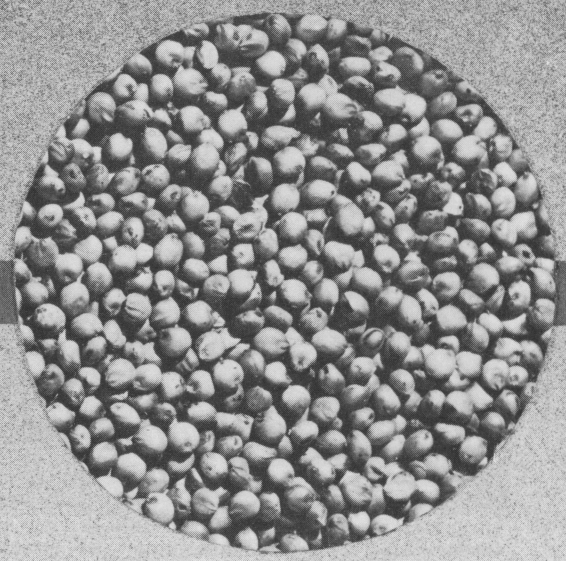
B-888

DRYING AND STORING

SORGHUM GRAIN



TEXAS AGRICULTURAL EXTENSION SERVICE
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Drying and Storing Sorghum Grain

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HIGH MOISTURE AND EXCESSIVE "TRASH" lead to insect, mold and heat damage in stored grain. They cause most of the problems encountered in storing grain. High moisture may result from leakage of outside moisture through bin walls or from placing high-moisture grain in storage.

If the following recommendations and procedures are followed, sorghum grain can be stored safely. They are based on research conducted at Beeville by the Texas Agricultural Experiment Station in cooperation with the United States Department of Agriculture and were proved by field applications in South and Central Texas.

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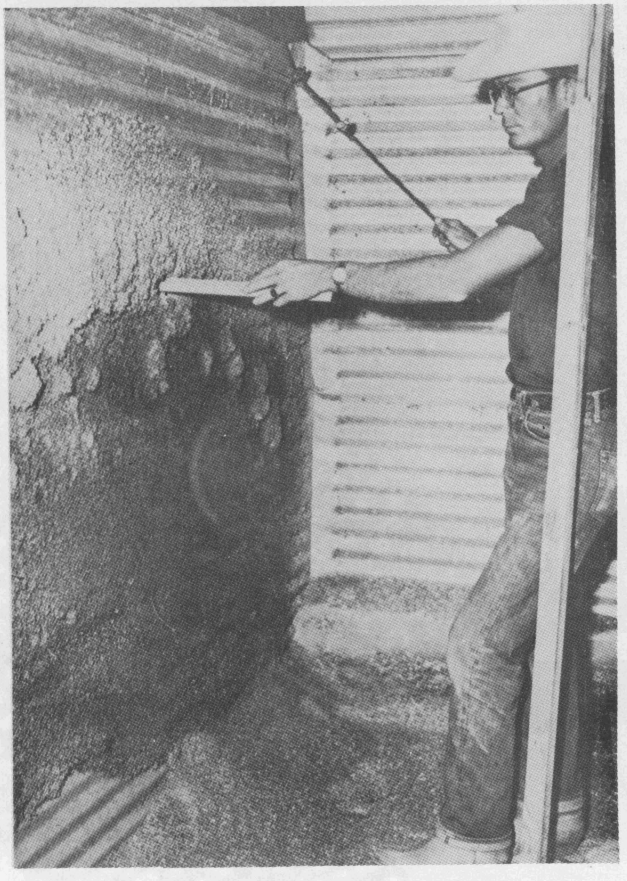

Figure 1. A tight structure is essential to prevent the entry of outside moisture. Moisture can cause high insect infestation and heating which result in considerable spoilage of grain.

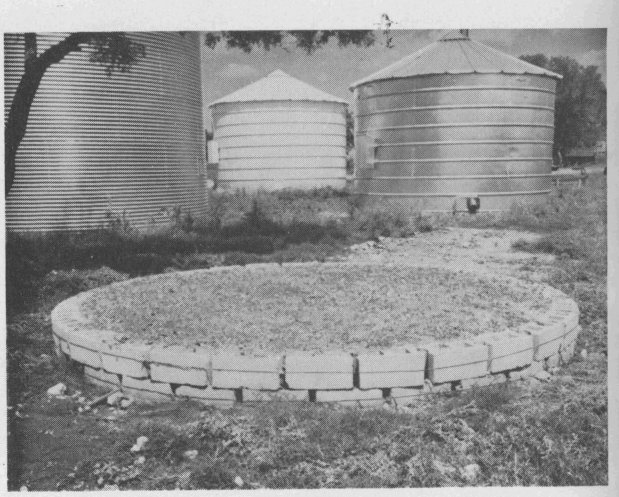

Figure 2. Good drainage around the bin foundation is necessary. One satisfactory method is a ring of blocks filled with well-tamped earth as shown above.

BIN CONSTRUCTION

A tight structure is essential for protection of the grain from the weather, insects and rodents. Properly constructed conventional wood or steel buildings and bins, and concrete and cement plaster bins treated with water-proofing paint, are satisfactory for storing sorghum grain. Adequate ventilation at the grain surface should be provided for all types of grain-holding structures.

Wooden bins with single walls normally are not tight enough to exclude moisture or prevent the loss of fumigants. Single-wall bins can be made tight by lining the walls with roofing felt, but repairs usually are necessary before each filling of the bin.

Leakage of moisture through the walls of steel bins where wall joints and bolt heads are sealed poorly causes heating and high insect infestation. Such leakage can be prevented by caulking all joints and sealing all bolt heads properly.

Round steel bins should be located on well-drained areas and the floor elevated enough that water cannot collect and leak through the floor-wall joint. A tamped earth fill encircled by a concrete block retaining wall is a satisfactory foundation. Bins may be anchored to "dead men" buried in the ground to prevent the possibility of windstorm damage when the bins are empty.

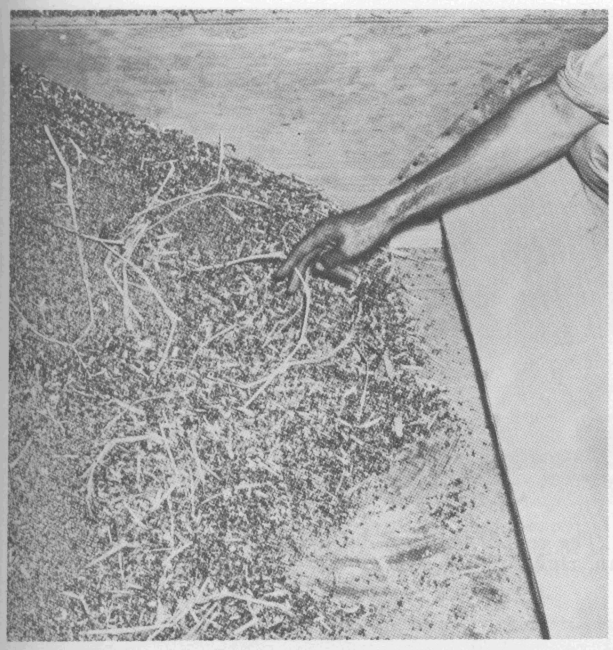

Figure 3. An example of how "trash" accumulates in pockets as the bins are filled. These pockets cause air to channel and result in musty, heat-damaged grain. Proper adjustment of combines at harvest will reduce the amount of trash.

MOISTURE CONTENT OF GRAIN

The maximum moisture for safe storage of sorghum grain in South Texas for 1 year, without periodic turning or aeration, or for longer, with regularly scheduled aeration practices, is 12 percent. Safe storage for longer than 1 year, without turning or aeration, limits the moisture content to 11 percent. Grain at 13 to 14 percent moisture, which was aerated or turned during storage, has been stored safely as long as 9 months. Grain with a moisture content higher than 14 percent is not recommended for farm storage unless the bins are equipped with fan and air distribution systems for drying.

CRACKED GRAIN AND "TRASH"

High concentrations of "trash," cracked grain and broken kernels provide favorable conditions for flour beetles or "bran bugs." Excessive "trash" can cause heating even though the moisture content of the grain is below 12 percent. Stems and leaves of sorghum plants usually are higher in moisture than the grain at harvest and tend to accumulate in pockets as the grain is loaded into the bin. Such conditions may result in excessive spoilage from heating, insects and molds and make effective fumigation difficult. Proper adjustment of combines at harvest will reduce the amount of "trash."

DRYING HIGH-MOISTURE GRAIN

The moisture content of grain harvested in some areas of Texas usually is too high for safe storage. For this reason, some method of drying may be necessary to reduce it to a safe storage level. This may be done by commercial or farm driers using heated or unheated air. Heated air is used for fast drying and unheated air is used for slow drying.

Drying With Unheated Air

If grain is to be stored on the farm, bin drying with unheated air (normal air) seems the most practical method. With this method, grain is dried in the bin in which it is stored.

Advantages of bin drying with unheated air are: (a) less investment in equipment is required; (b) fire hazards are reduced; and (c) more uniform

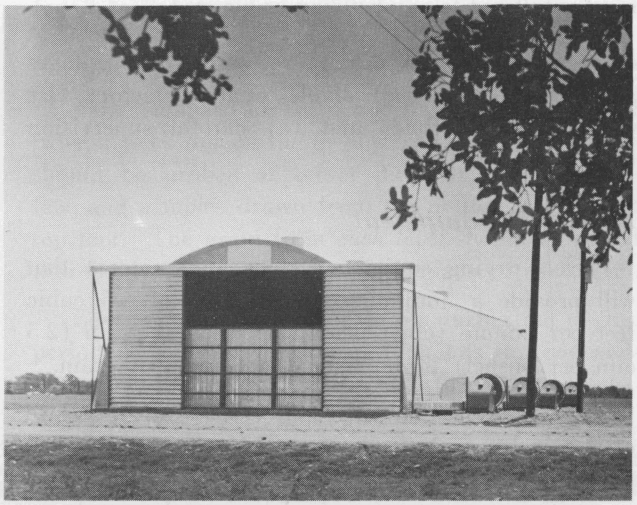

Figure 4. Typical grain drying building or bin installations. Handling equipment and arrangements are important in reducing labor.

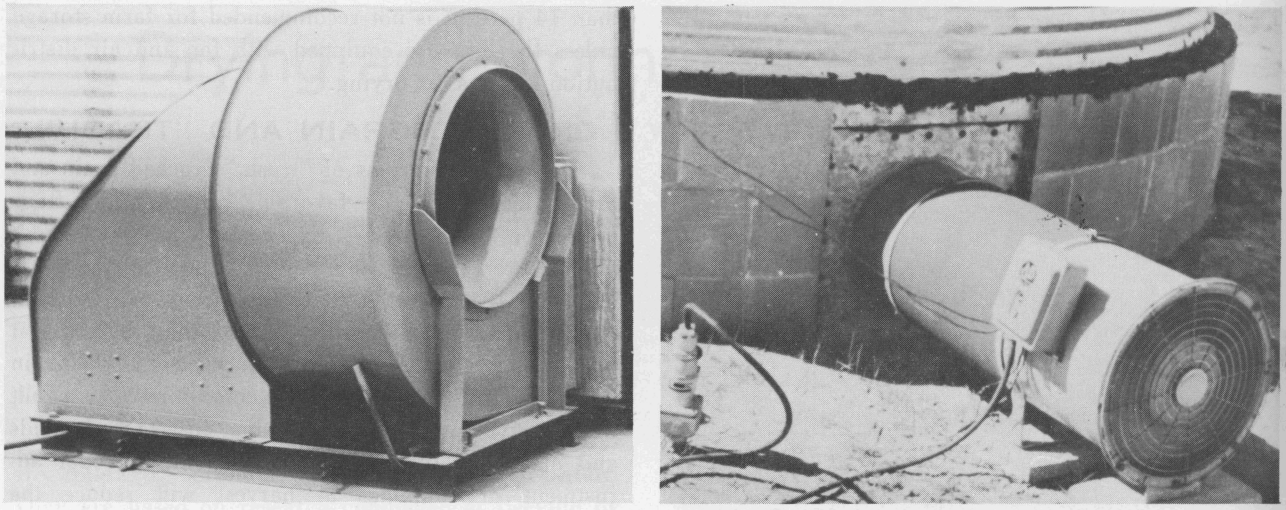

Figure 5. Types of fans suitable for drying grain. The centrifugal fan, left, is designed to move air over a wide range of volumes and pressures. The tubeaxial fan, right, is designed to move air through a wide range of volumes at medium pressures.

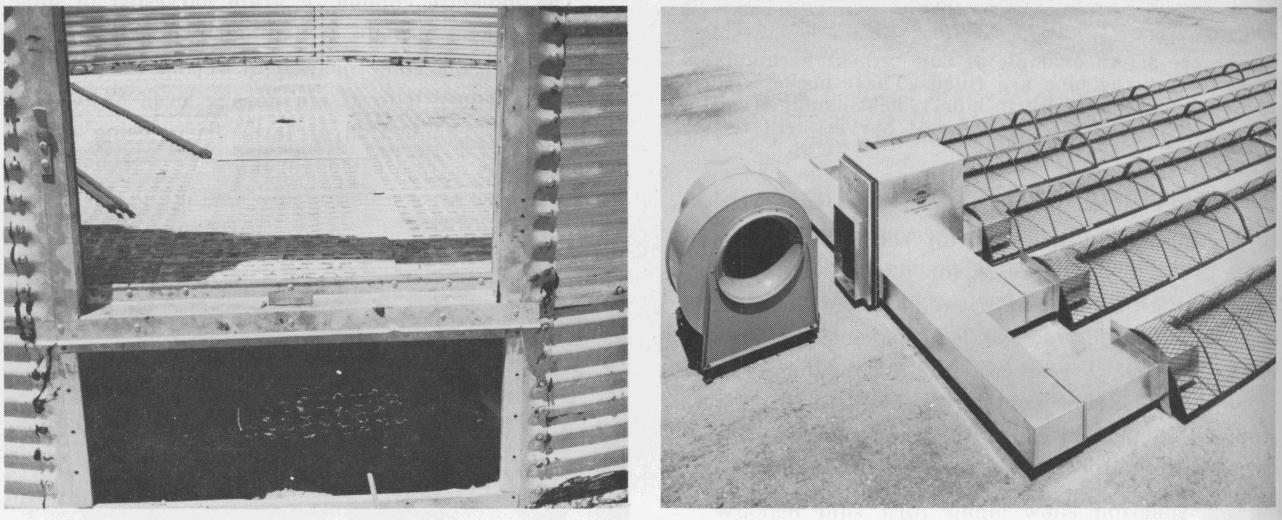

Figure 6. Types of air distribution system. Left, false floor, used in bins only; right, duct system, which may be tailored to any building or bin size.

drying of the grain usually results. Disadvantages are: (a) the uncontrollable weather factor; (b) variable drying time; and (c) careful supervision for a long time.

Bins and Equipment

Select drying equipment (fans and motors) that will provide a minimum air-flow rate of 4.5 cubic feet per minute (cfm) per 100 pounds of grain (2.5 cfm per bushel) through an 8-foot depth of grain.

Specify a fan to deliver air at a static pressure of 2.8 inches water column. This allows 0.25 inch pressure drop through the air distribution system.

Select an air distribution system that will provide uniform distribution of air throughout the bin. Designs of large systems should be checked by an engineer to prevent excessive pressure drops.

Loading Bins

Distribute the grain evenly as the bins are filled to prevent cracked kernels and "trash" from accumulating in spots.

Do not attempt to dry grain that contains excessive "trash."

Start the fan as soon as possible after the air distribution system is covered uniformly with grain.

Fill the bins to a maximum depth of 6 feet if the initial moisture content of the grain is 18 to 20 percent. Push air through the grain until the moisture content in the top foot is reduced to about 15 percent.

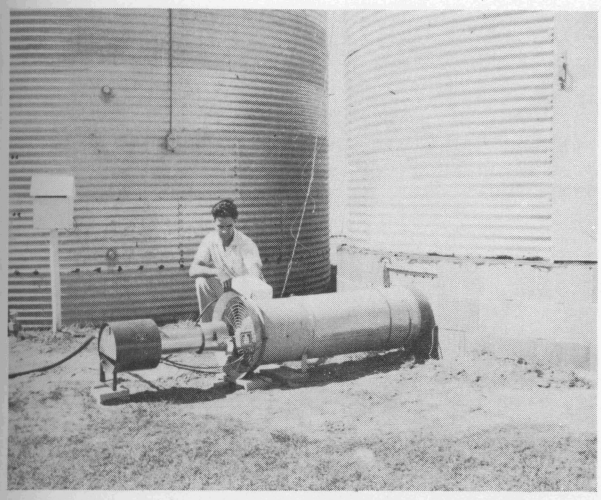

Figure 7. A commercial type of supplemental heater. This will be used only in weather unsuited to normal drying operations for unheated air systems. A temperature rise of 5 to 10 degrees F. is used.

Then add more grain and continue pushing air until the moisture content of the grain in all parts of the bin is reduced to 12 percent or less. If the moisture content is 15 to 18 percent, fill bins to a maximum depth of 8 feet. If the moisture content is below 15 percent, the bins may be filled to a maximum depth of 10 feet.

Drying time can be reduced considerably when the following procedure is used: fill one bin or one section of a building to a depth of not more than 3

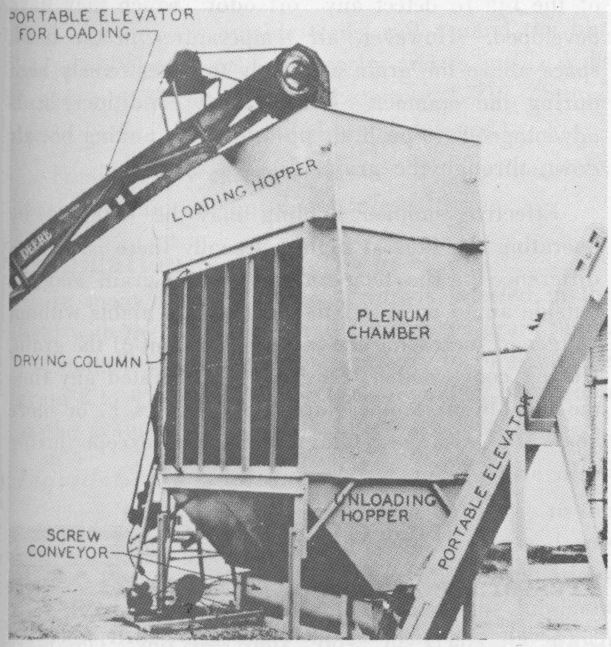

Figure 8. A batch (column-type) drier using heated air may be used. Commercial models range from 150 to 600 bushels-per-hour capacity. This model includes the necessary handling equipment.

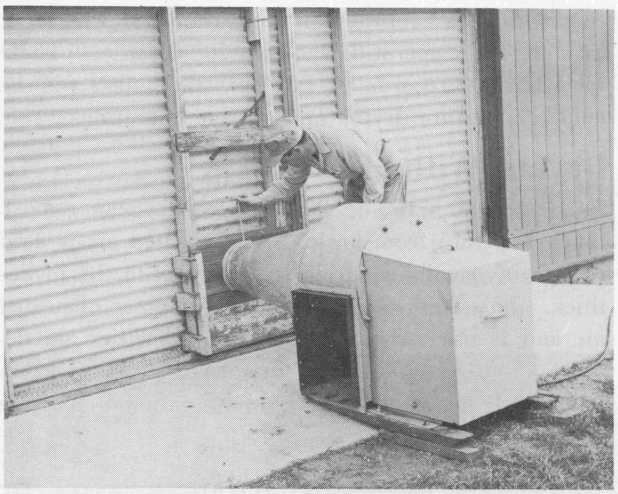

Figure 9. When grain was aerated by pulling air down through it, a reasonably accurate average grain temperature was determined by placing a good-quality thermometer in the duct between the fan and grain close to the bin wall, as shown here.

feet and then fill the next bin or section to the same depth. Continue this procedure until all the drying space is in use. Return to the first and add 2 to 3 feet of grain to each bin in the same manner until all are filled.

Fan Operation

Push air through the grain continuously until the moisture content of the top foot of grain is reduced to about 15 percent. Then complete the drying procedure to a maximum of 12 percent moisture by pushing air through the grain only when the outside relative humidity is less than 75 percent (usually during daylight hours on clear, bright days). Cut off the fan if it rains. When rainy periods last longer than 24 hours, keep the grain cool by operating the fan 2 to 3 hours each day until the weather clears.

Sampling Grain

Take samples for a check on moisture content twice a week during the drying operation. The grain should be probed at 8-foot intervals over the surface and samples drawn from the bottom, center and top foot. The grain from *each level* should be mixed thoroughly and a moisture check made of each level.

Low temperatures in the grain during the drying period do not always indicate that it is in good condition. Samples pulled for moisture content also should be checked for mold growth.

Records

A complete record of temperature and moisture checks will enable the operator to detect quickly any

change in the condition of the grain and will serve as a guide in operating the fans for aeration. These records, and records of fan operation, also will be helpful in future drying and storage operations.

Drying With Heated Air

Heated air (150 to 200 degrees F.) can remove much moisture from grain. When heated air is used the grain usually is dried in layers 6 to 18 inches thick. This method requires large volumes of heated air and is used when high drying capacities are desired. Using heated air to dry deep depths of grain may result in overdrying the lower part and spoilage in the upper layer.

COOLING GRAIN DURING STORAGE

The temperature of low-moisture or dry grain during storage is a good indication of its condition. Dry, clean, insect-free grain should not heat when held in a satisfactory storage structure. When "hot spots" occur, the cause of heating should be eliminated quickly.

When grain is harvested during summer months aerate the grain as soon as possible after the bin is filled until its temperatures are reduced to 90 degrees F. or less. Operate the fans 2 to 3 hours once a month during the summer to change the air in the bins. Further aeration is not necessary unless heating occurs. The grain should be aerated during the winter until its temperatures are reduced to 60 degrees F. or less. Cooling grain during the winter below 60 degrees F. will retard insect activity until the grain warms up in the spring.

Effective cooling can be obtained with air-flow rates as low as 0.20 cfm per 100 pounds of grain (1/10 cfm per bushel). However, the lower the air-flow rate, the longer the time required to cool the grain. Cooling time can be reduced considerably by using an air-flow rate of 0.60 cfm per 100 pounds (1/3 cfm per bushel). This amount of air can be used economically in farm storage bins. For example, a 12 1/4-inch-diameter centrifugal fan operated by a one-third horsepower electric motor will deliver air at a rate of 0.60 cfm per 100 pounds through a 14-foot depth of grain in an 18-foot diameter bin. Fan and air distribution systems used for drying grain supply air at a higher rate, but also are satisfactory for aeration. With the large volume of air supplied by drying systems, close supervision is required to prevent large losses in weight through an excessive reduction in the moisture content of the grain.

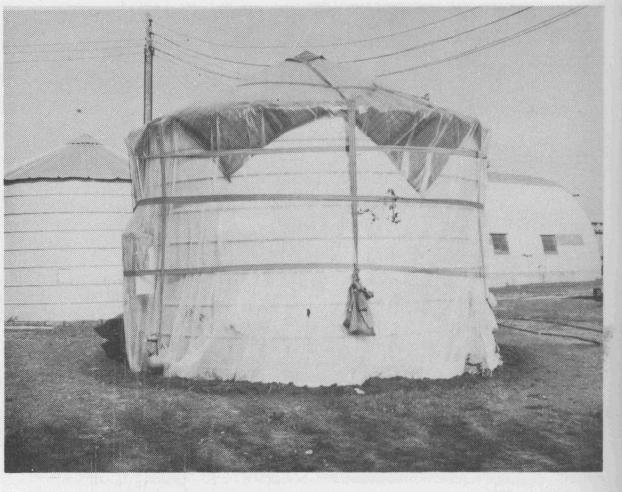

Figure 10. A round steel bin may be covered with a polyethylene sheet for recirculating fumigants.

For cooling purposes, air may be pushed up or pulled down through the grain. Both methods are equally effective.

When bins are equipped with drying systems, pushing air up for aeration eliminates the necessity of reversing the fan to change the direction of air flow.

Pulling air down avoids condensation in the winter. Humid air leaving the grain does not come in contact with the cool grain surface or bin roof. Pulling air down gives an opportunity to smell the air coming out of the bin to detect any "off odor" which may have developed. However, air temperatures in the headspace above the grain are likely to be extremely high during the summer. Under these conditions, it is advantageous to push air up to prevent pulling hot air down through the grain.

Effective summer cooling may be obtained by operating the fans at night. Usually there is enough difference in the temperatures of the grain and the outside air to operate fans during clear nights without danger of increasing the moisture content of the grain. During cool weather, fans may be operated any time the outside air temperature is 10 degrees F. or more below the average grain temperature, except during rain or fog.

INSECT CONTROL

Prestorage Cleanup

Clean empty bins and remove all dirt, webbing, spilled grain and old sacking. Clean up any nearby sources of insect infestation such as feed rooms, machinery, spilled grain and rat harbors. Apply a resi-

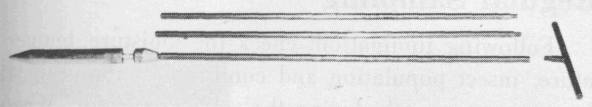

Figure 11. Sampling and checking the condition of the grain is essential. Every operator should have some type of probe for this purpose. Above, one type of probe.

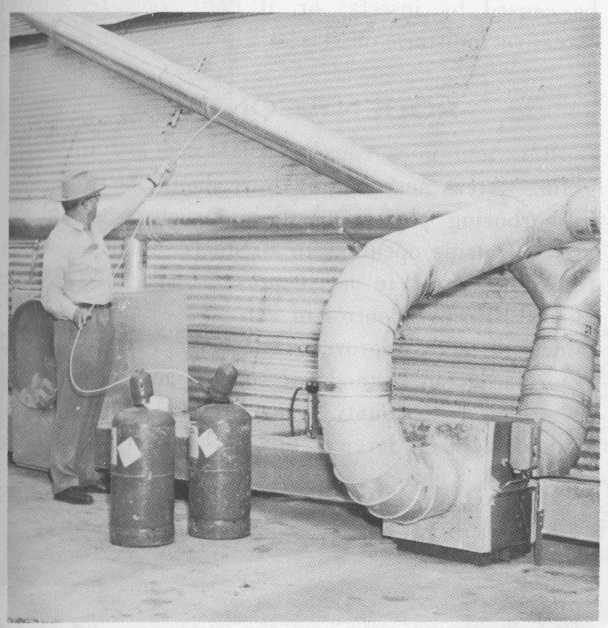

Figure 12. Large buildings generally can be fumigated more economically with gas-type fumigants. Here the fumigant is introduced into a duct and recirculated by means of a small fan.

dual spray to the outside walls, soil around the bin, any other cleaned-up area nearby and to inside walls to the point of runoff. (See Extension L-217, "Stored Grain Insects" for insecticides and dosages.)

Fumigate any carryover grain. *Do not dump* new sorghum grain on top of old infested grain.

Fumigation

In many areas of Texas, grain is infested in the field with the rice weevil and Angoumois grain moth. In South Texas it usually is necessary to fumigate the grain 2 to 4 weeks after the bins are filled, or as soon as the grain is dried to a safe storage level.

Liquid Grain Fumigants

These fumigants are applied as a wet spray to the surface of the grain and their vapors diffuse downward. Proper dosage rates of several formulations are given in L-217. *Read the label* on the fumigant container, and use only those materials for which residue tolerances or exemptions have been established under the Miller Amendment to the Food, Drug and Cosmetic Act.

Apply the fumigant when there is no wind and when the temperature of the headspace above the grain is less than that of the grain surface. The grain surface should be level and at least 6 inches below the top of the bin walls.

Recirculation Method

Where sorghum grain is stored in bins equipped with drying or aeration systems, the fumigant can be recirculated through the grain by installing a return duct or by covering the grain surface or the entire

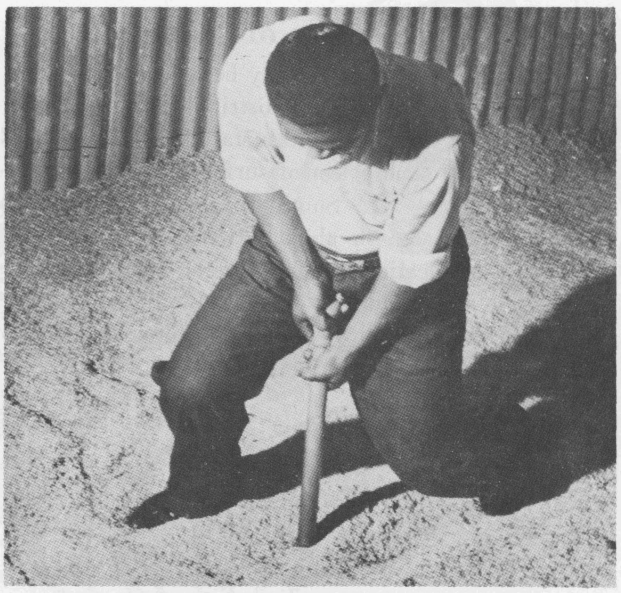

Figure 13. Use a deep-bin probe to collect samples of grain at a minimum of three levels—near the bottom, center and top. Check the moisture content and the insect activity at each level.

Figure 14. Some type of moisture tester should be available for checking the samples.

structure with a polyethylene tarpaulin. When the recirculation method is used, fumigants such as methyl bromide can be used, or the recommended dosage of liquid may be reduced by one-half. This method assures better distribution of the fumigant and is more likely to succeed.

Any fumigant is hazardous to use, but gas-type fumigants such as methyl bromide are extremely hazardous. Obtain the services of experienced personnel to make the initial fumigation. *USE EVERY SAFETY PRECAUTION LISTED ON THE LABEL.*

Surface Application of Mineral Oil

Following fumigation it may be advisable to apply a mineral oil spray, such as distributed by the major oil companies, to the grain surface at the rate of 2 quarts per 100 square feet of surface to prevent infestation by moths. In South Texas, this application should be repeated in about 6 weeks, but not more than two applications should be necessary between fumigation and winter season. Information on residue tolerances for oils can be obtained from your county agricultural agent.

Regular Sampling

Following fumigation, check the moisture, temperature, insect population and condition of the grain at least once a month during the storage period. When one weevil or lesser grain borer or five other stored grain insects, are found per quart sample, the grain should be refumigated. Hot spots in stored grain may be caused by insects; or, if hot spots are due to excessive moisture, insects will be attracted to them.

RODENT CONTROL

Rats and mice cause considerable loss in stored grain. Areas surrounding bins should be free from rat-harboring places. A tight structure should be used. Outside openings in air ducts should be sealed tightly when not in use to prevent entry by rats and mice. Effective control of rats and mice can be obtained through approved rodent control procedures. Information on methods of control may be obtained from your local county agricultural agent or from the Rodent Control Service, Box 1941, San Antonio 6, Texas.

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