Soil Testing and Using Fertilization Recommendations

Age: 10-12 years old (grades 5-6), but can be adapted for all youth 5-19 (grades K-12)

Objectives:

1. Members/students should be able to take a representative soil sample following correct procedure and prepare it for lab submission.
2. Members/students should know how to read and use soil fertilizer marketing labels.
3. Members/students will create the fertilizer blend needed based on fertilizer recommendations.

Preparation:

Soil Sampling

Materials Needed:

- Soil probe – may be able to borrow one from your local Extension office.
- Bucket
- Pen or marker
- Soil sampling bags – can be obtained from your local Extension office.
- WD-40 lubricant (optional)

Fertilization Recommendations

Preparation Resources Needed:

1. Computer used to make fertilizer recommendations must have Microsoft Excel
1. Download the "Fertilizer Recommendation Program" from the K-State Soil Testing Laboratory website at: http://www.agronomy.ksu.edu/SOILTESTING/DesktopDefault.aspx?tabid=32
2. Use data from "real" soil tests or use the sample data provided with this lesson. "Real" soil tests should come with fertilizer recommendations, so you may not need to input the lab results to obtain the recommendations. May need to modify "Intended Crop," "Previous Crop," and "Yield Goal" to fit your area. You may also wish to use commonly seen pH, buffer pH, P and K readings in your area. The sample data is based on East Central and Southeast Kansas soil test expectations.
3. Input data in the first worksheet called "Information." Print this page and the second worksheet called "Sufficiency Recommendations." The second worksheet will be needed when calculating fertilizer blends.

Interest Approach:

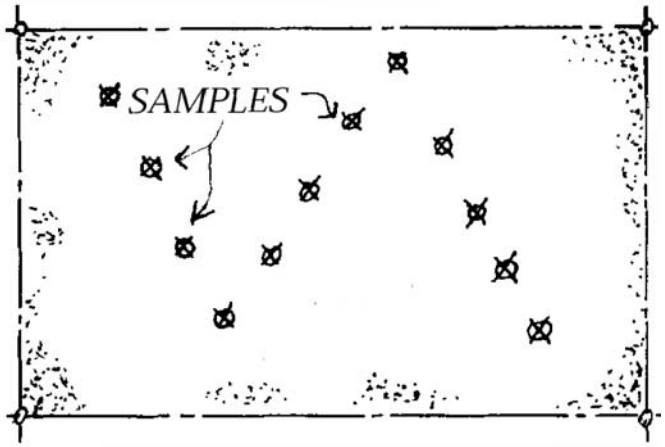
What happens to plants when they don't get enough nutrients? Brainstorm answers: don't grow well, die, yield less, leaves have scorched edges, etc. What about if plants get too much fertilizer? Brainstorm answers: plants die, plants have weak stems and fall over, get "fertilizer burn," etc. What other some other negative impacts associated with applying too much fertilizer? Brainstorm answers: extra cost, fertilizer runs off into water causing algae blooms or other environmental problems, etc. What can we do so we don't apply too little or too much fertilizer but instead the "correct" amount. Answer: Soil test!

Content:

Experience: Soil testing provides farmers, gardeners and homeowners with lawns with soil fertility information so they know how much of the major nutrients are in the soil and how much fertilizer they need to apply to meet crop needs. Soil testing is inexpensive and easy, but it takes some time to obtain good representative samples. We will learn how to soil test and take some samples to submit to a soil testing laboratory.

Soil Testing Procedure:

1. Obtain necessary materials. See Soil Sampling Materials Needed above.
2. Determine the area in which you wish to sample. The sampling area (field) should include soils that will be managed the same (i.e. one fertilizer rate applied to entire area and have the same intended crop).
3. Plan to take 15-20 soil cores from your field. More gives results with greater repeatability. The sampling pattern should resemble a "W" and cover the entire field. See diagram.



4. Use the soil probe to collect soil cores 6 inches deep. An application of WD-40 on the soil probe may help remove the soil cores more easily. WD-40 will not impact the soil test results. If the soil has a lot of residue, gently move it aside without disturbing the topsoil. Press the soil probe 6 inches deep and pull it straight back out of the soil. Deposit soil cores in the bucket.
5. Continue process until you have collected 15-20 cores and have traveled throughout the entire field with the "W" sampling pattern.
6. Mark the soil sampling bag with a description of the field you will remember. Also list your name, county, intended crop, previous crop and any yield information.
7. Mix the cores in your bucket with your hand. You may want to break up large pieces. Once it is thoroughly mixed, pour approximately 2 cups into the soil sampling bag. There is a line on the bag representing how much soil is needed. After filling the bag, you can dump the soil left in your bucket back into the field.
8. Repeat the process for all the fields you wish to sample.
9. Discuss why it was important to get a larger soil sample. The answer relates to the chance that each soil core represents the entire field. Analyzed separately, each core would have different soil test readings. We need many cores so the average will accurately represent the field.

10. Submit the samples to a soil testing laboratory. Samples can be submitted to the K-State Soil Testing Lab by taking them to your local Extension office. There will be charges associated with the tests you choose to run. For this class, package 1 is a good option that will provide a pH, buffer pH (if necessary), P and K reading. The nitrogen recommendation will be based on the intended crop and yield goal. This test usually costs somewhere between $7.50 and $10.00 each depending on shipping costs. Some counties have cost-share grant programs that can pay a portion of that cost. You should receive results in approximately 2 weeks.

Share: You can wait and use the results of your soil tests for the fertilization recommendations portion of this lesson. However, by using other soil test results you can learn the process and then apply it to your soil test results later.

You will receive both analytical (scientific test) results and fertilizer recommendations from the soil testing laboratory. The recommendations will tell you how many pounds per acre of nitrogen (N), phosphate (P_2O_5) and potassium (K_2O) fertilizer nutrient you should apply. Importantly, however, fertilizer is not "made" to fit every recommendation. Different commercial fertilizers must be blended to meet the fertilizer recommendations. Additionally, fertilizers are not 100% the nutrients nitrogen, phosphate and potassium. Based on how they are mined or made, other elements are included. For example, the common potassium fertilizer product called potash is KCl. The Cl stands for chloride and it cannot reasonably be separated from the K. KCl commonly has a K_2O rating of 60%. In other words, 60% (by weight) of KCl is K_2O.

There is a standard way in which all fertilizers must express the amounts of N, P_2O_5 and K_2O included in their product. It will be three numbers separated by dashes. The numbers are the percentage of N, P_2O_5 or K_2O included in the product. The first number is for N, the second number is for P_2O_5 and the third number is for K_2O. For example, if a fertilizer is labeled 7-21-3 that means it is 7% N, 21% P_2O_5, and 3% K_2O. For practice, how much K_2O is in a fertilizer product labeled 10-32-0? Answer: 0%, the last number represents K_2O. What percent of that product is P_2O_5? Answer: 32%. What nutrient makes up 10% of that fertilizer product? Answer: N.

Process: Now that we know how to read fertilizer labels, let's use that information to "make" a blended fertilizer that meets our fertilizer recommendation needs.

Commonly available dry bulk fertilizers
(Note ammonium nitrate is less common and fertilizer dealers usually carry only MAP (monoammonium phosphate) *or* DAP (diammonium phosphate.)
Urea 46-0-0
Ammonium Nitrate 34-0-0
MAP 11-52-0
DAP 18-46-0
Potash 0-0-60

Field 1: Recommendations are for 110 lbs of N, 15 lbs of P_2O_5 and 0 lbs of K_2O. Our fertilizer dealer only has urea, MAP and potash. How much of each fertilizer is needed to meet our fertilizer recommendations?
Step 1 – Start with P_2O_5 since all the available fertilizer sources also include some N. Divide the pounds recommended by the decimal form of the P_2O_5 nutrient percentage. Round to the nearest pound.
15 lbs / .46 = 33 lbs of DAP
Step 2 – How much N was included in your DAP application?
Take the pounds of DAP applied time the decimal form of the N nutrient percentage. Round to the nearest pound.
33 lbs * .18 = 6 lbs of N
Step 3 – Subtract this N application from the N recommendation.
110 lbs – 6 lbs = 104 lbs
Step 4 – Calculate the amount of fertilizer needed to meet the N recommendation. Divide the pounds recommended by the decimal form of the N nutrient percentage. Round to the nearest pound.
104 lbs / .46 = 226 lbs Urea
Step 5 – Calculate the amount of fertilizer needed to meet the K2O recommendation. Divide the pounds recommended by the decimal form of the K2O nutrient percentage. Round to the nearest pound.
K2O recommendation is zero, so no potash is needed.

Fertilizer blend applied to each acre should contain:
226 lbs of urea
33 lbs of DAP
No potash

Lime is advertised and sold as a percent ECC (Effective Calcium Carbonate.) This is based on the particle size and relates to how quickly lime will impact soil pH. Most agricultural lime is approximately 60% ECC. Although no lime is needed for Field 1, calculation instructions follow:
Lime ECC lb recommendation / percentage ECC of lime source
For example: 1750 lbs ECC / .60 = 2917 lbs of ag lime per acre

<u>Generalize:</u> Repeat this process for fields 2-4.
Field 2
40 lbs / .46 = 87 lbs DAP
20 lbs / .60 = 33 lbs potash
Fertilizer blend applied to each acre should contain:
87 lbs of DAP
33 lbs of potash
No urea
Lime – calculated above = 2917 lbs of ag lime per acre

Field 3
120 lbs / .46 = 261 lbs urea

15 lbs / .60 = 25 lbs potash
Fertilizer blend applied to each acre should contain:
261 lbs urea
25 lbs of potash
No DAP
Lime – 3000 / .60 = 5000 lbs of ag lime per acre

Field 4
40 lbs / .46 = 87 lbs DAP
87 lbs * .18 = 16 lb of N
90 lbs – 16 lbs = 74 lbs of N required
74 lbs / .46 = 161 lbs of urea
Fertilizer blend applied to each acre should contain:
161 lbs urea
87 lbs of DAP
No potash
No lime needed

Apply: Use this process to calculate the fertilizer blend needed for your soil test(s) when you receive the results.

Summary:

- Soil testing is an easy and inexpensive way to find out how much fertilizer should be applied to grow a certain crop.
- The soil sampling pattern should resemble a "W" and 15-20 soil cores should be collected.
- Fertilizers are marketed with three numbers separated by dashes that represent the percentage of N, P_2O_5, and K_2O in the fertilizer source (N-P_2O_5-K_2O).
- Although fertilizers are not 100% the recommended nutrient unit, it only requires basic math skills to blend together available fertilizers to meet fertilizer recommendations.

Assessment:

1. Draw out a soil sampling pattern for a field, marking with an "X" approximately where soil cores will be taken.
2. Use fertilizer recommendations and available fertilizers to develop a fertilizer blend for fields 2-4.

References:

Leikam, Dale F. Ray E. Lamond, and David B. Mengel, *Soil Test Interpretaions and Fertilizer Recommendations*, Kansas State University, September 2003.

Fertilizer Recommendation Program. Available at http://www.agronomy.ksu.edu/SOILTESTING/DesktopDefault.aspx?tabid=32 Kansas State University, 2003.

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