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Soil Analysis: Chemical Methods

The major essential nutrient elements supplied through the soil are Nitrogen (N), phosphorous (P), and potassium (K). Nutrients absorbed from the soil by plants are supplied by decomposition of rock, decomposition of organic matter, deposition by flood waters, application of commercial fertilizers, and the use of animal or plant manures.

Nitrogen is the most abundant element in the atmosphere (about 80%), but the gaseous form cannot be absorbed by plants. However, a relatively large group of plants, the legumes, have root nodules that contain Rhizobium bacteria which convert gaseous nitrogen into a form usable by plants (nitrogen fixation). Nitrogen promotes succulence in forage crops and leafy vegetables. It stimulates above-ground growth, hastens crop maturity, and is very influential in fruit sizing.

Phosphorous is necessary for the hardy growth of the plant and activity of the cells. It encourages root development, and by hastening the maturity of the plant, it increases the ratio of grain to straw, as well as the total yield. It plays an important part in increasing the palatability of plants and stimulates the formation of fats, convertible starches, and healthy seed. By stimulating rapid cell development in the plant, phosphorous naturally increases the resistance to disease.

Potassium is not a component of the structural makeup of plants, but it plays a vital role in the physiological and biochemical functions of plants. The exact function of potassium in plants is not clearly understood, but many beneficial factors implicating the involvement and necessity of potassium in plant nutrition have been demonstrated. Some of these factors are: it enhances disease resistance by strengthening stalks and stems, activates various enzyme systems within plants, contributes to a thicker cuticle which guards against disease and water loss, controls the turgor pressure within plants to prevent wilting, enhances fruit size, flavor, texture, and development, and is involved in the production of amino acids, chlorophyll formation, starch formation, and sugar transport from leaves to roots.

It is important to note that plants need more than these three nutrients to grow and reproduce successfully. Carbon, hydrogen, and oxygen from water and atmospheric carbon dioxide are used in abundance and other macronutrients like calcium, magnesium, and sulfur are crucial. Calcium is a component of cell walls and is known to stimulate root and leaf development as well activate several enzyme reactions. It also maintains optimum pH levels in the plant by neutralizing many of the organic acids generated by plant respiration. Sulfur and magnesium are both involved in the formation of chlorophyll. Photosynthesis cannot occur without these nutrients. Yellow spots on the leaves of houseplants are commonly the result of the lack of magnesium. Furthermore, there are a number of nutrients that plants require in much smaller quantities. These include manganese, iron, boron, copper, zinc, molybdenum, and chlorine. A healthy, balanced soil should contain appropriate levels of all of these nutrients.

Pre-Lab Questions:

1. Summarize the importance of nitrogen in soil.
2. Summarize the importance of phosphorus in soil.
3. Summarize the importance of potassium in soil.
4. Describe other things that plants need to stay healthy and reproduce successfully.

Procedure:

Using the same soil sample as your physical analysis, follow the procedures below for the chemical tests.

EXTRACTION:

1. Fill the large test tube about 4 inches with distilled water.
2. Add two *Floc-Ex Tablets (5504A). Cover the tube and mix until the tablets have disintegrated.
3. Remove the cover; add a heaping spoonful of soil.
4. Cover agin and shake for one minute.
5. Let the tube stand until the soil settles out. The clear solution above the soil will be used for the Nitrate, Phosphorus, and Potassium tests.

NITROGEN:

1. Use the pipet to transfer clear solution from above the soil to one of the small test tubes until it is full to the shoulder.
2. Add one *Nitrate WR CTA Tablet (3703 A). Cap and mix until the tablet disintegrates.
3. Wait 5 minutes for the color to develop. Compare the pink color of the solution to the Nitrogen Color Chart. Record the color.

L= 40lb A/6" soil
M= 160lb A/6" soil
H= 320lb A/6" soil

PHOSPHORUS:

1. Use the piper to transfer 25 drops of the clear solution above the soil to one of the small test tubes.
2. Fill the tube to the shoulder with distilled water.
3. Add one *Phosphorus Table (5422A). Cap and mix until the tablet disintegrates. Wait 5 minutes for the color to develop.
4. Compare the blue color of the solution to the Phosphorus Color Chart. Record the color.

L= 40lb A/6" soil
M= 80lb A/6" soil
H= 160lb A/6" soil

POTASSIUM:

1. Use the pipet to transfer clear solution from above the soil to one of the small test tubes until it is full to the shoulder.
2. Add one *Potassium Tablet (5424A). Cap and mix until the tablet disintegrates.
3. Compare the cloudiness of the solution in the test tube to the Potassium Color Chart. Hold the tube over the black boxes in the left column and compare it to the shaded boxes in the right column. Record the color.

L= 40lb A/6" soil
M= 80lb A/6" soil
H= 160lb A/6" soil

Clean up when finished. Make sure no soil goes down the sink.

Conclusion:

1. Based on your results, which nutrients are low in your soil sample?
2. What implications do low nutrient soils have?
3. What are some natural sources of the nitrogen, potassium and phosphorous found in soil?
4. How are the three primary plant nutrients used by living organisms?
5. By what process is atmospheric molecular nitrogen (N_2) converted into a form that plants can readily absorb through their roots? What form of nitrogen is this?
6. Evaluate the fertility of the soil used based upon your results.
7. What are some things that could be done to improve the fertility of your soil?