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Operational Considerations for Harvesting Corn Above 25% Moisture Content

Samuel G. McNeill
University of Kentucky, sam.mcneill@uky.edu

Douglas G. Overhults
University of Kentucky, doug.overhults@uky.edu

UNIVERSITY OF KENTUCKY
COLLEGE OF AGRICULTURE
Lexington, Kentucky 40546

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OPERATIONAL CONSIDERATIONS FOR HARVESTING CORN ABOVE 25% MOISTURE CONTENT[1]

1996 Harvest Situation

Many of Kentucky's grain farmers are interested in harvesting corn at higher moistures than in recent years because of potential market trends and weather patterns. Corn that was planted early is near maturity in many western KY counties and fortunately, the market is higher than in previous years. Additionally, most elevators are offering premiums between 25 and 50 cents per bushel for corn delivered prior to Sept. 15 this year, so farmers who have drying equipment are poised to take advantage of this rare opportunity. In contrast, late planted corn may be threatened by an early frost, so actually both groups of farmers are seeking information regarding the precautions and opportunities for harvesting corn at moisture levels higher than they may have experienced in recent years when weather has been favorable for field drying.

This article presents information regarding the value of harvest losses and compares the associated costs with the added costs of drying the crop in this high moisture range (> 25%). Different combine speeds, harvest periods, and moisture contents are considered in the evaluation to arrive at an estimate of the optimum harvest moisture level. These cost figures incorporate 'average' harvest losses for different combine speeds, weather conditions (cool and humid versus warm and dry), and grain prices.

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[1] Prepared by Mr. Samuel G. McNeill and Dr. Douglas G. Overhults, Biosystems and Agricultural Engineering Department, with contributions by Dr. Steve Riggins, Mr. Craig Gibson, and Dr. Richard Trimble, Agricultural Economics Department, University of Kentucky Cooperative Extension Service.

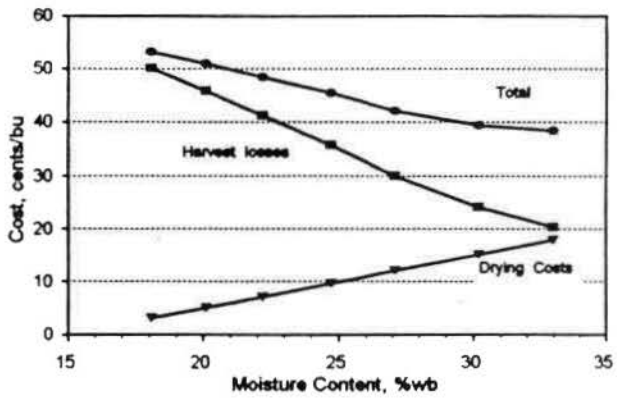
The questions that are addressed include: when to start harvesting corn this year; what machine adjustments are necessary; what field losses should be expected at various levels of corn moisture; where are the trade-offs between harvesting early (and paying a big LP gas bill), and harvesting late (and leaving more corn in the field). Additional comments reflect on the requirements of the dryer since high moisture corn must be processed quickly to avoid potential problems with aflatoxin or other mold related disasters!

Field Considerations

The optimum moisture for corn harvest for any given year varies to a large degree on the variety grown, weather patterns, fuel costs, length of harvest, and insect and disease pressure. A general rule of thumb is to strive for an average moisture throughout the harvest season of near 26%, which means starting when the corn is at a higher moisture level and finishing harvest near 20% to avoid excessive losses.

Figure 1 illustrates typical harvest losses that have been determined during a cool dry season in Ohio when operating the combine at a ground speed of 3.5 mph. Harvest losses are highly dependent on combine speed, with an increase in ground speed creating increased losses. Notice that harvest losses are substantially lower when corn is harvested at higher moisture levels and that protracted harvest periods increase losses.

Figure 1. Cost of Harvest Losses and Drying for Corn at Different Moistures



Drying costs in Figure 1 include the cost of fuel only, which obviously decreases as corn dries in the field. Total cost which is lowest in the high moisture range (30% or higher) is the sum of harvest losses and fuel costs. The numbers supplied in Figure 1 are designed to provide a starting point for comparison in your operation. If available, your own records should be used in place of this information to obtain a better estimate for your farm.

Combine adjustments should be set for high moisture corn according to the operators manual, if available, or consult you dealer/supplier for helpful hints on cylinder clearance and speed, ground speed, clearance of the stripper plates, snapping roller speed and clearance, fan setting, and the screen settings on the straw walkers and cleaning shoe. Be prepared to make frequent machine adjustments during harvest as corn moisture and field conditions change. Inspect several individual kernels for damage in the grain tank or collect samples from the flow stream during unloading and make other adjustments as needed. Check for machine losses at the header and behind the combine periodically to be sure they are held to a minimum.

Managing the Wet Holding Bin

Grain can begin to heat from microbial activity almost as soon as it is harvested, depending on the condition of the grain, its moisture content and temperature. Wet grain should be dried to 16 per cent moisture or less within 48 hours after harvesting to avoid potential problems with mold growth which can produce aflatoxin or other toxins. Provide an air flow rate of at least ½ cfm/bu in wet holding bins if grain is held longer than 12 hours to assure that grain near the center will not heat.

Managing the Dryer

Most high temperature dryers can handle high moisture corn although their capacity will be noticeably diminished because of the additional water (see Figure 2). Since grain dryers are normally rated at 10 points of moisture removal for corn, expect to process about 60% of their rated capacity if required to dry corn from 30% moisture to 15%. For example, a unit that will dry 6000 bushels of corn per day from 25 to 15 % would only be able to process 3600 bushels per day for the same temperature setting and air flow rate.

Figure 2. Amount of Excesss Water in Corn at Various Moisture Levels

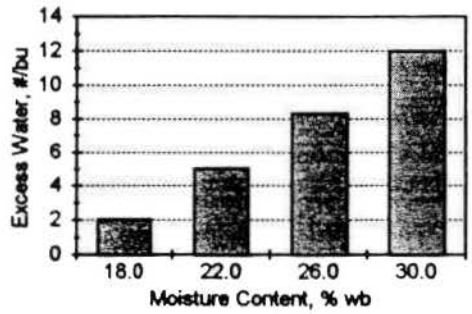


Table 1. Amount of excess water in corn.

Moisture Content	Amount of Water	Excess Water
15.0	8.4	0.0
18.0	10.5	2.1
22.0	13.4	5.0
26.0	16.7	8.3
30.0	20.4	12.0

Temperature settings may be adjusted upwards slightly to overcome some of the lost capacity, however the upper kernel limit of 180° F should be observed to prevent excessive damage by the dryer. This may limit the amount of heat that can be applied in dryers that have a single drying chamber or section. Multi-stage dryers may be able to increase drying air temperatures to 240° F if the kernel temperature does not exceed the maximum level. Running high moisture corn through the dryer twice to take out five to seven points of moisture each pass will greatly reduce dryer damage and may be the best option for those farmers who are set up to use this mode of operation.

Dryeration and In-bin Cooling

Corn may be dried to within 1.5 to 2.0 percentage points above the desired final moisture content in the dryer and cooled in a separate steeping tank (dryeration), or in storage bins (in-bin cooling) if sufficient fan capacity is available to cool the corn within 24 hours after it is dried. Dryeration tanks should be self-cleaning to facilitate complete removal of all grain prior to loading another batch for cooling. Fans should be run continuously on dryeration tanks after the corn has had a few hours to soak in the heat added by the dryer. Expect a ½ point of moisture removal for each 25° F above the cooling air temperature. For example, corn entering a dryeration bin with an average kernel temperature of 170° F will loose approximately 2 points of moisture when cooled with outside air at 70° F.

In-bin cooling differs from dryeration in that the fan should be run continuously while filling the bin with hot corn to control the massive amounts of free moisture that condenses on the roof and drips back on the top of the grain. For this reason the moisture lost will not be as great, but should be between 1 to 1½ points of moisture.

Either cooling method will increase the capacity of the dryer, reduce the amount of fuel required to dry each bushel of corn, and reduce internal stresses within the kernel which can lead to breakage during handling. In either case, sufficient air flow is the key to success with between ½ to 1 cubic feet of air per minute for each bushel of hot corn (cfm/bu). A rule of thumb is to run the fans according to the air flow available. For example, if ½ cfm/bu is provided it will take about 24 hours to cool a batch of corn, whereas 1 cfm/bu requires only about 12 hours to cool it.

Drying for Storage

Dry the crop to a moisture content that is appropriate for the length of storage. Corn that will be held through March may be dried to 15% provided that it is cooled to 60° F as soon as possible after drying. Corn that will be held through the spring should be dried to 14% and corn that will be held into July or August should be dried to 13% to keep the air surrounding the void spaces dry enough to discourage mold growth.

Although many farmers are reluctant to dry below 15% moisture content because of the additional water loss (called shrink), that decision should be based on storage risk management. Drier grain will store better in hot weather, but care must be taken to avoid drying corn below these recommended levels because over drying costs are excessive. An estimate of the additional costs associated with drying corn below the market level (15% moisture) is shown in the figure below.

Note that the combined costs of weight loss from the corn and drying fuel total about a nickel per bushel for each point below the market level. Keep these figures in mind to avoid over drying and to know the added costs of storing corn on the farm during warm weather in Kentucky. Hopefully, these added storage costs can be recovered by increases in market prices; otherwise other options should be considered.

Figure 3. Cost of Drying Corn Below 15% Moisture Content (@$3.50/bu)

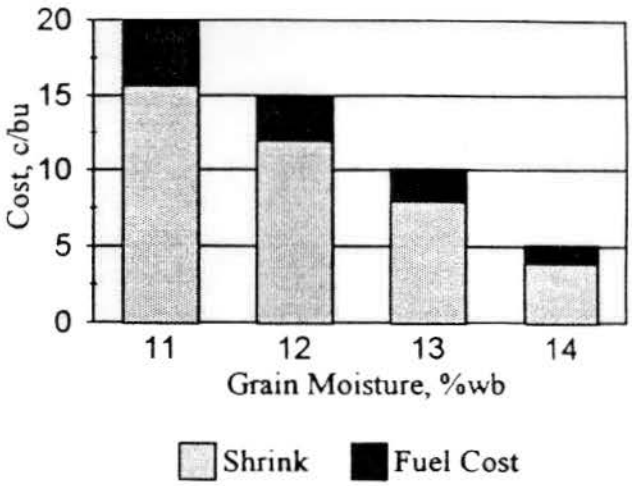


Table 2. Estimated costs of drying corn below 15.0% moisture based on a price for corn of $3.50 per bushel and a fuel cost of 50 ¢ per gallon of LP gas.

Moisture Content, %wb	Water in Corn # / bu	Amount of Weight Loss # / bu	Value of Water ¢ / bu	Approx. Fuel Cost ¢ / bu	Total Cost ¢ / bu
14	7.75	0.7	4.1	1	5.1
13	7.11	1.3	8.1	2	10.1
12	6.49	1.9	11.9	3	14.9
11	5.88	2.5	15.6	4	19.6