Lesson C7–4

Employing Conservation Tillage Practices

Unit C. Plant and Soil Science

Problem Area 7. Soil Erosion and Land Management

Lesson 4. Employing Conservation Tillage Practices

New Mexico Content Standard:

Pathway Strand: Plant Systems

Standard: **III:** Apply fundamentals of production and harvesting to produce plants.

Benchmark: **III-A.** Apply fundamentals of plant management to develop a production plan.

Performance Standard: **3.** Evaluate and demonstrate planting practices (e.g., population rate, germination/seed vigor, inoculation, seed and plant treatments).

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.

List of Resources. The following resources may be useful in teaching this lesson:

Recommended Resources. One of the following resources should be selected to accompany the lesson:

Plaster, Edward J. *Soil Science & Management.* Albany, New York: Delmar. 1997 (Chapter 15)

Other Resources. The following resources will be useful to students and teachers:

Brady, Nyle C. *The Nature and Properties of Soils*. Englewood Cliffs, New Jersey: Prentice-Hall, Inc. 1990 (Chapter 15)

Parker, Rick. *Introduction to Plant Science.* Albany, New York: Delmar. 1998 (Chapter 5)

List of Equipment, Tools, Supplies, and Facilities

Writing surface
Overhead projector
Transparencies from attached masters

Terms. The following terms are presented in this lesson (shown in bold italics):

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.

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.

Summary of Content and Teaching Strategies

Objective 1: Explain the uses of tillage.

Anticipated Problem: What are the various uses of tillage?

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. 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:

   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. ***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.

   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.

   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.

There are many techniques that can be used to assist students in mastering this material. Students need text material to aid in understanding the various uses of tillage. Chapter 15 in Soil Science & Management is recommended. Use TM: C7–4A to aid in the discussion on this topic.

Objective 2: Explain conventional tillage.

Anticipated Problem: What is conventional tillage?

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.

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. Other primary tillage tools are the disc plow and subsoilers. A disc plow is an implement with a series of three to ten large (2 to 2.5 feet) discs mounted on a frame at an angle to the direction of travel.

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. 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.

There are many techniques that can be used to assist students in mastering this material. Students need text material to aid in understanding conventional tillage. Chapter 15 in Soil Science & Management is recommended.

Objective 3: Explain conservation tillage.

Anticipated Problem: What is conservation tillage?

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. 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.

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 states.
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.
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.

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.
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.
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.
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.

There are many techniques that can be used to assist students in mastering this material. Students need text material to aid in understanding conservation tillage. Chapter 15 in Soil Science & Management is recommended. Use TM: C7–4B thru TM: C7–4D to aid in the discussion on this topic.

Objective 4: Discuss cropping systems.

Anticipated Problem: What are some various cropping systems?

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:

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.

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.

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 stub-

ble. 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.

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.

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.

There are many techniques that can be used to assist students in mastering this material. Students need text material to aid in understanding various cropping systems. Chapter 15 in Soil Science & Management is recommended.

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 at the end of the textbook chapters may also be used in the review/summary.

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

Lesson C7–4: 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: C7–4A

CROP RESIDUE IN POUNDS PER ACRE

Crop	Approximate Residue per Bushel Grain (lb/acre)		Sample Yield (bu/acre)		Sample Residue (lb/acre)
Barley	80	×	50	=	4,000
Corn	56		125		7,000
Oats	60		32		4,300
Rye	100		30		3,000
Soybeans	50		40		2,000
Wheat	100		40		4,000

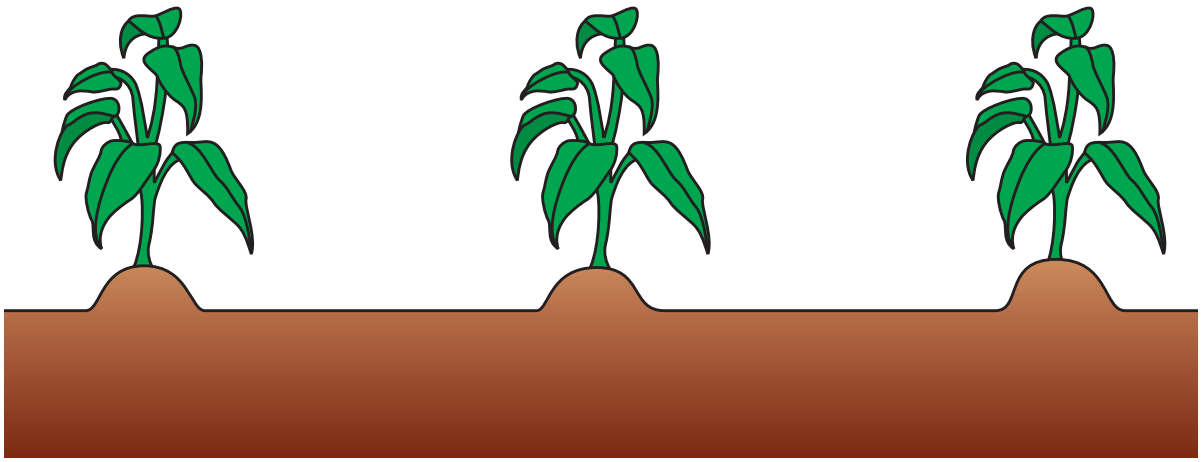
TM: C7–4B

THE CHISEL PLOW— PRIMARY TILLAGE TOOL IN THE MULCH-TILL SYSTEM

(Courtesy, Case Corporation)

TM: C7–4C

RIDGE TILLAGE SYSTEM PLANTING



TM: C7–4D

EFFECT OF TILLAGE SYSTEMS ON SOIL EROSION AND RUNOFF FROM CORN PLOTS