



Nitrogen Management for 1st- & 2nd-Year Corn after Alfalfa

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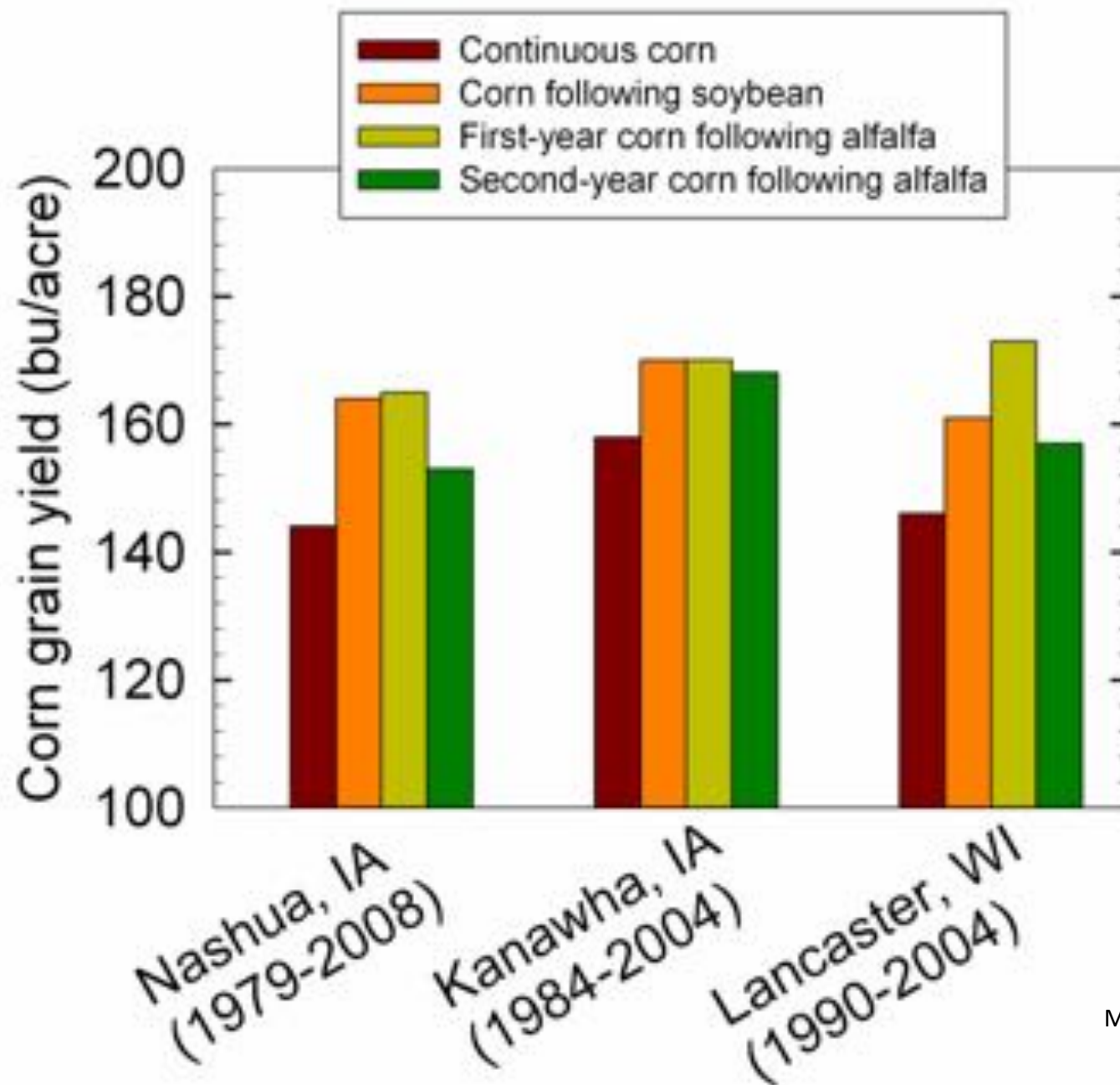


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Managing the Rotation from Alfalfa to Corn

Matt A. Tost, Jeffrey A. Coulter, and Michael P. Russelle





Mallarino & Ortiz-Torres (2006)
Stanger & Lauer (2008)

Alfalfa reduces corn N requirements, usually for at least 2 years

- Recovers soil nitrate
- Fixes atmospheric N
- Maintains high N concentration
- Adds N to soil organic matter pool
(50 to 150 lb N/acre/year)
 - Harvest losses
 - Stand losses
 - Thin root turnover
 - Root exudation



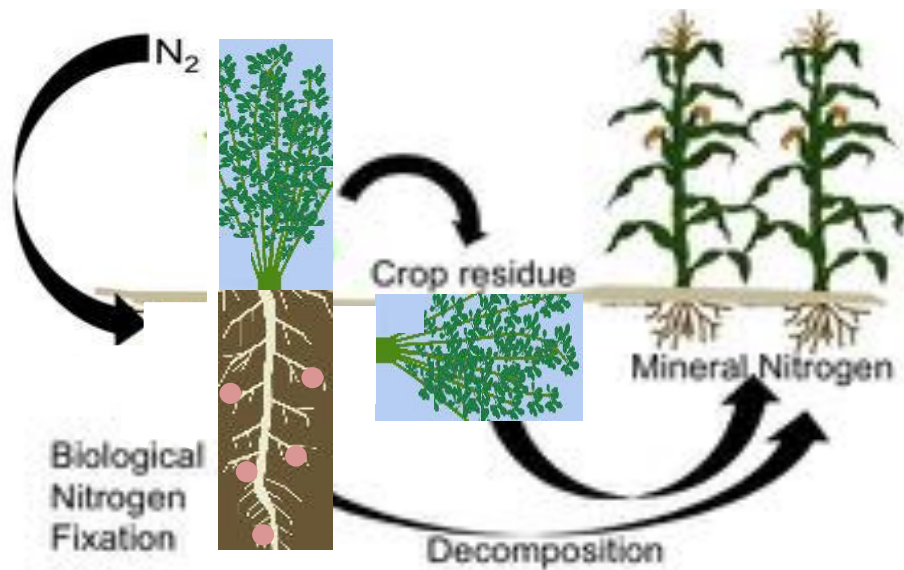
N credit from alfalfa to 1st-year corn (lb N/acre)

		Alfalfa stand at termination		
		Good	Fair	Poor
State	Regrowth	≥ 4 plants ft ²	2-3 plants ft ²	≤ 1 plant ft ²
MN	---	150	100	40
WI	< 8"	150	120	90
	> 8"	190	160	130
IA	---	Apply 0 - 30 lb N/acre for first-year corn		
SD	---	150	50 - 100	0
MI,IN,OH	---	140	100	40
MO	---	120 - 140	40 - 60	0 - 20
NE	---	150	120	90

A rotation with high N loading potential = 3 sources

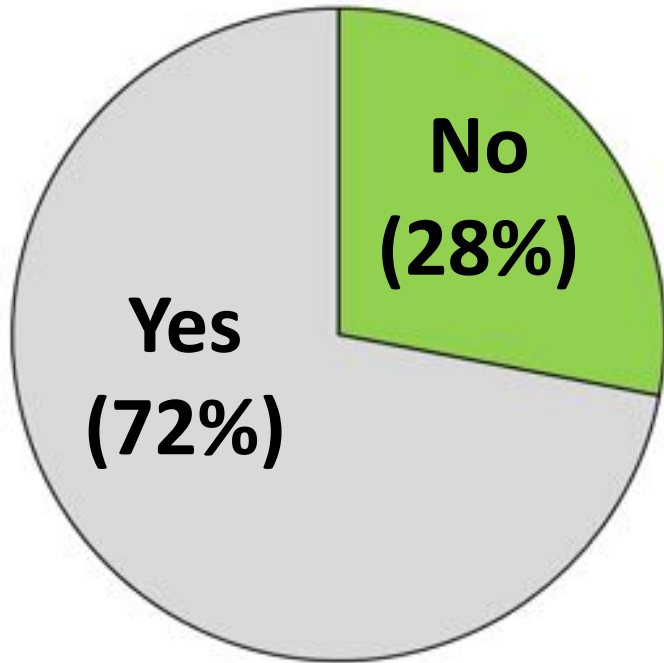
1st-year corn

2nd-year corn



Total N rate adds up fast!

Manure for 1st-year corn in MN



Example for 1st-year corn

Alfalfa N credit 150 lb N/ac

Manure N credit 50 lb N/ac

N fertilizer 80 lb N/ac

280 lb N/ac

Improved N management is needed for corn following alfalfa

- Some of the most ***extreme*** cases of excess N fertilization in corn are when corn follows alfalfa
- Do past N credit recommendations still apply to today's high-yielding corn crops?



Tim McCabe, NRCS

42 on-farm alfalfa-corn N rate trials (2009-2012)

1st-year corn
31 trials

2nd-year corn
11 trials



K



Regrowth, tillage time



No-till



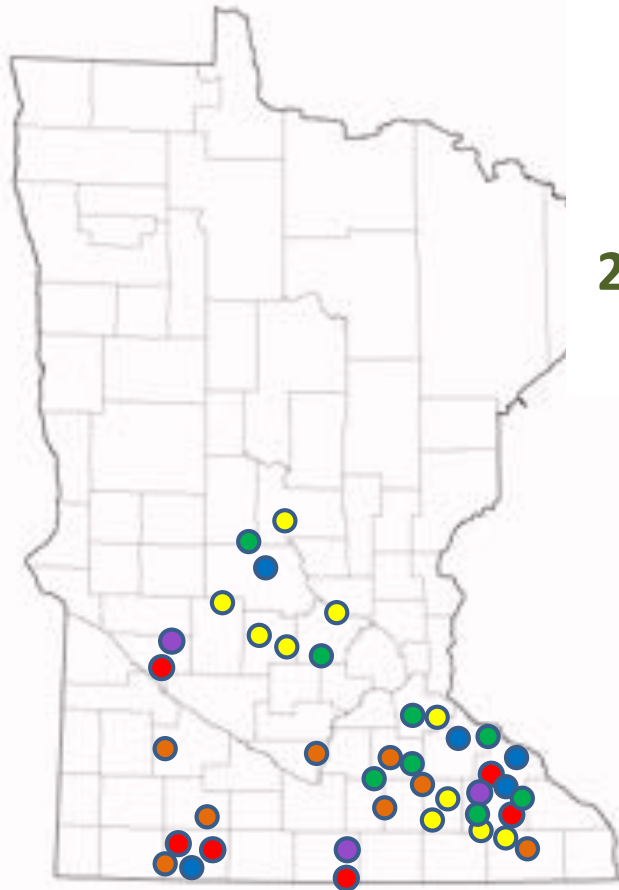
Manure



Predictors of N response



Stover removal, predictors



Farmer cooperators needed – 1 acre

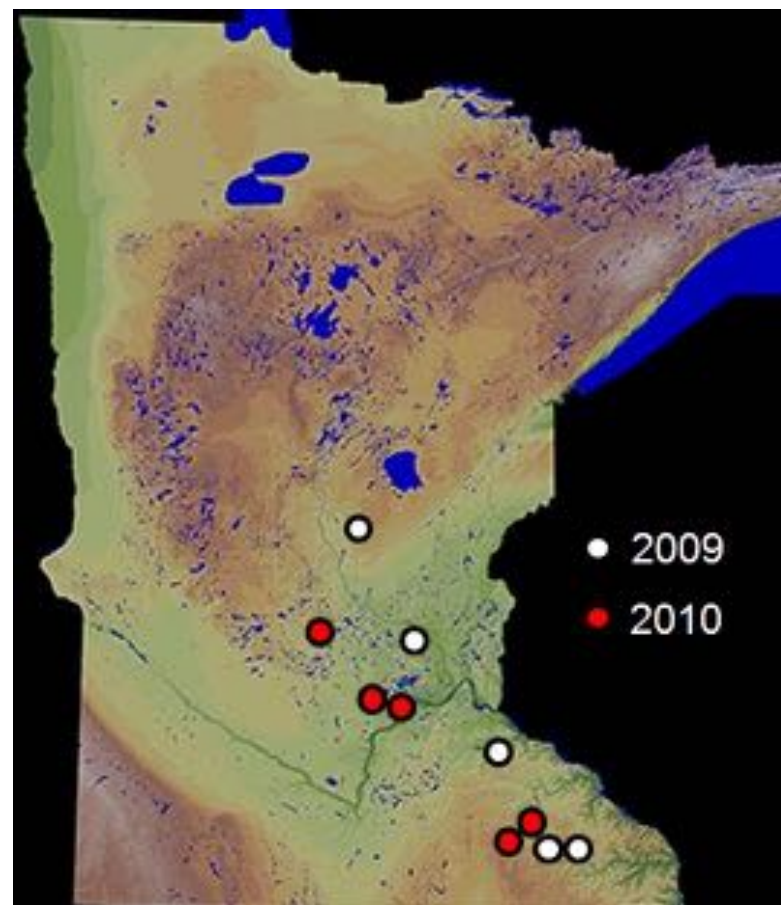
- Alfalfa in 2015, corn in 2016
 - No manure since alfalfa seeding
 - Withhold manure & fertilizers (other than starter)
 - Otherwise, manage like rest of field
- We apply N & other fertilizers & measure corn yield
- Receive a small payment each year
- Receive yield information on corn response to N

Study #1 = 10 on-farm trials in 2009 & 2010

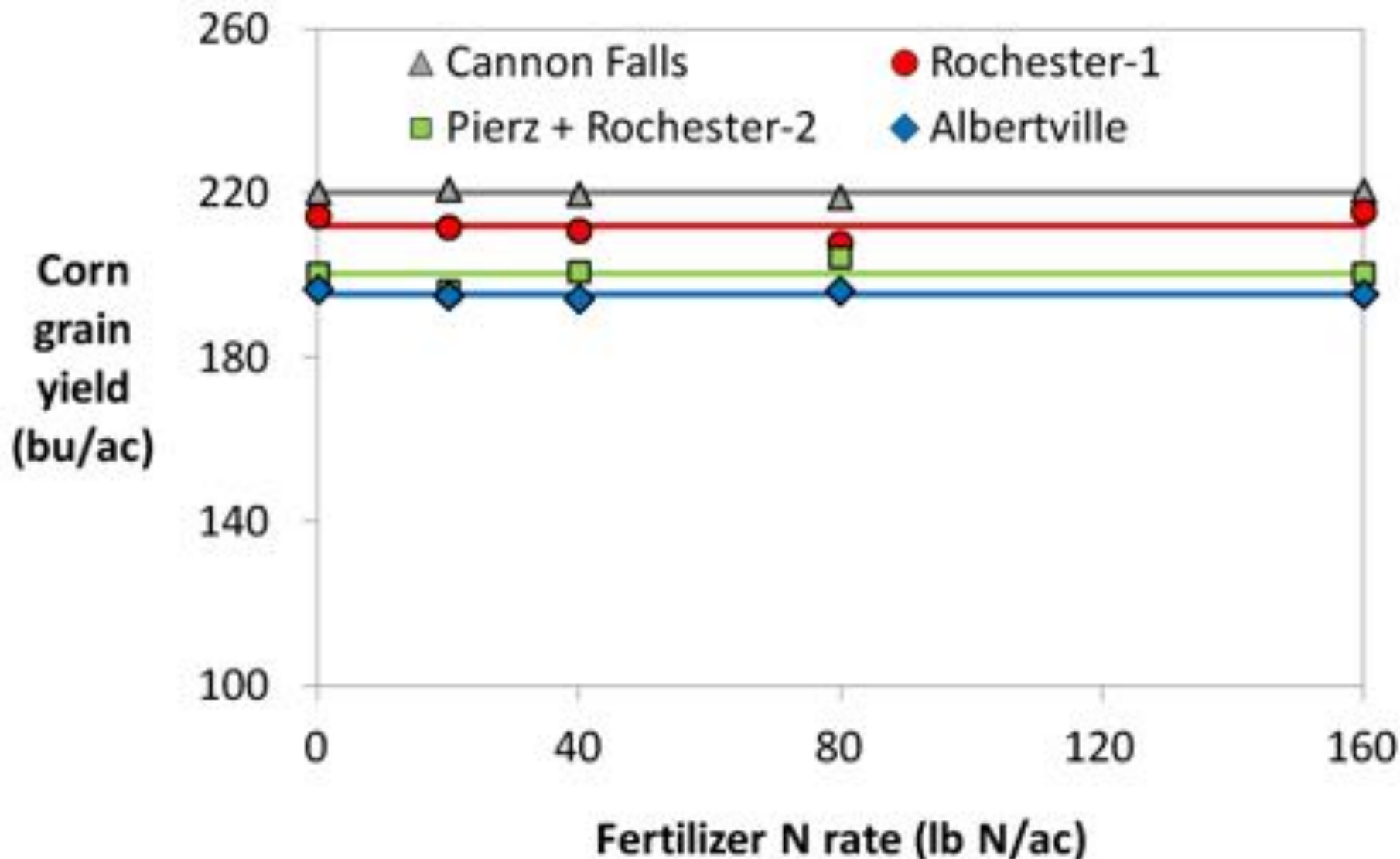
- Evaluated response to fertilizer N in 1st-year corn
- No manure during alfalfa
- Alfalfa stands 3-5 years old; 4-10 plants/ft²
- Tillage timing for stand termination varied with farm
- Loam to silty clay loam soils; 1 farm had loamy sand soil



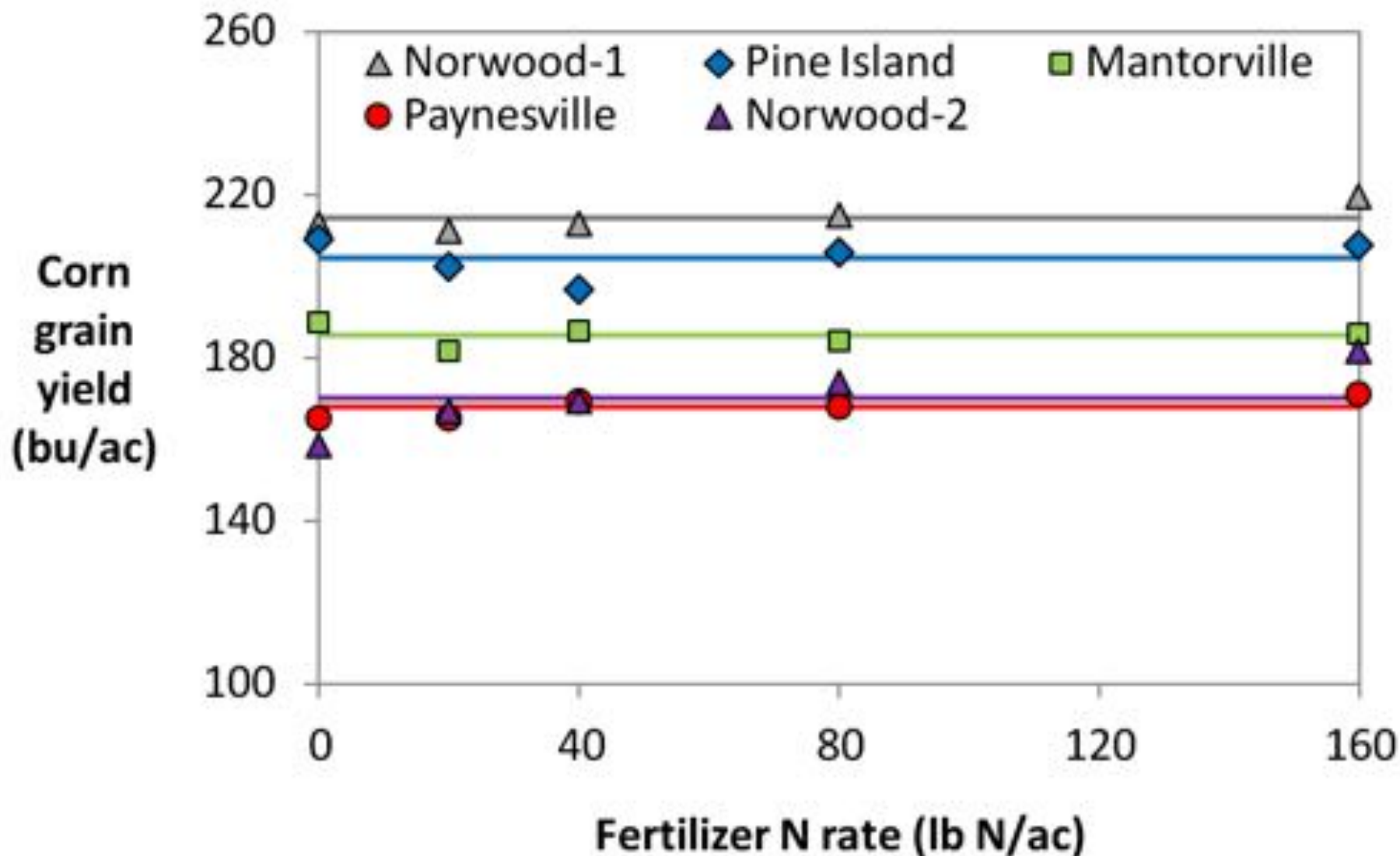
Minnesota's Agricultural Fertilizer
Research & Education Council



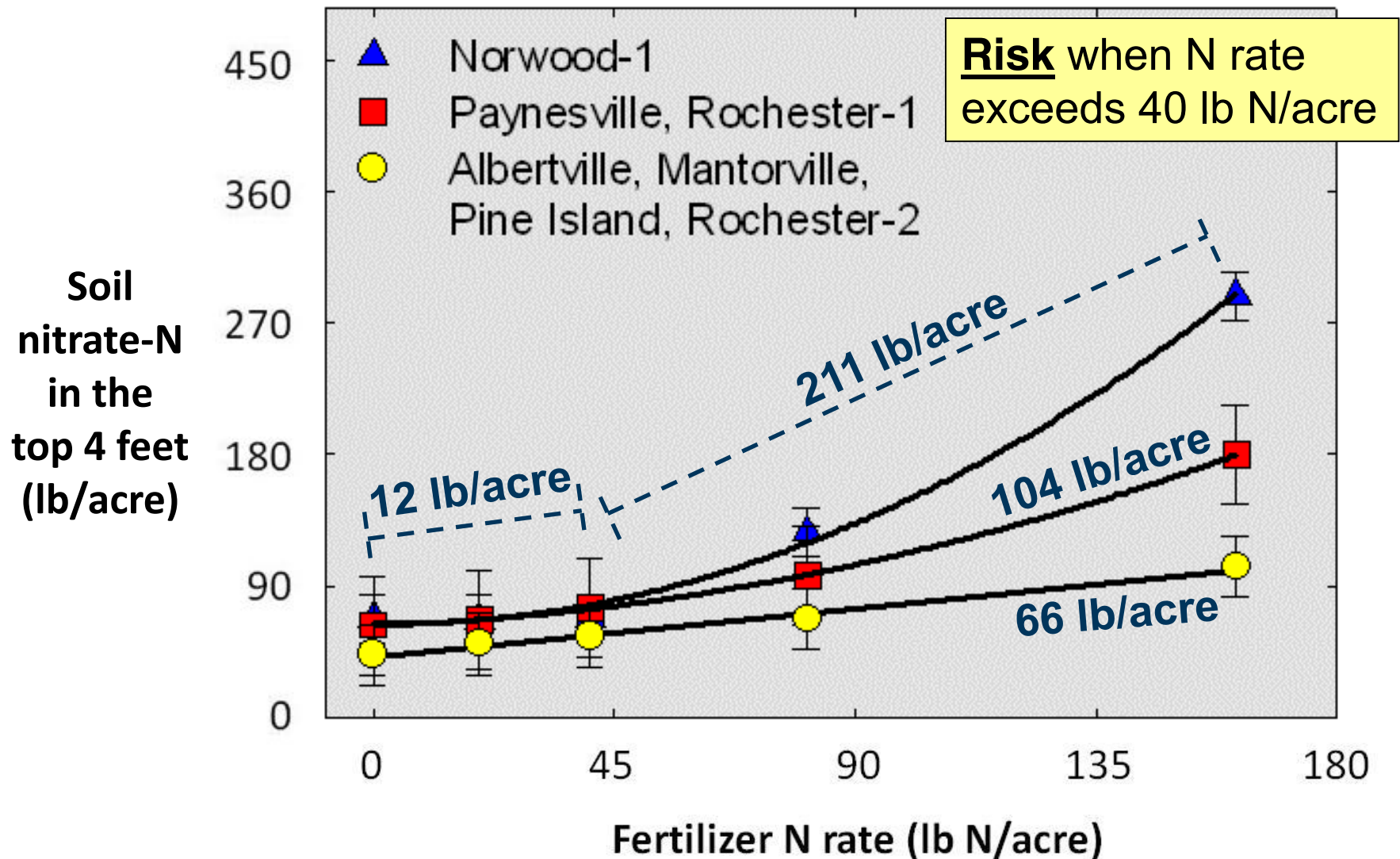
Grain yield was not increased with fertilizer N on any of the 5 farms in 2009



Grain yield was not increased with fertilizer N on any of the 5 farms in 2010



Soil nitrate-N after harvest in the top 4 feet at 7 farms in 2009-2010



Study #2 = 6 on-farm trials in 2010

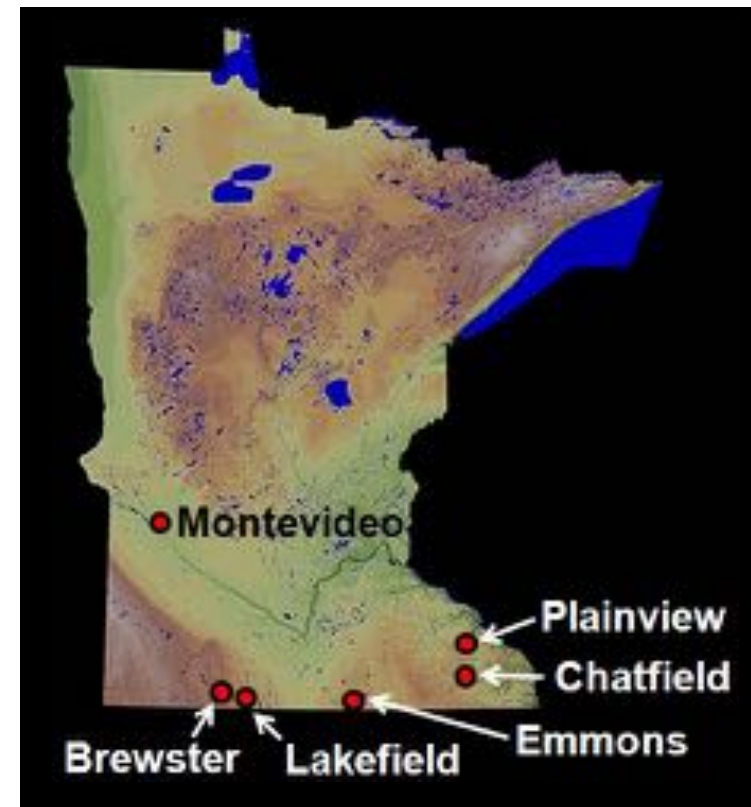
- Evaluated 1st-year corn response to fertilizer N based on alfalfa regrowth & tillage timing for alfalfa termination
- Loam, silt loam, & clay loam soils



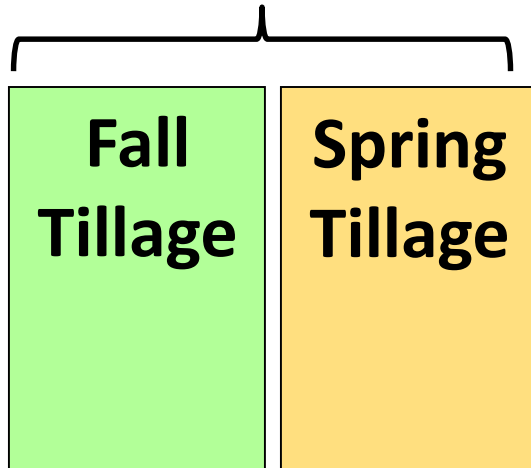
Regrowth Treatments



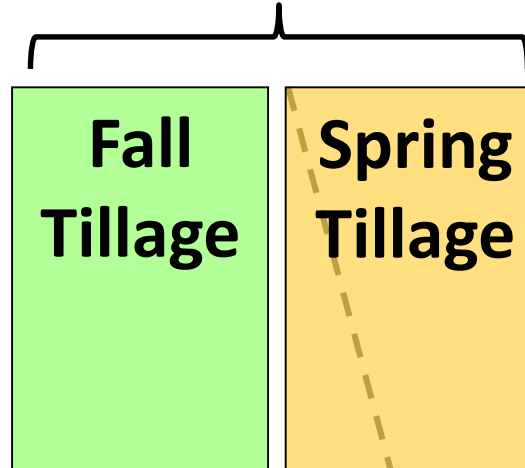
Tillage Timing Treatments



Regrowth



No Regrowth



- Alfalfa fields 3-7 years old
- 4-8 plants/ft²
- 4 replications per farm

Diagram showing the experimental design with dashed lines connecting treatments to a data table. The 'Fall Tillage' boxes (both under Regrowth and No Regrowth) are connected to the first column of the table. The 'Spring Tillage' boxes (both under Regrowth and No Regrowth) are connected to the second column of the table.

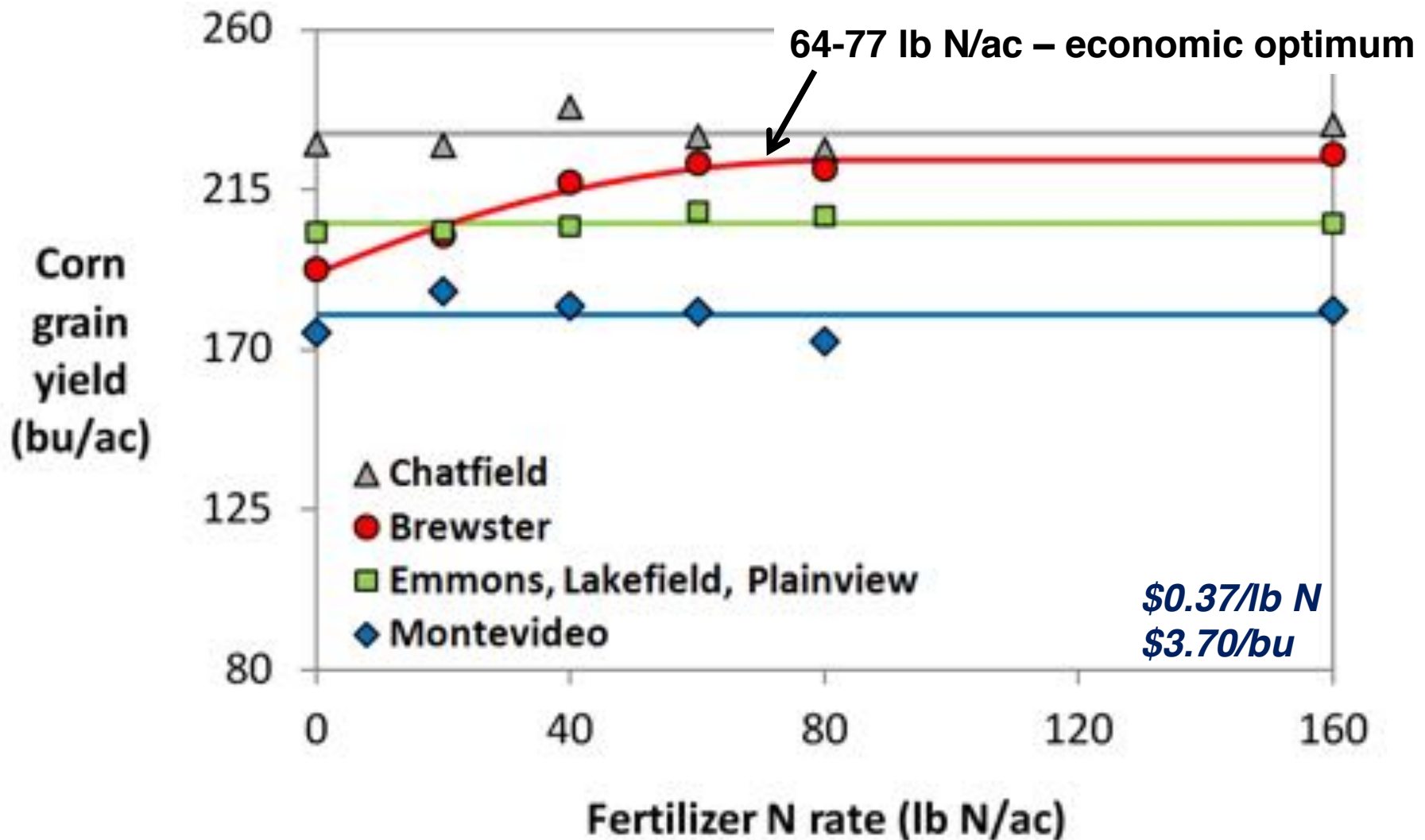
0	20
40	60
80	160

No effect of fall alfalfa regrowth or tillage timing on grain or silage yield, or their response to fertilizer N

Location in Minnesota	Fall alfalfa regrowth where it was not harvested		
	Height of regrowth	Dry matter yield	N content
	-- inches --	----- lb/acre -----	
Emmons	4	300	9
Brewster	6	400	17
Plainview	10	700	33
Chatfield	13	900	38
Lakefield	15	1,400	47
Montevideo	18	1,500	52

5 of 6 farms had no grain response to N in 2010

Responsive field had poorly-drained soil & abundant spring rainfall

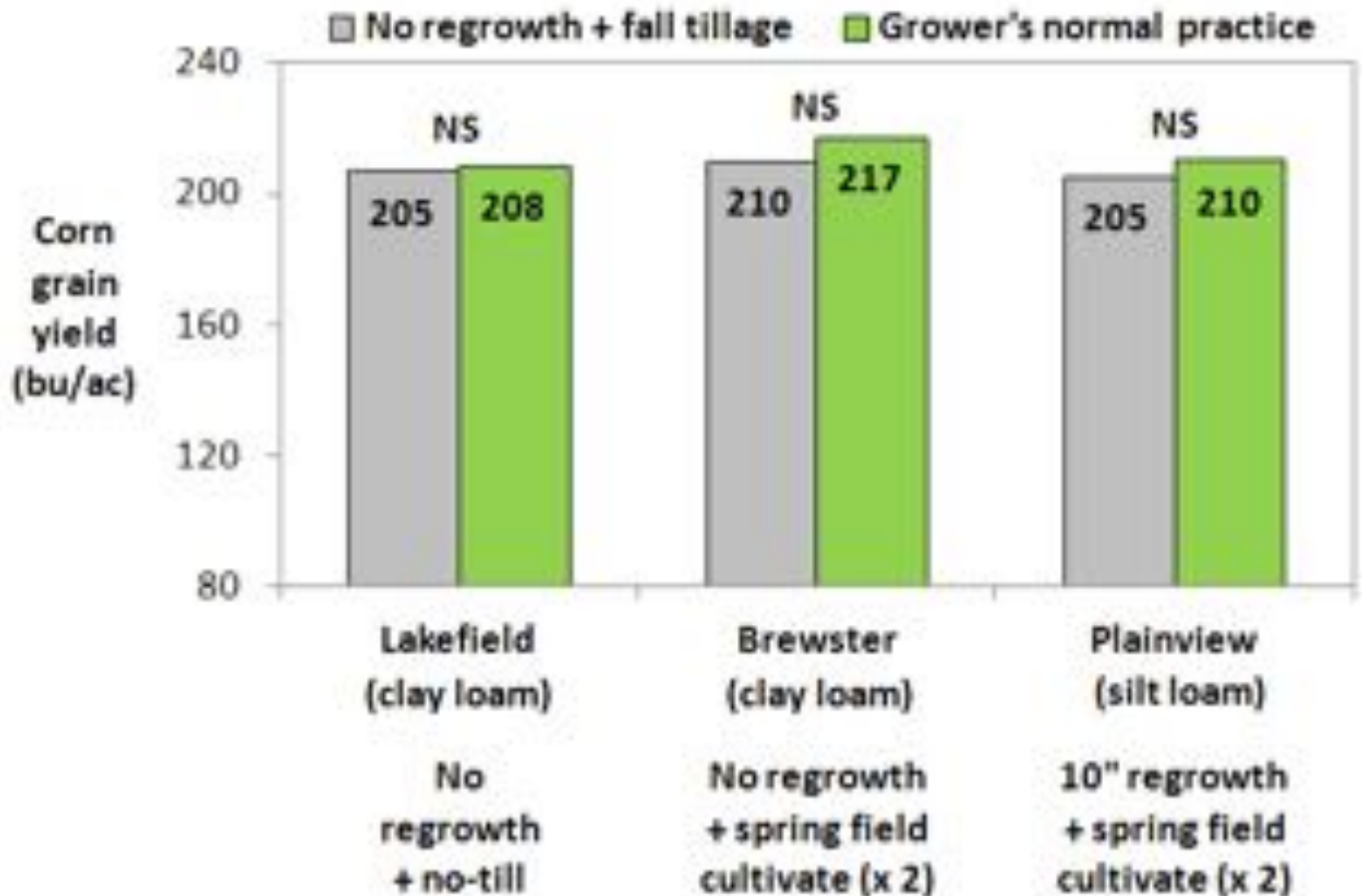


No-till & reduced-till can work well for 1st-year corn after alfalfa



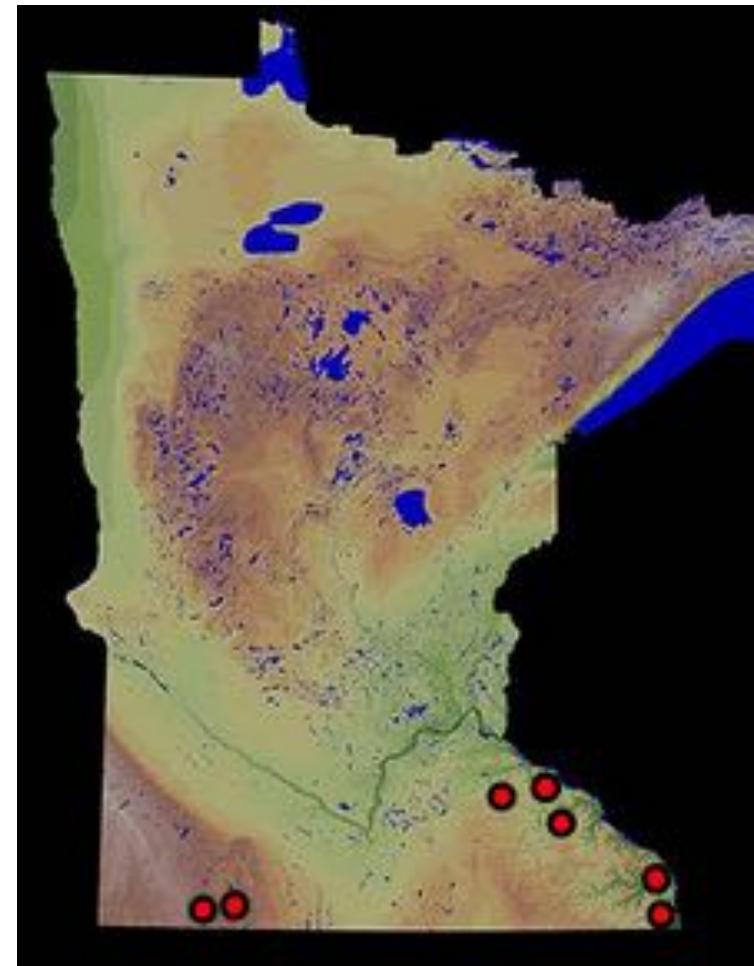
No-till & reduced-till worked well in 2010

(averaged over 6 N rates, as no difference in response to N)



Study #3 = 7 on-farm trials in 2010 & 2011

- Evaluated response to fertilizer N in 1st-year **no-till** corn after alfalfa
- No manure during alfalfa
- Alfalfa stands 2-7 years old; 4-8 plants/ft²
- Loam, silt loam, & clay loam soils
- Starter fertilizer (3-20 lb N/acre) used on all farms

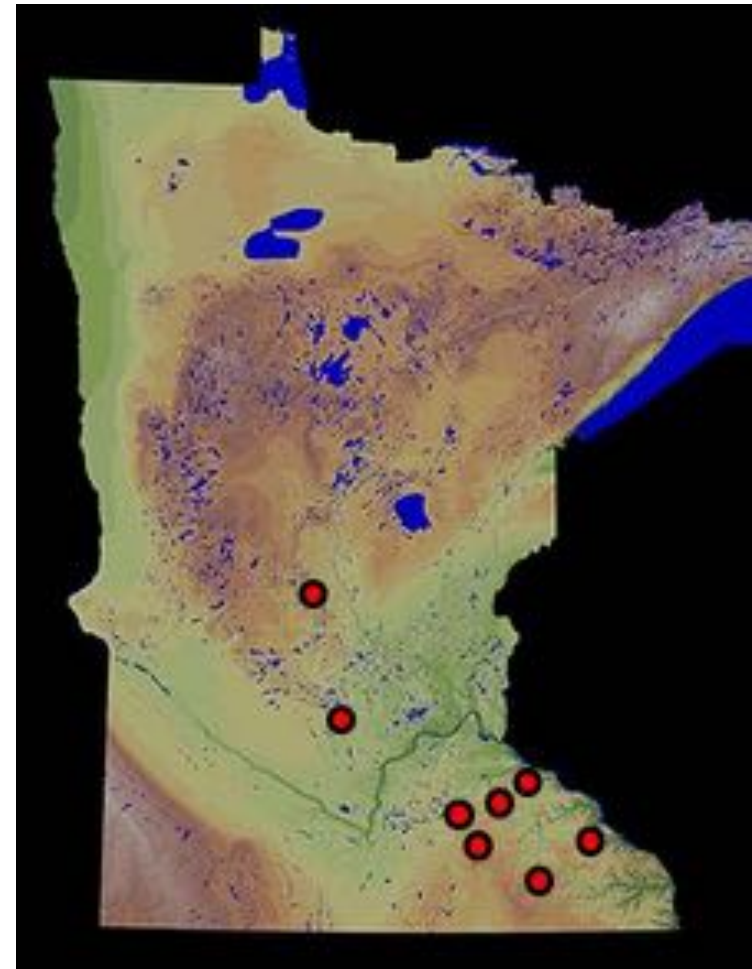


Grain and silage yields were not increased with fertilizer N on any of these 7 no-till farms

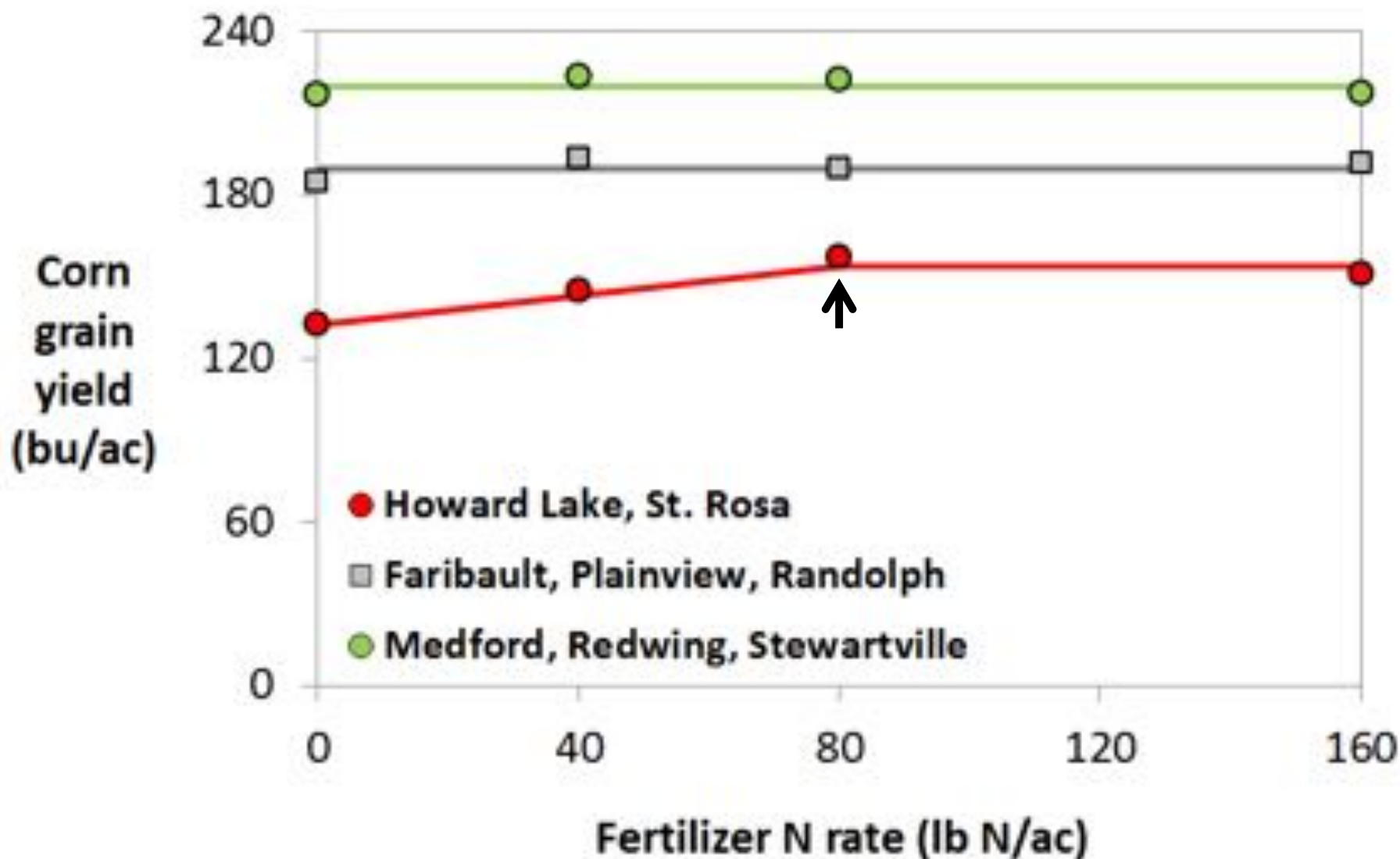
		Average yield across N rates (0, 20, 40, 80, 160 lb N/ac)	
Location	Soil type	Grain	Silage
		--- bu/ac ---	--- tons/ac ---
Cashton	Silt loam	199	27.9
Goodhue	Silt loam	203	21.1
Lake City	Silt loam	220	---
Lakefield	Loam	212	24.5
Norwalk	Silt loam	211	30.3
Okabena	Clay loam	209	---
Plainview	Silt loam	211	---

Study #4 = 8 on-farm trials in 2011

- Evaluated response to fertilizer N in 1st-year corn after alfalfa; used fall tillage
- No manure during alfalfa
- Alfalfa stands 2-5 years old; 3-7 plants/ft²
- Loam, silt loam, silty clay loam, & clay loam soils
- Starter fertilizer (2-15 lb N/acre) used on 6 of 8 farms



6 of 8 farms with tillage had no response to N in 2011

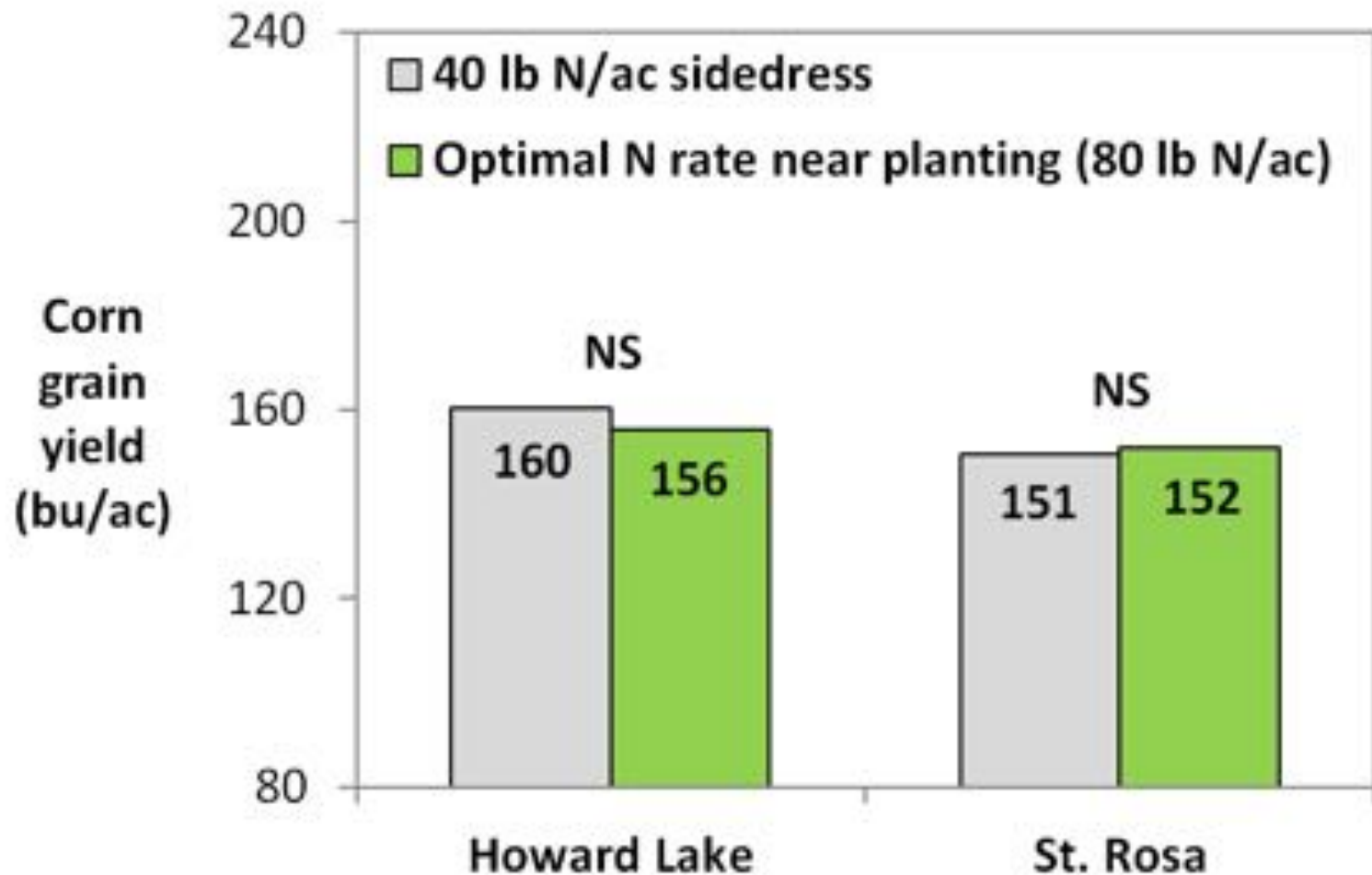


A sidedress rate of 40 lb N/ac was evaluated on these 8 farms in 2011

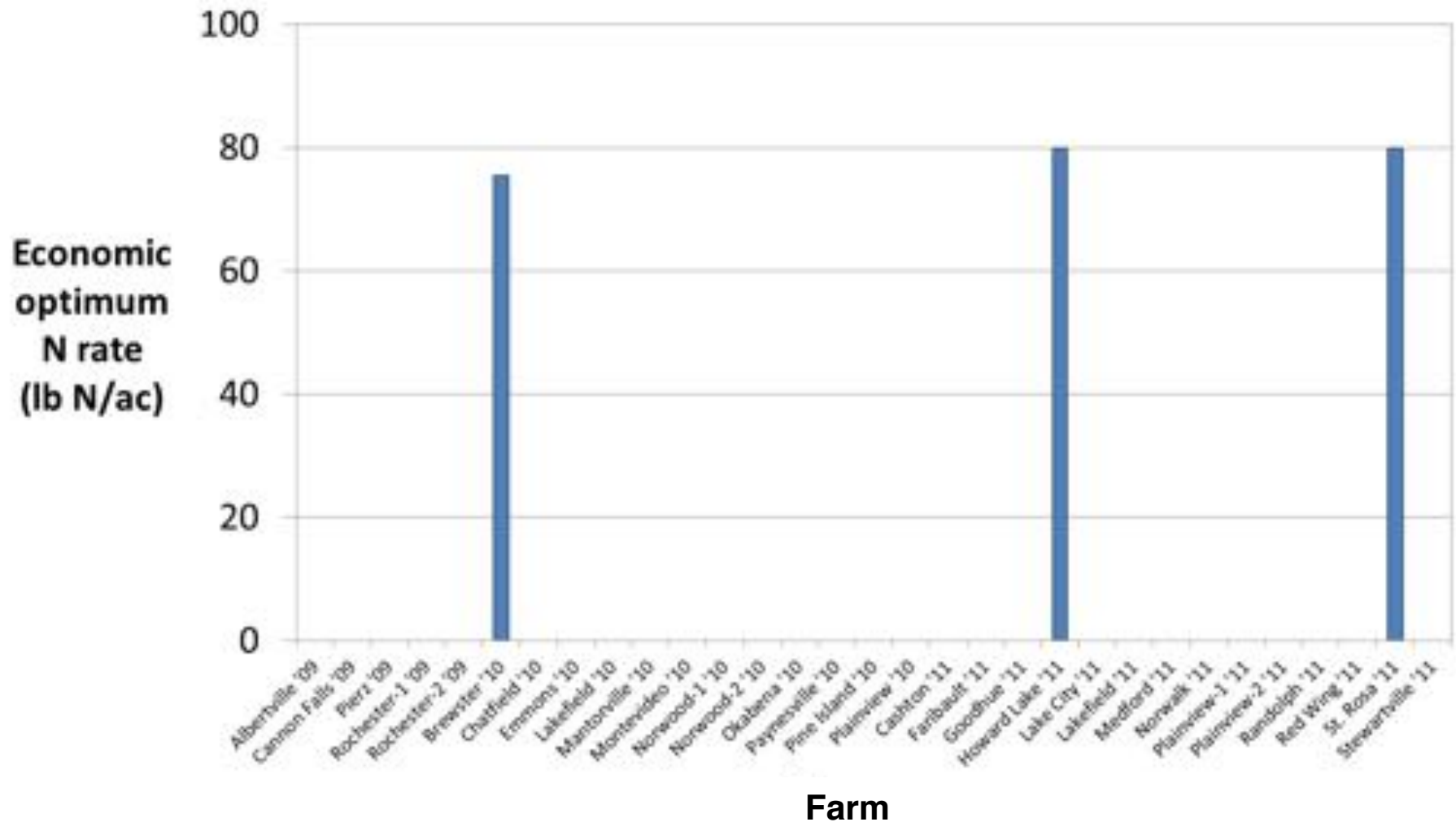


2 farms that responded to fertilizer N in 2011

Equivalent yield with 40 lb N/acre sidedressed at V6
or 80 lb N/acre near planting



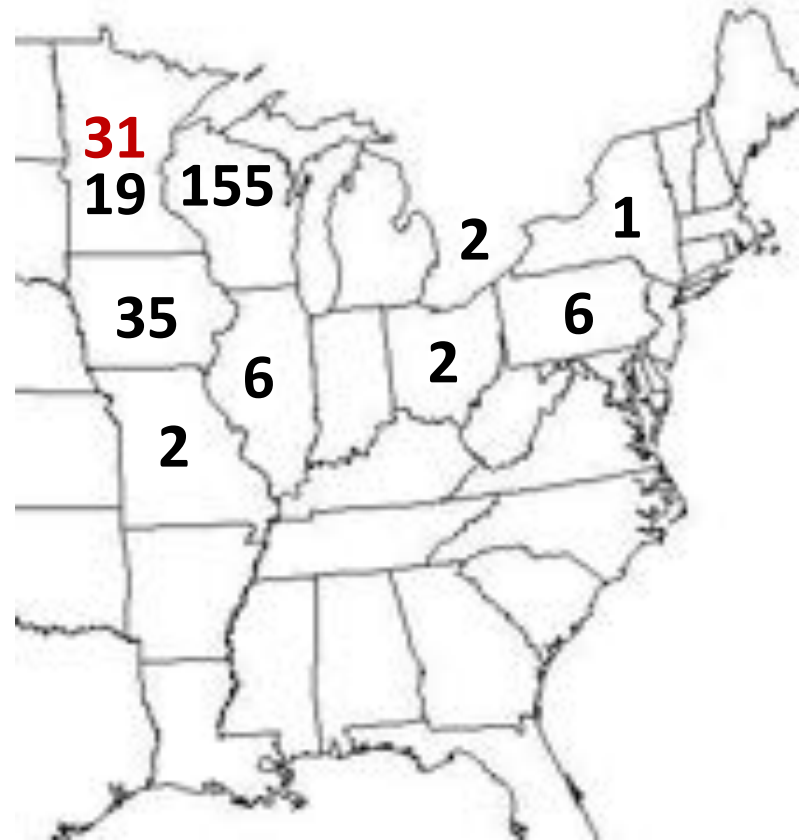
1st-year corn responded to N on 3 of 31 farms



\$0.37/lb N \$3.70/bu

Review of past N fertilizer rate trials in 1st-year corn after alfalfa

- N rates on first-year corn
- No manure
- At least 2 replications



31 recent MN sites + 228 from literature

Review of past N rate trials – 1st-year corn

Soil texture	Termination timing	Alfalfa age, years	Alfalfa seeding method	Sites responsive to fertilizer N	Total sites
Coarse				96%	11
Medium	Fall	1	Direct	56%	16
Medium	Fall	2	With oats	35%	54
Medium	Fall	2	Direct	8%	25
Medium	Fall	3+		5%	86
Medium	Spring	3+		17%	48
Fine				53%	19

Take home points for 1st-year corn

- Harvest alfalfa regrowth in the fall before termination
- No-till and reduced-till can work well
- Response to N unlikely (5% of time) on medium-textured soils following 3+ year-old alfalfa (including seeding year) if terminated in the fall



Likelihood of 1st-year corn requiring N is increased with:

- Coarse-textured soils (respond 96% of time)
- Fine-textured soils (respond 53% of time)
- Spring termination of alfalfa
- ***Significant rainfall*** between alfalfa termination & early-season corn growth on ***sandy*** or ***poorly-drained*** soils
- Warmer fall temperatures following alfalfa termination



Take home points for 1st-year corn

- If one thinks N may be needed for 1st-year corn on medium- or fine-textured soils...
 - Consider a small amount of N as a starter or pre-plant fertilizer
 - Sidedress a small amount of N (about 40 lb N/acre) based on early-season soil/crop conditions rather than applying a higher rate before planting



Alfalfa N credits to 2nd-year corn are real, but vary

State	1 st -year N credit [†]	2 nd -year N credit [†]
	----- lb N/ac -----	
IA	*	*
IL	100	30
IN	140	---
KS	120	---
MI	140	---
MN	150	75
MO	100	---
ND	150	75
NE	150	---
OH	140	---
SD	150	75
WI	150	50

*Iowa State Univ. guidelines:

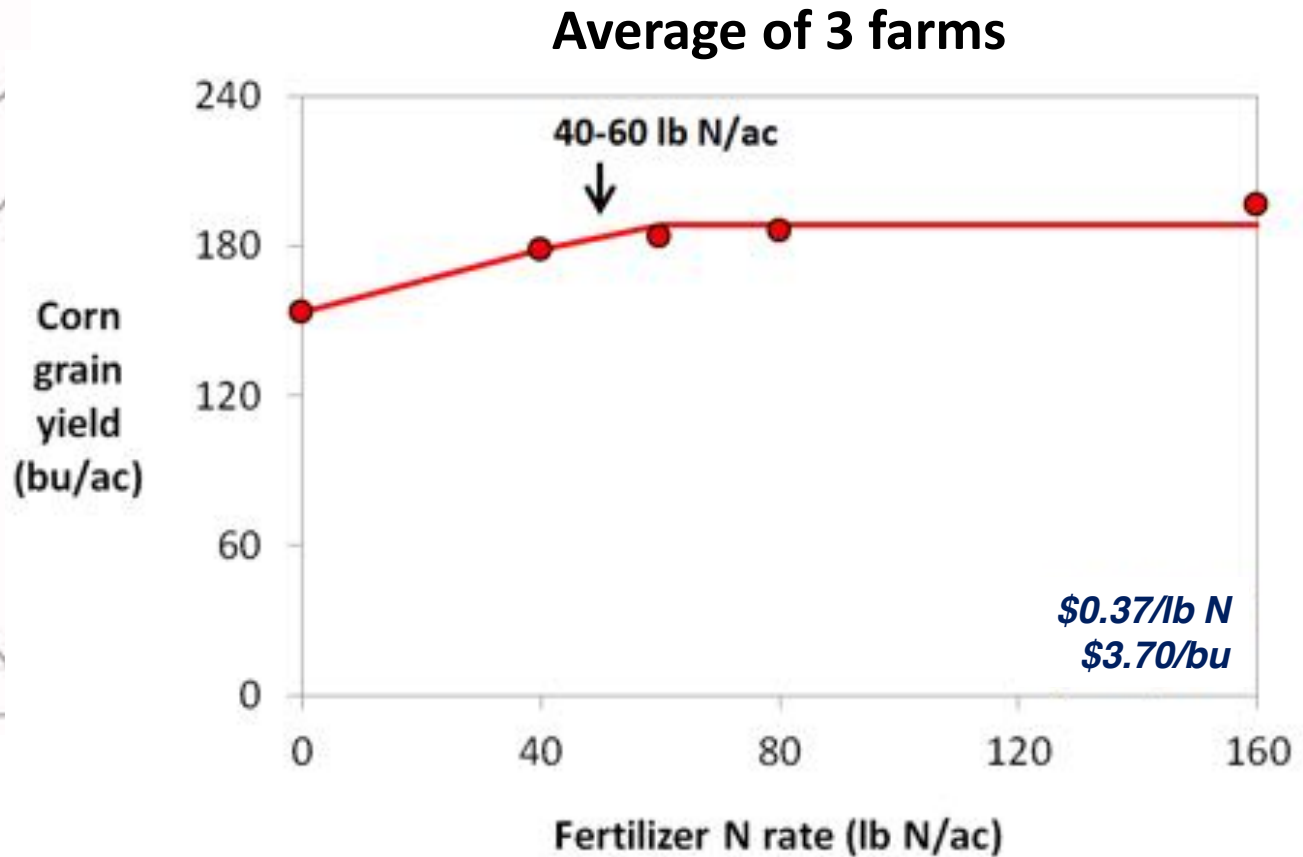
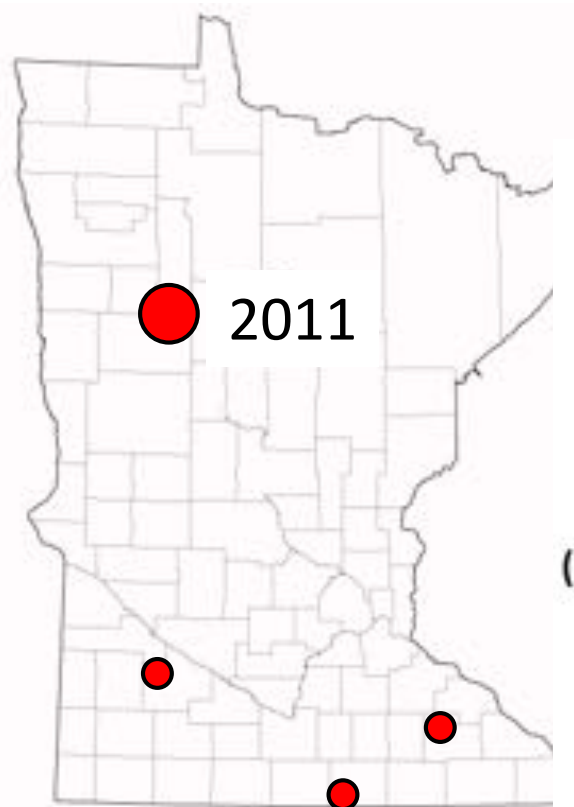
0-30 lb N/ac for 1st-year corn

0-60 lb N/ac for 2nd-year corn

**No university
recommendation for
2nd-year N credit**

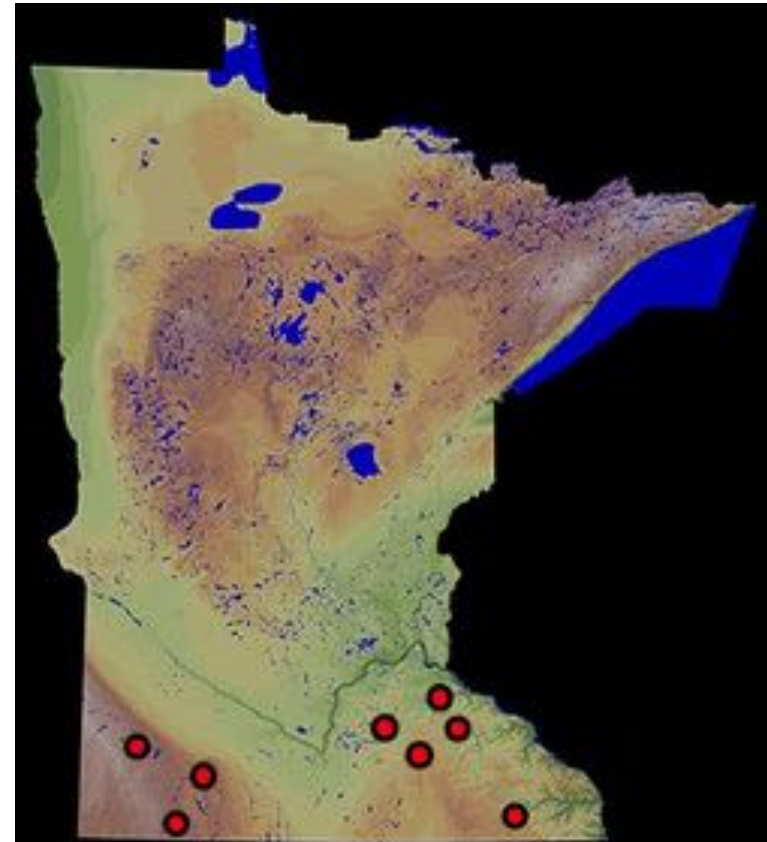
[†] For good stands on medium- to
fine-textured soils

40-60 lb N/ac optimized 2nd-year corn yield on 3 farms in 2011

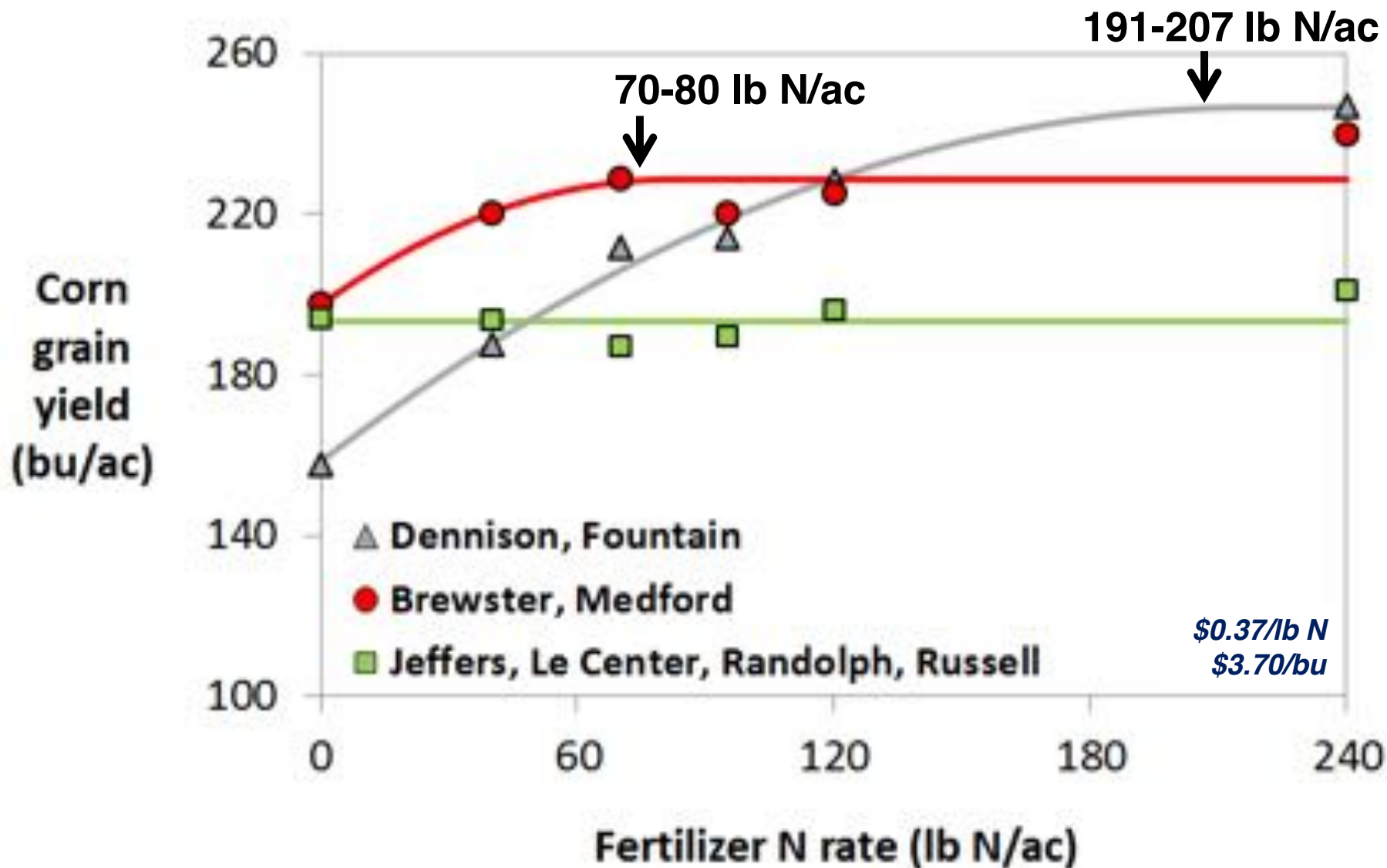


8 trials in 2012 in 2nd-year corn after alfalfa

- No manure since alfalfa seeding
- Alfalfa stands 2-7 years old with at least 4 plants/ft²
- Stand termination method varied with farm
- 0-6 lb N/ac in starter fertilizer
- Loam, silt loam, & clay loam soils



2nd-year corn grain yield was not increased with N on 4 of 8 farms in 2012

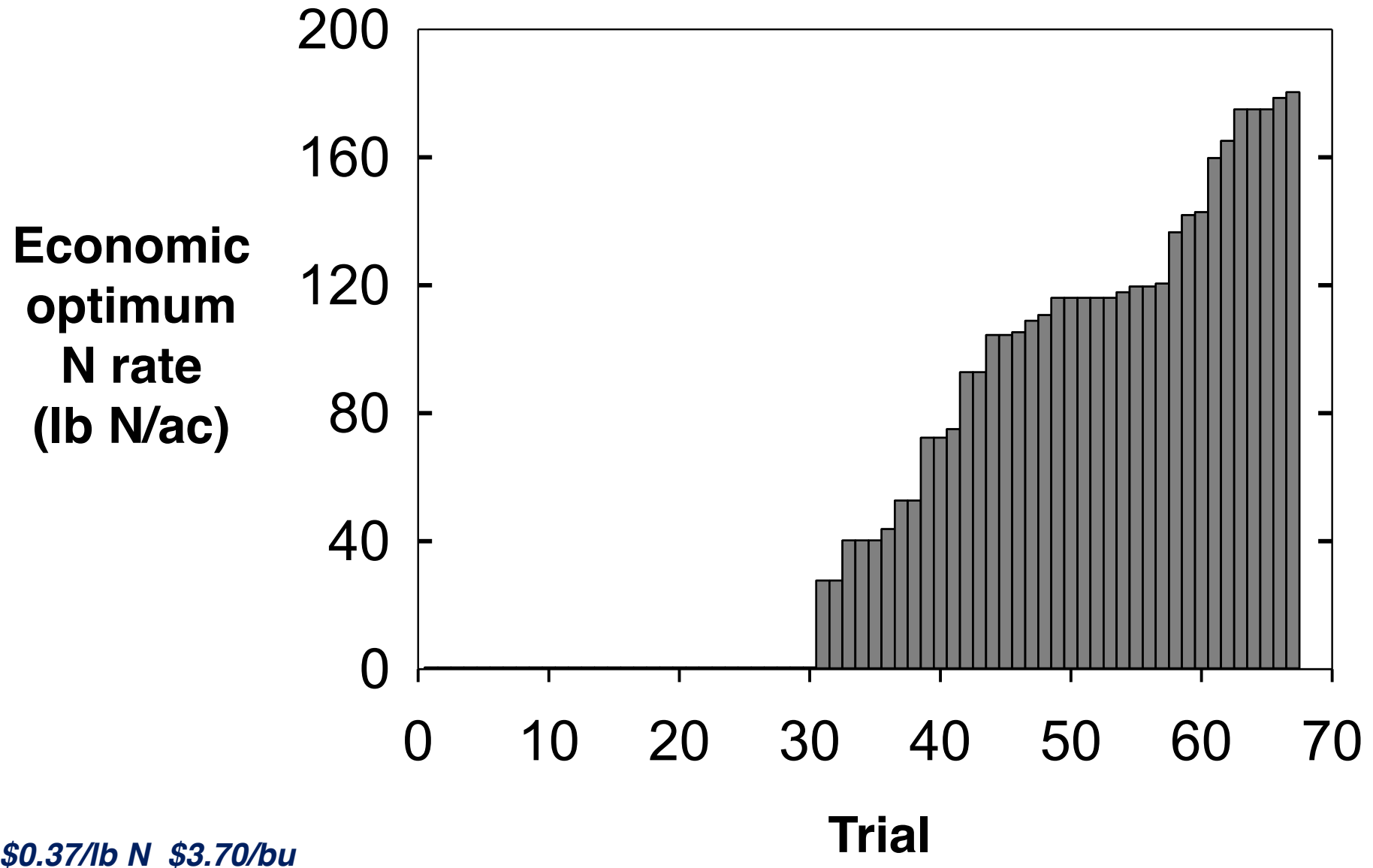


Enhanced efficiency when N was sidedressed at V6 in 2nd-year corn

- At the 4 of 8 farms with response to N in 2012:
 - Sidedressed N was more efficient
 - 100 lb N/ac sidedressed = 118 lb N/ac near planting



No response to N in 45% of 67 trials of 2nd-year corn



Take home points for 2nd-year corn

- 2nd-year corn required no N 45% of time
- Grow 2 years of corn after alfalfa to capture N benefits
- Responsive sites needed 30-180 lb N/ac
- Use current N credits, but we hope to have field-specific recommendations in the future
- Applying N as a sidedress can enhance fertilizer N use efficiency





Thank you!



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