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BEST MANAGEMENT PRACTICES

CHAPTER 37

Combine Adjustments to Reduce Harvest Losses

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Grain yield losses can be classified as: 1) preharvest ear losses, 2) ear losses from the header, 3) kernel shatter loss from the header, 4) threshing losses, and 5) separation and cleaning losses. Chapter 36 provided directions and calculations to determine the magnitude of these losses during harvest. This chapter provides a discussion of combine adjustments and settings that can be made to reduce losses that occur as the combine gathers and processes the crop.

Sources for Yield Losses

The header is the first contact point with the crop and, very often, the largest source of grain loss. In the header, the stalks are gathered and pulled downward into the header mechanisms, and the ears are snapped from the cornstalk and transported rearward onto the header pan and eventually, the combine feederhouse. Each of these steps will produce some losses. Understanding the process and knowing how adjustments affect the performance can help minimize losses. Directions for identifying where the losses are occurring and the magnitude of the loss are available in Chapter 36.

Ear Losses

Loss of whole ears most often occurs in the process of gathering the crop into the header. Crop conditions can have a pronounced effect on these losses. Since adjustments for lodged or down corn may be different, they will be addressed separately. In healthy, standing corn, the objective for the header system is to gently restrain the plant stalk with the gathering chain and allow the stalk rolls to pull the stem straight down until the ear is stripped from the stem. Ideally, the stalk should not be pushed forward, pulled backward or displaced sideways, and the ear should encounter the deck plates and be broken free about 2/3 of the way to the upper end of the deck plates. Most of the adjustments made to the header attempt to achieve this action. The settings suggested in the owner's manual are a good starting point to minimize the loss of whole ears.

Gathering Chain Speed

The relationship between forward machine speed and the rearward speed of the gathering chains (Fig. 37.1) influences the flow of the crop into the header system. If the rearward speed of the chain links is the same as the forward combine speed, the stalks entering between the flights or lugs on the chain will be restrained, but neither pushed forward or pulled rearward. In a combine model that has variable speed control of header functions, it may be possible to automatically maintain this condition at varying ground speeds. Increasing the forward machine speed would cause a matching increase in the speed of the gathering chains. While the trend in combine design is toward more automatic controls, most combines do not manage this speed ratio automatically. In this case, the operator is responsible for managing this important parameter. Increasing the ground speed without correspondingly increasing the gathering chain speed results in stalks being pushed forward by the chain lugs.

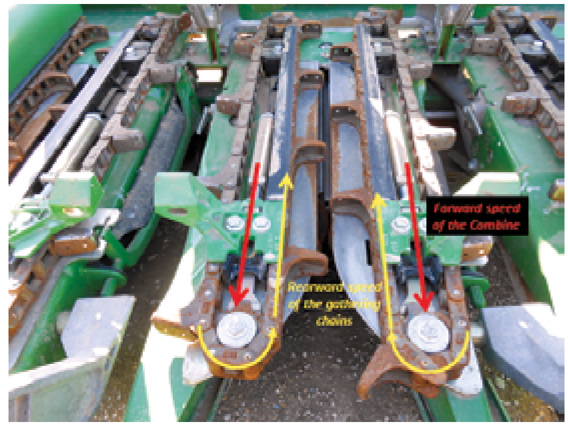

Figure 37.1 Rearward speed of gathering chains should be equal to the forward speed of the harvester. Stalks will see minimal disturbance as they proceed into the head.

The chains pull the stalks toward the platform when operating at too low of a ground speed. Either action can contribute to ear loss as the stalk is violently displaced and ears are flung forward or backward. Poor matching of gathering chain speed to ground speed can also cause stalks to be broken off or pulled from the ground, resulting in additional stem and leaf material passing through the harvester. If the speed of the header functions, including gathering chain speed, is adjustable, then this should be adjusted so that stalks appear to move smoothly into the head. If the chain speed is not adjustable, then the forward combine speed should be adjusted to minimize disturbance of the stalks as they proceed into the head.

Header and Row Alignment

Smooth feeding of the stalks into the header mechanism is difficult to achieve if the row widths do not accurately match the head row spacing. Adjust the head to match any variation in planter row spacing and make every attempt to keep the combine in sync with the planter. Harvesting with a match row of varying width in the swath will cause some stalks to enter the row unit off-center. Losses can increase if the stalks are displaced as the snouts force them into the gathering chains. Header size can impact this loss.

Careful planting and auto-steer technologies can help minimize stalk disturbance. Auto-steer technology also can reduce steering errors. Auto-steer can be GPS driven but can also be driven by sensors that detect cornstalks and cause steering corrections to minimize error from a target row. Some systems use both approaches.

Lodged Corn

Corn plants lodged because of weather, disease, or insect damage are more difficult to gather without ear losses. Since crop conditions can greatly vary, there isn't a lone solution for gathering lodged corn. However, there are adjustments that can reduce losses.

1. Lodged corn should be harvested as soon as possible to avoid further lodging, as well as damage to lodged ears from moisture and close proximity to the ground.
2. Lower speeds are generally required to allow downed stalks to be pulled up and over header snouts without losing the ear, so plan to slow down significantly.
3. If the crop is lying in the direction of the rows, it is usually more effective to harvest against the direction the stalks are pointing. This will require deadheading the combine to one end of the field prior to each pass.
4. Lowering the head as much as possible, without taking in rocks or dirt, will also capture more of the crop.
5. Increasing the angle of the head by loosening it on its mount and shifting the rear upward can make the gathering chains somewhat more aggressive. With the front of the head lower and the rear higher, the lugs on the gathering chains will reach down and lift stalks as they reverse direction.
6. Gathering chains can also be repositioned on their sprockets to position the lugs or flights to be directly across from each other. This will provide a more positive capture of stalks.

7. Aftermarket attachments in the form of a "reel" to gather downed material or powered cones to lift crop material over the end snouts of the head are available if lodged acreage is large.
8. It may be advantageous to open the spacing between ear savers to minimize any resistance to ears on down stalks as they are pulled in by gathering chains.
9. When adjusting for adverse conditions such as lodged corn, it is important to use the loss checks outlined in Chapter 36 to know whether a technique is reducing the losses or not. Check losses frequently and adjust when needed.

Shelling Losses at the Head

Kernel shelling losses at the head occur when ears impact hard surfaces and dislodge kernels that bounce out of the head or filter through the stripper plates. Many of the adjustments recommended above to lower whole ear losses also reduce losses caused by shelling because impact forces are lowered.

Deck Plates

Ideally deck plates should be positioned so that the space between them is centered above the space between the snap rolls underneath (Fig. 37.2). Stalks then are pulled straight down between the plates. Some heads require manual spacing of the deck plates. Others have hydraulically adjustable plate spacing. The lower spacing, where stalks enter, is recommended to be slightly narrower than the upper spacing. Many combine manuals suggest an initial spacing of 1 1/8" at the bottom and 1¼" at the top. With the trend to higher plant populations and smaller ears, it may be advantageous to narrow this spacing. Many producers use a pair of sockets as a handy way of spacing plates (for example, using a 1" diameter socket at the bottom and a 1 1/8" diameter socket at the top).

Figure 37.2 Position of snap rolls, deck plates, and gathering chains. Deck plate spacing is typically narrower where stalks enter and the gap is centered between snap rolls. Gathering chain lugs should extend about 1/4" into the deck plate gap.

Sizes should be selected to accommodate your crop and conditions. Setting the spacing too narrow will require more power and will break some stalks, taking in more material through the combine. Setting the spacing too wide will increase "butt shelling," which occurs when the butt end of the ear contacts the stalk rolls, and kernel loss. Hydraulically adjustable deck plates allow changes in plate spacing to accommodate local conditions in the field. Dryland producers who experience a wide variability in crop conditions with regard to terrain or spatial location may particularly benefit from this option. If adjusting on the go, the narrowest spacing that allows for free flow of the stalks between the deck plates will reduce shelling losses. Be sure to occasionally check to determine that this convenient option is working as intended. It is quite possible for the sliding mechanism to stick, rust, or seize as the machine ages. Checking for uniform plate spacing between rows will help prevent losses from a malfunction.

Gathering Chains

Manuals recommend that the gathering chain lugs extend into the gap between the deck plates by ¼". This will vary if deck plates are adjusted on the go. Chain lugs can be staggered or timed so that they move up the plates across from each other. Staggered lugs will be less aggressive and pull in fewer leaves. This may be preferable in wetter crop conditions. In a very dry crop, additional leaf material stripped by timed opposing lugs may help sweep kernels from butt shelling up and into the head. Timed chain lugs can also be more aggressive in lodged fields.

Cross Auger Position

Two clearance adjustments are common on the cross auger that delivers the crop to the center of the head where it enters the feederhouse. One adjustment is the spacing between the auger flighting and the stripper bar (Fig. 37.3). Begin with the combine manual's recommendation and adjust this space to minimize any wrapping of stalks or plant parts around the auger. A second clearance is the space under the auger to the pan on the head. Again, the manufacturer's recommendation is a starting place, but a spacing of 1¾" is common. Smaller spaces may increase the shearing of ears by the flighting, while too large a space may inhibit the steady flow of material along the pan.

It is also desirable to keep the cross auger close to the feederhouse drum where the feederhouse chain takes over from the auger. Reducing this space may minimize the accumulation of crop as it enters the feederhouse and help prevent backfeeding that can cause losses. Some combine designs have an overlap of the auger flighting from the right and left sides at the center, whereas others do not. An extension of the flighting to create this overlap can be added and may help propel the ears smoothly into the feederhouse.

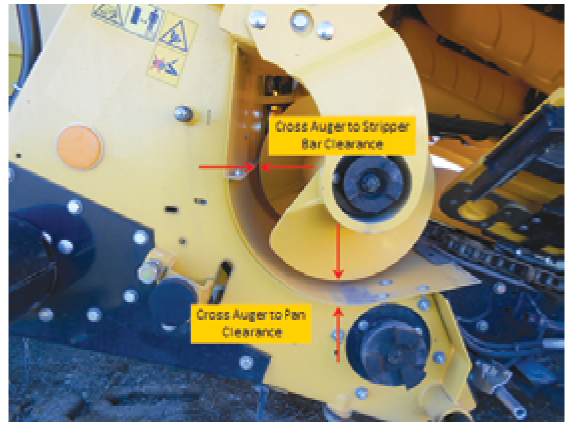

Figure 37.3 Clearance adjustments for the cross auger can affect shelling losses at the head. Clearance to the pan should begin with 1¾" to avoid slicing ears with the auger flighting. Stripper bar clearance is adjusted to prevent stalks and weeds from wrapping on the auger and flinging ears and kernels.

Feederhouse Adjustments

A traffic jam of ears waiting at the center of the cross auger to enter the feederhouse can cause both ears and kernels to be lost. Minimizing the space between the feederhouse chain and the auger can reduce this buildup. If the chain tensioning system will allow it, the addition of a link or half-link to the feederhouse chain will extend the drum forward, which may reduce the space between the auger and the feederhouse drum. Running the feederhouse at a fast speed will also reduce buildup of crop transitioning from the cross auger to the feederhouse.

Losses from the Combine Separator

The designs of newer combines are very forgiving with regard to their ability to thresh, separate, and clean the grain. In many cases, the losses from these internal systems may be less than 1% of the standing yield in the field. As indicated above, it is most common for the losses from the header to be the major source of machine losses.

Threshing Losses

Threshing losses occur when kernels fail to break free of the cob as it passes between the cylinder or rotor and the concave. Factors influencing this process include:

1. Crop conditions, such as moisture and variety, will affect how easily kernels thresh.
2. Speed of the cylinder or rotor.
3. Concave gap between the cylinder or rotor and the concave.
4. Concave type and style.
5. Guide vanes that determine the dwell time of the crop in the threshing system of some machines.
6. Rasp bar or rotor tine styles and condition.
7. Feed rate of the crop into the threshing system.
8. Material other than grain (MOG) rate through the threshing system.
9. Cleaning system settings that determine how much material enters the return threshing system.

Threshing losses are typically very low. However, if the losses are > 0.3% of the yield, adjustments may be warranted. Increasing the rotor or cylinder speed will generally decrease threshing losses, but may also cause an increase in kernel damage, particularly if the crop moisture content is very high or very low. Increasing speed will generally require more power.

Decreasing the concave gap forces the material through a smaller space and generally reduces threshing kernel loss. This can also cause kernel damage and cob breakup, which may cause an increase in returns and potentially more foreign matter in the grain sample. Tightening the concave gap will also increase power requirements.

Concave type or style can affect threshing. If corn is the predominant crop for a particular machine, it may be appropriate to select concave types that are specifically designed for corn.

Rotary or axial-flow threshing systems can have guide vanes that affect crop flow. The crop follows a helical path around the rotor, and guide vanes can change this path to a tighter helix, such that the crop makes more trips around the rotor before moving on.

Rasp bars and rotor tines will affect threshing performance. These can be changed or replaced as the combine is serviced prior to harvest but are not easily adjusted for changes in crop conditions. If you have chronic problems with threshing losses, then exploring hardware options for the rotor or cylinder for the following season may be appropriate.

The operator controls the feed rate of material using forward speed. The threshing system is most effective with a constant flow of material. Threshing is gentler when much of the rubbing action is from crop-to-crop contact rather than contact between the crop and the rotor or the concave. Keeping the concave gap filled aids threshing but also cushions the kernels so that damage is lower. Changing ground speed can help maintain constant flow through the threshing system. However, this should be balanced against the effects of changing speed upon header performance. In many cases, the combine's separator is more forgiving than the header.

The flow of material other than grain (MOG) through the combine affects performance of all internal systems in the separator. MOG in the form of stalks, leaves, and cobs is affected by the crop conditions and header settings. Most internal functions perform better with less MOG, so adjusting header functions to take in less MOG is generally desirable. Adjustment of stripper plate spacing, gathering chain speed and machine forward speed will affect MOG intake.

Some threshing losses are prevented by the combine's return, or tailings, system. That system is adjusted to capture cob fragments that may still contain kernels before they can be expelled and return them to a threshing system a second time. Opening the tailings trap at the back end of the cleaning shoe can make it easier to capture cob fragments that have attached kernels and return them for additional threshing. This system should be adjusted to prevent losses of poorly threshed cobs, but should not be the primary system to keep threshing losses low. Often the volume of tailings or returns can indicate that changes should be made in the first pass at the threshing system.

Separation Losses

Separation losses occur when kernels pass out of the back of the combine while embedded in stalk and leaf residue. Distinguishing separation loss from cleaning system loss is difficult because both appear as loose kernels on the ground behind the combine. In corn, harvest separation losses should be very low, with values of 0.1% loss common. It is not very difficult for the machine to separate corn kernels from the modest amount of stalk and leaf material that should enter the machine. Factors that affect separation efficiency include:

1. Material other than grain (MOG) feed rate.
2. Crop moisture content.
3. Rotor speed.
4. Concave gap.
5. Guide vanes on the concave.
6. Crop feed rate.

Separation losses can increase if lodging or other conditions cause a large volume of MOG to enter the combine. Wet grain and wet MOG do not slide easily next to each other and can cause separation problems. Much of the separation process occurs in the threshing system when kernels drop through the concave. Remaining separation occurs on the straw walkers or on the aft part of the rotor. Many adjustments that increase threshing may also increase separation. Increasing rotor speed increases the centripetal forces that cause separation in a rotary combine. Adjusting feed vanes that increase the dwell time of the crop on the rotor will increase separation efficiency and decrease losses. Decreasing the feed rate, and particularly the MOG feed rate, will increase separation efficiency and reduce these losses. In wet corn, it is even more important to limit the MOG intake.

Cleaning System Losses

The combine cleaning system is designed to separate clean grain from small-fragment MOG such as bee's wings chaff, leaf and stalk fragments, and small cob fragments. Cleaning system losses should also be very small and are hard to distinguish from separation losses. If the loose kernel losses from cleaning and separation exceed a few tenths of a percent, then adjustments are warranted. Cleaning losses occur when grain flows out of the back of the combine, passing over the chaffer and cleaning sieves. Factors that can affect cleaning system losses include:

1. Fan speed and baffle direction.
2. Sieve opening size.
3. Feed rate onto the sieves.
4. MOG feed rate.
5. Cylinder and concave settings that break up MOG and load the cleaning system.
6. Crop moisture content.
7. Distribution patterns on the sieves.
8. Crop test weight.

Cleaning grain is a balance between gravity and aerodynamic forces. The grain is allowed to fall through the sieve openings into the airstream while the chaff and lighter MOG float on the airstream upward and to the rear. The oscillation of the shoe helps to move larger heavier material to the rear. A low fan speed and full sieve openings would prevent any cleaning losses, but would allow much of the chaff to pass with clean grain into the tank. A high fan speed will clean the grain, but can potentially cause some kernels to float or bounce out of the rear of the combine. Baffles in the airstream can control where the airstream passes through the sieve openings and how evenly the air is distributed along the shoe. Opening the sieves (Fig. 37.4) can allow grain to more easily fall through, even with high airspeeds. The balance of cleaning losses and foreign matter in the grain can be affected by the feed rate of material onto the shoe. It is possible to overwhelm the airflow if the flow of material onto the shoe is not even. Adjustments of individual combine designs that promote the even distribution of grain and chaff onto the shoe will reduce losses and keep the grain clean. Consult the operator's manual for the adjustments specific to your machine.

Figure 37.4 The sieve elements that collectively make up the cleaning shoe. Most common adjustments involve adjusting fan speed and sieve openings to regulate the flow of grain through the shoe and the movement of chaff to the rear.

Not all adjustments are initially intuitive. For example, you could find excessive loose kernels on the ground behind the combine. The operator's manual may suggest that increasing the fan speed can reduce losses. This would seem counter to logic and might be expected to expel more grain. However, if the losses are occurring because a heavy layer of grain and chaff on the sieves is preventing grain from moving down, increasing the airflow can disperse the pile of material and allow the grain to filter down and the chaff to float off. Your operator's manual is the best source of information about your combine's specific systems. The manufacturer often provides a prioritized checklist to help find appropriate adjustments for a particular kind of loss.

A procedure called a "kill stall" can be used to check deposition patterns onto the shoe if cleaning system losses are excessive. The procedure, recommended by the combine manufacturer, involves rapidly stalling the combine engine by cutting throttle and simultaneously braking and pushing hydrostat ahead. After the engine stalls, the separator is disengaged and the engine is restarted to allow it to cool and shut down. Rapidly stopping the separator during the stall has the effect of freezing the process in place so that it is possible to open the side panels and view the loading of the separator system. If grain is piled disproportionately on one side or part of the shoe, the owner's manual can be studied to find appropriate adjustments to spread the grain more evenly on the shoe and improve cleaning. These problems will exist most clearly in high-yielding grain and with the combine separator systems heavily loaded.

More MOG means more work for the cleaning system. High rotor speeds, tight concave spacings, and a dry crop can result in lots of broken up MOG and a cleaning system that is overloaded. Managing one system within the machine often affects another. If cleaning system losses are high or if excessive cob fragments are found in the grain sample, it may be necessary to revisit the threshing system settings. Nearly every adjustment that is made on the threshing or cleaning system will affect other aspects of the machine's performance. Manuals recommend adjusting one thing at a time, and then checking the losses and clean grain quality before making any further adjustments.

Crop conditions also affect cleaning. High-moisture corn and MOG have more friction, and do not spread and flow as easily as dry grain. For example, if moving into a field that has higher moisture content, the losses from the separator should be determined and the grain sample examined. Opening sieves and increasing fan speed may be required to compensate for the increased friction from moisture. Other crop conditions, such as test weight, also can affect cleaning losses. Grain that failed to mature normally and has a resulting low test weight can blow out of the combine more easily with the chaff. Air and sieve openings can be adjusted again to retain more of the grain while keeping a clean sample.

Adjusting a combine to yield minimal grain losses involves a multitude of potential adjustments to accommodate the conditions that change from year to year and field to field. Manufacturers have incorporated ever-improving systems on combines to make the process easier and more robust. Even with these systems, however, the operator still must check for losses from the header and the separator and make appropriate adjustments to compensate for and reduce those losses. In corn harvest, the header will continue to be the area where the operator's skill at adjusting the machine and operating it in a way that accommodates local conditions has a huge impact on the amount of grain – and profit – that is left in the field.

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