

## STORED GRAIN

**Preparing Bins For Storage:** The key to good grain storage is anticipating and preventing potential problems through good bin management.

Before treating with protectant, make sure that the bins are free of insect-infested grain. Leftover grain should be removed from the bin, and the walls should be swept and vacuumed. All grain handling equipment including augers, combines, trucks and wagons should be thoroughly cleaned and grain residues removed before harvest.

A residual bin spray such as malathion, Tempo, Diacon, or a combination of the two should be applied to all interior bin surface areas 2 to 3 weeks before new grain is placed in the bin. The treatment will kill insects emerging from their hiding places (cracks, crevices, under floors and in aeration systems). Also, insects crawling or flying in from the outside will be killed.

Apply the spray to as many surfaces as possible, especially joints, seams, cracks, ledges and corners. Spray the

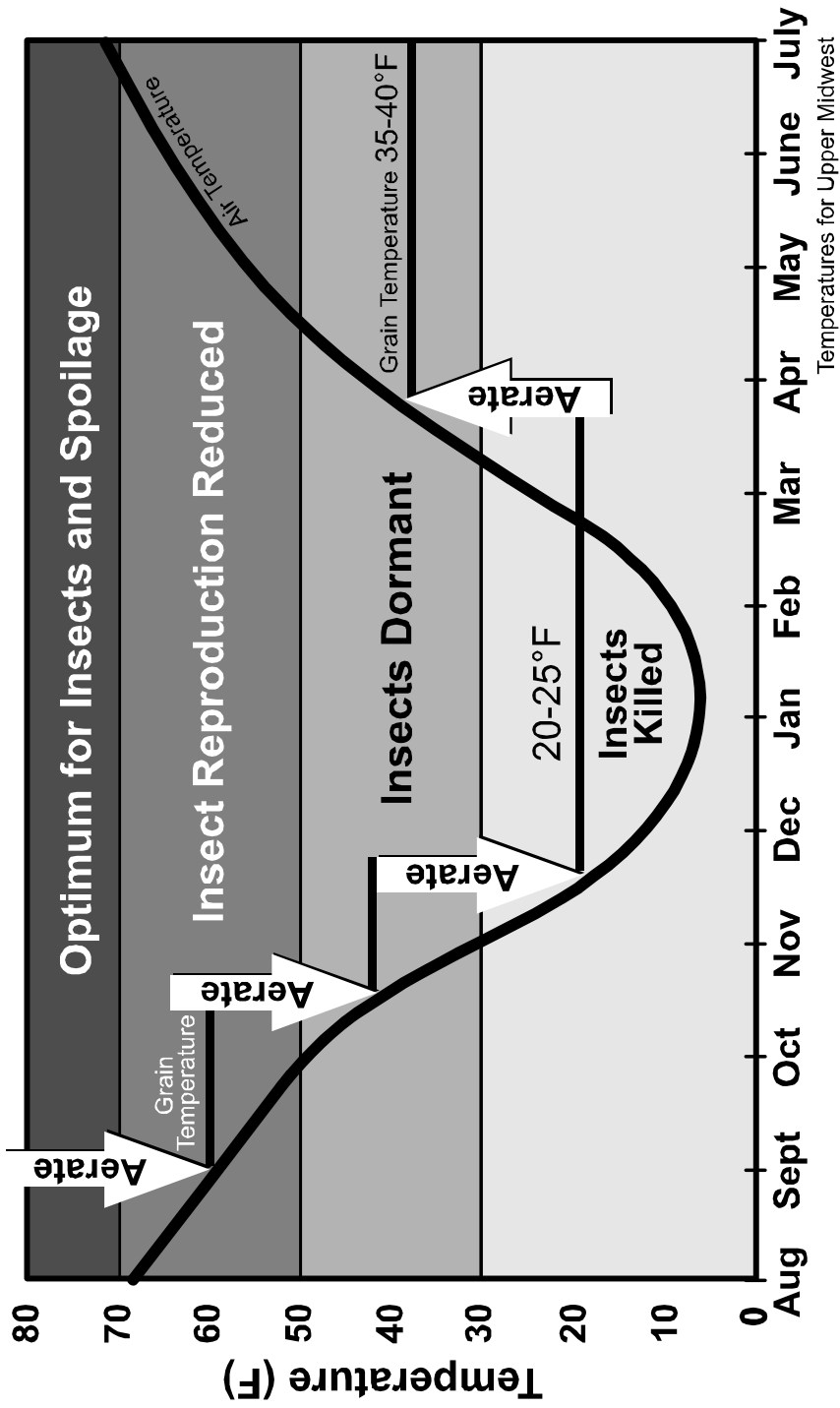
ceiling, walls and floors to the point of runoff. Use a coarse spray at a pressure of more than 30 lb per square inch and aim for the cracks and crevices.

Spray beneath the bin, its supports, and a 6 ft border around the outside foundation. Treat the outside surface, especially cracks and ledges near doors and fans.

The increased use of metal bins with perforated floors for grain drying and aeration has helped produce a serious insect problem in farm-stored grain. Grain dockage (broken kernels, grain dust, and chaff) sifts through the floor perforations and collects in the subfloor plenum creating a favorable environment for insect development. Unfortunately, the floors are usually difficult to remove, making inspection, cleaning and insecticide spraying in the plenum difficult if not impractical. The infested plenum may be disinfected with an approved fumigant such as chloropicrin.

TYPE OF TREATMENT	CROP	INSECTICIDE	Comments
<b>Residual Bin Sprays:</b> Clean, sweep and spray all bins before harvest. Diacon II may be mixed with an adulticide such as Tempo.  <b>Note:</b> Do not add grain to a treated bin for at least 24 hours or until walls have dried thoroughly.	All bins	<b>methoprene</b> Diacon II Diacon D	Active ingredient is an insect growth regulator. It prevents the development of larvae into adults. Adult insects are not controlled.
		<b>malathion</b>	May not provide control of Indian meal moth. Check label for listing of this use.
		<b>cyfluthrin</b> Tempo	Check product label for rates of application. Do not apply to grain.
		<b>chlorpyrifos-methyl + cyfluthrin</b> Storcide II	Storcide combines the active ingredients of Reldan (chlorpyrifos methyl) and Decis (deltamethrin).
<b>Surface Treatment:</b> Apply insecticide to surface after grain is binned.  <b>Note:</b> To ensure control, remove all surface crusting and webbing before treatment.	Wheat Barley Corn Oats Rye Soybeans Sunflowers	<b>Bacillus thuringiensis, subspecies kurstaki</b> Dipel	(Indian meal moth larvae only.) As a surface treatment, apply ½ lb of Dipel in 5-10 gal. of water per 500 sq ft of grain surface area: mix into top 4 inches.
		<b>diatomaceous earth</b> Insecto, Dryacide	4.0 lbs per 1,000 sq ft. Treat only the top 1 to 2 ft of the grain mass.
<b>Grain Protectant:</b> All the grain is treated when bin is being filled. Insecticides may be applied as a spray or dust to the grain as it is being augered into the bin. These products may also be used for treatment of the grain surface for registered commodities.	Corn Sorghum	<b>pirimiphos-methyl</b> Actellic 5E	No food or feeding restrictions. Lesser grain borer is not listed as a target pest.
	Wheat Barley Oats Sorghum Corn	<b>methoprene</b> Diacon II Diacon D	Active ingredient is an insect growth regulator. It prevents the development of larvae into adults. Adult insects are not controlled. May be mixed with Actellic for use on corn for lesser grain borer control. Sunflowers are also on Diacon II label.
		<b>malathion</b>	May not provide control of Indian meal moth. Products not labeled specifically for application to stored grain should not be used.
		<b>imidacloprid</b> Attendant 600 Dyna-Shield Imidacloprid 5 Senator 600	Provide protection against Indian meal moth, rice weevil, red flour beetle, and lesser grain borer. It is recommended that seed with existing populations of stored grain pests be fumigated prior to treating and bagging seed.
		<b>chlorpyrifos-methyl + cyfluthrin</b> Storcide II	Storcide II combines the active ingredients of Reldan (chlorpyrifos methyl) and Decis (deltamethrin). Storcide II does NOT have export restrictions on the label.

# Cool Grain to Prevent Storage Problems



\* Prevent crusting due to moisture migration by cooling grain to within 15°F of average outdoor temperatures.

\* Cooling grain by 10°F doubles its allowable storage time

Dr. Kenneth J. Hellevang, PE  
NDSU Extension Service

## FUMIGANTS

The two principal types of fumigants used for the treatment of farm-stored grain are liquids (chloropicrin) and solids (aluminum phosphide). Limited amounts of methyl bromide (a compressed gas) are also used in farm storage. These vapors permeate the grain mass and kill insects by suffocation or by chemical action on their breathing system, preventing the assimilation of oxygen or other vital functions. In order for a grain fumigant to kill insects, it is necessary that the vapor or gas remain at a toxic concentration for a sufficient period of time for the insects to contact the gas. No fumigant kills insects instantaneously; usually it requires several hours of exposure, even under ideal conditions, for fumigating.

### Some Important Steps for Successful Fumigation

1. Do not attempt fumigating grain unless the grain temperature is 60° F or higher.
2. Before applying fumigants, level the grain surface and break up any surface "caking."
3. Apply fumigants on a calm day. Seal bin as tightly as possible. The fumigant should be retained in the grain and not allowed to "leak" out. Use polyethylene and/or caulk to cover or seal all holes and cracks. Cover the grain with a tarpaulin or polyethylene if there is a large air space above the grain.
4. All fumigants should be handled with extreme care because the fumes are highly toxic. Apply the fumigant from the outside of the bin whenever possible. Always have a second person nearby while fumigating. Use a self-contained breathing apparatus if you must enter the bin.
5. Always use the recommended dosage.
6. Keep all people and animals out of the building for at least 48 hours.
7. Never use fumigants when the grain temperature is below 60° F. During the cold winter months, it would be better to aerate, turn or move the grain.

FUMIGANT*	COMMODITIES	COMMENTS
Chloropicrin <i>RUP</i>	Empty-bin treatment only. (See comments on right.)	Chloropicrin is no longer registered for direct application to stored grain. However, the fumigant can still be used for treating the perforated floors in empty bins in order to control insects in the subfloor area prior to bin filling.
Aluminum phosphide ** <i>RUP</i>	Wheat, barley, rye, oats, corn sorghum, safflower seed, sunflower seed, soybeans, triticale and millet	Aluminum phosphide is available under trade names such as Fumitoxin, Weevil-Cide and Phostoxin in pellet or tablet form. Since phosphine gas is only slightly heavier than air, it is very important that the bins are tightly sealed and the grain surface covered with plastic sheeting after the fumigant has been probed into the grain mass. Since there is a delay time of 1 to 2 hours with tablets before dangerous amounts of phosphine gas are released, applicators can normally complete application before toxic fumes begin to develop in the bin.
Methyl bromide <i>RUP</i>	Wheat (similar small grain), shelled corn and milo (grain sorghum)	Methyl bromide can affect the germination of seeds at high moisture levels and high dosages. It is more than 3 times the weight of air, and recirculation techniques may be needed to ensure even distribution. This, plus the fact that methyl bromide is very hazardous to work with, are reasons that this product should only be used by trained professional fumigators.

*RUP* - Restricted use pesticides are to be applied by or under the direct supervision of certified pesticide applicators only.

\* Dosage rates for the fumigants listed will vary depending upon the commodity and type of storage structure to be treated. Read and follow label directions carefully!

### \*\* Fumigation Management Plan:

The certified applicator is responsible for working with the owners and/or responsible employees of the structure and/or area to be fumigated to develop and follow a Fumigation Management Plan (FMP). The FMP is intended to ensure a safe and effective fumigation. The FMP must address characterization of the structure and/or area, and include appropriate monitoring and notification requirements, consistent with, but not limited to, the following:

- Inspect the structure and/or area to determine its suitability for fumigation.
- When sealing is required, consult previous records for any changes to the structure, seal leaks and monitor any occupied adjacent buildings to ensure safety.
- Prior to each fumigation, review any existing FMP, MSDS, Applicator's Manual and other relevant safety procedures with company officials and appropriate employees.
- Consult company officials in the development of procedures and appropriate safety measures for nearby workers who will be in and around the area during application and aeration.
- Consult with company officials to develop an appropriate monitoring plan that will confirm that nearby workers and bystanders are not exposed to levels above the allowed limits during application, fumigation and aeration.
- This plan must also demonstrate that nearby residents will not be exposed to concentrations above the allowable limits.
- Consult with company officials to develop procedures for local authorities to notify nearby residents in the event of an emergency.
- Confirm the placement of placards to secure entrance into any structure under fumigation.

- Confirm the required safety equipment is in place and the necessary manpower is available to complete a safe and effective fumigation.
- Written notification must be provided to the receiver of a vehicle that is fumigated in transit.

These factors must be considered in putting an FMP together. It is important to note that some plans will be more comprehensive than others. All plans should reflect the experience and expertise of the applicator and circumstances at and around the structure and/or area. In addition to the plan, the applicator must read the entire label and Applicator's Manual and follow its directions carefully. The FMP and related documentation, including monitoring records, must be maintained for a minimum of two years.

## REASONS FOR FUMIGATION FAILURES

**Insufficient Fumigant:** Because 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). Be sure to use the amount of fumigant required for the capacity of the bin, not the amount of grain contained in the bin.

**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 fumigant. 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 the head space.

**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. Wheat with dockage exceeding 3% requires nearly twice the dosage than wheat with less than 1% dockage requires.

**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%, a proportionally higher dosage is required. Generally you cannot satisfactorily fumigate grain having a surface moisture content of 15% to 20% because the fumigant vapors will not penetrate the moist layer.

**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° F, the fumigants 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° F or above, thus eliminating the need for fumigating. You need not fumigate stored grain with a temperature of 60° F or below as the insects are inactive at this temperature.