

Crop Residue Management

Benefits of Retaining Residue

High amounts of crop residue (more than 40 percent) can reduce soil loss from water erosion by 80 percent. Even a small amount of residue cover (10 percent) can reduce erosion losses by 20 percent.¹ Additionally, residue maintains soil moisture, improves soil tilth and quality, reduces nutrient runoff, and provides wildlife cover. These improvements can be related to potential yield benefits and should be considered when managing residue (Table 1). Conservation tillage practices resulting in greater sustainability of cropping systems are being adopted on a wider scale. This comes as the loss of crop productivity correlated to land degradation becomes a global issue.

Year	Crop	Yield (bu/acre)			Water Savings (inch)		
		Residue	Bare Soil	Difference	Yield	Soil	Total
2007	Corn	197	172	25	3.0	0.0	3.0
2008	Corn	186	169	17	2.0	1.5	3.5
2009	Soybean	68	58	10	3.0	2.0	5.0
2010	Soybean	61	53	8	2.5	0.0	2.5

Source: Van Donk, S.J. and Klocke, N.L. 2012. Tillage and crop residue removal effects on evaporation, irrigation requirements, and yield. Proceedings of the 24th Annual Central Plains Irrigation Conference.

Table 1. Comparison of water savings and yield on bare soil and residue-covered soil.

Residue can be managed through harvesting adjustments and tillage. However, tillage may not be desirable in all fields. Depending on crop rotation, additional steps may help decompose residue or allow for residue handling during planting of the next crop.

Harvesting

- For proper residue distribution, combines or similar machines used for harvesting should be equipped with spreaders capable of uniformly distributing residue over the working width of the header.
- Chopper attachments can be adjusted to help with spreading residue the full width. Chaff spreaders attached to the rear axle are most effective for spreading wheat and soybean residues because a larger percentage of the harvested residue is handled by the cleaning shoe of the combine.²
- To reduce evaporative losses and to provide adequate snow retention in no-till and strip-till operations, it may be helpful to keep stubble height at a minimum of 10 inches for crops with a row spacing of less than 15 inches. For crops with a row spacing of 15 inches or greater, crop stubble height can be kept at a minimum of 15 inches.³ This crop height should be present over at least half the field. Leaving stubble taller than 10 inches can help capture more snow and provide better insulation to plant roots.
- After harvest, grazing is another option if residue has accumulated over years, especially for areas that have frozen soils during winter. In a typical corn stalk or grain sorghum grazing period, cattle generally consume 25 to 50 percent of the available residue in 30 to 100 days, depending on stocking density.⁴

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Planting

- Planters equipped with row cleaners should be utilized to move residue and enhance seed-to-soil contact. Row cleaners can allow earlier soil warming and help reduce the chance of pinning residue into the seed slot. Aim for less than 10 percent residue cover on a zone one-third the row-width.¹
- Soil temperatures have been shown to be lower under corn residue compared to soybean residue.^{5,6} Planting dates may be later for fields following corn if measures were not taken at harvest to evenly distribute residue.
- Little to no modification will be needed for planters and drills operating with 20 to 30 percent residue cover on fields.¹

Residue Remaining After Tillage

- “Vertical” tillage, a form of conservation tillage, helps size residue while limiting soil disturbance. Vertical tillage tools cut the residue into smaller pieces for even distribution and better soil contact.
- Strip-tillage leaves the soil undisturbed except for narrow strips where tillage and residue removal are performed to facilitate planting. This allows for quicker soil warming in the planting area and helps reduce the potential for equipment-induced compaction.
- Consider the amount of residue remaining after each tillage operation. Chisel plowing can leave about 50 to 85 percent of non-fragile residue (corn or small grains) on the soil surface.² Approximately 70 to 95 percent of the remaining residue is maintained over winter. Remaining residue is reduced further by 60 to 80 percent with spring cultivation. Multiplying these factors together means an estimated 21 to 65 percent of residue would remain at planting time.

Residue in Continuous Corn Systems

- Consider harvesting continuous corn first to help maximize the time and availability of warmer weather, which aids microbial activity and, therefore, decomposition of residue.
- Combine heads should be set to cut corn about one foot or more above the ground (Figure 1).⁵ Harvesting at this height can:
 - 1) help reduce potential tire damage during field operations,
 - 2) make it easier to plant through because of less surface residue, and
 - 3) still provide wind and water erosion protection. Some heads chop the residue as it feeds through the head.



Figure 1. Photographed in May, these corn stalks were cut high in the fall and caught snow over winter.

- In wet springs, approximately two to three days before planting, consider running an empty planter across the field with row cleaners to move aside residue. This allows the topsoil to dry.⁷
- Corn stover can be chopped or baled and removed from fields. However, this will remove phosphorus and potassium and could also increase soil moisture loss from resulting bare soil.

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- Spring applications of additional nitrogen (N) would depend on environmental conditions that can influence microbial mediated residue degradation and release of N from residue. Residue decomposition is largely influenced by temperature and moisture that drives soil microbial populations. A corn crop that follows a late harvest, cold winter, and an early planting season may benefit from more N. Research has not consistently shown a benefit to fall applied N for the purpose of aiding residue decomposition.⁵

Measuring Residue

It may be helpful or required for conservation programs to estimate the percentage of crop residue cover. In some areas, about 12 to 20 percent residue is needed to protect relatively flat fields from water erosion. Fields with long or steep slopes may require at least 50 to 60 percent residue cover.⁸ The USDA recommends using the line-transect method for estimating and reporting percent residue cover. This method involves simple field observations and measurements using a 50- to 100-foot long measuring tape, line, or rope that can be marked at 100 equal intervals. Percent cover is determined by counting the number of marks that lie directly over a piece of residue. For complete details on the line-transect method and worksheets for reporting percent residue cover please refer to the USDA National Agronomy Manual (pages: 503-126 to 503-127) found at <http://www.nrcs.usda.gov>.

For a more general estimate of crop residue cover, when reporting is not necessary, the photo-comparison method can be used. This involves comparing sections of the field that are representative of typical residue cover throughout the field and comparing them to photographs of known percentage cover. Example photographs and a more detailed explanation on this method can be found in the Purdue University Agronomy Guide AY-269-W at <https://www.extension.purdue.edu>.

Summary

Harvest and planting are times to focus on residue management. The benefits of residue have led farmers to use less aggressive tillage to conserve some crop residue. Additional residue management options can be used in continuous corn systems.

Sources:

- ¹ Huber, A., King, D., Ribey, M. Best management practices residue management. Ontario Federation of Agriculture. AF179.
- ² Eck, K.J. and Brown, D.E. 2004. Managing crop residue with farm machinery. Agronomy Guide. AY-280-W. Purdue University Extension.
- ³ United States Department of Agriculture. Natural Resources Conservation Service. 2016. Residue and tillage management, no till. Code 329-CPS-2.
- ⁴ Rasby, R.J., Drewnoski, M.E., and Stalker, A. 2014. Grazing crop residues with beef cattle. Publication EC278, University of Nebraska-Lincoln.
- ⁵ Al-Kaisi, M. 2007. Tillage challenges in managing continuous corn. Iowa State University Extension. Integrated Crop Management.
- ⁶ Shen, Y., McLaughlin, N. Zhang, X., Xu, M., and Liang, A. 2018. Effect of tillage and crop residue on soil temperature following planting for a black soil in Northeast China. Scientific Reports.
- ⁷ Al-Kaisi, M. and Hanna, M. 2009. Tips for managing corn residue in continuous corn. Iowa State University. Integrated Crop Management News.
- ⁸ Al-Kaisi, M.M., Hanna, M., and Petersen, T.S. 2009. Residue management and cultural practices. Iowa State University Extension, PM 1901a.

Legal Statement

ALWAYS READ AND FOLLOW PESTICIDE LABEL DIRECTIONS. Performance may vary, from location to location and from year to year, as local growing, soil and weather conditions may vary. Growers should evaluate data from multiple locations and years whenever possible and should consider the impacts of these conditions on the grower's fields.

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