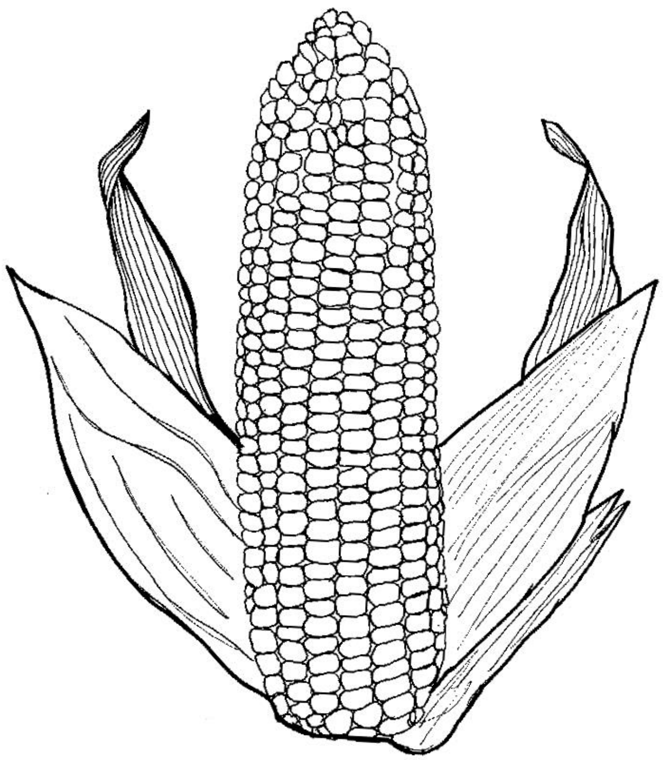
NORTHWEST CROPS & SOILS PROGRAM

2015 Vermont Organic Silage Corn Performance Trial



Dr. Heather Darby, UVM Extension Agronomist
Hillary Emick, Lily Calderwood, Erica Cummings, Abha Gupta, Julian Post, and Sara Ziegler
UVM Extension Crop and Soil Technicians
802-524-6501

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UNIVERSITY OF VERMONT EXTENSION
CULTIVATING HEALTHY COMMUNITIES

2015 VERMONT ORGANIC SILAGE CORN PERFORMANCE TRIAL

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

The University of Vermont Extension Northwest Crops and Soils Program conducted an organic silage corn variety trial in 2015 to provide unbiased performance comparisons of commercially available organic silage corn varieties. It is important to remember that the data presented are from a replicated research trial from only one location in Vermont and represent only one season. Crop performance data from additional tests in different locations and over several years should be compared before making varietal selections.

MATERIALS AND METHODS

In 2015, an organic corn silage performance trial was conducted at the Borderview Research Farm in Alburgh, VT. The trial site was certified organic by Vermont Organic Farmers, LLC. Two seed companies submitted varieties for evaluation (Table 1). The organic corn grown at the Alburgh site had relative maturities (RM) ranging between 82-99 days. The specific varieties and their RMs are listed in Table 2.

Table 1. Participating companies and contact information.

Albert Lea Seed	Blue River Hybrids
1414 West Main Street PO Box 127 Albert Lea, MN 56007 (800) 352-5247	Boucher Fertilizer 2343 Gore Road Highgate Center, VT 05459 (802) 868-3939

The soil type at the Alburgh location is a Benson rocky silt loam (Table 3). The seedbed was prepared with spring disking followed by a spike tooth harrow. The previous crop was organic corn. Plots were 30' long and consisted of two 30-inch rows. Plots were planted with a John Deere 1750 planter on 21-May at a seeding rate of 35,500 seeds per acre. The plot design was a randomized complete block with three replications. In order to reduce weed pressure, the plots were tine-weeded on 29-May and field cultivated on 7-Jul.

On 2-Oct the corn was harvested with a John Deere 2-row chopper, and the forage wagon was weighed. A subsample of the harvested material was collected, dried, ground, and then analyzed at the University of Vermont's Testing Laboratory (Burlington, VT) for quality analysis. Dry matter yields were calculated and adjusted to 35% dry matter.

Table 2. Organic corn varieties evaluated in Alburgh, VT, 2015.

Company	Variety	RM (days)
Blue River Hybrids	14A91	82
Blue River Hybrids	21L90	85
Blue River Hybrids	26A17	88
Viking/Albert Lea	0.85-90N	90
Viking/Albert Lea	0.42-92 NT	92
Blue River Hybrids	34C17	94
Viking/Albert Lea	E-95 OP	95
Viking/Albert Lea	0.6710	98
Viking/Albert Lea	0.35-99	99
Viking/Albert Lea	0.69-99	99

Table 3. Organic silage corn variety trial information, Alburgh, VT, 2015.

	Borderview Research Farm Alburgh, VT
Soil type	Benson rocky silt loam
Previous crop	Organic corn
Row width (in)	30
Plot size (ft)	5 x 30
Seeding rate (seeds/acre)	35,500
Planting date	21-May
Tillage operations	Spring disk, spike tooth harrow
Row cultivation	7-Jul
Harvest date	2-Oct

Silage quality was analyzed using the FOSS NIRS (near infrared reflectance spectroscopy) DS2500 Feed and Forage analyzer. Dried and coarsely ground plot samples were brought to the lab where they were reground using a cyclone sample mill (1mm screen) from the UDY Corporation. The samples were then analyzed using the FOSS NIRS DS2500 for crude protein (CP), starch, neutral detergent fiber (NDF), 30-hour digestible NDF (NDFD), total digestible nutrients (TDN), and milk per ton.

Mixtures of true proteins, composed of amino acids, and nonprotein nitrogen make up the CP content of forages. 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 (NDFD). NDFD is the percent of NDF that is digestible in 30 hours. 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% NDF.

Net energy of lactation (NE_L) is calculated based on concentrations of NDF. 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%. Non-structural Carbohydrate (NSC) are simple carbohydrates, such as starches and sugars, stored inside the cell that can be rapidly and easily digested by the animal. NSC is considered to serve as a readily available energy source and should be in the 30-40% range, on a dry matter basis. Total digestible nutrients (TDN) report the percentage of digestible material in silage. Total digestible nutrients are calculated from NDF and NDFD and express the differences in digestible material between silages.

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. 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 hybrids 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 (LSDs) at the 0.10 level of significance are shown. Where the difference between two hybrids within a column is equal to or greater than the LSD value at the bottom of the column, you can be sure that for 9 out of 10 times, there is a real difference between the two hybrids. Hybrids that were not significantly lower in performance than the highest hybrid in a particular column are indicated with an asterisk. In the following example, hybrid C is significantly different from hybrid A but not from hybrid B. The difference between C and B is equal to 1.5, which is less than the LSD value of 2.0. This means that these hybrids did not differ in yield. The difference between C and A is equal to 3.0, which is greater than the LSD value of 2.0. This means that the yields of these hybrids were significantly different from one another.

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

RESULTS AND DISCUSSION

Seasonal temperature and precipitation recorded at Borderview Research Farm in Alburgh, VT are reported in Table 4. Temperatures through most of the growing season were near historical averages, with warmer than normal temperatures at the beginning and end of the growing season (May and September). Rainfall through the growing season was much less than normal – a total of 11.42 inches below normal through the growing season. There was a total of 2522 Growing Degree Days (GDDs) for May through September—310 GDDs more than the historical average.

Table 4. Summarized weather data for 2015 – Alburgh, VT.

Alburgh, VT	May	June	July	August	September
Average temperature (°F)	61.9	63.1	70.0	69.7	65.2
Departure from normal	5.5	-2.7	-0.6	0.9	4.6
Precipitation (inches)	1.94	6.42	1.45	0.00	0.34
Departure from normal	-1.51	2.73	-2.70	-3.91	-3.30
Growing Degree Days (base 50°F)	376	399	630	626	470
Departure from normal	177	-75	-10	45	152

Based on weather data from a Davis Instruments Vantage Pro2 with WeatherLink data logger.
Historical averages are for 30 years of NOAA data (1981-2010) from Burlington, Vermont.

Yield and harvest dry matters (DM) results are listed in Table 5. Dry matter yields were calculated and adjusted to 35% dry matter. The average yield for the organic silage corn trial was 15.9 tons acre^{-1} and ranged from 21.7 to 13.0 tons acre^{-1} (Figure 1). The highest yield variety was Viking variety ‘0.35-99’. Four other varieties (‘0.69-99’, ‘0.671’, ‘34C17’, and ‘E-95 OP’) had statistically similar yield.

Table 5. Harvest characteristics of 10 organic corn silage varieties – Alburgh, VT, 2015.

Hybrid	RM	Harvest DM	Yield (at 35% DM)
		%	tons ac^{-1}
14A91	82	41.9*	13
21L90	85	41.7*	14.1
26A17	88	41.0*	13.6
0.85-90N	90	38.5*	15.5
0.42-92 NT	92	40.6*	14.3
34C17	94	**43.2**	15.9*
E-95 OP	95	42.8*	15.9*
0.671	98	42.4*	16.9*
0.35-99	99	42.4*	**21.7**
0.69-99	99	41.3*	17.9*
Trial Mean		41.6	15.9
LSD (p<0.10)		6.2	6.1

*Treatments indicated with an asterisk did not perform significantly lower than the top-performing treatment.
Treatments shown in **bold** are of the highest value or top performing.

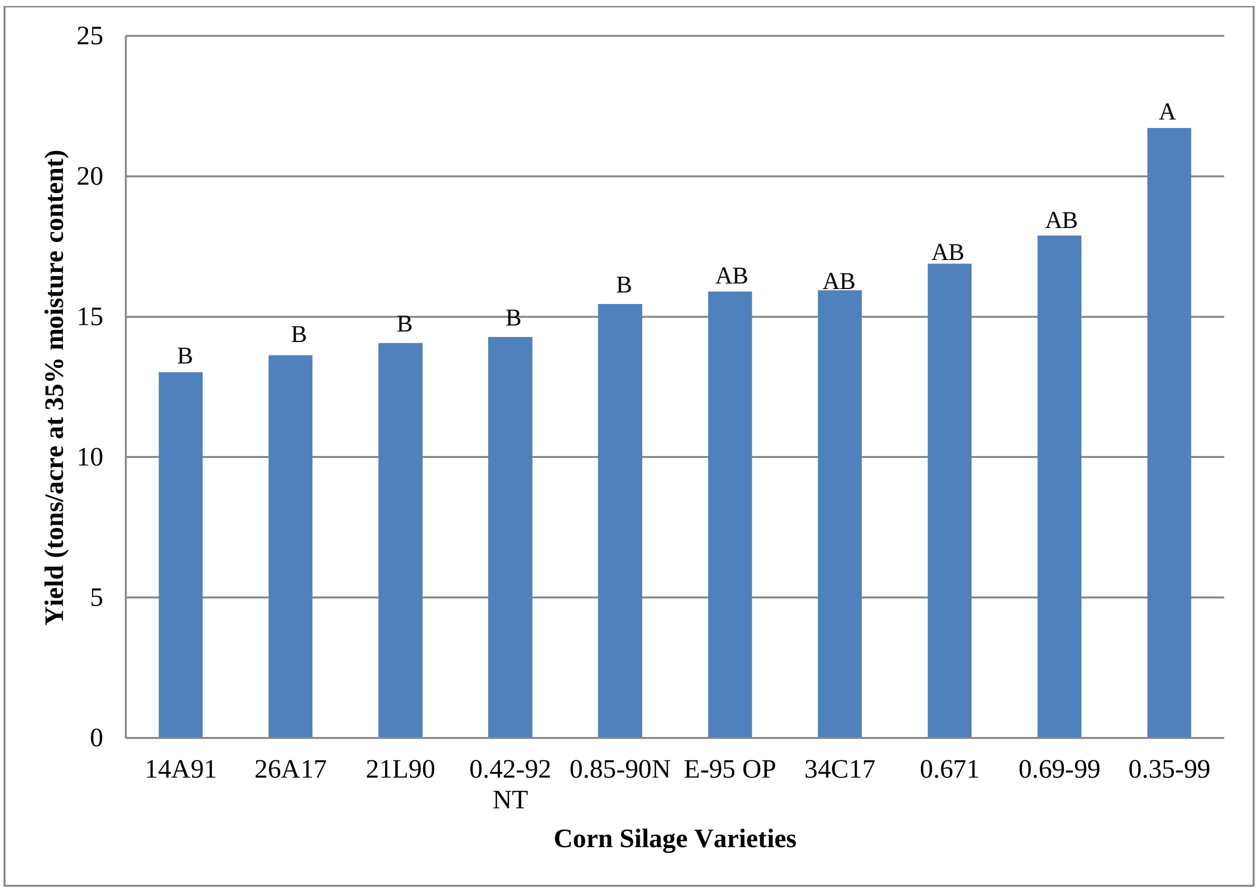

Figure 1. Organic corn silage yields, Alburgh, VT, 2015. Treatments with the same letter did not differ significantly from one another (p=0.10).

The quality results for the organic corn silage varieties are presented in Table 6. The Blue River Hybrid variety ‘0.85-90N’ and 34C17 had the highest CP concentrations. There were no significant differences between varieties in starch, and only one variety was significantly different from the rest in NDF (‘14A91’ was significantly lower in starch than all other varieties at 42.8%). The digestible NDF was highest in the varieties: 0.671, 0.69-99, and 0.35-99. Varieties did not differ in NE_L or milk ton. Varieties 0.35-99, 0.671 and 0.69-99 had the highest milk per acre.

Table 6. Silage quality of organic corn varieties, Alburgh, VT.

Variety	**Population**	**CP**	**Starch**	**NDF**	**NSC**	**NDFD**	**TDN**	**NE_L**	**Milk per**	
	plants/acre	%	%	%	%	% of NDF	%	Mcal/lb	ton	acre
14A91	27007	6	**42.3**	42.8	**48.8**	46.3	69.5*	0.71	3271	14778
21L90	31073	5.7	38.4	46.7*	46.0*	46.9	68.1*	0.7	3175	15673
26A17	27782	6.1	40.1	44.8*	46.6*	46.8	69.0*	0.71	3240	15411
0.85-90N	28072	**6.9**	37.9	**47.8**	45.5*	47	68.2*	0.7	3186	17115
0.42-92 NT	28266	6	35.3	46.8*	43.8*	47.1	67.9*	0.69	3156	15766
34C17	30298	6.2*	41	44.7*	47.4*	47.4	68.5*	0.7	3189	17786
E-95 OP	**31460**	5.9	37.7	47.8*	45.8*	47.1	67.1	0.68	3096	17054
0.671	26523	5.8	41.7	43.2*	48. 1*	**48.6**	**71.4**	**0.73**	**3410**	20098*
0.35-99	26620	5.8	40.4	44.6*	46.9*	47.7*	69.7*	0.71	3287	**25047**
0.69-99	27491	6.1	36.4	45.2*	42.6	48.4*	68.5*	0.69	3182	19270*
Trial Mean	NS	6.0	39.1	45.7	46.2	47.3	68.8	0.70	3219	17800
LSD (p<0.10)	6659	0.7	NS	4.9	5.9	1.13	4.3	NS	NS	6291

*Treatments indicated with an asterisk did not perform significantly lower than the top-performing treatment in a particular column.
Treatments shown in **bold** are of the highest value or top performing.
NS – No significant difference was determined between treatments.

Figure 2 displays the relationship between milk per ton and milk per acre. The dotted lines dividing the figure into four quadrants represent the mean milk per ton and mean milk per acre. Therefore, hybrids that fall above the lines performed better than the average and hybrids below the lines performed below average. Milk per ton measures the pounds of milk that could theoretically be produced from one ton of silage. Milk per acre is calculated by multiplying milk per ton by dry matter yield. Thus, milk per ton is an overall indicator of forage quality and milk per acre is an indicator of forage yield and quality. Shown in Figure 2 is a comparison of how each variety ranked in terms of milk per ton and milk per acre. The varieties 0.35-99 and 0.671 had high yield and quality.

Overall, the yield and quality of the varieties was low compared to past year trials. Excessive rain in June made it difficult to control weeds through mechanical cultivation. High weed pressure suppressed yields more so in shorter varieties that did not compete as well. In addition, nutrient leaching from the heavy and persistent rains may have led to lower quality and yields.

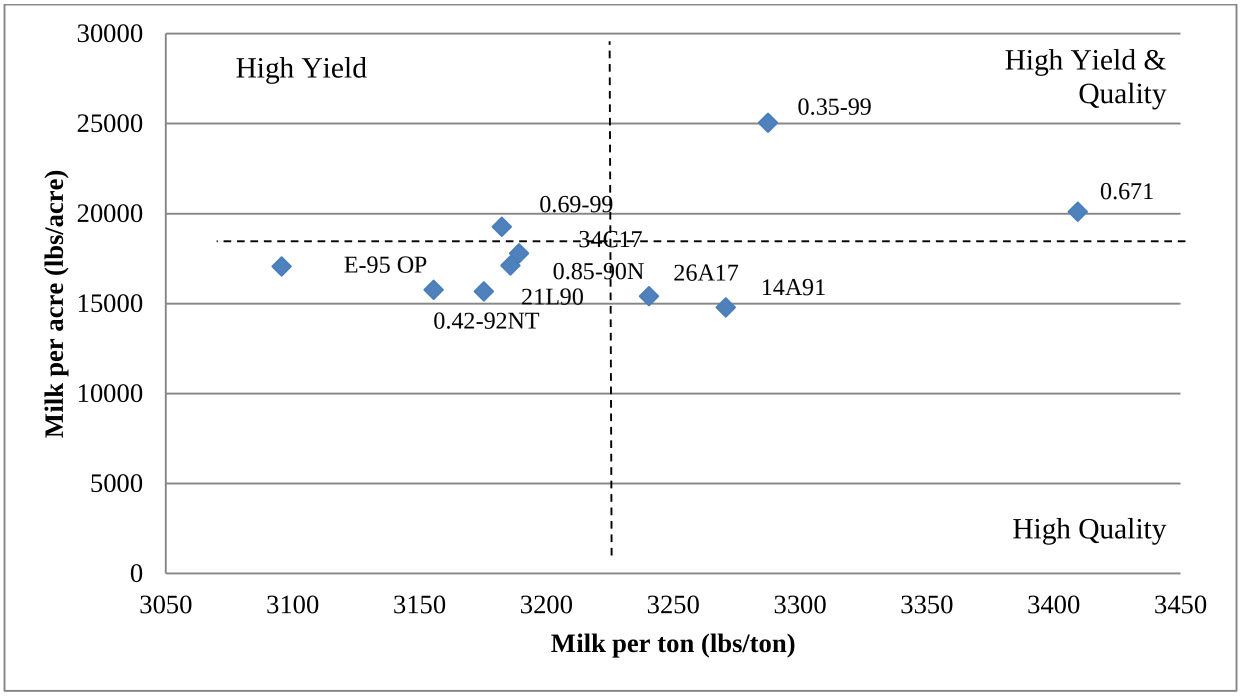

Figure 2. Relationship between milk per ton and milk per acre of organic corn silage varieties. *Dotted lines represent the mean milk per ton and mean milk per acre. Upper right quadrant represents both high yield and quality.*

ACKNOWLEDGEMENTS

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