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2011
Brown Mid-Rib
Corn Variety Trial

Dr. Heather Darby, UVM Extension Agronomist
Hannah Harwood, Erica Cummings, Rosalie Madden, Amanda Gervais, and Susan Monahan
UVM Extension Crop & Soil Technicians

University of Vermont Extension
(802) 524-6501

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The UNIVERSITY of VERMONT EXTENSION

2011 Vermont Brown Mid-Rib Corn Variety Trial

Heather Darby, University of Vermont Extension
heather.darby[at]uvm.edu

Brown mid-rib (BMR) corn has a lower lignin content than other silage corn varieties, and many growers are interested in this type of corn for its higher digestibility and potential to yield more milk than conventional silage corn. With BMR's high fiber digestibility it may help increase dry matter intake of forage and may reduce purchase of concentrates. In 2011, the University of Vermont Extension conducted a research trial to evaluate the yield and quality of ten BMR varieties. While the information presented can begin to describe the yield and quality performance of BMR corn varieties in this region, it is important to note that the data represents results from only one season and one location. Compare other hybrid performance data before making varietal selections.

MATERIALS AND METHODS

The BMR corn silage variety trial was conducted at Borderview Farm in Alburgh, Vermont. The soil was a Benson rocky silt loam, and the previous crop was corn. The experimental design was a randomized block with three replications. The plot size was 5' x 50'. The seedbed was prepared with spring plowing and harrowing and finished with a spike-toothed harrow. The corn was planted on May 25 at a rate of 34,000 seeds per acre with a John Deere 1750 four-row corn planter. A 10-20-20 starter fertilizer was applied at 260 lbs per acre, and additional fertilizer (ammonium sulfate) was applied as a sidedress at 99 lbs of actual N per acre. On June 15, Lumax® (S-Metolachlor, Atrazine, and Mesotrione) was applied at a rate of 2 quarts per acre. Trial agronomic information is summarized in Table 1.

Table 1. Agronomic information for the 2011 BMR Variety Trial at Borderview Farm.

Location	Borderview Farm – Alburgh, VT
Soil type	Rocky Benson silt loam
Previous crop	Corn
Tillage operations	Spring plow, harrow, spike-toothed harrow
Plot size (ft.)	5' x 50'
Replicates	3
Seeding rate	34,000 seeds ac^{-1}
Row width (in.)	30
Planting date	25-May
Starter fertilizer	260 lbs ac^{-1} of 10-20-20
Topdress fertilizer	99 lbs N ac^{-1} at V6 stage
Herbicide	15-Jun, Lumax®, 2 qt ac^{-1}
Harvest dates	26-Sep and 7-Oct

The seed for this trial was donated by two participating seed companies, Mycogen and Seedway, LLC, whose contact information is listed in Table 2. Varieties ranged from 90-109 days in relative maturity. Relative Maturity (RM) information was provided by the seed companies. Varities evaluated in the trial, relative maturities and varietal traits are listed in Table 3.

Table 2. Seed companies and area contacts.

Mycogen	Seedway
Claude Fortin District Sales Manager Highgate, Vermont (802) 363-2803	Ed Schillawski 3442 Rte. 22A Shoreham, Vermont (802) 897-2281

Table 3. Relative maturities and genetic traits of BMR varieties.

Company	Variety	Relative maturity	Traits
Mycogen	F2F298	90	BMR, HXI, LL, RR2
Mycogen	F2F383	95	BMR, HXI, LL, RR2
Mycogen	F2F387	95	BMR, HXT, LL, RR2
Mycogen	F2F488	99	BMR, HXT, LL, RR2
Seedway	RST100	100	BMR, CB/LL
Seedway	5555BMR	105	BMR
Mycogen	F2F569	105	BMR, HXT, LL, RR2
Seedway	RST105	105	BMR, CB/LL
Mycogen	F2F622	109	BMR, HXI, LL, RR2
Mycogen	F2F665	109	BMR, HXT, LL, RR2

BMR = Brown mid-rib, a naturally-occurring gene
HXI = Herculex® I Insect Protection, glyphosate (Roundup®, Touchdown®) and glufosinate (Ignite®) herbicide tolerance
LL = Glufosinate-ammonium (LibertyLink®) herbicide tolerance
RR2 = Roundup Ready corn, glyphosate (Roundup®, Touchdown®) herbicide tolerance
HXT = Herculex Xtra®, provides season-long control of a variety of pests, including European corn borer, western bean cutworm, corn rootworm

Plant population was measured just prior to harvest. Plots were harvested on September 26 or October 7, based on hybrid maturity. The target harvest timing was at 60 to 70% whole plant moisture. Due to fall rains several plots were harvested past optimum maturity. The plots were harvested with a John Deere two-row chopper, and whole-plant silage was collected in a forage wagon and weighed on drive-up platform scales. An approximate one-pound subsample was taken and shipped immediately to Cumberland Valley Analytical Services (Hagerstown, Maryland) for quality analysis.

Silage quality was analyzed using wet chemistry techniques. Plot subsamples were dried, ground and analyzed for crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF), 30-hour digestible NDF (dNDF), and starch content. Mixtures of true proteins, composed of amino acids, and nonprotein nitrogen make up the CP content of forages. The CP content of forages is determined by measuring the amount of nitrogen and multiplying by 6.25. The bulky characteristics of forage come from fiber. Forage feeding values are negatively associated with fiber since the less digestible portions of plants are contained in the fiber fraction. The detergent fiber analysis system separates forages into two parts: cell contents, which include sugars, starches, proteins, non-protein nitrogen, fats and other highly digestible compounds; and the less digestible components found in the fiber fraction. The total fiber content of forage is contained in the neutral detergent fiber (NDF). Chemically, this fraction includes cellulose, hemicellulose, and lignin. Because of these chemical components and their association with the bulkiness of feeds, NDF is closely related to feed intake and rumen fill in cows. Recently, forage testing laboratories have begun to evaluate forages for NDF digestibility. Evaluation of forages and other feedstuffs for NDF digestibility is being conducted to aid prediction of feed energy content and animal performance. Research has demonstrated that lactating dairy cows will eat more dry matter and produce more milk when fed forages with optimum NDF digestibility. Forages with increased NDF digestibility (dNDF) will result in higher energy values, and perhaps more importantly, increased forage intakes. Forage NDF digestibility can range from 20 – 80%.

The silage performance indices of milk per acre and milk per ton were calculated using a model derived from the spreadsheet entitled, "MILK2007" developed by researchers at the University of Wisconsin. Milk per ton measures the pounds of milk that could be produced from a ton of silage. This value is generated by approximating a balanced ration meeting animal energy, protein, and fiber needs based on silage quality. The value is based on a standard cow weight and level of milk production. Milk per acre is calculated by multiplying the milk per ton value by silage dry matter yield. Therefore milk per ton is an overall indicator of forage quality and milk per acre an indicator of forage yield and quality. Milk per ton and milk per acre calculations provide relative rankings of forage samples, but should not be considered as predictive of actual milk responses in specific situations for the following reasons:

1) Equations and calculations are simplified to reduce inputs for ease of use,
2) Farm-to-farm differences exist,
3) Genetic, dietary, and environmental differences affecting feed utilization are not considered.

Variations in yield and quality can occur because of variations in genetics, soil, weather, and other growing conditions. Statistical analysis makes it possible to determine whether a difference among treatments is real or whether it might have occurred due to other variations in the field. All data was analyzed using a mixed model analysis where replicates were considered random effects. At the bottom of each table a LSD value is presented for each variable (e.g. yield). Least Significant Differences (LSD's) at the 10% level (0.10) of probability are shown. Where the difference between two treatments within a column is equal to or greater than the LSD value at the bottom of the column, you can be sure in 9 out of 10 chances that there is a real difference between the two values. Treatments that were not significantly different than the top performing hybrid in a particular column are indicated with an asterisk.

In the example at right, hybrid A is significantly different from hybrid C but not from hybrid B. The difference between A and B is equal to 1.5, which is less than the LSD value of 2.0. This means that these two hybrids did not differ in yield. The difference between A and C is equal to 3.0, which is greater than the LSD value of 2.0. This means that the yields of these two hybrids were significantly different from one another.

Hybrid	Yield
A	**9.0***
B	7.5*
C	6.0
LSD (0.10)	2.0

RESULTS

The 2011 weather data is presented in Table 3. This season included an unusually wet spring, dry midsummer, and wet fall. Many growers postponed spring planting because of high rainfall and saturated soil conditions. Overall, the growing season was warmer than normal, but there were 13.7 inches of precipitation above the 30 year average. The accumulated Growing Degree Days (GDDs) for the season were 2790 and was 398 more GDDs than the 30-year average. GDDs were reported for corn based on 50° to 86°F temperatures.

Table 3. Summarized temperature, precipitation, and GDD information, Alburgh, VT, 2011.

South Hero, VT (Alburgh)	May	June	July	August	September	October
Average Temperature (°F)±	58.7	67.1	74.4	70.4	63.8	51.5
Departure from Normal	2.10	1.30	3.30	1.60	5.80	4.50
Precipitation (inches)*	8.67	3.52	3.68	10.2	5.56	2.68
Departure from Normal	5.35	0.09	-0.29	6.38	2.10	0.10
Growing Degree Days (base 50°F)	260	513	732	563	392	330
Departure from Normal	-0.9	39.0	79.5	-27.0	79.5	228

± Average temperatures for August-October is taken from Burlington, VT.
* Precipitation for May-July is taken from Burlington, VT.
Based on National Weather Service data from cooperative observation stations in South Hero, VT. Historical averages are for 30 years of data (1971-2000).

The plant populations at harvest did not differ by variety (Table 4). Surprisingly, despite a wet spring and non-ideal soil conditions, the average emergence rate for corn was 88% in the BMR trial. The average dry matter at the time of harvest was 37.5%, with the driest variety being RST105 (Seedway). There was no significant difference in moisture levels across variety.

Dry matter yields were calculated and then adjusted to 35% dry matter to evaluate yield across varieties. The BMR varieties differed significantly in yield. Mycogen F2F622 yielded the highest (24.1 tons ac^{-1}), significantly higher than all other varieties (Table 4; Figure 1). The mean yield for the trial was 18.6 tons ac^{-1}. This average yield was similar to other conventional corn trial mean yields for 2011.

Table 4. Impact of variety on selected yield and quality characteristics of BMR corn, Alburgh, VT, 2011.

Variety	Harvest date	Population	Yield at 35% DM	DM at harvest	Forage quality characteristics						Milk per	
					CP	ADF	NDF	dNDF	Starch	NEL	ton	acre
		plants/ac	tons/ac	%	%	%	%	%	%	Mcal/lb	lbs	lbs
5555BMR	9-Sep	29200	16.3	35.3	7.9	22.4	38.9*	71.6*	33.7	0.78	**3690***	21100
F2F298	9-Sep	30490	15.9	37.6	7.5	22.0	37.9*	69.8	36.4	0.78	3530	19700
F2F383	9-Sep	30550	18.9	35.5	8.0	22.6	38.2*	72.8*	34.6	0.78	**3690***	24400
F2F387	9-Sep	**33050**	19.4	35.4	8.1	24.5	42.5	71.3*	32.1	0.76	3630*	24700
F2F488	9-Sep	31100	16.1	36.0	**8.4**	21.5	**36.0***	69.9	35.5	**0.79**	3610*	20400
F2F569	7-Oct	29040	19.1	39.7	8.0	23.6	39.4*	68.4	35.2	0.78	3370	22500
F2F622	7-Oct	31800	**24.1***	37.7	8.0	25.1	43.0	66.6	33.0	0.76	3440	**29100**
F2F665	7-Oct	30550	20.4	37.4	8.3	24.3	41.4	66.9	34.1	0.77	3520	25200
RST100	9-Sep	28800	16.6	37.7	8.2	21.9	37.8*	**73.3***	34.5	0.78	3640*	21100
RST105	7-Oct	26200	19.2	**42.1***	7.5	**21.1**	36.6*	68.3	**37.5**	**0.79**	3310	22200
LSD (0.10)		NS	3.6	2.0	NS	NS	4.0	2.4	NS	NS	140	NS
Trial Mean		30100	18.6	37.5	8.0	22.9	39.2	69.9	34.7	0.78	3540	23040

Treatments indicated in bold are the top performers.

* Treatments indicated with an asterisk did not perform significantly lower than the top-performing treatment in a particular column.

NS – No significant difference was found among treatments.

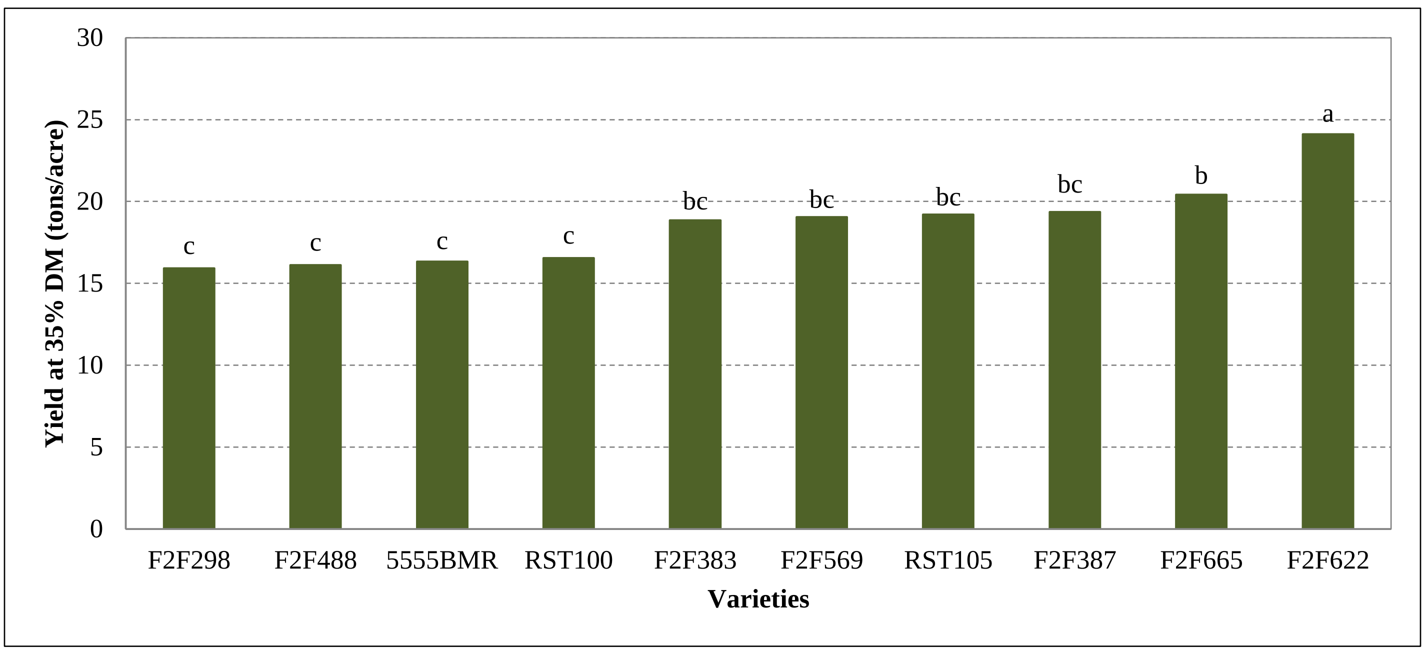

Figure 1. Corn silage yields of ten BMR corn varieties. Treatments with the same letter did not differ significantly (p=0.10).

There was no significant difference in CP, ADF and starch concentrations between the BMR varieties. However there was a significant difference in NDF and dNDF concentration among varieties (Figure 2). The variety F2F488 had the lowest NDF (36.0%), but this was not significantly lower than the NDF of RST105, RST100, F2F298, F2F383, 5555BMR, or F2F569. Digestible NDF (dNDF), a measure of the amount of NDF that is digestible over a 30-hour time period, was highest in the variety RST100 (73.3%), but not statistically greater than the dNDF concentration in F2F383, 5555BMR, or F2F387. Figure 3 illustrates dNDF values as they relate to milk per ton; in general, as dNDF increases, milk production per ton increases.

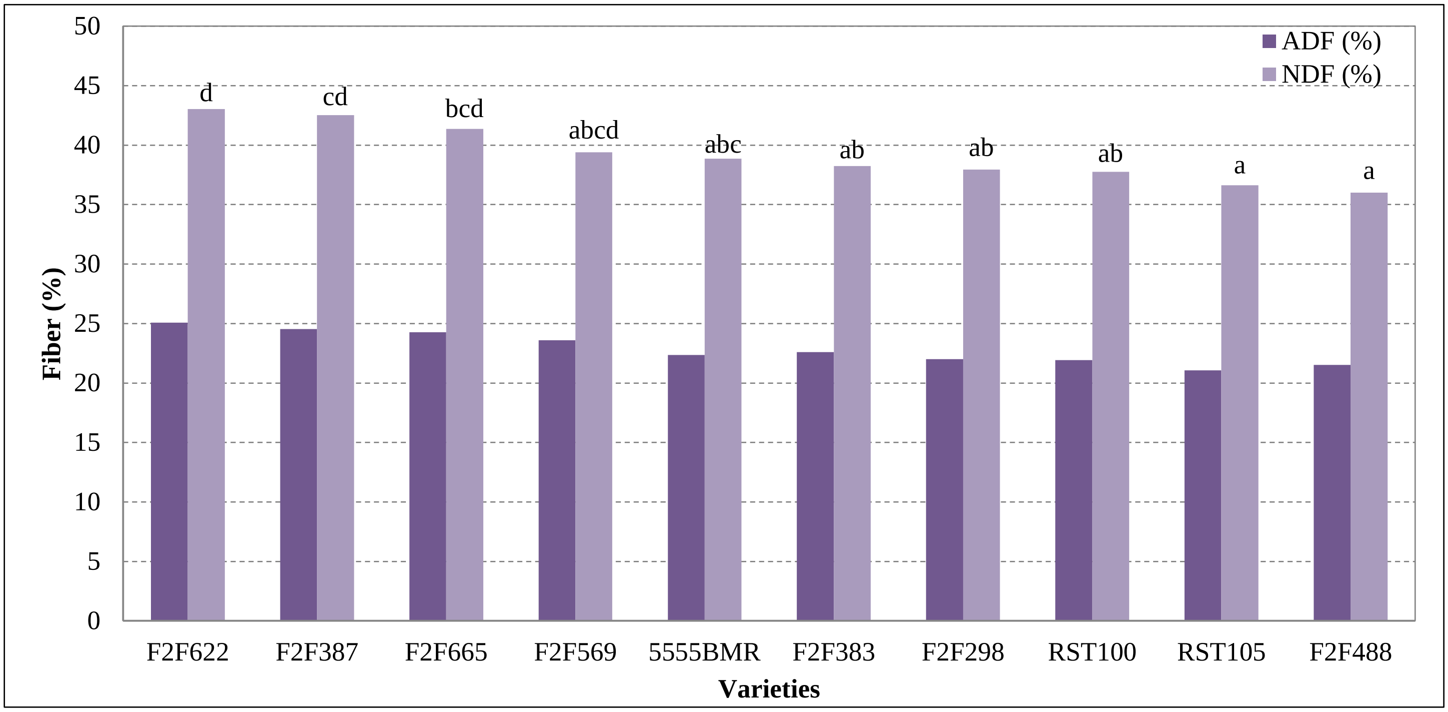

Figure 2. ADF and NDF concentrations of ten BMR corn varieties. Treatments with the same letter did not differ significantly (p=0.10).

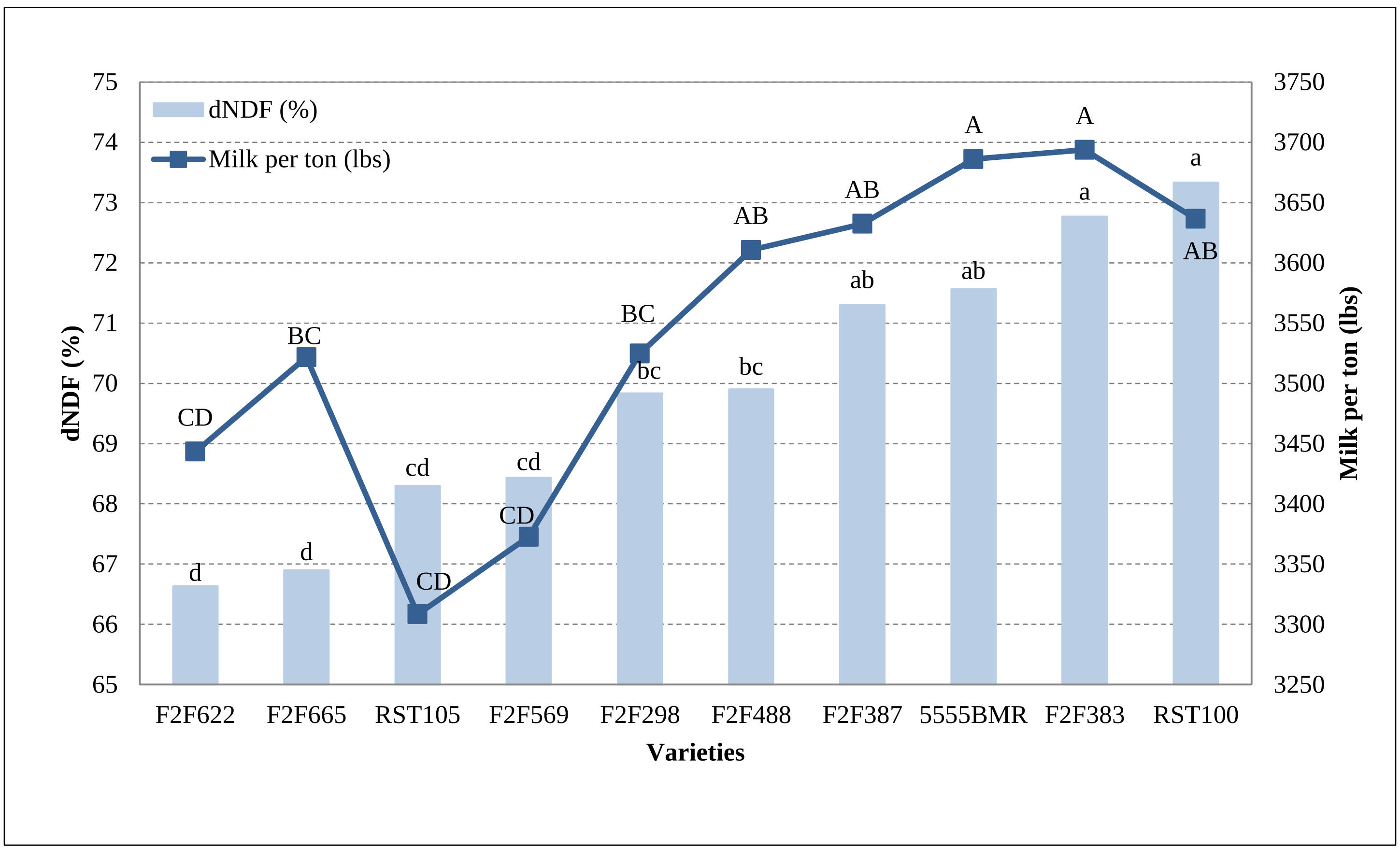

Figure 3. Digestible NDF and milk per ton by variety. Treatments with the same letter did not differ significantly (p=0.10; compare lower-case letters for dNDF and capital letters for milk per ton).

Milk per ton, an indicator of silage quality, was highest in the varieties F2F383 and 5555BMR. This was not significantly higher than RST100, F2F387, or F2F488. There was no significant difference in milk per acre, which indicates both silage quality and yield.

DISCUSSION

BMR corn is known for being of exceptionally high digestible fiber due to its low lignin levels. BMR is often also noted as yielding below conventional hybrids. This trial was initiated to compare BMR varieties against each other versus lumping them within a study composed primarily of conventional hybrids.

For some BMR varieties there were exceptional yields. For example, F2F622 had the highest yield (24.1 tons $^{-1}$). Because milk per acre is an indicator of yield, as well as quality, it is logical that F2F622, with its highest yield, also had the highest milk per acre (29100 lbs), though not statistically different from other varieties. The average yield for the 2011 BMR trial was 18.6 tons per acre, slightly lower than the 2010 BMR variety trial (23.0 tons ac^{-1}). This may be due to the cool, wet soil conditions of the spring or late summer rainfalls.

Varieties differed in overall NDF concentration—F2F488 had the highest NDF (36.0%), though not statistically higher than six other BMR varieties. Digestible NDF also varied by variety—RST100 had the highest dNDF (73.3%), while the varieties F2F383, 5555BMR, and F2F387 had statistically similar dNDF concentrations. The digestibility of NDF (dNDF) is related to total milk production, so that as the digestibility of silage corn increases, so does the number of pounds of milk produced per ton.

F2F387 and F2F383 both had above average milk per ton and milk per acre, indicating their top performance in overall milk production as silage corn. It is important to keep in mind, however, that this data represents only one season of data, in only one location. Further research is advised before making varietal selections.

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