

Appendix 1. Methods for Low Tunnel Trials

Introduction. Low tunnels are temporary, unheated structures 4-8 ft tall, 5-10 ft wide with hoops made of conduit (plastic or metal), covered with spunbonded rowcover, and/or plastic (Wells and Loy 1985, Coleman 2009). While they afford less winter protection and are inaccessible after snowfall when compared to the more widely used high tunnels, low tunnels with quick hoops can be erected for \$0.50-\$1.00 per square foot, estimated to be 5% of the cost of a 4-season greenhouse (Coleman 2009) or 15-30% of the cost of an unheated tunnel (Sideman). They offer the advantage of being easily moved, allowing rotation of winter production areas. To date, their documented uses are primarily for prolonging the fall harvest season until just prior to snowfall. Farmers have found that low tunnels can work for overwintering crops of the Brassica, allium, Chenopodia and umbel families (Coleman 2009, OHare 2006).

Research undertaken by this project will explore some of the many questions regarding overwintering crops in low tunnels:

- Which crops and varieties are adapted for this purpose?
- What amount of protection can we expect from low tunnels constructed of different materials?
- What are the planting dates that maximize spring production? How are they best managed in spring?
- Is production in low tunnels cost-effective and practical?

Low tunnels have been shown to provide sufficient winter protection for fall-planted extremely hardy crops to survive and speed up spring harvest by 4-5 weeks (Coleman 2009). We will study low tunnel structures and evaluate the potential for inexpensive protected field production for three classes of hardy vegetable crops (Brassicas, spinach and onion) with various coverings as described by Wells and Loy (1985) and Coleman (2009). Our experiments focus on the following objectives:

2010-2011 Objective 1. Determine the temperature moderating effects of low tunnels constructed of various materials, situated in a range of New England climates (on-farm and at research stations).

2011-2013 Objective 2. Evaluate the effects of varieties and planting date on overwintering survival and spring yields of three classes of hardy vegetable crops (at research stations).

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Materials Needed for each site:

- 200 feet - Dupont 5131, 1.25 oz/sq yd, 70% light transmission, heavyweight rowcover recommended for overwintering (Typar replacement)
- 50 feet 6 mil IR greenhouse plastic
- 50 feet perforated plastic - 2 mil perforated plastic row cover
- 60 pieces of 10' length 1 ½" PVC pipe (20 for each tunnel)
- 120 pieces 18" length 1 ½" metal rebar
- 4 Hobo UA-002-08 (Onset Computer Corporation) pendant data loggers for measuring light and temperature inside tunnels and one for outside monitoring.

**All materials should be able to be reused for at least one if not two additional growing seasons.*

Methods: At each participating site, we will install and evaluate three different types of low tunnels constructed with different types of covering materials. Orientation of tunnels will vary depending on the farmer cooperator's site; but east to west orientation is recommended. Tunnel coverings/treatments will include

1. 2 layers heavy row cover.
2. 1 layer heavy row cover plus 6 mil greenhouse plastic.
3. 1 layer heavy row cover 1 plus perforated plastic.
4. Uncovered control.

Prepare ground for planting. Each test low tunnel will be 50' long and 5' wide, covering 500 sq ft. Measure and mark outside frame of tunnel with flags or stakes. Be sure that outside frame of tunnel is square to avoid a parallelogram shape which will change the overall shape of the tunnel creating a low lying areas in the coverings. Lay measuring tape along 50' side and lay metal rebar marking every 2.5 feet. Pound the rebar into the ground with a metal mallet leaving 6" exposed. (This 6" will be inserted into the plastic conduit.) Do the same along the other 50' side. Once all of the rebar pieces (40/tunnel) have been inserted, bend and attach plastic conduit to either side of rebar, making a large hoop.

The first layer of row cover will be applied around the date of first frost in each site. The second layer of row cover or plastic will be applied prior to accumulating snowfall; late November – early December, depending on site. The Hobo UA-002-08 (Onset Computer Corporation) pendant data loggers for measuring light and temperature will be placed inside tunnels and outside before the first layer of row cover is applied.

Data Collection: Dates of tunnel setup, maintenance and tunnel orientation will be recorded. In each tunnel and outside at each site, the data loggers will record temperature and light levels every 2 hours throughout the winter. Yield and overall quality will be assessed by growers who are producing crops in tunnels during winter and early spring harvests.

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Recommended Plot Design: Tunnel orientation should be east to west if possible. Tunnels may be arranged end to end to avoid shading. Length may be shortened if necessary to 40 feet for adequate end coverage. Sides of coverings may be secured with sand bags or buried.

