Mud Effects on Feedlot Cattle

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Summary

Estimated mud depth and benefits of bedding were simulated under winter environmental conditions. In general, providing greater pen area per animal decreased mud depth. At lower temperatures (16°F), 250 or 350 ft² of pen space produced similar depths of mud and approximately 1 inch less than with the 150 ft² allocations. Under the coldest (16°F) and wettest (6 inches total precipitation) conditions, cost of gain (COG) was 56.1% ($1.07/lb) greater than with no precipitation falling at 26°F, while use of bedding reduced COG to $0.80 /lb or just 17.3% greater than COG under more ideal conditions at 26°F.

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 at a time when the muddy hair coat reduces insulation. Thus, cattle performance can be reduced for multiple reasons. The objectives of this study were to develop models to predict mud effects and related mitigation strategies for feedlot cattle.

Procedure

Data from cattle feeding studies conducted in Canada, California, Colorado, Nebraska, North Dakota, and South Dakota (references available upon request) were used to assess effects of mud and bedding on feedlot cattle. An initial model was developed to assess effects of muddy conditions on feedlot cattle feed intake and daily gain. Estimates of mud depth were determined based on quantity of rain and snowfall, feedlot layout, feedlot soil and surface properties, and stocking densities. From performance profiles, algorithms were derived to estimate maintenance energy requirements based on mud depth and environmental conditions.

To counter effects of mud, bedding can be used to absorb excess moisture. Therefore, a subsequent submodel of the first model was developed to determine the effects of bedding on cattle performance. Performance assessments were based on amounts and type of bedding used, environmental conditions, and estimates of feedlot pen conditions as defined from the previous model used for determining feedlot mud depth. Bedding quantities needed to absorb excess moisture can be calculated based on water holding capacity of the soil and potential for run-off. However, quantity of bedding (lb/head/day) needed is comparable to the potential mud depth. Thus, approximately 1 lb of bedding is needed daily to overcome impacts of 1 inch of mud.

Model simulations were conducted based on feedlot pen soil profiles that were composed of predominantly clay-based soils, reasonably clear of manure, with a 3% slope. A 120-day feeding period was simulated for cattle averaging 1,000 lb. Pen densities of 150, 250, and 350 ft²/animal were compared. Average winter temperatures of 16°F, 26°F, and 36°F were compared under low (2 inches) and high (6 inches) quantities of total precipitation between December 1 and April 1. Temperature and precipitation varied by week and month to simulate variable winter conditions. Estimates of daily water intake were used to determine moisture accumulations attributed to urinary output. Environmental conditions, in conjunction with feedlot and animal variables, were used to determine pen surface conditions and bedding requirements. Mud depth is an estimate of the depth of mud or mud and snow mix. Simulations were based on 50% of all snowfall blowing out of pens (50% remaining) with snow compaction rates varying, depending on stocking densities. Cost of gain was based on performance estimates. Feed ($150/dry ton), yardage ($0.35/head/day), and other costs comparable to those found in Nebraska feedyards were used. Bedding was charged out at $60/ton. Manure hauling and additional pen cleaning charges associated with bedding were prorated on a per head basis at $6/wet ton. Weight of bedding removed from the feedlot was estimated to be four times the original bedding weight, which would include the bedding, absorbed water, and attached mud and manure particles.

Results

For simulation purposes, a constant daily dry matter intake (DMI) of 22 lb was used. Under colder conditions, intakes would be expected to be greater; however, under muddy and/or adverse feeding and pen conditions, DMI would be expected to be lower. The first data column indicates what the performance and cost of gain (COG) are under ideal (68°F) feeding conditions. Percent changes in winter maintenance energy requirements (NEm) and COG were determined based on those ideal conditions. In general, providing greater area per animal decreases mud depth (Table 1). However, at lower temperatures (16°F), 250 or 350 ft² of pen space produced similar depths of mud with mud depths approximately 1 inch less than with the 150 ft² allocations. The difference may be largely due to precipitation coming in the form of snow, and the effects of total precipitation combined with urinary output begin to diminish in the winter with greater pen space allocations. Thus, at temperatures approaching 10°F below freezing or more, the potential for mud depth does not increase as pen space increases from 250 to 350 ft²/animal. As a result of snow accumulation, snow/mud depth increases until temperatures warm up and snow begins to melt, allowing moisture to leave the pen through run-off. In general, at temperatures that are below freezing, animals continue to disturb the snow/soil interface, which increases snow/mud depth. The impact of body heat from animals lying on the ground also contributes to snow melting and/or mixing with surface soil particles. This phenome-

Table 1. Estimated mud depth, change in net energy for maintenance (NEm), and cost of gain for feedlot cattle under different simulations.

Pen space, ft²/animal:	250	150	150	150	150	250	250	250	250	350	350	350	350
120-day precipitation, inches:	0	2	2	6	6	2	2	6	6	2	2	6	6
Mean temperature,°F:	68	36	16	36	16	36	16	36	16	36	16	36	16
Mud depth, inches	0.00	1.96	3.47	3.95	8.48	0.40	2.52	2.38	7.52	0.02	2.51	1.72	7.52
NEm, % change[1]	—	25.6	48.7	37.1	91.3	17.8	41.9	27.9	82.2	16.1	41.9	24.3	82.2
DMI, lb/day	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0
ADG, lb	3.71	3.23	2.78	3.01	1.94	3.37	2.91	3.18	2.12	3.41	2.91	3.25	2.12
F:G	5.93	6.82	7.91	7.32	11.32	6.52	7.55	6.91	10.36	6.46	7.55	6.77	10.36
Cost of gain/ lb, $	0.61	0.70	0.82	0.76	1.17	0.67	0.78	0.71	1.07	0.67	0.78	0.70	1.07
% change[2]	—	15.1	33.5	23.5	91.1	10.0	27.5	16.6	74.8	8.9	27.4	14.2	74.8

[1]Change (%) in NEm; at 26°F with no mud, NEm is approximately 20% greater than at 68°F.
[2]Compared to ideal feeding conditions averaging 68°F (first numerical column).

Table 2. Projected effects of mud and bedding on feedlot cattle.

Space, ft²/animal:	250	250	250	250	250	250	250
120 days precipitation, in:	0	2	2	2	6	6	6
Mean temperature,°F:	26	36	26	16	36	26	16
Estimated mud depth, inches	0.00	0.40	2.01	2.52	2.38	6.63	7.52
NEm, % change	—	1.8	11.2	16.0	11.9	43.9	56.2
Intake, lb	22.00	22.00	22.00	22.00	22.00	22.00	22.00
Without bedding							
ADG, lb	3.31	3.37	3.10	2.91	3.18	2.47	2.12
Change, %	—	1.8	-6.4	-12.1	-4.0	-25.6	-35.9
Feed/gain	6.64	6.52	7.10	7.55	6.91	8.92	10.36
Cost of gain, $/day							
Yardage and interest	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Health and feed	1.77	1.77	1.77	1.77	1.77	1.77	1.77
Total	2.27	2.27	2.27	2.27	2.27	2.27	2.27
Cost of gain/lb	0.68	0.67	0.73	0.78	0.71	0.92	1.07
Change, %	—	-1.8	6.9	13.8	4.1	34.4	56.1
With bedding[1]							
ADG, lb	3.31	3.41	3.31	3.22	3.41	3.31	3.22
Change, %	—	2.9	0	-2.9	2.9	0	-2.9
Feed/gain	6.64	6.45	6.64	6.83	6.45	6.64	6.83
Change, %	—	-2.8	0	3.0	-2.8	0	3.0
Cost of gain, $/day							
Subtotal (less bedding)	2.27	2.27	2.27	2.27	2.27	2.27	2.27
Bedding	0.00	0.01	0.06	0.08	0.07	0.20	0.23
Scraping and hauling, prorated	0.00	0.01	0.02	0.03	0.03	0.08	0.09
Total	2.27	2.29	2.35	2.38	2.37	2.55	2.59
Cost of gain/lb	0.68	0.67	0.71	0.74	0.70	0.77	0.80
Change, %	0	-2.1	3.7	7.4	1.5	12.3	17.3

[1]Bedding cost is $60/ton; scraping and hauling cost is $6/wet ton. Hauled weight is assumed to be four times original dry bedding weight.

non is enhanced as pen space declines.

Although these mud depths may not always be fully realized, the potential for mud depth (or a comparable effect) increases under conditions in which precipitation comes as snow rather than as rain. Thus, snow remaining in pens will provide a constant source of moisture, keeping cattle wet and mixing with pen surface particles, with the same effect as increasing mud depth. Precipitation that comes as rain (warmer temperatures) can easily run off and contribute less to muddy conditions or wet cattle. Costs of gain are greater under colder conditions due to the effects of increased mud depth, which contributes to wetter and colder cattle and directly impacts NEm.

Table 2 displays the COG for various simulated mud depth, with and without bedding. In all instances, benefits of bedding were observed. Under lower precipitation conditions, even a small amount of bedding was useful, although the amount required per head per day ranged from 0.4 to 2.5 lb under these conditions.

Even though simulations indicated a benefit for adding even a small amount of bedding, it is unlikely that bedding amounts less than 1 lb could be effectively distributed daily to absorb the moisture needed to produce these results. Thus, for average mud depths of less than 1 to 2 inches, depending on pen design, bedding may not be practical or recommended. In addition, with low average mud depths, the probability of having some dry places in the pen would be high. Nevertheless, the benefits of bedding, as determined by the percentage change in COG, were much greater under high versus low moisture conditions. Under the coldest (16°F) and wettest conditions, COG was 56.1% ($1.07/lb) greater than with no precipitation falling at 26°F, while the use of bedding reduced the COG to $0.80/lb or to just 17.3% greater than COG under more ideal conditions at 26°F.

Based on results of studies conducted primarily in the western and northern plains, the impacts of mud on feedlot cattle are substantial, but the use of bedding can help minimize the adverse effects. If bedding prices and/or cost of handling the bedding or handling and hauling the resulting waste increase, the cost/benefit ratios may change. In addition, applied bedding does not have to be equally distributed throughout the pen, but initially needs to provide comfortable space (20 to 40 ft²/animal) for each animal to avoid competition. Bedding will generally be distributed by the cattle. It should be noted that if bedding is used heavily, the dynamics of pen drying may differ in bedded versus non-bedded-pens when environmental conditions for drying improve. This is due to the enhanced water-holding capacity of soil containing more fiber. However, in virtually every bedding study in which an economical analysis was reported, a benefit to bedding was found during prevailing winter weather.

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