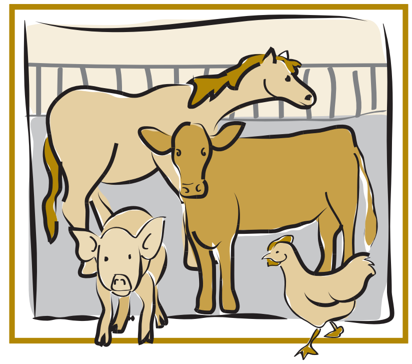
Colorado State University
Extension

Best Management Practices for Reducing Ammonia Emissions: Feedlot Pen Management

Fact Sheet No. **1.631A** Livestock Series | **Management**



by S.G. Lupis, K.J. Galles, J.M. Ham, J.J. Stratton, J.G. Davis, and N. Embertson*

Confined cattle feeding operations have been identified as a potential source of airborne ammonia emissions. The majority of ammonia produced at feedlots comes from fresh urine on pen surfaces. Even on pastures, urine spots are responsible for about 96% of total ammonia emissions. Further, 80% of the total ammonia emissions from urine spots occur during the first 48 hours of exposure to the atmosphere. Ammonia that is lost to the atmosphere is no longer available for managed application as a nitrogen fertilizer, decreasing the nutritive value of feedlot manure for land application.

Nitrogen transport from east to west in Colorado is seasonal and predictable. During springtime, upslope conditions occasionally occur when easterly winds move from the Front Range to the alpine areas of the Rocky Mountains, including Rocky Mountain National Park. Therefore, during springtime (when there is a higher risk of transporting nitrogen to these high alpine areas) frequent interventions are suggested to control emissions from the pen surface.

There are various pen management practices that have the potential to reduce ammonia emissions, especially when implemented to reduce emissions during the springtime weather patterns described above. For producers in Colorado and the Front Range, watering may be the most cost-effective practice to reduce ammonia emissions from the feedlot pen.

*S.G. Lupis, Institute for Livestock and the Environment, coordinator; K.J. Galles, Colorado State University, graduate student, soil and crop sciences; J.M. Ham, professor, soil and crop sciences; J.J. Stratton, graduate student, chemistry; J.G. Davis, professor, soil and crop sciences; N. Embertson, Whatcom Conservation District in Lyndon, Washington, nutritient management and air quality specialist. 12/12

Watering

Watering is a recognized best management practice (BMP) for controlling dust. Watering can be very expensive if the infrastructure is not already in place; however, many producers already water for dust control to reduce property line complaints. Watering may also be an effective way to control ammonia emissions.

Frequent (every 12-24 hours), small (0.2-inch) water applications have been shown to reduce and delay ammonia emissions for several days and could prevent transport of emissions, especially during springtime upslope weather conditions that are most likely to deposit nitrogen in sensitive alpine areas. In a recent Colorado State University study of simulated watering events, 0.2 inch of water was shown to reduce ammonia emissions by 27% in the first 24 hours and to slightly reduce the overall emissions (by about 9%) over a 7-day period (Figure 1). Other studies have had similar results. For example, an 81% reduction in emissions was reported when urine patches were exposed to ~0.4 inch of rainfall two hours after urination occurred. In another example, ~0.1 inch of rainfall two hours after urination reduced ammonia emissions by 15%.

There are several reasons why watering or precipitation events reduce ammonia emissions. One reason is that the water may simply move the ammonia away from the pen's surface, preventing exposure to the atmosphere. Another explanation is that the water dilutes the ammonia and minimizes ammonia loss. Most likely, both explanations are at work, and soil properties specific to a particular site may also play a role.

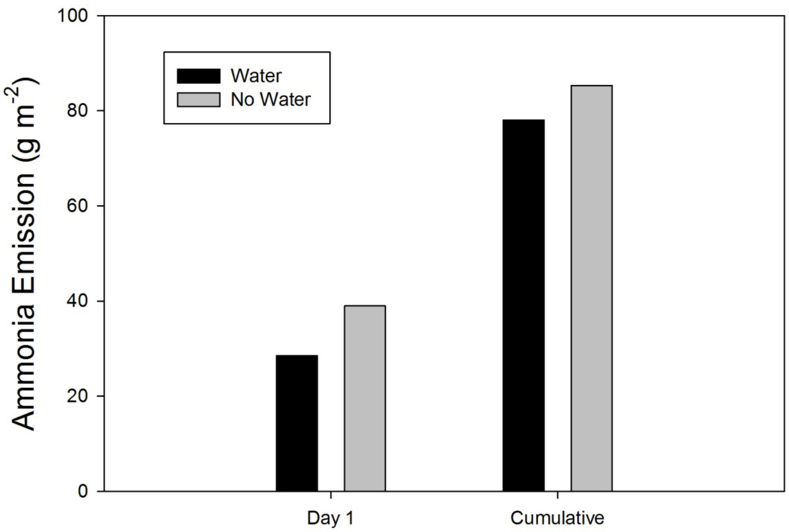
Feedlot pen watering requires water sprinklers, either solid set on fences or as part of a mobile truck unit. Either approach can be effective for delivering frequent, small

Quick Facts

- The majority of ammonia produced at feedlots comes from fresh urine on the pen surface.
- Most ammonia is emitted from urine spots during the first 48 hours of exposure to the atmosphere.
- Frequent but small water applications reduce and delay ammonia emissions for several days and could prevent transport of emissions during critical times.
- Typical dust control watering systems can be employed for ammonia emissions control watering.
- Other pen management practices are less economical, efficient, and practical for Colorado feedlot operators compared to watering.

www.ext.colostate.edu

Figure 1. In a recent Colorado State University study, sprinkling 0.2 inch of water to intact feedlot surface cores taken from fresh urine patches reduced ammonia emissions by 27% in the first 24 hours (Day 1) and by 9% over the entire 7-day test (Cumulative).



quantities or water to the pen surface. These types of watering systems are also widely recommended for controlling dust at large feedlots. Many operators already employ a watering system for dust control, so that little, if any, infrastructure cost would be associated with adopting this practice for ammonia control.

Alternative Pen Management Practices

Other practices, such as frequent manure removal (i.e., "scraping"), application of aluminum sulfate, and use of bedding (e.g., wood chips, compost, or sand) may be less economical and efficient for feedlot pen management compared to watering.

Pen scraping has the potential to temporarily increase ammonia emissions because it disrupts the emissions-trapping "crust" that can form on the pen surface. However, timing scraping to avoid days where upslope conditions are prevalent can help to avoid deposition events and improve the effectiveness of this practice.

Application of aluminum sulfate at recommended levels of 9,000 kg/ha would cost $1.3 million for a 30,000 head feedlot and is, therefore, not affordable for most operators. Sand, straw, and wood chip bedding is not typically used in feedlots, and so its use would require regular investments. Compost bedding, when produced on-site, is more cost-effective than other bedding materials, but requires at least weekly maintenance to achieve optimal reductions in ammonia emissions.

References

Baron, J. S., H. M. Rueth, A. M Wolfe, K. R. Nydick, E. J. Allstott, J. T. Minear, and B. Boraska. 2000. Ecosystem responses to nitrogen deposition in the Colorado Front Range. Ecosystems 3:352-368.

Mukhtar, S. and B.W. Auvermann. 2009. Improving the air quality of animal feeding operations with proper facility and manure management. Texas Agricultural Extension Service publication No. E-585.

Ndegwa, P. M., A. N. Hristov, J. Arogo, and R. E. Sheffield. 2008. A review of ammonia emission mitigation techniques for concentrated animal feeding operations. Biosystems Engineering 100:453-469.

Saarijärvi, K., P. K., Mattila, and P. Virkajärvi. 2006. Ammonia volatilization from artificial dung and urine patches measured by the equilibrium concentration technique JTI method). Atmospheric Environment 40:5137-5145.

Sweeten, J. M. 1990. Cattle feedlot waste management practices for water and air pollution control. Texas Agricultural Extension Service publication No. B-1671.

Whitehead, D. C. and N. Raistrick. 1991. Effects of some environmental factors on ammonia volatilization from simulated livestock urine applied to soil. Biology and Fertility of Soils 11:279-284.

Further Reading

Colorado State University Extension fact sheet: 1.631 *Best Management Practices for Reducing Ammonia Emissions*