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2014

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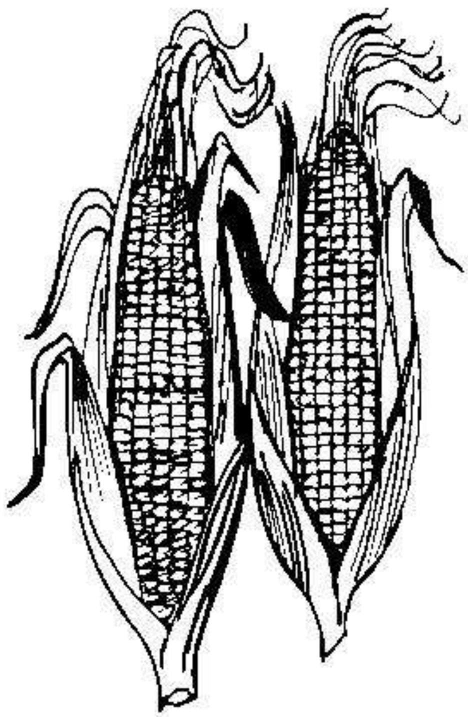

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UNIVERSITY OF VERMONT EXTENSION
CULTIVATING HEALTHY COMMUNITIES

2014 BROWN MID-RIB CORN POPULATION TRIAL

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Brown mid-rib (BMR) corn hybrids are of interest to many growers in the Northeast who would like to maximize milk production on homegrown forage. BMR corn has a naturally-occurring genetic mutation that leads to less lignin in the stalk and makes corn silage more digestible. Corn yields can be highly dependent on population, and it is generally recommended to plant BMR corn at lower populations than conventional silage corn. BMR corn has always been considered to be more prone to lodging due to its lower lignin content, and lower populations allow for less stress on each individual plant. However, optimal populations for the Northeast have yet to be developed. With this in mind, University of Vermont Extension Northwest Crops & Soils Program conducted a field experiment in 2014 to evaluate the yield and quality performance of four BMR corn hybrids at three different populations. The data presented are only representative of one year, but this information can be combined with other research to aid in making agronomic decisions for BMR corn in the Northeast.

MATERIALS AND METHODS

The BMR population trial was established at Borderview Research Farm in Alburgh, VT in 2014. Four varieties of BMR corn were planted at three different populations on 13-May 2014. The soils are a Benson rocky silt loam, and the area was planted with silage corn and sunflowers in 2013 (Table 1). The seedbed was prepared with spring disking and finished with a spike tooth harrow. The corn was planted in 30” rows with a John Deere 1750 four-row corn planter. All corn was planted at 48,000 seeds per acre and plots were thinned by hand at the end of June to reach population targets (32,000, 36,000, and 40,000 plants per acre). The experimental design was a randomized complete block design with plots 10’ x 100’ replicated three times. The varieties planted were Pioneer ‘P0238XR-102RM’, ‘P1180XR-111RM’, ‘P1449XR-114RM’, and ‘P0783XR-107RM’. All varieties have the following traits: Herculex XTRA® (HXX), which combines Herculex I and Herculex RW traits to provide season-long control of insects; Glufosinate-ammonium (LibertyLink®) herbicide tolerance; and Roundup Ready glyphosate (Roundup®, Touchdown®) herbicide tolerance.

A 10-20-20 starter fertilizer was applied at 250 lbs per acre at the time of planting. On 5-Jun, 3 quarts per acre of the selective herbicide Lumax® (S-Metolachlor, atrazine, and mesotrione) and 0.33 ounces per acre Dupont Accent® (Nicosulfuron) were applied to control weeds. Urea fertilizer (46-0-0) was applied as a sidedress at 200 lbs per acre on 2-Jul. Corn was harvested on 3-Oct with a John Deere two-row chopper, and whole-plant silage was collected and weighed in a forage wagon fitted with scales. An approximate one pound subsample of chopped corn was collected for forage quality analysis.

Table 1. Agronomic practices for the 2014 BMR corn population trial at Borderview Research Farm, Alburgh, VT.

	Borderview Research Farm – Alburgh, VT
Soil type	Benson rocky silt loam
Previous crop	silage corn and sunflowers
Tillage operations	Fall chisel plow, spring disk, spike tooth harrow
Plot size (ft.)	10 x 100
Replications	3
Variety	P0238XR, P1180XR, P1449XR, and P0783XR
Population treatments	32,000; 36,000; and 40,000 plants ac^{-1}
Row width (in.)	30
Planting date	13-May
Starter fertilizer	250 lbs ac^{-1} 10-20-20
Additional fertilizer	200 lbs ac^{-1} Urea (46-0-0), 2-Jul
Herbicide	3 qt ac^{-1} Lumax®, 0.33 oz ac^{-1} Accent®, 5-Jun
Harvest date	3-Oct

Silage quality was analyzed using wet chemistry at Dairyland Lab in Arcadia, WI. Plot samples were analyzed for crude protein (CP), starch, sugar, and neutral detergent fiber (NDF). 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, nonprotein 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 24-hour digestibility (NDFD). Evaluation of forages and other feedstuffs for NDFD 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 NDFD. Forages with increased NDFD will result in higher energy values, and perhaps more importantly, increased forage intakes. Forage NDFD can range from 20–80%, and is typically higher in BMR corn than conventional silage corn. High grain corn silage can have average starch values exceeding 40%, although levels greater than 30% are not considered to affect energy content, and might in fact have a negative impact on digestion. Starch levels vary from field to field, depending on growing conditions and variety.

The silage performance indices of milk per acre and milk per ton were calculated using a model derived from the spreadsheet entitled, “MILK2006” 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, on a dry matter basis. 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.

Yield data and stand characteristics were analyzed using mixed model analysis using the mixed procedure of SAS (SAS Institute, 1999). Replications within trials were treated as random effects, and hybrids were treated as fixed. Hybrid mean comparisons were made using the Least Significant Difference (LSD) procedure when the F-test was considered significant ($p<0.10$).

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 (LSDs) 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 lower in performance than the highest value in a particular column are indicated with an asterisk.

In the example below, 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 AND DISCUSSION

Weather data was recorded with a Davis Instrument Vantage PRO2 weather station, equipped with a WeatherLink data logger at Borderview Research Farm in Alburgh, VT. In general, the spring and summer months were wetter than normal with an additional 6.44 inches (Table 2). The fall months however were drier than normal with 3.91 fewer inches of precipitation. In addition, temperatures were relatively normal throughout the season with the exception of October which was 6.8 degrees above normal producing 69 additional Growing Degree Days (GDDs). There were an accumulated 2,241 GDDs at a base temperature of 50 degrees Fahrenheit (May-September). This was 40 less than the historical 30-year average for May-September.

Table 2. Summarized weather data for 2014 – Alburgh, VT.

Alburgh, VT	May	June	July	August	September	October
Average temperature (°F)	57.4	66.9	69.7	67.6	60.6	55.0
Departure from normal	1.0	1.1	-0.9	-1.2	0.0	6.8
Precipitation (inches)	4.90	6.09	5.15	3.98	1.33	2.00
Departure from normal	1.45	2.40	1.00	0.07	-2.31	-1.60
Growing Degree Days (base 50°F)	238	501	613	550	339	69
Departure from normal	40	27	-27	-31	21	69

Based on weather data from a Davis Instruments Vantage Pro2 with WeatherLink data logger.
October data represents weather recorded through the last corn harvest, 14-Oct 2014.
Historical averages are for 30 years of NOAA data (1981-2010) from Burlington, VT.

Variety x Population Interactions

There were not any significant interactions between variety and plant population for any of the parameters measured. This means we can look at results by variety with confidence that the trends apply across populations, and likewise we can look at results by populations with confidence that the trends apply across varieties.

Impact of BMR variety

There was not a significant difference in yield among the varieties when they were averaged across populations. Yields ranged from 18.2 to 21.2 tons acre^{-1} (Table 3). The variety ‘P0238XR’ had the least amount of lodging with only 5.6% of the plot lodged. This variety also had the greatest dry matter content at harvest. The variety ‘P1449XR’ had the highest sugar content, but the lowest starch content of the varieties. Three of the varieties had significantly higher digestible neutral detergent fiber (NDFD) content than the variety ‘P0783XR’.

Table 3. Yield and forage quality characteristics of BMR corn by variety, Alburgh, VT, 2014.

	Lodging	Yield	Harvest DM	CP	Sugar	Starch	NDF	NDFD	Milk per Ton	Milk per Acre
	%	tons/acre	%	%	%	%	%	% of NDF	lbs/ton	lbs/acre
P0238XR	**5.6***	18.2	**54.8***	7.6	3.0	31.7*	45.0	51.6*	3419	21760
P0783XR	56.7	19.9	48.4	7.7	3.2	**32.3***	43.3	50.0	3344	23341
P1180XR	16.1*	21.1	45.7	7.7	4.5	30.2*	44.6	**52.4***	3461	25549
P1449XR	66.7	21.2	41.1	7.2	**6.0***	26.7	45.9	51.6*	3367	23716
Trial Mean	36.3	20.1	47.5	7.6	4.2	30.2	44.7	51.4	3398	23592
LSD (p<0.1)	10.8	NS	4.0	NS	0.8	3.1	NS	1.2	NS	NS

Treatments indicated in **bold** were the top performers.

* Treatments with an asterisk were not significantly different than the top-performing treatment in a particular column.

NS – No significant difference was determined between treatments.

Impact of plant population

In general, there were no significant differences among the corn populations. However, there was less lodging in the lower populations than when the corn was thinned to 40,000 plants acre[1] (Table 4). Yields ranged from 19.2 to 20.6 tons acre^{-1}.

Table 4. Yield and forage quality characteristics of BMR corn by population, Alburgh, VT, 2014.

	Lodging	Yield	Harvest DM	CP	Sugar	Starch	NDF	NDFD	Milk per Ton	Milk per Acre
	%	tons/acre	%	%	%	%	%	% of NDF	lbs/ton	lbs/acre
32,000	34.2*	19.2	46.8	7.7	4.5	29.7	45.1	51.9	3397	21837
36,000	**29.6***	20.6	48.0	7.4	3.9	31.8	43.3	51.0	3425	24739
40,000	45.0	20.5	47.7	7.6	4.1	29.2	45.7	51.4	3371	24199
Trial Mean	36.3	20.1	47.5	7.6	4.2	30.2	44.7	51.4	3398	23592
LSD (p<0.1)	9.4	NS	NS	NS	NS	NS	NS	NS	NS	NS

Treatments indicated in **bold** were the top performers.

* Treatments with an asterisk were not significantly different than the top-performing treatment in a particular column.

NS – No significant difference was determined between treatments.

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