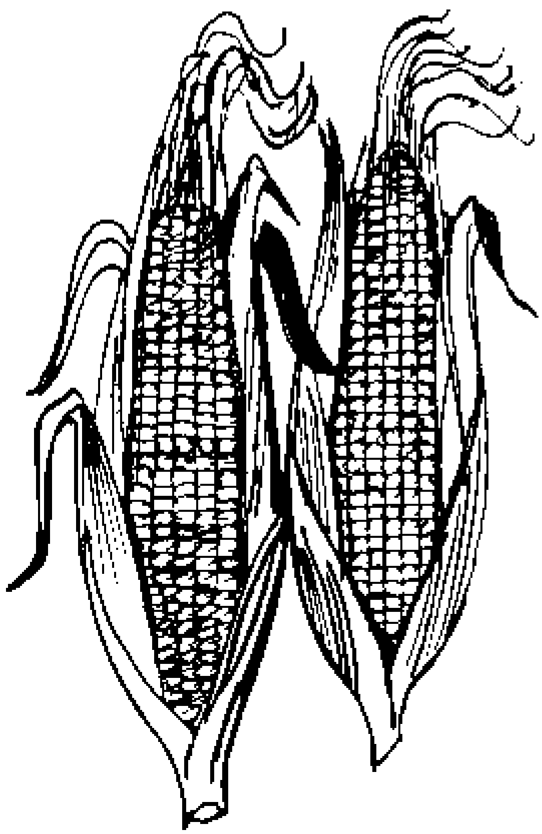
UNIVERSITY OF VERMONT EXTENSION

CULTIVATING HEALTHY COMMUNITIES

2009
Vermont Corn Silage
Seeding Rate Trial



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2009 VERMONT CORN SILAGE SEEDING RATE TRIAL

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In 2009, the University of Vermont Extension conducted corn silage seeding rate trial. The goal of the project was to determine optimum seeding rates for silage specific hybrids (i.e. BMR and leafy hybrids). Recent evidence suggests that corn silage specific hybrids may require different plant densities to achieve maximum yield and quality. The standard plant recommendation for corn silage hybrids is 34,500 plants to the acre. It is important to remember that the data presented are from a single test at only one location. Research data from additional tests in different locations and over several years will need to be gathered before we can draw more accurate conclusions.

TESTING PROCEDURE

In 2009, a corn silage plant density study was conducted in Alburgh, VT. For the study there were five silage specific corn hybrids planted at 4 different seeding rates (28,000, 32,000, 34,000, and 36,000 kernels/acre). The maturity of the corn hybrids is based on the hybrid Relative Maturities provided by the companies. The specific varieties and relative maturities are listed in Table 1.

Table 1. Corn hybrids evaluated in the seeding rate trial – Alburgh, VT.

Company	Variety	RM	Description & Traits
Mycogen	TMF2Q296	86	RR, fixed ear
Mycogen	F2F297	90	BMR
Mycogen	TMF2L418	94	HXXTRA, LL RR, flex ear
Mycogen	TMF2R521	98	YGVT3, RR, fixed ear
Mycogen	TMF2W583	105	RR, flex ear

BMR – Brown Mid-Rib Corn is of higher digestibility because it contains less lignin than other non BMR corn hybrids. BMR corn is not considered a GMO.
HXXTRA – The HerculexXTRA® insect protection trait controls European corn borer, corn rootworm, western bean cutworm, black cutworm and fall armyworm
LL – LIBERTY LINK CORN® is tolerant to broadcast applications of Liberty herbicide, glufosinate ammonium.
RR – ROUND-UP READY CORN® is resistant to the herbicide glyphosate, a post-emergent, foliar applied, non-selective herbicide.
YGVT3 – YieldGard VT Triple® insect protection trait controls Western Corn Rootworms, Northern Corn Rootworms, European Corn Borers, Black Cutworms, Stalk Borers, Wireworms, White Grubs, Seed Corn Maggots, Early Flea Beetles, and Corn Earworms

WEATHER DATA

Seasonal precipitation and temperature was recorded at a weather station close in proximity to Alburgh (Table 2). This season brought cooler than normal temperatures and higher than normal rainfall patterns across the region. Below average GDD resulted in corn maturing at a slower rate and hence a later than normal harvest date. The total accumulated GDD for corn growth was 1945 which was about 340 GDD less than normal for this area.

Table 2. Temperature, precipitation, and growing degree days summary – Alburgh, VT.

Alburgh	April	May	June	July	August	September	October
Average Temperature	44.9	53.9	62.8	65.9	67.7	57.7	44.1
Departure from Normal	+1.4	-2.7	-3.0	-5.2	-1.3	-2.7	-4.7
Precipitation	2.89	6.32	5.19	8.07	3.59	4.01	5.18
Departure from Normal	+0.38	+3.39	+1.98	+4.66	-0.26	+0.55	+0.79
Growing Degree Days (50˚)	111.5	209.0	398.0	494.5	557	286	40.5
Departure from Normal	+71.0	-51.4	-76.0	-158.1	-32.0	-26.0	-61.8

*Based on National Weather Service data from cooperative observer stations in close proximity to field trials. Historical averages are for 30 years of data (1971-2000)..

CULTURAL PRACTICES

The seedbed was prepared by conventional tillage methods. The previous crop was corn silage. Fertilizer and herbicides were applied based on the farms standard practices. Plots were planted with a four row corn planter. Plots were 100 feet in length. The plots were harvested with a two-row corn chopper. Yield was measured by weighing wagons on drive-up platform scales. A subsample of corn was taken and analyzed for forage quality by the Cumberland Valley Forage Laboratory in Maryland. Pertinent trial information is summarized in Table 4.

Table 3. Organic corn variety trial information - 2009

Trial Information	Alburgh, VT
Soil type	Silt loam
Previous Crop	Corn
Row Width (in.)	30
Planting date	15-May
Harvest date	24-Sep. & 2-Oct.
Harvest population (plants/acre)	28, 32, 34, 36000
Tillage operations	Spring Chisel Spring Disk
Manure (gal/acre)	Fall applied - 7000 gal/acre
Starter fertilizer (lbs/A)	10-20-20 @ 150 lbs/a
Other fertilizer (lbs/A)	90 lbs N/acre sidedressed

SILAGE QUALITY

Silage quality was analyzed using wet chemistry techniques at the Cumberland Valley Forage Laboratory in Pennsylvania. Plot samples were dried, ground and analyzed for crude protein (CP), neutral detergent fiber (NDF), 30h digestible NDF (dNDF), and starch. 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 N 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. 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 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 exists.
3) Genetic, dietary, and environmental differences affecting feed utilization are not considered.

PRESENTATION OF DATA

Results are listed in Table 4, 5, and 6. Dry matter yields were calculated and than adjusted to 35% dry matter for the report. Varieties are ranked by dry matter at harvest in table 5. The numbers presented in the tables are an average of two replications. A graph (Figure 1) has been included to report yields. Hybrids with the same letter were not statistically different in yield. Figure 2 displays the relationship between milk per ton and milk per acre. The dotted line dividing the figure into four quadrats represents the mean milk per ton and acre for the location. Therefore hybrids that fall above the lines performed higher than the average and hybrids below the lines performed below average.

LEAST SIGNIFICANT DIFFERENCE (LSD)

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 varieties is real or whether it might have occurred due to other variations in the field. At the bottom of each table a LSD value is presented for each variable (i.e. yield). Least Significant differences (LSD's) at the 10% level of probability are shown. Where the difference between two varieties 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 varieties. Varieties that were not significantly lower in performance than the highest hybrid in a particular column are indicated with an asterisk. In the example below A is significantly different from C but not from hybrid. 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 varieties 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 varieties were significantly different from one another. The asterisk indicates that B was not significantly lower than the top yielding variety.

Variety	Yield
A	6.0
B	7.5*
C	9.0*
LSD	2.0

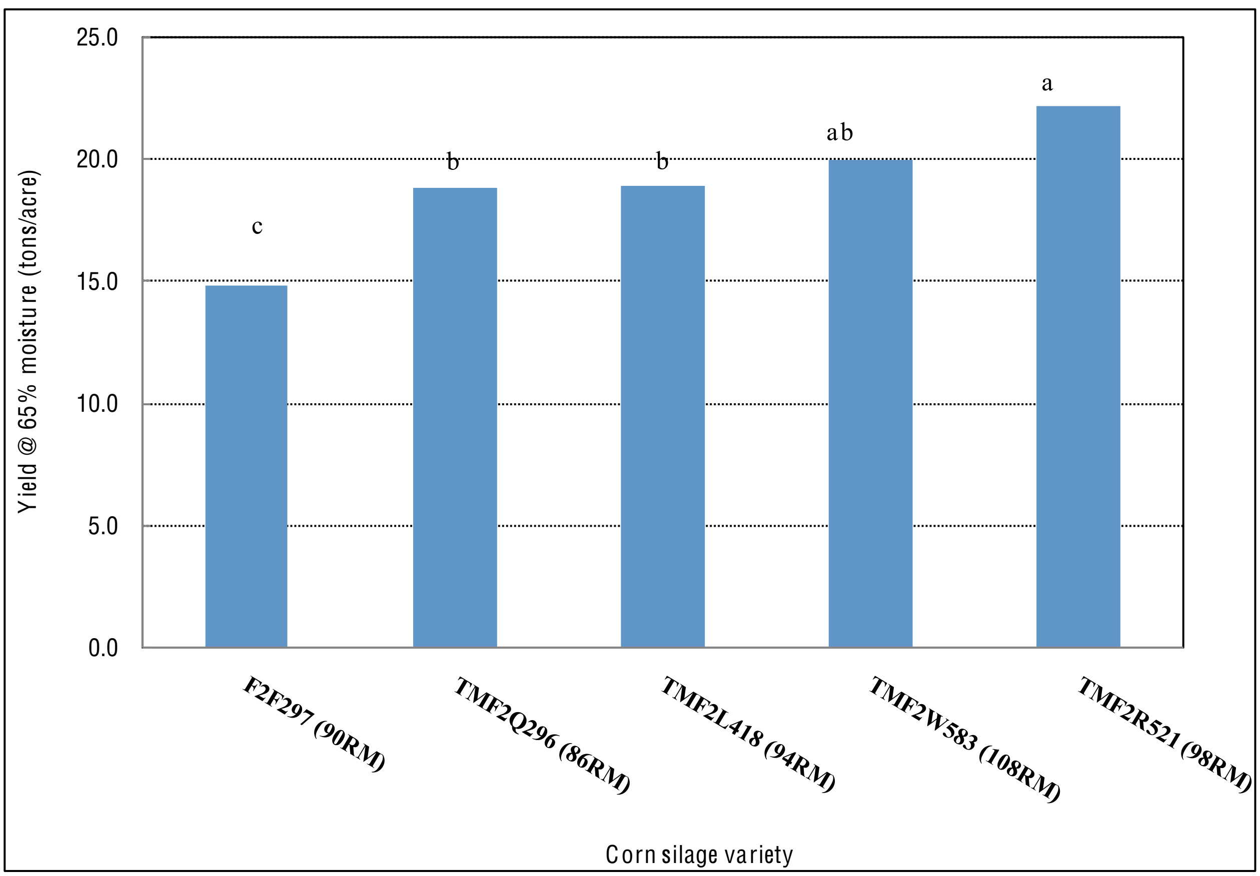
RESULTS

Table 4. Silage yield evaluation of five corn silage specific varieties – Alburgh, VT.

Hybrid	Relative maturity	DM at harvest %	Yield 35 % DM T/A	Forage Quality Characteristics CP %	ADF %	NDF %	dNDF %	Nel %	Milk per ton	Milk per acre
TMF2Q296	86	38.0	18.9	6.74	24.9*	40.8*	59.1	0.76*	2933	19416
F2F297	90	33.1	14.8	7.68*	26.9	44.6	65.5*	0.75	3051*	15894
TMF2L418	94	34.2	18.9	8.10*	26.8	44.3	57.9	0.74	2898	19239
TMF2R521	98	39.1*	22.2*	6.73	24.3*	39.5*	57.3	0.77*	2947	22864*
TMF2W583	108	34.6	20.0*	7.45	25.8*	42.1*	55.7	0.75	2854	19964
Trial Mean		35.8	18.9	7.34	25.7	42.3	59.1	0.75	2936	19475
LSD (0.10)**		1.8	2.3	0.48	1.6	2.7	1.4	0.01	71	2581

* Corn that did not perform significantly lower than the top performing variety in a particular column are indicated with an asterisk.
** See text for further explanation.
NS - None of the varieties were significantly different from one another.

Figure 1. Corn yield of silage specific varieties – Alburgh, VT.



Hybrids with the same letter do not differ significantly in yield.

RESULTS

Table 5. Impact of plant density on corn silage yield and quality.

Plant density plants/acre	DM at harvest %	Yield 35 % DM T/A	Forage Quality Characteristics CP %	ADF %	NDF %	dNDF %	Nel %	Milk per ton	Milk per acre
28000	34.9	17.5	7.71*	26.4	43.4	59.6	0.75	2950	18120
32000	36.5	19.2*	7.31*	25.0	41.3	59.5	0.76	2954	19860*
34000	35.3	18.3	7.14	26.0	42.3	58.6	0.75	2918	18658
36000	36.5	20.7*	7.19	25.6	42.0	58.7	0.75	2925	21263*
LSD (0.10)**	NS	2.06	0.43	NS	NS	NS	NS	NS	2309

*Corn that did not perform significantly lower than the top performing density in a particular column is indicated with an asterisk.
** See text for further explanation.
NS - None of the varieties were significantly different from one another.

Table 6. Impact of plant density on silage specific hybrid yield and quality – Alburgh, VT.

Variety	Plant density plants/acre	DM harvest %	Yield 35% DM tons/acre	Milk per ton	Milk per acre
TMF2L418					
	28000	32.8	16.0	2880	16135
	32000	34.9	20.2	2944	20760
	34000	34.3	18.7	2805	18535
	36000	34.9	20.7	2966	21525
LSD (0.10)**		NS	NS	NS	NS
TMF2Q296					
	28000	37.7	17.6	2931	18066
	32000	40.2	20.0	2988	20948
	34000	35.0	17.8	2881	17910
	36000	39.2	20.2	2933	20739
LSD (0.10)**		NS	NS	NS	NS
TMF2R521					
	28000	39.8	21.3	2994*	22289
	32000	38.0	22.1	2964*	22928
	34000	37.4	20.4	2926	20863
	36000	41.2	24.9	2904	25375
LSD (0.10)**		NS	NS	44	NS
TMF2W583					
	28000	34.7	19.6	2996*	20508
	32000	34.2	17.5	2734	16792
	34000	33.3	19.6	2791	19145
	36000	36.2	23.1	2896*	23411
LSD (0.10)**		1.2	3.1	185	4200
F2F297					
	28000	29.4	13.2	2949	13601
	32000	35.4	16.2	3141*	17870
	34000	36.4	15.1	3189*	16839
	36000	35.4	14.8	2927	15265
LSD (0.10)**		NS	NS	190	NS

*Corn that did not perform significantly lower than the top performing density in a particular column is indicated with an asterisk.
** See text for further explanation.
NS - None of the varieties were significantly different from one another.

DISCUSSION

The objective of this project was to evaluate the impact of seeding rate on corn silage specific hybrids (TMF and BMR). First we evaluated the performance of the silage specific hybrids averaged across all seeding rates (Table 4 and Fig. 1). The TMF varieties yielded higher than the BMR hybrid. As expected the BMR hybrid had the best quality as compared to the others. The seeding rate recommendations for corn silage have been primarily developed by evaluating dual-use hybrids. The standard recommended seeding rate for corn silage is 34,500 kernels per acre (Cox et al., 2009). Some corn such as leafy (TMF) and brown midrib (BMR) hybrids has been developed specifically for silage production. Currently, there is no data to confirm if the best seeding rate for silage specific hybrids is also 34,500 kernels per acre. Overall, from this study we found that a seeding rate of 36,000 kernels to the acre resulted in the highest yields. With the exception of CP, there was no difference in quality over the different seeding rates. In general, the lower seeding rates had a slightly higher quality. This is commonly seen in other research studies. Essentially a higher seeding rate (up to some maximum) will result in higher yields and lowered quality. Likewise a lower seeding rate (up to some minimum) will result in higher quality but lowered yields. The goal is to find the happy medium where we maximize yield and quality without increasing seed costs too much. Interestingly, there appeared to be a difference in optimum seeding rates among the varieties. For example, the BMR variety had the top yield and quality when seeded between 32,000 and 34,000 kernels per acre. The TMF varieties had the highest yield and quality (milk per acre) at 36,000 kernels per acre. Additional years of data collection are needed to confirm the results. We plan to repeat the study next season.

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