td>13%</td>
</tr>
<tr>
<td>Soybeans</td>
<td></td>
</tr>
<tr>
<td>Sold by spring</td>
<td>14%</td>
</tr>
<tr>
<td>Stored up to 1 year</td>
<td>12%</td>
</tr>
<tr>
<td>Stored more than 1 yr</td>
<td>11%</td>
</tr>
</tbody>
</table>

Moisture percentages for good quality grain; reduce 1% for poor quality grain (drought, frost, harvest damage, etc.)
Grain Storage for Corn and Soybean

Management procedures. The time it takes to complete a full warming or cooling cycle depends on the aeration rate and time of year and can be figured with the following formulas by season:

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

Cooling Grain for Winter Storage

In general, most growers will cool grain to 35-40 degrees for most of the Midwest; or below 35 for colder average temperatures. The first aeration cycle should begin when the average daily temperature is 10-15 degrees cooler than the grain. Grain that has been dried at higher temperatures should be aerated immediately. Operate equipment long enough to complete the full aeration cycle to prevent spoilage; roughly a week depending on aeration rate. In a couple weeks, when the temperatures have dropped another 10-15 degrees, you should repeat the full aeration cycle. A maximum of three cycles are needed. If you are planning to run only two cycles to reduce costs, be sure to delay the second cycle until outside temperatures will help cool grain to 35-40 degrees. The exact number and length of cooling cycles depend on fan capacity, when and the temperature at which grain was binned, and how fast air temperatures cool during the fall.

It is important to know how long it will take your fan to move a cooling/warming cycle through your bin. If you don’t know the rate, contact the dealer where you purchased the fan to find out. Once you know the rate, you can easily figure the number of hours by the formula in the aeration management section. You should ensure that the cooling/warming front moves completely through the bin as this reduces the chance that moisture will accumulate in one area and cause spoilage. To check your bin to see if the cycle has completed:

- **Negative pressure system**: check the temperature of air coming out the fan discharge. Air temperature represents an average; there may be warmer spots in the center or if grain is peaked.
- **Positive pressure system**: check grain temps by placing thermometer 6-12 inches into the surface grain. A sudden change in temperature will indicate that the front has gone through (temperature should be about what the average outdoor temperature was when the cycle began.)

Making sure the front has completed is MOST crucial during the final cycle. It is a good habit to record dates, times, and grain and air temperatures. Cross check the actual time with the amount of time you calculate. If it is taking longer than expected, airflow may be reduced or fines may be causing a blockage. Each time you run a cycle in the same bin with the same equipment, it should take about the same amount of time.

Observation and Management

During the fall and spring when temperatures are quickly changing, be sure to observe your bins weekly. This can be reduced to every two or three weeks throughout the winter. It may be easier to remember if you establish a set day of the week and time of day to check. Keep an eye on the surface conditions, temperatures, grain condition, and be mindful of different smells, both in the grain and exhaust air. Once grain is cooled, continue checking exhaust air for smells to indicate grain going out of condition. Regardless of the season or weather, if you detect signs of heating or hot spots, run the fan continuously until no further heating can be detected. If hot spots cannot be remedied with aeration, you may have to remove the grain and clean, dry, or even sell it. It will likely be better to sell at a lower price than to allow an entire bin to go out of condition and lose quality.

Insect Control in Stored Grain

Insect infestations can arise from residue in combines, handling equipment, and old grain left in storage. In addition to all other management precautions, be sure to watch for insect activity during regular observation. Some preventative measures that may help prevent insect issues in your stored grain include:

- Clean debris from harvesting, handling, and drying equipment, and from 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.
- DO NOT put new grain on top of old grain – just a few insects in the old grain can infest the entire bin.

Safety

The dangers of grain handling cannot be stressed heavily enough. NEVER enter a bin when 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.


Individual results may vary, and performance may vary from location to location and from year to year. This result may not be an indicator of results you may obtain as local growing, soil and weather conditions may vary. Growers should evaluate data from multiple locations and years whenever possible. ALWAYS READ AND FOLLOW PESTICIDE LABEL DIRECTIONS. Leaf Design® is a registered trademark of Monsanto Company, Channel® and the Arrow Design® and Seedsmanship At Work® are registered trademarks of Channel Bio, LLC. ©2013 Monsanto Company. 08262013JMG

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