Extension
ALABAMA A&M & AUBURN UNIVERSITIES

IPM-0330

Stored Grains

2023 Insect Pest Management Recommendations for On-farm Stored Commodities in the Southeast

IPM

All the expense and effort of making a crop can be wasted if not enough attention is paid to storage. The key to storing grains and other commodities on the farm is to make storage conditions unfavorable for the survival of stored-grain insects and molds. The following steps are designed to reduce the initial number of insects in the bin, slow the development of any remaining insects, and apply corrective measures to reduce insect populations if necessary. Following these steps will also greatly reduce stored-grain molds and associated mycotoxins.

- Clean storage facilities thoroughly inside and out to eliminate starter colonies of insects. Remove any weeds, crop debris, or clutter to reduce insect and rodent activity. Clean the bins as soon as they are emptied. All grain residues from the previous year should be removed from inside the facility as soon as the old crop is shipped.
- Seal any gaps or holes in the sides and roof of the bin, using caulk or polyurethane foam. Check to make sure the bottom seal with the concrete is intact. Prevent water from flowing underneath the bin by applying plastic roof cement.
- Apply an EPA-approved insecticide (Table 1) on the floors and sides of empty storage facilities to eliminate insects hiding in cracks and crevices and to create a first line of defense against any insects that do find their way into the bin. Spray the outside of the bin to a height of 3 feet, and the surrounding concrete, gravel, or sod to a distance of 6–10 feet surrounding the bin. The following insecticides can be used for this empty bin treatment:

Table 1. Insecticides for Use for Empty Bin Treatments[1]

Insecticide	Rate	MoA[2]	Remarks
TEMPO SC ULTRA (beta-cyfluthrin)	0.25–0.5 fl.oz./gal./1000 sq.ft.	3A	Apply to all interior surfaces of storage bin and allow to dry before filling bins.
CENTYNAL EC (deltamethrin)	0.25–1.5 fl.oz./gal./1000 sq.ft.	3A	Apply to wall and floor surfaces of grain bins and warehouses prior to storing or handling grain.
D-FENSE SC (deltamethrin)	0.25–1.5 fl.oz.//1000 sq.ft.	3A	Apply to wall and floor surfaces
SUSPEND SC (deltamethrin)	0.25–1.5 fl.oz./gal./1000 sq.ft.	3A	Apply finished spray to equipment and wall and floor surfaces of grain bins and warehouses prior to storing or handling grain.
INSECTO (diatomaceous earth)	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.
DRYACIDE 100 (diatomaceous earth)	Dust: 1–3 lb./1000 sq.ft. Slurry: 1.5 lb./1.5 gal./100 sq.ft..		Apply as a dust with a hand or power duster or as a slurry spray.
PROTECT-IT (diatomaceous earth)	Dust: 0.6 lb./1000 sq.ft. Slurry: 1.5 lb./1.5 gal./100 sq.ft.		Apply 2 weeks before filling bins. Use a dust blower or bin fan to reach all cracks, crevices, and surfaces. Apply slurry as a fine mist.
STORCIDE II (deltamethrin + chlorpyrifos methyl)	1.8 fl.oz./gal./1000 sq.ft.	1B + 3A	Application can only be made from outside the bin using automated spray equipment.
NYGUARD IGR Concentrate (pyriproxyfen)	0.8–2.4 t./gal./1500 sq.ft. 4–12 ml/gal./1500 sq.ft.	7C	This product will not kill adults but will control immatures; may be mixed with an adulticide
DIACON-D IGR ((s)-methoprene)	1.5 oz./1000 sq.ft.	7A	This product will not kill adults but will control immatures; applicators must wear dust mask and protective gloves.
DIACON IGR ((s)-methoprene)	Fogging Treatment: 1 ml/1000 sq.ft. (0.2 t./1000 sq.ft.) Pressure Spray: 2 ml/1000 sq.ft. (0.4 t./1000 sq.ft.)	7A	Apply fogging treatment in water or oil in a cold aerosol generator. Diacon IGR is an insect growth regulator that interferes with the development of insects. It will not kill adult insects. Apply as a pressure spray in low-pressure sprayer to all areas that may harbor insect pests.
DIACON IGR PLUS ((s)-methoprene + deltamethrin)	0.25–1.5 fl.oz./gal./1000 sq.ft.	3A + 7A	Apply after equipment and buildings have been thoroughly cleaned.

[1] The use of residual insecticides by themselves does not constitute an insect management program. Appropriate programs should also include incoming product inspection, product rotation, sanitation, monitoring with traps, properly sealing doors and windows, and sealing cracks and wall voids. Exterior premises should be maintained by draining water away from the facility, directing light away from the building, removing vegetation near the structure, and promptly cleaning up spilled grain.

[2] Mode of Action Group from the Insecticide Resistance Action Committee (IRAC)

- Eventually, insects will build up under the bin floor. Bins with false floors should be fumigated if the grain debris cannot be removed (Table 2). Cover with plastic tarp (6 ml or thicker) to contain and hold the gas. Place the fumigant below the floor if possible, or scatter it over the empty floor under the tarp. These materials are **RESTRICTED USE** pesticides. Fumigation should only be conducted by trained and licensed applicators. Read the label and the applicators manual. You will need to prepare a fumigation management plan before you fumigate.

Table 2. Fumigants for Controlling Insects Beneath the False Floor

Insecticide	MoA*	Remarks
ALUMINUM or MAGNESIUM PHOSPHIDE	24A	See fumigant section below for individual product names. Use rates as indicated on label.

* Mode of Action Group

- Clean out harvesting and loading equipment, such as combines, trucks, and augers, at the end of each harvest season. If not clean, insects will reproduce in the small amounts of grain left in the equipment and then be conveyed into the new crop grain..
- Store the grain at the appropriate moisture content (Table 3). Insects and molds require moisture to survive:

Table 3. Recommended Maximum Moisture Content for Grain in Aerated* Storage Conditions

	Planned storage time before marketing		
Crop	6 months	6 to 12 months	more than 1 year
Corn and grain sorghum	14%	13%	12%
Soybeans	13%	12%	11%
Small grains	12%	11%	10%
Edible beans	14%	12%	10%

*Decrease each moisture content percentage by 2 percent if storing grain without aeration

- Store clean grain. Removing or equally dispersing fine particles and other foreign debris will increase aeration efficiency and the effectiveness of grain protectants and grain fumigants.

  The following steps each contribute to clean grain:

  Effective in-season weed control

  A properly adjusted combine

  Use of a grain precleaner

  Coring the bin after it has been loaded or using a mechanical spreader at the top of the bin.

- Apply an approved grain protectant directly to clean grain as it is loaded into the bin. Apply to a moving grain stream at the bottom of the bucket elevator or auger so the material has an opportunity to contact as many kernels as possible as the grain is moved. It is important to run the grain through a cooling cycle or similar procedure before applying the protectant as high heat rapidly breaks down insecticides.

Table 4. Insecticides for Applying Directly on the Commodity as a Protectant Treatment[1,2]

Insecticide	MoA*	Rate per 1000 Bushels	Remarks
ACTELLIC 5E (pirimiphos-methyl)	1B	Dilute in 5 gal. of spray 8.6–11.5 fl.oz. (corn) 8.6-11.5 fl.oz. (grain sorghum)	Shelled corn, popcorn, and grain sorghum only. DO NOT use if grain has been previously treated with Actellic or if Actellic will be used as a topdress treatment.
CENTYNAL EC (deltamethrin)	3A	Dilute in 5 gal. of spray 9–18 fl.oz. (corn) 9.6–19.2 fl.oz. (wheat) 5.1–10.3 fl.oz. (oats) 8–16 fl.oz. (grain sorghum) 8–16 fl.oz. (rye)	Labeled for use on barley, corn, oats, popcorn, rice rye, grain sorghum, and wheat. Low rate is 0.5 ppm and high rate is 1 ppm. Use the higher rate for longer term storage.
D-FENSE SC (deltamethrin)	3A	Dilute in 5 gal. of spray 8.53 fl.oz. (corn) 9.14 fl.oz. (wheat) 4.9 fl.oz. (oats) 8.5 fl.oz. (sorghum) 8.5 fl.oz. (rye)	Labeled for use on barley, corn, oats, popcorn, rice, rye, grain sorghum, and wheat. Rate is for 0.5 ppm, the maximum allowed.

Table 4. Insecticides for Applying Directly on the Commodity as a Protectant Treatment[1,2] cont.

Insecticide	MoA*	Rate per 1000 Bushels	Remarks
DIACON IGR ((s)-methoprene)	7A	Dilute in 5 gal. of spray 1.75 to 7 fl.oz. (wheat, corn, grain sorghum) 1 to 4 fl.oz. (oats, peanuts)	Labeled for use on wheat, corn, grain sorghum, barley, rice oats, peanuts, and sunflower; will not control weevils. Diacon IGR is an insect growth regulator that interferes with the development of insects. It will not kill adult insects. Treat existing insect populations with an adulticide before or at the same time as applying Diacon IGR. Apply only once to grain of known treatment history. Use highest rates for maximum residual. Lowest rate provides shorter residual.
DIACON-D IGR ((s)-methoprene)	7A	8–10 lb.	Labeled for use on cereal grains, corn, sunflower, canola, legumes, popcorn, wheat, spices, sorghum, rice, cocoa, peanuts, oats, and millet; will not control weevils. Diacon IGR 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 or at the same time as applying Diacon IGR. Apply only once to grain of known treatment history.
DIACON IGR PLUS (deltamethrin + s-methoprene)	3A + 7A	Dilute in 5 gal. of spray 9–18 fl. oz. (corn) 9.6–19.2 fl.oz. (wheat) 5.1–10.3 fl.oz. (oats) 8–16 fl.oz. (sorghum) 9–18 fl.oz. (rye)	See label for other grains (barley, popcorn, rice). Use the high rate, equivalent to 1 ppm deltamethrin + 2.5 ppm s-methoprene for longer term storage.
DRYACIDE 100 (diatomaceous earth)	UNM*	1–2 lb./ton	Thoroughly mix with grain. For use on grains, soybeans, peanuts, popcorn, and others (see label). Diatomaceous earth products are less effective when used on grain with increased moisture content and under humid conditions; diatomaceous earth is known to decrease test weight and grain flowability
INSECTO (diatomaceous earth)	UNM*	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). See note above.
PROTECT-IT (diatomaceous earth)	UNM*	Wheat, beans, peas: 18 lb. Oats: 9.6 lb. Rye: 16.8 lb.	Uniformly treat grain as it is loaded into bin. For use on grains, soybeans, peanuts, popcorn, and others (see label). See note above.
STORCIDE II (deltamethrin + chlorpyrifos- methyl)	1B + 3A	Per 5 gal. of spray: 12.4 fl.oz. (wheat) 11.6 fl.oz. (grain sorghum) 6.6 fl.oz. (oats)	Dilute with water or an FDA-approved food grade mineral oil or soybean oil. Wheat, barley, oats, rice, and grain sorghum
SENAT (spinosad)	5	Dilute in 5 gal. spray 9.8 fl. oz. (corn) 10.5 fl.oz. (wheat) 5.9 fl.oz. (oats) 9.8 fl.oz. (sorghum)	See label for other grains (bird seed, barley, popcorn, millet, triticale). Note: product should be used on commodities intended for domestic consumption or for export to countries where you have confirmed the specific import residue policies and applicable residue limits per such import.

[1] Do not apply before sending the grain through a grain drier or immediately after coming out of the drier as the heat will quickly degrade the insecticide. Grain protectants should only be applied to cool grain that is of proper storage moisture with minimal dockage and fines. It is best to apply protectants at the bottom of the auger so the insecticide can thoroughly coat the kernels as they are conveyed.

[2] Surveys consistently show that stored grain insect populations are resistant to malathion.

* Mode of Action Group from the Insecticide Resistance Action Committee

* Non-specific mechanical disruptors

- Once the grain is in the bin, make sure that the surface is level and that the bin is not overfilled. Leave a few feet of the straight side of the bin as air space to facilitate aeration and monitoring. If your bin does not have a spreader, unloading some grain will help level the central peak as well as remove many fine particles that otherwise accumulate in the center of the bin.
- If grain will be stored for more than a few months and was not treated with a protectant, a top dress treatment (Table 5) may be helpful, but is never as effective as a full protectant treatment (Table 4).
- If you have had problems with Indian corn moths in the past, you may want to consider a headspace treatment (Table 6).

Table 5. Insecticides Labeled for Top Dress Treatments

Insecticide	MoA*	Rate per 1,000 sq.ft. of grain surface	Remarks
ACTELLIC 5E (pirimiphos-methyl)	1B	3 fl.oz.	Shelled corn and grain sorghum only. DO NOT use if grain has been previously treated with Actellic spray.
DIACON-D IGR ((s)-methoprene)	7A	8 lb.	Use sufficient water or oil to provide adequate coverage as a spray or a fogging treatment. Note: labeled for use on cereal grains, corn, sunflower, canola, legumes, popcorn, wheat, spices, grain sorghum, rice cocoa, peanuts, oats, and millet; will not control weevils. Apply only once to grain of known treatment history. Methoprene is an insect growth regulator that interferes with the development of insects. It will not kill adult insects.
DIACON IGR ((s)-methoprene)	7A	0.2 t. (1 ml)	Apply uniformly and rake into the grain to a depth of 1 foot. See note above.
SENAT (spinosad)	5	2.6 fl.oz./2 gal./1000 sq.ft.	For bird seed, barley, corn, popcorn, millet, oats, sorghum, triticale, and wheat). Note: product should be used on commodities intended for domestic consumption or for export to countries where you have confirmed the specific import residue policies and applicable residue limits per such import.
INSECTO (diatomaceous earth)	UNM*	4 lb.	Apply Insecto as a dust to surface of binned grain (see instructions on the label). For grains, soybeans, peanuts, popcorn, and others (see label).
PROTECT-IT (diatomaceous earth)	UNM*	3 lb. or 40 lb. See remarks.	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. Uniformly treat grain as it is loaded into bin. For use on grains, soybeans, peanuts, popcorn, and others (see label).
Bacillus thuringiensis (various products including BIOBIT HP, DIPEL DF, JAVELIN WG, and XENTARI DF)		11A	Controls Lepidopteran pests only. Apply evenly over the surface immediately after loading and mix into a depth of 4 inches with a scoop or rake.

* Mode of Action Group from Insecticide Resistance Action Committee

* Non-specific mechanical disruptors

Table 6. Headspace Treatments

Dichlorvos including PROZAP INSECT GUARD and HOT SHOT NO PEST STRIP.	1B	80 grams per 900–1200 cu. ft.	Polyvinyl strips impregnated with dichlorvos can be hung in the bin headspace to help control Indianmeal moth adults.

- Stored grain insects thrive in warm grain. The hotter it is, the faster insects feed, grow, and reproduce. Conversely, stored grain insects quit feeding and developing when temperatures are below 60 degrees F. Grain temperatures are optimally managed using thermostatically controlled aeration that lets the fans operate only when the outside air temperature is cooler than the set point; once the grain reaches the set point temperature, set the thermostat to the next cooler set point. Growers in the Deep South should use temperature set points of 75 degrees F, 65 degrees F, and 45 degrees F, whereas growers farther from the coast should use 70 degrees F, 60 degrees F and 40 degrees F. Don't let the grain freeze as this will result in "sweating" when the grain warms in the spring; similarly, grain can sweat if the differential between the grain and air temperatures is greater than 20 degrees F. Temperature cables, moisture sensor cables, and automated aeration controllers make aeration more efficient, but you can do this manually. Grain Storage Aeration Guidelines for the Southeast.
- Initiate a systemic and thorough insect-monitoring system. Check the grain every 21 days from spring to fall and monthly in winter for the presence of insects. Five trier samples or probe traps should be sufficient on each sampling date.
- If you begin to find insects such as weevils or lesser grain borers, sell the grain, move the grain to another bin, and apply a grain protectant as you move it, or fumigate the grain (Table 7). Read the fumigant label and applicator guide carefully. Follow the instructions provided because the label is the law. Aluminum phosphide is the most frequently used on-farm fumigant. It requires the preparation of a fumigation management plan before any fumigant is applied. If there are leaks in the bin, the fumigant cannot be held long enough to kill the insects. Seal all openings before loading the bin, including the aeration fan, top vents, eaves, roof entry door, and side entry door. Many fumigation attempts end in failure.
- Be sure to leave the fumigant in the bin long enough to be effective. Read the fumigant label to determine how long it will take the fumigant to reach a lethal level. It may take a day or two to reach the desired concentration; therefore, leave the bin sealed for the recommended time. A closed-loop fumigation can make fumigation more efficient and safe. In this method, fumigant is circulated in a pipe outside the bin from the top to the bottom and then drawn up through the grain to the surface. See Extension publication ANR-1154, "Fumigating Agricultural Commodities with Phosphine."

Table 7. Grain Fumigants

Product	Rate	Comments
aluminum phosphide (phosphine gas)		All formulations of aluminum phosphide now require you to prepare a written fumigation management plan. R**EAD 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 WEEVIL-CIDE 60% pellets, PH3 (formerly PHOSFUME2) 60% pellets, or PHOSTOXIN 60% pellets	Farm bins: 350-725 pellets/1,000 cu.ft.	
tablets WEEVIL-CIDE 60% tablets, PH3 (formerly PHOSFUME2) 60% tablets, or PHOSTOXIN 60% tablets	Farm bins: 70-145 tablets/1,000 cu.ft	
PHOSTOXIN TABLET PREPAC (33 tablets)*	See label.	Phostoxin tablet prepack is a **RESTRICTED USE** chemical.
cylinderized phosphine + carbon dioxide gas ECO2FUME FUMIGANT GAS	See label.	Eco2Fume is a mixture of phosphine and carbon dioxide gases that are packaged in compressed gas cylinders; it is labeled for use by certified applicators only. It is a restricted use insecticide and requires specialized training and equipment. Eco2Fume is a **RESTRICTED USE** chemical.
pure phosphine gas VAPORPH$_3$OS PHOSPHINE FUMIGANT	See label.	Vaporph$_3$os is a **RESTRICTED USE** chemical and requires specialized training and equipment for application. It is pure phosphine gas that is blended with carbon dioxide on site.
cylinderized sulfuryl fluoride PROFUME	See label.	To be blended with carbon dioxide or forced air on site. Profume is a **RESTRICTED USE** insecticide. See label and applicator's manual.

*Other trade names and packaging are available.

Table 8. Helpful Conversions for Applying Insecticides to Stored Grains

1 bushel is 1.25 cubic feet
1 cubic foot is 0.8 bushels
Number of tons = (Number of bushels x test weight in pounds per bushel) / 2000
Grain surface area (square feet) = 3.1416 x (bin diameter in feet/2) x (bin diameter in feet/2)
Grain volume (cubic feet) = (grain surface area) x (height of grain in feet)
Bin volume (cubic feet) = [(grain surface area) x (height of bin in feet)] + [1.05 x (bin diameter in feet/2) x (height of roof cone in feet)]

- For more information on storing commodities on the farm, see the website Maintaining Quality of Stored Grain from Alabama Extension.

Protecting Small Quantities of Stored Products

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 purchased from a reputable source.
2. Purchase only as much food or pet food as you normally consume in a month. Keeping foodstuffs in the home for several months makes them much more likely to become infested with stored product insects.
3. If there is good reason for thinking the food may be infested, freeze the package in a household freezer or use a heat treatment before it is stored. (See step 6.)
4. Make sure food is dry (see Table 3). Whole grains and beans stored before they have been completely dried are prone to insect and disease problems.
5. Store food in tightly sealed containers that are safe for food products.
6. Monitor the food periodically for pest infestations. Discard any heavily infested food to keep problems from spreading. Likely infestation sources include pet foods and treats, breakfast cereal, wheat, flour, cornmeal, spices, dry noodles, popcorn, and dried beans.
7. 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 4 days (small package) or a week (large box). Alternatively, spread the material out into a thin layer on cookie sheets and bake the material at about 130 degrees F for 30 minutes.
8. If storing in bulk (more than 1 gallon), it may be beneficial to use a grain protectant. An example is diatomaceous earth, such as Insecto. When working with this product, wear a mask or work outdoors to avoid overexposure 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 anticaking agent. Do not use pool-grade or beverage-grade diatomaceous earth.

Grain Bag Storage

Storing grain in large plastic grain bags has become popular in recent years. Research studies have shown varying results in terms of how well the system prevents insect and mold infestations. The most important consideration is that bags be placed on hard, level, well-drained land. If bags are placed on a slope, they must be arranged to run along the direction of the slope, not across it. Every precaution must be taken to prevent the bags from being punctured, which is why bags should not be placed on top of crop stubble or other sharp surfaces.

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.ag.ndsu.edu/graindrying/publications/ae-84-temporary-grain-storage.

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 and Dipel DF (subsp. *kurstaki* strain ABTS-351), Javelin WG (subsp. *kurstaki* strain SA-11), and Xentari (subsp. *aizawai* strain ABTS-1857). (Javelin WG is for use on stored soybeans only. Pyganic Crop Protection EC 5.0II insecticide is OMRI approved and contains 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.

Controlling Molds and Mycotoxins in Stored Grain

Molds are fungi that can attack grains and grain products at any stage of production and can produce some of the most catastrophic losses in the crop. We have all seen mold on corn left standing in the field, perhaps on an ear opened by birds. The kernels are odd colors and are “fuzzy” in appearance, like the mold on stale bread. These more obvious signs of fungi on grain are hard to miss, and common sense tells us not to eat this spoiled grain or feed it to livestock. In fact, some of the most deadly toxins are produced by fungi growing on grains, so our intuition is quite justified in this case. Fungi can also produce toxins (mycotoxins) even if the fungus is not readily apparent or visible to the naked eye, and a small amount of the fungus can contaminate an entire lot of grain, making it unsuitable for food or feed. Fungi can also grow on the grain if

harvest or storage have been mishandled. With proper care, this contamination can be prevented, and if it occurs, testing can tell you whether or not the grain is safe for feeding.

There are many different kinds of fungi that can grow on grains. Some are worse than others in terms of toxins produced. In Alabama and Georgia, almost any grain can be affected by mycotoxins. Any stored grain (as well as soybeans, cotton- seed, and peanuts) can be contaminated by the fungus *Aspergillus* if conditions are right, and the result is the production of aflatoxin, one of the most serious toxins in agricultural commodities. Only 20 parts per billion of this toxin will make the grain unusable for feed. This toxin is also dangerous if fed to dairy animals because a form of the toxin can be transferred to milk. Other possible problem fungi are *Fusarium* in corn and most small grains and *Penicillium* in any grain. These toxins produce many different types of detrimental effects in humans and animals, so the diagnosis of mycotoxin poisoning is often difficult based on symptoms. It is more easily diagnosed from suspect grain samples.

Fungi usually come from spores, which act like “seeds” of the fungus. Spores are microscopic, dustlike particles that are almost everywhere in the environment. Because they are so widespread, it is impossible to prevent most fungi from inoculating the grain at some point in the production cycle, so the best strategy for preventing contamination is to avoid conditions that will allow these spores to germinate and grow. Preventing fungal contamination starts in the field with practices that lead to overall plant health, the cornerstone of IPM. Vigorous, healthy plants are less susceptible to attack by fungi, and this includes not only those fungi that cause grain-storage toxins but also those that cause plant disease (pathogens). Similarly, insects can increase storage fungi in two ways: by weakening the plant, making it generally more susceptible to disease, and by serving as vectors, or carriers, of the fungi. In almost every case, the insect feeding site is a point of inoculation for these toxigenic fungi, and in the field, or in storage, these feeding sites are foci from which fungal contamination begins. Insect control in the field and in sto age is an absolute must if mycotoxin contamination is to be controlled in grains.

Timely and sanitary harvest is another essential ingredient in mycotoxin control. Grain that is harvested before it is fully mature contains excessive moisture that will promote the growth of fungi in storage bins. Maturity can best be judged by checking moisture content, using a moisture meter. Remember that even grain that is mature will contain excessive moisture just after a rain. There is never enough time at harvest, but a brief waiting period to allow grain to dry before combining will pay off later by preventing fungi from potentially spoiling the larger harvest in storage. Grain left in the field after physiological maturity will also begin to grow fungi due to insects, bird damage, and rain. Plants that have lodged, allowing ears to come in contact with the soil, may serve as sources of contamination, so adjusting combines to avoid picking up lodged ears will help prevent spoilage later.

Moisture is the main reason for spoilage of grains in storage. Grain that gets wet must be dried immediately before it can be placed in storage; otherwise, the entire bin may be lost to fungi. Check bins for leaks, and stop rain from getting in. Hot pockets in the bin are a sign of leakage, and when the bin is emptied, these areas of caked grain will be obvious.

Try not to mix spoiled grain with sound grain. Contaminated grain enclosed in a grain bin is a potential health hazard in the form of spores in the air. Much of that “dust” in the air in a grain bin is fungi spores, which can cause illness if breathed and can cause an explosion if there is even a spark. Always wear a dust mask if you must enter a grain bin.

This will also keep you from smoking and causing that explosion!

If you suspect contamination of grain by storage fungi, have the grain tested before feeding it to livestock. Certain laboratories can test for the presence of *Aspergillus* and *Fusarium* toxins and tell you whether or not the grain is safe to feed.

Controlling Molds and Mycotoxins in Stored Grain was originally written by Richard Shelby for inclusion in Circular ANR-1126, IPM Tactics for On-farm Stored Grain, 1998, Alabama Cooperative Extension System.

Insect Pest Management Recommendations for On-farm Stored Commodities in the Southeast was revised by Katelyn Kesheimer, *Extension Specialist*, Assistant Professor, Entomology and Plant Pathology, Auburn University.

FOR MORE INFORMATION on pesticides, pesticide safety, or submitting samples for analysis, see the following publications in the IPM series:
IPM 1293, “Safety.” Safety contact information; worker protection standards; the safe use, handling, and storage of pesticides
IPM 1294, “Submitting Samples.” Procedures for submitting samples for diagnosis, analysis, and identification
IPM 1295, “General Pesticide Information.” Federal and state restricted use pesticide lists; pesticides and water quality
IPM 1317, “Appendix.” Pesticide guidelines for agronomic crops, including preharvest intervals; rain-free requirements; grazing restrictions; crop rotation guidelines; and the names, classifications, and toxicities of pesticides.

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