PENNSTATE

College of Agricultural Sciences • Cooperative Extension

Entomological Notes

Department of Entomology

MANAGING STORED GRAIN ON THE FARM

According to the Agricultural Statistical Reporting Service, 120 million bushels of corn, 4.5 million bushels of wheat, and 0.4 million bushels of soybeans are stored on the farm in Pennsylvania (December 1, 1986 figures). Based on United States Department of Agriculture estimates, Pennsylvania farmers may lose as much as 10 percent of the grain crop from the time of harvest until the grain is fed or processed. This percentage roughly equates to loses of $31.4 million annually to insects infesting stored grains. Most of the loss from insect damage and/or contamination could be avoided if farmers would practice several relatively easy management techniques. The potential savings possible by practicing good stored grain management techniques is approximately three times the combined value for managing both the corn rootworm and potato leafhopper; two of the most important field and forage crop insects in Pennsylvania.

SANITATION

Proper management of stored grain begins with sanitation of bins, equipment, and the surrounding grounds before the grain is harvested. Each bin should be emptied of last year's grain if possible and cleaned thoroughly before any new grain is introduced. To clean a grain bin, the walls, floor, ceiling, and any ledges should be cleaned of old grain and dust. Insects and molds are easily concealed in these areas where they are ready to infest new grain placed in the bin. Other areas in the bin where insects can hide include augers, areas under the floor, and areas under loose tin or wood. A shop vacuum can be used to remove debris from under loose tin and in cracks. Debris which has fallen through the floor can be removed by removal of the flooring. This is a difficult task and in most cases unnecessary when chemical controls are applied in addition to sanitation.

A thorough examination of the surrounding area for habitats conducive to insect populations should be made. Insects residing in old piles of grain, grassy areas, and contaminated feed bags near the grain storage area will move into the storage bin. If any of these habitats are found, they should be disposed of by burning, burying or cutting.

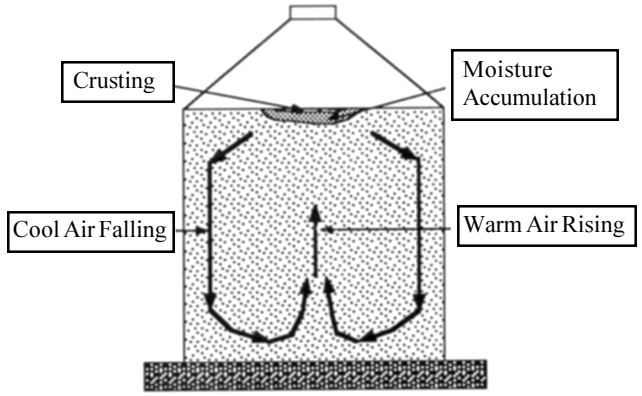

Figure 1. Air flow patterns in warm grain during cold outside temperature.

Insects frequently contaminate harvesting equipment and may survive in grain residues remaining in a combine. If these residues are not removed, the first load of newly harvested grain will contain insects that can infest stored grain. All the sanitation steps taken to this point will have been wasted if time is not taken to examine the harvest equipment and remove any sources of insect infestation.

GRAIN CONDITION

Many insects, particularly in their immature stages, feed primarily on broken kernels and other debris in the bin. By cleaning grain before placing it in the bin, a primary insect food source can be removed. Clean grain is also easier to aerate. Unless the bin has a distribution system, most of the fine materials end up in a column down the middle of the bin as the grain is augered in the bin. Because air always takes the path of least resistance through the grain, the middle of the bin is not properly aerated. As a consequence, the middle of the bin experiences moisture build-up and heating which are conducive to insect outbreaks.

Once the grain bin has been filled, the grain should be leveled on top. Otherwise, air movement again takes

the path of least resistance and comes out along the walls of the bin. The grain in the peak is therefore not aerated properly, and in many cases becomes moist, caked with mold, and heated. Insect outbreaks frequently occur in the peaked area.

ENVIRONMENTAL MANAGEMENT

A grain bin is a biological system. A good manager must be aware of the interactions among the stored grain and temperature, moisture, insects, fungi, and bacteria. Harvested grain normally has a 15 to 30 percent moisture content when placed in a bin. A grain dryer is then used to bring the moisture level down to 13 percent or less for storage. Most biological organisms, such as insects, fungi, and bacteria, do not do well at low moisture contents (less than 15%). Their reproductive and developmental rates are greatly reduced, resulting in a slower population build-up. However, drying the grain below 13 percent results in an unnecessary weight loss when the grain is sold. Temperature also influences the development of insects, fungi, and bacteria in the grain bin. Most insects develop at an optimum rate when temperatures are between 85^{o} and 90^{o}F. At these temperatures, many stored grain insects can complete development from egg to adult in two to three weeks. When the temperature is lowered to below 50^{o}F, most insects stop their development and reproduction. Therefore, keeping the grain as close to 50^{o}F as possible throughout the year will minimize insect population build-up in a grain bin. The same is true of fungi and bacteria. Unless the grain is to be used for seed, the temperature can be drawn down below 50^{o}F to maintain cool temperatures well into the summer months.

Once the grain temperature and moisture have been lowered to the desired level (Table 1), do not assume that the grain will stay at that level. Physical events can lead to increased moisture content and higher temperatures within a grain bin. Because a grain bin is a closed container with the outside exposed to ambient temperatures, convective currents can be started in the grain mass due to temperature difference in the interior and exterior of the grain. In the process of the air being heated and cooled, moisture in the bin is picked up and moved. This phenomenon is similar to the mechanism that causes cloud formation on a warm day and is called “moisture migration.” In the summer, the outside surface of the grain is warmed while the grain in the core of the storage bin remains cool. The air that is warmed at the sides of the bin rises, absorbing moisture from the grain. When this air is cooled by the cool grain in the center of the bin, the moisture condenses and can lead to crusting of the grain (Figure 1). The same forces cause similar transfer of moisture in the winter, only the convective currents move in the opposite direction.

When the moisture content is increased, bacteria and fungi begin to decompose the grain. Respiration of these organisms causes the grain to heat, raising the temperature high enough for optimal development of bacteria, fungi, and insects. Temperatures in the grain can be as high as 100^{o}F, even in the winter. The combined action of moisture, fungi, and insects results in caking of the grain near the surface. Once the grain is caked, the bin can not be effectively aerated to control the temperature without breaking up or removing the caked grain. Caked grain can be removed by augering out part of the grain. Because of the auger design, grain in the top center of the bin is drawn down and out of the bin.

To avoid the problems that can develop as a result of moisture migration, periodic monitoring of the grain is essential. A grain bin should be monitored once a month during the winter and twice a month during warmer periods to measure grain temperature, moisture content, and insect and fungus activity. To sample for insects in the grain, a piece of equipment known as the partitioned grain trier is commonly utilized. The trier consists of a compartmentalized hollow brass tube which is approximately five feet in length. The trier is inserted to the desired depth through the use of extension rods. The compartments are opened, filled with grain, and closed by twisting the rod handle. A grain temperature probe can be used to check the temperature of the grain at several random locations within the bin. Moisture can be measured using a moisture probe or moisture meter. A common household thermometer can be used, but the temperature probe must be inserted at least one foot into the grain mass. The presence of hot spots in the grain mass is an indication that insect populations may be developing in the grain. If hot spots are found, aeration should be initiated at once to lower the grain temperature and moisture content. Do not aerate on warm and/or moist days. This can result in increased grain temperature and moisture content. Insects and fungi do not develop and reproduce well under cool and dry conditions. Through proper monitoring and timing, aeration can be a powerful management tool to maintain grain quality by discouraging insects and fungi.

CHEMICAL MANAGEMENT

Grain that is to be stored for longer than six months may need a protective application of an approved insecticide. Treatments can be applied as the grain is loaded into the bin through the use of a metering device calibrated to apply the proper amounts. After the grain is binned and leveled, a surface dressing can be applied to prevent insects from entering the grain surface. Vapona strips should be hung in the air space above the grain starting in early April of the following year. When insects and/or grain debris has accumulated under the bin floor, chemical sprays are recommended. The grain can be protected for up to six

months from insects harbored under the floor by applying a surface treatment of a registered residual insecticide to the floor. The floor should be drenched to get as much insecticide as possible under the floor where it can kill the insects. The area under the floor can also be fumigated with a registered fumigant before the grain is placed in the bin. If an infestation occurs in spite of these precautions, fumigation of the grain will be necessary. Because of the high toxicity and restricted classification of registered fumigants, an extensive technical knowledge and a special applicator certification is needed for their proper and legal use. A qualified, licensed pesticide applicator with the appropriate credentials should always be contacted to perform fumigations.

By understanding the mechanisms that lead to grain deterioration and following the discussed management procedures, grain quality can be maintained on the farm for long periods of time. When grain in storage is ignored, farmers can lose a large amount of money because of reduced grain quality. In some cases, grain elevators may not accept contaminated grain. By taking the time to practice good grain management techniques, farmers can save themselves many headaches and increase the profitability of their grain enterprises.

WARNING

Pesticides are poisonous. Read and follow directions and safety precautions on labels. Handle carefully and store in original labeled containers out of the reach of children, pets, and livestock. Dispose of empty containers right away, in a safe manner and place. Do not contaminate forage, streams, or ponds.

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Table 1. Recommended temperatures and moisture contents for storage of grain.

Month of year	Grain temp[1] (°F)		Maximum allowable recommended moisture content (%)			
	Minimum	Maximum	Corn	Soybeans	Wheat	Sorghum
Jan.	35	45	15.7	14.3	14.2	14.3
Feb.	35	45	15.5	14.0	14.1	14.2
Mar.	41	51	14.9	13.7	13.7	14.1
Apr.	53	63	14.3	12.2	13.3	13.8
May	55	65	13.8	11.6	13.1	13.7
June	55	65	13.3	11.1	12.8	13.5
July	55	65	13.1	10.9	12.7	13.4
Aug.	55	65	13.3	11.0	12.8	13.5
Sept.	55	65	13.6	11.4	13.0	13.6
Oct.	55	65	14.2	12.1	13.3	13.8
Nov.	42	52	14.9	13.2	13.7	14.1
Dec.	35	45	15.5	14.0	14.1	14.2

Adapted from: Management of On-Farm Stored Grain. University of Kentucky, College of Agriculture, Cooperative Extension Service.

[1]When the average monthly temperature is less than 40°F, the grain should range between 35° and 45°F. When the average monthly temperature is greater than 60°F, the grain temperature should range between 55° and 65°F.