EDUCATIONAL OUTREACH
FLORIDA POLYTECHNIC UNIVERSITY

FLORIDA POLYTECHNIC
SOIL TESTING
Environmental Engineering

Overview:

Nutrient rich soil is needed to grow healthy crops to provide food for humans and animals. Soils contain phosphate and other nutrients such as nitrogen and potassium. Unfortunately, not all soils are naturally nutrient rich. When farmers apply nutrients, either in organic or mineral form, it is to fertilize the soil, not the plant. The soil then acts as a conversion system for the crops, receiving, storing, transforming, transporting and exchanging plant nutrients. The key to growing crops that are plentiful and that contain the nutrients we need is to assure that the local soil has the nutrients it needs.

Fertilizers are needed to maintain the level of soil fertility needed to meet the nutritional needs of the world's population. There is an ongoing discussion on the matter worldwide in the agricultural community, and agronomy and soil experts agree that the use of fertilizers, both inorganic and organic, needs to be tailored to the local soil needs. Soil testing and other diagnostic tools should be used. If the nutrients in the soil are already sufficient, adding fertilizers is more likely to be damaging environmentally, as well as economically wasteful. Adding the correct nutrients to make a custom blended fertilizer is a best management practice (BMP).

Best management practices (BMPs) are methods that have been determined to be the most effective and practical means of preventing or reducing non-point source pollution to help achieve environmental goals. BMPs include both measures to prevent pollution and measures to mitigate pollution. For soil nutrient efficiency, custom blended fertilizers can be made. These fertilizers are custom blended by adding macro and micronutrients the soil is deficient in or can be customized to meet the needs of a particular crop. For example, blueberries grow best in acidic soil, therefore a fertilizer with a lower pH would be optimum.

Learning Outcomes

-Student will be able to identify the nutrient components of fertile soil

-Students will be able to explain what best management practices (BMP) are

-Student will be able to design a custom blended fertilizer

-Student will understand how soil conservation methods can protect the soil and its fertility

Materials

Gloves
Goggles
Distilled Water (400 mL/1 pint for 10 tests)
Stopwatch
Plastic spoon
1 cup each of various soil samples (3 samples)

Extraction Tube
Pipette
3 test tubes
Commercial Soil Test (**Rapitest Kit used in this exercise)*

Note- commercial soil test kits can be purchased from a local hardware store, home improvement store, nursery or online laboratory supply company.

The Activity

Note: Lab safety at all times. Reagents are considered to be a potential health hazard- gloves and goggles should be worn at all times.

Preparation

1. Using the trowel take a soil sample from 2-4" below the ground surface
2. Take several samples from the same area
3. Place the samples in a clean container
4. Break the sample up with the trowel or spoon and allow it to dry out naturally (not necessary but makes working with the sample easier)
5. Remove small stones and organic matter such as grass, weeds, roots or hard particles
6. Set aside a small sample (1/4 cup) of soil in a cup
7. Fill a clean container with 1 cup soil and 5 cups of water (larger or smaller quantities may be tested as long as the 1 part soil and 5 parts water proportions are maintained). For best results use distilled water
8. Thoroughly shake or stir the soil and water together for at least 1 minute then allow to stand undisturbed until it settles

Phosphorus Test

1. Select the blue phosphorus comparator. Remove the cap
2. Using the pipette fill the test and reference chambers to the fill mark
3. Carefully separate the two halves of the blue phosphorus capsule and pour powder into the test chamber
4. Replace the cap on the comparator making sure the cap is on tightly
5. Shake thoroughly
6. Allow the color to develop in the test chamber for 10 minutes
7. Compare the color of the solution in the test chamber to the color chart. For best results allow natural light to illuminate the solution.

Nitrogen Test

1. Select the purple nitrogen comparator. Remove the cap
2. Using the pipette fill the test and reference chambers to the fill mark
3. Carefully separate the two halves of the purple nitrogen capsule and pour powder into the test chamber
4. Replace the cap on the comparator making sure the cap is on tightly
5. Shake thoroughly
6. Allow the color to develop in the test chamber for 10 minutes
7. Compare the color of the solution in the test chamber to the color chart. For best results allow natural light to illuminate the solution.

Potassium Test

1. Select the orange potassium comparator. Remove the cap
2. Using the pipette fill the test and reference chambers to the fill mark
3. Carefully separate the two halves of the orange potassium capsule and pour powder into the test chamber
4. Replace the cap on the comparator making sure the cap is on tightly
5. Shake thoroughly
6. Allow the color to develop in the test chamber for 10 minutes
7. Compare the color of the solution in the test chamber to the color chart. For best results allow natural light to illuminate the solution.

pH Test

1. Remove the cap from the green comparator
2. Fill test chamber to soil fill line with soil sample
3. Carefully separate the two halves of the green pH capsule and pour powder into the test chamber
4. Using the pipette, add water (preferably distilled) to the water fill line
5. Replace the cap on the comparator making sure the cap is on tightly
6. Shake thoroughly
7. Allow soil to settle and color to develop for about a minute
8. Compare the color of the solution against the pH chart. For best results allow natural light to illuminate the solution.

Data/Observations

SAMPLE NUMBER	pH	Phosphorus (P)	Nitrogen (N)	Potassium (K)
1 **Location:**				
2 **Location:**				
3 **Location:**				

Observations:

Assessment

1. What are the components of fertile soil?
2. How can soil conservation methods protect the soil and its fertility?
3. What causes soil degradation (soil becomes unfertile)?
4. What would happen to crops if they were grown in unfertile soil? What would happen to the organisms that consume them?
5. How have modern farming practices replaced the traditional methods of farming?
6. What are the foods produced in the greatest amounts throughout the world?
7. How has the demand for food worldwide affected the demand for fertilizers for soil?
8. How has the green revolution increased yields of new crop varieties through modern agricultural techniques?

Extensions or Additional Resources

1. Students may write a persuasive essay addressing the question: which is better for plants, organic or chemical fertilizers?
2. Students may develop a fertilizing plan to improve the nutrient value of the soil in the school garden.
3. Students may get involved in the school composting procedures and worm farm processes in order to improve the school garden soil.
4. Students can research genetic engineering in plants and animals and discuss if genetic engineering can compensate for nutrient poor soils.
5. Students can be given a future situation in which they are the last hope for human survival. Split students into groups of 4 or 5. Due to the over-use of nutrients in the soil each group has a hypothetical farm that is responsible for producing enough food to feed the world. Furthermore, the amount of phosphorus, nitrogen, potassium, and other important minerals and trace elements on the earth are very scare. First the students must identify the impact that human activity has on the earth, specifically the depletion of nutrients in the soil due to agriculture and other human activities. They then must come up with a feasible plan to replenish nutrients to soil and conserve.
6. Students can have a debate over the "hot topics" related to agriculture. The scientists concerned with soil having the perfect composition as their main concern vs. politics vs. society vs. economics.

Suggested Soil Kits

LaMotte Complete Soil Test Kit

Luster Leaf 1601 Rapitest Test Kit

Vernier and Pasco sensors are also a great method of testing

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