UF/IFAS Extension

The Journey to Sustainability Begins with Education

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Sarasota County

UNIVERSITY OF FLORIDA
IFAS EXTENSION

Organic Vegetable Gardening
Soil Management

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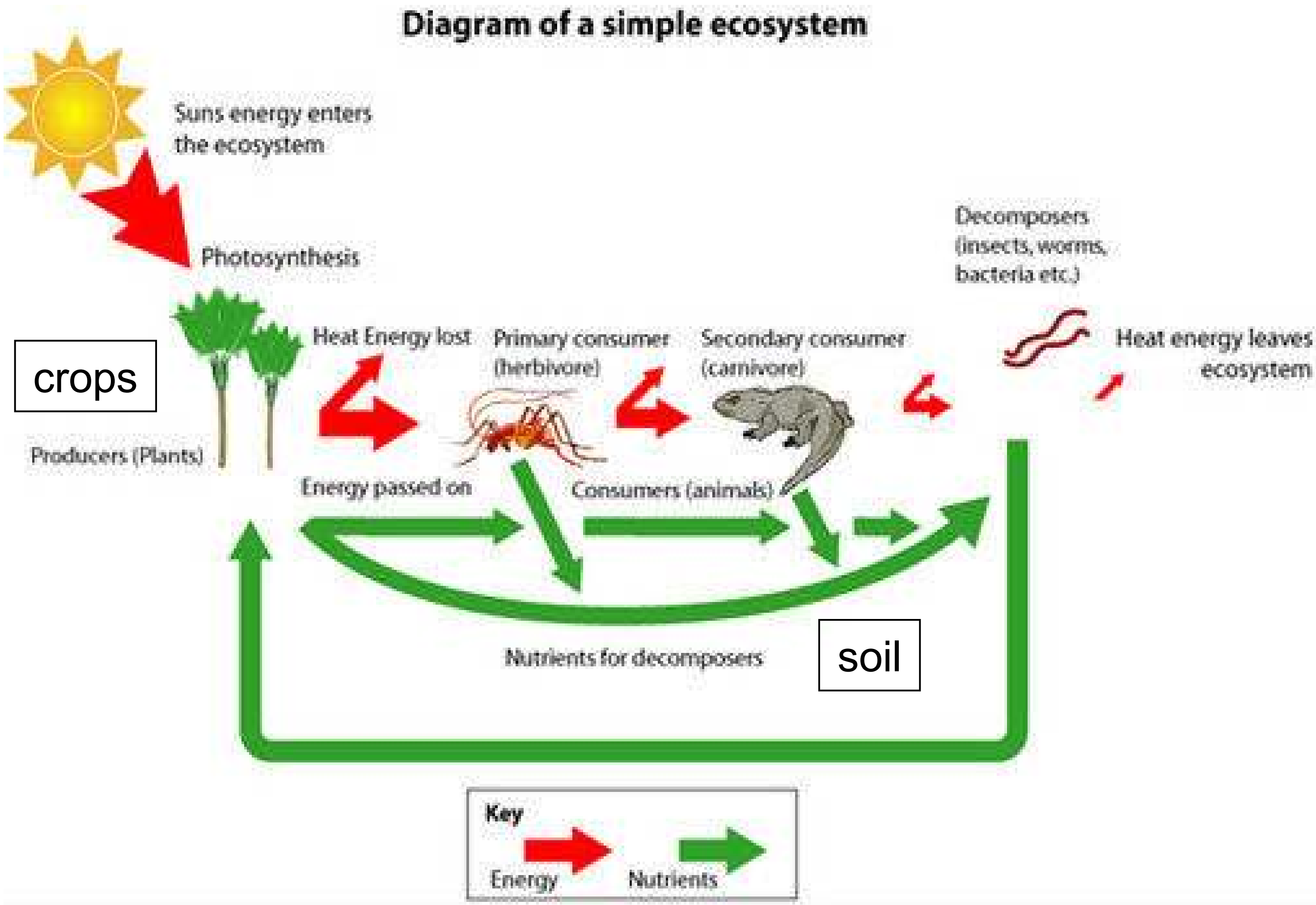
Introduction

- Objectives of this presentation
  - Provide the concepts, principles and science from agroecology of soil management practices in organic vegetable gardening
  - Provide resources in the management practices of soils and plant nutrition, in addition to our text "Vegetable Gardening in Florida" by James Stephens, UF/IFAS

Organic Vegetable Garden Ecology



- Soil ecosystems have functional properties & subsystems (e.g., nutrient cycling,etc) from biodiversity

Agroecosystem Concept

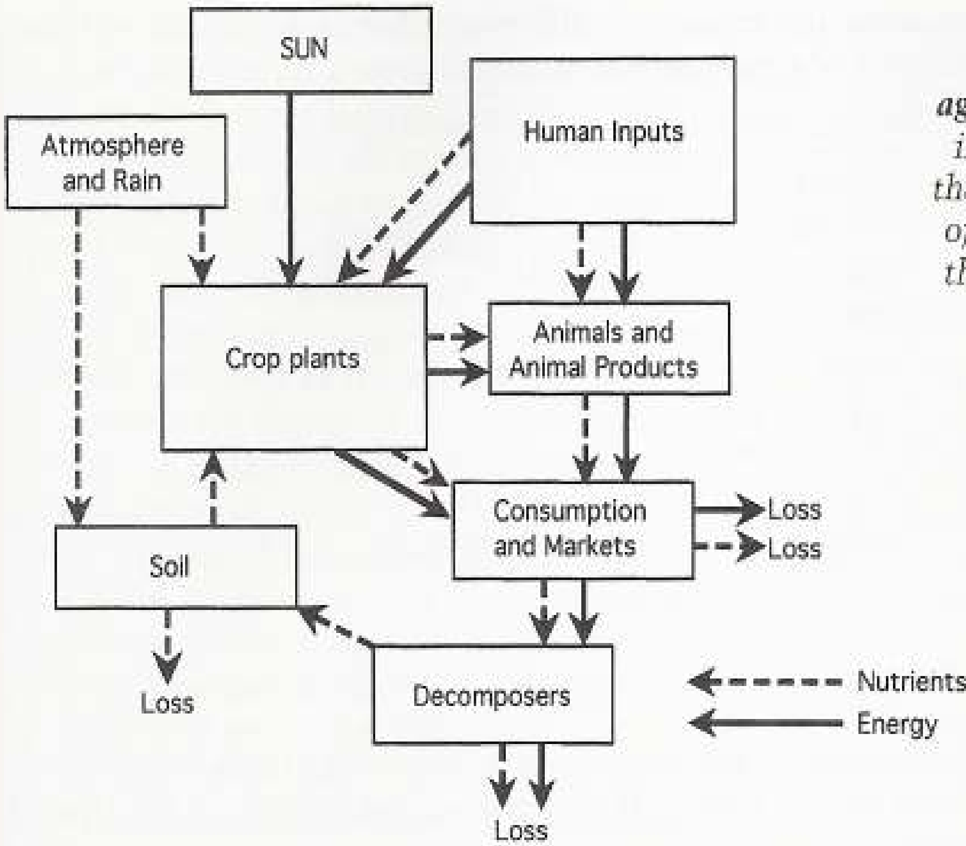


FIGURE 2.7
Functional components of an agroecosystem. *In addition to the natural inputs provided by the atmosphere and the sun, an agroecosystem has a whole set of human inputs that come from outside the system. An agroecosystem also has a set of outputs, labeled here as "Consumption and Markets."*

- Vegetables garden can be analyzed as agroecosystem.

Agroecosystem "Health"

- This concept addresses the failures and side-effects of agroecosystem developments that have focused on the well-being of separate subsystems (e.g., soil fertility) rather than on their aggregated whole.
- The problem is rooted in philosophic paradigms of reductionism which implicitly assume that the well-being of a subsystem can be studied without considering its relations with the surroundings.

Soil Quality

Soil Fertility

Physical Properties

Biological Activity

"The ability of soil to function; to supply plants with adequate nutrients, have good drainage and aeration, promote root growth and biological activity."

What Is Soil?

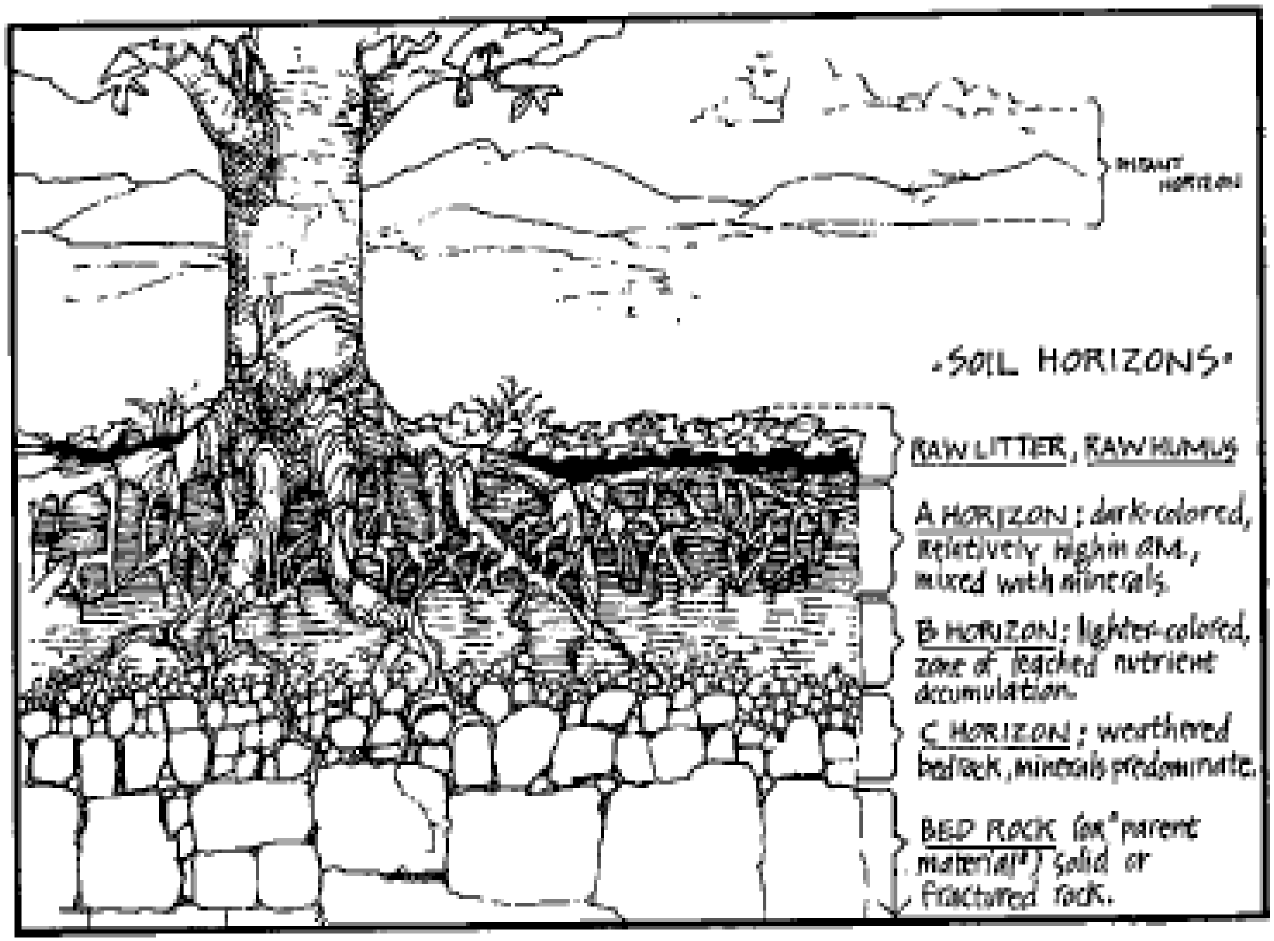


Figure 3.9 As edible landscapers, we are most concerned with the quality of soil in horizon "A."

Kourik, 1986, Designing & maintaining edible landscape naturally.

What is Soil?

- **2 MAJOR PERSPECTIVES**
- **Pedological (holistic) - a product of nature based on**
  - **climate**
  - **living organisms**
  - **nature of parent material**
  - **topography of area**
  - **time**
- **Edaphological (reductionistic) – a habitat for plants (e.g., for food/fiber production & landscapes)**

Brady, 1974, Nature and Properties of Soils

What is Soil?

- **A Mixture of Components**
- **Solids 50% (v)**
  - **minerals**
  - **organic matter**
- **Pore space 50% (v)**
  - **Water**
  - **Air**

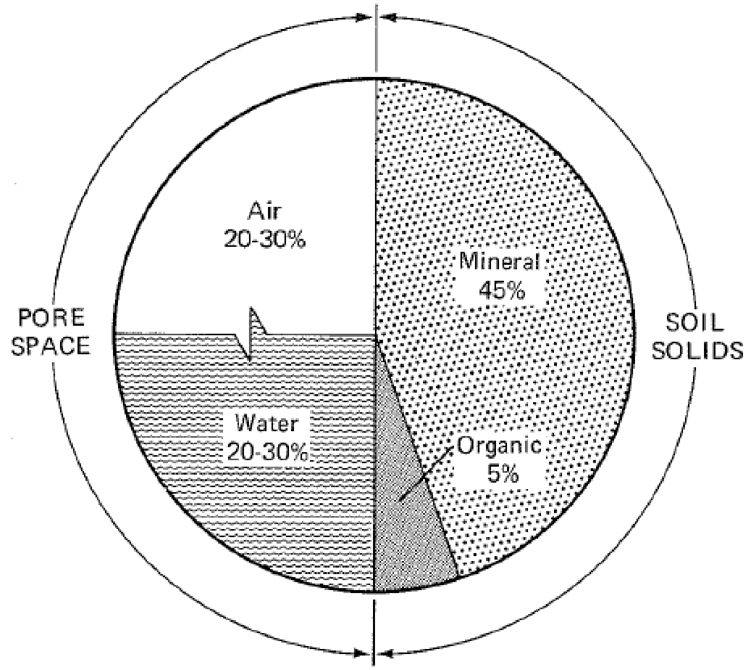


FIGURE 1:4. Volume composition of a silt loam surface soil when in good condition for plant growth. The air and water in a soil are extremely variable, and their proportion determines in large degree its suitability for plant growth.

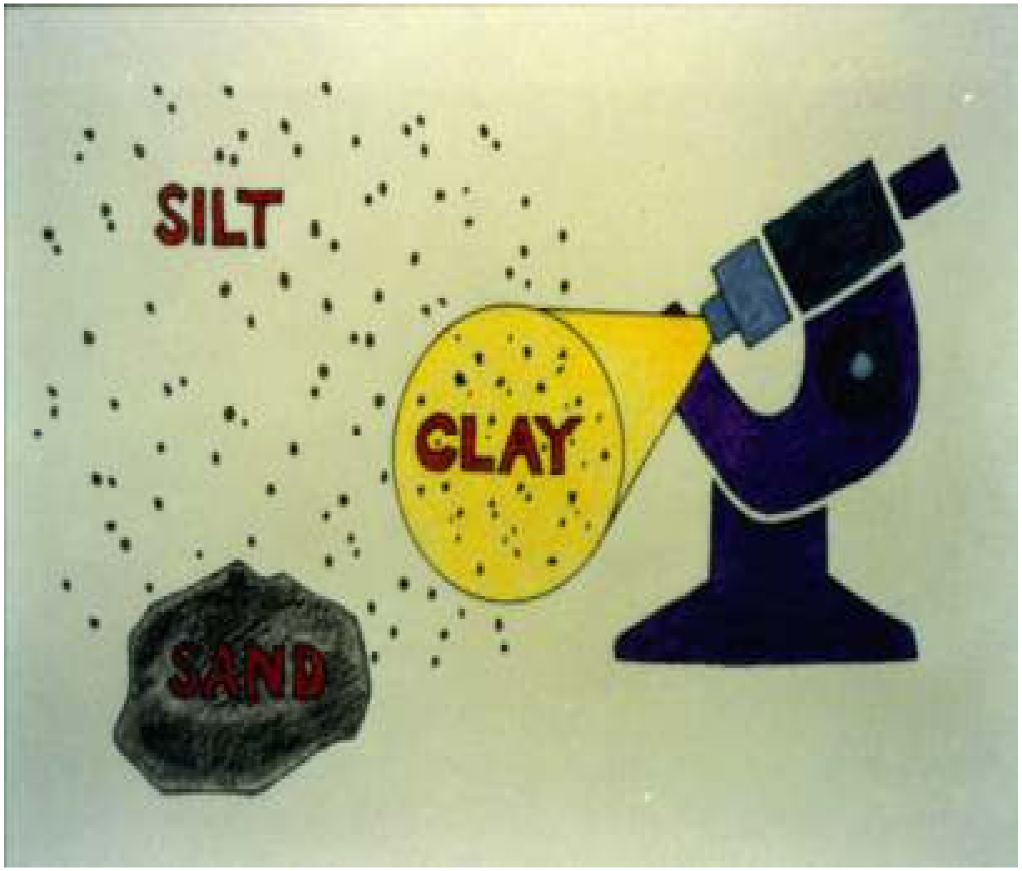
Brady, 1974, Nature and Properties of Soils

Soil Mineral Components

- **<u>Sand:</u> large particles, 0.05-2.0 mm in diameter.**

- **<u>Silt:</u> medium particles, 0.002-0.05 mm. Settles within 48 hours.**

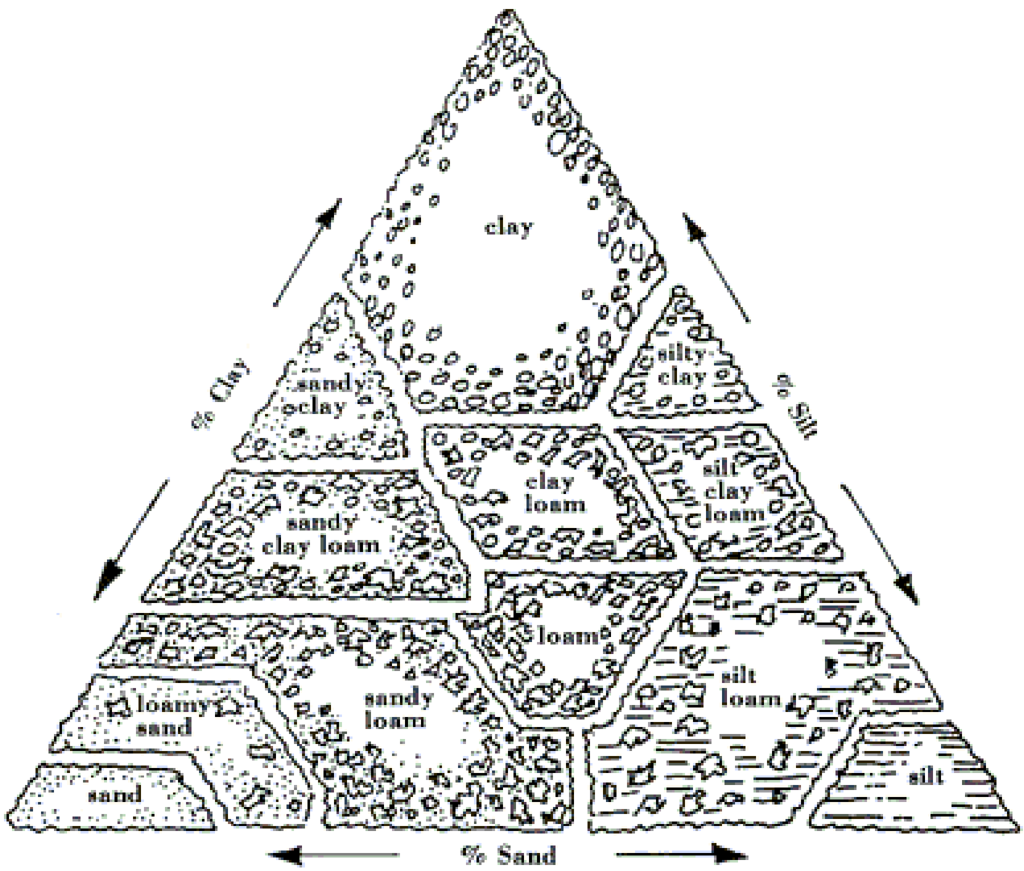
- **<u>Clay:</u> extremely small particles, less than 0.002 mm.**



Soil Triangle

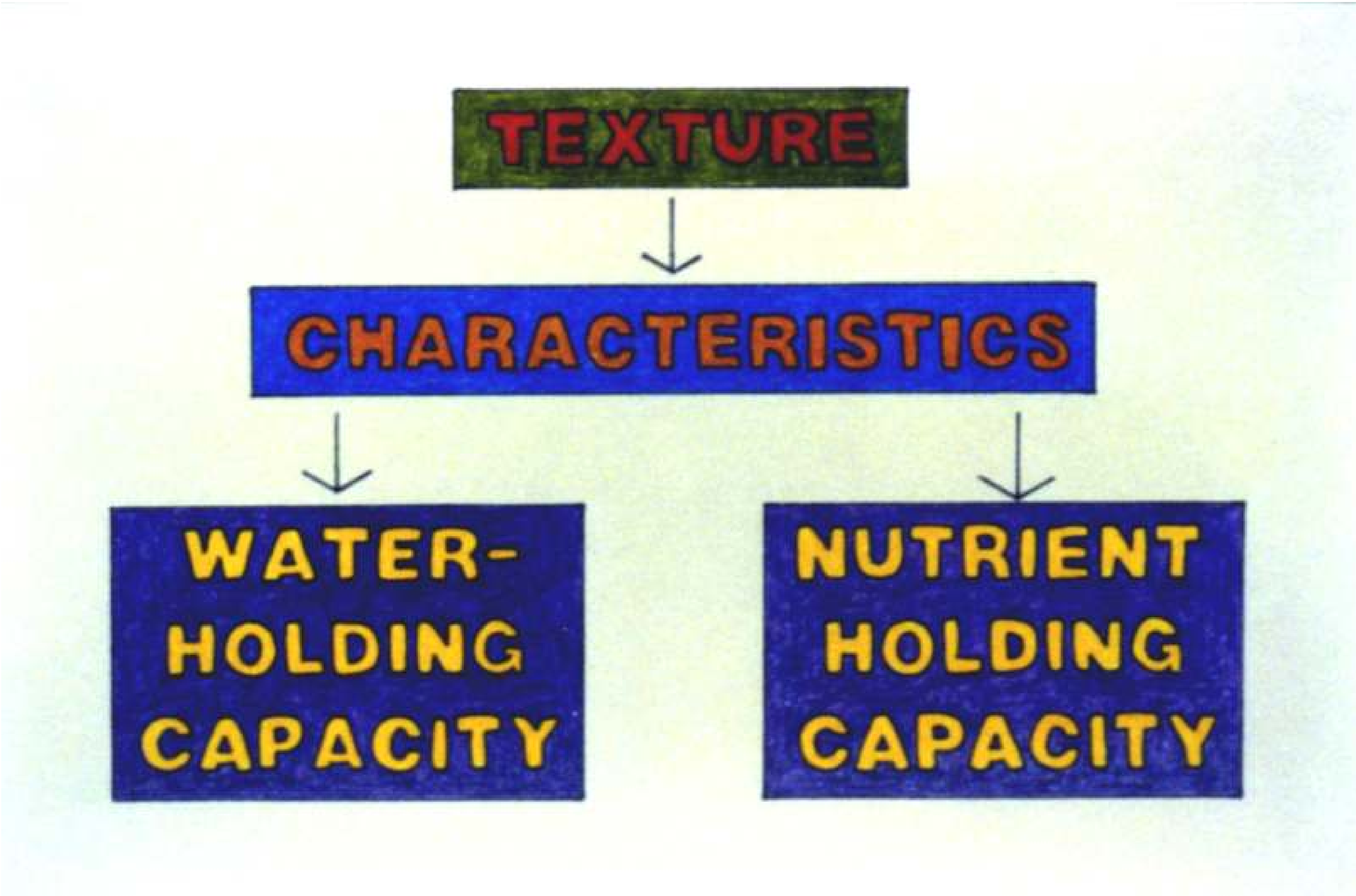
- **Determines Soil Texture Class**

- **Sandy soil: primarily sand**

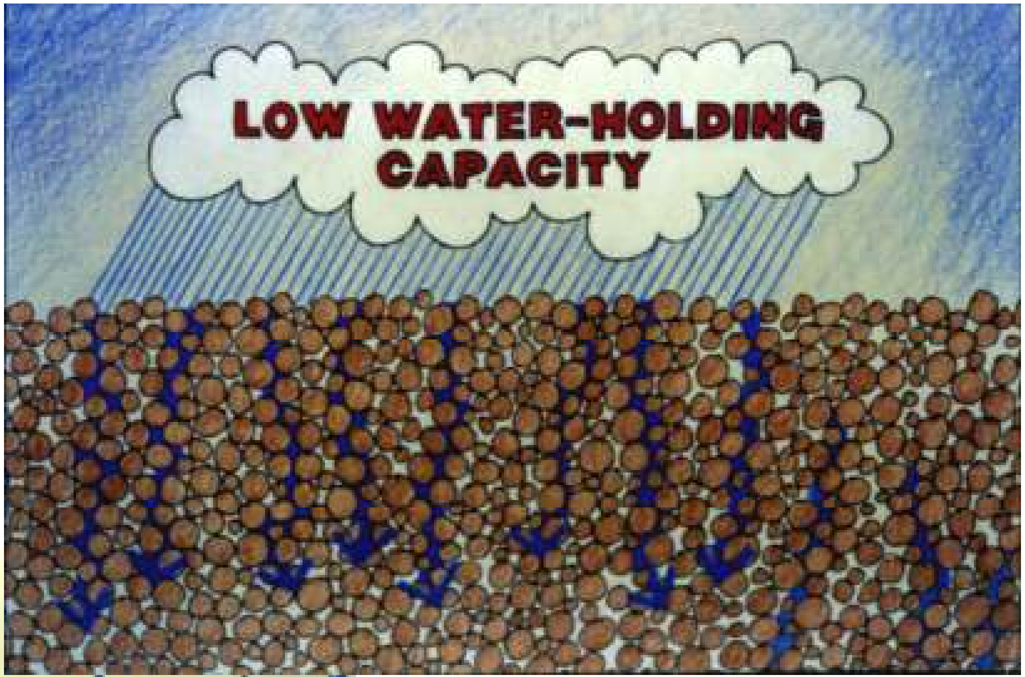


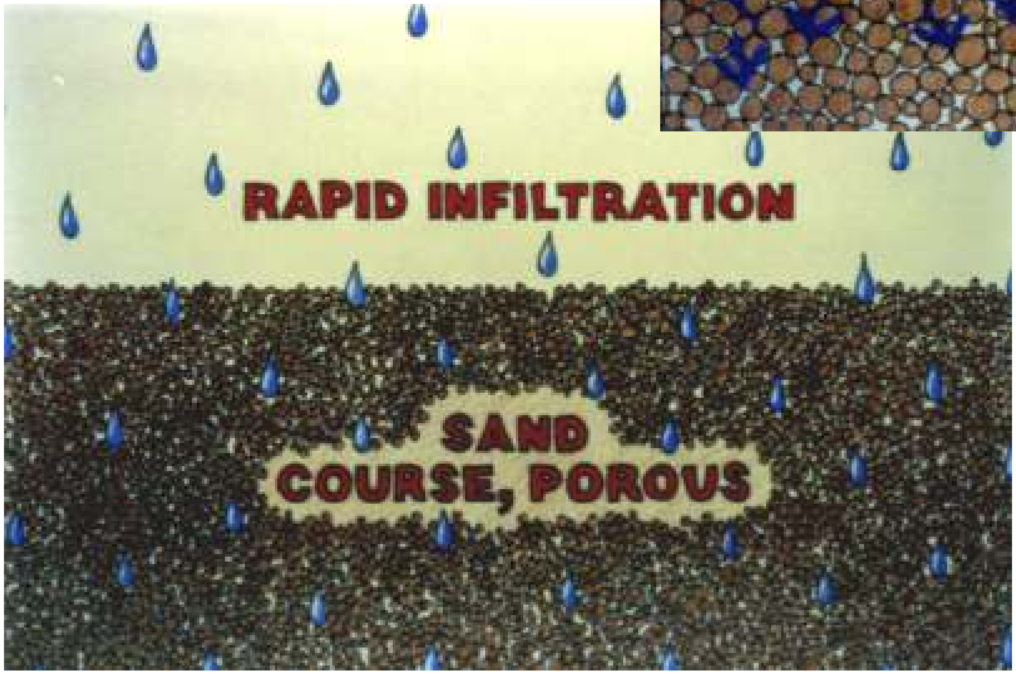
- **Sandy clay: clay with sand**

Textures Affect Capacities

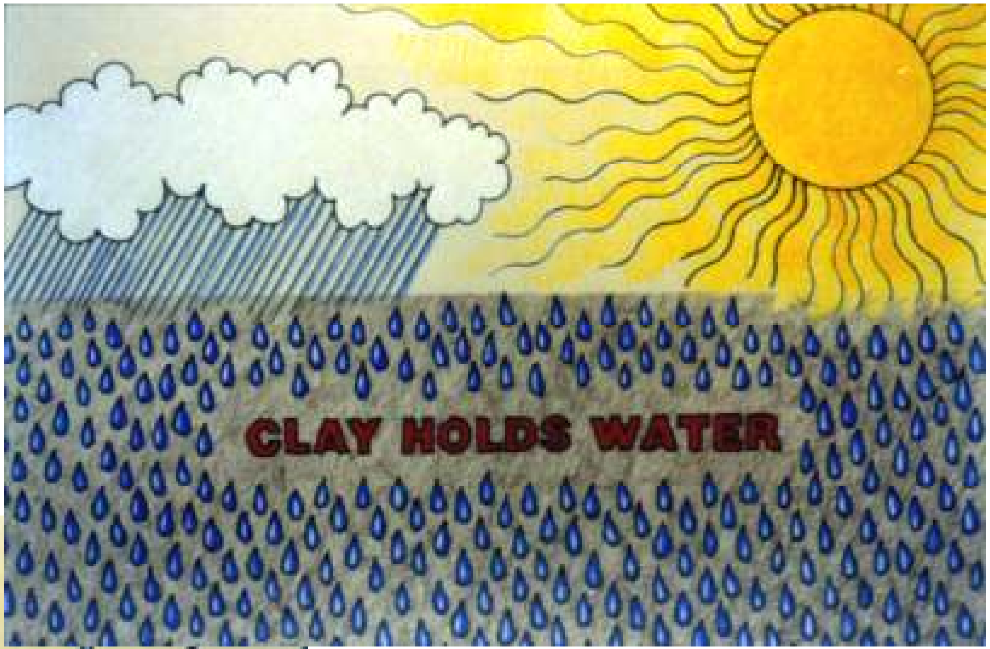


Sand Characteristics

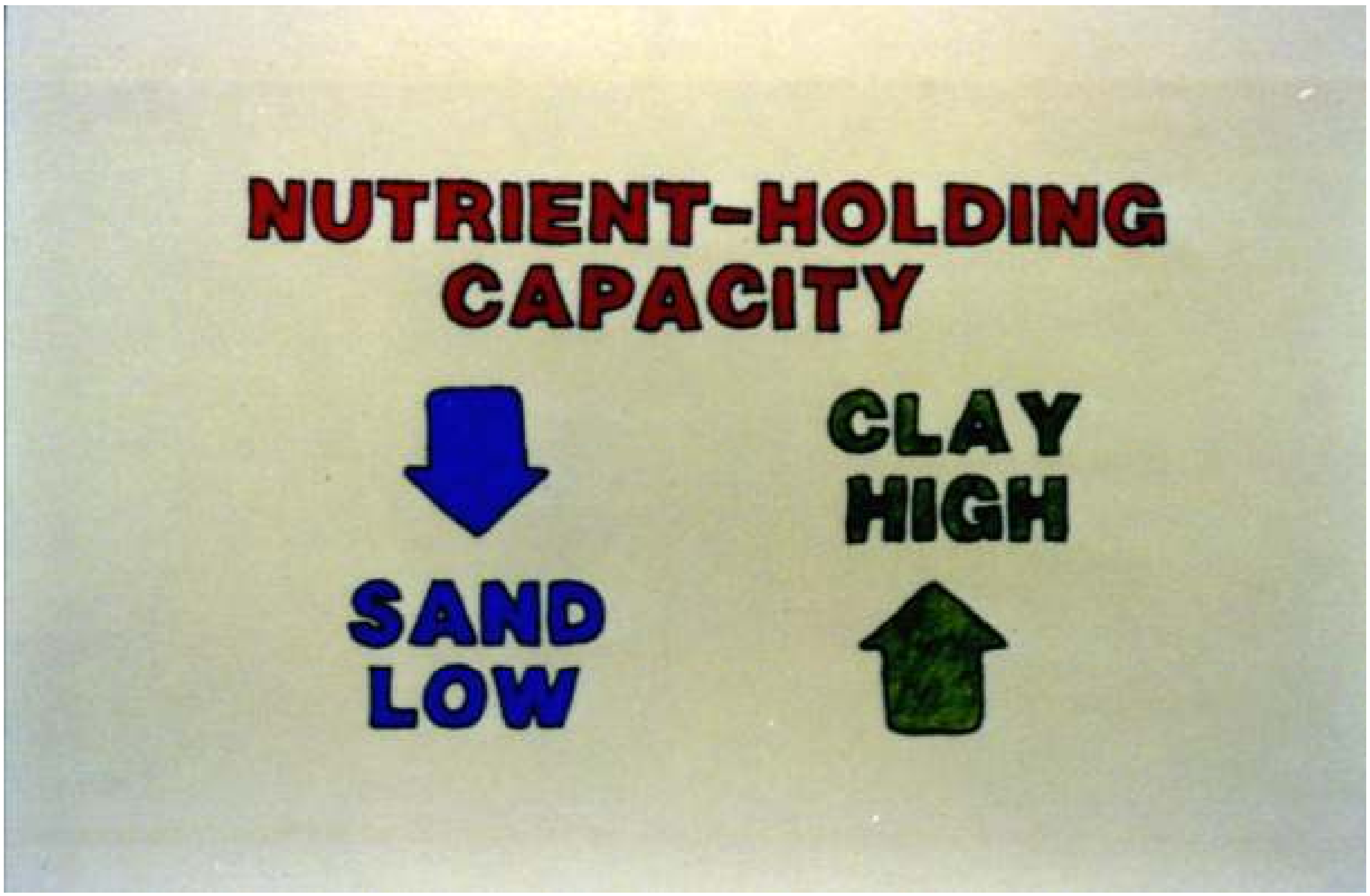




Clay Characteristics

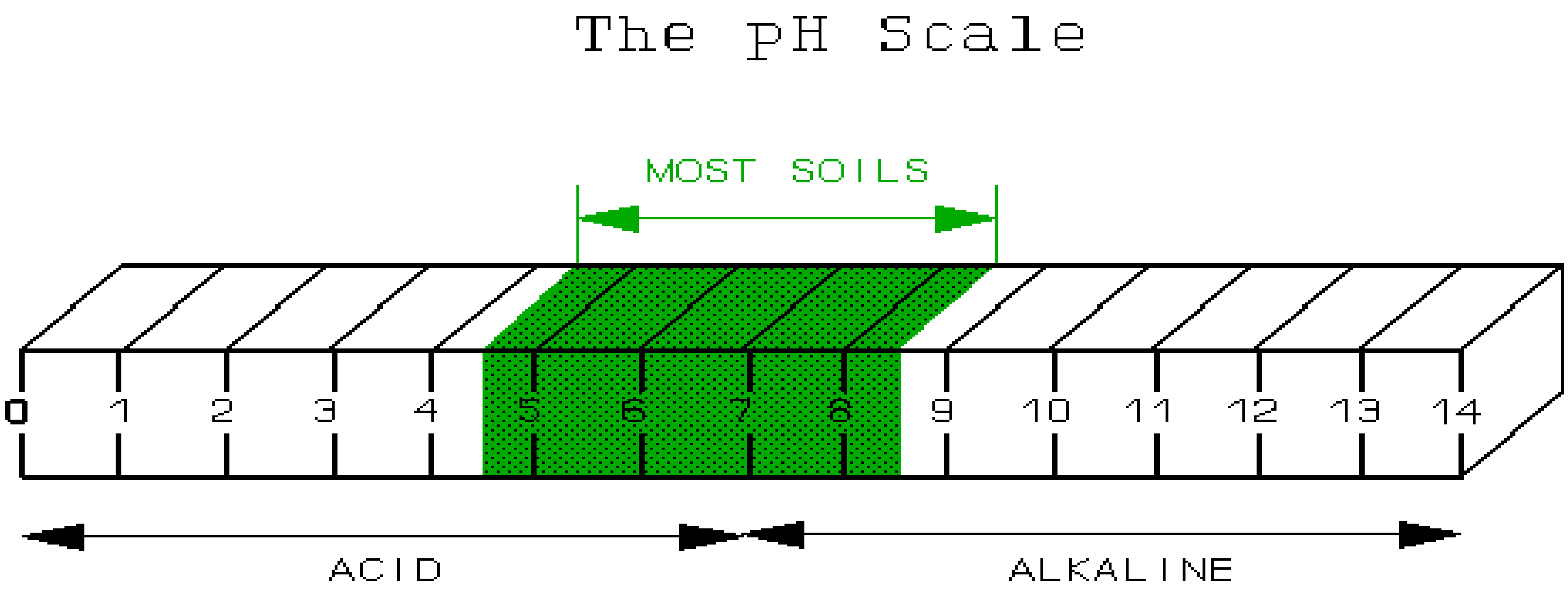


Soil Nutrient Capacity

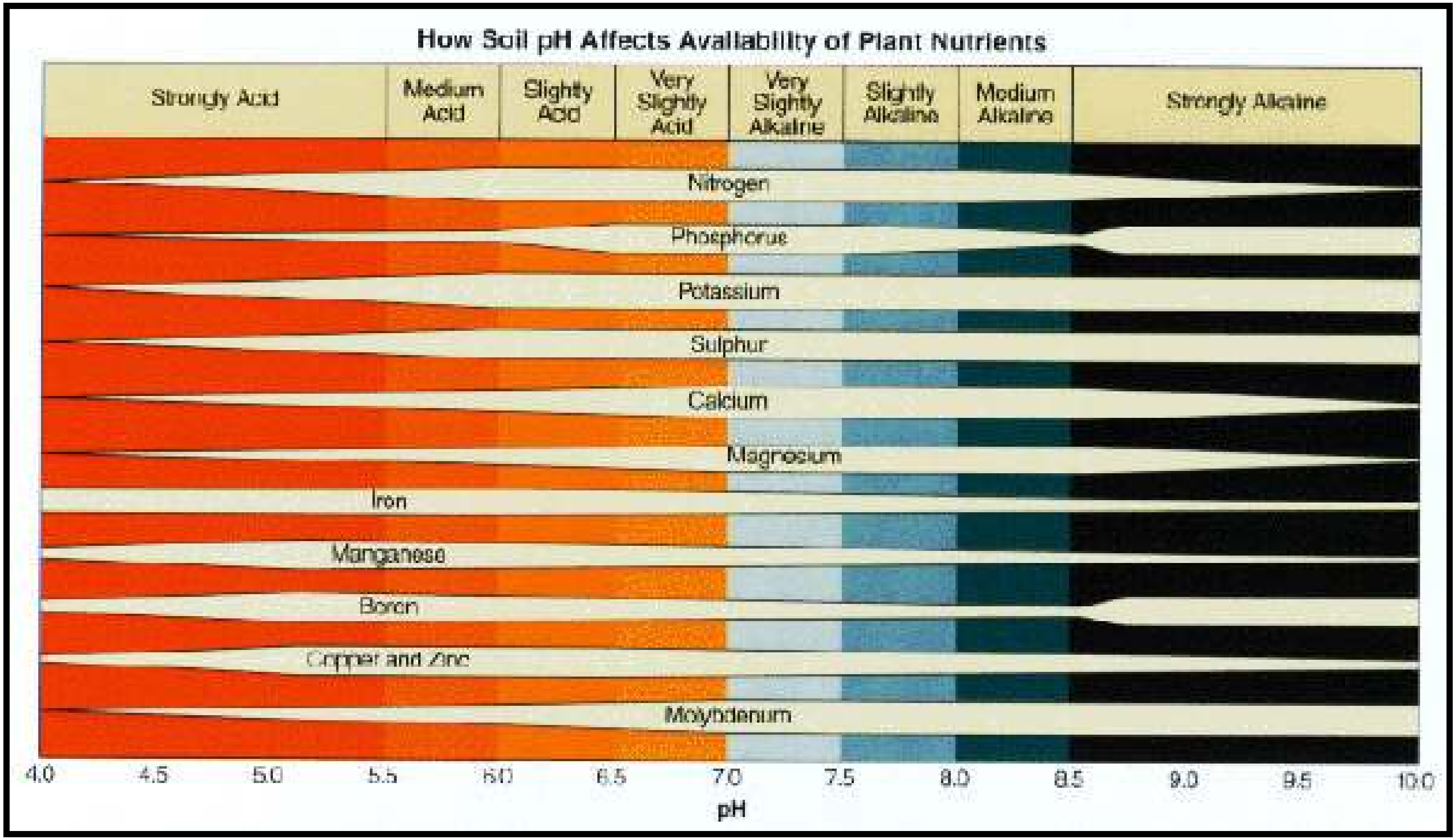


Soil pH

- **The measure of acidity or alkalinity of the soil**
- **Determines the concentration of nutrients in solution in the soil water (availability of nutrients for the plant)**



Soil pH and Nutrients Availability



Adjusting Soil pH

- **To raise soil pH (make more alkaline): apply lime (calcium carbonate) or dolomite (magnesium carbonate) - carbonate compounds**

- **To lower soil pH (acidify) temporarily: apply elemental sulfur compounds.**

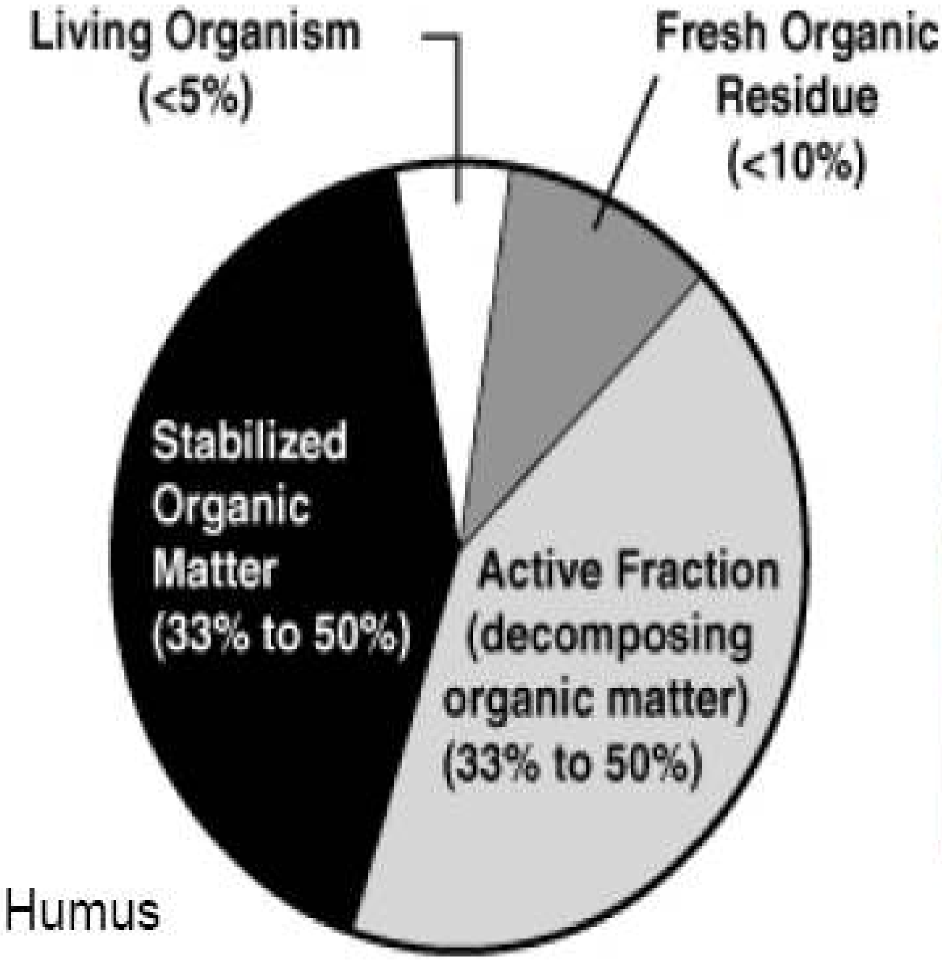
- **To add calcium or magnesium without changing soil pH: use sulfate compounds (ex.: gypsum = calcium sulfate)**

Organic Matter

- **Major contributions to soil fertility & quality**

- **Range of values**
  - **Temperate soils have higher OM levels (5-10%)**
  - **Tropical soils generally have 0.5-1.0% (this is us)**

Organic Matter



Brady & Weil, 2004. Elements of the Nature and Properties of Soils

Soil Structure

- **Aggregation**
  - **how components are held together not just composition**
  - **results in good “tilth”**
  - **improved by root growth and OM**
  - **reduced by compaction and increased density**

Figure 2. Comparison of good, crumb-like soil structure (left), with a poor, clod-like structure (right). (Drawing by Stewart Hoyt.)

Gershuny & Smillie, 1995, Soul of Soil.

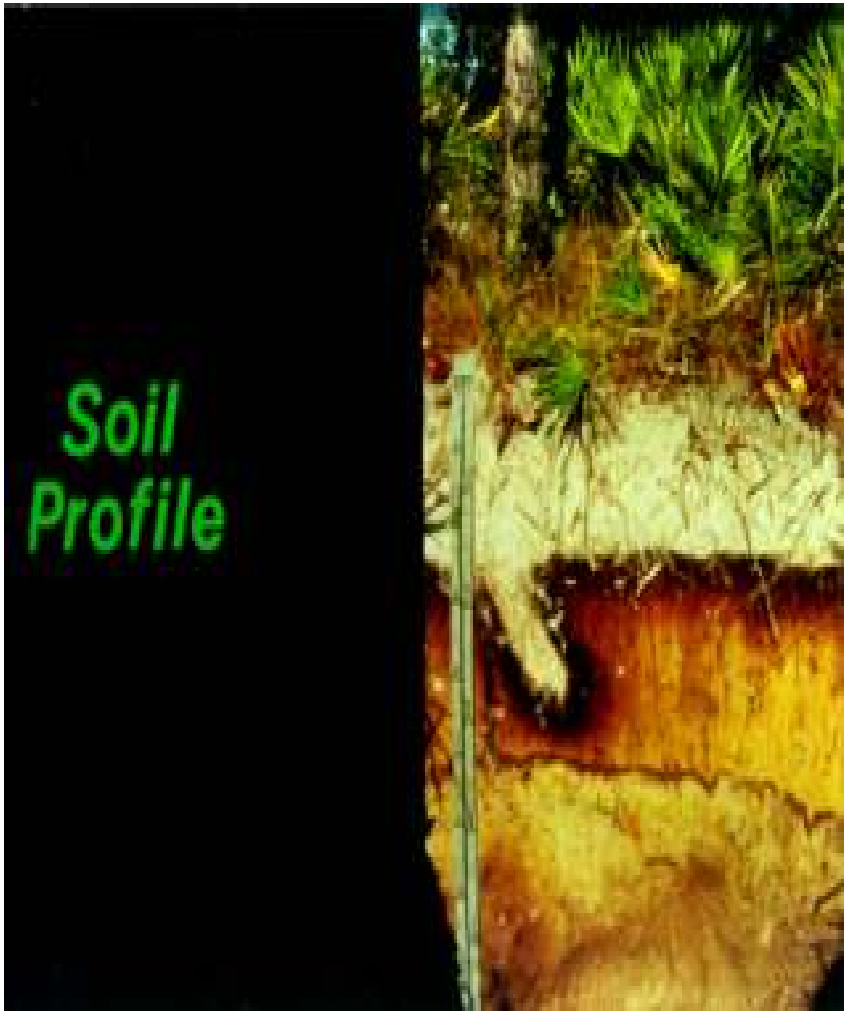
Water Stable Aggregates

- Formed by the aggregation of clay (smallest particles), followed by gluing together of macro-aggregates with bacterial secretions, fungal hyphae, and root hair bonding.



Soil Profiles

- **Arrangements of layers or “horizons” of soils with particular characteristics.**
- **Main characteristics determining “soil type or series” Ex.: “Myakka fine sand”).**
- **Indicator of landscapes & ecosystems**



Soil Survey

- **Soils information for land use planning**
- **Highlights soil capabilities/limitations for many different users**
- **Available at county level & online**
- **Intended for a general level application**

http://websoilsurvey.nrcs.usda.gov/app/

Plant Nutrition Concepts

Historical Perspectives

Neolithic
10,000 yrs ago

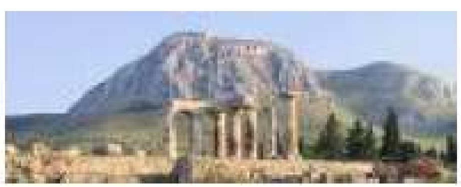
Ancient Greece and Rome
2,000 yrs ago

Medieval
Up to16th Cent

Justus von Liebig/Morrill Act
1862

http://www.cri.org/InTheField/bolivia_s_b.htm

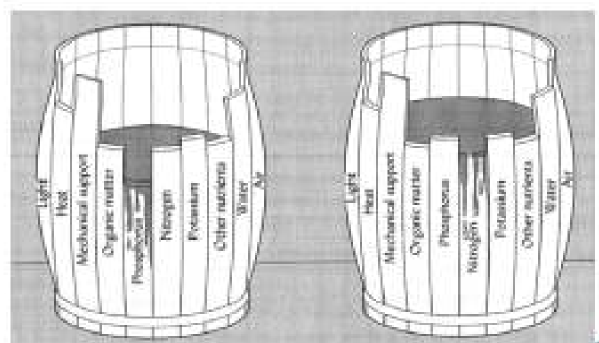
Irrigation
Manure
Lime



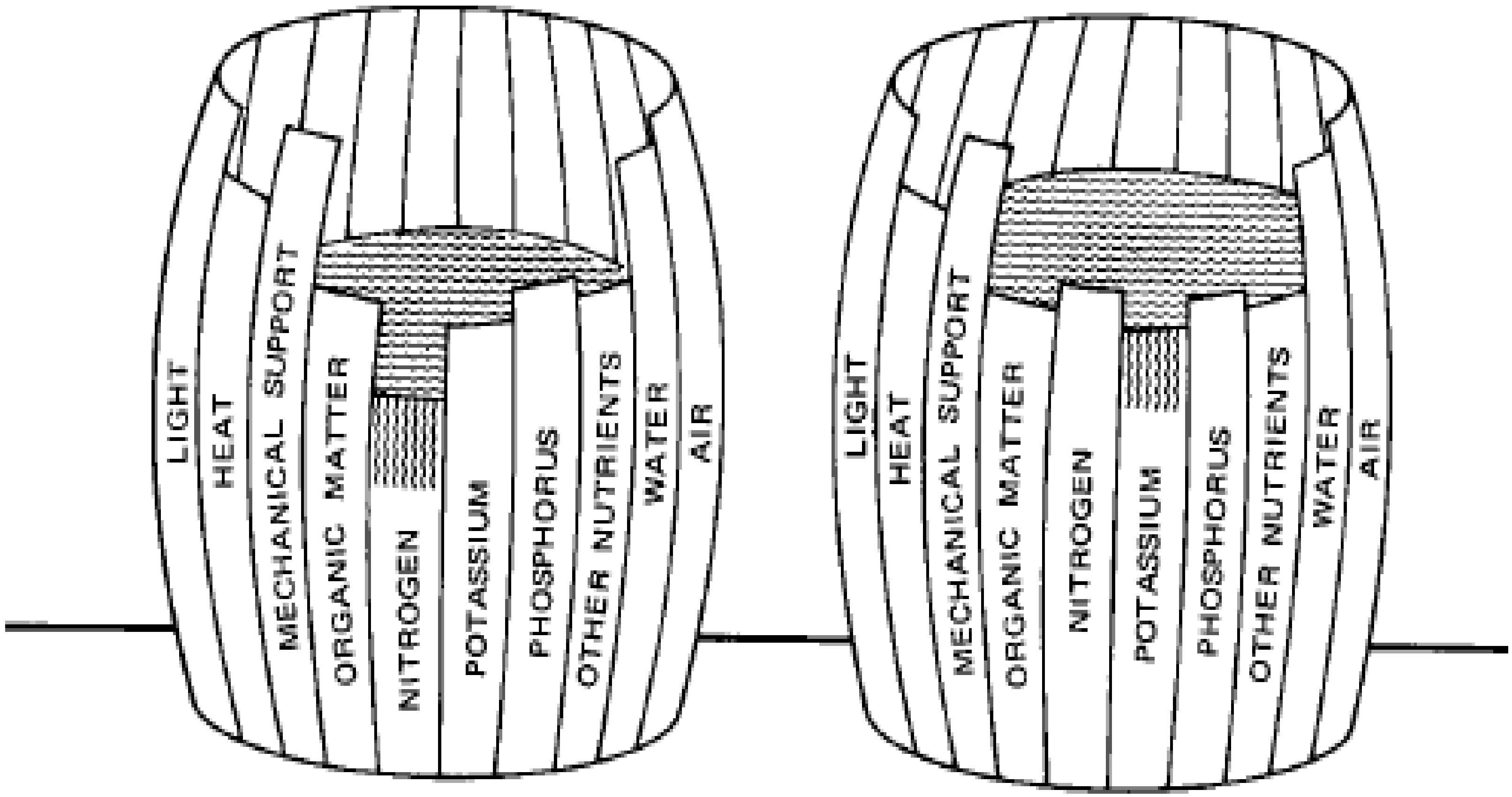
http://www.classicadventures.com/pages/itin_bike_tour_greece.html

Rotations

Law of the Minimum
Morrill Act

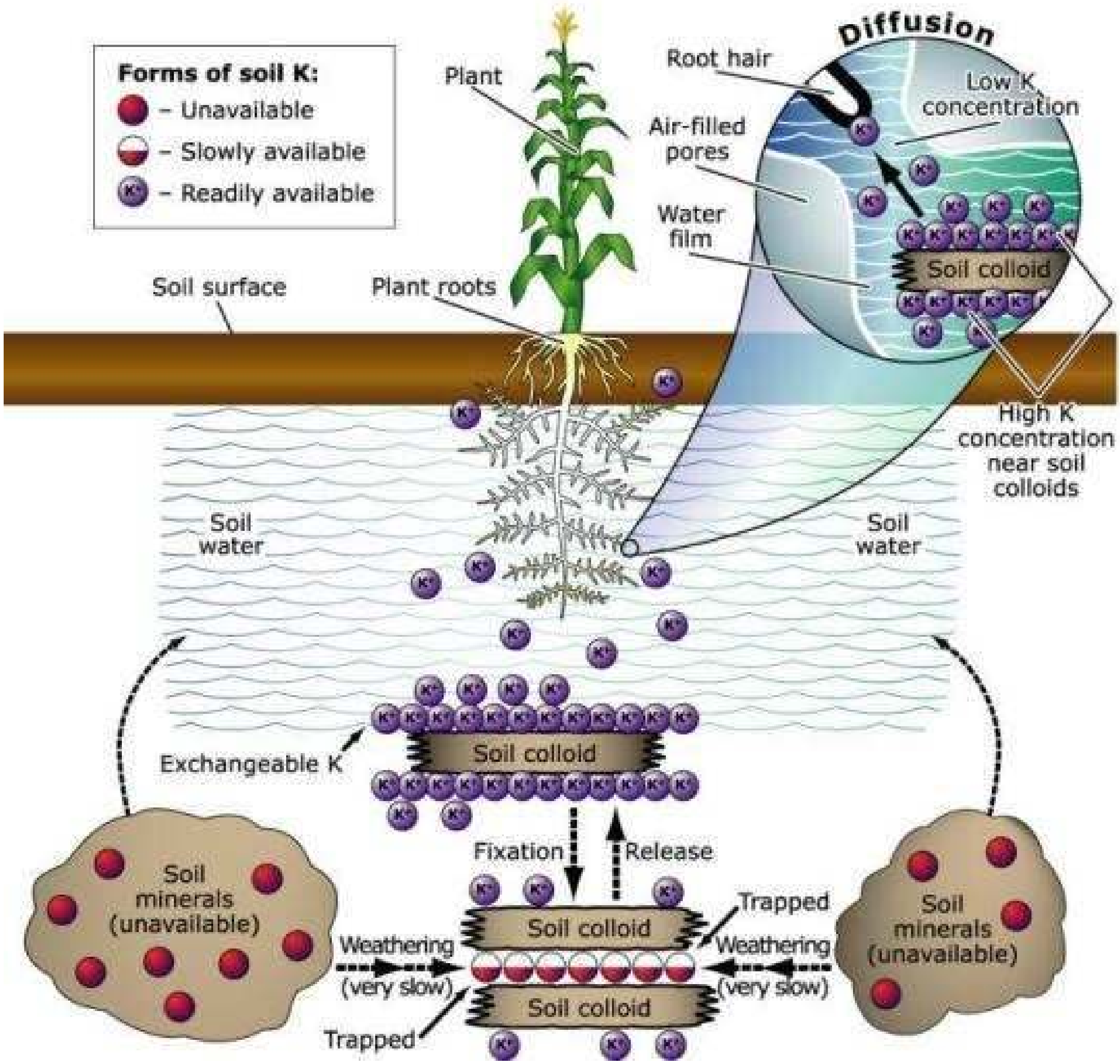


- **<u>Principle of Limiting Factors</u>**
  - **Justus von Liebig (1803-1873)**



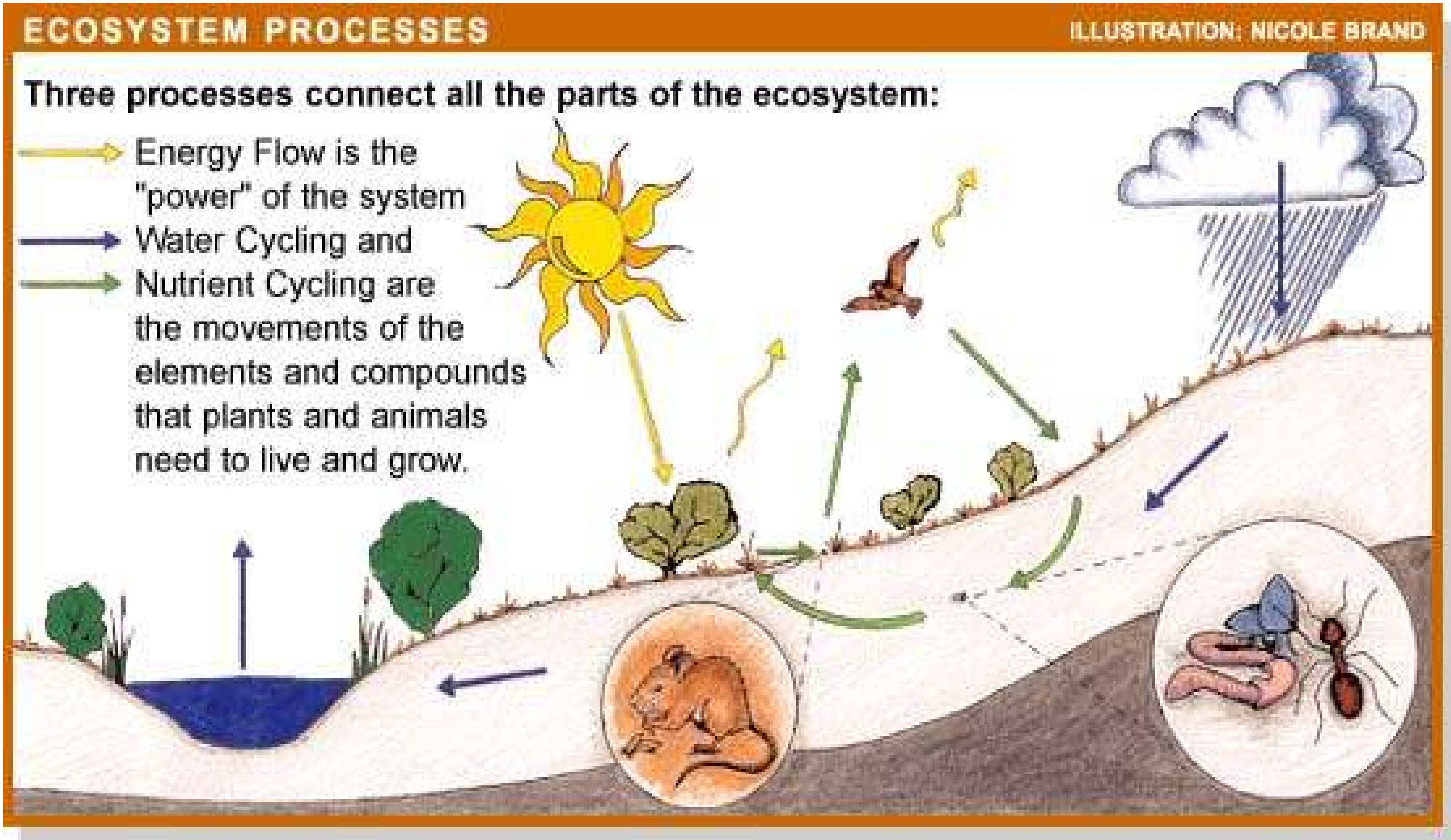
- The research of the "father of the agricultural chemicals industry" also acknowledged the importance of soil organic matter

Soil Chemistry Plant Nutrition Example

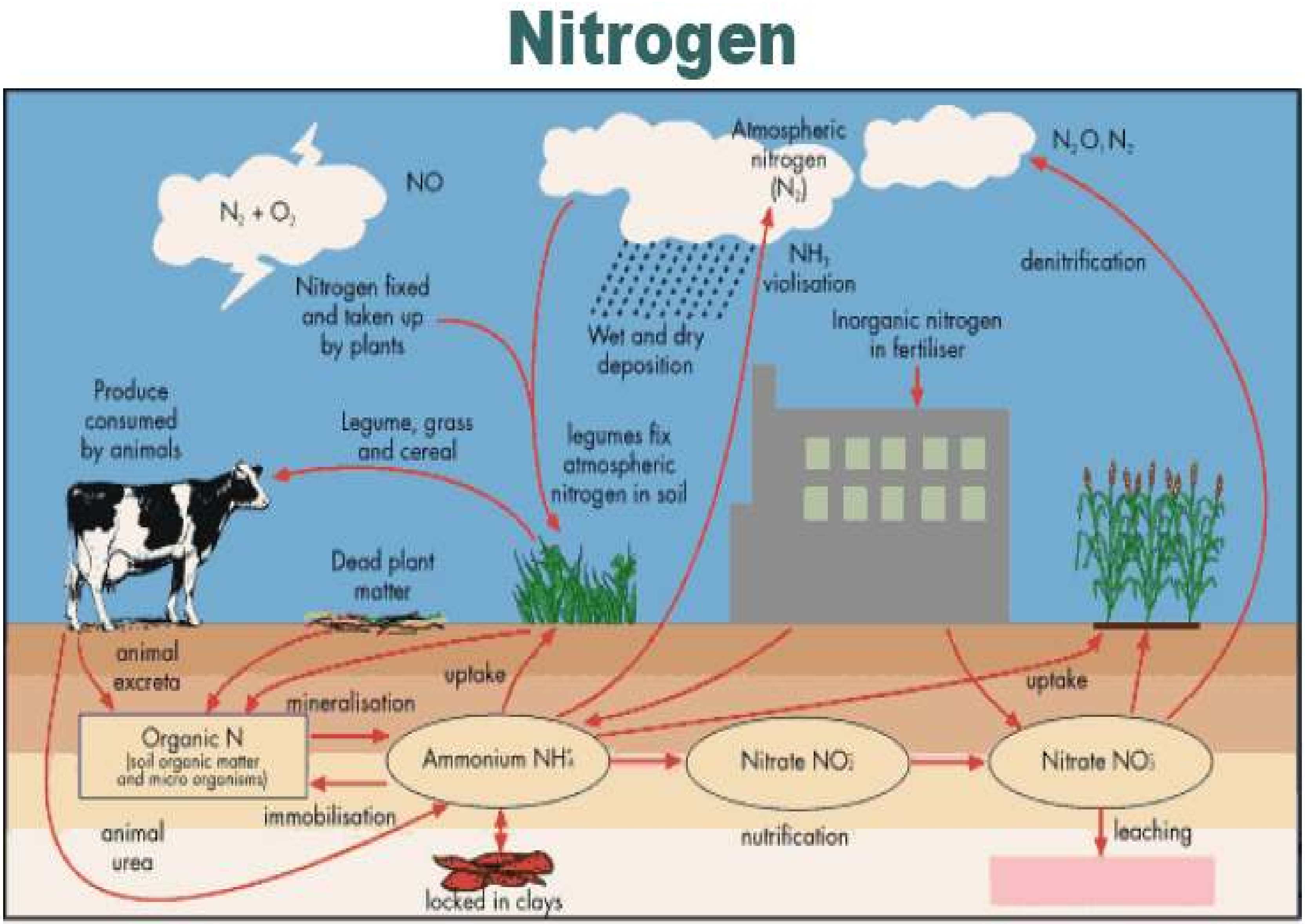


Potassium (K) Example

Soil As An Ecosystem

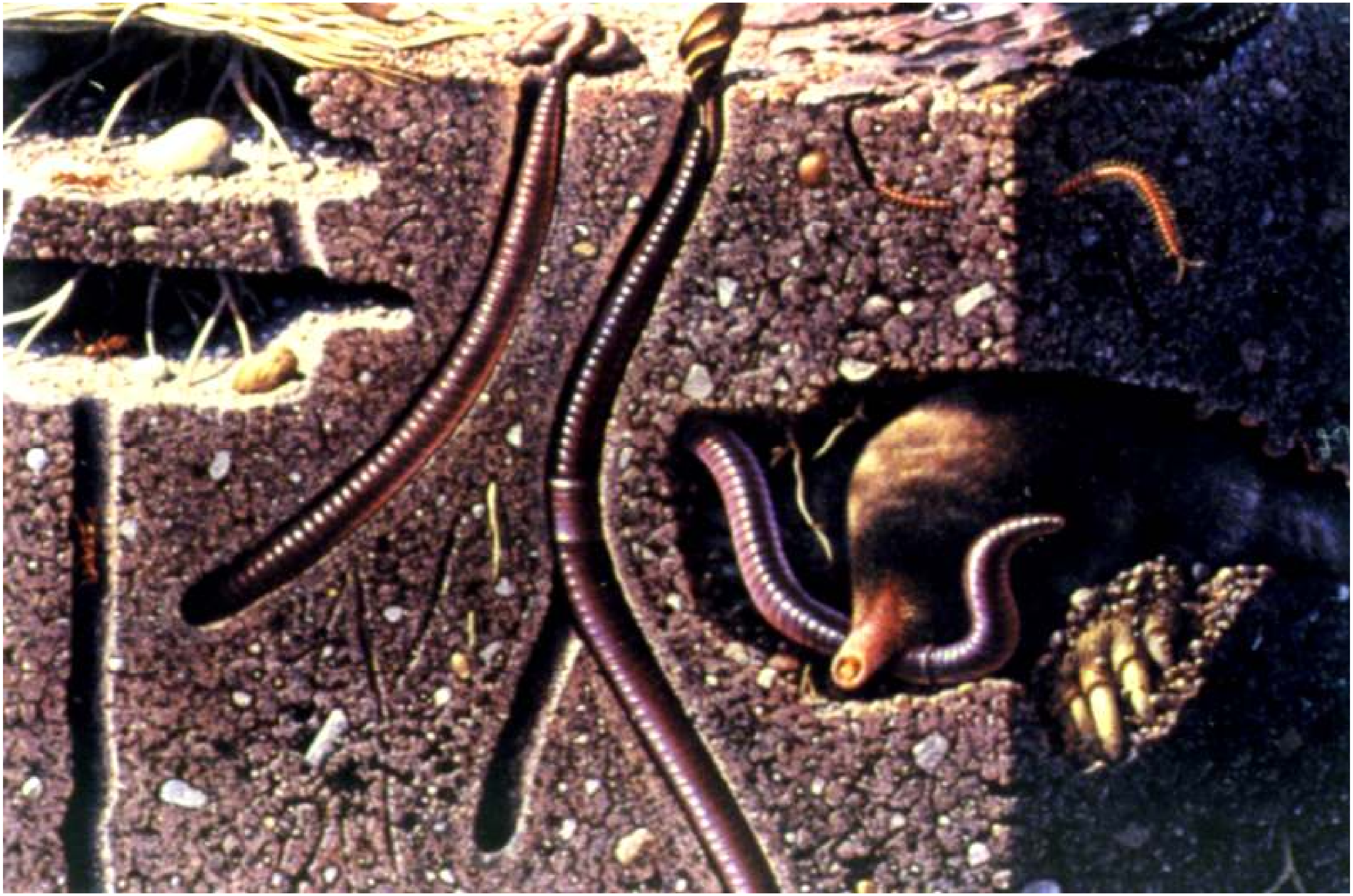


Soil Nutrient Cycle Example

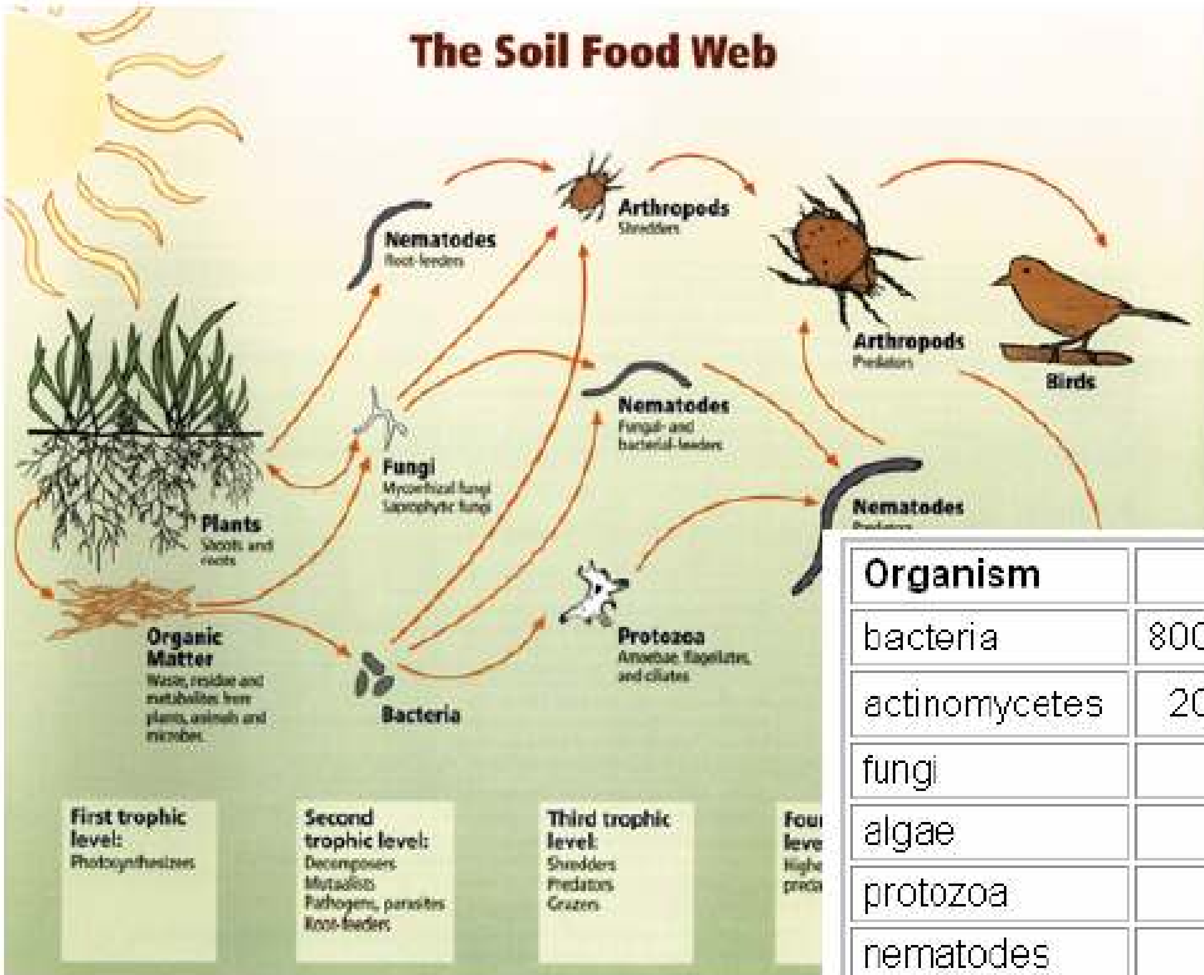


http://www.bettersoils.com.au/module2/images/27.gif

Soil is Habitat



Soil is Alive



Importance of Soil Biology
- diversity
- nutrient cycling
- pest/pathogen suppression
- symbioses

Organism	Number/acre	Lbs./acre
bacteria	800,000,000,000,000,000	2600
actinomycetes	20,000,000,000,000,000	1300
fungi	200,000,000,000,000	2600
algae	4,000,000,000	90
protozoa	2,000,000,000,000	90
nematodes	80,000,000	45
earthworms	40,000	445
insects & other arthropods	8,160,000	830

Source: Thompson and Troeh, 1978

Soil Life in Soil Profile

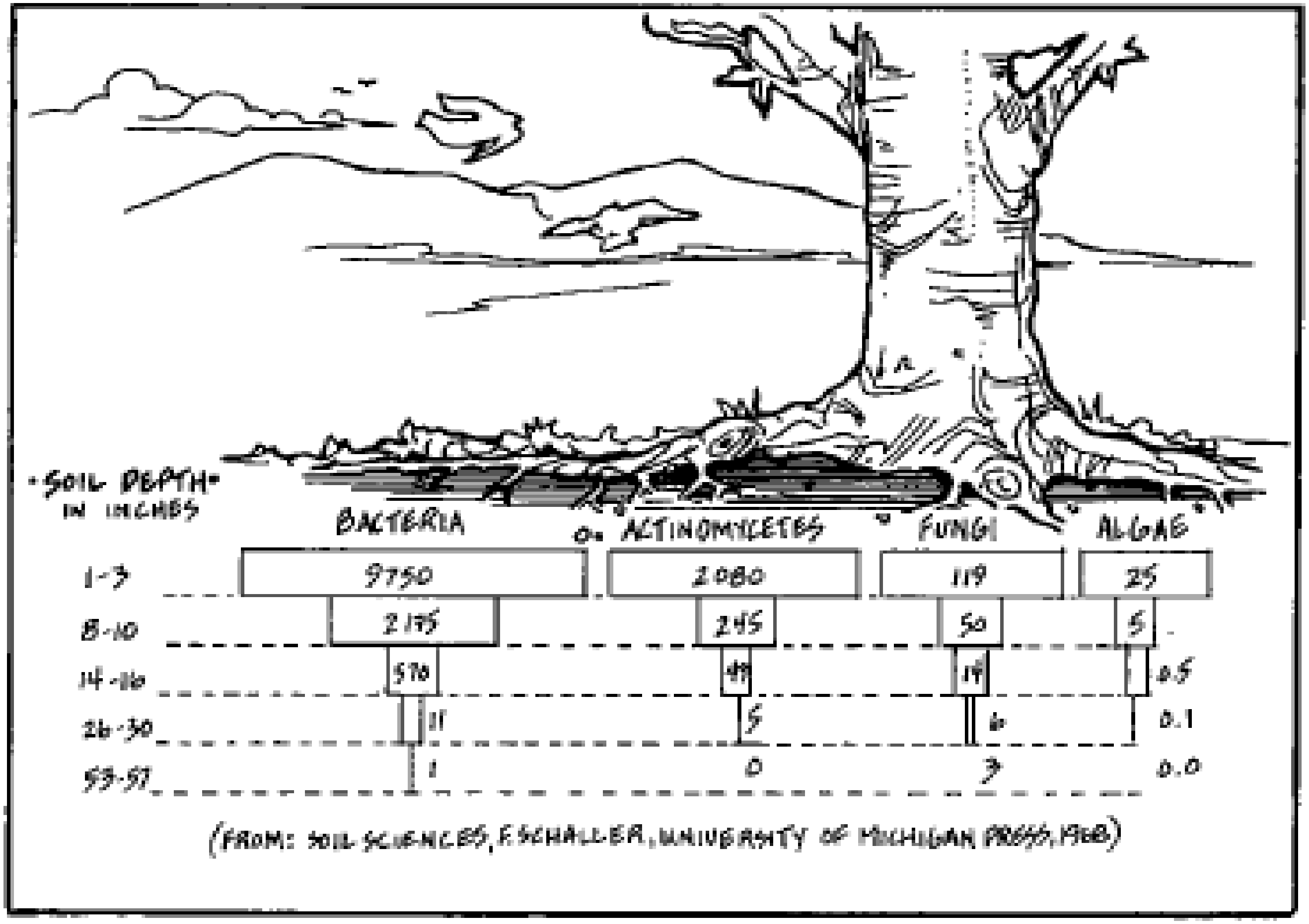


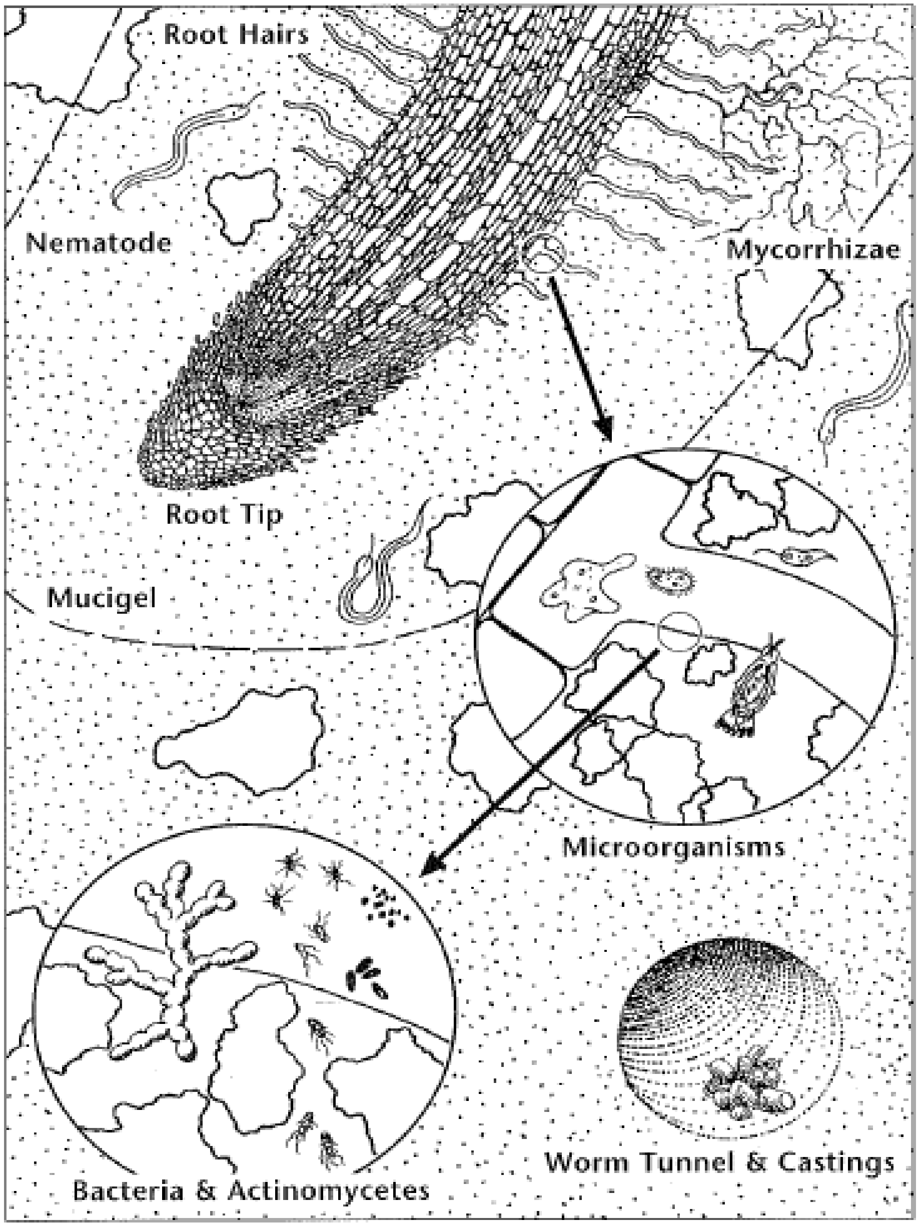
Figure 3.10 The soil's bacteria live at specific depths. When soil is tilled under, surface-loving bacteria die.

Kourik, 1986, Designing & maintaining edible landscape naturally.

Soil Organisms

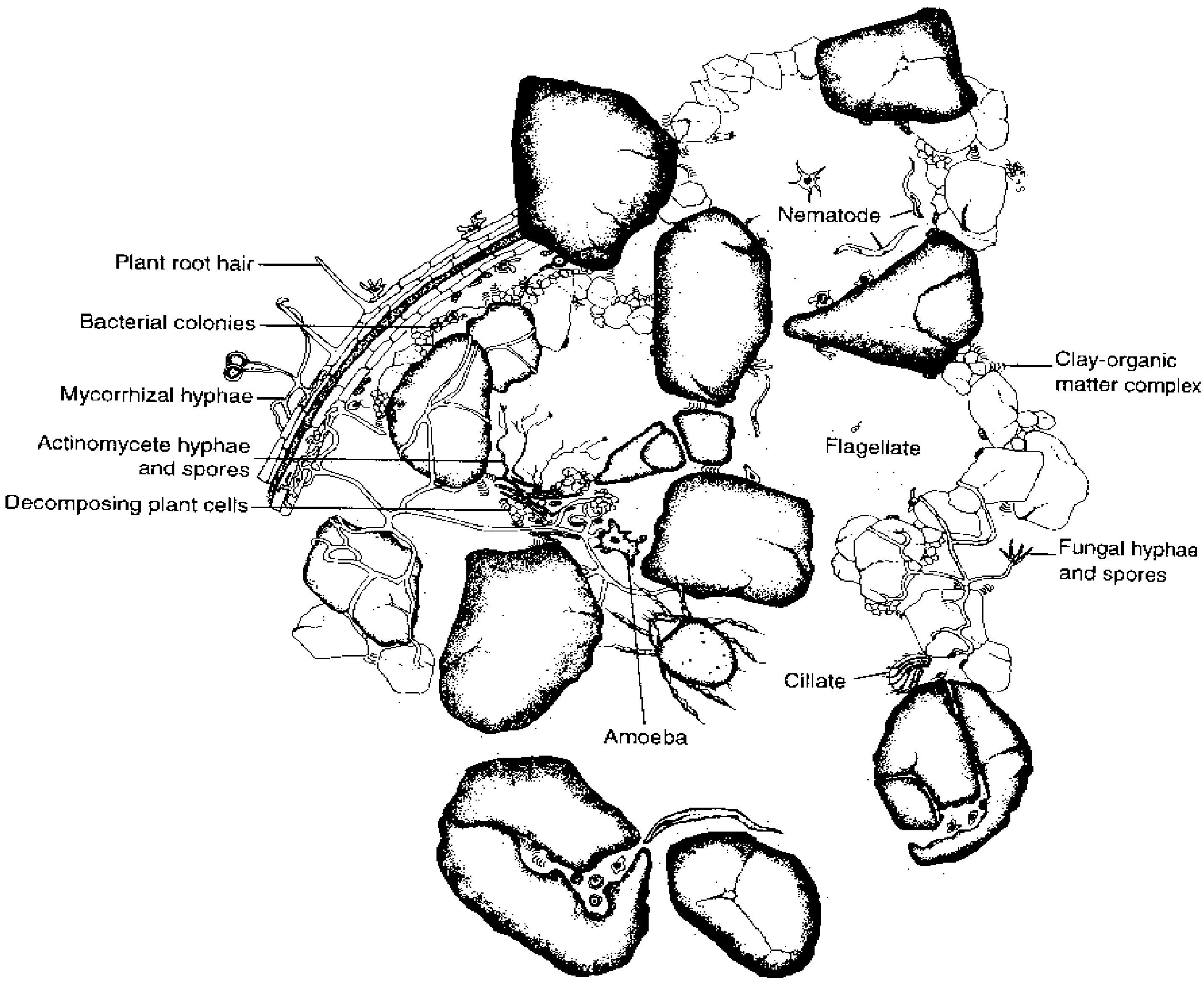
- **Microbes**
  - **Bacteria**
  - **Fungi**
  - **Actinomycetes**
  - **Algae**
  - **Protozoans**
  - **Nematodes**

- **Macrobes**
  - **Earthworms**
  - **Moles/Gophers**
  - **Ants/Termites**
  - **Herpetofauna**



Gershuny & Smillie, 1995, Soul of Soil

Soil Life and Soil Properties



Soil Life on Plant Roots

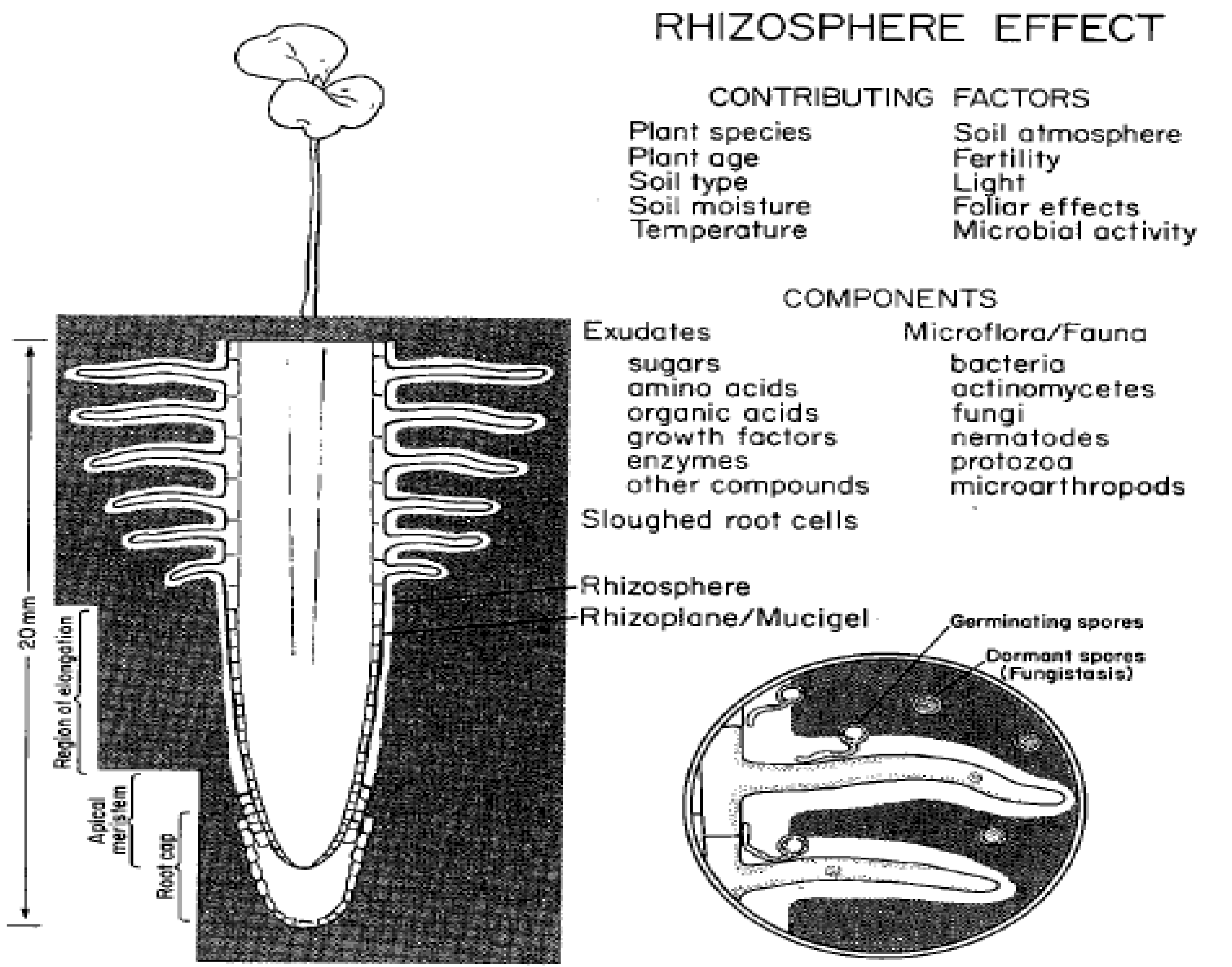
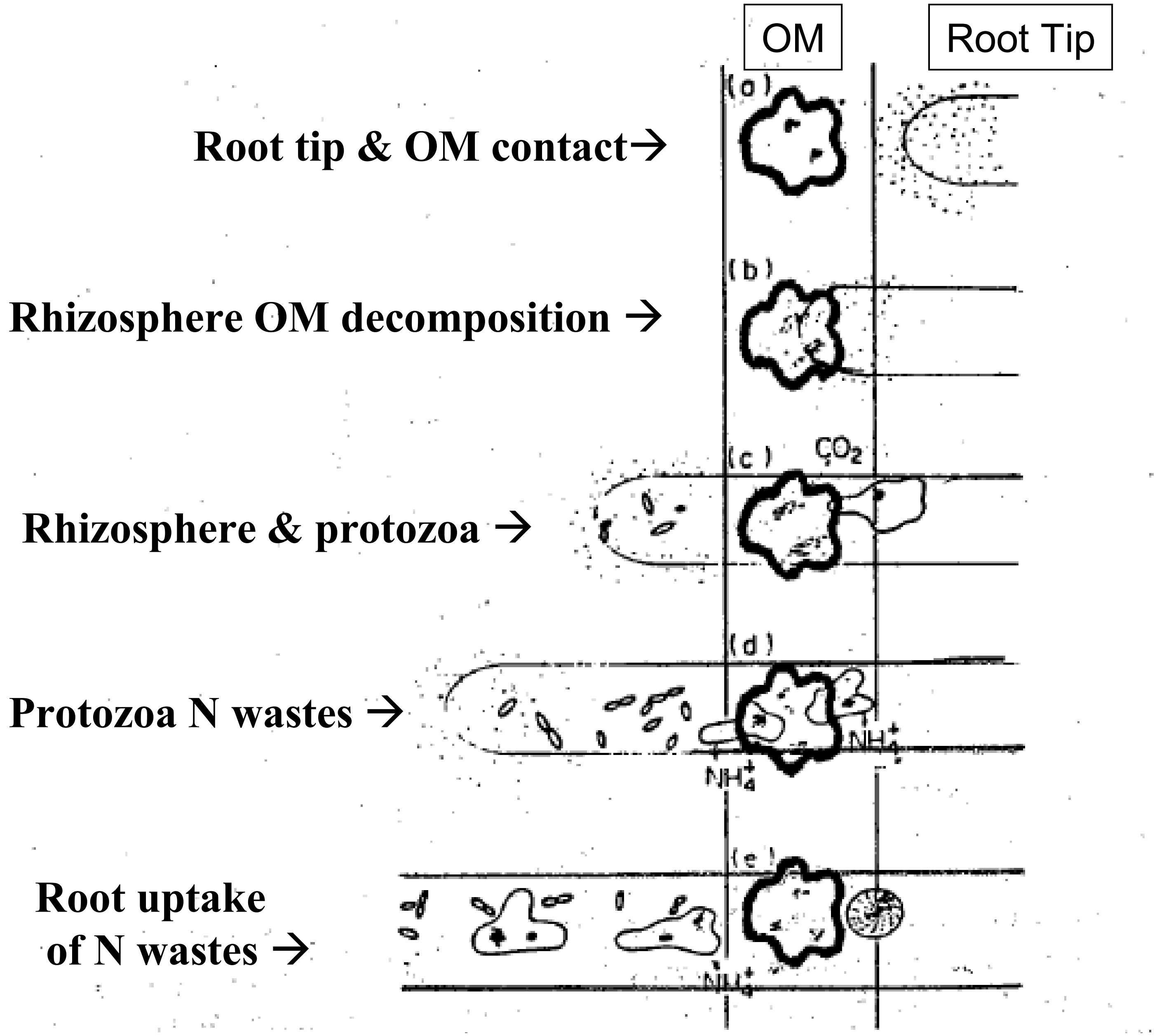


Fig. 1.2. Diagram of a young root featuring the rhizosphere and rhizoplane. Major organic materials released by the root, and groups of the microbiota affected are indicated along with factors governing the extent of root influence. *Inset* shows fungal spores germinating in the rhizosphere but not outside this nutrient zone

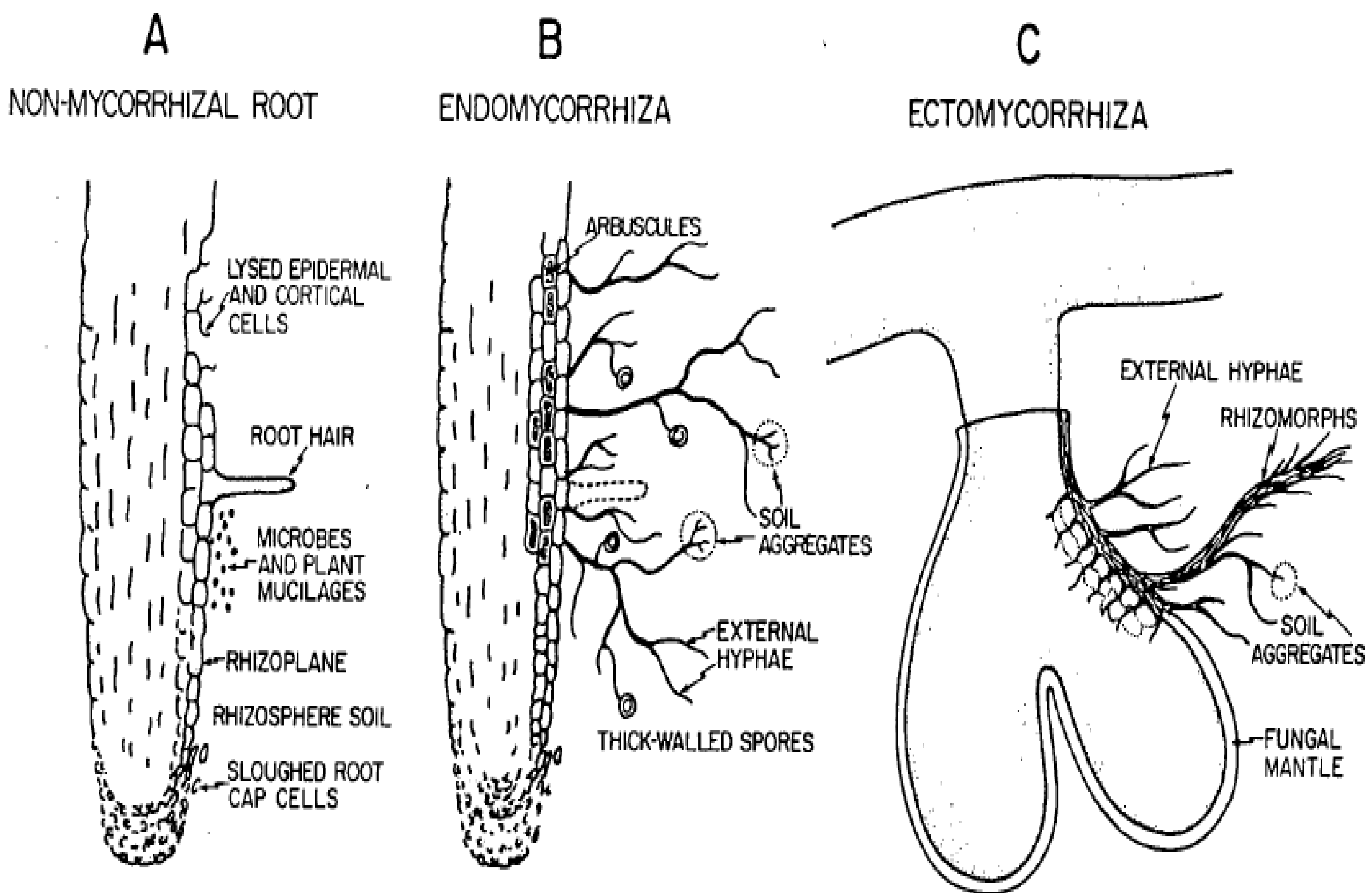
Curl, E.A. & B.T. Truelove, 1986, The Rhizosphere.

Rhizosphere and Plant Nutrition



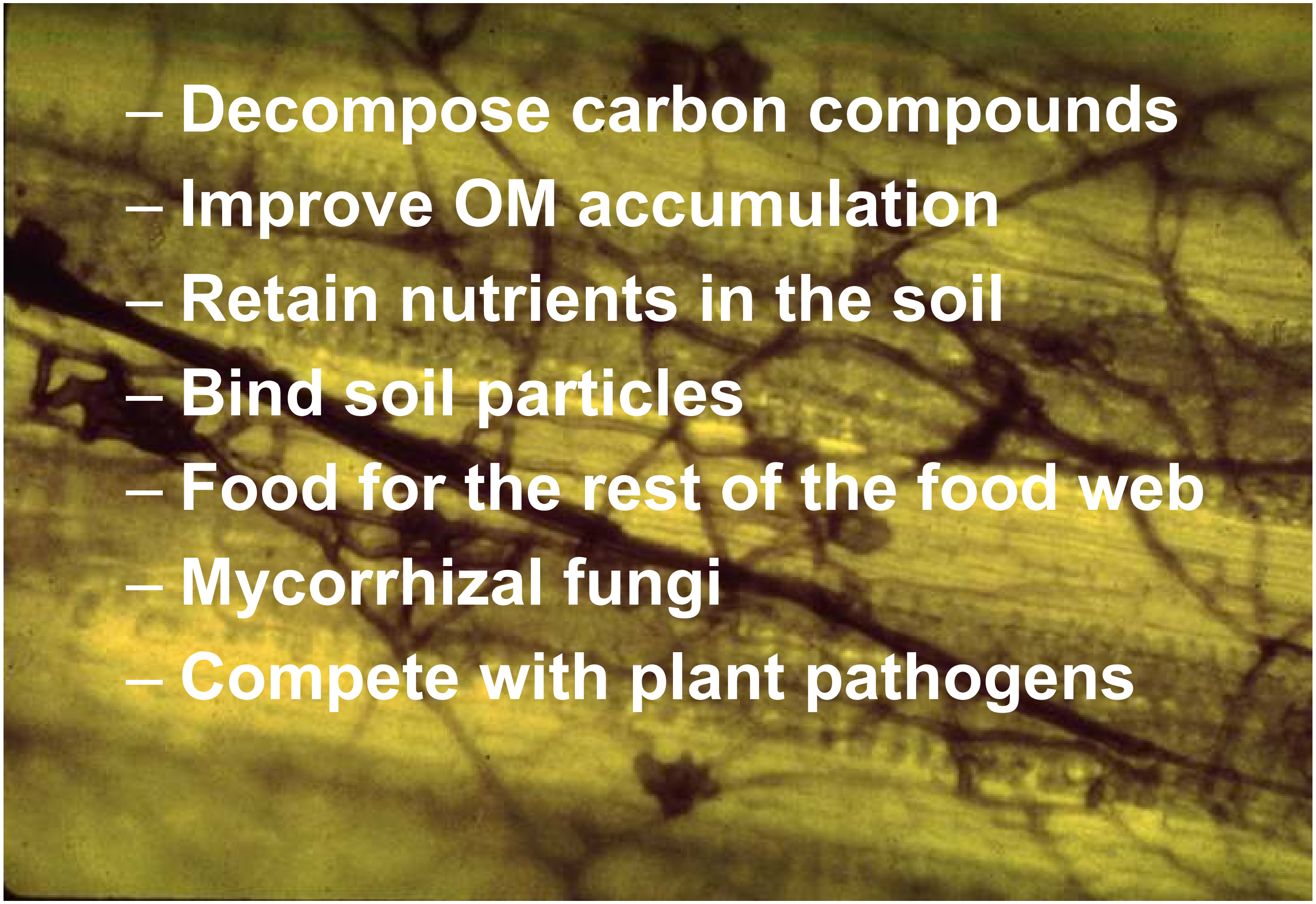
Clarhom, M.C., 1985

Root Mycorrhizal Mutualism



Pfleger and Linderman, 1994, Mycorrhizae and Plant Health.

Fungi and Soil Quality



- Decompose carbon compounds
- Improve OM accumulation
- Retain nutrients in the soil
- Bind soil particles
- Food for the rest of the food web
- Mycorrhizal fungi
- Compete with plant pathogens

Nitrogen-fixing Bacteria

- Nodules formed where *Rhizobium* bacteria infected soybean roots.

EARTHWORMS

- **Earthworms generate tons of casts per acre each year, dramatically altering soil structure.**

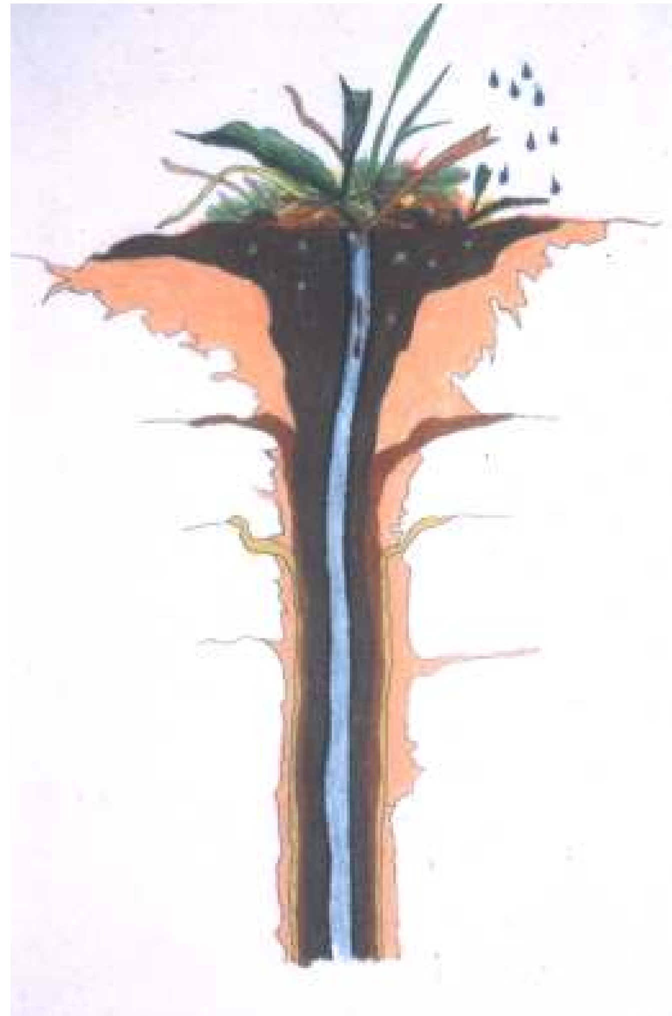
Earthworms Bury Litter

- **A corn leaf pulled into a night crawler burrow**

Earthworm Burrow

- **A mixture of soil and organic matter within an earthworm burrow. Earthworms incorporate large amounts of organic matter into the soil.**

Vertical Burrows



- **Some worms live in permanent vertical burrows such as these. Others move horizontally near the surface, filling their burrow with casts as they move**.

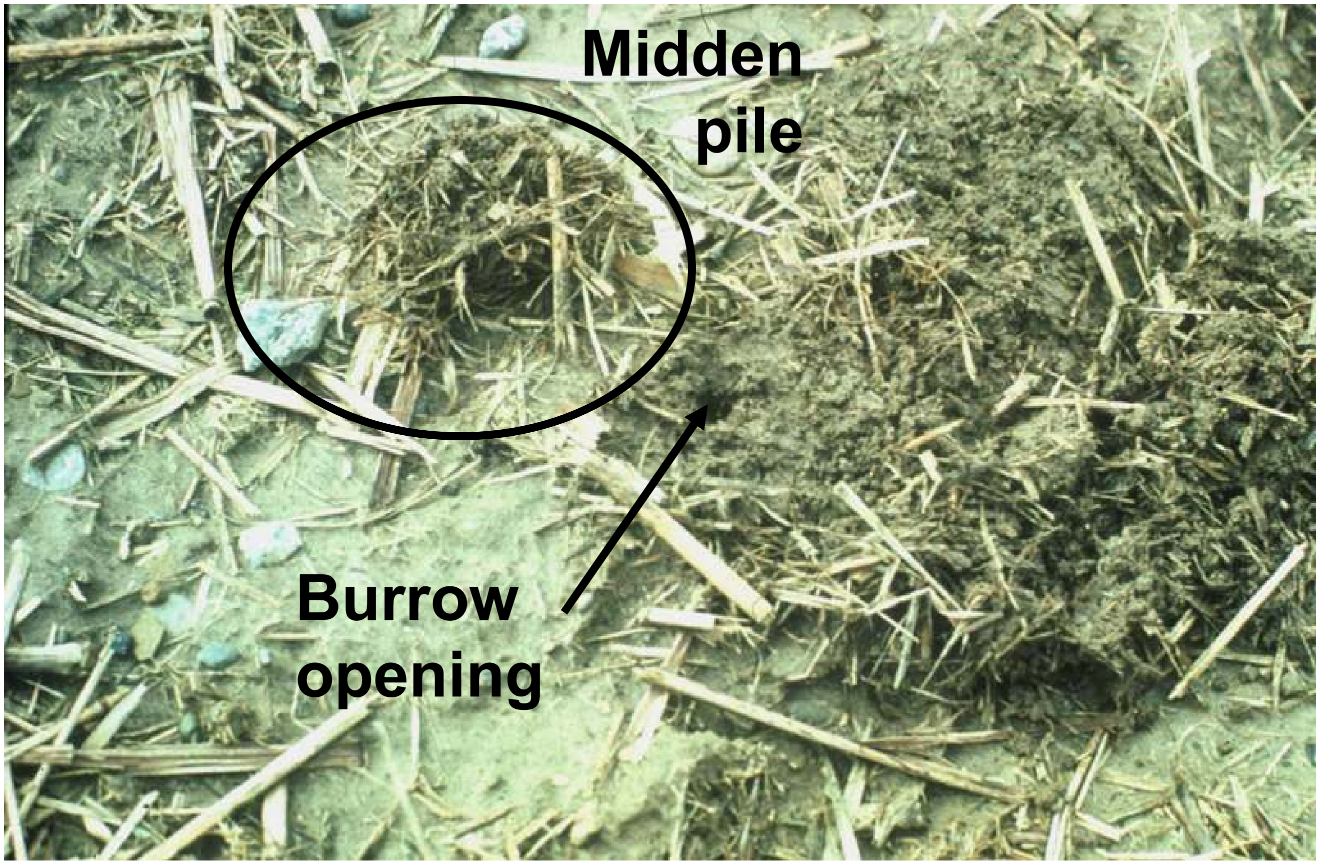
Earthworm Casts

- **Casts at the soil surface are evidence that earthworms are shredding, mixing, and burying surface residue.**

Earthworm Burrow Opening

- **This earthworm burrow is an opening in an otherwise crusted soil surface.**

Earthworm Burrow Opening



- A mound of organic matter was moved aside to expose the entrance to a burrow. *L. terrestris* will quickly replug its burrow if its mound is removed.

Earthworm Reproduction

- ***L. terrestris*** **mating, and earthworm cocoons. Earthworms mate periodically throughout the year, except when environmental conditions are unfavorable.** ***L. terrestris*** **cocoons are about a quarter inch long.**

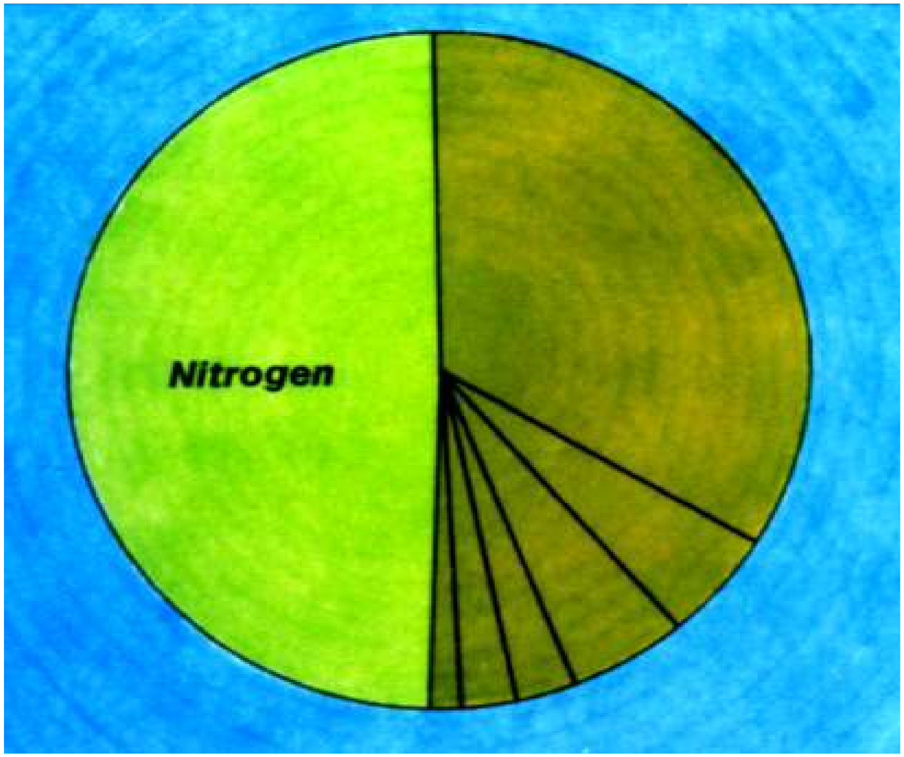
Night crawlers and tillage

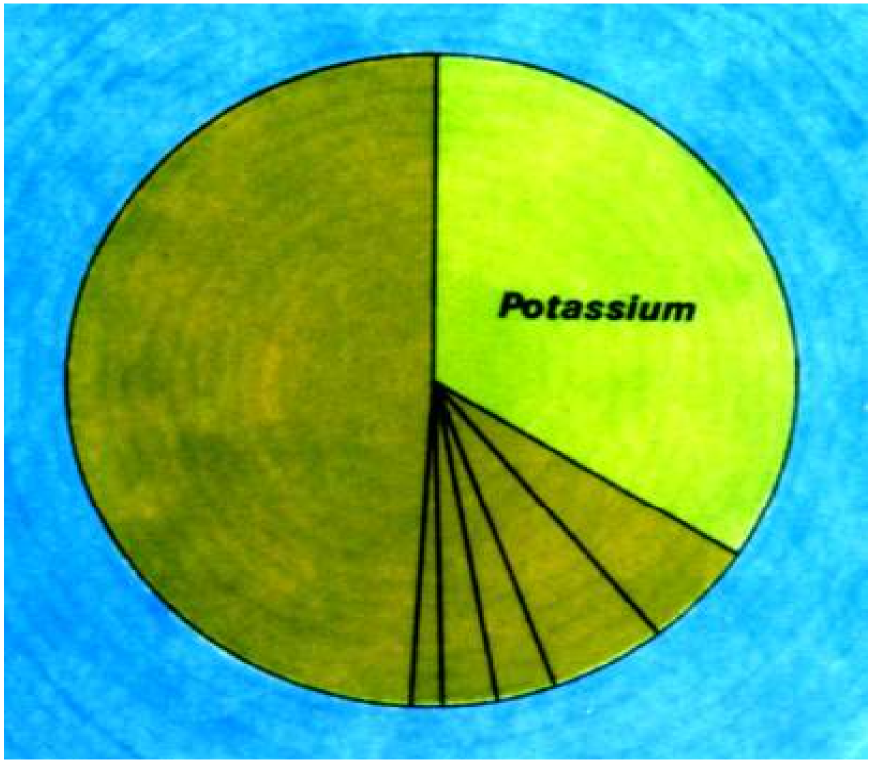
Without *Lumbricus terrestris* With *Lumbricus terrestris*

Earthworm Benefits

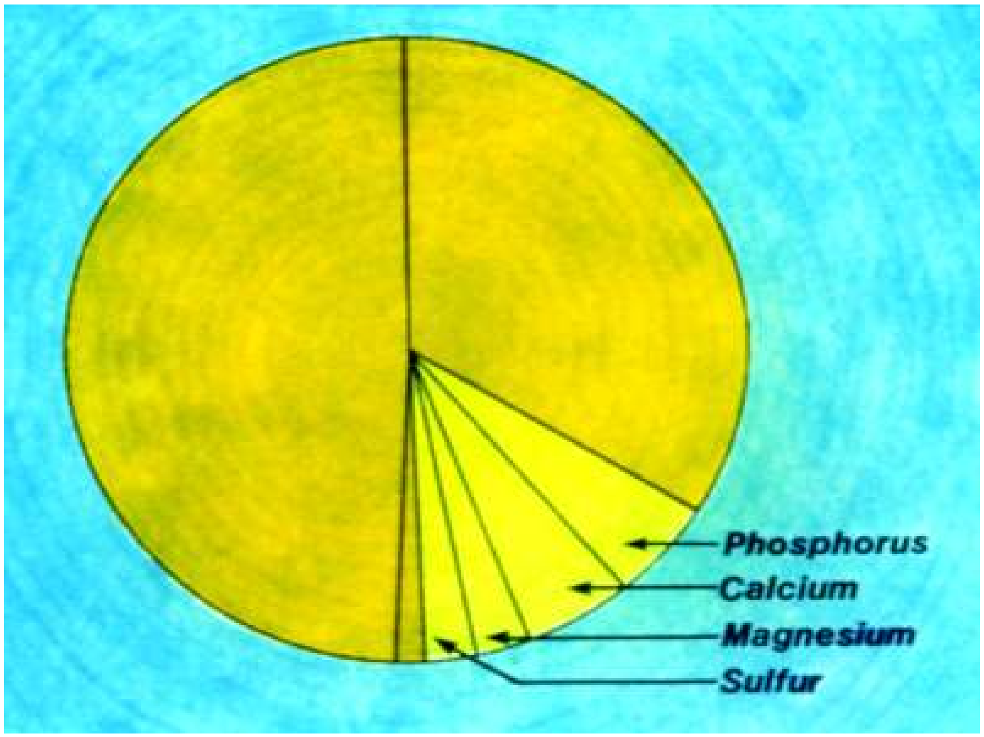
- **Stimulate microbial activity**
- **Mix and aggregate soil**
- **Increase infiltration**
- **Improve water-holding capacity**
- **Provide channels for root growth**
- **Bury and shred plant residue**

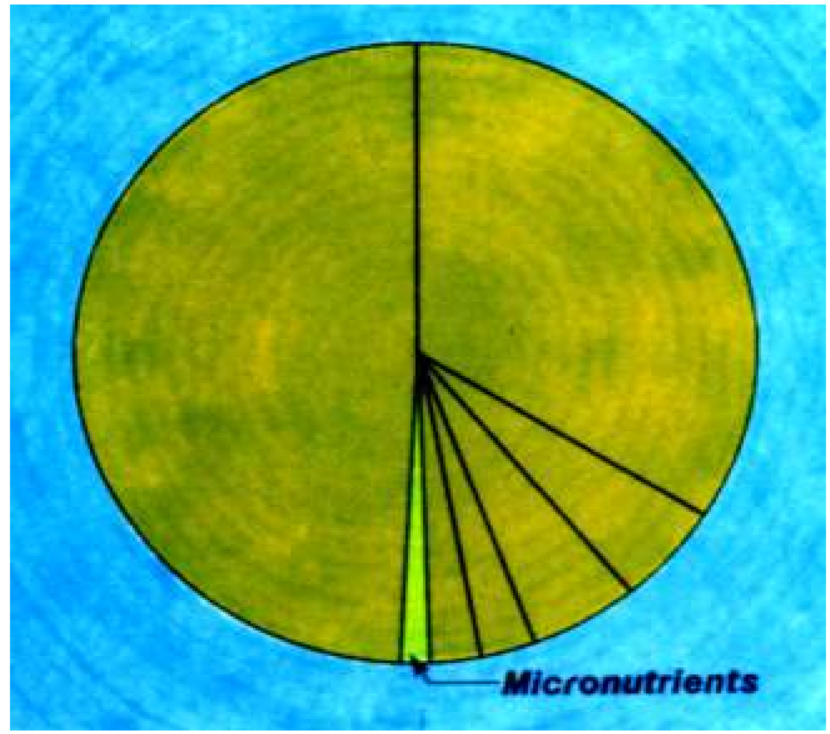
Nitrogen & Potassium Needs



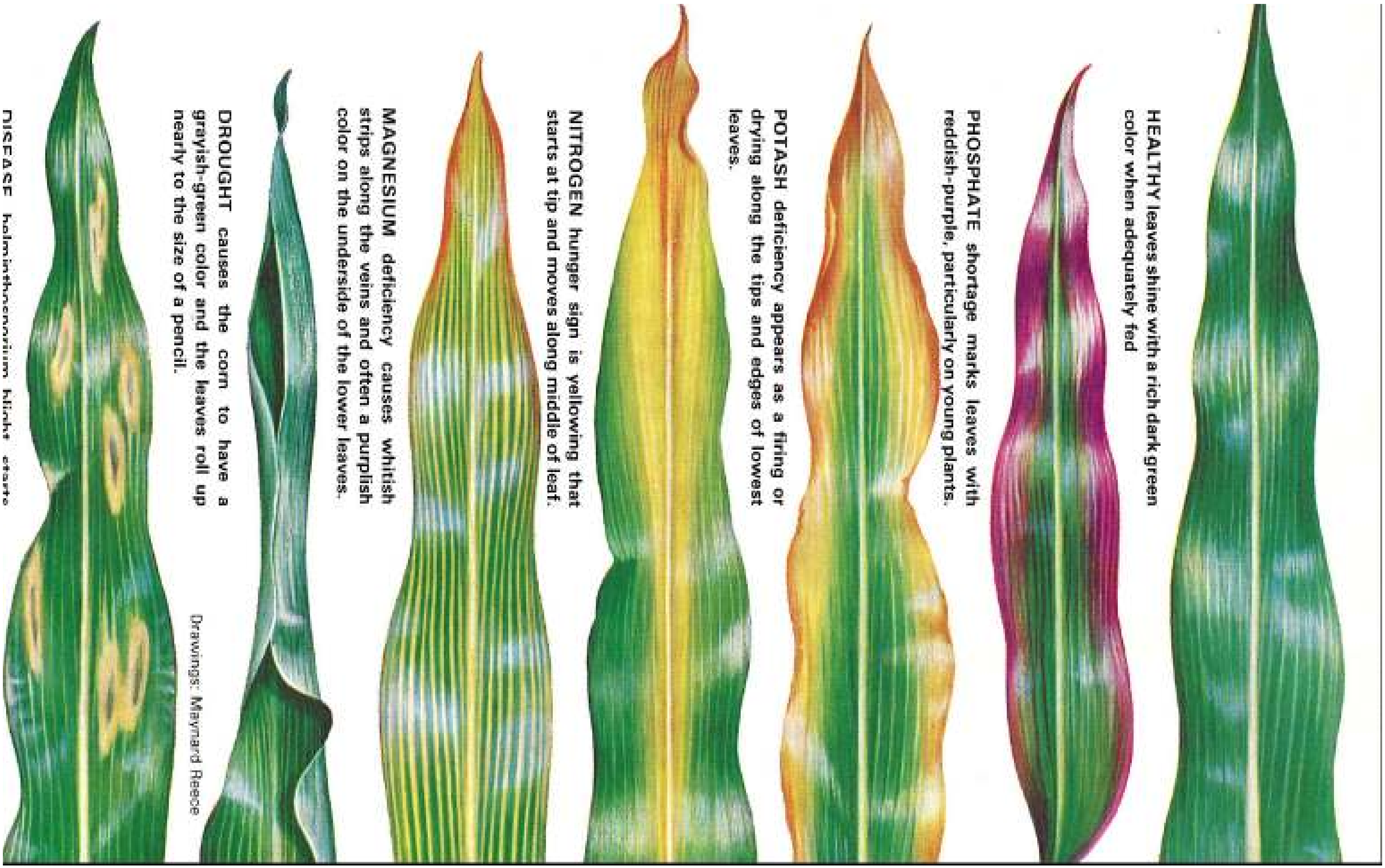


Other Nutrient Needs





Plant Nutrition Deficiencies



UF/IFAS Plant Nutritional Deficiencies Website

Nitrogen

Magnesium

- User-friendly "decision tree" database
- Ornamental plant examples primarily
- http://hort.ifas.ufl.edu/nutdef/

Nitrogen Deficiency Symptoms
Vegetable Crops Examples
(poor growth, yellow OLDER leaves)

Carrot: Growth dwarfed and thin; leaves pale green and older leaves yellow and red tints and die off early.

Celery Plant: Growth dwarfed; foliage pale green and older leaves yellow and die early.

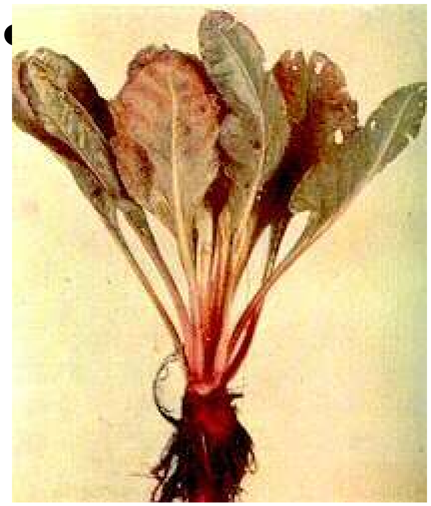
Tomato: Growth dwarfed, thin and upright habit; stem and petioles rigid; leaves pale green, occasional purplish tints, older leaves yellowing.

from
The Diagnosis of Mineral Deficiencies in Plants by Visual Symptoms
by Thomas Wallace, M.C., D.Sc., A.I.C.
Published by His Majesty's Stationary Office —
1943

Phosphorus Deficiency Symptoms

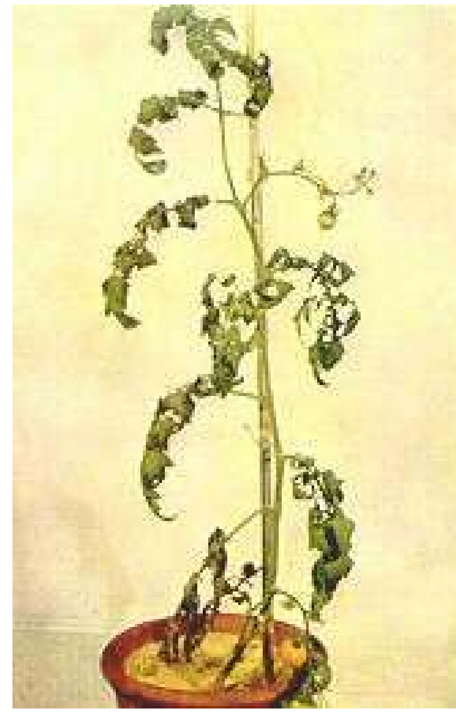
Vegetable Crops Examples

(poor root growth, purple color)



Growth stunted; leaves lustreless green and dull purple tints.

Leaves strong purple tints.

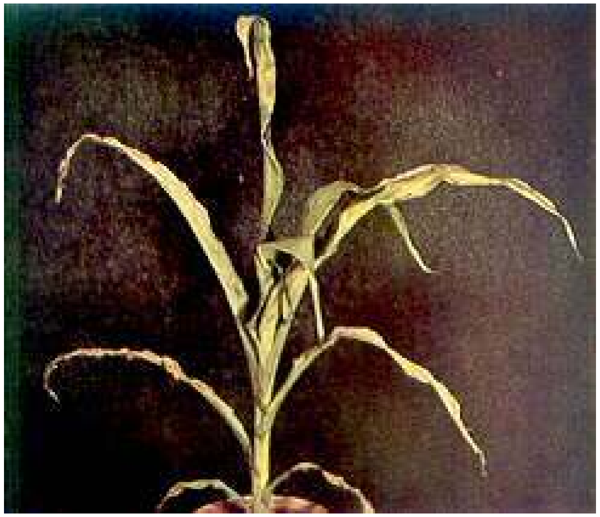


Growth dwarfed and thin; leaflets droop, curl backward and develop strong, dull purple tints.

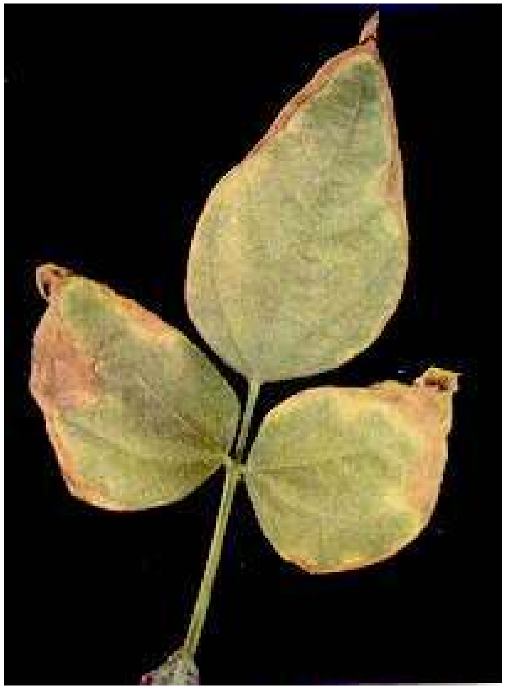
from
The Diagnosis of Mineral Deficiencies in Plants by Visual Symptoms
by Thomas Wallace, M.C., D.Sc., A.I.C.
Published by His Majesty's Stationary Office — 1943

Potassium Deficiency Symptoms
Vegetable Crop Examples
(burning at leaf edges, don't confuse with insect damage)

Leaflets slight marginal and intervenal chlorosis followed by brown marginal scorching; scorched margins curled foward.



Internodes short, leaves relatively long; marginal and tip browning of leaves.



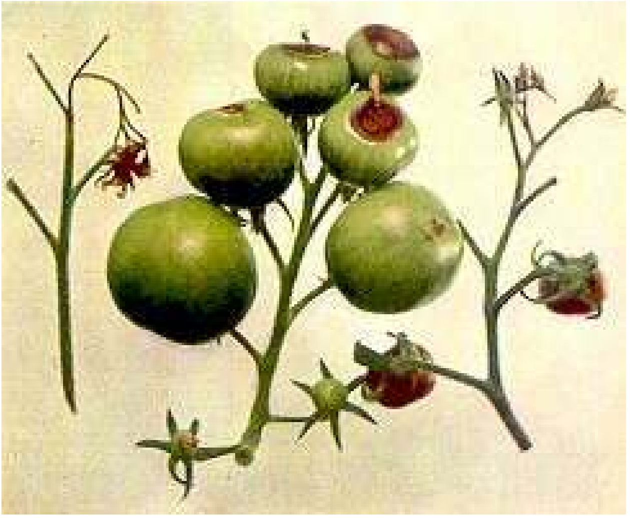
Intervenal chlorosis near margins followed by marginal scorch.

Calcium Deficiency Symptoms Vegetable Crop Examples

(youngest leaves show deficiency, opposite of N effect)

Dying off of terminal leaflets and flowers; leaves purplish brown tinting.

- Dying back of trusses and "Blossom End Wilt" of distal fruitlets



Dying off of terminal leaflets and flowers; leaves purplish brown tinting.

Plant Nutrition Deficiency Identification Caveats

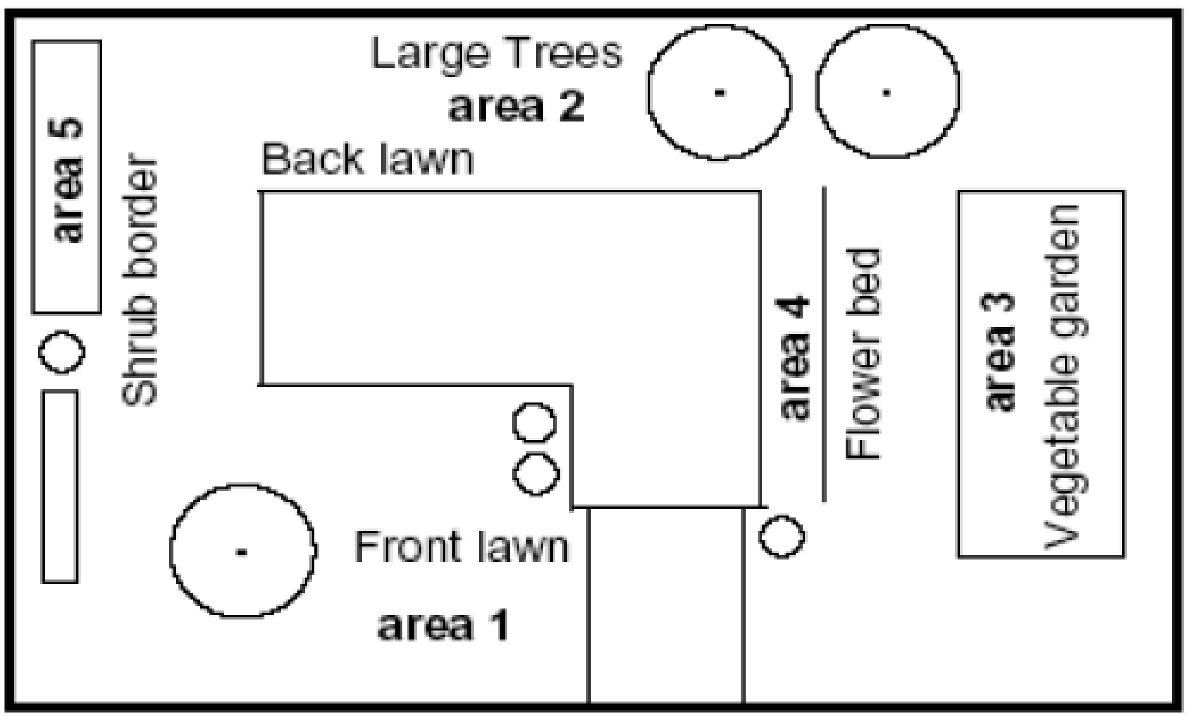
- **Changes can be normal part of a plant's cycle, e.g., iris foliage dieback or fall leaf colors**
- **Often related to other problems**
  - **Pesticides**
  - **Disease**
  - **Insects**
  - **Soil factors**
  - **Environment (rainfall, wind, cold, etc)**
- **In order to treat the problem, first necessary to diagnosis it correctly**

Soil Testing

- **Program that includes:**
  - **nutrient analyses and interpretation**
  - **fertilizer & amendment recommendations**
  - **other considerations**
    - **salinity**
    - **elemental toxicity**
- **Soil Testing Labs**
  - **UF/IFAS Soil Lab (http://soilslab.ifas.ufl.edu/)**
  - **Alternative Soils Labs (http://attra.ncat.org/attra-pub/soil-lab.html**

Soil Sampling

- **Representative sample = goal**
- **Sample separately distinct areas**



Soil Sampling

How to Sample Your Lawn or Garden

Obtain a small amount of soil from 10-15 different spots over the area you wish to test (a minimum of one-half pint). When you sample a lawn, take the soil from the upper 2-4 inches. When sampling a vegetable garden or landscape plants, take soil from the upper six inches. If soil is wet, spread soil on clean paper or other suitable material to air dry.

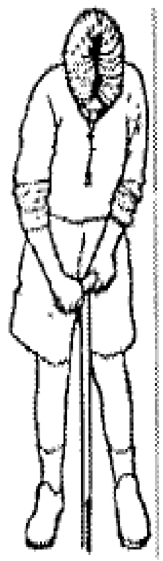


Figure 1a. Use a soil probe to speed soil sampling, or...

Figure 1b. Use a hand trowel, shovel or other garden tool. Trim out soil of uniform thickness to the recommended depth.

Figure 2. Place 10 to 15 soil cores into a plastic bucket; mix, dry, and transfer to a bag.

Soluble Salt Levels

- **Soil soluble salt levels are generally classified as damaging in the following ways:**
  - **<700 ppm = normal levels, no damage**
  - **700-1400 ppm = slightly damaging levels for sensitive plants.**
  - **1400-2100 ppm = damaging levels, higher than acceptable for most plants.**
  - **>2100 ppm = very damaging levels, tolerable only by the most salt-tolerant plants**
- **As reference:**
  - **Fresh water (<700 ppm)**
  - **Gulf waters (28,000-35,000 ppm)**
  - **“softened” water (700-2100 ppm)**

UNIVERSITY OF FLORIDA
IFAS EXTENSION

Extension Soil Testing Laboratory

PO Box 110740 / Wallace Building 631, UF / Gainesville, FL 32611-0740
SOILSLAB@IFAS.UFL.EDU

Landscape & Vegetable Garden Test Information Sheet

Mailing Address (please print)

Note: This Lab Only Tests Samples from the State of Florida.

Name ____________________ Phone __________

Address ______________________________

City ____________________ FL Zip __________

Date __________ E-Mail ____________________

Direct any questions regarding this test or the interpretation of the results to your county Extension Agent.

NOTE:
* Consult an expert to determine if plant growth problems require soil testing.
* These samples will NOT be tested for nematodes, disease organisms or chemicals other than those listed on this form.
* Commercial producers should use the Producers Soil Test Information Sheet, SL-135.

Step 1. Collect samples from your landscape or garden. See the instructions at the bottom of this page.

Step 2. Select EITHER Test **A** or **B**, **but not both**, for any sample.

Test A. The pH and Lime Requirement Test will give you the following information.

- Soil pH
- Lime Requirement

Test A is especially for you if you:
1) use only complete fertilizers (such as 16-4-8),
2) follow the generic fertilizer recommendations in IFAS landscape and vegetable garden publications, or
3) need only the soil pH test.

Test B. The Soil Fertility Test will give you these 6 analyses

- Soil pH
- Lime Requirement
- P
- K
- Ca
- Mg

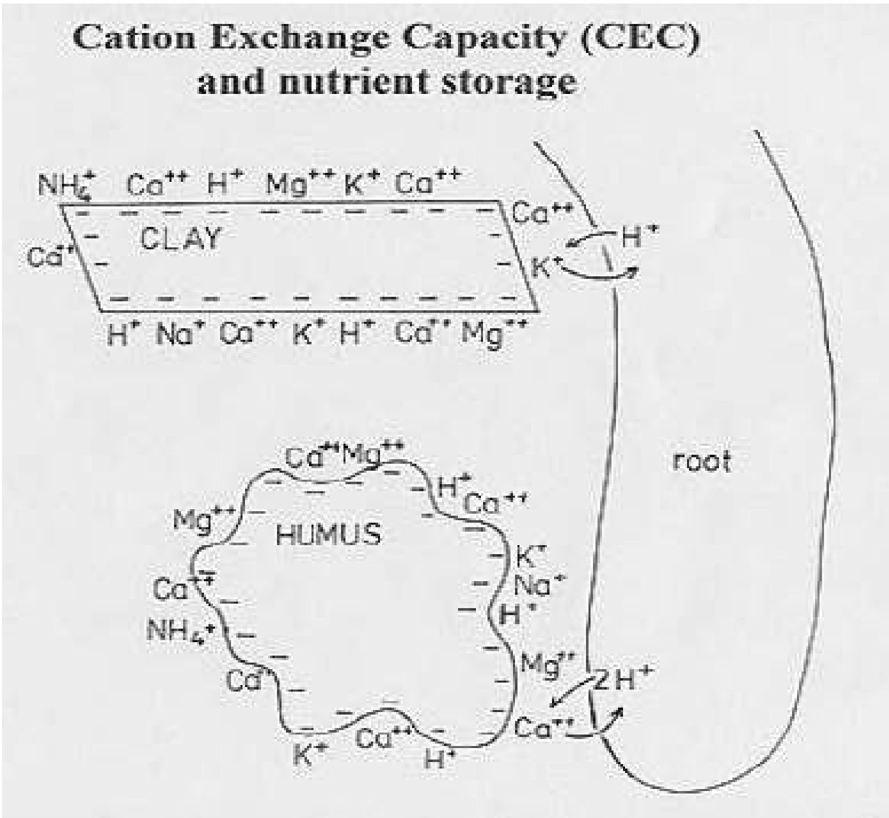
Test B will enable you to tailor your use of single-element fertilizers based on existing soil fertility status. However, if you use a complete fertilizer, such as 10-10-10, the extra tests for extractable P, K, Mg, and Ca are of little value.

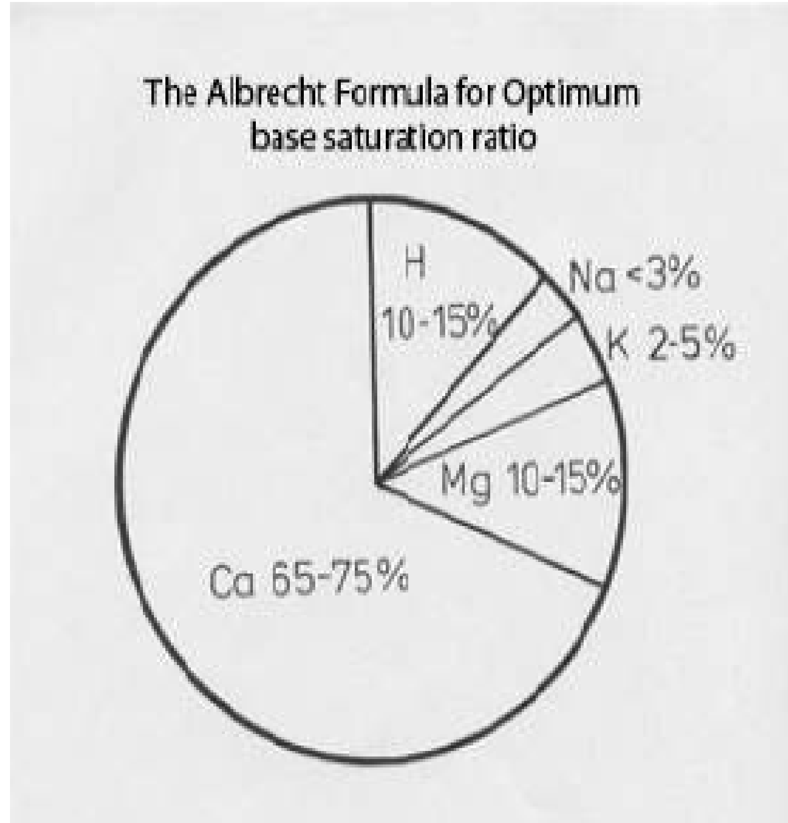
Fill in all requested information, using one line per sample and additional sheets for more than 5 samples.

Remember: Choose only one test for each sample.

Lab Use Only	Sample ID	County	Crop Code(s) See Page 2 (or back).	Acreage or Square Feet (optional)	Cost of Test A (Circle appropriate amount.)	Cost of Test B
					$3.00	$7.00
					$3.00	$7.00
					$3.00	$7.00
					$3.00	$7.00
					$3.00	$7.00

Alternative Soil Test Example





- Soils, crops and livestock require balanced nutrition for health, just as people need a balanced diet to stay healthy. Organic farmers strive to provide a 'balanced diet" for their farms by adding a variety of organic materials and natural mineral amendments to the soil.

M. Schonebeck, Soil Cation Nutrient Balancing in Sustainable Agriculture
http://www.vabf.org/infosht.php

REPORT NUMBER
07-284-0270
REPORT DATE
Oct 16, 2007
RECEIVED DATE
Oct 11, 2007

IDENTIFICATION
TOP GROWER
HOME FARM
ANYWHERE IL

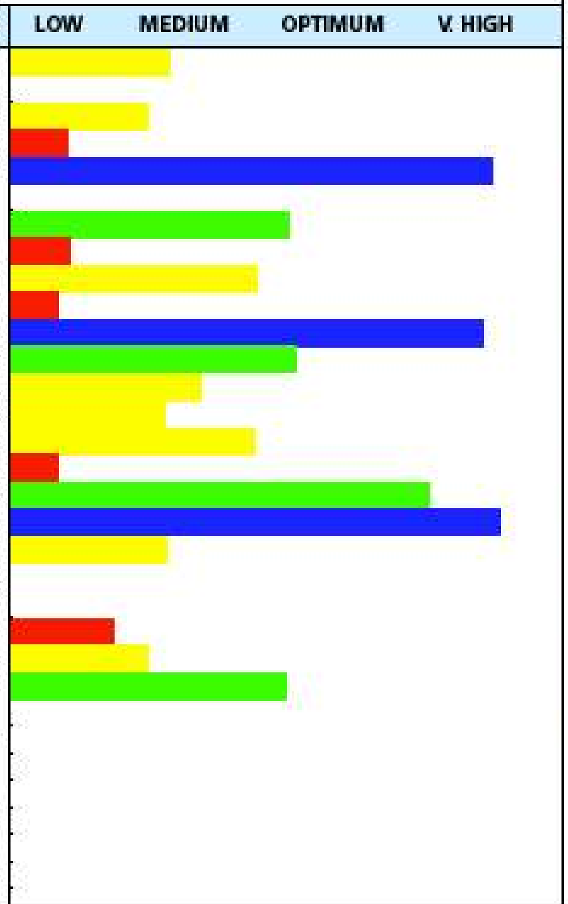
AgriEnergy Resources

21417 1950 E. Street Princeton, IL 61356
Phone: (815) 872-1190 Fax: (815) 872-1928
www.agrienergy.net

ANALYTICAL LABORATORY FINDINGS

SAMPLE IDENTIFICATION: 1
LABORATORY NUMBER: 7828986

ANALYTE	UNITS	RESULTS
Organic Matter	%	2.9
Nitrate-N	lbs/A	18
P_1 Phosphorus	lbs/A	18
Water Sol P	lbs/A	4
P_2 Phosphorus	lbs/A	122
Bicarb-P	lbs/A	
Potassium	lbs/A	351
Water Sol K	lbs/A	61
Calcium	lbs/A	4448
Water Sol Ca	lbs/A	178
Magnesium	lbs/A	1132
Water Sol Mg	lbs/A	83
Sulfur	lbs/A	18
Water Sol S	lbs/A	14
Zinc	ppm	1.0
Manganese	ppm	2
Iron	ppm	35
Copper	ppm	2.3
Boron	ppm	0.8
Sodium	lbs/A	34
Water Sol Na	lbs/A	27
Soluble Salts	mmhos/cm	0.3
Excess Lime Rt		L
pH		6.9
Buffer Index		
C.E.C.	meq/100g	18.2
Base Saturation	Desired	
Percent K	2-5%	2.7
Percent Mg	12-18%	28.8
Percent Ca	65-75%	68.0
Percent H	0-12%	0.0
Percent Na	< 1.5%	0.5



APPLICATION GUIDELINES

INTENDED CROP	YIELD GOAL	PREVIOUS CROP

SUGGESTED FERTILITY GUIDELINES (lbs/Acre)

FERTILITY ELEMENT	AgriEnergy SUGGESTS	
NITROGEN (N)		
PHOSPHATE (P_2O_5)		
POTASH (K_2O)		
MAGNESIUM (Mg)		
SULFUR (S)		
ZINC (Zn)		
MANGANESE (Mn)		
IRON (Fe)		
COPPER (Cu)		
BORON (B)		

SUGGESTED AMENDMENT GUIDELINES

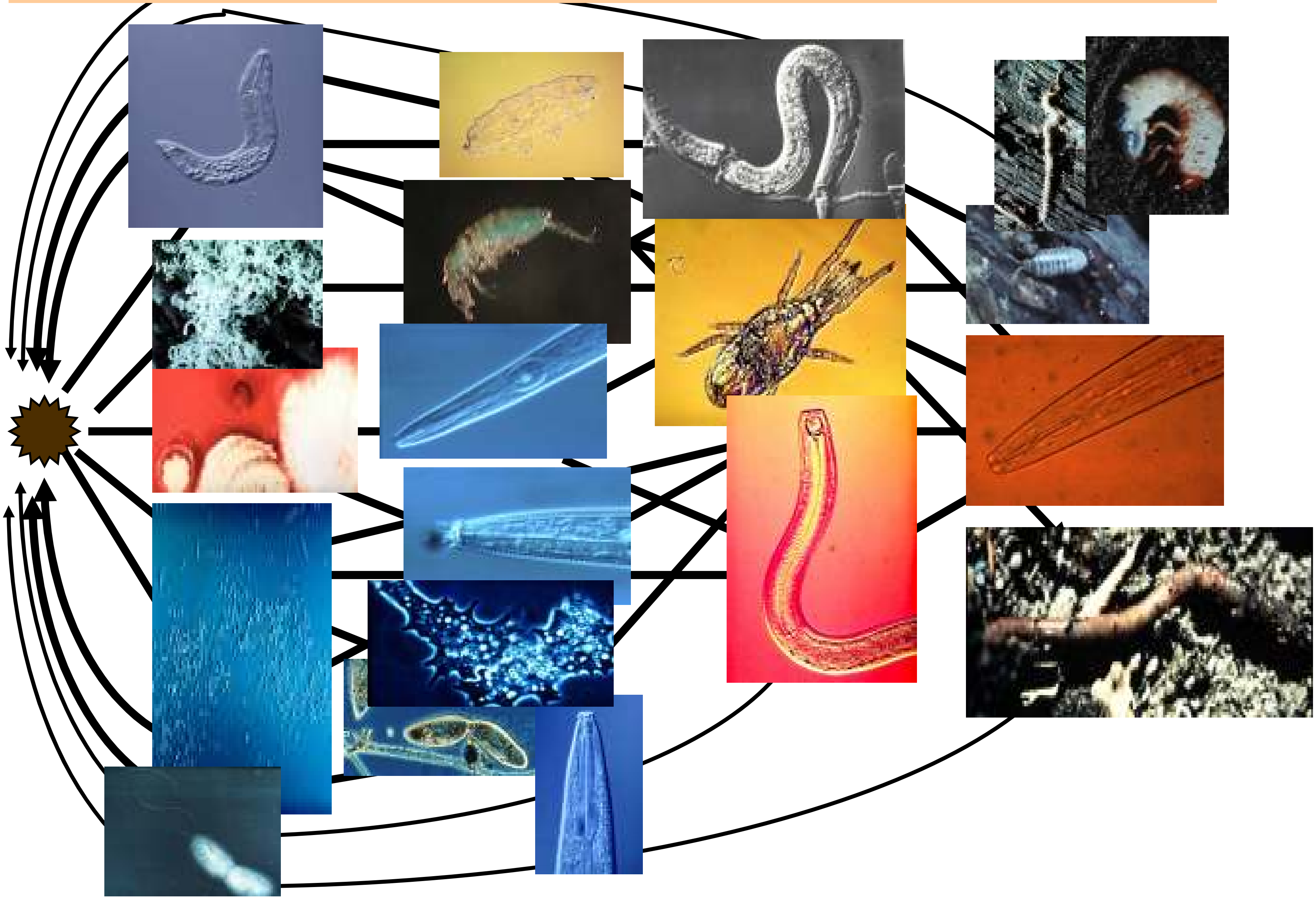
AMENDMENT	AgriEnergy SUGGESTS
LIME POUNDS	
LIME TON	
ELEMENTAL SULFUR	
GYPSUM TONS	

COMMENTS

Surface Nitrate Depth: 0-6

The above analytical results apply only to the sample(s) submitted.
Samples are retained a maximum of 30 days.
Analytical work performed by Midwest Laboratories, Inc

Soil Test Food Web Bioindicators



Biondicator Soil Test Example

“The **Solvita® soil-life test kit** provides an important new tool for gardeners, farmers and scientists to evaluate soil microbial respiration rate in an efficient and cost-effective manner. Soil respiration is an important aspect of soil quality and a good indicator of soil fertility.”

“The Solvita test enables you to:
•estimate annual nitrogen release based on soil biological activity
•evaluate organic matter sufficiency of soils
•make overall judgements to fit into "soil quality" interpretation
•achieve accuracy comparable to and less expensive than Dräger tubes”

Soil Respiration Rate –the reality

- More CO2 (carbon dioxide) coming off the soil means the soil is respiring (breathing) more. This indicates either a high rate of respiration of existing organisms, or high numbers, or both.
- Having more organisms is a <u>good</u> thing, but a high respiration rate also means your soil system is burning off carbon…which lowers your organic matter levels, which is a <u>bad</u> thing.
- High respiration rate is a result of optimal temperatures, moisture, and aeration, sometimes as a result of tillage.

Soil Bioindicator Test Example

Soil
Foodweb Analysis

Report prepared for:

-
David Drell
6150 Hearst Rd
Willits, CA 95490-9211 USA
(707) 459-4110
wece@sbcglobal.net

Report Sent: 12/02/2005
Sample#: 01-101703
Unique ID: 05 Brookside schoolyard
Plant: variety
Invoice Number: 0
Sample Received: 11/23/2005

For interpretation of this report please contact:
Local Advisor: or regional lab
Soil Foodweb, Inc
info@soilfoodweb.com
(541) 752-5066
Consulting fees may apply

Organism Biomass Data		Dry Weight	Active Bacterial (µg/g)	Total Bacterial (µg/g)	Active Fungal (µg/g)	Total Fungal (µg/g)	Hyphal Diameter (µm)
Results		0.820	65.7	674	64.1	378	3
Comments		In Good Range	Excellent	Excellent	Excellent	Excellent	
Expected Range	Low	0.45	1	175	1	175	
	High	0.85	5	300	5	300	

		Protozoa Numbers/g			Total Nematodes #/g	Percent Mycorrhizal Colonization	
		Flagellates	Amoebae	Ciliates		ENDO	ECTO
Results		5610	**1688**	70	**7.38**	**5%**	**0%**
Comments		High	Low	Good	Low	Low	Low
Expected Range	Low	5000	5000	50	10	40%	40%
	High			100	20	80%	80%

Organism Biomass Ratios		Total Fungal to Total Bacterial	Active to Total Fungal	Active to Total Bacterial	Active Fungal to Active Bacterial	Plant Available N Supply
Results		**0.56**	0.17	**0.10**	0.98	50-75
Comments		Low	Good	Low	Good	
Expected Range	Low	0.8	0.15	0.15	0.75	
	High	1.5	0.2	0.2	1.5	

Nematodes per Gram of Soil
Identification to genus

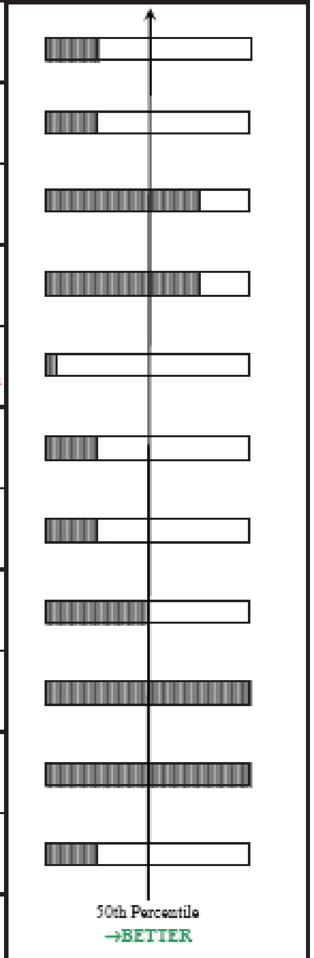
Bacterial Feeders		
Cephalobus		0.34
Fungal Feeders		
Chrysonemoides		0.17
Epidorylaimus		0.17
Fungal/Root Feeders		
Aphelenchoides	Foliar nematode	0.17
Aphelenchus		0.67
Ditylenchus	Stem & Bulb nematode	4.04
Filenchus		0.17
Root Feeders		
Pratylenchus	Lesion nematode	0.34

Soil Bioindicator Test Example

CORNELL SOIL HEALTH TEST REPORT

FARM NAME/FARMER: GATES FARM	SAMPLE ID: D901	DATE:
ADDRESS:	E-MAIL:	PHONE:
FIELD/TREAMENT: PLOW TILL NO COVER CROP	AGENT:	SLOPE:
TILLAGE: / /	DRAINAGE:	SOIL SERIES:
CROPS: / /	SOIL TEXTURE: SILTY	

	INDICATORS	VALUE	RATING	CONSTRAINT	PERCENTILE RATING*
PHYSICAL	Aggregate Stability (%)	17.0	1.0	aeration, infiltration, rooting	
PHYSICAL	Available Water Capacity (m/m)	0.18	2.0	water retention	
PHYSICAL	Surface Hardness (psi)	147	7.0		
PHYSICAL	Subsurface Hardness (psi)	266	6.0		
BIOLOGICAL	Organic Matter (%)	2.4	1.0	energy storage, C sequestration, water retention	
BIOLOGICAL	Active Carbon (ppm)	557	2.0	soil biological activity	
BIOLOGICAL	Potentially Mineralizable Nitrogen (µgN/ gdwsoil/week)	4.0	1.0	N supply capacity, N leaching potential	
BIOLOGICAL	Root Health Rating (1-9)	5.5625	5.0		
CHEMICAL	pH (see CNAL Report)	7.2	10.0		
CHEMICAL	Extractable Phosphorus (see CNAL Report)	9.85	10.0		
CHEMICAL	Extractable Potassium (see CNAL Report)	52.375	7.5		
CHEMICAL	Minor Elements (see CNAL Report)		10.0		
	OVERALL QUALITY SCORE (OUT OF 100)		LOW		52.1

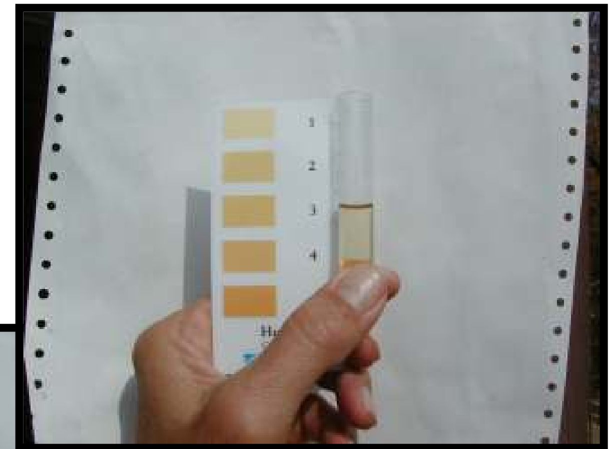


Ratings on this report are based on generalized crop production standards for New York. For crop specific nutrient

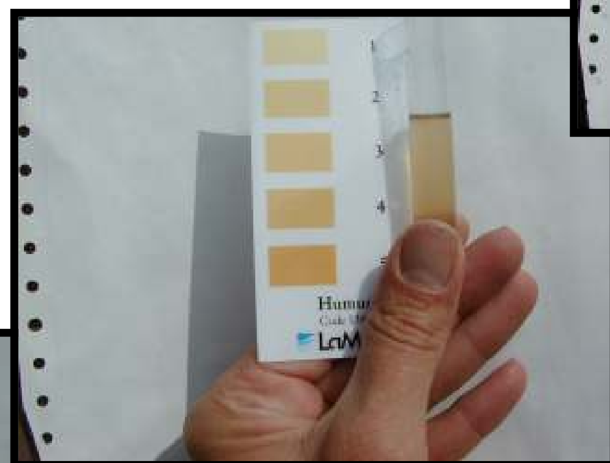
Soil Bioindicator Test Example

Humus Testing

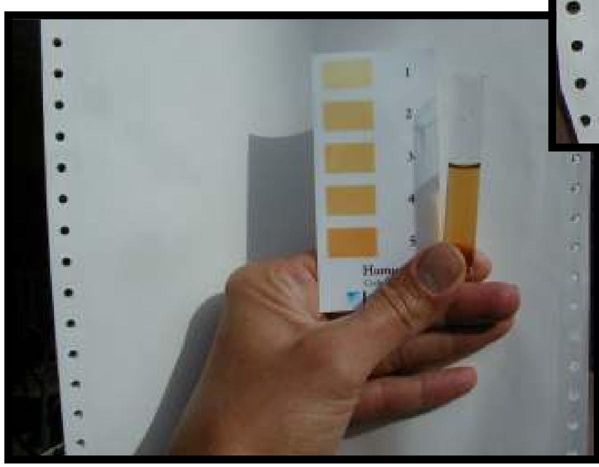
[using LaMotte humus index test.]



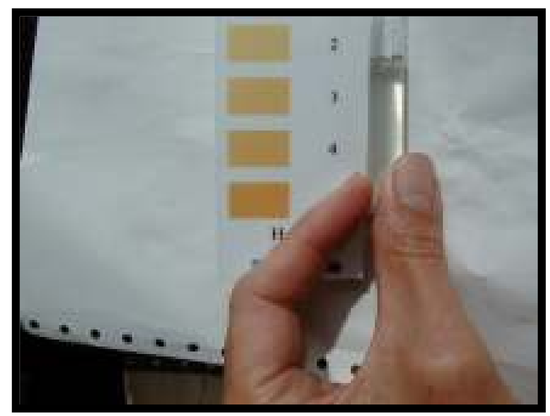
Newer garden soil with mulch = 1.0



Improved garden soil = 3.0



Fresh worm compost = 5



Near-by ag field (with subsoil) = 0

Summary of Tests for Soil Quality

- **Physical**
  - **Texture**
  - **Macro-organic matter**
  - **Water stable aggregates**
  - **Infiltration rate (lab & field)**
  - **Bulk density**
  - **Water holding capacity**

Summary of Tests for Soil Quality:

- **Chemical**
  - **pH**
  - **Nitrogen (NO_3 and NH_4)**
  - **Phosphorus**
  - **Potassium**
  - **Organic Matter (lab)**
  - **Humus (quick test)**
  - **Total N & P in OM (lab)**

Summary of Tests for Soil Quality

- **Biological**
  - **Earthworms**
  - **Soil insects and other arthropods**
  - **Coliform bacteria & E. coli**
  - **Respiration rate**
  - **Simple “will it rot” test with filter paper or other materials.**

Summary

- **Organic vegetable gardening depends on a functional soil ecosystem**
- **Practices are designed to enhance soil quality and life**
- **Feed the soil so that the soil can feed the plant**

Acknowledgements

- Janke, R., Sustainable Cropping Systems, KSU
  - Soil quality

    www.oznet.ksu.edu/rff/**Soil**%20Quality%20NEW.**ppt**
  - Soil tests interpretations

    www.oznet.ksu.edu/rff/**Soil**%20**Test**%20**Interpretation**.**ppt**
- USDA NRCS Soil Quality Publications

  http://soils.usda.gov/sqi/publications/publications.html