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Best Management Practices for Corn Production in South Dakota: Corn Grain Harvest

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CHAPTER 11
Corn Grain Harvest

Corn (grain) harvest can begin when grain moisture drops below 30%. However, most producers will allow corn to dry in the field until grain moisture is between 18 to 25%. Harvesting corn when grain moisture levels are high can result in excessive drying costs, kernel damage, and harvest loss from improper threshing. Allowing corn to stay in the field too long can result in excess harvest loss from stalk lodging, ear drop, or kernel shattering.

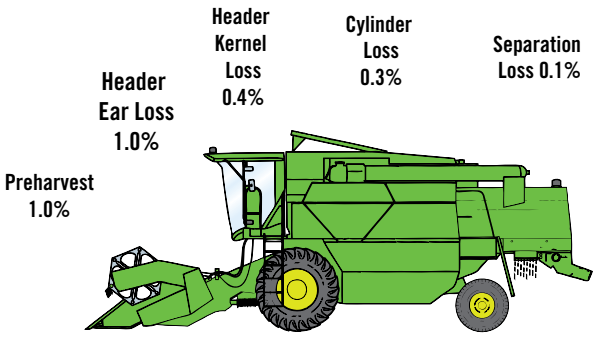
An optimal harvest depends not only on the condition of the crop but also on the proper maintenance and adjustment of harvest and grain handling and drying equipment. This chapter provides guidance for assessing harvest losses and kernel damage to determine if equipment adjustment is necessary to minimize losses.

(Photo courtesy of USDA-NRCS)

Sources of Grain Harvesting Losses

Corn (grain) lost in the field during harvest operations reduces profits and can result in weed problems (volunteer corn) in following years. The combine harvester performs a series of operations, each of which can contribute to grain losses. While it is not possible to eliminate all harvest losses, skillful operators evaluate the amount of loss, identify the source, and adjust the combine for optimal performance (fig. 11.1).

Figure 11.1. Acceptable harvest losses at optimum combine adjustment



(Source of data: Nicolai and Humberg)

Harvest losses can be classified into the following groups:

- **Preharvest loss** – Where a portion of crop loss is caused by lodging or ear drop. Incidence of disease, insects, and severe weather can increase loss severity. As the crop dries, loss potential increases. Producers should evaluate crop loss potential and mechanical drying cost when considering delaying harvesting for grain dry-down purposes.

- **Header ear loss** – Results from driving too fast, driving off the row, or operating the header too high off the ground. Losses often average 3 to 4% of the total crop yield, but losses can be reduced to 1% with proper machine operation and adjustment.

- **Header kernel loss** – Occurs at the header and is the result of ear shattering (ears make contact with gathering chains, snapping bars, stalk rolls, and feeder-house conveyor chains). Losses average about 0.6% but can be reduced to 0.4% with proper adjustments or with the replacement of excessively worn parts. Kernel loss can be reduced by proper adjustment of gathering chain and feeder house conveyor chain tension and speed. Inspect wear on snapping bars, stalk rolls, and feeder house conveyor chains, and replace if wear exceeds the tolerances stated by the manufacturer.

- **Combine cylinder or threshing loss** – The result of incomplete shelling, with some kernels remaining attached to the cob as they pass through the machine. Correct rotor or cylinder speed and concave clearance adjustment can reduce losses to 0.3% or less. Correct adjustment is achieved when cobs are not broken and kernels are removed from the cob. Excessive threshing results in low threshing losses but increases kernel damage. Worn concaves and rasp bars can also lead to threshing loss. Replace concaves and rasp bars if wear exceeds the tolerances stated by the manufacturer. When combining high moisture corn (> 20%), concave inserts are an option to avoid losses from reduced threshing.

- **Combine separation and cleaning loss** – Results from kernels passing through the combine (kernels are embedded in the stalk and husk residue and are not separated). Others pass over the sieves and out of the combine. With correct rotor speeds, sieve openings, and fan adjustments, this loss should be held to 0.1%.

Measuring Grain Combine Losses

Yield loss determinations should be made at least 300 feet from the field border. If the combine is equipped with a calibrated yield monitor, a yield observation should be made while operating at a constant speed. This yield can be used to determine percentage losses from combine operations. The total yield loss at a given point in the field can be determined by abruptly stopping the combine and disengaging the separator. Backup a short distance to allow access to the area behind the header (but ahead of the chaff discharge pattern).

To measure ear losses, mark off an area that represents 1/100 of an acre, centered over a harvested combine pass. The area should have a width equal to the width of the combine and a length that is determined by dividing 435.6 by the combine harvesting width in feet. For example, if the combine has a 6-row head (30-inch rows), then the size of 1/100 acre is calculated in the following manner:

$$6 \text{ rows} \times \left(\frac{30 \text{ in}}{\text{row}}\right) \times \left(\frac{1 \text{ ft}}{12 \text{ in}}\right) = 15 \text{ ft}$$

The length of the area for 1/100 of an acre (435.6 ft^2) is then calculated:

$$\left[\left(\frac{1 \text{ acre}}{100}\right) \times \left(\frac{43560 \text{ ft}^2}{1 \text{ acre}}\right)\right] \div 15 \text{ ft} = 29 \text{ ft}$$

Thus: 15 ft × 29 ft ≈ 0.01 acre or 435.6 ft^2

Collect all ears on the ground in this area. Each 0.75lb. ear represents one bushel per acre loss. If smaller ears are found, the equivalent number of 0.75lb. ears should be determined. For example, if three 0.5lb. ears are found, this is equivalent to two of the larger ears. When equipment is properly adjusted, ear loss should be less than one bushel per acre. If losses are excessive, determine the pre-harvest loss in an area that has not yet been harvested. This can be done by measuring a length corresponding to 1/100 of an acre ahead of the harvester, counting dropped ears in that area, and converting the result to bushels. The preharvest loss should be subtracted from ear loss measurements that have been taken behind the combine. The difference is the ear loss that is attributable to the machine.

To measure kernel loss, use a 10-square-foot (ft^2) area centered over each row. The width of the loss-measurement area should be equal to the row spacing, and the length should be 48 inches for a 30-inch row and 40 inches for a 36-inch row. A rectangular PVC pipe frame with the correct inside dimensions for row spacing is a handy tool for this procedure. Loss should be determined for each row harvested in a single pass of the combine.

Two kernels per ft^2, or 20 kernels per $10ft^2$, is equivalent to a 1-bushel per acre loss. Count the kernels found in the 10 ft^2 area over each row and calculate the average number of kernels per 10 ft^2. The average number should be less than 40 kernels per 10 ft^2, or 2 bushels per acre.

Kernel-loss measurements can be taken in a harvested area behind the combine where the machine was in steady operation. If these losses appear large (in excess of 1%), repeat the measurement in the area behind the header but ahead of the chaff pattern. The losses measured here are attributable to the header. Review header adjustments and operating parameters if kernel losses exceed 0.5 to 0.6% of the total yield. The owner's manual is the best source of guidelines for proper settings and operating parameters.

If kernel losses are large but header losses are acceptable, possible causes include the following:

- excessive air through the sieves
- sieve opening that is too small
- separator and cleaning system overload due to excessive forward speed
- worn concaves or rasp bars

Too many kernels remaining on cobs can result either from cylinder or rotor speeds that are too slow or from cylinder-concave or rotor-concave clearances that are too large.

The largest single source of loss is typically from ear loss at the gathering head. Since these losses are affected by both machine settings and operator performance, every effort should be made to

- drive accurately on the rows,
- maintain an appropriate ground speed for crop conditions,
- operate the header at an appropriate height for crop conditions,
- set and maintain gathering chains according to the operator's manual,
- check the operator's manual for proper combine maintenance and adjustment.

Adjustments to Prevent Cracked Kernels

Improper adjustments of cylinder or rotor speed and concave clearance can lead to excessive kernel damage. Initial settings should be made according to the operator's manual, with further adjustments made in the field to correct for field conditions. Inspect grain in the tank after harvesting a small portion of the field, evaluating the grain for proper threshing, broken cobs, and kernel attachment. Correct adjustment results in few or no broken cobs, with zero kernels attached to them. Shelling action that is too vigorous, however, results in excessive kernel breakage.

Adjustments for Reducing Foreign Material in Grain

The amount of foreign material (i.e., stalks, leaves, and cobs) can be reduced with correct sieve and fan adjustment. High volumes of plant residues add to the load on sieves, resulting in high amounts of foreign material in the grain and increased kernel loss. Make initial settings according to the operator's manual, and make fine adjustments, if necessary, based on observations of grain losses in the field. Grain separation losses may occur when extra stalks and leaves pass either through the rotary separator or over straw walkers, as not all kernels filter through residue before its discharge. Reducing ground speed helps to reduce kernel loss by allowing more time for kernel and residue separation.

Although combine manufacturers continue to make combine adjustments easier, operators must make proper adjustments to ensure that losses are below 5%. Time spent evaluating and optimizing harvest equipment loss efficiency can make a difference in profit margins.

Combine Safety Considerations

For anyone who operates a combine, good safety habits are important for avoiding injury or death. Combines have many moving parts that need regular adjustment and maintenance. Set aside time to properly prepare the equipment for harvest. Rushed repairs and breakdowns may lead to injuries. To minimize problems routine winter maintenance and daily servicing is recommended.

Winter maintenance includes the following:

- Cleaning the combine with a power washer.
- Checking all bearings, chains, and belts.
- Checking the auger and the condition of the straw chopper.
- Replacing or repairing broken guards shields and lights.

Daily servicing during harvesting should include the following:

- Greasing zerks.
- Filling the fuel tank.
- Checking the hydraulic oil, radiator fluid, chain tensions, rock traps, and air pressure.
- Clearing the engine compartment for debris that can cause fire.

When repairing or conducting maintenance, always be safe:

- When working on machinery, put the ignition key in your pocket (so no one can start the machinery).
- Check hydraulic leaks carefully. Never use your hand to look for hydraulic leaks, because oil under high pressure can easily be injected through the skin, resulting in serious medical problems. Use a piece of cardboard, wood, or sheet metal to detect leaks.
- Don't trust hydraulics with your life. Use the safety stops on lift cylinders when working under the header.
- Always refuel the combine after it has cooled. Fuel vapors can easily ignite on hot engine and combine parts. Refueling accidents are a major cause of combine fires.
- Keep the cab windows clean of dust. Dust on the windows reduces visibility and adds to the stress of long hours at work. A spray bottle of window cleaner and a roll of paper towels should be kept in the combine cab and used often.
- The cab's air conditioning-system filter should be cleaned or replaced on a regular basis. Dust and mold in the air or in air conditioner filters can lead to serious illness. Working conditions in the cab are important to a safe harvest.

When transporting the combine from one field to another:

- Drive the combine only while you are alert and aware of your surroundings. Hours of steady operation can put you into a trancelike state. To avoid dangerous situations, it is recommended to schedule breaks for every 3 hours,
- Move combines from field to field only during daylight. Driving combines on public roads after dark is risky. The size of a combine, coupled with its unfamiliar shape and lighting pattern, makes it a hazard on the road after dark.
- Keep your distance from other vehicles and machines. Combines need a lot of room to maneuver, and they have large blind spots. Always be aware of the location of other equipment.

When operating the combine in the field:

- Examine fields for hazards such as washouts and other surprises that can develop during the growing season. Alert other workers to those hazards.
- Don't make sudden changes in speed or turn sharply when operating on slopes; combines have a high center of gravity and rollovers can occur.
- Maintain a safe distance from ditch banks that could shear under the weight of a combine. A grassed buffer strip at the edge of all ditches can help minimize this risk.
- No one should be in the combine's grain tank or in the receiving wagon/truck while unloading, as this can result in serious injury or death.
- Shut off the engine and pocket the key before attempting to clear a residue plug. If reversing the header does not clear the plug, stop the combine as quickly as possible and pocket the key. A good rule to follow is to avoid having anyone in the cab when working on equipment.

To minimize the risk of fires:

- Attempt to keep the combine free of harvest materials. Use a leaf blower frequently, or use a pressure washer to clear the combine of dust and debris around hot surfaces. Combine fires may be caused by electrical shorts, harvest materials, refueling when combine is hot, and overheated cooling systems.
- Keep a freshly filled fire extinguisher on each combine. It should be readily accessible from the ground and should be a 10-pound, class ABC dry-chemical unit.
- Keep wiring and fuses in proper operating condition and position.

Keep a complete first-aid kit on the combine. First-aid kits, like fire extinguishers, should be kept in a safe location and be easy to reach from the ground. The kit should be equipped with supplies for treating major injuries. Pressure bandages and wraps should be in plentiful supply. Immediately use the cell phone and call for help when a major injury occurs.

Additional Information and References

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