MINERAL COMPOSITION AND PH OF DAIRY WASTE

R. M. Jones and M. A. Sanderson

Summary

Utilizing dairy manure in forage production requires knowledge of its mineral composition for efficient nutrient use. Manure was analyzed for 10 mineral elements and pH at 17 application dates during 4 years and found to vary widely in composition. Nitrogen (N) concentration of manure "as is" (variable moisture) ranged from 0.73% to 2.24% and phosphorus (P) concentration ranged from 0.36% to 0.85%. Dry matter of manure ranged from 42% to 75%. Because of this high variation, we recommend analysis of manure for N and P at each application to achieve target nutrient rates.

Introduction

The intensification of the dairy industry in Central Texas has resulted in waste (manure) disposal problems. Disposal of manure through use in forage crop production requires knowing its plant nutrient concentration. Since 1992 we have begun two studies to evaluate forage systems for manure disposal. Manure was analyzed for plant nutrient minerals at each of 17 applications during these studies. This report focuses on the variation in the mineral composition of manure.

Procedure

Manure was obtained from the same dairy for all application dates and was used in two studies to evaluate forage systems for waste management. This dairy has approximately 500 milking cows confined in holding pens located on a rocky, sloping (4%-6%) terrain. Manure was scraped from these pens weekly and stockpiled before land application. We used manure from these stockpiles when it was available, but otherwise we used manure that was scraped and loaded directly from the pens. Therefore, the manure varied in soil, rock, and water content. Rocks were removed by sieving with a one-inch mesh screen. A manure sample was collected from each of 4 randomized complete blocks during application on 17 dates. The sample was

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thoroughly mixed and divided into 4 subsamples. Three subsamples were used for mineral analyses, pH, and dry matter determinations. A fourth subsample was stored in a freezer. Dry matter was determined by drying manure subsamples at 131° F for 48 hr. The pH of a manure slurry was measured with a pH meter for subsamples collected on all but two dates. Manure subsamples were placed into sealed plastic bags and frozen for later analysis or sent directly to the Texas Agricultural Extension Service Soil, Water, and Forage Testing Laboratory at College Station. Manure was analyzed for N, P, potassium (K), calcium (Ca), magnesium (Mg), sodium (Na), zinc (Zn), iron (Fe), copper (Cu), and manganese (Mn). Results were reported on an "as is" basis. Coefficients of variation (CV) were calculated by multiplying the standard deviation by 100, dividing by the mean, and were reported as percent. No attempt was made to relate dairy ration to manure mineral content.

Results and Discussion

Mineral composition of manure varied widely (Table 1). Iron, Na, and N were the most variable with coefficients of variation (CV) of 62%, 33%, and 32%, respectively. Nitrogen concentration ranged from 0.73% to 2.24%, P ranged from 0.36% to 0.85%, and K concentration ranged from 0.67% to 1.61% of the "as is" weight. Manganese, Zn, and Ca concentrations were the least variable, with CV between 15% and 20%. Manure pH ranged from 8.0 to 9.4, but was less variable (CV = 4%) than elemental composition. Variation of dry matter from 42% to 75% (CV = 16%) caused some of the variation in elemental composition.

Variation in application rates of nutrients in manure can be illustrated by comparing manure analyses within our studies and with published values (Sweeten 1989). Assuming that the target rate of 400 lbs N/acre is to be applied annually to Coastal bermudagrass (*Cynodon*

dactylon L. Pers.), we find that 18,182 lbs manure/acre would be required (2.2% N, wet basis, Sweeten). At this manure rate, 200 lbs P_2O_5 and 291 lbs K_2O/acre would also be applied. If the same rate of manure is applied (18,182 lbs/acre), but the actual N concentration is 2.24% (our highest N analysis), then 407, 354, and 353 lbs N, P_2O_5, and K_2O/acre, respectively, would be applied. (This P_2O_5 rate would be more than triple the required rate for Coastal bermudagrass, since it uses N, P_2O_5, and K_2O in a 4:1:3 ratio.) However, if the actual manure N concentration should be our minimum (0.73%), then significantly less nutrients would be applied (133 lbs N, 196 lbs P_2O_5, and 199 lbs K_2O/acre).

These data show that manure composition varies widely. This variation may be a result of frequency of drylot scraping (freshness of the manure), amount of soil removed during scraping, rainfall, changes in dietary components, and other factors. Thus, using average or "book" values for manure composition may result in over- or under-application of nutrients and perhaps result in environmental problems. The N:P composition ratio of manure is generally too low for most crops, so that too much P will be applied when adequate N is used. Analysis at each manure application is necessary if target nutrient rates are to be achieved.

Literature Cited

Sweeten, J. M. 1989. Dairy manure handling systems and equipment. Texas Agri. Ext. Ser. Bulletin 1446.

Table 1. Mean dry matter, pH, and plant nutrient content of dairy manure at application on different dates.

	DM	N	P	K	Ca	Mg	Na	Zn	Fe	Cu	Mn	pH
Date	percent[1]						ppm[1]					
17 Jun 1992	57.4	1.71	0.80	1.55								9.1
31 Aug 1992	70.9	1.49	0.74	1.57								9.2
3 Mar 1993	60.5	0.99	0.45	1.11								9.4
18 May 1993	71.0	1.19	0.49	0.99	1.69	0.32	2165	114	591	21	112	8.9
29 Jun 1993	68.4	0.80	0.36	0.91	2.72	0.32	1708	89	82	17	126	9.2
11 Feb 1994	48.0	1.34	0.44	0.85	2.97	0.36	1723	139	564	25	126	8.9
20 Apr 1994	75.0	2.24	0.85	1.61	2.44	0.61	3598	262	850	37	173	
17 May 1994	51.4	1.67	0.80	1.42	1.68	0.51	4238	208	521	38	128	
10 Jun 1994	49.6	1.26	0.64	1.24	2.48	0.46	3438	170	660	34	135	8.9
19 Oct 1994	53.3	0.99	0.52	1.05	2.17	0.46	3008	153	1344	30	145	8.6
21 Oct 1994	53.3	0.96	0.47	0.97	1.67	0.43	2193	140	1588	26	144	8.8
20 Feb 1995	50.3	1.10	0.40	0.70	1.56	0.35	1808	147	253	20	122	8.0
20 Apr 1995	42.1	1.15	0.47	0.67	1.60	0.39	1945	157	298	21	116	8.1
25 Apr 1995	67.4	0.79	0.36	0.75	1.91	0.32	1548	126	853	18	153	9.0
2 Jun 1995	57.3	1.13	0.59	0.91	1.80	0.52	2410	180	938	25	179	8.9
1 Nov 1995	62.6	0.73	0.47	0.91	2.79	0.42	1793	185	462	26	174	8.3
1 Nov 1995	66.9	0.81	0.44	1.06	2.90	0.44	2132	198	487	26	179	8.5
Mean	59.1	1.2	0.55	1.07	1.79	0.35	1983	162	678	26	144	7.8
Std. Dev.	9.3	0.39	0.15	0.29	0.51	0.08	803	25	420	6	22	0.4
CV (%)	16	32	28	27	24	20	33	15	62	23	15	4

[1]Values are means of four replications and are reported on an "as is" basis.