    

THE UNIVERSITY OF VERMONT
EXTENSION

2020 No-Till & Cover Crop Symposium

February 26th, 2020

DoubleTree by Hilton Conference Center | Burlington, Vermont

PROCEEDINGS

WELCOME

It is my honor to welcome you to the **7th annual No-Till & Cover Crop Symposium**. It is hard to believe that only seven years ago, we were just starting this conversation about farming with the shared goals of production and conservation. Together we have risen to the challenge to do MORE. In a time of challenging climate conditions and uncertain farm economies, you have taken the path to try new things, invest in different equipment, and constantly adapt your systems do better with less. It is not an easy feat, but worth the effort for sure.

That said, we still have work to do. This year's theme is **"Going Deeper for Soil Health."** While we have moved beyond the basics, we by no means have it all figured out and so now we will dig deeper to do even better. As Dr. Heather Darby reminded us last year, sometimes the last push to the summit of any mountain is the hardest. The first step is to get started and figure out all the things you don't know, what gear you need and how to manage the terrain. Then you just have to climb for a while and find your rhythm. But then there's the steepest part of the trail. You have to gather your resources and your energy, remember your wisdom and your faith, do a gut check and then GO.

Cover Photo *(UVM Extension)*

A three-way cover crop mix of annual ryegrass, radish and red clover grows between rows of 60-inch corn at Foster Bros. Farm in Middlebury, Vt. The cover crop was drilled into rolled winter rye residue about a month after the corn was planted in July 2019. This system is a new approach, but shows a unique way to having living, growing plants 365 days a year working to build soil health.

As we move towards that summit, we have to be ready to keep the course, even in the face of unforeseen challenges. So we hope this year's conference provides you with more skills and tools to conquer those challenges.

Today we will hear from people with an amazing amount of information and experience. You will see a focus on **PROGRESS, PROFIT, PRECISION, PLANET** and **PEOPLE.** We can't really get where we're going without a focus on all of those P's! We also ask you to add to that resource by sharing what you have discovered along the way and engaging in our roundtable discussions in the afternoon. For certain, most of what I know on this topic of Conservation Agronomy, I've learned from YOU. Don't be shy...you have so much to share and we will only get there if we can rely on each other to avoid pitfalls and mistakes, take advantage of the approaches that have been successful, and push each other to do better. So let's dig DEEP and see where it takes us next.

ENJOY THE SYMPOSIUM!!

Kirsten Workman, Agronomy Outreach
UVM Extension

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AGENDA: February 26th, 2020

Time	Session	Speaker	Topic
8:00	*Registration Opens*	*Check in, visit our Exhibitor Fair and visit with Friends*	
9:00	*Opening Session*	*Jeff Carter, UVM Extension*	*Where are we headed with no-till Farming in Vermont ?*
9:45	*Precision Agriculture*	***Scott Magnan*** *Scott Magnan's Custom Service*	*The power of precision agriculture in Vermont no-till*
10:30	*Exhibitor Fair - Time to Visit and Exchange Ideas*		
11:00	*Views from the Field*	Jeff Sanders, UVM Extension George Foster & Mark Anderson	*Progressive northeast farmers meet the challenges of a no-till cover cropped system.*
11:45	***LUNCH*** *(and door prizes)*		
	Putting Soil Health to Work	*David Brandt No-Till Farmer from Carroll, OH*	*David Brandt will share the techniques and systems he used on his farm for the last 40 years.*
1:15	*Exhibitor Fair - Time to Visit and Exchange Ideas*		
1:30	*ROUNDTABLE DISCUSSIONS*	***1. Advanced No-Till & Cover Cropping w/ David Brandt*** Get specific on the details of these conservation cropping systems.	***2. Precision Ag UP CLOSE w/ Scott Magnan*** *Show & tell technology, software, hardware and more, get specific.*
2:15	*Exhibitor Fair - Time to Visit and Exchange Ideas*		
2:45	*Current Research & New Initiatives in Soil Health*	*Dr. Heather Darby, UVM Extension*	*Cropping Systems for Conservation Agriculture—Research Results & Future Projects.*
3:30	*Move to Roundtable Discussions*		
3:40	*ROUNDTABLE DISCUSSIONS*	***3. Making $$ with No-till & Cover Cropping? w/ Betsy Miller & Kirsten Workman*** *Are you tracking the right metrics, which practices have the potential for the most profitability, a few local case studies and tools to share.*	***4. No-Till & Manure*** *A perennial conundrum...what are the best ways to responsibly and efficiently deal with livestock manure in our no-till systems?*
4:30	*Say goodbye to our exhibitors and travel home safely*		

Special thanks to our Platinum Sponsor!

Our Speakers

FARMERS & CONSULTANTS

DAVID BRANDT | Brandt Farm & Walnut Creek Seeds (Carroll, Ohio)
David is a long-time no-tiller and cover cropper farming over 1,000 acres in Carroll, Ohio. They have used no-till on their farm since 1971, and added cover cropping in 1978. While he and his wife, Kendra like what they see from the soil health system they're using on their central Ohio farm, everything they do still has to pass muster through the combine's yield monitor.

SCOTT MAGNAN| *Scott Magnan's Custom Service (St. Albans, Vermont.)*
Scott operates a custom service business in St. Albans, Vermont where he has become proficient in installing and providing education to farmers on precision ag equipment and software to enable his customers to get the biggest return on their investment. In addition he offers custom manure spreading, crop planting and harvesting services to farms in northern Vermont.

MARK ANDERSON | *Landview Farms LLC (White Creek, New York)*
Mark farms in Partnership with Rody, Jane, and Randy Walker in White Creek, New York. They milk 1350 cows in a modern milking facility built in 2016. They have been using no-till and cover crops on their 2300 acres for serveral years, and are now learning how to use these practices together to increase soil health and ultimately farm profitability. Mark is constantly on the lookout for information that be utilized to improve the way they farm.

GEORGE FOSTER | *Foster Bros. Farm (Middlebury, Vermont)*
George Foster farms with his family in Middlebury, Vermont. Along with his son, Jeremy, he manages all the cropping for their 2200 acre dairy farm where they grow corn silage, soybeans, small grains and hay. Over the last 6+ years, they have transitioned the farm to about 99% no-till and they use cover crops on their corn and bean crops every year. The Foster family also operates Vermont Natural Ag Products, a commercial composting business.

OUR SPEAKERS

UVM EXTENSION AGRONOMY

JEFFREY CARTER | ***UVM Extension Agronomist***
Jeff Carter has worked at UVM Extension for the past 35 years to assist farmers all around Vermont regarding crop production including corn & beans, alfalfa, pasture, Christmas trees and wildlife food plots. 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 | ***Professor of Agronomy***
Heather Darby is a Soils & Agronomic Specialist for UVM Extension. Raised on a dairy farm in northwestern Vermont, she can 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. Heather is involved with implementing 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. Her research has focused on traditional and niche crop variety trials, weed management strategies and cropping systems development.

JEFF SANDERS | ***Agronomy Outreach Specialist***
Jeff spends much of his time working with farmers in the northern Lake Champlain Basin with UVM Extension's Northwest Crop and Soils Program. He works hard to demonstrate how no-till/reduced tillage techniques can be implemented successfully on a wide variety of soil types and conditions. His expertise is in reduced tillage systems, cover cropping practices, soil health, and interseeding, and he provides on-farm technical assistance to farmers statewide. Jeff is always looking for innovative ways to address water quality issues on farms through the use of technology and common sense.

KIRSTEN WORKMAN | ***Agronomy Outreach Specialist***
Kirsten works with farmers to implement practices that improve crop production and protect water quality in her role with UVM Extension's Champlain Valley Crop, Soil & Pasture Team. She started her career in Washington state and after 10 years of working with West Coast farmers, she joined the UVM Extension Middlebury in 2011. She helps farmers understand, prepare and implement comprehensive nutrient management plans. A major focus of her work has been on improving and implementing cover cropping systems on Vermont farms and more recently on grassland manure injection.

Betsy Miller | ***Farm Business Educator***
Betsy Miller is a farm management educator for University of Vermont Extension. Working with the Farm Viability program for over twelve years Betsy has had the opportunity to assist various types and sizes of farms in completing business plans, conducting cash flow and enterprise analyses and working on farm transfers. Maple sugaring, and sawing logs are some of the things Betsy enjoys doing with her family.

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

The two UVM Extension teams that bring you this symposium are proud to share our work with you. Here is a little bit more information about us.

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, such as: Quality Forage & Crop Production, Soil Health, Grazing Management and Pasture Production, Cover Crops, No-Till Agriculture, Nutrient Management, Water Quality and more.

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

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Kirsten Workman, Agronomy Outreach | kirsten.workman@uvm.edu

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/nwcrops

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Cover Crops, Forage Seeding, Forage Production and Crop Insurance

Cover crops are used primarily for erosion control, soil health improvement, water quality improvement and other conservation purposes. Cover crops can include grasses, legumes, and forbs. When a farm has crop insurance and cover crops, practices must go along with the policy provisions.

The NRCS Guidelines serve as the cover crop management guide for the entire United States and for all USDA agencies. This includes RMA (Risk Management Agency), the USDA agency that oversees crop insurance programs and policies. These NRCS guidelines were established so producers can achieve conservation benefits of cover crops while minimizing the risk of reducing yield on the crops that follow due to soil water use.

Insurance shall begin on a crop following a cover crop when the cover crop 1) meets the definition provided in the basic provisions, 2) was planted within the last 12 months, and 3) is managed and terminated according to NRCS guidelines.

Forage Seeding Insurance
A forage seeding is insurable if:

- It is alfalfa, or forage mixture containing at least 50 percent alfalfa, clover, birdsfoot trefoil, or any other locally recognized and approved forage legume species (by weight); or
- It is planted during the current crop year to establish a normal stand of forage.

The policy does NOT cover any acreage that is grown with the intent to be grazed, or grazed at any time during the insurance period; or interplanted with another crop (except nurse crops).

Pasture, Rangeland, Forage (PRF) Insurance is designed to provide insurance coverage on pasture, rangeland or forage acres against forage losses due to one peril: the lack of precipitation. The PRF program does not measure production or loss of products, but instead utilizes a rainfall index to determine precipitation for coverage purposes. Rainfall in the acreage location within a grid system is compared to the 50-year average for that grid location. Each grid section is approximately 17 X 17 miles. Coverage is based on the producer's selection of coverage level, index intervals and productivity factor. The index interval represents a two-month period selected by the producer, and policyholders can select coverage from 70 to 90 percent.

For more information on these and other agricultural risk management programs, visit the UVM Agricultural Risk Management Education website:
http://go.uvm.edu/ag-risk

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USDA Risk Management Agency (RMA) website https://www.rma.usda.gov/

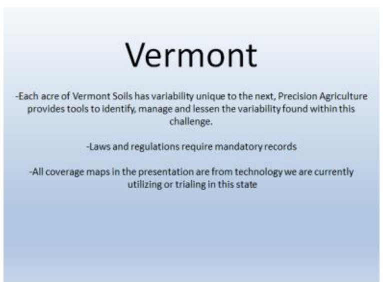
USDA Farm Service Agency (FSA) website https://www.fsa.usda.gov/

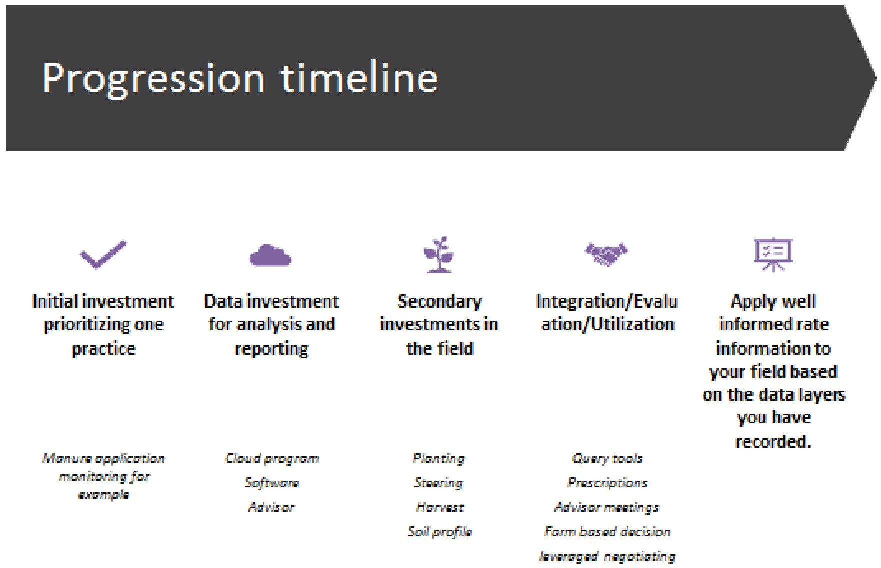
USDA
U.S. Department of Agriculture
Risk Management Agency

USDA and the University of Vermont are equal opportunity providers and employers. This material is funded in partnership by USDA, Risk Management Agency, under award number RM18RMETS524C022.
February 2020

The Power of Precision Agriculture in Vermont No-Till

A guide to understand how each investment in precision agriculture performs alone and how it can be utilized more progressively with each additional investment



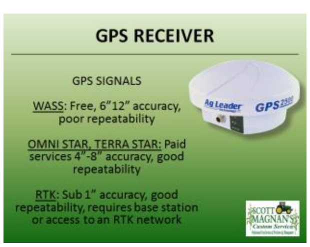


Initial investments that prioritize one practice to meet one or two immediate goals

Display and Receiver

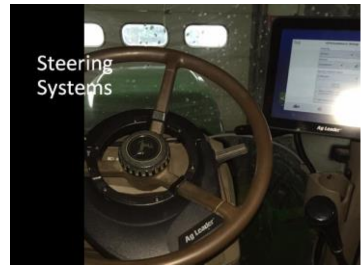
Before you can do anything a display and GPS receiver is a must.

- Displays range from entry level to very advanced. Very basic usually provide guidance for a steering system and some basic coverage mapping. As you upgrade displays, you will have much more information gathering capabilities and functional control of your implement



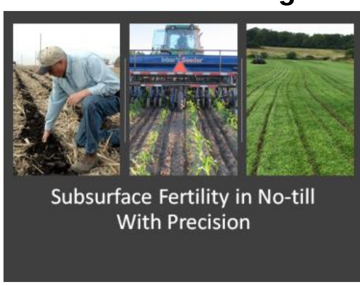
- Receivers are the tools that deliver the satellite information to the display to pinpoint the location of the tractor (rover). Basic service, called WAAS, was and is free, but has limited accuracy and repeatability. To increase accuracy, you must add satellites generally through a subscription service to increase the number of triangulation points or have a fixed point called Real Time Kinetics (RTK). Baud and Hertz rates can also affect the function of the system

Guidance and steering offer several advantages to a no-till operation.



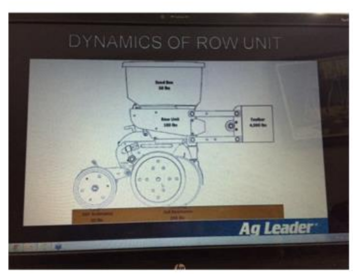
- No-till can be hard to see pass to pass, guidance and steering take your focus off this task and allow you to put your energy and focus on other aspects of the job.
- With greater accuracy pass to pass, overlap and underlap is reduced, in effect reducing wasted land, wasted seed, while increasing yield and crop uptake, planting and harvest efficiency
- Fertilizer spreading is a popular task with steering. Much like planting there is reduction in under and overlapping which result in efficiency gains in the use of fertilizer while maximizing the fields yield potential.

Many farmers make early investments in cover cropping and manure application tools. These investments offer several benefits, below are some examples of applications and tools used in this area of agriculture.




- Manure application rates can be monitored and in some cases controlled using flow meters and modules connected to the Guidance display.
- Cover crop seeding can be monitored for rate and be used with swath control which shuts down the drive mechanism that applies seed when recognizing overlap.
- There are record keeping benefits to be covered later.

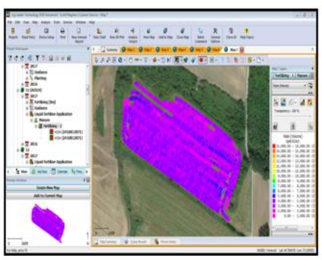
Planting Investments



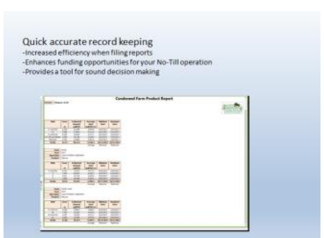
- Planter Monitoring can be greatly enhanced with technology. Every aspect of seed going through the tube is measured. You should be able to get a very exact idea of planter metering performance and related components. Data on population, spacing, singulating, skips and doubles can be in front of you at times on a row by row level.

- Planter downforce issues have resulted in no-till failures. Downforce monitoring allows you to see how much pressure is on the gauge wheels, low numbers indicate compaction or the need for greater down pressure. High numbers indicate soft areas of the field and or excessive down pressure. Manual adjustments can be made in response to this data. Automatic downforce control can come from generally two types of systems; pneumatic which inflates or deflates airbags to increase or decrease the pressure bases on the monitoring data. Hydraulic can very rapidly respond and adjust to monitoring data. Both systems can assist at keeping planting depths even with over compacting the gauge wheels around the seed trench.
- Planter metering control, controls the speed at which your meter is turning in reference to speed. Traditional ground control, chain drives are replaced with hydraulic and motors using the GPS speed data to control output of seed delivery, with this type of control, once calibrated seed populations are controlled from the cab.
- Automatic shutoff stops seed from flowing in an already planted area. Hydraulic systems utilize clutches to shut off each row. Electric motors will simply shut off and restart as needed.

Data for recording and reporting



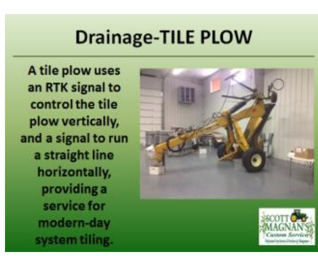
- Data is stored in a display. Some limited data can sometimes be found with exporting it.
- Data can be sent to a cloud program wirelessly.
- Data can be transferred to a software program through a USB drive, software programs can also be connected to cloud programs. You will learn more in using data to make decisions.

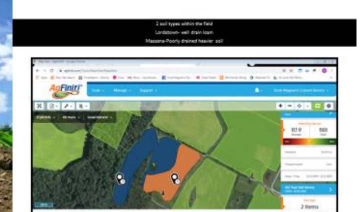


- Each pass over the field creates a coverage map with all of your information. These files can also be converted to shape files and can also be shared with advisors, advisors, funders and regulators.

- Reports of the data can be filtered to share necessary, valuable, and interesting aspects of any pass through the field.

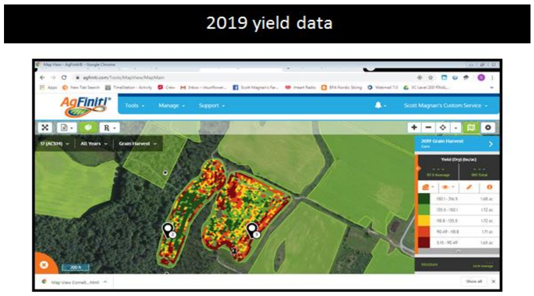
Other Tools in No-till





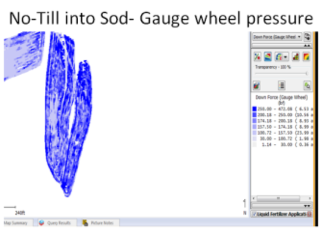
- Weed control is the operation that precision agriculture started in, much like manure application and seeing common functions are rate control, and swath control.
- Tile drainage uses RTK level accuracy to place tiles in the exact horizontal and vertical location needed to meet drainage goals
- Optrix sensor technology, rarely used in Vermont to date at the farm level, could be part of the future in mapping live data of crop health from an implement or a drone.
- Soils sampling and data information can be entered and utilized in precision ag software and be a key component to data analysis and utilization.

Harvest Technology



Implementing harvest technology that utilizes precision ag unlocks the ability to measure the success of all other investment tools. Yield data is measured throughout the field producing live data such as yield and moisture while producing a map to evaluate later. Modern chopping data can also measure constituent data to help identify feed quality.

Data Analysis



2019 | Corn

Magnan, Scott | All Farms | 17 (ACS14)

Corn

Soil Type	Yield (Dry) (bu/ac)	Moisture (%)	Area (ac)
Lordstown	123.9	24.26	5.25
Massena	116.7	23.77	3.22
Total	**121.2**	**24.07**	**8.47**

Once an investment is made, you should have some data for analysis. Harvest data is the most powerful tool as it gives you the metrics to show how each observation from the other tools performed. Common tools that are handy at the farm level are **application maps**, these have data sets you can click on to see the coverage map for that application. For example a planting map will have a skips map, a population map, and down pressure map. Each layer tells a little bit more of the story. As you spend more time looking at these you will learn more and more about how your planter performs in all conditions. To give you an idea light gauge wheel pressure is an indicator of compaction. Another example is harvest data along a tree line, that shows low yield, perhaps shade is a bigger problem than you realized on small fields. A **query tool** lets you box an area of the field in to look at the data within the box to see how it performed against the rest of the field, it is valuable in determining the yield potential of a field or soil type and then using the tool identify why other areas did not match up to that potential. **Comparison**

reports let you compare different attributes such as seed varieties, soil types and population rates. A soil type report would give you stats such as yield for each of your different soils, with that information you could go back and look at your maps, perhaps use the query tool and check that information to see if the information was truly a reflection of soil type.

On Farm Trials

With the ability to change rates from the cab we can create our own trials either well in advance or on the fly. Certainly having data at harvest is the most useful tool to check these trials, but crop scouting and manual agronomy work can also assist in gathering and utilizing information.

Data Utilization

Now that you have made some multilevel investments, ran some comparison reports, done some query work, and made some accurate conclusions about your farm; you can put that into action the following crop year. You can simply make some simple adjustments to rates on your own on a field by field bases or generate prescriptions. Prescription options are becoming more and more available at an affordable cost. The more on farm data layers you have and can share, the more farm and field specific the prescription will be. You can have legend based prescriptions which generally take data from one data set such as yield and can prescribe for example a fertilizer prescription based on crop uptake the prior year. Equation based prescriptions plug in more data layers, such as soil test, soil type and rotations to form a more comprehensive application prescription. If you use university prescriptions with limited data sets, it is important to do some of your own analysis because they are basing the prescribed rates on information gathered through their own research. An example would be a planting prescription based on soil type. While massena clay might have a regionally recommended rate of 34,000 population, your trials might show that your highest return is at a little lesser rate.

You can contact Scott Magnan at (802) 527-7707 or scttmgnn@gmail.com
Facebook: @ScottMagnansCustomService

Progressive Perspectives
A Conversation with George Foster & Mark Anderson

FARMER PANEL

Moderated by Jeff Sanders, UVM Extension | jeffrey.sanders@uvm.edu

This presentation will briefly discuss UVM data on roller crimping rye in a no-till system and then a discussion with two farmers and what they have done to take their no-till/cover crop programs to the next level. We will discuss some of the different ways they have implemented rolling cover crops and how they have incorporated manure into their no-till systems. We will touch on equipment modifications, drag lining manure, applying manure to corn fields post planting, and what's next for them as they continue to make improvements to their systems. The conversation will focus around take home tips that they have provided. There will be time at the end of the presentation for questions.

NOTES

Landview Farms

White Creek, NY

A large dairy farm milking over 1000 cows and cropping more than 2300 acres just across the western border of Vermont. Mark Anderson is a progressive and innovative no-tiller, always willing to take on a new challenge. Whether it is innovative cover cropping strategies or progressive manure management, they are always on the look out for a 'better way.'

Foster Bros Farm

Middlebury, VT

George and Jeremy Foster manage the cropping at Foster Bros Farm, a 2200 acre dairy farm in the heart of Addison County. They grow hay, corn silage, soybeans and small grains utilizing almost 100% no-till methods. They are firm believers that cover crops are the key to their no-till system working and value the improvement in soil health they have seen over the last six years of transitioning their cropping system. Whether it is manure, cover crops or planting...flexibility is key on this farm.

2019 Interseeding Cover Crops into Wide-Row Corn Silage

Dr. Heather Darby, UVM Extension Agronomist
Sara Ziegler, Ivy Luke, and Rory Malone
UVM Extension Crops and Soils Technicians
(802) 524-6501

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

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2019 INTERSEEDING COVER CROPS INTO WIDE-ROW CORN SILAGE

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

There has been increased interest in interseeding cover crops into corn. Cover cropping is a way to prevent soil erosion, maintain and/or improve soil nutrients, improve soil aggregation, prevent nutrient loss from runoff, and increase water retention. Such soil improvements can promote conditions that add resiliency to a crop, especially in light of extreme weather patterns that may affect yields. Interseeding can be beneficial by providing year round ground coverage and maximizing a short growing season by interseeding early to allow for full cover crop growth. It can be difficult to grow a successful cover crop, given other demands from a farm operation and weather limitations. One challenge that farmers face when trying to implement interseeding is establishing the cover crops into dense rows of corn. Shading by corn plants restricts cover crop growth especially as the season progresses. Traditionally corn is planted in dense 30-in. rows to maximize yields and decrease weed pressure. In 2018, Practical Farmers of Iowa conducted on-farm research trials to study the effect of wide rows (60-inch) on corn grain yields and cover crop biomass, and researchers saw mixed results (Gailans, 2018). This innovative practice may be a viable solution for farmers in the northeast but research needs to be conducted to determine the impact of wide rows on corn silage yield and quality and cover crop biomass. In 2019, the University of Vermont Extension Northwest Crops and Soils Program initiated a trial to examine the impact of corn row spacing on interseeded cover crop success, and corn yield and quality here in the northeast.

MATERIALS AND METHODS

The experimental design was a randomized complete block with split plots and 4 replicates. Main plots were three combinations of row widths and corn populations (Table 1). The subplots were three different types of cover crops interseeded into corn; varietal information and seeding rate are provided in Table 2 below. Plots were 20’ x 30’.

Table 1. Treatment descriptions for wide row corn trial, Alburgh, VT, 2019.

Treatment	Row widths	Corn populations
	in.	plants ac^{-1}
60-49	60	49,000
30-30	30	30,000
30-34	30	34,000

Specifics of the trial management are included in Table 3. The soil type at the Alburgh location is a Covington silty clay loam. The seedbed was prepared with spring disking followed by a spike tooth harrow. The previous crop was corn grain.

Plots were planted on 30-May with a 4-row cone planter with John Deere row units fitted with Almaco seed distribution units (Nevada, IA) at a rate of 49,000 seeds ac^{-1}. On 5-Jul, plots with 30-in. row spacing were thinned to either 30,000 or 34,000 plants ac^{-1} depending on treatment; plots with 60-in. spacing were not thinned. Plots consisted of 8 rows of corn 30 inches apart or 4 rows of corn 60 inches apart. Cover crops were interseeded into corn on 5-Jul and 9-Jul.

Table 2. Cover crop information for wide row corn trial, Alburgh, VT, 2019.

Cover crop	Seeding rate lbs ac^{-1}	Species
Cow pea	60	VNS
Summer solar mix	50	cow pea 'Iron Clay', buckwheat 'VNS', sunn hemp ''VNS', Peredovik sunflower
Mix	30	Annual ryegrass, tillage radish, red clover

Photosynthetic Active Radiation (PAR) was measured using a LI-COR LI-191R Line Quantum Sensor equipped with a LI-1500 GPS (Lincoln, NE) enabled data logger. In each plot two readings were taken, one above the corn canopy to capture the total available sunlight, and one under the canopy at approximately ground level in the center of the plot. These two measures were used to calculate PAR canopy infiltration (%). On 27-Sep, cover crop samples were taken, by collecting two 0.25 m^2 quadrats per plot. Samples were weighed and dried to determine yield and dry matter content. On 30-Sep, the corn was harvested with a John Deere 2-row chopper and a wagon fitted with scales. An approximate 1 lb subsample was taken from each plot and dried to calculate dry matter content. The dried subsamples were ground on a Wiley sample mill to a 2mm particle size and to 1mm particle size on a cyclone sample mill from the UDY Corporation. The samples were then analyzed for quality at the University of Vermont Cereal Testing Lab (Burlington, VT) with a FOSS NIRS (near infrared reflectance spectroscopy) DS2500 Feed and Forage analyzer.

Table 3. Wide row corn agronomic and trial information, Alburgh, VT, 2019.

Location	**Borderview Research Farm Alburgh, VT**
Soil type	Covington silty clay loam
Previous crop	Corn grain
Plant population (seeds ac^{-1})	49,000 – 60 in 34,000 – 30 in 30,000 - 30 in
Corn variety	NK8618 (Roundup Ready) - 86RM
Plot size (ft.)	20 x 30
Planting date	Corn: 30-May Cover crop: 5-Jul & 9-Jul
Tillage operations	Spring disk, spike tooth harrow
Starter fertilizer (gal ac^{-1})	5 (9-18-9)
Additional fertilizer (lbs ac^{-1})	200 (10-20-20)
Harvest date	Cover crop: 27-Sep Corn: 30-Sep

Mixtures of true proteins, composed of amino acids, and non-protein nitrogen make up the crude protein (CP) content of forages. The CP content 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. Recently, forage testing laboratories have begun to evaluate forages for NDF digestibility (NDFD). This analysis can be conducted over a wide range of incubation periods from 30 to 240 hours. Research has demonstrated that lactating dairy cows will eat more dry matter and produce more milk when fed forages with optimum NDFD. Forages with increased NDFD will result in higher energy values and, perhaps more importantly, increased forage intakes. Forage NDFD can range from 20 – 80% NDF. The undigested NDF (uNDF) is the residue after fermentation for a given amount of time, from 30 to 240 hours. 240-hr uNDF is typically used for forages as it represents the indigestible fiber portion of the total DM content.

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 treatments is real or whether it might have occurred due to other variations in the field. Yield data and stand characteristics were analyzed using the PROC MIXED procedure of SAS (SAS Institute, 1999). Replications within trials were treated as random effects, and application treatments were treated as fixed. Treatment mean pairwise comparisons were made using the Tukey-Kramer adjustment. Treatments were considered different at the 0.10 level of significance. At the bottom of each table, a level of significance is presented for each variable (i.e. yield). Treatments that differed at a level of significance >0.10 were reported as being not significantly different. Treatments within a column with the same letter are statistically similar. In the example, treatment C is significantly different from treatment A but not from treatment B. This means that these treatments did not differ in yield. The same letter indicates that treatment B was not significantly lower than the top yielding treatment C, indicated in bold.

Treatment	Yield
A	6.0^{b}
B	7.5^{a}
C	**9.0^{a}**
Level of significance	<0.10

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 (Table 4). Overall the season began cooler and wetter than normal but became hot and dry in the middle of the summer. The month of July brought above normal temperatures and little rainfall. The longest period without rainfall in July lasted 12 days. This dry period, which occurred around the time corn plants were developing tassels and silks for pollination, may have negatively impacted corn plant growth and productivity. This was evident in smaller than normal ears and poor tip fill experienced in corn fields around the region. However, these warm conditions did provide corn with well-needed Growing Degree Days (GDDs). Although the season was relatively cool a total of 2254 GDDs accumulated May-Sep, 42 above normal.

Table 4. Weather data for Alburgh, VT, 2019.

Alburgh, VT	May	June	July	August	September
Average temperature (°F)	53.3	64.3	73.5	68.3	60.0
Departure from normal	-3.11	-1.46	2.87	-0.51	-0.62
Precipitation (inches)	4.90	3.06	2.34	3.50	3.87
Departure from normal	1.45	-0.63	-1.81	-0.41	0.23
Growing Degree Days (50-86°F)	189	446	716	568	335
Departure from normal	-9	-29	76	-13	17

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.

Measurements of light infiltration began at the time of interseeding (9-Jul) and continued until 9-Sep (Figure 1). Light infiltration was highest for 60-in row widths until 6-Aug. In August, light infiltration was below 20% for both row widths but increased slightly as corn began to dry down and become more mature.

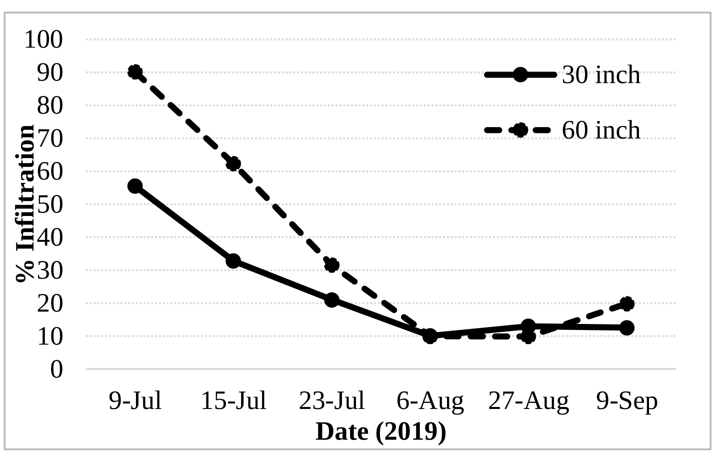

Figure 1. Percent light infiltration through canopy to soil surface by row width, Alburgh, VT, 2019

Cover crop by row spacing interaction

There was a significant interaction (p=0.0304) between row width and cover crop treatment for predicted milk yield (lbs) per acre (Figure 2). The corn silage grown in combination with the Summer Solar cover crop mixture resulted in the highest predicted lbs of milk per acre for the 60-49 and the 30-34 treatment. Interestingly, the annual ryegrass/radish/clover mix resulted in the highest milk per acre for the 30-30 treatment and the lowest milk per acre for the 60-49 and 30-34 treatments. This difference indicates that the Summer Solar mix may have contributed more to overall yield/quality in the 60-in rows compared to the 30-inch rows. This makes sense as the Summer Solar mix contained species, such as sunflower, that may have actually provided some additional yield in the sider row. The ryegrass/radish mixture was shorter and with less biomass, hence likely contributing less in the case of the 60-in rows. There were no significant interactions between other harvest or quality measures.

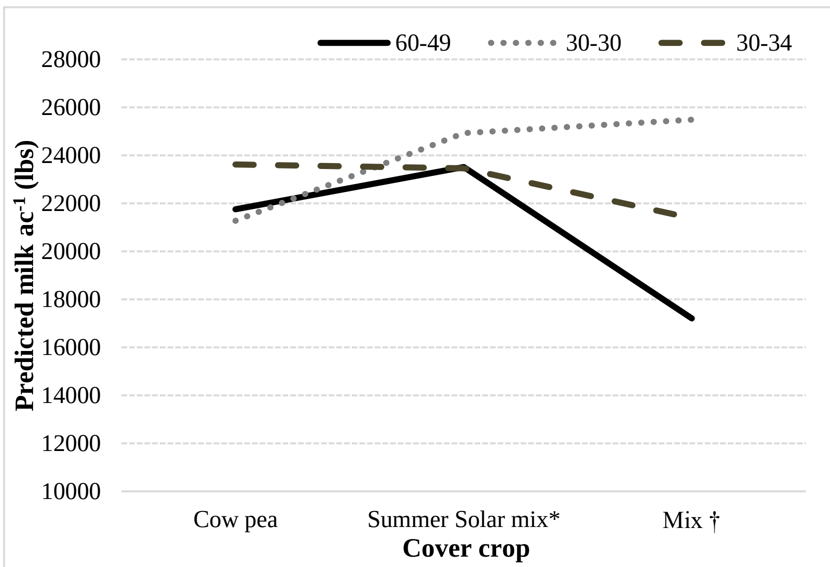

Figure 2. Predicted milk ac^{-1} for each cover crop type by row width/population treatment, Alburgh, VT, 2019.

Cover crop results

There were significant differences in dry matter yield between cover crop types (Table 5). All three cover crop types were significantly different from one another. Cow peas had the highest dry matter yield (1397 lbs ac$^{-1)}$ and that was almost 3 times more than the lowest yielding cover crop, which was the mix of annual ryegrass, tillage radish, and red clover (502 lbs ac^{-1}).

Table 5. Impact of cover crop type on cover crop yield, Alburgh, VT, 2019.

Cover crop ȶ	Dry matter yield
	lbs ac^{-1}
Cow pea	**1397**[a]†
Summer Solar mix*	1017[b]
Mix †	502[c]
p value	<.0001
Trial mean	1035

†Treatments within a column with the same letter are statistically similar. Top performers are in **bold**.
ȶ Cow pea 'Iron Clay'; Summer Solar mixture, cowpea 'Iron Clay', buckwheat 'VNS', sunn hemp "VNS', Peredovik sunflower; Mix, annual ryegrass 'VNS', tillage radish 'Ground Hog', red clover 'Mammoth'.

Cover crop type had no significant impact on corn harvest yield or quality (Table 6). The corn yields averaged 21.5 tons per acre with an average dry matter of 41.2%. The only quality parameter that was significantly different between cover crop treatments was the predicted milk (lbs) ac^{-1}. The summer solar mix had a predicted milk yield of 23,972 lbs ac^{-1}, which was statistically similar to the cow pea treatment.

Table 6. Impact of cover crop type on corn harvest and quality, Alburgh, VT, 2019.

Cover crop ȶ	DM	Yield, 35% DM	Starch	Crude protein	Lignin	Ash	ADF	NDF	24-hr NDFD	48-hr NDFD	240-hr uNDF	Milk	
	%	tons ac^{-1}	-------------------------% DM----------------------						-----% NDF----		% DM	lbs ton^{-1}	lbs ac^{-1}
Cow pea	41.0	21.6	29.5	8.24	2.65	4.57	26.3	46.7	52.6	63.7	12.2	2937	22222[ab]†
Summer Solar mix*	40.7	22.7	30.8	8.16	2.64	4.19	25.6	46.0	52.1	63.3	12.3	2981	**23972[a]**
Mix †	41.9	21.0	32.2	8.07	2.62	4.09	24.8	44.7	52.3	64.3	11.5	2972	21359[b]
p value	NS¥	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0803
Trial mean	41.2	21.5	30.8	8.16	2.64	4.29	25.6	45.8	52.3	63.7	12.0	2963	22518

†Treatments within a column with the same letter are statistically similar. Top performers are in **bold**.
ȶ Cow pea 'Iron Clay'; Summer Solar mixture, cowpea 'Iron Clay', buckwheat 'VNS', sunn hemp "VNS', Peredovik sunflower; Mix, annual ryegrass 'VNS', tillage radish 'Ground Hog', red clover 'Mammoth'.
¥NS: no significant difference at p=0.10.

Row width and population results

There was a significant impact on cover crop yield by row width and population (Table 7). The cover crops grown in the 60-49 treatment had the highest dry matter yield at 1924 lbs ac^{-1}. Cover crops in the 60-in. rows yielded almost 3 times more than either of the other two treatments. There was no significant difference between the 30-in. rows with a corn population of 30,000 plants ac^{-1} and the rows with 34,000 plants ac^{-1}.

Table7. Impact of row width and population on cover crop yield, Alburgh, VT, 2019.

Treatment	DM yield
	lbs ac^{-1}
60-49	**1924^{a}†**
30-30	678 ^{b}
30-34	502^{b}
p value	<.0001
Trial mean	1035

†Treatments within a column with the same letter are statistically similar. Top performers are in **bold**.

Row width and plant population significantly impacted corn yields (Table 8). The 30-in. rows with 30,000 plants ac^{-1} had the highest yield at 23.1 tons ac^{-1}, and that was statistically similar to the 30-in. rows of 34,000 plants ac^{-1} (22.3 tons ac^{-1}). This indicates that similar corn silage yields can be obtained with less seed, potentially an economic savings to the farmer. The corn grown in 60-in rows yielded 2 to 3 tons less per acre compared to 30-in row corn. There was a significant difference in predicted milk (lbs) ac^{-1} between row width and population treatments. The 30-in. rows with 30,000 plants ac^{-1} had a predicted 23,899 lbs ac^{-1}, which was statistically similar to the 30-in. rows with 34,000 plants ac^{-1}.

Table 8. Corn harvest measures and quality by treatment, Alburgh, VT, 2019.

Treatment	DM	Yield, 35% DM	Starch	Crude protein	Lignin	Ash	ADF	NDF	24-hr NDFD	48-hr NDFD	240-hr uNDF	Milk	
	%	tons ac^{-1}	----------------------% DM---------------------						-----% NDF-----		% DM	lbs ton^{-1}	lbs ac^{-1}
60-49	40.7	19.8^{b}	32.2	8.24	2.58	4.26	25.0	44.6	52.3	64.6	11.7	3001	20829 ^{b}†
30-30	41.1	**23.1^{a}**	29.6	8.27	2.63	4.31	26.0	46.5	52.6	63.7	12.1	2959	**23899 ^{a}**
30-34	41.8	22.3^{a}	30.6	7.96	2.71	4.29	25.6	46.2	52.1	62.9	12.3	2930	22825 ^{a}
p value	NS ƚ	<0.05	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<0.05
Trial mean	41.2	21.5	30.8	8.16	2.64	4.29	25.6	45.8	52.3	63.7	12.0	2963	22518

†Treatments within a column with the same letter are statistically similar. Top performers are in **bold**.

ƚ NS: no significant difference at p=0.10.

DISCUSSION

In 2019, the interseeded cover crops produced more biomass when planting into wide row corn. Corn planted with 60-in. row-widths had almost 3 times more cover crop biomass by the time the corn was harvested in late September. While all cover crop types in this trial did better with 60-in. spacing, the cow peas had the highest dry matter yield compared to the summer solar and cover crop mix. One of the challenges for farmers of integrating wider row corn, is the potential to decrease corn yields in a given area compared to conventional 30-in. row-widths. Overall, corn yields were higher in the 30-in. rows compared to the 60-in. rows. The corn yields were not impacted by cover crop type. Corn quality was not impacted by row spacing or by cover crop type. When implementing wide row-widths, farmers need to consider some factors when making management decisions. In corn that has been interseeded with cover crops, farmers cannot go through rows to spray or cultivate weeds once cover crops have established or else the plants can get damaged. Wider rows also do not suppress weeds as well as densely packed rows. The light infiltration was higher in the wider rows which may lead to higher weed biomass, but if cover crops establish better in wider rows as was seen in this trial, then the cover crops can be a viable weed control strategy. Farmers may also have to plant corn at a higher seeding rate in 60-in. rows to account for the decrease in rows per acre. Further investigation on other corn row widths should be investigated as yield decline may be less severe in 36 or 42 in rows. These data only represent one year of research at one location. More research, including on farm trials needs to be done for 60-in. row-widths to be a viable option for farmers.

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Gailans, S. 2018. Planting corn in 60-in. row-widths for interseeding cover crops. Practical Farmers of Iowa Cooperators' Program, Ames, IA. https://practicalfarmers.org/research/planting-corn-in-60-in-row-widths-for-interseeding-cover-crops/

ACKNOWLEDGEMENTS

UVM Extension Northwest Crops and Soils Program would like to thank Ben & Jerry's for their generous support for this project. A special thanks to Roger Rainville and the staff at Borderview Research Farm for their generous help with this research trial as well as John Bruce, Catherine Davidson, Hillary Emick, Haley Jean, Shannon Meyler, and Lindsey Ruhl for their assistance with data collection and entry. We would also like to thank the seed companies for their seed and cooperation in these study. 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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A Vermont Case for Conservation Agriculture:
A GIC Grant Looking at the Economics of NO-Till & Cover Cropping in VT

ROUND TABLE DISCUSSION

Kirsten Workman | kirsten.workman@uvm.edu **Betsy Miller | betsy.miller@uvm.edu**

When looking at the economics of adopting no-till and cover cropping, we found that unlike a typical enterprise budget we need to take a more long term approach to assessing the value and return on investment on these types of cropping systems. We need to assess some of the costs of entry associated with adopting new systems (equipment, technology, etc.) and also recognize and value the many incentive programs and grants available for making this transition on farms in Vermont. While there are economic benefits beyond the farm gate to improving soil health, they are currently hard to quantify and value, so until Payment for Ecosystems Services becomes a reality, it needs to make sense for the individual producer to adopt these systems. The next page shares some details on the numbers and trends of cost and production. However, below are some of our anecdotal findings from this project.

———- HIGHLIGHTS ———-

The most successful producers have whole-heartedly adopted no-till and cover cropping as a system.

While seed costs tend to go up, other inputs like fertilizer, herbicide, and fuel go down—ultimately saving the producer dollars/acre across the farm (although not always in every crop or every field).

Costs of entry can be significant, but there are many programs designed to assist with these costs.

Improved soil health and time/labor savings rank at the top of the list for why producers adopt these practices.

- Farmers should take advantage of cost share, grants and incentive programs to help defray start-up costs while adopting this new system. This significantly shortens the time to see a return on their investment in new equipment.
- Cover crops on their own might not pay if you look at them as a single enterprise. They seem be a lynch pin to the conservation cropping system, and it is hard to attribute dollar values to some of the benefits. However, if individual enterprise profitability is important, there are strategies to break even or make a profit with cover crops. These include: grazing or harvesting the cover crop as forage, growing your own seed and potentially selling both seed and straw from a cereal grain cover crop, using cover crops to address specific management issues (compaction, fertility, herbicide resistant weeds), and utilizing incentive payments.
- Similarly, putting a value on soil health can be challenging. Improving soil quality has increased water infiltration on farms that have adopted these systems. Soils are now infiltrating and storing water better and draining better. In one (Addison County clay) farm's case, they report that a 2-inch rain storm is "no problem" now and does not cause significant delays in field operations.
- While labor savings in no-till seems a clear winner, there are additional benefits to this time savings. The ability to get crops planted or harvested in a timely manner is becoming increasingly valuable in our changing climate. This flexibility and time savings may not just be the difference in labor costs, but might be the difference in getting your corn crop planted in a given year or not having to have conflicting priorities of planting annual crops or getting first cut hay crops out of the field on time. Flexibility also becomes a benefit that is hard to quantify, but is very important. When you don't need to till in order to plant, you can be more flexible when it comes to challenging weather, manure applications, crop rotations, etc. If you don't fall plow anymore, you can just plant where you can go in the spring, even if you weren't planning on it.
- The best examples of producers seeing a return on investment have bought into the 'whole system' not individual practices. When they take that approach, they start to be creative and innovative, are motivated to make things work instead of giving up and start to adapt their system. They are doing things like growing their own cover crop seed, building and modifying their own equipment, utilizing precision agriculture technology, constantly seeking out new and better information, testing things on their farms and even adjusting their crops and rotations as the system changes. They aren't trying to fit round pegs into square holes, they are using new pegs or drilling new holes so that things are really working well.
- Many producers identify Conservation Agriculture practices like no-till and cover cropping as both an economic benefit and an economic challenge. Often this is due to the risk of trying something new and cost of equipment to get started.
- In addition to money, there are other challenges to adopting these cropping systems. Timing of field operations, perceived risk, and basic aversion to change are often referred to as the top barriers to adoption.

OVER

A Vermont Case for Conservation Agriculture...
(continued)

One Example Farm—Medium Sized Dairy Farm (Addison Co. Vermont)

Cost of Entry			
New Equipment	**Purchase Price**	**Incentive payment**	**Out of pocket**
3600 Kinze planter	$ 92,000.00	$ 40,000.00	$ 52,000.00
5660 Landoll Drill	$ 95,000.00	$ 80,000.00	$ 15,000.00
30' Roller Crimper	$ 25,000.00		$ 25,000.00
Equipment Modifications	$ 42,300.00		$ 42,300.00
Total	**$ 254,300**	**$ 120,000**	**$ 134,300**

Cost of entry is a common challenge and concern for producers. New no-till planting and cover crop management equipment can be costly. However, most producers space out these investments over time, and many have been able acquire cost share and grant funding to defray costs. In this example, out of pocket expense made up roughly 53% of the actual equipment cost. When divided by the savings seen annually (below) just on 600 corn acres, this investment was paid for after 5 years.

In this corn silage example, one of the most common cost increases many farmers see (cover crop seed) is not included as this farm is growing their own. There is a cost of production as well as savings and revenue from that enterprise, but it is not included here. This budget also doesn't account for the many acres of cover crop and no-till incentive payments received from state and federal programs, which would have increased savings in those initial years. In this example of current conditions, the farm is realizing a $45.25 per acre savings over 600 acres of corn, equaling $27,000 savings annually.

Changes in Cost attributed to CoverCrop &/or No-till

Increase in Cost (per acre)		Decrease in Cost (per acre)			
					total/acre
Cover Crop Seed[1]	-	Labor			$ 41.67
Machinery Cost of Planting[2]	$ 16.79		Per pass	# of passes	
Termination		Machinery Cost[2]			
Spray[3]	-	Plowing	10.32	1	$ 10.32
Roller Crimper	$ 7.08	Harrowing	5.71	3	$ 17.13
Total	**$ 23.87**	**Total**			**$ 69.12**

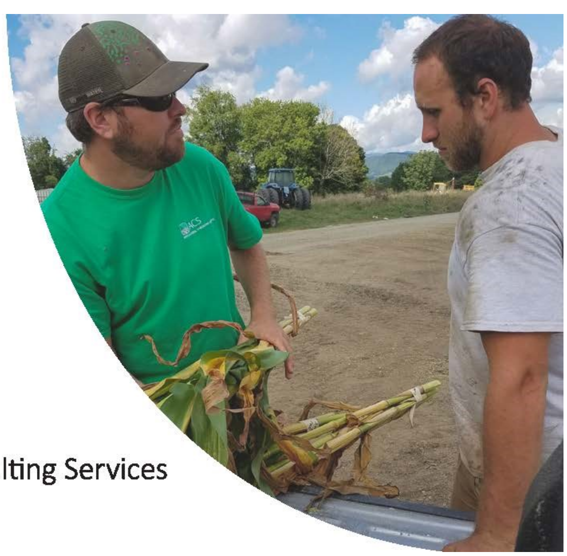
[1] Seed is raised on 80 acres

[2]Source NRCS Farm Machinery Cost Estimator *Cover Crop Economics Version 2.1*

3 No change due to Cover crop/No till practices

Categorical Trends in No-Till & Cover Crop Systems in Vermont

Yield	+	• amount and/or quality of crops increased • consistency in yields (less reactive to weather and other conditions)
Seed Costs	+	• Cover crop seed is an additional cost • Quality crop seed is important when using no-till in the northeast (cool, moist soil)
Fuel	-	• One farm reported a 30% fuel decrease • Another farm reported $600 annual savings
Herbicide	- / =	• Less expensive materials needed • Less passes
Fertility costs	-	This is variable and had other factors contributing to it. Most of the response was driven by adoption of Nutrient Management practices as well. It also depended on manure usage. Soil Organic Matter going up, yields go up, fertility needs to go up too.
Equipment Maint. Costs	-	Tillage equipment is expensive to maintain, operate and repair. Less tillage = less costs here
Manure	=	Costs not directly tied to cover crops or tillage
Labor/Time	-	• One farm reported eliminating two field passes to get corn planted • Another farm reported reducing 1.25 days of labor during planting • Cover crop can sometimes be incorporated into other passes, reducing the addition of overall labor/equipment time • Another farm reported reducing labor by 3 people during the cropping season, reducing 3 passes in fields and needing less equipment

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Additional funding provided by USDA, Risk Management Agency, under award number RM18RMETS524C022

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