



UNIVERSITY OF VERMONT EXTENSION
CULTIVATING HEALTHY COMMUNITIES

2015 No-Till & Cover Crop Symposium

February 19, 2015

Sheraton Hotel and Conference Center | Burlington, Vermont

CONFERENCE PROCEEDINGS

WELCOME

Every year you make changes in farm practices. In fact, every day the decisions you make are the changes that add up to a better farm business over time. That is not to say changes are easy, or even always in the right direction. Decisions to meet the demands for increasing farm income to cover costs, for clean water in our lakes and streams, or for just “moving forward” can weigh heavy on any farm or business owner.

Good business decisions take a mix of real facts and information, conversations with trusted advisors, and a willingness to accept the probable risk associated with a new change. The shift to a new crop system that combines less tillage, more cover crops, better soil drainage, new crop mixes, really is a big change.

Today we bring you this No-Till and Cover Crop Symposium with new current ideas and information to help you make the changes on your farm that you think will make the best sense. Learn from experiences of other farmers, listen to new ideas that are happening in other states, continue to question the wisdom of adopting new practices on your farm. But then, make a bold move to try it. Make sure to give that new idea a fair try by measuring the results on your farm, then to share your successes with others so we can all learn together.

We hope the 2015 No-Till and Cover Crops Symposium is a place where you can talk about these management decision issues, meet some new people and get some new ideas to take your farm business to the next level.

ENJOY THE SYMPOSIUM!!

Jeffrey E Carter
UVM Extension Agronomy

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UNIVERSITY OF VERMONT EXTENSION

AGENDA: February 19, 2015

Time	Speaker	Topic
8:30	Check in, get coffee & snacks, visit our Exhibitor Fair	
9:00	**Jeff Carter, UVM**	Welcome
9:20	**Gerard Troisi** **Upper Susquehanna CMA**	Setting up a no-till & cover crop system to reduce weed pressure, achieve less costly weed control, make better seedbed conditions and improve nutrient cycling
10:00	**Lucas Criswell** **Criswell Acres & PA No Till Alliance**	Planting Green: How to make the most of your cover crop residue in a no-till system. Equipment & Strategies for Success
10:40	Break & Exhibitor Fair	
11:00	**Pierre-Olivier Gaucher, Terralis** **Patrice Kevin, Belisle Nutriton**	Cover Crops, Interseeding and No-Till Planting: A consortium of Canadian farmers adopt a new cropping strategy for soil health.
12:00	* * * LUNCH * * *	
12:45	**John Koepke** **Koepke Farms, Wisconsin**	Soil Based Farming: A Wisconsin dairy farms shares their story of caring for the soil to increase farm viability
2:00	Break & Exhibitor Fair	
2:15	**Heather Darby, UVM**	Strategies for growing short season corn in Vermont without sacrificing yields
2:45	**Kirsten Workman, UVM**	Cover Crops in Vermont...What's new, exciting, and works!
3:15	**Richard Hall, Fairmont Farms**	A Vermont No Till Success Story
3:35	**Shawn Gingue, Ron & Chad Machia, Scott Magnan, & Gerard Vorsteveld**	Vermont Farmers who attended the 2015 National No Till Conference share the strategies they use on their farms and what they will be trying new in 2015 with no till and cover crops.
4:30	**Jeff Carter, UVM**	Closing Remarks

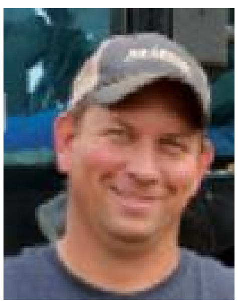
Our Speakers

JOHN KOEPKE | Koepke Farms, Ocnoomowoc, WI

Mr. Koepke and his family own and operate Koepke Farms Inc. in Ocnomowoc, Wi. They milk 330 Holstein cows, raise replacement heifers and no-till farm corn, alfalfa , soybeans and wheat on 970+ acres of land. Their farm is an active participant in the University of Wisconsin Discovery Farms program, collecting data on farm practices since 2004. His resume includes numerous awards including 2012 Gathering Waters Policy Maker of the Year, 2011 Sand County Leopold Conservation Award, 2011 World Dairy Expo Dairymen of the Year, State of Wisconsin commendations for distinguished dairy management, 2003 Watertown Area Outstanding Young Farmer and many milk production and herd genetics awards.

GERARD TROISI | *Production Consultant Upper Susquehanna Crop Management Associates*

Gerard Troisi has been a crop advisor and production consultant since 1991. He currently consults on 24,000 acres in central Pennsylvania. He works with operators who no-till or those transitioning to no-till. He is especially skilled at increasing production on marginal or poor soils while reducing input costs and adjusting production practices. His vision for the future of agriculture is implementing more biodiversity, animal integration, and cover crops to improve the health of the soil and therefore the health of the produce.

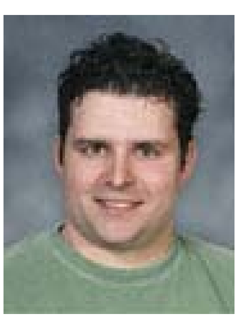


LUCAS CRISWELL | Criswell Acres & PA No Till Alliance, Lewisburg, PA

Lucas Criswell and his father, William, own and operate Criswell Acres in the Buffalo Valley of Pennsylvania. His farm consists of 1800 acres of corn, soybeans, wheat rye, dry peas. William was an early adopter of not ill in the late 80s, and the farm had transitioned completely to no till by early 90s with a purchase of a no till drill to complete their no till line up. Lucas grew up chasing his day with a three bottom moldboard plow for a quite a few years, so he understands where their farm was to where they are now. He worked with a 400 cow dairy for 8 years managing 7 million gallons of manure annually and growing and selling crops, all managed under notill. He still hauls hog manure and chicken manure that is used on their current operation. The Criswells have been using covers for the last 20 years, but only feel they have been getting better use out of them the last three years by letting them build more bio mass and capturing sunlight .

Pierre-Olivier Gaucher | *Terralis, Contrecoeur, QC*

Pierre-Olivier graduated in 2000 from a Agricultural College in St-Hyacinthe , Quebec. He worked 11 years for a fertilization company called William-Houde in the St-Hyacinthe region. He was a sales rep, in charge of 88 cash crop, vegetable and dairy farms and provided seed, fertilizer and herbicide. Between 2002 and 2007, he owned a vegetable farm with 65 acres of sweet corn, 65,000 strawberry plants and 2.5 acres of blueberries. In 2009, he started to second guess everything he was doing because he could see how badly we generally mistreating our soil. After a very long thinking process and many trips to Europe, he decided to start his own company called Terralis in 2011 . At the same time, he started a consortium of 30 farmers ready to change their cropping techniques to improve soil health. They have developed a crop rotation strategy to include cover crops, winter cereals and interseeding cover crops in corn.



Patrice Vincent | *Belisle Nutrition, Quebec*

Patrice grew up on a dairy farm and graduated from McGill in Agriculture in 2002. He is a feed consultant for a feed company called Belisle Solution Nutrition for 11 years now. He supplies different cover crop mixes, interseeding mixes and winter cereal from Pierre-Olivier in the US. As a feed consultant, he is interested these cropping systems because he has seen that animals are much healthier when they eat feed growing on healthy soils. Milk production improves as forage quality improves and forage quality improves and forage yields improve because it is easier to control quality from the smallest amount of land as possible.

Our Speakers

Vermont Farmer Presenters

RICHARD HALL, Fairmont Farm (E. Montpelier)

Richard graduated in 1986 from SUNY Cobleskill with an Agricultural Science degree. The following year, Richard was married to Bonnie and they began farming on their own. In 1992 their farming operation was one of three local dairy farms that came together to form Fairmont Farm Inc. Fairmont Farm has seen a lot of growth over the years. Starting in 1992 milking 225 +/- cows growing to milking about 1,400 today with expectations to get to 1,500 by Spring of 2015. 2014 was a big year for the farm as well, an expansion at the home farm in East Montpelier and the purchase of the Lylehaven Farm, now known as “The Haven”. Richard is the “General Manager” and has played a role in all aspects of the farm over the years. In more recent years, , Richard has spent a lot of his efforts in Crop Management. He has been diligent to work towards more sustainable and more efficient methods, often trying something new each year. The farm has done a lot of tiling over the last few years, and has successfully transitioned to 100% no till. Efforts are currently being made to become more efficient in Manure Handling to further reduce soil compaction. Richard and Bonnie have always been active in the community, often welcoming tours of the farm. In 2008, they formed Udderly Crazy 4-H Club and have participated in numerous Regional, Statewide and National events.

SHAWN GINGUE, Gingue Brothers Dairy LLC (Fairfax/Waterford)

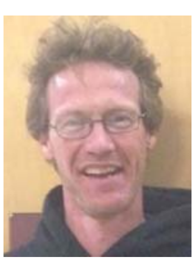
Shawn and his brothers Dan, Jeff and James along with their father, Paul own and operate Gingue Brothers Dairy LLC in Fairfax and Waterford. Since merging the two farms in 2010, they milk 550 cows at their Fairfax farm and raise 450 young stock and transition cows in Waterford. Shawn manages their crop production on 1100 acres and has been implementing no-till and cover crop practices on all 420 acres of corn silage production. Over the last 4 years, he has implemented practices and purchased the equipment to achieve their goal of 100% no-till and 100% cover cropping. He looks forward to perfecting those systems on his farm, and building on the progress they have made thus far. Shawn is also Vice Chairman of the Franklin/Grand Isle Farmers Watershed Alliance, a farmer driven water quality group working with farmers to tackle the on going clean up of Lake Champlain.

CHAD MACHIA, Machia & Sons Dairy (Sheldon)

Chad is a dairy farmer from Sheldon, Vermont. He works with his brother, Dustin Machia, and father, Ron Machia, on a 1800 acre dairy milking 750 cows and a total of 1800 head. They were introduced into no till back in 2011, and have been progressing every year since. The Machias have a total of 300 acres no till and are working to get land ready for more!! They have introduced cover crops like triticale harvested for forage and winter rye. Chad will share the new things their farm will be trying in 2015.

SCOTT MAGNAN, Custom Service (St. Albans)

Scott is the owner of Scott Magnan's Custom Service, a professional crop service located out of St. Albans. He has worked in connection with UVM Extension over the past four seasons, running a no-till corn planter for interested farmers in the region. The past two season's his company ran a Jamesway manure injector also in connection with UVM Extension, on one of their tanks on area farms. Scott has started working with GPS systems and software to better document field practices. In addition to the custom hire part of his business, he farms 200 acres, also in St. Albans. He keeps about half the acres in hay, and grows and sells soybeans. He has experience growing crops like oats and winter rye on that farm as well. He currently has fields going into a fifth season in no-till, and is experimenting will all methods of tillage and planting. In addition he raises 15-20 beef cows.

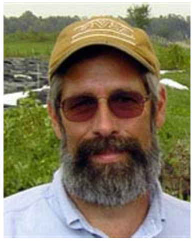


GERARD VORSTEVELD, Vorsteveld Farm (Panton)

Gerard farms with his brothers Hans and Rudy (and now some of their children) on their farm in Panton, Vermont not far from the shores of Lake Champlain. There they milk 750 cows and crop more than 2400 acres, much of which is some of the heaviest Addison County clay soils. They are always willing to try new things on their farm, and keep the practices the will make sense in the long term financially and for production.

Our Speakers

UVM Extension Agronomy Presenters



JEFFREY CARTER | Agronomy Specialist: Field Crops & Nutrient Management

Jeff Carter has worked with farmers all around Vermont regarding crop production including corn, alfalfa, pasture, Christmas trees and wildlife food plots. For 29 years he has provided information on using fertilizer, manure and pesticides; how to grow crops and take care of the soil and; nutrient management planning to meet farm regulations. Jeff works with commercial farmers, backyard growers and public officials to promote agriculture. As a UVM Extension Faculty member, Jeff leads the Champlain Valley Crop, Soil & Pasture Team out of the Middlebury Extension office. He procures grant funding, provides direction for the team and is the foundation for the work the team does to serve the needs of agricultural producers in the Champlain Valley and beyond.

DR. HEATHER DARBY | Associate Professor of Agronomy

Heather Darby is an agronomic and soils specialist for the UVM Extension. She received her MS from the University of Wisconsin in Agronomy and her Ph.D. in Crops and Soils at Oregon State University. Being raised on a dairy farm in Northwestern Vermont has also allowed her to play an active role in all aspects of dairy farming as well as gain knowledge of the land and create an awareness of the hard work and dedication required to operate a farm. These practical experiences complemented by her education have focused her attention towards sustainable agriculture and promotion of environmental stewardship of the land. Heather is involved with implementing many research and outreach programs in the areas of fuel, forage and grain production systems in New England. Outreach programs have focused on delivering on-farm education in the areas of soil health, nutrient management, organic grain and forage production, and oilseed production. Research has focused on traditional and niche crop variety trials, weed management strategies and cropping systems development.

KIRSTEN WORKMAN | *Agronomy Outreach Professional*

Kirsten works with farmers to implement practices to improve crop production and protect water quality. She started her career in Washington state, and after 10 years of working with West Coast farmers, she joined the UVM Extension staff in Middlebury in 2011, and hopes to provide practical information that farmers value. She helps farmers understand the benefits of nutrient management and assists them in preparing and implementing comprehensive nutrient management plans, and lately has been working on cover cropping systems for Vermont farms. She also helps farmers access cost-share funding to implement Best Management Practices on their farms. Kirsten is working on a master's degree in Plant & Soil Science (Agronomy) at the University of Vermont. Her research project aims to provide farmers with information about successful cover cropping systems that make the most of their livestock manure while reducing nutrient runoff and increasing soil health.

UNIVERSITY OF VERMONT EXTENSION

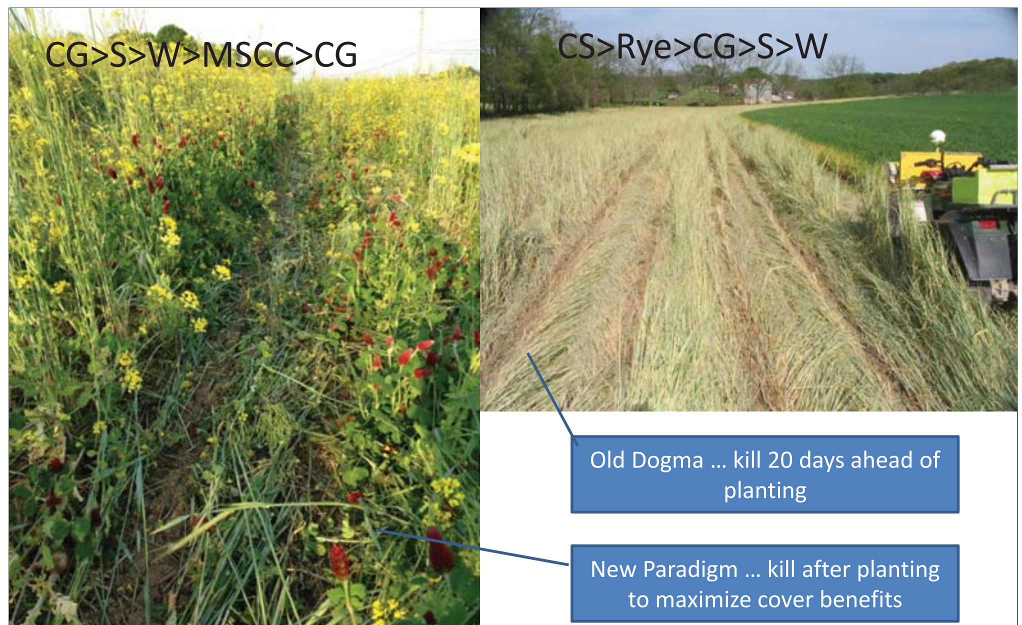
Planting Green

Lucas Criswell and Gerard Troisi
Lewisburg, PA

Planting in live mature covers radically improves soil properties in a short period of time.

Four Principals of Soil Health Improvement

1. Continuous Crop Growth
   – Rapid rotations and cover crops
2. Reduce Soil Disturbance : No-till!!!
   – Use less fertilizer, less herbicides and less pesticides
3. Increase Diversity
   – More crops in sequence, more species in covers
4. Integrate Livestock
   – Crops and livestock and/or manure can improve soils or degrade them depending upon management



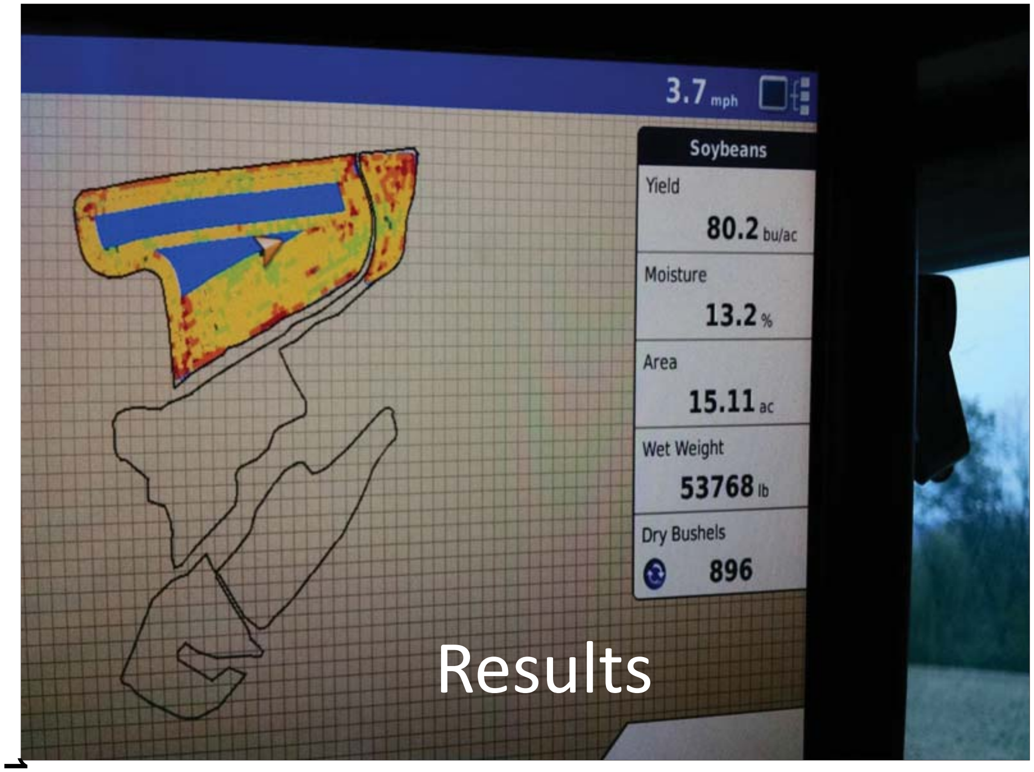
Lucas' Planting Green Corn Program

1500 gal hog manure at green up (no that's not a typo)

15 gal – nitrogen band 10 gal 30% plus 5 gal ATS
out the back of planter 3 " off side

Herbicide
Prefer 1 qt Gramoxone and 1 qt Bicep
2nd pass 22 oz Roundup (which really wasn't needed now looking back)

Side dress
Run agleader optrx sensors to maximize nitrogen needs
PSNT to double check Optrx



Large Mature Covers Offer More!

- More root mass means more soil exploration
- More time growing means more carbon moved into the soil profile
- More biomass means more soil protection and more water infiltration, more weed suppression
- Less insecticide and fungicide use means more soil life, more soil life means greater mineralization, nutrient cycling and bio-defences for invading insect and disease pests

Lucas' Planting soybeans green program

Herbicide Pre 1oz Canopy EX and ½ pnt 2 4 D
At least week before.

Been planting untreated seed for two years now
(they do survive)

Bite finger nails as neighbors will think your crazy!

Wait to spray Roundup 25-30 days after emergence

Second week of August we sprayed for aphids.

Donning No-Till Armor To Save Soils

Lucas Criswell is pushing his 30-year no-till system another step higher by seeding row crops into taller cover crops and using precision technology to safeguard nutrients and the environment.

By Lucas Criswell
As interviewed by Martha Mintz

I wish I could rewind and start over no-tilling with what I know now. The longer we no-till, the more we learn about what was really happening in our fields as we made the transition, and what we could have done then to take our soils farther, faster.

When my Dad, William, started no-tilling he really just did it to save time. He worked off the farm for the post office, so not having to take any extra trips over the field attracted him to the practice.

Years later, we've come to realize everything that no-till was doing for our soils, and we're actively working to amplify those benefits with tools such as cover crops, strategic nutrient management and diverse rotations.

Since adding cover crops we've watched our soils improve in leaps and bounds, and we can only imagine how far we'd be now in soil health and performance if we had used them in the beginning.

Looking forward, we want no-till to save us more than just time, as was the original intent. We want it to save our soil, save nutrients and save money. We're achieving those goals through cover crops and precision management.


STANDING TALL. Though Lucas Criswell was nervous about planting into a green, growing cover, it actually reduced slug damage, delivered soil benefits and the resulting corn crop required slightly less nitrogen than crops planted into smaller residue stands.

HUNGRY FIELDS

My Dad and I farm in the Buffalo Valley in Pennsylvania, which is part of the Chesapeake Bay watershed. A lot of our acres are very hilly and easily classify as highly erodible land.

We've been in conservation programs for some time now. And because of these conditions our acres responded very positively to no-till when Dad started experimenting with it in the mid 1980s. Our land has continued to excel as we fully adopted the practice and began using cover crops.

We get about 40 inches of rain per year, but moisture is still a challenge if we don't get the rain at the right time. While no-till has greatly helped us with water infiltration and holding soil moisture, we were always looking to improve when it came to water management. That's one of the reasons cover crops seemed like a good idea.

Going to no-till conferences has resulted in us trying a number of different practices on our farm. One of those is planting cover crops. I started out a few years ago by planting straight cereal rye.

Due to direction by the experts, and a bit of fear of planting green, I would

Lucas and William Criswell

burn the rye down when it was only 4 to 5 inches tall in the spring. Part of my reasoning was concern about slug damage. We have slug issues in this area and I thought if I burned the cover down before the crop came up that it might reduce slug pressure.

That strategy didn't deter slugs at all. Once the corn plant sprouted through that brown, dead cereal rye it was a bright, shining green beacon that the slugs were drawn to like it was magnetized.

Another problem we were having was that our soils were very carbon hungry. Even with cover crops our residue would disappear very quickly. Despite years of no-till we were still getting some soil erosion with major rain events.

I listened to speakers out of North Dakota talking about stepping up cover crops and creating armor for your soil — a thick barrier that holds soils in place, crowds out weeds and helps moderate soil temperatures. It was then that I decided to shift my management strategy for covers.

In 2013 I closed my eyes and planted corn and soybeans directly into living, green, 3- to 5-foot-tall cereal rye.

To my surprise, this practice actually resulted in less slug damage. The slugs don't care if they're eating corn or cereal rye, they just want something green to munch on. With so much green in the field it was far more likely that they found a cereal rye plant to nibble than a corn seedling. That was a great benefit I didn't anticipate.

Some of the cereal rye did stand back up, and I was concerned with shading, but I wasn't at all concerned about allelopathy from the cereal rye. One of the biggest myths out there is that corn planted into green rye will die due to the allelopathy of the still-growing cereal rye. I didn't see that problem at all. In my opinion, it's more of a nitrogen-competition issue between the plants than a chemical issue.

Cereal rye is a huge carbon crop, so it's essential to offset that carbon with

SOIL ARMOR. Getting 6 inches of rain in one hour washed no-till soybean residue, piling it against growing corn stalks (L), and some soil. Where corn was planted into a living, 5-foot-tall cereal rye cover crop (R), neither the residue or the soil budged an inch.

nitrogen, which I do by dribbling on 15 gallons of starter (10 gallons nitrogen and 5 gallons thiosulfate) 2 inches off the row with my planter. That little bit of nitrogen helps boost the corn through the rye until I can sidedress nitrogen, or until nitrogen is released from the decaying cover.

Waiting to burn down the cereal rye until after planting definitely piled on a nice protective layer of soil armor. Instead of melting away quickly like it did when we burned it down early, the big, carbon-dense cover really sticks around. The residue covers the soil, protecting it from direct hits from raindrops and deflecting harsh sunlight. And the still-anchored roots hold the soil firmly in place.

Last August, my soil armor was tested to the extreme by a 100-year rain event. In an isolated area right over my home farm, 6 inches of rain fell in 1½ hours. When I went up to the fields to see to assess the damage, I was pleasantly surprised to see just how strong my soil armor turned out to be.

I had a plot of corn where I had rolled some tall cereal rye next to bare, no-tilled soybean stubble. The soybean stubble had moved, drifting up against the corn stalks. Some dirt moved, too, but far less than would have been the case without no-till.

Where I had rolled large rye, nothing moved at all. It was proof that I had soil armor to protect my soils from these huge rain events. Moisture wasn't necessarily absorbing in this particular situation, but my soil certainly wasn't moving either.

NITROGEN CHECK

The manure feeds the cover crop, the cover crop feeds the soil microbes and, in turn, my next corn or soybean crop…

Being in the Chesapeake Bay watershed means that we, and everyone around us, are 'hyper aware' of the impacts of poor nutrient management.

I'm a member of the county conservation district board, am a Pennsylvania No-Till Alliance board member and am a big proponent of everyone becoming better nutrient managers. If we don't start cutting back and learning to grow crops with fewer inputs, we won't be doing the environment any favors, and will never get regulatory agencies off our backs. In this situation, it's best to be proactive.

For my part in reducing inputs and being a better manager of nutrients, I've realized that data and records are powerful tools, so I've been slowly adopting precision technology.

I decided to take control of my nitrogen applications and make them data- and need-driven. I switched from putting on all of my nitrogen up front at planting to applying 15 gallons of liquid nitrogen at planting and sidedressing the balance later.

To help me apply only what was needed at sidedressing — and help me evaluate the impacts of management decisions, such as seeding cover crops — I decided to practice what I preach and install an Ag Leader OptRx crop sensor system. They guide on-the-go precision sidedress applications of exactly the amount of nitrogen my corn actually needs.

The OptRx crop sensors scan my corn crop in real time and adjust the nitrogen rate on my sidedress bar based on my yield goals and the current color of the plant leafs. Every square foot of my corn field gets exactly the nitrogen it needs. No more, no less.

So far I haven't used less overall nitrogen with this system, but I'm putting what I do apply where it's needed to be fully utilized by the corn plant. I've seen the rate plummet in one field from 90 pounds of nitrogen required per acre to 45 pounds.

To be extra thorough we backed up the OptRx data with some Pre-Sidedress Nitrogen Tests (PSNTs) and we were happy to see the OptRx and

ROLLING SOLUTION. To help plant through such daunting residue, Criswell worked with Charles Martin to attach his custom helical cover-crop residue rollers to the front of his planter. The rollers are divided by solid-disc row cleaners that divide the heavy residue and clear a nice path for planting.

PSNT recommendations were very close. We can be confident in the accuracy of our variable-rate applications.

COVER CROP SYNERGY

Being able to variable-rate apply nitrogen based on need also helps me assess how cover crops impact my nitrogen use. I was concerned about how planting into large, green cereal rye might impact nitrogen availability and overall corn performance.

Those concerns, as it happens, were unfounded. When I went through my fields with the OptRx sensors in 2014, I found the corn planted into large, living covers actually needed 15 to 20 pounds less nitrogen than corn planted into a more immature cover crop.

Some of the fields I planted into had younger cover crops, because when you have 900 acres of corn to plant you can't wait on all your covers to hit that perfect point. In the past, this rush to plant is part of what led me to burn down the rye while it was still small. I was concerned about the cover getting away from me, sucking up moisture and nutrients and creating a mess I couldn't plant into.

These results have convinced me that letting my cover crops grow and planting into living covers is not only doable, but beneficial.

We've definitely seen some interesting benefits with our cereal rye cover and we continue to be surprised. At our Pennsylvania No-Till Field Days, Christine Jones, an Australian soil expert, spoke and helped explain some of the benefits we're seeing.

We learned that we need to have something green on our soils all the time, as those green crops are capturing sunlight and putting energy in the form of carbon into the soil for soil microbes and fungi.

Christine spoke about plants producing liquid carbon and excreting it through their roots as part of photosynthesis. If you don't have something capturing that sunlight and energy, and depositing carbon for soil life to feed on, you're probably planting into a stale, lifeless environment that isn't actively cycling nutrient to the new crop, she says.

With cover crops we're providing that living plant soil armor and plenty of organic matter for the soil life to feed on.

In 2014 we made an interesting observation. This fall there was a lot of leaf blight in our valley. My corn that was planted a little later into the larger cereal rye cover crop had a lot less leaf disease than other fields.

Christine also shared with us that cover crops release carbon dioxide as they break down. Corn requires a lot of carbon dioxide per day to grow, and her theory is that because this carbon dioxide is being released from the huge mass of residue breaking down, the plant is able to capture it on the bottom of the corn leaves — helping to make a healthier, more disease-resistant corn plant.

MANAGING COVERS

The physical act of planting into 5-foot-tall cover crops can present some challenges, both real and perceived.

When I planted corn into a large, living cover with my 12-row, Kinze 30-inch no-till corn planter I did have some stand backup, which concerned me. I want the cover to lay down and shield my soil, not stand up and shade my germinating crops.

In 2013 I saw a cover-crop roller that Charles Martin was developing. It's a helical roller planter attachment specifically for no-tilling into cover crops.

With Martin's rollers, each row has two solid disc row cleaners with treaded crimping rollers on each side. The row cleaner cuts the rye and lays it to the side so the roller can flatten and crimp the rye. This design clears a nice path for the row unit to come through with double-disc openers to plant corn.

For my Kinze planter I worked with Martin to make the rollers like pusher units, attaching them to the front of the planter. They flow independently with spring down pressure.

I also use Thompson spoked closing wheels. I have had other spader closers that wrapped constantly with cover crops. It can make for a very nerve-wracking day when your closing wheels wrap up every other round. But I don't have that issue with the Thompson closing wheels.

HERBICIDE TRICK

Not all management strategies for cover crops are mechanical.

One of my buddies learned by accident that if you forget to put Roundup in your burndown mix with Canopy and Sharpen that cereal rye won't die, but will be stunted. While it was an accident for him, it provided a cover crop opportunity for me.

By just spraying Canopy and Sharpen in the spring on acres that I'm planting to soybeans, I can take out broadleaf weeds and still have the cereal rye growing. This crowds out other problem weeds like marestail, as well as building soil armor, increasing water infiltration and improving soil health.

Once I tried field peas in my rotation, they really got my attention. Anything that follows the field peas does very well…

In 2014 I planted soybeans into green rye that I had stunted with this combination and then terminated the cereal rye 30 days after planting. It worked out great. When we went back to kill the cereal rye it was 4 feet tall. The soybeans seemed just fine.

MIXING IT UP

Diversifying our crop rotation has proven to be a wise decision on our farm. Once again, I was listening at a no-till conference to guys like Dwayne Beck, who was challenging no-tillers to try something new. So I did.

In 2010 I planted a few acres of

PROACTIVE MANAGEMENT. Criswell uses OptRx sensors to variable-rate sidedress nitrogen in corn (L) based on what the crop needs. Cover crops prevent sediment from moving, even in 6-inch rains that washed this veritable canyon in his yard (R).

yellow field peas, which was quite a change from our traditional corn-soybean rotation. I had to work to find a market for the specialty crop, but eventually found I could sell them for birdseed.

Peas are planted in early April and harvested the beginning of July, which allows for double-cropping opportunities. This year I planted a forage mix of BMR sorghum, forage pea, triticale and soybeans, which we will chop for forage. Triticale should then come back and serve as our cover crop for the fall.

Once I tried field peas in my rotation, they really got my attention. Anything that follows the field peas does very well. It doesn't matter if it's corn, soybeans or a forage crop — there is something to the added diversity that I think goes beyond the nitrogen they provide.

This knowledge got us to try adding more diversity with our cover crops as well. In 2013, I planted a mix of cereal rye, Austrian winter peas and hairy vetch. I seed covers with my Kinze 15-inch corn planter and 15-foot John Deere 1590 drill.

When I was planting a monoculture of cereal rye I would seed 2 bushels per acre. I always use my drill or planter to seed it and have planted very late into the year, even doing frost seedings with success.

Once I added legumes to the mix I dropped the rate to 1 bushel of rye and intend to drop the rate to 30 to 40 pounds of rye with 30 pounds of Austrian winter peas and 5 pounds of hairy vetch for 2014.

SOLVING THE NITROGEN PUZZLE

I'm looking to the legumes in my cover-crop mixes to add diverse root and plant types to benefit my soil life and provide nitrogen.

But figuring out how much nitrogen we get from some covers is a challenge. We know there's a nitrogen benefit, but a lot of farmers just keep putting on the standard fertilizer program and they're not saving any money. They like to save money, but they don't want to lose yields by reducing fertilizers.

> **It can make for a very nerve-wracking day when your closing wheels wrap up. But I don't have that issue with the Thompson closing wheels...**

With the data we collect through using the OptRx system, I'll be able to tell if my legumes are paying without having to blindly experiment with nitrogen rates.

I'm also trying to be more accurate with my manure spreading and have changed my strategy. In the past I'd bring in hog manure and apply 4,000 gallons per acre. Now I'm shifting to putting less manure on more acres.

I'm dropping down to 1,500 gallons per acre applied with a Pik Rite manure spreader that uses a Krohne flow meter and GPS to log the volume and location of applications. The manure is applied to cover crops in the fall right after they're established.

Cover crops are able to quickly and efficiently utilize the manure, making sure it stays in place. The manure becomes less of a liability to me and I get more out of it. It's also is part of the circle of life I'm establishing on my farm. The manure feeds the cover crop, the cover crop feeds the soil microbes and, in turn, my next corn or soybean crop.

I wish we had started using cover crops in the very beginning. In 2013 I seeded 1,200 out of my 1,800 acres to cover crops, and this year I'm hoping to seed covers on 100% of acres.

It can be hard to quantify the benefits cover crops provide us, but I'm not one to want a 100% payback the first year. I look to the long term. Just like with no-till, I think there are bigger paybacks waiting for us in the long term with cover crops.

Koepke Farms: Creating a Soil Based Dairy

Koepke Farms- Success with No till in a Dairy Environment- Creating a Soil Based Dairy

By John Koepke

Koepke Farms has been working with no-till farming practices since 1986, and has been completely no-till since 2004. The Koepkes have also used various forms of cover crops since the early 1990s. Over the years, we've made great strides in areas of reducing erosion, improving soil organic matter, bettering soil health, and reducing costs at the same time.

Unlike a lot of Midwest no-till systems, we had something else to deal with- dairy manure with sand bedding. While this seemed like a large hurdle, it really has not been. In fact manure seems to benefit no-till more than anything.

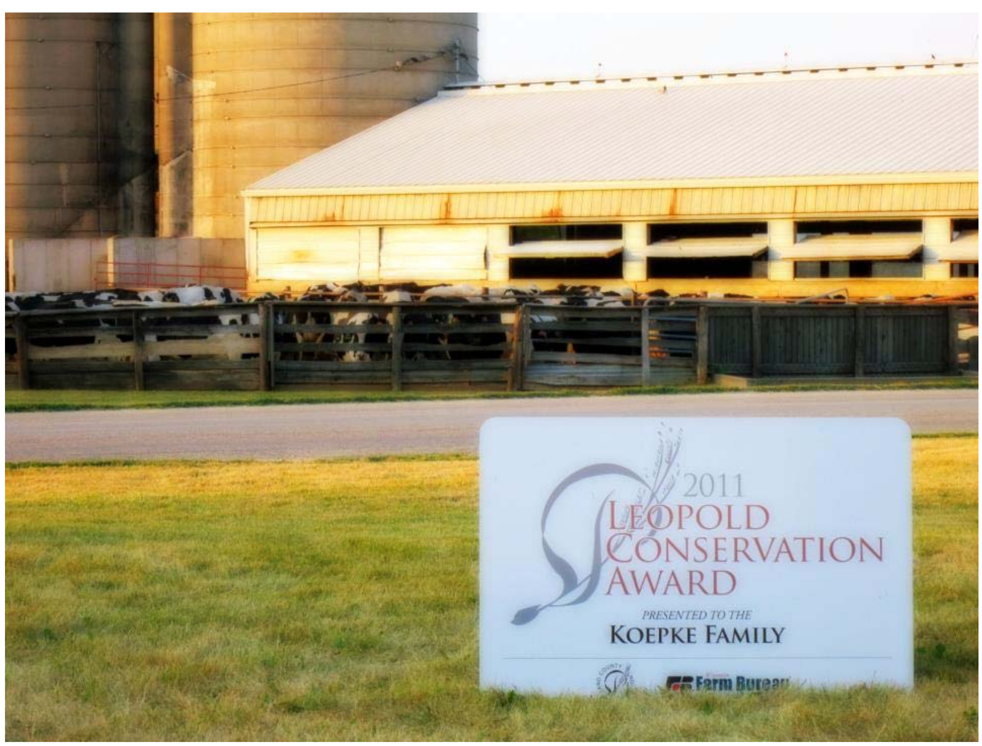
In conjunction with the Wisconsin Buffer Initiative and University of Wisconsin Discovery Farms, we monitored our effects on the environment from 2003-2009. The data collected there helped us further refine our system- pointing out our strong points, and where we could improve.

I would hope my slides show the following:

- It is possible to integrate a complete no-till system into a typical free stall dairy system.
- No till has increased productivity, profitability, and reduced our footprint on the land.
- The practices involved required little capital investment up front, and new management changes were very intuitive- they make sense from a farmer's viewpoint.

"At the end of the presentation, I'd hope you all understand that any of you can do what we've done."

KOEPKE FAMILY FARMS™ EST. 1875



2014 Corn Cropping Systems to Improve Economic and Environmental Health

Dr. Heather Darby, UVM Extension Agronomist
Lindsey Ruhl, Erica Cummings, Susan Monahan, Julian Post, and Sara Zeigler
UVM Extension Crops and Soils Technicians
802-524-6501

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2014 CORN CROPPING SYSTEM TO IMPROVE ECONOMIC AND ENVIRONMENTAL HEALTH

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

In 2014, UVM Extension's Northwest Crops & Soils Program initiated a trial at Borderview Research Farm in Alburgh, VT to assess the impact of corn cropping systems on overall health and productivity of the crop and soil. Yields are important, and they affect the bottom line immediately and obviously. Management choices involving crop rotation, tillage, nutrient management, and cover crops also make differences in the long term. Growing corn with practices that enhance soil quality and crop yields improves farm resiliency to both economics and the environment. This project evaluated yield and soil health effects of five different corn rotations: continuous corn, no-till, corn planted after perennial forage, corn planted after a cover crop of winter rye, and a perennial forage fescue.

MATERIALS AND METHODS

The corn cropping system was established at Borderview Research Farm in Alburgh, VT. The experimental design was a randomized complete block with replicated treatments of corn grown in various cropping systems (Table 1).

Table 1. Corn cropping system specifics for corn yield and soil health, Alburgh, VT, 2014.

Crop	Management Method	Treatment Abbreviation
Corn silage	Continuous corn, tilled	CC
Corn silage	New corn, in tilled alfalfa/fescue	NC
Corn silage	No-till in alfalfa/fescue	NT
Corn silage	Winter cover crop, tilled	WCCC
Perennial Forage	Fescue	PF

The soil type at the research site was an Amenia silt loam with 0-25% slopes (Table 2). Each cropping system was replicated 4 times in 20'x50' plots. This site has been in a cropping systems study for the last six years. Soil samples were taken on 7-May for Cornell Soil Health analysis. Ten soil samples from five locations within each plot were collected 6 inches in depth with a trowel, thoroughly mixed, put in a labeled gallon bag, and mailed with 2-day shipping on blue ice. Compaction was measured at 0-6 inch depth and 6-12 inch depth by penetrometer twice at the same 5 stops the soil samples were collected. The compaction measurements and soil types were used by the Cornell Nutrient Analysis Laboratory to calculate surface and sub-surface hardness (psi).

Percent aggregate stability was measured by Cornell Sprinkle Infiltrometer and indicates ability of soil to resist erosion. Percent available water capacity was measured by placing soil samples on ceramic plates that are inserted into high pressure chambers to determine field capacity and permanent wilting point. Percent organic matter was measured by loss on ignition when soils are dried at 105^{o}C to remove water then ashed for two hours at 500^{o}C. Active carbon (active C mg/soil kg) was measured with potassium permanganate and is used as an indicator of available carbon (i.e. food source) for the microbial community. Soil proteins (N mg/soil g) are measured with citrate buffer extract, then autoclaved. This measurement is used to quantify organically bound nitrogen that microbial activity can mineralize from soil organic matter and make plant-available. Soil respiration (CO_2 mg/soil g) is measured by amount of CO_2 released over a 4 day incubation period and is used to quantify metabolic activity of the soil microbial community.

The corn variety was Seedway's '5554GT,' which has a relative maturity (RM) of 105 days and is glyphosate tolerant. The NC, CC, and WCCC treatments were plowed on 10-May. Corn was seeded in 30" rows on 13-May with a John Deere 1750 corn planter at 34,000 seeds per acre. At planting, 250 lbs per acre of the starter fertilizer 10-20-20 was applied.

Table 2. Agronomic information for corn cropping system, Alburgh, VT, 2014.

Location	Borderview Research Farm – Alburgh, VT
Soil type	Amenia silt loam, 0-25% slope
Previous crop	Corn or Alfalfa/Fescue
Plot size (ft)	20 x 50
Replications	4
Management treatments	Tilled continuous corn (CC), tilled rye cover crop (WCCC), tilled fescue (NC), no-till (NT), perennial forage (PF)
Corn variety	Seedway '5554GT' (105 RM)
Seeding rates (seeds ac^{-1})	34,000
Planting equipment	John Deere 1750 corn planter
Plow date	10-May
Planting date	13-May
Row width (in.)	30
Corn Starter fertilizer (at planting)	250 lbs $acre^{-1}$ 10-20-20
Chemical weed control for corn	3 qt. Lumax® $acre^{-1}$, 5-Jun
Additional fertilizer (corn topdress)	Based on plot recommendation (Table 6)
Forage 1st cut date	6-Jun
Forage 2nd cut date	1-Aug
Corn harvest date	25-Sep

On 5-Jun, 3 quarts of Lumax® were applied per acre for weed control on corn plots. Corn was topdressed with nitrogen fertilizer by broadcast according to Pre-Sidedress Nitrite Test (PSNT) recommendations on 2-Jul (Table 6). The PSNT soil samples were collect with a 1-inch diameter Oakfield core to 6 inches in depth at five locations per plot. The samples were combined by plot and analyzed by UVM's Agricultural and Environmental Testing Laboratory using KCl extract and ion chromatograph.

Corn was harvested for silage on 25-Sep with a John Deere 2-row chopper, and weighed in a wagon fitted with scales. Corn populations were determined by counting number of corn plants in two rows the entire length of the plot (50 feet). Corn borer and corn rootworm populations were based on number of damaged plants observed per plot. Dry matter yields were calculated and yields were adjusted to 35% dry matter. 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 UVM's

Cereal Grain Testing Laboratory 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), acid detergent fiber (ADF), neutral detergent fiber (NDF), 30-hour digestible NDF (NDFD), total digestible nutrients (TDN), and Net Energy-Lactation (NE_L).

Perennial forage first cut biomass samples were harvested by hand with clippers in an area of 12' x 3' section in fescue treatments on 6-Jun and second cut biomass samples were cut using the same procedure on 1-Aug. Perennial forage moisture and dry matter yield were calculated and yields adjusted to 35% dry matter. An approximate 2 lb. subsample of the harvested material was collected, dried, ground, and then analyzed at the University of Vermont's Cereal Grain Testing Laboratory, Burlington, VT, for quality analysis.

Mixtures of true proteins, composed of amino acids, and non-protein nitrogen make up the CP content of forages. The CP content of forages is determined by measuring the amount of nitrogen and multiplying by 6.25. 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). 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. In recent years, the need to determine rates of digestion in the rumen of the cow has led to the development of NDFD. This in vitro digestibility calculation is very important when looking at how fast feed is being digested and passed through the cow's rumen. Higher rates of digestion lead to higher dry matter intakes and higher milk production levels. Similar types of feeds can have varying NDFD values based on growing conditions and a variety of other factors. In this research, the NDFD calculations are based on 30-hour in vitro testing.

Net energy for 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.

Milk per acre and milk per ton of harvested feed are two measurements used to combine yield with quality and arrive at a benchmark number indicating how much revenue in milk can be produced from an acre or a ton of corn silage. This calculation relies heavily on the NE_L calculation and can be used to make generalizations about data, but other considerations should be analyzed when including milk per ton or milk per acre in the decision making process.

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 to the right, 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. The asterisk indicates that hybrid B was not significantly lower than the top yielding hybrid C, indicated in bold.

Treatment	Yield
A	6.0
B	7.5*
C	**9.0***
LSD	**2.0**

RESULTS

Weather Data

Weather data was collected with an onsite Davis Instruments Vantage Pro2 weather station equipped with a WeatherLink data logger. Temperature, precipitation, and accumulation of Growing Degree Days (GDDs) are consolidated for the 2014 growing season (Table 3). Historical weather data are from 1981-2010 at cooperative observation stations in Burlington, VT, approximately 45 miles from Alburgh, VT.

The spring of 2014 was wetter with 3.81 inches more rain than the average year. This delayed corn planting for many farmers. However, after June the summer was drier and cooler than normal. GDDs are calculated below at a base temperature of 50°F for corn (Table 3) and 32°F for perennial forage (Table 4). Between corn planting in May and harvest in September, there was a total of 2,241 corn GDDs, 30 more than the 30-year average. There were 5,299 GDDs accumulated for perennial forage crops between April and September (50 less than the historical average). In mid-September there was an early frost that prevented the corn from maturing and drying down quickly.

Table 3. Consolidated weather data and GDDs for corn, Alburgh, VT, 2014.

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

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.

Table 4. Consolidated weather data and GDDs for perennial forage, Alburgh, VT, 2014.

Alburgh, VT	April	May	June	July	August	September
Average temperature (°F)	43.0	57.4	66.9	69.7	67.6	60.6
Departure from normal	-1.8	1.0	1.1	-0.9	-1.2	0.0
Precipitation (inches)	4.34	4.90	6.09	5.15	3.98	1.33
Departure from normal	1.52	1.45	2.40	1.00	0.07	-2.31
Perennial forage GDDs (base 32°F)	330	789	1041	1171	1108	860
Departure from normal	-54	33	27	-27	-31	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.

Soil Data

On 7-May, before planting corn, soil samples were collected on all plots (Table 5). The NC and PF treatments had significantly higher aggregate stability with 57.6% and 55.8%, respectively. However, there was no significant difference in available water capacity among the cropping systems. Surface and sub-surface hardness was lowest in the CC treatment. Percent organic matter was highest in the PF (4.7%) and NC (4.5%) treatments. In addition, active carbon was highest in those two treatments (NC, 380.2 ppm; PF, 664.6 ppm). Potentially, mineralized nitrogen and soil respiration was highest in the NC, PF, and NT cropping systems.

Table 5. Soil quality for five corn cropping systems, Alburgh, VT, 2014.

Corn cropping system	Aggregate stability %	Available water capacity (m/m)	Surface hardness psi	Sub-surface hardness psi	Organic matter %	Active carbon ppm	Soil proteins (N mg/ soil g)	Soil respiration (CO_2mg/ soil g)
CC	34.7	0.2	**85.0***	**200.0***	3.9	568.0	7.7*	0.4
NC	**57.6***	0.2	125.6	257.5	4.5*	**680.2***	**8.8***	**0.7***
NT	54.7	0.2	140.0	248.8	4.3	611.2	8.0*	0.6*
WCCC	37.1	0.2	84.4*	233.1	4.0	565.2	7.0	0.5
PF	55.8*	0.2	120.6	255.0	**4.7***	664.6*	8.4*	0.6*
LSD (0.10)	10.3	NS	20.6	26.2	0.36	62.2	1.2	0.10
Trial Mean	48.0	0.2	111	239	4.3	618	8.0	0.6

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

On 2-Jul, soil samples were collected for PSNT analysis in corn crop plots (Table 6). There was no significant difference among the tested corn cropping systems of nitrogen in the soil or medium and high recommendations. The mean soil nitrate-N (NO^{-3}) among the treatments was 14.31 ppm. Nitrogen fertilization recommendations were highest for continuous corn and lowest for corn planted into winter cover crop. Nitrogen, in the form of urea, was applied to the corn treatments based on their respective PSNT results. Hence, WCCC treatments received 65 lbs. of N per acre and CC treatments 95.0 lbs. of N per acre.

Table 6. Soil nitrate-N and N recommendations for medium and high yield potential, Alburgh, VT, 2014.

Corn cropping system	NO^{-3}-N (ppm)	Medium N recommendation	High N recommendation
CC	8.25	95.0	118.75
NC	10.75	87.5	108.75
NT	21.75	67.5	83.75
WCCC	16.50	65.0	78.75
PF	N/A	N/A	N/A
LSD (0.10)	NS	NS	NS
Trial Mean	14.31	78.75	97.50

NS – No significant difference was determined.

Corn Silage Data

On 25-Sep, data was collected on corn silage populations and plots were harvested to determine moisture and yield (Table 7). Corn silage planted in tilled winter cover crop or in no-till conditions had significantly higher populations with 19,907 and 21,301 corn plants per acre, respectively. Corn borer populations were lowest in the NC plots and highest in the CC plots. However, there was no statistical difference among corn borer populations by corn cropping treatment. With respective dry matter yields of 22.72 and 20.40 tons per acre, NC and WCCC cropping systems had significantly higher yields (Figure 1).

Table 7. Corn Silage and corn borer population and yield by treatment, Alburgh, VT, 2014.

Corn cropping system	Harvest population plants ac^{-1}	Corn pest population % ac^{-1}	Harvest dry matter %	Yield at 35 DM t ac^{-1}
CC	18,687	20.3	31.6	16.98
NC	18,513	**0.0**	34.5	**22.72***
NT	19,907	9.54	33.8	16.54
WCCC	21,301*	13.3	**35.3**	20.40*
LSD (0.10)		NS	NS	2.5
Trial mean	19,602	10.9	33.8	16.16

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

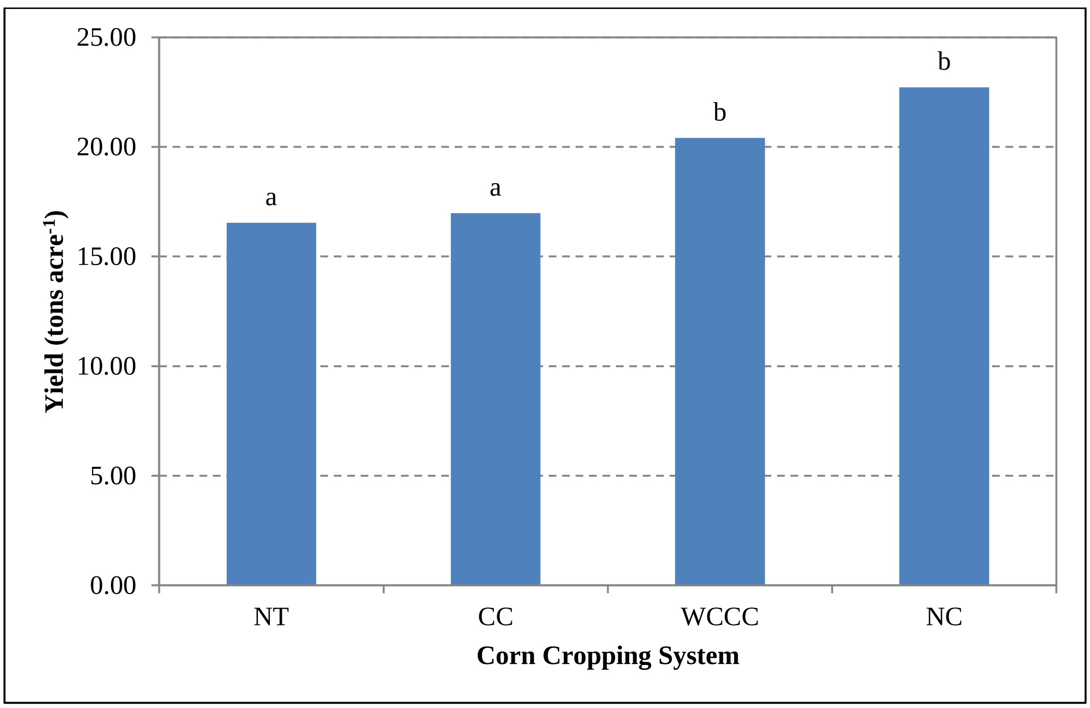

Figure 1. Dry matter yields of corn cropping systems in tons per acre, Alburgh, VT, 2014. Treatments that share a letter were not significantly different from one another (p=0.10).

Standard components of corn silage quality were analyzed (Table 8). There was no significant difference in NDF, NDFD, starch, TDN, NE_L, or Milk ton^{-1}. Crude protein was significantly higher in the NC cropping system than the NT and WCCC treatments (Figure 2). Milk per acre was significantly higher for NC and WCCC treatments. This measurement is calculated using yield, as well as quality data, which is why higher yielding plots also result in greater milk per acre.

Table 8. Impact of cropping systems on corn silage quality, 2014.

Corn cropping system	CP % of DM	ADF % of DM	NDF % of DM	NDFD % of NDF	TDN % of DM	NE_L Mcal lb^{-1}	Milk lbs ton^{-1}	Milk ac^{-1} lbs
CC	7.0*	23.1	43.2	45.2	71.4	0.7	3,298	19,591
NC	**7.5***	**24.4***	43.6	46.0	71.6	0.7	3,314	**26,387***
NT	6.8	23.4*	**42.8**	45.6	**72.0**	0.7	**3,342**	19,360
WCCC	6.4	23.2*	43.1	**45.0**	71.5	0.7	3,300	23,580*
LSD (0.10)	0.6	1.3	NS	NS	NS	NS	NS	3,297
Trial mean	6.9	23.5	43.2	45.4	71.6	0.70	3,313	22,229

Treatments indicated in **bold** had the top observed performance.
* Treatments indicated with an asterisk did not perform significantly lower than the top-performing treatment in a particular column.
NS – No significant difference was observed between treatments.

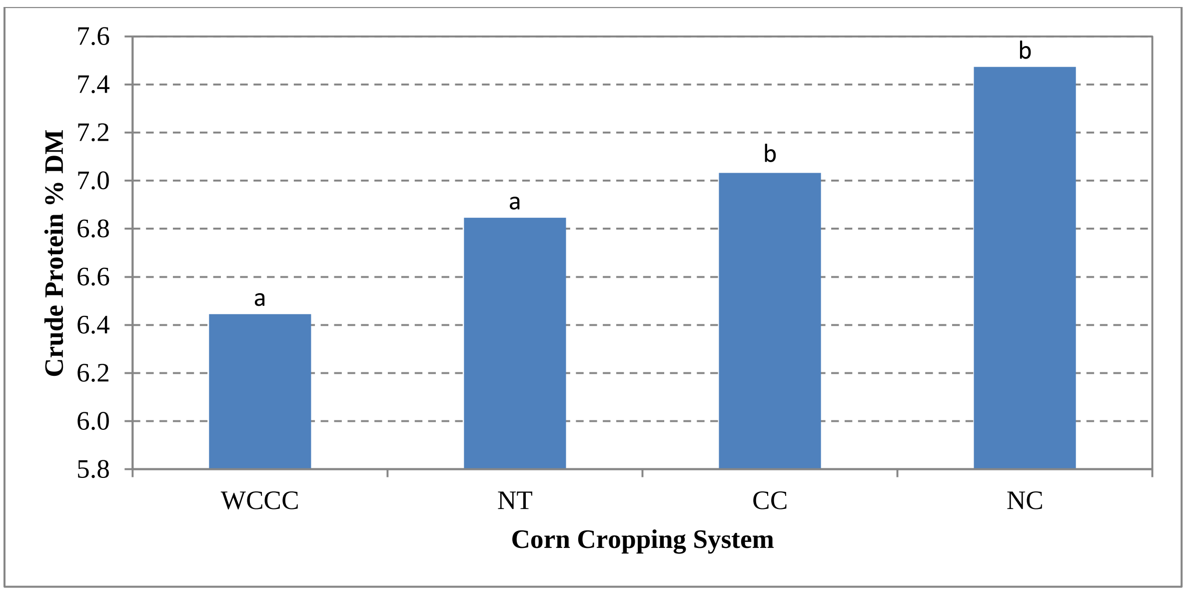

Figure 2. Crude protein as percent DM in corn cropping systems, Alburgh, VT, 2014. Treatments that share a letter were not significantly different from one another (p=0.10).

Perennial Forage Data

The perennial forage plots were analyzed for basic quality parameters (Table 9). Percent crude protein and acid digestible feed were affected by cutting date. The first harvest had higher quality with statistical significance of CP and ADF. There was no statistical difference between NDF and NDFD between first and second dates. Although there was nearly twice as much dry matter yield per acre in the first cutting, there was no statistical difference of dry matter yield between the cutting dates.

Table 9. Impact of harvest date on perennial forage quality, 2014.

Alfalfa/Fescue cutting	CP % of DM	ADF % of DM	NDF % of DM	NDFD % of NDF	Yield at 35 DM t ac^{-1}
6-Jun	**19.2***	**35.5***	57.3	62.4	10.5
1-Aug	17.6	32.9	55.9	62.3	5.23
LSD (0.10)	1.2	1.7	NS	NS	NS
Trial mean	13.4	34.2	56.6	62.3	7.88

Treatments indicated in **bold** had the top observed performance.

* Treatments indicated with an asterisk did not perform significantly lower than the top-performing treatment in a particular column.

NS – No significant difference was observed between treatments.

DISCUSSION

It is important to note that the results of this trial represent only one year of data and only in one location. The goal of this project is to monitor soil and crop health in these cropping systems over a five year period. Based on the analysis of the data, some conclusions can be made about the results of this year's trials. In terms of soil quality, NC and PF systems performed best overall, particularly in areas of aggregate stability, organic matter, active carbon, potential nitrogen, and soil respiration. These two cropping systems have the greatest potential to reduce erosion and nutrient runoff and likely provide resiliency to extreme weather conditions. The CC and WCCC treatments had the lowest aggregate stability indicating that these soils would be more prone to runoff and erosion. The higher microbial activity represents that ability for these soils to cycle nutrients and also better retain nutrients. The NT treatments were transitioned from PF to corn 3 years ago and the lack of soil disturbance is reflected in the soil quality measurements. The soil quality of the NT treatments closely rivaled the PF and NC. This treatment clearly reflects the potential for NT corn to maintain soil quality during the corn years of a rotation. Interestingly, the CC and WCCC cropping systems had less surface and subsurface compaction in the spring. This likely is due to the fact that these treatments are regularly tilled and compacted layers disturbed.

Despite the difference in microbial activity among the cropping systems, there was no significant difference in either nitrate-N in the soil or recommended nitrogen application among any of the treatments. This suggests that although the potential nitrogen was higher in the NC cropping system, the plowed plant biomass had not fully mineralized to meet the needs of the corn crop. The organic nitrogen bound in the plowed plant biomass should be available for next year's corn crop. Interestingly, these results do indicate that winter cover crops do provide nitrogen value to the subsequent crop and likely can reduce N applications by 30 or more lbs. per acre.

Although NT and CC cropping systems had higher corn populations, NC and WCCC cropping systems had the highest yields. Since treatments were fertilized to meet the needs of the crop, the increase in yield was likely due to better soil conditions for crop growth. Overall corn populations were low and may have been due to heavy rains in early June and/or difficult seeding conditions in the case of newly plowed sod in the NC treatment. Corn pests were prevalent in all treatments with the exception of NC. This indicates that proper rotation can minimize corn borer and corn rootworm issues. It is difficult to determine if these corn pests had an impact on yield but NC did out yield all other corn treatments.

The perennial forage first cutting had nearly twice as much crude protein as the highest corn silage cropping system (new corn), but the perennial forage had only 0.04% the DM yield ton per acre than the new corn cropping system. The PF treatment however had the highest soil quality and will be an important component of the overall corn rotation to build soil productivity prior to continuous corn production.

Overall, the NC cropping system performed best in terms of soil quality and yield. The NT treatment improved soil quality but yield drag was still an issue with this system. Furthermore, the winter cover cropping corn system did not appear to remediate the low soil quality of the CC system in one year. The high soil quality and yields of the NC cropping system suggests that years of established perennial forages will improve soil quality, crop yield, and provide the forage that winter cover crop does not necessarily produce.

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 Conner Burke, Lily Calderwood, Julija Cubins, Hannah Harwood, Ben Leduc, Laura Madden and Dana Vesty for their assistance with data collection and entry. This study was funded by the Ben & Jerry’s Caring Dairy Program. Any reference to commercial products, trade names, or brand names is for information only, and no endorsement or approval is intended.

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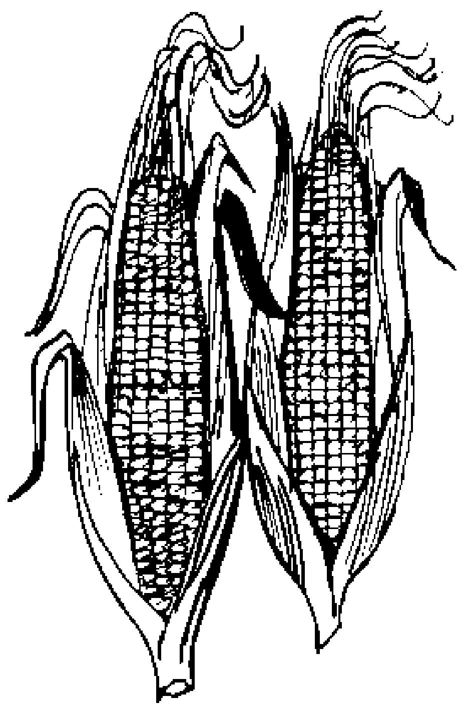
2014 Short Season Corn Silage Variety Trial



Dr. Heather Darby, UVM Extension Agronomist
Sara Ziegler, Erica Cummings, Susan Monahan, and Julian Post
UVM Extension Crops and Soils Technicians
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UNIVERSITY OF VERMONT EXTENSION
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2014 SHORT SEASON CORN SILAGE VARIETY TRIAL

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

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.

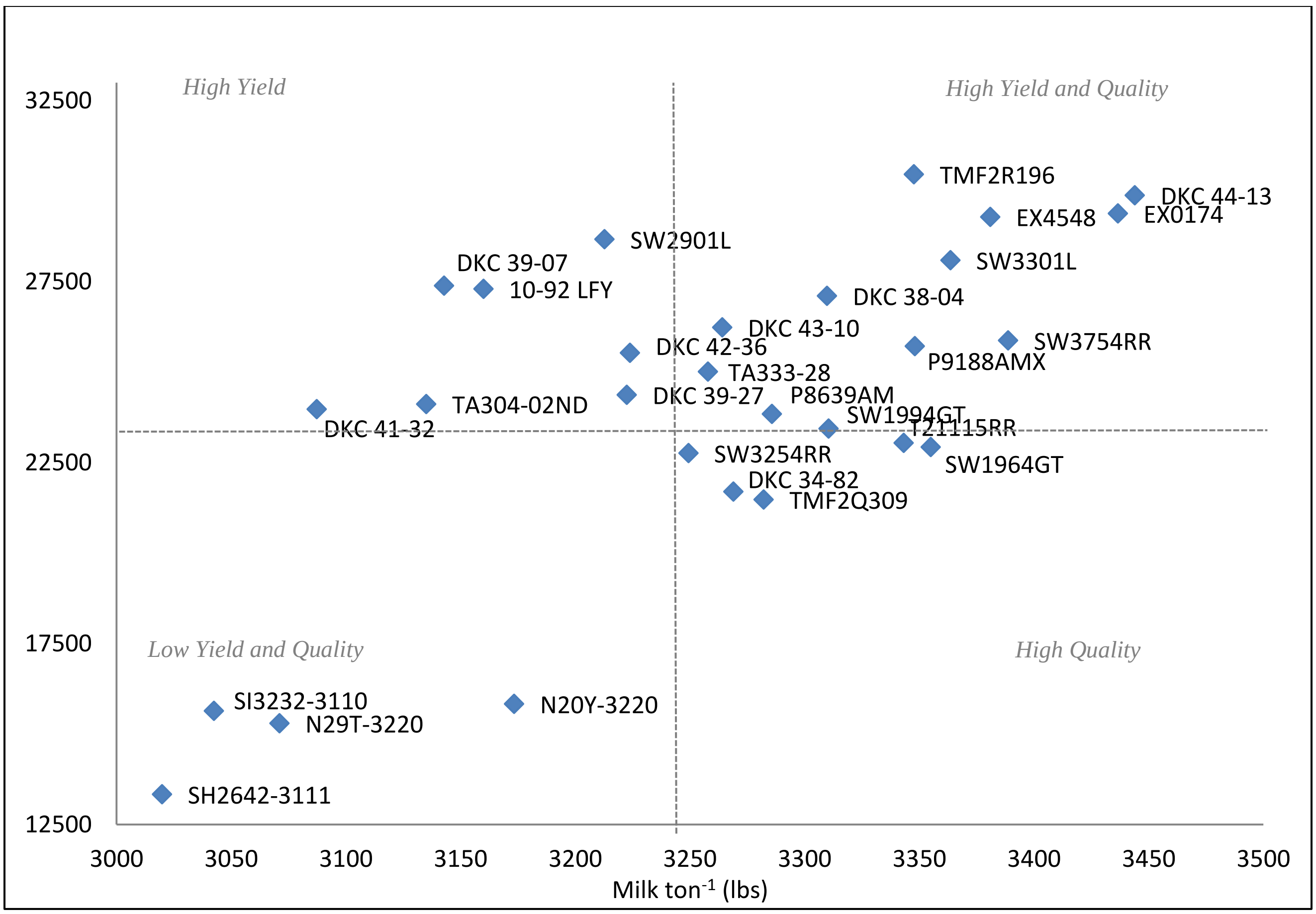

Figure 1. Relationship between milk per ton and milk per ac^{-1} for short season corn silage varieties grown in Alburgh, VT. ***Dotted lines represent the mean milk per ton^{-1} and milk per ac^{-1}.***

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.

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 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 Mac Ehrhardt of Albert Lea Seeds, Klaus Busch of Dekalb/Monsanto, Claude Fortin of Mycogen, Rodney Hostetler of Prairie Hybrids, Ed Schillawski of Seedway, Alvin Winslow of Syngenta, Jacob Bourdeau of Bourdeau Brothers (Pioneer), and Cory 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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CULTIVATING HEALTHY COMMUNITIES

UVM Extension Fact Sheet: Champlain Valley Crop, Soil and Pasture Team

Manure and Cover Crops…A Winning Combination

By Kirsten Workman, Agronomy Outreach Professional

Introduction

Table 16. Availability of ammonium nitrogen from fall-applied manure (% fertilizer N equivalent).

Time to incorporation by tillage or rain	Dairy cattle or other livestock				Poultry
	Liquid or slurry			Solid	
	Thin (<5% DM)	Medium (5-10% DM)	Thick or semi-solid (>10% DM)	(>20% DM)	
	% available				
Immediate/1 hr	40	35	35	40	40
<8 hr	30	25	25	30	35
1 day	30	25	15	25	35
2 days	25	20	10	20	30
3-4 days	25	20	10	15	25
5-7 days	25	15	10	10	25
>7 days (or non-incorporated)	25	15	10	0	20

from Nutrient Recommendations for Field Crops in Vermont, UVM

Fall applied manure is often a subject of concern – for farmers, water quality advocates and even the general public. As you know, most farmers have the conundrum of having ideal field conditions for spreading manure in the fall (dry, open, great weather oftentimes) and a need for making sure they have adequate winter storage, but not wanting to lose out on the nutrients in that manure.. Especially producers who farm heavier soils with higher clay content, that try and avoid as much spring tillage as possible. If you are a no-till farmer, you know even better that fall applied manure without incorporation will not yield much of that nitrogen for you next year's corn crop. You can lose up to 90% of your ammonium nitrogen with the right (or rather wrong) conditions.

23 Pond Lane, Suite 300 Middlebury, VT 05753 | 802-388-4969 or 800-956-1125 | www.uvm.edu/extension/cvcrops

Get the Most from Your Fall Manure

So how do we make the most of fall applied manure… plant a cover crop, of course!! Fall applied manure as part of the establishment of a cover crop can be a win-win. Not only do you better utilize your manure, potentially doubling the amount of nitrogen retained, but your cover crop will perform better too. This all leads to better soil coverage, less erosion, better nutrient cycling, and lower fertilizer costs.

Fall 2013, we conducted a small demo/experiment at the Farm at VYCC in Richmond, Vt. Although this is not 'scientific research' per se, we did utilize a randomized split block design with three different treatments with and without manure. On October 2nd, we seeded 100 pounds of winter triticale per acre with different treatments of 'Purple Bounty' hairy vetch…either 10, 20 or 30 pounds per acre with the triticale. Five days later, liquid dairy manure was broadcast over half of all the plots at a rate of around 4,000 gallons per acre. We then measured percent cover one month later in November 2013 and then collected forage samples to analyze nutrient content, measured biomass, and re-measured percent cover on May 15th, 2014 right before the cover crop was plowed down. We found that the plots that received manure out performed those that didn't in all aspects that were measured. Not surprisingly, a fertilized cover crop does better!! Plus you have better utilized your fall manure. The manured plots had double the biomass, double the nitrogen and phosphorus and potassium, and roughly one and half times the soil coverage in the fall and spring.

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Triticale/Hairy Vetch Cover Crop Plots with/without manure @ VYCC

Hairy Vetch Treatment (lbs./ac.)	Manure	AVG DM Yield lbs/Ac	AVG lbs N/acre	AVG lbs P/acre	AVG lbs K/acre	FALL 2013 AVG % Cover	SPRING 2014 AVG % Cover
10	Yes	939.0	28.4	6.2	43.7	32%	62%
20	Yes	**1115.1**	**34.0**	**7.4**	**52.6**	**35%**	60%
30	Yes	1035.0	31.7	6.9	48.4	34%	**64%**
10	No	250.8	12.3	2.4	16.8	17%	42%
20	No	**522.8**	**17.1**	**3.5**	**24.2**	**21%**	37%
30	No	501.5	16.5	3.4	23.1	16%	**43%**

There is more to come on this topic. In Fall 2014, we commenced a two year research project that is investigating combinations of winter rye and tillage radish (in comparison to straight winter rye) established with dairy manure. We hope to determine if the addition of the radish in manured systems can amplify winter rye's effectiveness as a winter cover crop. We also hope to determine the most effective seeding rates and establishment methods.

More Resources:

Michigan State University Slurry Seeding of Cover Crops: http://www.mccc.msu.edu/slurryseeding.html
Cover Crops: Manure's Best Friend: https://www.msu.edu/~mdr/vol13no3/rector.html
eXtension Webinar - Manure Nutrients, Cover Crops, and Slurry Seeding:
http://www.extension.org/pages/25311/manure-nutrients-cover-crops-and-slurry-seeding#.VN9j6y5wEuM

For more information, please contact the UVM Extension Champlain Valley Crop, Soil & Pasture Team

Jeff Carter	Extension Agronomy Specialist	jeff.carter@uvm.edu	388-4969 x 332
Kirsten Workman	Agronomy Outreach Professional	kirsten.workman@uvm.edu	388-4969 x 347
Rico Balzano	Agronomy Outreach Professional	rico.balzano@uvm.edu	388-4969 x 338
Cheryl Cesario	Grazing Outreach Professional	cheryl.cesario@uvm.edu	388-4969 x 346
Kristin Williams	Agronomy Outreach Professional	kristin.williams@uvm.edu	388-4969 x 331
Nathaniel Severy	Agronomy Outreach Professional	nate.severy@uvm.edu	388-4969 x 348

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UNIVERSITY OF VERMONT EXTENSION
CULTIVATING HEALTHY COMMUNITIES

SOIL HEALTH & COVER CROP FIELD DAY

NOVEMBER 6, 2014 * VORSTEVELD FARM * PANTON, VT

CHAMPLAIN VALLEY FARMER COALITION INC.

A special thank you:

Hans, Gerard & Rudy
Vorsteveld Farm
Panton, VT

Edmund Schilliwaski
SeedWay
**Seed donation*

SEEDWAY

Cory Chelko & Jeff Grembowicz
TA Seeds
**Seed donation*

T.A. SEEDS

Ben & Jerry's Caring Dairy

CARING DAIRY — A Ben & Jerry's Initiative

LAWES AGRICULTURAL SERVICE, INC.

Matthew's Trucking

Resource Management Incorporated
Down to Earth Recycling Solutions

Project Summary:

The Vorstevleds farm is located in Panton, Vermont near the shores of Lake Champlain and the Dead Creek on notoriously 'heavy clay soils' of Addison County . They are innovative, ambitious brothers who are not afraid to try new things on their dairy farm. They have been adopting a modified reduced tillage system on their farm that has mostly eliminated fall plowing in exchange for manure injection in the fall and light harrowing in the spring on their annually cropped fields. They have also been adding cover crops to their cropping system to take full advantage of their fall manure applications, while trying to keep in mind the difficult to manage spring conditions on soils that can have upwards *of 90% clay content*.

During the field day we will take a look at:

- 8 different **cover crop mixes** no-till drilled after a winter rye/winter wheat harvest in August along with manure injection
- A new cover crop mixture after corn silage harvest that includes **winter rye, winter wheat, oats and forage radish.** They hope to maximize fall biomass and residue for nutrient cycling and erosion control, while reducing the amount of living material in the spring when conditions can be limiting for field work.
- **MANURE**. On any dairy farm, efficient manure utilization is an important concern. The Vorstevelds are trying different **injection** methods in conjunction with their cover crops. We'll take a look at some of the things they've tried this year...injecting before and after cover crop plantings, utilizing different sweeps during injection, etc.

Champlain Valley Crop, Soil & Pasture Team

Project Leader
Jeffrey Carter
Extension Agronomist

Agronomy Outreach
Rico Balzano
Kirsten Workman
Cheryl Cesario
Nate Severy

Field Technicians
Daniel Infurna
Kristin Williams
Lindsey Ruhl

(802) 388-4969
cvcrops@uvm.edu
blog.uvm.edu/cvcrops
23 Pond Lane, Ste. 300
Middlebury, VT 05753

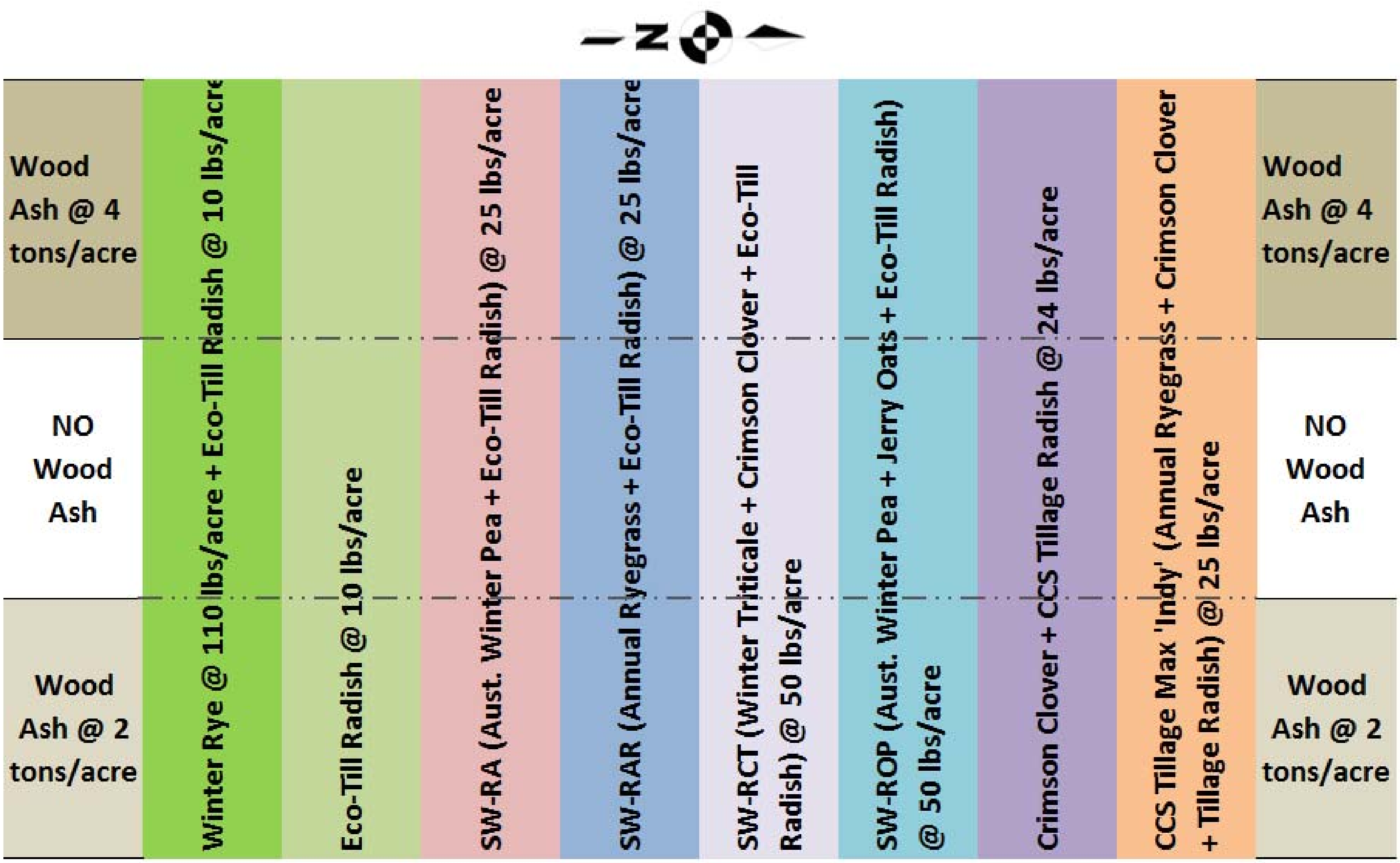
Site Statistics:

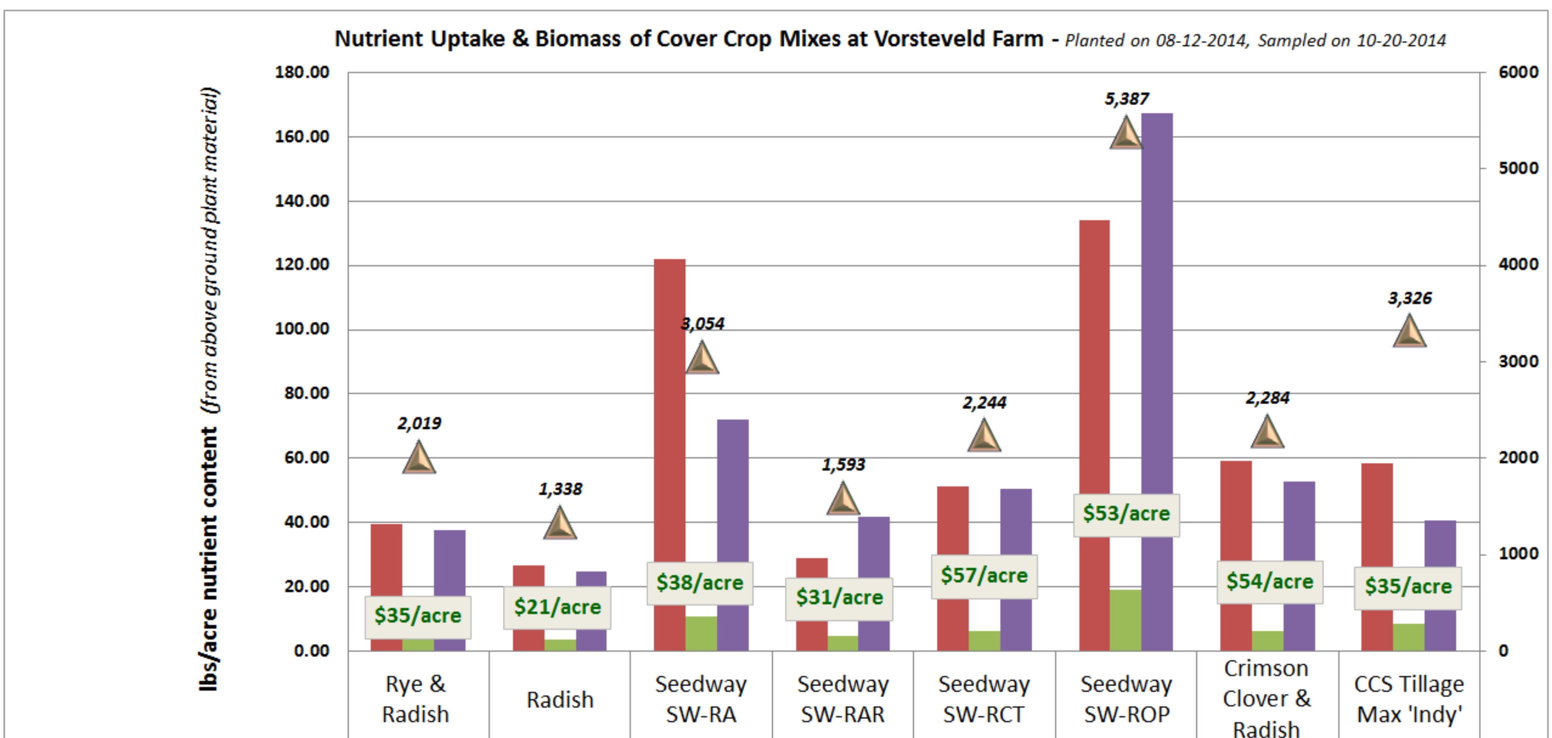
Location: Panton,VT
Soil Type: Vergennes Clay & Covington/Panton silty clay
Cover Crop Mixes Drilled*: August 12, 2015
Previous Crop: Winter Rye/Winter Wheat Grain
Manure: Liquid dairy manure injected
**Drilled plots seeded with Haybuster No-Till Grain Drill*

Funding for this project was provided by: USDA NRCS United States Department of Agriculture Natural Resources Conservation Service — Conservation Innovation Grant; USDA United States Department of Agriculture National Institute of Food and Agriculture

Cover Crop Plots

Vorsteveld Family Farm - Soil Health Field Day





	Rye & Radish	Radish	Seedway SW-RA	Seedway SW-RAR	Seedway SW-RCT	Seedway SW-ROP	Crimson Clover & Radish	CCS Tillage Max 'Indy'
Nitrogen (N)	39.56	26.57	121.95	29.04	51.13	134.11	59.31	58.37
Phosphorus (P)	5.25	3.60	10.86	4.84	6.11	19.09	6.27	8.40
Potassium (K)	37.56	24.72	71.88	41.72	50.60	167.37	52.80	40.63
Dry Matter Biomass (lbs/ac)	2019	1338	3054	1593	2244	5387	2284	3326

Champlain Valley Crop, Soil & Pasture Team | www.uvm.edu/extension/cvcrops
(802) 388-4969 | 23 Pond Lane, Suite 300, Middlebury, VT 05753

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CULTIVATING HEALTHY COMMUNITIES

UNIVERSITY OF VERMONT EXTENSION
CULTIVATING HEALTHY COMMUNITIES

COVER CROP FIELD DAY

NOVEMBER 7, 2014 * CLIFFORD FARM * STARKSBORO, VT

CHAMPLAIN VALLEY FARMER COALITION INC.

A special thank you:

Eric & Jane Clifford
Clifford Farm
Starksboro, VT

Stephen Linehan
Custom Spreading, Inc.
Bristol, VT

Edmund Schilliwaski
SeedWay
**Custom seed mixes*

SEEDWAY

Funding for these projects was provided by:

USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service
Conservation Innovation Grant

USDA United States Department of Agriculture National Institute of Food and Agriculture

NORTHEAST SARE
Sustainable Agriculture Research & Education

Project Summary:

The Clifford Farm is a multi-generational dairy farm located in Starksboro, Vermont. They milk 250 Holstein dairy cows and grow crops on roughly 500 acres. Eric is the President of the Champlain Valley Farmer Coalition and takes leadership roles in several other local organizations

The Cliffords have been utilizing several methods to establish cover crops in their corn fields, using winter cereal rye. The previous two years it was applied with a helicopter aerially into standing corn in early September. This year, the helicopter was unavailable, and Eric and his crew spread around 150 acres of winter cereal rye by broadcasting it on the surface and rolling the field after with a roller harrow. Many of the fields also received a fall application of manure in conjunction with the cover crop. Eric is interested in adopting no-till planting methods, and is also been planting shorter day (relative maturity) corn varieties to open up his window for planting cover crops and his ability to add some new and different cover crop species.

The Clifford Farm hosts two important Extension projects.

- **"Better Cover Crop Mixes in Vermont"** is a NRCS Conservation Innovation Grant demonstrating 10 different cover crop mixtures planted at three different times, broadcast on two dates into standing corn and drilled after harvest. This project was implemented on 5 farms throughout the Champlain Valley.
- **"Evaluating the Use of Forage Radish to Enhance Winter Rye Cover Crop Performance"** is a USDA-NIFA and Northeast SARE Graduate Student research project. It aims to assess whether the addition of forage radish to a winter rye cover crop enhances the fall and spring cover crop performance. This project has an emphasis on utilizing manure in conjunction with cover crops in a corn silage system.

Champlain Valley Crop, Soil & Pasture Team

Project Leader
Jeffrey Carter
Extension Agronomist

Agronomy Outreach
Kirsten Workman
Rico Balzano
Cheryl Cesario
Nate Severy

Field Technicians
Daniel Infurna
Kristin Williams
Lindsey Ruhl

(802) 388-4969
cvcrops@uvm.edu
blog.uvm.edu/cvcrops
23 Pond Lane, Ste. 300
Middlebury, VT 05753

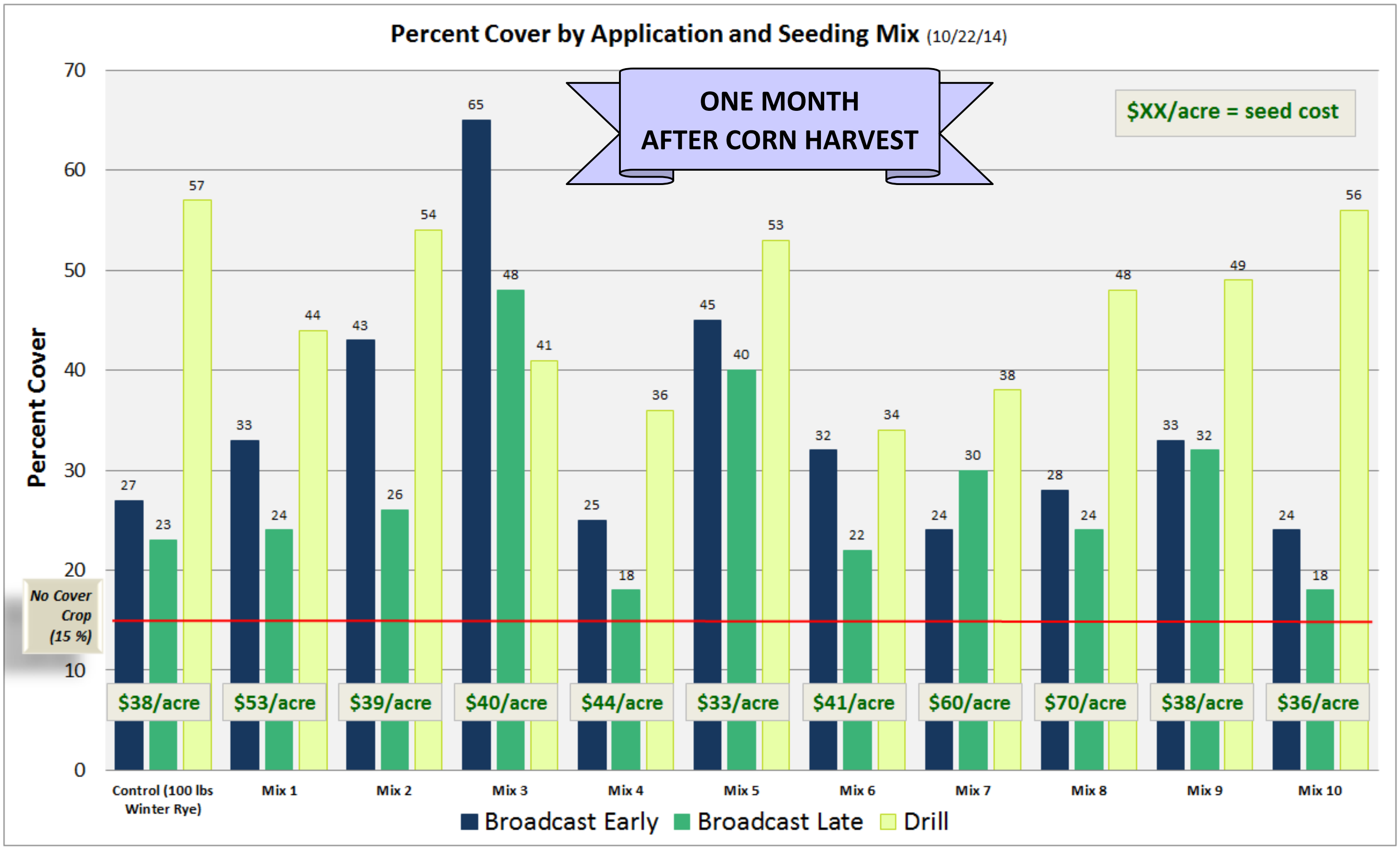
Site Statistics:

Location: Starksboro, VT
Soil Type: Canandaigua silt loam (up to 35% clay)
Corn Planted: May 25, 2014
Corn Maturity: 87 RM (Wolf River 2387L)
Corn Harvested: September 17th, 2014
Average Yield: 19.5 tons/acre

USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

BETTER COVER CROP MIXES FOR VERMONT

An NRCS Conservation Innovation Grant Demonstration Project



20 feet

Early Broadcast (11-Jul-14)

	Grass/Grain	Legume	Brassica/ Forbe	Lbs/Acre
Control	Winter Rye 100			100
Mix 1:	Forage Oats 30	Field Pea 25	Tillage Radish 5	60
Mix 2:	Winter Triticale 50	Aust. Winter Pea 25	Rapeseed 5	80
Mix 3:	Ann. Ryegrass 15	Aust. Winter Pea 25	Tillage Radish 5	45
Mix 4:	Winter Wheat 50	Aust.Winter Pea 25	Tillage Radish 5	80
Mix 5:	Ann. Ryegrass 15	Clover - Berseem 5	Tillage Radish 5	25
Mix 6:	Winter Triticale 50	Clover - Crimson 5	Tillage Radish 5	60
Mix 7:	Forage Oats 30	Hairy Vetch 10	Mustard 5	45
Mix 8	Winter Triticale 50	Hairy Vetch 10	Mustard 5	65
Mix 9:	Winter Rye 50	Aust. Winter Pea 25	Forage Turnip 5	80
Mix 10:	Winter Rye 50	Clover-Crimson 5	Rapeseed 5	60

100 feet

20 feet

Late Broadcast (14-Aug-14)

	Grass/Grain	Legume	Brassica/ Forbe	Lbs/Acre
Control	Winter Rye 100			100
Mix 1:	Forage Oats 30	Field Pea 25	Tillage Radish 5	60
Mix 2:	Winter Triticale 50	Aust. Winter Pea 25	Rapeseed 5	80
Mix 3:	Ann. Ryegrass 15	Aust. Winter Pea 25	Tillage Radish 5	45
Mix 4:	Winter Wheat 50	Aust.Winter Pea 25	Tillage Radish 5	80
Mix 5:	Ann. Ryegrass 15	Clover - Berseem 5	Tillage Radish 5	25
Mix 6:	Winter Triticale 50	Clover - Crimson 5	Tillage Radish 5	60
Mix 7:	Forage Oats 30	Hairy Vetch 10	Mustard 5	45
Mix 8	Winter Triticale 50	Hairy Vetch 10	Mustard 5	65
Mix 9:	Winter Rye 50	Aust. Winter Pea 25	Forage Turnip 5	80
Mix 10:	Winter Rye 50	Clover-Crimson 5	Rapeseed 5	60

100 feet

20 feet

Drill (19-Sep-14)

	Grass/Grain	Legume	Brassica/ Forbe	Lbs/Acre
Control	Winter Rye 100			100
Mix 1:	Forage Oats 30	Field Peas 25	Tillage Radish 5	60
Mix 2:	Winter Triticale 50	Aust. Winter Peas 25	Rapeseed 5	80
Mix 3:	Ann. Ryegrass 15	Aust. Winter Pea 25	Tillage Radish 5	45
Mix 4:	Winter Wheat 50	Aust.Winter Pea 25	Tillage Radish 5	80
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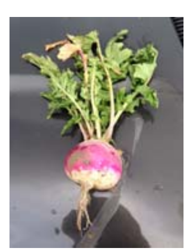
Mix 10:	Winter Rye 50	Clover-Crimson 5	Rapeseed 5	60

100 feet

N



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EVALUATING THE USE OF FORAGE RADISH TO ENHANCE WINTER RYE COVER CROP PERFORMANCE

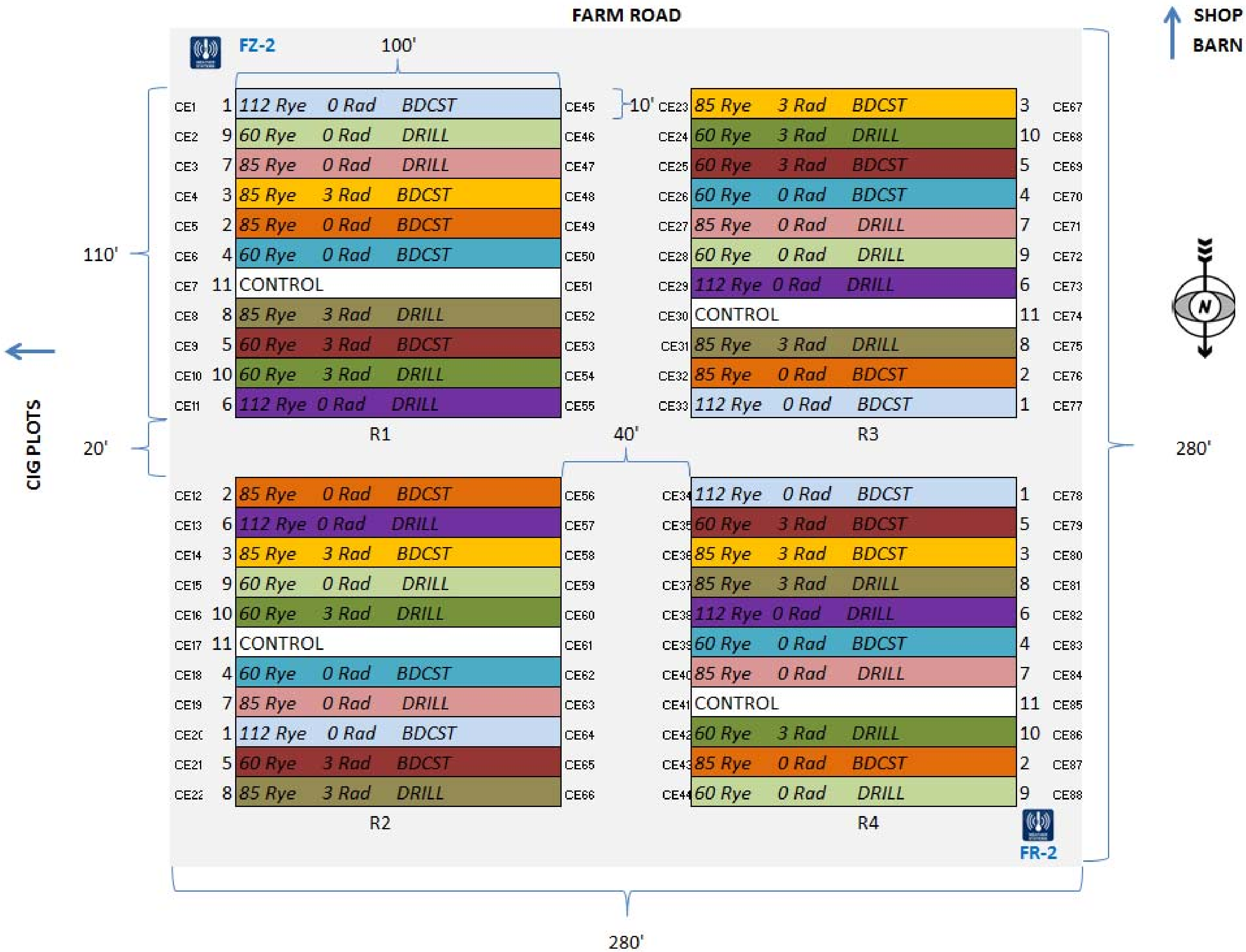
A USDA-NIFA and Northeast SARE Graduate Research Project

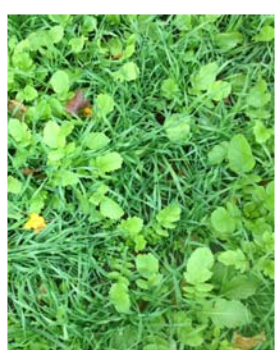
NORTHEAST SARE Sustainable Agriculture Research & Education

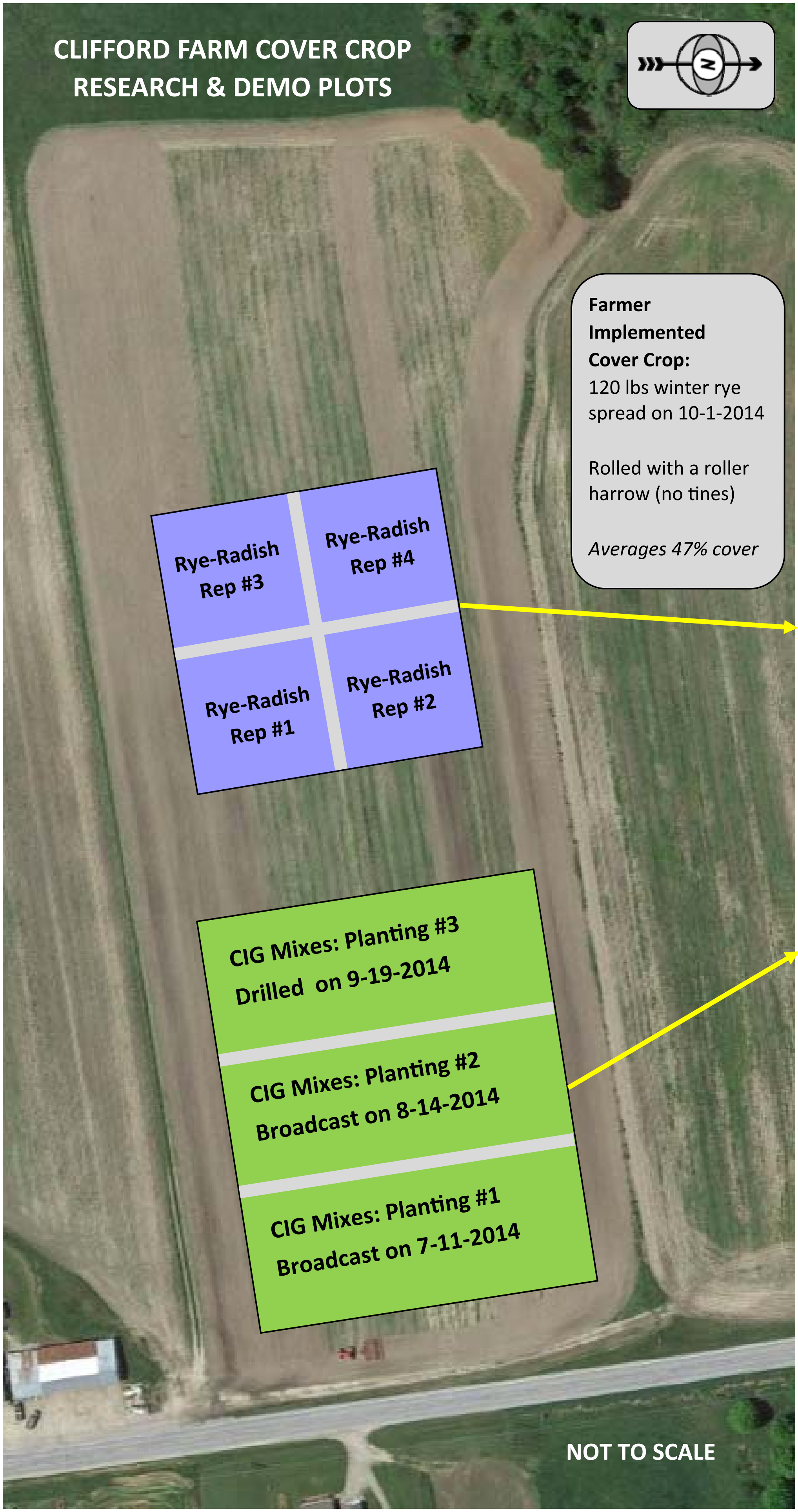
USDA United States Department of Agriculture National Institute of Food and Agriculture

RYRA TREATMENTS

	lbs./ac. Rye	lbs./ac. Radish	Planting Method	Legend
T1	112	0	*BDCST*	
T2	85	0	*BDCST*	
T3	85	3	*BDCST*	
T4	60	0	*BDCST*	
T5	60	3	*BDCST*	
T6	112	0	*DRILL*	
T7	85	0	*DRILL*	
T8	85	3	*DRILL*	
T9	60	0	*DRILL*	
T10	60	3	*DRILL*	
T11	0	0	*CNTRL*	







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Corn Planted: May 25, 2014
Corn Maturity: 87 RM (Wolf River 2387L)
Corn Harvested: September 17th, 2014
Average Yield: 19.5 tons/acre

NIFA-SARE Cover Crop Plots

Planted: *9-19-2014*
Manure Spread: *9-23-2014*
@ 7000 gal./ac. over
East half of all plots

CIG Cover Crop Mixes

Planted:
7-11-2014, 8-14-2014, 9-19-2014
Manure Spread: *9-23-2014*
@ 6000 gal./ac. over
East half of all plots

NOTES:

University of Vermont Extension: Helping farmers in Vermont put knowledge to work!

The University of Vermont Extension has a vast amount of resources available to farmers in Vermont and around the Northeast. Here are just a few that you mind find helpful.

The Champlain Valley Crop, Soil & Pasture Team is a group of UVM Extension professionals and their partners working to provide technical assistance to Vermont Farmers in the Lake Champlain Watershed. We strive to bring you research-based knowledge that has practical applications on your farm, and address many production related issues such as: Quality Forage & Crop Production; Soil Health; Grazing Management and Pasture Production; Nutrient Management; Water Quality and more.

23 Pond Lane, Suite 300, Middlebury, VT 05753 | (802) 388-4969 | www.uvm.edu/extension/cvcrops

Jeff Carter, Agronomy Specialist: Field Crops & Nutrient Management | jeff.carter@uvm.edu
Rico Balzano, Agronomy Outreach Professional | rico.balzano@uvm.edu
Kirsten Workman, Agronomy Outreach Professional | kirsten.workman@uvm.edu
Cheryl Cesario, Grazing Outreach Professional | cheryl.cesario@uvm.edu
Daniel Infurna, Kristin Williams, Nathaniel Severy

The mission of the UVM Extension Northwest Crops and Soils Team is to provide the best and most relevant cropping information, both research-based and experiential, delivered in the most practical and understandable ways to Vermont farmers.

278 S Main Street, Suite 2, St. Albans, VT 05478 | 802-524-6501 | www.uvm.edu/extension/cropsoil

Dr. Heather Darby, Associate Professor of Agronomy| heather.darby@uvm.edu
Jeff Sanders, Agronomy Specialist | jeffrey.sanders@uvm.edu
Susan Brouillette, Program Manager | susan.brouillette@uvm.edu
Erica Cummings, Abha Gupta, Amanda Gervais, Conner Burke, Susan Monahan, Deb Heleba, Lily Calderwood, Sara Zeigler, Julian Post, Lindsey Ruhl

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MORE EXTENSION RESOURCES:

- **Sidney Bosworth,** Extension Associate Professor, University of Vermont
  Agronomy, Forages, Pasture Management | sid.bosworth@uvm.edu | 802-656-0478 | http://pss.uvm.edu/vtcrops
- **Daniel Hudson**, Assistant Professor: Agronomist & Nutrient Management Specialist
  St. Johnsbury Extension Office | daniel.hudson@uvm.edu | 802-751-8307 x356
- **University of Vermont Extension Agriculture Programs** | http://www.uvm.edu/extension/agriculture

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Vermont Agency of Agriculture, Food & Markets

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