



Making Diverse Rotations Work

*Small Grains in the Corn Belt:
Production Data Synthesis*

July 2020



SUSTAINABLE
FOOD LAB



PRactical
FARMERS
of Iowa

Methods

- Farmers participate in cost share for small grain crop + legume cover crop '17-present
- Farmer data collected via survey in 2017, 2018 & 2019
- Two cohorts in this analysis:
 - 2017 cohort: 2017, 2018, 2019 (3 years of rotation – N =10)
 - 2018 cohort: 2018, 2019 (2 years of rotation – N = 35)
- Corn-soy rotation with cover crop serves as a baseline, provided by corn and soy company supply chain project
- Data used to populate:
 - Fieldprint Calculator (FPC)
 - Cool Farm Tool (CFT)
- Management changes captured include addition of a cover crop and changes in inputs to following crop years

The Tools

- Fieldprint[®] Calculator (FPC) measures **emissions only** for GHG
- Cool Farm Tool (CFT) measures **emissions and sequestration** of GHG
- FPC also offers metrics on:
 - Soil Conservation
 - Soil Carbon
 - Water Quality
 - Biodiversity

Our Hypotheses

1. Diverse rotations with small grains lead to more roots in the ground year round
2. Fertilizer reduction to corn following a legume cover crop has a big impact on reducing GHG emissions
3. Extended rotation benefits of increase corn and soy yields and biological nutrient cycling that allows more drastic cutting of fertilizer cannot be capitalized fully by farmers in first 1-3 years of practicing the rotation

1. More Roots

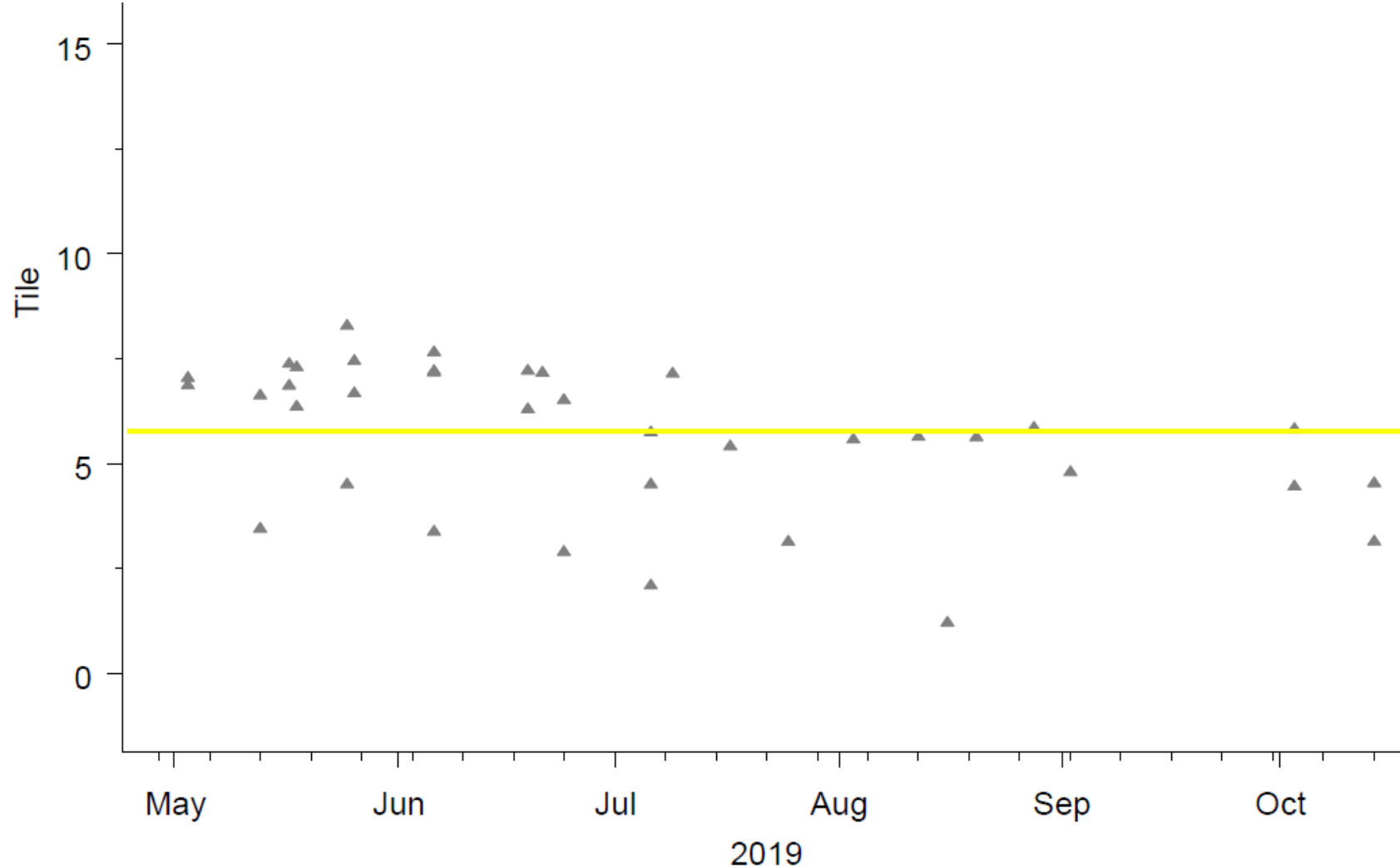
Rotation	2017 Crop	Cover Crop	2018 Crop	Cover Crop?	2019 Crop	Proportion Practicing
1	Small Grain	Legume Cover Crop	Corn	100% (6/6)	Soybeans	60% (6/10)
2	Small Grain	Legume Cover Crop	Corn	50% (1/2)	Corn	20% (2/10)
3	Small Grain	Clover	Clover	100% (1/1)	Corn	10% (1/10)
4	Small Grain	Alfalfa	Alfalfa	100% (1/1)	Alfalfa	10% (1/10)
				90% (9/10)		

90% of 2017 cohort had continuous living cover for 3 years straight

(from small grain planting in fall of 2016 or spring of 2017 until crop harvest in fall of 2019)

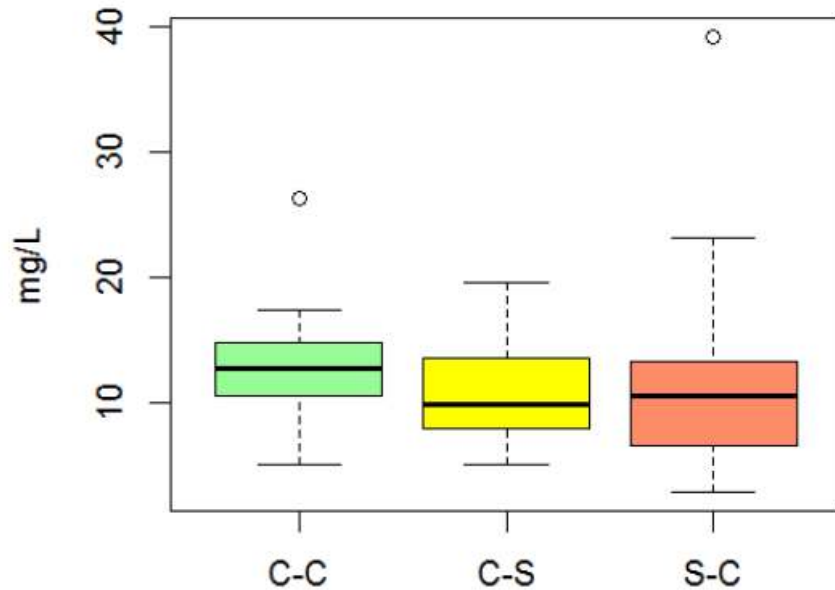
1. More Roots

2019 Practical Farmers of Iowa Nitrate-N Concentrations



PFI Average
Under Small
Grains = 5.75

1. More Roots



Rotation 2019 - 2018

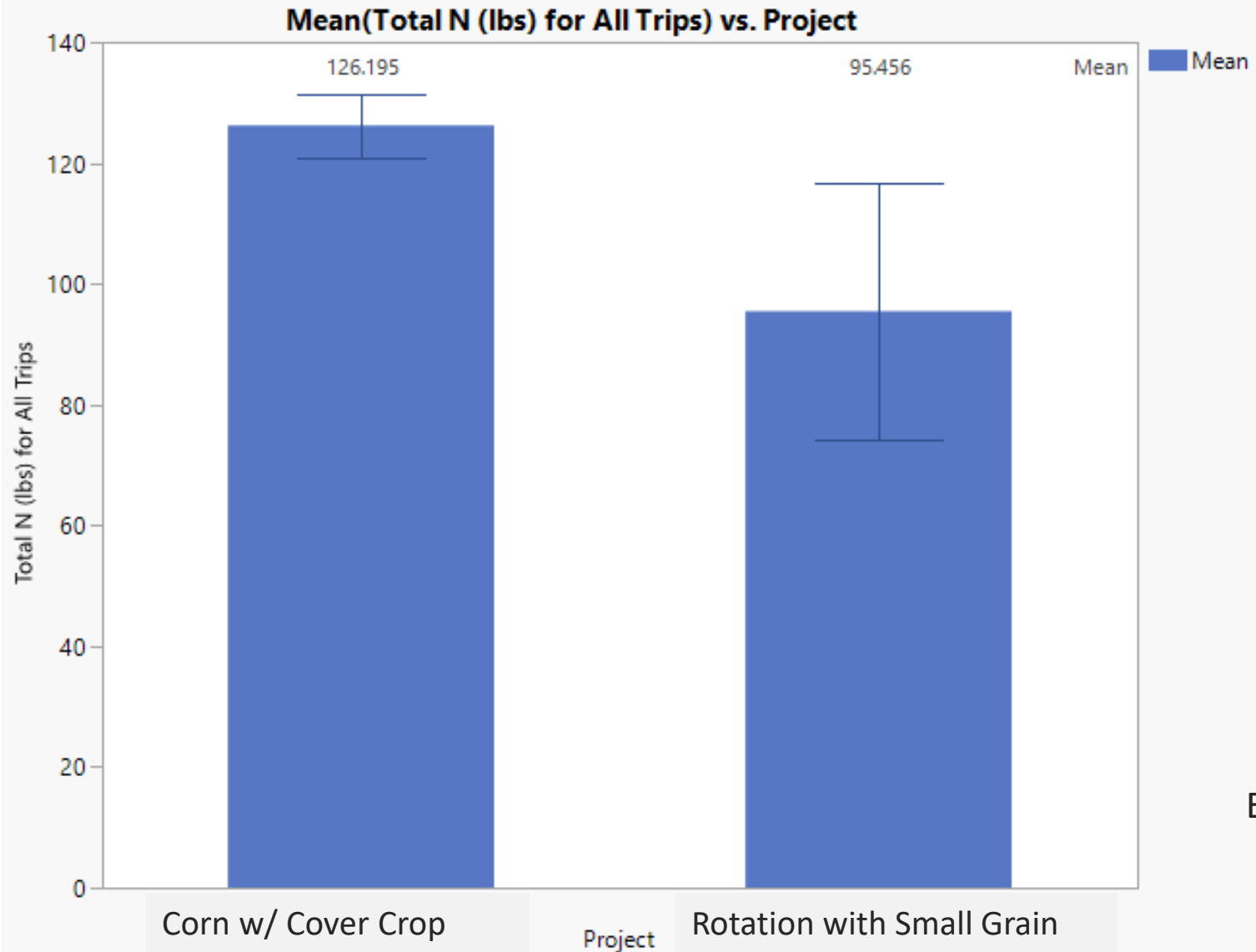
Average Nitrate-N
Concentration (mg/L)

Corn - Corn	12.6
Corn - Soybean	10.8
Soybean - Corn	11.4
Other	5.8

2. Fertilizer Reductions

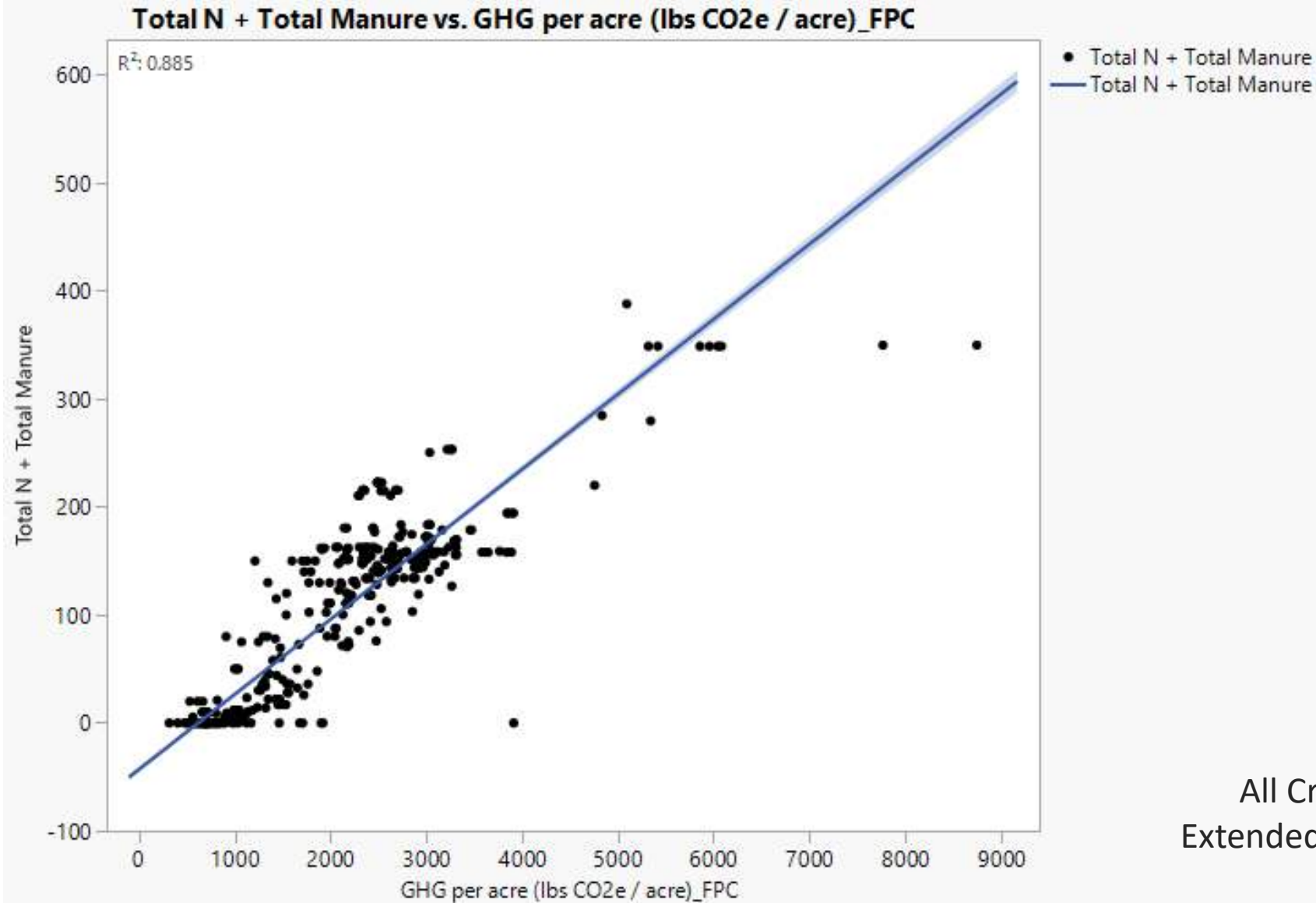
- Of population that grew corn in 2019 after small grain + legume cover ...
 - **48% used less fertilizer** compared to two-year rotation corn
 - **36% used the same fertilizer** compared to two-year rotation corn
 - 16% did not have a comparison field
- Farmers self-reported reducing an average of **46 lbs/ac** (median 50 lbs) if they indicated they applied less fertilizer

2. Fertilizer Reductions



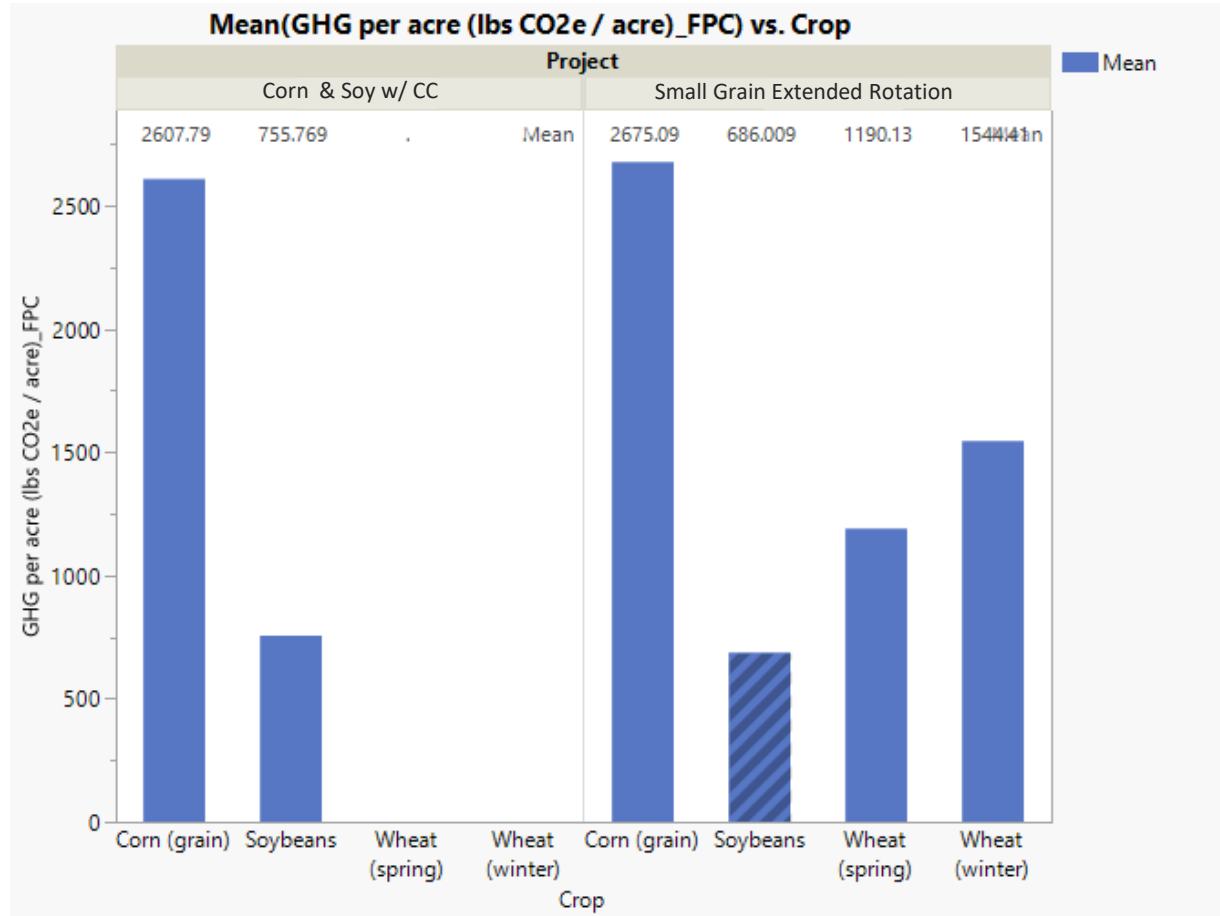
Ex. Rotation Corn 2017-2019,
N=41
Corn with Cover Crop 2017-
2019, N = 529

2. Fertilizer Reductions



All Crops in Cover Crops and
Extended Rotation Data Set, N =
1304

2. Fertilizer Reductions



In six years:

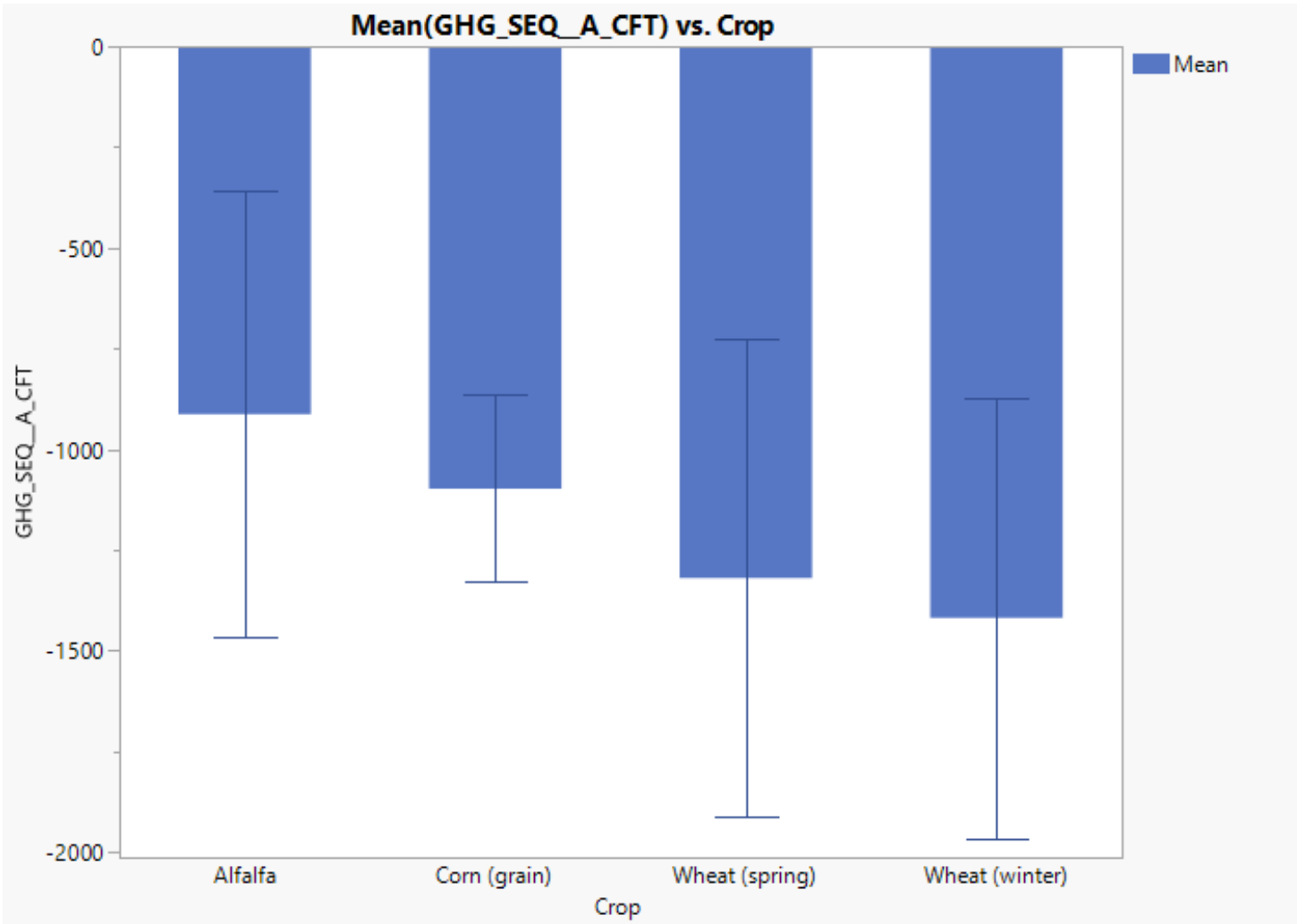
- Spring small grains rotation result in **10% reduction in GHG**
- Winter small grains rotation results in **3% reduction in GHG**

From emissions only (and with only half cutting fertilizer)

Corn w/ CC	Soy w/ CC	Corn-SG	Soy-SG	Spring SG	Winter SG
2607.79	755.77	2675.09	686.01	1190.13	1544.41

Corn w/ cover crop = 529
 Soy w/ cover crop = 651
 Ex. Rotation Corn = 41
 Ex. Rotation Soy = 11
 Spring Small Grain = 37
 Winter Small Grain = 21

2. Fertilizer Reductions



Incorporating sequestration estimates from CFT would lead to:

- Spring small grains rotation result in **21% reduction in GHG**
- Winter small grains rotation results in **14% reduction in GHG**

(again with only half cutting fertilizer)

Crops from Extended Rotation

Data Set

Alfalfa: N=9

Corn: N=29

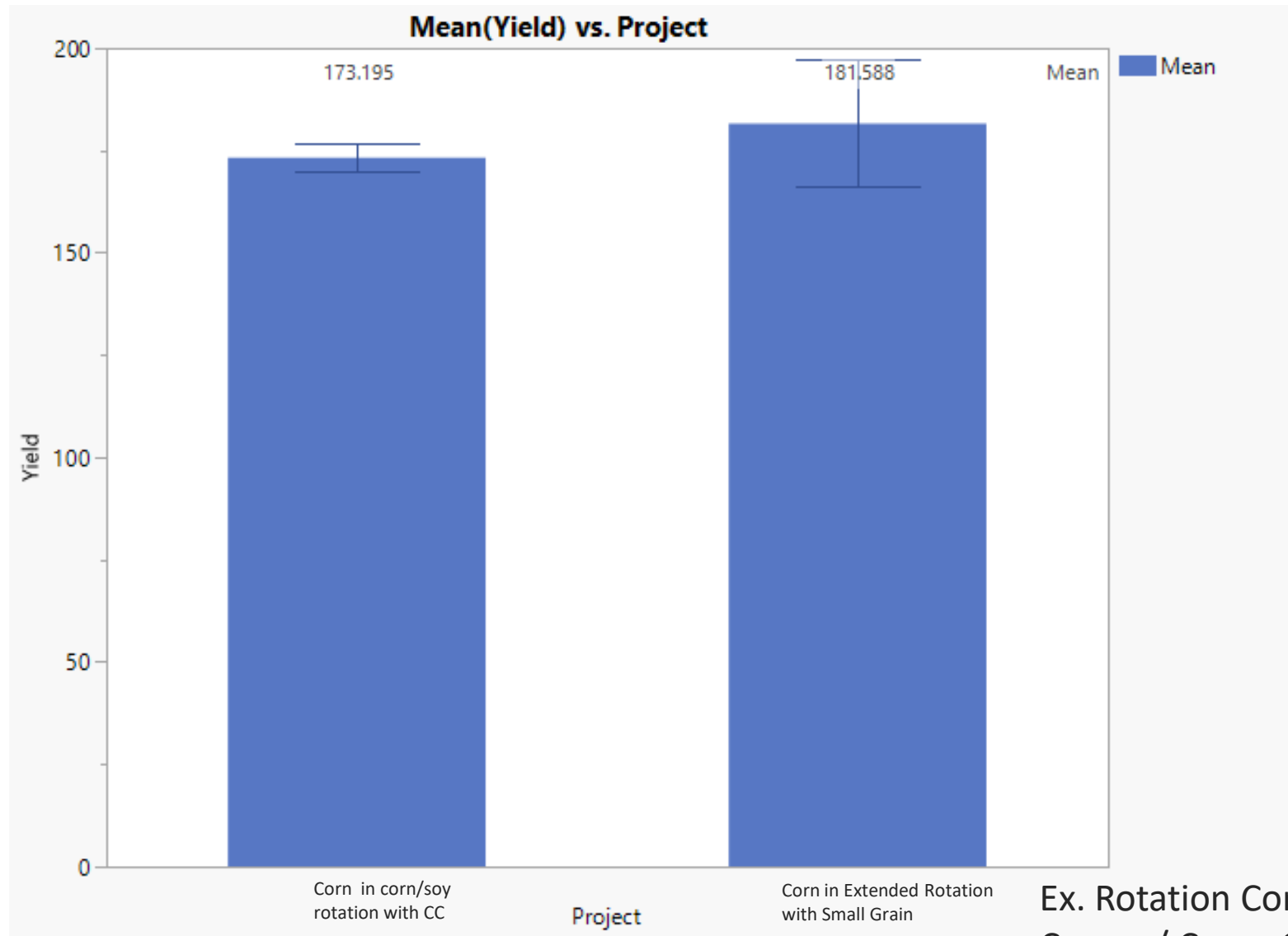
Spring Small Grain: N=28

Winter Small Grain: N=17

3. Delayed Gratification

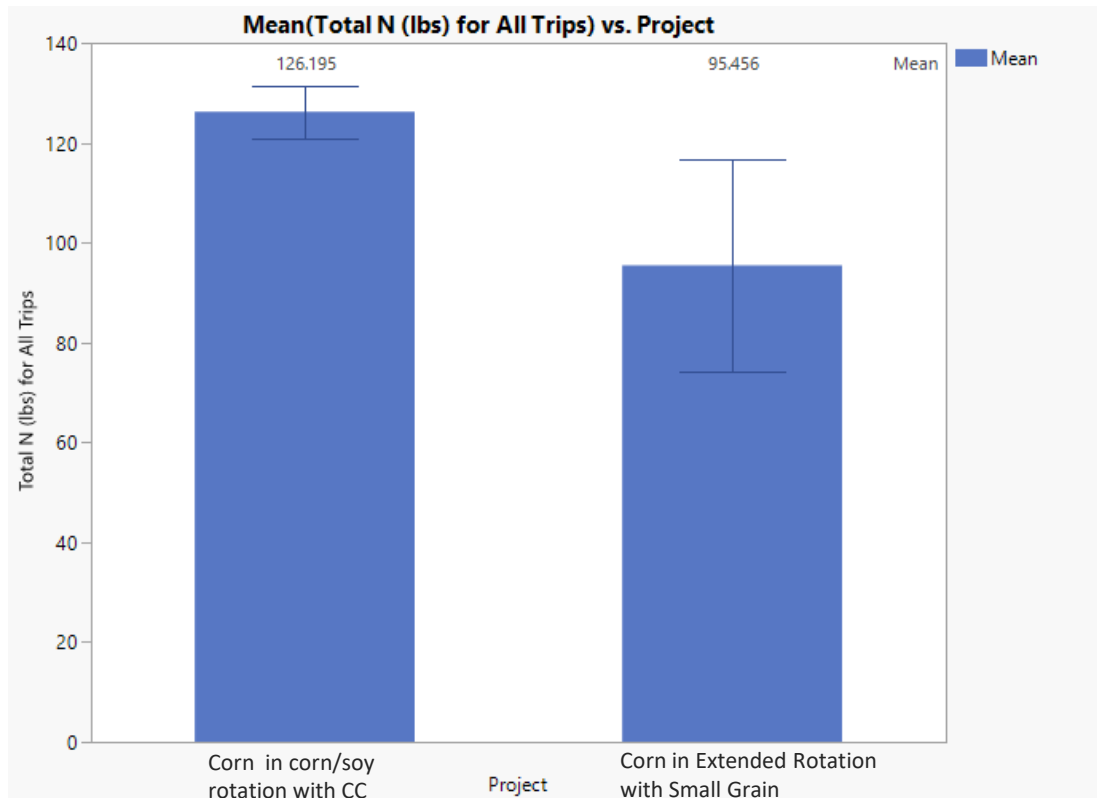
- Of population that grew corn in 2019 after small grain + legume cover ...
 - **44% reported higher yields** compared to two-year rotation corn
 - Average +14.7 bushel/acre
 - **20% reported similar yields** compared to two-year rotation corn
 - **16% reported lower yields** compared to two-year rotation corn
 - Average -32.5 bushel/acre
 - 20% had no comparison for their yields

3. Delayed Gratification

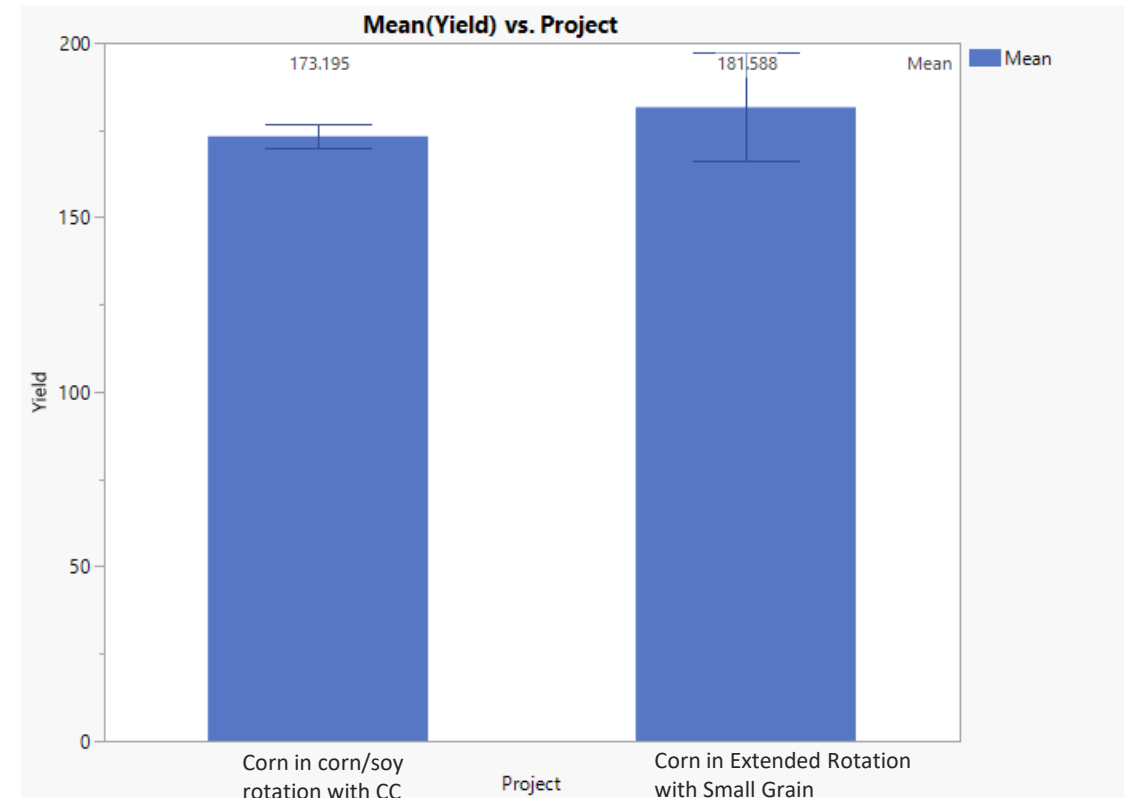


3. Delayed Gratification

- **Instant Gratification:** Corn grown in extended rotation uses 31 lbs N/acre less synthetic fertilizer (statistically significant)



- **Delayed Gratification:** Corn yields statistically the same in extended rotation (but we expect yields to climb with longer practice of rotation)



Ex. Rotation Corn 2017-2019, N=41
Corn 2017-2019, N = 529

QUESTIONS?

Summary/Next Steps

- Small grain + legume cover crop results in 50 lbs less fertilizer to following corn without sacrificing corn yields (instant gratification!)
- Farmers continue to see delay in increasing yields, require support in early years (delayed gratification)
- Need to tie incentive to reducing fertilizer to get the next 50% – Included in recently submitted CIG proposal
- Need more evaluation of what data is driving farmer behavior change (soil tests, neighbor experience, extension, etc.)
- None of this is scalable without a market and there are high program costs associated with the use of tools (may not be scalable)

Discussion Questions

What additional research/learning questions are important for this group to be asking and PFI/SFL to be supporting as we look ahead?

Thank You!

Questions?

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