Specialty Crop Block Grant Agreement No. 15-SCBGP-VT-0010

Appendix to Final Performance Report to USDA Agricultural Marketing Service

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Cc: Carly Borgmeier
Date: December 28, 2018

Submitted by

VERMONT
AGENCY OF AGRICULTURE, FOODS & MARKETS

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Project 1: Evaluating the Efficacy of Biostimulants and Biofungicides for Downy and Powdery Mildew in Specialty Crops

ATTACHMENT 1. BIOFUNGICIDE EFFICACY IN SQUASH TRIAL

NW CROPS & SOILS PROGRAM

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CULTIVATING HEALTHY COMMUNITIES

2016 Biofungicide Efficacy in Squash Trial

Heather Darby and Abha Gupta

Powdery mildew scouting

Disease Forecasting:

- Moderate temperatures (60-80°F), humidity, and shady conditions are generally most favorable.
- Spores and fungal growth are sensitive to extreme heat (above 90°F) and direct sunlight

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Powdery mildew scouting

Life cycle:

- Requires living plant tissue to grow
- Special resting spore for overwinter survival of the mildew.

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Biofungicides

- Biofungicides contain microorganisms that work as the active ingredient
  - The microorganisms produce a toxin, prey on the disease, and/or induce plant resistance
  - Most of these microorganisms occur naturally in soil or on plant surfaces

Photo credit: Livescience

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Trial design

Spray	Active ingredient	Cost per unit	Quantity used, 0.25 acres acorn squash	Cost for quantity used, 0.25 acres acorn squash
Actinovate	*Streptomyces lydicus*	$135/18 oz	1.23 oz	$9.23
Cease + Milstop adjuvant	*Bacillus subtilus* (Cease)	$65/gal (Cease) $80/5 lbs (Milstop)	0.15 gal (Cease) 0.31 lbs (Milstop)	$14.71
Champ	Copper based	$130/20 lbs	0.24 lbs	$1.56
Regalia	Plant extract	$95/gal	0.15 gal	$14.25
Sonata	*Bacillus pumilus*	$80/2.5 gal	0.12 gal	$3.84

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- Five spray treatments, all OMRI approved
- One control

Trial design

- Two varieties: 'Jet' (susceptible) and 'Reba' (resistant)
- Planted 3-Jun
- Sighted powdery mildew 14-Jul
- Began spraying 17-Jun, 7 times till 11-Aug (every 7-14 days)
- Harvest: 15-Sep

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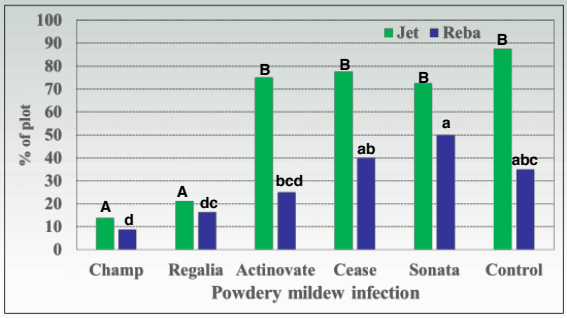
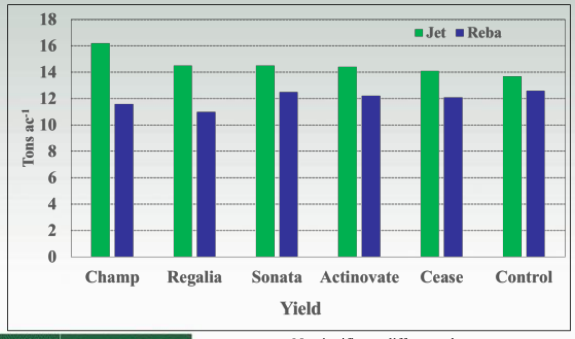
Powdery Mildew Infection Rates
2016 Biofungicide on Squash Trial, Alburgh, VT



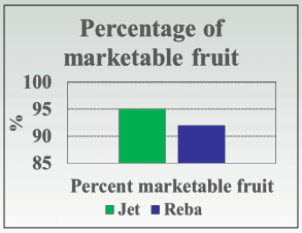
Treatments with the same letter did not differ significantly from each other.

Harvest Yields
2016 Biofungicide on Squash Trial, Alburgh, VT



No significant difference between treatments or across varieties.

2016 Biofungicide on Squash Trial, Alburgh, VT



A significant difference was seen between varieties for the parameters graphed.

Summary

- Overall, 2016 experienced low powdery mildew pressure
- Reba performed better for resisting powdery mildew while Jet yielded higher
- Champ and Regalia consistently performed better for reducing powdery mildew
- This represents one year of data with two varieties of squash

This project was supported through State of Vermont grant #02200-SCBGP-11-1

ATTACHMENT 2. POWDERY MILDEW BLOG

Blog Post:

The unfortunate, regular appearance of powdery mildew

Every year, seemingly without fail, cucurbit plants (melons, cucumbers, zucchini, squash) become infected with powdery mildew. Powdery mildew first appears as white, powdery spots that generally start on one leaf surface and then spreads to both sides and plant stems. Infection sites may also turn yellow. Powdery mildew grows well in high humidity, moderate temperatures (60-80°F), and shady conditions. Spores and fungal growth are sensitive to extreme heat (above 90°F) and direct sunlight. You can predict if powdery mildew is likely to come your way, by noting of these favorable conditions.

Photo: The start of powdery mildew, Purdue University (left). A heavy powdery mildew infestation, University of Minnesota (right)

Powdery mildew fungi require living plant tissue to grow. Year-round availability of crop or weed hosts is important for survival of some powdery mildew fungi. Special resting spores are produced, allowing survival of the mildew over winter. The mildew spores are carried by wind to new hosts. Powdery mildew infections can decrease photosynthetic surfaces and therefore, decrease yields. Also, powdery mildew infections in pumpkins and other winter squash can lead to further infections by fruit rotting diseases, like black rot.

How to prevent powdery mildew?

To try to prevent infection, try using tolerant or resistant cucurbit varieties, planting in full sun, and spacing plants to promote air flow. Even still, these diseases are likely to worsen given current and impeding climate changes that call for more frequent rainfall events.

Biopesticides are a potential low-impact management tool that are still being evaluated for efficacy. Biofungicides contain microorganisms that work as the active ingredient to control certain pathogens through competition, producing a toxin, predation, and/or inducing plant resistance. Most organisms in biofungicides on the market today occur naturally in soil or on plant surfaces.

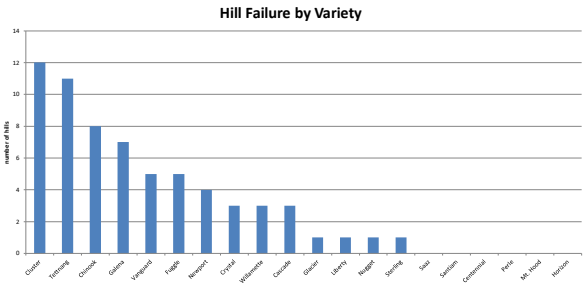
The Northwest Crops and Soils Program of UVM Extension has been evaluating 4 different biofungicide products (Sonata, Cease, Regalia, and Actinovate) along with 2 additional products (Champ and Oxidate) for their efficacy in preventing and treating powdery mildew. Results from the 2016 field season can be found at our website, http://www.uvm.edu/extension/cropsoil/. Results from the 2017 field season will be posted online during winter 2017.

ATTACHMENT 3. HOP RESEARCH UPDATES

Low Performance Cultivars

Lowest Yields Over 5 Years

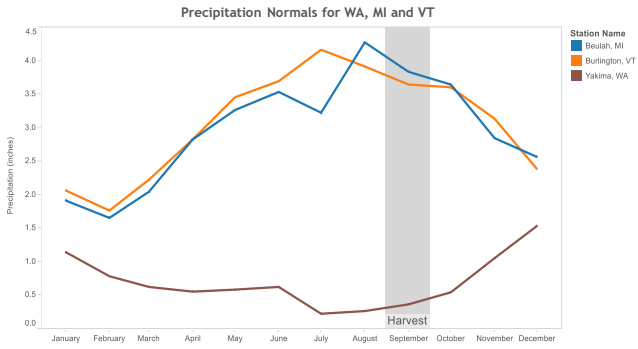
- Liberty
- Crystal
- Saaz
- Sterling
- Cluster



High performance cultivars

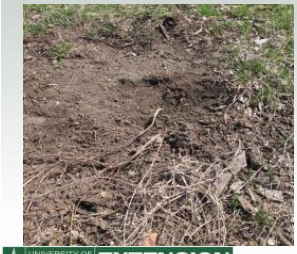
Highest Yields Over 5 Years

- Centennial
- Chinook
- Newport
- Cascade
- Nugget



Crowning

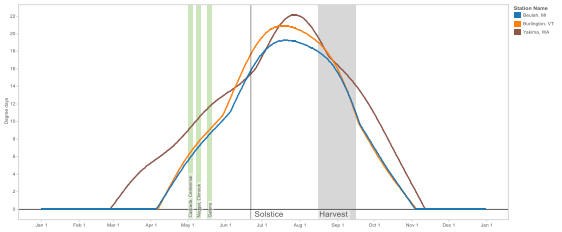
Crowning



Finish Crowning 30 days before training!!

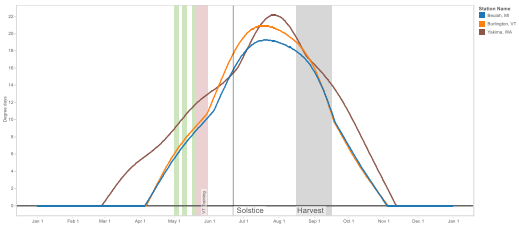
- Late Season Varieties – April 1st
- Early Season Varieties – May 1st

Washington Training Dates



Cascade, Centennial:	May 1-5	47-51 days to solstice
Nugget, Chinook:	May 8-12	40-44 days to solstice
Galena:	May 17-21	31-35 days to solstice

Vermont training dates

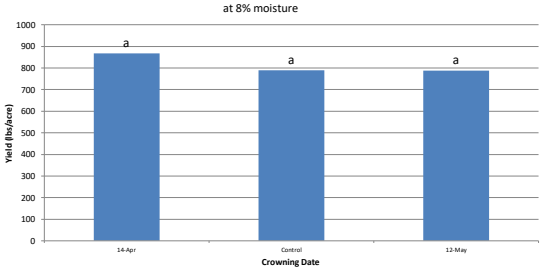


May 19-30

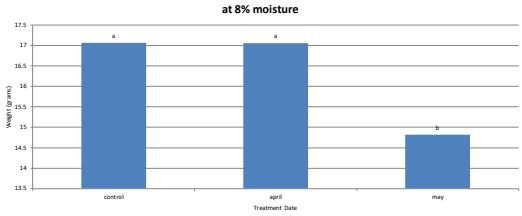
UVM Crowning Trial

Year	April	May
2014	14	12
2015	23	13

Crowning Study Yields- 2014



Crowning Trial 100 Cone Wt.



While the control and April treatment reached the top of the trellis by mid-June, the May treatment was later. As the graph shows, the May treatment also yielded smaller cones. Interestingly, the harvest yield was not much different (next slide).

2015 Crowning trial yield

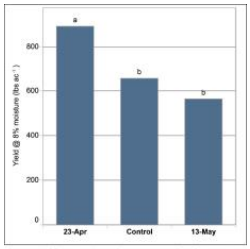


Figure 4: Yield at 8% moisture by treatment, Alburgh, VT 2015

Crowning works – earlier is better

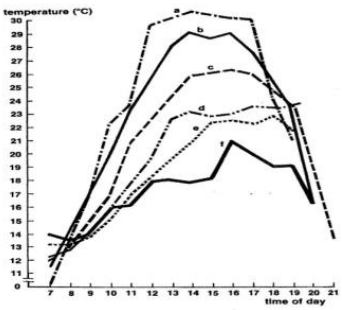


Fig. 88. Temperature of soil near old wood, under soil layers of different thickness, at different times of the day: a – air temperature, b – no cover, c – the cover 5 cm thick, d – the cover 10 cm thick, e – the cover 15 cm thick, f – the cover 20 cm thick.

Crowning Trial – April 18th

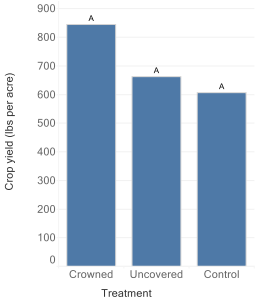
Crowned

Uncovered

Control

Is crowning or higher soil temperature making the difference?

2016 Crowning (18th April) yield

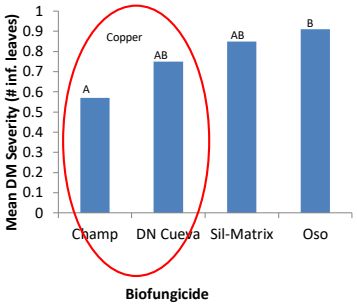


Biofungicide Study - 2015

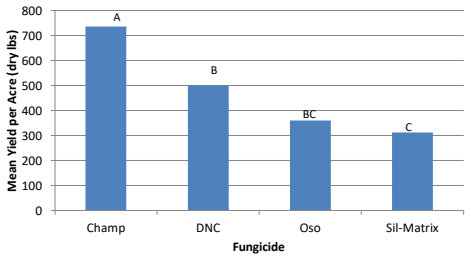
- Method of in-season, foliar DM mgmt

Product Name	Active Ingredient	Source
Champ WG	Copper Hydroxide	Johnny's Select Seeds
Oso	Polyoxin D zinc salt	Certis USA
Double Nickel 55 + Cueva	*Bacillus amyloliquefaciens* strain D747* + copper octanoate	Certis USA
Sil-Matrix	potassium silicate	Certis USA

How did biofungicides manage in-season downy mildew?



Biofungicides and Dry Yield



P < 0.0001

(Cascade and Nugget combined)

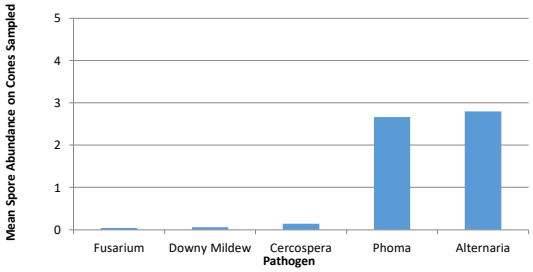
Cone Discoloration Biofungicides and Hop Quality

No quality difference between treatments.

AESTHETIC DIFFERENCES: Cascade

Spores Identified on Hop Cones

(Severity Scale 0-5)



Biofungicide Study-2016

Product Name	Active Ingredient	Rate per Acre
Champ WG	Copper Hydroxide	1.33 pounds
Regalia	Extract of *Reynoutria sacharensis*	2.4 quarts
Cease	QST 713 strain of *Bacillus subtilis*	2.4 quarts
Actinovate	*Streptomyces lydicus* WYEC 108	180 grams
Milstop	Potassium bicarbonate	1.2 pounds

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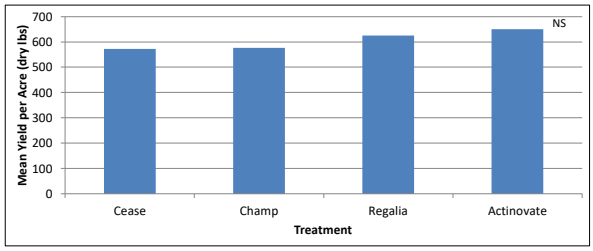
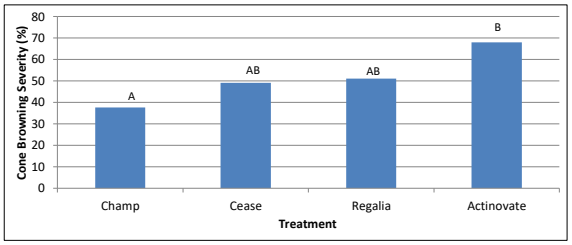
CULTIVATING HEALTHY COMMUNITIES

Biofungicides and Dry Yield



Cascade and Nugget combined

Nugget Cone Browning Severity



Cascade cones did not have significant differences

Cone Comparison

Cascade: No Differences in Aesthetic

Cone Diseases

Cultivar	Treatment	Cones with Disease Present		
		Alternaria	Downy Mildew	Fusarium
Nugget	Actinovate	80%	80%	0%
	Cease	90%	50%	0%
	Champ	100%	40%	0%
	Regalia	90%	30%	0%
Cascade	Actinovate	100%	0%	30%
	Cease	100%	40%	20%
	Champ	100%	0%	0%
	Regalia	100%	0%	20%

Measured in percent of cones inspected with disease

Hop Cone Discoloration

Dark bracts from downy mildew or other secondary infection

Healthy

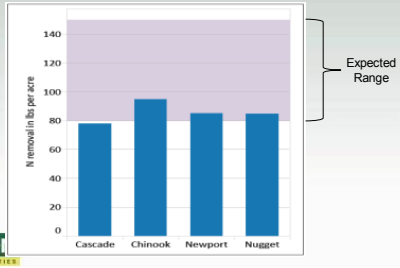
Severe dry-down from disease

Cone browning from Alternaria + Phoma

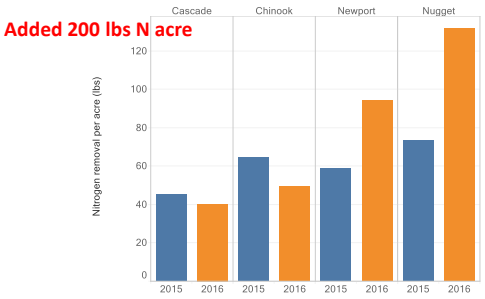
Nitrogen Removal by Variety

	Cascade	Chinook	Newport	Nugget
	lbs N ac^{-1}			
Bine	45.2	64.6	58.8	55.6
Cone	32.8	30.2	26.4	29.2
Total	78.0	94.8	85.2	84.8

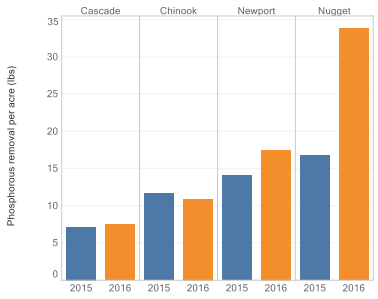
Added 169 lbs N acre



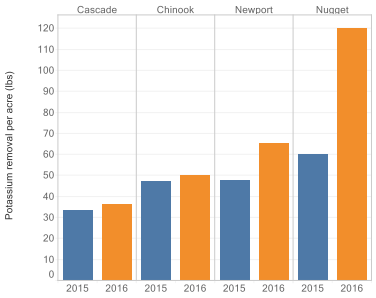
Bine Nitrogen Removal in 2015 and 2016



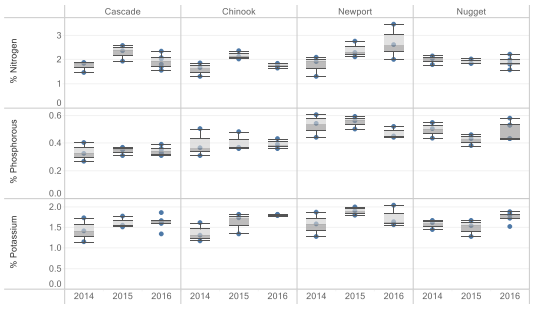
Bine Phosphorous Removal in 2015 and 2016



Bine Potassium Removal in 2015 and 2016



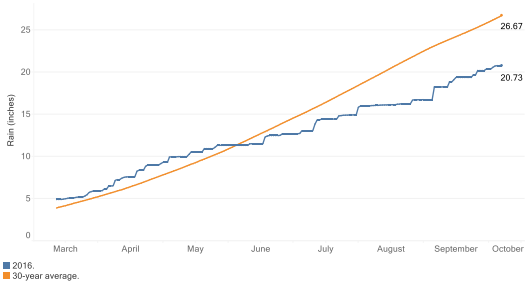
Bine Percent NPK by variety and year



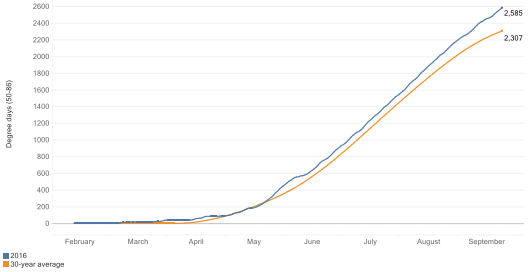
Bine Percent NPK by variety and year

Year	Var	% Nitrogen	% Phosphorous	% Potassium
2014	Cascade	1.73	0.33	1.43
	Chinook	1.60	0.39	1.36
	Newport	1.77	0.53	1.57
	Nugget	1.99	0.49	1.57
2015	Cascade	2.29	0.34	1.61
	Chinook	2.16	0.40	1.63
	Newport	2.38	0.55	1.89
	Nugget	1.90	0.42	1.50
2016	Cascade	1.91	0.34	1.62
	Chinook	1.76	0.39	1.80
	Newport	2.69	0.47	1.75
	Nugget	1.88	0.50	1.74

2016 Rain (inches) vs. average



2016 degree days (50-86) vs. average



Monthly Average Potential Evapotranspiration

							July					
Boston, MA	0.37	0.57	1.15	1.95	3.09	3.58	**4.02**	3.49	2.29	1.36	0.63	0.37
Bridgeport, CT	0.44	0.63	1.31	2.21	3.41	3.90	**4.38**	3.76	2.52	1.54	0.74	0.44
Buffalo, NY	0.24	0.40	0.99	1.92	3.26	3.74	**4.05**	3.43	2.23	1.18	0.47	0.24
Burlington, VT	0.24	0.42	0.97	1.96	3.26	3.74	**4.13**	3.47	2.18	1.13	0.45	0.23
Caribou, ME	0.17	0.30	0.73	1.51	2.88	3.39	**3.64**	3.07	1.84	0.89	0.31	0.16

Water Requirements for Hops

Irrigation Requirements by Month for Hops

- August: 16.63 gallons of water/ week for one hop plant
- July: 19.79 gallons of water/ week for one hop plant
- June: 18.52 gallons of water/ week for one hop plant
- May: 15.62 gallons of water/ week for one hop plant

If 1200 plants in a hop yard = 23,748 gallons water per week in July or roughly an inch (0.87 in) of rain per week.

Water Requirements for Hops

The weekly precipitation amount is subtracted from the irrigation recommendation to get the actual weekly irrigation amount.

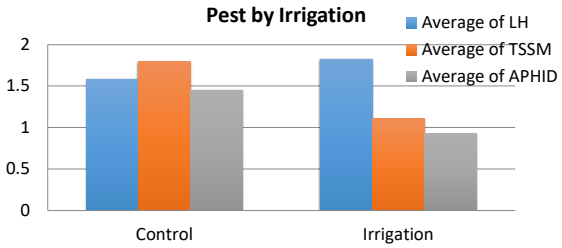
The conversion of precipitation from inches to gallons is 27154 gallons in one inch.

For example, the precipitation last week is 1.03 inches, so the calculation would be :

19.79 gallons of water July - (1.03 inches rain/acre * 27154 gallons of water/ inch * 0.00055894918 acre/hop) = 4.16 gallons of water/ hop plant

Irrigation Study – Just Started

Impact of Irrigation on Pest Pressure



Project 4: Post-Harvest Management Team & FSMA-Readiness Produce Safety Workshops to Strengthen Vermont's Produce Industry

ATTACHMENT 1. PHMT SCREENING RUBRIC

PHT SELECTION RUBRIC

12.10.15 Revision. HE and GN

FARM NAME:

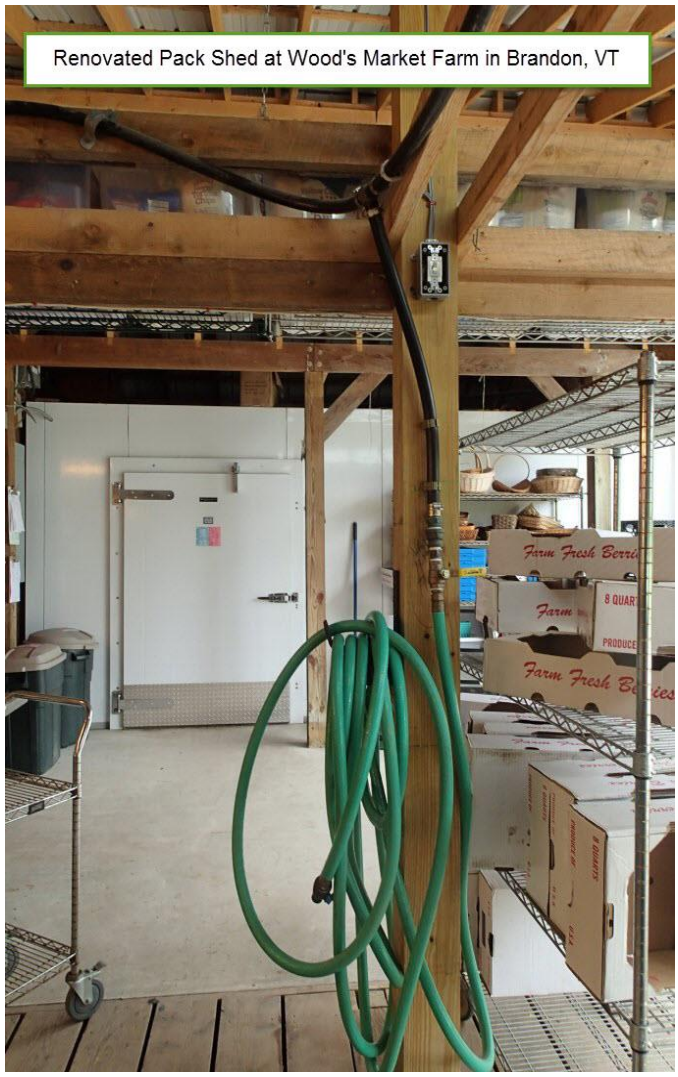
REPRESENTATIVENESS				
	Small	**Medium**	**Large**	
Scale (need ranges)				
Size of investment needed (Need ranges)				
	Yes	**No**		
Building New or Renovating Old				
need GAPs/FSMA				
Markets (direct or wholesale)				
Summer or Year Round				
PRIORITIZATION	**Weak**	**Adequate**	**Strong**	**Very Strong**
Clear Need? business/personal need – market mandate, life change, etc.				
Project Relevance? Innovation, and /or positive impact on economy, public health, environment				
Developing New Markets? Season extension, new product, etc.				

ATTACHMENT 2. PHMT APPLICATION

Post-Harvest Team Overview

Want help making post-harvest improvements to your produce farm?

From 2016-2018, UVM Extension is coordinating a new "**Post-Harvest Team**" (PHT) that will select and support 5 VT produce farms planning and making post-harvest infrastructure investments. The integrated team will consist of an agricultural engineer, farm business specialist, produce safety specialist and additional service providers as needed (e.g. horticulturist, marketing specialist, lender, NRCS agent, building contractor, (etc).


Renovated Pack Shed at Wood's Market Farm in Brandon, VT

Three Primary PHT Objectives

1) **SAVE TIME and $ by providing a single point of contact** for you to optimize access to multiple technical service providers (TSP's) and specialists to support your post-harvest improvement project.
2) **Improve post-harvest practices on your farm AND for our specialty crop Industry — We will document and share lessons learned from the PHT projects** among produce farmers and service providers in the region
3) **Develop a model for on-farm technical support—this integrated team approach** will promote inter-disciplinary research and farmer support, serving as a model for the agriculture service provider industry.

Can anyone apply?

Because PHT is a pilot program, and we need a good mix for limited slots, we will be inviting farms to apply. We welcome your application inquiry, or recommendations of other farms

could benefit from this program. To inquire, please contact PHT Coordinator Hans Estrin (802 380 2109, hestrin@uvm.edu)

What are the PHT selection criteria?

The Post-Harvest Team is looking for farms that meet the following criteria:

- **Building new or renovating** wash/pack or storage areas.
- Expanding operations and plannig the "**scale up**"(vs. just starting) as that is where greatest need is

- **Clear need for help:** Need to make changes in market/life/business plan. Business as usual is not a viable option.
- **Project relevance—**Project employs innovative technology, technique or practice; or project has a positive impact on local economy, public health or environment.
- **Developing new markets-** doing something new in terms of marketing in VT (season extension, etc…)
- **Model for others--Case study/ changes could help inform other farms**
- **Responsive:** farm is committed and positioned to implementing changes immediately.

How to Apply?

Following inquiry and/or invitation to apply please complete the PHT Application below and return to Hans Estrin. Applications are reviewed on a rolling basis, please contact coordinator Hans Estrin (802 380 2109) for more information.

1. **Name** and **Contact Information** (farm name, phone, address, email).
2. Are you a year-round **VT resident**?
3. Do you **own or rent** at least one parcel of **VT Land**
4. Do you have **3 + years** of farming **experience**?

Please Note: If you answered "no" to any of the above questions, please contact Hans Estrin before continuing.

PHT Application

Please answer the following short answer question in 1- 2 pages total:

5. Approx. gross sales in most recent year:
6. Approx. acres in active production:
7. List primary crops:
8. Estimate % of your sales that go to non qualified-end-users (e.g. distributers, brokers, some food hubs):
9. **Approx. # of seasonal and year-round employees:**
10. **List primary Market outlets and their seasonal window(s**) (e.g. year-round, spring/fall, summer/fall)

11. **Describe your reasons or needs** for initiating your post-harvest improvement project. Include a market-based explanation of where your farm has been, where you hope it to go, and how this project fits in.

12. **Describe your post-harvest improvement project**, including a general description of your existing conditions and proposed infrastructure and process changes, including season expansion. If possible attach one or more pictures/sketch(es) of your current site, and proposed project.

13. **Describe** how you think your project will potentially impact your business and **improve your community (**e.g. jobs, or increased production)

14. **Outline a proposed time-line** for your project, including your labor capacity **(who will do what when?)**

15. Have you established a **budget** for your project? If so, please provide it, or describe here

16. **List and describe your primary technical assistance needs** for the project (i.e. In what way(s) could the PH Team best help you?)

17. **Describe any other concerns, needs or issues** that might help the team prioritize your project.

UVM Extension helps individuals and communities put research-based knowledge to work. Extension and USDA, cooperating, offer education and employment to everyone without regard to race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, and marital or familial status.

ATTACHMENT 3. EXAMPLE: MIGHTY FOOD FARM COMPLETE STUDY

Mighty Clean and Comfortable

A New Wash and Pack Shed at Mighty Food Farm

Lisa MacDougall has led Mighty Food Farm through start-up, relocation from rented land to owned land and now through the construction of a brand-new 60 ft x 90 ft wash and pack shed. She's done this all while producing a diverse mix of organic vegetables, tree fruit and berries on fourteen acres, now, in Shaftsbury.

The packshed has become the central "hub" of the farm boasting new, slab on grade construction with a large overhead door on the east side for receiving from field and packing out for market, person-door for crew access on the northeast corner, and a second person-door for retail and CSA access on the northwest corner.

One of Lisa's primary goals in her new location was "a proper P-shed"; a pack shed where she and her crew could comfortably and safely wash, store, and pack produce for delivery to her customers year-round. Mighty Food Farm serves retail farm stand, farmers market, CSA, and wholesale customers.

"It was 10 years of just slogging through the process every time we had to pack out at our prior location." says MacDougall, "It's what we do all of this work for, to bring fresh, awesome produce to our customers. And the final step was just... not very enjoyable. Every week." Lisa also noted that drainage was really poor in her prior location. Packing out for market in winter would inevitably mean negotiating ice or slush with arms full. They had a door that you had to duck through if you were over 5'9".

About the Project

Overview: New, slab-on-grade construction 30'x60 (1,800 sq. ft.), single story. Mixed use of wash/pack, storage, retail/CSA, and crew space.

Cost: Approx. $100,000 ($55 per sq. ft.)

About Mighty Food Farm

- Location: Shaftsbury, VT (previously in Pownal, VT)
- Acreage: 14 acres in production
- Crops: lettuce, kale, mixed greens, winter greens, scallion, onion, winter squash, carrot, tomato, cucumber, strawberries, blueberries, apples, pears and plums.
- USDA Sales bracket: $100,000-249,999
- Markets: CSA, On-farm Retail, Farmers Markets, Wholesale
- Crew: Summer (May-September) is 7; Fall (September-November) is 5; Winter (December-March) is 1.
- Wash/Pack Operations: Triple bay greens washing with gently shaken crate for drying, Barrel/drum washer, bunch washing in spray sink, 3 coolers (CoolBots)

A large open pack shed, with large doors, cleanable walls and ample lighting provides an efficient and comfortable work space. Trench drains in the floor provide for easy and safe drainage.

A trench drain (12"x20', top grate removed for photo) provides an efficient drain option that also allows for things to be rolled over it. The slightly elevated outlet on the far end of the photo allows sediment to settle out and be scooped out by a 12" shovel. The new space has two of these drains which are directed outside to a vegetative area for discharge.

Before deciding to build from scratch, Lisa considered retrofitting a space into an existing, relatively new horse barn. Walking through the space with some rough floor plan sketches in hand she explored the pro's and con's. Finally, she landed on new construction so that she could get just what she wanted. She also felt converting a perfectly good horse barn to a vegetable wash/pack could reduce the future value of the horse barn and also her use of it for her own horses. Ultimately, the new construction added approximately $20,000 to an $80,000 project. Though not insignificant, the additional cost was well worth the benefits for Mighty Food Farm.

What was at the top on the list? Comfort, efficiency, and safety.

Lisa knew she wanted large doors and shaded floor space to "stage" produce coming in from the field and out to market. Her previous washpack required maneuvering crates in both hands up and down stairs, through narrow doors and around corners. The need for more space was a given; her previous location was about one-third the size of the new building.

"I've realized that there is a key question you need to ask yourself as a growing farm." she notes, "Am I going to be a fork truck farm or a not?" Lisa decided that the right scale for her was supported by harvesting into handheld crates not pallet bins and that the majority of product movement could be in crates. Once in the packshed and storage coolers, the crates can be palletized and moved with a simple pallet jack. The smooth, continuous concrete floor serves the need for storage in both cartons and pallets.

A key feature of the new wash area are two central trench drains. Trench drains provide for a high volume floor drain that is flush with the floor surface and able to accommodate solids and sediment. They are also easier to clean regularly. "The steel grates pop off and a standard 12" square shovel can scoop out the soil", MacDougall pointed out. These drains can also fully dry once cleaned which is an added produce safety benefit.

"It's just clean and bright. We like to be in the space." Lisa noted as she pointed out smooth and cleanable wall finishes making use of fiber reinforced plastic (FRP), also known as "dairy board." Ample, energy efficient LED lights overhead also make for an improved workspace.

The space is so new, clean, and bright that the contractors commented on the "old", "used" wash equipment being

A crew break area. Comfortable, out of the elements, and great for morale.

moved back in “messing up the place.” Lisa actually helped complete the construction crew with some of her farm crew who had some building experience.

Lisa also wanted to provide a space for the crew to actually take a break and eat lunch, not to mention having a dedicated sink for handwashing. “Once you have a crew of more than three people, you really need to provide a dedicate break area.” She also wanted a clean and comfortable place for customers to visit for retail purchases and CSA pickup. The western third of the new building serves these needs. “The wash/pack has really become ‘the hub’ for the farm.”

“I just feel better about my product and my crew.”

Looking back on the project there are a few things that Lisa would spend a little more attention on. She knows she’ll have to add some ventilation into the space eventually and it might have been easier to do from the start. There is no toilet in the new building which was avoided due to the need for septic system (though there are facilities nearby). The building is a “dry building” with the only water source being a frost-free hydrant outside which is currently brought in by hose. Wash water is sent to a vegetative swale.

Lisa notes that the project has really opened up a lot of possibilities for Mighty Food Farm. The farm was previously limited by cold storage capacity and was able to build additional storage space as part of the construction. It is easier to maintain a high crew morale thanks to some of the softer aspects of the project such as making it a clean and bright space and providing a dedicated place for breaks. Lisa is proud to have a great crew with longevity and aims to keep

The new retail shop at the farm is on the west end of the new building. It also serves as the CSA pickup location.

The coolers are now easy to access from the wash/pack area and the CoolBots seem to run better, are easier to maintain, and add some heat to the space.

them as long as possible. Coolers and CoolBots are easier to maintain indoors and the life of the CoolBots have been increased. Lisa has also noticed a marked improvement in her ability to regulate cooler temperatures with the coolers inside. Product quality has also improved with a dedicated, clean space to efficiently wash, pack and store. Produce safety practices are much easier to achieve in the new space. Record keeping and crew organization has also been improved now that there is a central "hub" for activity.

Acknowledgments

Funding for this publication was made possible, in part, by the Food and Drug Administration through grant PAR-16-137, by the USDA's National Institute of Food and Agriculture through the Food Safety Outreach Program award 2016-70020-25792 accession 1010528 and by The Vermont Agency of Agriculture Food and Markets via the Vermont Specialty Crop Block Grant (USDA-AMS-SCBGP-2015). The views expressed in the publication do not necessarily reflect the official policies of the U.S. Department of Health and Human Services, the U.S. Department of Agriculture or the Vermont Agency of Agriculture; nor does any mention of trade names, commercial practices, or organization imply endorsement by the United States Government or the State of Vermont.

Favorite Things

Large Overhead Door—$3,000

Landing Zone for Harvest and Packout— about $6.00 per square foot. $1,500 to 15,000 depending on the size of slab and features (drains, etc.) - (http://go.uvm.edu/floors)

Heated Space - Propane unit heater—$1,000-3,500 depending on size and efficiency.

Bright Cleanable Walls - FRP (http://go.uvm.edu/smoothnclean) - about $1.00 per square foot.

Trench Drains - Two 12"x20' - Included in slab.

Techno Post Helical Pile vs. traditional footings for slab on grade (https://www.technometalpost.com/en-US/) - Saves $4,000 on concrete (no footings).

Techno Posts (circular shape in center of photo) were used in place of traditional poured footings to reduce construction cost. This photo shows the top of a post on the east edge of the slab at the large overhead door opening. Techno Posts are helical piles that "screw" into the ground to provide foundational stability (https://www.technometalpost.com/en-US/). They avoid the need for formed footings beneath the slab.

Agricultural ENGINEERING

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An online version of this publication is available at go.uvm.edu/mightyfoodcase

THE UNIVERSITY OF VERMONT EXTENSION

CULTIVATING HEALTHY COMMUNITIES

September 2018—v 1.0

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COLLEGE OF AGRICULTURE AND LIFE SCIENCES

ATTACHMENT 4. EXAMPLE OF MIGHTY FOOD FARM “SHORT” CASE STUDY

Post-Harvest Project Template for Crowd Sourcing

Mighty Food Farm, Shaftsbury, VT

Farm Contact: Lisa MacDougall

Basic Farm Description (should live in account set up –maybe as an option that is mandated when a user clicks to contribute):

- **Main Crops:** Diversified 4-season lettuce/greens, Squash, Onions, tomatoes
- Gross Sales bracket: $100,000-249,999
- Markets --Approximate ratio of wholesale vs. retail sale: 50/50
- Acres in production: 14
- Approximate # of employees: 7

Project Title? --New Clean and Comfortable Wash/pack Shed

What did you do? – Wen relocating our farm, we built a brand-new single-story 30 X 60 ft mixed use shed—for wash/pack, storage, retail/CSA, and farm crew space.

1. **Project description**: This single story, 1,800 sq. ft slab on grade is insulated and heated-with: .
   - Trench drain
   - Large overhead doors with landing space inside
   - Bright cleanable walls
   - Cold storage
   - Slab with drilled "Techno Posts" saved $4,000 over traditional footings

2. **About how much did it cost?** $100,000 ($55/ft2)

3. **Why did you do it?** –We moved and had to build anew. In the old space, we spent 10 years slogging through the process every pack out …the location and layout were poor-- negotiating ice or slush with arms full and ducking through low doors. It was not enjoyable. So our primary motivation beyond efficiency was to make the pack-out process more enjoyable.

4. **Show and Tell**—Upload one or more photos with captions (and/or video?) that show what you did.
5. **How did it help?** — The comfort, light, and well-designed space has increased crew efficiency, morale, and loyalty. It is easy to clean and dry, which has decreased food safety risk. The cleaner ample storage has increase product quality and longevity.
6. **What are you most pleased with?** –Double overhead doors with large indoor shaded area.
7. **Any mistakes or lessons learned?** Building has no plumbing (besides frost-free hydrant and swale drainage) and no ventilation. Wish I had invested in these, especially ventilation.

ATTACHMENT 5. SLIDE SUMMARY OF PHMT FARM PROJECTS

Photo Summary of Post Harvest Management Team Farm Projects

Hans Estrin, UVM Extension

October 1, 2018

Sunrise Farm, Hartland, VT

Project:

Dairy Barn renovation and conversion to wash-pack storage facility, and farm retail store

Key accomplishments:

- Complete project design and plan
- Complete major infrastructure upgrade of power, foundation, plumbing
- Complete and Install slab, drain, cold storage, landing shed, bum- out green house, dumb-waiter, retail space

Sunrise Farm barn renovation from the south, showing bump-out green house

PHMT conducting team consult in the Sunrise Farm barn basement—planning stage

Sunrise Farm barn basement wash pack area, phase one complete, from the inside, showing bump-out green house

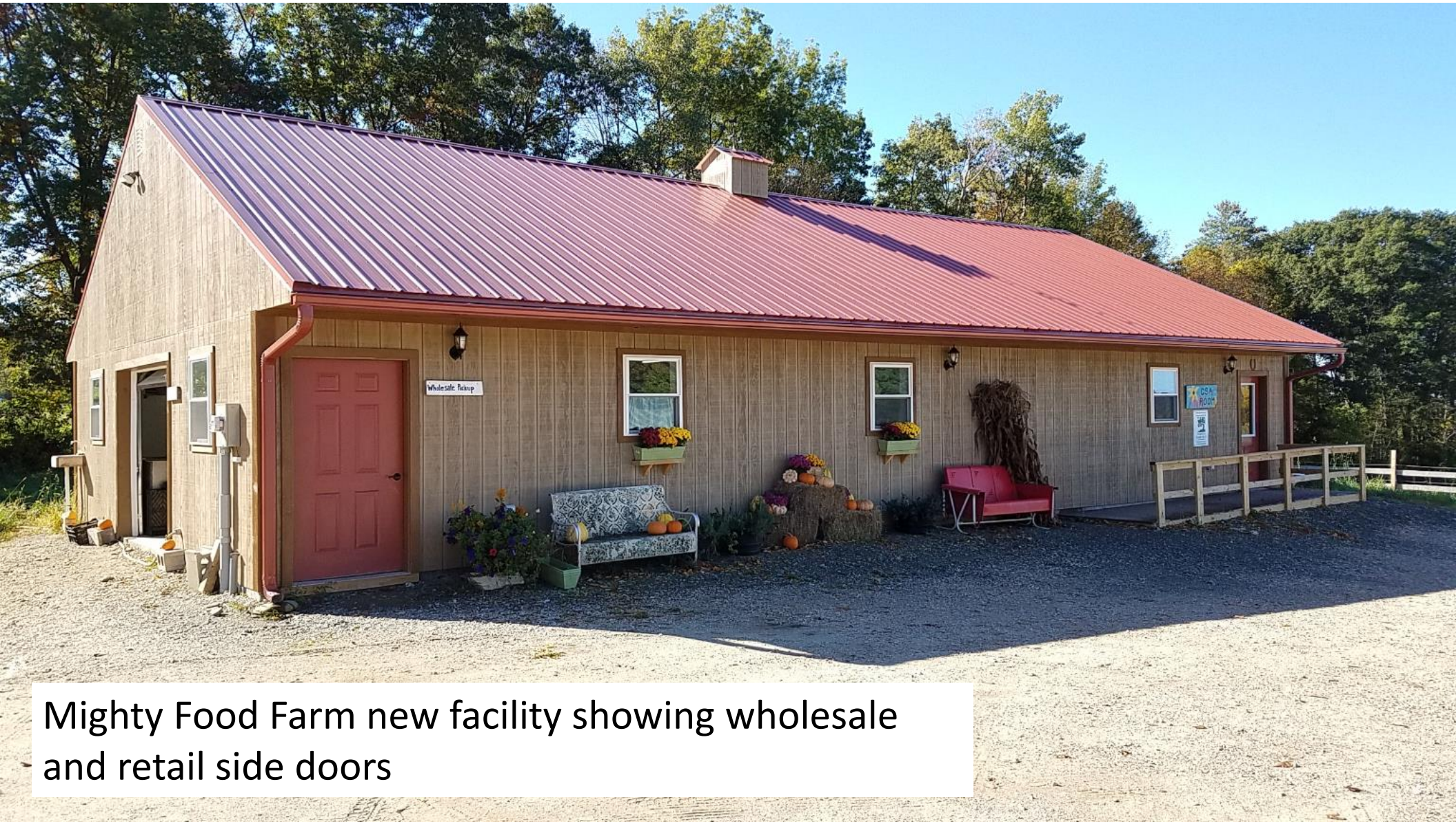
Mighty Food Farm, Pownal, VT

Project:

- Constructions of on-grade, multi-use wash/ pack/storage facility

Key accomplishments:

- Plan and complete construction of a 1,800 sq. ft Multi-use facility with
- Slab on grade is insulated and heated-with:
- Slab with Trench drain
- Large overhead doors with landing space inside
- Cold storage
- Retail and employee spaces



Mighty Food Farm new facility showing wholesale and retail side doors

Mighty Food Farm facility inside, showing wash line.

Mighty Food Farm facility showing hand-washing sink and overhead door

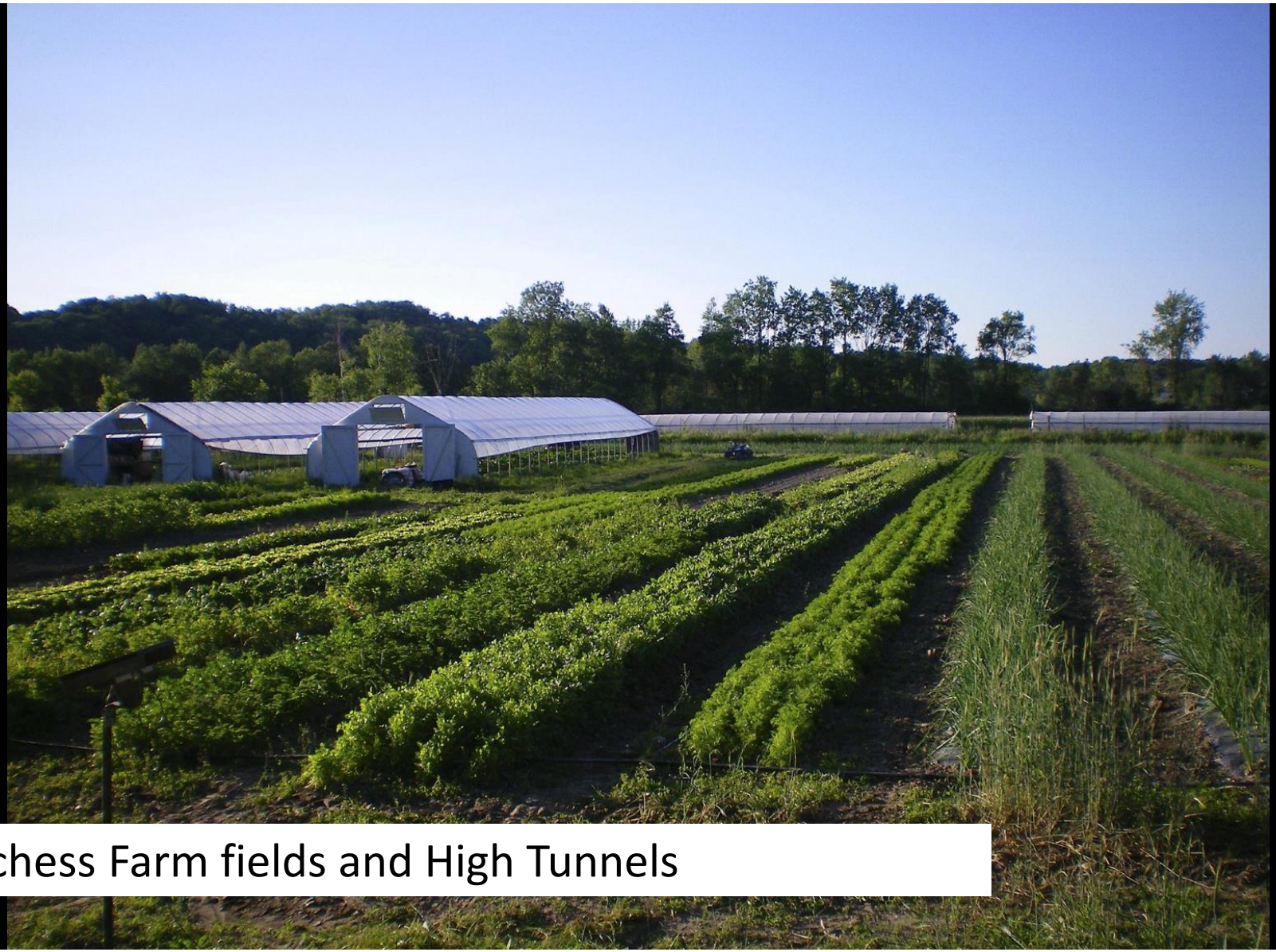
Dutchess Farm, Castleton, VT

Project:

- Winter green processing upgrading

Key accomplishments:

- Complete financial/ business plan for improvement project
- Complete planning for a new wash/ pack shed
- Install 4-season water and improve winter green processing high-tunnel
- Purchased and installed new walk-in cooler



Dutchess Farm fields and High Tunnels

Dutchess Farm heated high tunnel wash line with frost-free hydrant

ON-OFF

Dutchess Farm current outside wash area where new facility is planned

Footprint Farm, Starksboro, VT

Project:

- Construction of new multi-use home and wash/pack storage facility

Key accomplishments:

Plan and complete construction of 2-story multi-use facility with:

- insulated and heated
- First-floor slab with trench drain
- Exterior slab, with overhead door with landing space in and out
- Diversified produce wash pack area
- Cold and dry storage

Footprint Farm multi-use home and wash/pack/store facility showing concrete pad and overhead door

Footprint Farm interior wash/pack area

Footprint Farm multi-use storage area

Harlow Farm, Westminster, VT

Project:

Upgrading root processing line and renovating former apple storage facility

Key accomplishments:

Plan and complete construction of 2-story multi-use facility with:

- Replace barrel washer
- Repair and improve root crop processing conveyor line
- Plan and begin renovation of former apple storage facility

Harlow Farm Fields, lettuce harvest and main barn

Harlow Farm in the barn with Paul Harlow inspecting Carrots

Harlow Farm new barrel washer and repaired root processing line

The Last Resort Farm, Bristol, VT

Project:

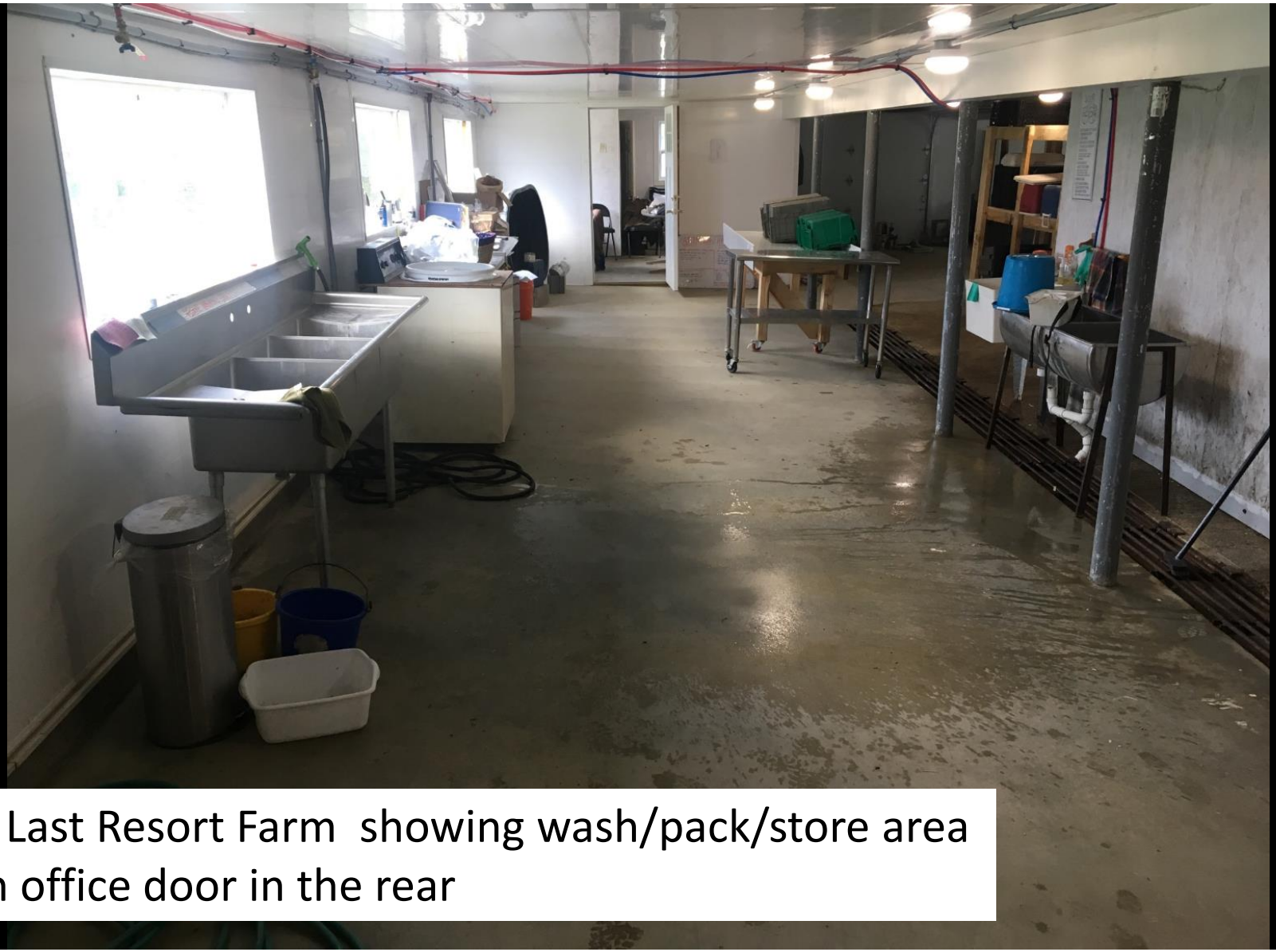
Dairy Barn conversion to diversified produce wash/pack facility

Key accomplishments:

Plan and complete renovation of a dairy barn adding:

- Slab with trench drain
- Wash/ pack line
- Multi-zone cold storage
- Employee longue and farm office
- Loading dock

The Last Resort Farm dairy barn a crop field



The Last Resort Farm showing wash/pack/store area with office door in the rear

Root 5 Farm, Fairlee, VT

Project:

Construction of multi-use wash/pack and kraut processing facility

Key accomplishments:

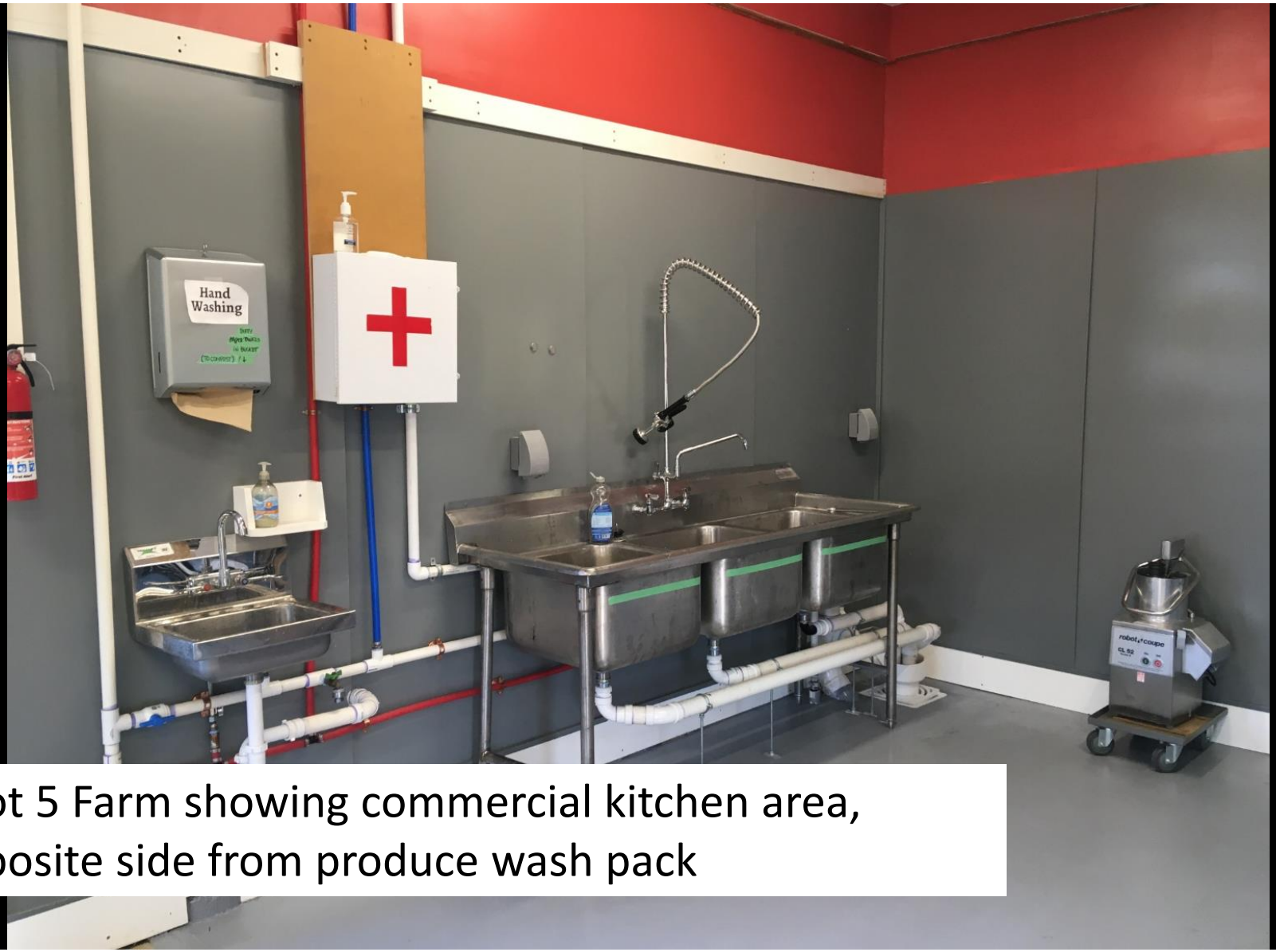
Plan and complete new facility including:

- Commercial kitchen for Kraut processing
- Vegetable wash pack
- Exterior covered slab storage area

Root 5 Farm wash pack/pack shed, pre slab, attached to family home

Root 5 Farm showing inside wash pack/pack shed, with processing equipment, and trench drain

Root 5 Farm showing commercial kitchen storage area opposite side from produce wash pack



Root 5 Farm showing commercial kitchen area, opposite side from produce wash pack

Roots Too Farm, St. Johnsbury, VT

Project:

Dairy-Barn renovation to create wash/pack/storage facility for a small diversified produce operation

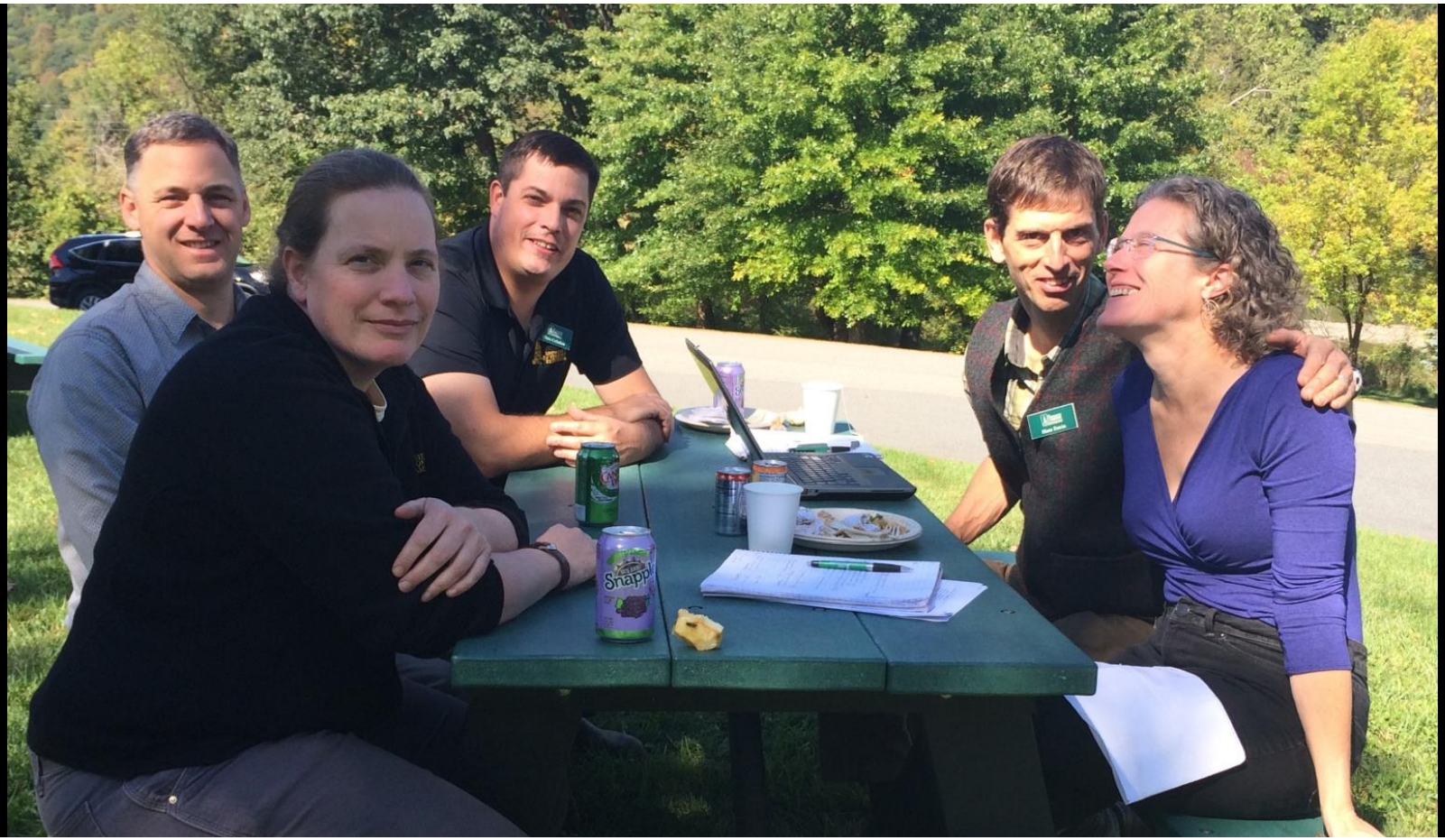
Key accomplishments:

- Completed financial and business plan
- Completed conversion of “milk room” to wash pack area
- Built cold storage unit
- Improved basement storage and livestock stalls

Roots Too Farm showing dairy barn and “milk room”

Roots Too Farm showing “milk room” conversion to a wash/ pack area with working center drain

Roots Too Farm showing cold-storage unit



The Post Harvest Management Team (PHMT) planning their approach and process. From left to right: Betsy Miller, Mark Cannella, Chris Callahan, Hans Estrin, and Ginger Nickerson. Andrew Chamberlin is missing from the photo.