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CENTER FOR INTEGRATED AGRICULTURAL SYSTEMS/UW-MADISON COLLEGE OF AGRICULTURAL AND LIFE SCIENCES

Research Brief

#35 Outwintering dairy cattle: the fate of manure components

Farmers who wish to outwinter their cattle to decrease facility and labor costs can do so in environmentally sound ways. In a study conducted during the winter of 1997-98, manure from outwintered cattle on three Wisconsin dairy farms retained nutrients rather than releasing them to the environment where they could pollute ground or surface water. But muddy spring conditions were a concern on all of the farms.

Ed Brick, a UW-Madison research assistant funded by the Center for Integrated Agricultural Systems (CIAS), found that most of the nutrients in the winter pasture-deposited manure were available for spring pasture growth. Brick also looked at manure distribution and stability on pastures.

The outwintering study's second year in the winter of 1997-98 provided Brick an opportunity to further research on winter manure decomposition. Outwintering is a practice in which dairy cattle are kept outside during the winter for at least part of the day. During the first year of the outwintering study, Brick visited 33 dairy farms that use management intensive rotational grazing and outwinter cattle. He observed that outwintered dairy cattle can stay healthy and that strategic cow placement enhances a pasture's ability to capture manure nutrients and organic matter (see CIAS *Research Briefs* #27 and 28). Both years of the outwintering study were supported by CIAS and the Great Lakes Protection Fund through the Wisconsin Rural Development Center.

Sample collection

Brick's goal in the study's second year was to evaluate the stability of the outwintered cows' manure. Brick tested manure samples for nitrogen, phosphorus, potassium, sulfur, and organic matter content. Little change in manure pat composition over winter would indicate stability, while a loss of nutrients and organic matter would suggest possible surface and ground water pollution.

Brick collected samples from 20 manure pats on each farm in November, 1997, and 20 more in January, 1998. He moved the manure pats from the pastures to locations protected by electric fencing where no trampling could occur. Brick used manure pats that were relatively fresh (several days old) but firm, and he labelled and froze samples from each pat. Each manure pat was resampled in March, 1998.

Nutrient analysis

"Most of the nutrients and organic matter remained in the manure pats over winter and were available for possible plant use in the spring," Brick observes. Only potassium content showed statistically significant decreases for both the early and mid-winter samples. Differences that are not statistically significant may be due to variations within manure pats or other factors.

Nitrogen content of the manure samples did not change enough to be considered statistically significant. The slight increase in nitrogen in the early winter sample may reflect sample variation or organic matter decomposition within the manure which would make more nitrogen available. Phosphorus also did not show a statistically significant change in the study.

Losses in potassium are the largest of any of the nutrients in the study. The early winter sample showed losses of 62 percent of potassium; the mid-winter sample showed losses of 46 percent. Potassium is readily leached from plants and microbial tissue. But once absorbed by the soil, potassium is held by soil exchange sites and is therefore not considered much of an environmental risk.

Sulfur showed a moderate percentage increase for the mid-winter sample, but the increase was not notable in absolute numbers. The increase may be explained by sample variation or by the sulfur content of deposited snow and rain. The decrease in organic matter content for the early

Changes in composition of manure on winter pasture

	Early winter sample			Mid-winter sample		
Nutrient	November 1997	March 1998	percent change	January 1998	March 1998	percent change
(lbs. per ton)						
Nitrogen (N)	8.31	8.56	+3.01	7.98	7.90	-1.00
Phosphorus (P)	4.96	4.50	-9.27	4.82	4.93	+2.28
Potassium (K)	4.07	1.54	-62.16*	3.70	2.05	-44.59*
Sulfur (S)	0.70	0.68	-2.86	0.58	0.64	+10.34*
Organic matter	88.40	82.00	-7.24*	90.40	89.10	-1.44
(percent of total)						

**Difference between beginning and ending sample is statistically significant (P=.05).*

Study dairy farms and their approaches to outwintering

Farm with sacrifice paddock and rotated hay feeding paddocks

Location: Milk cows, dry cows, and bred heifers on paddocks; in cold rains or cold windy conditions, in shed with a bedded pack.

Feeding location: Grain fed in sacrifice paddock; hay fed in ring feeders on several rotated paddocks.

Manure distribution and pugging: Fairly even distribution of manure in sacrifice paddock, some manure concentrations around round bale feeders in rotated paddocks. Pugging was moderate near hay feeders.

Farm with sacrifice paddock and bedded pack

Location: Milk cows, dry cows, and bred heifers on sacrifice paddock during the day; two sheds with bedded pack at night.

Feeding location: Grain fed in wagons in the barnyard; hay fed along sacrifice paddock fences.

Manure distribution and pugging: Severe pugging in sacrifice paddock made a manure distribution analysis impossible. Unless significant renovation takes place in spring, the paddock may harden up and become a dirt yard.

Farm with large sacrifice paddock and windbreaks

Location: Bred heifers kept on large sacrifice paddock with several windbreaks.

Feeding location: Haylage fed in sacrifice paddocks, usually near windbreaks; pizza dough fed along fence in several locations.

Manure distribution and pugging: Moderately even manure distribution throughout sacrifice paddock. Pugging was moderate to severe along fence feeding areas and windbreaks.

winter set was statistically significant. Like nitrogen, this change may be caused by early winter microbial decomposition.

These relatively low nutrient losses from winter-deposited manure are encouraging from a nutrient management perspective. Brick notes that "the winter of 1997-98 was an excellent year for this study since the warm weather would enhance the possibility for microbial decomposition and subsequent loss of either nutrients or organic matter for manure pats deposited on pastures." In a more typical winter, longer periods of temperatures below freezing and deeper snow cover would increase the number of days during which the manure pats would remain frozen and stable.

Brick observed that manure pats also appeared physically stable. "The manure pats were crusted over soon after they were deposited, and were frozen most of the time on pasture," Brick remarks. He also observed that manure pats tended to anchor to the underlying vegetation and snow. "The manure pats are not likely to move under all but the most concentrated rainfall or snow melt water runoff conditions," Brick concludes.

Pugging

On all three farms, Brick observed muddy sacrifice paddocks. He walked the pastures in early spring to observe the degree of pugging before any remedial work was performed to redistribute the manure or seed areas down. Pugging refers to areas where hoof action kneads mud and manure into a soupy mire. Pugging can be a real problem for farmers, resulting in a patch of bare, pocked ground instead of pasture. The sacrifice paddocks in Brick's study experienced moderate to severe pugging, depending on the level of concentration of animals and feed in each paddock.

Pugged areas had multiple hoof depressions up to several inches deep. Since pugging occurred primarily on flat ground, relatively little soil erosion would be expected. Pugging can lead to soil compaction, which would lessen the infiltration of water and manure components into the soil. Runoff from water in hoofprints is also a concern.

Managing for water quality

Losses in potassium and slight losses in nitrogen can be captured by the pasture soil if the chances for runoff are minimized. Brick offers several recommendations for locating cows and feeding stations to minimize the effects on both ground and surface water.

- Brick concludes that "level sacrifice paddock locations are required to minimize the potential for runoff of manure or pugged pasture soil."
- When flat ground is not available, hay feeding stations should be located on ridges and slopes which have low runoff potential, or places where the runoff will spread over an area that can take advantage of the manure's nutrients. Manure concentrations on ridges will add organic matter and fertility to areas most likely to have eroded.
- Even pugging can be used as a tool. Some farmers use their cattle to pug areas where they would like to reseed in the spring, to replace an undesirable pasture plant or try a new one.
- To avoid muddy conditions, Brick advises farmers to keep their cattle on a hard surface, whether concrete or ag lime, during the wettest weather. Farmers can easily scrape either of these surfaces and spread the manure on their pastures.

The Center for Integrated Agricultural Systems (CIAS) brings together university faculty, farmers, policy makers, and others to study relationships between farming practices, farm profitability, the environment, and rural vitality. Located at the University of Wisconsin-Madison, it fosters multidisciplinary inquiry and supports a range of research, curriculum development, and program development projects. For more information on the center or on the research in this brief, contact:

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This research brief is part of a series. Contact CIAS for other titles. CIAS staff members are grateful for the reviews of this research update by UW-Madison and UW-Extension faculty and CIAS Citizens Advisory Council members. Printed on recycled paper. January, 1999.