Utilizing farmers' changed nitrogen application technologies to demonstrate improved nutrient management practices – year 2

Final Report 2015

Objectives and Hypothesis

In year two, we continue working with farmers to obtain data on their nitrogen management changes. We looked at four N management systems, each impacting one of the 4R's; right rate, right source, right timing and right placement. Two of the four farmers were a part of this study in 2014.

In addition, we partnered with the Clinton Conservation District to host the "What's New with Poo Tour", August 18, 2015 in Clinton and Gratiot Counties. This tour highlighted farmer's changed practices for managing manure nutrients both on the farm and in the field.

Rate – A comparison of N application rates for corn grown under irrigation.
Clinton County – Marilyn Thelen

New to this study in 2015 this farmer cooperated with another study in 2014 using Dr. Nielson's protocol for N rate under irrigation. N applications from 125 to 225 pounds were evaluated on irrigated corn with a yield goal of 220 bu/acre. In the 2014 trial the maximum $ returned was at an N rate of 166 pounds/acre. We have not received the analysis for the 2015 trial at this point.

There was no difference in yield for any of the nitrogen rates. Utilizing the rate of commercial nitrogen applied, nitrogen use efficiency was calculated. Table 1 indicates that the most efficient is 125# of nitrogen. This corn followed soybeans and the nitrogen from soybeans was not accounted for when calculating efficiency.

Table 1: Comparison of N rate under irrigation

Rate	125 lbs.	150 lbs.	175 lbs.	200 lbs.	225 lbs.
Total N[2,3]	125	150	175	200	225
Population	31,900	31,676	31,000	32000	32,333
Yield [4]	258	256	259	260	260
N use efficiency[5]	115.6	95.6	82.9	72.8	64.7

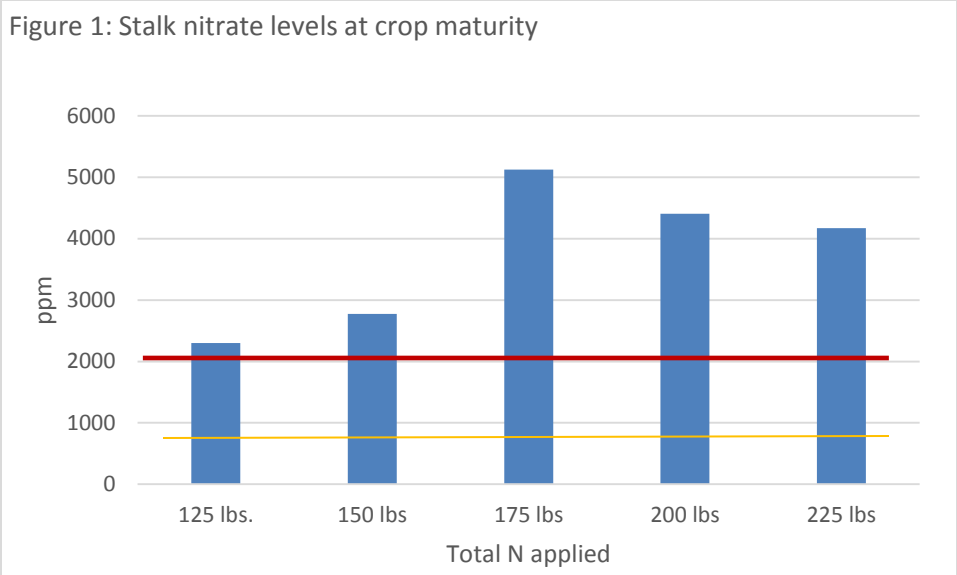
[1]Planted May 1, 2015

[2]Lbs. per acre

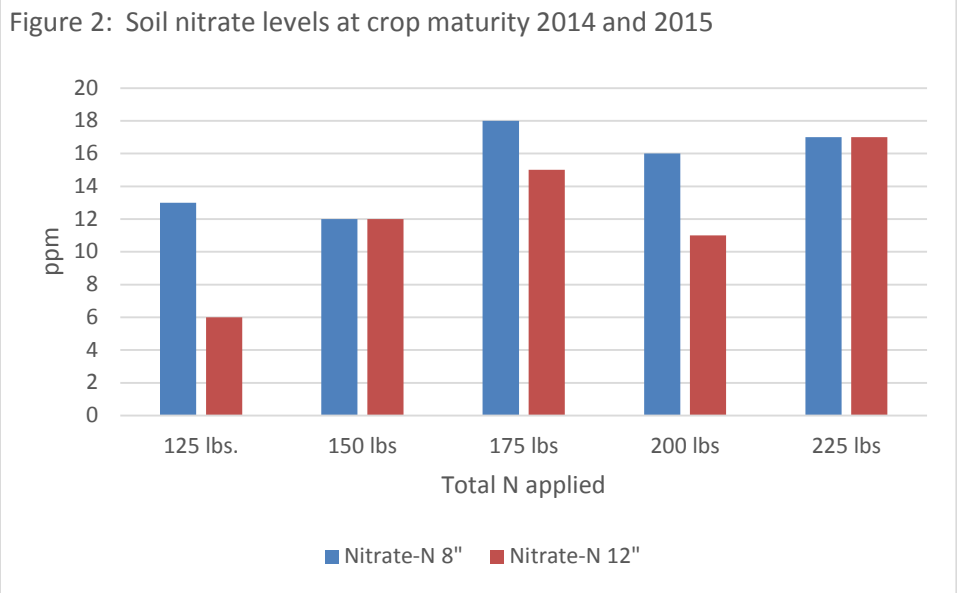
[3]50# MAP, 8-18-5,S and 28-0-0 at plant, SD 32% w/ S

[4]Yields are not significantly different, LSD=4.8, 0.05

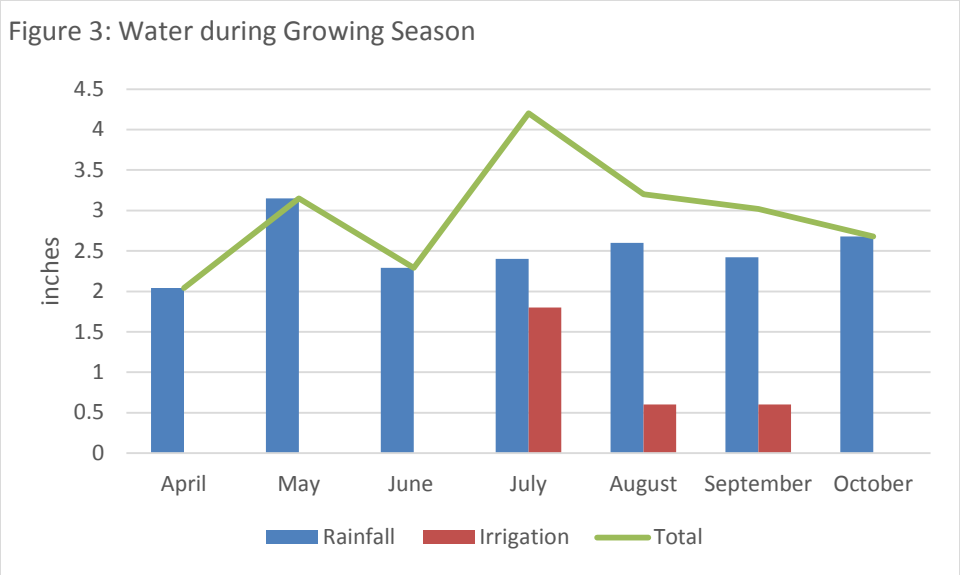
[5]Lbs. yield/1 lb. N



Soil nitrate and stalk nitrate samples were taken when the crop was mature. The results of the stalk nitrate test are summarized in Figure 1. Optimal levels are between 700 and 2000 ppm. All treatments were above optimal indicating the corn had more than enough nitrogen. Soil samples were taken at 0-8 inches and 8-16 inches after the crop had matured. Samples with less than 10 ppm are considered low. 11-15 ppm are medium – low and would have an N credit of 30 lbs N/a; 16-20 ppm is considered medium and would have a credit of 60 lbs of N/a. This is an indication of nitrate left in the soil (Figure 2).



Water was not a limiting factor in yield. Figure 3 shows monthly rainfall totals for April through October. Irrigation was applied 5 times during the growing season at a rate of 0.6 inches. The crop was irrigated three times in July, once in August and again on September 1.



Source – A comparison between swine manure N and liquid N.
Gratiot County – Jerry May

This is the second year of comparing corn yield response to N provided by swine manure (SM), commercial nitrogen (CN) and the combination of SM and CN (CN + SM). In 2014 the manure was side-dressed in mid-June using a manure spreader the farmers had purchased for that purpose. In 2015 the manure was applied (injected) in the spring, approximately 10 days prior to planting. The commercial N (28% liquid N) was applied prior to planting and incorporated. The 2015 manure application rate was determined using the average of the 2014 analysis from samples collected during that manure application and was calculated to equal the N provide by CN. The actual N application rate reported in Table 1 was determined from manure samples collected during spring 2015 manure application.

Table 2: Comparison of commercial N and swine manure[1]

Item	CN + SM	SM	CN	Low N
Total N[2,3]	256	166	181	52
Population	32,332	32,236	32,623	33,784
Yield[4]	210[a]	209[a]	213[a]	191[b]
N use efficiency[5]	43	65	66	

[1] Planted May 19, 2015
[2] Lbs. per acre
[3] Manure N calculated using analysis of sample collected during application and application rate. P and K were equal across all treatments
[4] Yields with different subscripts are significantly different, LSD=5.29, 0.05
[5] Lbs. yield/1 lb. N

In 2015 there were no differences in yield between CN+SM, SM and CN (Table 2). These results are consistent with the 2014 comparison when there were also no reported differences in yield between the three N

treatments. As expected there was a significant difference between the three N treatments and the Low N treatment. The N use efficiency reported in Table 1 confirms there is reduced crop N utilization when SM is combined with additional CN when the SM has been spread evenly across the field, applied at agronomic rate for N and applied in a manner to reduce environmental losses. The two year average yield of the four treatments, CN+SM, SM, CN and Low N, are reported in Table 3.

Table 3: Average of two year comparison of commercial N and swine manure N

Item	CN + SM	SM	CN	Low N
Yield[1]	203[a]	194[a]	202[a]	160[b]
N use efficiency[2]	42	60	63	

[1] Yields with different subscripts are significantly different

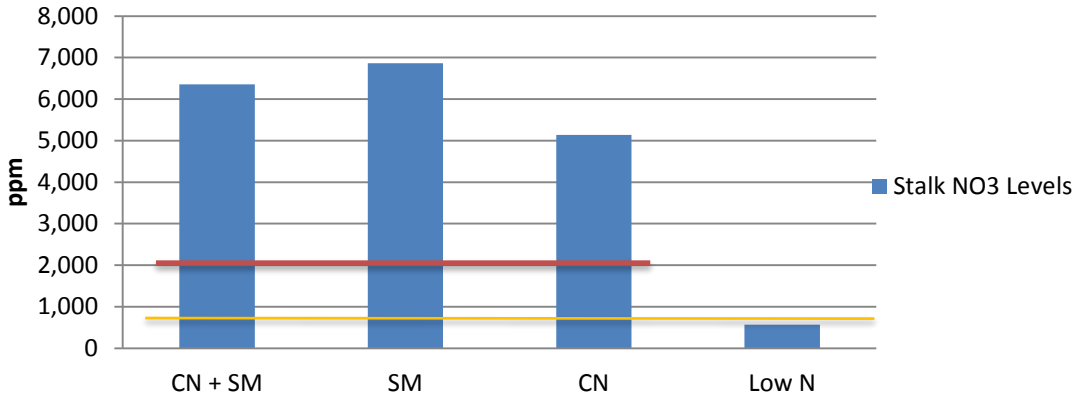
[2] Lbs. yield/1 lb. N

The 191 bushel per acre yield for the Low N treatment reported in Table 1 is higher than one would expect with the reduced N application rate. Given that the previous crop was sugar beets, a non-nitrogen fixating crop, one may hypothesize that in the spring of 2015 there was residual N in the field used for this study left over from a 2013 late summer application of swine manure applied to wheat stubble.

Approximately 14 days after the corn reached black layer stalk samples were collected for the stalk nitrate (Stalk NO_3) tests displayed in Figure 4. At the same time soil samples were collected at 0-12" and 12"-24" depths for the post growing season soil nitrate (Soil NO_3) tests reported in Figure 4.

The acceptable range for the post maturity Stalk NO_3 level test is 700 – 2,000 ppm. Below 700 ppm suggests a lack of available N during the growing season and a subsequent reduced yield. Tests results over 2,000 ppm indicate available N exceeded crop requirements and there is a potential for N loss to the environment after the crop is harvested. In Figure 4 this acceptable range is indicated by the yellow line across at 700 ppm and the red line across at 2,000 ppm. The reported Stalk NO_3 levels suggest the N provided by all three N treatments exceeded the needs of the growing crop. Only the Low N treatment, at 570 ppm, is below the yellow line.

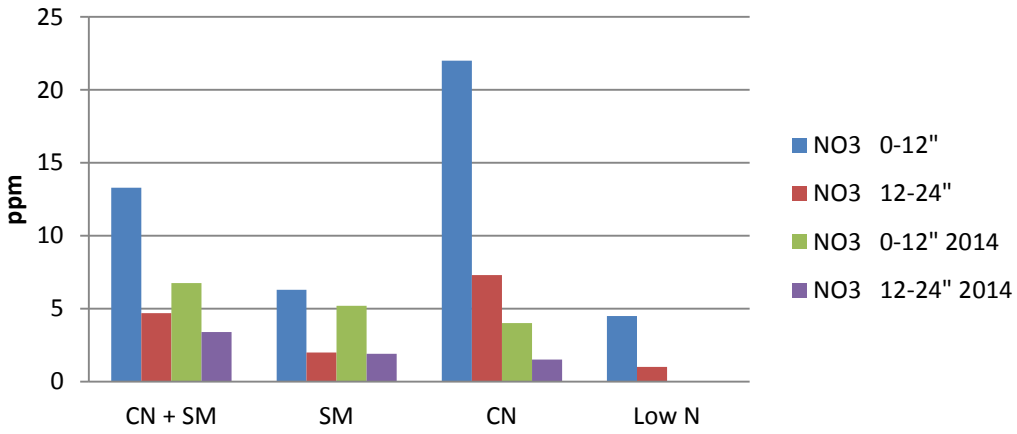
Figure 4: Stalk nitrate levels at crop maturity (ppm)



Post crop maturity Soil NO_3 is that N left in the soil and at risk of leaching out of the crop root zone and lost to the environment. For comparison the 2014 post crop maturity Soil NO_3 results were include in Figure 5.

The results of this two year study indicate that N provided by SM is equivalent to CN when the SM is applied at agronomic rates and in a manner to reduce environmental losses. The results also discourage the use of additional CN when SM has been applied in this manner. The 2015 trial suggests the opportunity for continued study to help farmers evaluate available N prior to additional SM or CN applications.

Figure 5: Soil nitrate levels at crop maturity 2014 and 2015 (ppm)



Timing – A comparison of multiple N applications throughout the growing season to optimize nitrogen utilization.
Clinton County – Marilyn Thelen

2015 provided much better planting and growing conditions for this trial. All treatment received 29.8 pounds of N pre-plant. Total Pre received an additional 124.2 pounds of N for a total of 154 pounds. Final SD received 19.8 pounds of N in the starter and the remainder at sidedress. Final PT received 19.8 pounds of N in the starter then 52 pounds at sidedress and the remaining 52 pounds at pre-tassel. Extra PT was managed the same as Final SD and then received an additional 45 pounds of N pre-tassel. Waiting to apply the final dose of N at pre-tassel reduced yield compared to Extra PT, but was not different from other treatments receiving 154 pounds of N. Applying extra at pre-tassel increased yield but was not significantly greater than Total Pre and Final SD.

Table 4: Comparison of timing of N application

Timing	Total Pre	Final SD	Final PT	Extra PT	Low N
Total N[2,3]	154	154	154	199	49
Population	36,444	35,778	36,333	36000	36,333
Yield [4]	208[ab]	210[ab]	200[b]	223[a]	139[c]
N use efficiency[5]	76	76	73	63	

[1]Planted May 2, 2015

[2]Lbs. per acre

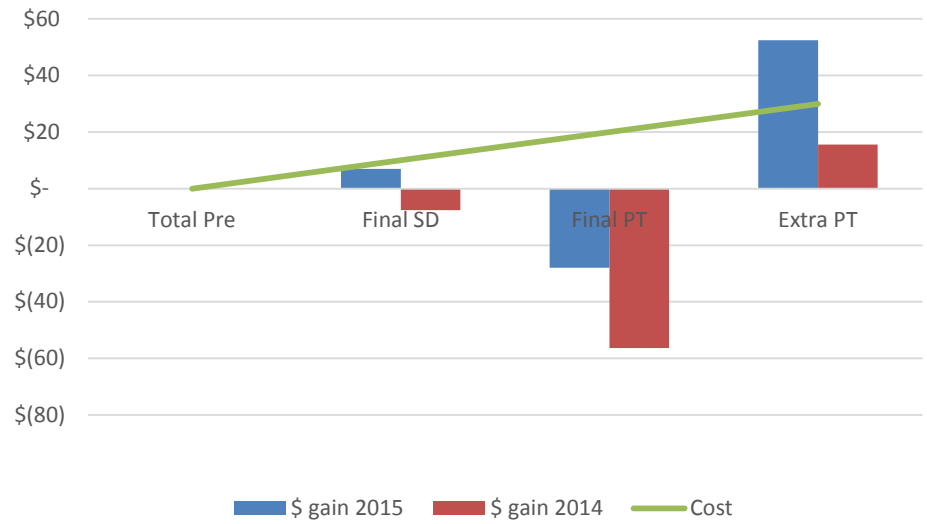
[3]Starter fertilizer, 9-25-20, all other 28%

[4]Yields with different subscripts are significantly different. LSD=17.98, 0.05

[5]Lbs. yield/1 lb. N

To evaluate the dollar return on the change in practice, $10 was assessed for each additional trip and $30 for the extra nitrogen that was applied (base on $250/T 28-0-0). The corn was valued at $3.50 per bushel.

Figure 6: Return on practice change



Change in yield from total pre to new practice with $3.50 corn
Cost includes $10/ trip and $250/ton for extra fertilizer in pre tassel treatment

Better planting and growing conditions resulted in better yields in 2015 and more efficient nitrogen utilization. (Table 5)

Table 5: Two year of timing of N application

Timing	Total Pre	Final SD	Final PT	Extra PT	Low N
Yield 2014[2]	132[a]	130[a]	116[a]	136[a]	56[b]
Yield 2015[2]	208[ab]	210[ab]	200[b]	223[a]	139[c]
2014 N use eff.[1]	56	55	49	47	
2015 N use eff.[1]	76	76	73	63	

[1]Lbs. yield/1 lb. N

[2]Yields with different subscripts are significantly different. 0.05

End of season stalk nitrate test were done as well as soil nitrate tests (Figures 7 & 8). Total Pre and Final SD stalk nitrate test showed nitrate level below optimal. Nitrate levels were also low in soils for those treatments. Both treatment receiving N pre-tassel were in the optimal range for stalk nitrate however, soils for those treatment were medium to high. Nitrogen remaining in the soil is subject to loss before the next growing season.

Figure 7: Stalk nitrate levels at crop maturity

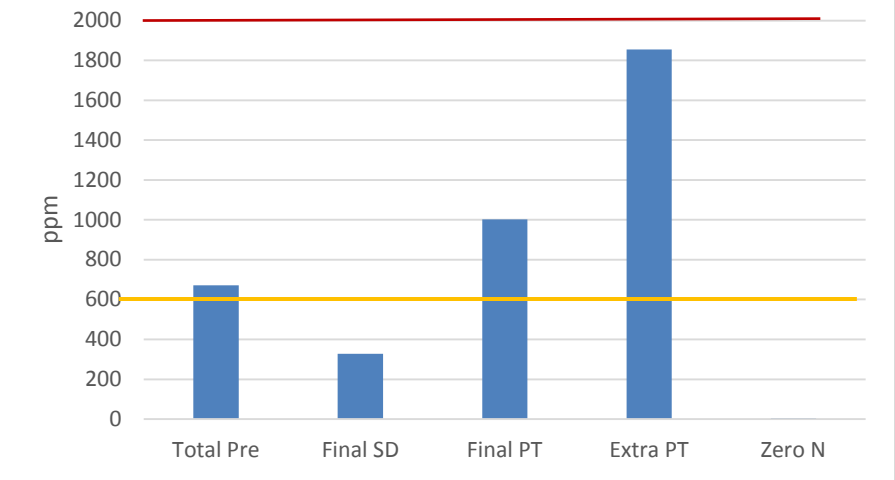
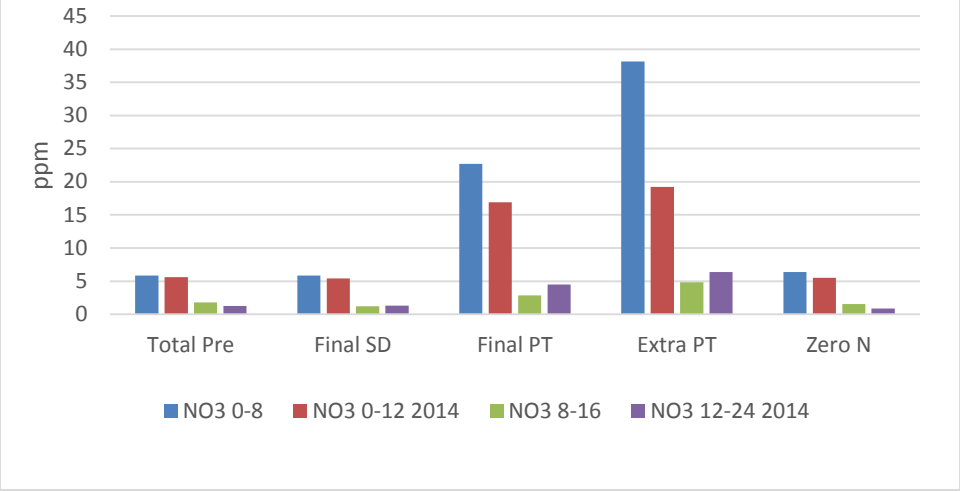


Figure 8: Soil nitrate levels at crop maturity 2014 and 2015



Timing and Placement – Comparison of timing and the use of Y drops for nitrogen placement
Corn Report – Eaton County - George Silva 2015

A farmer in Charlotte, MI has been sidedressing his corn for the past 15 years. His standard practice has been to apply about 30 lbs at planting and 120 lbs at sidedress using anhydrous ammonia. During the past two years unfavorable weather has interrupted the timing of the sidedress application.

With new concerns about nitrogen cost and changing climate, this farmer invested in new technology to stretch the N application and hopefully increase N use efficiency. He purchased a high clearance self- propelled sprayer with a 60 foot boom and mounted a Y-Drop fertilizer placement system. This system will enable him to place liquid N very close to the plant on both sides of the row during middle and late in the season.

In 2015, we conducted a trial to compare the traditional N practice with extended N sidedress application.

Picture 1: Y-drop system filled with liquid UAN solution

Picture 2: Applying N to tall corn

Proposed split N application treatments in 2015 using the Y-Drop fertilizer placement system

Treatment	N at planting (lb/A)	N at V4-V5 (lb/A)	N at V8 (lb/A)	N at V12-VT (lb/A)	Total N (lb/A)	Remarks
1	30	120	0	0	150	Grower standard practice
2	30	60	60	0	150	Placement by Y Drop
3	30	60	30	30	150	Placement by Y-Drop

However the extended rainfall and flooding conditions in 2015 from June to August prevented driving through the field and forced us to skip the V8 application. The next application had to be delayed until the Tassel stage. The N treatments were adjusted to the following:

Modified split N application treatments in 2015 using Y-Drop fertilizer placement system

Treatment	N at planting (lb/A)	Traditional N at V4-V5 (lb/A)	N at VT (lb/A)	Total N (lb/A)	Remarks
1	30	120	0	150	Grower standard practice
2	30	60	30	120	Placement by Y Drop
3	30	60	60	150	Placement by Y-Drop

Record rainfall totals in Charlotte in 2015

Year	Rainfall in inches June 1 to Aug 30, 2015
2010	7.92
2011	9.61
2012	5.93
2013	9.36
2014	9.20
2015	10.48*

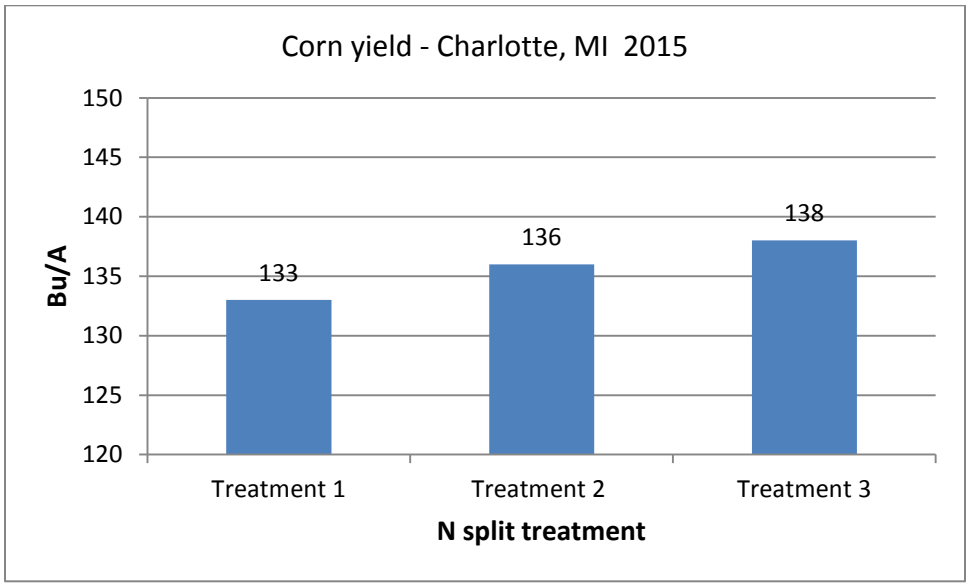
Corn yield - Charlotte, MI 2015

Treatment	N at planting (lb/A)	Traditional N at V4-V5 (lb/A)	Y-Drop N at VT (lb/A)	Total N (lb/A)	Corn yield Bu/A
1	30	120	0	150	133
2	30	60	30	120	136
3	30	60	60	150	138

Yield differences were not significantly different. Yield average of 4 replications

All 3 treatments produced below average yields in 2015. The 5-year average yield in this field is 155 bu/A. We speculate that wet conditions favored N loss due to denitrification and leaching. Delayed N application tall corn at tassel stage did not produce substantial yield increases.

Based on climate and rainfall patterns we have observed in the past few years, the farmers will benefit by having options to stretch the sidedress N application window depending on current season weather, soil type, N source and fertilizer application equipment. However the prolonged wet conditions in 2015 prevented us from using the Y-Drop system during most of the summer months and may have negated any perceived yield benefits.



What's New with Poo - field day August 18, 2015

The "What's New with Poo" farm tour was intended to educate farmers, their consultants and allied industry on innovative technologies and conservation practices being implemented on farms that improve manure nutrient management and protect surface water. The tour visit four central Michigan farms and demonstrate manure processing, cover crops rotations that are harvested for feed and harvestable vegetative buffers that collect sediment and protect surface water. Amber Radatz from the University of Wisconsin Discovery Farms was the keynote speaker for the tour. Amber discussed research taking place at Discovery Farms and the manure handling and application practices being evaluated there. Over 200 attendees participate in the tour. In a post tour on line evaluation almost 90% of those taking the survey rated the tour good-excellent. A video clip discussing the tour is available at: https://youtu.be/sHfZkfCe0V8

Budget Summary

	Grant	Expensed	Remaining
Summary	**$ 8,495.00**	**$ 5,951.96**	**$ 2,543.04**
	Budgeted	**Expensed**	
Materials & Supplies	**$ 2,920.00**	**$ 1,263.82**	
(soil samples)			
Travel	**$ 1,075.00**	**$ 762.14**	
Other Direct Costs	**$ 4,500.00**	**$ 3,926.00**	

Request a no-cost extension
We would like to request a no-cost extension. MSU ANR Communications is still finalizing the editing on the videos from the Poo Tour. We plan to pay them with work is completed. This payment is reflected in the expensed column as we have encumbered the funds.

The remaining $2,543.04 we propose using to conduct a 3rd year of research on:

- A comparison between swine manure N and liquid N.
- A comparison of multiple N applications throughout the growing season to optimize nitrogen utilization.

Funds would be used as follows:

Materials and Supplies:	$1343
Travel:	$ 200
Other Direct Cost:	$1000
Total	$2,543

Collaborators
Marilyn Thelen, MSUE Integrated Cropping and Livestock Systems Educator, will identify and work with one cooperator and serve as project lead.
Jerry May, Retired MSU Extension Sr. Educator