Unit F: Soil Fertility and Moisture Management

Lesson 1: Determining Fertilizer Formulations
Terms

- Bulk blending
- Complete fertilizers
- Fertilizer
- Fertilizer analysis
- Fertilizer grade
- Fertilizer ratio
- Fillers
- Inorganic fertilizers
- Mixed fertilizers
- Nutrient management plan
- Organic fertilizer
- Single-grade fertilizer
How is a nutrient management plan developed?

- Nutrient management planning is an effort to balance necessary soil fertility levels with environmental protection.

- A nutrient management plan identifies the amount, source, time of application, and placement of each nutrient needed to produce the crop grown in a given field each year.
• Objectives of a nutrient management plan are to optimize efficient use of all sources of nutrients and to minimize the potential for plant nutrients to degrade water and soil quality. Includes soil reserves, commercial fertilizer, legume crops, and organic sources such as manure, industrial waste, or municipal waste for crop production.

• Recognize sensitive areas within fields that require special nutrient management precautions to avoid environmental contaminations. Those areas include sinkholes, wells, drainage ditches, lakes streams, and highly erodible land.
A four-year plan, with changes being made after new soil tests have been taken, is most effective. The steps involved in developing a nutrient management plan are:

1. Assess the natural nutrient sources, soil reserves, and legume contributions.
2. Identify field or areas with fields that require special nutrient management precautions.
3. Assess nutrient need for each field by crop.
- Determine the quantity of nutrients that will be available from organic sources, such as manure, industrial, or municipal wastes.
  - 1. Allocate nutrients available from organic sources.
  - 2. Calculate the amount of commercial fertilizer needed for each field.
  - 3. Determine the ideal time and method of application.
  - 4. Select nutrient sources that will be most effective and convenient for the operation.
What are organic and inorganic fertilizers?

- 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 **fertilizer** is an organic or inorganic material applied to soils or water, which provide nutrients that increase plant growth, yield, and nutritional quality.
• **An organic fertilizer** is organic material that releases or supplies useful amounts of a plant nutrient when added to a soil.

• 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, slaughterhouse tankage, blood meal, dried and ground sewage sludge, cottonseed meal and soybean meal.
• Characteristics of organic fertilizers:
  • 1. Nitrogen is usually the predominating nutrient with lesser quantities of phosphorus and potassium. 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. 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.
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. Characteristics of inorganic fertilizers that are different from organic fertilizers.
3. Nutrients are in a soluble form and are quickly available for plant use.
4. The soluble nutrients make them caustic to growing plants and can cause injury. 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. Analysis of chemical fertilizer is relatively high in terms of the nutrients they contain.
ORGANIC

DRIED SHEEP MANURE

Decay

MINERAL

LIME

Weathering

Nutrient ions dissolved in the soil solution

INORGANIC

FERTILIZER 10-10-10

Dissolve
Explain fertilizer analysis, grade, and ratio.

- It is important to know the nutrient content of a fertilizer in order to apply the recommended amount.
  - **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. 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. These will be identified as water-insoluble nitrogen (WIN) or slow-release nitrogen (SRN).
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$_2$O$_5$), which is also called phosphoric acid, and potash (K$_2$O).

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. Similarly, one may find sulfur (S) or magnesium (Mg) as a fourth number.
3. Fertilizer grades never total 100 percent. A 10–10–10 fertilizer is 30 percent nutrient and 70 percent other ingredients. 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. *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. Conditioners improve the quality of the fertilizer and make it easier to use.
• Fertilizer ratio states the relative amounts of nitrogen, phosphate, and potash in fertilizers. Ratios are useful when comparing two fertilizers.
Examples (a) and (b) have the same ratio. This means that one fertilizer can be used in place of the other. Applying one metric ton of 10–10–10 is the same as applying ½ metric ton of 20–20–20.

Being able to obtain fertilizers of different ratios is very useful. The grower simply selects a fertilizer with the ratio recommended by soil test reports. If the test report recommends 45 kilograms of nitrogen, 22 kilograms of phosphate, and 34 kilograms of potash per half a hecatare, a single fertilizer with the ratio of 4–2–3 would be ideal.
The way fertilizer grade is listed leads to some confusion. Most people think of fertilizer grade as N–P–K; nitrogen, phosphorus, and potassium. Actually, nitrogen is listed as the element, but the other two nutrients are listed in their oxide forms. The true grade should be listed as N–P2O5–K2O, which is read as nitrogen, phosphoric acid, and potash.
Consider the fertilizer 20–10–10, the numbers would seem to mean that there are 90 kilograms of phosphorus in a ton of this fertilizer. Actually one ton contains only 39 kilograms of phosphorus. The amounts of nutrients in a metric ton of 20–10–10 can be listed in the elemental and oxide forms:

<table>
<thead>
<tr>
<th></th>
<th>Oxide</th>
<th>Elemental</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>400</td>
<td>400</td>
</tr>
<tr>
<td>P</td>
<td>200</td>
<td>88</td>
</tr>
<tr>
<td>K</td>
<td>200</td>
<td>166</td>
</tr>
</tbody>
</table>
• When reading soil test reports or other recommendations, always check to see which form is being used. To convert between the amounts of phosphorus/phosphoric acid, and potassium/potash, the following formulas are used:

\[ P \times 2.29 = P_2O_5 \]
\[ P_2O_5 \times 0.44 = P \]
\[ K \times 1.2 = K_2O \]
\[ K_2O \times 0.83 = K \]
FERTILIZER
20-10-5

Grade

Analysis

Total Nitrogen .................. 20%
Total Phosphoric Acid ........... 10%
Available Potash ................. 5%
Iron Chelate ..................... 0.5%
How are fertilizers mixed?

- Growers can apply a fertilizer that contains a single nutrient, which would mean a fertilization operation for each nutrient.

  - It would be more convenient to use fertilizers that contain several nutrients.

    1. A fertilizer containing only one element is called a *single-grade fertilizer*.

    2. Many fertilizers contain two or three nutrients and are called *mixed fertilizers*.

    3. *Complete fertilizers* have all three of the primary elements but that does not mean that all 13 mineral nutrients are included.
4. To determine the amount of each nutrient in a complete fertilizer, the percentage of the nutrient is multiplied by the weight of the fertilizer. For example, in a 22 kilogram bag of 20–10–10:

- Nitrogen = 22 kilograms × 20 percent/100 = 10 kilograms
- Phosphate = 22 kilograms × 10 percent/100 = 5 kilograms
- Potash = 22 kilograms × 10 percent/100 = 5 kilograms
Growers may buy a premixed fertilizer, but a limited number of ratios are available. Fertilizer can be custom blended to mix carriers to obtain the analysis and ratio that best suits the needs of the grower.

1. **Bulk blending** is physically mixing solid fertilizer materials into multinutrient mixtures.

2. Fertilizer bulk-blending plants provide a convenient and economical means of mixing dry fertilizer materials to produce specified ratios and grades of varying nutrient percentages.
• 3. A principle asset of blending is the ability of the blender to produce an unlimited number of ratios and grades to suit individual needs. The reasons blending is attractive are economy, versatility, and convenience.

• 4. The finished raw materials of nitrogen, phosphate, and potassium fertilizers can be produced in large economic plants in different areas and combined in the market area.
• 5. Practically any grade or ratio can be produced.

• 6. Bulk-spreader truck can carry freshly blended material directly to field. No bagging or storage of fertilizers or farmer labor is required.

• 7. The disadvantages of bulk blending are materials must have approximately the same particle size and be chemically compatible.
How are fertilizers selected?

Growers can choose from a wide variety of fertilizers.

- Factors influencing the selection include the crop to be fed, the time of year, the application method, and the cost. For most crops, the form of the fertilizer is not critical. The form absorbed will depend somewhat on the weather conditions.
• 1. Plants absorb both the nitrate and ammonium nitrogen. But the preference is the nitrate form. However, under warm moist conditions, ammonium ions will nitrify to nitrate nitrogen in four to six weeks. For that reason, ammonium and nitrate usually have the same effect on crop growth. On the other hand, nitrates are lost more easily from the soil.

• 2. Growers need to be concerned with crop sensitivity to certain elements and about a fertilizer’s affect on soil pH or salinity. The selection of fertilizers commonly depends upon the price, the least costly fertilizer per kilogram of plant food is the one commonly selected.
Nutrient management planning is an effort to balance necessary soil fertility levels with environmental protection.

Organic and inorganic fertilizers assist in plant development and growth.

It is important to know the nutrient content (analysis, grade, and ratio) of a fertilizer in order to apply the recommended amount.

Fertilizers can be mixed in with various ingredients and parts.

Factors influencing the selection include the crop to be fed, the time of year, the application method, and the cost.