PREVENTING STORAGE ROTS OF GRAINS

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Storage rots or moldy grain may develop in grain storage bins if the moisture content of the kernels is too high and the air temperature is high enough to permit fungus growth. Some 25 or more different species of fungi can cause storage rots. The majority of these fungi are species of the common molds, Aspergillus and Penicillium. Some species of fungi can cause infection in the field and develop further under storage conditions, but most problems result from conditions favorable to fungus growth in storage.

SPOILAGE AND TOXINS

Storage rot fungi cause loss of germination, bin burning, mustiness and heating. Moldy grain has reduced feeding value, lower market grade, and may even become unacceptable in trade for seed or feed. Some of the fungi that grow in grains can form toxins that seriously affect livestock. For example, Aspergillus flavus produces several toxins called aflatoxins. Only a few parts of aflatoxin B1 per billion parts of feed can cause pathological changes in animals susceptible to it. Other fungi common in grains are also capable of producing toxins. For this reason, grain containing detectable amounts of toxin cannot be used for food or feed. Toxins may be produced by fungi growing in grain without much outward evidence of damage or moldiness, but when moldy grain is apparent a considerable risk is taken when it is used for feed.

STORAGE CONDITIONS

The major factors contributing to storage rots are: (1) moisture content of the grain; (2) temperature during storage; (3) physical damage to the kernels; and (4) the presence of storage rot fungi.

The moisture content and the temperature of grain must be controlled if grain is to be stored safely. Lowering the moisture content or the temperature of the grain results in lowering the relative humidity of the air surrounding grain particles. It is known that microbes cannot function when the relative humidity is below about 60 percent.

For Kentucky conditions, the temperature of grain will be in the 60 to 70°F range when harvested. Therefore, it is necessary to lower the moisture content to the levels indicated in Table 1 to have safe storage.

<table>
<thead>
<tr>
<th>Kind of Grain</th>
<th>At Harvest</th>
<th>For Safe Storage*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn (Shelled)</td>
<td>14 to 30</td>
<td>Up to 13</td>
</tr>
<tr>
<td>Soft Red Winter Wheat</td>
<td>9 to 17</td>
<td>Up to 13 1/2</td>
</tr>
<tr>
<td>Oats</td>
<td>10 to 18</td>
<td>Up to 13</td>
</tr>
<tr>
<td>Grain Sorghum</td>
<td>10 to 25</td>
<td>Up to 13</td>
</tr>
<tr>
<td>Soybeans</td>
<td>9 to 20</td>
<td>Up to 11</td>
</tr>
<tr>
<td>Rough Rice</td>
<td>16 to 26</td>
<td>Up to 13 1/2</td>
</tr>
</tbody>
</table>

*For grain stored as seed stock or for long-time storage up to 5 years, the moisture levels should be 2 percent lower for each of the grains.

Storage fungi develop very slowly in the temperature range between 40°F and 50°F and much more rapidly at 80°F to 90°F. Some fungi are capable of development down to or below 32°F and if grain is moderately invaded by fungi of this type, very slow development may occur. When the temperature increases later in the spring or when the grain is moved out of storage, the grain may spoil rapidly.
GRAIN DAMAGE

Physical damage to the grain permits ready entrance of storage fungi and rapid development of storage rots under favorable moisture and temperature conditions. In a recent research project, most aflatoxin development in corn was located in broken and damaged kernels and in foreign material carried along with the grain.

OPERATING THE DRYING SYSTEM

The method of drying may have an effect on the development of aflatoxins in storage grain. If the right microorganisms are present, raising the temperature slightly for an extended period could promote the production of aflatoxins. Systems should be operated as follows:

Layer drying - In-storage layer dryers can produce conditions highly favorable for mold development. The temperature of the drying air is increased only 10 to 20°F above the outside air temperature, and the relative humidity is quite high in the top layer of grain for an extended period of time. The depth of the grain must be restricted to allow drying to below 16 percent moisture in 48 hours or less. After the moisture is reduced to 16 percent, several days can be allowed for further moisture reduction to the level shown in Table 1. This is normally a slow method of drying, and restricting the depth of the grain layers could make it an even slower process. In general, this method should not be used to dry all the grain produced when more than one bin is available. A batch or continuous flow method should be used.

Batch-in-Bin - Drying is accomplished by placing 2 to 4 feet of grain in a bin and increasing the temperature of the drying air to about 140°F. The usual practice is to dry the grain in less than 24 hours. The grain is then cooled and stored. This method should be used when grain is to be dried in a bin and more than one bin is available. Providing the heater is large enough, use of this method can increase one's drying capacity by three times over layer drying while using the same equipment. The chances of aflatoxins being produced in this drying system are greatly reduced, though care must be taken to assure that the average moisture content of the layer of grain is below 13 percent and the grain is cooled after drying.

Column Batch Drying - Any chance of aflatoxins being produced in this method of drying is highly unlikely due to the high temperatures used (180 to 220°F) and the short drying time (1 to 2 hours). Each batch must be dried to the proper moisture content to avoid wet spots in the bin.

Continuous Flow Drying - Chances of aflatoxins being produced with this method of drying are highly unlikely because of the high temperatures (180 to 220°F) and the short drying time (1 to 2 hours). The moisture content can be measured as the grain leaves the dryer, allowing one a high degree of moisture control over the grain being placed into storage.

MEASURE THE MOISTURE CONTENT OF GRAIN

Measuring the moisture content of grain is a necessity if grain quality is to be maintained during storage. The moisture content of grain leaving a batch or continuous flow dryer should be measured with a reliable tester. The producer should own his own tester for these types of operations.

Grain in storage bins should be sampled with a properly designed probe every 3 or 4 weeks. The grain should be inspected for insect infestation, high temperature, mold growth, and moisture content. lf the moisture content at any spot in the bin is higher than desired, the grain should then be observed each day to assure that no damage is occurring. If necessary, the grain should be mixed again, by rotating, or redried.

AERATE TO CONTROL TEMPERATURES

After grain is dried to the recommended level, it should be cooled to near the average outside air temperature. Aeration should be continued as needed until grain temperature reaches 35 to 40°F. An air flow rate of 1/10 CFM (cubic feet per minute) is adequate for cooling grain. The aeration fans should pull air down through the grain any time the grain temperature is 10 to 15°F warmer than the average outside air temperature. Crop dryers can be used to cool the grain by turning the fans on for 3 to 4 hours when outside air temperatures are favorable. NOTE: Do not turn the heaters on for aeration.