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Nutritive Value and Amount of Corn Plant Parts

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Summary

Corn plants were separated into seven different plant parts and analyzed for digestibility. Digestibility of the different parts of the plant ranged from 33.85% to 59.03%. The amount of highly digestible residue averaged 13.4 lb/bu of grain. Digestibility and amount of residue has considerable impact on the stocking rate and performance of cattle on cornstalks. Subsequent crop yields were not affected by grazing.

Introduction

Several studies have shown the quality and amount of corn residue available for cattle to graze (*2004 Nebraska Beef Cattle Report*, p. 13; *Journal of Animal Science*, 69:1741; *Journal of Animal Science* 67:597); however, most of this work was done on older hybrids and smaller yields than typical today, and some of the plant parts have not been analyzed (e.g., shanks and leaf sheath)(*Journal of Animal Science*, 69:1741). Our objective was to determine the digestibility values of the parts of the corn plant and determine if there is a change in the digestibility from the top to the bottom of the stem. A second objective was to determine the amount of residue available and if it was affected by grazing treatment. A third objective was to determine if subsequent crop grain yields have changed due to numerous years of grazing of the corn residue in both fall and spring.

Procedure

This study utilized a corn field at the Agricultural Research and Development Center (ARDC) near Mead, Neb., that has been in a corn/soybean rotation for several years and is irrigated by a linear move irrigation system. The field has three treatments that have been maintained for 13 years, a fall grazed, spring grazed, and an ungrazed section. On Oct. 2 we collected 10 consecutive complete plants from 24 locations; eight from each of the three treatments. The plants were separated into grain, cobs, shanks, husks, leaf blades, leaf sheaths, and stems. Stems were measured individually and then divided into top 1/3 and bottom 2/3. All of the samples were dried in a 60°C oven, weighed, and analyzed for IVDMD (48 hours). Soybean yields the subsequent growing season and corn yields the next growing season were measured with the yield monitor on the combine.

Table 1. Plant part IVDMD, % of total plant DM, and lb DM/bu grain.

Plant Part	IVDMD	SEM	% of Plant DM	SEM	lb/bu[1]	SEM
Top 1/3 stalk	37.57%	0.80	3.60%	0.001	1.21	0.06
Bottom 2/3 Stalk	33.85%	1.74	41.83%	0.007	14.12	0.60
Leaf	45.70%	0.74	18.72%	0.003	6.30	0.25
Leaf sheath	38.56%	0.71	12.60%	0.004	4.23	0.15
Husk	59.03%	0.76	7.48%	0.002	2.51	0.08
Shank	49.75%	1.16	1.09%	0.001	.37	0.03
Cob	34.94%	0.68	14.68%	0.003	4.93	0.11

[1]15.5% moisture corn grain.

Results

Digestibility, percentage of the plant, and plant part per bushel are listed in Table 1, and there were no differences due to grazing treatments. Previous studies (*Journal of Animal Science* 69:1741; 2004 Nebraska Beef Cattle Report , p. 13) reported digestibilities for leaf, husk, and cob similar to the current study values but were higher than our values for stem. The stem was similar in digestibility throughout the plant with the top only slightly more digestible, however there was a considerable difference in the digestibility of the leaf sheath compared to the leaf blade. It is interesting to note that even though the shank makes up a very small proportion of the plant, it is one of the more highly digestible parts, ranking intermediate between leaf and husk. Others (*Journal of Animal Science* 67:597; *2004 Nebraska Beef Cattle Report* p. 13) found that the percentage of leaf, husk, stem, and cob relative to the total plant varied some from the current study values, suggesting changes in plant proportions may be changing as hybrids and yields change. Part of this difference in leaf may be due to a hail storm in late September that damaged primarily the upper leaves and upper stem.

Depending on the particular parts cattle eat, the amount per bushel available to them can range from 8.80 lb to 13.42 lb (Table 2). Post-grazing observations suggest most or all of the stem is on the ground, but it is very hard to determine if the cattle were eating the upper 1/3 of the stem. The leaf sheath remains on the stalk at times, and is removed from the stem at other times. This suggests at least some of the leaf sheath is being consumed, and the amount probably depends on how tightly the leaf sheath is attached to the stem and if it comes off when the animal is eating the leaf blade. It is also difficult to determine

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Table 2. Digestible plant parts, lb DM/bu[1].

Plant Parts	lb/bu
Leaf and husk	8.80
Leaf, leaf sheath, and husk	13.04
Leaf, leaf sheath, shank, and husk	13.40

[1]15.5% moisture grain.

if the shank is being eaten or not. There is very little found on the ground but occasionally it is found still attached to the cob. This suggests that, similar to the leaf sheath, whether it is consumed is probably due to how it is attached to the plant part cattle are selecting.

Past research and current observations show that cattle consume primarily the husk and leaf blade. These parts are the most digestible, apparently most palatable, and most readily available for consumption. Of course residual corn is readily consumed, but with hybrids that resist insects and diseases, and with efficient combines, residual grain is less than measured previously.

Because the husk is the most digestible plant part, cattle performance is better when more husk is being consumed than leaf. Further, as grazing continues or stocking rate is increased, more leaf blade is consumed and eventually some leaf sheath, cob, and upper stem are consumed. This lowers the digestibility of the diet and animal performance declines. Therefore, there is an interaction between quantity and quality. The greater the utilization of corn residue by increasing stocking rate or length of grazing, the lower the quality of the diet and animal performance.

The best indicator of residue (leaf plus husk) available is grain yield because cattlemen know the grain yield before determining stocking rate. Our data suggests the yield of leaf and husk per bushel may have declined in the past 15 to 20 years. Samples collected in 2009 (*2010 Nebraska Beef Cattle Report* p. 22) showed a range from 13.1 to 19.4 lb of leaf plus husk (average = 15.5) for 12 hybrids grown in Western Nebraska.

Table 3. Soybean yield; bu/ac at 15.5% moisture[1].

Year	Fall Grazed	Spring Grazed	Ungrazed
2004	56.76	58.67	56.95
2005	68.45	67.35	65.66
2006	68.85	67.76	67.56
2007	64.93	64.07	63.81
2008	68.75	65.78	63.38
2009	74.13	71.61	71.09
2010	54.80	53.23	53.13

[1]SEM =4.34; P=0.35.

Table 4. Corn yields; bu/ac at 15.5% moisture[1].

Year	Fall Grazed	Spring Grazed	Ungrazed
2004	179.30	181.01	184.55
2005	184.54	186.27	185.83
2006	198.97	198.93	194.88
2007	202.85	194.64	196.81
2008	189.58	189.55	187.23
2009	261.03	255.61	255.51
2010	237.03	238.75	232.31

[1]SEM=10.95; P=0.30.

This suggests that hybrid differences and perhaps the amount of leaf and husk per bushel is declining slightly with increasing corn yields. Harvest efficiency by cattle may be 50% on average but may be as high as 70% with heavy stocking. While it is very difficult to estimate, 8 lb/bu of consumable leaf and husk is still a relatively good estimate to use to calculate stocking rate. The interaction of stocking rate and diet quality can be illustrated as follows. If the stocking rate is set so that 6 lb/bu of residue is consumed and we assume 80% of husk is consumed, then the IVDMD of the diet would be about 52%. If stocking rate were higher so that 10 lb/bu were harvested, then IVDMD would be 49.4%. Further, if we assume 1.5% of the corn grain is left in the field, then the respective diet IVDMD (or TDN) values would be 56 and 52%.

Fall, spring, and ungrazed corn residue treatments have been maintained for 13 years in this corn-soybean rotation. Tables 3 and 4 show soybean and corn yields from 2004 to 2010. The soybean yields were actually numerically greater from the plots grazed the year before but were not statistically different. Spring grazing had no negative effect on the subsequent soybean yield even though spring grazing increases the amount of mud and potential compaction compared to the fall grazing. Corn yields the second year after grazing showed similar results. This suggests that cattle grazing corn residue have no effect on the subsequent yields in irrigated fields.

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