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Accurate Amounts and Nutritive Values of Corn Residues

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Summary

It is important to have accurate data on the amounts and nutritive values of residues, especially for grazing situations. Ten plants were harvested for each field replication. Statistical analysis suggests 6 to 10 plants are needed to obtain accurate grain yields and accurate amounts of residue. Further laboratory analysis of the leaves and husks suggests that the energy and protein contents of the residue that is consumed is less than previously reported.

Introduction

Supplies of conventional forages, pasture, and hay have declined in recent years and corn residue supply has increased. It is important to the cattle industry to make efficient use of this corn residue. Extensive sampling of corn residue has been reported previously (*2012 Nebraska Beef Report*, pp. 11–12; *2015 Nebraska Beef Report*, pp. 56–58). This was done by sampling 10 plants, assuming they were representative. Further, laboratory analytical procedures have been updated. The Objective was to determine variation in individual plants and to re-evaluate energy and protein values of corn residues.

Procedure

An irrigated field in a corn, soybean rotation has been used for stalk grazing research for over 20 years (*2015 Nebraska Beef Report*, pp. 53–55). There are non-grazed areas and areas grazed in the fall and areas grazed in the spring. There are 4 field replications that contain each of these areas. In the fall of 2014, 10 consecutive corn plants were harvested from each of these field replications (3 treatments × 4 reps = 12 sampling locations). Each of the 120 corn plants, harvested above the anchor roots just before grain harvest, was

Table 1. Yield of corn grain and residue measured by clipping individual corn plants

Yield	Treatment[a]			SEM	*P*-value
	Fall Grazed	Spring Grazed	Non-grazed		
Grain, g	207.2	199.8	199.3	5.24	0.49
Husk, % of grain	5.64[c]	6.35[b]	5.56[c]	0.22	0.02
Leaf, % of grain	11.48	11.85	11.44	0.60	0.87
Sheath, % of grain	6.20	6.71	6.29	0.28	0.38

[a]Samples were collected from a field in a corn-soybean rotation. Treatments were due to timing of cattle grazing residue 2 years prior to these samples being collected. Ten plants were collected from each of 4 replications per treatment.
[b,c]Means within a row without a common superscript differ ($P < 0.05$).

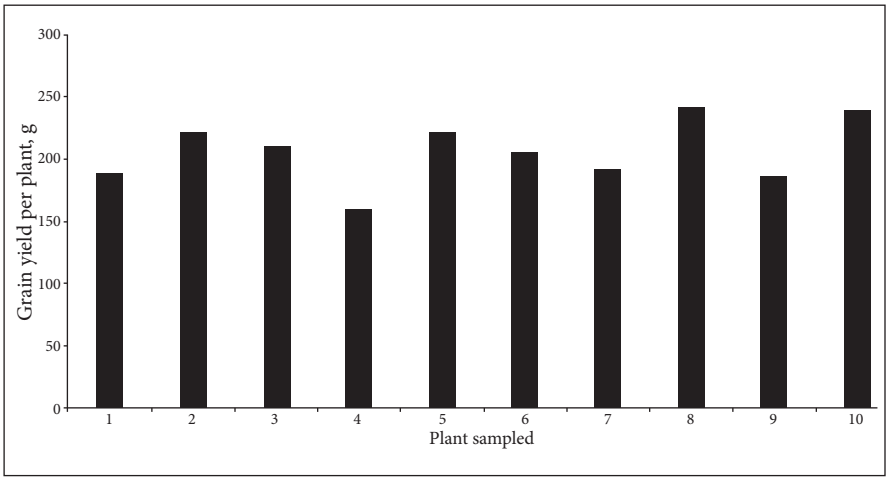

Figure 1. Grain yield measured on individual plants in replication 4 of the non-grazed treatment.

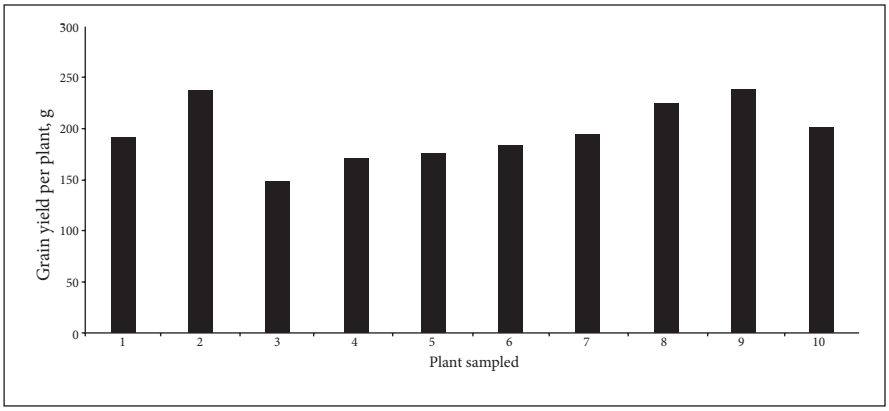

Figure 2. Grain yield measured on individual plants in replication 2 of the spring grazed treatment.

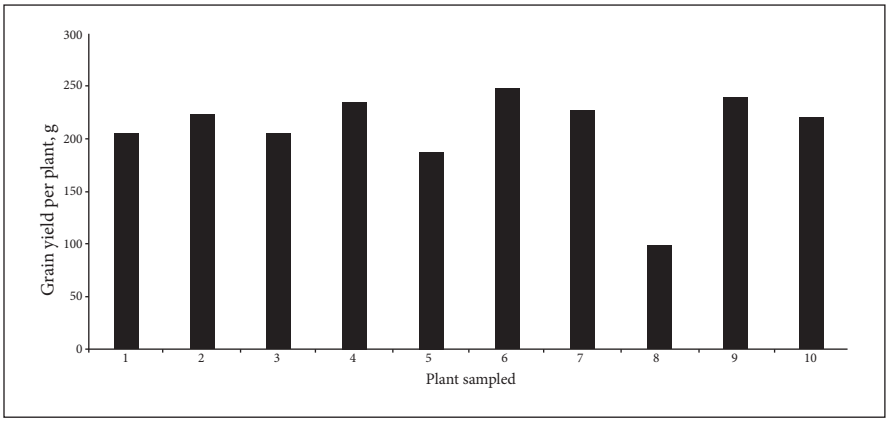

Figure 3. Grain yield measured on individual plants in replication 2 of the fall grazed treatment.

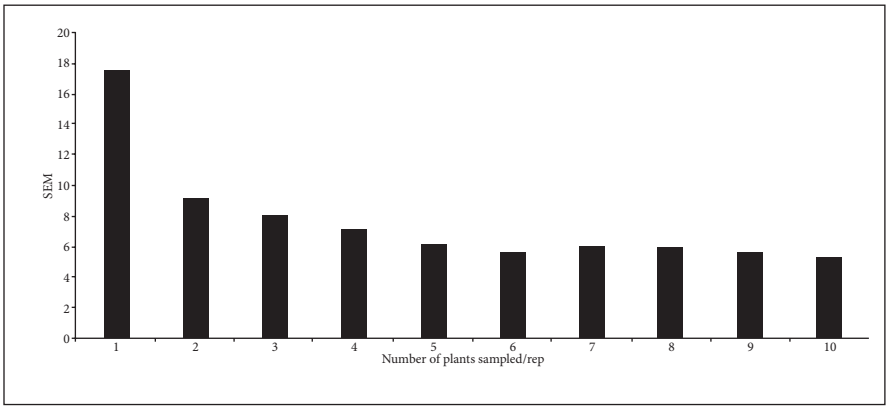

Figure 4. Standard error of the mean for grain yield (g) as the number of plants sampled per replication increased from 1 to 10.

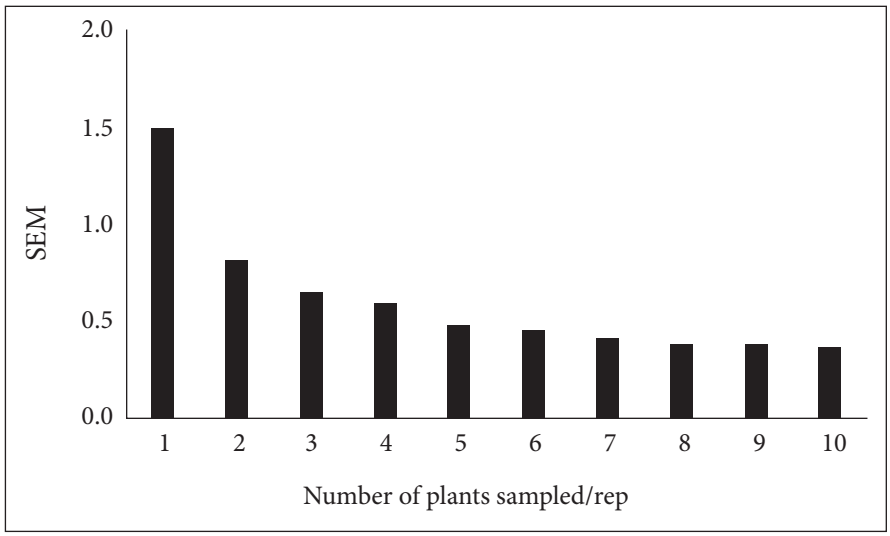

Figure 5. Standard error of the mean for residue (leaf + sheath+ husk) yield, expressed as a % of grain yield, as the number of plants sampled per replication increased from 1 to 10.

separated into grain, cob, leaf blade, leaf sheath, and husk. Each plant part was dried (60°C) and DM amounts determined.

The 10 plant parts within each replication were composited for organic matter and in vitro organic matter digestibility (IVOMD) determination. Previous samples of corn leaf and husk (*2011 Nebraska Beef Report*, pp. 33–34) were analyzed for protein degradability using in situ and mobile bag techniques. Statistical analysis was conducted using a model with 3 treatments and 4 replications, with corn plant as the experimental unit. The analysis was repeated 10 times using 1 corn plant, 2 corn plants, etc. until all 10 were included.

Results

Amount of grain per plant and the amount of residue as a percentage of grain are shown by treatment (Table 1). Grain yield was not affected by grazing treatment ($P = 0.49$). Numerically, fall grazing produced the greatest grain yield which is consistent with previous yield data (*2015 Nebraska Beef Cattle Report*, pp. 56–58). Grain yields are in grams per plant (ear). Yield of 200 grams dry matter per plant at a plant population of 36,000/ac would yield approximately 240 bu/ac. As expected, all plants were not the same. As an example figure 1 shows the grain yield per plant for rep 4 of the nongrazed area. Figure 2 shows the yield for rep 2 of spring grazed and Figure 3 shows rep 2 of fall grazed. Overall, grain yield ranged from 160 to 293 grams/plant.

The analysis of variance was conducted using 1 to 10 plants per rep. The analysis is the same as reported in Table 1. Figure 4 illustrates the change in the standard error of the mean (SEM) as additional plants were added. This suggests that 6 to 10 plants are needed to obtain sufficient statistical power when measuring grain yield.

The average amount of leaf blade, leaf sheath and husk was 23.8% of the grain. That is 15.8lb of residue dry matter/bu of corn at 15.5% moisture. Cows and (or) calves grazing corn residue consume the husk and leaf and very little of the steam and cob. Previous research has shown 15 to 16 lb of leaf and husk are produced per bu of corn, and harvest efficiency was measured at about 50%. This allows producers to estimate carrying capacity as 8 lb DM

available per bu or 1920 lb per acre at corn yield of 240 bu/ac.

The amount of leaf and husk harvested from the 10 plants is presented as a percentage of the grain. (Figure 5). The SEM declined as number of plants increased through 10. This illustrates the need to harvest a sufficient number of plants to get a representative sample of residue, probably 6 to 10 plants.

Organic matter digestibility was greatest in the husk while no difference was observed between the leaf and sheath. Grazing treatment had no effect on organic matter digestibility within the husk, leaf, or sheath. The IVOMD values are similar to previous data. However, the ash content of the leaves is very high. In previous research where samples were collected off the ground, the ash was assumed to be soil contamination. Recent results show leaves have high ash content, even with no soil contamination. The leaf blades contained 15.4% ash and the leaf sheaths 8.8%. The blades are more accessible for consumption so it is assumed more blade is consumed than sheath. The leaf material consumed may contain up to 14% ash. Ash has no energy so it is important to account for that by calculating the amount of digestible organic matter (DOM). There was no effect of grazing treatment on DOM of the plant parts. Husk had 55.6% DOM, leaf blade 40.7% DOM and leaf sheaths 38.6% DOM. The DOM equates closely to TDN. This calculation shows the leaves to have less energy than previously thought. Assuming cattle consume the leaf blade and husk in the proportions it is produced on the plant, the TDN of the consumed residue would be 45%.

Residue samples were collected at the Brule, NE site in 2009 (*2011 Nebraska Beef Report*, pp. 33–34). Crude protein was 3.75% for the husk and 5.75% for the leaf. The rumen degradable protein (RDP) contents were 2.72 and 4.43% of DM, respectively. Digestibility of the ruminally undegradable protein (RUP) was less than 25% for both plant parts. Therefore, new values have been calculated that would be appropriate for use in the NRC metabolizable protein system assuming residue consumed is 1/3 husk and 2/3 leaf. The adjusted CP is 4.25% and RDP is 90.7% of the CP.

The protein and energy values for corn residue reported herein are lower than previously reported. They do not include values for residual grain in the field that can be a source of both energy and protein. Residual corn was estimated at 0.5 bu/ac for the field sampled in 2014. A cow grazing the field for 70 days would consume about 0.3 lb corn grain DM per day. Residual corn may vary up to 2 bu/ac and if cows grazed fewer days, up to 2 ½ lb of corn could be available per day.

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