

# Agronomic Uses of Manure that Reduce Environmental Risk

---

Greg LaBarge, Field Specialist, Agronomic Systems  
Glen Arnold, Field Specialist, Manure Management  
Ohio State University Extension

**CFAES**



**THE OHIO STATE UNIVERSITY**

COLLEGE OF FOOD, AGRICULTURAL,  
AND ENVIRONMENTAL SCIENCES

## Question to answer:

- Do 4R Nutrient Stewardship principals apply to Manure Management?
- Is manure only “insurance” nutrients or a “primary nutrient source” that replace purchased fertilizer?
- Can manure sourced Nitrogen be better utilized and Phosphorus Balanced in a crop rotation?
- What effects to water quality could happen?

# How are the 4R's being adopted into Manure Sourced Nutrients

## What are the 4Rs



### RIGHT SOURCE

Matches fertilizer type to crop needs.

Primary nutrient source P & K, also N



### RIGHT RATE

Matches amount of fertilizer type crop needs.

Rates limited to 2-year (in some situations 3 year) crop rotations P needs  
Using technology to monitor and or VRT rate



### RIGHT TIME

Makes nutrients available when crops needs them.

Apply in growing cash crop  
Apply into established forage/cover crop



### RIGHT PLACE

Keep nutrients where crops can use them.

Use manure application to establish cover crop seeding  
Manure Incorporation

**Makes economic & environmental sense...**

# P Losses from Manure vs Fertilizer Applied at Same Rate

Field 1: Liquid dairy manure - 13,000 gallons/A



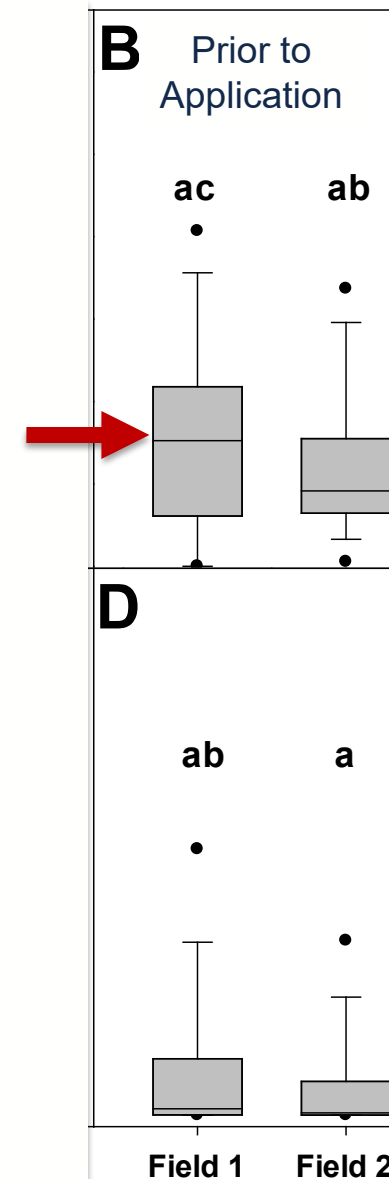
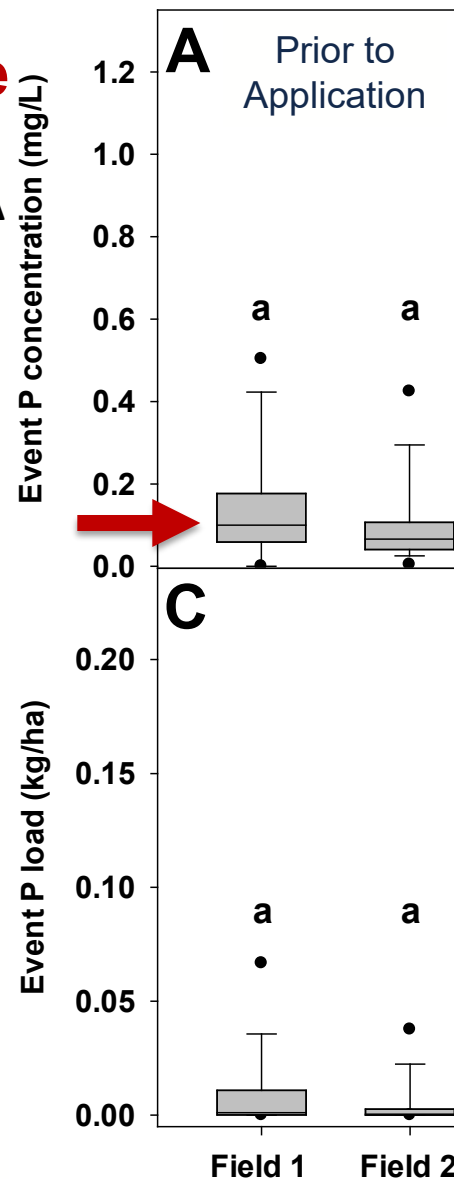
Field 2: MAP



76 lbs  
 $P_2O_5/A$

Dissolved Reactive P (DRP)

Total P (TP)



## Manure Supplied Nutrients Compared to 2-year removal

### Corn - 180 bu/ac & Soybeans - 60 bu/acre

2-Year Grain Removal		Swine*	Dairy*	Poultry*
Nutrient	(pounds/ac)	5500 gallon/ac	13000 gallon/ac	2 ton/ac
<b>N</b>	<b>133</b>	<b>=</b>	<b>-</b>	<b>-</b>
<b>P</b>	<b>111</b>	<b>=</b>	<b>-</b>	<b>-</b>
K	104	=	+	-
Ca	24	+	+	+
Mg	17	+	+	-
S	20	=	=	-
B	0.19	=	-	nd
Cu	0.07	+	+	=
Fe	0.56	+	+	+
Mn	0.14	+	+	-
Zn	0.32	-	+	=

+ More than  
= Meets  
- Less than

\* Based on a single operation's test values. Recommend each operation establish history of manure test results



# In Season Application Utilizes Nitrogen



Corn

N Requirement-190 lbs. Ac  
\$68.25 @ \$0.35 N



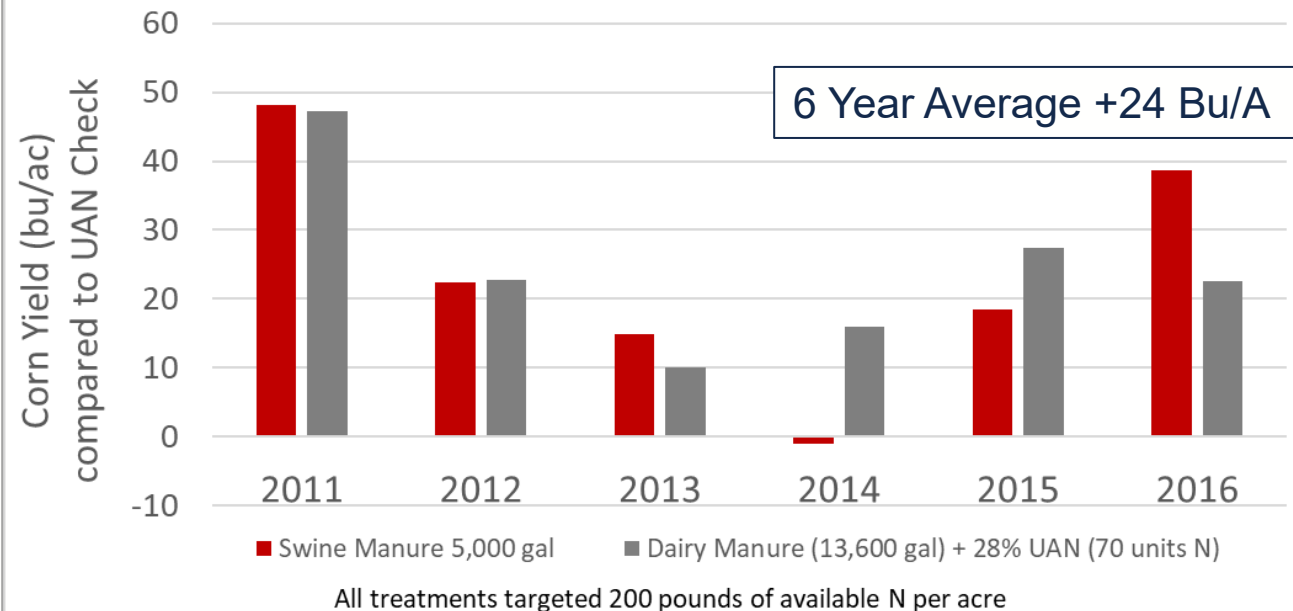
Wheat

N Requirement-115 lbs. Ac  
\$40.25 @ \$0.35 N

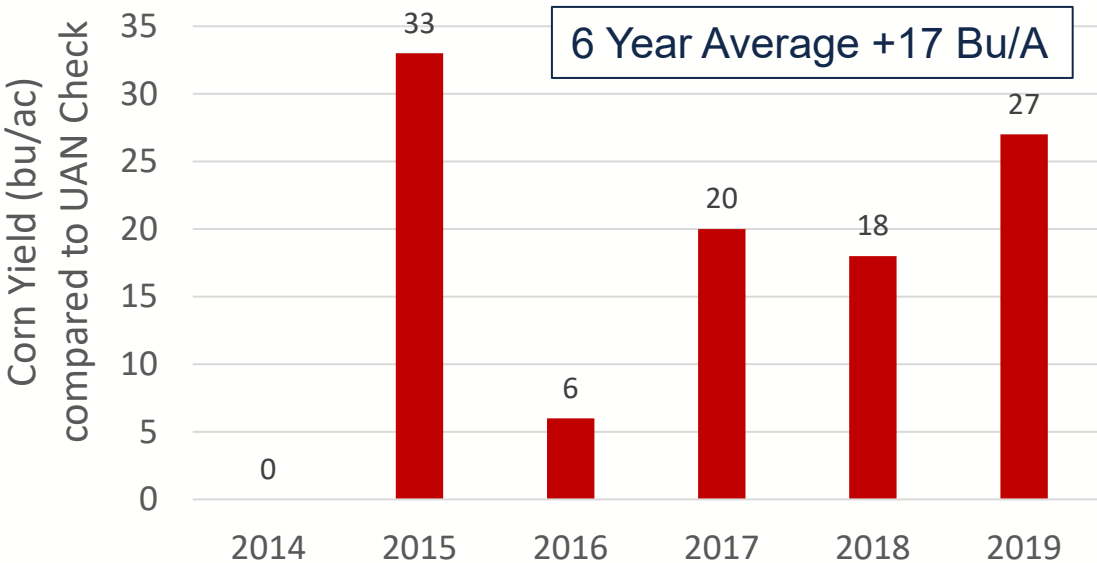


# Sidedressing Manure on Corn - Economic Incentive to Use this Practice

Corn Yield with Sidedress Manure Compared to 28% UAN Check (OARDC NW)



Corn Yield with Sidedress Swine Manure Compared to 28% UAN Check On-Farm in Darke County, OH



Partial Budget  
Nitrogen Cost

Treatment	Cost	Yield Increase	Net Over UAN
UAN @ \$0.35	\$75	--	--
Swine (5500 gal)	\$55*	\$84	\$104
Dairy (13,600) + 70 UAN	\$160 (\$136* + \$24)	\$84	-\$1

\* Cost of application @ \$0.01/gallon

THE OHIO STATE UNIVERSITY COLLEGE of FOOD, AGRICULTURAL, and ENVIRONMENTAL SCIENCES

# Edge of Field Monitoring In-Crop Manure vs Standard Practice

## North Field Treatment

28% UAN applied on June 5

- 172 pounds of N per acre
- 0 pounds per acre  $P_2O_5$

## South Field Treatment

Swine manure on June 1 @ 6000 gallons/acre

- 172 pounds available N per acre
- 120 pounds per acre  $P_2O_5$





# Soil Test Results 6/24/2020

## 20 Days after nutrient application



- Sample Core Depth of 0-12 inch
- Eleven cores composited across the row
- Timing
  - 19 days after manure
  - 23 days after UAN

### Results

Treatment	Nitrate (PPM)	Ammonium (PPM)	Total N $\text{NO}_3 + \text{NH}_4$	P (PPM)	OM (%)
28%	21	15	36	32	3.3
Manure	32	7	39	38	3.4

STP values of N and P identical after nutrient application

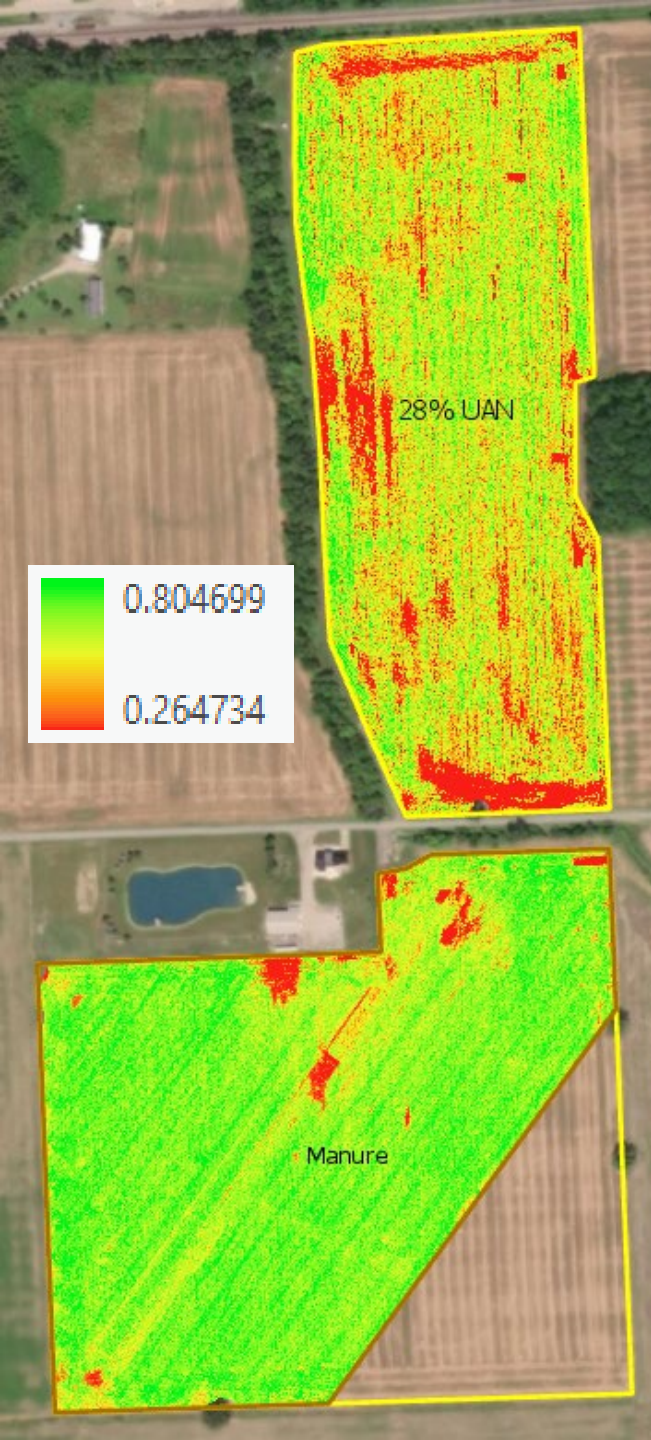


# Normalized Difference Red Edge (NDRE) Index of Plant Health



Treatment	NDRE Index	Stand Count
28%	0.60	28,500
Manure	0.63	31,000

- South field appears healthier common comment by farmers.
- South field corn is planted diagonally to reduce equipment/labor cost recent adaptation

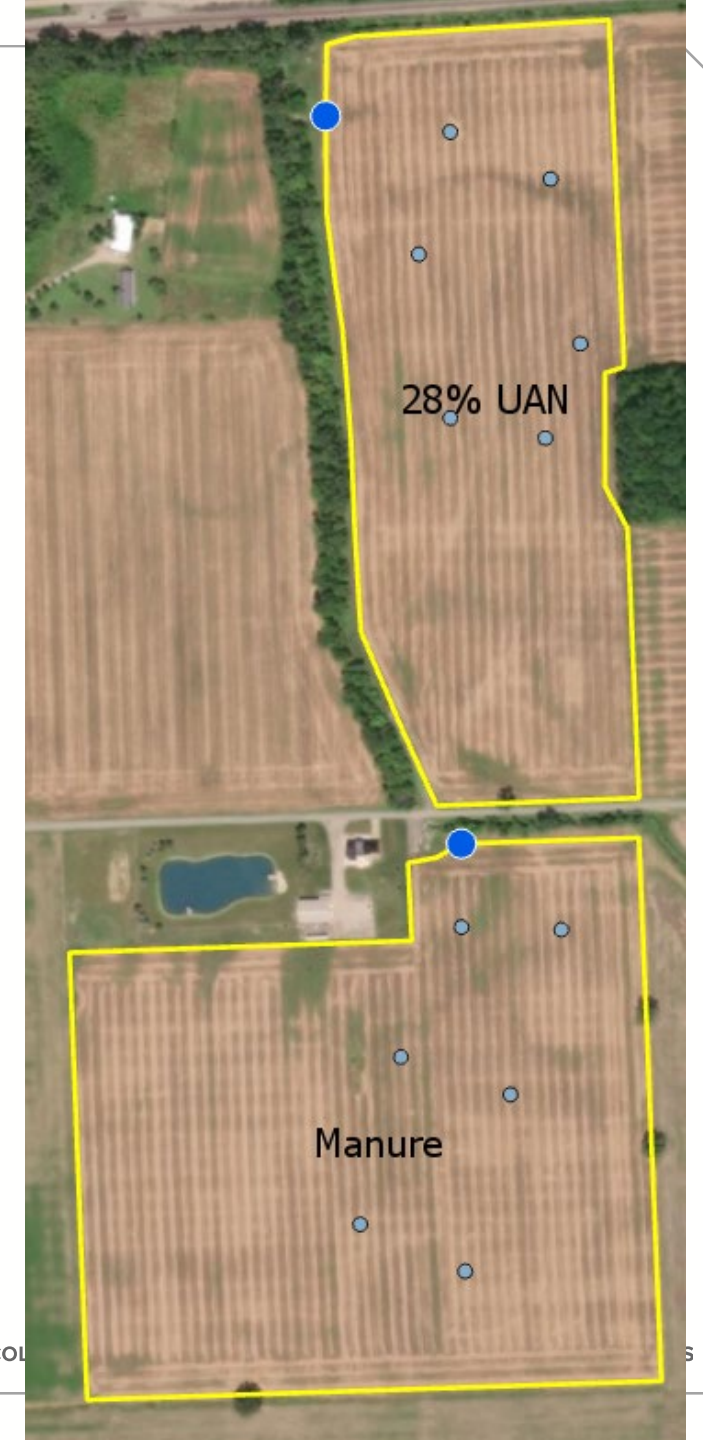




## Estimated Yield on 8/26/2020

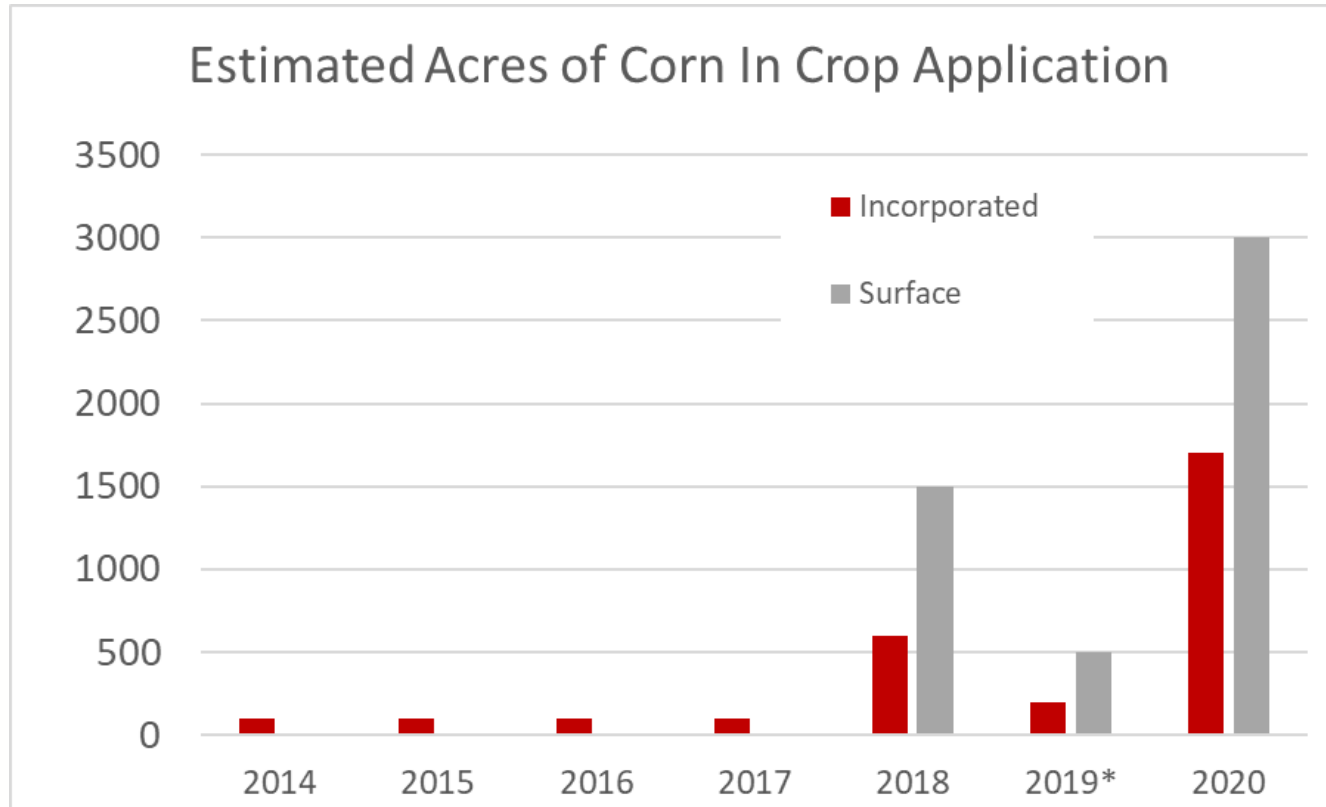


Treatment	Yield Bu/A
28%	132
Manure	185
	+53





## Use of Practice/Adoption Barriers to be Overcome



\* 2019 Weather Hindered Planting and Manure Applications

- Application window based on crop growth stage
- Equipment availability
  - Applicators
  - Transport
- Weather Window
- Farmer confidence

# Manure Compared to Commercial Fertilizer over a Crop Rotation



2016 Soil Test P 53 PPM

2019-September

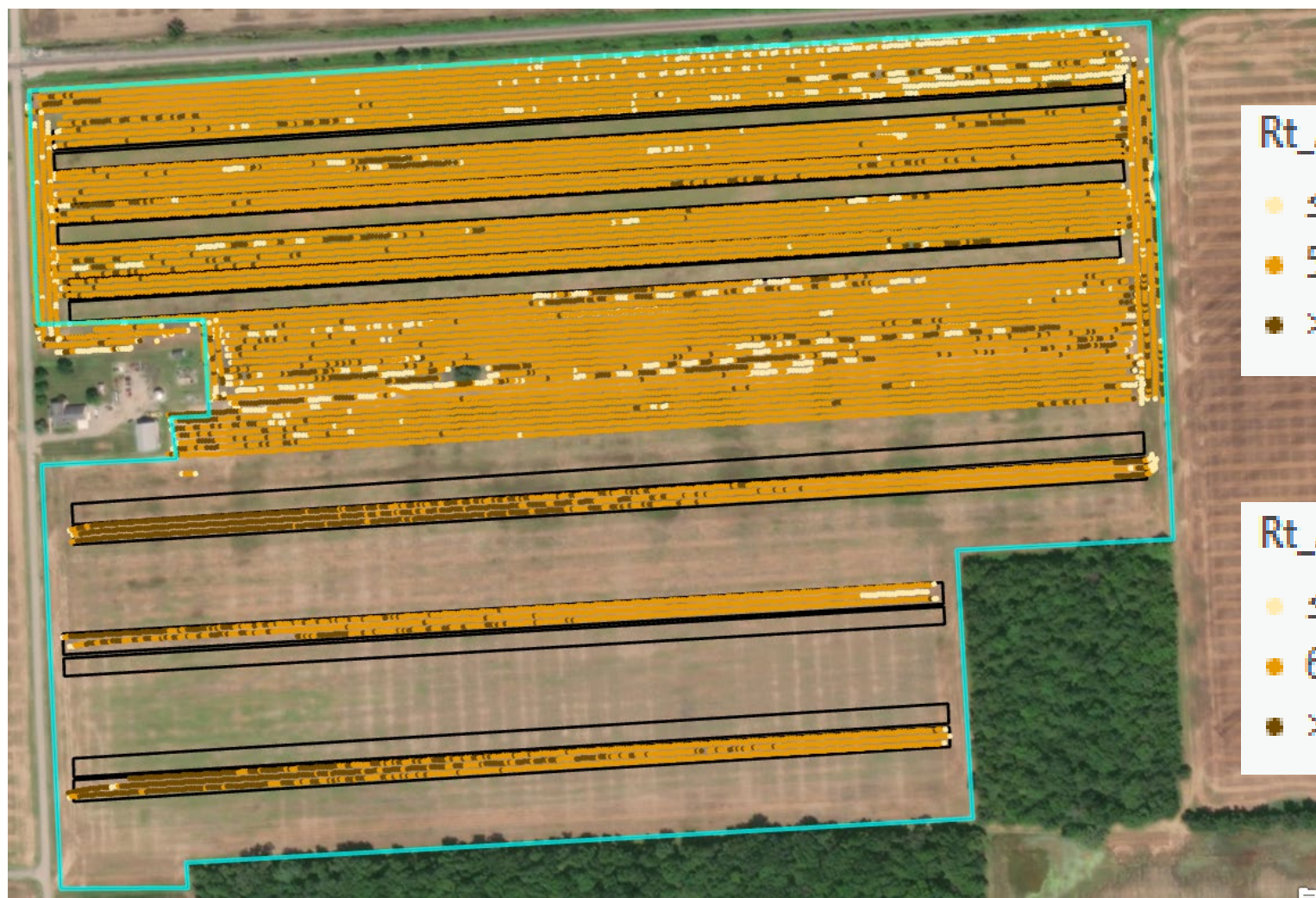
- Applied Swine Finishing Manure
- Planted to Cereal Rye/Rape Seed

2020-May

- North Field-Corn
- South Field-Soybeans



## Swine Manure Applied on 9/15/2019



Rt\_Apd\_Liq

- $\leq 4700$
- 5200 (plus/minus 500)
- $> 5700$

Corn

Rt\_Apd\_Liq

- $\leq 5800$
- 6300 (plus/minus 500)
- $> 6800$

Soybean



# Soil Test Results in Spring after Fall Applied Manure



Soil Sample (0-8 inch) Taken  
5/6/2020.

	Treatment	
Soil Test Parameter	No Manure	Manure
pH	5.4	5.3
Organic Matter(%)	4.3	4.3
NO3-N (ppm)	7	7
NH4-N (ppm)	4	5
P* (ppm)	57	56
S* (ppm)	8	8



## Cover crop- Rye/Rape Seed Planted



40% Cover

Cover Crop Growth on  
5/6/2020.

Manure Applied	% Ground Cover
Yes	70 a
No	42 b
LSD (0.01)	21
C.V. %	20



80% Cover

Full 2018 WY  
10/2017 to 9/2018

## Cover Crop with Manure at 2 Rates

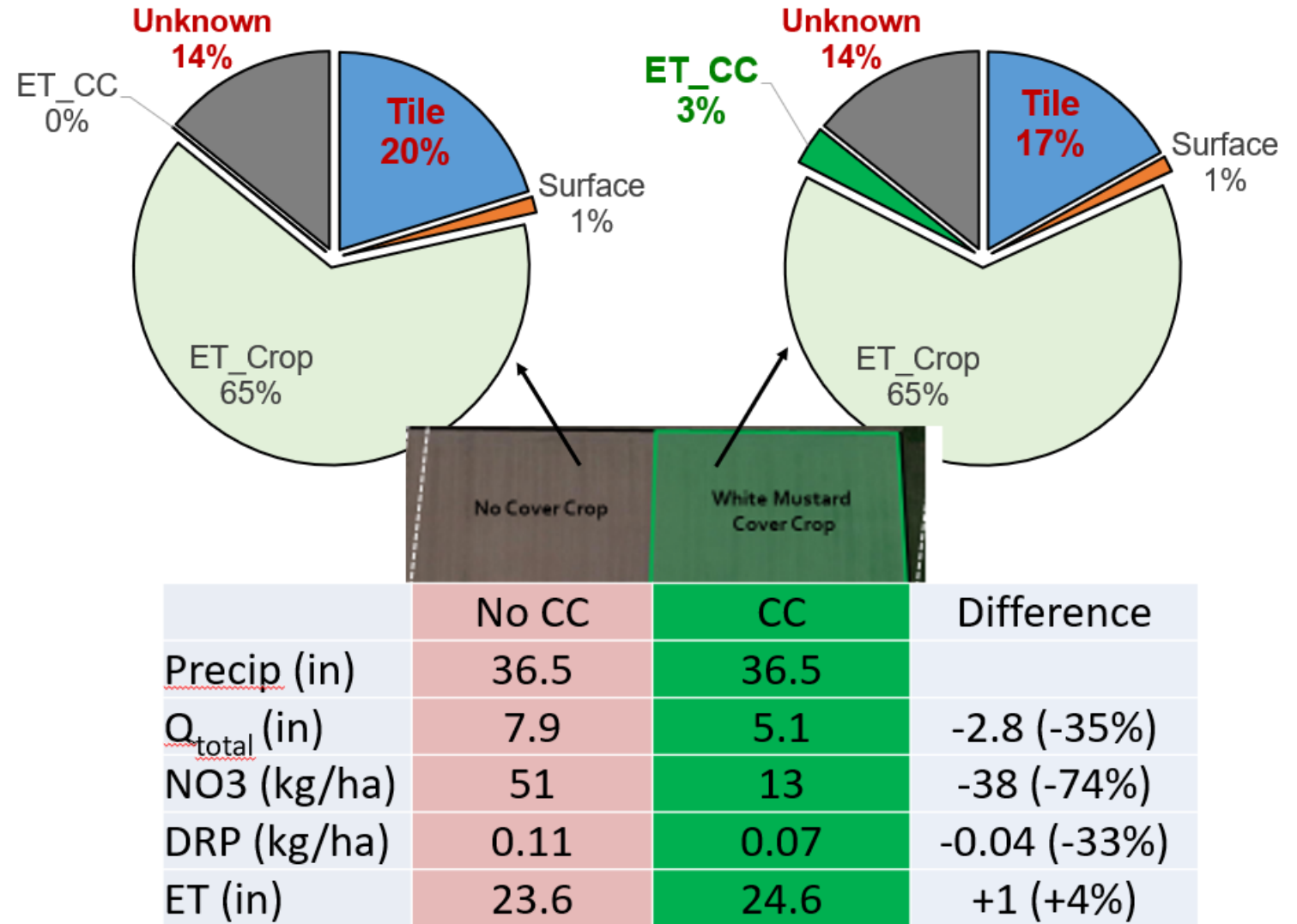
### Treatments

- 7,000 and 14,000 gallons per acre applied August 1
- Cover crop species White Mustard

### Results:

- tile flow (-35%)
- Nitrates (-74%)
- DRP (-33%)

Note: DRP reductions from CC are not consistent across literature.





## Summary

- Farmers knowledge/confidence of using manure as a primary nutrient source for P & K is common.
- Knowledge/confidence to better utilize N as a primary nutrient source increasing.
- Practices of:
  - Cover crop after summer manure application
  - In crop applications to corn and wheat are increasing
- Economics are driving innovation in planting and application equipment improvements.
- All leading to 4R Nutrient Stewardship in use of manure sourced nutrients.
- Water Quality impacts:
  - Manure and fertilizers applied at the same rate have an equal impact
  - Cover crops reduce N losses, for P there is variable results
  - In crop applications of manure reduces overall applied N in environment

## Contacts

- Greg LaBarge [labarge.1@osu.edu](mailto:labarge.1@osu.edu)
- Glen Arnold [arnold.2@osu.edu](mailto:arnold.2@osu.edu)