Harvesting Wheat

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Today's modern, high-capacity combines are designed to do an excellent job of threshing and cleaning wheat. All too often, however, part of the crop is left in the field or the quality of the grain harvested is less than desirable. Even in good harvesting conditions, combine losses as high as 10 bushels per acre of wheat can occur in Kansas. In most cases, a few minor adjustments could drastically reduce losses or improve grain quality. Since any additional wheat saved is clear profit and clean samples are not docked, a little extra attention to combine adjustment can pay off.

Preliminary Adjustments

As a general rule, start with the machine adjusted according to the specifications in the operator' s manual. If these specifications cannot be found, Table 1 contains some suggested ranges for initial settings. Engine speed is often taken for granted, but it is one of the most important adjustments of all. If the engine speed is too slow, separator speed will also be too low and performance will suffer.

Once the combine is adjusted and ready to operate, be prepared to fine tune it as required. To fine tune a combine, the functions of the machine and how they relate must be considered. The combine' s five basic functions are cutting and feeding, threshing, separating, cleaning, and handling. The crop moves through the combine in this order. So if one function is not performing adequately, the areas that follow will have performance-related problems. For example, if the header is too low and excess straw is entering the combine, threshing and separation will be difficult because of the excess material.

Cutting and feeding take place at the header and feeder house. Adjustments include header or cutting height, reel height and speed and reel position fore/aft. Cutting height is controlled by the operator as conditions change. The goal should be to harvest all grain with minimal chaff and straw.

The reel should be adjusted to gently move wheat into the cutter-bar by positioning it slightly ahead of the cutter-bar. It should turn slightly faster than ground speed and be far enough down in the wheat to lay the heads onto the platform.

Make sure the sickle is sharp and in good condition. A dull sickle can limit ground speed and cause shatter loss. Crop feeding from the header should be uniform to insure proper threshing.

Threshing occurs at the cylinder or front portion of the rotor and is affected by concave clearance and cylinder/rotor speed. Cylinder/rotor speed determines how much grain damage will occur and the amount of seeds threshed from the head. Clearance will determine how many seeds are separated and drop through the concaves. Ideally, threshing removes all grain from the head without damaging grain or straw.

Cylinder adjustment is also important since it affects the performance of the rest of the machine. First of all, verify that the cylinder clearance indicator on the machine is accurate. The bars and concaves may be worn so that the clearance is greater than shown by the pointer. The concave and cylinder must be parallel from side-to-side and the cylinder-concave clearance must have the correct convergence from front-to-rear. The operator' s manual should

Table 1. Recommended initial settings for combines used to harvest wheat.

	Range	Recommended
Chaffer Opening, inches	1/4 to 3/4	5/8
Sieve Opening, inches	1/8 to 3/8	1/4
Fan Setting, speed or choke	medium to high	near high end
Cylinder/Rotor Speed, rpm	750 to 1350	1000
Cylinder/Rotor & Concave Spacing, inches	1/8 to 1/2	1/4

include detailed instructions on checking and adjusting these items.

Underthreshing, or not completely removing grain from the head, makes separation difficult. It occurs when concave spacing is too wide or cylinder speed is too slow. Overthreshing is indicated by the straw being pulverized and broken up. As a result, part of the straw may overload the shoe, thus carrying grain over. Other symptoms of overthreshing are cracked grain and excessive amounts of material being returned to the cylinder. The cracked grain is more likely to be blown over the shoe, and even if retained in the grain tank, it causes problems in handling and storage.

To avoid overthreshing, set the cylinder no faster and no tighter than absolutely necessary to thresh the grain from the heads. Some operators prefer to leave an occasional kernel in the head as a sign of the best balance in threshing action.

Since threshing plays an important role in grain cleaning, the cleaning shoe should not be adjusted until satisfactory threshing occurs. Shoe losses can be caused by several factors in addition to overthreshing. Narrow chaffer openings can cause grain to be carried over, as can improper fan adjustment. If the chaffer is opened too wide, it will overload the sieve and increase tailings. Chaffer and shoe openings are measured perpendicular to the louvers.

An underblown condition at the shoe occurs when material is not adequately suspended in the air over the chaffer. This is caused by narrow openings or insufficient airflow. Grain should fall through the first two-thirds of the chaffer. If there is a thick mat of material on the shoe, grain cannot fall through and is carried over the rear of the shoe.

If chaffer openings are too narrow, grain through them is limited, increasing losses and limiting the overall capacity of the combine. Changing chaffer openings also affects air velocity and direction; therefore they should be adjusted together. Ideally chaffer airflow and movement suspends material over the chaffer and allows kernels to drop through to the sieve. Sieve openings should be set large enough to let all grain through without allowing foreign material into the grain bin. However if they are closed to keep foreign material out, returns should be monitored to insure not too much grain is being recycled.

Manufacturers have greatly improved the cleaning area on newer combines by developing new fans and precleaners. Many changes in machines have focused on achieving more uniform airflow across the cleaning shoe. These changes have improved the overall performance of the combine. Air type chaffers are popular as aftermarket equipment for combines. Some of these are adjustable and others are not, but most of them do a good job of removing large straw fragments.

Combine Capacity

Combine capacity is the maximum rate at which a properly adjusted combine can harvest a crop while maintaining an acceptable loss level. Capacity may be limited not only by cutting and feeding or power limitations, but also by the performance of any of the functional areas of threshing, separating, or cleaning. It is important to relate capacity to an acceptable overall loss level.

A common limitation on conventional combines in wheat is straw walker overload. As Figure 1 shows, if the combine is pushed beyond a reasonable rate, walker overloading causes the losses to increase rapidly.

With constant crop conditions, feed rate will be proportional to ground speed. At low to moderate feed rates, much of the grain is actually separated in the concave area. About 90 percent of the separation should occur in the concave, leaving only 10 percent for straw walkers. At higher feed rates, the amount of separation in the concave area is drastically reduced so more grain is passed onto the walkers, resulting in excessive separating losses.

The only way to reduce walker losses is to SLOW DOWN. Reducing ground speed by 25 percent on an overloaded combine can easily cut harvesting losses in half.

High Quality Wheat

Combine adjustment can affect wheat quality in two fundamental ways: grain damage and cleanliness. Grain damage consists of cracked and broken kernels which make wheat harder to handle, generate dust, harbor insects, and increase mold growth. Damaged grain can also be hidden in that the operator may not see it. Some damaged grain may end up in the bin, but a high portion will probably go out the back of the machine in the form of flour and small fragments. Generally 0.5 to 2 percent grain damage is achievable, but it can be much higher.

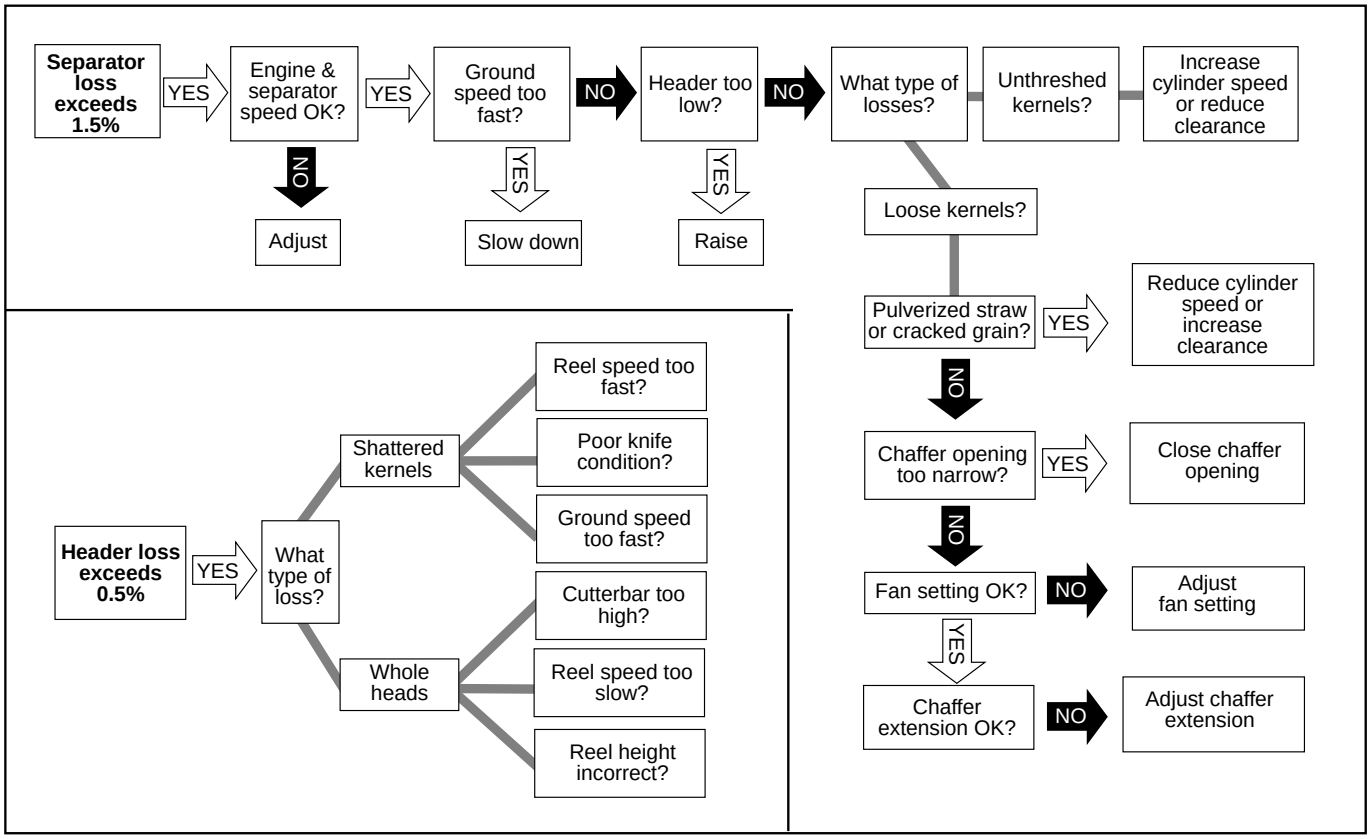
Grain damage occurs mainly in the threshing area of the combine, but can also be caused in the clean grain conveying system. In hard threshing wheat, there is a trade-off between thorough threshing and grain damage. An operator may not be able to completely thresh the crop without causing damage. Grain damage is usually caused by excessive cylinder/rotor speed. If slowing the cylinder/rotor speed doesn' t improve the grain sample, adjustment of the concave clearance may be needed.

Foreign material also contributes to a lower quality wheat sample. Some weed seeds, especially cheat and downey brome, are difficult to separate from wheat. A good way to help is to harvest cheat infested fields last. Drier cheat is easier to clean, and the yield in "cleaner" fields is probably higher which makes them more important. Some general adjustments for cheat infested fields are:

1. Set chaffer toward open end of recommended range,
2. set sieve toward closed end of recommended range, and
3. set fan toward high end.

Following these guidelines will probably cause returns to increase, so

Figure 1. Correcting harvest losses



keep an eye on machine capacity to avoid plugging.

Also watch your travel patterns when dealing with cheat. The combine is a serious vector for weed seed. It typically takes more than one minute to fully discharge cheat from a combine. If the combine is cutting cheat along the edge of a field, it can carry it 200 yards or further into the field before it is through.

Rotary Combine Performance

There are some performance characteristics that distinguish rotary combines from conventional combines. The most notable differences are the grain loss vs. feed rate characteristics and grain damage.

The grain losses from rotary combines do not increase as rapidly at higher feed rates as they do on conventional combines, although overloading still causes excessive losses for both types of combines. For example, a rotary and a conventional combine may have the same capacity at 3 percent grain loss. If feed rate is increased by 50 percent, the rotary combine losses may increase to 8 percent while the conventional combine losses may increase to 16 percent.

Grain damage is another area where differences between rotary and conventional combines exist. Comparison tests in wheat in Kansas showed crackage with a rotary to typically be less than one-half of the crackage with a conventional combine.

It is important to realize that acceptable harvesting losses and acceptable grain quality are obtainable with both rotary and conventional combines, provided that both machines are properly adjusted and operated.

Estimating Your Losses

Checking the machine frequently is the best way to insure efficient harvesting. During a single afternoon, conditions can change enough to require resetting some of the machine' s components. A few simple ground counts will give an indication of combine performance. As a general rule, it takes about twenty kernels of wheat per square foot to equal one bushel per acre when spread evenly across the field. The only item needed to check losses is a one square foot frame made out of heavy wire to carry on the combine or in the grain truck. Follow these steps, illustrated in Figure 2, to determine losses:

1. Cut through a typical area at the usual speed, then stop the combine and back up about 20 feet.
2. In the area behind the separator discharge, lay the one foot square frame down three times and take ground counts (see Figure 2). Average the three counts. This is

the separator count.

3. In the area between the cutterbar and the standing wheat, take three more ground counts and average them. Don' t forget to look for heads. This is the header count.
4. Take a final three ground counts in the standing wheat and average them. This is the pre-harvest count.
5. Calculate header loss in bushels per acre.

$$\text{Header Loss} = \frac{\text{Header Count - Preharvest Count}}{20}$$

6. Calculate the separator loss in bushels per acre.

$$\text{Separator Loss} = \frac{\text{Separator Count - HeaderCount}}{80}$$

Since header width for most combines is about four times as wide as the separator, it takes about 80 kernels per square foot behind the separator discharge to equal 1 bushel per acre if no spreading devices are being used. If your combine has a bat type spreader, use 65 kernels per square foot instead of 80. If you have a straw chopper, use fifty and if you also have a chaff spreader, use 25.

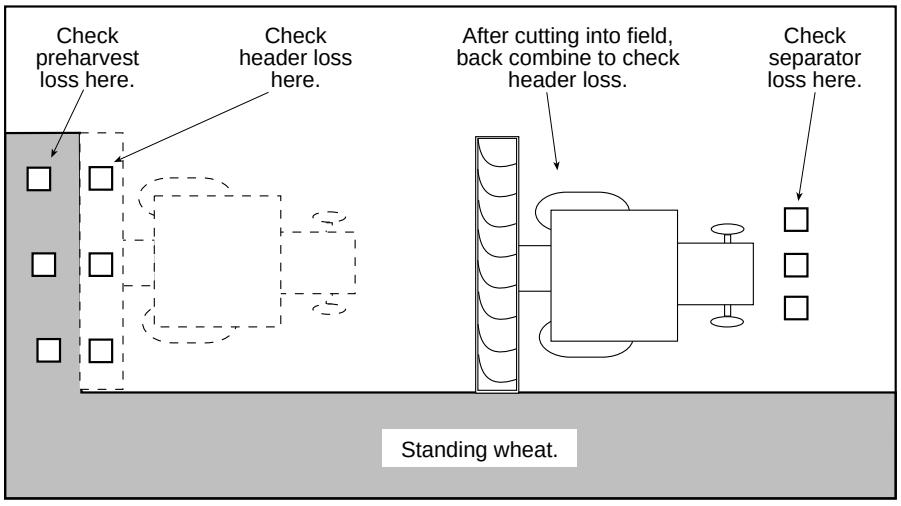
What are acceptable losses? This depends on the condition of the crop as well as the attitude of the operator. However, for standing wheat under good harvesting conditions, machine losses can usually be held to 2 percent of the total yield. Higher losses will have to be tolerated in downed or damaged wheat.

Although simple to perform, the ground counts can be time consuming. It may be more practical to have the truck or grain cart driver perform the separator ground count periodically during the day. This allows the combine to continue harvesting while you are making the count.

Correcting Your Losses

Since there are many factors that can create combine losses, an organized approach to correcting the problem is needed. The two block diagrams show one method for pinpointing the cause of the lost grain. When fine tuning a machine, try to change only one thing at a time so that the effects can be seen. Keep referring to the operator' s manual; it seldom pays to deviate very far from suggested settings.

Figure 2. Checking wheat harvest losses



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