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The Grass Grows Greener when Planted in Healthy Soil

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Healthy Soil

- Evaluation of soil health focuses on the condition of a particular soil/site and how its status can be improved for the intended use.
- How capable is a defined volume of soil to sustain biological productivity, promote plant and animal health, and maintain overall environmental quality?

- Analogy to biological health
  - Implies many different factors that must work together to allow optimal functioning of the whole system
  - Ecosystem health depends on "health" of populations of organisms as well as abiotic factors: soil, water, air, climate

Intended use: Sustainable sub/urban landscape

Soil functions supporting healthy plants

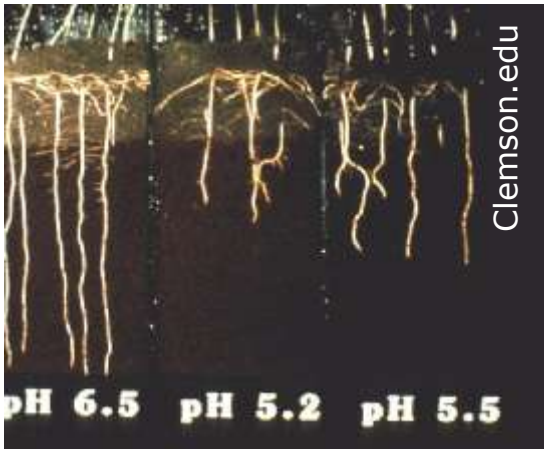
- Mechanical support
- Nutrient supply
- Nutrient re/cycling
- Diffusion of O_2 in (and CO_2 out)
- Temperature moderation
- Water storage
- Habitat for related organisms

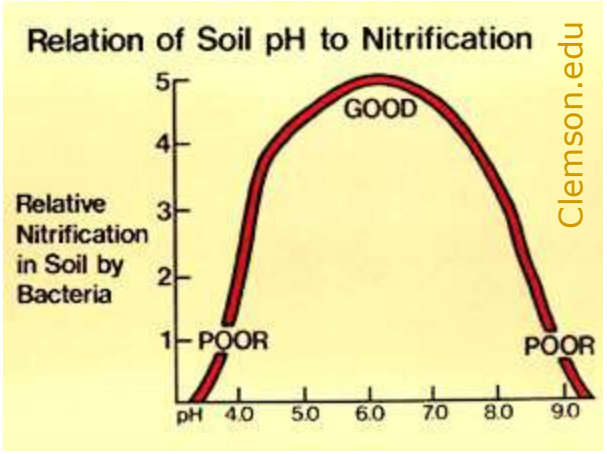
Soil functions managing rainwater

- Infiltration
- Storage
- Percolation(drainage)

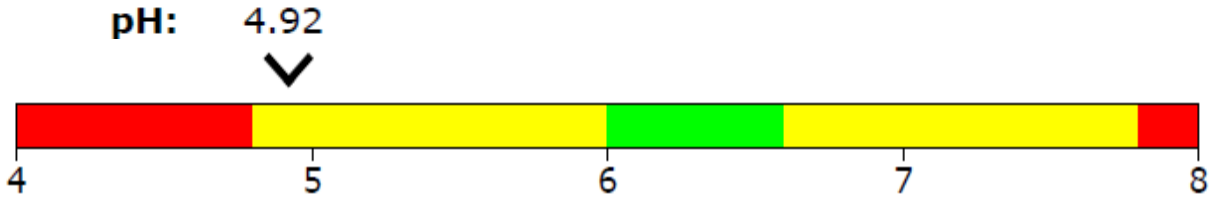
Soil characteristics supporting sustainable systems: 1.

- Chemical -
  - pH 6.0 – 6.8 for most plants
  - Optimal, balanced nutrients
  - Organic matter 2 – 5% (?)
  - Low soluble salt content

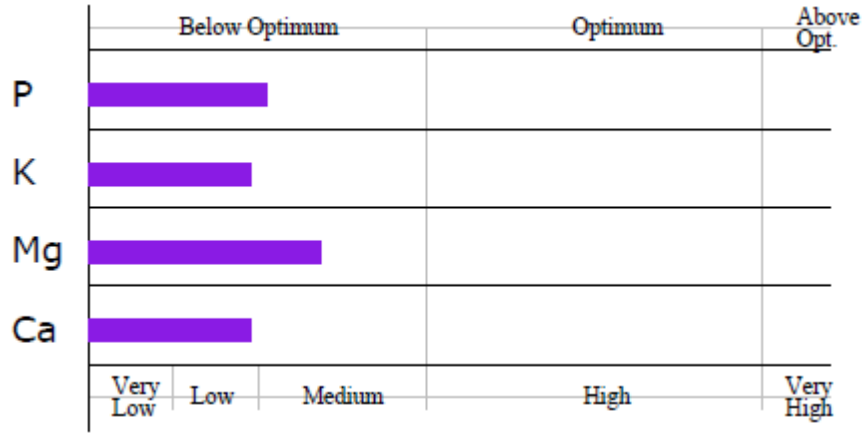




Conventional Soil Testing



- Chemical tests
  - Nutrient availability
  - pH
  - Soluble salts
  - Organic matter
- Physical tests
  - Soil texture
  - Sieve analysis



Soluble Salts- Electrical conductivity= 0.07 mmho/cm (Low)

Organic matter by dichromate oxidation- Organic Matter= 1.9% Organic Carbon= 1.1%

Medium for Sandy Loam

Gravel Content- Larger than 2mm: 0.1%

Mechanical Analysis- Sand= 67% Silt=19% Clay= 14% Texture: Sandy Loam

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Soil characteristics supporting sustainable systems: 2.

- Physical
  - depth
  - pore size distribution
  - Structure and/or absence of compaction
  - Bulk density, "strength"
  - Water-holding capacity
  - Pore-size distribution
  - Aggregation
  - Infiltration rate
  - Permeability

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Soil characteristics supporting sustainable systems: 3.

Biological: Life of the Soil

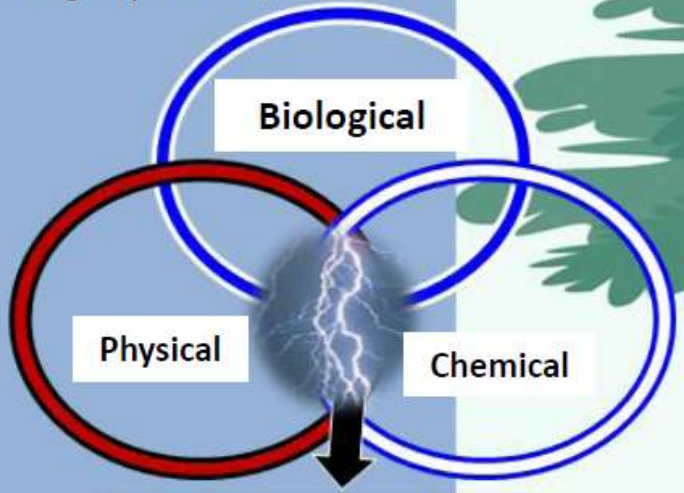
- Soil as an ecosystem
- Organism populations
  - Population/activity
  - Classification
  - Diversity
- Root growth, top growth, crop yield
- Cycling of nutrients inputs vs. availability
- Organic matter –
  - Source of energy, C, other nutrients

"Land, then, is not merely soil; it is a fountain of energy flowing through a circuit of soils, plants, and animals."
Aldo Leopold, A Sand County Almanac, 1949

Soil is the Heart of the System

- Connects above and below
- Ultimate recycler of C, N, O, and other nutrients
- Drives physical, chemical, and biological processes , and much more.

Biodiversity with minimal soil disturbance drives soil health (NOTE: the Soil Food Web is sustained by Root Exudates, Glomalin, Crop Residues, Manure, Compost, Predator-Prey relationships , Plant Symbiosis, and Soil Humus).



Unleashing Soil Health
(Emphasis: understanding Dynamic Soil Properties)

Soil Temperature

Root Exudates (Liquid Carbon)

Soil Respiration (CO_2)

Soil Moisture Tension (matric potential)

Oxygen (O_2)

Rhizosphere

pH

Salinity (osmotic potential)

Soil Food Web

Natural Resources Conservation Service

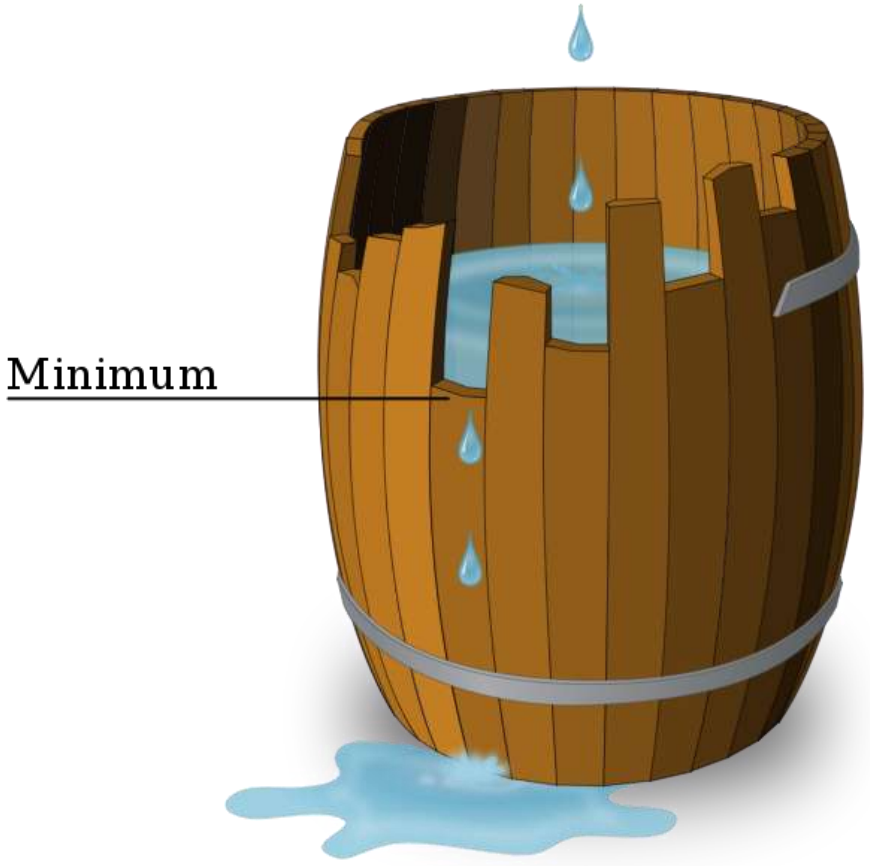
NRCS

Liebig's Law of the Minimum

Plant growth is controlled not by the total amount of resources available, but by the scarcest resource (limiting factor).

Liebig's barrel analogy

- The many necessary requirements for plant growth are represented by staves of the barrel
- Lengths of staves represent availability relative to need
- Amount of water the barrel can hold demonstrates growth and/or production of the plant relative to genetic potential



USDA - NRCS: 4R's of Nutrient Management

For application of commercial fertilizers, manure, soil amendments, and organic by-products:

- Right amount (rate)
- Right source
- Right placement (method of application)
- Right timing

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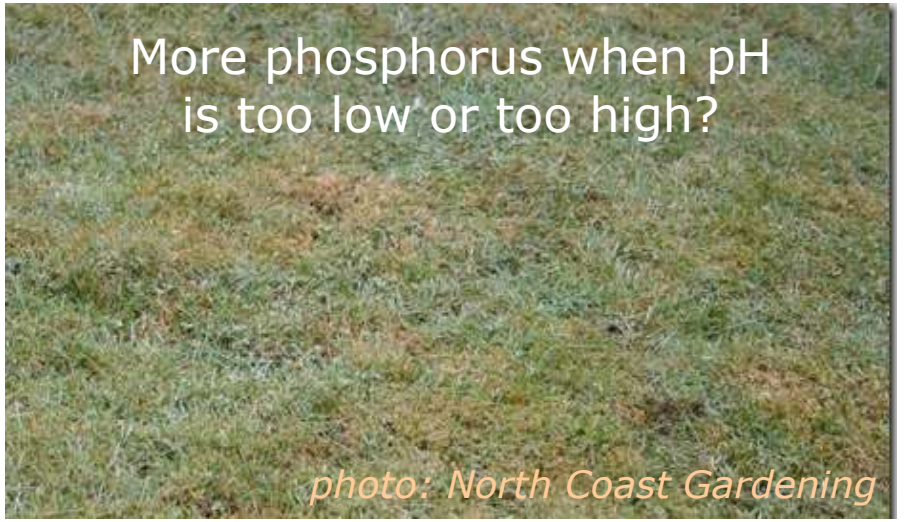
Corollary to Liebig's Law

- Adding more of a non-limiting growth factor is a waste! Why add…



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Soil quality for turf quality

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Consequences

Poor soil health leads to poor turf cover which allows erosion and sediment and nutrient transport into waterways.

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Reversing Soil Health Decline

- Test soil
- Loosen when necessary
- Promote soil life