

Unit F: Soil Fertility and Moisture Management

Lesson 3: Applying Fertilizers to Field Crops

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

1. Explain the application of fertilizers to field crops.
2. Identify the methods of fertilizer application.
3. Explain the rate of fertilizer application.

Recommended Teaching Time: 2 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
Copies of Student Work Sheets

Terms: The following terms are presented in this lesson (shown in bold italics and on PowerPoint Slides 2 and 3):

- Banding
- Broadcasting
- Build up
- Chiseling
- Deep placement
- Fertigation
- Foliar feeding
- Knifing
- Luxury consumption
- Maintenance
- Pop-up fertilizers
- Post-emergence
- Pre-emergence
- Preplant
- Root zone banding
- Sidedressing
- Site-specific application
- Soil injection
- Soil testing
- Starter fertilizer
- Tissue testing
- Top dressing
- Variable rate technology (VRT)
- Global positioning systems (GPS)
- Trilateration

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.

Display examples of crops or grain and ask students to identify the differences. Lead a class discussion concerning what makes one crop or grain better than another. The discussion should move towards healthy plants and how they become or stay healthy.

Summary of Content and Teaching Strategies

Objective 1: Explain the application of fertilizers to field crops.

(PowerPoint Slide 4)

I. Fertilizing can increase yields and increased yields add to a grower's income.

(PowerPoint Slide 5)

A. Because fertilizers cost money, a grower must add the amount that is most profitable. The yield of a crop is directly related to the nutrient level of the soil. The nutrient level of a plant can be divided into four levels.

(PowerPoint Slide 6)

1. Level I: Deficient—The nutrient is clearly deficient; growth and productivity are affected. After the missing mineral is applied, growth response is strong and profitable.
2. Level II: Sufficient—A critical level is reached which satisfies plant needs. More fertilizer may increase yields slightly, but not enough to pay for fertilizer.

(PowerPoint Slide 7)

3. Level III: High—Nutrient levels are high, yields are maximum. Additional nutrients would be stored in the plant which is referred to as ***luxury consumption***. Fertilization could shift the plant to Level IV or contribute to water pollution.
4. Level IV: Toxic—Nutrient levels in plant tissue are so high as to be toxic. Yields decline.

(PowerPoint Slide 8)

- B. Three methods can be used to find nutrient shortages in plants.
1. Visual inspection of crops for deficiency signs may uncover clear shortages. This method often notes only critical shortages after yield damage has already occurred.

(PowerPoint Slide 9)

Visual symptoms may be unreliable. Other problems not related to soil nutrient levels may be present that are affecting plant growth.

(PowerPoint Slide 10)

2. **Tissue testing** measures nutrient levels in plant tissue. This type of testing may uncover problems that soil testing misses.

(PowerPoint Slide 11)

3. **Soil testing** measures nutrient levels in soil as well as other soil features. Testing laboratories operate on one of two concepts of fertility levels. Fertilize the soil to bring it to an optimum level, then adding yearly maintenance amounts to replace those lost by crop harvest.

(PowerPoint Slide 12)

Frequent soil tests followed by fertilization of the plant to supply needs. Growers depend on these tests to determine the lime and fertilizer needs for crops. Soil tests have limits. Conditions that affect nutrient uptake, such as wet soils, cannot be detected in the laboratory.

****Use TM: F3-1 as visual material for lecture and discussion**

Objective 2: Identify the methods of fertilizer application.

(PowerPoint Slide 13)

II. Producers have a number of options for placement of fertilizer.

(PowerPoint Slide 14)

- A. Selecting the proper application technique for a particular field depends at least in part upon the inherent fertility level, the crop to be grown, the land tenure, and the tillage system.

(PowerPoint Slide 15)

1. On fields where the fertility level is at or above the desired goal, there is little research evidence to show any significant difference in yield that is associated with the method of application.

(PowerPoint Slide 16)

2. On low-testing soils placement of the fertilizer within a concentrated band has been shown to result in higher yields.

(PowerPoint Slide 17)

- B. Fertilizers can be applied before a crop is planted, while it is being planted, after it is growing, or in some combination of the three. The time of application has different effects on the crop.

(PowerPoint Slide 18)

1. Fertilizer applied before a crop is planted is called **preplant**.
2. The simplest way to fertilize before planting is broadcasting.
Broadcasting is spreading fertilizer evenly on the soil surface.
3. **Soil injection**, also known as **root zone banding, deep placement, knifing** or **chiseling**, is a process where the fertilizer is placed below the surface in the root zone.

(PowerPoint Slide 19)

4. Fertilizer applied while planting is called **starter fertilizer**. The most common method of applying starter is called **banding**, where the planter places a band of fertilizer below and to the side of the seeds.

(PowerPoint Slide 20)

5. ***Pop-up fertilizers*** are placed in the row with the seeds. Only small amounts are applied to prevent seedling damage.

(PowerPoint Slide 21)

- C. There are several ways to fertilize after planting.
 1. ***Pre-emergence*** is fertilizing after the planting but before the crop emerges from the ground.
 2. ***Post-emergence*** is fertilizing after the crop has emerged from the ground.

(PowerPoint Slide 22)

3. ***Top dressing*** is the same as broadcasting, except that the fertilizer is spread over a growing crop and is not mixed into the soil.
4. ***Sidedressing*** is a way of making a second application of fertilizer part way through the growing season by fertilizing along the crop row.
5. ***Fertigation*** is a method of injecting fertilizer into irrigation water.

(PowerPoint Slide 23)

6. ***Foliar feeding*** is fertilizing by spraying solutions directly on the leaves of the crop. This method offers the quickest response of any fertilizing method.

(PowerPoint Slide 24)

7. ***Site-specific application*** also known as ***variable rate technology (VRT)*** uses computer technology to alter the rate of fertilizer application as the fertilizer applicator passes across the field. This approach offers the potential to improve yield while minimizing the possibility of over fertilization, which results in improved profit.
8. ***Global positioning systems (GPS)*** are used in precision farming to locate exact points in the field.
 - a. Twenty-four Navstar satellites orbiting the earth send radio signals.
 - b. Exact points are located by determining the distance from three or more points. This is known as ***trilateration*** or triangulation.

****Use TM: F3-2, TM:F3-3, and TM:F3-4 as visual material for lecture and discussion. PowerPoint Slide 25 can be used to explain GPS.**

Objective 3: Explain the rate of fertilizer application.

(PowerPoint Slide 26)

- III. Rate of fertilizer application depends upon the soil test level.
- A. Soil fertility problems are largely associated with acidity, phosphorus, potassium and nitrogen. Recommended soil tests for making decisions about lime and fertilizer:

(PowerPoint Slide 27)

1. Water pH test, which shows soil reaction as pH units.

2. Bray P1 test for plant available soil phosphorus, which is commonly reported as parts per million (ppm)
3. Potassium test, which is commonly reported as ppm as well.

(PowerPoint Slide 28)

4. Testing to determine nitrogen fertilizer needs for field crops is not recommended in the same sense as testing for the need for lime, phosphorus, or potassium since nitrogen can change forms or be lost from the soil.

(PowerPoint Slide 29)

5. Testing soil to predict the need for nitrogen fertilizer is complicated by the fact that nitrogen availability, both the release from soil organic matter and the loss by leaching and denitrification is regulated by unpredictable climatic conditions.

(PowerPoint Slide 30)

- B. The amount of fertilizer recommended may be build up plus maintenance, maintenance or no fertilizer.

(PowerPoint Slide 31)

1. **Build up** is the amount of material required to increase the soil test to the desired level.
2. **Maintenance** is the amount required to replace the amount that will be removed by the crop to be grown.

(PowerPoint Slide 32)

3. Build up plus maintenance: when soil test levels are below the desired values, it is suggested that enough fertilizer be added to build the test to the desired goal and to replace what the crop will remove.
4. At or below the desired values, the yield of the crop will be affected by the amount of fertilizer applied that year.

(PowerPoint Slide 33)

- C. Maintenance: when the soil test levels are between the minimum and 9 kilograms above the minimum for phosphorus or between the minimum and 45 kilograms above the minimum for potassium, apply enough to replace what the crop to be grown is expected to remove.

(PowerPoint Slide 34)

1. The yield of the current crop may not be affected by the fertilizer addition, but the yield of subsequent crops will be adversely affected if the materials are not applied to maintain soil-test levels.

(PowerPoint Slide 35)

2. No fertilizer—it is recommended that soil test levels be maintained slightly above the level at which optimum yield would be expected. It would not be economical to attempt to maintain excessively high values.

****Have students complete WS: F3-1 and WS: F3-2. When they have finished, divide them into groups to check their answers. Make sure all group members agree on an answer before moving on.**

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 Slides 36 and 37.

Application:

Use TM: F3-1 thru TM: F3-4 and have students explain the process of applying fertilizer to field crops in comparison to how it may be done locally.

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 = k, 2 = b, 3 = f, 4 = h, 5 = a, 6 = j, 7 = e, 8 = g, 9 = l, 10 = c, 11 = d, 12 = i

Part Two: Completion

1. Maintenance
2. broadcasting
3. banding
4. Side-dressing
5. Foliar feeding

Part Three: Short Answer

1. Inherent fertility level, the crop to be grown, the land tenure, and the tillage system.
2. Acidity, phosphorus, potassium, and nitrogen.

Sample Test

Name _____

Test

Unit F Lesson 3: Applying Fertilizers to Field Crops

Part One: Matching

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

- | | | |
|-------------------|-------------------|------------------------------|
| a. Broadcasting | e. Pop-up | i. Site-specific application |
| b. Build up | f. Post-emergence | j. Starter fertilizer |
| c. Fertigation | g. Pre-emergence | k. Tissue testing |
| d. Foliar feeding | h. Preplant | l. Top dressing |

- _____ 1. Measures nutrient levels in plant tissue.
- _____ 2. Amount of material required to increase the soil test to the desired level.
- _____ 3. Fertilizing after the crop has emerged from the ground.
- _____ 4. Fertilizer applied before a crop is planted.
- _____ 5. Spreading fertilizer evenly on the soil surface.
- _____ 6. Fertilizer applied while planting.
- _____ 7. Fertilizer placed in the row with the seeds.
- _____ 8. Fertilizing after the planting but before the crop emerges from the ground.
- _____ 9. Same as broadcasting, except that the fertilizer is spread over a growing crop and is not mixed into the soil.
- _____ 10. Method of injecting fertilizer into irrigation water.
- _____ 11. Method offers the quickest response of any fertilizing method.
- _____ 12. Also known as variable rate technology (VRT) uses computer technology to alter the rate of fertilizer application as the fertilizer applicator passes across the field.

Part Two: Completion

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

1. _____ is the amount of fertilizer required to replace the amount that will be removed by the crop to be grown.
2. The simplest way to fertilize before planting is _____.
3. The most common method of applying starter, where the planter places a band of fertilizer below and to the side of the seeds is known as _____.
4. _____ is a way of making a second application of fertilizer part way through the growing season by fertilizing along the crop row.
5. _____ is fertilizing by spraying solutions directly on the leaves of the crop.

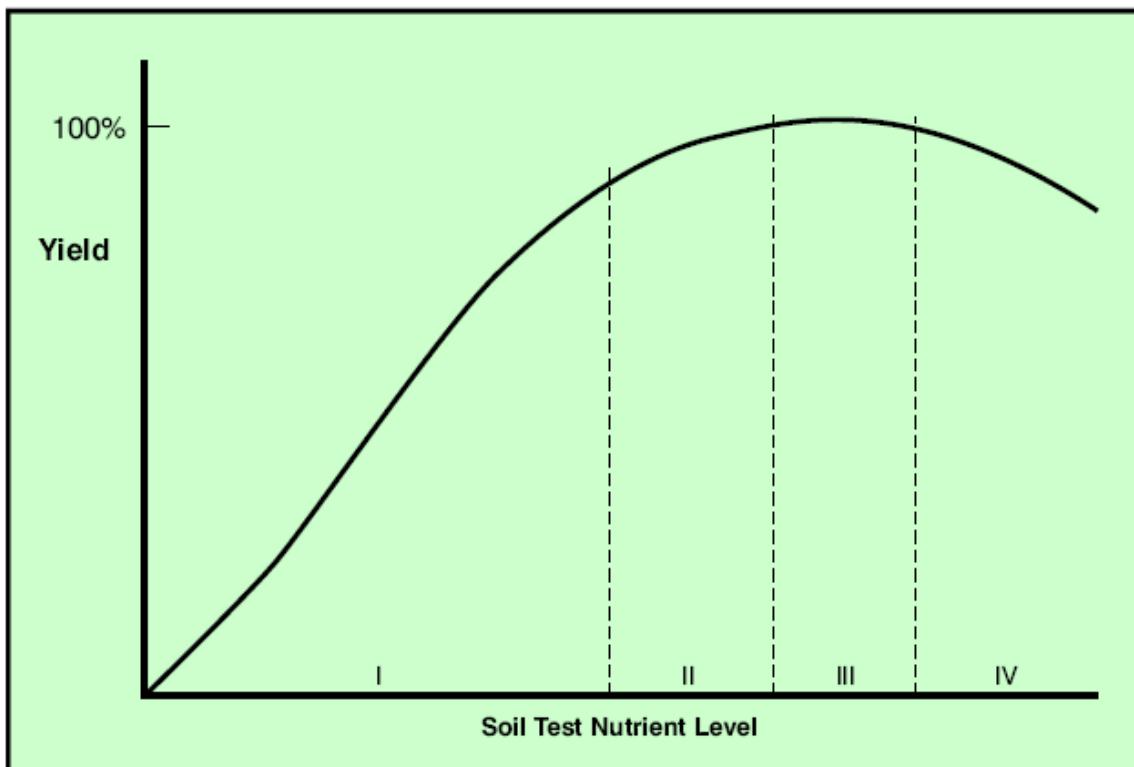
Part Three: Short Answer

Instructions. Provide information to answer the following questions.

1. What does selecting the proper application technique for a particular field depend upon?
2. What are soil fertility problems associated with?

TM: F3-1

SOIL TEST NUTRIENT LEVEL



The yield of a crop is directly related to the nutrient level of the soil.
Fertilization is most profitable for crops in Level I.

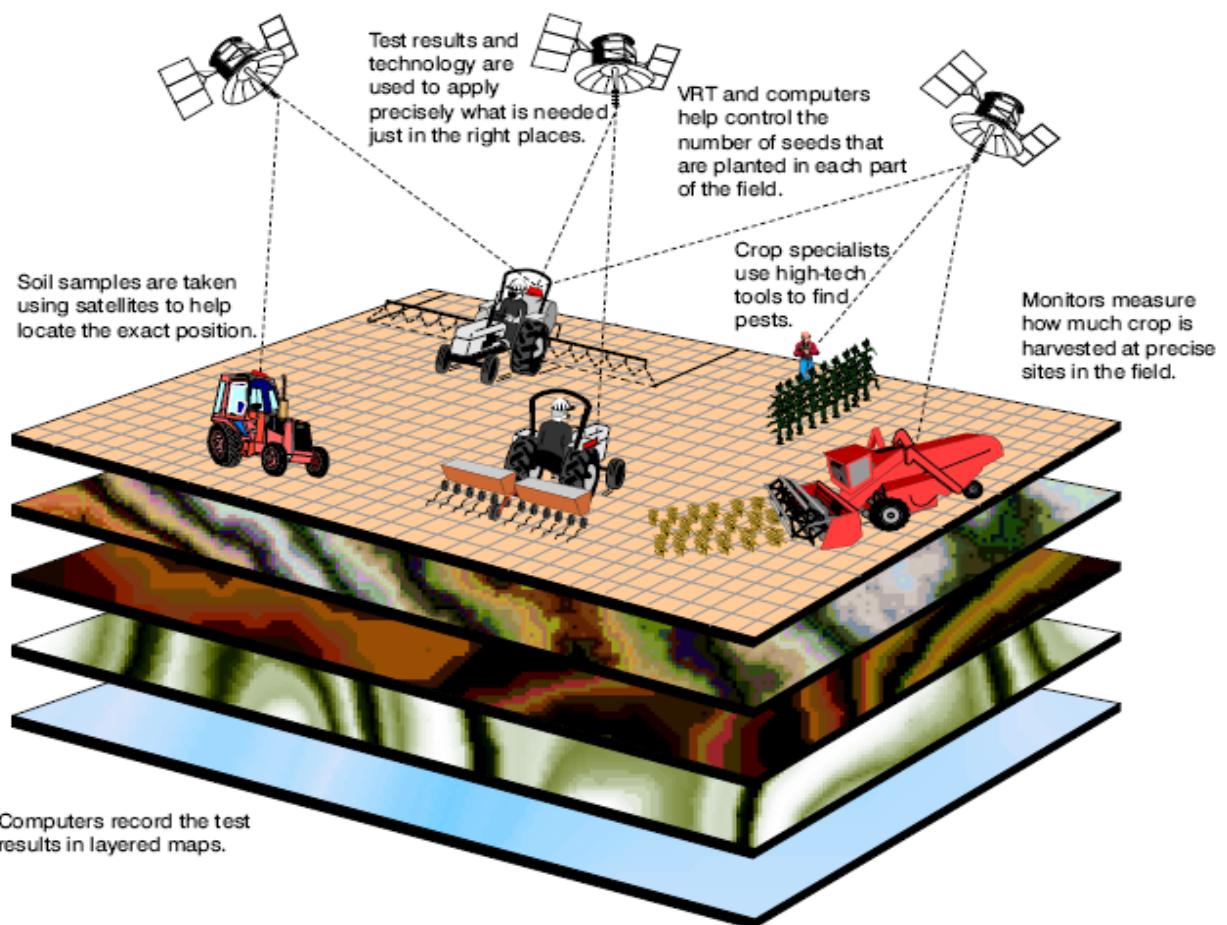
TM: F3-2



TM: F3-3



TM: F3-4



WS: F3-1

Name_____

Work Sheet

Determining the Actual Amount of Dry Fertilizer Applied

To measure the actual amount of dry fertilizer applied, the applicator is driven over a measured distance while the fertilizer is collected using one or more containers. To calculate the amount applied, use the following formula where distance and width are measured in meters:

$$\text{Kilograms/Hectare} = \text{Kilograms applied} / (\text{distance} \times \text{width} / 10000 \text{ sq meters})$$

Tony is calibrating his nitrogen fertilizer applicator that spreads dry fertilizer over a 15 meter width. After traveling 60 meters while collecting the fertilizer, the applicator had applied 36 kilograms. How many kilograms/hectare is his applicator applying?

WS: F3-2

Name _____

Work Sheet

Determining the Actual Amount of Liquid Fertilizer Applied

To measure the actual amount of liquid fertilizer applied, the applicator is driven over a measured distance while the fertilizer is collected using one or more containers. To calculate the amount applied, use the following formula where distance and width are measured in feet:

$$\text{Kilograms/Hectare} = \text{liters applied}/(\text{distance} \times \text{width}/10000 \text{ sq. meters})$$

Amanda needs to calibrate her 60 foot fertilizer spreader. When she drives 47 meters, 158 liters are collected. How many liters/hectare did she apply?