



PoultryPractices

Oklahoma Cooperative Extension Service

A newsletter for poultry producers and poultry litter applicators...

Controlling Poultry Litter Pathogens on Antibiotic Free Farms

Poultry Drinking Water Quality

P Application Strategy Research: Poultry Litter Nutrient Availability & Carryover

New Approaches for Avian Influenza Mass Mortality Composting

poultrywaste.okstate.edu



Editor's Column

In this last issue, we focus our attention on controlling litter pathogens on antibiotic free programs. New approaches for composting avian influenza mortalities are also highlighted. Additionally, poultry drinking water quality is examined and litter phosphorus application strategy research is summarized.

It has been an absolute pleasure to work with Oklahoma's poultry growers and litter applicators since 2005. I have accepted a position with a company serving the poultry industry; however, I plan to remain active with growers throughout Oklahoma and the US.

For publications, regulatory information, and upcoming classes, visit your local county Extension office or poultrywaste.okstate.edu where you can also obtain archived issues.

Josh Payne

Controlling Poultry Litter Pathogens on Antibiotic Free Farms

Josh Payne, Ph.D.
State Poultry Specialist, OSU

Consumer groups, restaurant chains and food retailers are challenging poultry growers, nutritionists and veterinarians to raise birds using fewer or no antibiotics. The challenge for poultry producers is to maintain good animal health, performance and welfare without raising food safety concerns. Poultry litter consists of bedding, manure and feathers and is known to harbor pathogens. The survival of pathogens in poultry litter is dependent on both physical and chemical factors such as temperature, moisture content and pH. Whenever environmental stress factors fall outside the optimum range for microbial growth and survival, the factors can lead to cellular damage. Depending on the severity of the stress factors, growth can be inhibited or cell death can occur. Thus by altering litter temperature, moisture content and pH we can effectively control pathogens that impact both bird health and human food safety.

Temperature

Temperature is considered one of the most important environmental factors affecting growth and survival of microorganisms. The optimum temperature for most pathogens is around 98°F. If temperatures rise to high levels (target of 131°F), pathogen growth rate sharply declines, proteins denature and thermal breakdown of the cell membrane occurs resulting in cellular death.

In-house windrow composting of built-up broiler litter between flocks is being adopted in some production complexes and can increase litter temperatures high enough to reduce or destroy pathogens. Careful management is key for this process to work. The nature of modern litter management strategies and relatively short downtimes between flocks of broiler production can create challenges for successful adoption of in-house litter windrowing. Litter management strategies attempt to achieve a dry litter which conflicts with achieving optimal moisture content for effective windrowing. Poultry litter also does not contain the proper C:N ratio for optimal composting. Another challenge is the high levels of ammonia produced both during and following the windrow process. Proper management must be in place so that ammonia concentrations after windrowing do not negatively affect the health of the next flock. Following windrow spreading, houses should be given sufficient time with proper ventilation to purge ammonia prior to chick placement.

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Moisture Content

Water is essential to the growth of microorganisms. Wet litter can promote both pathogen growth and ammonia release. Research has shown that a relative humidity below 84% effectively controls pathogens. Controlling relative humidity inside the house (ideally 50-70%) and litter moisture content are vital management strategies for controlling pathogens.

Proper summertime ventilation practices are not only critical to cooling birds, but are also a key management tool used to remove excess moisture from the broiler house and maintain a certain degree of dryness in the litter. During the winter months, removal of excess litter moisture can become problematic since the cooler incoming air has less moisture holding capacity than warmer air. Additionally, cool outside air should not directly contact birds. However, these challenges can be largely overcome by ensuring proper directional airflow through sidewall inlets within the house allowing cooler outside air to mix with warmer air along the house ceiling. Proper mixing increases the moisture holding capacity of incoming air which allows increased moisture removal from the litter. The saturated air can then be circulated out of the house leaving a drier litter. Cold air that enters through leaks in the house or through sidewall inlets at a low velocity will drop downward along the sidewalls resulting in cold drafts, chilled birds, wet litter, increased ammonia levels and increased fuel usage.



Other control measures to ensure drier litter and reduce pathogen loads include preventing leaks from water lines, selecting a proper bedding material with desirable absorption properties, providing a proper bedding depth, removing caked litter between flocks and allowing dirt floor pads sufficient time to dry following clean-out.

pH

The acidity or alkalinity of an environment, measured by pH, has a profound effect on microbial viability and survival. pH is defined as the negative logarithm of the hydrogen ion concentration. While different organisms can exhibit growth in different extracellular pH environments, the intracellular pH must remain near neutral. With a highly acidic external environment, the cell can become overburdened as it tries to maintain a neutral pH, deplete its energy reserves and eventually die.

Poultry litter usually contains a slightly basic pH between 7.5 and 8.5 which is optimal for pathogen growth. Acidifying litter amendments are commonly used in poultry houses to reduce harmful ammonia levels by lowering litter pH. This process occurs by releasing hydrogen ions into the litter, creating an acidic environment which neutralizes ammonia. A secondary benefit of reducing litter pH to an acidic level (below pH 4) is pathogen control. Most pathogens will be reduced or destroyed in such an environment. Sodium bisulfate, sulfuric acid and aluminum sulfate are all common litter amendments that can accomplish this task. Sodium bisulfate can also provide a synergistic antimicrobial effect by releasing sodium into the environment. Litter amendments are often applied to the litter prior to flock placement and have even been used to shock treat the pad in poultry houses that have a history of disease challenges.

Summary

As the industry continues to shift toward antibiotic free production, new challenges may arise to control pathogens from both a bird health and human food safety perspective. Proper litter management is a key component for effective poultry production. By better understanding the ecology of poultry litter along with the interactions and impacts of environmental factors such as temperature, moisture content and pH, the industry can develop alternative pathogen control strategies for improved bird health, improved performance and reduced food safety risks.

References:

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- Y. Liang, J.B. Payne, C. Penn, G.T. Tabler, S.E. Watkins, K.W. VanDevender and J.L. Purswell, 2014. Systematic evaluation of in-house broiler litter windrowing effects on production benefits and environmental impact. *J. Appl. Poult. Res.* 23(4):625-638.

Poultry Drinking Water Quality

Susan Watkins, Ph.D.

Professor/Extension Specialist, University of Arkansas

Optimizing drinking water quality is one of the last frontiers in animal production. Significant time and money have been invested in optimizing the poultry environment with state of the art housing and no stone is left unturned for optimizing ingredient and feed quality. Yet with that said, many producers spend little time and effort on water quality, the nutrient birds consume twice as much as feed. The first step in developing a successful water program is acknowledging water quality can be significantly impacted by both the natural contaminants present in supplies as well as the products added. If water supplies have not been tested for pH and mineral content, it is important to do so because you cannot fix what you do not know is broken. The next crucial step is choosing the best products for drinker line cleaning and using them at the appropriate rate while the barns are empty.

One of the biggest challenges with water supplies in confined animal feeding operations such as poultry barns is the fact that water flow is typically slow; and during parts of the grow-out cycle, it may be warm, both factors in promoting bacteria growth. Combine this with naturally occurring iron, manganese and sulfur and products such as citric or organic acids, vitamins and electrolytes and it can quickly be the perfect recipe for biofilm slime with harmful bacteria that can lead to poor bird performance. Once established, biofilms can hide harmful pathogens and make water systems as much as 1,000 times harder to clean. There are many excellent products available for removing biofilm slime and mineral deposits. Visit with your company representative or a poultry specialist for recommendations best suited for your operation.



It is important to note that most line cleaning products must be injected in stronger concentrations than what a medicator can do. Most medicators are set at a 1:128 rate which only gives a 0.78% solution. If products are recommended for use at stronger concentrations be sure to get a pump that can do this. It is also important to make sure the products are left in the lines for the recommended time length. The last step in successful line cleaning is flushing the lines with water that contains a sanitizer level that is acceptable for the birds to drink. This helps to assure that if any biofilm was not eliminated by the line cleaning, it will not have an opportunity to re-establish or pass to the birds. Cleaning the whole system, including the distribution lines from the well to the barns, is also highly important and has been key for improving performance on many farms. These systems are also vulnerable to challenges. For one reason, any loss in pressure in the water distribution system creates a siphon or back flow which can drag contamination along with it. While many times farm managers and owners are drinking from the same water supply or well as the birds with no health issues, remember, our digestive systems have had an opportunity to build up a tolerance plus we rarely consume the water that has been warmed and treated in the barns where the biggest challenges can be harbored.



Taking water quality seriously could pay dividends in healthier birds, better feed conversions and improved production. It may take line cleaning several times between flocks before all challenges are eliminated so don't get discouraged if immediate benefits are not achieved after the first line cleaning. The final suggestion for maximizing water quality is to minimize the use of water additives and try to maintain a good daily water sanitation program with the birds present. In a business where every penny counts, don't throw away performance because of lack of attention to water.

Photos courtesy of Oklahoma State University

P Application Strategy Research: Poultry Litter Nutrient Availability & Carryover

Brian Pugh

Area Agronomist, OSU

Let's take a moment to reflect on the data from the Eastern Research Station study to assess nutrient carryover in forages and directly compare poultry litter to commercial fertilizer applications. Treatments in this study consist of common agronomic rates of poultry litter (PL) and "nutrient equivalent" treatments of commercial fertilizer (CF) on an annual, two, or three year basis and were first applied in May 2012. Annual treatments were re-applied in June 2013 and July 2014. Fertility applications are staged after the first harvest of the growing season. Therefore, first harvest yields are an indicator of possible nutrient carryover from the previous years' application. Data reported here is an average of replications, but has not yet been subjected to statistical analysis.

It is widely accepted that since much of the Nitrogen in PL is in an organic form, release of this N occurs over a period of 2-3 years. Our current OSU rule-of-thumb is that 50% of N is available in year 1, 15% is released in year 2, and 5% in year 3. Therefore, repeated annual applications of PL can increase (build up) the amount of N available to plants in one growing season. Referring to Figure 1, it is likely we are beginning to see this N release from previous year applications when comparing treatments 5 and 6. These treatments are true "nutrient equivalent" rates of CF sources and PL in regards to N,P and K. Recall that year 1 data from 2012 (a very dry year) illustrated that PL-treatment 6 produced 93% of the forage yield observed with CF – treatment 5. For the first harvest in 2014, representing two consecutive years of PL application, forage yield is now favoring PL when compared to CF sources by 1%. This data may further indicate that more immediate N credit is received from PL than previously thought in typical Eastern OK soils.

In 2014, CF and PL applications elicited a yield increase one or two years after application when compared back to the control. 2013 data illustrated the highest application rate from 2012 was still the highest yielding in early 2013, indicating significant N contribution was still occurring within one year of application. However data from this year indicates a trend that 2014 yield was greater from 2013 applications than from applications in 2012, regardless of rate. This substantiates previous data that N contribution from even very high rates of PL is greatly diminished by the third growing season. This is evident when comparing treatments 10 and 6 or treatments 7 and 2, where even drastic differences in total applied N rates (435 vs 260 or 217 vs 66 respectively) result in little yield difference in subsequent years. Much of the N in these higher application rates is either lost to the environment over time or taken up rapidly by more actively growing plant populations and then removed through harvest. A solid case could be made that the "long-term" contribution of PL nutrients to forage yield is relatively short-lived and dictated by available N rather than P or K contributions. Granted, the unused P and K would be available for future use once N is reapplied to the forage stand.

Figure 1 represents forage production over three growing seasons, encompassing a severe drought and two "good growing" summers. Interestingly, the one-time application (OTA) of PL at 435-400-443 remains the highest producing treatment in the study. Although its lead was rapidly decreasing by 2014 this continues to illustrate the effect of large applications of PL nutrients, while "saving" 2/3 of the application costs over a 3-year period. We would expect this treatment to fall behind significantly in future years when compared to the other "normal rate" annual applications. When comparing the nutrient equivalent treatments 5 and 6, it again becomes obvious that PL is a solid competitor with CF in regards to N availability and subsequent yield. This data is backed by an increased level of confidence, since it was collected from both an extremely dry growing season and two ideal moisture growing seasons. At this point in the study PL has yielded 6% more forage than the same nutrient rate as CF.



Figure 1. Total Dry Matter Yield of Midland 99 Bermudagrass 2012-2014 (first harvest).

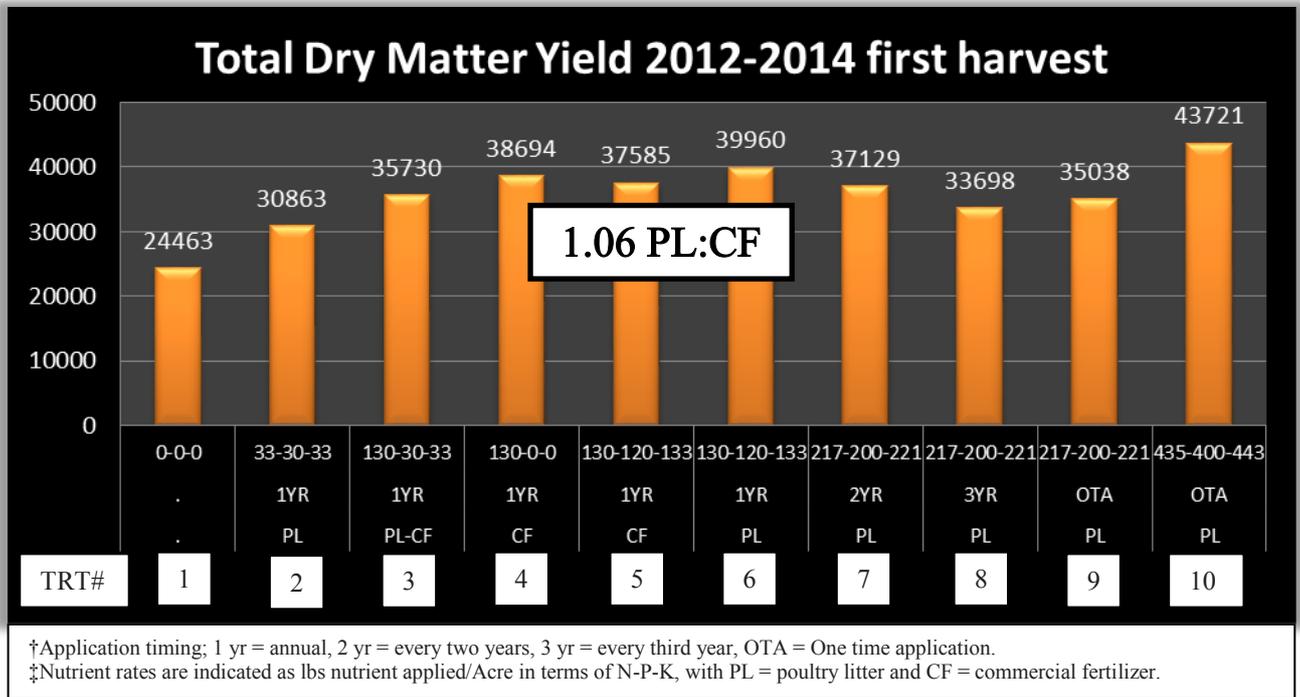
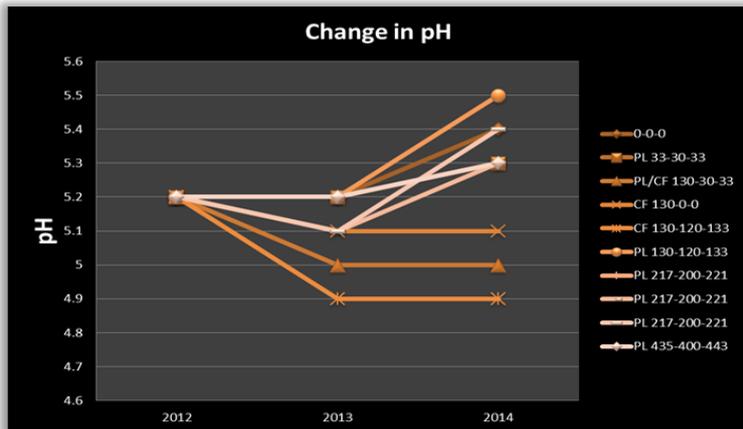


Figure 2. Change in soil pH across poultry litter and commercial fertilizer treatments.



While much of the soil data has not been analyzed as of yet, it may be pertinent to look at some generalized trends observed for various soil characteristics. Figure 2 illustrates the change in measured soil pH over a three year period. It is evident that any application of CF tended to decrease soil pH over time in proportion to the rate of applied nutrients (and in turn forage yield). Inversely, PL applications exhibited a resulting increase in soil pH dependent on rate and frequency of application. In other words, consistent annual applications of litter showed the most potential to maintain a buffering of acidic soil pH, while increased rates of PL magnified the pH change.

Figure 3 illustrates the change in measured soil P Index over a three year period. In agreement to other studies, P Index seemed to increase with increasing P application rate, while lack of P application or application rates below the removal of P from harvested forage resulted in a decline in P index. CF applications tended to show the fastest increase in P index compared to PL at identical P application rates. This illustrates there is obviously further information to be discovered as to why these differences are observed with similar yields of forage. Hopefully, by comparing the soil data to the forage nutrient concentration data from this study, we can identify the mechanism of this difference between nutrient sources.

Figure 4 illustrates the change in measured soil K index over the same three year period. Looking at this data, it is hard to draw any conclusions about the change of soil K based on source or K rate. The only exception could be the highest PL rate, where over 400 pounds of K was applied. This is not unusual, as K has been noted to undergo "luxury consumption" by the plant. This process removes excess K from the soil, beyond plant need, and at harvest this K is removed from the field. Again, further scrutiny of the data from this study should shed more light on whether this was the case.

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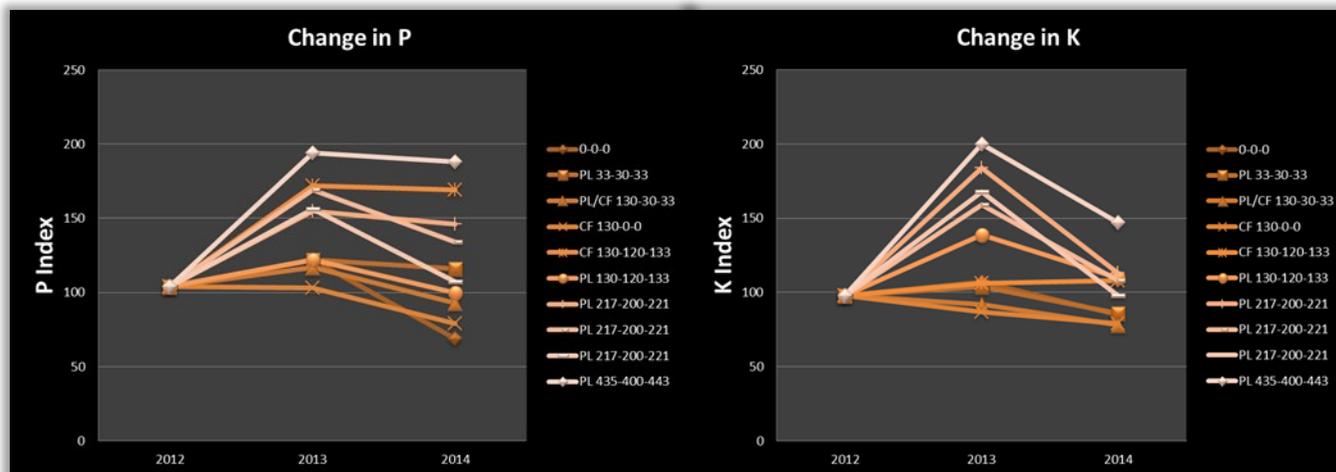


Figure 3. Change in soil P across poultry litter and commercial fertilizer treatments.
 Figure 4. Change in soil K across poultry litter and commercial fertilizer treatments.

This study is unique in that it illustrates the usefulness of PL as a comparable source of nutrients to CF, both as a soil nutrient builder and for improved forage yields. If one also values the maintenance or slight increase of soil pH under PL applications, it can be argued this may be the “best” fertilizer option for the introduced forage grower. This data highlights the fact that past N credit for PL may have been undervalued, while at the same time applications of nutrients can be “banked” in the soil for future use. These facts may lead to an increased knowledge and understanding by producers to use PL as a tool to reach their management objectives.

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Mortality Management Options During an Avian Influenza Outbreak

Josh Payne, Extension Specialist

Options include: 1. Burial, 2. Composting, 3. Rendering, 4. Incineration, 5. Landfilling.

Soil

Soil is a critical component of any farm's ecosystem. It provides a habitat for many organisms, including bacteria, fungi, and plants. It also plays a role in water filtration and nutrient cycling.

Soil Health

Soil health is the capacity of soil to function as a medium for plant growth, to store water and nutrients, and to regulate the climate.

E. coli: An Overview

Josh Payne, Extension Specialist

Introduction

E. coli is a group of bacteria that are found in the intestines of many animals, including humans. Some strains of E. coli are harmless, while others can cause illness.

Transmission

E. coli is transmitted through direct contact with infected animals or humans, or through contaminated food, water, or surfaces.

Prevention

Prevention of E. coli infection involves good hygiene, proper food handling, and avoiding contact with infected animals.

Small Flock Biosecurity for Prevention of Avian Influenza

Josh Payne, Extension Specialist

What is Biosecurity?

Biosecurity is the practice of preventing the introduction and spread of infectious diseases.

Avian Influenza in the United States

Avian influenza is a type of influenza that affects birds. It can also infect humans and other animals.

SOIL, WATER & FORAGE ANALYTICAL LABORATORY

Halin Zhang, Ph.D., Laboratory Director
 Josh Payne, Ph.D., State Poultry Specialist

TABLE 3. Recommended Levels of Concentration of Some Primary Toxic Substances in Drinking Water for Livestock and Poultry

Substance	Safe Level (ppm)
Arsenic	Not established
Boron	5
Cadmium	0.05
Chlorine	500
Chromium	5.0
Copper	0.5
Cyanide	0.05
Fluoride	2.0
Lead	Not established
Manganese	0.5
Molybdenum	0.50
Nickel	Not established
Nitrate-N	100
Nitrite-N	10.0
Sulfur	1000
Sulfate	2000
Vanadium	0.5

Livestock and Poultry Drinking Water Quality: Understanding Your Water Test Report

L-256

New Approaches for Avian Influenza Mass Mortality Composting

Josh Payne, Ph.D.

State Poultry Specialist, OSU

During an avian influenza outbreak in commercial turkey production, mass mortality composting has been utilized as the most common carcass management practice. The traditional method is to deliver bulk loads of carbon material (wood shavings, wood chips, corn stover, etc.) to the infected farm. Using equipment, carcasses and litter are moved from the center aisle of each house, exposing the dirt floor. The carbon material is then transported inside the turkey houses and used to form a base layer (10-15" thick; 12-15' wide) directly on the floor. Carcasses, litter and other infected organic material, such as feed, are then placed onto the base layer. The mixture is then capped with 8-12" of carbon material and allowed to compost reaching target temperatures above 131°F.



Pallets of bagged shavings strategically placed inside house.

An alternative approach for constructing mortality compost windrows was used during a recent avian influenza outbreak on a commercial turkey operation. Compressed bagged shavings were used as the carbon source. The center aisle of each house was cleared to the dirt floor. Pallets of shavings were delivered to the farm on a semi-trailer, unloaded and transported directly into each turkey house. Contract laborers formed a base layer by breaking apart bales and manually spreading shavings in the center alley of each house. Track loaders were then used to move carcasses, litter and feed onto the base layer of shavings. Bagged shavings were then emptied on either side of each windrow. A track



Shaving base layer.

loader with a snow blower attachment was then used to cap windrows by blowing shavings onto the piles.

The traditional method of delivering bulk loads of carbon to the infected farm can sometimes present challenges in regards to delivery of a consistent, uniform product. Bagged shavings provide a dry, uniform carbon source. Depending on the supplier they may be comparable in price and available in fine, medium and coarse particle sizes. Because the shavings are compressed, approximately 3 times the amount per cubic foot can be shipped per semi-load compared to bulk shavings, reducing the amount of traffic entering and leaving the infected premises. Reducing the vehicle traffic

also reduces the amount of necessary vehicle cleaning and disinfection. By utilizing compressed shavings, bales can be strategically placed throughout the house as needed. This approach can save significant time in comparison to moving bulk carbon material into the house using track loaders. Contract laborers are then able to quickly form a windrow base by distributing bagged shavings. Following placement of carcasses, litter and feed onto the base, a snow blower attachment can uniformly and rapidly cap windrows compared to traditional methods using track loader buckets saving a substantial amount of time constructing windrows.



Snow blower attachment capping windrow.

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Bagged shavings and a snow blower attachment worked well for this operation saving time and money but may not work for every farm. Considerations include carbon cost and availability, porosity (fine vs coarse), available contract labor and available equipment.

(Photos by Josh Payne)



Final windrow.

Mass Animal Mortality Management Workshop and Demo Tour Raleigh, NC April 18th, 2017



As part of the 3rd International Waste to Worth Conference on Livestock and Poultry Environmental Quality, a network of agri-professionals addressing issues related to air, water, soil, and climate. The workshop will provide seminars highlighting mass animal mortality response including biosecurity, euthanasia, disposal options, cleaning and disinfection, and lessons learned from recent events.

Following the workshop field demonstrations will showcase various equipment and technologies used during mass animal mortality events to manage euthanasia, disposal, cleaning and disinfection. Animal compost windrows will be demonstrated and will include carbon sourcing, construction, management, turning and troubleshooting practices. Site selection assessment for both outdoor and composting and on-site burial will also be covered.

Early Registration Fee: \$100 until March 20th, 2017
includes lunch and transportation for tour.

To register for the one day pre-conference workshop click [here](#).

For more information or to register for the full Waste to Worth Conference visit: wastetoworth.org.

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