Effect of Hay Feeding Methods on Hay Waste and Wintering Costs

Progress Report

D.G. Landblom[1], W.W. Poland[1], G.P. Lardy[2], T. Gilbery[2], C.J. Wachenheim[3], and T.A. Petry[4]
[1] Dickinson Research Extension Center, North Dakota State University
[2] Animal and Range Science Dept., North Dakota State University
[3] Agribusiness and Applied Economics Dept., North Dakota State University
[4] Extension Agricultural Economics, North Dakota State University

Summary

The effect of hay feeding method on cow performance and economics are being evaluated in a 3 year investigation. To date, two years of the study have been completed using 252 (n=84 cows/treatment) three to ten year old beef cows maintained at the Dickinson Research Extension Center. Methods evaluated included 1) rolling round bales out on the ground, 2) shredding round bales on the ground using a PTO driven bale processor , and 3) a tapered-cone round bale feeder engineered with a center tapered cone creating a manger around the inner circumference of the feeder. Gestating cows were fed an average 58 days to document feed waste, cow performance (weight gain, ultrasound fat depth change, body condition score change and hay intake), labor inputs, and feeding time, which were subsequently used to develop an economic analysis.

After two years, the tapered cone feeder increased cow body weight gain (P<.01), cow ADG (P<.01) rib and rump fat depth change [(P=.05) and P=.01)], ending body condition score (BCS) (P=.02), and reduced hay consumption (P=.002). A statistical difference for BCS change was not identified.

Using data generated from the three hay feeding methods, an economic analysis model was developed for 100 and 300 head cow herd sizes wintered for 135 days. Results from the feeding methods comparison suggest that feeding with a tapered-cone round bale feeder offers substantial cost savings per cow arising from reduced hay consumption, equipment cost, and feeding time. Feeding costs per cow in the 100 head analysis model for rolling out bales, shredding bales with a processor and feeding bales in a tapered-cone feeder were $113.90, $128.10, and $101.80, respectively. When costs were projected for a 300 head cow herd in the model, rolling out bales, shredding bales with a processor and feeding bales in a tapered-cone feeder were $113.90, $122.80, and $101.80, respectively. Using a PTO driven bale processor to shred bales into windrows before feeding was the most expensive due to higher equipment ownership cost and higher hay intake per cow necessary to maintain comparable condition compared to the tapered-cone bale feeder. Rolling bales out on the ground or shredding into windrows with a bale processor increased hay consumption and winter feeding cost without enhancing cow performance.

An incomplete third year of this study was in progress when this report was prepared. A subsequent and final report of this study will appear in the next DREC annual report.

Introduction

Winter feed cost makes up a large portion of production costs for North Dakota beef cattle producers (Hughes, 1999) and is the single largest variable influencing profitability (Miller, et al., 2001). Over the last five years, winter feed costs averaged $144 per head for producers participating in North Dakota’s IRM program.

The most common method for putting up hay in North Dakota is the large round bale. Rolling round bales out on the ground has been the most common hay feeding method until recently when PTO operated bale processors were introduced to range cattle producers. And even more recently, a tapered-cone round bale feeder, manufactured by Weldy Enterprises, has also been introduced.

Michigan State University data suggests feeder type and animal behavior can influence the amount of hay wasted by beef cattle. In a recent study, Buskirk et al. (2003), reported losses of 3.5% (tapered cone), 6.1% (ring), 11.4% (trailer) and 14.6% (cradle feeder). Further review of the literature indicates hay waste can be high ranging from 20 to 45% (Belya et al., 1985; Bell and Martz, 1973). Hay processors have gained acceptance because they are reported to reduce overall investment in machinery compared to tub grinding and feeding hay with a mixer wagon. While bale processing machines do not have mixing capabilities, they can be used very effectively for filling bunks and many users believe hay waste is less with this feeding method (compared to feeding on the ground or in a feeder), especially with 'stemmy' hays since the stems are chopped and essentially mixed in the windrow as the cattle are fed, eliminating or reducing the sorting problems, which often occur.

Considering the three methods available for delivering winter hay to free ranging beef cows fed on the ground, this study was designed to compare cow wintering performance, hay consumption necessary to maintain cow body condition, labor inputs, wintering cost, and hay waste, when hay was either rolled out on the ground, shredded, or fed in a tapered-cone round bale feeder.

Materials and Methods

Two hundred fifty-two crossbred cows with an average initial weight of 1343 pounds were used in this delivery/economic analysis study. Cows were divided into 12 groups with either 12 (yr 1) or 9 (yr. 2) cows assigned randomly to each of twelve five acre wintering lots located at the Dickinson Research Extension. Each hay feeding treatment was replicated four times.

Hay Feeding Treatments Evaluated:

1. Round bales fed by removing the strings and rolling the bale out on the ground
2. Round bales shredded on the ground with a PTO driven bale processor
3. Round bales fed by placing the bale in a tapered-cone round bale feeder

Cows in the study were weighed, visually condition scored, and measured for fat depth using real-time ultrasound at the beginning, middle, and end of the study. Fat depth measurements are taken 3 inches distally from the midline between the 12th and 13th ribs and at a rump location measured medially on a line between the hook and pin bones. Quantity and quality of hay delivered and feeding time for each system was recorded. Individual bales were weighed and core sampled for subsequent nutrient analysis.

Hay waste was evaluated by securing two 40" x 80" carpet pieces to the ground and daily hay deliveries were fed over the carpets for three consecutive days in each pen replicate. Twenty-four hours after feeding, the carpets were cleaned and the residual forage and fines were collected, dried (140º F for 72 hrs.), weighed and analyzed for nutrient content.

Data is being analyzed using the statistical analysis system (SAS, 1996).

Accounting for Unutilized Feed Energy Delivered (Waste)

This portion of the investigation was incomplete at the time this progress report was written. A summary of waste and relationship to the feeding methods will appear in a subsequent and final report.

Economic Analysis of Winter Feeding Methods

Production measurements and efficiency, time required for feeding, and equipment and machinery inputs and depreciation were used to conduct an economic analysis of the feeding methods tested for 100 and 300 head herd sizes, which represent two of the most common cow herd sizes in North Dakota. The economic model assumed a winter feeding period of 135 days and hay in the model was priced at $42.50/ton. The round bale feeders were priced at $800.00 each and were assumed to feed 13 cows. The round bale processor cost $15,000. It was assumed bale processor cutting flails would be replaced every 2,500 bales at a charge of $250 including labor. Tractor expenses were based on a 110 horsepower unit in all treatments and allocation was based on typical use in other farm activities of which winter feeding is one of those activities (Lazarus and Selley, 2002). Operation and ownership costs were $27.00 per hour which included a $7.00 per hour labor charge. Based on feeding time measured for each feeding method, tractor time allocation for filling the round bale feeders was calculated to be three minutes per bale and 5 minutes per bale for the bales either rolled out on the ground or shredded with the PTO driven bale processor.

Results and Discussion

Two year summaries for forage analysis, animal performance, hay consumption, and economic analysis are shown in Tables 1, 2, and 3. The third year of this investigation was in progress when this progress report was prepared. Therefore, the results and project discussion will appear in a subsequent and final report of this project.

Literature Cited

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Table 1. Forage Analysis.

	System			
	Round Bale Rollout	PTO Driven Round Bale Processor	Tapered-Cone Round Bale Feeder	P-Value
Dry Matter, %	95.2	94.9	95.1	.47
Ash, %	9.0	9.2	8.9	.12
Crude Protein, %	14.6	14.4	14.6	.87
ADF, %	38.9[a]	39.3[a]	40.7[b]	.008
NDF, %	53.9	54.6	53.1	.81
Calcium, %	1.1	1.0	1.0	.92
Phosphorus, %	.23	.22	.22	.80
IVDMD, %	59.9	58.1	59.2	.39
IVOMD, %	58.1	56.2	56.7	.20

Table 2. Two year bale feeding methods: cow gain, fat depth change, condition score change and hay consumption.

	Bale Roll Out	Bale Processor	Rd. Bale Feeder	P-Value		
				Yr	Trmt	Yr x Trmt
No. Cows	84	84	84			
Days Fed	57	57	57			
Starting Wt., lb.	1343	1334	1351	.13	.88	.91
End Wt., lb.	1382[a]	1404[a]	1429[b]	.07	.37	.78
Gain, lb.	40.0[a]	70.5[b]	78[c]	.39	.007	.55
ADG, lb.	.71[a]	1.25[b]	1.39[c]	.23	.006	.50
Ultrasound Fat Depth (mm):						
Rib Fat - Start[a]	.526	.515	.561	.26	.55	.99
Rib Fat - End	.553	.548	.686	<.0001	.01	.86
Rib Fat Change	.027[a]	.033[a]	.125[b]	<.0001	.05	.87
Rump Fat - Start[b], Yr 1	.550	.548	.563	.01	.53	.69
Rump Fat – Start, Yr 2	.663	.636	.750			
Rump Fat – End, Yr 1	.750	.628	.955	.26	.04	.53
Rump Fat – End, Yr 2	.897	.758	.922			
Rump Fat Change, Yr 1	.20	.08	.393	.30	.01	.05
Rump Fat Change, Yr 2	.234	.122	.172			
Body Condition Score[c]						
Start	5.72	5.57	5.82	.003	.22	.33
End	5.68[a]	5.53[a]	5.96	.84	.02	.28
Change	-.04	-.04	+.14	.0003	.40	.22
Hay/Cow, lb., Yr 1	1795[a]	1761[b]	1524[c]	<.001	<.001	.15
Yr 2	2249[a]	2350[b]	2037[c]			
Hay/Cow/Day, lb., Yr. 1	30.9[a]	29.9[a]	26.3[b]	<.0001	<.0001	.02
Yr. 2	40.9[a]	42.7[b]	37.1[c]			

[a] Backfat measurement was taken 3 inches distally from the midline between the 12th and 13th ribs.

[b]Rump fat measurement was taken medially on a line between the hook and pin bones.

[c]1 to 9 scale (1 = extremely thin; 9 = obese)

Table 3. Two year economic analysis comparing hay feeding methods for 100 and 300 head cow herds.

	System		
	Round Bale Rollout	**PTO Driven Round Bale Processor**	**Tapered-Cone Round Bale Feeder**
Hay consumed/day, lb.	30.9	36.3	31.7
Hay fed, Tons [a]			
100 cow herd	242.3	245.1	213.8
300 cow herd	726.9	735.4	641.3
Hay Cost/Cow, $			
100 cow herd	$103.00	$104.20	$90.90
300 cow herd	$103.00	$104.20	$90.90
Total Herd Hay Cost, $			
100 cow herd	$10,297	$10,418	$9,085
300 cow herd	$30,892	$31,254	$27,256
Equipment[b]			
100 cow herd	------------	$1,293	$513
300 cow herd	------------	$2,271	$1,539
Tractor operation[c]			
100 cow herd	$1,090	$1,103	$577
300 cow herd	$3,271	$3,309	$1,732
Total non-hay expense			
100 cow herd	$1,090	$2,395	$1,090
300 cow herd	$3,271	$5,580	$3,270
Total expense			
100 cow herd	$11,388	$12,814	$10,175
300 cow herd	$34,163	$36,834	$30,526
Cost per cow			
100 cow herd	$113.90	$128.10	$101.80
300 cow herd	$113.90	$122.80	$101.80
Hay as % of total cost			
100 cow herd	90.4	81.3	89.3
300 cow herd	90.4	84.9	89.3

[a] Tons of hay fed over a 135 day period. Hay was priced at $42.50 per ton.

[b] Each bale feeder cost $800 and fed 13 cows in the analysis model. Bale feeders were depreciated over 12 years. The bale processor cost $15,000. It was depreciated over 12 years for the 100 cow operation and 7 years for the 300 cow operation. Cutting flails were replaced every 2,500 bales at a total replacement cost of $250 including labor charge.

[c] A 110 HP tractor is used regardless of system; model expense referenced from Lazarus and Selley (2002). Ownership expenses calculated assuming the tractor experiences typical use in other farm operation activities. Operation and ownership costs are $27 per hour including a $7 per hour labor charge. Tractor time is three minutes per bale for the bale feeder and five minutes per bale for roll out and bale processor systems.