



Effect of bale feeder and forage on hay waste, disappearance, and sorting¹

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ABSTRACT

Three feeders and 2 forage types were used in a 3×2 factorial treatment arrangement within a Latin-square design to evaluate forage feeding waste. A total of 48 spring-calving, gestating cows were stratified by age, BW, and BCS into 6 replicate pens with 8 cows per pen. Bale feeders evaluated were open ring with slanted feeding stations (OFD), sheeted lower section with slanted feeding stations and tapered sides (TFD), and sheeted lower and upper sections with straight feeding stations and a chain cone (CFD). Forages were alfalfa (*Medicago sativa* L.) haylage (AH) or tall fescue (*Festuca arundinacea* Schreb.) hay (FH). A forage $\times$ feeder type interaction ($P < 0.05$) was observed for percentage of bale wasted, where FH OFD was greatest (19.2%), FH TFD was intermediate (13.6%), and FH CFD (8.9%) was least ($P < 0.05$); however, FH CFD was not different ($P > 0.10$) from AH OFD (7.0%) or AH CFD (6.5%) but was greater than AH TFD (4.9%; $P < 0.05$). A feeder $\times$ forage $\times$ day interaction ($P < 0.01$) was observed for waste per day bale was offered. No difference ($P > 0.10$)

was observed for percentage AH waste due to day or feeder. Fescue-hay waste was least ($P < 0.01$) in CFD at 24 and 48 h compared with OFD and TFD. At 96 h, TFD wasted the least ($P < 0.05$) for FH compared with CFD and OFD. The CFD feeder with lower-section sheeting reduced FH waste, whereas AH waste was not influenced by feeder design.

Key words: bale feeder, beef cattle, forage quality, hay waste

INTRODUCTION

Feed cost accounts for 63% of the annual cow cost and is the greatest variable influencing Midwest producers' profitability (Miller et al., 2001). In the last decade, hay production has decreased 11%, and hay prices have increased 77% (NASS, 2013). More efficient harvested-forage use can be achieved by reducing waste of large round bales during storage and feeding (Lechtenberg et al., 1974; Belyea et al., 1985; Baxter et al., 1986; Buskirk et al., 2003; Landblom et al., 2007). Improving the efficiency of forage use from harvest to feeding will be increasingly important as competition for land use between hay, pasture, biomass, and row-crop enterprises increases.

Large-round-bale feeders are the most adopted stored-forage feeding method for Oklahoma beef produc-

ers (Sexten, 2011). Bale-feeder design affects hay waste by altering agonistic interactions, entrance frequency (regular and irregular), and feeder occupancy (Buskirk et al., 2003). Ring feeders allow cattle to eat in a natural position preventing hay loss from frequent entrances (Buskirk et al., 2003). Cone-type feeders also reduce hay waste by providing a larger feeding area inside the feeder (Comerford et al., 1994; Buskirk et al., 2003). The effect of feeder design on waste associated with different forage types is unexplored. The experimental objective was to quantify hay waste by gestating beef cows using 3 bale-feeder designs and 2 forage types. We hypothesized tall fescue (*Festuca arundinacea* Schreb.) hay (FH) would result in greater waste than alfalfa (*Medicago sativa* L.) haylage (AH). Additionally, we hypothesized that cone-type feeders and feeder sheeting would reduce waste with FH but not AH.

MATERIALS AND METHODS

Treatments and Animal Management

Animal-use procedures were approved by University of Missouri Animal Care and Use Committee. Forty-eight spring-calving Simmental and Angus crossbred cows, 124 ± 8 d in

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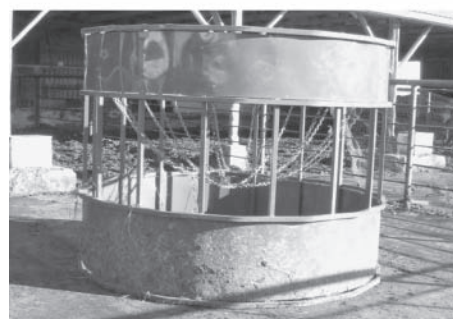
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(a)



(b)



(c)

Figure 1. Round-bale feeder designs: (a) OFD = open ring with slanted feeding stations (Hay Ring; Hatton Vermeer Sales LLC, Auxvasse, MO), (b) TFD = sheeted lower section with slanted feeding stations and tapered sides (Double Slant Hay Feeder; Sioux Steel Co., Sioux Falls, SD), and (c) CFD = sheeted lower and upper sections with straight feeding stations and a chain cone (Hay Hopper; Action Signs and Billboards, Chandler, MN).

gestation, were used in a 3×2 factorial treatment arrangement within a 6×6 Latin-square design. Three bale-feeder designs and 2 forage types were used to evaluate the effect of bale feeder and forage type on hay waste and DMI. The 6 combinations of bale feeder and forage type were applied to 6 pen replicates in each of the 6

periods. Periods were 12 d in length. Cows were stratified by age (4 ± 2.5 yr), BW (517 ± 68.8 kg), BCS (5.5 ± 0.42 units; Wagner et al., 1988), and ultrasound-measured fat thickness over the 12th rib (0.4 ± 0.16 cm) into 6 replicates with 8 cows per replicate. Each replicate was randomly assigned to 1 of 6 concrete pens (16.6×7.3 m) with 4.5 m of linear bunk space. Facilities included barns open to the south with an uncovered 8.8×7.3 m hay-sampling pad, and the remainder of the pen was covered by roof and bedded with sawdust. Replicates remained in pens, and bale feeder and forage type rotated to different pen replicates upon completion of each 12-d sampling period.

Bale-Feeder Design

The 3 bale-feeder designs are shown in Figure 1. Open feeders (OFD) had no lower- or upper-section sheeting and measured 2.4 m in diameter and were 1.2 m tall (Hay Ring; Hatton Vermeer Sales LLC, Auxvasse, MO). Feeding spaces for OFD ($n = 17$) were 41 cm wide and 65 cm tall, and bars were angled at 73° . Tapered feeders (TFD) had 0.5 m of straight lower-section sheeting and measured 2.4 m in diameter at the bottom and 2.1 m in diameter at the top and were 1.2 m tall (Double Slant Hay Feeder; Sioux Steel Co., Sioux Falls, SD). Dividing bars in the TFD feeder were angled at 74° with a 46-cm-wide and 66-cm-tall feeding space ($n = 15$). Cone feeders (CFD) were 2.3 m in diameter and 1.7 m tall and had 0.6 m of lower-section sheeting, 0.5 m of upper-section sheeting, and a 16-chain cone spaced at 41 cm (Hay Hopper; Action Signs and Billboards, Chandler, MN). Dividing bars in the CFD feeders were angled at 90° with a feeding space ($n = 16$) 41 cm wide and 69 cm tall.

Forage Type and Sampling

Two forage types were used to evaluate the interaction of bale feeder

Table 1. Forage nutrient composition determined by near-infrared spectroscopy

Item, % of DM	Tall fescue	Alfalfa
DM	92.0	41.0
CP	7.5	17.0
NDF	66.6	49.4
ADF	36.4	34.4
Ash	10.5	9.1

and forage. Alfalfa haylage was harvested May 18, 2012, (first cutting) and ensiled as plastic-wrapped bales. Tall fescue hay was harvested June 19, 2012, (first cutting) and barn stored until experiment initiation. Alfalfa-haylage bales were 1.5 m wide, 1.1 m in o.d., and weighed 364 ± 34 kg (DM basis), and FH bales were 1.5 m in width, 1.5 m in diameter, and weighed 546 ± 45 kg (DM basis). Bale DM and forage nutritional value were determined from 3 core samples (Hayprobe, Hart Machine Co., Madras, OR) collected from each bale before feeding (Table 1). Bales were oriented horizontally in the feeder and removed from storage no greater than 5 d before feeding.

Cows were acclimated to combinations of feeder and forage type at period initiation to minimize effects associated with modifying feeding positions or changing forage types because treatment combinations within pen changed each period. One bale of FH was provided for acclimation to feeder design for 96 h. Two AH bales were provided for acclimation for 72 h each. The additional AH bale during acclimation was provided to maintain 12-d periods.

Following acclimation orts and debris were removed from the feeding pad and a new bale was introduced for collection. Waste was collected at 24, 48, 72, and 96 h following new FH-bale introduction, and AH waste collection and samples were taken at 24, 48, and 72 h following bale introduction due to less DM per bale. After initial bale-waste and orts

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