O$U TIP$ on $TORED GRAIN

The OSU Stored Product Management Newsletter

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This newsletter is designed to keep the commercial grain industry current on issues regarding stored grain management. We plan to publish at quarterly intervals throughout the year. The stored grain newsletter is designed to share information from industry and OSU to optimize stored grain management. The newsletter will include key articles about useful grain management information, new technology, applied research developments, current and pending government regulations coupled with key articles on stored grain marketing and details about future industry meetings.

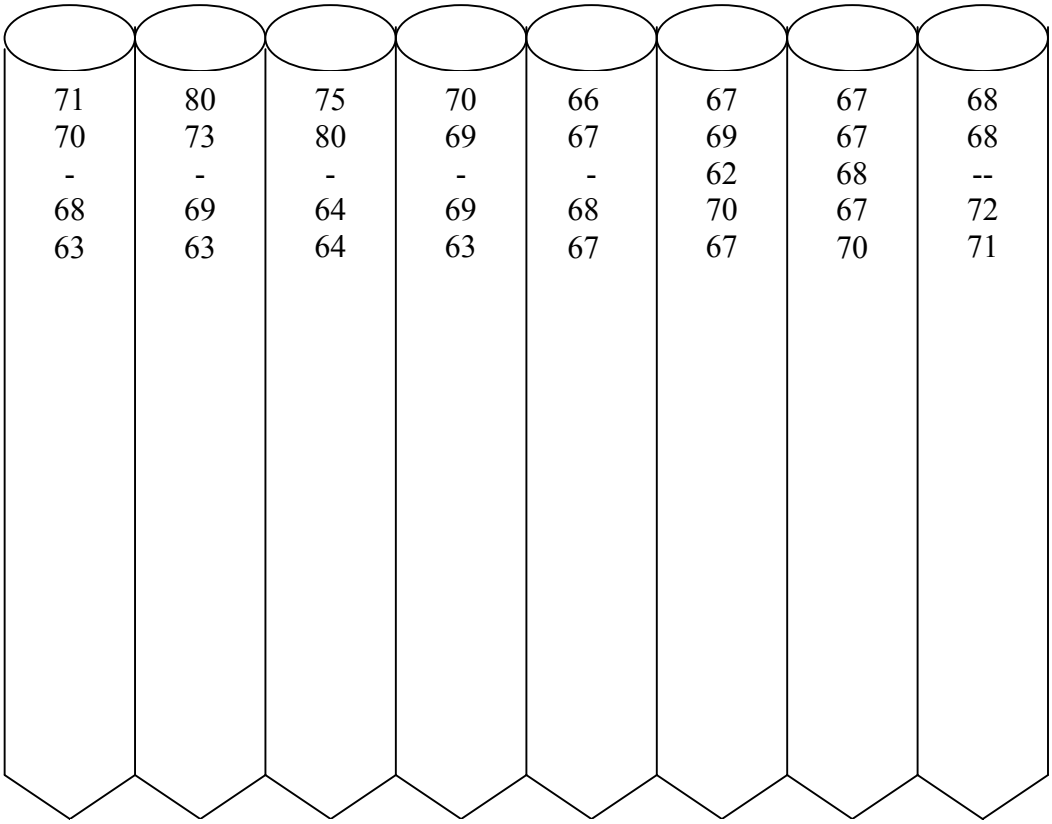
If you have ideas or want to contribute something, please contact Gerrit Cuperus (405-744-9419). If you have grain management or elevator technology ideas that you want to contribute, please contact Gerrit Cuperus at email: BUGS1@OKSTATE.EDU.

OSU AREA WIDE PROJECT OBSERVES MORE THAN INSECTS
By Gary Gilbert, Project Manager

Oklahoma State University and Kansas State University are working closely with USDA/ARS on a four-year Area Wide Project on stored wheat Integrated Pest Management (IPM). In addition to vacuum sampling for insects and grain quality, Area Wide Technicians are recording grain temperatures. Actual temperatures and aeration practices have been observed resulting in some conditions, which were thought to be of interest to Oklahoma elevator managers.

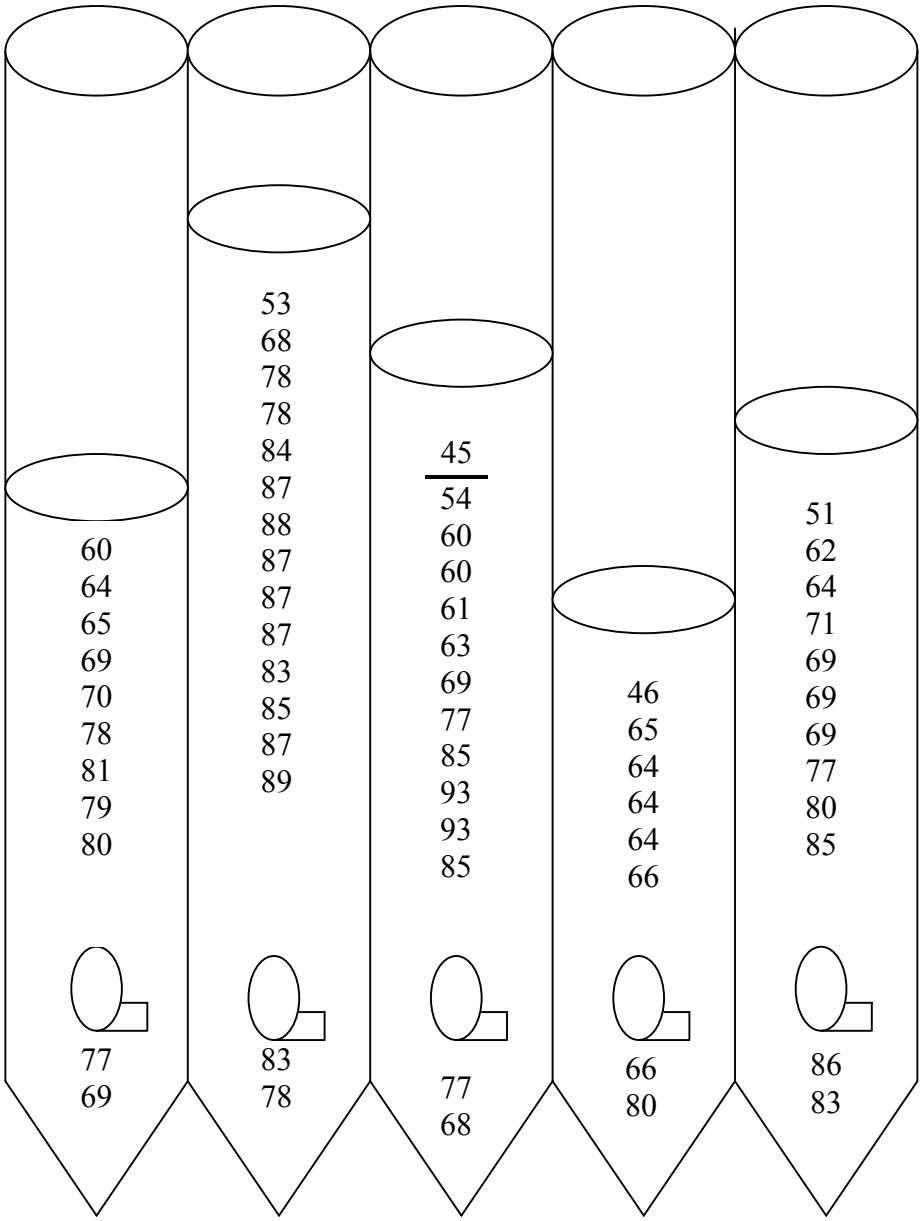
Aeration or timely turning can extend the storage life of grain by removing heat and/or equalizing moisture. Wheat stored at reasonably safe 'short-term' moistures (12.0-12.5%) and temperatures (75 to 85° F), but stored for extended periods without beneficial aeration or turning, can create zones with musty odors, damaged kernels (DK) and insect damaged kernels (IDK). Six months or more of continued low mold activity can result in the discoloration of the germ. Once the discolored germ exceeds the Federal Grain Inspection interpretive color line (OSU Ext. leaflet # L-213 Dr. Kim Anderson), damaged kernel percentages can appear to increase dramatically in a very short time. The Area Wide Project is now documenting some storage situations in which formerly good quality wheat (Oct/Nov) is now grading

Sample Grade Musty with more than 20% DK as well as increasing IDK. This damage appears to be the result of failing to turn or aerate the wheat down to storage temperatures that will slow mold activity nor support insect reproduction. Even though sometimes challenged by grain managers, research suggests that with time, germ discoloration can occur without the grain visibly appearing moldy.



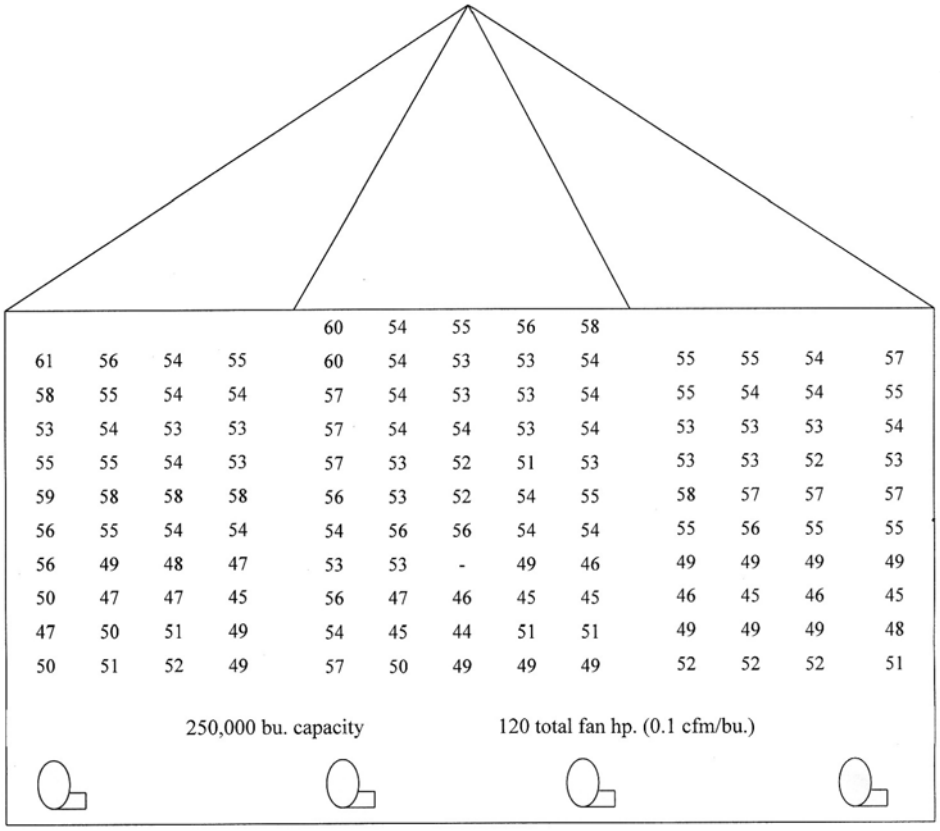
How much cooling can result from timely turning of grain with an unusually warm Fall/Winter?

The October 31,2001 grain temperatures (above) represent an actual Oklahoma concrete elevator, which does not have thermocouples or aeration fans. Post-harvest grain temperatures (90 to 100° F) were reduced by timely turning the wheat twice. Area Wide technicians took the above temperatures in the top ten feet with probed thermocouples. Since the entire bins were turned the temperatures should fairly represent the grain mass and variability. These sampled bins also showed 'At Risk' insect populations prior to turning. By fumigating and turning to temperatures, which reduced insect reproduction, this elevator superintendent utilized a combination of good IPM practices. Further Fall cooling was needed to successfully store the grain longer term. The economics of turning costs vs. aeration costs will vary with every location.



More Tools… Results in Better Grain Management?

The above actual grain temperatures were recorded in January 2002. The majority of the temperatures represent grain that is 'At Risk' of quality loss and insect damage. These particular bins have individual down-flow fans and thermocouples. The ambient air temperature in the headspace above the grain was 34 degrees F the day of sampling. These fans were run in November to pull 100-110° F temperature zones from the bins, but were apparently not used again to lower to safe storage temperatures. These bins were fumigated in October and again for the second time this January. The January fumigation could have been avoided if the fans were used to adequately cool the grain.



Successful implementation of Integrated Pest Management (IPM) practices

In order to remove harvest and summer temperatures in the above bin, the aeration fans were run to take advantage of some cool September nights. On October 1st the Area Wide Technicians recorded grain temperatures ranging between 65 and 80 degrees F. The very uniform actual December temperatures (above) were achieved by running the aeration fans early when the ambient temperatures and grain temperatures were not extremely different. Insect reproduction slows dramatically when grain temperatures fall below 65 degrees F. The above bin was sprayed down with "Tempo" prior to filling at harvest. The wheat in this bin has not been fumigated. Only three live insects (two Rusty Grain Beetles and a Red Flour beetle) were found in the bin at the January sampling. Successful implementation of Integrated Pest Management (IPM) practices have resulted in excellent grain quality with significant cost savings to the owners.

SAMPLING INSECTS

This section of the newsletter will discuss key aspects of sampling insects including the migratory species, sampling populations in concrete silos, and sampling insects in large steel bins. The key to any sampling program is to know where to look and how they are distributed.

Distribution of insects:

Most stored grain insects are very good fliers and migrate to bins and warehouses. Any area in bins or silos that has an opening is a possible entry access point for insects. Table 1 details field research trap catches at points of access on steel bins at Oklahoma elevators. The grain surface and access points are critical locations for access and infestation. That is the place to look carefully when sampling.

Table 1. Insects collected in sticky traps on steel bins at an OK grain elevator.

Bin wall location	Trap catch (Insects/trap)
Eaves	4.89
2/3 height	2.78
1/3 height	2.36
Ground	2.18

Because of variable points of access, stored grain insect trap catches often occur differently with each type of facility: Points of heaviest concentration:

Steel bins – On the surface and points of access like doors, vents.
Concrete silos – Difficult places for sanitation like seams, doors, and basements

Should I use a trap and what type of trap should I use?

With any trapping system, emphasis will be on the interpretation and use of traps used in grain storage and food processing. Each different system requires different traps and monitoring. Our recommendations include:

Grain storage: grain surface probe traps for beetles marketed by Trece' or Agrisense are recommended.

Food and feed processing and warehouses: Sticky traps baited with Indianmeal moth pheromone are recommended for processed foods when you are most concerned about Indianmeal moth. For flour milling, the Dome^{R} trap is recommended to minimize dust when sampling beetles.

Dissertation Completed on Sampling Stored Grain Insects

Mike Toews recently completed a Ph.D. thesis entitled "Use of traps to estimate rusty grain beetle in stored wheat". He worked with Dr. Thomas Phillips. His thesis focused on the use of WB II traps in a commercial elevator. Mike worked with several elevators in the USDA Area Wide IPM project. Mike is now on a post-doc at Kansas State University. He concluded that the following factors influence trap catch:

1. Grain temperature. The greater the temperature, the greater the trap catch.
2. Trapping duration. The longer traps are run, the greater the trap catch.
3. Species. Some species like the rusty grain beetle are very active and readily caught (like rusty grain beetle). Others (like lesser grain borer) are not active and are not recovered as much.
4. Insects are very active in the early evening hours.
5. Insects were heavily distributed on the surface.

OSU recommends using this trap and discussion of the use and thresholds for using was in last years (2001) elevator proceedings.

10% of OK Elevators Use Traps

Recent survey work by Phil Kenkel et al. indicated traps of any kind are used by only 10% of elevators. The primarily used traps are the WBII traps marketed by Trece´. Address: P.O. Box 6278, Salinas, CA 93912

OSU recommends:

At least 3 traps/bin
Place traps on the surface at roof entry, peak, and near wall opposite the roof and aeration doors.
Insert traps so the trap-top is just below the surface with flag documenting trap location.
Do not use a bait or pheromone. Research shows this does not increase trap catch.
Temperature directly affects insect movement and trap catch.
Don't over react with trap catch. These traps are very sensitive and capture a lot of insects.

Action thresholds for fumigation are (with warm grain):

	Number/probe/week
Cryptolestes (flat and rusty grain beetles)	3,000-5,000
lesser grain borer and rice weevil	5
red flour beetles	1000

FUMIGATION CERTIFICATION
By Jim Criswell, Pesticide Coordinator

Fumigation category certification requires both a written and practical (hands-on elevator site exam). To schedule the practical exam, contact the Oklahoma Department of Agriculture at 405-522-5972. The written exam is designed to test the applicator's practical understanding and knowledge including a written exam that can be at local locations throughout the state. Reservations are not required for these exams. Fumigation is one of the few categories that require a "hands-on" practical exam. The practical session is a legal requirement and an ODA inspector in Oklahoma observes the process.

WEBSITE UPDATE

The OSU website for stored grain IPM is available at:
http://ipm.okstate.edu/ipm/stored_products/stored_products.html
This web site will feature new products available, new approaches, and issues in grain grading and monitoring. It will focus on new monitoring approaches and tools. This appears to be critical as new biotech products are available and international trade issues are raised. We are excited about the possibilities of getting new technologies out to the industry.

RELDAN UPDATE
By Jim Criswell, Pesticide Coordinator

Reldan is marketed by Gustafson but the technical or parent material is owned by Dow AgroSciences. EPA initiated a review of chlorpyrifos-methyl (Reldan) and had some major concerns. As a result, Dow AgroSciences requested from EPA to voluntarily cancel all registrations/uses of Reldan. Gustafson did not want this to happen. At the same time, EPA was reviewing pirimiphos-methyl (Actellic) and arrived at the same concerns. Thus, EPA was in the situation of having the two major grain protectants removed from the market at the same time. There have been lengthy negotiations since.

From EPA's review, the initial results were that EPA did not have any dietary concerns about Reldan, even though it is found on over 50% of the wheat samples analyzed through the USDA Pesticide Data Program. Although EPA stated there is no dietary exposure concern, much of EPA's discussion still revolved around the use of Reldan on grain and the resulting residues on grain. Since Reldan is not used

for crop production in the United States, EPA had no exposure concerns resulting from their drinking assessments. EPA had major concerns over worker exposure.

Gustafson has agreed to change the label to only allow empty bin treatments to be made from outside the bin and the applicator must direct the spray downward. Also, if Reldan is applied to a grain stream, the application must be made in an enclosed system. That means there must be a hood-like device over the application nozzle and grain stream as Reldan is being sprayed on the grain stream.

Part of the interim agreement was that EPA would consider the registration of another insecticide for use on grain that would be used in combination with Reldan. This new product would reduce the rate of Reldan used and satisfy EPA's concern over the amount of Reldan used on grain. One of the potential insecticides has looked good in efficacy tests; however, that process has been slowed by that insecticide's review by EPA. EPA has risk concerns about that insecticide also. A third insecticide is a possibility; however, it is not registered in the U.S. for use on food and that registration does not seem to be moving forward.

To complicate the matter, Dow AgroSciences has received a tolerance for its insecticide spinosad for use on stored grain. It seems unlikely that Dow AgroSciences would market two products in the same low use market of stored grain. However, stranger things have happened.

EPA, Gustafson and Dow AgroSciences are still negotiating the use of Reldan. EPA is in a corner as no company has stepped forward with an alternative insecticide to register on stored grain, except for Dow's spinosad. EPA's present policy is not to remove a major use without a new replacement being registered.

Dr. Tom Phillip's team has been conducting efficacy tests on a few of the potential grain protectants. There are not many companies who wish to have their products used on stored wheat. This is partly due to the "risk cup" policy in the Food Quality Protection Act. A use on stored wheat could potentially use up a large portion of an insecticide's risk cup. This is because wheat is used in crackers, bread and cereals that are eaten by children. These types of food have the greatest concern of potential exposure by EPA risk assessors.

GROCERY STORE PROJECT

Several years ago a graduate student, Ray Platt, a MS graduate student in Entomology working with Gerrit Cuperus, completed his thesis that investigated and documented current pest management practices and pests of grocery stores in Oklahoma City and Stillwater.

General findings were as follows:

1. The majority of stores use a pest control firm
2. Almost 100% of the stores had detectable Indianmeal moths
3. Beetle insects were quite abundant in most stores
4. Recovered beetle species included: drug store beetles and merchant grain beetles
5. Pitfall traps were very effective sampling beetles
6. Aerial traps were effective for monitoring Indianmeal moth.
7. The majority of grocery stores do not do a good job in pest monitoring or sanitation.
8. The majority of grocery store employees could not recognize pest problems
9. The greatest concentration of insects was in the pet food areas
10. Most stores depend on insecticides to manage insects.

Copies of this study are available from: Gerrit Cuperus 405-744-9419 Email: bugs1@okstate.edu

MOISTURE MIGRATION 9MM0 – SERIOUS OK GRAIN PROBLEM
By Ron Noyes, Extension Agricultural Engineer, Stored Grain Management

Moisture Migration (**MM**) or **"Top Crusting"** is a moist grain layer that develops at or near the grain surface in steel bins and flat storages. **MM** occurs during cold weather by convection air currents generated by the extreme difference between cold outer grain and warm center grain.

Air in cold outer grain settles to the bottom, pushing bottom air to the center. As the warm center air rises, it absorbs moisture from the grain, then condenses water on cold grain near the surface, Figure 1.

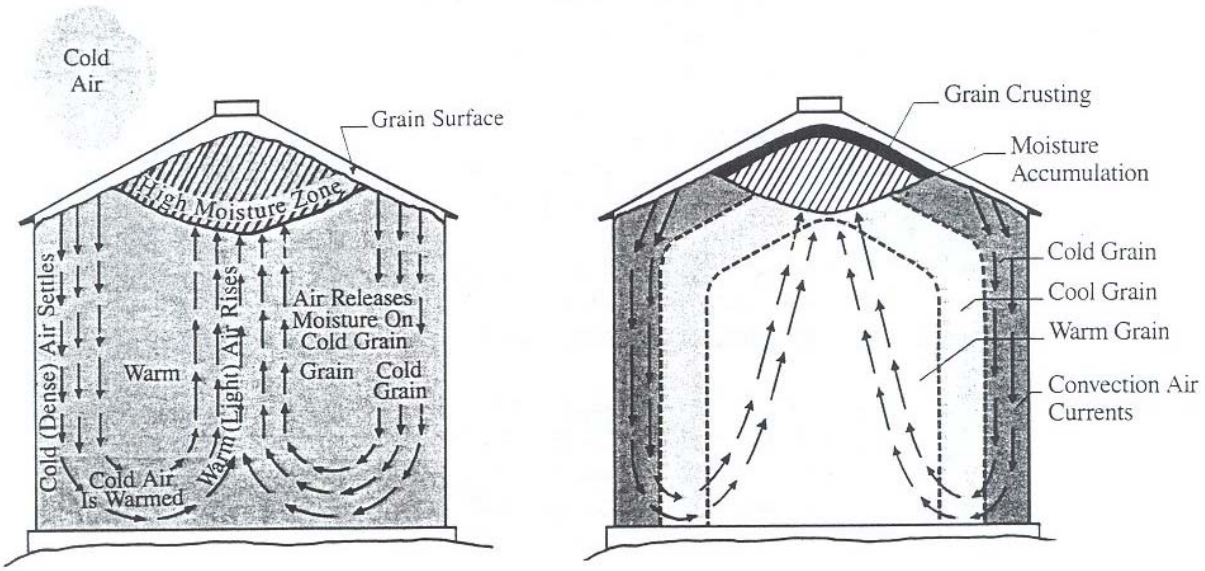


Figure 1. How moisture migration develops in steel bins after several months in storage without aeration.

After several months, grain near the surface increases from 10-12% to 20-25% moisture. Warm daytime headspace temperatures activate grain molds, forming a crust. As mold forms, the crust blocks the airflow, so the crusted grain area gradually increasing in diameter and thickness.

MM occurs in the Southern, Central and Northern U.S. climatic conditions. **MM** occurs in all sizes of grain bins, 10 ft to 105 ft diameter. It occurs in grain considered to be at safe (10-13%) moisture grain. The higher the grain moisture, the faster **MM** develops for a given temperature difference as the warm dry air absorbs more water from wet grain. Also, the greater the difference between the central and outer wall grain temperature, the stronger the convection currents will be and the faster **MM** will develop.

MM is not the same as wet, tough surface grain caused by roof moisture condensate from poor headspace ventilation. Roof condensate falls in streaks on the grain from under-roof structural supports. Also, **MM** does not cause the localized vertical column of moist moldy grain or "soldier" under the downspout. That moldy column of grain is caused by warm moist air condensing in cold downspouts, forming a steady stream of water that soaks deep into the peak.

Under-roof condensate problems are eliminated by installing a roof vent right beside the fill cap, or adding a hinged horizontal plate, adjustable weight, gravity flap valve over the end of a vertical downspout. The flap valve is adjusted to open with very light pressure from minimal flow of grain, but closes and shuts off airflow when grain flow stops.

The solution to controlling **MM?** Keep grain temperatures uniform using: (1) proper aeration, coordinated with; (2) monitoring grain temperature cable readings. Many bins set with aeration systems unused while grain goes out of condition due to lack of attention by grain managers.

Stored grain is a living, dynamic ecosystem, continually changing with outside temperature changes. **You, the grain manager** must continually monitor grain temperatures and operate the aeration system carefully on a timely basis. **You have to walk the bin and check the grain!** Or, have a superintendent or assistant grain manager who can give you reliable information on surface grain condition, and probe the grain to detect crusting cool grain just below the surface.

You can't store it and forget it for 6-9 months or you'll have **MM with musty odors or weevil sour grain, high insect populations and high IDK**. Grain molds attract insects. **MM** and insects respiration moisture and growth contribute to a vicious grain damage cycle.

Some gain managers think that after aerating once, they shouldn't aerate a second time because they'll lose marketable grain moisture. Normal fall and winter aeration reduces grain moisture, but you can lose much more from **MM** than from moisture shrinkage from aerating twice.

During fall aeration, monitor temperature cables weekly so you know when the cooling zone moves out of the bin, and grain temperatures are uniformly cool in the 40°Fs or 50°Fs. After aeration, **seal fan openings** immediately and monitor grain temperatures bi-weekly. Look for sudden rises of 5-10°F at one or more levels, and watch for hot spots. If grain temperatures 2 feet from wall and the center grain differs by 15-20° F or more, or early stages of **MM** (1-3 ft. below the surface) is detected (hopefully peaks have been lowered by coring), aerate until the temperature difference is 5-10°F.

The **Store it and Forget it Management Philosophy** just feeds the insects, creates a lot of work chunking out moldy grain, while LOSSES increase! Managers, who maintain harvest grain quality from binning to market, continually manage grain from receiving to shipping! If you haven't checked your grain lately, climb in the bin NOW!

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