

Unit E: Basic Principles of Soil Science

Lesson 8: Employing Conservation Tillage Practices

Student Learning Objectives: Instruction in this lesson should result in students achieving the following objectives:

1. Explain the uses of tillage.
2. Explain conventional tillage.
3. Explain conservation tillage.
4. Discuss cropping systems.

Recommended Teaching Time: 3 hours

Recommended Resources: The following resources may be useful in teaching this lesson:

- A PowerPoint has been developed for use with this lesson plan

List of Equipment, Tools, Supplies, and Facilities:

Writing surface
PowerPoint Projector
PowerPoint Slides
Transparency Masters

Terms: The following terms are presented in this lesson (shown in bold italics and on PowerPoint Slide 2):

- 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

Interest Approach: Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

Explain to the students that in order to grow a crop, a producer plants seeds into the soil. The producer must in some way provide nutrients, control pests, and provide for the general well being of the plant in order for it to produce. Although all crops start by the planting of the seed, there are various methods a producer can use to prepare the seedbed. Ask the student's for various methods and lead into a discussion about tillage.

Summary of Content and Teaching Strategies

Objective 1: Explain the uses of tillage.

(PowerPoint Slide 3)

I. **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.

(PowerPoint Slide 4)

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:

(PowerPoint Slide 5)

- A. 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.

(PowerPoint Slide 6)

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.

(PowerPoint Slide 7)

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.

(PowerPoint Slide 8)

- B. 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.

(PowerPoint Slide 9)

- C. 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.

****Have students talk about their experience with tillage. Ask questions to engage the students before you present the information. Find out how much they know and then go over objective one.**

Objective 2: Explain conventional tillage.

(PowerPoint Slide 10)

II. **Conventional tillage** is a tillage system which is 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.

(PowerPoint Slides 11 and 12)

A. 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.

(PowerPoint Slides 13 and 14)

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.

(PowerPoint Slide 15)

B. 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.

(PowerPoint Slide 16)

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.

(PowerPoint Slides 17 and 18)

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.

Objective 3: Explain conservation tillage.

(PowerPoint Slide 19)

III. **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.

(PowerPoint Slide 20)

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.

(PowerPoint Slide 21)

- A. As with all things, conservation tillage has its advantages and disadvantages when compared to conventional tillage.
 1. 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 provinces.

(PowerPoint Slide 22)

- 2. 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.

(PowerPoint Slide 23)

- 3. 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.

(PowerPoint Slides 24 and 25)

- B. Because of soil conservation and economic benefits of conservation tillage, its use has spread rapidly. The term conservation tillage covers several different tillage methods. Some of them are:

- 1. 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.

(PowerPoint Slides 26 and 27)

- 2. 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.

(PowerPoint Slides 28 and 29)

- 3. 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.

(PowerPoint Slides 30 and 31)

- 4. 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.

****Use TM: E8-1 and TM: E8-2 to aid in the discussion on this topic. Ask the students if they perform these methods at their homes. Even if they don't**

use the specific machines, they might still use some of the same techniques.

Objective 4: Discuss cropping systems.

(PowerPoint Slide 32)

IV. 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:

(PowerPoint Slide 33)

A. Continuous cropping—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.

(PowerPoint Slide 34)

B. Crop rotation—**Crop rotation** means that a series of different crops is planted on the same piece of land in a repeating order. Crop rotation has important benefits. 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.

(PowerPoint Slide 35)

C. Double cropping—**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.

(PowerPoint Slide 36)

D. Organic farming—**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.

(PowerPoint Slide 37)

E. Sustainable agriculture—Increasing concern for long-term farm productivity and the effect of agricultural practices on the environment led to this concept. **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.

****Ask students what type of cropping systems they care currently using at their homes. Have the students explain their operations.**

Review/Summary: Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used in determining which objectives need to be reviewed or taught from a different angle. Questions on PowerPoint Slide 38 can also be used.

Evaluation: Focus the evaluation of student achievement on mastery of the objectives stated in the lesson. Measure student performance on classroom participation, laboratory assignments, and written tests or quizzes.

Answers to Sample Test:

Part One: Matching

1 = e, 2 = h, 3 = d, 4 = b, 5 = g, 6 = a, 7 = f, 8 = c

Part Two: Completion

1. chisel plow
2. cooler
3. 40,50
4. Double cropping
5. tillage
6. moldboard plow

Part Three: Short Answer

Answers will vary. See Objective 2 and 3 for scoring.

Sample Test

Name _____

Test

Unit E Lesson 8: Employing Conservation Tillage Practices

Part One: Matching

Instructions. Match the term with the correct response. Write the letter of the term by the definition.

- | | |
|----------------------------|---------------------------|
| a. Conservation tillage | b. Organic farming |
| c. Pre-plant tillage | d. Conventional tillage |
| e. Sustainable agriculture | f. Post emergence tillage |
| g. Primary tillage | h. Secondary tillage |

- _____ 1. A philosophy and collection of practices that seek to protect resources while ensuring adequate productivity.
- _____ 2. Produces a fine seedbed by a series of operations that break up the soil into smaller and smaller chunks.
- _____ 3. A tillage system which is made up of two stages, primary and secondary tillage.
- _____ 4. Farming in which no inorganic fertilizers or synthetic pesticides are used.
- _____ 5. Breaks up the soil and buries crop residues.
- _____ 6. A tillage program aimed at reducing erosion by leaving crop residues on a rough soil surface.
- _____ 7. Tillage done between rows of growing crops.
- _____ 8. Tillage of the soil before the crop is planted.

Part Two: Completion

Instructions. Provide the word or words to complete the following statements.

1. A _____ loosens the soil but does not invert it is used for primary tillage.
2. Soil prepared by conservation tillage tends to be _____ than clean-tilled soil because of light reflection off the mulch and increased soil moisture.
3. Conservation tillage reduces water and wind erosion by at least _____ to _____ percent.

4. _____ is the practice of harvesting two crops from the same land in one year.
5. Organic farms depend on _____ and other cultural techniques to control pests.
6. The _____ shears off a section of soil, tips it upside down, and fractures it along several planes.

Part Three: Short Answer

Instructions. Provide information to answer the following question.
Compare and contrast conventional tillage and conservation tillage.

TM: E8-1



(Courtesy, Case Corporation)

TM: E8-2

RIDGE TILLAGE SYSTEM PLANTING

