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NUTRIENT ANALYSIS OF SAND-LADEN DAIRY MANURE

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Summary

Nine concrete storage basins were sampled on Kansas dairies and analyzed for nutrient content of sand-laden dairy manure. The manure average 75% moisture content during the three sampling periods. The average total nitrogen, phosphate, and potash were 9.7, 4.6, and 7.4 lb/ton, respectively. The data collected from the basin indicated that when the scraped manure from a dairy is applied at an agronomic rate of 15 tons or less per acre, accumulation of nutrients should be minimal, in particular phosphorus. The manure value was $3 to $4 per ton depending on whether commercial sources of phosphorus normally would be applied to the cropland.

(Key Words: Manure, Nutrients, Sand.)

Introduction

Environmental regulations generally focus on control and proper land application of manure nutrients. State permit procedures require submission of a nutrient management plan. This usually includes an estimate of the manure nutrients applied to the land as well as crop nutrient utilization. Consulting engineers may work with the land owners and extension educators or crop consultants within a region to obtain reasonable nutrient utilization rates for the crops. However, data on manure nutrients actually applied to the land are not as readily available.

Many dairies use total mixed rations (TMR) and sand-bedded freestalls. The difficulties in handling sand-laden manure are offset by the benefits of cow comfort and higher milk quality. However, limited information is available on the nutrient content of sand-laden manure. The purpose of this study was to characterize the nutrients in sand-laden manure scraped from dairy facilities using TMR.

Procedures

The study includes data from three sampling dates: February 5, April 8, and August 13, 1999. Samples were collected from concrete manure storage basins at nine Kansas dairies. With one exception, all the dairies used sand bedding in the stalls. Each dairy scraped the freestall housing and feeding area and the milking parlor holding pen. The concrete basins were sized to provide 160 cubic ft of storage per cow. The depth of the basin was 4 ft, and the width and length were adjusted for each dairy's site and size. Rainwater and effluent could drain from a basin through a perforated gate (4 by 12 ft) or a perforated pipe riser. All dairies fed a corn silage-based TMR. These high-producing herds ranged from 60 to 120 cows.

Liquid manure samples were retrieved using a capped polyvinyl chloride cylinder attached to a metal electrical conduit handle. A cord was connected to open the spring-closed lid while it was under the surface. Depending on the amount of manure in the

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basin, samples were taken at depths of 0.5 to 3 ft. The sampler was used to open the crust and then was pushed to the desired depth before the lid was pulled open to collect the sample. Four to six individual samples were taken from around the perimeter (3 to 4 ft from the edge) of each basin and then mixed in a bucket to make one composite sample. A plastic funnel was used to pour the sample into a 1-liter plastic bottle. The samples were refrigerated until sent for laboratory analysis. Total nutrient analysis was completed on each sample by Servi-Tech Laboratories.

Results and Discussion

Table 1 shows the average results for the samples taken from nine dairies at three dates and the overall average. The results show very little variability among the concrete basins tested, even though the storage time and volume were different. Minimal differences among the average nutrient values occurred for sampling dates. The total nitrogen, P_2O_5, and K_2O averaged 10.1, 4.6, and 7.5 lbs per ton, respectively. The nitrogen to phosphorus (P_2O_5) utilization ratio of most crops is 2:1 to 4:1. Therefore, crops with a high N/P ratio would need supplemental N sources to meet their nutrient needs, if phosphorus was a limiting nutrient. If we assume that most of the ash content is from the sand scraped into the basins, approximately 10 to 25% by weight of every load is sand. More variability among the farms occurred for the ash content than any other nutrient. This is probably a reflection of the differences in the management of the cow housing areas and amount of sand used in the freestalls.

The moisture content of the solids applied to the land ranged from 66 to 83% with an average of 76% for the February samples. Manure spread from a concrete storage basin using gravity separation of the water may have a higher moisture content than that spread by mechanical separators using screens. The dry matter content was 24%.

The economic value of the nutrients is dependent on the current phosphorus levels of the cropland. The value of the manure placed on land with high phosphorus levels is only $3 per ton, if only credit for the nitrogen and potassium is taken. Manure value increases to $4 per ton, if credit for the phosphorus is included. These values were based on nitrogen, phosphate and potash values of $0.20, 0.30, and 0.14 per lb, respectively. Manure may serve as a lime replacement to increase the soil pH of cropland that is acidic. Soil quality may be improved by addition of the sand to improve moisture movement through the soil.

Conclusions

The following are preliminary conclusions obtained from this study:

1) The total nitrogen to phosphorus (P_2O_5) ratio of manure was approximately 2:1 from dairies using corn silage-based, total mixed rations.

2) Approximately 10 to 25% of the manure applied to the land by weight was sand.

3) In the concrete solid storage basins, the moisture content of the manure averaged 75% during the winter and spring months.

4) The economic value of the nutrients in the manure was $3 to $4 per ton depending upon the current phosphorus levels in the cropland.

Table 1. Nutrient Contents of Manure from Nine Dairies

		Sampling Month			Overall
Nutrient	Units	February	April	August	Average
Organic nitrogen	lb/ton	6.88	6.89	5.70	6.49
Urea	lb/ton	3.26	2.29	2.47	2.67
Nitrate-nitrogen	lb/ton	0.01	0.01	0.01	0.01
Total nitrogen	lb/ton	10.14	9.19	7.36	8.89
Phosphorus P_2O_5	lb/ton	4.62	4.49	5.45	4.85
Potassium K_2O	lb/ton	7.54	7.25	7.54	7.44
Calcium	lb/ton	8.04	7.80	8.72	8.19
Magnesium	lb/ton	3.14	3.13	3.81	3.36
Sulfur	lb/ton	1.27	1.23	1.36	1.29
Sodium	lb/ton	1.82	1.82	1.90	1.85
Zinc	lb/ton	0.05	0.05	0.06	0.05
Iron	lb/ton	1.40	1.48	1.65	1.51
Manganese	lb/ton	0.08	0.09	0.10	0.09
Copper	lb/ton	0.01	0.02	0.02	0.01
Boron	lb/ton	0.01	0.01	0.01	0.01
Other Properties					
Moisture	%	76.0	73.8	76.3	75.4
Solids	%	24.0	26.2	23.7	24.6
Organic matter	lb/ton	195.74	198.52	197.59	197.3
Ash	lb/ton	284.93	324.74	275.70	295.1
Carbon/nitrogen ratio		11	12	14	12
Electrical conductivity	mmho/cm	10.4	6.2	33.6	16.7
pH		7.3	6.9	6.8	7.0
Total salts	lb/ton	36.10	35.10	38.41	36.54