Precision Conservation Management

Smart Nitrogen Management

Timing, Rate, and Return on Investment (ROI)

College of Agricultural, Consumer & Environmental Sciences

UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

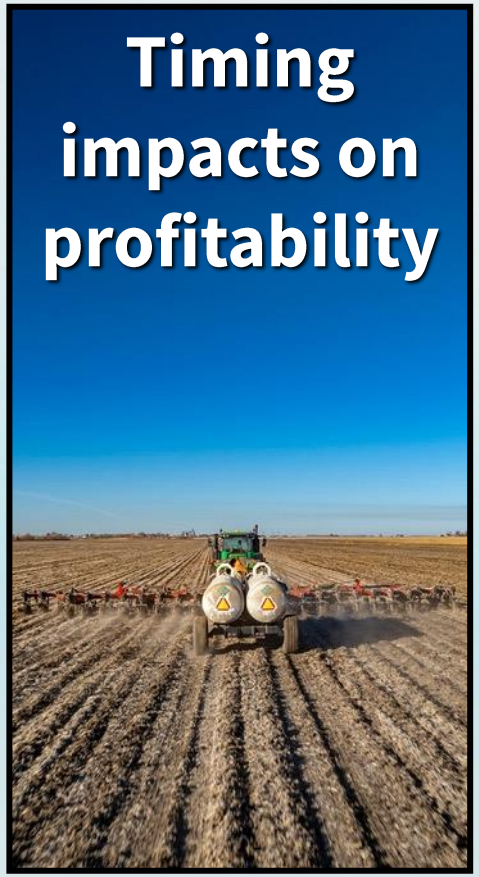
Gary Schnitkey

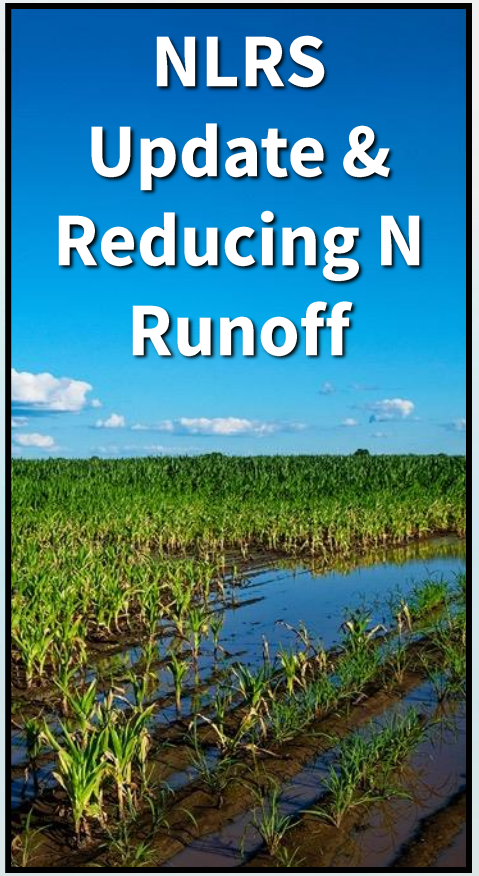
farmdoc

Laura Gentry

Topics

N rate impacts on profitability





Rates and profitability

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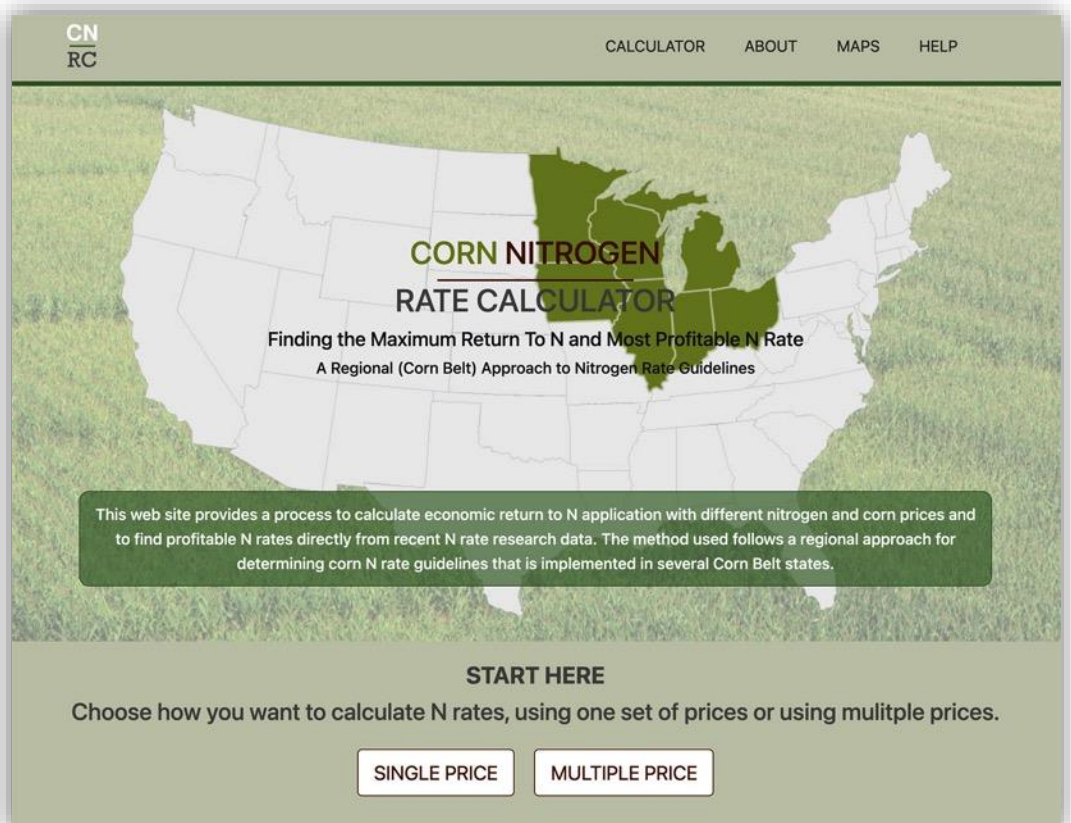
Review of Maximum Return to Nitrogen (MRTN)

MRTN is a regional approach developed by soil fertility specialists across the Corn Belt states to determine the **most profitable nitrogen fertilizer application rates** for corn production.

The MRTN identifies the nitrogen application rate that provides the **greatest economic return to nitrogen application** for a given dataset, prices, and crop rotation.



MRTN Rates (lb N/acre) for Central Illinois Example

Corn following Corn using Anhydrous Ammonia

AA Price $ per Ton	Corn Price in $/bushel			
	$3.50	$4.00	$4.50	$5.00
$600	202	208	214	219
$700	196	201	206	211
$800	189	196	200	205
$900	182	190	196	200

https://www.cornnratecalc.org/

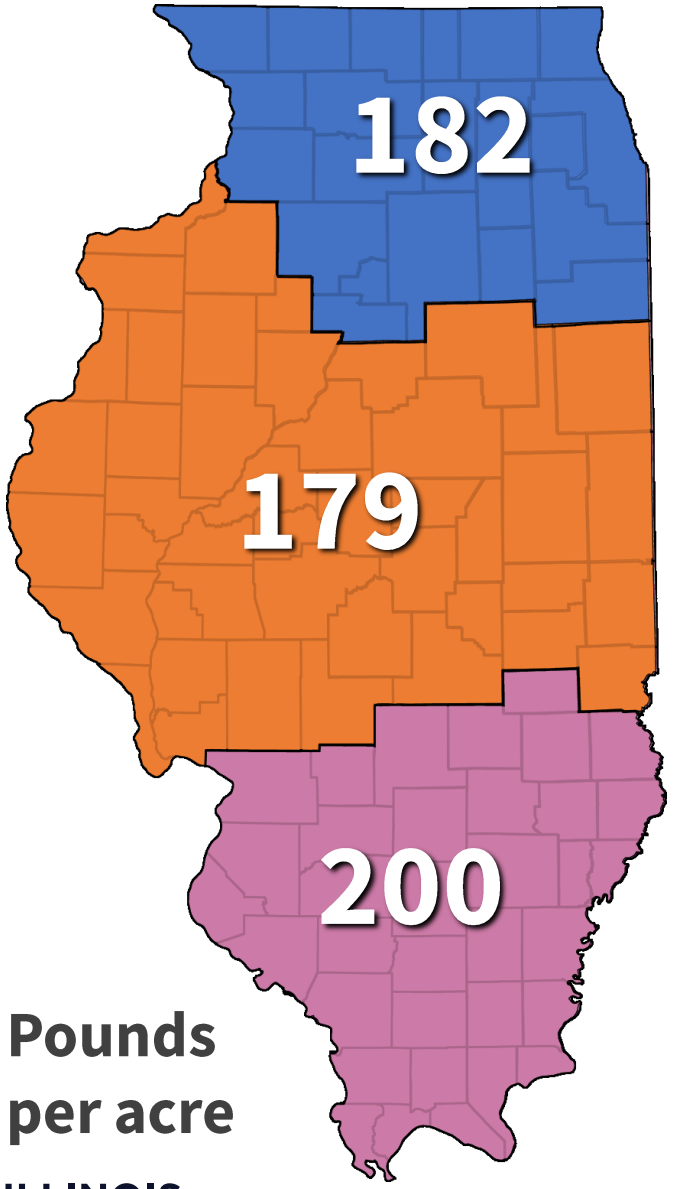
MRTN Rates (lb N/acre) for Central Illinois Example

Corn following Soybeans using Anhydrous Ammonia

AA Price $ per Ton	Corn Price in $/bushel			
	$3.50	$4.00	$4.50	$5.00
$600	185	190	195	200
$700	179	185	189	193
$800	174	179	184	188
$900	169	174	179	184

https://www.cornnratecalc.org/

Maximum Return To Nitrogen (MRTN)



Based on August 2, 2024 values

- Corn price
  $4.00 per bushel
- Anhydrous Ammonia price
  $800 per ton
- Yield does not enter into calculation

Corn HIGH-SPR, N TIMING I 2015-24 AVG VALUES	>40% FALL	MOSTLY PREPLANT	MOSTLY SIDEDRESS	50% PRE/ 50% SIDEDRESS	3-WAY SPLIT
NUE (lb N/bu grain)	0.96	0.90	0.89	0.92	0.91
# fields	3,326	1,589	1,807	556	701
Yield per acre	226	221	225	224	228
GROSS REVENUE	**$968**	**$945**	**$958**	**$957**	**$977**
N fertilizer	$104	$98	$97	$110	$106
Other direct costs	$357	$330	$347	$356	$380
TOTAL DIRECT COSTS*	**$461**	**$428**	**$444**	**$466**	**$486**
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TOTAL NON-LAND COSTS	**$629**	**$589**	**$612**	**$632**	**$656**
OPERATOR & LAND RETURN	**$338**	**$356**	**$347**	**$325**	**$321**

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Returns for different N Rates

Corn N RATE, HIGH-SPR, LBS PER ACRE I 2015-24 AVG VALUES	<150	151-175	176-200	201-225	>225
# fields	218	710	2,139	3,063	1,849
AVG Corn Yield (bu/a) 2015-24	**208**	**220**	**223**	**225**	**231**
OPERATOR & LAND RETURN	**$344**	**$355**	**$352**	**$341**	**$332**
GHG emissions (metric tons CO2e/a)	0.42	0.63	0.69	0.77	0.91

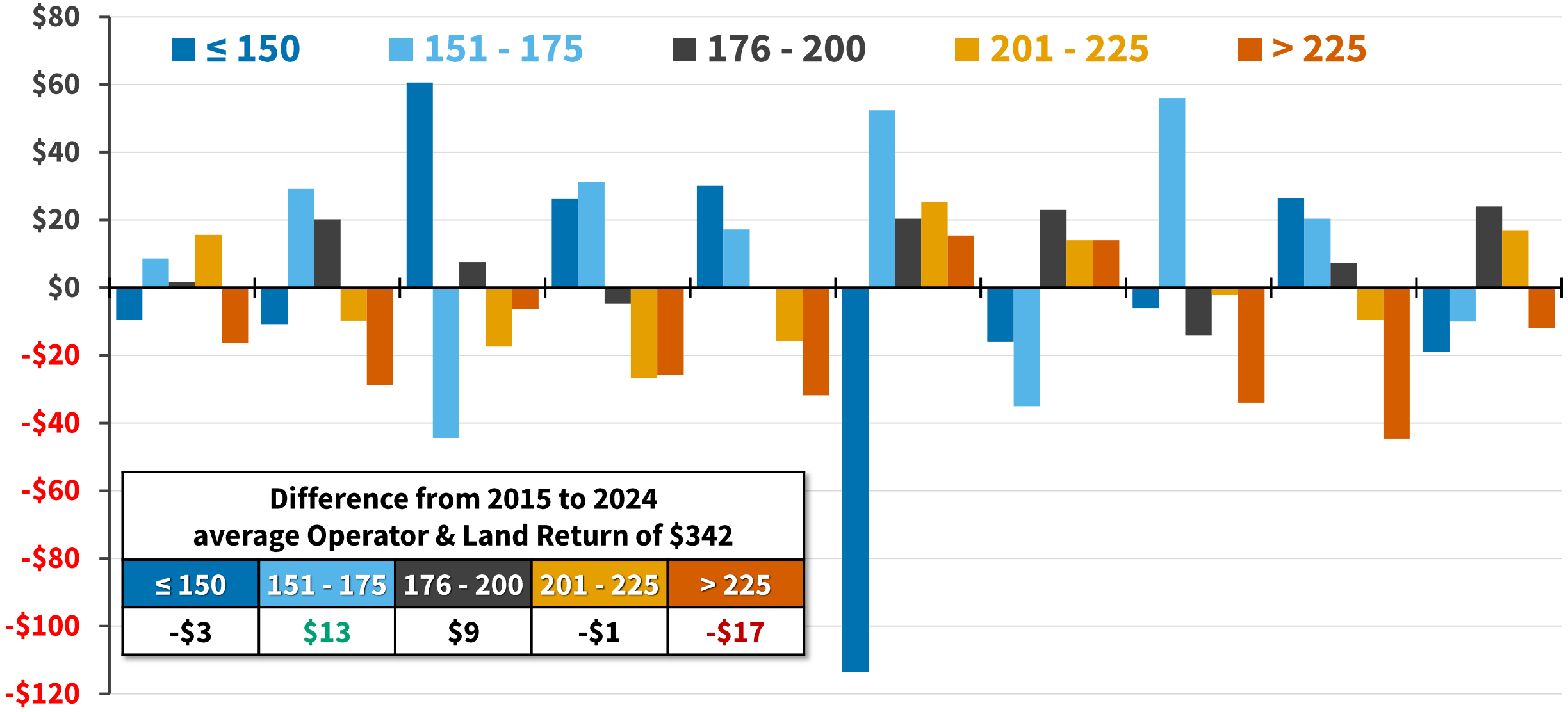
SPR = Soil Productivity Rating

Note: When reviewing these tables, please keep in mind that the nitrogen values represent the TOTAL nitrogen fertilizer application rate, including any nitrogen applied in MAP or DAP or with herbicides or other sources.

Operator and Land Return ($/a) by Nitrogen Rate Class

Year	≤ 150	151 - 175	176 - 200	201 - 225	> 225	Average
2015	$197	$215	$208	$222	$190	$206
2016	$246	$286	$277	$247	$228	$257
2017	$272	$167	$219	$194	$205	$211
2018	$360	$365	$329	$307	$308	$334
2019	$297	$284	$267	$251	$235	$267
2020	$174	$340	$308	$313	$303	$288
2021	$559	$540	$598	$589	$589	$575
2022	$761	$823	$753	$765	$733	$767
2023	$316	$310	$297	$280	$245	$290
2024	$210	$219	$253	$246	$217	$229
Average	$339	$355	$351	$341	$325	$342

Operator and Land Return by Difference of Yearly Average Nitrogen Rate Application Class (pounds of N per acre)



Difference from 2015 to 2024 average Operator & Land Return of $342				
≤ 150	151 - 175	176 - 200	201 - 225	> 225
-$3	$13	$9	-$1	-$17

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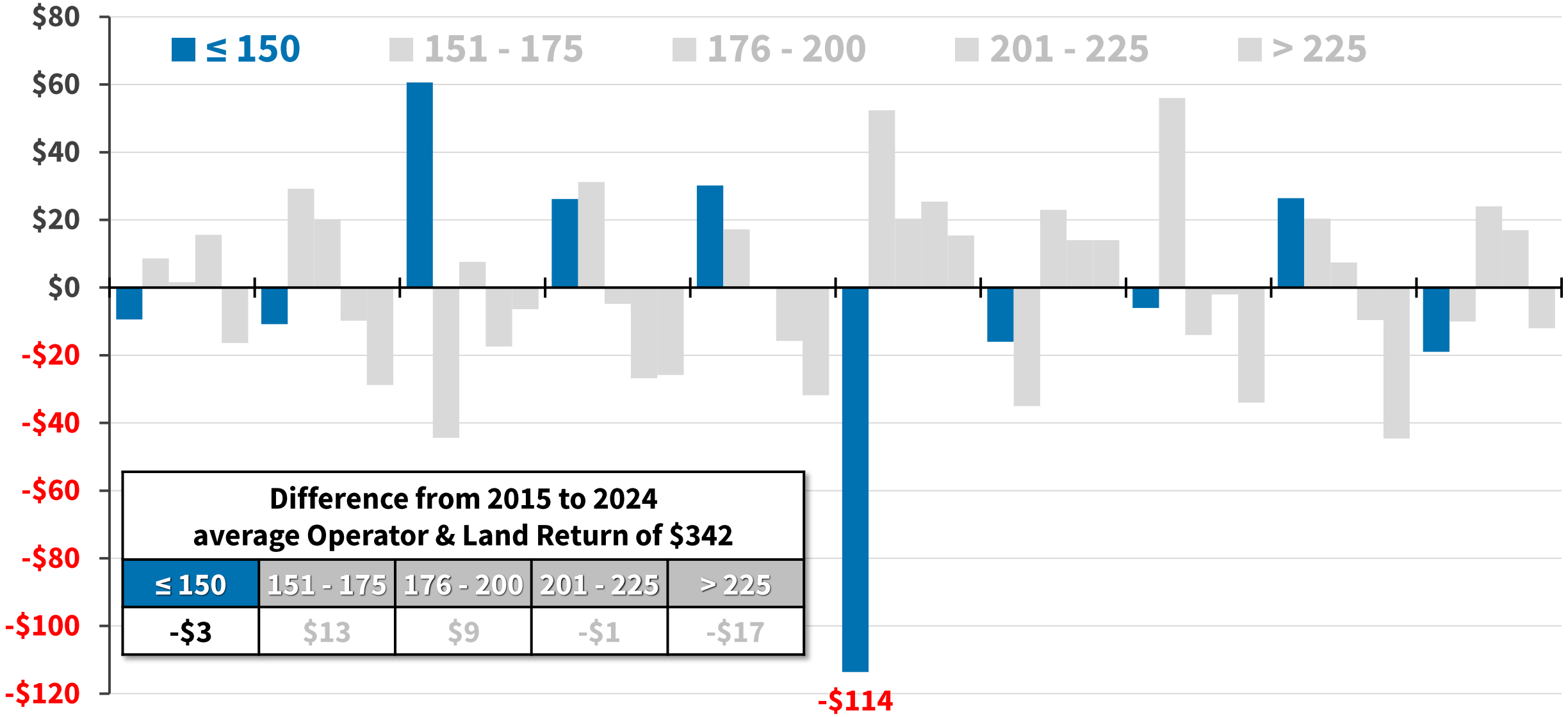

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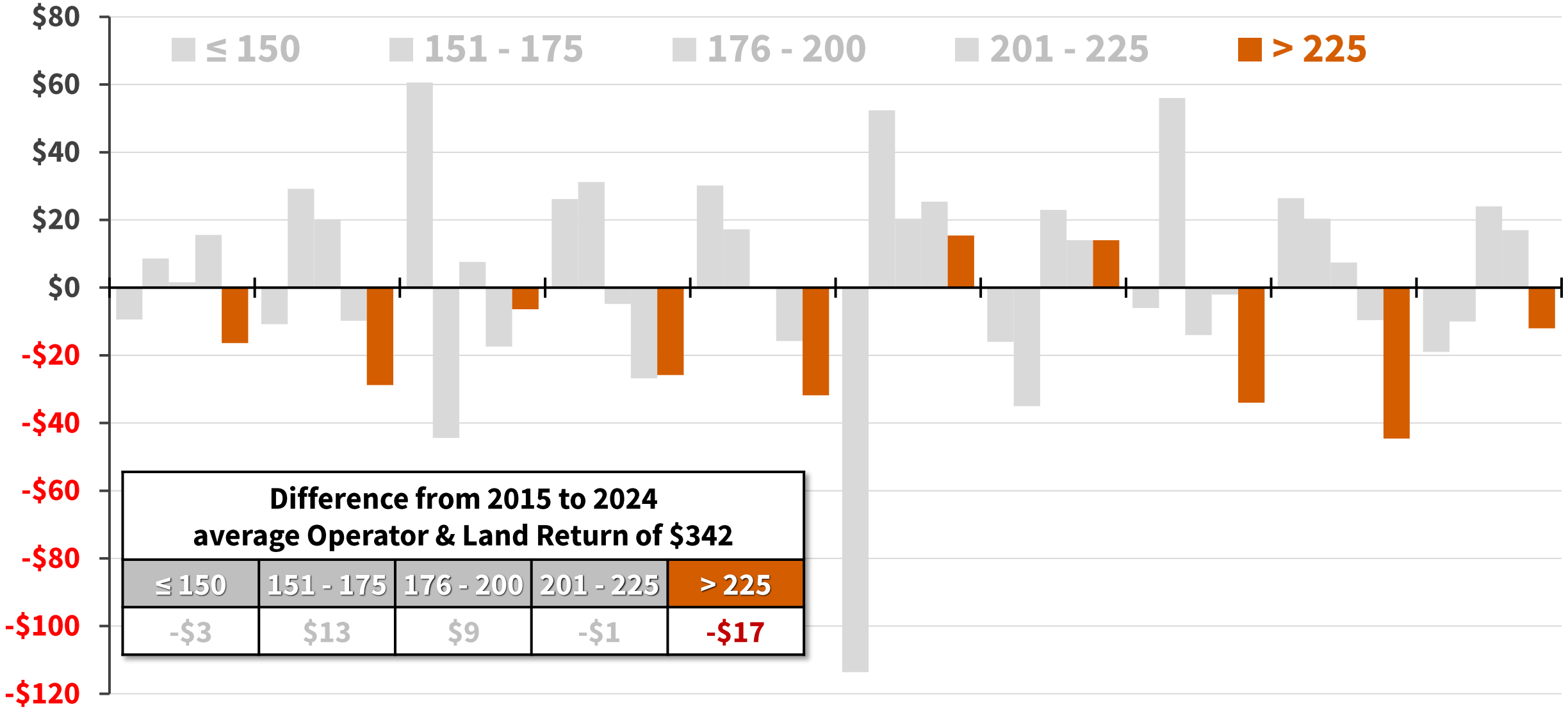

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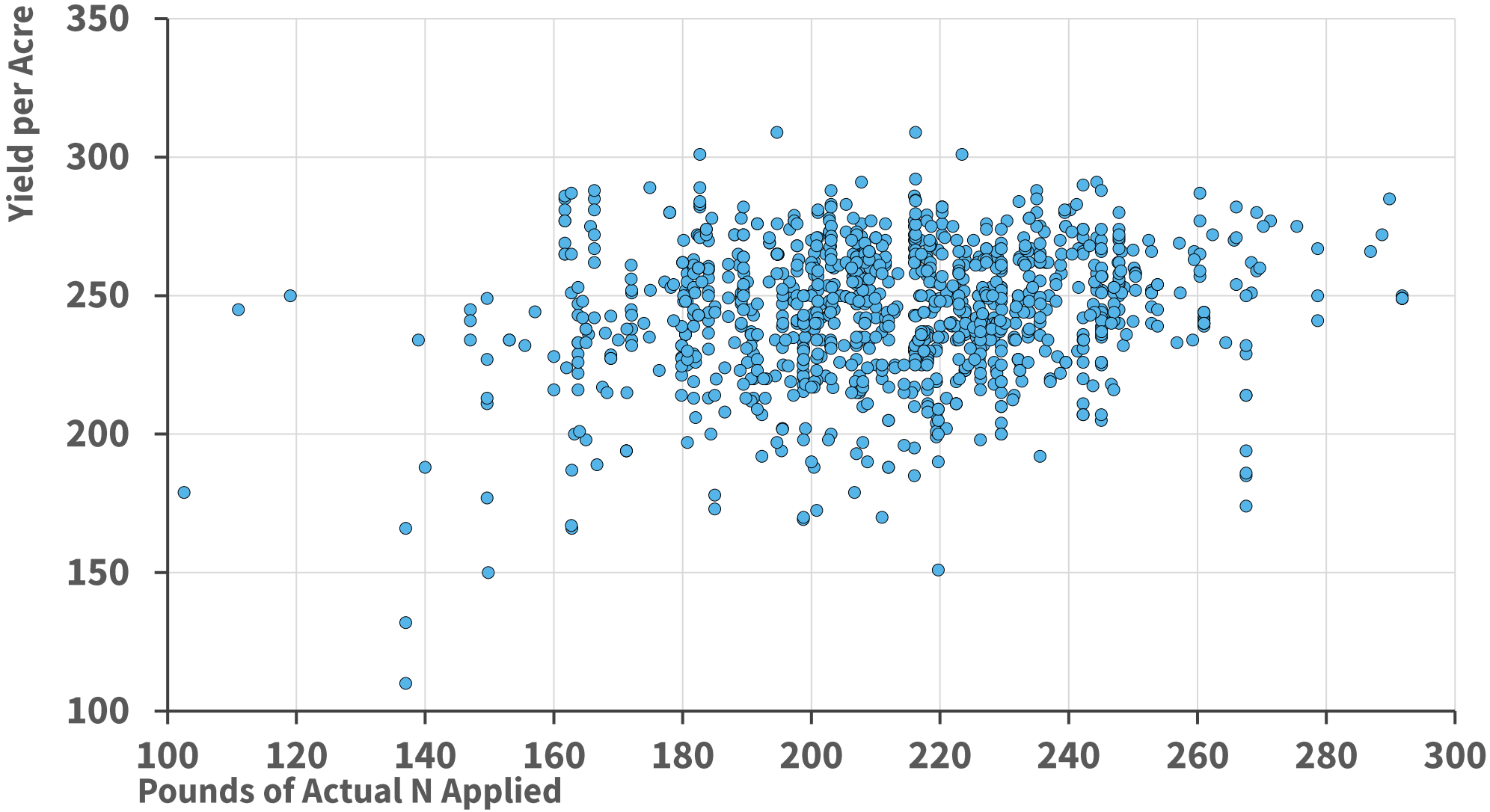
Yield and Actual Nitrogen, 2024

Yields from High-SPR fields without manure applications

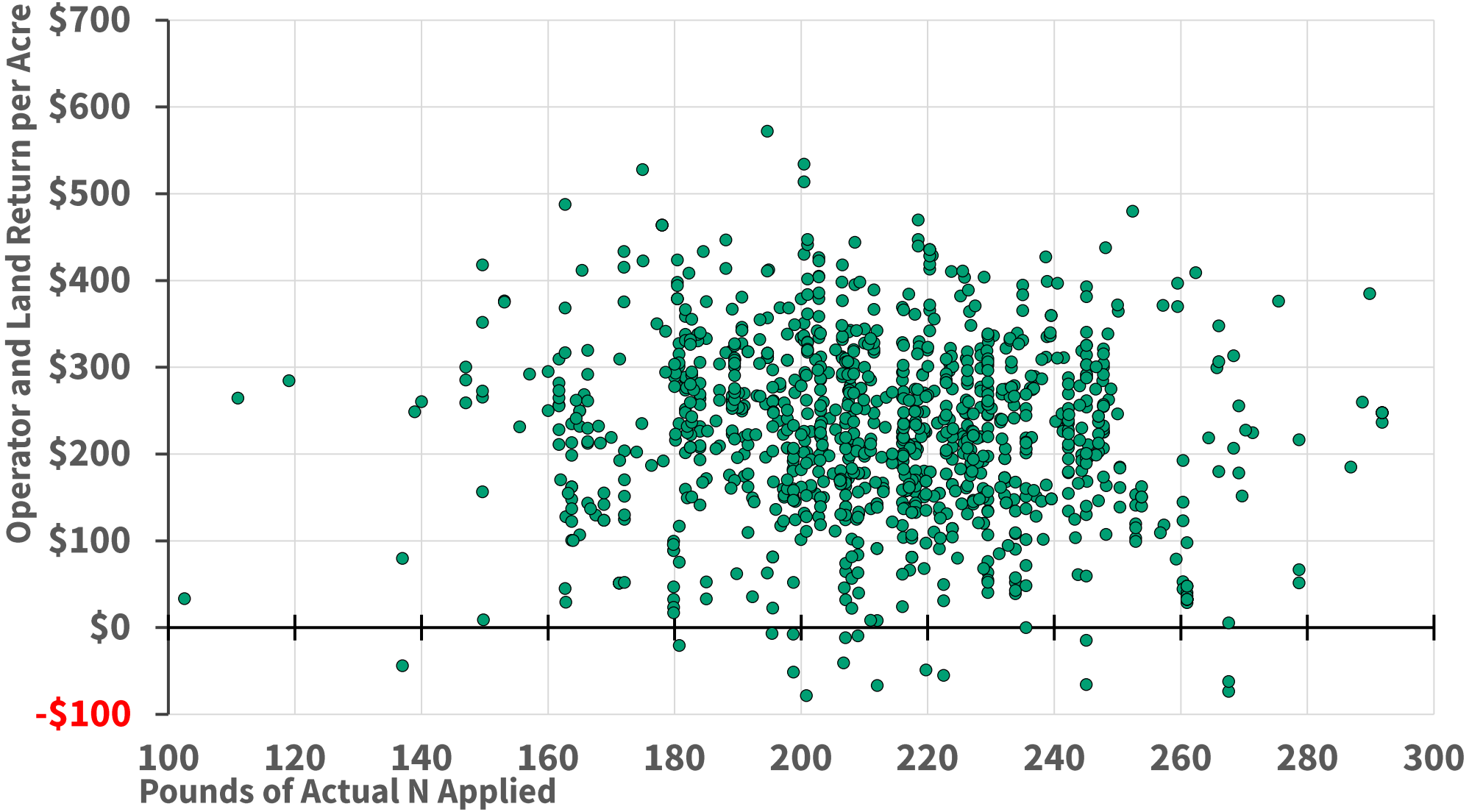


Notes

- *Large amount of variability*
- *Significant relationship because of low application rates*

Operator and Land Returns and Actual Nitrogen, 2024

Yields from High-SPR fields without manure applications



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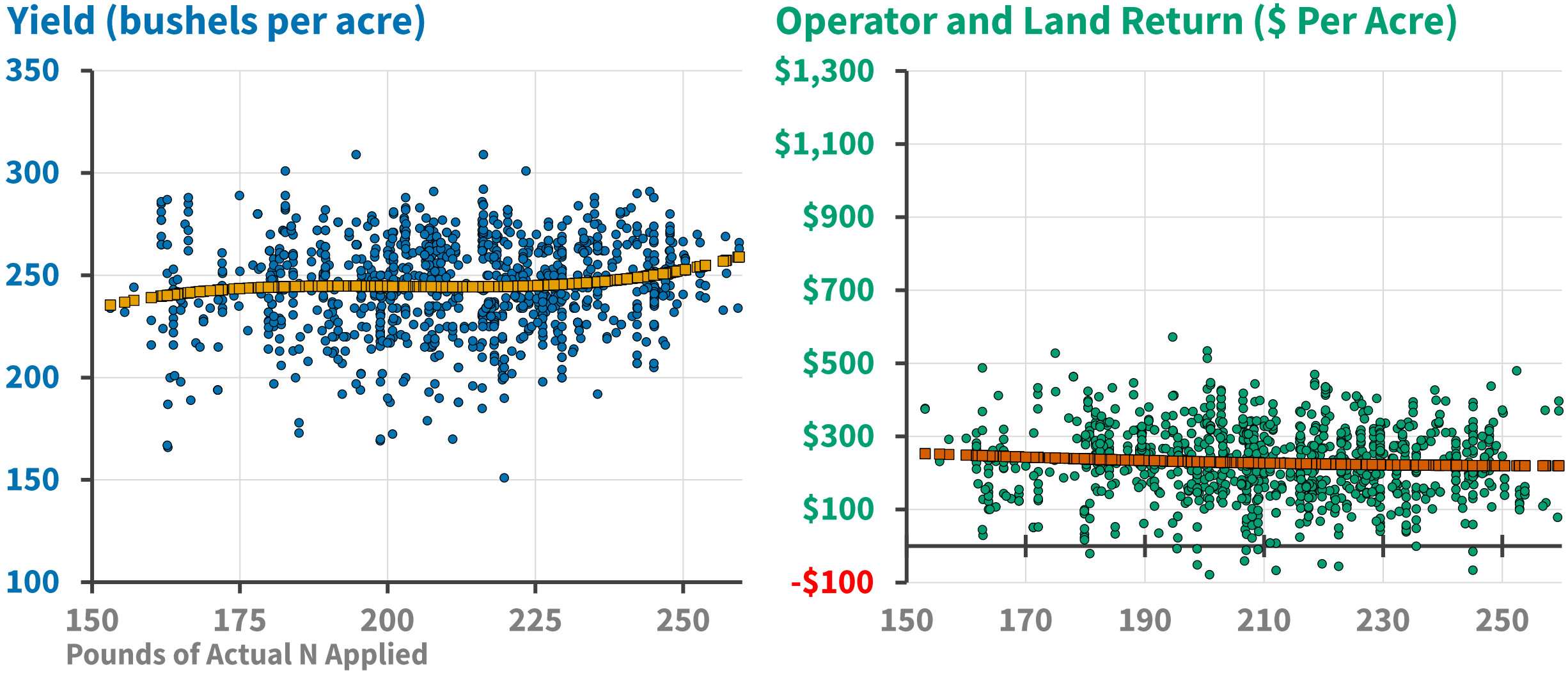
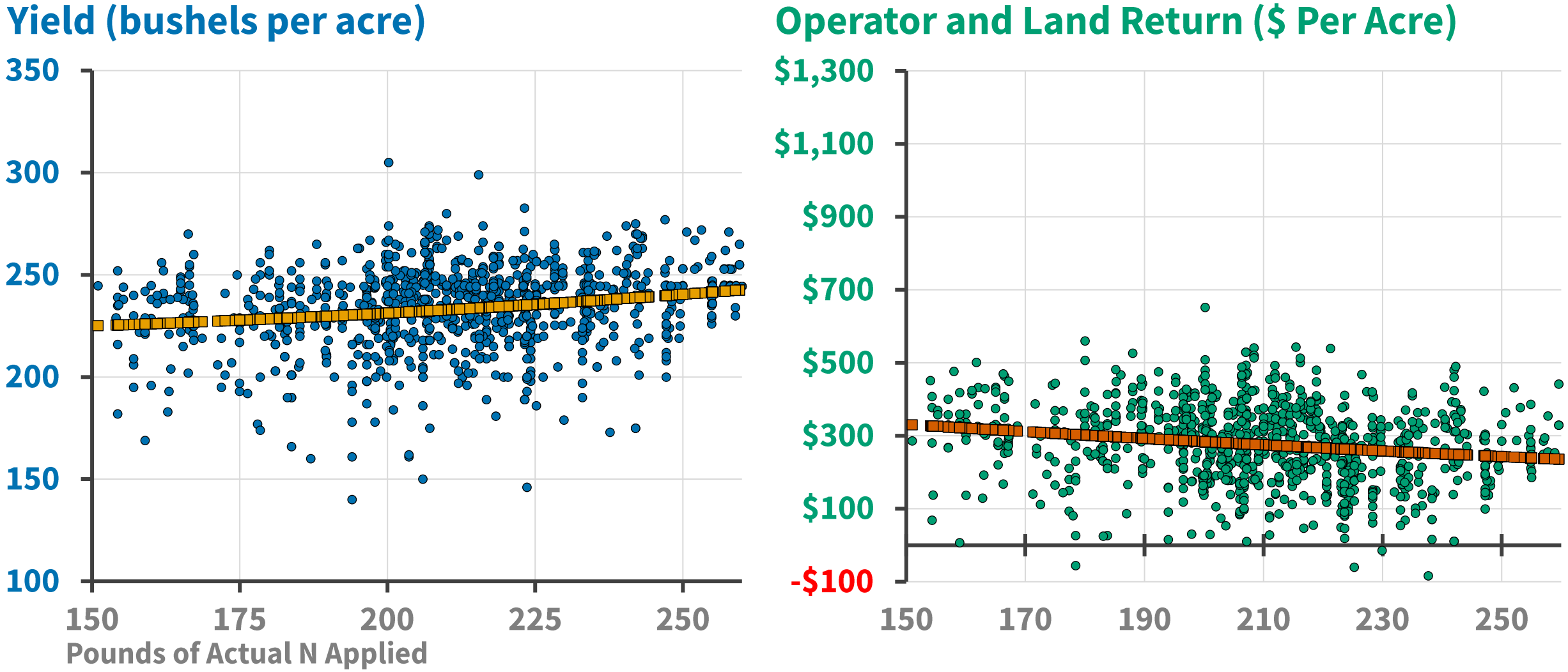
- *Significant relationship because of low application rates*

Yield and Operator and Land Return vs Actual Nitrogen, 2024



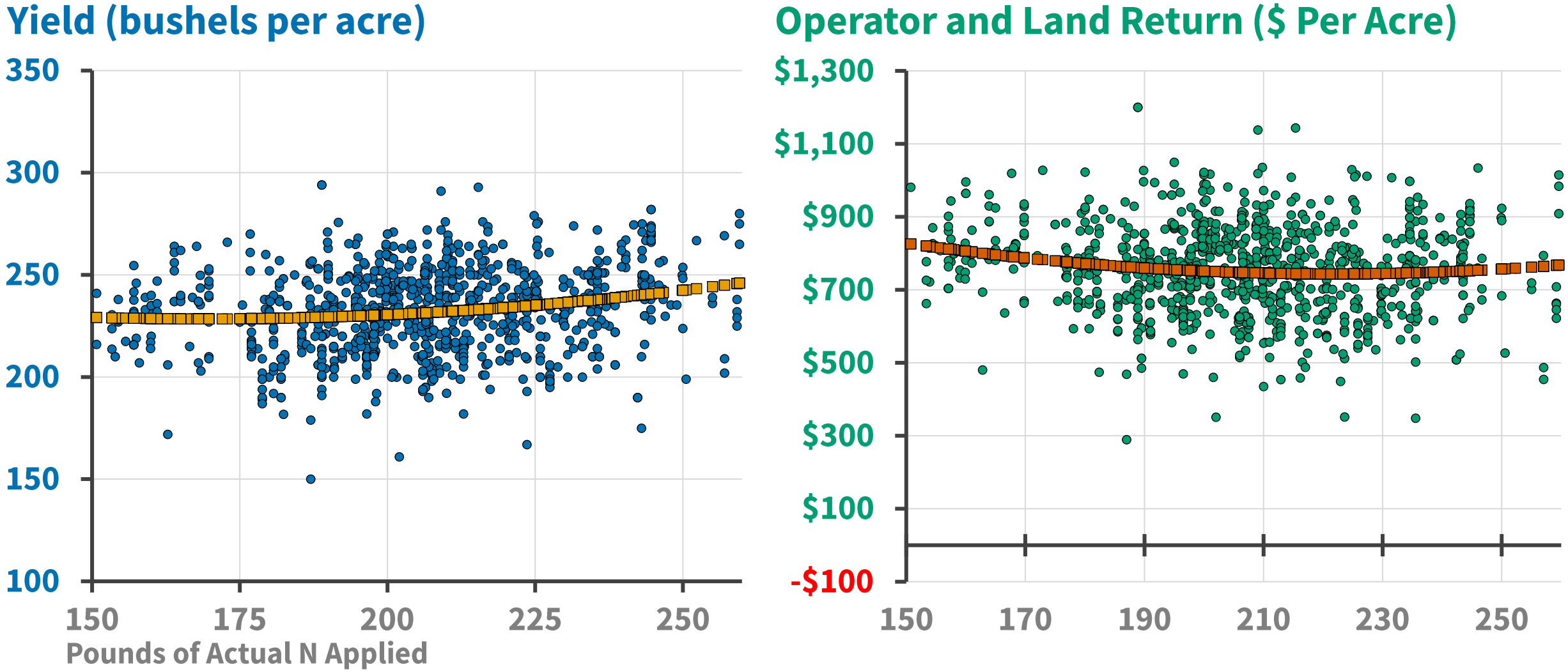
Neither relationship is statistically significant

Yield and Operator and Land Return vs Actual Nitrogen, 2023



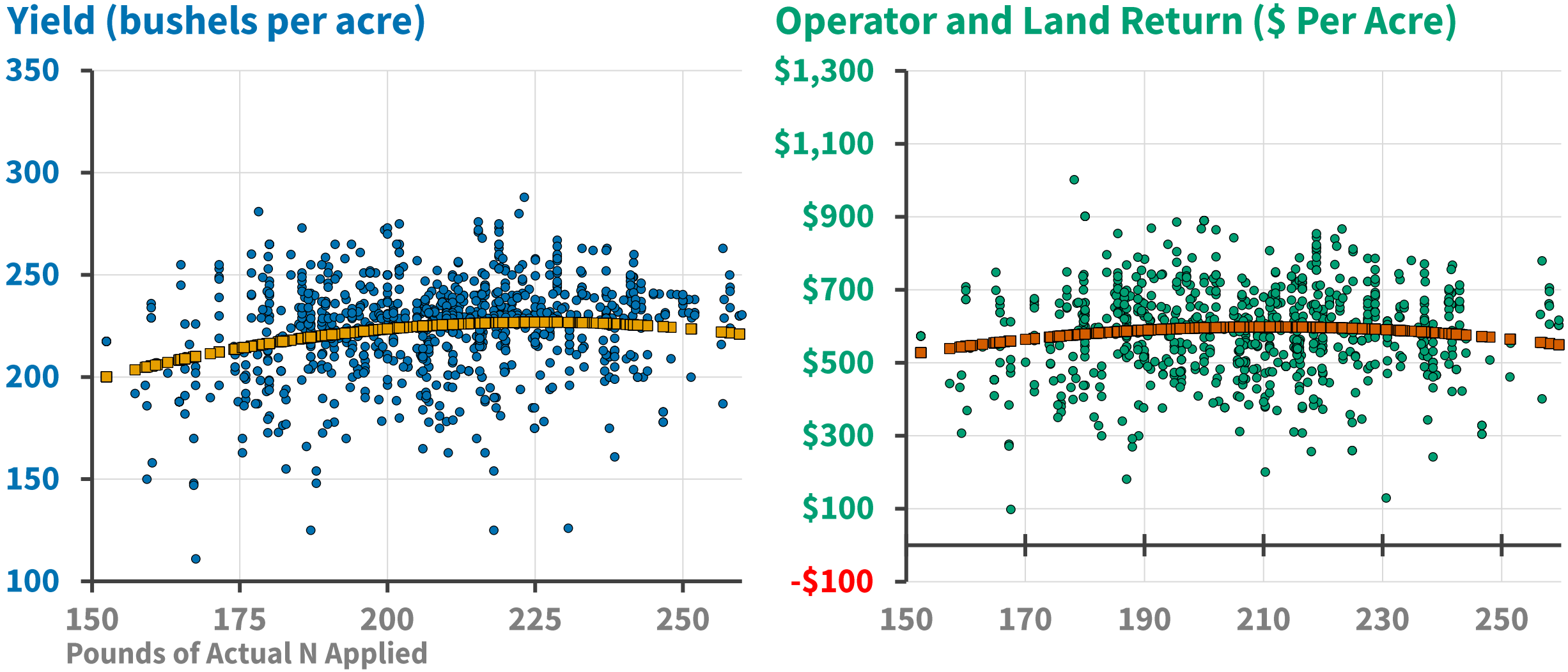
Neither relationship is statistically significant

Yield and Operator and Land Return vs Actual Nitrogen, 2022



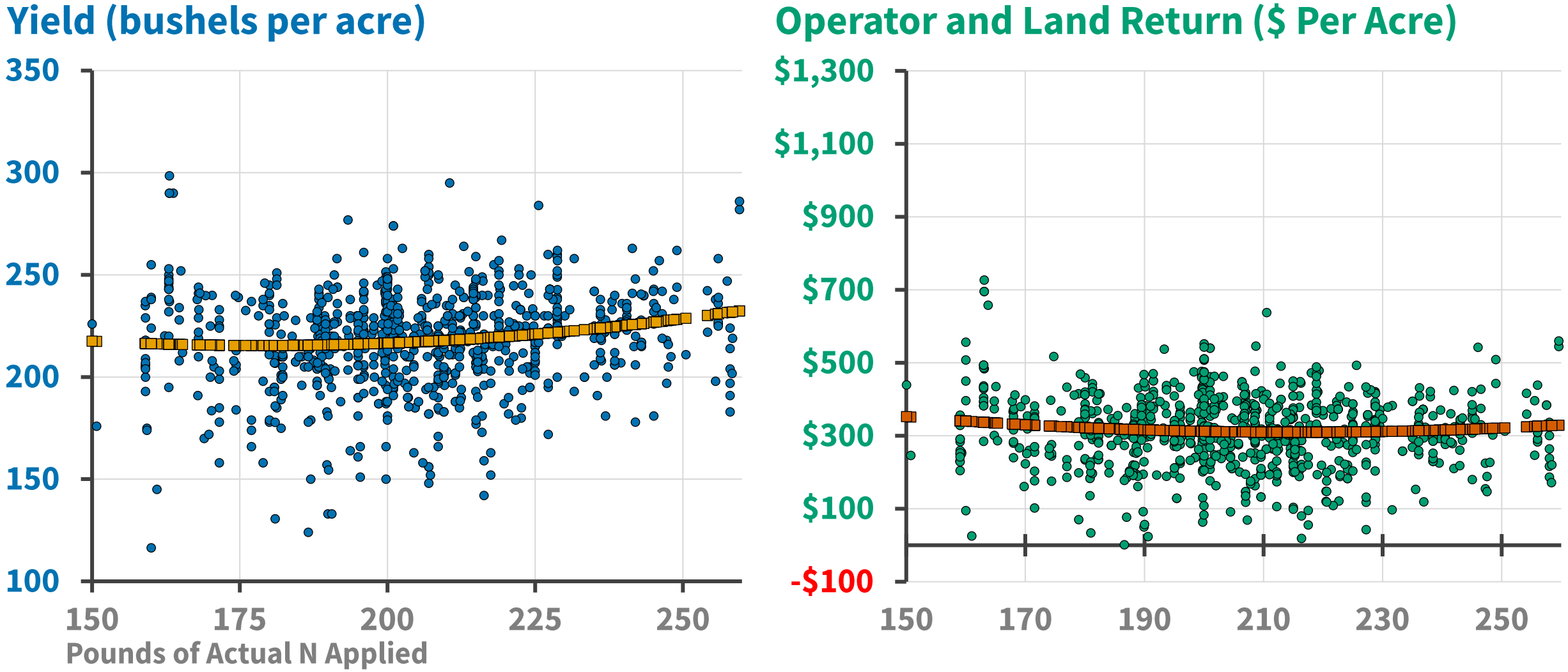
Both are (barely) significant, Low nitrogen highest return

Yield and Operator and Land Return vs Actual Nitrogen, 2021



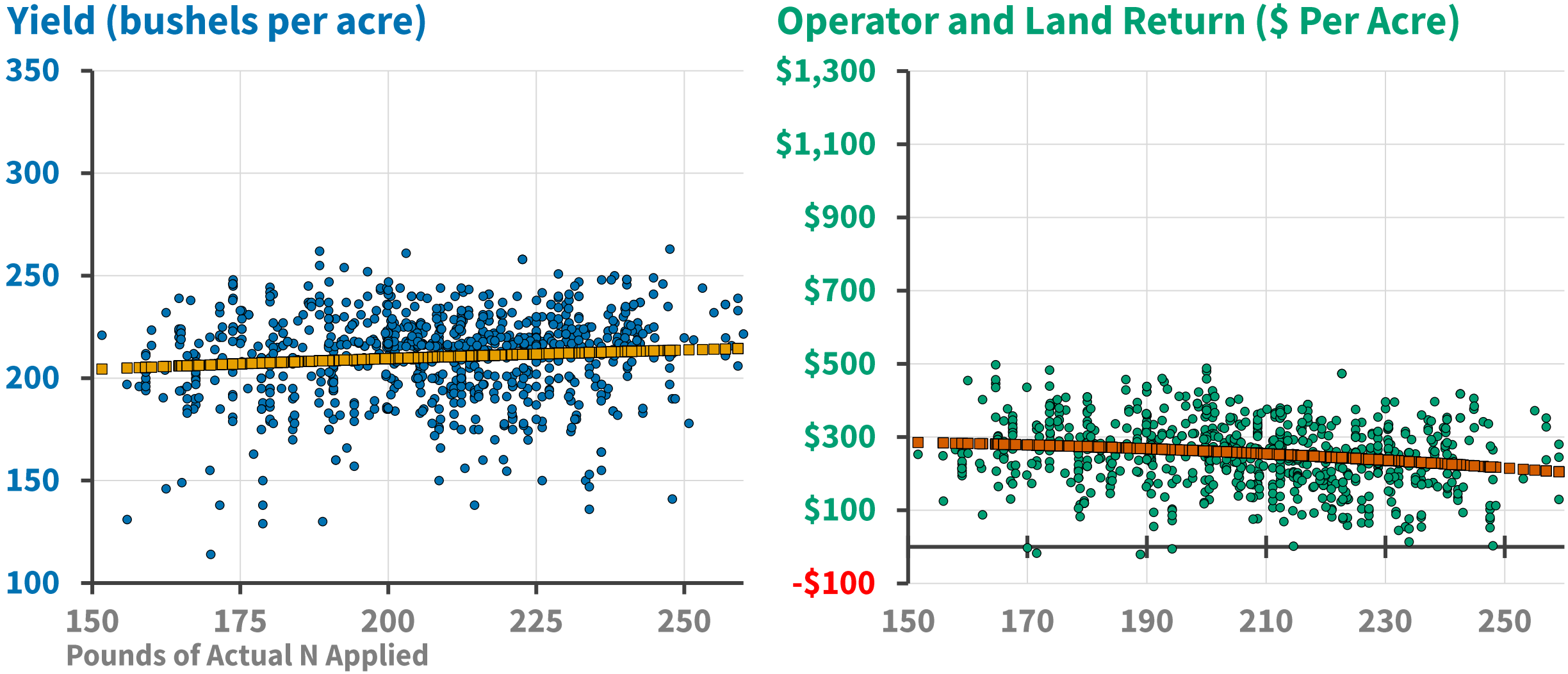
Both are (barely) significant

Yield and Operator and Land Return vs Actual Nitrogen, 2020



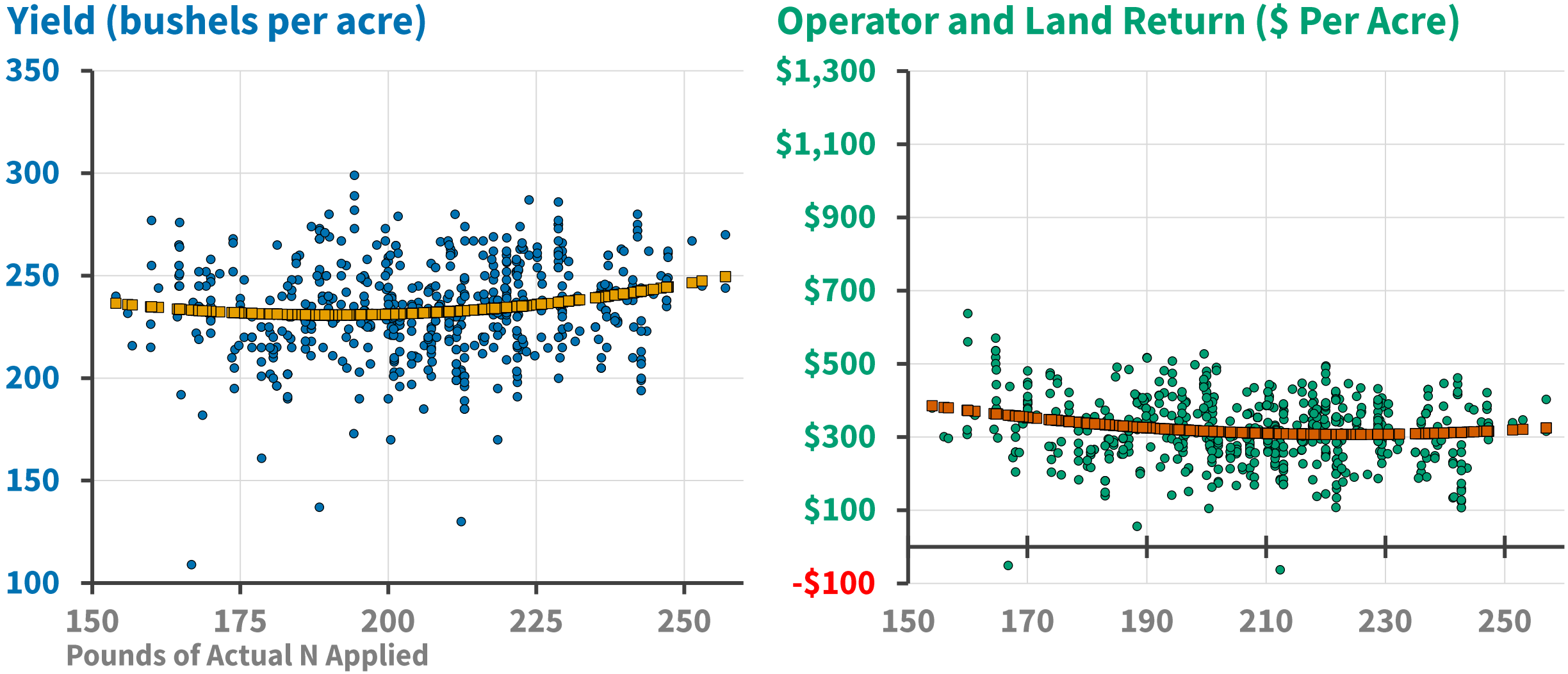
Both are not significant

Yield and Operator and Land Return vs Actual Nitrogen, 2019



Yield not significant, OLR is significant

Yield and Operator and Land Return vs Actual Nitrogen, 2018

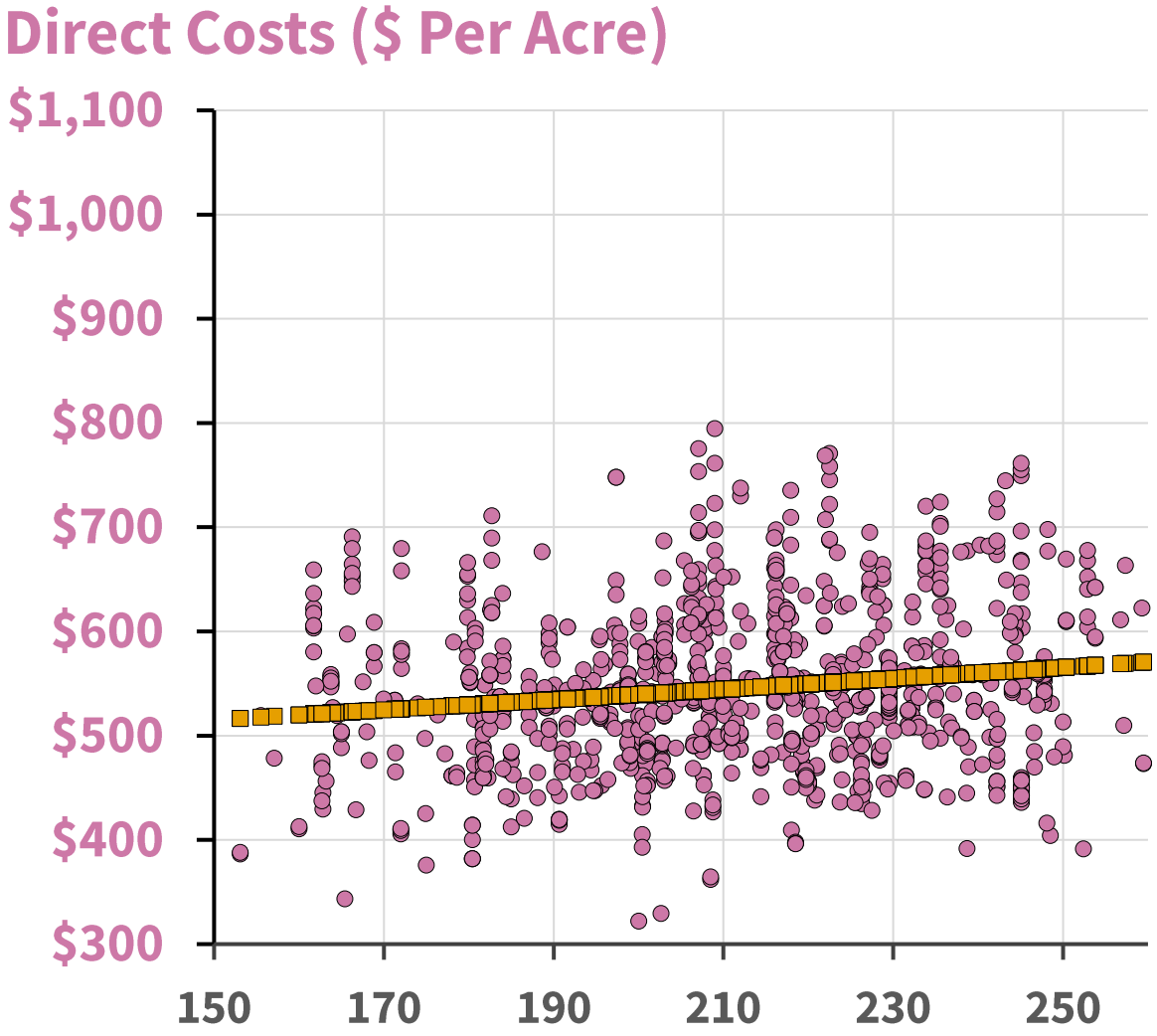


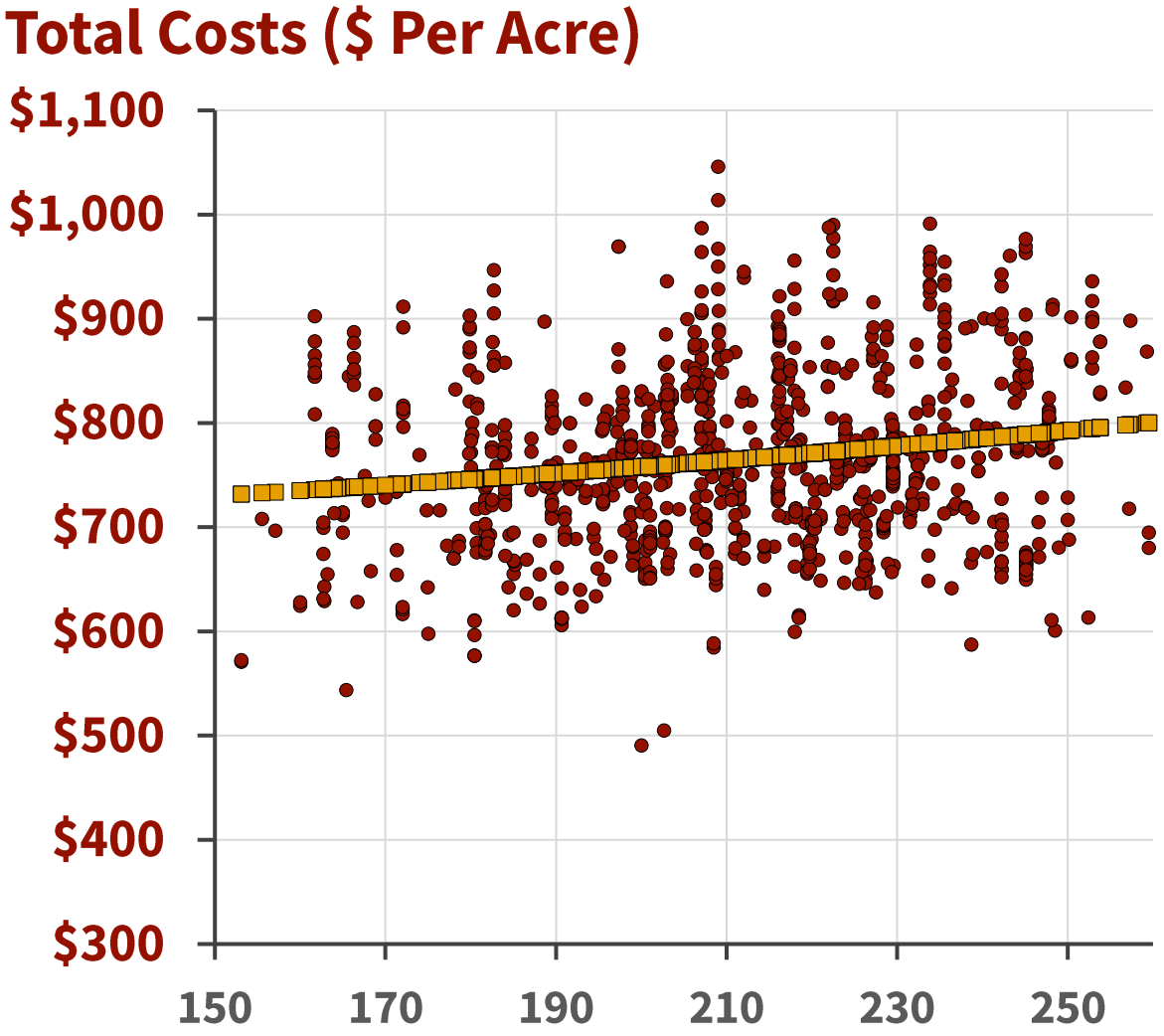
Yield not significant, OLR is significant

Results

- Increasing nitrogen rates usually are not significant, but can occasionally result in statistically greater yields
- Operator and land returns have higher returns when below 200 pounds per acre
- **Important caveat:**
  Farmers who spend more to apply higher rates of N fertilizer often spend more on other inputs as well.

Stronger Relationships with Costs, 2024





Both have significant increases with nitrogen applied, More than nitrogen rates

Do farmers follow the MRTN?

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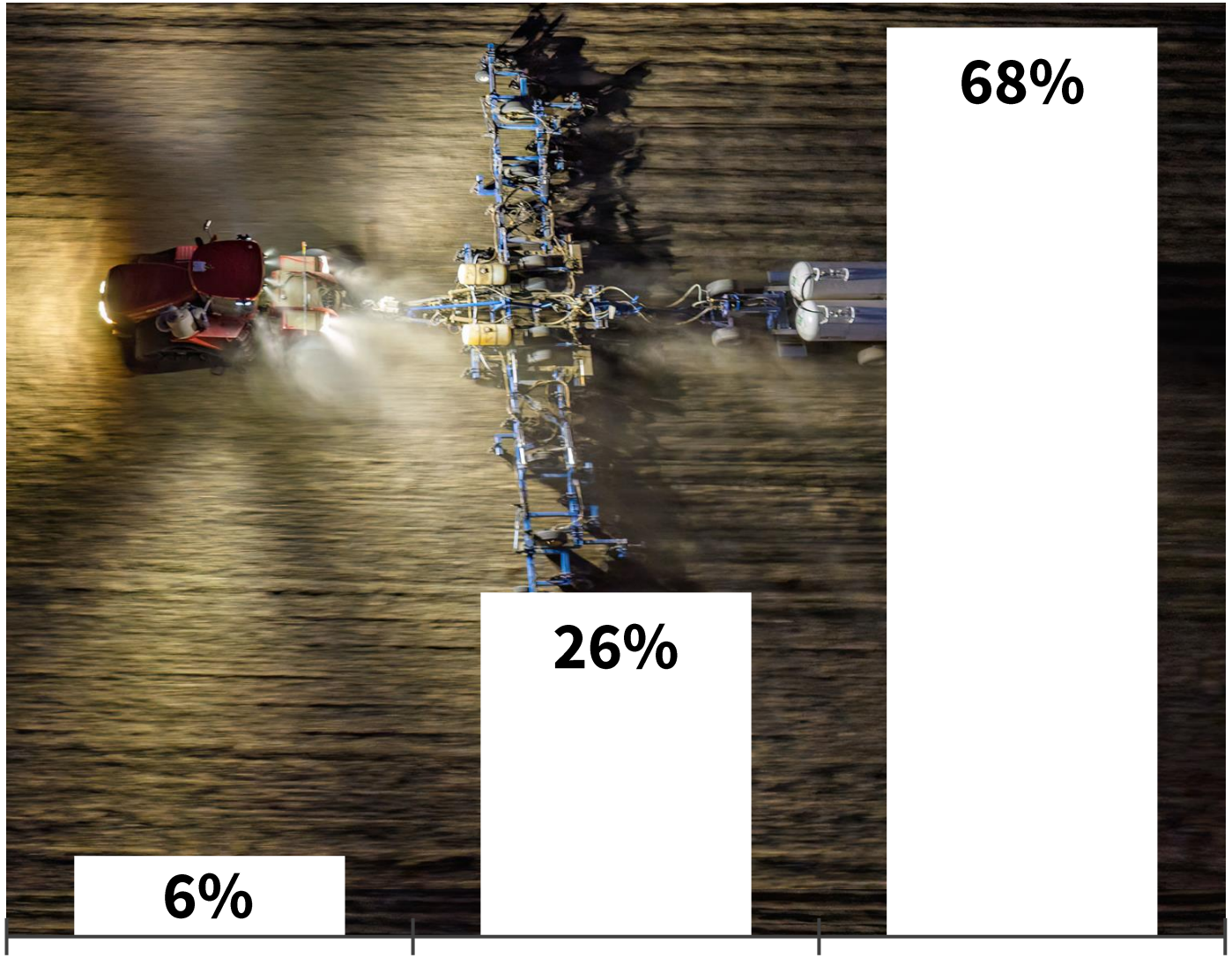
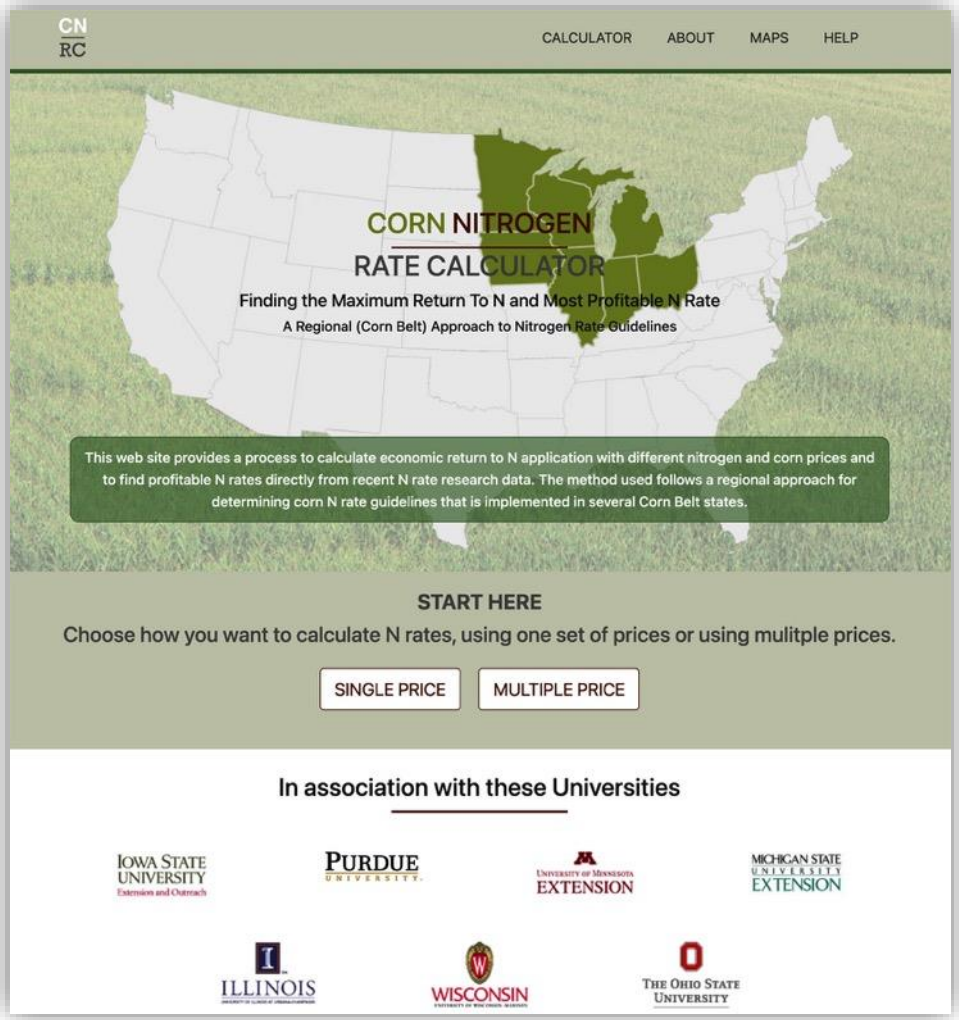
Percent of Fields Below, At, and Above MRTN





https://www.cornnratecalc.org

MRTN Adoption Study

What are the observed factors associated with the adoption of the MRTN in Illinois?

Results:

Extension strategies should target farmers that you would think based on their characteristics should be using the MRTN but are not

Take aways

Increases Likelihood of Adopting MRTN

- Cover crops
- Enrollment in an NRCS program
- Use of strip-till or no-till

Decreases Likelihood of Adopting MRTN

- Custom application

Takeaways

Results suggest that applying above the MRTN may increase yield but **does not increase returns compared to applying at the MRTN**

PCM and Nitrogen Programs

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TECHNICAL ASSISTANCE

PCM Farmers recieve ongoing one-on-one support from their regional Specialist including data collection, agronomic recommendations, and data review.

COST-SHARE OPPORTUNITIES

PCM Supply Chain Partnerships create a financial advantage for farmers who use reduced tillage, nitrogen management, and/or cover crops.

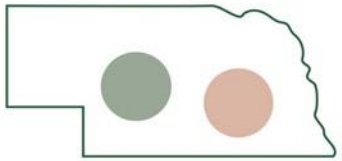
DATA ANALYSIS

Secure personal data analysis PLUS aggregated, anonymized data demonstrating financial and environmental impact of practices.

www.precisionconservation.org

PCM Specialist

Nebraska



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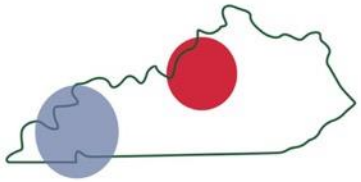

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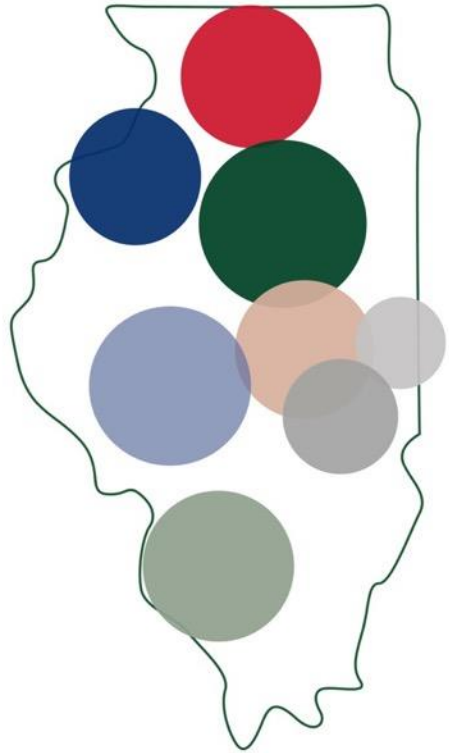


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NFWF
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USDA
Natural Resources Conservation Service
U.S. DEPARTMENT OF AGRICULTURE
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Established 1957
ESMC
Ecosystem Services Market Consortium
FFAR
KYCORN
SUSTAINABLE FOOD LAB
KENTUCKY DISTILLERS' ASSOCIATION
KDA
EST 1880
Field to Market
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10% Nitrogen Reduction Incentive

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Overview

Farmers receive **$10/acre** by committing to reducing total N fertilizer application rate on enrolled fields by **at least 10%** compared to their historical baseline. Includes all nitrogen sources (MAP, DAP, manure, etc.).

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10% Nitrogen Reduction Incentive

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To Participate

- Submit data for ≥ 90% of corn acres (for baseline)
- May enroll a subset of those acres
- Enrolled fields must match SPR classification (high or low)
- At least 4 corn fields per year in historical data
- New farmers may use 1 year of data if it includes ≥ 4 corn fields

PEPSICO

10% Nitrogen Reduction Incentive

Precision Conservation Management

Calculation Example

A farmer applied:

195 lbs N/a in 2024 across all corn acres

200 lbs N/a in 2025 across all corn acres

Baseline = (195 + 200) / 2 = 197.5 lbs/ac

10% Reduction = 197.5 × 10% = 19.75 lbs/acre

2026 Qualifying Rate = 197.5 – 19.75 = ≤ 177.75 lbs/acre

Timing Impacts on profitability

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N Timing Benchmarks

Fall: Most applications are in fall
*Primarily as Anhydrous Ammonia **with** inhibitor*

Mostly Pre-plant: most applications with a pass before planting

Mostly Side-dress: most applications with a pass after planting
divided between Ammonia and N solutions

50% Pre-plant / 50% post-plant

3-way split: Application of nitrogen in 3 passes

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Special Analysis

- Look at fields that have rates between 150 and 220 pounds of Nitrogen applied
- Controls for differences in nitrogen applied when looking at results

Operator and Land Return by Timing Category

		Difference from the Average				
Year	Average $ per acre	>40% Fall	Mostly PrePlant	Mostly Sidedress	50% Pre 50% Sidedress	3-Way split
2018	325	-6	15	6	21	-35
2019	258	5	22	18	-12	-33
2020	313	-6	11	20	3	-27
2021	576	30	-25	29	-18	-16
2022	759	21	-15	-9	5	-2
2023	759	42	25	44	11	-25
2024	269	12	-17	11	-8	2
Ave	390	14	2	17	0	-19

Yield by Timing Category

		Difference from the Average				
Year	Yield per acre	>40% Fall	Mostly PrePlant	Mostly Sidedress	50% Pre 50% Sidedress	3-Way split
2018	232	9	-2	-1	0	3
2019	209	4	2	-0	-5	-1
2020	217	-1	-1	3	1	-1
2021	220	4	-7	2	-7	9
2022	233	4	-8	-9	1	13
2023	232	2	-3	0	4	-15
2024	245	0	-16	-1	7	10
Ave	227	2	-5	-1	0	1

Nitrogen Cost by Pound Timing Category

		Difference from the Average				
Year	Ave $ per lb N	>40% Fall	Mostly PrePlant	Mostly Sidedress	50% Pre 50% Sidedress	3-Way split
2018	0.36	-0.01	-0.01	-0.00	0.02	0.01
2019	0.42	-0.02	-0.01	-0.01	0.02	0.00
2020	0.38	-0.02	0.00	-0.01	0.03	0.01
2021	0.41	-0.01	-0.01	0.01	0.00	0.02
2022	0.78	-0.03	-0.02	0.01	0.03	0.01
2023	0.93	-0.07	-0.03	-0.07	0.11	0.06
2024	0.58	-0.05	-0.01	0.01	0.03	0.05
Ave	0.55	-0.03	-0.01	-0.02	0.04	0.02

Total Costs by Timing Category

		Difference from the Average				
Year	Average $ per acre	>40% Fall	Mostly PrePlant	Mostly Sidedress	50% Pre 50% Sidedress	3-Way split
2018	522	4	-21	-7	-21	45
2019	556	13	-15	-19	-9	29
2020	532	2	-16	-10	1	23
2021	583	-7	-16	-19	-14	58
2022	757	0	-36	-45	1	82
2023	867	-32	-41	-41	5	109
2024	766	-14	-45	-12	35	34
Ave	655	-5	-27	-22	1	55

Timing conclusions

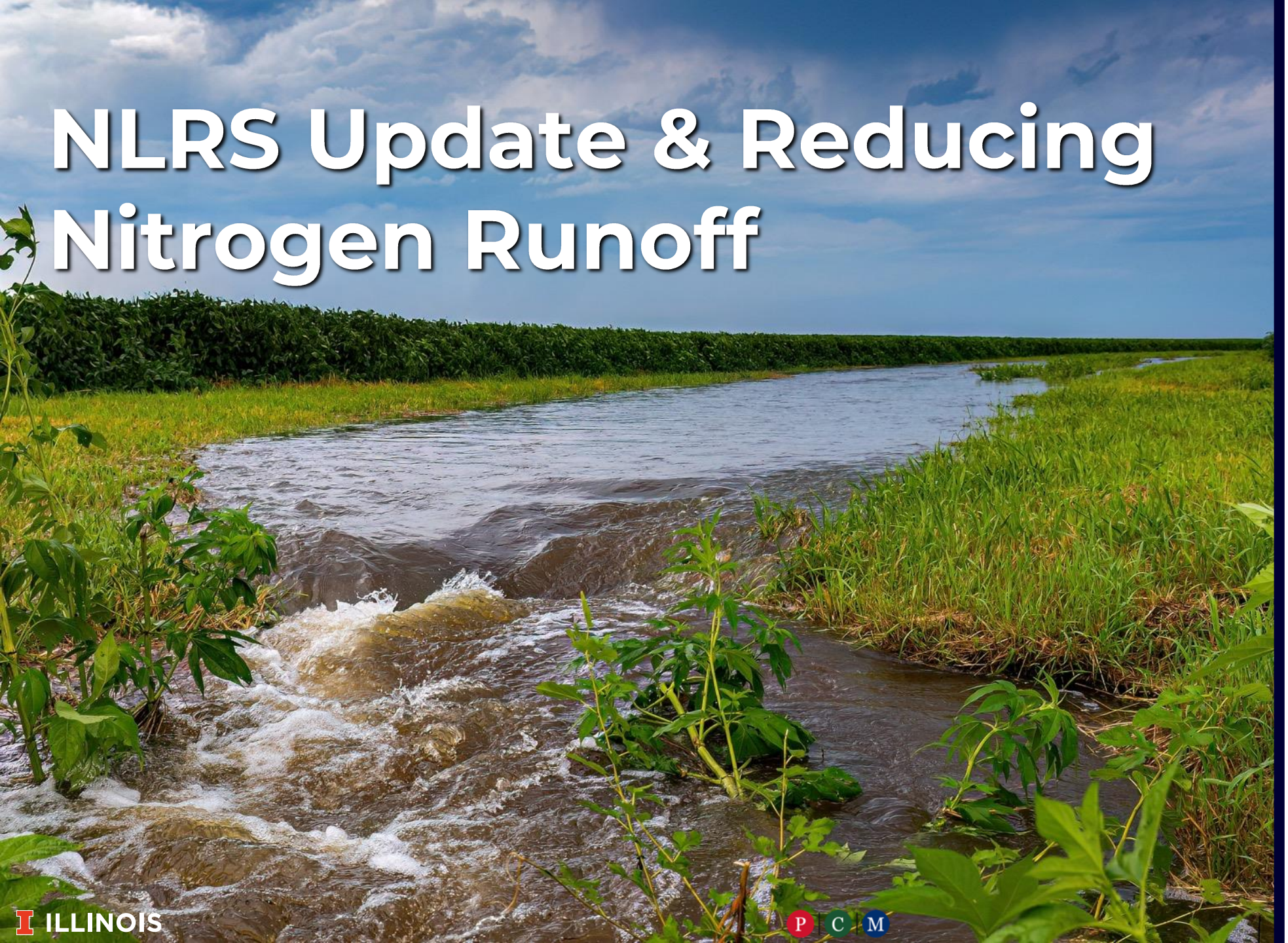
Highest profit was systems with a single dedicated nitrogen pass:

1. Mostly side-dress
2. Fall
3. Most pre-plant

The costs of nitrogen and nitrogen applications are essential in longer-term profitability of nitrogen systems

Farmers who adopt higher-cost systems in nitrogen are likely to adopt higher-cost systems in other areas.
Need to think about the justification

NLRS Update & Reducing Nitrogen Runoff



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Illinois Nutrient Loss Reduction Strategy

https://epa.illinois.gov/topics/water-quality/watershed-management/excess-nutrients/nutrient-loss-reduction-strategy.html

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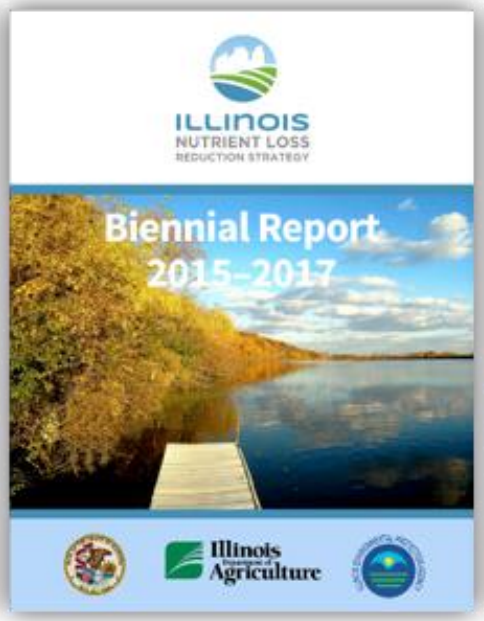
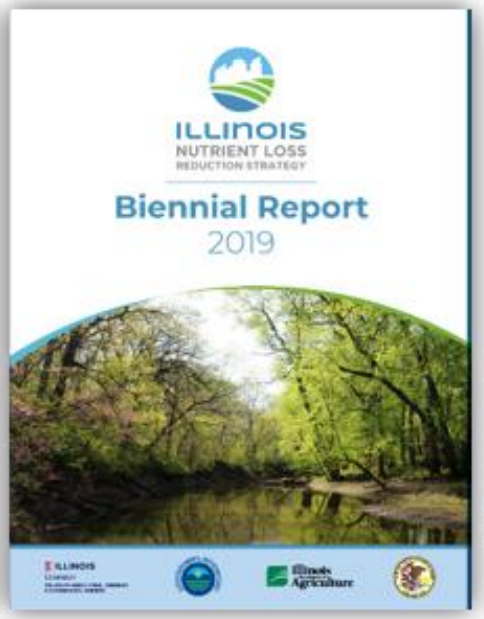
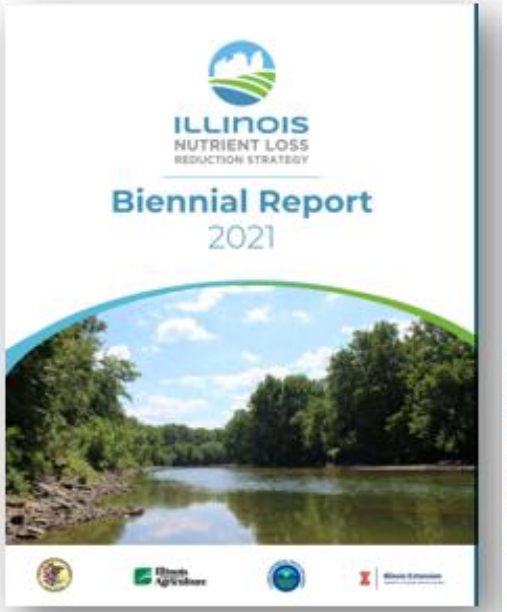
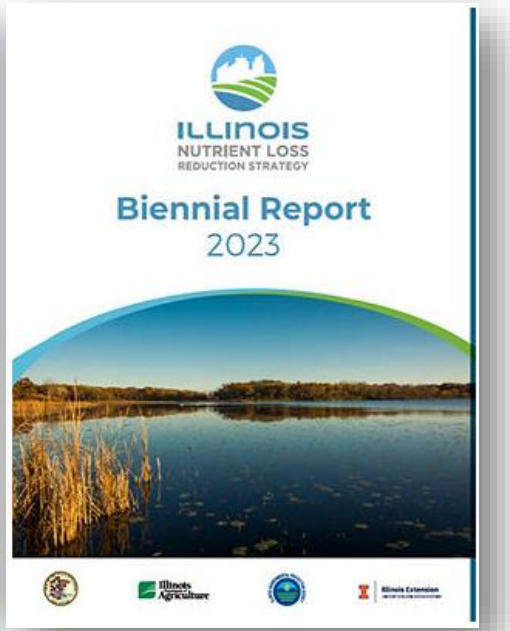
Precision Conservation Management

PCM was created as a response to the Illinois Nutrient Loss Reduction Strategy



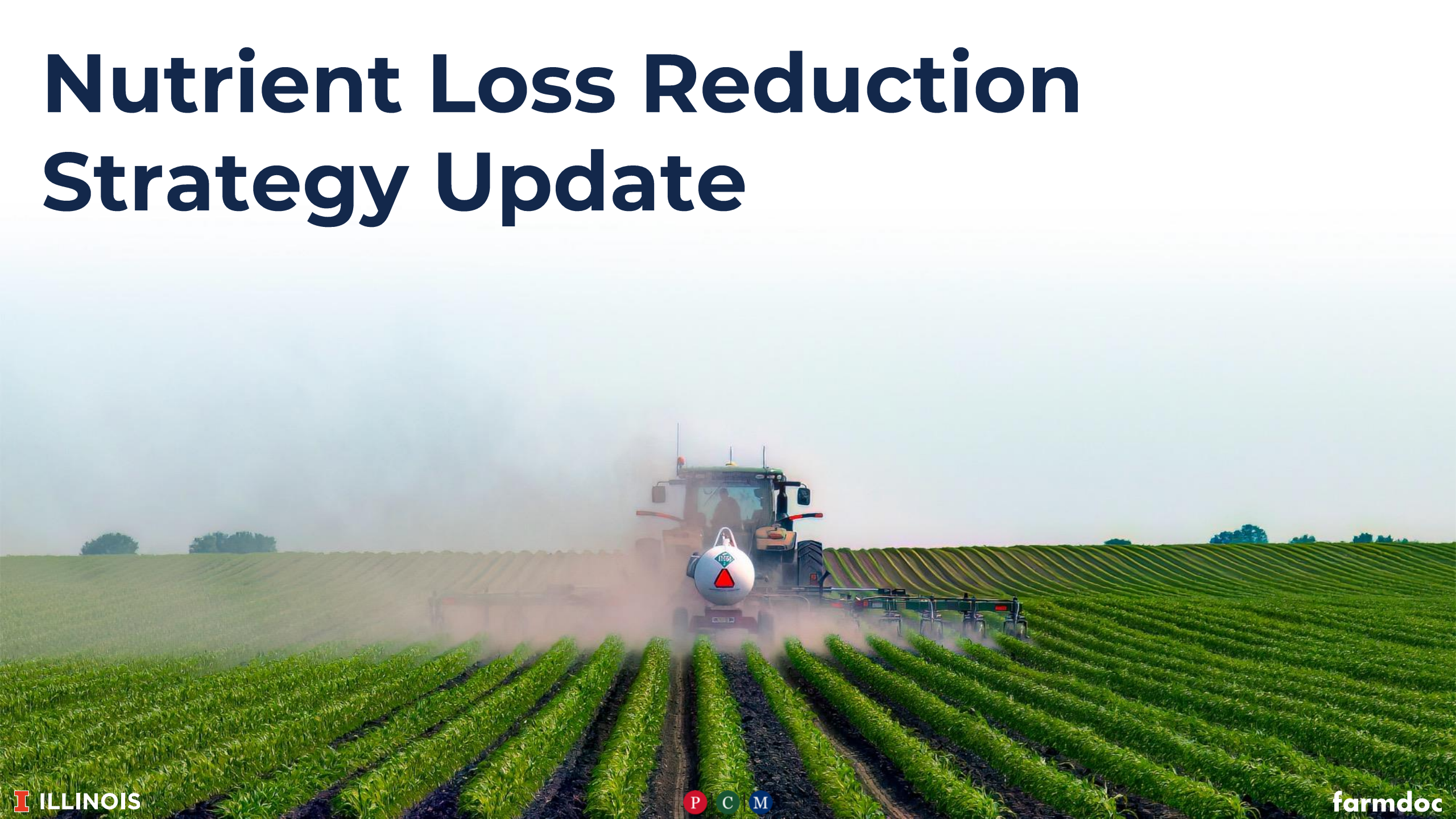






www.precisionconservation.org

Nutrient Loss Reduction Strategy Update



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Nutrient Loss Reduction Strategy Update

- Across Illinois, nutrient levels in rivers are **above the 2025 interim targets**

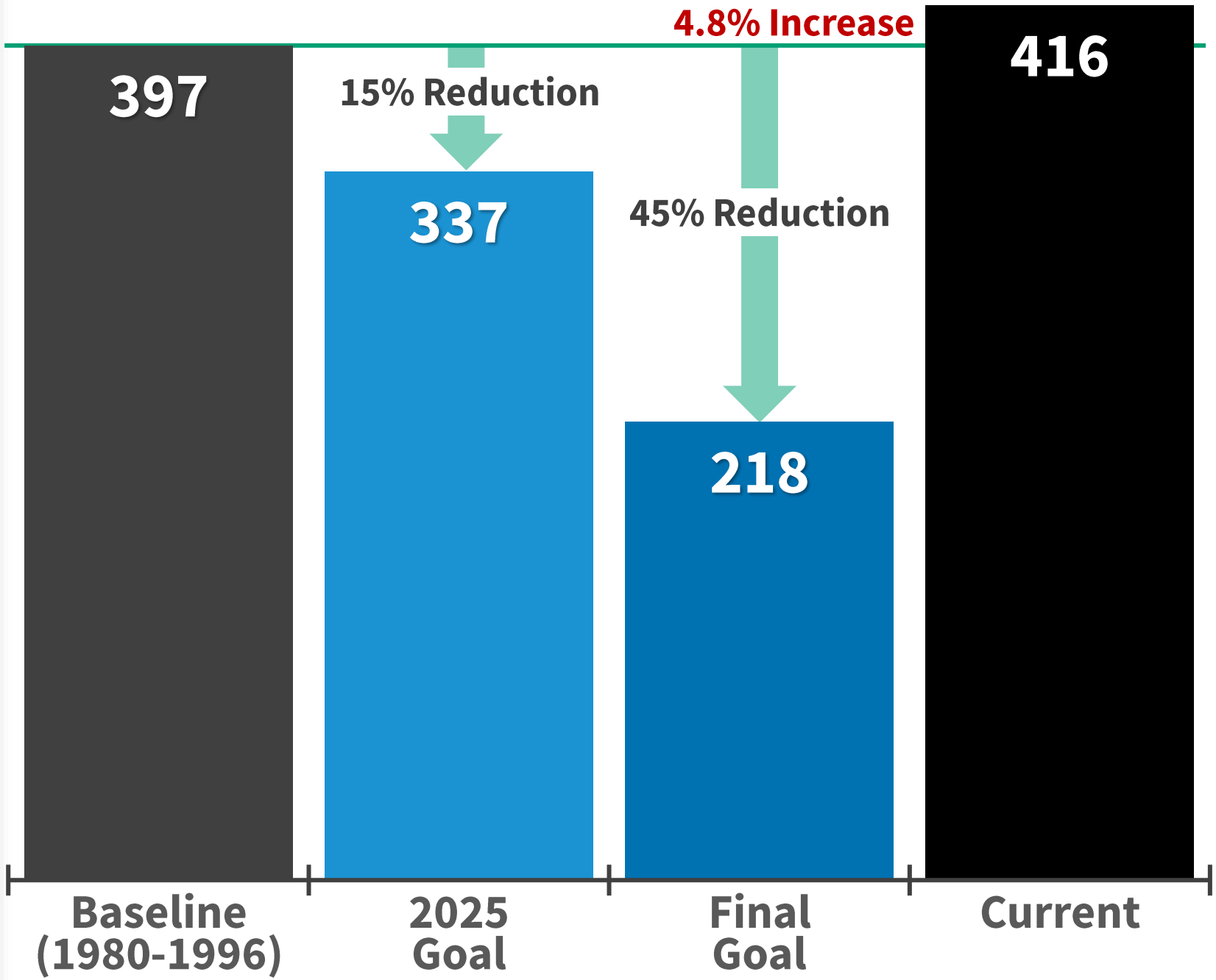
- Phosphorus is a **significant concern**

5-year averages (2017-2021) compared to the 1980-1996 baseline

- Nitrate-N loads **4.8% greater**
- Total P loads **35% greater**
- River flow (water yield) **23% greater**

Nitrate-N

in million lbs per year



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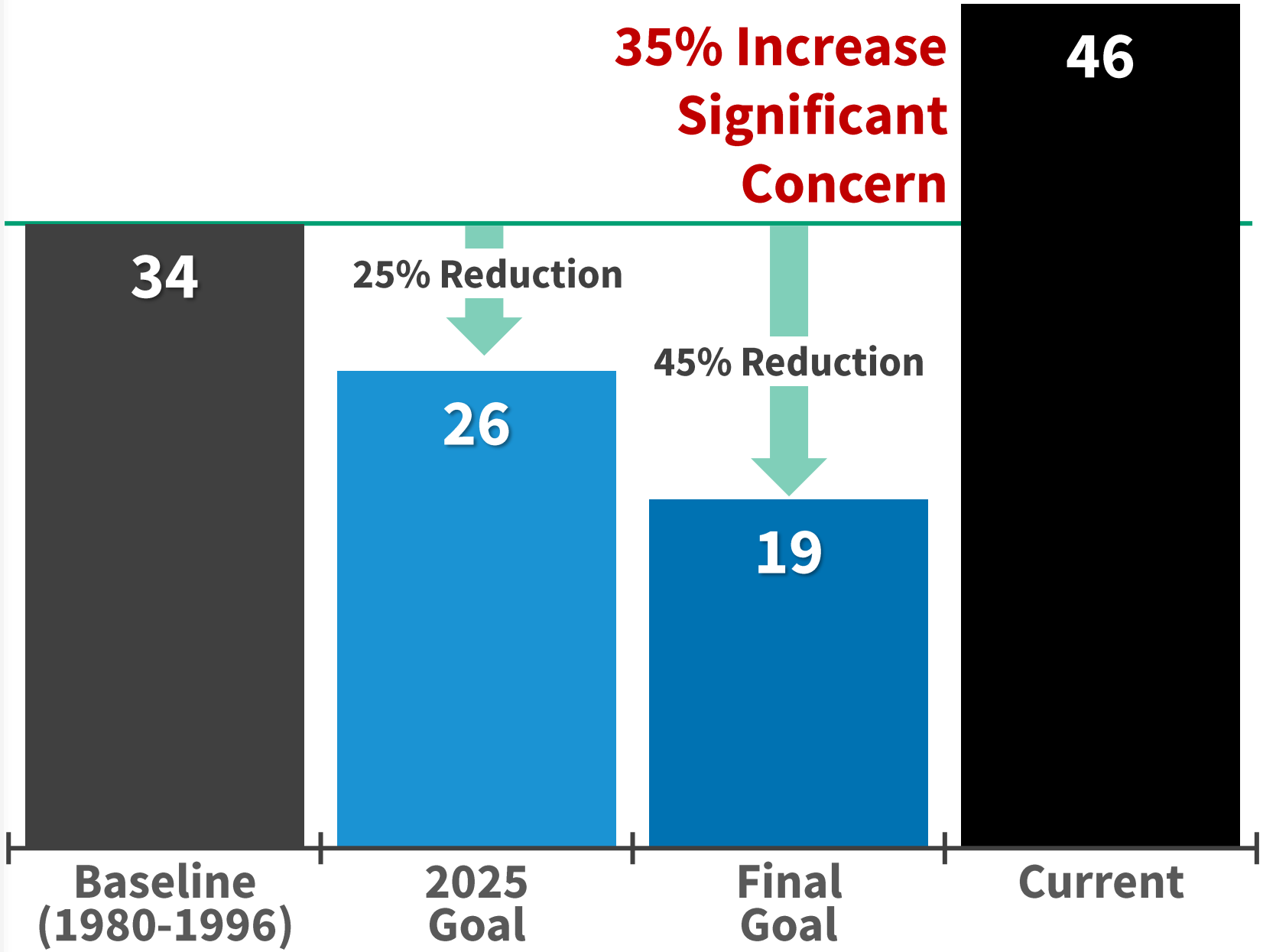
Total Phosphorus

in million lbs per year



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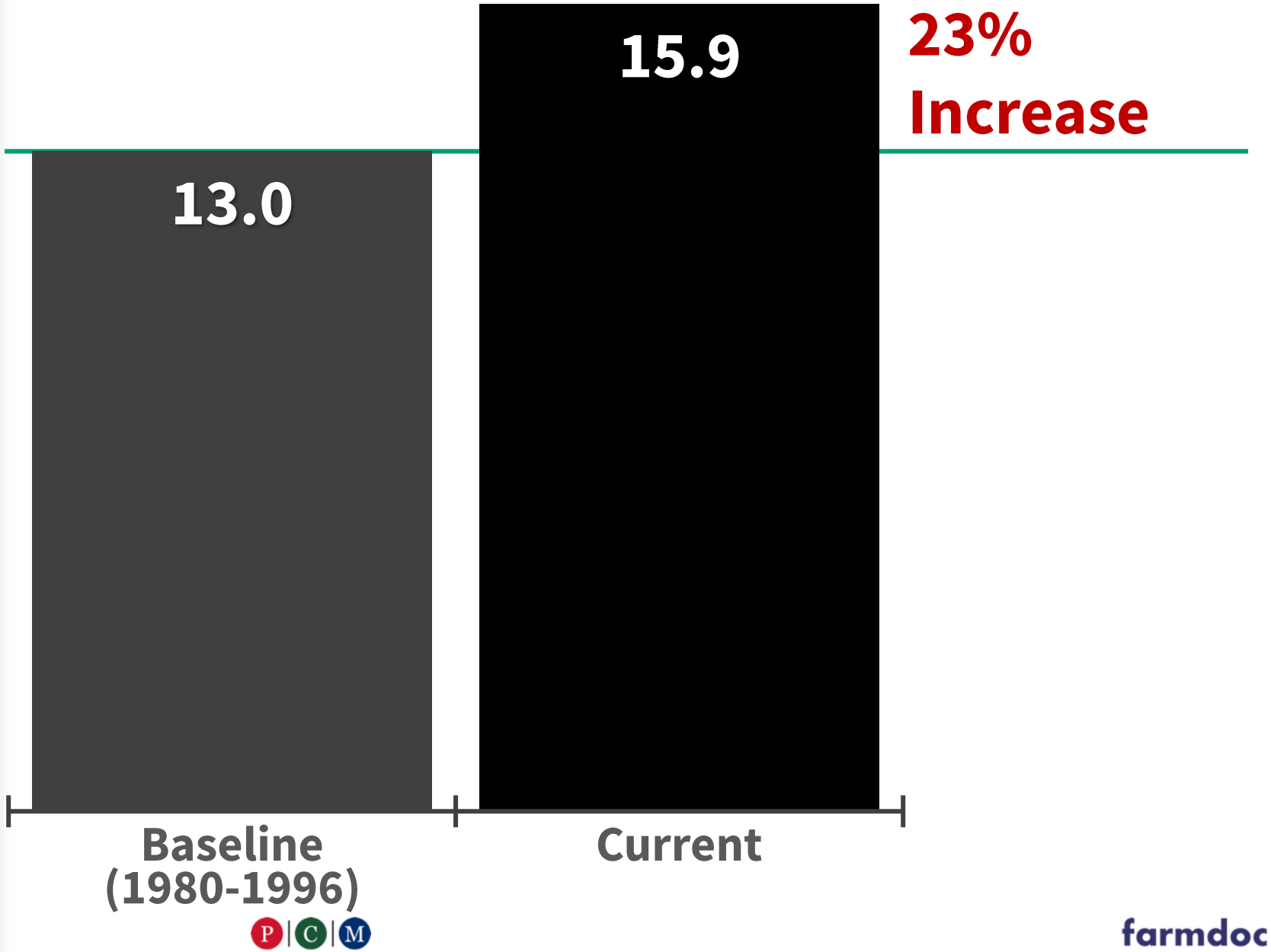
Water Yield

in inches per year



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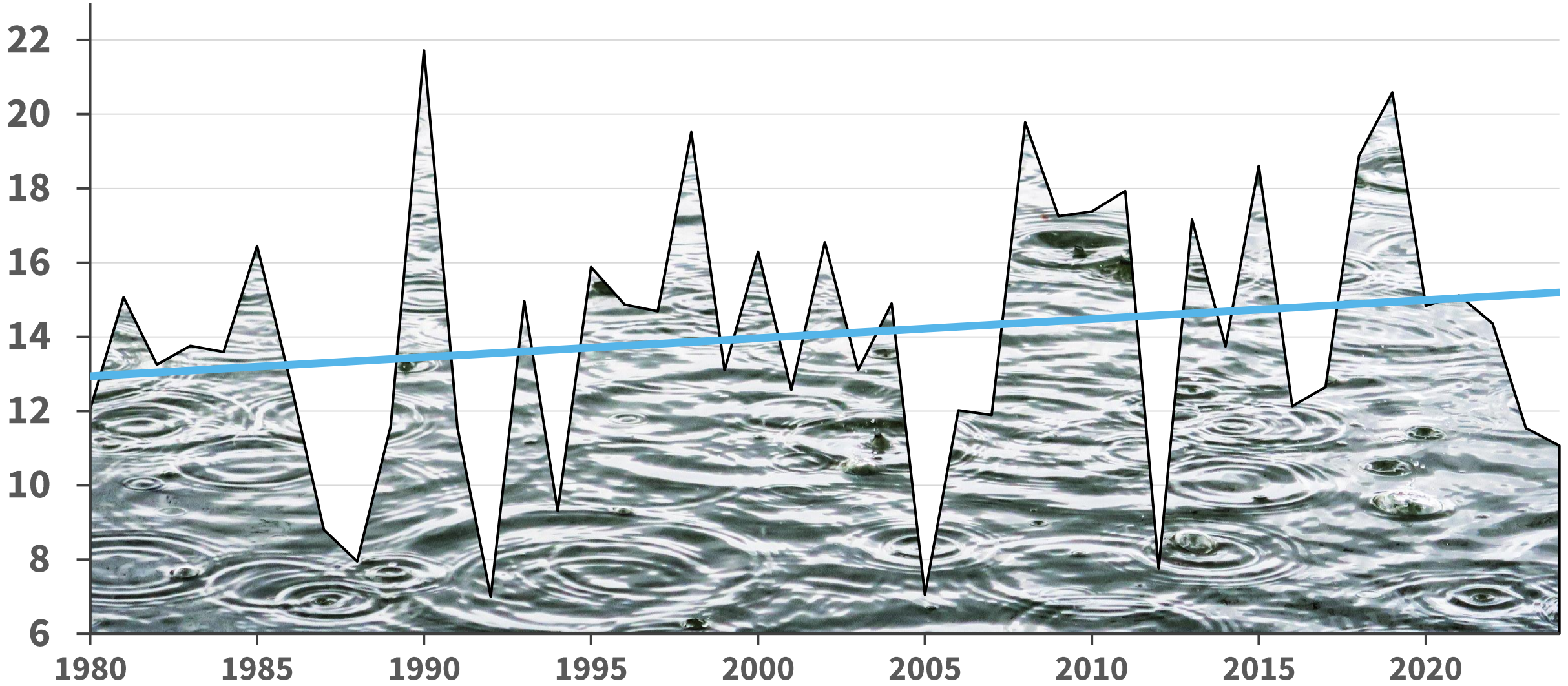
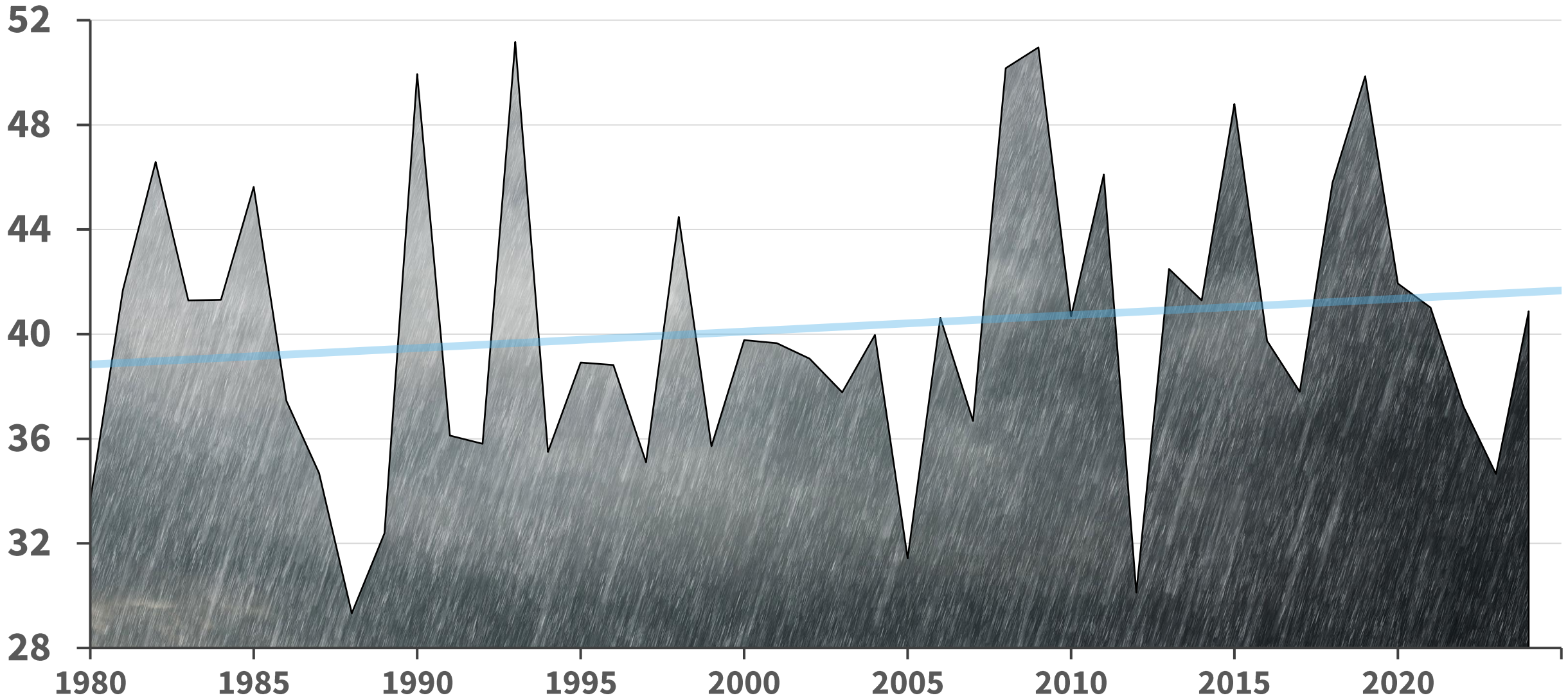
Illinois Rainfall *1980 to 2024 in inches* for February, March, May, and June



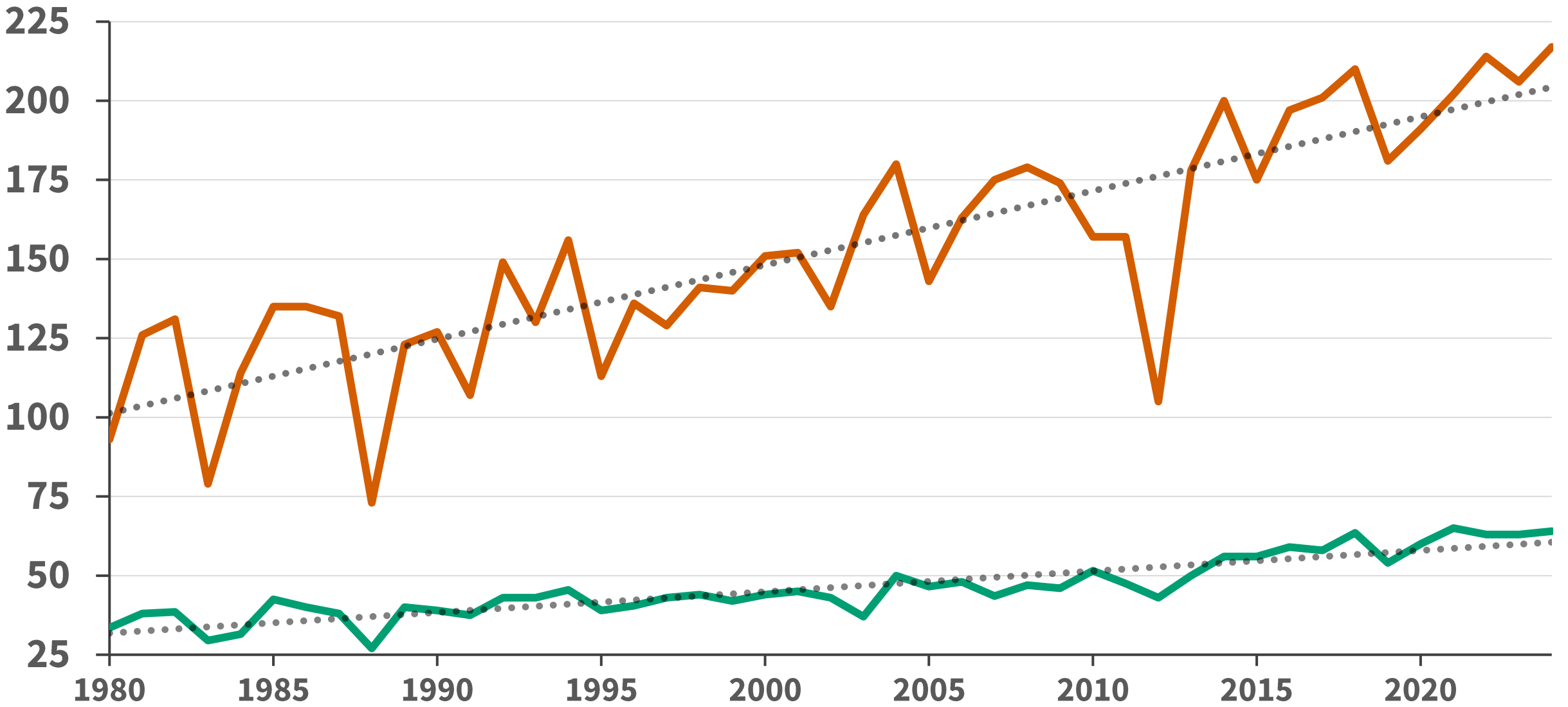
Illinois Total Rainfall Amounts

1980 to 2024 in inches



Illinois Corn and Soybean Yield

in bushels per acre from 1980 to 2024



In-Field Practices to Reduce N and P Losses

Practice	Loss Reduction (per acre)	
	Nitrogen	Phosphorus
Conservation Tillage	0%	30-70% depending on tillage & erodibility
N Reduction To MRTN	10% +	0%
Move from All-fall N to All Spring N	15-20%	0%
Cover Crops	30%	30-50% depending on erodibility

What PCM Farmers are Saying…

According to survey responses following the 2025 PCM Report deliveries:

- ✓ **67% of PCM farmers** who don't already use reduced tillage practices are likely to reduce or eliminate tillage
- ✓ **70% of PCM** who don't already use cover crops on their whole farm are likely to try or expand cover crop use.
- ✓ **68% of PCM farmers** who don't already use MRTN rates are likely to apply nitrogen using the MRTN recommendation
- ✓ **66% of PCM farmers** who don't already apply nitrogen in-season are likely to apply in-season

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