

Management of Stored Grain

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A grain crop in the storage bin represents a large investment of money and labor. To help prevent any reduction of your investment return caused by spoilage, this guide explains the reasons grain spoils in storage and outlines management procedures for maintaining grain quality.

Storing a Mixture of Wet and Dry Grain. Some grain-drying systems dry some portions of the grain more than others. For example, in-bin batch dryers and column dryers over-dry the grain where the hot air enters. To get a desirable average moisture content, the drying must stop before all the grain is dry. When grain from these dryers is put into storage, there may be places in the bin where the wet grain is not mixed well with the dry.

Common Problems in Storage

Three storage conditions lead to grain spoilage.

Moisture Migration. This problem arises even though the grain is dry when placed in storage. The outside edges and top 8 inches of grain cool to outside temperatures, while the center mass of grain remains relatively warmer. This temperature difference causes warm air in the bin center to rise and condense moisture in the top grain surface. Continuing throughout the winter, moisture migration causes a bowl-shaped mass of grain with a high moisture content to form in the top center of the bin. Later, warm spring temperatures cause this grain to spoil. The loss may not be great, 30 to 50 bushels, depending on the diameter of the bin.

Storing Wet Grain. Because of an unusually late harvest or because of poor in-bin drying conditions, grain is sometimes stored at moisture contents too high for safe storage.

Allowable Storage Time

When grain is placed in a bin at a given temperature and moisture content, it will remain in condition for a period of time called allowable storage time. Table 1 gives the allowable storage time for grain at various moisture contents and temperatures. This data was obtained for grain stored under constant moisture and temperature conditions. In actuality, however, grain on farms is stored at a given moisture, but the temperatures vary throughout the storage period.

At each storage temperature, the grain deteriorates to some extent and "uses up" some percentage of the allowable storage time. For example, a grain stored at 20% moisture at 55°F has an allowable storage life of 36 days. If the 20% moisture grain is stored at

Table 1. Maximum Allowable Storage Time—Days¹

Grain Temp. °F	Percent Moisture								
	15	16	18	20	22	24	26	28	30
35	—	670	265	112	74	49	37	30	25
40	870	500	200	85	56	37.5	27.5	22.5	19
45	650	385	150	64	41.5	28	20.8	17	14
50	490	290	115	48	31.5	21	15.8	12.8	10.5
55	360	215	86	36	23.5	16	11.8	9.6	8
60	270	165	65	28	18	12	9	7.2	6
65	200	125	49	21	13.5	9	6.7	5.4	4.5
70	152	93	36.5	16	10	6.8	5	4	3.4
75	112	70	27.5	12	7.7	5.1	3.8	3	2.6

¹Data was developed for shelled corn. It can be applied to all grain.

55°F for 27 days, 75% of the allowable life is used up and 25% remains. If grain temperature is then lowered to 45°F, the allowable storage life at that temperature is 16 days, 25% of the allowable storage life of 64 days. Thus, for a given moisture content, the cooler the grain, the longer the storage time.

How to Keep Grain in Condition

Filling the Bin. Two management procedures should be carried out when the bin is filled.

1. The fines should be removed by a cleaner or distributed evenly with a spreader. When a spreader is not used, the fines collect in a column in the center of the bin. During drying, they offer high resistance to the air flow and as a result they dry less and have a higher moisture content than the grain in the rest of the bin. Also, the grain where the fines are concentrated heats first. So if a spreader is not used, it is a good idea to empty several bushels from the sump of the bin, and spread the removed grain back on top of the grain in the bin. This procedure reduces the amount of fines in the center column.
2. The grain surface should be level when the last load is placed in the bin. A cone of heaped grain at the surface causes uneven drying, and this grain will often not be dried properly. Also, when aeration is used to cool the grain, the cone of grain is not properly aerated.

Cooling The Grain. The most important factor in keeping grain in condition through the fall and early winter is to keep it cool by forcing cool air through the grain. If the bin is equipped with a drying fan, that fan can be used. If not, an aeration fan should be used. An aeration fan is smaller than a drying fan but has a capacity sufficient to cool the grain. The procedure for keeping grain in condition is:

- Measure and record grain temperatures every two weeks throughout the storage period. Measure grain temperature in the bin center and at least two feet down into the grain.
- In the fall, the cooling fan should be run whenever the average outside temperature is below grain temperature. Where the air enters the grain, a cooling front develops and moves through the grain as cooling continues. The fan should be kept running until the front passes through the entire grain mass. The time for the front to pass through the grain depends on the size of the fan. A drying fan may force the front through the grain overnight, while an aeration fan may take several days.

A number of fronts will be forced through the grain before it is cooled to winter storage temperature.

- Continue cooling until the grain temperature is down to about 40°F. Do not freeze the grain.

Checking Grain Conditions. After the grain is cooled, don't assume that the grain will stay in condition through the winter. Trashy spots or high moisture spots may still cause problems. Two procedures will warn you of trouble developing.

1. Keep measuring temperatures every two weeks, and watch temperature trends. If temperatures begin to increase, turn on the fan and cool the grain again.
2. Turn the fan on periodically, and smell the air coming out of the grain. If there is a musty odor, run the fan until the musty odor is gone.

Rewarming Grain. In the spring when warm weather returns, the outside surfaces of the grain are warmed, and the center mass of grain remains cold. Air currents in the bin cause condensation in the cold grain. To avoid problems with summer storage, the grain should be warmed.

- Begin by forcing air through the grain when the outside air temperature is 10°F or less above the grain temperature.
- Once the fan is started, it *must not* be turned off until the warming front goes completely through the grain. Just ahead of this front, a condensation layer moves through the grain, which will cause problems if the fan is turned off too soon.
- Continue warming until the grain temperature is about 65°F.

Precautions. Corn, wheat and sorghum should have a moisture content no higher than 13% if they are to be stored through the summer. Soybeans should have a moisture content no higher than 12% during summer storage. If the moisture content is higher than these in the spring, the grain should be marketed or dried.

Cool winter storage reduces insect activity. However, when the grain is rewarmed in the spring watch the bins carefully for insects, and use proper treatment procedures if insects do appear.

Management Checklist for Stored Grain

- ✓ Remove fines or distribute them evenly.
- ✓ Level the grain surface.
- ✓ Cool grain to 40°F.
- ✓ Make regular winter checks. Run fan if temperature increases or mustiness develops.
- ✓ Warm grain in spring.
- ✓ Check for insects.