Unit B: Establishing a Fruit Garden

Lesson 5: Fertilizing Fruit and Nut Trees

Terms

- Banding
- Broadcasting
- Deficient
- Fertigation
- Fertilizer
- Fertilizer grade
- Fertilizer ratio
- Fertilizer analysis
- Foliar feeding
- Post-emergence
- Preplant
- Top dressing
- Fillers
- Inorganic fertilizers
- Macronutrients
- Micronutrients
- Organic fertilizer
- Potash
- Sidedressing
- Site-specific application
- Soil injection
- Starter fertilizer
- Variable Rate Technology (VRT)

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.

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.

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.

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.

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.
2. The essential nutrients are divided into mineral (Carbon, Hydrogen and Oxygen) and nonmineral (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.

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.

Macronutrients	Micronutrients	Non-mineral
• Nitrogen • Phosphorus • Potassium • Calcium • Magnesium • Sulfur	• Boron • Copper • Iron • Chlorine • Manganese • Molybdenum • Zinc	• Carbon • Hydrogen • Oxygen

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

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.

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.

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.

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.

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.

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.

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.

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.

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.

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.

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.

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.

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.

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.

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.

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.

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.

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.

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).

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.

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.

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 ½ 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.

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.

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.

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.
    a. This method offers the quickest response of any fertilizing method.

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.

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.

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.

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.

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 $P_2 0_5$/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 K2O/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

1. What are some sources of organic and inorganic fertilizers?
2. What are the essential nutrients required by plants?
3. What are some deficiency symptoms of the essential plant nutrients?
4. What is the difference between fertilizer grade, analysis and ration?
5. Discuss the factors that influence fertilizer placement and application methods.
6. Which fertilizer is best for a specific fruit or nut tree?