

Swine Manure

Land Application Practices to Minimize Odors

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Introduction

Odor from swine production systems is generated at three primary sources: animal housing, manure storage and during land application. This publication addresses controlling odors during the land application of swine manure. Unlike odor generation from animal housing and manure storage, which are usually continuous in nature, odor from manure application is an "event-based" occurrence. The majority of odor complaints associated with animal operations are associated with the land application of manure. In order for odor to result in a complaint, the odor must be generated, released to the air, and transported downwind where people are located. Therefore, odor control methods could involve methods that minimize the generation, release or transport of odorous compounds.

Mixing and Application Timing

The land application of manure usually begins with the agitation of stored manure. It is difficult to avoid odor release during manure agitation. Odor transport during agitation can be minimized by agitating manure on sunny days when as the atmosphere warms, odor will be transported upward by convective mixing. If possible, planning the land application of manure for sunny periods as the atmosphere warms will also help reduce the transport of odor to downwind receptors. Avoiding manure application on days when the wind is blowing toward people who are close enough to be impacted by the odor release should also be considered. While a producer cannot control the weather, choosing to avoid mixing and application of manure during weather conditions that are likely to result in complaints is wise.

Land Application Methods

The greatest opportunity to reduce manure odor release during land application is during the actual land application process. The largest reduction in odor release is obtained by injecting or incorporating manure into the soil. Research has shown that injecting manure below the soil surface can reduce the release of odors by more than 90 percent when compared to broadcasting manure on the soil surface. Differ-

ent incorporation methods including disking, chisel plowing and harrowing have been shown to reduce odor release from 20 to 90 percent by researchers. Table 1 shows the odor detection threshold measured in conjunction with various manure incorporation and injection methods and compared to broadcast manure with no incorporation. The odor detection threshold values represent the ratio of fresh air to odorous air required to dilute the odorous air to a barely detectable level. The larger the odor detection value, the greater the odor associated with the application practice.

Table 1. Odor Thresholds from Various Land Application Methods
Source: Livestock Poultry Environmental Stewardship Lesson 44

Land Application Method	Odor Detection Threshold	Odor Intensity
Broadcast	2818	More Odor
Plow	200	
Harrow	131	
Inject	32	
No application	50	Less Odor

Data in table 1 indicate that there is no difference in odor from land where manure is injected below the soil surface and unmanured land. Note that incorporating manure by plowing or harrowing are very effective at reducing odor release, but not as effective as injection. It is also important to note that odor will be released prior to incorporation at a level equal to a broadcast manure, so it important that incorporation occur immediately after manure broadcast to effectively reduce odor release.

When applying liquid manure using spray guns or other types of sprinkler systems, odor release can be minimized by using low-trajectory guns that produce large droplets. If liquid manure is applied using center pivot systems, the use of low-pressure drop nozzles will reduce odor release. Solid manure that cannot be injected should be incorporated immediately following land application. Since solid manure must be transported in trucks rather than tanker or pipe systems, odor release is possible during transport. Solid manure should be covered during transport or when stockpiled for more than short periods of time to minimize odor release.



Spray gun used to apply liquid manure



Center pivot irrigation system

Liquid manure injection on wheat stubble



Drag line transports effluent to applicator



Application Considerations

It is common for double application of manure and/or manure spillage to occur at the end or turn rows of a field. This is because as an applicator comes to the end or edge of a field and makes the turn to start application on a piece of ground previously not fertilized, the manure injectors will be lifted from the ground possibly causing spillage. Essentially the spillage will be like broadcasting manure, which is more odorous. If manure application is continued during the turn, then double or multiple application may occur on the end row. Pay close attention to avoid manure spillage and double application on end rows. This excess manure can serve as a significant odor source even though the remainder of the field has been injected or incorporated. Although frequent manure application traffic on end rows is difficult to avoid, applying manure to a field's end rows last is a good safeguard against odorous end row spillage and over-application. Any spillage that does occur should be incorporated into the soil before leaving the field.



Liquid manure knifed into a field

Summary

Injection below the soil surface is the most effective method to reduce odor release from land-applied liquid manures. Solid manure that cannot be injected should be incorporated into the soil immediately following spreading on the land. Both manure agitation and application should be planned for sunny days with warming temperatures, if possible. The following list summarizes methods that can be used to reduce odor complaints during land application events.

- Inject liquid manure into the soil
- Use low trajectory irrigation guns with large droplet size
- Incorporate solid (and liquid if not injecting) manure into soil
- Agitate and apply manure in the morning on sunny days
- Avoid application when the wind is blowing toward a receptor
- Avoid double application or spillage on end or turn rows
- Incorporate any excess manure at end rows immediately

For additional information please see the following publications:

LPES Lesson 44 Emission Control Strategies for Land Application

Manure Incorporation Equipment Effects on Odor, Residue Cover, and Crop Yield. H.M. Hanna, D.S. Bundy, J.C. Lorimor, S.K. Mickelson, S.W. Melvin and D.C. Erbach. 2000. *Applied Engineering in Agriculture*, Vol. 16(6): 621-627.

To learn more about odor mitigation practices, visit the Check-off-funded Air Management Practices Assessment Tool at <http://www.extension.iastate.edu/airquality/practices/homepage.html>.