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Combine harvest settings to reduce grain loss and improve grain quality

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Harvesting all grain available in the field with the combine in a manner that preserves grain storability has always been important but two new developments in 2010 re-emphasize this point. Observing greater incidence of sudden death syndrome (SDS) in soybeans ISU plant pathologists Yang and Navi (2010) reported that SDS pathogen survived more easily on corn kernels than other types of corn or soybean residue. They suggested “that a nice and clean harvest of corn should help reduce the risk of SDS, while a high amount of harvest loss increases SDS risk.” Renewed concerns about grain storability surfaced this summer as ‘blue-eye’ mold started appearing in storage bins as a result of reduced shelf life of the previous 2009 crop (Hurburgh and Robertson, 2010).

At harvest time virtually all costs have been input into the crop except for drying and storage. Every bushel left in the field is profit lost. Good news is that data suggest combine machine harvest loss can be limited to no more than about one bushel per acre if the crop is standing reasonably well and the combine is well adjusted. Bad news is that significantly greater losses of several bushel per acre are possible without paying attention to combine operation and adjustment. Because most soybean and corn losses occur at the gathering head, grain loss sensors at the rear of the cleaning shoe usually are of only limited help.

Two large earlier studies involved measurements of combine losses in the field. The more recent study measured losses from 55 corn and 69 soybean combines in western Ohio during fall 1989 (Gliem et al., 1990, table 1). Crop was standing well and most fields had less than 5% lodging. Although average machine loss was 1.5 bu/acre, study authors concluded that losses less than one bushel per acre in both corn and soybeans were possible.

Table 1. Combine field losses in western Ohio (Gliem et al., 1990)^a

	Machine loss, bu/acre		Percentage of combines with losses	
	Average	Range	>2.5 bu/acre	<0.5 bu/acre
Corn	1.5	0.1 – 5.0	19	14
Soybeans	1.4	0.2 – 4.1	15	9

^aLosses measured from 55 corn and 69 soybean combines

A previous similar study was done in central Iowa in the early 1970's shortly after combine harvest had become widely adopted. Losses were measured from 84 corn combines (table 2). A companion study on 40 soybean combines had an average loss of 2.8 bu/acre, but the best operator only lost 0.7 bu/acre even with using earlier technology. The studies indicate that a good harvest is possible, but a significant percentage of operators leave too much grain in the field. Fields harvested early in the crop season followed by conditions warm and wet enough to sprout grain frequently leave telltale signs of growing plants later in the fall. Some combine operators may be led into a false sense of security by monitoring grain loss sensors at the rear of the cleaning shoe that can't detect losses at the gathering head, common in soybean and corn harvest.

Table 2. Combine field losses in central Iowa (Ayres et al., 1972)^a

	Machine loss, bu/acre		Percentage of combines with losses	
	Average	Range	>3 bu/acre	<1 bu/acre
Corn	3.7	0.5 – 23.0	48	7

^aLosses measured from 84 corn combines

Detailed descriptions of how to measure combine field losses and make adjustments are in Extension bulletins (Hanna, 2008; Ayres and Hanna 2006) but brief procedures are given here.

Grain loss – corn

Although losses can occur with poor adjustment in the threshing and cleaning areas, field trials consistently indicate most losses occur at the corn head from dropped ears or shelling of corn kernels on exposed stalk rolls. Each two kernels of corn per square foot represents one bushel per acre of loss. Dropped ears with several hundred kernels can add up quickly to significant losses.

To measure combine loss start behind the combine. If total field loss is greater than acceptable, checks can be made in front of the combine to measure pre-harvest field loss in standing crop and also in an area harvested by the corn head but not yet passed by the rear of the combine (stop combine in field and back-up to expose measuring area). Loose kernels can be measured in 10-square-foot areas centered directly over each row (e.g., 4-ft by 30-in. wide area over 30-in. wide row). Searching individual rows allows mis-adjustment on a single cornhead row unit to be detected.

Because dropped ears are infrequent but add to losses quickly, sort through residue in a larger area behind the combine. Searching a total area of 436 square feet (the width of the cornhead with length determined by total area) allows each $\frac{3}{4}$ lb ear found to equal one bushel per acre field loss. Shuffling and kicking through corn residue and feeling with hands helps find ears quickly.

Subtracting pre-harvest loss from total field loss gives total combine (machine) loss. Subtracting losses only at the cornhead from total combine losses gives loss due to threshing and separating. Threshing and separating losses can be further sub-divided by noting that any kernels still attached to cobs that have gone through the combine are threshing losses.

If corn combine losses are excessive, adjust the combine based on the type of losses. Avoid dropped ears by keeping snouts low, maintaining ear savers and avoiding excessive travel speed. Adjust stalk roll speed to snap ears about one-half to two-thirds of the way up snapping plates. Loose kernels found under the cornhead can be minimized by adjusting snapping plates for ear size. Spacing between snapping plates for average size ears is about 1 $\frac{1}{4}$ in., but should be adjusted for conditions. Some operators use an $\frac{1}{8}$ in. wider spacing at the rear of plates to avoid stalk wedging. Threshing and separating losses should be under 0.3 bu/acre. Don't use more rotor/cylinder speed or narrow concave clearance more than necessary. Do use adequate air speed in the cleaning shoe to fluidize the crop for good separation.

Soybean loss

Soybean loss occurs from uncut stubble underneath the cutterbar, loose stalks cut but not gathered into the combine, unthreshed pods, and loose individual soybeans. Every four soybeans per square foot equals one bushel per acre loss. In normal conditions soybeans thresh and separate easily (similar to corn) and field trials indicate that 90% of soybean losses occur at the gathering head.

Loss measurement is similar to corn in that losses are first checked behind the combine. If loss is excessive, loss is measured in an area traversed by the head but not the rear of the combine and preharvest loss is measured and subtracted to determine combine loss. Loss should be measured across the entire width of the grain head. Total measurement area should be at least 20 square feet for grain heads 25 feet or wider (30 ft by 8 in. area equals 20 square feet).

Use the type of losses and where they are found to help guide combine adjustments to correct the problem. Because losses are frequently at the head but can be random throughout the field check a couple more locations in the field if light losses under the head point to significant threshing and separating loss in an initial check.

Uncut stubble suggests checking header height control and flexible cutterbar settings. Cutterbar condition can affect any loss type so make sure knives are sharp, in close tolerance with guards, and in register with guards. Pods still present on loose stems may be knocked out of the head by improper reel speed or position or even by the platform auger. Unthreshed pods found behind the combine but not under the head suggest more aggressive threshing and separating are required. Loose pods and soybeans primarily measured under the head suggest shattering by cutterbar or reel rather than being blown out the rear of the combine.

Grain quality

Coarse-seed crops such as corn and soybeans thresh and separate relatively easily. Measuring grain loss is integral to setting the combine for grain quality in that threshing and separating should be only aggressive enough to limit field loss measured from these activities. Field studies suggest actual threshing and separating loss can be held to about 0.2 bu/acre or less unless conditions are difficult (e.g. wet grain, green weeds present).

Harvesting grain to a higher standard than #2 quality can help better maintain storability. Cracks in the seed coat caused by excessive threshing serve as entry points for microorganisms attacking grain. General principles are to set the rotor/cylinder speed no greater than needed or concave clearance no narrower than required for adequate threshing of grain (figure 1). Also keep the combine loaded for more grain-on-biomass threshing and less opportunity for grain-on-steel threshing. Keep fan air speed in the cleaning shoe at a high level, just below the point where grain would be blown out the rear of the combine. Lower fan speeds not only inhibit separation, but along with narrow sieve openings create a greater likelihood grain that is already threshed will drop into the tailings auger and be returned past the rotor/cylinder for more damage.

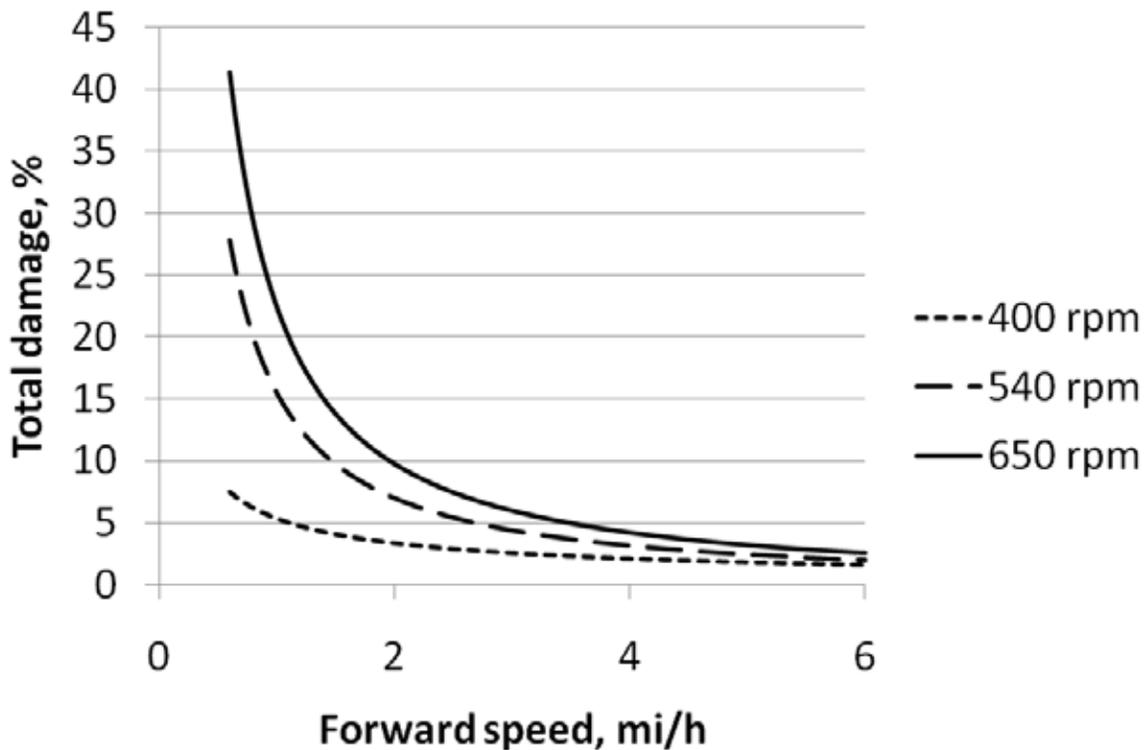


Figure 1. Total damage visible on soybeans at various rotor and forward travel speeds.

Summary

Field studies indicate combine losses of 1 bu/acre or less are an achievable goal if the crop is standing well. Operators should take a few minutes to measure and quantify losses so that proper adjustment can be accomplished. Losses and grain quality are integrally related. Unless conditions are difficult, corn and soybeans thresh easily enough that rotor/cylinder speed and concave clearance can be adjusted for gentle threshing and still maintain threshing and separating losses about 0.2 bu/acre or less. Observe grain condition in the grain tank.

Most harvest loss occurs at the gathering head during corn and soybean harvest so particular attention should be paid to adjustments affecting ear loss and stalk roll shelling on corn combines and to cutterbar, reel, and grain platform auger adjustment on soybean combines.

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