Nitrogen Considerations for the 2023 Season

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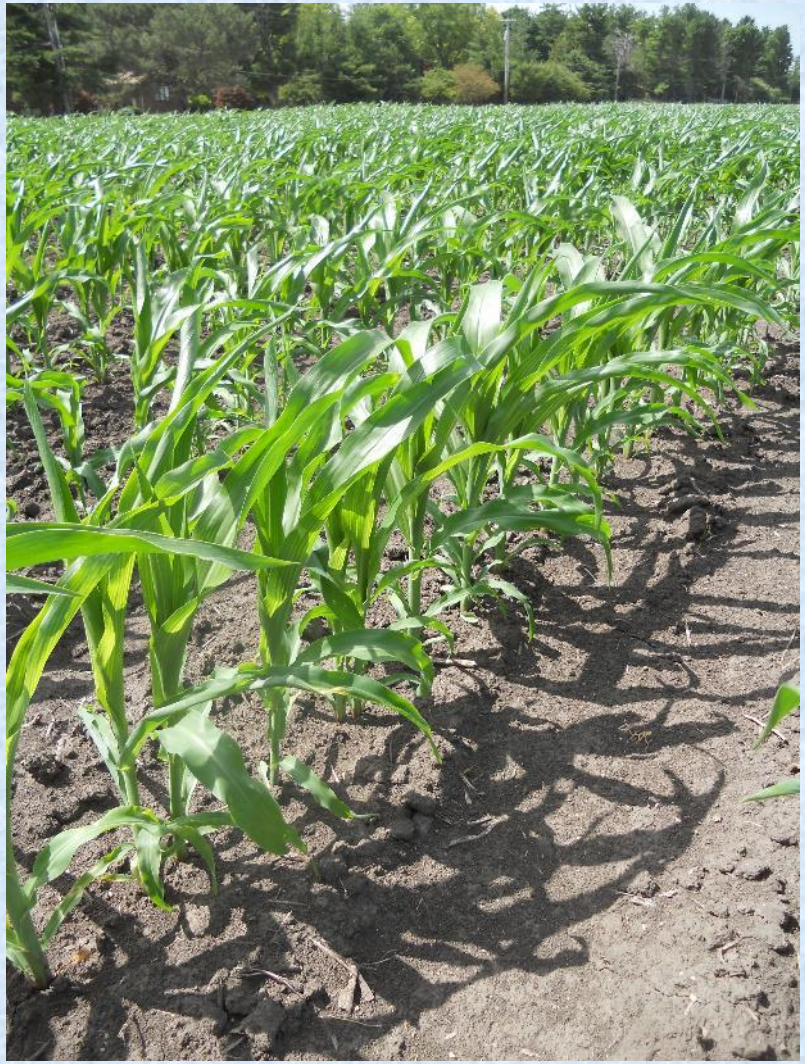
Champaign-Urbana IL, 2022 – June 1.3” July 2.9” rain

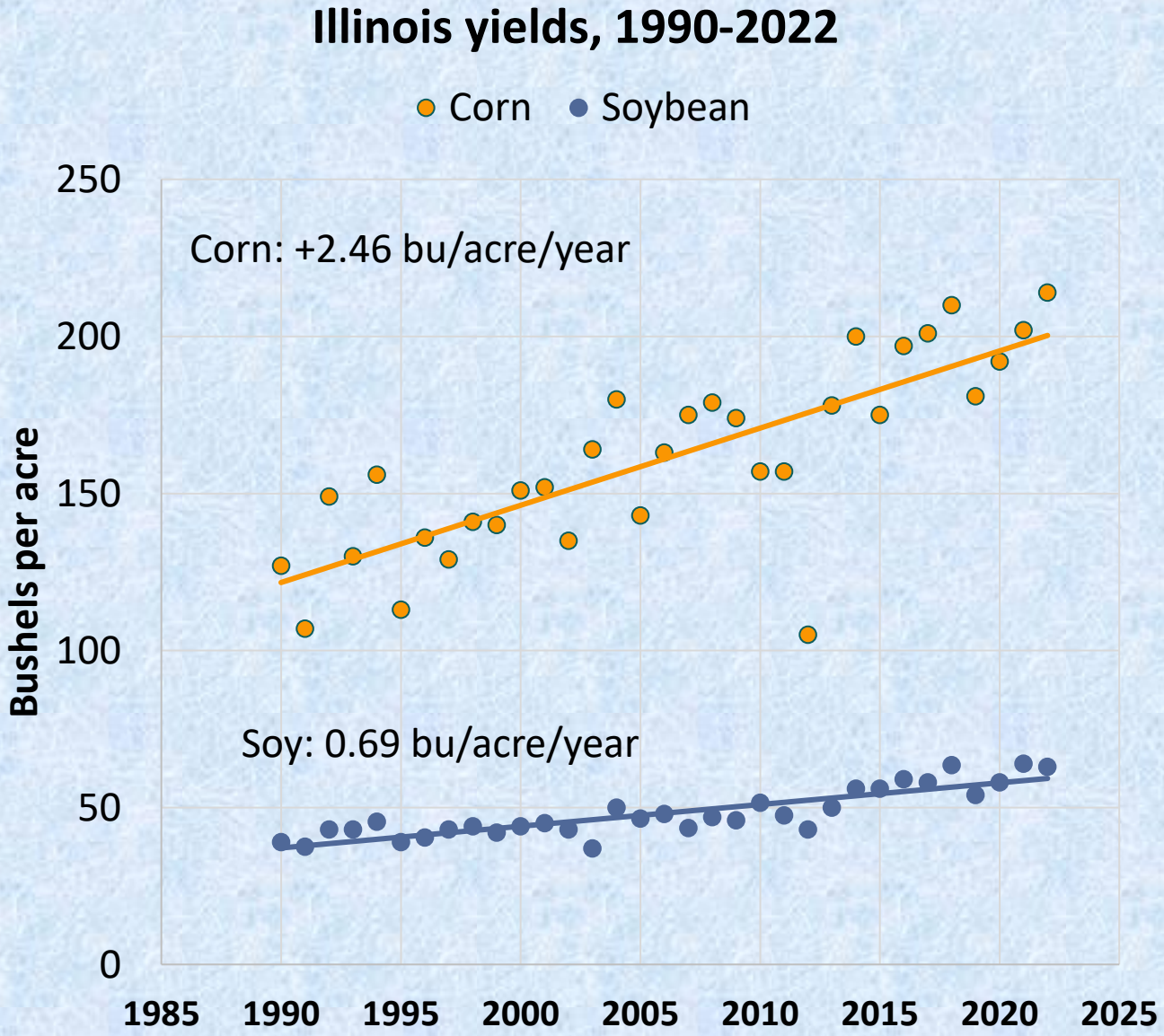
June 15

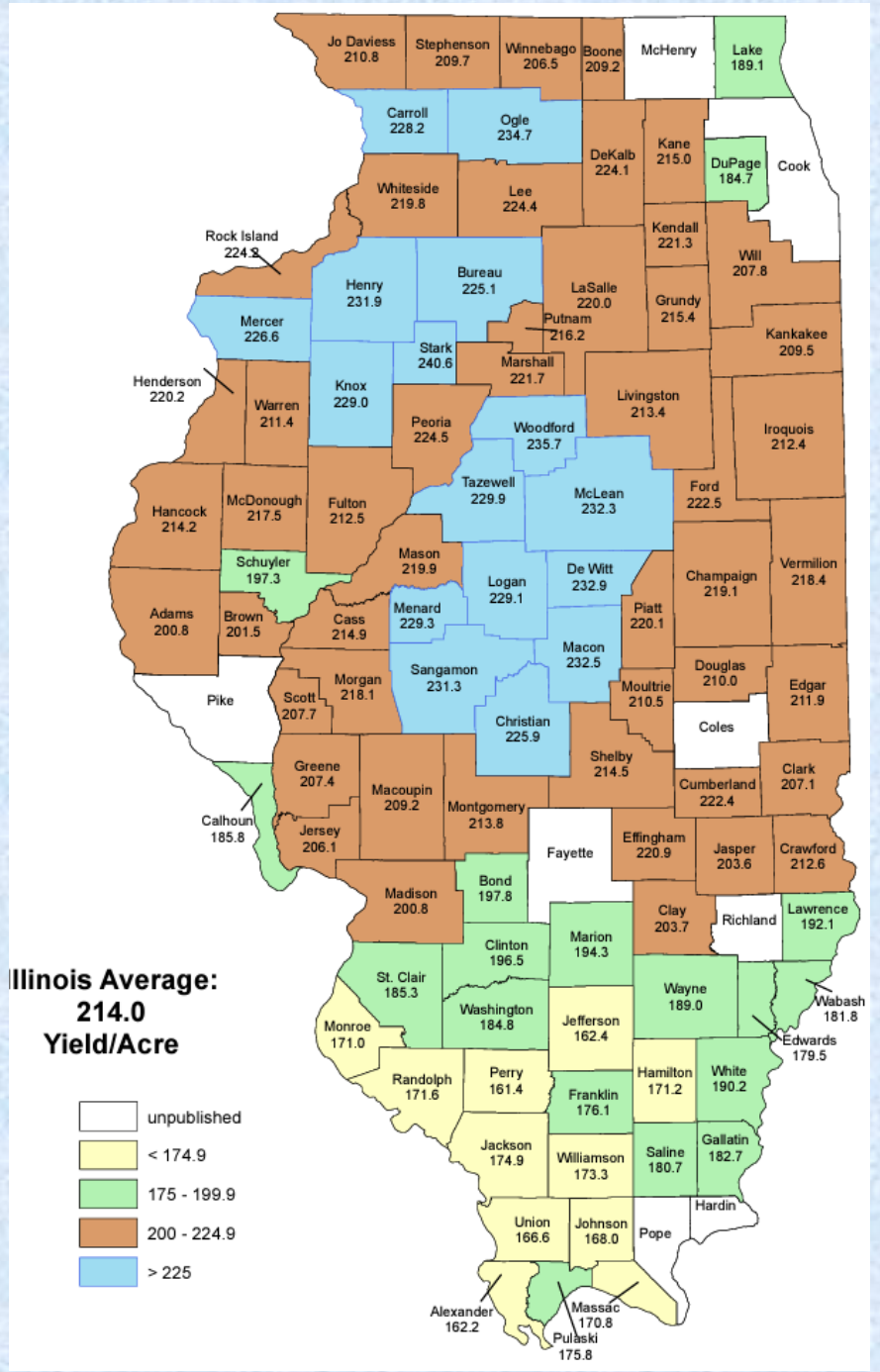


July 11

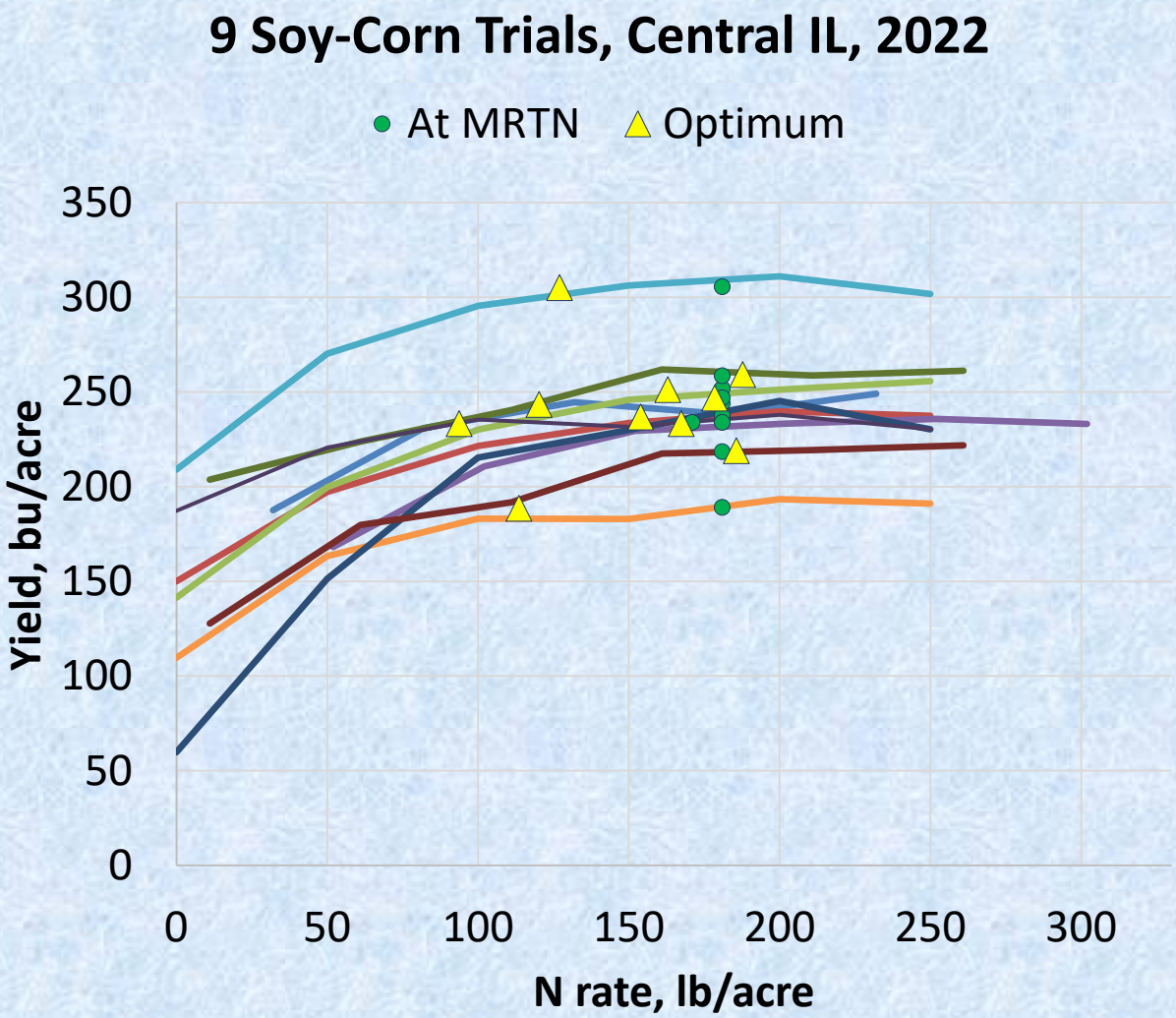
July 26

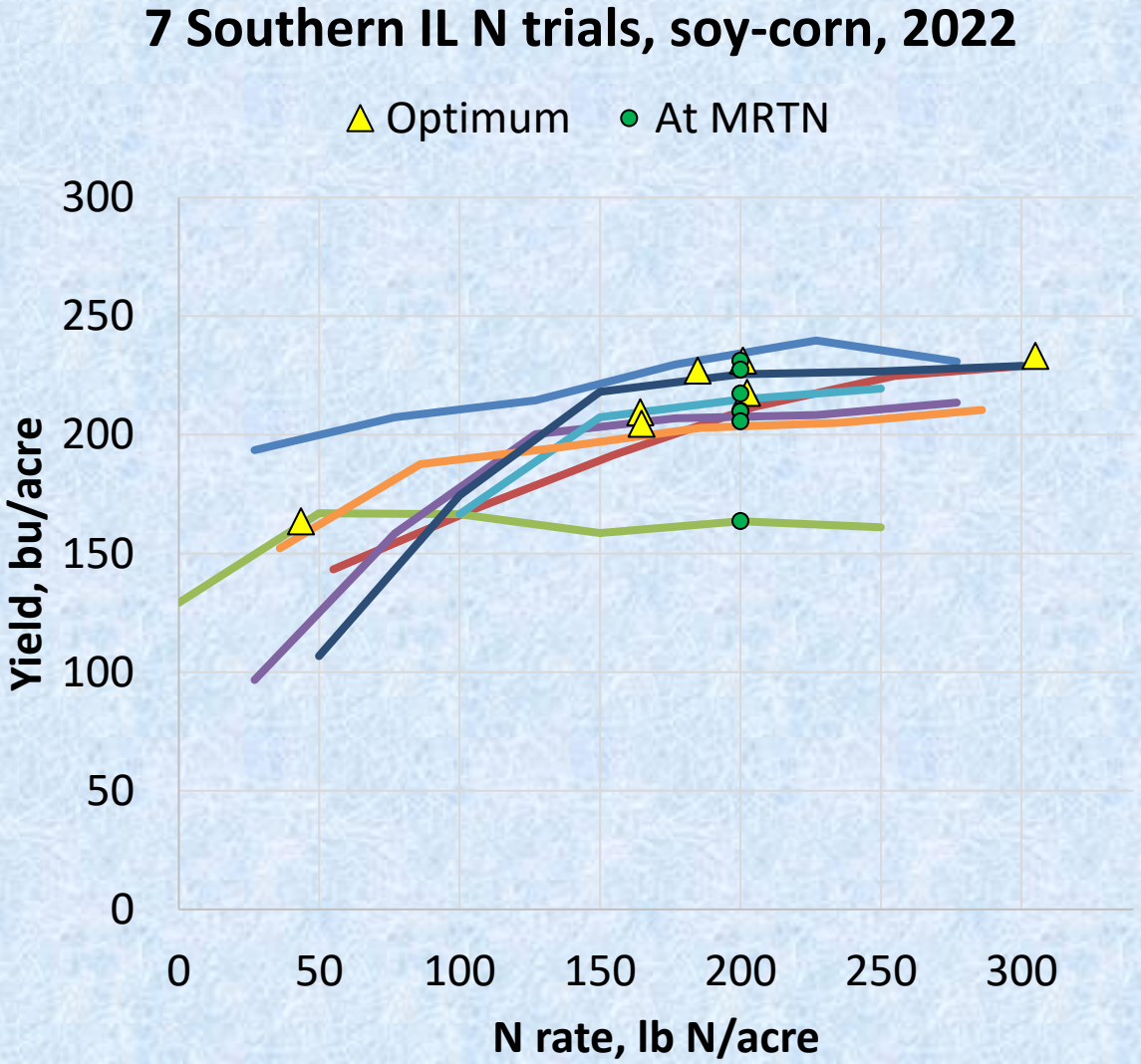
Dry periods did not “dampen” yields much in 2022





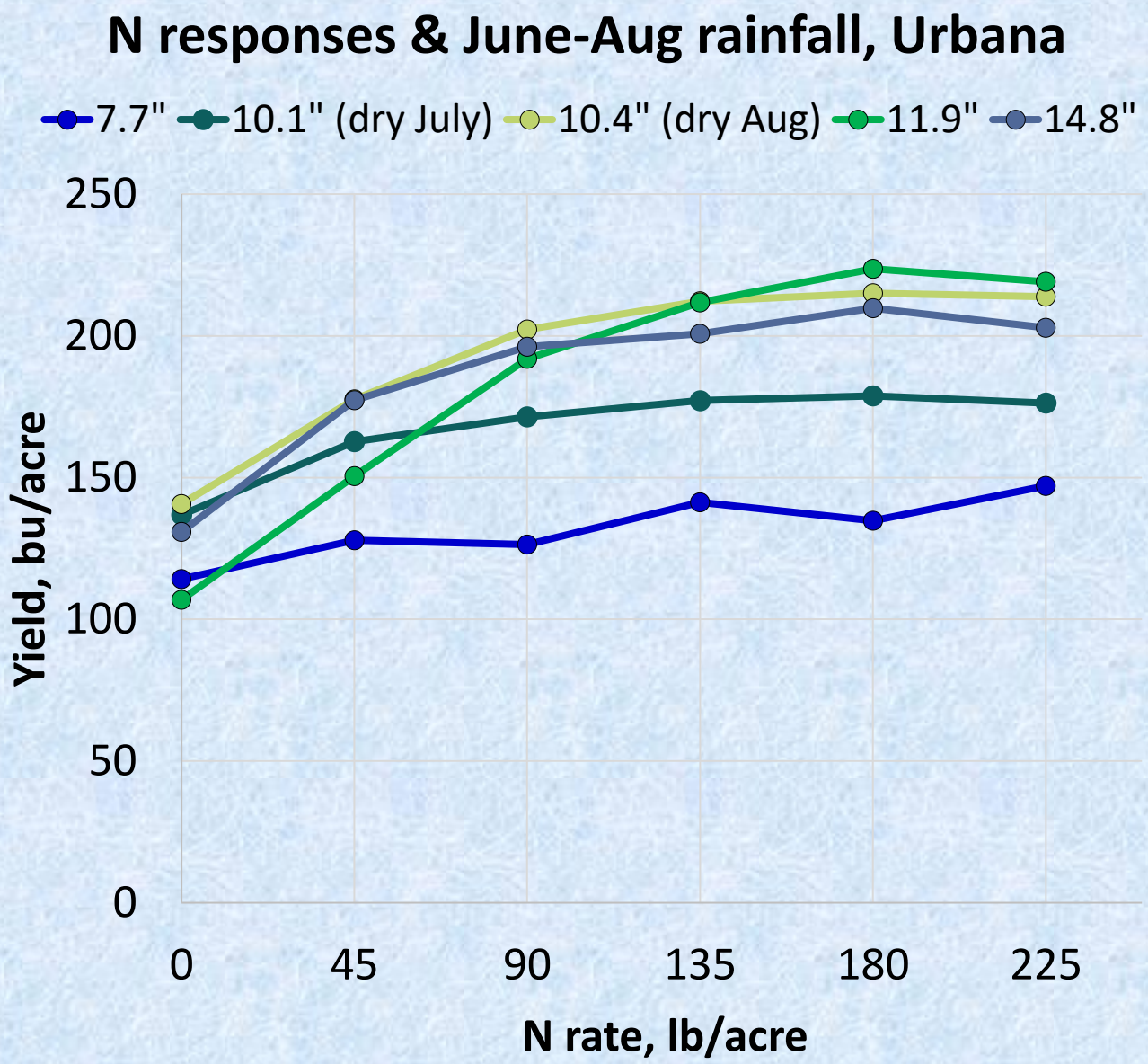
Nitrogen responses in 2022





Dry weather and N

- Dry enough early to limit root growth can delay and lower N uptake, reducing yield potential
- Drying soils during June can mean better roots and less N movement, so good uptake, and good yield if rain returns in July
- If dry soils persist into July, less root access can mean high N rates needed to produce (lower) yields
- Dry weather through the season can bring lower yields, less loss, and a lot of residual soil N

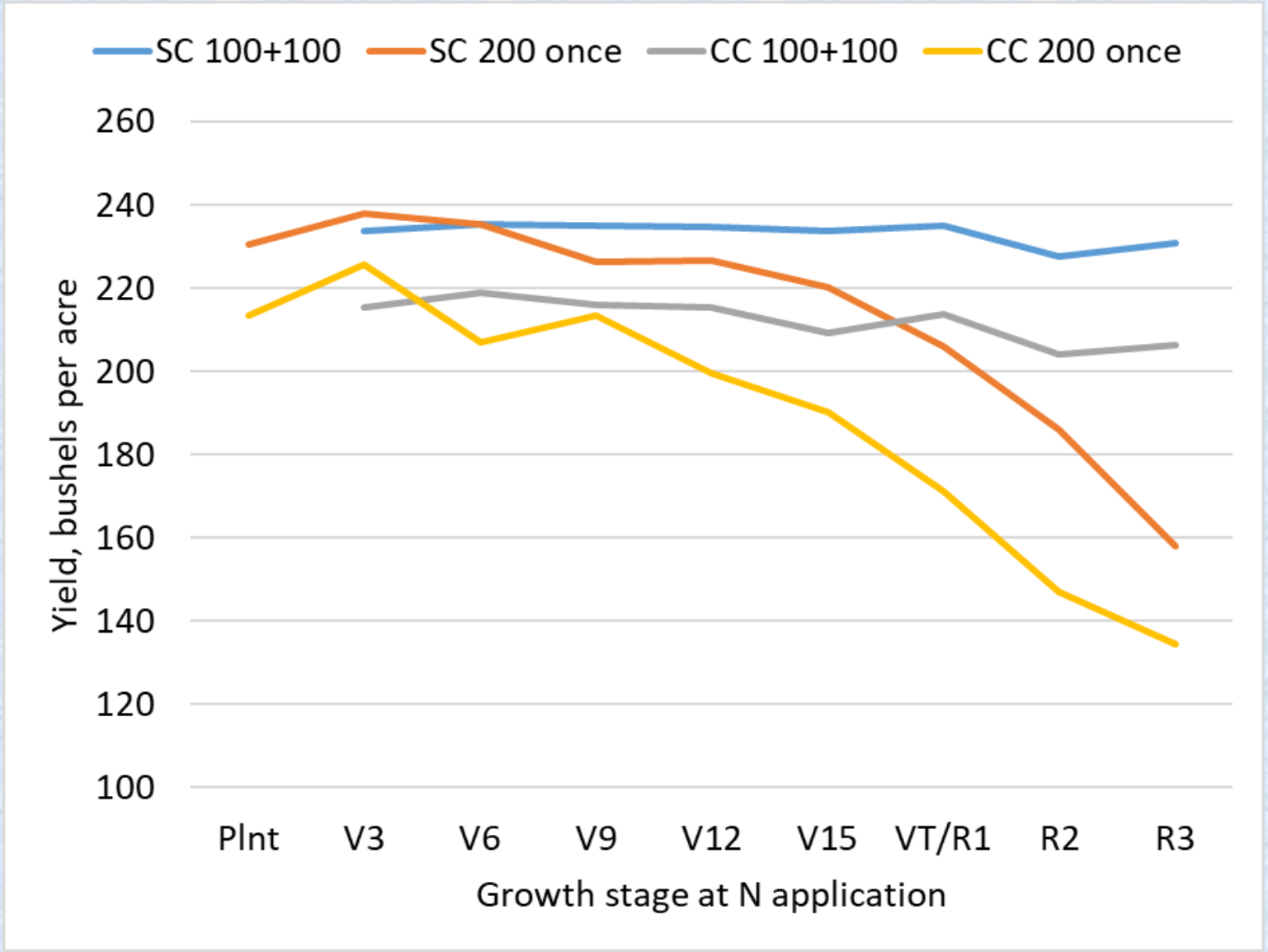


N timing study 2015-2017

UAN applied two ways:

- 100 lb inj UAN at planting + 100 lb dribbled at stages from V3 to R3 (100+100)
- 200 lb applied at planting or at stages from V3 to R3 (200 once)

- SPAD meter readings at and then after each N application
- Corn-corn (CC) and soy-corn (SC)
- Bottom line:
  - With 100 lb N at planting, the rest could be delayed to pollination with no loss in yield
  - When all N was delayed, the delay could be only to V6 without potential loss of yield



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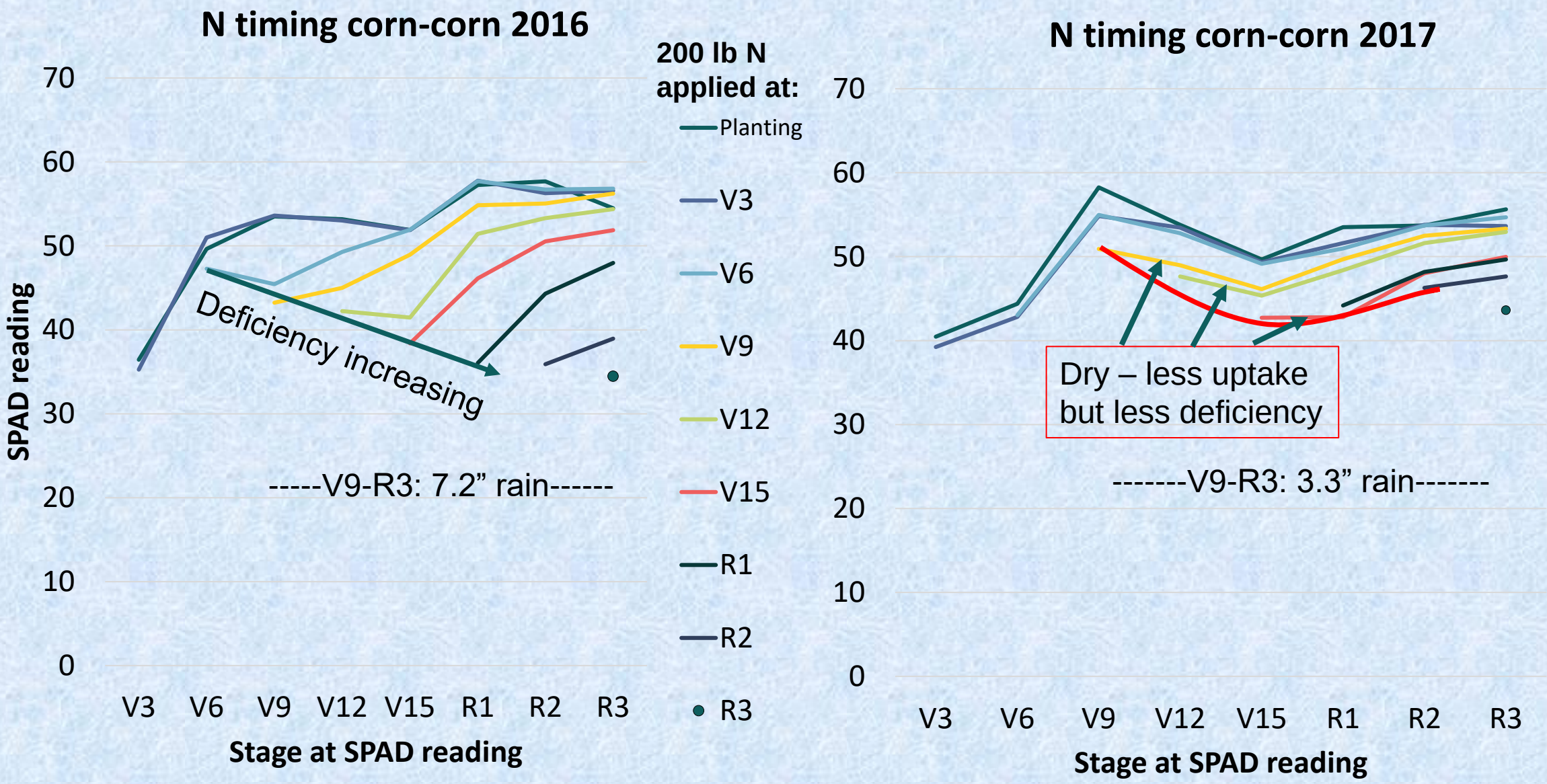
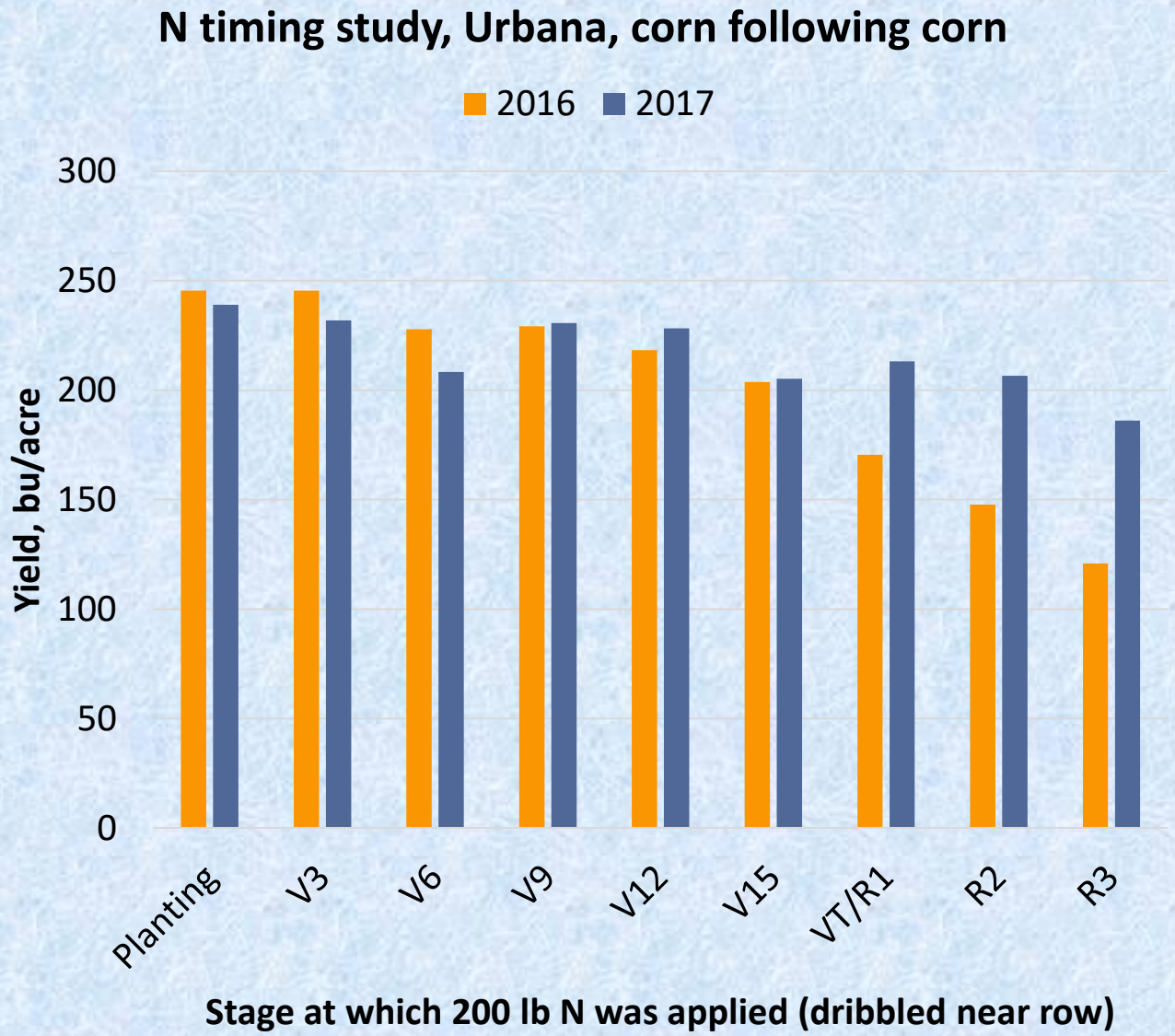
Dry weather and N timing: it's "complicated"

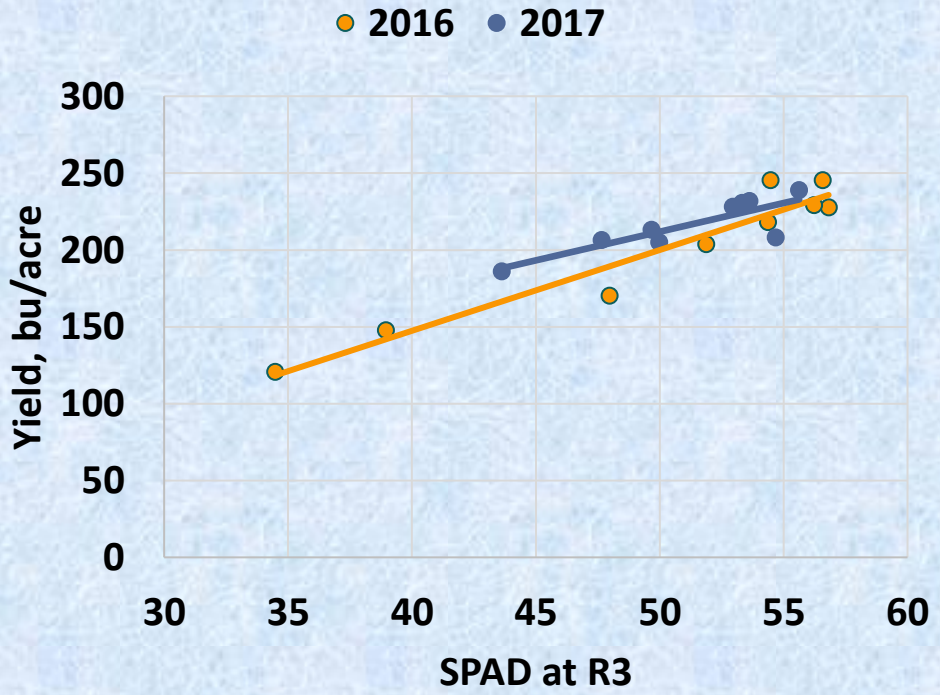


…but recovery from N deficiency may not always help yield – it's complicated



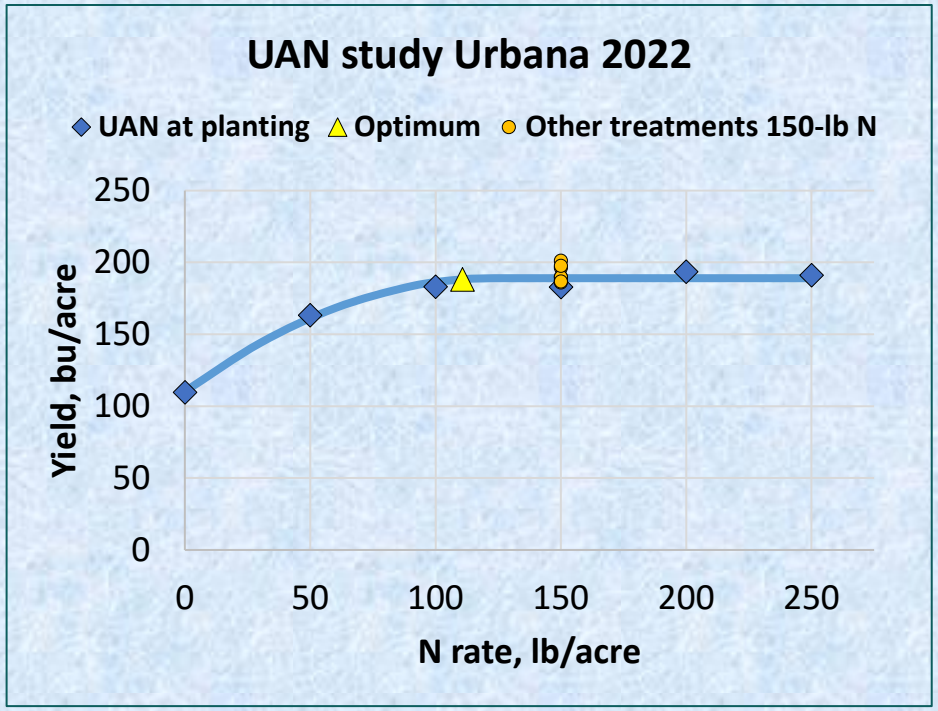
Crop recovered leaf color (SPAD) better in 2016, but was "too far gone" at delayed applications to recover full yield.

Drier weather in 2017 increased the soil supply of N, deficiency was less severe, and recovery less necessary for higher yield



UAN timing/placement

- Study with UAN rate, timing, and placement at Urbana
- Included a full N rate study w/ UAN injected at planting
- 2022 trial: planted 5/17; V6 appl 6/14; V9 appl 6/27 (no rain 6/14-6/24)



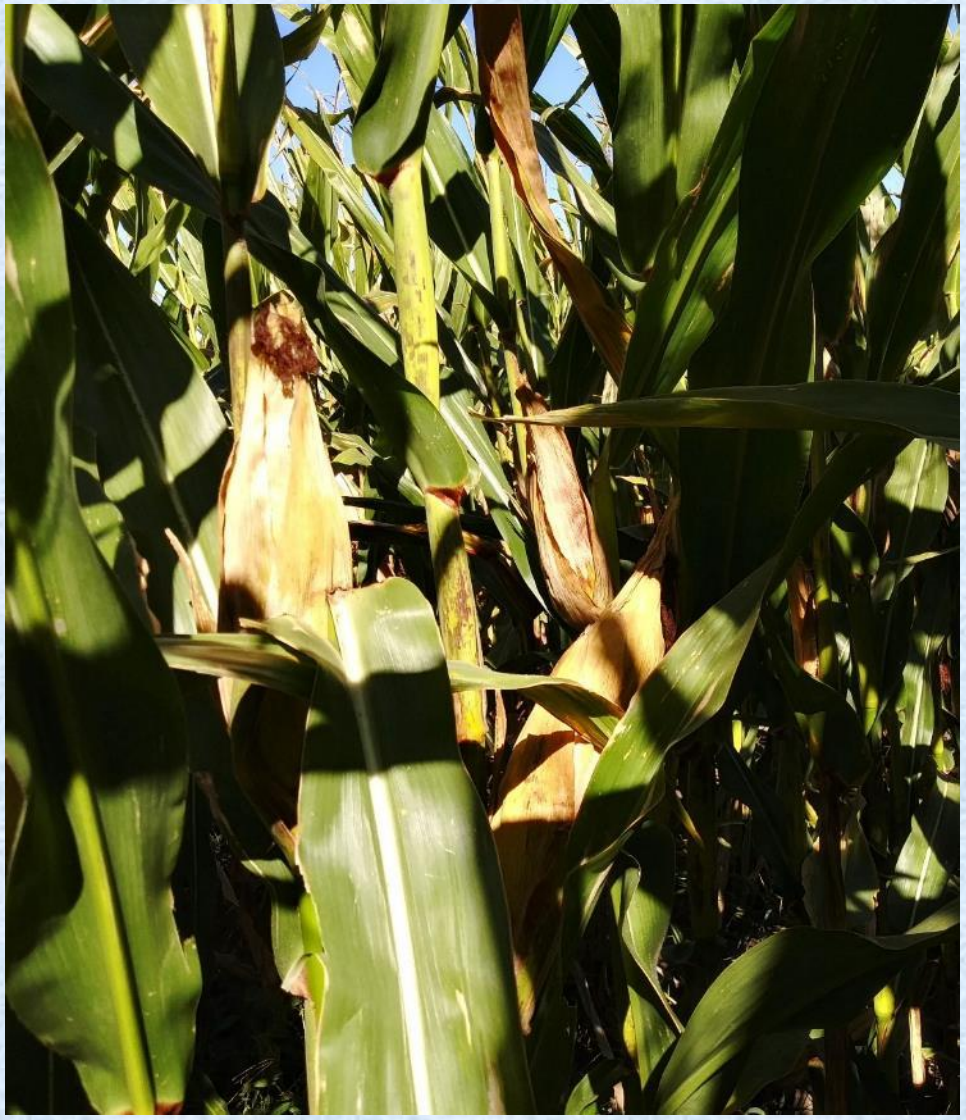
	Yield, bu/ac			
Timing/placement	2022	2021	2020	2019
150 injected at planting	183	176	164	172
50P+100 injected at V6	186	**189**	167	184
50P+100 dribbled at V6	188	**181**	165	176
50P+50inj/50dr at V6	196	174	166	178
50P+50inj at V6+50dr at V10	190	176	170	173
50P+50dr at V6+50dr at V10	**201**	**168**	173	162
50P+100dr at V10	190	165	179	172
75inj/75dr at planting	187	175	165	169
150 dribbled at planting	197	**156**	155	**195**
Optimum N rate in trial, lb/ac	***111***	***205***	***187***	***149***

Rainfall amounts:

	2019	2020	2021	**2022**
Plant to V6	3.15	7.25	3.49	**1.54**
V6 to V9	2.87	3.28	0.81	**1.05**
V9 to silk	1.77	3.63	6.62	**2.79**

Green leaves at maturity, 2022

Photos taken on October 3: ~3,000 GDD after planting – 109-d RM hybrid req 2,750 GDD to BL



N rate: 200 lb/acre

Grain moisture: >30%, black layer not distinct

Yield: 208 bu/acre

Grain N: 1.37% = 0.65 N lb/bu; ~135 lb N/acre in grain

Stover (including cobs) N: 1.01% = ~92 lb N/acre

Total plant N: 227 lb N/acre, ~1.1 lb N per bushel (high)

<u>We think that:</u>

N accumulated in the soil, and was concentrated in water taken up mid- to late grainfill

Late N buildup kept leaf tissue green (and sugars coming) after the crop would normally have black-layered

Sugar buildup (green leaves + kernel uptake slowing) added more weight to kernels – “bonus fill”

Sugars in kernels slowed drying

2022 – a “nitrogen-rich” season in Illinois

- Timely start to mineralization (soils warm at planting) and very little N loss from soils
  - Likely less response than usual to planter-applied N
- In-season N applications on the surface (Y-drop) may have been delayed in reaching the plant, but with little or no N deficiency, this may not have done much harm – or much good (for yields)
- High leaf N content at maturity and slow drydown:
  - High soil N (and N concentration in water taken up late)
  - Signaling of maturity (ears to rest of plant) may have been “off”
- Relatively high yields with no or low fertilizer N, and N rates needed to maximize $ return were less than the MRTN in most trials
  - **There is no doubt that actual N amounts used in many IL corn fields in 2022 were higher (maybe much higher) than the crop required**

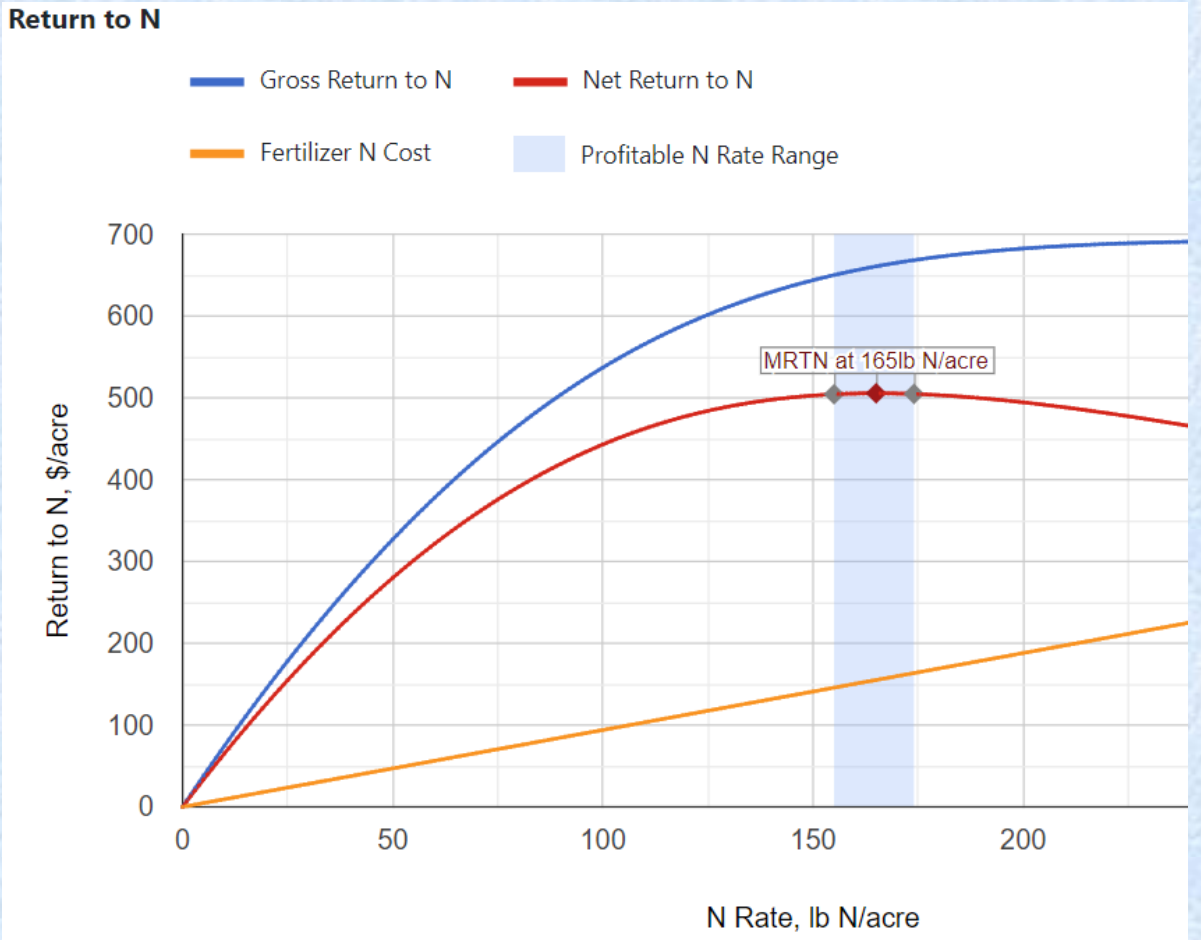
The N Rate Calculator has moved: https://cornnratecalc.org/

Still looks about the same, but:

- Developed by PAQ Interactive (IL)
- Not an Iowa State University website anymore
- Better images
- Same calculations with (soon-to-be-updated) data

State : **Illinois**
Region : **Central**
Number of sites : **290**
Rotation : **Corn following soybean**

Nitrogen Price ($/lb):	**0.94**
Corn Price ($/bu):	**6.25**
Price Ratio:	**0.1504**
MRTN Rate (lb N/acre):	**165**
Profitable N Rate Range (lb N/acre):	**155 - 174**
Net Return to N at MRTN Rate ($/acre):	**$505.56**
Percent of Maximum Yield at MRTN Rate:	**98%**
UAN (32% N) at MRTN Rate (lb product/acre):	**515**
UAN (32% N) Cost at MRTN Rate ($/acre):	**$155.10**



MRTN values with corn at $6.25/bu and UAN at $0.94/lb N (UAN 32 at $600/t)

The current version of the N rate calculator runs on data from 2006-2021. It will be updated this winter with 2022 data, but output will not change very much.

Illinois region	Soy-corn	Corn-corn
	lb N/acre	
North	156	184
Central	165	181
South	184	178

Note: MRTN rate is the total N applied, including N from MAP/DAP, planter-applied, herbicide carrier, etc.

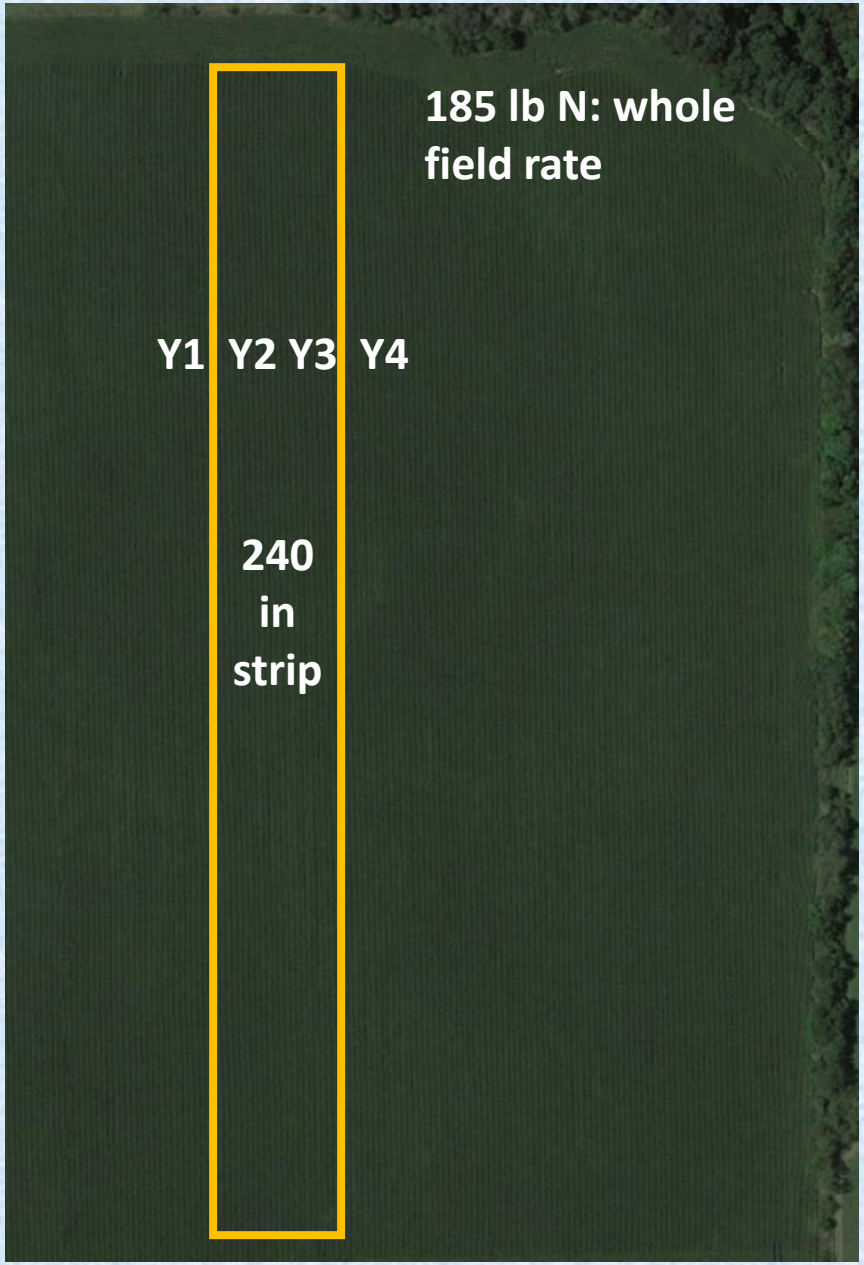
The N price used to calculate the MRTN should be the price of the last N applied (the N that "tops off" the total) – not fall NH_3, herbicide carrier, or other "fixed" amounts. (Those N costs are already "sunk.")

N Rate Verification Trials:

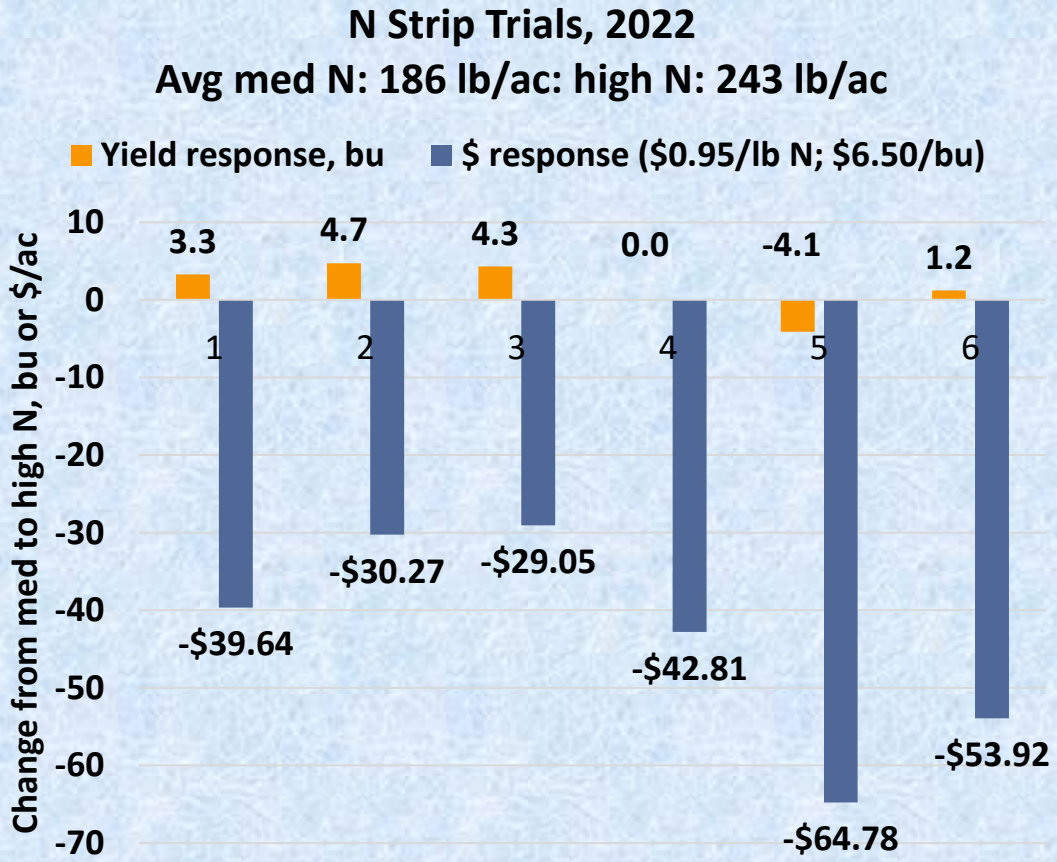
- Project in its early years, funded by NREC
- Likely to replace most full-rate trials over time
- Dan Schaefer (IFCA) will coordinate

Instead of this (in few IL fields each year)

This, in 500(?) IL fields each year

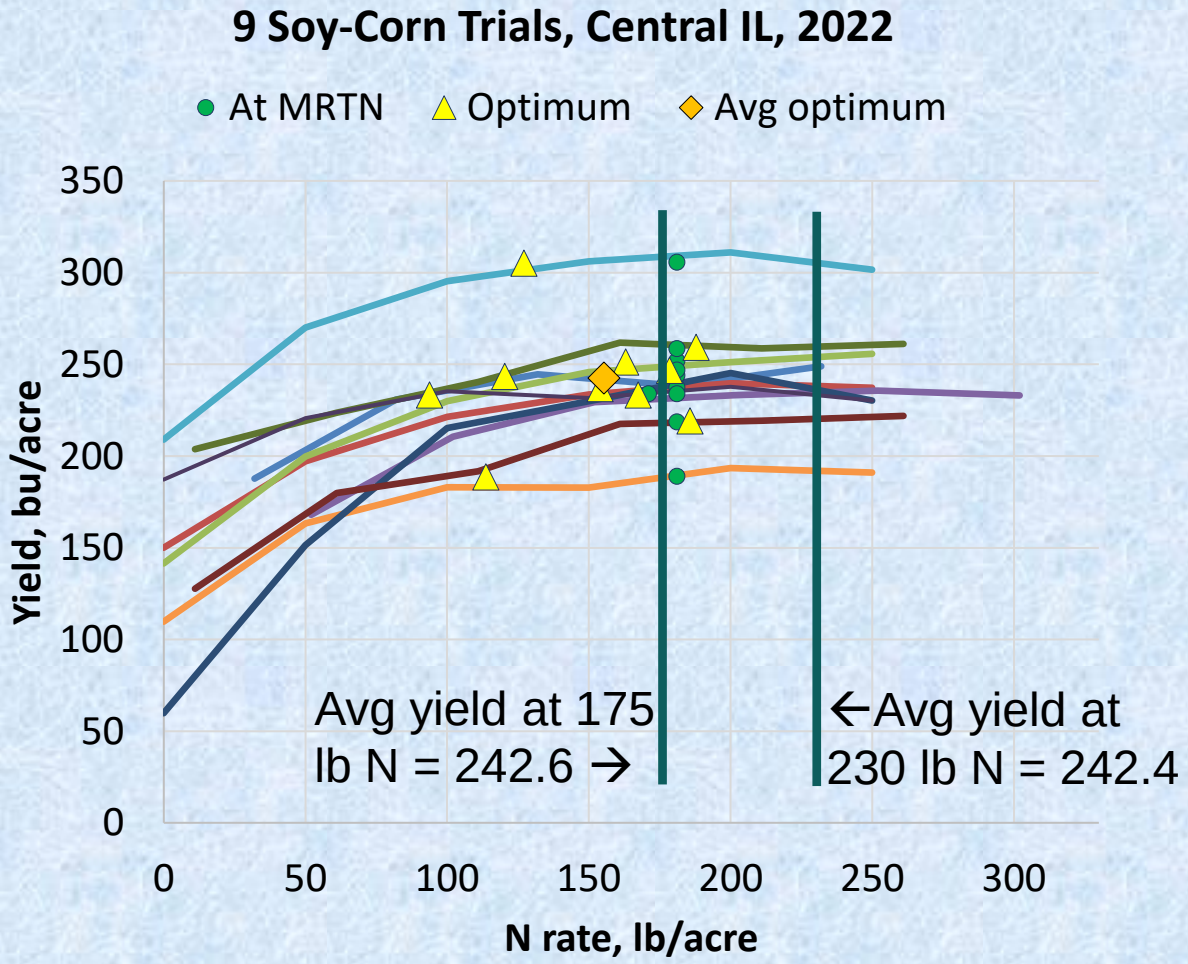


Nitrogen responses in 2022: N rate Verification Trials (2-rate strips)



Adding an average of 57 lb N increased yield by 1.6 bu/ac and lowered net by $43.41 (without application cost)

We can also extract data from full-rate trials



Adding 55 lb N lowered yield by 0.2 bu and net by $53.55

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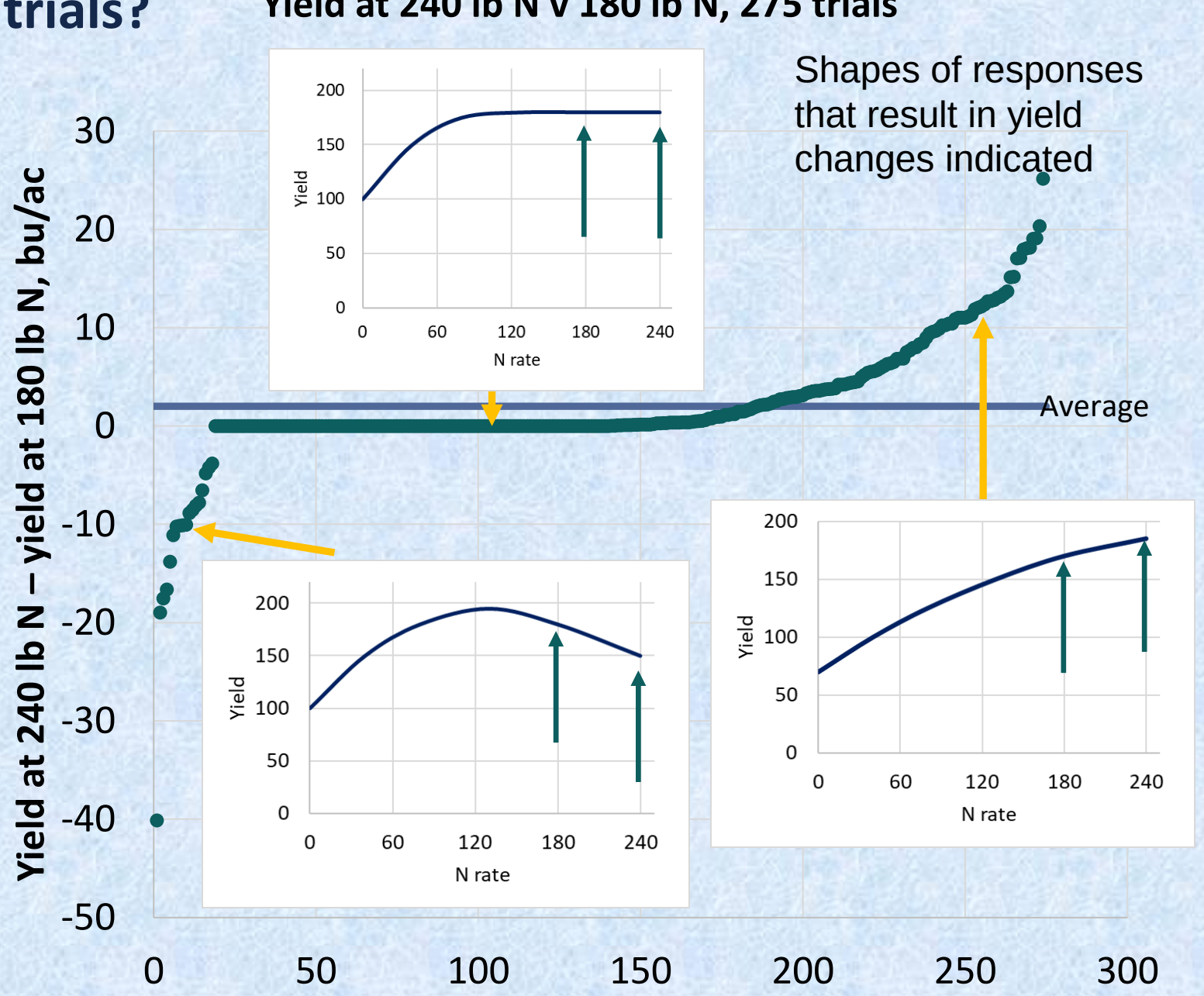
What might we see in 2-rate trials?

Across 275 N rate trials in central Illinois corn following soybeans:

Yield at 240 lb N/acre averaged **2 bushels more** than yield at 180 lb N

- 18 trials had higher yields at 180 than at 240 (curve bent down after reaching a maximum)
- 119 trials had the same yield at 180 as at 240 (yield response flat above 180 lb N)
- 48 trials yielded less than 2 bushels more at 240 than at 180
- If 60 lb of N "cost" 8 bushels of yield, 40 trials (15%) showed positive return to using 240 lb N
- On average, **added 60 lb N cost 3 times as much as it returned**



Should we be applying (more) N with the planter?

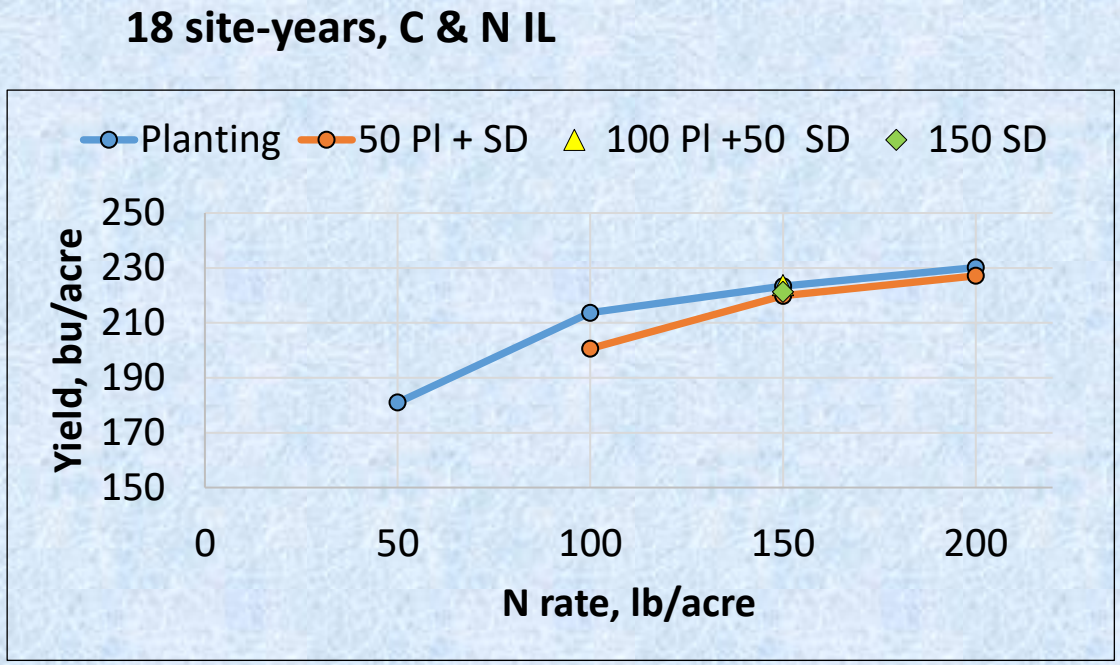
- Still not a favorite of IL farmers, but promoted by companies (e.g., Precision Planting) developing new equipment
- Small plants need N near their roots
  - Planter-placed N does this well
  - UAN atop the row, with flood nozzles, or injection with GPS
  - If soils are warm at planting, mineralization may be enough
- Results of research in Illinois have been mixed

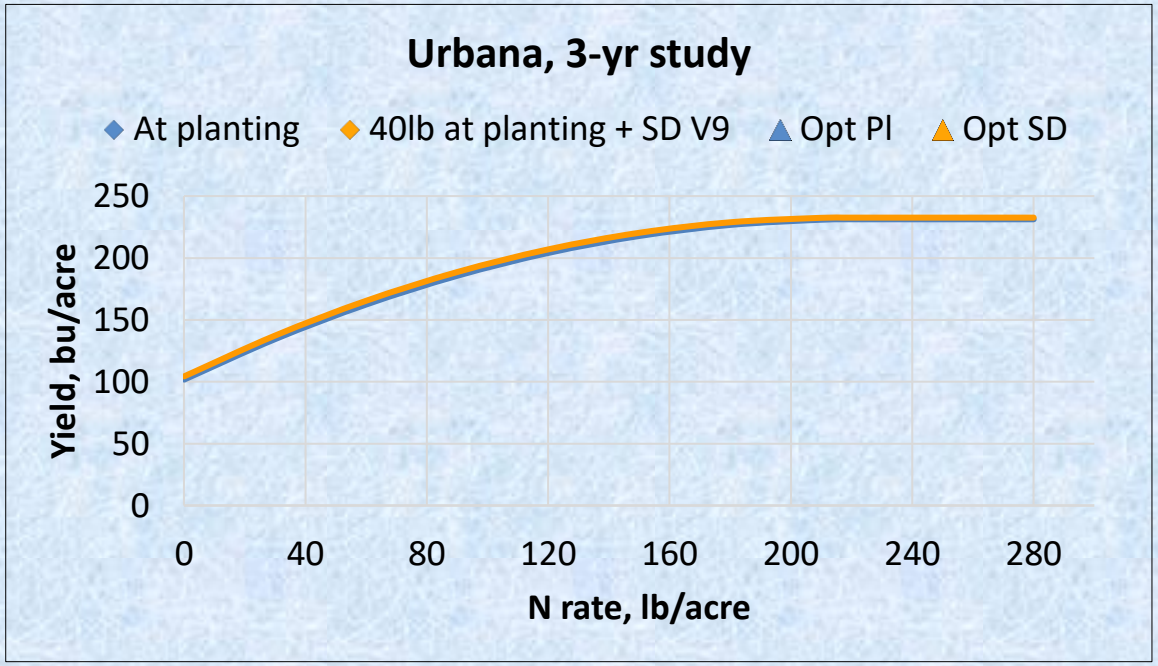
Study in Piatt County in 2022

Planter-applied fertilizer	Yield
None	241
1 gal 8-27-4-2.75S-0.25Zn	243
3 gal "	243
5 gal "	241
3 gal 6-20-4-2.75S-0.25Zn	244
5 gal "	245

What about splitting N?

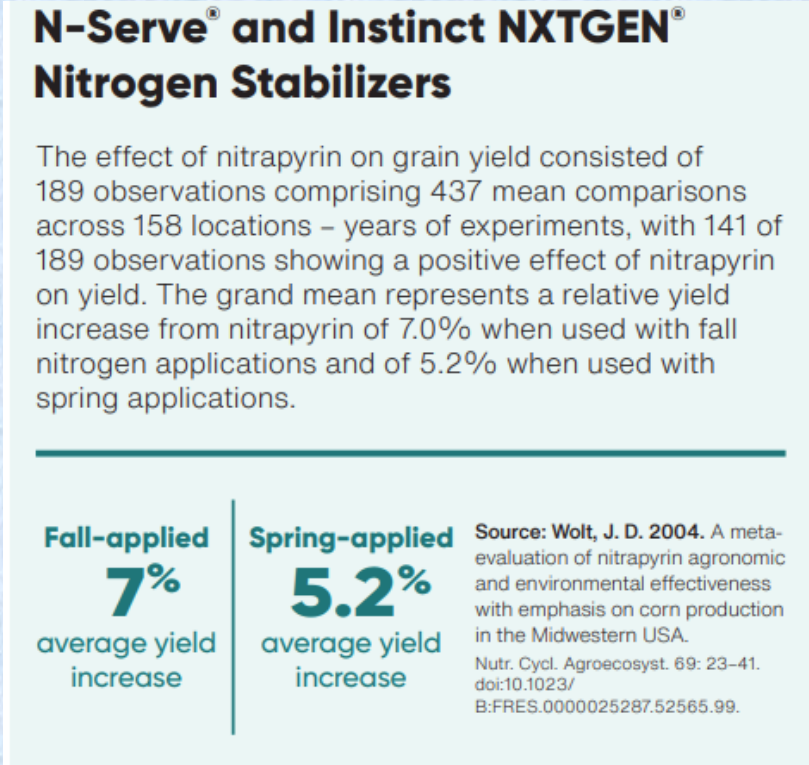
- It's a very reasonable way to apply some N for many
- It seldom, though, has produced higher yield with the same N rate or the same yield with less N than all-early N
- Might occasionally be needed to supply additional N (e.g., wet early)
- Small plants need N early
- Timing of split is not critical in most soils and years

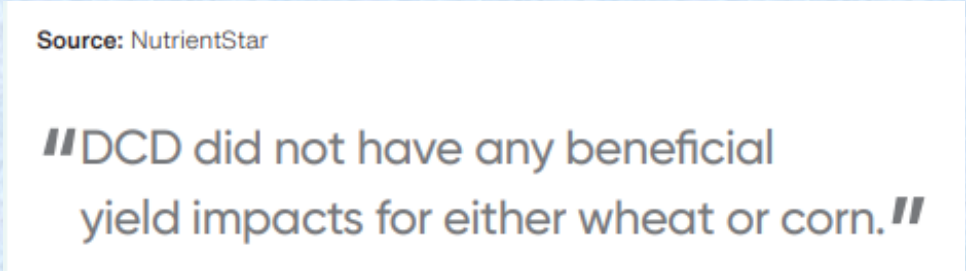




Stabilizers?

- The value of any inhibitor in any field situation depends what N rate is used, and on what happens between N application and plant N uptake
- Two main chemical types:
  - Nitrification inhibitors (nitrapyrin, DCD) slow microbial conversion of ammonium to nitrate
  - Urease inhibitors (NBPT) slow release of NH3 from urea
- Slow-release stabilizers: coatings (ESN); chemical agents (methylene urea)
- THINK before using – is loss likely, and will stabilizers be effective?





Can we learn to sense corn N status and fertilizer accordingly?

We can match canopy color (sometimes, and at some stage) to yield when N availability varies due to N rate or N loss

The timing aspect – is it already too late to get N into the plant when we see deficiency? – is a barrier

It seems unlikely that we will learn to do this in rainfed production without increasing yield and profitability risks

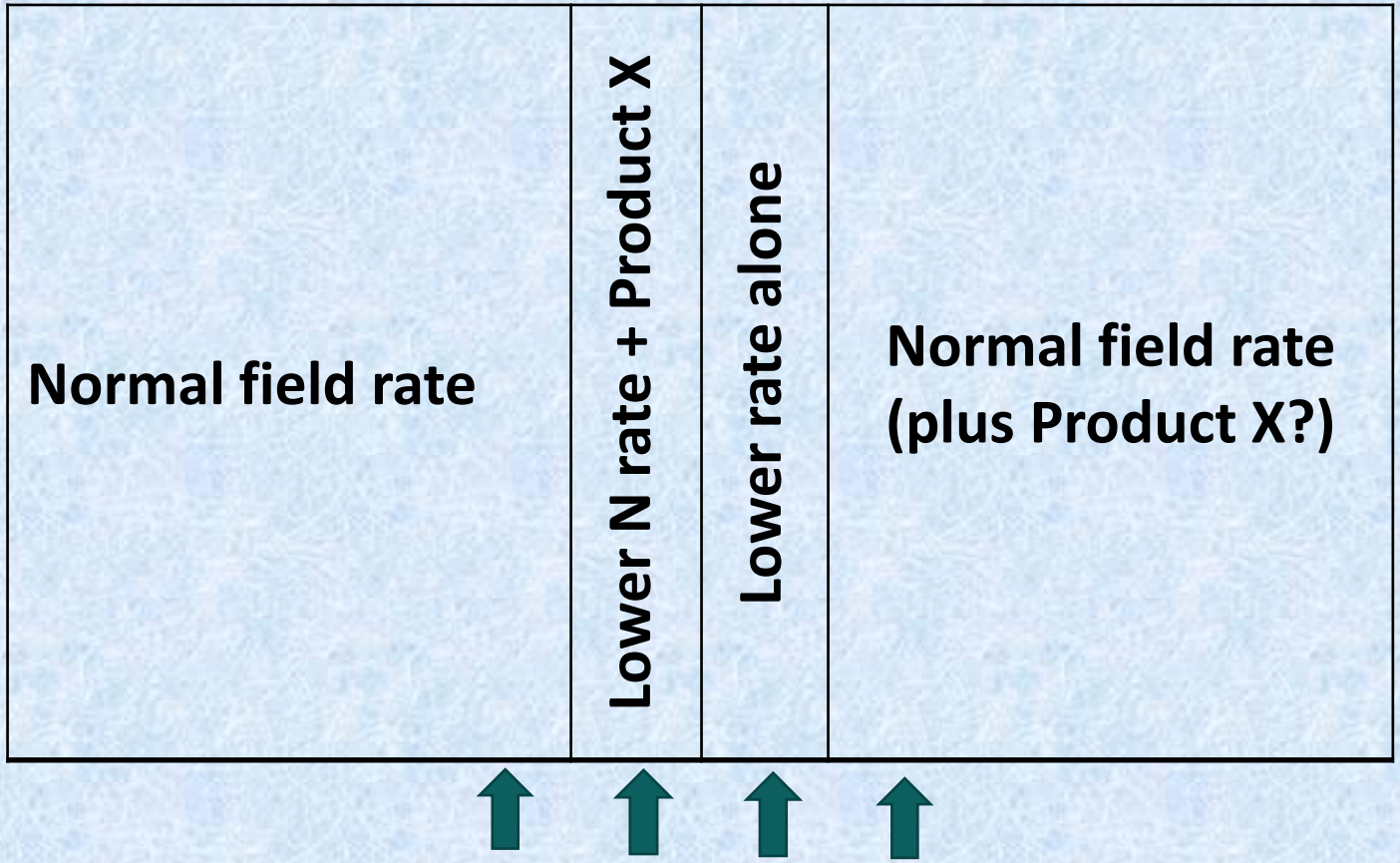
But stay tuned…

“Lower the N rate and add Product X” – a winning strategy?

If we compare a normal (higher) N rate without Product X to a lower N rate with Product X:

We do not know what the yield at the low N rate by itself would have been, so do not know if Product X affected yield

We need the lower N rate both with and without Product X to know if Product X affected yield



Make strips wide enough to take YM data, in strips and next to strips

A second set of strips in the same or another field would be very useful

New technology: on-seed pulsing of liquid

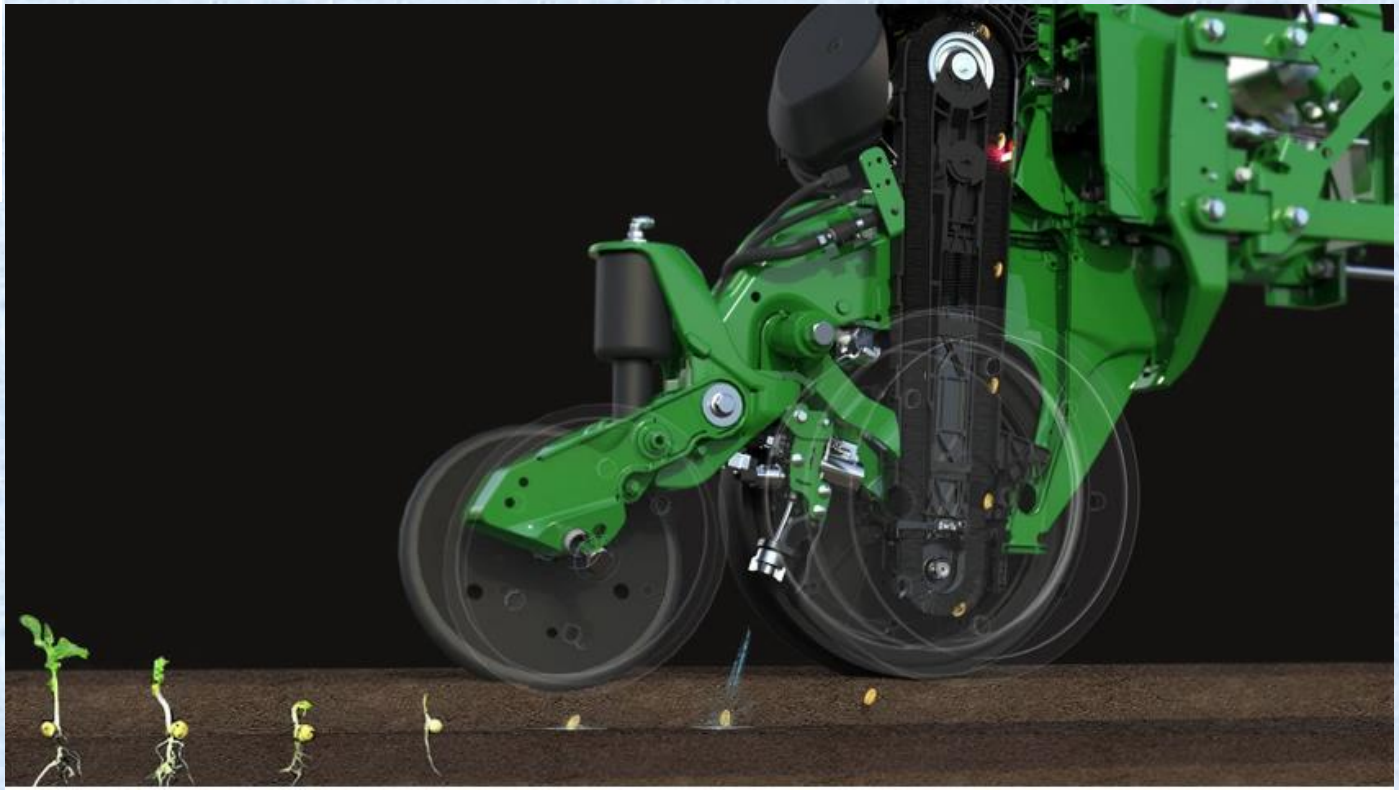
Add precision to starter fertilizer use

John Deere's new ExactShot tech directs starter fertilizer to hit only the seed, cutting costs.

At a Glance

- ExactShot offers per-seed pulse spraying of starter at planting.
- System uses spray tech also found in ExactApply nozzles.
- System can be purchased to put on existing planters.

Story (Farm Progress daily, Jan. 18, 2023) talks about fertilizer (savings – says fertilizer applied between plants is "wasted"), but not insecticide



Revised Illinois Agronomy Handbook chapter

Website: https://extension.illinois.edu/global/agronomy-handbook

Nitrogen Management for Corn

Comments and questions are welcome:
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THANK YOU

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