SCIENCE OF SOIL HEALTH

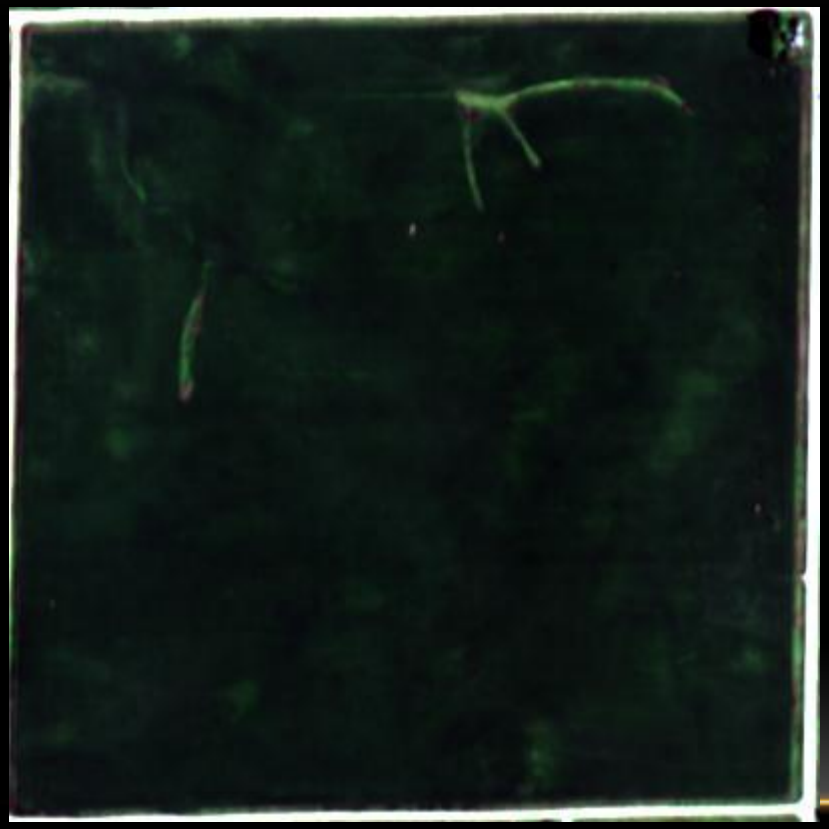
What is it worth?

KEY POINTS

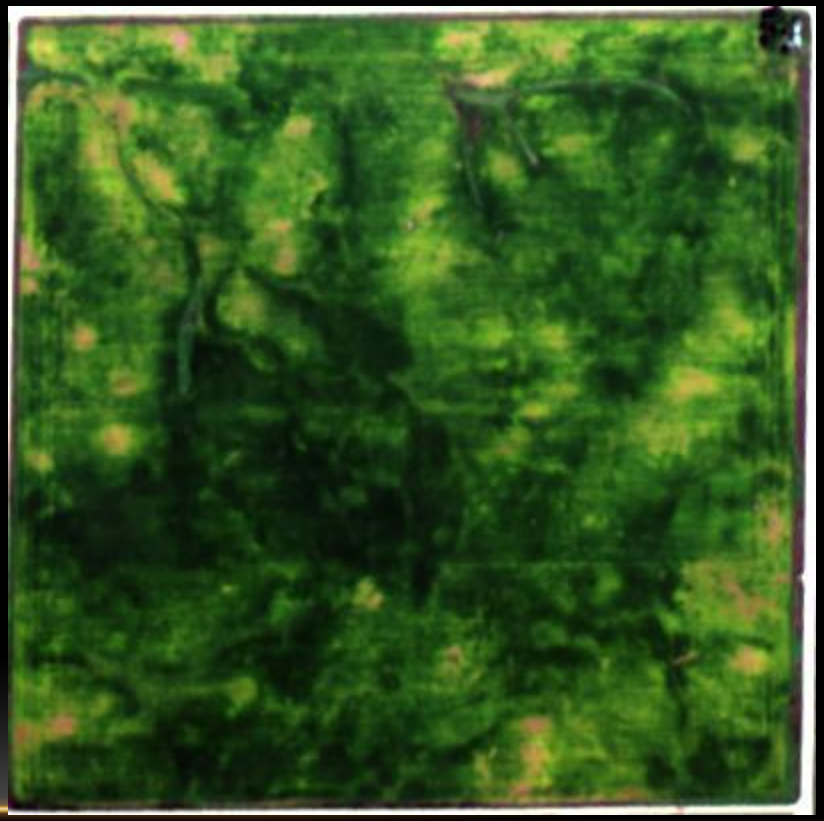
- Why soil health is important
- Examples of the impacts of poor soil
- Enhancing soil health

SOYBEAN PRODUCTION FIELD

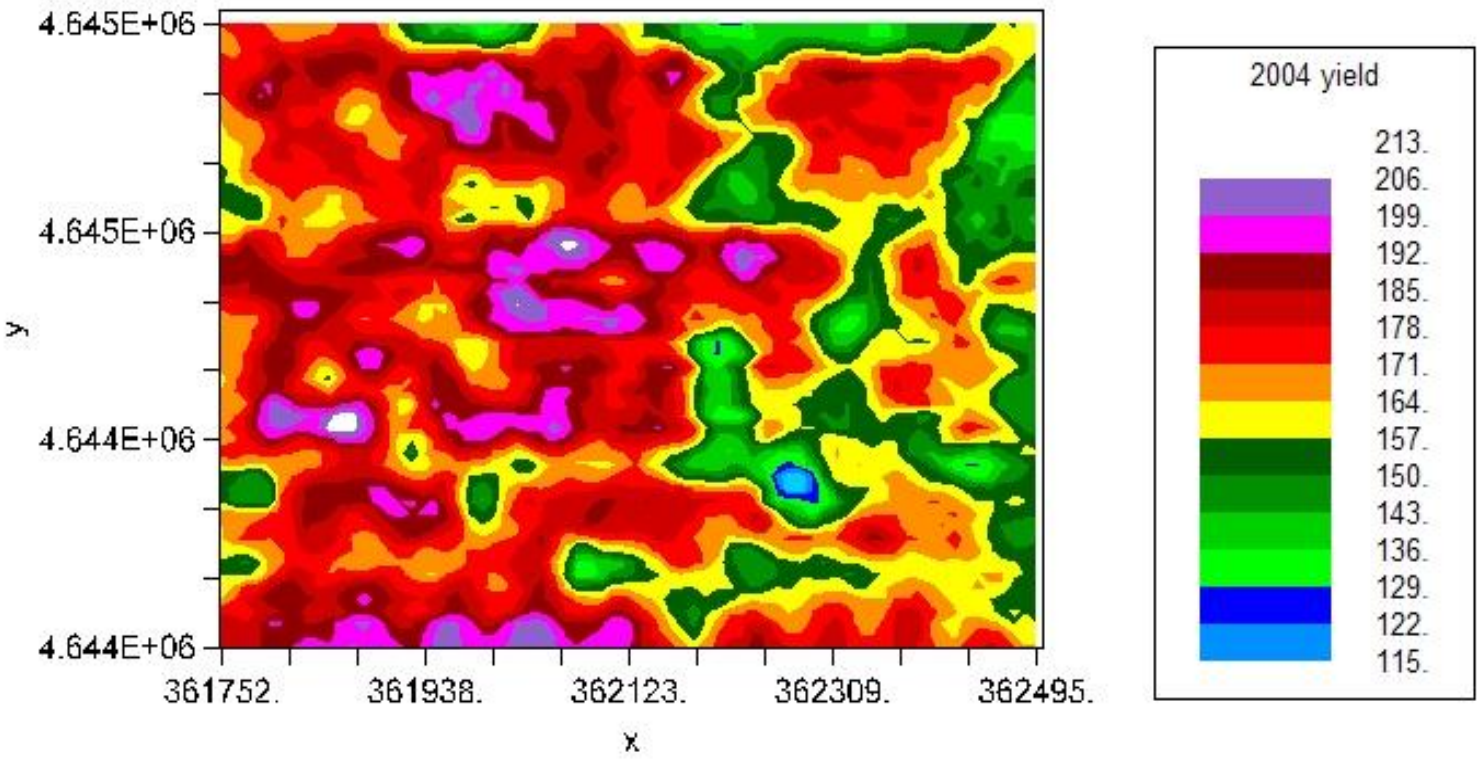
Early August



Late August

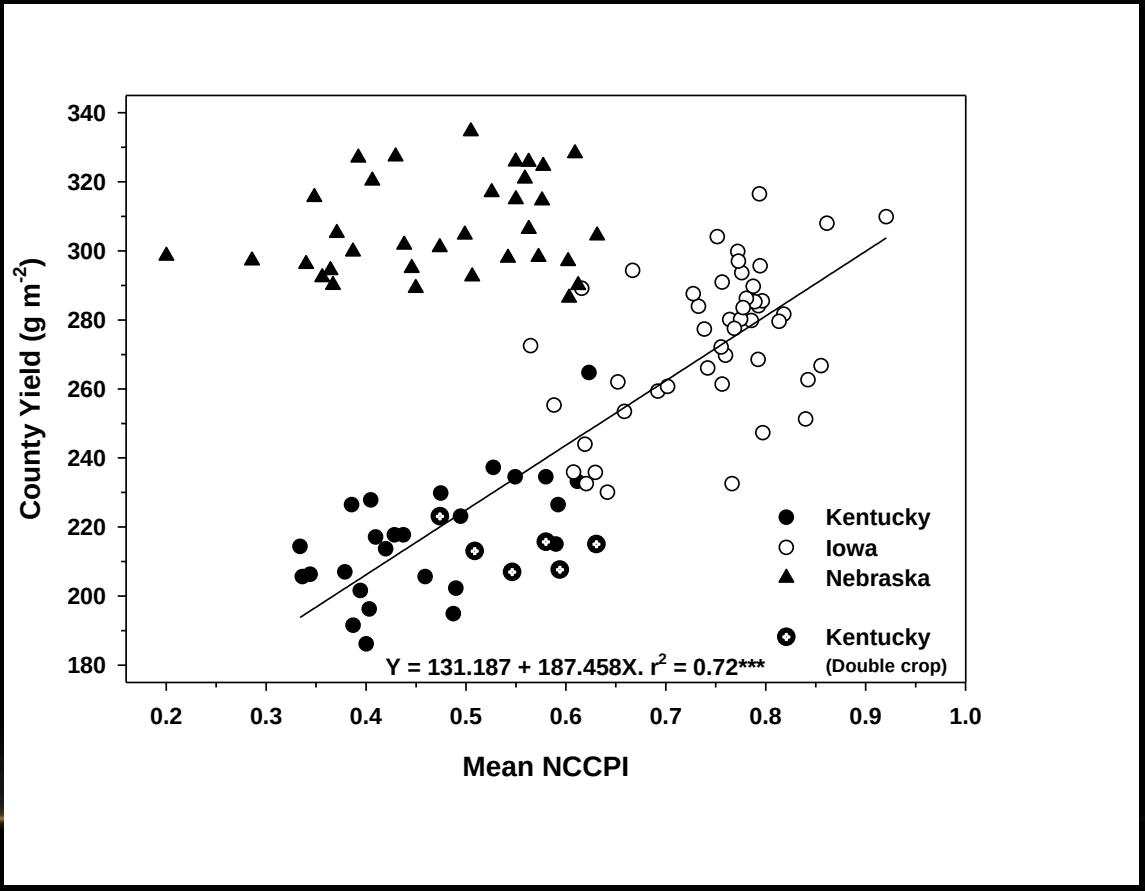


CROP YIELD VARIATION

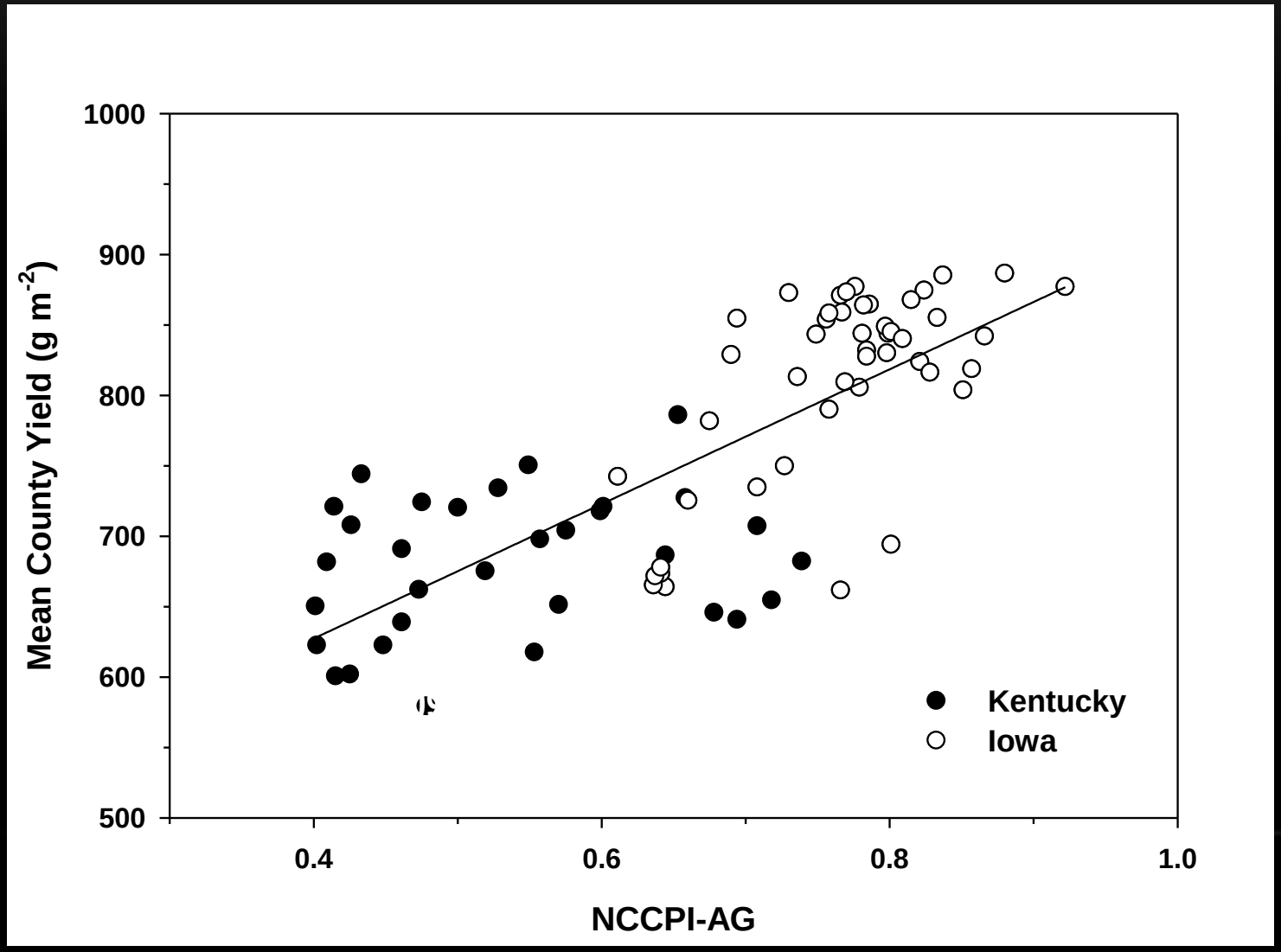


GOOD SOILS = GOOD YIELDS

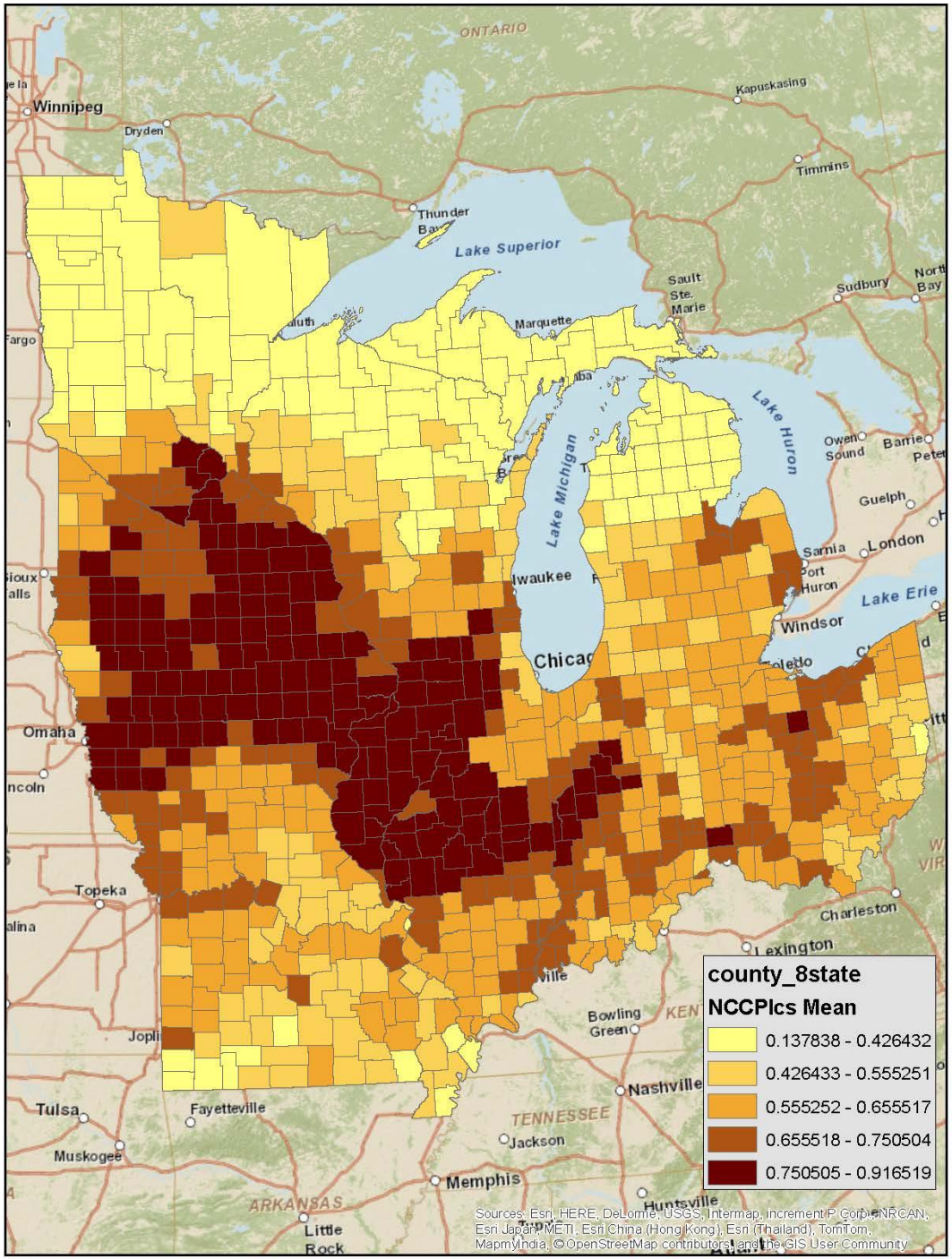
Soybean yields across Iowa, Kentucky, and Nebraska



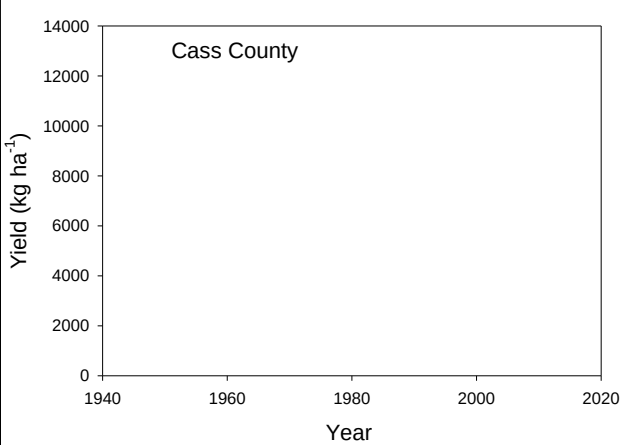
MAIZE COUNTY YIELDS

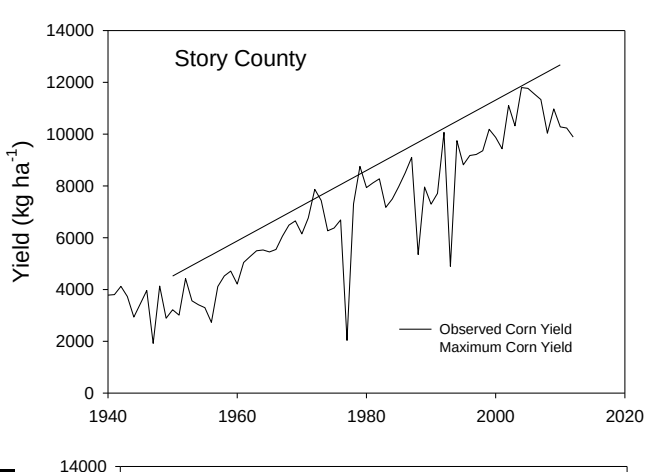


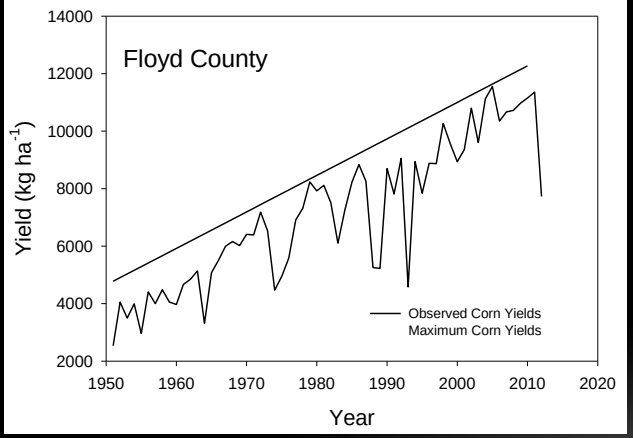
NCCPI ACROSS THE MIDWEST

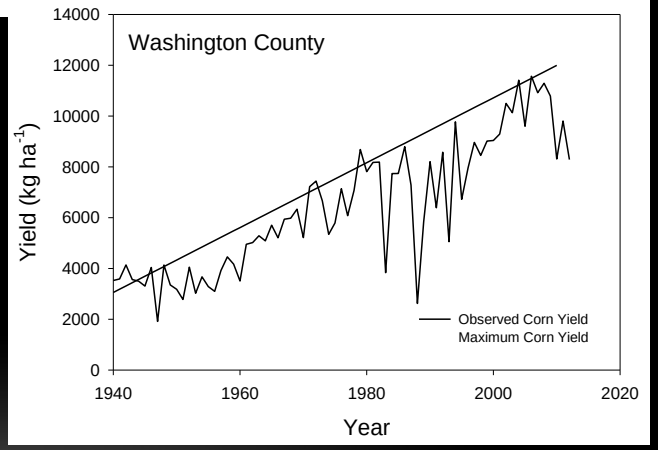


IOWA COUNTY YIELDS

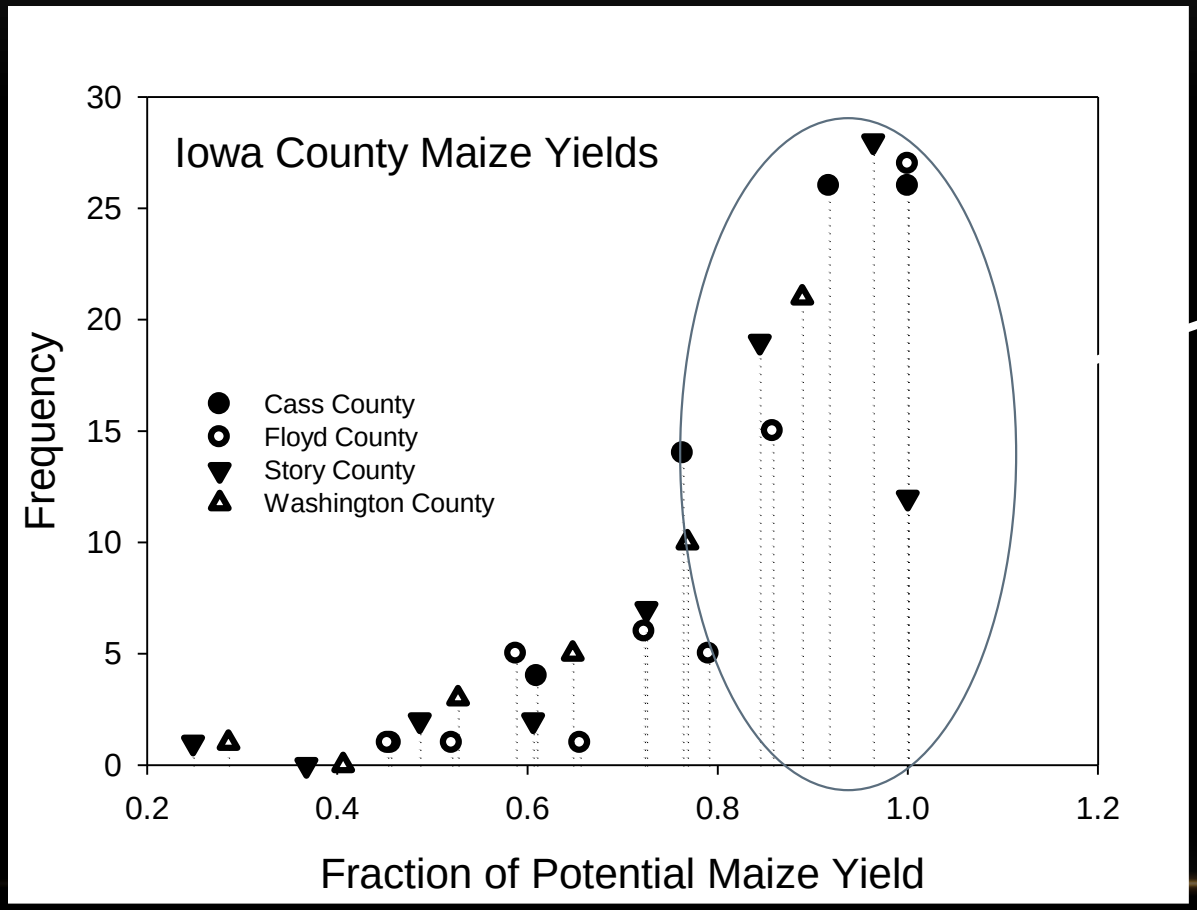








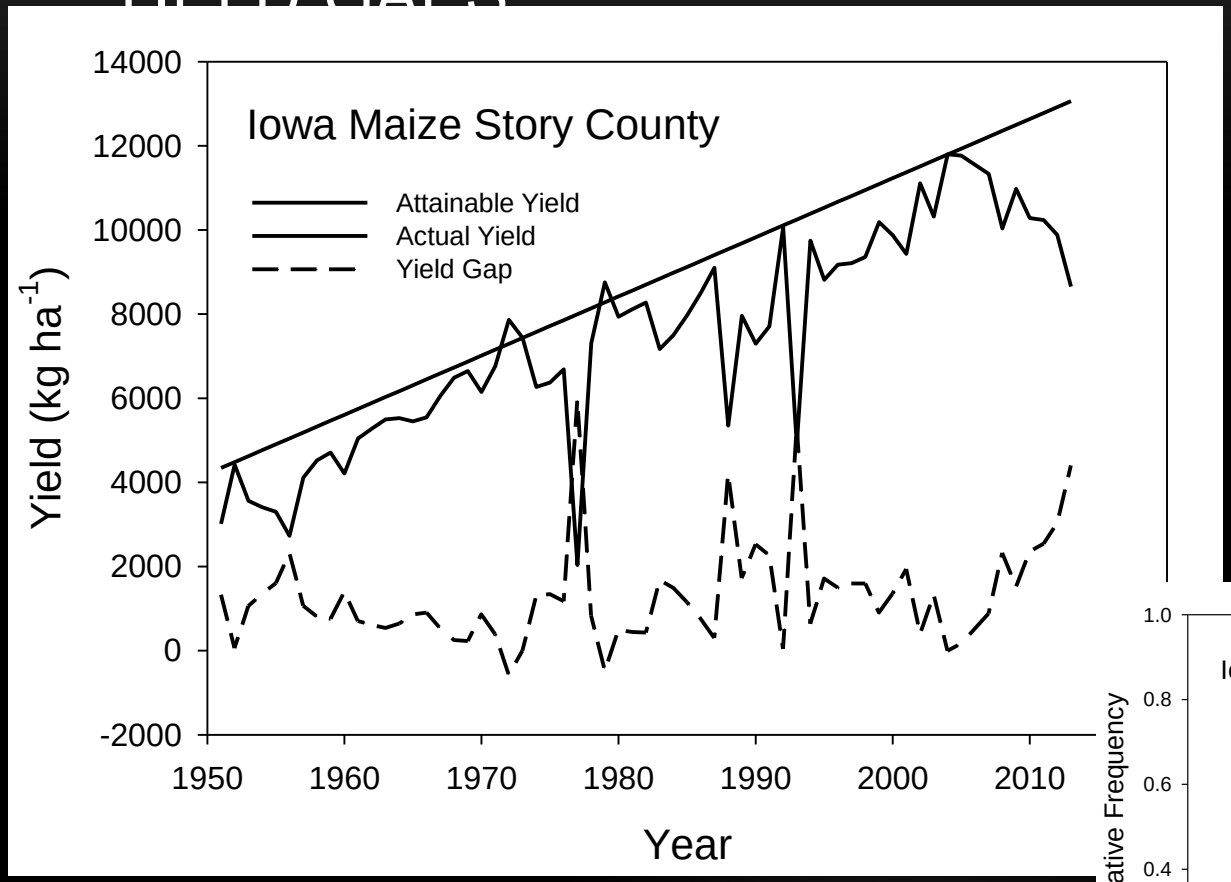
VARIATION IN YIELDS

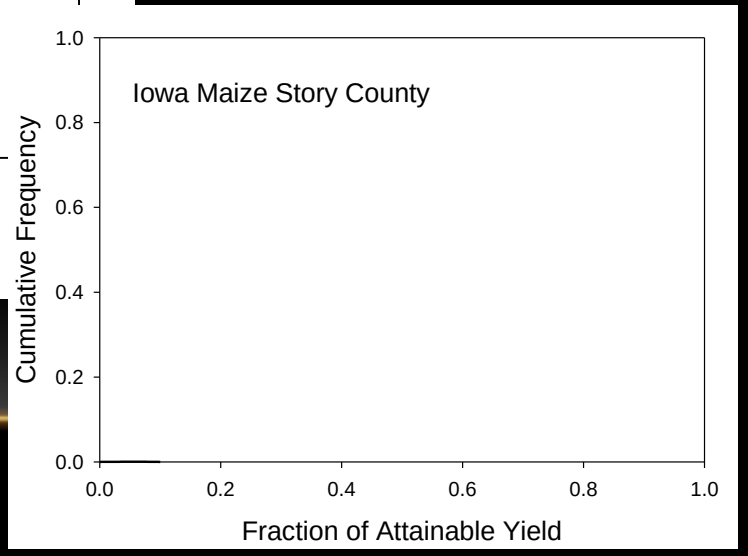


20% of the yield loss occurs 80% of the time due to water availability

The majority of the yield losses due to the weather are short-term stresses

YIELD GAPS


Iowa Maize Story County
Attainable Yield
Actual Yield
Yield Gap
Yield (kg ha-1)
14000
12000
10000
8000
6000
4000
2000
0
-2000
1950
1960
1970
1980
1990
2000
2010
Year


Iowa Maize Story County
Cumulative Frequency
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Fraction of Attainable Yield

OBSERVATIONS

- Quality soil is critical to efficient crop production
- Variation in production is due to the short-term stresses
- These degraded soils have a large economic impact across the US in terms of yield and efficiency of input use

SOIL DEGRADATION SPIRAL

Poor Land Management

Aggregation Degradation

Compaction & crusting

Water & Wind Erosion

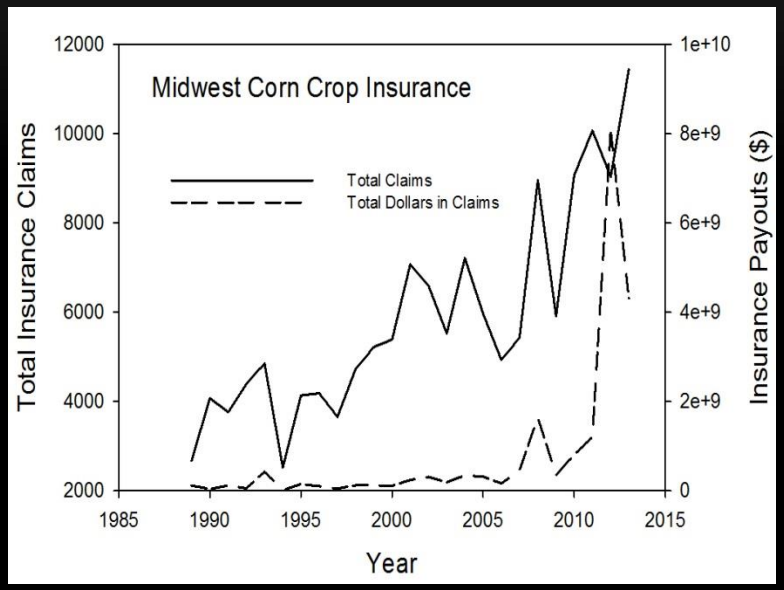
Plant Growth

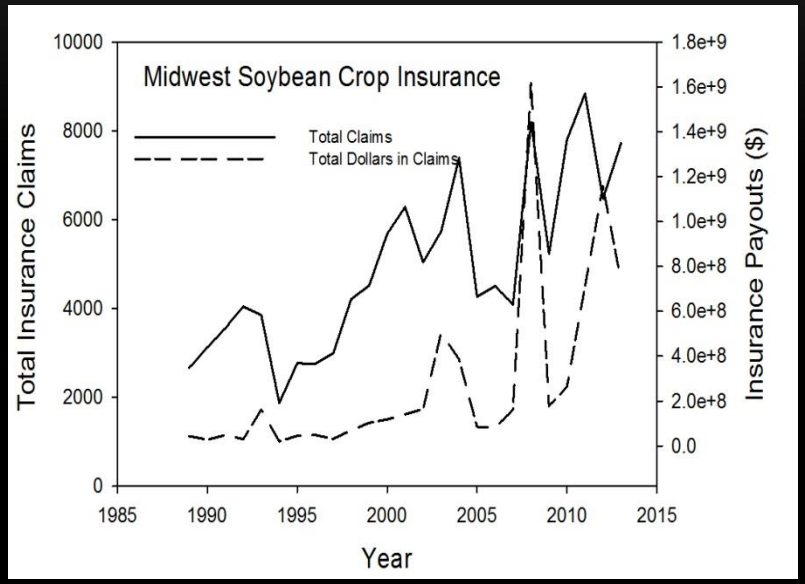
Soil Biology

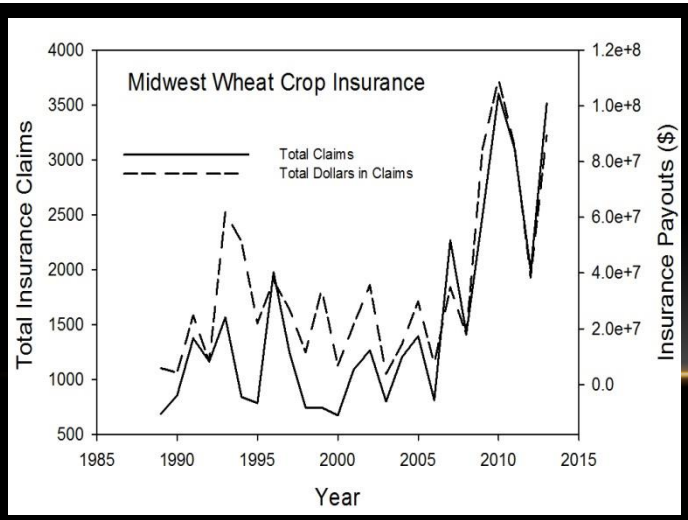
Yield

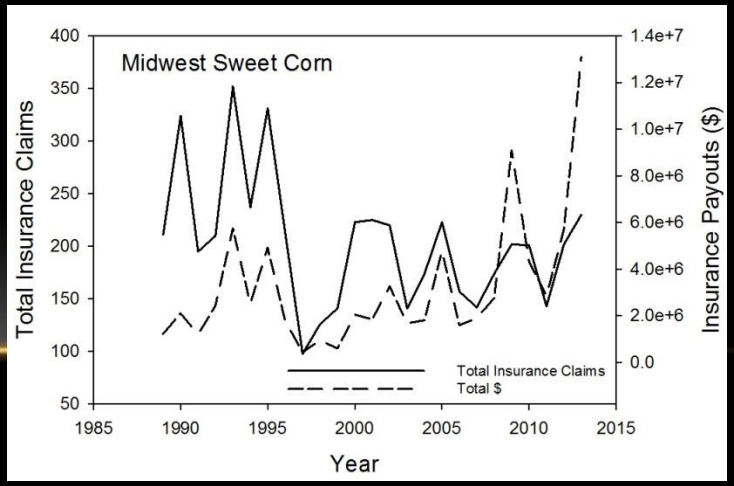
Reduced Soil Productivity

CROP INSURANCE









SOIL AGGRADATION CLIMB

Efficiency
Yield
Profit

Improved Water Availability

Improved Soil Structure

Improved Nutrient Cycling

Organic Matter Turnover

Biological Activity

BUILDING SOIL HEALTH

- Improving the soil requires a system with a stable environment for the soil biological system
- Have to couple soil biological system with a stable food source

The “living soil”, a biological system.

Mammals - gophers, moles, mice, groundhogs

Earthworms - night crawlers, garden worms

Insects and mollusks - ants, beetles, centipedes, snails, slugs

Microfauna - nematodes, protozoa, rotifers≈

Microflora - fungi, yeast, molds, mychorhiza

Actinomycetes - smaller than fungi, act like bacteria

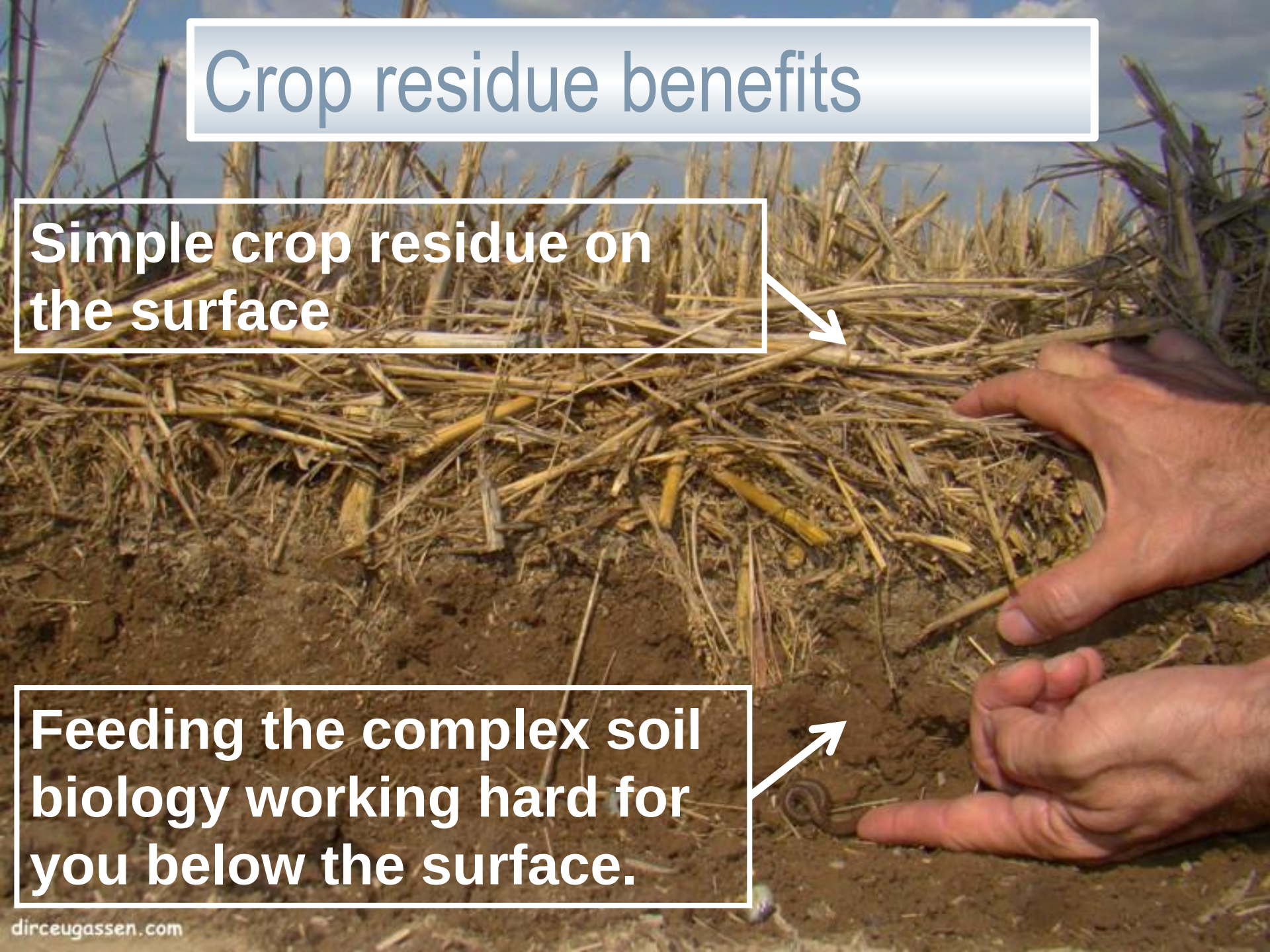
Bacteria - autotrophs, heterotrophs, rhizobia, nitrobacter

Algae - green, blue-green

≈

Earthworms, insects and rodents are “nature’s plow” and the most visible components of the “living soil” team. They work in tandem with other soil fauna, soil microorganisms and fungi to contribute to aeration and nutrient cycling as part of a “soil factory” team effort.

Crop residue benefits

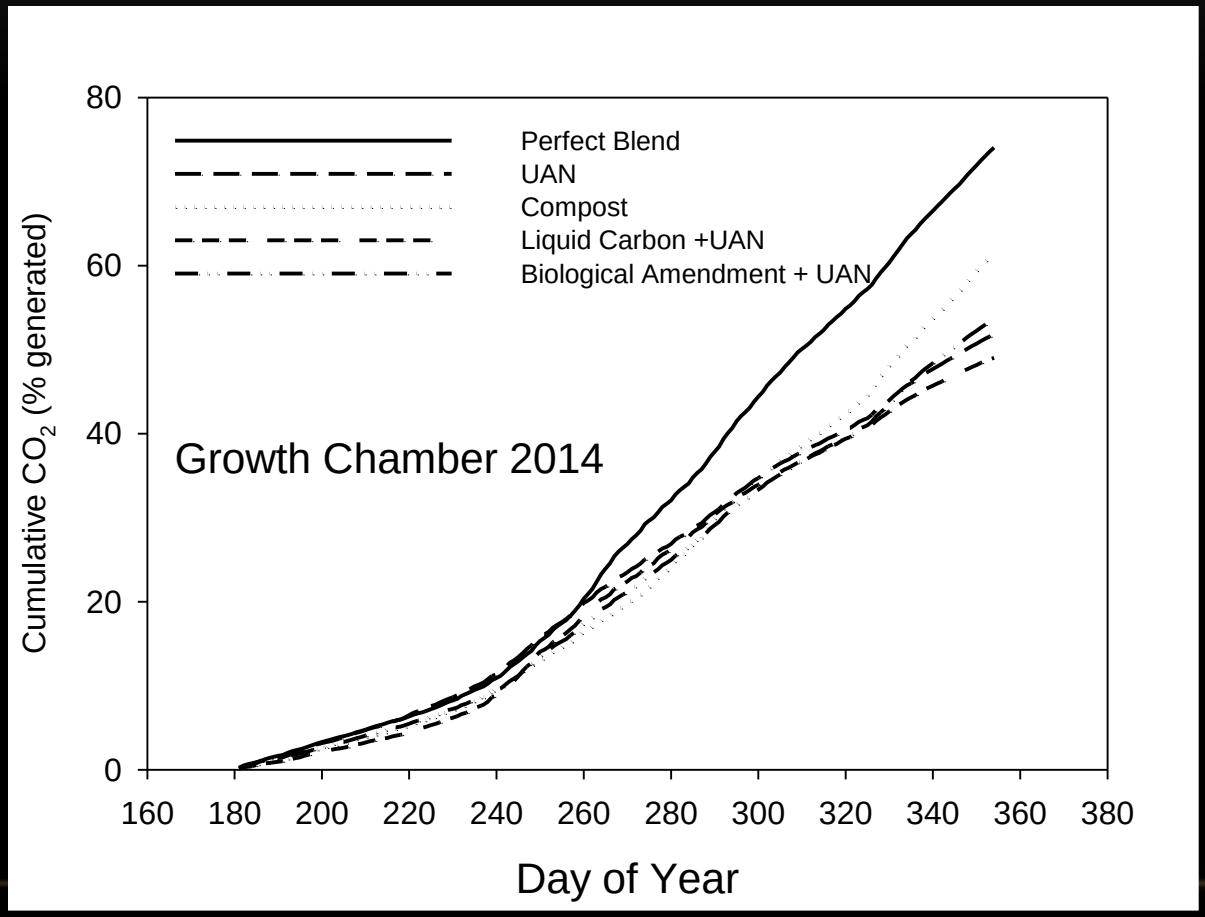


“Passive protective blanket”

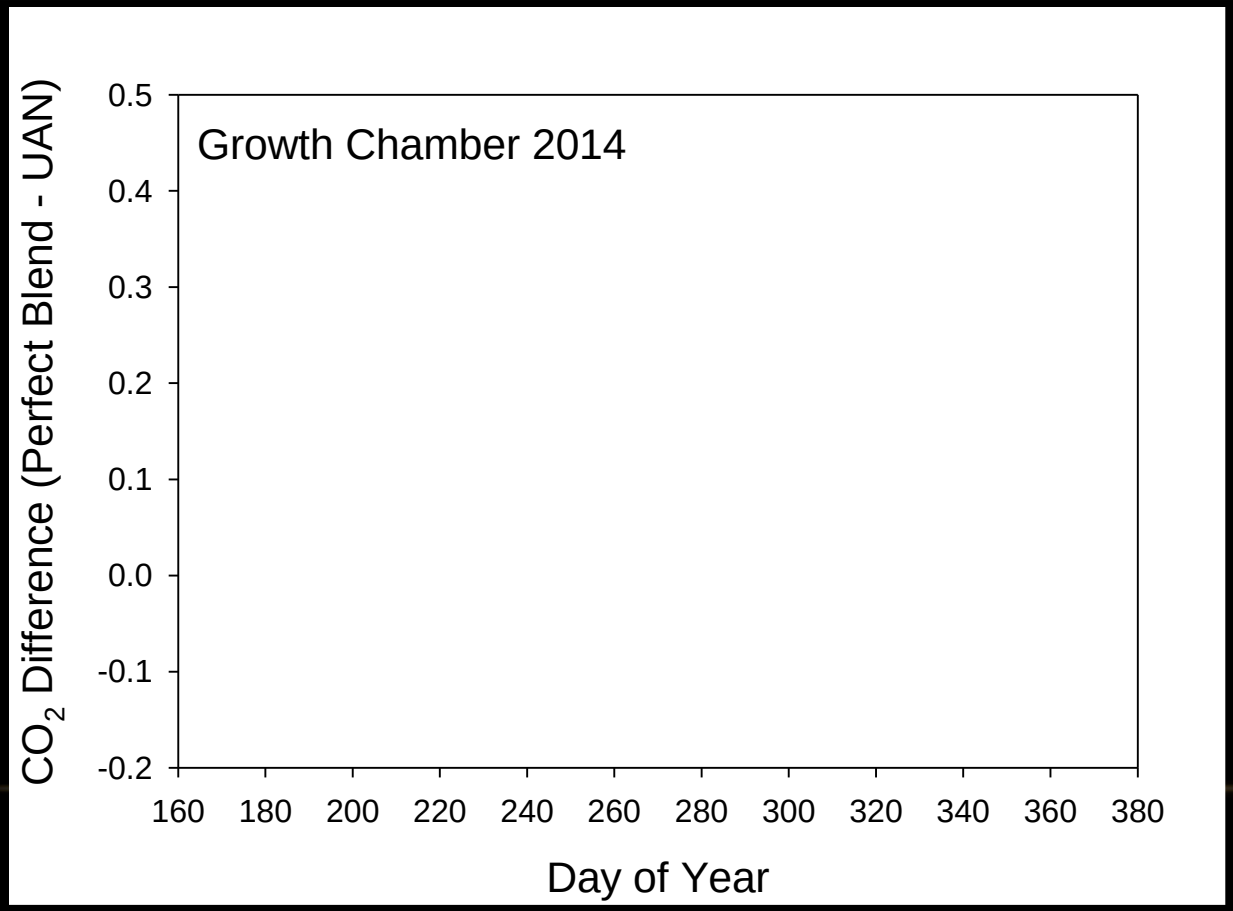
“Active protective blanket”

SOIL EXPERIMENT

CO_2 EVOLUTION



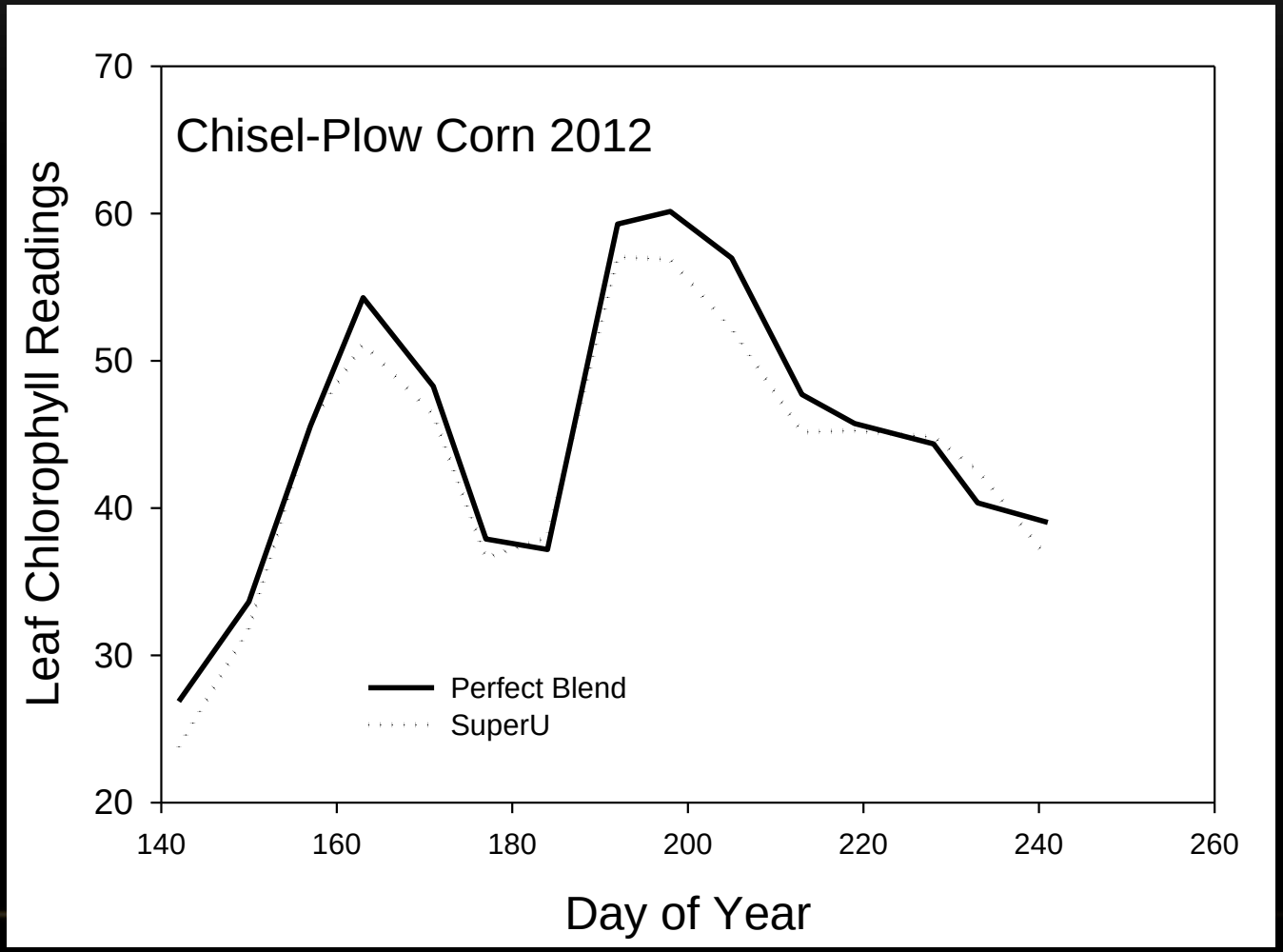
IMPACT OF TREATMENTS



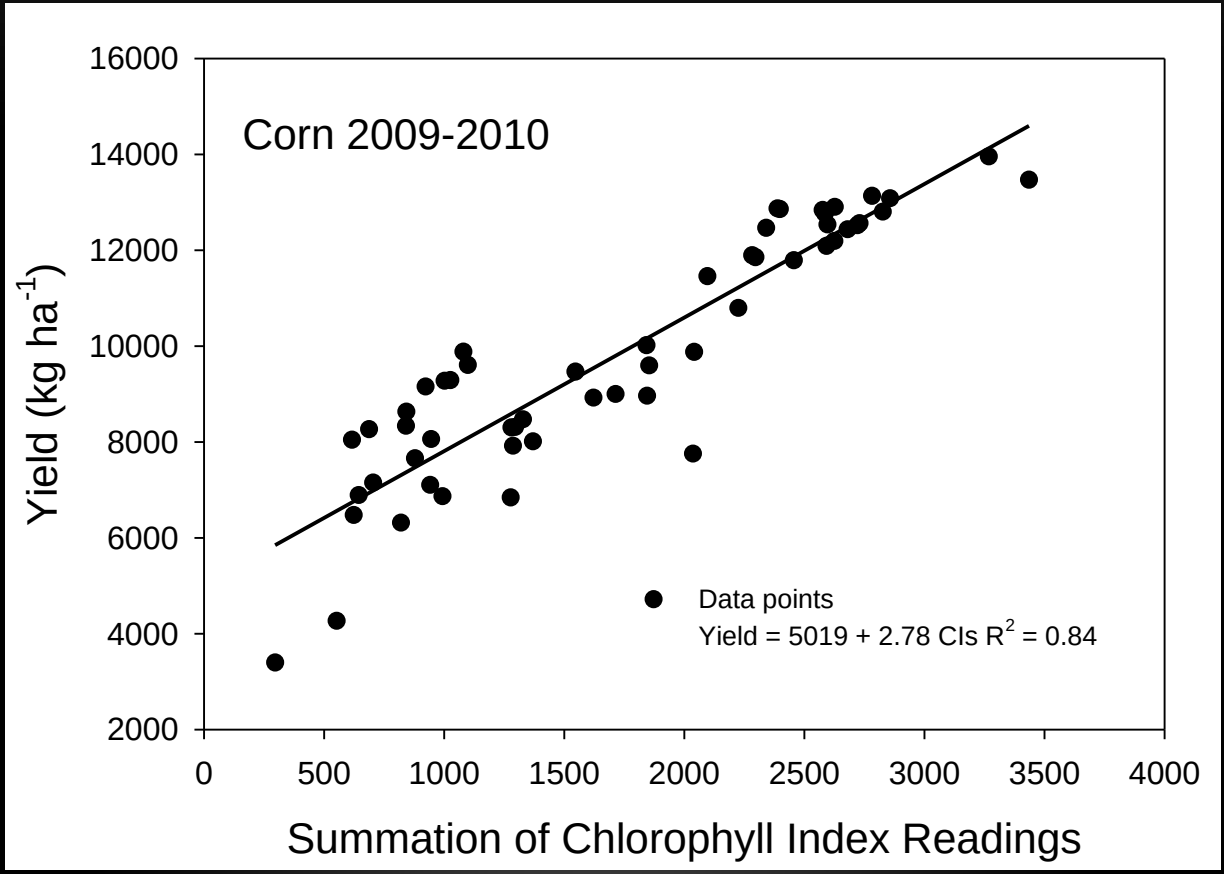
SOIL CHANGES

- Increasing soil biology increases the respiration rate
- Soil biology is critical to the formation and stabilization of soil aggregates
- Soil biology is linked to nutrient cycling in soil

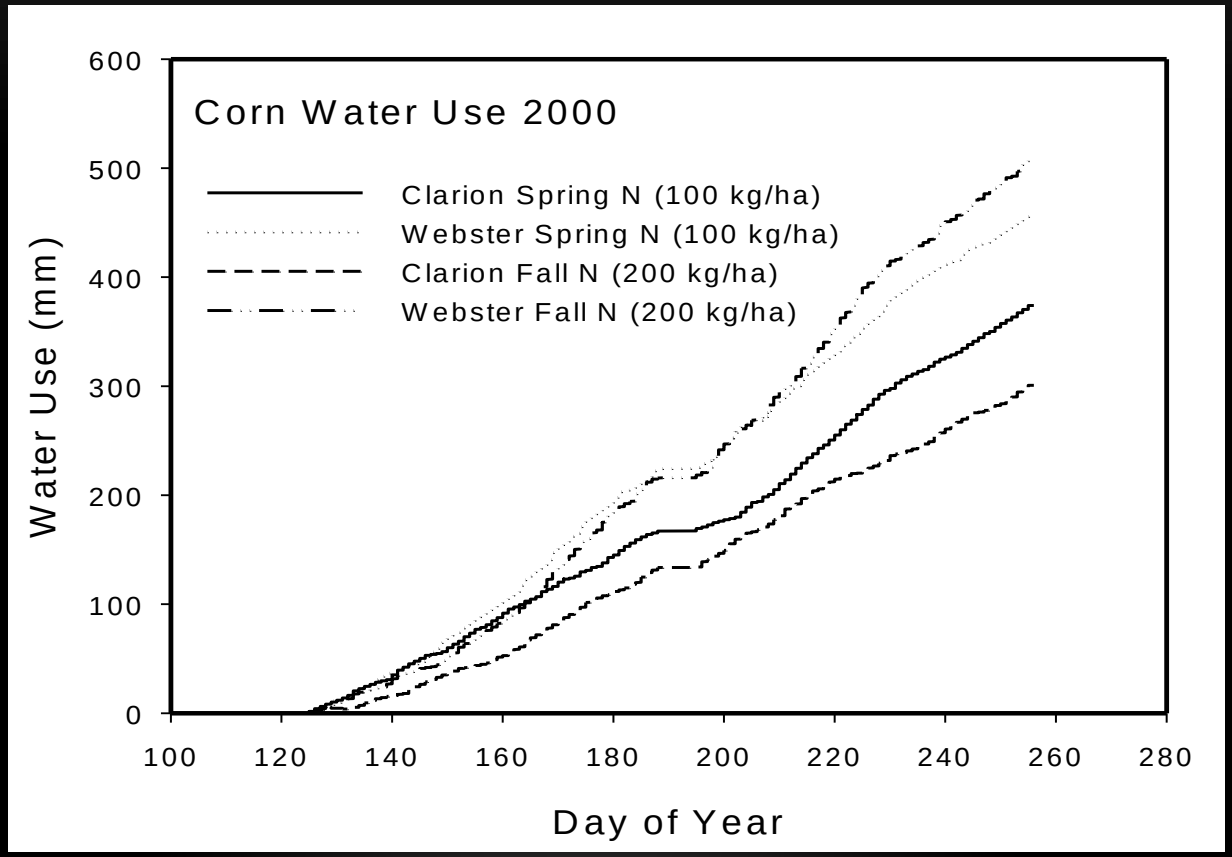
LEAF CHLOROPHYLL 2012



CHLOROPHYLL SUMMATION INDEX



SOIL WATER USE RATES



SOIL AGGRADATION CLIMB

Efficiency
Yield
Profit

Improved Water Availability

Improved Soil Structure

Improved Nutrient Cycling

Organic Matter Turnover

Biological Activity

SCIENCE OF SOIL HEALTH

- Assume we change soil health without considering that we need to use soil biology as the first step
- Recognize that biology is linked to all of attributes we consider as soil health