



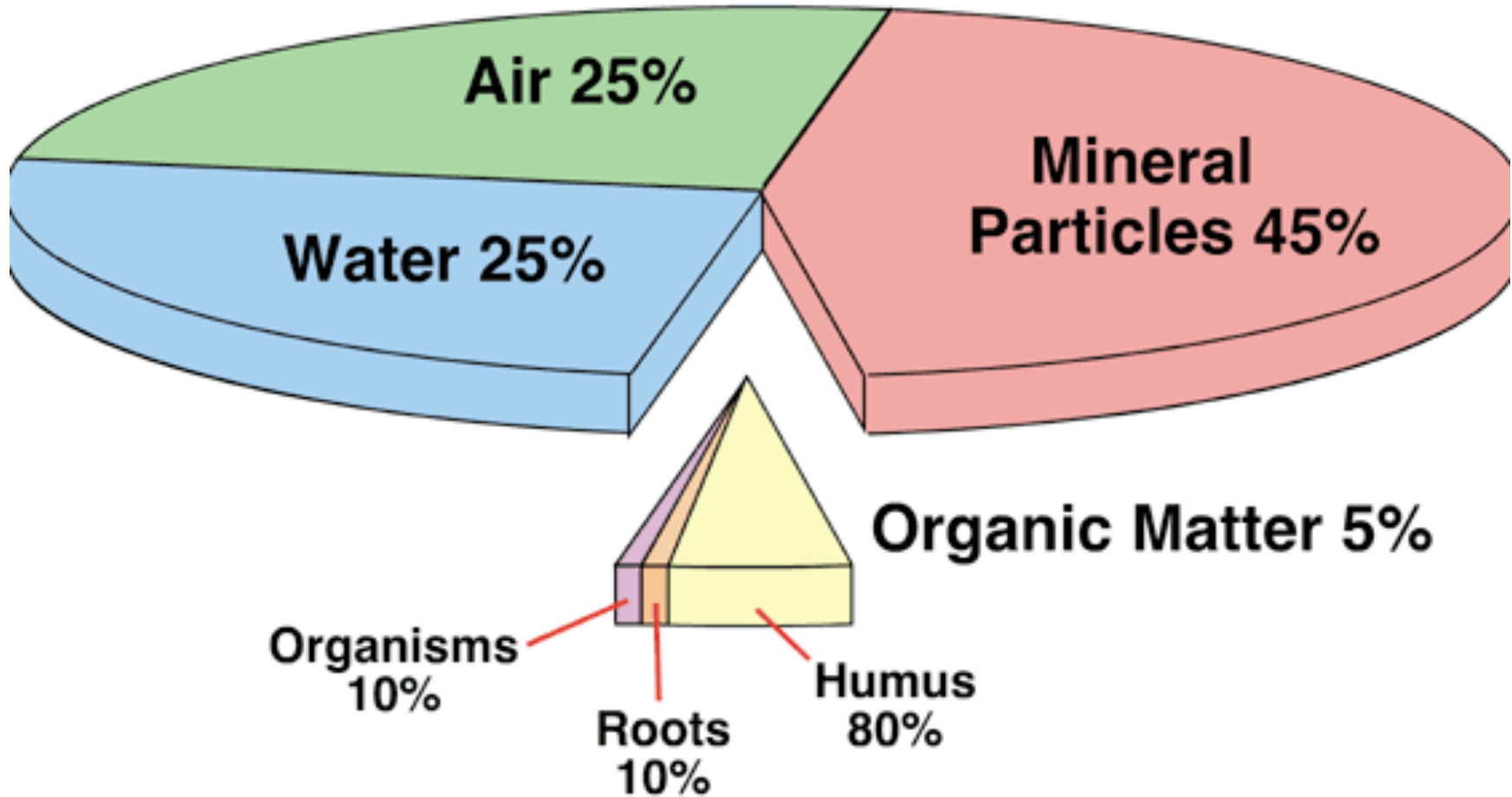
Building Soil Health

**Weston Miller,
OSU Extension Service**

Preview of presentation

- **Soil building with organic matter**
 - **Compost**
 - **Cover crops**
- **Nitrogen management**
- **Soil preparation techniques**

Components of Soil Mixture



Tilth

- the state of aggregation of a soil especially in relation to its suitability for crop growth
 - <http://www.m-w.com/dictionary>
- **Our job as gardeners/farmers:**
 - **Maintain and enhance tilth in soil through addition of composted organic material (balanced) and regimented care**

Soil Structure

- **Micropores / Macropores**
- **Individual particles together = peds**
- **Aggregation- bio activity = binding agent**
- **Compaction-**
 - **Many ways to destroy soil structure**

Soil Structure is Improved by Soil Life

- **Aggregation from biological activity influences:**
 - **Soil porosity (spaces) & permeability (water entry)**
 - **Water movement & holding capacity**
 - **Improves root growth**
 - **Improves environment for beneficial organisms**
- **Role of organic matter**

Soil Aggregates



Organic Matter



“The best single overall strategy for nutrient management... is to enhance organic matter levels in soils” (BSBC)

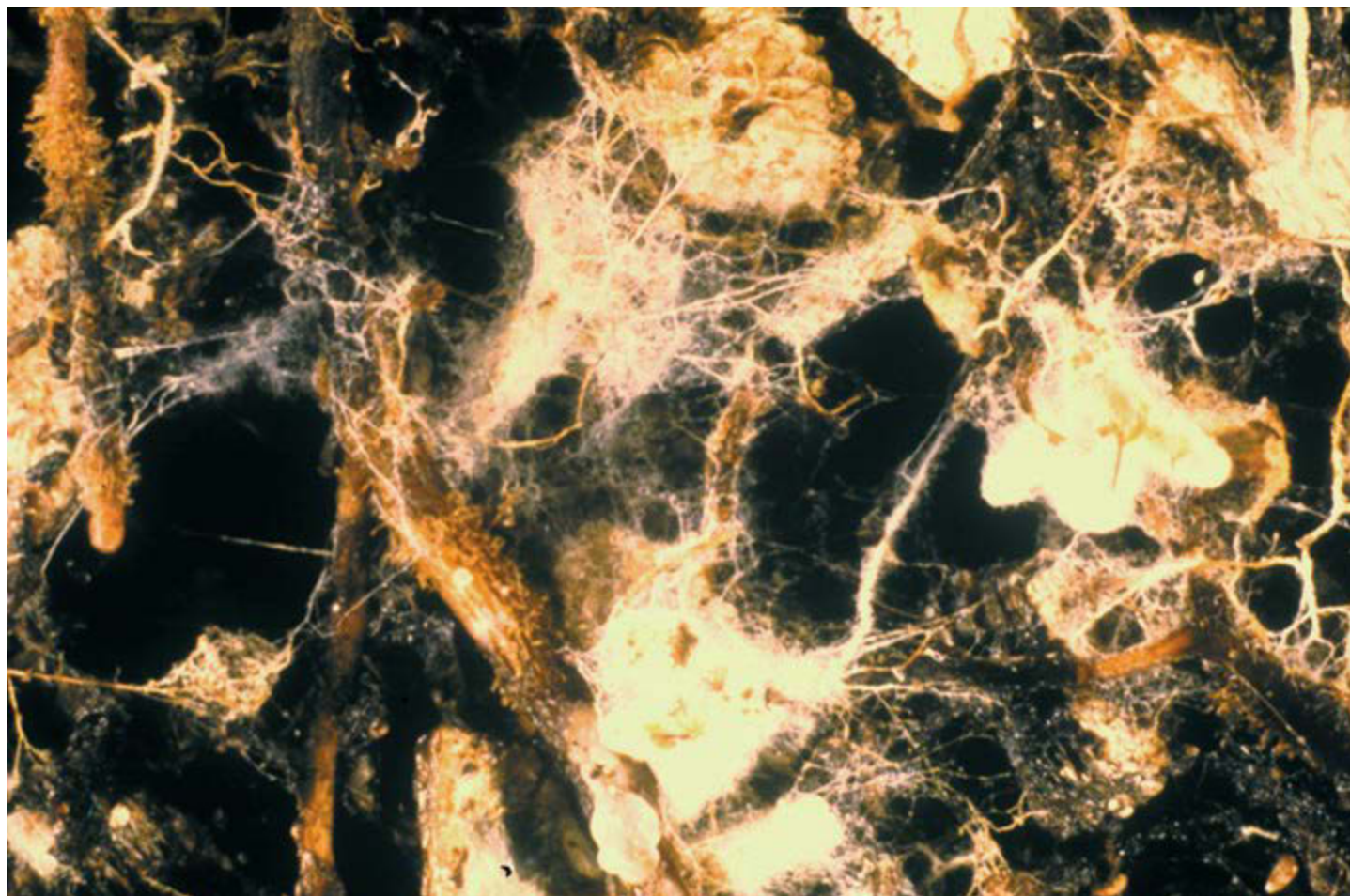
- **increases CEC (holds onto cations)**
- **mineralizes N, P, S and B**
- **chelates micronutrients (Zn, Cu, Mn, etc.)
keeping them plant available.**



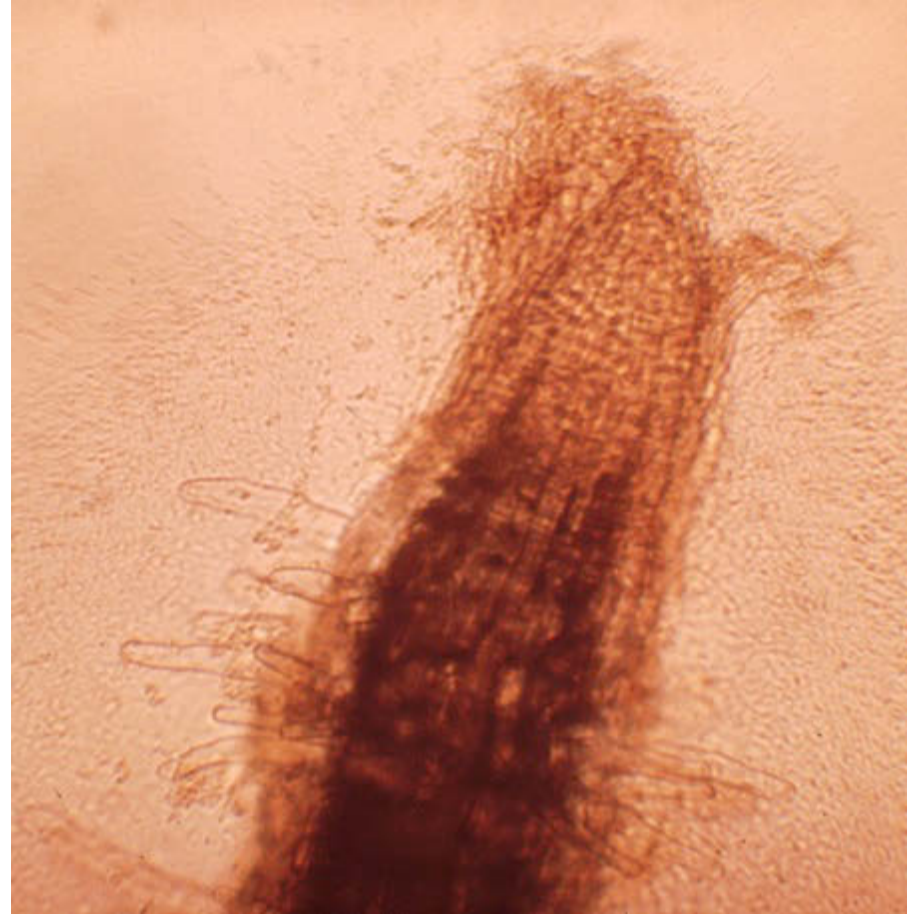
Soil Building

- **Goal is to provide food for soil biology**
- **Soil biology:**
 - **creates favorable structure**
 - **makes nutrients available to plants**
 - **Mineral from parent soil**
 - **Organic matter / amendments**

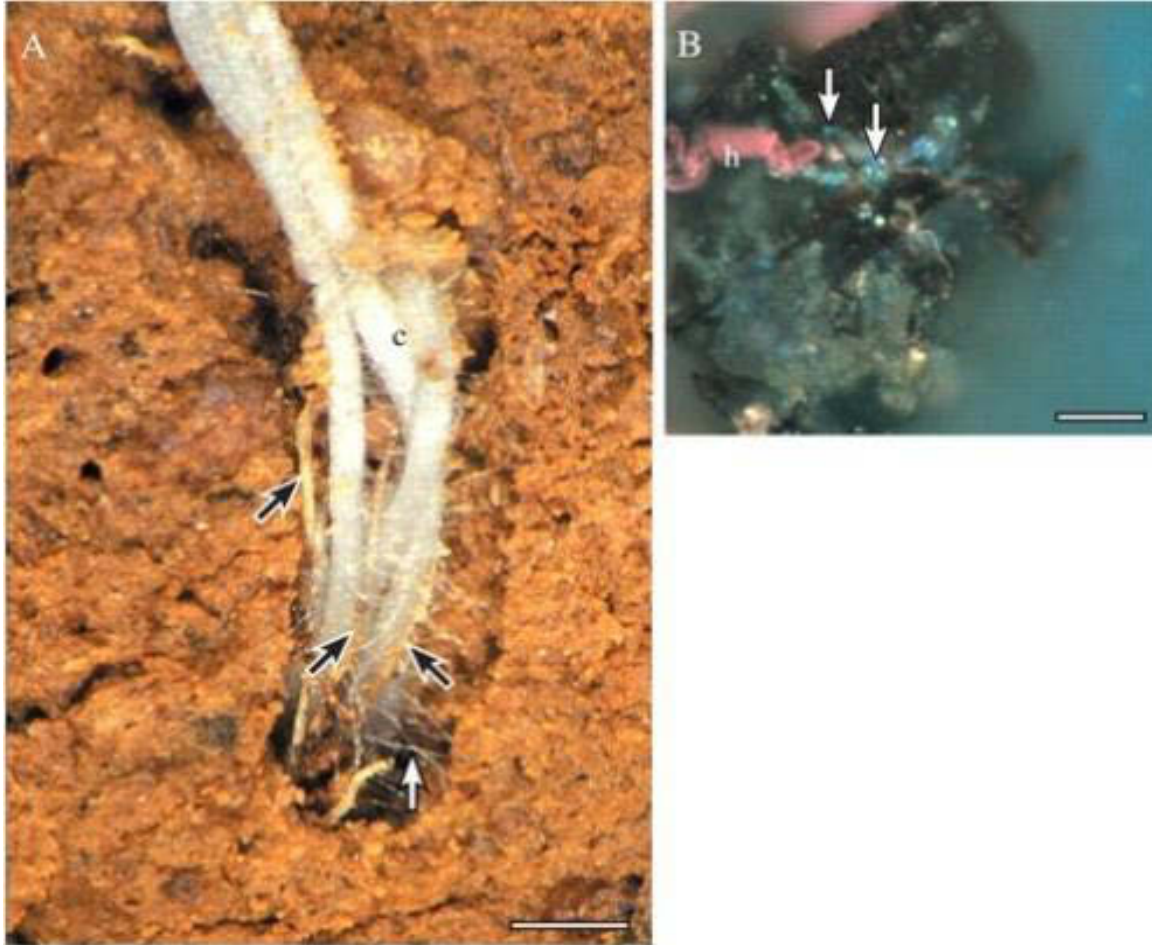
Soil Fungi



Soil Bacteria



Organic matter, microbes, roots coexist in soil in close proximity



“Feed plants by feeding the plants”



“Feed plants by feeding the soil”

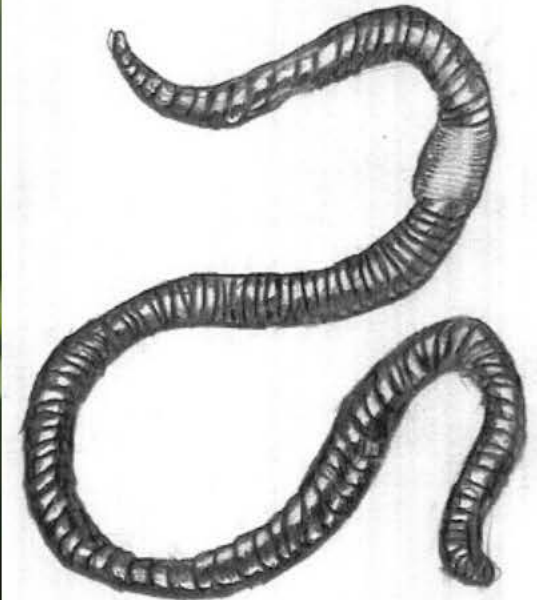
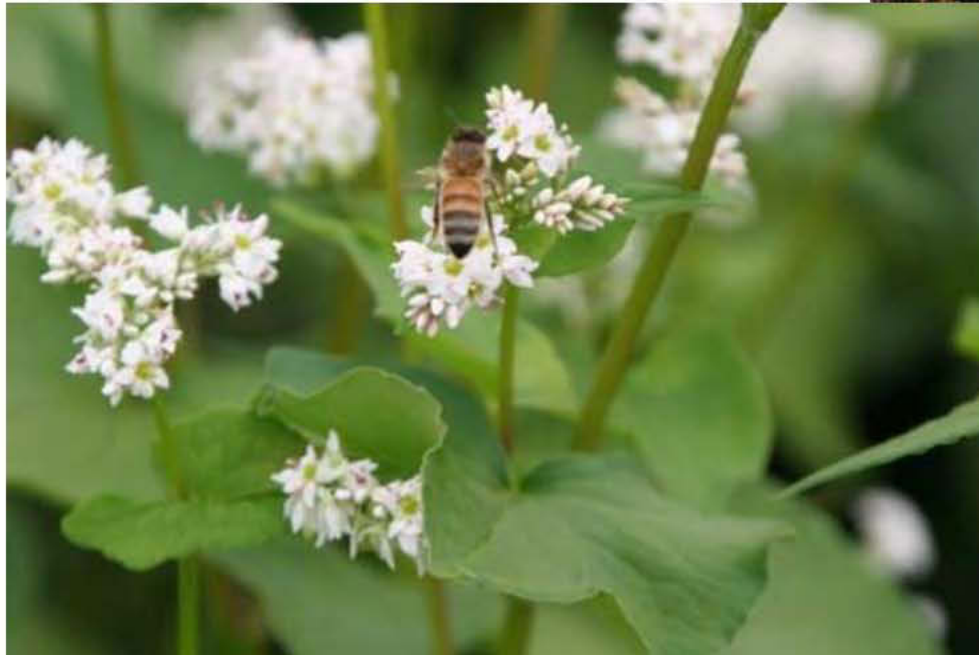


Types of Soil Organic Matter

Pool	Size/Age (years)	Functions
Biologically Active	Small 1-5	Meat: nutrient mineralization, macro-aggregation, disease suppression
Protected	Intermediate 5-30	Bones: soil structure, porosity, water relations
Stable	Large 50-10,000	Micro-aggregation, CEC, fate of compounds, color

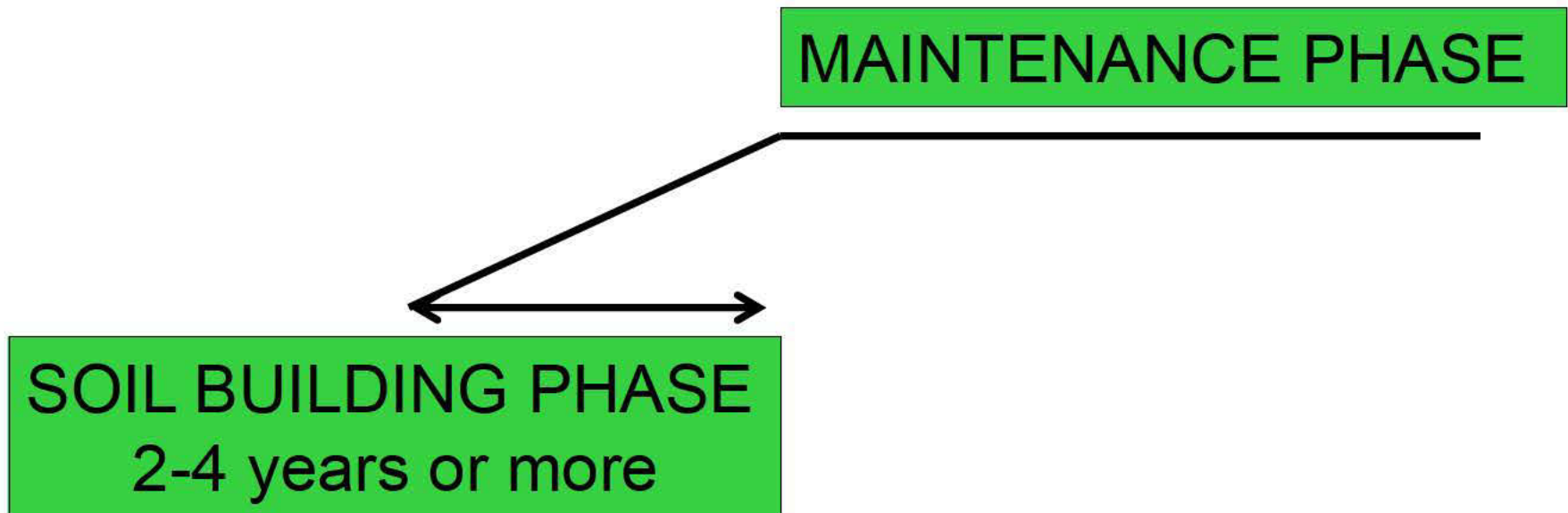
Build soil over time

- **Compost**
- **Cover crops**
- **Organic fertilizers**
- **Digging techniques**



Organic equilibrium

- Organic matter & soil C accumulate over time
- Soil fertilizer (e.g. N mineralization) increases over time



Organic matter

HOT STUFF

High N (>2.5%), high N availability

Raw manure, blood meal, feather meal

Little contribution to organic matter, use sparingly, do not exceed N and P requirements

COOL STUFF

Medium N(1.5-2.5%), low N availability

Compost, leaf mulch and cover crops

Allow time to decompose and add in large amounts

WOODY STUFF

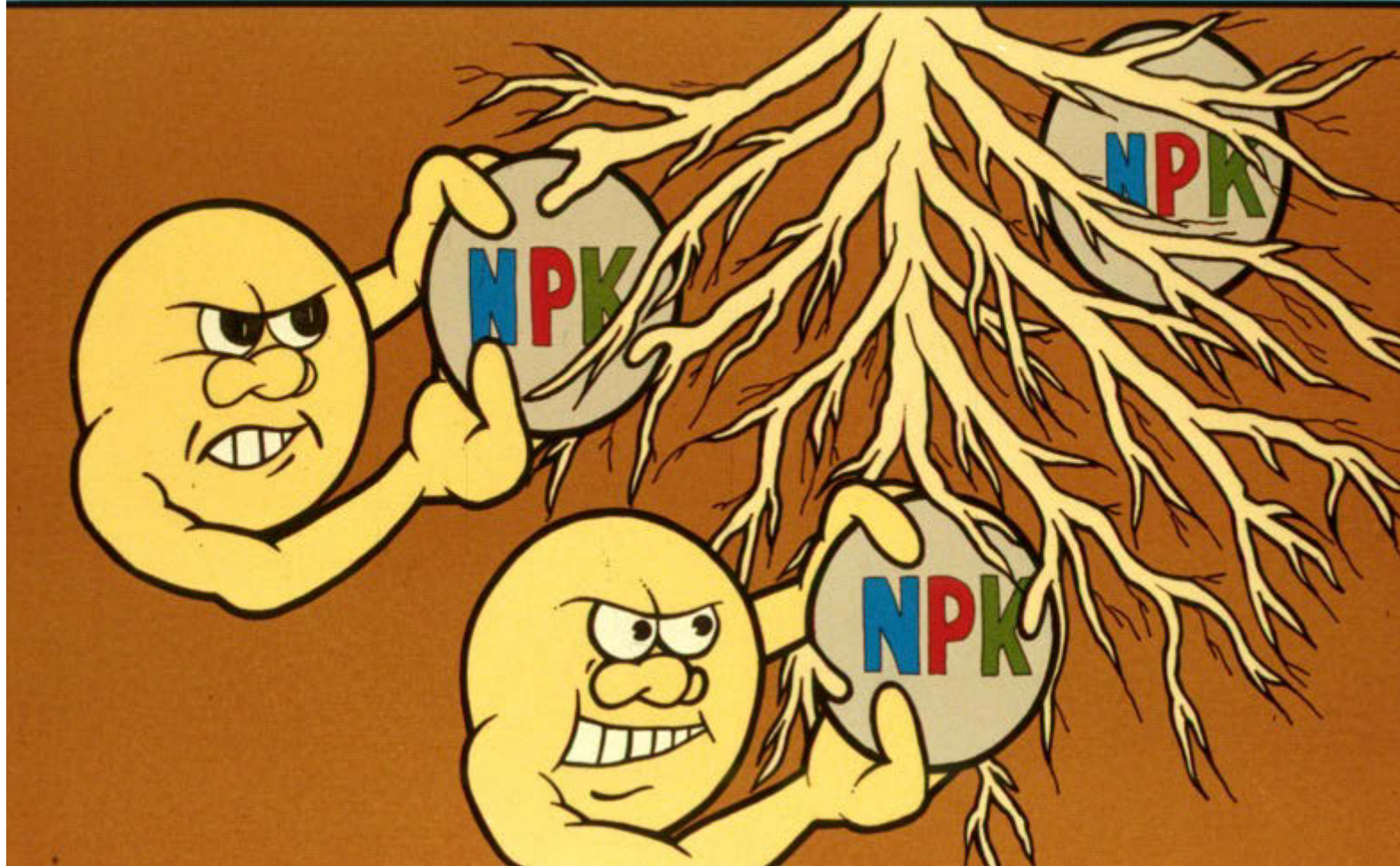
Low N (<1.5%), 0 or negative N

Straw, bark and sawdust

Can immobilize N, use as mulch or long before planting a crop

Carbon-rich Organic Matter

Soil Microbes Compete for Nutrients



Quantity:
2-3 parts soil:1 part amendment



➤ **rototilling**

➤ **digging**

Courtesy Linda McMahan

Using Compost

- **Mature compost is a stable organic material that builds the active OM pool (humus)**
- **N release is very slow, but it is steady and can accumulate over time**
- **Desired characteristics vary with use: potting soil or field application?**

Using Compost

Characteristics	Field Applied	Potting Soil
Stability	Low OK	High
Particle size	Large OK	Small
Nutrient & salt content	Higher	Lower
Weed seeds & other contaminants	Low	Low
Cost	Low	High

Cover Crops



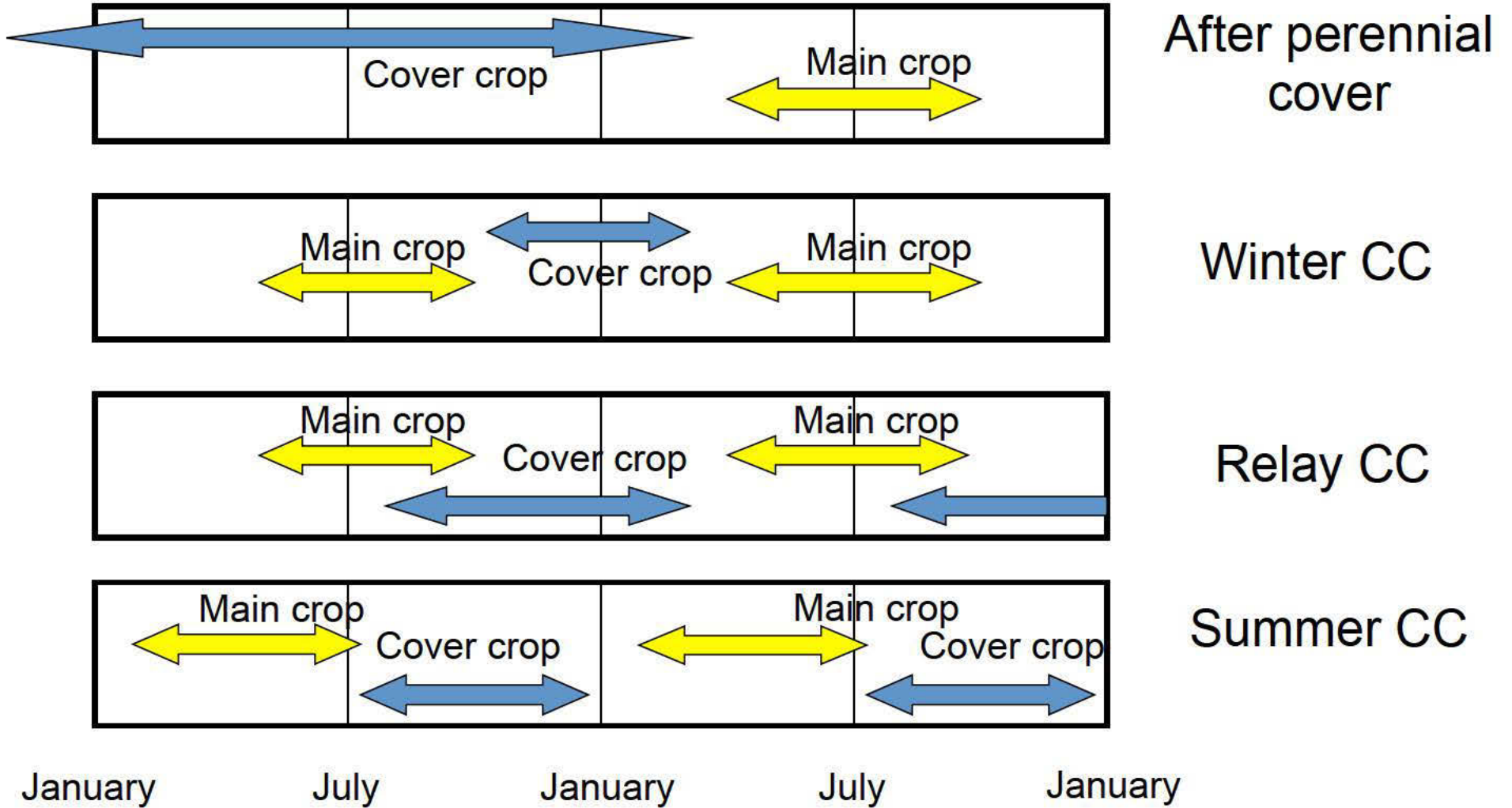
- Reduce erosion
- Protect soil structure
- Increase organic matter
- Fix atmospheric N
- Supply N w/o supplying P
- Scavenge residual N
- Reduce weed pressure
- Nectar and pollen for beneficial insects

Management challenges?

Types of Cover Crops

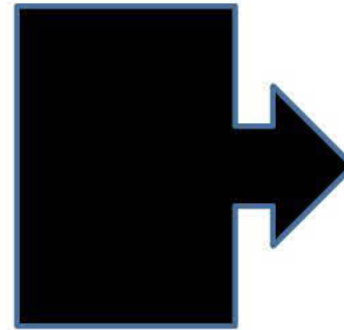
- **Legumes: clovers, vetches, peas, beans**
 - Fix atmospheric N
 - Put on most biomass in the spring
 - Provide pollen and nectar
- **Grasses: oats, rye, wheat, triticale, Sudhan**
 - Scavenge soil N
 - Provide C and build organic matter
- **Forbs: buckwheat, phacelia, mustards**
 - Scavenge soil N
 - Provide C and build organic matter
 - Provide pollen and nectar

Cover Crop Niches



Winter Cover Crop Choices

- **Annual rye**
- **Common vetch**
- **Austrian field peas**



3-way
mixture

- **Crimson clover**



Winter Cover Crop Practicality in Garden Setting?





Extreme measures to deal with mature winter cover crops

- **Cut down with scythe or weed whacker**
- **Chop in as best you can**
- **Add slow-release fertilizer**
- **Cover with black plastic or burlap for 4-6 weeks, depending on soil temperature**



Summer Cover Crops: Daikon, Buckwheat



Phacelia tanacetifolia native - borage fam.



Sudhan grass: mid-September



Winter-killed Sudhan grass



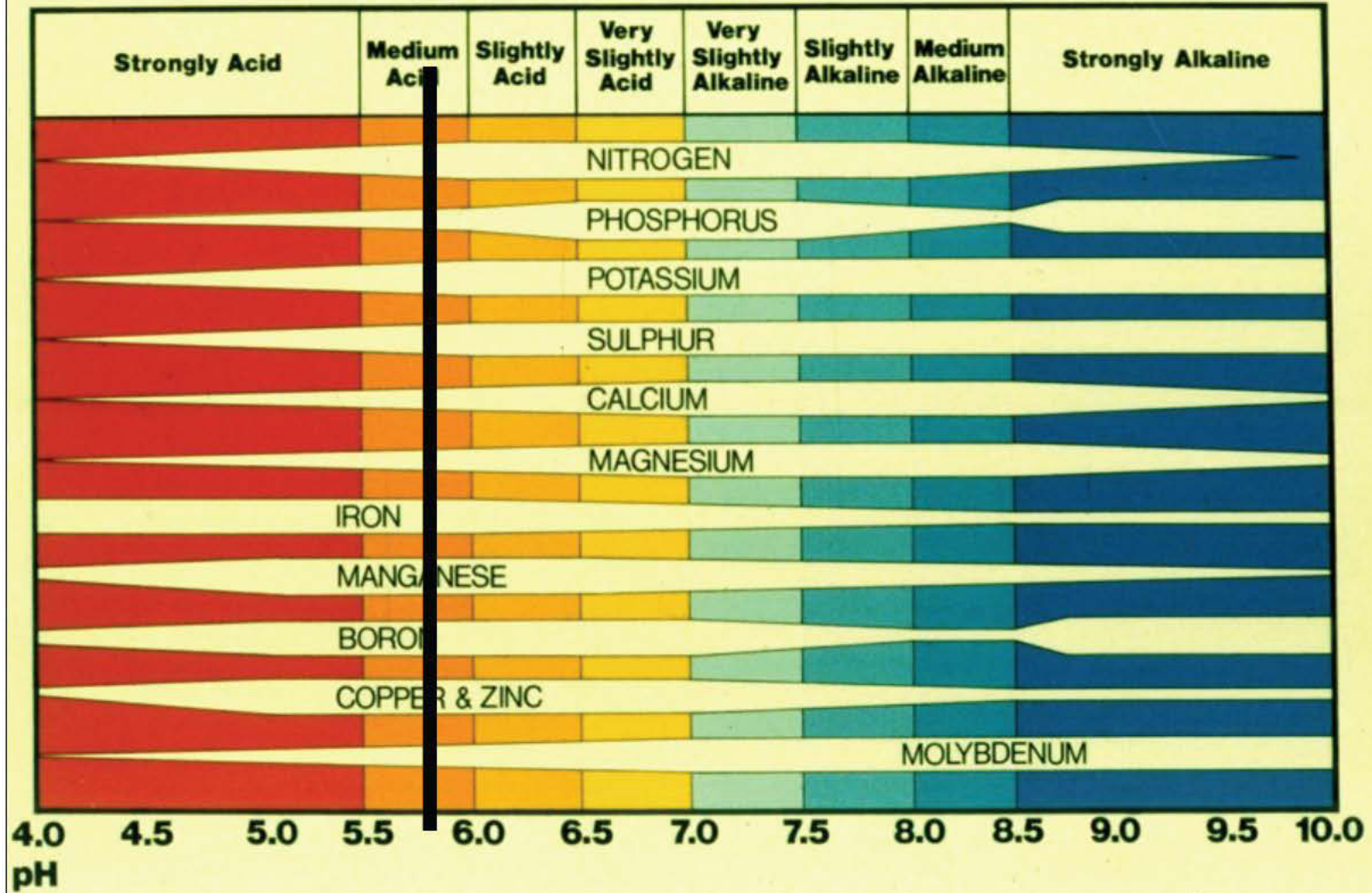
Relay sewn red clover
Seeded July (last cultivation)
Photo mid-October



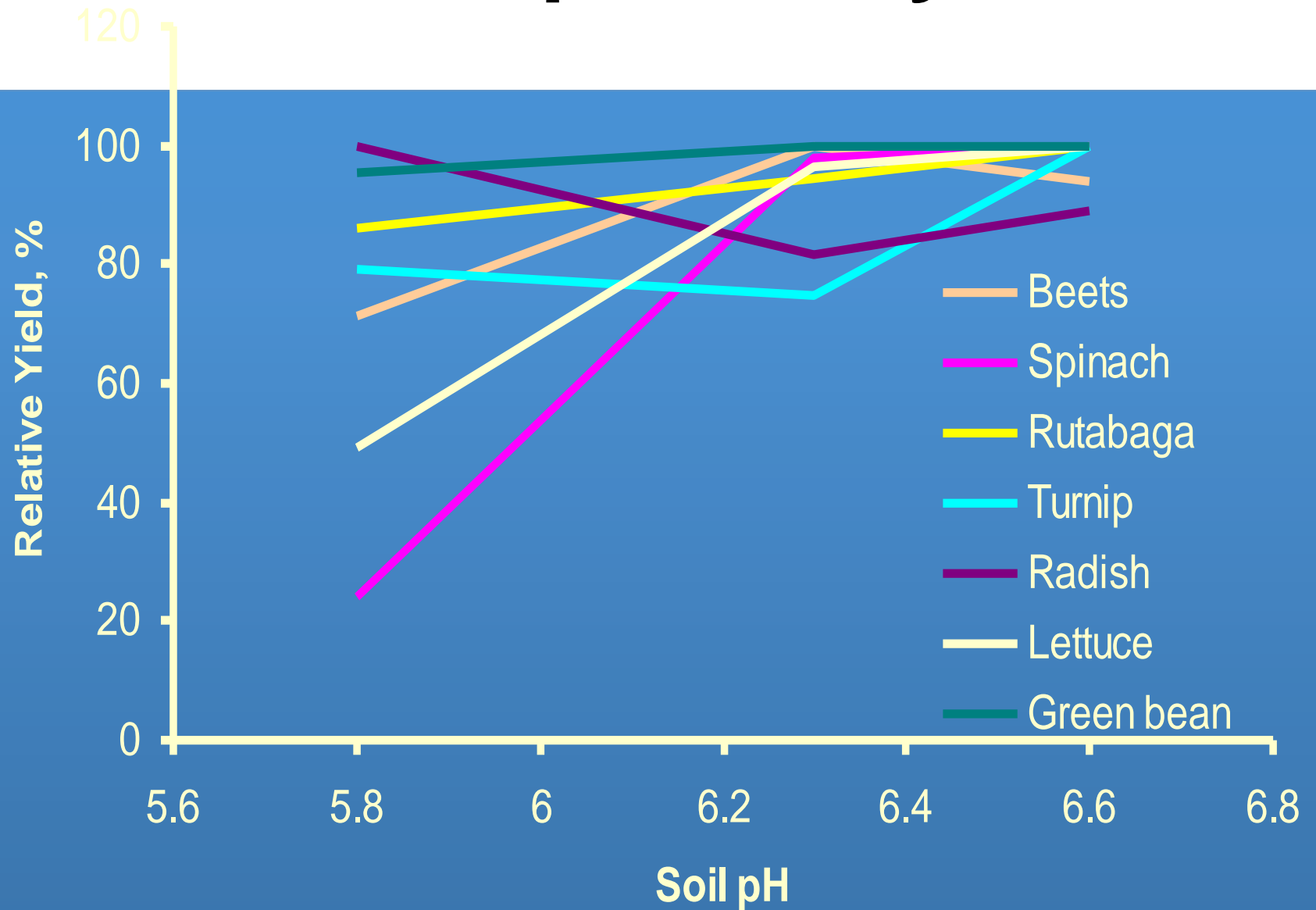
Relay seeded red clover the following April



How Soil pH Affects Availability of Plant Nutrients



Soil pH is Key

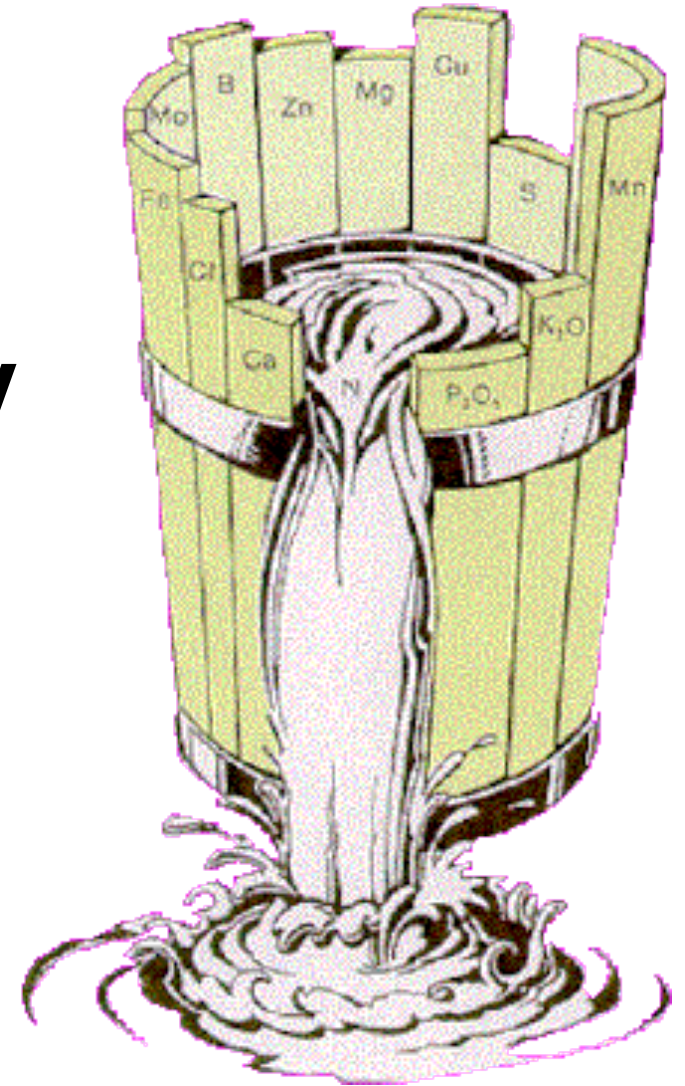


Courtesy John Hart, OSU Crop & Soil Science

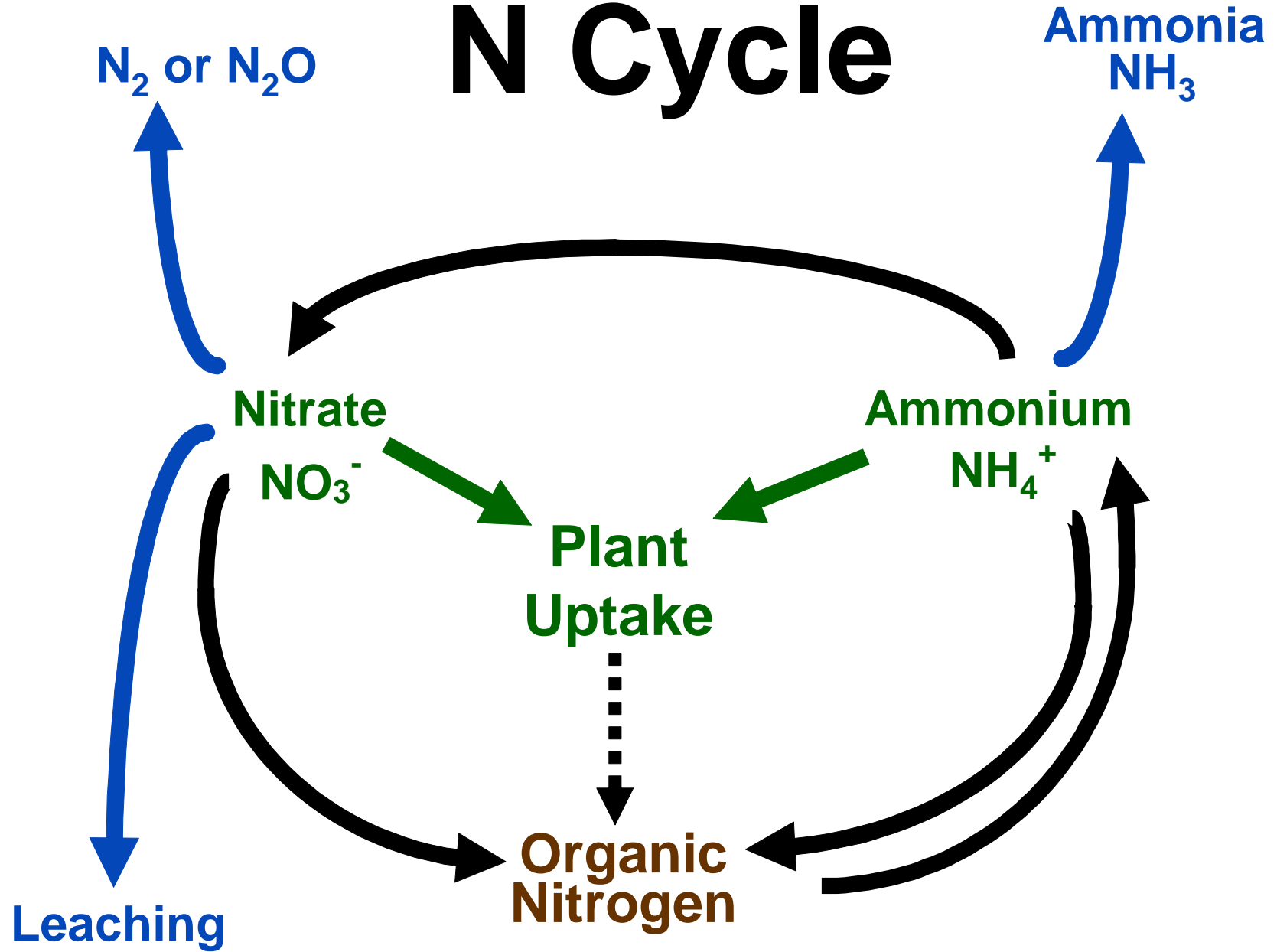
To Increase Soil pH

- **Lime (Calcium carbonate)**
 - Per soil test recommendations
 - Or 5 # / 100 sq. ft.
 - Dolomite also has Mg
 - Apply in fall

**Nitrogen is generally
limiting nutrient in
metro area soils**



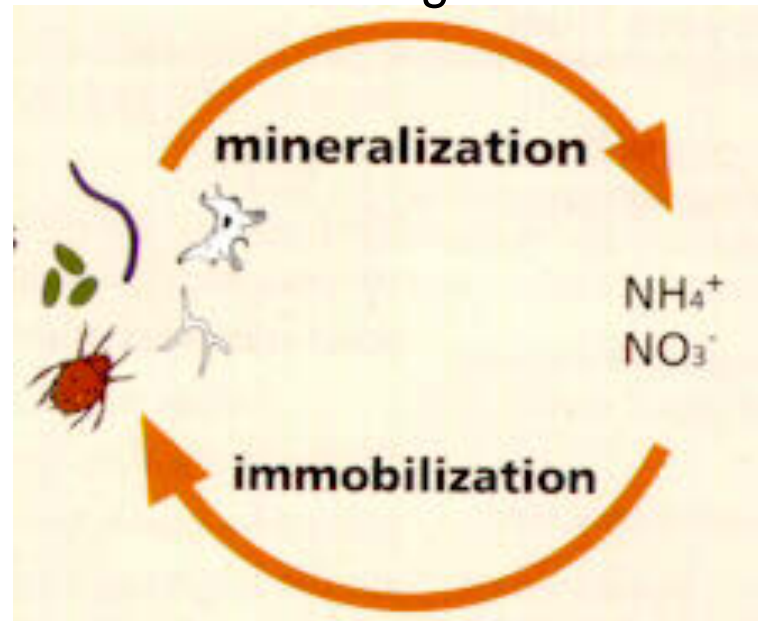
N Cycle



Mineralization and Immobilization

Organisms consume other organisms and excrete inorganic wastes.

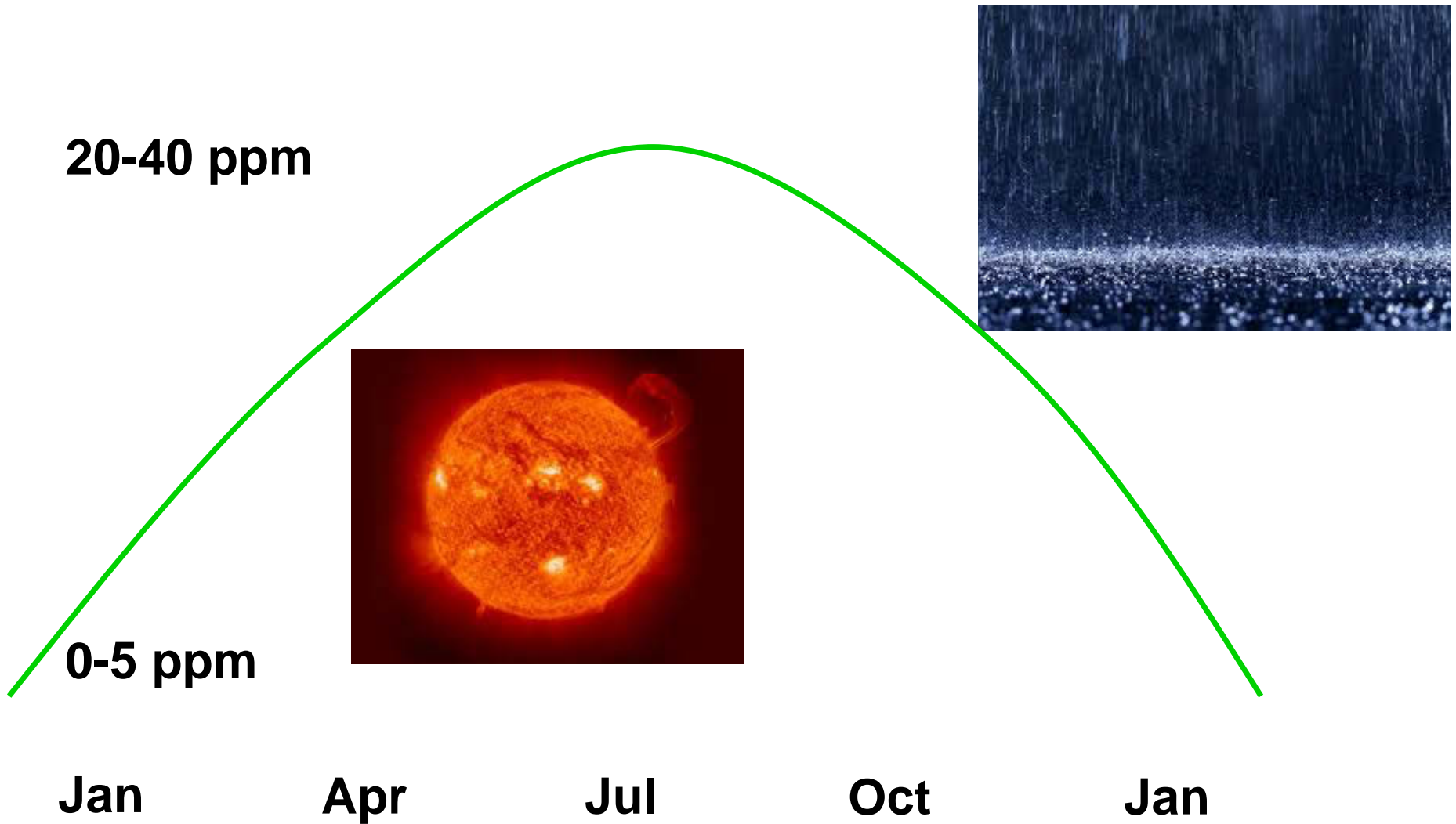
Organic nutrients are stored in soil organisms and organic matter.



Inorganic nutrients are usable by plants, and are mobile in soil.

Organisms take up and retain nutrients as they grow.

Seasonal Soil Nitrate (NO_3) Levels



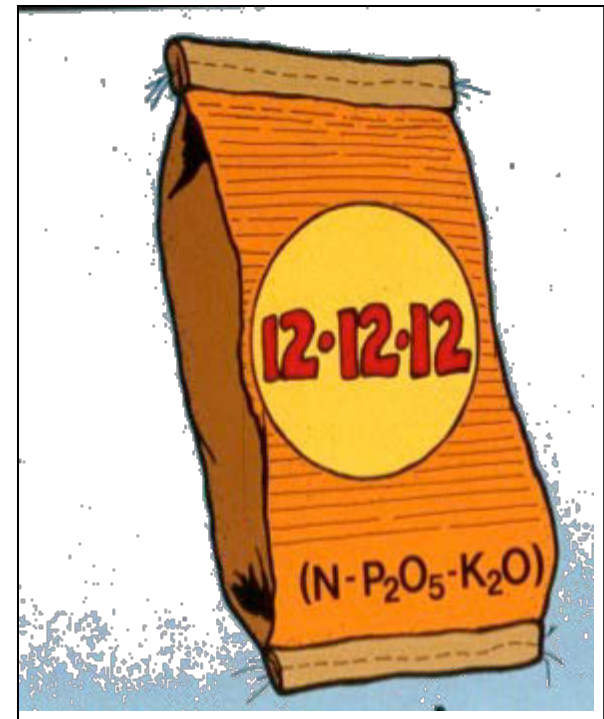
Organic nitrogen management is complex since N sources are difficult to predict and they all interact together

N Gains	N Losses
Soil N mineralization	Plant uptake
Compost and cover crops	Leaching
Fertilizers	Volatilization

If you ignore non-fertilizer N-sources, you are probably over-applying N and spending too much on fertilizer.

Synthetic Fertilizer

- **Follow instructions**
- **Incorporate in soil at planting**
- **Side dress during growing season**
- **Most cost-effective**



Organic Fertilizers (pg 51)

- **Mostly slow release (3-4 months) depending on soil temperature**
 - N- many choices
 - P- soft rock phosphate, bone meal
 - K- green sand, kelp meal
- **Blood meal, fish, and other animal products can burn**
- **Compost builds nutrients long-term**

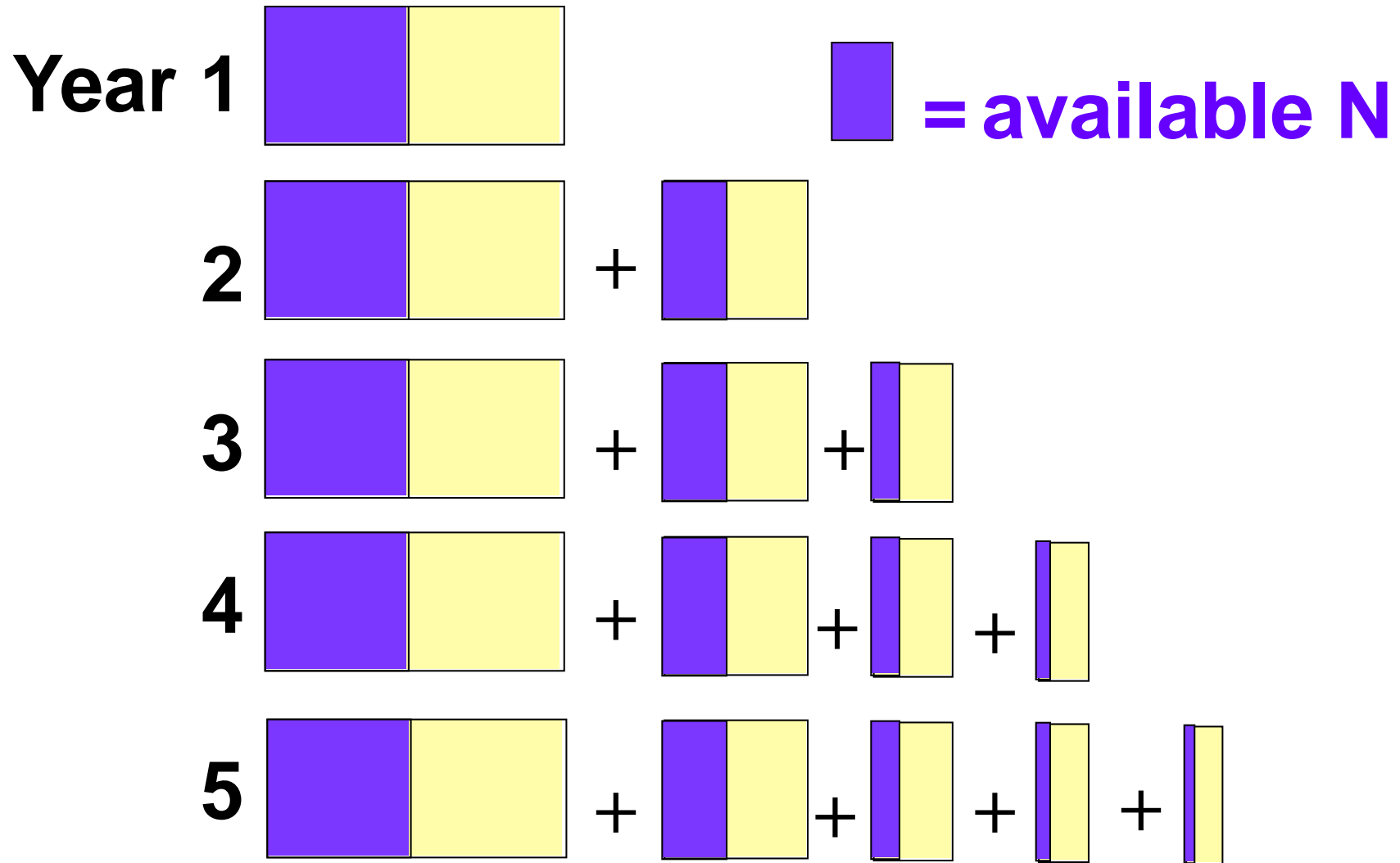
Organic Fertilizers (pg. 51)

<u>Material</u>	<u>% N</u>	<u>% P</u>	<u>% K</u>
Cotton seed meal	6-7	2	1
Blood meal	12-15	1	1
Alfalfa	2	0.5	2
Bat guano	10	3	1
Fish meal	10	4	0
Fish emulsion	10	4	0
Bone meal	1-4	12-24	0
Rock phosphate	0	25-30	0
Greensand	0	0	3-7
Kelp meal	1	.1	2-5

Water-in with Soluble Fertilizer



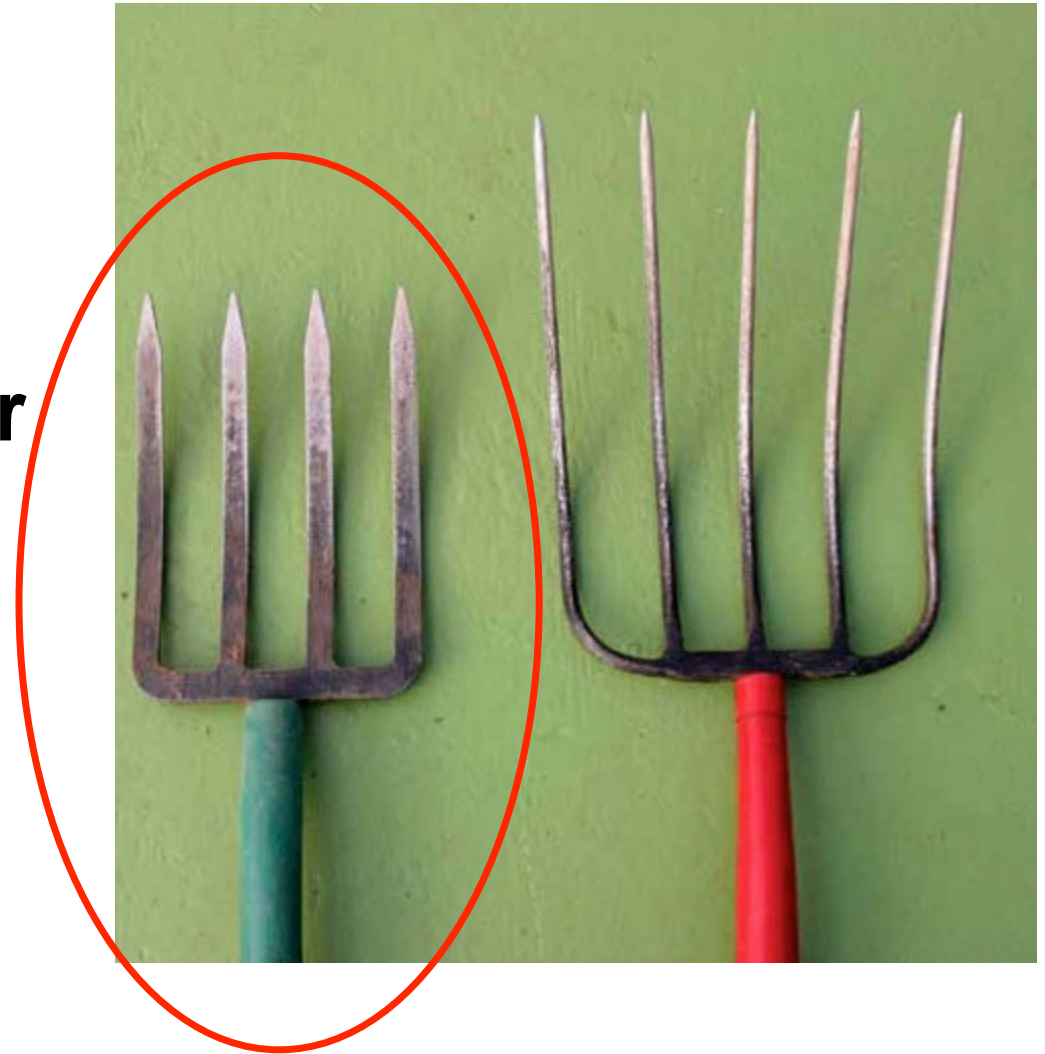
Accumulation of plant-available N (PAN) from organic sources



Courtesy of Dan Sullivan OSU Crop & Soil Science

Preferred Hand-digging tools

- **Spade**
- **Spading fork**
- **Broad fork/ U-bar**
- **Rake**
- **Digging board**





Broad Fork U-bar

Notice head trench

Digging Board



Walk Behind Tractors



Avoid tillage pan



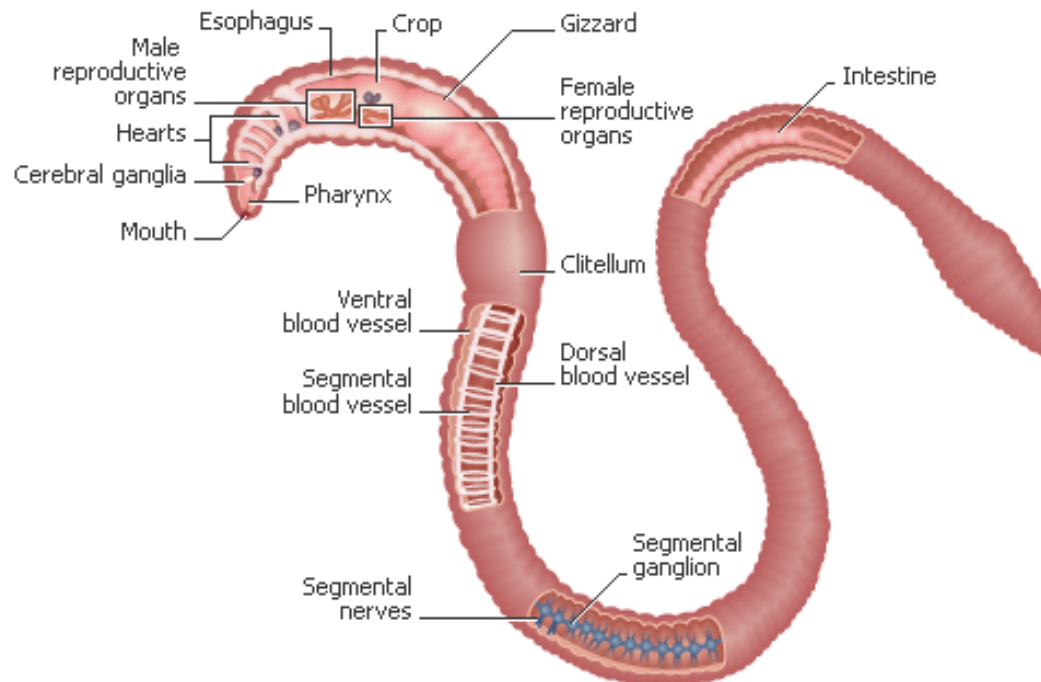
Sheet Mulch: Longer-term bliss

- **Wet soil thoroughly**
- **High nutrient material**
- **Overlapping cardboard or newspaper**
- **3-4" compost**
- **Wait 3-4 months**
 - **Worms eat lawn**
- **Beware perennial weeds**



Sheet Mulching

- **Earth Worms**
 - **Surface feeders**
 - **Till soil from underneath cardboard**
 - **Supply lots of nutrients to encourage migration**



Preview of presentation

- **Soil building with organic matter**
- **Nutrient management**
- **Soil preparation**