



# ATTRA *news*

Newsletter of the National Sustainable Agriculture Information Service: A project of the National Center for Appropriate Technology (NCAT)

## Extending the Growing Season

Farmers can get top dollar when they bring their product to market early in the season, late in the fall, or during the winter. Many producers across the country are using hoop houses to extend their growing season. This issue of ATTRAnews looks at ways farmers can put this technology to work.

### Hoop Houses and High Tunnels

Hoop houses, also called high tunnels, are arched or hoop-shaped frames covered with one or more layers of clear plastic. They are high enough to drive a tractor through. Crops are grown in the ground, usually with drip irrigation. Most high tunnels are solar heated, using no electricity.

Less expensive than greenhouses, some of these structures can pay for themselves in one season. High tunnels are used extensively in Europe, Asia, and the Middle East. Now they are catching on in the United States. Researchers are experimenting with various systems. Market growers are hosting workshops about hoop houses at conferences and on their farms.

High tunnels can have a big impact on season extension:

- Crops grown in hoop houses can have higher quality and yields than those grown in the field.
- Crops grown in hoop houses can hit the market early while prices are still high, helping to capture loyal customers for the entire season.
- Hoop houses allow certain crops to be grown throughout the winter, providing a continuous supply for the entire year.

Crops grown in high tunnels include cut flowers, carrots, tomatoes, peppers, squash, melons, lettuce, and other greens. Some growers use hoop houses to produce cane berries, strawberries, blueberries, and even cherries. Although high tunnels provide a measure of protection from low temperatures, they are not frost protection systems in the same sense that greenhouses are.



Photo: Rex Dufour, NCAT

At a March field day on Rick Lattin's farm in Fallon, Nevada, farmers examine hoop house sides that roll up for ventilation.

On sunny mornings, the sides must be rolled up to prevent a rapid rise in temperature. Tomato plants, for example, may set less fruit when temperatures go above 86°F for a few hours. Even on cloudy days, rolling up the sides provides ventilation to reduce humidity that could lead to disease problems. The sides should be rolled down in the evening until night temperatures heat up to 65°F. A thermometer that records minimums and maximums is a great way to keep track of temperatures.

Maine market gardener Eliot Coleman has devised a method for moving hoop houses in his fields. This allows him to grow crops outside in the warm season, and then cover and harvest them during the winter. His new *Winter Harvest Handbook* summarizes his considerable experience with the technology.



Photo: Andy Pressman, NCAT

## Free Webinar: Hoop Houses for Extending Your Growing Season

May 7, 2009, 11 a.m. Mountain Daylight Time

Register at:

[www.attra.ncat.org/webinars2009/hoophouses](http://www.attra.ncat.org/webinars2009/hoophouses)

NCAT specialists Tammy Hinman and Andy Pressman will discuss

- Uses and benefits of high tunnels, including quality and yields
- Different types of high tunnels
- Construction, materials, and cost estimates
- Management of crops, soil fertility, pests, and weeds
- Economics and marketing of crops
- Your questions about high tunnel production

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 [www.attra.ncat.org](http://www.attra.ncat.org)

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# Where to Find Information About Hoop Houses

## Publications

### Books from Eliot Coleman

Maine farmer/author Eliot Coleman has been an enthusiastic innovator of high tunnel production for 30 years. See [www.fourseasonfarm.com](http://www.fourseasonfarm.com). His books are available from Chelsea Green Publishing (800-639-4099, [www.chelseagreen.com](http://www.chelseagreen.com))

Winter Harvest Handbook: Year-Round Vegetable Production Using Deep Organic Techniques and Unheated Greenhouses. 2009

Four Season Harvest: Organic Vegetables from Your Garden All Year Long. 1999

### Books from Growing for Market

Lynn Byczynski, Kansas publisher of Growing for Market magazine (800-307-8949, [www.growingformarket.com](http://www.growingformarket.com)), offers two publications on hoop house production.

The Hoophouse Handbook: Growing Produce and Flowers in Hoophouses and High Tunnels. 2006

Extending the Season (a compilation of season-extension articles from Growing for Market). 2005

High Tunnel Production Manual. Bill Lamont and Mike Orzolek. Pennsylvania State University, 2003. \$26.50 from Dr. Bill Lamont, Department of Horticulture, 206 Tyson Building, Penn State University, University Park, PA 16802 <http://plasticulture.cas.psu.edu/manual.htm>

Solar Gardening. Leandre and Gretchen Poisson, 1994. Chelsea Green Publishing (800-639-4099, [www.chelseagreen.com](http://www.chelseagreen.com))

Walking to Spring: Using High Tunnels to Grow Produce 52 Weeks a Year. Alison and Paul Wiediger, 3298 Fairview Church Road, Smiths Grove, KY 42171. \$15 from [www.aunaturefarm.homestead.com](http://www.aunaturefarm.homestead.com)

## Web-Based Resources

Hightunnels.org is a comprehensive Web site, the creation of Midwest researchers, professors, growers, technicians, and students. [www.hightunnels.org](http://www.hightunnels.org)

High Tunnel Tomato Production. Lewis Jett, University of Missouri Extension Bulletin M170. <http://extension.missouri.edu/explore/manuals/m00170.htm>

High Tunnel Melon and Watermelon Production. Lewis Jett, University of Missouri Extension Bulletin M173. <http://extension.missouri.edu/explore/manuals/m00173.htm>

eXtension's informative page on high tunnels includes resources, plans, and Powerpoint presentations. [www.extension.org/article/18369](http://www.extension.org/article/18369)

Michigan Food & Farming Systems has an active series of hoop house projects. Contact Adam Montri, (517) 432-3381, [admontri@anr.msu.edu](mailto:admontri@anr.msu.edu), [www.miffs.org/programs6.asp](http://www.miffs.org/programs6.asp)

North Carolina's Center for Environmental Farming Systems offered a workshop on high tunnels in February. [www.cefs.ncsu.edu/calendar2009.htm#hightunnel](http://www.cefs.ncsu.edu/calendar2009.htm#hightunnel)

Noble Foundation in Oklahoma conducts research about hoop houses. Contact Steve Upson, [sdupson@noble.org](mailto:sdupson@noble.org), 580-223-5810, [www.noble.org/Ag/Staff/Profile/Upson\\_Steve.html](http://www.noble.org/Ag/Staff/Profile/Upson_Steve.html)



Inside Nevada market farmer Rick Lattin's hoop houses, low tunnels add a second layer of protection for cold winter nights. Here, the cover has been pulled off the low hoops for the day.

## Video and CD-Rom Presentations

Building a Hoop House. Adam Montri, Michigan State Univ. Part 1: [www.youtube.com/watch?v=z5dyGHurXdA](http://www.youtube.com/watch?v=z5dyGHurXdA)  
Part 2: [www.youtube.com/watch?v=Bsv1\\_Jr4l00&feature=related](http://www.youtube.com/watch?v=Bsv1_Jr4l00&feature=related)

High Tunnels: Using Low-Cost Technology to Increase Yields, Improve Quality and Extend the Season. [www.uom.edu/otvegandberry/Videos/hightunnelvideo.html](http://www.uom.edu/otvegandberry/Videos/hightunnelvideo.html)

North Central Region Organic and Sustainable Ag Video Series includes an Indiana workshop on hoop houses [www.tristateorganic.info](http://www.tristateorganic.info)

High Tunnel Workshop at Ohio State University, 2008. CD with six hours of discussion on high tunnel design, construction and management, including in organic systems. Speakers include farmers, scientists, and industry professionals. A packet of written material contains complementary information. \$10 for the CD, \$20 for the packet, \$25 for both: (330) 263-3810, [kleinhenz.1@osu.edu](mailto:kleinhenz.1@osu.edu).

## More Research on Hoop Houses

In addition to the resources listed above, other universities and colleges are conducting research on hoop houses. To find out about various projects and workshops, search the Internet for "high tunnels" or "hoop houses" with one of these university names. Or try the search using the name of a college near you.

Kansas State University, Rutgers University, University of Kentucky, University of Maryland Cooperative Extension, University of Minnesota, University of Nebraska, University of New Hampshire, University of Wisconsin's Healthy Farmers/Healthy Profits Project

## Manufacturers and Suppliers

ATTRA's publication *Season Extension Techniques for Market Gardeners* provides a very extensive list of manufacturers and suppliers of hoop house equipment. To order or download this free publication, see the box on page 3.

## Design and Construction

High tunnels are not too difficult to build. A common and inexpensive design uses galvanized metal bows attached to metal posts driven into the ground—a traditional Quonset-style structure. Designs with vertical walls provide unhindered internal access and growing space along the sides of the house, but are more costly and time-consuming to construct because of the additional pipe required.

Strength is important. Heavy-gauge galvanized steel pipe is best for hoops. The hoops should not be set farther than 4 feet apart. In cold climates a peaked-roof structure that will shed snow is preferable to the quonset style, which can collapse in a heavy snowfall. Strong end walls are the most critical components for hoop house stability. The cover must also be anchored securely to withstand strong winds.

The most economical covering is 6-mil greenhouse-grade, UV-treated polyethylene, which should last three to five years. Do not use plastic that is not UV-treated, as it will disintegrate quickly. Market growers commonly use hoop houses that are 20 feet by 96 feet. This allows efficient heating and cooling, enough growing space, and adequate natural ventilation.

The roll-up sides used on many high tunnels provide a simple and effective way to manage ventilation and control temperature. The edge of the plastic is taped to a 1-inch pipe that runs the length of the tunnel. A sliding “T” handle is attached to the end of the pipe so that the plastic can be rolled up as high as the hip board. Ventilation is controlled by rolling up the sides to dispel the heat. Depending on temperature and wind factors, the two sides may be rolled up to different heights.



Photo: Andy Pressman, NCAT

In September 2008 NCAT technical specialists Lee Rinehart and Andy Pressman conducted a high tunnel workshop for Pennsylvania Women in Agriculture. The workshop was held at Josie Porter Farm in Stroudsburg, Penn. The high tunnel was purchased from Ledgewood Farm ([www.ledgewoodfarm.com](http://www.ledgewoodfarm.com)).



Students and community members build a self-designed hoop house using locally available materials at a school in Sallis, Attala County, Mississippi. Photo: Daniel Teague.

## East-West or North-South?

Hoop house manufacturers recommend orienting the house to capture the most light in winter. For locations north of 40° latitude, the ridge should run east to west so that the end walls don't block sunlight. For locations south of 40° latitude, the ridge should run north to south. (The border between Kansas and Nebraska is at 40°N.) At any latitude, according to *Growing for Market's* Lynn Byczynski, gutter-connected or closely spaced multiple greenhouses will get more light if they are aligned north-south to avoid shadows cast by the structures to the south. Dr. Lewis Jett, in Columbia, Missouri, says that a high tunnel should be oriented perpendicular to prevailing winds. Sunlight may be less important than ventilation.

## Irrigation

In hoop houses, irrigation is essential. Watering can be done by hand, through a trickle or drip system, or by overhead emitters. Advantages of drip irrigation:

- Efficient water and fertilizer use
- Reduced weed competition in areas outside the beds
- Ability to simultaneously irrigate and work inside tunnels
- Reduction in disease potential because water doesn't get on plant leaves

(Adapted from *High Tunnel Production Manual*, Penn State Center for Plasticulture)

## Year-Round Production

### Benefits

- Earn year-round income
- Retain old customers
- Gain new customers
- Higher prices at times of the year when local growers with unprotected field crops do not have produce
- Possible higher yields, better quality
- Extended or year-round employment for skilled employees

### Disadvantages

- No break in the yearly work schedule
- Increased management demands
- Higher production costs

The articles in this issue of *ATTRAnews* are adapted from the *ATTRAnews* publication *Season Extension Techniques for Market Gardeners*, written by NCAT agriculture specialist Janet Bachmann. In addition to offering information about high tunnels, the publication discusses low tunnels and other season-extension techniques. It provides an excellent list of suppliers of hoop houses and related equipment. You can download the publication for free at [www.attra.ncat.org/attra-pub/summaries/seasonext.html](http://www.attra.ncat.org/attra-pub/summaries/seasonext.html) or call 800-346-9140 for a paper copy.

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## Au Naturel Farm

Alison and Paul Wiediger of Au Naturel Farm in south-central Kentucky grow winter vegetables in high tunnels. In their book, *Walking to Spring: Using High Tunnels to Grow Produce 52 Weeks a Year*, the Wiedigers advise growers to prepare the site so that the ground is level from side to side, with no more than a 3 percent slope from end to end. Avoid wet or shady areas and obstructions to ventilation. Make sure drainage around the site is good. You don't want water running through the house every time it rains.



Full production of lettuce and spinach in early March at Au Naturel Farm. Photo courtesy of Au Naturel Farm.

The Wiedigers use a commercially available 20 by 96 foot hoop house, in addition to two 21 by 60 foot tunnels. They think there is value in building as large a structure as is practical. "Most of the growing in this tunnel will be in spring, fall, and winter when outside temperatures are colder," they say. "We believe that both the earth and the air within the tunnel act as heat sinks when the sun shines. At night, they give up that heat, and keep the plants safe. The smaller the structure, the smaller that temperature 'flywheel' is, and the cooler the inside temperatures will be."

They also find that plants close to the walls do not grow as well as the plants closer to the center. Twenty feet wide, however, may be as wide as you can get with inexpensive hoophouses that don't use interior bracing. Longer than 100 feet or so may be too long for effective natural ventilation, which is very important in order to avoid disease problems. The Wiedigers use a double layer of 6-mil, four-year poly to cover their tunnels. A small fan blows air between the two layers to create an insulating barrier against the cold. To learn more, see their Web site, [www.aunaturelfarm.homestead.com](http://www.aunaturelfarm.homestead.com)

## Multibay Tunnel Systems

Some growers literally cover their fields to protect high-value crops from early and late frost, heavy rain, wind, hail, and disease. The British company Haygrove ([www.haygrove.co.uk](http://www.haygrove.co.uk)) was the first to manufacture the multibay tunnel systems that are popular in Europe and the United States. The system eliminates walls

between bays and can be used on slopes and large expanses. However, multibay tunnels cannot carry a snow load.



Multibay tunnels can be used on slopes and entire fields. Photo courtesy of Haygrove Tunnels.

## ATTRAnews

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