Northern NY Agricultural Development Program
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Agronomic and forage quality characteristics of brown midrib (BMR) and non-BMR corn silage hybrids grown in Northern New York

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Background:
Corn silage is a major source of energy in dairy cattle rations and an important source of dietary fiber and starch. Corn produced for silage can vary tremendously in yield and quality depending on growing environment characteristics, genetics and harvest management (Cherney et al., 1991; Oba and Allen, 2000; Johnson et al., 2003; Ballard et al., 2001; Kung et al., 2008). For example, brown midrib (BMR) hybrids differ markedly in the amount and digestion potential of fiber due to differences in quality and quantity of lignin compared to non-BMR hybrids and offer an opportunity for greater whole-plant fiber digestibility (Cherney et al., 1991). The BMR trait in both corn and sorghum-sudan silage has shown greater fiber digestibility and milk production potential compared with non-BMR genetics (Grant et al., 1991; Aydin et al. 1999).

In general, there is a tradeoff between yield and fiber digestibility with respect to corn hybrids. Fiber digestibility (measured as 30-hr neutral detergent fiber digestibility/NDFd) of BMR is typically 8 to 10 units higher than NDFd of non-BMR hybrids, with 20 to 30% lower lignin content. Research has shown that the increase in NDFd observed with BMR hybrids comes at the expense of yield (Oba and Allen, 2000; Ballard et al., 2001; Kung et al., 2008). While the so-called "yield drag" of BMR hybrids compared to non-BMR hybrids has improved over the past three decades, farmers often report reduced overall yields for BMR.

Commercially-available BMR hybrids include both the bm3 and bm1 genotypes, however, relatively little research has evaluated performance among bm1, bm3, and non-BMR hybrids. While hybrid selection is important, other farm-specific factors such as soil type, fertility, ration forage level, and feed inventory must also be considered. Dairy farms in Northern New York (NNY) would benefit from a greater number of replicated studies focused on hybrid genetics and forage quality in order to optimize efficiency of dairy rations.

Objectives:

1. Determine yield and forage quality differences among BMR (bm1 and bm3), and non-BMR hybrids grown at two locations in NNY, and
2. Evaluate overall forage quality differences among hybrids, including indigestible or undigested fiber measures (uNDF profile).

Methods:

A 14-acre tile-drained research field at Miner Institute, Chazy, NY, was used for the trial. The soil type is mapped as Adjiduamo silty clay. A randomized complete block design was utilized and hybrids were randomly assigned to plots within each block. Five commercially-available hybrids were planted at 34,000 seeds/acre with a 6-row planter (30-inch row spacing) on 5/21/2015. Two bm3 hybrids, one bm1 hybrid, and two non-BMR hybrids were evaluated in this study (Table 1).

Table 1. Hybrid and planting information, Miner Institute and Adirondack Farm, 2015.

Hybrid and planting data	Hybrid 1	Hybrid 2	Hybrid 3	Hybrid 4	Hybrid 5
			Miner Institute		
Hybrid (company and number)	Mycogen F2F379 (bm3)	Mycogen F2F499 (bm3)	Pioneer PO238R (bm1)	Pioneer PO533AM1 (non-BMR)	Mycogen TMF2Q419 (non-BMR)
Planting date	5/21/15	5/21/15	5/21/15	5/21/15	5/21/15
Planting population (seeds/acre)	34,000	34,000	34,000	34,000	34,000
Harvest date	10/2/15	10/2/15	10/2/15	10/2/15	10/2/15
			Adirondack Farm		
Hybrid	Mycogen-F2F379	Mycogen-F2F499	Pioneer-PO238XR	Pioneer PO533AM1	Mycogen TMF2Q419
Planting date	5/18/15	5/17/15	5/21/15	5/10/15	5/21/15
Planting population	35,700	34,150	35,000	35,420	33,070
Harvest date	-	-	-	-	-

Each replicated strip was 6-rows wide and approximately 500 feet long. Total nitrogen (N) application rate was based on a yield goal of 20 wet tons/acre. Phosphorus and potassium requirements were based on recent soil test results and Cornell University guidelines were followed. The Adapt-N model was used in combination with soil and crop records to estimate economically-optimum sidedress N rate. All field strips were harvested on 10/2/2015. For comparison, the same hybrids were grown at Adirondack Farm, LLC, Peru, NY. Hybrids were grown in separate fields without field replication. Hybrids at Adirondack Farm were planted between 5/10/15 and 5/21/15 at 34,000 to 35,700 plants/acre. (Table 1, Appendix). For both locations, two vacuum-sealed bags (FoodSaver) were filled on the day of harvest and stored at room temperature for 0, 30, 60, 90, and 120 days. Subsamples of fresh-chopped corn forage were analyzed at either Miner Institute or Cumberland Valley Analytical Services (CVAS):

- pH – Miner
- Dry matter (DM) – Miner
- Wet chemistry analysis – CVAS
- 7-hour starch digestibility (StarchD) – CVAS
- In vitro analyses - 0, 30, 120, 240 hours – Miner
    - Amylase NDF (aNDF) and ash-corrected NDF, expressed on an organic matter basis (aNDFom)
    - NDF disappearance (NDFd)
    - Undigested NDF (uNDF; 30, 120, and 240 hour) for all fresh chop hybrid samples and 120-day samples from Miner Institute. A standard Tilley-Terry artificial rumen fermentation system was used to measure the uNDF at each time point.
- Kernel processing score of silage (CSPS) – CVAS.

After reaching the desired ensiling time, duplicate vacuum bags were opened, thoroughly mixed and composited. Subsamples were analyzed for:

- pH – Miner
- Dry matter – Miner
- Wet chemistry analysis – CVAS
- NDFd (30-hr) and uNDF (30, 120, and 240 hr) profile –Miner (120-day samples from Miner only)
- 7-hour starch digestibility – CVAS
- Titratable acidity – CVAS
- Lactic acid – CVAS
- Acetic, Propionic, isobutyric, and butyric acids – CVAS

Statistical analyses were performed with the Statistical Analysis System (version 9.2; SAS Institute Inc., Cary, NC).

Hybrids grown at Adirondack Farm were not replicated and therefore results were not statistically analyzed. Means and standard errors were computed as a relative comparison to the results from the replicated strips at Miner Institute.

Results and Discussion:

Fresh Chop Samples:

Mean percent DM ranged from 34.5 to 38.4 across hybrids at Miner Institute (Tables 2 and 3, Appendix). Mean yield ranged from 16.9 to 18.4 tons/acre (at 35% DM). Non-BMR hybrids had slightly higher yields, but did not differ from BMR hybrids ($P = 0.46$). Mean total starch content ranged from 33.7 to 35.7% and did not differ across hybrids ($P = 0.55$). Seven-hour starch digestibility was greater for the non-BMR hybrids. There were small but significant differences in crude and soluble protein across hybrids (Table 2).

Total digestible nutrients and acid detergent fiber content (ADF) were greater for BMR hybrids. Neutral detergent fiber (aNDF and aNDFom) of non-BMR was numerically greater than BMR, however, differences were not significant. There were relatively large differences in 30-hour ash-corrected NDF digestibility (aNDFd30om) among hybrids, with BMR having up to 9% greater aNDFd30om than non-BMR (i.e., hybrid 1 vs. hybrid 4). Fiber digestibility differences among BMR and non-BMR hybrids are similar to those reported by other studies (Ballard et al., 2001; Kung et al., 2008). While aNDFd30om differed between BMR and non-BMR, there was no difference between bm1 (hybrid 3) and bm3 (P = 0.10 for bm1 vs. bm3-F2F370; P = 0.48 for bm1 vs. bm3-F2F499).

Fiber digestibility trends were similar at Adirondack Farms and differences were even more pronounced. The F2F379 had >13% higher aNDFd30om compared to hybrid 4 (Table 3). In addition, there was >5% unit difference between bm1 and bm3 (F2F379). BMR had lower lignin content, however bm1 and bm3 did not differ in lignin. Relative differences among hybrids with respect to lignin content were similar at Miner Institute and Adirondack Farms (Tables 2 and 3).

Table 2. Fresh chop corn forage quality measures for hybrids, Miner Institute, 2015.

	Miner Institute fresh chop samples						
Component	**Hybrid 1**	**Hybrid 2**	**Hybrid 3**	**Hybrid 4**	**Hybrid 5**	**SEM¶**	***P***
Yield (@35% DM)	16.9	18.3	16.8	18.7	18.6	1.1	0.460
DM (%)	37.1a¶¶	34.5c	35.6ac	38.4b	36.1ac	0.8	0.019
Starch (%DM)	35.7	33.7	35.7	35.8	35.6	1.3	0.549
StarchD (% of starch)	56.1a	56.2a	54.1a	59.6b	64.4b	2.0	0.009
CP (%DM)	7.8a	7.3ab	8.2ac	7.7abc	6.8d	0.2	0.001
SP (%DM)	2.2a	1.9a	2.0a	2.0a	1.7b	0.1	0.013
TDN (%DM)	76.4a	76.6a	76.4a	74.9b	74.4b	0.4	0.002
ADF (%DM)	19.5a	19.6a	19.4a	20.4ab	21.2b	0.4	0.041
aNDF (%DM)	37.8	37.8	38.5	39.9	39.7	0.8	0.140
aNDFom (%DM)	37.6	37.6	38.3	39.8	39.5	0.8	0.129
aNDFd30om (% of aNDFom)	63.3a	61.2a	59.7a	54.3b	56.6b	1.6	0.008
uNDF30om (%DM)	13.8a	14.5a	15.5a	18.2b	17.2ab	0.6	0.001
uNDF120om (%DM)	8.3a	7.6a	9.9b	12.2c	11.0bc	1.6	0.004
uNDF240om (%DM)	6.2a	5.9a	7.9b	9.2c	8.2bc	0.4	0.001
Lignin (%DM)	1.9a	1.8a	2.0a	2.6b	2.5b	0.1	<.0001
NSC (%DM)	38.1	36.9	38.4	38.1	37.4	1.1	0.727
Ash (%DM)	4.0	3.9	3.9	3.9	4.2	0.1	0.406
pH	5.48a	5.44a	5.47a	5.43a	5.56b	0.02	0.022
CSPS (%)	51.2a	60.1b	52.9a	55.9b	57.7b	1.8	0.001

¶ Standard error of the mean; the highest standard error among hybrids is presented

¶¶ Means without a common letter are different at $P \leq 0.05$

Table 3. Fresh chop corn forage quality measures, Adirondack Farms, Peru, NY.

	Adirondack Farm fresh chop samples					
Component	**Hybrid 1**	**Hybrid 2**	**Hybrid 3**	**Hybrid 4**	**Hybrid 5**	**SEM¶**
Yield (@35% DM)	-	-	-	-	-	-
DM (%)	34.9	36.2	36.9	44.1	37.9	0.6
Starch (%DM)	32.1	38.0	37.4	39.1	33.3	1.1
StarchD (% of starch)	55.4	48.9	49.2	45.5	54.0	0.8
CP (%DM)	7.8	7.2	7.8	7.0	7.7	0.2
SP (%DM)	2.1	1.6	1.6	1.6	2.3	0.2
TDN (%DM)	74.8	77.3	75.9	74.9	74.1	0.5
ADF (%DM)	22.5	19.9	19.8	21.6	23.4	0.6
aNDF (%DM)	41.7	38.2	39.0	39.7	43.8	0.9
aNDFom (%DM)	41.9	38.4	39.0	40.0	44.1	0.9
aNDFd30om (% of aNDFom)	67.7	64.0	62.0	54.4	57.2	0.5
uNDF30om (%DM)	13.6	13.8	14.8	18.3	18.9	0.5
uNDF120om (%DM)	7.8	8.2	10.2	12.5	11.7	0.5
uNDF240om (%DM)	7.7	7.3	9.2	11.7	11.5	0.4
Lignin (%DM)	2.2	1.7	2.2	2.7	2.8	0.1
NSC (%DM)	34.4	39.8	39.8	40.6	35.4	1.1
Ash (%DM)	3.2	3.4	3.6	3.1	2.8	0.1
pH	5.31	5.26	5.25	4.79	5.61	0.03
TA	8.0	7.1	7.0	5.3	6.4	0.1

¶ Standard error of the mean; the highest standard error among hybrids is presented

In addition to 30-hour NDF digestibility, uNDF profiles varied among hybrids (Tables 2, 3; Figure 1).

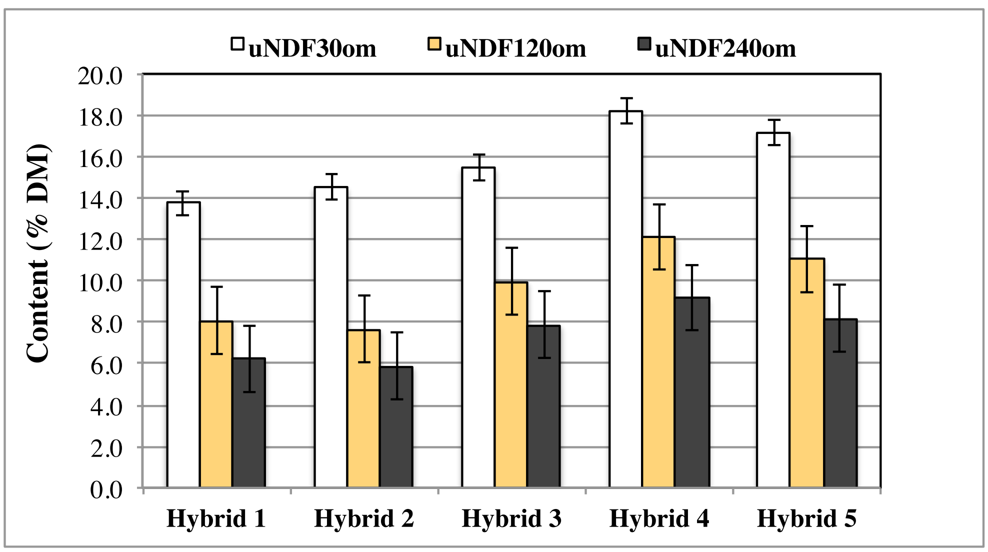

Figure 1. uNDF profile of BMR and non- BMR hybrids grown at Miner Institute.

Mean uNDF30om values for hybrids 1 through 5 grown at Miner (bm3, bm3, bm1, and the two non-BMRs, respectively) were 13.8, 14.5, 15.5, 18.2, and 17.2, (%DM basis) respectively. Hybrid 3 (bm1) had a tendency for higher uNDF30om ($P = 0.06$) compared to hybrid 1 (bm3; F2F379). At Adirondack Farms, respective uNDF30om values were 13.6, 13.8, 14.8, 18,3, and 18.9 (%DM basis).

There was also good separation between BMR and non-BMR based on uNDF120om and uNDF240om (Tables 2 and 3). In general, the bm3 hybrids had significantly lower uNDF120om and uNDF240om compared to non-BMR. Mean uNDF120om values for hybrids one through five grown at Miner were 8.3, 7.6, 9.9, 12.2, and 11.0 (%DM basis), respectively. Respective values at Adirondack were 7.8, 8.2, 10.2, 12.5, and 11.7 (%DM basis).

The consistent and relatively close range in uNDF among hybrids shows that it was a good indicator of fiber quality among hybrids at both sites. Values for uNDF240om were not as similar; however, the trends among hybrids were consistent. Our results show that uNDF pools appear to be a sensitive measure of fiber digestibility and may be important for ranking hybrids with respect to milk production potential of corn silage.

Hybrid Quality Differences over Time

Analysis of nutritive measures over time in vacuum bags showed thatDM, starch digestibility, soluble protein, TDN, ADF, non-structural carbohydrate (NSC), ash, pH, titratable acidity (TA), total volatile fatty acids, lactic acid, acetic acid, and DM recovery varied significantly over time (Table 4).

Studies have shown that starch-D increases during fermentation due to production of acids and subsequent acid hydrolysis of the protein matrix surrounding starch molecules. In our trial, starch-D of 30-day samples increased by >20% for BMR and from 13 to 17% for non-BMR compared to fresh chop (Table 4). In addition, soluble protein nearly doubled at 30-days post-fermentation for most hybrids.

Interestingly, both soluble protein and starch-D appeared to peak at 60 to 90 days of fermentation and dropped significantly at 120 days (Table 5). For Adirondack Farms, starch-D increased from 45-55% at fresh chop across hybrids to 71-77% at 30-days post-ensiling (Table 5). Similar to the Miner Institute results, starch-D and soluble protein levels were greatest at 90 days and both dropped significantly for 120-day vacuum bags.

In addition to changes in quality that accompany fermentation (starch and protein solubility), changes in water content can also alter fermentation processes and impact nutrient dynamics and nutritional quality. It is possible that vacuum bags had some amount of ambient air exchange from unobservable leaks. Notwithstanding, while measures showed some variation over time, relative differences among hybrids were small and are not biologically meaningful. For example, a 0.03 unit difference in pH was enough to declare a statistical difference between hybrids but is not a manageable difference on a farm. Similarly, a difference of 0.3 to 0.4% units of ash content may be a true difference related to hybrid variation, we do not yet have the technology to make management decisions based on a difference of this level relative to all other factors interacting on a farm that influence overall forage quality.

Table 4. Corn forage quality measures at 30-days post ensiling, Miner Institute, 2015.

30-day fermented samples							-------------*P*-values---------		
Component	**Hybrid 1**	**Hybrid 2**	**Hybrid 3**	**Hybrid 4**	**Hybrid 5**	**SEM ¶**	**Hybrid**	**Time**	**Time x hybrid**
DM (%)	35.0a¶¶	32.0b	34.0a	37.3c	35.3a	0.5	<.0001	0.231	1.000
Starch (%DM)	40.8	38.2	38.8	37.5	38.3	0.7	0.007	0.240	0.692
StarchD (% of starch)	78.2a	79.0a	76.7a	73.4b	77.2a	1.4	0.004	<.0001	0.027
CP (%DM)	7.9	7.7	8.5	7.7	7.1	0.2	<.0001	0.188	0.892
SP (%DM)	3.6ab	3.5a	3.8b	3.7ab	3.6ab	0.2	<.0001	<.0001	0.524
TDN (%DM)	77.3a	77.0a	77.1a	75.3b	75.7b	0.5	<.0001	<.0001	0.901
ADF (%DM)	19.3a	19.8a	18.8a	21.3b	20.6b	0.6	<.0001	0.023	0.693
Lignin (%DM)	1.78a	1.76a	1.97a	2.43b	2.45b	0.07	<.0001	0.584	0.751
NSC (%DM)	41.7	39.1	39.8	38.3	39.0	0.7	0.003	0.097	0.606
Ash (%DM)	4.0a	4.4b	4.0a	4.0a	4.2ab	0.1	<.0001	<.0001	0.646
pH	3.76abc	3.74ab	3.74ab	3.72ab	3.78c	0.02	<.0001	<.0001	0.007
TA (meq/g)	6.4a	6.6a	6.3ab	5.8b	6.5a	0.3	<.0001	<.0001	0.644
TotVFA (%DM)	6.1a	5.9ab	6.0a	5.6b	6.1a	0.3	<.0001	0.051	0.007
Lactic (%DM)	4.7a	4.8a	4.8a	4.3b	4.8a	0.3	<.0001	<.0001	0.651
Acetic (%DM)	1.4a	1.1b	1.1b	1.3b	1.3b	0.1	0.472	<.0001	0.037
DM Recovery (%)	94.2	92.5	95.7	95.1	96.1	1.4	0.0001	0.009	0.320

¶ Standard error of the mean; the highest standard error among hybrids is presented
¶¶ Means without a common letter are different at $P \leq 0.05$

Table 5. Fiber digestibility and uNDF profile for 120-day hybrids samples, Miner Institute, 2015.

	120-day uNDF profile						-------------*P*-values----------		
Measure	**Hybrid 1**	**Hybrid 2**	**Hybrid 3**	**Hybrid 4**	**Hybrid 5**	**SEM¶**	**Hybrid**	**Time**	**Time x hybrid**
aNDF	37.6	36.5	35.6	37.8	35.6	0.7	0.107	<.0001	0.070
aNDFom	37.4	36.2	35.4	37.7	35.5	0.7	0.078	<.0001	0.079
aNDFd30om	64.7b	65.7b	61.4b	58.7a	53.0a	3.0	<.0001	0.188	0.164
uNDF30om	13.2a	12.4a	13.7a	15.6b	16.6b	1.2	<.0001	0.004	0.574
uNDF120om	7.3a	6.7a	8.5b	10.0b	9.2b	0.6	0.001	0.020	0.991
uNDF240om	6.5a	5.5abc	7.6ab	8.8b	7.7b	0.6	<.0001	0.441	0.874

¶ Standard error of the mean; the highest standard error among hybrids is presented. *P*-values are for time (fresh vs. 120-day), hybrid, and interaction of hybrid and time
¶¶ Means without a common letter are different at $P \leq 0.05$; *P*-value for time is between fresh chop and 120-day samples

Previous research has shown that some important nutritive components of corn silage (i.e., digestible starch and soluble protein) change predictably during fermentation, however, data indicating measurable fiber digestibility changes during fermentation is scarce. In comparing results from fresh and 120-day samples, our results suggest that some fiber pools may have changed during fermentation.

Mean aNDFom consistently dropped across hybrids for 120-day samples and mean aNDFd30om increased in 4 of 5 hybrids ($P = 0.19$). Mean uNDF30om and uNDF120om were both significantly lower for 120-day vacuum bags compared to the fresh chop samples, implying greater fiber digestibility. There was no difference in uNDF240om between fresh chop and 120-day samples (Table 5). With the exception of starch-D and soluble protein, many of the nutritional measures from the Adirondack Farm samples for later time points were similar.

See Appendix A Tables 6-12 with data on corn forage quality at 30-days, 60-days, and 120-days post-ensiling for hybrids at Adirondack Farms and Miner Institute, 2015.

<u>Conclusions/Outcomes/Impacts</u>:
Results showed that BMR and non-BMR hybrids differed significantly in fiber digestibility/indigestibility, starch digestibility, and fermentation profiles.

There were large differences in fiber digestibility between BMR and non-BMR hybrids, however, total starch and yield did not differ among hybrids. Fiber digestibility as measured by NDFd30om did not differ among bm1 and bm3 hybrids, however, uNDF30om and uNDF120om were significantly greater for the bm1 hybrid compared to one of the bm3 hybrids.

Our results showed that uNDF pools closely tracked differences in potential fiber digestibility at both growing locations, and suggest that uNDF is a good measure to include in hybrid ranking tools designed to predict milk production potential of corn silage.

Results also highlight the importance of hybrid selection and its impact on dairy ration formulation and farm economics. Rumen fill and dry matter intake (DMI) are affected by uNDF of forages. Higher uNDF forages tend to result in lower DMI. As we continue to research how uNDF affects DMI, we have observed that small differences in uNDF between forages results in DMI differences.

<u>Outreach</u>:
A manuscript will be prepared after year two (2016, NNYADP) of the study and submitted for publication in Agronomy Journal. Preliminary results were shard at an Alltech meeting in Ontario, Canada. Results were presented at the 2016 Corn Congress and in a Miner Institute Farm report. A series of Farm Report articles will be written during 2016-2017, highlighting results with a focus on quality differences and implications for rations.

<u>Next Steps</u>:
Hybrids identical to those used in the 2015 study will be grown in the same field at Miner Institute and the same hybrids will be planted at Adirondack Farms. Research in 2016-2017 will include characterizing uNDF across at different whole plant moistures. Future work will utilize forage quality data to evaluate predicted milk response using the latest version of the Cornell Net Carbohydrate and Protein Sysems (CNCPS) assuming a typical high-cow ration used at Miner Institute.

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Appendix A: Tables 6-12.

Table 6. Corn forage quality at 30-days post-ensiling, Adirondack Farms, 2015.

	Adirondack Farm 30-day samples					
Component	**Hybrid 1**	**Hybrid 2**	**Hybrid 3**	**Hybrid 4**	**Hybrid 5**	**SEM¶**
DM (%)	33.5	35.2	36.6	43.7	38.4	0.6
Starch (%DM)	34.0	41.3	40.3	40.4	38.4	1.1
StarchD (% of starch)	75.3	73.2	73.4	71.1	77.4	1.2
CP (%DM)	8.1	7.8	8.4	7.3	7.6	0.2
SP (%DM)	3.7	3.7	3.8	3.2	3.7	0.2
TDN (%DM)	76.2	76.9	77.9	75.9	76.0	0.4
ADF (%DM)	22.2	20.3	18.8	21.1	20.6	0.6
Lignin (%DM)	2.1	2.2	2.0	2.7	2.7	0.1
NSC (%DM)	35.0	42.1	41.5	40.9	39.2	1.1
Ash (%DM)	3.2	3.3	3.2	2.8	3.0	0.1
pH	3.7	3.7	3.7	3.7	3.8	0.01
TA (meq/g)	8.0	7.1	7.0	5.3	6.4	0.1
TotVFA (%DM)	8.1	6.4	6.3	4.9	6.7	0.3
Lactic (%DM)	6.7	5.4	5.2	4.1	5.3	0.2
Acetic (%DM)	1.4	1.1	1.1	0.8	1.4	0.1
DM Recovery (%)	96.6	96.9	97.0	95.2	97.7	1.3

¶ Standard error of the mean; the highest standard error among hybrids is presented

Table 7. Corn forage quality at 60-days post-ensiling, Miner Institute, 2015.

	60- day fermented samples					
Component	**Hybrid 1**	**Hybrid 2**	**Hybrid 3**	**Hybrid 4**	**Hybrid 5**	**SEM¶**
DM (%)	- ¶¶	-	-	-	-	-
Starch (%DM)	-	-	-	-	-	-
StarchD (% of starch)	74.1	72.4	75.7	73.4	76.4	1.4
CP (%DM)	-	-	-	-	-	-
SP (%DM)	3.8	4.1	4.8	4.3	3.9	0.2
TDN (%DM)	77.5	77.0	76.0	75.5	75.0	0.5
ADF (%DM)	18.3	19.2	19.6	20.2	21.2	0.6
NSC (%DM)	-	-	-	-	-	-
Ash (%DM)	4.3	4.6	4.5	4.2	4.4	0.2
pH	3.71	3.66	3.68	3.68	3.72	0.02
TA (meq/g)	6.8	7.3	7.2	6.5	7.3	0.3
TotVFA (%DM)	6.5	6.4	6.4	5.2	6.4	0.3
Lactic (%DM)	4.8	4.9	5.0	4.0	4.8	0.3
Acetic (%DM)	1.6	1.4	1.4	1.2	1.6	0.1
DM Recovery (%)	94.4	91.6	90.1	94.7	91.7	1.4

¶ Standard error of the mean; the highest standard error among hybrids is presented.
–¶¶ Indicates time was not significant; refer to means presented in Table 4.

Table 8. Corn forage quality at 60-days post-ensiling, Adirondack Farms, 2015.

	Adirondack Farm 60-day samples					
Component	**Hybrid 1**	**Hybrid 2**	**Hybrid 3**	**Hybrid 4**	**Hybrid 5**	**SEM¶**
DM (%)	32.3	35.2	36.4	43.9	38.2	0.6
Starch (%DM)	33.3	37.8	42.5	47.5	36.8	1.5
StarchD (% of starch)	75.7	69.3	73.8	70.3	75.4	1.3
CP (%DM)	7.9	7.7	8.2	7.1	7.6	0.2
SP (%DM)	3.8	3.8	3.9	3.0	3.8	0.3
TDN (%DM)	76.2	76.9	77.9	75.9	76.0	0.5
ADF (%DM)	22.2	20.3	18.8	21.1	20.6	0.6
Lignin (%DM)	2.0	2.0	1.9	2.3	2.5	0.1
NSC (%DM)	34.6	38.7	43.8	48.0	37.8	1.1
Ash (%DM)	3.1	3.4	3.4	2.7	3.4	0.1
pH	3.55	3.62	3.59	3.66	3.68	0.01
TA (meq/g)	9.4	7.5	6.4	5.2	7.6	0.6
TotVFA (%DM)	8.1	6.4	6.3	4.9	6.7	0.3
Lactic (%DM)	7.2	6.0	5.2	4.5	6.3	0.2
Acetic (%DM)	1.3	1.3	0.9	1.1	1.9	0.2
DM Recovery (%)	96.6	95.9	94.2	98.9	92.8	1.3

¶ Standard error of the mean; the highest standard error among hybrids is presented

Table 9. Corn forage quality at 90-days post-ensiling, Miner Institute, 2015.

	90- day fermented samples					
Component	**Hybrid 1**	**Hybrid 2**	**Hybrid 3**	**Hybrid 4**	**Hybrid 5**	**SEM¶**
DM (%)	-	-	-	-	-	-
Starch (%DM)	-	-	-	-	-	-
StarchD (% of starch)	73.8	72.9	75.1	72.3	75.6	1.3
CP (%DM)	-	-	-	-	-	-
SP (%DM)	4.1	4.3	4.7	4.8	4.2	0.2
TDN (%DM)	78.4	77.2	77.1	75.9	75.8	0.5
ADF (%DM)	17.9	19.3	19.6	20.8	20.8	0.6
NSC (%DM)	-	-	-	-	-	-
Ash (%DM)	3.8	4.4	4.1	4.1	4.3	0.1
pH	3.72	3.66	3.76	3.74	3.75	0.02
TA (meq/g)	6.7	8.0	6.8	5.8	7.3	0.4
TotVFA (%DM)	6.5	6.4	6.4	5.2	6.4	0.3
Lactic (%DM)	4.0	4.5	4.1	3.3	4.2	0.3
Acetic (%DM)	1.8	1.9	1.8	2.0	1.9	0.1
DM Recovery (%)	93.6	90.8	94.2	95.3	94.7	1.4

¶ Standard error of the mean; the highest standard error among hybrids is presented

Table 10. Corn forage quality at 90-days post ensiling, Adirondack Farms, 2015.

	Adirondack Farm 90-day samples					
Component	**Hybrid 1**	**Hybrid 2**	**Hybrid 3**	**Hybrid 4**	**Hybrid 5**	**SEM¶**
DM (%)	33.2	35.0	36.6	44.4	37.0	0.6
Starch (%DM)	32.7	37.2	39.5	46.3	37.2	1.1
StarchD (% of starch)	75.3	71.5	72.9	70.6	75.2	1.3
CP (%DM)	8.1	7.3	8.3	7.2	7.8	0.2
SP (%DM)	4.4	4.0	4.3	3.8	4.5	0.3
TDN (%DM)	76.2	77.3	77.9	78.6	76.6	0.5
ADF (%DM)	22.3	20.4	19.1	17.6	20.8	0.6
Lignin (%DM)	2.1	1.9	2.1	2.3	2.5	0.1
NSC (%DM)	33.8	38.3	41.1	46.9	38.4	1.1
Ash (%DM)	3.2	3.3	3.2	2.6	2.9	0.1
pH	3.57	3.67	3.59	3.65	3.73	0.01
TA (meq/g)	8.8	8.1	7.5	5.0	6.9	0.6
TotVFA (%DM)	9.3	8.0	7.1	5.3	7.7	0.3
Lactic (%DM)	7.9	6.2	5.7	4.2	6.0	0.2
Acetic (%DM)	1.5	1.8	1.3	1.1	1.7	0.2
DM Recovery (%)	97.6	92.6	96.5	99.8	96.7	1.3

¶ Standard error of the mean; the highest standard error among hybrids is presented

Table 11. Corn forage quality at 120-days post ensiling for hybrids, Miner Institute, 2015.

	120- day fermented samples					
Component	**Hybrid 1**	**Hybrid 2**	**Hybrid 3**	**Hybrid 4**	**Hybrid 5**	**SEM¶**
DM (%)	-	-	-	-	-	-
Starch (%DM)	-	-	-	-	-	-
StarchD (% of starch)	66.6	68.6	68.1	69.9	73.9	1.4
CP (%DM)	-	-	-	-	-	-
SP (%DM)	3.8	3.7	4.5	3.7	3.6	0.2
TDN (%DM)	77.0	75.9	76.0	74.5	74.3	0.5
ADF (%DM)	19.2	20.5	19.7	21.8	22.3	0.6
Lignin (%DM)	1.78	1.76	1.97	2.43	2.45	0.7
NSC (%DM)	41.7	39.1	39.8	38.3	39.0	0.7
Ash (%DM)	4.1	4.9	4.7	4.5	4.6	0.2
pH	3.78	3.72	3.81	3.85	3.83	0.02
TA (meq/g)	7.3	8.5	7.9	7.1	8.0	0.4
TotVFA (%DM)	5.8	8.5	6.1	5.5	6.0	0.5
Lactic (%DM)	3.9	4.5	3.8	2.9	3.8	0.3
Acetic (%DM)	1.9	4.0	2.3	2.6	2.2	0.6
DM Recovery (%)	92.6	90.7	91.8	94.2	93.9	1.4

¶ Standard error of the mean; the highest standard error among hybrids is presented

Table 12. Corn forage quality at 120-days post-ensiling, Adirondack Farms, 2015.

	Adirondack Farm 120-day samples					
Component	**Hybrid 1**	**Hybrid 2**	**Hybrid 3**	**Hybrid 4**	**Hybrid 5**	**SEM¶**
DM (%)	34.0	36.0	37.4	43.9	38.2	0.6
Starch (%DM)	34.4	41.2	40.5	45.0	37.7	1.1
StarchD (% of starch)	63.1	69.3	66.2	60.2	65.3	1.0
CP (%DM)	7.8	7.2	8.0	7.1	7.3	0.2
SP (%DM)	3.4	3.1	3.8	3.1	3.7	0.2
TDN (%DM)	75.5	77.6	77.2	77.1	75.7	0.5
ADF (%DM)	22.1	19.7	18.9	18.8	21.4	0.6
Lignin (%DM)	2.2	1.7	2.0	2.3	2.4	0.1
NSC (%DM)	35.4	41.9	41.7	45.7	38.6	1.1
Ash (%DM)	3.4	3.4	3.4	3.0	3.4	0.1
pH	3.57	3.69	3.64	3.72	3.72	0.02
TA (meq/g)	10.1	7.8	7.2	5.7	8.0	0.5
TotVFA (%DM)	9.8	7.6	7.1	5.7	7.7	0.3
Lactic (%DM)	8.0	5.8	6.0	4.7	6.5	0.2
Acetic (%DM)	1.8	1.8	1.1	1.1	1.3	0.2
DM Recovery (%)	98.0	97.1	97.5	99.8	95.5	1.3