Corn Silage with Winter Rye Cover and Forage Crops

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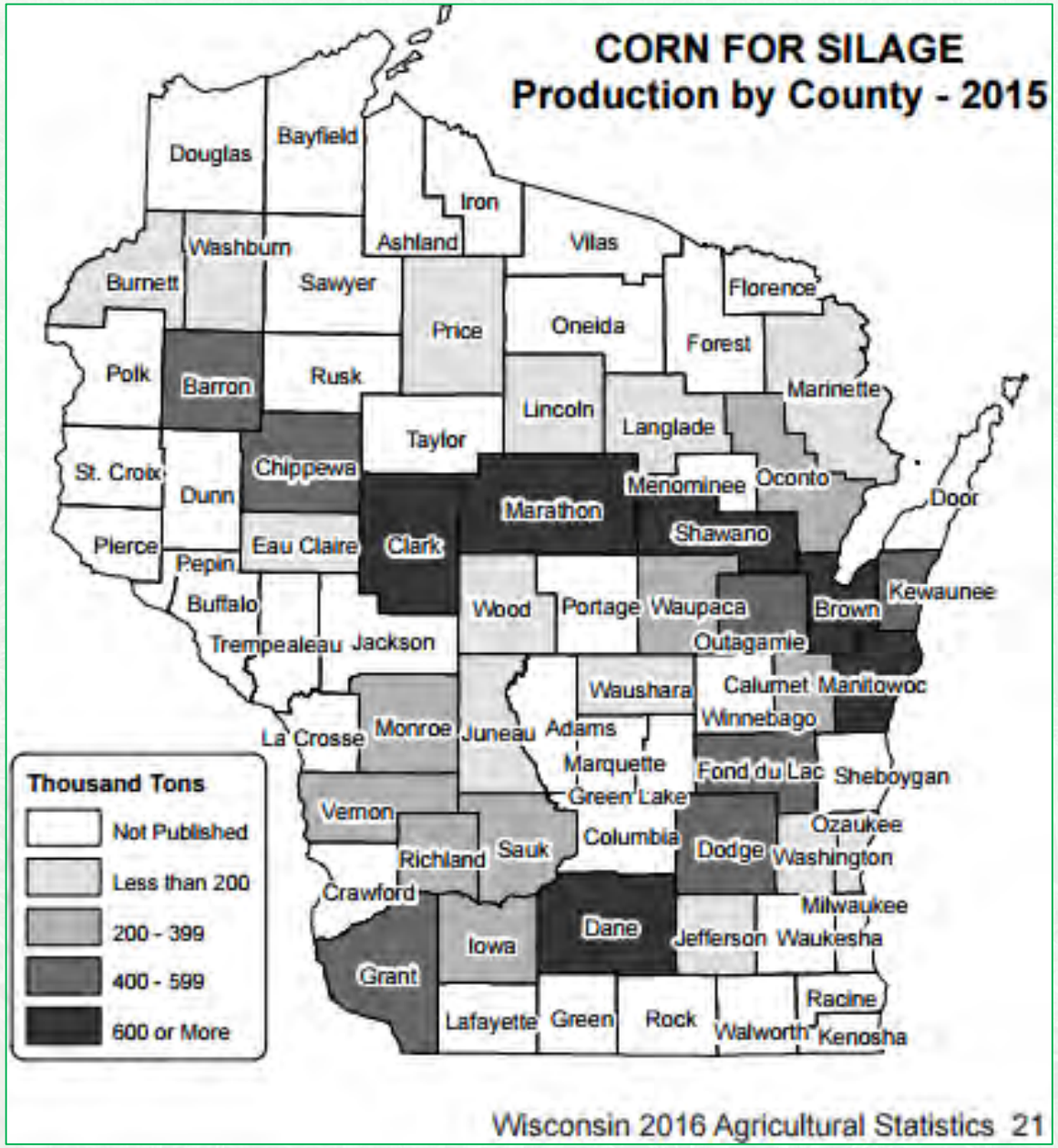


WI Agricultural Statistics, 2015 =
970,000 acres Corn Silage

Arlington Agricultural Research Station
Southcentral WI
2-6% slope
April 2013

Why Rye after Corn Silage?

- Fast establishing over-winter cover when planted in fall
- Prevents soil and nutrient losses (runoff)
- Scavenges soil NO_3^-
  - Provide N credit?
- Potential to utilize as an early-season forage crop

Corn Silage with Winter Rye Cover and Forage Crops

Arlington Ag Research Station 2012 – 2016

Objectives:

Evaluate winter rye as a cover crop and forage crop following corn silage

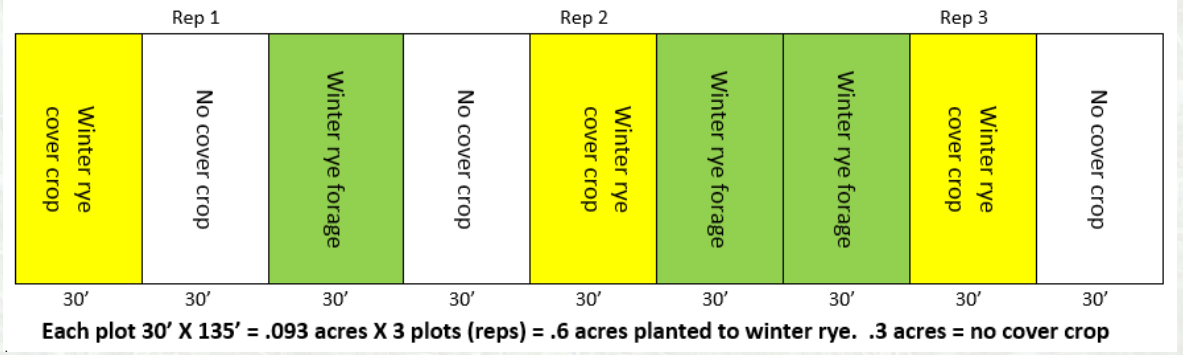
- Do rye cover and forage crops affect the yield of a following corn silage crop?
- How does the rye cover or forage affect the manure N credit to, and the N requirement of, the following corn silage crop?
- What is the economic impact (+/-) from including rye as cover or forage in a continuous corn silage rotation?

Corn Silage with Winter Rye Cover and Forage Crops

Arlington Ag Research 2012 - 2016

- Continuous corn silage rotation - No-till
  - Corn silage followed by
    - **Winter rye as a cover crop**
    - **Winter rye as a forage crop**
    - **No rye**
  - UW guideline (MRTN) =
    Corn silage 160 - 190 lbs N per-acre
  - Manure provides 60 – 100 lbs N
  - Side dressed $NH_4^+NO_3^-$
    - **60 lbs N – below MRTN rate**
    - **100 lbs N – MRTN rate**
    - **160 lbs N – above MRTN rate**

Plano silt loam,
(Typic Argiudoll)
OM=3%

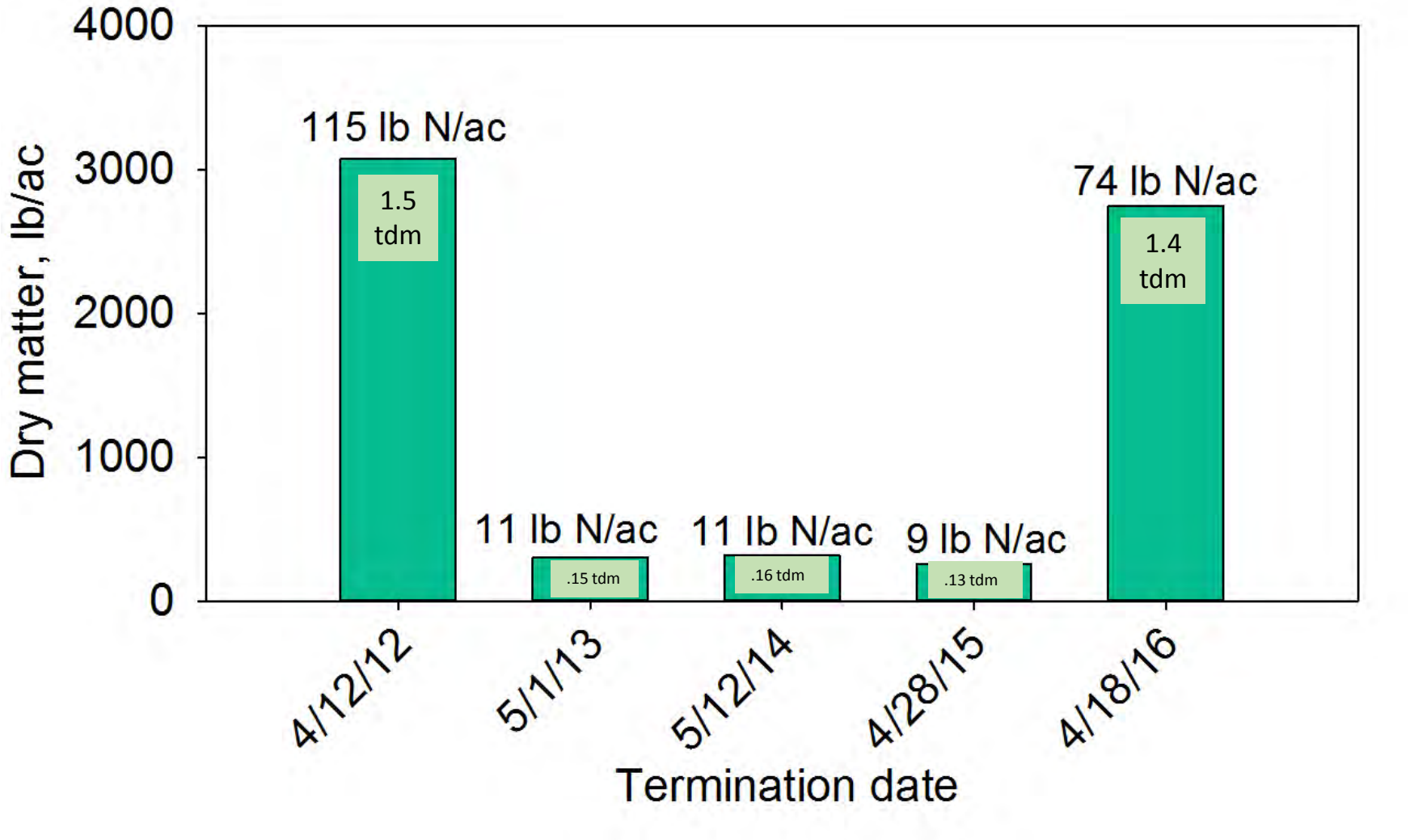


Corn silage – rye management

	2011/12	2012/13	2013/14	2014/15	2015/16
Liquid dairy manure applied	9,700 gpa N credit = 64	11,800 gpa N credit = 106	12,000 gpa N credit = 80	12,300 gpa N credit = 72	10,000 gpa N credit = 80
Rye planted Lbs Seed/acre	10/5 119	10/11 100	10/18 93	10/10 109	9/23 93
Rye forage harvest/stage	5/10 boot	5/21 pre-boot	5/30 boot	5/21 Late boot	5/12 Late boot/head
Corn planted No rye/cover crop Rye forage	 5/14 5/14	 6/3 6/3	 5/23 6/5	 5/8 5/22	 5/6 5/16

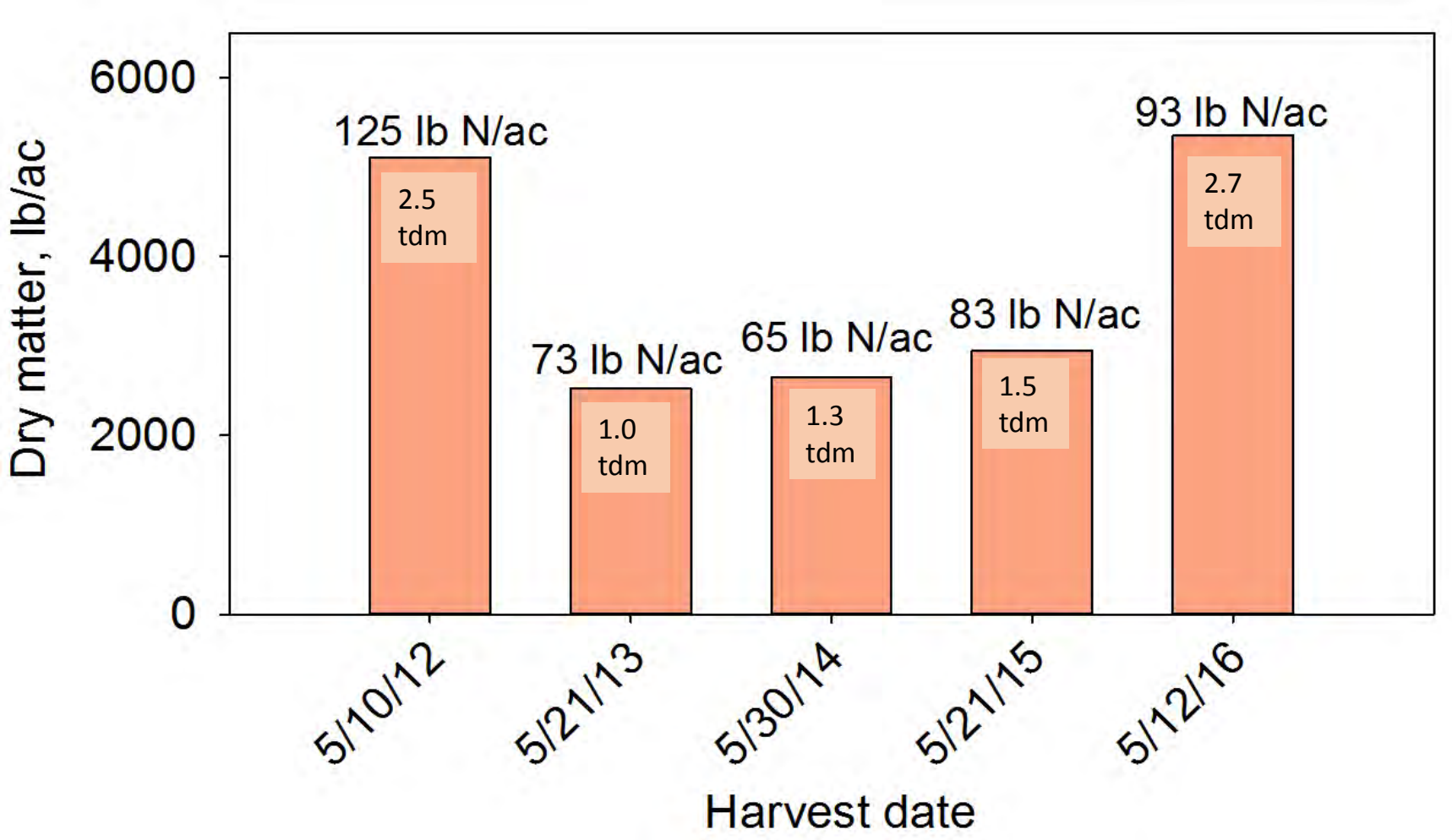
How does the rye cover or forage affect N availability from manure and the N credit to the following corn crop?

N Uptake - Rye Cover Crop Biomass

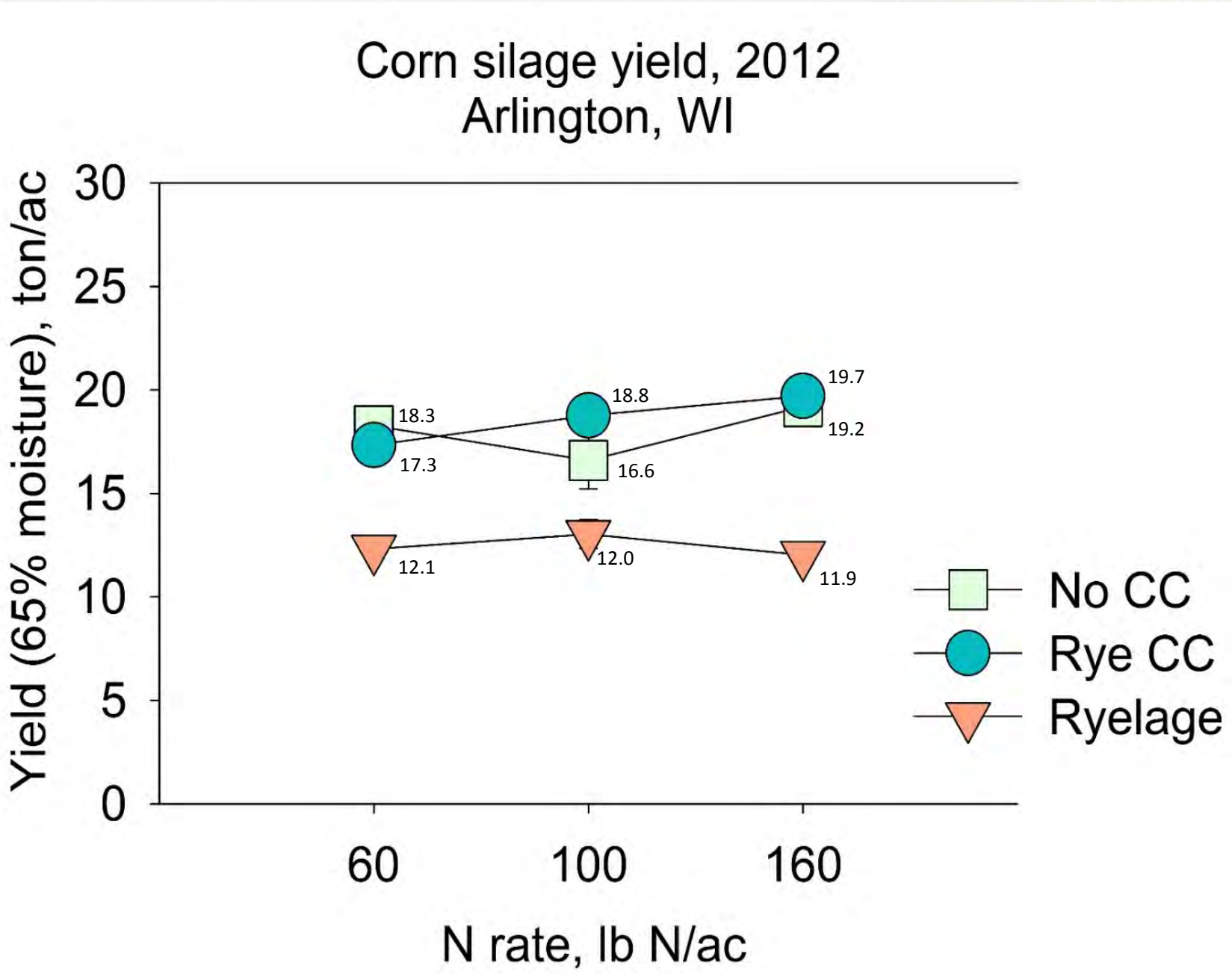


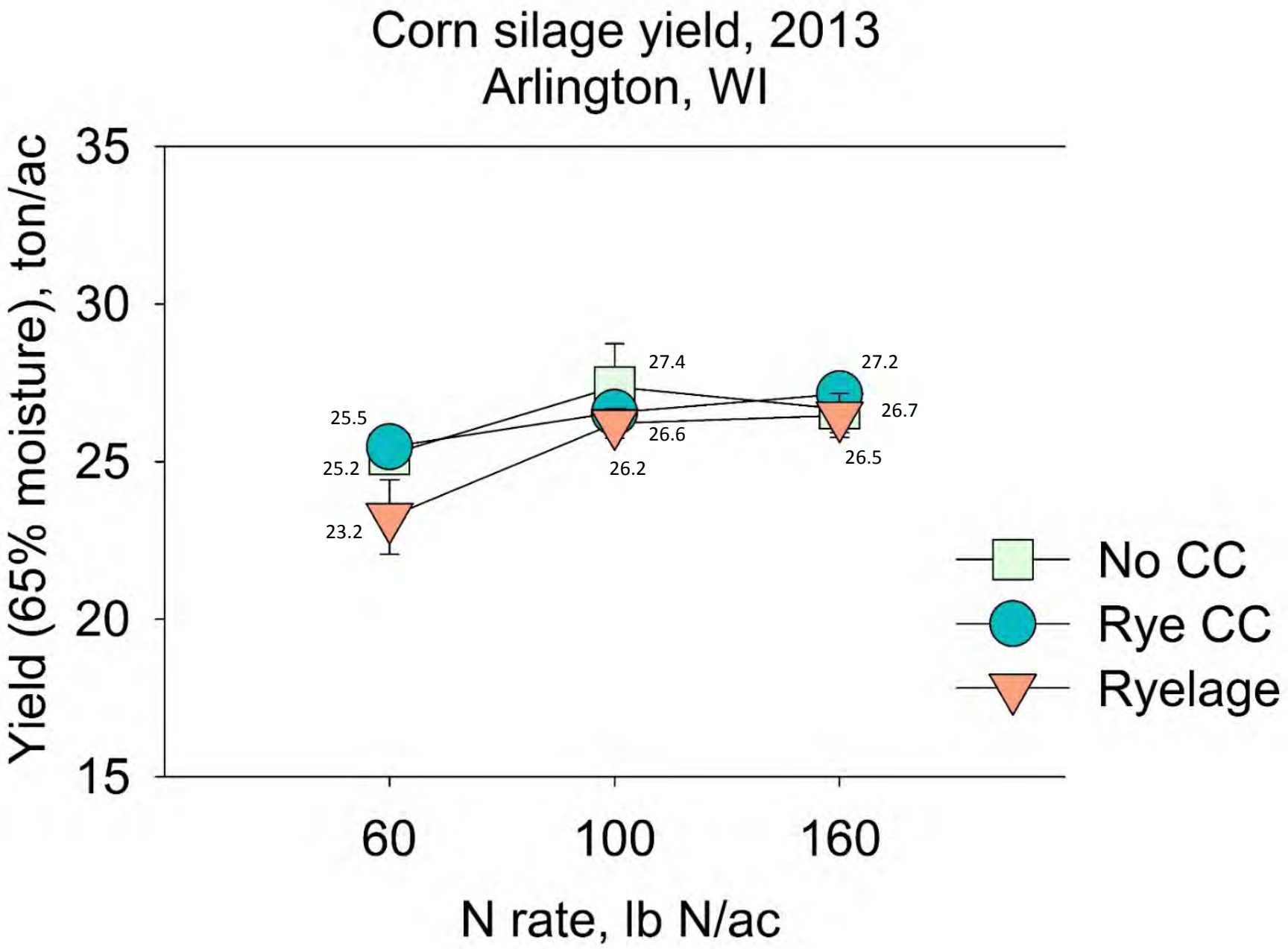
How does the rye cover or forage affect N availability from manure and the N credit to the following corn crop?

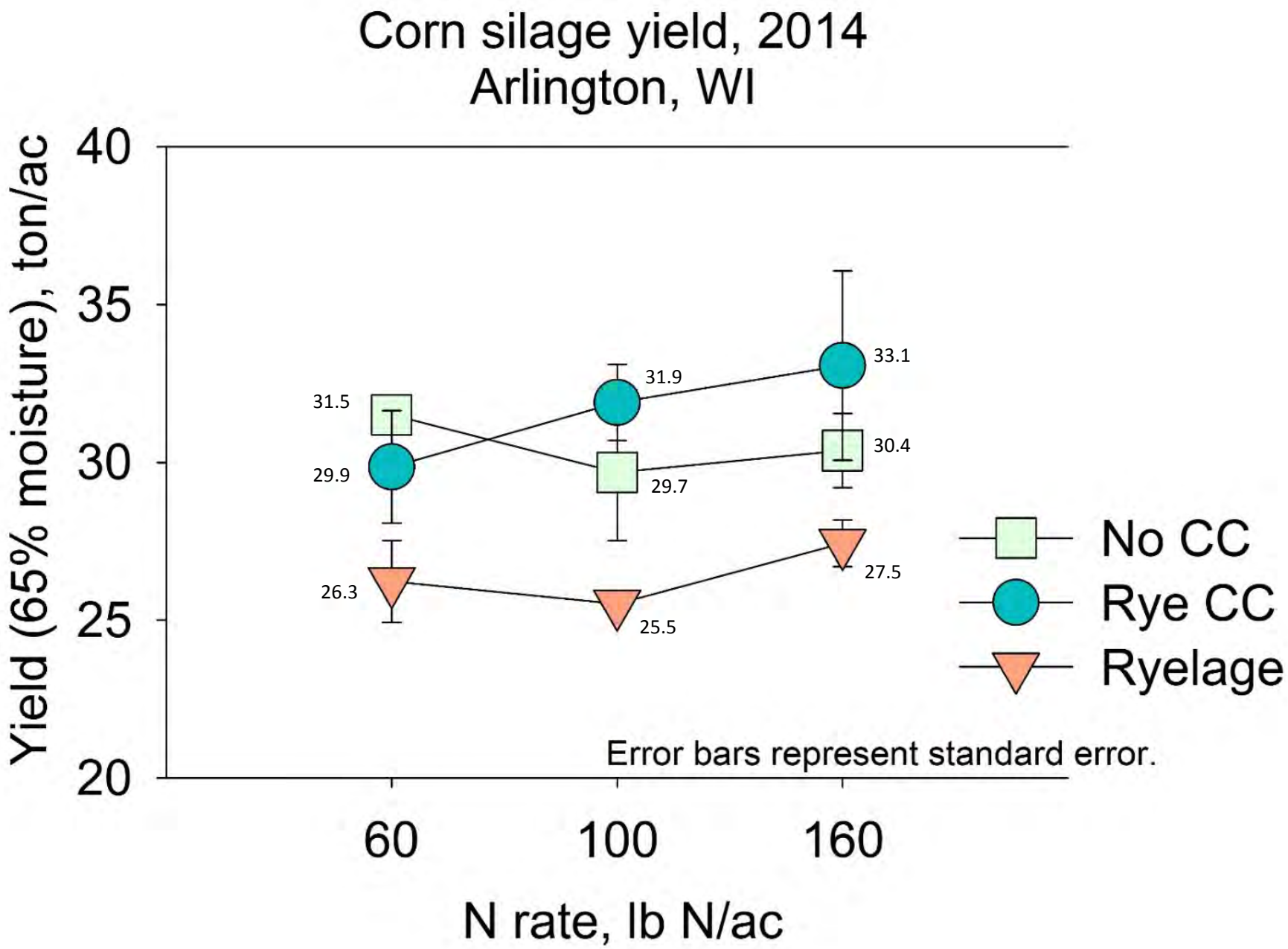
N Removal - Rye as Forage

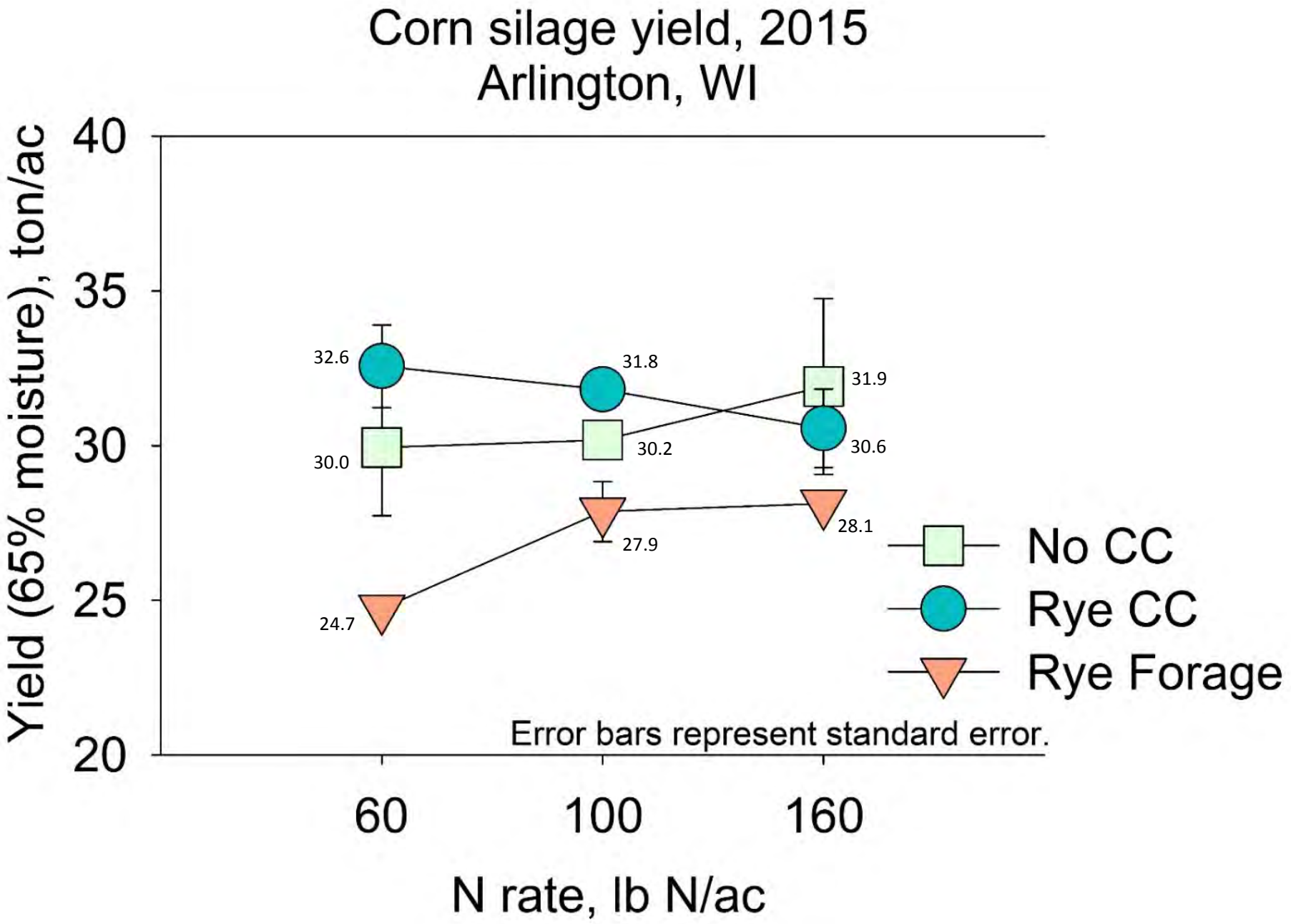


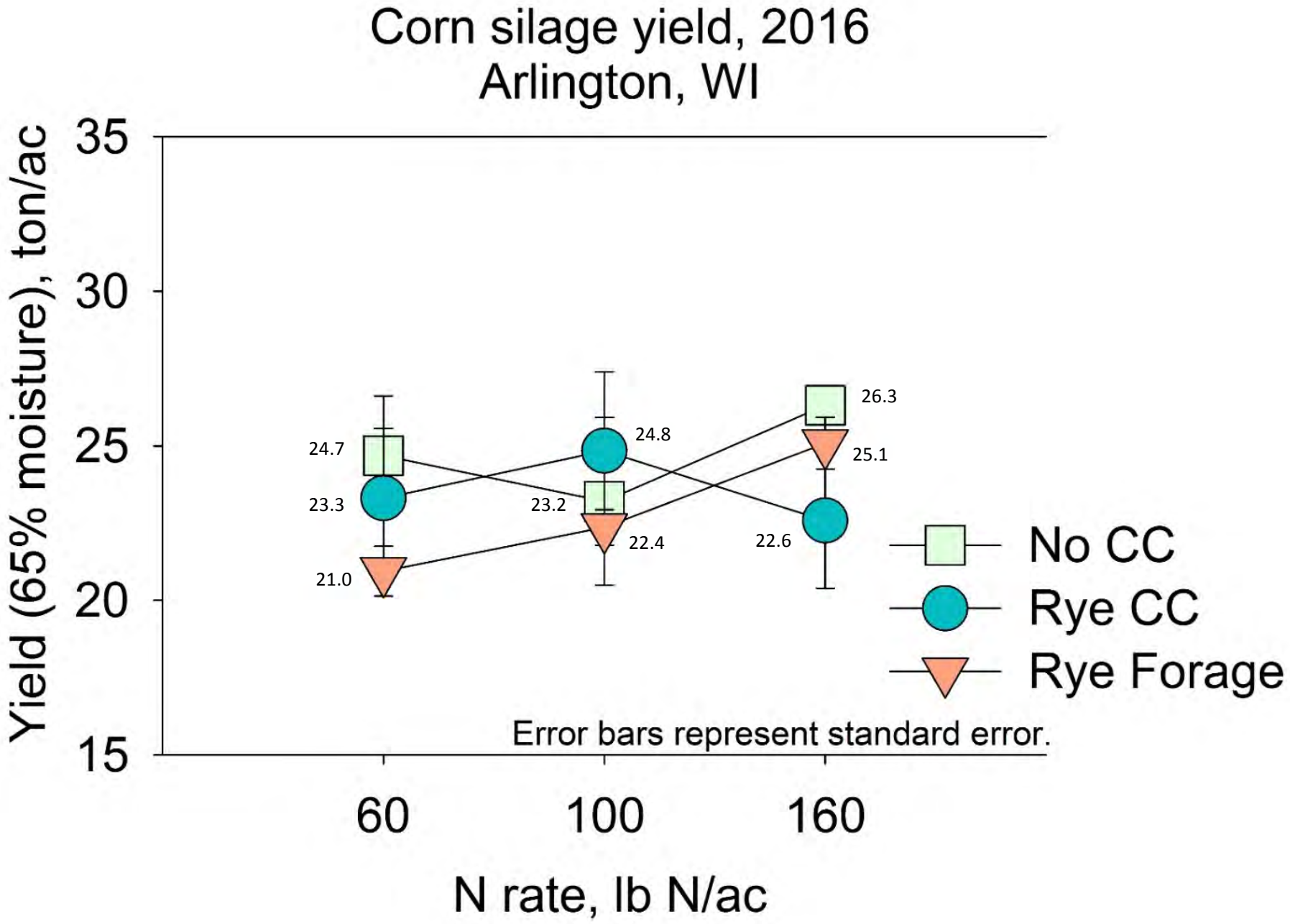

Rye as forage crop
Rye as cover crop


Corn silage yield, 2012
Arlington, WI
Yield (65% moisture), ton/ac
30
25
20
15
10
5
0
18.3
17.3
18.8
16.6
19.7
19.2
12.1
12.0
11.9
60
100
160
N rate, lb N/ac
No CC
Rye CC
Ryelage


Corn silage yield, 2013
Arlington, WI
Yield (65% moisture), ton/ac
35
30
25
20
15
60
100
160
N rate, lb N/ac
27.4
27.2
25.5
26.7
26.6
25.2
26.2
26.5
23.2
No CC
Rye CC
Ryelage


Corn silage yield, 2014
Arlington, WI
Yield (65% moisture), ton/ac
40
35
30
25
20
60
100
160
N rate, lb N/ac
31.5
29.9
26.3
31.9
29.7
25.5
33.1
30.4
27.5
No CC
Rye CC
Ryelage
Error bars represent standard error.


Corn silage yield, 2015
Arlington, WI
Yield (65% moisture), ton/ac
40
35
30
25
20
32.6
31.8
31.9
30.0
30.2
30.6
24.7
27.9
28.1
No CC
Rye CC
Rye Forage
Error bars represent standard error.
60
100
160
N rate, lb N/ac


Corn silage yield, 2016
Arlington, WI
Yield (65% moisture), ton/ac
35
30
25
20
15
24.7
23.3
21.0
24.8
23.2
22.4
26.3
25.1
22.6
No CC
Rye CC
Rye Forage
Error bars represent standard error.
60
100
160
N rate, lb N/ac

How does the rye cover or forage affect the manure N credit to, and the N requirement of, the following corn silage crop?

- Results not definitive on optimum N rate or N credits (+/-) from rye.
- Winter rye as a **cover crop** took up soil NO_3^-, winter rye as a **forage crop** removed soil NO_3^- **.** Both appeared to reduce early season soil NO_3^- levels.
- Winter rye did not have a significant effect on N rate response for corn silage.
  - No penalty, no advantage to rye cover or forage w/respect to N rate compared to no rye
  - Soil N removed by rye forage did not affect N rate response as might be expected
- **Corn silage following rye forage** has significantly lower yield 3/5 years
  - Yield reduction was not affected, or could not be overcome, by N rate.

Economic Return +/-
from adding rye as cover crop or forage crop

Partial budget analysis:

Value of all forages produced **–** Relevant costs associated with adding rye

Milk/TDM forage[1] * DM forages[2] * Milk price[3]

<u>- Input costs relevant to rye cover or forage[4]</u>

= Gross return to forage and cover crop system ($/acre)

[1]Milk/TDM forage: Index of milk production potential based on energy content using forage analysis parameters CP, NDF, in vitro NDF digestibility, starch, and non-fiber carbohydrate and an estimate of DM intake (Shaver, et al. 2001).

[2]Corn silage yields at 100 lb./acre N rate

[3]Mailbox – by/year

[3]Input costs differing between the three systems: Rye seed and planting, rye forage harvest and soil nutrient removal in all harvested forages – by year.

Forage Yields

Tons Dry Matter/Acre

Corn silage	Ave
w/No rye	8.6
Following rye cover	9.2
Following rye forage	7.5
Rye forage	1.8

Crop Rotation →		No Rye – CS	Rye Cover - CS	Rye Forage - CS
2012	Corn Silage	5.7	6.6	3.7
	Rye Forage			2.5
	Total	5.7	6.6	6.2
2013	Corn Silage	9.0	8.6	8.3
	Rye Forage			1.0
	Total	9.0	8.6	9.3
2014	Corn Silage	9.7	10.1	8.4
	Rye Forage			1.3
	Total	9.7	10.1	9.7
2015	Corn Silage	10.2	10.9	9.8
	Rye Forage			1.5
	Total	10.2	10.9	11.3
2016	Corn Silage	8.2	8.9	7.4
	Rye Forage			2.7
	Total	8.2	8.9	10.1

Rye forage quality % DM – average/3 reps

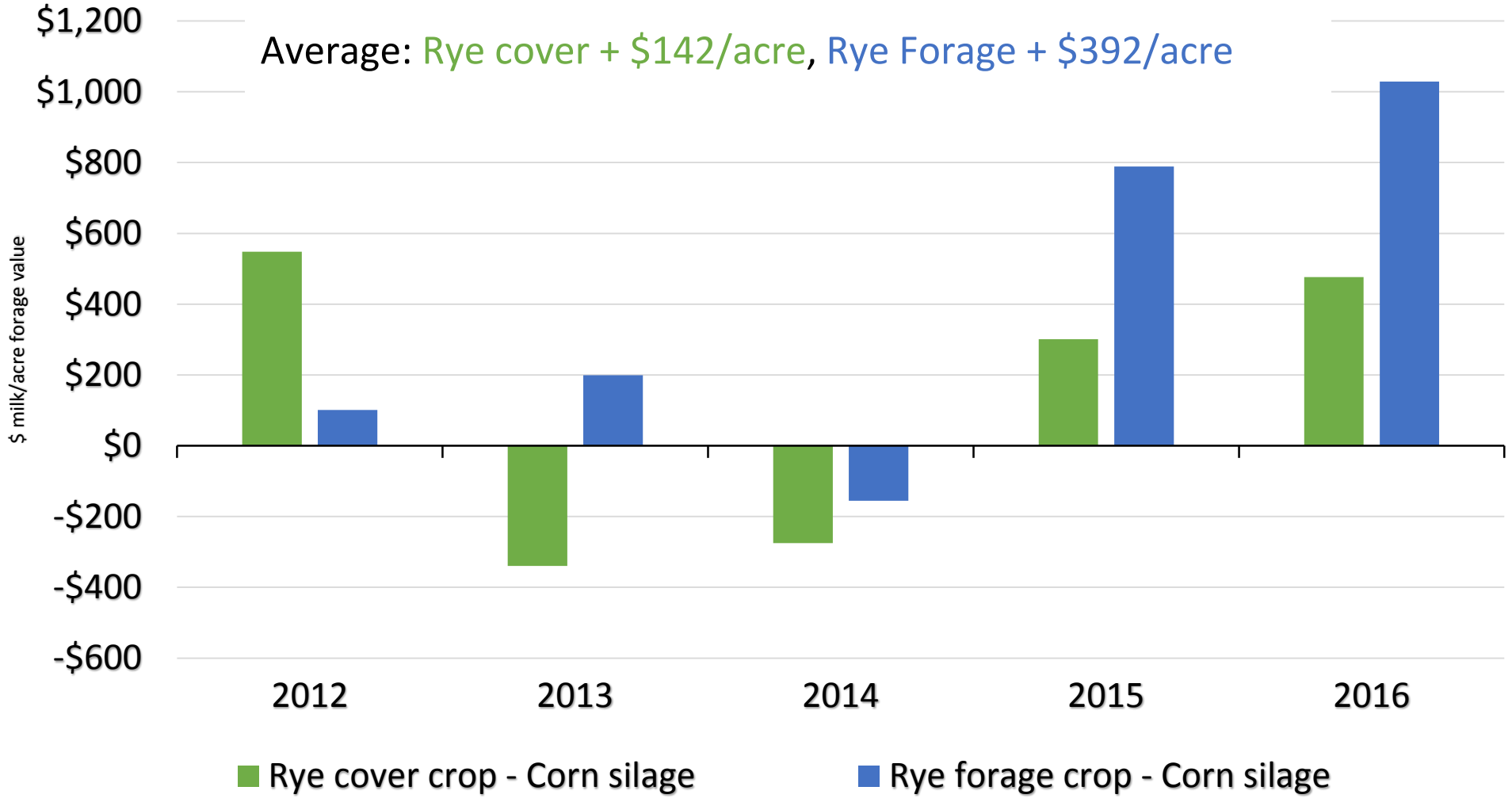
	Crude Protein	NDF	NDFD	RFQ	Milk/ TDM	K
2012	16.4	53.72	64.39	149	3213	2.33
2013	20.1	46.98	70.54	189	3638	3.15
2014	19.7	50.25	66.60	169	3480	2.55
2015	17.6	44.64	83.62	235	4114	2.37
2016	10.9	60.59	65.93	139	3270	1.98

Corn silage quality – Milk per-ton DM

average/3 reps

	No Rye	Rye cover crop	Rye forage
2012	3146	3201	3149
2013	3151	3135	3178
2014	3043	2835	2982
2015	3191	3165	3236
2016	2873	3021	2990

Gross value of milk produced ($/acre) from forages[1] relative to corn silage - no rye treatment (+/-)



Trial Results – Economics

- Winter rye as a cover crop did not affect subsequent corn silage yield
- Winter rye as a forage crop decreased subsequent corn silage yield, but total forage production was comparable or increased.
- Economic returns considering potential milk yield from all forages produced favored the rye forage system 4 of the 5 study years compared to the no rye treatment.

Thank you!

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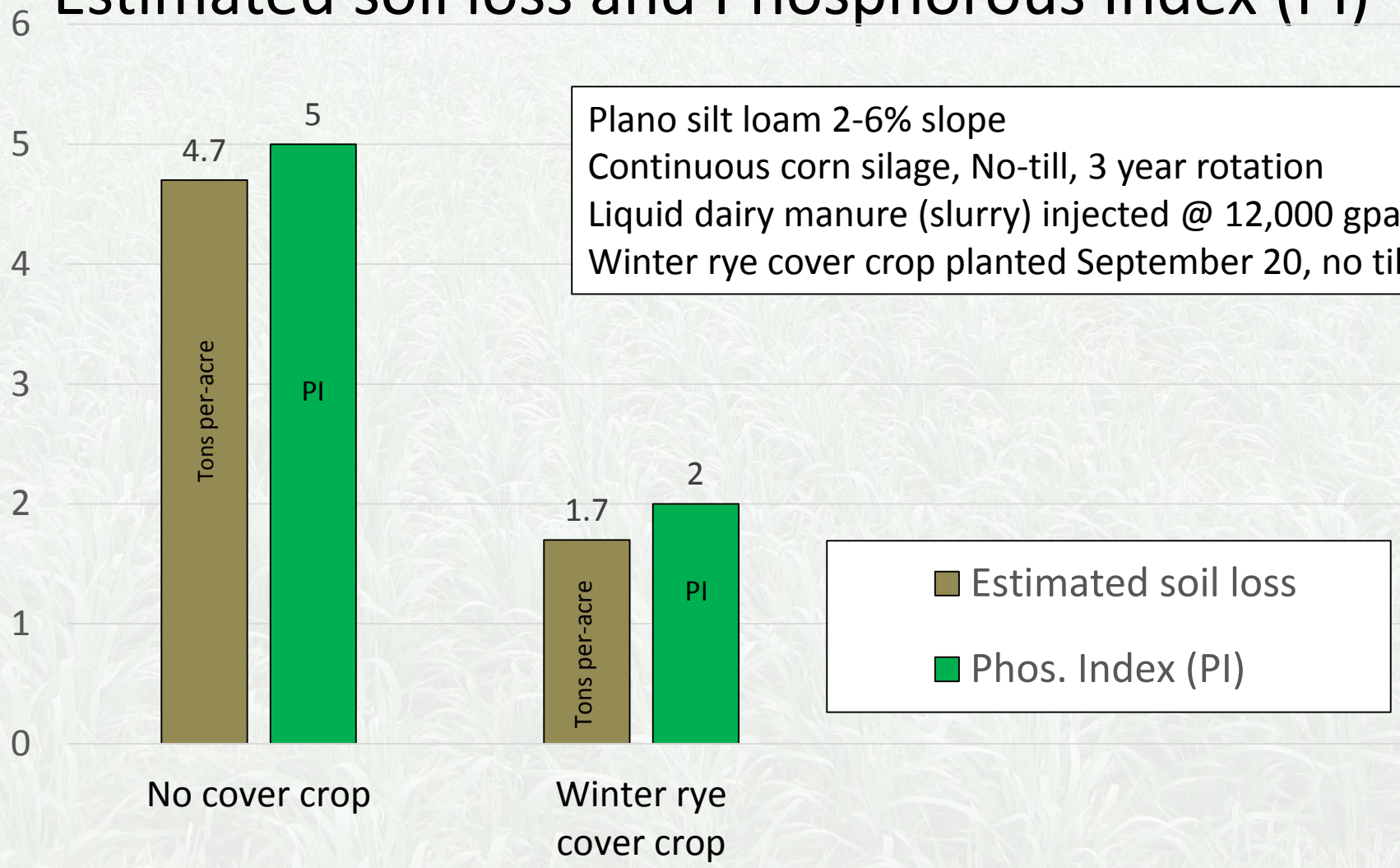
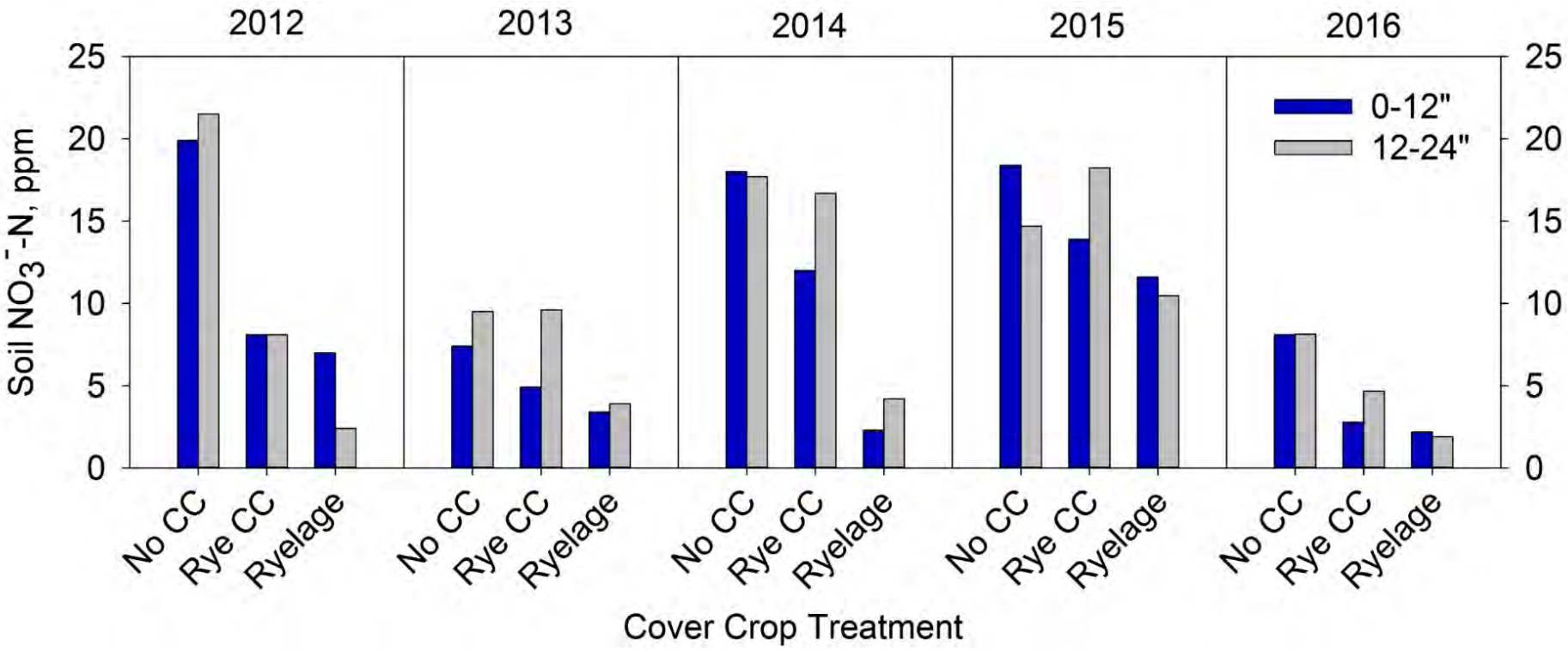
SNAP Plus
Estimated soil loss and Phosphorous Index (PI)



How does the rye cover or forage affect N availability from manure and the N credit to the following corn crop?

Pre-plant soil nitrate



Other factors

- Consider herbicide rotation intervals when planning for rye as forage
- Be aware of final planting dates for corn insurability
- Time of N application
- Time of corn planting relative to rye termination
- Planting equipment and conditions