Saskatchewan
Soil Conservation
Association

Soil Facts

Hog Manure BMP's

The application of hog manure to farmland is an economical and environmentally sustainable mechanism for increasing crop production while providing a waste management service for the hog industry. Nutrients in hog manure can replace commercial fertilizers. However, the value of manure is more than the accumulated value of the individual nutrients. Hog 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. Therefore, the value of the manure can best be thought of as the overall crop yield and quality response over several years.

Getting the maximum value out of liquid hog manure requires applying the manure at proper rates and using good application methods. Unique challenges arise with swine manure application. Over-application or improper application can lead to transport of nutrients into the groundwater through leaching or overland flow. As well, improper or over-application can lead to losses of ammonia and nitrous oxide into the atmosphere. Contamination of the soil can also occur in situ as excess quantities of nutrients, sodium and other soluble salts can reduce soil quality and productivity.

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);

Coulter injection systems have been developed to fit into existing direct seeding cropping systems.

4) strategy for application, and

5) record keeping and monitoring.

Hog Manure as a Fertilizer

Hog manure has most of the nutrients required for plant growth. The effluent 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 with moisture content. It also varies with type of hogs, age, composition of feed, rations, climate, the presence of bedding, manure storage and manure handling. Without bedding material or the addition of other solid materials, hog manure is in the liquid state (about 95% water). Liquid hog manure can be composted and spread as

Table 1. Nutrient concentration in hog manure.

	Liquid Swine Manure (Lb/ 1000 gallons)	Commercial Fertilizer (Lb/ 1000 gallons)
Nitrogen (N)	15-50	2000
Phosphorus (P)	1-20	700
Potassium (K)	8-20	700
Sulphur (S)	0.1-3	600

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

Soil surface after 3000 gallons per acres was injected into standing stubble with a coulter injection system.

Soil surface after 6000 gallons per acres was injected into standing stubble with a coulter injection system.

a solid, but requires additional manure handling and processing.

Compared to commercial fertilizers, the relative nutrient concentration of liquid hog manure is quite low. This decreases the distance the manure can be economically transported. The low concentration of nutrients in hog 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. Liquid hog manure has a high portion of the nutrients in the immediately plant available inorganic form. 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. Nutrients in the organic form must go through a decomposition process to be converted into the inorganic form. Between 50% to 90% of N in liquid hog manure is available for crop use in the year of application.

Phosphorus also exists in both the mineral (inorganic) and organic form. Phosphorus must be in the inorganic phosphate form to be plant available. Fall applied P *may be* less available than spring applied P. In the absence of lab results, applicators can assume 40% of P is available in year one.

The phosphorus content is found predominantly in the solid fraction of the liquid manure. An increased amount of solid material will typically be associated with increased amounts of total P. The phosphorus content of the effluent can be reduced through multi-phase storage systems as solids settle during each of the phases. By the latter stages a liquid virtually free of solids is created.

Soil surface after 9000 gallons per acres was injected into standing stubble with a coulter injection system. Note the effluent pooling on the surface.

Manure Sampling

The only way to determine the content and form of the nutrients in hog 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, so sampling technique is important. Sampling requirements will vary with analytical

Table 2. Estimated nitrogen losses during application

Application Method	Retention Factor
Injected manure	1.0
Surface spread and incorporated (within 24 hrs)	0.85
Surface spread without incorporation	0.65

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labs, however accurate sampling requires creating a slurry and taking a composite sample.

Analysis Results

Laboratory analysis of manure usually present the nutrient content as a "wet %" basis. This represents the percentage of that particular nutrient in the manure.

To calculate concentration in liquid manure:

- wet % x 100 = lbs/1000 gallons

- wet % x 10 = kg/1000 litres

To calculate equivalent pounds of P_2O_5

- total P x 2.3 = lbs of P_2O_5

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 hog manure is different than the fertility requirements from commercial fertilizer. The nutrient requirement of crops doesn't often match the nutrient composition of hog manure. Crops require nitrogen and phosphorus in a ratio of 10:1, but if the N:P ratio in manure is around 3:1, this translates into an excess application of phosphorus when the nitrogen requirements are met.

Matching Nutrient Demand to Nutrients Supplied

On most prairie agricultural soils, applying hog manure to meet the crop requirements for N can be safely accomplished without P overload. Prairie soils have a high pH and sorption capacity that immobilizes the P to the soil. 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.

Manure injection truck injecting 9000 gallons per acre. Note the pooling that occurs at higher injection rates.

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 thereby determining 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

Table 3. Calculating manure application rates - Example

A - Soil test N recommendation	95 lbs/ac
B - Total manure nitrogen	30 lbs/1000 gal
C - Ammonium (NH4) in manure	21 lbs/1000 gal
D - Estimated loss factor after volatilization	1.0
E - NH4 available in growing season:	C x D 21 x 1.0 = 21 lbs/1000 gal
F - Organic nitrogen:	B - C 30 - 21 = 9 lbs/1000 gal
G - Organic nitrogen available in growing season:	F x 0.30 9 x 0.3 = 2.7 lbs/1000 gal
H - Total nitrogen available in growing season:	E + G 21 + 2.7 = 23.7 lbs/1000 gal

Source: Saskatchewan Agriculture, Food and Rural Revitalization

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 moves wherever water does. Phosphorus is not as mobile as nitrates and tends to accumulate in the top layer of soil. Therefore P is not susceptible to leaching, but can be lost with surface runoff.

Application Technique

Application technique is also a very important method of minimizing losses. Injecting the manure into the soil is an important step to reducing gaseous losses of ammonia. The application method greatly determines the agronomic response to the manure. Injected manure provides greater crop response and nutrient recovery compared to surface applied manure. Odour is also minimized. The injection of manure can be done with low disturbance coulters or knives. Row spacing of less than 18 inches should be used to get good distribution and minimize volume in each row.

Surface spread and incorporated manure requires increased rates to match the yield response of the injected manure. This reflects the nutrients lost through volatilization and runoff.

The soil landscape should be conducive to manure application. Since large quantities of liquid hog manure are applied, soils and landscapes susceptible to leaching or runoff should be avoided.

Ideally, the manure should be applied in spring prior to seeding, but late fall applications when the soil is cooled are also effective. As with commercial fertilizer, volatilization and denitrification losses can be greater with fall application. Spreading of manure on snow or frozen ground is not a recommended practice. Winter application can result in overland runoff and volatilization.

Application to Established Forages and Crop Stands

Application to established forages and crop stands is a viable option that extends the window of opportunity for application. With minimum disturbance coulters, the liquid manure can be added to grass pastures and as a post- emergent option for cereals to boost protein and yield. Damage to the stand can be minimized if coulters are used, soil moisture is good and the application to the cereal crop is made early.

Timing of application is similar to commercial fertilizer applications. Crop response and forage growth determines the optimal application time. Forage crops can be injected in the fall or early spring. **Forages that have received manure application should be tested for nitrate content.**

Record Keeping

Good records will maximize nutrient utilization, reduce risk of 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.

For more information contact

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Canadian Cattlemen's Association

Canadian Pork Council / Conseil canadien du porc

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