Research on Benefits of Cover Crops

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Why Choose Small Grains as Cover Crops?

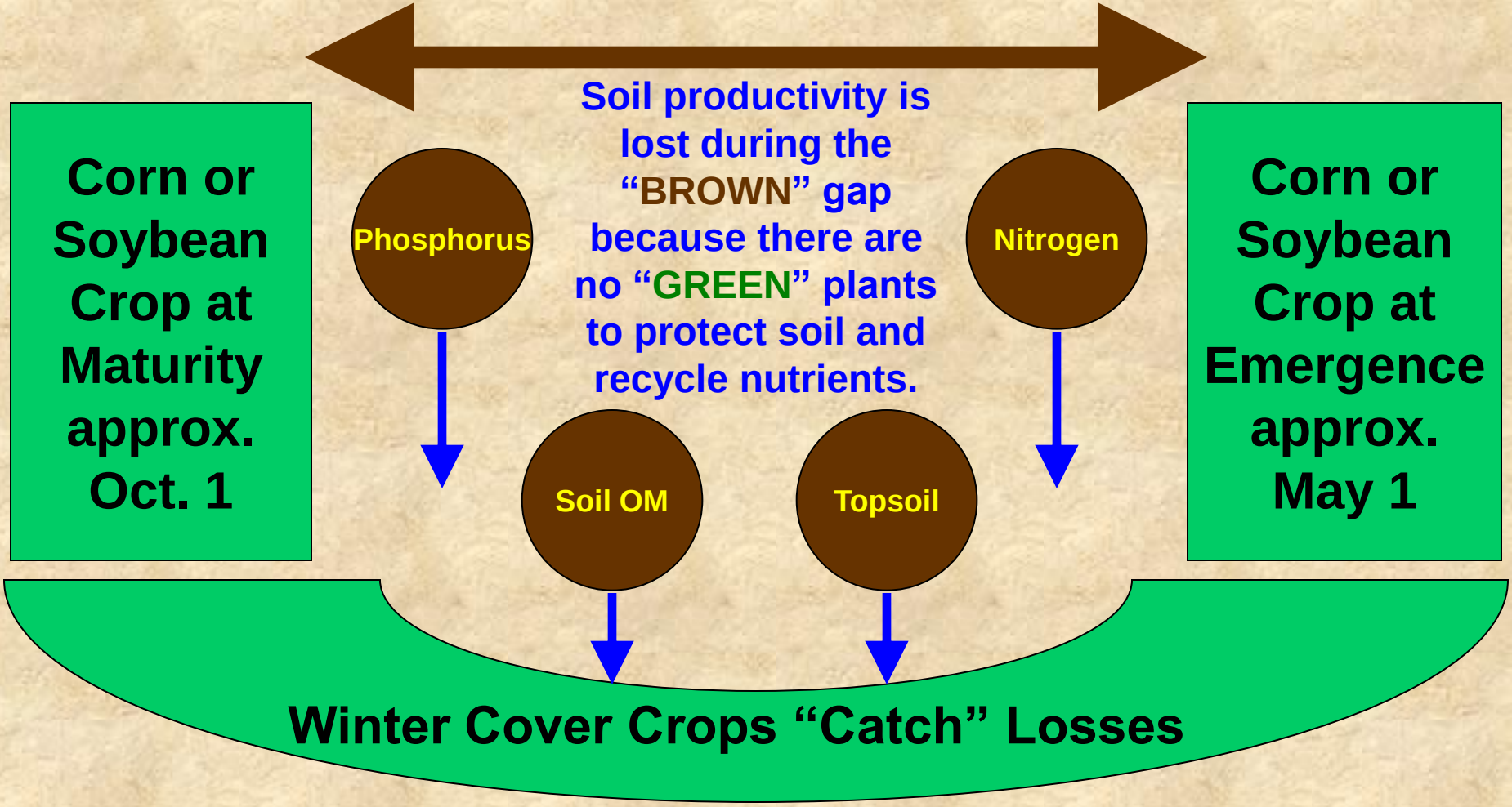
- Grow rapidly in cool weather
- Easy to plant and get established
- Keep growing after moderate frost
- Seed is “relatively” inexpensive
- Some winter-hardy and some not
- Easy to control – not a weed
- Good environmental and soil benefits
- So far, no other cover crop “fits” as well in Iowa in a corn-soybean rotation

Rye after Corn Silage

Oats after Soybean

Rye in Spring on Berger Farm

Corn and Soybeans have a 7 Month "BROWN" Gap



Cover Crops Fill the "BROWN" Gap with "GREEN" Plants

Benefits of Using Small Grain Cover Crops

- Reduced erosion
- Reduced nitrate leaching
- Increased soil organic matter
- Reduced phosphorus losses
- Improved weed control – especially organic systems
- Provide spring forage for cattle
- Part of manure management plan
- Conservation Payments – EQIP & CSP

Erosion Measurements with Simulated Rainfall

NO COVER CROP **OAT COVER** **RYE COVER**

Which side has 30% cover?

RUSLE2 Erosion Estimates Using Beta Version of Cover Crop Vegetation Files

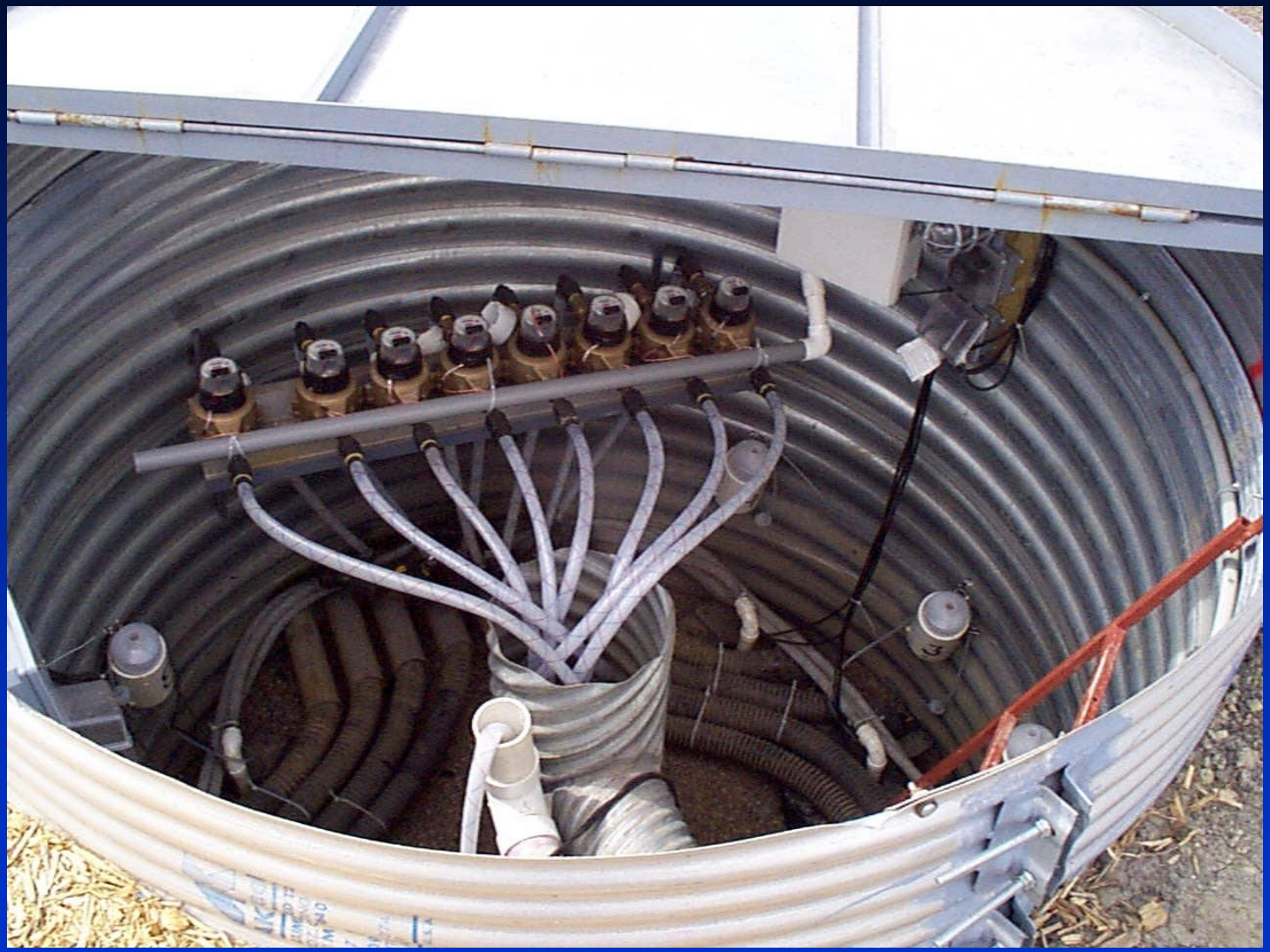
- Corn–Soybean rotation, NT, spring anhydrous, 5% slope, 150 ft slope length, Ames, IA
  - without rye cover crop = 2.1 t/ac/yr
  - with rye cover crop = 1.2 t/ac/yr
- Continuous Corn Silage, NT, spring anhydrous, 5% slope, 150 ft slope length, Ames, IA
  - without rye cover crop = 4.8 t/ac/yr
  - with rye cover crop = 1.9 t/ac/yr

Erosion Summary

- Winter cover crops reduce erosion by replenishing residue cover and root mass, increasing infiltration, and by anchoring other residue. In no-till anchoring other residue may be the most important.
- Winter cover crops are especially effective in reducing rill erosion.
- Unlike some conservation practices, erosion control is not the only benefit of winter cover crops.

Nitrate Loss in Tile Drainage

Flow Meters & Sample Collectors



Kaspar et al. J. Environ. Qual. 36:1503-1511.

Fig 1. Average NO_3 concentrations of drainage water for control, oat, and rye treatments in 2008. Gaps in the data resulted when no drainage occurred.

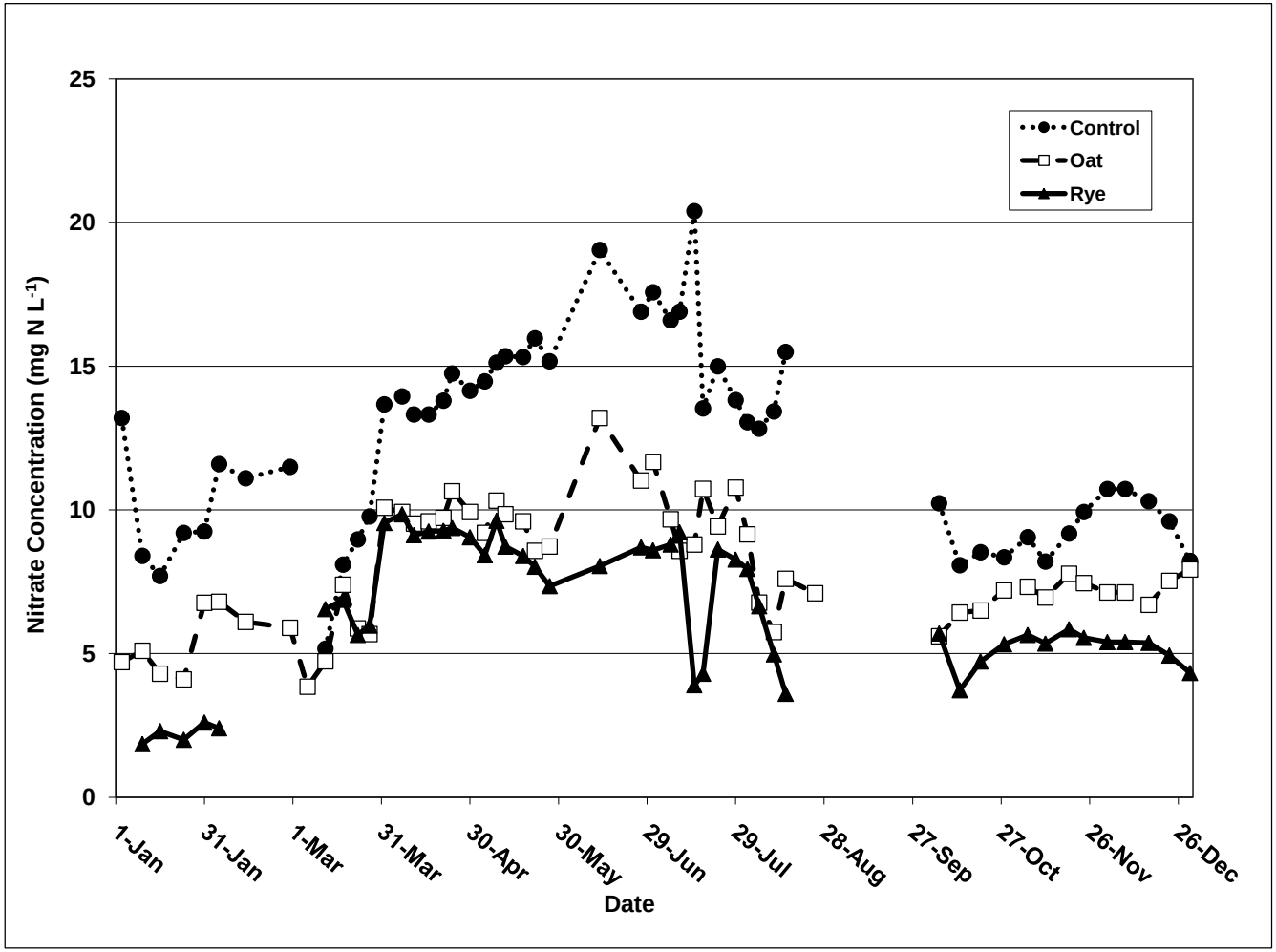
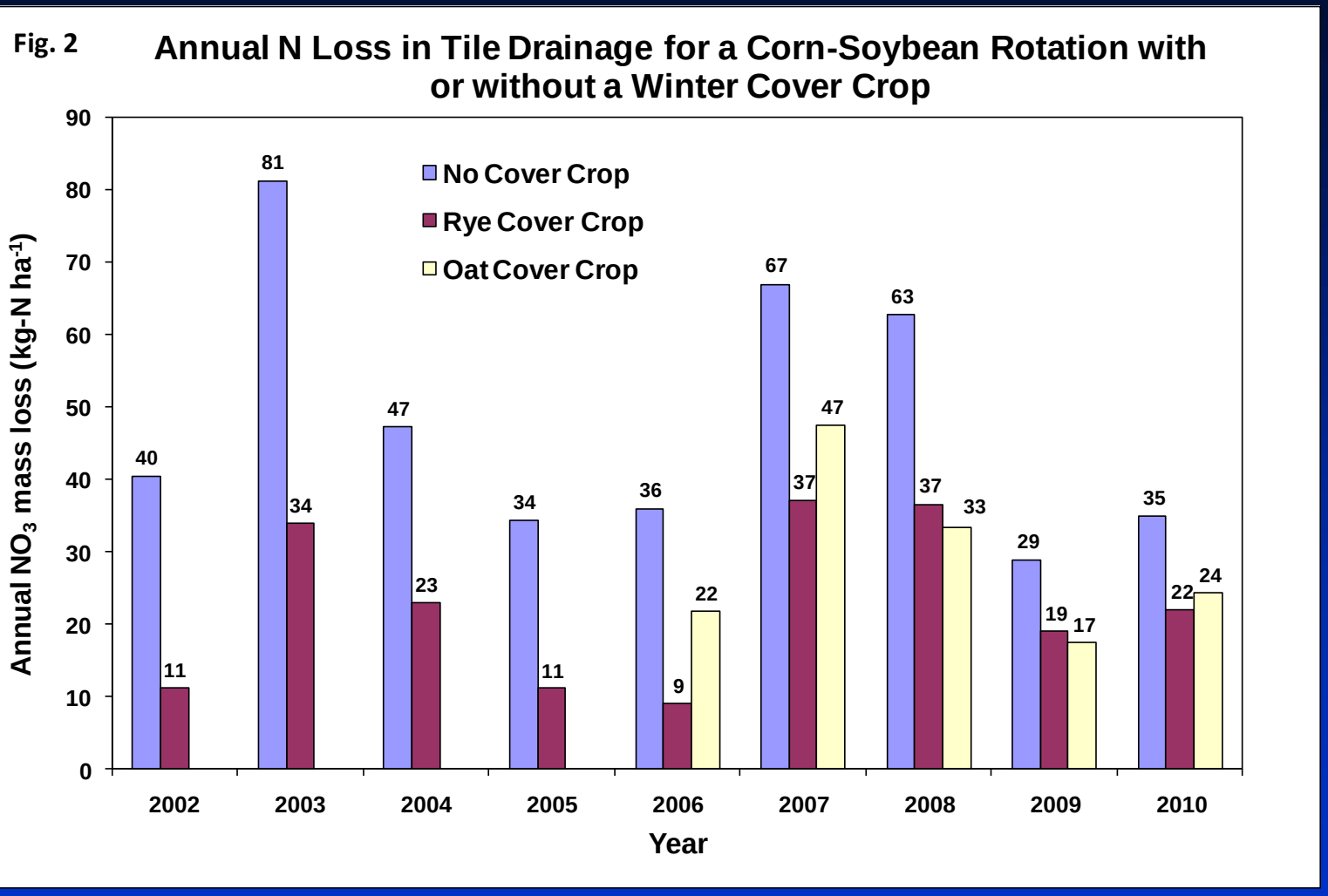


Fig. 2


Annual N Loss in Tile Drainage for a Corn-Soybean Rotation with or without a Winter Cover Crop
No Cover Crop
Rye Cover Crop
Oat Cover Crop
Annual NO3 mass loss (kg-N ha-1)
Year
0
10
20
30
40
50
60
70
80
90
2002
2003
2004
2005
2006
2007
2008
2009
2010
40
11
81
34
47
23
34
11
36
9
22
67
37
47
63
37
33
29
19
17
35
22
24

Total Nitrate-N Lost 2002-2010

Treatment	Nitrate-N lost	
	9-yr total lbs/acre	9-yr avg lbs/acre
Corn-soybean	386	43
Corn-Soyb w. Rye	181	20
Reduction	205	23
% Reduction	53%	

Nitrogen Summary

- Winter cover crops reduce N losses in tile drainage by taking up N and reducing soil N concentrations during the times of the year when corn and soybean are not present and a lot of drainage is occurring.
- Winter cover crops don't seem to have a large impact on the total annual cumulative drainage because a mulching effect reduces water loss during the summer offsetting spring uptake.
- Unlike other practices used to reduce N contamination of water, winter cover crops provide other benefits.

Rye Cover Crop Effect on Soil Quality in a Corn Silage System

- **17 % more total soil organic matter**
- **47 % more Particulate Organic Matter (POM)**
- **48% greater Potential N mineralization**
- **It is easier to see changes in these measurements in a corn silage system after 8 years, but they indicate that even in a corn grain system the trends are in the right direction**

Cover Crops and No-Till Soil Structure

Rye Cover Crop Root Weight and Rooting Depth in the Spring

Year	Root Dry Weight	Rooting Depth
	(lbs/acre)	(in)
2004	294.41	38.00
2005	642.34	32.71
2006	606.66	45.75
2007	458.34	36.44
2008	388.08	….
Avg.	477.96	38.22

Some Risk to Main Crop Yields

- Soybean yields no change.
- Corn silage yields no change.
- Corn grain yields on average 4 to 6 bu/ac lower following rye cover crop in our experiments. No change with oats. If rye killed 14 d before corn planting and at less than 8” tall risk greatly reduced.

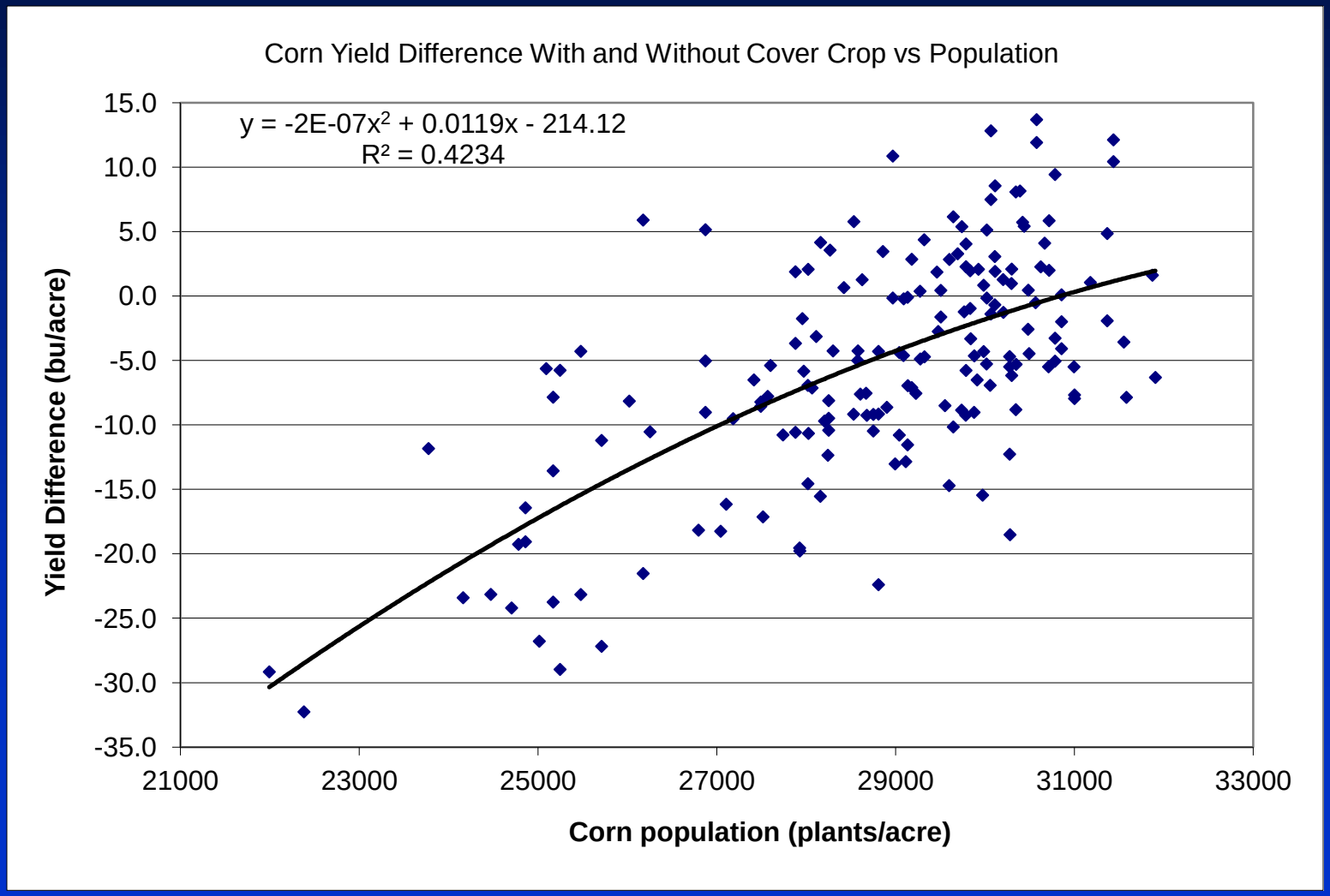
Observations

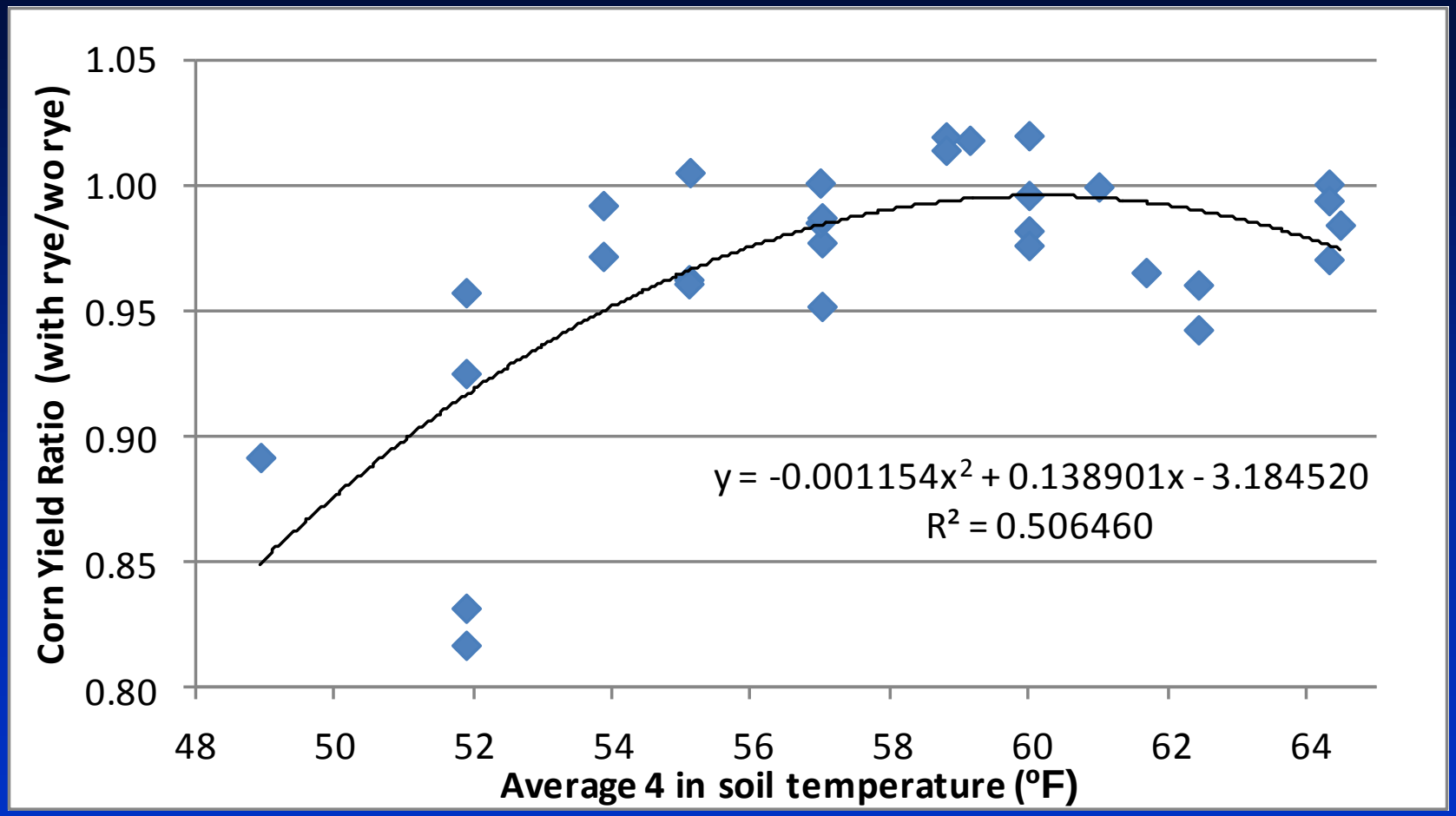
- Does not happen every year or in every field
- Other factors later in the year may limit yield or allow corn following rye to compensate for reduced early growth or reduced population
- It seems to occur more often with cold and dry conditions at corn planting
- Yield reductions more often in the early years of our studies – What has changed?
- Very similar to no-till continuous corn

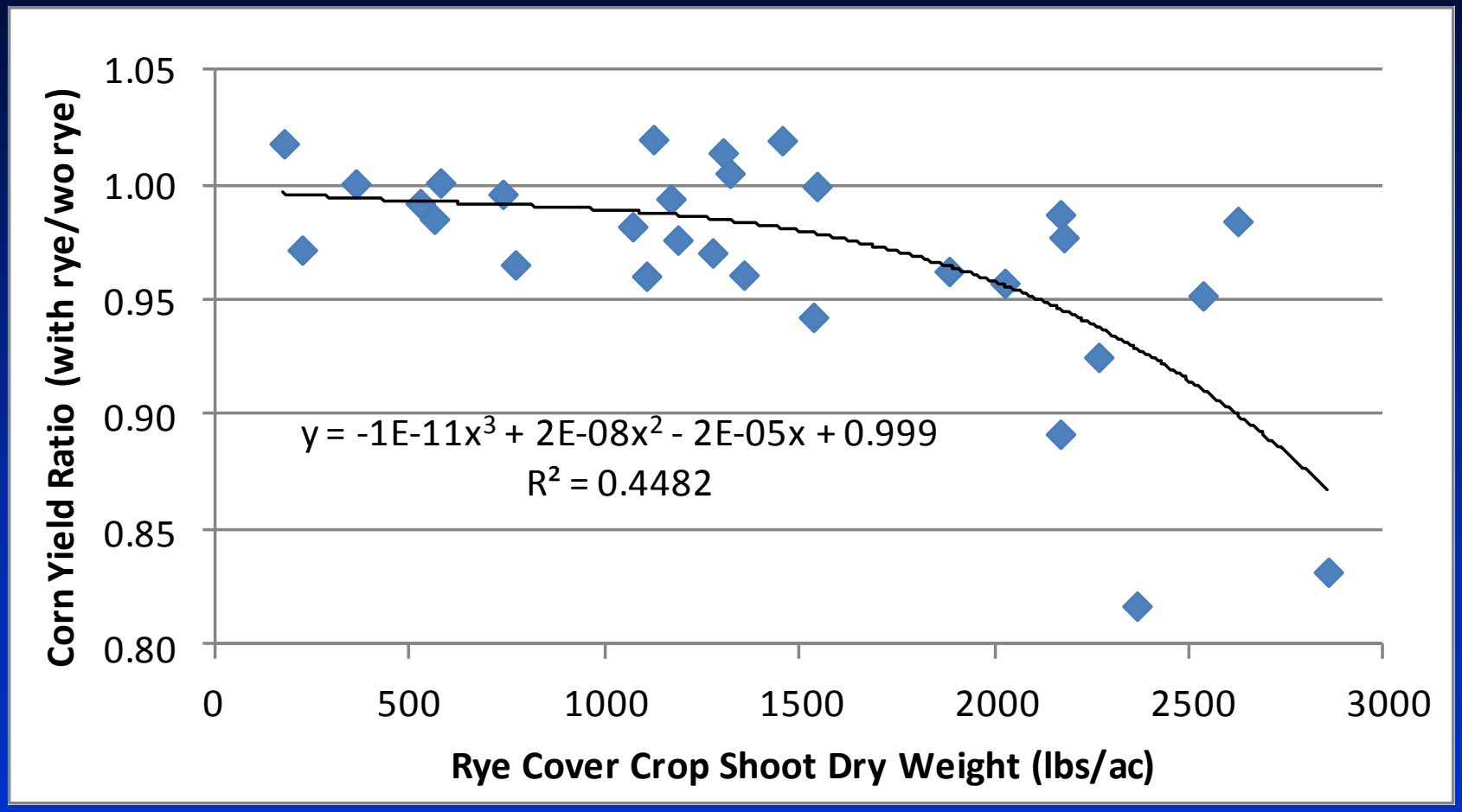
What are Possible Causes of Corn Yield Drag Following Rye Cover Crops

- Water use or dry soil at planting (rare)
- Nitrogen immobilization
- Cold soil from increased surface residue
- Planter problems from surface residue
- Disease or pest problems – “green bridge”
- Rotation effect or allelopathy
- Most of these possible causes/problems should increase with increasing rye biomass

Corn Population Following a Rye Cover Crop vs. Yield Difference




Corn Yield Ratio (with rye/wo rye)
1.05
1.00
0.95
0.90
0.85
0.80
48
50
52
54
56
58
60
62
64
Average 4 in soil temperature (°F)
y = -0.001154x² + 0.138901x - 3.184520
R² = 0.506460


Corn Yield Ratio (with rye/wo rye)
1.05
1.00
0.95
0.90
0.85
0.80
0
500
1000
1500
2000
2500
3000
Rye Cover Crop Shoot Dry Weight (lbs/ac)
y = -1E-11x³ + 2E-08x² - 2E-05x + 0.999
R² = 0.4482

What does 800 lbs/acre of rye shoot dry weight look like?

What does 800 lbs/acre of rye shoot dry weight look like?

Practices to Reduce the Risk of Corn Yield Drag Following Rye Cover Crops

- Kill rye cover crops 14 days before corn planting or use spring oat which winter kills
- Kill rye cover crops as soon as they reach 1000 lbs/acre in the spring; about 6 to 8 in tall
- Increase corn population/stand - ???
- Apply some N and P fertilizer at planting

Killing a Rye Cover Crop with Glyphosate

- Apply acid equivalent (a.e.) of 1 lb/acre (28 oz WeatherMax or 43 oz of generic)
- Use low spray volume – check label (e.g. WeatherMax is labeled for 3-20 gal/acre; 7-10 gal/acre would be reasonable)
- Add AMS (ammonium sulfate)
- Add Non-ionic Surfactant if not included in formulation (NIS is in WeatherMax already)
- Try to spray on days when temperatures are above 50 F in the day and above 40F at night. Sunny days are best.
- Try to spray between 10 AM and 4 PM or start spraying when dew is dry and end by 4 PM.
- Use or have available an ATV sprayer if possible so that timing is not as limited by wet field conditions

Midwest Cover Crops Council Website
http://www.mccc.msu.edu/

Questions?
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