SILAGE FOR BEEF CATTLE
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CORN SILAGE AND EARLAGE
Characteristics and Use in Iowa (2017)

An Iowa Beef Center Project

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INTRODUCTION

Approximately 349,000 acres of corn are harvested as corn silage in Iowa. (USDA Census of Ag 2012-2016) No data is available on number of acres harvested as earlage. Both of these feeds can increase beef production per acre as compared to corn grain but require good management from production through feeding to optimize beef production. Little information has been collected about production practices that are being used in Iowa and if there is any correlation to the feeding value of the feeds.

A survey of production, harvesting, storage and feeding practices combined with sample analysis was completed to help characterize production and feeding practices and nutrient analysis.

SURVEY METHODS

A survey was developed to gather data from producers who utilized corn silage or earlage. The survey included questions on acres harvested, verities used, type of harvesting equipment, estimated yield, storage methods and feeding practices (Table 1). The survey was mailed to selected producers and also made available on line through the Iowa Beef Center website during the winter and spring of 2017. Ninety six completed surveys were returned. Forty six of the surveys were from producer using silage, 31 were from producers who utilized both corn silage and earlage, and 19 used earlage only.

TABLE 1.

Survey results

Survey information reported	Silage	Earlage
Number of surveys: 96 total	**77 (31 for both)**	**50 (31 for both)**
Hybrid for corn silage planted	32%	NA
Total acres of those completeing surveys	10000	18000
Average acres harvested per producer	129	427
Range in acres harvested per producer	8- 1000	7-2800
Reported yield range wet basis	20 to 31 ton/acre	9.3 to 15.8 ton/acre
Harvest time per acre average and range	1.44 hours/ acre avg 1 -6.7 hours/acre	.025 hours/acre avg .08-.34 hours/acre
Reported moisture target for harvest	63% avg 55-66% range	33.6% avg 30% - 40 % range
Estimated reported moisture at harvest		
Start and finish	64% start and 56% finish	36% start -31.5 % finish
Use Custom harvester	60%	80%
Kernel processing used	72%	NA
Inoculant used	58%	58%
Storage type	37% bunker, 32 % silage bag, 18% drive over pile, 13 % upright silo	52.5% bunker, 24.6 % silage bag, 13.1% drive over pile, 9.8 % upright silo
Testing	40% for moisture, 66% for nutrient	66% for both moisture and nutrient
Cut length	.625 in .25-1.25 in	NA

PRODUCER CHARACTERISTICS

80 % of surveys were from producers in northern Iowa but all of Iowa was represented.
Producers only harvesting silage
42 were cow calf producers with an average herd size of 162 head.
36 were feedlot operators with an average size of 666 head one time inventory.
Producers harvesting both corn silage and earlage
18 were cow calf with average herd size of 262 cows and
30 were feedlot with average inventory of 1297 head.
Producers harvesting earlage only
19 feedlot operators with an average inventory of 2544 head

For those using bunker or drive over pile storage for corn silage, reported packing time per load averaged 8.4 minutes per load with a range of 2 minutes to 15 minutes per load. Packing equipment most commonly used was a four wheel drive tractor with a blade. 78% of those using a bunker or drive over pile for storage used a cover.

For those using bunker or drive over pile storage for earlage, packing time per load averaged 10.7 minutes with a range of 3.5 minutes to 30 minutes per load. Packing equipment most commonly used was a four wheel drive tractor with a blade. 92% of those using a bunker or drive over pile covered the bunker or pile.

There was considerable variation in practices used in silage production, harvest and storage by producers represented in the surveys. The sample analysis data was sorted by several of the characteristics of production, harvest and storage in the survey responses. No major differences in averages of the nutrient analysis were observed.

USE OF SILAGE AND EARLAGE IN DIETS

The majority of those using corn silage or earlage fed them in a total mixed ration. The following tables show the average and range of percent corn silage or earlage being fed in diets on an as fed basis across all those who responded. 42% indicated they used corn silage as primary source of effective fiber in the diet.

On average the 42% of producers using corn silage as effective fiber had higher inclusion percent of corn silage in diets than the 58% that did not indicate that corn silage was the primary source of effective fiber. For 400-600 lb. cattle, corn silage was 20% points higher in the diet and 12-13% points higher on other weight ranges. For beef cows the inclusion percent 100-200 days pre calving was 19 % points higher, 16 % points higher immediately after calving and 5 to 7 % points higher in the other two defined periods. Average targeted cut length was .63 in for those using corn silage as effective fiber and 1 in for those indicating it was not the primary source of effective fiber.

TABLE 2.

Average and range of percent corn silage as fed included in diets for feedlot cattle and beef cows

	Feedlot cattle weight ranges in lbs.			
	400-600	**600-800**	**800-1000**	**>1000**
Avg	26.46	24.04	16.35	11.58
Min	5.00	5.00	5.00	4.00
Max	80.00	70.00	60.00	70.00
	Beef cow stage - days relative to calving			
	100-200 pre	**100 to calving**	**Calving to 50 post**	**50-100 post**
Avg	33.76	38.84	27.72	13.38
Min	10.00	10.00	10.00	20.00
Max	75.00	80.00	75.00	50.00

TABLE 3.

Average and range of percent earlage as fed included in diets for feedlot cattle

	Feedlot cattle weight ranges in lbs.			
	400-600	**600-800**	**800-1000**	**>1000**
Avg	30.0	36.0	38.2	35.0
Min	5	10	10	10
Max	95	75	75	80

SAMPLE ANALYSIS METHODS

Sample analysis of corn silage and earlage samples were available to producers participating in the survey. Sampling was completed by the producer or Extension Beef Field Specialist. Thirty five silage samples and 20 earlage samples were sent to Dairyland Labs for analysis. Corn silage samples were analyzed using the Near Infrared Complete Corn Silage analysis, which includes all nutrient analysis, digestibility analysis, and some fermentation analysis measures. Earlage samples were analyzed using the NIR UW Grain analysis which includes nutrient analysis, fermentation analysis and grain particle size analysis measures. Of those completing surveys, 27 submitted silage samples and 20 submitted earlage samples.

In addition to the laboratory analysis, the Penn State Particle Separator was used when possible to evaluate particle size, mainly on samples collected by field specialists. Ten silage samples and 17 earlage samples were evaluated using the particle separator

ANALYSIS RESULTS

Analysis of corn silage and earlage samples showed a large variation in most of the traits. Utilizing a book value for the individual samples in formulating a diet would result in an error in calculated feed and nutrient intake in most situations. Only 40% of survey respondents tested for moisture content routinely on silage and two-thirds analyzed silage for nutrients and moisture and nutrients for earlage. Analysis averages, minimums, maximums, and standard deviations for a few of the analyzed characteristics are shown in Table 4 and Table 5.

Samples were sorted by information provided on the associated survey. Averages by silage variety used or not, storage type or other characteristics did not vary greatly within this sample set. Sample moisture was compared to the target moisture indicated on the producer survey. Analyzed moisture of silage samples was on average 9.25% percent points and on earlage samples 6.25% percent points different than the targeted moisture indicated on the survey. As in any sampling of high moisture feed, sampling time and method could be a potential source of variation.

The Penn State Particle Separator results are shown in Table 6 for corn silage samples and Table 7 for earlage sample. Again, there was considerable variation among the samples. The targeted cut length stated on the survey was compared to the particle separator data where available. There was a clear trend that the smaller target cut size the particle size was smaller.

For the samples that had associated survey estimates on yield the corn silage to beef calculator excel spreadsheet was used to calculate beef per acre for corn silage and earlage. Those results ranked in order of beef per acre are in Tables 8 and 9.

TABLE 4.

Corn silage sample analysis 35 samples

	Average	Maximum	Minimum	Standard Deviation
Dry Matter	43.26%	58.85%	28.65%	8.12%
Crude Protein	6.84%	8.74%	5.47%	0.74%
Adj. Crude Protein	6.72%	8.74%	5.47%	0.73%
Calcium	0.21%	0.36%	0.16%	0.05%
Phosphorus	0.23%	0.27%	0.20%	0.01%
Magnesium	0.14%	0.23%	0.10%	0.03%
Potassium	0.92%	1.38%	0.10%	0.28%
Sulfur	0.13%	0.90%	0.09%	0.16%
Starch	40.50%	48.58%	21.78%	6.22%
Ash	5.19%	7.94%	3.58%	1.02%
Sugar (ESC)	1.17%	8.70%	0.25%	1.67%
NFC	51.75%	62.30%	36.80%	5.26%
Fat (EE)	3.36%	3.93%	2.80%	0.30%
ADF	23.27%	33.57%	19.36%	3.35%
aNDF	34.51%	46.84%	24.29%	4.53%
Lignin	9.61%	20.44%	7.55%	2.45%
NDFD 30	51.79%	60.64%	29.48%	5.58%
uNDFom30	16.19%	22.94%	11.63%	2.67%
pH	4.05	4.52	3.54	0.1988
Lactic Acid	2.74%	5.63%	0.60%	1.09%
Acetic Acid	1.83%	3.37%	0.57%	0.87%
Propionic Acid	0.39%	0.65%	0.21%	0.14%
Silage Acids	4.93%	8.29%	1.71%	1.51%
NEm OARDC, Mcal/cwt	72.55	79.27	0.77	15.32
NEg OARDC, Mcal/cwt	48.17	52.11	38.67	3.52
Nem ADF, Mcal/cwt	75.47	80.01	71.47	1.71
Neg ADF, Mcal/cwt	47.80	51.80	44.26	1.51

TABLE 5.

Earlage sample analysis 20 samples

	Average	Maximum	Minimum	Standard Deviation
Dry Matter	66.10%	76.84%	52.82%	6.13%
pH	4.17	4.77	3.44	0.35
Crude Protein	7.86%	8.62%	6.58%	0.60%
Adj. Crude Protein	7.77%	8.62%	6.58%	0.63%
Calcium	0.66%	6.00%	0.04%	1.77%
Phosphorus	0.26%	0.31%	0.23%	0.02%
Magnesium	0.11%	0.13%	0.10%	0.01%
Potassium	0.45%	0.51%	0.40%	0.03%
Starch	60.11%	65.99%	49.61%	3.94%
Ash	1.75%	2.24%	1.48%	0.19%
Sugar (ESC)	1.07%	2.33%	0.15%	0.55%
NFC	72.30%	78.77%	63.29%	4.05%
Fat (EE)	3.55%	4.01%	3.09%	0.25%
ADF	7.61%	12.03%	5.08%	1.83%
aNDF	15.65%	25.13%	9.43%	4.06%
Lactic Acid	1.12%	2.06%	0.41%	0.45%
Acetic Acid	0.50%	1.61%	0.12%	0.36%
NEM ORDAC Mcal/cwt	92.77	95.69	88.85	2.19
NEG ORDAC Mcal/cwt	62.82	65.31	59.47	1.87
Nem ADF Mcal/cwt	92.04	94.45	88.20	1.72
Neg ADF Mcal/cwt	62.20	64.26	58.91	1.47
Mean Particle Size MPS, microns	2101.00	2823.00	1630.00	368.37
Effective MPS, microns	711.54	1786.00	0.00	686.50

TABLE 6.

Penn State Particle Separator results for silage- 10 samples

	Average	Maximum	Minimum	Standard Deviation
Top tray	7.78%	15.40%	2.50%	5.21%
Middle tray	54.57%	61.90%	43.59%	6.48%
Bottom tray	37.65%	53.85%	26.50%	9.55%

TABLE 7.

Penn State Particle Separator results for earlage 17 samples

	Average	Maximum	Minimum	Standard Deviation
Top tray	4.55	10.00	1.34	2.94
Middle tray	23.78	44.16	12.50	10.31
Bottom tray	69.37	85.00	32.50	15.22

TABLE 8.

Pounds of beef per acre of corn silage

Bu yield	Silage yield ton	Dry matter	%NDF	% NDF digestibility	Beef per acre, lb.
247.5	28	58.85	32.51	54.9	3496.4
247.5	28	55.23	32.3	51.85	3208.0
220	21	51.01	30.98	54.44	2320.8
215	23.5	44.52	33.58	53.77	2151.0
228	26	38.99	31.77	56.88	2105.4
225	30	37.27	37.24	55.72	2077.9
225	24	44.30	37.4	54.65	1978.8
197.5	18.5	43.86	31.9	49.23	1876.6
190	18	39.89	31.64	53.8	1519.7
182.5	22	39.76	38.93	50.42	1479.2
197.5	18.5	37.92	36.19	49.97	1422.9

TABLE 9.

Pounds of beef per acre of earlage

Bu yield	Earlage yield ton	Dry matter	%NDF	% DM digestibility	Beef per acre, lb.
275	17.5	52.82	21.53%	82.67%	2961
225	12	76.84	18.55%	84.23%	2953
225	12	68.25	20.41%	82.70%	2623
210	11	66.39	9.43%	87.26%	2343
230	11	61.44	16.30%	84.47%	2166
248.5	8	67.92	12.36%	86.57%	1743

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