FALL MANURE AND COVER CROPS: WHO WINS? WHO LOSES?

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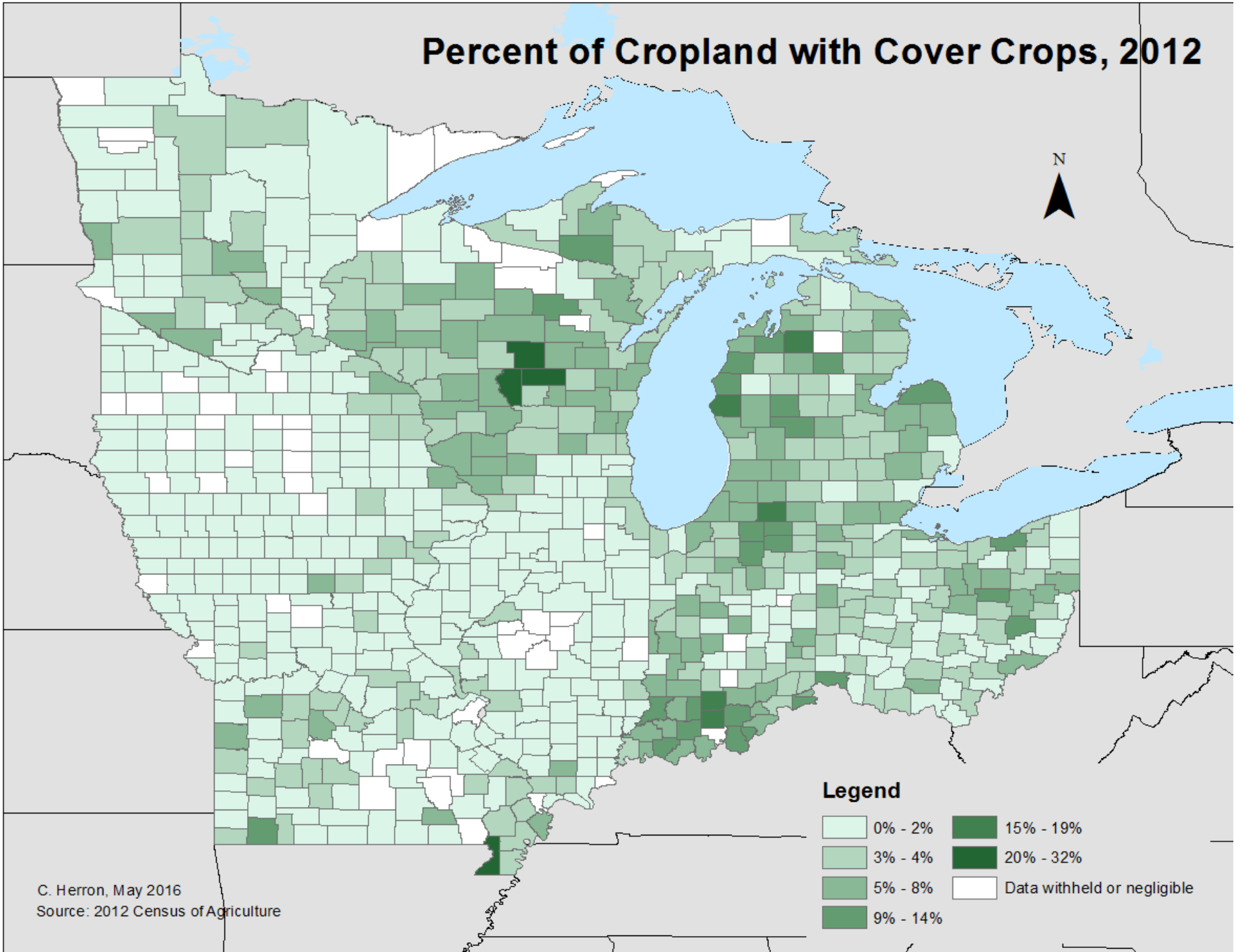
Percent of Cropland with Cover Crops, 2012
N
Legend
0% - 2%
3% - 4%
5% - 8%
9% - 14%
15% - 19%
20% - 32%
Data withheld or negligible
C. Herron, May 2016
Source: 2012 Census of Agriculture

Multi-site and multi-year research is underway to evaluate cover crops as funded by the WI Fertilizer Research Council.

Objectives:

- Evaluate growth of fall seeded cover crops and their , effect on soil nitrate
  - post corn silage harvest and manure application
  - no-till
- Determine yield and optimal N rate for corn following different cover crops.

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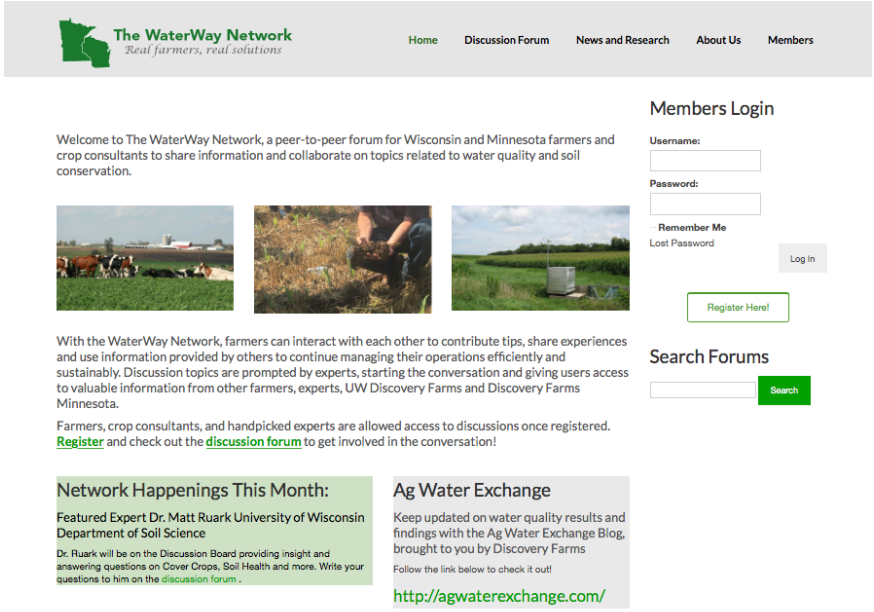

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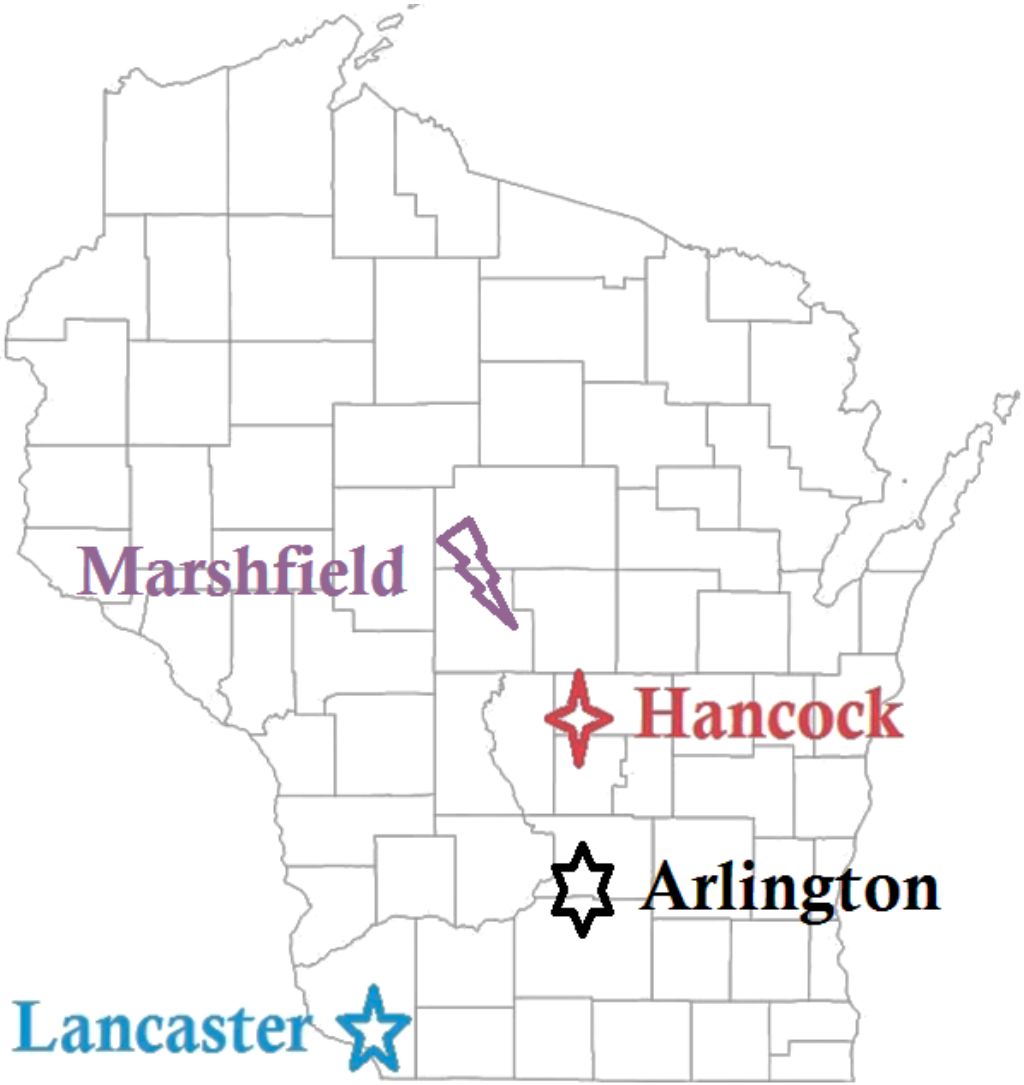
Research was conducted at UW Agricultural Research Stations



- **Arlington,**
  South Central WI
  - Plano silt loam
  - Very deep, well drained
- **Marshfield,**
  North-central WI
  - Withee silt loam
  - Somewhat poorly drained
- **Lancaster,**
  SW “Driftless” WI
  - Fayette silt loam
  - Well-drained
  - 2-6% slopes; moderately eroded

Evaluating cover crops following corn silage harvest and fall manure application

Four treatments:

- No cover crop
- Spring Barley (71-140 lb/ac)
- Winter rye (75-120 lb/ac) – terminated in spring
- Triticale (69-173 lb/ac)
  - Harvested as a forage crop

Evaluate the effects of cover crops on key parts of the production system

- Fall erosion control – how well does it grow and cover?
- Fall soil nitrate – how much less nitrate was potentially leached?
- Presidedress nitrate test – did the cover crop take away from this estimate of the manure N credit?
- Yield – were the covers a benefit or cause a drag?
- Response to N – is more or less N required to achieve optimal yields?

All fall manure is not alike.

COVER CROP GROWTH

Fall growth of cover crop ranges from minimal to excessive.

		Date	Fall'14	Date	Fall'15	Date	Fall'16
		2014	ton/ac	2015	ton/ac	2016	ton/ac
ARL	Rye	9/18	0.30	9/23	0.40	9/15	0.92
	Barley		0.39		0.37		1.06
	Triticale		0.44		0.36		1.00
LAN	Rye	9/29	0.15	9/23	0.62	9/27	0.44
	Barley		0.14		0.98		0.51
	Triticale		0.19		0.86		0.44
MAR	Rye			9/21	0.37	9/15	0.86
	Barley				0.25		1.16
	Triticale				0.25		0.78

November 13, 2014

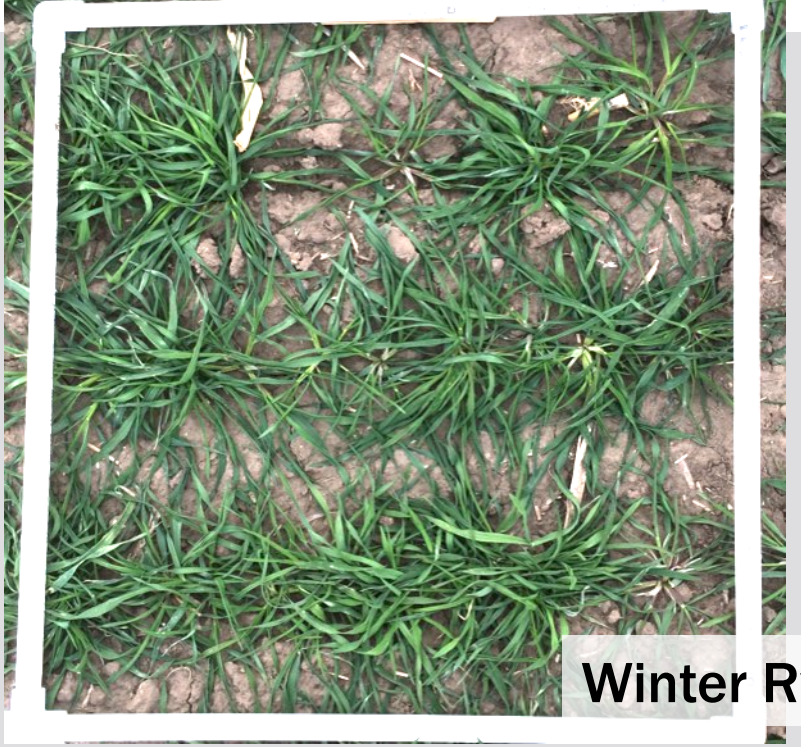
Lancaster ARS

1/8 ton DM biomass

November 14, 2014

Arlington ARS

1/3 ton DM biomass



Winter Rye

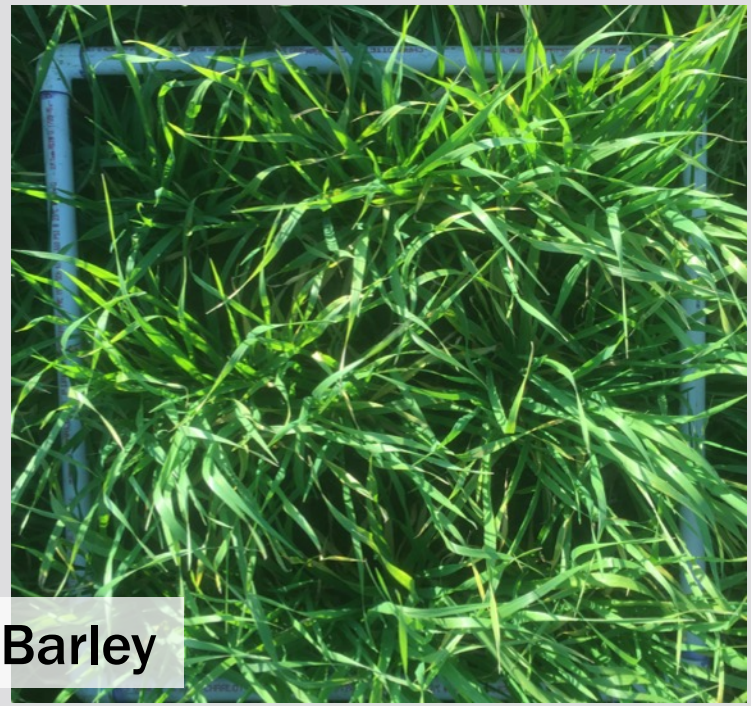
Barley

Triticale

November 16, 2016

Marshfield ARS

¾ to 1 ton DM biomass



FALL SOIL NITRATE

One-third of a ton of biomass can lead to a decrease of 25 lb-N/ac in the upper 2' of soil

Site	Cover	DM	Fall 2014 nitrate-N reduction	DM	Fall 2015 nitrate-N reduction
		ton/ac	lb-N/ac	ton/ac	lb-N/ac
ARL	Rye	1/3	19	1/3	24
	Barley		23		18
	Triticale		25		19
LAN	Rye	1/8	6	3/4	25
	Barley		8		13
	Triticale		5		21
MAR	Rye			1/4	1
	Barley				2
	Triticale				5

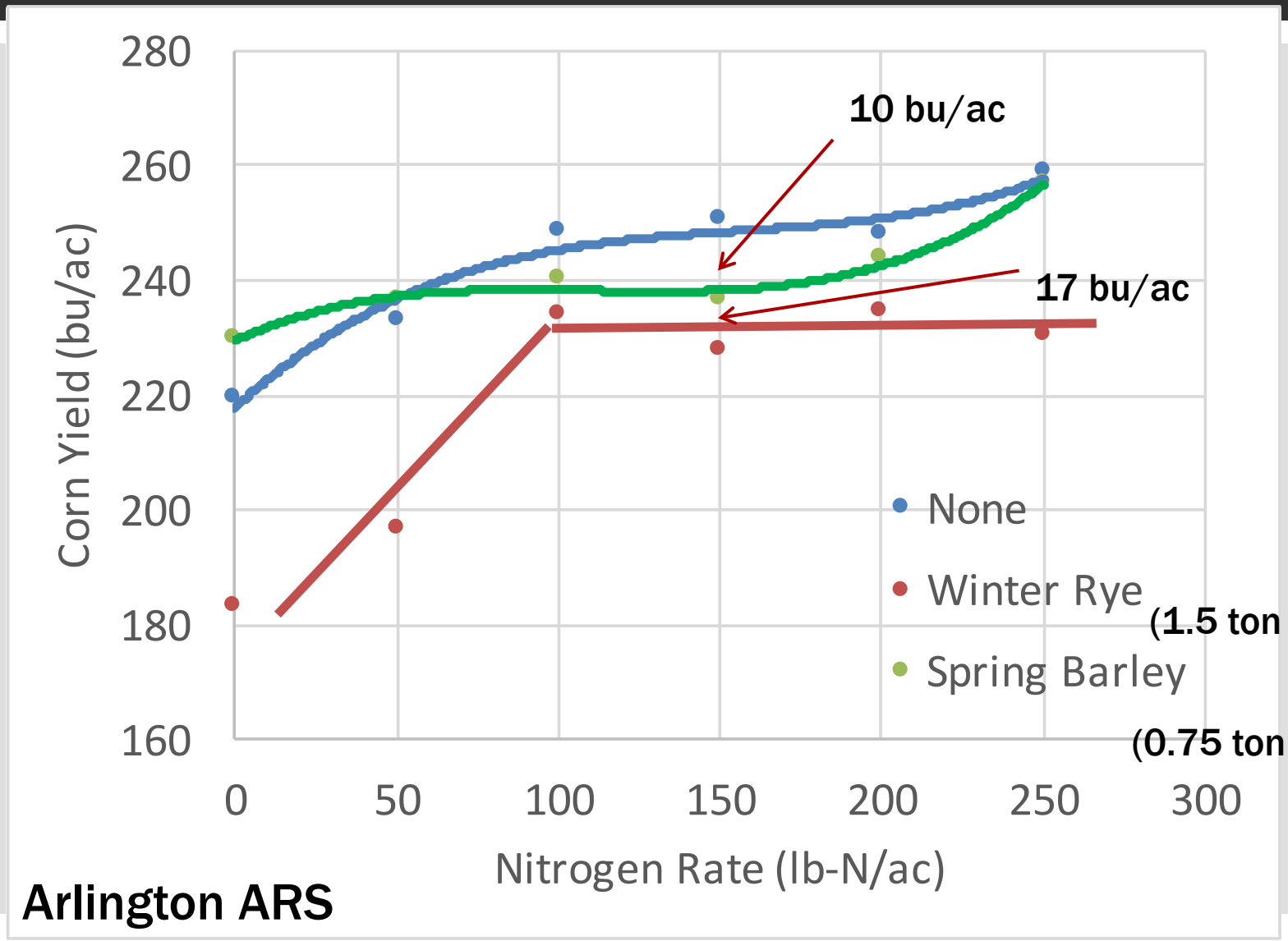
MANURE NITROGEN CREDITS

Cover crops wipe out some of the manure N credit based on PSNT

	ARL		LAN		MAR	
	ppm	N credit	ppm	N credit	ppm	N credit
None	14	35	13	35	16	60
Barley	18	100	16	60	8	0
Rye	11	10	5	0	5	0
Triticale	5	0	6	0	5	0

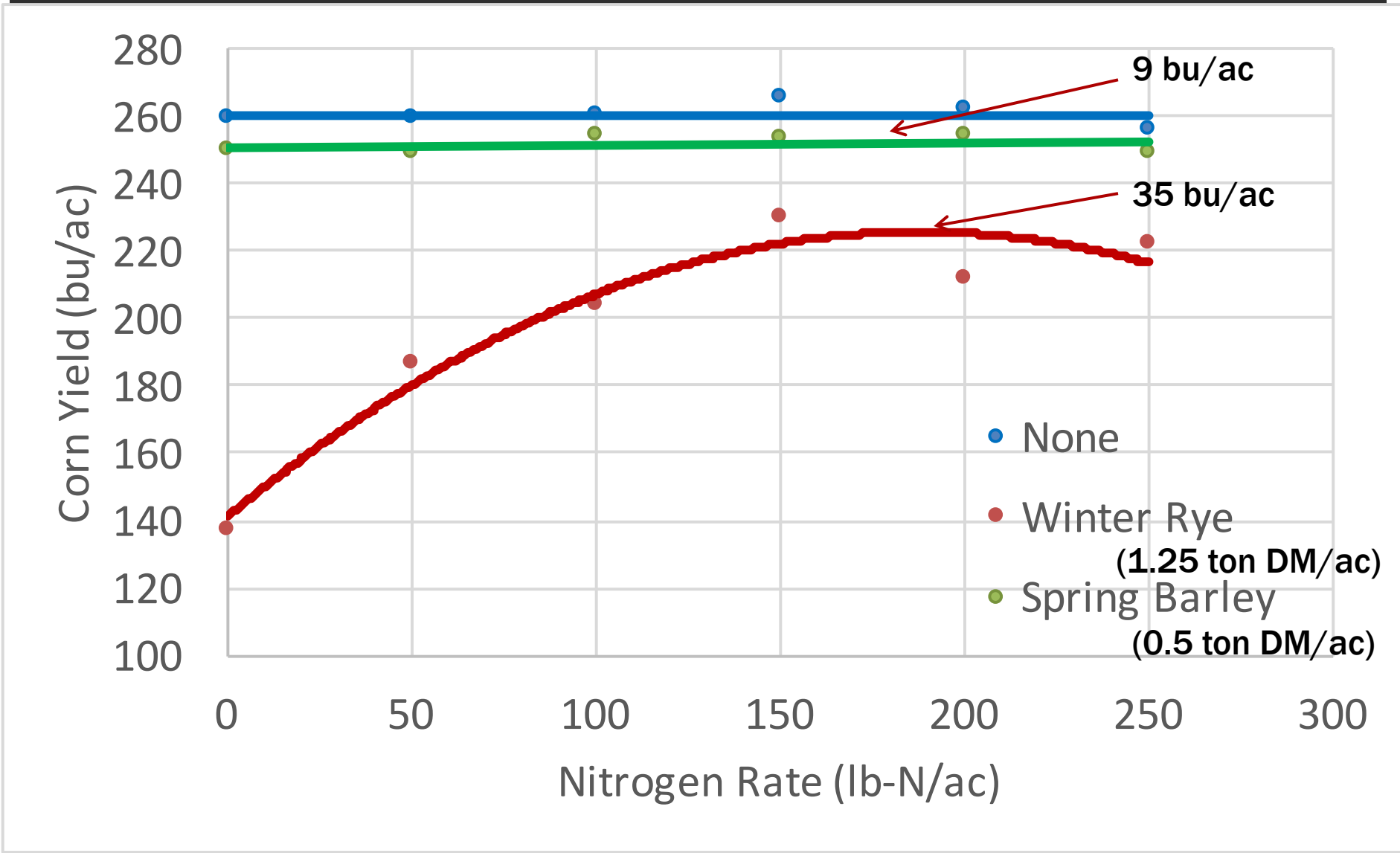
YIELDS

Yield drag flowing covers, although with spring barley can be reduced with more N

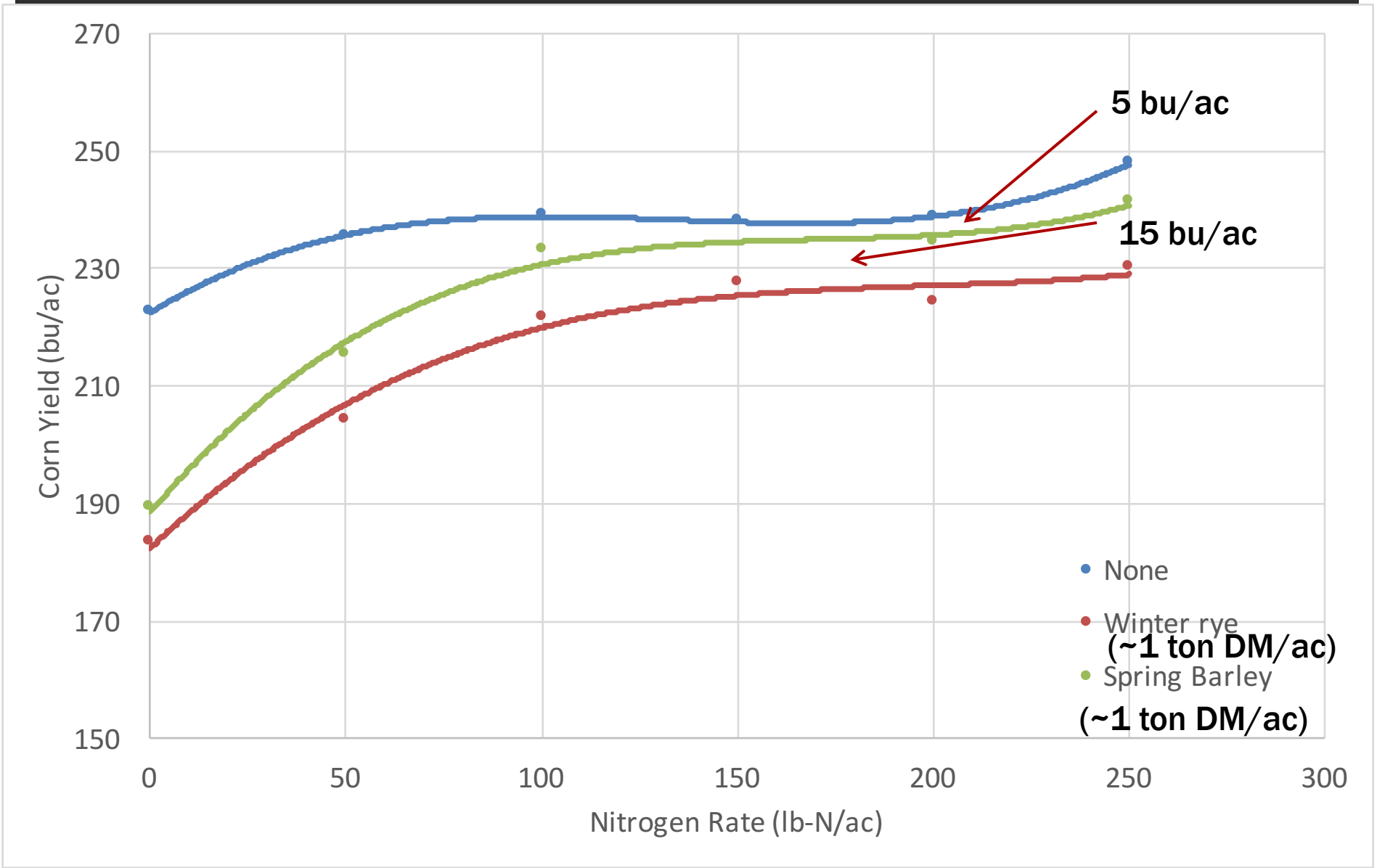


Arlington ARS

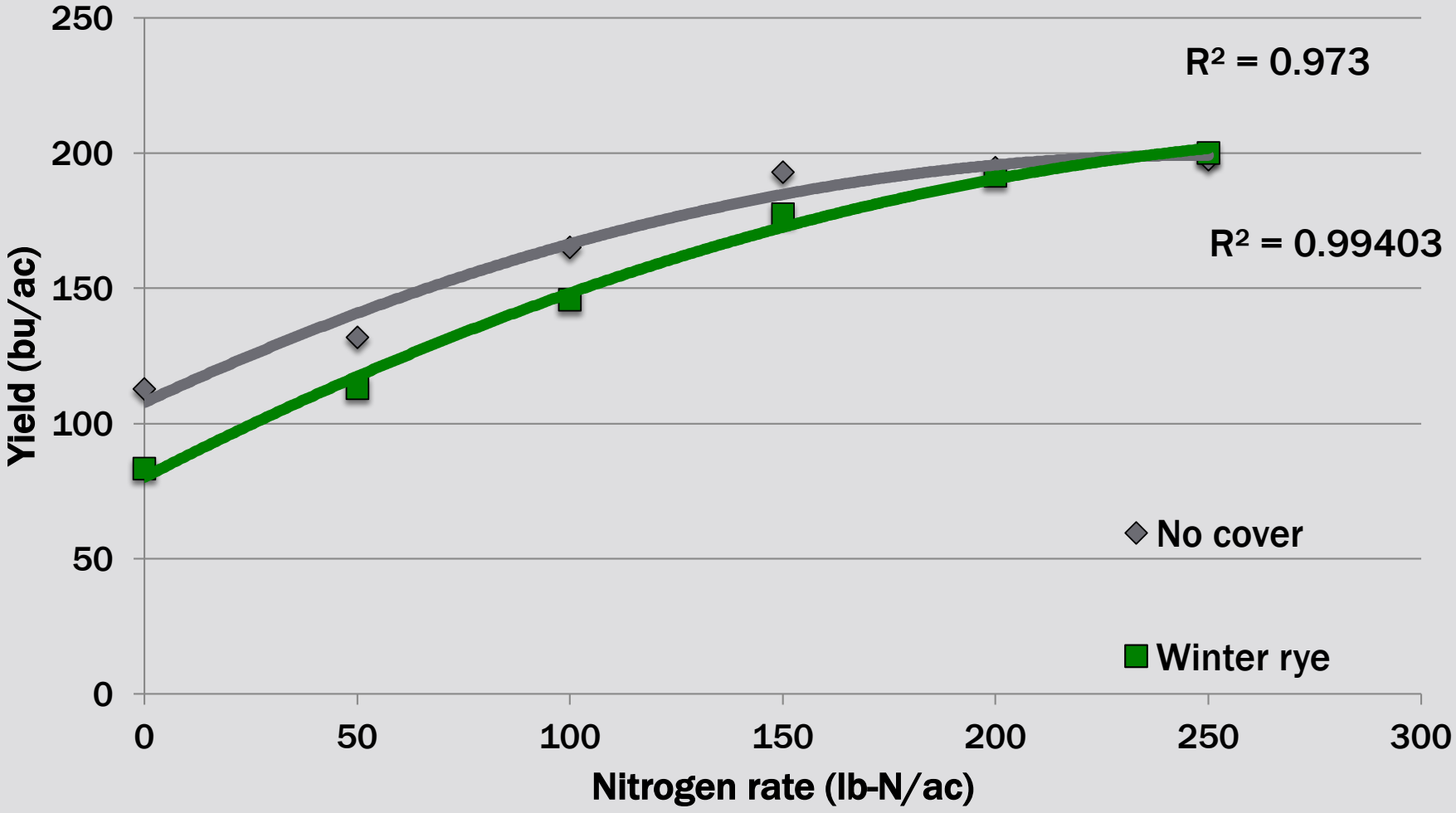
Flat responses at LAN, but still yield drag with spring barley. Larger yield drag (+30 bu/ac) with winter rye.



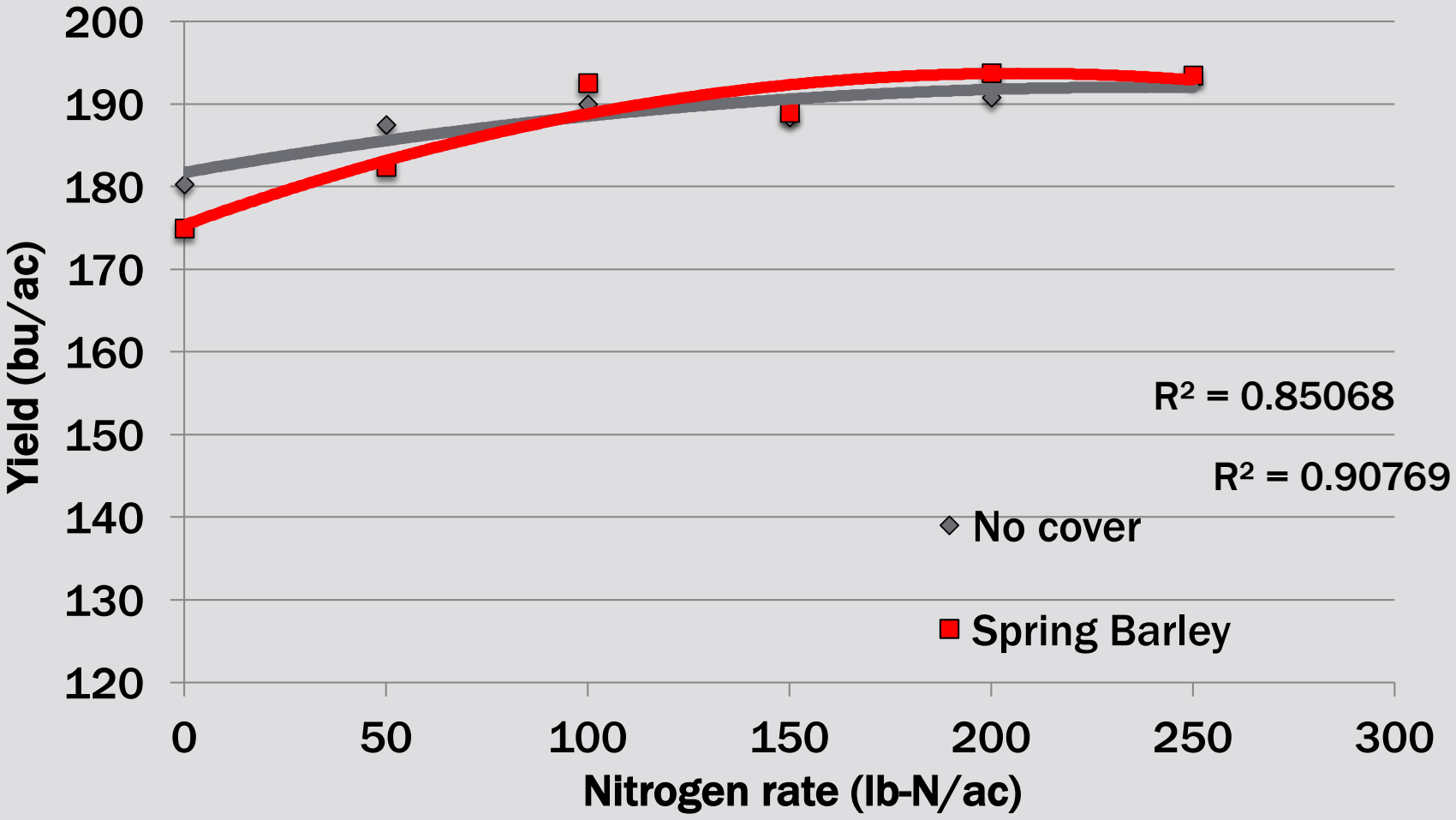
Same trend at MAR with small yield drag with barley, larger drag with rye.

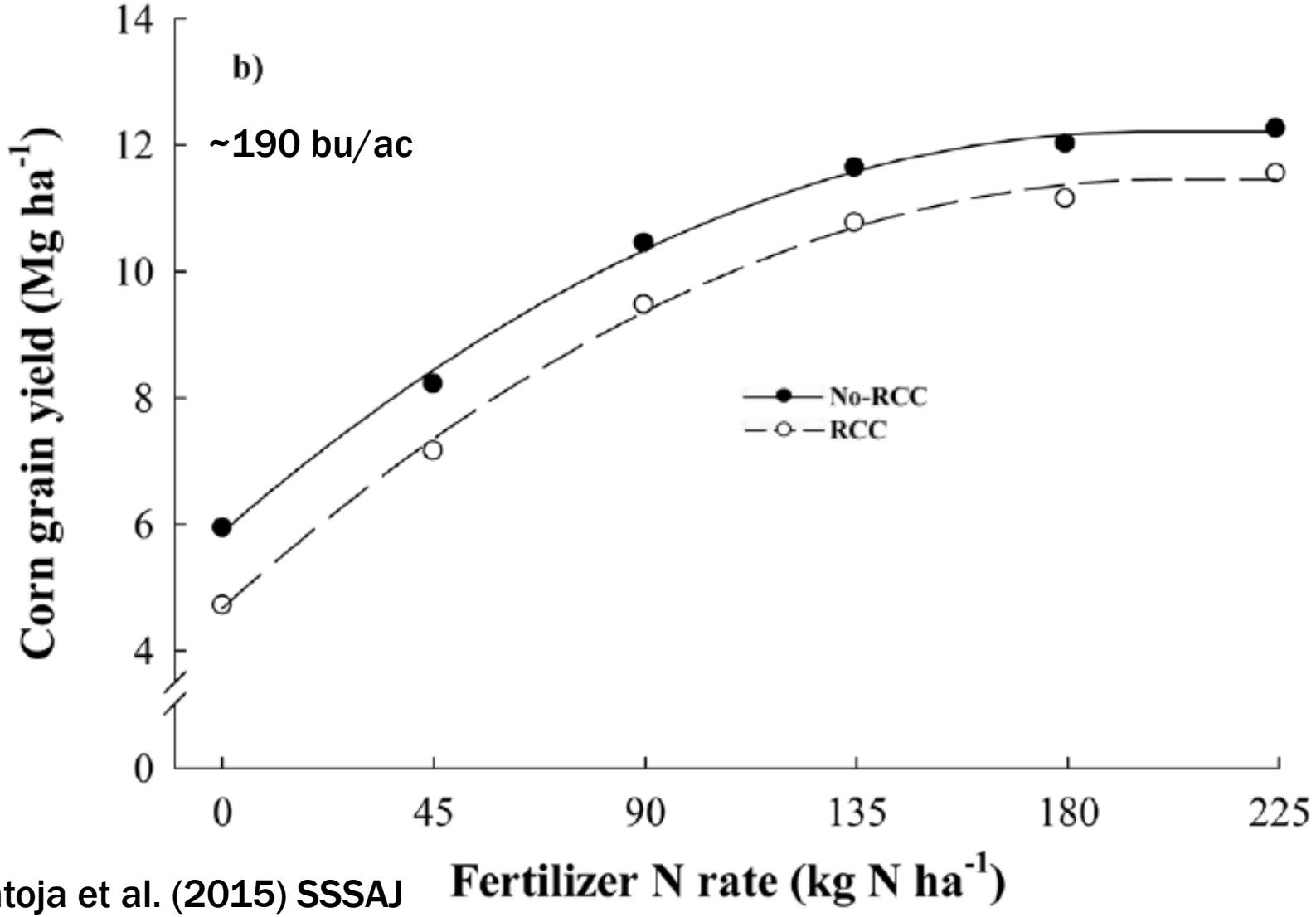


No yield drag, but different optimum N rate for winter rye (Lancaster 2015)



No statistical difference in yields among no cover and winter-killed covers (ARL '15)





Pantoja et al. (2015) SSSAJ

Two years, four locations = 8 site-years in Iowa
C-S rotation, always the first year effect of cover cropping

Corn

Average Yield Difference of the 50 trials displayed: **0.0** bu/acre.

90% Confidence Interval for the Average Yield Difference: from **-1.0** to **1.0** bu/acre.

Soybean

Average Yield Difference of the 12 trials displayed: **0.2** bu/acre.

90% Confidence Interval for the Average Yield Difference: from **-0.6** to **1.0** bu/acre.

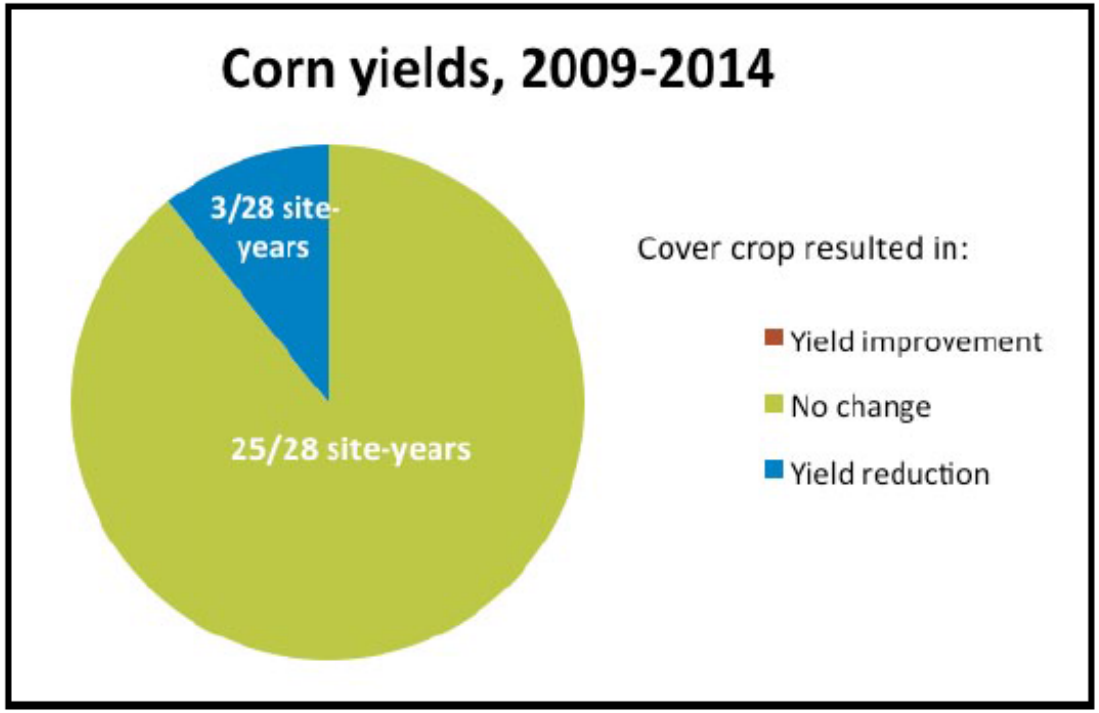


Figure 2. Trends with respect to cover crop effect on corn yields at 28 site-years from 2009 to 2014.

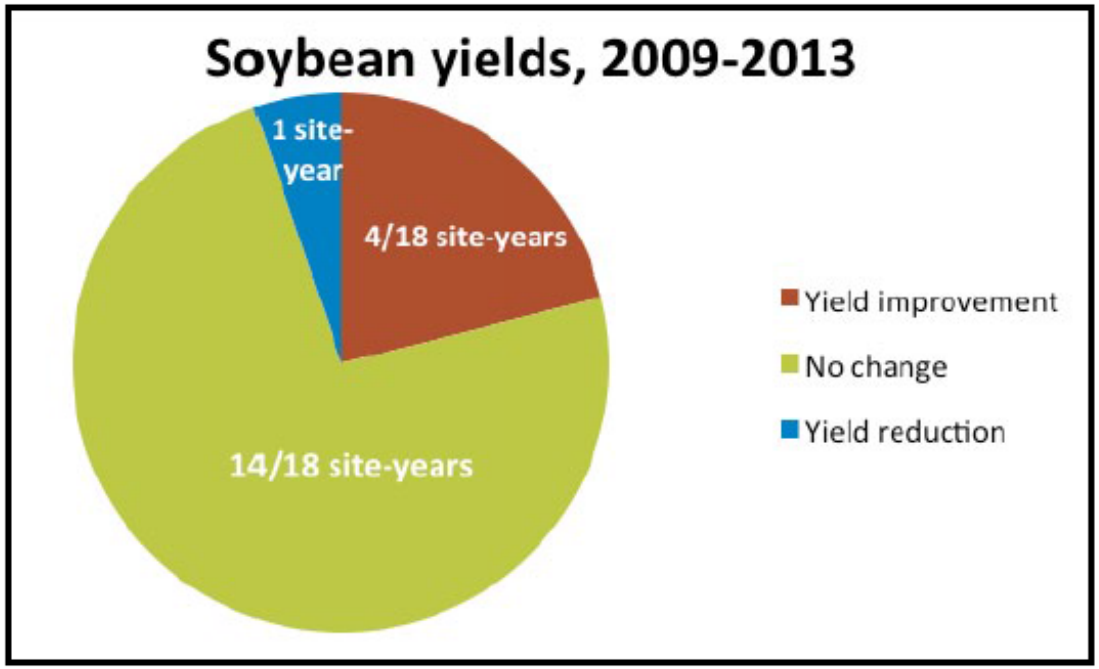


Figure 3. Trends with respect to cover crop effect on soybean yields at 18 site-years from 2009 to 2013.

WHO WINS, WHO LOSES?

WINNERS

- Soil
  - Reduction in erosion
- Groundwater quality
  - Reduction in nitrate leaching in fall

LOSERS

- Manure
  - Reduction in manure N credit (based on PSNT)
- Yield
  - Consistent reductions have been noted

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QUESTIONS?
COMMENTS?
CONCERNS?

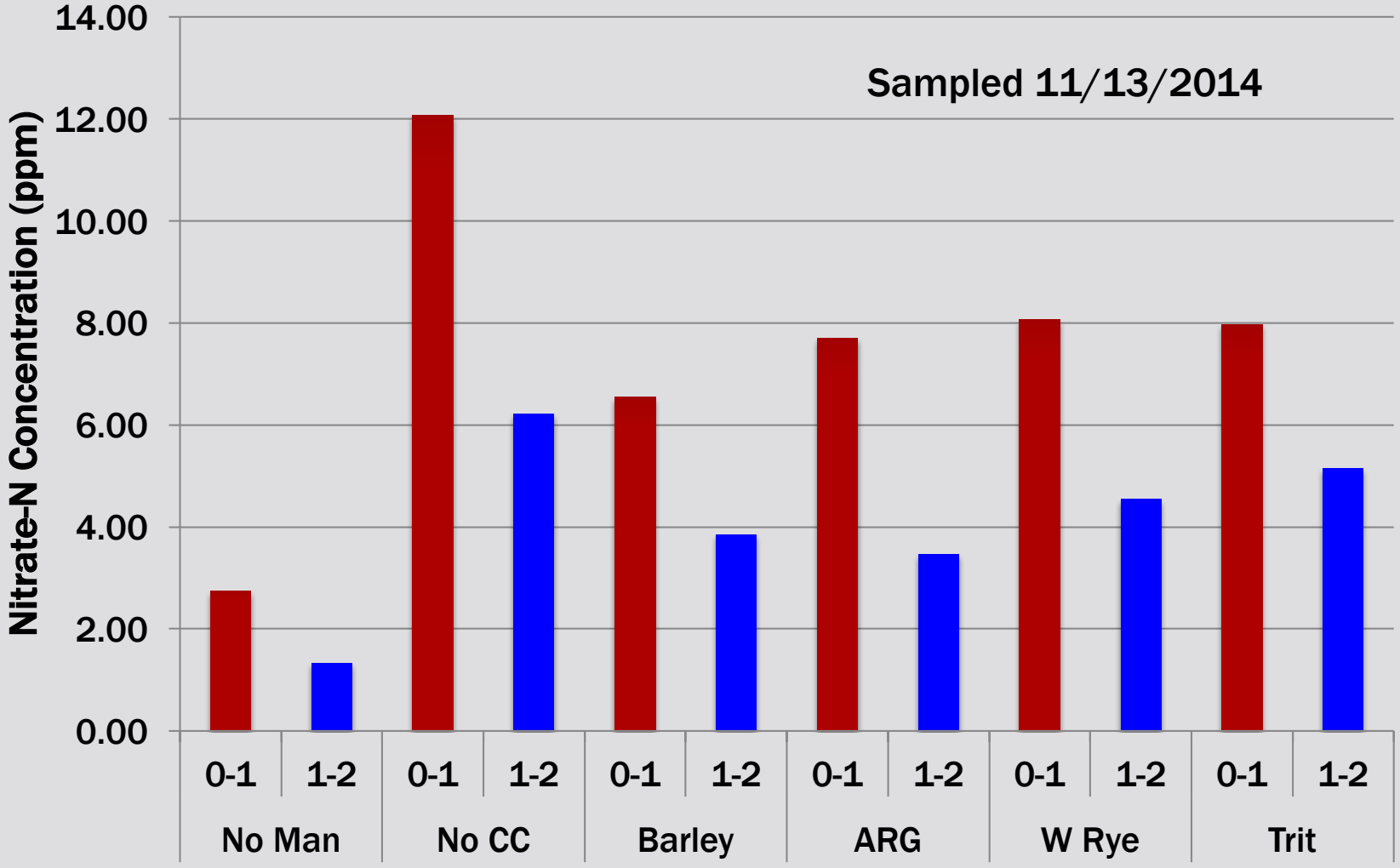
Lancaster

Cover	Winter DM biomass	Winter N Uptake	Winter C:N Ratio	Spring DM Biomass	Spring N Uptake	Spring C:N Ratio
	lb/ac	lb/ac		lb/ac	lb/ac	
Winter Rye	300	14	10	1,580	36	17
Annual Ryegrass	na	na	na			
Spring Barley	270	14	8			
Triticale	380	16	10	4,540	47	41

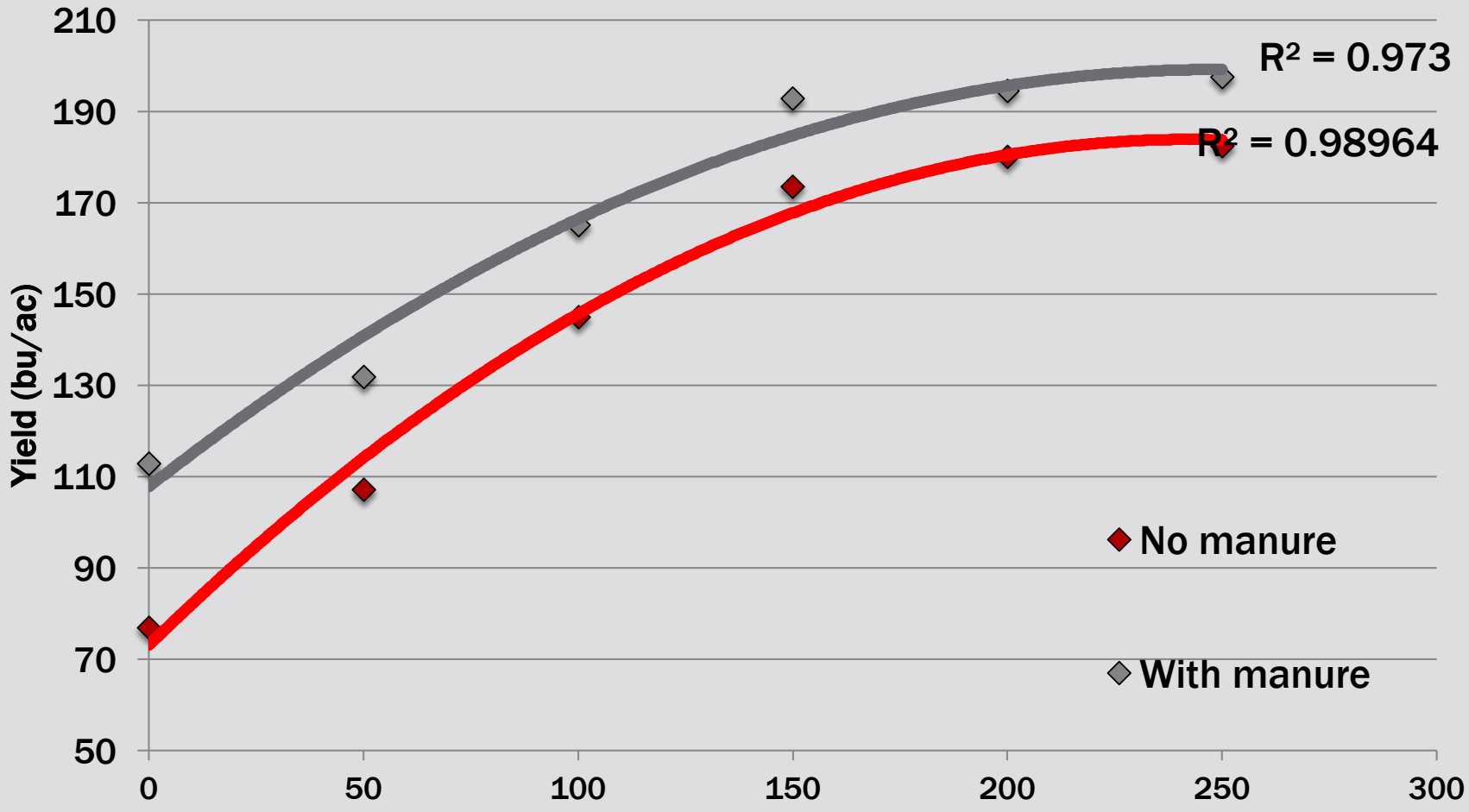
Terminated on April 29th

Harvested on June 2nd

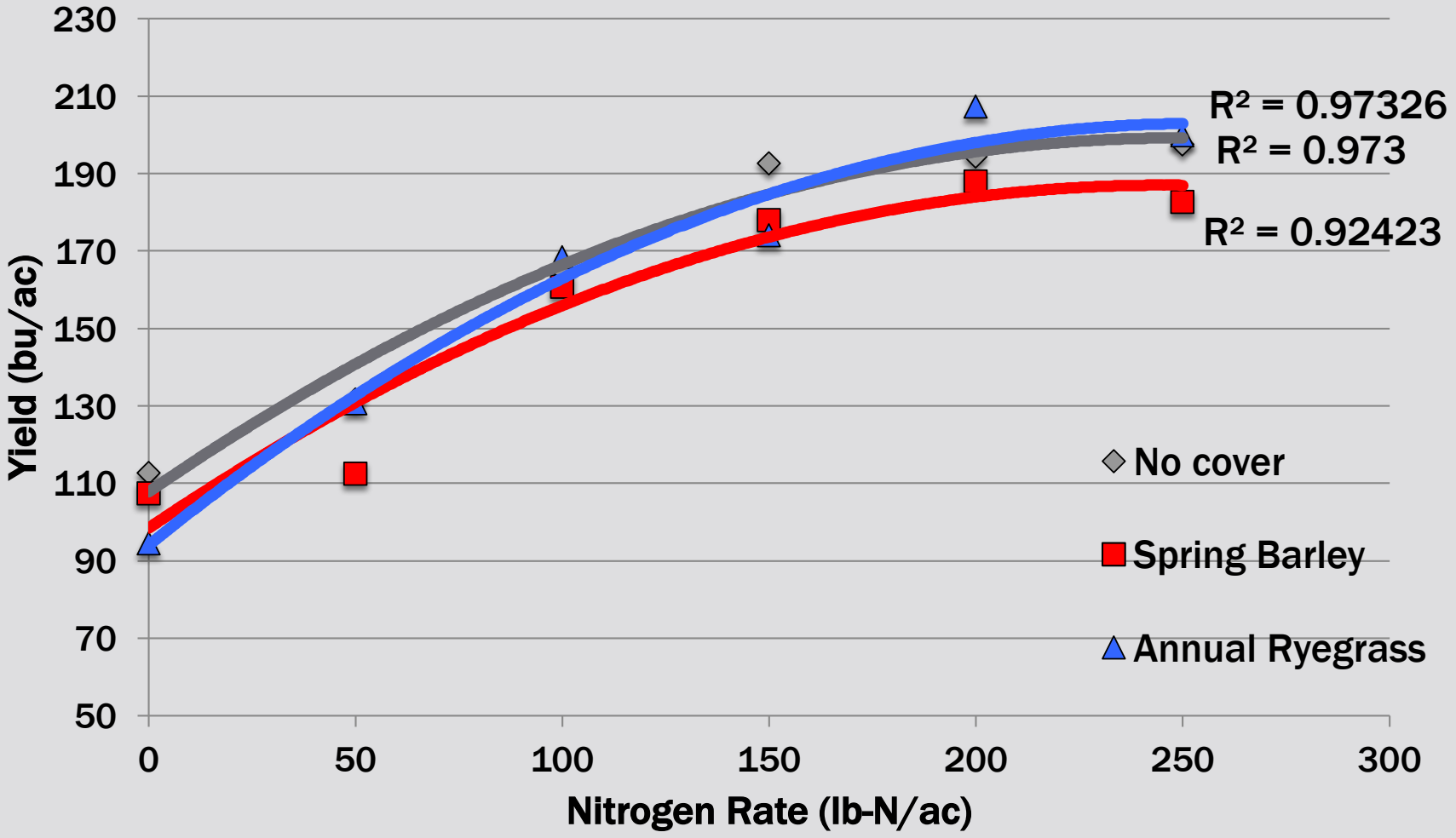
Slight reduction of soil nitrate at both 0-1 & 1-2' depths across all covers



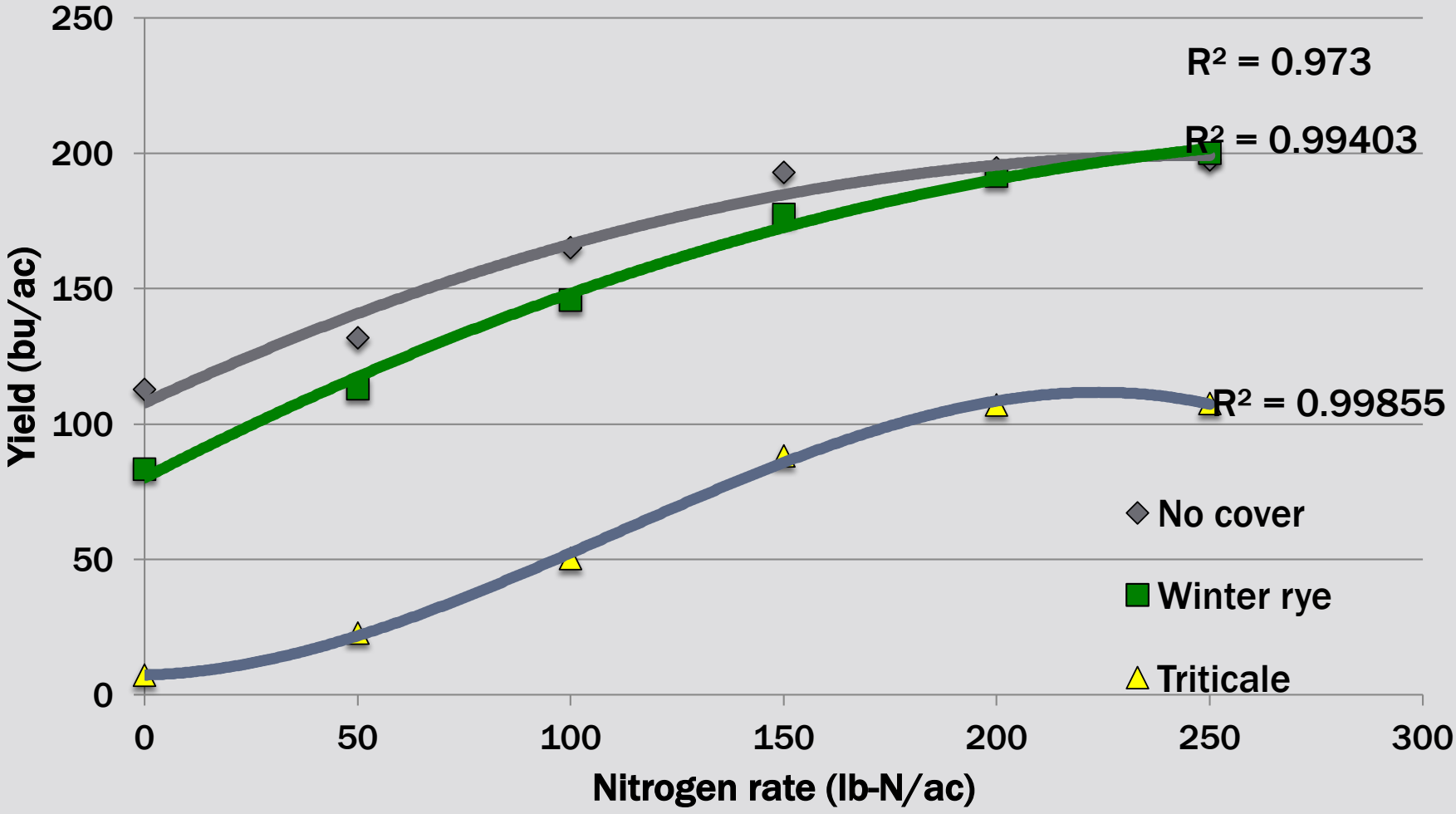
Addition of manure resulted in no N credit, but increased yields.



No yield drag with winter-killed covers, but more N required?



No yield drag, but different optimum N rate for winter rye



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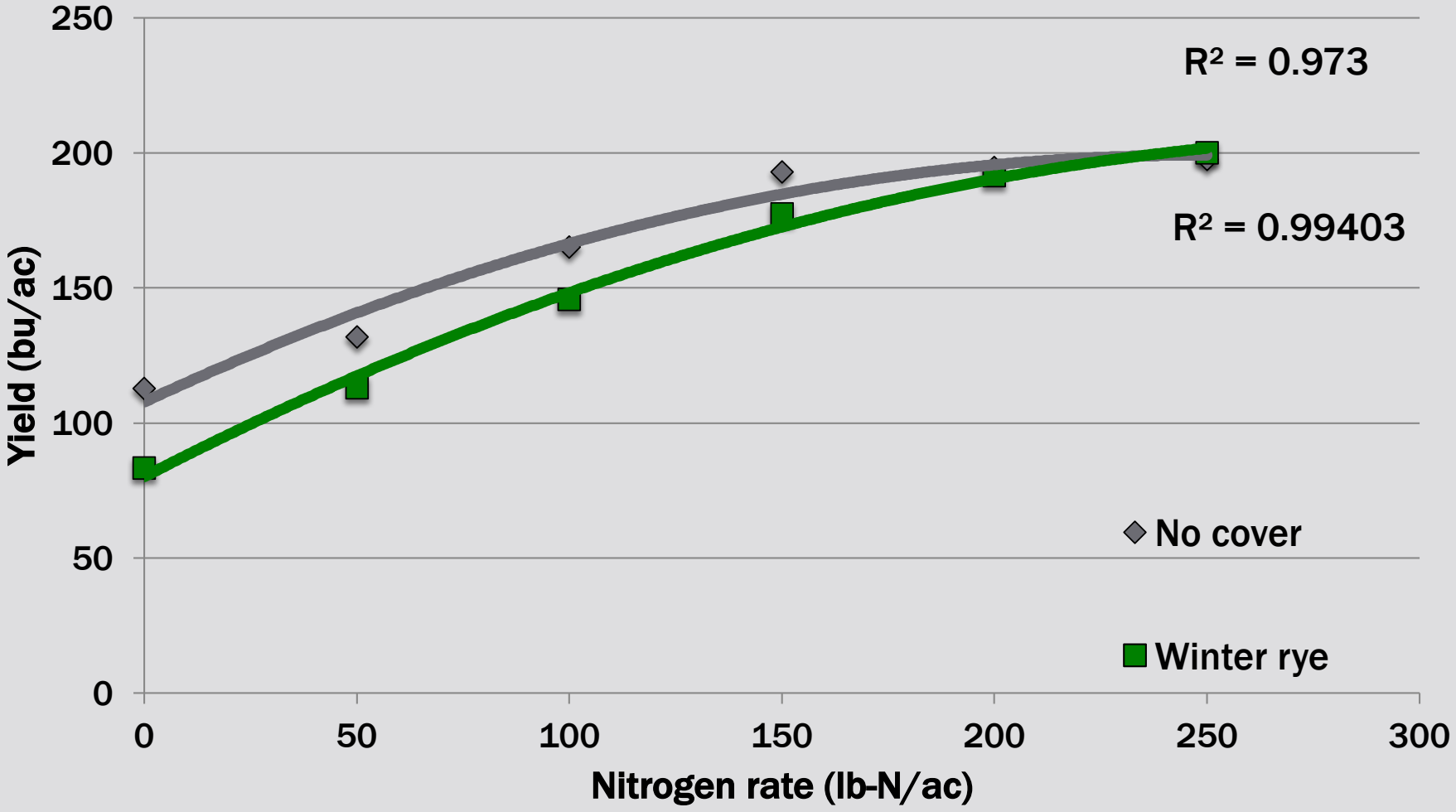


ARLINGTON

Arlington field plan

- Corn silage harvest (9/8/14)
- Liquid dairy manure application (9/17/14):
  - Injected at 10,000 gal/ac
  - 4.6% solids
  - 100 lb-N credit
- Light cultivation prior to cover crop planting (9/18/14)
- Barley and Annual ryegrass winterkilled
- Winter rye burndown (4/30/15)
- Corn planted (5/8/15); 5 lb-N in starter
- Remainder of N applied as broadcast urea with Agrotain®
- Triticale harvest + late corn planting (5/22/15)

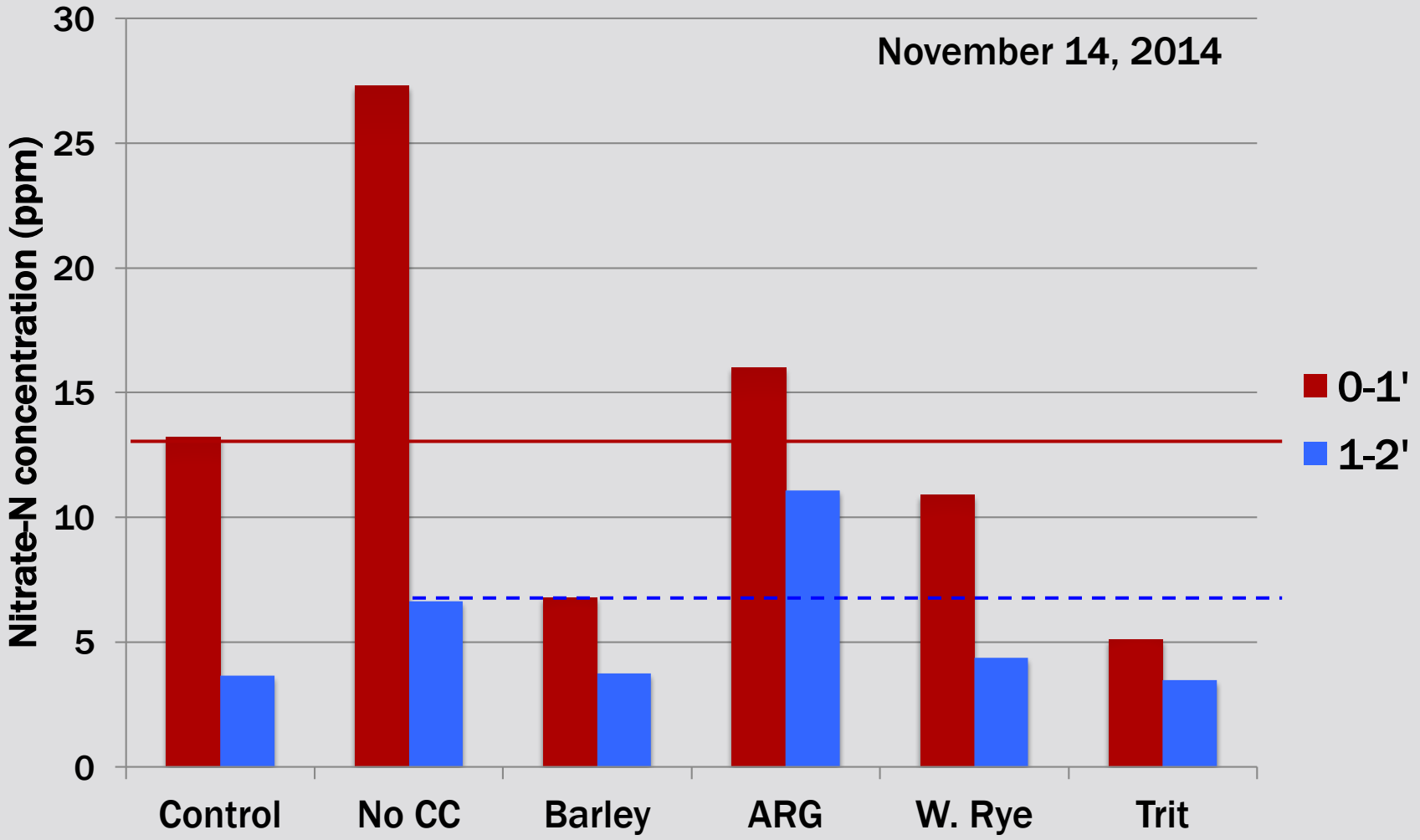
Triticale & Spring Barley had faster growth and more biomass in the fall

Cover	Winter DM biomass	Winter N Uptake	Winter C:N Ratio	Spring DM Biomass	Spring N Uptake	Spring C:N Ratio
	lb/ac	lb/ac		lb/ac	lb/ac	
Winter Rye	580	25	9	2,460	83	12
Annual Ryegrass	550	20	10			
Spring Barley	780	42	8			
Triticale	880	41	9	6,350	129	20

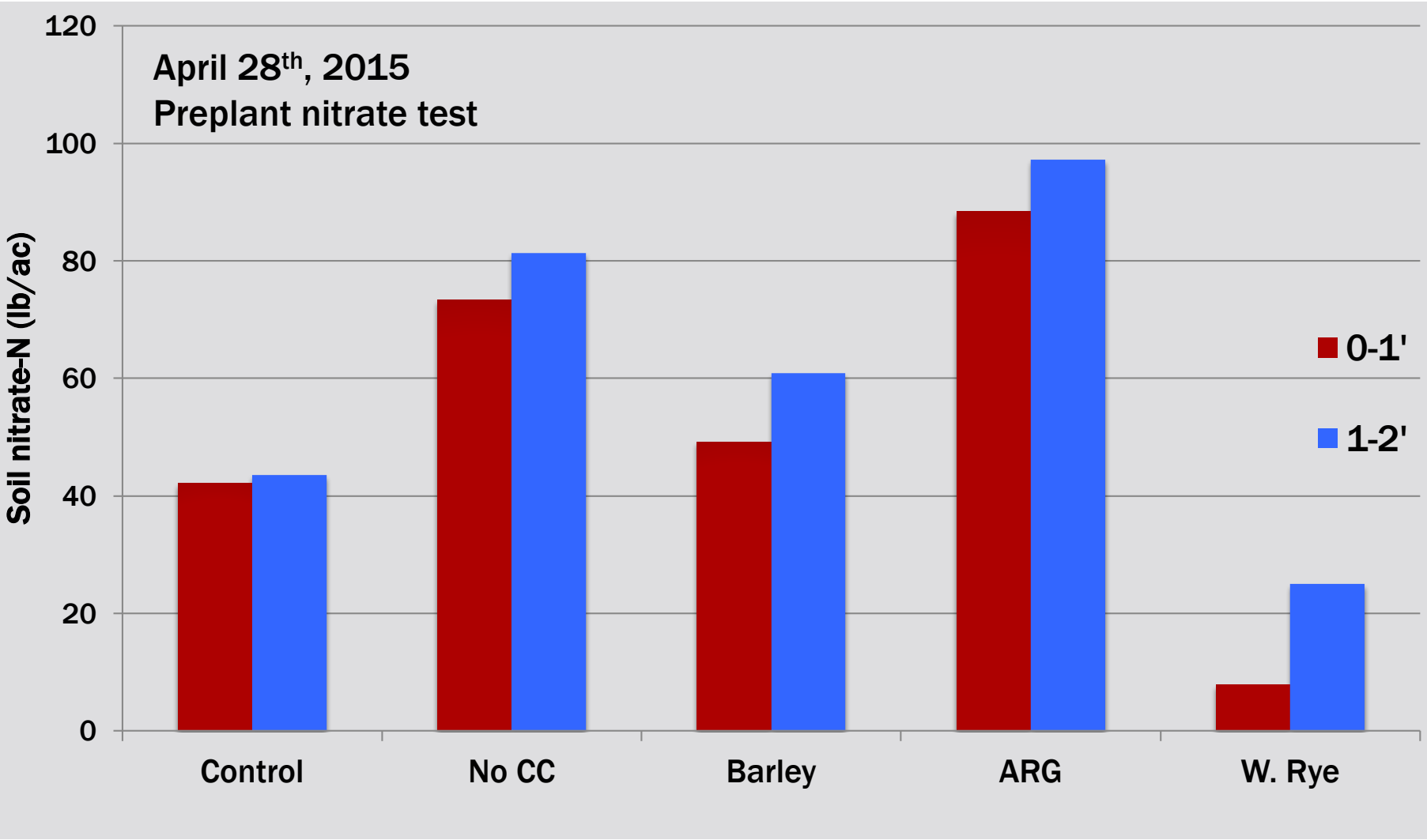
Terminated on April 30th

Harvested on May 22nd

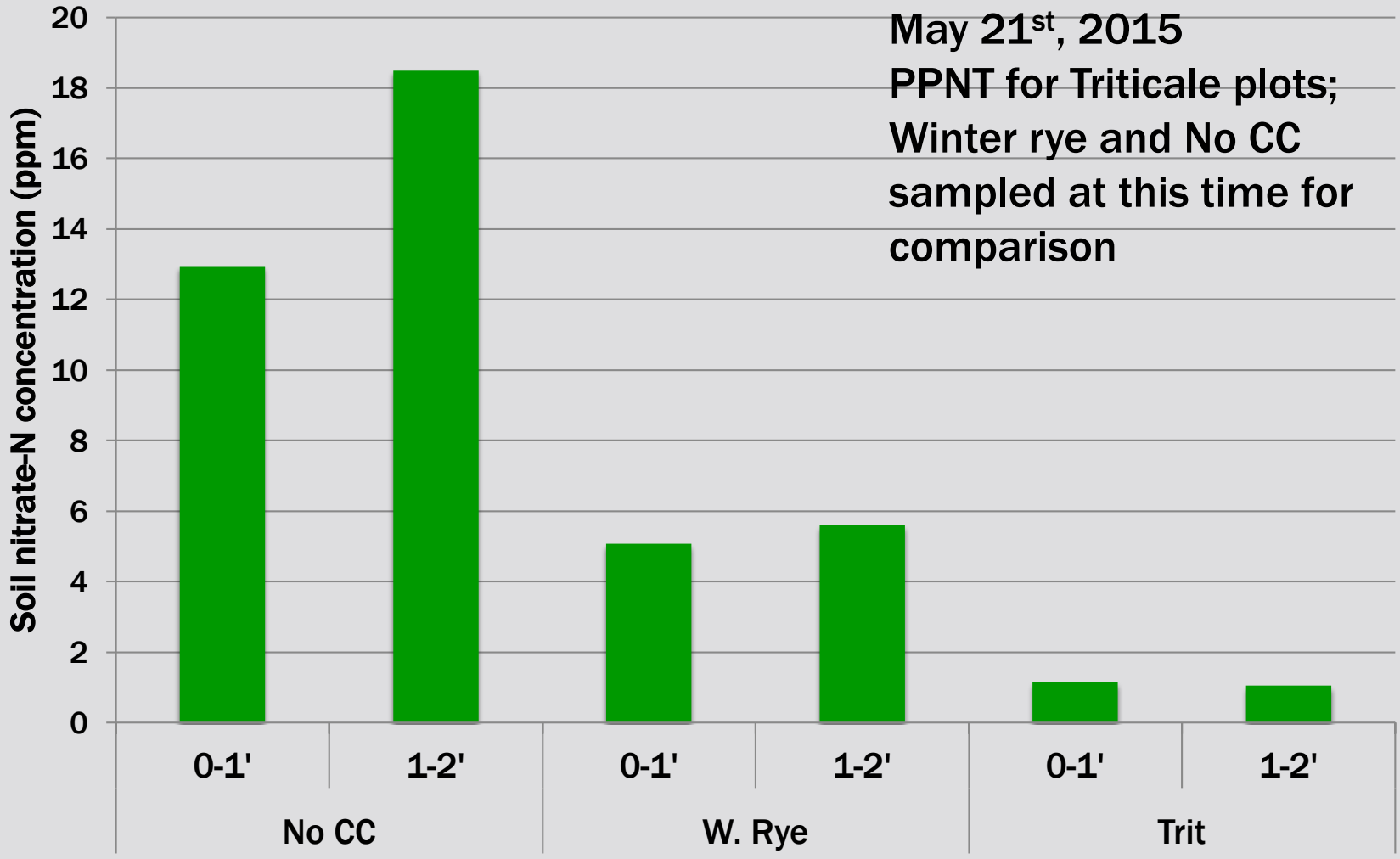
Cover crops reduce fall soil nitrate, some even relative to no manure control.



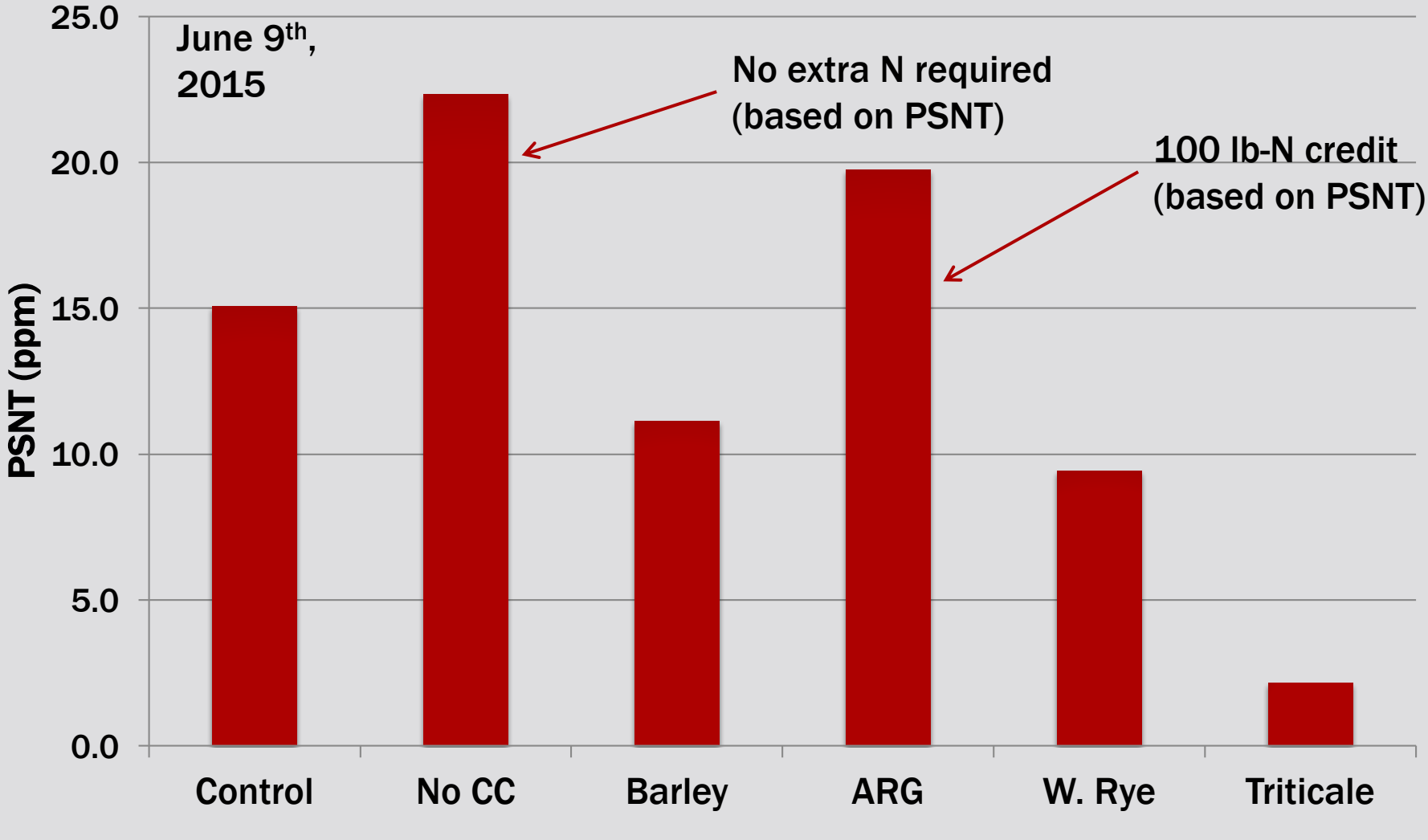
Spring growth of winter rye further reduced soil nitrate-N



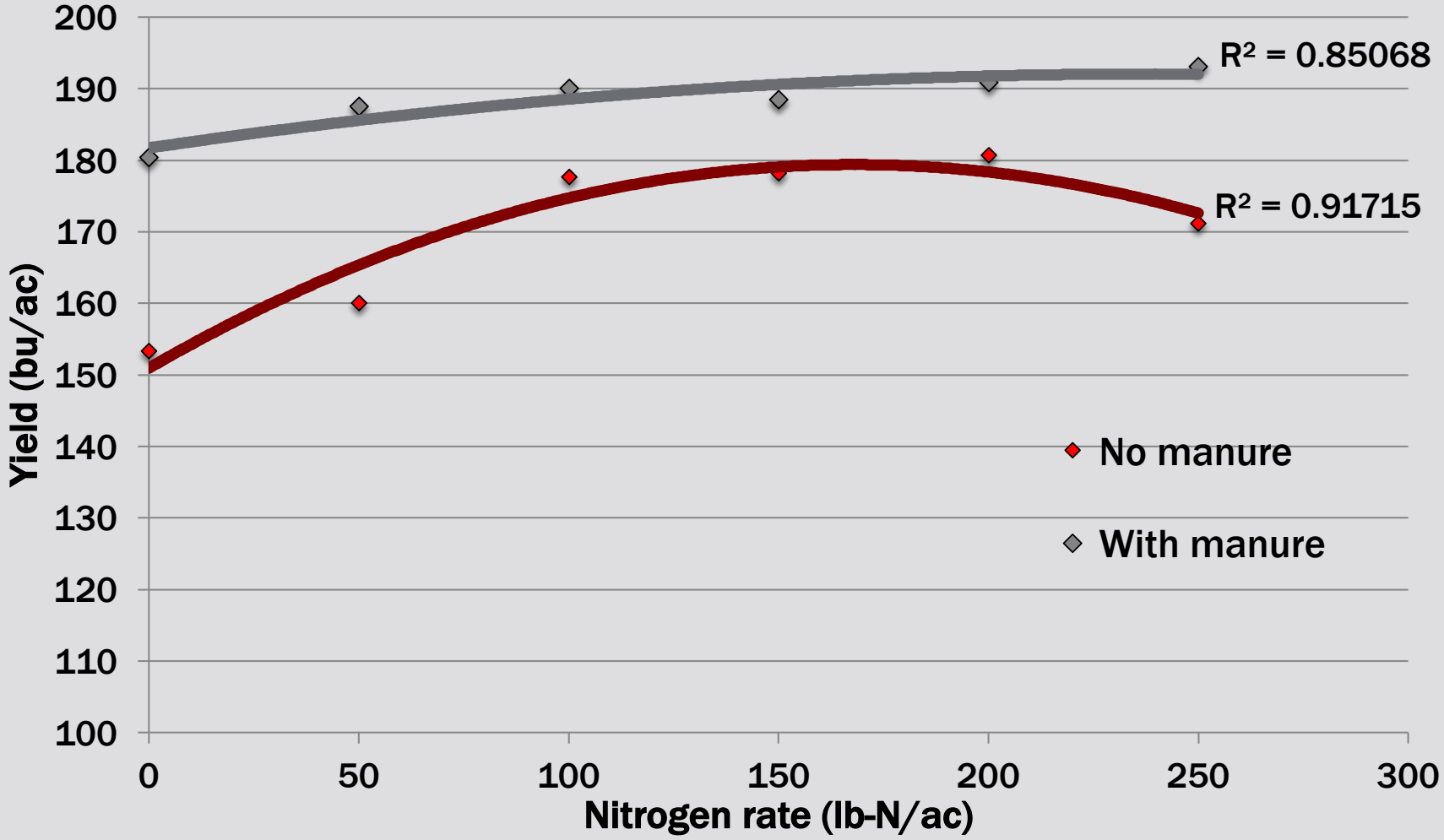
Triticale depletes soil nitrate; Winter rye maintains low soil nitrate into season



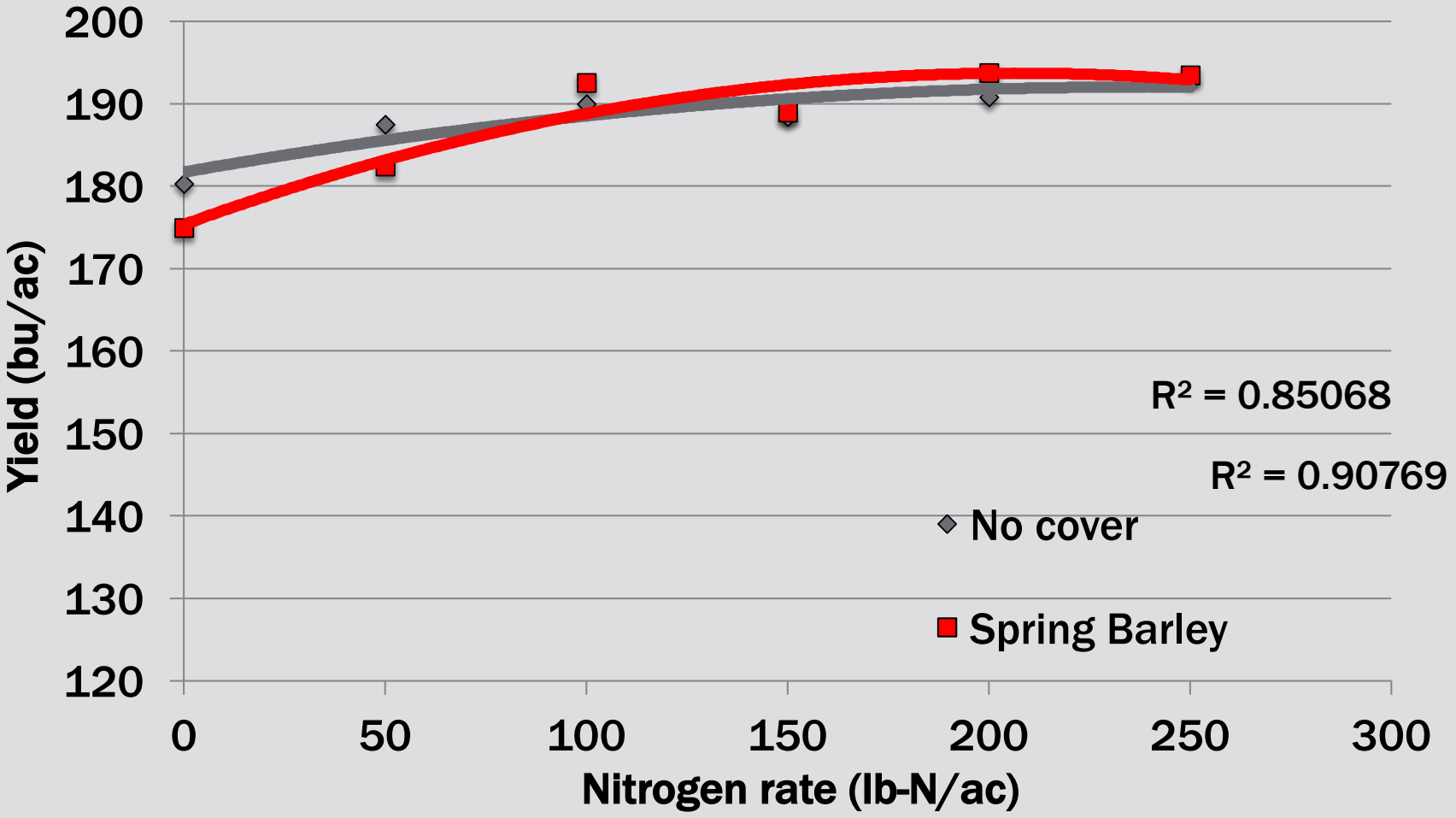
Barley, Winter Rye, and Triticale eliminated the N credit based on PSNT (0-1')



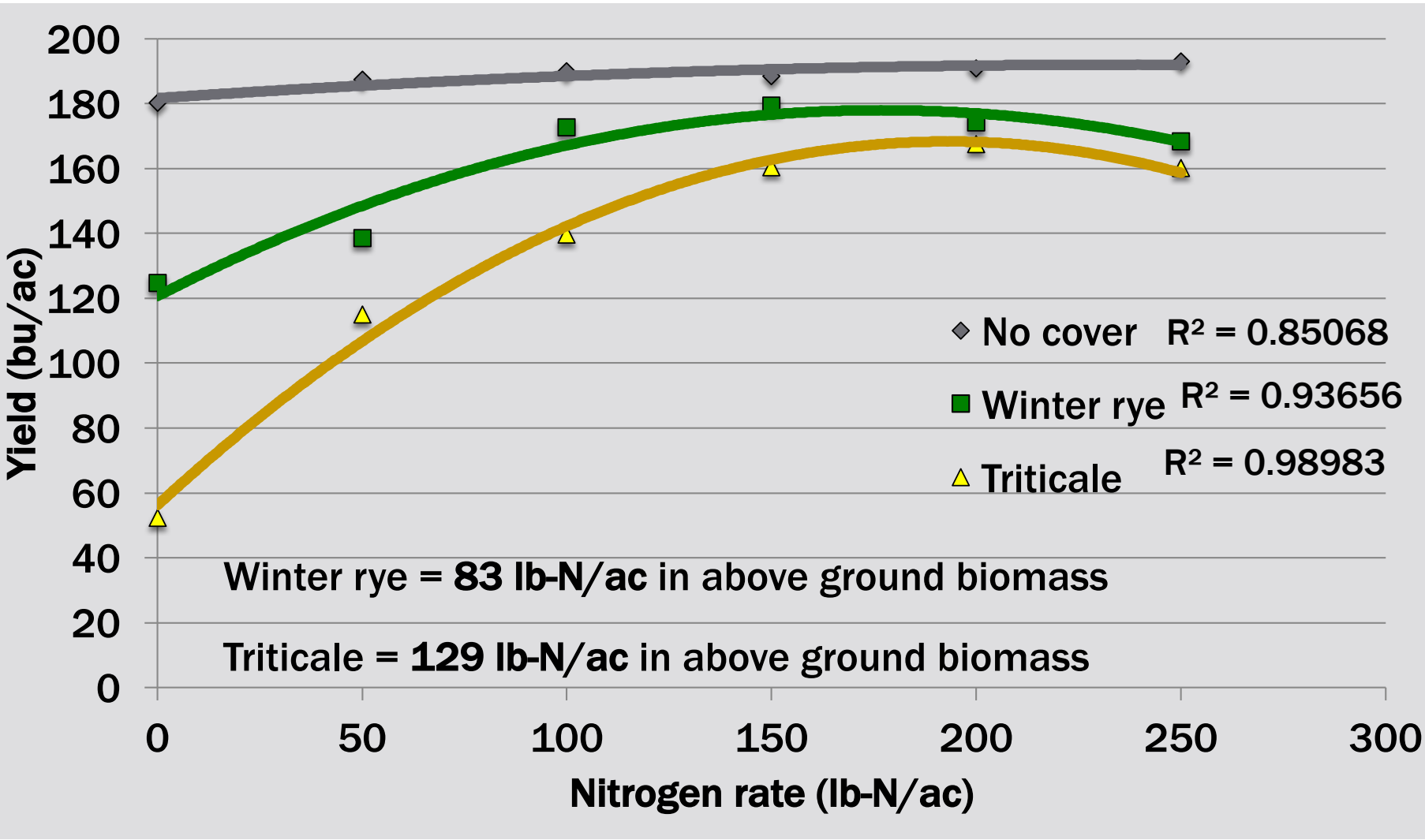
Manure N credit and a yield gain over plots with no fall manure/No CC.



No statistical difference in yields among no cover and winter-killed covers.



Clear difference in optimum N rate with Rye or Triticale, and some yield drag with winter rye.



HANCOCK

Hancock field plan

- Corn silage harvest (9/23/14)
- Liquid dairy manure application (9/26/14):
  - Surface applied, incorporation within 1-3 hours
  - 10,000 gal/ac, 4.5% solids
  - 99 lb-N/ac credit
- Field finisher prior to planting cover crops (10/1/14).
- Barley and Annual ryegrass winterkilled
- Winter rye burndown (5/4/15)
- Corn planted (5/8/15), 20 lb-N in starter
- Remainder of N applied as broadcast urea in 2-3 splits
- Triticale harvest + late corn planting (5/28/15)

Less growth at Hancock compared to Arlington, with greater C:N ratios

Cover	Spring DM Biomass	Spring N Uptake	Spring C:N Ratio
	lb/ac	lb/ac	
Winter Rye	920	16	24
Triticale	2,000	27	31

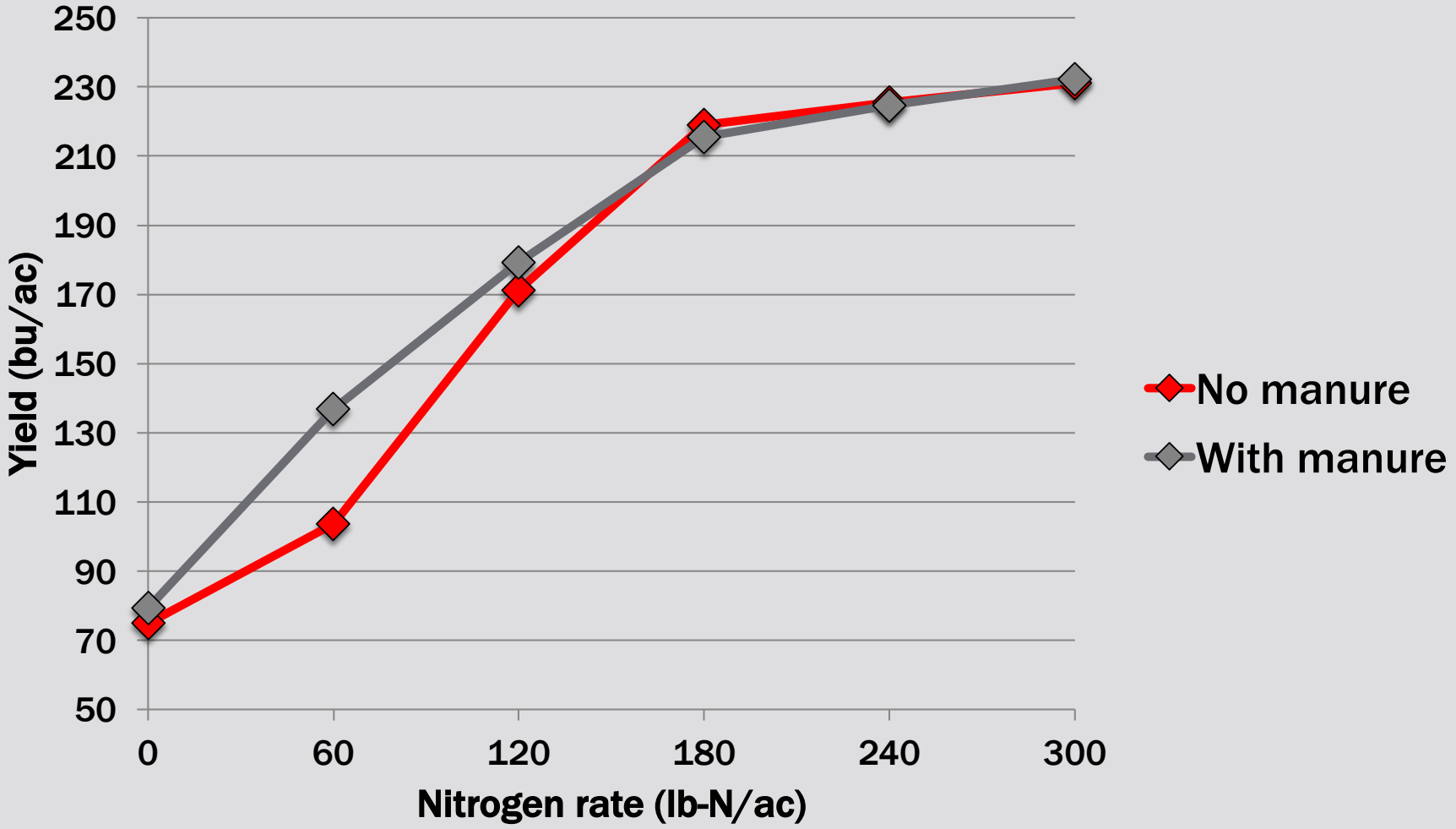
Terminated on May 1st

Harvested on May 28th

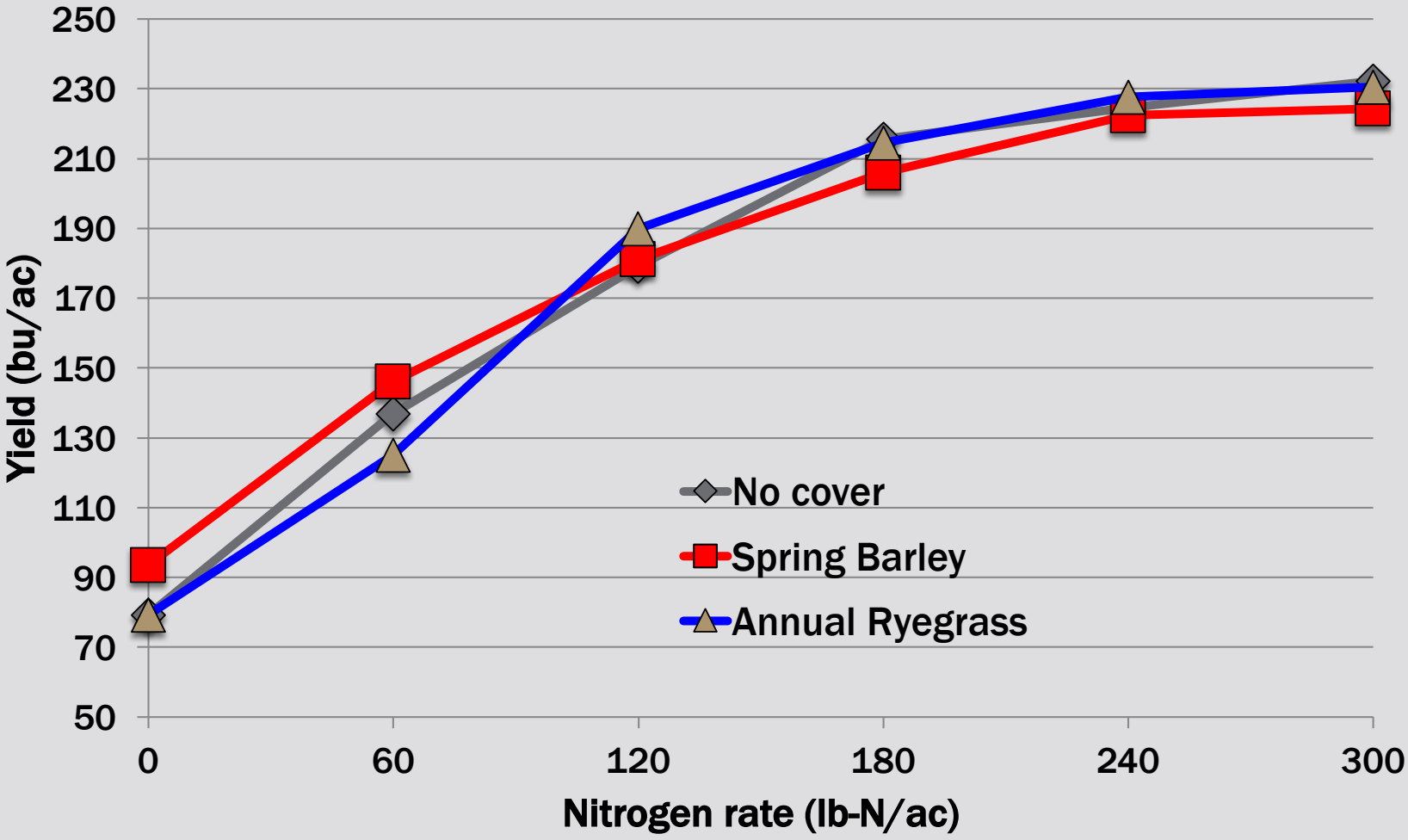
There's never any nitrate in these soils, so why do I keep on measuring it?

	Winterkill	Preplant	Triticale preplant	~PSNT
	11/11/14	5/1/15	5/28/15	6/17/15
	Nitrate–N (ppm)			
No manure	8.55	1.00		0.78
No cover	**9.44**	**2.04**	**1.11**	**0.95**
Spring Barley	8.29	2.36		1.37
ARG	8.61	1.45		0.77
Winter Rye	11.70	0.64	0.84	0.85
Triticale	11.61		1.96	1.67

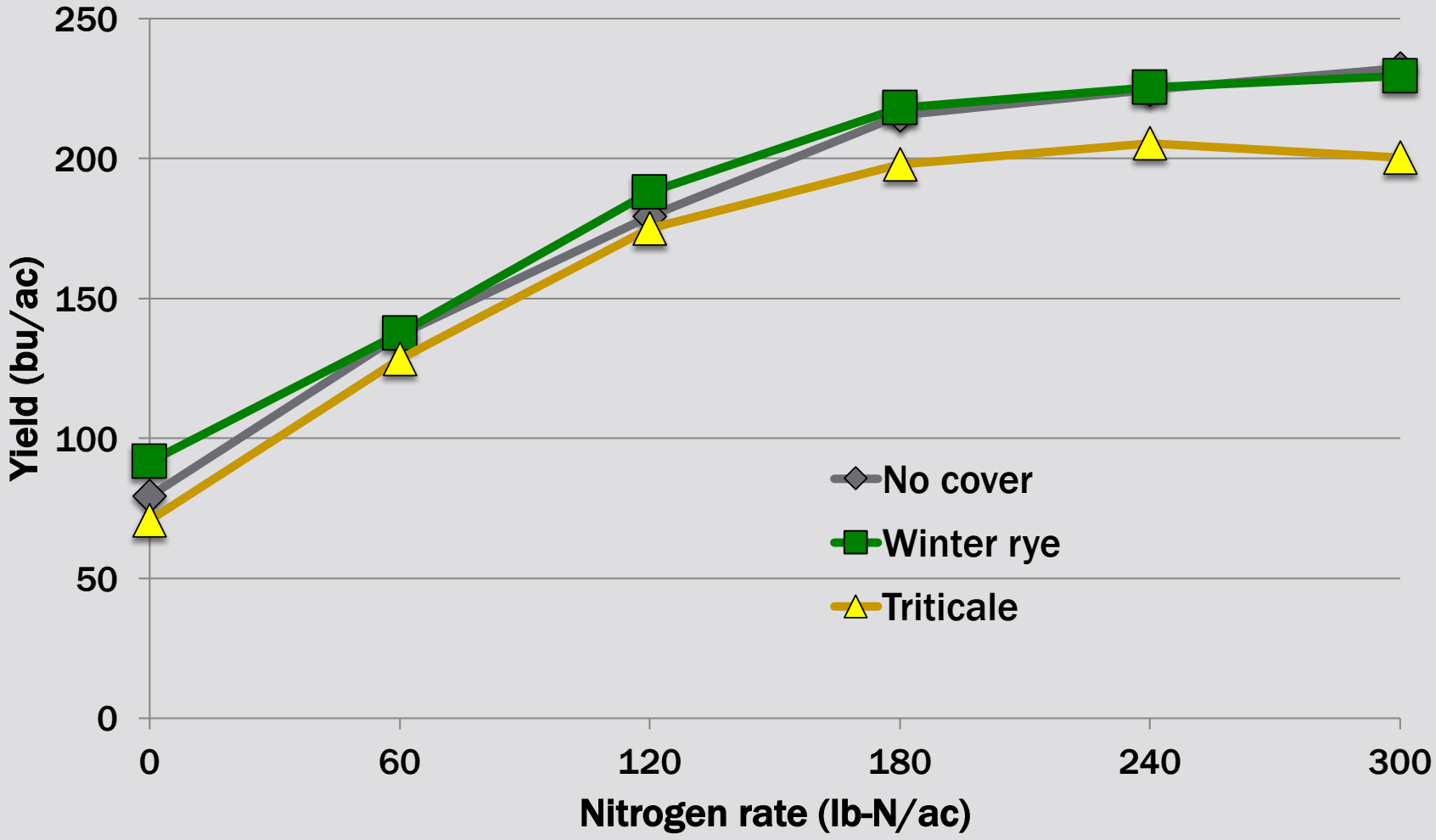
Manure increased yields at lower N rates, but did not affect optimum N rate (nor yield at optimum N rate)



No difference in yields or N response with winter-killed covers



Winter rye did not affect yield relative to No CC; some yield drag with triticale.



CONCLUSIONS

- Fall-seeded cover crops that winterkilled (annual ryegrass and barley) did not reduce yields compared to no cover crop treatments.
- Winter rye may have caused yield drag or an increase in optimal N rate at some locations.
- Harvesting triticale as silage always lowered the subsequent corn grain yield.

- **Decreased soil nitrate (fall & spring) reduces leaching.**
- **Increased soil coverage reduces erosion.**

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