

In Situ Digestibility of Residue Parts of Corn Planted in Different Populations and Row Widths

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Summary with Implications

Plant density can be changed by altering row width and/or number of plants within a row. The use of narrower rows at seeding may increase yield and reduce plant-to-plant competition. Corn seeds were planted at 2 row widths (15 and 30-inch rows) and 3 plant populations (25,200, 35,000 and 54,000 seeds / acre). Samples of corn residue were collected 4 dates (October 8, October 24, November 5 and November 19) post-harvest and separated into cob, stem, leaf and husk to determine changes in quality over time. The greatest plant population increased the NDF content and NDF digestibility of husk, NDF and true digestibilities of cob, NDF content of stem, and decreased the true digestibility of the stem. The NDF content of the leaves and stem increased over time while the NDF and true digestibilities of cob decreased over time. Row width did not affect the corn residue. Planting densities and management strategies can affect the digestibility of leaf and husk and may impact residue quality.

Introduction

Plant density can be changed by either altering row width and/or number of plants within a row. The use of narrower rows at seeding may increase yield per area and reduce plant-to-plant competition by increasing the distance between plants in a row, which allows more efficient use of light, water and nutrients. However, corn silage quality is usually inversely proportional to plant yield (2013 *Nebraska Beef Cattle*

Report, pp. 42–43) and decreases as plants mature and NDF content increases (2015 *Nebraska Beef Cattle Report*, pp. 56–58). Digestibility also may differ between parts of the corn residue, and had been demonstrated to be greater for husk and lower for stem and cob (2015 *Nebraska Beef Cattle Report*, pp. 59–61). However, the impacts of plant population and row spacing on NDF content and digestibility of corn residue have not been evaluated. Therefore, the objectives of this project were to evaluate the NDF digestibility of residue parts for corn planted in different row widths and populations over time.

Procedure

The experiment was conducted at the University of Nebraska—Lincoln Eastern Nebraska Research and Extension Center near Mead, Neb. Corn seeds of hybrid Stine 9733 and 9728 were planted on May 6, 2013 at 2 row widths: 15 and 30-inch rows, and 3 populations: 25,200, 35,000 and 54,000 seeds / acre. Additionally, corn plants were harvested for grain and corn residue samples collected at four dates October 8, October 24, November 5 and November 19 (Julian Dates 281, 297, 309 and 323 days, respectively). Plots were divided into 4 quarters; each quarter was a replication of the treatments. Samples from each quarter consisted of ten plants in a row representative of the field and were separated into stem, leaf blade/sheath, husk/shank and cob. Samples were dried in a forced air oven at 60°C for 48 hours and ground through a 2-mm screen in a Wiley mill and analyzed for *in situ* NDF digestibility. The NDF *in situ* digestibility was expressed as a percentage of the original NDF content determined using a fiber analyzer (ANKOM Technology Corp., Fairport, NY, USA). Two ruminally cannulated steers were used for this study were fed a mixed diet consisting of 70:30 forage- to-concentrate ratio (DM-basis). Approximately 1.25 g of sample were weighed into Dacron bags (50 µm pore size)

with 2 bags per sample per steer. Due to the number of bags, four runs of incubations were performed, one run per replication. Forty-eight bags were placed in a mesh bag and four mesh bags were placed in each steer during each incubation period. After 36 hour incubation, bags were removed from the steers, rinsed 5 times in washing machine using a 1 min agitation and 2 min spin cycle and analyzed for NDF content. Bags were dried in a forced air oven at 100°C for 12 hours and then weighed. Solubles were considered 100% digestible and were calculated by subtracting the percentage of NDF from 100%. Therefore, true digestibility is the sum of the solubles and digestible NDF (NDF content X NDF digestibility). The leaf samples collected on October 8 were not retained and therefore could not be analyzed.

Data were analyzed using the MIXED procedure of SAS (SAS Institute, Inc., Cary, N.C.). The experimental unit consisted of field replication incubated within animal. The model included the effects of plant parts, row spacing, plant population and collection date, and their interactions. Covariate regression was used to determine how plant parts changed over time in regards to NDF content, *in situ* NDF digestibility.

Results

There was a significant interaction ($P < 0.05$) of plant parts (PP) and plant population (POP) on NDF content, NDF digestibility and true digestibility of corn residue (Table 1). The PP by POP interaction influenced NDF content and NDF digestibility of husk. When seeds were planted at 54,000 plants / acre, the NDF content of husk increased; however NDF digestibility also improved. Similarly, the greatest population increased NDF content and decreased the true digestibility of stem. At higher population both NDF digestibility and true digestibility of cob were improved. There was no effect of row width on NDF content

Table 1. Effect of plant parts and population on neutral detergent fiber and *in situ* neutral detergent fiber digestibility.

Item	Cob			Husk			Leaf			Stem			SEM	P-value ²		
	25,200 ¹	35,000	54,600	25,200	35,000	54,600	25,200	35,000	54,600	25,200	35,000	54,600		PP	POP	PP x POP
NDF	85.49	87.32	86.63	77.09 ^b	78.75 ^b	81.02 ^a	73.95	73.96	76.02	54.42 ^{ab}	53.16 ^b	55.94 ^a	0.72	<0.01	<0.01	0.05
NDFD ³	36.47 ^b	36.32 ^b	40.22 ^a	49.86 ^b	51.33 ^{ab}	52.07 ^a	47.26	47.70	47.93	34.26	34.76	33.64	0.73	<0.01	0.01	<0.01
TD ⁴	45.68 ^b	44.41 ^b	48.19 ^a	61.33	61.70	61.36	61.07	61.40	60.42	64.18 ^{ab}	65.31 ^a	63.04 ^b	0.74	<0.01	<0.01	0.05

^{a,b} Means with different superscripts are different within each plant part.

¹ Plant population (number of seeds / acre).

² PP = main effect for plant part; POP = main effect for plant population; PP x POP = interaction of plant part and plant population.

³ NDFD = Neutral detergent fiber digestibility.

⁴ TD = True digestibility.

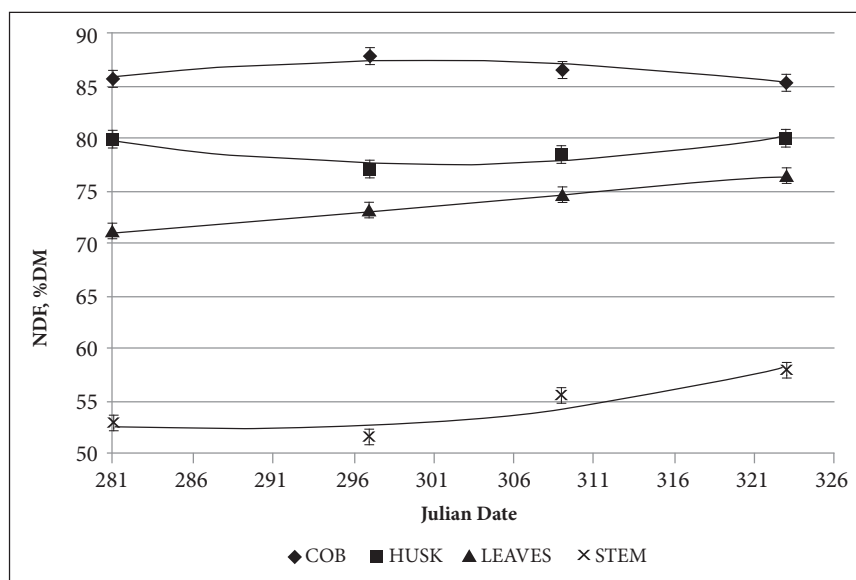


Figure 1. Neutral detergent fiber content of corn residue plant parts over time.

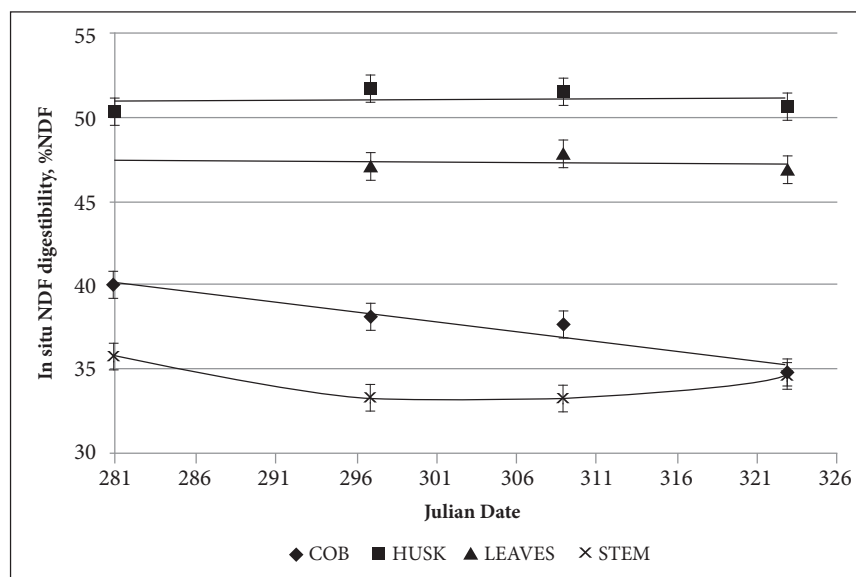


Figure 2. Neutral detergent fiber digestibility of corn residue plant parts over time.

($P = 0.19$), *in situ* NDF digestibility ($P = 0.37$) or true digestibility ($P = 0.84$).

Time affected the quality of parts of corn residue. The NDF content increased linearly for leaf ($P < 0.01$, Figure 1) and quadratically for stem ($P = 0.05$) over time. The NDF content of stem increased from 51.54 to 57.93% and leaf NDF from 73.17 to 76.52%. There was a quadratic response of NDF content of cob ($P < 0.01$) and husk ($P = 0.01$) over time. However, this variation was small compared to other parts of the plant, ranging from 85.44 to 87.96% for cob and from 77.20 to 80.14% for husk. The digestibility is expected to decrease due to the increase in NDF as plant matures, which is correlated with decreased soluble content in the plant. However, when all samples were collected the plant was already mature and dry so minimal changes may have occurred due to plant metabolism. It is not clear, but a possible explanation could be the solubles decrease by volatilization or microbial activity increasing the proportion of NDF and altering digestibility.

There were linear decreases ($P < 0.01$) and quadratic responses ($P < 0.01$) of *in situ* NDF digestibility of cob and stem over time (Figure 2), respectively. Cob *in situ* NDF digestibility decreased 13.2%, ranging from 40.1 to 34.8% from the first to the last collection date, being the most negatively affected part of the plant over time regarding NDF digestibility. The NDF digestibility of husk and leaf remained unaffected by dates of collection ($P > 0.05$, Figure 2) which are also the parts of the plant of greatest quality. These results are supported by previous work (2015 Nebraska Beef Cattle Report, pp. 59–61) which also found a quadratic decrease of cob digestibility and no effect on leaf and husk over time.

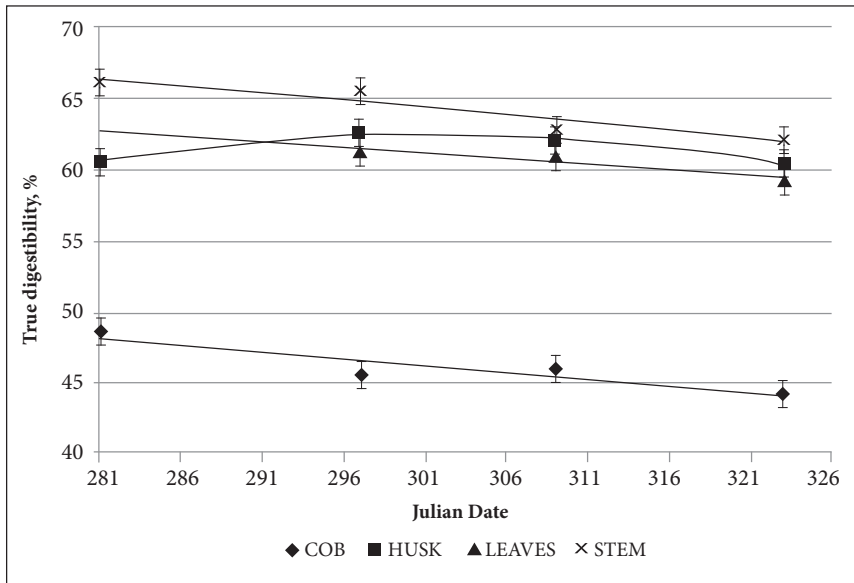


Figure 3. True digestibility of corn residue plant parts over time.

The true digestibility of cob, leaf and stem were linearly decreased ($P < 0.01$, Figure 3) across time, decreasing 9.0, 3.13 and 6.1%, respectively. The true digestibility of husk had a quadratic response ($P > 0.01$), with a small range from 60.56 to 62.67%. The true digestibility of stem was greater than reported in previous research (2015 *Nebraska Beef Cattle Report*, pp. 59–61), that found true digestibility of approximately 42% and can be explained by the lower NDF content.

Conclusions

When seeds were planted in a greater population, the NDF digestibility of husk

and cob increased regardless the row width. The cob was the most negatively affected part of the plant by time, with small changes for leaf and husk. Harvest techniques could be developed to increase the proportion of leaf and husk of corn residue to increase animal intake and performance.

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