

- Energy
- Water
- Carbon
- Nitrogen
- Phosphorus

Know your Cycles

- Chloroplast collect energy from the sun and use CO₂ and H₂O in a process called photosynthesis to produce sugars.
- Animals make use of the sugars in their own energy factories, the mitochondria to produce a versatile energy currency in the form of adenosine triphosphate (ATP)

Energy

- the cycle of processes by which water circulates between the earth's oceans, atmosphere, and land, involving precipitation as rain and snow, drainage in streams and rivers, and return to the atmosphere by evaporation and transpiration.

Water

Source of Fresh Water	% of Fresh Water
Ice caps, Glaciers and Permanent Snow	68.600 %
Fresh Groundwater	30.100
Ground Ice and Permafrost	00.860
Fresh Water Lakes	00.260
Soil Moisture	00.050
Atmosphere	00.040
Swamp Water	00.030
Rivers	00.006
Biological Water	00.003

Fresh water distribution

- the series of processes by which carbon compounds are interconverted in the environment, chiefly involving the incorporation of carbon dioxide into living tissue by photosynthesis and its return to the atmosphere through respiration, the decay of dead organisms, and the burning of fossil fuels.

Carbon Cycle

- Nitrogen is both the most abundant element in the atmosphere and, as a building block of proteins and nucleic acids such as DNA, a crucially important component of all biological life. The nitrogen cycle is a complex biogeochemical cycle in which nitrogen is converted from its inert atmospheric molecular form (N_2) into a form that is useful in biological processes.

Nitrogen

- The Haber process, also called the Haber–Bosch process, is an artificial nitrogen fixation process and is the main industrial procedure for the production of ammonia today. It is named after its inventors, the German chemists Fritz Haber and Carl Bosch, who developed it in the first decade of the 20th century. [Wikipedia](#)

Synthetic Nitrogen and the green Revolution

- The **phosphorus cycle** is the biogeochemical **cycle** that describes the movement of **phosphorus** through the lithosphere, hydrosphere, and biosphere. ... Low concentration of **phosphorus** in soils reduces plant growth, and slows soil microbial growth - as shown in studies of soil microbial biomass.

Phosphorus

- Already happened in US, 1980
- 1 or 2 generations worldwide
- Currently 1 way street with a dead end
- Only 2% efficiency
 - 2% of mined phosphorus ends up in food
- The Future of Phosphorus Management
 - Peter Scharf, MU Crop Management conference

Peak Phosphorus

Case Study- Does Soil Health Pay?

Plot Parameters	No till/Cover Crop	Minimum Till
Soil Type	Laganda S.C.L.	Laganda S.C.L.
Weather (1000' apart)	Identical	Identical
Planting, same planter	5/8/2018	5/7/2018
Varieties	3427,3738,3927,EX	3427,3738,3927,EX
Population	121,000	121,000
Previous Crop	241 bushel corn	232 bushel plot
Harvest Date	11/20/18	11/21/18
Yield	65.4 bpa	45.3 bpa

Accidental Comparison

Soil Paramaters	No till/Cover Crop	Minimum Till
Soil Type	Laganda S.C.L.	Laganda S.C.L.
Cropping History	Plowed in 2011, NT-Cover since 2012	Longer cropping history
P and K fertility	Medium, Low	High, Medium
Soil Organic Matter	3.2	3.0
Ph	6.4	7.7
CEC	13.4	19.6
Soil Health Calculation	13.8	9.7
Cyst Nematode egg ct.	Not detected	3322 per 100cc
2" infiltration time (3)	240 seconds	837 seconds
Yield	65.4 bpa	45.3 bpa

Accidental Comparison

Date Tested	Organic matter %	Lab	Notes
6/17/2011	2.5%	MU	West Plot, out of sod
11/17/2013	2.8%	MU	West Plot
2015	Replant	WB	Plot Divided WB, WF
3/6/2017	3.1% WB	MW lab	Cereal Rye
3/6/2017	3.8% WF	MW lab	Annual Ryegrass
3/5/2018	4.9% WF	MW lab	N 6 rows, CC, No K
3/5/2018	4.3% WF	MW lab	Nxt 6 rows, AGG, K
12/18/2018	3.2% WB	MW lab	After 240 c, 68 sb

Soil Test History- West Back

Management Differences	No-Till Cover Crop	Minimum Till
Yield	65.4	45.3
Cyst Nematode	0	+7.0
Banded MESZ	0	+4.3
Spray 1	0	0
Spray 2	0 (27 DAP)	+2.0 (44 DAP)
Fungicide and Insecticide	0	+3.6
Harvest Loss	+1.0	0
Adjusted Yield	66.4	62.2
Soil Health Advantage	4.2	

My educated guess based on past plots and hours of research.