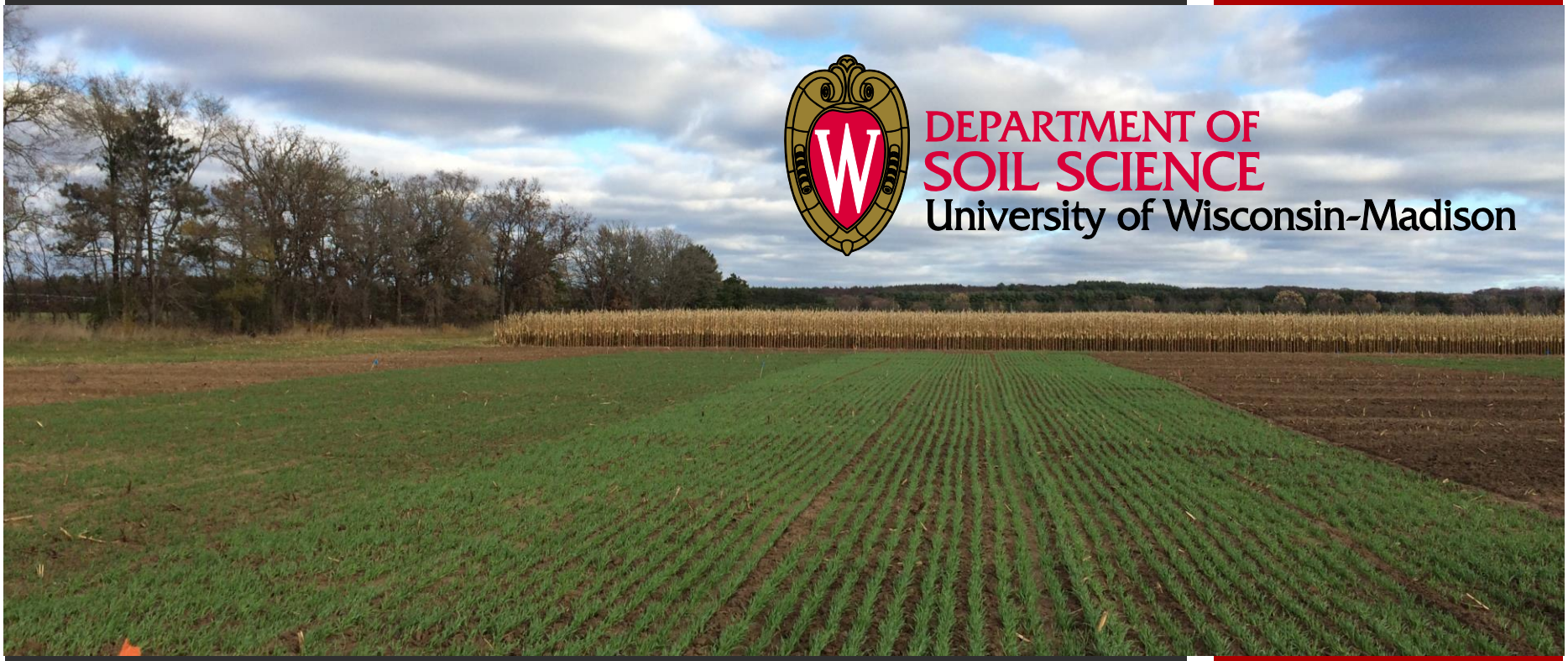
Proceedings of the 2nd Annual Nitrogen: Minnesota's' Grand Challenge & Compelling Opportunity Conference

COVER CROPS & NITROGEN MANAGEMENT



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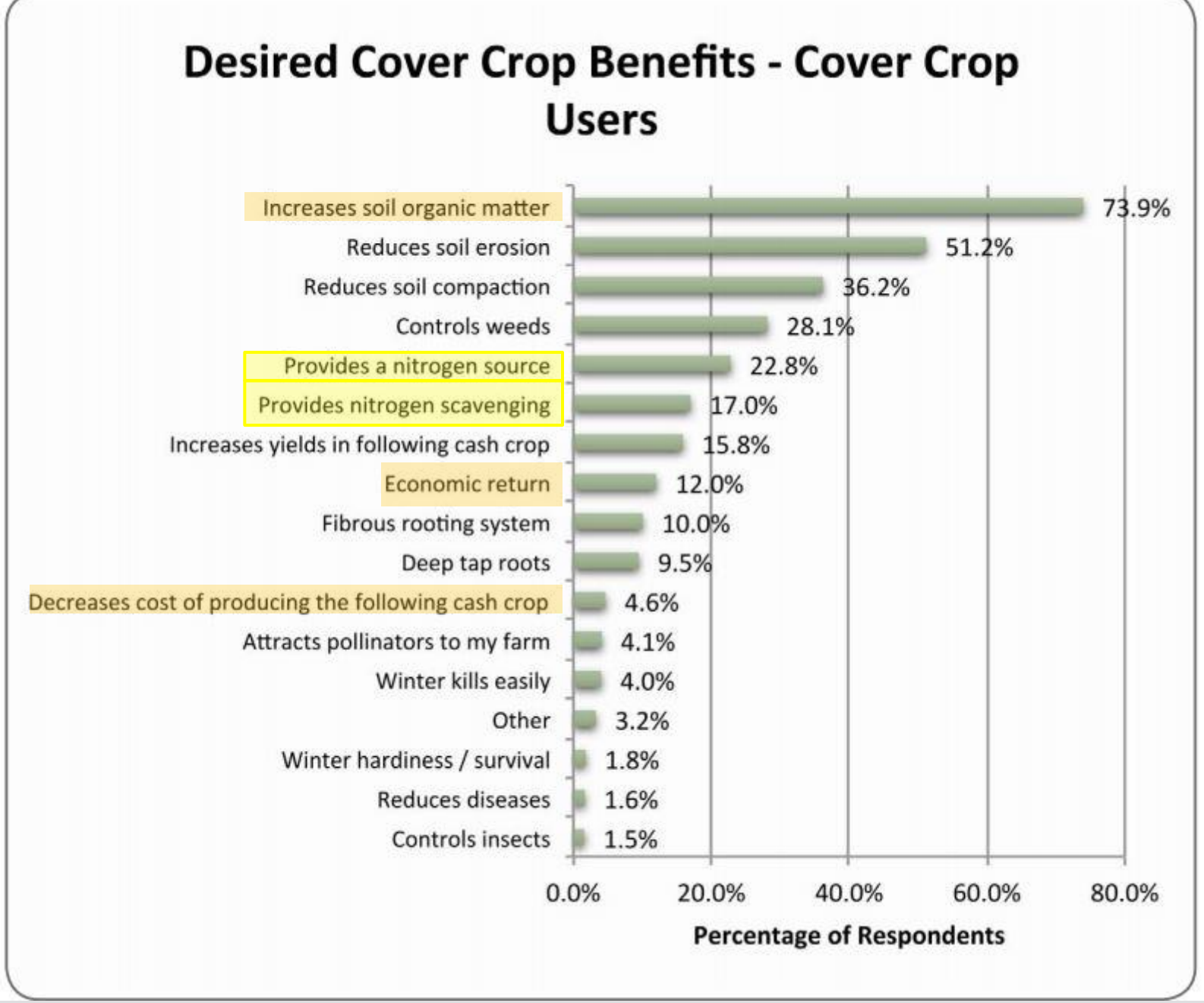


2013-2014 Cover Crop Survey conducted by North-Central SARE (www.sare.org)

USDA United States Department of Agriculture
USDA-ARS Northern Great Plains Research Laboratory

Cover Crop Chart

AREA 4 SCD Cooperative Research Farm

GROWTH CYCLE	PLANT ARCHITECTURE	RELATIVE WATER USE
A = Annual	♈ = Upright	= Low
B = Biennial	✱ = Upright-Spreading	= Medium
P = Perennial	〰 = Prostrate	= High

COOL — WARM

-- GRASS --			BROADLEAF					-- GRASS --	
				LEGUME					
A BARLEY ♈								A AMARANTH ♈	A FOXTAIL MILLET ♈
A OAT ♈	A/B CANOLA ✱	A/B CAMELINA ♈						A BUCKWHEAT ♈	A PEARL MILLET ♈
A WHEAT ♈	A/P MUSTARD ✱	A PHACELIA ♈	A FIELD PEA ✱	A BERSEEM CLOVER ♈	A/B VETCH 〰	A COWPEA ✱	A CLUSTER BEAN ♈	A QUINOA ♈	A PROSO MILLET ♈
A CEREAL RYE ♈	A RADISH ✱	A FLAX ♈	A LENTIL ✱	A CRIMSON CLOVER ♈	P BIRDSFOOT TREFOIL 〰	A/P FENUGREEK ♈	A SUNNHEMP ♈	P CHICORY ✱	A GRAIN SORGHUM ♈
A TRITICALE ♈	B TURNIP ✱	A KALE ✱	A LUPIN ♈	A/P RED CLOVER ♈	A/B SWEET CLOVER ♈	P PIGEONPEA ✱	A MUNG BEAN ✱	A CUCURBITA 〰	A SUDAN GRASS ♈
A ANNUAL FESCUE ♈	B BEET ✱	A SPINACH ✱	A/P MEDIC ✱	P WHITE CLOVER 〰 ♈	P SAINFOIN ♈	A CHICKPEA ✱	A SOYBEAN ✱	A SAFFLOWER ♈	A TEFF ♈
P SALINE TOLERANT ♈	A/B CARROT ✱	A/B CHARD ✱	P ROUNDHEAD LESPEDEZA ♈	P KURA CLOVER 〰	P ALFALFA ♈	A FAVA BEAN ♈	A/P PEANUT ✱ 〰	A SUNFLOWER ♈	A CORN ♈

V 2.1. January 2016

www.usda.gov and search term “cover crop 20323”

◈ *Additional Information*

COVER CROPS & NITROGEN

Cover crops can:

1) Scavenge (or trap) N

   Benefit: reduce leaching

   Drawback: N availability for following crop?

2) Produce N

   Benefit: reduce N application

   Drawback: Potential asynchrony

Research objectives:

1) Define practices for specific management goals

2) Measure and test N credits, yield drag, coverage, etc…

COVER CROPS & NITROGEN

Cover crops can:

1) Scavenge (or trap) N

Cool season grass cover crops following corn silage

2) Produce N

Annual clovers following winter wheat

COOL SEASON GRASS COVER CROPS

[FALL-SEEDED WINTER RYE, TRITICALE, BARLEY, AND ANNUAL RYEGRASS]

FOLLOWING CORN SILAGE AND FALL MANURE

OBJECTIVES: COOL SEASON GRASS COVER CROP STUDY

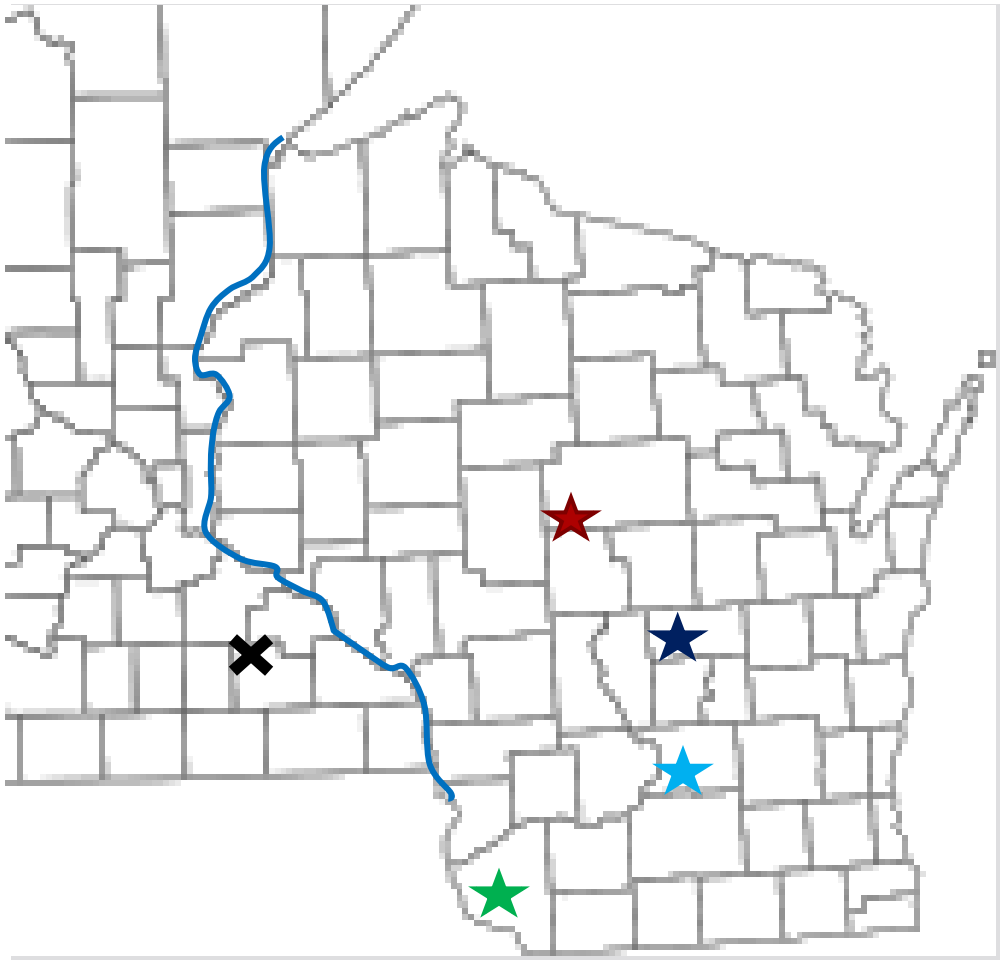
- Funded by the Wisconsin Fertilizer Research Council.
- Evaluate growth, N uptake, and effect on soil nitrate of fall seeded cool season grass cover crops
  - post corn silage harvest and manure application
- Determine response of the following corn grain crop to N application following cover crops

Evaluating four grass cover crop species

Six treatments:

- No manure / no cover crop
- No cover crop (with manure)
- Spring Barley (71-140 lb/ac)
- Annual Ryegrass (15-26 lb/ac)
- Winter rye (75-120 lb/ac)
  - Terminated in spring
- Triticale (69-173 lb/ac)
  - Harvested as a forage crop
  - This delayed planting of corn in these plots only.

STUDY LOCATIONS



- **Marshfield, North-central WI**
  - Withee silt loam
  - Somewhat poorly drained
- **Hancock, Central Sands of WI**
  - Plainfield sand (Excessively drained
  - Wind Erodibility Group = 1 (I = 493 Mg ha^{-1} yr^{-1})
- **Arlington, South Central WI**
  - Plano silt loam
  - Very deep, well drained
- **Lancaster, SW "Driftless" WI**
  - Fayette silt loam
  - Well-drained
  - 2-6% slopes; moderately eroded

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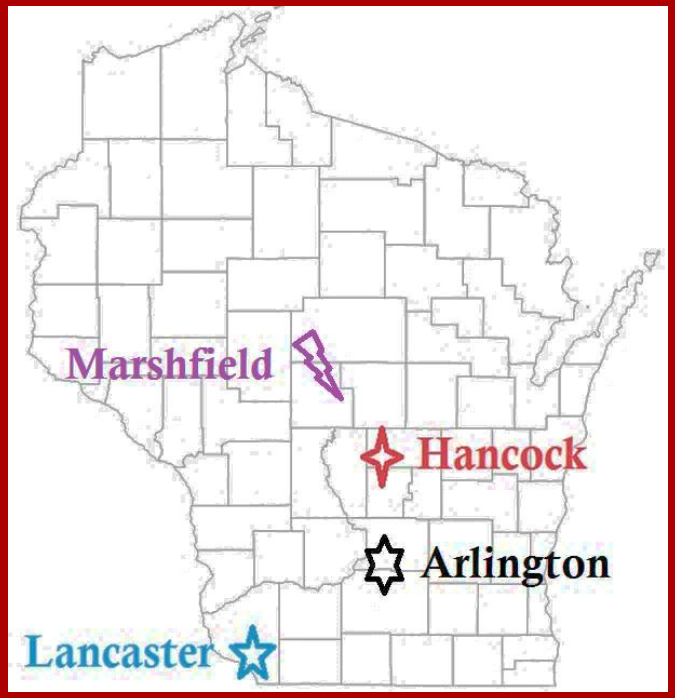
MARSHFIELD



MARSHFIELD FIELD PLAN

- Corn silage harvest (9/24/14)
- Liquid dairy manure application (9/25/14):
  - Injected at 10,000 gal/ac, 1.1% solids
  - 23 lb-N credit
- Cover crop planting (9/26/14)
- Cover crop burndown (5/5/15)
- Winterkill: Annual ryegrass 25%,Barley 75%
- Corn planted (5/13/15); 14 lb-N in starter
- Remainder of N applied as broadcast urea with Agrotain®
- Triticale harvest + late corn planting (6/1/15)
- **We don't have a no manure control treatment.**

9/26/14: Planted cover crops on a diagonal relative to previous crop; weedy conditions.

May 5, 2015

Winter Rye

No cover crop

Annual Ryegrass: May 5, 2015


Barley: May 5, 2015

Cover crop biomass production: Winter rye & triticale performed well with late planting date

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	–	–	–	1,020	23	17:1
Annual Ryegrass	–	–	–	610	13	15:1
Spring Barley	–	–	–	–	–	–
Triticale	–	–	–	2810	39	31:1
	Terminated on May 5th			Harvested on June 1st		
2015–Winter Rye	*743*	*37*	*8:1*	–		
2015–ARG	*336*	*15*	*8:1*	–		
2015—Spr Barley	*492*	*25*	*8:1*	–		
2015–Triticale	*503*	*22*	*8:1*	–		

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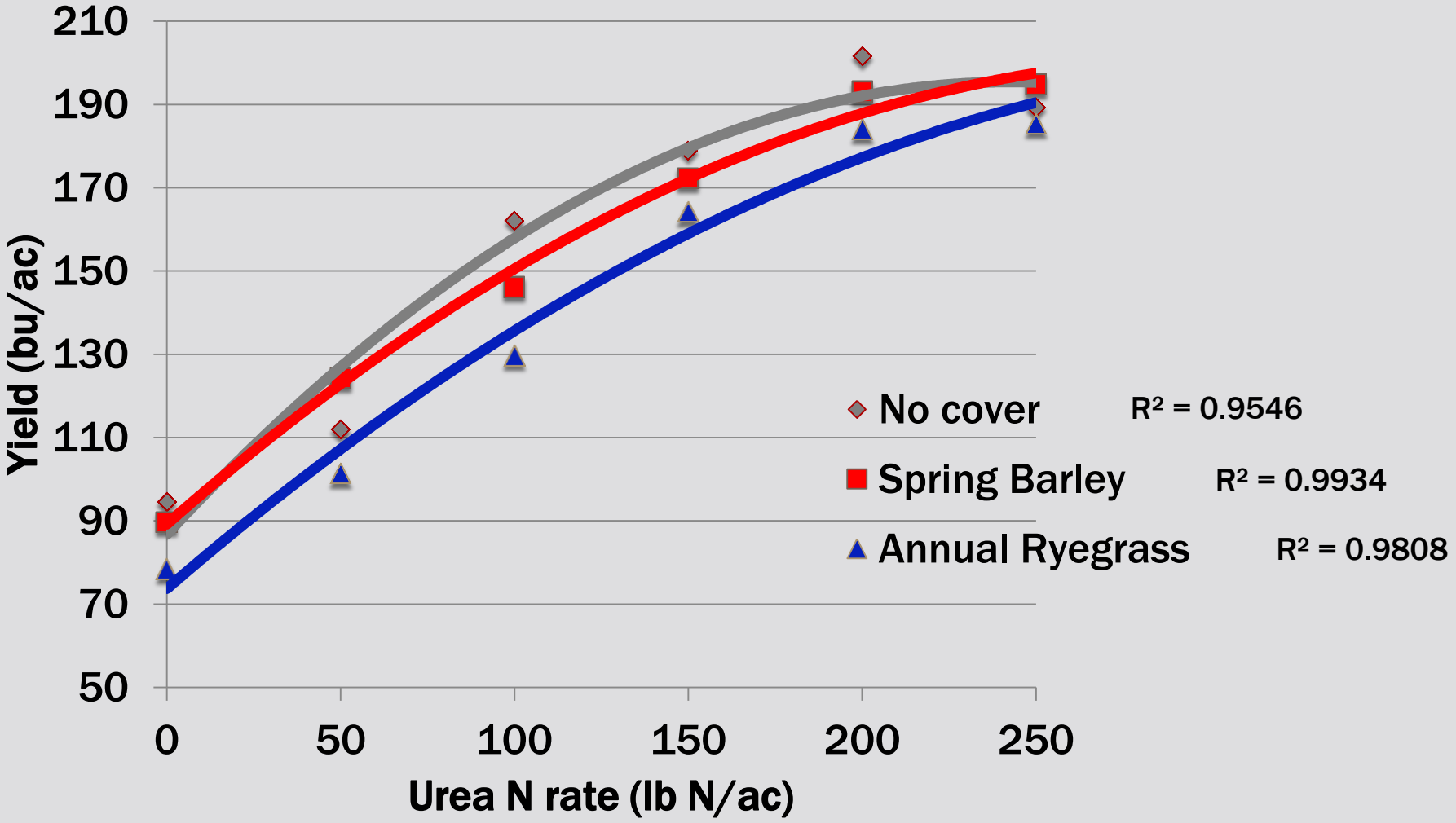
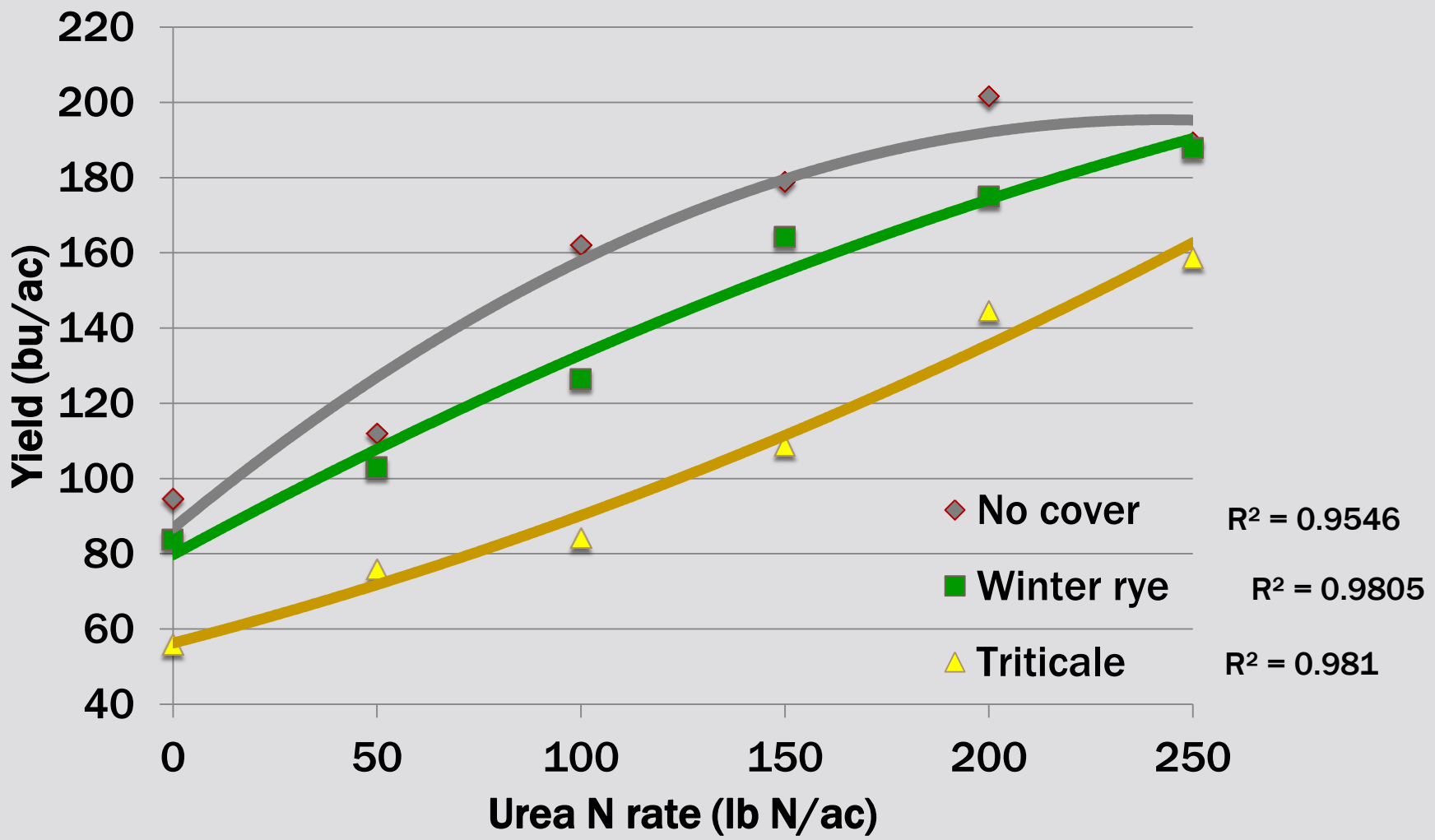
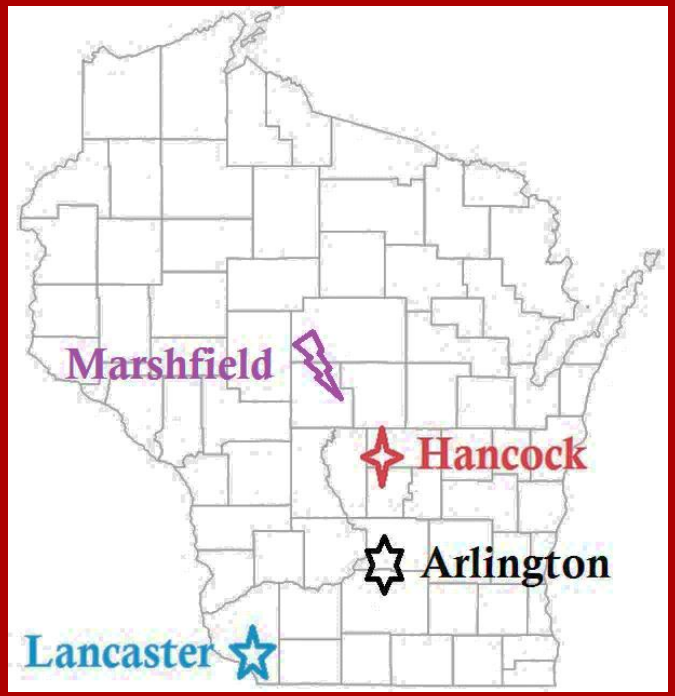
Overall, high yields linear to N rate. Possible yield drag with annual ryegrass.



Yield drag apparent with winter rye, triticale

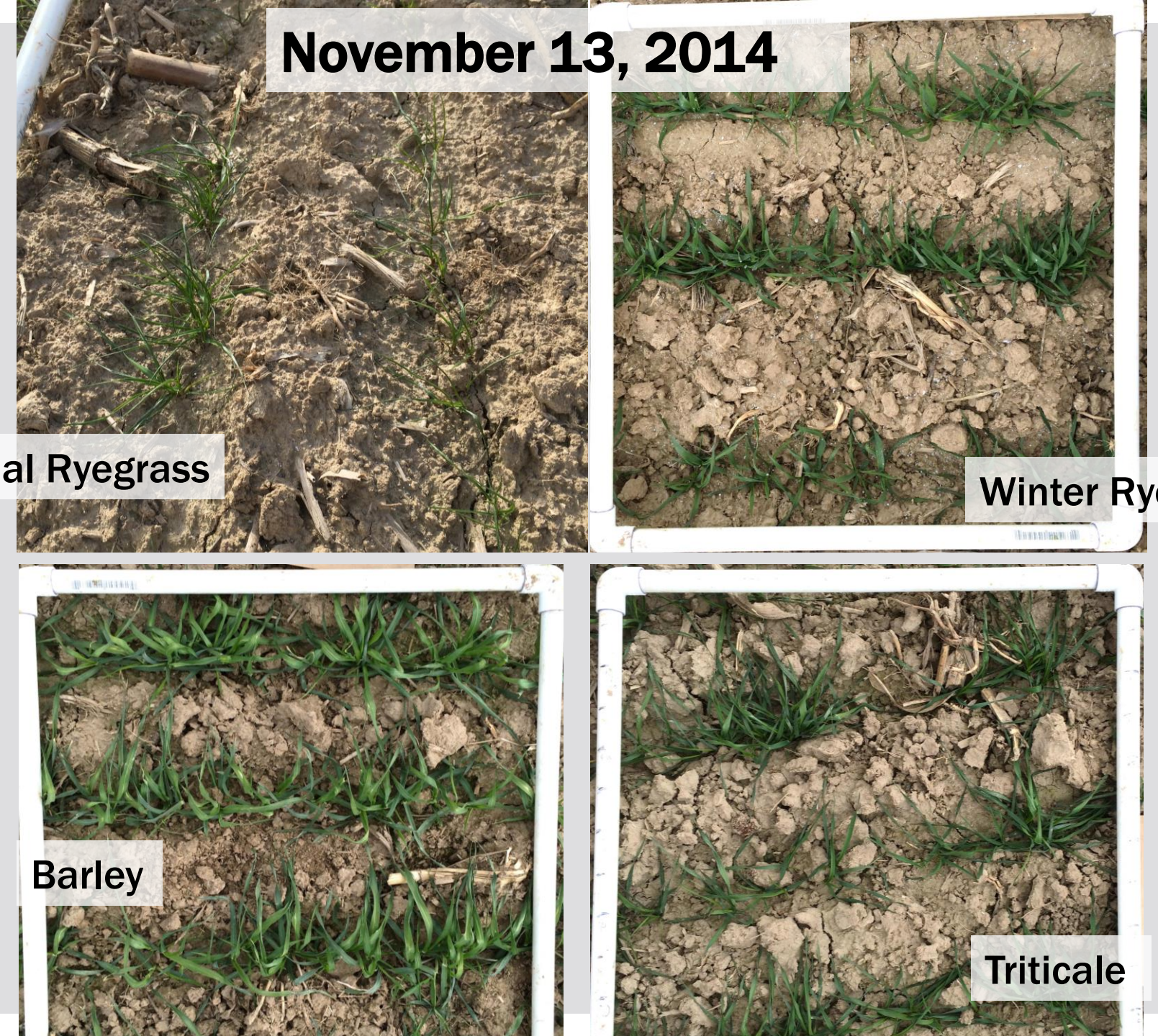


LANCASTER



LANCASTER FIELD PLAN

- Corn silage harvest (9/18/14)
- Liquid dairy manure application (9/23/14):
  - AERWAY vertical aeration before and after surface application
  - 10,000 gal/ac
  - 5.75% solids
  - 94 lb-N credit
- Cover crop plantin
- Winter rye burndo
- Barley and Annual
- Corn planted (5/1
- Remainder of N ap
- Triticale harvest +


November 13, 2014
Annual Ryegrass
Winter Rye
Barley
Triticale

Good spring production following little biomass production in the 2014 fall. Long fall 2015 demonstrates increased growth.

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	1,580	36	17:1
Annual Ryegrass	–	–	–			
Spring Barley	270	14	8:1			
Triticale	380	16	10:1	4,540	47	41:1
	Terminated on April 29th			Harvested on June 2nd		
2015–Winter Rye	*798*	*42*	*8:1*	–		
2015–ARG	*325*	*15*	*9:1*	–		
2015—Spr Barley	*737*	*40*	*8:1*	–		
2015–Triticale	*712*	*34*	*8:1*	–		

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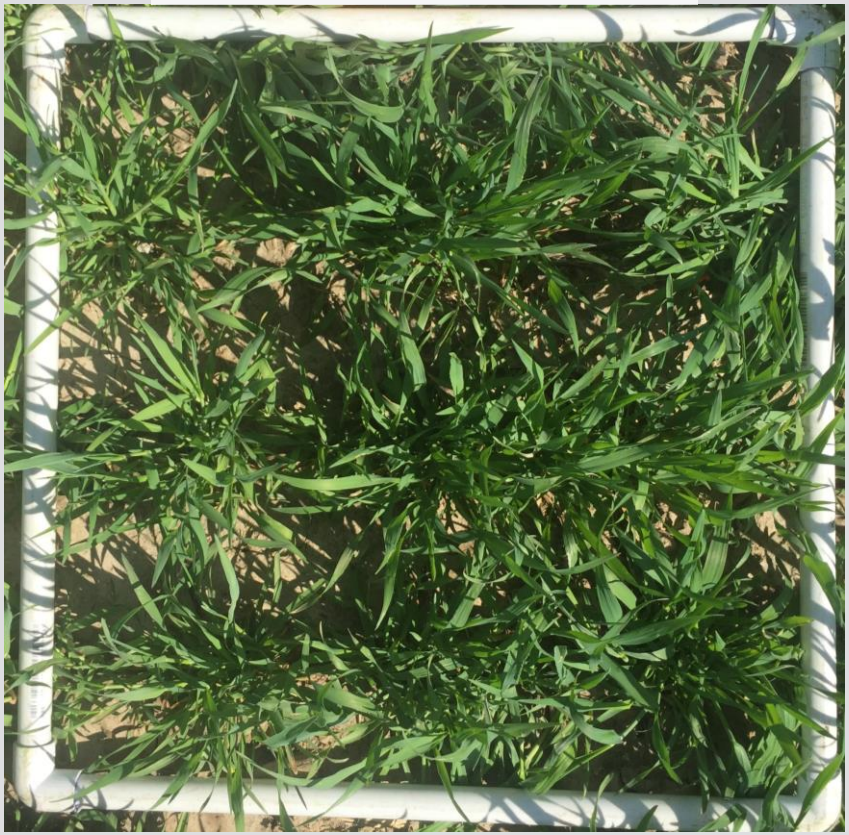
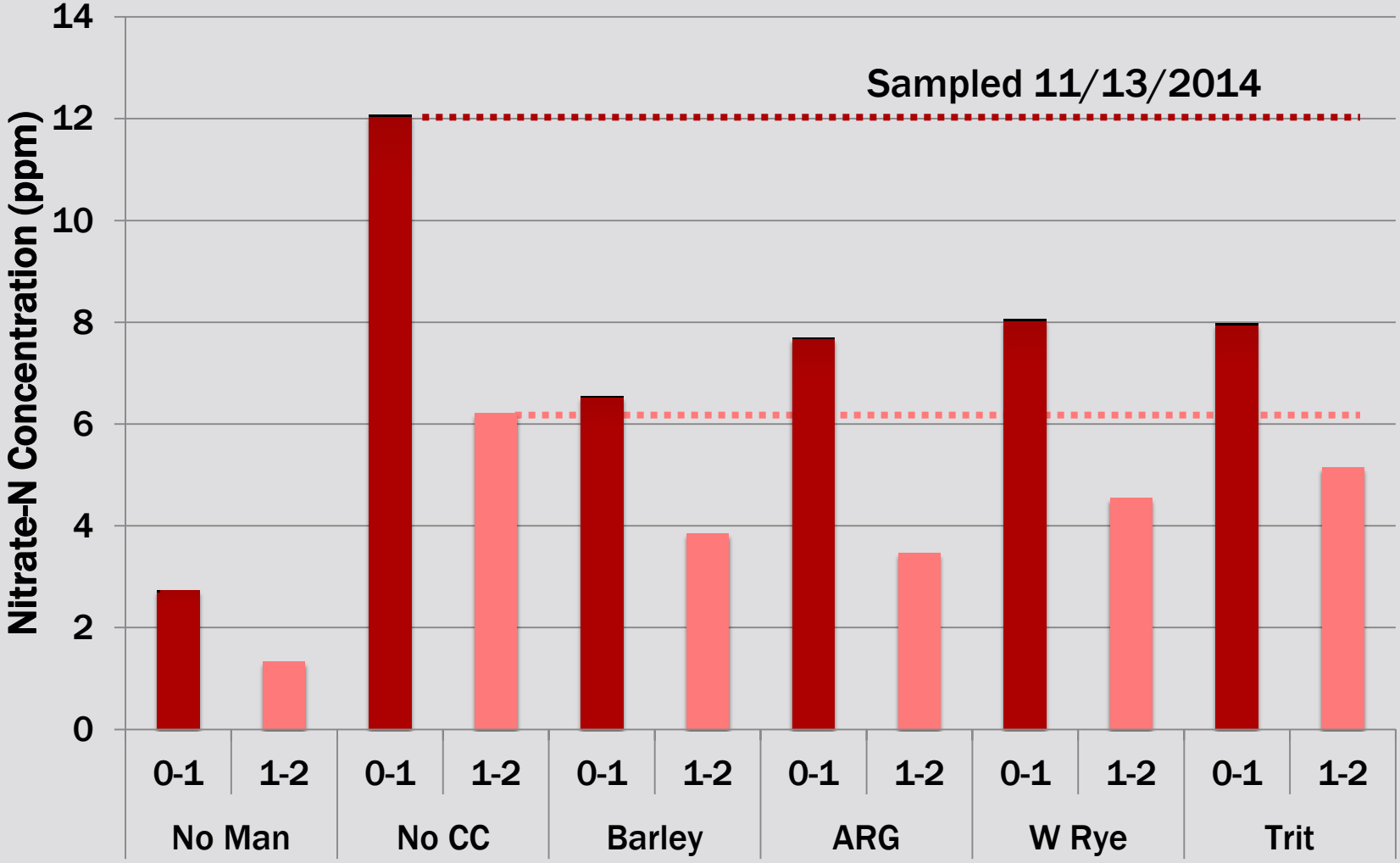
Winter rye burndown: April 29, 2015

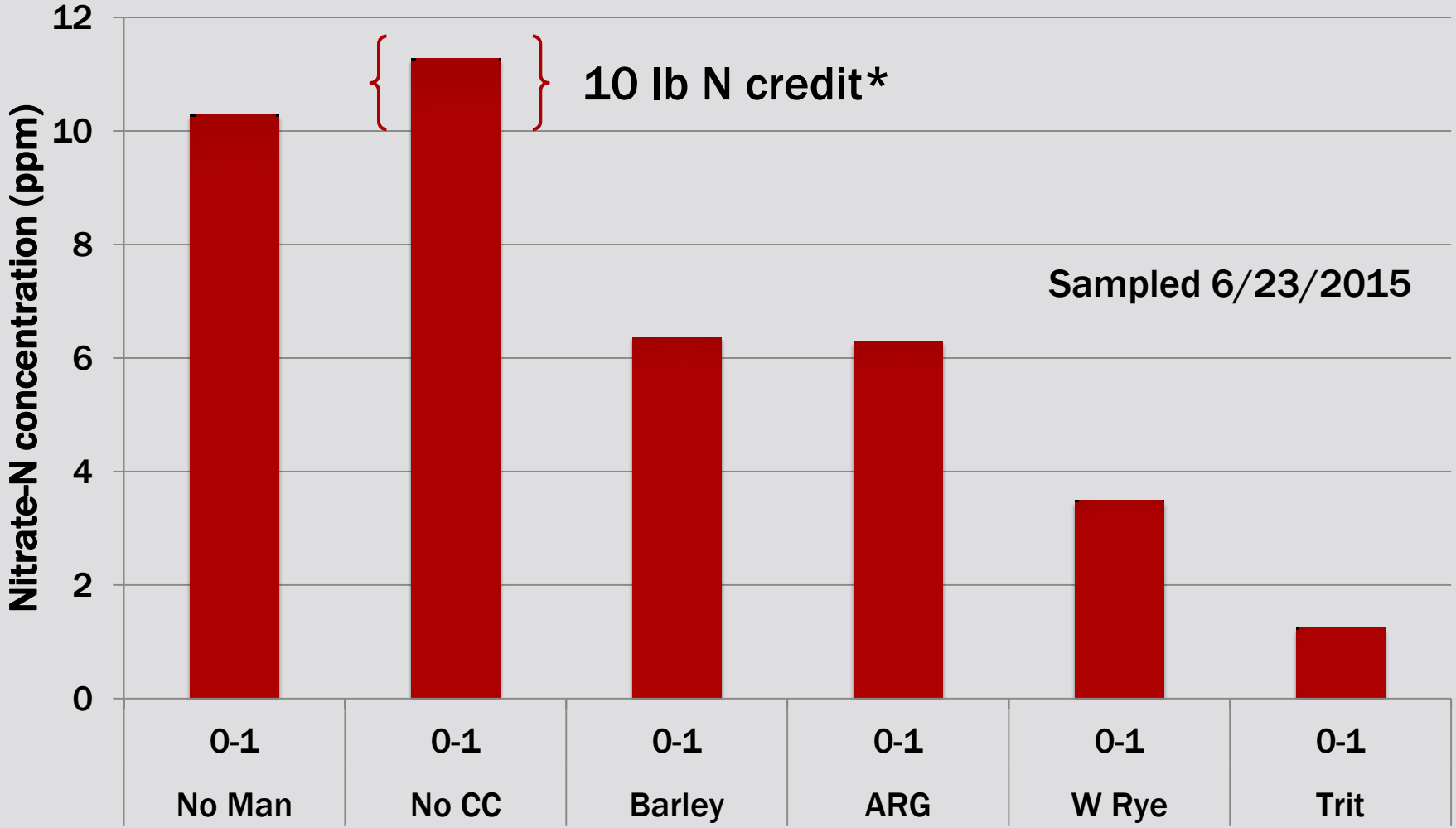


Triticale harvest: June 2, 2015

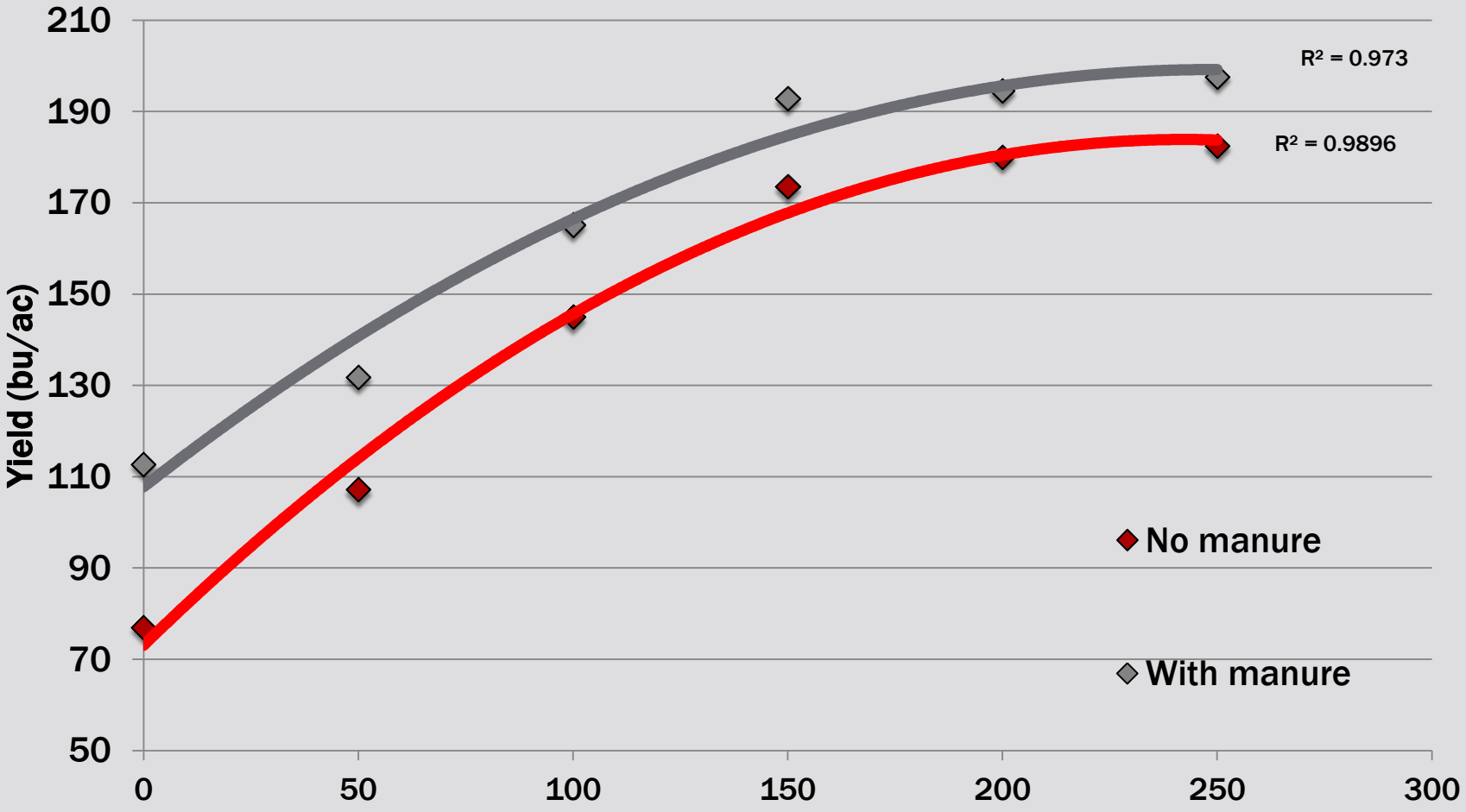
Slight reduction of soil nitrate at both 0-1 &1-2’ depths across all covers



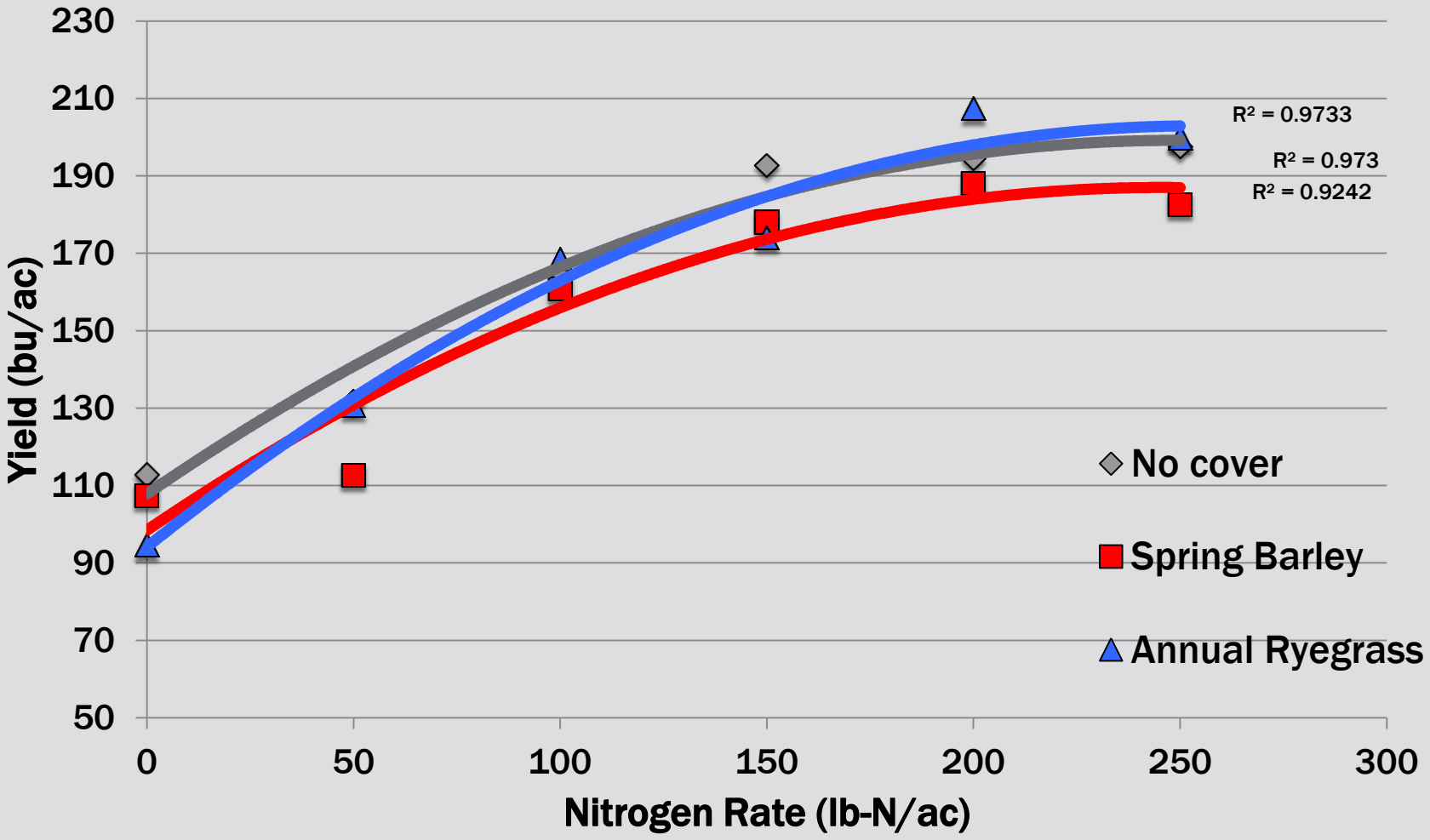
Covers reduced early season soil nitrate; potential reduction in N credit



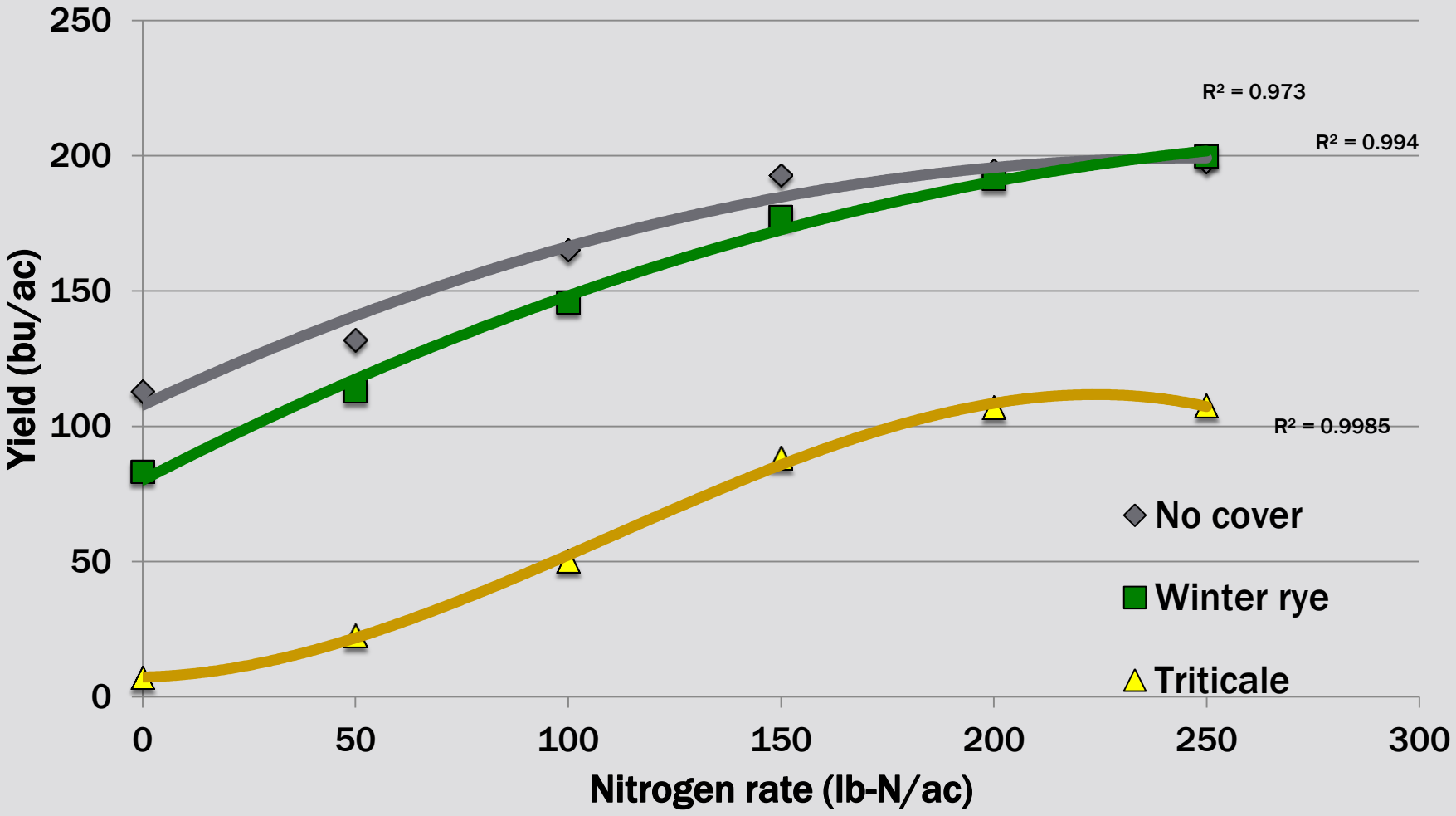
Fall manure increased yields (no cover crops)



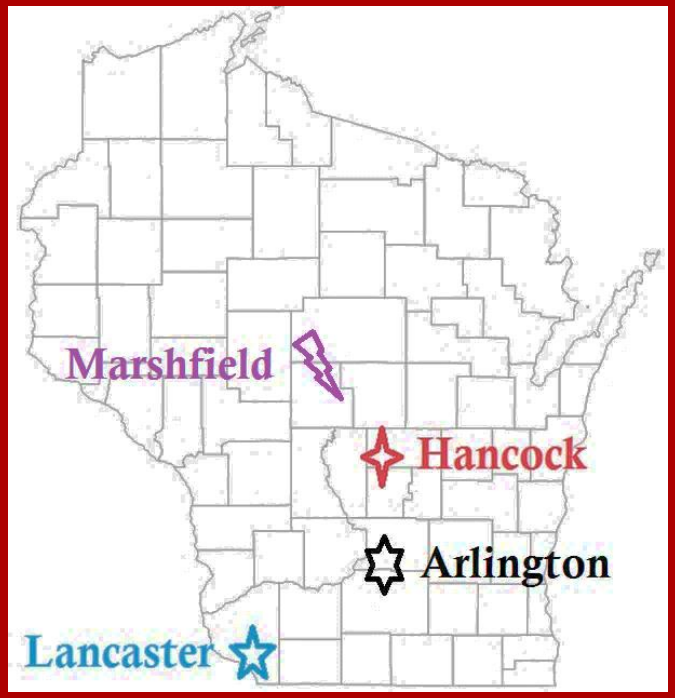
Potential yield drag with Spring barley?



N application overcame yield drag in winter rye



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
- Winter rye burndown (4/30/15)
- Barley and Annual ryegrass winterkilled
- 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)

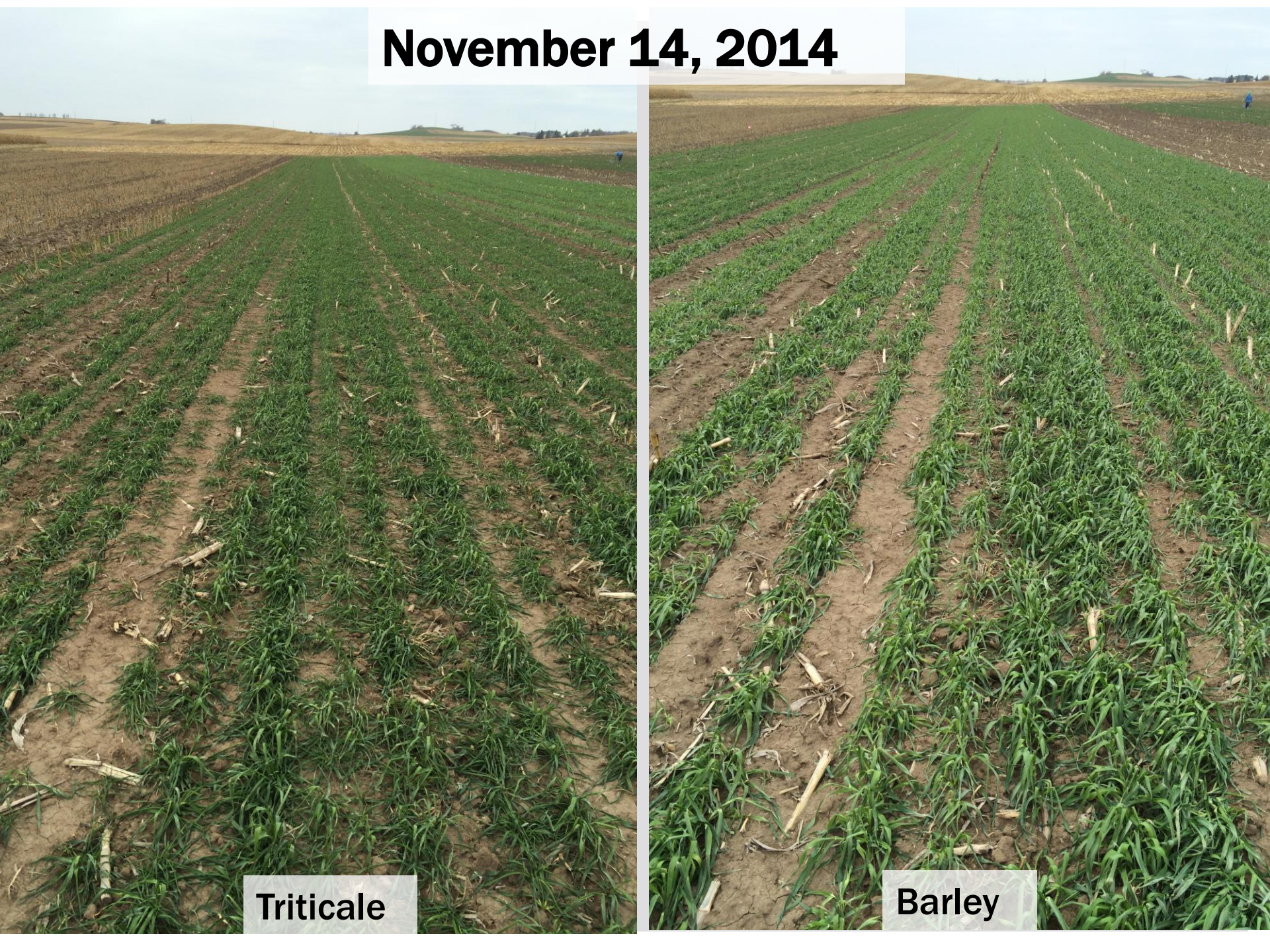

JAMESWAY

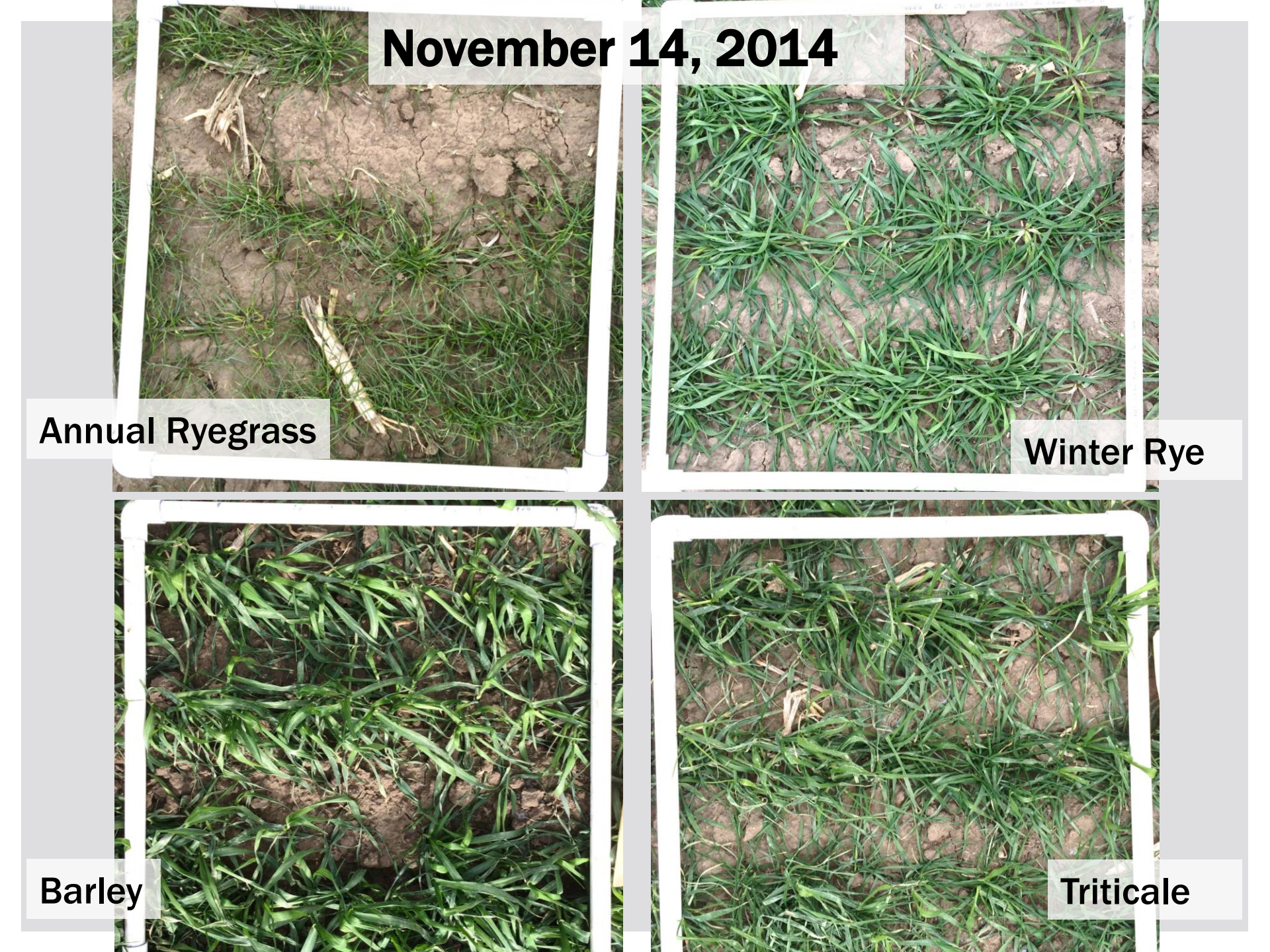

JOHN DEERE
1590

Triticale & Spring Barley had faster growth and more biomass in the fall (2014)

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	9:1	2,460	83	12:1
Annual Ryegrass	550	20	10:1			
Spring Barley	780	42	8:1			
Triticale	880	41	9:1	6,350	129	20:1
	Terminated on April 30th			Harvested on May 22nd		
2015–Winter Rye	*798*	*42*	*8:1*	–		
2015–ARG	*325*	*15*	*9:1*	–		
2015—Spr Barley	*737*	*40*	*8:1*	–		
2015–Triticale	*712*	*34*	*8:1*	–		

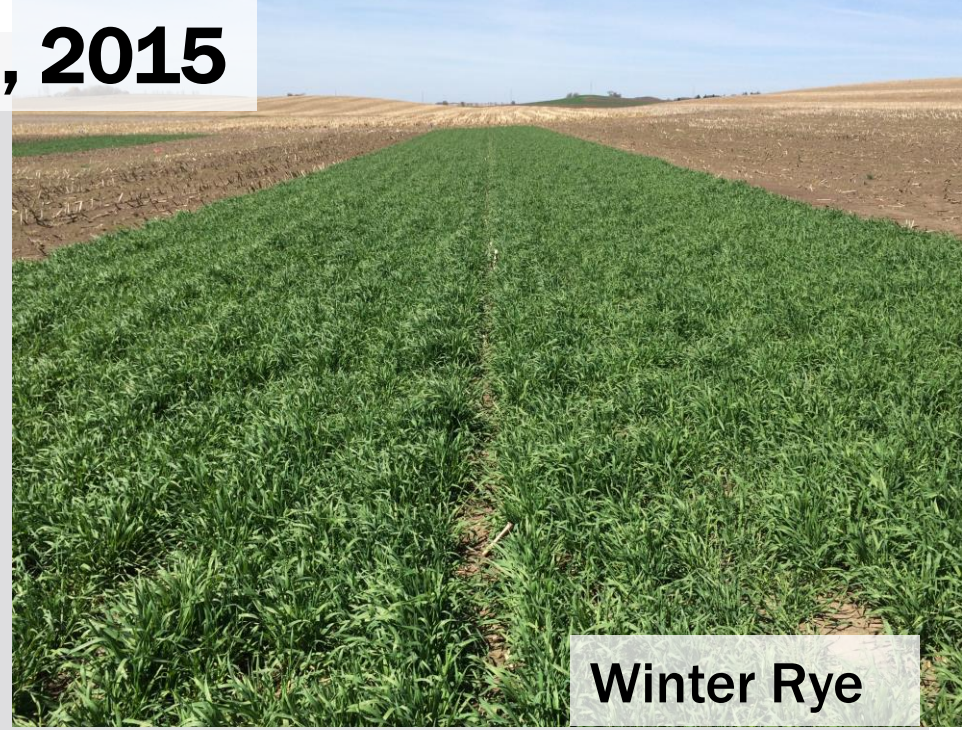
November 14, 2014




November 14, 2014
Annual Ryegrass
Winter Rye
Barley
Triticale

April 28, 2015

Annual Ryegrass

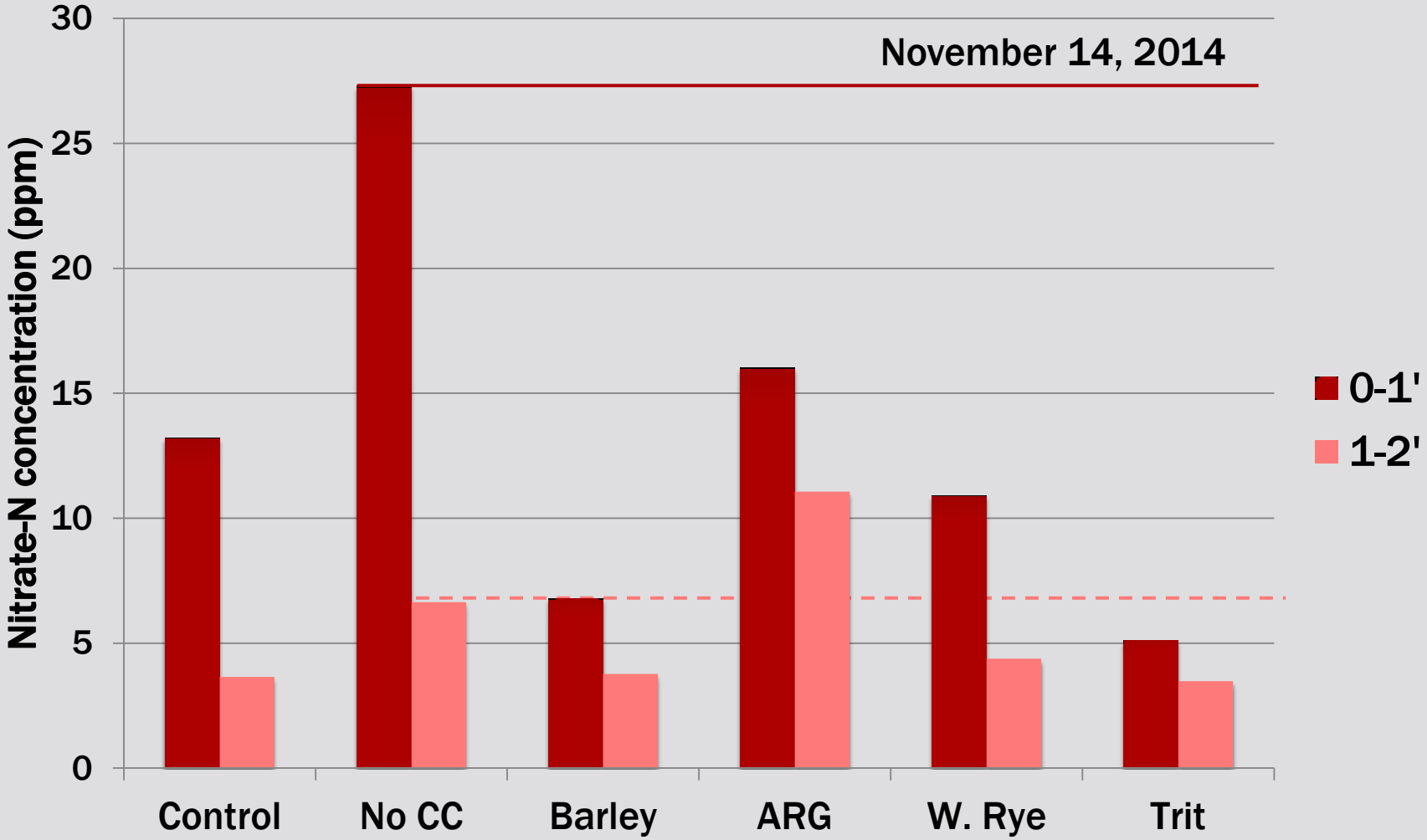


Winter Rye

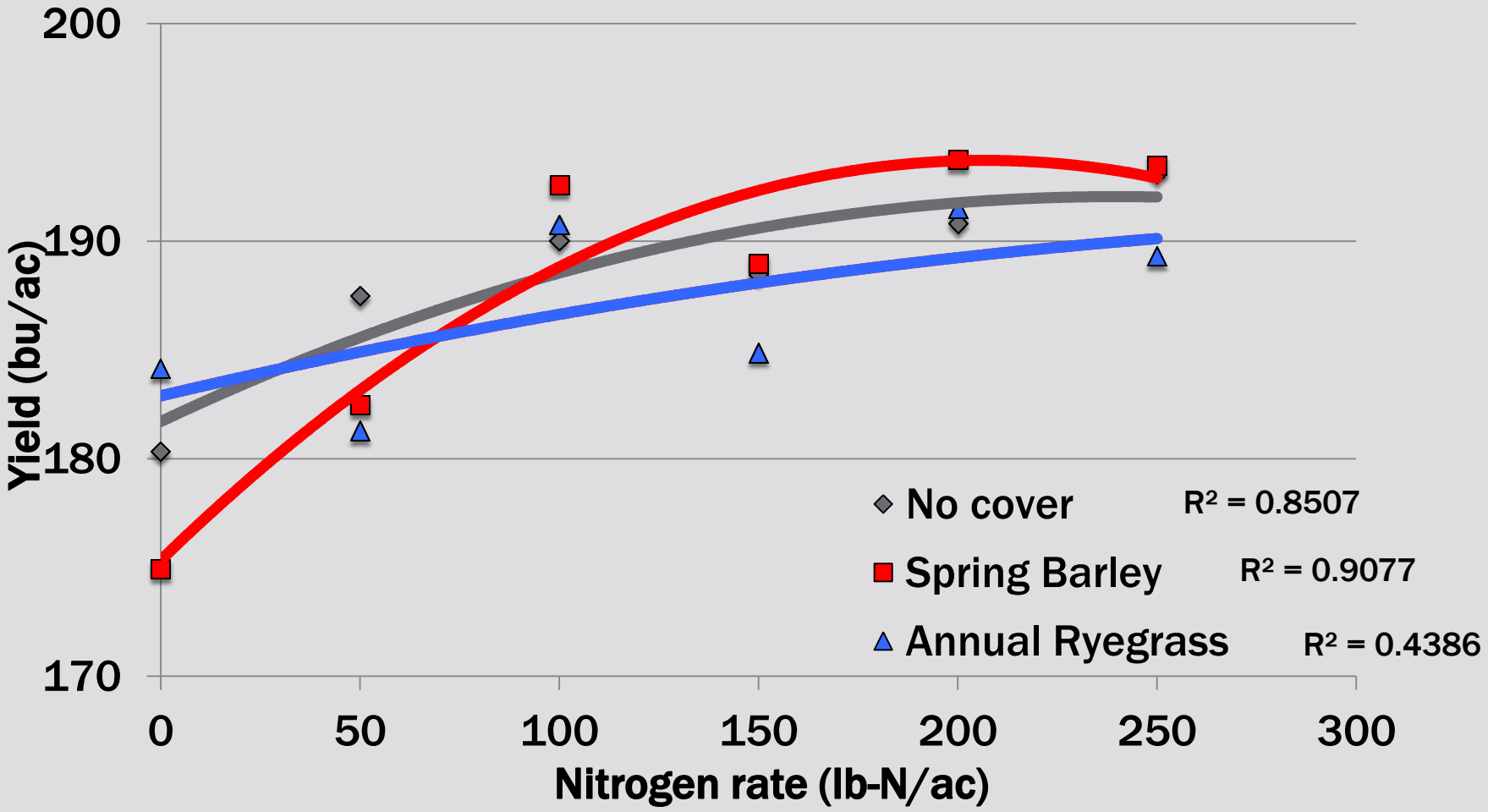
Barley

No CC

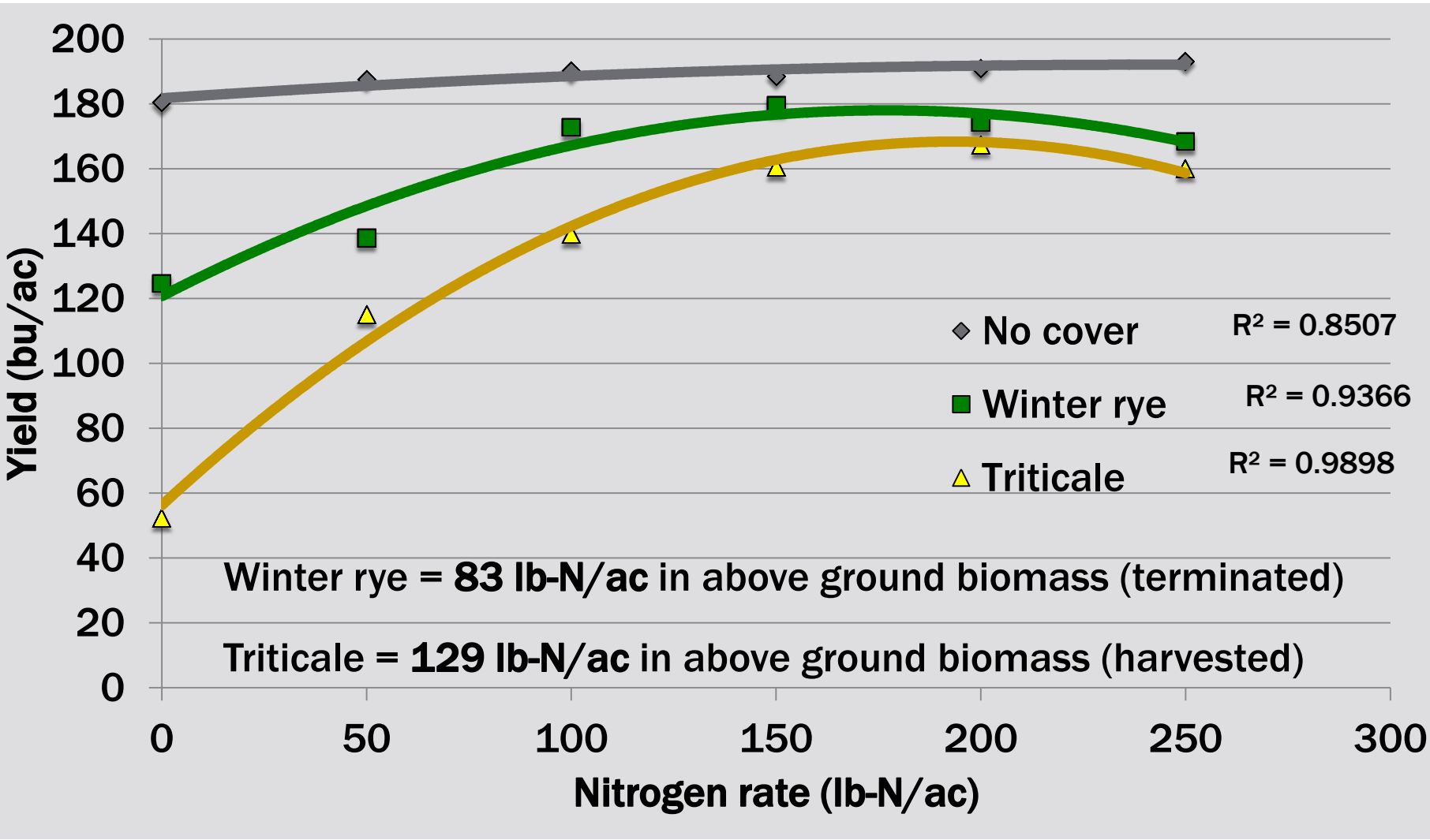
Cover crops reduce fall soil nitrate, some even relative to no manure control.



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.



FALL GRASS COVER CROP STUDY: PRELIMINARY CONCLUSIONS

- Fall-seeded cover crops that winterkilled (ARG and spring barley) did not affect yields compared to no cover crop treatments.
- Winter rye and triticale may have caused yield drag or increased N rates (some locations).
- Triticale forage is worth considering in total production.
- Decreased soil NO_3 may reduce fall & spring leaching
- Increased soil coverage reduces erosion

BERSEEM CLOVER, CRIMSON CLOVER, & SPRING BARLEY IN A WINTER WHEAT & CORN ROTATION

ANNUAL CLOVERS

- Opportunity following winter wheat harvest
  - Cannot frost seed
- Fast growing, can produce >12” biomass
  - Erosion control
- Scavenges N early on, then vigorous N fixation
  - Spring N source
- **Winterkills in Upper Midwest**

GREEN MANURE N CREDITS

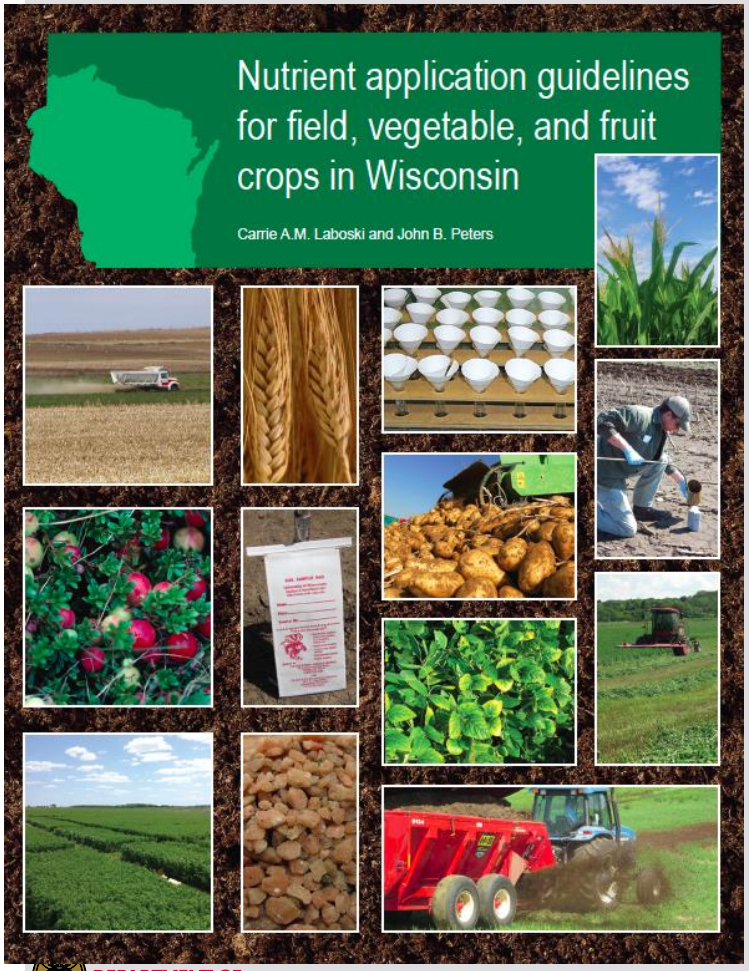


Table 9.5. Green manure nitrogen (N) credits.

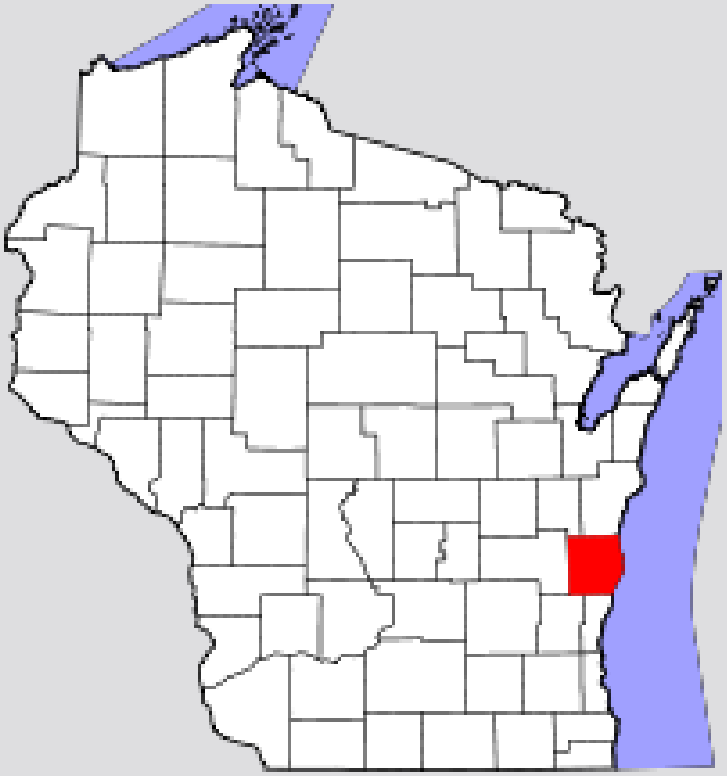
Crop	< 6" growth	> 6" growth
	----------lb N/a to credit----------	
Alfalfa	40	60–100[a]
Clover, red	40	50–80[a]
Clover, sweet	40	80–120[a]
Vetch	40	40–90[a,b]

[a] Use the upper end of the range for spring-seeded green manures that are plowed under the following spring. Use the lower end of the range for fall seedings.

[b] If top growth is more than 12 inches before tillage, credit 110–160 lb N/a.

STUDY DESIGN

- Location: On farms in Sheboygan County
- No manure application
- Cover crops (planted 8/15/14, 8/12/15):
  - Berseem clover (10-12 lb/ac)
  - Crimson clover (12-15 lb/ac)
  - Spr. barley (60 lb or 1.25 bu/ac)



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BERSEEM CLOVER

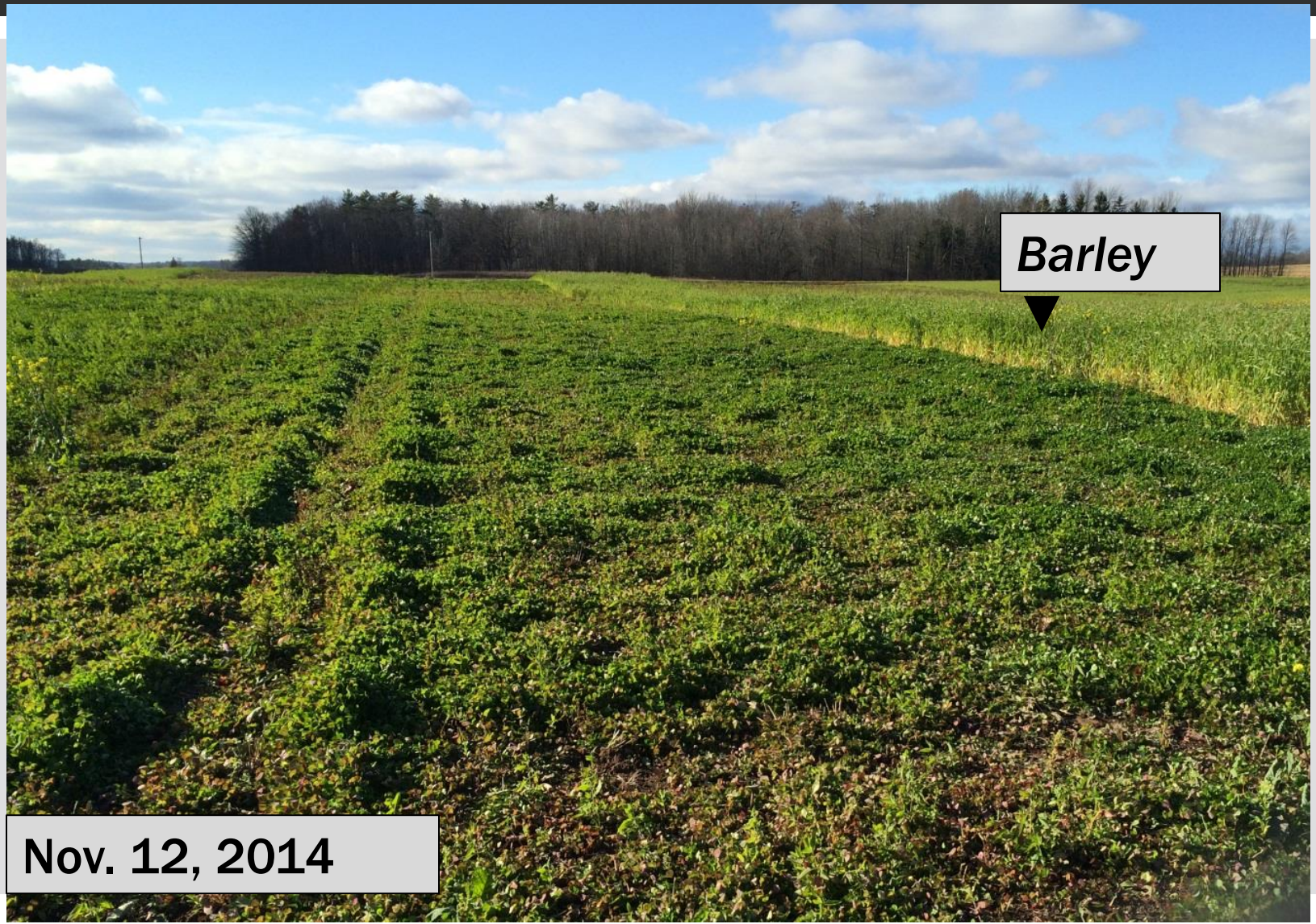
BERSEEM CLOVER

BERSEEM CLOVER—SPRING RESIDUE

CRIMSON CLOVER

Oct. 7, 2013
Ballweg, UWEX

CRIMSON CLOVER



CRIMSON CLOVER—SPRING RESIDUE

DIFFERENCE IN COLD TOLERANCE

Oct. 25, 2013
Ballweg, UWEX

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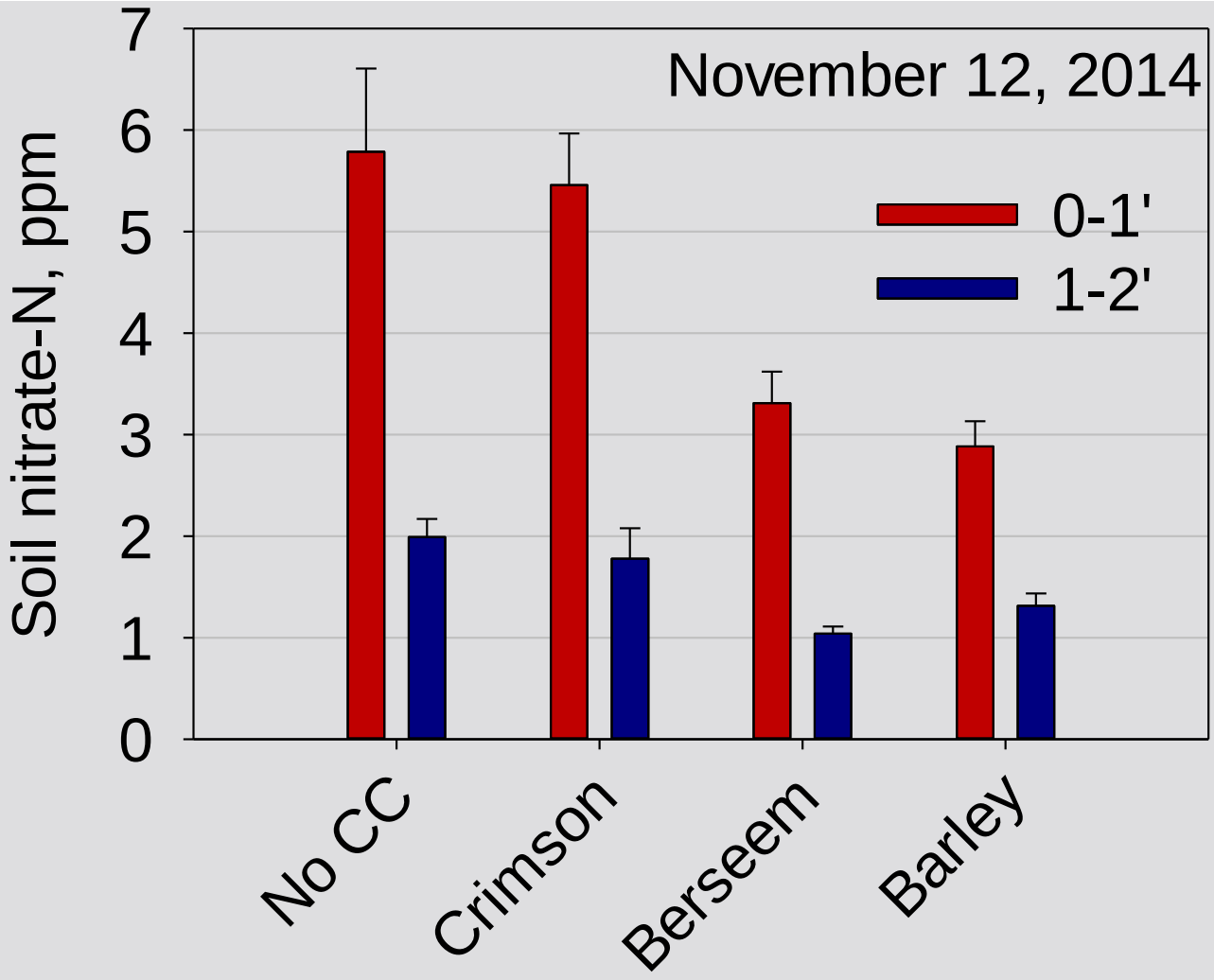
Berseem

Crimson

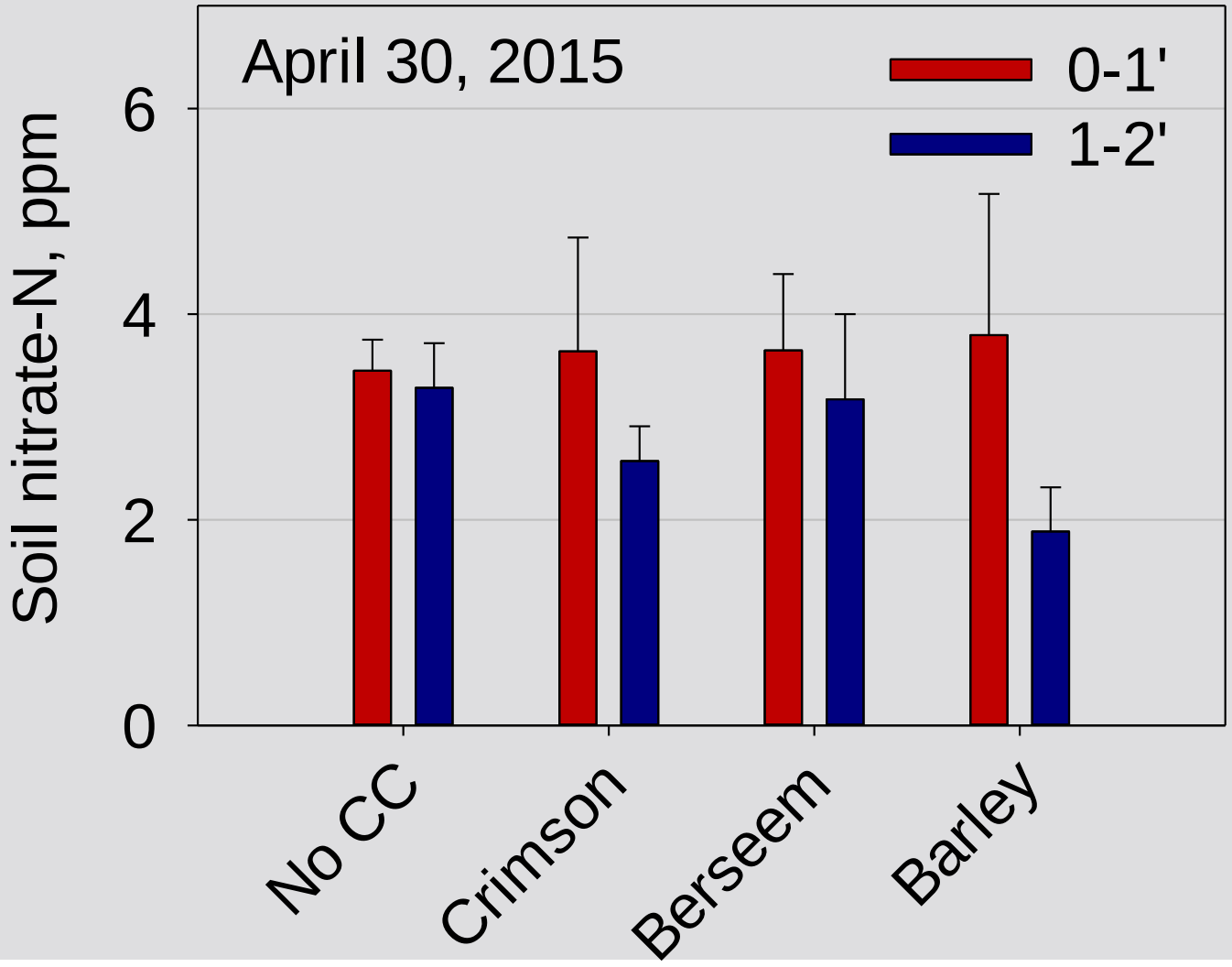
Crimson and berseem clovers produce a lot of biomass late summer, maintain low C:N

Cover	DM , ton/ ac	N content, lb/ac	C:N Ratio
2013			
Crimson clover	3.3	177	15
Berseem clover	2.7	117	19
Oat	3.8	110	30
2014			
Crimson clover	1.1	47	16
Berseem clover	1.2	75	14
Barley	1.3	31	36
2015			
Crimson clover	1.1	70	11
Berseem clover	1.2	81	13
Barley	1.8	34	45

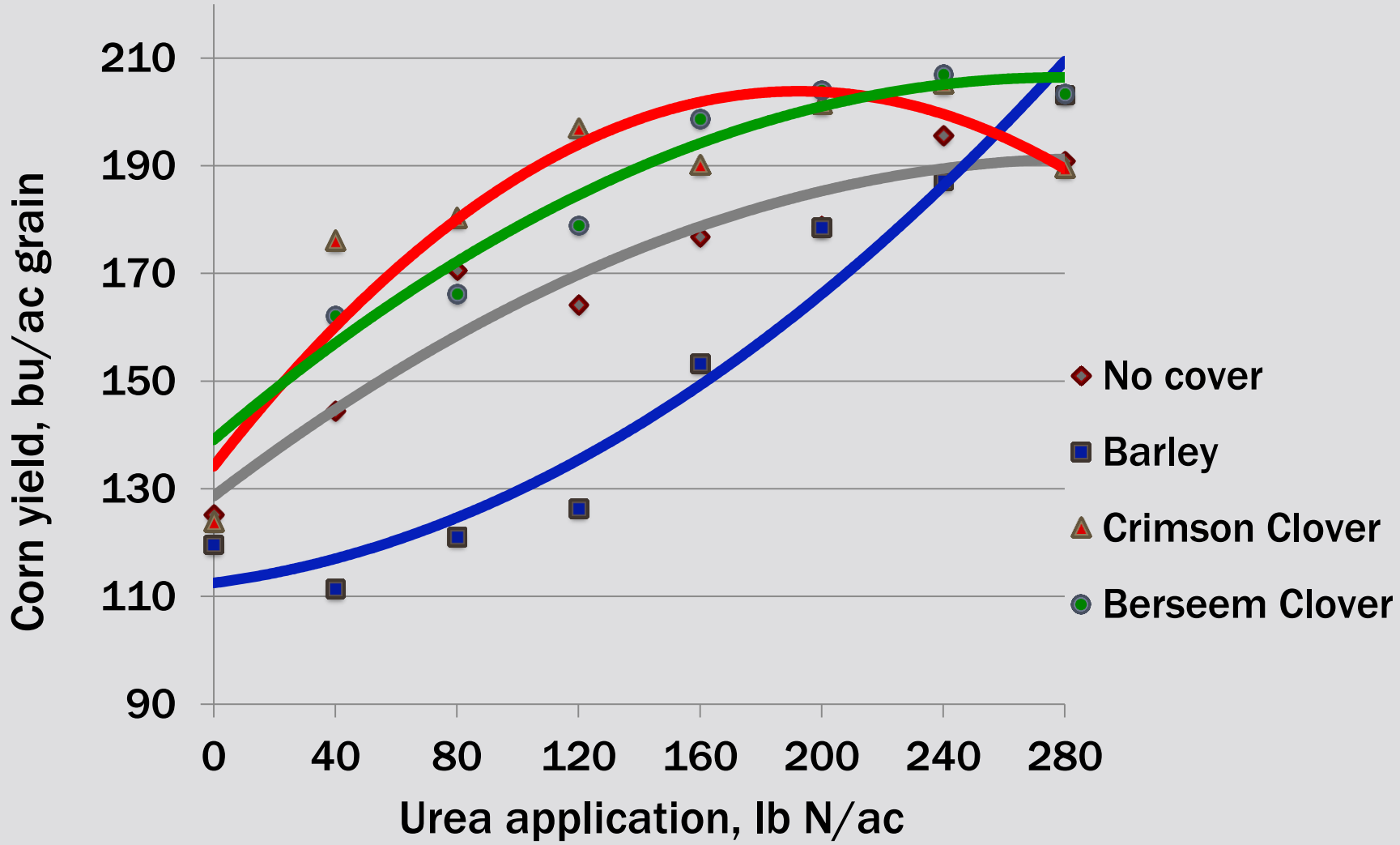
Berseem clover and barley reduced soil nitrate at winterkill



Soil nitrate at preplant was the same across clover and No CC treatments, reduced in barley at 1-2’



Clovers increase yield by up to 20 bu/ac; reduction in N rate in crimson clover.



CLOVER STUDY: PRELIMINARY CONCLUSIONS

- Winter annual clovers (Berseem and Crimson) performed well following winter wheat
  - Good soil coverage, high biomass production
  - Consistent winterkill
- Clover cover crops resulted in 20 bu/ac yield increase AND possible reduction in optimum N rate
- Barley decreased corn grain yields

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