DRYING SMALL GRAIN AND SHELLED CORN

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Drying Small Grain and Shelled Corn

Small grain and shelled corn when harvested often contain too much moisture for safe storage. Drying is one method of handling these crops to prevent spoilage and avoid price discounts due to high moisture content.

Several factors should be considered by the farmer who plans to use drying facilities for grain and shelled corn:

1. Initial moisture content of the crop at time of harvest.
2. Moisture discounts at market time.
3. Trend of market prices as harvest season progresses.
4. Cost of owning and operating drying equipment.

A farmer may choose from three general methods of handling and drying damp grain: natural air drying, drying with forced unheated air, or drying with forced heated air.

NATURAL AIR DRYING

Natural air drying consists of stirring, turning, or storing the grain in sacks in a well ventilated area. This method is adapted to small acreages and grain that is not too damp. The following procedure is suggested.

Bring grain of 16- to 18-percent moisture directly from the combine or picker sheller and spread it out in an open shed to a depth not over 18 inches. Stir and turn the grain frequently until the moisture content is reduced to 12 percent. A small 4-inch auger may be used as a power scoop shovel to mix and transfer grain about or between bins during this conditioning process.

DRYING WITH FORCED UNHEATED AIR

Facilities for drying with forced unheated air consist of a bin or storage place with an air distribution system and a power-driven fan. The fan may be used on one or more bins, or it may be made portable and moved from one storage place to another.

The success of this system depends on weather conditions, since drying is accomplished by forcing outside air through the grain. Under adverse weather conditions, several weeks or even months may be required to dry a batch of damp grain. Drying is effective only on warm, dry days although the fan should be operated occasionally during cold weather to cool the grain and prevent it from heating. Drying with unheated forced air is not recommended for grain exceeding 25 percent moisture.

Here are some factors that should be considered in drying with unheated forced air.

Relative Humidity of Air

Grain with a high moisture content can be dried with the fan even on a damp day. But when the moisture content of the grain

goes down to 17 to 18 percent, dry air will be required to dry the grain to a moisture content that will make it safe for storage. The maximum relative humidity of air which will dry the crop down to a safe storage level is 60 percent. You may follow weather reports, use a simple humidistat, or have the fan automatically controlled by an air humidistat switch to make sure the fan operates at the proper time and to take maximum advantage of favorable drying weather.

Drying Depths to Use

The maximum depth of grain that may be dried at one time in a tight bin or structure is shown in the following table.

Maximum Recommended Depths for Economically Drying Various Grains and Seeds at Different Initial Moisture Contents

Moisture Content—Percent	25	22	18	15
		Depth of Feed Grain—Feet		
Grain				
Corn (shelled)	7	8	9	11
Corn (ear)	20	20	20	20
Grain Sorghum	4	5	8	9
Oats	7	8	10	11
Soybeans	8	9	11	11
Wheat	4	5	7	9

Drying will be speeded up at shallower depths of 4 to 6 feet, and these depths are preferred. Propeller fans in particular will deliver much larger volumes of air through shallower depths. The fan must be able to deliver the required amount of air for storage depths selected.

The amount of air needed is usually given as the number of cubic feet that must be moved through each bushel of grain every minute. Under most conditions an air flow of 5-6 cubic feet per minute per bushel is satisfactory for small grains or shelled corn.

Preparations for Forced Air Drying

An existing or new bin or structure with tight sides and floor may be modified for forced air drying by installing a false perforated floor or by placing a homemade or manufactured duct system in the bottom.

The false floor may be made by supporting 2 by 4 stringers edgewise on cement blocks at intervals of 8 inches and covering with a close-mesh hardware cloth. Expanded metal or perforated metal sheets are also available and may be used in place of hardware cloth. Supporting stringers may be spaced further apart but should be placed according to manufacturer's recommendations.

A duct system of inverted rectangular, triangular, semi-circular, or vertical circular tubes is frequently used in circular bins and in individual granary bins. Air is usually supplied to lateral ducts for uniform distribution from a main duct along one side or in the center of the bin.

For more information, consult your county extension office.

Fan Requirements

Any fan may be used as long as it will deliver the required amount of air against fairly high resistance pressures offered by 2- to 8-foot depths of grain. Sorghum is similar to shelled corn and weighs 56 pounds per bushel but offers almost twice as much resistance to air flow.

How to Tell When Drying Is Completed

As air is forced through the grain, it dries the inside layers it passes through first and the outside layers last. Since the evaporation of moistures liberates heat, the air that is drying the grain will be warmer as it leaves the grain. The only sure way to check whether grain is dry enough to keep safely is to take a sample and have it tested. Most local elevators will be glad to do this. Since the outer or top layer of grain will be the last to dry, a representative sample should be taken from several places 6 to 12 inches under the surface.

When the moisture content has been reduced to 12 percent or less, the fan may be shut off. After that, it is good practice to operate the fan from 4 to 8 hours every few weeks during very dry, cold days to prevent moisture migration and wet spots within the bin of stored grain. Experience in large government storages has shown that cold and warm spots in stored grain cause condensation and moisture migration, which in turn cause grain to go out of condition and spoil.

DRYING GRAIN WITH FORCED HEATED AIR

The equipment and principles used for drying with heated air are similar to those for drying with unheated air.

Compared with natural air drying which takes weeks and even months, heated air drying under identical conditions can be completed in a few hours or days. The total time depends on the volume to be dried, the amount of moisture to be removed, and the air temperature. As a general rule, for each 20-degree rise in temperature the drying capacity of the air is doubled.

Heated air drying is not limited by relative humidity. It is possible to dry grain even during a rain, but the cost will be higher. From a cost viewpoint, most economical drying will take place under the same climatic conditions that are most favorable for natural air drying.

Maximum Moisture Content

For satisfactory drying with heated air, the maximum moisture content of grain at harvesting should not exceed 30 percent.

The maximum moisture content for safe storage in tight bins is 12 percent for short periods and 10 to 11 percent for year-round storage.

Maximum Depths for Drying

The maximum depth of grain when drying in large bins should be the same as when using unheated air. Preferably the depth should be kept to 4 to 6 feet since fans on many heated air driers are not capable of delivering large volumes of air through excessive depths of grain.

Batch drying is widely used with heated air. The recommended depth of crop for batch drying with heat is 16 to 24 inches. Shallow depths give more uniform drying and a higher capacity.

Minimum Air Flow

When heated air is used to dry large quantities of grain in deep layers of 4 to 6 feet, the temperature rise should be held to 15°.

When grain is batch-dried rapidly in thin layers 1 to 2 feet deep, much higher volumes of air are used. Suggested air flows are 20 to 40 cubic feet of air per minute per bushel.

Maximum Drying Air Temperatures

Germination and chemical composition of grain can be altered and damaged by too-high drying air temperatures. The maximum safe temperature to which drying air may be heated depends on how the crop is to be used after drying.

110°—Maximum safe drying temperature of air entering crop to be used as seed.

140°—Maximum safe drying temperature of air entering crop to be sold for commercial use.

180°—Maximum safe drying temperature of air entering crop for animal feed.

Higher temperatures may be used for corn and sorghum destined for commercial use if it is dried under carefully controlled conditions so the maximum temperature of the kernels does not exceed 130° at any time.

Cooling Grain After Drying

For safe storage the fan must be operated after the heat has been shut off to cool the grain down to near outside air temperature. Cooling also removes additional moisture from outside layers. Several hours may be required to cool deep layers, while 30 to 60 minutes are usually sufficient to cool thin layers in batch driers.

Systems for Drying With Heated Air

Bin Drying—This method may be used when you want to use the storage facilities already available on the farm. A false perforated floor may be installed in the bottom of an existing bin, or a horizontal or vertical center duct may be used in round vertical bins. The false floor system is supported 18 to 24 inches above the tight bin floor, and the drying air is forced between the two and up through the grain.

The duct system in the bottom or the vertical center duct is generally less expensive but requires more pressure, and air distribution is difficult to control. Quantities of 1,000 to 3,000 bushels can be dried at one time.

Batch Drying—This method utilizes special built wagons, structures, bins, or towers holding 200 to 600 bushels. After drying, grain is moved to market or other bins for storage. Large drying capacities of 40 to 100 bushels per hour can be obtained, permitting the drier to keep up with a combine or corn picker. Batch driers are portable and may be taken from bin to bin and into the field. Batch driers should be equipped with wet-grain holding bins to permit rapid refilling of the drying chamber.

Requirements for Heated Air Crop Driers

A crop drier consists of a fan, power unit, heating unit, safety controls, and automatic controls.

The fan should deliver the required CFM of air at static pressures up to 2½ inches of water. It may be either a centrifugal or propeller type.

The heating unit may be electric or burn gas, oil, or coal. A direct-fired unit exhausts the products of combustion into the drying air stream. It utilizes 90 to 95 percent of the fuel heat but presents some fire hazard. The indirect type discharges the exhaust gases out a stack like a home furnace and has less fire hazard but is 25 to 30 percent less efficient. The electric heaters produce 100 percent of thermal heat from electric energy at the rate of 3,415 BTU's per kilowatt. The power unit to operate the fan is usually a 2-, 5-, or 7½-horsepower motor or a tractor PTO. Where electricity is not available, a tractor can furnish power and electrical energy for burner ignition and automatic controls.

All crop dryers should be equipped with at least two safety controls, one to shut off the drier if temperature gets too high and the other to shut off the fuel in case of flame failure or power failure to the fan. The drier should carry the Underwriters Laboratory approval.

It is a good idea to check with your fire insurance agent before using a heated air crop drier around farm buildings. Where possible, dry grain in a fire-resistant bin isolated from other major farm buildings.

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