Harvesting, Drying, and Storing Malting Barley

To Get Market Premiums

Maltsters will pay premiums for malting barley that has been harvested in good condition and stored properly. Bright barley with good germination, sound kernels and intact husks are required for malting and brewing.

PROPERLY THRESHED & STORED MALTING BARLEY

Six-Row Barley

Two-Row Barley

Skinned and Broken Kernels

Skinned kernels are kernels with the husk loosened or removed over the germ or with one-third or more of the husk skinned off. Broken kernels are kernels which are cracked or broken. Malting barley which is threshed properly and contains a low percent of skinned and broken kernels generally has short pieces of awns still attached to the kernels. Buyers of malting barley do not object to these short pieces of awns even though they may result in lower test weight. The percentage of plump kernels remaining on barley sieves gives a much more accurate measure of kernel plumpness than does test weight.

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Skinned Kernels Cause Problems in the Malting Process

In making malt, barley is steeped in water until it reaches high moisture content. The barley is then germinated under controlled conditions. This sprouting results in activation of enzymes which break down starch granules in the grain so that they may be converted to dextrins and sugars that are important in processes that use malt.

Above – Properly threshed malting barley.

Below – Malt produced from properly threshed malting barley. Note that the sprout is completely protected by the undamaged husk.

A high percentage of skinned kernels results in inferior quality malt. The undamaged husk on sound kernels provides a protective covering for the developing sprout or acrospire which grows under the husk towards the awn end of the kernel. Skinned kernels take up water faster than sound kernels, and therefore grow faster. Germination must be uniform and complete so all the kernels are completely malted. Skinned kernels or kernels with damaged husks germinate with exposed sprouts which are easily broken

Above – Skinned and broken kernels from improper threshing.

Below – Skinned and broken kernels of malt. Note exposed sprouts.

off when the barley is stirred during malting. If the unprotected sprout is broken off, germination is interrupted and the kernel is not completely malted. Skinned kernels are also more susceptible to mold growth than kernels which are protected by the husk.

Broken kernels are largely removed by cleaning before barley is malted. Broken kernels which cannot be removed before malting reduce the quality of the malt.

Straight Combining vs. Windrowing/ Swathing and Combining

The first harvesting decision that affects final grain quality is whether to cut and windrow or straight combine the barley crop. Weather conditions, crop variety, and timing of harvest are factors to consider when deciding whether or not to windrow/swath the barley. Barley producers need to consider varietal characteristics such as height, straw strength and susceptibility to shattering and sprouting when determining which basic harvesting method to use.

Barley is considered to be physiologically mature at approximately 35% moisture in the seeds and can be cut when the moisture content is 20-30% and allowed to dry in windrows or swaths. Barley harvested at 18% or higher moisture content can be easily damaged during threshing in the combine. However, there is a high potential for shattering when mature barley is allowed to stand for an extended period of time before harvesting. Producers who choose to straight combine may need to choose between harvesting wet barley or losing some grain to shattering while it is standing. Barley combined at moisture levels above 13.5% requires artificial drying for proper storage. To avoid any grain storage problems, it is critical that the farm operator understands the different aspects of using natural-air vs. a grain drying system that uses heat (see “Drying Barley”). Pre-harvest desiccants should **never** be used on malting barley as the malting and brewing industry will not knowingly buy malting barley treated with desiccants.

Harvesting Issues

All makes and models of combines can be adjusted and operated to thresh barley with a low percentage of skinned and broken kernels. Threshing without mechanical damage requires more attention and greater care during adverse harvest conditions. When threshing malting barley, regular checks should be made for skinned and broken kernels. If more than a few kernels in a handful are skinned or broken, adjustments should be made to reduce this damage. Minor adjustments may be necessary during the day to compensate for changes in temperature or in moisture content of the straw and grain.

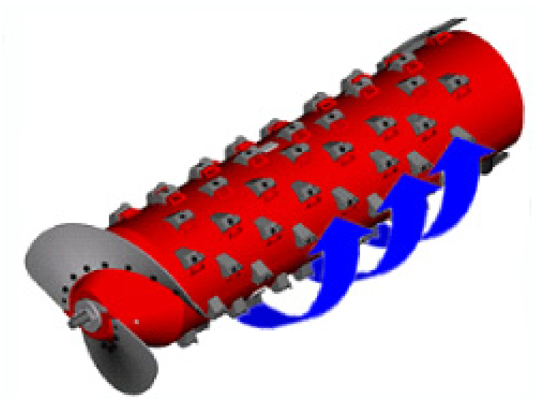
The type of harvesting equipment and harvesting practices directly affect malting barley quality. Combine equipment and combine systems adjustments must be considered during the harvesting operation. Platform, feeder, feeder house, cleaning and grain handling adjustments are similar on rotor and walker type combines. The rotor, cylinder, concave and fan adjustments must be set differently on each type of combine. Kernel damage, quality of straw, presence of weeds, and the amount of material other than grain in crop sample are the most important quality factors affected by combine settings.

Combine Adjustments

The combine platform and feeder adjustments are similar for most types of platforms and feeding systems. All types of headers must be properly leveled to ensure the crop feeds evenly into the feed house and onto the combine cylinder. There should be 3 mm (1/8”) clearance between the feeder conveyor chain and the feeder housing floor. The belt speed of pickups used with windrowed grain should be slightly faster than the combine’s ground speed.

Walker Type Combine

Threshing and separating the grain from the straw and chaff is accomplished differently in rotor and walker-type combines. In rotor-type combines if the rotor speed is set too fast kernels can be skinned and broken and more material other than grain will enter the cleaning system which reduces combine efficiency. Set rotor speeds between 600 and 900 rpm. Rotors operate in conjunction with the concaves. Select concave clearance according to recommendations for barley threshing. Reducing the clearance between the rotor and concave adds additional threshing aggression but can cause cracked kernels. Set the concave clearance between 10-25 mm (3/8-1”). In both types of combines the cylinder and concaves operate together to thresh the crop. The recommended cylinder and concave clearance in walker-type combines is also between and 10-25 mm (3/8-1”) the cylinder speed is 600-900 rpm. On specific combines the clearance and speed designations may be indicated in different graduations which would require the operator to consult the operator’s manual to determine the specific distances and speed settings.



Rotary-Type Combine

Combine cleaning systems include a fan and set of sieves that operate in relation to each other. Fan speed settings vary for different combines but excessive fan speed results in wasted grain blown out the rear of the combine while fan speeds that are too slow cause sieves to overload or plug. The upper sieve, sometimes called a chaffer, should be set with a 14-18 mm (0.5-0.7”) opening, and the lower sieve should be set to have a 4-8 mm (0.2-0.3”) opening.

Modern combines allow the operator to make most threshing and separation adjustments from the operator’s cab based on information supplied by electronic monitors and sensor systems.

The grain handling system includes the clean grain and return grain elevators, the grain tank and unloading auger. To reduce the potential for kernel damage, maintain the proper elevator chain tension, so the grain doesn’t get caught between the chain and gear.

Grain Elevators

Improper adjustment, operation, or use of on-farm hauling and elevation equipment at the storage site can be a source of kernel damage. Auger elevators should be in good operating condition and used at recommended speed and capacity. Bent augers, dented auger housings or ragged edges cause skinning and breaking. Pneumatic (air) elevators can be used to elevate barley with minimum damage. Do not operate this type of equipment above the recommended speed. Air elevators will skin and crack barley when run at excess speeds. Improper feeding can also cause damage. Sharp angles, long distances, and high velocity air may all damage grain.

Drying Barley

If malting barley is harvested at moisture levels above 13.5% it must be dried using various methods to assure the barley maintains quality in storage. Natural air/low temperature drying generally costs less and yields higher quality malting barley compared to high temperature drying. High temperature drying, if not properly monitored, can reduce test weights and germination, and can result in cracks in the kernels which are then more prone to breakage.

Natural air or low temperature drying is energy efficient, economical and reduces drying bottlenecks. Drying time is normally three to four weeks using airflow rates of 0.75 to 1.0 cubic feet per minute per bushel (cfm/bu). An airflow rate of 0.75 cfm/bu permits drying barley at moisture contents up to 17% and 1.0 cfm/bu up to 18% when average outdoor temperatures are 70°F or lower (day temperature + night temperature/2). The maximum moisture content for natural air drying is 16% with an airflow rate of at least 0.75 cfm/bu if air temperatures average between 75° and 80°F. Drying occurs in a zone that moves from the bottom of the bin to the top, if the air is pushed up through the barley. Grain at the top will stay near the initial moisture content until the drying zone reaches the top of the grain, so adequate airflow to dry the barley within its allowable storage time is critical. The allowable storage time (or drying time) is related to the grain temperature and moisture content. The allowable storage time is about 25 days for 18% moisture barley at 70°F, 35 days at 17%, and 50 days at 16%. The allowable storage time is about 13 days for 18% at 78°F, 17 days at 17% and 35 days at 16%. The allowable storage time is approximately doubled for each two percentage point reduction in moisture content and for each 10°F reduction in temperature. Generally, a centrifugal fan of adequate size is needed to provide the airflow.

A grain kernel will either lose or gain moisture, depending on its moisture content and the temperature and relative humidity of the surrounding air. Water moves from an area of high vapor pressure to areas of low vapor pressure. Eventually, the vapor pressure inside the kernel will equate to the vapor pressure of the air. When this occurs, the grain has reached the equilibrium moisture content. Higher temperatures and lower relative humidity result in lower equilibrium moisture contents. The equilibrium moisture content for barley is about 12% at 70°F and 60% relative humidity. This moisture content is recommended for long term storage to prevent mold growth.

Adding supplemental heat to a natural-air drying system will reduce the equilibrium moisture content of the grain and only reduces the drying time slightly. Normally, air should be warmed no more than about 5°F. Warming the air by 5°F will reduce the relative humidity by about 10% and the barley moisture content by about 1.5%. As a rule of thumb, one kilowatt of electric heat per fan motor horsepower will warm the air about 5°F for wheat and barley. Adding more heat will result in over drying unless the grain is stirred. The air will normally be warmed 3°-5° F by the fan operating at a static pressure of about 6” when drying barley. Consider the effect of the fan heat on air relative humidity before adding supplemental heat. Normally, additional heat is not required. Adding heat frequently causes grain to be dried to a moisture content lower than desired.

Drying temperatures need to be limited when using a high temperature dryer to prevent damaging the quality of malting barley. Since germination is important in the malting process, 100°F is the maximum recommended drying air temperature.

A moisture variation develops in the kernel when barley is dried in a high temperatures, with the outside being drier than the inside. This moisture variation causes electronic meters to give an erroneously low value, since they are influenced primarily by the outer surface of the kernel. If the outer surface is wetter than the inside of the kernel, the meter reading will be erroneously high. To determine if the meter reading is erroneous, place a sample in a plastic bag and allow the moisture to equalize in the kernel for about 12 hours and then re-check the moisture content.

Managing Stored Barley

Grain stores best if it is cool, dry and clean. The recommended maximum moisture content for storage of clean, sound barley during warm summer temperatures is 12%. Barley can be stored at slightly higher moisture contents if it is kept cool. Examine an allowable storage time chart to determine acceptable temperatures and grain moisture contents. Grain that contains considerable foreign material or broken kernels will be more susceptible to mold and insects than sound clean grain. The grain should be cleaned to reduce this hazard or be dried to a moisture content of at least one percentage point lower than that of clean grain.

Cooling stored barley with aeration is critical to maintain grain quality. Insect reproduction is slowed at grain temperatures below 70°F, they become dormant at temperatures below about 50°F, and insects can be killed if grain temperatures are maintained at or below 30°F for about two months. The allowable storage time, based on quality loss, is approximately doubled for each 10°F that the barley is cooled. Moisture migration will cause a moisture accumulation and crusting in the top central part of a bin if about a 20°F or more temperature difference exists in the stored grain. This temperature variation occurs if the stored barley is not cooled using aeration as outdoor temperatures cool. Begin aeration to reduce the grain temperature when the average outdoor temperature is about 10° to 15°F cooler than the grain temperature and the grain can be cooled below 70°F. Two, or more, aeration cycles will be required to cool the grain during the fall, eventually cooling to about 20° to 25°F for winter storage.

The required aeration cycle time can be estimated by dividing 15 by the airflow rate. It takes about 150 hours to cool grain with an aeration airflow rate of 0.1 cfm/bu. Make sure the fan runs long enough to cool all the grain. Little if any drying will occur during aeration. Also, very little rewetting will occur if the fan is run during humid weather as long as the fan is operated only long enough to cool the grain. The aeration fan or duct should be covered whenever the fan is not running to prevent insects and snow from blowing into the bin and to prevent warm moist air from warming and wetting the grain in the spring.

Grain may be warmed in the spring if it has been cooled to below 20°F, but should only be warmed to about 35° to 40°F for summer storage. Research has not shown that it is better to warm the grain than to leave it at about 20° to 30°F. Moisture accumulation during the summer due to moisture migration typically occurs in the center of the bin at depths of two to four feet below the grain surface. The moisture increase will normally be less than 1%. Grain should not be aerated during the summer except to cool warm grain typically near the top of the bin. Aeration to cool the grain at the top of the bin should push the air up through the grain, only when outside temperatures are below 60°F, and the fan should only be operated long enough to cool the top surface. Warming barley to 70° F, for example, will add moisture to the grain and put the grain at a temperature conducive to mold growth and insect activity.

Check stored grain at least every two weeks during the fall until the barley has been cooled and a history of the grain has been developed. Check the stored barley at least monthly during the winter after the grain has been cooled to 20° to 25°F, and again every two weeks during the spring and summer. Search for small changes that are indicators of potential problems. Check and record the temperature and moisture content at several locations. Examine samples from several locations for insects.

General Recommendations for Harvesting Quality Malting Barley

1. Pre-harvest desiccants should never be used on malting barley.
2. Harvest barley when the grain moisture content is lower than 18%. Only with adequate drying capabilities should barley be harvested above 13.5% moisture to the maximum of 18%.
3. When threshing malting barley, regular checks should be made for skinned and broken kernels.
4. Excessively high cylinder speeds are mainly responsible for skinned and broken barley kernels. With slower cylinder speeds, concaves can be adjusted close enough to thresh the grain without excessive skinned and broken kernels.
5. The fan speed should be high enough to "float out" most chaff but low enough to permit the grain to fall through. Many machines use more wind for barley than other small grains.
6. Sieves and air should be adjusted for minimum material other than grain in the return.
7. Review the operator's manual, and consult the company representative for proper combine adjustments for harvesting malting barley.
8. Cooling stored barley with aeration is critical to maintain grain quality.
9. Check the stored barley at least monthly during the winter.

This pamphlet covers some of the more important aspects of harvesting and storing malting barley. For specific adjustments for your combine or elevating equipment be sure to follow the directions in your operator's manual. Further storage tips should be obtained by local extension or purchasing agents.

Careless Threshing, Handling and Storing Can Make Feed Barley Out of Good Quality Malting Barley.

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