How much nitrogen is in a healthy Iowa soil from 0-45”?

a. 0-100 lbs per acre

b. 2000-4000 lbs per acre

c. 5000-7000 lbs per acre

d. 9000-11000 lbs per acre

How much nitrogen is in a healthy Iowa soil from 0-45”?

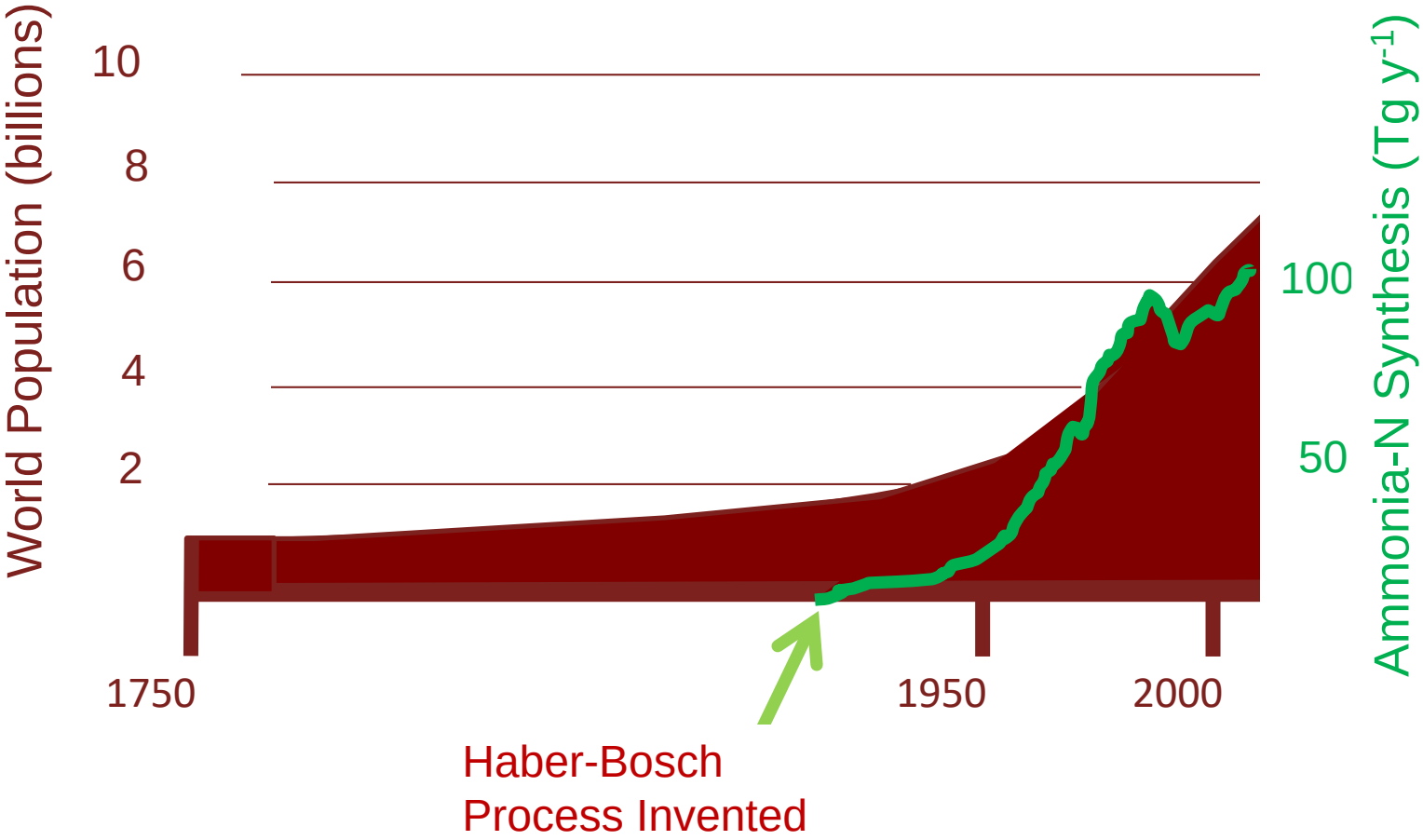
a. 0-100 lbs per acre

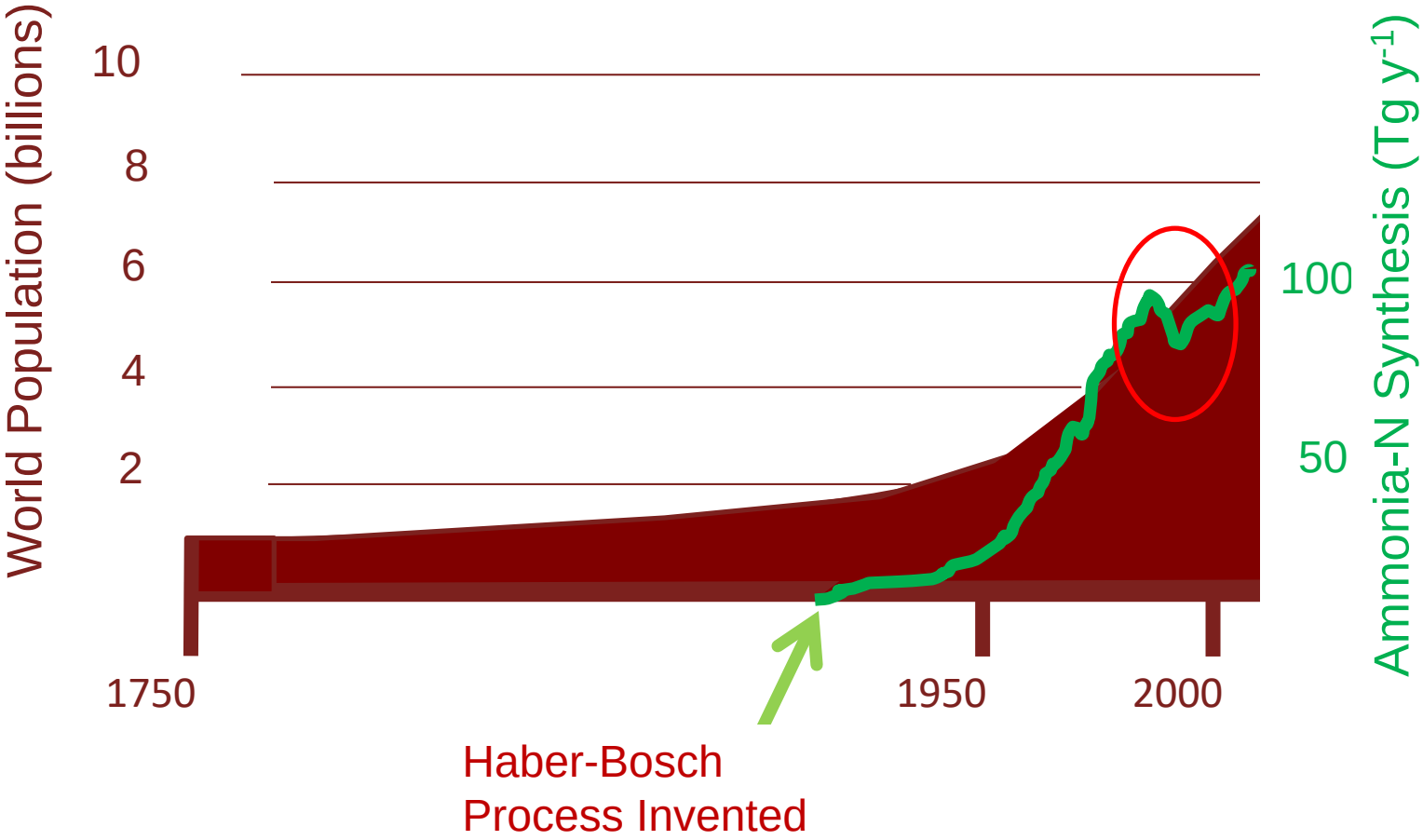
b. 2000-4000 lbs per acre

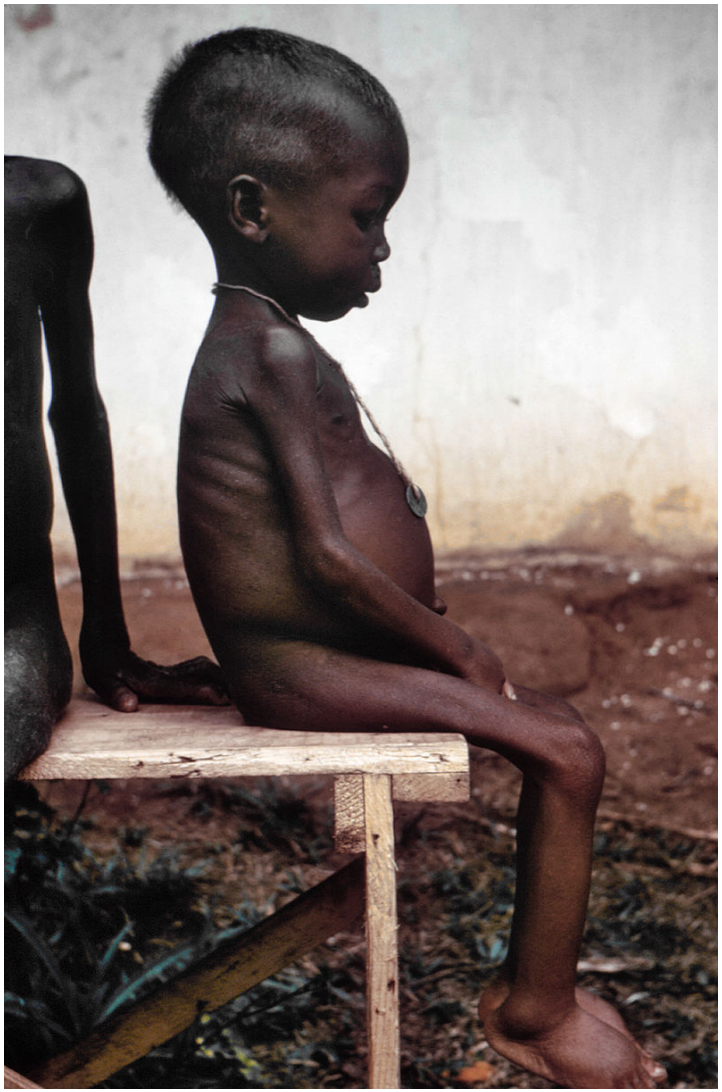
c. 5000-7000 lbs per acre

d. 9000-11000 lbs per acre

Courtesy Stuart Holmes


World Population (billions)
10
8
6
4
2
1750
1950
2000
100
50
Ammonia-N Synthesis (Tg y-1)
Haber-Bosch
Process Invented

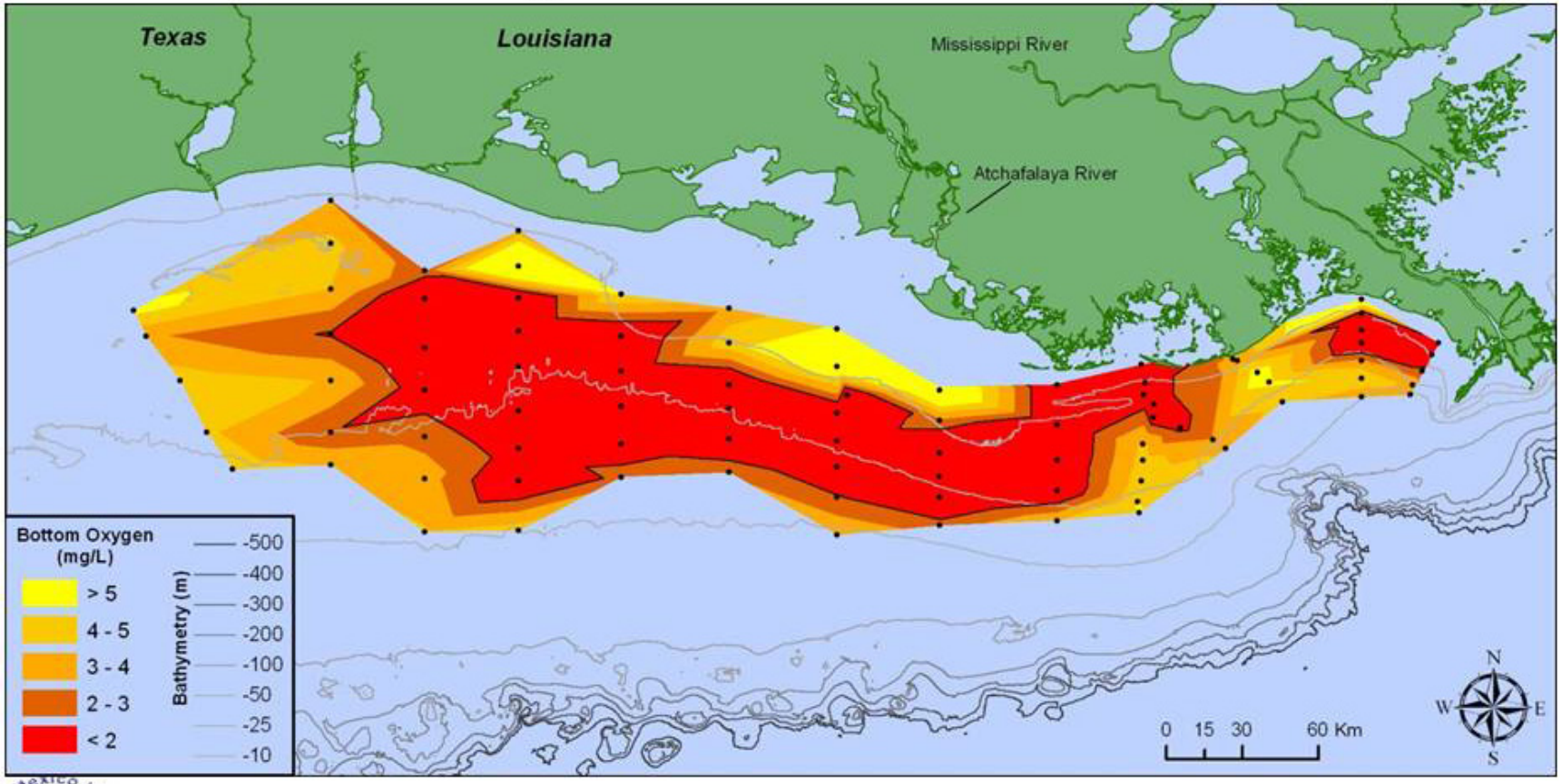

World Population (billions)
10
8
6
4
2
1750
1950
2000
100
50
Ammonia-N Synthesis (Tg y-1)
Haber-Bosch
Process Invented



By Dr. Lyle Conrad - Centers for Disease Control and Prevention, Atlanta, Georgia, USA Public Health Image Library (PHIL); ID: 6901http://phil.cdc.gov/, Public Domain, https://commons.wikimedia.org/w/index.php?curid=425975

LIFE

Bottom-water dissolved oxygen across the Louisiana shelf from July 22-28, 2013

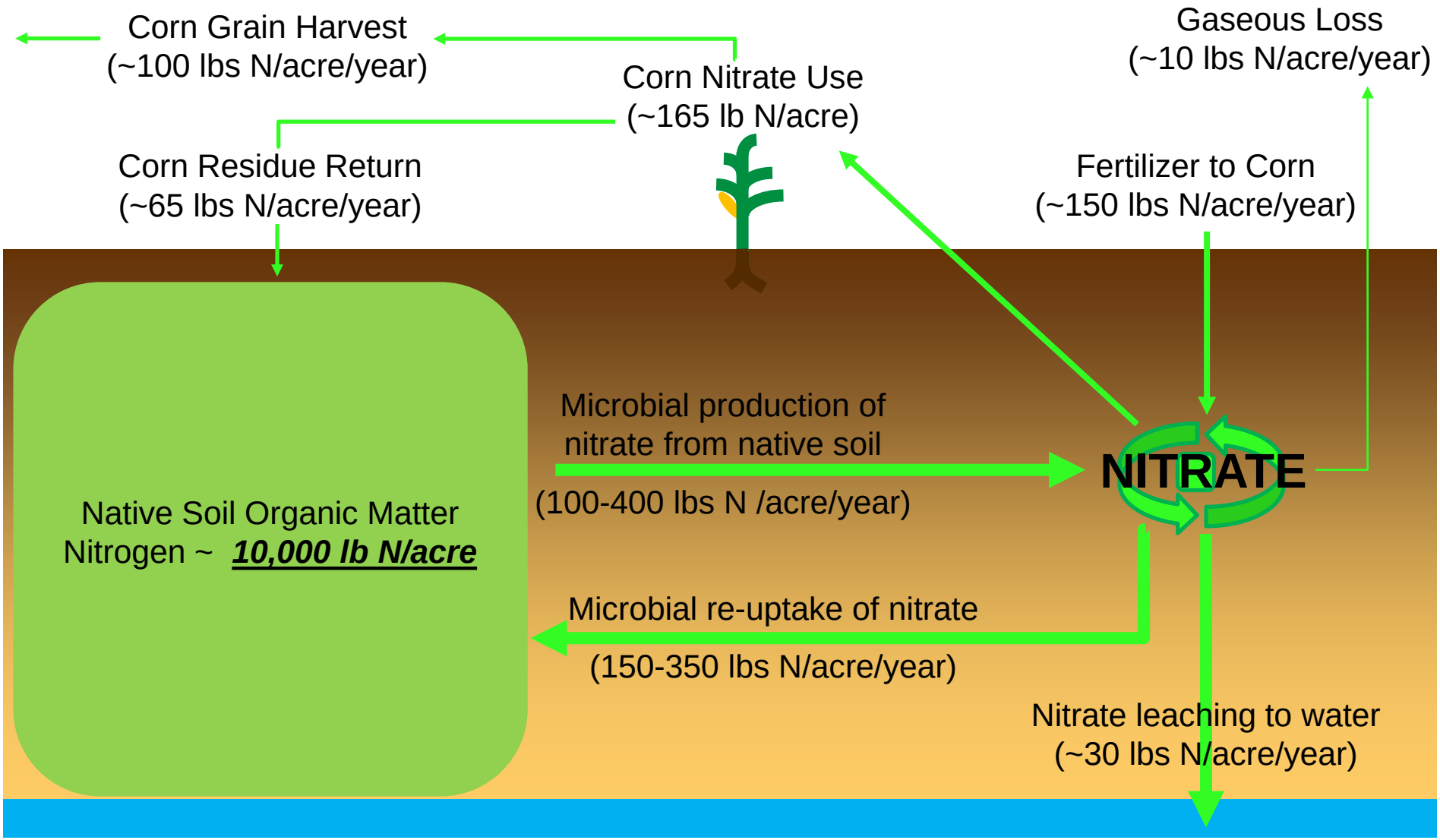


Data source: N.N. Rabalais, Louisiana Universities Marine Consortium, R.E. Turner, Louisiana State University

Funded by: NOAA, Center for Sponsored Coastal Ocean Research

10

Corn Nitrogen Cycling & Budget @ 177 bushels



Is N fertilizer bad for soil health?

Is N fertilizer bad for water quality?

THE N2 DILEMMA: IS AMERICA FERTILIZING DISASTER?

New research: synthetic nitrogen destroys soil carbon, undermines soil health

By Tom Philpott on Feb 24, 2010

Share Tweet

"Fertilizer is good for the father and bad for the sons."
–Dutch saying

Just precisely what does all of that nitrogen ferilizer *do* to the soil?

For all of its ecological baggage, synthetic nitrogen does one good deed for the environment: it helps build carbon in soil. At least, that's what scientists have assumed for decades.

If that were true, it would count as a major environmental benefit of synthetic N use. At a time of climate chaos and ever-growing global greenhouse gas emissions, anything that helps vast swaths

SUSTAINABILITY

Fertilizer Runoff Overwhelms Streams and Rivers--Creating Vast "Dead Zones"

The nation's waterways are brimming with excess nitrogen from fertilizer--and plans to boost biofuel production threaten to aggravate an already serious situation

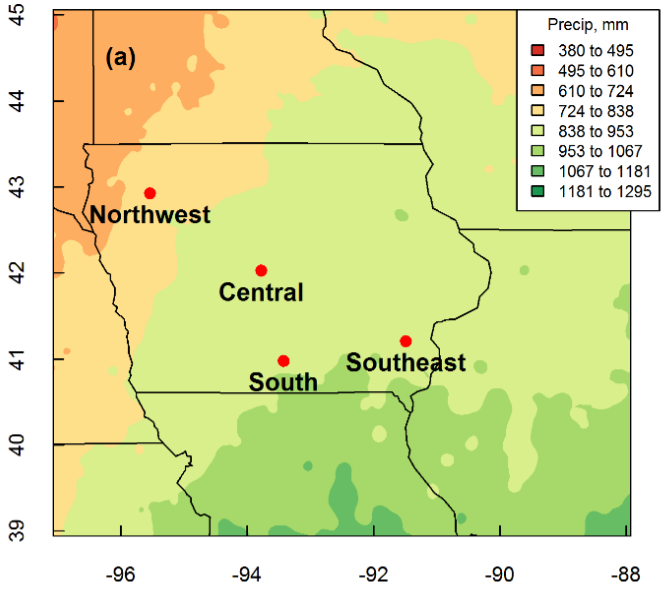
By David Biello on March 14, 2008 9

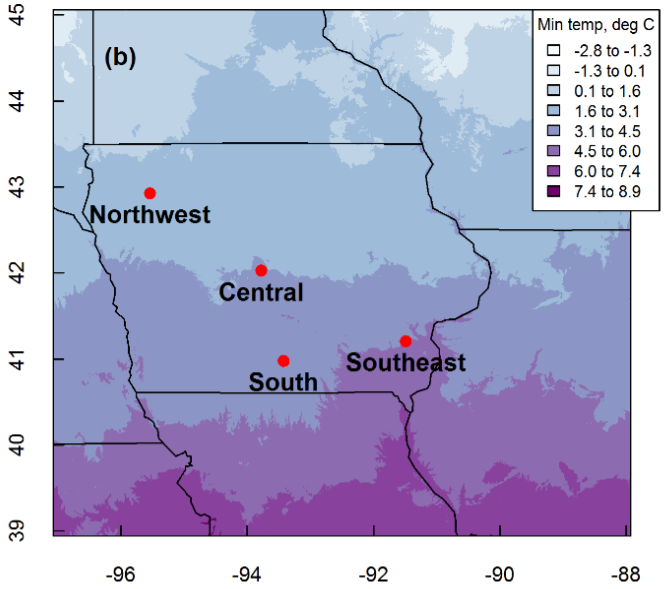
Is N fertilizer bad for soil health?

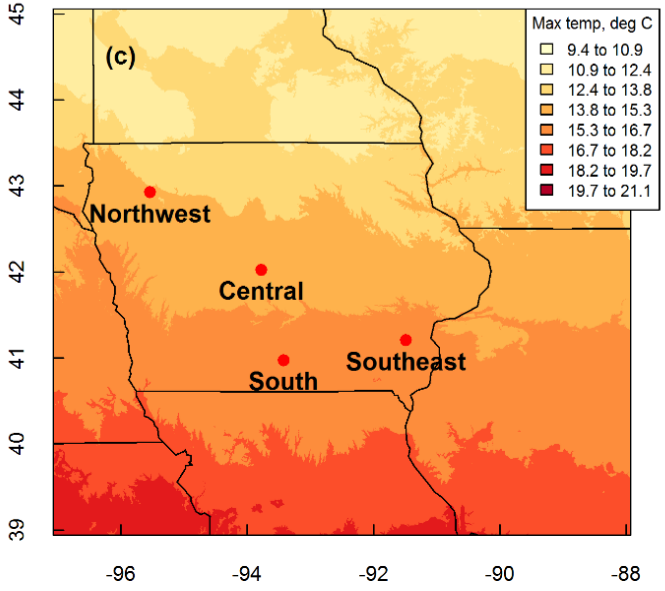
Is N fertilizer bad for water quality?

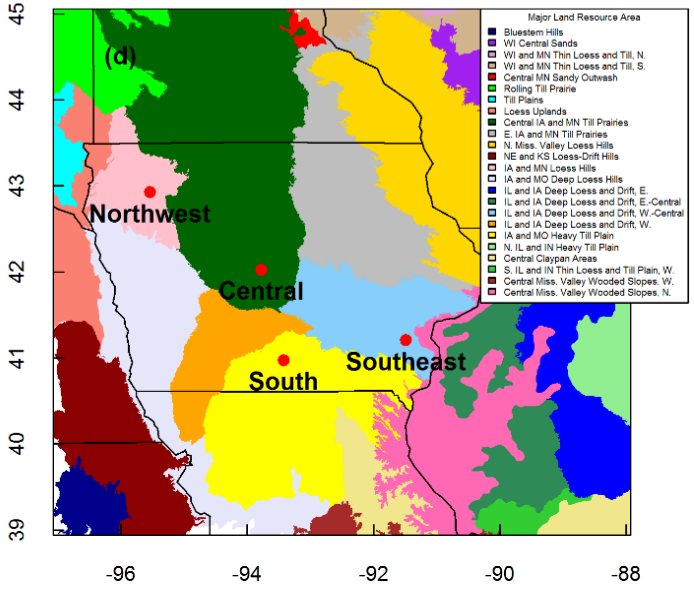
Can we have it all?
Yield, healthy soil and water quality?

If the soil is:
under-fertilized, over-fertilized, or optimally-fertilized
for more than a decade, does it affect soil health?

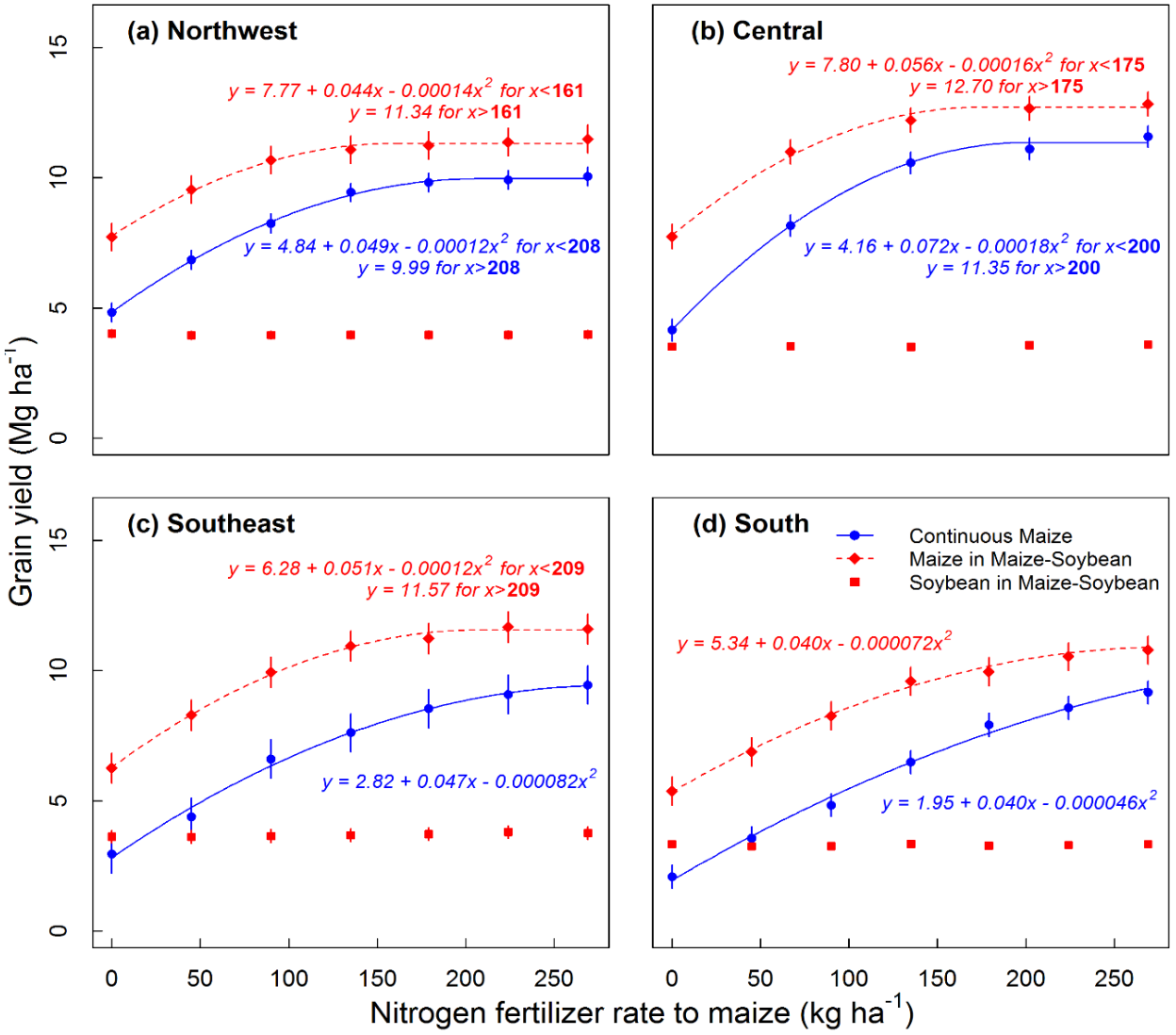

(a)
Precip, mm
380 to 495
495 to 610
610 to 724
724 to 838
838 to 953
953 to 1067
1067 to 1181
1181 to 1295
Northwest
Central
South
Southeast
45
44
43
42
41
40
39
-96
-94
-92
-90
-88


(b)
Min temp, deg C
-2.8 to -1.3
-1.3 to 0.1
0.1 to 1.6
1.6 to 3.1
3.1 to 4.5
4.5 to 6.0
6.0 to 7.4
7.4 to 8.9
Northwest
Central
South
Southeast
45
44
43
42
41
40
39
-96
-94
-92
-90
-88


(c)
Max temp, deg C
9.4 to 10.9
10.9 to 12.4
12.4 to 13.8
13.8 to 15.3
15.3 to 16.7
16.7 to 18.2
18.2 to 19.7
19.7 to 21.1
Northwest
Central
South
Southeast
45
44
43
42
41
40
39
-96
-94
-92
-90
-88


(d)
Major Land Resource Area
Bluestem Hills
WI Central Sands
WI and MN Thin Loess and Till, N.
WI and MN Thin Loess and Till, S.
Central MN Sandy Outwash
Rolling Till Prairie
Till Plains
Loess Uplands
Central IA and MN Till Prairies
E. IA and MN Till Prairies
N. Miss. Valley Loess Hills
NE and KS Loess-Drift Hills
IA and MN Loess Hills
IA and MO Deep Loess Hills
IL and IA Deep Loess and Drift, E.
IL and IA Deep Loess and Drift, E.-Central
IL and IA Deep Loess and Drift, W.-Central
IL and IA Deep Loess and Drift, W.
IA and MO Heavy Till Plain
N. IL and IN Heavy Till Plain
Central Claypan Areas
S. IL and IN Thin Loess and Till Plain, W.
Central Miss. Valley Wooded Slopes, W.
Central Miss. Valley Wooded Slopes, N.
Northwest
Central
South
Southeast
45
44
43
42
41
40
39
-96
-94
-92
-90
-88

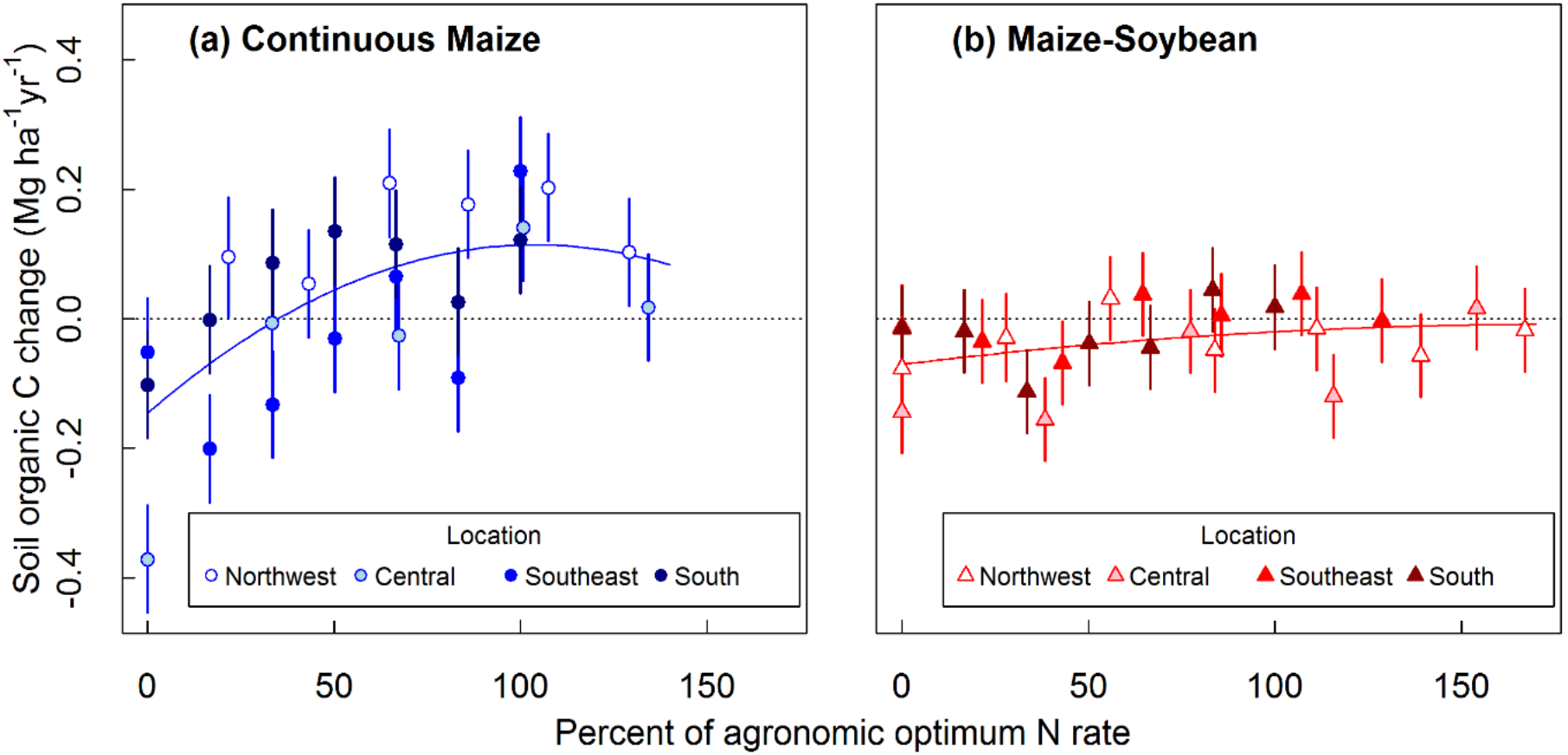
Average optimum N rate 1999-2014



Red = corn-soybean (only corn receives N; no effect of N rate to corn on bean yield, which is shown in red squares)

Blue = corn-corn

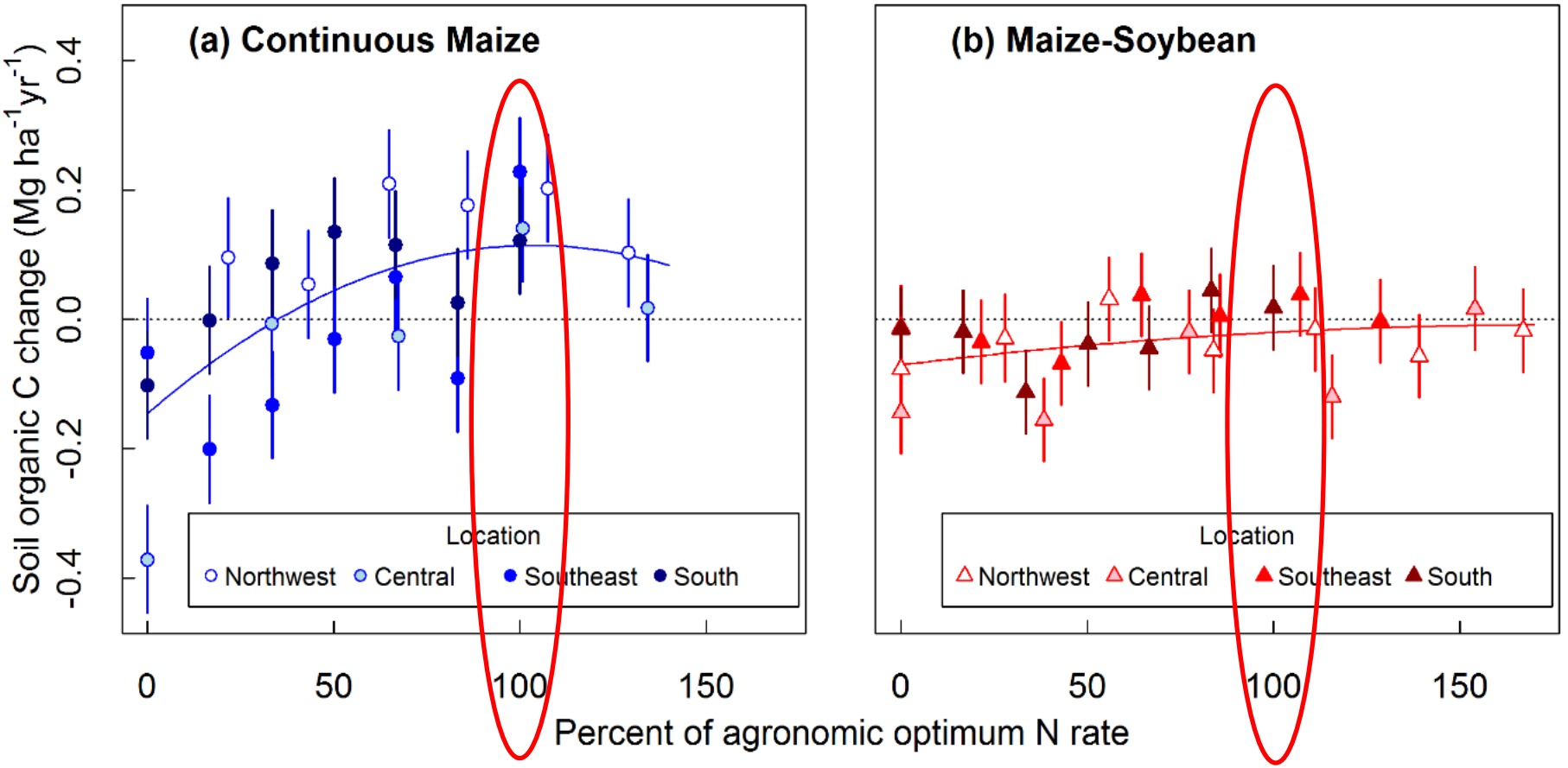
Nitrogen fertilizer is critical for soil health



All responses from previous slide scaled as a percent of the optimum rate at each site

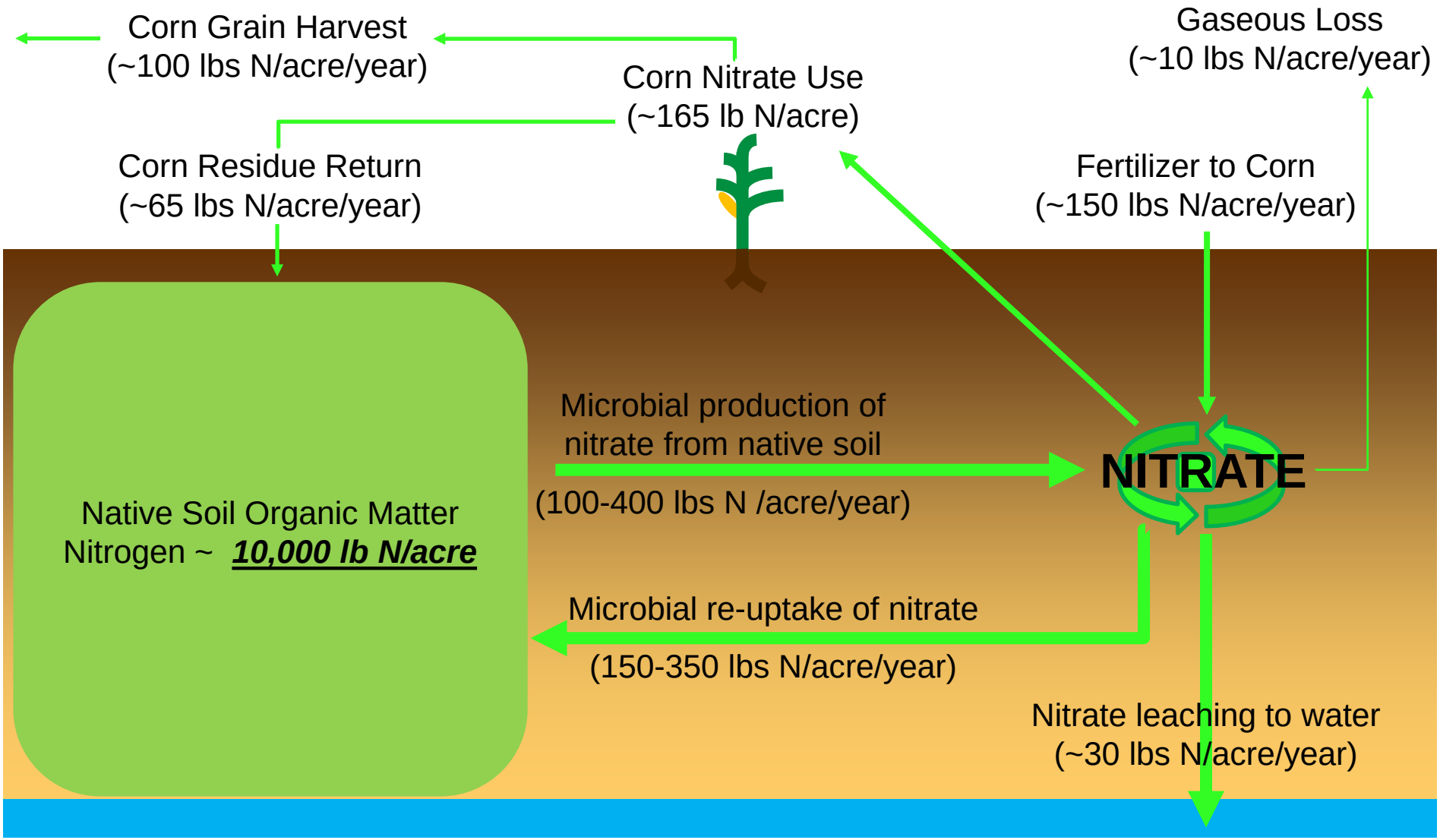
Nitrogen fertilizer is critical for soil health

Is it bad for water quality?

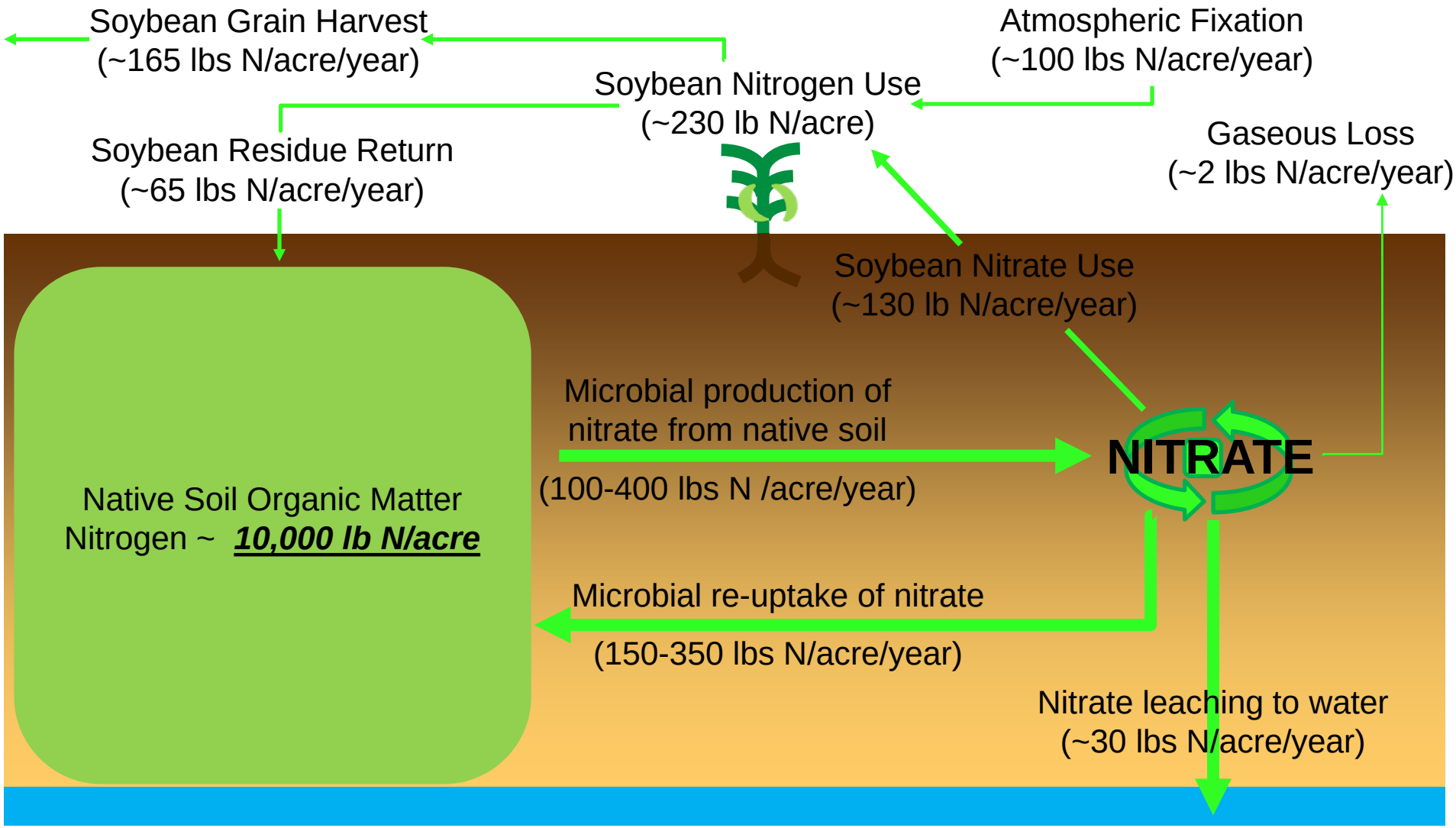


To understand the role of N fertilizer in water quality challenges, we need to know where the nitrate comes from…

Corn Nitrogen Cycling & Budget @ 177 bushels

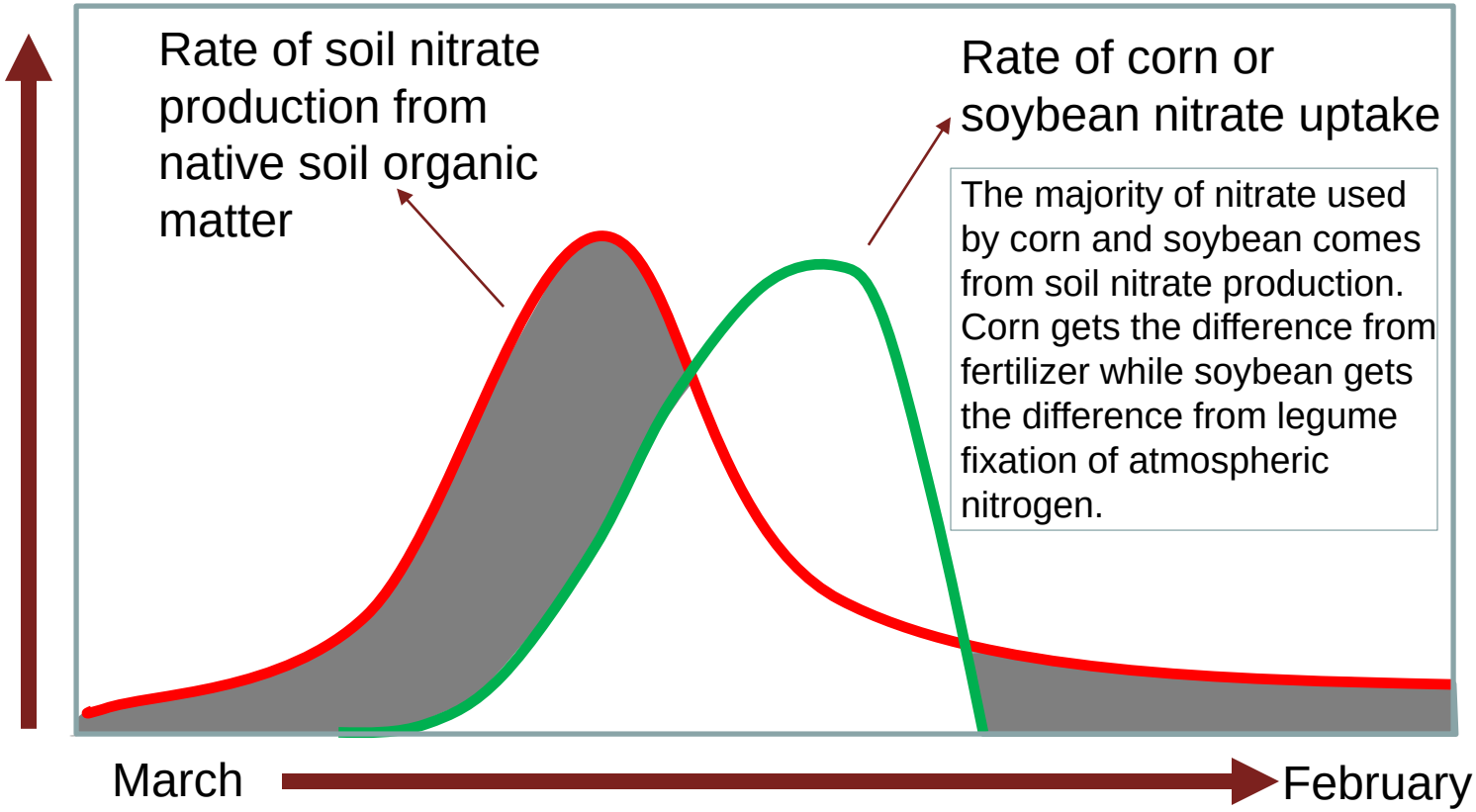


Soybean Nitrogen Cycling & Budget @ 51 bushels



Soil Nitrate Production Rate Is High

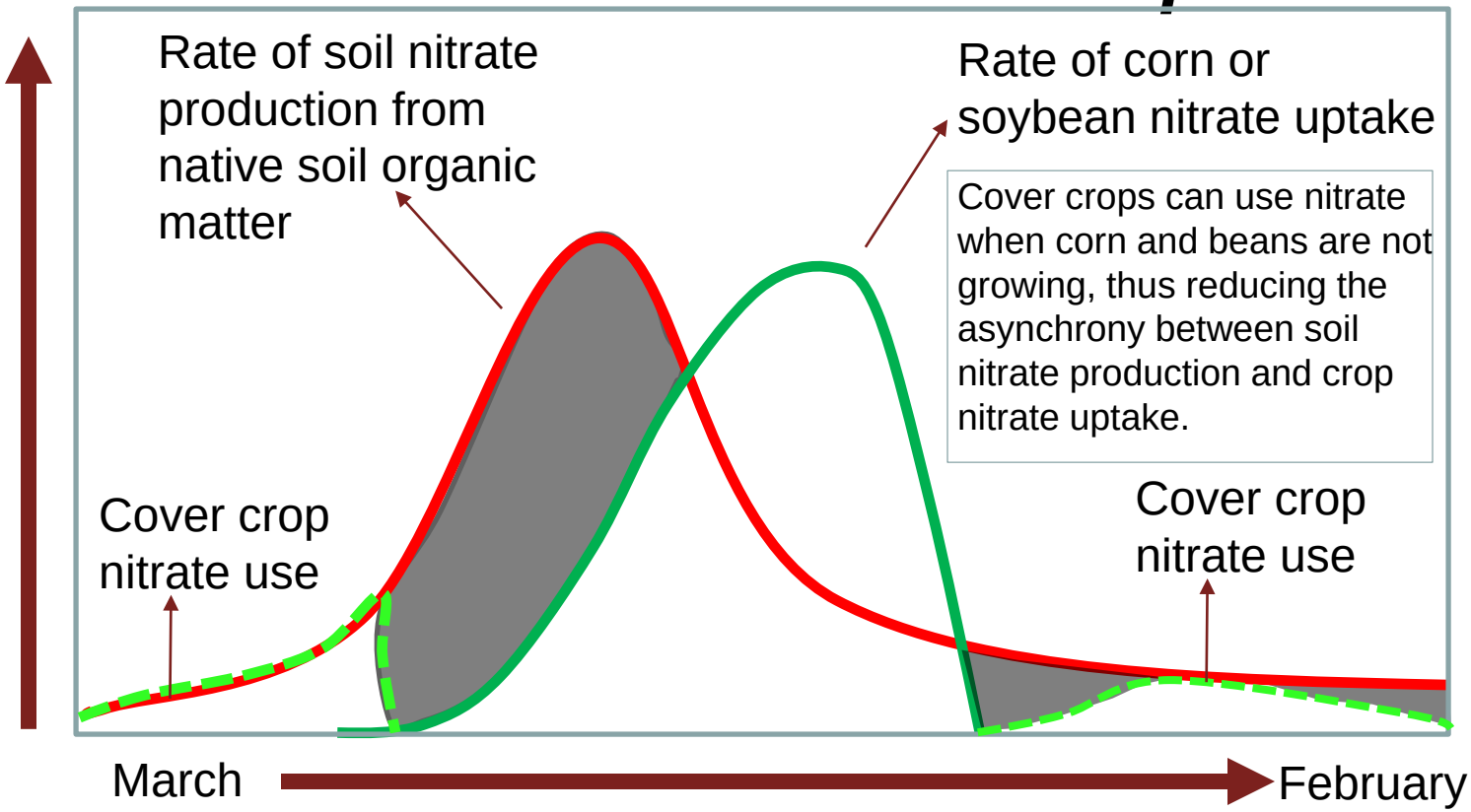
Soil Nitrate Production *vs.* Crop Nitrate Uptake



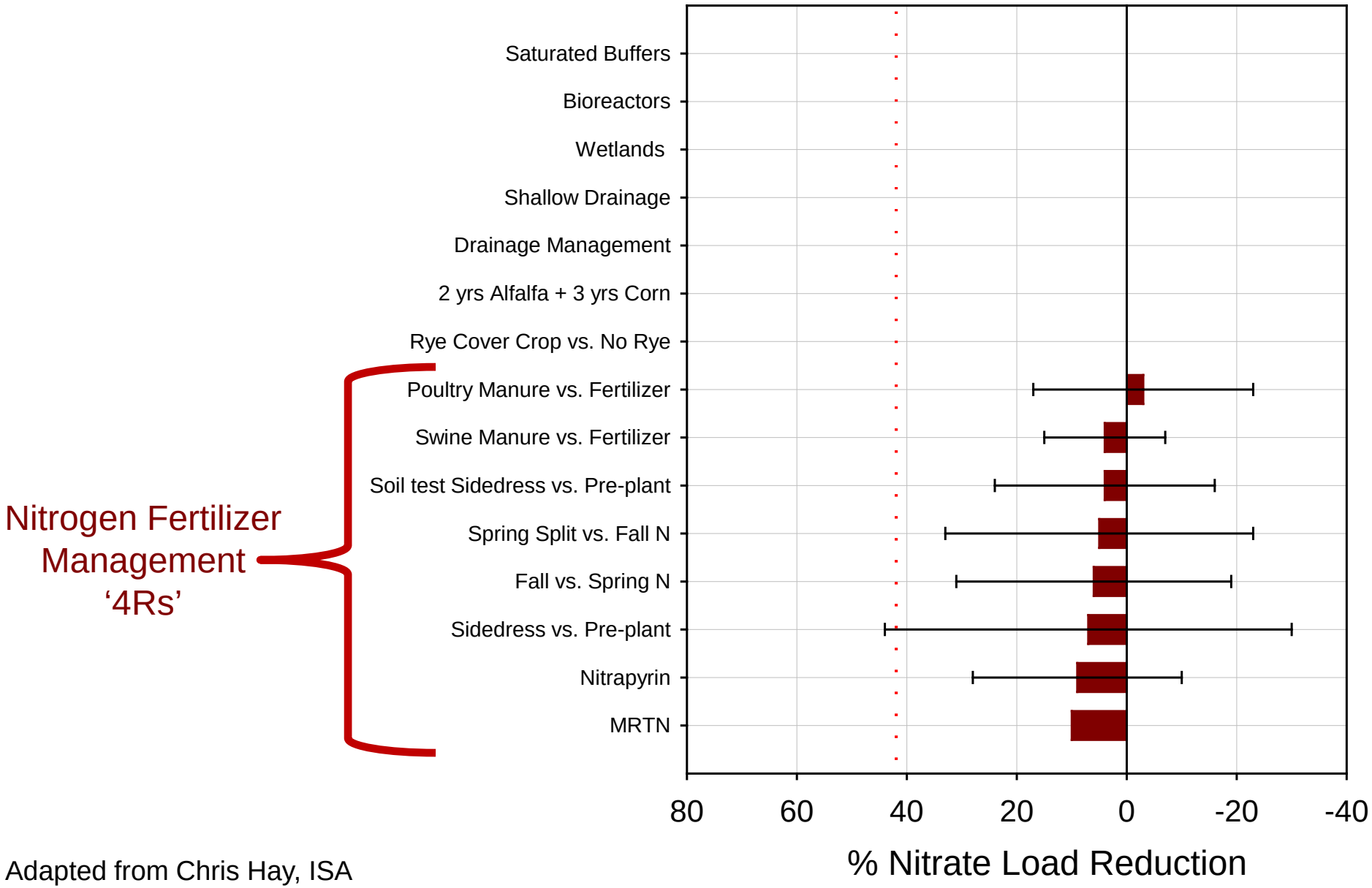
In the shaded areas, the soil produces nitrate, but there is no crop to use it. As a result, <u>some</u> nitrate is lost to waterways.

Soil Nitrate Production *vs.* Crop Nitrate Uptake

Addition of a Cover Crop



In the shaded areas, the soil produces nitrate, but there is no crop to use it. As a result, <u>some</u> nitrate is lost to waterways.

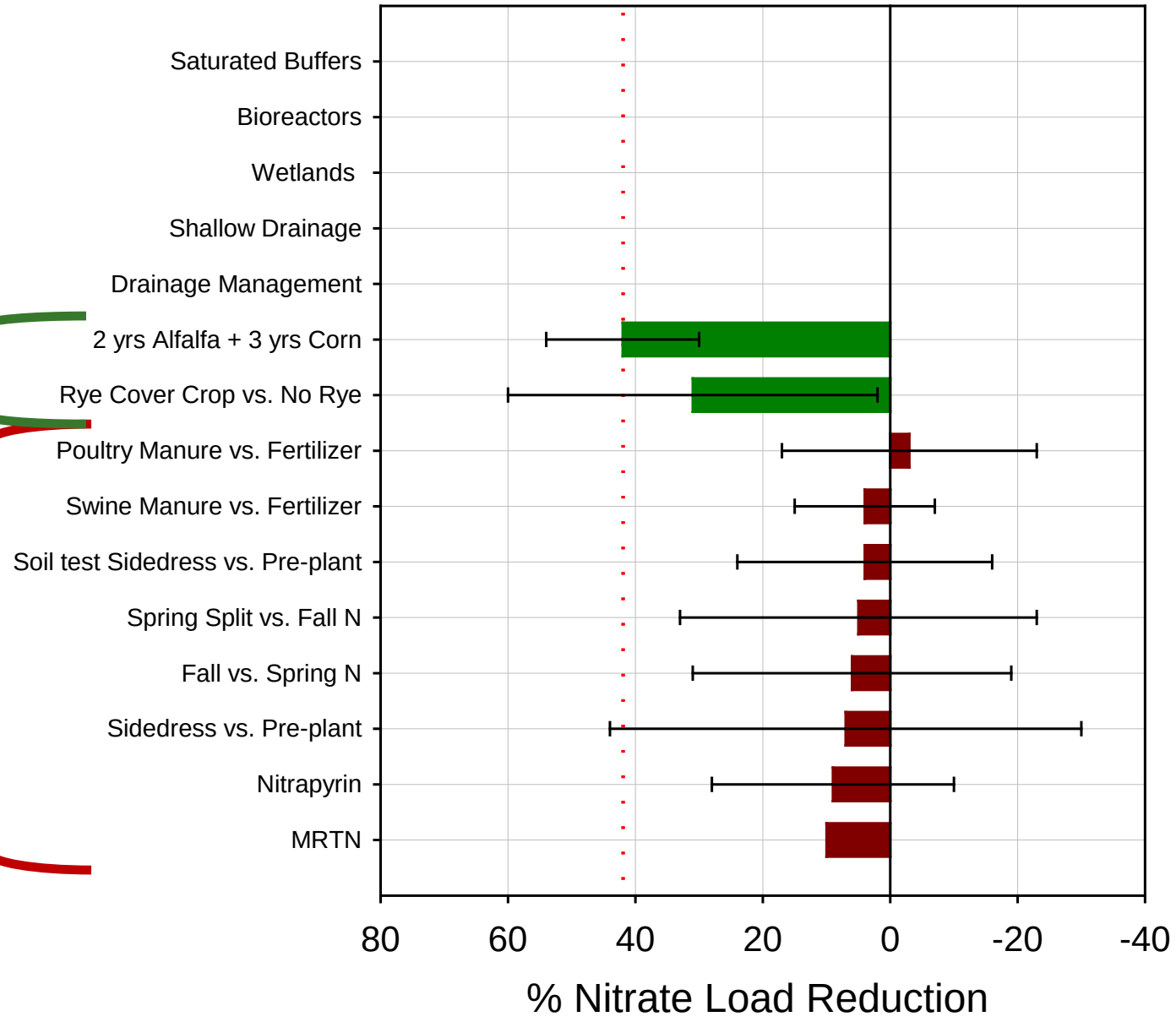


Nitrogen Fertilizer Management '4Rs'

Adapted from Chris Hay, ISA

In-Field/
Land Use Change

Nitrogen Fertilizer
Management
'4Rs'

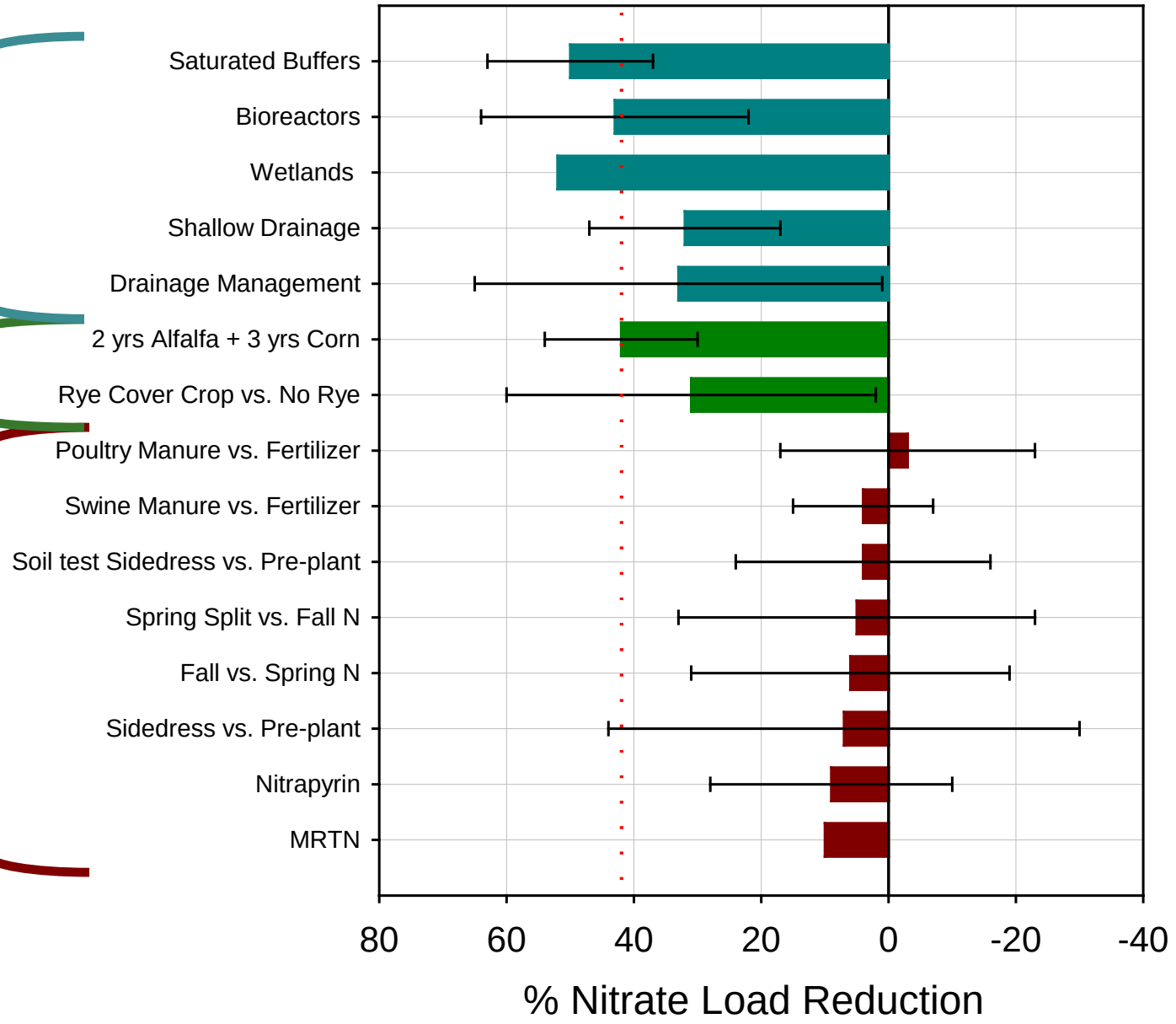


Adapted from Chris Hay, ISA

Edge-of-Field
(tiles only)

In-Field/
Land Use Change

Nitrogen Fertilizer
Management
'4Rs'

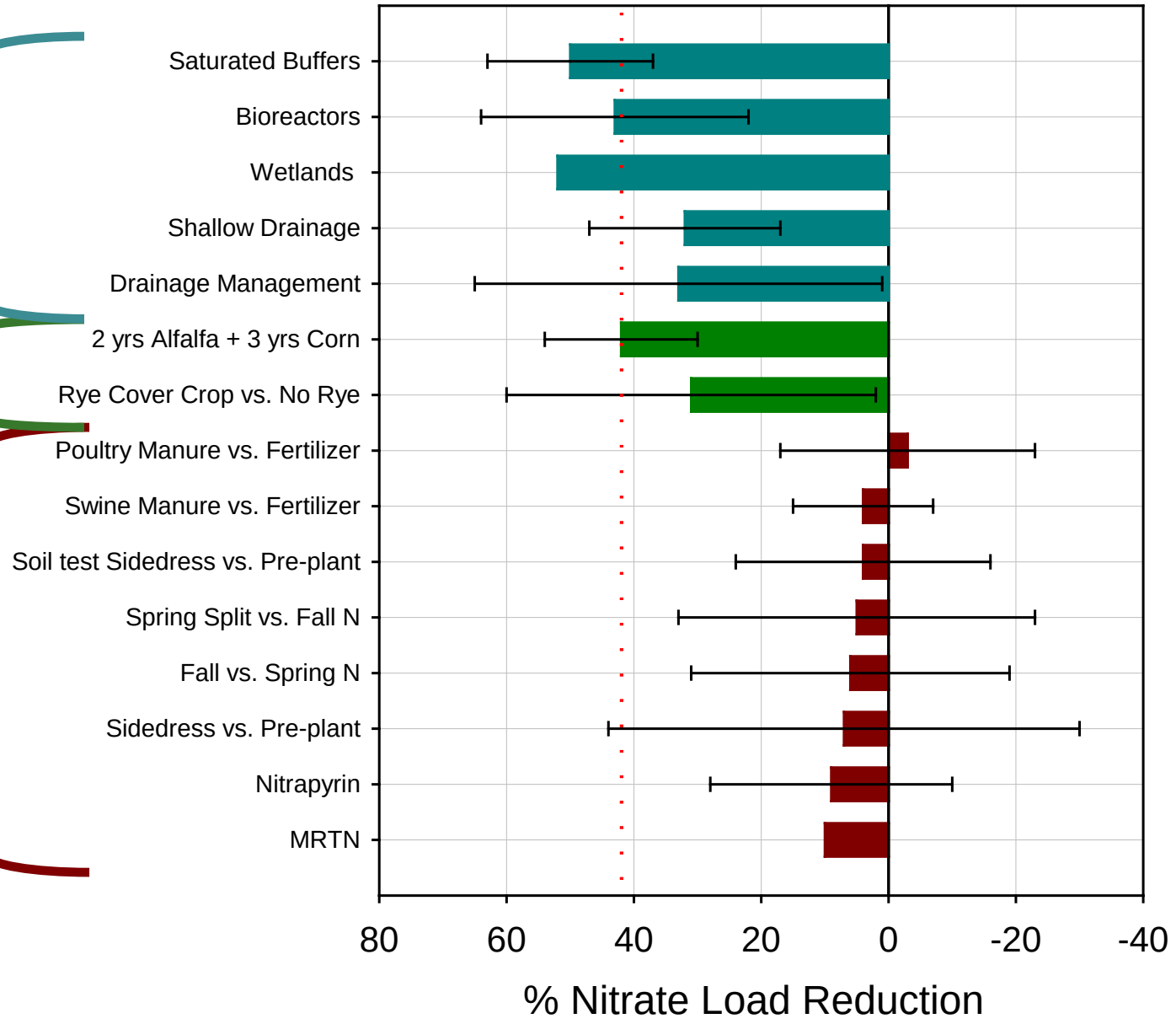


Adapted from Chris Hay, ISA

Edge-of-Field
(tiles only)

In-Field/
Land Use Change

Nitrogen Fertilizer
Management
'4Rs'



Adapted from Chris Hay, ISA

Nitrogen fertilizer mismanagement is not the cause of nitrate loss. It's the lack of a rapidly growing crop during times when the soil is warm and wet. Drainage can improve soil health, and it's an opportunity reduce nitrate loss.

When we consider quantification of soil health, how might improved drainage affect the organic matter-based measurements?

Michael Castellano
castelmj@iastate.edu
515-294-3963

@castellmj on twitter

http://www.nutrientstrategy.iastate.edu/center