Nutrient Management in Tile Drained Fields

(Results from 2016 NREC Projects)

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Project 1
Evaluating a Combination of Practices (Testing the IL NLRS)



Corn - Soybean - Wheat

Cover crops

Woodchip bioreactor

Lowell Gentry

and

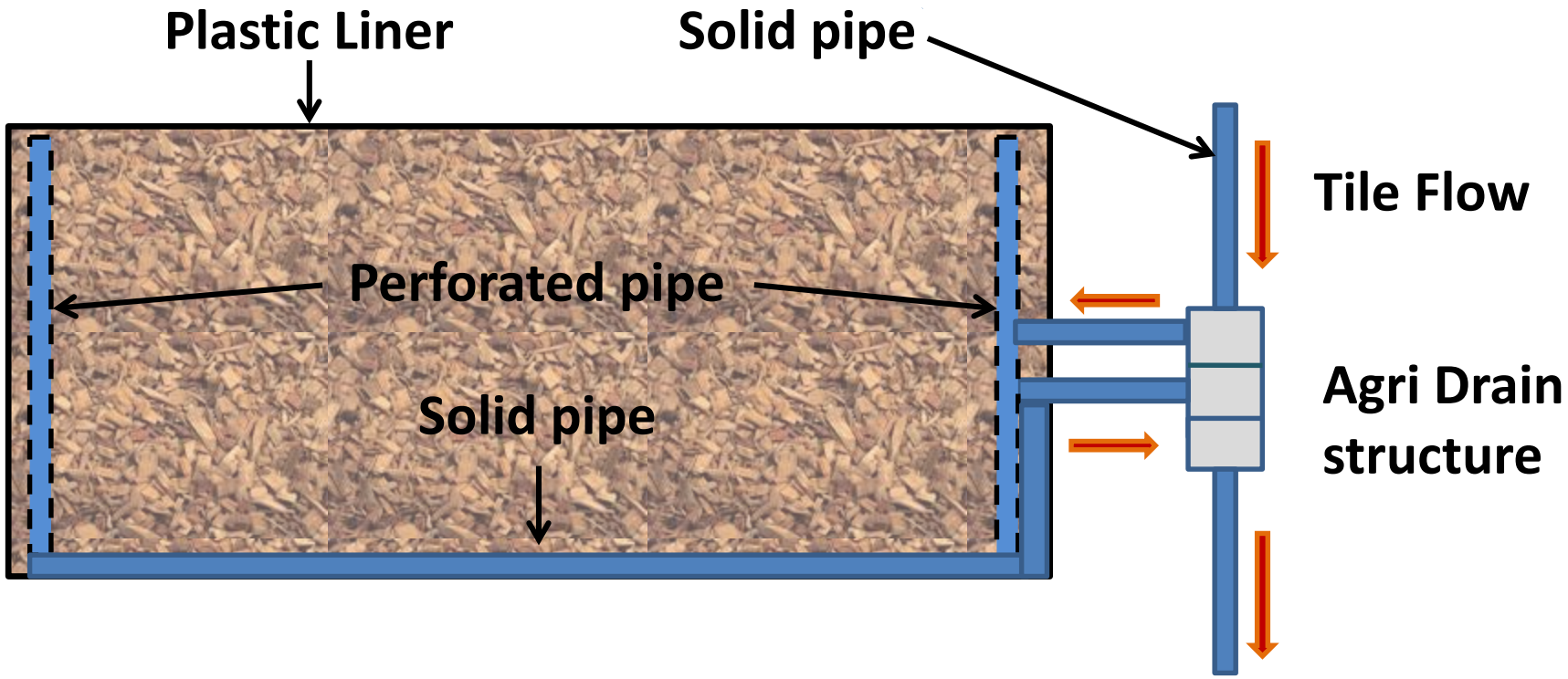
Mark David

NRES

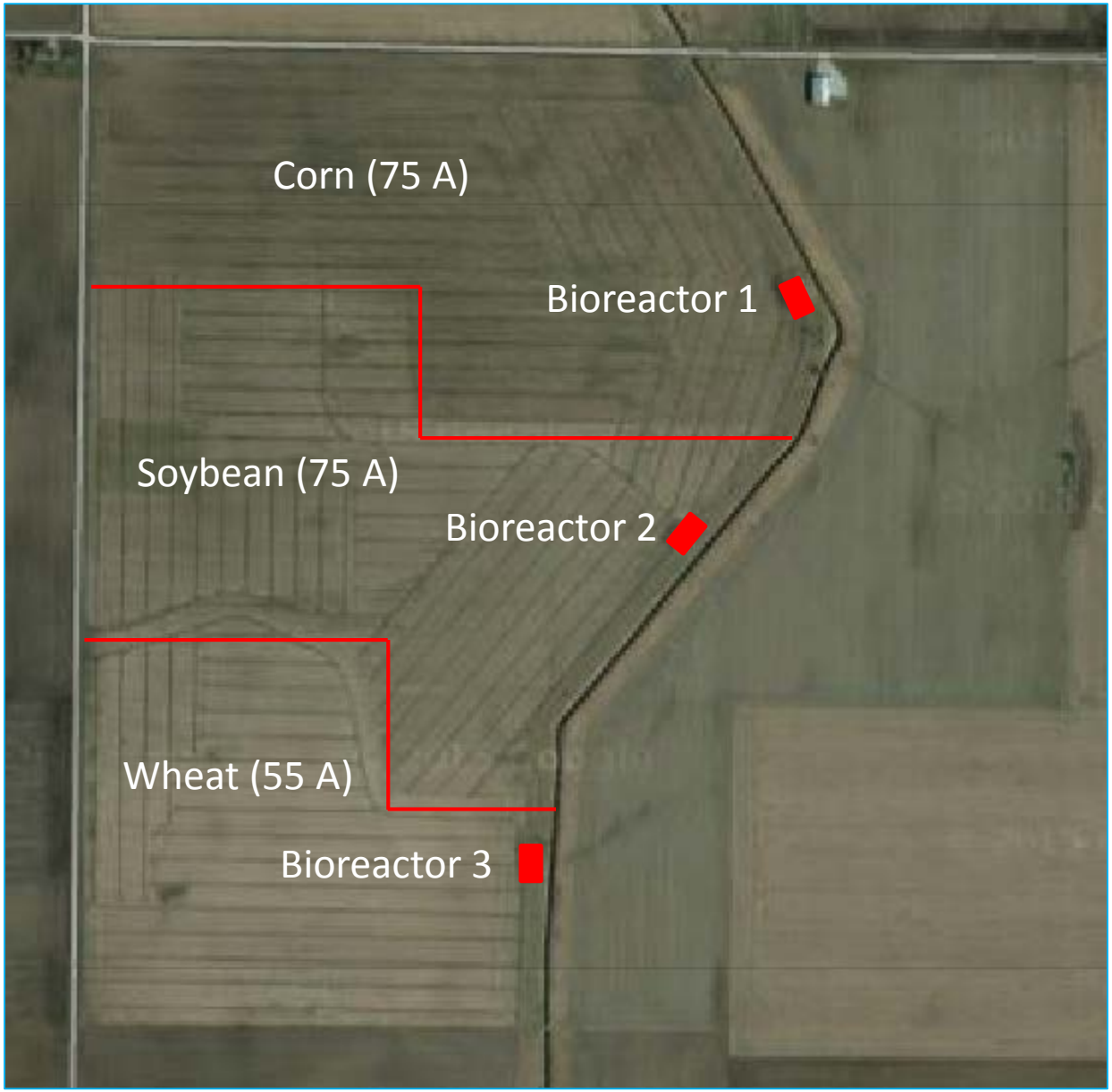
Methods

- C-S-W with each phase of the rotation every year.
- Cereal rye after corn, winter wheat after soybean, and radish, turnip and red clover after wheat.
- Strip-till corn, no-till soybean, and no-till wheat.
- Woodchip bioreactor at the end of each tile outlet.

Bioreactor Plumbing

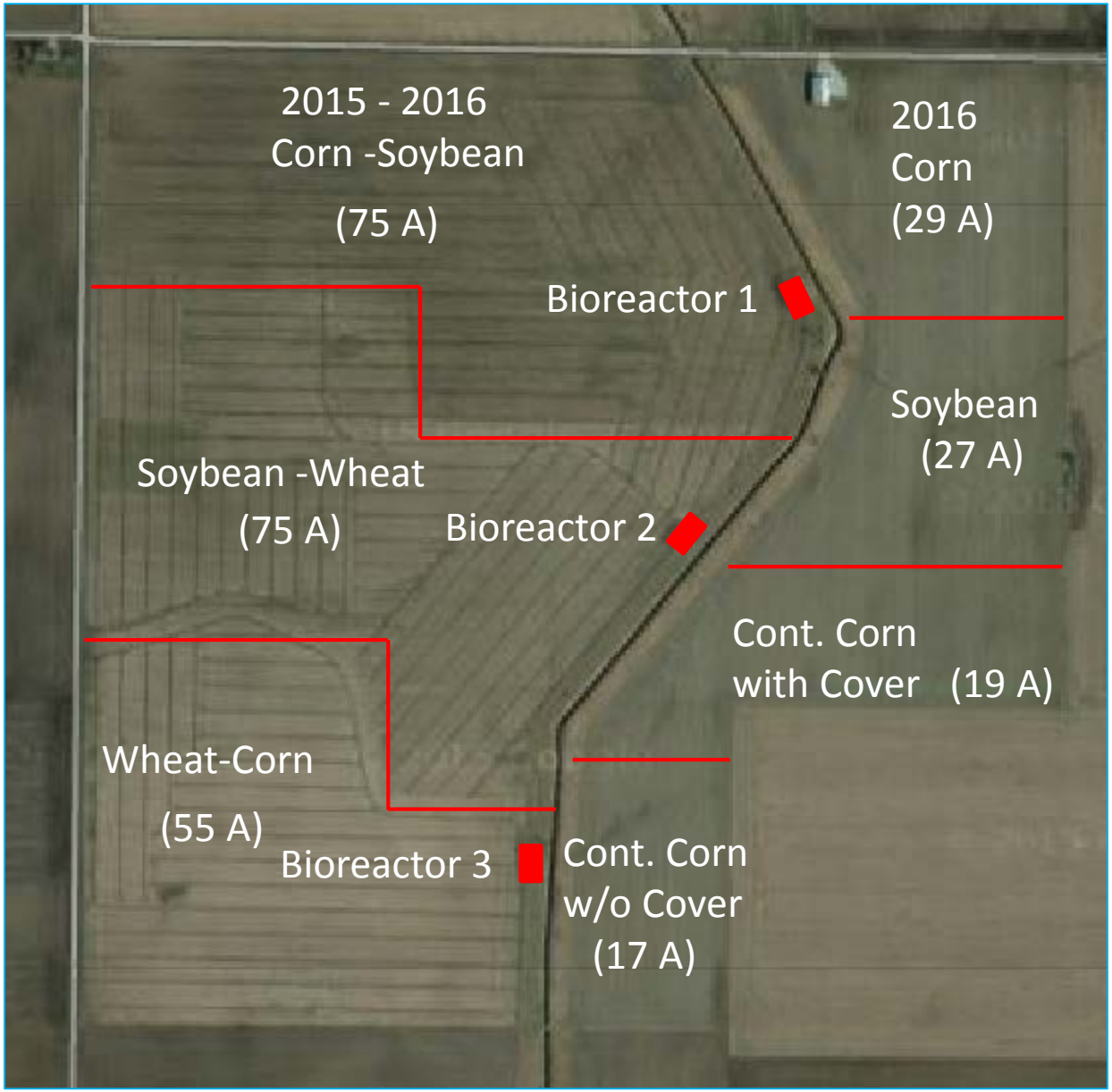


Experimental Design



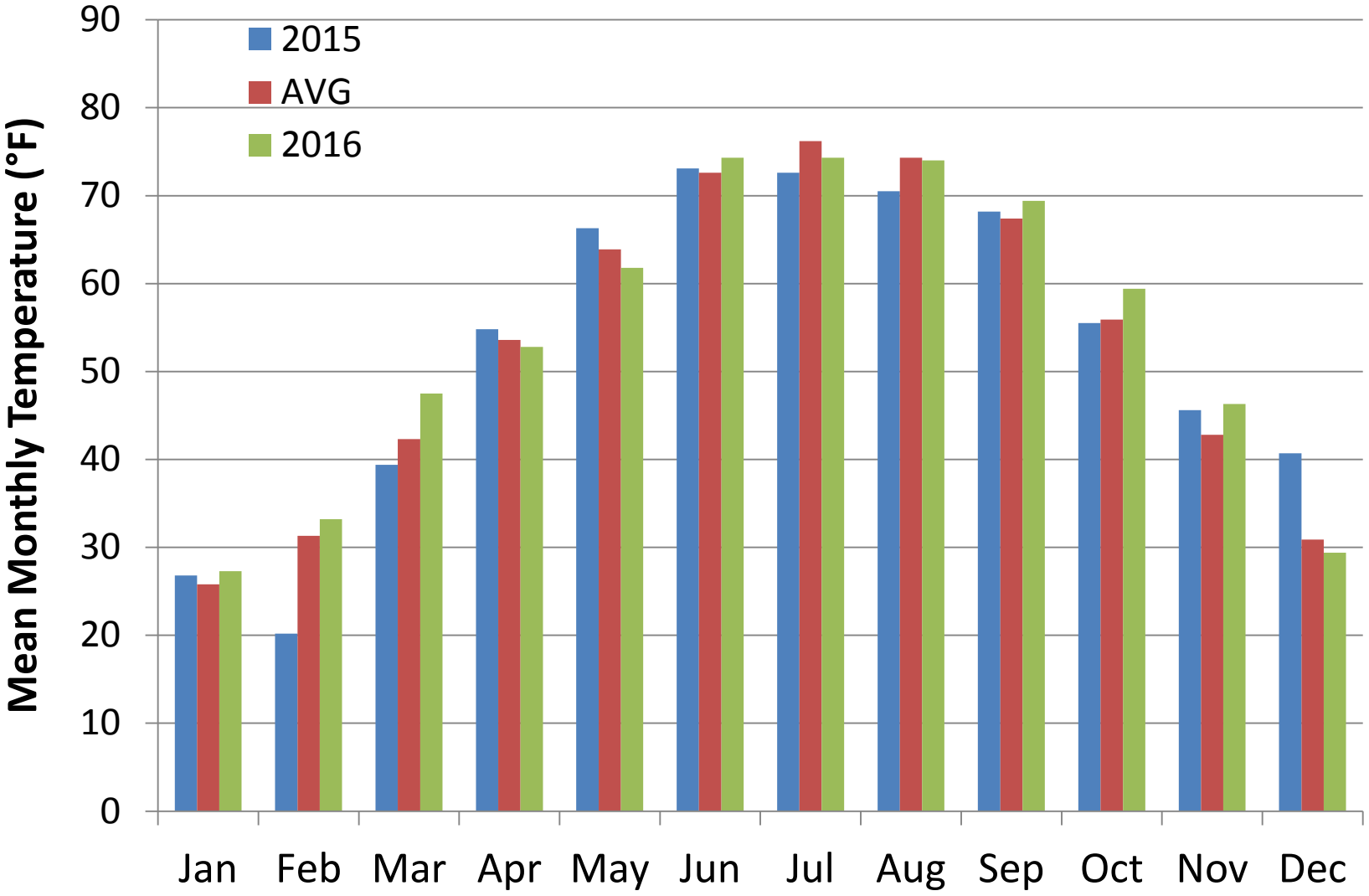
Field Design and Crop Rotation

Wheat on west side in 2014 for tiling

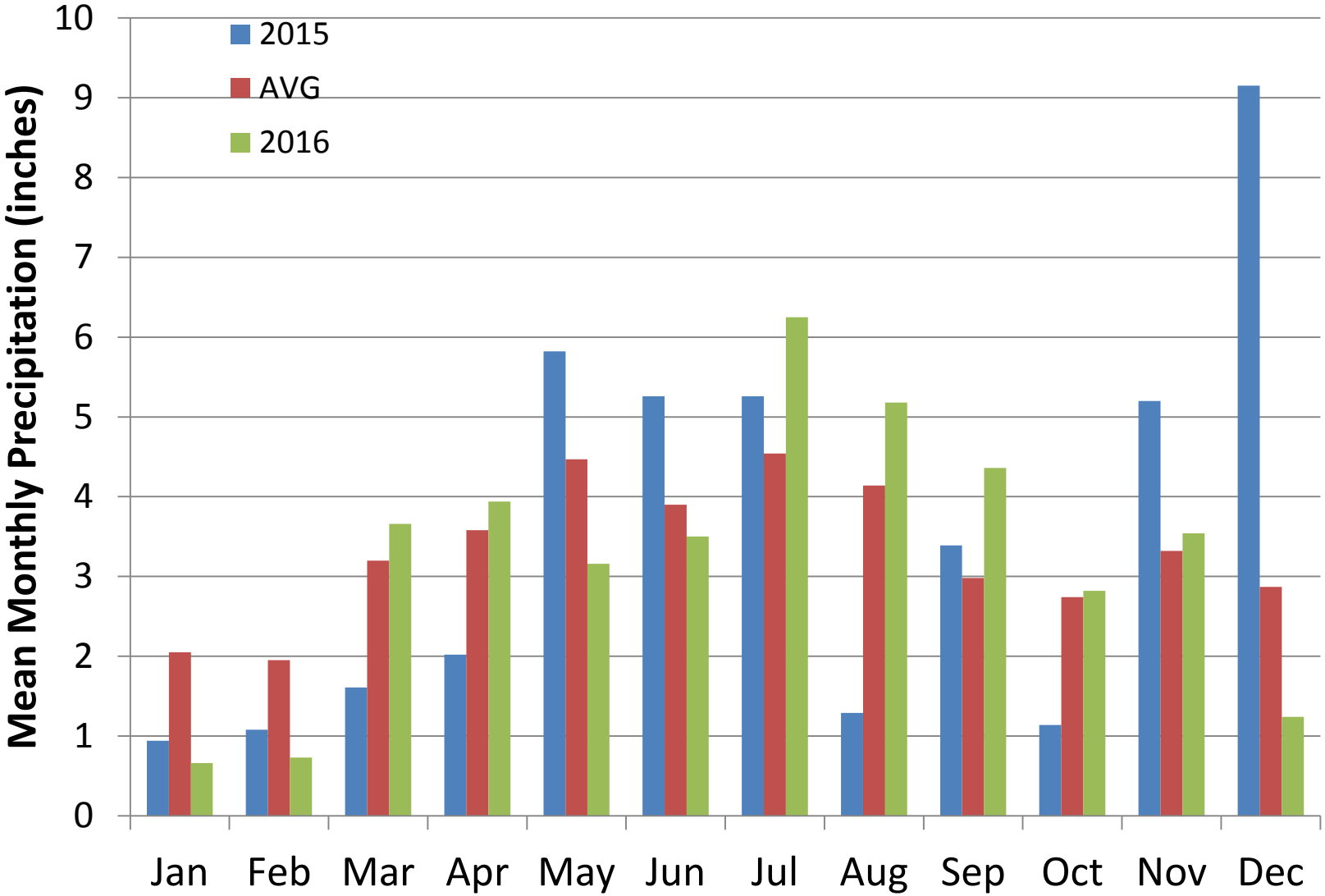


Wheat on east side in 2015 for tiling

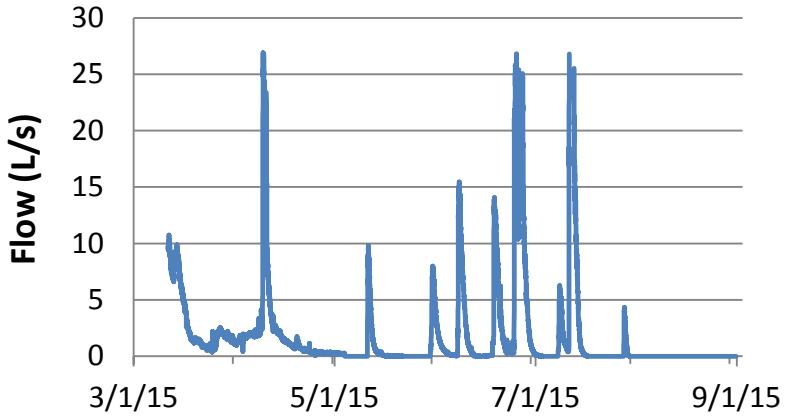
Temperature



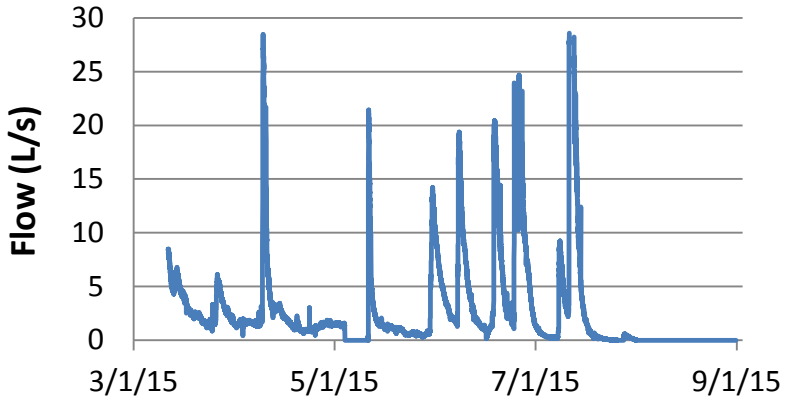
Precipitation



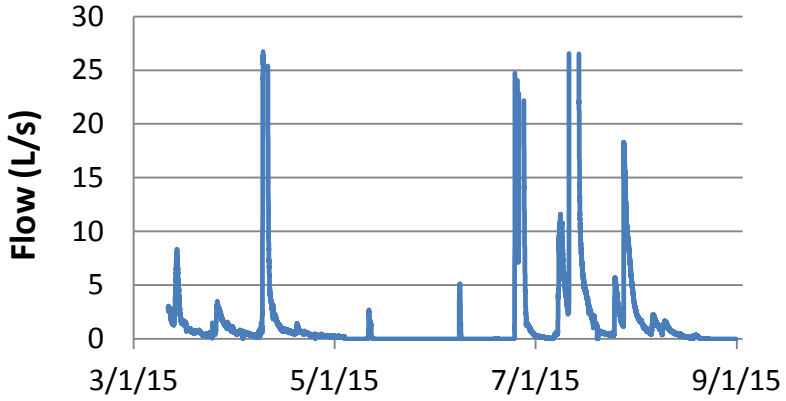
Hydrograph of tile flow from each field



Corn



Soybean

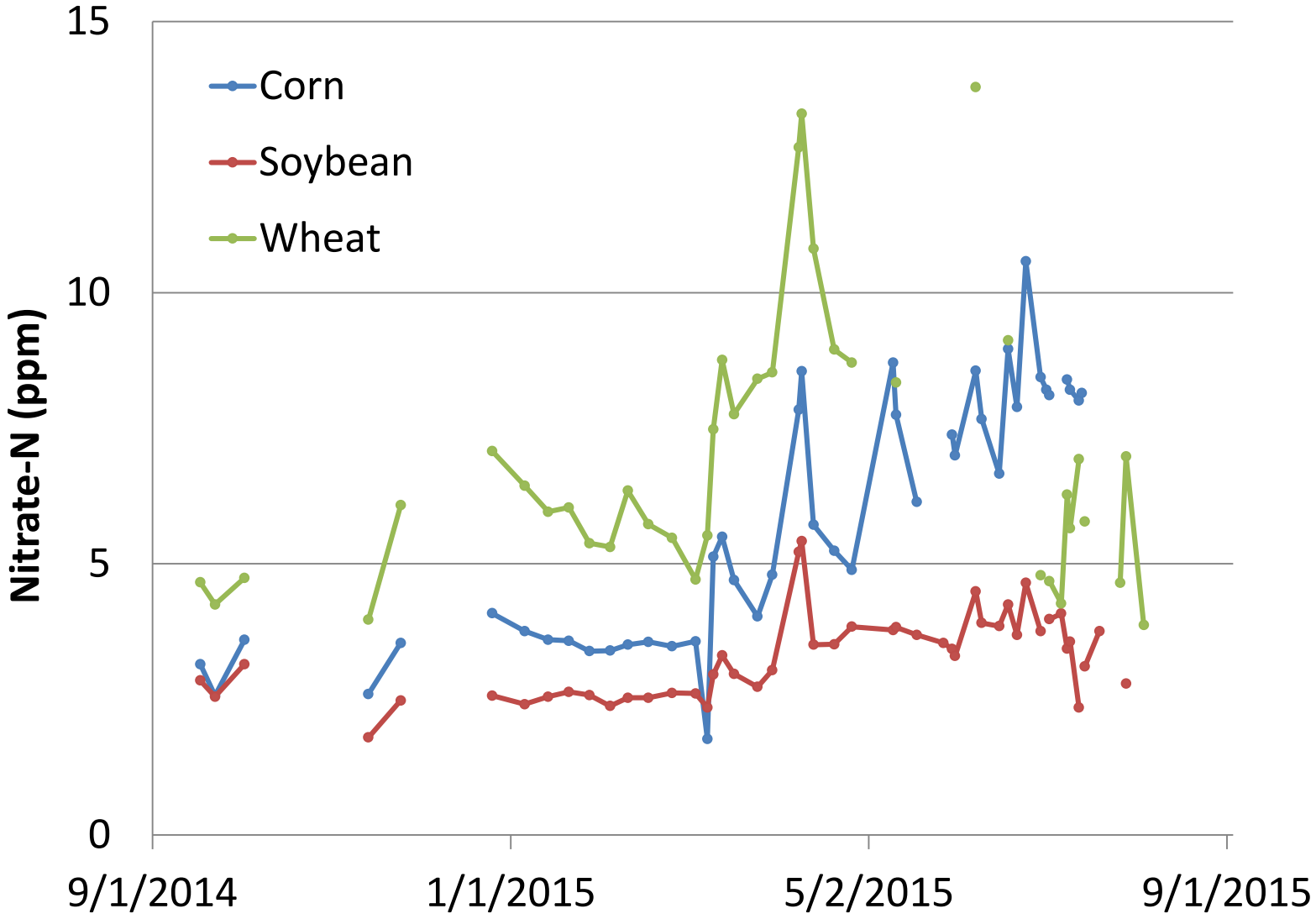


Wheat

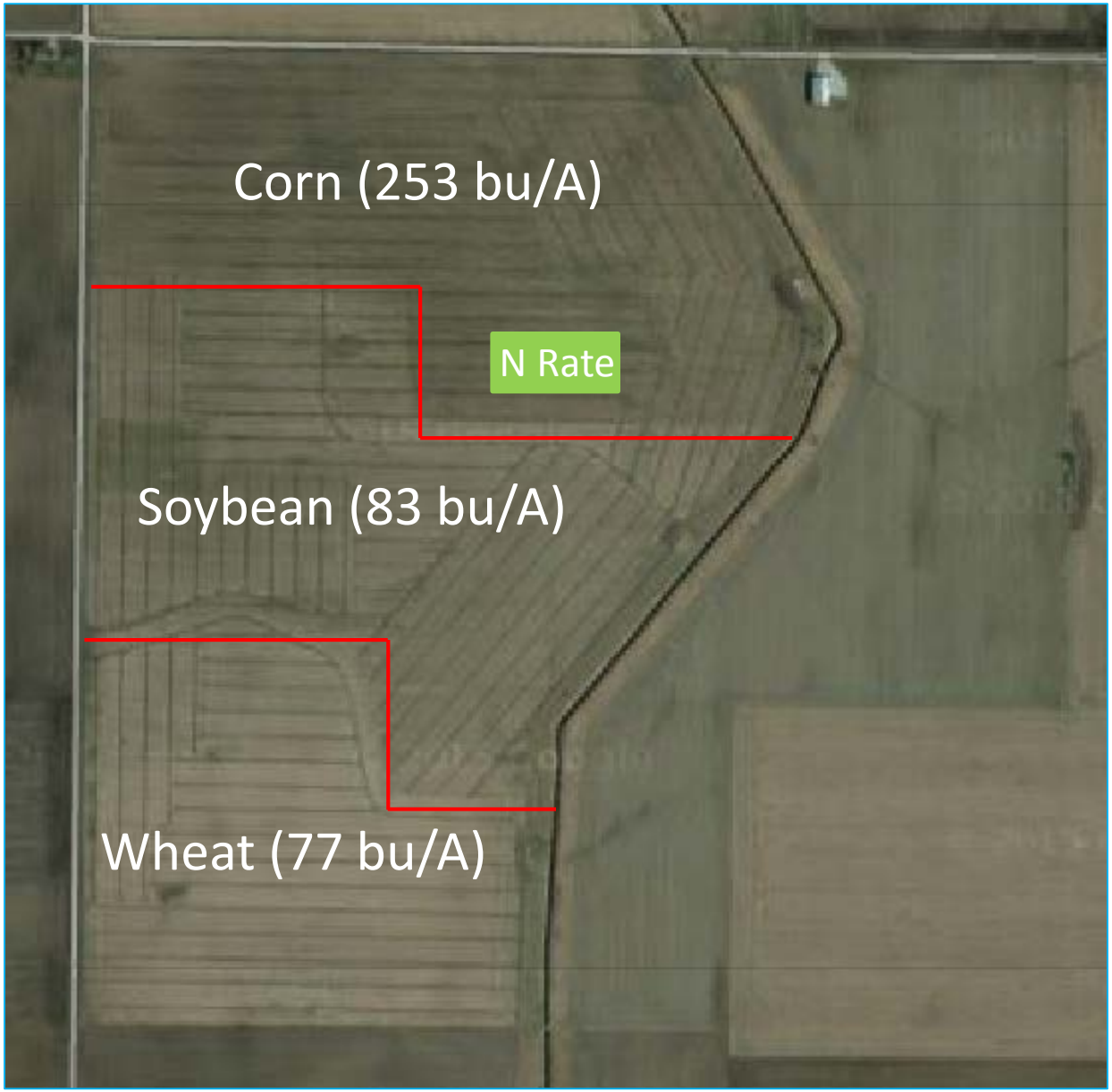
The wheat field had little tile flow during May and June compared to either the corn or soybean fields.

This occurred again in 2016 (and on a new plot).

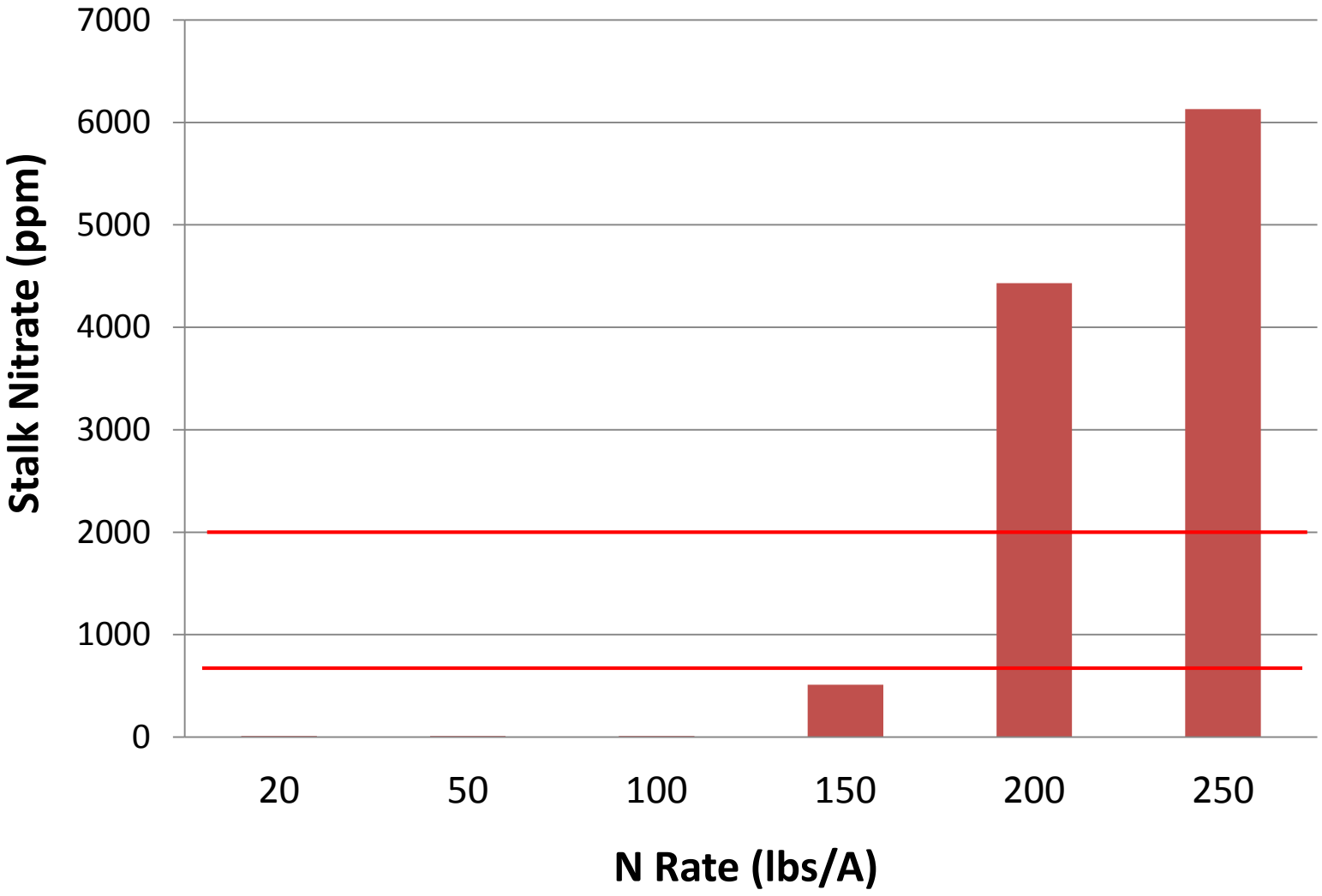
Tile Nitrate Concentration



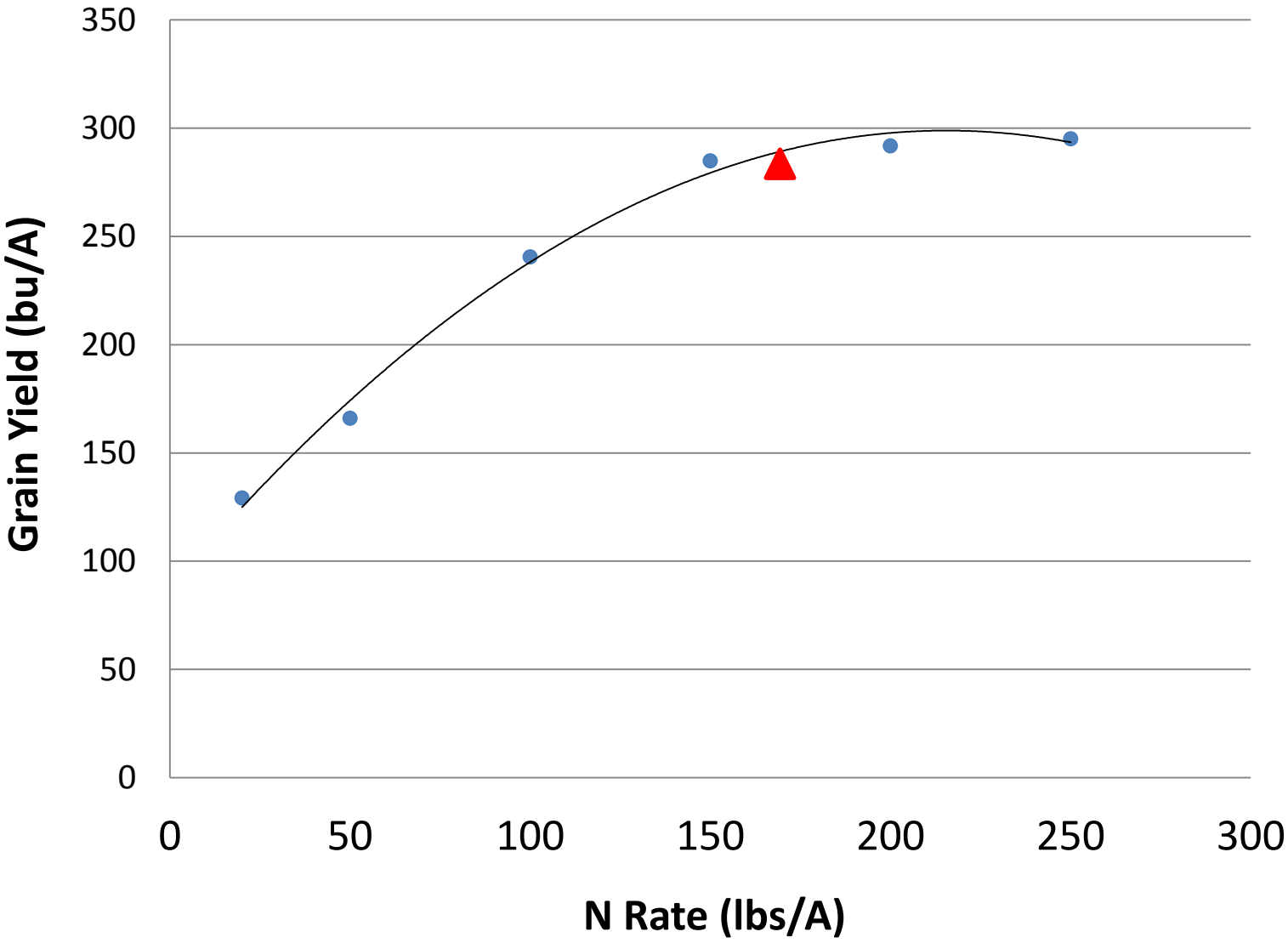
Crop Yield in 2015



2015 Corn Stalk Nitrate



2015 Corn Grain Yield



Cover Crop (Spring)	Biomass	Biomass N
	Tons/A	lbs/A
Cereal Rye	0.61	31

Cover Crop Cocktail

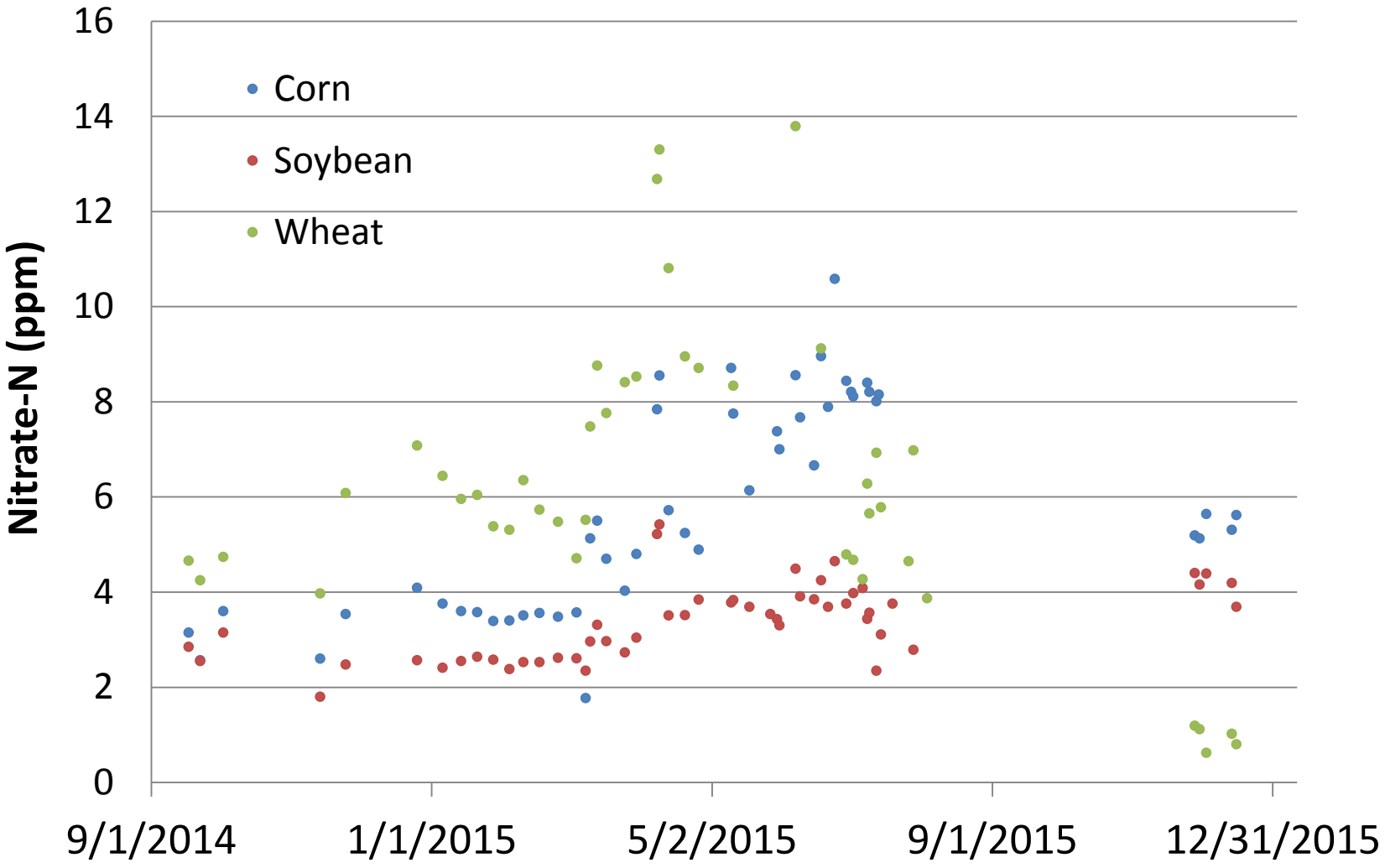
Radish, turnip, and red clover (plus volunteer wheat)

Photo by John M. Green

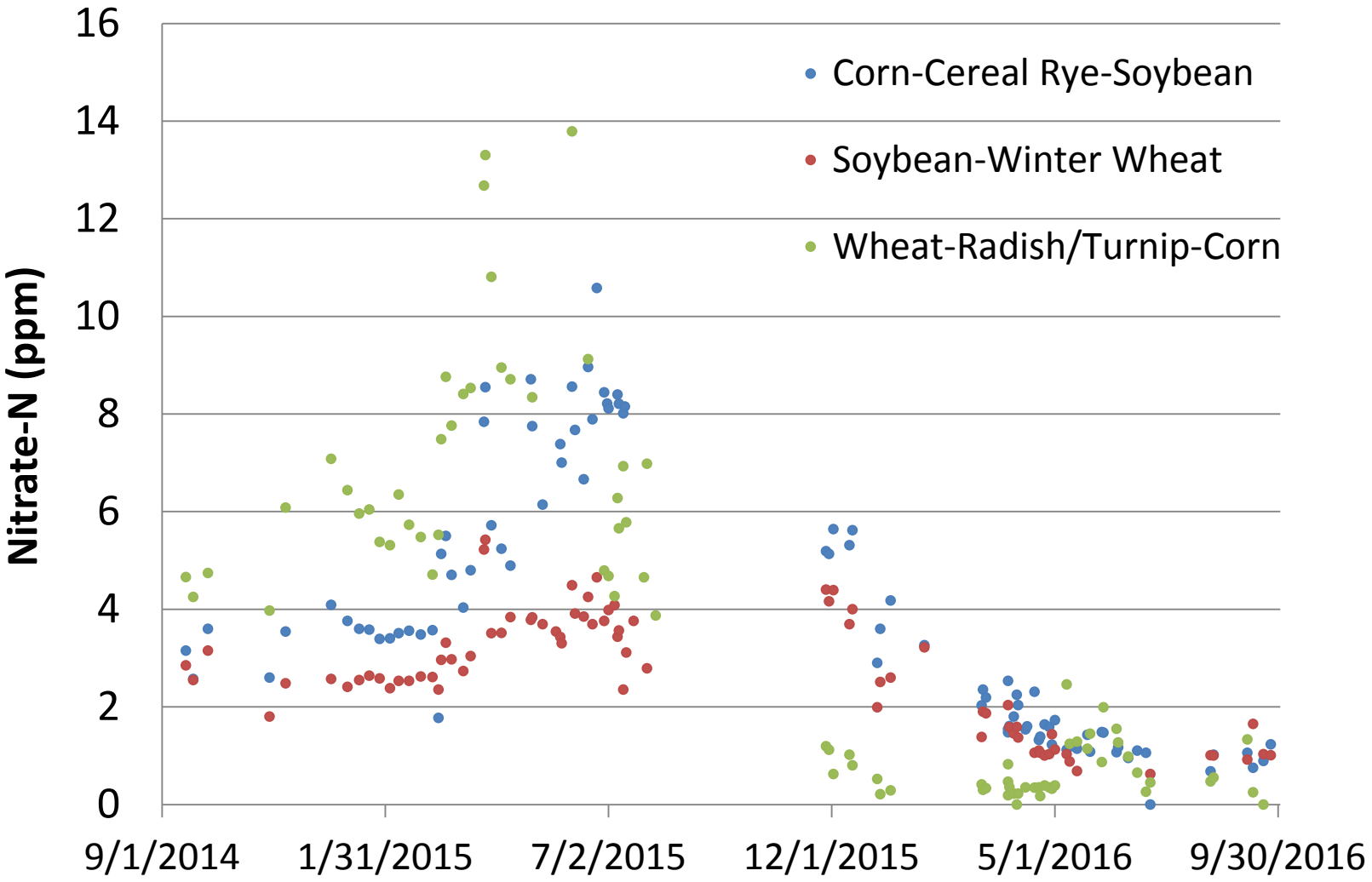
Cover Crop (Fall)	Biomass	Biomass N
	Tons/A	lbs/A
Radish	1.67	50
Turnip	0.73	18
Red Clover	0.26	14
Volunteer wheat	0.21	10
Total	2.87	92

Cover Crop (Spring)	Biomass	Biomass N
	Tons/A	lbs/A
Red Clover	0.49	44
Volunteer wheat	0.40	20
Total	0.89	64

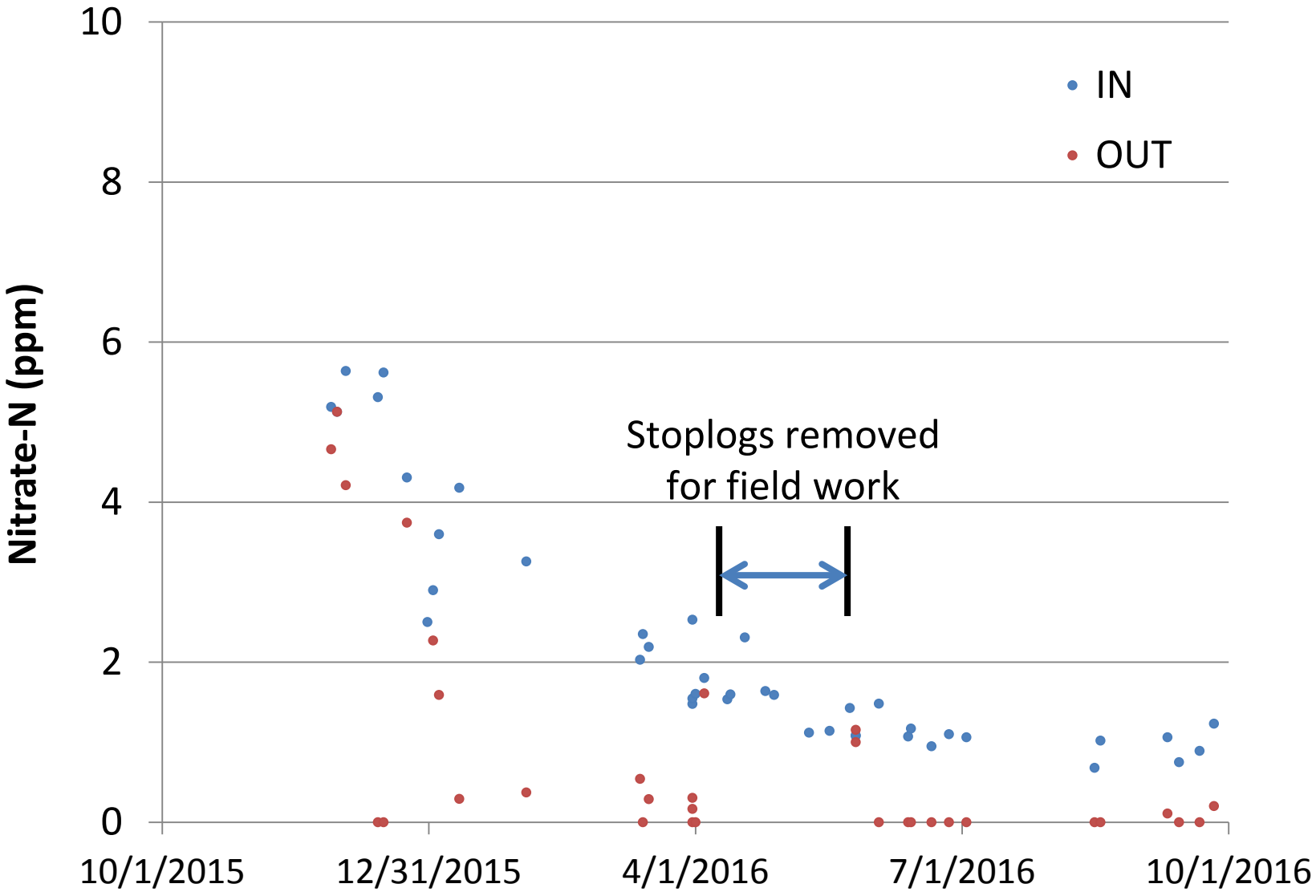
Tile Nitrate from C-S-W



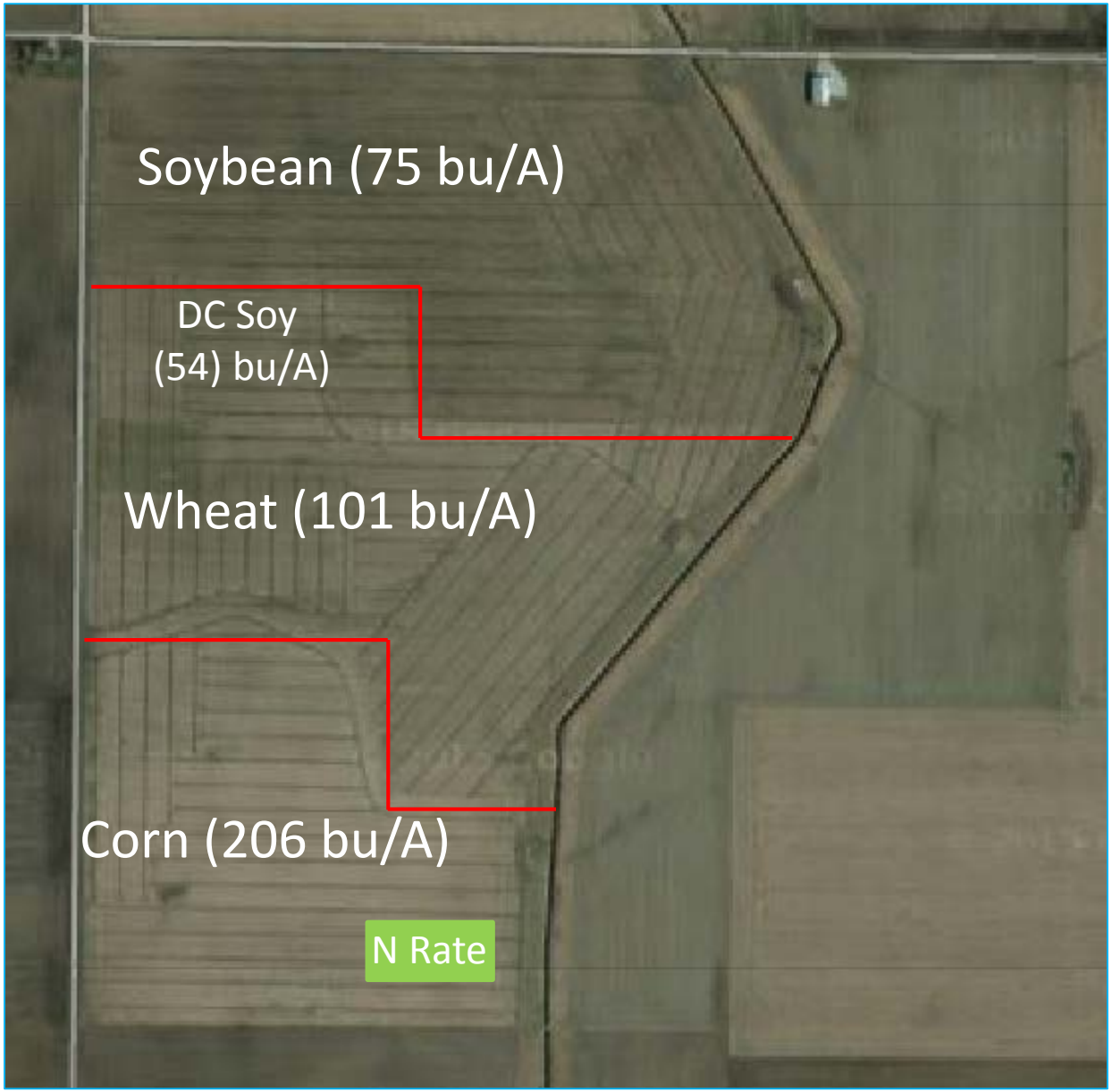
Tile Nitrate from C-S-W



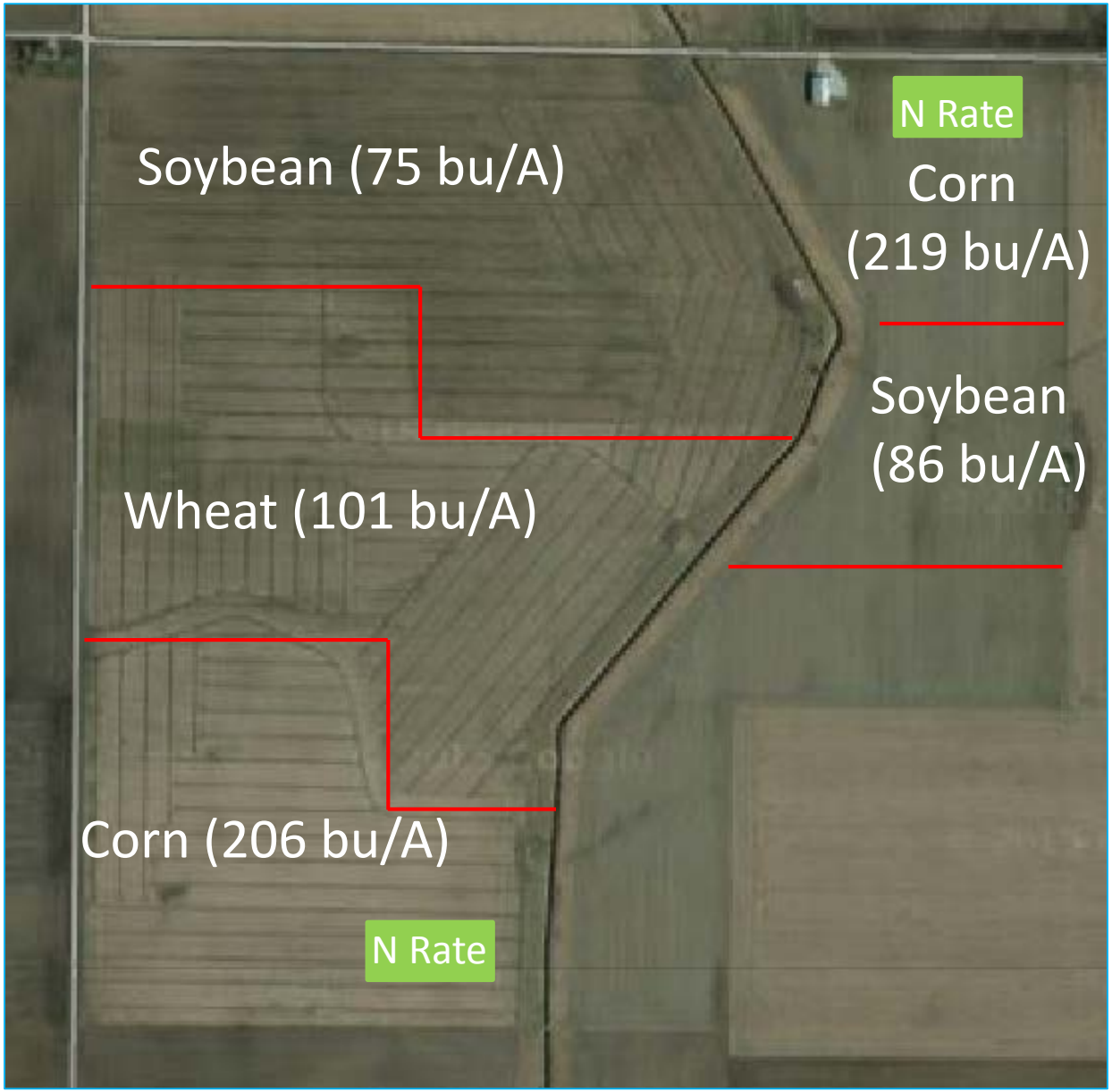
Nitrate In and Out of Bioreactor



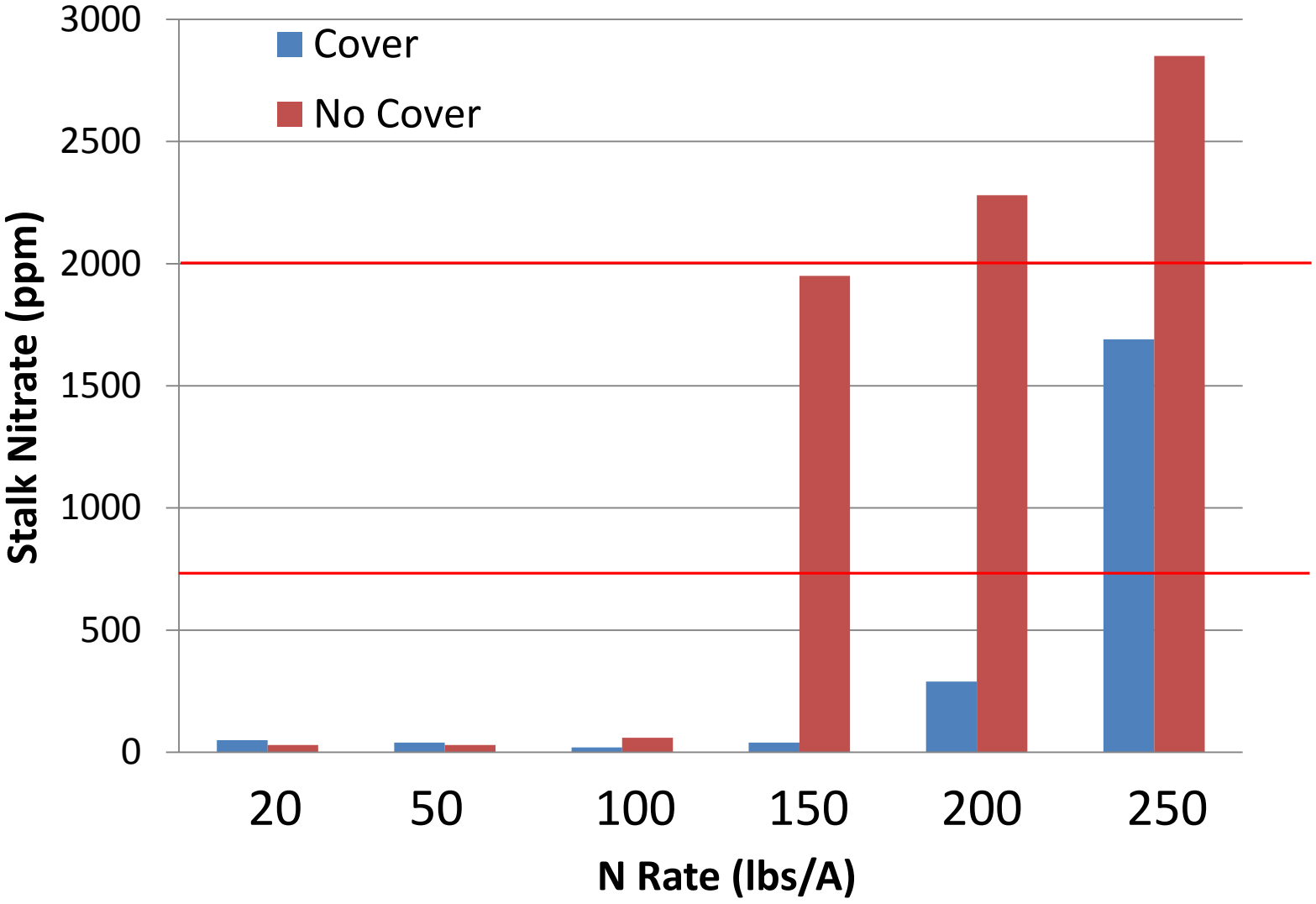
Crop Yield in 2016



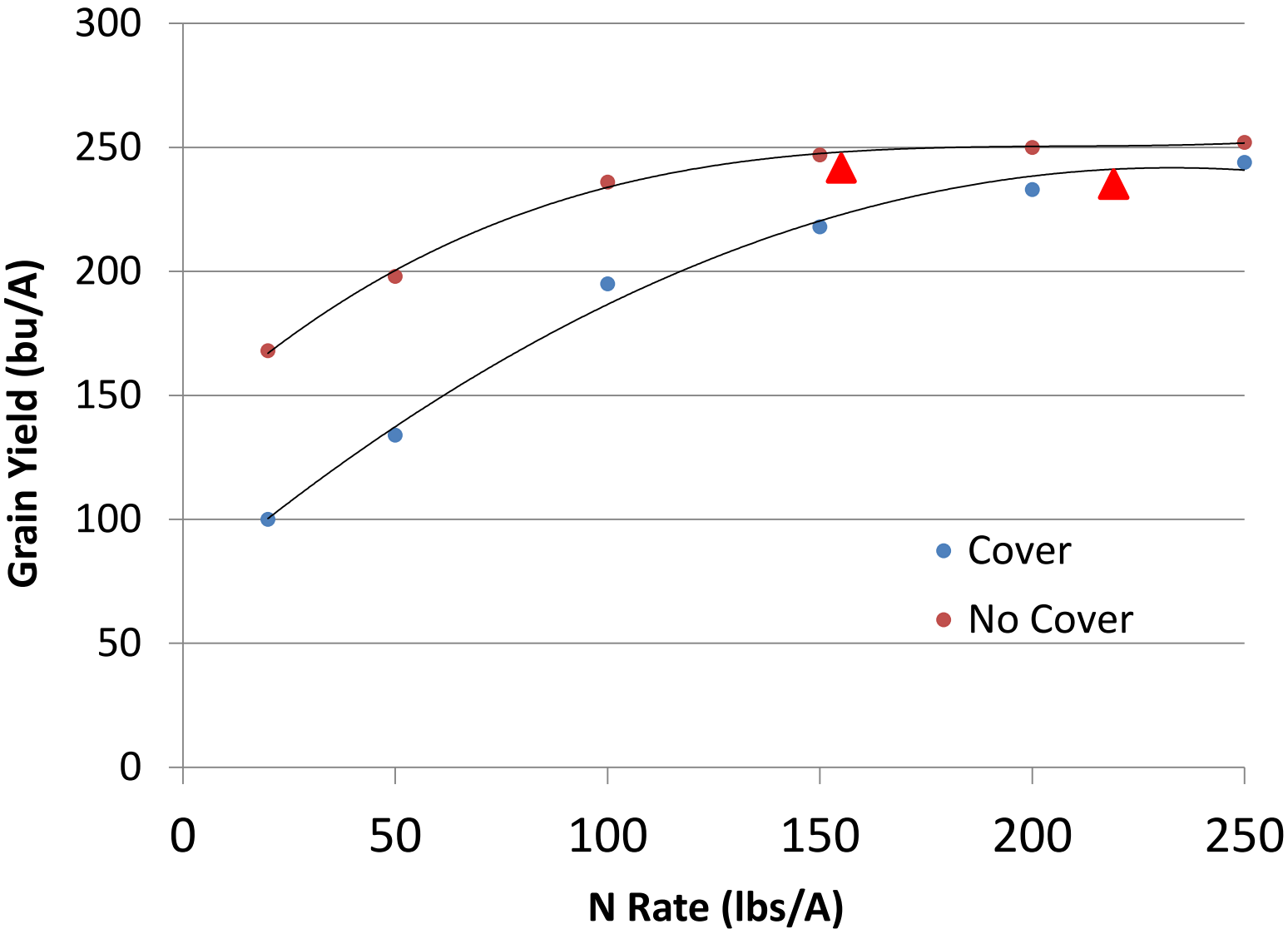
Crop Yield in 2016



2016 Corn Stalk Nitrate



2016 Corn Grain Yield



What caused the problem?

- Huge cover crop biomass (↓ soil temps.)
- Poor quality biomass (↑ immobilization)
- Too much volunteer wheat (allelopathy)

This study provides proof of concept that:

Tile nitrate loads can be greatly reduced with a longer rotation and cover crops,

and nearly be eliminated when cover crops are combined with a bioreactor.

Project 2

Nitrogen Management Systems in Tile Drained Fields:

Optimizing Yields while Minimizing Losses

Mark David

NRES

Emerson Nafziger

Crop Sciences

Lowell Gentry

NRES

Nitrogen Treatments

1. Full rate of NH_3 (160 lb N/acre) with nitrapyrin in the fall.

2. - 80 lb N applied as NH_3 with nitrapyrin in the fall
   - 40 lb N/acre as UAN at planting
   - 40 lb side-dressed as UAN

3. Full rate applied as NH_3 (no nitrapyrin) in early spring.

Nitrogen Treatments (cont.)

4. Reduced rate (120 lb N/acre) as NH_3 (no nitrapyrin) in early spring.

5. - 80 lb N applied as NH_3 early spring
   - 80 lb N as UAN side-dressed.

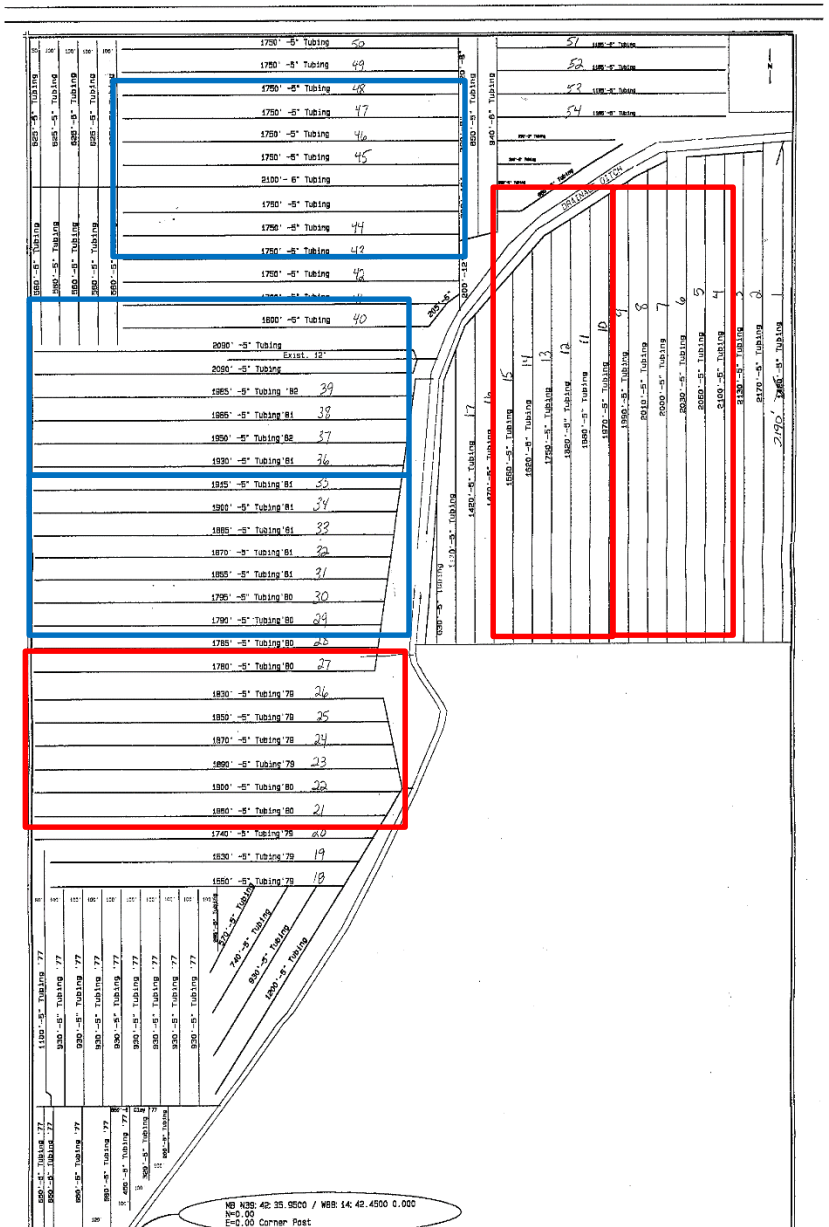
6. N split as in #5 with cover crops

   (Oats-radish mixture seeded into standing soybean)
   (Cereal rye after corn).

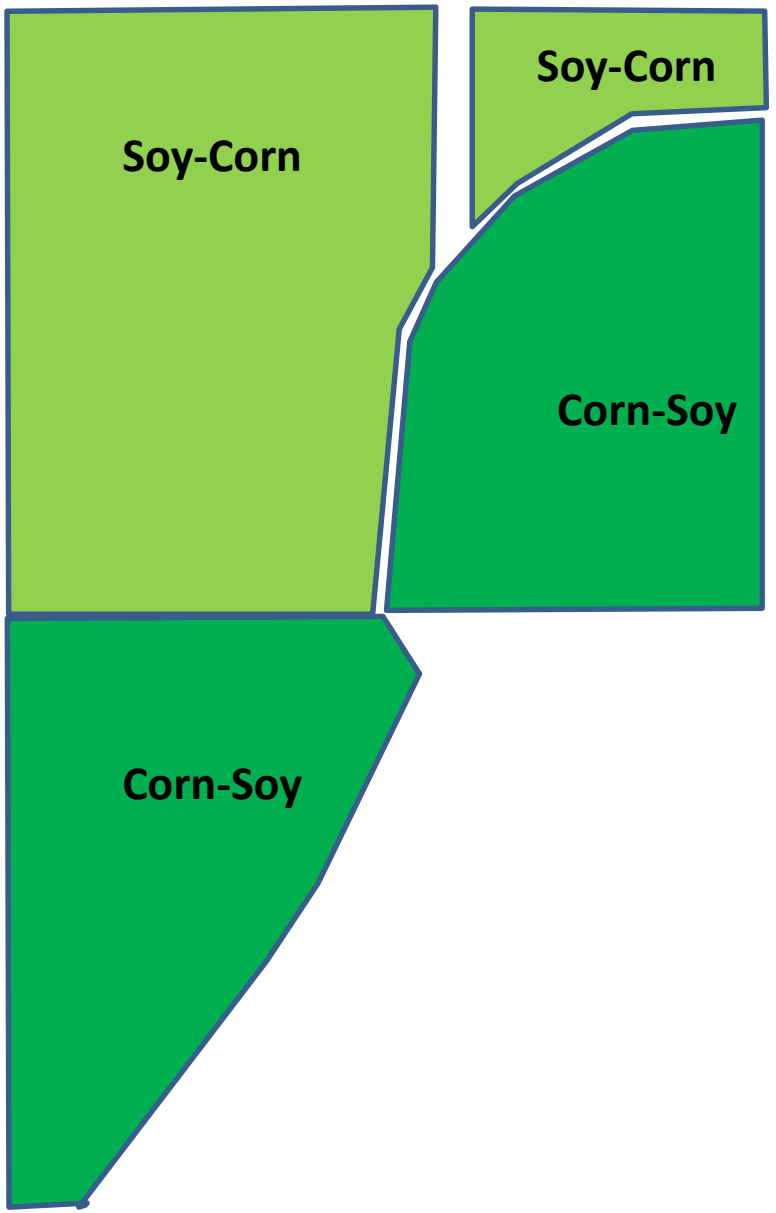
Methods

- 6 treatments with 3 replicates
- Both phases of the corn/soybean rotation every year
- 36 tile monitored tile lines (18 in corn and 18 in soybean)
- Plots are 100 feet wide (50 ft on each side of 5 inch lateral) (AVG = 4.2 A)
- RCB design (6 blocks/6 treatments)
- Treatments began in the spring of 2015 (no fall N or cover crops in 2014) (Corn on all plots in 2014)
- Fall N applied and cover crops established in 2015 and 2016

Tile Map



Cropping Pattern



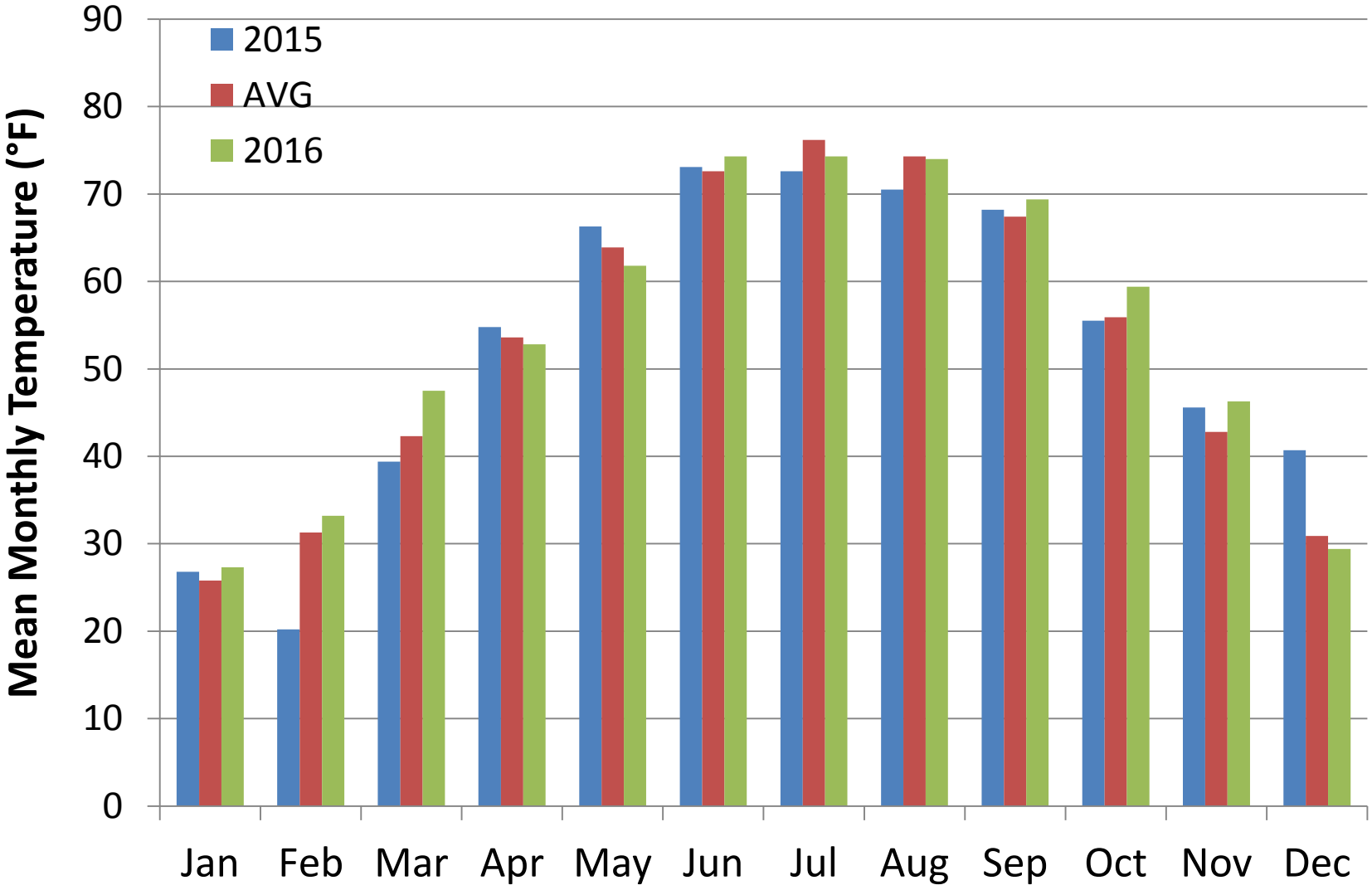
Tile Monitoring

Agri Drain structure

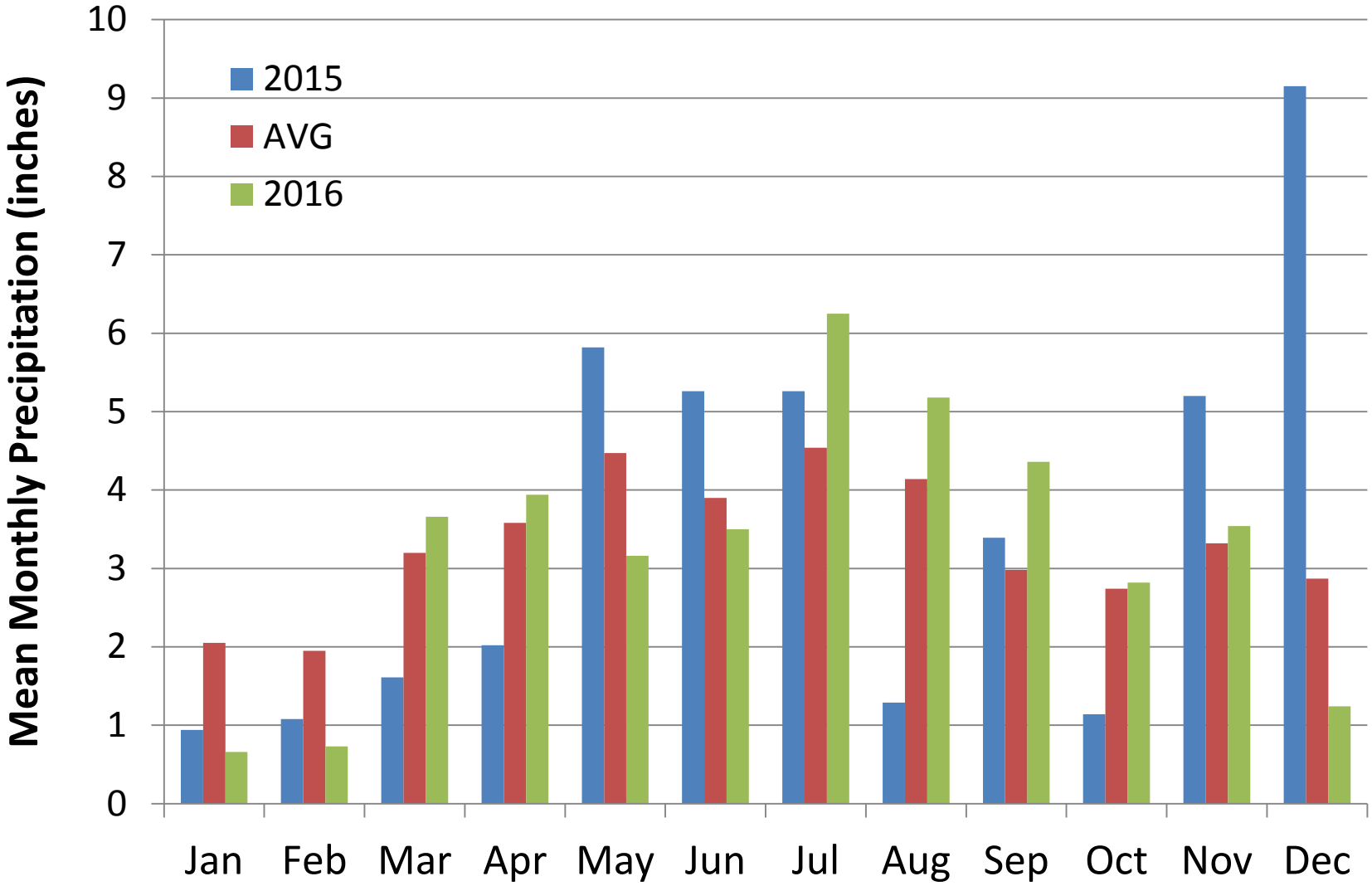
V-notch and pressure transducer

ISCO

Temperature

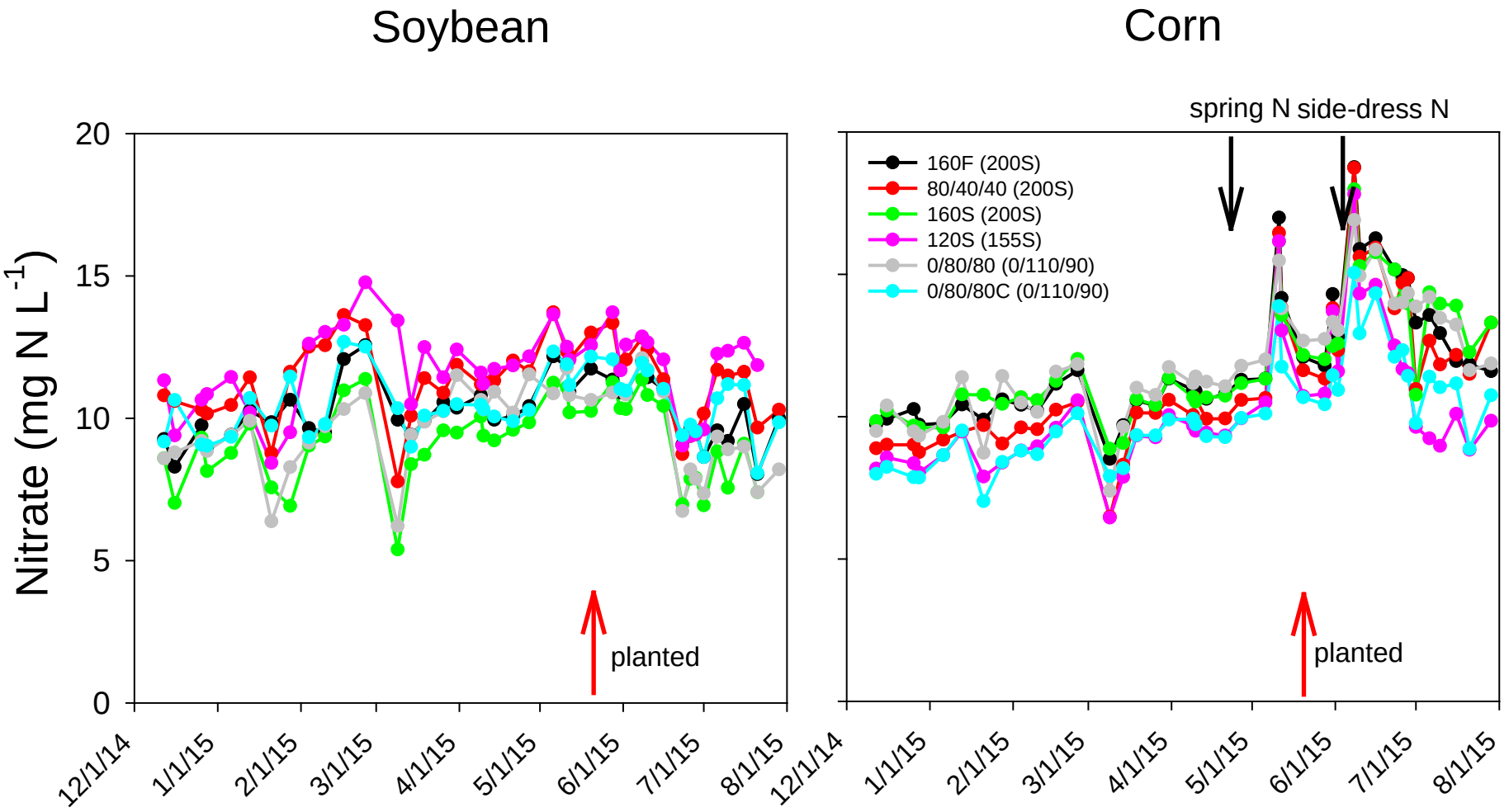


Precipitation



Tile Nitrate Concentrations Averaged across Treatments

(from 12/12/14 to end of tile flow)



Note: All plots were in corn in 2014. Corn N rate is greater (max of 200 lbs/A) in this first year (2015 N rates in parenthesis).

No fall N was applied to corn in 2014. Fall N treatments were switched to 100% spring application. Each point is the average of the three replicates, and 1400 samples were collected.

Tile N Loads

- No significant differences between treatments
- There is significant differences between crops

	All Year		After May 1	
	lbs/A	ppm	lbs/A	ppm
Corn	18.6	11.3*	9.0*	13.7*
Soybean	16.6	10.2	7.4	10.3

* Denotes significant difference $p < 0.05$

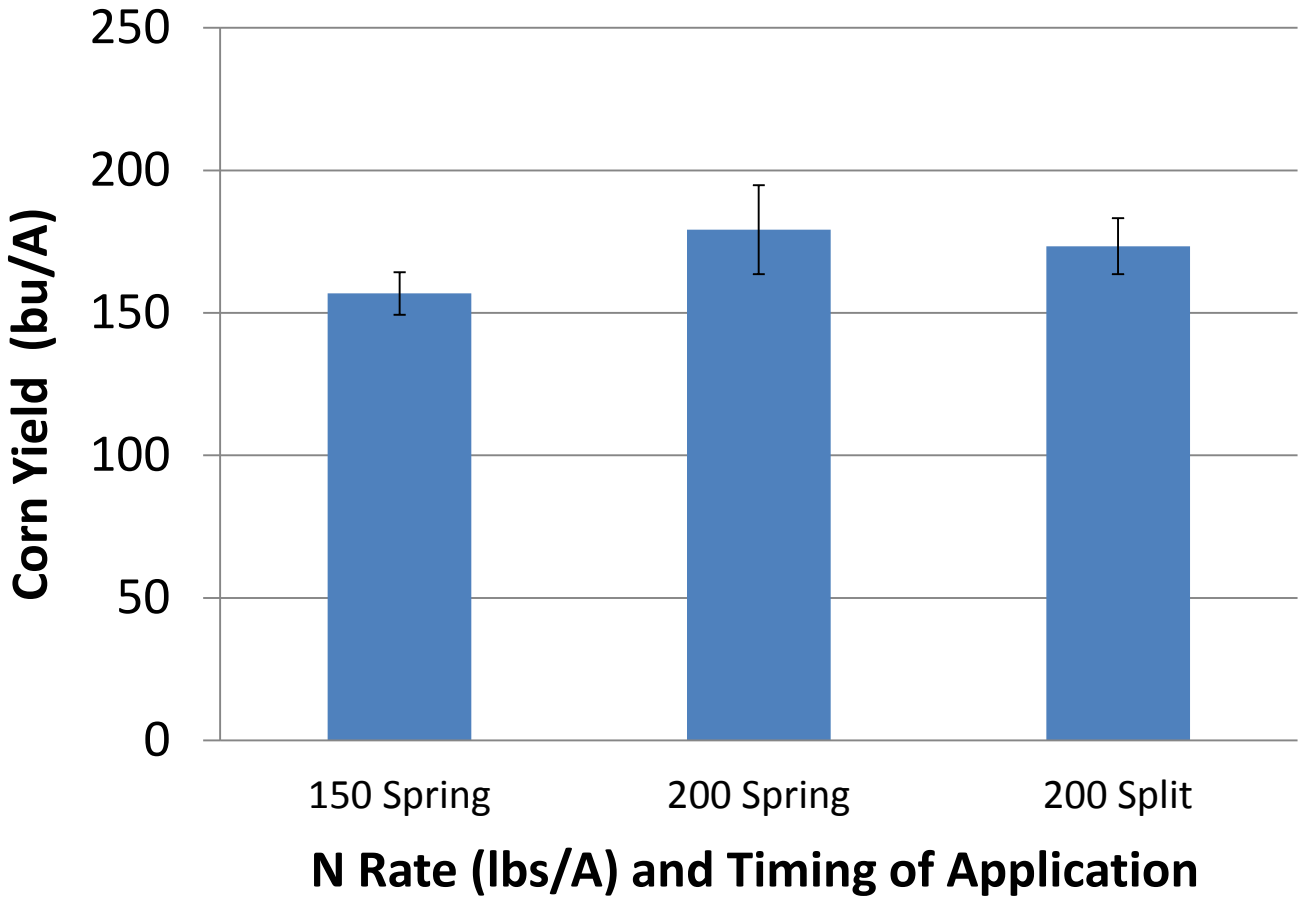
Corn Harvest 2015

Yield rows consisted of 8 rows
in the middle of each plot

Dan and Jason hard at work

Corn Yields 2015

(2nd year corn)



Note: 2015 Soybean Yield = 54 bu/A

Planting Cover Crops

Oat and radish with Hagie seeder

Sept. 14, 2015

Fall Biomass = 0.22 tons/A

Biomass N = 16 lbs/A

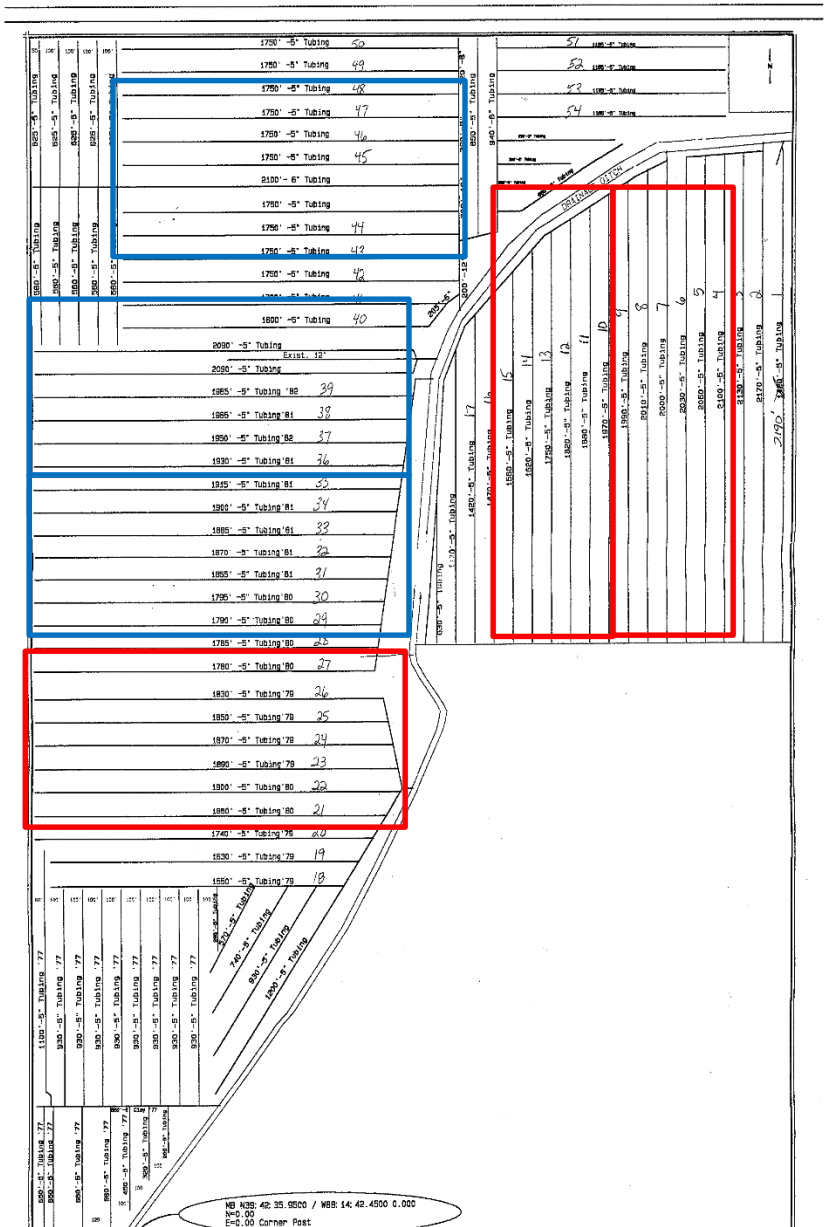
Aerial seeding of cereal rye

Sept. 16, 2015

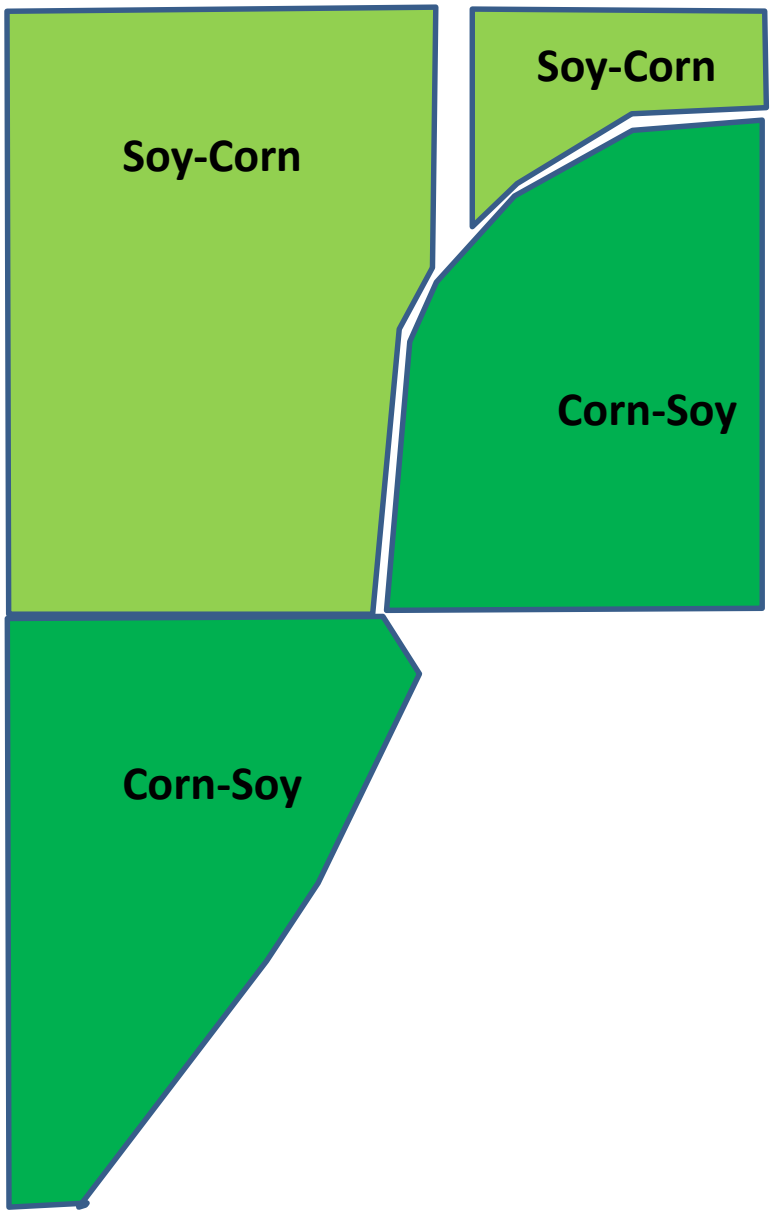
Spring Biomass = 1.10 tons/A

Biomass N = 54 lbs/A

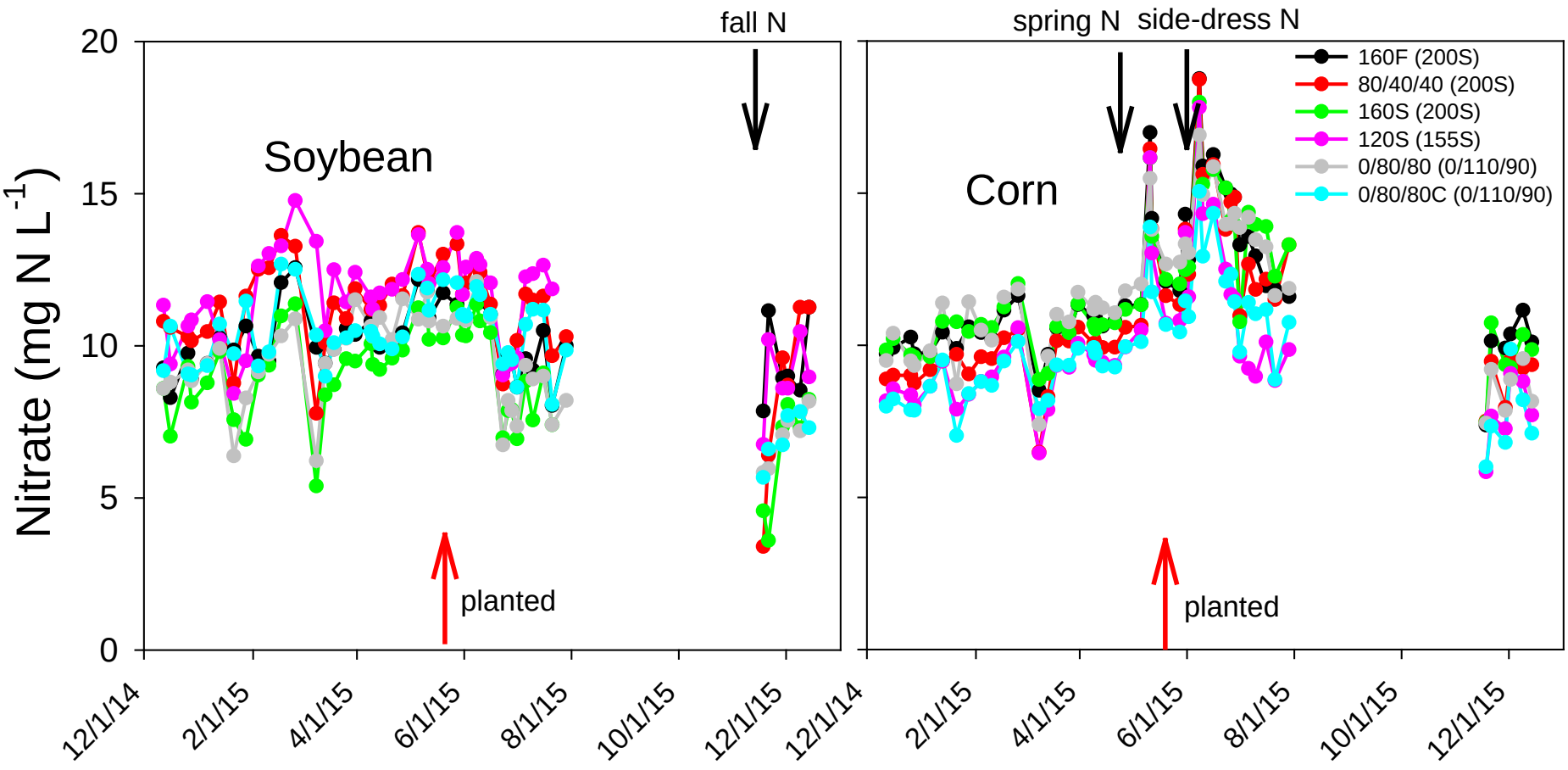
Tile Map



Cropping Pattern



Tile Nitrate Concentrations Averaged across Treatments

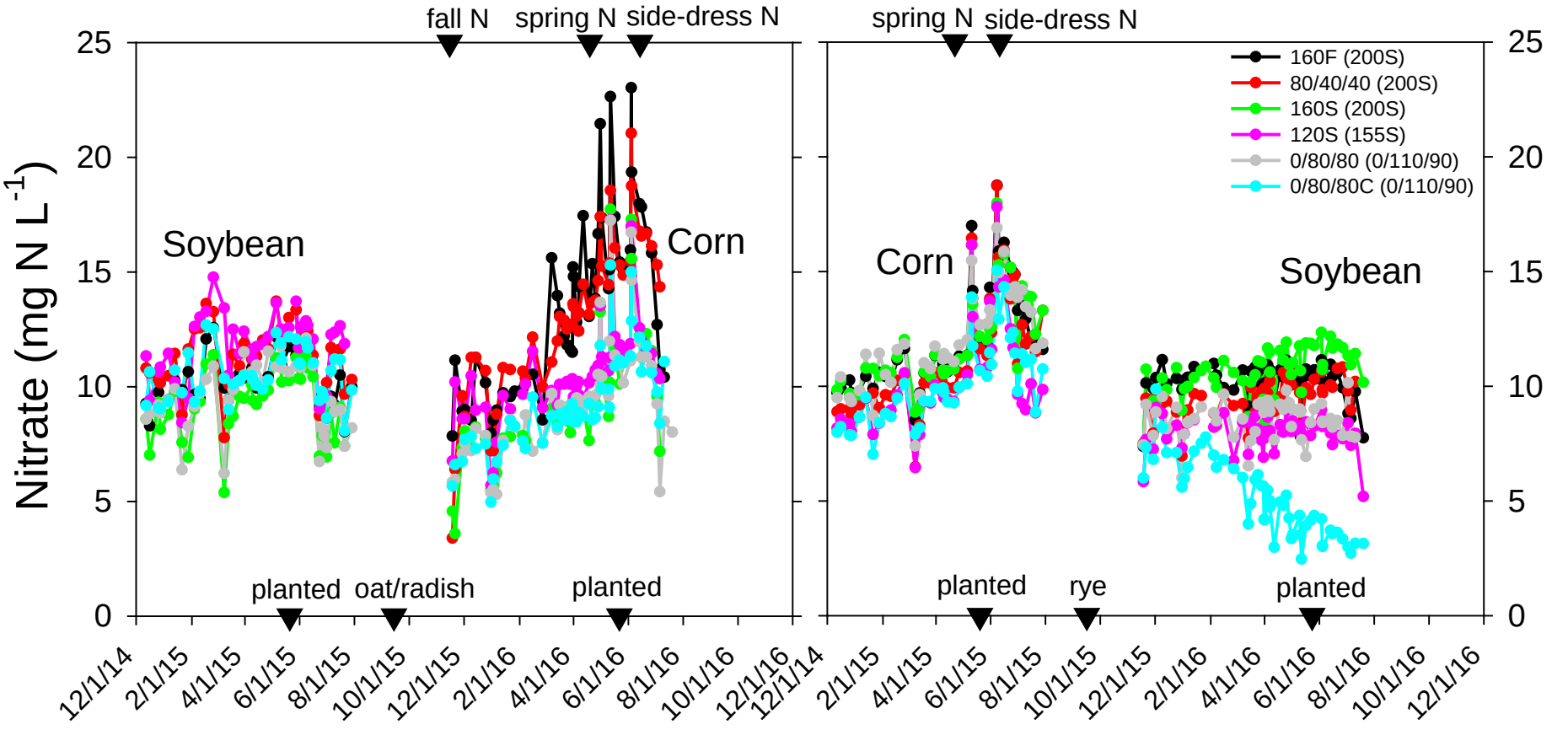


Note: All plots were in corn in 2014. Corn N rate is greater (max of 200 lbs/A) in this first year (2015 N rates in parenthesis).

No fall N was applied to corn in 2014. Fall N treatments were switched to 100% spring application. Each point is the average of the three replicates. (1400 samples collected)

Tile Nitrate Concentrations Averaged across Treatments

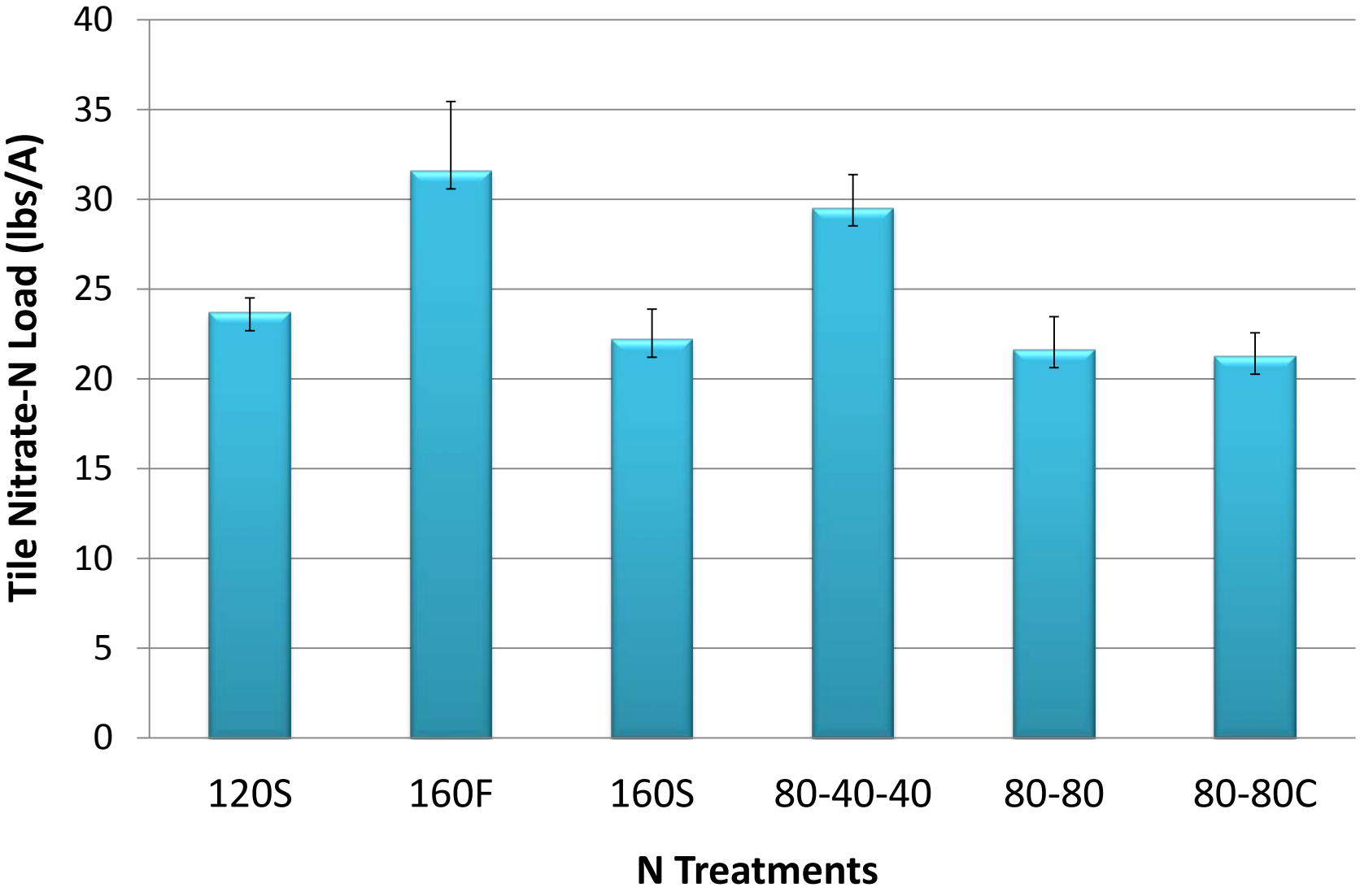
(from 12/12/14 to end of tile flow in August 2016)



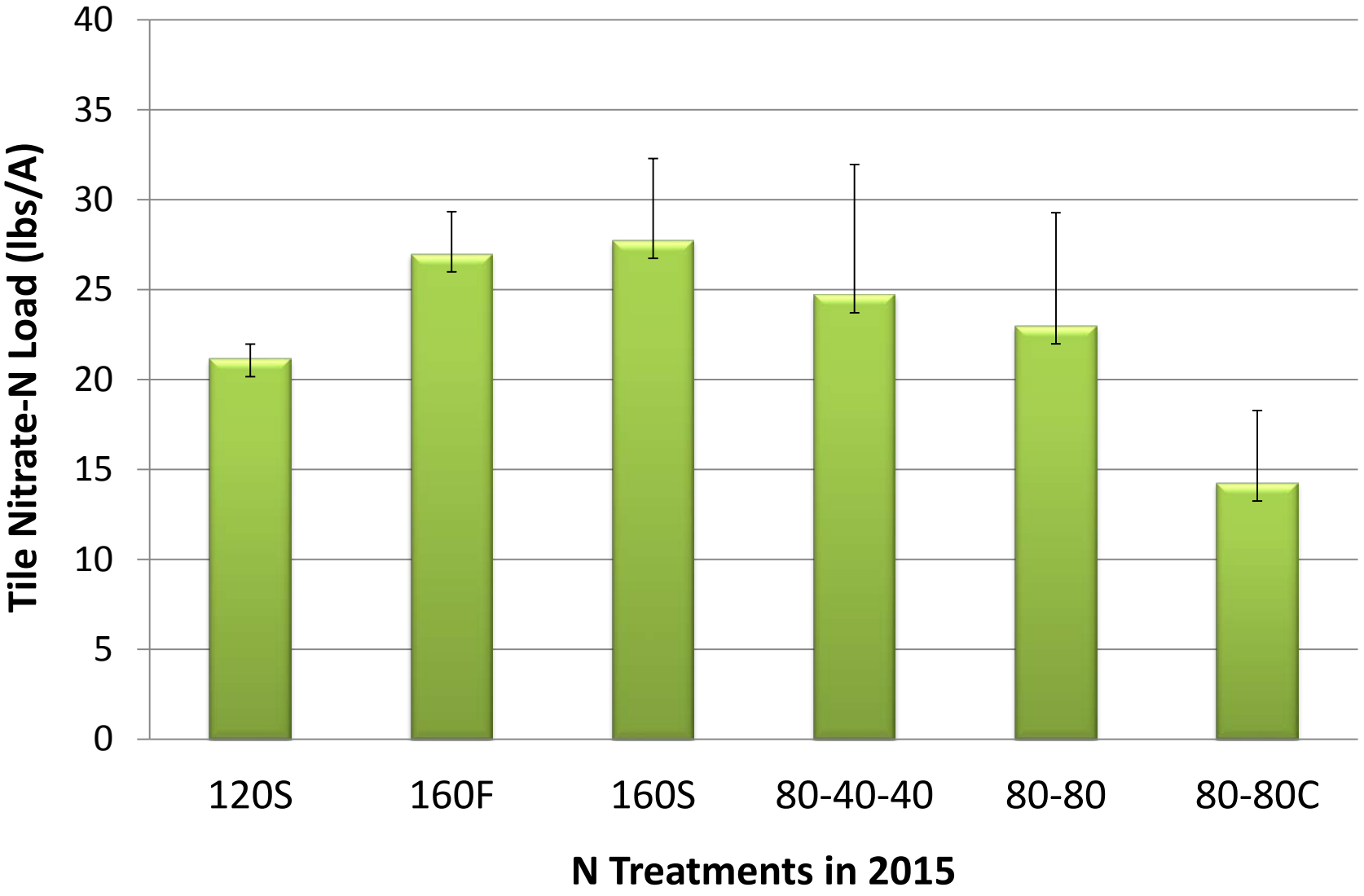
Note: All plots were in corn in 2014. Corn N rate is greater (max of 200 lbs/A) in first year (2015 N rates in parenthesis)

No fall N was applied to corn in 2014. Fall N treatments were switched to 100% spring application. Each point is the average of the three replicates. (3500 samples collected)

Tile N Loads in 2016 Corn Plots



Tile N Loads in 2016 Soybean Plots

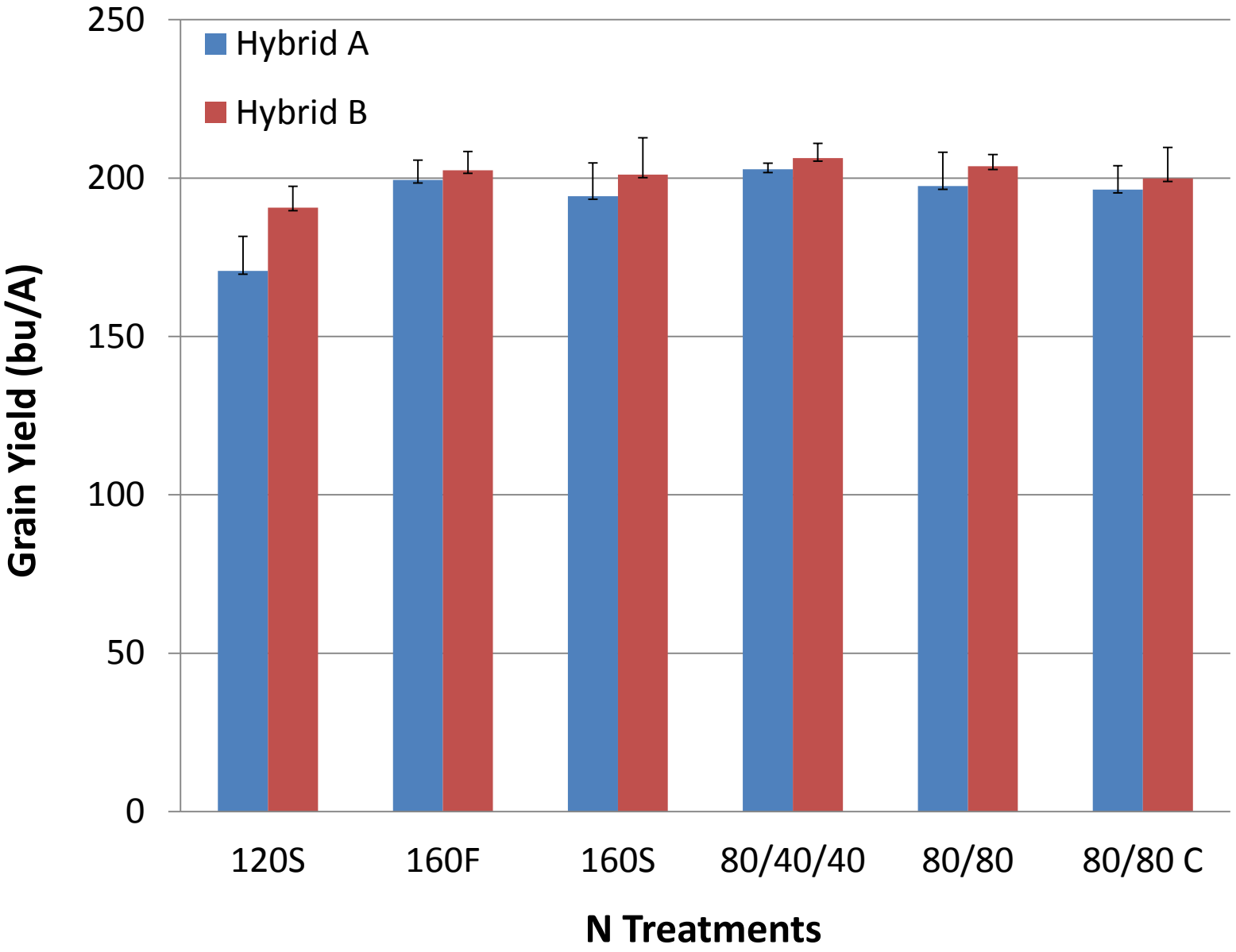


Corn Harvest 2016

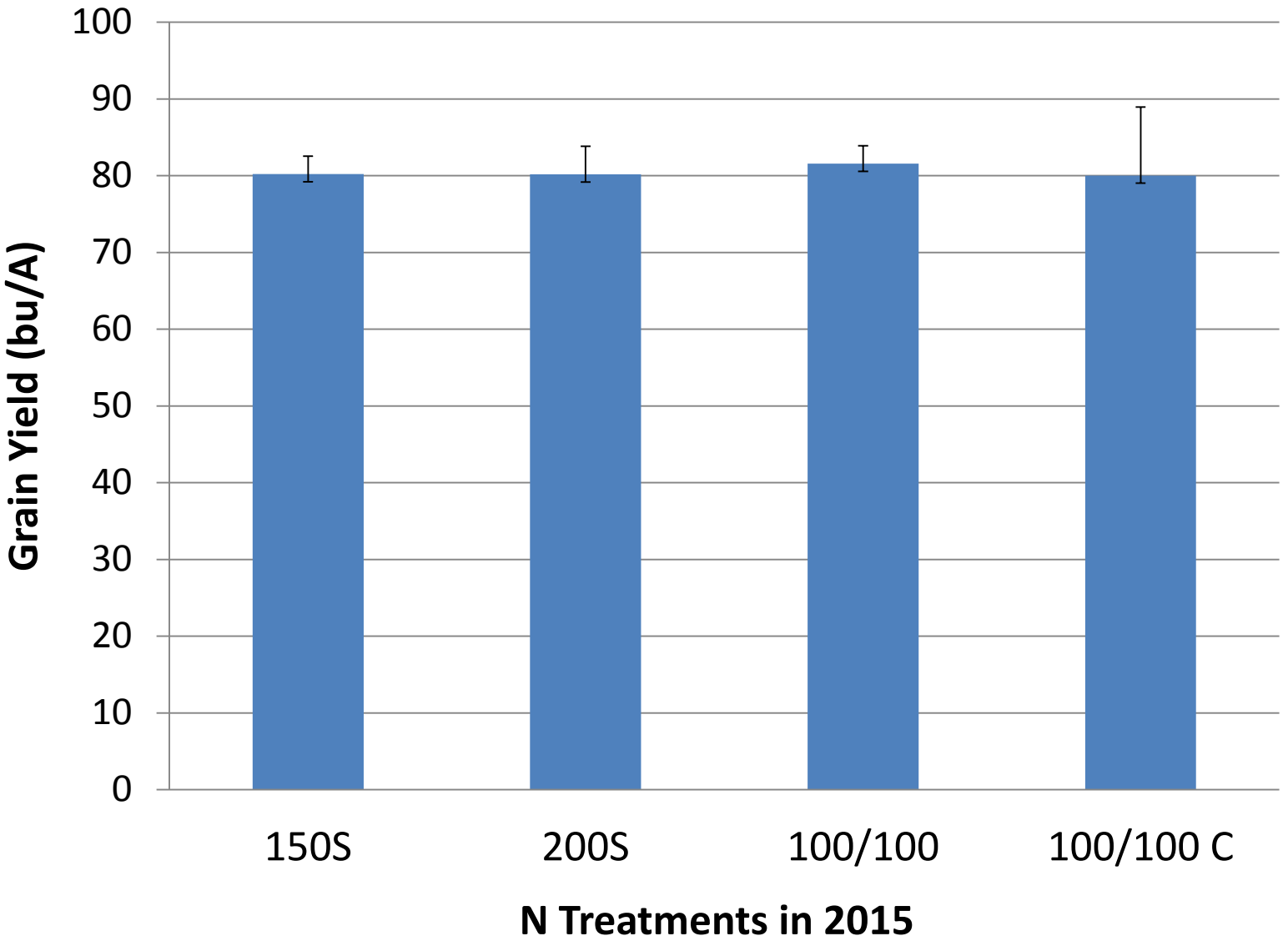
Farmer planted 2 hybrids.

(Yield rows for each hybrid consisted of 4 rows in the middle of each plot.)

2016 Corn Yields



2016 Soybean Yields



Conclusions

- Little difference between spring and split N (yield or tile N)
- Fall N treatments show increased tile nitrate load
- Spring growth of cereal rye made a large difference in cover biomass and biomass N
- Cereal rye decreased tile nitrate without soybean yield loss
- Illinois Nutrient Loss Reduction Strategies are working

Thank you