

Soil Fertility, Soil Testing, and Raising Heritage Corn

Presentation by Jon Zirkle of Bushelcraft Farm
and Zuleyja Prieto of Rooting Through Corn, Planting Families

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What we will cover today (in English and in Spanish)

- An overview of what we mean by soil fertility and why it matters
- What is soil organic matter?
- Soil nutrients (minerals) and soil texture
- Soil testing (why do it, and HOW to test your soil) **Includes a video**
- Thoughts about growing crops in your backyard and why it's helpful to know the soil fertility in spring before planting
- Updates about growing backyard corn and the Rooting Through Corn, Planting Families project

Done by 6:30pm

What is soil fertility? Why does it matter?

There are two (or more) approaches to thinking about soil fertility and growing crops.

- 1) Feed the plant (focuses on giving the plant what it needs)
- 2) Feed the soil (focuses on the soil system first, which then feeds the plant)

We can test for particular nutrients, but there are other factors to keep in mind. Does the soil look healthy, dark, and feel soft and crumbly to touch? Or is the soil light colored, crusty, and hard/brittle to the touch? Is it easy to put a shovel through your soil, or very difficult and burdensome?

Do you see earthworms when you're working in the soil? Do plants tend to look healthy and productive?

Soil Organic Matter

It matters! And in many fields and places all over the world, soil organic matter is being depleted.

Carbon is the fuel--the food--for the soil system. The best way we have to measure soil carbon is to assess the soil organic matter (SOM). This carbon source in the soil is made up of:

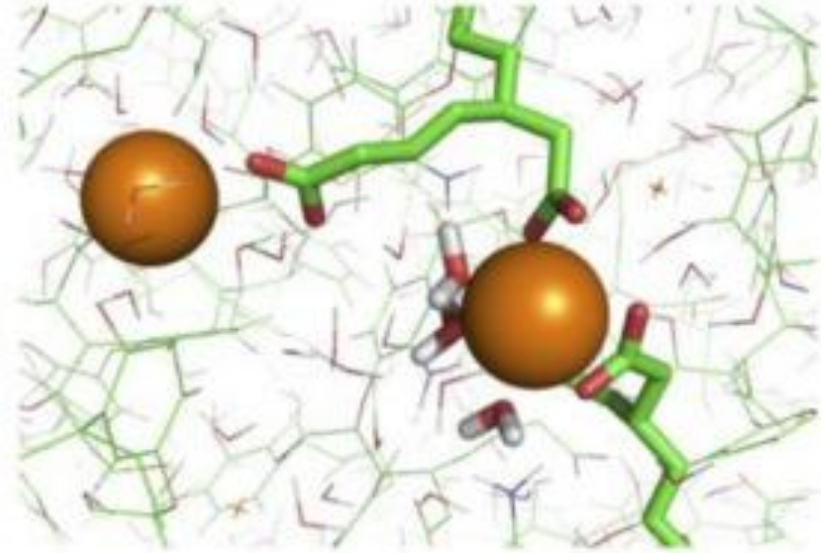
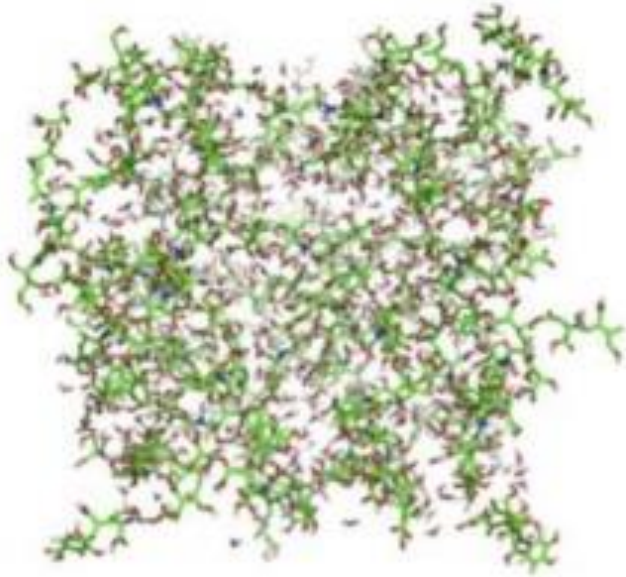
- the living (think organisms and living roots),
- the dead (dead and actively decomposing plants, roots, and organisms)
- The 'very dead' (humus, which is stable material that has been weathered with time)

It is typical for many agricultural fields in Indiana to have 1 to 3% organic matter. Small gardens might have a higher %, especially if you add compost, leaves, manure, or cover crops each year.

To save the planet, help the ecosystem, and feed the microbes and worms and your crops, aim to increase your garden's soil organic matter! Put something back on your garden every year (Jon likes covering the garden with leaves in fall, which stay there all winter)

Image of Soil Organic Matter

If we were to look with a microscope, we'd picture large blobs made up of chains of molecules. Microorganisms feed on the organic matter, slowly breaking up the chains





Macronutrients: the major ones affecting plant health

NPK

=

Nitrogen (N), Phosphorus (P), and Potassium (K)

If you've ever bought fertilizer, these are the three numbers on the bag (example: "3-5-6")

Nitrogen (N)

Nitrogen helps plants put on green aboveground growth (think leaves and stalks) and is a major component of all proteins. If your soil is quite low in nitrogen (or soil has poor nitrogen cycling from being compact, cold, wet, etc) lower leaves of plants turn yellow during growing season.

Nitrogen has solid, liquid, and gaseous forms. In the soil, N is affected by temperature and moisture. *A basic soil test will NOT give you nitrogen results and instead requires a separate test. However, most basic soil tests do measure your soil organic matter (SOM or OM), which can help you estimate how much nitrogen can be naturally available in your soil.

Most soil nitrogen is held in the organic matter and must be broken down ('mineralized') by microorganisms before it can be released for plant use.

Note: if you have too much nitrogen in your garden, plants can grow too tall vegetatively (and sometimes fall over), and may not favor the development of fruits.

Phosphorus (P)

Essential for photosynthesis, N fixation, crop growth, produce quality, and root development. Component of DNA molecules!

pH affects the availability to plants and the chemical form of phosphorus in your soil. Can be tightly held to clay and organic matter, and only slowly available to plants. Not susceptible to leaching/runoff.

If your soils are low in phosphorus, your plants may show signs of purple or red on the leaves and plants will often look thin and weak (example: corn stems may be puny).

If you use manure on your garden, phosphorus is often abundant.

Potassium (K)

Essential element in many enzymes, and regulates the opening and closing of plant stomata, is essential for photosynthesis and disease resistance.

Can be tightly held to clay and organic matter, and only slowly available to plants. Not susceptible leaching/runoff.

Plants use a lot of potassium and may take in more than they need (luxury consumption). With fixation and luxury consumption, K can often be in short supply. CEC and pH will dictate ability of soil to buffer against potassium shortages.

If you use manure on your garden, phosphorus is often abundant.

Micronutrients

These minerals are less plentiful relative to the macronutrients mentioned in previous slides. Examples: calcium, magnesium, sulfur, manganese, boron, zinc, iron, etc. Sometimes we overlook the importance of these ‘trace minerals’

Sometimes these micronutrients are present in our soil, but other factors make them unavailable to the plants we are growing. Such factors might include:

- Soil texture (the presence or absence of clay, for example)
- Soil organic matter
- Soil pH

Essential Concept: Nutrient Removal

Every year we harvest food from our gardens, we are removing nutrients. Those nutrients are going to good homes...into our bodies! But they are leaving the soil less rich for the following year.

Nutrients need to be replaced. If not replaced, we are simply mining our soil, and it gradually becomes infertile.

Some crops are 'heavy feeders' which removed lots of nutrients. Examples:

Corn, Tomatoes, Broccoli, Melons, Cucumbers, Cabbage, Peppers, Squash, Pumpkins, Potatoes, etc.

Think of crops that you harvest from repeatedly...tomatoes, kale, etc

Rules of Thumb About Crop Nutrient Needs

Crops that need a large, tall, vegetative plant (think corn!), or you are going to be eating the leaves (think collards or spinach) will need plenty of NITROGEN

Crops where you will be eating the seeds or flowers will require adequate PHOSPHORUS

Crops that produce a fruit you eat (think tomato, cucumber, melon, pumpkin, etc) will require adequate POTASSIUM and CALCIUM.

Adding Nutrients (fertilizing)

We will talk more about this in the class coming up April 30th

But, even before we think about adding fertilizer, we want to know whether the fertilizer we add will stay in place when we do. Here are some questions:

STOP AND REFLECT ON YOUR GARDEN FOR A MINUTE.

- Is your garden soil sandy? Or heavy in clay? Somewhere in between?
- Is it dark brown or even black in color? Or is it very light colored?
- Is the garden sloped, prone to erosion?

Let's Get Technical!

Cation Exchange Capacity (CEC)

= the ability of the soil to adsorb cations (positively charged ions and molecules), a measure of a soil's ability to supply nutrients such as K^+ , Ca^{++} , and Mg^{++} .

Soils with high CEC tend to have a lot more organic matter and clay and a neutral to high pH. (close to pH of 7 or higher)

Think of soils having little magnets. The more magnets, the more the soil can hold on to the good stuff that plants will need to be healthy and keeps the soil system balanced and less likely to change drastically.

Clay particles and soil organic matter have negatively charged surfaces. Positively charged ions (cations) will be attracted to these surfaces under particular conditions. This is an important concept for understanding soil fertility. Surface area is important! Clay particles and soil organic matter have lots of surface area (=binding sites).

Soil pH

Soil pH may be a bit complicated to explain. It's a measure (negative log) of the relative quantity of hydrogen ions of a substance. The ideal is generally around pH of 7 (plants usually thrive when pH is from 6.5-7). Less than pH of 7 and the soil is considered acidic, greater than 7 and the soil is more alkaline or basic.

**Some soil nutrients are present in soil but are not available to plants because the soil pH is too low or too high. That's why we test for soil pH! We don't just care about the soil nutrients, but also the pH and some of the physical properties of our soil.

Soil Testing

It is not necessary to test your soil every year. But doing so at least once is very important. Ideally you test every 3-5 years. It's helpful to watch the results change, especially if you are working to build soil organic matter!

There are limitations to what a soil test can tell you. First of all, when you test soil, you will likely only be extracting samples from the top 6-12" of soil. There may be plenty of nutrients below that part of the soil! Who knows.

If your soil is very sandy, some minerals may 'leach' down into the soil more easily than if your soil has lots of clay and/or organic matter.

Making a plan for soil testing

- Make a map (on paper or simply in your head as you look at your garden)
- Keep it simple in strategizing where you will sample: Example below

W N
+
S E

This shows 10
sampling
locations



Soil testing: time to watch a soil sampling video!

Here's the [link to the video](#) (24 minutes long).

Sampling is completed by about 9:06 minute mark.

Rules and Good Practices for Basic Soil Testing

A good rule of thumb is to take soil samples from throughout the garden.

- Gather your tools (borrowing a metal soil probe is good. Or use a trowel)
- Include variable spots: example: low spots, wet spots, problem areas, edges, and the center.
- Pick a consistent depth to which you sample to each time (example: 8" deep)
- The more samples you take, the better; 10-20 samples is probably good.
- You will mix all your samples together in a pan or bucket, then remove rocks, worms, roots, and sticks. Once dry, you will extract a handful (2-3 cups) from this mixture.
- Dry out your soil sample (2 days?) in a warm spot (not in an oven!) before submitting to a lab. LABEL your sample (date, location, etc).
- Know where you are sending your soil sample before you get started

Where to send your soil sample

Purdue University Extension offices can help you find places for soil testing:

See this bulletin for more information:

https://www.extension.purdue.edu/extmedia/HO/HO-71-W.pdf?_ga=2.244375941.1845580922.1618498713-106117325.1618498713

Private soil testing labs not far from us include:

A & L Great Lakes(NW side of Ft. Wayne) <https://algreatlakes.com/>

Soil Solutions (Valparaiso, IN) <http://www.soilsolutions-inc.com/>

Agri-Labs Inc (Auburn, IN) <https://www.agri-labsinc.com/>

Growing Heritage Corn in Your Backyard

Rooting Through Corn, Planting Families project (Zuleyja Prieto) - this is a USDA-Sustainable Agriculture Research & Education grant project that connects backyard growers of heritage corn! To learn more, contact Zuleyja by email at drazuleyja@gmail.com. Or find the Rooting Through Corn, Planting Families Facebook page.

To grow backyard corn, we recommend you have the space to grow 4 or 5 rows of corn that are 20-25' feet in length. This ensures you have enough of a plant population to achieve good pollination of the ears.

What nutrients are needed by corn?

For vibrant leaves and tall vegetative growth, corn needs plenty of nitrogen

For producing its flowers and corn kernels, corn needs a decent amount of phosphorus

For strong stalks that help the plant withstand drought, insect pests, and disease, corn needs plenty of potassium

And corn also needs micronutrients (listed in earlier slide). Come to the next class to learn more!

Upcoming classes

The next class (most likely online) is Friday **April 30th** (5:30-6:30pm), where we will look closely at real soil tests and will interpret the results live before talking about fertilizers and how to apply them.

Interested? Please RSVP to: bushelcraftfarm@gmail.com

If you use Facebook, mention on the Rooting Through Corn, Planting Families Facebook page and/or the Bushelcraft Farm page that you are going (mark “going”)

www.bushelcraftfarm.org

Questions?

Please stick around to ask questions,

Or email Jon Zirkle at bushelcraftfarm@gmail.com

Or email Zuleyja Prieto at drazuleyja@gmail.com

Thanks for coming! Stick around if you'd like to ask questions