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The Basics of Soil Test Interpretation

Review of difference between soil tests:

- CT Agricultural Experiment Station
- Cooperative Extension Service (University of CT Dept. of Plant Science)
- A & L Laboratories

Other soil test examples to study:

- University of Massachusetts (Soil and Plant Tissue Testing Lab)
- Soil Food Web

Electromagnetic force holds atoms together.
In order for it to work, there must be + and – charges present.
91 elements occur naturally on earth.
Most are made up of atoms that have either a + or – charge.

Compound- when the atom of 1 element bonds with the atom of another element, it is called a compound.

Ions- ions are atoms of elements or molecules of compounds- ***that carry a + or – charge***.

Cations- Ions of Hydrogen (H) Calcium (Ca) Magnesium (Mg) Potassium (K)
have positive (+) charges and are called CATIONS

Anions- Ions of Phosphorus (P) Nitrogen (N) Sulfur (S)
have negative (-) charges and are called anions

Carbon (C) and Silicon (Si) can have either positive or negative charges so they can be cations or anions.

Clay has plate-like layers. Clay has a high cation exchange capacity **(C.E.C.)**
Clay is colloidal and has particles (called micelles) with an electro-negative charge.
Therefore, cations (which have a positive + charge) are VERY attracted to colloids.

Humus – biologically stable end product of organic matter decomposition. It is considered the "wealth of the soil" because of its ability to hold water and nutrients and support an incredible diversity of soil life.
Humus particles are also colloidal in nature (negatively – charged) and has an even HIGHER cation exchange capacity (C.E.C.) than clay. But their C.E.C. is very dependent on soil pH.

Clay and humus form colloidal complexes together. This increases their C.E.C.
Humus breaks up clay's adhesive nature.

C.E.C. (Cation Exchange Capacity) - CEC measures the soil's ability to hold elements with positive charges (cations) such as calcium, magnesium, potassium, sodium and hydrogen. The CEC of a soil will increase with the increasing amount of clay and organic matter. **The normal value for loamy soil is 4-8.**

The cation exchange capacity of a soil is determined by the amount of clay and/or humus that is present. These two colloidal substances are essentially the "cation warehouse" or reservoir of the soil. Sandy soils with very little organic matter (OM) have a low C.E.C., but heavy clay soils with high levels of OM have a much higher C.E.C. That means they have a much better ability to hold cations.

The C.E.C. is expressed in milli-equivilents per 100 grams (meq/100g) of soil. The larger this number, the more cations the soil can hold.

Percent Base Saturation (Calculated Cation Saturation) tells what % of the exchange sites are occupied by the cations in the soil- hydrogen, calcium, magnesium, potassium. Soil test will give you normal ranges and base recommendations on that.

The ratio of calcium to magnesium is important. 7:1 is ideal. This indicates a healthy balance in the soil. Diseases, weeds, and insect infestations appear when the ratio falls below this level!

Knowing the CEC and base saturation tells you 2 very basic facts about the soil. First, it tells you how much potash, magnesium, and calcium the soil can hold, and second, if the proper balance of those nutrients exist.

Acidity is the amount of the total C.E. C. occupied by the acidic cations Hydrogen and aluminum.

Soil pH is the measure of the concentration of hydrogen +positive cations. The more H+ cations, the more acidic a soil is.

Buffer pH is a value generated in a soil laboratory to develop lime recommendations.

Limestone recommendations are determined in part by whether the soil is clay or sand, which determines its C.E.C. It takes a lot more limestone to change the pH in clay as compared to a sandy soil.

Lime neutralizes soil acidity and contributes many benefits to the soil environment.

Chemically, there are two types of lime:

1) Ground limestone and Calcite limestone contains calcium carbonate only ($CaCO_3$)

2) Dolomite limestone contains both calcium and magnesium. Use dolomitic lime if the magnesium level is rated medium or lower.

Physically, there are powdered and pelletized limes. Both are equally effective. The lime application should keep soil pH within the desired range for 1 to 2 years on sandy soils and for 2 to 3 years on silt and/or clay soils. You don't need to lime every year. Lime is insoluble in water thus moves very slowly downward in the soil. For best results, broadcast lime over the surface, incorporate and mix it 4 to 8 inches into the soil. For places where mixing is not possible or may cause damage to the plants, apply the recommended lime over the surface prior to rainfall or irrigation. If not incorporated into the soil, do not surface apply more than 50 lbs/1000 ft^2 per application. If the suggested rate is higher, apply up to 50 lbs every 6 months until the total suggested amount is fulfilled.

What lime does:

Corrects soil acidity

Furnishes important plant nutrients- calcium and magnesium (remember the importance of the balance of these 2 nutrients)

Reduces solubility and toxicity of certain elements such as aluminum, manganese, and iron.

Promotes availability of major plant nutrients such as zinc, copper, and especially phosphorus.

Increases bacterial activity and helps create favorable soil structure. This is also improved by addition of decaying matter or compost. The soil becomes more porous, increasing air circulation and the ability of the soil to absorb and hold moisture.

Understanding Beneficial Soil Bacteria and Fungi

- They decompose organic matter
- They retain soil nutrients in the organic matter (OM)
- They build and rebuild soil structure. Bacteria produces glues that help form soil aggregates
- They suppress disease!

Plants produce exudates and organic matter. These things feed the beneficial bacteria and fungi. In return, the beneficial bacteria and fungi in the soil protect the plants, help them to retain nutrients, and build structure.

Soils are either **fungally dominated** or **bacterially dominated**.

Conifers- require a very strongly fungal soil

Deciduous trees- strongly fungal

Shrubs, vines, perennials- slightly fungal
***If you remove leaf litter, you must REPLACE fungal foods.
Fungal foods include kelp, rock dusts and minerals, humic acid/humate, feather meal, fish hydrolysate, wood chips, dried leaves, straw.

Bentgrass and fescue grass- equal fungal and bacterial

Ryegrass and bluegrass- slightly bacterial

Annuals and vegetables- bacterial

Weeds- strongly bacterial
***Bacterial foods include manures, corn gluten, blood meal, fish emulsion, molasses, alfalfa meal.

Coast of Maine composts:

Quoddy lobster compost- bacterially dominated

Penobscott compost- fungally dominated

Therefore, use the appropriate compost for the plants you are installing:

- If you are putting in a tree and shrub border, use Penobscott blend.
- If you are installing a flower garden or vegetable garden, use Quoddy.

If soil becomes anaerobic (lacking in oxygen, often due to water saturation), the beneficial fungi will not tolerate it and will die. But the disease causing organisms will thrive.

Earthworm castings

Nitrogen fixing bacteria in the soil can increase 10 times in soils enriched with earthworm castings!

They are a very concentrated form of compost. If someone asks why they are so much more expensive compared to regular compost, make sure they know to use a lot less per square foot.