Hoop House Vegetable Production

Guide H-252

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If you are an enthusiastic vegetable gardener who is ready to take the next step toward increasing production in your garden, installing a hoop house is a worthwhile endeavor. A hoop house can boost the temperature within. This can extend the growing season for warm-season vegetables and also provides adequate protection for cool-season vegetables to prolong their harvest throughout the winter months. A hoop house can be used to modify your crop's overall environment, or microclimate, including temperature, wind, and humidity.

For the purposes of this guide, a hoop house refers to a plastic-covered structure that typically does not have supplemental heating or cooling. Hoop houses (also called **high tunnels**) use the sun's solar energy and natural air movement to passively heat and cool the structure. In contrast, a **greenhouse** is actively heated and cooled with furnaces and fans. In a hoop house, vegetable crops are often planted directly into the soil under the structure (Figure 1), although raised beds, grow bags, benches, pots, and hanging baskets may also be used. Hoop houses are more economical to build and maintain than greenhouses, but frequent monitoring and management must be carried out to optimize growing conditions for vegetable crops.

For detailed instructions on constructing a hoop house, see NMSU Cooperative Extension Service Circular 606, *Hoop House Construction for New Mexico* (http://aces.nmsu.edu/pubs/_circulars/CR-606.pdf).

Figure 1. **Hoop house research plots (spinach and lettuce) at New Mexico State University's Leyendecker Plant Science Research Center near Las Cruces, NM.**

FACTORS TO CONSIDER BEFORE BUILDING A HOOP HOUSE

Hoop houses are relatively easy and inexpensive to construct, costing around $2 to $3 per square foot, with low maintenance once constructed. They are easily adapted to small parcels of land to meet the needs of gardeners and farmers. Since plants need sunlight to grow, light penetration should be considered during structure design. In areas with strong winds or snow accumulations, consider the load stress that the structure must tolerate. The height of the hoop house can be adjusted so that one can walk and work inside comfortably; therefore, height must be considered before construction starts.

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Temperature

Heating of hoop houses depends on solar radiation to modify the internal temperature. Although the lack of supplemental heating or cooling keeps operational costs to a minimum, extremely cold temperatures during winter months or very hot temperatures during summer months may create unsuitable growing conditions for the production of vegetables. It is a good idea to install a maximum/minimum thermometer inside the hoop house to monitor seasonal temperature changes, as well as fluctuations during the day and night. Keeping records of hoop house temperatures can help with future planning of crops. You can record temperatures with an inexpensive automatic data logger and temperature probe.

Hoop house cooling usually depends on passive ventilation, but fans and automatic systems can be used. When the temperature within the hoop house exceeds the desired maximum, the structure must be vented either by opening doors, venting through the top, or opening the sides of the structure. While venting is especially critical during summer months, temperature and humidity can become excessive within the hoop house on cooler, sunny days. It is common for growers to vent a hoop house during the day and close it at night. Some growers replace the plastic covering with a shade cloth during hot summer months to optimize growing conditions for their crops. Overcast or cold days may warrant keeping the hoop house closed to increase or maintain a desired warm temperature. Without supplemental heat, plants within the hoop house can still freeze if outside temperatures drop too low. Row covers may be used within the hoop house for additional crop protection.

Water

A reliable source of quality water is critical for irrigating plants and must be available for use in the hoop house throughout the entire season. Efficient methods of watering vegetable crops within a hoop house include overhead sprinklers, drip irrigation, soaker hoses, micro sprinklers, sprayers, and emitters, although manual application of water can also meet crop requirements. No matter what method you use, make sure to install a filter on water lines to keep abrasive particles from damaging your delivery system. If you irrigate from overhead sprinklers, particularly during the winter, try to do so during the warmest part of the day to allow the foliage to dry before temperatures drop at night. It is important to drain water lines after each use to prevent freezing or algae growth in the lines. Lastly, it is a good idea to collect a water sample to submit for testing and analysis. Irrigation water in the Southwest can often be high in dissolved salts, which can build up in your soil with frequent irrigation. Because hoop house covering materials normally exclude rainfall, salts are not leached deeper into the soil profile. It is therefore important to have your irrigation water analyzed and to carefully monitor your soil as described in the following section.

Soil

The soil must be properly prepared and fertilized for the planting of seeds and transplants; therefore, it is important to regularly collect soil samples so that you are aware of your soil's characteristics. The use of improved soil mixes and amendments should be considered in your hoop house to improve soil quality and plant performance.

PLANTING CONSIDERATIONS

Vegetables may be transplanted or direct seeded depending on the crop and the grower's preferences. Spacing between plants will be similar to that of outside gardens. Trellising or other plant support will usually be installed within a hoop house for indeterminate and vining type vegetables to conserve space.

Pollination

Some vegetable crops, including most of the cucurbits (some cucumbers, squash, melons), will not set fruit without the aid of pollinating insects such as bees. If the hoop house is regularly opened so that plants within are exposed to outside elements, insects will have easy access to naturally pollinate crops during flowering. If the hoop house remains closed for heat retention, you may have to pollinate your crop manually or introduce beneficial pollinating insects to complete this task. Very high and low temperatures within the hoop house will also inhibit pollination, and thereby prevent fruit set in fruiting-type vegetable crops such as cucurbits, tomatoes, and peppers.

Warm-Season Vegetables

Warm-season vegetable plants are highly susceptible to damage or death at freezing temperatures. Crop harvest can be prolonged by preventing freezing temperatures and prolonging the growing season within a hoop house. However, very high temperatures may also slow growth or kill plants. These crops are best planted 4 to 5 weeks before your average last frost date in the spring. Table 1 provides temperature requirements and days to maturity for some warm-season crops suitable for hoop house production. This list is not comprehensive, and other crops may be successfully grown in hoop houses or high tunnels. Crops that performed particularly well in hoop house culture during trials in New Mexico are in bold.

Cool-Season Vegetables

Cool-season vegetables thrive at cooler temperatures and suffer at very high temperatures. Although cool-

Table 1. Temperature Requirements and Days To Maturity for Select Warm-Season Crops Under Hoop House Production

Crop	Temp. Range for Optimum Growth (°F)[x]	Lethal Minimum Temp. (°F)	Approx. No. of Days to Maturity[y]	Special Considerations for Hoop House Production
Beans, bush	60-70	32	48-60	
Cucumbers	65-75	32	48-72	Pollinating insects usually required.
Eggplant	70-85	32	50-80[z]	
Melons	65-75	32	85-110	Pollinating insects usually required.
Okra	70-85	32	50-60	
Peppers, bell	70-75	32	65-80[z]	
Peppers, chile	70-85	32	65-80[z]	
Squash, summer	65-75	32	40-50	Pollinating insects usually required.
Squash, winter (including pumpkins)	65-75	32	85-120	Pollinating insects usually required.
Tomatoes	70-75	32	60-90[z]	Vibrating or shaking plants will enhance pollination and aid in fruit set.
Watermelons	70-85	32	75-95	Pollinating insects usually required.

[x]Nighttime temperatures will also affect plant growth.

[y]Days to maturity are influenced by temperature extremes and other environmental stresses.

[z]Days from transplanting.

Table 2. Temperature Requirements and Days To Maturity for Select Cool-Season Crops Under Hoop House Production

Crop	Temp. Range for Optimum Growth (°F)[x]	Lethal Minimum Temp. (°F)	Approx. No. of Days to Maturity[y]	Special Considerations for Hoop House Production
Beets	60-65	15-20	56-70	
Broccoli	60-65	25	55-78[z]	
Cabbage	60-65	10-15	62-120	
Carrots	60-65	12	50-95	Temps <50°F result in poor color development. High temps decrease quality.
Cauliflower	60-65	25	50-125	Developing curd must be protected from light to prevent off color and flavor.
Lettuce, leaf	60-65	15-25	40-50	High temps may cause bitterness, bolting.
Spinach	60-65	0-5	37-45	
Swiss chard	60-65	10	50-60	
Collards	60-65	12	70-85	

[x]Nighttime temperatures will also affect plant growth.

[y]Days to maturity are influenced by temperature extremes and other environmental stresses. Days to maturity may be longer, particularly when night temperatures are near the lethal minimum and days are shorter.

[z]Days from transplanting.

Source: Knott's Handbook for Vegetable Growers (3rd Edition)

season crops are tolerant to frost, very low temperatures will slow their growth rate and may damage or kill the plants. These crops are best planted 4 to 5 weeks before your average first frost date in the fall. Table 2 provides temperature requirements and days to maturity for some cool-season crops suitable for hoop house production. This list in not comprehensive and other crops may be successfully grown in hoop houses or high tunnels. Crops that performed particularly well in hoop house culture during trials in New Mexico are in bold.

SELECTING A SITE FOR A HOOP HOUSE

Select a site that is moderately level with good drainage and good soil for planting. A site can be modified by soil fill so that construction is on a level surface. Select a site in an open area where trees and other obstacles will not affect sun penetration. Consider the surrounding area so the structure will be protected against high winds and heavy snows, thus prolonging its life. A good-quality water source should be readily available year-round. Electricity may be needed for the hoop house, so

a source nearby should be considered. Security and protection against vandalism of the hoop house and crop may also be factors to consider when selecting a site.

Orientation Of Your Hoop House

There are several ways to orient your hoop house and the planting beds within it, depending on your production goals.

East – West: For maximum passive warming in the winter months, consider orienting your hoop house so the long side runs east/west. This may enable you to produce a crop in the coldest part of the winter rather than simply extending your season. Keep spring winds in mind when choosing the orientation of your hoop house. Doors on the west side of the hoop house should be kept closed and well-secured during windy weather. Consider planting a wind break on the west side of your hoop house if high spring winds are of concern.

North – South: By positioning the hoop house in a north/south direction, you receive the air currents coming from a south or southwest direction that will help ventilate the hot air buildup within the hoop house on hot days. The north/south orientation also favors sun penetration during the summer months since the sun tracks from east to west, going directly over the hoop house for maximum light penetration.

You may notice differential growth of your crop near doors and in different locations inside your hoop house. This is normal and is generally a response to slight differences in the microclimate within your hoop house.

PESTS AND DISEASES

Many of the same disorders that affect vegetable crops in the garden can affect plants in your hoop house. In fact, the microclimate you have created may even favor certain pests and diseases. Pests that enter a hoop house may be particularly problematic due to the protection they receive within the structure from natural predators and freezing temperatures. Some other common pests may not thrive within the microclimate of the hoop house and may therefore be of less concern. Regardless, you should adopt a regular scouting and rotation schedule to catch any signs of diseases and pests before they become a serious issue. Adverse environmental conditions within the hoop house, such as temperature extremes or uneven water or nutrient application, may also cause physical disorders in the plants.

Not all insects are a problem. Beneficial insects help maintain balance in your hoop house by keeping harmful insects in check. Beneficial insects can be introduced into the hoop house and should be encouraged to take up residence.

FINAL THOUGHTS

Start small and expand upon your successes. Do not be afraid to experiment, but be sure to have a back-up plan if your experiment fails. With some experimentation and perseverance, a hoop house can be a wise investment and an enjoyable way to get even more from your garden or farm.

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