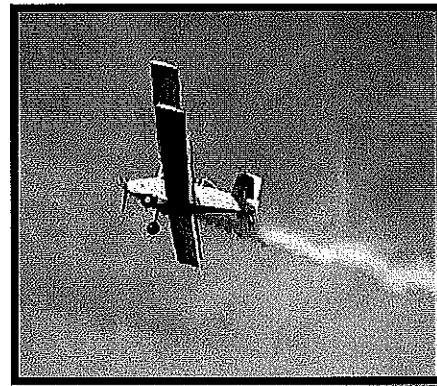




# 2016 Fulton County OFR Results



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# Conducting On Farm Research

## Why on Farm Research?

At the county level, on-farm research offers opportunities for educators to build relationships with county stakeholders and develop research responding to local concerns. Since the research is conducted using your equipment and normal production practices, it is directly applicable to your operation. Areas of interest:

- Nutrient management
- Corn Starter Phosphorus
- Late Season Corn N Apps
- Crop Rotation Benefits
- Conservation practices
- New technologies
- Cultural practices

OSU Extension's Agronomic Crops Team has published 517 peer-reviewed on-farm research reports written by 48 different lead authors since 1997. The on-farm research effort allows the team to address issues relevant to county needs as identified by local stakeholders, while contributing to statewide research efforts. (Martin et al, December 2016). Please visit [www.agcrops.osu.edu/onfarmresearch](http://www.agcrops.osu.edu/onfarmresearch) for a complete list of technical reports by category and year.

Research in Fulton County is a product of an On Farm Research Team of interested farmers who have given trial suggestions for the coming year.

## Preliminary Data

While the data contained in the On Farm Research booklet is believed to be true and accurate, the discussion of results is considered preliminary (draft) that has not yet been peer reviewed and accepted. Methods are based on a protocol that has been determined beforehand. Trial data has been statistically analyzed with an Analysis of Variance (ANOVA) at a confidence level of 95% ( $P=.05$ ).

## Statistics 101

**Replication:** In statistics, replication is repetition of a treatment or observation in the same or similar conditions. Replication is important because it adds information about the reliability of the conclusions or

estimates to be drawn from the data. The statistical methods that assess that reliability rely on replication. Multi-year data is considered some of the most important replications for a particular trial and is considered more valuable than one year data.

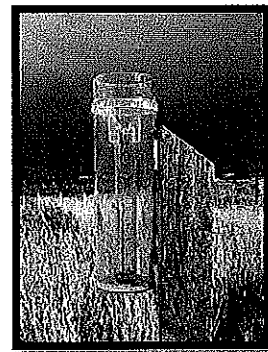
**Randomization:** Using random sampling as a method of selecting a sample from a population in which all the items in the population have an equal chance of being chosen in the sample. Randomization reduces the introduction of bias into the analysis. In on farm research, this same randomization helps account for spatial and soil variation.

**What is the P-value, LSD or CV?** The P-Value reported for each trial is the calculated probability that the differences found in the study are due to chance. As the P-Value number gets smaller, the probability increases that there are real differences. This helps differentiate between random variation and real treatment effects. For these studies we use a P-Value of 0.05 as the cutoff to determine whether the treatment differences are greater than random variation (sometimes called experimental error). When the differences are thought to be real we call them significant (Source: Nebraska On Farm Research Network). Most used research P values are .01, .05, .1 or .2. As P values go to .2, there is less confidence in the treatments that cause significant difference, and as P values go to .01, there is more confidence in the treatments that caused the significant difference. Least Significant Difference (LSD) is the amount of difference that is required within a particular data point to be called significant or due to the treatment. In this book the treatment data that is not different (P-Values are greater than 0.05 or within the LSD listed) are followed by the same letter. Finally, Coefficient of Variation (CV) is the amount of variation in the data that is analyzed in ANOVA. The higher the CV, the more variance there is in the data. The lower the CV (closer to 0.0), the "cleaner" the data.



## Rainfall & Soil Data

Rainfall data was acquired from the nearest CoCoRaHS / National Weather Service stations for key growing season months of May through August. Generally, the goal is to acquire rainfall data at field level or within at least 3 miles of the nearest CoCoRaHS station. If you are interested in being a CoCoRaHS weather reporter, visit [www.cocorahs.org](http://www.cocorahs.org) and let your county Extension Educator know.



Field level soil types were determined by visiting the National Resource Conservation Service (NRCS)-Web Soil Survey site and identifying the two most prevalent soil types for each trial. These are identified in each technical report under the background information. Randomization of treatment replications helps account for spatial and soil variations in on farm research.

## Profit Calculation

Many of our studies include a net return calculation. It is difficult to make this figure applicable to every producer. In order to calculate revenue for our research trials we used standardized input costs from The Ohio State University Extension's *2016 Corn, Soybean, and Wheat Budgets*. Where applicable custom farming rates from the *Ohio Farm Custom Rates 2016* fact sheet were used. Commodity Prices were approximated for the 2016 market year.

Average market commodity prices for the 2016 report are:

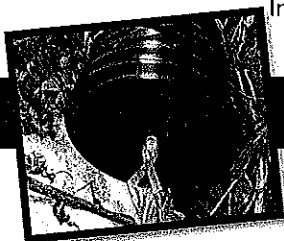
Corn: \$3.50 / bu

Soybeans: \$9.00 / bu

Wheat: \$4.00 / bu

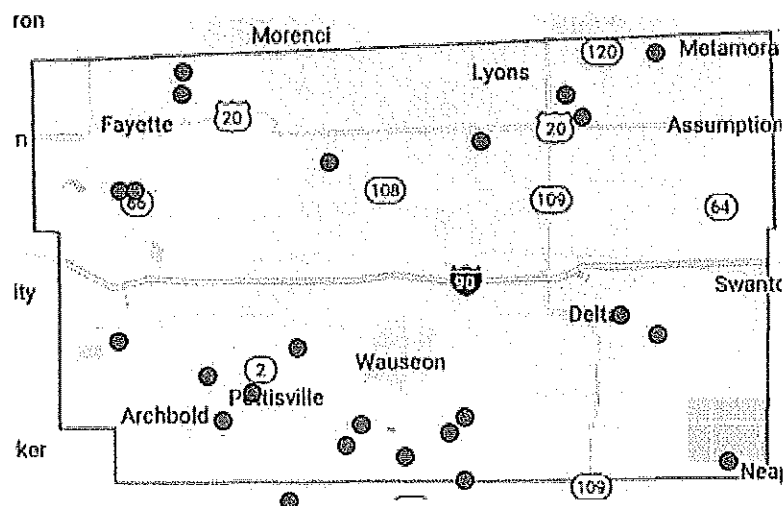
Forage: \$50 / ton

In order to make this information relevant to your operation, you may need to refigure return per acre with costs that you expect



## Water Quality

There are currently 24 end-of-tile outlet monitors throughout Fulton County; this monitoring program began in the fall of 2015 and will continue through the spring of 2017. In the first sampling cycle (fall 2015) statewide concentrations (n=245 sites) have ranged from no discharge to .05 ppm DRP, with a statewide average of .006-.01 ppm DRP for the first 3-month cycle. The Lake Erie Task Force has set a target of .05 ppm Dissolved Reactive Phosphorus leaving the farm through sub-surface drainage.



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# Multi-Year Trials Summary



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# 2016 Fulton OFR Review – Multiyear Studies

## 1b. Corn Yield response to Seeding Rate 2014-2016

Seeding Rate *	2014 Yield (3 sites)	2015 Yield (1 site)	2016 Yield (1 site)	3 Year Average Yield	3 Year Average Final Stand (plants/ac)	Revenue Minus Seed Cost ** (\$/ac)
(seeds/ ac)	(bushels per acre)					
23,000	-	152.1 b	191.3 ab	171.7	22,100	\$522
28,000	166.7 a	159.8 ab	193.4 ab	173.3	27,100	\$510
33,000	159.9 ab	171.3 a	191.6 ab	174.3	32,900	\$497
38,000	158.1 b	158.5 ab	195.5 a	170.7	37,600	\$467
43,000	155.6 b	-	186.0 b	170.8	41,000	\$450
County Average	183.1	161.3	TBD	172.2	-	-
Ohio Average	176.0	153	TBD	164.5	-	-

\*23,000 and 43,000 seeds per acre rates only had 2 years of data.

\*Based on \$3.44/1,000 seeds and \$3.50 market price (Source: OSUE Corn Production Budget 2016)

## 5b. Soybean Yield Response to Seeding Rate 2014-2016

Seeding Rate	2014 Yield	2015 Yield	2016 Yield	3 Year Average Yield	3 Year Average Final Stand (plants/ac)	Revenue Minus Seed Cost (\$/ac)
(seeds/ac)	bushels per acre					
100,000	48.9	46.1	60.3	51.8	75,300	\$423
125,000	50.7	48.5	61.9	53.7	95,800	\$430
150,000	53.3	51.7	64.6	56.5	113,400	\$444
175,000	56.1	51.1	63.9	57.0	132,500	\$438
200,000	57.5	54.2	66.0	59.2	147,800	\$447
County Average	51.1	51.4	TBD	51.3	-	-
Ohio Average	52.5	50.0	TBD	51.3	-	-

\*Based on \$.43/1,000 seeds and \$9.00 market price (Source: OSUE Soybean Production Budget 2016)

## 6b. Foliar Fungicide, Insecticide and Combination Treatments on Soybean Yield 2013-2016

Treatment	2013 Yield	2014 Yield	2016 Yield	3 Year Average Yield	Return Minus Cost (\$/ac)
	bushels per acre				
Fungicide + NIS	-	60.2	73.6	66.9	\$580
Fungicide + Insecticide	66.3	60.6	73.8	66.9	\$576
Fungicide	64.8	60.5	73.2	66.2	\$574
Fungicide - 2 passes	66.0	-	-	66.0	\$550
Insecticide	65.1	-	-	65.1	\$575
Untreated	63.3	57.0	73.0	64.4	\$580
LSD (P<.05)	1.45	1.79	2.16		

\*Based on \$9/bu soybean price, \$15/ac fungicide, \$4/ac insecticide, \$.50/ac NIS and \$7/ac application.

# 2016 Fulton OFR Review – Multiyear Studies

## 10e. Corn Yield response to Nitrogen Rate 2014-2016

Nitrogen Rate (pounds/N)	2014 Yield (4 sites)	2015 Yield (5 site)	2016 Yield (4 sites)	Average Yield (all sites)	Revenue Minus N Cost (\$/ac)
	bushels per acre				
0	-	76.9	-	76.9	\$269
50	117.9	108.5	140.7	123.6	\$412
100	171.2	84.7	169.8	137.8	\$440
150	183.2	183.2	184.9	169.7	\$531
200	196.5	181.4	184.1	188.5	\$576
250	189.9	192.4	184.5	189.2	\$557
300	-	-	192.4	192.4	\$547
County Average	183.1	161.3	TBD	172.2	-
Ohio Average	176.0	153	TBD	164.5	-

\*\*Based on \$3.50/bu corn and \$.42/lb N (Source: OSUE 2016 Corn Budget)



# 2016 OFR Trials Yield Summary



# 2016 Fulton OFR Review

## 1a. Corn Yield Response to Seeding Rate (All results listed per acre)

Seeding Rate (seeds)	Harvest Stand (plants)	Seed Cost* (\$/ac)	Moisture (%)	Yield (bushels)	Return Minus Seed Cost* (\$/ac)
23,000	22,100	\$79	18.0	191.3 ab	<del>\$590</del>
28,000	27,000	\$96	18.0	193.4 ab	\$581
33,000	33,200	\$114	18.5	191.6 ab	\$557
35,000	33,600	\$120	18.1	195.5 a	\$564
43,000	42,100	\$148	18.6	186.0 b	\$503

LSD (P<.05, CV 2.08)

7.5

\*Based on \$3.44/1,000 seeds and \$3.50 market price (Source: OSUE Corn Production Budget 2016)

## 3. Corn Yield Response to Fungicide Timing

Fungicide Timing Trial A - Variety P0993HR	Test Weight (lb/bu)	Moisture (%)	Yield (bu/ac)	Return Minus Cost (\$/ac)*
No Fungicide	56.3 a	15.7 b	213.8 a	<del>\$748</del>
V5 (June 21)	56.5 a	15.7 b	218.0 a	\$740
VT (August 1)	56.5 a	15.9 a	218.8 a	\$738
LSD P<.05 (CV)	.86 (.88)	.17 (.61)	10.23 (2.73)	

Fungicide Timing Trial B - Variety P0506	Test Weight (lb/bu)	Moisture (%)	Yield (bu/ac)	Return Minus Cost (\$/ac)*
No Fungicide	58.7 a	15.3 a	204.5 b	\$716
V5 (June 21)	58.5 a	15.4 a	211.8 a	<del>\$718</del>
VT (August 1)	58.8 a	15.4 a	211.3 a	\$711
LSD P<.05 (CV)	.32 (.32)	.13 (.5)	6.51 (1.8)	

\*Based on \$3.50/bu corn, \$16/ac fungicide, \$7/ac ground application at V5, \$12.30/ac aerial application at VT (Source: 2016 Ohio Farm Custom Rates)

## 5a. Soybean Yield Response to Seeding Rate (All results listed per acre)

Seeding Rate (seeds)	Stand on 6/24 (plants)	Stand on 7/25 (plants)	Seed Cost* (\$/ac)	Moisture (%)	Yield (bushels)	Return Minus Seed Cost* (\$/ac)
100,000	76,400	76,000	\$43	12.4	60.3 c	\$500
125,000	95,100	93,300	\$54	12.6	61.9 bc	\$503
150,000	99,500	98,800	\$65	12.4	64.6 ab	<del>\$517</del>
175,000	130,000	131,400	\$75	12.6	63.9 ab	\$500
200,000	150,400	148,100	\$86	12.4	66.0 a	\$508

LSD (P<.05, CV 3.7)

3.6

\*Based on \$.43/1,000 seeds and \$9.00 market price (Source: OSUE Soybean Production Budget 2016)

# 2016 Fulton OFR Review

## 6a. Foliar Fungicide, Insecticide and Combination Treatments on Soybean Yield

Treatment	Moisture (%)	Yield (bu/ac)	Cost* (\$/ac)	Return Minus Cost* (\$/ac)
Approach + NIS	9.7	73.6 a	\$23	\$640
Approach + Asana	9.6	73.8 a	\$26	\$638
Approach	10.0	73.2 a	\$22	\$637
Untreated	9.5	73.0 a	-	\$657
LSD (P<.05, CV 1.47)		2.16		

\*Based on \$9/bu soybean price, \$15/ac fungicide, \$4/ac insecticide, \$.50/ac NIS and \$7/ac application.

## 7. Wheat plus Second Crop Economics

Treatment	Wheat Yield (bu/ac)	Soybean Yield (bu/ac)	Forage Yield (tons/ac)	System Gross Revenue*
Soybeans in 15" rows (160,000 seeds/ac)		49.5 a		\$446
Frost seed red clover in March (10#/A)			1.5 a	\$75
Wheat in 7.5" rows (1.8 M seeds/ac)	88.9 a			\$356
Wheat in 15" rows (.9 M seeds/ac)	65.8 c			\$263
Wheat in 7.5" rows fb dbl crop soybeans	86.8 a	12.8 b		\$462
Wheat in 7.5" rows w/ frost seed clover	78.9 b		1.4 a	\$386
Wheat in 15" rows w/MRI soybeans	51.6 d	17.4 b		\$363
Wheat in 15" rows w/frost seed clover	70.4 c		1.1 a	\$337
Wheat in 7.5" rows fb forage oats	92.6 a		1.8 a	\$460
LSD (P<.05)	6.24	5.41	0.77	
	CV 5.5	CV 11.79	CV 26.61	

\* Based on \$9.00/bu soybeans, \$4.00/bu wheat and \$50/ton forage

## 8. Wheat plus Interseeded Soybeans

Treatment	Wheat Population (million seeds/ac)	Wheat Seed Cost** (\$/ac)	Wheat Yield (bu/ac)	Soybean Seed Cost** (\$/ac)	Soybean Yield (bu/ac)	Revenue Minus Seed Costs* (\$/ac)
Drilled wheat & double crop soybeans	1.6	\$49.6	91.5 a	\$86	42.2 a	\$610
15" wheat & MRI 15" soybeans at boot	0.8	\$24.8	82.3 b	\$86	18.5 b	\$384
Drilled w/tramlines wheat & MRI 15" soybeans at boot	1.4	\$43.4	80.6 b	\$86	18.9 b	\$363
LSD (P<.05, CV 4.29 & 11.84)			6.3		5.43	

\*Soybeans were all planted at about 200,000 seeds per acre

\*\* Based on \$.42 & \$.031 per 1000 seeds (Source: Soybean & Wheat OSU Production Budget 2016)

# 2016 Fulton OFR Review

## 10a. Corn Yield Response to Nitrogen Rate - Delta

Nitrogen Rate (lbs/ac)	Yield (bu/ac)	NUE (lbN/bu)	CSNT (ppm nitrate N)	Return Minus N Cost* (\$/ac)
90	180.8 a	0.50	158	\$595
150	194.5 a	0.77	1592	<del>\$618</del>
210	183.9 a	1.14	1551	\$555
270	178.6 a	1.51	3030	\$512

LSD (P<.05, CV 6.39) 18.85

\*Based on \$3.50/bu corn and \$.42/lb N (Source: OSUE 2016 Corn Budget)

## 10b. Corn Yield Response to Nitrogen Rate - Ridgeville

Nitrogen Rate (lbs/ac)*	Yield (bu/ac)	NUE (lbN/bu)	CSNT (ppm nitrate N)	Return Minus N Cost** (\$/ac)
48	122.2 c	0.39	43	\$408
80	148.6 b	0.54	1912	\$487
140	178.7 a	0.78	617	<del>\$567</del>
200	180.9 a	1.11	2469	\$549
260	180.2 a	1.44	2588	\$522

LSD (P<.05, CV 3.52) 9.69

\* 48 lbs/ac rate was unreplicated, planter applied only.

\*\*Based on \$3.50/bu corn and \$.42/lb N (Source: OSUE 2016 Corn Budget)

## 10c. Corn Yield Response to Nitrogen Rate - Metamora

Nitrogen Rate (lbs/ac)*	Yield (bu/ac)	NUE (lbN/bu)	CSNT (ppm nitrate N)	Return Minus N Cost** (\$/ac)
21	135.0 e	0.16	73	\$464
75	164.8 d	0.46	56	\$545
150	181.5 c	0.83	124	<del>\$572</del>
225	187.0 b	1.20	532	\$560
300	193.0 a	1.55	775	\$550

LSD (P<.05, CV 1.23) 3.56

\* 21 lbs/ac rate was unreplicated, planter applied only.

\*\*Based on \$3.50/bu corn and \$.42/lb N (Source: OSUE 2016 Corn Budget)

## 10d. Corn Yield Response to Nitrogen Rate - Lyons

Nitrogen Rate (lbs/ac)*	Yield (bu/ac)	NUE (lbN/bu)	CSNT (ppm nitrate N)	Return Minus N Cost** (\$/ac)
84	180.0 c	0.47	114	<del>\$595</del>
165	184.7 b	0.89	1528	\$577
180	184.7 b	0.97	2058	\$571
230	192.3 a	1.20	2048	\$576
280	191.7 a	1.46	5556	\$553

LSD (P<.05, CV 1.23) 3.56

\* 84 lbs N/ac rate was unreplicated, planter applied only.

\*\*Based on \$3.50/bu corn and \$.42/lb N (Source: OSUE 2016 Corn Budget)

# 2016 Fulton OFR Review

## 11a. Corn Yield Response to Starter Phosphorus - Delta

Starter P Rate - Trial A P0157 (lbs/ac)	Starter P Rate (gal/ac of 11-25-0)	Yield (bu/ac)	Return Minus P Cost* (\$/ac)
0	-	181.2 a	\$634
28	10	179.1 a	\$608
56	20	184.2 a	\$608
LSD (P<.05, CV 3.75)		11.79	
Starter P Rate - Trial B P0506 (lbs/ac)	Starter P Rate (gal/ac of 11-25-0)	Yield (bu/ac)	Return Minus P Cost* (\$/ac)
0	-	192.1 a	\$672
28	10	199.8 a	\$681
56	20	193.7 a	\$641
LSD (P<.05, CV 4.41)		14.9	

\*Based on \$3.50/bu corn and \$.66/lb P (Source: OSUE 2016 Corn Budget)

## 11b. Corn Yield Response to Starter Phosphorus - Pettisville

Starter P Rate (lbs/ac)	Starter P Rate (gal/ac of 10-34-0)	Yield (bu/ac)	Return Minus P Cost* (\$/ac)
0	-	143.9 a	\$504
20	5.0	140.5 a	\$479
40	10.1	140.5 a	\$465
LSD (P<.05, CV 2.73)		26.68	

\*Based on \$3.50/bu corn and \$.66/lb P (Source: OSUE 2016 Corn Budget)

## 12a. Soybean Response to Foliar Fertilizer

Treatment	Yield (bu/ac)	Return Minus Foliar Cost (\$/ac)*
Check	66.8 a	\$601
Finishline Foliar	67.3 a	\$594
LSD (P<.05, CV 1)		1.51

\*Based on \$4.50/ac for foliar sulfur product, \$7/ac for application (Source: 2016 OSUE Custom Farm Rates)

# 2016 Fulton OFR Review

## 14a. Swine Manure vs. Beef Manure vs. 28% at Corn Sidedress

Nitrogen Source	Application Rate (gal/ac)	Units of N/ac Applied at Sidedress	Yield (bu/ac)	CSNT (ppm NO3-N)
Swine (25-11-33/1,000 gal)	5,000	125	203.8 b	6,930
Beef (41-26-30/1,000 gal)	4,000	161	214.0 a	6,270
28% UAN	50	150	215.8 a	6,557
LSD (P<.05, CV 1.25)			4.57	

## 14b. Steer Manure vs. Anhydrous vs. 28% at Corn Sidedress

Nitrogen Source	Application Rate	Units of N/ac Applied at Sidedress	Yield (bu/ac)	CSNT (ppm NO3-N)
Beef (41-26-30/1,000 gal)	4,000 gal/ac	166	220.4 a	1,007
Anhydrous	200 lb/ac	165	222.4 a	580
28% UAN	55 gal/ac	165	218.5 a	960
LSD (P<.05, CV 2.04)			7.78	

## 14c. Steer Manure vs. 28% Late Season at Corn Sidedress

Nitrogen Source	Application Rate (gal/ac)	Units of N/ac Applied at Sidedress	Yield (bu/ac)	CSNT (ppm NO3-N)
Beef (41-26-30/1,000 gal)	4,000	164	191.5 a	3,380
28% UAN (V8)	45	135	194.8 a	2,260
LSD (P<.05, CV 1.74)			7.55	

## 14d. Swine Manure vs. 28% at Corn Sidedress

Nitrogen Source	Application Rate (gal/ac)	Units of N/ac Applied at Sidedress	Yield (bu/ac)	CSNT (ppm NO3-N)
Swine (25-11-33/1,000 gal)	5,000	125	133.6 a	2,293
28% UAN	40	120	114.8 a	447
LSD (P<.05, CV 8.6)			24.28	

## 15a. N Application Timing in Corn (Anhydrous)

Nitrogen Application and Source**	Yield (bu/ac)	CSNT (ppm NO <sub>3</sub> -N)	System Application Cost (\$/ac)*	Return Minus Application Cost (\$/ac)
Anhydrous (V5)	212.8 a	3,324	\$13.55	\$731
Late (V12)	211.2 a	1,706	\$10.00	\$729
Split (V5 & V12)	214.4 a	1,701	\$23.55	\$727
Zero Rate (30#)	133.1 b	62	-	\$466
LSD (P<.05, CV 1.8)		8.7		

\*Based on \$13.55 anhydrous application, \$10.00 highboy application and \$3.50/bu corn. (Source: 2016 Ohio Custom Rates)

\*\*All Systems used 140 lbs N/ac in season, 70 lbs N/ac at plant; zero rate unreplicated

# 2016 Fulton OFR Review

## 15b. N Application Timing in Corn (28%)

Nitrogen Application and Source**	Yield (bu/ac)	CSNT (ppm NO3-N)	System Application Cost (\$/ac)*	Return Minus Application Cost (\$/ac)*
28% Check (V5)	219.0 a	2,678	\$9.25	\$757
Late Season (V10)	218.8 a	4,756	\$10.00	\$756
Split (V5 & V10)	222.0 a	5,698	\$19.25	\$758
LSD (P<.05, CV .97)	3.68			

\*Based on \$9.25 28% application, \$10.00 highboy application and \$3.50/bu corn (Source: 2016 Ohio Custom Farm Rates)

\*\*All Systems used 110lbN/ac in season, 92/lbN/ac at plant

## 15c. N Application Timing and Placement in Corn (28%)

Nitrogen Application and Source**	Yield (bu/ac)	CSNT (ppm NO3-N)	System Application Cost (\$/ac)*	Return Minus Application Cost (\$/ac)*
28% Check (V5)	138.7 a	764	\$9.25	\$476
Placement (V5)	140.0 a	1,154	\$10.00	\$480
Late Season (V10)	144.2 a	989	\$10.00	\$495
Split (V5 & V10)	139.1 a	1,014	\$19.25	\$468
Zero Rate (#48)	122.0 b	43	-	\$427
LSD (P<.05, CV 5.95)	13.37			

\*Based on \$9.25 28% application, \$10.00 highboy application and \$3.50/bu corn. (Source: 2016 Ohio Farm Custom Rates)

\*\*All Systems used 120lbN/ac in season, 80/lbN/ac was applied at plant

## 15d. N Application Timing and Rate in Corn

Nitrogen Application and Source**	Yield (bu/ac)	CSNT (ppm NO3-N)	System Application Cost (\$/ac)*	Return Minus Application Cost (\$/ac)
Anhydrous at V5 (100#N/210#TN)	173.9 a	1,055	\$55.55	\$553
Late Season at V10 (100#N/210#TN)	176.2 a	685	\$52.00	\$565
Late Season - .9 rate at V10 (78#N/188#TN)	174.8 a	1,278	\$42.76	\$569
Late Season - .8 rate at V10 (57#N/167#TN)	175.6 a	693	\$33.94	\$581
LSD (P<.05, CV 1.77)	6.19			

\*Based on \$13.55 anhydrous application, \$10.00 highboy application, \$.42/lb of nitrogen cost and \$3.50/bu corn (Source: OSUE 2016 Corn Budget & Ohio Farm Custom Rates)

\*\*All Systems used 110lb of nitrogen at plant

## 15e. Foliar N application in Corn at VT

Nitrogen Application and Source**	Yield (bu/ac)	System Application Cost (\$/ac)*	Return Minus Application Cost (\$/ac)
CoRoN foliar - 2.5 gal/ac	211.5 a	\$24.80	\$715
Untreated check	208.0 a	-	\$728
LSD (P<.05, CV 2.6)	19.13		

\*Based on \$12.30 aerial application, \$2.50/gal product cost and \$3.50/bu corn (Ohio Farm Custom Rates)

# Multi-year OFR Technical Reports





## 1b. Corn Yield Response to Seeding Rate (2014-2016)

Eric Richer, Ohio State University Extension Educator, Fulton County

### Objective

To determine the effects of seeding rate on corn yield and profitability.

### Background

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Crop Year: 2014-2016	Soil Test ('14-16 avg): pH 6.1
County: Fulton	P 19 ppm (Bray P1)
Location: Fayette, OH	K 105 ppm
Drainage: Systematic, 50' laterals	CEC 10.5 meq/100g
Previous Crop: Soybeans	O.M. 2.8%
Soil Type: Blount, Glynwood	Rainfall (April - Sept): 2016 – 21.6"
Tillage: No-till/strip till	2015 – 22.1"
Applied Fertilizer (each year): 200-65-75/ac	2014 – 10.9"

### Methods

This multi-year study was designed with five treatments replicated four times in a randomized complete block design. Plots were 6 rows wide (15 ft) by 2250 feet long. All treatments received the same starter fertilizer, herbicide and sidedress nitrogen. Various seed corn hybrids were used in the research, based mainly on farmer choice. The trial was planted, sprayed, sidedressed and harvested with commercial farm equipment. Yields and moistures were measured by using a calibrated Ag Leader yield monitor. Yields were shrunk to 15% moisture. Precipitation data was obtained from the nearest CoCoRaHS station (OH-WL-9).

Treatments:	1. 23,000 seeds per acre
	2. 28,000 seeds per acre
	3. 33,000 seeds per acre
	4. 38,000 seeds per acre
	5. 43,000 seeds per acre



## Results

### 1b. Corn Yield response to Seeding Rate 2014-2016

Seeding Rate *	2014 Yield (3 sites)	2015 Yield (1 site)	2016 Yield (1 site)	3 Year Average Yield	3 Year Average Final Stand	Revenue Minus Seed Cost **
(seeds/ ac)		(bushels per acre)			(plants/ac)	(\$/ac)
23,000	-	152.1 b	191.3 ab	171.7	22,100	\$522
28,000	166.7 a	159.8 ab	193.4 ab	173.3	27,100	\$510
33,000	159.9 ab	171.3 a	191.6 ab	174.3	32,900	\$497
38,000	158.1 b	158.5 ab	195.5 a	170.7	37,600	\$467
43,000	155.6 b	-	186.0 b	170.8	41,000	\$450
LSD (p<.05)	7.2	15.8	7.5	-	-	-
County Average	183.1	161.3	TBD	172.2	-	-
Ohio Average	176.0	153	TBD	164.5	-	-

\*23,000 and 43,000 seeds per acre rates only had 2 years of data.

\*\*Based on \$3.44/1,000 seeds and \$3.50 market price (Source: OSUE Corn Production Budget 2016)

### Discussion:

This three year study showed that a seeding rate of 23,000-33,000 seeds per acre achieved the highest statistically significant yield. The 33,000 seeds per acre showed the highest 3 year average agronomic yield while the 23,000 seeds per acre rate showed the maximum economic return. Because only 2 years of data were collected at the lowest rate of 23,000 seeds per acre, the author believes that there is higher confidence in the results of the 28,000-33,000 seeds per acre rates. In 2014 there was no statistical yield advantage to planting more than 33,000 seeds per acre. In 2015 and 2016, there was no statistical yield advantage to planting more than 38,000 seeds per acre.

Whereas 2015 was a year of higher than average rainfall during the growing season, both 2014 and 2016 had some early season drought stress that could have affected normal yield results. Additionally, the NRCS soil description for Blount-Glynwood soils indicates only a moderate water holding capacity. These site specific characteristics make a case for reduced corn seeding rates as an improved return on investment.

### Acknowledgement

The author expresses appreciation to on-farm collaborators Les Seiler and Richard Snyder for the planting and harvesting of these plots. Thanks to summer agronomy interns Emily Herring, Troy Grime and Ben Eggers for assistance with data collection.



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## 5b. Soybean Yield Response to Seeding Rate (2014-2016)

Eric Richer, Ohio State University Extension Educator, Fulton County

### Objective

To determine the effects of seeding rate on soybean yield and profitability.

### Background

Crop Year: 2014-2016	Soil Test (grid avg):	pH 6.6
County: Fulton		P 101 ppm (Bray P1)
Location: Archbold, OH		K 295 ppm
Drainage: Systematic, 50' laterals		CEC 14.6
Previous Crop: Corn		O.M. 3.3%
Soil Type: Fulton, Latty clay	Rainfall (April-Sept):	2016 – 19.1"
Fertility: applied in corn year with VRT		2015 – 25.6"
Tillage: Minimum		2014 – 17.8"

### Methods

Five treatments of different soybean seeding rates were replicated four times in a randomized complete block design. Treatments were made with a 40 foot commercial planter with 15" rows and planter units. All treatments received the same tillage and herbicide applications. The seed variety used was determined by the farmer-collaborator. However, the variety was not the same in all years. Plot centers were harvested with a commercial combine equipped with a 35 foot grain header. Yields and moistures were obtained by using a calibrated yield monitor. Yields were shrunk to 13% moisture. Rainfall data was obtained from farm level/producer data.

Treatments:	1. 100,000 seeds per acre
	2. 125,000 seeds per acre
	3. 150,000 seeds per acre
	4. 175,000 seeds per acre
	5. 200,000 seeds per acre



## Results

### 5b. Soybean Yield Response to Seeding Rate 2014-2016

Seeding Rate	2014 Yield	2015 Yield	2016 Yield	3 Year Average Yield	3 Year Average Final Stand	Revenue Minus Seed Cost*
(seeds/ac)	bushels per acre				(plants/ac)	(\$/ac)
100,000	51.2 b	46.1 cd	60.3 b	52.5	75,300	\$430
125,000	52.9 b	48.5 bc	61.9 ab	54.4	95,800	\$436
150,000	55.5 a	51.7 ab	64.6 a	57.3	113,400	\$451
175,000	54.2 ab	51.1 b	63.9 ab	56.4	132,500	\$432
200,000	55.7 a	54.2 a	66.0 a	58.6	147,800	\$442
LSD (p<.05)	2.49	2.98	3.6	-	-	-
County Average	51.1	51.4	TBD	51.3	-	-
Ohio Average	52.5	50.0	TBD	51.3	-	-

\*Based on \$.43/1,000 seeds and \$9.00 market price (Source: OSUE Soybean Production Budget 2016)

### Discussion:

Generally speaking, the agronomic optimum seeding rate was 150,000 seeds per acre or more for all years in the trial, except for 2015 when the 175,000 seeds per acre rate yielded significantly lower than the top yielding treatments. Furthermore in 2016, seeding at 125,000 seeds per acre resulted in the highest statistically significant agronomic yield.

The 3 year average seeding rate with the maximum economic return was 150,000 seeds per acre, netting over \$450 per acre after seed cost. Finally, it should be noted that an average final stand of 113,400 plants per acre resulted in the highest agronomic yield *and* economic return.

### Acknowledgement

The author expresses appreciation to on-farm collaborators Rufenacht Farms for the planting and harvesting of this plot. Thanks to summer agronomy intern Emily Herring, Troy Grime and Ben Eggers for assistance with data collection. This project was supported by the Ohio Soybean Association Research and Education Fund.



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## 6b. Foliar Fungicide, Insecticide and Combination Treatments on Soybean Yield (2013-2016)

Eric Richer, Ohio State University Extension Educator, Fulton County

### Objective

To evaluate the effect of foliar fungicide, insecticide or combination treatments soybean yield and profitability over three years.

### Background

Crop Year: 2013-2016

County: Fulton

Location: Delta, OH

Drainage: Systematic, 40-50' laterals

Previous Crop: Corn

Soil Type: Hoytville clay loam

Fertility: applied in corn year with VRT

Tillage: conventional

Herbicide: Various pre-emerges f.b. glyphosate

Soil Test (2014): pH 6.7

P 44 ppm (Bray-P1)

K 268 ppm

CEC 16.1 meq/100g

OM 4.6%

Rainfall (April-Sept.): 2016 – 19.1"

2014 – 14.5"

2013 – N/A

### Methods

This multi-year study was designed with six treatments replicated three times in a randomized complete block design. Plots were planted in 15" rows, 40 feet wide by 2,500 feet long. The seed variety used was determined by the farmer-collaborator and was not the same each year. In each year of the study, all treatments received the same tillage, herbicide, and fertility applications. All fieldwork—including treatments—was completed with commercial farm equipment. While Aproach fungicide was used in all three years of the study, insecticide used was an off-patent generic approved for use in soybeans. Disease and insect pressure were objectively measured in 2016 only (<2%). Yields and moistures were measured by using a calibrated yield monitor. Yields were shrunk to 13% moisture. Rainfall data were obtained from the nearest CoCoRaHS/NWS station.

Treatments:

1. 6 oz/ac Aproach fungicide plus 1pt/100 gallons non-ionic surfactant (NIS) at R2 growth stage
2. 6 oz/ac Aproach fungicide plus insecticide at R2 growth stage
3. 6 oz/ac Aproach fungicide at R2 growth stage
4. 6 oz/ac Aproach fungicide at R1 & R3 growth stages (2 passes)
5. Insecticide only at R2 growth stage
6. Untreated (Check)



## Results

### 6b. Foliar Fungicide, Insecticide and Combination Treatments on Soybean Yield 2013-2016

Treatment	2013 Yield	2014 Yield	2016 Yield	3 Year Average Yield	Return Minus Cost
	bushels per acre				(\$/ac)
1. Fungicide + NIS	-	60.2	73.6	66.9	\$580
2. Fungicide + Insecticide	66.3	60.6	73.8	66.9	\$576
3. Fungicide	64.8	60.5	73.2	66.2	\$574
4. Fungicide - 2 passes	66.0	-	-	66.0	\$550
5. Insecticide	65.1	-	-	65.1	\$575
6. Untreated	63.3	57.0	73.0	64.4	\$580
LSD (P<.05)	1.5	1.79	2.16		

\*Based on \$9/bu soybeans, \$15/ac fungicide, \$4/ac insecticide, \$.5/ac NIS and \$7/ac application.

### Discussion:

This trial was designed to primarily emphasis the three treatments: fungicide plus insecticide, fungicide and untreated. As such, those three treatments received priority and were replicated every year of the study. Additional treatments were added on given years as per conversations with the farmer-collaborator. In 2016, there was no statistical difference among all treatments. In 2013 and 2014, only the untreated check was significantly lower than any of the treatments for the respective year.

When looking at the three year average data, one could assume a nominal yield increase for any of the treatments in question, but the increase yield result may or may not be driven by the treatment. Foliar fungicide and insecticide treatments in soybeans should be based on active field scouting and an integrated pest management (IPM) approach. Subjectively speaking, disease and insect pressure was slightly higher in 2013 and 2014 versus that of 2016. Thus a statistically significant yield increase could be expected in those years. However, the economics suggest that at least a 2.5 bushel per acre increase in yield is necessary to justify an application when utilizing standard production costs.

### Acknowledgement

The author expresses appreciation to on-farm collaborator L&L Farms for planting, spraying and harvesting this plot all three years. Thanks to agronomy interns Ben Eggers, Troy Grime and Emily Herring for helping with the data collection on this plot. Thanks to DuPont for providing fungicide product for this trial. This study was supported by the Ohio Soybean Association Research and Education Fund.



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## 10e. Corn Yield Response to Nitrogen Rate (2014-2016)

Eric Richer, Ohio State University Extension Educator, Fulton County

### Objective

To determine the effects of nitrogen rate on corn yield and profitability.

### Background (all farms, all years)

Crop Year: 2014-2016	Soil Test: all in maintenance range or higher
County: Fulton	Starter: all used a blended N-P analysis except 2 sites with only N in starter
Drainage: Systematic, 50' laterals or closer	Rainfall Average (April-September):
Previous Crop: All soybeans except one wheat	2016 – 19.1"
Population: 31,000-35,000 seeds per acre	2015 – 23.5"
Variety: all seed had 2 or more traits	2014 – 14.8"
Tillage: No-till, minimum and conventional	

### Methods

Nitrogen rate trials were set up at thirteen sites over 2014-2016. Generally, trials were set up with four to five treatment rates replicated four times in a randomized complete block design. Rates were in increments of 50 lbs of total nitrogen per acre (0-300 lbs total N per acre). Plots were the width of the collaborating farmers' planters and at least 1,000 feet long (field length). The trials were planted, sprayed and harvested with commercial farm equipment. The treatments were made with commercial nitrogen application equipment. Corn was sidedressed with the balance of the total N rate for each treatment when corn was at vegetative growth stages V3-V6. Corn Stalk Nitrate Tests were conducted at black layer (Graph 3). Yields and moistures were measured using a calibrated yield monitors and shrunk to 15% moisture (Table 1, Graph 1). Rainfall data is based on the average of the active CoCoRaHS stations in Fulton County (Graph 2).

### Results

**Table 1. Corn Yield response to Nitrogen Rate 2014-2016**

Nitrogen Rate	2014 Yield (4 sites)	2015 Yield (5 site)	2016 Yield (4 sites)	Avg Yield (all sites)	Revenue Minus N Cost
(pounds/N)	bushels per acre				(\$/ac)
0	-	76.9	-	76.9	\$269
50	117.9	108.5	140.7	123.6	\$412
100	171.2	84.7	169.8	137.8	\$440
150	183.2	183.2	184.9	169.7	\$531
200	196.5	181.4	184.1	188.5	\$576
250	189.9	192.4	184.5	189.2	\$557
300	-	-	192.4	192.4	\$547
County Average	183.1	161.3	TBD	172.2	-
Ohio Average	176.0	153	TBD	164.5	-

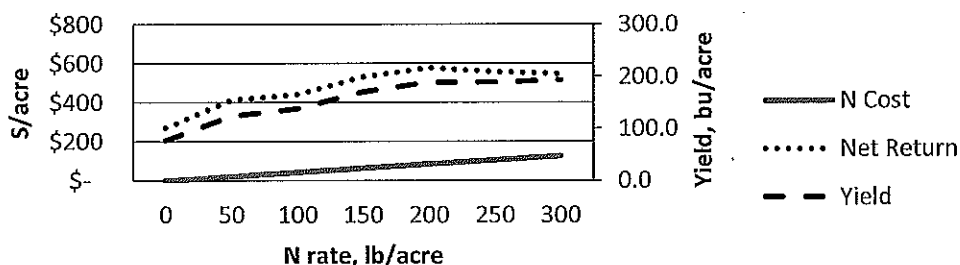
\*Based on \$3.50/bu corn and \$.42/lb N (Source: OSUE 2016 Corn Budget)



## Graph 1. Corn Nitrogen Rate vs. Yield & Economics

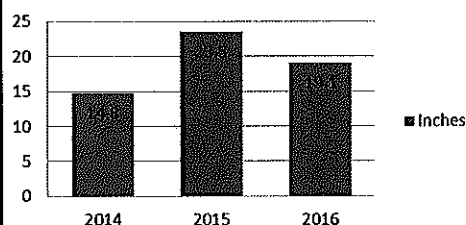
13 sites from 2014-2016 in Fulton County

N cost = \$.42/lb; Corn price = \$3.50



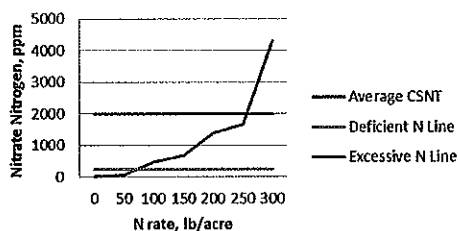
## Graph 2: Rainfall Average Across Sites

April-September growing season



## Graph 3. End of Season Corn Stalk Nitrate Test

n=99 samples



## Discussion

The maximum economic return rate across the average of 13 sites is 200 lbs of total nitrogen for an average yield of 188.5 bu/ac, \$576/ac and a commercial nitrogen use (NUE) rate of 1.06 lbs N/bushel. Agronomic returns continued to increase slightly above the maximum economic return. However, rates above 250 lbs N/ac resulted in excess nitrate-nitrogen in the end of season CSNTs.

Economic optimum nitrogen rates vary greatly by nitrogen cost, corn price, soil type, rainfall timing and amounts, application practices and other factors. Conducting nitrogen rate trials on a specific farm is the best way to determine the economic optimum rate for that farm.

## Acknowledgement

The author expresses appreciation to on-farm collaborators Tom Boger, Ken Clark, Scott Conrad, Matt Eggers, Dave Prentiss, Larry Richer, Les Seiler, Keith Truckor, and Mike Vorwerk for conducting trials. Thanks to summer agronomy interns Ben Eggers, Troy Grime and Emily Herring for assistance with data collection. This project was supported by the Ohio Corn Checkoff Board and the Culman Lab at OARDC in Wooster.



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# 2016 OFR Full Technical Reports



## 1a. Corn Yield Response to Seeding Rate

Eric Richer, Ohio State University Extension Educator, Fulton County

Ben Eggers, Ohio State University Extension, Agronomy Intern, Fulton County

### Objective

To determine effects of corn seeding rate on grain yield and profitability.

### Background

Crop Year: 2016  
County: Fulton  
Location: Fayette, OH  
Drainage: Systematic, 40-50' laterals  
Previous Crop: Soybeans  
Variety: Pioneer 0216  
Planting Date: May 22, 2016  
Harvest Date: October 9, 2016  
Herbicide: Cinch ATZ, Instigate

Soil Type: Blount, Glynwood  
Tillage: strip-tilled with fall fertilizer  
Soil Test (2014): pH 6.1  
P 16 ppm (Bray-P1)  
K 95 ppm  
CEC 8.4 meq/100g  
OM 2.7%  
Applied Fertilizer: 200-65-75/ac  
Rainfall (May-August): 14.7"

### Methods

This trial was designed with five treatments replicated three times in a randomized complete block design. Plots were 12 rows wide (30 ft), by 2250 feet long. All treatments received the same starter fertilizer, herbicide and sidedress nitrogen. The trial was planted, sprayed, sidedressed and harvested with commercial farm equipment. Stand counts were taken prior to harvest by obtaining eight counts per treatment and calculating the simple average. Yields and moistures were measured by using a calibrated Ag Leader yield monitor. Yields were shrunk to 15% moisture. Precipitation data was obtained from the nearest CoCoRaHS station (OH-WL-9).

Treatments:

1. 23,000 seeds per acre
2. 28,000 seeds per acre
3. 33,000 seeds per acre
4. 35,000 seeds per acre
5. 43,000 seeds per acre

### Results: Corn Yield Response to Seeding Rate (All results listed per acre)

Seeding Rate (seeds)	Harvest Stand (plants)	Seed Cost* (\$/ac)	Moisture (%)	Yield (bushels)	Return Minus Seed Cost* (\$/ac)
23,000	22,100	\$79	18.0	191.3 ab	\$590
28,000	27,000	\$96	18.0	193.4 ab	\$581
33,000	33,200	\$114	18.5	191.6 ab	\$557
35,000	33,600	\$120	18.1	195.5 a	\$564
43,000	42,100	\$148	18.6	186.0 b	\$503

LSD (P<.05, CV 2.08)

7.5

\*Based on \$3.44/1,000 seeds and \$3.50 market price (OSUE Corn Production Budget 2016)



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**Discussion:**

There was no statistical significance for yield among the seeding rates 23,000-35,000 seeds per acre. However, there was a significant statistical difference in yield for the highest seeding rate of 43,000 seeds per acre, which yielded 9.5 bushels per acre lower than the highest yielding treatment. According to rainfall data, this site received adequate and timely rains during the 2016 growing season. Further data in the form of multi-year replications will add to the validity of these results.

**Acknowledgement**

The authors express appreciation to on-farm collaborator Les Seiler for his help in planting and harvesting this plot.

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### 3. Corn Yield Response to Fungicide Timing

Eric Richer, Ohio State University Extension Educator, Fulton County

Ben Eggers, Ohio State University Extension, Agronomy Intern, Fulton County

#### Objective

To determine effects of fungicide application timing on grain yield, test weight, harvest moisture and profitability.

#### Background

Crop Year: 2016  
County: Fulton  
Location: Wauseon, OH  
Drainage: Systematic, 40' laterals  
Previous Crop: Soybeans  
Variety: Pioneer 0506AM & 0993HR  
Population: 33,500 seeds per acre  
Planting Date: May 24, 2016  
Harvest Date: November 12, 2016  
Herbicide: Cinch ATZ f.b. Roundup

Soil Type: Rimer, Haskins  
Tillage: In-line ripped fall, field cultivated spring  
Soil Test (grid avg): pH 6.6  
P 75 ppm (Bray-P1)  
K 134 ppm  
CEC 9.1 meq/100g  
OM 2.3%  
Starter Fertilizer: 11-52-90/ac  
Rainfall (May-August): 14.0"

#### Methods

This trial was designed with three treatments replicated four times in a randomized complete block design. The trial was planted, sprayed and harvested with commercial farm equipment and all treatments received the same starter fertilizer, herbicide and sidedress nitrogen. The trial was planted with two varieties, splitting a 16-row planter into two-8 row (varietal) treatments. Treatment 1 received no fungicide (check). Treatment 2 was made with a commercial sprayer with 80' booms and Treatment 3 was made with an airplane with 65' booms. In Treatments 1 & 2, the fungicide rate per acre was the same while the carrier volume differed. Only 8 rows closest to the center of the fungicide treatment were harvested for yield data. Yields and moistures were measured using a calibrated yield monitor and shrunk to 15% moisture. Test weights samples were pulled from every treatment strip and analyzed at the local elevator. Rainfall data was obtained from collaborating farmer's records.

Additionally, 25 ear leaf samples were pulled from each treatment on the day prior to fungicide application to visually evaluate for disease pressure. For the June and August treatments, a visual evaluation indicated less than one percent (<1%) of the surface area was affected by corn foliar disease (Northern Corn Leaf Blight or Grey Leaf Spot).

- Treatments:
1. Check (No Fungicide)
  2. 6.8 oz/ac Aproach Prima application at V5 with a ground sprayer
  3. 6.8 oz/ac Aproach Prima application at VT with an airplane



## Results

### 3a. Corn Yield Response to Fungicide Timing

Fungicide Timing Trial A - Variety P0993HR	Test Weight (lb/bu)	Moisture (%)	Yield (bu/ac)	Return Minus Cost (\$/ac)*
No Fungicide	56.3 a	15.7 b	213.8 a	\$748
V5 (June 21)	56.5 a	15.7 b	218.0 a	\$740
VT (August 1)	56.5 a	15.9 a	218.8 a	\$738
LSD P<.05 (CV)	.86 (.88)	.17 (.61)	10.23 (2.73)	

Fungicide Timing Trial B - Variety P0506	Test Weight (lb/bu)	Moisture (%)	Yield (bu/ac)	Return Minus Cost (\$/ac)*
No Fungicide	58.7 a	15.3 a	204.5 b	\$716
V5 (June 21)	58.5 a	15.4 a	211.8 a	\$718
VT (August 1)	58.8 a	15.4 a	211.3 a	\$711
LSD P<.05 (CV)	.32 (.32)	.13 (.5)	6.51 (1.8)	

\*Based on \$3.50/bu corn, \$16/ac fungicide, \$7/ac ground application at V5, \$12.30/ac aerial application at VT (Source: 2016 Ohio Farm Custom Rates)

### Discussion:

There was no statistical significance for yield among all the treatments in Trial A. However, the untreated check showed a significantly lower yield than either treatment 2 (V5) or treatment 3 (VT) in Trial B. Based on one year of data at this plot, fungicide treatment at V5 or VT resulted in the greatest agronomic yields in both Trials A and B.

Fungicide timing and treatment did not have a significant effect on test weight in either trial. Grain moisture at harvest was significantly higher for treatment 3 (VT) in Trial A but moisture was not significantly impacted by treatment in Trial B.

Ultimately, fungicide treatment to a corn crop should be based on disease pressure and maximum economic return. For this year, disease pressure at V5 and again at VT did not suggest a fungicide was needed. When utilizing standard product costs and application rates, the economics suggest that no fungicide (Trial A) and V5 fungicide (Trial B) provide the greatest economic return. Further data in the form of multi-year or multi-site replications will add to the validity of these results.

### Acknowledgement

The author expresses appreciation to on-farm collaborator John Aeschliman for his help in planting, spraying and harvesting this plot. Thanks also to Mark Gaerte/Gaerte Ag Service for applying the VT application and Jeremy Crouch/DuPont for supplying the Aproach Prima.



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## 5a. Soybean Yield Response to Seeding Rate

Eric Richer, Ohio State University Extension Educator, Fulton County

Ben Eggers, Ohio State University Extension, Agronomy Intern, Fulton County

### Objective

To determine the effects of seeding rate on soybean yield and profitability.

### Background

Crop Year: 2016

County: Fulton

Location: Archbold, OH

Drainage: Random

Previous Crop: Corn

Variety: Rupp 7283

Planting Date: May 23, 2016

Harvest Date: October 7, 2016

Herbicide: 2.3 oz/ac Surveil, 4 oz/ac metrobuzin,  
16 oz/ac 2-4D and 48 oz/ac Glyphosate (Preplant)

32 oz RoundUp PowerMax (Post Emerge)

Soil Type: Pewamo, Blount

Tillage: Minimum fall, No-til into Cereal Rye

Soil Test (grid avg): pH 6.3

P 91 ppm (Bray-P1)

K 297 ppm

CEC 13.3 meq/100g

O.M. 3.8%

Fertility: applied in corn year with VRT

Rainfall (May-Aug): 14.0"

### Methods

In this trial, five soybean seeding rates were replicated four times in a randomized complete block design. Plots were 40 feet, by 2,100 feet long, planted in 15" rows. All treatments received the same tillage and herbicide applications. The trial was planted, sprayed and harvested with commercial farm equipment. Stand counts were taken at growth stage V3 as well as prior to harvest by obtaining eight counts per treatment and calculating the simple average. Plot centers were harvested with a 35 foot grain head. Yields and moistures were obtained by using a calibrated yield monitor. Yields were shrunk to 13% moisture. Rainfall data was obtained from the collaborating farmer's records.

- Treatments:
1. 100,000 seeds per acre
  2. 125,000 seeds per acre
  3. 150,000 seeds per acre
  4. 175,000 seeds per acre
  5. 200,000 seeds per acre



## Results

### 5a. Soybean Yield Response to Seeding Rate (All results listed per acre)

Seeding Rate (seeds)	Stand on 6/24 (plants)	Stand on 7/25 (plants)	Seed Cost* (\$/ac)	Moisture (%)	Yield (bushels)	Return Minus Seed Cost* (\$/ac)
100,000	76,400	76,000	\$43	12.4	60.3 c	\$500
125,000	95,100	93,300	\$54	12.6	61.9 bc	\$503
150,000	99,500	98,800	\$65	12.4	64.6 ab	\$517
175,000	130,000	131,400	\$75	12.6	63.9 ab	\$500
200,000	150,400	148,100	\$86	12.4	66.0 a	\$508

LSD (P&lt;.05, CV 3.7)

3.6

\*Based on \$.43/1,000 seeds and \$9.00 market price (Source: OSUE Soybean Production Budget 2016)

### Discussion:

There was no statistically significant difference in agronomic yield between the 150,000 and 200,000 seeds per acre treatments. However, seeding rates of 125,000 seeds per acre or less yielded significantly lower than those seeded above 150,000 seeds per acre. Based on this trial's economic data, seeding soybeans at 150,000 seeds per acre netted the greatest economic return. Finally, this data shows that soybean fields with a stand of at least 98,800 plants per acre this year could have produced the maximum agronomic yield and economic return. Further data in the form of multi-year replications will add to the validity of these results.

### Acknowledgement

The author expresses appreciation to on-farm collaborators Rufenacht Farms for the planting and harvesting of this plot. This project was supported by the Ohio Soybean Association Research and Education Fund.



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## 6a. Foliar Fungicide, Insecticide and Combination Treatments on Soybean Yield

Eric Richer, Ohio State University Extension Educator, Fulton County

Ben Eggers, Ohio State University Extension, Agronomy Intern, Fulton County

### Objective

To determine effects of corn seeding rate on grain yield and profitability.

### Background

Crop Year: 2016

County: Fulton

Location: Delta, OH

Drainage: Systematic

Previous Crop: Corn

Variety: Pioneer 27T91

Population: 165,000 seeds per acre

Planting Date: May 25, 2016

Harvest Date: October 25, 2016

Herbicide: 6 oz/ac Envive (Pre-emerge) 22 oz/ac

Roundup, 5.3 oz/ac Assure (Post)

Soil Type: Hoytville clay loam

Tillage: Conventional

Soil Test (grid avg): pH 6.7

P 44 ppm (Bray-P1)

K 268 ppm

CEC 16.1 meq/100g

OM 4.6%

Starter Fertilizer: applied in corn year with VRT

Rainfall (May-Aug): 14.0"

### Methods

This trial was designed with four treatments replicated three times in a randomized complete block design. Plots were planted in 15" rows, 40 feet wide by 2500 feet long. The trial was planted, sprayed and harvested with commercial farm equipment. Insect pressure was recorded based on 10 sweeps replicated three times throughout the plot to get a final average insect pressure. Fungicide pressure was recorded by taking 10 plants at random at three replications throughout the plot, then averaged the pressure. Both the insect and fungus pressures were at 1-2%, under the economic thresholds for the crop and pest. Yields and moistures were obtained by using a calibrated yield monitor. Yields were shrunk to 13% moisture. Rainfall data were obtained from the nearest CoCoRaHS/NWS station.

Treatments:

1. 6 oz/ac Aproach fungicide plus 1pt/100 gallons NIS at R2
2. 6 oz/ac Aproach fungicide plus 6 oz/ac Asana insecticide at R2
3. 6 oz/ac Aproach fungicide at R2 growth stage
4. Untreated (Check)



## Results

### 6a. Foliar Fungicide, Insecticide and Combination Treatments on Soybean Yield

Treatment	Moisture (%)	Yield (bu/ac)	Cost* (\$/ac)	Return Minus Cost* (\$/ac)
Approach + NIS	9.7	73.6 a	\$23	\$640
Approach + Asana	9.6	73.8 a	\$26	\$638
Approach	10.0	73.2 a	\$22	\$637
Untreated	9.5	73.0 a	-	\$657
LSD (P<.05, CV 1.47)		2.16		

\*Based on \$9/bu soybean price, \$15/ac fungicide, \$4/ac insecticide, \$.5/ac NIS and \$7/ac application.

### Discussion:

There was no significant difference in yield among all treatments. Based on the standardized costs listed, the maximum economic return of \$657 was achieved with the untreated check.

Foliar fungicide and insecticide treatment on soybeans should be based on active field scouting and an integrated pest management (IPM) approach. Disease and insect pressure indicated in the methods sections did not warrant foliar treatments at this site, this year. Further replications in the form of multi-year data will add to the validity of these results.

### Acknowledgement

The author expresses appreciation to on-farm collaborators Lawrence Onweller and Austin Arps for their help in planting, spraying and harvesting this plot. Thanks also to Jeremy Crouch/DuPont Pioneer for providing fungicide product to the collaborator. This project was supported by the Ohio Soybean Association Research and Education Fund.



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## 7. Wheat plus Second Crop Economics

Eric Richer, Ohio State University Extension Educator, Fulton County

Bruce Clevenger, Ohio State University Extension Educator, Defiance County

Laura Lindsey, Ohio State University Extension State Specialist, Soybean & Wheat Production

### Objective

To determine effects of wheat and soybean grain yield and profitability.

### Background

Crop Year: 2016	Oct. 25, 2016 (Soybeans)
County: Wood	Herbicide: Roundup PowerMaxx and Shadow
Location: Custar, OH	after wheat harvest
Drainage: Systematic, 35' laterals	Soil Type: Hoytville clay loam
Previous Crop: Soybeans	Tillage: Minimal
Varieties: Wheat: Rupp 911	Soil Test (grid avg): pH 7.0
Soybean: Pioneer 31T11	P 34 ppm (Bray-P1)
Red clover: Cisco Gallant	K 196 ppm
Oats: Forage Oats	CEC 16.1 meq/100g
Planting Date: Sept. 28, 2015 (Wheat),	OM 3.8%
May 23, 2016 (Soybean)	Starter Fertilizer: 30-78-78/acre
Harvest Date: July 5, 2016 (Wheat)	

### Methods

This trial was designed with nine treatments replicated four times in a randomized complete block design (See Table 1). Plots were 10 feet wide by 75 feet long. All treatments received the same starter fertilizer, herbicide and topdress nitrogen. The trial was planted, sprayed and harvested with small test plot equipment. Yields and moistures were measured by using a calibrated weigh wagon and commercial moisture tester. Yields were shrunk to 15% moisture.



## Results

**Table 1. Wheat plus Second Crop Economics**

Treatment	Wheat Yield (bu/ac)	Soybean Yield (bu/ac)	Forage Yield (tons/ac)	System Gross Revenue*
1.Soybeans in 15" rows (160,000 seeds/ac)		49.5 a		\$446
2.Frost seed red clover in March (10#/A)			1.5 a	\$75
3. Wheat in 7.5" rows (1.8 M seeds/ac)	88.9 a			\$356
4. Wheat in 15" rows (.9 M seeds/ac)	65.8 c			\$263
5. Wheat in 7.5" rows fb dbl crop soybeans	86.8 a	12.8 b		\$462
6. Wheat in 7.5" rows w/ frost seed clover	78.9 b		1.4 a	\$386
7. Wheat in 15" rows w/MRI soybeans	51.6 d	17.4 b		\$363
8. Wheat in 15" rows w/frost seed clover	70.4 c		1.1 a	\$337
9. Wheat in 7.5" rows fb forage oats	92.6 a		1.8 a	\$460
LSD (P<.05)	6.24	5.41	0.77	
	CV 5.5	CV 11.8	CV 26.6	

\* Based on \$9.00/bu soybeans, \$4.00/bu wheat and \$50/ton forage

### Discussion:

Treatments 3, 5, and 9 resulted in a significantly higher wheat yield than all other treatments. Treatment 1 resulted in the significantly highest soybean yield of the three treatments with soybeans. All of the forage treatments resulted in no statistical yield difference.

After an economic calculation using standard prices, treatments 5 and 9 resulted in the greatest economic return for 2016. Treatment 2 resulted in the lowest economic return of all treatments in 2016.

This trial is a three year trial that will be repeated in 2017 and 2018. Corn yield impact in the year following will also be evaluated from 2017-2019.

### Acknowledgement

The authors express appreciation to Matt Davis at OARDC Northwest Branch for conducting this trial. Thanks to agronomy intern Ben Eggers for helping with the data collection on this plot. This trial is supported by the Ohio Small Grains Marketing Program and the Michigan Wheat Program..



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## 8. Wheat plus Interseeded Soybeans

Eric Richer, Ohio State University Extension Educator, Fulton County

### Objective

To determine effects of wheat and soybean grain yield and profitability.

### Background

Crop Year: 2016	Fungicide: Prosaro in wheat
County: Fulton	Soil Type: Hoytville, Nappanee
Location: Pettisville, OH	Tillage: Minimal
Drainage: Systematic, 35' laterals	Soil Test (grid avg): pH 6.3
Previous Crop: Soybeans	P 68 ppm (Bray-P1)
Variety: Rupp 9exp011	K 240 ppm
Population:	CEC 15.9 meq/100g
Planting Date: Sept. 19, 2015 (Wheat)	OM 4.7%
May 23, 2016 (Soybean)	Starter Fertilizer: 30-65-75
Harvest Date: July 5, 2016 (Wheat)	Rainfall (May-August): 14.1"
October 24, 2016 (Soybean)	
Herbicide: Roundup PowerMaxx (Soybeans)	

### Methods

This trial was designed with three treatments replicated four times in a randomized complete block design. Plots were 15 feet, by 500 feet long. All treatments received the same starter fertilizer, herbicide and topdress nitrogen. The trial was planted, sprayed and harvested with commercial farm equipment. Yields and moistures were measured by using a calibrated weigh wagon. Yields were shrunk to 15% moisture (wheat) and 13% moisture (soybeans). Precipitation data was obtained from the nearest CoCoRaHS station (OH-FL-2).

#### Treatments:

1. Drilled wheat planted at 1.6 million seeds per acre, and 15" row soybeans planted at 200,000 seeds per acre
2. 15" wheat planted at 800,000 seeds per acre, and 15" row soybeans planted at 200,000 seeds per acre
3. Drilled wheat with tramlines planted at 1.4 million seeds per acre, and 15" row soybeans planted at 200,000 seeds per acre



## Results

**Table 1. Wheat plus Interseeded Soybeans**

Treatment	Wheat Population (million seeds/ac)	Wheat Seed Cost** (\$/ac)	Wheat Yield (bu/ac)	Soybean Seed Cost** (\$/ac)	Soybean Yield (bu/ac)	Revenue Minus Seed Costs* (\$/ac)
1. Drilled wheat & double crop soybeans	1.6	\$49.6	91.5 a	\$86	42.2 a	\$610
2. 15" wheat & MRI 15" soybeans at boot	0.8	\$24.8	82.3 b	\$86	18.5 b	\$384
3. Drilled w/tramlines wheat & MRI 15" soybeans at boot	1.4	\$43.4	80.6 b	\$86	18.9 b	\$363
LSD (P<.05, CV 4.29 & 1.84)			6.3		5.43	

\*Soybeans were all planted at about 200,000 seeds per acre

\*\* Based on \$.42 & \$.031 per 1000 seeds (Source: OSU Soybean & Wheat Budget 2016)

### Discussion:

The drilled wheat followed by double crop soybeans showed the highest statistically significant yield among the treatments in this trial in 2016. Economics strongly support treatment 1. Interseeded soybeans in treatments 2 and 3 did not get planted at an ideal depth in this trial. Additionally, late season rains (August) strongly favored double crop beans in 2016. Further data in the form of multi-year replications will add to the validity of these results.

### Acknowledgement

The author expresses appreciation to on-farm collaborator Rupp Seed/John King for his help in planting and harvesting this plot and use of a weigh wagon. Thanks to agronomy intern Ben Eggers for helping with the data collection on this plot. Thanks to Lawrence Onweller for the use of his bean planter. Thanks to Michigan Center For Excellence for the supporting this trial.



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## 10a. Corn Yield Response to Nitrogen Rate - Delta

Eric Richer, Ohio State University Extension Educator, Fulton County, Ohio

### Objective

To determine the effects of nitrogen rate on corn grain yield and profitability.

### Background

Crop Year: 2016  
County: Fulton  
Location: Delta, Ohio  
Drainage: systematic  
Previous Crop: Wheat  
Variety: SQC 108  
Population: 32,000 seeds per acre  
Plant Date: May 19, 2016  
Harvest Date: October 31, 2016  
Herbicide: Accuron f,b, Roundup  
Soil Type: Wauseon, Mermill

Tillage: No-till  
Soil Test (grid avg): pH 5.4  
P 33 ppm (Bray-P1)  
K 140 ppm  
O.M. 2.6%  
CEC 8.5 meq/100g  
Starter Fertilizer: 66-20-90-5S-3B  
Pre-Sidedress Nitrogen Test: 7 ppm NO<sub>3</sub>-N  
Nitrogen Source: Anhydrous Ammonia  
Rainfall (May – August): 11.6"

### Methods

Four corn nitrogen rates were replicated four times in a randomized complete block design. Plots were 12 rows wide (30 ft), by 1200 feet long. The trial was planted, sprayed and harvested with commercial farm equipment. The treatments were made with commercial nitrogen application equipment. All treatment received 66 units of nitrogen at plant (planter applied + pre-emerge herbicide program). Corn was sidedressed with the balance of the total N rate for the trial when corn was at vegetative growth stage 6 (V6). At approximately 5-10 days after black layer, a corn stalk nitrate test (CSNT) was taken by averaging 1 test of 12 stalks for every treatment replication (4 tests for each treatment). Yields and moistures were measured using a calibrated yield monitor and shrunk to 15% moisture. Rainfall data was recorded by farmer at field level.

Treatments:

1. 90 lbs. Total N/acre
2. 150 lbs. Total N/acre
3. 210 lbs. Total N/acre
4. 270 lbs. Total N/acre

### Results

**Table 1. Corn Yield Response to Nitrogen Rate - Delta**

Nitrogen Rate (lbs/ac)	Yield (bu/ac)	NUE (lb N/bu)	CSNT (ppm nitrate N)	Return Minus N Cost* (\$/ac)
90	180.8 a	0.50	158	\$595
150	194.5 a	0.77	1592	\$618
210	183.9 a	1.14	1551	\$555
270	178.6 a	1.51	3030	\$512

LSD (P<.05, CV 6.39) 18.85

\*Based on \$3.50/bu corn and \$.42/lb N (Source: OSUE 2016 Corn Budget)



Table 2. Nitrate Concentration Categories		
Nitrate-Nitrogen ppm	Rating	Interpretations <sup>+</sup>
Less than 250	Low	Nitrogen was likely yield limiting during the growing season, especially if the test result is less than 250 ppm.
250-2,000	Optimal	Grain yield was not limited by the amount of nitrogen available to the crop. <i>Note</i> : the high end of this category is appropriate when nitrogen prices are low and corn prices high. The low end of this category is appropriate when nitrogen prices are high and corn prices low.
Greater than 2,000	Excess	Excessive nitrogen available to the crop, or some other production factor limited crop growth and yield.
<sup>+</sup> Corn Stalk Nitrate Tests-Research and Recommendation Update, Purdue University, 15 September 2014.		

### Discussion:

There was no statistically significant difference for yield among the four nitrogen rates. CSNTs indicate that optimal nitrate-N concentrations were achieved at the 150 and 210 lb. rates and excess nitrate-N concentrations at the 270 lb. rate. A CSNT for the lowest rate of 90 lbs Total N/acre was most likely yield limiting.

A standard economics calculation shows that the maximum economic return rate is 150 lbs of total nitrogen, netting \$618/acre after nitrogen cost. At the economic optimum rate, the commercial nitrogen use efficiency (NUE) proved to be .77 lb of nitrogen per bushel of corn.

Economic optimum nitrogen rates vary greatly by nitrogen cost, corn price, soil type, rainfall timing and amounts, application practices and other factors. Conducting nitrogen rate trials on a specific farm is the best way to determine the economic optimum rate for that farm.

### Acknowledgement

The author wishes to express appreciation to on-farm collaborator Prentiss Farms for conducting this trial. Thanks to agronomy intern Ben Eggers for assistance with data collection. Thanks to Dr. Steve Culman and Anthony Fulford at OARDC for processing CSNT tests and to the Ohio Corn Checkoff Board for supporting this research.

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## 10b. Corn Yield Response to Nitrogen Rate - Ridgeville

Ben Eggers, Ohio State University Extension Agronomy Intern, Fulton County, Ohio

### Objective

To determine the effects of nitrogen rate on corn grain yield and profitability.

### Background

Crop Year: 2016	Soil Type: Hoytville
County: Henry	Tillage: No-till into Cereal Rye
Location: Napoleon, Ohio	Soil Test (grid avg): pH 6.5
Drainage: systematic, 30' laterals	P 52 ppm (Bray-P1)
Previous Crop: Soybeans	K 225 ppm
Variety: Pioneer P0993	O.M. 4.2%
Population: 34,800 seeds per acre	CEC 13.9 meq/100g
Plant Date: May 24, 2016	Starter Fertilizer: 48-0-0
Harvest Date: November 10, 2016	Pre-Sidedress Nitrogen Test: 5 ppm NO <sub>3</sub> -N
Herbicide: Abunbit, CinchATZ, Shredder	Nitrogen Source: 28% UAN
Fungicide: 6 oz/ac Approach at VT	Rainfall (May – August): 13.5"

### Methods

Five corn nitrogen rates were replicated four times in a randomized complete block design. Plots were 12 rows wide (30 ft), by 650 feet long. The trial was planted, sprayed and harvested with commercial farm equipment. The treatments were made with commercial nitrogen application equipment. All treatment received 48 units of nitrogen at plant (planter applied + pre-emerge). The balance of the nitrogen was applied at sidedress at growth stage V5-V6. A corn stalk nitrate test (CSNT) was taken by averaging 1 test of 12 stalks for every treatment replication (4 tests for each treatment) at black layer. Yields and moistures were measured using a calibrated yield monitor and shrunk to 15% moisture. Rainfall data was recorded by farmer at field level.

Treatments:	1. Check (Zero/low Rate)
	2. 80 lbs Total N/acre
	3. 140 lbs N/acre
	4. 200 lbs N/acre
	5. 260 lbs N/acre

### Results

**Table 1. Corn Yield Response to Nitrogen Rate - Ridgeville**

Nitrogen Rate (lbs/ac)*	Yield (bu/ac)	NUE (lbN/bu)	CSNT (ppm nitrate N)	Return Minus N Cost** (\$/ac)
48	122.2 c	0.39	43	\$408
80	148.6 b	0.54	1912	\$487
140	178.7 a	0.78	617	\$567
200	180.9 a	1.11	2469	\$549
260	180.2 a	1.44	2588	\$522

LSD (P<.05, CV 3.52) 9.69

\* 48 lbs/ac rate was unreplicated, planter applied only; rate not used in discussion.

\*\*Based on \$3.50/bu corn and \$.42/lb N (Source: OSUE 2016 Corn Budget)



**Table 2. Nitrate Concentration Categories**

Nitrate-Nitrogen ppm	Rating	Interpretations <sup>+</sup>
Less than 250	Low	Nitrogen was likely yield limiting during the growing season, especially if the test result is less than 250 ppm.
250-2,000	Optimal	Grain yield was not limited by the amount of nitrogen available to the crop. <i>Note</i> : the high end of this category is appropriate when nitrogen prices are low and corn prices high. The low end of this category is appropriate when nitrogen prices are high and corn prices low.
Greater than 2,000	Excess	Excessive nitrogen available to the crop, or some other production factor limited crop growth and yield.
<sup>+</sup> <i>Corn Stalk Nitrate Tests-Research and Recommendation Update</i> , Purdue University, 15 September 2014.		

## Discussion

This trial showed that there was a no significant difference in yield among the 140-260 lb/acre rates in 2016. However, there was a statistically significant difference between the highest three rates and the 80 lb/acre rate. A CSNT indicates that optimal nitrate-N concentrations were achieved at the 80-140 lb/ac rates and that excess nitrogen was available to the crop at the 200-260 lb/ac rates. A CSNT for the lowest rate of 48 lb/acre indicates the rate was most likely yield limiting. Limited rainfall in the early-mid growing season could have limited nitrogen uptake and thus yield in this trial.

A standard economics calculation shows that the maximum economic return rate for this site is 140 lbs/ac of total nitrogen, netting \$567/acre after nitrogen cost. At the economic optimum rate, the commercial nitrogen use efficiency (NUE) proved to be .78 lb of nitrogen per bushel of corn.

Economic optimum nitrogen rates vary greatly by nitrogen cost, corn price, soil type, rainfall timing and amounts, application practices and other factors. Conducting nitrogen rate trials on a specific farm is the best way to determine the economic optimum rate for that farm.

## Acknowledgement

The author wishes to express appreciation to on-farm collaborator Matt Eggers for conducting this trial. Thanks to agronomy intern Ben Eggers for assistance with data collection. Thanks to the Culman Lab at OARDC for processing CSNT tests and to the Ohio Corn Checkoff Board for supporting this research.

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## 10c. Corn Yield Response to Nitrogen Rate - Metamora

Eric Richer, Ohio State University Extension Educator, Fulton County, Ohio

### Objective

To determine the effects of nitrogen rate on corn grain yield and profitability.

### Background

Crop Year: 2016	Tillage: Fall disc rip f.b. spring finisher
County: Fulton	Soil Test (grid avg): pH 5.7
Location: Metamora, Ohio	P 31 ppm (Bray-P1)
Drainage: systematic, 40' laterals	K 123 ppm
Previous Crop: Soybeans	O.M. 2.1%
Variety: Great Lakes 5470	CEC 6.9 meq/100g
Population: 34,200 seeds per acre	Starter Fertilizer: 21-31-150/ac
Plant Date: May 8, 2016	Pre-Sidedress Nitrogen Test: 9 ppm NO <sub>3</sub> -N
Harvest Date: October 24, 2016	Nitrogen Source: Anhydrous Ammonia
Herbicide: Capreno and Atrazine (Post-emerge)	Rainfall (May – August): 14.3"
Soil Type: Brady, Millgrove	

### Methods

Five corn nitrogen rates were replicated four times in a randomized complete block design. Plots were 16 rows wide (40 feet) by 1320 feet long. The trial was planted, sprayed and harvested with commercial farm equipment. The treatments were made with commercial nitrogen application equipment. All treatment received 21 units of nitrogen at plant and the balance of the total nitrogen rate at sidedress during growth stage V5-V6. A corn stalk nitrate test (CSNT) was taken for every replication and then averaged. Yields and moistures were measured using a calibrated yield monitor and shrunk to 15% moisture. Precipitation data was recorded by farmer.

Treatments:	1. Check (Zero/Low Rate)
	2. 75 lbs Total N/ac
	3. 150 lbs Total N/ac
	4. 225 lbs Total N/ac
	5. 300 lbs Total N/ac

### Results

#### 10c. Corn Yield Response to Nitrogen Rate - Metamora

Nitrogen Rate (lbs/ac)*	Yield (bu/ac)	NUE (lbN/bu)	CSNT (ppm nitrate N)	Return Minus N Cost** (\$/ac)
21	135.0 e	0.16	73	\$464
75	164.8 d	0.46	56	\$545
150	181.5 c	0.83	124	\$572
225	187.0 b	1.20	532	\$560
300	193.0 a	1.55	775	\$550

LSD (P<.05, CV 1.23) 3.56

\* 21 lbs/ac rate was unreplicated, planter applied only; not used in discussion.

\*\*Based on \$3.50/bu corn and \$.42/lb N (Source: OSUE 2016 Corn Budget)



**Table 2. Nitrate Concentration Categories**

Nitrate-Nitrogen ppm	Rating	Interpretations <sup>†</sup>
Less than 250	Low	Nitrogen was likely yield limiting during the growing season, especially if the test result is less than 250 ppm.
250-2,000	Optimal	Grain yield was not limited by the amount of nitrogen available to the crop. <i>Note</i> : the high end of this category is appropriate when nitrogen prices are low and corn prices high. The low end of this category is appropriate when nitrogen prices are high and corn prices low.
Greater than 2,000	Excess	Excessive nitrogen available to the crop, or some other production factor limited crop growth and yield.

<sup>†</sup>Corn Stalk Nitrate Tests-Research and Recommendation Update, Purdue University, 15 September 2014.

### Discussion:

There was a statistical significant difference for yield among the 4 replicated nitrogen rates at this site in 2016. The highest statistically significant yield was 193 bu/ac using a total nitrogen rate of 300 lbs/ac. The lowest statistically significant replicated yield was 164.8 bu/ac using a total nitrogen rate of 75 lbs/ac. A CSNT indicates that optimal nitrate-N concentrations were achieved at the 225-300 lbs/ac rate, but rates of 150 lbs/ac and lower could have been yield limiting.

However, a standard economics calculation shows that the maximum economic return rate is 150 lbs of total nitrogen, netting \$572/acre after nitrogen cost. At the economic optimum rate, the commercial nitrogen use efficiency (NUE) proved to be .83 lb of nitrogen per bushel of corn.

Economic optimum nitrogen rates vary greatly by nitrogen cost, corn price, soil type, rainfall timing and amounts, application practices and other factors. Conducting nitrogen rate trials on a specific farm is the best way to determine the economic optimum rate for that farm.

### Acknowledgement

The author wishes to express appreciation to on-farm collaborator Scott Conrad for conducting this trial. Thanks to agronomy intern Ben Eggers for assistance with data collection. Thanks to the Culman Lab at OARDC for processing CSNT tests and to the Ohio Corn Checkoff Board for supporting this research.

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## 10d. Corn Yield Response to Nitrogen Rate - Lyons

Eric Richer, Ohio State University Extension Educator, Fulton County, Ohio

### Objective

To determine the effects of nitrogen rate on corn grain yield and profitability.

### Background

Crop Year: 2016	Soil Type: Blount, Mermill
County: Fulton	Tillage: Fall chisel f.b. spring finisher
Location: Lyons, Ohio	Soil Test (grid avg): pH 6.2
Drainage: Random	P 50 ppm (Bray-P1)
Previous Crop: Corn	K 127 ppm
Variety: Dekalb 4812	O.M. 2.8%
Population: 33,300 seeds per acre	CEC 9.4 meq/100g
Plant Date: April 24, 2016	Starter Fertilizer: 84-0-72/ac
Harvest Date: October 15, 2016	Pre-Sidedress Nitrogen Test: 18 ppm NO <sub>3</sub> -N
Herbicide: Triple Flex and Atrazine (Pre-emerge)	Rainfall (May – August): 11.6"

### Methods

Five corn nitrogen rates were replicated four times in a randomized complete block design. Plots were 16 rows wide (40 feet) by 2000 feet long. The trial was planted, sprayed and harvested with commercial farm equipment. The treatments were made with commercial nitrogen application equipment. All treatment received 84 units of nitrogen at plant (planter applied + pre-emerge). Corn was sidedressed with the balance of the total N rate for the trial when corn was at vegetative growth stage V5-V6. A corn stalk nitrate test (CSNT) was taken by averaging 1 test of 12 stalks for every treatment replication (4 tests for each treatment) at black layer. Yields and moistures were measured using a calibrated yield monitor and shrunk to 15% moisture. Rainfall data was recorded by farmer at field level.

- Treatments:
1. 84 lbs Total N/ac (Zero/Low Rate))
  2. 165 lbs Total N/ac
  3. 180 lbs Total N/ac
  4. 230 lbs Total N/ac
  5. 280 lbs Total N/ac

### Results

#### 10d. Corn Yield Response to Nitrogen Rate - Lyons

Nitrogen Rate (lbs/ac)*	Yield (bu/ac)	NUE (lb N/bu)	CSNT (ppm nitrate N)	Return Minus N Cost** (\$/ac)
84	180.0 c	0.47	114	\$595
165	184.7 b	0.89	1528	\$577
180	184.7 b	0.97	2058	\$571
230	192.3 a	1.20	2048	\$576
280	191.7 a	1.46	5556	\$553

LSD (P<.05, CV 1.23) 3.56

\* 84 lbs/ac rate was unreplicated, planter applied only; not used in yield discussion.

\*\*Based on \$3.50/bu corn and \$.42/lb N (Source: OSUE 2016 Corn Budget)



Table 2. Nitrate Concentration Categories

Nitrate-Nitrogen ppm	Rating	Interpretations <sup>+</sup>
Less than 250	Low	Nitrogen was likely yield limiting during the growing season, especially if the test result is less than 250 ppm.
250-2,000	Optimal	Grain yield was not limited by the amount of nitrogen available to the crop. <i>Note</i> : the high end of this category is appropriate when nitrogen prices are low and corn prices high. The low end of this category is appropriate when nitrogen prices are high and corn prices low.
Greater than 2,000	Excess	Excessive nitrogen available to the crop, or some other production factor limited crop growth and yield.

<sup>+</sup>Corn Stalk Nitrate Tests-Research and Recommendation Update, Purdue University, 15 September 2014.

### Discussion:

This trial showed that there was a significant difference in yield between the 230-280 lbs/ac rates and the 165-180 lbs/ac rates in 2016. The higher rates produced an additional 7 bu/ac of yield over the the 165-180 lbs/ac rates. A CSNT indicates that optimal nitrate-N concentrations were achieved at the 165 lbs/ac rate and that excess nitrogen was available to the crop at the 180-280 lbs/ac rates. A CSNT for the lowest rate of 84 lbs/ac indicates the rate was most likely yield limiting. Limited rainfall in the early-mid growing season could have limited nitrogen uptake and thus yield in this trial.

A standard economics calculation shows that the maximum economic return rate (replicated) is 165 lbs of total nitrogen/acre, netting \$577/acre after nitrogen cost. At the economic optimum rate, the commercial nitrogen use efficiency (NUE) proved to be .89 lb of nitrogen per bushel of corn.

Economic optimum nitrogen rates vary greatly by nitrogen cost, corn price, soil type, rainfall timing and amount, application practices and other factors. Conducting nitrogen rate trials on a specific farm is the best way to determine the economic optimum rate for that farm.

### Acknowledgement

The authors express appreciation to on-farm collaborator Tom Boger for conducting this trial. Thanks to agronomy intern Ben Eggers for assistance with data collection. Thanks to the Culman Lab at OARDC for processing CSNT tests and to the Ohio Corn Checkoff Board for supporting this research.

For more information on this trial, contact:  
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## 11a. Corn Yield Response to Starter Phosphorus

Eric A. Richer, Ohio State University Extension Educator, Fulton County

### Objective

To evaluate corn yield response to starter phosphorus.

### Background

Crop Year: 2016	Herbicide: Cinch ATZ f.b. glyphosate
County: Fulton	Soil Type: Bixler, Mermill
Location: Delta, OH	Tillage: Conventional
Drainage: Systematic	Soil Test (grid avg): pH 6.4
Previous Crop: Soybeans	P 33 ppm (Bray-P1)
Varieties: Pioneer 0157, Pioneer 0506	K 107 ppm
Population: 33,000 seeds per acre	O.M. 2.7%
Planting Date: April 25, 2016	CEC 7.6 meq/100g
Harvest Date: October 6, 2016	Rainfall (May-August): 14.1"

### Methods

Three corn phosphorus starter rates were replicated four times in a randomized complete block design. Plots were 16 rows wide (40 feet) by 1200 feet long. In this trial, the planter was split to include two varieties. The trial was planted, sprayed, sidedressed and harvested with commercial farm equipment. The yield goal on this farm was 200 bushels per acre. In order to ensure nitrogen rates and timing was consistent, the starter mixtures were nitrogen-balanced at planting so that all treatments began with 24 lbs N/ac. The base for starter was 11-25-0 liquid and additional N was added to dilute treatment 2. Only 28% UAN was used in treatment 1. All treatments received 165 lbs N/acre at sidedress (V3-V4), for a total nitrogen rate of 189 lbs/acre. Yields and moistures were measured using a calibrated yield monitor and shrunk to 15% moisture. Rainfall data was sourced from the Wauseon Water Treatment Plant.

#### Treatments

- 1) 0% Starter Rate – 0 gal/ac (Net: 24-0-0 per acre)
  - a. Recipe: 8 gal 28-0-0 plus 12 gal water
- 2) 50% Starter Rate – 10 gals/ac (Net: 24-28-0 per acre)
  - a. Recipe: 10 gal 11-25-0 plus 4 gal 28-0-0 plus 6 gal water
- 3) 100% Starter Rate – 20 gals/ac (Net: 24-56-0 per acre)
  - a. Recipe: 20 gal 11-25-0



## Results

**Table 1 - Corn Yield Response to Starter Phosphorus - Delta**

Starter P Rate – Trial A, P0157 (lbs P/ac)	Starter P Rate (gal/ac of 11-25-0)	Yield (bu/ac)	Return Minus P Cost* (\$/ac)
0	-	181.2 a	\$634
28	10	179.1 a	\$608
56	20	184.2 a	\$608
LSD (P<.05, CV 3.75)		11.79	
Starter P Rate – Trial B, P0506 (lbs P/ac)	Starter P Rate (gal/ac of 11-25-0)	Yield (bu/ac)	Return Minus P Cost* (\$/ac)
0	-	192.1 a	\$672
28	10	199.8 a	\$681
56	20	193.7 a	\$641
LSD (P<.05, CV 4.41)		14.9	

\*Based on \$3.50/bu corn and \$.66/lb P (Source: OSUE 2016 Corn Budget)

## Discussion

There was no statistically significant difference in grain yield among all rates across either Trial A or B in 2016. This site received lower than average rainfall through July and the month of May was generally cooler and wetter than average. As such, these weather conditions could have had an impact on yield results.

Standard economic calculations show that reduced rates of starter phosphorus can produce maximum economic returns. Further research in the form of multi-year replications would add to the validity of these results.

## Acknowledgement

The author expresses appreciation to L & L Farms as the cooperating farmer, Tim Barney for help with data processing, Davis Farm Services for assistance in blending the starter solutions and to agronomy intern Ben Eggers for helping with data collection on these trials. Thanks to the Culman Lab at OARDC in Wooster and Ohio Corn Checkoff Board for supporting this research.

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## 11b. Corn Yield Response to Starter Phosphorus

Eric A. Richer, Ohio State University Extension Educator, Fulton County

### Objective

To evaluate the yield response to starter phosphorus.

### Background

Crop Year: 2016	Herbicide: Bicep II Magnum
County: Fulton	Soil Type: Latty, Fulton clay
Location: Pettisville, OH	Tillage: Conventional
Drainage: Systematic, 25' laterals	Soil Test (5/2016): pH 6.3
Previous Crop: Soybeans	P 33 ppm (Bray-P1)
Variety: Rupp A03-91	K 263 ppm
Population: 32,480 seeds per acre	CEC 15.1 meq/100g
Planting Date: May 18, 2016	O.M. 3.7%
Harvest Date: October 24, 2016	Rainfall (May-August): 10.9"

### Methods

Three corn phosphorus starter rates were replicated four times in a randomized complete block design. Plots were 6 rows wide (15 feet) by 1200 feet long. The trial was planted, sprayed, sidedressed and harvested with commercial farm equipment. The yield goal on this farm was 170 bushels per acre. In order to ensure nitrogen rates and timing was consistent, the starter mixtures were nitrogen-balanced at planting so that all treatments began with 42 lbs N/ac. The base for starter was 10-34-0 liquid and additional N was added to dilute treatment 2. Only 28% UAN was used in treatment 1. All treatments received 150 lbs N/acre at sidedress (V3-V4), for a total nitrogen rate of 192 lbs/acre. Yields were measured using a weigh wagon and moistures calculated with a commercial moisture tester and shrunk to 15% moisture. Rainfall data was sourced from CoCoRaHS station OH-FL-11 in Wauseon, Ohio.

#### Treatments

1. 0% Starter Rate – 0 gal/ac (Net: 42-0-0 per acre)
  - a. Recipe: 14 gal 28-0-0 plus 6 gal water
2. 50% Starter Rate – 10 gals/ac (Net: 42-20-0 per acre)
  - a. Recipe: 5 gal 10-34-0 plus 12 gal 28-0-0 plus 3 gal water
3. 100% Starter Rate – 20 gals/ac (Net: 42-40-0 per acre)
  - a. Recipe: 10 gal 10-34-0 plus 10 gal 28-0-0



## Results

**Table 1. Corn Yield Response to Starter Phosphorus - Pettisville**

Starter P Rate (lbs/ac)	Starter P Rate (gal/ac of 10-34-0)	Yield (bu/ac)	Return Minus P Cost* (\$/ac)
0	-	143.9 a	\$504
20	5.0	140.5 a	\$479
40	10.1	140.5 a	\$465

LSD (P<.05, CV 2.73) 26.68

\*Based on \$3.50/bu corn and \$.66/lb P (Source: OSUE 2016 Corn Budget)

## Discussion

There was no statistically significant difference in grain yield among all rates of starter P in 2016. This site received lower than average rainfall through July and the month of May was generally cooler and wetter than average. As such, these weather conditions had an impact emergence and yield results.

Standard economic calculations show that reduced rates of starter phosphorus can produce maximum economic returns. Further research in the form of multi-year replications would add to the validity of these results.

## Acknowledgement

The author expresses appreciation to Josiah Hoops as the cooperating farmer, Gerald Grain Agronomy for assistance in blending the starter solutions, Rupp Seed for use of the weigh wagon and to agronomy intern Ben Eggers for helping with data collection on this trial. Thanks to the Culman Lab at OARDC in Wooster and Ohio Corn Checkoff Board for supporting this research.

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## 12. Soybean Yield Response to Foliar Fertilizer

Eric Richer, Ohio State University Extension Educator, Fulton County

### Objective

To determine the effects of foliar fertilizer on soybean yield and profitability.

### Background

Crop Year: 2016  
County: Fulton  
Location: Metamora, Ohio  
Drainage: Systematic, 40' laterals  
Previous Crop: Corn  
Variety: Asgrow 2836  
Population: 170,000  
Planting Date: May 28, 2016  
Harvest Date: October 7, 2016  
Herbicide: Roundup, Sharpen, metribuzin

Soil Type: Hoytville clay loam  
Tillage: No-till  
Soil Test: pH 6.6  
P 30 ppm (Bray-P1)  
K 200 ppm  
CEC 14.2  
O.M. 3.8%  
Starter Fertilizer: applied VRT in corn year  
Rainfall (May - August): 13.1"

### Methods

There are many foliar fertilizer products available to producers. One such product is Finish Line (Nachurs) which has .8 lb N-.4 lb P- .6 lb K with trace amounts of boron, copper, manganese, and zinc. A one quart/acre rate of Finish Line nets .2 lb N, .1 lb P, .15 lbs K per acre.

This research trial included a treatment with foliar fertilizer and a check treatment without. Both treatments were replicated four times in alternating strips in a complete block design. Plots were approximately 750 feet long by 90 feet wide. Soybean variety was Asgrow 2836. All other fertilizer, tillage, and herbicide operations were the same across treatments. Foliar fertilizer treatments were sprayed at a rate of 1 quart/acre at soybean growth stage R1 on June 29, with a 90 foot sprayer. Plot centers were harvested with a commercial combine, and yield data were collected with a calibrated Greenstar 3 yield monitor and calculated at 13% moisture content (Dry Yield). Weather data were obtained from CoCoRaHS (OH-LS 23 station).

- Treatments:
1. Check strip with no foliar fertilizer
  2. Finishline

### Results

**Table 1. Soybean Response to Foliar Sulfur**

Treatment	Yield (bu/ac)	Return Minus Foliar Cost (\$/ac)
Check	66.8 a	\$601
Finishline	67.3 a	\$594
LSD (P<.05, CV 1)	1.51	

\*Based on \$9/bu soybeans, \$4.50/ac for foliar sulfur product, \$7/ac for application (Source: 2016 OSUE Custom Farm Rates)



**Discussion:**

The research data showed no statistically significant difference in yield across the treatments in 2016. A standard economic calculation shows that the untreated check returned the greatest amount at \$601/acre. Further data in the form of multi-year replications will add to the validity of these results.

**Acknowledgement**

The author expresses appreciation to on-farm collaborator Keith Truckor for the planting, spraying and harvesting of this plot. Thanks to summer agronomy intern Ben Eggers for assistance with data collection and to Nachurs/Tommy Roach for providing the product for this trial. This project was supported by the Culman Lab at OARDC in Wooster and the Ohio Soybean Association Research and Education Fund.

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**THE OHIO STATE UNIVERSITY**

COLLEGE OF FOOD, AGRICULTURAL,  
AND ENVIRONMENTAL SCIENCES

## 14a. Comparison of Swine Manure, Beef Manure and 28% as Nitrogen Sources at Sidedress for Corn Yield

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 Eric Richer, Ohio State University Extension Educator, Fulton County, Ohio  
 Ben Eggers, Ohio State University Extension Agronomy Intern, Fulton County, Ohio

### Objective

To compare corn yield response to nitrogen applied at side-dress as incorporated swine manure, incorporated beef manure and incorporated 28% UAN.

### Background

Crop Year: 2016  
 County: Fulton  
 Location: Wauseon, Ohio  
 Drainage: Systematic, 25' laterals  
 Previous Crop: Soybeans  
 Variety: Rupp D05-04  
 Population: 37,000 seeds per acre  
 Plant Date: May 18, 2016  
 Harvest Date: October 26, 2016  
 Herbicide: Bicep II Magnum

Soil Type: Nappanee, Hoytville clay loam  
 Tillage: Conventional  
 Soil Test (grid avg): pH 6.1  
 P 231 ppm (Bray-P1)  
 K 347 ppm  
 O.M. 4.2%  
 CEC 15.4 meq/100g  
 Starter Fertilizer: 51-20-0  
 Pre-Sidedress Nitrogen Test: 27 ppm NO<sub>3</sub>-N  
 Rainfall (May – August): 14.1"

### Methods

This trial was designed with three treatments of sidedress nitrogen sources replicated four times in an alternating block design. Plots were 6 rows wide (15 feet) by 1100 feet long. The trial was planted, sprayed and harvested with commercial farm equipment. The nitrogen treatment was made with a commercial 28% applicator using knife injection. The manure was sidedressed using a 5,200 gallon Balzer tanker with Dietrich shanks that incorporated the manure to a depth of 5 inches. All treatments received 51 units of nitrogen at plant (planter applied + pre-emerge). Manure samples were taken from tank and analyzed at a commercial lab. This swine manure had a nutrient analysis of 25-11-33 per 1,000 gallons and the beef manure had a nutrient analysis of 41-26-30 per 1,000 gallons. The sidedress application rate goals were 5,000 gallons/acre of swine manure, 4,000 gallons/acre of beef manure and 50 gallons/acre of 28% UAN. A corn stalk nitrate test (CSNT) was taken for every replication and then averaged. Yields were determined using a weigh wagon and a calibrated moisture tester and then shrunk to 15% moisture. Precipitation data was recorded by farmer.

#### Treatments:

1. Liquid swine manure at sidedress
2. Liquid beef manure at sidedress
3. 28% UAN at sidedress



## Results

**Table 1. Swine Manure vs. Beef Manure vs. 28% at Corn Sidedress**

Nitrogen Source	Application Rate (gal/ac)	Units of N/ac Applied at Sidedress	Yield (bu/ac)	CSNT (ppm NO <sub>3</sub> -N)
Swine (25-11-33/1,000 gal)	5,000	125	203.8 b	6,930
Beef (41-26-30/1,000 gal)	4,000	161	214.0 a	6,270
28% UAN	50	150	215.8 a	6,557
LSD (P<.05, CV 1.25)			4.57	

## Discussion

There was no statistically significant difference in yield between the beef manure and commercial nitrogen. The swine manure did show a significantly lower yield than the other two treatments and this may have been due to a lower than expected ammonia nitrogen content in the swine manure. CSNTs indicated that nitrate nitrogen was not a yield limiting factor. Further data in the former multi-year replications will add to the validity of these results.

## Acknowledgement

The authors express appreciation to on-farm collaborator s Vicky and Jeff Nofziger for conducting this trial. The authors would also like to thank Unverferth Manufacturing for the use of the weigh wagon and the Ohio Pork Producers and Farm Credit Mid America for supporting this research.



## 14b. Comparison of Beef Manure, Anhydrous and 28% as Nitrogen Sources at Sidedress for Corn Yield

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 Eric Richer, Ohio State University Extension Educator, Fulton County, Ohio  
 Ben Eggers, Ohio State University Extension Agronomy Intern, Fulton County, Ohio

### Objective

To compare corn yield response to nitrogen applied at side-dress as incorporated beef manure, incorporated anhydrous and incorporated 28% UAN.

### Background

Crop Year: 2016  
 County: Henry  
 Location: Ridgeville Corners, Ohio  
 Drainage: Systematic, 25' laterals  
 Previous Crop: Soybeans  
 Variety: Pioneer 0843AM  
 Population: 34,000 seeds per acre  
 Plant Date: May 23, 2016  
 Harvest Date: October 31, 2016  
 Herbicide: 2-4D, CinchATZ, Instigate

Soil Type: Hoytville, Haskins  
 Tillage: Conventional  
 Soil Test (grid avg): pH 6.1  
 P 70 ppm (Bray-P1)  
 K 229 ppm  
 O.M. 4.1%  
 CEC 16.5 meq/100g  
 Starter Fertilizer: 40-16-120  
 Pre-Sidedress Nitrogen Test: 20 ppm NO<sub>3</sub>-N  
 Rainfall (May – August): 13.5"

### Methods

This trial was designed with three treatments of sidedress nitrogen sources replicated four times in an alternating block design. Plots were 6 rows wide (15 feet) by 850 feet long. The trial was planted, sprayed and harvested with commercial farm equipment. The nitrogen treatments were made with commercial nitrogen application toolbars. The liquid manure was sidedressed using a 5,200 gallon Balzer tanker with Dietrich shanks that incorporated the manure to a depth of 5 inches. All treatment received 40 units of nitrogen at plant (planter applied + pre-emerge). Manure samples were taken from the tank and analyzed at a commercial lab. This beef manure had a 41-26-30 per 1,000 gallons. The sidedress application rate goal was 4,000 gallons/acre of the beef manure, 55 gallons/acre of 28% UAN and 200 pounds/acre of anhydrous ammonia. A corn stalk nitrate test (CSNT) was taken for every replication and then averaged. Yields and moistures were measured using a calibrated yield monitor and shrunk to 15% moisture. Precipitation data was recorded by farmer.

- |             |                              |
|-------------|------------------------------|
| Treatments: | 1. Liquid beef manure        |
|             | 2. Anhydrous Ammonia (check) |
|             | 3. 28% UAN                   |



## Results

**Table 1. Steer Manure vs. Anhydrous vs. 28% at Corn Sidedress**

Nitrogen Source	Application Rate	Units of N/ac Applied at Sidedress	Yield (bu/ac)	CSNT (ppm NO <sub>3</sub> -N)
Beef (41-26-30/1,000 gal)	4,000 gal/ac	164	220.4 a	1,007
Anhydrous	200 lb/ac	164	222.4 a	580
28% UAN	55 gal/ac	165	218.5 a	960
LSD (P<.05, CV 2.04)			7.78	

## Discussion

There was no statistical significant difference in yield among the three nitrogen sources. The ability to match total nitrogen applied between all the sources possibly enabled these treatments to yield the same. CSNT values indicate that nitrate nitrogen levels at harvest were in the optimum range (250-2,000 ppm, University of Purdue) and thus did not limit yield.

It is believed that the moisture and organic matter added from the manure offset potential compaction concerns in the manure treatments. In the future, dragline injected manure application to growing crops could further offset compaction concerns and improve yield. Further data in the former multi-year replications will add to the validity of these results.

## Acknowledgement

The authors express appreciation to on-farm collaborator Ryan Hoffman/Hoffman Farms for conducting this trial. The authors would also like to thank Unverferth Manufacturing for the use of the weigh wagon and Farm Credit Mid America for supporting this research.





## 14c. Comparison of Beef Manure and 28% at Late Season as Nitrogen Sources at Sidedress for Corn Yield

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 Eric Richer, Ohio State University Extension Educator, Fulton County, Ohio  
 Ben Eggers, Ohio State University Extension Agronomy Intern, Fulton County, Ohio

### Objective

To compare corn yield response to nitrogen applied at side-dress as incorporated beef manure and soil applied 28% UAN at growth stage V8.

### Background

Crop Year: 2016  
 County: Fulton  
 Location: Archbold, Ohio  
 Drainage: Systematic, 32' laterals  
 Previous Crop: Soybeans  
 Variety: Dekalb 5775  
 Population: 35,000 seeds per acre  
 Plant Date: May 9, 2016  
 Harvest Date: November 1, 2016  
 Herbicide: CinchATZ, Buccaneer

Soil Type: Latty, Fulton clay  
 Tillage: Chisel in Fall, Spring finish  
 Soil Test (grid avg): pH 6.7  
 P 29ppm (Bray-P1)  
 K 181ppm  
 O.M. 3.3%  
 CEC 14.2 meq/100g  
 Starter Fertilizer: 72-12-150-6s-2z  
 Pre-sidedress Nitrogen Test: 10 ppm NO<sub>3</sub>-N  
 Rainfall (May – August): 12.3"

### Methods

This trial was designed with two treatments of sidedress nitrogen sources replicated four times in a randomized complete block design. Plots were 12 rows wide (30 ft) by 1000 feet long.. The trial was planted, sprayed and harvested with commercial farm equipment. The commercial nitrogen treatment was made with a highboy sprayer and late season drops at approximately growth stage V8. The liquid manure was sidedressed using a 5,200 gallon Balzer tanker with Dietrich shanks that incorporated the manure to a depth of 5 inches at growth stage V3. All treatments received 72 units of nitrogen at plant (planter applied + pre-emerge). Manure samples were taken from tank and analyzed at a commercial lab. This beef manure had a nutrient analysis of 41-26-30 per 1,000 gallons. The sidedress application rate goal was 4,000 gallons/acre of the beef manure and 45 gallons/acre of 28% UAN. A corn stalk nitrate test (CSNT) was taken for every replication and then averaged. Yields and moistures were measured using a calibrated yield monitor and shrunk to 15% moisture. Rainfall data was collected at the nearest CoCoRaHS station OH-HY-9.

- Treatments:
1. Liquid beef manure at V3
  2. 28% UAN applied late season at V8



## Results

**Table 1. Steer Manure vs. 28% Late Season at Corn Sidedress**

Nitrogen Source	Application Rate (gal/ac)	Units of N/ac Applied at Sidedress	Yield (bu/ac)	CSNT (ppm NO <sub>3</sub> -N)
Beef (41-26-30/1,000 gal)	4,000	164	191.5 a	3,380
28% UAN (V8)	45	135	194.8 a	2,260
LSD (P<.05, CV 1.74)			7.55	

## Discussion

There was no statistical significant difference in yield between the two nitrogen sources. A mid-season Pre-Sidedressed Nitrogen Test (PSNT) suggested a rate of only 135 units was necessary to maximize yield. As such, the in season rates and total rates of nitrogen were not constant in this trial. CSNTs indicated that nitrate nitrogen levels were not yield limiting for either treatment.

This site experienced early season drought stress. It is believed that the moisture and organic matter added from the manure offset potential compaction concerns in the manure treatments. In the future, dragline injected manure application to growing crops could further offset compaction concerns and improve yield. Further data in the former multi-year replications will add to the validity of these results.

## Acknowledgement

The authors express appreciation to on-farm collaborator Jason Rufenacht/Rufenacht Farms for conducting this trial. The authors would also like to thank Unverferth Manufacturing for the use of the weigh wagon and Farm Credit Mid America for supporting this research.



## 14d. Comparison of Swine Manure and Anhydrous as Nitrogen Sources at Sidedress for Corn Yield

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Eric Richer, Ohio State University Extension Educator, Fulton County, Ohio  
Ben Eggers, Ohio State University Extension Agronomy Intern, Fulton County, Ohio

### Objective

To compare corn yield response to nitrogen applied at side-dress as incorporated swine manure and incorporated 28% UAN.

### Background

Crop Year: 2016	Soil Type: Colonie, Tedrow sand
County: Fulton	Tillage: No-till into cereal rye
Location: Wauseon, Ohio	Soil Test (grid avg): pH 5.9
Drainage: Random	P 56 ppm (Bray-P1)
Previous Crop: Soybeans	K 58 ppm
Variety: Pioneer 1498	O.M. 1.5%
Population: 28,000 seeds per acre	CEC 3.9 meq/100g
Plant Date: May 5, 2016	Starter Fertilizer: 48-20-105-5s-1z
Harvest Date: October 19, 2016	Pre-Sidedress Nitrogen Test: 5 ppm NO <sub>3</sub> -N
Herbicide: Abundant, 2-4D, Instigate, CinchATZ	Rainfall (May – August): 10.9"

### Methods

This trial was designed with two treatments of sidedress nitrogen sources replicated four times in an alternating block design. Plots were 6 rows wide (15 ft) by 450 feet long. The trial was planted, sprayed and harvested with commercial farm equipment. The 28% UAN nitrogen treatment was made with a commercial toolbar and injection knives. The liquid manure was sidedressed using a 5,200 gallon Balzer tanker with Dietrich shanks that incorporated the manure to a depth of 5 inches. All treatments received 48 units of nitrogen at plant (planter applied + pre-emerge). Manure samples were taken from the tank and analyzed at a commercial lab. This swine manure had a nutrient analysis of 24-3-39 per 1,000 gallons. The sidedress application rate goal was 5,000 gallons/acre of the swine manure and 40 gallons/acre of 28% UAN. A corn stalk nitrate test (CSNT) was taken for every replication and then averaged. Yields and moistures were measured using a calibrated yield monitor and shrunk to 15% moisture. Rainfall data was collected at the nearest CoCoRaHS station OH-FL-11.

- Treatments:
1. Swine Manure at sidedress
  2. 28% UAN at sidedress



## Results

**Table 1. Swine Manure vs. 28% at Corn Sidedress**

Nitrogen Source	Application Rate (gal/ac)	Units of N/ac Applied at Sidedress	Yield (bu/ac)	CSNT (ppm NO <sub>3</sub> -N)
Swine (25-11-33/1,000 gal)	5,000	125	133.6 a	2,293
28% UAN	40	120	114.8 a	447
LSD (P<.05, CV 8.6)			24.28	

## Discussion

There was no statistical significant difference in yield between the two nitrogen sources. The ability to match total nitrogen applied between all the sources possibly enabled these treatments to yield the same. This site faced early season drought stress and as such, the moisture and organic matter from the manure likely contributed to the increase in yield for manured treatments. CSNTs indicate that nitrate nitrogen levels are in the optimum range or higher and thus were not a yield limiting factor. Further data in the former multi-year replications will add to the validity of these results.

## Acknowledgement

The authors express appreciation to on-farm collaborators Keith Jones for conducting this trial and to Pettisville Grain Co for supplying the liquid swine manure. The authors would also like to thank Unverferth Manufacturing for the use of the weigh wagon and the Ohio Pork Producers for supporting this research.



## 15a. Late Season 28% Nitrogen Application vs. Anhydrous at Sidedress for Corn Yield

Eric Richer, Ohio State University Extension Educator, Fulton County, Ohio

Ben Eggers, Ohio State University Agronomy Intern, Fulton County, Ohio

### Objective

To determine the effects of nitrogen timing on corn grain yield and profitability.

### Background

Crop Year: 2016

County: Fulton

Location: Wauseon, Ohio

Drainage: systematic, 50' laterals

Previous Crop: Wheat

Plant Date: May 21, 2016

Harvest Date: October 31, 2016

Herbicide: 2-4d, Glyphosate, Acuron

Fungicide: Quilt Xcel at VT

Soil Type: Haskins loam, Rimer sand

Tillage: Fall finisher, stale seedbed

Soil Test (grid avg): pH 6.3

P 43ppm (Bray-p1)

K 145ppm

O.M. 2.8%

CEC 8.1

Starter Fertilizer: 70-20-90-5S-3B

Pre-Sidedress Nitrogen Test: 16 ppm NO<sub>3</sub>-N

Rainfall (May – August): 14.1"

### Methods

Three corn nitrogen timing systems were replicated three times in a randomized complete block design. Plots were 24 rows wide (60 ft) by 2,200 feet long. The trial was planted, sprayed and harvested with commercial farm equipment. The sidedress treatments were made with commercial anhydrous application equipment and late season nitrogen treatments were made with a high boy sprayer with drop tubes at each row. The total nitrogen budget for this farm was 210 units of nitrogen with a yield goal of 210 bushels per acre. All treatment received 70 units of nitrogen at plant (planter applied + pre-emerge). In this trial the sidedress treatment was made at V5 (June 11<sup>th</sup>), and the late season treatment was applied at V12 (July 12<sup>th</sup>). The first significant rain (.28") fell 60 hours after late season application. A corn stalk nitrate test (CSNT) was taken by averaging 1 test of 12 stalks for every treatment replication (4 tests for each treatment) at black layer. Yields and moistures were measured using a calibrated yield monitor and shrunk to 15% moisture (Table 1). Rainfall data was recorded by farmer at field level.

#### Treatments:

1. Sidedress anhydrous (V5) 140 lbs N/acre
2. Late Season 28% (V12) 140 lbs N/acre
3. Split: Sidedress anhydrous (V5) 70 lbs N/ac and Late Season 28% (V12) 70 lbs N/ac
4. Zero Rate - 30 lbs N/acre (unreplicated)



## Results

**Table 1. N Application Timing in Corn (Anhydrous)**

Nitrogen Application and Source**	Yield (bu/ac)	CSNT (ppm NO <sub>3</sub> -N)	System Application Cost (\$/ac)*	Return Minus Application Cost (\$/ac)*
Anhydrous (V5)	212.8 a	3,324	\$13.55	\$731
Late (V12)	211.2 a	1,706	\$10.00	\$729
Split (V5 & V12)	214.4 a	1,701	\$23.55	\$727
Zero Rate (30#)	133.1 b	62	-	\$466
LSD (P<.05, CV 1.8)	8.7			

\*Based on \$13.55 anhydrous application, \$10.00 highboy application, and \$3.50/bu corn.

(Source: 2016 Corn Ohio Custom Rates)

\*\*All Systems used 140 lbs N/ac in season, 70 lbs N/ac at plant; zero rate unreplicated.

Table 2. Nitrate Concentration Categories		
Nitrate-Nitrogen ppm	Rating	Interpretations*
Less than 250	Low	Nitrogen was likely yield limiting during the growing season, especially if the test result is less than 250 ppm.
250-2,000	Optimal	Grain yield was not limited by the amount of nitrogen available to the crop. <i>Note</i> : the high end of this category is appropriate when nitrogen prices are low and corn prices high. The low end of this category is appropriate when nitrogen prices are high and corn prices low.
Greater than 2,000	Excess	Excessive nitrogen available to the crop, or some other production factor limited crop growth and yield.

\*Corn Stalk Nitrate Tests-Research and Recommendation Update, Purdue University, 15 September 2014.

## Discussion

There was no statistically significant difference for yield among the three nitrogen timing systems in 2016 except for the zero/low rate, which is the unreplicated check for this trial (Table 1). CSNTs indicate that optimal nitrate-N concentrations were achieved using treatment 2 (late season) and treatment 3 (split V5 & V12) and excess nitrate-N concentrations were achieved with treatment 1 (anhydrous). A CSNT for the zero/low rate of 30 lbs Total N/acre shows that this rate yield limiting (Table 2).

A standard economics calculation shows that each of the systems have a very similar economic return, with the anhydrous system showing a slight economic edge in this trial. These returns will also vary depending on each producer's equipment and nitrogen cost.

With the development and use of in-season nitrogen application equipment, the risk of N loss can be minimized by applying later in season when the corn crop needs it. Further research in the form of multi-year replication will add to the validity of these results.

## Acknowledgement

The authors express appreciation to on-farm collaborator Larry Richer for conducting this trial. Thanks to the Culman Lab at OARDC for processing CSNT tests and to the Ohio Corn Checkoff Board for supporting this research.



## 15b. Late Season 28% Nitrogen Application for Corn Yield - V5 vs. V10

Eric Richer, Ohio State University Extension Educator, Fulton County, Ohio

Ben Eggers, Ohio State University Agronomy Intern, Fulton County, Ohio

### Objective

To determine the effects of nitrogen timing on corn grain yield and profitability.

### Background

Crop Year: 2016

County: Fulton

Location: Fayette, Ohio

Drainage: Old clay, random

Previous Crop: Soybeans

Plant Date: May 20, 2016

Harvest Date: October 24, 2016

Herbicide: Triple Flex, atrazine

Fungicide: Priaxor at V6

Soil Type: Colwood, Dixboro

Tillage: Fall chisel plow, Spring finisher

Soil Test (grid avg): pH 6.2

P 18 ppm (Bray-p1)

K 144 ppm

O.M. 3.7%

CEC 12.2 meq/100g

Starter Fertilizer: 92-52-90/acre

Pre-Sidedress Nitrogen Test: 18 ppm NO<sub>3</sub>-N

Rainfall (May – August): 14.7"

### Methods

Three corn nitrogen timing systems were replicated four times in a randomized complete block design. Plots were 24 rows wide (60 feet) by 1,000 feet long. The trial was planted, sprayed and harvested with commercial farm equipment. The sidedress treatments were made with commercial 28% UAN knife application equipment and late season nitrogen treatments were made with a high boy sprayer with drop tubes at each row. The total nitrogen budget for this farm was 212 units of nitrogen with a yield goal of 220 bushels per acre. All treatment received 92 units of nitrogen at plant (planter applied + pre-emerge). In this trial the sidedress treatments were made at V5 (June 15<sup>th</sup>) and the late season treatment was applied at V10 (July 13<sup>th</sup>). The first significant rain (.9") fell 36 hours after late season application. A corn stalk nitrate test (CSNT) was taken by averaging 1 test of 12 stalks for every treatment replication (4 tests for each treatment) at black layer. Yields and moistures were measured using a calibrated yield monitor and shrunk to 15% moisture. Rainfall data was collected from the nearest CoCoRaHS station OH-FL-9 in Fayette.

- Treatments:
1. Sidedress 28% (V5) 120 lbs N/acre
  2. Late Season 28% (V11) 120 lbs N/acre
  3. Split: Sidedress 28% (V5) 60 lbs N/ac and Late Season 28% (V11) 60 lbs N/ac



## Results

**Table 1. N Application Timing in Corn (28% UAN)**

Nitrogen Application and Source**	Yield (bu/ac)	CSNT (ppm NO <sub>3</sub> -N)	System Application Cost (\$/ac)*	Return Minus Application Cost (\$/ac)*
28% Check (V5)	219.0 a	2,678	\$9.25	\$757
Late Season (V10)	218.8 a	4,756	\$10.00	\$756
Split (V5 & V10)	222.0 a	5,698	\$19.26	\$758
LSD (P<.05, CV .97)	3.68			

\*Based on \$9.25 28% application, \$10.00 highboy application and \$3.50/bu corn.  
(Source: 2016 Ohio Custom Farm Rates)

\*\*All Systems used 110 lbs N/ac in season, 92 lbs N/ac at plant

## Discussion

There was no statistical significant difference for yield among the three nitrogen timing systems in this 2016 trial (Table 1). CSNTs indicate that nitrogen was not a yield limiting factor in this research (Table 2).

A standard economics calculation shows that each of the systems have a very similar economic return, with the split nitrogen system (treatment 3) showing a slight economic edge in this trial. These returns will also vary depending on each producer's equipment and nitrogen cost.

With the development and use of in-season nitrogen application equipment, the risk of N loss can be minimized by applying later in season when the corn crop needs it. Further research in the form of multi-year replication will add to the validity of these results.

## Acknowledgement

The authors express appreciation to on-farm collaborator JJA LLC/Jack Rupp for conducting this trial and thanks to Von Seggern Family Farms for applying the late season nitrogen treatments. Thanks to the Culman Lab at OARDC for processing CSNT tests and to the Ohio Corn Checkoff Board for supporting this research.





## 15c. Nitrogen Timing and Placement for Corn Yield

Ben Eggers, Ohio State University Agronomy Intern, Fulton County, Ohio

### Objective

To determine the effects of nitrogen timing and placement on corn grain yield and profitability.

### Background

Crop Year: 2016	Fungicide: Aproach at VT
County: Henry	Soil Type: Hoytville, Nappanee clay loam
Location: Napoleon, Ohio	Tillage: Fall land level, No-till into Cereal Rye
Drainage: Systematic, 30' laterals	Soil Test (grid avg): pH 5.9
Previous Crop: Wheat	P 40 ppm (Bray-P1)
Variety: Pioneer 0993	K 222 ppm
Population: 34,800 seeds per acre	O.M. 3.0%
Plant Date: May 25, 2016	CEC 16.3 meq/100g
Harvest Date: November 12, 2016	Starter Fertilizer: 80-0-0
Herbicide: 64 oz/ac Abunbit and CINCH ATZ	Pre-Sidedress Nitrogen Test: 6 ppm NO <sub>3</sub> -N
12.5 oz/ac Atrazine, 8 oz/ac Shredder	Rainfall (May – August): 13.5"

### Methods

Four corn nitrogen timing systems were replicated four times in a randomized complete block design. Plots were 24 rows wide (60 feet) by 600 feet long. The trial was planted, sprayed and harvested with commercial farm equipment. The sidedress treatments were made with commercial 28% UAN knife application equipment and late season nitrogen treatments were made with a high boy sprayer with drop tubes at each row. The total nitrogen budget for this farm was 200 units of nitrogen with a yield goal of 200 bushels per acre. All treatments received 80 units of nitrogen at plant (planter applied + pre-emerge). In this trial the sidedress treatment was made at V5 (June 29<sup>th</sup>), and the late season treatment was applied at V11 (July 22<sup>nd</sup>). Only rain between the two applications was a total of .6". The first significant rain (.5") fell 36 hours after late season application. A corn stalk nitrate test (CSNT) was taken for every replication and then averaged. Yields and moistures were measured using a calibrated yield monitor and shrunk to 15% moisture. Rainfall data was collected by the farmer at field level.

- Treatments:
1. Check: Sidedress 28% (V5) 120 lbs N/acre
  2. Placement: Root Applied 28% (V5) 120 lbs N/acre
  3. Timing: Late Season 28% (V11) 120 lbs N/acre
  4. Split: Sidedress 28% (V5) 60 lbs N/ac and Late Season 28% (V11) 60 lbs N/ac
  5. Zero rate 48 lbs N/acre (unreplicated)



## Results

**Table 1. N Application Timing and Placement in Corn (28% UAN)**

Nitrogen Application and Source**	Yield (bu/ac)	CSNT (ppm NO <sub>3</sub> -N)	System Application Cost (\$/ac)*	Return Minus Application Cost (\$/ac)*
Check: Sidedress 28% (V5)	138.7 a	764	\$9.25	\$476
Placement: 28% at Root (V5)	140.0 a	1,154	\$10.00	\$480
Timing: Late Season (V10)	144.2 a	989	\$10.00	\$495
Split: 28% both times (V5 & V10)	139.1 a	1,014	\$19.25	\$468
Zero Rate (#48)	122.0 b	43	-	\$427
LSD (P<.05, CV 5.95)	13.37			

\*Based on \$9.25 28% application, \$10.00 highboy application and \$3.50/bu corn.

(Source: 2016 Ohio Custom Rates)

\*\*All Systems used 120 lbs N/ac in season, 80 lbs N/ac at plant; zero rate unreplicated.

Table 2. Nitrate Concentration Categories		
Nitrate-Nitrogen ppm	Rating	Interpretations <sup>†</sup>
Less than 250	Low	Nitrogen was likely yield limiting during the growing season, especially if the test result is less than 250 ppm.
250-2,000	Optimal	Grain yield was not limited by the amount of nitrogen available to the crop. <i>Note</i> : the high end of this category is appropriate when nitrogen prices are low and corn prices high. The low end of this category is appropriate when nitrogen prices are high and corn prices low.
Greater than 2,000	Excess	Excessive nitrogen available to the crop, or some other production factor limited crop growth and yield.

<sup>†</sup> Corn Stalk Nitrate Tests-Research and Recommendation Update, Purdue University, 15 September 2014.

## Discussion:

There was no statistically significant difference for yield among the four replicated nitrogen timing systems in this 2016 trial (Table 1). CSNTs indicate that nitrate-nitrogen levels were at optimum ranges for all systems except the zero rate (Table 2). This site was under drought stress from planting until pollination and as such, these conditions could have affected nitrogen uptake and yield.

A standard economics calculation shows that the late season timing treatment (treatment 3) had the greatest economic return of \$495/acre after nitrogen application costs. These returns will vary depending on each producer's equipment and nitrogen cost.

With the development and use of in-season nitrogen application equipment, the risk of N loss can be minimized by applying later in season when the corn crop needs it. Further research in the form of multi-year replication will add to the validity of these results.

## Acknowledgement

The author expresses appreciation to on-farm collaborator Matt Eggers for conducting this trial and for Tri-flo, Inc for making the placement and timing treatments. Thanks to the Culman Lab at OARDC for processing CSNT tests and to the Ohio Corn Checkoff Board for supporting this research.



## 15d. Late Season 28% UAN Application and Reduced Rates

Eric Richer, Ohio State University Extension Educator, Fulton County, Ohio

Ben Eggers, Ohio State University Agronomy Intern, Fulton County, Ohio

### Objective

To determine the effects of nitrogen timing and reduced rates on corn grain yield and profit.

### Background

Crop Year: 2016

County: Fulton

Location: Delta, Ohio

Drainage: Systematic

Previous Crop: Soybeans

Plant Date: May 20, 2016

Harvest Date: October 25, 2016

Herbicide: Sharpen, Tripleflex, Atrazine, Roundup  
PowerMaxx

Soil Type: Nappanee, Mermill loam

Tillage: Minimal tillage

Soil Test (grid avg): pH 6.1  
P 18 ppm (Bray-p1)  
K 126 ppm  
O.M. 3.5%  
CEC 10.6 meq/100g

Starter Fertilizer: 55-78-148-4s-1z/acre

Rainfall (May – August): 10.9"

### Methods

Four corn nitrogen rates were replicated three times in a randomized complete block design. Plots were 48 rows wide (120 feet) by 600 feet long. The trial was planted, sprayed and harvested with commercial farm equipment. The sidedress treatments were made with commercial anhydrous application equipment and late season nitrogen treatments were made with a high boy sprayer with drop tubes at each row. The total nitrogen budget for this farm was 210 units of nitrogen with a yield goal of 210 bushels per acre. Reduced rates replicated in this trial include .9 lbs of N per anticipated bushel of yield (treatment 3) and .8 lb of N per anticipated bushel of yield (treatment 4). All treatment received 110 units of nitrogen at plant (planter applied + pre-emerge). In this trial the sidedress treatment was made at V3 (June 2<sup>nd</sup>), and the late season treatment was applied at V10 (June 29<sup>th</sup>). The first measureable rain (.1") fell approximately 48 hours after late season application. A corn stalk nitrate test (CSNT) was taken by averaging 1 test of 12 stalks for every treatment replication (4 tests for each treatment) at black layer. Yields and moistures were measured using a calibrated yield monitor and shrunk to 15% moisture. Rainfall data was recorded at field level by the farmer.

- Treatments:
1. Anhydrous sidedress 100 lbs N/ac at V3 (210 lbs total N/ac)
  2. Late Season - Full Rate 100 lbs N/ac at V10 (210 lbs total N/ac)
  3. Late Season - .9 of Full Rate 78 lbs N/ac at V10 (188 lbs total N/ac)
  4. Late Season - .8 of Full Rate 57 lbs N/ac at V10 (167 lbs total N/ac)



## Results

**Table 1. N Application Timing and Rate in Corn**

Nitrogen Application and Source**	Yield (bu/ac)	CSNT (ppm NO <sub>3</sub> - N)	System Application Cost (\$/ac)*	Return Minus Application Cost (\$/ac)*
1. Anhydrous at V3 (100#N/210#TN)	173.9 a	1,055	\$55.55	\$553
2. Late Season – Full rate V10 (100#N/210#TN)	176.2 a	685	\$52.00	\$565
3. Late Season - .9 rate at V10 (78#N/188#TN)	174.8 a	1,278	\$42.76	\$569
4. Late Season - .8 rate at V10 (57#N/167#TN)	175.6 a	693	\$33.94	\$581

LSD (P<.05, CV 1.77) 6.19

\*Based on \$13.55 anhydrous application, \$10.00 highboy application, \$.42/lb of nitrogen cost and \$3.50/bu corn. (Source: OSUE 2016 Corn Budget & Ohio Farm Custom Rates)

\*\*All Systems used 110lb of nitrogen at plant

Table 2. Nitrate Concentration Categories		
Nitrate-Nitrogen ppm	Rating	Interpretations <sup>†</sup>
Less than 250	Low	Nitrogen was likely yield limiting during the growing season, especially if the test result is less than 250 ppm.
250-2,000	Optimal	Grain yield was not limited by the amount of nitrogen available to the crop. <i>Note</i> : the high end of this category is appropriate when nitrogen prices are low and corn prices high. The low end of this category is appropriate when nitrogen prices are high and corn prices low.
Greater than 2,000	Excess	Excessive nitrogen available to the crop, or some other production factor limited crop growth and yield.

<sup>†</sup>Corn Stalk Nitrate Tests-Research and Recommendation Update, Purdue University, 15 September 2014.

## Discussion

There was no statistically significant difference for yield among the four nitrogen treatments at this 2016 trial (Table 1). CSNTs indicate that optimal nitrate-N concentrations were achieved using all four treatments and thus nitrogen was not yield limiting (Table 2). This site did experience drought stress from planting through pollination that could have impacted nitrogen uptake and yield results.

A standard economics calculation shows that Treatment 4 (lowest late season rate) produced the greatest net return of \$581/acre after nitrogen and application costs. Treatment 4 also resulted in the lowest commercial nitrogen use efficiency (NUE) of .95 lb N per bushel of corn produced.

With the development and use of in-season nitrogen application equipment, the risk of N loss can be minimized by applying at lower rates and later in season when the corn crop needs it. These returns will vary depending on rainfall, each producer's equipment and nitrogen cost. Further research in the form of multi-year replication will add to the validity of these results.

## Acknowledgement

The authors express appreciation to on-farm collaborator Von Seggern Family Farms for conducting this trial. Thanks to the Culman Lab at OARDC for processing CSNT tests and the Ohio Corn Checkoff Board for supporting this research.



## 15e. Late Season Foliar Nitrogen Application for Corn Yield

Eric Richer, Ohio State University Extension Educator, Fulton County, Ohio

Ben Eggers, Ohio State University Extension Agronomy Intern, Fulton County, Ohio

### Objective

To determine the effects of foliar nitrogen on corn grain yield and profit.

### Background

Crop Year: 2016  
County: Fulton  
Location: Wauseon, Ohio  
Drainage: systematic, 50' laterals  
Previous Crop: Soybeans  
Variety: Pioneer 0604  
Seeding rate: 33,000 seeds per acre  
Plant Date: May 21, 2016  
Harvest Date: October 31, 2016  
Herbicide: Acuron

Soil Type: Haskins loam, Rimer sand  
Tillage: conventional  
Soil Test (grid avg): pH 6.3  
P 43 ppm (Bray-p1)  
K 145 ppm  
O.M. 2.8%  
CEC 8.1 meq/100g  
Starter Fertilizer: 70-20-90-5S-3B/acre  
Rainfall (May – August): 14.1"

### Methods

Two treatments were replicated three times in an alternating block design. Plots were 24 rows wide (60 feet) by 2200 feet long. The trial was planted, sprayed and harvested with commercial farm equipment. Prior to the foliar nitrogen treatment, both treatments had received 200 lbs of total nitrogen. Treatment 1 received 2.5 gallons per acre of CoRoN foliar nitrogen at tassel using commercial aerial application equipment. This treatment netted an additional 7 lbs of nitrogen and .15 lb of boron per acre. The untreated check received no additional foliar nitrogen. Yields and moistures were measured using a calibrated yield monitor and shrunk to 15% moisture. Rainfall data was recorded by farmer at field level.

Treatments: 1. Foliar CoRoN at VT – 2.5 gallon per acre (7 lbs N/acre)  
2. Untreated check

### Results

**Table 1. Foliar N application in Corn at VT**

Nitrogen Application and Source**	Yield (bu/ac)	System Application Cost (\$/ac)*	Return Minus Application Cost (\$/ac)
CoRoN - 2.5 gal/ac	211.5 a	\$24.80	\$715
Untreated check	208.0 a	-	\$728

LSD (P<.05, CV 2.6) 19.13

\*Based on \$12.30 aerial application, \$2.50/gal product cost and  
\$3.50/bu corn (Source: 2016 Ohio Farm Custom Rates)



**Discussion**

There was no statistically significant difference for yield between the foliar nitrogen treatment and the untreated check in this 2016 trial. A standard economic calculation shows that the untreated check was more profitable at \$728 per acre.

Further data in the former multi-year replications will add to the validity of these results.

**Acknowledgement**

The authors express appreciation to on-farm collaborator Larry Richer for conducting this trial and for Mark Gaerte/Gaerte Ag Service for making timely application of the nitrogen.



## 16. Yield Response to Strip Tillage

Eric A. Richer, Ohio State University Extension Educator, Fulton County  
Thomas Van Wagner, Michigan Center For Excellence, Lenawee County

### Objective

To compare the yield response and economics for strip till, no till, conventional tillage and minimum tillage.

### Methods

This study was designed to evaluate the impact of strip tillage against no tillage and other tillage systems. All treatments were replicated a minimum of 4 times in alternating strips (2 treatment trials) or in randomized strips (trials with more than 2 treatments). All strip tillage work was conducted in the fall of 2015 using an Orthman 1TRPR. Where noted fertilizer was applied in the strip and then matched equally in the spring. Fertilizer was applied on the surface in the spring to minimized nutrient loss associated with fall applied surface fertilizer. Within each trial location, all planting, fertilizing, pesticide application and harvesting was consistent.

Measureable data points included yield, economics, soil temperature at planting, and average growth stage at a particular date. Stated soil temperatures and growth stages are the mean of 10 measurements per treatment. Yield data were analyzed using a simple Analysis of Variance (ANOVA) and considered to be significant at  $P < .05$ . Economics were calculated using relevant crop prices and custom tillage/fertilizer application rates from the 2016 Ohio Farm Custom Rates Survey.

### Results

For easier readability, see results chart on the next page.

### Discussion

Much discussion and analysis of this data can be made. In the Ohio trials, three out of four trials showed no statistical difference in yield for strip tillage and the highest yielding treatment. In one trial, strip till showed a statistically significant yield difference over a no tillage system. In Michigan, the disk ripper followed by spring cultivator showed a statistically significant yield increase over strip tillage in the corn crop. However, the soybean strip till trials showed one trial where strip tillage was significant over the disk ripper system and one trial where strip tillage was not significant. It is important to remember that these trials represent one year's worth of data from one region of the country. Multi-year data will increase the validity and confidence of these research results.



## Acknowledgements

Support for this project was provided by Michigan Center For Excellence, OSU Conservation Technology Conference and OSU Extension Fulton County. Thanks to Countryside Land Management for assisting with these strip tillage plots. Thanks to OSUE Fulton intern Ben Eggers for assistance with data collection and processing.

Ohio-Michigan Strip Till Data									
Location	Soil	Crop	Tillage Treatment	Fertilizer Applied	Soil Temp. at Plant	Stage on 7/1	Mean Yield (bu/ac)	Significant Difference (p<.05)	Net Return over Cost*
Lenawee Co-1	Hoytville	Soybeans	Strip till	Broadcast VRT over both treatments			58.1 a	LSD 7.10; CV 4.9	\$500.15
			Disk ripper/S. Cultivate				63.6 a	Not significant	\$540.55
Lenawee Co-2	Hoytville	Soybeans	Strip till	Broadcast VRT over both treatments			53.4 a	LSD 3.23; CV 2.63	\$457.85
			Disk ripper/S. Cultivate				49.5 b	Significant	\$413.65
Lenawee Co-3	Hoytville	Corn	Strip till	Broadcast VRT over both treatments			165.8 b	LSD 2.54; CV .088	\$557.55
			Disk ripper/S. Cultivate				181.8 a	Significant	\$604.45
Lenawee Co-4	Hoytville	Corn	Strip till	Broadcast VRT over both treatments			219.5 b	LSD 3.23; CV 1.07	\$745.50
			Disk ripper/S. Cultivate				229.8 a	Significant	\$772.45
Location	Soil	Crop	Tillage Treatment	Fertilizer Applied	Soil Temp. at Plant	Avg Growth Stage on 7/13	Mean Yield (bu/ac)	Significant Difference (p<.05)	Net Return over Cost*
Fulton Co-5	Hoytville-Mermill	Corn	Strip till	200# Potash fall	60.7	11.6	189.7 a	LSD 2.07; CV .74	\$641.20
			No till	200# Potash spring broadcast	58.1	11.3	190 a	Not significant	\$658.75
Fulton Co-6	Hoytville-Nappanee	Corn	Strip till	50# MAP, 50# Potash fall	67.2	12.4	205.6 a	LSD 3.01; CV 1.15	\$696.85
			No till	50# MAP, 50# Potash spring broadcast	61	11.9	196 b	Significant	\$679.75
6/23									
Fulton Co-7	Haskins-Nappanee	Corn	Strip till	50# MAP, 50# Potash fall	67.6	6.0	219.5 ab	LSD 10.8; CV 3.08	\$745.50
			No till	50# MAP, 50# Potash spring broadcast	61.4	5.9	211.2 b		\$732.95
			F.chisel/S.cultivate	50# MAP, 50# Potash spring broadcast	66.7	6.4	218 ab		\$724.90
			Spring cultivate	50# MAP, 50# Potash spring broadcast	65.9	6.0	224.6 a	Significant	\$765.85
Fulton Co-8	Haskins-Nappanee	Corn	Strip till	50# MAP, 50# Potash fall	67.6	5.7	208.9 a	LSD 6.23; CV 1.90	\$708.40
			No till	50# MAP, 50# Potash spring broadcast	61.4	6.0	201.6 b		\$699.35
			F.chisel/S.cultivate	50# MAP, 50# Potash spring broadcast	66.7	6.3	205.2 ab		\$680.10
			Spring cultivate	50# MAP, 50# Potash spring broadcast	65.9	6.0	205.3 ab	Significant	\$698.30
*Equipment costs based on 2016 Ohio Farm Custom Rates									
Soybean Price		\$9.00							
Corn Price		\$3.50							
Strip till with fertilizer		\$22.75							
Dry bulk fertilizer		\$6.25							
Disk Rip/Disk Chisel		\$17.85							
Spring Cultivate/Finish		\$14.00							

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