

Growing Diverse Crops in Walk-in Caterpillar Tunnels

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Walk-in tunnels are inexpensive alternatives to the greenhouse-like structures that come to mind when thinking about high tunnels. For an equivalent area under cover, they cost less than a quarter of the price of a more traditional high tunnel. With respect to environmental modification, they are intermediate between traditional high tunnels and the low tunnels commonly used by vegetable growers. Due to their segmented appearance, we call these structures caterpillar tunnels. We have used them to grow vegetables, cut flowers, greens, and herbs.

The size of walk-in tunnels is variable. They range from 8' to 18' in width and cover two to four beds. Their length may be up to 300' or more, depending on the length of beds they are intended to cover and limits to the sizes of available covers. The flexible tunnel length enables us to construct a walk-in tunnel virtually anywhere on the farm because it can be sized to fit virtually any bed. The tunnels are tall enough to walk in and are accessed by ducking under the sides anywhere along their length (hence their name).

Bows for walk-in tunnels may be made from PVC, electrical conduit, or galvanized steel hoops. To erect the tunnel, the bows are either slipped over ground stakes made of rebar or tubular steel, or the bows are set directly into the ground about a foot deep. Bows are spaced six to ten feet apart, depending on the site's wind exposure. It is best not to construct the tunnel broadside to the wind, but if that is unavoidable, the tunnel will serve as an effective windbreak for crops planted on its lea side.

A 1/4" rope tied from hoop to hoop is used to form a ridge purlin; the purlin is attached to heavy-duty ground stakes at both gable ends. The structure is quite "loose" when uncovered; much of the tunnel's structural integrity comes from the cover and the way it is secured to the ground. Walk-in tunnels may be covered with greenhouse plastics, heavy spun-bonded fabrics such as Typar, or shade cloth. The cover should be matched to the intended use of the structure. The less expensive Typar might be the better choice, for example, if the goal is to give a boost (or insect protection) to cool-season crops such as spring greens. Greenhouse plastic would be the better choice for an early planting of tomatoes. And shade cloth might be selected for rooting strawberry tip cuttings.

The covering is held fast by 1/4" ropes that are drawn over the top of the structure (Conestoga wagon-style) and are secured to stakes or earth anchors in the ground. These ropes give the structure its segmented, caterpillar-like appearance. The edges of the plastic are left loose, but the covering should be sized so that there are at least two feet of extra material on each side. In particularly windy locations, the covering may be secured by placing rocks or small sand bags on the edges of the plastic. At the gable ends, the plastic is bunched together using rope, and the

rope is tied to a secure stake. The tunnel's dimensions should be configured to fit commonly available greenhouse films or floating row covers.

While they have many advantages, starting with their cost, walk-in tunnels are really three-season structures. The wide bow spacing that keeps them cost-effective greatly reduces their snow load capacity, so the covering should be removed before winter. However, walk-in tunnels with a bow-to-bow spacing of 4' and a width of 10' have reliably withstood snow.

Walk-in tunnels must be ventilated manually to avoid excessive temperatures. During the coldest periods of the year, sections of the sides (the cover) are propped up with short "Y" shaped props or branches cut for the purpose. When temperatures warm, the sides may be rolled up along the entire length of the tunnel. Clamps or tall "Y" props can help hold the rolled up plastic in place. The sides must be rolled down when high winds threaten.

These tunnels are highly portable. They may be erected and dismantled relatively quickly. For example, we erected two 200' long units, each built to cover three beds of lettuces, with the help of a co-worker over the course of a morning. One way to reduce the annual costs of construction and dismantling is to leave the caterpillar tunnel in place from year to year, and to develop a list of tunnel crops around which a crop rotation plan might be developed. Walk-ins are highly adaptable structures. They may be built over existing crops, or over bare ground for a later planting. They may be built in the fall, left uncovered during the winter, and then covered in the spring for an early planting. Or they may be used to cover tomatoes during the spring and summer, and then taken down and reconstructed over an existing fall spinach crop.

We have found many uses for walk-in tunnels to produce vegetables and cut flowers. We construct some of our caterpillars with metal bows spaced 10' apart, and others using PVC bows spaced 6 to 8' apart. At any given time in the growing season, we might have as many as 10 or 15 walk-in tunnels on our farm, with the typical tunnel 200' long. Most are covered in 6 mil greenhouse plastic. Other walk-ins are skinned in 3 mil plastic or Tyvar. Caterpillars have become so important on our farm because they are easy to construct and cover, and are inexpensive, while providing many of the benefits of a multi-bay structure like a Haygrove. Steel hoops and plastic film for one of our 16' x 200' tunnels cost about \$1,500, about one-third the cost of a Haygrove multi-bay high tunnel. In addition, air-flow in caterpillars is excellent – better than in a many conventional high tunnels – as caterpillars open fully like a Haygrove. (But unlike a Haygrove, management of high winds in a caterpillar requires closing the sides.)

To get high quality fruit early from their first planting, we transplant zucchinis and cucumbers into walk-in tunnels on May 1. These tunnels span three beds that are six feet on center. Early harvests of both vegetables are important in meeting their goal of delivering a diversity of vegetables to our New York City-based CSA membership. Our trellised cucumbers, planted two rows per bed into black plastic (or six rows across a tunnel), start yielding a substantial harvest by the end of June. On May 1 we set tomato transplants into three beds in walk-in tunnels for first harvest in July. Using the hybrid variety 'Mountain Spring' as our early variety, we get high quality fruit that bears well over a long period of time. We also produce eggplants and bell peppers in walk-in tunnels.

We initially experimented with walk-in tunnels to protect China asters from aster yellows. This disease is transmitted by leafhoppers, and the alfalfa fields that surround Windflower Farm are leafhopper habitat. We skinned these tunnels with Typar because we thought we could get away without rolling up the sides, something that wouldn't be possible for plastic-covered tunnels which trap heat more effectively. Besides preventing aster yellows, the tunnel environment produced China asters with stems three feet long. Short-stemmed cut flowers are not desirable, and we realized that the extended stem length was a benefit that tunnels could provide other cut flowers. The absence of wind and reduction of light in the walk-in tunnels are two factors associated with longer stems.

We currently grow stock, snapdragons, godetia, larkspur, Bells of Ireland, and lisianthus in walk-in tunnels to achieve much earlier blooms and longer stems. In some ways we prefer walk-in tunnels to regular high tunnels. We are convinced that plastic film is superior as a tunnel cover to Typar except for mid-summer and early fall production. In the summer we might use Typar to protect against insects, diffuse the brightness of the sun, and shelter the flowers from wind. Though we are moving away from Typar, it does have two virtues. It costs about half as much as plastic, and its light weight makes it easy to use. I can cover a 200-foot tunnel myself. It takes a minimum of two people to install a plastic cover.

On walk-in tunnels built for fall lettuce and salad mix, we might still use Typar as the cover. We sometimes build tunnels over beds where we have already set transplants. Using a marking rod, we pound in stakes at 10' intervals and then lower hoops over the stakes. For an inside cover, we use mid-weight fabric, such as 0.9 oz. Covertan, suspended over low wire hoops. We harvest mature lettuce from these unheated tunnels as late as Thanksgiving. The environment inside is suitable for even later production, but walk-in tunnels have little capacity to bear snow.