Saskatchewan
Soil Conservation
Association

Soil Facts

Solid Cattle Manure

The application of cattle manure to farmland is an economical and environmentally sustainable mechanism for increasing crop production. Nutrients in cattle manure can replace commercial fertilizers. However, the value of manure is more than the accumulated value of the individual nutrients. Cattle manure is an excellent soil amendment capable of increasing soil quality. Manure can increase crop yields by providing large inputs of nutrients and organic material. The benefit of the nutrients and organic material may not be immediately evident. Therefore, the value of the manure can best be thought of as the overall crop yield and quality response over several years.

Solid cattle manure can be an excellent nutrient source and soil ammendment. Getting the maximum value out of cattle manure requires applying the manure at proper rates and frequency.

Cattle manure is a combination of feces and manure, bedding material, wasted feed, and water. In solid form as pen manure, it has a high organic matter content. The organic fraction of manure plays an important role in increasing soil organic matter and tilth, improving soil structure and water infiltration. Many of the nutrients in the manure, however, are tied up in the organic fraction and must go through a decomposition process to be converted to the inorganic forms available for plant uptake.

Getting the maximum value out of cattle manure requires applying the manure at proper rates and frequency. Over application can lead to transport of nutrients into the groundwater through leaching or overland flow. As well, over application can lead to losses of ammonia and nitrous oxide into the atmosphere. Contamination of the soil can also occur in situ, as excessive loading of nutrients, sodium and other soluble salts can reduce soil quality and productivity.

Table 1. Nutrient concentration in cattle manure.

	Solid Beef Manure (Lb/ tonne)	Commercial Fertilizer (Lb/ tonne)
Nitrogen (N)	7-36	1030
Phosphorus (P)	2-6	500
Potassium (K)	7-17	1160
Sulphur (S)	0.1-3	540

Note: multiply P by 2.3 to get P_2O_5 and K by 1.2 to get K_2O
Adapted from Schoenau , 1997

Best Management Practices

Adopting Best Management Practices for manure application requires:

1) knowing what is in the manure (manure nutrient analysis);

2) determining nutrients available in the soil (soil testing);

3) matching crop nutrient demand to total nutrients applied (in manure and commercial fertilizers);

4) strategy for application, and

5) record keeping and monitoring.

Composition of cattle manure varies considerably depending on the type of cattle, age, composition of feed, rations, climate, type of bedding, and manure storage and manure handling.

Cattle Manure as Fertilizer

Cattle manure has most of the nutrients required for plant growth. The manure can replace or reduce the need for commercial nutrients in crop production. However, the nutrient composition of manure varies considerably. The composition of manure differs for fresh or composted manure. It also varies with type of cattle, age, composition of feed, rations, climate, type of bedding, manure storage and manure handling.

Compared to commercial fertilizers, the relative nutrient concentration of cattle manure is quite low. This decreases the distance the manure can be economically transported. The low concentration of nutrients in cattle manure requires large application rates to apply an equivalent amount of nutrients.

In addition to the quantity of nutrients in the manure, it is important to know the form of the nutrients. Animal manure has nutrients in the inorganic and the organic form. Solid manure has a high percentage of nutrients in the non-plant available organic fraction. The organic form of the nutrients must undergo mineralization (decomposition) to convert it to the inorganic form. Solid cattle manure typically has 10% to 20% of the nitrogen immediately available in the inorganic fraction. A variable amount of the organic N becomes available through mineralization during the year of application, depending on the carbon: nitrogen ratio. For example, if the manure has a lot of straw bedding or woodchips mixed with it, the large amount of carbon relative to nitrogen will slow the release of available nitrogen and may result in limited increases in soil available nitrogen in the first year or two following application. The inorganic form of nitrogen in manure is found as ammonium nitrogen (NH_4-N). Lab tests will normally test for total N and ammonium nitrogen. Approximate organic N can be determined by subtracting ammonium-nitrogen (NH_4-N) from total N. The availability of phosphorus in cattle manure is estimated to be about 50% compared to commercial phosphorus fertilizer and the response to the phosphorus depends on the availability of other nutrients in the manure such as nitrogen.

Manure Sampling

The only way to determine the content and form of the nutrients in cattle manure is to sample the manure. Manure samples should be collected and sent to an analytical lab for analysis. Instant analysis techniques may be limited to analyzing for only one or two elements and there could be shortcomings in accuracy and precision. The nutrient content of manure is highly variable. Solid manure samples can be taken from holding areas or manure piles prior to application. Composite samples (7-15) should be mixed and sent to the lab for analysis.

Analyses Results

Laboratory analyses of manure usually present the nutrient content as a "wet %" basis, including solids plus water, as wet manure is the material that is applied to the field.

Manure software recommendation packages have been developed by commercial testing laboratories and government agencies. The software simplifies the rate calculations and allows record keeping and provides applicator calibration information.

It is important to know the relative amounts of nitrogen, phosphorus and other nutrients in order to avoid the over or under application of another nutrient. Getting the crop fertility requirements from manure is different than the fertility requirements from commercial fertilizer. The nutrient requirement of crops doesn't match the nutrient

composition of manure. Crops require nitrogen and phosphorus in a ratio of 10:1. The N:P ratio in cattle manure is often much less. This translates into an excess application of phosphorus when the nitrogen requirements are met.

Matching Nutrient Demand to Nutrients Supplied

Applying manure to meet the crop requirements for N may be accomplished without P overload initially as most prairie soils have a high pH and high phosphorus sorption capacity that immobilizes the P in the soil. However, if the soil phosphorus sorption capacity becomes saturated due to repeated applications in excess of crop removal, further additions of phosphorus may remain in a soluble, more mobile form. Sandy soils are the most susceptible to over application. Preventing soil erosion and overland water movement by maintaining soil cover through soil conservation practices such as direct seeding will prevent phosphorus from entering water systems.

Composting cattle manure reduces manure volume, destroys weeds and pathogens, stabilizes plant nutrients, and reduces odor.

Efficient, economic and environmentally sustainable manure application over the long term requires balance between manure nutrient application and crop nutrient demand. Determining application rates for the manure requires establishing target yields. Establishing target yields will determine the nutrient requirements of the crop. Required nutrients must be supplied either by the soil or the manure. Matching the nutrient requirements of the crop to nitrogen supplied by the manure and soil maximizes grain yield and protein without leaving excess nitrates in the soil.

Over application can occur by applying higher rates than the crop can take off over time. Since all nutrients aren't available in the year of application, repeated applications in excess of crop uptake are one method of over application. Over application can lead to nutrient saturation and losses. Excess nitrates in the soil are readily soluble in water and move with water. Nitrogen can also be lost to denitification as either N_2 or N_2O gases. N_2O is of concern because ti is a powerful greenhouse gas. Phosphorus is not as mobile as nitrates and tend to accumulate in the top layer of soil. Therefore, P is not as susceptible to deep leaching but can be lost with surface runoff and erosion.

Manure testing will give the operator a good indication of the nutrients applied to the field, but it can be difficult to determine the actual rate of applied available nutrient. Since the solid cattle manure cannot be injected into the soil, nutrient losses through volatilization, denitrification, and surface runoff are variable. Also, since the nutrients in cattle manure slowly become plant available it is hard to match the nutrients applied to the crop demand. The nutrients from a single application will slowly become available for plant uptake over a number of years. Soil testing is a critical tool in preventing over application of cattle manure.

Composting

Solid cattle manure can be applied either as fresh manure or as compost. Applying the manure as compost is an efficient method for handling cattle manure.

Applying compost may be preferable to fresh manure for the following reasons:

- Composted manure can be applied more uniformly and efficiently through the reduction of mass and volume.
- The nutrients are in a more stable form, more similar to that of soil humus.
- Proper composting can eliminate viable weed seeds and pathogens in the product.
- Odors during application are minimized.

Record Keeping

Good records will maximize nutrient utilization, reduce risk environmental damages and reduce liability. Records for manure application should include manure nutrient content, manure application rate, location of manure application, and the date of manure application. Crop records should include crop grown, commercial fertilizer added, yield, and nutrients removed with seed and straw.

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Canadian Cattlemen's Association
Canadian Pork Council / Conseil canadien du porc
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