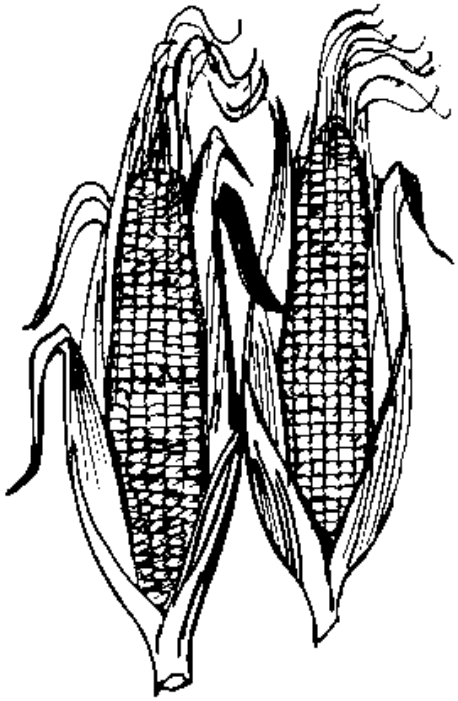
NORTHWEST CROPS & SOILS PROGRAM

2013 Short Season
Corn Silage Variety Trial



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UNIVERSITY OF VERMONT EXTENSION
CULTIVATING HEALTHY COMMUNITIES

2013 SHORT SEASON CORN SILAGE VARIETY TRIAL

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In 2013, the University of Vermont Extension Northwest Crops and Soils Team evaluated yield and quality of short season corn silage varieties at Borderview Research Farm in Alburgh, VT. While short season corn is an obvious choice in areas that accumulate fewer Growing Degree Days (GDDs), it also has a place in longer season areas. Past UVM Extension variety trials have shown that many shorter season corn varieties can have comparable yield and quality to longer season corn. Growing a shorter season variety can also provide other benefits such as an earlier harvest allowing for more time in the fall for planting of cover crops and manure applications. It is important to remember that the data presented in this report is from a single year. Hybrid-performance data from additional tests over several years should be compared before making varietal selections.

MATERIALS AND METHODS

Several seed companies submitted varieties for evaluation. Companies and contact names are listed in Table 1. Twenty-seven corn varieties were evaluated, ranging in relative maturity (RM) from 79 to 99 days. Specific varieties, their traits, and RM are listed in Table 2.

Table 1. Participating companies and local contact information.

Dekalb/Monsanto	Mycogen	Pioneer	Seedway	T.A. Seeds
Klaus Busch Territory Sales Manager Knox, NY 518-320-2462	Claude Fortin District Sales Manager Highgate, VT 802-363-2803	Jacob Bourdeau Bourdeau Bros. Sheldon, VT 802-933-2277	Ed Schillawski 3442 Rt. 22A Shoreham, VT 802-897-2281	Cory Chelko 39 Seeds lane Jersey Shore, PA 866-813-SEED

Table 2. Short season silage corn varieties evaluated in Alburgh, VT.

Company	Hybrid	RM (Days)	Traits
Dekalb	DKC36-30	86	GENVT2P
Dekalb	DKC43-10	93	GENVT2P
Dekalb	DKC43-48	93	GENVT2P
Dekalb	DKC44-13	94	SSX
Mycogen	2H079	79	HXI/LL
Mycogen	X13004XR	80	Herculex Xtra
Mycogen	2R158	83	SSX/LL/RR2
Mycogen	F2F298	88	HXI/LL/RR2
Mycogen	TMF2Q298	89	SSX/LL/RR
Mycogen	X12301S3	91	SSX/RR
Mycogen	F2F343	92	RR2
Mycogen	X12309GH	93	Agrisure corn borer, RR/LL and root worm

Mycogen	X13432S3R1	93	SmartStax
Mycogen	X13322GM	94	Agrisure 3000GT
Mycogen	F2F387	95	HXI/LL/RR2
Mycogen	TMF2Q427	96	SSX/LL/RR2
Pioneer	P9690AM	93	AM/LL/RM
Pioneer	P9917AMX	93	AMX/LL/RR2
Seedway	SW2901L	86	Leafy
Seedway	SW2184RR	83	RR
Seedway	SW3937	94-96	Conventional BMR
Seedway	SW3804RR	95-97	RR
T.A. Seeds	TA290-31	89	GT/LL/BL/CB/RW
T.A. Seeds	TA304-02ND	89	RR
T.A. Seeds	TA33322DRR1B	91	GENVT2P
T.A. Seeds	TA370-30	92	Viptera 3110
T.A. Seeds	TA451-31	95	GT/LL/BL/CB/RW

Agrisure 3000GT - With corn borer and corn rootworm control, the Agrisure® 3000GT triple stack provides the ultimate in yield protection plus the flexibility to choose weed management practices that meet individual needs. It provides hybrids with excellent tolerance to in-season applications of glyphosate and glufosinate herbicides and protects against corn borer and corn rootworm.
AM - Optimum® AcreMax® Insect Protection system with YGCB, HX1, LL, RR2. Contains a single-bag integrated refuge solution for above-ground insects.
AMX - Optimum® AcreMax® Xtra Insect Protection system with YGCB, HXX, LL, RR2. Contains a single-bag integrated refuge solution for above- and below-ground insects.
BMR – Brown mid-rib, a naturally occurring gene.
GENVT2P - Genuity® VT Double PRO™ provides protection against corn earworm and other ear-feeding insects as well as fall armyworm, European corn borer, and corn earworm GT – Glyphosate herbicide (Roundup®, Touchdown®) tolerant.
HXI – Herculex I® provides protection against above-ground pests such as European corn borer, Western bean cutworm and black cutworm.
Herculex Xtra - Herculex® XTRA (HXX) insect protection offers a complete spectrum of in-plant above- and below- ground insect control, by combining the Herculex I and Herculex RW traits. Herculex XTRA provides consistent, season-long control of corn rootworms.
Leafy - Conventional hybrid.
LL – Glufosinate-ammonium herbicide (LibertyLink®) tolerant.
RR – Roundup Ready corn is glyphosate herbicide (Roundup®) tolerant.
RR2 – Roundup Ready corn is glyphosate herbicide (Roundup®, Touchdown®) tolerant.
SSX – SmartStax corn provides a broad spectrum of insect control, using multiple modes of action, as well as glyphosate herbicide (Roundup Ready®, Touchdown®) and glufosinate-ammonium (LibertyLink®) tolerance.
Argisure Viptera 3110 - The Agrisure Viptera® 3110 trait stack delivers unparalleled control of above-ground insects for growers who do not need to manage for corn rootworm.

The soil type at the Alburgh location was a Benson rocky silt loam (Table 3). The seedbed was spring disked followed by spike tooth harrow. The previous crop was sunflower. Starter fertilizer (10-20-20) was applied at a rate of 200 lbs per acre. Plots were 30' long and consisted of two 30-inch rows. They were planted with a John Deere 1750 planter on 14-May. The seeding rate was 34,000 seeds per acre. The plot design was a randomized complete block with three replications. Treatments were twenty-seven varieties. On 6-Jun Lumax (S-metolachlor, atrazine, and mesotrione) was sprayed at 3 quarts per acre and .33 oz. of Accent (Nicosulfuron) was sprayed at per acre for post emergence for weed control. Urea was side-dressed at a rate of 200 lbs per acre on 20-Jun, when the corn was at the V6 growth stage. Prior to corn harvest the severity of plant disease was recorded based on a visual rating of a 0 – 10 scale, where 0 indicates no disease and 10 indicates severe infection. On 25-Sep the corn was harvested with a John Deere 2-row chopper, and the forage wagon was weighed on a scale. 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 then adjusted to 35% dry matter.

Table 3. 2013 short season corn trial specifics for Alburgh, VT.

	Borderview Research Farm Alburgh, VT
Soil type	Rocky silt loam
Previous crop	Sunflower
Row width (in.)	30
Planting date	14-May
Harvest date	25-Sep
Tillage operations	Spring disk, spike tooth harrow
Starter fertilizer	200 lbs ac^{-1} 10-20-20
Sidedress	200 lbs ac^{-1} Urea

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, acid detergent fiber (ADF), neutral detergent fiber (NDF), 30-hour digestible NDF (NDFD), non-structural carbohydrates (NSC), 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 % 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 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-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 ADF and express the differences in digestible material between silages.

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 example below, 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

Weather data is recorded with a Davis Instrument Vantage PRO2 weather station, equipped with a WeatherLink data logger at Borderview Research Farm in Alburgh, VT. May and June were wetter than normal with an additional 6.88 inches (based on 1981-2010 data), however, July, August, and September all had less precipitation than normal (Table 4). June, August, and September had lower than normal average temperatures (based on 1981-2010 data). There were an accumulated 2,259 Growing Degree Days (GDDs) at a base temperature of 50 degrees Fahrenheit. This was 22 less GDDs than the historical 30-year average for May-September.

Table 4. 2013 weather data for Alburgh, VT.

Alburgh, VT	May	June	July	August	September
Average temperature (°F)	59.1	64.0	71.7	67.7	59.3
Departure from normal	2.7	-1.8	1.1	-1.1	-1.3
Precipitation (inches)	4.79	9.23 ǂ	1.89	2.41	2.20
Departure from normal	1.34	5.54	-2.26	-1.50	-1.44
Growing Degree Days (base 50°F)	312	427	677	554	289
Departure from normal	113	-47	37	-27	-29

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, VT.
ǂ June 2013 precipitation data based on National Weather Service data from cooperative stations in South Hero, VT. (http://www.nrcc.cornell.edu/page_summaries.html)

The average yield for the short season corn trial was 22.7 tons acre^{-1} at 35% dry matter (DM). The Mycogen variety 'TMF2Q427'yielded significantly higher (29.7 tons ac^{-1}) than most other varieties evaluated (Table 5). Other high yielding varieties include: Pioneer 'P9690AM' (29.6 tons ac^{-1}), Dekalb 'DKC43-10' (28.2 tons ac^{-1}), T.A. Seeds 'TA304-02ND' (26.4 tons ac^{-1}), Dekalb 'DKC44-13' (25.9 tons ac^{-}), and Mycogen 'X12301S3' (25.1 tons ac^{-1}). Yields ranged from 16.3 to 22.7 tons acre^{-1}. The average harvest (DM) for the trial was 41.2% (or 58.8% moisture content). The lowest DM was the Mycogen variety 'TMF2Q298' at 35.4% DM. The corn was harvested at less than ideal moistures due to wet conditions prior to harvest. Two varieties, Mycogen 'TMF2Q298' and T.A. Seeds 'TA33322DRR1B' had the lowest leaf disease rating of 1.00. The variety with the highest level of leaf disease was the Seedway variety 'SW3937' with a rating of 6.67.

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Table 5. Harvest characteristics of 27 short season corn silage varieties – Alburgh, VT, 2013.

Hybrid	RM	Harvest DM	Yield 35% DM	Plant disease
		%	tons ac^{-1}	1-10 scale
SW2184RR	83	42.7	17.5	5.00
2H079	79	43.0	19.9	6.33
2R158	83	48.5	19.1	5.67
SW3804RR	95-97	40.4	24.4	2.00*
DKC36-30	86	42.1	24.7	2.00*
DKC43-10	93	40.0*	28.2*	1.33*
DKC43-48	93	38.2*	23.3	1.67*
DKC44-13	94	39.0*	25.9*	1.33*
F2F298	88	42.0	16.3	4.67
F2F343	92	41.3	19.1	3.67
F2F387	95	37.0*	22.3	4.00
P9690AM	93	43.7	29.6*	3.33*
P9917AMX	93	40.7	23.0	1.33*
SW2901L	86	42.4	24.9	1.67*
SW3937	94-96	44.3	18.4	6.67
TA290-31	89	44.7	22.7	3.33*
TA304-02ND	89	38.7*	26.4*	1.67*
TA33322DRR1B	91	39.4*	21.5	**1.00***
TA370-30	92	41.8	20.2	2.67*
TA451-31	95	39.2*	24.1	1.67*
TMF2Q298	89	**35.4***	20.0	**1.00***
TMF2Q427	96	38.7*	**29.7***	1.33*
X12301S3	91	41.8	25.1*	3.00*
X12309GH	93	42.7	19.8	5.00
X13004XR	80	47.0	21.6	6.00
X13322GM	94	41.0	22.9	3.67
X13432S3R1	93	37.2*	23.2	1.33*
LSD (0.10)		4.81	4.68	2.48
Trial Mean		41.2	22.7	3.05

Treatments indicated in bold had the top observed performance.
* Varieties that did not perform significantly lower than the top performing variety in a particular column are indicated with an asterisk.

With the exception of neutral detergent fiber (NDF), all of the other forage quality parameters were significantly different among the 27 varieties evaluated (Table 6). Short season corn variety 'TMF2Q298' (Mycogen) produced the highest CP (7.71%), although this was not statistically different from 'TMF2Q427' (Mycogen), 'SW2184RR' (Seedway), 'F2F387' (Mycogen), 'F2F343' (Mycogen), 'SW3937' (Seedway), 'TA33322DRR1B' (T.A. Seeds), or 'DKC44-13' (Dekalb). The variety with the lowest percent of ADF was '2R158' (Mycogen), although not significant, this variety also had the lowest percent NDF. The BMR variety 'F2F387' (Mycogen) had the highest percent NDFD at 64.3%. The

Mycogen variety '2R158' had both the highest percent starch (43.2%) and NSC (40.9%). The short season corn variety with highest percent nutrient digestibility (TDN) and NE_L (Mcal lb^{-1}) was 'SW3937' (Seedway), although this was not significantly different from '2R158' (Mycogen), 'F2F298' (Mycogen), 'F2F343' (Mycogen), 'P9917AMX' (Pioneer), 'TA290-31' (T.A. Seeds), 'X12309GH' (Mycogen), 'SW2901L' (Seedway), 'X13004XR' (Mycogen), and 'TA370-30' (TA Seeds). The Seedway variety 'SW3937' had the highest milk per ton^{-1} with 2938 lbs. Other short season corn varieties with high milk per ton^{-1} values were; '2R158' (Mycogen), 'F2F298' (Mycogen), 'F2F343' (Mycogen), 'SW2901L' (Seedway), and 'P9917AMX' (Pioneer). The variety with the highest milk per acre was'TMF2Q427' (Mycogen) at 28183 lbs, however this was not statistically different from 'P9690AM' (Pioneer), DKC43-10 (Dekalb), TA304-02ND (T.A. Seeds), 'DKC44-13' (Dekalb), 'SW2901L' (Seedway), 'X12301S3' (Mycogen), and 'SW3804RR' (Seedway).

Table 6. Forage quality of 27 short season corn silage varieties - Alburgh, VT, 2013.

Hybrid	RM	Forage quality characteristics								Milk	
		CP % of DM	ADF % of DM	NDF % of DM	NDFD % of NDF	Starch %	NSC %	TDN %	NE_L Mcal lb^{-1}	ton^{-1} lbs	$acre^{-1}$ lbs
SW2184RR	83	7.55*	24.5	43.3	57.8	31.6	33.8	70.6	0.73	2721	16736
2H079	79	6.63	23.6	41.9	58.1	35.1	35.3	70.9	0.73	2605	18448
2R158	83	6.45	**19.8***	**36.4**	50.5	**43.2***	**40.9**	75.5*	0.79*	2861*	19272
SW3804RR	95-97	6.38	22.8	39.7	49.5	39.0*	37.4	72.6	0.75	2756	23566*
DKC36-30	86	6.31	24.2	42.6	55.7	34.0	34.3	71.2	0.74	2664	23099
DKC43-10	93	6.50	25.5	43.3	52.0	33.9	35.4	71.4	0.74	2684	26651*
DKC43-48	93	6.75	25.1	44.0	53.2	32.7	34.4	70.5	0.73	2633	21443
DKC44-13	94	7.11*	23.0	40.9	50.9	37.1	36.5	71.9	0.75	2742	24915*
F2F298	88	6.80	21.7*	39.8	60.6	38.2	38.8	75.0*	0.78*	2866*	16341
F2F343	92	7.39*	22.1	40.8	60.2	36.7	38.0	75.0*	0.78*	2911*	19385
F2F387	95	7.51*	24.2	43.9	**64.3***	31.9	34.4	71.9	0.75	2782	21686
P9690AM	93	6.30	24.2	41.1	50.4	37.6	38.2	72.9	0.76	2702	28157*
P9917AMX	93	6.40	23.5	39.3	51.1	39.8*	39.9	74.5*	0.78*	2801*	22566
SW2901L	86	6.44	22.5	38.4	54.6	38.8*	38.4	73.5*	0.76*	2807*	24465*
SW3937	94-96	7.18*	21.0*	38.4	58.4	39.6*	39.7	**75.9***	**0.79***	**2938***	17991
TA290-31	89	5.95	23.2	40.7	52.7	37.7	39.3	74.1*	0.77*	2722	21676
TA304-02ND	89	6.77	24.6	42.8	53.7	34.1	34.9	71.6	0.74	2707	25236*
TA33322DRR1B	91	7.14*	24.3	41.9	52.4	36.4	37.2	73.0	0.76	2759	20775
TA370-30	92	5.94	23.5	40.1	51.6	37.9	38.1	73.2*	0.76*	2704	19089
TA451-31	95	5.95	26.6	45.9	50.1	31.7	33.7	69.4	0.72	2457	20719
TMF2Q298	89	**7.71***	23.7	41.1	57.0	35.6	35.5	71.7	0.74	2779	19712
TMF2Q427	96	7.58*	24.3	43.5	54.1	34.1	34.5	71.0	0.74	2714	**28183***
X12301S3	91	6.13	22.7	40.4	51.3	37.5	38.1	73.0	0.76	2677	23651*
X12309GH	93	6.12	22.0*	40.1	49.4	40.2*	39.3	74.1*	0.77*	2683	18557
X13004XR	80	5.89	23.3	41.9	52.1	36.3	38.3	73.5*	0.76*	2660	19842
X13322GM	94	6.28	24.6	42.9	52.6	35.0	36.2	72.0	0.75	2688	21583
X13432S3R1	93	6.40	23.9	41.7	50.7	36.8	36.5	72.3	0.75	2721	22241
LSD (0.10)		0.82	2.24	NS	3.59	4.95	NS	4.23	0.03	166	4992
Trial Mean		6.65	23.5	41.4	53.9	36.4	36.9	72.7	0.75	2731	21703

Treatments indicated in bold had the top observed performance.
NS – no statistical significance was determined between varieties.

* Varieties that did not perform significantly lower than the top performing variety in a particular column are indicated with an asterisk.

Figure 1 displays the relationship between milk per ton and milk per acre for varieties trialed in Alburgh, VT. The dotted lines dividing the figure into four quadrants represent the mean milk per ton and acre for the location. Hybrids that fall above or to the right of the lines performed better than the average, and hybrids below or to the left of the lines performed below average. There were many varieties at the Alburgh location that ranked above average in yield and quality. Varietal selection should be based on the goals of the farm as well as data compared from multiple sites and years.

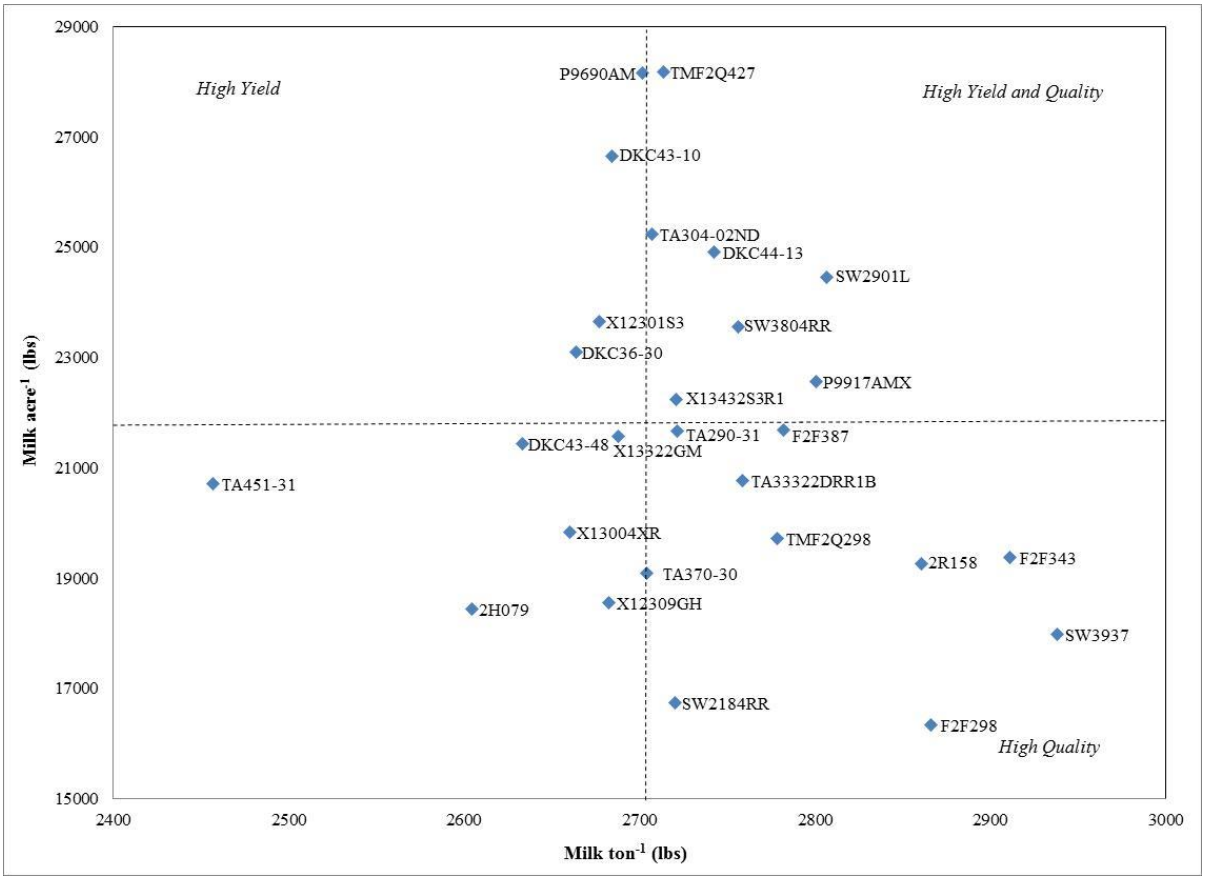

Figure 1. Relationship between milk per ton and milk per ac^{-1} for short season corn silage varieties grown in Alburgh, VT. *Dotted lines represent the mean milk per ton^{-1} and milk per ac^{-1}.*

DISCUSSION

It is important to remember that the results only represent one year of data. The fields dried out and temperatures warmed in April allowing us to plant this trial a week earlier (14-May) than in 2012. However, the cool wet weather in June delayed corn development and resulted in harvesting two weeks later (25-Sep) than the previous year. All varieties reached proper maturity for harvest at Borderview Research Farm in Alburgh, VT. It is important to note that several varieties were higher than the desired 35% DM at the time of harvest. There was no severe lodging of corn stalks. However, there was a high

incidence of corn leaf disease (Northern Corn Leaf Blight and Grey Leaf Spot) this year. This could be attributed to prolonged wetness and cool temperatures during late season corn growth.

All the protein levels were lower than in previous years. The highest protein level this year was 2.5% lower than in 2012. The overly wet conditions during planting and topdress could have eroded away plant available nitrogen, resulting in lower protein.

The range of yields was between 16.3 and 29.7 tons per acre, indicating the importance of proper varietal selection to maximize short season corn yields. The Mycogen variety 'TMF2Q427' yielded the highest and had the most milk per acre. Several short season varieties yielded well and produced high quality feed.

ACKNOWLEDGEMENTS

UVM Extension would like to thank Roger Rainville and the staff at Borderview Research Farm for their generous help with this research trial. We would like to acknowledge Laura Madden, Katie Blair and Ben Leduc for their assistance with data collection and entry. We would also like to thank Klaus Busch of Dekalb/Monsanto, Claude Fortin of Mycogen, Ed Schillawski of Seedway, Jacob Bourdeau of Pioneer, and Corey Chelko of T.A. Seeds for the hybrid seed donation. The information is presented with the understanding that no product discrimination is intended and no endorsement of any product mentioned or criticism of unnamed products is implied.

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