

Unit B: Establishing a Fruit Garden

Lesson 5: Fertilizing Fruit and Nut Crops

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

1. Identify and describe sources of organic and inorganic fertilizers.
2. List and categorize the essential nutrients required by plants.
3. List the role of essential nutrients in plants and their deficiencies.
4. Explain fertilizer grade, analysis and ration.
5. Discuss the factors that influence fertilizer placement and application methods.
6. Properly choose and apply fertilizers to fruit and nut crops.

Recommended Teaching Time: 3 hours

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

- A PowerPoint has also 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 Lab Sheet
Fertilizer samples (both organic and inorganic)

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

Root Zone Banding	Fillers
Broadcasting	Inorganic fertilizers
Deficient	Macronutrients
Fertigation	Micronutrients
Fertilizer	Organic fertilizer
Fertilizer grade	Potash
Fertilizer ratio	Sidedressing
Fertilizer analysis	Site-specific application
Foliar feeding	Soil injection
Post-emergence	Starter fertilizer

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 fertilizers of different types. Ask students to identify the differences they observe. Direct the discussion towards the plant nutritional value.

**** Use this activity to lead into Objective 1.**

Summary of Content and Teaching Strategies

Objective 1: Identify and describe sources of organic and inorganic fertilizers

(PowerPoint Slide #3)

- I. Agricultural crops use the nutrients that are held in the soil. As crops are harvested and removed from the land, nutrients are removed with the plant tissues. To maintain high yields, nutrients must be added to the soil.
 - A. A **fertilizer** is an organic or inorganic material applied to soils or water, which provide nutrients that increase plant growth, yield, and nutritional quality.

(PowerPoint Slide #4)

1. An **organic fertilizer** is organic material that releases or supplies useful amounts of a plant nutrient when added to a soil.
2. Fertilizers can originate as plant or animal tissue and includes animal manures and compost made with plant or animal products. Organic commercial fertilizers include dried and pulverized manures, bone meal, blood meal, dried and ground sewage sludge, and soybean meal.

(PowerPoint Slide #5)

- B. Characteristics of organic fertilizers:
 1. Nitrogen is usually the predominating nutrient with lesser quantities of phosphorus and potassium.
 - a. One exception is bone meal in which phosphorus predominates and N is a minor ingredient.
 2. Nutrients are only made available to plants as the material decays in the soil, so they are slow acting and long lasting.
 3. Organic materials alone are not balanced sources of plant nutrients, and their analysis in terms of the three major nutrients is generally low.
 - a. They contribute to the organic matter content in the soil.
 4. The material is bulky and the exact amount of fertilizer applied is difficult to measure.

(PowerPoint Slide #6)

- C. **Inorganic fertilizers** are those from a non-living source, and included various mineral salts, which contain plant nutrients in combination with other elements.
 1. Inorganic fertilizer is manufactured in dry, liquid, or gaseous forms.

2. Nutrients are in a soluble form and are quickly available for plant use.
3. The soluble nutrients make them caustic to growing plants and can cause injury.
 - a. Care must be used in applying to growing crops so as not to come in contact with the roots or remain on plant foliage for any length of time.
 - b. Analysis of chemical fertilizer is relatively high in terms of the nutrients they contain.

Show students various examples of fertilizers. Try to show the students examples of both organic and inorganic fertilizers so they can see the difference. Discuss the samples with the students by asking “Which fertilizer would be best for fruit trees?” “Which fertilizer do you think is less expensive?” “What makes one fertilizer better than the other?” The students may not know the answer to these questions but will allow you to see how much knowledge they already have about fertilizer.

Objective 2: List and categorize the essential nutrients required by plants.

(PowerPoint Slide #7)

- II. Chemical **elements** needed by plants for normal growth and development are called nutrients.
 - A. There are 16 nutrients that are needed for plants to grow and mature properly
 1. These sixteen are considered the essential plant nutrients.

Pass out TM: B5-1 “The Sixteen Essential Plant Nutrients”

2. The essential nutrients are divided into non-mineral (Carbon, Hydrogen and Oxygen) and mineral (the remaining 12).
 - a. Hydrogen and oxygen are supplied to plants from carbon dioxide and water through photosynthesis.
 - b. Mineral nutrients are supplied by soil.

(PowerPoint Slide #8)

3. The twelve mineral nutrients and nitrogen are divided into three groups depending upon the amount of each used by the plant.
 - a. Those used in largest amounts are primary or **macronutrients**.
 - b. Nutrients used in intermediate amounts by plants are the secondary nutrients.
 - c. The seven **micronutrients** or minor elements are required by plants in small amounts.

(PowerPoint Slide #9) is a graphic representation of the essential nutrients. Use this as an opportunity to review the essential nutrients and to work on memorization. The contents of this objective are very important and should be memorized by the students. The students need to memorize all 16 nutrients essential to plant growth.

Objective 3: List the role of essential nutrients in plants and their deficiencies.

(PowerPoint Slide #10)

TM: B5-2 can be passed out at this point. It contains the nutrient, its function and the deficiency symptom but students should take notes about the general information and the forms of fertilizer the nutrient comes in.

III. Each nutrient completes a specific task in the plant. When one of these elements is lacking in the plant it is **deficient**.

(PowerPoint Slide #11)

A. Nitrogen

1. General Information

- a. One of the earth's most abundant and mobile nutrients.
- b. It is part of every plant cell.
- c. Soils may contain as much as five thousand pounds per acre.
- d. The air we breathe is 78% nitrogen.

2. Deficiency

- a. When plants do not receive enough nitrogen they lose their green color and turn yellow.
- b. Tips of the lower or bottom leaves will turn yellow first.
- c. Because of nitrogen's role in chlorophyll, deficient plants generally grow slowly with spindly stems.

(PowerPoint Slide #12)

3. Forms

- a. Nitrogen is one of the most important fertilizers and can be made in many forms.
- b. The most common sources of nitrogen fertilizers are urea, ammonium nitrate, and nitrogen solutions.
- c. Nitrogen fertilizers can be made in pelletized or gaseous forms.

4. Other information

- a. Using too much nitrogen is not only bad for a plant but also the environment.
- b. Nitrogen is one of the most mobile nutrients and is easily carried through the soil by water.
- c. Nitrogen is lost in many ways including nitrification, leaching, erosion, denitrification and volatilization.

(PowerPoint Slide #13)

B. Phosphorus

1. General information

- a. Phosphorus is very immobile and is only lost from the soil through plant removal and soil erosion.
- b. Very little phosphorus moves through the soil.
- c. Due to its immobility and the high need for phosphorus by young plants, an adequate supply of phosphorus must be near the plant's root system early in growth.
- d. Phosphorus is responsible for root growth and is also used in photosynthesis and respiration.

2. Deficiency

- a. When there is a deficiency leaves may turn purple and the plant may become stunted and delay in development.

(PowerPoint Slide #14)

3. Forms

- a. Diammonium phosphate (DAP) and triple superphosphate (TSP) are the main sources of fertilizer phosphorus.
- b. Phosphorus can also be found in animal manures, sludges, plant residues and ground rock phosphate.

(PowerPoint Slide #15)

C. Potassium

1. General information

- a. Potassium is the second most used nutrient next to nitrogen.
- b. It is relatively immobile generally only being lost through leaching.
- c. Potassium increases vigor, diseases resistance and stem strength.

2. Deficiency

- a. Potassium deficiency most commonly occurs in sandy soils.
- b. The deficiency begins in the older leaves first and will begin to turn yellow with the margins (outside edge) of the leaf dying.
 - i. Will also cause irregular fruit development.

(PowerPoint Slide #16)

3. Forms

- a. Muriate of **potash** (potassium chloride) is the most common source of potassium.
- b. A second source is potassium sulfate.

4. Other information

- a. The amount of potassium found in the soil is greater than any other nutrient but the amount available to the plants is relatively small.

(PowerPoint Slide #17)

D. Sulfur

1. General Information

- a. Sulfur is derived primarily from the decomposition of organic matter and crop residues.
- b. Sulfur is added to some fertilizers as an impurity, especially in lower grade fertilizers.
- c. Sulfur is also essential in amino acids, vitamins and gives green color.

2. Deficiency

- a. Initially the leaves turn yellow and spread to the whole plant.
- b. The symptoms are similar to nitrogen deficiency but occur in new growth.

(PowerPoint Slide #18)

3. Forms

- a. Sulfur is taken up by plants in the form of sulfate ions and is reduced down to assemble into organic compounds.

4. Other Information

- a. Sulfur is what gives the odors to flavors in mustard, onion, and garlic plants.

(PowerPoint Slide #19)

E. Calcium

1. General information

- a. Calcium is the major constituent of cell walls.
 - i. It also aids in cell division.

- ii. Normal transport and retention of other elements as well as plant strength or provided by calcium.
- 2. Deficiency
 - a. Reduced growth or death of growing tips.
 - b. Poor fruit development and appearance.

(PowerPoint Slide #20)

- 3. Forms
 - a. Calcium is supplied mainly by soil minerals, organic materials, fertilizers and liming materials.
- 4. Other information
 - a. Calcium is absorbed in a delicate balance with Magnesium and Potassium.
 - i. Too much of any one of these elements may cause insufficiencies of the other two.

(PowerPoint Slide #21)

F. Magnesium

- 1. General information
 - a. Magnesium is part of the chlorophyll in all green plants and essential for photosynthesis
 - b. It also helps activate many plant enzymes needed for growth.
- 2. Deficiency
 - a. Magnesium is readily mobile in plants and can easily travel from older to younger parts of the plant in the event of a deficiency.
 - b. The deficiency begins as an initial yellowing of older leaves between the leaf veins and then spreading to younger leaves.
 - i. Also poor fruit development and production.
- 3. Forms
 - a. Magnesium comes from soil minerals, organic material, fertilizers, and dolomitic limestone.

(PowerPoint Slide #22)

G. Iron

- 1. General information
 - a. Iron is a constituent of many organic compounds in plants.
 - b. It is essential for the synthesis of chlorophyll which in turn gives rise to green pigment.
- 2. Deficiency
 - a. Iron deficiency is generally caused by high levels of Manganese.
 - b. It begins as a distinct yellow or white area between the veins of young leaves and leads to spots of dead leaf tissue.
- 3. Forms
 - a. Because iron is a micronutrient and not needed in high quantities it is generally available to the plant in the soil.

(PowerPoint Slide #23)

H. Copper

- 1. General information
 - a. Essential for growth and activate many enzymes.
- 2. Deficiency

- a. Deficiency of iron results in interference with protein synthesis and causes a buildup of soluble N compounds.
 - b. Excess amounts of copper can induce iron deficiency.
 - c. The terminal leaves and buds will die and the plant will have a blue-green color.
3. Forms
- a. Copper is a micronutrient and can be obtained through the soil.

(PowerPoint Slide #24)

- I. Manganese
- 1. General information
 - a. Manganese is important for chlorophyll synthesis.
 - 2. Deficiency
 - a. A high manganese concentration may induce iron deficiency.
 - b. Manganese deficiency is easily identifiable by Interveinal yellowing or mottling of young leaves.

(PowerPoint Slide #25)

- J. Zinc
- 1. General Information
 - a. Used by the plant to produce growth hormones and starch.
 - b. Also important in most enzymatic reactions.
 - 2. Deficiency
 - a. Visible in Interveinal yellowing on young leaves and reduced leaf size.

(PowerPoint Slide #26)

- K. Molybdenum
- 1. General information
 - a. Molybdenum aids in nitrogen fixation and protein production.
 - b. It is only needed in very small amounts.
 - 2. Deficiency
 - a. Deficiency of Molybdenum looks similar to that of nitrogen and can be hard to diagnose.

(PowerPoint Slide #27)

- L. Boron
- 1. General information
 - a. Boron is needed by the plant for flowering, fruiting and cell division.
 - 2. Deficiency
 - a. Boron deficiency is signaled by the death of growing points and deformation of leaves with areas of discoloration.

Use the PowerPoint titled “Deficiency Symptoms Review” Use this as a means of assessing the students’ knowledge about nutrient deficiencies. A number of methods can be used: display the picture and have each student write down their answer and immediately give them the answer, use the pictures as a quiz or group the students up and hold a group quiz. Use these slides as a review when necessary.

Objective 4: Explain fertilizer grade, analysis and ration

(PowerPoint Slide #28)

IV. It is important to know the nutrient content of a fertilizer in order to apply the recommended amount.

A. **Fertilizer analysis** lists the fertilizer elements in the bag and their percent content.

1. This list could include any of the 13 mineral elements.
2. The percentage of the three macronutrients is always listed on the fertilizer label in the same order.
 - a. They appear as nitrogen, phosphoric acid, and potash.

(PowerPoint Slide #29)

3. Additional information may also be found in the analysis, like the percent of nitrogen that is ammoniacal and the percent which is nitrate.
4. Some fertilizers, especially those blended for turf, may contain nitrogen sources that dissolve slowly.
 - a. These will be identified as water-insoluble nitrogen (WIN) or slow-release nitrogen (SRN).

(PowerPoint Slide #30)

B. All bags of fertilizer should show the **fertilizer grade** which indicates the primary nutrient content of the fertilizer.

1. Grade lists the content as a sequence of three numbers that tell, in order, the percentage of nitrogen (N), phosphate (P_2O_5), which is also called phosphoric acid, and potash (K_2O).
2. Grade may also identify a secondary nutrient as a fourth number in the traditional N–P–K. For example, calcium nitrate may carry the grade 15–0–0–30Ca, meaning the material is 30 percent calcium.

(PowerPoint Slide #31)

3. Fertilizer grades never total 100 percent. A 10–10–10 fertilizer is 30 percent nutrient and 70 percent other ingredients.
 - a. The remainder of the fertilizer is the weight of the other elements that are part of the carrier, such as hydrogen and oxygen.
4. A small percentage of fertilizer is filler and conditioner.
 - a. **Fillers** may be sand, clay granules, ground limestone, or ground corn cobs and are used to bring a load of bulk fertilizer to a weight of one ton.
 - b. Conditioners improve the quality of the fertilizer and make it easier to use.

(PowerPoint Slide #32)

C. **Fertilizer ratio** states the relative amounts of nitrogen, phosphate, and potash in fertilizers.

1. Ratios are useful when comparing two fertilizers.
2. This means that one fertilizer can be used in place of the other.
 - a. Applying one ton of 10–10–10 is the same as applying $\frac{1}{2}$ ton of 20–20–20.
 - b. Being able to obtain fertilizers of different ratios is very useful.
 - c. The grower simply selects a fertilizer with the ratio recommended by soil test reports.
 - d. If the test report recommends 100 pounds of nitrogen, 50 pounds of phosphate, and 75 pounds of potash per acre, a single fertilizer with the ratio of 4–2–3 would be ideal.

Have students complete LS: B5-1 in groups.

Objective 5: Discuss the factors that influence fertilizer placement and application methods

(PowerPoint Slide #33)

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

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

(PowerPoint Slide #34)

- 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.
1. Fertilizer applied before a crop is planted is called **preplant**.
 2. The simplest way to fertilize before planting is broadcasting.
 - a. **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 #35)

- C. There are several ways to fertilize after planting.
1. **Top dressing** is the same as broadcasting, except that the fertilizer is spread over a growing crop and is not mixed into the soil.
 2. **Sidedressing** is a way of making a second application of fertilizer part way through the growing season by fertilizing along the crop row.
 3. **Fertigation** is a method of injecting fertilizer into irrigation water.
 4. **Foliar feeding** is fertilizing by spraying solutions directly on the leaves of the crop.
 - i. This method offers the quickest response of any fertilizing method.

(PowerPoint Slide #36)

5. **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.
 - a. This approach offers the potential to improve yield while minimizing the possibility of over fertilization, which results in improved profit.

Discuss with the students the most common methods of fertilizer application in Afghanistan. Ask the students which method they think would work best for an orchard or fruit tree. Have the students determine which form of fertilizer would work best for each application. For example, a solid pellet fertilizer will not work well for foliar feeding but a fertilizer solution will.

Objective 6: Describe the selection of fertilizer.

(PowerPoint Slide #37)

VI. Growers can choose from a wide variety of fertilizers.

- A. Factors influencing the selection include the crop to be fed, the time of year, the application method, and the cost.
1. For most crops, the form of the fertilizer is not critical.

(PowerPoint Slide #38)

2. The form absorbed will depend somewhat on the weather conditions.

- a. Plants absorb both the nitrate and ammonium nitrogen, but the preference is the nitrate form.
- b. However, under warm moist conditions, ammonium ions will nitrify to nitrate nitrogen in four to six weeks.
 - i. For that reason, ammonium and nitrate usually have the same effect on crop growth.
 - ii. However, nitrates are lost more easily from the soil.

(PowerPoint Slide #39)

- c. Growers need to be concerned with crop sensitivity to certain elements and about a fertilizer's affect on soil pH or salinity.
 - i. The selection of fertilizers commonly depends upon the price, the least costly fertilizer per pound of plant food is the one commonly selected.
- d. The nutrient content and the price per unit of nutrient are the most important considerations in choosing materials.

(PowerPoint Slide #40)

- B. The application of P, K, Ca, Mg is important but do not apply these materials unless you know a need exists.
 - 1. **Phosphorus (P)**. If phosphorus is needed, apply 200 to 400 lb of P_2O_5 /acre. Because P moves very slowly in soil, these rates will sustain most fruit crops for many years.
 - 2. **Potassium (K)**. Applications of 150 to 300 lb K_2O /acre will correct most deficiencies.
 - a. Stone fruit plantings on light, sandy soils may require these rates as a maintenance program every 3 to 5 years.
 - 3. **Calcium (Ca)**. Deficiencies are rare if pH is maintained above 6.0. Limestone applications of 2 to 4 tons/acre will correct shortages.

Review/Summary: Use the student learning objectives to summarize the lesson. Have the students explain the response to the anticipated problem of each objective. Student responses can be used to determine which objectives need to be reviewed. Questions on PowerPoint Slide # 41 can be used as review.

Application: Have the students, in groups or individually, pick a fruit or nut species of interest to them. Have them research what the fruit looks like when it is deficient in each essential nutrient (some may not experience deficiencies in all nutrients). Have them prepare a poster or paper describing their fruit or nut and the deficiencies. These posters or papers can then be kept in the classroom as a reference for the students.

Evaluation: Evaluation should focus on student achievement of this lesson's objectives. A sample written test is attached.

Answers to Sample Test:

Matching

1. A
2. D
3. G
4. C
5. H
6. B
7. E
8. F

Short Answer:

1. Factors influencing fertilizer selection include the crop to be fed, the time of year, the application method, and the cost.
2. **Nitrogen:** Light green to yellow appearance of leaves, especially older leaves; stunted growth; poor fruit development.
Phosphorus: Leaves may develop purple coloration; stunted plant growth and delay in plant development.
Potassium: Older leaves turn yellow initially around margins and die; irregular fruit development.

Answers to Lab Sheet

B5-1

1. $22.7 \text{ kg} \times 0.45 = 10.20 \text{ kg potash}$
2. $22.7 \text{ kg} \times 0.60 = 13.62 \text{ kg phosphate}$
3. $22.7 \text{ kg} \times 0.10 = 2.27 \text{ kg N}$
 $22.7 \text{ kg} \times 0.24 = 7.72 \text{ kg P}$
 $22.7 \text{ kg} \times 0.12 = 2.72 \text{ kg K}$
4. No. There will be filler material mixed with the nutrients in the fertilizer.
5. $1000 \text{ kg} \times 0.46 = 460 \text{ kg N}$
 $13200 \text{ AFA} / 460 \text{ Kg} = 28.70 \text{ AFA} / \text{kg N}$

TM: B5-1

The Sixteen Essential Plant Nutrients

Nonmineral

Carbon	C
Hydrogen	H
Oxygen	O

Primary

Nitrogen	N
Phosphorus	P
Potassium	K

Secondary Mineral

Calcium	Ca
Magnesium	Mg
Sulfur	S

Micronutrients

Boron	B
Chlorine	Cl
Copper	Cu
Iron	Fe
Manganese	Mn
Molybdenum	Mo
Zinc	Zn

The Roles of Nutrients in Plants and Their Deficiency Symptoms

Nutrient	Function	Deficiency Symptom
Nitrogen	Promotes rapid growth; chlorophyll formation; synthesis of amino acids and proteins.	Light green to yellow appearance of leaves, especially older leaves; stunted growth; poor fruit development.
Phosphorus	Stimulates root growth; aids seed formation; used in photosynthesis and respiration	Leaves may develop purple coloration; stunted plant growth and delay in plant development.
Potassium	Increases vigor, disease resistance, stem strength and seed quality	Older leaves turn yellow initially around margins and die; irregular fruit development.
Calcium	Constituent of cell walls; aids cell division	Reduced growth or death of growing tips; blossom-end rot of tomato; poor fruit development and appearance.
Magnesium	Component of chlorophyll, enzymes, and vitamins; aids nutrient uptake	Initial yellowing of older leaves between leaf veins spreading to younger leaves; poor fruit development and production.
Sulfur	Essential in amino acids, vitamins; gives green color	Initial yellowing of young leaves spreading to whole plant; similar symptoms to nitrogen deficiency but occurs on new growth.
Boron	Important to flowering, fruiting, and cell division	Death of growing points and deformation of leaves with areas of discoloration.
Copper	Component of enzymes; chlorophyll synthesis and respiration	Terminal buds and leaves die; blue-green color
Chlorine	Not well defined; aids in root and shoot growth	Wilting; chlorotic
Iron	Catalyst in chlorophyll formation; component of enzymes	Initial distinct yellow or white areas between veins of young leaves leading to spots of dead leaf tissue.
Manganese	Chlorophyll synthesis	Interveinal yellowing or mottling of young leaves.
Molybdenum	Aids nitrogen fixation and protein	Similar to nitrogen
Zinc	Needed for auxin and starch formation.	Interveinal yellowing on young leaves; reduced leaf size.
Carbon	Component of most plant compounds.	None
Hydrogen	Component of most plant compounds.	None
Oxygen	Component of most plant compounds.	none

Lab Sheet

Determining the Amounts of Nutrients in a Fertilizer

Directions:

Given the following information, answer the problems that follow.

$$\text{Amount of nutrient} = \text{weight of fertilizer} \times \text{percentage}/100$$

1. How much potash is in a 22.7 kilogram bag of 0-0-45? _____ kilograms of potash.
2. How much phosphate is in a one-ton mix of 0-60-0? _____ kilograms of phosphate.
3. Determine the amount of each nutrient in a 22.7 kilogram bag of complete fertilizer with a grade of 10-34-12?
_____ kilograms of nitrogen.
_____ kilograms of phosphate.
_____ kilograms of potash.

4. Do the kilograms of individual nutrients added together equal the total kilograms of the bag?

Explain why this is so.

5. Determine the price for nitrogen in a metric ton of Urea (46-0-0) that costs 13200 AFA.

Test

Unit B Lesson 5: Fertilizing Fruit and Nut Trees

Part One: Matching

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

- | | | |
|-----------------|--------------------------|-------------------|
| A. Broadcasting | D. Fertilizer analysis | G. Macronutrients |
| B. Deficient | E. Potash | H. Micronutrients |
| C. Fertilizer | F. Inorganic fertilizers | |

- _____ 1. Spreading fertilizer evenly on the ground.
- _____ 2. Lists the fertilizer elements in the bag and their percent content.
- _____ 3. The essential elements used in largest amounts
- _____ 4. An organic or inorganic material applied to soils or water, which provide nutrients that increase plant growth, yield, and nutritional quality.
- _____ 5. Essential elements required by plants in small amounts.
- _____ 6. When one of the essential elements is lacking in the plant
- _____ 7. The most common source of potassium
- _____ 8. Fertilizer from a non-living source, and include various mineral salts, which contain plant nutrients in combination with other elements.

Part II Short Answer

Instructions. Provide information to answer the following questions.

- 1. What factors influence the selection of fertilizer?

- 2. What are the deficiency symptoms of Nitrogen, Phosphorus and Potassium?