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Nutrient Characteristics of Solid Beef Manure in North Dakota

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Introduction and Overview

In 2019, North Dakota had 995,000 head of beef cows and 42,000 head of cattle on feed (National Agricultural Statistics Services, 2020). A 1,000-pound beef cow in confinement and a 750-pound finishing beef cow will produce, on average, an estimated 54 pounds and 37 pounds of manure per day, respectively (Midwest Plan Service, 2004).

These numbers indicate that in 2019, approximately 55,284,000 pounds of manure were produced by beef animals in North Dakota. The manure has useful nutrients that are an effective agronomic fertilizer that also can improve soil health.

Solid beef manure contains the primary macronutrients nitrogen, phosphorus and potassium, as well as secondary macronutrients and several micronutrients.

For more information on using manure as a fertilizer in North Dakota, refer to the publication NM1629, "North Dakota Manure Fertilizer Use Recommendations." NM1259, "Solid Manure Sampling for Nutrient Management Planning," has information on how to test manure for nutrients properly.

Manure nutrient content can be impacted by several variables, such as North Dakota's dynamic climate and available feedstuffs for cattle (Lardy et al., 2015). Animal diet and maturity also can impact nutrient content.

As an animal grows to maturity, protein requirements decrease and carbohydrate forms change, thereby decreasing the concentration of these nutrients excreted as a percent of body weight. Similarly, increased levels of minerals fed to livestock (e.g. copper, phosphorus, sodium) increase the levels of those nutrients in the manure (Midwest Plan Service, 2004).

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A project was created to test and identify what nutrients are specifically available in North Dakota's beef manure.

From 2011 to 2013, 192 solid beef manure samples were collected across North Dakota and analyzed for nutrient content. **Tables 1, 2 and 3** summarize the results of the analyses. The samples were collected from a range of beef cattle varying in gender, physiological animal state, time of year, location and feedstuffs offered.

Results

Table 1 shows the results for dry matter and primary macronutrients (nitrogen, phosphorus and potassium) in the beef manure samples. Although the average solid beef manure nutrient content for total nitrogen is 13 pounds/ton, the most repeated value taken from the samples, known as the mode, is 11 pounds/ton, and the range was quite large at 4 to 32 pounds/ton. This demonstrates that although average nutrient content is convenient to use for planning purposes, actual values are likely to vary widely and, therefore, we strongly recommend that you to analyze manure for nutrient content on an individual farm basis.

Figure 1 (Page 3) shows the distribution of total N in the 192 samples. Thirty-two samples had between 12 and 14 pounds of N per ton of manure but 26 samples had between 4 and 6 pounds of N per ton of manure.

These trends were not limited to total N and are evident throughout the dataset. Large range variability can be seen in nearly every parameter tested in **Tables 1, 2 and 3**. Relying strictly on averages for actual application may lead to severe over- or underapplication of manure for fertilizer purposes. Underapplying manure can cause crop yield losses, and overapplying manure can have negative environmental impacts.

Table 1. Moisture content and macronutrient values of North Dakota solid beef manure.

Item	Moisture	Dry matter	Total nitrogen	Ammonium nitrogen	Nitrate nitrogen	Phosphorus	Potassium
	%		lbs/ton				
Mean	62	38	13	0.42	0.27	6.0	12
Mode	84	16	11	0.02	0.43	4.8	14
Range	7-87	13-93	4-32	0.01-3.60	0.00-3.40	1.4-21.0	1.5-34.0

Table 2. Secondary macronutrient and micronutrient content of North Dakota solid beef manure.

Item	Sodium*	Calcium	Magnesium	Zinc	Iron	Manganese	Copper	Sulfur
	lbs/ton							
Mean	1.37	15.83	5.81	0.08	5.50	0.40	0.02	2.27
Mode	1.10	15.00	2.00	0.11	1.40	0.19	0.02	2.40
Range	0.1-7.3	2.2-70.0	0.9-27.0	0.01-0.32	0.1-21.0	0.04-8.70	0.00-0.06	0.55-6.70

* Sodium is not an essential plant nutrient

Table 3. pH and EC values for North Dakota solid beef manure.

Item	pH	EC (1:2), mmhos/cma
Mean	8.2	5.1
Mode	8.8	2.9
Range	5.5-9.2	0.3-65.0

^a Electrical conductivity (EC) is the measurement of manure salinity.

- **Mean (average):** The sum of all the individual samples divided by the total number of samples
- **Mode:** The number that is most often seen in a set of samples
- **Range:** The minimum and maximum values of the samples

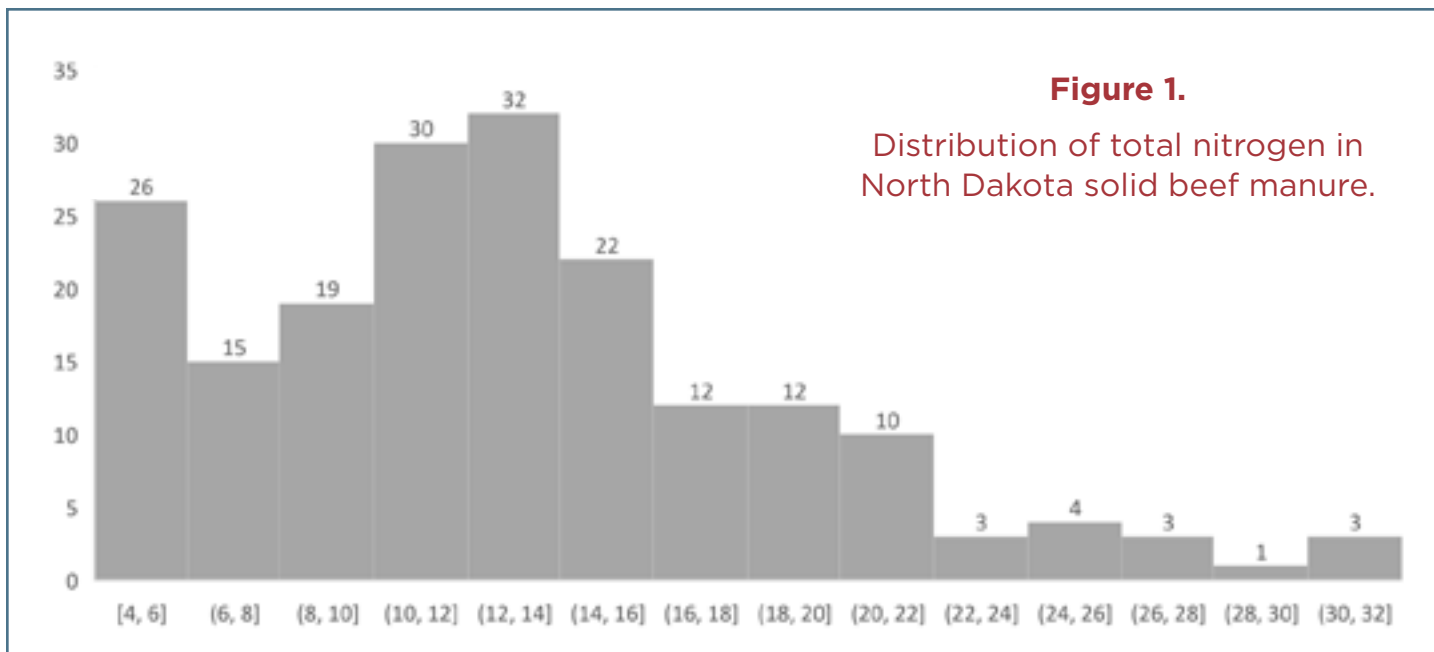


Figure 1.

Distribution of total nitrogen in North Dakota solid beef manure.

Table 2 shows the content of secondary macronutrients sulfur, calcium and magnesium, and micronutrients zinc, iron, manganese and copper. Sodium is not an essential plant nutrient.

Too much sodium can impact soil infiltration negatively and cause dispersion. Soil-applied manure will likely will not cause sodium issues.

Of these nutrients, sulfur may be a limiting nutrient in many common crops grown in North Dakota. Sulfur is especially important for canola and applications most likely will increase yields when applied

on sandy soils with low organic matter. Zinc may be beneficial for corn, flax, potatoes and dry edible beans (Franzen, 2018). Know and understand current food safety guidelines before using manure fertilizer in potato fields.

Table 3 shows the pH and electrical conductivity (EC) of the manure samples. pH is important to test for because it influences many chemical processes. Electrical conductivity measures salt content. Too much salt can hinder crop growth. However, when applied at agronomic rates, adverse effects of manure salts on crop production have not been observed.

Conclusion

While averages are convenient to have for planning purposes, actual values can vary widely. Therefore, analyzing your livestock manure for nutrient content is the best way to know the actual values to help make application as accurate as possible.

Manure testing should be paired with a soil test. Your NDSU Extension agent can help you find a laboratory that can analyze your manure and soil samples.

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Midwest Plan Service. 2004. Manure characteristics, MWPS-18 Section 1 Second Edition. Iowa State University, Ames, Iowa.

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Although fresh and composted beef manure contain the same nutrients, the management of each product as a fertilizer is different from a nitrogen standpoint.

The total nitrogen in solid beef manure is approximately 50% available for plant use during the first growing season, whereas the total nitrogen in properly composted beef manure is approximately 20% available.



More information on properly composting solid beef manure is available in “Composting Animal Manures: A Guide to the Process and Management of Animal Manure Compost” (NM1478).

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