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# Using Feedlot Manure as a Crop Nutrient Source

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As most of South Dakota seems to be drying out from the previous record setting year of precipitation, feedlot cleanout now seems like a possibility. Feedlot manure is an excellent source of crop nutrients. What was seen as a nuisance in the distant past has become a valuable nutrient and soil health building commodity. Manure is no longer viewed as a waste product. However, understanding the dynamics of prudent manure application is important for capturing the total value of the nutrients it contains as well as protecting the environment which includes water quality.

## Follow six basic steps for optimal manure/ nutrient application.

1. **Determine a realistic yield goal.** Setting a proper yield goal is not about the yield you "want" but the realistic yield you can "get". The steps in determining a yield goal should use the olympic average technique of actual reported yields from your fields the past 6-10 years (see example in Table 1). In the olympic averaging method, obvious highs and lows are removed. The remaining yields are averaged and multiplied by an efficiency factor. Depending on your field, zone or grid, the efficiency factor may be more or less, most are around 6% but no more than 10%. The efficiency factor allows for the increasing yield trends from year to year. Remember, a good yield goal is not about the yield you "want" but the yield you can "get".

Table 1. Olympic average yield goal

| Year | Corn grain yield (bu/a) |
|---|---|
| 2018 | ~~254 too high~~ |
| 2016 | 170 |
| 2014 | 150 |
| 2012 | ~~110 too low~~ |
| 2010 | 165 |
| 2008 | 155 |
| 2006 | 164 |
| 2004 | 156 |
| 2002 | 160 |
| **Average** | **160** |
| Efficiency factor | 6% |
| **Yield goal** | |
| 160 x 1.06 = | 169.6 = **170** |

2. **Determine amount of plant available nutrients in the soil.** Soil sampling and testing is the only way to determine the level of available plant nutrients. For help in determining appropriate soil sampling methods, consult the Recommend Soil Sampling Methods for South Dakota Guide (https://extension.sdstate.edu/recommended-soil-sampling-methods-south-dakota). Representable samples from common soil areas within a field, soil zones or grid points should be obtained and sent to an agricultural soil analysis laboratory (https://extension.sdstate.edu/soil-testing-labs).

3. **Determine crop nutrient requirements.** Crops differ in the amounts of nutrients they require. After determining your yield goal and completing step 2, consult the SDSU Fertilizer Recommendation Guide to determine the amount of nitrogen (N), phosphorus (P), potassium (K), and other nutrients required for the crop based on soil nutrient test levels and yield goal. (https://extension.sdstate.edu/fertilizer-recommendation-guide).

4. **Determine amount of nutrients available in the manure.** Feedlot manure is one of the most difficult manure sources to obtain a representable sample. Since only one sample is needed to send to the lab, it is very important to grab several smaller samples to composite into one sample to send to the lab. Try to sample manure in the feedlot or pile that best represents the majority of the available manure. Try to avoid getting "dirt" in the sample. While there is no typical manure analysis that can be used for your operation, it therefore becomes very important to get a sample that represents your operation. The lab does not need a large sample, but it needs to be representable. After getting many sub-samples (at least 10) try to mix or blend and provide about a quart of sample to the lab. The sample can be frozen if it cannot be shipped immediately to the lab. It is a great idea to double bag the sample in case the primary bag opens during shipment.

5. **Interpreting the Manure analysis.** Most labs report N and P content in the manure as these nutrients are the ones with regulatory concerns. Special requests can be made for other nutrients such as potassium (K), sulfur (S), and zinc (Zn).

The labs will generally report manure N content as ammonia N and Total N. The ammonia N is usually very low in feedlot manure and is known as the inorganic N source. This N is all plant available when it is injected or incorporated into the soil. When the manure is not incorporated into the soil, it can be lost to the atmosphere and is what you can smell. Because feedlot manure is low in inorganic N, surface applications are often not immediately incorporated. Some producers who can do a great job of evenly spreading feedlot manure in a thin enough layer have been know just to plant through it with no issues. The total N is the amount of ammonia N plus organic N, and feedlot manure is predominately organic N. The amount of organic N is calculated by subtracting the ammonia N (inorganic N) from the total N. This organic N is broken down into inorganic N (nitrate N and ammonium N) very slowly over time by microbial activity in the soil. These inorganic N forms are then usable by crops. During the first year after manure application, approximately 35% of the organic N is released for plant uptake. The remaining 65% should release during the second year. Manure with a high organic N content is the ultimate slow release N fertilizer.

Most of the P that is measured in the manure analysis is plant available during the first year. Since manure is a mixed nutrient source, applications of manure for given nitrogen crop needs will usually result in over applications of P and therefore, over time, the soil test P will increase. Higher and higher levels of soil phosphorus are not good for environmental protection of our surface waters in South Dakota. Therefore, it is a good idea to rotate manure applications from field to field and use soil testing to monitor soil test phosphorus levels. The goal with phosphorus is to keep soil levels in the optimum ranges (SDSU Fertilizer Recommendation Guide) for crop production and spread out the manure resource to benefit more acres.

The manure analysis will usually give results in pounds per ton as received manure. If the manure has 12 pounds of total N and 2 pounds of ammonia N per ton, there would be 10 pounds of organic N per ton (12-10). Since 35% of the organic N is available during the first year after application, there would be 3.5 pounds of available organic

N per ton. If the manure is incorporated soon after application, one could add the 2 pounds of inorganic N (ammonia) as well. One must not forget to use the 65% remaining organic N during the second year of crop production after manure application.

6. **Determining a manure application rate.** After you have determined your realistic yield goal (step 1), soil nutrient level (step 2), crop nutrient requirements (step 3), and nutrient content of your manure (step 4), you can calculate the level of nutrients that need to be applied to your field from manure and/or other fertilizers to optimize your crop yield. In the example below, the steps in the SDSU Fertilizer Recommendation Guide will be used to determine the nutrient requirements for corn.

## Example:

- Realistic corn yield goal: 170 bushels per acre
- Soil test results: 40 pounds of available nitrate-N in the top two feet of soil and the soil test P (Olsen) is 8 ppm.
- Soybean legume credit: 40 lb/a N credit because previous crop was soybean.
- Manure content: 3.5 lbs of available N and 8 lbs of available phosphorus per ton.
- Starter fertilizer application: 5 gallons/a 10-34-0 (equals approximately 6 lbs of N/a)

The yield goal is multiplied by 1.2 then the soil test N (40 lbs/a) and legume credit (40 lbs/a) is subtracted. The resulting N recommendation is 124 lbs N/a.

**170 bu/a yield goal × 1.2 – 40 lb/a N soil test credit – 40 lb/a N legume credit = 124 lbs N/a recommendation**

The farmer in this example is also applying 5 gpa of 10-34-0 starter fertilizer which contains 6 lbs of N resulting in an adjusted N requirement from manure to 118 lbs N/a.

**124 lb N/a recommendation – 6 lbs N/a from 10-34-0 = 118 lbs N/a needed from manure**

The amount of N per ton of manure (3.5) is then divided by the N needed (118) to determine the manure application rate which would be 33.7 tons per acre.

**118 lbs N/a / 3.5 lbs of N per ton = 33.7 tons of manure per acre**

The amount of phosphorus also applied at this application rate of 33.7 tons per acre is calculated by multiplying the application rate by the amount of phosphorus per ton of manure (8) which equals 269 lbs $P_2O_5$ per acre.

**33.7 tons of manure per acre × 8 lbs of $P_2O_5$ per ton of manure = 269 lbs $P_2O_5$ per acre**

This phosphorus rate is much higher than any typical fertilizer application. This is why manure applications need to be rotated between as many fields as possible. In this example with a soil test level of 8 ppm and yield goal of 170 bu/a, only 59 lbs of $P_2O_5$ were needed. It is ok to make this over application of phosphorus with this manure application, however it is important to note that the soil test P levels will greatly increase. SDSU recommends that soil test Olsen P be managed in the high category (12-16 ppm). Soil testing is the best tool to monitor soil nutrient levels and guide all nutrient applications from either manure or fertilizer.

## Alternative Option

In the manure application example discussed, over application of phosphorus occurred. Another option would be to cut the manure application for the purpose of spreading the manure across more acres to obtain the benefits from the phosphorus and therefore supplement the reduction in manure nitrogen application with fertilizer.

## Calibrating Manure spreaders

The South Dakota NRCS manure management team located in Mitchell (1820 North Kimball St.) is more than willing to help calibrate manure spreaders. Give the team a call at (605) 996-1564 Ext. 5.

## Summary

Feedlot manure is a great source for crop nutrients and building soil health. Proper use of manure through determining the appropriate crop nutrient needs based on realistic yield goals, use of soil sampling to determine the plant available nutrients in the soil and manure testing for available plant nutrients will lead to improved economic and environmental stewardship of our very important agricultural resources.

## References


Recommend Soil Sampling Methods for South Dakota Guide (https://extension.sdstate.edu/recommended-soil-sampling-methods-south-dakota)

SDSU Fertilizer Recommendation Guide (https://extension.sdstate.edu/fertilizer-recommendation-guide).

Soil Testing Labs (https://extension.sdstate.edu/soil-testing-labs).





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