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Cooperative Extension Service

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UNITED STATES DEPARTMENT OF AGRICULTURE COOPERATING



Control of Insects in farm-stored grain

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MAR 6 1974
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Grain producers suffer enormous losses annually from stored grain insects. This annual loss averages between 10 and 20 per cent of the total produced or \$200,000,000 to \$600,000,000 each year in the United States. Since North Dakota is a major grain producing state, its share in these losses is significant.

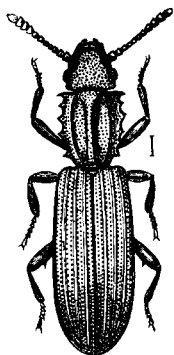
TYPES OF STORED GRAIN INSECTS

Insects that attack stored grain are classified as "primary" (those that attack whole kernels and complete their development inside the kernel) and "secondary" (those that feed primarily on cracked or broken kernels).

Primary Stored Grain Insects:

Included in this group are the weevils (granary and rice), lesser grain borer and Angoumois grain moth. Insects of this type rarely are found in North Dakota stored grain, although the term "weevily grain" is still used by many producers and grain handlers.

Secondary Stored Grain Insects:



Saw-toothed grain beetle

The secondary stored grain insects include the flour beetles, saw-toothed grain beetle, flat grain beetle, cadelle, Indian meal moth and dermestids. These insects feed principally on cracked grain, broken kernels and grain dust.
NOTE: Illustrations and descriptions of common stored grain insects can be found in color picture sheet No. 1, "Principal Stored Grain Insects."

Miscellaneous Stored Grain Insects And Mites:

Occasionally, incidental grain pests can be found in stored grain. Normally these are recognized as being important only insofar as contributing to heating of the grain is concerned. These pests include the grain mites, psocids or book lice and indicates that the grain is out of condition (damp, moldy, heating) or is in the process of going out of condition.

HOW GRAIN BECOMES INFESTED

Grain in North Dakota can become infested by stored grain insects anytime between combining and final processing. Any accumulation of post-harvest grain or grain products is a possible target for insect infestation. Such accumulations occur in combine hoppers, seed drills, garages and tool sheds, as well as in storage facilities used for feeding livestock.

Possibly one of the best arguments in favor of residual bin sprays and/or grain protectants is the fact that insects may already be in the bin at filling time or may gain entry during the grain bin filling operation.

Concrete and metal bins in good condition are not as likely to become infested after the bins have been filled and sealed as are wooden bins or bins in poor repair.

CONDITIONS THAT ENCOURAGE STORED GRAIN INSECTS

Temperature, moisture, and grain dockage or dust interact to provide conditions necessary for the reproduction and survival of stored grain insects. The most favorable temperature for them is about 80 degrees F. At temperatures above 95 degrees F. or below 70 degrees F., reproduction is nil and survival is reduced.

The most favorable moisture range for stored grain insects is 12 to 15 per cent. The lowest limit required for their reproduction and survival in clean grain is about nine per cent moisture. However, as temperatures increase insects can reproduce in grain with a low moisture content, and when moisture increases they can reproduce at low temperatures.

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Insect infestations are different in clean and dirty grain. Dockage content may directly influence the preference and subsequent infestation of grain by insects. Even the presence of grain dust or dockage permits some grain beetles to survive and reproduce at extremely low moisture levels.

PREVENTION OF STORED GRAIN INSECTS

1. Storage Bin Cleanup: Store grain only in bins that have been cleaned thoroughly. Remove old grain, trash, feed sacks and other debris that furnish living quarters for insects. Sometimes you must "sweep down" the ceiling and walls and clean the floor to remove hidden waste. Cover cracks with builders' molding or other suitable material to prevent grain from collecting. Destroy grain and other material beneath and near the bin.

2. Residual Bin Spray: After you have cleaned the bin thoroughly, spray inside surfaces with one of the following formulations at the rate of about two gallons per 1,000 square feet of surface area:

Methoxychlor 2½ per cent

Malathion (premium grade) 2½ per cent

Methoxychlor is available both as a wettable powder and an emulsifiable concentrate. To obtain a 2½ per cent mixture of this material, add 2 pounds of 50 per cent wettable powder to 5 gallons of water or 2 quarts of 25 per cent emulsifiable concentrate to 5 gallons of water. If you use malathion, mix 1 pint of 57 per cent premium grade malathion emulsifiable concentrate in 2 to 5 gallons of water.

Make applications to walls and floors of the storage area about two weeks before placing grain in the bin. Apply insecticide as a coarse spray.

3. Grain Protectants: You may apply grain protectants containing either synergized pyrethrins or malathion directly to the grain as it is being augered into the bin or on the surface of the grain after it is binned. You can apply these protectants as sprays or dusts and one application is usually effective for one year. They do not affect seed viability.

You need one pint of 57 per cent premium grade malathion mixed with 2 to 5 gallons of water to treat 1,000 bushels of grain or 1,000 square feet of grain surface area. Apply pyrethrins plus synergist undiluted at the rate of one gallon per 750 square feet of grain surface area or two gallons per 1,000 bushels as grain is being augered into the bin.

NOTE: Surface treatments are used primarily to prevent or control surface infestations of stored grain insects. The surface treatment will not control insects located below the surface in the grain.

4. Condition Of The Grain: Be sure that the moisture content is within the safe limits for storage and that there is a minimum of dirt, chaff, weed seeds, or damaged kernels. The moisture content of grain in a bin is

likely to change with outside temperature changes. As the grain cools around the edges of the bin, convection currents in the grain may cause "moisture migration." This phenomenon occurs most frequently in large volume storage, especially in flat storage. The proper installation and use of effective aeration equipment will help correct this problem.

5. Inspect Grain Regularly: Don't forget about your grain crop after it's in the bin. Examine it at monthly intervals in order to detect insects, rodents, heating or molds as early as possible. Use a grain probe or insert a metal rod with a thermometer mounted on the end into the grain at several locations.

CONTROL OF STORED GRAIN INSECTS

Turning the grain or moving it slowly on a cold day often will cool it sufficiently and break up pockets of insect infestation, thereby decreasing insect activity temporarily. But one of the most effective and economical ways to stop a stored grain insect infestation is through proper fumigation.

Fumigants: Fumigants are solids, liquids, or gases under normal atmospheric conditions. A common solid fumigant used today is aluminum phosphide. Carbon tetrachloride and carbon disulfide are commonly used liquids. Methyl bromide and hydrogen cyanide are examples of gases.

In order for a grain fumigant to kill insects, fumigant gases must be held in a lethal concentration in all parts of the bin for a long enough period to kill all stages of insects. No fumigant kills insects instantaneously; usually it requires several hours, even under ideal conditions.

You can use spot fumigation for treating "hot spots" in part of a bin for localized infestations. If you do this, release the fumigant directly to the infested area by using a length of pipe or conduit inserted into the grain at the site of infestation.

NOTE: Because there are a number of fumigants and formulations available it is impractical to list the various commercial mixtures in this publication. Since dosages vary according to types of grain, follow the directions on the label explicitly.

IMPORTANT REQUIREMENTS FOR GRAIN FUMIGATION

1. Grain Temperature: Do not attempt grain fumigation unless the grain temperature is 60 degrees F. or higher in order to insure proper vaporization. Apply fumigants on a calm day.

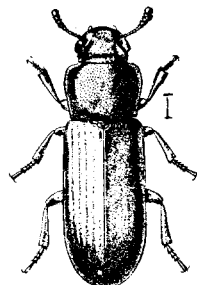
2. Level Grain: Always level the grain in a bin to aid in uniform penetration of fumigants. When grain is peaked or heaped up, the action of the fumigants will be much like that of water on a slope. Also, it is important to break up any "caking" or crust on the surface prior to fumigation.

3. **Tight Bins:** Grain fumigants must vaporize into gases before they can be effective. If the bin is full of cracks and holes, the gases will leak out. The leakage may result in undertreatment and poor control. Use building paper or other material to cover all holes.
4. **Even Application Of The Fumigant:** Apply liquid fumigants uniformly over the surface of the grain with a sprayer. Use a coarse droplet spray or a solid stream. If you use a 3 gallon compressed air sprayer, remove the nozzle. You may flatten the tip of the spray rod slightly to obtain a fan-shaped spray.

REASONS FOR FUMIGATION FAILURES

1. **Insufficient Fumigant:** Inasmuch as the efficiency of a fumigant depends on the maintenance of a killing concentration in the grain, any factor that affects gas concentration is important. You cannot get satisfactory results by applying less than the recommended dosage (a common problem).
2. **Storage Structure:** A loosely constructed, leaky bin may not retain fumigants long enough to kill the insects while a tight concrete or metal bin may hold the fumigant in killing concentrations for several days.
The depth of the grain in relation to its surface area also affects the efficiency of a fumigation. In general, the greater the surface area of the grain in proportion to the bulk, the greater the difficulties encountered in fumigation. This is the practical reason (except for leaks) that flat storages require higher dosages than round silo-type bins. Storage structures with a large amount of space over the grain are also difficult to fumigate effectively, as large amounts of gas escape into that space.
3. **Type of Grain and Dockage:** The kind of grain affects the efficiency of a fumigant in accordance with its sorption quality. For example, shelled corn and grain sorghum appear to be much more sorptive than wheat. The amount of dockage also affects the diffusion of the fumigant. Wheat with dockage exceeding three per cent requires nearly twice the dosage that wheat with less than one per cent dockage requires.
4. **Moisture:** The moisture content of the grain has a profound effect on the efficiency of a fumigant - - - the higher the moisture content the higher the dosage required. As the moisture content increases above 12 per cent, a proportionally higher dosage is required. Generally you cannot satisfactorily fumigate grain having a surface moisture content of 15 to 20 per cent because the fumigant vapors will not penetrate the moist layer.
5. **Temperature:** During fumigation the gas quickly assumes the temperature of the grain. An increase in temperature results in greater molecular activity of gases, which facilitates the diffusion and penetration of the fumigant. However, there are limiting factors for both extremes of high or low temperatures. If grain temperature reaches 115 degrees F., the fumi-

gants vaporize very rapidly and may escape from the bin before lethal gas concentrations can be obtained. Most stored-grain insects cannot survive in grain at 115 degrees F. or above, thus eliminating the need for fumigating. You need not fumigate stored grain with a temperature of 60 degrees F. or below as the insects are inactive at this temperature.



Confused flour beetle

PRECAUTIONS

- All fumigants are dangerous if improperly used. Carefully follow the cautions listed on the manufacturer's label and use only in strict accordance with label directions.
- Do not breathe fumigant vapors. If you will be exposed to fumes, wear a gas mask approved for the fumigant you are using. The effective life of a gas mask canister is limited. Keep an accurate account of the time that a canister is used and replace it after 30 minutes of continuous or intermittent exposure to grain fumigants.
- When applying fumigants, always work with someone who can assist in case of an accident or excessive exposure.
- If you spill fumigant on your skin or clothing, remove contaminated clothing and wash with soap and water immediately.
- You can feed grain to livestock four or five days after fumigation if it has been stirred or turned to hasten evaporation of the fumigant.
- Recommendations contained herein were current at publication. Insecticide restrictions and approved uses are subject to change, so always confirm recommended uses by referring to current labels on insecticide and fumigant containers.

