Effect of In-house Windrow Composting on Odors During Land Application

Scott Winkler[1], Craig Coufal[1], Daren Harmel[2] and Edward Caraway[3]

[1]Poultry Science Department, Texas A&M University, [2]USDA-ARS, Temple, TX, [3]West Texas A&M University, Canyon, TX.

ABSTRACT

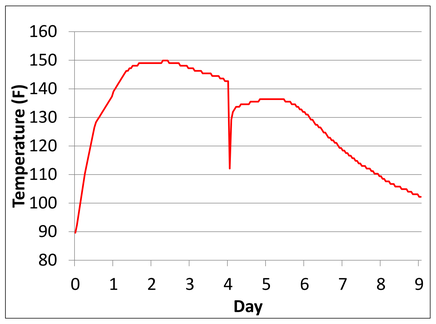
Managing odors associated with livestock feeding operations can be difficult, especially as urban growth expands into traditionally agricultural areas. A frequent cause of nuisance odor complaints is the land application of poultry litter. Composting is an aerobic process known to stabilize organic wastes and reduce the potential for offensive odors. In-house windrow composting (IWC) of poultry litter has become a common litter management practice in the poultry industry. An experiment was conducted to determine if IWC could influence odors during the land application of poultry litter. A commercial broiler house was divided in half length-wise. The litter on one side of the house was formed into a windrow (treated litter) and the other half of the house was not disturbed (raw litter). The windrow was turned on day 4, and both types of litter were removed from the house and hauled to the litter application site on day 9. Both types of litter were land applied to separate, nonadjacent fields the following day. Volatile gases were collected onto sorbent tubes from wind tunnel flux chambers placed directly on litter piles prior to application. The concentrations of 13 compounds commonly associated with animal manure were then determined by GC/MS. Concentrations were converted to odor activity values (OAV) by dividing the concentration of each compound by a detection threshold value. Human panelists also assessed odor concentration by taking edge-of-field measurements using Nasal Ranger® Field Olfactometers. Results of GC/MS analysis indicated that OAV values for butyric, isobutyric, isovaleric and hexanoic acids were greater in the treated litter compared to the raw litter by 325, 1164, 58 and 82%, respectively. However, phenol, P-cresol, 4-ethylphenol, 2-aminoacetophenone, and indole OAV values for the treated litter were 57, 54, 74, 79, and 97%, respectively, lower than the raw litter. Panelist data indicated higher odor concentrations at the treated litter field. These data indicate that IWC treatment of litter can alter the odor profile, but may not reduce the total amount of volatiles released during land application.

OBJECTIVE AND HYPOTHESIS

- The objective of this experiment is to determine the effectiveness of IWC as a litter treatment process to influence odors during the land application of poultry litter.
- Our hypothesis is that IWC will reduce offensive odors associated with poultry litter at the time of and application.

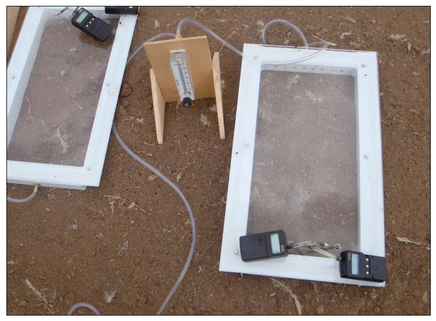
MATERIALS AND METHODS

Litter on the left side of a commercial broiler house was left undisturbed and litter on the right side was windrowed the day after broilers were removed.



The core temperature of windrows was monitored with iButton data loggers. Windrows were turned on day 4, and litter was removed on day 9.

Raw litter and IWC litter was transported to the USDA-ARS Riesel Watersheds Facility at Riesel, Texas on separate trucks. The two types of litter were applied to two separate, non-adjacent fields at a rate of 3 tons/acre.



Odor characterization was performed by GC/MS analysis of volatiles collect by sorbent tubes from wind tunnel chambers placed on litter piles prior to land application.

Human panelists also assessed odor concentration by taking edge-of-field measurements using Nasal Ranger® Field Olfactometers (St. Croix Sensory, Stillwater, MN).

RESULTS

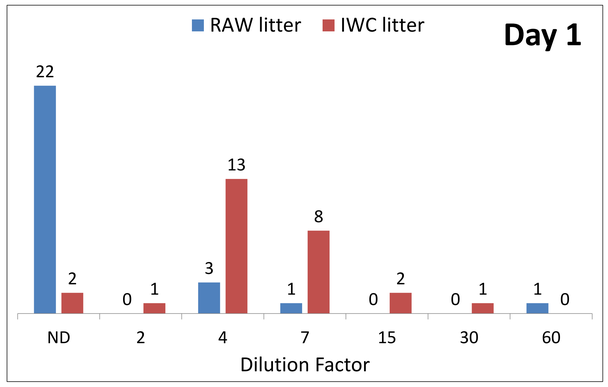
GC/MS analysis of volatile organic compounds collected by sorbent tubes from raw and IWC litter piles at the time of land application.

Compound	Description	Detection Threshold (mg/m^3)	Treatment [1]	Concentration (ng/L)	OAV[2]	Percent Reduction	P-Value
Acetic acid	Sour; vinegar	2.030	Raw litter	2.14	1.05	-41.92	0.65
			IWC	3.04	1.50		
Propionic acid	Body odor; vomitus	0.350	Raw litter	5.86	16.76	26.51	0.57
			IWC	4.31	12.32		
Butyric acid	Body odor; vomitus	0.034	Raw litter	2.47	72.77	-324.63	0.13
			IWC	10.48	308.99		
Isobutyric acid	Rancid; butter;	0.123	Raw litter	5.55	45.32	-1163.96	0.00
			IWC	70.16	572.77		
Valeric acid	Foul	0.036	Raw litter	1.93	53.19	-11.83	0.86
			IWC	2.16	59.49		
Isovaleric acid	Foul/sweat; buttery	0.007	Raw litter	3.61	555.36	-57.89	0.69
			IWC	5.70	876.88		
Hexanoic acid	Foul	0.180	Raw litter	7.14	39.57	-81.51	0.30
			IWC	12.96	71.82		
Phenol	Medicinal; floral	0.734	Raw litter	41.73	56.85	56.76	0.38
			IWC	18.05	24.58		
P-cresol	Barnyard	0.010	Raw litter	15.26	1573.44	53.87	0.42
			IWC	7.04	725.89		
4-ethylphenol	Spice; horse manure	13.000	Raw litter	4.83	0.37	73.76	0.30
			IWC	1.27	0.10		
2'-aminoaceto-phenone	Bat cave; taco shell	0.514	Raw litter	1.75	3.41	78.66	0.17
			IWC	0.37	0.73		
Indole	Piggy; musty	0.004	Raw litter	1.18	307.43	97.38	0.11
			IWC	0.03	8.05		
Skatole	Outhouse; fecal	0.002	Raw litter	0.33	146.66	-18.83	0.76
			IWC	0.39	174.27		

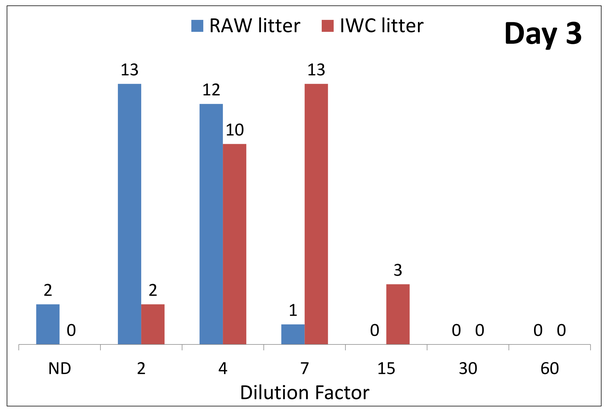
[1] Raw litter n = 4; IWC n = 3

[2] OAV = Odor Activity Value (concentration/detection threshold)

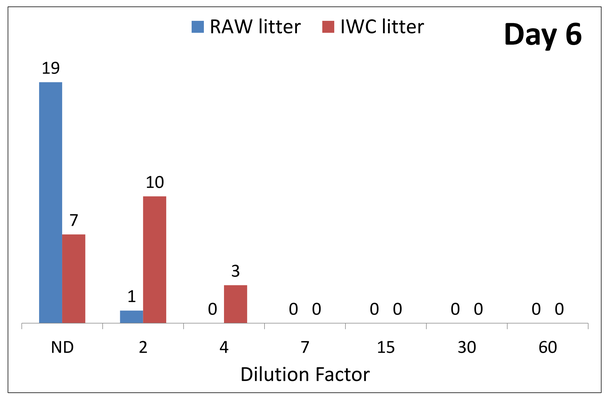
Frequency of dilution to detection threshold values determined by odor panelists at edge of application field.



n = 27 observations/treatment



n = 28 observations/treatment



n = 20 observations/treatment

CONCLUSIONS

- While the use of IWC did not result in a reduction in the overall amount of odors volatilized from litter during land application, it did alter the concentrations of individual odorant compounds, particularly those with a manure-like descriptor.
- These data indicate that IWC may be a useful best management practice to alter the odor characteristics of poultry litter, thus reducing the potential for nuisance odor complaints resulting from the land application of poultry litter.

AgriLIFE RESEARCH & EXTENSION
Texas A&M System