What happens to the food?

HUMUS - Black gold

A complex aggregate of amorphous substances, formed during the microbial decomposition or alteration of plant and animal residues and products synthesized by soil organisms; principal constituents are derivatives of lignins, proteins and cellulose; humus has a high capacity for base exchange (CEC), combining with inorganic soil constituents, and for water absorption.

As lignins are decomposed

• Generally only partially decomposed
• Remaining portions will be somewhat altered in their structure
• Will polymerize
• Series of types of SOM with humus the most complex and most stable

Types of SOM

Fulvic acid

Humus
What it looks like

Composting: a way to get humus
• Deliberate stabilization of organic matter
• Done to decrease volume
• Provide soil amendment

Soil pH
• Master variable
• Target pH generally 5.5 - 7
• pH < 5.5
  – Can be detrimental to certain plants and soil organisms
• pH > 7.5
  – Can be detrimental to certain plants and soil organisms

Some plants need higher pH
• Clovers and legumes

For legumes,
• The high pH requirement is primarily because of the bacteria that live on the plant roots
• These bacteria fix N and provide it to the plants in exchange for C

Some plants prefer acidic environment
• Azaleas, blueberries, rhododendrum
• High Fe requirement
Most plants

- Prefer a pH range of 5.5 → 7.0
- Why acidic (< 5.50) is detrimental?
- Function of Al and Mn solubility
- At low pH these elements are increasingly soluble and can be phytotoxic

Mn toxicity

- Mn toxic vs healthy

Al Toxicity - stunted roots

Can prevent growth

How pH affects Al species

Al is not just in solution:
What Al does

\[ \text{Al}^{3+} + \text{H}_2\text{O} \rightarrow \text{Al(OH)}^{2+} + \text{H}^+ \]
\[ \text{Al(OH)}^{2+} + \text{H}_2\text{O} \rightarrow \text{Al(OH)}^{3+} + \text{H}^+ \]
\[ \text{Al(OH)}^{3+} + \text{H}_2\text{O} \rightarrow \text{Al(OH)}_3 \downarrow + \text{H}^+ \quad (\text{pH} > 5.5) \]

What H\(^+\) does

$3 \text{H}^+ \rightarrow \text{Al}^{3+} + \text{siliceous acid}$

Soil acidity:

- Increased solubility of Al
  - Plant toxic
- Increased solubility of Mn
  - Plant toxic
- Increased amount of H\(^+\)
  - Dissolves soil clays

Toxicity never acts alone:

- P deficiency
- Ca deficiency (Blossom end rot)
- Mg deficiency

How soils get acid:

- Rainfall
  - Leaching of base forming cations
  - Acid rain
- Organic matter decomposition
  - Organic acids
- Carbonic acid (from CO\(_2\))
- Fertilizer addition
Three types of acidity

- Solution small
- Exchangeable bigger
- Reserve huge

Increase soil pH

- Neutralize all types of acidity
- Way that you do this is to add lime – CaCO₃

What lime does

- To H⁺: CaCO₃ + 2H⁺ → Ca²⁺ + H₂O + CO₂
- To Al³⁺:
**Determining Basic Lime Requirement**

- Soil type, texture
- pH calibration curve
- Goal pH
- Soil test laboratory
- Standard analysis

**A basic tool**