Economic Analysis of Increased Corn Silage Inclusion in Beef Finishing Cattle

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Summary with Implications

An economic analysis was conducted to assess the feasibility of feeding greater inclusions of corn silage in finishing diets. Cattle were fed two inclusions of corn silage (15 and 45% of diet dry matter) with or without tylosin. Cattle fed 15% corn silage with tylosin had the best feed conversion, 15 % corn silage without tylosin was intermediate, and both 45% corn silage with and without tylosin had the poorest feed conversion. Feeding corn silage at greater inclusions decreased ADG but increased final body weight when fed to an equal fatness (28 days longer). However, feeding corn silage at 45% was more economical compared to feeding 15% corn silage, especially at higher corn prices, provided shrink is well managed (less than 15%). Feeding elevated concentrations of corn silage may have an economic advantage while also offering the addition of liver abscess control in finishing diets without tylosin.

Introduction

Approximately 45% of feedyard cattle are finished in Nebraska, Iowa, and Kansas. Increasing silage inclusion in finishing diets decreased the risk of liver abscesses in cattle. Increasing corn silage by replacing corn grain reduces feed conversion and lowers average daily gain (ADG) of cattle but may still be economical (*2013 Nebraska Beef Cattle Report*, pp. 76–77; *2013 Nebraska Beef Cattle Report*, pp. 74–75; *2019 Nebraska Beef Cattle Report*, pp. 69–71; *2020 Nebraska Beef Cattle Report*, pp. 71–74). Traditional sources of roughage, like alfalfa and brome, can pose problems for feedyards due to bulk size and increased cost. However, it can be economically beneficial for cattle feeders with access to corn, who also have ownership of fed cattle, to use their corn crop as a feedstuff (corn silage) and realize profits in the form of pounds of beef. Historically when corn was relatively expensive, corn silage was used to partially replace corn as an energy source in finishing diets. Feeding corn silage allows cattle feeders to take advantage of the entire corn plant at a time of maximum quality and tonnage as well as secure substantial quantities of roughage and grain inventory. The objective was to determine if feeding more corn silage in finishing cattle would be equally or more profitable with and without the use of antibiotics.

Procedure

Performance data were used from *2021 Nebraska Beef Cattle Report*, pp. 66–68. Briefly, 640 steers were fed in a 2 × 2 factorial, that consisted of two inclusions of corn silage (15 or 45%), with or without tylosin. Corn silage was harvested at ENREC between August 27 and 31, and on September 10, 2018. Corn silage harvest was initiated when the field was approximately ¾ milkline and 37% DM.

Dry corn price was calculated using \$3.67 / bu, while corn silage was priced at \$43.99 per ton as-is (\$110 ton DM, 37% DM; Iowa State University corn silage pricing application). Costs and inputs used to calculate the price of corn silage are briefly described in Table 1. The following inputs for expected production were 60 acres and 28 tons of silage (37% DM) per acre (based on expected corn yield with 6% yield drag). The opportunity cost of harvesting and selling corn stover (\$28.84 / ton) as well as the cost to replace phosphate (\$0.34 / lbs phosphate fertilizer) and potash (\$0.25 / lbs potash fertilizer) after stalk removal was subtracted. Total replacement is estimated at 3.5 lbs/ton phosphate and 9 lbs / ton potash. Harvest and storage costs included \$38.22 / acre for harvesting using a forage harvester and \$0.10 / ton for hauling and storing, accounting for 15% shrink loss. A credit was given for manure value. Manure credit was assessed as spreading 1 out of every 4 years in a rotation to provide enough phosphorus for 4 years. The value of manure was calculated using The Beef Feed Nutrient Management Planning Economics (BFNMP\$) tool using 45% silage-based diet with 20% WDGS, adding up to a total value of \$2.83 / ton of silage intake. Cattle interest costs were set at 7.5% of the initial purchase price over the feeding period (Days on feed / 365) minus \$200 deposit. The cost of WDGS was set at 90% the price of corn (DM basis) including 5% shrink. Supplement, including monensin, was \$300 / ton (DM basis) with 1% shrink applied. Supplements containing tylosin were charged an additional \$0.01 / steer daily. Feed interest (7.5%) was applied to half of the total feed amount for the entire feeding period. Medicinal and processing charges were \$20 / steer and yardage was charged as \$0.50 / steer daily. A 5-year average (May 2014—May 2019) for feeder price in Nebraska (\$1.3952 / CWT; Livestock Marketing Information Center) was used to target a net return of \$0 / steer for cattle on the 15% silage treatment. Revenue was calculated as the difference in gross inputs and revenues where values represented profit in dollars per steer (\$ / steer) and were calculated using final body weights with a 63% common dressing percent.

A sensitivity analysis, for changes in corn price, was conducted where returns were calculated as the difference in gross inputs and revenues where values represented profit in dollars per steer (\$ / steer). Corn silage prices changed with the price of corn. Corn silage (at 37% DM) price compared to \$3.00, \$4.00, and \$5.00/ bu corn was \$38.84 (per tons as is, 37% DM), \$42.66, \$46.57, respectively. Revenue was calculated using a single 5-year average for live fed price for Nebraska (\$1.2500 / cwt). However, feeder price decreased with increasing corn price

Table 1. Expected production, inputs, and opportunity costs used for calculating the cost of harvesting and feeding corn silage

Item	Production / Costs
Expected Production	
Expected Yield (grain DM = 50% of total)	> 150 bu (50% grain DM)
Estimated % moisture for corn silage when harvested	63%
Actual silage yield, tons / acre, 6% yield drag	28 tons
Bushels of corn per ton of silage (bu / ton silage), 6% yield drag	7.82 tons
Corn stover produced, ton	4.53 tons
Phosphate fertilizer to replace stalks removed (lbs / ton harvested)	0.32 lbs / ton
Potash fertilizer to replace stalks removed (lbs / ton harvested)	0.22 lbs / ton
Harvesting Costs	
Corn price, $ / bushel, Sept. Price	$3.67
Grass hay, $ / ton	$100
Cost of phosphate fertilizer ($ / lbs; from above)	$0.34
Cost of potash fertilizer ($ / lbs; from above)	$0.25
Grain and stover harvesting, $ / acre (includes Combining)	$72.36
Hauling and storing, $ / ton	$1.10
Value based on opportunity cost to seller ($ / ton silage)	
Lost gross revenue from not harvesting corn grain	$28.84
Lost gross revenue from not harvesting corn stover	$4.05
Fertilizer cost for nutrient removal if harvested as silage	$1.85
Nutrient replacement from silage (added value)	-$2.83
Manure Spread Cost (45% corn silage diet)	$0.90
Drying and storage costs savings for corn grain and stover	$3.77
Equals opportunity cost of selling silage in the field	$28.14
Harvesting and storage costs for silage	$12.89
Shrink of Silage (15% DM shrink)	$4.97
Opportunity cost of selling stored silage	$42.42
Feed value of silage (as-is; 37% DM)	$43.99
Ingredient and Processing Costs	
Corn Silage, calculated from above ($ / ton DM)	$118.89
WDGS ($ / ton DM)	$138.78
DRC ($ / ton DM)	$154.20
DRC processing ($ / ton DM)	$2.17
Supplement ($ / ton DM)	$300
Animal processing ($ / animal)	$20
Tylosin (if included; $ / animal daily)	$0.01
Yardage ($ / animal daily)	$0.50
Initial Purchase Price ($ / CWT)	$1.66
Sale Price ($ / CWT)	$1.20

WDGS= Wet distillers grains plus solubles; DRC = Dry rolled corn; CWT = hundred weight (100 lbs)

to achieve breakeven ($0 net return) for the 15% corn silage treatment.

Data were analyzed using the PROC MIXED procedures of SAS (SAS Institute, Inc., Cary, N.C.) as a randomized block design with pen as the experimental unit and block as a fixed effect. The experiment was analyzed as a 2 × 2 factorial with two inclusions of corn silage (15 or 45) and with or without tylosin.

Results

By design, all cattle were fed to a similar 12th rib fat thickness ($P \geq 0.10$) to ensure equal degree of finish when comparing performance and carcass characteristics. Cattle fed 45 CS were fed for 213 days and 15 CS were fed for 185 days (Table 2). Performance results were reported in *2021 Nebraska Beef Cattle Report*, pp. 66–68. Briefly, there was an interaction for feed efficiency ($P = 0.10$). Cattle fed 15% CS with tylosin (15TCS) had the lowest F:G, 15 % corn silage without tylosin (15CS) was intermediate, and both 45% corn silage with and without tylosin (45CS and 45TCS) had the poorest feed conversion. Cattle fed 15% corn silage had a 2% decrease in F:G when tylosin was added to the diet. However, in cattle fed 45%, no improvements in F:G were observed when tylosin was added to the diet.

There was a tendency for an interaction ($P = 0.14$; Table 2) between corn silage and tylosin inclusion for returns ($ / steer). Projected profitability was least ($-9.57 / steer) for feeding 15% corn silage without tylosin compared to $13.43, $9.61 and $7.39 for CS45, TCS15, and TCS45, respectively. Cattle fed 15% corn silage without tylosin suffered performance losses, with poorer feed conversions, compared to cattle fed 15% corn silage with tylosin. The greatest returns were observed when cattle were fed 45% corn silage without tylosin due to increased final and carcass weights while also decreasing the overall cost of the ration. Even though cattle were fed longer and had poorer efficiencies when fed 45% corn silage (with no tylosin), the reduced feed costs and increased body weights led to similar or greater returns compared to just adding tylosin to 15% corn silage diets.

Feed costs heavily influence profitability and corn silage has been found to be

Table 2. Simple effects for carcass adjusted performance of cattle fed 15 or 45% corn silage with or without tylosin

	Treatment[1]					*P*-value		
	- Tylosin		+ Tylosin					
	CS15	CS45	TCS15	TCS45	SEM	Tylosin × Silage	Tylosin	Silage
Days on Feed	185	213	185	213	-	-	-	-
Initial BW, lbs	646	646	645	646	10.7	0.97	0.94	0.97
Live final BW, lbs	1282	1336	1294	1339	14.6	0.77	0.60	< 0.01
Carcass Adjusted Performance								
Final BW, lbs	1281	1336	1296	1328	16.1	0.51	0.82	0.01
DMI, lbs / d	21.7	23.1	21.7	23.1	0.25	0.94	0.86	< 0.01
ADG	3.43	3.24	3.52	3.21	0.046	0.21	0.55	< 0.01
F:G	6.34[b]	7.15[c]	6.16[a]	7.21	-	0.10	0.27	< 0.01
Return, $ / steer	-9.57	13.43	9.61	7.39	8.33	0.14	0.44	0.22
Carcass Characteristics								
HCW, lbs	807	841	816	837	10.2	0.53	0.84	0.01
12[th] rib fat, in	0.48	0.49	0.46	0.49	0.014	0.50	0.69	0.10

[1] Treatments included CS15: Corn silage included at 15% of diet DM without tylosin; CS45: Corn silage included at 15% of diet DM without tylosin; TCS15: Corn silage included at 15% with tylosin; TCS45: Corn silage included at 15% with tylosin.

[2] tylosin× CS = *P*—value for the interaction between corn silage inclusion and tylosin inclusions; tylosin= *P*—value for the main effect of tylosin inclusion; CS = *P*—value for the main effect of corn silage inclusion.

Table 3. Estimated returns ($ / steer) at varying corn prices for three inclusions of corn silage fed to feedlot cattle[1]

		Returns by Treatment[2]	
Dry Corn Price[3], $ / bu	Feeder Calf Price[4], $ / cwt	CS15, $ / animal	CS45 $ / animal
3.00	1.7743	$0.05	$11.92
4.00	1.6435	$0.02	$26.37
5.00	1.5125	$0.04	$40.68

[1] Returns calculated as the difference in gross inputs and revenues. Values represent profit in dollars per head ($ / steer).

Inputs: Total feed costs including processing and shrink. Cattle Interest = [(days on feed / 365) × (feeder price -$200) × 0.75]. Feed Interest = [Total feed costs / 2) × 0.75 × (days on feed / 365)]. Yardage = $ 0.50 / steer / d. Processing = $20 / steer.

Revenue: Final body weights using a 63% common dressing percent to calculate live final weight and 5-year average live fat price for Nebraska ($1.2500 / cwt).

[2] CS = corn silage.

[3] Corn silage prices floated with the price of corn utilizing a September corn price comparison ($-0.20 / bu) compared to $3, $4, and $5 dry corn. The corn silage prices were $38.84 (as-is, 37% DM), $42.66, $46.57, respectively.

[4]Initial purchase price was set to break even for 15% corn silage.

economical in times of high corn prices. Differences in returns ($ / steer), based on corn price, were evaluated at the varying inclusions of corn silage (Table 2). As corn price (and corn silage price) increased there was a greater difference in the returns ($ / steer) when cattle were fed 45% corn silage. For example, at $3.00 corn, cattle fed 45% corn silage returned an additional $11.87 per steer compared to cattle fed 15% corn silage. Furthermore, when corn was $5.00, returns were even greater ($40.64 / steer) for cattle fed 45% corn silage compared to 15% corn silage (Table 3).

Conclusion

These data suggest, as corn becomes more expensive, it becomes more economical to feed corn silage at greater inclusions. Overall, increasing corn price led to an increase in returns as $ / steer when cattle were fed more corn silage because of the difference in ration price. If more silage is fed (up to 45%), then cattle need to be fed longer to get to a similar fat endpoint, so grade is not hindered. By feeding cattle 45% corn silage for 28 days longer, there was more sellable carcass weight (and live weight). Despite increased yardage and feed inputs, the diet cost was sufficiently cheaper, and the cattle were heavier (+27 lb) which increased profitability by $10.50 per animal. This a system-based approach to integrate, utilize, and optimize corn acres while having the greatest economic impact on cattle feeding.

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