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Do you have healthy soils for healthy crops?

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MR. TODD ZEHR

- Todd Zehr - Founder of SoilBiotics
- Over 25 years of experience –
- North America, Asia, and Europe.
- Has a degree in Agronomy and Chemistry from Missouri State University
- Nutrient management planning was the basis for SoilBiotics.
- Has developed new cropping technologies.

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MR. RICH REINEKE

- Rich Reineke from SoilBiotics – Midwest Regional Manager
- MS in Horticultural Science from the University of Minnesota
- BS in Horticulture from Iowa State University
- Extensive experience in production systems
- Expertise in plant nutrition and soil health

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Seven Wonders of the Corn Yield World

Rank	Factor	Value	
		bu/acre	%
1	Weather	70+	27
2	Nitrogen	70	26
3	Hybrid	50	19
4	Previous Crop	25	10
5	Plant Population	20	8
6	Tillage	15	6
7	Growth Regulators	10	4
	Total =	260bu	100%

CROP SCIENCES UNIVERSITY OF ILLINOIS

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The Law of Yield Limits

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We Can Add More Nitrogen

>$ = >N = >Yield = >$

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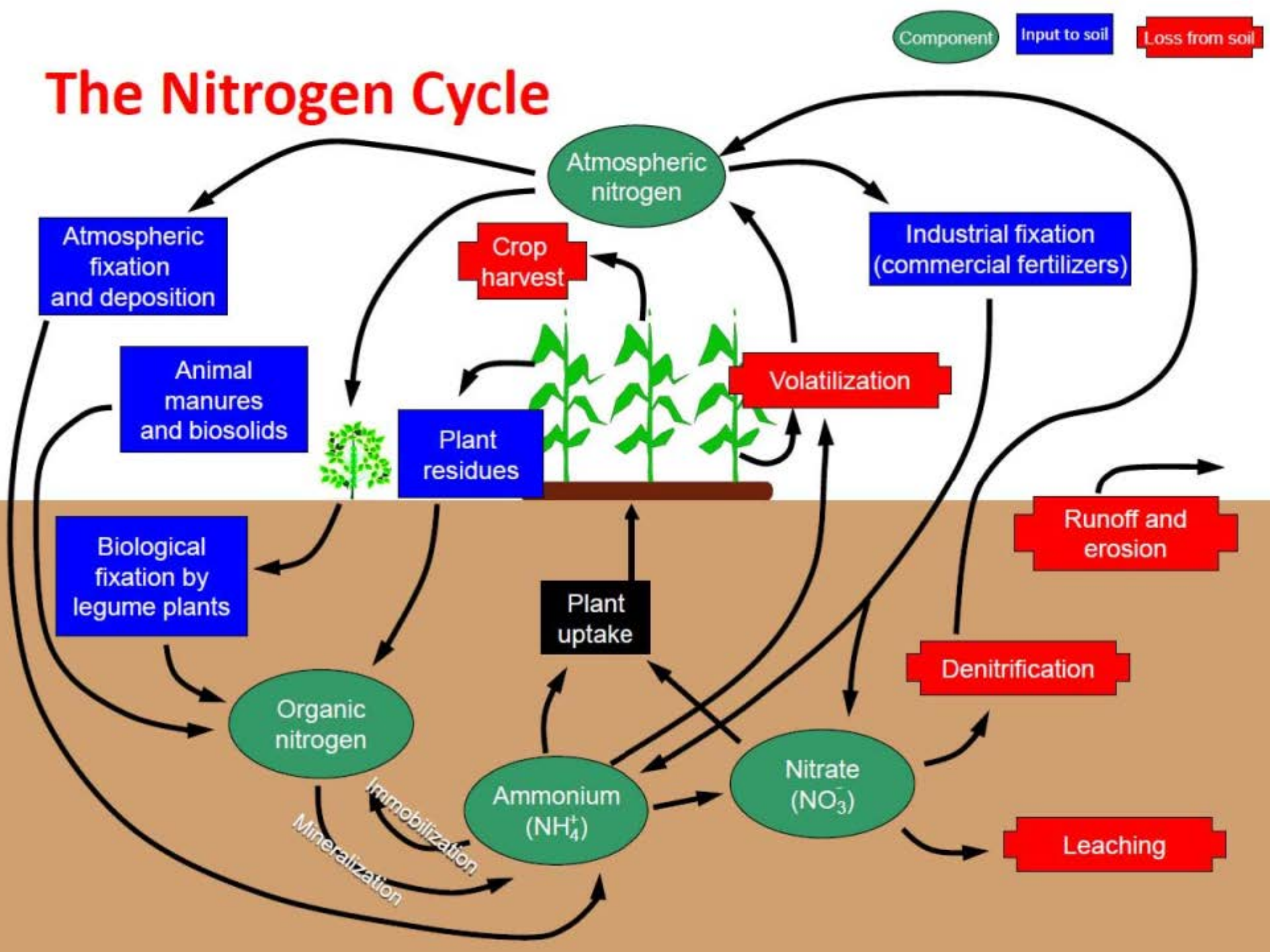
Component
Input to soil
Loss from soil
The Nitrogen Cycle
Atmospheric nitrogen
Atmospheric fixation and deposition
Industrial fixation (commercial fertilizers)
Crop harvest
Animal manures and biosolids
Volatilization
Plant residues
Runoff and erosion
Biological fixation by legume plants
Plant uptake
Denitrification
Organic nitrogen
Ammonium (NH_4^+)
Nitrate (NO_3^-)
Immobilization
Mineralization
Leaching

How is Nitrogen Added to the Soil?

- Decomposition of Crop Residues
- Animal Manures and Bio-Solids
- Atmospheric Fixation and Deposition
- Biological Fixation in Legume Plants
- Industrial Fixation (Commercial Fertilizers)
- How are you adding Nitrogen?

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How is Nitrogen Lost?

- Crop Harvest
- Runoff and Erosion
- Leaching
- Volatilization
- Denitrification

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Cation Exchange Capacity (CEC)

- The total number of cations a soil can hold--or its total negative charge--is the soil's cation exchange capacity
- A soil's CEC comes from negatively charged clay and organic matter particles
- Organic matter can have 4 to 50 times higher CEC than clay

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Limit to Nitrogen Added

in one application

Max Units N = 10 x CEC

Ex: CEC of 8 x 10 = 80 units

CEC in soils range 5 - 30 meq/100g

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What are the limits of your soil?

Are you maintaining Nitrogen?
Do you have low CEC's?
Do you have low OM?
Other factors limiting yields?

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Increasing OM by 1% increases per acre:

- 2000 pounds more of Nitrogen
- 650 pounds more of Phosphate
- 115 pounds more of Potassium
- 70 pounds more of Calcium

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Consequences of Overusing N

- Wasted Fertilizer Expenditures
- Failure to Maximize Yields
- Environmental Contamination
- New Legislation and Regulation
- Others?

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Iowa Water utility announces plan to sue nearby counties over nitrate pollution

Greens Market, 1/19/15

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Environmental Contamination

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Organic Matter (O.M.)

Organic matter is a component of soil, consisting of plant and animal residues at various stages of decomposition, cells and tissues of soil organisms, and substances synthesized
by soil organisms.

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Decomposition

Decomposition is *the process of breaking down organic material, such as dead **plant** or animal tissue, into smaller molecules that are available for use by organisms of an ecosystem.*

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Humus

Humus is the *product of the complete decomposition of organic matter* (humification).

Humus is the *active ingredient in organic matter.*

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Carbon is Important for Holding N

> O.M. = > Humus

> Humus = > CEC

> CEC = > N holding

More total nutrient and water holding capacity

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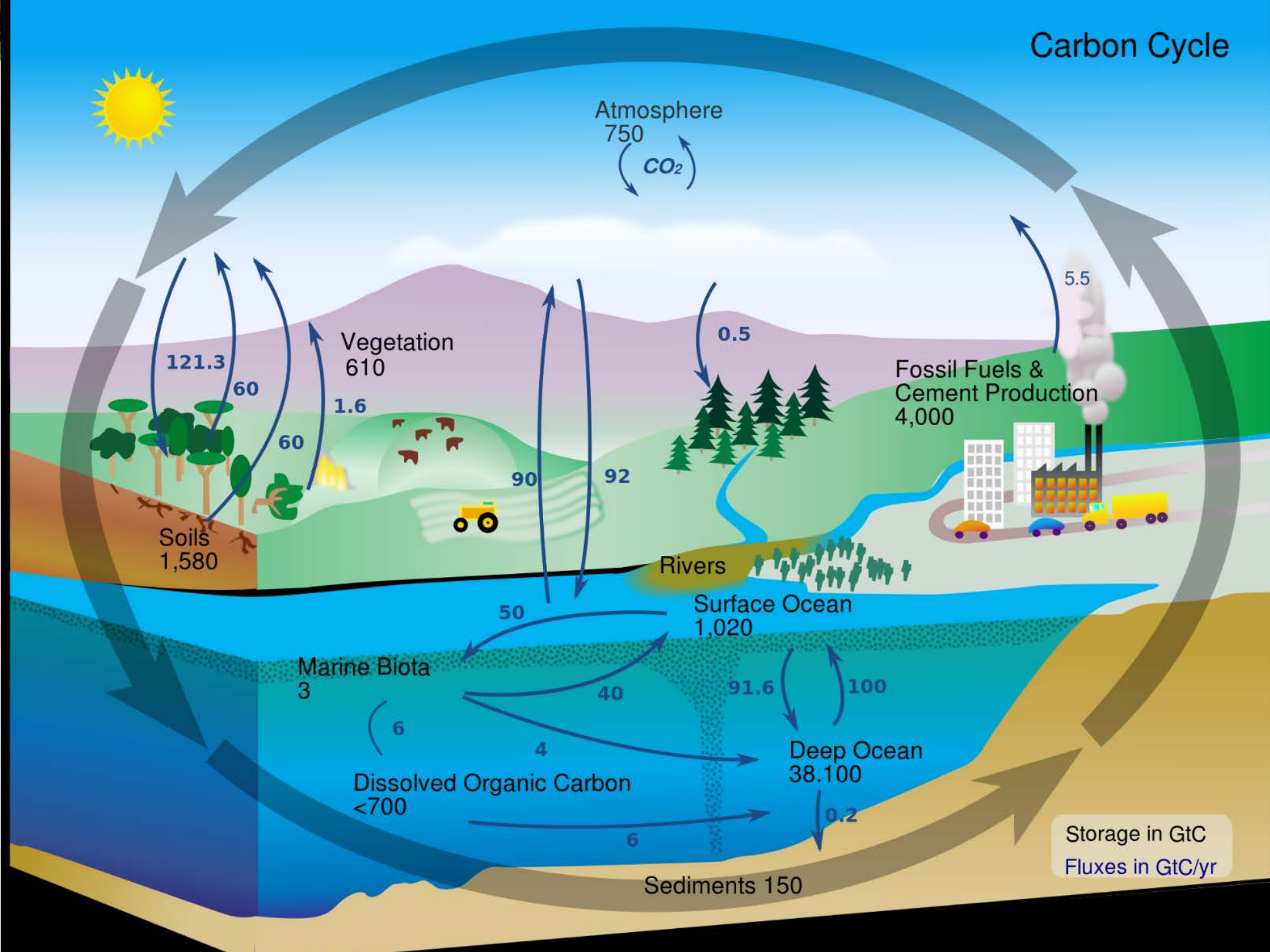
Carbon Cycle
Atmosphere
750
CO_2
121.3
60
60
1.6
Vegetation
610
0.5
5.5
Fossil Fuels &
Cement Production
4,000
90
92
Soils
1,580
Rivers
50
Surface Ocean
1,020
Marine Biota
3
40
91.6
100
6
4
Deep Ocean
38.100
Dissolved Organic Carbon
<700
0.2
6
Sediments 150
Storage in GtC
Fluxes in GtC/yr

The Carbon Cycle

- Global Populations Living and Dying
- Life Cycles of all Biological Systems
- Carbon Fixed in Plants by Photosynthesis
- Fossil Fuels Burned
- Mineral Deposits Excavated
- Absorption of CO2 in Bodies of Water
- Agriculture Planting and Harvesting

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Losing Carbon from the Soil

- Harvesting of Crops
- Removal of Crop Residues
- Decomposition of Crop Residues
- Modern soil fertility practices

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Importance of Soil Life

- "Because of the important contributions made by bacteria to the fertility level of the soil, life of higher plants and animals could cease if the functions of the bacteria were to fail" – A&L Agronomy Handbook
- "Microbial activity (biology) drives chemistry, including pH and ultimately determines fertility" – Dr. Elaine Ingham

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Microbial Decomposition

- There are more microbes in a teaspoon of soil than there are people on earth
- Soil contains 8 – 15 tons/acre of bacteria, fungi protozoa, nematodes, earthworms & arthropods
- Decomposition provides energy for microbial growth and carbon for new cell formation

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Carbon to Nitrogen (C:N) Ratio

- Carbon and Nitrogen cycle together
- Different plant tissues have differing C:N ratios
- Lower C:N ratio is associated with faster decomposition due to higher N content
- Higher C:N ratio is associated with slower decomposition due to lower N content

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University of Illinois Research Shows: 200 Bu/A Corn = 8,800 lbs/A Residue

Nutrient	Units Available
Potassium	209
Phosphorus	182
Nitrogen	88

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Carbon to Nitrogen Relationship

- Crop residues are decomposed by microbes in the soil through the use of available Nitrogen
- The optimum C:N ratio is 10:1 to increase microbial populations
- Complete decomposition of organic matter to humus is called humification
- Humus is considered the soil/plant active ingredient of organic matter
- Modern agricultural fertility practices result in incomplete humification (Rapid Carbon Cycling)

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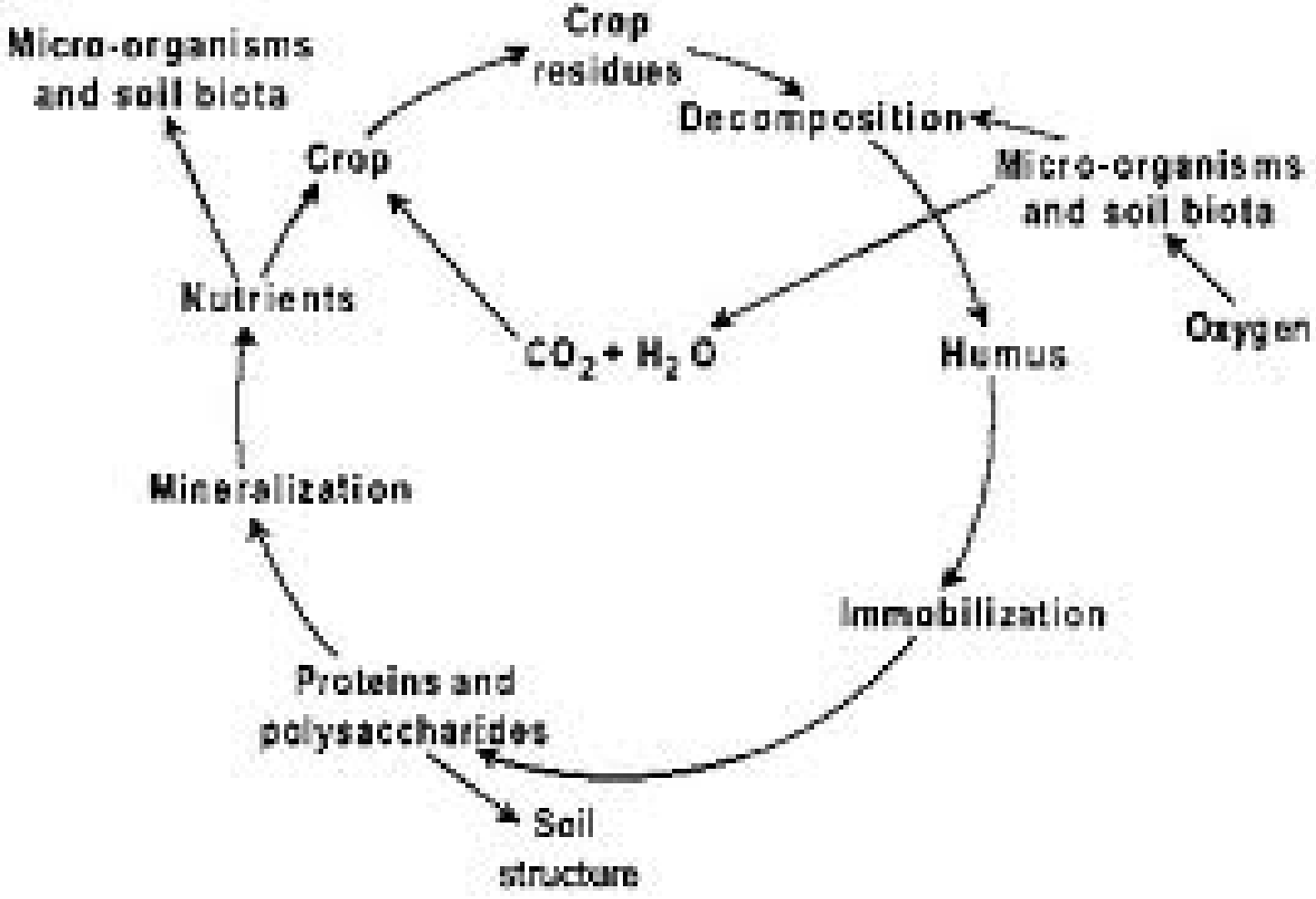
Soil Carbon Cycling



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Carbon Stabilization of Nitrogen

- Decomposition of O.M. releases minimum 65% CO2
- Maximum 35% of O.M. can become humus
- High inputs of N change the C:N ratio and cause rapid cycling of carbon, increased CO2 and decreased humification
- Adding carbon mediates the microbial breakdown of organic matter with available Nitrogen
- Adding carbon facilitates the complete decomposition of organic matter to humus

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Replacing Carbon-How to put it back?

▫ BioChar	10 tons/acre
▫ Crop Residues	
▫ Cover Crops	=
▫ Compost	
▫ Humic Substances	200 lbs/acre

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How are Carbon Sources Different?

- Age of the Carbon Source
- Process of Stabilization
- Stage of Decomposition
- Carbon to Nitrogen Ratio
- Length of Carbon Chains
- Degree of Oxidation

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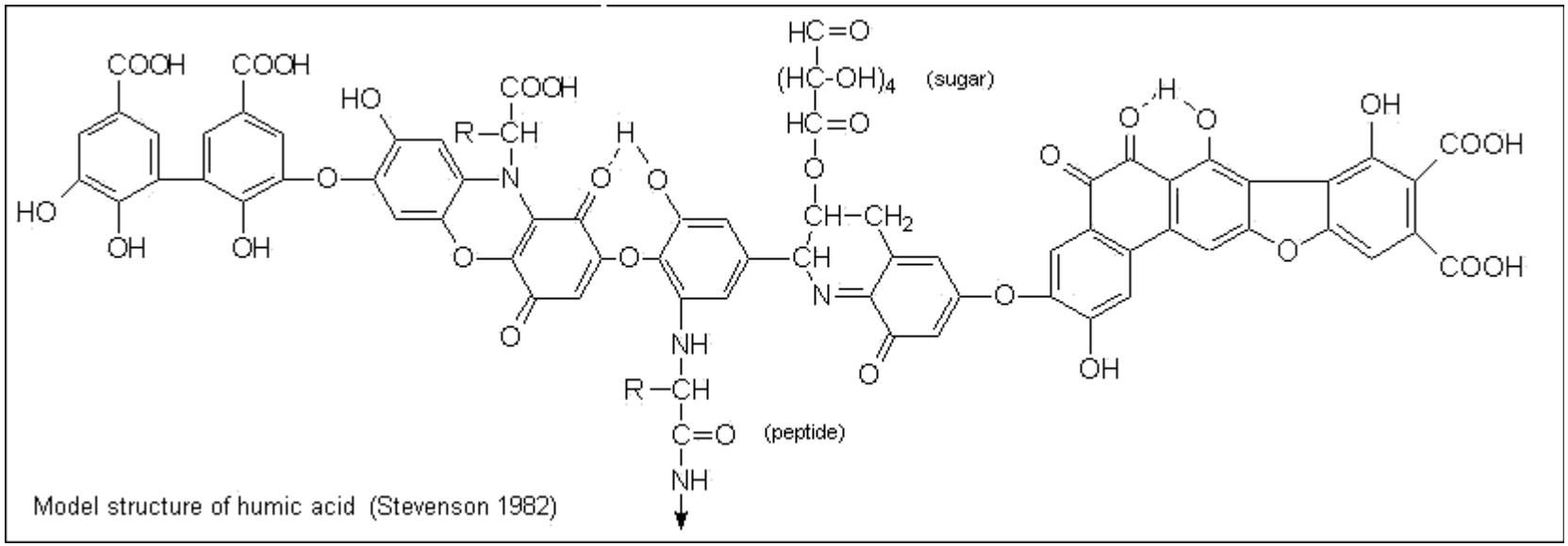
Humic Substances as Replacement



Model structure of humic acid (Stevenson 1982)

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Benefit of Humic Substances

- Humic Substances increase (CEC) cation exchange capacity (400-700 meq/100g), Compared to soils with 5 - 30 meq/100g
- Field soils CECs range 5-30 meq/100g
- Chelate N to prevent loss from soil profile
- Maintain nutrient availability for duration of growing season
- Humic Substances buffer soils against changes in pH and moisture

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More Benefits of Humic Substances

- Improve soil structure, drainage and aeration
- Increase water holding capacity, drought resistance
- Mitigate high salts and toxic substances
- Serve as catalyst to jumpstart proper, healthy humification (Increase Soil Organic Matter)
- Provide the essential substrate for soil biology
- Improve overall plant health, resulting in increased plant resistance and better yields

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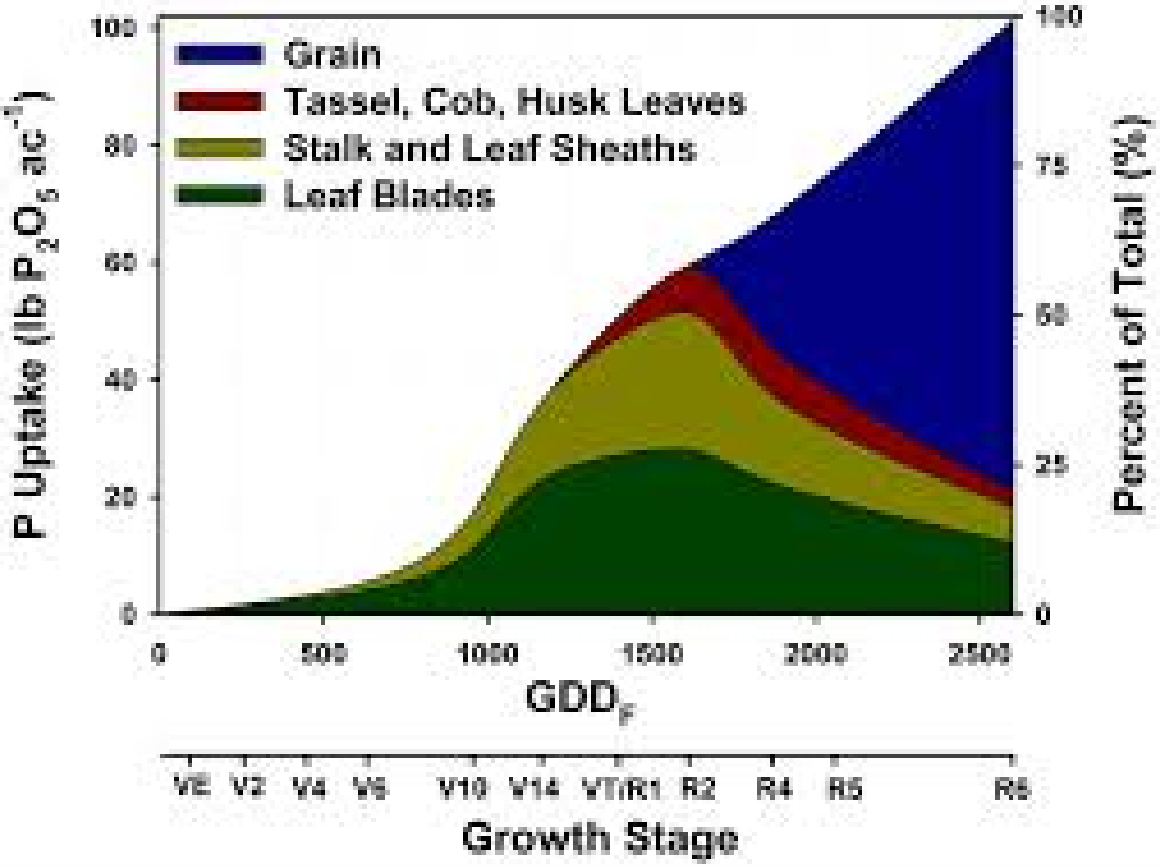
Maintaining Nutrient Availability

University of Illinois, Dr. Fred Below



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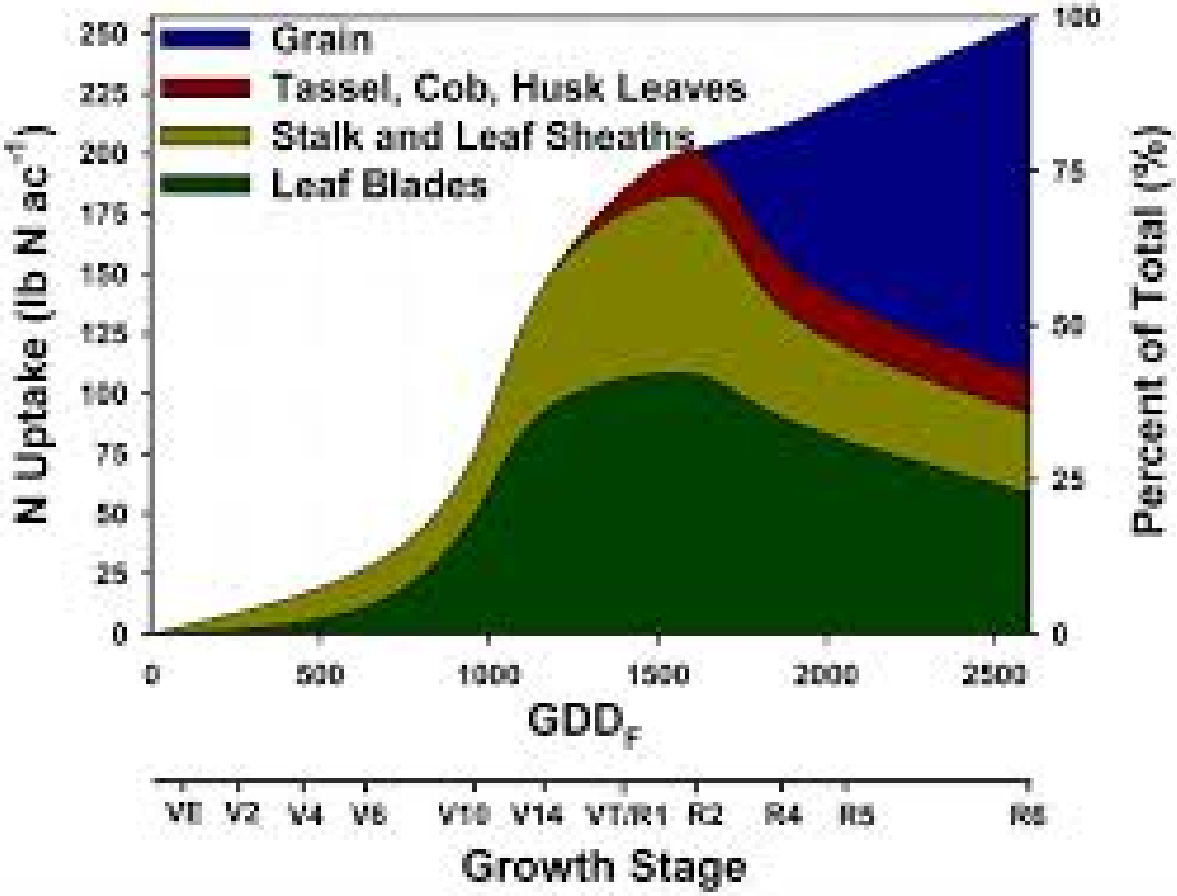

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SoilBiotics Growth Systems

- Improves overall health and vitality of the soil
- Improves Organic Matter
- Stabilizes Nitrogen*
- Increases release of nutrients due to chelation
- Improves overall plant health, which results in increased plant resistance, and better yields

*based on SoilBiotics 2013 and 2014 trial results

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SOIL BOOST (HUMIC SUBSTANCE)

- Sold World Wide - 20% Annual Increase in Sales
- Is a Humate, Lignite Ore
- 70% Humic Acid
- 25% Fulvic Acid
- 5% Ulmic Acid
- Mined and produced in USA (New Mexico State)
- Is non-toxic, safe to handle, non-plant food ingredient
- May be applied alone or with dry fertilizers
- Can be applied to all soils types

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SoilBiotics Products

Conventional Program

1. Seed Treatment
2. Soil Boost
3. Growth Boost
4. Ultra Boost
5. MicroNutrient Boost
6. Growth Supplement

Organic Program

1r. Seed Treatment
2r. Soil Boost
3r. Growth Boost
4r. Foliar Concentrate
5r. Soil Boost EA

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How Three Acids Work…

- **Humic Acid:** Enables plants to extract nutrients from the soil.
- **Ulmic Acid:** Stimulates and increases root formation and growth.
- **Fulvic Acid :** Gives plants strength to withstand stresses caused by pests, dry and wet weather.
- Increase in Yield – Anywhere 15 up to 30%.

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How to proceed…

- Contact SoilBiotics for more information
- Refer to your most recent soil test to assess the limitations of your field soils
- Address the most challenging fields first, as they offer the greatest opportunity for yield improvement

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Thank You

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