

## TIPS FOR TUNNELS OF ALL TYPES

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Tunnel production is booming, for a number of reasons: consumer demand for local products, enhanced crop yield and quality, season extension, and fast payback. Tunnels can be as simple as some piping stuck in the ground and covered with a single layer of plastic, often called a low tunnel or field house, to durable structures with many features found in a greenhouse, except a permanent cover or foundation. In the middle are so-called high tunnels that have Quonset or gothic shaped frames, use passive ventilation, drip irrigation, and may or may not have heating or electrical systems. Tunnels may also be gutter-connected or have multi-bay structures.

Whatever you call them and whatever their size and sophistication it takes good management to make the most of these structures. I'm not a tunnel or greenhouse expert, but I've seen enough problems during farm visits to make up a list of things for tunnel growers to consider.

Layout for the future. If you're new to tunnels think long and hard about where you put that first one because it may not be your last. Many growers I know started with one or two houses and now have more than they ever imagined. In hindsight many would have sited their tunnels differently, to better accommodate materials handling, farm traffic, snow removal, and/or multi-house house heating systems.

Plan for wet conditions. Consider the worst-case surface water situation when you set up a tunnel, especially if you'll be growing crops in the ground. In rainy years many farms struggle with excess water flowing into tunnels because perimeter drainage is insufficient. That can cause delayed planting, slow growth due to cold soil, and root rots. Growers doing winter production should keep in mind that water flowing under a tunnel can remove heat from the ground. Some farms don't have water problems inside the tunnel, but outside, the driveways and walkways were not designed to deal with high traffic in the early spring when the ground is really wet. Plan ahead for effective water diversion to prevent mud, ruts, and soil erosion.

Err on the side of strength. There's a time and a place for low-cost, less substantial growing structures. Typically, this is early in the season for temporary protection of relatively fast crops like lettuce. Relatively flimsy field houses can speed production and be very profitable, at very low cost to construct. However, for longer-season crops grown in structures that will remain in place for some time, stronger is better. The tunnel should be designed to withstand the maximum snow load and highest winds in your area. Don't skimp on the quality of steel pipe, the spacing of hoops or the extra structural features such as purloins and cross-braces that provide strength and stability. Consider anchoring the corner posts with concrete.

Change the cover. Greenhouse films last longer than regular construction plastic since they contain additives that make them resistant to ultraviolet degradation. But most greenhouse covers are only designed to last three to four growing seasons. After that, the amount of light under the cover that can be used by plants (photosynthetically active radiation) may decline significantly. Some of this loss is due to changes in the plastic that reduce transmission of certain light wavelengths, but a lot is due to accumulation of soil particles, mold, scratches, and other

blemishes that collect on the plastic over time, both inside and out. Pushing the lifespan of your greenhouse cover may be penny-wise and pound-foolish if it reduces crop growth or quality.

Know your growing media. Commercial peat-based growing mixes that contain conventional fertilizers typically provide very consistent performance. It's still a good idea to ask suppliers for the nutrient analysis of a mix, so you can keep track of what works, or doesn't, for specific crops. In the case of organic growing mixes, which contain compost and natural fertilizers, it's trickier to get consistency from batch to batch. I suggest that growers not only ask their supplier for the analysis, but also have a saturated media test done well in advance of planting. That gives you a record of mix characteristics from year to year, and allows you to make adjustments if needed. Most land grant university testing labs offer this as a 'greenhouse soil' or 'potting soil' test.

Know your water. Many university testing labs offer a greenhouse water test, which includes pH as well as alkalinity (dissolved carbonates and bicarbonates). To maintain proper pH (and thus nutrient availability) in your growing media, you need to avoid pH problems with your water. If the pH is too high, you can add some type of acid, but it takes more acid to decrease the pH of water with high alkalinity. Water can also contain excess soluble salts, which harm roots and can lead to nutrient deficiencies. High sodium is another possible problem. Annual water testing is an inexpensive management tool to help optimize crop nutrition.

Be vigilant for pests. Growers keep an eye out for pests as they work in their tunnels, but a more systematic approach is to have a scouting form and a person assigned to fill it out on a weekly basis. That makes sure all tunnels and crops are examined closely and frequently, increasing the chances of catching insect or disease problems early, when they're easier to control. Another good tool is a low-cost hand lens to aid in the observation of small problems, before they become big ones. Hang one of these up in each greenhouse. Placing sticky yellow cards throughout the greenhouse is another low cost way to stay ahead of potential insect pests.

Natural ventilation. Tunnels need the right set up to maintain good ventilation naturally. Smaller, narrow houses can get away with roll-up sides as their only form of ventilation, but even these may suffer when there is little or no wind, since that's what drives sidewall ventilation. Larger houses really need both sidewall and ridge vents to assure good air movement. That way, the greenhouse is vented by both wind and thermal gradients. Small roof vents, cut into the plastic, with heat-activated openers are a low-cost alternative to a ridge vent.

Mechanical ventilation. If a tunnel has electric power, fans can be used to draw cool air in and push hot, humid air out. But fans will pull from the point of least resistance, so a nearby open door, visible cracks in the endwall, or rolled up sides will diminish or even eliminate fan effectiveness. Be sure the tunnel is set up to force a fan to pull air from the desired location, usually the other end of the tunnel. Also, use of high-quality thermostats to control the operation of fans and vent motors can reduce unnecessary operation and lower electricity costs.

Horizontal air flow. In larger tunnels, HAF may be advisable to help mix the air to maintain uniform temperature and carbon dioxide levels, as well as to reduce the incidence of foliar diseases by removing moisture from plant surfaces. Small, 1/10 to 1/15 horsepower circulating fans can provide the air movement needed. The first fan should be placed about 10 to 15 feet

from one endwall to pickup the air that is coming around the corner from the other side. Subsequent fans should be located 40 to 50 feet away to keep the air moving.

Sanitation pays. Make greenhouse cleanliness a priority in your efforts to prevent pest problems. Recommended sanitation activities include regular washing of tools, containers, and equipment that comes in contact with plants or growing media using a greenhouse disinfectant. Employees should be aware that they can carry pests from one house to another and know how to minimize that risk.

To avoid the spread of disease, hose ends should not be left lying on the floor. It's pretty easy to set up hooks to keep these hung up. Benches and other working surfaces should be disinfected in between crops and kept as free of debris as possible. Under the benches, all weeds should be removed while still small, and efforts made to avoid standing water. Trash containers in the greenhouse should be emptied daily. If any plants are discovered to have insect or disease problems they should be put in a plastic bag to minimize spread of spores of bugs and then removed from the greenhouse.

Outside the greenhouse, weeds should be removed and turf kept closely mowed to limit the habitat for pests. Compost piles, dead plants, old pots and other breeding sites for insects and disease should be located as far from the greenhouses as practical.

There are many excellent web sites with tunnel information, including UMass Extension Greenhouse Crops and Floriculture: [www.umass.edu/umext/floriculture](http://www.umass.edu/umext/floriculture), and a northeast High Tunnel Manual at: [www.uvm.edu/sustainableagriculture/hightunnels.html](http://www.uvm.edu/sustainableagriculture/hightunnels.html).