

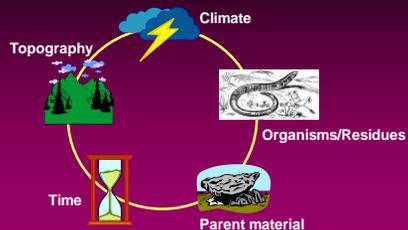
Organic and Conventional Fertility: A Grower's Toolbox

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PLANTS, SOILS & CLIMATE

How are soils formed?



17 Essential nutrients

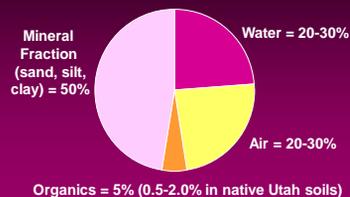
Macronutrients (large quantities, % in tissue):

oxygen	nitrogen	phosphorus
hydrogen	potassium	sulfur
carbon	calcium	magnesium

Micronutrients (small quantities, ppm or ppb):

zinc	iron
copper	manganese
chlorine	molybdenum
boron	cobalt

Composition of a loam soil



Soil structure

- The combination of sand, silt and clay (with organic matter) into secondary particles called *aggregates*



Soil Structure – single best indicator of soil health!

Plants are Not Source-ist



Toolbox Concept

- **Organic Sources** – provide needed nutrients as they breakdown (low nutrient content, much slower release—fraction each year), **feeds microbes**, helps form/maintain soil structure. If certified organic producer, may be only options
- **Inorganic Sources** – provide high concentrations of needed nutrients, faster release—complete release, guaranteed content, targeted application possible

Sources of nutrients

- Inorganic fertilizers (soluble mineral salts of nutrient elements—no organic matter)
- Organic fertilizers (manures, composts, plant and animal byproducts – mostly organic materials)
- Green manures (legumes and other plants grown and used in place)
 - Legumes: Pea, Vetch, Clover
 - Grasses: Rye, Oats, Wheat, Barley

Inorganic Sources

Inorganic Fertilizers: Label info.

- 3 numbers always appear on the label
- Numbers refer to % Nitrogen – % Phosphate - % Potassium Oxide % (N-P2O5-K2O)



A few N-P-K labels out there

- | | |
|-----------------------|----------------------------|
| ● 34-0-0 (Am Nitrate) | ● 24-6-12 |
| ● 21-0-0 (Am Sulfate) | ● 16-4-8 |
| ● 46-0-0 (Urea) | ● 16-16-16 ("All purpose") |
| ● 29-3-4 | ● 12-12-12 |
| ● 26-3-3 | ● 22-4-11 |
| ● 28-4-4 | ● 22-4-14 |
| ● 25-3-5 (Lawn/turf) | ● 20-27-5 |
| ● 20-2-4 | ● 18-5-9 |
| ● 26-3-3 | ● 5-10-10 |
| ● 32-3-5 | ● 9-17-9 |

Other nutrients in fertilizer

- "Fine print" reference to other secondary nutrients such as sulfur, iron, etc.
- Other properties of fertilizer also indicated on the label
 - Slow release polymer coatings (NOTE: some current environmental concern over micro-plastics)
 - Added pesticides (weeds, insects...)

Selecting a fertilizer

- What nutrients do I need?
 - Soil test
- What ratio of nutrients do I need?
 - Nitrogen alone or a "complete" fertilizer?
- Do I need the extras?
- The cost factor
 - The extras in fertilizers increase the cost
 - You pay for TLC in manufacturing

Consider

- Use soil test results to select fertilizer (N-P-K label) you need
- Most established landscapes/gardens need nitrogen annually; a few need other nutrients, so base application on soil tests
- Apply only needed elements and additives to avoid buildup and non-target effects

Organic Sources

Organic nutrient sources

- Much lower concentrations of nutrients
 - Example: ~2-1-2 for composts
- **Great sources of organic matter—needed always!**
- If not managing for certified organic -- may need to supplement with inorganic nitrogen fertilizer to get needed level of nutrition (esp. N)

Traditional group

- Fresh animal manure (dry or slurry sources)
- Plant and animal materials (composted manures, mulches, food/fiber wastes)
- Bone/blood meals
- Green Manures or Cover Crops – Legumes (high N "fixation") and Grasses (low N, organic matter additions)
- Class A Bio-solids (treated municipal sludges, food processing wastes like whey, mashes, pulps, etc.) – not recommended for vegetable products—OK on pastures

Typical Nutrients in Non-Traditional Organic Sources

- 0% to 5% N: Kelp and Kelp products (1-2%); Fish Emulsion (2-5%)
- 5 to 10% N: Alfalfa meal (5%); Cotton Seed Meal (6%); Soybean Meal (7%); Corn Gluten (9%).
- 10 to 15% N: Bird/Bat Guano (8-12%); Blood Meal (12%); Fish Meal (10-14%); Feather Meal (14-16%)
- > 15% N: ORGANIC: Cover Crops (Legume 50 to 200 lb N/ao); MINERAL: Sodium Nitrate (mined deposits, unprocessed) 16-20%.
NOTE: use to supply no more than 20% of crop N need (sodium problems with soil structure, plant toxicity)

Some guiding principles

- Organic matter additions are the single most effective soil amendment in improving soil quality (tilth, structure, water and nutrient retention, erosion resistance, productivity, etc.).
- Soils almost never get enough OM, especially in arid areas. Mechanically intensive cropping systems further reduce OM in soils by promoting exposure and oxidation.
- Half life of soil structure development under perennial forage (most rapid condition) 4.5 years.
- Half life of structure loss under mechanically intensive annual cropping is 0.2 years! Mostly due to the loss of OM.

Some guiding principles

- "More *is* better" when it comes to soil OM. Anything that can be done to increase soil OM should be encouraged (within limitations).
- Some potential limitations on organic sources:
 - High N content – determine "agronomic rates"
 - High P content – often the limiting factor in some areas (erosion-prone surfaces in sensitive watersheds – prevent eutrophication)
 - High salt content – some sources "hotter" than others
 - High weed seed content (generally only un-composted sources)
 - Highly woody/fibrous material – cause N immobilization
 - High bio-toxin content (plant/plant or plant/microbe – eg., black walnut and cedar wood residues)
 - High metal content (municipal treatment biosolids—test!)

Rate Calculation Example -- Nitrogen

General Nitrogen needs

- Intensity or plant requirement
 - Low = 1 to 2 lb nitrogen/1000 sq feet
 - Low maintenance turf (buffalo, other slow growth species)
 - Low intensity vegetables (legumes: pea, bean)
 - Medium = 2 to 4 lb nitrogen/1000 sq feet
 - Medium maintenance turf (yards, most landscapes)
 - Medium intensity vegetables (most vegetables)
 - High = 4 to 6 lb nitrogen/1000 sq feet
 - High maintenance turf (high traffic, parks, golf)
 - High intensity vegetables (corn, potato, onion)

Rate Comparison – Organic and Inorganic

Based on need of 3 lbs N per 1000 sq ft:

- Organic
 - Traditional Compost (~2% N, dry) would require 150 lbs compost per 1000 sq ft (dry) – or about 230 lbs/1000 sq ft at normal moisture content (35% moisture) – but only 25% of N available in year of application, so need about 900-1000 lbs/1000 sq ft.
- Inorganic
 - Urea (46-0-0) would require 6 lbs urea fertilizer per 1000 sq ft.; Ammonium Sulfate (21-0-0) – abt. 15 lbs/1000 sq ft (also has 20% S)

USE ALL YOUR TOOLS!



- Combine Sources when possible to meet plant needs

- DON'T forget the living part of the soil – FEED IT (annual organic matter applications)

- Consider the external limitations beyond nutrient need (salt, weed seed, added pesticides, etc.)