Reducing Yield Variability Through Soil Health

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Journey to Where?

Any Rewards?

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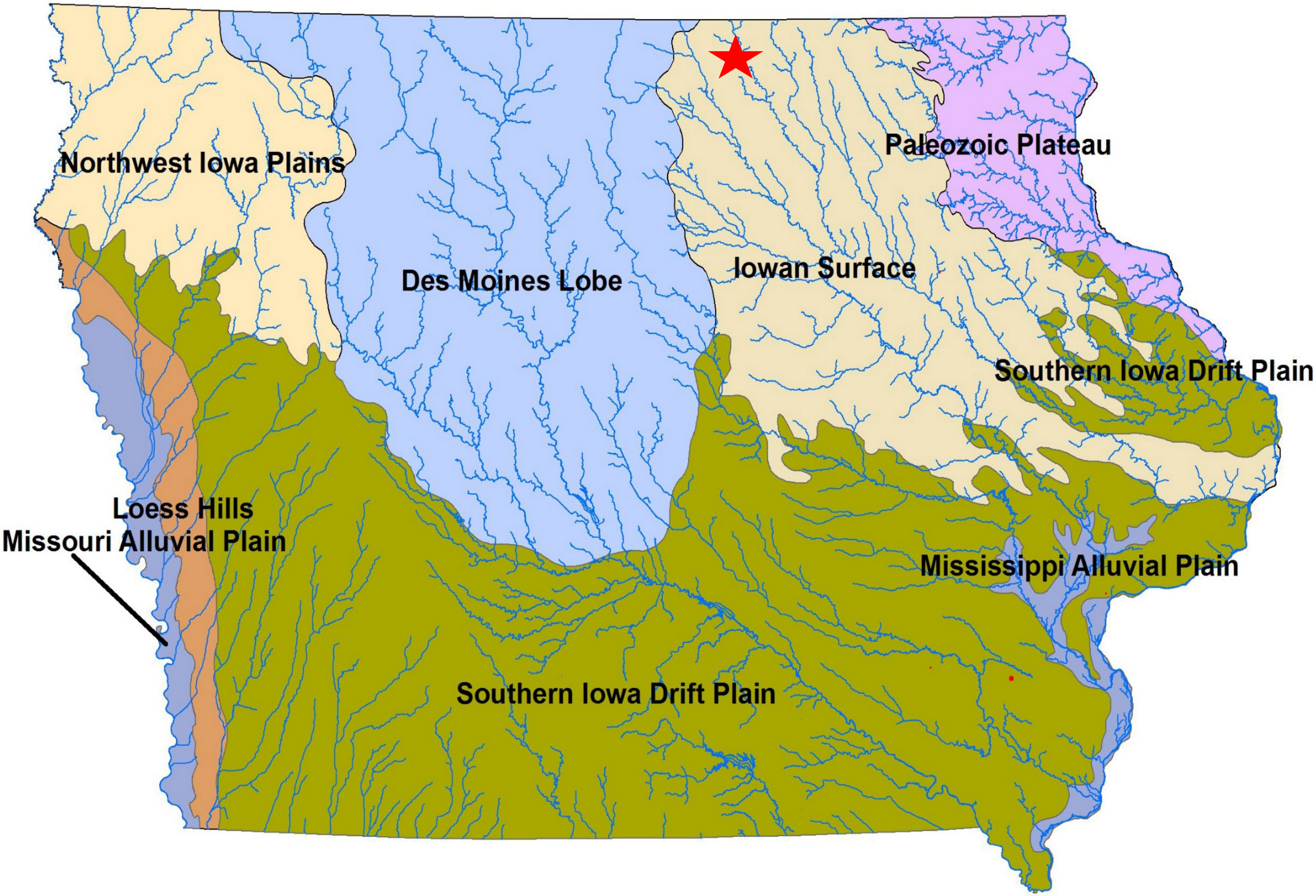

Northwest Iowa Plains
Des Moines Lobe
Iowan Surface
Paleozoic Plateau
Southern Iowa Drift Plain
Loess Hills
Missouri Alluvial Plain
Mississippi Alluvial Plain
Southern Iowa Drift Plain

First Fork in the Road

NO TILL BEANS

Winter 1991-92

Froze early, no plowing

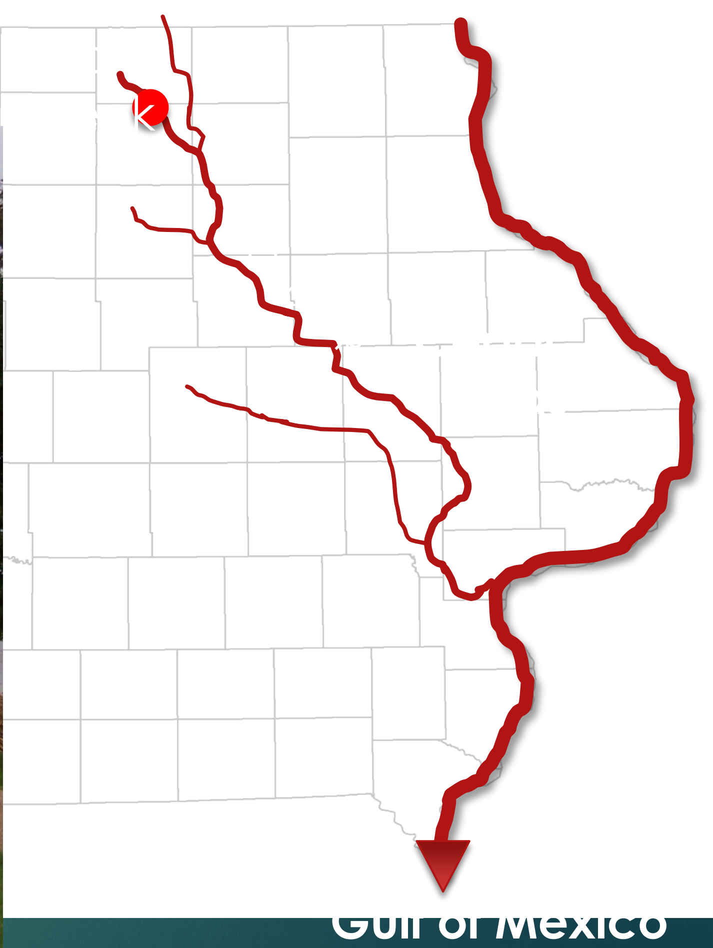
Second Fork in the Road

Strip Till Corn

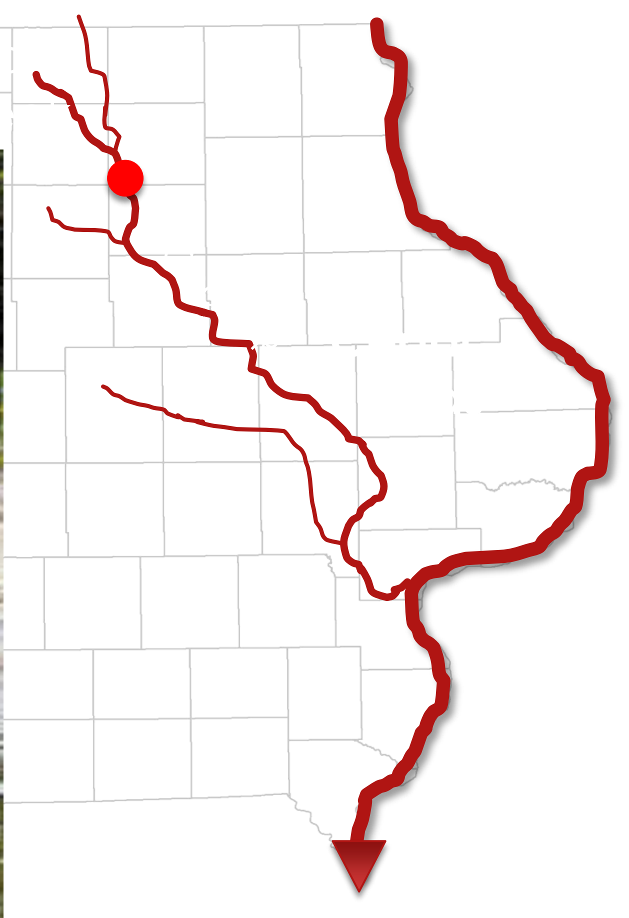
Third Fork in the Road

Cover Crops

Rock Creek – June 8, 2008



Charles City – June 9, 2008



Gulf of Mexico

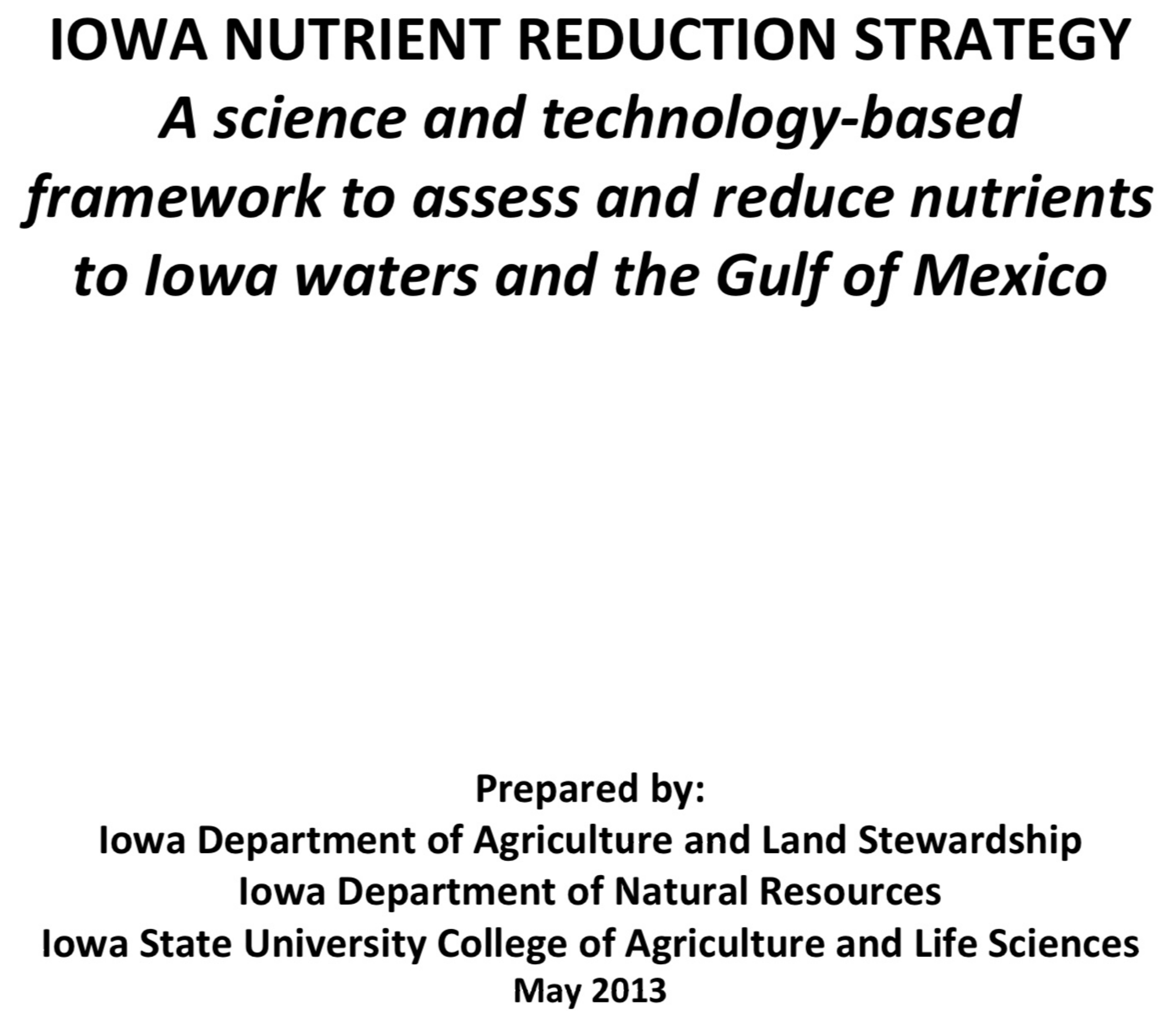
Cedar Rapids – June 13, 2008

Gulf of Mexico

Elected to Iowa Soybean Association Board 2009

Heavily involved with On-Farm Network

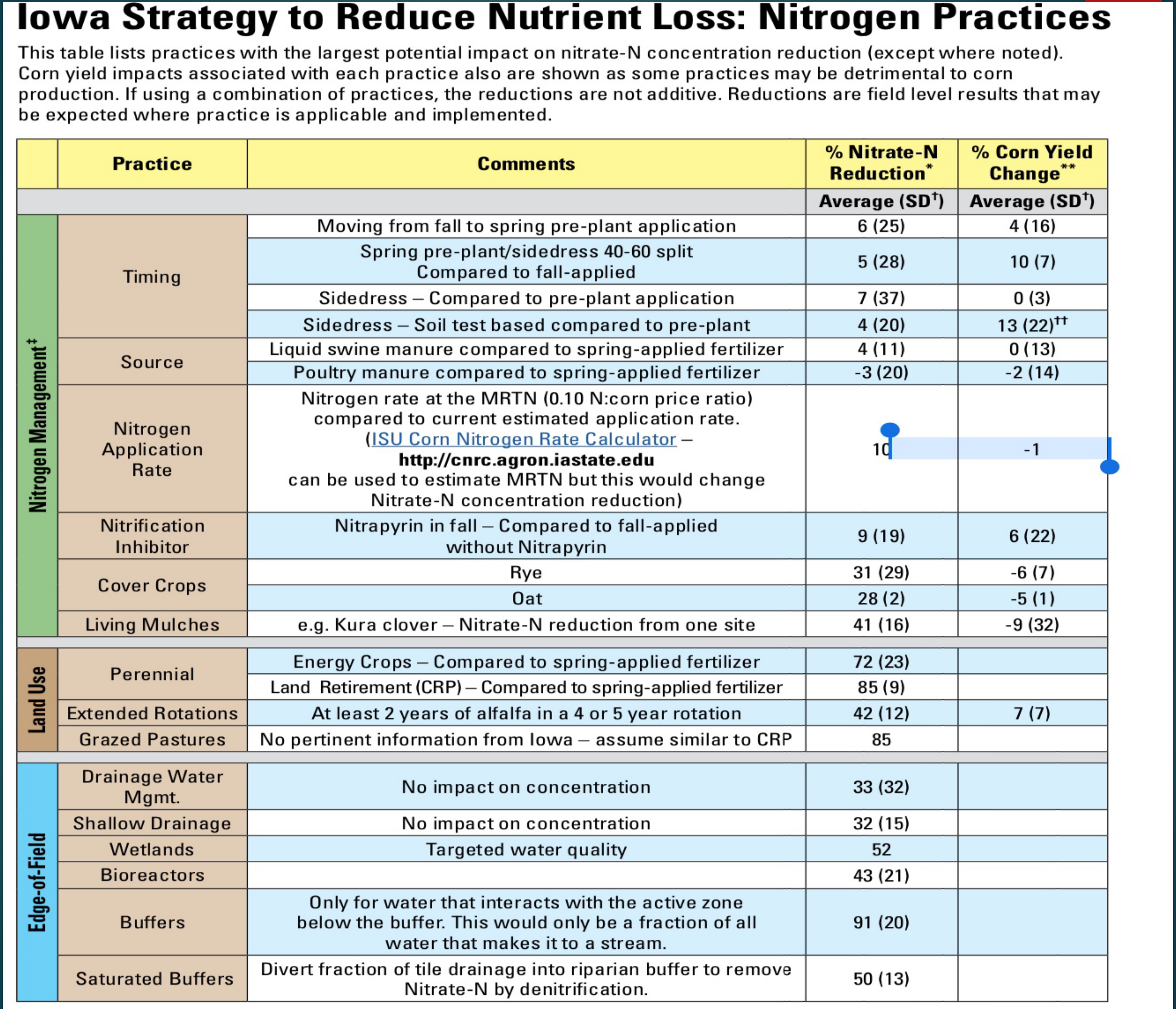
Began Cover Crop trials in 2012



IOWA NUTRIENT REDUCTION STRATEGY

A science and technology-based framework to assess and reduce nutrients to Iowa waters and the Gulf of Mexico

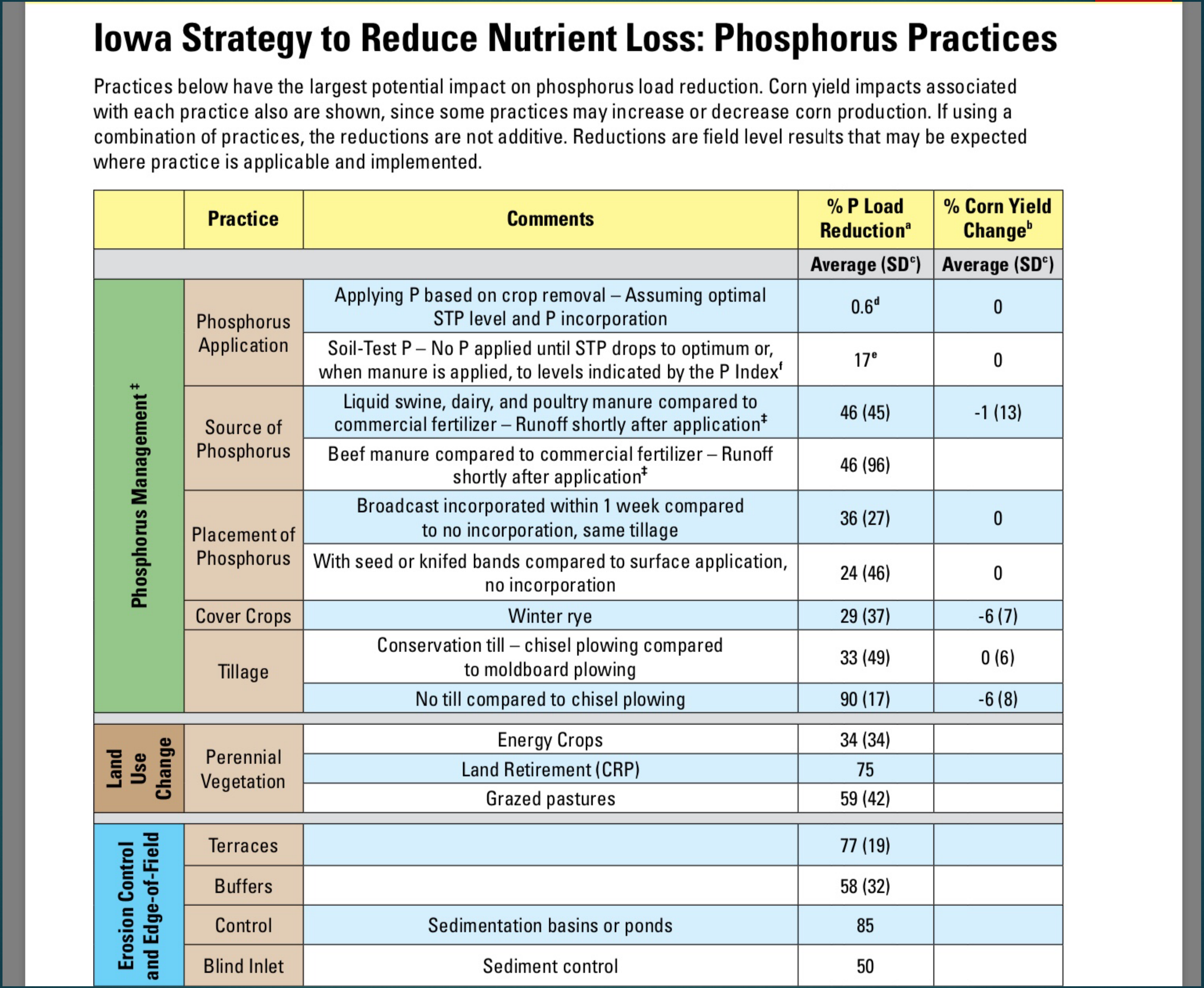
Prepared by:
Iowa Department of Agriculture and Land Stewardship
Iowa Department of Natural Resources
Iowa State University College of Agriculture and Life Sciences
May 2013



Iowa Strategy to Reduce Nutrient Loss: Nitrogen Practices

This table lists practices with the largest potential impact on nitrate-N concentration reduction (except where noted). Corn yield impacts associated with each practice also are shown as some practices may be detrimental to corn production. If using a combination of practices, the reductions are not additive. Reductions are field level results that may be expected where practice is applicable and implemented.

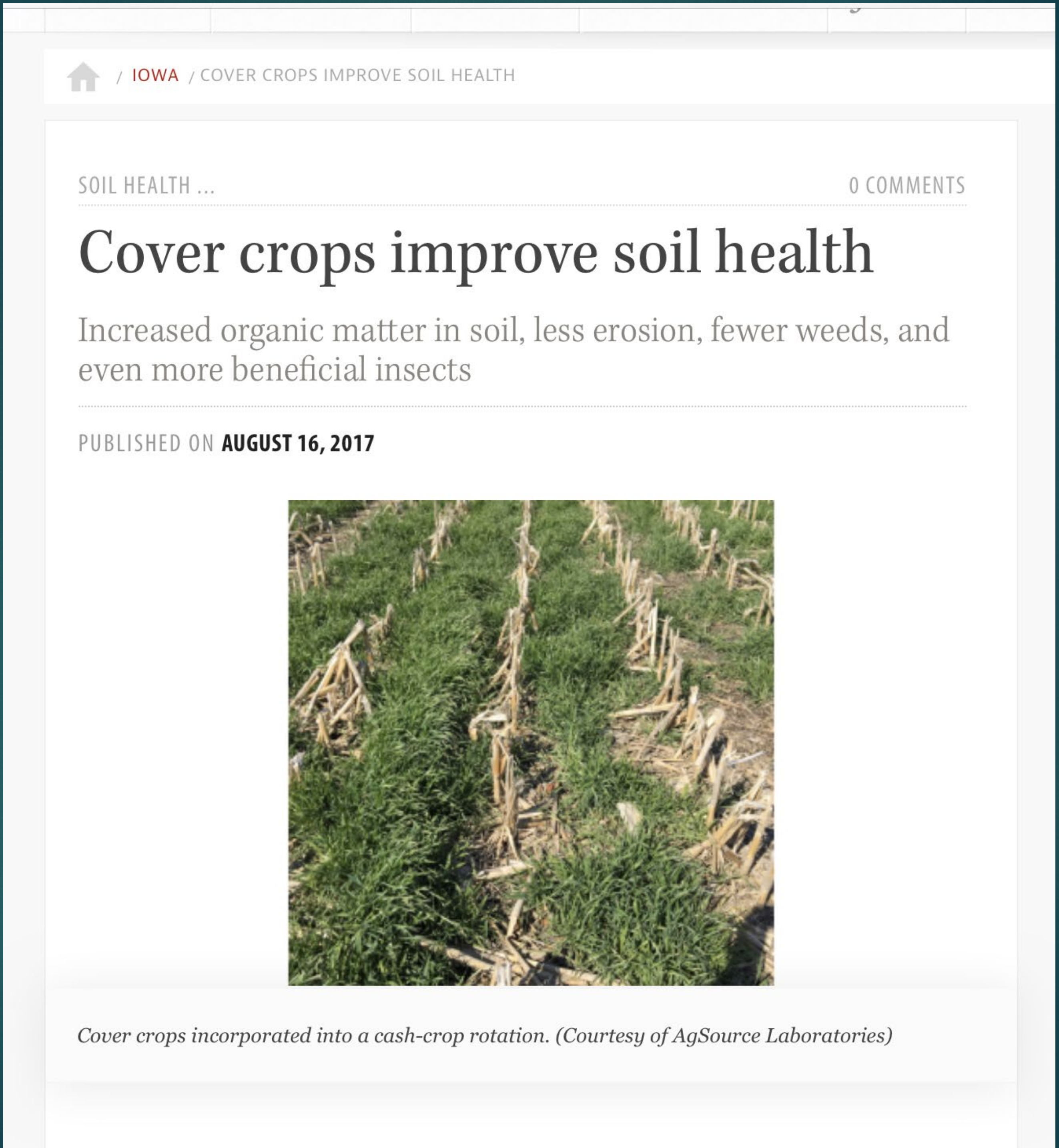
	Practice	Comments	% Nitrate-N Reduction*	% Corn Yield Change**
			Average (SD†)	Average (SD†)
Nitrogen Management‡	Timing	Moving from fall to spring pre-plant application	6 (25)	4 (16)
		Spring pre-plant/sidedress 40-60 split Compared to fall-applied	5 (28)	10 (7)
		Sidedress – Compared to pre-plant application	7 (37)	0 (3)
		Sidedress – Soil test based compared to pre-plant	4 (20)	13 (22)††
	Source	Liquid swine manure compared to spring-applied fertilizer	4 (11)	0 (13)
		Poultry manure compared to spring-applied fertilizer	-3 (20)	-2 (14)
	Nitrogen Application Rate	Nitrogen rate at the MRTN (0.10 N:corn price ratio) compared to current estimated application rate. (ISU Corn Nitrogen Rate Calculator – **http://cnrc.agron.iastate.edu** can be used to estimate MRTN but this would change Nitrate-N concentration reduction)	10	-1
	Nitrification Inhibitor	Nitrapyrin in fall – Compared to fall-applied without Nitrapyrin	9 (19)	6 (22)
	Cover Crops	Rye	31 (29)	-6 (7)
		Oat	28 (2)	-5 (1)
	Living Mulches	e.g. Kura clover – Nitrate-N reduction from one site	41 (16)	-9 (32)
Land Use	Perennial	Energy Crops – Compared to spring-applied fertilizer	72 (23)	
		Land Retirement (CRP) – Compared to spring-applied fertilizer	85 (9)	
	Extended Rotations	At least 2 years of alfalfa in a 4 or 5 year rotation	42 (12)	7 (7)
	Grazed Pastures	No pertinent information from Iowa – assume similar to CRP	85	
Edge-of-Field	Drainage Water Mgmt.	No impact on concentration	33 (32)	
	Shallow Drainage	No impact on concentration	32 (15)	
	Wetlands	Targeted water quality	52	
	Bioreactors		43 (21)	
	Buffers	Only for water that interacts with the active zone below the buffer. This would only be a fraction of all water that makes it to a stream.	91 (20)	
	Saturated Buffers	Divert fraction of tile drainage into riparian buffer to remove Nitrate-N by denitrification.	50 (13)	



Iowa Strategy to Reduce Nutrient Loss: Phosphorus Practices

Practices below have the largest potential impact on phosphorus load reduction. Corn yield impacts associated with each practice also are shown, since some practices may increase or decrease corn production. If using a combination of practices, the reductions are not additive. Reductions are field level results that may be expected where practice is applicable and implemented.

	Practice	Comments	% P Load Reduction[a]	% Corn Yield Change[b]
			Average (SD[c])	Average (SD[c])
Phosphorus Management[‡]	Phosphorus Application	Applying P based on crop removal – Assuming optimal STP level and P incorporation	0.6[d]	0
		Soil-Test P – No P applied until STP drops to optimum or, when manure is applied, to levels indicated by the P Index[f]	17[e]	0
	Source of Phosphorus	Liquid swine, dairy, and poultry manure compared to commercial fertilizer – Runoff shortly after application[‡]	46 (45)	-1 (13)
		Beef manure compared to commercial fertilizer – Runoff shortly after application[‡]	46 (96)	
	Placement of Phosphorus	Broadcast incorporated within 1 week compared to no incorporation, same tillage	36 (27)	0
		With seed or knifed bands compared to surface application, no incorporation	24 (46)	0
	Cover Crops	Winter rye	29 (37)	-6 (7)
	Tillage	Conservation till – chisel plowing compared to moldboard plowing	33 (49)	0 (6)
		No till compared to chisel plowing	90 (17)	-6 (8)
Land Use Change	Perennial Vegetation	Energy Crops	34 (34)	
		Land Retirement (CRP)	75	
		Grazed pastures	59 (42)	
Erosion Control and Edge-of-Field	Terraces		77 (19)	
	Buffers		58 (32)	
	Control	Sedimentation basins or ponds	85	
	Blind Inlet	Sediment control	50	



/ IOWA / COVER CROPS IMPROVE SOIL HEALTH

SOIL HEALTH ...

0 COMMENTS

Cover crops improve soil health

Increased organic matter in soil, less erosion, fewer weeds, and even more beneficial insects

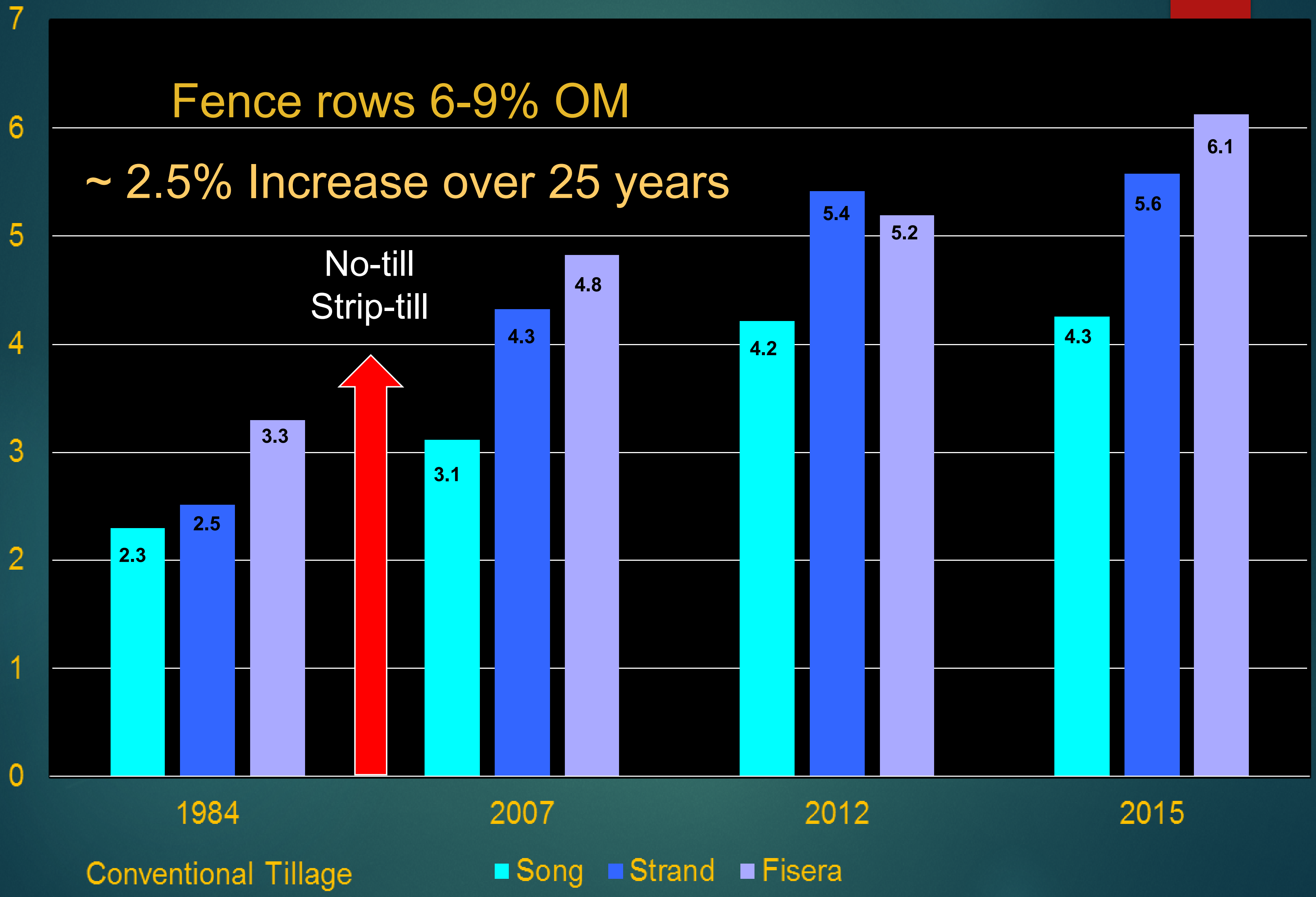
PUBLISHED ON **AUGUST 16, 2017**

Cover crops incorporated into a cash-crop rotation. (Courtesy of AgSource Laboratories)


JOHN DEERE
1790

What Has My Data Reveled?

Organic Matter % Change Over Time



Fence rows 6-9% OM

~ 2.5% Increase over 25 years

No-till
Strip-till

Conventional Tillage

IOWA

VALUE OF soil health

unlock the SECRETS IN THE SOIL

Incremental Value of 1% (10 Tons) Soil Organic Matter (IA, NRCS)

- Enhanced water availability (20/80 rule)
  - $18
- Mineralizable N and P
  - $11
- Total value per 1% organic matter
  - $29
- Value Our Farm (2.5% OM Change)
  - $72 (Capitalized?)

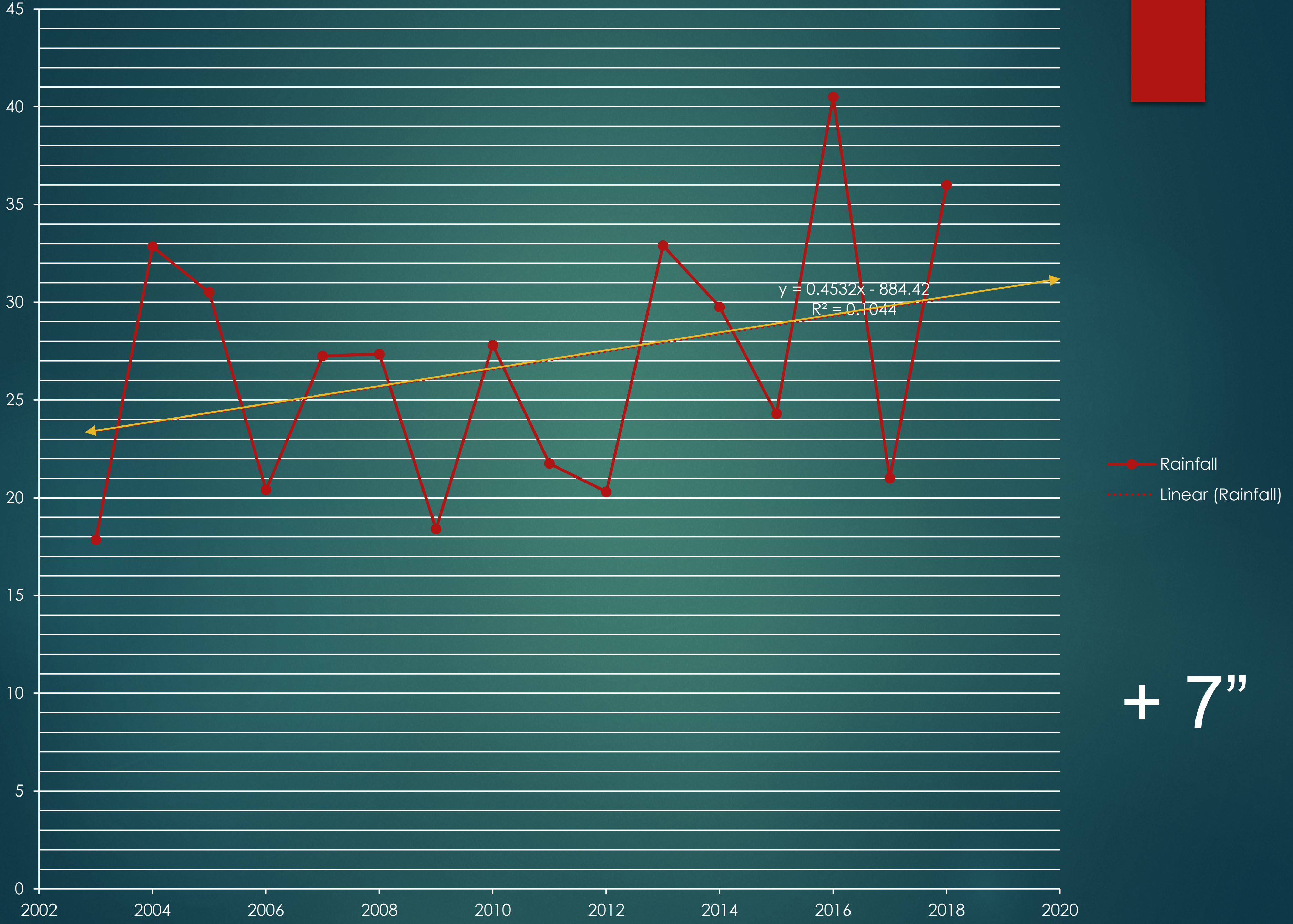
What else have we learned from the study of 17 years of yield data on 10 different fields?

Dr. Jerry Hatfield, USDA ARS, Ames, IA

Data Availability

- Yield monitor data from 2003 to 2018
- Soil maps for each field
- Weather data
- Soil organic matter across fields and years

April - Sept. Rainfall

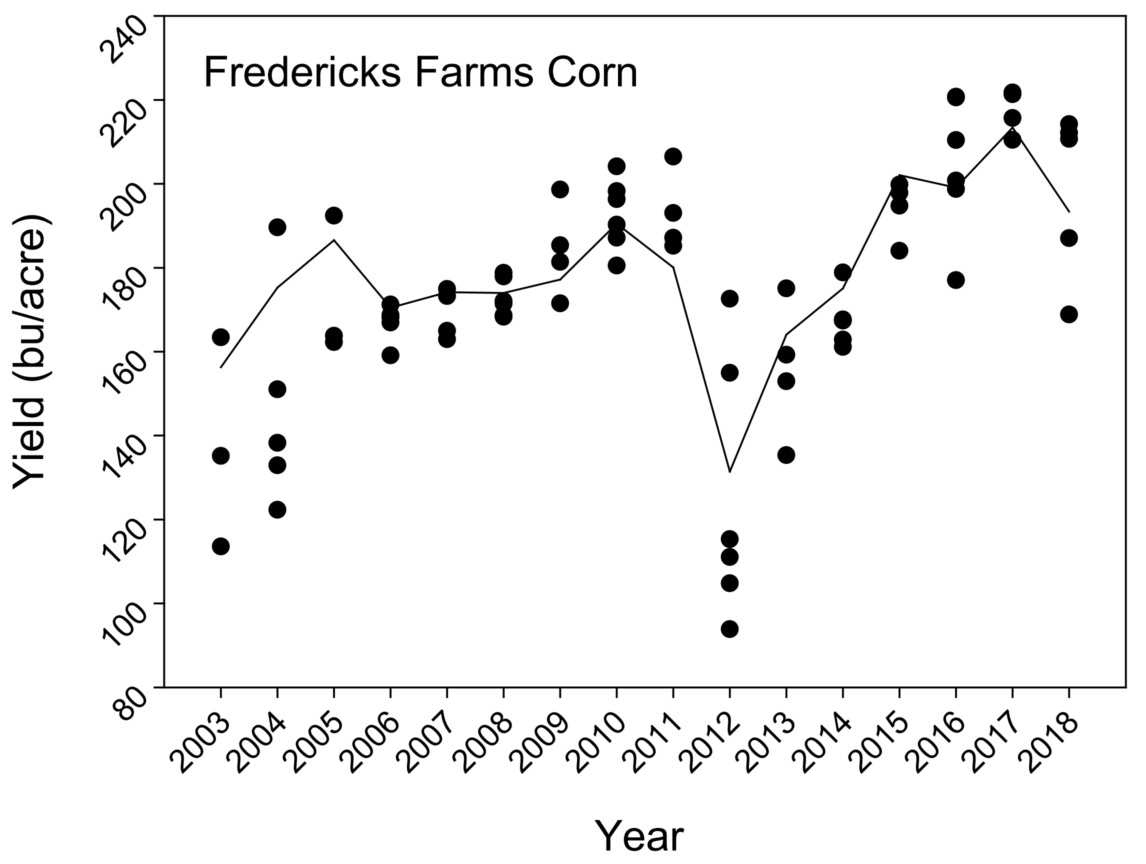


+ 7”

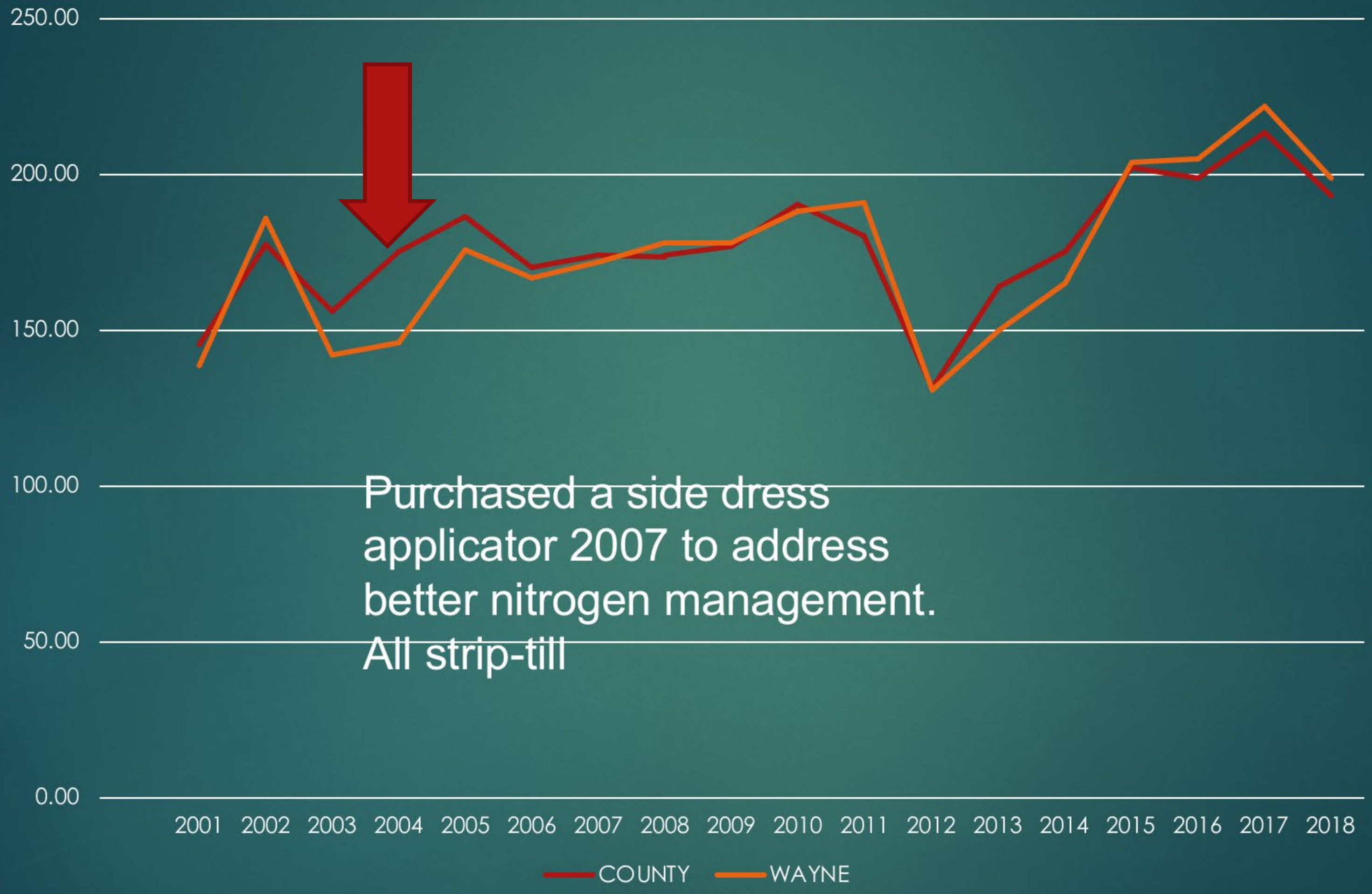
Data Analysis

- Means and standard deviations of yield data by field and year
- Skewness and kurtosis of yield data segregated by soil within field
- Geospatial analysis to quantify field variability
- Water use efficiency

Corn Yields relative to Mitchell County

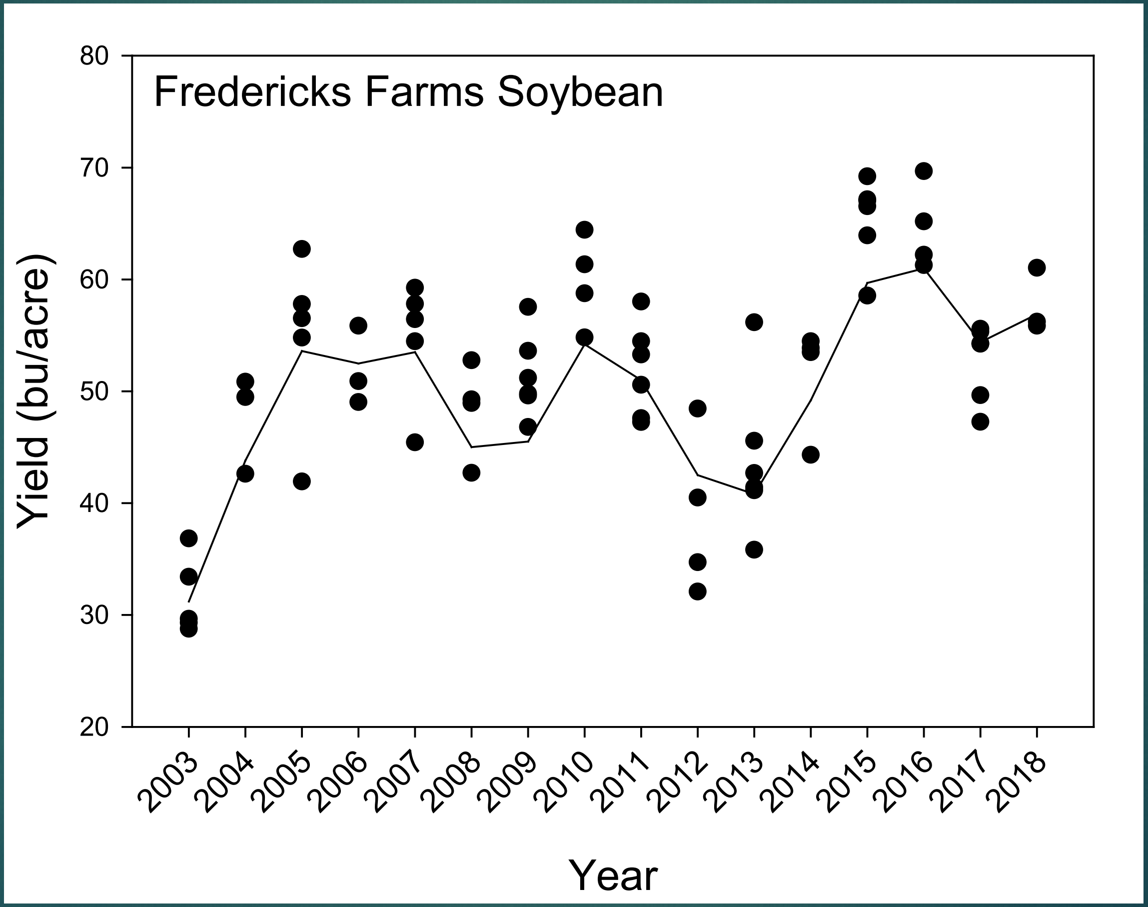


Wayne's Whole Farm Corn Yields vs County Average

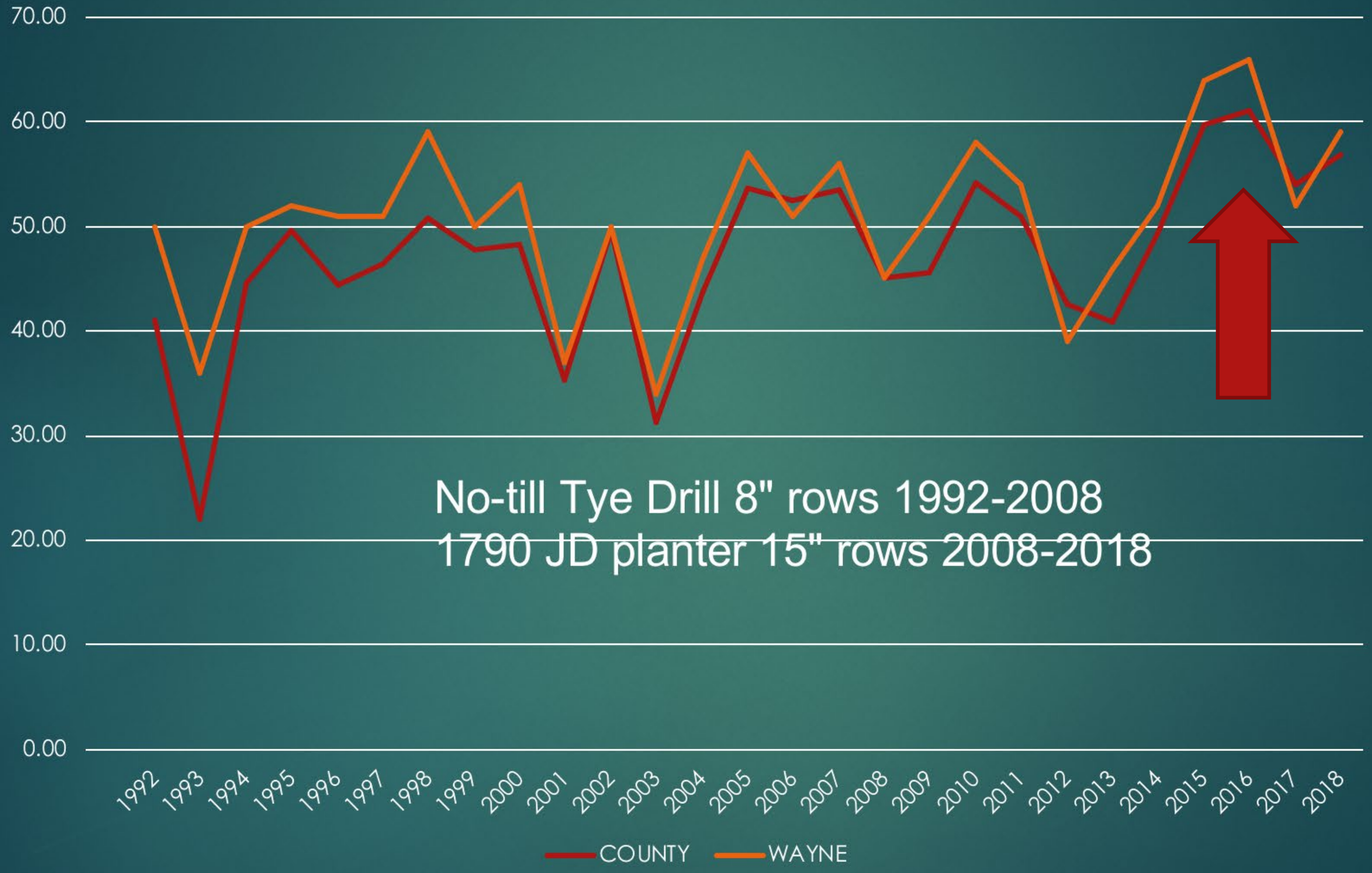


Purchased a side dress applicator 2007 to address better nitrogen management. All strip-till

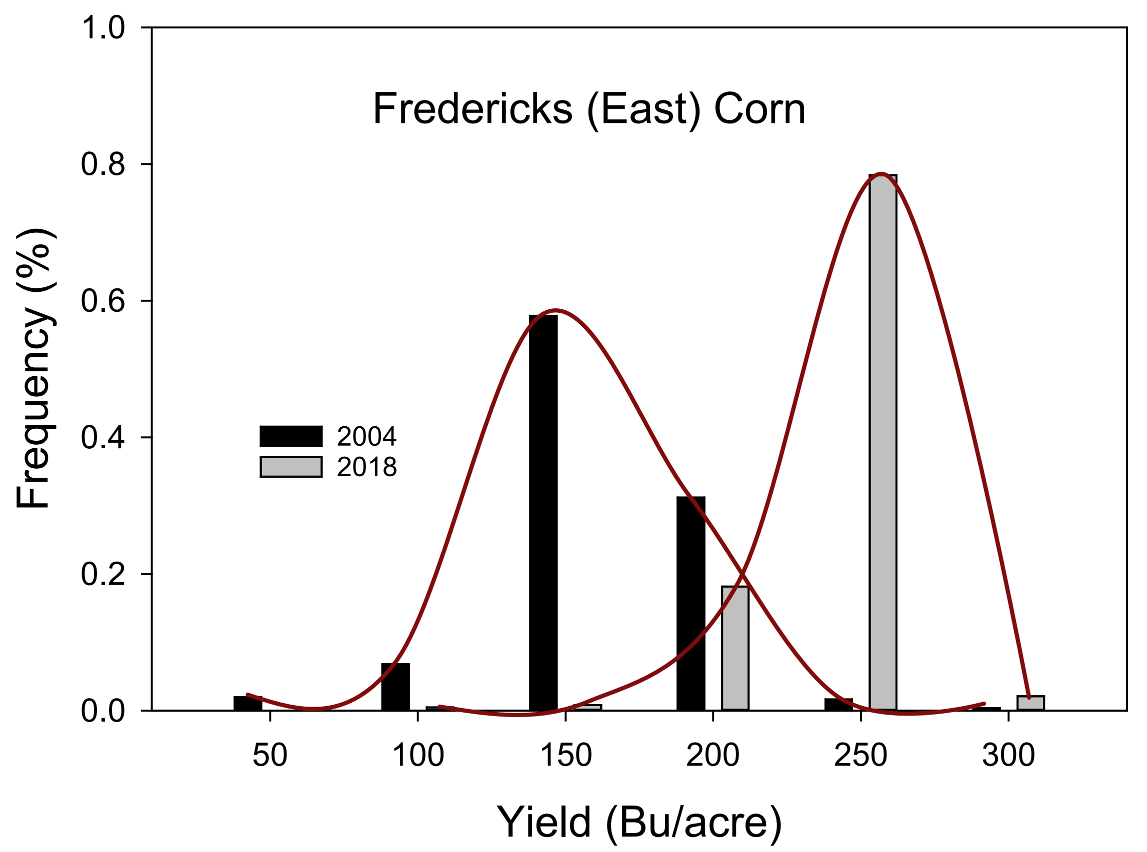
Soybean Yields relative to Mitchell County

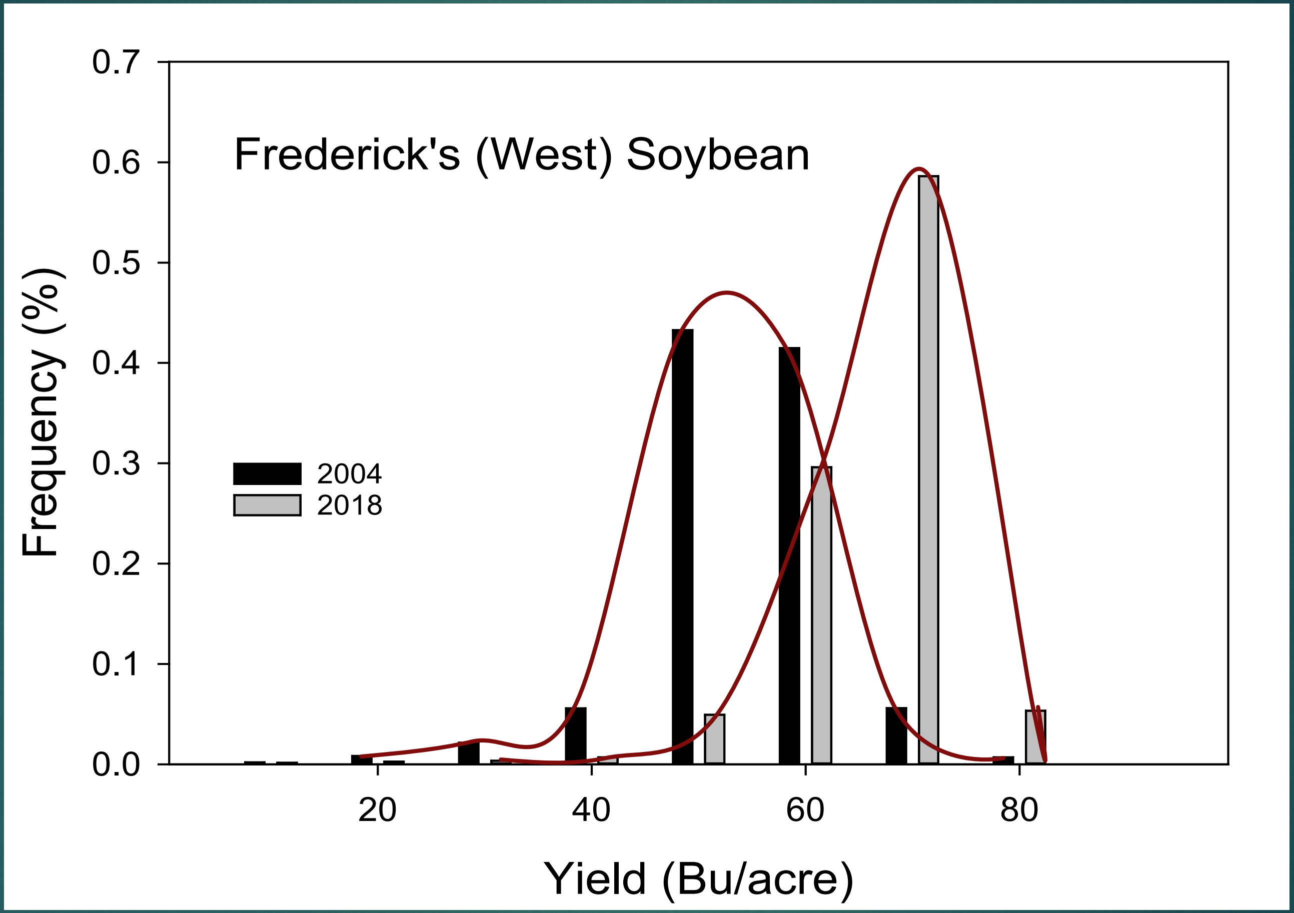


Wayne's Whole Farm Soybean Yields vs. County Average

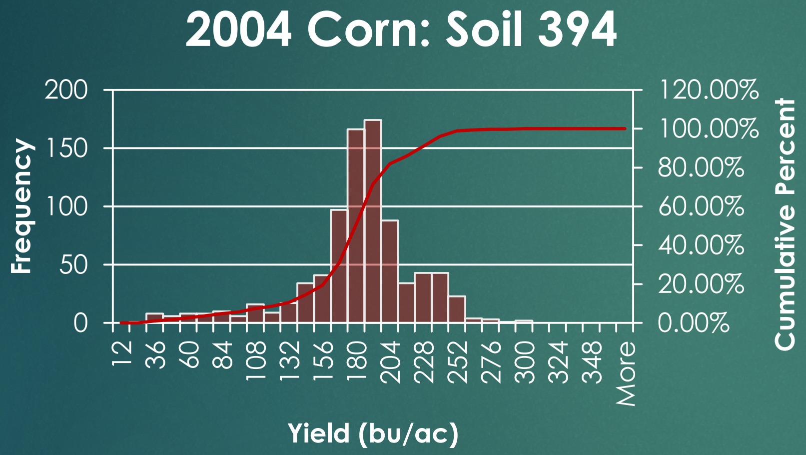


No-till Tye Drill 8" rows 1992-2008
1790 JD planter 15" rows 2008-2018

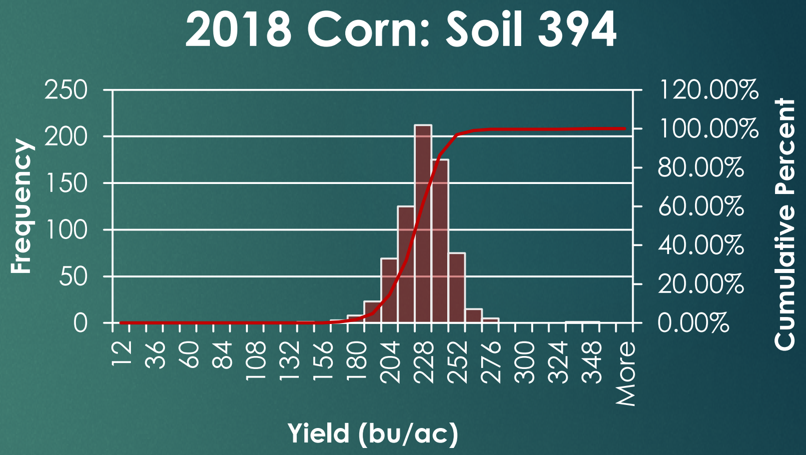

Fredericks (East) Corn
Frequency (%)
1.0
0.8
0.6
0.4
0.2
0.0
2004
2018
50
100
150
200
250
300
Yield (Bu/acre)


Frederick's (West) Soybean
2004
2018
Frequency (%)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
20
40
60
80
Yield (Bu/acre)

Increasing Uniformity



2004 Corn: Soil 394



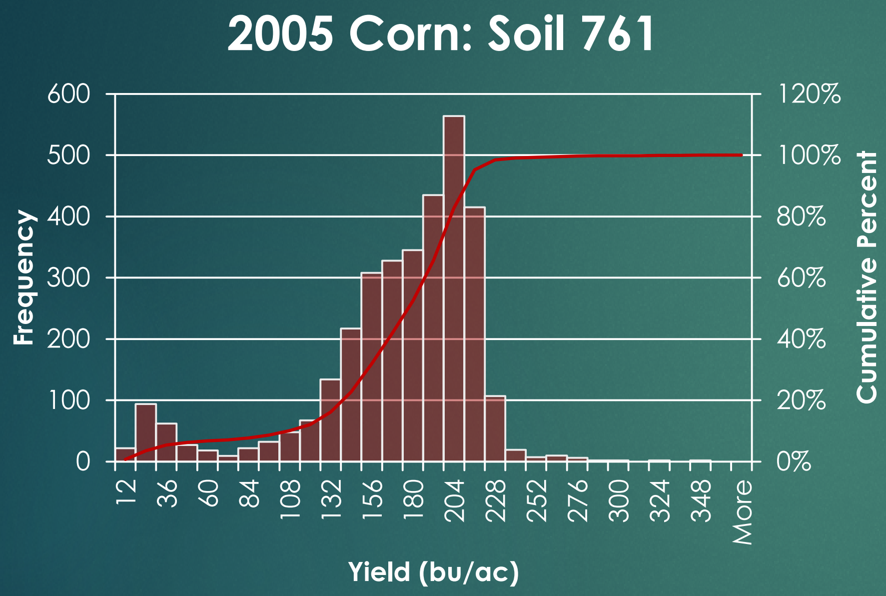
2018 Corn: Soil 394

Skewness -1.01
Kurtosis 2.30

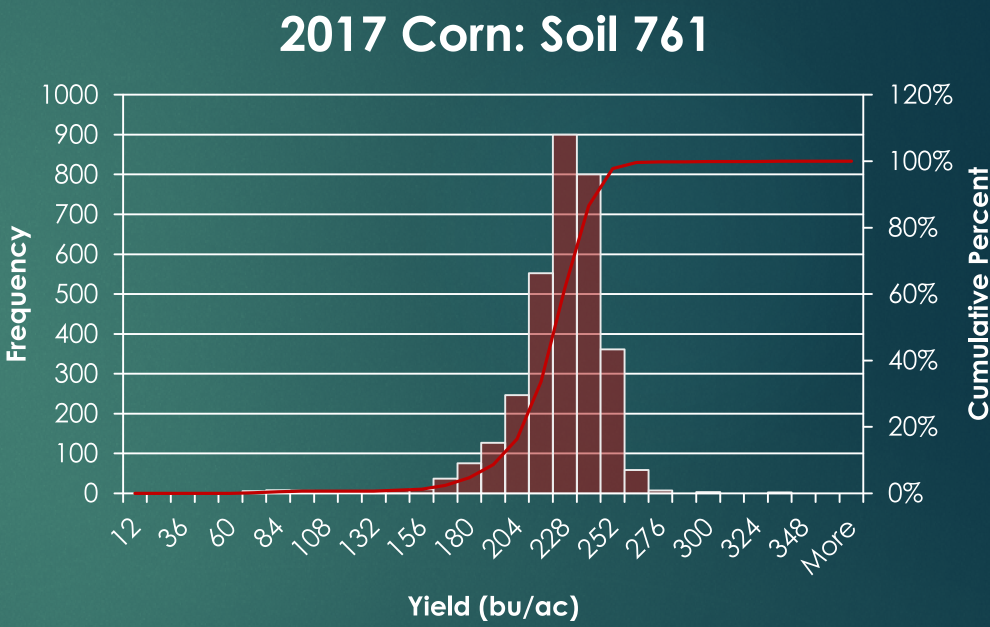
Skewness 0.19
Kurtosis 4.48

Soil 394 Ostrander loam

Increasing Uniformity


2005 Corn: Soil 761

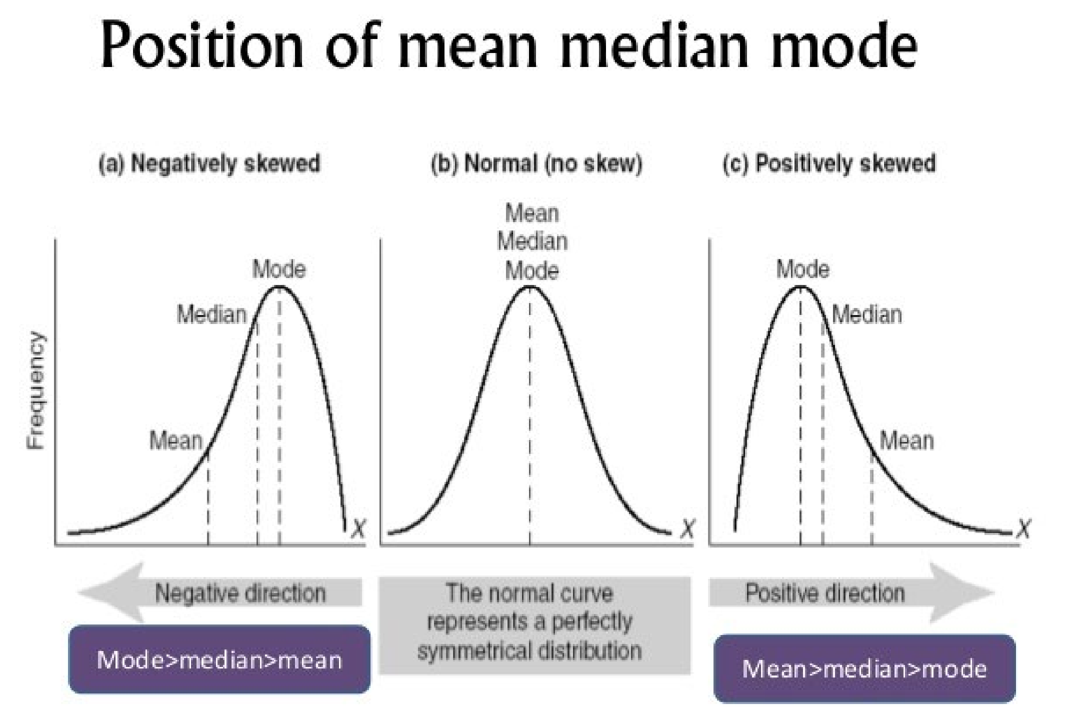
Skewness -1.99
Kurtosis 2.21


2017 Corn: Soil 761

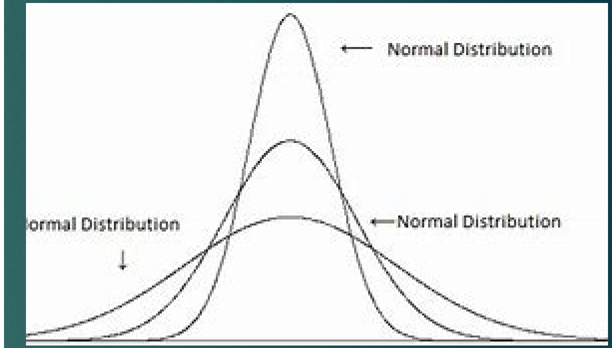
Skewness -0.86
Kurtosis 7.91

Soil 761 Franklin silt loam

Implications



Skewness

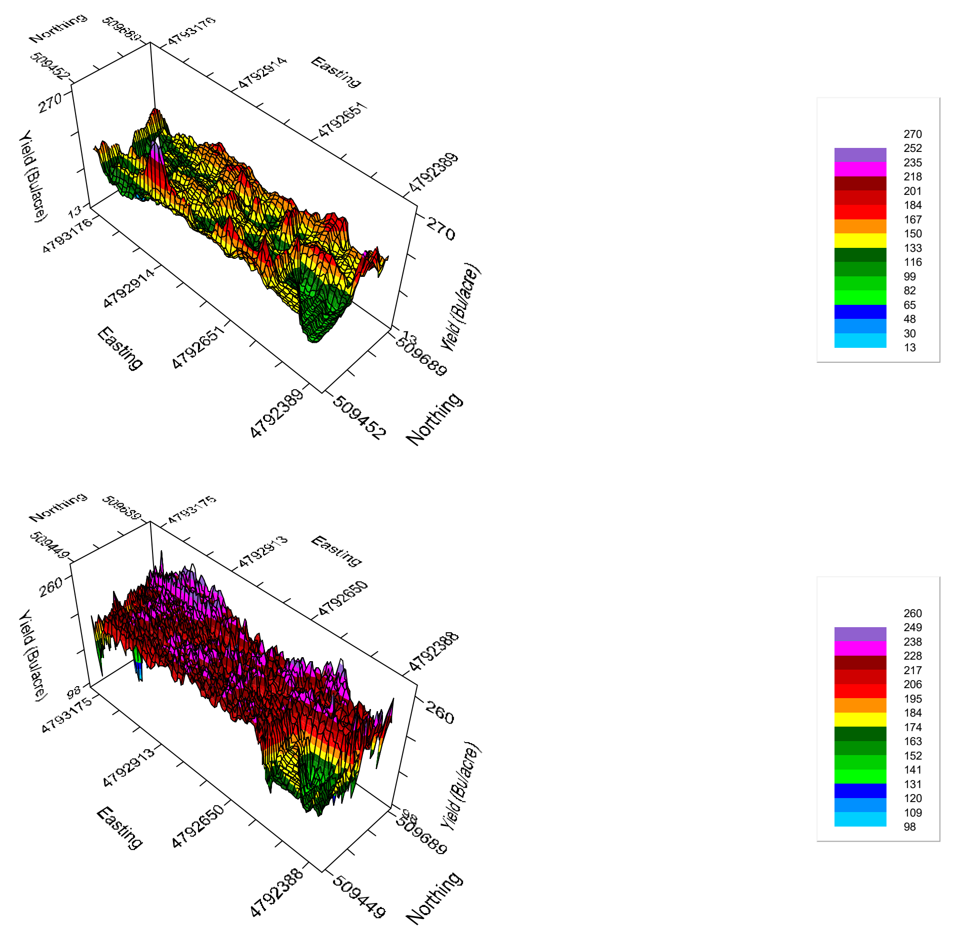


Kurtosis

Implications

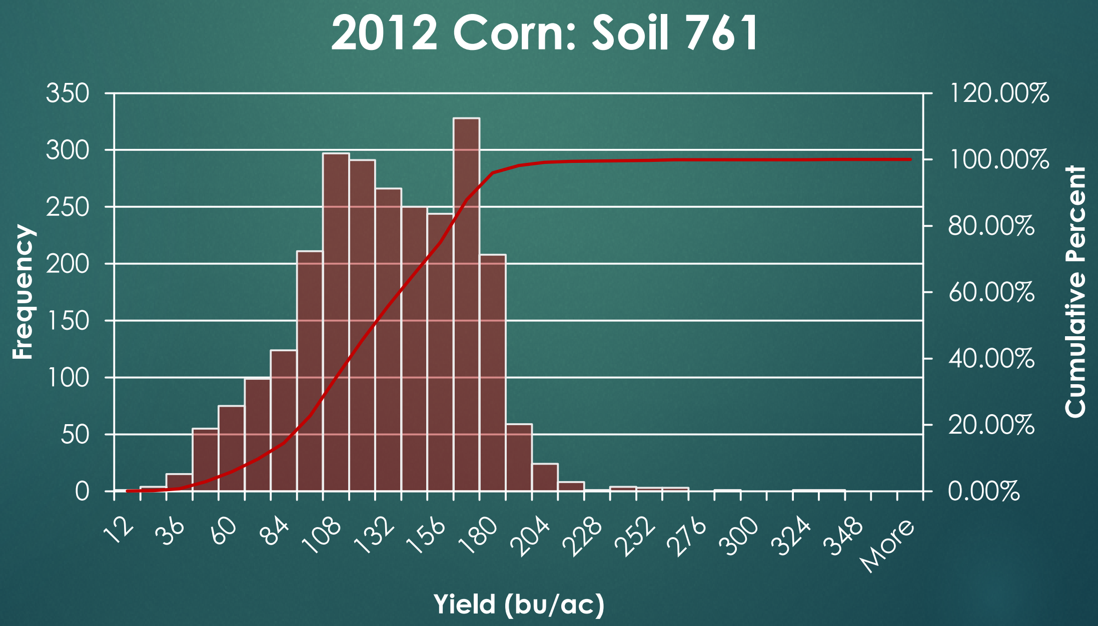
- The shifts from negative to positive skewness and increasing kurtosis tightens the distribution about the mean
- The more we shift to the right the greater the income in the field because we have less low yielding areas in the field, i.e., a greater portion of the field becomes a profit center

Geospatial Analysis



Results

- Fields have become more uniform and the values of the yield monitor observations are more closely correlated across the field
- Increase in uniformity across the field with time
- Only in extreme years (2012) was there a lack of uniformity



Implications of the changes in soil

- Yield is negatively correlated with April and May rainfall at the county level
- Yield is positively correlated with July-September rainfall at the county level
- Water use efficiency (corn) Fredericks fields
  - 2004 3.9 bu/inch 2018 5.5 bu/inch 41% increase
  - 2005 5.3 bu/inch 2017 7.9 bu/inch 49% increase
- Water use efficiency (soybean)
  - 2005 1.9 bu/inch 2017 2.4 bu/inch 26% increase
- Profitability of the field will increase because the yields have become more uniform.

Changes in water use efficiency

- Soil is capable of storing more water
- Greater infiltration of rainfall events
- More resilient in the years with uneven distribution of rainfall
- Reduction in the correlations with excessive spring and deficit summer rainfall
- Increased ability to convert the soil water into grain

Lessons Along the Journey

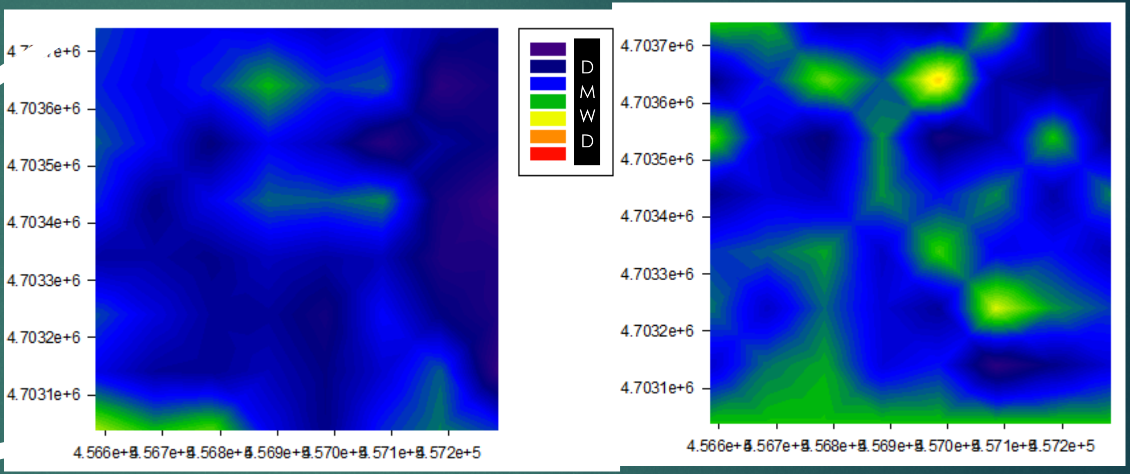
- Change the uniformity of the field with the combination of reduced tillage and cover crops
- Observe a shift in the distribution of yields around the mean to fewer lower yields and tighter distribution around the mean
- Increases in organic matter are coupled with change in water infiltration and availability
- Cultural operations are more timely because of improved soil conditions
- Fields become more resource use efficient, light, water, and nutrients
- Management is dynamic and there is constant adaptations and tweaks

Conversion from Conventional to No-till Cover Crop

At each sampling location:
-1.2 m deep core
-5,10 cm surface sample

Gridded soil sampling

Dry Aggregate Size Distribution



Conversion to no-till w/cover crop

Doubled the microbial biomass in two years after conversion

Changed from negative to positive carbon balance in this two year period

Systems

- Genetics x Environment x Management
  - Oversee (M) to overcome (E) to optimize (G)
- Sometimes the genetics don’t respond the way we expect
- There needs to be constant attention to the nutrient management
- Management has to evolve to take advantage of the changing soil conditions

What are the Implications?

- How does this reduce risk and increase management options?
- Can this affect land values?
- What might this do to rental agreements?
- Could this broaden the offering of crop insurance discounts?
- How does this change the discussion of carbon sequestration?
- Can this create more engagement from the food industry?
- How might this affect state and federal farm policy?
- Can this lift the burden of water quality and quantity?
- Can these practices make farming more profitable?

Healthy, Resilient Soils

Cleaner Water

Profitable Farms

Less Variable Yields

Positive Carbon Message

Where Are You In Your Journey?

Questions?

herminutomo www.fotosearch.com