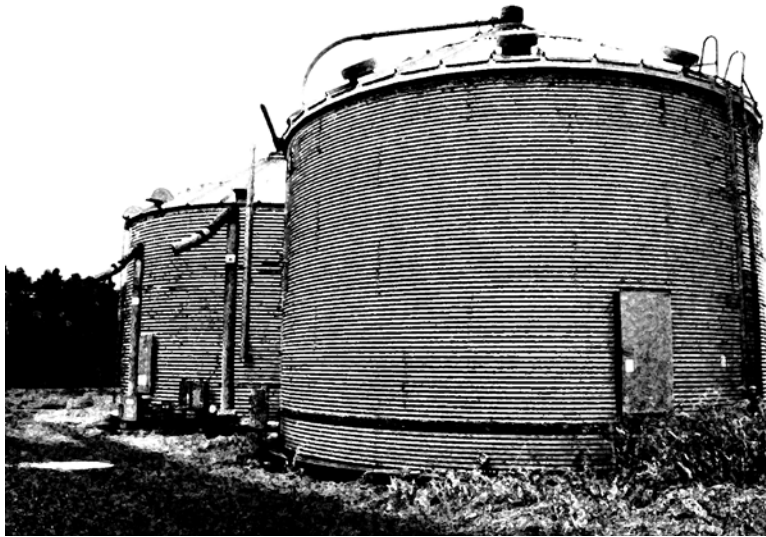


FARM-STORED GRAIN INSECT MANAGEMENT FOR 2009



Robert G. Bellinger, Ph.D.
*Extension Stored Grain Pest Management Specialist &
Pesticide Coordinator*

April 2009

The quality of farm-stored grain is at its peak when the grain is loaded into the bin for storage. After loading the best you can do is to try to maintain this level of quality. Thus, it is important to maximize the quality of your grain *prior* to storage. At harvest, for instance, make sure that your harvesting equipment is adjusted to minimize breaking or cracking the grain or beans.

Sanitation is critical in on-farm grain storage. Only load your grain into a thoroughly cleaned, empty bin! Thoroughly clean bins using brooms, brushes, compressed air, vacuuming to remove grain dust and debris and webbing (wear a dust mask!). Be sure to clean out seams and joints, inside hollow ladder rungs, and especially the ledge over the door. Clean out under perforated flooring (if possible), and be sure the fan and air duct are clean. Cover the fan when it is not in use. You may even want to use silicone caulk to seal seams. *Also* clean combines, grain truck beds, augers and other equipment that can be contaminated with grain and grain debris and dust.

Don't load grains on top of older grains! When loading grain into the storage bin make sure your loading auger and mechanical spreaders in the bin are in good condition and will not damage the grain when loading. Run the auger at full capacity (run at a slow speed) to minimize breaking the grain kernels or beans. And the cleaner and drier the grain is going into the bin the better.

Do not overfill the bin. Carefully level the grain in the bin as soon as it is filled and immediately begin aeration to cool the grain. Poorly controlled temperatures are the most important cause of stored grains going out of condition. Get the grain cooled down to the outside air temperature as soon as possible. Keep the bin temperature no more than 10 – 15°F of the outside temperature during storage. Ideally the temperature should be maintained at 35 - 40°F.

As soon as bins are loaded, clean up *all* spilled grain. Keep ground around bins clear of weeds and debris.

Proper storage management provides the best control for the cost. Proper harvest, loading and storage of grain is critical for managing potential insect infestations. It is important in any insect management system to not rely solely on insecticides. This is particularly true for stored grains, as there are few insecticides registered in this use area, and fewer still for the individual stored commodities. Also, insecticide resistance has already made at least malathion essentially useless in many stored grain environments; malathion is not recommended (*and see notes below.*)

Insects will stop feeding and reproduction at temperatures below about 50°F. Because some grains, wheat and corn for example, are harvested when temperatures can still be fairly warm in South Carolina, immediate aeration to get harvested corn to ambient temperature is critical to help prevent insect infestations. Even grain, especially corn, held at the moisture levels that will not allow mold growth, can still be infested by at least Indian meal moth. This moth infests the grain from the top of the bin. Indian meal moth can be controlled using DDVP resin strips in the head space of the bin, using 1 strip per 1,000 cubic feet (controls adults only). Change strips every one to two months in hot weather, every three to four months after that. You may alternatively, or also, use a *Bacillus thuringiensis (Bt)* product (for example, Dipel) as a top dressing (grain surface treatment) applied immediately after bin loading (controls larvae only.) Diatomaceous earth products may also be used here but monthly treatments will be needed.


Properly loaded grain should be stored in thoroughly cleaned and surface-treated bins (bin surface treatment). A grain protectant can also be used when loading the grain. However, even if both of these procedures are followed, do not fail to regularly check your grain – check storage temperature and moisture levels, and for flying moths and for surface crusting. Remember that grain protectants have low volatility and don't penetrate grain kernels and so won't control insects feeding inside the kernels, and also usually don't kill eggs. Soybeans stored for short time periods may not need to be treated with a grain protectant; they are less prone to insect attack by other than surface feeders, than other grains. Before you use grain protectants, check with your buyer(s) to see what materials may or may not be acceptable to them. Grain with below U.S. pesticide residue tolerances may still not be acceptable to some buyers, and may not be acceptable for sale or use outside of the U.S.

Remember that grain protectants cannot replace good initial storage preparation and thoroughly cleaned equipment and bins, and that top-dressing cannot replace grain protectants.


Farm-Stored Grain Insect Management – 2009

Robert G. Bellinger, Ph.D., *Extension Stored Grain Pest Management Specialist*

These recommendations are based on active ingredients. These recommendations are not a substitute for carefully reading the pesticide label. Other registered products not mentioned here may be as effective.

Pest or Application Type	Active Ingredient(s) (Products)	Rates <i>READ and FOLLOW the LABEL INSTRUCTIONS</i>	Site(s)	Re-entry Interval (REI)	Comments <i>(And see Notes after this table)</i>
Bin Repair & Sanitation			Interior <i>and</i> exterior of grain storage bins prior to loading.		Sanitation is critical. Repair (fix and fill holes, cracks) and <i>thoroughly</i> clean bins before loading with grain. Most pesticide product labels note sanitation as a pre-treatment procedure!
Empty Bin Residual Sprays <small>(Bin interior surface treatment)</small>	<p><i>beta</i>-Cyfluthrin (Tempo 20WP, Tempo 2.0, Tempo SC Ultra)</p> <p>Chlorpyrifos-methyl + deltamethrin (Storcide II)</p> <p>Diatomaceous earth (DE) (Insecto)</p>	<p>Spray empty, cleaned bin to run-off with low pressure sprayer ("garden sprayer") (less than 50 psi) with flat fan nozzle tip. One gal. spray covers 750–1,000 sq. ft.</p> <p>Bin surfaces – 1.8 fl. ozs. for 1.0 gal. of spray solution applied</p> <p>1 lb./1,000 sq.ft. of surface</p>	<p>Empty bin <i>only</i></p> <p>Empty bins</p>	<p>When sprays have dried</p>	<p><i>Do not</i> treat grain with Tempo <i>Do not</i> treat bins to be used for storing soybeans.</p> <p><i>Must be applied from the outside only with downward spray with automated equipment.</i></p> <p>Applied through aeration fan. May meet organic requirements.</p>
Empty Bin Fumigation	Aluminum phosphide - phostoxin gas (Phostoxin; Phosfume; Weevil-cide; pellets /tablets)	<p><i>Follow label, applicator manual instructions exactly</i></p> 	Insects which infest stored crops	<i>Follow label, applicator manual procedure sexactly</i>	Fumigate empty bin after <i>thorough</i> bin clean-out and interior residual treatment. Extremely toxic RUP with strict application procedures. No residual control.

Pest or Application Type	Active Ingredient(s) (Products)	Rates <i>READ and FOLLOW the LABEL INSTRUCTIONS</i>	Site(s)	Re-entry Interval (REI)	Comments <i>(And see Notes after this table)</i>
Grain Protectants (Direct grain / Admixture treatment)	Pirimiphos-methyl (Actellic 5E) Chlorpyrifos-methyl + deltamethrin (Storcide II) s-methoprene (Diacon II) Diatomaceous earth (DE) (Insecto)	9.2 – 12.3 fl.ozs. (6 – 8 ppm) in 5 gal. water /1,071 bu. (30 tons) 6.6 to 12.4 fl. ozs./ 1,000 bu. grain – <i>rate varies with each grain.</i> (For five (5) gals. of solution (3.0 ppm chlorpyrifos methyl and 0.5 ppm deltamethrin). /1,000 bu. grain) 8 to 14 fl. ozs./5gal. water/1,000 bu. grain – rate varies with kind of grain. 1- 2 lbs./ton of grain to top 2-3 ft. of grain.	Corn, grain sorghum only Wheat, barley, oats, grain sorghum, rice, seeds with storage tolerances Wheat, corn, sorghum, (milo), oats, barley, peanuts	When sprays have dried When sprays have dried	One (1) treatment per load of grain only. Use calibrated applicator One (1) treatment per load of grain only. Use calibrated applicator . U.S. marketed grain only. Not labeled for corn. Controls larvae only May meet organic requirements. Treatment varies with time of harvest, anticipated storage time.
Grain Top-Dressing (Stored grain surface treatment, especially for Indian-meal moth larvae- <i>Applications are to leveled grain</i>)	Pirimiphos-methyl (Actellic 5E) (s)-methoprene (Diacon II) <i>Bacillus thuringiensis</i> (Bt) (Biobit HP, Dipel DF, Javelin WG) Diatomaceous earth (DE) (Insecto)	3 fl. ozs./2 gal. water/1,000 sq.ft. (3.0 ppm) 0.2 teaspoons or 0.1ml./1,000 sq.ft. 1 lb./10-20 gal. water/1,000 sq.ft.; see label 4 lbs./1,000 sq.ft.	Corn, grain sorghum only	When sprays have dried	Clear webbing, break-up crusting. Apply 1 gal. and rake into top 4 inches of grain; apply second gal. to raked surface. Use only enough water to give coverage – <i>Do not flood grain surface.</i> Controls only larvae. Apply to surface and rake into top 4 inches of grain; see label instructions. Controls only larvae. May meet organic requirements. Especially for Indian-meal moth. May require second application for heavy infestation. Apply at monthly intervals. May meet organic requirements.

Pest or Application Type	Active Ingredient(s) (Products)	Rates READ and FOLLOW the LABEL INSTRUCTIONS	Site(s)	Re-entry Interval (REI)	Comments (And see Notes after this table)
Filled Bin Fumigation	Aluminum phosphide - phostoxin gas (Phostoxin; Phosfume; Weevil-cide; pellets or tablets)	<i>Follow label, product applicator manual exactly</i> 	Insects which infest stored crops	<i>Fumigant detection, post-treat ventilation</i>	Extremely toxic RUP. Strict application procedures including placarding, fumigant detection, other required measures.
	Sulfuryl fluoride gas (Profume)		Insects which infest stored crops	<i>Follow label, product applicator manual all products.</i>	<i>Extremely toxic RUP. Strict application procedures fumigant detection, other measures.</i>

Note: Product use sites - Read the label carefully! Use sites vary widely from product to product. Some products may only be used to treat grain storage bin surfaces and not grain; few products may be used for both applications. Grains that may be treated vary with product.

Note: Product rates - Read product labels carefully! Rates vary with formulation of product used, use site/crop being stored, anticipated storage time, and pest species, and pest development stage. Some products may only have one (1) application made to a load. Period of control can vary with pest insect species and is shortest at the lowest rates.

Note: Pests controlled – Read the label. Not all products control all pests, especially at the lowest rates. Insect growth regulators (IGRs), such as Diacon II, and *Bacillus thuringiensis* (*Bt*) products control only immature stages (larvae, caterpillars, grubs). Control will be slow. *Bacillus thuringiensis* controls only caterpillars (moth larvae), and not beetle grubs.

Note: Formulations – Read the label. Choose the correct formulation. Be sure you have the necessary application and safety equipment and PPE to make an application with the product formulation you consider. Some formulations may not be applied directly to grain. Some products may be applied with water or food-grade oil or soybean oil, usually except for peanuts.

Note: Actellic 5E – only one (1) application method is allowed per load. Only one (1) application allowed per load.

Note: Diacon II (s-methoprene) – Insect growth regulator controlling larvae only. Lowest rates give control for less than 6 months. May be applied with water or food-grade oil or soybean oil, except for peanuts. Product may be applied with an insecticide controlling adults. Read the label(s).

Note: Insecto (a diatomaceous earth product) – “Insecto Control Plan” calls for dusting the empty bin, treating the bottom 2 feet of grain, treating the top 2 feet of grain, top-dressing leveled grain with this product at labeled rates. Inspect grain bi-weekly. Organic Materials Review Institute (OMRI) Listed.

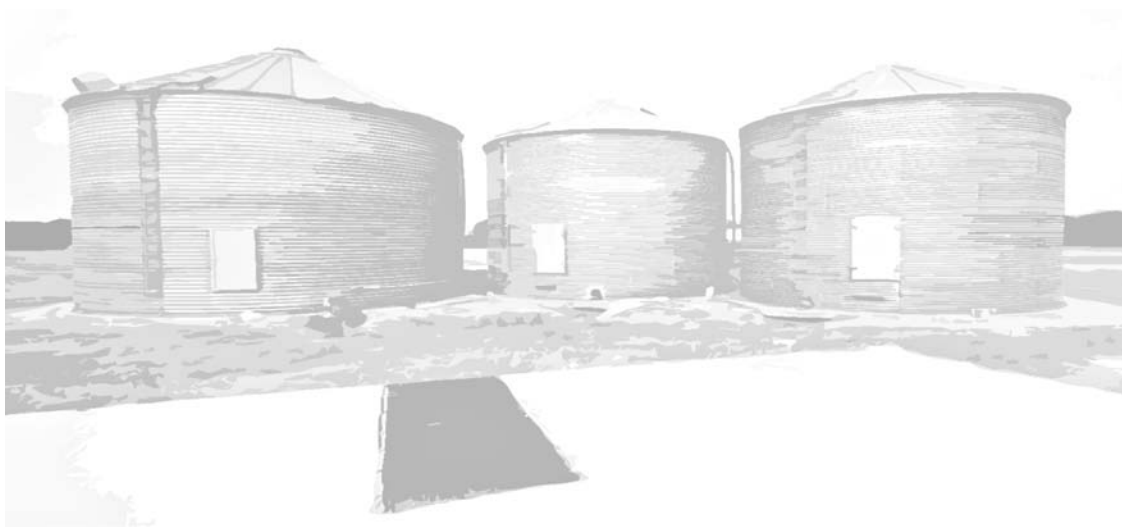
Note: Fumigants are the most effective way of controlling insect infestations in stored grain; however, fumigants provide no residual control. Fumigants are Restricted Use Pesticides (RUPs) and may be purchased and used only by licensed applicators. These pesticides are Danger, Danger/Poison labeled because of acute toxicity. Fumigants have strict application requirements via the label and applicator manual. Product-specific training and/or product company supervision may be required, especially for liquid and gas formulations.

Note: Malathion is registered for empty bin treatments (labeled EC formulations only) and for grain protectant treatments (labeled *dust formulations* only). However, malathion is not being recommended here as it is not seen as effective by many because of widespread insect resistance to it, especially in the Indian-meal moth. Further, international tolerances for malathion on grain have been lowered and are now much lower than U.S. tolerances, effectively making malathion treated grain unmarketable outside of the U.S. Grain buyers are telling growers that they will not accept grain treated with malathion.

Grain Bin Surface Areas and Capacities

R.G. Bellinger 1/09

Bin Diameter (Feet)	Grain Head Surface Area or Bin Floor Area (Square Feet)	Approximate Surface Area of Empty Bin (Square Feet)	Bushels per Foot of Bin Height	Approximate Bin Head-space (Volume of a cone - Cubic Feet)
15	177	(Height x 47) + 354	141	59 x cone height
18	254	(Height x 57) + 508	204	85 x cone height
21	346	(Height x 66) + 692	277	115 x cone height
24	452	(Height x 75) + 900	362	151 x cone height
27	573	(Height x 85) + 1146	458	191 x cone height
30	707	(Height x 92) + 1400	566	236 x cone height
33	855	(Height x 104) + 1710	685	285 x cone height
36	1,018	(Height x 113) + 2000	815	339 x cone height
42	1,385	(Height x 132) + 2770	1109	462 x cone height
48	1,810	(Height x 151) + 3,620	1448	603 x cone height
54	2,290	(Height x 170) + 4580	1833	763 x cone height
60	2,827	(Height x 188) + 5654	2263	942 x cone height



The Clemson University Cooperative Extension Service offers its programs to people of all ages, regardless of race, color, sex, religion, national origin, disability, political beliefs, sexual orientation, marital or family status and is an equal opportunity employer.

Clemson University Cooperating with U.S. Department of Agriculture, South Carolina Counties, Extension Service, Clemson, South Carolina. Issued in Furtherance of Cooperative Extension Work in Agriculture and Home Economics, Acts of May 8 and June 30, 1914