Dan DeSutter-Attica, IN

- Raise 5,300 acres of corn, soybeans, wheat, alfalfa, pasture, cover crops and Hoosier Grassfed Beef in West Central Indiana

5 Universal Principles of Soil Health

- Minimize disturbance
- Keep the soil covered
- Maintain a living root
- Maximize diversity
- Utilize managed ruminant impact

When Corn Prices Were High…

- Continuous no till corn for 4 years
- GMO's
- Fungicides
- Insecticides
- Herbicides
- Fertilizer

2015 Eisenhower Fellowship

- Looked at the social, economic and cultural practices that cause farmers to adopt good soil health practices
- 3 months in Australia and New Zealand
- No agricultural subsidies since the 1980's
- Depend on being competitive in export market
- 80% farms raised at least 5 cash crops
- >50% used grazing as part of rotation

Enter Soil Biology

- As we started to understand soil biology, we also began to understand the ecology of diversity.
- Went from continuous corn to corn/rye/soybeans/wheat/covercrop cocktail/corn
- Added alfalfa and pasture

As Diversity Increases

- Weed pressure decreases
- Pest pressure decreases
- Fertility needs decrease
- Inputs decrease
- Yields increase

Which Herbicide Program Do You Prefer?

Income Increase

- Agronomic stability from diversity allowed us to eliminate GMO's
- Earn 10-15% premium while maintaining yield
- What's next?

CCSI

- Multi-year on-farm research project on a dozen farms in Indiana
- Long-term notill with covers vs. Long term notill with no cover vs. conventional neighbor
- Exhaustive testing. Conventional soil test, Cornell, Haney, PLFA, Earthfort

Good News

- Significant increase in organic matter(doubled since purchase in 1991)
- Some structural improvements
- Significantly more mycorrhizal fungi
- After cocktail, saw increases in Haney soil health score and soil respiration

Bad News

- By most measures, biology not significantly better
- Why?

Back to the 5 Principles

- Minimize disturbance-BOTH physical and chemical
- Keep the soil covered
- Keep a living root
- Maximize diversity
- Utilize managed ruminant impact

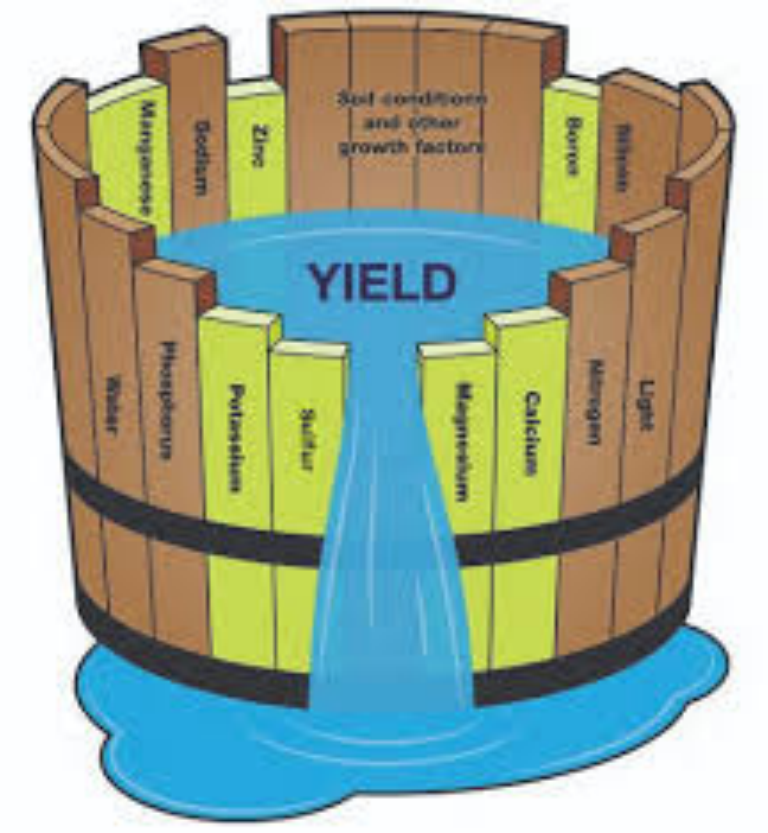
How many tons of root mass under here?

Back to the 5 Principles

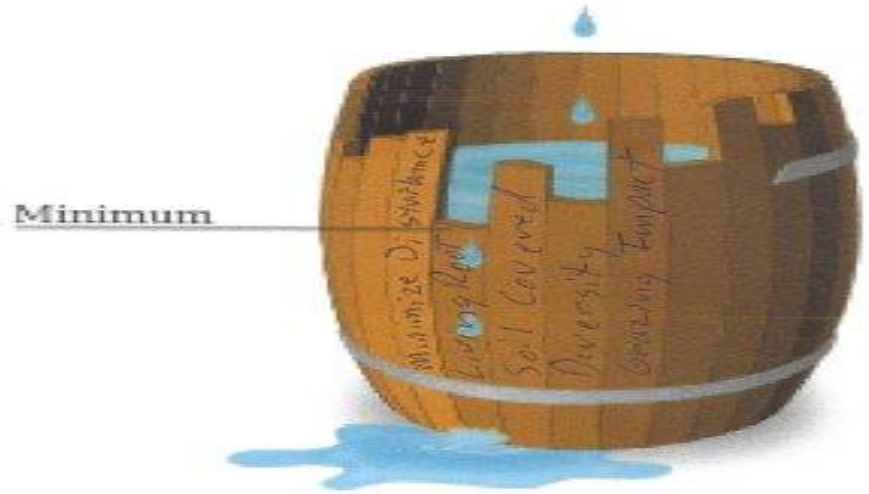
- Minimize disturbance-BOTH physical and chemical
- Keep the soil covered
- Keep a living root
- Maximize diversity
- Utilize managed ruminant impact

Where did it all go?

Liebig's Law of the Minimum

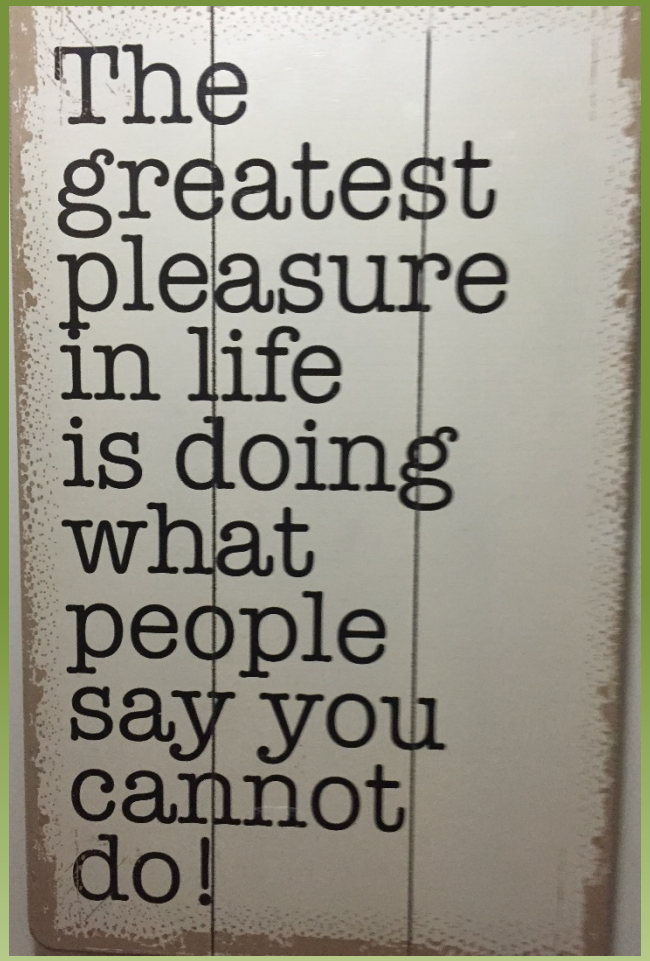


Montgomery's Holistic Law



Five Universal Principles of Soil Health

Diversity in Action


The
greatest
pleasure
in life
is doing
what
people
say you
cannot
do!

Who says I Can’t ?

Gratitude


Gratitude
It's not happiness that brings us gratitude.
It's gratitude that brings us happiness.

Keep the Soil Covered

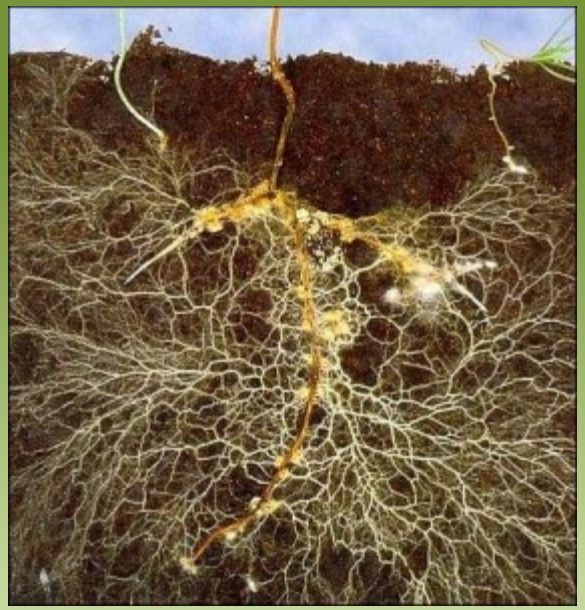
- Erosion Protection
- Stabilize Microbiome

Best Management Practice?

Minimize Disturbance

- Physical
- Chemical

Mycorrhizal Fungi



Maintain a Living Root

- Energy source for Mycorrizhal Fungi
- Free Carbon Pump

Increase Diversity

- You can’t have healthy soils without diversity.
- Solves many agronomic problems.

Nature is our template.

Graze When Possible

- Strategic Animal Impact
- Use Managed Grazing to Accelerate Soil Improvement

If These Principles Work So Well, Why Aren't They Practiced More Widely?

#1 Government Subsidized Crop Insurance

- Stifles Diversity
- Discourages Innovation
- Promotes Poor Agronomic Practices

#2 Land Tenure

- Most Acres on <3 year lease
- When Landowners understand the difference between Regenerative and Degenerative practices…

#3 Attitude

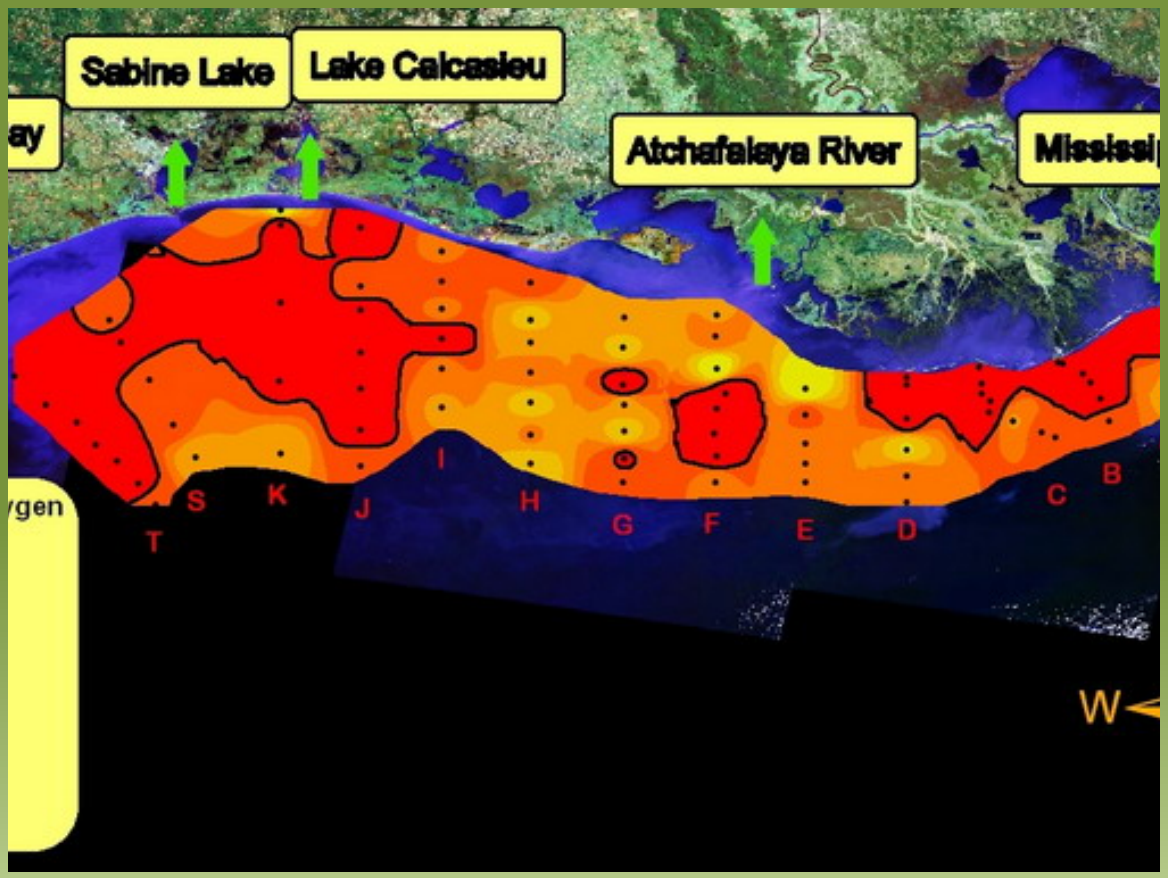
- Proud to do it the way grandad did it
- Fear of Failure

Thank You!

Resilience

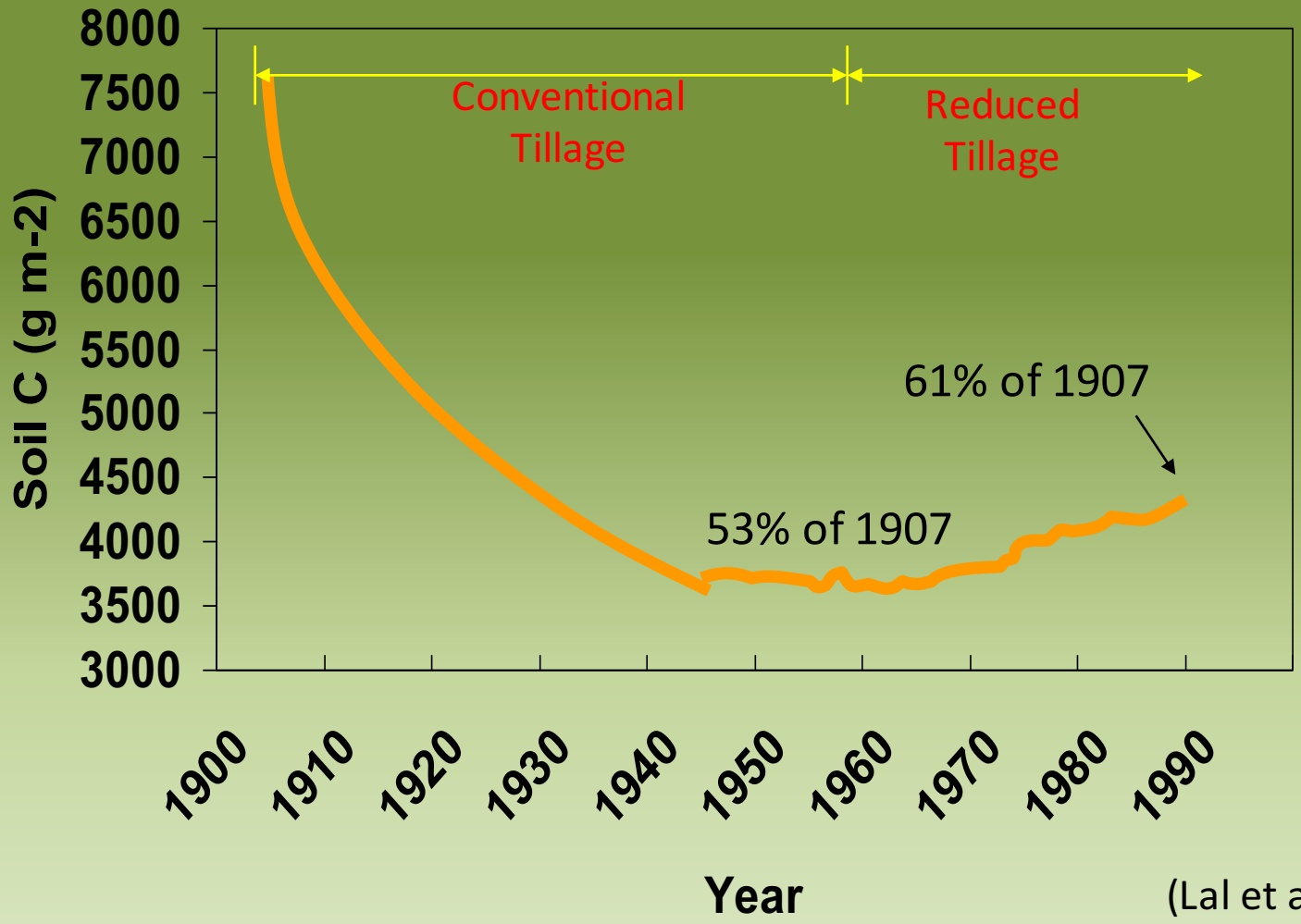
- The ability of the system to revert to its original or near original level of performance or state that existed before the impressed forces altered it. (Eswaran 1994)

How Resilient does this look?



Hypoxic Zone-Gulf of Mexico

Historic Loss of Soil Carbon



(Lal et al., 1998)

Signs of Degenerative Agriculture

- Soil Quality and Organic matter in decline
- Soil Erosion and Nutrient Leaching causing problems off the farm
- Each unit of output requires more input
  - Resistant bugs
  - Resistant weeds
  - Less mineralized Nitrogen, have to add more
  - ETC, ETC…

Broker Performance

- If you had money invested with a manager who lost half of it over a 60 year period, what would you do?

You’re Outta Here!

Resilience

- **1**. the ability of a substance or object to spring back into shape; elasticity.

- **2**. the capacity to recover quickly from difficulties;

Honest evaluation

- Our soil resource is in decline
- “We have the technology, we can rebuild it”
- We have an education gap, not a technological gap.

An Observation:

- In nature, manmade solutions tend to degrade resources over time. Natural solutions tend to improve resources over time.

Good news-win/win

- “Good soil health practices are driven by efficiency, good soil health is a byproduct”

-Scott Vaessen, Tabitha Farming Company, Griffith Australia

.5%OM to 1.5%OM=30% increase in yield with same input!

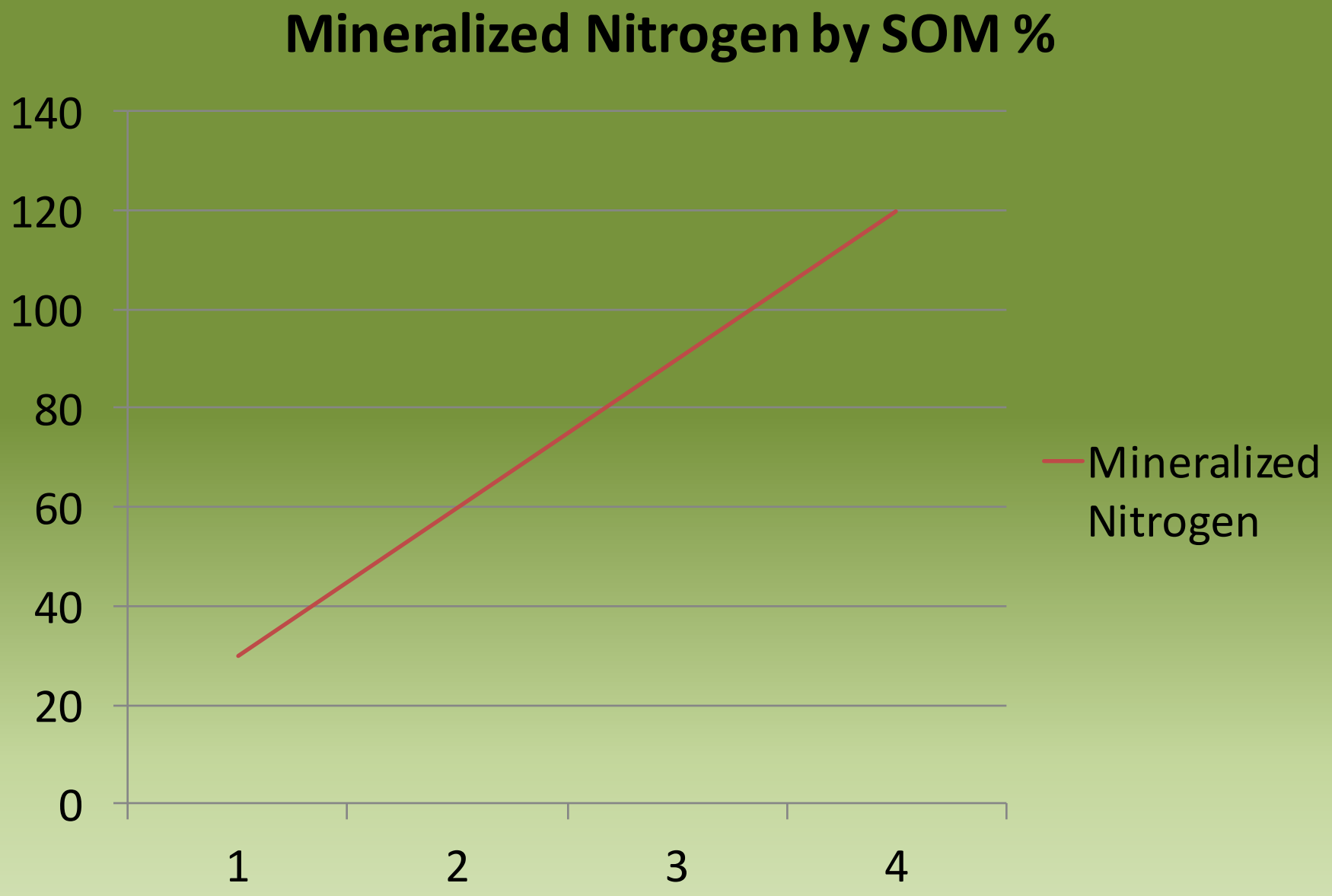
Nature is Complex

Need to Simplify

- Rebuild Organic Matter
- Facilitate Soil Biology
- Increase Diversity

“It’s the Organic Matter Stupid”

- The sun’s energy is our free resource.
- In 20 years, gone from 2%-4% O.M.
- Every 1% O.M.=1,000lbs Nitrogen in top 12”
- Mineralize from 2-4% annually
- @3%=60lb N/year
- $30/acre annuity


Mineralized Nitrogen by SOM %
140
120
100
80
60
40
20
0
1
2
3
4
Mineralized Nitrogen

Water Holding Capacity

- For every 1% O.M. in top 12”= the soil can store approximately 1” water.
- How much is a 2” rain in August worth?
- 20bpa*$4.50=$90/acre

How do you build SOM?

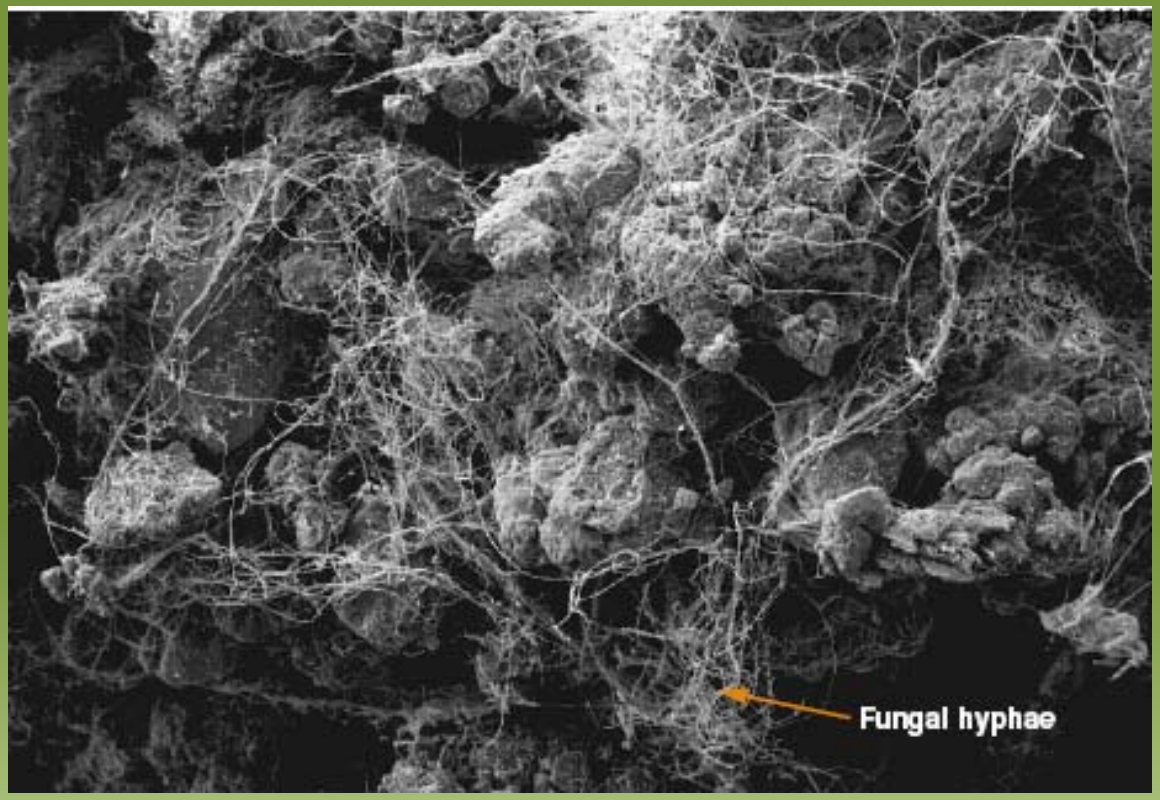
- Minimize tillage
- Grow more roots

Minimize/Eliminate Tillage

- Whenever we till, we oxidize SOM and we disrupt soil livestock.

.

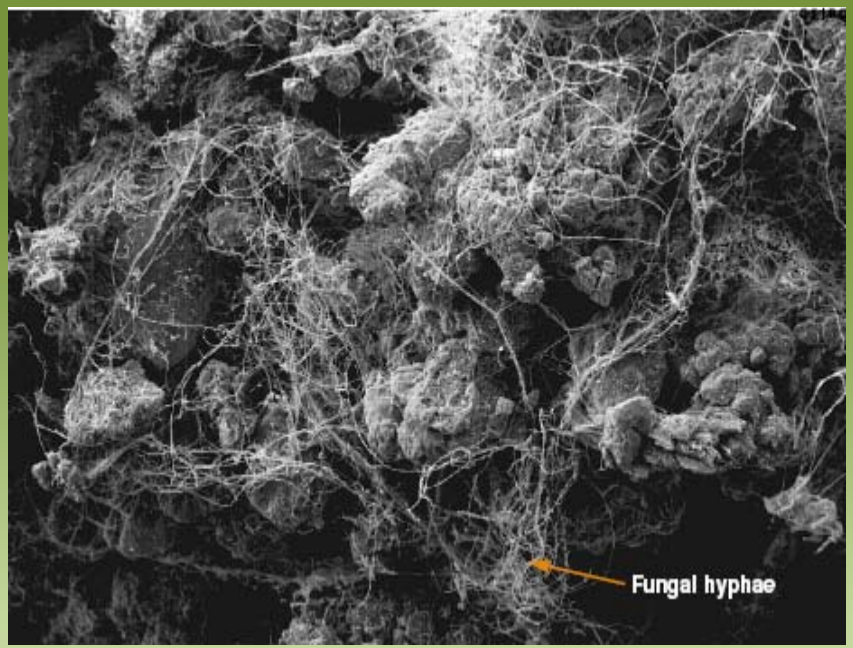
- Building SOM=Using the sun's energy to pump carbon into the soil via growing roots.



Fungal Hyphae-Soil Livestock

Fungi, more so than bacteria, enhance soil physical structure and add chemical compounds that bind soil aggregates and serve as building blocks for organic matter

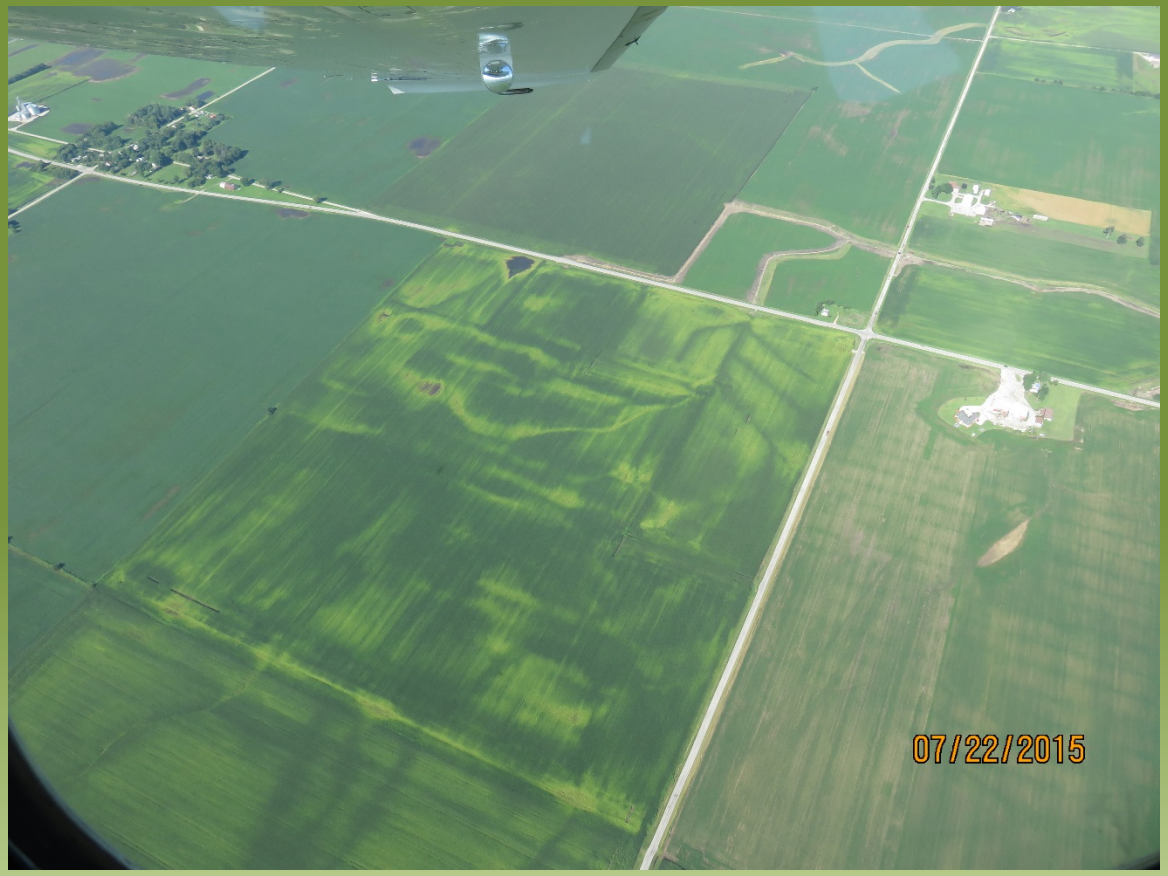
There are more living organisms in a teaspoon of healthy soil than there are people on the planet.



How do you encourage active soil biology?

- Soil livestock have to breathe
- Soil livestock need food
- Soil livestock appreciate shelter

Aerobic



Anaerobic

Tough year for soil livestock in this neighborhood

Livestock need food and cover.

Any Questions?

Diversity

When the going gets tough…

- Survivors diversify!

In Australia and New Zealand… (Read unsubsidized agriculture)

- The average crop farmer raises at least 5 different crops.
- 80% of crop farms also have livestock.

Basic Ecological Principle

- Increased Diversity=Increased Resilience

	Conventional	Soil
	Average	Health
Yield	167	222
Price	$4.00	$4.00
Premium		$0.60
Revenue	$668.00	$1,021.20
Expenses:		
Seed	$118.00	$61.00
Nitrogen	$90.00	$60.00
Phosphorus-removal	$25.38	$33.74
Potassium-removal	$14.88	$19.78
Lime	$9.00	$6.00
Herbicide	$30.00	$30.00
Freight and Drying	$50.10	$66.60
Cover Crop	$0.00	$25.00
Fungicide and Insecticide	$25.00	$0.00
Machinery	$93.00	$73.00
	$455.36	$375.12
Net Per Acre Before Land Cost	**$212.64**	**$646.08**
Land Payment(PV=8,500,n=20,i=4.2)	636.57$	$636.57
Surplus/(Deficit)	**-$423.93**	**$9.51**

Crimson Clover

How am I going to plant into this?

Planting into 12-way mix

Which one is more resilient?

Simple practices that increase resiliency

- Minimize Tillage
- Keep Something Growing all the time
- Increase Biodiversity
- Rebuild Mycorrhizal Network

Barriers to Adoption

- Subsidized Crop Insurance
- Short term interest in the land
- Lack of Knowledge of healthy soil function

- “The biggest barrier to agricultural progress is between the ears”

-Kristine Nichols, soil microbiologist

In Conclusion

- Problems are Opportunities
  - Knowledge-based economies reward those that apply knowledge to solve problems.
  - Competitive Advantage in economics and relationships
  - Not suggesting sacrifice, but rather a strategy to improve infrastructure.

Benefits

- Increase Land Value
- Increase Profitability
- Decrease Dependence on Band-Aid Solutions
- Minimize Erosion
- Minimize Nutrient Losses
- Minimize Purchased Inputs
- Enhance Landscape
- Minimize Risk-Allow You to Deal Better with Extremes!

Crimson Clover N-Rate Study
Purdue University

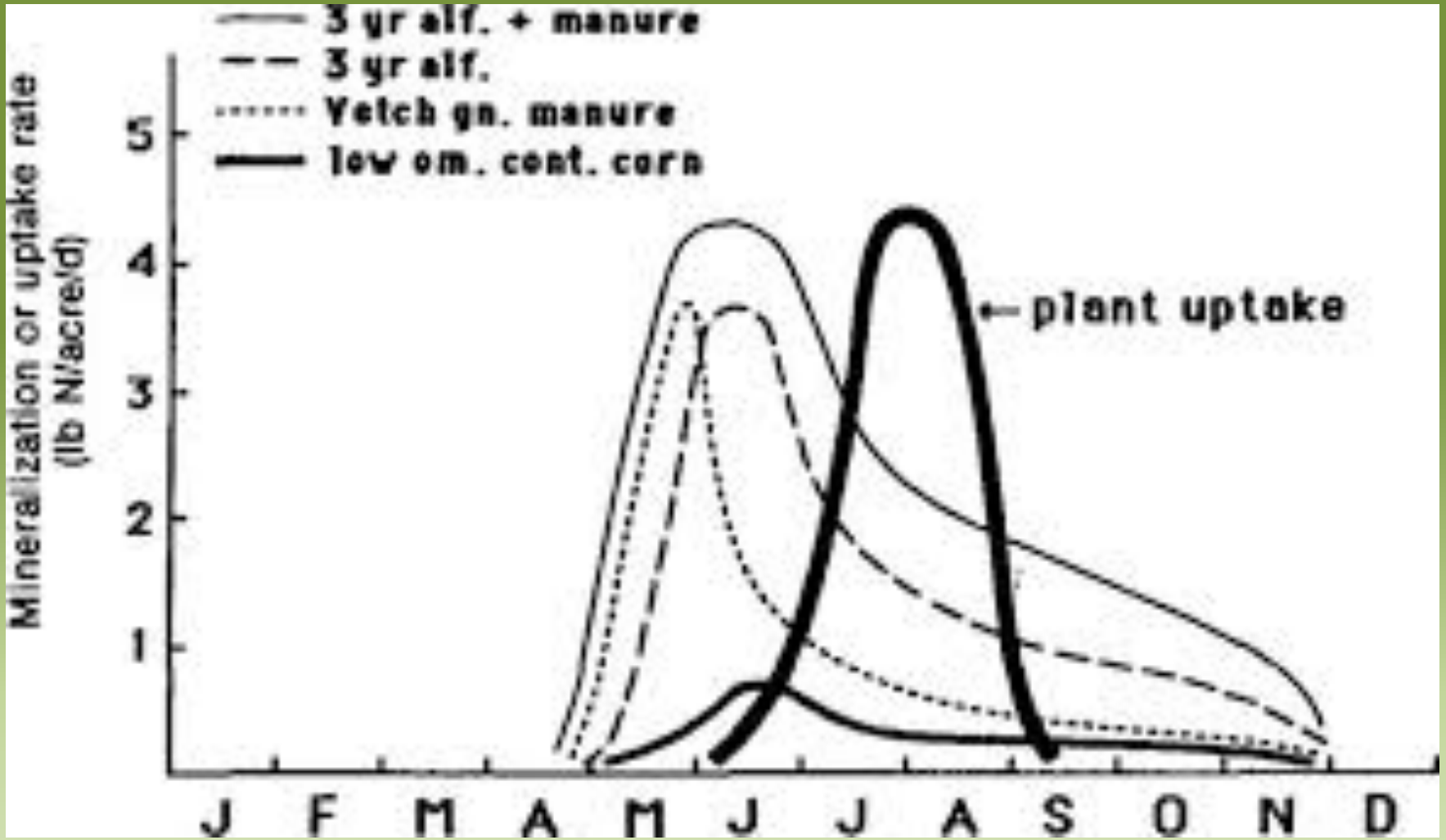
N fertilizer rates:																		
1)	"normal" rate																	
2)	30 lbs less																	
3)	60 lbs less																	
			Replicate 1						Replicate 2						Replicate3			
	Early	Early	Early	Late	Late	Late	Early	Early	Early	Late	Late	Late	Early	Early	Early	Late	Late	Late
	normal	-30 lbs	-60 lbs	normal	-30 lbs	-60 lbs	-60 lbs	normal	-30 lbs	-60 lbs	normal	-30 lbs	-30 lbs	-60 lbs	normal	-30 lbs	-60 lbs	normal
Yield:	177.5	172.9	156.9	170.0	159.0	149.2	158.7	187.5	180.4	156.6	178.4	165.1	184.3	165.3	194.1	179.3	156.0	184.2
Moisture:	24.3%	23.4%	23.1%	24.2%	23.9%	23.9%	23.2%	24.0%	23.6%	23.7%	24.4%	24.1%	23.6%	23.2%	24.0%	24.3%	24.0%	22.9%
		169.1			159.4			175.5			166.7			181.2			173.2	
Kill Timing:																		
Early Avg:	**175.3**																	
Late Avg:	**166.4**																	
Sidedress N Rate(Normal=120):																		
Normal:	**182**																	
-30	**173.5**																	
-60	**157.1**																	

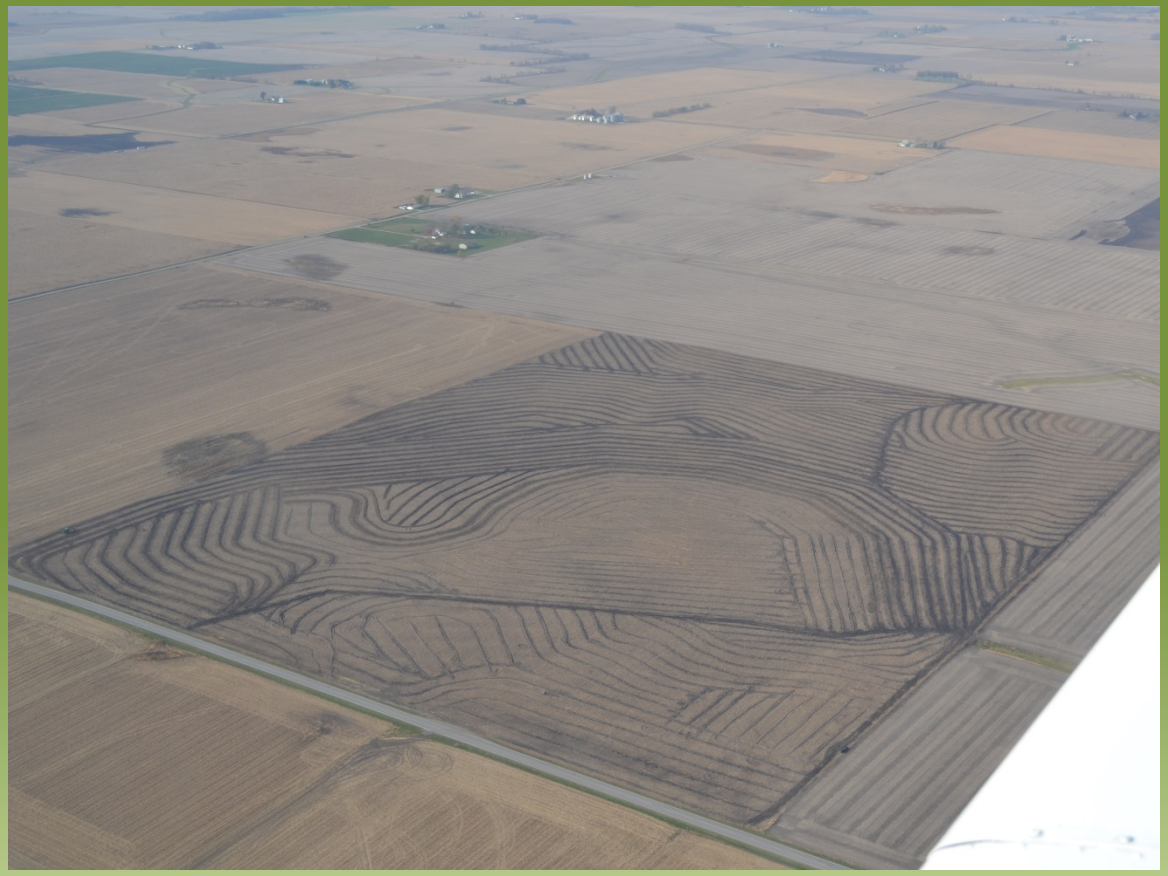
Cumulative Benefits

- $40 additional nitrogen mineralization
- $100 extra water holding capacity
- $45 extra Nitrogen production
- $100 increase due to additional O.M.

- $285 per acre
- IU handicap still leaves $142 per acre

Phase Shift


3 yr alf. + manure
3 yr alf.
Vetch gn. manure
low om. cont. corn
Mineralization or uptake rate
(lb N/acre/d)
1
2
3
4
5
plant uptake
J F M A M J J A S O N D



Most soil livestock are aerobic