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Prevent Damage to Stored Wheat

Michigan State University Cooperative Extension Service

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Departments of Farm Crops, Entomology, Zoology, Agricultural Engineering

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Prevent Damage to STORED WHEAT

✓ **MOISTURE** ✓ **INSECTS**
✓ **RODENTS**

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DEPARTMENTS of FARM CROPS,
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AGRICULTURAL ENGINEERING



MICHIGAN STATE UNIVERSITY
COOPERATIVE EXTENSION SERVICE
EAST LANSING

Prevent Damage to STORED WHEAT

Wheat Must Be Clean

WHEAT MUST BE CLEAN TO BE SOLD FOR FOOD PURPOSES. The best milling process can't make clean flour from unclean wheat. And wheat unfit for food can be sold only for animal use, at a loss in price on every bushel.

On July 1, 1956, new regulations of the Food and Drug Administration regarding wheat sanitation tolerances become effective. In the future, other grains will probably be included in this program to upgrade the cleanliness of the grain supply. The new tolerances provide that legal action against filth-contaminated wheat will be taken at the following lower levels:

One or more rodent pellets per pint of wheat (liquid measure) or

1 percent or more of insect-damaged kernels. (Kernels which have been bored by insects shall be considered damaged kernels. Kernels which are otherwise sound but which are only slightly eaten by insects or from which the germ has been removed by insects shall be considered sound kernels.)

The principal causes of contamination in Michigan wheat are:

1. Animals — rats, mice, birds, etc.
2. Insects — weevils and other insects.
3. Chemical residues — “pink wheat”; this is wheat grain treated with a poisonous seed treatment material. Michigan law permits *no* mercury in food.

What these regulations mean to Michigan wheat growers and shippers:

Wheat found to be contaminated by rodents and insects above the tolerances listed will be diverted from use as human food. If this occurs, substantial discounts in price may be expected. Wheat found to contain “pink wheat” will be diverted from use either as human or animal food. Such wheat will be very difficult to sell *at any price*.

The situation in Michigan:

1. Some Michigan wheat has *already been confiscated* under tolerances twice as liberal as those effective July 1, 1956.
2. Nine out of ten contamination cases can be traced to contamination which took place *on the farm*.
3. Small producers contribute heavily to the con-

tamination problem.

4. Michigan wheat is clean when it is ready for harvest.

What should be done:

1. All handlers of grain must learn and use *good housekeeping* methods.
2. All wheat growers must market clean grain.

How can this be accomplished:

1. *Store dry grain in rodent-proof storage.*
2. *Inspect the grain for insect activity at regular intervals.*
3. *Do not put treated seed wheat with market wheat.*

Following are specific recommendations for carrying out these steps.

Don't Store Wet Grain

FOR SAFE STORAGE, WHEAT SHOULD CONTAIN 14 PERCENT MOISTURE OR LESS. Grain with more than 14 percent moisture is subject to “sick” and mold damage. In addition, insects are more active in wet grain than in dry.

BORDERLINE MOISTURE IS DANGEROUS! Don't take the risk involved in storing wheat with more than 14 percent moisture. During warm weather, grain with excess water in it may become damaged or “sick” in a period of 2 weeks. “Sick” wheat is more difficult to market, without high discounts, than sprouted wheat.

“Sick” wheat may appear normal on the outside. However, the germ is dead or partly dead. Wheat in such a condition is generally not suitable for flour milling. The normal color of a healthy wheat germ is white or creamy white; “sick” wheat has a germ which is tan to black in color. A wheat germ can be examined by carefully removing the seed coat which covers it.

TEST FOR MOISTURE IN WHEAT — Thresh by hand or combine enough for a sample (at least ½ pint), and take it to your local elevator manager for a moisture test. If they tell you it contains too much moisture, DON'T COMBINE your wheat! (CAUTION: *The sample of threshed grain should be placed in an airtight container, such as a fruit jar, for carrying to the elevator.*)

Think! Before Combining

Keep these points in mind before you begin combining your wheat.

1. Just because the dew has dried off the heads

of the standing grain doesn't mean the grain is ready for combining. The kernels have had all night to absorb moisture. It may take a couple of hours of drying, after the dew is off, before the grain is dry enough to thresh and store safely.

2. Cool grain will keep better in storage than warm grain. Grain exposed to the hot sun after threshing becomes very warm in a short time. Or if the grain is bagged and left lying in the sun in the bags, it will become very warm and may also absorb moisture from damp soil. Haul and store the grain as fast as it is combined.

Ventilate the Grain

If you use the home granary for storage, provide good ventilation either with mechanical cooling equipment or by ventilation through open doors and windows that are screened—for 2 weeks or more, if necessary.

Mechanical ventilation is the use of a fractional horsepower motor, small fan, and small center tube or tubes to cool grain and maintain quality by forcing low airflows (of one-tenth CFM/cu. ft. or less) through the grain.

Mechanical ventilation is not designed for drying grain; however, in the case of borderline moisture, mechanical ventilation will remove about $\frac{1}{2}$ of 1 percent of moisture and improve keeping quality.

Proper fumigating methods with mechanical cooling equipment insure almost complete fumigation of stored grain. Reducing the temperature of the stored grain with mechanical cooling helps reduce insect infestation providing the grain contains less than 14 percent moisture.

(If wheat has been harvested while too wet for storage, see M.S.U. Extension Bulletin 316, "Drying Grain With Forced Air," for suggestions on handling wet grain.)

To Prevent Loss from Granary Insects

- Store grain in insect-free granaries.
- Store grain with less than 14 percent moisture.
- Mix a "wheat protectant" with the wheat when it is put into the bins.
- Fumigate stored grain 6 weeks after it is harvested.

All of these methods may be necessary to prevent insect damage to grains. However, if a "wheat protectant" is used, it may not be necessary to apply a

GRAIN-DESTROYING INSECTS

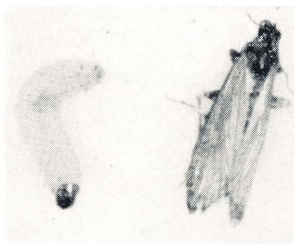
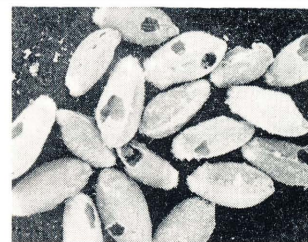
Numerous insects cause damage to stored grain. Of these, the rice and granary weevils, the lesser grain borer, and the Angoumois grain moth are the most important. These insects cause damage by the adults or worms, or both, burrowing into the kernels.

Fortunately for wheat growers, these insects are not very prevalent in Michigan. However, such insects as the saw-toothed grain beetle, the confused flour beetle, the cadelle, mealworms, Indian-meal moth, Mediterranean flour moth, and others very often infest stored small grains, causing spoilage and loss in weight of grain because of insect feeding.



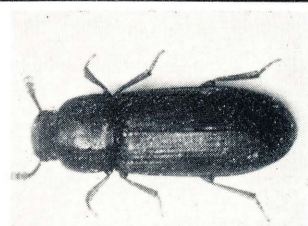
The granary weevil has a long snout, at the end of which are its mouth parts. With these mouth parts, it bores holes in kernels of grain. This beetle is chestnut-brown to blackish in color. It is not more than three-sixteenths of an inch long.

These kernels of wheat show the damage caused by the larvae (grubs) of the granary weevil. The female granary weevil lays her eggs in small holes which she makes with her mouth parts. The grubs which hatch from these eggs mine out of the kernels of grain.



The Mediterranean flour moth has a wingspread of less than 1 inch. When the moth is not flying, the upper wings are grayish. The worms are white to pinkish in color and about one-half inch long when full-grown.

The confused flour beetle is reddish-brown in color, elongated in shape, and about one-seventh of an inch long. It belongs to a group of insects commonly called "bran bugs." This insect and others similar to it can be seen easily by putting a sample of infested grain on white paper.



fumigant. If a fumigant is used, it is generally not necessary to use a "wheat protectant"—a chemical which keeps insects away.

Fumigation of *insect-infested grain* is not a preventive measure. When insects are in the grain, that grain is already contaminated. Killing them by fumigation does not remove the damage or contamination. Both dead and live insects are undesirable in grain for human food.

Storing grain with less than 14 percent moisture in insect-free granaries is a "must" in preventing damage to stored grain. Granary insects develop rapidly in stored grain with excessive moisture. In other words, every farmer should: (a) clean out his granaries; (b) treat them with methoxychlor or pyrethrum-piperonyl butoxide combinations; and (c) see to it that his grain does not have more than 14 percent moisture when it is put into the granary.

The granary should be cleaned out and treated with methoxychlor or pyrethrum-piperonyl butoxide combinations at least 2 weeks before new grain is put into it. Do the following:

1. Sell *all* old grain that is not to be kept through another winter.

2. Put *all* old grain not to be sold in a granary by itself. Insects will travel from old grain stored near new grain to the new grain. *Don't pile newly harvested grain on old grain!*

3. Thoroughly "house-clean" the granary, and repair all mouse and rat holes.

4. Treat the walls, ceilings, and floors of the granary with 50 percent wettable methoxychlor powder. Use it at the rate of 2 gallons to each 1,000 square feet of wall, floor, and ceiling surface. Follow one of these methods:

- (a) Use 2 pounds to 5 gallons of water. Put on with a broom. Be sure to keep the water and methoxychlor well stirred, *or*

- (b) Use 1¼ pounds to 3 gallons of water. Put on with a knapsack sprayer. Keep shaking the mixture in the sprayer, *or*

- (c) Use 40 pounds to 100 gallons of water. Put on with a power sprayer.

5. Use pyrethrum-piperonyl butoxide combinations at the manufacturer's directions. Read the label.

Leave the granary undisturbed for at least 2 weeks after treating, then sweep the walls and floors. Re-

move all traces of loose methoxychlor or pyrethrum-piperonyl butoxide combinations and dead insects.

"Wheat protectant" is applied directly to the grain as it is being stored. Various methods can be devised for mixing the "wheat protectant" with the grain. The aim is to thoroughly mix the grain and insecticide together. "Wheat protectant" is usually not effective if thorough cleaning of the granary is neglected. This material is not satisfactory for controlling insects *once they have established themselves in the grain*.

FUMIGATION: To prevent insect damage, fumigate 6 weeks AFTER THE GRAIN IS HARVESTED. (Other insects, such as sweet clover weevils or wireworm adults, often appear in the grain when it comes from the field and may be confused with grain-destroying insects.) Do the following:

1. Be sure the lower part of the granary is tightly constructed before using a fumigant to prevent insect damage to stored grain. This means that the floor and sidewalls should be equally tight to prevent the fumigant from escaping.

2. The grain should be level, and piled not more than 6 inches from the top of the boards on the bins.

3. Use a mixture of ethylene dichloride and carbon tetrachloride† as follows:

- (a) 5 gallons to each 1,000 bushels of grain stored in deep bins.‡
- (b) 1 gallon to each 150 bushels for lots less than 1,000 bushels.‡
- (c) 8 gallons to each 1,000 bushels for grain stored in shallow bins.

Pour the mixture over the top of the bins of grain. Grain stored more than 4 feet in depth may need special means of applying the mixture. Get special instructions for such cases. (*Note: It is best to put the ethylene dichloride-carbon tetrachloride mixture on the grain from outside of the granary*). Do not breathe the fumes of the MIXTURE for any extended period. Do not spill it on the hands or skin.

†This mixture will not kill granary insects very well when the temperature of grain is less than 65° F. Ethylene dichloride mixture should be factory-made in the proportion of 3 parts ethylene dichloride and 1 part carbon tetrachloride. It is the standard recommended fumigant for Michigan.

‡After fumigating with ethylene dichloride-carbon tetrachloride mixture, leave the grain undisturbed for 6 days to obtain the best results. Follow manufacturer's directions for other materials.

4. Other good fumigants like ethylene dibromide§ can be bought to treat grain. They should be used according to the manufacturer's directions.

When the granary insects are found infesting stored grain, the only thing that will control them is fumigation. *Follow the instructions given for the use of fumigants to prevent insect damage.*

NOTE: Grain fumigants are poisonous. Read the label on how long you should wait after fumigating until the grain can be sold.

To Prevent Loss from Rodent Contamination

- Rat- and mouse-proof existing granaries.
- Erect only rodent-proofed new granaries.
- Keep rodent population down by eliminating shelters and food supplies.

Increasingly, grain is being condemned for human use because of contamination by animal hair and filth. Contamination such as dung, urine, and hair comes mostly from rats and mice—but birds, cats and other animals can also be responsible.

Rodent-proof storage is the only satisfactory protection. Even with proper sanitation and efficient control, rats and mice may come into a farm from some place outside to enter a granary.

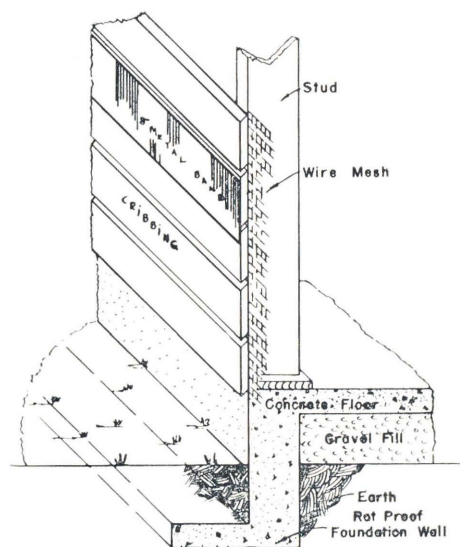


Fig. 1. Metal band along siding.

§Fumigants containing carbon bisulfide are generally not suggested for use in Michigan.

Suggestions for rat- and mouse-proofing:

1. Screen all ventilation openings with woven wire screen ("hardware cloth") of $\frac{3}{8}$ -inch mesh or smaller. Small mice can pass through $\frac{1}{2}$ -inch mesh. Metal lath of the expanded-metal type is cheaper, but it is harder to handle. And since it rusts easily, it can be used only in sheltered places.

2. All holes which are not necessary for ventilation or access must be patched with sheet metal. The granary bins can also be lined with sheet metal.

3. An 8-inch band of galvanized sheet metal applied over the siding, 2 feet or more above the ground, will prevent rats from climbing up sidewalls (Fig. 1).

4. All doors must be kept closed or be screened. Door jambs should be metal-sheathed. Door edges

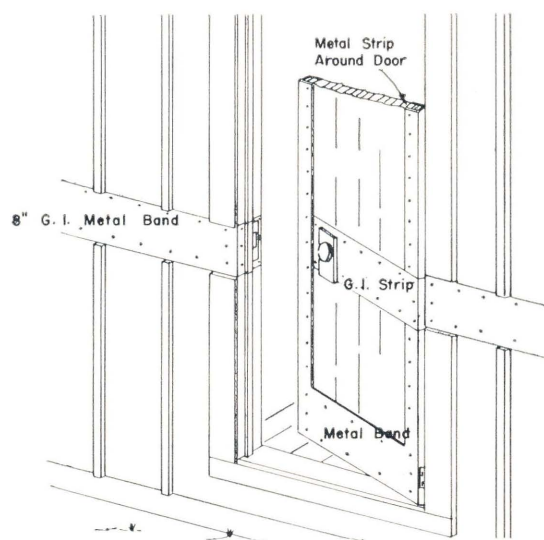


Fig. 2. Metal strip around door-edge.

should be covered with metal, applied as a U-shaped strip around the door (Fig. 2). Properly screened openings should be provided for ventilation.

5. *Don't leave openings for cats* to enter the granary. Rodents can use the same openings—and the cats themselves can foul the grain.

6. To prevent cats, rats, and mice from entering through the top—and to prevent birds from dropping through the top—grain bins should be covered with sheet metal. Use 1-inch board covered with metal or a frame of 2 x 2-inch material and sheet metal (Fig. 3).

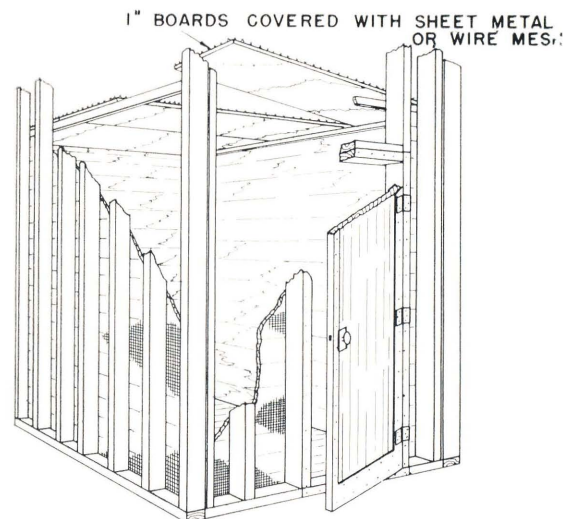
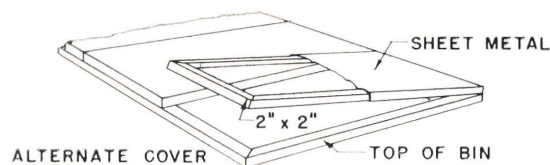


Fig. 3. Covering for top of bin.

Control of rats and mice already present:

Where rats and mice are already present, poison them with an anti-coagulant bait such as warfarin. (*Warning: Anti-coagulant baits must be kept from other animals.*) Prepare the bait by mixing 1 part of poison (0.5 percent concentrate) with 19 parts of cereal bait, by weight. Powdered sugar substituted for cereal, up to 1 part, increases the attraction.

Expose the bait where the rodents can get at it continuously, since it must be eaten by a rodent for several days in order to kill. Protect the bait by covering it with a box or a bait station. Inspect each station every day, adding new bait as long as it is being taken. Don't ever let the bait run out. But remember—poisoning is only a temporary remedy; the only permanent control is elimination of all rodent food and shelters.

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