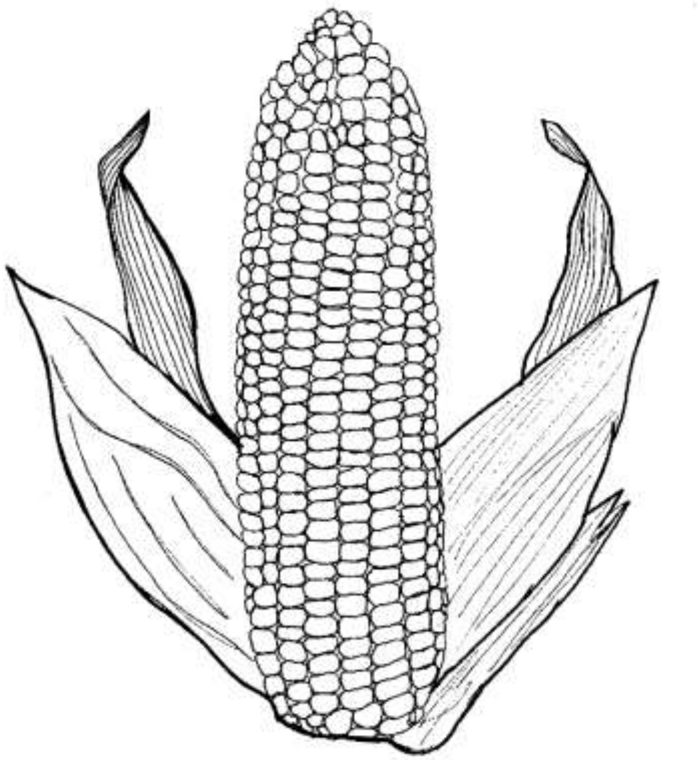

# 2016 Vermont Organic Silage Corn Performance Trial



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**2016 VERMONT ORGANIC SILAGE CORN PERFORMANCE TRIAL**
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The University of Vermont Extension Northwest Crops and Soils Program conducted an organic silage corn variety trial in 2016 to provide unbiased performance comparisons of commercially available 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 2016, 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 80-108 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 St, PO Box 127<br>Albert Lea, MN 56007<br>(800) 352-5247 | 2326 230th Street<br>Ames, IA 50014<br>(800) 370-7979 |

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 barley. Plots were 30’ long and consisted of two 30-inch rows. Plots were planted with a John Deere 1750 planter on 17-May at a seeding rate of 35,500 seeds per acre. The plot design was a randomized complete block with three replications.

Plots were fertilized with 3 tons per acre of poultry manure prior to planting. Weeds were controlled with early season tine weeding and periodic row cultivation. In late June, corn was side-dressed with 30 lbs of additional N per acre in the form of sodium nitrate. On 15-Sep and 30-Sep 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, 2016.**

| Variety | Company | RM (days) |
|---|---|---|
| Viking O.87-80N | Albert Lea Seed | 80 |
| 21L90 | Blue River Hybrids | 85 |
| Viking O.44-86N | Albert Lea Seed | 86 |
| 27B16 | Blue River Hybrids | 88 |
| Viking O.31-92N | Albert Lea Seed | 92 |
| Viking 42-92 UNT | Albert Lea Seed | 92 |
| 34C17 | Blue River Hybrids | 93 |
| 35M70 | Blue River Hybrids | 94 |
| 40R73 | Blue River Hybrids | 97 |
| Viking O.58-98GS | Albert Lea Seed | 98 |
| 43L96 | Blue River Hybrids | 98 |
| Viking O.35-99N | Albert Lea Seed | 99 |
| Viking O.69-99N | Albert Lea Seed | 99 |
| Viking O.63-05N | Albert Lea Seed | 105 |
| Viking O.59-06N | Albert Lea Seed | 106 |
| Viking O.73-08GS | Albert Lea Seed | 108 |

**Table 3. Organic silage corn variety trial information, Alburgh, VT, 2016.**

| | Borderview Research Farm Alburgh, VT |
|---|---|
| Soil type | Benson rocky silt loam |
| Previous crop | Organic barley |
| Row width (in) | 30 |
| Plot size (ft) | 5 x 30 |
| Seeding rate (seeds/acre) | 35,500 |
| Planting date | 17-May |
| Tillage operations | Spring disk, spike tooth harrow |
| Harvest date | 15-Sep and 30-Sep |

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), 48-hour digestible NDF (NDFD), total digestible nutrients (TDN), and milk per ton. A subset of samples (n=5) was sent to DairyOne forage laboratory (Ithaca, NY) for wet chemistry analysis. This information was used to bias our current NIR forage calibration.

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 48 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 June and July of the growing season were near historical averages, with warmer than normal temperatures at the beginning and end of the growing season (May and August and September). Rainfall through the growing season was less than normal – a total of 7.27 inches below normal through the growing season. There was a total of 2562 Growing Degree Days (GDDs) for May through September—268 GDDs more than the historical average.

**Table 4. Summarized weather data for 2016 – Alburgh, VT.**

| **Alburgh, VT** | May | June | July | August | September |
|---|---|---|---|---|---|
| Average temperature (°F) | 58.1 | 65.8 | 70.7 | 71.6 | 63.4 |
| Departure from normal | 1.80 | 0.00 | 0.10 | 2.90 | 2.90 |
| | | | | | |
| Precipitation (inches) | 1.50 | 2.80 | 1.80 | 3.00 | 2.50 |
| Departure from normal | -1.92 | -0.88 | -2.37 | -0.93 | -1.17 |
| | | | | | |
| Growing Degree Days (base 50°F) | 340 | 481 | 640 | 663 | 438 |
| Departure from normal | 74 | 7 | 1 | 82 | 104 |

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 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 22.3 tons $ac^{-1}$ and ranged from 29.3 to 18.0 tons $ac^{-1}$ (Figure 1). The highest yield variety was Blue River variety '43L96'. Five other varieties ('0.59-06N', '42-92 UNT', '0.63-05N', '0.73-08GS' and '27B16') had statistically similar yield. It is important to note that all varieties were higher than the desired 35% DM at the time of harvest. This was partially due to very dry conditions around harvest and to an equipment breakdown causing delays in corn harvest.

**Table 5. Harvest characteristics of 16 organic corn silage varieties – Alburgh, VT, 2016.**

| Variety | Company | Relative maturity | Harvest DM† | Yield @ 35% DM |
|---|---|---|---|---|
| | | days | % | tons ac$^{-1}$ |
| O.87-80N | Albert Lea Seed | 80 | 38.7 | 18.3 |
| 21L90 | Blue River Hybrids | 85 | 39.7 | 22.2 |
| O.44-86N | Albert Lea Seed | 86 | 39.9 | 21.5 |
| 27B16 | Blue River Hybrids | 88 | 40.9 | 23.1* |
| O.31-92N | Albert Lea Seed | 92 | 37.9* | 21.8 |
| 42-92 UNT | Albert Lea Seed | 92 | 36.9* | 24.3* |
| 34C17 | Blue River Hybrids | 93 | 39.6 | 19.2 |
| 35M70 | Blue River Hybrids | 94 | 35.2* | 19.3 |
| 40R73 | Blue River Hybrids | 97 | 34.3* | 22.8 |
| O.58-96GS | Albert Lea Seed | 98 | 39.4 | 18.0 |
| 43L96 | Blue River Hybrids | 98 | 39.5 | **29.3*** |
| O.35-99N | Albert Lea Seed | 99 | 37.5 | 21.7 |
| O.69-99N | Albert Lea Seed | 99 | 36.1* | 21.6 |
| O.63-05N | Albert Lea Seed | 105 | 35.7* | 23.9* |
| O.59-06N | Albert Lea Seed | 106 | **34.1*** | 26.6* |
| O.73-08GS | Albert Lea Seed | 108 | 34.4* | 23.8* |
| **LSD (p<0.10)** | | | **4.10** | **6.31** |
| Trial Mean | | | 37.7 | 22.3 |

*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.
†DM, dry matter

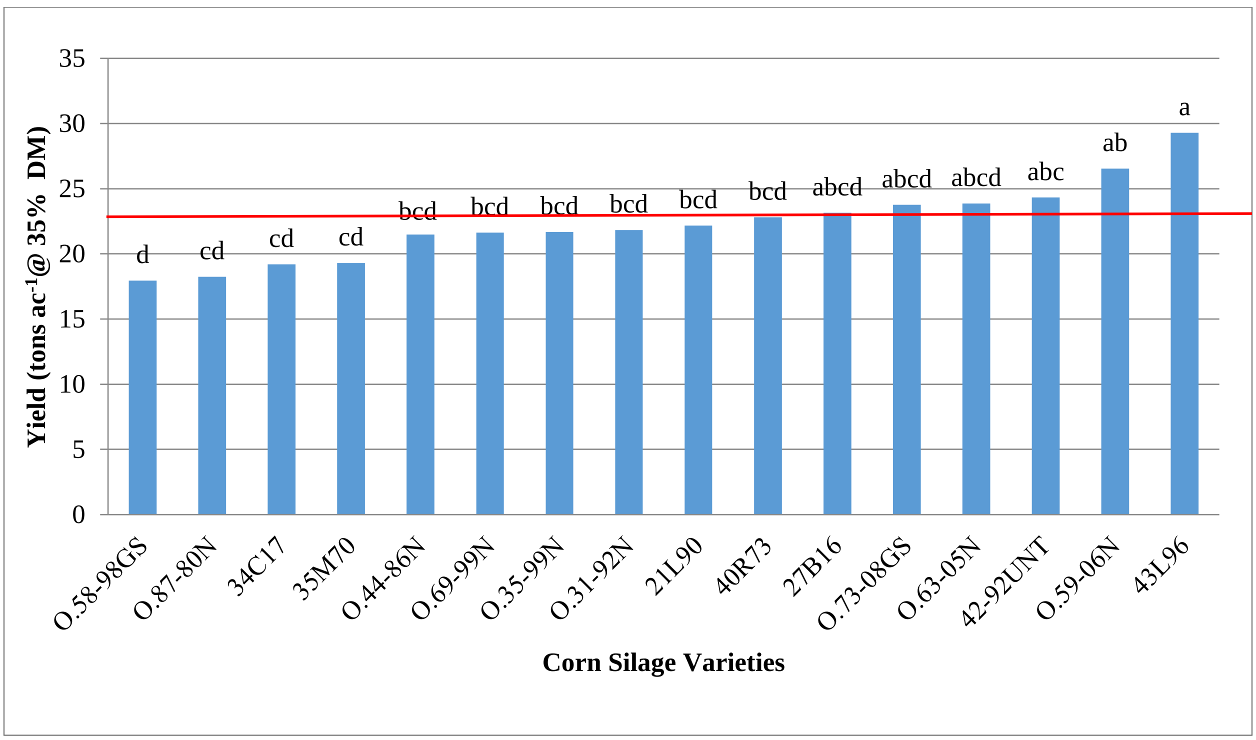


**Figure 1. Organic corn silage yields, Alburgh, VT, 2016. The red line indicates the average yield.**
*Treatments with the same letter did not differ significantly from one another (p=0.10).*

The quality results for the organic corn silage varieties are presented in Table 6. The Blue River Hybrid variety 40R73 had the highest CP concentration but was not statistically different from the other varieties. The Viking variety O.44-86N was the top performing variety in terms of NDFD but was not statistically different than the varieties 21L90, O.31-92N, 42-92 UNT, 34C17, 35M70, and O.63-05N. The varieties did not different significantly from each other in ADF, NDF, TDN, $NE_L$, or Milk per ton. The Blue River Hybrid variety 43L96 produced the highest milk per acre but was statistically similar to varieties 42-92 UNT, O.63-05N, O.59-06N, and O.73-08GS.

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

| Variety | Company | RM | CP | ADF | NDF | NDFD | TDN | $NE_L$ | Milk per | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | % of | % of | % of | % of | % of | | $ton^{-1}$ | $acre^{-1}$ |
| | | days | DM | DM | DM | NDF | DM | Mcal/lb | lbs | lbs |
| O.87-80N | Albert Lea Seed | 80 | 7.77 | 25.1 | 48.0 | 69.2 | 61.7 | 0.62 | 2680 | 17309 |
| 21L90 | Blue River Hybrids | 85 | 7.12 | 24.9 | 46.7 | 70.5* | 63.6 | 0.64 | 2810 | 21948 |
| O.44-86N | Albert Lea Seed | 86 | 7.76 | **20.8** | **41.5** | **71.3*** | 64.7 | 0.65 | 2888 | 21741 |
| 27B16 | Blue River Hybrids | 88 | 7.75 | 24.4 | 45.6 | 69.3 | 62.4 | 0.62 | 2723 | 22114 |
| O.31-92N | Albert Lea Seed | 92 | 7.39 | 23.5 | 44.8 | 70.2* | 63.6 | 0.64 | 2809 | 21409 |
| 42-92 UNT | Albert Lea Seed | 92 | 8.43 | 23.4 | 44.3 | 70.6* | 65.0 | 0.65 | 2913 | 24810* |
| 34C17 | Blue River Hybrids | 93 | 8.80 | 25.6 | 48.3 | 70.8* | 61.5 | 0.61 | 2662 | 17865 |
| 35M70 | Blue River Hybrids | 94 | 8.88 | 24.3 | 46.7 | 70.6* | 64.4 | 0.64 | 2873 | 19471 |
| 40R73 | Blue River Hybrids | 97 | **9.41** | 22.2 | 43.3 | 68.5 | 61.4 | 0.61 | 2652 | 20264 |
| O.58-98GS | Albert Lea Seed | 98 | 7.44 | 22.7 | 43.7 | 69.4 | 64.3 | 0.65 | 2870 | 18054 |
| 43L96 | Blue River Hybrids | 98 | 8.58 | 23.1 | 44.7 | 69.4 | 63.7 | 0.64 | 2816 | **28877*** |
| O.35-99N | Albert Lea Seed | 99 | 8.16 | 21.5 | 41.6 | 69.0 | 65.0 | 0.66 | 2920 | 22164 |
| O.69-99N | Albert Lea Seed | 99 | 8.97 | 24.8 | 46.1 | 68.6 | 64.0 | 0.64 | 2847 | 21447 |
| O.63-05N | Albert Lea Seed | 105 | 8.31 | 23.6 | 43.6 | 70.0* | **66.8** | **0.67** | **3048** | 25447* |
| O.59-06N | Albert Lea Seed | 106 | 8.74 | 24.2 | 45.3 | 68.7 | 65.0 | 0.65 | 2924 | 27162* |
| O.73-08GS | Albert Lea Seed | 108 | 8.13 | 23.5 | 44.8 | 68.8 | 65.0 | 0.65 | 2912 | 24343* |
| **LSD (p<0.10)** | | | **NS** | **NS** | **NS** | **1.60** | **NS** | **NS** | **NS** | **6018** |
| Trial Mean | | | 8.16 | 23.6 | 44.9 | 69.7 | 63.9 | 0.64 | 2834 | 22152 |

Top performing variety is indicated in **bold**.
Varieties that did not perform significantly lower than the top performing variety are indicated with an asterisk *.
NS – No significant differences detected between varieties.

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 O.35-99N, O.73-08GS, 42-92UNT, O.63-05N, and O.59-06N had high yield and quality.

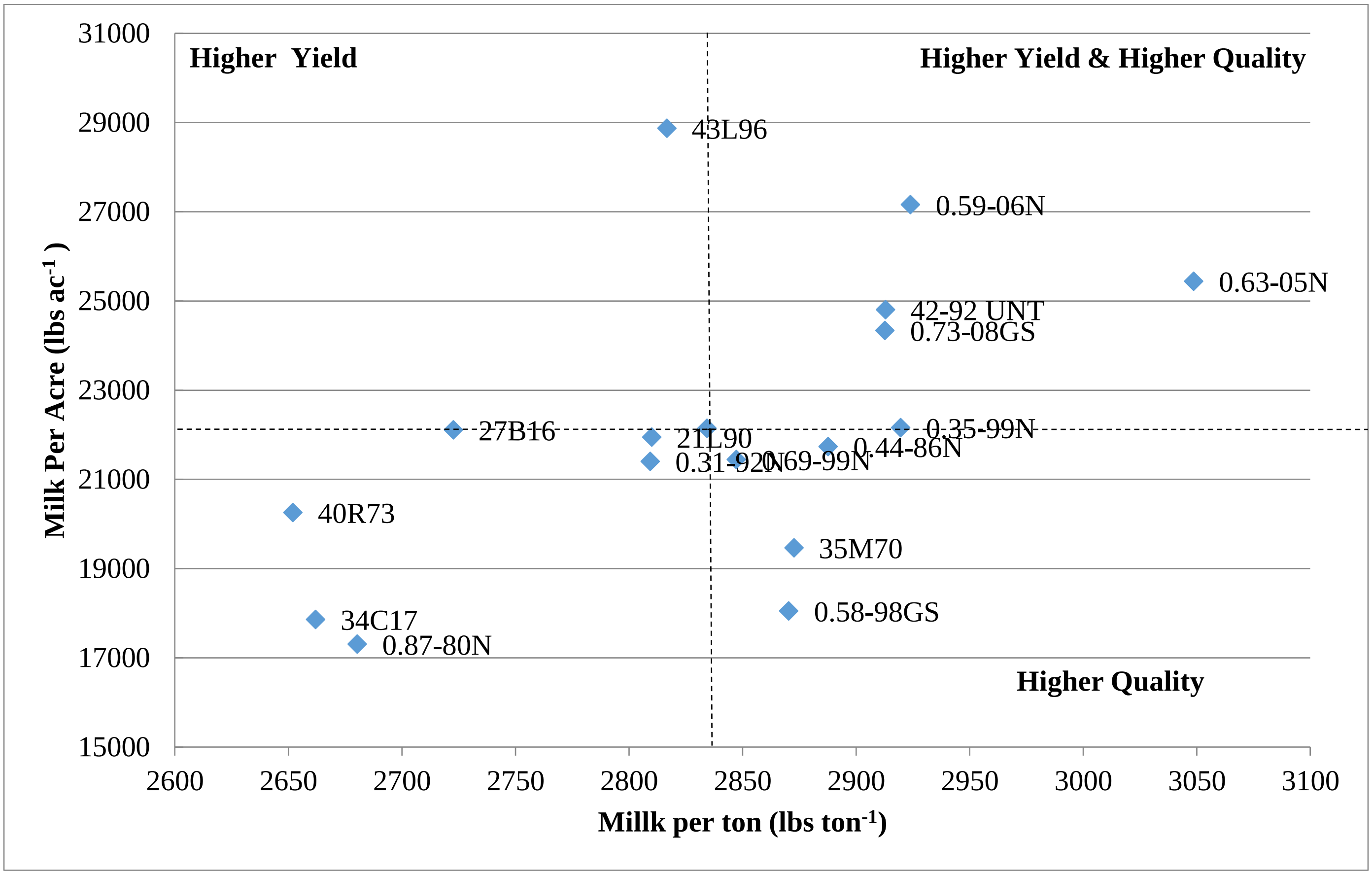


**Figure 2. Relationship between milk per ton and milk per acre of organic corn silage varieties.** *Dotted lines represent the mean milk per ton and mean milk per acre.*


# ACKNOWLEDGEMENTS

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