MANAGING DRY GRAIN IN STORAGE

Scott Sanford [1/]

A great deal of resources and effort are invested in growing, harvesting, drying and transporting grain crops. Managing the dry grain in storage is important to protect that investment. The quality of grain cannot be improved during storage but if not properly managed, grain quality can deteriorate quickly. The majority of grain losses are caused by living things such as fungi, mold, insects and rodents. The grain temperature and moisture can provide a haven for living things or aid in preventing problems.

There are six main causes of grain storage problems: grain is too warm, grain is too wet, too much foreign matter and fines, uneven grain temperatures in bin, storage bins not cleaned before harvest, and grain not checked often enough during storage.

Grain that is too warm and too wet invite molds and insects, the primary reasons for grain deterioration in the U.S. Insects and molds thrive in temperatures above 60°F. Molds are more predominate if grain moisture is too high while insects can survive in dry or moist conditions. Insect damage and mold will often occur in areas of high foreign matter and fines because it is often higher in moisture and broken kernels are easy to access. Too much foreign matter and fines also causes higher resistance to airflow compounding the problem of aerating the grain. Screening all grain before it enters the storage bin and the use of a spreader to evenly distribute the grain and fines in the bin will reduce concentrated areas of fines. If not using a spreader, fines and foreign matter will concentrate under the fill spout.

Differences in air temperature within a grain bin can lead to convection patterns within the grain. The grain near the wall of the bin will be cooler while the grain in the center of the bin will be warmer. The warm air will migrate up through the grain in the center of the bin, picking up moisture until it comes in contact with the cold grain on the top where the moisture condenses on the cold grain and the bin roof. The wetted corn will be prone to mold growth and insects as the sun heats the roof and head space as the weather warms in the spring. Crusting of grain is an indication of convection air movement and uneven grain temperatures. It is recommended that the grain temperature be kept within 10 to 15°F of the average outdoor temperatures down to 30-35°F for southern WI, Iowa, Michigan and Northern IL and 25 to 30°F for northern WI, Minnesota and the Dakotas. During the warmer months the grain temperatures should be kept slightly lower than the average temperature. The maximum recommended summer temperature of the grain is 50°F for the upper Midwest. Keep the grain temperatures within 10 to 15°F of the average outdoor temperatures will reduce convection air flow in the grain.

Bins that were not cleaned out from the previous year are more likely to have insect infestations from adult insects, larvae and eggs that are harbored in the old grain. Cleaning bins is effective for insect control but has little effect on molds. The best strategy mold control is to prevent mold spores from germinating by keeping the grain cool, clean and dry. Trapping insects to determine infestation level should be done for grain that is stored during warm weather. Sticky traps, probe traps and pitfall traps are useful in determining infestation levels. Check with buyers of grain before applying any insecticides to ensure you are not jeopardizing your market.

[1/] Distinguished Outreach Specialist, Biological Systems Engineering, Univ.of Wisconsin-Madison, 460 Henry Mall, Madison, WI 53706.

Neglect or irregular visits to grain bins or storage facilities can result in a small problem, which could have been controlled, turning into a large costly problem. It is recommended that grain be checked every one to two weeks in warm weather and every two to four weeks in cold weather. During inspections check that bin hatches are closed and not leaking water, roofs are not damaged, roof vents and fan inlets are not blocked by frost, ice or debris, fans are operable (tripped breakers, burned out motors, damaged bearings or impellers), and controllers are operational. What does the grain smell like - musty or spoiled odor? Hard crust on surface, condensation under the roof, exhaust air temperatures warmer in center than those towards the side walls, these are all indicators of storage problems. Make a log of your observations for future reference. The storage moisture of the grain will depend on how long it is planned to be in storage, the grain crop and the type of storage facility. Typically 15% for corn if it will be marketed by May, 14% if it will be kept into the following summer and 13% if it is stored for more than a year. It may be desirable to reduce the moisture content of crops stored in a temporary storage structure by a percentage point or two to reduce the spoilage risk because of less than ideal conditions.

Aeration

It is not critical for maintaining grain quality in storage whether the aeration system is a positive or negative pressure system, there are advantages and disadvantages of both. The airflow per bushel is more critical because it affects the time required to change the grain temperature. A bin with 0.10 cfm per bushel airflow rate will require approximately 140 hours (6 days) to change the grain temperature of corn 10 to 15°F while an airflow rate of 0.25 cfm per bushel will require only 56 hours (2-1/3 days), 2.5 times less time. Higher flow rates allow operator to take advantage of short periods of cool weather (nights, cold fronts) during the warmer parts of the harvest season to cool the grain and provides more accurate temperature control. But as airflow rate doubles, the horsepower requirement will increases by a factor of about five and will require larger electrical services. Aeration times will depend on how uniform air flows through the grain; areas of concentrated fines may require 2 to 5 times longer to cool than if grain were clean. Operators often try to avoid aeration during very high or low humidity conditions but this will only have a slight effect on corn at the point were the air enters the bin because temperature of grain changes about 50 times faster than its moisture content changes. It is important to turn off the aeration fans as soon as the grain reaches the target temperature so drying or wetting of the grain is minimized.

Temperature sensors

The only way to determine if grain cooling is complete is to take temperature measurements of the grain in several locations. This can be accomplished with a grain probe with a thermometer pushed into the grain or by pulling a grain sample and measuring the temperature quickly to determine grain temperature at various locations and depths. Permanently installed vertical temperature cables can also be used. These cables have temperature sensors every 4 to 6 feet along the length to measure grain temperatures. This data is useful if it is recorded regularly and compared to previous readings to detect temperature increase or decreases at sensor locations. Sensors can only accurately measure the grain temperature within a few feet of the sensor so they should be considered an aid but not a substitute for measuring temperatures in other locations. Small temperature increases in one area can be an indication of problems.

Controls

Fans can be controlled manually, with time clocks, thermostats, microprocessor based controller or computer-based software. Automatic controls can reduce time and energy required to manage stored grain and improve the accuracy. If using a simple thermostatic controller, an hour meter

should be installed so the number of hours the fans operate is known. Automated controllers do not eliminate the need to visually check the grain.

Safety

Every year people are injured or killed in association with grain handling and storage. DO NOT ENTER BINS WITH UNLOADING EQUIPMENT OPERATING! Even a low capacity auger can bury a person in seconds. Don't walk on crusted grain if grain has been removed from bin. A cavity can form under the crust which may collapse when walked on, burying the person. Lock-out controls if entering a bin so unloading equipment can't be started. Wear respirators when working with moldy grains. Be aware of overhead electrical lines when moving equipment or lifting dump bodies.

Monthly Monitoring Checklist

1) Turn on aeration fans
    a. Is fan operating correctly? Inlet clear, bearing, fuses
    b. Check Static pressure in plenum
2) Climb up and look inside bin
    a. Condensation under roof, wet grain near hatches
    b. Snow cover – run fans until sublimated
    c. Check for off-odors
    d. Check grain surface – crusting, mold, wet spots (roof leaks?)
    e. Measure grain temperatures at several locations and depths
3) Check for signs of insect, mold and rodent activity
4) Record observations in logbook
5) Compare observations with previous records
6) Take any corrective action required

References

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Available for ordering from www.mwps.org