Soil Chemistry Laboratory Manual

Introduction to Agriculture Chemistry

SCIT 1305

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SOIL SAMPLING TUBE

LaMotte Model EP 1055

The LaMotte Soil Sampling Tube is a hollow galvanized steel tube with a handle on one end and a saw-toothed cutting edge on the other end.

One side of the tube is cut away to permit inspection of soil core stratification.

Procedure

1. Holding the tube in a vertical position, force it into the soil approximately six to nine inches. Leave about one inch of the cutaway portion of the tube showing above the surface of the soil. Deeper penetration will compress the soil in the tube, making it difficult to remove.

2. Twist the tube back and forth to sever the core.

3. Continuing to twist the tube back and forth with a rapid motion, lean the tube toward you with the cutaway portion facing up and slowly withdraw the tube from the soil. The twisting motion will insure that the tube is withdrawn without breaking soil or turf, resulting in a perfect soil sample. The wetter the soil, the more carefully these instructions must be followed.

4. Remove the soil sample through the cutaway portion of the tube. When soil tests are to be performed on sample taken from a particular depth (e.g., six to eight inches), simply measure downward from the top of the soil core to locate soil from the desired depth. Use a clean utensil to dislodge soil remaining in the tip of the sampler.

Soil Extraction for a Single Test

1. Using a 1ml pipet, add 1ml of **acid extracting solution** to the test tube (0701).

2. Dilute to the 15 ml line with DI water.

3. Add 3 – 1gram spoon measures of soil.

4. Add 0.5ml of **charcoal suspension**.

5. Cap and shake for 5 minutes.

6. Filter the mixture.

7. Save the soil extract for the any of the following tests:

- Nitrate Nitrogen
- Phosphorus
- Potassium
- Calcium
- Magnesium
- Ammonia Nitrogen
- Nitrite Nitrogen
- Copper
- Manganese
- Aluminum

Soil Extraction for Multiple Tests

1. Using a 1ml pipet, add 5 ml of **acid extracting solution** to a 100 ml graduated cylinder
.
2. Dilute to the 75 ml line with DI water.

3. Pour into a 100 ml bottle (0990).

4. Add 15 – 1 gram spoon measures of soil.

5. Add 2 ml of **charcoal suspension**.

6. Cap and shake for 5 minutes.

7. Filter the mixture.

Save the soil extract for any combination of the following tests:

- Nitrate Nitrogen
- Phosphorus
- Potassium
- Calcium
- Magnesium
- Ammonia Nitrogen
- Nitrite Nitrogen
- Copper
- Manganese
- Aluminum

Neutralization of Soil Extract

The soil extract for the Ca, Mg, ammonium nitrogen, Cu, and Fe tests must be neutralized before proceeding with the tests.

Procedure

Add 15% **sodium hydroxide** (NaOH) to the soil filtrate, one drop at a time, until the pH paper indicates the pH is between 6.0 and 7.0.

Nitrate Nitrogen

Nitrogen, in the form of nitrate (NO_3^{-1}), is an important element in plant growth. It is found in plant proteins, chlorophyll, nucleic acids, and other plant structures. Adequate levels result in larger and healthy plants with increased yields. Since nitrogen is readily leached from the soil, levels may change rapidly.

In this test, cadmium in the nitrate-reducing agent reduces the nitrate to a nitrate ion that produces a red dye stuff through a diazotization reaction.

The resulting color is matched to a color standard to determine the nitrate nitrogen level.

Procedure

1. Fill the test tube (0106) to the 5ml with the soil extract.
2. Dilute to 10ml line with the **mixed acid reagent**.
3. Add 2 - 0.1g spoons **nitrate reducing reagent**.
4. Cap and invert 50 – 60 times in one minute to mix.
5. Let stand for 10 minutes
6. Invert the sample once to mix.
7. Insert the test tube in to the Octa-Slide viewer.
8. Slide the nitrate nitrogen octa-side bar into the viewer.
9. Match the sample color to a color standard.
10. Record as lb/acre nitrate nitrogen.

NOTE: If the sample color is darker than the highest color standard, dilute the sample and repeat the test.

Ammonia Nitrogen

Fertile soils will give low ammonia nitrogen results unless a nitrogenous fertilizer was recently applied to the soil. After applications there is a rapid decrease in the ammonia nitrogen levels since the ammonia is transformed into other nitrogen compounds, more available for plants (i.e. nitrates).

In less fertile soils (i.e. forest), ammonia is the most available form of nitrogen.

In this procedure, Nessler's Reagent reacts in direct proportion with the ammonia in the soil to produce a reddish-brown color. The resulting color is matched to a color standard.

Procedure

1. Add 5ml of neutralized soil extract to the test tube (0106).

2. Add 6 drops of Ammonia Nitrogen Reagent #1.

3. Cap and mix.

4. Add 0.5 ml of Ammonia Nitrogen #2 using this 0.5 ml pipet.
.
5. Cap and mix.

6. Let stand for 5 minutes.

7. Invert the sample once to mix.

8. Insert the sample into the Octa – Slide viewer.

9. Slide the Ammonia Nitrogen Octa – Slide Bar standard into the viewer.

10. Match the sample color to the standard color.

11. Record as lb/acre ammonia nitrogen.

Nitrite Nitrogen

When ammonia is being transformed into nitrates, nitrites are an intermediate step.

Ammonia ⟶ Nitrites ⟶ Nitrates

A well drained and aerated soil speeds up the process, so the nitrite levels in these types of soils is usually low.

In poorly aerated soils, toxic levels of nitrite, may be found

In soils with high levels of nitrates, some of the nitrates may decompose back into toxic levels of nitrites.

In this procedure, the nitrites will react with sulfanilamide through a diazotization reaction to form a pink AZO dye.

Procedure

1. Fill the test tube (0106) to the 2.5 ml with soil extract.

2. Dilute to 5ml with DI water.

3. Dilute to 10 ml with mixed acid reagent.

4. Using the 0.1g spoon, add 2 measures of color developing reagent

5. Cap and mix for one minute.

6. Let stand for 5 minutes.

7. Invert the sample once to mix.

8. Insert the test tube into the Octa – Slide Viewer and compare with the Nitrite in Soil Octa - Slide Bar.

9. Record as lb/acre Nitrite Nitrogen.

Iron

Iron is only used in small quantities by plants but is essential for numerous enzyme systems in the plant metabolism.

Iron is more soluble in acidic solutions therefore; iron is more available to plants in soils with a low pH.

In this procedure, a bipyridal indicator reacts with the iron in the soil at a proper pH to produce a pink color.

Procedure

1. Fill the test tube (0106) to the 5 ml line with neutralized soil extract.
2. Add 5 drops of Iron reagent #1.
3. Using the 0.05g spoon, add one measure of Iron reagent #2.
4. Cap and mix until the powder has dissolved.
5. Let stand for 5 minutes.
6. Invert the sample once to mix.
7. Insert the test tube into the Octa – Slide view and compare with the Iron Octa – Slide bar.
8. Record as ppm of iron.

Copper

Plants use copper for an enzymatic catalyst

In soils with a low pH (acidic), aluminum may compete with copper, resulting in a decreased uptake of copper by the plant Overall, the balance of Cu/Fe/Mo is more important than the actual amount of copper

In this procedure the copper will be reacted with sodium diethyldithiocarbamate to produce a color. This will be compared to an untreated sample

Procedure

1. Fill two test tubes (0106) to the 10ml line with neutralized soil extract.

2. Add 5 drops of copper reagent to one of the test tube.

3. Cap and mix.

4. Remove the cap.

5. Hold both test tubes ½ inch a above a white plastic sheet.

6. The extract to which the Copper Reagent was added will appear yellow if copper is present.

7. Add Copper 2 Reagent to the second (hold bottle vertically) untreated, one drop at a time, with mixing until the colors of both samples are the same.

8. Make sure you count the number of drops.

9. Multiple the number of Copper 2 Reagent by 0.25

   Example: 4 drops X 0.25 = 1 ppm
   8 drops X 0.25 = 2 ppm

10. Record as ppm Copper.

pH

pH is a measure of alkalinity or acidity. The pH of soil ranges from 3.5 to 11.0.

Research has found that plants grow best in the range of 5.0 to 8.5.

In soils with low pH, some nutrients may reach toxic levels and the activity of soil microbes may be drastically reduced.

Soils with higher pH generally have lower availability of micronutrients and some nutrients may not be present at sufficient levels.

To test the pH, a flocculating agent will be used to obtain a clear solution.

Procedure

1. Fill the tube (0106) to the 5ml with Tricon Flocculating Regent.
2. Add three 0.5g level spoons of the soil sample to the tube.
3. Cap and slowly invert back and forth for one minute to mix.
4. Let the soil particles settle to the bottom.
5. Using a pipet, fill another tube (0106) to the 2.5ml line with the clear solution above the settled soil particles.
6. Add 6 drops of Wide Range Indicator.
7. Cap and mix.
8. Insert the tube into the Octa-Slide Viewer.
9. Slide the pH wide Range Octa-Slide bar into the viewer.
10. Match the sample color to the color standard.
11. Record the pH.

Phosphorus

Phosphorus is an important element for both plants and animals.

Phosphorus is contained in the nucleus of the plant cell, which controls cell division and growth. Phosphorus also plays an important role in energy storage and chemical transfer within the plant.

In this test procedure, the phosphorous in the soil extract will react with the molybdate in the VM Phosphate reagent to from a phosphor- molybdate compound.

A reducing agent is added which contains stannous chloride to produce a blue color.

Procedure

1. Add 1 ml of soil extract to the test tube (0106) and dilute to the 5 ml mark with DI water.

2. Add 0.5 ml of VM Phosphate Reagent.

3. Cap and invert several times to mix.

4. Let stand for 5 minutes.

5. Add two drops of Reducing Agent.

6. Cap and mix. Solution should turn blue in 10 seconds.

7. Match the color to the standard and record as lb/acre phosphorus.

Potassium

Potassium is found in abundance as a component of many common minerals but the low solubility of potassium in the minerals limits availability to plants.

Although potassium is not part of the actual plant structure, it is important in many biochemical functions of the plant, which includes cell division and resistance to disease.

In this procedure, the soil extract will be made alkaline and the potassium in the soil extract will combine with sodium tetra phenyl boron (soluble) to form potassium tetra phenyl boron precipitate (insoluble).

The resulting turbidity (cloudiness) is used to determine the potassium level.

Procedure

1. Add 2 ml of soil extract to the test tube (0796).
2. Add 2 mL of Potassium TPB Solution.
3. Let stand 5 minutes.
4. Dilute to the top line with DI water.
5. Cap and shake to mix.
6. Remove the cap and slowly insert the square tube with the collar. The square tube will slide up and down through the collar and fill with liquid.
7. Viewing from above, lower the square tube into the solution until the black dot on the base is no longer visible.
8. Hold the round tube at the top to prevent blocking the light.

9. Read the level of the liquid level in the square tube.

10. Record as lb/acre potassium.

11. Convert to lb/acre potash by multiplying lb/acre potassium by 1.2.

Aluminum

All soils contain significant amounts of aluminum. This aluminum is in the form of inorganic colloidal material and undecomposed minerals.

In neutral, slightly alkaline and slightly acidic soils the aluminum is inert and does not affect plant growth.

In more acidic soils, aluminum can form potentially toxic salts. High aluminum level results indicate an undesirable acid soil. Plants that normally thrive in acidic soils may fail in a soil with high active aluminum test readings.

A medium test result is tolerable to many plants including grasses, corn, oats, potatoes, and tobacco.

A low or negative aluminum test result is preferable.

In this procedure, the aluminum will react with hematein in the Aluminum Test Solution to form a colored solution. The resulting solution is matched to a color chart.

Procedure

1. Add two drops of soil extract to the spot plate.

2. Add two drops DI water.

3. Add one drop of Aluminum Test Solution.

4. Stir with a stirring rod.

5. Wait one minute.

6. Match color to the color standard on the "Aluminum in Soil Color Chart".

Color Standard	Concentration PPM	Color Standard	Concentration PPM
Very Low	5 ppm	High	80 ppm
Low	10 ppm	Very High	125 ppm
Medium	30 ppm		

Sulfur

Sulfur is essential to the formation of protein and affects various aspects of plant metabolism.

The pale green color and thin reedy stems can distinguish plants that are deficient in sulfur.

The major sources of sulfur are fertilizers containing sulfate compound. And atmospheric sulfur dioxide carried into the soil by precipitation.

In this test the sulfate reagent contains barium chloride which reacts with sulfur to form a barium sulfate precipitate. The resulting turbidity is matched to a standard to determine the sulfur concentration.

Procedure

1. Fill the tube (0701) to the 15ml line with DI water.
2. Add 3 – 1.0g level spoons of soil.
3. Add 0.5ml of charcoal suspension.
4. Cap and shake for 5 minutes.
5. Filter.
6. Fill the tube to the 5ml (0106) with soil extract.
7. Dilute to the 10ml line with DI water.
8. Add 1 – 0.1g level spoon of sulfate reagent.
9. Cap and shake until the powder is dissolved. Wait 5 minutes. (A white precipitate will form if sulfur is present).
10. Invert the sample once to mix.

11. Insert the tube into the Octa-Slide viewer with printing away from the operator.

12. Slide the sulfur Octa-Slide bar into the viewer.

13. Compare colors

14. Record the ppm sulfur.

Manganese

Manganese is an essential element in the enzyme system of plants.

Manganese plays a role in metabolic reactions affecting germination, photosynthesis and other vital aspects of plant development. Yellowing and stunted growth may indicate a manganese deficiency.

Some insoluble manganese is present in all soils and its solubility (availability) is related to pH.

Calcareous soils (heavily limed) may be deficient in manganese. This can be corrected by applying manganese sulfate or another soluble manganese salt.

Highly acidic soils may have extremely high, even toxic levels of Mn. The acidity can be lowered by the application of lime.

Since available Mn may be leeched from soils or altered to less available forms by oxidation, test should be performed just before planting and during plant growth.

A positive test generally indicates sufficient available Mn. A high test result is undesirable and indicates a need for lime.

Procedure

1. Add ten drops of soil extract to the spot plate.

2. Use the 0.05g spoon to add one measure of Manganese Buffer Reagent.

3. Mix with a clean stirring rod until the powder dissolves.

4. Using another 0.05g spoon add one measure of Manganese Periodate Reagent.

5. Mix with a clean stirring rod for 20 seconds. (Clean Spoon immediately afterwards to prevent staining).

6. Match the color in the spot plate to the Manganese color standard chart.

7. Record ppm Mn

Color Standard	Concentration (ppm)
Low	5 ppm
Medium	12 ppm
High	25 ppm
Very High	40 ppm

HUMUS

Humus consists of the complex remains of fresh plant and animal residue after extensive chemical and biological breakdown. It accounts for 60 to 70% of the total organic carbon in soil. Humus can modify the physical properties of soil as well as the chemical and biological properties.

EDTA will extract the humus from the soil. The resulting color will be compared to a color standard.

Procedure

1. Add two measures of soil to the extraction tube (0704) using a 2.5 g spoon.

2. Add DI water to the 14 ml mark.

3. Cap and shake to mix.

4. Using the 0.5 g spoon add 2 measures of Humus Screening Reagent Powder (if necessary add additional water to bring the level back to the 14 ml mark).

5. Cap and shake vigorously for one minute.

6. Add 15 drops of Soil Flocculating Reagent.

7. Cap and mix gently.

8. Allow the soil to settle for several minutes.

9. Filter and collect in a second extraction tube (0704).

10. Match the color to the color on the Humus Color Chart.

11. Record the result.

12. Use the following chart to convert the color result to a value.

Humus or Organic Matter in the Soil					
Humus Reading	**1**	**2**	**3**	**4**	**5**
Agricultural Soils	low	medium	high		
Garden Greenhouse Soils		low	medium	high	
Organic Soils			low	medium	high

CALCIUM AND MAGNESIUM

Calcium is a necessary ingredient in cell division. Rapidly growing root tips contain calcium. Calcium plays a role in the selectivity of the absorption of nutrients in cells

Magnesium is in the chlorophyll that makes plant green. Magnesium plays a part in the production of fats and oils and assists in the uptake of phosphorus.

In this procedure two EDTA titrations will determine the amount of calcium. Magnesium is then determined by the difference between the two titrations.

Procedure

Dilution of Soil Extract

1. Using a graduated cylinder, transfer 10ml of soil extract to a 50 ml beaker.

2. Add 10 ml of DI water and mix.

3. Add Sodium Hydroxide Solution (15%) one drop at a time until the pH paper indicates that the pH is between 6.0 and 7.0

Titration of Calcium and Magnesium

1. Fill the test tube (0778) to the 5 ml line with the above diluted neutralized soil extract solution.

2. Dilute to the 10 ml mark with DI water.

3. Add 5 drops of Calcium Magnesium Inhibitor Regent.

4. Swirl to mix.

5. Let stand for 5 minutes.

6. Add 10 drops of CM Indicator Solution.

7. Swirl to mix (Solution will turn red)

8. Place the special test tube cap onto the test tube

9. Using the direct reading titration, dispense the plunger to expel the air

10. Insert the adapter tip on the titrator into the plastic plug on the standard EDTA bottle

11. Invert the EDTA bottle while holding the bottle and titrator together

12. Slowly pull out the plunger of the titrator until the large ring on the plunger is opposite the zero (0) line on the scale

13. If there is any air in the titrator barrel on the adapter tip, partially fill the barrel with solution and pump the solution back and forth until all the air is expelled

14. When the air is expelled and the plunger reads zero (0), turn the bottle upright and remove the titrator

15. Invert the titrator tip into the center hole on the special cap that was placed on your sample tube

16. Slowly depress the plunger to dispense the titrating solution while gently swirling the test tube to mix

17. Continue slowly adding the EDTA standard until the solution turns from red to blue

18. If need be, refill the titrator and continue

19. Read the volume used from where the plunger meets the scale

20. Multiply this number by 5.16 and record as "total Ca and Mg".

Titration of Calcium

21. Clean the previously used test tube (0778) and fill to the 5 ml mark with your diluted neutralized soil extract.

22. Dilute to the 10 ml mark with DI water.

23. Add 2 drops of Inhibitor Solution.

24. Swirl to mix.

25. Add 2 drops of TEA Reagent.

26. Swirl to mix.

27. Add 8 drops of Sodium Hydroxide Reagent with metal Inhibitors.

28. Swirl to mix.

29. Add one Calcium Hardness Indicator Tablet.

30. Cap and swirl until the tablet disintegrates. (solution will turn red).

31. Fill the Direct Ready Titrator with standard EDTA as was done previously.

32. Insert the Titrator into the center hole of the special cap on the test tube.

33. While swirling the tube, slowly depress the plunger on the titrator until the color changes from red to blue and does not revert back to red for at least a minute.

34. Record the result from where the plunger tip meets the scale.

35. Multiply this number 5.16

36. Record this number as “Total Ca”.

Final Results

“Total Calcium and Magnesium” =

“Total Ca” =

Ca = “TOTAL Ca” X 0.4 = ppm Ca

Mg = [Total Ca and Mg” – “Total Ca”] X 0.24 = ppm Mg

CHLORIDE

Chloride does not exist as a deficiency in natural soils. Fertilizers that contain chloride may lead to excess or toxic levels of chlorides. A high chloride level in the soil and stunted growth may indicate toxic levels of chloride.

The chloride test is used when soils are saline or when seawater or spray is suspected of contaminating the soil.

Normal soil from humid soil will typically have chloride levels below what can be determined from the test except when fertilizers with excessive chlorides have been applied.

In this procedure, the chloride will be titrated with Silver Nitrate using Chlorine Reagent 2S, after an indicator of potassium Dichromate (Chloride Reagent 1) has been added

1. Fill a clean test tube (0701) to the 15 ml mark with DI water.
2. Using a 1 g spoon, add three measures of soil sample.
3. Add 0.5 ml of Charcoal Suspension.
4. Cap and shake for 5 minutes.
5. Filter the soil sample and collect the filtrate (liquid) and use as youe soil extract.
6. Fill a clean test tube (0778) to the 10 ml mark with the soil extract.
7. And 3 drops of Chloride Reagent #1.
8. Cap and swirl to mix (solution should turn yellow).
9. Insert the adapter tip on the titrator into the plastic plug on the Chloride Reagent 2S bottle.

10. Invert the Chloride Reagent 2S bottle while holding the bottle and titrator together.

11. Slowly pull out the plunger of the titrator until the large ring on the plunger is opposite the zero (0) line on the scale.

12. If there is any air in the titrator barrel on the adapter tip, partially fill the barrel with solution and pump the solution back and forth until all the air is expelled.

13. When the air is expelled and the plunger reads zero (0), turn the bottle upright and remove the titrator.

14. Invert the titrator tip into the center hole on the special cap that was placed on your sample tube.

15. Slowly depress the plunger to dispense the titrating solution while gently swirling the test tube to mix.

16. Continue slowly adding the Chloride Reagent 2S until the solution changes permanently from yellow to brick red.

17. If need be, refill the titrator and continue.

18. Read the volume used from where the plunger meets the scale.

19. Record as ppm Cl.

SOIL TEXTURE

The soil texture test is designed to separate soil into its three basic mineral fractions:

- Sand
- Silt
- Clay

The three basic soil textures are based on particle size.

Soil Particle	Diameter (mm)	Soil Particle	Diameter (mm)
Very Coarse Sand	2.0 – 1.0	Very Fine Sand	0.10 –0.05
Coarse Sand	1.0 – 0.5	Silt	0.05 – 0.002
Medium Sand	0.5 – 0.25	Clay	Less than 0.022
Fine Sand	0.25 – 0.10		

The amount of time required for the sail particles to settle in the soil separation tubes form the basis for this test. From the amount of material collected in each tube it is possible to determine the approximate percentage of each fraction as represented in the original soil sample.

Procedure

1. Place the three Soil Separation Tubes in the rack.

2. Add the soil sample to tube A until it is even with the15 ml line. (Gently tap the tube while adding the soil to pack the soil and eliminate air spaces).

3. Add one ml of Texture Dispensing Reagent to the soil in “tube A”.

4. Dilute to the 45 ml line with DI water.

5. Cap and gently shake for two minutes making sure the soil and water are thoroughly mixed.

6. Place “tube A” in the rack and allow settling undisturbed for 30 seconds.

7. Carefully pour of all the solution from “tube A” into a second “tube B”.

8. Return “tube A” and “tube B” to the rack.

9. Allow “tube B” to settle undisturbed for 30 minutes.

10. Carefully pour off the solution from “tube B” into a third “tube C”.

11. Return “tube B” to the rack.

12. All one ml of Soil Flocculation Reagent to “tube C”

13. Cap and shake for one minute.

14. Place “tube C” in the rack and allow to stand until all the clay in the suspension settle (this may require up to 24 hours).

Due to the colloidal nature of clay in solution and its tendency to swell and form a gel, the portion of clay in “tube C” will not be used to determine the clay fraction in the soil.

Adding the sand and soil fractions together and subtracting this from the initial volume of soil used for the separation calculate the clay fraction.

15. Read the level of soil in tube A:

$$\%\,sand = \frac{reading\ tube\ A}{15} \ x \ 100$$

16. Read the level of soil in tube B:

$$\%\,silt = \frac{reading\ tube\ B}{15} \ x \ 100$$

17. Calculate the volume of clay:

$$ml\ clay = 15 - tube\ A - tube\ B$$

18. Calculate the % clay:

$$\%\ clay = \frac{ml\ clay}{15}\ x\ 100$$

Interpretation

Sandy soil is described as soil that contains 85% or more sand. The % silt + 1.5 times the percentage of clay should not exceed 15%.

Silt soil is described as soil material that contains 80% or more silt and less than 15% clay.

Clay soil is described as soil material that contains 40% or more clay and less than 45% sand and less than 40% silt.

Additional terms are also used to describe various graduations possible under each general soil texture classification. Some examples are loamy sand, sandy loam, silty clay, sandy clay or a silty clay.

GREEN PLANT TISSUE TESTS

Nutrient deficiencies during plant growth can be determined by using a plant tissue extract

Due to the variables in species, age, and environment, the tests are meant only to be comparative

When testing the plant tissue, compare tissue from a healthy plant in the same environment to the plant with possible problem

Procedure

Preparation of Tissue Extract

1. Collect samples of the leaf petioles, a succulent portion of the stem or from areas where the abnormality is most visible.
2. Do the same for a healthy plant using the same parts for a comparison. Make two extracts and perform the following procedure on each separately.
3. Cut the material in to 1/8 to 1/16 inch pieces in both length and thickness using a clean knife.
4. Fill the extraction vial (0989) halfway with plant material (do not pack the material into the vial).
5. Add 1 ml of Acid Extracting Solution.
6. Dilute to the line with DI water.
7. Cap and shake for 5 minutes.
8. Filter the plant material and collect the filtrate.
9. Use this plant extract in place of the soil extract for the tests.

Plant Tissue Procedure

Follow the test procedures for Nitrate in Nitrogen, Potassium and Phosphorus except use the plant tissue extract instead of the soil extract.

Compare the results of the problem plant to the healthy plant.

Guidelines for Interpreting Plant Tissue Tests		
Test Faction	**Test Reaction**	**Relative Amount of Nutrient in Plant Tissue**
Nitrate Nitrogen	Dark Pink Color Light Pink Color Colorless	Abundant Adequate No Reserve/Probably Deficient
Potassium	Heavy Precipitate Medium Precipitate Trace Precipitate No Precipitate	Adequate to Abundant Low to Deficient Deficient Very Deficient
Phosphorus	Deep Blue Color Light Blue Color Yellow to Colorless	Adequate Adequate Low to Deficient