

WHAT CAN A SMALL GREENHOUSE DO FOR YOU?

Overview of Residential and Educational Uses

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Greenhouses enable the environment around plants to be altered to optimize growth and quality, and they can even enable year-round growing in temperate climates. The cultivation of plants in small-scale greenhouses for personal or instructional use has many enjoyable aspects beyond food production or plant growth. From learning and teaching new skills to quality of life benefits, greenhouses can be a valuable asset to a range of horticulture and gardening pursuits. This publication series will cover some of the most common benefits and uses as well as design and management aspects of small-scale greenhouses for residential or educational use in Tennessee.

GREENHOUSES: VERSATILE TOOLS TO MANAGE PLANT GROWING ENVIRONMENTS

Controlling the environment around crops has been practiced by humans for centuries. Since the 1950's, the use of plastics

has revolutionized the practice and made these structures and systems much more cost effective and simpler to use.

Controlling the environment around plants can be practiced on a range of scales. For example, the principles of trapping light energy with temporary plastic coverings, such as mulches, row covers and low tunnels, are used for short-term benefits in gardens large and small. High tunnels are permanent plastic-covered structures that alter environments around plants and function as greenhouses without heating or cooling. These tools all rely on energy from the sun (passive heating) along with natural air movement (passive cooling) and do not generally include heaters and fans or coolers (active heating or cooling). In these structures, environmental conditions can be made more appropriate for growing crops, but there are limits to their use in temperate climates because they rely on solar radiation for heating and natural air movement for ventilation. If the sun doesn't shine for several days, then benefits of such



FIGURE 1. A polycarbonate greenhouse being used to augment a community vegetable garden growing area in east Tennessee.



FIGURE 2. Garden transplants are a common crop in home greenhouses.

covers are minimal. Likewise, a lack of air movement can quickly lead to still, hot air that is a higher temperature than optimum for plants. See UT Extension publication **W 346-F** for more details on the use of these various passively heated and cooled structures.

Structures that we refer to as greenhouses use passive heating from sunlight, but also include active environmental control for heating and cooling and sometimes control of light, humidity and carbon dioxide. Greenhouses are enclosed using transparent coverings that can be plastic or glass. The transparency of these materials allows solar radiation to pass through and provide light for photosynthesis as well as heat. However, this requirement of letting light pass through means that greenhouse coverings have low heat retention (low insulation properties) as compared to other buildings, so heating will be needed to maintain temperatures in the cooler seasons. This publication series will be focused on small-scale greenhouses that include some heating and cooling to expand their utility and seasons of use in Tennessee climates systems.

GETTING STARTED WITH THE RIGHT QUESTIONS: WHAT CAN A GREENHOUSE DO FOR YOU?

Residential or educational greenhouses can provide great utility to the gardener, educator or small-scale grower and can certainly be a very enjoyable addition to gardening activities. However, for the non-commercial grower, a different perspective from other types of gardening is needed when considering whether to build a greenhouse. Gardeners know that annual flowers and vegetables provide a near endless opportunity for diversity and creativity and even perennials and woody plants

can often be moved by the gardener to meet new needs or to avoid a site or soil issue. However, the beneficial flexibility employed in the residential landscape does not apply to greenhouses. Poor drainage or low light issues that were not recognized when a greenhouse was installed can be quite challenging or impossible to overcome after construction. These poor site conditions can significantly reduce the functionality and enjoyment of the greenhouse for years to come. Keep in mind that moving a greenhouse is difficult in many circumstances and nearly impossible in others.

Greenhouses need to be considered and planned differently than plants in our personal gardens and landscapes as well as community or school gardens. Understanding the possible benefits of a greenhouse and clarifying your main greenhouse goals are a crucial first step. Planning, site selection and greenhouse design and construction can then support the homeowner or educator in reaching their goals.

To provide a sense of the possibilities and limitations, this discussion will begin with the most common ways that non-commercial greenhouses are used and some of the needs and options for these types of uses. A separate UT Extension publication (**W 935-B**) will provide principles of greenhouse structures, including information on structures, equipment and management needed to help you reach these uses and goals.

1. PRODUCING GARDEN TRANSPLANTS

Raising transplants is a very common use of residential or educational greenhouses, and both vegetable (see Figure 2) and flower transplants are well within reach with a well-managed small greenhouse. There are many benefits to being able to raise transplants for the garden on site or for selling or giving away to friends and family members. Many gardeners and teachers raise transplants using artificial lights in their basements, garages or classrooms. However, it is often simpler to grow high quality transplants using natural light. It is also easier to scale up growing with the space a greenhouse provides.

In some instances, growing transplants can be more cost effective than buying them, but when the cost of supplies, heating and time are included, residential greenhouse growers are probably better served to focus on benefits other than cost savings. Cultivar selection is one of the clearest benefits because the gardener is not limited to what crops local garden centers carry. Heirloom or family-saved seed can be used to grow transplants. And, newer cultivars that may not be grown commonly are also available as seed much easier than as transplants. Having control over the timing of crops is also important, and growing transplants (see UT Extension publication **W 346-B**) fits well with other practices such as using season extension methods (see UT Extension publication **W 346-F**) for early or later garden cropping.

Crop health benefits can also be important, especially for those who grow vegetables. Many bacterial diseases of commonly transplanted crops, such as bacterial leaf spot in pepper, and bacterial canker, spot and speck in tomato as well as black rot in



brassicas are often seed borne. Purchasing disease-free seeds from established seed suppliers can be a way that residential and community gardeners can greatly reduce the chance of bringing these damaging diseases into their growing areas.

Keep in mind when planning a greenhouse primarily used for growing transplants that production often requires only a few months a year of operation. So, it may be possible for the greenhouse to be used for other crops in the fall and winter. However, other uses should be balanced with the need to maintain disease and insect free growing areas for your (generally) spring transplants. Times of year that the greenhouse will be used are important to plan in advance because heating and cooling systems will need to be selected based on seasons of use. Also keep in mind that many transplants can be grown in a relatively small greenhouse area. The most common flat size (10" x 20") can hold 18 to 72 transplants, so a few square feet can literally provide hundreds of plants. However, don't size your greenhouse solely based on how many plants you plan to produce. While a minimum size of 100 square feet is recommended, larger greenhouses are better at moderating temperatures. If it is determined that transplant production needs are not sufficient to warrant building a freestanding greenhouse, window greenhouses could be an option as well.

2. GROWING FOOD CROPS

If producing food at the residence or in educational settings is the goal, greenhouses can provide many opportunities. While fruit crops are possible, the most common edible crops for small-scale greenhouses are vegetable crops, such as lettuce, tomatoes, peppers, and herbs. Gardeners should consider a couple things when designing greenhouses for vegetable production. First, it is important to determine if year-round production is the goal. Greenhouses will need to be sized and designed to manage a wide range of environmental conditions if year-round production is the goal. Smaller greenhouses can be more challenging to heat and cool evenly, so if year-round production is intended, a larger greenhouse with higher levels of light and temperature control will be needed.

Second, growers will need to understand the limits of light at their site or be willing to use supplemental lighting in the lowest light times of year. If extending growing seasons is the goal, then small greenhouses can be used to augment outdoor production in the garden. This could be accomplished by growing leafy crops early in the spring or late in the fall with minimal heating in a small greenhouse. Warm season crops could also be grown in the fall to spring time period. However, warm season crops need more control over temperature, meaning higher heating expenses and supplemental lighting would likely be needed to optimize production.

The second important question in regards to vegetable production in an educational or residential greenhouse is what type of

FIGURE 3. Leafy crops, such as lettuce, are some of the best food crops for production in small greenhouses due to their tolerance for colder weather and lower light than fruit crops.

growing system is needed or desired. Raised beds or containers could be used with a range of soil or soilless growing substrates. Additionally, small-scale hydroponic systems could be installed to enable the production of both warm and cool season crops. When properly selected, such systems can be space and time efficient. Because of the specificity of these systems, a separate series of Extension publications details their use in home greenhouses (see Extension publications **W 844-A**, **W 844-B**, and **W 844-C**).

3. FOLIAGE AND FLOWERING PLANTS

Many residential greenhouse growers focus on the care and production of specialty crops. Of these many crop choices, orchids may well be the most common for greenhouse hobbyists. Orchids are by no means a homogenous group of plants. In fact, orchids are one of the largest families of flowering plants with almost 30,000 species estimated along with many hybrids developed by professional breeders and hobbyists alike. Due to the wide range of climates these plants hail from and the different growth patterns (aerial roots versus terrestrial), home greenhouses can be used to create a range of conditions for orchids. Some of the most common environmental manipulations include the need to control light levels in the greenhouse. For instance, Phalaenopsis, a common genus in trade, requires lower levels of light than Cattleya (figure 4). If being grown in the same greenhouse, the ability to provide different levels of shade is essential. Other examples of specific requirements include humidity and temperature along with the ability to control these conditions seasonally to replicate conditions present in the native region.

Orchids may be the most common example of specific crop environments that are possible for hobbyists, but there are numerous other examples. Many plant collections are maintained for teaching use by schools and volunteer groups, such as Master Gardeners. Tropical foliage and flowering plants housed in small greenhouses can provide great opportunities to teach botany, plant physiology and propagation for youth and adults through the year.

Bonsai could be maintained in a home greenhouse as could many other types of tropical plants, such as small-scale citrus trees. Historically, the production of these tropical fruits was practiced with beautiful (and expensive) orangeries. These ornate structures are quite uncommon today, but the attraction of being able to produce tropical fruits is still present for some gardeners. Gardeners and educators should understand which of their temperate crops require dormancy and ensure they are given proper conditions for continued productivity. Bonsai collections often contain both temperate and tropical plants that may or may not require dormancy. Because of the specific light, temperature, humidity or size requirements of these specialty plants, it is important for the gardener to plan the greenhouse according to the needs of the plants they intend



FIGURE 4. Cattleya orchids are common specialty crops in small greenhouses, and they generally require more light than can be provided in residential settings.

to grow. The ability to precisely control humidity, light or other factors will need to be considered in selecting the structure and equipment.

4. MANY OTHER ODDS AND ENDS

There are certainly many uses for residential or educational greenhouses which do not fit in the above categories. Often gardeners prefer to overwinter containerized tropical or tender crops that cannot or may not reliably overwinter in their area (like figs or even large flowering plants). However, in all of these cases, it is crucial to carefully screen incoming plants for insects or disease issues as bringing in plants with pre-existing issues creates challenges for the greenhouse manager that can be spread to other crops.

SUMMARY

These scenarios of common greenhouse uses provide examples of the many beneficial aspects of a residential or educational greenhouse for non-commercial growers. Different types of crops, though, can require different growing seasons, space requirements and management input. So, it is important to know the intended uses of the greenhouse at the beginning to enable siting and selection of the greenhouse structure and environmental control system to be tailored to your location and needs. This early identification of key needs will reduce the chances of you being disappointed in the future because your greenhouse ended up not being well suited for your intended uses. Careful consideration now will lay the foundation for years of enjoyment and production in your small-scale greenhouse.



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