Northern New York Agricultural Development Program
2016 Project Report

Agronomic and Forage Quality Characteristics of Brown Midrib (BMR) and Non-BMR Corn Silage Hybrids Grown in Northern NY: Year 2

Project Leaders:

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Collaborators:

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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 silage varies in yield and quality depending on growing environment, 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 have higher fiber digestibility and can offer more milk production potential per ton compared to non-BMR hybrids (Cherney et al., 1991). The BMR trait in both corn and sorghum-sudan silage confers higher fiber digestibility and the potential for higher 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 can come at the expense of yield (Oba and Allen, 2000; Ballard et al., 2001; Kung et al., 2008). Farmers often report reduced yields for BMR compared to non-BMR.

Commercially-available BMR hybrids include bm3 (Dow AgroSciences/Mycogen Seeds) and bm1 (Dupont/Pioneer) genotypes. Relatively little research has evaluated performance among bm1, bm3, and non-BMR hybrids with respect to yield and forage quality. Dairy farms in Northern New York (NNY) and other regions of the US are interested in potential yield/quality differences among bm1, bm3, and no-BMR hybrids in order to optimize economic and production efficiency of dairy rations.

Objectives:

1. Determine yield and forage quality differences among three BMR (bm1 and bm3) and two non-BMR hybrids grown at two locations in NNY.

2. Evaluate overall forage quality differences among hybrids, including indigestible or undigested fiber measures (uNDF).

Methods:

A 14-acre tile-drained research field at Miner Institute in 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. All hybrids at Miner Institute were at planted at 34,000 seeds/acre with a 30-inch row spacing. Hybrids at Adirondack Farms were planted between 5/9 and 5/211/16 with populations between 33,500 to 36,070 (Table 1) and each hybrid was planted to a single field without replication. Replicated strips at Miner were 6-rows wide and approximately 500 feet long arranged in a randomized complete block design.

Table 1. Hybrids and planting information for Miner Institute, Chazy, NY, and Adirondack Farms, Peru, NY, 2016.

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 PO238XR (bm1)	Pioneer PO533AM1 (non-BMR)	Mycogen TMF2Q419 (non-BMR)
Planting date	5/12/16	5/12/16	5/12/16	5/12/16	5/12/16
Population	34,000	34,000	34,000	34,000	34,000
Harvest date	9/20/16	9/20/16	9/20/16	9/20/16	9/20/16
	----------Adirondack Farms----------				
Hybrid	Mycogen-F2F379	Mycogen-F2F499	Pioneer-PO238XR	Pioneer PO533AM1	Mycogen TMF2Q419
Planting date	5/21/16	5/11/16	5/9/16	5/10/16	Not planted
Population	34,100	33,500	36,070	35,950	-
Harvest date	-	-	-	-	-

At planting, 100 lb/ac of 23-12-18 was applied and 80 lb/ac of N was sidedressed to strips in late June. The Adapt-N model was used in combination with soil and crop records to estimate economically optimum sidedress N rate assuming a yield goal of 20 tons/ac.

All plots at Miner Institute were harvested on 9/20/16 by chopping individual strips into dump trucks and weighing on truck scales. A composite sample was taken from each load and two vacuum-sealed bags (FoodSaver) were filled and stored at room temperature for 0, 30, 60, 90, and 120 days. Samples from Adirondack and Miner Institute were analyzed for the following:

- pH (Miner)
- Percent dry matter (DM)

- Starch, 7-hr starch digestibility (StarchD), crude protein (CP), soluble protein (SP), total dissolved nutrients (TDN), acid detergent fiber (ADF), lignin, non-structural carbohydrates (NSC), and ash content (CVAS).
- NIR analyses (CVAS): Amylase NDF (aNDFNIR), 30-hr fiber digestibility (aNDFd30), and undigested NDF at 30-, 120- and 240-hr calibrated for ash corrected basis (uNDF30NIR, uNDF120NIR, and uNDF240NIR).
- *In vitro* analyses (Miner Institute): Ash-corrected amylase NDF (aNDFom), 30-hr ash corrected amylase NDF digestibility (aNDFd30om), and undigested NDF for fresh chop and at 120 days of ensiling for 30-, 120- and 240-hr time points (uNDF30om, uNDF120om, uNDF240om) using the Tilley-Terry rumen fermentation system.
- Kernel processing score (CSPS) for fresh chop samples (CVAS)
- Lactic acid, acetic acid, ammonia-N, and percent dry matter recovery were also measured for 30, 60, 90, and 120-day fermentation samples.

Statistical analysis was performed with the Statistical Analysis System (version 9.2) using the generalized linear mixed modeling procedure (PROC GLIMMIX) to conduct analysis variance and determine treatment effects. Hybrid (and time for some analyses) was considered a fixed effect and block was treated as a random effect. Linear regression was used to compare uNDF measures between NIR- and Tilley-Terry based methods. Significance was declared at $P \leq 0.05$ and tendency at $0.10 \geq P > 0.05$. Hybrids grown at Adirondack Farms were planted to individual fields without replication and therefore only means and standard errors were calculated.

Results and Discussion:

Fresh Chop Samples

- DM at harvest ranged from 35.1 to 38.7% at Miner and from 38.4 to 44.3% at Adirondack (Tables 2, A1).

- Yields ranged from 19.0 to 22.2 tons/acre (35% DM) for the Miner trial, with no consistent difference in yield between BMR and non-BMR hybrids (Tables 2, A1).

- Starch content ranged from 34.7 to 40% at Miner and from 34.0 to 39.3 % at Adirondack. At Miner, hybrid 4 had significantly greater starch than BMR hybrids, whereas a bm3 (F2F379) had the highest starch for hybrids grown at Adirondack.

- StarchD for hybrid 5 (63.8%) was significantly greater than all other hybrids, whereas differences in starchD for hybrids at Adirondack were minimal (range = 56.0 to 59.9%).

- There were relatively minor differences in CP, SP, TDN, and ADF for hybrids grown at Miner, with larger differences for hybrids grown at Adirondack. This is partly due to different growing environments.

- bm3 hybrids had significantly greater aNDFd30 than bm1 and non-BMR at Miner, whereas BMR hybrids had similar aNDFd30 at Adirondack.

- BMR had significantly lower uNDF30NIR than non-BMR hybrids at Miner, with no difference between bm1 and bm3; uNDF30NIR was also similar for BMR hybrids at Adirondack and substantially lower than the non-BMR hybrid.

- uNDF120NIR and uNDF240NIR were also significantly lower for BMR hybrids grown at Miner and lower for BMR hybrids at Adirondack.

- Lignin content was significantly lower for bm3 hybrids compared to bm1 and non-BMR hybrids at Miner. Lignin content for BMR at Adirondack was lower than non-BMR.

Table 2. Fresh chop corn forage quality measures for hybrids grown at Miner Institute,Chazy, NY, 2016.

Variable	Hybrid 1	Hybrid 2	Hybrid 3	Hybrid 4	Hybrid 5	SEM†	*P*
Yield (ton/ac 35% DM)	19.0a††	22.0b	20.9ab	19.8ab	22.2cb	0.94	0.070
DM (%)	36.9a	33.5b	35.1c	38.7d	36.3ae	0.41	<.0001
Starch (%DM)	34.7a	34.7a	38.5ab	40.0cb	37.2abc	1.3	0.040
StarchD (% of starch)	57.2a	56.0a	59.3a	56.2a	63.8b	1.0	0.0001
CP (%DM)	7.6a	7.5a	8.3b	7.7a	7.8a	0.18	0.036
SP (% of CP)	21.8	24.1	21.3	26.6	25.0	1.9	0.304
TDN (%DM)	75.7	75.4	75.5	76.0	74.5	0.77	0.690
ADF (%DM)	20.5	19.8	19.6	19.9	21.6	0.71	0.278
aNDFNIR (%DM)	36.4	34.8	33.5	34.0	36.4	1.1	0.211
aNDFd30 (% of NDF)	62.2a	62.4a	58.7b	53.9c	54.1c	0.60	<.0001
uNDF30NIR (%DM)	13.9a	13.3a	14.1a	15.9b	17.1b	0.57	0.001
uNDF120NIR (%DM)	9.4ab	8.9a	10.1b	12.2c	13.8c	0.62	<.0001
uNDF240NIR (%DM)	8.0a	7.5a	8.9a	11.1b	12.6b	0.64	<.0001
Lignin (%DM)	1.8a	1.7a	2.2b	2.3b	2.7c	0.14	<.0001
NSC (%DM)	36.4a	37.0a	40.6b	41.5bc	38.6ab	1.3	0.060
Ash (%DM)	4.1	4.9	4.6	3.5	4.0	0.56	0.203
pH	5.08a	5.08a	5.18a	5.15a	5.30b	0.04	0.004
CSPS (%)	41.8	44.3	43.3	50.3	42.3	3.4	0.267

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

- CSPS for hybrids at Miner were less than average scores, with no significant differences. CSPS for hybrids at Adirondack were average to optimal with relatively small differences among hybrids.
- bm1 had significantly less uNDF240om than bm3 and non-BMR hybrids and a higher proportion of fast-pool NDF at 120 days of fermentation (Table 3).

The lack of a consistent difference in yield between BMR and non-BMR hybrids is an important result. Last year's findings (2015) also showed no significant difference in yield between BMR and non-BMR hybrids grown at Miner. Brown midrib hybrids are often characterized by the industry as having lower yield potential compared to non-BMR,

however, our data suggest that BMR can have similar yield potential under the same field conditions.

Table 3. uNDF240om, fast/slow NDF, and degradation rates (Kd) at 120 days of fermentation, Bmr/non-BMR corn silage trials, NNY, 2016,

Variable	Hybrid 1	Hybrid 2	Hybrid 3	Hybrid 4	Hybrid 5	SEM†	*P*
uNDF240om (% NDF)	22.8a	22.8a	32.7b	34.3b	35.7b	0.46	<.0001
Slow pool NDF (% NDF)	17.0	12.8	15.4	17.4	14.4	1.8	0.453
Fast pool NDF (% NDF)	60.3a	64.5a	51.9b	48.4b	49.9b	1.8	0.0001
Kd1 (%/hr)	8.4	7.9	9.8	7.9	8.0	0.54	0.115
Kd2 (%/hr)	1.9	2.0	1.8	1.8	2.0	0.15	0.889

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

Starch content was lower for bm3 hybrids grown at Miner, however, fiber digestibility as measured by aNDFd30 and uNDF was substantially greater, equating to approximately 4 lb of milk/cow/day more than non-BMR hybrids (i.e., assuming 0.5 lb milk/cow/day for every one percentage-unit increase in aNDFd30; Oba and Allen, 2000).

Another interesting result is the lower lignin content of the two bm3 hybrids and higher aNDFd30 compared to bm1. The bm3 hybrids also had significantly lower uNDF240om and more fast-pool NDF compared to bm1 (Table 3). While differences between bm1 and bm3 were not apparent at Adirondack, all hybrids were replicated and grown in the same field at Miner, providing a more uniform growing environment and greater opportunity to measure genetic variation among hybrids.

Differences in yield, starch, and fiber digestibility have important implications for dairy ration formulation and farm economics. Our results show clear differences in fiber quality related to hybrid genetics.

Forage Quality at Different Fermentation Time Points
With the exception of digestible starch (starchD), soluble protein (SP), and pH, there were relatively minor differences in forage quality with increasing fermentation time (Appendix: Tables A1-A6). Fiber digestibility, lignin, and undigested fiber trends among hybrids were similar to fresh chop results (Tables A1-A6). StarchD increased with time of fermentation and peaked at 90 to 120 days of fermentation. At 120 days of fermentation, hybrid 5 had significantly higher starchD (76.9%) than bm3, but was not higher than bm1 (Table A5). For Adirondack samples, starchD for hybrid 4 (non-BMR) at 90 days of fermentation was >10%-units higher than bm3 hybrids.

Differences in starchD trends between sites suggest that growing environment influenced starch degradability. Soluble protein also peaked at 120 days of fermentation. A decrease in pH occurs with fermentation as organic acids are produced, increasing starch and soluble protein degradability.

While trends among hybrids were similar for fresh chop and later fermentation time points with respect to fiber quality, there was evidence of fiber quality changes between fresh chop and 120 days of fermentation. There was no difference in aNDFNIR, however, aNDFom was significantly lower at 120 days of fermentation compared to fresh chop (Table A7). This may suggest fiber was altered during fermentation. Furthermore, uNDF120om and uNDF240om were significantly greater at 120 days of fermentation for each hybrid. Results for uNDF120NIR and uNDF240NIR showed a similar trend, with the exception of uNDF240NIR for hybrid 5. **Collectively, results suggest an overall decrease in fiber digestibility after 120 days of fermentation compared to fresh chop samples.**

Comparison of uNDF measured by Tilley-Terry and NIR Methods

The Tilley-Terry procedure for measuring uNDF is considered the standard method, however, many commercial laboratories use NIR equations to predict uNDF. Therefore, it is important to better understand how Tilley-Terry and NIR-based measures compare. We used fresh chop and 120 day fermentation samples from Miner and Adirondack Farms to determine relative agreement between the two methods with respect to uNDF.

Results showed that there was a poor relationship ($R^2 = 0.12$) between aNDFNIR and aNDFom (Fig. A1). There was a strong relationship ($R^2 = 0.67$) between uNDF30NIR and uNDF30om, uNDF120om and uNDF120NIR ($R^2 = 0.59$), and between uNDF240NIR and uNDF240om ($R^2 = 0.62$). While NIR-based estimates of uNDF did not accurately predict wet chemistry uNDF values, they provided relatively consistent estimates and ranked hybrids similarly.

Use of NIR in commercial laboratories requires seasonal calibrations to the "new" corn crop each season, which has not yet undergone fermentation. Differences between fresh chop and fermented samples can introduce additional error into NIR-based estimates of uNDF. Notwithstanding, NIR-based estimates of uNDF for corn may be sufficient for ranking hybrids assuming uNDFom differences are > 2-3 units of aNDFom, as documented in this trial.

Conclusions/Outcomes/Impacts:

Our results showed large differences in silage quality among bm3, bm1, and non-BMR hybrids. There was not a consistent difference in yield between BMR and non-BMR hybrids, however, BMR hybrids had a distinct advantage in fiber digestibility and therefore milk production potential.

In general, bm3 hybrids had significantly greater fiber digestibility over bm1 for fresh chop and fermented samples, however, bm3 and non-BMR hybrids had greater total starch content for hybrids grown at Miner Institute.

In general, bm3 hybrids had significantly lower lignin content, lower uNDF, and higher NDF digestibility compared to bm1 and the non-BMR hybrids at both growing locations. Rumen fill and dry matter intake are affected by uNDF of forages, with higher uNDF resulting in lower intake and milk potential.

Starch digestibility and soluble protein increased with fermentation time, with few consistent differences among hybrids. There were significant differences in uNDF between fresh chop and 120-day fermentation samples, suggesting a possible decrease in fiber digestibility at 120 days of ensiling compared to fresh chop. Our results show hybrid differences in NDFd and uNDFom profiles have trended similarly for two growing seasons, highlighting the importance of hybrid selection on dairy farms in Northern NY.

Outreach:

A manuscript will be prepared after year three of this study for publication. Results from 2015 were shared at the 2016 Corn Congress. A Miner Institute Farm Report article will be written in 2017 summarizing our findings.

Next Steps:

This trial will be repeated in 2017 with the same hybrids at Miner Institute and Adirondack Farms.

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APPENDIX

Table A1. Fresh chop corn forage quality measures at Adirondack Farms, Peru, NY, BMR/non-BMR corn silage project, NNY, 2016.

Variable	Hybrid 1	Hybrid 2	Hybrid 3	Hybrid 4	SEM¶
Yield (35% DM)	21.7	21.2	20.2	23.0	-
DM (%)	44.3	38.4	41.5	39.1	1.0
Starch (%DM)	39.3	35.7	36.5	34.0	1.1
StarchD (% of starch)	59.9	56.0	57.4	58.7	2.0
CP (%DM)	7.3	8.0	9.2	7.4	0.2
SP (% of CP)	21	25.4	25.3	23.7	1.4
TDN (%DM)	75.8	77.0	75.0	73.5	1.0
ADF (%DM)	20.4	19.1	18.8	23.1	0.73
aNDFNIR (%DM)	35.9	34.8	34.4	38.6	0.78
aNDFd30 (% of NDF)	62.2	62.8	62.4	54.0	0.58
uNDF30NIR (%DM)	13.8	13.2	13.1	18.2	0.30
uNDF120NIR (%DM)	9.3	8.8	8.8	15.2	0.41
uNDF240NIR (%DM)	7.9	7.4	7.4	13.9	0.53
Lignin (%DM)	2.0	1.6	1.9	2.7	0.18
NSC (%DM)	40.4	37.9	38.6	35.7	1.0
Ash (%DM)	4.0	3.7	5.3	3.9	0.71
pH	5.60	5.43	5.38	4.89	0.03
CSPS (%)	72.4	72.7	65.9	65.7	1.8

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

Table A2. Forage quality measures after 30 days of fermentation for hybrids grown at Miner Institute, Chazy, NY, BMR/non-BMR corn silage project, NNY, 2016.

Variable	Hybrid 1	Hybrid 2	Hybrid 3	Hybrid 4	Hybrid 5	SEM†	*P*
DM (%)	35.1a††	31.3b	33.7b	37.3c	35.5ab	0.44	<.0001
Starch (%DM)	37.1	36.6	39.1	38.5	36.4	1.0	0.332
StarchD (% of starch)	61.7ab	59.9a	66.2b	62.1ab	66.2b	1.6	0.058
CP (%DM)	7.8ab	7.6a	8.4b	7.6a	7.8ab	0.15	0.021
SP (% of CP)	45.8	47.9	47.3	48.2	47.6	1.1	0.623
TDN (%DM)	75.9ab	76.6a	75.9ab	74.7b	74.8b	0.47	0.053
ADF (%DM)	21.2	20.2	19.7	20.9	22.0	0.65	0.195
aNDFNIR (%DM)	36.2	34.5	32.6	35.1	35.6	0.83	0.086
aNDFd30 (% of NDF)	64.9a	63.2b	61.2c	56.9d	56.4d	0.39	<.0001
uNDF30NIR (%DM)	12.9a	13.0a	13.0a	15.5b	16.0b	0.27	<.0001
uNDF120NIR (%DM)	8.2a	8.5a	9.0b	11.5c	12.0c	0.24	<.0001
uNDF240NIR (%DM)	6.7a	7.2b	7.7c	10.2d	10.6d	0.24	<.0001
Lignin (%DM)	1.9a	1.8b	2.3c	2.6d	2.7d	0.08	<.0001
NSC (%DM)	37.6	37.4	40.1	38.9	36.9	1.0	0.235
Ash (%DM)	4.2	4.3	4.7	4.3	4.2	0.4137	0.210
pH	3.84a	3.80b	3.82c	3.85a	3.90d	0.005	<.0001
Lactic (%DM)	5.1a	5.3a	5.4a	4.4b	5.0a	0.18	0.009
Acetic (%DM)	1.3a	1.3a	1.1a	0.9b	1.3a	0.07	0.005
Ammonia (% of CP)	6.9	6.9	6.9	6.4	6.5	0.26	0.408
Dry matter recovery (%)	94.3a	92.6a	95.3ab	95.5ab	97.0bc	0.75	0.018

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

Table A3. Forage quality measures after 60 days of fermentation for hybrids grown at Miner Institute, Chazy, NY, BMR/non-BMR corn silage project, NNY, 2016.

Variable	Hybrid 1	Hybrid 2	Hybrid 3	Hybrid 4	Hybrid 5	SEM†	*P*
DM (%)	35.2a††	32.1b	34.1c	38.0d	36.3e	0.55	<.0001
Starch (%DM)	37.8a	37.0a	40.8b	40.9b	38.8b	1.1	0.097
StarchD (% of starch)	63.1ab	64.0ab	65.7ab	61.3a	70.7b	3.2	0.206
CP (%DM)	8.3a	8.0a	9.1b	8.0a	8.2a	0.18	0.002
SP (% of CP)	46.5a	47.4ab	48.6ab	47.5ab	50.4b	1.1	0.119
TDN (%DM)	75.6	76.5	76.3	74.4	74.5	0.63	0.100
ADF (%DM)	21.6	20.7	19.6	21.1	21.6	0.57	0.142
aNDFom (%DM)	35.6a	34.9ab	32.1b	34.6ab	34.9ab	0.91	0.082
aNDFd30 (% of NDF)	64.9a	63.9a	59.6b	55.8c	55.8c	0.59	<.0001
uNDF30NIR (%DM)	12.7a	12.8a	13.2a	15.5b	15.7b	0.53	0.001
uNDF120NIR (%DM)	9.2a	9.1a	10.1a	12.4b	11.8b	0.47	<.0001
uNDF240NIR (%DM)	7.8a	7.7a	8.9a	11.2b	10.6b	0.38	<.0001
Lignin (%DM)	2.0a	1.8a	2.4b	2.7b	2.8b	0.16	0.000
NSC (%DM)	38.5	38.0	42.0	41.5	39.5	1.2	0.085
Ash (%DM)	4.3	4.5	4.4	4.4	4.6	0.22	0.896
pH	3.70a	3.69a	3.71a	3.73a	3.78b	0.004	<.0001
Lactic (%DM)	4.8a	5.2b	5.0ab	4.3c	5.0	0.11	0.001
Acetic (%DM)	1.6a	1.6a	1.3a	1.0b	1.3b	0.08	0.001
Ammonia (% of CP)	7.2	6.8	6.8	6.9	7.7	0.25	0.079
Dry matter recovery (%)	94.3a	94.6a	96.3a	96.9b	99.2b	1.1	0.037

†Standard error of the mean; the highest SEM among hybrids is presented

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

Table A4. Forage quality measures after 90 days of fermentation for hybrids grown at Miner Institute, Chazy, NY, BMR/non-BMR corn silage project, NNY, 2016.

Variable	Hybrid 1	Hybrid 2	Hybrid 3	Hybrid 4	Hybrid 5	SEM†	*P*
DM (%)	35.4a††	32.1b	34.7a	37.9c	36.8cd	0.71	0.0001
Starch (%DM)	36.1	35.6	35.6	37.2	34.4	1.20	0.620
StarchD (% of starch)	62.9a	63.8a	62.1a	58.4b	60.5c	0.82	0.001
CP (%DM)	8.3a	8.1a	9.3b	8.3a	8.4a	0.14	0.001
SP (% of CP)	49.6a	49.7a	52.5b	53.5b	55.8bc	0.99	0.001
TDN (%DM)	75.8a	77.3b	75.9ab	74.6a	73.4a	0.48	0.001
ADF (%DM)	21.3	19.7	20.2	21.7	22.3	0.69	0.086
aNDFom (%DM)	36.5a	34.0ab	33.3b	35.8a	36.8a	0.87	0.058
aNDFd30 (% of NDF)	63.0a	61.6a	58.8b	55.3c	54.5c	0.69	<.0001
uNDF30NIR (%DM)	13.7a	13.2a	13.9a	16.2b	17.0b	0.39	<.0001
uNDF120NIR (%DM)	10.0a	9.5a	10.6a	12.8	12.5	0.35	<.0001
uNDF240NIR (%DM)	8.6a	8.2a	9.4b	11.6c	11.2c	0.34	<.0001
Lignin (%DM)	2.1a	1.8a	2.4b	2.8b	3.3c	0.21	<.0001
NSC (%DM)	37.0	36.7	37.0	38.0	35.3	1.30	0.645
Ash (%DM)	3.9	3.8	4.1	3.9	4.3	0.15	0.254
pH	3.69a	3.67a	3.71ab	3.73b	3.77bc	0.009	<.0001
Lactic (%DM)	5.4a	5.2a	5.3a	4.6b	5.6c	0.18	0.031
Acetic (%DM)	1.6	1.3	1.1	1.2	1.6	0.24	0.493
Ammonia (% of CP)	8.0	8.1	8.2	8.4	8.9	0.26	0.205
Dry matter recovery (%)	94.5a	94.3a	97.7ab	96.3ab	100.0b	1.20	0.033

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

Table A5. Forage quality measures after 120 days of fermentation for hybrids grown at Miner Institute, Chazy, NY, BMR/non-BMR corn silage project, NNY, 2016.

Variable	Hybrid 1	Hybrid 2	Hybrid 3	Hybrid 4	Hybrid 5	SEM†	*P*
DM (%)	36.1a††	32.1b	34.9c	38.5d	36.9a	0.46	<.0001
Starch (%DM)	35.6	35.0	39.4	39.3	37.3	1.50	0.204
StarchD (% of starch)	70.0a	69.9a	74.6bc	70.2ab	76.9c	2.10	0.118
CP (%DM)	8.1a	8.3a	8.9b	8.1a	8.2a	0.18	0.026
SP (% of CP)	56.5a	58.3b	59.8cb	58.4b	55.9ab	1.00	0.074
TDN (%DM)	75.8a	76.8a	76.3a	75.6ab	74.4b	0.46	0.027
ADF (%DM)	22.0a	21.3ab	20.0b	21.6ab	22.3a	0.48	0.054
aNDFom (%DM)	36.4	36.0	33.4	35.5	36.3	0.76	0.091
aNDFd30 (% of NDF)	63.5a	62.6a	59.5b	56.0bc	55.3c	0.54	<.0001
uNDF30NIR (%DM)	13.5a	13.9a	13.7a	15.9b	16.4b	0.33	<.0001
uNDF120NIR (%DM)	9.9a	9.9a	10.5a	12.6b	12.4b	0.24	<.0001
uNDF240NIR (%DM)	8.5a	8.4a	9.2b	11.3c	11.1c	0.22	<.0001
Lignin (%DM)	2.0a	1.8a	2.2b	2.3b	2.9c	0.16	0.0001
NSC (%DM)	36.6	36.1	40.8	40.0	38.3	1.50	0.184
Ash (%DM)	4.1	4.1	4.2	3.9	4.2	0.17	0.536
pH	3.71ab	3.69a	3.73b	3.73b	3.79c	0.008	<.0001
Lactic (%DM)	5.3a	5.3a	5.3a	4.4b	5.3a	0.21	0.010
Acetic (%DM)	2.0a	1.9a	1.9a	1.6b	1.6b	0.11	0.002
Ammonia (% of CP)	7.9	7.9	8.1	8.1	8.6	0.31	0.325
Dry matter recovery (%)	96.0ac	94.0ab	98.0bc	97.5abc	99.9cd	0.88	0.006

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

Table A6. Forage quality measures after 90 days of fermentation for Adirondack Farm, Peru, NY, BMR/non-BMR corn silage project, NNY, 2016.

Variable	Hybrid 1	Hybrid 2	Hybrid 3	Hybrid 4	SEM†
DM (%)	43.9	37.2	41.5	38.5	1.0
Starch (%DM)	35.2	34.0	38.4	33.2	1.6
StarchD (% of starch)	54.1	54.3	63.3	65.4	2.3
CP (%DM)	7.9	8.5	9.5	7.7	0.16
SP (% of CP)	46.1	47.6	47.0	46.9	1.3
TDN (%DM)	75.6	77.4	78.2	73.0	0.60
ADF (%DM)	21.4	19.7	17.6	23.9	1.2
aNDFom (%DM)	37.2	36.0	31.8	40.0	1.4
aNDFd30 (% of NDF)	63.5	63.2	61.8	55.4	0.61
uNDF30NIR (%DM)	13.8	13.4	12.4	18.1	0.5
uNDF120NIR (%DM)	9.6	9.4	9.0	13.7	0.34
uNDF240NIR (%DM)	8.1	8.0	7.7	12.3	0.34
Lignin (%DM)	2.1	1.8	1.8	3.0	0.21
NSC (%DM)	36.3	35.2	39.9	34.2	1.6
Ash (%DM)	3.6	3.4	3.4	3.5	0.21
pH	3.74	3.47	3.59	3.60	0.01
Lactic (%DM)	5.9	7.0	5.9	5.8	0.32
Acetic (%DM)	1.3	1.5	1.2	1.1	0.12
Ammonia (% of CP)	6.5	5.7	5.9	5.5	0.38
Dry matter recovery (%)	98.2	95.5	98.5	96.3	1.6

†Standard error of the mean; the highest SEM among hybrids is presented

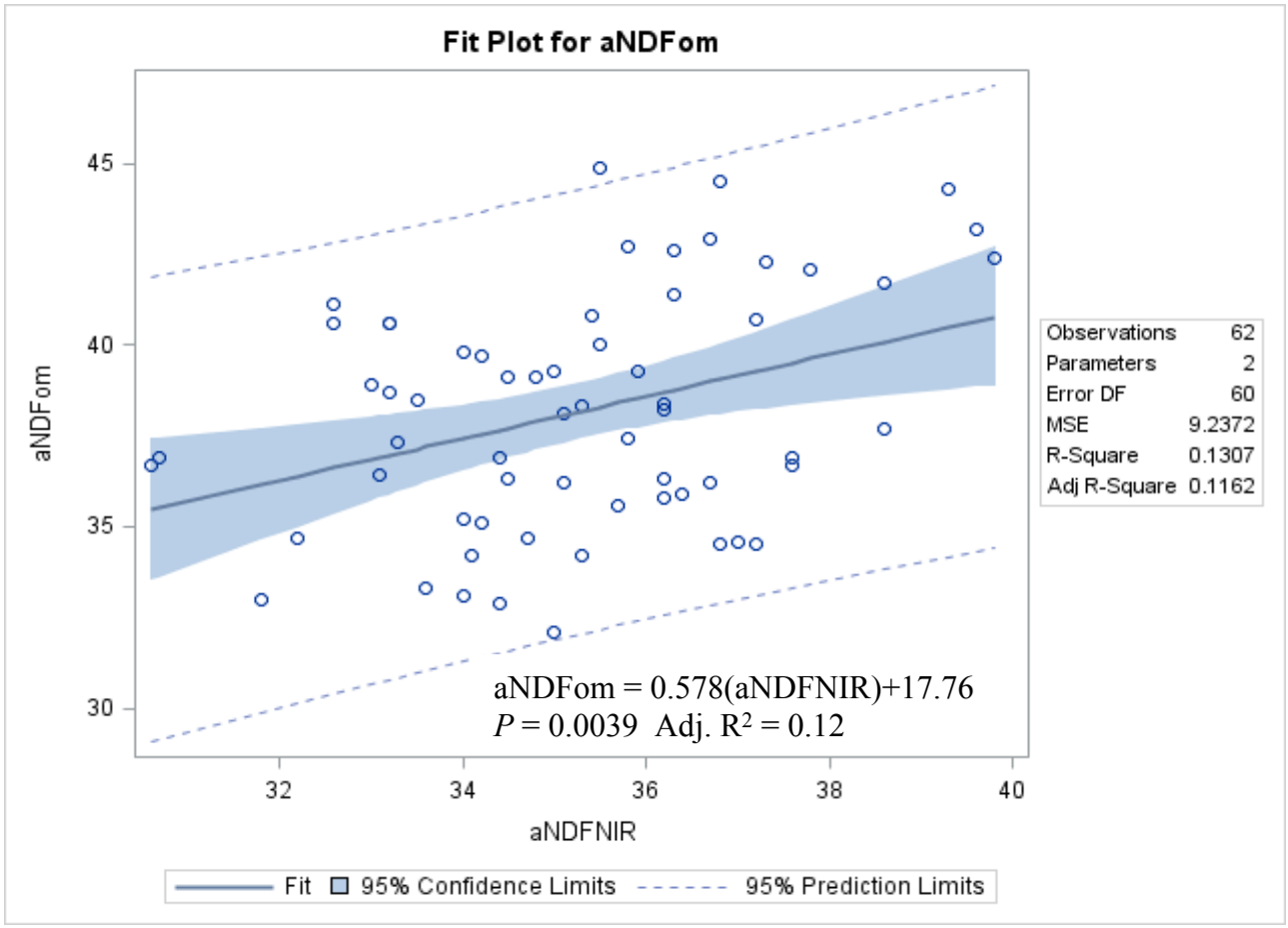

Figure A1. Linear regression between aNDFom and aNDFNIR for fresh chop and at 120 days of fermentation for Miner Institute, Chazy, NY, and Adirondack Farms, Peru, NY, corn silage samples, BMR/non-BMR corn silage project, NNY, 2016.

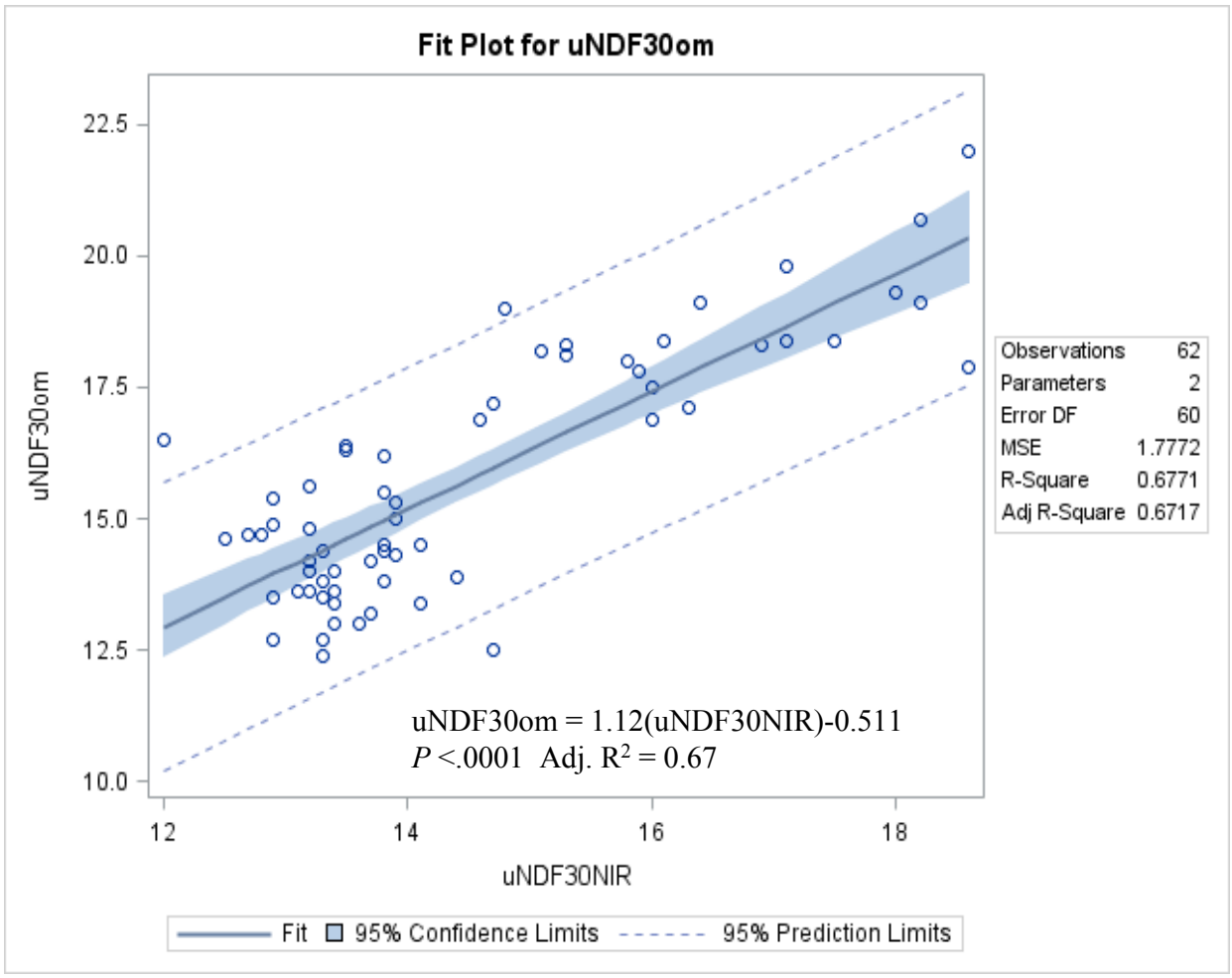

Figure A2. Linear regression between uNDF30om and uNDF30NIR for fresh chop and at 120 days of fermentation for Miner Institute, Chazy, NY, and Adirondack Farms, Peru, NY, samples, BMR/non-BMR corn silage project, NNY, 2016.

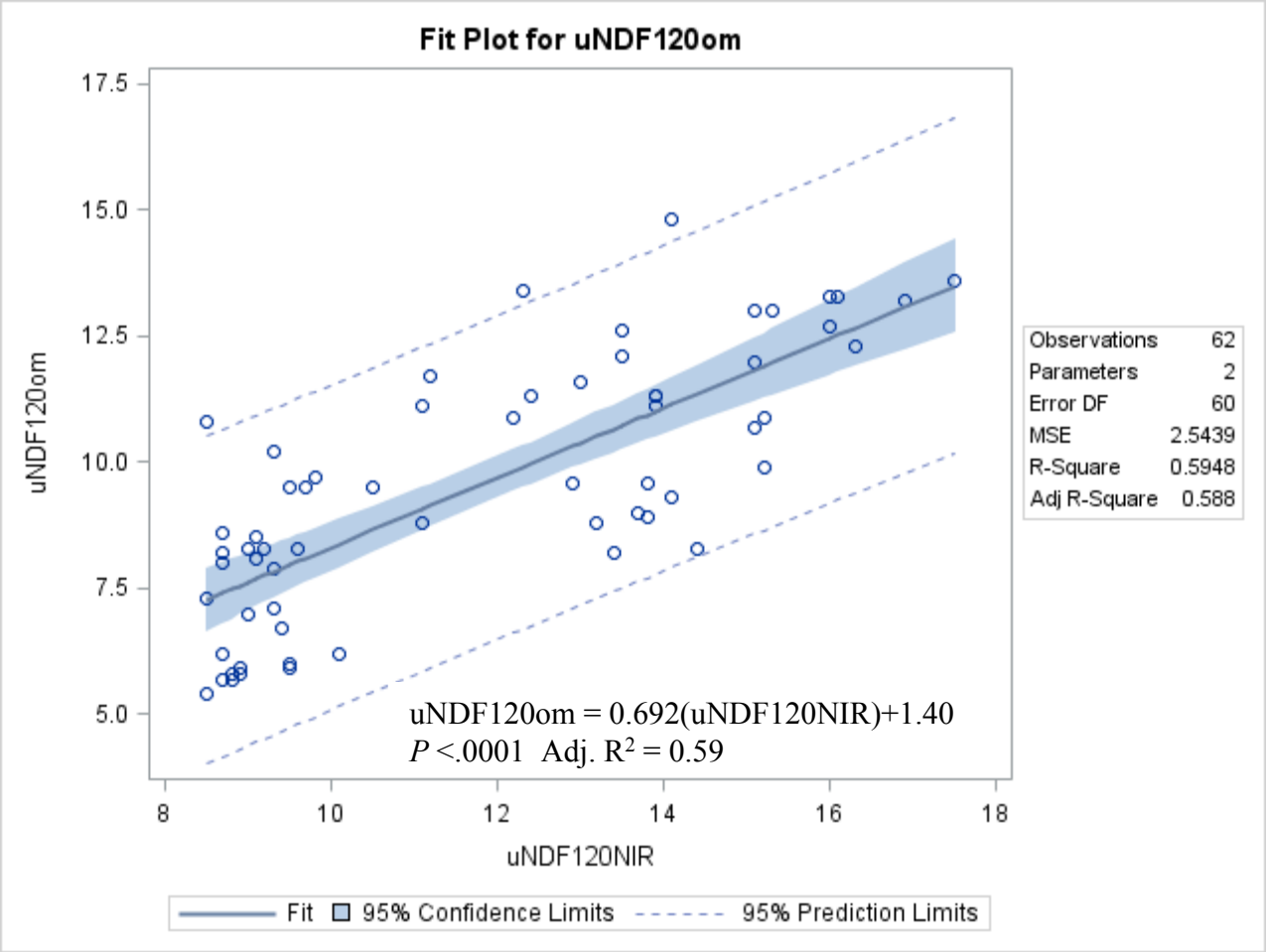

Figure A3. Linear regression between uNDF120om and uNDF120NIR for fresh chop and at 120 days of fermentation for Miner Institute and Adirondack Farms samples, BMR/non-BMR corn silage project, NNY, 2016.

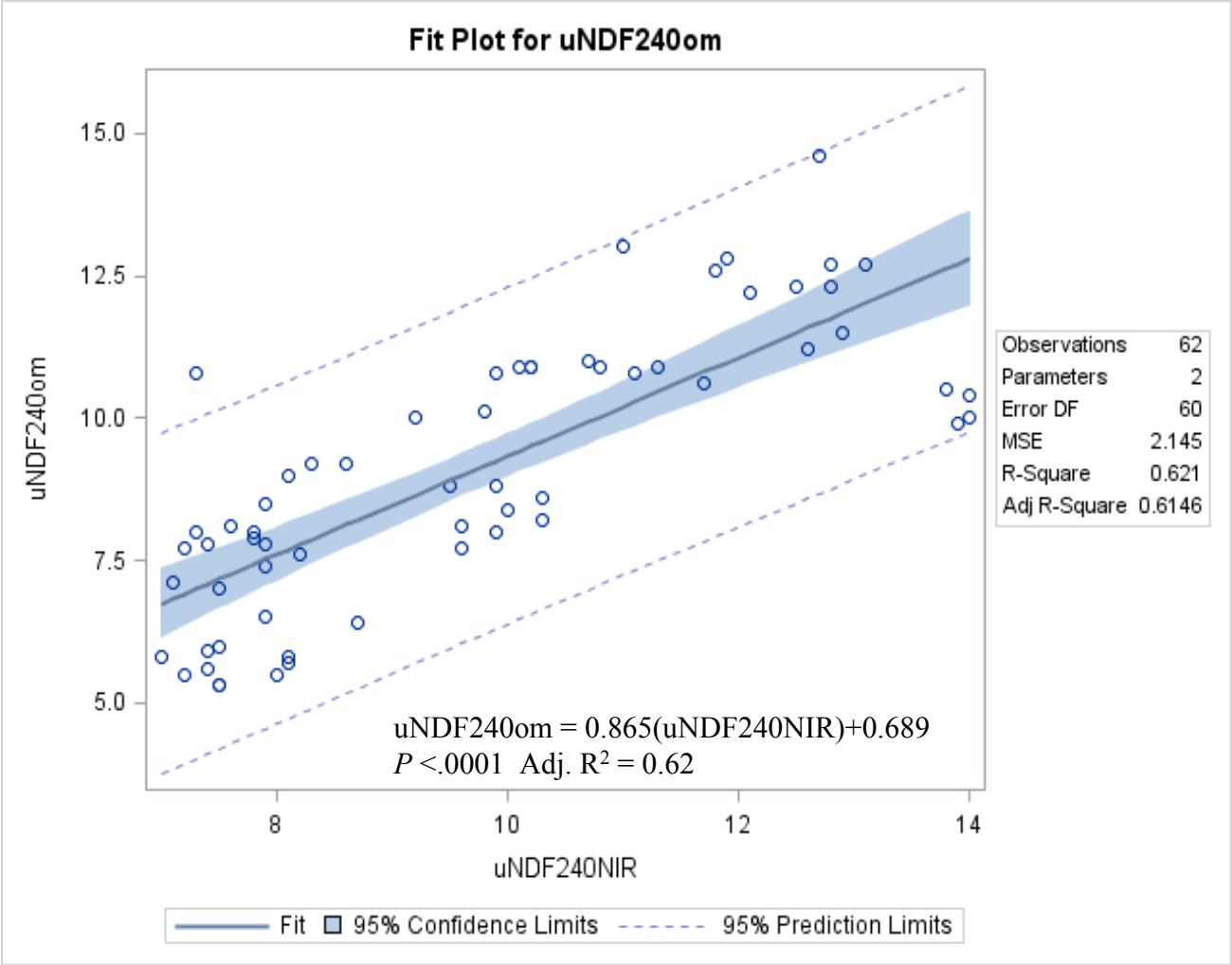

Figure A4. Linear regression between uNDF240om and uNDF240NIR for fresh chop and at 120 days of fermentation for Miner Institute and Adirondack Farms samples, Miner Institute, Chazy, NY, BMR/non-BMR corn silage project, NNY, 2016.