



## Insects in stored grain

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The end of the season means harvest and grain storage. Grain is put into storage under the assumption that the selling price later will be equal or more than the price now. Insects reduce quality (and therefore, price) by directly feeding on grain and reducing test weight, in some cases up to 8 pounds per bushel. Grain shipments with insect damage may be reduced in grade. For example, if 32 or more damaged kernels are found in a 100-gram sample of wheat, the grain is downgraded to “U.S. sample grade,” to be sold as livestock feed, rather than for human consumption.

As insects feed, fine matter accumulates in the bin and reduces airflow. This fine dust consists of tiny grain pieces, shed insect skins, dead insect bits and webbing. Insect feeding also produces hot spots in the grain. Reduced airflow and hot spots, combined with moisture, often lead to another problem—growth of stored grain fungi, some of which produce toxins.

### Prevention and sanitation

The best way to manage an insect infestation in grain is not to have an infestation in the first place. Good sanitation pays off in the long run, and may reduce or eliminate the need for insecticide applications to your grain. This is important because USDA food testing programs find that a high percentage of grain samples have pesticide residue. The sanitation practices discussed below should be part of your routine prior to storing grain at your facility or farmstead.

- ◆ Clean grain handling equipment (augers, combines, wagons, scoops, trucks, rail cars). Grain and fine material stuck in equipment can harbor pests.
- ◆ Clean inside the bin, especially beneath floors. Most people do a good job cleaning the bin, only to ignore the floor, which may harbor rodent dropping, insects, and fungal spores.
- ◆ Clean around the bin, and remove weeds from a six to ten foot border around the area. Spilled grain or debris is food for both insects and rodents.
- ◆ Seal all cracks and crevices. Cracks are entry points for insects
- ◆ Cover or screen fans when not in use. This is another entry point for insects.

After cleaning and sealing, treat the bin with a registered bin treatment. Bin treatments are used in and around structures after cleaning, but before adding grain. They kill insects still in the area and create a barrier to infestation. Treat floors, walls up to six feet, the foundation, and ground directly around the bin. The following is a list of products registered as bin treatments. Read the product label before using any of these insecticides, as formulations can vary, and labels may change from year to year. Some products are registered only for bins containing certain grains.

- 1) Tempo (cyfluthrin - a pyrethroid). Registered for all indoor warehouses, bins, grain-handling equipment, trucks, rail cars, and outer areas around bins. Tempo is NOT registered for direct application to grain.
- 2) Reldan 4E or 3% dust (chlorpyrifos-methyl - an organophosphate) Registered for bins that will contain barley, oats, sorghum, or wheat. Do NOT use in bins that will contain corn, rye, or soybeans.
- 3) malathion = numerous formulations (an older organophosphate). Registered for use in structures that will contain barley, corn, oats, rye, and sorghum. Do NOT use in bins that

will contain soybeans.

If you follow these recommendations, you will likely not need to use an insecticide on the grain itself or during storage in Michigan. Compared to southern states, we harvest grain later in the field season, and can cool grain faster after harvest, reducing insect and fungus activity.

### Treatments directly to grain

If you anticipate storing the grain for a long period, you may need to apply insecticide to the grain itself. There are two different types of insecticide applications on grain. If the grain entering the bin is clean and is not layered over old grain, a “top dress” or surface treatment may be all that is needed. A surface treatment is applied on the last grain going into the bin, or directly on the grain surface once the grain is in the bin. A surface treatment must not be disturbed after application, since this ruins the barrier. Surface treatments protect against insects entering from the top of the bin, but will not control insects already present lower down in the grain mass (for example, if you layer new grain over infested old grain). A surface treatment should not be applied to grain which already received a protectant (see below) at bin-fill.

**Protectants** are insecticides directly applied to the grain stream as it enters the bin. These treatments are designed to control infestations throughout the grain mass. In Michigan, protectants generally are not necessary if grain will be used or sold within six months, and if the bin is properly cleaned, sealed, and sprayed with a sanitary spray (see above) prior to fill.

The success of both surface and protectant treatments depends on a variety of factors:

- *Correct identification of current and expected insect problems.* Some treatments, for example methoprene and Bt, are useful only against particular types or stages of insects.
- *Grain condition.* Grain moisture and temperature are very important. Protectants may fail under excessive moisture and temperature - for corn this would be over 16 percent moisture and 90oF. Grain should not be treated until it is in the proper condition.
- *Age of the spray mix.* A fresh spray mixture is important because insecticides can break down under warm conditions before application.
- *Application method.* Insecticides must be thoroughly mixed, then applied under the right pressure. Low pressure is better, since this creates larger droplets that coat the grain surface better.

Products labeled as protectants and/or surface treatments include:

*Reldan 4E* or 3 percent dust (chlorpyrifos-methyl). Registered for barley, oats, sorghum, and wheat. NOT registered for use on corn and soybean.

*Actellic* (pirimiphos-methyl). Registered for corn and sorghum. NOT labeled for wheat.

*Malathion.* Many trade names and formulations, registered for different sites and uses.

Refer to the individual product label, as some may not be registered for use on stored grain, or a particular type of grain. Also, some millers will not take malathion treated grain.

*Diatomaceous earth* or “DE”. Several trade names. Registered for: barley, corn, oats, rye, soybean, sorghum, sunflower, wheat (different products registered for different crops - check labels). DE is a chemically inert dust that abrades the insect cuticle, causing the insect to dry out.

*Pyrethrins.* Several trade names. Registered as a surface treatment for barley, corn, oats,

sorghum, sunflower, and wheat. NOT registered for soybean.

*Diacon* (methoprene). Registered as a surface treatment for barley, corn, oats, sorghum, and wheat. NOT registered for soybean. Methoprene is an insect growth regulator, or IGR, disrupting insect development. It thus controls larvae, but not adult insects.

*Dipel, Top-Side, etc.* (Bt). Registered as a surface treatment for barley, corn, oats, rye, sorghum, soybean, sunflower, and wheat. Bt kills Indianmeal moth larvae, and is usually acceptable for the organic market. Bt will not control adult moths, weevils, and other grain beetles.

## Notes on label changes

*Malathion* (many formulations) is still used as a bin spray and grain protectant. Due to a variety of problems, including insect resistance and residue concerns, products containing malathion may undergo label changes for use on stored grain. Any malathion you have on your farm is still legal to apply. However, be aware that grain that has been treated with malathion may not be acceptable to some processors. Before you apply malathion to a bin or commodity, check the label of the product to make sure stored grain is still on the label. It is a good idea to check with your buyer to make sure your application will meet their standards.

## Infestation after storage

The key to grain management is prevention. But if you find an infestation in your bin several months into storage, there are several things to consider.

*Type of insect:* Some insects are primary pests, i.e., they attack undamaged grain and develop inside kernels. This group includes several weevil species and the lesser grain borer. Primary feeders not only cause direct damage, but also create holes into kernels and fine material so that secondary insects can infest the grain. Most other stored grain pests are secondary pests. Thus, the presence of weevils in your grain is of great concern.

*Location and density of insects:* Where is the infestation - in the top of the grain mass, or throughout the bin? How many insects are there? Answering these questions requires you to at a minimum to enter the bin, and hopefully to sample with a grain trier or probe trap. Infestation throughout the bin requires a different management strategy than infestation in the top layer of the grain.

*Environmental conditions:* Can the infestation be managed using temperature? At temperatures of 60oF or less, reproduction of grain insects drops off. Pulling cool air through the grain mass cools the insects, and also removes moisture pockets and hot spots that favor insect and fungal growth. However, care must be taken not to reduce grain moisture too much.

*Plans for the grain:* Grain destined for livestock feed can handle more insects and damaged kernels than grain destined for human consumption.

If new grain in a small bin is infested only in the top few inches (for example, by Indianmeal moth or by insects crawling in from access points in the roof) you may be able to shovel out the infested layer and treat the top of the grain. Repairs to the roof, screening or closing of access hatches, etc. must also be done to prevent new insects from entering.

If the bin is infested throughout (for example, grain stored for a long period, or new grain stored over old), you can move the grain into a clean, empty bin if one is available, applying a protectant (see above) during the transfer. Another option is to fumigate the bin. Unfortunately, there are no easy rules to help you decide exactly when to fumigation. Federal guidelines say that wheat is infested if two or more live insects are found in a sample. Barley, corn, oats, and sorghum are infested if two live weevils, or one live weevil plus five secondary pests, or ten secondary pests are found in a sample. Another suggestion is that if one live primary pest is found per grain sample or if several insects are collected within 24 hours in probe traps, then fumigation is justified.

Some additional notes about fumigation – Fumigation penetrates the grain and kills even primary feeders inside kernels. But fumigants dissipate quickly, and thus reinfestation of the grain can occur if the bin is not repaired and entry points remain. Fumigation can be dangerous. Aluminum phosphide, the most common grain fumigant, is very toxic, highly reactive with water, and can explode if handled incorrectly. It requires special handling, special protective equipment, and specific application procedures. In Michigan, a commodity fumigation standard is required in addition to your private or commercial applicator license to do fumigation.



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