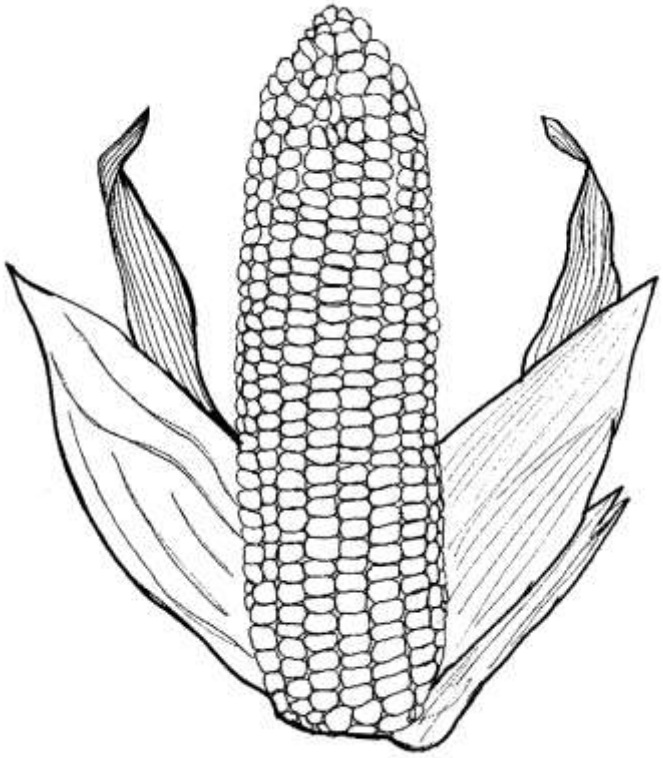
NORTHWEST CROPS & SOILS PROGRAM

2014 Vermont Organic Silage Corn Performance Trial



Dr. Heather Darby, UVM Extension Agronomist
Susan Monahan, Erica Cummings, Julian Post, Sara Ziegler
UVM Extension Crop and Soil Technicians
802-524-6501

Visit us on the web at http://www.uvm.edu/extension/cropsoil/

UNIVERSITY OF VERMONT EXTENSION
CULTIVATING HEALTHY COMMUNITIES

2014 VERMONT ORGANIC SILAGE CORN PERFORMANCE TRIAL

Dr. Heather Darby, University of Vermont Extension
heather.darby[at]uvm.edu

The University of Vermont Extension Northwest Crops and Soils Program conducted an organic silage corn variety trial in 2014 to provide unbiased performance comparisons of commercially available organic silage corn 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 2014, 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. Several seed companies and farmers submitted varieties for evaluation (Table 1). The organic corn grown at the Alburgh site had relative maturities (RM) ranging between 82-106 days. The specific varieties and their RMs are listed in Table 2.

Table 1. Participating companies and contact information.

Albert Lea Seed	American Organic	Blue River Hybrids
1414 West Main Street PO Box 127 Albert Lea, MN 56007 (800) 352-5247	Art Scheele PO Box 385 Warren, IL 61087 (866) 471-9465	Boucher Fertilizer 2343 Gore Road Highgate Center, VT 05459 (802) 868-3939

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 sod. Plots were 30' long and consisted of two 30-inch rows. Plots were planted with a John Deere 1750 planter on 2-Jun at a seeding rate of 35,500 seeds per acre. The plot design was a randomized complete block with three replications. In order to reduce weed pressure, the plots were field cultivated on 3-Jul.

On 13-Oct 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, Vermont.

Company	Variety	RM (days)
Blue River Hybrids	14A91	82
Blue River Hybrids	21B50	85
Viking (Albert Lea)	6085-NT	85
Blue River Hybrids	23A71	86
Viking (Albert Lea)	044-86N	87
Blue River Hybrids	26A17	88
Blue River Hybrids	23L99	88
Viking (Albert Lea)	O61-91N	90
Viking (Albert Lea)	O85-90	90
Viking (Albert Lea)	90-91N	91
Blue River Hybrids	33L98	93
American Organic	3G36	95
American Organic	3G33	97
American Organic	VP4P12LFY	104
American Organic	4G56	106

Table 3. Organic silage corn variety trial information, Alburgh, Vermont, 2014.

	Borderview Research Farm Alburgh, VT
Soil type	Benson rocky silt loam
Previous crop	sod
Row width (in)	30
Plot size (ft)	5 x 30
Seeding rate (seeds/acre)	35,500
Planting date	2-Jun
Tillage operations	Spring disk, spike tooth harrow
Row cultivation	3-Jul
Harvest date	13-Oct

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 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. The spring season started out with above average rainfall in May, June, and July. However, it was drier than normal for the month of September, just prior to harvest. Temperatures throughout the growing season were similar to the historical average. There was a total of 2,310 Growing Degree Days (GDDs) for May through mid-October—99 GDDs more than the historical average.

Table 4. Summarized weather data for 2014 – Alburgh, VT.

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

Based on weather data from a Davis Instruments Vantage Pro2 with WeatherLink data logger.
October data represents weather recorded through the last corn harvest, 14-Oct 2014.
Historical averages are for 30 years of NOAA data (1981-2010) from Burlington, VT.

Yield and harvest dry matters (DM) 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 19.3 tons acre^{-1} and ranged from 14.2 to 26.9 tons acre^{-1} (Figure 1). There was not a significant difference in yield among the varieties. This was likely due to high variability within the field site. Heavy rains shortly after planting resulted in low plant populations in a low spot of the research area.

Table 5. Harvest characteristics of 15 organic corn silage varieties – Alburgh, VT, 2014.

Hybrid	RM	Harvest DM	Yield (at 35% DM)
		%	tons ac^{-1}
14A91	82	49.9*	15.1
21B50	85	**56.2***	19.2
23A71	86	46.9	17.3
23L99	88	41.9	20.2
33L99	93	43.2	19.8
26A17	88	44.1	18.0
3G33	97	39.9	17.8
3G36	95	39.4	18.9
4G56	106	37.8	22.4
6085-NT	85	48.7	14.2
90-91N	91	41.7	19.4
O44-86N	87	45.7	19.3
O61-91N	90	44.9	19.8
O85-90	90	46.9	21.6
VP4P12LFY	104	39.7	26.9
Trial Mean		44.5	19.3
LSD (p<0.10)		7.3663	NS

*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.
NS – No significant difference was determined between treatments.

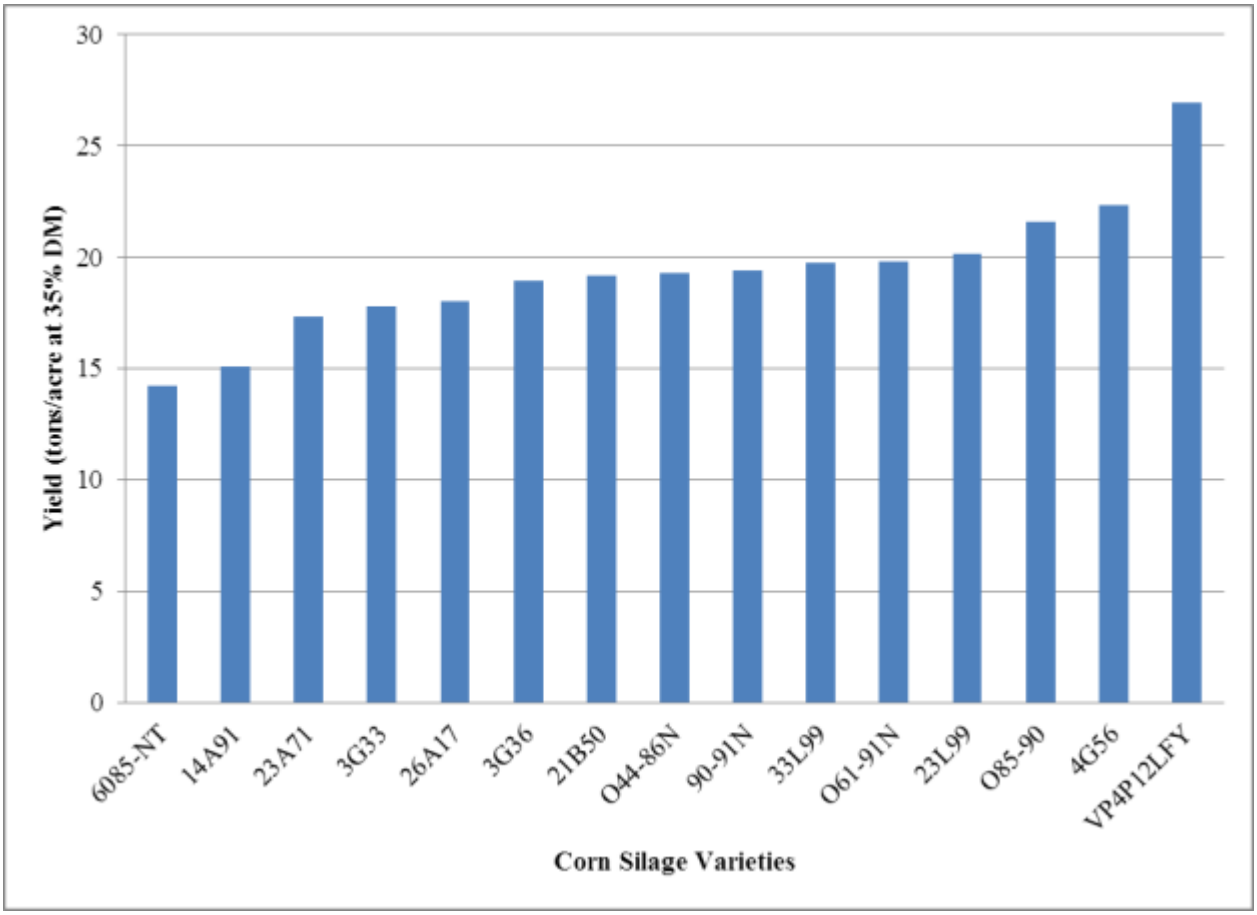


Figure 1. Organic corn silage yields, Alburgh, Vermont, 2014.

The quality results for the organic corn silage varieties are presented in Table 6. The Blue River Hybrid variety '26A17' had the highest crude protein at 7.9%. Six other varieties had crude protein levels similar to the top performer. The Viking variety '6085-NT' had the highest starch levels at 35.3%. '14A91' had the lowest and most desirable ADF levels at 25.8%. There was no statistically significant difference in NDF, however three varieties had more digestible NDF than the other varieties: '4G56', '90-91N', and '33L99'.

Table 6. Silage quality of organic corn varieties, Alburgh, Vermont.

	Population	**CP**	**Starch**	**ADF**	**NDF**	**NSC**	**NDFD**	**TDN**	**NEL**	**Milk per**	
	plants/acre	%	%	%	%	%	% of NDF	%	Mcal/lb	ton	acre
14A91	29718	7.1*	34.6*	**25.8***	48.3	37.4*	43.5	69.8	0.686	3188	16886
21B50	26330	6.2	33.0*	27.4*	51.6	34.9*	42.3	68.4	0.670	3084	20220
23A71	28362	6.6	28.4	29.5	55.0	31.1	43.0	66.7	0.651	2957	18003
23L99	28556	6.7	25.0	31.8	55.4	28.3	43.6	67.2	0.656	2990	21113
33L99	32428	7.5*	26.9	30.1	52.8	30.4	44.8*	68.2	0.668	3070	21274
26A17	30976	**7.9***	27.6	29.4	51.8	30.7	44.4	68.3	0.670	3081	19425
3G33	28750	6.0	30.0	29.3	53.2	33.0	43.1	68.0	0.665	3052	19025
3G36	32525	7.7*	25.6	30.0	53.4	28.3	44.1	67.7	0.662	3029	19955
4G56	25265	7.5*	26.4	30.1	53.5	29.2	**45.9***	68.8	0.675	3116	24386
6085-NT	26039	6.6	**35.3***	26.7*	49.7	**38.0***	44.3	69.9	0.687	3199	15976
90-91N	27782	6.0	29.1	30.8	55.7	32.0	44.8*	67.8	0.660	3023	20531
O44-86N	31073	6.8*	31.2*	27.7*	51.7	33.8*	43.1	68.2	0.668	3070	20795
O61-91N	30976	6.8	34.5*	26.0*	48.6	37.1*	43.6	69.8	0.686	3189	22092
O85-90	29814	6.4	30.7*	28.4	52.8	33.2	43.1	67.9	0.663	3038	23374
VP4P12LFY	27878	7.2*	26.8	30.3	52.8	29.3	43.4	67.7	0.662	3033	28866
Trial Mean	29098	6.9	29.7	28.9	52.4	32.5	43.8	68.3	0.668	3075	20795
LSD (p<0.10)	NS	1.08	4.78	2.36	NS	4.54	1.38	NS	NS	NS	NS

*Treatments indicated with an asterisk did not perform significantly lower than the top-performing treatment in a particular column.
Treatments shown in **bold** are of the highest value or top performing.
NS – No significant difference was determined between treatments.

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 '4G56' and '061-91N' had high yield and quality.

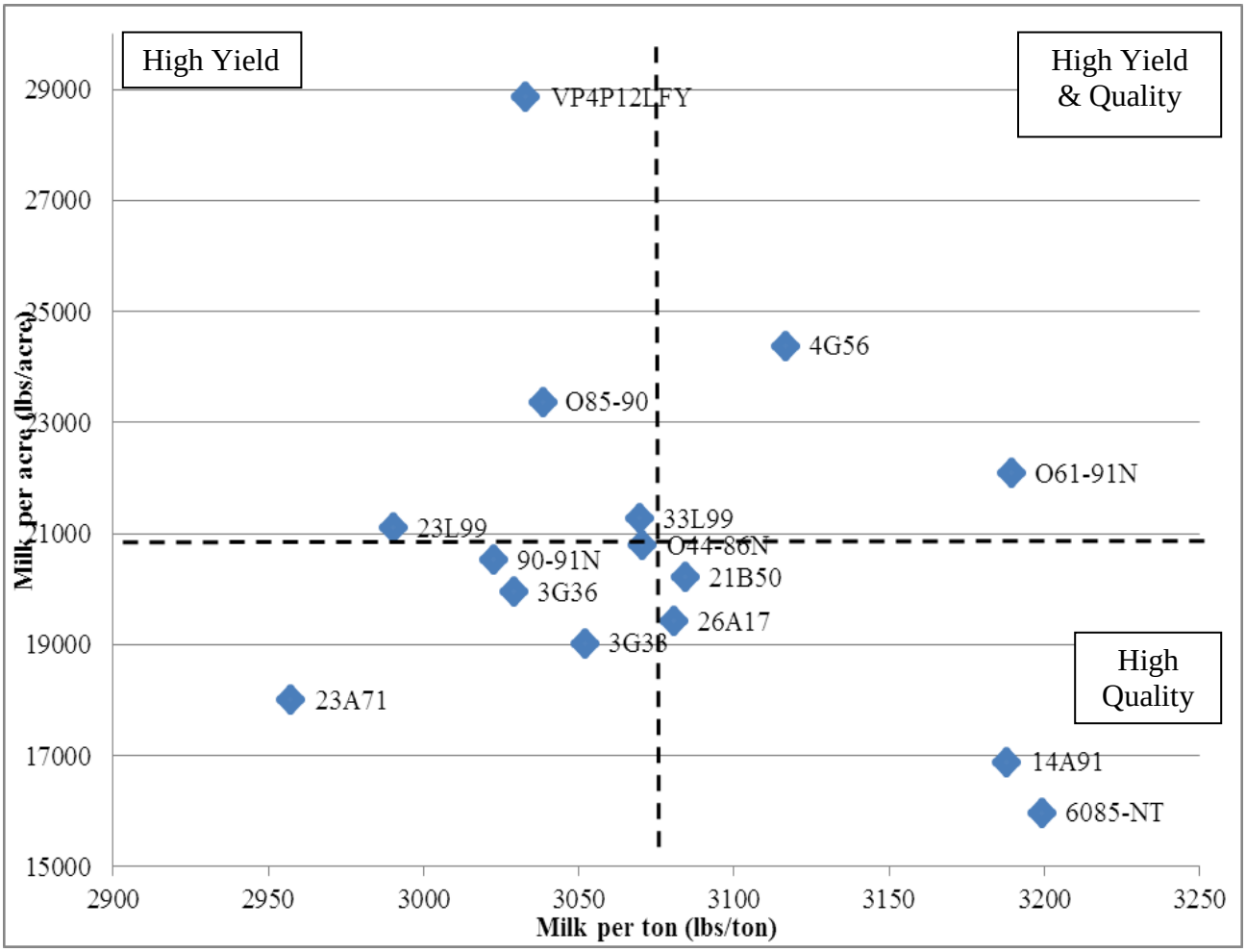


Figure 2. Relationship between milk per ton and milk per acre of organic corn silage varieties. *Dotted lines represent the mean milk per ton and mean milk per acre. Upper right quadrant represents both high yield and quality.*

ACKNOWLEGEMENTS

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 thank Conner Burke, Lily Calderwood, Julija Cubins, Hannah Harwood, Ben Leduc, Laura Madden, and Dana Vesty for their assistance with data collection and entry. We would also like to thank American Organic, Albert Lea Seed, and Blue River Organics for their seed donations. This information is presented with the understanding that no product discrimination is intended and no endorsement of any product mentioned, nor criticism of unnamed products, is implied.

UVM Extension helps individuals and communities put research-based knowledge to work