EQUIPMENT

Tillage

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SECTIONS

Section 1: Tillage

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INTRODUCTION

Tillage is the mechanical loosening, inverting, or mixing of soil. Tillage can affect many different aspects of production including managing weeds or plant residues, incorporating fertilizers, remediating compaction at the surface level, and establishing good seed-to-soil contact. The importance of each factor to your production goals may influence the tillage system you choose to use. Different types of equipment can be used to achieve each tillage goal, or a combination of goals, based on the depth and amount of soil disturbance.

How to Get Started

It's important to understand the conditions and characteristics of your fields when selecting a tillage system, as tillage systems are not "one size fits all". Soil characteristics, including physical properties, slope, and moisture need to be considered. Crop rotation and management (i.e., organic crops will require more tillage) may also be factors in determining the ideal tillage systems for your fields.

Another consideration for tillage equipment would be matching the implement to the appropriate tractor. Many tillage implements require a certain amount of horsepower and some require an optimal speed for effective performance. Consider what equipment you already have or may need before settling on any specific tillage implement.

Once a tillage system has been identified, the next step is to determine which implements will be needed. Tillage equipment, or implements, can often be expensive and require a large amount of capital to buy. Used equipment may be more economical upfront than newer equipment. However, used equipment may require extensive repairs to restore them to peak operating ability or into a condition that is good enough for what you want, even if you are not after peak performance. If finances are limited to purchase equipment, another alternative is to hire other farms that offer custom tillage or planting services.

SECTION 1

Tillage

Primary Considerations

- Types of tillage systems
- Types of tillage equipment and their functions
- Advantages and disadvantages of tillage

Process for Getting Started

Types of Tillage Systems

Tillage systems can be generally classified into three categories: conventional tillage, reduced tillage, or conservation tillage.

In **conventional tillage**, there is a higher degree of soil mixing or disturbance. Sometimes referred to as primary tillage; equipment often includes plows, disks, sub-soilers, or even rotary tillers.

In **reduced tillage**, at least one or more operations in conventional tillage are removed. Often the more aggressive forms of tillage, such as plowing. In some instances, lighter tillage equipment is used in place of heavy-duty implements. Examples include light to medium size disks, field cultivators, rollers, or soil finishers. Note: the terms "minimum tillage" or "secondary tillage" are often associated with reduced tillage.

In **conservation tillage**, a minimal amount of soil mixing or disturbance is seen and at least 30% of the soil surface has crop residue coverage. The goal is to keep crop residues on the soil surface to reduce erosion, improve water infiltration, and enhance soil health. A few examples of conservation tillage include no-till, strip tillage and vertical tillage.

Strip tillage

- ***No-till practices*** use a planter designed to create a narrow opening to place seeds in the ground without soil mixing or turning. No-till systems do not include physical soil disturbance before or after planting.
- ***Strip Tillage*** uses a strip tiller machine and only tills the ground where the seed bed will be leaving the area in between the rows undisturbed.
- ***Vertical Tillage*** uses a vertical tillage machine, and it cuts up, or "chops", crop residue and lightly tills the top 1-4 inches of soil. This kind of tillage moves the soil vertically rather than sideways.

Types of Tillage Equipment and Their Functions

Soil finisher

There are different types of tillage equipment or implements. Each implement performs a different type or combination of types of tillage in a field. It's important to understand what each implement does and which type of tillage system it is associated with.

Plows

An aggressive form of tillage that inverts or turns the soil over. Soil depth for plows can be 6-16 inches deep and may leave large soil clods or aggregates. Additional tillage is often needed to finish preparing the soil before planting.

- ***Moldboard*** – Inverts soil leaving very little surface residue, deeper tillage method (8-12 inches) and typically occurs in the fall.
- ***Chisel (straight or twisted shank)*** – Less aggressive than moldboard plow and can leave 40—45% residue, has a row of coulters or disks to break up residue and then has shanks that are staggered to work the subsoil.

Disks

This type of tillage implement cuts through the soil and buries part of the crop residue. They can be used to break up the soil surface or used in deeper tillage similar to a plow. Depending on the shape and type of disk, it can leave a smooth surface.

- ***Disk Ripper*** – Tills at a depth of 12-16 inches with a set of disks, followed by shallow shanks and then deep shanks. Can leave 35-45% residue coverage.
- ***Disk*** – Tills at a depth of 5-8 inches, unlike a disc ripper this does not have shanks.

Disk ripper

Cultivators

Field cultivator with rolling basket

A field cultivator can be used as a primary or secondary tillage tool to bury crop residue, control weeds, loosen the soil, mix in products, and prepare the seedbed. Field cultivators affect the entire surface of the soil they pass over at a depth of 5 inches or less. Another type of field cultivator is a row cultivator. Row cultivators only impact soil between crop rows and are used to remove weeds or apply fertilizers in-season.

Harrows

A harrow is a secondary tillage tool used to level the soil surface, redistribute surface residue, break apart soil clods, and disturb weed germination. These types of tillage equipment can be used independently or attached to the rear of disks, field cultivators, or drills.

Finishers

Soil finishers are another type of tillage implement that combines several tillage operations into one tool. They are used to finish preparing the seed bed before planting. Disking, field cultivating, and soil leveling implements are commonly seen on soil finishers.

Vertical Tillage Tools

Tillage equipment used to mix the soil vertically not horizontally. This can include subsoilers, disk chisels (not true vertical tillage), chisel plows with vertical points, or secondary spike tooth harrows. For more information on vertical tillage, visit **North Carolina State's Vertical Tillage website** (https://soilmanagement.ces.ncsu.edu/tillage-management/vertical-tillage).

Planters

Planter

Planters utilize light soil disturbance to place seed in the soil. Single or double disk openers cut through surface residue to open a slot in the soil for seed placement. Row cleaners may also be equipped to physically move crop residue away from the seedbed. They are common on many planters, including no-till planters, to aid the planting process. Coulters may also be used to assist in creating a wider slot in the soil for planting.

For more information on types of tillage equipment, review the University of Minnesota's **The purpose and ideal uses for tillage implements** (https://extension.umn.edu/soil-management-and-health/tillage-implements-purpose-and-ideal-use).

Also, review USDA's **Tillage Equipment Pocket Identification Guide** (https://downloads.snapplus.wisc.edu/nrcseprd1323703.pdf).

Disclaimer: For a specific list of resources in the above description, view the Necessary Resources area of this section.

TILLAGE

COMMON QUESTIONS

01 Is it considered a conservation tillage system if I use reduced tillage for a crop one year and no-till for another crop the next?

No. If no-till or other conservation tillage practices are used on only some crops in a rotation, the field is not considered to be in a conservation tillage system. For example, a field cultivator is used prior to planting corn in a field. The next year, soybeans are planted with a no-till planter in the same field. Because a field cultivator is used in the field's crop rotation, a reduced tillage system rather than a no-till system would be a more appropriate description.

02 What are the advantages of tilling?

Tillage loosens the soil for planting, controls weeds, incorporates fertilizer and organic matter, and can improve soil temperatures in the spring.

03 What are the disadvantages of tilling?

Tillage can create soil compaction, breakdown soil structure, disturb soil life (worms, fungi, microbes) important to soil health, and loss of moisture from drying out soils.

RESOURCES & PARTNERS

Necessary Resources

- Corn Tillage Systems (University of Wisconsin Madison)
  https://corn.agronomy.wisc.edu/Management/L007.aspx
- Definitions of Tillage Systems for Corn (University of Nebraska-Lincoln)
  https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1247&context=biosysengfacpub
- Fall-Tillage Tips for Vegetables (MSU Extension)
  https://www.canr.msu.edu/news/fall_tillage_tips_for_vegetables
- Farmer Field Schools reference material on tillage from the Food and Agriculture Organization of the United Nations
  https://www.fao.org/fileadmin/templates/nr/images/resources/pdf_documents/tillage_module.pdf
- Lessons from Long Term Research: Comparing No-Till to Conventional Tillage Over 30 Years (MSU Extension)
  https://www.canr.msu.edu/resources/lessons-from-long-term-research-comparing-no-till-to-conventional-tillage-over-30-years

- The purpose and ideal uses for tillage implements (University of Minnesota) https://extension.umn.edu/soil-management-and-health/tillage-implements-purpose-and-ideal-use
- Tillage in Michigan Soybean Systems (MSU Extension) https://www.canr.msu.edu/videos/tillage-in-michigan-soybean-systems
- Tillage Management (NC State Extension) https://soilmanagement.ces.ncsu.edu/tillage-management/
- Upper Midwest Tillage Guide https://www.swiftswcd.org/uploads/9/8/2/9/98296824/upper_midwest_tillage_guide.pdf
- USDA Natural Resources Conservation Service (NRCS) Tillage Equipment Pocket Identification Guide https://downloads.snapplus.wisc.edu/nrcseprd1323703.pdf
- USDA Natural Resources Conservation Service (NRCS) Tillage Practice Guide https://mssoy.org/sites/default/files/documents/tillage-practice-guide-five.pdf
- Vertical Tillage for Corn Residue Management (MSU Extension) https://www.canr.msu.edu/news/vertical_tillage_for_corn_residue_management

Partners

- USDA Natural Resources Conservation Service (NRCS) https://www.nrcs.usda.gov/