



# Stored Grains

Insect Control Recommendations for 2008

## INSECT MANAGEMENT

Stored grains can be heavily damaged by insects if they are not properly conditioned and protected. Small grains, including wheat, are harvested in spring and stored through the hottest and most humid months of the year. These conditions make it extremely difficult to prevent damage. Corn also can be difficult to store because of field infestation by maize weevil. And, soybeans are a challenge because few insecticides are registered for use in stored soybeans.

Insects that attack grains and grain products are beetles, their larval stages, and the larval stages of moths. There are many different kinds of these insects. Their length varies from about 0.0625 inch to as much as 1.25 inches.

Some of the more important beetle pests are the maize weevil, rice weevil, lesser grain borer, confused flour beetle, red flour beetle, and rusty or flat grain beetle. Both adults and larvae of these insects damage and contaminate grains or grain products.

The moth larvae that damage grains and grain products include those of the Angoumois grain moth, the Indian meal moth, almond moth, and Mediterranean flour moth. The Indian meal moth is the most common moth pest in Alabama. Unless the grain is infested when it is placed in storage or some infested grain or grain product is already in the bin, most of the damage from moth larvae will occur in the surface layer of the grain. The Angoumois grain moth was once a serious pest because it attacked corn stored in corn cribs. Now that little corn is stored in this way, the Angoumois grain moth has declined in importance.

Lesser grain borers, maize weevils, and rice weevils are the most serious of these pests because they feed directly on undamaged grain. Most of the other stored-product beetles feed on broken kernels, grain dust, or grain molds. The larval stages of the maize weevil, rice weevil, and lesser grain borer spend their developmental period inside kernels of grains where they are unseen and difficult to detect. Initial infestation by these pests may occur in the field, creating a problem that may not become evident until well into the storage period.

More information on managing insects in stored grain can be found at <http://www.aces.edu/dept/grain/StoredGrainInformation.php>

### Steps to Successful Grain Storage

Clean and spray equipment before using it to harvest and handle your grain. Remove all old grain and other debris

where insect infestations may be harbored. After thoroughly cleaning the equipment, spray it with a residual insecticide, using one of those listed in Table 2. Concentrate on cracks and crevices where insects may be hiding. It is best to complete this job at least two weeks before harvest.

Thoroughly clean and spray the storage bin. Removal of all grain, grain products, and other organic matter is essential for eliminating existing infestations. Grain bins with perforated floors can be difficult to clean and treat with insecticides. Completely cover all areas inside the bin with a residual insecticide to eliminate existing infestations.

**Table 1. Maximum Moisture Contents for Aerated Grain Storage in the South <sup>1</sup>**

Grain Type and Storage Time	Maximum Moisture Content for Safe Storage <sup>2</sup> (Percent Wet Basis)
<b>Shelled Corn and Sorghum</b>	
Sold as #2 grain by spring	14
Stored 6 to 12 months	13
Stored more than 1 year	12
<b>Soybeans</b>	
Sold by spring	13
Stored 6 to 12 months	12
Stored more than 1 year	11
<b>Wheat, Oats, Barley, Rice</b>	
Stored up to 6 months	12
Stored 6 to 12 months	11
Stored more than 1 year	10
<b>Edible Beans</b>	
Stored up to 6 months	14
Stored 6 to 12 months	12
Stored more than 1 year	10

<sup>1</sup> Adapted from "Stored Grain Management Techniques," by Noyes, Ronald T., et.al., in Stored Product Management. Cooperative Extension Service, Oklahoma State University, and USDA, 1995.

<sup>2</sup> Values for good quality, clean grain, and aerated storage.

NOTE: Reduce one percent for poor quality grain, such as grain damaged by blight, drought, etc. Reduce each entry by two percent for nonaerated storage.

Spray the entire inner area of the bin according to the directions on the pesticide label. A small compressed air sprayer can be used for spraying equipment and bins. But better penetration of cracks, crevices, and other remote areas can be obtained by using a power sprayer that will develop at least 150 psi (pounds per square inch) of pressure. An exception is cyfluthrin; use it with as little as 50 psi of pressure. Spray should be applied at least 2 weeks before storage. Remove all dead insects before putting grain in the bin.

Completely seal the bin using caulk, polyethylene foam, or other suitable materials such as sheets of polyethylene or tar paper. Pay particular attention to joints in the metal. At night, place a light inside the bin to find any openings that may have been missed. Or, step inside the empty bin, close the door, and look for places where daylight shines through. The bin must be airtight if the grain is to be fumigated after it is stored. All unnecessary openings should be sealed, but do not seal the aeration fan ducts or the top vents which are used during aeration.

Grain must be in good condition to be stored successfully. Moisture level of the grain should be below critical levels (see Table 1). The grain should be as free of debris as possible. Excessive debris usually ends up in "pockets" where it traps moisture, and moisture can cause molding and the build-up of insect populations. These trash pockets also prevent good air movement through the grain, which may be necessary for aeration or fumigation.

There should be at least 1 foot of space between the top of the bin and the surface of the grain. The top surface of the grain should be level. Be careful not to overfill the bin.

### **Aerating Grain**

Insect development in stored grains slows when temperatures drop into the 60-degree range, and it effectively stops below 60°F. Lowering grain temperature, therefore, lessens the chance of insect problems. In Alabama, temperatures are still warm during the first few months of wheat storage and the first month of corn storage. However, stored grains can be cooled as soon as the temperature begins to drop in the fall.

Many farm bins are equipped with aeration fans. If fans are available, use them to cool grain as soon as weather permits. Aeration will make the grain temperature uniform, eliminating troublesome hot pockets where insect and mold development is favored. Aeration can also eliminate moisture migration, a process where moisture accumulates in the center of the bin.

The length of time to cool a grain bin depends on the size of bin, the size of fan, the outside temperature, and the condition of the grain. A rule of thumb is that it takes 60 hours of aeration at or below a desired outside temperature at an airflow rate of 0.2 cubic feet per minute. More powerful fans can make the aeration time even shorter. Many of the grain bins in Alabama can be cooled in less time because they have powerful fans. Bins that were built to dry soybeans will generally have fans with a high airflow rate.

Cooling the grain in steps as the temperature begins to drop in the fall can reduce the risk of insect problems. Lowering grain temperature to 65°F, then 60°, and finally to 55° will result in fewer insect development days than waiting to cool the grain when temperatures fall below 55°F.

Automatic controllers are now available that will run aeration fans as necessary to cool grain to a desired temperature.

### **Controlling Insects**

Basically, there are two approaches to controlling stored grain insects: (1) using an insecticidal protectant at the time the grain is placed in storage, or (2) using a fumigant at the first sign of infestation. If a protectant is used and the grain is still infested by insects, a fumigant should be used.

Inspect stored grain at least once a month to determine if it has been reinfested by insects. Use a grain trier or probe traps to take samples from at least five different spots in each bin. Examine the samples carefully and fumigate if live insects are found.

**Grain Protectants.** The protectant treatments listed in Table 4 will provide excellent insect control if grain is not infested prior to storage, if the proper moisture level is achieved, and if the grain is free of foreign materials. Using heated air to dry the grain after it is stored will usually cause the protectant to be ineffective. Grain that is heavily infested with insects before being put into storage should be fumigated for control.

Resistance to malathion is a frequent problem. If control failures with malathion have occurred in the past, consider an alternative insecticide. The Angoumois grain moth, almond moth, and at least two species of beetles have shown some resistance to malathion. Good coverage of grain is essential for effective control.

Apply protectant to the stream of grain as it is placed in storage. If the protectant is a liquid, a nozzle should be mounted over the stream and adjusted to deliver the recommended amount of protectant in 5 gallons of water per 1000 bushels. Using dust is not as exact, and the recommended dosage must be uniformly applied to the grain. Follow manufacturers' recommendations to get good coverage. You cannot get adequate coverage without moving the grain.

**Surface Treatments.** The insecticides listed in Table 4, in addition to grain protectants, will help maintain insect-free grain. These surface or "top-dress" treatments should be made immediately after grain is stored and repeated as needed.

**Fumigation.** Thorough fumigation is the only effective way to kill stored grain pests after grain is in the storage bin. Fumigants will kill the insects that are in the bin, but they do not prevent reinfestation. An airtight bin is essential for effective fumigation. Most fumigation failures are due to an inadequately sealed bin. Fumigants form poisonous gases and they are extremely dangerous. At least two people should be present when fumigants are applied.

Aluminum phosphide is an effective fumigant but is extremely toxic. All label precautions should be carefully followed. In 2004 the law was changed, and these changes are listed on the new label and applicators manual. As part of the new requirements, the fumigator will need to develop a written fumigation management plan. Aluminum phosphide is formulated as tablets and pellets. The tablets or pellets generate phosphine gas (hydrogen phosphide) as they contact moisture in the air. The gas, which is released slowly from the tablets or pellets, is highly toxic. The phosphine gas has moderate penetrating ability and does not adversely affect seed germination.

Five gas detectors that monitor the concentration of phosphine gas have been purchased with Alabama Wheat And Feed Grain Check-Off funds. The detectors are available to be checked out for on-farm use. They are kept in Autauga, Henry, Escambia, Madison, and Calhoun Counties. Your Alabama Cooperative Extension System regional agronomy agent can arrange for you to borrow one. See ANR-1154, "Fumigating Agricultural Commodities With Phosphine" (<http://www.aces.edu/pubs/docs/A/ANR-1154/>). A video on fumigating on-farm grain bins can be obtained from your Alabama Cooperative Extension System regional agronomy agent. The video can also be viewed at <http://wms.aces.edu/fumigate.htm>.

Profume, applied by commercial applicators, can be used on-farm but is better suited for commercial operations, such as grain elevators, flour mills, and warehouses.

### **Protecting Small Quantities of Commodities**

Here are several tips to keep unwanted visitors from getting into your dried commodities, such as beans, flour, spaghetti, dog biscuits, and peanuts.

1. Avoid buying material that is already infested. Start with high quality material that has been purchased from a reputable source.

2. If there is good reason for thinking the food may be infested, a freeze treatment or heat treatment may clean up the food before it is stored. (See 6, below.)

3. Make sure food is dry. (See Table 1.) Whole grains and beans that are stored before they have been completely dried are prone to insect and disease problems.

4. Store food in tightly sealed containers that are safe for food products.

5. Monitor the food periodically for pest infestations. Discard any heavily infested food to keep problems from spreading.

6. A light insect infestation can be dealt with by sifting out as many insects as possible and freezing the affected materials at 0°F. for four days. Or, bake the material slowly at about 130°F. for 30 minutes.

7. If storing in bulk (more than one gallon), it may be beneficial to use an organic grain protectant. An example is diatomaceous earth, sold as Insecto, Dryacide, Protect-It, and others. These products can be used to protect grains and other stored, dried commodities from insects.

Diatomaceous earth is safe for humans and companion animals. People would not be harmed even if they accidentally ingested some of this product. The naturally occurring material, silicon dioxide, is actually used as an anti-caking agent or filler in foods such as sugar substitutes, coffee creamers, pain killers, antacids, and spices.

When working with this product, wear a mask or work outdoors to avoid over-exposure to dust, particularly if you have pre-existing respiratory ailments. Mixing a bit of diatomaceous earth into the bottom and top layers of stored product can help keep bulk stored commodities insect free. Use it at a rate of 0.5 to 1 cup per 5 gallons of stored product. You may also find food-grade diatomaceous earth at your farmers coop or feed store as an anti-caking agent. Do not use pool-grade diatomaceous earth.

### **Temporary Grain Storage**

Stored grain in the Southeast is at high risk for damage from insects and molds. That risk is dramatically increased if the grain is stored under unaerated conditions or if the grain is not stored in a sealed structure. Use caution in storing grain in piles and in structures not intended for grain storage. For more information see:

<http://www.ces.purdue.edu/extmedia/GQ/GQTF38/GQTF-38.html>

**Table 2. Pesticides That Should Be Effective for Control of Common Stored Grain Pests in Alabama**<sup>1,2</sup>

Pesticides	Stored Grain Pests				
	Indian Meal Moth	Maize/Rice Weevil	Lesser Grain Borer	Red Flour Beetle	Sawtoothed Grain Beetle
Actellic	X	X		X	X
Aluminum phosphide (Phostoxin, Phosfume, Weevil-Cide)	X	X	X	X	X
Diacon II	X		X	X	X
diatomaceous earth (Insecto, Dryacide, Protect-It)	larvae	X	X	X	X
Dichlorvos no-pest strip	X				
Dipel, other Bt products	X				
Malathion dust <sup>3</sup>	?	?	?	?	?
Profume	X	X	X <sup>4</sup>	X	X
Tempo SC Ultra <sup>5</sup>	X	X	X	X	X
Tempo 20WP <sup>5</sup>	X	X	X	X	X
Storcide II	X	X	X	X	X

<sup>1</sup> Based on the label. <sup>2</sup> The absence of an insect from a label indicates that the manufacturer or the EPA does not recommend the use of the insecticide for that pest. This can be because the insect has developed resistance to the insecticide or because the mode of action of the insecticide is not appropriate for the pest. <sup>3</sup> Many insect populations have developed resistance to malathion. If you have experienced control failures in the past, do not use malathion. <sup>4</sup>Not specifically listed. <sup>5</sup>Empty bin treatment only.

**Table 3. Insecticides and Fumigants Registered for Applying as Grain Protectants, Topdress Treatments, or Layer Treatments for Control of Common Pests on Stored Grain Crops**

Pesticides	Crops				
	Barley	Corn	Oats	Peanuts	Popcorn
Actellic		X			X
Aluminum phosphide (Phostoxin, Phosfume, Weevil-Cide)	X	X	X	X	X
Diacon II	X	X	X	X	
diatomaceous earth (Insecto, Dryacide, Protect-It)	X	X	X	In shell	X
Dichlorvos no-pest strip <sup>1</sup>	X	X	X	X	X
Dipel; other Bt products	X	X	X	X	
Malathion dust	X	X	X		
Profume	X	X	X	X	X
Storcide II	X		X		

**continued**<sup>1</sup> Some formulations list “head space treatment for bulk storage of raw grains, such as corn, soybeans, cocoa beans, and peanuts.”**Table 3. Insecticides and Fumigants Registered for Applying as Grain Protectants, Topdress Treatments, or Layer Treatments for Control of Common Pests on Stored Grain Crops (cont.)**

Pesticides	Crops				
	Rye	Sorghum	Soybeans	Wheat	Other
Actellic		X			
Aluminum phosphide (Phostoxin, Phosfume, Weevil-Cide)	X	X	X	X	See label.
Diacon II	X	X		X	
diatomaceous earth (Insecto, Dryacide, Protect-It)	X	X	X	X	See label.
Dichlorvos no-pest strip <sup>1</sup>	X	X	X	X	
Dipel; other Bt products	X	X	X	X	See label.
Malathion dust	X			X	
Profume		X		X	See applicators manual
Storcide II		X		X	Rice

<sup>1</sup> Some formulations list “head space treatment for bulk storage of raw grains, such as corn, soybeans, cocoa beans, and peanuts.”

**Table 4. On-Farm Stored Grains Insect Control**

Insect	Insecticide and Formulation	Dosage	Comments
<b>Grain Handling Machinery: Augers, Combines, Conveyors, Seeders</b>			
diatomaceous earth DRYACIDE PROTECT-IT		dust: 0.4 lb./1000 sq.ft. dust: 0.6 lb./1000 sq.ft. slurry spray: 1.5 lb./1.5 gal./1000 sq. ft.	Dust throughout machine ensuring distribution to hidden or relatively inaccessible parts. For slurry spray, spray as a fine mist.
<b>Empty Bin Treatments Applied Before Loading Grain</b>			
<i><b>General Comments:</b> Grain dust dramatically reduces the effectiveness of empty bin treatments. Thoroughly clean equipment bins and buildings before treatment. When applying the bin treatment, give special attention to cracks and crevices where insects may hide. Spray the entire surface area of the bin. After treatment, remove dead insects before filling bins.</i>			
aluminum phosphide fumigant		See fumigation section for dosage	Place tablets or pellets below the floor, if possible, or scatter them over the empty floor. Cover with 6 ml polyethylene or plastic tarp to contain the gas. This is a <b>RESTRICTED USE</b> pesticide.
beta-cyfluthrin TEMPO SC ULTRA		0.25-0.5% solution 0.5-1 T./gal.	Apply beta-cyfluthrin to all interior surfaces of grain bin and spray to point of run-off.
cyfluthrin TEMPO 20WP		0.05-0.1% solution 2-4 scoops/gal 0.02-0.04 lb/gal	Apply cyfluthrin to all interior surfaces of grain bin and spray to point of run-off.
deltamethrin + chlorpyrifos-methyl STORCIDE II		1.8 fl.oz./gal./1000 sq.ft.	Apply from outside the bin. Only downward-direct spray permitted. <b>DO NOT</b> enter the bin until spray has dried.
diatomaceous earth DRYACIDE		Dust: 0.4 lb./1000 sq.ft. Slurry: 1.2 lb./1.2 gal./1000 sq.ft.	Apply as a dust with a hand or power duster or as a slurry spray.
INSECTO		Dust: 1 lb./1000 sq.ft.	Apply at least 2 to 3 days before filling bin. Use aeration fan or other air supply to apply dust.
PROTECT-IT		Dust: 0.6 lb./1000 sq.ft.  Slurry: 1.5 lb./1.5 gal./1000 sq.ft.	Apply 2 weeks before filling bins. Use a dust blower or bin fan to reach all cracks, crevices, and on surfaces. Use a sprayer to reach all cracks, crevices, and on all surfaces, applying spray as a fine mist.
malathion MALATHION 5 MALATHION 57EC		10 T./gal. 10 T./gal.	Apply to all interior surfaces of grain bin and spray to the point of run-off. Resistance to malathion is evident in many populations of stored-product insects; where resistance is a problem, use an alternative insecticide. Check label carefully to be sure the formulation of malathion is registered for use as an empty bin treatment. Other liquid malathion formulations may also be labeled for this use.
(S)-methoprene DIACON II		Fogging Treatment: 1 ml/1000 sq.ft. 0.2 t./1000 sq.ft. Pressure Spray: 1 ml/1000 sq.ft. 0.2 t./1000sq.ft.	Apply in water or oil in a cold aerosol generator. Diacon II is an insect growth regulator that interferes with the development of insects. It will not kill adult insects.  Apply in sufficient water for adequate coverage with a low-pressure sprayer to all areas which may harbor insect pests.

Insect	Insecticide and Formulation	Dosage	Comments
<b>Protectant Treatments Applied to the Entire Grain Mass as It is Loaded</b>			
<i><b>General Comments:</b> Apply protectant insecticides after grain is dry and cool. Avoid severely dusty application site. See Table 3 to see which commodities can be treated with a particular insecticide.</i>			
	deltamethrin + chlorpyrifos-methyl STORCIDE II	Barley: 9.9 fl.oz./5 gal./1000 bu. Oats: 6.6 fl.oz./5 gal./1000 bu. Rice: 9.3 fl.oz./5 gal./1000 bu. Sorghum: 11.6 fl.oz./5 gal./1000 bu. Wheat: 12.4 fl.oz./5 gal./1000 bu.	Dilute with water or an FDA-approved food grade mineral oil or soybean oil.
	diatomaceous earth		
<i><b>General Comments:</b> Diatomaceous earth may affect grain handling and/or test weight in some cases. Consider using layer treatments. (See next section of this table)</i>			
	INSECTO	1 lb./ton 1-2 lb./ton (if grain is infested)	Apply uniformly as a dust on grains, soybeans, peanuts, popcorn, and others (see label).
	PROTECT-IT	Wheat, beans, peas: 18 lb./1000 bu. Oats: 9.6 lb./1000 bu. Rye: 16.8 lb./1000 bu.	Grain mass treatment cannot be used on corn, popcorn, sorghum, or peanuts in shell. See next section of this table on layer treatments. Uniformly treat grain as it is loaded into bin.
	malathion MALATHION 6% GRAIN PROTECTANT ALLPRO GRAIN PROTECTION DUST	10 lb./1000 bu. 60 lb./1000 bu.	For use on stored grains such as wheat, oats, corn, rye, and barley. Apply uniformly to the grain as it is being loaded or turned into final storage. Thorough coverage is important. There is resistance to malathion in some populations of stored-product insects; where resistance is a problem, use one of the other approved insecticides. Some grain buyers will not accept grain that has been treated with malathion. Check label carefully. Liquid formulations of malathion are not registered for use as grain protectants.
	pirimiphos-methyl ACTELIC 5EC	8.6-11.5 oz./5 gal./1000 bu. (9.2-12.3 oz./5 gal./60,000 lb.)	<b>DO NOT</b> use if grain has been previously treated with Actellic or if Actellic will be used as a topdress treatment. Apply to grain as uniformly as possible as it is being loaded. Protects against most stored grain pests. No waiting period for use. <b>DO NOT</b> store diluted Actellic in spray tank for more than 48 hours before use.
	(S)-methoprene DIACON II	Wheat, corn, sorghum: 1.75-14 fl.oz. Oats, peanuts: 1-8 fl.oz. Rice: 1.5-12 fl.oz.	Use 5 gallons of water or food grade oil per 1000 bushels. Diacon II is an insect growth regulator that interferes with the development of insects. It will not kill adult insects. Treat existing insect populations with adulticide before applying Diacon II. Apply only once to grain of known treatment history. Use highest rates for maximum residual. Lowest rate offers shorter residual for commodity that will be stored for 6 months or less.

Insect	Insecticide and Formulation	Dosage	Comments
<b>Protectants Applied as Layer Treatments as the Grain is Loaded</b>			
<i>General Comments: Not as effective as treating entire grain mass, but an option for uninfested grain or short-term storage.</i>			
diatomaceous earth DRYACIDE		Dust: 56 lb./1000 bu. 2 lb./ton	Treat top 1 foot of grain as it is loaded into the bin. For slurry, use 28 gallons of water per 1000 bushels or 1 gallon per ton.
PROTECT-IT		Slurry: 2 lb./gal. water Wheat: 18-24 lb./1000 bu. Oats: 9.6-12.8 lb./1000 bu. Rye: 16.8-22.4 lb./1000 bu. Corn, sorghum: 56 lb./1000 bu. Popcorn: 42-54.1 lb./1000 bu. Beans: 18 lb./1000 bu. Peanuts in shell: 0.25 lb./cwt.	Treat bottom and top 3 feet as they are loaded into bin. If a range of rates is listed, use the higher rate for weevils and lesser grain borers.
INSECTO		1 lb./ton	<b>FOR FALL HARVESTED GRAIN:</b> Treat the bottom 10 percent of grain at 1 pound per ton. Treat every fifth load at 1 pound per ton. Treat the top 10 percent at 1 pound per ten. Then topdress at 4 pounds per 1,000 square feet.
<b>Surface or Topdress Treatments for the Top 4 Inches of Grain (Primarily for Indian Meal Moth Larvae)</b>			
<i>Bacillus thuringiensis</i> BIOBIT HP DIPEL DF		1 lb./10-20 gal./1000 sq.ft. 1 lb./10-20 gal./1000 sq.ft.	Apply evenly over the surface immediately after loading and mix into a depth of 4 inches with a scoop or rake. If applied to the surface, split the dosage into three applications and mix the grain between applications.
BIOBIT HP DIPEL DF JAVELIN WG		0.05 lb./gal. 0.05 lb./gal. 1.5 oz./gal.	<b>FOR THE TOP 4 INCHES OF GRAIN:</b> Apply 0.6 pint of the mixture to each bushel of grain as it is loaded into the bin.
diatomaceous earth INSECTO PROTECT-IT		4 lb./1000 sq.ft. 3 lb./1000 sq.ft. or 40 lb./1000 sq.ft.	Apply Insecto as a dust to surface of binned grain (see instructions on the label). Apply the 3-pound rate on surface that has already been treated with Protect-It. Apply the 40-pound rate on surface that has not been previously treated with Protect-It.
pirimiphos-methyl ACTELIC 5EC		3 oz./2 gal./1000 sq.ft.	Spray half of the mixture over the top and rake it 4 inches into grain; apply remaining half on top of raked surface. <b>DO NOT</b> use if grain has been previously treated with Actellic spray.
(S)-methoprene DIACON II		1 ml/1000 sq.ft. 0.2 t./1000 sq.ft.	<b>DO NOT</b> flood topdress area. Use sufficient water to provide adequate coverage as a spray or a fogging treatment. Apply only once to grain of known treatment history. Diacon II is an insect growth regulator that interferes with the development of insects. It will not kill adult insects.

Insect	Insecticide and Formulation	Dosage	Comments
Head Space Treatment			
dichlorvos PROZAP INSECT GUARD		80 g strip (900-1200 cu.ft.)	See Table 3 and the label for allowed uses. Controls adult moths in head spaces. Treat in early spring before moths begin to emerge. Calculate cubic feet of air space above the commodity.
Fumigation Treatments			
aluminum phosphide (phosphine gas)			All formulations of aluminum phosphide now require you to prepare a written fumigation management plan. <b>READ THE LABEL AND THE APPLICATORS MANUAL CAREFULLY BEFORE USING ALUMINUM PHOSPHIDE.</b> Aluminum phosphide is sold under various trade names. Many on-farm fumigations fail because the bin is not sealed adequately. Seal bin as tightly as possible. Dosage must be based on the capacity of the grain bin, not on the amount of grain in storage, unless the surface of the grain is tarped after aluminum phosphide application. If grain is tarped, dose can be based on the volume of the grain in storage. Approximately 25 percent of the tablets or pellets may be placed down below, in the aeration duct, and 75 percent may be placed on or just below the surface of the grain. Make sure the aeration duct is dry before adding aluminum phosphide because adding aluminum phosphide to water in the duct may cause a fire. Seal bin for at least 5 days if temperature is 54° to 59°F, 4 days if it is 60° to 68°F, and 3 days if temperature is above 68°F. Aerate thoroughly following the exposure period. All formulations of aluminum phosphide are <b>RESTRICTED USE</b> pesticides. Dosage rate varies with the site. See the Applicators Manual that is part of the label. See ANR-1154, "Fumigating Agricultural Commodities With Phosphine" ( <a href="http://www.aces.edu/pubs/docs/A/ANR-1154/">http://www.aces.edu/pubs/docs/A/ANR-1154/</a> ) For more information.
pellets			
WEEVIL-CIDE 60% pellets	See label.		
PHOSFUME 60% pellets	See label.		
PHOSTOXIN 60% pellets	See label.		
tablets*			
WEEVIL-CIDE 60% tablets	See label.		
PHOSFUME 60% tablets	See label.		
PHOSTOXIN 60% tablets	See label.		
other formulations**			
PHOSTOXIN TABLET PREPAC (33 tablets)	See label.		
cylinderized phosphine + carbon dioxide gas ECO <sub>2</sub> FUME FUMIGANT GAS			Cylinderized phosphine gas is now available. However, users must receive complete special training before becoming certified to use this product. Contact David Mueller at 1-317-896-9300 for details.
cylinderized sulfuryl fluoride PROFUME			Profume is a <b>RESTRICTED USE</b> insecticide. See label and applicators manual.

\*Tablets are five times larger than pellets.

\*\*These formulations reduce the time it takes to place the required dose in the bin. They are usually more expensive but are much safer to use.

NOTE: Read manufacturer's label carefully for specific information for all product use restrictions and safety. No waiting period is required for any of these recommended application rates except fumigation. Grains can be fed or sold after fumigant gases have been exhausted.

**Table 5. Helpful Conversions for Applying Insecticides to Stored Grains\***

Bin Diameter (Feet)	Grain Surface Area (Square Feet)	Bushels per Foot of Height	Approximate Surface Area of Empty Bin (Square Feet)
8	50	40	100 + (height x 25)
16	201	161	400 + (height x 50)
24	452	362	900 + (height x 75)
32	804	643	1600 + (height x 100)

\* 1 bushel = 1.25 cubic feet; 1 cubic foot = 0.8 bushels.

Number of tons = (Number of bushels x test weight in pounds per bushel) / 2000

**Table 6. Manufacturers of Stored Grain Insecticide**

Insecticide	Manufacturer or Distributor	Web Site	Telephone Number
Actellic	Agriliance	<a href="http://www.agriliance.com">www.agriliance.com</a>	1-800-535-4635
ALLPRO Grain Protectant Dust	Value Garden Supply, LLC	<a href="http://www.valuegardens.com">www.valuegardens.com</a>	1-888-603-1008
Dryacide	Agriliance	<a href="http://www.agriliance.com">www.agriliance.com</a>	1-800-535-4635
Diacon II	Wellmark International	<a href="http://www.wellmarkinternational.com">www.wellmarkinternational.com</a>	1-800-877-6374
Insecto	Natural Insecto Products, Inc.	<a href="http://www.insecto.com">www.insecto.com</a>	1-800-332-2002
Javelin	Certis	<a href="http://www.certisusa.com">www.certisusa.com</a>	1-800-250-5024
Biobit, Dipel, Xentari	Valent	<a href="http://www.valent.com">www.valent.com</a>	1-800-6-valent
Malathion 5 <sup>1</sup>	Agriliance	<a href="http://www.agriliance.com">www.agriliance.com</a>	1-800-535-4635
Malathion 6% Grain Dust	Agriliance	<a href="http://www.agriliance.com">www.agriliance.com</a>	1-800-535-4635
Malathion 57EC <sup>1</sup>	UAP	<a href="http://www.uap.com">www.uap.com</a>	1-334-875-7873
Phostoxin	Degesch	<a href="http://www.degeschamerica.com">www.degeschamerica.com</a>	1-540-234-9281
Phosfume	Douglas Products	<a href="http://www.douglasproducts.com">www.douglasproducts.com</a>	1-800-223-3684
Profume	Dow AgroScience	<a href="http://www.dowagro.com/profume/us/about">www.dowagro.com/profume/us/about</a>	1-800-258-3033
Protect-It	Hedley Technologies	<a href="http://www.hedleytech.com">www.hedleytech.com</a>	1-888-476-4473
Prozap Insect Guard	Chem-Tech, LTD	<a href="http://www.chemtechlimited.com">www.chemtechlimited.com</a>	1-515-287-6778
Storcide II	Bayer	<a href="http://www.bayercropscienceus.com">www.bayercropscienceus.com</a>	1-800-248-6907
Tempo SC ULTRA	Bayer	<a href="http://www.bayerprocentral.com">www.bayerprocentral.com</a>	1-800-842-8020
Tempo 20WP	Bayer	<a href="http://www.bayerdvm.com">www.bayerdvm.com</a>	1-800-633-3796
Weevil-Cide	United Phosphorus Inc.	<a href="http://www.upi-usa.com">http://www.upi-usa.com</a>	1-229-439-2632

<sup>1</sup> Other liquid formulations of malathion may be registered for treating empty grain bins. Check to make sure empty grain bins are on the label. Liquid malathion formulations cannot be applied to grain as a protectant treatment.

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**For more information**, call your county Extension office. It is listed in your telephone directory under your county's name.

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Use pesticides **only** according to the directions on the label. Follow all directions, precautions, and restrictions that are listed. Do not use pesticides on plants that are not listed on the label.

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The pesticide rates in this publication are recommended **only** if they are registered with the Environmental Protection Agency or the Alabama Department of Agriculture and Industries. If a registration is changed or cancelled, the rate listed here is no longer recommended. Before you apply **any** pesticide, check with your county Extension agent for the latest information.

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Trade names are used **only** to give specific information. The Alabama Cooperative Extension System does not endorse or guarantee any product and does not recommend one product instead of another that might be similar.

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