2014

Short Season Corn Silage Variety Trial

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NORTHWEST CROPS & SOILS PROGRAM

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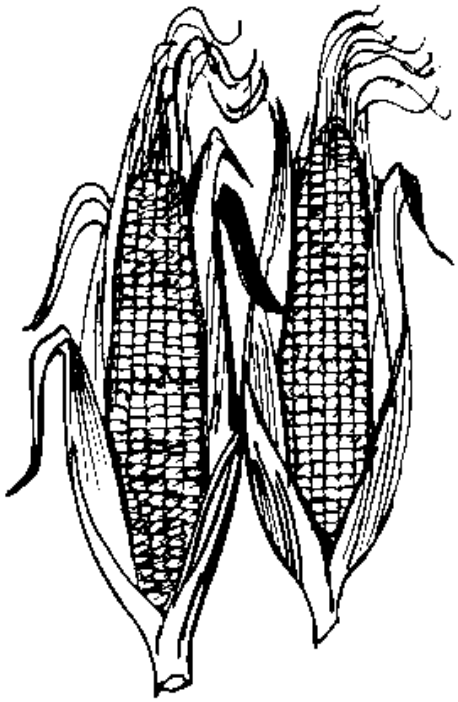

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UNIVERSITY OF VERMONT EXTENSION
CULTIVATING HEALTHY COMMUNITIES

2014 SHORT SEASON CORN SILAGE VARIETY TRIAL

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In 2014, 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). Twenty-nine corn varieties were evaluated, ranging in relative maturity (RM) from 77 to 95 days. Details for the varieties including company, their traits, and RM are listed in Table 2.

Table 1. Participating companies and local contact information.

Dekalb	Mycogen	Pioneer	Prairie Hybrids
Klaus Busch Knox, NY (518) 320-2462	Claude Fortin Highgate, VT (802) 363-2803	Bourdeau Bros. Sheldon, VT (802) 933-2277	Rodney Hostetler Deer Grove, IL (815)438-7815

Seedway	Albert Lea/Viking	T.A. Seeds	Syngenta
Ed Schillawski Shoreham, VT (802) 897-2281	Mac Ehrhardt Albert Lea, MN (507) 383-1070	Cory Chelko Jersey Shore, PA (866) 813-7333	Alvin Winslow New Glouster, ME (207) 740-8248

Table 2. 2014 Short season silage corn varieties evaluated in Alburgh, VT.

Variety	Company	Traits	RM
10-92 LFY	Albert Lea / Viking	nonGMO, Leafy	92
DKC 34-82	Dekalb	GENVT2P RIB	84
DKC 38-04	Dekalb	GENSS RIB	88
DKC 39-07	Dekalb	GENVT2P RIB	89
DKC 39-27	Dekalb	GENSS RIB	89

DKC 41-32	Dekalb	GENSS RIB	91
DKC 42-36	Dekalb	GENSS RIB	92
DKC 43-10	Dekalb	GENSS RIB	93
DKC 44-13	Dekalb	GENSS RIB	94
EX0174	Prairie Hybrids	nonGMO	90
EX4548	Prairie Hybrids	nonGMO	95
N20Y-3220	Syngenta	Agristure Viptera 3220 E-Z Refuge	85
N29T-3220	Syngenta	Agristure Viptera 3220 E-Z Refuge	91
P8639AM	Pioneer	AM,LL, RR2	86
P9188AMX	Pioneer	AMX, LL, RR2	91
SG1922-3011A	Syngenta	Agrisure Artesian 3011A	84
SH2642-3111	Syngenta	Agrisure Viptera 3111	90
SI3232-3110	Syngenta	Agrisure Viptera 3110	95
SW1964GT	Seedway	GT	77
SW1994GT	Seedway	GT	80
SW2901L	Seedway	Leafy	88
SW3254RR	Seedway	RR2	90
SW330IL	Seedway	nonGMO	93
SW3754RR	Seedway	RR	93
T21115RR	Mycogen	RR	89
TA304-02ND	T.A. Seeds	RR2	89
TA333-28	T.A. Seeds	SSX, RIB Complete	91
TMF2Q309	Mycogen	RA, SSX, LL, RR2	91
TMF2R196	Mycogen	RR2	85

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
Agristure Viptera 3220 E-Z Refuge- herbicide tolerance, protection from lepidopterans and corn borer, refuge seed mixed in bag
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.
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).
GT – Glyphosate tolerant.
Herculex® I- insect protection from corn borer, cutworm, armyworm and more
Leafy - Conventional hybrid.
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 type at the Alburgh location was a Covington silt clay loam (Table 3). The seedbed was spring disked followed by spike tooth harrow. The previous crop was sunflower and silage corn. Starter fertilizer (10-20-20) was applied at a rate of 250 lbs per acre. Plots were 30’ long and consisted of two

rows spaced at 30 inches planted with a John Deere 1750 planter on 21-May. The seeding rate was 34,000 seeds per acre. The plot design was a randomized complete block with three replications and twenty-nine varieties as treatments. On 5-Jun Lumax (S-metolachlor, atrazine, and mesotrione) and Accent (Nicosulfuron) were sprayed at 3 quarts per acre and .33 oz. per acre respectively for post emergence for weed control. Urea (46-0-0) was side-dressed at a rate of 200 lbs per acre on 2-Jul.

Table 3. 2014 short season corn trial specifics for Alburgh, VT.

	Borderview Research Farm Alburgh, VT
Soil type	Covington silt clay loam 0-3% slope
Previous crop	Sunflower and silage corn
Row width (in.)	30
Planting date	21-May
Harvest date	22-Sep; 6-Oct
Tillage operations	Spring disk, spike tooth harrow
Starter fertilizer	250 lbs ac^{-1} 10-20-20
Sidedress	200 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 and dried. These samples were then 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), non-structural carbohydrates (NSC), 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. Evaluation of forages and other feedstuffs based on NDFD is being conducted to strengthen 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. 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. 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 was recorded with a Davis Instrument Vantage PRO2 weather station, equipped with a WeatherLink data logger at Borderview Research Farm in Alburgh, VT. In general, the spring and summer months were wetter than normal with an additional 6.44 inches (Table 4). The fall months however were drier than normal with 3.91 fewer inches of precipitation. In addition, temperatures were relatively normal throughout the season with the exception of October which was 6.8 degrees above normal producing 69 additional Growing Degree Days (GDDs). There were an accumulated 2,241 GDDs at a base temperature of 50 degrees Fahrenheit (May-September). This was 40 less than the historical 30-year average for May-September.

Table 4. 2014 weather data for Alburgh, VT.

Alburgh, VT	April	May	June	July	August	September	October
Average temperature (°F)	43.0	57.4	66.9	69.7	67.6	60.6	55.0
Departure from normal	-1.8	1.0	1.1	-0.9	-1.2	0.0	6.8
Precipitation (inches)	4.34	4.90	6.09	5.15	3.98	1.33	2.00
Departure from normal	1.52	1.45	2.40	1.00	0.07	-2.31	-1.60
Growing Degree Days (base 50°F)	16	238	501	613	550	339	69
Departure from normal	16	40	27	-27	-31	21	69

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 42.4% (Table 5). The variety SW3754RR from Seedway had the lowest dry matter at 34.1%. The average yield at 35% dry matter for the trial was 21.0 tons per acre. The highest yielding variety was Mycogen's TMF2R196 which yielded 26.0 tons per acre. Other varieties including SW2901L, DKC 39-07, DKC 44-13, 10-92 LFY, EX4548, and EX0174 all yielded above 24 tons per acre. It is interesting to note that our highest yielding variety had a significantly lower population than many other varieties in the trial. In addition, the lowest yielding

varieties actually did not statistically differ in population from the varieties with the highest populations. Corn borer and corn rootworm damage was noted in some plots and is represented as the percentage of the population that was affected. Corn borer damage did not significantly differ between varieties. Corn rootworm damage was observed at a statistically significant level between varieties. The variety 10-92LFY had statistically more corn rootworm damage than any other variety. Despite this, 10-92LFY was one of the varieties with the lowest dry matter, highest yields, and highest plant populations.

Table 5. Harvest characteristics of short season corn silage varieties – Alburgh, VT, 2014.

Variety	RM	Corn Borer	Corn Rootworm	Harvest DM	Yield 35% DM	Population
		% plants damaged	% plants damaged	%	tons ac^{-1}	plants ac^{-1}
10-92 LFY	92	0.3	16.5	38.1*	24.7*	24757*
DKC 34-82	84	0.0	0.0*	41.1	18.9	23450
DKC 38-04	88	0.0	0.0*	41.6	23.3*	24829*
DKC 39-07	89	0.0	0.0*	41.5	25.0*	24248*
DKC 39-27	89	0.0	0.0*	41.3	21.5	24248*
DKC 41-32	91	0.0	0.0*	40.5	22.3*	26789*
DKC 42-36	92	0.0	0.0*	38.9	22.6*	**26935**
DKC 43-10	93	0.0	0.0*	39.6	23.0*	22070
DKC 44-13	94	0.0	0.0*	42.6	24.8*	23014
EX0174	90	1.6	3.6*	37.6*	24.4*	25192*
EX4548	95	0.0	1.2*	44.2	24.7*	22579
N20Y-3220	85	0.0	0.0*	53.7	12.5	24321*
N29T-3220	91	0.0	0.0*	51.8	15.1	22942
P8639AM	86	0.0	0.0*	44.9	21	24321*
P9188AMX	91	0.3	0.0*	40.4	21.9	24539*
SG1922-3011	84	0.0	0.0*	50.7	13.9	25265*
SH2642-3111	90	0.0	0.0*	54.2	12.5	23958*
SI3232-3110	95	0.0	0.0*	56.2	17.2	24902*
SW1964GT	77	0.0	0.0*	43.2	19.5	19166
SW1994GT	80	0.0	0.0*	41.4	20.2	22579
SW2901L	88	0.0	0.0*	39.5	25.5*	20183
SW3254RR	90	0.6	7.4	37.9*	20.5	23159
SW330IL	93	0.3	4.8*	38.5*	23.9*	24974*
SW3754RR	93	0.0	4.7*	**34.1**	21.8	21272
T21115RR	89	0.0	0.0*	38.7	19.7	25846*
TA304-02ND	89	0.0	4.4*	38.8	22.0*	25991*
TA333-28	91	0.0	0.0*	35.1*	21.9	20110
TMF2Q309	91	0.0	0.0*	39.6	18.6	23087
TMF2R196	85	0.0	**0.0**	42.5	**26**	22942
LSD (0.10)		NS	6.77	4.6	4.13	3405
Trial Mean		0.1	1.5	42.4	21	23713

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.

All forage quality characteristics varied statistically across varieties (Table 6). The variety SW3301L had the highest protein content of 8.7%. However, this did not differ statistically from DKC 39-27, SW3754RR, SW1964GT, or DKC 41-32. The variety DKC 43-10 was the top performer in ADF (22.2%), NDF (39.7%), Starch (42.8%), NSC (44.3), TDN (73.1%), NE_L (0.72Mcal lb^{-1}), and milk per ton (3444 lbs. ton^{-1}). This variety also did not differ from the top performer in milk per acre. The variety TMF2R196 had the highest potential milk per acre of all varieties in the trial (30,463 lbs $acre^{-1}$).

Table 6. Forage quality of 29 short season corn silage varieties - Alburgh, VT, 2014.

Variety	RM	Forage quality characteristics								Milk	
		CP	ADF	NDF	NDFD	Starch	NSC	TDN	NE_L	ton^{-1}	$acre^{-1}$
		% of DM	% of DM	% of DM	% of NDF	%	%	%	Mcal lb^{-1}	lbs	lbs
10-92 LFY	92	7.2	27.7	49.0	43.1	30.9	32.9	69.4	0.68	3160	27298*
DKC 34-82	84	7.1	24.6*	44.7*	43.9	38.1*	39.9*	70.8*	0.70*	3269*	21696
DKC 38-04	88	7.1	24.8*	44.5*	43.9	37.9*	39.7*	71.3*	0.70*	3310*	27107*
DKC 39-07	89	7.2	26.7	47.8	43.0	33.9	35.6	69.1	0.68	3143	27388*
DKC 39-27	89	8.0*	25.6	45.4	44.3	34.7	36.3	70.2	0.69	3223	24373
DKC 41-32	91	7.8*	26.0	47.2	42.9	32.5	34.0	68.4	0.67	3087	23971
DKC 42-36	92	7.6	25.4	45.0	44.0	35.5	37.3	70.2	0.69	3224	25527*
DKC 43-10	93	7.2	24.7*	44.2*	43.3	37.6*	39.1*	70.8*	0.70*	3264*	26235*
DKC 44-13	94	7.6	**22.2***	**39.7***	44.7	**42.8***	**44.3***	**73.1***	**0.72***	**3444***	29885*
EX0174	90	6.9	23.3*	41.2*	44.2	42.5*	44.1*	73.0*	0.72*	3437*	29383*
EX4548	95	7.6	24.7*	43.3*	44.4	37.8*	39.3*	72.3*	0.71*	3381*	29289*
N20Y-3220	85	6.8	23.2*	45.2	41.4	39.2*	40.5*	69.6	0.68	3173	15832
N29T-3220	91	6.8	24.1*	46.7	40.4	37.0*	38.3*	68.3	0.67	3071	15299
P8639AM	86	6.3	25.6	46.0	43.5	38.8*	40.0*	71.0*	0.70*	3286*	23839
P9188AMX	91	7.1	24.4*	43.1*	44.3	39.9*	41.4*	71.9*	0.71*	3348*	25718*
SG1922-3011	84	6.3	25.9	50.6	40.7	33.5	35.2	67.0	0.65	2975	16307
SH2642-3111	90	6.1	26.5	50.8	42.0	33.7	35.8	67.6	0.66	3020	13335
SI3232-3110	95	6.4	27.6	50.2	41.7	33.7	35.3	67.9	0.66	3043	15638
SW1964GT	77	7.9*	23.5*	43.4*	43.9	37.8*	39.4*	71.9*	0.71*	3355*	22927
SW1994GT	80	7.1	25.6	45.4	44.0	37.0*	38.8*	71.4*	0.70*	3311*	23441
SW2901L	88	6.6	29.0	48.3	43.9	32.9	35.0	70.1	0.69	3213	28667*
SW3254RR	90	6.5	26.6	46.6	43.3	37.0*	38.3*	70.5*	0.70*	3249*	22758
SW330IL	93	**8.7**	26.2	45.0	**46.1**	32.5	34.6	72.0*	0.71*	3364*	28089*
SW3754RR	93	8.0*	26.6	44.7*	44.7	35.2	36.8	72.3*	0.72*	3389*	25870*
T21115RR	89	7.5	25.1*	44.4*	44.8	36.3	38.9*	71.7*	0.71*	3343*	23040
TA304-02ND	89	7.1	28.1	49.6	43.4	32.7	34.3	69.0	0.68	3135	24117
TA333-28	91	7.6	26.5	46.5	44.0	33.3	35.2	70.6*	0.70*	3258*	25011
TMF2Q309	91	6.9	23.6*	43.7*	43.2	40.8*	42.2*	71.0*	0.70*	3282*	21479
TMF2R196	85	6.6	22.9*	42.7*	43.9	42.3*	44.0*	71.9*	0.71*	3348*	**30463***

LSD (0.10)	0.96	3.09	5.21	1.12	6.13	5.98	2.71	0.03	209	5090
Trial Mean	7.2	25.4	45.7	43.5	36.5	38.2	70.5	0.69	3245	23930

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.

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. Most of the varieties performed above the average in yield or quality, if not both. Varietal selection should be based on the goals of the farm as well as data compared from multiple sites and years.

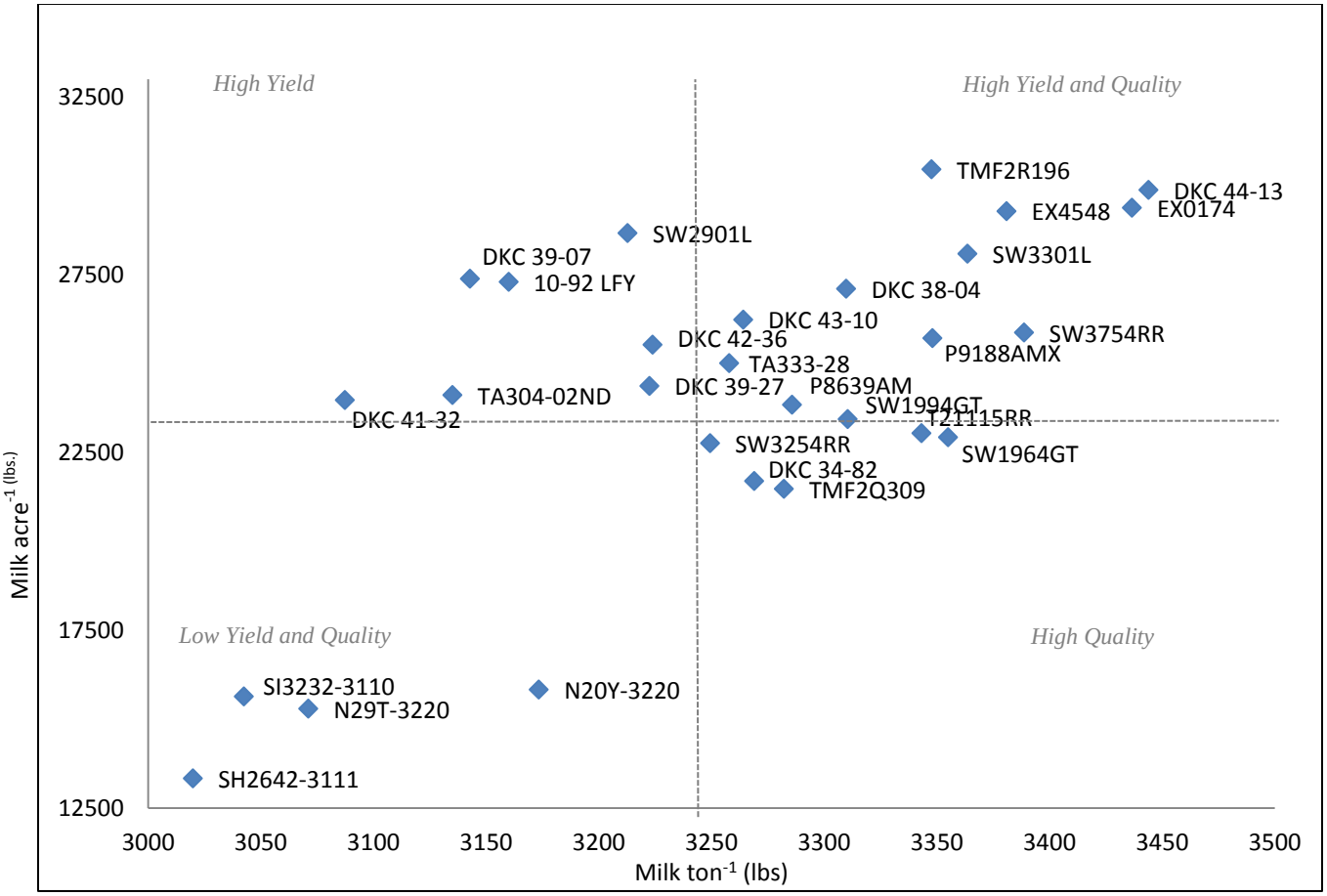

Figure 1. Relationship between milk per ton and milk per ac^{-1} for short season corn silage varieties grown in Alburgh, VT. *Dotted lines represent the mean milk per ton^{-1} and milk per ac^{-1}.*

DISCUSSION

It is important to remember that the results only represent one year of data. Late spring and early summer were wetter this year, postponing planting for many farmers. Despite this, in Alburgh we were able to plant by 21-May, only one week later than last year when fields dried out early. Wet weather in June following planting delayed corn development, reduced plant populations and resulted in late harvesting (22-Sep). All varieties reached proper maturity for harvest at Borderview Research Farm in Alburgh, VT. It is important to note that all varieties except one were higher than the desired 35% DM at the time of harvest. There was no severe lodging of corn stalks. However, insect damage was noted in some plots. Yields ranged from 12.5 to 26.0 tons per acre, indicating the importance of proper varietal selection to maximize short season corn yields. The Mycogen variety 'TMF2R196' yielded the highest and had the most milk per acre. Several short season varieties yielded well and produced high quality feed.

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