Dairy Manure Odor Perception and Management Series

Part 6: Mitigation options for manure application

Odor nuisance can be defined by four factors: *frequency*, *duration*, *intensity* and *offensiveness*. The *frequency* of land-application of manure is often low when farmers are following a nutrient management plan (NMP) since application typically occurs before planting or right after harvest. The *duration* may also be limited to the time it takes manure on the surface to dry, but the *intensity* (since many fields receive manure during an application cycle) and the *offensiveness* (coming from an untreated manure storage) can create quite a nuisance.

Manure is recycled back to cropland to supply nutrients needed for crop growth and organic matter for soil health. The best method to recycle manure to the land base depends on: 1) the quantity and type of manure and location of the land base, 2) soil type, 3) topography, 4) field size, 5) crops, 6) degree of need for odor control, 7) energy use, 8) equipment available, 9) field management methods, and 10) cost.

To reduce manure spreading-based odor complaints, farmers can consider timing and application methods. Various application methods affect the odor potential from the manure spreading operation and are shown in Table 1.

Application approaches

Most farms typically have the equipment needed to broadcast manure and to incorporate it in a second pass. Cropping systems, the need for crop residue to control erosion and moisture conditions of the soil, may limit any tillage method. Residue retention on the surface, to reduce soil erosion, is generally best to least: broadcast/irrigation > rotating spikes > disc >

Table 1. Application methods and their comparative impact on off-site odor, tractor draw bar power, and surface residue retention.

Method and Description	Odor Reduction	Power Required	Residue Retention
Surface broadcast -- Manure spread on field surfaces typically with box, slinger, and V spreaders; these implements cannot include concurrent incorporation.		-	+++++
Broadcast with incorporation – Mixing, or incorporating, the manure into the soil with subsequent separate tillage equipment after broadcasting.	++	XXX	_
Knife injection – Vertical shanks used to create a narrow vertical slot approximately six to eight inches deep with manure concurrently placed in slot. Concentrates manure into narrow strips.	+++	XXX	+
Sweep injection - Shanks have a horizontal blade at the lower end to create a broad, horizontal band under the soil surface for manure placement and mixing with soil.	++++	XXXX	+
Disk/Coulter – Implement used to open a vertical slot for the manure. Then closing disks cover the slot to bury the manure.	++	XX	++
Rotating spikes – Implement used to open the soil to allow more soil contact and mixing of the manure concurrently applied. Can be done on most hay fields but may turn flat stones up to be caught in harvesting equipment.	+	X	++
Irrigation – Various methods used with treated (see Part 5 Anaerobic digestion and odor control) and often diluted manure. Without treatment; significant odors are emitted.	++	-	+++++

knives or sweeps. Costs are related to the equipment purchase and power requirements for the incorporation method. Power needed for tillage from most to least are: sweeps > knives> disc> rotating spikes. Specialized incorporation tools may not be available to all farms.

Use equipment and apply methods that minimize manure aerosols. Discharge manure as close to the soil surface as possible by using low trajectory spreading equipment or directly into the ground. Spread manure uniformly and if on the surface in a layer thin enough to promote rapid drying.

Odor control after spreading is proportional to the amount of covering and mixing of the manure with the soil. Odors can be significant until manure dries to below 40% moisture, when gas volatilization is limited.

In all cases the NMP needs to reflect both the amount, timing, and method of application as these factors impact nitrogen volatilization.

Timing of land application is very important to reduce/minimize odor nuisances. It is best to avoid spreading manure when the wind could move odors toward sensitive areas. Increasing distance from the source adds to the possibility of dispersion. Spread or apply manure in the morning when air is warming and rising rather than in the late afternoon. Select times when turbulent breezes will dissipate and dilute odors and dry applied manure. Manure odors from gases heavier than air can remain concentrated and move downhill as air drainage during stable and inverted air conditions.

Avoid manure spreading right before or on weekends and holidays when people are likely to engage in outdoor recreational activities. Try to be flexible with the implementation of the NMP.

Social capital of excellent neighbor relations with open communication channels is very useful in limiting and handling complaints in a responsible way. Manure odor control on dairy farms is essential to maintain positive neighbor relations. When manure is recycled to maximize nutrient uptake there are several strategies outlined in this fact sheet that assist with minimizing the release of offensive manure odors. Besides recycling nutrients, manure provides a benefit by adding organic matter to improve soil structure, and increase water infiltration. Both of these characteristics reduce soil erosion.

FACT SHEET SERIES
Dairy Manure Odor Perception and Management

Part 1: Manure odor basics
Part 2: The human sense of smell
Part 3: How are manure odors quantified?
Part 4: Mitigation options for manure-based odor control
Part 5: Anaerobic digestion and odor control
Part 6: Mitigation options for manure application
Part 7: Positive neighbor relations

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Manure application methods and nitrogen losses https://extension.umn.edu/manure-land-application/manure-application-methods-and-nitrogen-losses

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