



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.

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

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

The Indian meal moth is the most common moth pest of stored grain in Alabama. Other moth larvae that damage grains and grain products include Angoumois grain moth and Mediterranean flour moth. 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 and rice weevil 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.

The following sections discuss practices that reduce the likelihood of insect problems in stored grain. These practices also reduce the chances that mold problems will develop in the bin. Once grain has been placed in storage, it is difficult to get rid of insect infestations that develop. The grain will have to be fumigated or treated with a protectant insecticide as it is moved to another bin. The only exception is if surface infestations of moths develop. These can usually be cleaned up with a surface application of an appropriate insecticide.

More information on managing insects in stored grain can be found at the stored grain section of alabamacrops.com.

Steps to Successful Grain Storage

Clean 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 3. Concentrate on cracks and crevices where insects may be hiding. It is best to complete this job at least two weeks before harvest.

Preparing the grain bin. Thoroughly clean the storage bin. Removal of all grain, grain products, and other organic matter is essential for eliminating existing infestations. Pay attention to the outside of the bin as well. Control any weeds that are close to the bin, and remove any grain debris or excess equipment lying near the bin. Grain bins with perforated floors can be difficult to clean, but do the best that you can. Any residue remaining in the bin can reduce the effectiveness of the residual insecticide.

Spray the floor of the bin, as well as the inside walls as high as can be reached, with a residual insecticide to eliminate existing infestations. Also spray the outside of the bin, as high as can be reached, as well as the ground or concrete pad surrounding the bin, out to a distance of at least 5 feet. 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. Remove all dead insects before putting grain in the bin.

Completely seal any unnecessary openings in the bin using caulk, polyethylene foam, or other suitable materials such as sheets of polyethylene. Pay particular attention to joints in the metal. At night, place a light inside the bin to find any openings that you may have 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.

Loading the grain into the bin. Grain must be in good condition to be stored successfully. The moisture content 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.

Table 1. Maximum Moisture Contents for Grain Storage in the South¹

Grain Type and Storage Time	Maximum Moisture Content for Safe Storage ²	
	Aerated	Not Aerated
Shelled Corn and Sorghum		
Sold as #2 grain by spring	14	12
Stored 6 to 12 months	13	11
Stored more than 1 year	12	10
Wheat, Oats, Barley, Rice		
Stored up to 6 months	12	10
Stored 6 to 12 months	11	9
Stored more than 1 year	10	8
Soybeans		
Sold by spring	13	11
Stored 6 to 12 months	12	10
Stored more than 1 year	11	9
Edible Beans		
Stored up to 6 months	14	12
Stored 6 to 12 months	12	10
Stored more than 1 year	10	8

¹ Adapted from "Stored Grain Management Techniques, by Noyes, Ronald T., et.al., in Stored Product Management, Publication E-912, Cooperative Extension Service, Oklahoma State University, and USDA, 1995.

² Reduce one percent for poor quality grain, such as grain damaged by blight, drought, etc.

Grain protectants are insecticides that are uniformly applied to the grain as it is loaded into the bin. They are recommended for wheat that will be stored for longer than 1 month, corn that is placed into the bins before mid-August, and corn that will be stored for more than 6 months. Apply the protectant to the stream of grain as it is placed in the storage structure. 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 dust should be applied as uniformly as possible. Good coverage of grain is essential for effective control. Follow manufacturers' recommendations to get good coverage. See Table 2 to see which commodities can be treated with a particular protectant insecticide. Protectants applied as layer treatments as the grain is loaded are not as effective as treating entire grain mass, but this is an option for uninfested grain or short-term storage.

High temperatures cause the grain protectants to break down. Therefore, apply the grain protectant at the coolest point in the grain stream as it is loaded into the bin after drying.

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

Surface treatments. The insecticides listed in Table 3, 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.

Monitoring grain. Use grain triers or grain probe traps to check for insects in the grain mass. Monitor at least once per month in the summer months, and once every six weeks in the cooler months. Sample grain from at least five locations in the grain bin. A simple method is to take samples on the north, south, east, and west edges and a sample in the center. How many insects is too many depends on the end use of the grain. If you are using the grain as feed on farm, it is not as critical if you find insects. However, if you are planning on selling the grain, you may need to fumigate the grain to eliminate live insects before you sell it. See "IPM Tactics for On-Farm Stored Grain," www.aces.edu/pubs/docs/A/ANR-1126/ for more information on the number of insects that can be tolerated.

Aerating Grain

Insect development in stored grains slows when temperatures drop into the 60-degree F range, and it effectively stops below 60 degrees 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 per bushel. 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 degrees F, then 60 degrees, and finally to 55 degrees will result in fewer insect development days than waiting to cool the grain when

temperatures fall below 55 degrees F. For more information on aerating grain, see “Grain Storage Aeration Guidelines for the Southeast,”

www.aces.edu/dept/grain/documents/aerationmanual.pdf.

Automatic controllers are now available that will run aeration fans as necessary to cool grain to a desired temperature. This eliminates much of the guesswork involved in the aeration process. Thermocouples may be placed in the grain and used to monitor grain temperature.

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 inadequately sealed bins. 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 must 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, Morgan, 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” (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 www.youtube.com/watch?v=H5hkBTITKSI

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 step 6.)

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 degrees F for four days. Or, bake the material slowly at about 130 degrees 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:

www.extension.purdue.edu/extmedia/gq/gqtf38/gqtf-38.html

Resistance to Insecticides

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. For this reason malathion is no longer listed in Tables 2 and 3.

Storing Grain Using Organic Insecticides

Producers may want to consider the following insecticides, most if not all of which are OMRI approved. Be

sure to read the insecticide label to make sure it meets your needs. The following products contain *Bacillus thuringiensis*: Biobit HP (subsp. *kurstaki* strain ABTS-351), Dipel ES (subsp. *kurstaki* strain ABTS-351), Dipel DF (subsp. *kurstaki* strain ABTS-351), Javelin WG (subsp. *kurstaki* strain SA-11), and Xentari (subsp. *aizawai* strain ABTS-1857). PyGanic Crop Protection EC 1.4_{II} and PyGanic Crop Protection EC 5.0_{II}

insecticides are OMRI approved and contain natural pyrethrins. There are other insecticides that contain pyrethrins. Be sure to choose one that does not contain piperonyl butoxide, as that chemical is not considered organic. Insecto is a product containing diatomaceous earth. Other organic insecticides may be available.

Table 2. 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, Diacon-D ¹	X	X	X	X	X ¹
diatomaceous earth (Insecto, Dryacide, Protect-It)	X	X	X	In shell	X
Prozap Insect Guard ²	X	X	X	X	X
Dipel; other Bt products	X	X	X	X	
Profume	X	X	X	X	X
Pyronyl Crop Spray and other pyrethrin products	X	X	X	X	
Storcide II	X		X		

continued

¹ Diacon-D is labeled for popcorn; Diacon II is not.

² Some formulations list “head space treatment for bulk storage of raw grains, such as corn, soybeans, cocoa beans, and peanuts.”

Table 2. 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, Diacon-D ¹	X	X	X	X	
diatomaceous earth (Insecto, Dryacide, Protect-It)	X	X	X	X	See label.
Prozap Insect Guard ²	X	X	X	X	
Dipel; other Bt products	X	X	X	X	See label.
Profume		X		X	See applicators manual.
Pyronyl Crop Spray and other pyrethrin products	X	X	X	X	See label.
Storcide II		X		X	Rice

¹ Diacon-D is labeled for popcorn; Diacon II is not.

² Some formulations list "head space treatment for bulk storage of raw grains, such as corn, soybeans, cocoa beans, and peanuts."

Table 3. On-Farm Stored Grains Insect Control

Insect	Insecticide and Formulation	Dosage	Comments
Grain Handling Machinery: Augers, Combines, Conveyors, Seeders			
	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.
	beta-cyfluthrin TEMPO SC ULTRA	0.25-0.5% solution 0.5-1 T./gal.	Apply beta-cyfluthrin to all surfaces 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 surfaces and spray to point of run-off.
	pyrethrins + piperonyl butoxide + N-Octyl Bicycloheptene Dicarboxide DOUGLAS PYRETHRIN 5	ready-to-use contact spray	Clean equipment; then apply spray solution.

Insect	Insecticide and Formulation	Dosage	Comments
Empty Bin Treatments Applied Before Loading Grain			
<i>General Comments: 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 RESTRICTED USE 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. Spray the pad outside the bin to a distance of at least 5 feet.
	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. Spray the pad outside the bin to a distance of at least 5 feet.
	deltamethrin + chlorpyrifos-methyl STORCIDE II	1.8 fl.oz./gal./1000 sq.ft.	Apply from outside the bin. Only downward-direct spray permitted. DO NOT 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.
	pyrethrins PYGANIC CROP PROTECTION EC5.0 _{II}	8 fl.oz./1000 sq.ft.	Spray floors, walls, and other surfaces.
	pyrethrins + piperonyl butoxide PYRONYL CROP SPRAY	2.8 fl.oz./1000 sq.ft.	Spray floors, walls, and other surfaces.
	pyrethrins + piperonyl butoxide + N-Octyl Bicycloheptene Dicarboxide DOUGLAS PYRETHRIN 5	ready-to-use contact spray	Spray floors, walls, and other surfaces.
	pyriproxyfen NYGUARD	2.2 t./gal./1500 sq.ft. 11 ml/gal./1500 sq.fet.	Nyguard is an insect growth regulator. It kills immature stages of insects. Use with an adulticide to provide immediate control of adult insects.

Insect	Insecticide and Formulation	Dosage	Comments
Empty Bin Treatments Applied Before Loading Grain (cont.)			
(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./1000 sq.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.
DIACON-D		1.5 oz./1000 sq.ft.	Apply in sufficient water for adequate coverage with a low-pressure sprayer to all areas which may harbor insect pests. Wear a dust mask and protective gloves. Pay particular attention to cracks and crevices.
Protectant Treatments Applied to the Entire Grain Mass as It is Loaded			
<i>General Comments: Apply protectant insecticides after grain is dry and cool. Avoid severely dusty application site. See Table 2 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>General Comments: 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.
pirimiphos-methyl ACTELIC 5EC		8.6-11.5 oz./5 gal./1000 bu. (9.2-12.3 oz./5 gal./60,000 lb.)	DO NOT 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. DO NOT store diluted Actellic in spray tank for more than 48 hours before use.
pyrethrins PYGANIC CROP PROTECTION EC5.0 _{II}		30 fl.oz./5 gal water/ 1000 bu.	
pyrethrins + piperonyl butoxide PYRONYL CROP SPRAY		1.1 pt./4 gal./1000 bu. to 1.4 pt./5 gal./1000 bu.	

Insect	Insecticide and Formulation	Dosage	Comments
Protectant Treatments Applied to the Entire Grain Mass as It is Loaded (cont.)			
(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.
DIACON-D		0.8-1.0 lb./1000 bu.	Apply as uniformly as possible to the commodity stream to assure even coverage.
Surface or Topdress Treatments for the Top 4 Inches of Grain (Primarily for Indian Meal Moth Larvae)			
<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 XENTARI DF		0.05 lb./gal. 0.05 lb./gal. 1.5 oz./gal. 1 lb./10-20 gal./1000 sq.ft.	FOR THE TOP 4 INCHES OF GRAIN: 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. DO NOT 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.	DO NOT 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.
DIACON-D		0.8lb./1000 sq.ft.	Apply uniformly and rake into the grain to a depth of 1 foot.
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.

Insect	Insecticide and Formulation	Dosage	Comments
Fumigation Treatments			
	aluminum phosphide (phosphine gas)		All formulations of aluminum phosphide now require you to prepare a written fumigation management plan. READ THE LABEL AND THE APPLICATORS MANUAL CAREFULLY BEFORE USING ALUMINUM PHOSPHIDE. Many on-farm fumigations fail because the bin is not sealed adequately. Seal bin as tightly as possible. Use higher doses for older, less well-sealed grain bins. 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. All formulations of aluminum phosphide are RESTRICTED USE 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" (www.aces.edu/pubs/docs/A/ANR-1154/) for more information.
	pellets	Farm bins:	
	WEEVIL-CIDE 60% pellets	350-725 pellets/1000 cu.ft.	
	PHOSFUME 60% pellets	350-725 pellets/1000 cu.ft.	
	PHOSTOXIN 60% pellets	350-725 pellets/1000 cu.ft.	
	tablets*		
	WEEVIL-CIDE 60% tablets	70-145 tablets/1000 cu.ft..	
	PHOSFUME 60% tablets	70-145 tablets/1000 cu.ft.	
	PHOSTOXIN 60% tablets	70-145 tablets/1000 cu.ft.	
	other formulations**		
	PHOSTOXIN TABLET PREPAC (33 tablets)	See label.	
	cylinderized phosphine + carbon dioxide gas ECO ₂ 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 RESTRICTED USE 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, and all warning placards have been removed.

Table 4. 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 5. Manufacturers of Stored Grain Insecticide

Insecticide	Manufacturer or Distributor	Website	Telephone Number
Actellic 5E	Winfield Solutions LLC	www.agrisolutionsinfo.com	1-800-328-9680
Dryacide	Winfield Solutions LLC	www.agrisolutionsinfo.com	1-800-328-9680
Diacon II, Diacon-D	Wellmark International	www.wellmarkinternational.com/stored.htm	1-800-877-6374
Insecto	Natural Insecto Products Inc.	www.insecto.com	1-800-332-2002
Javelin	Certis USA	www.certisusa.com	1-800-847-5620
Biobit, Dipel, Xentari	Valent	www.valent.com	1-800-6-valent
Phostoxin	Degesch America Inc.	www.degeschamerica.com	1-540-234-9281 1-800-330-2525
Phosfume	Douglas Products	www.douglasproducts.com/agriculture/	1-800-223-3684
Profume	Dow AgroScience	www.dowagro.com/profume/us/	1-800-258-3033
Protect-It	Hedley Technologies	www.hedleytech.com	1-888-476-4473
Prozap Insect Guard	Chem-Tech LTD	www.chemtechlimited.com	1-515-287-6778
Prentox Pyronyl Crop Spray	Envincio	www.envincio.com	1-770-552-8076
Storcide II	Bayer	www.bayercropscience.us	1-800-248-6907
Tempo SC ULTRA	Bayer	www.bayerprocentral.com	1-800-842-8020
Tempo 20WP	Bayer	www.bayerdvm.com	1-800-633-3796
Weevil-Cide	United Phosphorus Inc.	www.upi-usa.com	1-800-438-6071

Stored Grains: Insect Control Recommendations prepared by Kathy L. Flanders, *Extension Entomologist*, Professor, Entomology and Plant Pathology, Auburn University.

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For more information, contact your county Extension office. Visit <http://www.aces.edu/counties> or look in your telephone directory under your county's name to find contact information.

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.

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 canceled, the rate listed here is no longer recommended. Before you apply **any** pesticide, check with your county Extension agent for the latest information.

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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