O$U TIP$ on $TORED GRAIN

The OSU Stored Product Management Newsletter

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MISSION:

OSU Tips on Stored Grain (***OSU TIPS***) is designed to keep the Oklahoma commercial grain industry current on issues regarding stored grain management. We plan to publish at quarterly intervals throughout the year.

This newsletter is designed to share information from industry and OSU faculty and staff to help grain elevators optimize their grain storage management. ***OSU TIPS*** will include key articles containing useful grain management information, new technology, applied research developments, current and pending government regulations, and details about future OK and national grain industry conferences, workshops or training meetings.

Objectives of ***OSU TIPS***:

1. Continued education of OK grain industry in principles of sound grain management.

2. Maximize elevator worker and employee safety through safety training and education.

3. Optimize elevator grain system profit through training in improved storage and handling technology.

If you have grain systems management or elevator equipment technology ideas that you want to share with OK elevators and mills, please contact Gerrit Cuperus at 405-744-9419, E-mail: bugs1@okstate.edu or Ron Noyes at 405-744-8416, E-mail: nron@okstate.edu.

Where Do Grain Storage Insects Come From?

Most stored grain insects are good fliers. They fly from the areas surrounding bins or silos when attracted by fresh grain. Table 1 outlines sources of insects found on steel bins in a commercial storage in central OK. These data emphasize that insects can be trapped any place that moving air carries odors which attract insects. This steel bin data is very different compared with concrete silo facilities where the numbers of insects that are recovered are high in the bin bottoms indicating poor bin clean out and sanitation.

Table 1. Average number of insects caught in flight traps at various locations in/on 180,000 bu. commercial steel bins at an elevator in central OK.

Trap Location	Average Insects per Trap
Eaves (Inside bin)	4.89
Eaves (outside bin)	4.67
2/3 bin sidewall height	2.78
1/3 bin sidewall height	2.36
Ground	2.18

Area-Wide Stored Grain IPM

What is the Area-Wide Program?

The ***Area-Wide IPM Program for Suppression of Insect Pests in Stored Wheat*** is a cooperative program effort of scientists and technicians from Kansas and Oklahoma to study in-depth storage and transfer of grain at three levels of marketing. Those participating from Kansas are faculty, scientists and technicians from the Grain Marketing & Production Research Center and Kansas State University in Manhattan Kansas. The Oklahoma group is members of the Stored Product Group at Oklahoma State University.

What are our goals?

Our overall goal is to develop a model to help reduce pesticide use, the cost of pest management and the risk of insect problems in commercial grain storage in OK and KS.

What have we been doing?

Sampling is a key component of this five-year field research study. Several sampling methods have been used to sample grain over the last three years of this project. The types of sampling most used on the project have been:

Vacuum Probe sampling - this is a beneficial technique for sampling grain that is not being moved. We use a portable vacuum pump power source with long suction hoses that can reach 200-300 ft from the vacuum pump. Our vertical probe is 4 ft sections of 1.0-inch ID aluminum pipe. One-gallon samples of grain can be taken at four-foot intervals to various depths. Sampling is commonly done to 40 feet, but we can go as deep as 140 feet in wheat.

Ellis Cup sampling of Moving grain - this utilizes a small Ellis cup to remove one-gallon samples from grain on a moving belt conveyor. This sampling method provides a good estimate of overall insect densities in the grain.

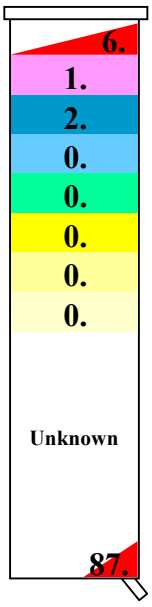
Truck Samples- We collect a small sample (1 gal) from the front and back hoppers of large trucks that relates to the methods grain inspectors sample incoming wheat.

Bottom Bin sampling - draining a small amount of grain (2-6 bushels) out of the bottom of concrete bins onto the unload conveyor belt is a good method of sampling grain at the bottom of concrete bins. We have to make sure that we remove more grain than the discharge spout holds to avoid sampling grain from the spout only.

Probe Trap - this is one of the easier methods of sampling, however, probe trap samples can be alarming because these traps catch certain insect species easier than others. Trap catch depends on the grain temperature and the length of time they are left in the grain. Traps left in very warm infested grain for more that a couple days can accumulate insect numbers at well over 5000 insects per trap.

Over the last few years we've gained a lot of insight on how grain becomes infested with insects in concrete silos. This data comes from over 28,000-grain samples taken with the vacuum probe and bottom samples. It indicates that insects from residual carryover grain or moldy grain can infest clean grain at the top and bottom of the bins.

The diagram of the silo (Figure 1) shows the percentage of insects found at different depths in a concrete silo after grain has been stored for a specific time period. Most of the insects were found in the top and bottom of the silo. Insects infest the top of the grain either through grain vents, roof eave cracks or through the top hatch. Bin bottom infestations apparently come from insects living in grain residues left in the silo before the bin was filled.



Empty-bin residue samples taken in April and May showed high numbers of insects (greater than 10) in 1/3 of the samples. Cleaning bin bottoms, discharge spouts and conveyors before new grain is added should reduce the chance of early infestations developing in grain at the bin bottom.

The highest number of insects in grain silos was found during October and November. The reason insect numbers are highest during these months is that it usually take 2-3 generations before insects reach densities that are detectable by sampling. Each generation takes about 1month in 90ºF grain and about 2 months in 75ºF grain. With each generation, the insects increase about 10-20 fold, depending on species.

The very high percentage of insects found in bin bottoms may not be serious cause for alarm. At this time we do not know how far up into the grain these infestations occur. This could be a relatively small amount of grain that has high insect densities. Further investigation is planned.

Grain "turning" in concrete silo facilities may inadvertently mix infested grain with clean grain, thereby contaminating the whole bin. This is one reason why sampling grain with a vacuum probe may be a better IPM practice than moving the grain from one bin to another to check, especially after grain has been stored for 2-3 months.

Malathion Not Recommended By OSU

Oklahoma State University no longer recommends malathion for any treatment in grain storage because of high insect resistance and rapid malathion degradation in warm, relatively moist grain. A small brochure from OSU that discusses why OSU does not recommend malathion should have been received by all OK elevators before harvest. It can also be accessed at the OSU Stored Product IPM web site. We have enclosed one brochure for your information. Recommended products for empty bins are included in the following table, which relates survival results of the products by Lesser grain borers:

Relative Survival Results for Lesser grain borer

Chemical Product		Survival rate
1.	Tempo*	0*
2.	Reldan	1.25
3.	Malathion	5.00**
4.	Control	11.75

*OSU recommendation.
** Malathion is no longer recommended by OSU for empty grain bins/sanitation. Diatomaceous earth (under trade names Insecto, Protect-it) is cleared for empty bin.
*** Diatomaceous earth (DE) test is available from Tom Phillips, 127 NRC, OSU, Stillwater, OK 74078. With DE, application is critical.

Fall Aeration in Oklahoma Grain Storage

By
RonNoyes *, Gerrit Cuperus **, Tom Phillips **, and Jim Criswell **
*** Biosystems & Agricultural Engineering Dept.; Entomology & Plant Pathology Dept.**

Stored grain insect populations increase rapidly in warm surface grain and deeper in steel bins during September and October. Field research indicates that residual grain in concrete silo bottoms usually are infested when filled with new grain at harvest. Insects stop feeding and breeding below 60°F, so stored grain should be cooled as quickly as possible to below 60°F. For each 10°F reduction in grain temperature, insect reproduction is cut in half.

Check the aeration system to make sure everything is ready. Set automatic aeration controllers to 65°F in early October, then 60°F after mid-October. Many facilities don't have aeration controllers, but manual operation of aeration fans will help cool grain quickly.

Suction cooling (down-flow system) is much more beneficial for insect control than pressure cooling (push or up-flow system) for two reasons. First, a high percentage of stored grain insects congregate initially in the top 3-6 feet of grain in steel bins and silos, especially when aeration fans, sidewall doors, unload augers and other insect access openings around the base of the bins are sealed year-round until time to aerate. Suction aeration uses the full cooling potential of the air where it is needed most, in the top grain.

Second, pressure aeration adds "heat of compression" to cooling air. This ranges from 3-5°F in shallow bins and flat storage (15-30 feet deep) using vane-axial fans, to 5-10°F in large steel bins, and 10-15°F (or higher) in concrete silos using centrifugal fans. If fans add 10°F to the

air, you need 50°F air to cool grain to 60°F. Check pressure fan heat rise by drilling a 1/4-inch hole between fan and bin/silo, insert a thermometer, and compare downstream air temperature to outside air. Pressure fans don't cool top grain until the end of aeration and then just to the "average" of lower grain temperature.

With **suction cooling**, ambient air cools top grain within two to five nights. Top grain keeps getting colder throughout the aeration period. It takes 100-150 hours to completely cool grain at 1/10th cfm/bu (typical steel bin aeration) in the Fall. Silos at 1/20th cfm/bu take 200-300 hours to cool. With suction aeration, near the end of the cooling period (early November) top grain will cool to 35-40°F and lower grain should cool to 50°F or lower. The important factor -- **suction aeration will cool many insects within the first 2-5 days of aeration**.

To cool steel bins faster, "core" bins by removing 1/3 to 1/2 of grain peak diameter. Removing part of the "core of fines" helps loosen the grain mass, "level" the grain, shortening air paths. "Coring" and lowering the peak by 1/3 to 1/2 should reduce cooling time by 15-20%.

Most vane axial fans have the same flange bolt pattern at each end. To reverse the fan, unbolt and reverse the fan housing. Put the inlet orifice ring and fan guard on the other end and re-bolt.

WARNING: Roof vents that supply inlet air for suction fan aeration systems must be kept open at all times. **Do not operate suction fan systems during snow or freezing rain conditions. Aeration fan(s) may cause roof collapse**.

Use the following steps for control of aeration systems:

Manual Aeration

1. Remove aeration fan covers, check aeration fans for obstructions.
2. Check roof vents to make sure they are clear/open and adequately sized.
3. Start fans to check for vibrations (mud daubers) and bad bearings (growling).
4. Install a thermometer in the shade near aeration fans.
5. When air temperature drops below the desired level (example: 65°F) in the evening, turn on the aeration fans. When temperatures rise to the selected upper temperature level (such as 65°F in early October) in the morning, turn off the fans.
6. **Alternative:** Watch TV weather channel for predicted nighttime temperatures.
7. If predicted temperature is 60°F or lower, turn fans on at 5-7 PM and off at 7-8 AM.

Automating Aeration Fan(s).

1. To **"automate"** aeration fans, install a 30-110°F heating/cooling ventilation thermostat with a 3-terminal switch "around" the "start switch" wiring to the aeration fan motor starter coil. Wire an "on/off" toggle switch in-line with the thermostat for "manual shut-off". A ventilation thermostat with a 2-terminal switch won't work -- it switches "off" when air cools down.

2. Wire the thermostat terminal screws on the micro-switch with one wire to the "Common" terminal and the other wire to the thermostat switch terminal that causes the switch to "close" and start the fan(s) when the temperature drops.

3. Install the thermostat so it is protected from rainy weather but with the thermostat bulb in ambient air in the shade.

4. For one or more (multiple) aeration fans, hire an electrician to install time delay relays activated by the thermostat to start large (10HP or larger) fans about 8-10 seconds apart.

5. Set the thermostat on 60^{o}F in mid-October and 50-55^{o}F in late October and early November.

6. To keep track of aeration fan hours, install an hour meter that operates each time your fan runs (turns on/off). For 1/10th cfm/bu, 120-150 hours of fall aeration will usually cool leveled grain. Plan on 150-200 hours of cooling for peaked grain. Silos at 1/20th cfm/bu will need 250-300 hours.

Fumigation Safety and air monitoring videos are available

Fumigation Safety and air monitoring videos are available from you local OSU county Extension offices that focuses on phosphine fumigant safety. The tapes are:

Commercial grain handling 15:45 1993 VT 351
Proper fumigation for worker safety 27 min 1994 VT 728
Fumigation Safety VT 395 11:15 Air monitoring emphasis.

If you want to borrow and watch these videos either contact your local County Educator or call Gerrit Cuperus (405-744-9419)

Phosphine Update

By Jim Criswell, Pesticide Coordinator

EPA and the Phosphine Coalition have reached agreement on almost every detail. The Coalition is waiting for final approval of the proposed new phosphine label.

This label is only slightly revised from the existing label. EPA was to rule on the new label in August of 2001. If this is done by August or September, 2001, the registrants (companies which produce and market phosphine fumigants) expect to have the new labels on the market by July or September of 2002. We have not heard if EPA has approved the proposed label.

The only major change is the requirement of a Fumigation Management Plan (FMP). This was mostly required under the old labels but will be more clearly stated on the new labels. The fumigator is responsible for developing the FMP for each facility to be fumigated.

The Fumigation Management Plan presently consists of:

a. Ensuring the facility is well sealed, relatively air tight and will hold phosphine gas dosage levels for a sufficient time for a good kill.
b. Before sealing the structure to be fumigated, check to make sure there have not been major construction changes since the last fumigation, then seal all openings.
c. Reviewing existing FMPs, MSDS, and applicators manual (label) with company officials and appropriate employees.
d. Consult with company officials in the development of procedures and appropriate safety measures for workers who will be near the fumigated area.
e. Consult with company officials to develop an appropriate monitoring plan that will confirm that nearby workers and bystanders are not exposed to levels of phosphine above 0.3ppm. This plan must also demonstrate that nearby residents are not exposed to 0.3ppm or higher levels of phosphine gas.
f. Consult with company officials to develop procedures for local authorities to notify nearby residents in the event of an emergency during fumigation.
g. Confirm placement of fumigant warning placards to all entrances into the area under fumigation.
h. Confirm that required safety equipment is in place and that necessary manpower is available to complete a safe and effective fumigation.

The current FMP and related documentation, including monitoring records, must be maintained for a minimum of two years following each fumigation.

The FMP requirement is subject to change until EPA makes a final ruling on the label.

Some of the concerns from the proposed regulations have been removed. The previously required buffer zones and notification zones are now removed from the agreement.

Improved/Safer Applications of Fumigants

By Ron Noyes

Oklahoma State recommends closed loop fumigation (CLF) systems to ensure good bin sealing, fast fumigant application and uniform fumigant distribution

See more details by requesting OSU Fact Sheet FS-219 “Economics of closed loop fumigation”.

Stored Product IPM Internet address:
http://ipm.okstate.edu/ipm/stored_products/stored_products.htm.

This is the Stored Products IPM Homepage.

Oklahoma State University has worked with closed loop fumigation technology in the field for the past 6-8 years. Results have been excellent. CLF has been shown to reduce costs and improve kill with almost no worker exposure. CLF Benefits are:

1. Improve efficacy (high insect kills).
2. Reduced fumigant dosage to minimum label rates (or less).
3. Reduced worker exposure, improved safety.
4. Reduced number of workers required to fumigate.
5. Minimizes pesticide handling.

6. Ensures uniform fumigant gas distribution.
7. Costs about 0.6 to 1.0 cents/bu in steel, concrete and flats using in-house labor.
8. CLF installed by outside contractor may add 2X-3X to CLF installation cost.
9. Payback is about 2-4 years, depending on installation cost.

Oklahoma State University has fumigation manuals available from the local OSU Cooperative Extension Service (OCES) offices. Check with your County Ag Agent.

Get *TIPS* newsletter via Internet

We would like to encourage everyone who has Internet access to email us at: bugs1@okstate.edu so we can send *TIPS* via E-mail. We hope to provide future TIPS stored grain newsletter as an electronic newsletter on field pests. This will help reduce costs and improve timing.

Dichlorvos update

Diclorvos (DDVP) has been in a regulatory dilemma forever. DDVP is used quite a bit for Indian mealmoth control either as an aerosol or No pest strips eliminating adults. OSU recommends using 1 strip/1000 ft^3. In tests, it has proven effective and is our recommended treatment.

Problems in using DDVP include:

1. It looks like registration for dichlorvos will continue for the time being.
2. Distribution – getting the strips placed in key locations
3. Restricting air flow – excessive air flow through bin headspace will cause rapid loss of fumigant

Gerrit W. Cuperus
Extension Entomologist

Ronald T. Noyes
Extension Agricultural Engineer