Animal Feed Science and Technology 186 (2013) 27–35

Contents lists available at ScienceDirect

Animal Feed Science and Technology

journal homepage: www.elsevier.com/locate/anifeedsci

Intake and digestibility by sheep, *in situ* disappearance in cannulated cows, and chemical composition of crabgrass hayed at two moisture concentrations and treated with a non-viable *Lactobacillus*–lactic acid additive☆

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ARTICLE INFO

Article history:
Received 26 April 2013
Received in revised form 3 September 2013
Accepted 4 September 2013

Keywords:
Crabgrass
Forage chemical composition
Hay additive

ABSTRACT

Crabgrass (*Digitaria ciliaris* [Retz.] Koel.) is a high-quality warm-season annual that can be used as hay, but field curing time may be lengthy compared with other forages. A 1.6-ha field of common crabgrass was divided into 12 plots (8.25 m × 50 m) that were used in a randomized complete block design with a 2 × 2 factorial treatment arrangement to determine the effects of a non-viable *Lactobacillus*–lactic acid additive and moisture concentration at baling on heating characteristics and pre- and post-storage chemical composition. Half of the plots within each block were treated with 0.081 ml/mg dry matter (DM) of a solution containing 110 g lactic acid/kg and non-viable *Lactobacillus acidophilus* at the time of mowing (T) and half were not treated (U). Within T and U plots, half were baled in small square bales at 163 g moisture/kg DM (L) and half at 251 g moisture/kg DM (H) of moisture. Six bales per plot were selected at random, weighed, and stored in separate insulated 6-bale stacks. Core samples were taken from 3 bales initially and 3 bales post-storage. Initial bale moisture concentrations were greater ($P<0.05$) and initial neutral-detergent fiber (NDF) concentrations were lower ($P<0.05$) from H *vs.* L. Post-storage concentrations of NDF and acid-detergent insoluble N (ADIN; g/kg DM and g/kg N), were greater ($P<0.05$) from H *vs.* L. Dry matter intake in sheep was unaffected ($P>0.05$) by either treatment, but DM digestibility and digestible DM intake were both positively affected ($P<0.05$) by the spray treatment. In addition, DM digestibility was also affected ($P<0.05$) by moisture, with H>L. *In situ* DM disappearance was largely affected by spray treatment × moisture interactions ($P<0.05$). The immediate soluble fraction and effective ruminal disappearance were greater ($P<0.05$), and

Abbreviations: ADF, acid-detergent fiber; ADIN, acid-detergent insoluble N; CP, crude protein; DM, dry matter; HDD, heating-degree days >35 °C; L, low moisture; sa, lignin; H, high moisture; NDF, neutral detergent fiber; U, not treated with non-viable *Lactobacillus*–lactic acid additive; T, treated with non-viable *Lactobacillus*–lactic acid additive.

☆ Mention of trade names or commercial products in this article is solely for the purpose of providing specific information, and does not imply either recommendation or endorsement by the U.S. Department of Agriculture.

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0377-8401/$ – see front matter
http://dx.doi.org/10.1016/j.anifeedsci.2013.09.002

the undegraded portion in the rumen was less (P<0.05) for HT compared to HU, indicating a positive relationship between applied spray treatment and digestibility of high-moisture crabgrass. Treating crabgrass with the additive at mowing may not affect forage chemical composition, but may improve digestibility in hay baled at elevated moisture levels.

1. Introduction

Crabgrass (*Digitaria ciliaris* [Retz.] Koel.) is a high-quality, warm-season annual that is typically considered undesirable for hay production because of the extended drying time after mowing (Ogden et al., 2006). The risk of frequent precipitation events early in the growing season in addition to these extended drying times may result in crabgrass being baled at moisture concentrations greater than the generally recommended maximum moisture concentration of 180 g/kg (McBeth et al., 2001).

During storage, hay baled at >200 g moisture/kg often undergoes heating that leads to an unfavorable change in chemical composition (Coblentz et al., 1996). Additives for hay are commercially available, but research has mainly focused on broadleaf forages. In one example, Johnson et al. (1983) used a solution containing potassium carbonate and emulsified methyl tallowate or methyl lardate, which reduced dry matter (DM) loss and mold in alfalfa (*Medicago sativa* L.) hay after a 42-d storage period compared to the untreated control. In a study conducted by Baah et al. (2005), *in situ* disappearance of timothy (*Phleum pratense* L.) and alfalfa was increased compared with the control when inoculated with *Lactobacillus buchneri* 40788.

Others authors were not able to report substantial effects on hay quality by adding biological additives. In a study conducted by Wittenberg and Mohstaghi-Nia (1990), bacterial treatments did not improve DM retention of alfalfa hay to the equivalent of anhydrous ammonia. Duchaine et al. (1995) added a bacterial inoculant containing *Pediococcus pentosaceus* to a humidified grass–legume mixture to test mold prevention. The inoculant did neither reduce mold growth nor pH, nor did it sufficiently preserve hay quality under the high humidity treatment of 35%. In addition, many studies have been conducted with respect to silage only. Reich and Kung (2010) demonstrated an increase in aerobic stability of corn (*Zea mays* L.) silage by adding a mix of *Lactobacillus*. Lactic acid-producing bacteria can affect other bacterial communities as indicated by Parvin et al. (2010), who showed that less desirable bacteria were suppressed by adding *Lactobacillus* to grass silage.

Hay producers in the southern US claim to have successfully used a product that contains non-viable *Lactobacillus* and lactic acid to retain warm-season grass hay quality during storage. Bass et al. (2012) showed that treating bermudagrass [*Cynodon dactylon* (L.) Pers.] with this product may not offset the negative effects expected with baling hay at excessive moisture concentrations. Moisture management of crabgrass is even more challenging in comparison to bermudagrass for reasons described above. Therefore, our objective was to study the effects of this product on the post-storage chemical composition, intake by sheep, and *in situ* ruminal disappearance by cows of crabgrass hay baled at two moisture concentrations.

2. Materials and methods

2.1. Experimental site and treatments

This research was conducted at the University of Arkansas Division of Agriculture – Watershed Research and Education Center (WREC) located within Fayetteville, AR (94°10′ W; 36°05′ N; 394 m elevation). The soil at the site was classified as a Captina silt loam soil (fine-silty, siliceous, active, mesic Typic Fragiudults; NRCS, 2009). The area is defined as a humid subtropical climate with an annual mean precipitation of approximately 117 cm, and an average annual temperature of 16.7 °C (AAREC, 2007). Climatic data for 2007 are summarized in Fig. 1.

An existing crabgrass stand of approximately 100 m × 50 m was divided into 3 field blocks, each containing 4 plots (8.25 m × 50 m), and then fertilized with 112 kg N/ha as ammonium nitrate (34-0-0) in May of 2007. Annual weeds were

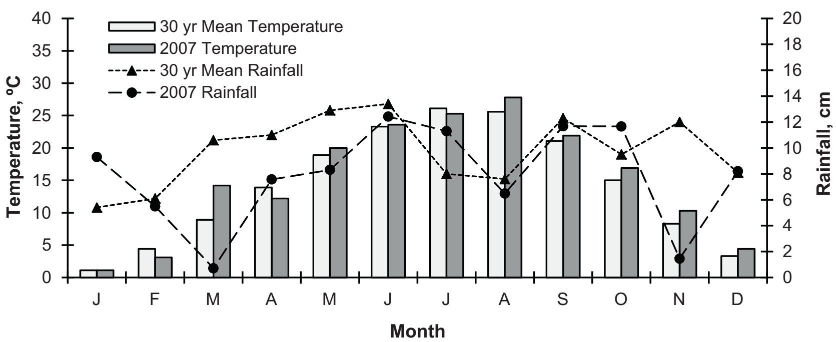

Fig. 1. Monthly average temperature and rainfall for Fayetteville, AR, USA comparing 2007 with the 30-yr mean.