Ext/CrS 140 • March 2012

SUSTAINABLE AGRICULTURE TECHNIQUES

Making Strip Tillage Work for You: A Grower's Guide

K.M. Foley, C.C. Shock, O.S. Norberg, and T.K. Welch

Photo by Clint Shock

Figure 1. A corn field planted using strip tillage in Malheur County, OR, and irrigated using a center pivot sprinkler system.

Kelly M. Foley, graduate research assistant in water resources, Oregon State University; Clinton C. Shock, superintendent and professor, Malheur Experiment Station, Oregon State University; O. Steven Norberg, regional forage specialist, Washington State University; and Teresa K. Welch, Wild Iris Communications, Corvallis, OR

Cite as K.M. Foley, C.C. Shock, O.S. Norberg, and T.K. Welch. 2012. Making Strip Tillage Work for You: A Grower's Guide, Oregon State University, Department of Crop and Soil Science Ext/CrS 140.

What is strip tillage?

Strip tillage is a form of conservation tillage in which only the row zones are tilled, leaving the 9- to 12-inch inter-row zone undisturbed (Figure 1). The soil is not plowed.

What are the benefits of strip tillage?

In other parts of the country, strip tillage has provided a number of economic advantages to growers who convert from conventional tillage, while simultaneously reducing soil erosion, building soil organic matter, and improving water quality.

Strip tillage has the potential to increase the daily maximum soil temperature in the row zone and enhance early emergence compared to no-till. At the same time, inter-row residue cover helps to conserve soil moisture (Licht and Al-Kaisi 2005). With strip tillage, usually at least 30 percent cover of crop residue remains on the surface after planting, and the number of passes utilized during cultivation is decreased from approximately 5–10 to 1–2 (Morrison 2002). By eliminating a number of operations during cultivation, soil compaction is reduced and soil infiltration capacity is increased, thereby reducing runoff along the soil surface. As a result of these factors, the specific advantages of strip tillage include the following:

- Equal or greater crop yields
- Increased profit through elimination of several tillage operations
- Reduced labor, fuel, and fertilizer costs
- Reduced nutrient loss to runoff and leaching
- Reduced soil erosion and soil compaction
- Increased water savings

How has strip tillage worked for growers in Malheur County?

While strip tillage was designed for row crops grown on the heavy, poorly drained, cool soils of the northern Corn Belt, some farmers in the Pacific Northwest have begun to adopt this technique. Approximately 1,300 acres of land in Malheur County were cultivated using strip tillage in 2011.

Oregon State University | Extension Service

In addition, the Oregon State University Malheur County Extension Office and the Malheur Experiment Station worked alongside a number of growers in the county on a strip-tillage project. The goal was to determine whether strip tillage would yield the same economic and environmental advantages in the Treasure Valley as found by growers in other parts of the country.

In 2010 and 2011, four study sites were used for tillage comparisons. A portion of each field was tilled conventionally, and the other part was strip tilled. All four sites were irrigated using center pivot sprinkler systems.

The results of the study showed that the four study sites had fuel savings, reduced soil loss, and comparable crop yields by utilizing strip tillage. However, because the four sites were consistently over-irrigated, no relationship could be drawn between tillage method and soil moisture at either shallow or deep depth.

The soil moisture results of this study stress the importance of irrigation water management; it is imperative to have more precise irrigation management to reduce the environmental impact of farming and enhance profit margins.

Comparable crop yields

The crop yields from the studies in 2010 and 2011 are listed in Table 1. It is important to note that the yields between each tillage method were comparable. Corn yields under strip tillage in 2011 were slightly depressed due

Table 1. Crop yields for the conventional and strip-tilled portions of the study sites during 2010 and 2011. The yields are comparable between the conventional and strip-tilled portion of each field (shaded yields are higher), with neither method consistently producing higher yields.

Year	Crop	Conventional yield	Strip yield
2010	Corn silage	32 ton/ac	30 ton/ac
2010	Dry edible beans	2,253 lb/ac	2,418 lb/ac
2011	Dry edible beans	4,180 lb/ac	4,688 lb/ac
	Bean avg.	**3,217 lb/ac**	**3,553 lb/ac**
2010	Corn for grain	239 bu/ac	248 bu/ac
2011	Corn for grain	254 bu/ac	242 bu/ac
2011	Corn for grain	215 bu/ac	201 bu/ac
2011	Corn for grain	160 bu/ac	171 bu/ac
	Corn avg.	**217 bu/ac**	**216 bu/ac**

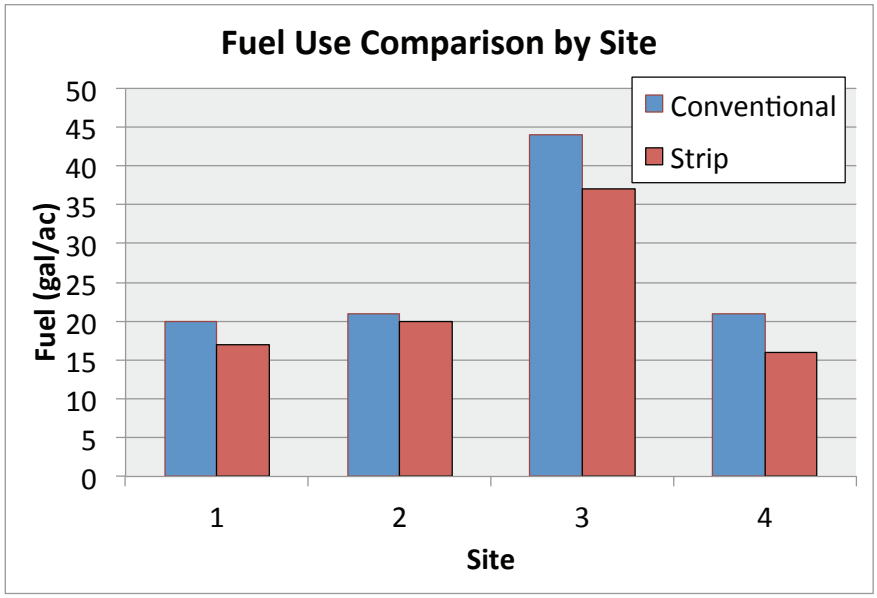

Figure 2. The fuel cost associated with conventional tillage and strip tillage at each of four sites in 2011. Strip tillage required less fuel than conventional tillage at all four sites. However, the fuel costs across sites were variable. The fuel consumptions in Figure 2 are in the same order as the 2011 crops listed in Table 1.

to cool, wet soil resulting from unusually cool, wet weather early in the season. If fuel and labor costs can be reduced while producing comparable yields, then strip tillage may be economically advantageous for many growers.

Fuel savings

The fuel costs at each site were determined using records of grower operations. Assuming that the model operations were representative of the true operations at each field, the results indicated that fuel costs were reduced by strip tillage at all four sites (Figure 2, page 2).

However, the strip-tillage fuel costs varied among sites, ranging from $25/acre to $135/acre. The reason for this variation is the lack of standards for what constitutes conventional tillage operations and strip-tillage operations. Regardless, the results show that by employing strip tillage and reducing the number of operations performed during tillage, fuel can be saved compared to conventional tillage.

Reduced soil loss

Table 2 shows the soil losses at all four sites for each tillage method. The soil losses were calculated using RUSLE2. At every site, strip tillage consistently showed lower soil losses than the conventionally tilled portion of the field. However, the soil loss at each site varied between <1 ton/acre/year to 11 ton/acre/year. This variation is indicative of differences in fields and how each tillage method was implemented differently by each grower.

Reduced soil temperature

At the site in which dry edible beans were grown in 2011, soil temperature sensors were installed at about 4-inch depth in the inter-row zone in order to determine whether or not the residue from the strip tillage would keep the soil cooler. Assuming that the locations where the sensors were installed were representative of the entire field, the conventional tillage consistently reached higher temperatures than the strip tillage between the months of June and September (Figure 3, page 4). The soil at 4-inch depth in the conventional tillage area was 4 to 6°F hotter in the early afternoon than with strip-tillage residue growing dry beans.

All other things being equal, cooler temperatures should result in decreased evaporation and, ultimately, higher soil moisture. This is especially advantageous for shallow-rooted crops such as dry beans, whose roots do not reach the deeper soil moisture.

How can strip tillage work for you?

While the benefits of strip tillage are variable, it is certainly a best management practice that, when used in conjunction with other best management practices, can help growers move toward more sustainable agriculture. In many cases, strip tillage is a viable means to increase

Table 2. The estimated soil loss at the four study sites was reduced under strip tillage. The percent savings ranged from 15–52 percent by utilizing strip tillage. Estimated soil losses ranged from <1 ton/acre/year to 11 ton/acre/year at the study sites.

	Tillage method			
	Conventional	Strip	Savings through strip tillage (ton/ac/yr)	Percent savings
Site #	Soil loss (ton/ac/yr)			
1	11.0	9.30	1.70	15
2	0.031	0.026	0.005	16
3	1.40	0.670	0.730	52
4	1.10	0.910	0.190	17

Malheur Experiment Station, Oregon State University, Ontario, OR, 2011.

profitability by reducing fuel and labor costs and simultaneously maintaining or even increasing yields.

The results of the strip-tillage study indicate that strip tillage is a relative term, interpreted differently by each grower and conducted on different soils in fields with different cropping histories. Thus, it should be noted that strip tillage cannot produce uniform increases in yield. The benefits of strip tillage depend on grower resources, irrigation water management practices, and a number of site-specific variables. Strip tillage is most effective in reducing environmental impacts and increasing profitably when it is combined with other best management practices, especially efficient irrigation systems and careful irrigation and nutrient management practices.

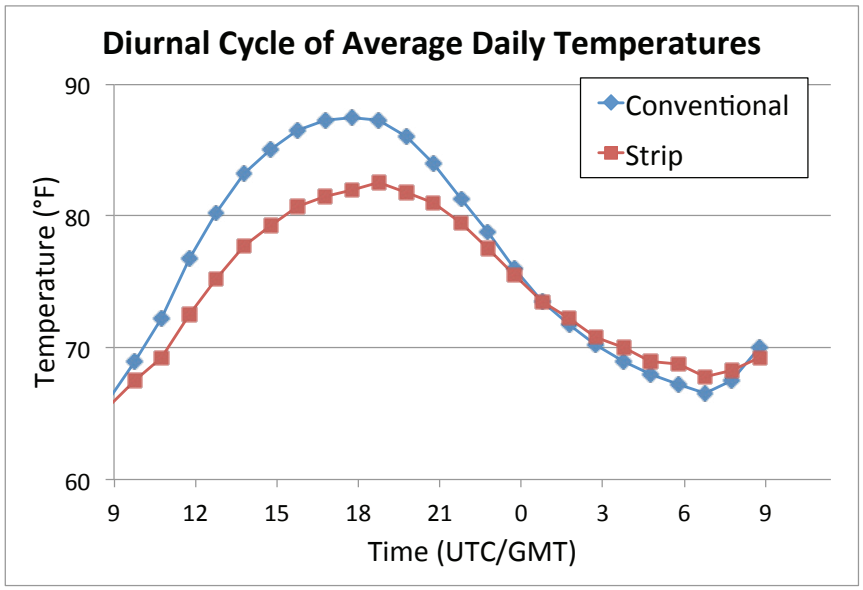

Figure 3. Average daily soil temperatures at 4-inch depth under conventional and strip tillage for a typical day.

What are the costs associated with investing in strip tillage?

While strip tillage can save money by reducing fuel, labor, and fertilizer costs, there is an initial investment cost in equipment when switching to strip tillage, which can be as much as $50,000.

Table 3. An estimate of the time it would take to pay off the initial equipment costs associated with adopting strip tillage in a wheat field.[1]

Cost scheduling for strip tillage

Number of acres strip-tilled	Savings per acre	Total savings	Time to pay off strip-till unit applying all savings to debt	Total savings after 10 years[2]
175	$75.50	$13,213	5.0 years	$66,170
250	$75.50	$18,875	3.5 years	$122,790
500	$75.50	$37,750	1.7 years	$311,540

[1]This example assumes $50,000 for the cost of the strip-till unit (including GPS). Yearly payments, including GPS, would be $13,192 for 5 years (total cost $65,960), which includes 10 percent interest. Life expectancy for equipment is generally estimated at 2,000 hours.

[2]Savings, after purchase of strip-till unit and carrying the loan for 5 years.

Adapted from Norberg, O.S. *Strip Tillage for High-residue Irrigated Cropping Systems*. Oregon State University Extension Service, EM 9009, August 2010.

The length of time needed to offset the initial investment costs depends on grower practices and operations, soil type, soil texture, soil compaction, soil nutrients, crop type, and irrigation management. Often, the cost savings associated with strip tillage can help you pay off the equipment in about 5 years, depending on your acreage.

Table 3 provides a cost schedule for paying off a $50,000 strip-tillage unit (including GPS) for three different-sized wheat fields. The cost savings are based on a reduction in labor, machinery, fuel, and herbicides associated with switching to strip tillage.

Yearly payments, including GPS, would be $13,192 for 5 years (total cost $65,960), which includes 10 percent interest. In this scenario, a grower farming 500 acres could pay off his strip-tillage unit in less than 2 years (assuming all savings are applied to debt)! It is important to note that this cost schedule is based on estimates, and that the costs, savings, and payments associated with any given field and crop are highly variable.

Can strip tillage be used with different irrigation systems?

Strip tillage is easier to incorporate under sprinkler or permanent drip irrigation systems. Strip tillage is less compatible with furrow irrigation due to the difficulty of residue management in the irrigation furrows.

What types of crops and field conditions are best suited for strip tillage?

When converting to strip tillage, it may be easier to start with a large-seeded crop, such as corn. Sugar beets and other small-seeded crops require a cleaner strip to plant. Dry beans, corn, wheat, and sugar beets have been grown successfully under strip tillage in Malheur County. Cutting wheat or barley stubble at 8 to 12 inches and baling is helpful prior to planting sugar beets.

Strip tillage is best suited for fields in which residue has been carefully managed. For example, significant piles of chaff from a previous crop will likely reduce stands. Fields left in poor condition, such as those with deep ruts from a wet harvest, may require a more conventional means of tillage.

Photo by Clint Shock

Figure 4. A strip-till unit allows cultivation only within the row zone.

It is also important to consider the soil type of your field when converting to strip tillage. For example, clay soils can get very dry under strip tillage, causing clods to form. However, strip tilling in the fall can help break down clods during winter freeze-thaw cycles prior to spring planting. Additionally, strip tillage when soil is too wet can cause compaction and smearing.

What equipment needs should I anticipate with strip tillage?

When converting to strip tillage, a strip-till unit is necessary in order to cultivate only the row zone and not the inter-row zone (Figure 4). For large areas, utilizing a GPS system is especially beneficial. Some growers prefer to attach a planter and/or a fertilizer pump to the tiller in order to further reduce fuel and labor costs.

Deep strip tillage requires greater horsepower during operations (up to 30 horsepower per row); however, these requirements will vary based on the tillage unit, shank depth, soil moisture, and speed of tillage. For best results, follow the manufacturer's recommendations. Row cleaners can be mounted on the front of the planting unit in order to move the residue aside during planting.

Photo by Clint Shock

Figure 5. A rolling stalk chopper used by growers in Malheur County to chop up residue prior to strip tillage.

Managing crop residue

Planning crop rotations ahead of time will help avoid problems with excessive residue. When harvesting the crop prior to strip tillage, ensure that residue is evenly spread. Evenly spreading the residue on the ground will help mitigate congestion of strip-tillage equipment. When it seems that there is too much residue for equipment to handle, consider grazing, baling, or use of a rolling stalk chopper or turbo till to reduce the size and total amount of residue prior to strip tillage (Figure 5).

If livestock are going to graze on the residue, be aware that volunteer wheat root mass may create problems later on when strip tilling A timely herbicide application may reduce problems in the following season.

Where can I learn more?

Oregon State University Malheur Experiment Station: http://www.cropinfo.net/

Oregon State University Malheur County Extension Office: http://extension.oregonstate.edu/malheur/agriculture/watershed-management

Strip Tillage in High Residue Systems Guide Sheet: http://extension.oregonstate.edu/malheur/sites/default/files/strip_tillage_in_high_residue_systems_em9009.pdf

Acknowledgments

The preparation of this publication was supported by the Oregon Department of Environmental Quality, the Oregon Watershed Enhancement Board, the U.S. Environmental Protection Agency, the USDA Natural Resources Conservation Service, and the Malheur County Soil and Water Conservation District.

For more information

Licht, M.A. and M. Al-Kaisi. 2005. Strip-tillage effect on seedbed soil temperature and other soil physical properties. Soil & Tillage Research 80:233–249.

Morrison Jr., J.E. 2002. Strip tillage for “no-till” row crop production. Applied Engineering in Agriculture 18:277–284.

Norberg, O.S. 2010 Strip Tillage for High-residue Cropping Systems. Oregon State University publication, EM 9009. http://extension.oregonstate.edu/

Tips for success

- Seek information from producers who are already using strip tillage.
- Allow time to learn a new farming system.
- Don’t conduct strip tillage or plant when it’s too wet.
- Planting in the center of the strip-tillage row will be worth your time, effort, and money.
- Apply fertilizer in rows for greater efficiency.
- Avoid compaction in the strip-tillage row.
- Anticipate new weed problems.