SDSU Extension

iGrow Soybean

BEST MANAGEMENT PRACTICES

Chapter 38:
Determining Harvest Losses in Soybeans

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Maximizing soybean profits involves minimizing harvest losses. Harvest losses can reduce your bottom line and may be the difference between making and losing money. The first step in minimizing harvest losses involves determining the amount and source of current losses. This chapter provides guidance on estimating soybean combining yield losses (Table 38.1).

Table 38.1. Key steps in determining harvest losses.

- Make a frame to count the number of lost beans on the ground. A square 1 ft^2 frame is easy.
- Place the frame on the ground behind the combine and count the number of beans on the ground within the frame.
- Estimate the size of your soybeans. (You can measure this; see calculations below.)
- For small soybeans, 5 soybeans/ft^2 is approximately equal to 1 bu loss/acre, and for medium-sized soybeans, 4 soybean/ft^2 is equivalent to 1 bu loss/acre.
- Estimate your percent loss (100 × measured loss / yield). Losses < 3% are generally acceptable. It should be possible to reduce losses if they are > 3%.

Calculating soybean yield losses

Measuring soybean harvest yield losses involves determining the number of soybeans on a known area of the soil surface. Yield losses per unit area can be measured using rectangles or hoops. A circular hoop can be made from a piece of stiff wire. A length of 42.5 inches fashioned into a circle will enclose one square foot and will be about 13.5 inches in diameter (Fig. 38.1). This can easily be stored in the cab of the combine or hung on a post or hook where it is available. A circular hoop that encloses five square feet would require a length of wire 95.125 inches in length fastened end to end, and would be 30.3 inches in diameter.

Figure 38.1. Harvest losses can be determined using a hoop or box. The green wire hoop encloses one square foot. The PVC frame encloses five square feet. For PVC frames, put a bungee cord through its ends which will allow it to collapsed and stored compactly. (Photo courtesy of D. Humburg, SDSU)

Another approach would be to make a frame of PVC pipe and 90° bends. Four pieces of pipe about 12 inches in length will enclose an area of one square foot with small adjustments needed depending upon the depth of the 90° corners used. A similar frame can be made to enclose five square feet 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 (Fig. 38.2). Two small bungee cords threaded through the two ends pieces and fixed with a knot will allow the frame to be broken down but kept as a unit so that it is always handy.

Make a device that is convenient and that you will use. Larger areas will provide a somewhat more accurate measurement of losses, but smaller areas are quicker to count.

Figure 38.2. Breaking down a sampler so that it is easier to store. (Photo courtesy of, D. Humburg, SDSU)

Combine losses are estimated by tossing the frame onto the ground and counting the number of soybeans within the frame's boundaries. The soybean count is divided into the area enclosed by the frame in square feet. The loss is determined by converting the number of soybeans/ft^2 to bushels/acre. These calculations depend upon the size and weight of the beans. For these calculations, the following information is needed:

- One acre contains 43,560 ft^2.
- One bushel of soybean at 13% moisture weighs 60 lbs.
- Soybeans generally range from 2500 beans/lb to 3500 beans/lb.
- Losses depend on soybean size and weight (Table 38.2).

Table 38.2. The relationship between soybean size and beans/ft^2. The # of beans per ft^2 that is equivalent to one bu/acre is determined by dividing the # of soybeans/bushel by 43,560.

Soybean size	Weight/bushel @ 13% Moisture	Bean/bushel	Kernels/lb @ 13% Moisture	Soybeans in beans/ft^2 Equivalent to 1 bushel/arce
Small soybeans	60 lbs	218,000	3633	5
Medium soybeans	60 lbs	174,000	2900	4
Large soybeans	60 lbs	130,800	2180	3

Determining the beans per bushel or bean per pound

Calculated soybean losses require an estimate of the bean size (Table 38.2) or the measured number of soybeans per bushel. If the conversion from beans/ft^2 to bushels/acre is known, then losses can be calculated as in the example below where 15 soybeans were found in each square foot.

$$\text{For medium beans, } \left(\frac{15 \text{ soybean}}{\text{ft}^2}\right) \times \frac{1 \text{ bushel}/\text{acre}}{4 \text{ soybeans}/\text{ft}^2} = \frac{3.8 \text{ bushels}}{\text{acre}}$$

If you are uncertain about the size of your beans in these conversions, then you can measure the number of beans/bushel by weighting 200 soybeans from the combine on a scale. This weight is then converted to lbs/bushel using the following example where 200 beans weighed 0.80 ounces.

$$\frac{\text{beans}}{\text{bushel}} = \left(\frac{200 \text{ beans}}{0.80 \text{ ounces}}\right) \times \frac{16 \text{ ounzes}}{1 \text{ lb}} \times \frac{60 \text{ lbs}}{\text{bushel}} = \frac{240{,}000 \text{ beans}}{\text{bushel}}$$

The bean counts (15 in this case) per ft^2 are then converted to bushel of loss/acre using the calculations below:

$$\frac{\text{bushel}}{\text{acre}} = \left(\frac{15 \text{ beans}}{\text{ft}^2}\right) \times \frac{43{,}560 \text{ ft}^2}{\text{acre}} \times \frac{\text{bushel}}{240{,}000 \text{ beans}} = \frac{2.72 \text{ bushels}}{\text{acre}}$$

A quick initial test can be performed to determine if you need to do further measurements. Using your measurement frame or hoop, take several counts of beans in areas behind where the combine has passed when operating normally. Determine the number of soybeans/ft^2 in these areas. This will include losses from all sources. Use the calculations above to determine your loss per acre. Now divide the bushel per acre loss by the harvested yield in this area of the field and multiply by 100%. This will provide the % loss. If your losses are 3% or less of the harvested yield, your combine is doing a good job. Reducing losses below this level may be difficult. If the overall losses exceed 3%, you should do a more thorough examination of the losses to determine where they are occurring and if the losses can be reduced.

To calculate corn harvest losses an identical approach can be used. However, the corn kernels weighs/bushel are slightly different. Information for these calculations are provided in Table 38.3.

Table 38.3. The relationship between corn kernel size and kernels/ft².

Kernel size	Weight/bushel @ 15.5% Moisture	Kernels/bushel	Kernels/lb @ 15.5% Moisture	Kernels/ft² Equivalent to 1 bushel/arce
Large kernels	56 lbs	70,000	1250	1.6
Medium kernels	56lbs	90,000	1607	2.1
Small kernels	56 lbs	110,000	1964	2.5

Reducing harvesting losses

Soybean losses occur primarily in the gathering process at the combine head. It is most common losses during threshing, separation, and cleaning to be very small, while losses at the head can be quite large. Losses can be categorized into the following categories:

- **Pre-harvest loss.**
  These are usually shatter losses and are visible as shelled beans or whole pods lying on the ground ahead of the combine.
- **Shatter loss.**
  These are additional beans lost onto the ground when pods open during the cutting and gathering process at the head.
- **Stubble loss.**
  This loss occurs when pods are attached to the plant stem below the height of the cutterbar and remain there after the passage of the machine.
- **Loose stem loss.**
  These losses are associated with pods attached to stems that are cut, but are not recovered by the head.
- **Lodging loss.**
  These losses are associated with stems that are uncut but lie on the ground, or are pushed to the ground by the head. Pods attached and the beans enclosed are lost.
- **Separator loss.**
  These losses occur when beans are not threshed, or are passed over the sieves and out the back of the combine with the chaff or straw.
- **Machine leakage loss.**
  These losses occur in some machines as wear or lose fitting parts allow beans to leak from holes or gaps in components. This type of loss is visible as an abnormal concentration of lost beans along a line under the machine.

Determining losses from different machine processes

Measurement of losses should be performed as an important component of the fieldwork. Losses from different components can be determined by following different procedures.

Step 1: Operate the combine at your normal forward speed and settings, moving far enough into the crop to be at steady conditions and away from headlands. Stop the machine and shut down the separator. Back the machine away from the uncut crop about the length of the combine. For machines with very wide heads, it may not be necessary to back away as there are enough places to access behind the head.

Step 2: Begin with pre-harvest losses. In the standing crop ahead of the combine, place the measurement hoop on the ground such as in locations "A" in Figure 38.3. In this case, using a hoop that is smaller in size than the row spacing is advantageous. Larger hoops can dislodge or shatter pods in the process of placing the device on the ground. Count and record the number of beans + beans within pods found on the ground within the hoop. Perform this test in several places and calculate the average number of beans per square foot. Calculate losses using the calculation steps above.

Step 3: Next, determine the shatter loss. Use the measurement hoop to perform counts of loose beans on the ground at several locations behind the combine header marked as "B" in Figure 38.3. If the combine has been backed away from the crop, these measurements can be made across the full swath width. If a wide head is used, this measurement can be performed to either side of the machine. Calculate the average number of loose beans per/ft^2. Subtract the average number of pre-harvest loose beans from this number. Calculate losses using the examples above.

Step 4: Stubble loss should be measured at each location where shatter loss is measured. Look for pods within the hoop still attached to the stubs of plants below the cut point. Shell these pods and determine the total number of beans contained within these pods. Repeat this at each measurement location and determine the average number of beans per square foot from stubble loss. Determine loss using the calculations above.

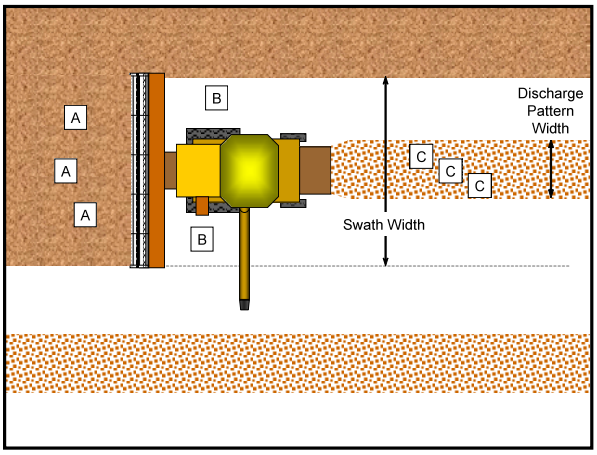


Figure 38.3. Locations for determination of preharvest and machine losses in soybean harvest. (Illustration by Daniel Humburg, SDSU)

Step 5: Determine the loose stem loss. At each location "B," also look for loose or cut stems within the sample area. Count the number of beans remaining within pods on loose stems. Average these numbers and determine the average number of beans on loose stems in each square foot. Calculate loss using the approach demonstrated above.

Step 6: Determine the lodging loss. Within the sample locations "B," look for stems that were not cut. Count the number of beans from the pods on these stems. Average these numbers for the sample locations and determine the average number of beans per square foot associated with lodged stems. Calculate loss using the approach demonstrated above.

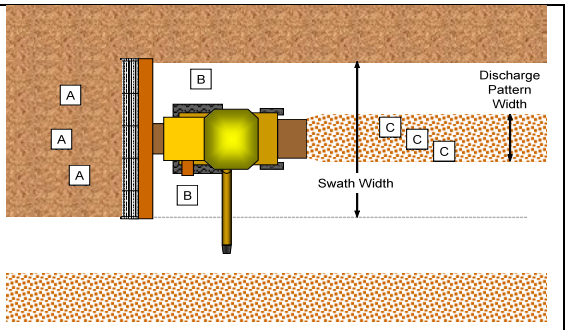
Step 7: Check for separator loss. Use the measurement hoop to determine beans per square foot from several locations within the discharge swath marked "C" in Figure 38.3. If the number of loose beans plus beans from free pods exceeds the numbers counted from locations "B," there is measureable separator loss. To identify the amount of separator loss, subtract the average number of loose beans per square foot at "B" from the number found at location "C". This difference is the separator loss, but it is concentrated in the swath behind the combine. To adjust it to the full machine swath, multiply this beans-per-square-foot by the discharge pattern width and then divide by the full machine swath width. The result is the number of beans/ft^2 attributable to the separator. Calculate loss using the approach demonstrated above.

Step 8: Look for machine leakage loss. The combine should be backed away from the standing crop for this examination. Look for any pattern of crop lost under the combine or across the swath. Most combines will not exhibit this loss, but it is not unusual to have a leak. Any concentration of beans in a line along the direction of travel may indicate a leak from the machine. If such a strip is found, the machine should be examined to locate the source of the loss and the part repaired. To include this loss in the calculation of percentage losses, the number of beans in a one-foot length of this strip must be divided by the combine swath width. For example, if a strip of beans is found that has 36 beans in each foot along the direction of travel and the header swath is 24 feet wide, the average loss would be 24/36 or 1½ beans/ft^2. Based on this value, calculate loss using the approach demonstrated above.

Step 9: Sum all of the bushel-per-acre losses to determine total losses in the crop. Determine the total per acre yield by adding the losses to the harvested yield. Now the percentage losses can be determined by dividing each individual type of loss by the yield and multiplying by 100%.

The page below (Table 38.4) is a calculator sheet that can be printed and used as a way of logging and calculating losses in soybeans. Some losses are inevitable. However, taking the time to count some beans in a few sample areas and quantifying the types of losses occurring will assist in making good decisions regarding which machine settings might reduce the losses. Even pre-harvest losses, although they cannot be prevented once they have occurred, are useful to measure as they may assist in making varietal selections in subsequent years.

Table 38.4. Harvest loss calculation worksheet.

Soybean Harvest Loss Calculation Worksheet	

Bean Counts by Sample Location and Loss Type						
Estimated Beans-Per-Square-Foot equating to 1 Bushel Per Acre:						❶
Sample Frame or Hoop Size in Square Feet:						❷
Sample Location (See Figure)	**#1 Bean Count**	**#2 Bean Count**	**#3 Bean Count**	**#4 Bean Count**	**Average Count**	**Average Beans/ft^2 (= Count Avg / ❷)**
“A” Loose						❸
“B” Loose						❹
“B” On stubble						❺
“B” On cut stems						❻
“B” On lodged stems						❼
“C” Loose						❽
Separator	(❽-❹) x discharge pattern width / cut swath width					❾
Leakage	If present, bean count per 1 ft of travel / swath width (ft)					❿
Total Losses in bushels per acre = [❹+❺+❻+❼+❾+❿]/❶						
Harvested Yield in bushels per acre						
Actual Yield = (Harvested Yield + Total Losses)						**Y**
Pre-Harvest Loss % = (❸/❶) / **Y** x 100%						
Shatter Loss % at Head = [(❹-❸)/❶] / **Y** x 100%						
Stubble Loss % = (❺/❶) / **Y** x 100%						
Loose Stem Loss % = (❻/❶) / **Y** x 100%						
Lodged Stem Loss % = (❼/❶) / **Y** x 100%						
Separator Loss % = (❾/❶) / **Y** x 100%						
Leakage % = (❿/❶) / **Y** x 100%						
Total % Loss						

An example using the loss calculator

An example can help show the value of the calculator (Table 38.5). In a 5-ft^2 area behind the combine, 67 loose beans are counted. Based on these values, the yield loss is 2.97 bu/acre (see below).

$$\left(\frac{67 \text{ beans}}{5 \text{ ft}^2}\right) \times \frac{43,560 \text{ ft}^2}{\text{acre}} \times \frac{\text{bushel}}{196,000 \text{ beans}} = \frac{2.97 \text{ bushels}}{\text{acre}}$$

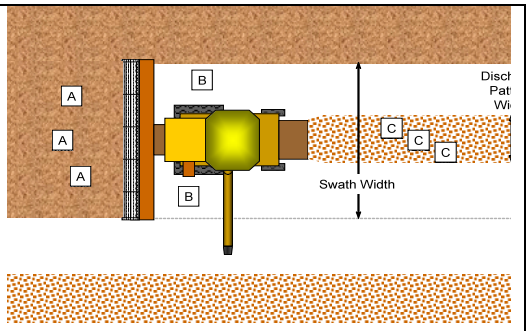
If the yield is 45 bu/acre then the loss is 6.6% (100×2.97/45). This value exceeds 3% and therefore a closer look is needed. The calculator sheet in Table 38.4 is used to identify the sizes and origins of the losses that are occurring.

The 5 ft^2 frame was used to measure pre-harvest losses ahead of the combine in three places. Three additional places were sampled behind the combine head but ahead of the discharge pattern. The discharge pattern width was also sampled at three locations behind the combine. The bean counts from each of the loss categories were recorded on the calculator sheet. The bean counts are adjusted to beans/ft^2. The bushels per acre from each loss type are determined and the total yield determined from the harvested yield and the lost yield. Percentage losses for each type are calculated. In this case, the shatter loss was 4.7% of the total yield, which may be excessive.

Once losses are measured and categorized, the combine can be adjusted. Suggestions for adjustment of machine operating parameters are given in Humburg (2012).

Table 38.5. Sample soybean harvest loss calculation worksheet.

Soybean Harvest Loss Calculation Worksheet



Bean Counts by Sample Location and Loss Type

Estimated Beans-Per-Square-Foot equating to 1 Bushel Per Acre:					**4.5**	❶
Sample Frame or Hoop Size in Square Feet:					**5**	❷
Sample Location (See Figure)	**#1 Bean Count**	**#2 Bean Count**	**#3 Bean Count**	**#4 Bean Count**	**Average Count**	**Average Beans/ft^2 (= Count Avg / ❷)**
“A” Loose	**3**	**2**	**3**		**2.67**	**0.53** ❸
“B” Loose	**54**	**49**	**59**		**54**	**10.8** ❹
“B” On stubble	**15**	**13**	**9**		**12.33**	**2.47** ❺
“B” On cut stems	**0**	**26**	**0**		**8.67**	**1.73** ❻
“B” On lodged stems	**0**	**0**	**0**		**0**	**0** ❼
“C” Loose	**65**	**61**	**67**		**64.33**	**12.86** ❽
Separator	(❽-❹) x discharge pattern width / cut swath width					**0.69** ❾
Leakage	If present, bean count per 1 ft of travel / swath width (ft)					**0** ❿
Total Losses in bushels per acre = [❹+❺+❻+❼+❾+❿]/❶						**3.60**
Harvested Yield in bushels per acre						**45**
Actual Yield = (Harvested Yield + Total Losses)						**48.6** **Y**
Pre-Harvest Loss % = (❸/❶) / **Y** x 100%						**0.24%**
Shatter Loss % at Head = [(❹-❸)/❶] / **Y** x 100%						**4.7%**
Stubble Loss % = (❺/❶) / **Y** x 100%						**1.13%**
Loose Stem Loss % = (❻/❶) / **Y** x 100%						**0.79%**
Lodged Stem Loss % = (❼/❶) / **Y** x 100%						**0%**
Separator Loss % = (❾/❶) / **Y** x 100%						**0.32%**
Leakage % = (❿/❶) / **Y** x 100%						**0%**
Total % Loss						**7.18%**

References and additional information

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