



NEWSLETTER

November 2007

This month, the Heartland Animal Manure Management Newsletter contains articles titled :

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Changing Nutrient Values mean 'New' Focus on Manure

By John Lawrence and Joe Lally, Iowa State University

In nutrient management planning a lot of attention is paid to balancing available nutrients from manure to the nutrients needed for crop production. One perspective is to look at whole farm balance accounting for nutrients entering the livestock farm in the form of purchased feed, fertilizer, and animals or as N fixed by legumes, and the nutrients leaving the farm in the form of animals or crops. Any imbalance between inputs and outputs could be added to soil reserves or lost to the environment. Nutrient planners evaluate this balance at the field level or even within a field. They develop a plan that is often defined by regulations or guidelines set by state or federal agencies.

When it comes to nutrient management most farmers have three objectives. First, they are stewards of the land and water and want to do the right thing. Second, if they are permitted or that have an EQIP contract they are legally bound to implement their plan. Third, they are in business to make a profit. Between 2002 and 2007 commercial fertilizer prices have doubled. Now, all three objectives are more closely aligned.

Table 1 illustrates how the value of manure has increased as the April price of commercial fertilizer has risen. The price in N rose from \$0.19 / unit in 2002 to \$0.42 / unit in 2007 or 121% increase. Similarly, the P₂O₅ and K₂O per unit costs have increased by 87% and 77%, respectively. As a result, the value of manure in a corn-soybean rotation has doubled in five years.

The opportunity to utilize manure nutrients will depend on the management activities that govern the capture of the nutrient load. Nitrogen, the leakiest element of all three will escape to the environment if given no consideration for its value or volatility. Land treatments, rotations, tillage practices, timing of application, and

environmental influences all contribute to successful manure handling and application of this source of natural and essential crop nutrients.

The value of manure nutrients is an opportunity to capture and nutrients are valued based on what can be utilized by crops. Farmers can capture greater value, greater profit, by putting manure nutrients where they are needed. That is where a nutrient management plan is essential. Now, that manure has more potential value they have the incentive to manage it closer to the plan, a plan that incorporated agronomics and stewardship.

Table 1. Impact of Changing Fertilizer prices on Manure Values 2007 v. 2002: 1000 A.U. Capacity Farm, 200 bushel corn - 60 bushel soybeans Rotation

Species	2002	2007	\$value/ unit 2002	\$value/ unit 2007	\$value/ac 2002 (cb)	\$value/ac 2007 (cb)
	NS.00 PS.00 K\$.00	NS.00 PS.00 K\$.00				
Grow-Finish Hogs (150 lbs) 625,000 gal	\$0.191 \$0.240 \$0.137	\$0.424 \$0.454 \$0.233	\$11.08 \$9.60 <u>\$6.16</u> \$26.84	\$24.59 \$18.16 <u>\$10.48</u> \$53.23	(every other year) \$78.64 212 ac. 2930 g/ac	(every other year) \$155.96 212 ac 2930 g/ac
Dairy Cows (1200 + lbs) 4,697,550 g	\$0.191 \$0.240 \$0.137	\$0.424 \$0.454 \$0.233	\$4.77 \$2.88 <u>\$1.50</u> \$9.15	\$10.60 \$5.44 <u>\$2.56</u> \$18.60	(every other year) \$80.52 533 ac. 8,800 g/ac	(every other year) \$163.68 533 ac 8,800 g/ac
Beef – Open Lot (1000 lbs) 2,000 T	\$0.191 \$0.240 \$0.137	\$0.424 \$0.454 \$0.233	\$3.05 \$3.84 <u>\$1.91</u> \$8.80	\$6.74 \$7.26 <u>\$3.26</u> \$17.26	(every fourth year) \$176.00 100 ac. 20 T/ac	(every fourth year) \$345.20 100 ac. 20 T/ac
Layer, Caged (6 lbs) 1,050 T	\$0.191 \$0.240 \$0.137	\$0.424 \$0.454 \$0.233	\$4.77 \$19.20 <u>\$6.85</u> \$30.82	\$10.60 \$36.32 <u>\$11.65</u> \$58.57	(every fourth year) \$123.28 262 ac. 4 T/ac	(every fourth year) \$234.28 262 ac. 4 T/ac
Turkey litter (10 lbs) 1,944 T	\$0.191 \$0.240 \$0.137	\$0.424 \$0.454 \$0.233	\$3.82 \$9.60 <u>\$3.42</u> \$16.84	\$8.48 \$18.16 <u>\$5.82</u> \$32.46	(every fourth year) \$134.72 243 ac. 8 T/ac.	(every fourth year) \$259.68 243 ac. 8 T/ac

The assumptions used in this table include:

- Corn-Soybean rotation, manure applied ahead of corn
- The land receiving the manure **can** utilize the nutrients and achieve the yield goal
- Multi-year application of P₂O₅ and K₂O and nutrient applications will stay put until the growing crop demands the nutrients.
- Additional N is added to corn in year three of four year rotations.

Transport of Pathogens (part 2 of a 4 part series)

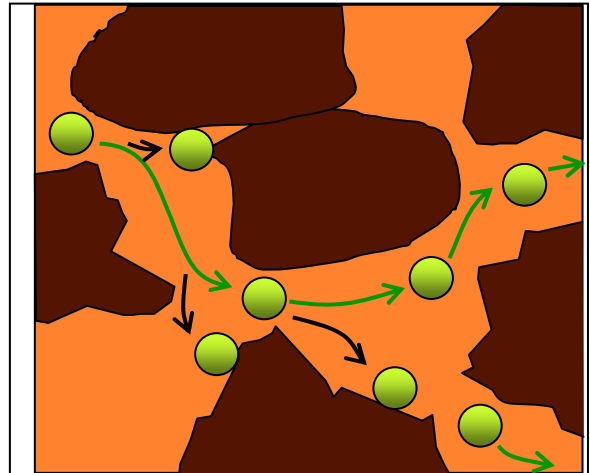
Rick Koelsch, University of Nebraska and Janice Ward, USGS

Introduction:

The movement of pathogens to water is dependent upon multiple environmental and transport factors.

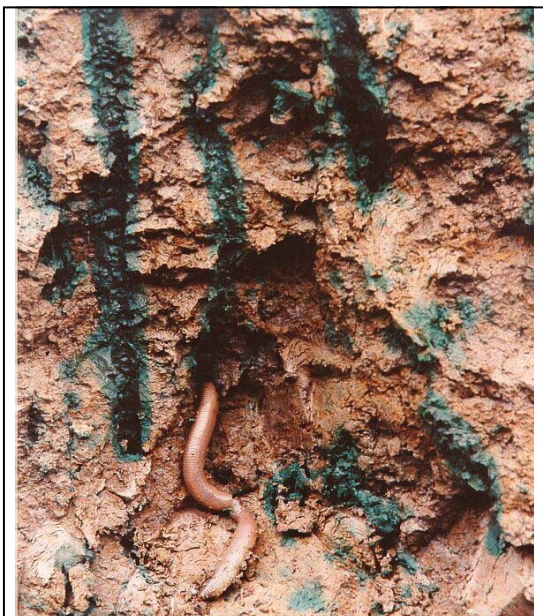
Thomas Harter, Groundwater Hydrologist at University of California-Davis discusses potential for ground water contamination:

“While invisible to the human eye, most pathogens are giants of the micro-world....A typical bacterial pathogen is ... much too large to fit between the clay or silt particles of many clay, silt, or loam soils. Only in sandy soils, the pore space is indeed large enough to provide ample traveling space for pathogens. Even there, pathogens frequently collide onto grain surfaces where they tend to become permanently attached. Ultimately, most pathogens are strained or filtered out of the water cycle long before reaching groundwater or a stream. Even if pathogens reach an aquifer, the aquifer itself will filter most remaining pathogens over relatively short distances (100 ft – 300 ft), ...



“Protozoa and bacterial pathogen are commonly too large to fit between the particles in most soils.

Graphic source: Thomas Harter, Cooperative Extension Specialist, Groundwater Hydrology, University of California, Davis



Macropores, caused by earthworms, roots, and cracks, allow pathogens to travel unfiltered through some soil. Image from <http://www.bee.cornell.edu/wlab/SoilWaterWeb/Research/pfweb/>

Dan Shelton, Environmental Microbial Safety Lab Research Leader, USDA Agricultural Research Service identifies some important exceptions including:

“sandy or rocky soils, which generally allow for greater infiltration, ...heavy soils (e.g., clay) containing significant cracks or fissures, or channels created by decayed plant roots or burrowing worms, (creating potential contamination of shallow ground water or tile drains)..., and soils/subsoils throughout the Appalachian region derived from limestone geological formations (know as karst). Finally, improper installation of wells can allow for direct contamination of groundwater via the leaching of organisms along the well casing.”

Pathogen contamination of surface water is more common than contamination of groundwater. Direct contact of animals

with surface water or runoff from animal housing is a significant risk. Land application sites with high runoff and erosion potential provide an additional potential pathogen connection to surface water. Thus, soil and nutrient conservation practices that minimize runoff and erosion are key BMPs for pathogen risk reduction.

Environmental factors also influence pathogen survival in the environment. Jeanette Thurston-Enriquez, USDA Agricultural Research Service scientist, summarizes environmental factors that reduce the survival of pathogens:

- *“High temperatures- each pathogen has a different susceptibility but generally high temperatures are very effective in reducing populations.*
- *Time- bacteria are living organisms, so they can't live forever...*
- *Sunlight-has a couple of effects on pathogens. It desiccates (reduced moisture) them and the UV light also inactivates pathogens...*
- *Desiccation- is one of the best ways to inactivate pathogens in the environment.”*

Typical survival time (Table 1) are summarized in a Manitoba Agriculture and Food publication, “Livestock Pathogens: a Natural Occurrence” found at <http://www.gov.mb.ca/agriculture/livestock/publicconcerns/cwa01s11.html>

Table 1. Survival times for various pathogens (days until the pathogen can no longer be detected).							
Material	Temperature	Giardia	Crypto-sporidium	Salmon-ella	Campy-lobacter	E. coli 0157:H7	Yersinia enterocolitica
Water	Frozen	< 7	> 84	> 182	14-56	> 300	> 365
	Cold (41 F)	77	> 84	> 182	8-120	> 91	> 365
	Warm (95 F)	14	70	45-152	>2	49-84	10
Soil	Frozen	< 7	> 84	> 84	14-56	> 300	> 365
	Cold (41 F)	49	56	63	20	99	> 365
	Warm (95 F)	7	28	> 45	10	56	10
Cattle Manure	Frozen	< 7	> 84	> 196	14-56	> 100	> 365
	Cold (41 F)	7	56	84-196	7-21	70	30-100
	Warm (95 F)	7	28	48	3	49-56	10-30
Pig Manure	-	365	> 365	13-75	> 112	10-100	12-28
Compost	-	14	28	7-14	7	7	7
Dry Surfaces	-	1	1	1-7	1	1	1

Hormones in Field Applied Animal Manure: Should We Be Concerned?

Teshome Regassa, University of Nebraska

The annual conference of American Society of Agronomy, Soil Science Society of American, and Crop Science Society of America was held in New Orleans, Louisiana from November 4-6. I wanted to share some of the research presentations and initiate discussion among peers relative to potential environmental risks associated with hormones in manure. The interaction of manure application with soil processes especially the degradation and transport component in relation to the fate of these potential contaminants.

A couple of research projects evaluated the fate of steroid hormones borne in field applied manure. Estrogen, androgen, and progesterone excretion rates of farm animals in the US have been estimated to be, respectively 49, 4.4, and 270 t/yr. Land application of manure thus is potentially contributing steroid hormone to the aquatic environment. Steroids in the environment also known as endocrine disruptors are responsible for causing hormone imbalance in aquatic animals such as fish resulting in impaired normal embryonic development and disruption of normal reproductive functions of affected animals. It is estimated that a dairy cow excretes two orders of magnitude more steroid oestrogens than humans while a pig excretes more than one order of magnitude than human. Consequently, it is important to determine the fate of steroid hormones to enable predictions of their long-term effects in the environment.

A study from Colorado by Borch and coworkers indicated the importance of photolysis in the degradation and removal of hormones in the environments and that humic acid influenced such photo-degradation potential of hormones especially that of 17β -estradiol. This may imply relevance for soil organic matter and the importance of interaction of soil processes at various levels affecting the degradation of environmental pollutants.

Another study from Denmark addressing the same issue identified the hormone 17β -estradiol and its degradation product estrone as an important environmental concern in areas where manure is used for land application in tile drained fields. The manure source bearing the hormone for this study was slurry from pregnant and cycling pigs. Both 17β -estradiol and estrone are potential endocrine disruptors at extremely low rates. The study suggested application of manure slurry even at the recommended manure application rate and method had potential contamination threat to the environment. Estrogens continued to leach from the root zone at concentrations exceeding the lowest observed effect level (level to cause physiological abnormality in target animals). This happened as long as three months after the application of manure. The findings show environmental threat due to hormones and their derivatives from environmental degradation after field application of manure particularly when manure is applied to areas where the majority of stream water derives from drainage water or the soil type allows deeper solute percolation or high degree of leaching.

The message from these studies is that the producer, the research-extension community, and the regulatory agencies may need to take a better look at the fate of

hormones such as 17 β -estradiol and their derivatives. It should be understood that the derivatives formed in the animal body or in the environment may not have the same environmental behavior as the parent product. Environmental behavior of derivatives may not be understood even if the parent product may have been evaluated. The characteristics of the parent product are not necessarily the same as its derivatives.

Often, gain of new information and new technologies result to the emergence of new ways of doing business. It also brings effects in to the system with a direct and indirect consequences.

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Kjær J., P. Olsen, K. Bach, H. C. Barlebo, F. Ingerslev, M. Hansen, and B. Halling-Sørensen. 2007. Leaching of Estrogenic Hormones from Manure-Treated Structured Soils. *Environ. Sci. Technol.*, 41 (11), 3911 -3917, 2007