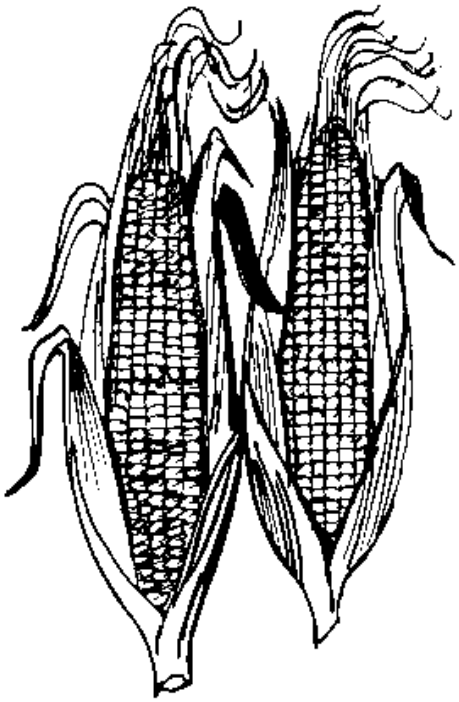
NORTHWEST CROPS & SOILS PROGRAM

2015 Short Season Corn Silage Variety Trial



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UNIVERSITY OF VERMONT EXTENSION
CULTIVATING HEALTHY COMMUNITIES

2015 SHORT SEASON CORN SILAGE VARIETY TRIAL

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In 2015, 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. Growing a shorter season variety can allow for more time in the fall to adequately prepare the soil for winter by applying manure and planting cover crops, thereby minimizing nutrient and soil losses. In addition to these benefits, past UVM Extension variety trials have shown that many of these shorter season corn varieties can have comparable yield and quality to longer season corn varieties. It is important to remember that the data presented in this report are from a single year. Hybrid-performance data from additional tests over several years should be compared when making varietal selections.

MATERIALS AND METHODS

Several seed companies submitted varieties for evaluation (Table 1). Forty-seven corn varieties were evaluated, ranging in relative maturity (RM) from 79 to 95 days. Details for the varieties including company, genetic traits, and RM are listed in Table 2.

Table 1. Participating companies and contact information.

DEKALB	Mycogen	Spectrum Seeds	Chemgro	Albert Lea/Viking
Klaus Busch Knox, NY (518) 320-2462	Claude Fortin Highgate, VT (802) 363-2803	Linden, IN (866) 400-9468	Donald Upton Clayton, NY (315) 436-1080	Mac Ehrhardt Albert Lea, MN (507) 383-1070

Seedway	T.A. Seeds	Syngenta	NuSeed/Legend Seed
Ed Schillawski Shoreham, VT (802) 897-2281	Cory Chelko Jersey Shore, PA (866) 813-7333	Alvin Winslow New Glouster, ME (207) 740-8248	Alsip, IL (800) 678-3346

Table 2. Short season silage corn varieties evaluated in Alburgh, VT, 2015.

Variety	Company	Traits	RM
X13002SR	Mycogen	RR	79
2H079	Mycogen	HXT, LL, RR	79
0.87-80N	Albert Lea/Viking	NonGMO	80
SW1994GT	Seedway	GT	80
2823	NuSeed/Legend	NonGMO	82
TA232-00	TA Seeds	NonGMO	83

N18Q-3011A	Syngenta	Agrisure Artesian 3011A	84
SW2400	Seedway	GENSS RIB	84
SW2754RR	Seedway	RR2	85
60-85N UNR	Albert Lea/Viking	NonGMO	85
N20Y-3122	Syngenta	Agrisure 3122	85
2P198	Mycogen	SSX	85
0.44-86N	Albert Lea/Viking	NonGMO	86
SW2349	Seedway	Agrisure 3000GT	86
TA266-22DP	TA Seeds	GENVT2P RIB	86
35-87N UNT	Albert Lea/Viking	NonGMO	87
SW2901L	Seedway	NonGMO	87
F2F298	Mycogen	BMR, HX1, LL, RR2	88-90
TA089-00	TA Seeds	NonGMO	89
TA304-02ND	TA Seeds	CM250, RR2	89
SW3654RR	Seedway	RR2	90
0.85-90N	Albert Lea/Viking	NonGMO	90
4130	Spectrum	NonGMO	90
T12101VH	Mycogen	GENSS RIB	91
90-91N	Albert Lea/Viking	NonGMO	91
5141RRN	Chemgro	RR2	91
DKC39-27	DEKALB	GENSS RIB	91
TA333-28	TA Seeds	GENSS RIB, CM250	91
TMF2Q309	Mycogen	GENSSRIB	91
TA370-00	TA Seeds	NonGMO	92
4216	Spectrum	NonGMO	92
N29T-3111	Syngenta	Agrisure Viptera 3111	92
5245RDP	Chemgro	GENSS RIB	92
SW3600	Seedway	GENSS RIB	92
42-92N UNF	Albert Lea/Viking	NonGMO	92
DKC43-48	DEKALB	VT3PRIB	93
SW3937	Seedway	NonGMO	93
N31H-3000GT	Syngenta	Agrisure 3000GT	93
TMF2L395	Mycogen	RR2	94
TA094-00	TA Seeds	NonGMO	94
DKC45-07	DEKALB	GENSSRIB	95
N35T-3110	Syngenta	Agrisure Viptera 3110	95
F2F346	Mycogen	HX1, LL, RR2	92-95
F2F379	Mycogen	GENSS RIB, LL, RR2, RA	95
0.24-95N	Albert Lea/Viking	NonGMO	95
51-95N	Albert Lea/Viking	NonGMO	95
T12302VH	Mycogen	GENSS RIB	95

Agrisure® 3000GT- corn borer control, corn rootworm control, glyphosate tolerant, glufosinate tolerant.
Agrisure® Artesian 3011A- protection from corn borer and corn rootworm, Agrisure Artesian drought tolerance and herbicide tolerance

Agrisure® Viptera® 3110- Agrisure Viptera trait for broad spectrum insect control + Agrisure GT/CB/LL trait stack for herbicide tolerance
Agrisure® Viptera® 3111- Agrisure 3000GT + Agrisure Viptera trait for broad spectrum insect control and glyphosate tolerance
Agrisure® 3122 – protects against corn borer, rootworm, glyphosate tolerant, 5% integrated, single-bag refuge
BMR- Brown mid rib, a naturally-occurring gene
CM250-CruiserMaxx®Corn250
GENSS RIB- Genuity® SmartStax®RIB Complete® provides broad spectrum protection against corn earworm and other ear-feeding insects as well as fall armyworm, European corn borer, and corn earworm with multiple modes of action; glyphosate herbicide tolerance ((Roundup Ready®, Touchdown®) and glufosinate-ammonium (LibertyLink®)). Bags of this seed also contain refuge seed mixed in eliminating the need for a separate refuge (Refuge-in-bag).
GENVT2P RIB- Genuity® VT Double PRO™ RIB Complete® provides protection against corn earworm and other ear-feeding insects as well as fall armyworm, European corn borer, and corn earworm. Bags of this seed also contain refuge seed mixed in, eliminating the need for a separate refuge (Refuge-in-bag).
GENVT3- Genuity® VT Triple PRO™ same as double with addition of rootworm trait
GT- Glyphosate tolerant.
HX1- Herculex® I Insect Protection, glyphosate (Roundup®, Touchdown®) tolerant and glufosinate (Ignite®) herbicide tolerance
HXT- Herculex Xtra®, provides season-long insect protection from corn borer, cutworm, corn rootworm, armyworm and more
LL – Glufosinate-ammonium herbicide (LibertyLink®) tolerant.
RA- Refuge Advanced® contains refuge seed mixed in with hybrid seed eliminating the need to plant a separate refuge.
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.

The soil types at the Alburgh location was Benson rocky silt loam (Table 3). The seedbed was spring disked followed by spike tooth harrow. The previous crop was cover crops. Starter fertilizer (10-20-20) was applied at a rate of 150 lbs per acre. Plots were 30' long and consisted of two rows spaced at 30 inches planted with a John Deere 1750 planter. The seeding rate was 34,000 seeds per acre. The plot design was a randomized complete block with three replications. The treatments were 47 varieties that ranged in relative maturity from 79 to 95 days. Lumax ® (S-metolachlor, atrazine, and mesotrione) was sprayed at 3 quarts per acre for post emergence weed control within a week after planting. Urea (46-0-0) was side-dressed at a rate of 240 lbs per acre on 19-Jun.

Table 3. 2015 short season corn trial specifics for Alburgh, VT.

	Borderview Research Farm Alburgh, VT
Soil types	Swanton fine sandy loam 0-3% slope Benson rocky silt loam 8-15% slope
Previous crop	Cover crops
Row width (in.)	30
Planting date	15-May
Harvest date	22-Sep
Tillage operations	Spring disk, spike tooth harrow
Starter fertilizer	150 lbs ac^{-1} 10-20-20
Side-dress	240 lbs ac^{-1} 46-0-0

Prior to corn harvest, plot populations were counted. On 22-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 silage quality. The samples were ground through a Wiley mill (2mm screen), and then through a UDY Corporation cyclone sample mill (1mm screen). The samples were then analyzed using the FOSS NIRS (near infrared reflectance spectroscopy) DS2500 Feed and Forage

analyzer for crude protein (CP), starch, acid detergent fiber (ADF), neutral detergent fiber (NDF), 30-hour digestible NDF (NDFD), total digestible nutrients (TDN), and milk per ton. Dry matter yields were calculated and then adjusted to 35% dry matter.

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 neutral detergent fiber (NDF). This fraction includes cellulose, hemicellulose, and lignin. Because these components are associated 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. 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. However, it 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. 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 starch values exceeding 40%. 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.

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. In this 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

Weather data was recorded with a Davis Instrument Vantage PRO2 weather station, equipped with a WeatherLink data logger at Borderview Research Farm in Alburgh, VT. June was a wet month with 2.73 more inches of precipitation than normal (Table 4). The remainder of the summer was relatively dry with 9.92 fewer inches of precipitation than normal over July, August, and September. Temperature varied with May and September being much warmer than the 30 year average. Overall, there were an accumulated 2500 GDDs this season, approximately 289 more than the historical 30-year average.

Table 4. 2015 weather data for Alburgh, VT.

Alburgh, VT	May	June	July	August	September	October
Average temperature (°F)	61.9	63.1	70.0	69.7	65.2	50.7
Departure from normal	5.5	-2.7	-0.6	0.9	4.6	2.5
Precipitation (inches)	1.94	6.42	1.45	0.00	0.34	0.04
Departure from normal	-1.51	2.73	-2.70	-3.91	-3.30	-3.56
Growing Degree Days (base 50°F)	376	399	630	626	470	36.7
Departure from normal	177	-75	-10	45	152	49.2

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.

The average dry matter content of the short season corn silage trial was 51.0% (Table 5). The dry matter at harvest was lower than recommended due to severe leaf blight infection. The average yield at 35% dry matter for the trial was 27.4 tons per acre (Table 5, Figure 1). The highest yielding variety was Mycogen's TMF2L395 which yielded 36.2 tons per acre. Other varieties including 0.87-80N, TA232-00, SW2754RR, 35-87N UNT, SW2901L, T12101VH, TA333-28, TA370-00, 42-92N UNF, 4216, N29T-3111, SW3600, DKC43-48, and N35T-3110 had yields that were not significantly different from the top yielder.

Table 5. Harvest characteristics of short season corn silage varieties – Alburgh, VT, 2015.

Variety	Relative maturity	Harvest DM %	Yield 35% DM tons ac^{-1}	Population plants ac^{-1}
X13002SR	79	50.7	26.8	36978
2H079	79	49.9	20.2	36978
0.87-80N	80	53.8	30.6	25846
SW1994GT	80	46.8	27.3	33977
2823	82	47.8	21.3	36784
TA232-00	83	58.2	29.7	37946
SW2400	84	62.0	24.4	38526
N18Q-3011A	84	61.0	27.9	34848
SW2754RR	85	43.3	29.3	38236
2P198	85	52.9	22.3	34170
N20Y-3122	85	52.9	25.9	36300
60-85N UNR	85	50.5	27.7	30686
TA266-22DP	86	53.0	27.8	37655
SW2349	86	51.2	22.0	36687
0.44-86N	86	46.8	25.6	31750
35-87N UNT	87	46.9	31.1	31654
SW2901L	87	50.6	31.5	32718
F2F298	88-90	52.8	20.4	37946
TA304-02ND	89	47.4	25.9	36590
TA089-00	89	49.3	22.8	36687
SW3654RR	90	49.9	26.6	37074
4130	90	51.0	28.1	33686
0.85-90N	90	49.7	26.5	30105
T12101VH	91	52.2	35.7	37558
90-91N	91	45.3	27.5	29137
DKC39-27	91	62.8	25.5	36978
5141RRN	91	47.9	19.7	35235
TMF2Q309	91	53.2	23.1	34461
TA333-28	91	45.5	30.8	34751
TA370-00	92	50.2	31.7	36010
42-92N UNF	92	46.6	32.8	33106
4216	92	58.7	30.0	38236
5245RDP	92	56.4	28.2	23135
N29T-3111	92	61.1	31.4	36590
SW3600	92	52.8	30.0	38333
SW3937	93	64.0	23.8	37752
N31H-3000GT	93	54.0	27.3	35042
DKC43-48	93	49.0	34.2	35429
TA094-00	94	49.4	24.8	31460
TMF2L395	94	50.1	36.2	36300
DKC45-07	95	50.1	28.0	37074
F2F346	92-95	46.3	26.8	34654
F2F379	95	46.1	27.2	37074
N35T-3110	95	49.3	35.4	37558
T12302VH	95	37.0	24.1	35138
0.24-95N	95	46.0	26.4	33202
51-95N	95	45.4	27.0	31170

LSD (0.10)	--	6.9	7.9	3625
Trial Mean	89	51.0	27.4	34877

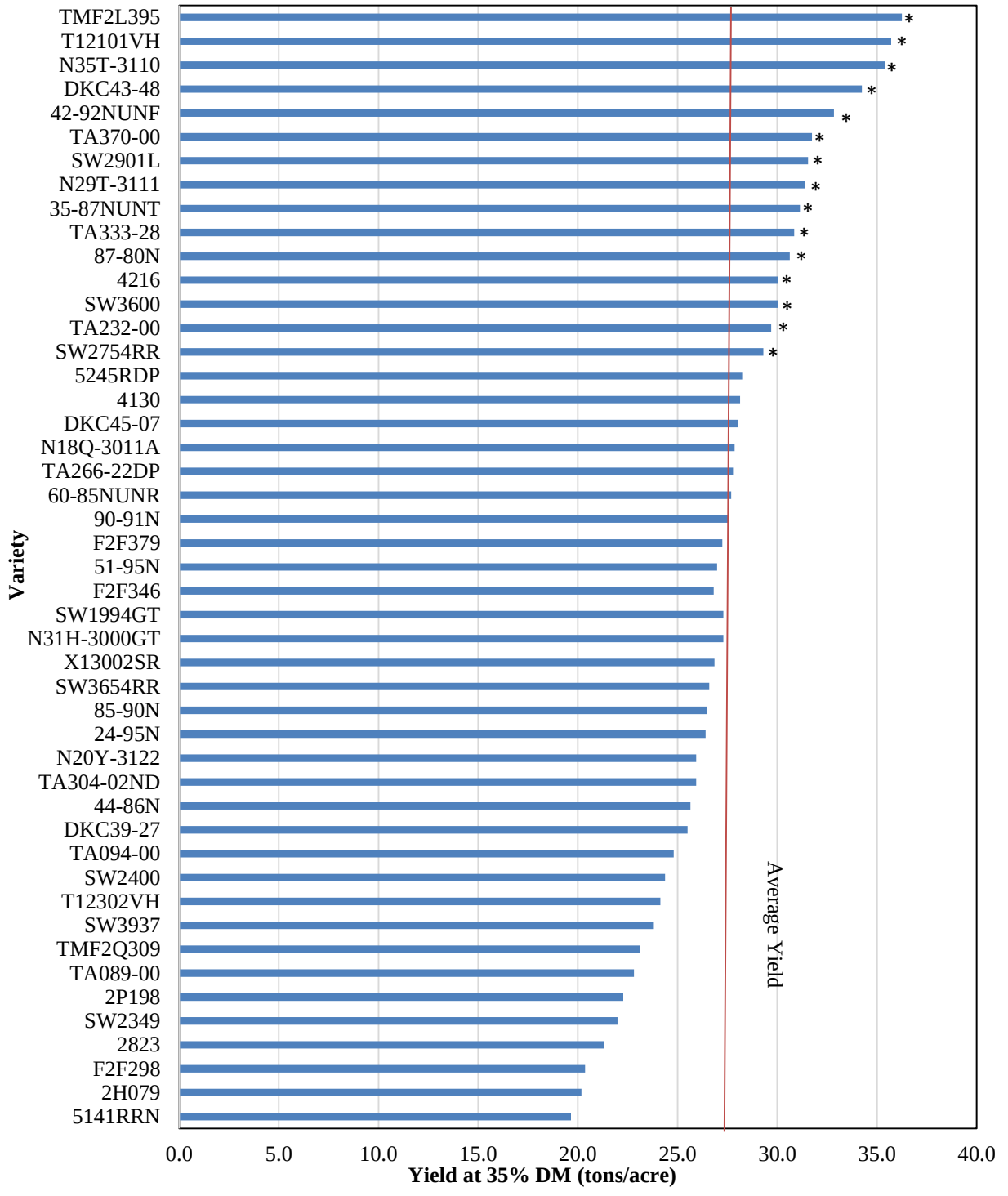

Figure 1. Yield at 35% moisture for 47 short season corn silage varieties. The red line indicates the average yield.

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

All forage quality characteristics varied statistically across varieties (Table 6). Forage quality of the varieties was high throughout the trial. However, some varieties with extreme susceptibility to leaf blight had quality compromised from this infection.

Table 6. Forage quality of 47 short season corn silage varieties - Alburgh, VT, 2015.

Variety	RM	Forage quality characteristics							Milk	
		CP	ADF	NDF	NDFD	Starch	TDN	NE_L	ton^{-1}	$acre^{-1}$
		% of DM	% of DM	% of DM	% of NDF	%	%	Mcal lb^{-1}	lbs	lbs
X13002SR	79	7.6	21.0	42.7	46.5	44.7	63.4	0.63	2775	26116
2H079	79	7.5	22.7	43.8	46.5	40.8	63.3	0.63	2772	20166
0.87-80N	80	6.1	18.4	37.3	47.8	54.4	68.9	0.70	3185	34260
SW1994GT	80	7.0	27.5	49.5	47.1	33.8	63.1	0.63	2776	26527
2823	82	7.2	20.7	40.2	45.8	47.2	66.0	0.67	2983	22289
TA232-00	83	6.5	22.4	42.8	45.3	44.9	64.6	0.65	2883	29872
SW2400	84	7.1	21.0	42.9	44.7	44.5	63.7	0.64	2817	24017
N18Q-3011A	84	6.4	22.8	45.3	44.9	41.6	62.9	0.63	2761	26966
SW2754RR	85	7.2	25.0	45.7	46.8	38.0	65.0	0.66	2920	29893
2P198	85	7.1	22.6	44.3	44.9	41.6	63.0	0.63	2771	21546
N20Y-3122	85	6.5	26.3	48.8	45.2	35.5	61.4	0.62	2659	24131
60-85N UNR	85	6.3	22.9	43.1	46.7	45.4	66.1	0.67	3001	29340
TA266-22DP	86	6.6	24.0	46.6	45.1	39.1	62.3	0.63	2720	26387
SW2349	86	7.4	22.9	43.6	46.5	40.8	65.3	0.66	2933	22475
0.44-86N	86	5.8	22.2	43.0	47.1	47.4	66.1	0.67	2987	26891
35-87N UNT	87	5.9	20.6	39.6	47.2	50.3	68.1	0.69	3134	34109
SW2901L	87	6.8	24.2	44.8	46.6	41.1	65.3	0.66	2937	32438
F2F298	88-90	7.3	25.2	50.0	44.0	36.6	58.9	0.59	2479	17777
TA304-02ND	89	6.9	23.9	45.1	47.3	40.0	65.2	0.66	2930	26622
TA089-00	89	7.2	25.7	47.7	47.3	35.0	64.9	0.65	2910	23328
SW3654RR	90	7.2	22.5	41.8	45.9	44.8	65.6	0.66	2955	27511
4130	90	6.5	23.3	45.0	46.1	43.1	63.9	0.64	2836	27945
0.85-90N	90	5.9	22.5	42.3	47.0	49.0	66.3	0.67	3007	27427
T12101VH	91	6.9	25.0	47.0	45.6	39.3	63.0	0.63	2772	34432
90-91N	91	5.7	21.5	40.9	47.7	49.6	67.5	0.68	3090	29853
DKC39-27	91	6.8	21.4	43.2	44.5	44.1	63.7	0.64	2818	25213
5141RRN	91	7.2	23.3	44.6	46.1	39.4	64.3	0.65	2862	19771
TMF2Q309	91	6.7	24.0	49.6	44.8	37.9	60.0	0.60	2556	20704
TA333-28	91	6.6	24.9	46.1	47.9	38.2	66.0	0.67	2993	32307
TA370-00	92	6.6	20.4	37.9	45.9	50.7	67.6	0.68	3099	34234
42-92N UNF	92	5.2	20.2	39.1	46.7	53.6	67.5	0.68	3093	35652
4216	92	6.3	21.7	43.1	44.8	44.5	63.9	0.64	2836	29734
5245RDP	92	6.4	24.3	47.3	44.8	39.3	61.7	0.62	2680	26484
N29T-3111	92	6.6	20.1	38.4	44.9	51.8	66.4	0.67	3014	33197
SW3600	92	6.8	22.8	43.8	45.4	42.3	63.8	0.64	2828	29845
SW3937	93	7.8	25.4	51.0	43.9	36.1	58.1	0.58	2418	20409
N31H-3000GT	93	7.5	22.6	43.7	44.6	42.2	63.7	0.64	2824	27215
DKC43-48	93	6.5	24.4	45.9	46.5	39.9	64.7	0.65	2894	34769
TA094-00	94	7.8	25.2	47.3	44.9	34.8	62.2	0.63	2717	23328

TMF2L395	94	6.8	24.2	45.1	45.6	41.3	63.9	0.64	2841	36057
DKC45-07	95	7.7	24.0	44.7	45.1	38.4	63.9	0.64	2839	27855
F2F346	92-95	6.8	23.5	44.9	46.6	40.9	64.3	0.65	2855	26839
F2F379	95	8.0	22.9	44.6	46.0	40.6	64.1	0.65	2847	27198
N35T-3110	95	7.0	23.9	42.9	46.6	42.5	66.4	0.67	3019	37534
T12302VH	95	6.8	27.0	49.8	44.3	36.2	61.0	0.62	2641	22590
0.24-95N	95	5.9	21.3	41.5	47.1	47.4	66.2	0.67	2990	27653
51-95N	95	5.9	23.0	44.0	46.6	44.3	65.2	0.66	2930	27766
LSD (0.10)		0.67	2.70	4.82	1.45	6.39	3.24	0.03	231	8531
Trial Mean		6.8	23.1	44.3	45.9	42.4	64.3	0.65	2864	27631

Figure 2 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. Varietal selection should be based on the goals of the farm as well as data compared from multiple sites and years.

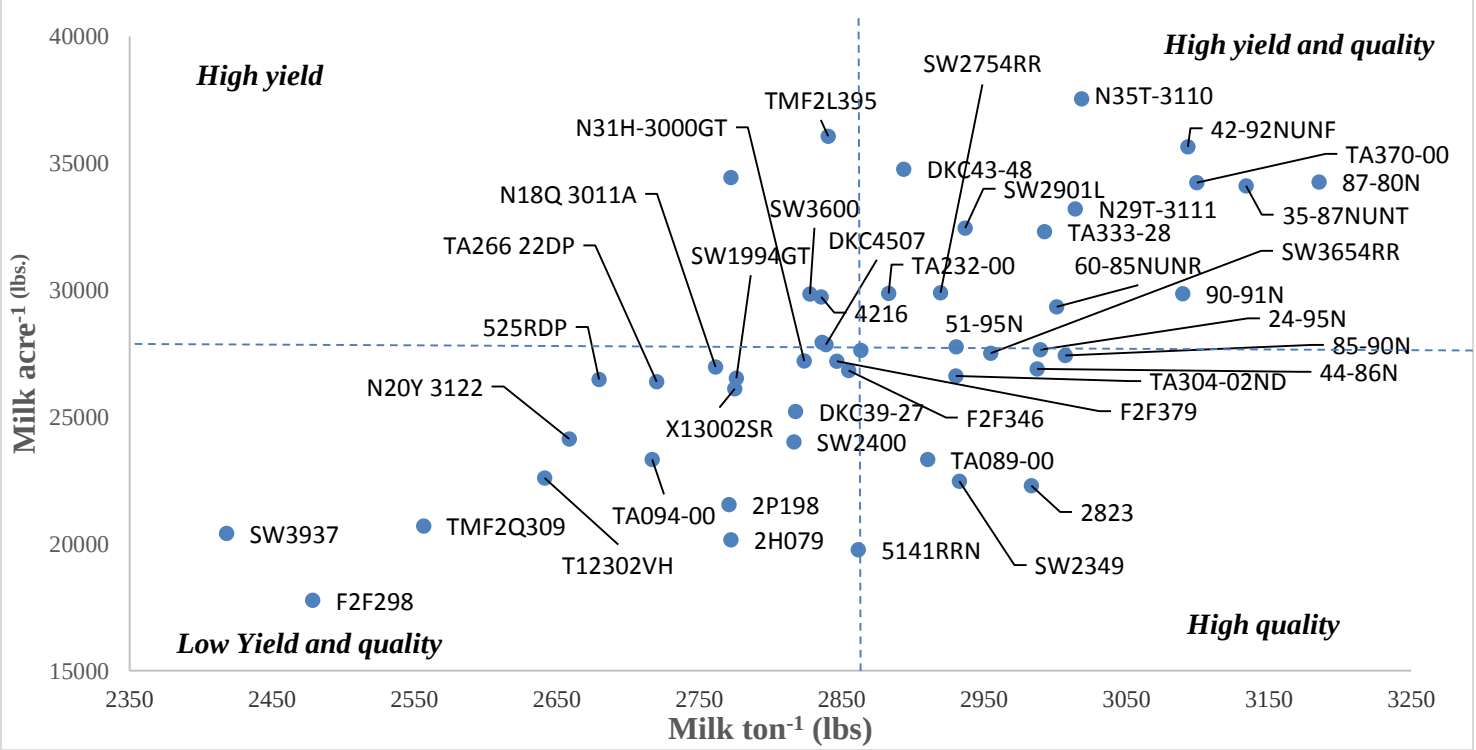

Figure 2. Relationship between milk per ton and milk per ac^{-1} for short season corn silage varieties grown in Alburgh, VT. Dotted lines represent the mean milk per ton^{-1} and milk per ac^{-1}.

DISCUSSION

It is important to remember that the results only represent one year of data. This season was favorable for silage corn, with a warm May and September allowing varieties to reach proper maturity for harvest. It is important to note that all varieties were higher than the desired 35% DM at the time of harvest. This was likely due to leaf blight plaguing the area in late August. Much of the leafy material was brown and degraded at harvest. There was no severe lodging of corn stalks. Yields ranged from 36.2 to 19.7 tons per acre, indicating the importance of proper varietal selection to maximize short season corn yields. Several short season varieties yielded well and produced high quality feed.

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