2012

Brown Mid-Rib Corn Population Trial

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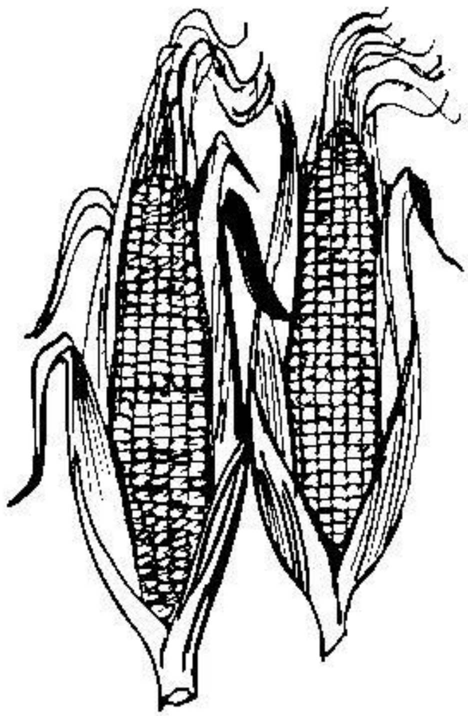

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2012 Brown Mid-Rib Corn Population Trial

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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 stover 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, the University of Vermont Extension Northwest Crops & Soils Program conducted a field experiment in 2012 designed to evaluate the yield and quality performance of a BMR corn hybrid 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

A trial was conducted at Borderview Farm in Alburgh, Vermont in 2012 in order to evaluate yield and quality of BMR corn grown at 3 plant densities. The soil was a Benson rocky silt loam, and the area was previously planted with silage corn. The experimental design was a randomized block of 10'x150' plots, with 30" spacing between rows and three replications. Treatments were three populations (32,000; 36,000; and 40,000 plants per acre). The seedbed was prepared with spring disking and harrowing and finished with a spike-toothed harrow. The corn was planted on 18-May with a John Deere 1750 four-row corn planter. All corn was planted at 45,000 seeds per acre and plots were thinned by hand on 18-Jun to reach population targets. The variety was Pioneer 'P1376XR,' which has a relative maturity of 113 days and 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; Roundup Ready glyphosate (Roundup®, Touchdown®) herbicide tolerance.

Table 1. Agronomic practices for the 2012 BMR corn population trial at Borderview Farm.

Location	Borderview Farm – Alburgh, VT
Soil type	Rocky Benson silt loam
Previous crop	Silage corn
Tillage operations	Spring disk, harrow, spike-toothed harrow
Plot size (ft.)	10 x 150
Replicates	3
Variety	Pioneer P1376XR
Population treatments	32,000; 36,000; and 40,000 plants ac^{-1}
Row width (in.)	30
Planting date	18-May
Starter fertilizer	200 lbs ac^{-1} of 10-20-20
Additional fertilizer	200 lbs ac^{-1} of 46-0-0
Herbicide	Lumax®, 3 pt ac^{-1}; 31-May
Harvest dates	5-Oct

A 10-20-20 starter fertilizer was applied at 200 lbs per acre at the time of planting. On 31-May, 3 pints per acre of the selective herbicide Lumax® (S-Metolachlor, atrazine, and mesotrione) was applied to control weeds. Urea fertilizer (46-0-0) was applied as a sidedress at 200 lbs per acre, or 92 lbs of actual N per acre on 23-Jun. Corn was harvested on 5-Oct with a John Deere two-row chopper, and whole-plant silage was collected and weighed in a forage wagon. Chopped silage was then dried and ground with a Wiley laboratory mill. A subsample was retained for analysis.

Silage quality was analyzed using wet chemistry at Cumberland Valley Analytical Services in Hagerstown, MD. Plot samples were analyzed for crude protein (CP), starch, acid detergent fiber (ADF), 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 digestibility (dNDF). Evaluation of forages and other feedstuffs for dNDF 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 dNDF. Forages with increased dNDF will result in higher energy values, and perhaps more importantly, increased forage intakes. Forage dNDF can range from 20–80%, and is typically higher in BMR corn than conventional silage corn.

Net energy for lactation (NE_L) is calculated based on concentrations of NDF and ADF. NE_L can be used as a tool to determine the quality of a ration, but should not be considered the sole indicator of the quality of a feed, as NE_L is affected by the quantity of a cow's dry matter intake, the speed at which her ration is consumed, the contents of the ration, feeding practices, the level of her production, and many other factors. Most labs calculate NE_L at an intake of three times maintenance. Starch can also have an effect on NE_L, where the greater the starch content, the higher the NE_L (measured in Mcal per pound of silage), up to a certain point. 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.
Non-fiber carbohydrate (NFC) and nonstructural carbohydrate (NSC) are also totaled and reported. NFC is comprised of starch, simple sugars, and soluble fiber, and is digested more quickly and efficiently than fiber. NFC provides energy for rumen microbes, once it is fermented by volatile fatty acids. NFC and NSC are sometimes referred to almost interchangeably, but pectin levels are included in NFC and omitted from NSC. In addition, NFC is calculated by difference [100 – (% NDF + % crude protein + % fat + % ash)], whereas NSC is determined through enzymatic methods. NSC should be in the 30-40% range, on a dry matter basis. NFC is generally between 35-40% in a high milk production ration, though levels as

high as 42% are acceptable, due to the variability of particle size, frequency of feeding, dry matter intake, and other factors.

The silage performance indices of milk per acre and milk per ton were calculated using a model derived from the spreadsheet entitled, "MILK2000" 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.

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

Using data from a Davis Instruments Vantage Pro2 weather station at Borderview Farm in Alburgh, VT, weather data was summarized for the 2012 growing season (Table 2). Though May was warmer and wetter than normal (based on 1981-2010 data), June, July, and August all had less precipitation than normal. There were an accumulated 2,717 Growing Degree Days (GDDs) at a base temperature of 50°F. This was 324 more than the historical 30-year average for May-October.

Table 2. Summarized weather data for 2012 – Alburgh, VT.

Alburgh, VT	May	June	July	August	September	October
Average temperature (°F)	60.5	67.0	71.4	71.1	60.8	52.4
Departure from normal	4.10	1.20	0.80	2.30	0.20	4.20
Precipitation (inches)	3.9	3.2	3.8	2.9	5.4	4.1
Departure from normal	0.5	-0.5	-0.4	-1.0	1.7	0.5
Growing Degree Days (base 50°F)	370	504	657	650	364	172
Departure from normal	102	30	17	69	46	60

Based on weather data from an on-site Davis Instruments Vantage Pro2 weather station with a Weatherlink data logger. Historical averages are for 30 years of NOAA data from Burlington, VT (1981-2010).
* Precipitation data from June-September is based on Northeast Regional Climate Center data from an observation station in Burlington, VT.

Yield did not vary significantly by population (Table 3, Figure 1). The average yield for the trial was 23.4 tons per acre at an adjusted 35% dry matter. Though not statistically significant, the highest yield was in the lowest population (32,000 plants per acre, 24.0 tons per acre). There was no significant difference in dry matter content at harvest on 5-Oct; the trial average was 39.3% dry matter.

Table 3. Yield and dry matter content in BMR corn by population, Alburgh, VT, 2012.

Population	Yield at 35% DM	DM at harvest
plants ac^{-1}	tons ac^{-1}	%
32,000	**24.0**	**41.4**
36,000	22.8	37.7
40,000	23.3	39.0
LSD (0.10)	NS	NS
Trial mean	23.4	39.3

Treatments indicated in **bold** had the top observed performance.
NS – No significant difference was determined between treatments.

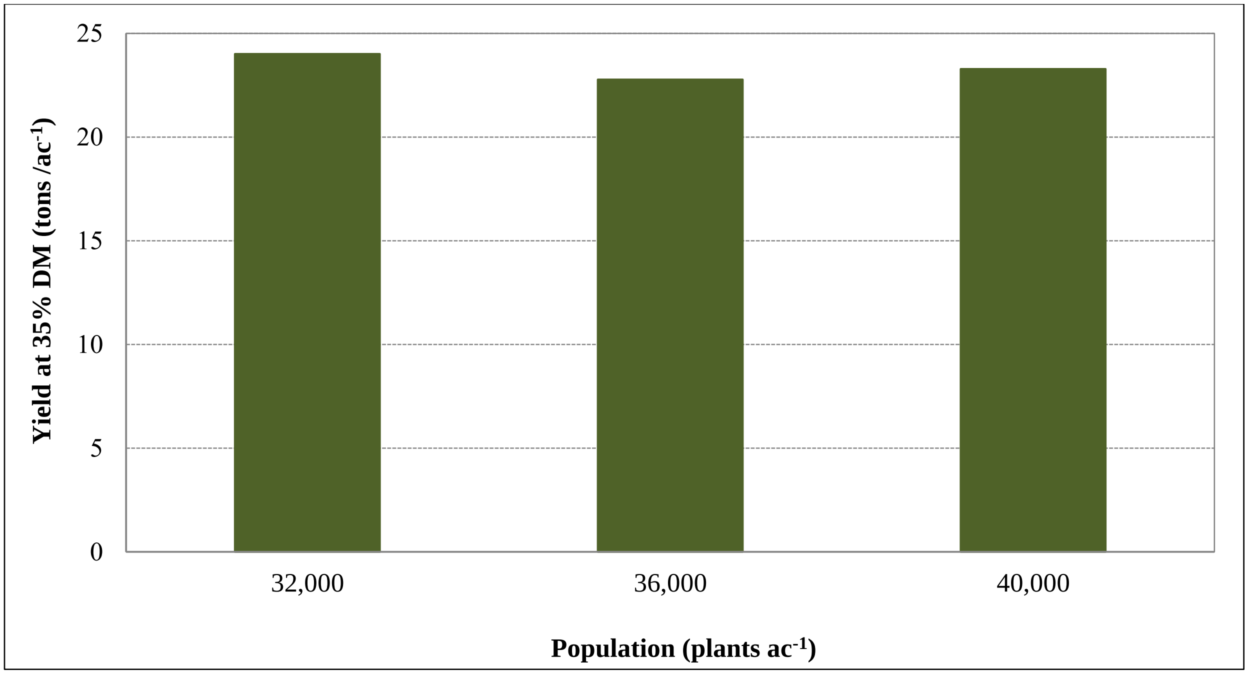

Figure 1. Effect of population on BMR corn yield. There was no significant yield difference between population treatments.

Forage quality did not differ significantly between populations in this trial of BMR corn (Table 4). However, there was a trend toward top performance in the lowest population (32,000 plants per acre). Crude protein (CP) was highest in the 36,000 plants per acre treatment. All other forage quality characteristics were most favorable in the 32,000 plants per acre treatment, though this treatment did not perform statistically better than other populations.

Table 4. Effects of population on BMR corn quality, Alburgh, VT, 2012.

Population	Forage quality characteristics									Milk	
	CP	ADF	NDF	dNDF	Starch	NFC	NSC	TDN	NE_L	ton^{-1}	ac^{-1}
plants ac^{-1}	% of DM	% of DM	% of DM	% of NDF	% of DM	% of DM	% of DM	% of DM	Mcal lb^{-1}	lbs	lbs
32,000	7.9	**24.1**	**42.9**	**66.4**	**33.5**	**43.3**	**34.6**	**73.0**	**0.76**	**2988**	**25149**
36,000	**8.1**	24.7	43.6	64.8	32.5	42.2	33.6	72.4	**0.76**	2930	23334
40,000	7.6	25.7	44.9	62.4	32.0	40.9	33.3	71.7	0.75	2775	22624
LSD (0.10)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Trial mean	7.9	24.8	43.8	64.5	32.7	42.1	33.8	72.4	0.76	2898	23702

Treatments indicated in **bold** had the top observed performance.
NS – No significant difference was determined between treatments.

Though not statistically significant, total digestible nutrients (TDN) and milk per ton both tended to decrease as populations increased in BMR corn (Figure 2).

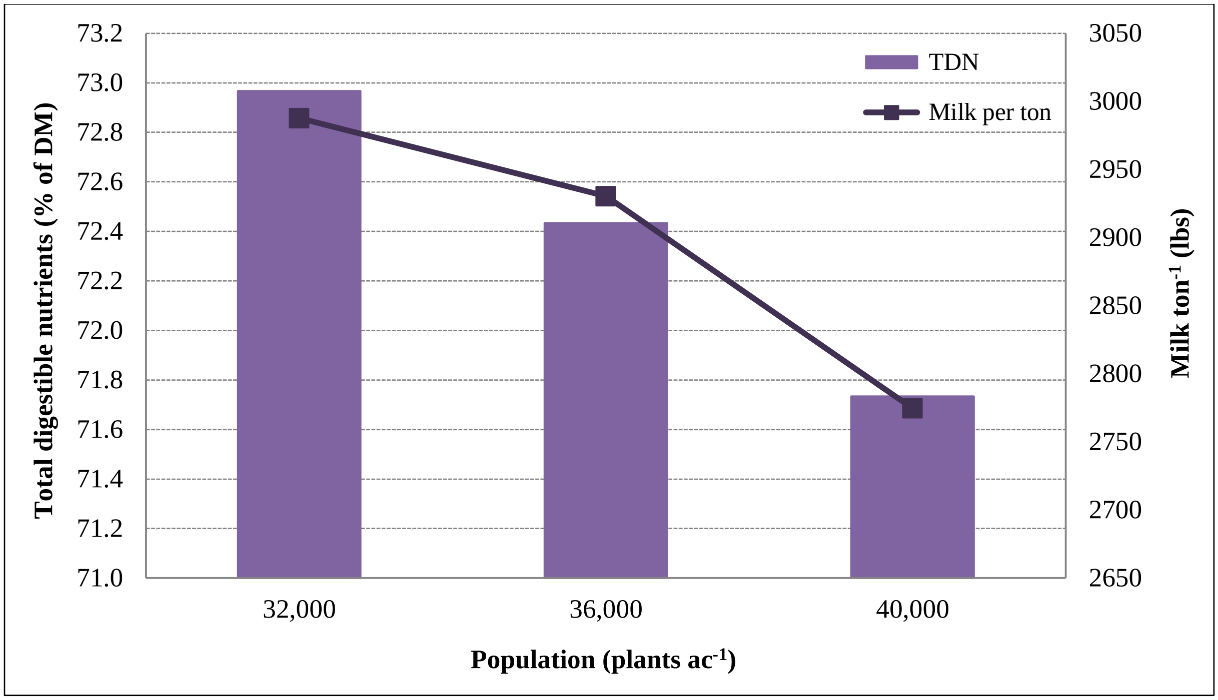

Figure 2. Effects of population on total digestible nutrients (TDN) and milk per ton of BMR corn, Alburgh, VT, 2012. There was no significant difference between populations for TDN or milk per ton.

DISCUSSION

Yield and quality indicators did not vary significantly between population treatments in this trial. However, there was a trend towards higher yields and quality in BMR corn thinned to lower populations (32,000 plants per acre). The '32,000 plants per acre' treatment yielded 24.0 tons per acre, 0.6 tons per acre higher than the trial average. Though not statistically significant, ADF and NDF were lowest in the lowest population (32,000 plants per acre), indicating that feed intake might be higher in BMR corn grown at lower populations, as shown in other regions. In addition, milk per ton and milk per acre were both highest in stands with the lowest population, though this treatment did not perform statistically differently than others. The digestibility of forages is positively correlated with potential milk production. Yield and quality was highest overall in corn thinned to 32,000 plants per acre, though these results were not statistically significant. Although lodging of plants was very minimal (data not shown) there was a trend toward higher percentages of lodged plants in the 40,000 plants per acre population. Further research needs to be conducted across multiple years and sites to determine the best plant population for BMR corn production in this region.

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