

Extending Vegetable Harvest and Sales Using Tunnels, Row Covers and Winter Storage

*An Overview of How New England Growers are
Riding the 'Buy Local' Wave through the Winter*

Mid-Atlantic Fruit and Vegetable Convention 2014

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Expanding **Winter** Harvest and Sales for New England Vegetable Crops

3 year project (2010-2013) funded by USDA/Northeast SARE



Goal:
*expand vegetable harvest
and sales from December-
April, and thereby increasing
winter income*



Thanks to....

- Becky Sidemann, Univ. of New Hampshire
- Amanda Brown, Univ. of Massachusetts
- Claire Morenon, CISA
- Kate Donald, Seacoast Eat Local



To deliver vegetables to winter markets from December through March,
you need a whole system—

- Row cover
- Low tunnel
- Caterpillar tunnel
- High tunnel/hoophouse
- Greenhouse/HT w/ heat
- Storage



Jeremy Barker-Plotkin, Simple Gifts Farm,
Amherst, MA

You also need:

- Winter Markets
 - CSA
 - Farmers Markets
 - Wholesale
 - Restaurants
- Year-round Labor
 - yours and others'
- Infrastructure
 - Growing, washing, storing and packing



http://www.fullmoonfarminc.com/images/IMG_6274.jpg



Riverberry Farm, VT

Critical challenges for growing

- Short days
 - Less than 10 hours of sunlight from Nov 14 to Jan 27 (Pennsylvania)
 - shortest day = 9hr 20 minutes
- Low light intensity
- Cold temperatures
- Little or no growth

Sunset: 4: 20 pm



'Phases of winter' w/ season extension to match

Phase of Winter	Where to grow	Growing conditions
<p>Late Fall (Mid Nov. to mid Dec.) Some growth, holding</p>	<p>Field: Row cover (RC) Low tunnel (LT) Caterpillar (Cat) High tunnel (HT)</p>	<p>Hard freeze (20-28°F) & thaw Shortening days</p>
<p>Deep Winter (Dec through January) stockpile what grew in Oct-Nov</p>	<p>High tunnel Greenhouse or HT w/ minimal heat</p>	<p>Unheated tunnel: Hard freeze every night(10-25°F) GH, Heated tunnel: > 34°F Low light, short days</p>
<p>Late Winter (February thru April) Growth returns Bolting</p>	<p>Low tunnel (overwintered), High tunnel (new plants, regrowth)</p>	<p>Freeze at night, days warm to >85°F Longer, stronger light</p>

Phases of winter = phases of growing

Phase of Winter	Crops that can be harvested (roughly*)
<p>Late Fall (Mid Nov. to Dec – solstice)</p>	<p>Row cover: Br sprouts; cabbage; kale*, tatsoi LT, Cat: head lettuce, salad turnips, chard, arugula, cilantro, spinach, kale, tatsoi HT: lettuce, bok choy, RR kale</p>
<p>Deep Winter (Dec. to early February)</p>	<p>HT, Cat: Very Hardy greens: spinach, Ripbor kale, RR Kale, Siberian Kale, tatsoi, miners lettuce With heat: same as Nov-Dec.</p>
<p>Late Winter (February thru April)</p>	<p>LT, HT, Cat: Regrow: spinach, Kale, carrots, onions, sprouting broccoli New DS or TP: kale, bok choy, salad mix, lettuce, chard, fennel</p>

* What's possible to grow in each structure depends on outer and inner covering, outdoor T, varieties, and other factors.

**Kale: RR= Red Russian, Sib=Siberian (*B. napa*); RB=Ripbor type, frilly green, *B. oleracea*.

Field Production for late fall harvest under row covers

- Heavy frost: lettuce, salad mix, broccoli, bok choy, chard
- Hard Freeze: spinach, kale



Overwintering under Row Covers

- Crops:
 - spinach, carrots, kale
- Seeding dates:
 - October-November



Row cover types

-Medium: 0.55 oz/sq yd

-Heavy: 1.25 oz/sq yd

(eg, Dupont 5131, Typar)

Low Tunnels for overwintering

- Goal: survival and regrowth for spring markets
- Low cost (0.50-\$1/sq ft)
 - 5% of 4-season GH
 - 15%-30% of unheated tunnel
- Support snow load
- No winter access



Research and Photos by
Becky Sidemann, Univ. of New Hampshire
Amanda Brown, Univ. of Massachusetts

Low Tunnels for overwintering



- Minimum T in tunnel 20-40 °F higher than outdoors
- Ground rarely freezes
- Temp. moderating effect is greatest when outdoors is the coldest
- Best protection: row cover plus GH plastic

Minimum winter temperatures (°F) outdoors and in experimental low tunnels in 2011-12.

R.G Sidemann et al, 2012

Location	Outdoors	2 layers Row Cover	RC + Perf Plastic	RC + GH Plastic
Enfield, NH	-19.7	13.1	14.3	22.7
Meredith, NH	-14.2	17.5	23.2	27.0
Durham, NH	-11.9	-6.7	0.3	13.4
Millis, MA	-14.8	24.7	27.3	21.4
Deerfield, MA	2.1	17.0	16.0	19.4
Little Compton, RI	-0.3	3.4	4.2	*

Testing three types of covering for low tunnels
 -- north to south in New England
 4b to 6a hardiness zones

Low Tunnel Construction

- 10 ft hoops (elect conduit or PVC)
- Heavy row cover (1.25 oz/sq yd)
- 0.6 ml Greenhouse plastic
- Post & rope at ends - taut
- Bury edges with soil
- Row cover: onset of heavy frost
- Plastic: before soils freeze





An acre of low tunnels, Redfire Farm, Montague MA

Spaced for tractor to roll soil over edges

Carrots, kale, spinach, onions

Inner row cover stays on longer in spring

Low Tunnel successful crops

- *Brassicas*: Red Russian, Siberian, Winterbor kale
 - Not *B. rapa* -- bolt too fast.
- Spinach





Low tunnels-- successful crops

Onions:

Seed in August

Transplant in late Sept-
Oct

Covered Oct-April

Harvest green April
or as bulbs May - June



Photos by : Becky Sideman, UNH Cooperative Extension
Reports:

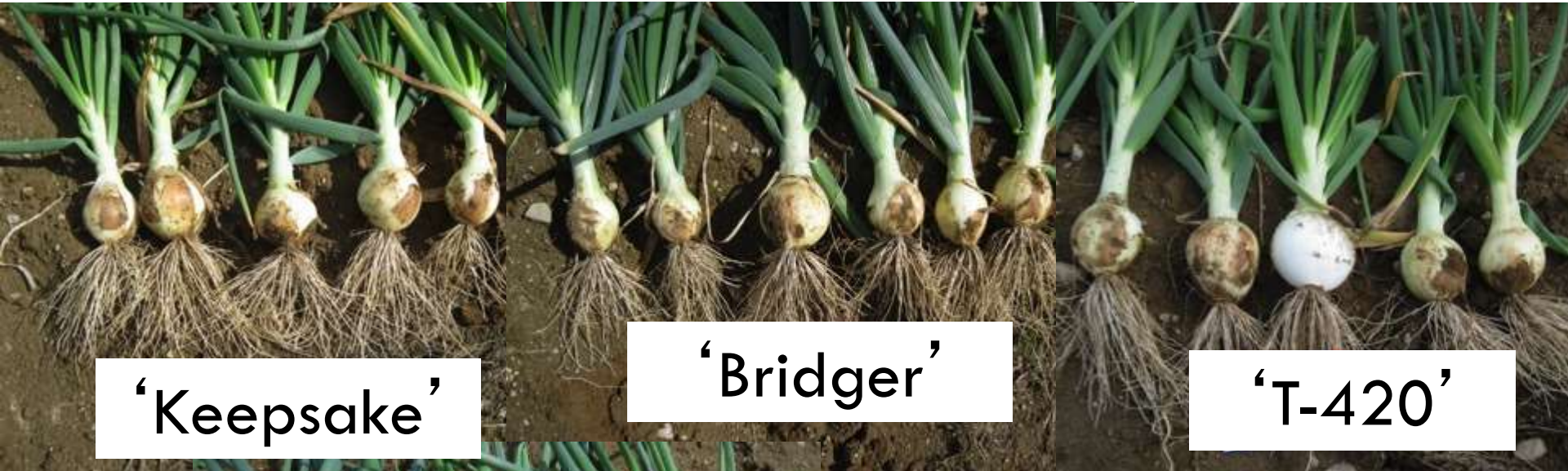
www.extension.umass.edu

winter production, storage and sales

www.nevfc.org

Proceedings and powerpoints,
Dec 2013 conference

Bulbing: Most bulbed nicely. May 7, 2012



‘Keepsake’

‘Bridger’

‘T-420’



‘Hi-Keeper’



‘TopKeeper’

Two varieties bulbed poorly in 2012

‘winter
white’
scallion



‘walla walla’ in 2013

‘walla walla’

Low tunnels-- successful crops



Carrots:

seed Oct to early Nov

harvest April-May

Cv. Napoli works well



Caterpillar Tunnels

- 20' chain link fence tubing
- Hoop bender
- Metal ground posts
- Single layer GH plastic



Simple Gifts Farm, Amherst, MA

Caterpillar tunnel construction

- End ties
- Ropes
- Hitch up sides



Caterpillar tunnels



- Inner row covers add protection
- Benefits: movable, cheap, 4-season use, can be built over field crops
- Limitations: ventilation, wind damage

High Tunnel Management for Winter

- Seed timing depends on harvest goals
 - Seed early fall to ‘stockpile’ for Dec-Jan
 - Seed late fall to overwinter small, grow in Feb-March
 - Seed or TP in February
- Inner covers
 - Multiple layers
- Don’t harvest till crops are thawed
- Little watering is needed





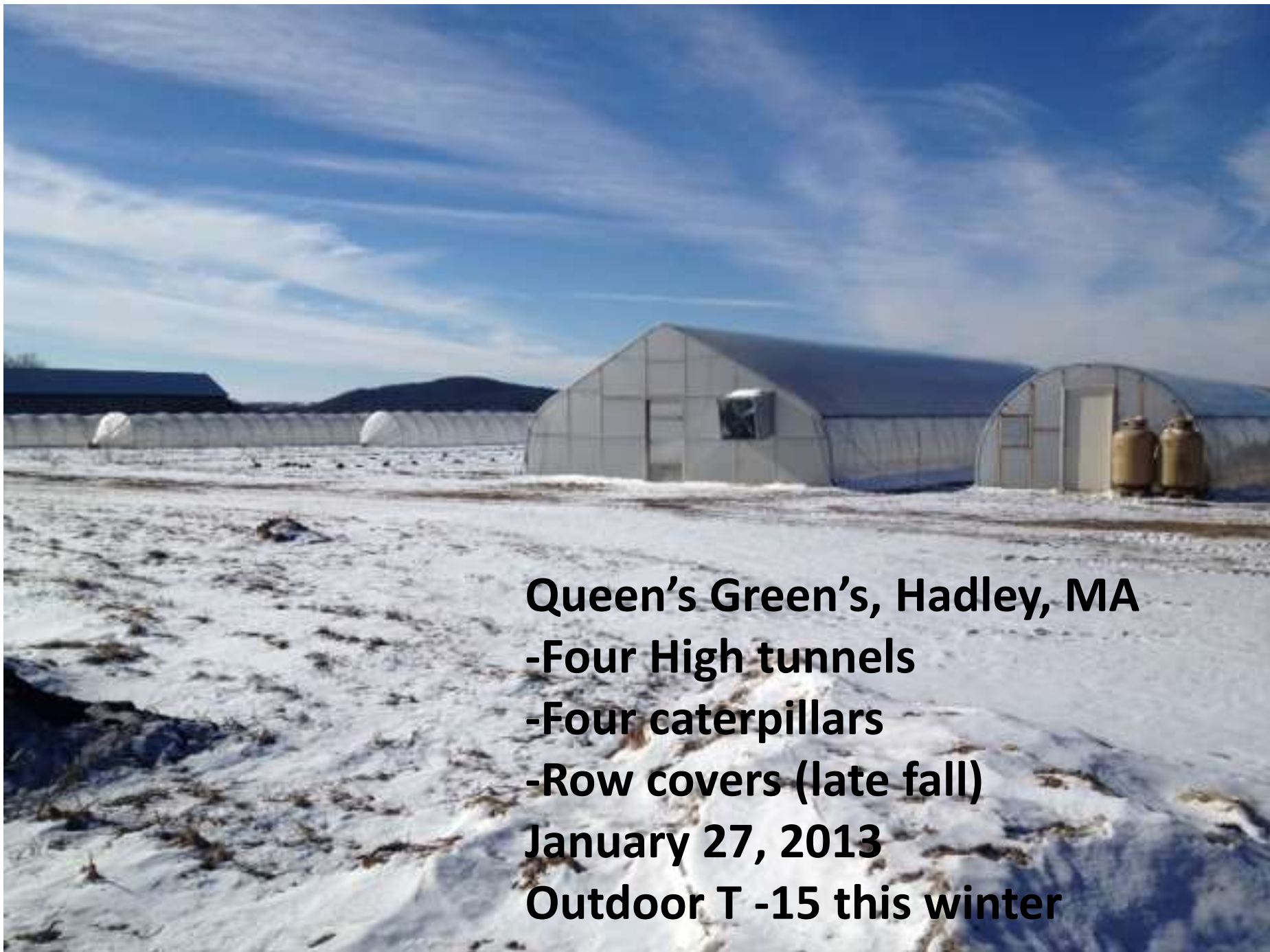
Photo by B. Sidemann



Minimally heated (just above freezing)



Simple Gifts Farm,
January 26, 2014



Queen's Green's, Hadley, MA

-Four High tunnels

-Four caterpillars

-Row covers (late fall)

January 27, 2013

Outdoor T -15 this winter

High Tunnel – minimally heated

- Bottom heat
 - Water circulates under the beds
 - Soil warms, row cover captures & holds
 - More costly to set up, less costly to run
- Air heat (furnace)
 - May already be set up in GH with ground production
 - More costly to run
- Air T 34-36
- Continuous growth without frost: lettuce, bok choy, mizuna

Storage

- Summer grown!
- Harvest windows:
 - September: Winter squash, sweet potato, onion
 - October: potato, carrot, beet
 - November: Brussels sprouts, cabbage, carrot, celeriac, beet



Storage goals?

2-6 months

crop quality – healthy going in
storage conditions match the need



Winter storage of vegetables: four different storage environments

Description	Crops	Temperature	Relative Humidity
Cold, moist	carrots, beets, turnips, celeriac, cabbage, leeks, Br. sprouts	32–34 °F	98-100%
Cool, moist	potatoes	40-45 °F	90%
Warm, dry	winter squash, sweet potato	55-60 °F	60-70%
Cold, dry	onion, garlic, shallot	32-34 °F	65-70%

Basement Root Cellar

- Barn for CSA farm
- Elevator for pallets
- Cement walls to earth (50F)
- 4 in foam insulation ceiling
- Best: foam under slab



Brookfield Farm, Amherst, MA

Storage rooms in new barn basement

Goransen Farm, Maine

1. Cold, moist roots
2. Cold, dry onions
3. Warm, dry squash



Photos by Rob Johanson
of Goransen Farm

Walk-in Cooler inside a barn

- Insulated, 8X8X10' tall
- Thermostat set to 38 F
- Multiple roots
- CSA share pickup



3 Storage rooms in half-buried bunker

Tangerini Farm, Millis, MA



Using packaging to increase/modify RH



- Totes
- wrapped bins & pallets
- burlap over pallets
- Perforated plastic bags

Atlas, Redfire & Tangerini Farms



High humidity Root Storage:

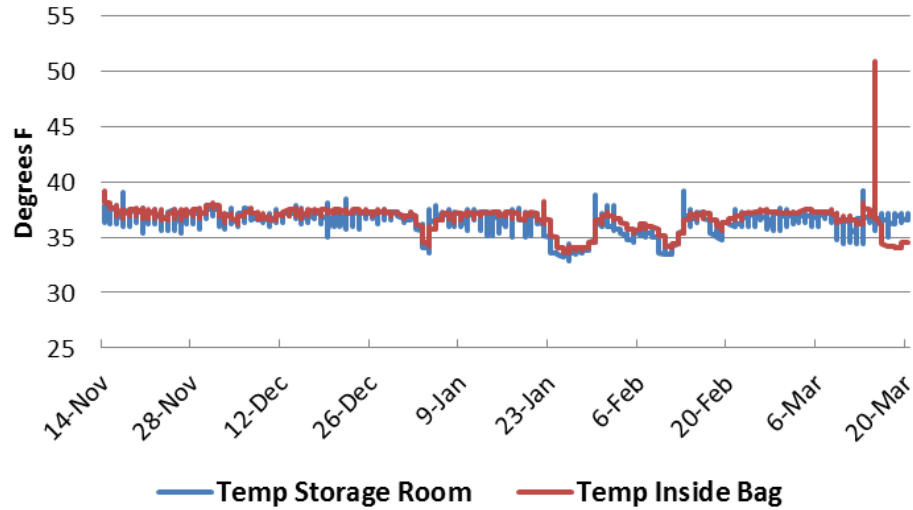
- Mister
- Sprinkler
- Water on floor



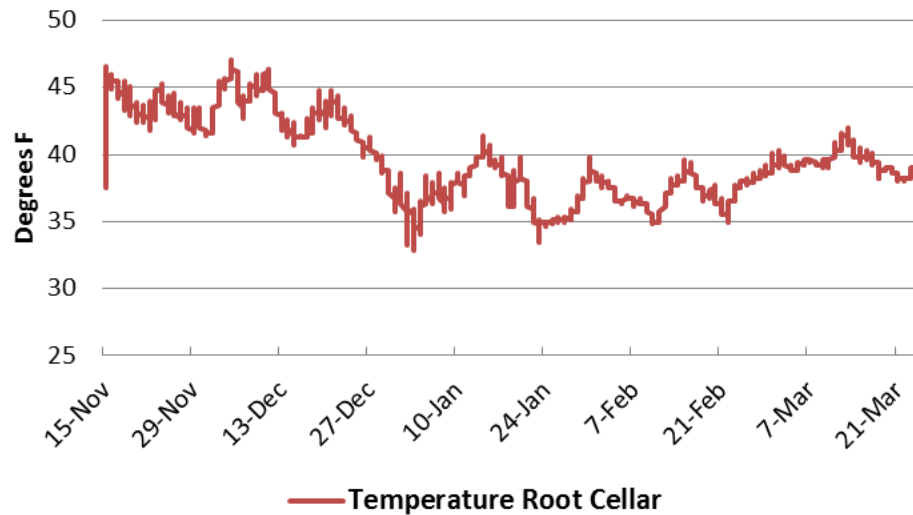
Sprinklers over bins of carrots/
burlap cover



Farm B (Walk-in Cooler) Temp. Nov 2012 to March 2013



Farm A (Root Cellar) Temp. Nov 2012 to March 2013



Using outdoor air to cool walk-in for winter storage

- Duct outdoor air into storage when temperatures allow
- Thermostats inside and outside
 - Compressor turns on when desired
T is less than outdoor T
- Energy efficient & cost effective
- Add humidity



Squash, Sweet potato

>50 F, 50-70 RH for



Fall:
greenhouse,
inner plastic,
heater



Winter: insulated,
heated above or below
ground

Reports and Articles:

SARE reports database

www.mysare.sare.org

Project # LNE 10-297. Annual reports

UMass Extension Vegetable Program website

<http://extension.umass.edu/vegetable/>

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Proceedings and powerpoints,
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