Corn planted into no-till corn residue © USDA

MINIMUM TILLAGE

A key characteristic of healthy soils is strong structure, or how particles of soil are grouped together into what are known as aggregates. These aggregates are instrumental to soil's ability to hold and infiltrate water, as well as facilitate nutrient and carbon cycling. However, the beneficial functions of soil aggregates are diminished when soil structure is damaged by destructive activities like tillage. By minimizing or even eliminating tillage, farmers can preserve soil function and avoid long term degradation. Minimizing tillage can lower costs in the form of reduced fuel and time in the tractor, and focusing on soil function also reduces needs for fertilizers when combined with other soil health practices.

Originally used as a means of clearing and preparing fields for planting, tillage has been used by farmers to create clean seed beds and reduce weed pressure. While tillage may provide short term benefits in terms of planting in a single season, over time these benefits are outweighed by negative impacts to the health of the soil. Tillage disturbs microbial communities and root-driven biological processes, which leads to compaction, reduces the soil's ability to feed plants and infiltrate water, and exposes soils to harsh conditions such as sun, wind and water erosion.

WHERE TO START

PRESCRIPTIVE TILLAGE

Prescriptive tillage, sometimes referred to as conservation or minimum tillage, refers to the practice of reducing the number and depth of tillage events to those that are only absolutely necessary for unavoidable circumstances, such as ruts in a field due to wet conditions, harvest of a root crop, weed pressure or water erosion events. Tillage reduction practices may include leaving residue post-harvest, direct seeding or even simply reducing the number of passes.

"We believe in soil health practices because we see firsthand the difference it makes for our crops and bottom line."

– Todd Ballard, farmer in Kimberly, ID

Figure 1. Strip tillage

Figure 2. No-tilling cover crops into grain residue

STRIP TILLAGE

Strip tillage is the practice of limiting tillage to the seed row. Row crops can be planted into a tilled strip, leaving the space in between the crop rows undisturbed. This is a good practice in areas with colder climates that need some solar heat to warm up the soils. Strip tillage also works well for crops that are not able to compete with residue or shade, such as dry edible beans. Strip till tools can either utilize a shank and coulters to till the strip or just coulters, which generally do less harm to the soil than a deep till shank. Strip tillage is also very useful in placing nutrients in the crop row.

NO TILLAGE (NO-TILL)

No-till is the act of planting and harvesting without disturbing the soil. This method is the best for soil health because without disturbance, soil microbes are able to create a granular soil structure that allows water to infiltrate, holds more air and water and enables soil life to thrive. No-till requires a different mindset and adjustments to overall operations. For instance, soils that have not been tilled are slower to warm up and dry out in the spring, potentially delaying planting dates. However, these same characteristics will be beneficial later in the season when air temperatures and water needs are high. Eliminating tillage also means leaving crop residue on the field at the end of the season. Management of residue is important in no-till systems, as the density and distribution of residue can impact seeding operations the next season. For best results, spread your residue at harvest evenly, leaving crop residue attached by the roots when possible. The most significant barrier to transitioning to no-till systems is equipment costs.

Those interested in trying strip tillage or no-till should contact their soil conservation district, as some have equipment available to rent.

IN THE FIELD

In 2018, Todd Ballard of Kimberly, ID decided to reduce tillage passes on his farm to improve his soil health and reduce input costs. To achieve this goal, Todd purchased a no-till drill that could seed directly into the soil without tillage and handle much higher residue levels during planting. Because another concern was chaff and straw (residue) management with the combine, an aftermarket chaff spreader was installed on the combine.

While Todd was able to no-till his barley, dry edible beans, cover crops and some alfalfa, he found that residue management remained an issue, especially with the cover crops. Crop emergence was reduced in the chaff row and poor seed-to-soil contact in the heavy chaff rows created problems for the drill.

To address these issues, Todd adopted a system of prescription tillage. In this system, shallow tillage was applied when residue levels were high, usually following barley. A high-speed disk, at a depth of 3-4 inches, was used to incorporate reside before planting. Single disk drills perform much better than double disk drills in these conditions. When residue levels are low, no tillage is needed before planting.

While no-till is the ultimate goal for maximum soil health benefits, some tillage may be necessary for the system to be successful. Haney tests on Todd's farm show that soil health indicators are increasing each year. Soil aggregation, soil biology, soil respiration (the amount of life in the soil) and soil carbon have all increased in this system. Crop residue is now decomposing at a faster rate because of the increased biology in the soil.

Todd Ballard on his farm in Kimberly © Neil Crescenti

ADDITIONAL RESOURCES

Idowu J., Angadi S., Darapuneni M., and Ghimire R. (2017) Reducing Tillage in Arid and Semi-arid Cropping Systems: An Overview. College of Agricultural, Consumer, and Environmental Sciences, New Mexico State University (Guide A-152). https://pubs.nmsu.edu/_a/A152/

Foley K.M., Shock C.C., Norberg O.S., and Welch T.K. (2012) Making Strip Tillage Work for You: A Grower's Guide. Oregon State University, Department of Crop and Soil Science (Ext/CrS 140). https://agsci.oregonstate.edu/system/files/extcrs140striptillage.pdf

Hilshey B. and Bench C. (2021) A Practical Guide to No-till and Cover Crops in the Mid-Atlantic. North Jersey Resource Conservation and Development District. Web page: https://www.northjerseyrcd.org/no-till-and-cover-crop-book

Creech, E. (2017) Saving Money, Time and Soil: Economics of No-Till Farming. Natural Resources Conservation Service-. Web page: https://www.usda.gov/media/blog/2017/11/30/saving-money-time-and-soil-economics-no-till-farming

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