Effects of Supplemental Energy and Protein Source on Performance of Steers Grazing Irrigated Corn Residue

Benjamin T. Tibbitts, Jim C. MacDonald, Rick N. Funston,
Cody A. Welchons, Robert G. Bondurant, F. Henry Hilscher

Summary

Steer calves grazing corn residue (86 d) were assigned to 1 of 5 treatments to evaluate the effects of protein and energy supplements on steer performance. The 5 treatments consisted of 1) un-supplemented control (NS), 2) dry rolled corn only (CRN), 3) 89% dry rolled corn/6% molasses/5% urea (C + RDP), 4) 60/40 blend of soy-pass/soybean meal (SP), and 5) dried distillers grains plus solubles (DGS). Supplements were fed to provide equal TDN intake. Average daily gain among treatments was 1.48, 1.32, 0.53, 0.31, and −0.18 lbs. for SP, DGS, C + RDP, CRN, and NS, respectively. Only steers fed SP and DGS produced over-winter gains greater than 1 lb/d, suggesting metabolizable protein requirements must be met for growing calves to utilize residue efficiently.

Introduction

Corn residue grazing, an abundant feed resource for some Nebraska beef producers, extends the grazing period, and decreases the amount of harvested feed needed per animal, which allows producers to decrease feed cost. Corn residue contains CP and energy concentrations sufficient to support mature, non-lactating, beef females (*2012 Nebraska Beef Report*, pp. 5–7); but those nutrients may not meet the requirements for growing animals. Dried distillers grains plus solubles is high in protein (30% CP), energy (104% TDN), and is a good source of rumen undegradable protein (RUP). Previous work has shown DGS to be an effective supplement to combine with corn residue grazing in order to optimize gain and improve forage intake (*2015 Nebraska Beef Report*, pp. 25–26). However, DGS price is variable and may not always be the most economical supplement choice. Therefore, the objective of this experiment was to compare DGS to alternative protein and energy supplement sources on performance of steers grazing corn residue.

Procedure

Seventy-five (7–9 mo) crossbred steer calves (initial BW = 516; SD = 3 lbs.) grazed irrigated corn residue for 86 d at the University of Nebraska–Lincoln Agricultural Research and Development Center near Mead, Nebraska. Treatments were arranged in a randomized complete block design. Steers were blocked by BW and assigned to 1 of 5 treatments (n = 15) to evaluate the effects of protein and energy supplementation on steer performance. All steers grazed residue from the same paddock throughout the study, and individual supplementation was provided daily for 1 hour from 1100 to 1200 hr via a Calan gate system. In addition to an un-supplemented control group (NS), supplements fed were 1) 60% soy-pass + 40% soybean meal (SP), 2) dried distillers grains plus solubles (DGS), 3) 89% dry rolled corn, 6% molasses, 5% urea (C + RDP), and 4) dry rolled corn only (CRN), fed at 3.50, 3.00, 4.00, and 3.75 lb DM/d, respectively. Estimated TDN values of supplement were 90% (SP), 104% (DGS), 78% (C + RDP), and 83% (CRN). Supplements were formulated to provide 3.12 lb of TDN, which is the amount of TDN provided by 3.0 lb DM of DGS. In order to provide an equal amount of TDN in each supplement, DM amounts of each supplement varied. Un-supplemented calves were sorted off prior to other treatments entering the Calan gate system. Therefore, non-supplemented steers did not have access to supplement or residue until all steers consumed their supplement. After individual supplementation, all steers were returned to the paddock to continue grazing.

Steers were limit-fed a 50:50 diet of alfalfa hay and Sweet Bran® at 2% of BW on a DM basis for 5 d before the trial. Body weight was measured on 3 consecutive days to reduce variation from gut fill. Steers were blocked by initial BW and assigned to 1 of 5 treatments. At the conclusion of the trial, steers were again limit-fed a 50:50 diet of alfalfa hay and Sweet Bran at 2% of BW on a DM basis and ending BW was measured on 3 consecutive days.

Stocking rate was calculated based on grain yield at harvest and previous research estimating the amount of residue available for grazing per bushel of grain yield. Available forage was determined by multiplying grain yield, estimated forage availability (8 lb/bu), and number of acres, to produce the total available forage in the paddock. Total available forage was then divided by the estimated DMI (10 lb) of all steers to determine the length of grazing period available in the paddock (*2015 Nebraska Beef Report*, pp. 25–26).

Supplement refusals were collected and weighed each week. Samples were analyzed for DM by drying at 60° Celsius for 48 hours in a forced air oven and weighed using a digital scale.

Results

Results from the trial are shown in Table 1. Ending BW and ADG differed ($P < 0.01$) among treatments. Average daily gain among treatments was 1.48, 1.32, 0.53, 0.31, and-0.18 lb/d for SP, DDG, C+RDP, CRN, and NS respectively. Both SP and DDG provided supplemental metabolizable protein as RUP. These data support a metabolizable protein deficiency for growing calves grazing corn residue.

It is likely that the TDN value assigned to the SP supplement may have been underestimated. When the NRC is utilized and a supplement TDN value of 95% instead of 90% is modeled for the SP supplement, the DM amount fed decreases to 3.3 lb instead of 3.5 lb, and the estimated TDN amount is 3.13 lbs. Under this scenario, a predicted ADG is 1.32 lb, equal to the actual ADG of the DGS treatment. Therefore, if a greater TDN value had been

Table 1. Comparison of ADG response to protein and energy supplements for calves grazing irrigated corn residue

	No Suppl.[a]	Corn[b]	Corn/ Urea[c]	DDGS[d]	Soypass[e]	SEM	*P*-value
Initial BW	516	516	516	516	516	3.5	0.1
Ending BW	504[h]	539[i]	559[j]	629[k]	640[l]	4.9	< 0.01
ADG	−0.18[h]	0.31[i]	0.53[j]	1.32[k]	1.48[l]	0.06	< 0.01
Suppl. DMI, lb/d[f]	—	3.75	3.23	3.0	3.5	—	—
TDN, %	—	83%	78%	104%	90%	—	—
TDN intake lb/d	—	3.11	2.52	3.12	3.15	—	—
DIP balance (g/day)	−144	−253	7	−161	−1	—	—
MP balance[g]	−19	126	93	144	258	—	—

[a]Calves did not receive suppl. throughout feeding period.
[b]Suppl. contained 3.75 lbs. DM, whole corn.
[c]Suppl. contained 4 lbs. DM, 89% whole corn, 6% molasses, 5% urea.
[d]Suppl. contained 3 lbs. DM, dried distillers grains + solubles.
[e]Suppl. contained 3.5 lbs. DM, 60% soy-pass + 40% soybean meal.
[f]Suppl. was formulated to provide 3.12 lbs. TDN intake, which is the TDN amount supplied by 3.0 lb. dried distillers grains + solubles. This formulation requires differing DM amounts.
[g]Metabolizable protein balance to achieve the observed ADG for each treatment.
[h–l] Means within a row with differing superscripts are different.

used for SP, steer performance between SP and DGS would have likely been similar.

Steers supplemented with C + RDP were the only treatment group to refuse feed each week, likely due to the high inclusion level and palatability of urea. Calves supplemented with C + RDP consumed less TDN than other treatment groups. The average daily DMI for C + RDP was 3.23 lb/d, which is 80% of the supplement offered. Differences in DMI (3.23 vs. 4.0 lb) and TDN (2.52 vs 3.11 lb) likely had an impact on performance of the C + RDP treatment group. When the NRC model is used and reflects the scenario of consuming 80% of C + RDP supplement, it projects an ADG of 1 lb/d, which is 0.5 lb above actual ADG. It is unlikely the decrease in DMI and TDN consumption accounts for the entire deficit in performance. While the NRC model did not predict a metabolizable protein deficiency at the observed 0.53 lb of ADG, it is likely that corn was not able to provide adequate metabolizable protein to achieve ADG similar to DDG, even when balanced for RDP. The CRN treatment group was further affected by a deficiency in RDP, which contributed to the reduced ADG compared to C + RDP. Additionally, a negative associative effect of starch digestion on fiber digestibility of corn residue is possible.

Supplements high in both RDP and RUP will produce greater growth response in growing cattle even when TDN is similar. This experiment supports protein supplementation (SP, DGS) being crucial for steers grazing corn residue even when TDN of high energy supplements (CRN, C + RDP) is equal. Meeting CP requirements with a combination of RDP and RUP will result in greatest growth response in steers grazing corn residue. Additionally, supplementing with corn grain, with or without urea, will produce insufficient over-winter gains, and supplements should contain protein, both RUP and RDP, at a higher level than what is supplied by corn and urea.

Benjamin T. Tibbitts, graduate student

Jim C. MacDonald, associate professor, University of Nebraska–Lincoln Department of Animal Science, Lincoln, Neb.

Rick N. Funston, professor, West Central Research and Extension Center, North Platte, Neb.

Cody A. Welchons, graduate student

Robert G. Bondurant, research technician

F. Henry Hilscher, research technician, UNL Department of Animal Science, Lincoln, Neb.