MANURE COMPOSITION FROM KANSAS SWINE LAGOONS

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Summary

Analysis of 41 manure samples from Kansas swine lagoons revealed that nutrient concentrations were higher than previously reported values from the Nebraska Cooperative Extension Service and the Midwest Planning Service. In addition, high standard deviations indicated that considerable variation exists in composition of waste in swine lagoons. Although means from some lagoons were lower, most producers had manure that analyzed higher than previously published values from other sources. These data reveal the importance of individual analysis of lagoons for proper application to cropland to maximize yield and environmental stewardship. Additional research needs to be completed to provide a more detailed understanding of nutrient concentrations from manure samples in Kansas.

(Key Words: Swine Lagoons, Manure, Environment.)

Introduction

Manure application to cropland compared to direct application of inorganic fertilizer is an important economic consideration for producers. Soil characteristics of structure, tilth, and water holding capacity are improved when manure is applied. Although applying swine manure to cropland is a common practice, active participation in environmental stewardship must be a top priority. Currently, no database for manure nutrient concentrations exists from Kansas swine lagoons, therefore,values from other sources are used to compare Kansas concentrations. Many potential problems with using these values exist, because these concentrations possibly were generated in other geographic locations with no uniform sampling technique and from samples collected many years ago. Furthermore, changes in management practices (i.e., phase-feeding, decreased particle size) and dietary factors such as feeding milo and wheat, which have greater available P than corn, also may affect the composition of Kansas swine lagoons. Therefore, a need exists for a database from samples of manure to determine the level of nutrients and minerals in Kansas swine lagoons. The objective of this survey was to determine mean concentrations of major and minor nutrients in swine lagoon samples from analysis filed in nutrient management plans at the Kansas Department of Agriculture in accordance with of HB 2950.

Procedures

Analyses of swine manure from 41 Kansas swine lagoons were obtained from the Kansas Department of Agriculture. Manure samples were obtained in 1999 from farrowing to finishing, sow, nursery, weaning to finishing, and finishing operations. The manure samples were collected by the individual operations for chemical analysis. Therefore, the sampling technique, time of year, type of lagoon, sample handling prior to analysis, and the laboratory used were not

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controlled among operations participating in this survey. Average concentrations of specific nutrients and minerals from all lagoons were summarized to obtain a database for mean values. In addition, the standard deviation (SD) of the mean for each nutrient and mineral was calculated. One SD indicates that 68% of the samples are ± 1 standard deviation from the mean. A range of two SDs would include 95% of the samples.

Results and Discussion

The nitrogen contents of the manure from Kansas lagoons (Table 1) were higher than previously reported values from sources located in other states (Table 2). For ammonium nitrogen (NH_4-N), which is available to plants during the growing season, Kansas lagoon concentrations were 709 ppm compared to 375 ppm from the Nebraska Cooperative Extension Service. The SD for NH_4-N was 398 ppm. This indicates that 68% of the samples have a range of 310 to 1,107 ppm concentration of NH_4-N. The amount of organic nitrogen (OrgN), which is nitrogen that is slowly released from the manure into the soil, was 190 ppm with an SD of 209 ppm. In addition, the amount of nitrogen in the nitrate form was less than 1 ppm. The total nitrogen in the manure, which is the sum of ammonium-nitrogen, organic-nitrogen, and nitrate-nitrogen, was 899 ppm with an SD of 584 ppm. This compares to the values from Nebraska and the Midwest Planning Service of 500 and 625 ppm, respectively.

For phosphorous concentration, the level of phosphate (P_2O_5) was 371 ppm. This mean is similar to the reported value of 375 ppm from the Midwest Planning Service. But, with an SD of 549 ppm, many of the manure samples would have concentrations under the Midwest Planning Service values. Elemental phosphorus, which is calculated by multiplying P_2O_5 by .44, had a mean of 163 ppm.

Potash (K_2O) levels were double the previous reported concentrations: 1,043 ppm compared to 500 ppm for both Nebraska and the Midwest Planning Service. For potassium, which is calculated by multiplying K_2O by .83, Kansas swine lagoons had a mean of 847 ppm. However, the SDs of 617 ppm for K_2O and 519 ppm for potassium indicated a high degree of variability among samples in this survey.

Our summary of the lagoons in Kansas also includes additional nutrients and mineral concentrations. Currently, we are not aware of any other sources with which to compare these major and minor nutrients concentrations. However, high SDs for the majority of these nutrients and minerals indicated a high variation between samples.

In order to determine how different types of operations compare in manure concentrations, as well as to increase the current knowledge of swine manure content, we are planning a study to further analyze nutrients in swine waste. This will allow determination of manure content from different phases of production with a uniform sampling technique to reduce possible variation between samples.

Application of manure to farmland is an environmentally and economically feasible practice for swine producers. Results for 1999 manure concentrations from Kansas swine lagoons indicate the importance of individual manure analyses of all manure storage facilities. In addition to management and dietary factors that could contribute to the variation in manure composition, variation between laboratories may exist. The Minnesota Department of Agriculture has established a certification process for laboratories conducting manure analysis. Producers are recommended to have certified labs analyze their samples to ensure accuracy of manure composition. This practice will allow proper amounts of manure to be supplied to cropland for optimal plant growth, as well as increase environmental stewardship by swine producers.

Table 1. 1999 Nutrient and Mineral Concentrations of Kansas Swine Lagoons[a]

Item, ppm	Mean	SD	Minimum	Maximum
Nitrogen				
Total nitrogen, N	899	584	76	2,361
Organic-nitrogen, OrgN	190	209	12	1,107
Ammonium-nitrogen, NH_4-N	709	398	64	1,702
Nitrate-nitrogen, NO_3-N	< 1	0.0	< 1	< 1
Major Nutrients				
Phosphorus, P	163	241	13	1,209
Phosphate, P_2O_5	371	549	30	2,748
Potassium, K	847	519	164	2,069
Potash, K_2O	1,043	617	190	2,400
Sulfur, S	44	43	10	200
Calcium, Ca	154	85	40	345
Magnesium, Mg	60	82	6	226
Magnesium oxide, MgO	76	81	10	330
Minor Nutrients				
Zinc, Zn	6.2	8.9	1	32
Iron, Fe	19.0	25.4	2	67
Manganese, Mn	2.0	2.9	0	9
Copper, Cu	1.6	2.3	0	12
Boron, B	1.2	.8	0	3
Other Constituents				
Sodium, Na	243	112	90	400
Chloride, Cl	390	248	73	1,149
Carbonate, CO_3	< 1	0.0	< 1	< 1
Bicarbonate, HCO_3	3,943	1,609	714	5,868
pH	8.0	.6	6.1	8.8

[a]Values represent the means of 41 swine lagoon samples. These analyses were sent into the Kansas Department of Agricultural as part of compliance with KHB 2950.

Table 2. Nutrient Concentrations of Swine Lagoon Manure

Item, ppm[a]	Nebraska[b]	Midwest Planning Service[c]
Nitrogen		
Total nitrogen, N	500	625
Ammonia-nitrogen, NH_4-N	375	NR[d]
Major Nutrients		
Phosphate, P_2O_5	250	375
Phosphorus, P[e]	110	165
Potash, K_2O	500	500
Potassium, K[f]	415	415

[a]Converted from lb/1,000 gal.
[b]Nebraska Cooperative Extension Service, EC 89-117, Lincoln, NE.
[c]1993.
[d]Not reported.
[e]Converted by multiplying P_2O_5 by .44.
[f]Converted by multiplying K_2O by .83.