Effect of Manure Application Methods on Corn Yields: Three-Year Summary

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Published August 21, 2023

Objective

To compare the yields of the H2Ohio manure practice of 1) subsurface applied swine finishing manure and 2) surface applied swine manure cultivated within 24 hours of application.

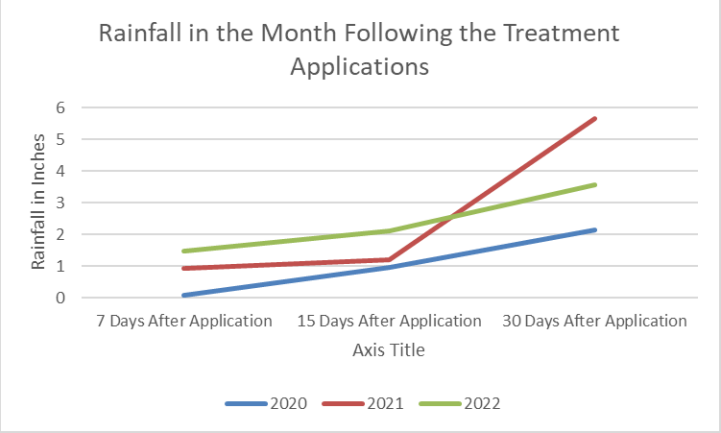
Background

Crop Years: 2020, 2021, 2022
Location: Northwest OARDC
County/Town: Wood/Hoytville
Soil Type: Hoytville Silty Clay
Drainage: Systematic Tile Drainage on 40' spacings
Tillage: Conservation Tillage
Soil Test: pH 6, P 45, K 180, OM 2.5
Seeding Rate: 31,000 plants/acre
Previous Crop: Soybeans

Table 1. Important Dates in the Three Years of Study

	2020	2021	2022
Planting Date	**May 7, 2020**	**April 26, 2021**	**May 23, 2022**
Sidedress Application Date	**June 11, 2020**	**June 16, 2021**	**June 29, 2022**
Harvest Date	**October 27, 2020**	**October 14, 2021**	**November 9, 2022**

Figure 1.



Governor Mike DeWine launched the H_2Ohio in 2019 to improve water quality in Lake Erie to combat the algal bloom issues that have been problematic for several years now. One of the practices that H_2O incentives is applying manure to a growing crop instead of bare ground to

reduce the amount of nutrients lost. The manure can be applied two different ways according to the H_2O guidelines: applied at sidedress via injection as a subsurface application or surface applied to corn and cultivated within 24 hours of application. The University of Minnesota and other research at Ohio State supports the use of the injection of manure at sidedress in corn and can result in yield increases. This research aims to determine what the yield impacts are from both subsurface and surface applications of manure into a growing corn crop are for farmers who want to follow the H_2O guidelines.

Methods

This trial was a randomized complete block design with four replicates. Plots were four rows wide and 90 feet long, the center two rows were used for harvest. Prior to harvest, the ends of the plots were mowed to be squared off and consistent. All treatments were made on the same day for each year of the study, when corn was in the V3 stage of growth (3 collared leaves). Stand counts were taken at harvest to determine the final stand population. The study had four treatments: 1) sixty-seven gallons per acre of 28% UAN were applied via subsurface placement with a split-row applicator for an equivalent of 200 pounds per acre of nitrogen, 2) swine-finishing manure, applied at 5,000 gallons per acre as subsurface treatment using Dietrich Sweeps with closing wheels at a depth of four inches, 3) swine-finishing manure, applied at 5,000 gallons per acre as surface treatment using Dietrich Sweeps with the applicator bar at a few inches above the soil surface, and 4) a zero-nitrogen check (e.g. control with no starter fertilizer, no UAN, no manure). Cultivation occurred the next day, following the H2Ohio guidelines. Stand counts were counted by measuring out 1/1000th of acre, 17’ 5”, and the corn plants in the two center rows of the plots were counted then divided by two. This resulted in the average number of plants per acre per plot. The cultivator had five-shanks per row and utilized a three-point hitch. The yield results were collected by the Northwest OARDC’s plot combine’s yield monitor.

Table 2. Treatment Summary

Treatment	Description
Incorporated 28% UAN	28% UAN Applied (66gal/ac)
Subsurface applied swine manure	Swine manure subsurface applied (6000 gal/ac)
Surface-applied swine manure incorporated the next day	Swine manure was applied to the surface and cultivated within 24 hours (6000 gal/ac)
Zero nitrogen check	No Nitrogen Applied

Results

Table 3. Manure Analysis

	Nutrient (lbs/1000 gallons)
Nitrogen, Ammonium	40.1
Phosphorus as P_2O_5	14.7
K_2O	28.3

Table 4. Yield Results

	Yield bu/acre			Average
Treatments	**2020**	**2021**	**2022**	
Incorporated 28% UAN	93.6	210.6	234.1	179.4b
Subsurface applied swine finishing manure	131.1	222.2	244.2	199.2a
Surface applied swine finishing manure incorporated the next day	129.4	191.6	233.5	184.8b
Zero nitrogen check	58.6	56.9	90.4	68.6c

Average Yield LSD = 0.1, C.V. = 17.98

After three years of study, the subsurface applied swine finishing manure had the significantly highest average yield. The zero-nitrogen check was the significantly lowest average yield. The average yield for the 28% UAN and the surface applied swine finishing manure that was incorporated the next day were significantly higher than the zero-nitrogen check but significantly lower than the subsurface applied swine finishing manure.

Summary

The subsurface-applied swine finishing manure provided the highest corn yield each of the study years. In the three-year summary, this treatment had significantly higher yields compared to all other treatments. In the drought year of 2020, corn yields were substantially lower, best yields that year were achieved with the subsurface applied manure yield and the surface applied plus incorporation treatment. In both 2021 and 2022, the subsurface-applied manure treatment corn yield was significantly higher than the surface-applied plus incorporation treatment.

Based on the grain yield results, one could expect that some of the nitrogen from the surface applied manure was lost. Some strategies to address to close the yield gap on the surface applied manure treatment include 1) using starter nitrogen fertilizer, 2) incorporation of manure, 3) side-dressing nitrogen, 4) increasing the manure rate (e.g. gallons of manure applied per acre), or 5) earlier timing for surface applications of manure.

There is a yield benefit to manure applications in corn, whether subsurface or surface applied. The best results in this three-study were achieved with the subsurface application. The H2Ohio program can pay livestock producers to apply manure to growing crops via subsurface or surface application with incorporation. From this study, livestock producers should consider applying 15 pounds of nitrogen per acre to supplement the 200 pounds of nitrogen applied using the swine-finishing manure.

The final stand counts data at harvest for each of the three years of this study indicated similar stands across all treatments.

Acknowledgments
The author expresses appreciation to the Ohio Agricultural Research and Development Center employees for their assistance. Thanks to Stateler Family Farms for providing the swine-finishing manure.

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