SDSU Extension

iGrow Corn

BEST MANAGEMENT PRACTICES

Chapter: 36
Profitability can be Enhanced by Reducing Corn Harvest Losses

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If the combine is not adjusted correctly, profits can be left in the field. Yield losses are unavoidable, but through careful management they can be minimized. The first step in minimizing combine yield losses is determining the source. This involves identifying where the loss occurred, followed by making appropriate adjustments. The combine should be adjusted to minimize ear and kernel losses, while also managing cracked or broken kernels and foreign matter in the grain. This chapter is devoted to the measurement of corn harvest losses, and then linking those losses to where the loss occurred.

Introduction

Producers are anxious to begin harvest, and once started, reluctant to stop or delay. However, counting some kernels on the ground and determining the losses from various machine systems can be time very well-spent and easily pay for itself, especially if problems are corrected early. The quick-count methods discussed in Table 36.1 provide information that can be used to determine whether combine header settings need adjustment to improve harvest efficiency. Every 1% loss of a 200 bu/acre yield at $4/bushel is $8/acre of reduced net income. Losses from a machine that is not properly adjusted for the harvest conditions can easily be 4% to 5% of the grain in the field. Without measuring losses, it is not possible to know whether they are high or low. Without analyzing where the losses are occurring, it is difficult to know which combine adjustments to make. Routine checks will help minimize preventable losses.

Table 36.1 Determining harvest loss when combining by quick-count methods:

Step 1. KERNEL LOSS: Count kernels on the ground inside a simple frame of known area (e.g., ft^2) in a harvested area. Determine the number of loose kernels per square foot. To calculate the loss in **bushels per acre due to kernel loss**, *divide the number of counted kernels/ft^2 by 2*. The **percent harvest loss to kernel loss** can be calculated by *dividing the kernel bu/acre losses (determined above) into your measured yield per acre*, and multiplying by 100%.

Step 2. EAR LOSS: Pick a row behind your combine and count any ears on the ground within 87 feet (approximately 30 paces) of the back of the combine. One ear on the ground in 30 paces between rows with 30" spacing is approximately 1 bushel per acre of harvest loss from ears. Therefore, the *number of ears counted is equal to the bushel per acre ear loss*. The **percent loss due to ear loss** is determined by *dividing by the ear loss/acre into your measured yield per acre* and multiplying by 100%.

These quick measurements help in observing "normal" and excessive losses, providing a check for combine header settings, and improving harvest efficiency.

In this chapter, we present the concept of using a simple frame that encloses a known area to measure kernel loss. The other measurement is done by counting ears along a length of 87 feet (about 30 paces) behind the combine. These measurements may be done while waiting for a truck or wagon. Yield loss in bu/acre can be quickly assessed using these methods. Two kernels/ft^2 is 1 bu/acre, and each ear in 30 paces along a 30" row is 1 bu/acre. If total losses exceed 1% of the yield, combine adjustments may be required.

Detailed Analysis of Loss Calculations

Example 36.1 What is the estimated corn yield loss if 6 kernels are found in a 1-ft^2 area?

Answer: $\frac{6 \text{ kernels}}{\text{ft}^2} \times \frac{43560 \text{ ft}^2}{\text{acre}} \times \frac{\text{bu}}{90{,}000 \text{ kernel}} = \frac{2.9 \text{ bu}}{\text{acre}} \approx \frac{3 \text{ bu}}{\text{acre}}$

Solving this problem shows why yield loss can be estimated by dividing kernels/ft^2 by 2. The assumption of 90,000 kernels/bu may need to be adjusted if corn kernels are large (decrease the number kernels per bushel) or small (increase the number kernels per bushel). See Table 36.2 for details.

Table 36.2 The relationship between corn kernel size and kernels/ft^2 equivalent to 1 bu/acre.

	Weight/bushel @ 15.5% moisture	Kernels/bushel	Kernels/lb @ 15.5% moisture	Kernels/ft^2 equivalent to 1 bushel/acre
Large kernels	56 lbs	70,000	1250	1.6
Medium kernels	56 lbs	90,000	1607	2.1
Small kernels	56 lbs	110,000	1964	2.5

General Formula: Kernels/ft^2 = Kernels/lb x 56 lbs/bu x 1 acre/43560 ft^2

Example 36.2 Assume corn kernel size is large, and the number of kernels lost is 6/ft^2. What is the estimated corn yield loss in bu/a? According to Table 36.2, the number of kernels/bu is 70,000. Therefore:

Answer: $\frac{6 \text{ kernels}}{\text{ft}^2} \times \frac{43560 \text{ ft}^2}{\text{acre}} \times \frac{\text{bu}}{70{,}000 \text{ kernel}} = \frac{3.7 \text{ bu}}{\text{acre}} \approx \frac{4 \text{ bu}}{\text{acre}}$

This example illustrates that the size of kernels and assumptions about kernels/bu influence the estimates of % yield loss.

Example 36.3 What is the yield loss if one ear is found along a distance of 87 feet between two 30" corn rows? In addition, each ear contains approximately 0.28 lbs of shelled corn.

Answer: For many people, 30 paces is approximately 87 ft and therefore, a rectangle that is 2.5 ft by 87 ft is an area of 217 ft^2.

$$\frac{1 \text{ ear}}{217 \text{ ft}^2} \times \frac{43560 \text{ ft}^2}{\text{acre}} \times \frac{0.28 \text{ lb corn}}{1 \text{ ear}} \times \frac{\text{bushel}}{56 \text{ lbs corn}} = \frac{1.003 \text{ bushel}}{\text{acre}}$$

$$\approx \frac{1 \text{ bushel}}{\text{acre}}$$

The amount of grain on an ear may be more or less than 0.28 lbs. The lbs/ear number in the equation can be modified if the ear is larger.

Example 36.4 What is the yield loss if one ear is found along a distance of 87 feet between two 30" corn rows? In addition, each ear contains about 0.4 lbs of shelled corn.

Answer: For many people, 30 paces is approximately 87 ft and therefore, a rectangle that is 2.5 ft by 87 ft is an area of 217 ft^2.

$$\frac{1 \text{ ear}}{217 \text{ ft}^2} \times \frac{43560 \text{ ft}^2}{\text{acre}} \times \frac{0.4 \text{ lb corn}}{1 \text{ ear}} \times \frac{\text{bushel}}{56 \text{ lbs corn}} = \frac{1.43 \text{ bushel}}{\text{acre}}$$

$$\approx \frac{1.4 \text{ bushel}}{\text{acre}}$$

Sources of Harvesting Losses

Determining the overall harvest loss will not tell you where the loss is occurring or how to reduce it. The combine harvester performs a series of operations on the crop, each of which can contribute to grain losses. Identifying the source of lost grain is critical to making appropriate machine adjustments

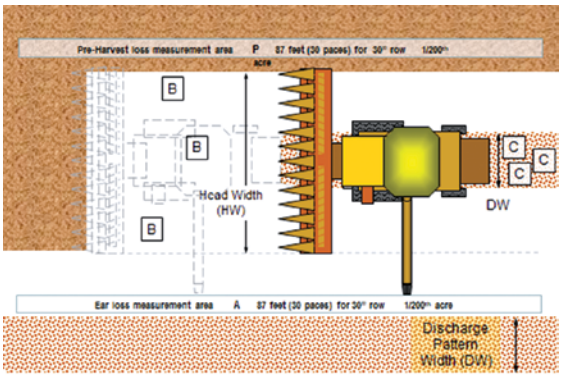


Figure 36.1 Sample locations when checking for harvest losses. The chaff spreader should be turned off, if possible, and then the combine is stopped abruptly and the separator is disengaged. The combine is then backed away from the crop to expose a region behind the head but ahead of the residue discharge.

Preharvest Loss

Some crop losses are caused by lodging or ear drop and appear as whole ear losses. These losses increase as the season progresses and are not preventable through combine adjustments. Average preharvest losses should be less than 1% of total crop yield. These losses can be much higher in diseased or insect-damaged crops, or if there is a delay in harvest and/or exposure to weathering and high winds. Preharvest ear drop has been greatly reduced among some corn varieties, such as Bt (*Bacillus thuringiensis*), which reduces stalk damage caused by European corn borer. Preharvest ear losses are measured in unharvested areas, such as the area marked "P" in Figure 36.1.

Header Ear Loss

Header ear loss occurs as the harvester gathers the crop and strips the ears from the stalk. An improperly adjusted head, or poor operator management of the header height, ground speed, and steering can cause losses of whole or broken ears that are missed or bounce out of the head. Losses can reach 3% to 4% of the total crop yield but can be held to 1% or less with proper machine operation and adjustment.

Header Kernel Loss

Some kernels are shelled out and lost at the header as ears make contact with gathering snouts, snapping bars, snapping rolls, and the cross auger. These losses typically average about 0.6%. With proper adjustment of gathering chains and machine speed, these losses can be as low as 0.4%.

Combine Separation and Cleaning Loss

The internal systems of the combine are collectively called the separator. Total separator losses include those from threshing, separation of grain from straw, and cleaning of chaff from grain. Separation losses occur as some kernels pass through the combine embedded in the stalk and husk residue and are not retained. Cleaning-system losses occur when kernels flow over the sieves with chaff and cob pieces and pass out of the combine. These losses can be held to 0.1% of the total crop yield by adjusting the fan, rotor speeds, and sieve openings.

Combine Cylinder or Threshing Loss

Insufficient shelling action causes some kernels to remain on cobs as they pass through the machine. With correct rotor or cylinder speed, and correct concave clearance adjustment, this loss should not exceed 0.3% of yield. Correct adjustment is observed when there is a minimum of broken cobs and no kernels attached to the cobs. Overly aggressive threshing results in low threshing losses but increased kernel damage as well as fragmented cobs.

Leakage Loss

Leakage losses occur when part of the combine has an opening large enough for grain to escape. This can occur when a cleanout trap door or access port is left open or not fully secured. It can also occur because of wear to or damage of sheet-metal parts. Unlike other loss types, leakage loss has little to do with machine settings and everything to do with careful inspection and maintenance.

Measuring Combine Losses

Loss determinations should not be made near the edge of a field. Effects of headlands and entry of the machine into the crop can create losses that are not typical of the rest of the field. Measurements should be taken at least 300 feet from the field border. If the combine is equipped with a calibrated yield monitor, an observation of the yield should be made while operating at a constant speed. This yield will be used to determine percentage losses from combine operations. If the chaff-spreader system is controllable from the combine cab, turning the system off a short distance before conducting a loss analysis can be advantageous. This concentrates the separator losses behind the combine and simplifies sampling. It is not necessary to disengage the chaff spreader if it distributes the residue across the full swath width. The combine should be stopped and the separator disengaged at the point where machine losses are to be determined. The machine is then backed up a short distance to allow access to the area below the combine (Table 36.3).

Preharvest Ear Losses (E_P)

To measure preharvest ear losses, step off a distance of 87 feet, or typically 30 paces, in an adjacent row of the standing crop. See the strip marked "P" in Figure 36.1. Count any ears found on the ground in this section of row. Each ear represents a bushel/acre of loss. Determine the preharvest loss from ear drop. This process is easy and quick to repeat if there are any doubts as to whether a chosen row section was representative of the field (or field area). While it is not possible to alter the preharvest loss, the value will be subtracted from the total ear loss to determine losses from the header operation and harvest loss during combining. If the crop has been stressed by disease, insects, or weather, the ear drop may be substantial and should be measured.

Header Ear Losses (E_A)

To determine the loss of ears at the header, repeat the ear count process in an area that already has been harvested in one or more rows, such as that marked "A" in Figure 36.1. Note that the chaff areas in these already harvested areas are avoided for this determination. Count ears in 30 paces of that row and convert the result to bushels per acre as in the preharvest loss calculation. Header ear loss (EL) is then determined *by subtracting the preharvest ear loss "P" from the total ear loss determined in area "A"* ($E_A - E_P$). The EL can then be used to calculate Header ear loss percent = (EL/measured yield) x 100%. With an optimally adjusted machine, the header ear loss (EL%) should average less than 1 bu/acre.

Kernel Losses (K_B, K_C, and K_{Cobs})

Assessing the combine's performance for kernel loss requires taking measurements at several different locations around the machine. The number of kernels found in these locations will reveal where the losses are occurring.

It will be necessary to have a tool to help count kernels from a known area on the ground. Select an approach that is convenient enough so that ***you will use it***. Devise a frame of known area that can easily be stored in the combine cab or hung on a post or hook where it is available. One approach is to use a circular hoop made from a piece of stiff wire. A length of 42.5 inches fashioned into a circle will enclose 1 square foot and will be about 13.5 inches in diameter. A circular hoop that encloses 2 ft^2 would require a length of wire 60.25 inches fastened end to end, and would be 19.2 inches in diameter. Another practical approach is to make a frame of PVC pipe with 90-degree bends. The frame can be

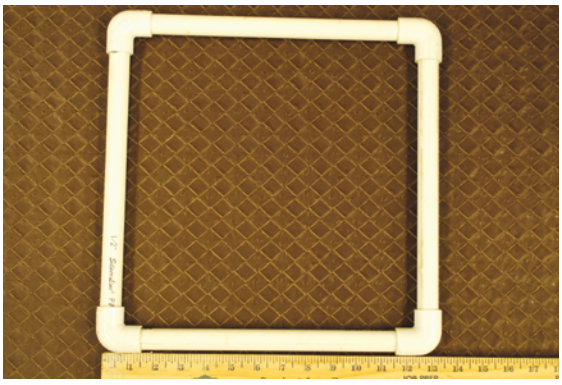
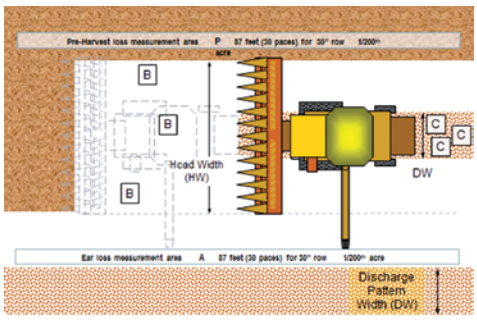


Figure 36.2 A PVC rectangular frame or cylinder that includes a known dimension can be used to measure yield losses. This PVC frame has bungee cords inside the tubes so it can be easily stored and assembled. Keep the frame in the combine cab and use it periodically to count lost kernels to help determine combine efficiency and areas that need adjustment for improvement.

Table 36.3 Example of harvest loss calculator worksheet.

Corn Harvest Loss Calculation Worksheet

Field: *Example*
Date: *November 1, 2014*
Variety: *X9215*
Operator: *John Doe*
Combine: *ACME 9000*



Step, Measurement, or Calculation	Calculated As:	Label	Value & Units
Combine Head Width (ft)		HW	20 ft
Discharge Pattern Width (ft)		DW	4.0 ft
Length of a 30" row to check for Preharvest and header ear loss. Equivalent to 1/200th acre.			87.12 ft
Area of **your** sample collection frame (ft^2)		S	5 ft^2
Kernels representing 1 bu/acre	Kernels in 1 lb x 56/43,560	N	2 #
Indicated yield prior to stopping (bu/acre)		Y	186 bu/a
0.28 lb ears, or equivalent in area marked "A"		E_A	6 #
0.28 lb ears, or equivalent, counted in unharvested area "P"		E_P	1 #
Preharvest losses due to ear drop (bu/acre)	E_P		1 bu/a
Header ear loss (bu/acre)	$E_A - E_P$	$EL_{bu/a}$	5 bu/a
Header ear loss percent	$((E_A - E_P)/Y)$ x 100%	EL%	2.7 %
Average kernel counts inside test frame in locations marked "B" (header kernel loss)		K_B	19 #
Average kernel counts inside test frame in locations marked "C" (include kernels on cobs)		K_C	39 #
Average kernel count inside frame at locations "C" ***found attached to cobs only***		K_{Cobs}	13 #
Average kernel count from the separator	$(K_C - K_B)$ x (DW/HW)	K_s	4.00 #
Kernels/ft^2 found in locations marked "B"	K_B/S	KSF_B	3.80 #
Kernels/ft^2 separator loss	K_s/S	KSF_s	0.80 #
Kernels/ft^2 on cobs	(K_{Cobs}/S) x (DW/HW)	KSF_{cobs}	0.52 #
Bu/acre loss from shelling at the header	$KSF_B/2$	$HL_{bu/a}$	1.90 bu/a
Bu/acre loss at through the separator	$KSF_S/2$	**$SL_{bu/a}$**	0.40 bu/a
Bu/acre loss from threshing	$KSF_{cobs}/2$	$TL_{bu/a}$	0.26 bu/a
Total bu/acre kernel losses from all sources	$HL_{bu/a} + SL_{bu/a}$	$TKL_{bu/a}$	2.30 bu/a
Header kernel shelling loss %	$HL_{bu/a}/Y$ x 100%	HL%	1.02 %
Separator loss %	$SL_{bu/a}/Y$ x 100%	SL%	0.22 %
Threshing loss %	$TL_{bu/a}/Y$ x 100%	TL%	0.14 %

made to enclose 5 ft^2 if the ***inside*** dimensions of the square frame are 26.8 inches. Rectangular frames of other sizes can also be constructed to be convenient to use or store. Inside length (inches) x inside width (inches) /144 will give the area enclosed in square feet. The frame can be glued permanently, or the end sections could be glued and the sides left loose to allow the frame to be broken down. Two bungee cords threaded through the two end pieces and elbows and fixed with a knot will allow the frame to be broken down but kept as a unit so that it is always handy (Fig. 36.2). Larger areas provide more accurate counts, whereas smaller areas are quicker to count.

Count kernels in the frame at several specific locations in the field around the combine to conduct a complete harvest loss analysis. This should be done at several locations, especially if using a small area, such as the 1-ft^2 hoop. The average number of kernels per square foot is determined from these counts. Then the bushel per acre loss (based on kernel size) can be determined by dividing kernels/ft^2 by the appropriate value in the right-hand column in Table 36.1.

Kernels located in areas "B" (Fig. 36.1) represent kernel losses from the header and any preharvest kernel loss (K_B). Kernels at locations "C" represent losses from the header, preharvest losses, and losses during threshing, separation, and cleaning (K_C). The width of the chaff discharge pattern must be considered here. Modern combines often have very wide heads and the width of the discharge pattern (DW) may not be as wide as the head, even with chaff spreaders operating. Because of this, the kernel counts must be adjusted to the width of the head (HW) (see calculations provided in Table 36.3).

If the chaff spreader is not easily turned off, the width of the chaff pattern can be estimated by observing how far the spreaders throw cobs. To determine the losses from the threshing, separation, and cleaning systems, the kernel counts in the chaff pattern (areas C) will first have the counts from areas B subtracted. The difference is then multiplied by the chaff pattern width and divided by the header width. This effectively distributes the internal machine losses across the full width of the cut swath. If the chaff spreaders evenly distribute the residue across the full header swath width, the measurement locations marked C in Figure 36.1 can be made anywhere behind the combine and no adjustment for chaff pattern width is required. Information in Table 36.3 can be used to estimate total harvest losses as well as to separate the total loss into header kernel shelling loss, separator Loss, and threshing loss.

Loss Calculation Example using a Worksheet

Loss calculations can be made easier with a worksheet to act as an aid in recording and calculating the types of losses from the machine. A sample yield loss calculator form is provided in Table 36.3. It is a good practice to keep copies of this form in the combine cab with the check frame. The calculation for losses can be separated into several steps.

Step 1. Enter the width of the combine head (**HW**) that is being used. For example, the combine has an eight-row head and the row spacing is 30 inches, or 2.5 feet. The head covers 20 feet of width (30"/12"/ ft *8 rows), and this number is entered next to the label HW. With a planted row spacing of 30 inches, 87 feet (or 30 paces) (**L**) of a single row represents 1/200th of an acre for measuring ear losses. (Note: If row spacing is 20 inches, this length will need to be adjusted.)

Step 2. Enter the discharge pattern width of the harvester (**DW**). In this example, the combine has a 4-ft discharge width.

Step 3. Enter the area of the frame or hoop you are using to determine kernel losses. In this example, a 5-ft^2 PVC frame is used. Enter 5 next to the label **S** for the area of this frame.

Step 4. Enter the number of kernels that represent 1 bu/acre loss per ft^2 (**N**). In this example, assume that the kernels are of medium size, so that 90,000 kernels represent 1 bu (Table 36.1). This means that 2 kernels/ft^2 represent 1 bu/a loss.

Step 5. Enter the yield on the yield monitor when the combine is stopped (**Y**). In this example, 186 bu/acre

is entered. If a yield monitor is not available, enter a yield estimate.

Step 6. Walk 30 paces in the area labeled "A" in the diagram (area that has been harvested). Over this area, 6 corn ears are found lying on the soil. Enter this value in the table next to $\mathbf{E_A}$. Assuming each ear represents 1 bu/a (see Examples 36.3 and 36.4), we have about 6 bu/a of ear losses. This number can be modified if the ear contains more or less than 0.28 lb grain/ear.

Step 7. The ear losses measured in Step 6 seem large, so repeat this measurement in the standing crop to quantify preharvest ear losses ($\mathbf{E_p}$). Stepping off 30 paces in the unharvested corn, we look for ears on the ground and locate 1 dropped ear. We enter this on the table next to $\mathbf{E_P}$ and conclude that the **preharvest** ear drop is roughly 1 bu/a.

The header ear loss (**EL**) can now be calculated. The combine header was producing an ear loss of about 5 bushels per acre (6 bushel total minus 1 bushel of preharvest loss). The header ear loss percent (**EL%**) is determined in the worksheet using the formula provided for "Header ear loss percent." It calculates to 2.7%. This value is high enough to be a source of improvement as we later consider adjusting the machine.

Step 8. Determine kernel losses. The PVC frame in Figure 36.3 encloses 5 ft^2 and is used to measure kernel losses at 3 points marked "B". If you are using a smaller frame, such as the 1-ft^2 hoop, you may wish to take additional counts. The 5-ft^2 frame, in this case, produced counts of 15, 17, and 25 loose kernels at each of the three locations. The average loss is 19 kernels per frame [(15+17+25)/3] and this value entered next to $\mathbf{K_B}$ in the table. These losses are from shatter at the header operation, and include any preharvest shatter.

Step 9. Determine kernel losses at area C in the worksheet. These losses are in the discharge pattern where separator losses are now concentrated. While making these counts, we count how many kernels are in each frame ($\mathbf{K_C}$) and make note of how many are still attached to a cob ($\mathbf{K_{Cobs}}$). Final total kernel counts for this example are 35, 40, and 42 (note that this includes single kernels, as well as kernels still attached to the cob) for an average of 39 kernels within the frame. This average count is entered next to the label $\mathbf{K_C}$. The number of kernels found attached to cobs within these frames was also noted at 11, 13, and 15. The average of 13 is entered next to the label $\mathbf{K_{Cobs}}$.

Step 10. Calculate yield losses using the equations provided in Table 36.3. The balance of the table is completed using the formulas given for each step. Counts taken in the chaff discharge pattern are adjusted using the chaff pattern and header widths to redistribute the losses over the full swath width.

1. The adjusted kernel counts are then converted to kernels/ft^2 using the area of the sample frame, which is 5 ft^2 in the example (the formulas that use #/**S** to calculate on the ft^2 basis)

2. The values of kernels/ft^2 are converted to bu/acre by dividing by 2 (#/**N**) for each loss.

3. The bu/a losses are combined ($\mathbf{HL_{bu/a}}$+ $\mathbf{SL_{bu/a}}$) and divided by the measured yield (**Y**) to calculate the percentage yield loss from the head (**HL%**), the separator (**SL%**), and the threshing system (**TL%**).

4. Overall, the results of the loss evaluation indicate that we are losing 5 bu/a or 2.7% of the harvested yield due to ears not captured by the header.

5. The check further indicates that 2.3 bu/a or 1.23% of the harvested yield is being lost as loose kernels. By counting kernels ahead of the chaff pattern, we determine that 1.02% of the harvested yield was lost as shatter at the head.

6. Additional kernels found behind the combine indicate a total separator loss of 0.22%, and keeping track of kernels attached to cobs as a part of that loss indicated a 0.14% loss from the threshing system.

7. **The losses from the header, both as whole ears, and as loose kernels, suggest a review of header adjustments operation.** The separator loss is small, although the threshing loss may also indicate

possible adjustments to systems to reduce the number of kernels lost with the cobs. Adjustments that can potentially reduce these losses are addressed in Chapter 37.

The blank form below can be printed and used as a tool to aid in quickly calculating harvest losses and to guide the process of adjusting the combine. Areas that are shaded tan in the worksheet can be entered for your combine and variety, and may not change often. Rows that are shaded gold indicate areas where to measure losses. An app can be used to simplify this process. Frequently checking losses using these tools will help you to better understand the combine and how it responds to the varying conditions (wet plants, lodged areas, very dry plants) that it faces during harvest. The benefits in terms of additional recovered crop can be disproportionately large compared to the modest time that it takes to count kernels.

References and Additional Information

Shay, C., L.V. Ellis, and W. Hires, 1993. Measuring and reducing corn harvest losses. University of Missouri Extension. Available at: http://extension.missouri.edu/p/G1290 (accessed 5 November 2015).

Vagts, T. 2003. Reducing harvest losses in lodged corn fields. Iowa State University Extension. Available at: http://www.extension.iastate.edu/nwcrops/reducing-harvest-losses.htm. (accessed 5 November 2015).

Acknowledgements

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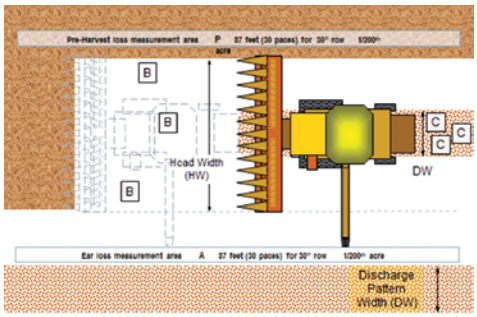
Corn Harvest Loss Calculation Worksheet

Field: _____
Date: _____
Variety: _____
Operator:_____
Combine:_____



Step, Measurement, or Calculation	Calculated As:	Label	Value & Units
Combine Head Width (ft)		HW	ft
Discharge Pattern Width (ft)		DW	ft
Length of a 30" row to check for Preharvest and header ear loss. Equivalent to 1/200th acre.	217.8/Row width(ft)	L	ft
Area of **your** sample collection frame (ft^2)		S	ft^2
Kernels representing 1 bu/acre	Kernels in 1 lb x 56/43,560	N	2 #
Indicated yield prior to stopping (bu/acre)		Y	bu/a
0.28 lb ears, or equivalent in area marked "A"		E_A	#
0.28 lb ears, or equivalent, counted in unharvested area "P"		E_P	#
Preharvest losses due to ear drop (bu/acre)	E_P		bu/a
Header ear loss (bu/acre)	$E_A - E_P$	$EL_{bu/a}$	bu/a
Header ear loss percent	$((E_A - E_P)/Y)$ x 100%	$EL_{\%}$	%
Average kernel counts inside test frame in locations marked "B" (header kernel loss)		K_B	#
Average kernel counts inside test frame in locations marked "C" (include kernels on cobs)		K_C	#
Average kernel count inside frame at locations "C" ***found attached to cobs only***		K_{Cobs}	#
Average kernel count from the separator	$(K_C - K_B)$ x (DW/HW)	K_s	#
Kernels/ft^2 found in locations marked "B"	K_B/S	KSF_B	#
Kernels/ft^2 separator loss	K_s/S	KSF_s	#
Kernels/ft^2 on cobs	(K_{Cobs}/S) x (DW/HW)	KSF_{cobs}	#
Bu/acre loss from shelling at the header	$KSF_B/2$	$HL_{bu/a}$	bu/a
Bu/acre loss at through the separator	$KSF_S/2$	**$SL_{bu/a}$**	bu/a
Bu/acre loss from threshing	$KSF_{cobs}/2$	$TL_{bu/a}$	bu/a
Total bu/acre kernel losses from all sources	$HL_{bu/a} + SL_{bu/a}$	$TKL_{bu/a}$	bu/a
Header kernel shelling loss %	$HL_{bu/a}/Y$ x 100%	HL%	%
Separator loss %	$SL_{bu/a}/Y$ x 100%	SL%	%
Threshing loss %	$TL_{bu/a}/Y$ x 100%	TL%	%