

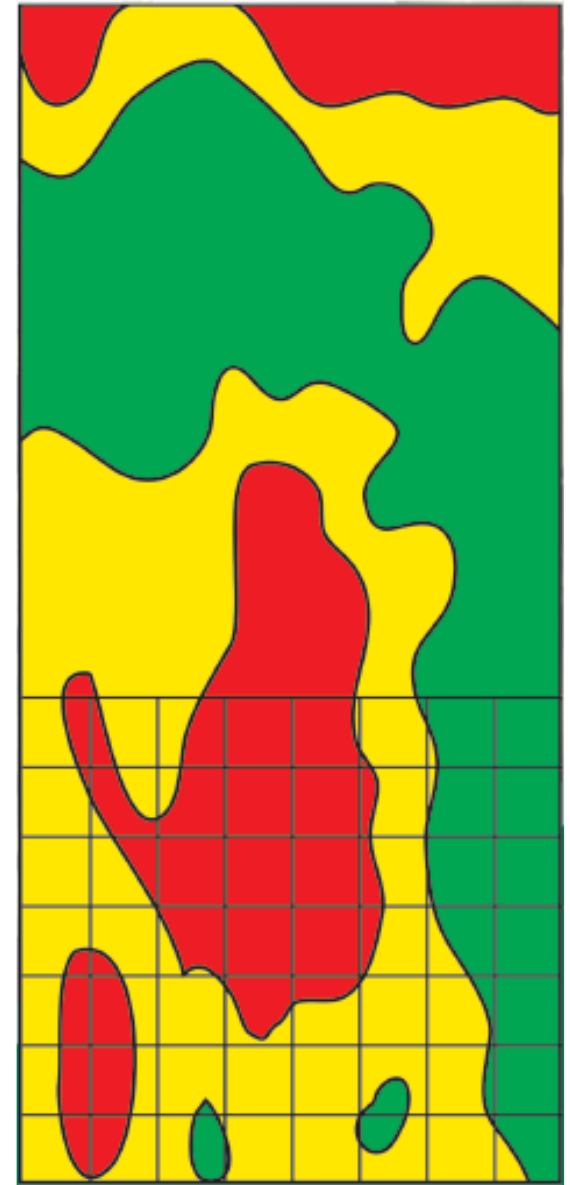
Managing Nitrogen after Drought

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Today's outline

1. 2021 residual soil nitrate overview
 - Drought, drought, and more drought
 - Soil water, plant roots, and stranded fertilizer
2. Field variability and zone soil sampling
3. Volunteer crops and nitrogen uptake
4. Soybean considerations
 - Delayed nodulation
 - Soybean iron deficiency chlorosis (IDC)

North American Drought Monitor

July 31, 2021

Released: Tuesday, August 10, 2021

<http://www.ncdc.noaa.gov/temp-and-precip/drought/nadm>

Analysts:

Canada - Trevor Hadwen
Alyssa Klein
Mexico - Reynaldo Pascual
Minerva Lopez*
Yenifeer Loranca
U.S.A. - Richard Tinker

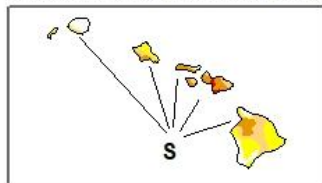
(* Responsible for collecting analysts' input & assembling the NA-DM map)

Intensity:

- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

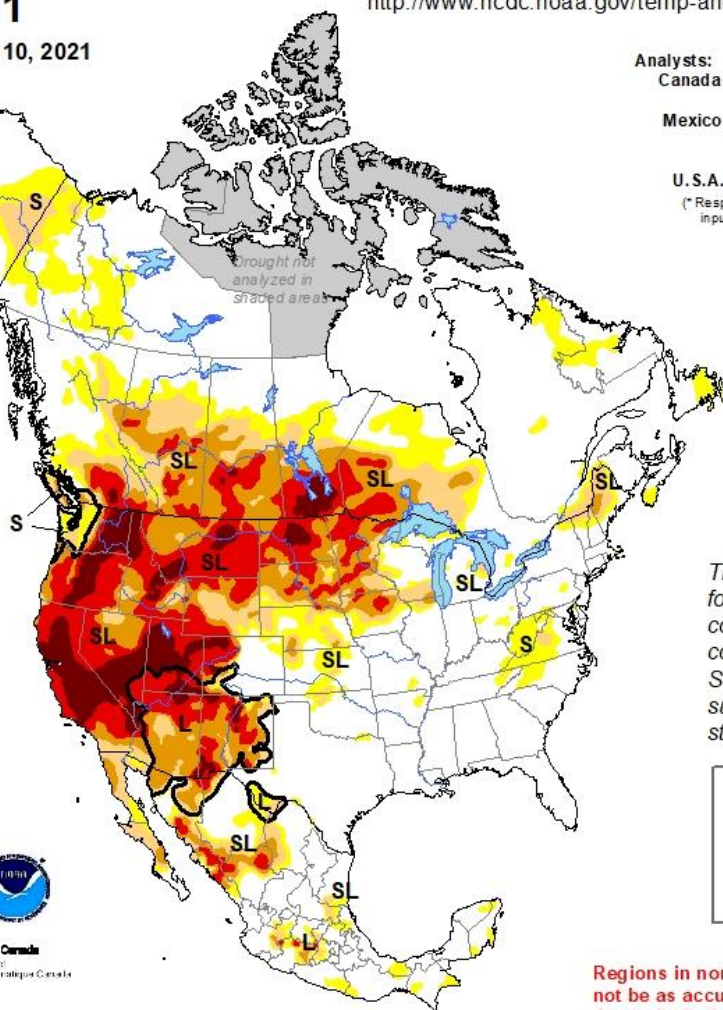
Drought Impact Types:

- ~ Delineates dominant impacts
- S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)
- L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

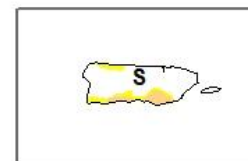


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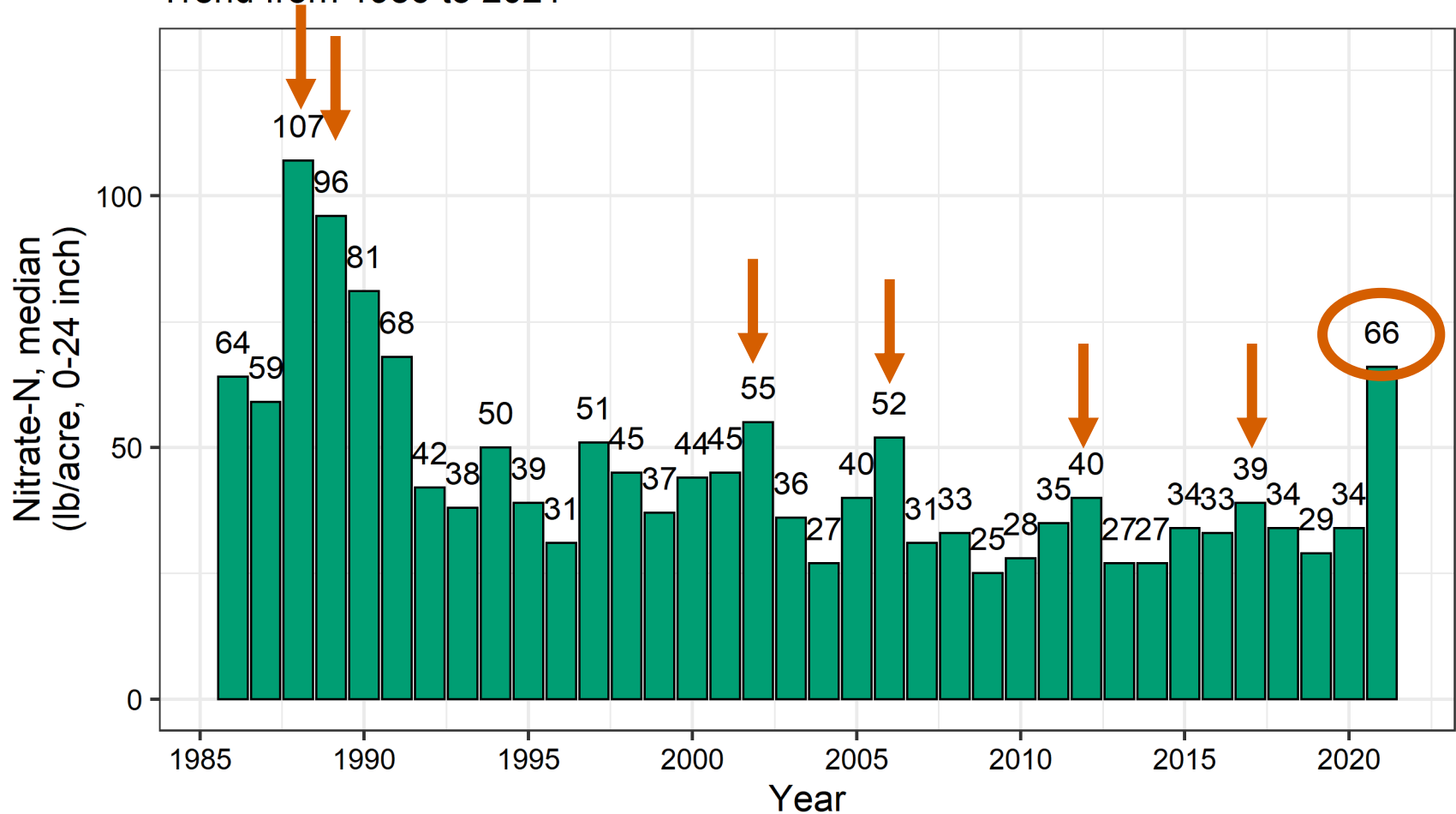
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.



Regions in northern Canada may not be as accurate as other regions due to limited information.

Residual nitrate following wheat

Trend from 1986 to 2021



Data not shown where $n < 100$
AGVISE Laboratories, Inc.

What do we know about nitrate-N carryover following drought?

More residual soil nitrate-N than usual

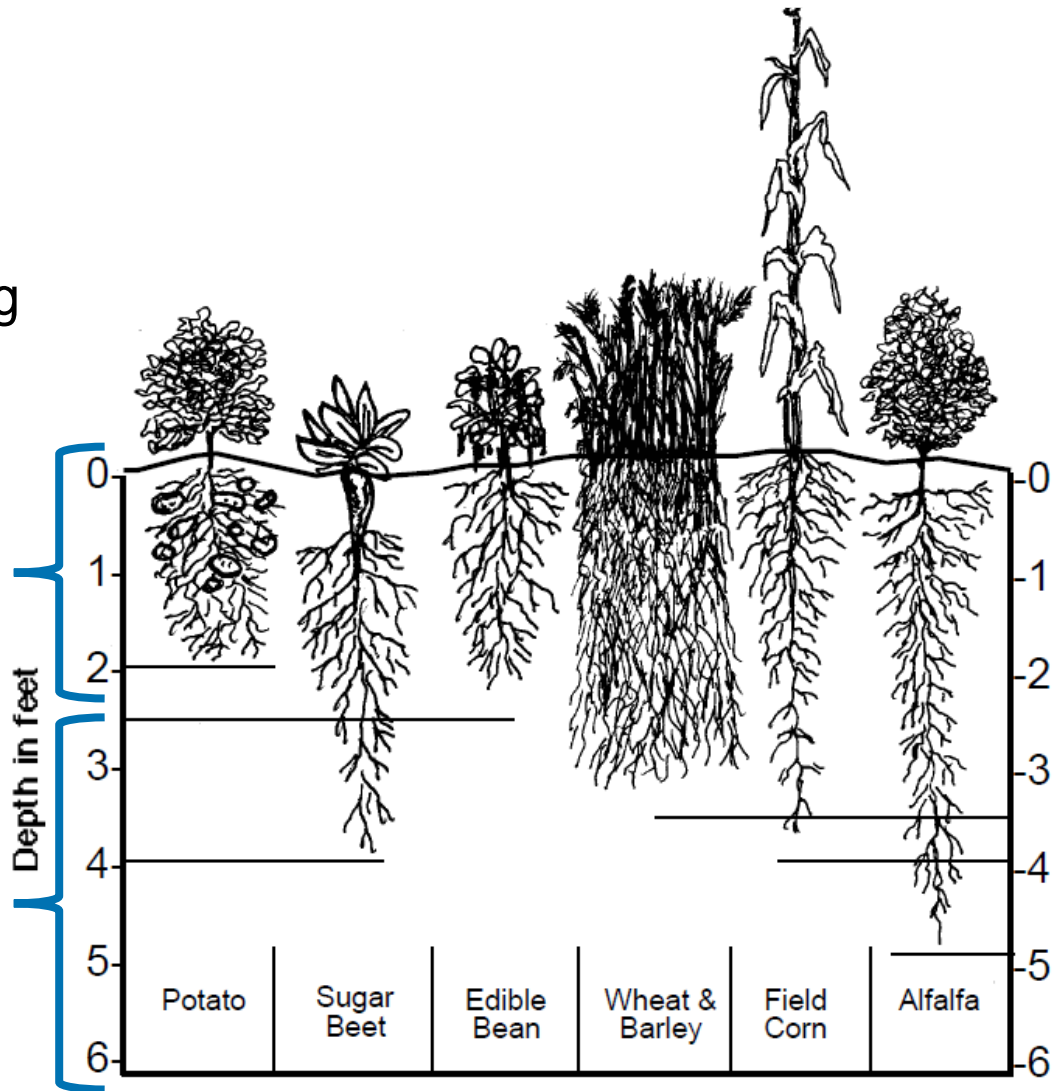
- Lower crop nitrogen uptake and use (low crop yield)
- Little to no soil nitrogen loss from leaching or denitrification
- Warmer than average soil temperatures, possibly more nitrogen mineralization
- Nitrogen fertilizer near soil surface was bypassed as plant roots searched for soil water

Where did plant roots find water and nitrogen?

Plant roots searched for subsoil water early, finding accumulated subsoil nitrate-nitrogen

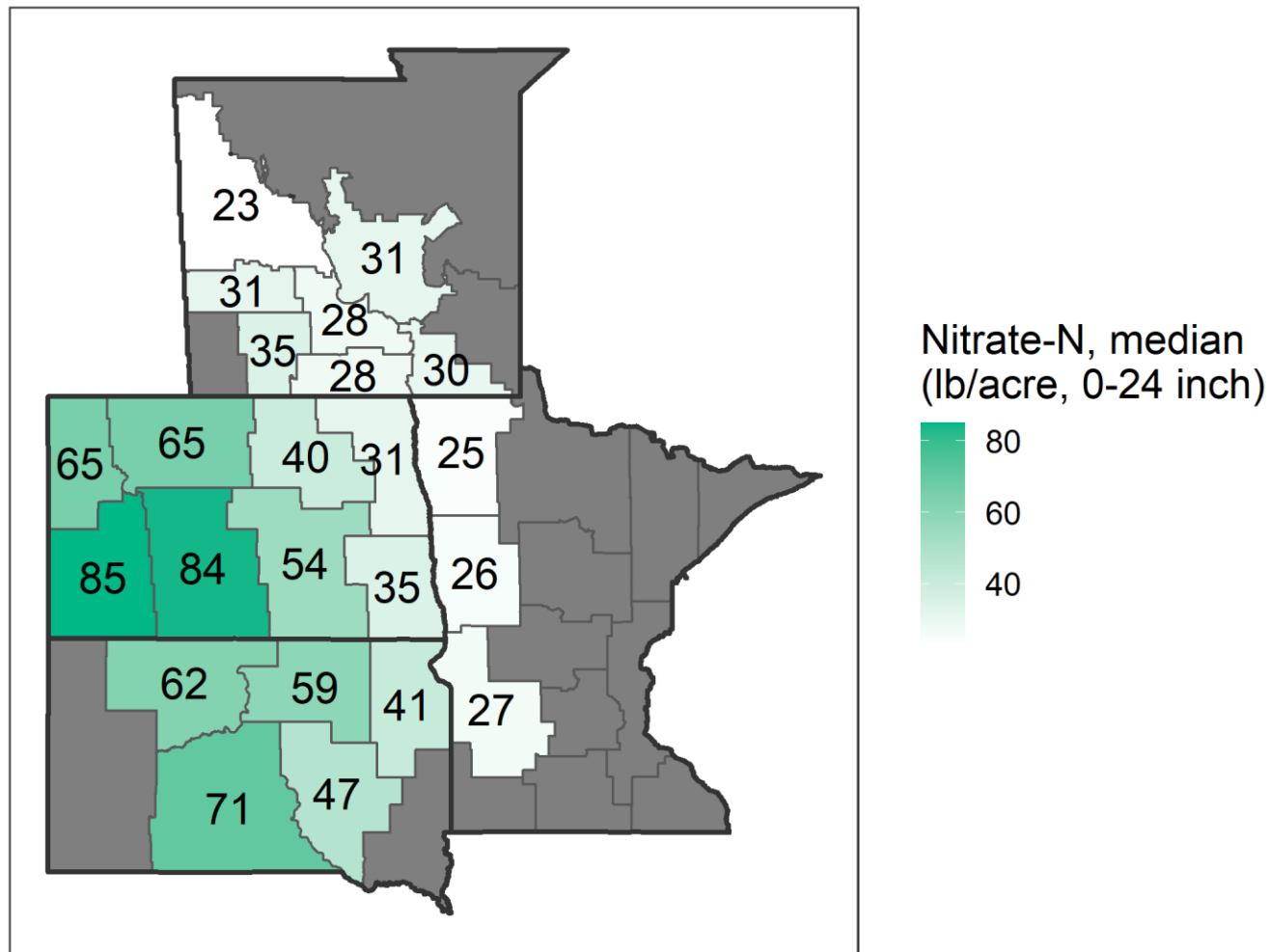
Standard 0-2 ft soil sampling depth

Accumulated nitrate-N from wet years past



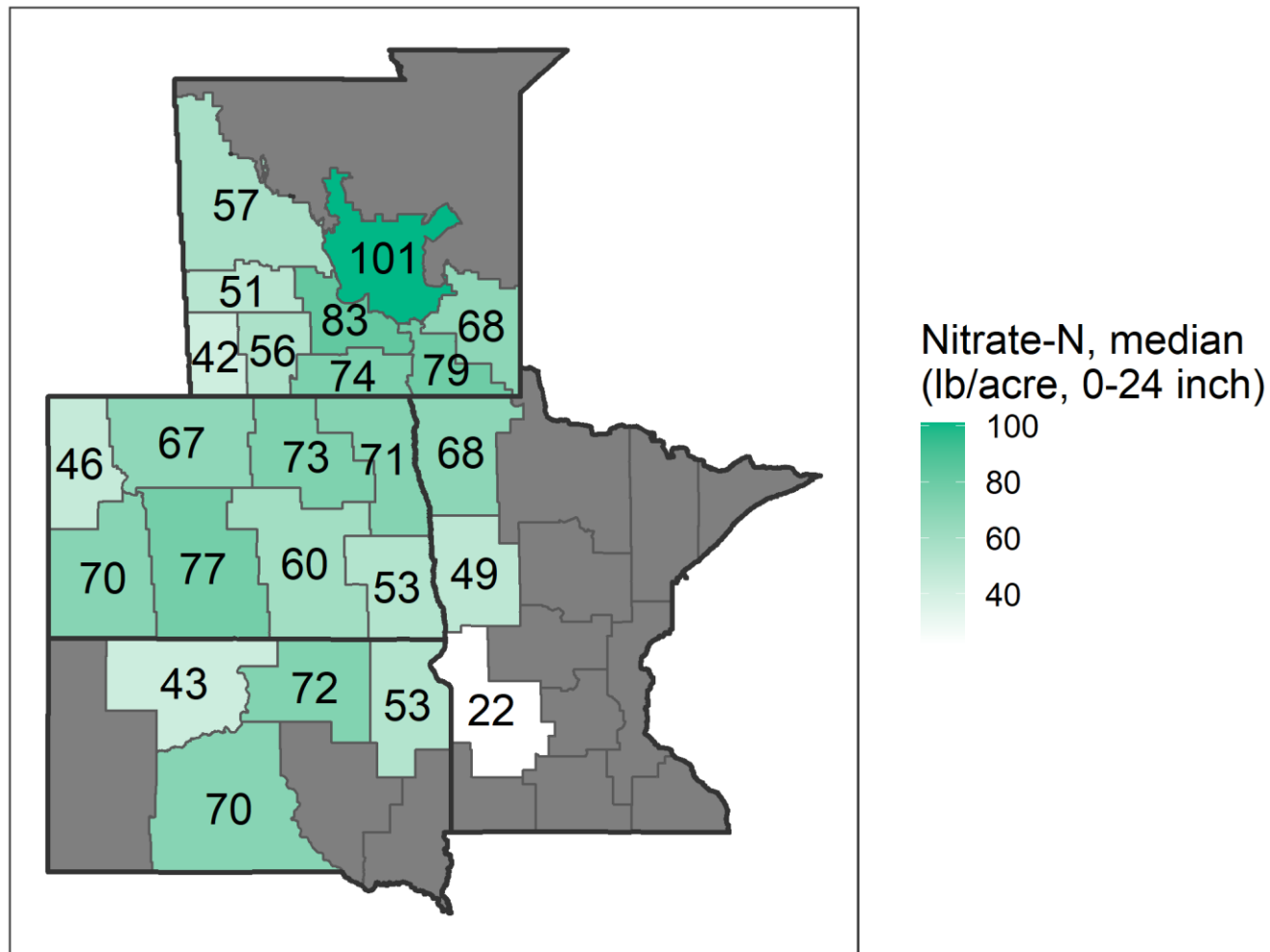
Typical plant rooting depth

Residual nitrate following wheat in 2017



Data not shown where $n < 100$
AGVISE Laboratories, Northwood, ND

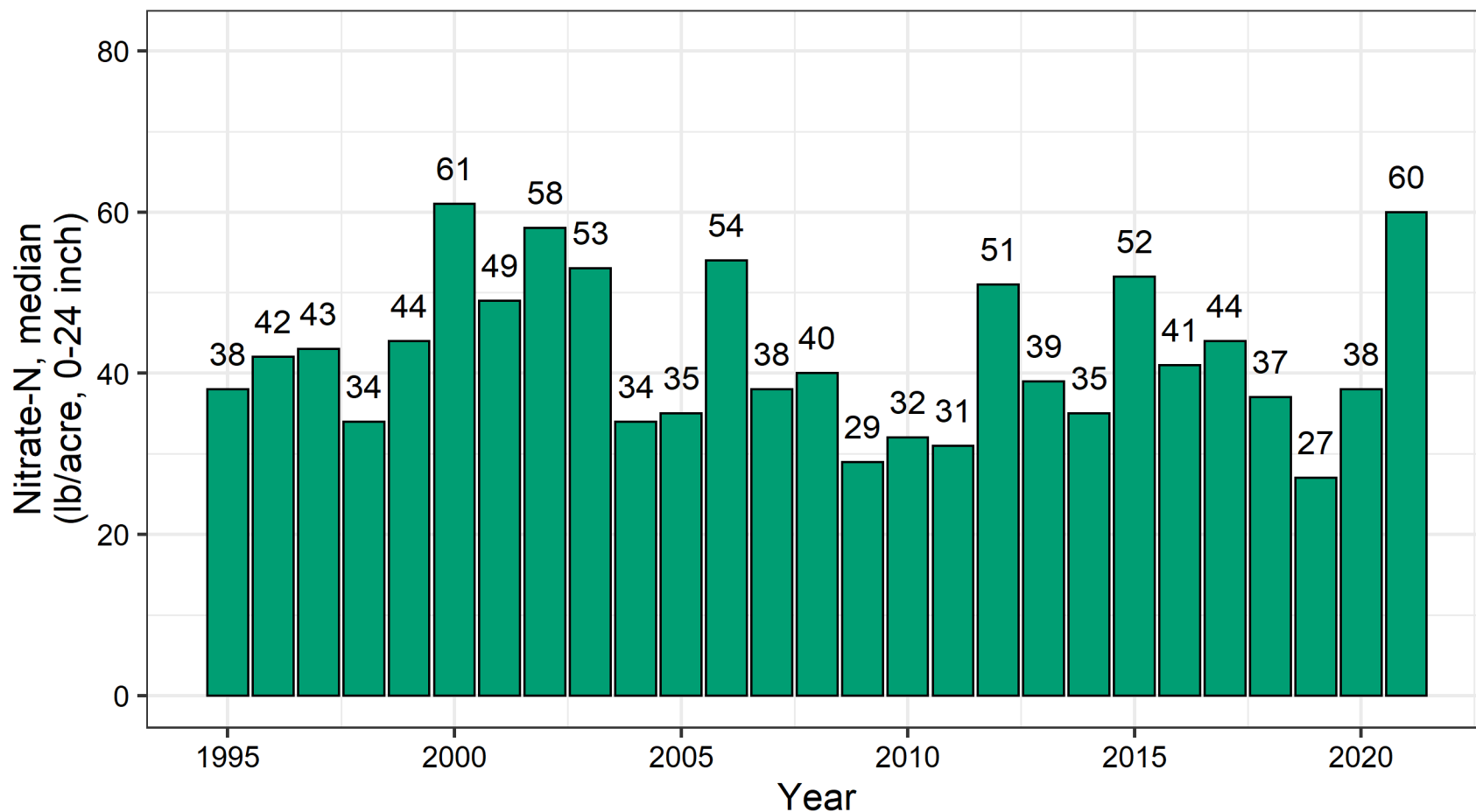
Residual nitrate following wheat in 2021



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AGVISE Laboratories, Inc.

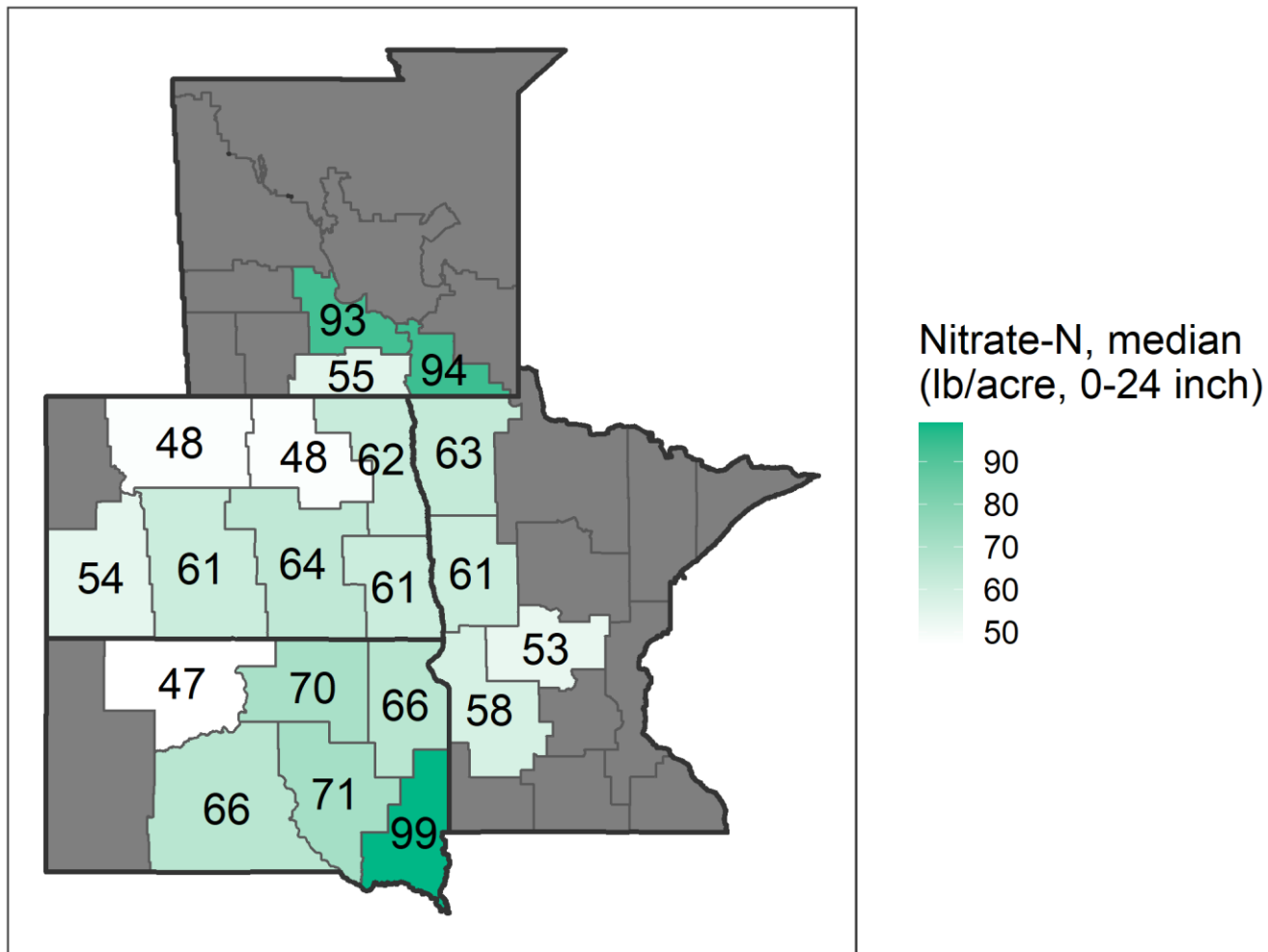
Residual nitrate following corn

Trend from 1995 to 2021



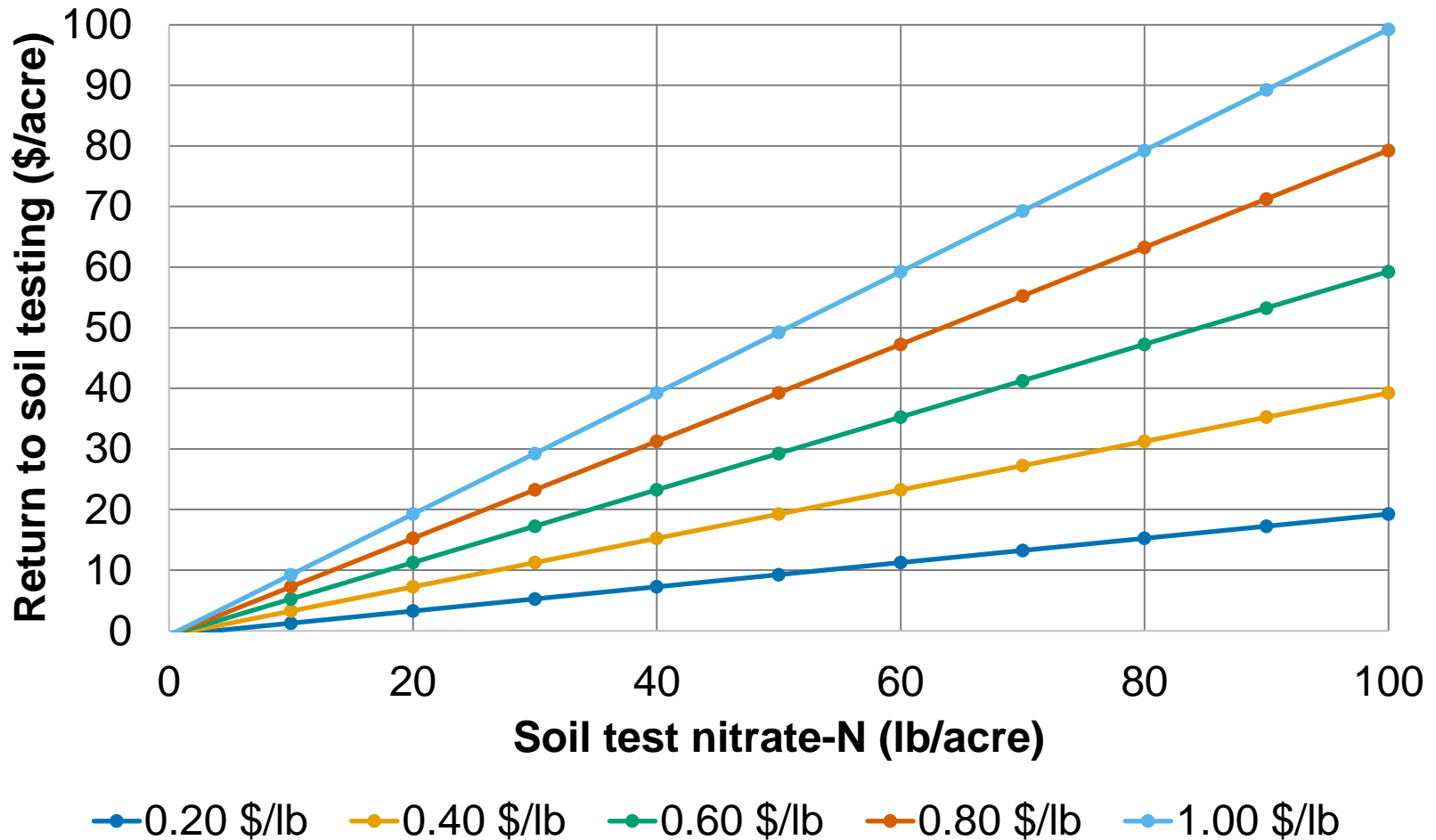
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AGVISE Laboratories, Inc.

Residual nitrate following corn in 2021



Data not shown where $n < 100$
AGVISE Laboratories, Inc.

When does soil testing pay?



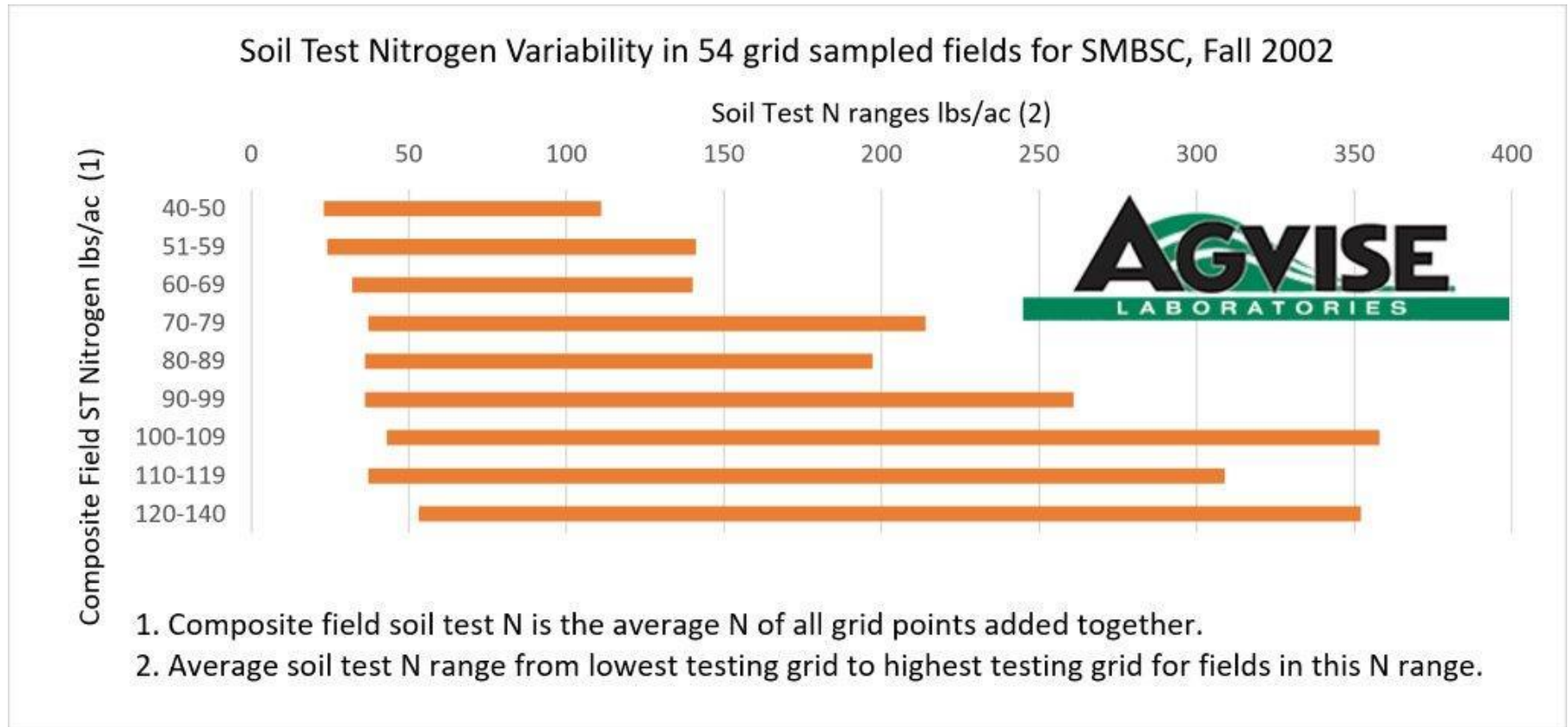
Assumed soil sampling and analysis cost of \$120 per field, 160 acre field, only nitrogen cost-savings calculated.

Let's scale it up!

Nitrogen rates, logistics, dollars

Example: 585 Bismarck, ND zip code	2018	2020	2022
Residual nitrate-N from last year (lb/acre, 0-24 inch)	84	21	77
Wheat yield goal (bu/acre)	40	40	40
Wheat N requirement (lb/acre)	108	108	108
Fertilizer N applied (lb/acre)	24	87	31
Wheat area (acre)	3000	3000	3000
Total urea (ton)	78	284	101
Total urea cost (\$925/ton=\$1.00/lb N)	\$72,000	\$261,000	\$93,000

What do you do about the really high fields?



Apply sufficient base nitrogen rate to cover field variability

Zone soil sampling reveals field variability

	Average soil test range within a field (high zone – low zone)					
Number of zones per field	Nitrate-N lb/acre, 0-24 inch	Olsen P ppm	K ppm	pH	EC(1:1) dS/m	SOM (%)
3	37	10	91	0.59	0.77	1.13
4	47	15	115	0.74	0.84	1.49
5	57	18	143	0.88	1.14	1.80
6	65	22	169	1.14	1.23	1.80
7	70	25	190	1.27	1.36	1.56
8	87	25	187	1.35	1.18	1.93

Summary of 33,000 precision soil sampled fields from Manitoba, Minnesota, North Dakota, South Dakota; AGVISE Laboratories, 2021

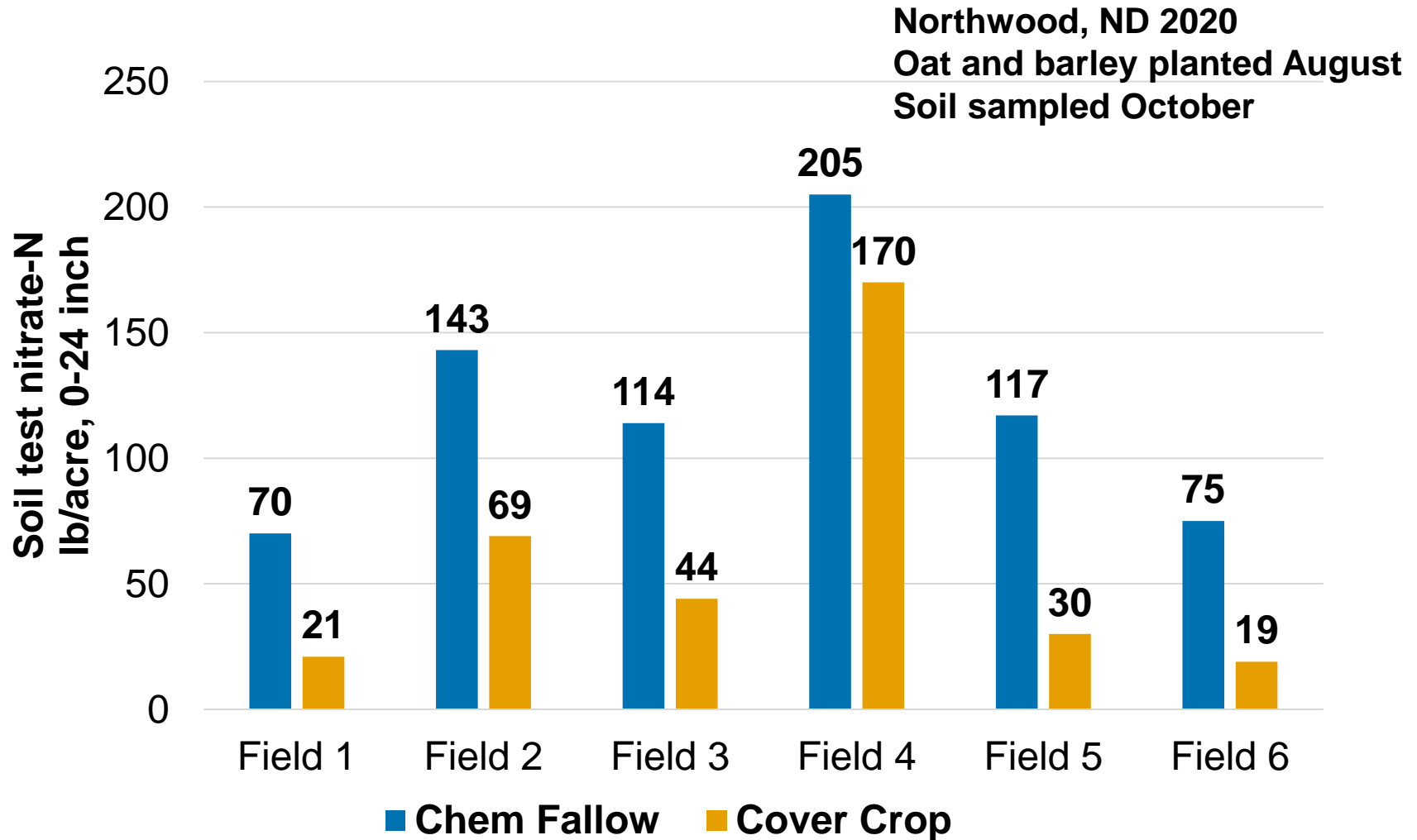
Recap on drought and soil nitrate-N

- Most widespread drought since 1988
- Large amounts of residual soil nitrate-N to credit toward next year
- ROI on soil testing is remarkable at current fertilizer prices
- Field variability must be managed with zone soil sampling and some base nitrogen rate

Fall-planted cover crops and volunteer crops

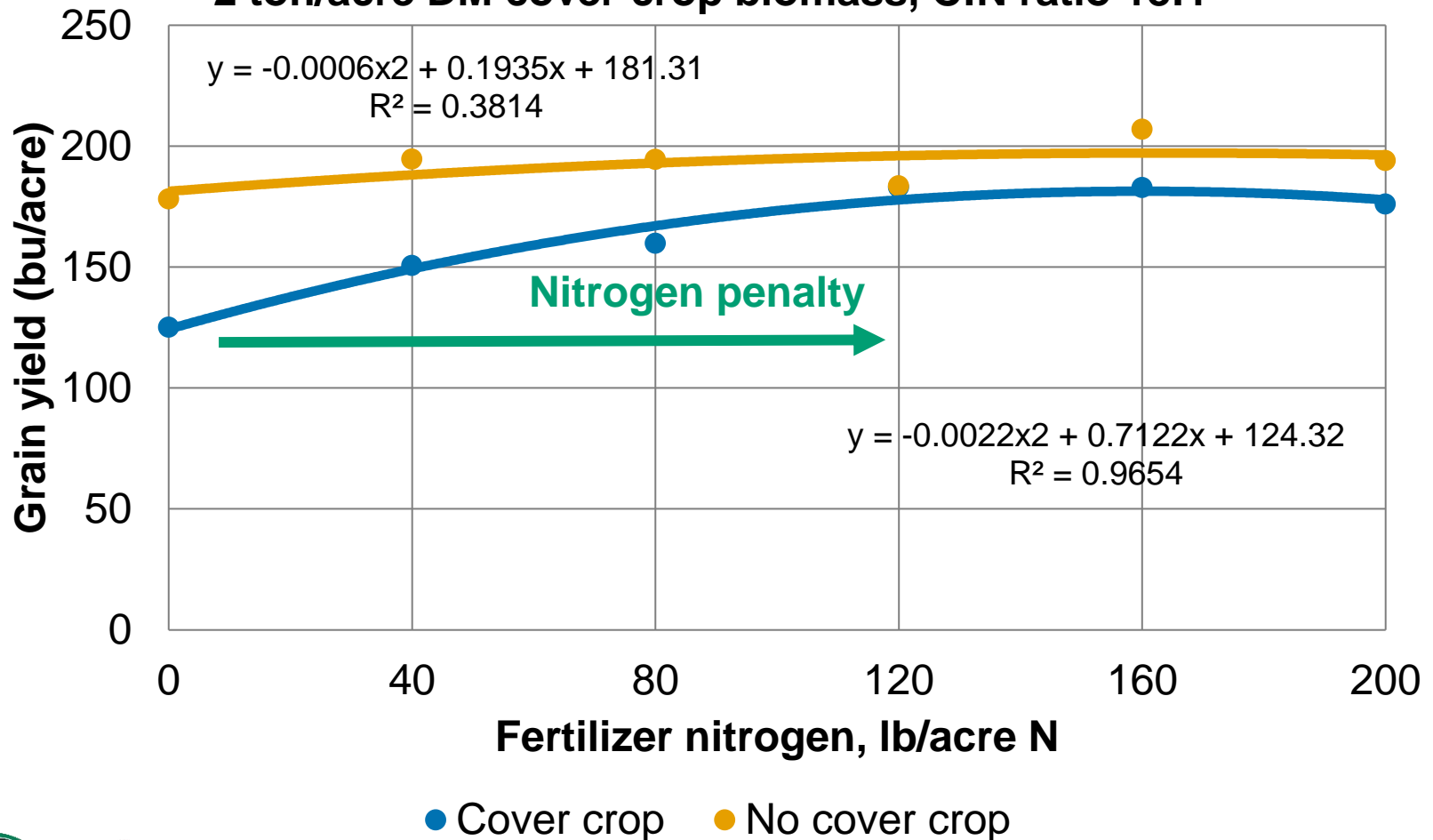


Volunteer cereals will accumulate residual soil nitrate-N



Cover crop nitrogen credit?

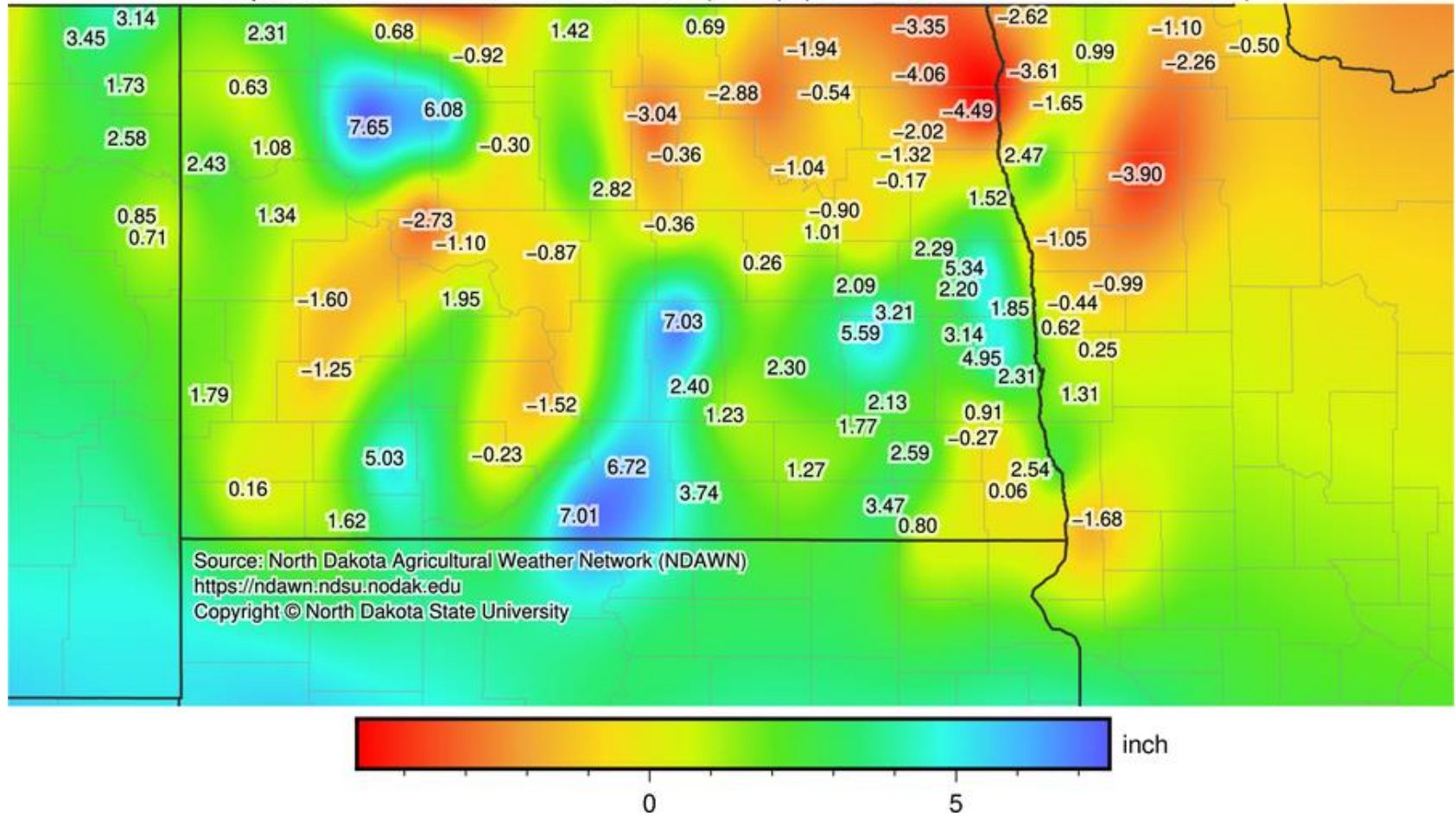
Corn after cover crop; Rutland, ND 2017
2 ton/acre DM cover crop biomass, C:N ratio 18:1



What happens if we get a bunch of rain?

Does anyone remember the 2019 summer drought?

Departure from Normal Rainfall (inch) (2019-06-01 – 2019-08-31)





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@jsbreker

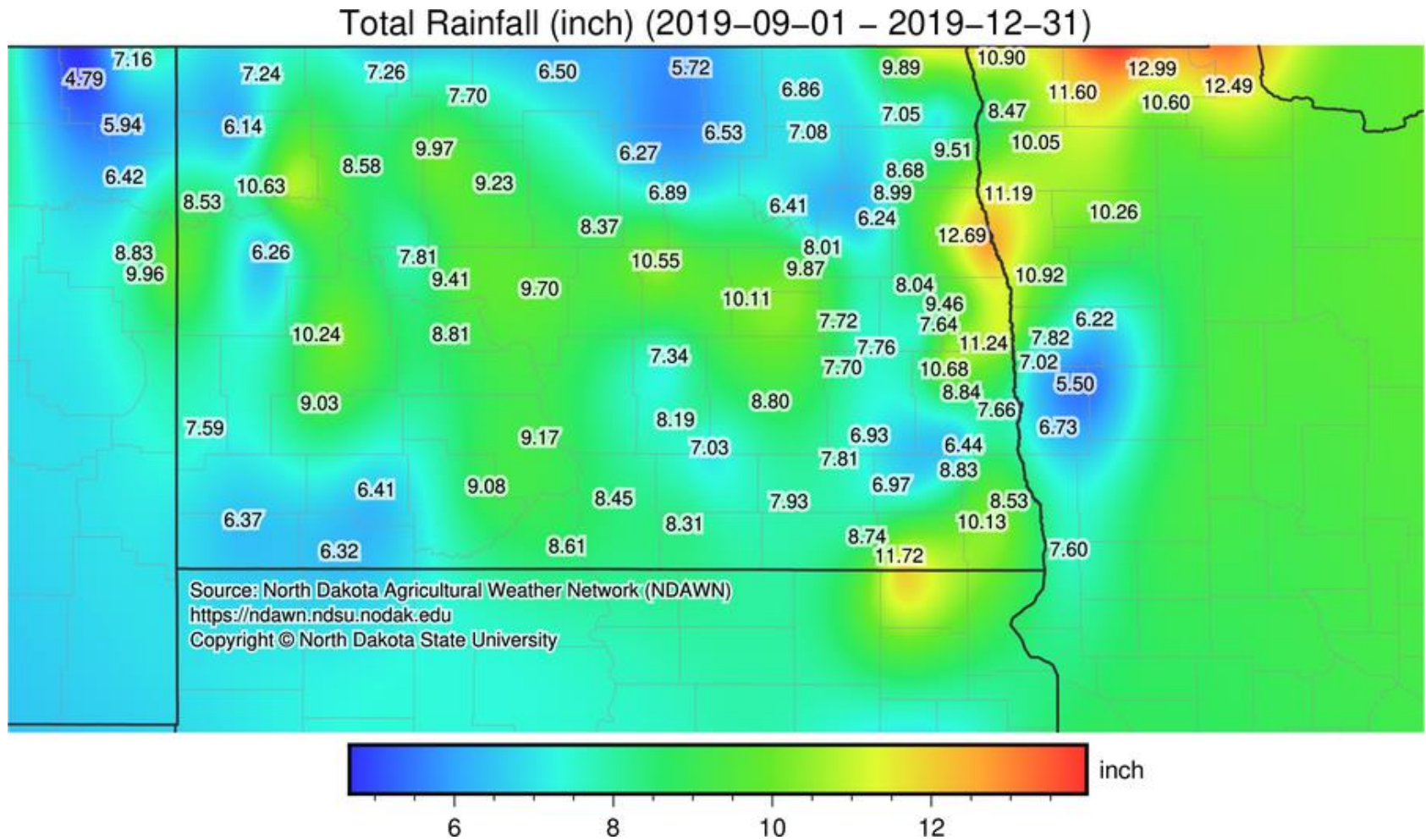


Mountain, ND: Corn adopting pineapple appearance; curling leaves to reduce transpiration. Local area only had about 5 inch precipitation so far this year (50-60% normal). [#drought19](#)



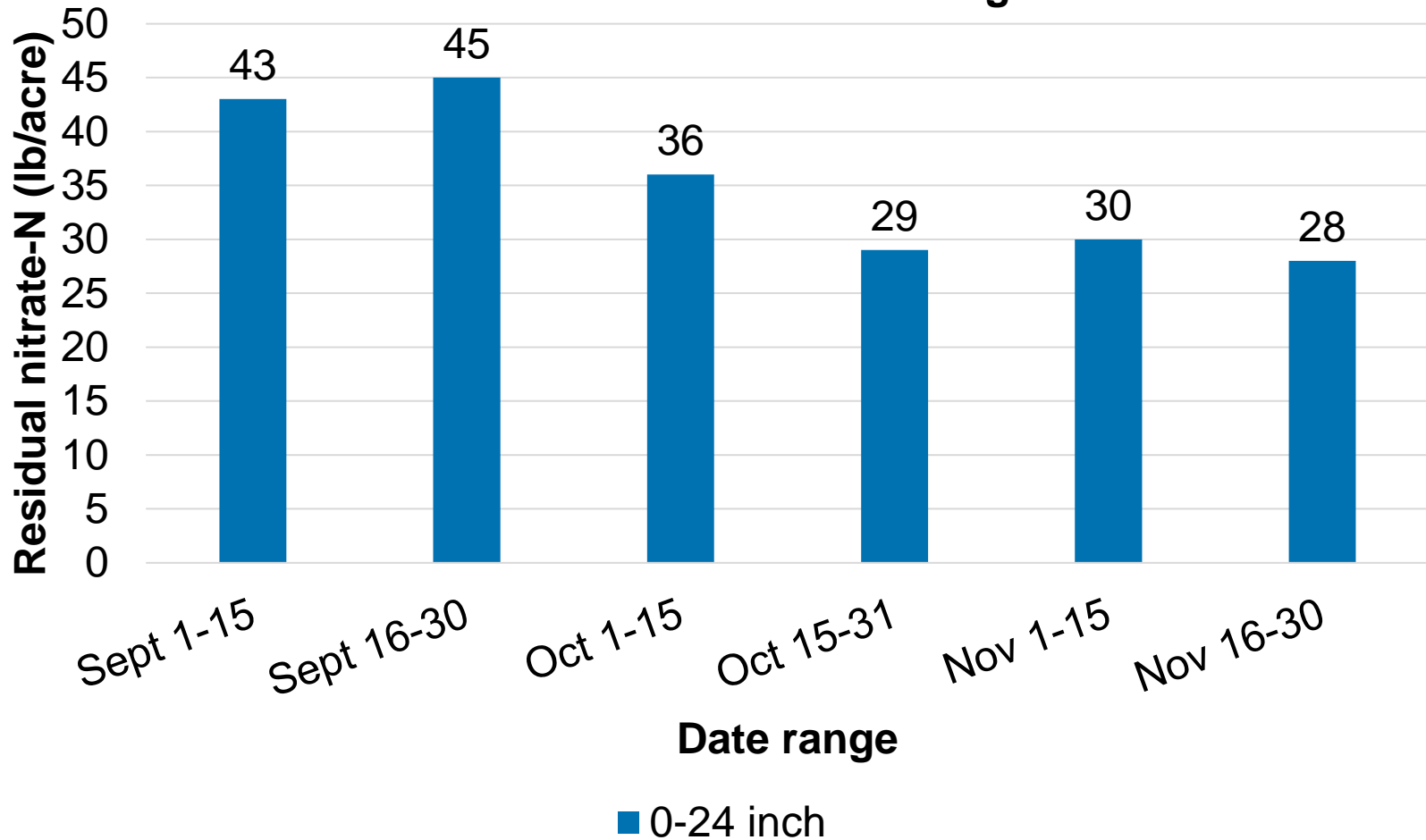
1:21 PM · Jul 24, 2019 · [Twitter for iPhone](#)

And then the rain came...



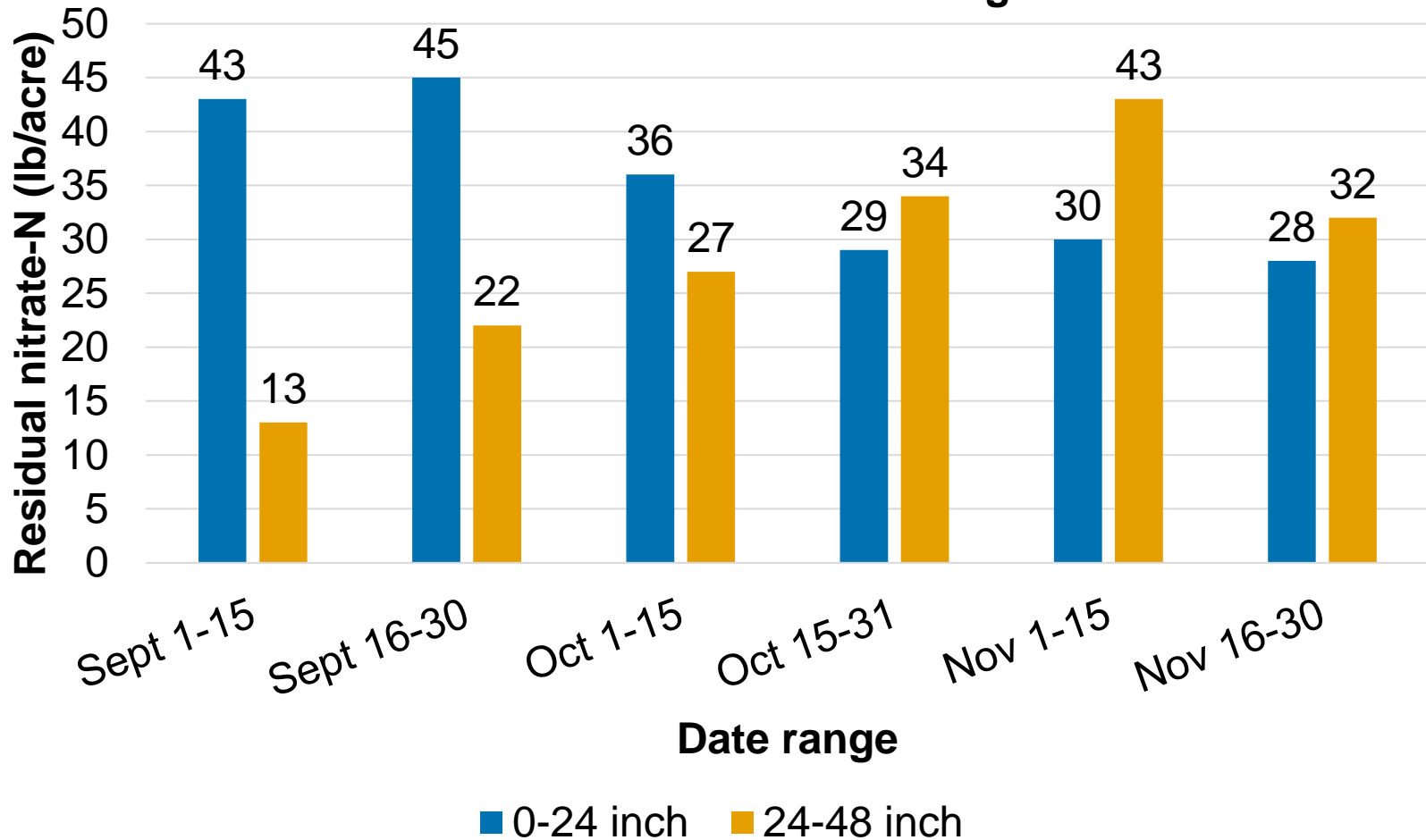
Excess rainfall shifted residual nitrate profile, Fall 2019

582 zip code; Grand Forks, ND
Following wheat

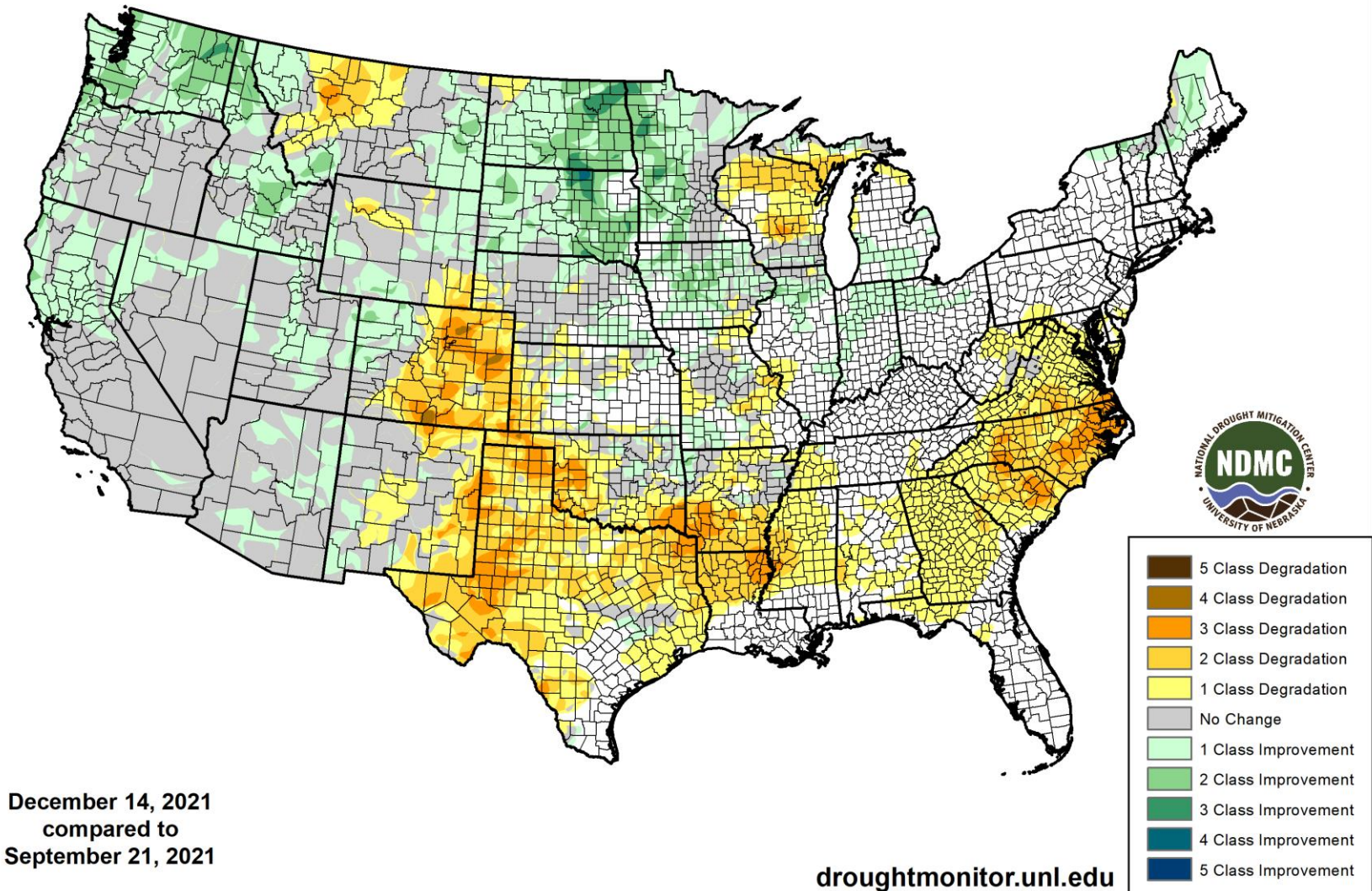


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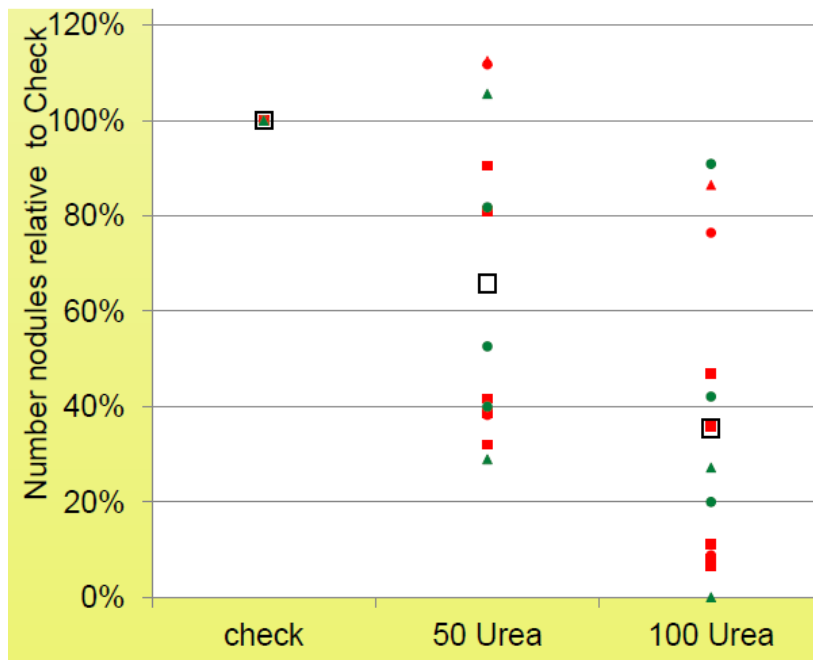


U.S. Drought Monitor Class Change - Contiguous U.S. (CONUS) 12 Week

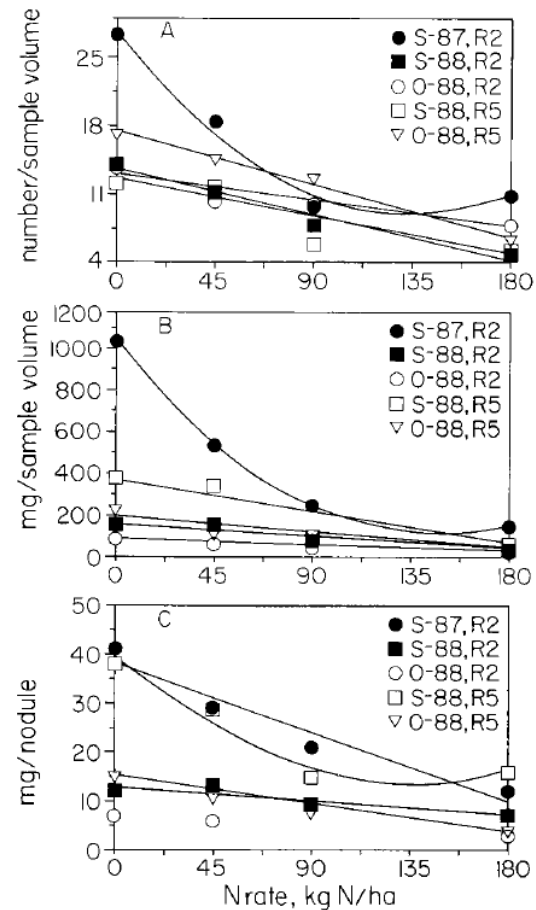


What do we know about high soil nitrogen and soybean nodulation?

2013 Manitoba and North Dakota



1987/88 Quebec



Will 2022 be a soybean iron deficiency chlorosis (IDC) year?

Identify fields with low IDC risk

- Soil test for carbonate and salinity
- Consider soil test nitrate-N
- Choose low IDC risk fields

Mitigating moderate to high IDC risk

1. Variety selection
2. Variety selection
3. Variety selection
4. Wider rows (plants closer together reduces IDC)
5. Apply high-quality FeEDDHA with seed
6. Plant companion cereal with soybean (uses excess water and nitrate)



Excess soil nitrate will exacerbate soybean IDC

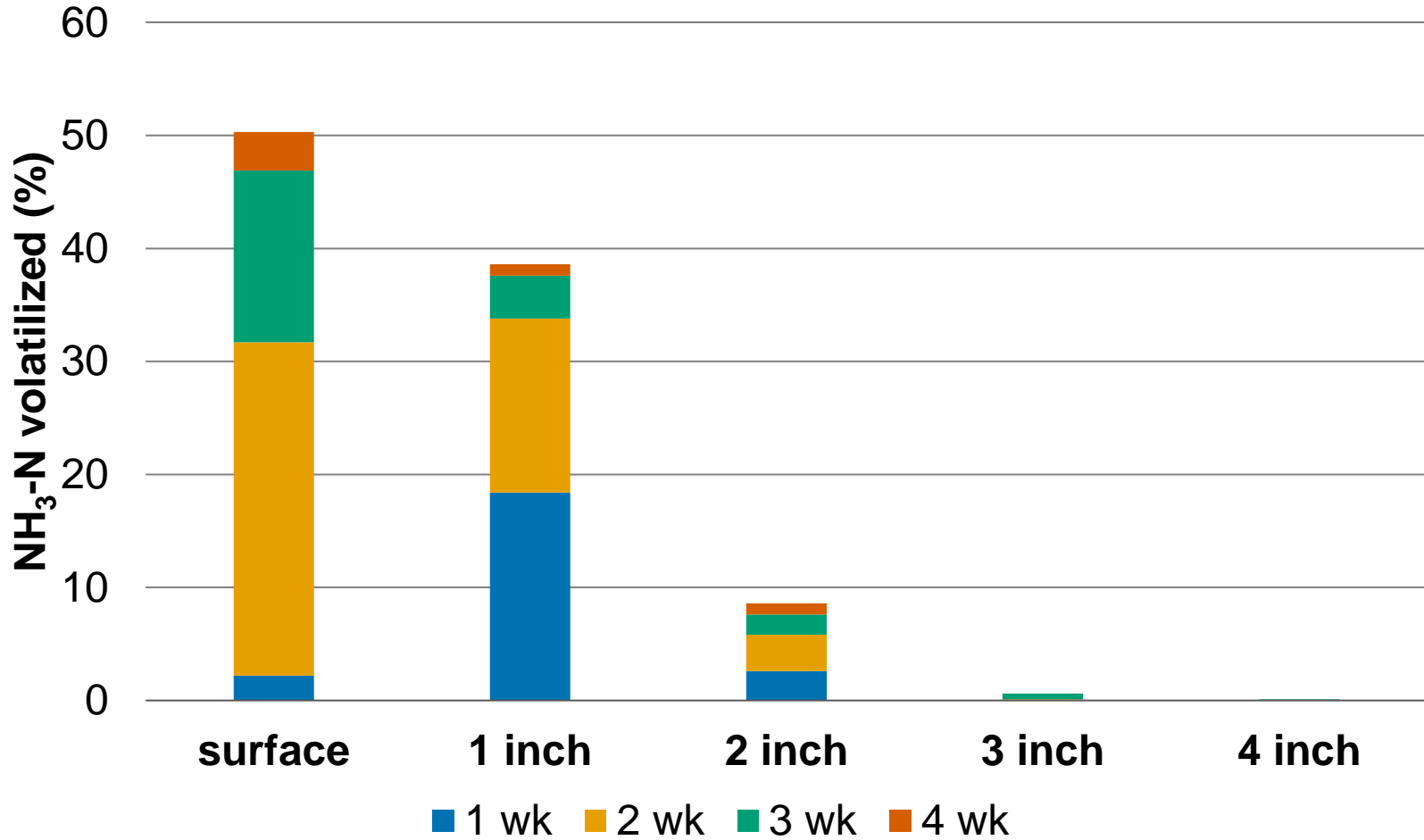
**100 lb N/acre
no companion cereal**

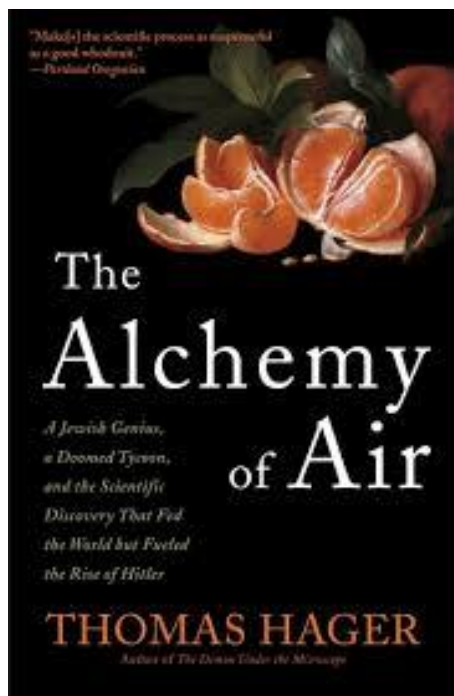


**100 lb N/acre
with companion cereal**



Maximize nitrogen use efficiency: Urea incorporation depth matters





If you want to learn more on the discovery of the Haber-Bosch Process, modern nitrogen fertilizer, and our ability to feed billions of people...

Thank you for your kind attention!

Are there any questions?