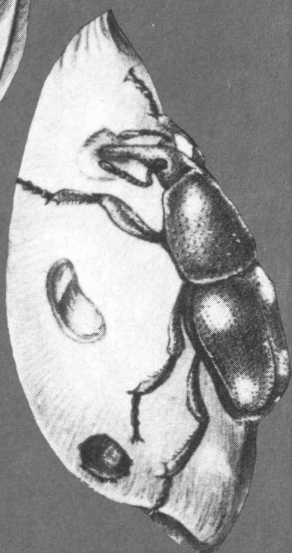
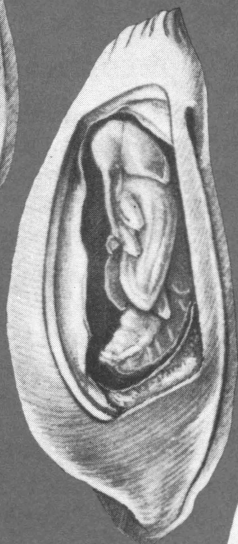
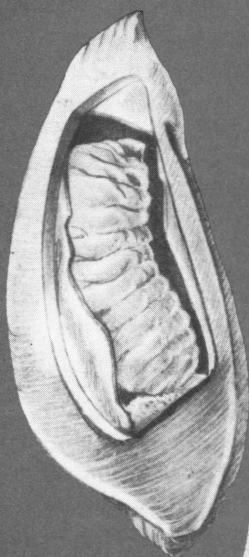


CONTROL OF INSECTS

IN FARM-STORED

GRAIN



Life Stages
of the
Rice Weevil
in Wheat

CONTROL OF INSECTS IN FARM-STORED GRAIN

Prepared by
Extension Entomologists
Texas A&M University

GRAIN PRODUCERS suffer enormous losses annually from stored-grain insects. Losses are due primarily to improperly cleaned storage structures or to high temperatures and high moisture content. Proper attention to these factors prior to and at storage time helps greatly in preventing later infestations.

KINDS OF STORED GRAIN INSECTS

Insects that attack stored grain are classified as *primary* (those that attack whole kernels and complete their development inside the kernel) and *secondary* (those that feed primarily on cracked or broken kernels).

Primary Pests

Three primary pest species—rice or corn weevil, lesser grain borer and Angoumois grain moth—are considered the most destructive stored-grain insects in Texas. The granary weevil, also a primary pest, rarely occurs in damaging numbers in Texas. In the immature stages these insects feed within the kernel unseen and usually unsuspected. These immature stages cannot be removed by ordinary cleaning machinery and in most cases must be controlled by fumigation.

The rice or corn weevil is about one-eighth of an inch long and can fly long distances. *Infestations may occur in the field when the grain begins to ripen.* This is especially true with grain sorghum. The rice or corn weevil can be distinguished from the granary weevil by the four light spots on its wing covers, and by the fact that it can fly. The granary weevil is slightly larger than the rice weevil but it cannot fly; consequently, infestations are more limited. Both species are destructive in the larval and adult stages. The *lesser grain borer* is a small, dark brown or black beetle with a roughened surface, about one-eighth of an inch long and

one-thirty-second of an inch wide. Its head turns down under the thorax. The adult Angoumois grain moth is small and buff-colored, with a wing spread of one-half to two-thirds of an inch. The hind wings have a heavy fringe of hairs longer than the wing width. The adults do not feed on grain. The females deposit eggs on the kernel, and the young larvae bore into the seed and destroy it. This insect also may infest grain while it is in the field.

Secondary Pests

Some of the more common species of secondary stored grain insects are the rice moth, Indian meal moth, Mediterranean flour moth, flat grain beetle, confused flour beetle, cadelle and sawtoothed grain beetle. These insects feed primarily on cracked grain or grain that has been damaged by primary insects.

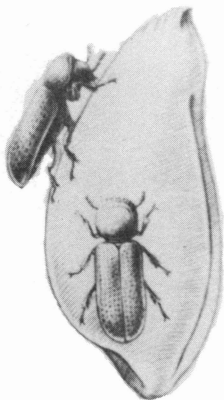
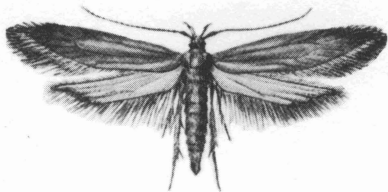
Psocids or book lice and grain mites are additional pests of a secondary nature found occasionally in large numbers in grain and grain products.

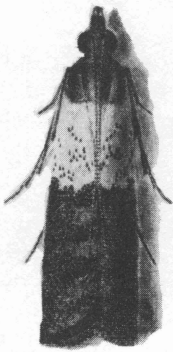
PREVENTION AND TREATMENT OF INFESTATIONS

When storing grain in farm facilities, take adequate steps to provide the least favorable conditions for insect development. Store clean, sound grain with a moisture content of 12 percent or less. Grain containing more moisture attracts insects, promotes mold growth and may induce heating. Dirty or

Angoumois grain moth (adult),
wingspread of about $\frac{2}{3}$ inch
long

Lesser grain borer (adult),
about $\frac{1}{8}$ inch long and $\frac{1}{32}$
inch wide

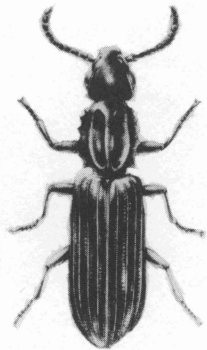




Indian meal moth,
wingspread of
nearly $\frac{3}{4}$ inch



Flat grain bee-
tle, about $\frac{1}{16}$
inch



Saw - toothed grain
beetle, about $\frac{1}{10}$
inch

cracked grain more readily attracts insects. Avoid filling grain bins too full. Allow for working space to inspect grain and to fumigate if necessary. Additional information on proper grain storage facilities is contained in Extension publication B-227, *Grain Storage*.

Prior to storage, clean and treat bins thoroughly with an approved residual spray. When grain is being put into final storage, an approved protectant insecticide can be mixed with the grain. During storage, surface moth infestations can be reduced greatly by employing surface spray treatments with certain materials. Control of other pests feeding below the surface requires thorough fumigation with liquid, gaseous or volatile solid fumigants.

Storage Bin Cleanup

Store grain only in bins that have been cleaned thoroughly. Remove old grain, trash, feed sacks and other debris that furnish living quarters for insects. Sometimes it is necessary to "sweep down" the ceiling and walls and clean the floor to remove hidden waste. Cover cracks with builders molding or other suitable material to prevent grain from collecting. Destroy grain and other material beneath and near the bins.

Residual Bin Spray

After the bin has been cleaned thoroughly, spray inside surfaces with one of the following formulations at the rate of about 2 gallons per 1,000 square

feet of surface area. Larger volumes of the spray mixture will be needed for spraying external areas.

Methoxychlor	2½ percent
Malathion (premium grade)	2½ percent

Methoxychlor is available both as a wettable powder and an emulsifiable concentrate. To obtain a 2½-percent mixture of this material, add 2 pounds of 50 percent wettable powder to 5 gallons of water or one-half of a gallon of 25 percent emulsifiable concentrate to 5 gallons of water. If malathion is used, mix 1.6 pints of 57 percent premium grade malathion emulsifiable concentrate in 5 gallons of water or 1 gallon of the concentrate to 25 gallons of water to obtain a 2½-percent mixture.

Allow treated surfaces to dry thoroughly before putting grain into the bin.

Grain Protectants

Premium grade malathion may be used as a grain protectant on wheat, oats, rice, corn, rye, barley, grain sorghum, peanuts and field or garden seeds. This material may be applied as a dust or spray at the time the grain is being placed in final storage. The spray application is preferred over the dust treatment. *Use only premium grade malathion.* One pint of 57 percent premium grade malathion mixed with 2 to 5 gallons of water is required to treat 1,000 bushels of grain. A specially prepared 1 percent malathion impregnated wheat flour may also be used at the rate of 60 pounds to 1,000 bushels of grain.

Sprays may be applied to the grain stream as the grain is being unloaded or turned into final storage. Any type of standard spray arrangement is suitable for applying malathion. After the spray equipment has been selected, calibrate the sprayer by spraying a known volume of water to determine the exact amount of water the sprayer puts out in a given time. Correlate this volume with the rate of grain flow and apply the correct amount of malathion per 1,000 bushels.

Small quantities of grain to be used for *planting seed* can be protected from insects by treating with malathion or methoxychlor dust at a dosage to

provide 2 ounces of active ingredient per bushel of seed. *Do not use treated seed as food or feed.*

Insect-free planting seed also may be protected for several months by storing in commercially available insecticide-treated bags.

Surface Treatments

Post-storage surface treatments help prevent or control surface infestations of the rice moth, Mediterranean flour moth and Indian meal moth. Apply premium grade malathion wheat flour dust or methoxychlor dust to the grain surface to provide 5 ounces of actual malathion or 0.13 ounces of actual methoxychlor per 1,000 square feet of grain surface.

Water sprays prepared from premium grade malathion or methoxychlor emulsifiable concentrate can also be used as surface treatments for moth control. Apply mixed sprays at the rate of 1 to 2 gallons per 1,000 square feet of grain surface. Mix concentrates with water in the proper proportion to provide application rates of 5 ounces actual malathion or 0.13 ounces of methoxychlor per 1,000 square feet of grain surface. For example, most malathion emulsifiable concentrates contain 5 pounds (80 ounces) of active ingredient per gallon. Mix one-half pint (8 fl. oz. or 1/16 gallon) of malathion concentrate in the amount of water to be applied per 1,000 square feet to obtain the correct rate of malathion (5 ounces) by weight.

To control established infestations of Indian meal moth on *shelled corn* or *grain sorghum*, use refined mineral oil instead of malathion or methoxychlor. Mineral oil used for this purpose must meet the following specifications: (1) unsulfonated; (2) technically white; (3) 100 to 200 seconds viscosity (Saybolt, 100° F); and (4) free of objectionable odors. Apply 2 quarts per 100 square feet (5 gallons/1,000 square feet). If the treated surface is disturbed by walking across the grain or probing for insects, retreat the disturbed area. Major oil company bulk stations can usually supply mineral oils meeting the above specifications.

Surface treatments are ineffective for controlling weevils, beetles and Angoumois grain moths feeding below the grain surface.

Fumigants

Effective control of primary insects developing inside grains and others which feed below the grain surface requires fumigation with one of several approved chemicals. Fumigants are available in liquids, gases and volatile solid formulations. Formulation choice depends upon experience, application and safety equipment available, amount of grain to be treated, construction of storage facilities and other factors. Fumigants are highly toxic to humans and should not be used by inexperienced persons or without proper safety equipment.

Liquid Fumigants

Several commercially available liquid fumigants are effective against stored-grain pests. Formulations usually contain a mixture of two or more liquids, and it is impractical to list the various commercial mixtures in this publication. Since dosages vary according to the ingredients and sometimes according to types of grain, *follow directions on the label explicitly*. Observe strictly all safety precautions to avoid application hazards.

Liquids commonly used in fumigant mixtures include ethylene dibromide, ethylene dichloride, carbon tetrachloride and carbon disulphide. Do not use carbon disulphide alone because of the fire hazard.

Liquid fumigants are usually applied to the grain surface and the fumes, because they are heavier than air, penetrate the grain mass to a depth of 10 to 12 feet. Control is much less effective at greater depths.

Gaseous Fumigants

Two gaseous fumigants, methyl bromide and hydrogen cyanide, are commonly used. They are usually released from pressurized containers into the storage areas. Since these gases are lighter than air and will not effectively penetrate downward through the grain mass, they are normally employed in facilities having recirculation systems which force the fumigants through the entire grain mass. Gaseous fumigants are hazardous and require special equipment and precautions for handling. Application should be done only by experienced persons equipped to use these materials.

Volatile Solid Fumigant

Pellets or tablets containing 55 percent aluminum phosphide (Phostoxin®) can be used to fumigate stored grain. *This material is extremely dangerous if improperly used, so it should be applied only by experienced persons who are thoroughly familiar with proper use procedures.* Tablets properly placed in the grain mass are activated by moisture to release highly toxic phosphine gas. Depending upon grain temperature, fumigation is complete after 3 to 5 days. In certain applications, the tablets can be pulverized and applied with a special grinder-blower apparatus.

PROPER USE OF FUMIGANTS

All fumigants are dangerous and can cause serious injury or death if improperly handled or applied. Before using any fumigant, *read the label* thoroughly to avoid misuse which might result in poor control, application hazards or excessive residues. Use only on specified stored grains. Fumigants properly applied for approved uses will not result in excessive residues above those permitted under federal regulations if all applicable restrictions are conscientiously observed.

When to Fumigate

In many instances, grain is infested in the field and should be fumigated as soon as it is stored.

After grain has been stored, make inspections at about 2-week intervals. Take probe samples at various areas and depths throughout the grain. Sift the samples through a 10 to 12-mesh screen and examine them for insects. Apply fumigants if one granary weevil, one rice weevil or one lesser grain borer or as many as five insects of other species, such as bran beetles, cadelle or grain moths are found per quart sample of grain. Before fumigation, spray the outside of the bin with a residual spray to kill insects forced out of the building by the fumigant. Also, destroy all waste grain outside of the bin to prevent carryover of insect pests. Fumigants are most effective when the grain temperature is 70 to 85 degrees F. and the air is calm.

How to Fumigate

Make a special effort to make the grain bin as tight as possible before fumigation. The grain

surface should be level to insure even penetration. Apply liquid fumigants to the entire grain surface as a coarse spray. A 3 to 5-gallon capacity hand-type compressed air sprayer may be used to obtain a coarse spray; remove the spray nozzle and flatten the tip of the spray rod with pliers, or remove the disc from the spray nozzle.

Use some form of power equipment when fumigating a large volume of grain. Compressed air tanks or diaphragm or brass gear pumps may be used. These pumps may be operated by a small motor or from the power take-off of a tractor. Select or construct a discharge nozzle that disperses the liquid in an even pattern as a coarse spray. Close the bin immediately after applying the fumigant and do not open it for at least 24 hours—preferably 4 or 5 days. Air the bin at least overnight before entering. Fumigated grain may be fed to livestock as soon as no fumigant odor is present.

Fumigants, when applied properly, penetrate grain and in most cases kill all stages of insects to a depth of 10 to 12 feet. Grain may be fumigated effectively at greater depths when bins are equipped with proper aeration facilities. Even when fumigation is carried out in structures that are air tight the movement of outside air influences fumigation efficiency. Consequently, best results are obtained if fumigants are applied when the air is calm.

CAUTIONS

All fumigants are dangerous if improperly used. Carefully follow the cautions listed on the manufacturer's label and use only in strict accordance with label directions.

Wear gas masks with a full facepiece and proper canister approved by the U. S. Bureau of Mines when applying fumigants inside bins. Gas masks of this type will not protect the wearer against heavy concentrations in bins where oxygen has been replaced by fumigants. The effective life of a gas mask canister is limited. Keep an accurate account of the time that a canister is used and replace it after 30 minutes of continuous or intermittent exposure to grain fumigants.

Avoid spilling the fumigant on the skin, clothing or shoes. Remove clothing wet with fumigant at once and wash the skin thoroughly with soap

and water. Do not use or feed grain that has been fumigated to livestock until aeration has eliminated the fumigant odor.

When applying fumigants always work with someone who can assist you in case of an accident or excessive exposure.

Recommendations contained herein were current at publication. Insecticide restrictions, tolerances and approved uses are subject to change, so always confirm recommended uses by referring to current labels on insecticide and fumigant containers.

ACKNOWLEDGMENTS

Information in this leaflet was revised and adapted from a previous leaflet by the same title prepared by C. F. Garner and R. L. Ridgway, former Extension entomologists, and assisted by other members of the Texas A&M University Department of Entomology.

For further information contact your local county agricultural agent or the Extension entomologists, Texas A&M University, College Station 77843.