Manure Management Facts

Liquid Gold?

The Composition of Liquid Pig Manure in Manitoba

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Introduction

Livestock typically excrete anywhere from about 50 per cent to 90 per cent of the nutrients they are fed, depending on their stage of growth. However, fully-grown animals that are not gaining weight, gestating or producing milk or eggs, excrete almost all of the nutrients they are fed. A major portion of these nutrients end up in the manure and can be recycled to fertilize crops and increase yields. Unfortunately, the water and nutrient content of manure varies greatly, making it more costly and challenging to manage than synthetic fertilizer.

The composition of liquid pig manure can vary according to:

- the type of housing and manure handling system
- the source and amount of additional water
- the stage of growth of the animals
- the diet (feed source and supplements)
- the type of manure storage structure
- the time manure spends in storage

Even an individual pig operation managed in the same way from one year to the next can have variations in manure analyses as a result of differences in weather.

Solids and associated nutrients in liquid manure settle to the bottom of storage structures relatively quickly, creating variability within each structure. Thinner, more dilute manure tends to be at the surface, with thicker, more concentrated manure at depth. In a two-celled manure storage structure, about one-third of the total volume is contained in the primary cell and is thicker than the remaining manure that is decanted to the secondary cell. Typically, liquid manure is aggressively agitated to re-suspend the solids and create a more uniform product. Therefore, manure nutrient composition is also greatly affected by how well the manure is mixed at the time of land application.

Estimating the nutrient composition of the manure is required to determine how much should be applied to produce optimal yields, while avoiding over-applying nutrients in the long term. The recommended method for estimating nutrient composition of manure involves creating a reliable, farm-specific database. Average nutrient concentrations can then be calculated from numerous manure nutrient analyses taken at multiple times during the pump-out of the storage structure over a number of years. Until reliable on-farm estimates are available, book values for liquid pig manure, like those below, can be used to determine manure application rates.

Manitoba

Results

Tables 1 to 4 contain dry matter and nutrient analyses from 2,703 liquid pig manure samples collected from 2010 to 2014 as part of annual manure management planning by Agra-Gold Consulting in Manitoba. These data have been organized by pig operation type (sow, nursery, feeder and farrow to finish) as well as by dry matter (DM) intervals (less than two per cent, two to four per cent and greater than four per cent). The DM intervals were established to group the manures according to increasing viscosity or thickness.

Almost 70 per cent of the sow manure samples were less than two per cent DM. Sow manure tends to have very low DM levels due to the higher water use in the barns. Only about 11 per cent of the samples from the sow, nursery and farrow to finish operations had greater than four per cent DM. About a third of the feeder manure samples, on the other hand, fell within each DM interval.

Mean and median nutrient concentrations consistently increased with each DM interval, particularly for phosphorus (P). When selecting book values to determine the amount of manure to apply, the median P concentrations based on the estimated dry matter ranges may be the most appropriate for manures with changing thickness.

The available nitrogen to phosphorus ratio (avail N:P_2O_5) provides a quick indication of how much P_2O_5 is applied per unit of available N. Most crops require around three or four units of available N for every unit of P_2O_5 they remove. Therefore, when manure is applied based on crop N requirements, manures with ratios below 3:1 supply more P_2O_5 than is removed by the crop. Manures with less than two per cent DM have median avail N:P_2O_5 ratios more closely matched to the ratios of what is used by crops (Tables 1-4). Manures with very low P contents can have very high avail N:P_2O_5 ratios which can be seen in the maximum avail N:P_2O_5 ratios for the manures with less than two per cent DM.

Tables 1 to 4 show the mean, median, maximum and minimum nutrient concentrations. Mean and median values are used to estimate typical nutrient concentrations in manure. The mean is the mathematical average of the data set, whereas the median is the middle number in the data set. If there are a few very high values in the dataset, the mean may overestimate the average and the median may be more indicative of a typical value. The range of the dataset is represented by the maximum and minimum values.

The ratios in Table 1 to 4 are the mean available N:P_2O_5 where available N is all of the ammonium-N plus 25 per cent of the organic N and P_2O_5 is 2.3 times total P. $P_2O_5$is the manure P expressed as the fertilizer equivalent.

Management Implications

Repeated application of more P than crops remove, results in a buildup of soil test P. As soil test P increases, the risk of P being lost to surface water in runoff also increases. Therefore, to minimize excessive buildup of soil test P, more intensive manure management strategies may be required. Ideally, manure management activities should be optimized so that P applications can be balanced with crop removals over the long term, while keeping manure application operations affordable.

The natural settling of solids in manure storage structures could be exploited to better manage P application rates. Agitation of the manure could be modified to allow the thinner manures that are lower in P to be pumped off for application to land that is high in soil test P and the thicker manures that are higher in P to be transported more economically to lands that are lower in soil test P and often further away.

Summary

The new book values for liquid pig manure provided in this factsheet can be used to estimate manure nutrient concentrations until a reliable database of manure analyses has been developed for the farm. For calculating manure application rates, the median concentrations in the tables below should be used, since the median values are the most typical for this dataset.

For More Information

- MAFRD Growing Opportunities (GO) Centre or Office
- **www.manitoba.ca/agriculture**

Table 1. Means, medians, maximums and minimums for total N, ammonium, organic N P, K, S, DM and available N:P_2O_5 ratios for liquid pig manure from sow operations.[¥]

Sow Operations		TKN	NH_4-N	Org N	P	K	S	DM	avail N: P_2O_5
		lb/1000 gal						%	
All	Mean	20.9	14.6	6.4	5.6	8.9	1.4	1.9	1.7
N=772[§]	Median	19.0	14.0	5.0	3.6	8.3	1.0	1.3	0.8
	Max	58.0	34.0	32.0	43.7	68.3	7.5	12.0	55.6
	Min	2.5	0.5	0.0	0.0	0.8	0.04	0.3	0.1
<2% DM	Mean	16.5	12.6	3.9	2.4	8.5	0.8	1.0	2.3
N=526	Median	16.0	12.0	4.0	1.8	8.3	0.7	0.9	1.5
	Max	35.0	30.0	18.0	8.3	18.3	2.0	1.9	55.6
	Min	2.5	0.5	0.0	0.0	0.8	0.0	0.3	0.2
2-4% DM	Mean	25.9	17.2	8.6	9.0	9.0	2.1	2.8	0.5
N=162	Median	26.0	17.0	9.0	8.7	9.2	2.1	2.7	0.4
	Max	41.0	28.0	22.0	15.3	22.5	3.8	4.0	1.3
	Min	12.0	8.8	0.0	4.0	3.8	1.1	2.0	0.2
>4% DM	Mean	38.8	21.4	17.3	19.5	11.3	4.1	6.0	0.3
N=84	Median	39.0	21.0	17.0	18.3	10.4	3.8	5.7	0.3
	Max	58.0	34.0	32.0	43.7	68.3	7.5	12.0	0.8
	Min	17.0	10.0	5.0	6.6	5.8	2.1	4.1	0.1

Table 2. Means, medians, maximums and minimums for total N, ammonium, organic N, P, K, S, DM and available N:P_2O_5 ratios for liquid pig manure from nursery operations.[¥]

Nursery Operations		TKN	NH_4-N	Org N	P	K	S	DM	avail N: P_2O_5
		lb/1000 gal						%	
All	Mean	26.2	17.9	8.3	5.9	13.7	2.3	2.4	1.3
N=301[§]	Median	24.8	17.0	7.2	4.8	13.3	1.9	2.0	0.8
	Max	71.0	44.0	35.0	48.0	43.3	9.0	12.0	32.2
	Min	7.2	1.8	0.0	0.1	0.3	0.0	0.4	0.1
<2% DM	Mean	18.7	13.7	5.0	2.6	11.6	1.3	1.2	1.9
N=146	Median	19.0	13.5	5.0	2.3	10.8	1.3	1.3	1.2
	Max	34.0	27.0	17.0	7.0	22.5	3.3	1.9	32.2
	Min	7.2	1.8	0.0	0.1	0.3	0.0	0.4	0.4
2-4% DM	Mean	29.7	20.0	9.7	7.2	15.1	2.7	2.7	0.8
N=120	Median	29.0	19.0	10.0	7.0	15.0	2.5	2.6	0.6
	Max	51.0	36.0	26.0	14.0	43.3	6.1	4.0	16.0
	Min	17.0	6.0	0.0	0.2	0.6	0.1	2.0	0.1
>4% DM	Mean	45.2	28.0	17.2	15.3	17.8	5.1	6.0	0.5
N=35	Median	45.0	28.0	16.0	14.4	17.5	4.6	5.2	0.5
	Max	71.0	44.0	35.0	48.0	29.2	9.0	12.0	0.9
	Min	30.0	13.0	4.0	7.0	7.7	3.2	4.1	0.1

Table 3. Means, medians, maximums and minimums for total N, ammonium, organic N, P, K, S, DM and available N:P_2O_5 ratios for liquid pig manure from feeder operations.[¥]

Feeder Operations		TKN	NH_4-N	Org N	P	K	S	DM	avail N: P_2O_5
		lb/1000 gal						%	
All	Mean	35.0	25.9	9.1	7.4	14.1	2.9	3.7	1.6
N=973[§]	Median	34.0	25.0	7.5	6.1	13.3	2.4	2.9	0.8
	Max	83.0	51.0	41.0	52.4	125.0	14.0	14.0	48.2
	Min	5.0	0.2	0.0	0.1	1.0	0.0	0.1	0.1
<2% DM	Mean	22.5	18.9	3.7	1.8	11.9	1.2	1.3	3.4
N=309	Median	22.4	19.0	3.5	1.6	11.7	1.0	1.2	2.4
	Max	50.0	32.0	27.0	7.0	23.3	5.0	1.9	48.2
	Min	5.0	4.2	0.0	0.1	1.1	0.0	0.1	0.5
2-4% DM	Mean	32.8	25.0	7.7	6.4	14.1	2.5	2.9	0.9
N=323	Median	33.0	25.0	7.0	6.1	13.3	2.2	2.8	0.8
	Max	51.0	41.0	34.8	52.4	125.0	14.0	4.0	7.3
	Min	16.0	0.2	0.0	0.5	1.0	0.2	2.0	0.1
>4% DM	Mean	48.3	33.1	15.2	13.3	16.2	4.9	6.6	0.6
N=341	Median	47.6	32.0	15.0	12.7	15.8	4.5	6.1	0.6
	Max	83.0	51.0	41.0	34.9	35.0	11.0	14.0	1.5
	Min	27.0	13.0	1.0	3.6	8.1	1.9	4.1	0.2

Table 4. Means, medians, maximums and minimums for total N, ammonium, organic N, P, K, S, DM and available N:P_2O_5 ratios for liquid pig manure from farrow to finish operations.[¥]

Farrow to Finish Operations		TKN	NH_4-N	Org N	P	K	S	DM	avail N: P_2O_5
		lb/1000 gal						%	
All	Mean	26.9	18.7	8.2	6.2	11.4	1.8	2.2	1.9
N=118[§]	Median	26.0	18.0	7.0	5.0	11.7	1.5	1.7	0.8
	Max	67.0	35.0	37.0	43.7	17.5	9.1	10.0	12.5
	Min	7.0	3.9	0.0	0.1	1.4	0.3	0.5	0.2
<2% DM	Mean	20.6	15.0	5.5	2.6	10.9	1.0	1.1	2.7
N=68	Median	19.0	14.5	5.5	1.9	10.8	0.9	1.0	1.4
	Max	32.0	27.0	15.2	7.0	15.8	2.0	1.9	12.5
	Min	7.0	3.9	0.0	0.1	3.7	0.3	0.5	0.4
2-4% DM	Mean	31.9	22.8	9.1	8.6	12.3	2.3	2.8	0.6
N=37	Median	32.0	22.0	9.0	8.3	13.3	2.3	2.8	0.6
	Max	43.5	35.0	16.0	14.0	17.5	4.2	4.0	1.0
	Min	18.0	8.9	0.0	4.80	5.8	1.3	2.0	0.2
>4% DM	Mean	45.5	26.4	19.1	17.7	11.5	4.5	6.3	1.0
N=13	Median	45.0	30.0	17.0	18.8	12.5	4.6	5.7	0.3
	Max	67.0	34.0	37.0	43.7	16.7	9.1	10.0	5.4
	Min	31.0	16.0	8.6	1.2	1.4	0.5	4.2	0.2

[¥] All data in Tables 1 to 4 provided by Agra-Gold Consulting (2015) for analyses conducted from 2010-2014.

[§] Number of samples in the dataset for operation manure type.