

Rethinking Corn Residue

Effects of Grain Yield on Quality and Quantity of Residue

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Summary with Implications

A two-year experiment evaluated the effects of corn grain yield on the resulting quality and quantity of corn residue. Among the wide variety of corn hybrids, locations, and growing conditions, observed grain yields ranged from 120 to 350 bushels per acre. As corn yield increased, the total pounds of residue increased. However, the amount of residue relative to grain decreased. Within the residue, the proportion of leaf increased from 10 to 28% as corn yield increased while husk remained unchanged at 13%. Overall, the yield of leaf and husk per bushel of corn grain was not affected by grain yield and averaged 12 lb/bu. As the grain yield increased, there was an increase in proportion of leaf, but there was a decrease in total residue per bushel, resulting in no change of leaf quantity per bushel. However, as yield increased, the digestibility of leaf and husk declined. Given the decrease of residue quality in higher yielding fields, impacts of grain yield on cattle performance should be evaluated.

Introduction

Corn residue grazing offers producers an economical winter feed source and can reduce the need to purchase feed. Grazing corn residue has unique challenges due to all forage being present at the beginning of grazing as well as the forage no longer

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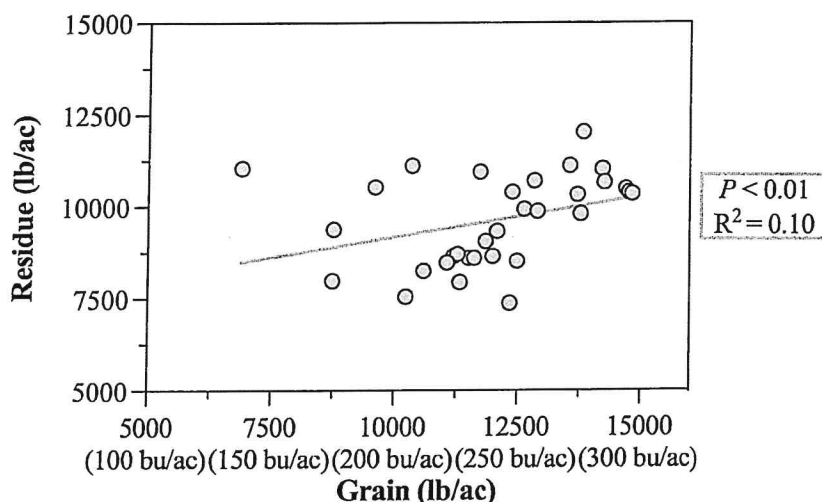


Fig. 1. Pounds of corn grain compared to pounds of residue produced per acre. Linear regression equation for leaf ($Y = 0.06187 \cdot X + 5.312$) proportion.

being rooted in the ground. This means that corn residue is very susceptible to grazing selection and disappearance. Cattle will consume any remaining grain first along with husk, followed by more leaf as grain availability declines (2004 Nebraska Beef Cattle Report, pp. 13–15). Minimal cob and stalk are consumed. Despite the utility of corn residue, cattle producers have reported variable cow performance even when grazing corn residue at current stocking recommendations of one animal unit month per acre per 100 bushels of corn grain harvested. This recommendation is based off the assumption that there are 16 lb of leaf and husk (dry matter basis) available for every bushel of corn grain produced. This recommendation estimates a 50% utilization rate, meaning 8 lbs of leaf and husk are assumed to be grazed by the animal. The objectives of this experiment were to investigate the correlation of grain yield to residue yield, plant proportions and husk and leaf digestibility to determine how grain yield impacts the feed value of corn residue.

Procedure

A two-year experiment was conducted at a variety of locations across Nebraska

including experiment stations and producer farms (7 site years total). This experiment investigated the correlation of corn yield with the quality and quantity of corn residue (husks and leaves). In Year 1 (2021), 24 different varieties were planted in four locations across Nebraska. Of the 24 varieties planted, seven were planted in two or more locations, yielding 32 samples in year 1. Of the locations, three were dryland and one was irrigated. In Year 2 (2022), 26 different varieties were planted in three locations across Nebraska. Of the 26 varieties planted, five were planted in two or more locations, yielding 31 samples in year 2. Of these locations, one was dryland and two were irrigated. Six varieties were planted in both Year 1 and 2.

In Year 1, leaf and husk samples were collected from each plot ($n = 4$ replication plots per variety per location) for quality analysis. In Year 2, 12 whole plants were harvested above anchor roots from each plot ($n = 4$ replication plots per variety per location) at the time of grain harvest. Whole plants were separated by plant part into grain, cob, leaf, husk and stalk. Each plant part was dried (140°F) and dry matter (DM) amounts were determined. After drying, all leaf and husk samples were ground

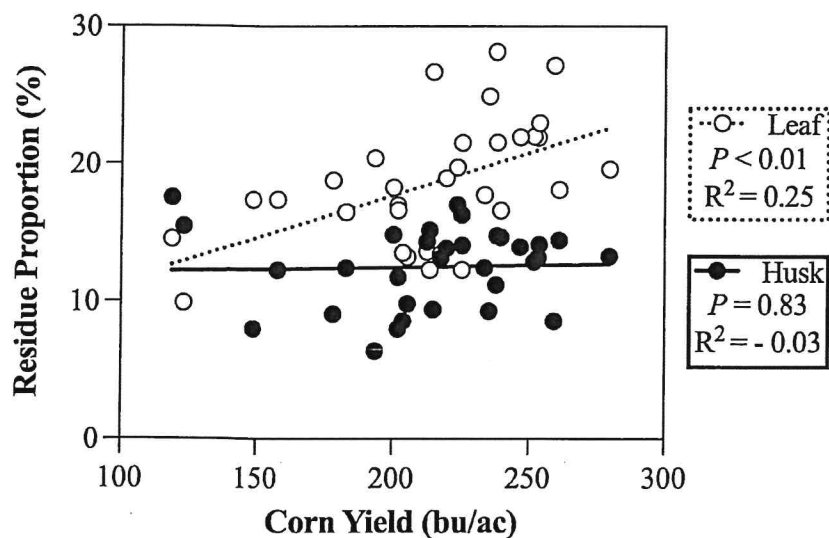


Fig. 2. Proportion of corn leaf and husk within total corn residue compared to corn yield. Linear regression equation ($Y = 0.2208 \cdot X + 6975$).

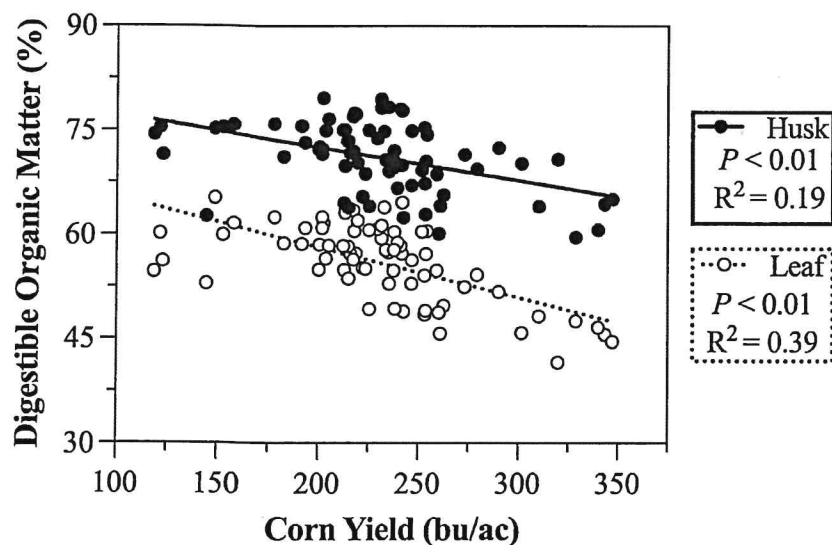


Fig. 3. Digestible organic matter of corn leaf and husk compared to corn grain yield. Linear regression equations for husk ($Y = -0.04790 \cdot X + 82.12$) and leaf ($Y = -0.07247 \cdot X + 72.66$) digestibility.

through a 1mm screen to be analyzed for digestible organic matter (DOM) using the in vitro method. From the determined in vitro organic matter digestibility (IVOMD), samples were adjusted using standards with known in vivo digestibility and DOM was calculated for all leaf and husk samples. Corn grain yield was estimated by harvesting the middle two rows of the plot.

Statistical analysis was conducted using the regression procedure to determine correlations of corn grain yield to residue yield,

proportions, and digestibility using plot as the experimental unit.

Results

Observed corn grain yield across the two years, locations, and varieties ranged from 120 to 350 with an average of 231 and a median of 232 bushels per acre. As corn grain yield increases, the proportion of grain relative to residue increased ($P < 0.01$). Thus, as expected, grain proportion

increased with increased grain yield from 38% to 63% (Figure 1). Although total pounds of residue increased with grain yield, there was less residue produced per bushel of corn grain produced.

The proportion of leaf within the residue increased ($P < 0.01$) with grain yield from 10% to 28% with an average of 19% (Figure 2). In contrast, the proportion of husk within the residue remained unchanged ($P = 0.83$) across the range of yields with an average of 13% (Figure 2). Previous reports did not include corn grain yield but have estimated residue proportions to be 27% leaf and 12% husk (2004 Nebraska Beef Cattle Report, pp. 13–15), 30% leaf and 11% husk (2011 Nebraska Beef Cattle Report, pp. 33–34), or 22% leaf and 13% husk (2015 Nebraska Beef Cattle Report, pp. 59–61). Although actual grain yields were not reported, these reports evaluated irrigated corn in Eastern, Nebraska, thus average yields can be assumed near 150–200 bushels per acre. Additionally, the reported plant proportions support the results observed in this experiment of about 13% husk with varying amounts of leaf within the residue.

Pounds of husk and leaf per bushel did not vary with corn grain yield ($P = 0.44$). Thus, it is variable but grain yield is not a driving factor. It is generally expected that 13 to 16 pounds of husk and leaf are produced per bushel of grain. The observed range in this experiment was 8 to 20 pounds of husk and leaf per bushel with an average of 12 lb/bu. Thus, the expected range falls within the observed range (Table 1).

The digestibility of both leaf and husk decreased ($P < 0.01$) as yield increased. In leaf samples, DOM decreased from 65% in lower yielding hybrids to just 41% in higher grain yielding hybrids (Figure 3) with the average being 56%. In husk samples, DOM decreased from 80% to 60% with an average of 71% (Figure 3). It has also been reported that leaf DOM ranges from 30 to 34% with husk at 58% (2017 Nebraska Beef Cattle Report, pp. 60–61). Another report estimated leaf DOM to be 40% and husk to be 56% at a corn yield of 240 bushels per acre (2016 Nebraska Beef Cattle Report, pp. 71–73). These two reports estimate leaf and husk to be 15% below the digestibility observed in this experiment. However, the results from this experiment are consistent with in vivo digestibility estimates (2016 Nebraska Beef Cattle Report, pp. 74–75 and pp. 76–78).

Table 1. Estimate of Residue and Nutrient Yield

	Estimated Range ^a	P Value of Correlation with Yield	Mean	Max	Min
Pounds of Residue per Bushel					
Husk	2.8–3.5	0.75	5.0	12.1	2.8
Leaf ^b	10.2–12.5	0.39	7.2	10.3	4.3
Husk + Leaf	13–16	0.44	12.3	19.8	8.4
Pounds of Digestible Organic Matter (DOM) per Bushel					
Husk	1.7–2.2	0.69	3.5	8.6	2.0
Leaf ^b	4.5–5.5	0.62	4.1	5.6	2.6
Husk + Leaf	6.2–7.7	0.28	7.6	13.0	5.4

^a Ranges are estimated from Nebraska Extension publication EC278, Grazing Crop Residues with Beef Cattle (<https://extensionpublications.unl.edu/assets/pdf/ec278.pdf>).

^b Leaf samples include the leaf sheath.

As observed with residue yield, pounds of DOM per bushel also did not vary with corn grain yield ($P = 0.28$). It is generally expected, based on previous reports, that husk and leaf will yield 6.2 to 7.7 pounds of DOM per bushel of grain. The observed range in this experiment was 5.4 to 13 pounds of DOM from husk and leaf per bushel of grain with an average of 7.6. Again, the expected range falls within the observed range of this study (Table 1).

Given the dilution of nutrients in higher yielding fields, it stands to reason that current recommendations may need to be adjusted. Current stocking recommendations are calculated based on grain yield with higher stocking rates on higher yielding fields. The decline in nutrient concentration could impact dry matter intake and thus cow performance when grazing corn residue. Adjusting stocking rates or providing supplementation for cows grazing higher yielding fields could combat this decline, and these strategies need further evaluation.

Conclusion

Cattle select leaf and husk in the greatest amount. The pounds per bushel of leaf and husk, does not appear to change with corn grain yield. However, the digestibility of leaf

and husk declined as grain yield increased. Yet, the overall yield of digestible nutrients from leaf and husk (lbs of DOM per bushel of corn) did not change with grain yield. The decrease in digestibility could negatively impact cow performance in higher yielding fields by limiting intake and future research needs to evaluate the effect of corn yield on performance of cows grazing corn residue.

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