# 2024 Corn Manure Trial Project

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## Purpose

To determine the effect and best fit of using manure at sidedress timing in standing corn as a nitrogen source.

Livestock producers can often be faced with the challenge of timely planting while also emptying manure storages before they become overfull. In-crop nutrient application also matches 4R nutrient stewardship with nutrients being applied at the time crops can best utilize them.

In light of this, producers are exploring various application timings to determine when they can most effectively apply manure.

This trial was specifically designed to compare various combinations of nutrient programs, consisting of commercial fertilizer and beef feedlot manure.

## Background

Foster's Custom Farming owns and operates a beef feedlot and has often been limited by manure application windows in the spring and fall. They made the decision a few years ago to purchase an in-crop Nuhn Row Crop manure applicator. The tank is 9000gal and is designed to open the ground, drop manure and then a pair of wavy coulters incorporates the manure into the soil in a 18-20" band. This widens the manure application window from about V5/V6 corn, until close to V10 timing (the true guideline is when the applicator toolbar starts snapping corn, not just bending it a bit while applying).

Figure 1: Nuhn Row Crop Manure Applicator used in the project

Figure 2: Manure application into corn

The beef feedlot manure has a high nutrient concentration which makes transporting to fields further from the farm more economical. Using manure as a sidedress material has helped them reduce fertilizer costs, both for corn sidedress and for soybeans, which typically follow the corn crop. It's also allowed them a larger application window and adds some flexibility to storage demands.

A combination of converted milk trucks and actual manure tanks are used to haul the manure to various farms, some more than 30km away. Using this applicator has also allowed them to get the manure into fields in more urban areas. The incorporation process reduces almost all of the odour that typically accompanies manure applications.

**Method**

One on-farm trial was completed in 2024. A tillage pass was completed across the entire field, and then fertilizer applications were made at 60' (18.2m) intervals. After a second tillage pass, the field was planted, all with the same variety. The trial consisted of 12 treatments, with 2 replications on the check treatment. Manure treatments were applied at approximately V6 stage, and all completed in one day. Fertilizer applications were applied to the remaining treatments 16 days later.

**Field History**

The field where the trial was conducted had soybeans in 2023, and corn the year prior (2022). Soil fertility levels in the field were relatively high (average pH 5.8; OM 5.2; P (bicarb) 50; K 173; CEC 19). The farm has a history of manure at sidedress when in corn, for a couple of crop rotations. The field has a history of good weed control and medium disease pressures (white mould in soybeans multiple years).

**Treatments**

| | Up-front/pre-plant broadcast | Sidedress treatment |
|---|---|---|
| **102** | 0lbs/ac | 440lbs/ac 42-0-0 3.8Su |
| **103 x4000gal** | 0lbs/ac | 4000gal manure injected |
| **103 x8000gal** | 0lbs/ac | 8000gal manure injected |
| **104** | 465lbs/ac 23-7-16 1.3Su | 4000gal manure injected |
| **105** | 235lbs/ac 23-7-16 1.3Su | 4000gal manure injected |
| **106** | 235lbs/ac 23-7-16 1.3Su | 4000gal manure Surface applied |
| **107** | 465lbs/ac 23-7-16 1.3Su | 4000gal manure injected |
| **108** | 465lbs/ac 23-7-16 1.3Su | 170lbs 42-0-0 3.8Su |
| **109** | 235lbs/ac 23-7-16 1.3Su | 170lbs 42-0-0 3.8Su |
| **110** | 465lbs/ac 23-7-16 1.3Su | 2800gal manure injected |
| **111** | 235lbs/ac 23-7-16 1.3Su | 2800gal manure injected |

| | | |
|---|---|---|
| **112** | 235lbs/ac 23-7-16 1.3Su | 2800gal manure injected |
| **113** | 465lbs/ac 23-7-16 1.3Su | 4000gal manure injected |

- Manure analysis: 11 % DM
- 80 lbs/1000 Imp gal Total N with ~60 % as $NH_4$-N
- Estimated available N-$P_2O_5$-$K_2O$/1,000 Imp gal: ~50-31-31 (Agrisuite) 40-26-26/1,000 US gal/ac

**Samples Collected**

- Pre-spring field work soil samples (pH, OM, P, K, Mg, Ca, Zn, Mn, Cu, Fe, CEC, K/Mg)
- Pre-sidedress N samples (PSNTs) at 12” a week before sidedress
- Manure analysis at time of application (DM, N, NH4-N, P, K, Mg, Ca, Zn, Mn, Cu, Fe, B, Na, Ec, C:N, OM, pH)
- Dosimeter tubes monitored twice a day for 7 days post application, for both manure & fertilizer treatments.
- Tissue tests (N, P, K, Mg, Ca, Zn, Mn, Cu, Fe, Bo, Su) at tassel
- Soil samples at tassel (6”, pH, OM, P, K, Mg, Ca, Zn, Mn, Cu, Fe, CEC, K/Mg)
- Soil N samples at tassel (12”, Nitrate Nitrogen & Ammonium Nitrogen)
- Stalk Nitrate Samples (taken late October, after corn reached maturity)
- Grain samples at harvest (test weight, moisture, oil, protein, starch)
- Post harvest soil samples (all treatments, 6” cores, pH, OM, P, K, Mg, Ca, Zn, Mn, Cu, Fe, CEC, K/Mg)

**Dosimeter Tubes**

*Dosimeter tubes are used to measure ammonia losses after nitrogen applications. A 12” plot stake is stuck in the ground with a binder clip attached sideways to hold the tube. The end is broken off the tube and then it’s slid into the binder clip. A 3-gallon pail with holes drilled in it is then placed upside down over the stake. This protocol was developed by Holly Loucas (Marijke Van Andel). The dosimeter tubes are then monitored each day, ideally 12 hours apart. Weather conditions, including windspeed, daily high and low temperatures, humidity and rainfall are also all recorded. At the conclusion of the seven days, the pails, stakes and tubes are removed from the field and the data collected can be entered in a formula (which is part of the protocol) to determine the pounds of N lost in that time frame.*

Tubes were checked every day at 7:00am and 7:00pm. Several of the treatments actually required the tube to be changed out, as they reached the maximum recordable value before the 7 days were up. Each of the pails were moved 3-4 feet (~1m) after each rainfall. Daily high and low temperatures, humidity levels, rainfall, and windspeed were recorded for each of the 7 days for both the manure and fertilizer treatments.

**Results**

Data was collected over the course of the growing season and samples were analyzed during the trial period; however a deep dive wasn’t completed until after harvest and the final soil samples were collected.

**Sampling**

The initial soil samples that were pulled before spring work began to create a baseline showed us that the soil test values for Phosphorus, Potassium and several micros were at levels that are above average for the region and soil type. While not a concerning levels, values were approaching luxury.

Pre-side dress nitrogen samples (PSNTs) collected approximately a week prior to the manure application showed us there wasn't a big difference in the Nitrate Nitrogen (ppm) values.

At tassel, we took soil samples, soil N samples and tissue samples. Soil nitrate samples at tassel time were inconsistent in what they showed. While some treatments showed lower Nitrate Nitrogen (ppm) values post-application, others showed an increase in values after application.

The three sets of soil samples pulled (6" cores) also showed conflicting results. P and K values fluctuated over the course of the season, and ultimately, in the post-harvest samples, test values were lower than the start of the season.

Tissue samples pulled at tassel timing were more with in the realm of what we were expecting. Treatments were tested for nitrogen, phosphorus, potassium, magnesium, calcium, zinc, manganese, copper, iron and boron. N, P and K values were all within normal ranges, however micros such as Manganese, Copper, Iron and Boron were all significantly above the critical values. That was consistent across all treatments.

**Dosimeter Tubes**

The dosimeter tubes provided a lot of insight into nitrogen losses. Some of it we already knew, but others were a surprised that we'd like to continue to dive into. Once we entered the data from the dosimeter tubes into the pre-developed formula, there were several key findings surrounding the ammonia losses.

- For all treatments with 4000 gal/ac manure injected at sidedress and an upfront fertilizer application, the average ammonia loss was 31lbs/ac (or 16%)
- For treatments with 4000 gal/ac manure surface applied at sidedress and an upfront fertilizer application, the average ammonia loss was 51lbs/ac (or 27%)
- For the one treatment with 8000gal manure injected (and an upfront fertilizer pass), the ammonia losses were 35lbs/ac (9.4%)
- For the treatments that received no up-front fertilizer and had 4000gal manure injected at side-dress, the average losses were lower – 10lbs/ac (5.4%). Compare this to a 27% loss on the treatments that did get an upfront broadcast.

The treatments that received only 2800 gallons/ac of manure injected at side-dress trended the same way as the 4,000 gallon/ac treatments. The treatments that got the full rate of up-front broadcast showed losses averaging 27%, compared to the treatments that received a half rate up front broadcast at 7.3%.

We saw higher N losses on days that had high winds or rainfall in excess of 10mm (usually thunderstorms). Days that received both high winds and larger rainfalls showed the higher losses.

Treatments that were side dressed with a urea blend saw significantly lower nitrogen losses compared to those that received manure. The average ammonia loss across all the urea treatments is 16.2lbs/ac.

**Yield Data**

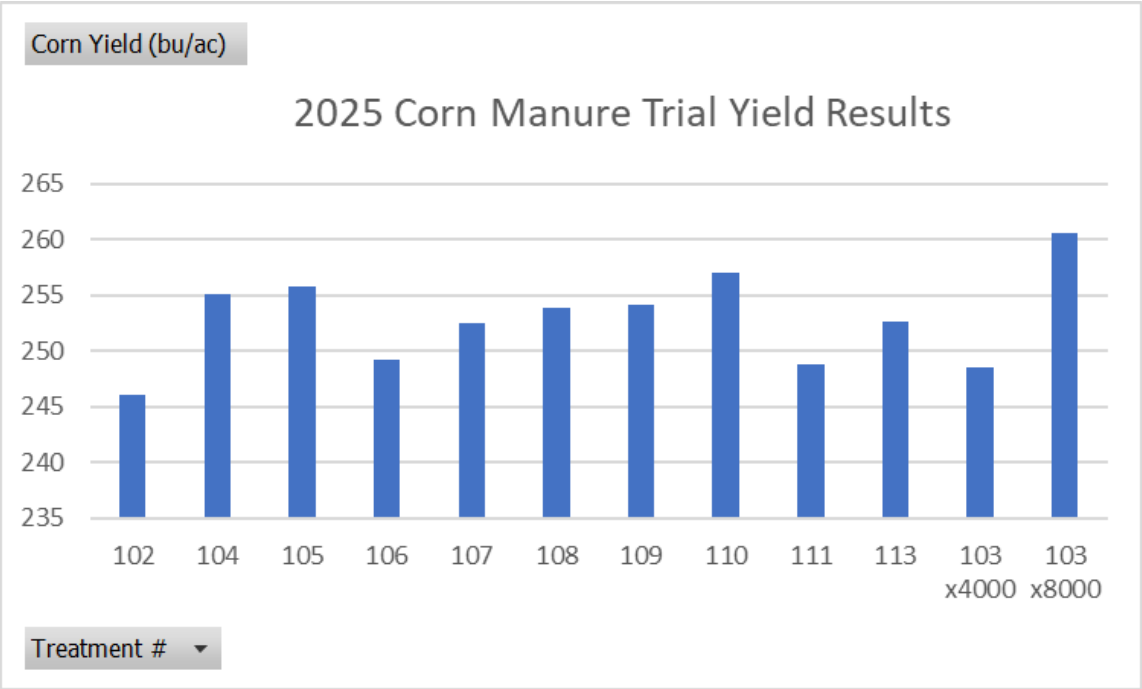
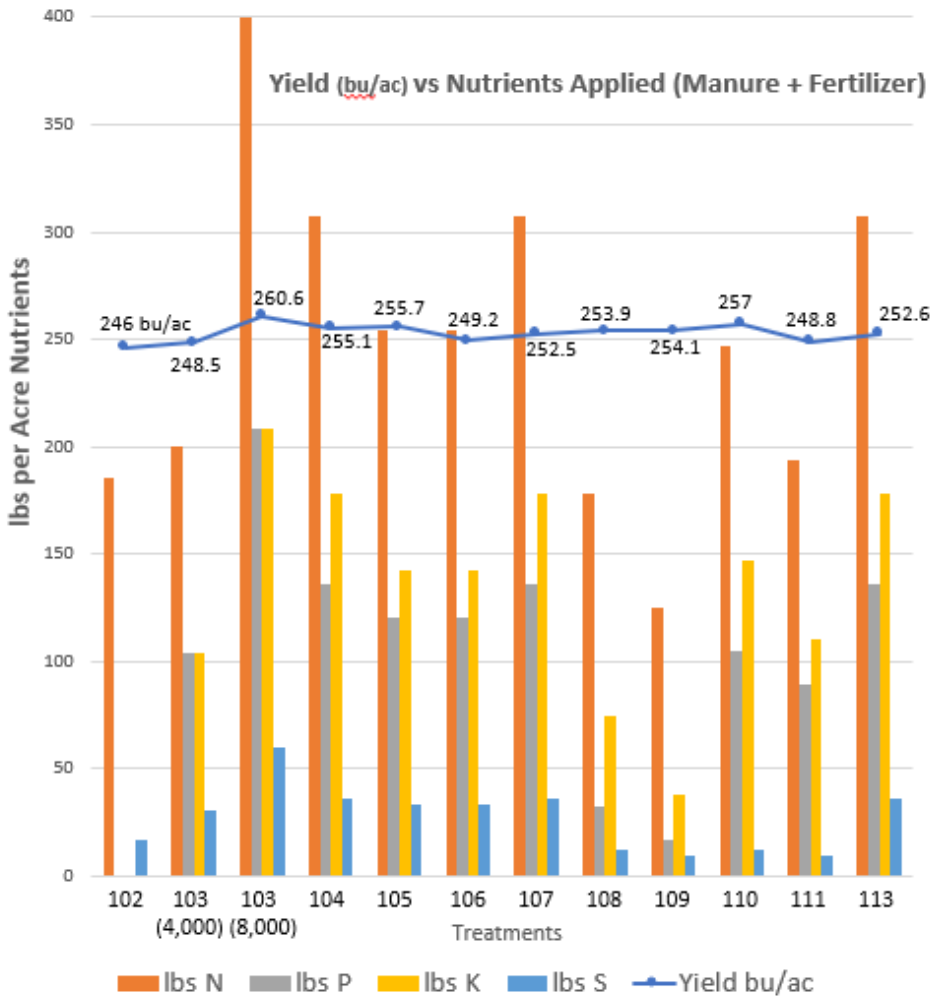



Figure 3. Corn yield results by treatment number.

Yields didn't vary dramatically between the treatments. The lowest yielding treatment averaged 246 bu/ac and the highest yielding averaged 260.6 bu/ac. Using the corn price on the day the trial was harvested ($5.32/bu), the economical difference in the 14.6-bushel range is $77.62. The treatments showed no significant differences in test weight, moisture, oil, protein or starch values.

The treatment that received no up-front fertilizer, but 8000gal of manure at side dress (508-327-277 N-P-K) topped the trial in yield data at 260.6bu/ac. However, treatment 110, with full rate of up-front broadcast, and 2800gal of manure at side dress (285-158-173 N-P-K) was a close second, yielding 257.0bu/ac. Economically, the 3 bushel yield advantage does not pay for the increased nutrient expense by applying nearly double the actual pounds of nitrogen, phosphorus and potassium. Treatments with no up-front fertilizer applications still yielded strongly – there's only a 14.6bu difference from the highest yielding to the lowest yielding. An economic analysis/cost breakdown will have to be completed to determine where the optimal combination of nutrient applications can be found.




Treatment Summary
102 – high rate side dress N
103 – manure at 4,000 gal/ac
103 – manure at 8,000 gal/ac
104 – high fert preplant + 4000 gal/ac
105 – low fert pre-plant + 4000 gal/ac
106 – low fert pre-plant + 4000 gal surface
107 – 4000 gal/ac + side dress N
108 – high fert pre-plant +low side dress N
109 – low fert pre-plant + low side dress N
110 - high fert preplant + 2800 gal/ac
111 – low fert preplant + 2800 gal/ac
113 – high fert preplant + 4000 gal/ac

Figure 4: Comparison of yield to the N, P, K and S (lbs/ac) applied from pre-plant fertilizer, manure, and side dress N

## Conclusion

This trial provided multiple opportunities for investigating further into the questions surrounding manure as a side dress material. While data was at times inconsistent, we did learn that extremely high rates of manure are not necessary to achieve high yields. There is also some intriguing data supporting the grower forgoing a pre-plant pass of fertilizer, and merely applying liquid starter with the seed. The responses we saw in this trial are specific to a number of things – higher testing soils are traditionally less responsive to nutrients, so we may see larger yield swings in fields with lower testing soil values. We also had a favourable growing season. Despite early rainfalls making planting challenging, consistent rains and above average heat units, alongside an extended, open fall, created a season where many growers had well above average farm yields, no matter the level of management for that crop.

The dosimeter tubes also gave us a new perspective into ammonia losses in corn, and how they may change, outside of the realm of varying rates, weather, etc. The drastic changes in losses for treatments that received a pre-plant fertilizer pass compared to those that didn't leaves room for more inquiry – something that may be pursued with the farmer-co-operator in the future.