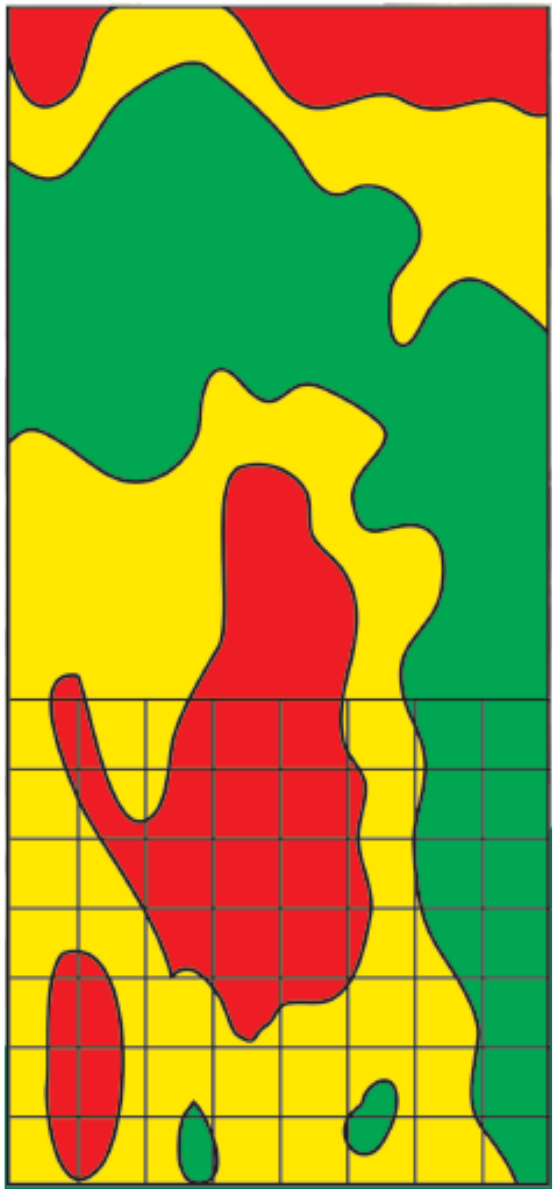
Managing Nitrogen after Drought



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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)

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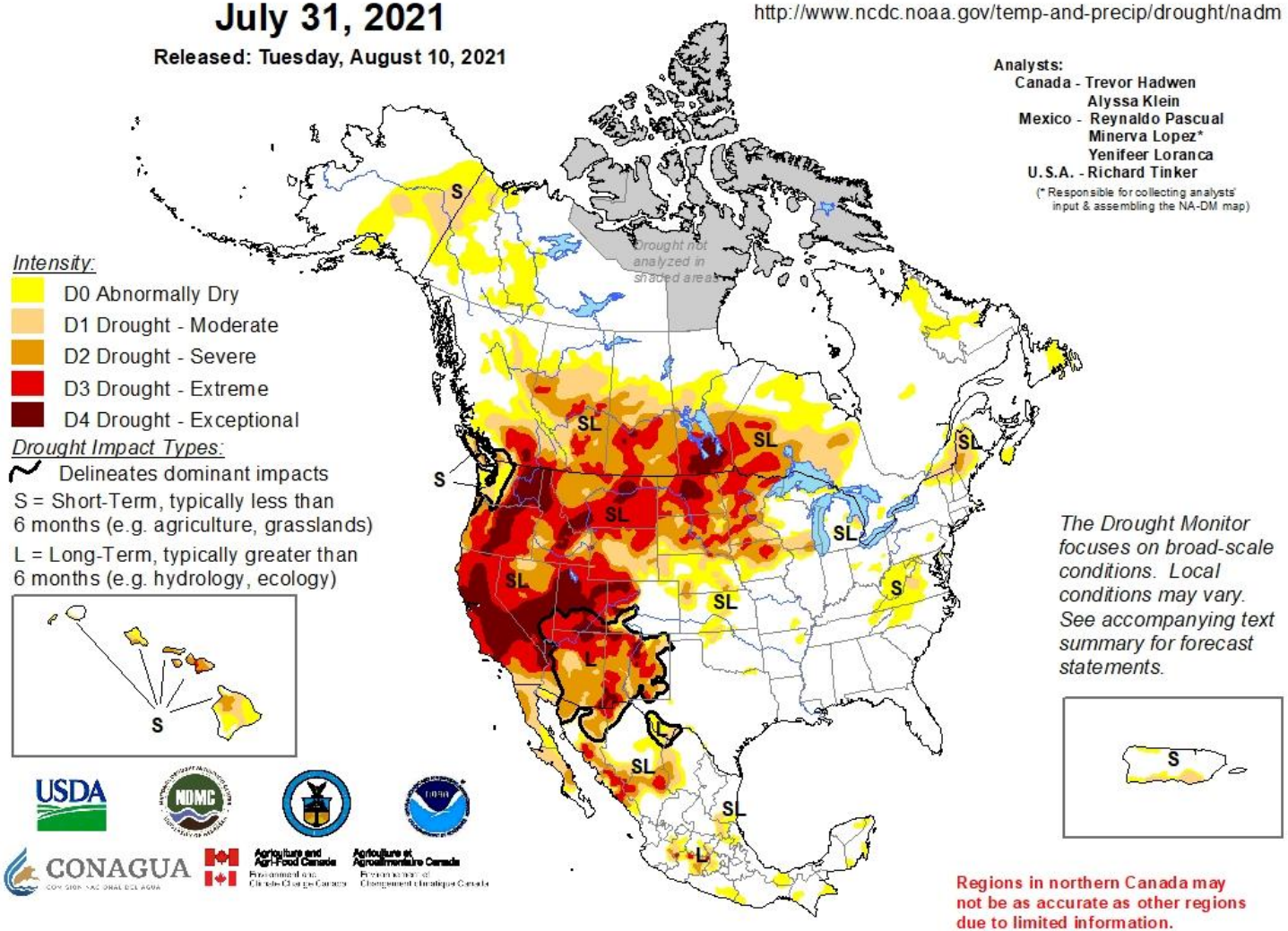
North American Drought Monitor

July 31, 2021

Released: Tuesday, August 10, 2021

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



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

More residual soil nitrate-N than usual

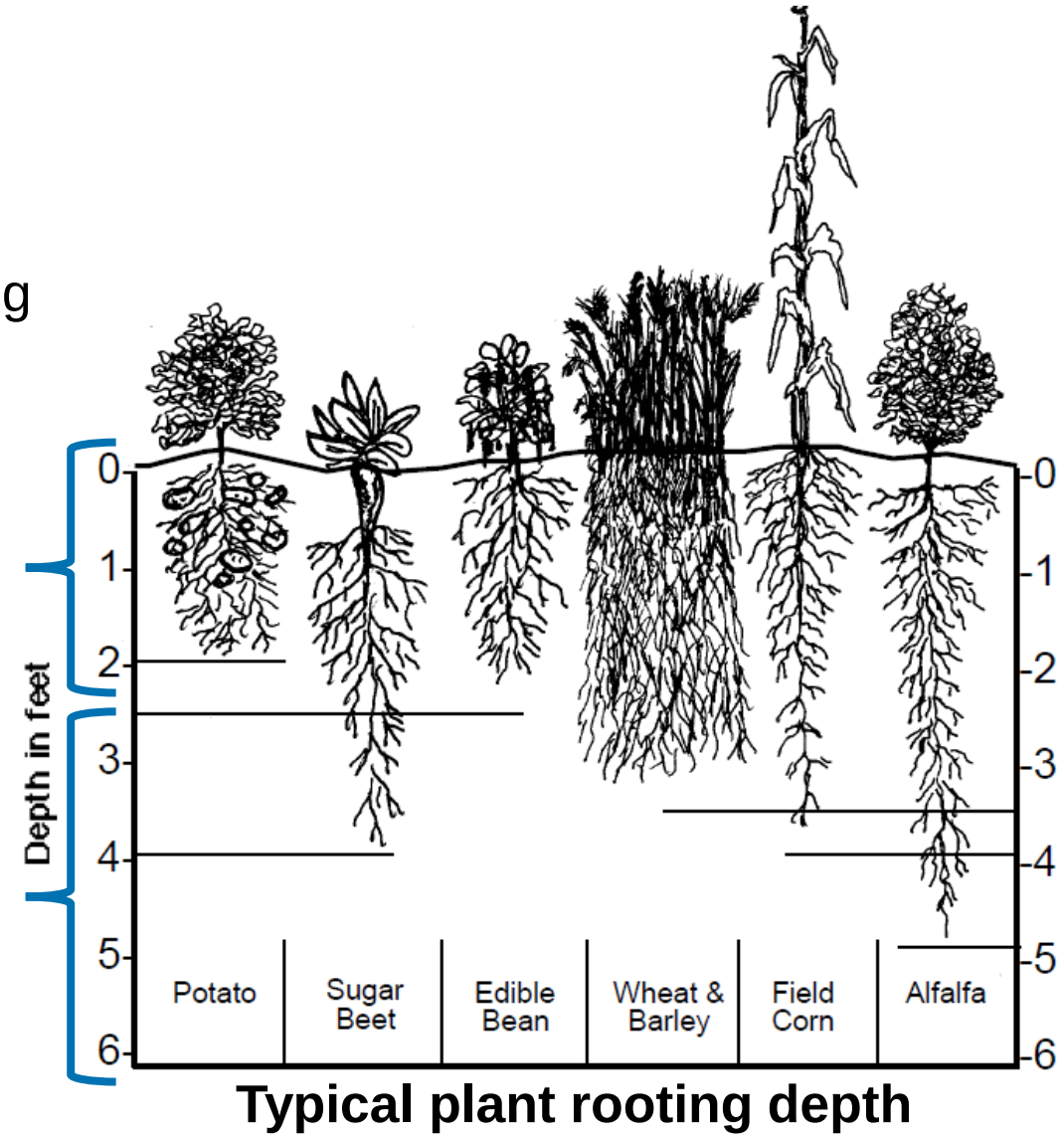
- Lower crop nitrogen uptake and use (low crop yield)
- Little to no soil nitrogen loss from leaching or denitrification
- Warmer than average soil temperatures, possibly more nitrogen mineralization
- Nitrogen fertilizer near soil surface was bypassed as plant roots searched for soil water

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

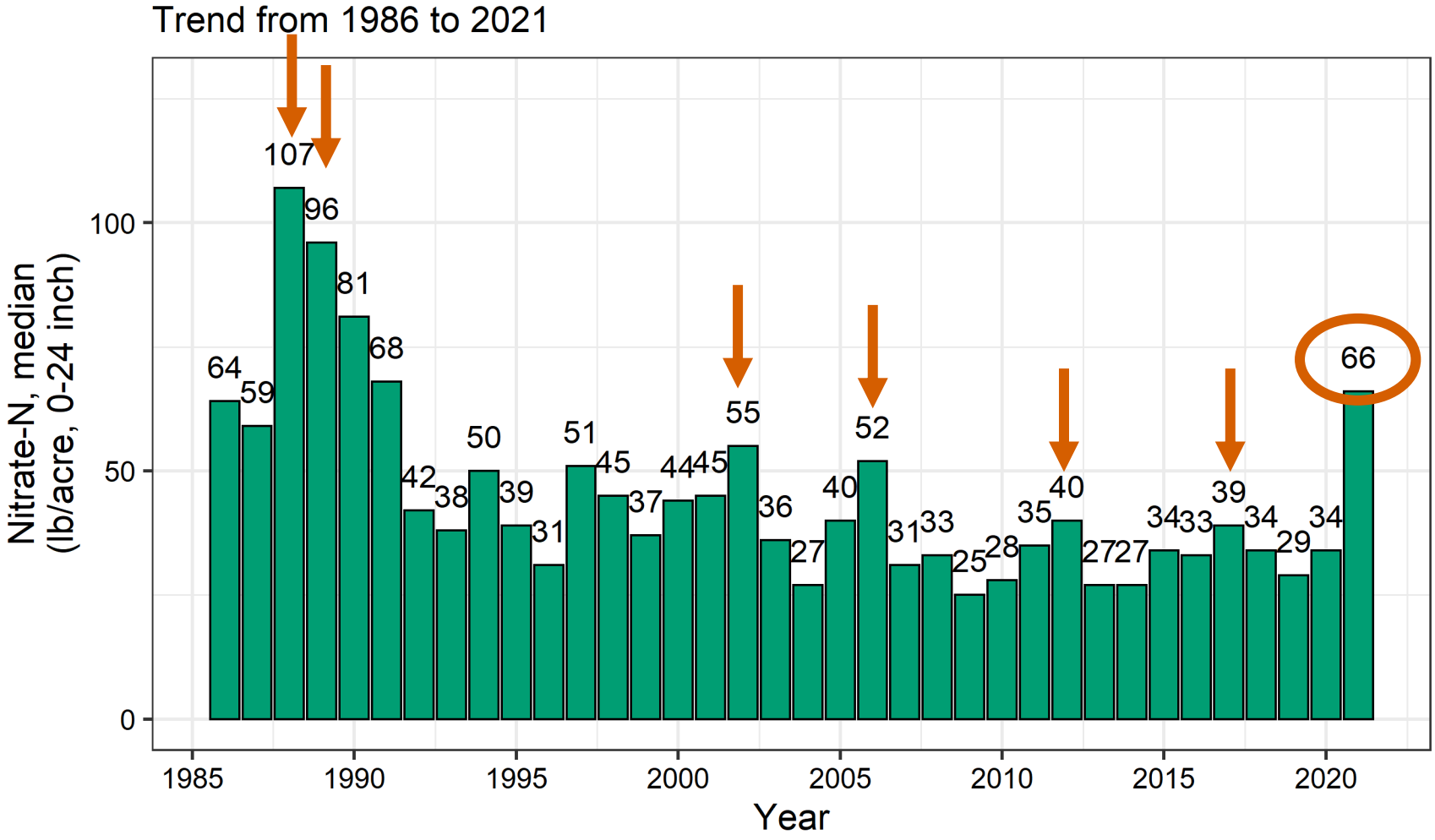
Accumulated nitrate-N from wet years past



Typical plant rooting depth

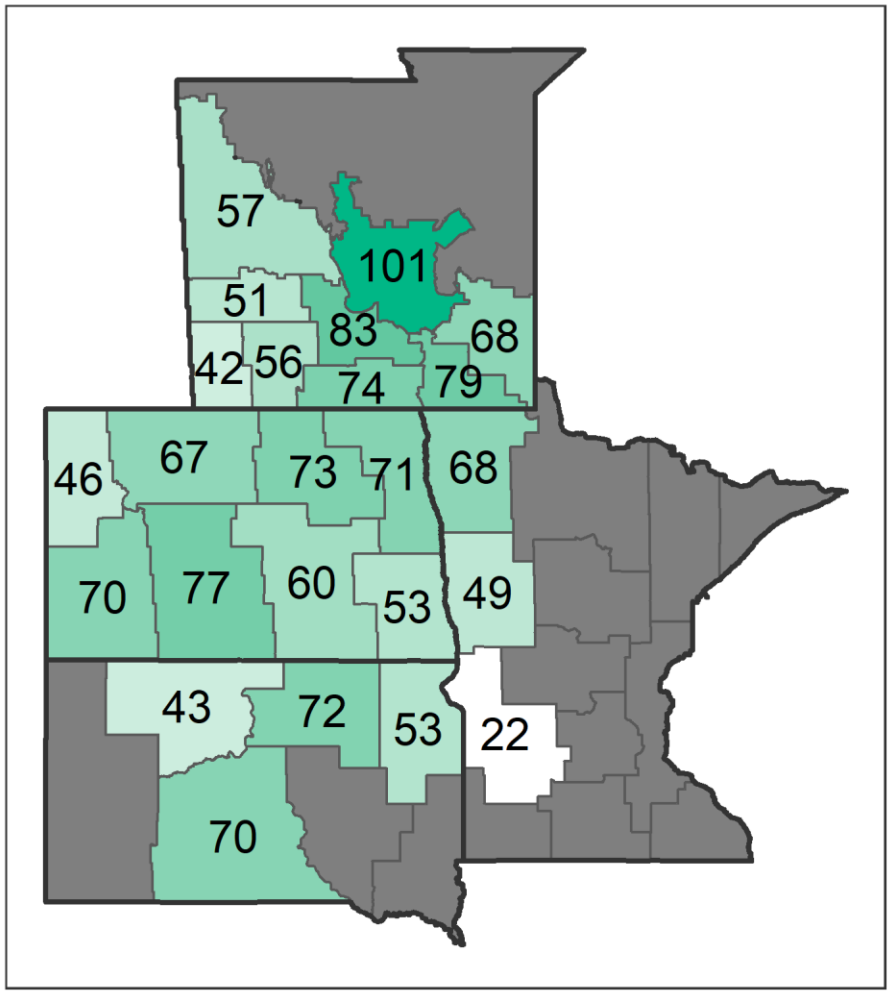
Lundstrom, D.R., and E.C. Stegman. 1988. Irrigation scheduling by the checkbook method. NDSU Ext. Circ. AE-792 (revised). North Dakota State Univ., Fargo, ND.

Residual nitrate following wheat



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

Residual nitrate following wheat in 2021



Nitrate-N, median
(lb/acre, 0-24 inch)

100
80
60
40

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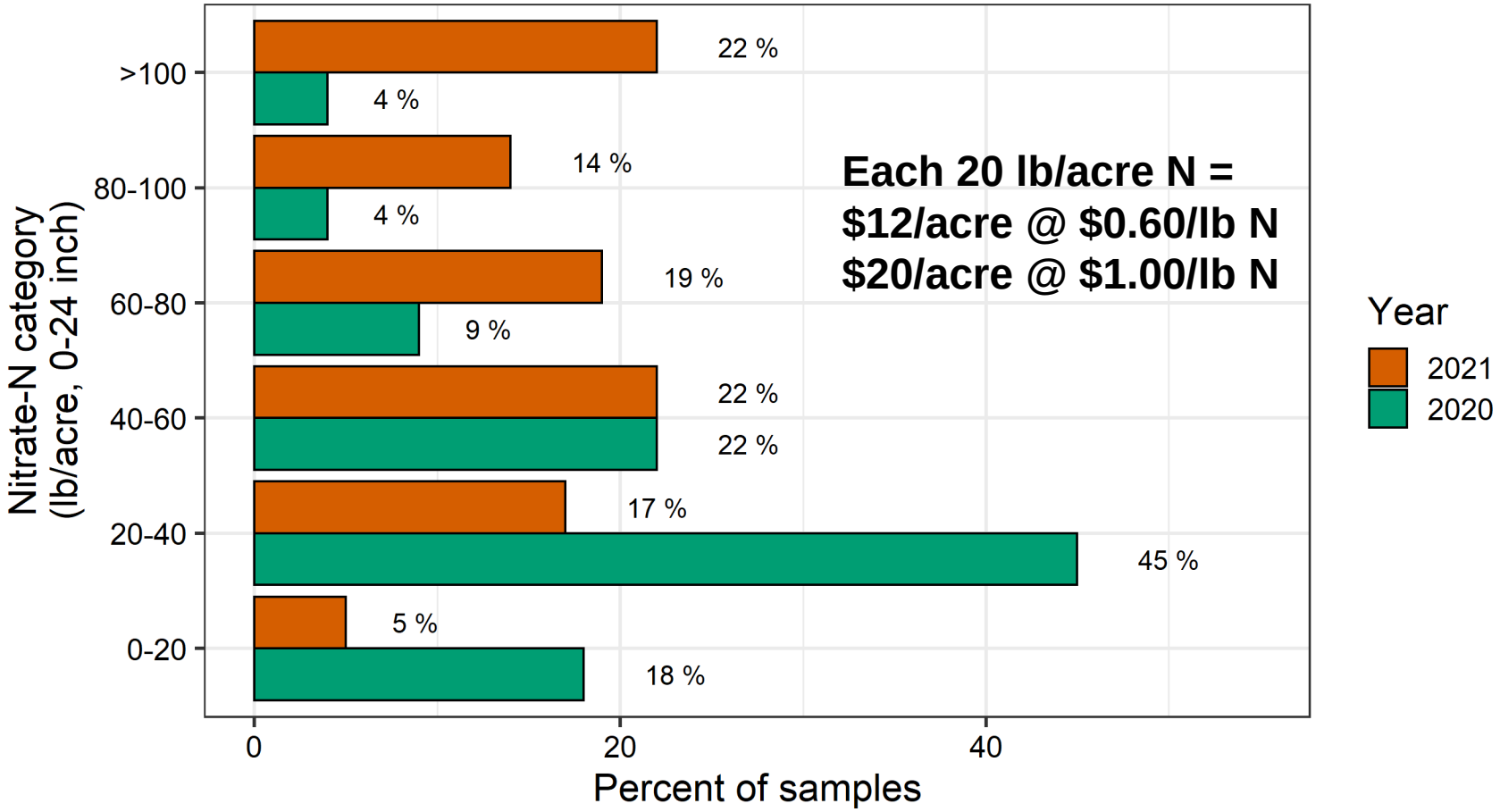
AGVISE Laboratories, Inc.

Residual nitrate variability following wheat in 2020 & 2021



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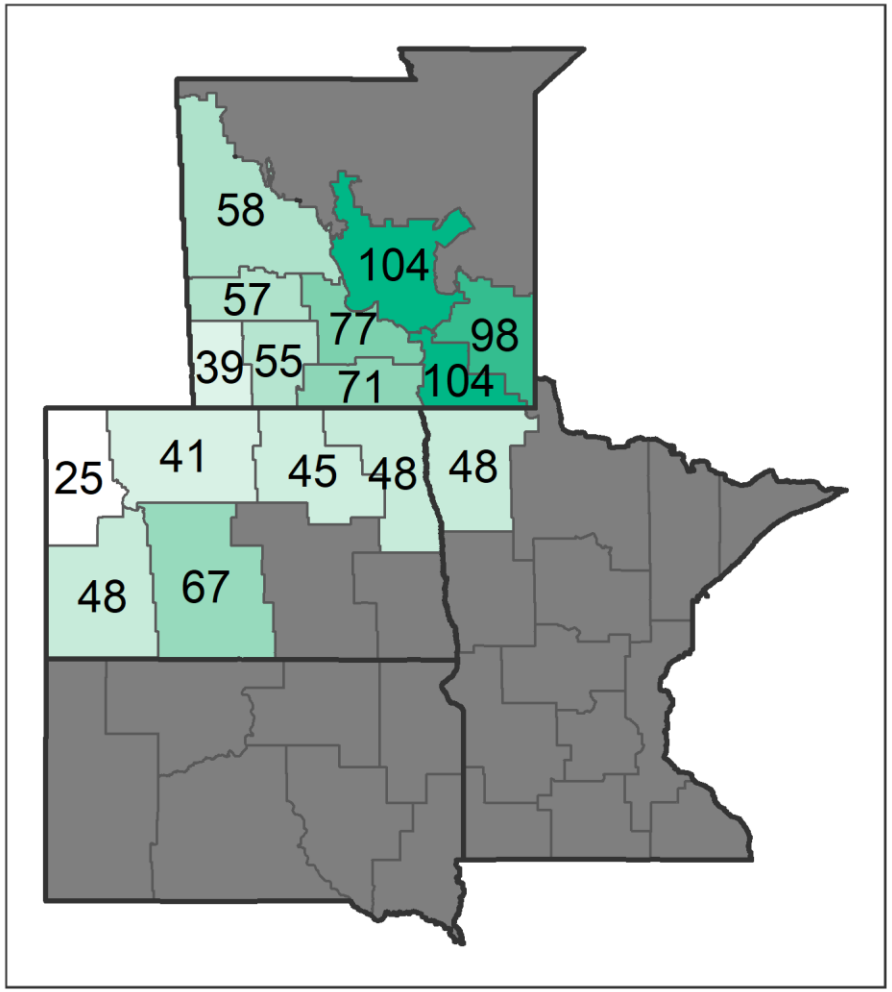
Residual nitrate following canola in 2021



Nitrate-N, median
(lb/acre, 0-24 inch)

100
80
60
40

Data not shown where n< 100
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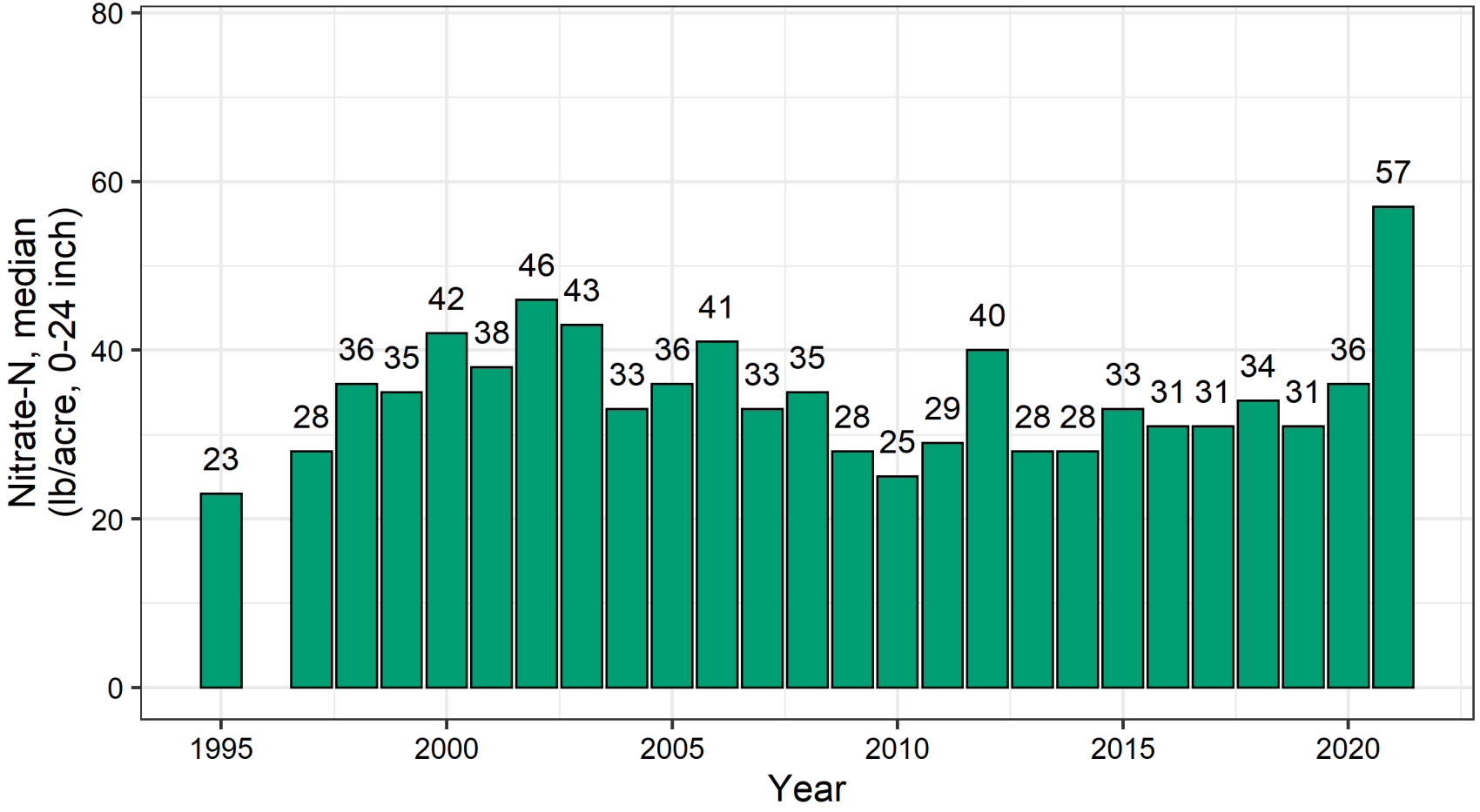
Residual nitrate following canola

Trend from 1995 to 2021



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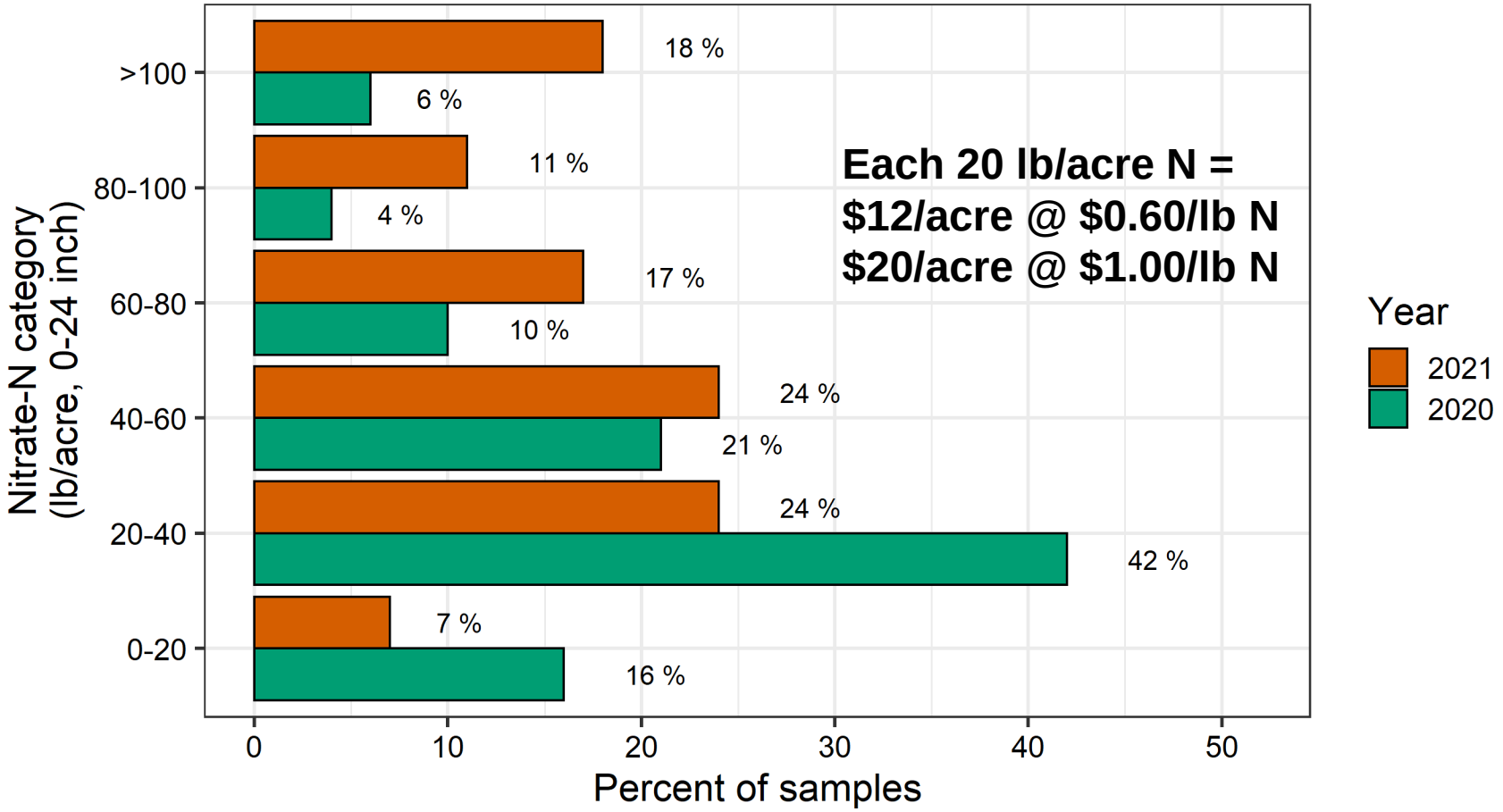
Residual nitrate variability following canola in 2020 & 2021



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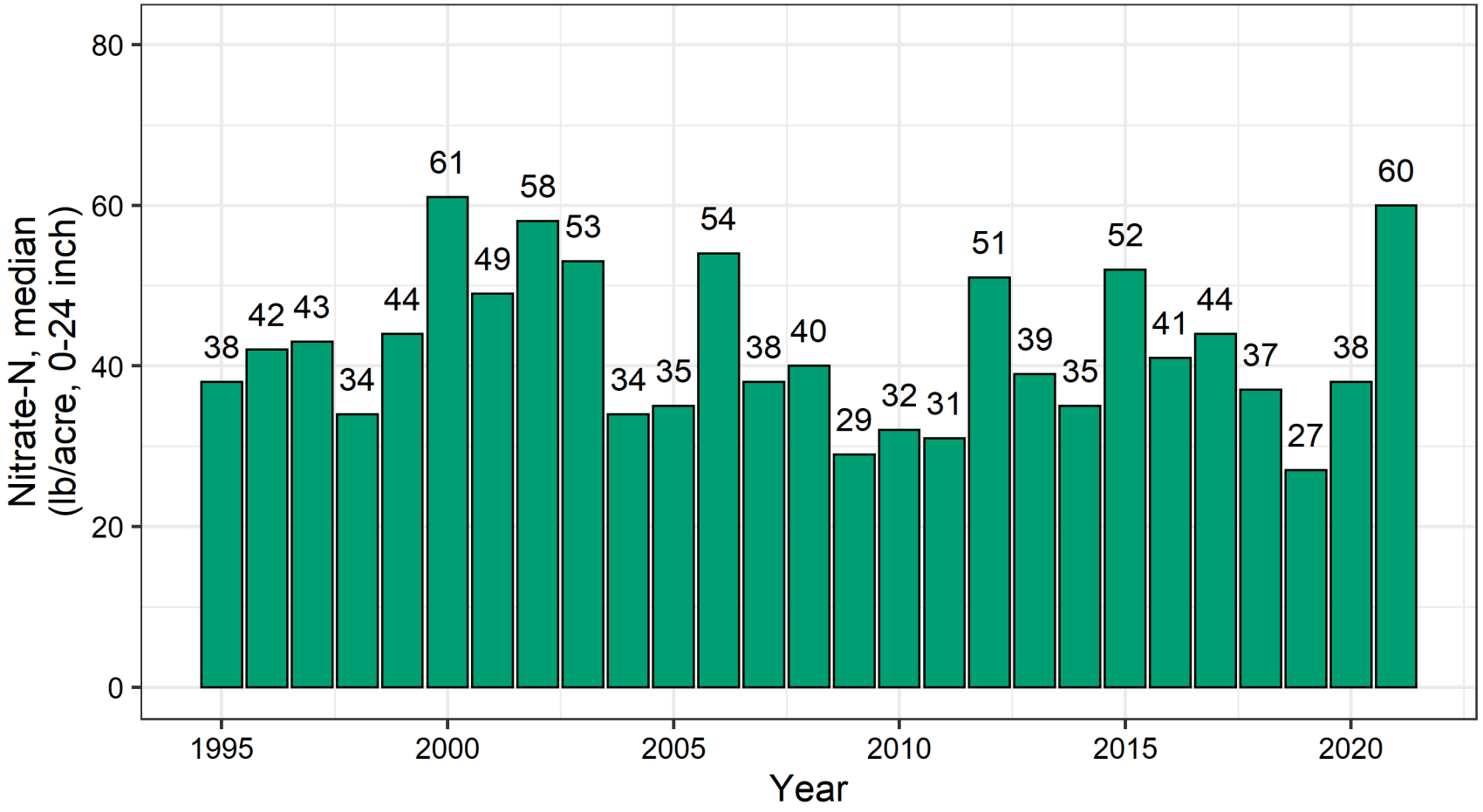
Residual nitrate following corn

Trend from 1995 to 2021



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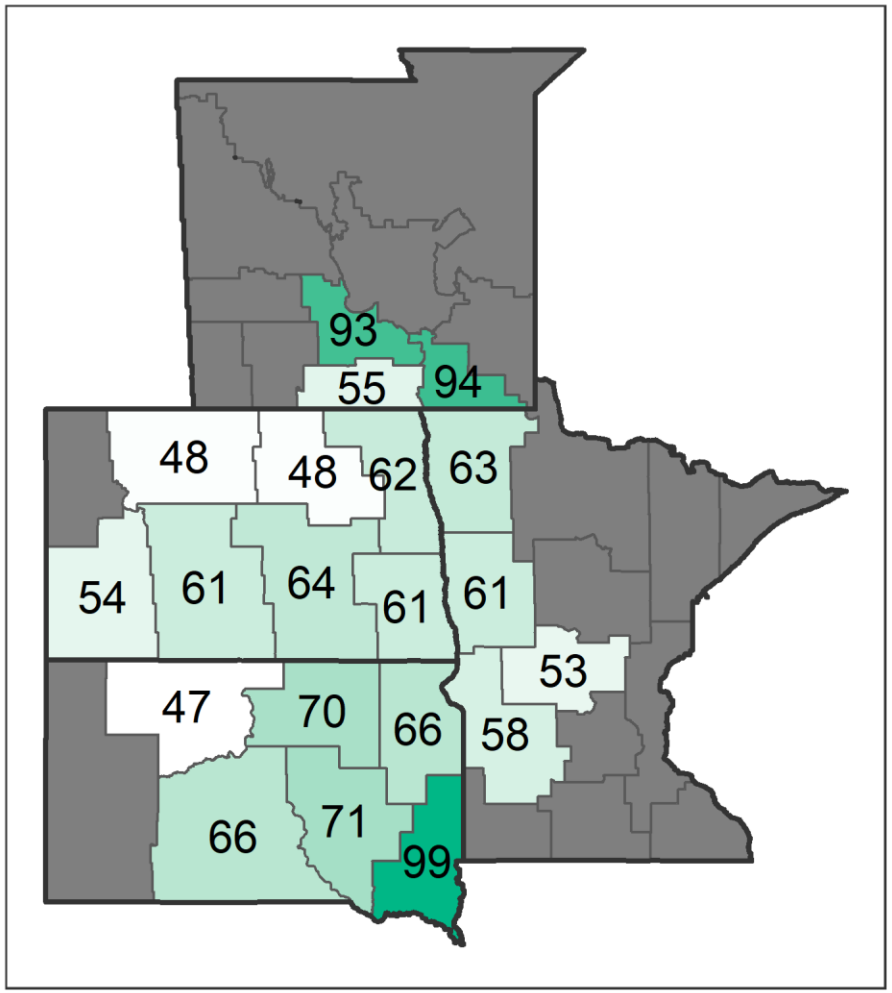
AGVISE Laboratories, Inc.

Residual nitrate following corn in 2021



Nitrate-N, median
(lb/acre, 0-24 inch)

90
80
70
60
50

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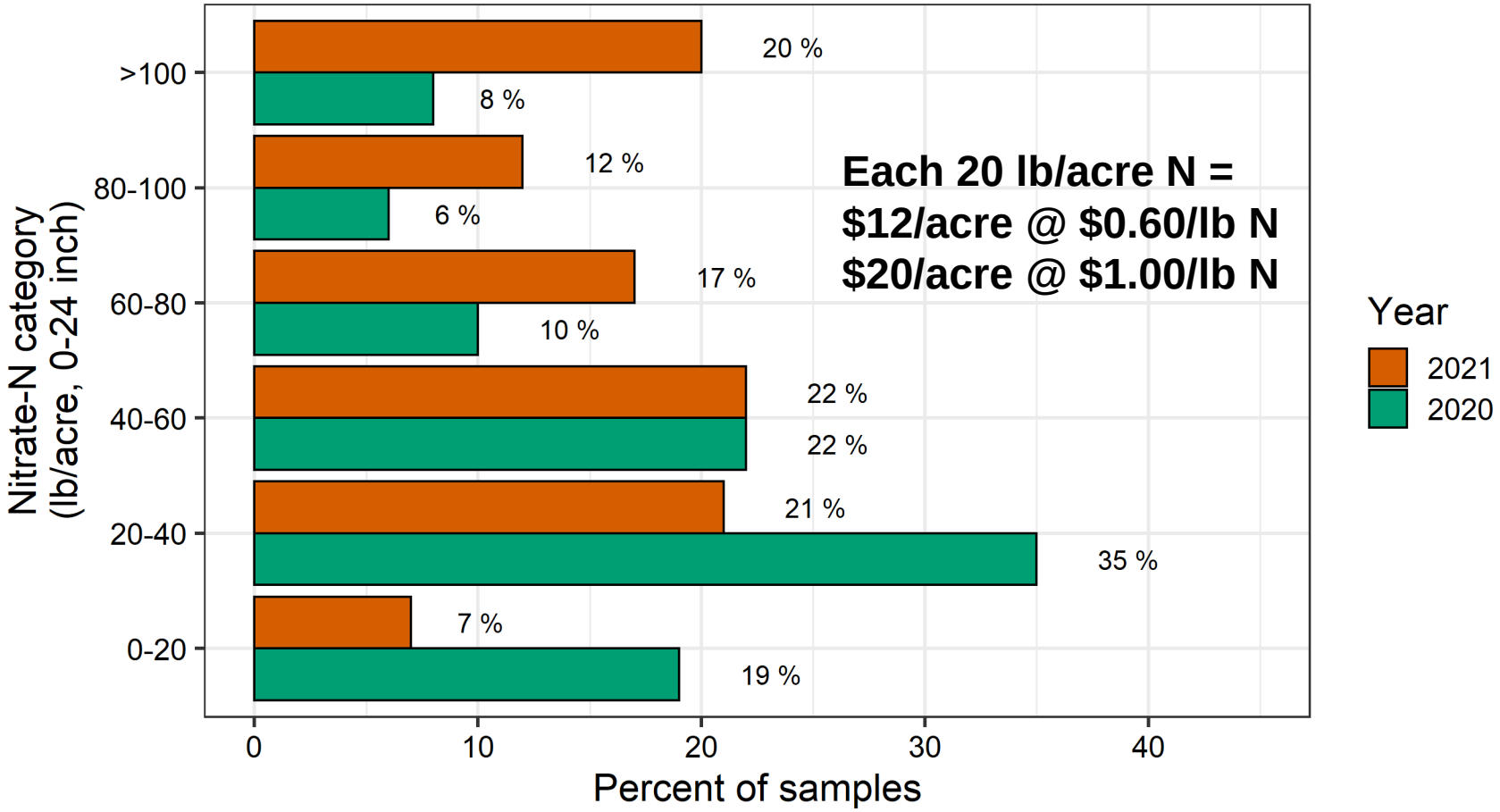
AGVISE Laboratories, Inc.

Residual nitrate variability following corn in 2020 & 2021



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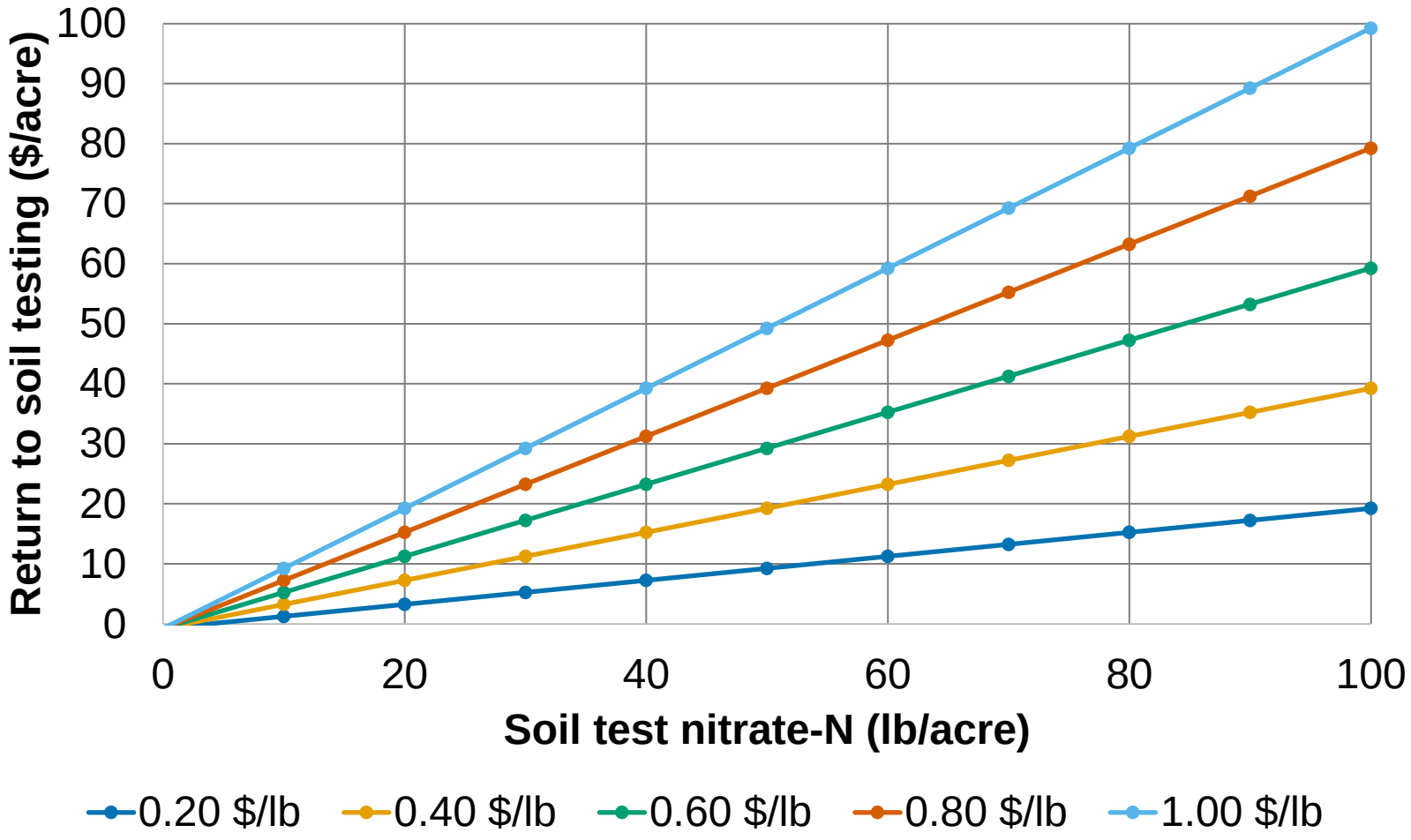
When does soil testing pay?



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**

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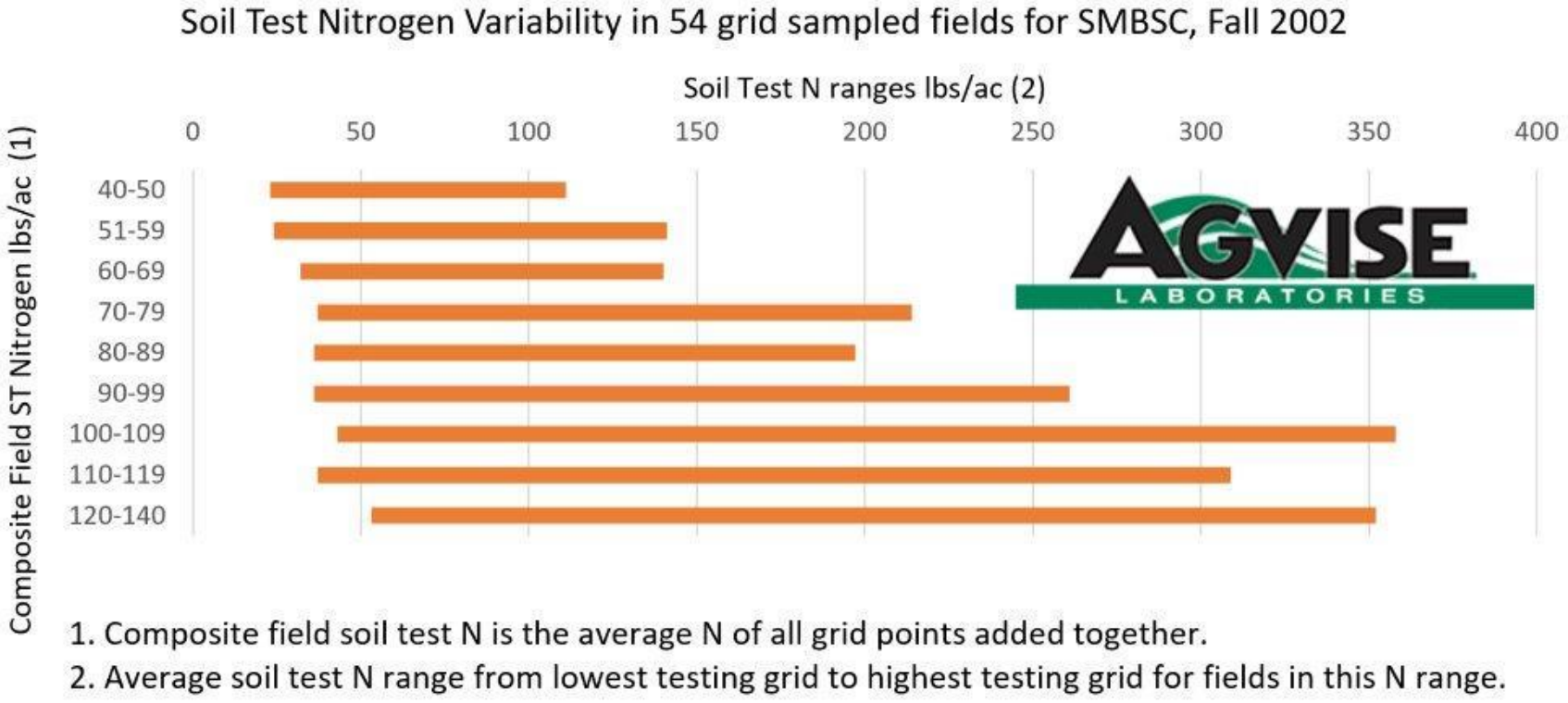
What do you do about the really high fields?



Apply sufficient base nitrogen rate to cover field variability

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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

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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

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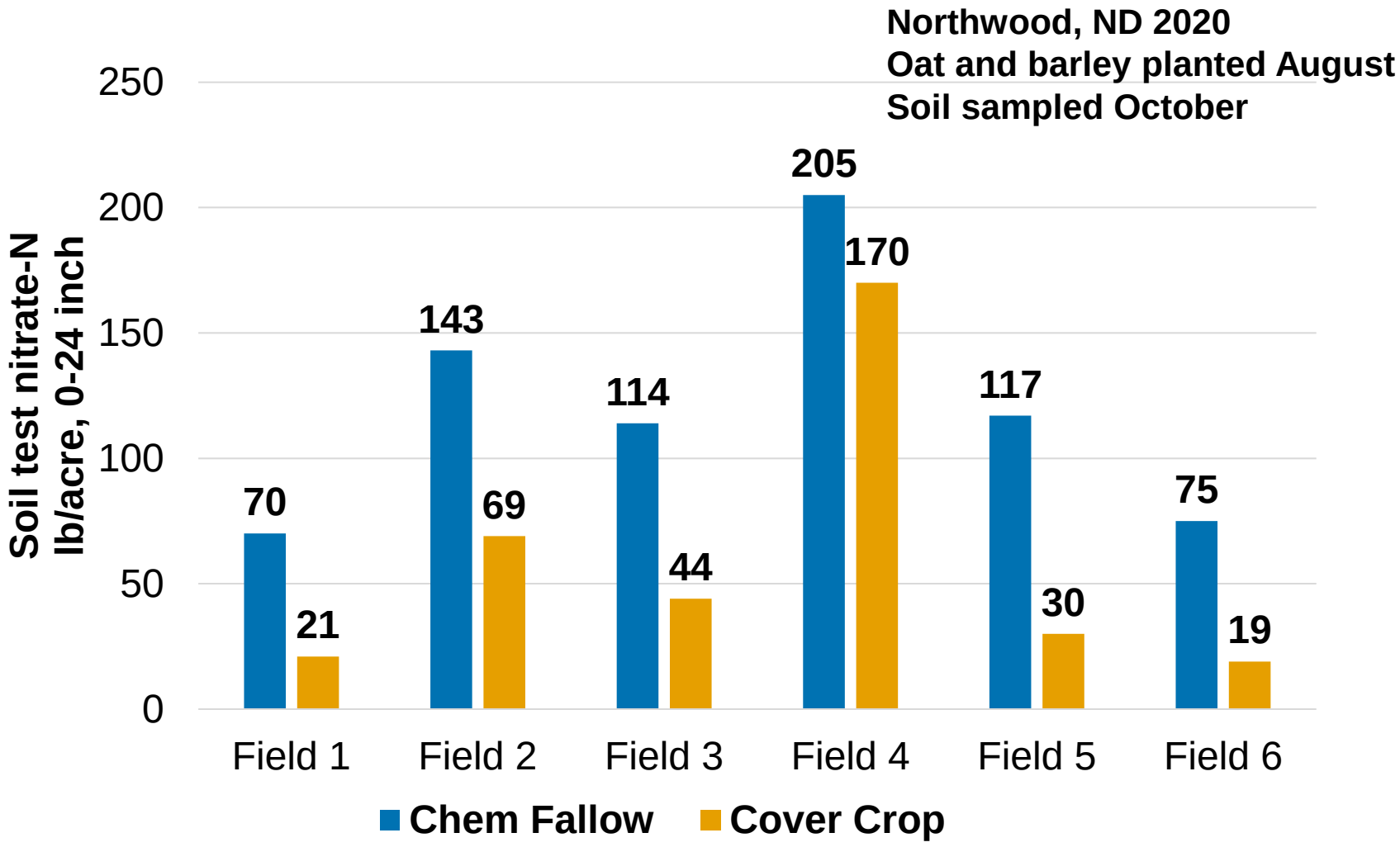
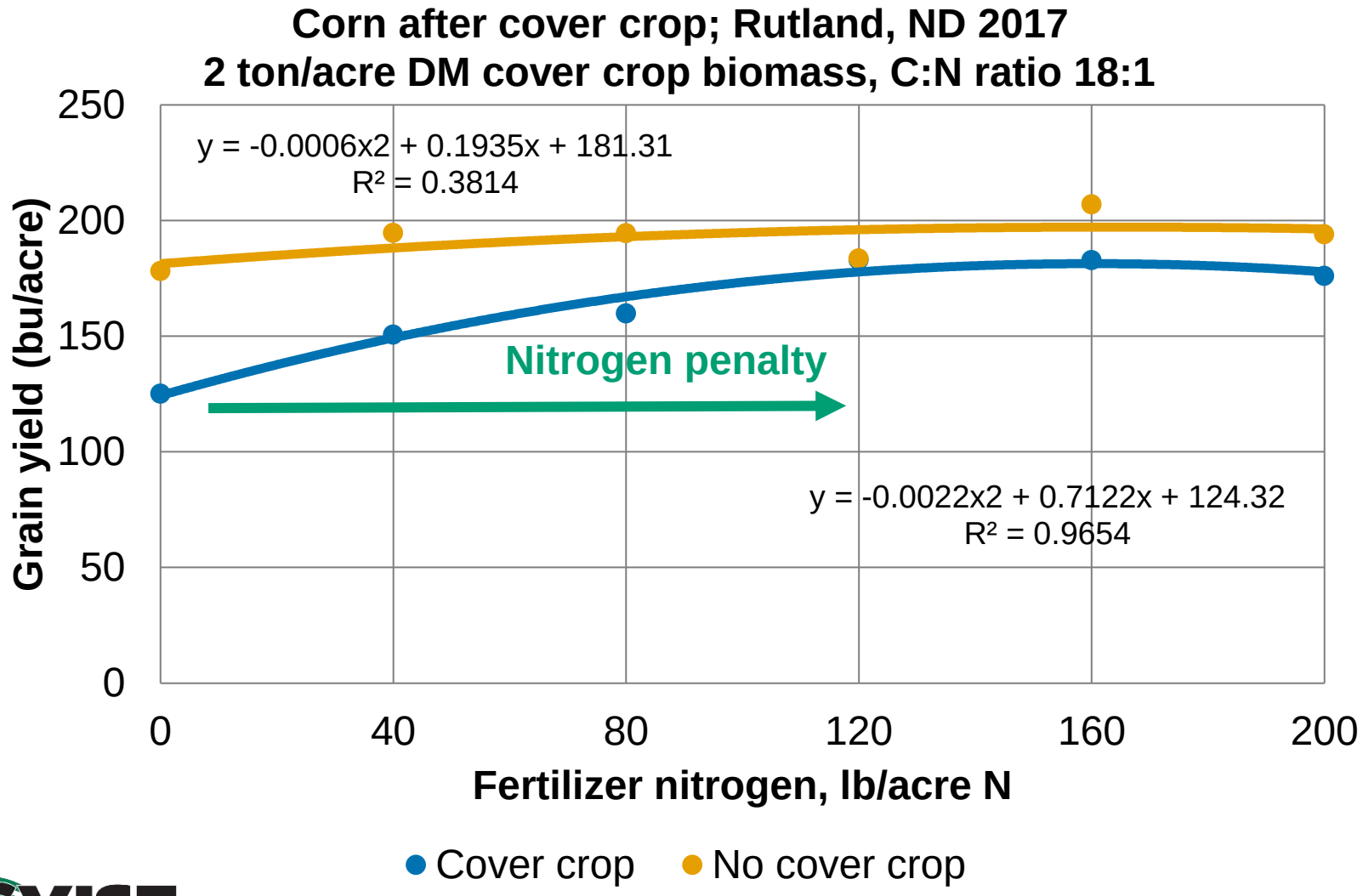
Fall-planted cover crops and volunteer crops

Image from https://www.mncorn.org/2019/06/10/cover-crops-a-popular-option-for-prevent-plant-fields-what-to-know/

Volunteer cereals will accumulate residual soil nitrate-N



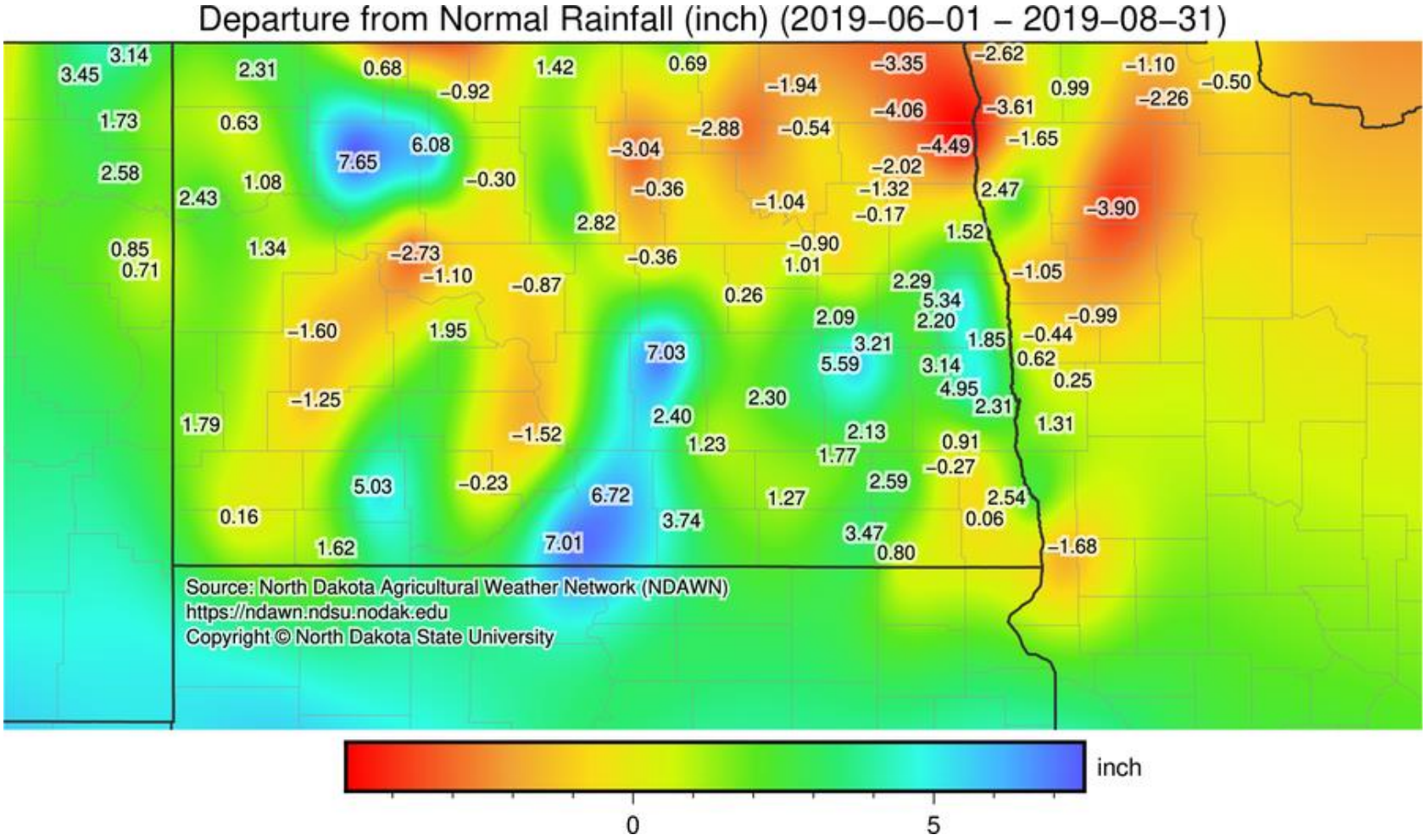
Cover crop nitrogen credit?



Franzen, D.W., and A. Wick. 2019. Nitrogen credit from cover crops? NDSU Crop Pest Rep. 18 July 2019. North Dakota State Univ. Ext. Serv., Fargo, ND. https://www.ag.ndsu.edu/cpr/soils/nitrogen-credit-from-cover-crops-07-18-19 (accessed 25 July 2019).

What happens if we get a bunch of rain?

Does anyone remember the 2019 summer drought?

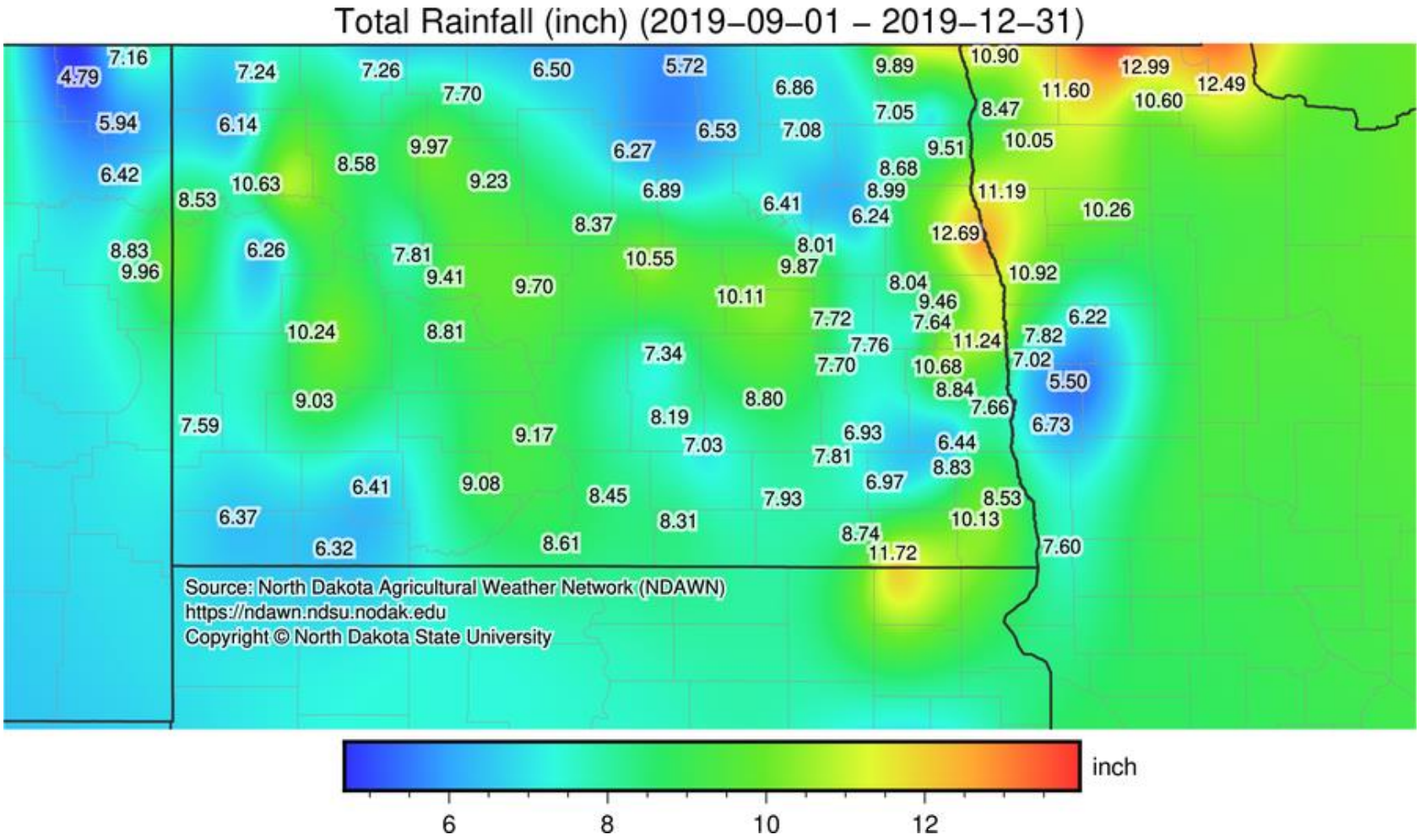


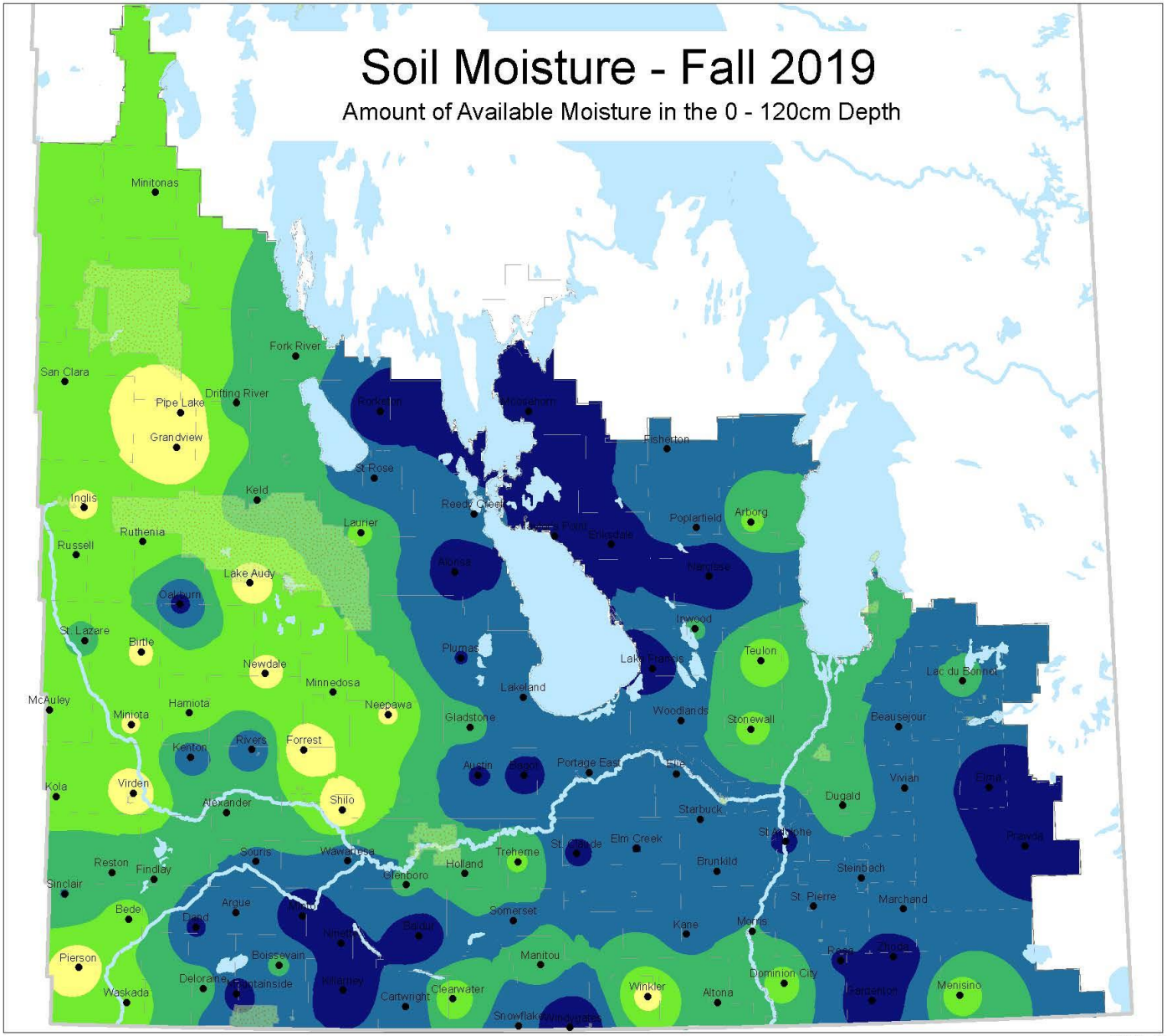
John Breker
@jsbreker

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…



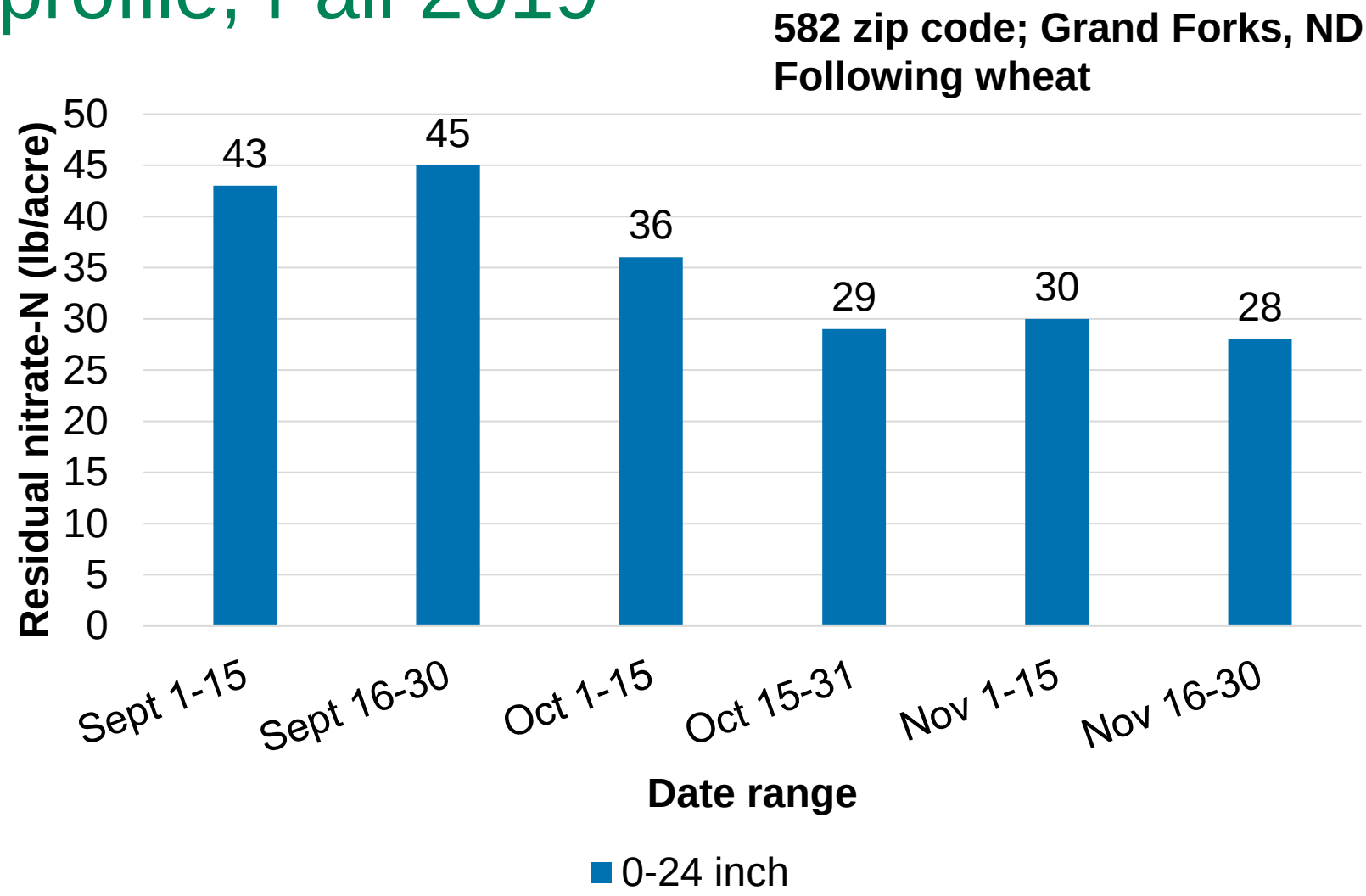


Manitoba

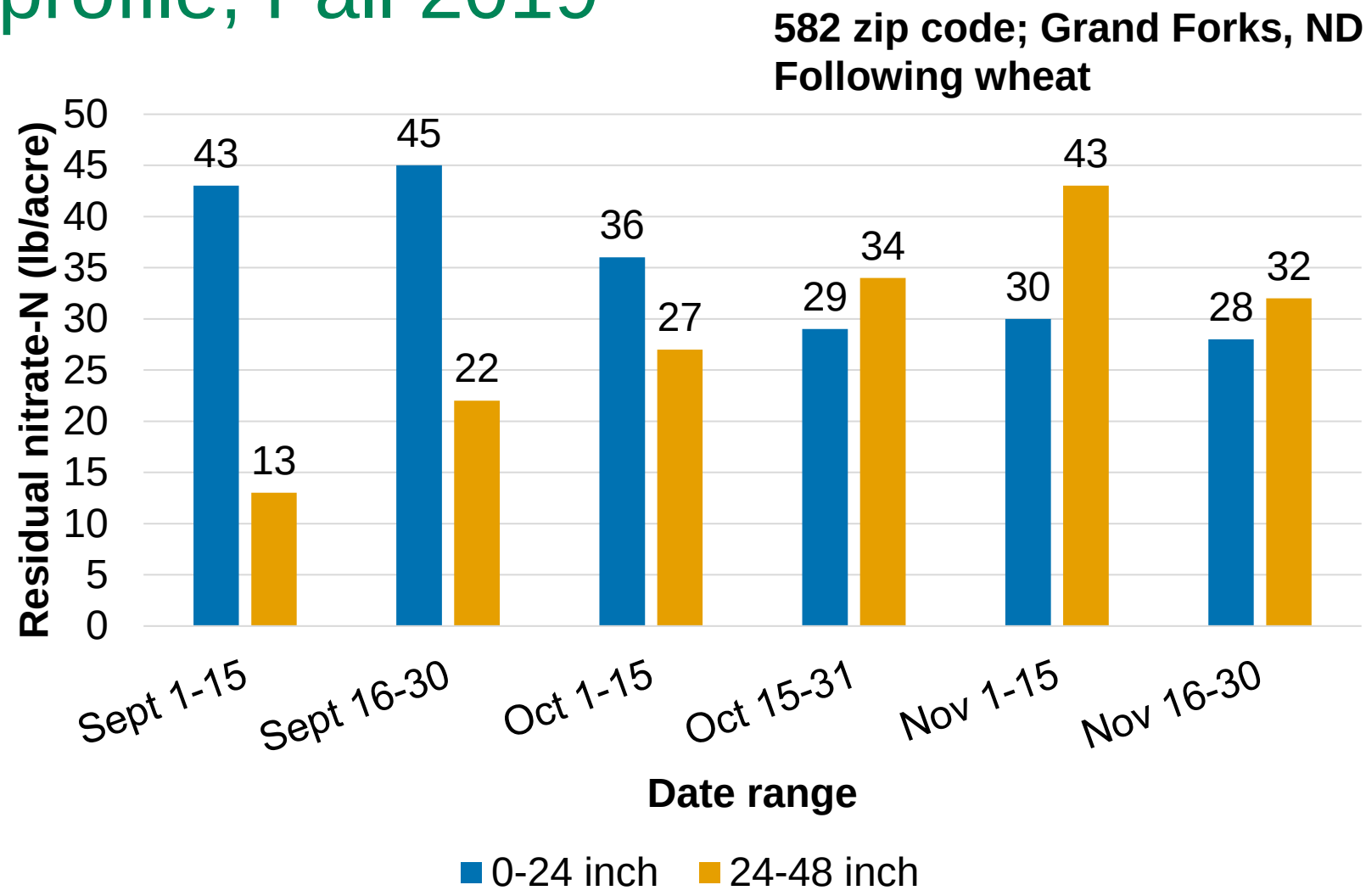
CANADIAN AGRICULTURAL PARTNERSHIP

Canada

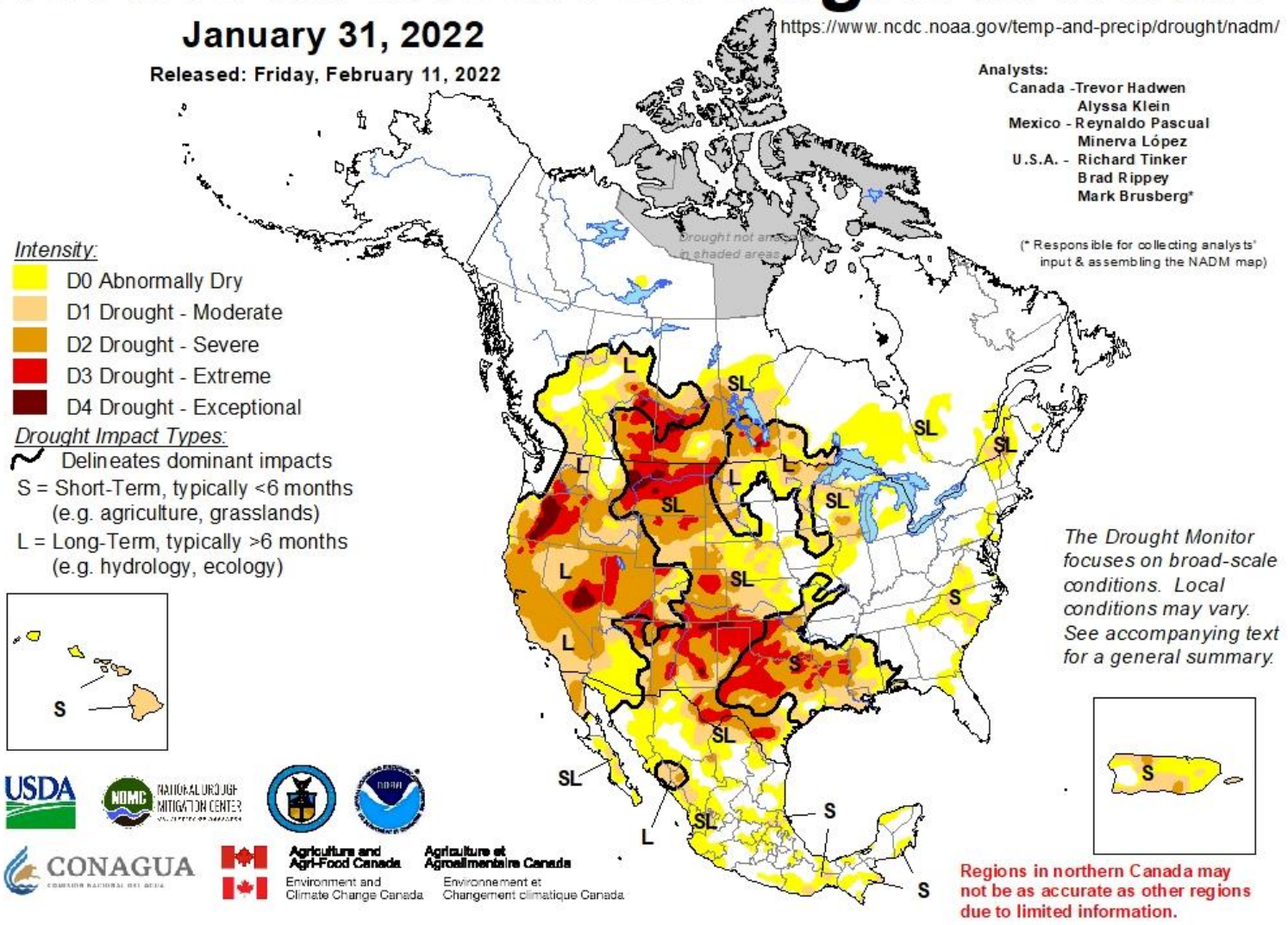
Excess rainfall shifted residual nitrate profile, Fall 2019



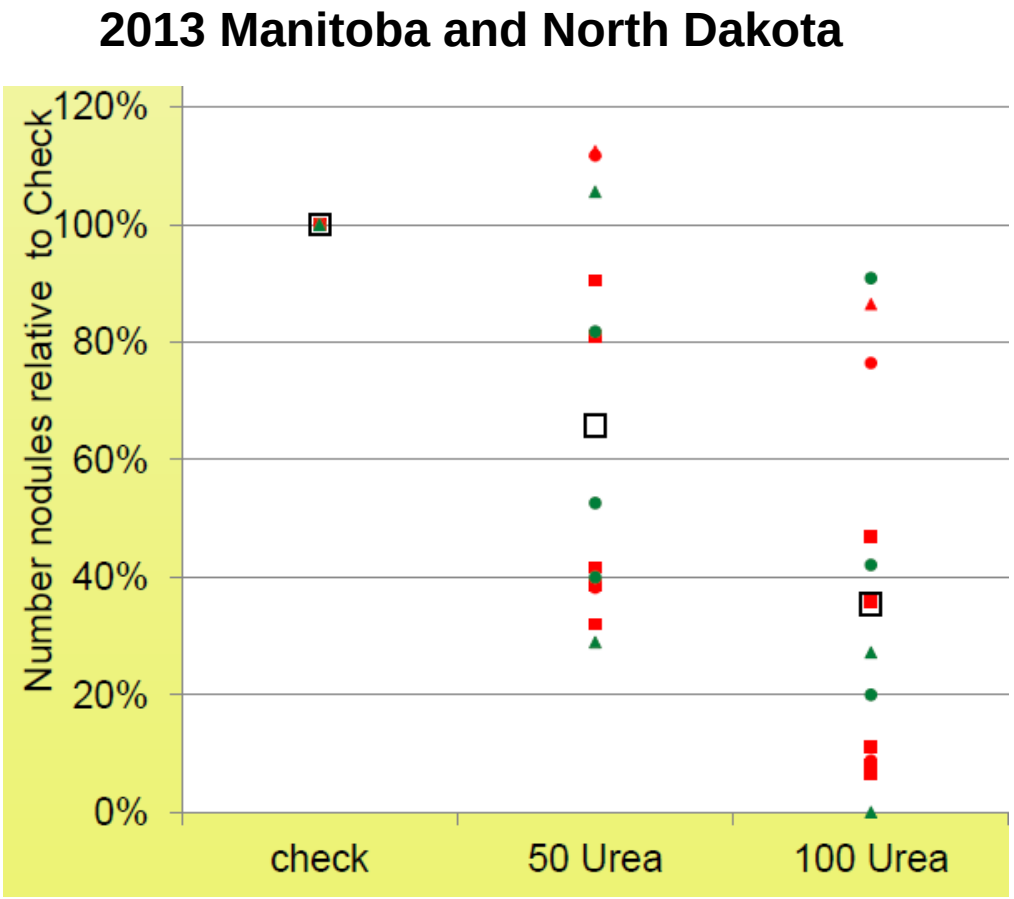
Excess rainfall shifted residual nitrate profile, Fall 2019



North American Drought Monitor



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



Heard, J., J. Lee, and R. Tone. 2013. Nitrogen and soybeans: Friends, foes, or just wasted fertility? Manitoba Agronomists Conference,11-12 December 2013, Winnipeg, MB.
Chen, Z., A.F. MacKenzie, and M.A. Fanous. 1992. Soybean nodulation and grain yield as influenced by N-fertilizer rate, plant population density and cultivar in southern Quebec. Can. J. Plant Sci. 72(4): 1049–1056.

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)

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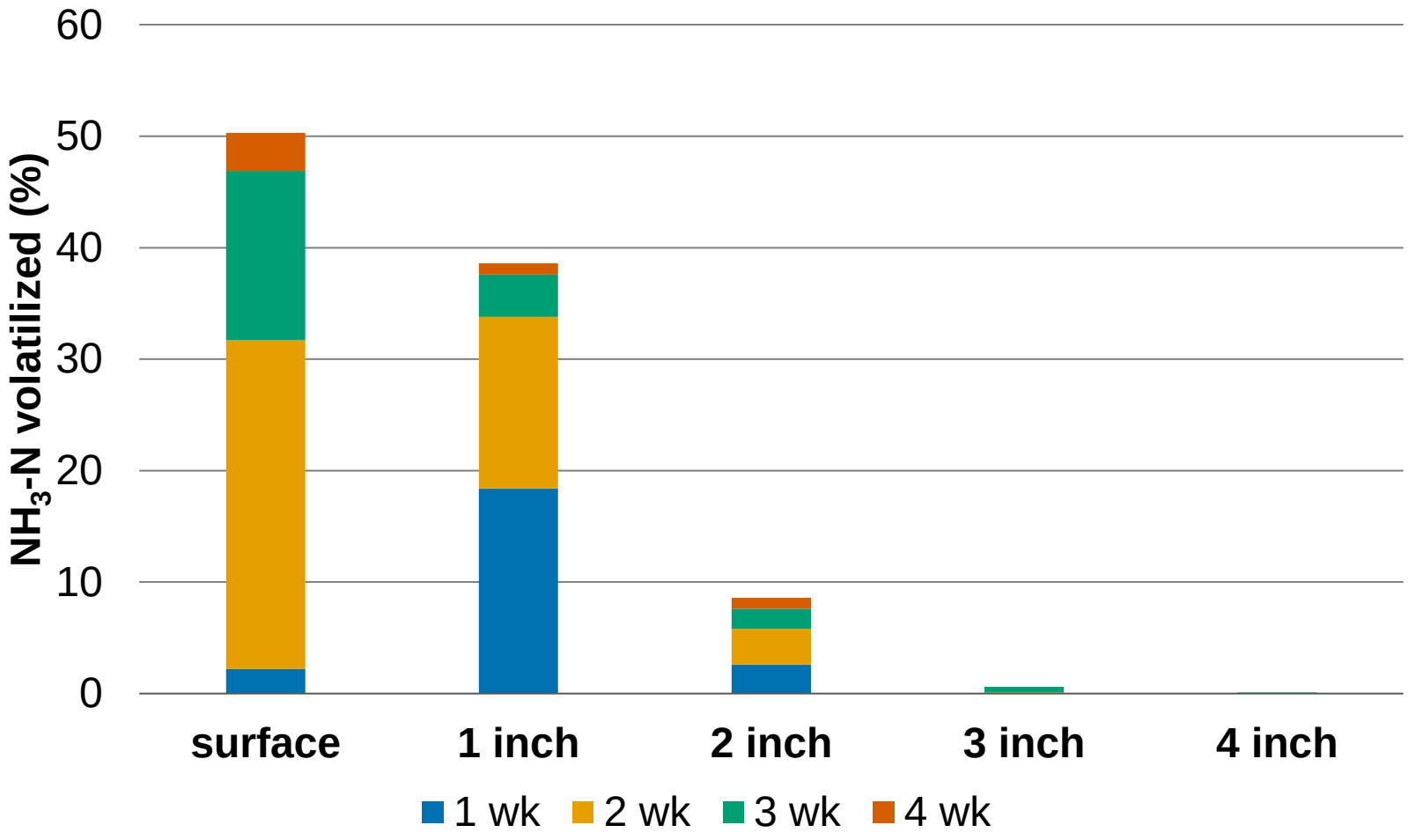
Excess soil nitrate will exacerbate soybean IDC

100 lb N/acre
no companion cereal

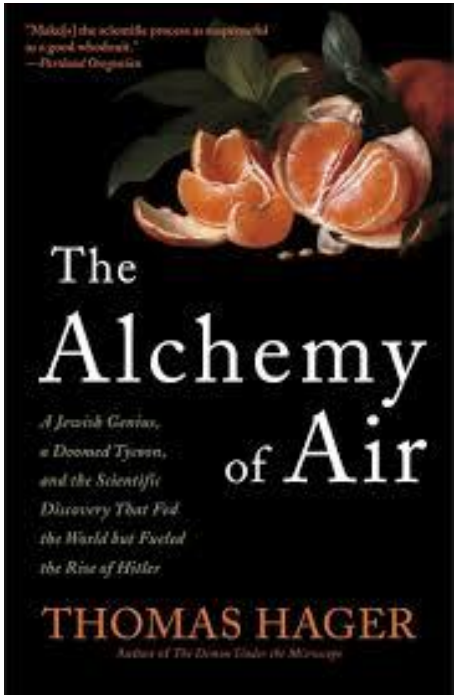
100 lb N/acre
with companion cereal

Bloom, P.R., G.W. Rehm, J.A. Lamb, and A.J. Scobbie. 2011. Soil nitrate is a causative factor in iron deficiency chlorosis in soybeans. Soil Sci. Soc. Am. J. 75(6):2233–2241.
J.A. Lamb (Univ. Minnesota) in Franzen, D.W. 2013. Soybean soil fertility. NDSU Ext. Circ. SF-1164. North Dakota State Univ., Fargo, ND.

Maximize nitrogen use efficiency: Urea incorporation depth matters



Rochette, P., D.A. Angers, M.H. Chantigny, M.-O. Gasser, J.D. MacDonald, D.E. Pelster, and N. Bertrand. 2013. Ammonia volatilization and nitrogen retention: How deep to incorporate urea? J. Environ. Qual. 42(6):1635–1642.



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?

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