



## Research Report: Using Low Tunnels for Overwintering Crops

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In cooperation with University of Massachusetts colleagues and several grower-cooperators located throughout New England, the goal of this project was to evaluate the potential for low tunnels to be used for overwintering hardy vegetable crops that require minimal winter protection. We acknowledge financial support from Northeast SARE Project LNE 1027 – Expanding Winter Harvest and Sales for New England Vegetable Crops and the NH Agricultural Experiment Station. We appreciate the support and collaboration of our many grower partners and project collaborators at the University of Massachusetts, Communities Involved in Sustaining Agriculture, and Seacoast Eat Local.

Over a period of four years (2009-2013), we established low tunnels at the NH Agricultural Experiment Station's Woodman Farm in Durham, NH (zone 5B). These low tunnels were used for a variety of experiments, some replicated and some merely observational. In this report, we share general observations and lessons learned from our work using low tunnels to overwinter crops.

### About Our Low Tunnels

**Tunnel bows.** Our low tunnels were constructed from 10'-long bows made of 0.5" diameter polyvinyl chloride (PVC) or electrical metallic tubing (EMT). For EMT bows, the QuickHoops benders (Johnny's Selected Seeds, Albion ME) were used to bend the metal. Metal EMT bows were spaced 4-5' apart, and were pushed into the ground at least 6" on either side. PVC bows were spaced 2.5-3' apart, and were reinforced by sliding each end over a 12" rebar groundpost, pounded at least 6" into the ground. These bows result in low tunnels ranging from 3-5' tall, and 3.5-6' wide (See photo, right – PVC bows in front, EMT bows in back).



**Coverings.** We have worked with many types of coverings on the low tunnels. We found that the combination of heavy weight (1.25 oz/square yard) rowcover and 6 mil polyethylene resulted in both the greatest buffering against very cold winter temperatures and the greatest crop survival. Effects of different coverings on temperatures are described in detail in the research report entitled '*Effects of low tunnels on winter temperatures*' linked [here](#). In all cases, we constructed the low tunnels in two phases; we began by adding the rowcover in the fall when temperatures fell into the low 20s, and then added the plastic later in the fall, when nighttime temperatures fell into single digits. Because temperatures fluctuate widely in the fall, it was difficult for us to determine the optimum time to add covers, and this timing was highly subjective.



**Tunnel construction and site selection.** Our research farm site experiences relatively high winds, as well as significant snow accumulation. One of the most challenging aspects of setting up low tunnels is securing the coverings against wind. We tried many things, but found that the most reliable method is to bury the edges. This poses challenges, particularly if the tunnel becomes compromised in the winter and you need to re-assemble it when the ground is frozen. We have also used sandbags with good luck. Orienting the tunnel so that the length of the tunnel runs in parallel to (rather than perpendicular to) prevailing winds reduces the chances of the cover blowing off. Other helpful tips that we have learned from growers include the following:

- Keep the tunnels small (e.g. less than 40' long). Longer tunnels catch wind more easily, and if one does come apart, you lose more crops in a large tunnel than in a smaller one.
- Secure the ends of the tunnel covering very well, so that wind cannot get underneath. We gather the plastic end together, wrap it tightly with twine, and tie it to a rebar post pounded as deeply into the soil as possible. (See photo, Top Right).
- Consider establishing a windbreak. If you are in a windy site, setting up an obstacle upwind from your low tunnels will reduce the chances of them blowing apart.

We have not experienced entire low tunnels collapsing from snow accumulation. However, we have had the ends cave in, especially during spring when the ground is very wet and the groundposts move easily in the soft ground (See photo, Bottom Right). Avoiding very wet areas can help reduce this problem.



**Winter access.** While it possible to gain access to the low tunnels during the winter, it is difficult, and presents logistical challenges. If sandbags are used to secure the covering, they can be removed, but if edges are buried, another strategy is needed. One strategy is to install tarp zippers on the tunnel. Tarp zippers are stick-on zippers that can be found in the painting supplies section of hardware stores. While these provide access to the tunnels, the zippers do not stick well to plastic during winter cold temperatures, and this can result in undesired gaps in the low tunnel. Lastly, the small size of the low tunnels makes movement inside without damaging the crop difficult. Low tunnels are best suited for crops that are planted in the fall and not harvested until spring, when covering can be removed.





**Crops for overwintering.** Over the years that we have used low tunnels for overwintering, we have experimented with several crops, with varying degrees of success. Brief descriptions for each crop follow:

**Spinach** – We have included ‘Space’, ‘Tye’ and ‘Spargo’ in different low tunnel experiments. We observed good winter survival. Leaves that were large but not harvested in the fall were mostly killed or damaged during the winter, but plants put out new healthy leaves in the spring and were ready for harvest in March-April. Severe aphid infestations were observed in one out of two years.

**Mustard** – Mixed mustard greens obtained from R. Hazzard (University of Massachusetts) showed excellent survival in low tunnels, and grew rapidly in spring, ready for harvest as large bunched greens in March-April. Plants varied in speed of bolting, which suggests that there is potential to select for varieties that may be slower to bolt.

**Kale** – Both ‘Siberian’ (see photo, Right). and ‘Red Russian’ kale showed excellent survival in low tunnels, and grew rapidly in spring, ready for harvest as large bunched greens in March-April. Plants bolted quickly, so early harvest was essential.



**Broccoli** – We tried several cultivars of purple sprouting broccoli (including ‘Santee’), and ‘Happy Rich’ green sprouting broccoli. Survival in low tunnels was generally poor, and yields on plants that did survive were quite low.

**Onions** – We have evaluated several varieties of onions in low tunnels. While all showed excellent survival, some bolted whereas others bulbed well in the spring. A more detailed explanation of this work is shown in our report entitled “*Overwintering onions in low tunnels*”, linked [here](#).



**Cilantro** – In one year, the cultivar “Santo” grew well and produced harvestable yields in both December and in March (see photo, right). While cilantro showed promise for this system, additional work is needed before this can be recommended.



**Lettuce** – In one year, the cultivars ‘Winter Density’ and ‘Nevada’ remained marketable until December, but few survived until spring (March). By late December, heads showed a high incidence of necrosis, possibly due to freeze-thaw damage. Additional experimentation would be required to determine the conditions under which lettuce may perform well in this system.

**Swiss Chard** – In one year, ‘Yellow’ and ‘Rhubarb’ Chard showed high percentages of survival and good growth in very early spring (March). However, neither variety was marketable due to severe aphid infestation. With improved insect management, chard may work in this system.

## Other lessons learned:

**Weeds** – the low tunnel environment is perfect for winter annual weeds (e.g. shepherd’s purse, chickweed). These weeds grow throughout the fall and winter, and bloom inside low tunnels in very early spring. Further, weeds such as shepherd’s purse can serve as excellent hosts for aphid pests (see photo, right). As a result, it is important to have a plan to manage winter annual weeds. It is also important to rotate ground used for low tunnels, to prevent buildup of winter annual weed populations. In most of our experiments, we used black plastic mulch for weed control.



**Vertebrate pests** – While low tunnels offer protection against deer, they are perfect protected environments for other pests. We have occasionally observed feeding damage from voles and woodchucks on older leaves of spinach in late winter. While new growth has observed without any subsequent damage, management of these pests may be necessary in some sites.

**Harvest protection & infrastructure** – Crops grown under low tunnels are protected from full sun and wind, and are therefore more tender than those grown outside. We found that removing the low tunnel coverings for harvest on a windy and sunny spring or fall day could result in unmarketable crops. The tender leaves suffered wind and sunburn, and wilted to the point that they were not recoverable. As a result, we learned that we needed to plan our harvest dates to be calm, preferably overcast, days.

**In conclusion**, we have found that low tunnels present several unique challenges, as compared with high tunnel and field growing, but at the same time offer a low-cost overwintering solution for some early spring crops.

**With any questions, please contact Becky Sideman ([becky.sideman@unh.edu](mailto:becky.sideman@unh.edu), 603-862-3203).**

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