Basics of Professional Lawn Care

Soil Fertility, Soil Test Results, and Fertilizers Simplified

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Are You in the Light or in the Dark?

Soil Testing- Your 1st Best Step

How do you start a project on a lawn?

Do you just look at the condition of the grass and start making adjustments on soil pH, fertilizers, etc., strictly based on the appearance of the foliage?

I certainly hope not!!!

We must take a systematic approach that involves soil testing and perhaps other diagnostic techniques (plant tissue analyses) to determine where we are, and get some direction as to where we need to be!!

Soil Fertility is actually Soil Chemistry!!

Exchangeable				Soil solution		Fertilizer
Ca^{++}	Mg^{++}	Na^{+}		NH_4^+	SO_4^{-2}	$(NH_4)_2SO_4$
- -	- -	-				
Clay or Organic Matter Particle (Colloid)			- H^+		NO_3^-	NH_4NO_3
					HPO_4^{-2}	H_3PO_4
- - -	-	-				
Al^{+++}	NH_4^+	K^+		K^+	Cl^-	KCl
				Na^+ Ca^{+2}	Mg^{+2}	

Lime reaction:

Step 1. $Al^{+3} + CaCO_3 + OH^- \text{---->} Ca^{+2} + Al(OH)_2 + OH^- + CO_2$

Step 2. $H^+ + OH^- \text{---->} HOH$ (pH goes up)

Plant Nutrients

Plants need **<u>16 elements</u>** for plant growth. These are called the **essential elements**.

Carbon, **C** from carbon dioxide; Hydrogen, **H** from water and Oxygen, **O** from water and the air, as O_2. These are the **non-mineral nutrients.**

There are 13 other elements (nutrients) that are grouped into three categories:

Major nutrients
Secondary nutrients
Micronutrients

The Major Nutrients

Nitrogen, **N**
Phosphorus, **P**
Potassium, **K**

Plants require these in larger quantities;
Most likely to be deficient.
These are the three elements on a fertilizer label. (**N** – **P**$_2$O$_5$ – **K**$_2$O)

Nitrogen

Dark green color of leaves; usually responsible more for increasing plant growth than any other element.
Proteins & DNA/RNA

Excess- succulent growth and weak spindly plants

Deficiency- yellowing of the leaves, reduced growth

Plants can absorb their N in the form of ammonium, but nitrates are absorbed in the largest quantity.

Mobile in the plant; nitrates may leach in sandy soil.

Phosphorus

No other nutrient can be substituted for it. Contained in proteins and amino acids. Without it, plants could not convert solar energy to chemical energy for synthesis of sugars, starches and proteins.

Excess- micronutrient deficiencies of Zinc and Iron

Deficiency- reduced growth, purpling in foliage or veins of some plants

Fixed by Al, Fe and Mn in acid soils; fixed by Ca in alkaline soils. Important in root development of young plants. Mobile in plant; doesn't leach but in organic soils

Applied as a fertilizer in the phosphate form.

Potassium

Involved in photosynthesis, sugar transport, water and nutrient movement, protein synthesis, and starch formation. Improves tolerance to disease, water stress, winter hardiness and uptake efficiency of other nutrients. Takes a part in 60 different enzymatic Reactions.

Excess causes N deficiency and may affect uptake of other positively charged nutrient elements.

Deficiency marginal burn or scorch affecting photosynthetic activity. Short internodes, weak stalks.

Involved in photosynthesis, plant-water relations, cold tolerance and disease tolerance.

Mobile in the plant, but can leach in the soil.

The Secondary Nutrients

Calcium, **Ca**
Magnesium, **Mg**
Sulfur, **S**

These are not any less essential than the major nutrients, only being used in a smaller quantity. Lime, if needed to raise soil pH, will supply Calcium and/or Magnesium. Calcitic or Dolomitic lime; there are other liming materials.

Gypsum is not a liming material (Calcium sulfate) contains Calcium and Sulfur.

Calcium

Important in the structure of the plant cell walls.
Stimulates root and terminal bud development.

Excess- interferes with Mg absorption; replaces K, Na and NH_4^+ on soil complex; causes high soil pH-micro's

Deficiency- inhibition of bud and root tip growth; roots become "nubby" and stop growing.

Important in pH control by reducing soil acidity.
Limited mobility in the plant; moderately leachable.

Magnesium

Central element of the chlorophyll molecule, so it's actively involved in photosynthesis, energy metabolism, and is required for protein formation.

Excess: interferes with Ca uptake

Deficiency: reduced growth, marginal chlorosis, interveinal chlorosis starting at leaf tips at lower to mid-plant.

Leaches from soils, is mobile in the plant. Epsom salts (Magnesium sulfate) for very small areas or Dolomitic lime, if the soil pH is low.

Sulfur

Component of some amino acids that are important in building proteins.

Excess: over-application of elemental S to lower soil pH

Deficiency: symptoms are general yellowing of the younger leaves or the entire plant - severe !

Mehlich 3 extractable Sulfur < 10 ppm is Deficient!!

High Nitrogen rates may induce S deficiency. Is not mobile in the plant, but sulfate-S is leachable in the soil; especially sandy-textured soils.

The Micronutrients

Boron, B; Copper, Cu; Manganese, Mn ; Zinc, Zn; **Iron, Fe**; Molybdenum, Mo and Chlorine, Cl

Micro meaning small; at one time called minor nutrients, but not of minor importance. **Soil availability depends on pH** with deficiencies likely above a soil pH of 6.8

Many micronutrients are enzyme activators. Used in smaller quantities than major or secondary nutrients

Soil or foliar applications, considering the soil pH

Iron

Important in chlorophyll and protein formation, enzyme systems, respiration, photosynthesis and energy transfer.

Deficiency: interveinal chlorosis on younger tissue that may change from yellowish to white.

Conditions for deficiency include soils high in Ca, poorly drained soil, high soil pH, high soil P, Cu or Zn.

Can be corrected with chelated forms of iron and other type fertilizers containing iron , as well as amendments that lower soil acidity; Aluminum sulfate - **Caution!!!**

Finely-ground Elemental Sulfur, to lower pH. Not "chunk-type" or pelletized Sulfur!!

Soil pH

The term pH defines the relative acidity or alkalinity of a substance.

The pH scale ranges from " **0** " to " **14** " , with a pH of " **7** " being neutral.

0 ----------7----------14

Acid Alkaline

pH is defined as the negative logarithm of the hydrogen (H^+) concentration. What does that tell you?

pH - Hydrogen Ion Activity

Soil pH is expressed in logarithmic terms, not a linear scale! Each pH unit change means a **tenfold change** in acidity or alkalinity. Ex: pH 4 is 10 times as acidic as pH 5 and a pH of 4 is 100 times as acidic as pH 6

Older literature spoke of a soil being sour (acid) or sweet (basic or alkaline)

pH is one of the most important soil chemical reactions

Soil pH has a profound effect on availability of nutrients and microbial activity.

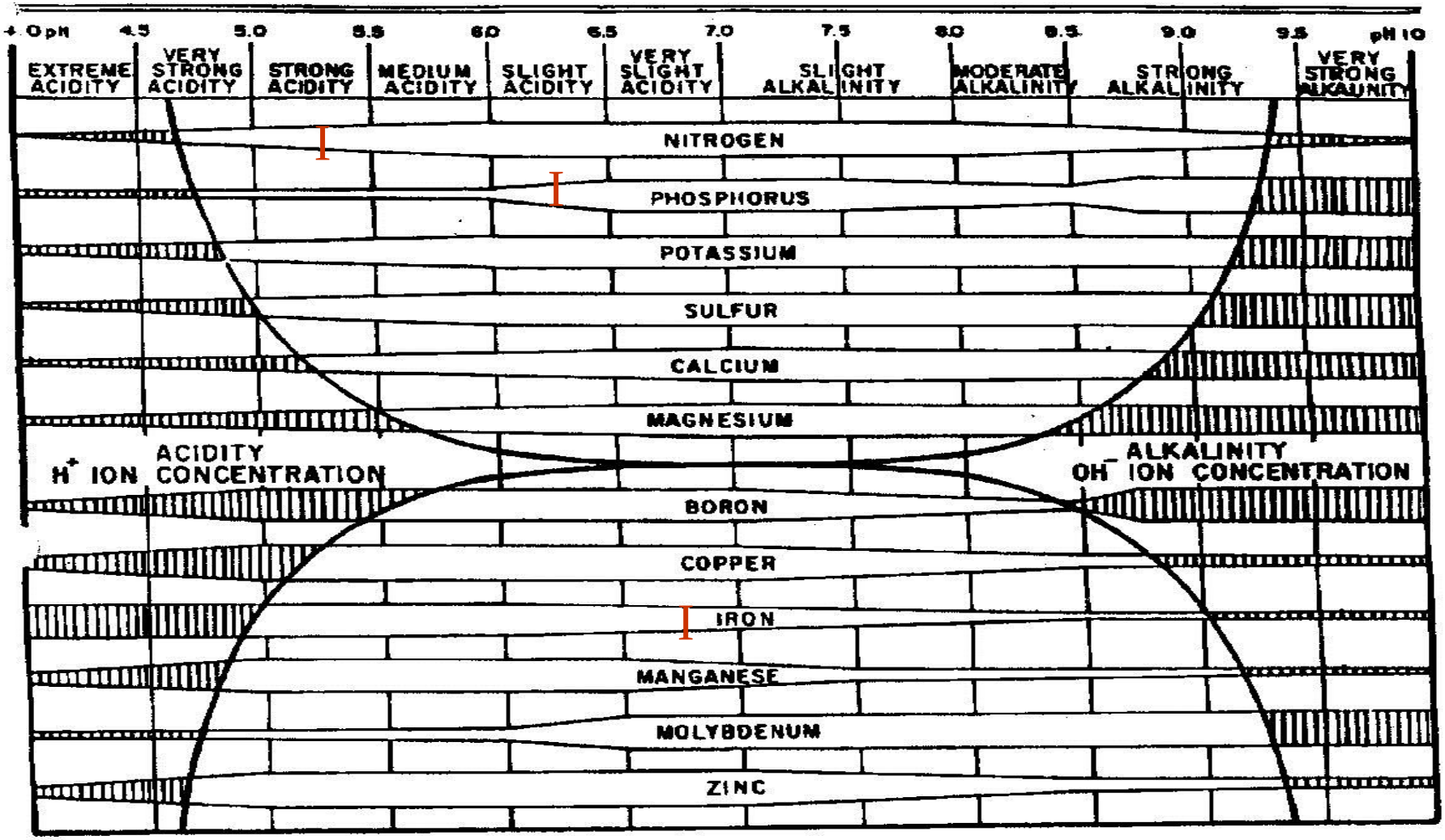

Figure 1.–Effect of soil pH and associated factors on the availability of plant nutrient elements. The width of the band for each element indicates the relative favorableness of this pH value and associated factors to the presence of the elements in readily available forms (the wider the band the more favorable the influence). It does not necessarily indicate the actual amount present since this is influenced by other factors. (Reproduced from *Changing Patterns in Fertilizer Use*, p. 152, 1968, by permission of the Soil Science Society of America.)

Limestone makes Fertilizer Work. Fertilizer Efficiency Goes Up as Soil Acids Go Down

SOIL ACIDITY	NITROGEN	PHOSPHATE	POTASH
Extremely Acid 4.5 pH Need to lime	30%	23%	33%
Very Strong Acid 5.0 pH Need to lime	53%	34%	52%
Strongly Acid 5.5 pH Need to lime	77%	48%	77%
Medium Acid 6.0 pH	89%	52%	100%
Don't lime to this level Neutral 7.0 pH	100%	Never happen 100%	100%

Adjusting Soil pH- Why?

Lime or Sulfur requirement.

Change soil pH to increase nutrient availability and meet the preferred pH range of the grass species involved. Base it on a soil test!!

Lime raises the soil pH; Sulfur lowers soil pH, makes it more acidic.

The old adage " if a little is good, more is better" will get you in a bind if you over-apply either of these materials.

Raise pH – Calcitic (Ag) or Dolomitic lime, Hydrated lime (caution) Pelletized lime, same rate as Ag lime. Liquid lime, No; There is a big misconception, 2.5 gallon jug usually has ~ 27 lbs. of finely ground lime Chemically and physically impossible to be equivalent to a ton of lime.

Lower pH- Finely ground Elemental Sulfur is the material of choice, Aluminum sulfate (caution); Not for lawn situations!! Very acidic.

Soil Testing

Purpose - supply clients with enough information to make a wise choice regarding applications of soil amendments and fertilizers.

Measures the plant-available portion of soil nutrients. Soil test results form the basis for nutrient recommendations.

Routine soil test from the LSU Ag Center Soil Testing and Plant Analysis Laboratory costs $10, provides a soil texture, soil pH, Calcium, Magnesium, Phosphorus, Potassium, Sodium, Zinc, Copper, and Sulfur plus a lime or sulfur requirement, if needed, to adjust pH for the grass that will be planted or maintained.

Using the Soil Test Results

Need to understand the information on the Soil Test Results Sheet.

*Soil Test Results and ratings (interpretations)
*Fertilizer and lime recommendations
*Fertilizer management practices or concerns found on Soil Test Information Sheet, T-610

Calculations for Bermuda grass

Bermuda grass- sod

For Nitrogen, it says "see sheet", the T-610 sheet. Says 1 lb. of Nitrogen/1,000 sq. ft. We are going to use Ammonium sulfate (21-0-0-24 S) for Nitrogen, Sulfur and to lower the soil pH a bit.

$\frac{1 \text{ lb.}}{0.21}$ = 4.8 lbs. Ammonium sulfate, supplies 1 lb. of Nitrogen

To maintain a stand it calls for 1.4 lbs. Phosphate/1,000 sq. ft. We are going to use Triple super phosphate/ TSP (0-46-0).

$\frac{1.4 \text{ lb.}}{0.46}$ = 3 lbs. TSP supplies the 1.4 lbs. of Phosphate

For Potash, 1.4 lbs., and we will use Muriate of Potash (0-0-60)

$\frac{1.4 \text{ lb.}}{0.60}$ = 2.3 lbs. Muriate of Potash supplies 1.4 lbs. of Potash

Calculations for Zoysia-Maintain

This sample is in the "mail-in" box format. The Soil Test Results sheet gives you the lbs. of specific fertilizer materials on a 1,000 sq. ft. basis.

You have 3 choices for Nitrogen, and would use a 33% Nitrogen fertilizer (33-0-0-12 S); we need Sulfur so this is a good choice.

It is not as acid-forming and at a pH of 4.99,~ 5.00, we need to lime. Look at the Magnesium rating (Very Low), so we need to use

Dolomitic lime, at a rate of ~ 9.2 lbs./100 sq. ft. = 92 lbs./1,000 sq. ft.

Since the results give you the lbs. of the various fertilizers to use, by following these recommendations the situation will begin to improve.

Lime that is surface-applied will take about 2 years for the soil neutralization reaction to reach down to 1 inch; Slow process!

Soil pH (Soil Reaction)

*Soil pH indicates the level of active acidity.

*Maintaining a soil pH between 5.5 to 6.5 will generally provide a favorable environment for growth and development of many grasses.

*Lime recommendations are made to correct problems with soil acidity; H, Mn & Al

*Recommendations are based on the soil pH, soil texture and the crop to be grown.

*Two types of lime: Calcitic/Calcium carbonate, Dolomitic/Calcium and Magnesium carbonate.

*Look at soil test Ca and/or Mg levels to choose

Soil Test Ratings

Soil testing labs use some form of rating scale within which soil test values are placed. What do these ratings mean?

An example of this :

Very Low	< 50% crop potential, with no fertilizer
Low	50-75% crop potential, if not fertilized
Medium	75- perhaps 95% of the crop potential
High	no fertilizer is needed, soil can supply all
Very High	no fertilizer is needed, just more cost; potential for environmental issues

Phosphorus- P

*In LA, P is extracted using the Mehlich III soil testing extractant.

*Test results given as ppm of Extractable P, a measure of the relative availability of P.

*Not a measure of total phosphorus.

*Recommendations as lbs. of Phosphate/Ac (P_2O_5) as lb./100 or 1,000 sq. ft., based on the grass species.

Calcium, Magnesium,Potassium, Sodium, Copper, Sulfur, Zinc

* Cations are extracted by the Mehlich III soil test extractant.

* Reported as Extractable nutrients, as ppm.

* Calcium/Magnesium levels determine the type of lime to apply.

* Recommendations for Potassium are as lbs. of Potash/Ac (K_2O) or per 100 or 1,000 sq. ft.

Know the Size of the Plot

**** 1 Acre = 43,560 square feet AND**
**** Anything at ~ 45 lb./1,000 sq. ft. = 1 Ton/Ac**

Ex: Length in feet X Width in feet = Square feet
The lawn is 20 ft. X 50 ft. = 1,000 sq. ft.

1,000 sq. ft. divided by 43,560 sq. ft. = 0.023 Ac and
0.023 Ac X 2000 lb. of Lime (1 ton) = 46 lb of lime
(rounded-up)

Use this type equation to figure lime/sulfur rates on small areas of less than one acre. **Cowboy Math!!**

Fertilizer Selection

Recognize the plant response you are seeking

Contains the needed nutrient (s)

Releases the nutrients when needed

Cost effective

Safe and convenient to use

Environmentally friendly

Common Nitrogen Fertilizers

Fertilizer material	% Nitrogen
Urea + Ammonium sulfate (50/50)	33
Ammonium sulfate	21
Urea	45-46
Potassium nitrate	13
Calcium nitrate	15

Common Phosphate Fertilizers

Fertilizer material	% P_2O_5
Triple superphosphate (TSP), 0-46-0	46
Di-ammonium phosphate, 18-46-0	46

Common Potash Fertilizers

Fertilizer material	% K_2O
Muriate of potash	60
Potassium sulfate	52
Potassium nitrate	44
Sulfate of potash magnesia also known as K Mag	21

Slow- Release Fertilizers

Slow release of nutrients at a controlled rate, with a balance of nutrients throughout the growth cycle.

Categorized by the way the fertilizer is released:

1. materials that dissolve slowly
2. materials from which nitrogen is released by microorganisms
3. granular materials with membranes made of resins or sulfur that control the rate of nutrient release from the granules into the soil

Ex: Sulfur-coated Urea and Osmocote

Slow Release - Pros and Cons

Advantages

- Fewer applications
- Low burn potential
- Release varies based on fertilizer characteristics
- Comparatively slow release rate

Disadvantages

- Unit cost is high
- Availability may be an issue
- Release rate governed by factors other than plant need – temperature and frequency of watering

Conventional Fertilizer – Pros and Cons

Advantages

- Fast acting
- Some are acid-forming (Ammonium sulfate, moreso)
- Low cost

Disadvantages

- Greater burn potential (fertilizer salts)
- Solidifies in the bag when wet
- Nitrogen leaches readily

Organic Fertilizers

Refers to nutrients contained in fertilizer - type products derived solely from the remains (or a by-product) of a once living organism.

If sold as a fertilizer, will have a label on it, based on the amount of fertilizer nutrients, per 100 lbs.

Many times sold as a soil conditioner, without a guaranteed fertilizer analysis. Some have fertilizer added to them, so pay attention!!

Depend on soil organisms to break them down.

Soluble Salts- Soil or Water Test

Fertilizers don't burn or damage plants if applied correctly.

Fertilizers are **salts**: nitrates, sulfates, phosphates, chlorides, carbonates, bicarbonates, borates, etc.

Consider table salt (Sodium chloride); we have a fertilizer material, Muriate of Potash (Potassium chloride.)

Fertilizer applied to the soil dissolves in the soil moisture and diffuses out into the soil. Tender roots near fertilizer have water drawn from them and the surrounding soil; roots begin to dehydrate and collapse if the salt concentration is too high, roots "burn" and plants may die or suffer severe damage.

Gypsum for Sodium Problems

Gypsum is calcium sulfate, a neutral **salt.**

Does not increase or decrease the soil pH.

Soil areas should receive an application of gypsum to dislodge the Sodium on the soil exchange sites.

Thorough watering/irrigation, will move Na somewhat deeper into the soil (away from active rooting zone)

Calcium is left on the soil exchange sites.

Gypsum does not improve soil tilth; does not alleviate compaction problems, unless Sodium is the problem!

Fertilizer Application Methods

Broadcast - normally used before planting and soil incorporated into seed bed or a surface application after seed or sod has grown for 30 45 days. Lime and/or Sulfur applications!

Starter solutions - generally not recommended since nitrogen is already in the fertilizer.

Foliar feeding - generally not recommended except for issues with Iron deficiency.

Thanks for your attention!

Are there any questions?

STPAL website

http://www.lsuagcenter.com/soiltest