

Unit E: Basic Principles of Soil Science

Lesson 8: Employing Conservation Tillage Practices

Terms

- Conservation tillage
- Continuous cropping
- Conventional tillage
- Crop rotation
- Double cropping
- Organic farming
- Post emergence tillage
- Pre-plant tillage
- Primary tillage
- Secondary tillage
- Sustainable agriculture
- Tillage

What are the various uses of tillage?

- Tillage is working the soil to provide a favorable environment for seed placement, germination, and crop growth.
- To grow properly, seeds need a moist soil at the appropriate temperature with sufficient air for seed respiration.
- The seedbed should be loose enough for good aeration, yet compact enough around the seed for good soil-seed contact. It should be free of clods that prevent proper seedling emergence.

- There are a variety of tillage system options available to the crop producer.
- However, there are three basic goals that must be met by whatever tillage system a producer decides to utilize. Those three goals are: weed control, physical soil conditions, and crop residue management.

- Weed control
 - The importance of tillage for weed control has declined with the increase in herbicide use.
 - Some herbicides are incorporated into the soil by shallow tillage.
 - Tillage for weed control can be divided into two time periods.

- Pre-plant tillage is tillage of the soil before the crop is planted.
 - This tillage prepares a weed free seedbed that reduces the weed pressure during the growing season.
 - This tillage is designed to destroy young weed seedlings.



- Post emergence tillage is tillage done between rows of growing crops.
 - This cultivation is designed to destroy or bury emerging weed seedlings.
 - Deep cultivation or cultivation late in the growing season could sever crop roots.

- Physical soil conditions
 - Tillage alters physical soil properties such as structure, moisture, and temperature.
 - Tillage during seedbed preparation stirs and loosens soil, improves aeration, and creates a suitable medium for plant growth.
 - Deep tillage and subsoiling may temporarily break up subsoil compaction.

- Crop residue management
 - After a crop is harvested, residues like stalks or leaves remain in the field.
 - The amount of residue depends on the type of crop, how well it grew, and how it is harvested.
 - Different tillage methods leave varying amounts of crop residue on the surface of the soil.

What is conventional tillage?

- Conventional tillage is a tillage system made up of two stages, primary and secondary tillage.
 - Primary tillage breaks up the soil and buries crop residues. This is often accomplished with a soil inverting implement, like a plow.
 - Secondary tillage produces a fine seedbed by a series of operations that break up the soil into smaller and smaller chunks.

- The traditional primary plowing tool is the moldboard plow.
 - The moldboard plow shears off a section of soil, tips it upside down, and fractures it along several planes. During this process, any organic matter on the soil surface is buried.
 - When finished, this implement leaves the soil surface very rough with a series of ridges and furrows.

Moldboard Plow

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- Other primary tillage tools are the disc plow and subsoilers.
 - A disc plow is an implement with a series of three to ten large discs mounted on a frame at an angle to the direction of travel.

Disc Plow



- Secondary tillage is usually a two-step process.
 - First ridges left from plowing are smoothed out and large clods are broken. Then smaller lumps are pulverized and a fine seedbed is produced.
 - The first step is commonly accomplished with a tandem disc.

- The typical tandem disc has four gangs of discs set like the four arms of an “X.” The front two gangs turn the soil inward, and the back two turn it back out.



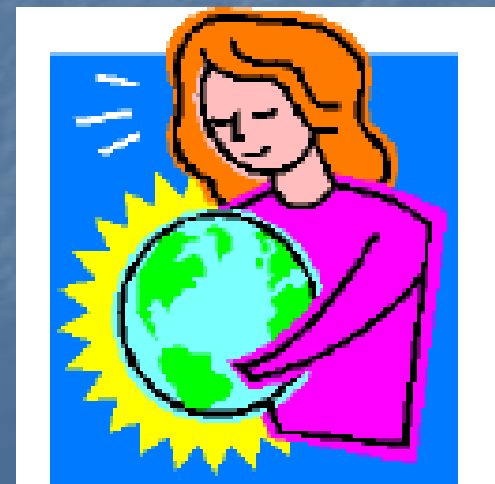
- A spring-tooth harrow can also be used in secondary tillage.
 - This implement is made of long, springy, C-shaped teeth with a shear point or broad shovel that digs into the soil, dragging clods to the surface and breaking them up.
 - A finishing harrow or drag is used to pulverize the soil clods into a smooth, fine surface.

Spring-tooth harrow



What is conservation tillage?

- Conservation tillage is a tillage program aimed at reducing erosion by leaving crop residues on a rough soil surface.
 - Rather than plowing under crop residues, some or all of the residue is left exposed.



- The definition of conservation tillage has required that, at planting, 30 percent or more of the soil surface be covered with crop residues.
- Conservation tillage reduces water and wind erosion by at least 40 to 50 percent. This practice also improves organic matter content near the surface of the soil.

- Conservation tillage has its advantages and disadvantages when compared to conventional tillage.
 - Soil prepared by conservation tillage tends to be cooler than clean-tilled soil because of light reflection off the mulch and increased soil moisture.
 - In warm climates, cooler soil benefits production, but may hinder initial plant growth in northern states.

- Conservation tillage provides the benefit of fewer trips across the field.
- This means less time in the fieldwork and lower fuel costs.
- This can also translate into reduced soil compaction because of less wheel traffic.

- With less tillage in a conservation tillage program, greater reliance is placed on herbicides for weed control.
- Tillage will kill any weed seedling, but herbicides are more selective.
- This makes weed identification and herbicide selection critical.

- Because of soil conservation and economic benefits of conservation tillage, its use has spread rapidly.
- The term conservation tillage covers several different tillage methods.
 - Mulch-till or chisel-plow—A chisel plow loosens the soil but does not invert it. This is used for primary tillage. Chisel plowing to eight inches leaves the soil rough with about 50 –80 percent residue cover. Light disking can then reduce residues to 30–50 percent. Seeds are then planted through the remaining residues.

Chisel Plow



- Strip-till—With no primary tillage, a specialized implement tills a band of soil and plants seeds into the band. Another implement sweeps residues off a strip into the middle of the rows. This operation normally leaves about 50 percent of crop residue.

Strip Till



- Ridge-till—The ridge-till system excels in cool, moist conditions. Seed is planted on six-inch ridges with crop residues swept into the shallow furrows. About two-thirds of crop residues remain after planting. Cultivation with special tools minimizes residue burial and rebuilds ridges for the coming year.

Ridge Till



- No-till—In this method soil is barely disturbed. Specialized planters cut a slot through the residue, insert the seed and possibly fertilizer and then close the slot. About 90 percent of the soil surface remains untouched after planting. Herbicides are the main form of weed control used in this system.

No Till



What are some various cropping systems?

- A number of different cropping systems are available to the crop producer. The system selected depends on climate, economics and market demand, government programs, and producer preferences. Each system requires different soil management techniques and has different effects on the soil.
- Some of the most common cropping systems are:

- In continuous cropping, a producer grows the same crop each year.
 - Many favor this system because it allows the producer to grow the most profitable crop. It also allows a person to specialize in the crop best suited to local soil or climate.
 - However, yields often decline with continuous cropping.

- Crop rotation means that a series of different crops is planted on the same piece of land in a repeating order.
 - Crop rotation aids the control of diseases and insects that rely on one plant host. Helps control weeds. Supplies nitrogen if certain legumes are in the rotation. Improves soil organic matter and tilth. Reduces erosion if the rotation includes small grains and forages.

- Double cropping is the practice of harvesting two crops from the same land in one year.
 - A common example is planting soybeans into winter wheat stubble. In this system soil is covered with vegetation for a larger part of the year, thus reducing erosion.
 - Also this allows the producer to gain two incomes off the property. However, double cropping does draw more heavily on soil nutrients and water.

- Organic farming is farming in which no inorganic fertilizers or synthetic pesticides are used.
 - There are many varieties of organic farms.
 - Organic farms depend on tillage and other cultural techniques to control pests.



- Sustainable agriculture can be defined as a philosophy and collection of practices that seek to protect resources while ensuring adequate productivity.
 - It strives to minimize off-farm inputs like fertilizer and pesticides, and to maximize on-farm resources like livestock manure and nitrogen fixation by legumes.
 - Soil and water management are central components.

Review/Summary

- What are the various uses of tillage?
- What is conventional tillage?
- What is conservation tillage?
- What are some various cropping systems?