The Professional Animal Scientist 33:668–679
https://doi.org/10.15232/pas.2017-01632

Effects of feeding corn plant residues during the growing phase on steer growth performance and feedlot economics

P. H. V. Carvalho,* W. T. Meteer,* PAS, A. R. Schroeder,* A. DiCostanzo,† PAS, and T. L. Felix,*[1,2] PAS
*Department of Animal Science, University of Illinois at Urbana-Champaign, Urbana 61801; and †Department of Animal Science, University of Minnesota, Saint Paul 55108

ABSTRACT

Feeding harvested corn crop residues (CCR) to cattle has become increasingly common; however, the poor quality of mature CCR presents nutritional challenges. Therefore, the objectives of these studies were to evaluate the effects of feeding CCR harvested at 2 maturities and the effects of 2 silage additives, Silage SAVOR Plus (propionic acid-based additive) or Silo-King (lactobacillus-based additive), on in situ fiber disappearance, cattle growth performance and carcass characteristics, and economic traits of growing cattle. A total of 128 Angus × Simmental steers (initial BW = 327 ± 40 kg) were allotted to 20 pens and fed 4 treatments in diets that contained 25% forage: (1) corn stover, wetted to 40% DM and ensiled; (2) corn stalklage, harvested at 40% DM and ensiled (STK); (3) STK plus Silo-King; or (4) STK plus Silage SAVOR Plus. Corn stover was harvested 186 d after planting after harvesting dry corn. Corn stalklage was harvested 158 d after planting after harvesting high moisture corn. Growing diets contained CCR at 25% inclusion (DM basis) and were fed from d 0 to 85. From d 86 to 186, steers were fed a common finishing diet. Corn crop residue samples were incubated in 2 ruminally fistulated steers to determine in situ DM disappearance and NDF disappearance. There were no effects of treatment on in situ DM disappearance ($P = 0.40$) or in situ NDF disappearance ($P = 0.34$). There were no treatment effects ($P \geq 0.19$) on steer growth performance from d 0 to 85 and from d 86 to 186; thus, there were no effects ($P \geq 0.14$) of treatment on overall steer performance, carcass characteristics, and economic traits for the entire 186 d. Feeding mature CCR resulted in similar ruminal fiber degradation, steer growth, carcass performance, and economic traits when compared with immature CCR in diets fed to growing steers, and there was no benefit of additive inclusion.

Key words: beef cattle, corn crop residues, stalklage, stover

INTRODUCTION

Corn crop residue (**CCR**), harvested and baled after dry corn is harvested, has been researched as an alternative feedstuff when corn is expensive (Russell et al., 2011; Duckworth et al., 2014; Chapple et al., 2015); however, studies have varied in storage and handling techniques. Vadas and Digman (2013) calculated economics for different CCR harvest and storage systems and concluded that storing CCR baled and dry is more economical than storing CCR in a bag, but baled CCR requires additional processing (chopping) when fed in a TMR to feedlot cattle to be competitive when feedlot carcass returns are calculated (Russell et al., 2011). Many trials have been conducted comparing dry, ground mature CCR to chemically treated, ensiled CCR processed from stored bales (Chapple et al., 2015; Schreck et al., 2015). Additional processing costs are expensive, and Berger et al. (1979) reported a 19% improvement in feed efficiency when cattle fed CCR harvested after high-moisture corn (**HMC**) were compared with those fed CCR harvested after dry corn. However, few other data have investigated simply altering time of harvest to economics of feeding 25% CCR in beef cattle growing diets. Another technique to improve digestibility of ensiled feedstuffs is adding inoculants at ensiling time (Casper, 2008). In grass silages, inoculants have been used to enhance the production of lactic acid and improve the stability of silage during long-term storage (Kleinschmit and Kung, 2006). However, the efficacy of inoculants has not been evaluated in harvested CCR. We hypothesized that harvesting and ensiling a less mature CCR would improve nutrient digestibility, cattle performance, and carcass characteristics when fed during the growing phase of the feedlot. We also hypothesized that a silage additive would further improve nutrient digestibility and growth performance of cattle fed the immature CCR, when compared with feeding CCR that were ensiled after harvesting dry corn. Therefore, the objectives of this study were to evaluate the effects of feeding CCR, harvested at 2 maturities, and effects of 2 silage additives, Silage SAVOR Plus (propionic acid–based additive; Kemin Industries Inc., Des

This work was supported by a grant from the MN Corn Research and Promotion Council. The authors declare no conflict of interest.
[1] Current address: Department of Animal Sciences, Penn State University, University Park, PA 16802.
[2] Corresponding author: tfelix@psu.edu

Moines, IA) or Silo-King (*Lactobacillus*-based inoculant; Agri-King Inc., Fulton, IL), on in situ fiber disappearance, growth performance, carcass characteristics, and economic traits of growing feedlot cattle.

MATERIALS AND METHODS

All animals used in this trial were managed according to guidelines recommended in the *Guide for the Care and Use of Agriculture Animals in Agriculture Research and Teaching* (FASS, 2010). The University of Illinois Institutional Animal Care and Use Committee approved all experimental procedures before the initiation of this study (IACUC #12009).

Animal and Diet Management

A total of 128 Angus × Simmental crossbred steers (averaging 9 ± 1.5 mo of age; initial BW = 327 ± 40 kg) were used for this experiment at the University of Illinois Beef Cattle and Sheep Field Research Laboratory in Urbana, Illinois. Steers were housed in a confinement barn constructed from a wood frame with ribbed metal roofing and with siding on the north, west, and east sides. The south side was covered with 1.27 cm × 1.27 cm wire mesh bird screen and had retractable curtains. The barn was divided into 20 pens (4.9 m × 4.9 m constructed of 5.08 cm of galvanized steel tubing, with a concrete slatted floor covered with 1.9-cm-thick rubber matting).

Steers were shipped 355 km from a single source (Dixon Springs Agricultural Center, Simpson, IL) and rested 24 h before processing. Steers were weighed individually, using a hydraulic squeeze chute (Flying W, Watonga, OK) equipped with an electronic weighing system (Tru-Test Inc., Mineral Wells, Texas), on 2 consecutive days (d −1 and 0) to determine initial BW. Steers were blocked by BW into heavy (BW = 364 ± 7 kg) and light (BW 304 ± 11 kg) blocks. Steers within block were stratified by d-0 BW and allotted to treatment pens on d 1, such that each pen within block had the same initial starting pen weight. Hence, there were 8 heavy block pens (2 pens per treatment) and 12 light block pens (3 pens per treatment), for a total of 5 pens per treatment. Steers were implanted with a commercial growth implant (Component TE-IS; 80 mg of trenbolone acetate, 16 mg of estradiol, and 29 mg of tylosin tartrate; Elanco Animal Health, Greenfield, IN) at the start of the trial (d 0).

Pens within blocks were randomly assigned to 1 of 4 treatments: (1) corn stover, wetted to 40% DM and ensiled (**SVT**); (2) corn stalklage, harvested at 40% DM and ensiled (**STK**); (3) STK plus Silo-King (**STKL**; Agri-King Inc., at 0.25 kg/t on an as-is basis); or (4) STK plus Silage SAVOR Plus (**STKP**; Kemin Industries Inc., at 0.5 kg/t on a DM basis). All growing diets included, on a DM basis, 25% of the corn plant residue (SVT; STK; STKL; STKP), 30% modified wet distillers grains with solubles, 35% HMC, and 10% vitamin–mineral supplement and were fed as a TMR for 85 d (Table 1). The CCR was all the same variety (SP 2867 GenVT3P RIB, DuPont Pioneer, Johnstown, IA; a 113-d variety to target 12,950 plants/ha), harvested from the same field, with the same technique (described below).Thus, the only differences among the forages were the harvest dates and additives. Corn stover was harvested 186 d after planting, and corn stalklage, for all 3 stalklage treatments (STK, STKL, and STKP), was harvested 158 d after planting. After the growing phase, all steers were fed a common finishing diet containing 20% corn silage, 20% modified wet distillers grains with solubles, 50% HMC, and 10% vitamin–mineral supplement (DM basis) for a 100-d finishing phase (Table 1). Diets were mixed in a mixer wagon (Knight Reel Auggie 3130; Kuhn Agricultural Machinery, Brodhead, WI) and delivered to pens once daily. Steers were fed in 3-m concrete bunks located at the front of each pen. The TMR was delivered at 0800 h, and pens were managed for slick bunks. Bunks were read at 0630 h and were considered slick if less than 0.2 kg/steer (as fed) of feed remained. If bunks were considered slick for 2 consecutive d, TMR delivery was increased by 0.91 kg/steer (as fed). Samples of each dietary ingredient were collected every 14 d and analyzed to adjust DM inclusion of ingredients. Subsamples were composited to be analyzed at the end the trial.

Steers were weighed every 28 d throughout the trial. When cattle were switched from the growing diets to the finishing diet, steers were weighed again on 2 consecutive d (d 85 and 86) and reimplanted (d 85) with a commercial growth implant (component TE-S (120 mg trenbolone acetate, 24 mg of estradiol, and 29 mg tylosin tartrate; Elanco Animal Health). For the last 28 d of the finishing period, all steers were fed 300 mg/steer daily of ractopamine hydrochloride (Optaflexx45; Elanco Animal Health). Steers were then individually weighed on 2 consecutive days (d 185 and 186) to record final BW.

After the trial was completed, NE_m and NE_g of the total diets were back calculated based on animal performance (initial BW, final BW, ADG, and DMI) using NRC (1996) iterative equations (Figure 3). When NE_m and NE_g of a feedstuff, such as CCR, is unknown, the back-calculations of the dietary energy values can *aid* in describing treatment effects even though they may not be a more sensitive measure statistically (Vasconcelos and Galyean, 2008).

Harvesting and Treating CCR

Corn stalklage was harvested at HMC harvest using a 3-pass method. The first pass, or step (corn harvesting), was done by a combine (6 rows; IH 5088; Case IH Inc., Grand Island, NE) used to harvest the HMC (77% DM) on September 22, 2014 (158 d after planting). During harvest, the chaff spreader was turned off at the rear discharge of the machine, allowing the combine to deposit harvest residue in a windrow. The windrow consisted of primarily corn stalks, husks, cobs, and some leaf. After HMC harvesting, a mower (Speedrower 200; New Holland Inc., New Holland, PA) was used to mow the remaining