Organic Nutrients

By A.E. Ludwick and A.M. Johnston

Organic nutrient sources are economic and agronomic resources that can supplement inorganic fertilizer use. They contain varying concentrations of essential nutrients and provide organic carbon (C) that enhances physical properties of soils. When applied in excess of crop removal, organic nutrients can be potentially damaging to the environment because of excessive nitrate (NO_3^-) leaching to groundwater, phosphorus (P) moving to surface waters through runoff and erosion, and ammonia (NH_3) loss to the atmosphere. Indiscriminate use of animal manure and sewage sludge can also create human health hazards because of the accumulation of heavy metals and pathogens. A further challenge of managing manure as a nutrient source is that of variable composition, as shown in **Table 1**.

The dominant source of livestock manure potentially recoverable in North America is from confined animal operations, including beef and dairy cattle, swine, and poultry...about 38 million animals in the U.S. The total number of such operations is declining, but average size is increasing.

Nutrients from manure that are available for land application in North America were recently estimated at about 2,865 million pounds of nitrogen (N), 3,691 million pounds of P_2O_5, and 4,318 million pounds of K_2O (**Table 2**). Much of this manure is already being used in crop production, so it represents a part of the nutrient pool rather than a potential addition. It is uncertain, however, what proportion of the nutrients from manure is being efficiently utilized as opposed to that being disposed of as a waste.

Poultry contributes the largest amount of recoverable N and P of all livestock types in the U.S., while milk cows contribute the most potassium (K), **Table 3**. The contributions of poultry and swine have been increasing while other livestock types have been on the decline.

For example, the poultry contribution of recoverable N grew from

Livestock production operations are declining in number and growing in size. This concentration of animal units (AU) has led to problems in utilizing manure for maximum agronomic and environmental benefit. The issue facing North America is how to economically transport or otherwise utilize a product of large volume and low nutrient content.

TABLE 1. Average composition of various manures.

	Total N, % by wt.	NH_4-N, % of total N	Ratio N:P_2O_5	Ratio N:K_2O
Liquid				
Hog	0.37	62	1.5:1	1.9:1
Dairy	0.29	48	1.8:1	0.9:1
Beef	0.25	64	1.4:1	1.2:1
Poultry	0.75	75	1.2:1	2.0:1
Solid				
Hog	1.00	27	0.7:1	1.2:1
Dairy	1.10	12	3.4:1	2.0:1
Beef	0.59	12	1.8:1	0.8:1
Poultry	2.00	27	1:1	1.5:1

Calculated from OMAFRA, 1998; (based on total composition).

TABLE 2. Recoverable nutrients from manure produced by livestock in the U.S. in 1997 and Canada in 1996.

	Million pounds of recoverable nutrients (available for soil application)		
	N	P_2O_5	K_2O
U.S.			
Fattened cattle	390	582	755
Milk cows	636	559	1,072
Other beef and dairy	131	248	364
Swine	274	634	811
Poultry	1,153	1,268	812
All livestock types	2,583	3,290	3,814
Canada			
Fattened cattle	102	153	185
Milk cows	89	78	140
Other beef and dairy	12	26	33
Swine	45	104	125
Poultry	33	39	21
All livestock types	282	400	505
Total, North America	**2,865**	**3,691**	**4,318**

U.S. N and P data: Kellogg et al., 2000.
U.S. K data: Dr. C.H. Lander, NRCS (personal communication).
Canadian data: Anonymous, 1997.

TABLE 3. Percent of total recoverable manure nutrients accounted for by each livestock type in the U.S. in 1997.

	Recoverable nutrients, %		
Livestock type	**N**	**P_2O_5**	**K_2O**
Fattened cattle	15.1	17.7	19.8
Milk cows	24.6	17.0	28.1
Other beef and dairy	5.1	7.5	9.5
Swine	10.6	19.3	21.3
Poultry	44.6	38.5	21.3
All types	100.0	100.0	100.0

N and P data: Kellogg et al., 2000.
K data: Dr. C.H. Lander, NRCS (personal communication).

The amount of livestock manure available for land application in North America continues to increase.

34 percent in 1982 to 45 percent in 1997, while the swine contribution grew from 9 percent in 1982 to 11 percent in 1997. The greatest percent decline in recoverable manure nutrient contribution during this period occurred for milk cows.

The amount of farm-level manure will continue to increase as confined livestock numbers rise. Also, the percentage of recoverable nutrients will likely increase as handling and processing facilities improve. Estimates for the U.S. show that currently only 20 percent of excreted manure N and about 37 percent of P and K are recoverable.

Historically, manure has been applied based on its N content, but repeated applications on the same areas have resulted in a buildup of soil P. Guidelines are now being developed to evaluate the environmental hazards associated with this excess P and how they can be minimized through controlled application rates.

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