Effects of Bedding Type on Animal Performance, Manure Nitrogen Retention and Composting Efficiency (Preliminary Report)

M.B. Johnson[*], V. Anderson[**], D. Landblom[*]
[*]Dickinson and [**]Carrington Research Extension Centers, North Dakota State University

Research Summary: Preliminary results have not demonstrated a significant improvement in the performance of developing heifers when bedding is added to feedlot pens during winter feeding. In addition, no significant differences were found in nutrient content of fresh manure, although potassium levels tended to be higher in bedded treatments. Further analysis will have to be completed before further conclusions can be made.

Introduction

This project was designed to assist producers with pen management decisions that aid in the capturing and utilization of nutrients from livestock manure. Previous research has proven that bedding improves cattle comfort and performance, but there is little information on the use of bedding to capture nutrients from livestock manure. Therefore, it was hypothesized that bedding could serve a dual purpose of providing cattle comfort during inclement weather as well as absorb and capture nutrients that would otherwise be lost to runoff or volatilization into the atmosphere. In addition to providing an absorptive material in the pen, bedding also provides the carbon source needed for composting manure. Most research to date has studied the quantity of bedding that should be used whereas this project will focus on the type of bedding.

This project was designed to determine if: 1) bedding type has an effect on animal performance, 2) there is a preferable bedding source for nutrient absorption in the pen, and 3) carbon source effects composting of manure.

Material and Methods

One hundred heifers were weighed, blocked by weight, assigned to pens and one of the following treatments: 1) control – no bedding, 2) barley straw, 3) oat straw, 4) corn stover or 5) wheat straw. Each experimental pen contained five heifers and each treatment was replicated four times for a total of 20 pens. Heifers were confined and fed for a total of 111 days. The nutrient composition of the diet can be found in Table 1. During this period heifers were bedded on a weekly basis and weights were taken every 28 days and at the conclusion of the study. Feed was delivered daily and weighed in order to calculate feed efficiency. At the conclusion of the study, heifers were removed from the pens. Pens were scraped and manure and bedding was piled in order to begin the composting process. Samples for nutrient analysis were collected immediately and measurements were taken to estimate pile volume. Piles were monitored weekly for changes in temperature and were turned four times from June to November.

Results and Discussion

No significant difference was found in the start weight, end weight, average daily gain or feed efficiency of heifers with or without bedding as shown in Table 2. The mild weather and protection from the wind may have lessened the effect of the bedding. There was no significant difference in feed intake among treatments, although, the heifers in the Control treatment tended to eat more during the second feed period ($p = .2041$). Pen intake for each period can be found in Table 3.

Heifers were bedded each week with approximately 84 pounds of bedding. The goal was to provide approximately 266 pounds of bedding per head over the feeding period based on findings by Birkelo and Lounsbery (1992). Four weeks after initiation of the project it was determined that additional bedding needed to be delivered to create an adequate bedding pack. Sufficient bedding was added to each pen to create a pack and future bedding weights were adjusted to create similar weights among treatments. Heifers received approximately 320 pounds of bedding per head over the feeding period. However, heifers receiving wheat straw had a significantly higher bedding weight than heifers in other treatments. Total bedding weights and volumes can be found in Table 4. Volumes were calculated from three measurements taken immediately after piling. There was a significant difference in volume between the control and bedded treatments. This can be attributed to the additional material that was added to the bedded pens.

Manure samples were sent to NDSU Soils Lab and analyzed for dry matter, (DM), ammonia-nitrogen (NH4), nitrogen (N), phosphorus (P),

potassium (K) and organic matter (OM). Results can be found in Table 5. Dry matter was significantly different among treatments. Pens without bedding (control) had significantly higher dry matter. This can most likely be explained by the lack of absorptive material resulting in an increase in runoff. Ammonia-nitrogen values for barley and wheat treatments tended to be higher than other treatments indicating a more stable carbon to nitrogen ratio and reduced nitrogen volatilization. The significantly higher amount of bedding in the wheat treatment may also have contributed to less nitrogen volatilization. No significant differences were found in percent nitrogen, phosphorus, potassium or organic matter amongst the treatment. Lack of differences in manure nutrients could be attributed to varying nutrients in bedding sources. Further analysis of bedding sources will help determine their contribution to the nutrients found in the manure. A difference in organic matter was expected between the control and bedded treatments but was not detected. Feed intake was not significantly different among treatments suggesting that if bedding was consumed by heifers it was not enough to reduce feed intake. Failure to obtain a representative sampling may also have contributed to the results.

Once initial sampling and measuring of manure piles was completed, piles were moved to a location where they could be monitored and turned until the composting process was completed. Two temperatures were taken from each pile on a weekly basis. When pile temperatures, on average, fell below 120 degrees F, piles were turned. Significant differences between treatments were found at several readings. Temperature differences became significant approximately four weeks after piling and remained significantly different for three weeks. Temperatures were similar until the last two weeks of sampling when they became significantly different. Table 6 shows the changes in average temperature to date. Graph 1 shows the temperature fluctuations among treatments.

The nature of this project and the lack of supporting research make it difficult to make conclusions after one year of data collection. Research being conducted this fall at the Carrington Research Extension Center will compliment the data that has been collected thus far, but will represent a different portion of the state.

Literature Cited

Birkelo, C.P. and J. Lounsbery. 1992. Effect of straw and newspaper bedding on cold season feedlot performance in two housing systems. South Dakota Beef Report pp. 42-45.

Table 1. Nutrient composition of diet fed to heifers during bedding trial (dry matter basis).

	Hay	HI-EN 14*
Dry matter, %	88.58	88.51
Crude protein, %	12.55	14.0
Calcium, %	0.84	0.5
Phosphorus, %	0.26	0.5
Acid detergent fiber, %	44.69	
Neutral detergent fiber, %	63.17	
Total digestible nutrients, %	51.59	
Salt, %		0.25
Vitamin A, IU/lb		4,000
Vitamin D, IU/lb		400
Crude Fat, %		2.5

* Commercial feed supplement.

Table 2. Performance data for heifers in bedding trial. Reported on a pen basis.

	Control	Barley	Oats	Stover	Wheat	P Value
Start Wt, #	3706.0	3705.0	3739.0	3750.5	3736.3	0.9994
End Wt, #	4846.8	4804.6	4890.1	4884.9	4890.37	0.9932
ADG, #/d	10.37	9.99	10.46	10.31	10.49	0.8528
Feed:Gain	10.53	10.52	10.36	10.29	10.05	0.8026

ADG = Average daily gain.

Table 3. Feed intake for heifers in bedding trial. Reported on a pen basis.

	Control	Barley	Oats	Stover	Wheat	P Value
Feed – PD 1	2917.0	2869.5	2907.0	2939.5	2894.5	0.9384
Feed – PD 2	3137.5	2965.0	3117.5	2965.0	2920.0	0.2041
Feed – PD 3	3182.5	3038.75	3162.5	3110.0	3025.0	0.4661
Feed – PD 4	2743.75	2657.5	2732.5	2632.5	2717.5	0.7017
Total Feed	11,980.75	11,530.75	11,919.5	11,647.0	11,557.0	0.3911

PD 1, 2, 3, 4 = First, second, third and fourth period.

Table 4. Bedding weight and pile dimensions for bedding trial.

	Control	Barley	Oats	Stover	Wheat	P Value
Bedding total, #	0.0a	1587.75b	1595.50b	1599.50b	1607.25b	<0.0001
Initial Volume, cu in	435,436a	813,117b	869,452b	826,503b	816,574b	0.0033

Values with differing subscripts are significant.

Table 5. Manure characteristics of initial manure and bedding pile.

	Control	Barley	Oats	Stover	Wheat	P Value
Dry Matter, %	58.99a	45.01bc	47.61bc	49.15bc	40.46c	0.0114
Ammonia-N, ppm	158.15	328.50	288.19	249.50	311.13	0.2007
Nitrogen, %	1.23	1.42	1.25	1.48	1.40	0.6098
Phosphorus, %	.39	.48	.39	.42	.41	0.4371
Potassium, %	.59	.88	.81	.75	.75	0.1585
Organic Matter, %	39.65	46.62	36.00	44.60	43.40	0.4277

Values with differing subscripts are significant.

Table 6. Average pile temperatures of composting manure from bedding trial.

	Control	Barley	Oats	Stover	Wheat	P Value
Temp 1	72.0	64.7	70.1	63.4	65.87	0.3711
Temp 2	131.9	134.9	140.9	137.8	138.5	0.1318
Temp 3	139.1	140.9	145.6	141.6	141.5	0.1013
Temp 4	144.5a	146.6a	150.2b	147.9a	147.5a	0.0896
Temp 5	147.2a	143.0b	148.2b	149.0b	148.5b	0.0549
Temp 6	141.4a	140.4a	147.6b	147.1b	145.1a,b	0.0928
Temp 7	134.5c	137.9b,c	144.9a,b	142.5a,b,c	138.8b,c	0.0193
Temp 8	126.8	131.5	138.6	137.7	134.5	0.2082
Temp 9	120.4	138.1	128.0	140.4	139.0	0.3248
Temp 10	108.6	136.2	122.2	126.5	132.0	0.2364
Temp 11	109.2a	145.0b	145.9b	149.0b	146.0b	0.0034
Temp 12	128.1a	136.0a,b	145.6b	141.4b	143.6b	0.0259

Graph 1. Pile Temperatures