Iowa Manure Matters

Odor and Nutrient Management

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Composting saves time, money, and nutrients

by Tom Glanville, Department of Agricultural and Biosystems Engineering

For poultry and livestock producers, the daily task of animal carcass disposal poses constant problems. In the summer heat, prompt disposal is essential to avoid odors and biosecurity hazards. During the winter, frozen ground makes on-farm burial difficult at best. Meanwhile, the valuable service provided by the rendering industry continues to become more scarce and expensive. In some regions, livestock operations no longer have access to rendering services. Those that do pay as much as $50 per week for services that used to be nearly free.

For some poultry and livestock producers, composting may provide the solution to animal disposal. Composting is a year-round on-farm carcass management option that greatly reduces weather-related concerns and dependence on availability of rendering services.

If you raise poultry or livestock, you already understand the basics of composting because bacteria and fungi that break down organic matter have the same basic needs as mammals and birds. If kept at a comfortable temperature and given suitable amounts of water, food, and oxygen, these microbes reproduce at a remarkable rate, decomposing small-animal carcasses in as little as 4–6 weeks. The primary end products are water, carbon dioxide, and a heat-treated humus-like product that adds organic matter and nutrients to the soil.

Composting can be done successfully on nearly any scale if you pay attention to the basic needs of the microbes: moisture, food, oxygen, and temperature.

Moisture. Moisture is the most critical factor in composting. Bacteria need water to help dissolve organic matter and transport vital nutrients through their cell walls. At moisture content below 35 percent, bacteria starve because their food source has literally dried up. In contrast, too much water can prevent the compost pile from

This issue

Composting saves time, money, and nutrients

Manure application with dry spreaders

Applicator certification workshops

Manure planning pays for small farms

Manure management assistance

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"breathing." Moisture content above 60–70 percent causes pore spaces within compost to become filled with water. These spaces impede the movement of oxygen into the pile and the release of ammonia and carbon dioxide that are potentially toxic to bacteria. The good news is that you do not need a laboratory analysis to tell you when moisture levels are okay. Compost operators soon learn to judge moisture content by look and feel. Compost needs to be slightly damp, but if you can squeeze water out of a handful of compost, it is too wet and should be mixed with drier materials to keep bacteria healthy and productive.

Food. Like many plants and animals, bacteria need a balanced diet containing 20 to 30 times as much carbon as nitrogen. Carbon-to-nitrogen ratios (C:N) greater than 30:1 lack sufficient nitrogen to support rapid decay. C:N ratios below 20:1, however, contain more nitrogen than needed, which can lead to increased ammonia odor when the compost pile is turned. But as with moisture, compost operators soon learn to recognize these symptoms and correct C:N imbalances. Addition of high-carbon materials, such as sawdust, can raise the C:N ratio if needed. If decomposition is extremely slow and moisture levels seem adequate, low nitrogen is a likely cause. In this situation, addition of nitrogen-bearing organic material can help lower the C:N ratio and boost decomposition rates.

Oxygen. Given sufficient oxygen, the bulk of carcass decomposition is carried out by aerobic bacteria. Aerobic bacteria produce more heat and fewer odor-causing by-products than their anaerobic counterparts. Sophisticated high-rate industrial composting operations are kept fully aerobic by blowing air through the pile or by frequently turning the compost. On-farm composting operations typically do not go to these extremes, however, because mechanical aeration equipment is costly and slower decomposition rates are not of great concern. Low-maintenance, passively aerated composting operations supply oxygen to the outer layers of the compost pile through natural diffusion of air into the pile. Covering carcasses with coarse sawdust or wood chips provides numerous large pore spaces for gas movement. Combined with proper sizing of the pile and occasional turning, this strategy maintains sufficiently aerobic conditions although portions of passively aerated piles may become anaerobic from time to time.

Temperature. Heat-loving microbes called thermophiles do most of the composting work. They produce heat as they degrade organic matter, causing temperature within the compost pile to reach 120–150°F. In addition to keeping thermophiles working at top speed, these temperatures improve the safety and value of composted organics by killing disease-causing bacteria and weed seeds. Keeping the composting environment warm during cold weather is mainly a matter of constructing compost piles large enough to retain heat. Research conducted by Iowa State University has demonstrated that, even during extended periods of subfreezing weather, internal temperatures within unheated poultry composting bins (8 feet in width by 6 feet in depth by 5 feet in height) were in the 120–140°F range. Occasionally, internal temperatures become too hot. At temperatures above 160°F, even thermophilic bacteria start to die. Periodic monitoring with a long-stemmed compost thermometer and occasional turning if temperatures are too high can reduce internal temperatures when needed.

For more information on how to plan and operate an animal mortality composting operation, contact your ISU county extension office for a copy of Leopold Center for Sustainable Agriculture publication SA-8, *Composting dead livestock: A new solution to an old problem*. The National Pork Producers Council also offers an excellent videotape and guidelines for swine carcass composting. The *On-Farm Composting Handbook*, published by the Natural Resource, Agriculture, and Engineering Service (Cooperative Extension, 152 Riley-Robb Hall, Ithaca, New York 14853-5701, phone (607) 255-7654, E-mail: NRAES@cornell.edu) is an excellent resource on composting fundamentals.

Manure application with dry spreaders

by Jeffery Lorimor, Department of Agricultural and Biosystems Engineering

Variability is one of the main reasons farmers are reluctant to take full credit for manure nutrients. This problem is generally worse with dry manure than with liquid manure. To fully use manure nutrients, spreaders must meet two application criteria: 1) they must apply the right overall amount, and 2) they must distribute the manure uniformly across the swath.

Research during the past few years has documented the lack of uniformity provided by box spreaders. In 1993, spinner-type spreaders had a coefficient of variation of 50 percent across a 40-foot swath with poultry manure. Reducing the swath width to 30 feet helped significantly. In 1998, research indicated a 30 percent coefficient of variation average for 10 different spreaders and off-center spread patterns for 7 of these 10 spreaders.

Tests of two rear-discharge spreaders with beaters (not spinners) and one side-discharge spreader at Iowa State University in 1999 showed coefficients of variation of 100 and 108 percent for the rear discharge spreaders. Figure 1 shows the distribution for one spreader; the second spreader had a very similar distribution pattern.

A 6-foot overlap (30 percent of the swath width) does not significantly improve the uniformity (Figure 2).

By driving even closer, a more uniform pattern can be achieved (Figure 3). The data in this figure represent a 6-foot swath width (12-foot overlap). Notice that the narrow swath width has increased the overall application rate from approximately 15 tons/acre to approximately 25 tons/acre. Although the uniformity has been improved, many producers would consider a 6-foot swath width to be undesirable.

The distribution for the side-discharge spreader was significantly better, with a

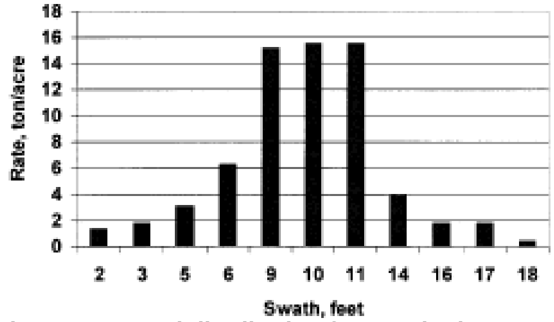

Figure 1. Spread distribution from a single pass of a rear-discharge dry manure spreader. Notice the 18-foot swath width.

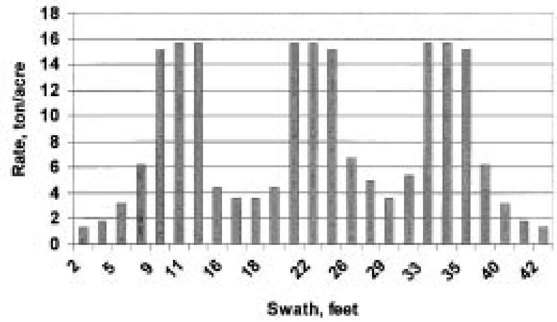

Figure 2. Spread distribution from rear-discharge dry manure spreader with 12-foot swath width.

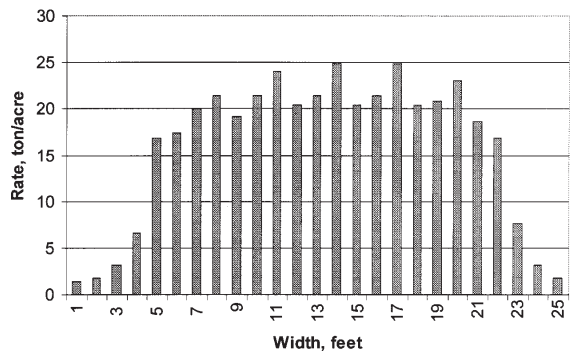

Figure 3. Spread distribution from a rear-discharge dry manure spreader with 6-ft swath width.

coefficient of variation of 66 percent (Figure 4).

What can you do? If you want to fully use your manure nutrients, you need to check your spreader distribution across the swath, as well as calibrate the total amount of manure it applies. Be willing to take a narrower swath. From Figure 2, it is apparent that small overlap may not be enough to achieve uniform application rates. You may have to experiment to find the swath width that gives an acceptable uniformity; it may mean driving faster to put on less with each pass, while making more passes.

If you achieve uniform application rates and avoid streaks, the payoff is lower fertilizer costs. As always, it is up to you to figure out a way to do a good job and make the system work until better spreaders can be developed.

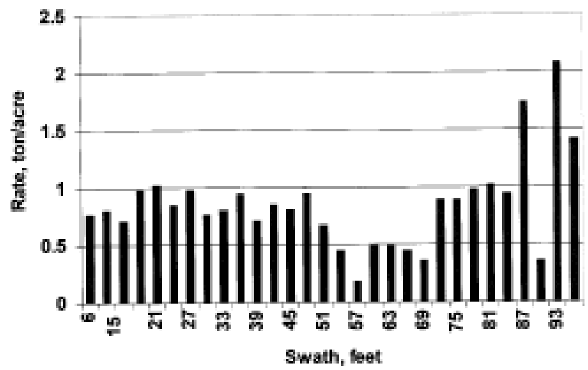

Figure 4. Distribution pattern for side-discharge spreader with 100-foot swath width.

This article uses some material from another article called *Solid manure application: Toward a sophisticated spreader*, by Tom Richard and Mark Hanna, ISU Department of Agricultural and Biosystems Engineering.

Applicator certification workshops

by Angela Rieck-Hinz, Department of Agronomy

If you are a confinement site manure applicator, you can receive the required 2 hours of training by attending the ongoing workshops scheduled for March and April 2000. Iowa law requires producers with an average weight capacity of 200,000 pounds or more of swine or poultry and 400,000 pounds or more of bovine (dairy and beef) to be certified to handle or land-apply manure from their confinement facilities. This requirement also applies to producers who handle manure in a dry or solid form from confinement facilities that exceed the above-mentioned weight requirements.

If you were certified in 1999, you are required to attend 2 hours of continuing education each year for a 3-year period to maintain your 3-year certification. If you do not attend the 2 hours of annual training, you will be required to take an exam at the end of the 3-year period to be recertified.

If you are a confinement site manure applicator and not currently certified, you are encouraged to attend one of the remaining workshops to become initially certified. You also may choose to take an exam to become initially certified.

For more information about the workshops, contact your county extension office or visit the program page at extension.agron.iastate.edu/immag/certificationFr.html

Confinement Site Manure Applicator Workshops, March–April 2000

County	Date	Phone Number
Allamakee	March 16	(319) 568-6345
Audubon	March 9	(712) 563-4239
Carroll	March 15	(712) 792-2364
Cass	March 7	(712) 243-1132
Cerro Gordo	March 23	(515) 423-0844
Clarke	March 1	(515) 342-3316
Clay	March 1	(712) 262-2264
Clayton	March 16	(319) 245-1451

County	Date	Phone Number
Crawford	April 12	(712) 263-4697
Dickinson	March 1	(712) 336-3488
Emmett	March 2	(712) 362-3434
Fayette	March 27	(319) 425-3331
Hamilton	March 21	(515) 832-9597
Hardin	March 9	(515) 648-4850
Harrison	March 9	(712) 644-2105
Keokuk	March 13	(515) 622-2680
Kossuth	March 6	(515) 295-2469
Lyon	March 7	(712) 472-2576
Madison	March 1	(515) 462-1001
Marshall	March 16	(515) 752-1551
O'Brien	April 5	(712) 757-5045
Osceola	April 5	(712) 754-3648
Palo Alto	March 2	(712) 852-2865
Pocahontas	April 4	(712) 335-3103
Pottawattamie (East)	March 7	(712) 482-6449
Pottawattamie (West)	March 7	(712) 366-7070
Sioux	March 17	(712) 737-4230
Story	March 16	(515) 382-6551
Wapello	March 8	(515) 682-5491
Warren	March 1	(515) 961-6237
Washington	March 13	(319) 653-4811
Winnebago	March 16	(515) 584-2261
Winneshiek	March 1	(319) 382-2949
Wright	March 21	(515) 532-3453

Manure planning pays for small farms

by Chad Ingels, Maquoketa Watershed Project, Fayette, Iowa

Public awareness of nitrogen (N) and phosphorus (P) and how they affect water quality continues to increase, especially with the growing number of large livestock operations. However, a significant number of livestock farms are still considered small animal feeding operations (SAFOs) by the Iowa Legislature, and these operations are not subject to writing manure management plans and the resulting regulations. Information from the Iowa Statistics Service shows that in 1998, the average dairy farm in Fayette County and Clayton County had 67 and 58 cows, respectively. The smaller farms are not required to produce detailed manure management plans. Each year, a 75-cow milking herd and replacements produce approximately 2,500 tons of manure containing 30,000 pounds of N and 15,000 pounds of P. As producers of a nutrient rich by-product, small livestock operations need to manage on-farm nutrients in an environmentally and economically sound manner.

With spreader calibration and a nutrient management plan, an economic analysis can be established for manure produced on an average 75-cow dairy herd in northeastern Iowa. A typical dairy herd produces 32.77 tons of solid manure/milk cow/year (See ISU Extension publication Pm 1811, *Managing manure nutrients for crop production*.) The 75 cows and replacements create 2,458 tons of manure per year. For this example, assume that manure (85 percent) is collected and surface-applied on the available cropland. The 2,089 tons of manure to be spread has an analysis of 12-6-12 (N-P-K [potassium]), and 70 percent of the N will be available to the crop after in-field volatilization (See Pm 1811). If 50 percent of the N will be available to the crop the first year, there will be 8,774 pounds of N; 12,534 pounds of P; and 25,068 pounds of K credited for crop use if soils are testing in the optimum range or lower.

The farm in this example will produce 150 bushels of corn and 50 bushels of beans per acre in a corn–bean rotation. There are 130 acres of corn per year following soybeans. A credit of 50 pounds N/acre is used in the crop rotation. To supply the rest of his or her N needs, the farmer typically applies N as anhydrous ammonia and has the local cooperative spread a crop removal rate of potash and phosphate following beans. The total commercial N applied is 120 pounds/acre.

When developing a manure management plan, there are two different methods to determine the desired application rate. The first, and most widely used, method is to apply manure based on the desired N rate for the crop. The second method is to apply manure at the crop removal rate of P. This latter method may be required in the future for manure management planning. The economic benefit of each method can be compared in the table.

Commercial N for the crop is from two sources: 102 units are from the anhydrous application at $0.14 per unit, and 18 units are from the plowdown fertilizer at $0.20 per unit. The unit rates for the P and K are $0.211 and $0.137, respectively.

Planning for application at the N rate would require spreading manure on 73 acres (120 pounds N/acre) and commercial fertilizer on 57 acres each year. The costs associated with manure hauling are not included because it would be hauled to some fields anyway. Applying manure at 28.6 tons/acre would provide the nutrients for this scenario. (From Northeast Iowa Demonstration Project spreader calibrations, the average 280-bushel spreader applies 21.4 tons/acre.) A nutrient management plan with the N rate application of manure would save $4528.19 per year in input costs compared with the current plan where no manure credits are taken.

Using the P rate for manure application would require 130 acres each year. Fifty-five units of N/acre would need to be purchased under this plan; however, the P and K would not be overapplied and would maintain the soil test values. The use of the P rate plan would result in spreading manure at a rate of 16 tons/acre. Profit would be increased by $6,243.90/year when recognizing the manure credit at the P rate application. This is an increase of $1,715.71 above the savings with the N rate plan.

To feel comfortable with taking manure credits, it is essential to calibrate the spreader to achieve the desired application rate of nutrients. With proper calibration, it is easy to acknowledge the nutrient credits that are available and apply the cost savings directly to the farm's bottom line.

For more information about this topic and the nutrient demonstrations in the Maquoketa River Watershed, call me at (319) 425-3233 or e-mail x1ingels@exnet.iastate.edu

Nutrient management plan for 130 acres of corn.[a]

	Current Plan (No Manure Credit), $	N Rate of Manure Application, $	P Rate of Manure Application, $
N	17.88	17.88	7.70
P	19.41	19.41	0
Potash	16.44	16.44	0
NH_3 application[b]	6.30	6.30	6.30
Crop removal application[a]	2.00	2.00	0
Cost/acre	62.03 × 130	62.03 × 57	14.00 ×130
Total fertilizer cost	8,063.90	3,535.71	1,820.00

[a] Nutrient prices and spreader rate supplied by a northeastern Iowa fertilizer supplier.
[b] Iowa State University Custom Rate Survey.

Manure management assistance

by Paul Miller, USDA–Natrual Resources Conservation Service, Des Moines

The Natural Resources Conservation Service (NRCS) provides technical assistance in the planning, design, and construction of animal manure management systems. This assistance includes the collection, storage, treatment, and use of manure that is consistent with the principles of conservation of natural resources. Financial assistance also is provided through various state and federal cost-sharing programs to help producers implement components and practices of a system.

The Environmental Quality Incentive Program (EQIP) is a voluntary conservation program that provides cost-share to install structural practices, such as a manure storage facility, and incentive payments for certain management practices such as nutrient management and filter strips. EQIP funds are directed to locally led project areas and are used to address statewide resource concerns. Manure management has been designated as a statewide concern and eligible for cost-share. To be eligible for EQIP funding, a livestock operation needs to be less than 1,000 animal units, which is approximately 6,600 finishing hogs; 2,200 sows and litter; 700 dairy cows; and 1,000 beef cows, depending on the animals' weight.

EQIP applications are ranked and selected for funding based on environmental benefits and costs of applying the planned conservation practices. Producers selected for funding enter into 5- to 10-year contracts to implement a plan that addresses the resource concerns and treats the land to a sustainable level.

Practices needed, as part of a manure management system, may vary from one operation to another, depending on the operation's objectives. Practices for a solid manure system include earthen or concrete sediment basins, solids stacking facilities, and solids settling terraces. A concrete floor and ramp to accommodate solids cleanout are recommended for sediment basins and stacking facilities. Sediment basins also may include a stop log or intake structure to slowly release liquids and allow time for solids to separate from the liquid. To prevent water source contamination, liquids released from a basin, terrace, or stacking facility need to be treated or stored until used by crops.

Private consultants are available statewide to provide nutrient and manure management planning and storage facility design assistance. For a listing of consultants see the Iowa Manure Management Action Group Web site at extension.agron.iastate.edu/immag

For details about technical assistance and federal- and state-funded programs, please contact your local USDA Service Center, NRCS, or Soil and Water Conservation District office.

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