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Pen Density and Straw Bedding During Feedlot Finishing

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Summary

Two experiments evaluated effects of straw bedding (in sheltered and unsheltered facilities) and pen density (in unsheltered facilities) on cattle performance during winter/spring (mid-December to late March) seasons. Bedding had no effect on overall performance in the sheltered facilities, but performance improvements were noted from December through February in unsheltered facilities. Lowering pen density (increasing pen space per animal) improved performance and lowered mud condition scores on the animal and in the feedlot.

Introduction

Managing cattle in periods of adverse weather can be challenging. Winter cold and wind, combined with precipitation, can increase the maintenance requirement of feedlot cattle and decrease performance. While cold stress alone can reduce profits, it is most detrimental when combined with mud. Cattle in mud have a tendency to eat less frequently and the muddy hair coat reduces insulation. Shelter belts and windbreaks have been shown to be effective at reducing cold stress, however, more knowledge regarding how to reduce mud and mud effects in feedlots is needed.

While feedlot surface maintenance, such as removing manure and rebuilding mounds, can help reduce mud in the winter and spring time, more can be done to further minimize the problems associated with mud. The objectives of our trials were to evaluate the effects of adding straw bedding and reducing pen density to reduce mud and cold stress in feedlot cattle.

Procedure

One-hundred eighty (Trial 1) and two-hundred thirty-four (Trial 2) crossbred steers were received at Haskell Agricultural Laboratory, Concord, Neb. Following receiving, all cattle were vaccinated (Vision 7 and Titanium 5 PHM Bac 1; Intervet, Millsboro, Del.). Additionally, in Trial 1, cattle were implanted (Ralgro; Schering-Plough Animal Health, Kenilworth N.J.) following receiving. At trial initiation (d-1), steers in both trials were revaccinated (Vision 7 and Titanium 5; Intervet, Millsboro, Del.), treated for external parasites (Saber; Schering-Plough Animal Health, Kenilworth, N.J.), and weighed. In Trial 2, cattle were implanted with Ralgro at trial initiation. On day 0 (Dec. 18, 2003, and Dec. 16, 2004, respectively) of each trial, steers were weighed and randomly assigned to 20 pens (Trial 1) or 24 pens (Trial 2) based on the weight from the previous day (day-1). Average body weight for the two consecutive days was used as the initial weight (Trial 1 mean BW=824 lb; Trial 2 mean BW=885 lb). In both trials, cattle were treated for external parasites (Saber) and reimplanted (Revalor-S; Intervet, Millsboro, Del.) on day 35 (Trial 1) or d 34 (Trial 2). Throughout both trials, all cattle were fed a 65.2 NEg mcal/cwt finishing diet which contained (DM Basis) 83.1% dry rolled corn, 6.0% corn silage, 5.0% alfalfa, 3.7% liquid protein supplement, and 2.2% dry Rumensin-Tylan (Elanco; Indianapolis, Ind.) supplement.

In Trial 1, pens were randomly assigned to the following treatments: 1) Low pen density, oat straw bedding, sheltered (overhead shelter, enclosed on north side, and open to dirt lot on south side) feeding area; 2) Low pen density, no bedding, sheltered feeding area; 3) Low pen density, no bedding, unsheltered feeding area; or 4) high pen density, no bedding, unsheltered feeding area. The treatments (Trt) were chosen to exemplify a range of environmental conditions from most comfortable (Trt 1) to least comfortable (Trt 4). For Trial 2, treatments were assigned to pens using a 2 x 2 factorial design, which consisted of pen density (High vs Low) and oat straw bedding (provided vs not provided).

In both trials, pen density was obtained by adjusting the number of head per pen in two different pen sizes. The low pen density treatment consisted of 6 or 7 head/pen for a stocking rate of approximately 500 ft^2/head. The high pen density treatment had 12 or 14 head/pen for a stocking rate of approximately 250 ft^2/head. All cattle had a minimum of 18 inches of bunk space/head.

In both trials, pens receiving the bedding treatment were bedded at the rate of 5 lb/head/day the first day of the trial. Thereafter, bedding was applied at the rate of approximately 2 lb/head/day based on the following two primary thresholds: 1) air temperature was below 14°F; and/or 2) precipitation of at least 0.10 inch rain or 1 inch snow was received. When more than 0.10 inch rain or 1 inch snow was received, cattle were bedded on subsequent days for each 0.10 inch rain or 1 inch snow. Additionally, when there was melting snow or mud in the pen, even if thresholds were not met, cattle received 2 lb/head/day of bedding every day or every other day, respectively, until the snow and mud were gone. Slight alternations in the bedding schedules were made to maintain a minimal amount of bedding in the pens at all times, however, in Trial 2, no bedding was added from day 98 to the end of the trial due to warmer temperatures and greater windspeeds, which allowed for improved conditions in the pens. Bedding was added to pens a total of 65 and 59 days in Trial 1 and 2, respectively.

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Feed intakes were recorded daily. Body weights were obtained on days 0, 35, and 110 in Trial 1 and on days 0, 34, 71, and 98 in Trial 2. Cattle were fed 110 and 124 d in Trials 1 and 2, respectively. In Trial 1 (after thawing) and Trial 2 (trial duration), animal and lot mud condition scores were recorded twice per week. Animal mud condition scores were defined as: 0) clean, no mud; 1) small lumps of mud on the hide in limited areas of the leg and underbelly; 2) small and large lumps of mud covering larger areas of the legs, side, and underbelly; 3) small and large lumps of mud covering the hide in even areas that included the hind quarter, stomach, and front shoulder; or 4) lumps of mud continuously covering the underbelly and side of the animal from brisket to rear quarter. Lot mud condition scores were defined as: 0) no mud or mud less than 3 inches deep; 1) mild mud, 3 to 7 inches deep; or 2) severe mud, more than 7 inches deep. Additionally, in Trial 2, lot condition was denoted as frozen ground or thawed. At slaughter (day 110, Trial 1; and day 124, Trial 2) final weight, hot carcass weight, liver score, USDA marbling score, and USDA yield grades were obtained.

Statistical analysis of performance data, marbling scores, and yield grade was done using General Linear Models procedures of SAS. In Trial 1, the model included Trt. Contrasts were used to compare density in the unsheltered feed area treatments and bedding in the sheltered feed area treatments. In Trial 2, the model included density, bedding, and the density by bedding interaction. Liver and mud condition scores (animal and lot) were analyzed using frequency procedures of SAS. The P-value reported is the Mantel-Haenszel Chi-Square.

Table 1. Weather conditions for trials.[a]

	Mean Ta, °F	Max Ta, °F	Min Ta, °F	RH, %	WSPD, mph	Precip, in
Trial 1						
day 0 to 35	25.44	36.43	13.97	75.30	5.29	0.16
day 36 to 110	35.78	47.26	24.39	73.96	6.46	3.75
day 0 to 110	32.58	43.90	21.16	74.38	6.10	3.91
Trial 2						
day 0 to 33	16.55	25.83	5.82	75.30	5.83	0.13
day 34 to 70	30.85	40.46	20.47	82.35	5.99	1.21
day 71 to 98	33.28	46.11	20.06	67.53	6.79	0.03
day 99 to 124	49.77	60.57	38.25	68.03	8.34	1.98
day 0 to 124	31.56	42.06	20.21	74.13	6.62	3.35

[a]Ta = Ambient temperature; RH = relative humidity; WSPD = wind speed; Precip = precipitation, as rain or melted snow.

Table 2. Performance and carcass data (Trial 1).

	Facilities								
	Sheltered		Unsheltered						
Pen Density:	Low	Low	Low	High					
Bedding:	Yes	No	No	No			Contrasts		
Treatment No:	1	2	3	4	SEM	P-Value	1 v 2	3 v 4	1 v 4
Weight, lb									
day 0	823	822	824	827	2.0	0.48	0.89	0.46	0.21
day 35	968	967	969	967	8.2	1.00	0.99	0.89	0.99
day 110	1281	1272	1277	1245	14.3	0.31	0.68	0.13	0.10
day 110 (adjusted)[a]	1239	1238	1247	1216	13.2	0.42	0.93	0.12	0.24
ADG, lb									
day 0 to 35	4.14	4.15	4.14	4.02	0.23	0.98	0.98	0.72	0.73
day 36 to 110	4.12	4.01	4.05	3.65	0.16	0.18	0.60	0.09	0.05
day 0 to 110	4.13	4.05	4.08	3.77	0.12	0.20	0.66	0.09	0.06
day 0 to 110 (adjusted)[a]	3.75	3.74	3.81	3.51	0.11	0.30	0.94	0.08	0.15
DMI, lb									
day 0 to 35	20.57	21.13	20.80	20.64	0.47	0.84	0.41	0.82	0.92
day 36 to 110	22.94	22.99	23.22	22.80	0.60	0.97	0.95	0.62	0.88
day 0 to 110	22.19	22.40	22.46	22.12	0.53	0.96	0.78	0.66	0.93
Feed/gain									
day 0 to 35	5.01	5.12	5.11	5.21	0.26	0.97	0.79	0.80	0.61
day 36 to 110	5.58	5.80	5.75	6.26	0.23	0.22	0.50	0.13	0.05
day 0 to 110	5.39	5.57	5.50	5.88	0.18	0.27	0.49	0.15	0.07
day 0 to 110 (adjusted)[a]	5.94	6.03	5.90	6.32	0.22	0.54	0.78	0.19	0.24
Carcass data									
HCW, lb	769	767	773	754	8.2	0.43	0.92	0.13	0.24
Marbling score[b]	483	460	495	481	11.3	0.22	0.18	0.39	0.91
Yield grade	2.45	2.26	2.39	2.34	0.11	0.65	0.23	0.73	0.47
Dressing %	60.0	60.3	60.6	60.6	3.30	0.57	0.45	0.96	0.22
Liver score[c]	0	3.33	2.86	5.71	—	—	0.31	0.52	—

[a]Based on hot carcass weight adjusted to a 62% dressing percentage.
[b]Marbling score: 400 = slight[0] (select), 500 = small[0] (low choice).
[c]Percentage condemned, due to abscesses based on Chi-Square analysis.

Table 3. Performance and carcass data (Trial 2).

	Pen density (Den)[a]		Bedding (Bed)			P-values		
	Low	High	No	Yes	SEM	Den	Bed	Den*Bed
No. pens	12	12	12	12				
Weight, lb								
Initial	879	882	878	884	2.5	0.33	0.11	0.19
day 34	1048	1054	1043	1059	4.3	0.34	0.01	0.09
day 71	1163	1160	1150	1172	5.8	0.76	0.02	0.25
day 98	1252	1248	1243	1257	7.2	0.64	0.20	0.37
Final[b]	1328	1327	1320	1336	8.5	0.95	0.41	0.45
ADG, lb								
day 0 to 34	4.84	4.91	4.73	5.02	0.09	0.61	0.04	0.23
day 0 to 71	4.00	3.91	3.85	4.07	0.06	0.33	0.02	0.46
day 0 to 98	3.82	3.74	3.74	3.82	0.06	0.33	0.41	0.70
day 0 to 124[b]	3.63	3.59	3.57	3.65	0.04	0.57	0.36	0.50
DMI, lb								
day 0 to 34	22.87	24.96	23.81	24.01	0.39	<0.01	0.73	0.57
day 0 to 71	22.42	24.02	23.25	23.18	0.38	0.01	0.90	0.38
day 0 to 98	21.83	23.41	22.64	22.60	0.35	0.00	0.93	0.27
day 0 to 124	22.11	23.87	23.04	22.94	0.39	0.19	0.89	0.20
F/G								
day 0 to 34	4.74	5.10	5.05	4.80	0.11	0.03	0.12	0.63
day 0 to 71	5.62	6.15	6.05	5.72	0.10	<0.01	0.03	0.75
day 0 to 98	5.72	6.28	6.05	5.94	0.11	<0.01	0.46	0.45
day 0 to 124[b]	6.11	6.66	6.46	6.31	0.05	0.07	0.25	0.45
Carcass data[c]								
Dressing %	63.9	64.0	63.5	64.3	0.19	0.65	0.21	0.40
HCW	823	823	818	828	6.8	0.94	0.32	0.46
Marbling[d]	563	527	537	552	7.6	0.00	0.16	0.59
Yield Grade	2.38	2.37	2.40	2.34	0.07	0.92	0.56	0.34
Liver Score[e]	10.56	5.63	2.35	6.57	—	0.23	0.02	—

[a]Low = 500 ft^2/animal; High = 250 ft^2/animal.
[b]Final weight (d 124) calculated as hot carcass weight (HCW) divided by a 62% dressing percentage.
[c]Carcass data was analyzed using the individual animal as experimental unit.
[d]Marbling score: 500 = Small^0 (Low Choice), 600 = Modest^0 (Average Choice)
[e]Percentage condemned, due to abscesses; based on Chi-Square analysis.

Table 4. Animal and lot mud condition scores (Trial 1).

Feeding area:	Sheltered			Unsheltered		
Pen density:	Low	Low		Low	High	
Bedding:	Yes	No		No	No	
Treatment no.:	1	2	P-value	3	4	*P*-value
Animal condition[b]			0.020			0.003
Score 0, %[a]	20.00	46.67		50.00	16.67	
Score 1, %[a]	43.33	36.67		26.67	43.33	
Score 2, %[a]	36.67	16.67		20.00	33.33	
Score 3, %[a]	0.00	0.00		3.33	13.67	
Lot condition[c]			0.001			0.002
Score 0, %[a]	50.00	0.00		26.67	0.00	
Score 1, %[a]	50.00	100.00		73.33	96.67	
Score 2, %[a]	0.00	0.00		0.00	3.33	

[a]Percentage of pens observed at given score.
[b]Animal condition: 0 = clean, no mud; 1 = small lumps of mud on the hide in limited areas of the leg and underbelly; 2 = small and large lumps of mud covering larger areas of the legs, side, and underbelly; 3 = small and large lumps of mud covering the hide in areas along the hind quarter, stomach, and front shoulder.
[c]Lot condition: 0 = no mud or mud less than 3 inches deep; 1 = mild mud, 3 to 7 inches deep; 2 = severe mud, more than 7 inches deep.

Results

In Trial 1 (Table 2), there were no differences for bedding versus no bedding (Trt 1 vs Trt 2) in the sheltered cattle. In the unsheltered groups, low pen density tended to increase ($P<0.10$) ADG from days 35 to 110, and day 0 to 110, when based on unadjusted full weights. Cattle with bedding and the most pen space (Trt 1) had improved ADG and lower F/G from days 36 to 110 ($P\leq0.05$) when compared with nonbedded cattle with the least pen space (Trt 4). Overall performance was similar among groups when comparisons were based on a common dressing percentage, however, in the unsheltered group, increased cattle density tended ($P\leq0.10$) to reduce overall gain. In Trial 2 (Table 3), the addition of bedding increased ($P<0.05$) day 34 weight, day 71 weight, ADG from days 0 to 34 and ADG from days 0 to 71, and improved feed efficiency from days 0 to 71. The low density group had lower ($P<0.05$) DMI and F/G from day 0 through day 98 when compared with the high density group. The low density group tended ($P=0.07$) to have lower overall F/G and a greater ($P=0.001$) marbling score when compared with the high density group. Bedding improved ($P=0.03$) F/G through day 71 only, however, it did result in a greater ($P=0.02$) percentage of condemned livers. There were no pen density by bedding interactions for performance or carcass data.

In Trial 1, bedding did not ($P=0.02$) result in lowering animal mud condition scores, but did lower ($P<0.001$) lot mud condition scores. However, animal and lot mud condition scores were lower ($P<0.005$) in the low density treatment when compared with the high density treatment. Data suggest cattle with bedding were dirtier ($P<0.05$) than cattle without bedding, even though pens with bedding were less muddy ($P<0.05$). In Trial 2 (Table 5), no differences ($P>0.05$) in animal or lot mud condition were observed for bedded versus

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nonbedded treatments. Lower cattle density resulted in lower ($P<0.05$) mud condition scores on cattle day 36 to day 71, and lower ($P<0.05$) mud condition scores in the lot for days 36 to 71, and days 72 to 98. These results indicate a lower stocking density can potentially improve comfort and performance during winter (cold) and spring (rainy) weather patterns.

In both trials, positive responses to providing more pen space per animal and to providing bedding were observed. However, responses were not always maintained for the duration of the trials. Lowering pen density tended ($P=0.08$) to enhance ADG over the entire trial in Trial 1, while F/G tended ($P=0.07$) to improve and marbling score increased ($P=0.001$) in Trial 2. Benefits of bedding were not sustained. Bedding did increase the percentage of condemned livers in Trial 2, however trends in the percentage of condemned livers as a result of providing bedding or changing pen density were opposite for the two trials. For both trials, decreasing pen density lowered lot mud condition scores; however, the use of bedding did not consistently improve animal or lot mud condition scores.

The use of straw bedding may improve cattle performance during periods of cold stress in feedlots that are not sheltered. However, in sheltered feedlots or times of no cold stress, bedding has little effect on ADG or F/G. It was more effective to reduce mud in feedlots by reducing the pen density versus using bedding during typical winter/spring weather patterns.

Table 5. Animal and lot mud condition scores (Trial 2).

	Bedding			Density		
	None	Bedded	*P*-Value	Low	High	P-Value
Animal condition[b]						
Score, day 0 to 35			1.00			0.31
0, %[a]	57.41	58.33		60.19	55.56	
1, %[a]	24.07	26.85		26.85	24.07	
2, %[a]	12.96	4.63		12.04	5.56	
3, %[a]	5.56	10.19		8.33	7.41	
Score, day 36 to 71			0.92			0.001
0, %[a]	0	0		0	0	
1, %[a]	31.82	30.30		52.27	9.85	
2, %[a]	56.06	58.33		37.88	76.52	
3, %[a]	12.12	11.36		9.85	13.64	
Score, day 72 to 98			1.00			1.000
0, %[a]	0	0		0	0	
1, %[a]	100.00	100.00		100.00	100.00	
2, %[a]	0	0		0	0	
3, %[a]	0	0		0	0	
Lot condition[c]						
Score, day 0 to 35[d]			1.00			1.000
0, %[a] 1	33.33	33.33		33.33	33.33	
1, %[a] 1	66.67	66.67		66.67	66.67	
2, %[a] 1	0	0		0	0	
Score, day 36 to 71[e]			0.557			0.001
0, %[a]	10.61	11.36		15.15	6.82	
1, %[a]	75.00	69.70		77.27	67.42	
2, %[a]	14.39	18.94		7.58	25.76	
Score, day 72 to 98[f]			0.641			0.001
0, %[a]	75.00	71.88		84.40	62.50	
1, %[a]	17.71	19.79		12.50	25.00	
2, %[a]	7.29	8.33		3.10	12.50	

[a]Percentage of animals or pens observed at given score over all days in given period.
[b]Animal Condition: 0 = clean, no mud; 1 = small lumps of mud o the hide in limited area of the leg and underbelly; 2 = small and large lumps of mud covering larger areas of the legs, side, and underbelly; 3 = small and large lumps of mud covering the hide in areas along the hind quarter, stomach, and front shoulder; 4 = lumps of mud continuously covering the underbelly and side of the animal from brisket to rear quarter.
[c]Lot condition: 0 = no mud or mud less than 3" deep; 1 = mild mud 3 to 7" deep; 2 = severe mud, more than 7" deep.
[d]n = 216; 144 frozen, 72 thawed.
[e]n = 264; 168 frozen, 96 thawed.
[f]n = 192; 24 frozen, 168 thawed.
n = number of pen observations.

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