WHEAT HARVEST, DRYING AND STORAGE

Most wheat is harvested during a 4-6 week period in Missouri beginning in late May in the south and ending in early July in the north. The timing of the wheat harvest is highly dependent on the weather. A warm, early spring can push wheat harvest up by as much as two weeks, while damp cool weather at maturity can cause delays of two weeks or more in completing the harvest.

Most Missouri wheat growers do not hold wheat on-farm unless it is for a short period of time to let the market stabilize or to remove moisture. Many farmers endeavor to harvest wheat at a moisture content that is suitable to transport the grain directly from the field to a local elevator.

Wheat should be harvested without delay when it reaches maturity and begins to dry down to market moisture contents. After wheat begins to dry in the field, repeated precipitation and drying begins to decrease quality and test weight. It is often true that harvesting wheat while it is still somewhat wet and using artificial drying produces the highest quality wheat.

An early harvest also extends the available growing period for a double crop of soybean. Double cropping soybean after wheat is particularly suitable in the south and becomes relatively risky in the north due to the shorter growing season.

There are several advantages to harvesting wheat early and using artificial drying to remove the last points of moisture.

An early harvest reduces the risk of catastrophic damage to the crop from high winds or hail. An early harvest also may prevent the mature crop from drying and rewetting due to rain, which results in more harvested bushels and a higher quality product with higher test weights.

Finally, an early wheat harvest extends the growing season for a double crop of soybean. Length of the growing season is a primary limiting factor for soybean double cropping, especially in northern Missouri.

HARVESTING

Prepare for the wheat harvest by performing routine maintenance early and then equipping and adjusting the combine according to the operator's manual. Most modern combines will perform adequately simply by setting them according to the operator's manual. Develop a harvest plan based on the quality of the wheat and weed control. Harvest high-quality wheat first. Schedule weedy fields last because yield and quality are likely to be poorer as well. Harvest the weediest areas of those fields using a pattern that minimizes the chances of spreading weed seed to clean areas of the field.

When making adjustments to the combine, it is important to keep in mind that the crop passes through five distinct systems respectively: (1) cutting and feeding, (2) threshing, (3) separating, (4) cleaning and (5) materials handling. The performance of a particular system depends on the performance of any systems that precede it. Hence, adjustments to combine performance should begin by optimizing cutting and feeding and end with an analysis of the final cleaning operation by observing how much grain is left on the ground and by inspecting the materials-handling systems.

Cutting and feeding

The objective for setting the header for wheat should be to gather all of the grain while minimizing the volume of straw that must be handled by the rest of the combine.

Before beginning harvest, make sure the sickle is in good operating condition. Sharp sickle sections cut straw quickly and cleanly for peak performance. Dull sickle sections that tear at the stalk transmit some of the aggressive motion of the sickle to the head and can cause shattering.

Since wheat produces heads only at the top of the stem, cutting height for wheat should be relatively high to limit the amount of straw that must be handled by the combine. The combine operator should constantly be aware and ready to change header height as the terrain or the height of the crop changes. The goal always should be to harvest approximately the same length of stem to maximize feeding and cutting performance.

The reel should be adjusted just slightly ahead of the cutter bar and low enough to make good contact with the top of the stems. Reel speed should be adjusted relative to ground speed so that the bats begin to lay the stems over just before they are cut. Combines, like most other machinery, are designed to operate best at some moderate ground speed.

When ground speed is too high, some wheat may be poorly cut or knocked down. When ground speeds are excessively slow, some stems may not drop over into the header properly and fall to the ground underneath the cutter bar.

Threshing and separating

Setting the combine for maximum performance almost always involves some kind of trade-off between maximizing the volume of grain harvested and the quality of the grain. This is particularly true for the threshing system. The same adjustments that improve threshing can damage grain and increase the amount of foreign material in the sample.

Threshing is completed with the rotor or cylinder turning at high speeds and with narrow clearances inside the concaves. The concaves confine material to a small space and allow threshed seeds and other small debris to pass through where they are collected below on the grain pan. The primary threshing action for combines equipped with a cylinder is from high-velocity impacts created as the cylinder spins at several hundred rpm. Threshing also takes place in part from the rubbing action against the plant material, especially for combines equipped with a rotor.

The aggressive action of threshing is the primary cause of physically damaged seeds. Damage is especially high for overly dry seeds (below 13 percent moisture content), which become cracked or broken during threshing. Excessive damage can also be caused to the seed coat of very wet seeds (above 22 percent) when harvest begins too early.

Seed damage is minimized by harvesting seed with moderate moisture contents and by reducing cylinder or rotor speed to the minimum level necessary for good threshing. Cylinder or rotor speeds and clearances should be changed throughout the day to match the requirements of the crop.

Under moderate operating conditions and when the amount of straw that is fed into the combine is minimized, most separation will occur through the concaves during threshing. At high feed rates or when a lot of material is fed through the combine, more grain will reach the straw walkers or the separation stage of the rotor, which results in higher separator losses as more grain is carried out the back of the combine with the straw.

Fine tuning cylinder or rotor speed and clearance is a balance between achieving complete threshing and minimizing damage to grain. It is sometimes advisable to err on the side of leaving a little grain in the heads to minimize the amount of chaff and damaged grain that is produced.

Damaged grain and grain with high amounts of foreign material reduce profits when marketed and are more difficult to store. Broken and damaged grain is more susceptible to damage by insects and storage molds. The smaller fragments from damaged kernels and foreign material further reduce storability by restricting airflow during storage.

Cleaning

Grain, partially threshed heads and chaff are sorted in the cleaning shoe. The cleaning shoe consists of two oscillating sieves. The top sieve is known as the chaffer, while the lower sieve is known as the cleaning sieve. The fan blows air through the chaffer to remove lightweight material or chaff.

Ideally, only grain and small, unthreshed seed heads fall through the chaffer sieve down to the cleaning sieve. Large unthreshed heads are propelled to the rear of the chaffer, where they may fall through the chaffer extension and drop into the tailings auger. Any material that does not pass through the cleaning sieve is propelled to the rear of the sieve, where it is collected in the tailings auger as well. Materials with intermediate aerodynamic properties, such as straw, are both floated and mechanically propelled over the chaffer and the chaffer extension, where they are expelled.

Overloading the shoe is a common problem and ultimately limits overall combine capacity. Overly aggressive threshing can pulverize straw into finer pieces and show up as excess amounts of straw at the shoe. Here, the excess straw can overload the sieves and result in carrying grain over the back of the shoe.

Similar shoe losses can be caused by setting the chaffer openings too narrow or by setting the fan speed too low. Setting the fan speed too high can result in blowing lighter kernels right out the back of the shoe. If the chaffer is set too wide, excess straw and unthreshed heads may pass through and overload the cleaning sieve, which causes excessive amounts of threshed grain to be recycled.

DRYING AND STORAGE

Wheat is often a relatively small crop for many Missouri farmers, and many elevators are only equipped to receive wheat during a period of several weeks at harvest. For these reasons, many farmers often plan on selling wheat directly from the field. Hence, much wheat is allowed to dry naturally in the field. When grain is stored on-farm, a grower must remember that quality never improves during storage. Store only the highest quality grain.

Storage facilities

If wheat is dried or stored on-farm, use a properly designed and constructed storage structure to minimize handling losses and quality deterioration during storage. A cylindrical metal bin has many distinct advantages over any other structure that might be used to store grain. Cylindrical metal bins are designed, and should be installed, to

- Contain grain in a controlled atmosphere away from livestock.
- Provide weather-tight shelter to protect grain from precipitation.
- Provide barriers to pests.
- Provide for aeration.
- Permit effective treatment to prevent or control insect infestation.
- Provide suitable access and safety for those managing the grain during storage.
- Provide easy and complete cleanout.

Prepare the storage bin before harvest by emptying the bin and removing all traces of the previous crop. Good sanitation practices eliminate sources of food for rodents as well as host locations for disease and insect pests. A thorough cleanup involves cleaning pits, augers and transitions as well as any other locations in the grain-handling system where grain can accumulate. For best results, follow the physical cleanup process with an approved insecticide to get ahead of insects before harvest begins. Thorough cleaning and pest control before bins are filled will help protect new crop grain from old crop pests.

When building new facilities, do not skimp on installing access doors and don't miss any chances to install self-cleaning components. Accessibility and ease of cleaning should be high-priority considerations in the final design of any new grain-handling system. These features can quickly pay for themselves if they help avoid even a few docked loads from a little extra mold, insect damage or sprouts from grain exposed to the elements in a hard-to-clean place. Building in the ability to thoroughly clean the grain-handling system also prepares these facilities to preserve identity and capture a premium on grain that has some relatively "highly valued" property.

Drying

Drying wheat during the summer months requires more attention than drying corn during the fall. Although the principles are the same, the rules of thumb are not. Wheat restricts airflow more than corn, so fans that can provide just enough air in a full bin of corn will fail to do so in wheat. Wheat is also harvested at the onset of some of the highest temperatures of the year, while corn is harvested at the onset of cooler temperatures. Therefore, wheat must be dried quickly to prevent spoilage.

Table 5. Minimum recommended airflow rates for drying wheat with natural air.

Initial harvest moisture content (% wet basis)	Minimum recommended airflow rate (cfm/bu)
Up to 16%	1.0
Up to 18%	2.0
Up to 20%	3.0

Wheat should be dried with natural air whenever possible to obtain the highest quality grain. Natural-air drying also reduces the tendency to overdry wheat. Wheat should be dried in shallow layers to maximize the airflow. Minimum airflow rates for drying wheat with natural air are listed in Table 5. Wheat should be dried to 13.5 percent for immediate sale since overdrying reduces the total weight of grain to be sold. However, if wheat is to be stored for any period of time during a warm Missouri summer, dry to 12 to 12.5 percent moisture content to prevent spoilage.

For most in-bin systems with properly sized drying fans, natural-air drying works best when initial wheat moisture content i less than about 18 percent and the depth of wheat is kept below about 9 or 10 feet. Remember that the higher the initial moisture content, the more quickly the wheat must be dried to prevent the top layer from spoiling. The corollary to this rule is that wetter wheat must be dried in shallower layers.

Do not attempt to dry wheat with a fan sized for aeration. High-speed dryers are the best choice for drying wet wheat because they generally provide maximum airflow. A small amount of heat may be required on only high-humidity days.

Soft red winter wheat dried with natural air at constant conditions will eventually reach the equilibrium moisture contents shown in Table 6. In practice, the relative humidity and temperature of ambient air vary throughout the day, and the final moisture content will be a function of the average conditions of the air. For example, during daytime hours with a full sun, suppose the temperature and relative humidity of the air reached 90 F and 50 percent humidity. Under these conditions, the wheat would eventually dry to a final moisture content of about 10.8 percent.

During the night as air temperatures drop, the relative humidity also tends to increase. Suppose the nighttime air reached a temperature of 60 F and relative humidity of 90 percent. The equilibrium moisture content at this condition is about 17.2 percent. If drying fans were running continuously, the final moisture content of the grain would fall somewhere between 10.8 percent and 17.2 percent.

When drying wet wheat with natural air, fans should be run day and night until the moisture content drops to about 15 percent. Wheat on the bottom of the bin is the first to dry, especially during hotter and drier daytime hours. As the air passes through the lower layers, it removes moisture from the wheat on the bottom layers and eventually becomes saturated so that it can't hold any more moisture. Hence, the wheat on the top layers does not dry until the wheat in the bottom layers is relatively dry.

During the night, the drier wheat on the bottom absorbs some moisture from the air and increases the depth of the drying front by removing moisture from grain above.

Run the fan selectively after the moisture content of the wheat reaches about 15 percent to remove the last percentage point or two of moisture. The best drying air occurs from about 10:00 a.m. to 8:00 p.m. on normal days when temperatures are high and humidity is low.

Heat should be used sparingly when necessary to improve drying efficiency. Supplemental heat shifts the properties of the drying air toward the lower left corner of Table 6, which increases the drying potential of the air and the tendency to overdry wheat.

Stirring devices and recirculating systems improve success when using supplemental heat. Supplemental heat increases the chances of spoiled grain at the top of the bin because the wheat at the top remains wet until the wheat at the

Table 6. Equilibrium moisture content for soft red winter wheat.

	Relative humidity %								
Temp F	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**
35	6.3	8.3	9.8	11.1	12.3	13.5	14.8	16.3	18.3
40	6.2	8.1	9.6	10.9	12.1	13.3	14.6	16.1	18.1
50	6.0	7.9	9.4	10.6	11.8	13.0	14.2	15.7	17.6
60	5.9	7.7	9.1	10.4	11.5	12.7	13.9	15.3	17.2
70	5.7	7.5	8.9	10.1	11.3	12.4	13.6	15.0	16.9
80	5.6	7.4	8.7	9.9	11.0	12.1	13.3	14.7	16.5
90	5.5	7.2	8.5	9.7	10.8	11.9	13.0	14.4	16.2
100	5.4	7.1	8.4	9.5	10.6	11.7	12.8	14.1	15.9

bottom is dry and the higher temperatures from the added heat increase the rate of dry matter loss.

MONITORING AND AERATION

Wheat should be cooled as weather permits to reduce the activity of insects, to inhibit the growth of storage molds and to prevent moisture migration. As outside air temperatures drop, the grain against the wall of the bin begins to cool. The cooler air in the grain at the walls is relatively dense compared with the warm air in the center of the bin. This dense air at the walls moves downward and displaces air in the warm core of the bin. As this natural air current moves through the grain, it picks up moisture. When the air reaches the cooler surface grain at the top of the bin, the moisture condenses on that grain and causes spoilage. Regular aeration intervals prevent moisture migration by keeping the average grain temperature more similar to outside temperatures.

If using an aeration fan designed to provide a relatively small airflow rate on the order of 0.1 to 0.2 cfm/bu, begin cooling wheat when the average air temperature drops by about 10 F. Run the fan continuously until the exhaust air temperature drops to the new level. When using a drying fan that can provide an airflow rate of ½ to 1 cfm or more, begin aerating when the average air temperature drops by about 15 F.

Monitor stored wheat on a regular basis, at least weekly until wheat is cooled to 50 F and then at least monthly until the grain is sold. Good monitoring practices require checking the moisture content and temperature of the wheat throughout the grain mass. Aeration fans should be run immediately if musty smells or crusted grain are detected. Continue running fans until the problem is solved or until the wheat is sold.

SUMMARY

- Prepare the combine, storage and drying facilities well before harvest.
- Harvest wheat without delay after maturity and when moisture content is low enough to store or to dry quickly.
- Adjust the combine and pay particular attention to the header to minimize harvest losses.
- Set threshing characteristics of the combine to produce the highest quality wheat.
- Use natural air to finish drying wheat if necessary. Use heat sparingly to improve drying performance.
- Cool wheat as the weather permits to improve storability. Monitor bins periodically to catch small storage problems before they become large problems.