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ON-FARM PLOT RESULTS FROM SIDEDRESSING CORN WITH LIQUID LIVESTOCK MANURE USING A TANKER

Arnold, G. , Manure Nutrient Management Specialist, Ohio State University Extension
Richer, E., County extension educator, Ohio State University Extension
Custer, S., County extension educator, Ohio State University Extension
Noggle, S., County extension educator, Ohio State University Extension
Stachler, J., County extension educator, Ohio State University Extension

ABSTRACT

Liquid swine manure was applied as a post-emergent sidedress source of nitrogen and compared to 28% Urea Ammonium Nitrate (UAN) in on-farm corn plots in Ohio at 15 sites over three crop seasons. The manure was applied using a 5,250 gallon manure tanker, modified to travel down corn rows, and Dietrich incorporation sweeps. The 28%UAN was incorporated using standard sidedressing equipment. The incorporated manure treatments resulted in a statistically similar corn yields compared to the commercial fertilizer treatments in nearly all the plots. Livestock producers with liquid manure can better capture the nitrogen in the manure by applying it to a growing crop at a time when the crop can utilize the nutrient. Livestock producers could also potentially save money by not purchasing nitrogen to sidedress the corn crop.

INTRODUCTION

In Ohio, swine finishing operations typically store manure in an eight-foot deep pit beneath the animals. A study in the Canadian Journal of Soil Science (Beauchamp, 1983) found that approximately 60% of the nitrogen in liquid dairy cattle manure injected into the soil was available for corn growth as compared to 100% from commercial nitrogen sources. Chantigny et al. (2008) concluded that raw liquid swine manure had a fertilizer value similar to mineral fertilizer when sidedressed to corn and immediately incorporated.

The nitrogen in liquid swine manure is primarily in the ammonium form (NH-4), a form readily available for plant uptake. Swine finishing manure is typically much higher in nitrogen than manure from swine nurseries or sow units. If the nitrogen in manure could be applied to corn, a crop that responds well to large amounts of nitrogen, then livestock producers could capture more the nitrogen in the manure and potentially save money on purchasing sidedress nitrogen.

The application of manure to corn would also open a window of time to apply manure that is currently seldom taken advantage of. A four-year small plot research plot study in Ohio on corn grain (Arnold, 2015) found that corn sidedressed with manure resulted in higher yields compared with 28%UAN. This earlier study utilized a small (1,250 gallon) manure tanker and only the middle two rows of the four fertilized were harvested so soil compaction was not a major concern.

METHODS

This study was designed to determine if the available nitrogen in liquid swine manure could provide adequate sidedress nitrogen for corn yield. In each of the three years of this on-farm study, liquid swine finishing manure was applied as the sidedress nitrogen source and compared to commercial 28%Urea Ammonium Nitrate (UAN) in a complete block design. All manure applications were made with a 5,250 gallon manure tanker with a Dietrich toolbar with dual covering wheels and injected to a depth of five inches. The flotation tires on the manure tanker were replaced with narrow tires that permitted the manure tanker tires to follow the outer dual tires of an 8300 John Deere tractor through the corn rows.

Figure 1. Sidedressing emerged corn with liquid swine finishing manure.

The 28%UAN treatments were applied using a standard applicator that injected the fertilizer to a depth of three inches. The plots were replicated four times at each farm location in a complete block design. The number of locations were: 8 in 2013; 5 in 2014; and 6 in 2016. The liquid manure application rate was generally about 6,000 gallons per acre but was increased or decreased to approximate the same pounds per acre of commercial sidedress nitrogen that each farmer applied. Manure samples were collected during application. Application rates were based on previous manure samples provided by each farmer. Manure flow on the tanker was restricted to allow these lower volumes of manure to be applied with a travel speed of approximately three miles per hour. Manure applications and 28%UAN fertilizer applications were normally made on the same day for each plot, and the corn stage was usually about the V3 stage of growth.

Figure 2. Narrow tires replaced the flotation tires on the manure tanker

The on-farm plots were generally the length of a quarter mile field (minus end rows) although some plots were a half mile in length. Fields were scouted in advance for accessibility with the manure tanker and to be certain there were no bridges with weight restriction concerns that would interfere with transporting the manure. Plot widths were designed to match each farmer's harvest equipment width. Each farmer provided a pump and manure top loading equipment at the manure source.

With the restricted manure flow, it was not certain that all rows got even amounts of manure. The application toolbar was a box with five ports designed to be level when the toolbar was in the ground. The six-row applicator had five injectors so a row was skipped when the plot width was 12 rows. The manure toolbar was not designed to apply 150% rate to the skipped row as a 28%UAN applicator would be. In this study the 28%UAN applicator used was either was a 12-row toolbar or a 16 row toolbar depending on the farmers harvesting equipment. When a plot required a 16-row manure treatment, three trips with the manure toolbar was required with a manure injector between each row. The application rate was reduced slightly to apply the proper amount of manure.

Treatments were typically 12 rows in width although 16 rows was occasionally used. Yields were measured either using the farmers combine yield measurement system or a weigh wagon. All yield results were adjusted for moisture. Yield data were analyzed by ANOVA at the 0.05 probability level. The farm locations were spread across four Ohio counties and the soil types varied from Paulding Clay to Tedrow Sand. There were no sidedress plots completed in 2015 as the wet weather prevented using a manure tanker in corn fields. None of the fields were irrigated in this study.

RESULTS

Tables 1, 2 and 3 show the corn yields and nitrogen content of the manure applied for each location for each of the three years. All rows of each treatment plot were harvested and counted towards the yield. In 15 of the 19 sites over three seasons, there was no significant difference between the manure treatments and the 28%UAN treatments. In two of the plots the manure had a significant yield advantage. In two of the plots the 28%UAN had a significant yield advantage. In the plots where the 28%UAN treatments were higher there was usually some combination of crop damage from corn being plowed out by the Dietrich sweeps or soil compaction caused by the weight of the fully loaded manure tanker.

At harvest time, the manure treatments had a slightly higher moisture percentage (approximately 0.5 %) than the commercial fertilizer treatments. This occurred at each site.

The available nitrogen was calculated for each manure source. Available nitrogen was the pounds of ammonium nitrogen per 1,000 gallons plus 50 percent of the organic nitrogen amount in the sample analysis.

Table 1. Corn plot yield results (bushels/acre) and manure nitrogen applications, 2016. Each table row represents one farm location. Yield data are means of four replications; means within a row followed by different letters are significantly different at $P<0.05$.

Manure treatment yield bu/acre	**28%UAN treatment yield bu/acre**	**LSD**	**CV**	**Available Nitrogen per 1,000 gallons**
153.4	149.2	5.47	1.63	36.5
143.1	143.1	3.22	1.28	35.1
199.5	195.5	13.03	2.93	24.6
143.6	143.1	5.44	1.67	35.1
133.6	114.8	24.28	8.60	25.0
203.8 **b**	215.8 **a**	4.57	1.25	25.0

Table 2. Corn plot yield results (bushels/acre) and manure nitrogen applications, 2014. Each table row represents one farm location. Yield data are means of four replications; means within a row followed by different letters are significantly different at $P<0.05$.

Manure treatment yield bu/acre	**28%UAN treatment yield bu/acre**	**LSD**	**CV**	**Available Nitrogen per 1,000 gallons**
215.8	214.0	9.07	2.60	42.4
223.6	226.5	5.43	1.07	29.1
198.8	198.5	11.95	2.53	41.5
210.8 **a**	205.9 **b**	5.76	1.23	34.9
177.7	177.3	4.53	1.13	29.1

Table 3. Corn plot yield results (bushels/acre) and manure nitrogen applications, 2013. Each table row represents one farm location. Yield data are means of four replications; means within a row followed by different letters are significantly different at $P<0.05$.

Manure treatment yield bu/acre	**28%UAN treatment yield bu/acre**	**LSD**	**CV**	**Available Nitrogen per 1,000 gallons**
233.7	235.3	15.31	3.88	42.4
202.2	200.5	33.0	7.43	58.4
178.1	168.1	13.43	3.45	58.4
151.5	152.1	4.40	1.29	31.5
197.7	198.7	17.31	3.88	41.4
184.8 **b**	198.3 **a**	15.72	4.66	40.5

194.1	190.5	7.87	1.82	28.4
214.5 **a**	200.3 **b**	13.84	2.96	46.1

DISCUSSION

Corn yields were closely tied to favorable growing conditions. Corn population stands were similar between the two treatments in the plots. The use of the manure tanker caused more damage when turning on the end rows on the manure treatments than the 28%UAN applicator caused. Also, the Dietrich sweeps on the tanker toolbar plowed out corn whenever the tractor operator was inattentive. The sweeps, however, likely helped to alleviate some of the compaction caused by the tractor and manure tanker. There was no auto steer on the tractor.

Due in part to the travel time from the building site to the field, the use of a manure tanker to apply manure as a sidedress nitrogen source for corn is not efficient. If the manure tanker remained in the field and manure was hauled to the field using semi-tankers, the process could be more efficient. Replacing the manure tanker tires with tracks could be a method to mitigate some of the soil compaction concerns.

The slightly higher moisture for the manure treatments at harvest time could be due to the nitrogen being available further into the growing season. Farmers concerned about this moisture increase could switch to a corn hybrid with a slightly shorter season.

The nitrogen cost for the 28%UAN treatments was roughly $90 per acre. The liquid manure application cost, using the Minnesota Manure Distribution Cost Analyzer spreadsheet, was calculated at $20 per 1,000 gallons or $.02 per gallon. The cost of applying 6,000 gallons of swine finishing manure per acre as side-dress nitrogen was $120 per acre. In addition, the liquid swine manure applied at each site contained approximately $43.00 of P_2O_5 per acre and $40.00 of K_2O per acre along with organic matter and a broad range of micronutrients.

CONCLUSION

In this study, liquid swine finishing manure proved an adequate replacement for commercially purchased 28%UAN as a sidedress nitrogen source for corn. If corn fields are close to the manure source the use of swine finishing manure for sidedress nitrogen could save a livestock farmer money by replacing purchased sidedress nitrogen. All livestock producers must eventually land apply the manure produced from their operations. Applying the manure in-season as a replacement for purchased fertilizer does lower the final cost of the manure application process through savings on purchased nitrogen.

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6584 W. Duroc Road | Maroa, IL 61756 | T (217) 794-3700 | F (217) 794-5901