

BEST MANAGEMENT PRACTICES

Chapter 40: Combine Adjustments and Soybean Harvest Losses



Daniel Humburg

Soybean management decisions regarding field practices, timing of harvest, and operator settings of the combine can mean the difference between minimal losses of the crop and losses that can reach twenty bushels per acre. At current prices, these types of losses can dramatically influence profit or loss for the enterprise. The purpose of this chapter is to discuss combine harvest adjustments that minimize losses (Table 40.1).

Table 40.1. Keys for optimizing combine settings.

- Soybeans are most effectively harvested from a flat surface that is smooth.
- Harvest as soon as the crop reaches acceptable moisture level. A soybean crop that is drier than 13.5% moisture costs you money.
- Under normal conditions the reel-to-combine speed ratio is 1.25. If the soybean are lodged, a higher value will recover more crop.
- Keep the reel higher and farther forward in normal crop. In lodged soybeans, pull the reel closer to the cutter bar and lower it to lift the fallen stems.
- Learn the effects and interactions of combine adjustments. Use the dynamic simulator program, located at http://cell25.com/CaselH/htmls/global/course.html to test effects of different combine settings.
- Modern combines are capable of handling a variety of crop conditions. However, putting the highest
 possible percentage of the standing crop in the bin still requires that producers learn how to measure
 the machine performance, identify avoidable losses, and then make appropriate adjustments to machine
 settings and operating parameters.

Planting impact on harvest efficiency

Some decisions that impact harvest are made when the crop is planted. It is easiest for a combine harvester to harvest soybeans from a field that has a smooth, flat surface. Practices such as no-till, conventional tillage, ridge till, or field rolling impact how smooth a field is at harvest. Corn stubble and root balls can affect the harvest operation and soybean quality.

Evidence suggests that harvesting as soon as the crop reaches acceptable moisture levels provides for maximum yield recovery. If the crop is not harvested, rapid temperature and moisture changes can lead to shattering losses. These losses can be significant. For example, a study conducted at Pennsylvania State University showed that delaying harvest three weeks can reduce yields 12 to 20 bushels per acre (Voight, 2010). Additional losses occur when the crop moisture content is less than the market moisture content of 13.5%. Once the moisture % decreases below the market standard moisture content, the marketable yield decrease because the market does not compensate for moisture levels below 13.5%.

The following equation can be used to calculate potential yield of soybeans at market moisture from moisture contents below the market standard level. In the equation, $MC_{harvest\%}$ is the moisture content at the time the soybeans were harvested. Yield_{harvestMC%} is the yield of the dry beans and Yield_{13.5%} is the yield that could have been obtained at 13.5% moisture content.

$$Yield_{13.5\%} = \frac{100 - MC_{harvest\%}}{100 - 13.5} \times Yield_{harvestMC\%}$$

For example, a 45-bushel per acre yield harvested at 10% moisture content would equate to a 46.8-bushel per acre yield if it had been recovered at the market allowable moisture content of 13.5%. The result is a loss of 1.8 bushels per acre, which at a market price of \$15/bushel represents \$27/acre of reduced revenue. Table 40.2 shows the relationship between soybean selling price, grain moisture %, and lost \$/bu. When the soybean is dried to 10% moisture, the amount of dry bean sold in a bushel (60 lbs) increases and the amount of water decreases.

moisture contains less	dry soybe	ans than a bus	shel at 10% r	noisture.		
Soybean Selling Price	lbs/bu when sold	Moisture %		Moisture %		Lost \$/bu from drying
		10	13.5	10	13.5	soybean to 10%
\$/bushel		lbs water/ bushel	lbs water/ bushel	lbs dry beans/bu	lbs dry beans/bu	\$/bu
5	60	6	7.8	54	52.2	0.172

54

54

54

52.2

52.2

52.2

0.344

0.517

0.690

7.8

7.8

7.8

Table 40.2. The influence of soybean selling price on the cost of selling soybean at 10% moisture as opposed to 13.5% moisture. This occurs because a bushel of soybeans is assumed to weigh 60 lbs. A bushel at 13.5% moisture contains less dry soybeans than a bushel at 10% moisture.

Harvest Losses

10

15

20

60

30

60

6

6

6

Details on measuring harvest losses are provide in Chapter 38. While delaying harvest may result in losses, rushing the harvest without determining machine losses will almost certainly result in avoidable losses as well. Most machine losses in soybeans occur at the combine head. Soybeans are a relatively easy crop to thresh and separate. Crop that enters the separator generally results in losses of less than 1%. However, losses at the combine head can be many times this amount. Take the time to measure the performance of your machine and its settings.

Pre-harvest losses

These types of losses cannot be avoided by machine adjustment, but must be determined to be able to assess other losses. Typical losses due to pre-harvest shatter are 0.25%, but can be much larger in very dry crop, or if harvest is delayed.

Header shatter losses

Processes that take place at the head include gathering or guiding by the reel, cutting by the knife and sickle bar, and conveying by the cross auger or drapers. The greatest shatter losses occur in the process of gathering and cutting the plants by the reel and cutting system. Operator adjustments include the height of the reel, the forward separation of the reel from the cutter bar, the reel speed, and the forward vehicle speed. Shatter losses from all of these sources are aggravated by excessively dry drop conditions.

Shatter losses of 2% are generally considered acceptable, but average losses have been found to be 5% or more among different operators. It is recommended that you begin adjustments to reduce machine losses by reviewing the recommendations of the combine manufacturer in the owner's manual. The suggested settings for different crops and conditions are specific to your model machine. However, the following are general guidelines to reduce machine losses.

The height of the reel should be adjusted no lower than needed to guide the plants across the cutter bar. In lodged crop, it may be necessary to lower the reel to recover plant stems that are close to the ground, but in standing crop it is more desirable to stay in the top ¹/₃ of plants.

The centerline of the reel is positioned 6 to 12 inches ahead of the cutter bar. This produces a motion where the reel fingers are lifting out of the crop just as it is cut. For a lodged crop, the reel should be moved rearward so that the crop is guided farther onto the head before the reel fingers lift out. By lowering the reel and moving it rearward, the lodged stems can be lifted up and back across the cutter bar and recovered. Some increase in shatter of pods may occur in this process. However, the increased recovery of whole lodged stems with multiple pods can more than offset the shatter loss. If you move into a field that does not have lodged stems, do not forget to reset the reel height and forward position to the recommended positions for standing crop.



Figure 40.1. Reel and cutter bar. Note the center of the reel is about 10 inches ahead of the cutter bar in this case. The reel fingers are low for storage or heavily lodged crop. In standing crop, the fingers are operated in the upper 3rd of the crop. (Photo courtesy of D. Humburg, SDSU)

The speed of the reel at its lowest point should be rearward at about 125% of the forward speed of the harvester. This ratio is called the reel index. A reel index of 125% means that the fingers of the reel are guiding the crop backward at a speed that is about ¼ of the machine speed. This results in a gentle guiding of the stems, such that they tip backward as they are cut and fall onto the grain platform or drapers.

Current model machines may automatically slave the reel speed to the forward vehicle speed so that if you increase the harvester speed, the reel speed will increase to keep this ratio constant. In this case, you will have control over the reel index as an adjustment within the electronic settings of the machine. The operator's manual will provide the details of how to adjust the ratio. For normal crop conditions, an index

of about 1.25 is recommended. When harvesting lodged soybeans, a reel index closer to 1.5, or 150%, may provide better crop recovery. Again, if you move from a field with lodged stems to one with a clean standing crop, do not forget to readjust the reel speed, or the reel index to the recommended setting for this crop condition.

The cutting system should be examined and maintained to keep it in optimum working condition. The knife sections must be kept sharp and in good repair. A damaged section will result in incomplete cutting of stems and will result in increased shatter loss, stubble loss, and lodged stem loss along the path of that knife section. Hold-down clips should position the knife to within 1/32" of the guards. Wear plates should be adjusted to make light contact with the back of the knife. In most cases, the oscillation speed of the knife will be sufficient to provide complete cutting of the crop stems. However, the cutting action is determined by the knife reciprocation rate and the forward speed of the machine. Check the recommended speeds of operation in the owner's manual for your combine and stay within those recommendations.



Figure 40.2. Knife and guard maintenance is critical. At left a guard section has broken. At right a knife or sickle section has broken off at the knife bar. Both conditions will produce losses when stems encounter this part of the head. (Photos courtesy of D. Humburg, SDSU)

A flexible head can keep the cutting system in the closest possible contact with the ground to recover low pods. The use of a rolling implement (Chapter 12) while the crop is small can flatten the soil surface and press rocks, clods, and other debris into the soil surface. This provides a smooth, flat surface at the time of harvest for the cutter to follow and leaves fewer rocks and other materials protruding to damage the knife or be taken into the combine. Rolling can improve the quality of harvested beans for seed producers as less dirt and foreign matter are picked up from the flattened surface than from an uneven soil surface. Protocols for determining yield benefits from rolling are provided in Chapter 12.

Alternate gathering systems

Alternate gathering systems include draper heads and air assist reels. Draper heads transport the cut stalks to the center of the head after they are propelled onto the drapers by the reel. The process is gentler to the crop than the conventional cross augers. The stems maintain a consistent orientation as they are transported. That "head first" orientation is maintained as the stems enter the feeder house and eventually the threshing system. This approach should produce less shatter on the head and fewer split soybeans and higher quality.



Figure 40.3. Draper head used in soybean harvest. The drapers transport crop to the feederhouse in a consistent orientation and with less disturbance to the pods. Draper heads are available both in rigid and flexible types. (Source: www.macdon.com)

An air assist reel uses directed jets of air to help propel the crop across the cutter bar and onto the grain platform or drapers. It may also be able to reduce shatter losses at the head when conditions are dry and the crop is fragile.



Figure 40.4. An air assist reel. Air jets help to propel the crop across the cutter bar onto the grain platform. (Source: http://www. mascus.com/agriculture/used-combine-harvester-accessories/crary-wind-system-crary-wind-system/do7i7men.html)

Separator losses

Although soybeans are not generally difficult to thresh and separate when compared to other crops, it is important to pay attention to the settings of these systems. The measurement procedures to determine losses at the threshing system or at the separator are provided in Chapter 38. Follow the recommendations of the combine manufacturer with regard to initial settings of the rotor speed, concave gaps, and sieve and fan settings to adjust for losses in the threshing, separating, and cleaning sections of the combine.

A software application developed by CaseIH can be useful for gaining a general understanding of the interaction of machine settings and operator controls on the combine performance. Figure 40.5 shows an image of the rotor, shoe, and fan of an axial flow combine. The program animates the components showing relative motion and the flow of material. At the top of the diagram, graph bars indicate performance measures such as losses, grain damage, and engine load. Ideal performance is shown. The user can increase or decrease any of these settings or inputs.

The software will indicate the likely impact of the change in setting on the six performance measures. In this way, it is possible to see which performance measures are impacted by a setting change. The tool is a quick way to consider the impact of a change to the machine or operating point. It may also help identify the unintended consequences of operating at an extreme of one machine setting. The Case IH course on combine theory and settings, along with the dynamic simulator program can be accessed at http://cell25. com/CaseIH/htmls/global/course.html.



Figure 40.5. CaseIH combine simulator illustration. Changing one or more of the operator adjustments at the bottom is reflected by corresponding changes in performance. (Source: http://cell25.com/CaseIH/htmls/global/course.html)

Soybeans produced for seed and for some specialty markets are particularly sensitive to quality measures. Producers for these markets will want to pay particular attention to adjustments that impact crop quality. Foreign matter and split seeds will detract from the seed quality and can lower premiums or lose the opportunity for sale as seed.

Follow the manufacturer's recommendations with regard to rotor speeds. In general lower rotor speeds will produce fewer split seeds so in fragile crop, move to the lower end of the recommended range. Keeping the threshing and separating systems consistently loaded results in less damage to seed as the crop stems act as a cushion between seed and moving parts. A lightly loaded rotor and concave will result in greater impacts from the rotor tines or rasp bars on the seeds and more breakage. Larger concave spacing will in general produce less damage.

The combine simulator can be a tool in addition to the operator's manual to understand how separator adjustments will affect damage and foreign material in the harvested crop. Sharp metal edges in contact with soybeans will produce more split seeds. If quality is critical to the market, it can pay to relieve sharp edges on the cross auger, feeder house chain flighting, and rotor parts. Maintain clearance between the cross auger and the underlying platform of 5/8 inch or 15 mm, or the clearance recommended in the operator's manual to avoid splitting seeds.

References and additional information

- Shay, C.W., L. Ellis, and W. Hires. 1993. Measuring and reducing soybean harvesting losses. G1280. University of Missouri Extension. Available at http://extension.missouri.edu/p/G1280
- Staton, M. 2012. Pay close attention to reducing soybean harvest losses this fall. Michigan State University Extension news item. Available at http://msue.anr.msu.edu/news/pay_close_attention_to_reducing_ soybean_harvest_losses_this_fall
- Voight, D. 2010. Measuring and reducing soybean harvesting losses. Pennsylvania State University Extension Crop Management publication. Available at http://cmegicmlebanon.blogspot.com/2011/09/ measuring-and-reducing-soybean_3886.html

Acknowledgements

Funding for developing this chapter was provided by the South Dakota Soybean Research and Promotion Council, USDA-AFRI, and South Dakota 2010 research program.

Humburg, D. 2013. Combine adjustments and soybean harvest losses. In Clay, D.E., Carlson, C.G. Clay, S.A., Wagner, L, Deneke, D., and Hay C. (eds). iGrow Soybeans: Best Management Practices for Soybean Production. South Dakota State University, SDSU Extension, Brookings, SD.

In accordance with Federal civil rights law and U.S. Department of Agriculture (USDA) civil rights regulations and policies, the USDA, its Agencies, offices, and employees, and institutions participating in or administering USDA programs are prohibited from discriminating based on race, color, national origin, religion, sex, gender identity (including gender expression), sexual orientation, disability, age, marital status, family/parental status, income derived from a public assistance program, political beliefs, or reprisal or retaliation for prior civil rights activity, in any program or activity conducted or funded by USDA (not all bases apply to all programs). Remedies and complaint filing deadlines vary by program or incident.

Persons with disabilities who require alternative means of communication for program information (e.g., Braille, large print, audiotape, American Sign Language, etc.) should contact the responsible Agency or USDA's TARGET Center at (202) 720-2600 (voice and TTY) or contact USDA through the Federal Relay Service at (800) 877-8339. Additionally, program information may be made available in languages other than English.

To file a program discrimination complaint, complete the USDA Program Discrimination Complaint Form, AD-3027, found online at http://www. ascr.usda.gov/complaint_filing_cust.html and at any USDA office or write a letter addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992. Submit your completed form or letter to USDA by:

- mail: U.S. Department of Agriculture Office of the Assistant Secretary for Civil Rights 1400 Independence Avenue, SW Washington, D.C. 20250-9410;
- (2) fax: (202) 690-7442; or
- (3) email: program.intake@usda.gov.

USDA is an equal opportunity provider, employer, and lender.

SDSU Extension is an equal opportunity provider and employer in accordance with the nondiscrimination policies of South Dakota State University, the South Dakota Board of Regents and the United States Department of Agriculture.