

to only a few antibiotics, one might rethink using antibiotics for treating diarrhea. Fluid therapy and preventive medicine are likely to be the best way to manage GI infections.

### Antibiograms

In general, the antibiogram (Table 1) for respiratory diseases in cattle, *P. multocida* and *Mannheimia haemolytica*, shows that the bacteria are susceptible to most antibiotics. When looking at resistance over time a statistically significant trend does occur for *P. multocida* to tetracycline, going from 100 to 67 percent susceptible from 1998 to 2002, respectively. Tribriessen shows a numeric trend towards resistance, but at this time the trend is not statistically significant. No trend towards resistance has been observed for *Mannheimia haemolytica* at this time. In conclusion, these data greatly differ from that of the GI bacteria in that the commonly used antibiotics used to treat respiratory disease are still effective except for tetracycline in some cases.

The mastitis antibiogram (Table 2) covers the years 1997 thru 2000. Like the respiratory pathogens, a generalization can be made that the bacteria are susceptible to a majority of the antibiotics, although *S. aureus* has a lower susceptibility to ampicillin and penicillin. *Streptococci* are highly susceptible to all antibiotics except *S. agalactiae* is highly resistance to gentamicin. As for the coliforms, *E. coli* and *K. pneumoniae*, they are susceptible to most antibiotics. Analysis found no trend for resistance over time for the mastitis pathogens to any of these antibiotics. This does not mean that prudent use of antibiotics can cease. An area that can be improved upon

is to stop the use of antibiotics for treating coliform mastitis. These bacteria may show susceptibility in a laboratory test, but with susceptibility testing a 'susceptible' result does not always lead to a clinical cure, which is the case with mastitis due to *E. coli* or *K. pneumoniae* infections. Instead, coliform mastitis should be treated with anti-inflammatory agents and fluids.

### Summary

Antibiograms may help dairy producers make more educated choices about which antibiotic might work when culture results are not available. Information gathered from an antibiogram is helpful in establishing standard operating procedures on a farm for employees to know when and which antibiotics should be used. The down side to antibiograms is that they are not readily available to farmers or veterinarians. With farms expanding, large operations are finding that having an antibiogram for their farm is beneficial economically because older generation drugs are just as effective as newer more expensive ones.

So the next time you are about to give a calf an antibiotic for a cough, think about the respiratory antibiogram and think about which drug you should use. Should I use tetracycline, sulfa, or ceftiofur? The longer we can preserve the antibiotics available to us, the longer effective therapy will remain.



## Nutrient Management

# Manure Application on Tile-Drained Cropland

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**M**uch of the productive cropland in the Great Lakes region has been improved with drain tile for sub-surface drainage. Most of this land is in animal production areas where animal manure is applied to the land as part of an important nutrient use and manure treatment program.

On some fields, land-applied manure quickly enters sub-surface drains by preferential flow through macropores—large, continuous openings in soil formed by plant roots, cracks, earthworms, and other natural processes. Nutrients and contaminants that escape from application sites through sub-surface drains are not recycled in the cropping system and can degrade surface waters.

To address this issue, a group of researchers, extension educators, and Natural Resource Conservation Service (NRCS) personnel from Michigan and Ohio organized a conference held in Columbus, Ohio in early November, 2004. The conference brought together stakeholders in an educational

and networking effort to better understand the nature and scope of the challenge, to share guidelines and suggestions for improved management of livestock manures, and to identify research needs and extension opportunities to ensure continued development of sustainable livestock systems. Conference attendees included farm managers, regulatory and technical service providers, extension personnel, and researchers from the Great Lakes region.

A summary of the conference follows.

### Scope of the Challenge

William Boyd, leader of the NRCS animal waste utilization team in Greensboro, NC presented information about the potential scope of the challenge.

- Across the U.S., about 72,000 farms have excess manure (based on land area and manure nutrient levels for crop production). More than 250,000 farms need a Comprehensive Nutrient Management Plan (CNMP).
- In the Great Lakes region (excluding Pennsylvania and New York), only seven counties have excess manure. But that

number increases to 41 counties if drained cropland is assumed not available for land application. Many of the most productive counties in Michigan are included.

### On-Farm Manure Application

Martin Shipitalo, USDA-ARS, and Frank Gibbs, Ohio NRCS reported on work with on-farm manure application.

- Injected manure in no-till cropland has appeared in sub-surface drains within minutes of application. Earthworm holes were the primary transmission routes.
- Tillage disrupted macropores, delayed manure movement and greatly decreased bacterial concentration in the effluent.

### Ohio Violations

Jim Hoorman, The Ohio State University water quality educator reviewed Ohio Department of Natural Resource records of 98 manure violations in 2000-2003.

- Violations occurred throughout the year, predominantly in October-December. About two-thirds occurred on wet ground or in rainy weather.
- Reported application rates ranged from 1,400 to 47,500 gallon/acre. But, in cases where Soil and Water Conservation Districts were able to verify rates, operators had applied about twice the rate reported to investigators.
- Violations occurred most often because of: **1)** excessive rain or saturated soil; **2)** over-application; **3)** poor management of storage facilities; **4)** ponding of surface applications or excessive irrigation; and, **5)** tiles lines already flowing at the time of application, or a tile plug that failed.

### Management Challenges

Tim Harrigan, Department of Biosystems and Agricultural Engineering, Michigan State University (MSU) addressed retention of manure in the root zone for nutrient recycling and removal of contaminants.

- Managing tillage intensity, amount of manure applied, and timing of application as well as expanding the land and cropping base available for application are opportunity areas.
- Manure management must be farm- and field-specific. Discovering and adopting the right amount of tillage that will simultaneously prevent overland flow, minimize odor, distribute manure throughout the root zone, and inhibit movement to sub-surface drains are essential. Soil conservation practices that stabilize soil will help keep manure in the proper place also.
- The allowable agronomic rate may not be the right application rate. Agronomic rates are based on manure nutrient content and annual crop nutrient requirements, not necessarily the ability of the soil to process the manure. With dilute manure slurries low in nutrients, the volume applied in one pass can be too high to be retained in the root zone.
- Farm managers must manage manure intensively, similar to the way they manage cropping and feeding programs. A process of *application, observation, and evaluation* will

provide insights into cropland's response to manure application and its ability to process and capture manure in the root zone.

### Canadian Experience

Bonnie Ball Coelho has considerable experience in manure application on tile-drained cropland in Ontario as a researcher with Agriculture and Agri-Food Canada. She described her work over a wide range of application rates and methods.

- Pre-till the soil, use injector tools with lots of tillage and mixing action, or drop manure behind rolling tines. A closer injector spacing with more injector tines is better because the effective rate per tine is less.
- High risk soils typically are fine-textured soils with night crawler burrows. Sandy loams are lower risk.
- On high risk soils, manure movement to tile can be minimized by applying when soil is dry and tiles are not flowing, for example at side-dress time. Side-dress time also is a good time to apply liquid manure because roots are absorbing water and nutrients actively.
- Apply the right rate. In Ontario, side-dressing with swine manure at 6,000 gallons/acre with a 30-inch injector spacing did not lead to a tile discharge.

### Controlled Drainage

Larry Brown, Department of Food, Agriculture and Biological Engineering at The Ohio State University, discussed controlled drainage structures and other alternatives for managing manure applications in artificially drained cropland. Practices included:

- Installing head control structures at each outlet to prevent effluent from leaving the field.
- Integrated systems that include drainage, water table management, reservoirs, constructed wetlands, buffer strips, and other conservation practices.
- Harvesting drainage waters for treatment and reuse as irrigation water supplies.

### Current Guidelines

Bill Bickert, Department of Biosystems and Agricultural Engineering at MSU, moderated a session with each state and Ontario sharing current guidelines for managing manure on drained cropland to provide the basis for developing comprehensive, unified and consistent guidelines for use throughout the region. Some of the states (MN, WI, IL, IA and IN) did not have specific guidelines, and recommendations varied considerably among the reporting states.

- Ohio recommended a combination of tillage, rate management, and tile blocks. Application rates are suggested based on available water-holding capacity in the upper 8 inches of soil up to a maximum 13,000 gallons/acre.
- Ontario offered a range of options: **1)** on untilled ground, apply at rates lower than 3,600 gallons/acre; **2)** pre-till within 7 days of application; or, **3)** apply when tiles are not flowing or

tiles are blocked (for at least 72 hours), or when tiles discharge to a holding pond. Farm managers are to observe tile outflow and stop application if any discoloration of effluent occurs.

- Michigan recommendations included use of soil conservation practices to prevent overland flow, and adoption of a process of application, observation, and evaluation to discover the right amount of tillage and the right application rate on a field-by-field basis.

### Research Priorities

Several focus groups were formed to establish regional guidelines for manure application on drained cropland, and to develop research and extension priorities. The top ranked research needs included:

1. To better understand the fate and transport of pathogens in land-applied manure and practical environmental impacts of preferential flow.
2. To characterize soils relative to the propensity for preferential flow based on easily identifiable criteria such as texture and water-holding capacity.
3. To characterize manure slurries relative to the propensity for preferential flow based on easily identifiable criteria such as percent solids, fiber content, and flowability.

### Extension Education Priorities

The top extension and education priorities developed by program participants included:

1. Develop management guidelines that are easily understandable and capable of integration into whole-farm systems.
2. Develop CNMPs that are easier to understand and apply, and develop a training and certification program with

continuing education credits for manure applicators.

3. Develop information sheets, demonstration projects, and related materials to help farmers and technical service providers better understand preferential flow hazards, site-specific risk assessment, recommended application procedures, and environmental impacts of manure violations.

### Summary

Preferential flow of land-applied manure to sub-surface drains is difficult to predict. Problems are likely when high rates are applied (few problems have been reported with rates less than 6,000 gallon/acre) and when manure is applied on wet ground or when tiles lines are flowing. Tillage generally is helpful in disrupting flow paths, but tillage alone will not solve the problem. Efforts to minimize problems must include low application rates also. An on-going process must be developed for applying, observing, and evaluating the effectiveness of land application methods. Tile lines must be monitored. Because all fields are different, it is essential to learn the right application rate, the right amount of tillage, and the right way to manage each field. Land application of manures must receive the same attention to detail as the feeding and cropping programs.

Manure loss through tile lines is a real challenge with real consequences – for farm managers and for the environment. Without a doubt, the most important part of a successful land application program will be the determination to understand the nature of the problem, and to do whatever is needed to prevent nutrient and contaminant loss to the environment.



## Business Management and Finances

# 2003 Michigan Dairy Farm Financial Summary

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**F**inancial results for 2003 show that Michigan dairy farms began a recovery from the dismal outcomes of 2002. This article presents 2003 results for dairy farms throughout Michigan with comparisons to the previous 3 years. To be included, farms must have produced at least 50 percent of gross cash farm income from milk and dairy animal sales. The farms in this database and analysis were located throughout Michigan. Records came from Michigan State University's Telfarm/MicroTel project, the Farm Credit Service system, or from AgriSolutions in Michigan. The values were pooled into averages for reporting purposes. The farms are larger than the average Michigan dairy farm.

In 2003, the average dairy farm in the database had 196 cows and an average of 20,638 pounds of milk sold per cow.

Milk price, based on gross income rather than "mailbox" milk price, averaged \$12.59/cwt. This value was slightly larger than the 2002 value but still far below the record prices of 2001. The 2004 average milk price will exceed the 2001 value. Table 1 describes selected average farm statistics from the MSU business analysis summaries of 2000 through 2002.

Keeping in mind that all farms across years are not exactly the same farms, it is illuminating to compare average income statements from 2000 through 2003 (Table 2). The goal of an income statement is to calculate profit, which is best measured by net farm income. Net farm income is the return to operator unpaid management, labor, and capital invested. Net farm income in 2003 averaged \$57,519 (Table 2). This average somewhat obscures a very large range in net farm income values among farms in the database for 2003. For example, the farms in the top 25 percent of the net farm income distribution averaged \$119,553 while those in the bottom 25 percent