2011 VERMONT ORGANIC CORN SILAGE VARIETY TRIAL

Many organic dairies are considering corn silage production to help reduce expensive concentrate purchases. Corn silage is a good source of energy/starch for livestock. There are few organic corn silage variety trials in the United States. The goal of the organic corn silage variety trial was to evaluate yield and quality of ten varieties of organic silage in Vermont's climate. Please remember that the results only represent two replicates and one year of trial results for the varieties. To select a variety that works best for your area data from multiple environments should be compared.

MATERIALS AND METHODS

The University of Vermont Extension conducted a variety trial at Borderview Farm in Alburgh, VT. The soil was a rocky silt loam. The experimental design was a randomized complete block with two replications. Ten varieties of organic silage corn were planted on May 26, 2011 at a rate of 34,000 plants per acre with a John Deere 1750 corn planter. The research plots were 5' x 20'. The previous crop was small grains, and the seedbed was prepared with a spring plow, disc, harrow, and spike-tooth harrow. On 5-July the trial was fertilized with 750 lbs of Pro-Booster® (10-0-0) per acre. The treatments were ten organic silage corn varieties evaluated for yields and quality. Trial agronomic information is summarized in Table 1.

Table 1. General trial information for organic silage trial.

Trial Information	Borderview Farm Alburgh, VT
Soil type	Benson rocky silt loam
Previous crop	Small grains
Plot size(ft.)	5 x 20
Seeding rate	34,000 Plants/acre
Replicates	2
Planting date	26-May
Harvest date	23-Sept
Cultivation	2x
Tineweed	1x
Fertilizer	750 lbs ac^{-1} Pro Booster®
Tillage operations	Spring disc, harrow, spike-tooth harrow
Row width (in.)	30

The seed for this trial was donated by two participating seed companies and farmers (Table 2). Varieties ranged from 78-107 days in relative maturity. Relative Maturity (RM) information was provided by the seed companies. Varieties evaluated in the trial, relative maturities and varietal traits are listed in Table 2.

Plant population was measured just prior to harvest. Plots were harvested on 26-September. 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.

All data was analyzed using a mixed model analysis where replicates were considered random effects. The LSD procedure was used to separate cultivar means when the F-test was significant ($P< 0.10$).

Table 2. Organic corn silage varieties in Alburgh, VT.

Company	Variety	Relative maturity	Description
Albert Lea Co, Viking Corn, MN	23-86N	86	Hybrid
Albert Lea Co, Viking Corn, MN	80-92	92	Hybrid
Albert Lea Co, Viking Corn, MN	99-90	90	Hybrid
American Organic Seed & Grain, IL	B916	86	Hybrid
American Organic Seed & Grain, IL	VPD749	107	Hybrid
Blue River Hybrid, IA	08N01	78	Hybrid
Blue River Hybrid, IA	19K19	84	Hybrid
Blue River Hybrid, IA	26A17	88	Hybrid
Butter works Farm, VT	Early Riser	80	Open pollinated
De Dell Seeds Incorporated London, Ontario	DL1445	93	Hybrid

Silage quality was analyzed using wet chemistry techniques at the Cumberland Valley Forage Laboratory in Maryland. Plot samples were dried, ground and analyzed for crude protein (CP),acid detergent fiber (ADF), neutral detergent fiber (NDF), 30h digestible NDF (dNDF), starch, and net energy lactation(Nel). Mixtures of true proteins, composed of amino acids and non-protein 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, 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 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 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 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 top-performer in a particular column (listed in bold) are indicated with an asterisk.

In the example at right, A is significantly different from C but not from 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 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.

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

In the example at right, variety A is significantly different from variety C but not from variety B. The difference between A and B is equal to 1.5, which is less than LSD value of 2.0. This means that these two 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 two varieties were significantly different from one another.

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. Temperature, precipitation, and Growth Degree Day's summary – Alburgh, VT.

South Hero, VT (Alburgh)	May	June	July	August	September
Average temperature (°F)	58.7	67.1	74.4	70.4	63.8
Departure from normal	2.1	1.3	3.3	1.6	5.8
Precipitation (inches)	8.67	3.52	3.68	10.23	5.56
Departure from normal	5.35	0.09	-0.29	6.38	2.10
Growing Degree Days (base 50°F)	260	513	732	563	392
Departure from normal	-0.9	39.0	79.5	-27.0	79.5

Average temperatures for August and September are 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).

Corn populations varied by variety (Table 4). The Variety 99-90 (Albert Lea Company) had the highest population (36,500 plants per acre). This was not statistically different than varieties 26A17 (Blue River Hybrid), 80-92 (Albert Lea Company), Early Riser (Butterworks Farm), and VPD749 (American Organic Seed and Grain). Some of the varieties had lower than recommended plant populations for corn silage. The low populations may have been a result of poor germination in the spring. Heavy rains and cool conditions in the early season can reduce seed germination. Organic seed is not treated with fungicide and may be more susceptible to soilborne diseases. The average dry matter at the time of harvest was 41.2% with no significant differences among varieties. Overall the corn was harvested at drier than recommended whole plant moistures. Poor fall harvest conditions resulted in a delayed harvest.

Yield of each corn silage variety is reported at 35% dry matter. There were no significant differences in yield among the 10 organic varieties (Table 4). A high level of variability was detected among the replicates and may have caused a lack of significance for most measured variables. American Organic variety VPD749 and Viking varieties 88-90 and 90-99 yielded over 20 tons per acre. The average yield for 2011 organic corn silage variety trial was 17.2 tons per acre.

Table 4. Silage yields and quality of organic corn varieties in Alburgh, VT.

Variety	Population	Yield at 35% DM	DM	Forage quality characteristics						Milk per	
				CP	ADF	NDF	dNDF	Starch	Nel	ton	acre
	plants/acre	tons/acre	%	%	%	%	%	%	Mcal/lb	lbs	lbs
08N01	28500	11.6	41.5	7.9	24.9	40.2	59.3	30.2	0.76	2951	11971
B916	24500	14.8	41.2	6.7	26.4	43.6	56.7	29.9	0.74	2895	12199
26A17	30500*	12.5	41.3	7.2	25.6	44.2	58.4	27.8	0.75	2901	12858
23-86N	20500	12.5	38.9	7.8	22.8	38.7	59.2	32.9	0.78	3272	13232
Early Riser	30000*	13.7	41.3	7.8	25.6	43.6	60.2	29.2	0.75	3068	14864
19K19	18500	17.2	42.9	7.5	25.4	43.8	58.9	29.8	0.75	2981	18103
VPD749	35000*	**27.0**	34.2	**7.9**	25.6	41.3	**63.8**	28.9	0.77	**3433**	**32883**
DL1445	27500	17.4	44.1	6.8	24.9	42.0	61.1	32.1	0.76	2967	18133
80-92	30500*	22.8	**44.5**	7.1	23.7	40.1	57.1	33.1	0.77	2930	23143
99-90	**36500***	22.8	42.9	6.7	**21.6**	**37.8**	57.0	**38.5**	**0.79**	3055	23786
LSD (0.10)	7338	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Trial Mean	28200	17.2	41.2	7.3	24.6	41.5	59.1	31.2	0.76	3045	18117

Treatments indicated in bold had the highest observed value or top performance.
*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.

Forage quality did not differ among the varieties. The variety VPD749 had the highest crude protein (7.9%) this was not significantly different than the other nine varieties evaluated. The variety with the lowest fiber contents was 99-90 (21.6%), though this was not significantly lower than the other varieties. The evaluated varieties did not differ significantly, though this was not statistically lower than other varieties. The percent of NDF that is digestible in a 30-hour period is the dNDF (Table 4). In this trial there was no significant difference in dNDF by variety. Though not statistically significant, VPD749 had the highest dNDF (63.8%) and NeL (0.79 Mcal per lb). The variety 99-90 had the highest starch content (38.5%), but this was not significantly higher than the other varieties.

Milk per ton, a characteristic of silage quality, did not differ statistically by variety, but was highest in VPD749 (3433 lbs). There was no significant difference by variety in milk per acre. Though not statistically different, the variety VPD749 had the highest milk per acre (32883 lbs). See Figure 1 for milk production data for each of the ten varieties evaluated. The trial means are represented on each axis by a dashed line, so any value higher than the dashed line indicates better performance than the trial average. Though neither milk per ton nor milk per acre was statistically significant by variety, VPD749 and 99-90 had both higher than average milk per ton and milk per acre, indicating high milk production over all.

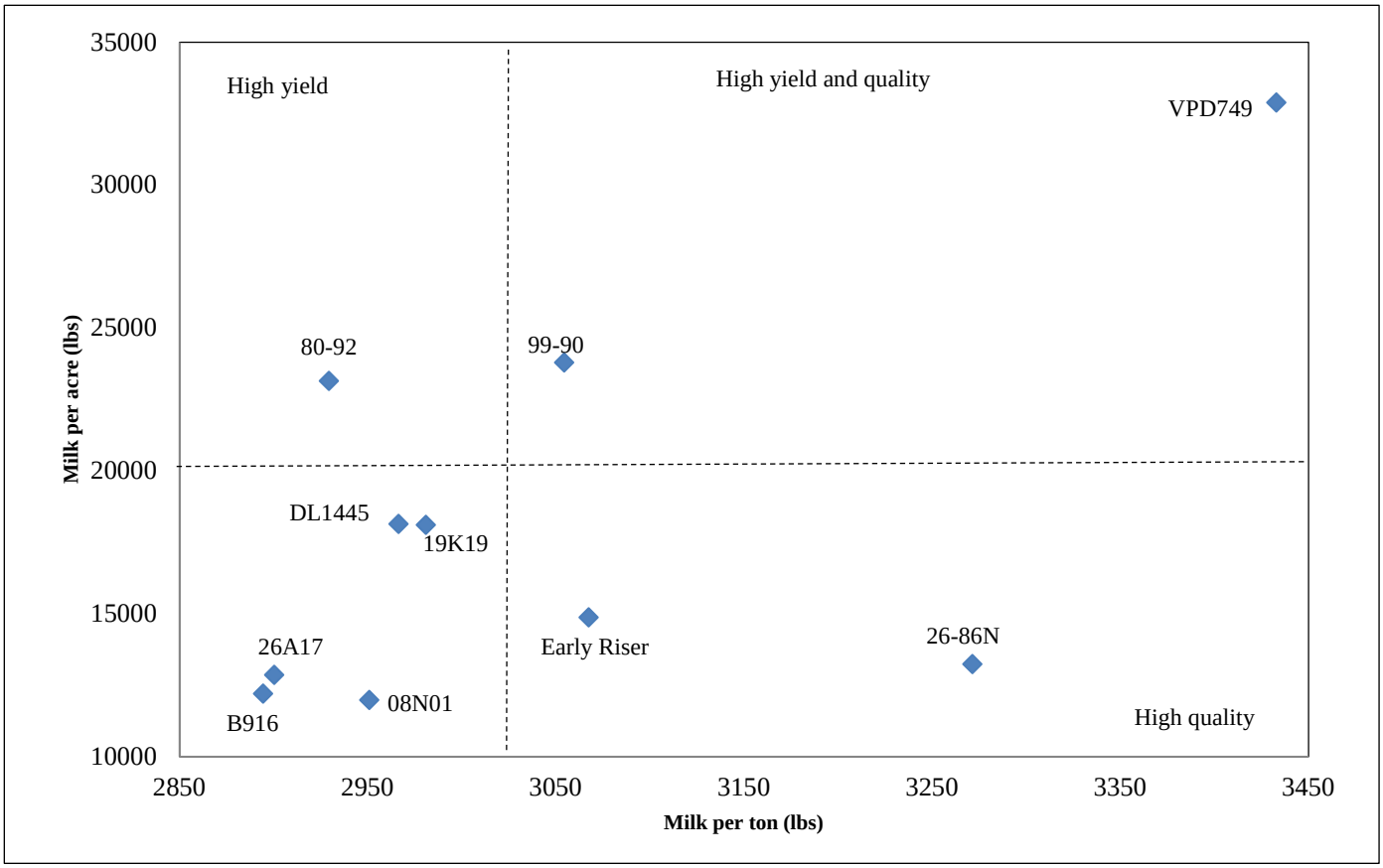

Figure 1. Milk performance of ten organic corn silage varieties. Dash line indicates an average milk per ton and milk per acre of the ten varieties evaluated.

DISCUSSION

Poor weather conditions throughout the 2011 growing season most likely resulted in poor corn stands. Interestingly some varieties seemed to be more impacted than others. This may indicate better early season vigor of some varieties. Mechanical weed control through tineweeding and cultivation may have also led to reduced stands. It is not uncommon to reduce plant stands through this type of weed control. Low plant populations may have also impacted yields of some corn varieties. Although a few of the lowest yielding varieties had adequate populations. Higher seeding rates may be required to reach adequate final plant populations in organic corn.

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