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Hobby Greenhouses

What should a gardener consider when planning to build a small hobby greenhouse? What materials should be used to build it? Does it need heating and cooling? Where can it be placed on the property? There are many considerations, and careful planning is important before a project is started.

Building a home greenhouse does not need to be expensive or time-consuming. The greenhouse can be small and simple, with a minimum investment in materials and equipment, or it can be a fully equipped, fancy, automated conservatory. The greenhouse must, however, provide the proper environment for growing plants.

LOCATION

The greenhouse should be located where it gets maximum sunlight. The first choice of location is the south or the southeast side of a building or shade tree. Sunlight all day is the best, but morning sunlight on the east side is sufficient for plants. An east-side location captures the most November-to-February sunlight. The next best sites are southwest and west of major structures, where plants receive sunlight later in the day. North of major structures is the least desirable location and is good only for plants that require little light.

Deciduous trees, such as maple and oak, can effectively shade the greenhouse from the intense late afternoon summer sun. Deciduous trees also allow maximum exposure to the winter sun because they shed their leaves in the fall. Evergreen trees that have foliage year-round should not be located where they will shade the greenhouse because they will block the less-intense winter sun. You should aim to maximize winter sun exposure, particularly if the greenhouse is used all year. Remember that the sun is lower in the southern sky in winter, causing long shadows to be cast by buildings and evergreen trees.

Good drainage is another requirement for the site. When necessary, build the greenhouse above the surrounding ground, so rainwater and irrigation water will drain away. Other site considerations include the light requirements of the plants to be grown; locations of sources of heat, water and electricity; and shelter from the winter wind. Access to the greenhouse should be convenient for both people and utilities. A workplace for potting plants and a storage area for supplies should be nearby.

TYPES OF GREENHOUSES

A home greenhouse can be attached to a house or garage, or it can be a freestanding structure. The chosen site and personal preference can dictate the choices to be considered. An attached greenhouse can be a half greenhouse, a full-size structure or an extended window structure. There are advantages and disadvantages to each type.

Attached Greenhouses:

Lean-to: A lean-to greenhouse is a half greenhouse, split along the peak of the roof or ridge line. A lean-to greenhouse is useful where space is limited to a width of approximately 7 to 12 feet, and is the least expensive greenhouse structure. The disadvantages include some limitations on space, sunlight, ventilation and temperature control. The lean-to should face the best directions for adequate sun exposure.

Even-span: An even-span is a full-size structure that has one gable end attached to another building. It is usually the largest and most costly option but it provides more usable space and can be lengthened. The even-span has a better shape than a lean-to for air circulation to maintain uniform temperatures during the winter heating season.

Freestanding Structures: Freestanding greenhouses are separate structures; they can be set apart from other buildings to get more sun and can be made as large or small as desired.

When deciding on the type of structure, be sure to plan for adequate bench space, storage space and room for future expansion. Large greenhouses are easier to manage because temperatures in small greenhouses fluctuate more rapidly. Small greenhouses have a large exposed area, through which heat is lost or gained, and the air volume inside is relatively small; therefore, the air temperature changes quickly in a small greenhouse. Suggested minimum sizes are 6 feet wide by 10 feet long for a lean-to and 8 or 10 feet wide by 12 feet long for an even-span or freestanding greenhouse.

STRUCTURAL MATERIALS

A good selection of commercial greenhouse frames and framing materials is available. The frames are made of wood, galvanized steel or aluminum. Build-it-yourself greenhouse plans are usually for structures with wood or metal pipe frames. Plastic pipe materials generally are inadequate to meet snow and wind load requirements. Frames can be covered with glass, rigid fiberglass, rigid double-wall plastics or plastic films. All of these have advantages and disadvantages. Each of these materials should be considered — it pays to shop around for ideas.

Greenhouse frames range from simple to complex, depending on the imagination of the designer and engineering requirements. The following are several frames commonly used:

- **Quonset:** The quonset is a simple and efficient construction with an electrical conduit or galvanized steel pipe frame. The frame is circular and usually covered with plastic sheeting. Quonset sidewall height is low, which restricts storage space and headroom.

- **Gothic:** The gothic frame construction is similar to that of the quonset but it has a gothic shape. Wooden arches may be used and joined at the ridge. The gothic shape allows for more headroom at the sidewall than does the quonset.

- **Rigid-frame:** The rigid-frame structure has vertical sidewalls and rafters for a clear-span construction: There are no columns or trusses to support the roof. Glued or nailed plywood gussets connect the sidewall supports to the rafters to make one rigid frame. The conventional gable roof and sidewalls allow maximum interior space and circulation. A good foundation is required to support the lateral load on the sidewalls.

- **Post and Rafter and A-frame:** The post and rafter is a simple construction of an embedded post and rafter, but it requires more wood or metal than some other designs. Strong sidewall posts and deep post embedment are required to withstand outward rafter forces and wind pressures. Like the rigid frame, the post and rafter design allows more space along the sidewalls and efficient air circulation. The A-frame is similar to the post and rafter construction except that a collar beam ties the upper parts of the rafters together.

COVERINGS

Greenhouse coverings include long-life glass, fiber-glass, rigid double-wall plastics and film plastics with one- to three-year lifespans. The type of frame and cover must be matched correctly.

Glass: An aluminum frame with a glass covering provides a maintenance-free, weather-tight structure that minimizes heat cots and retains humidity. Tempered glass is frequently used because it is two or three times stronger than regular glass. Small prefabricated glass greenhouses are available for do-it yourself installation, but most should be built by the manufacturer because they can be difficult to construct.

The disadvantages of glass are that it is easily broken, is initially expensive to build and requires much better frame construction than fiberglass or

plastic. A good foundation is required and the frames must be strong and must fit well together to support heavy, rigid glass.

Fiberglass: Fiberglass is lightweight, strong and practically hailproof. A good grade of fiberglass should be used because poor grades discolor and reduce light penetration. Use only clear, transparent or translucent grades for greenhouse construction. Tedlar-coated fiberglass lasts 15 to 20 years. The resin covering the glass fibers will eventually wear off allowing dirt to be retained by exposed fibers. A new coat of resin is needed after 10 to 15 years. Light penetration is initially as good as glass but can drop off, considerably over time with poor grades of fiberglass.

Double-wall plastic: Rigid double-layer plastic sheets of acrylic or polycarbonate are available to give long-life, heat-saving covers. These covers have two layers of rigid plastic separated by webs. The double-layer material retains more heat, so energy savings of 30 percent are common. The acrylic is a long-life, nonyellowing material; the polycarbonate normally yellows faster, but usually is protected by a UV-inhibitor coating on the exposed surface.

Film Plastic: Film plastic coverings are available in several grades of quality and several different materials. Generally, these are replaced more frequently than other covers. Structural costs are very low because the frame can be lighter and plastic film is inexpensive. The films are made of polyethylene (PE), polyvinyl chloride (PVC), copolymers and other materials. A utility grade of PE that will last about a year is available at local hardware stores. Commercial greenhouse grade PE has ultraviolet inhibitors in it to protect against ultraviolet rays and it lasts 12 to 18 months. Copolymers last two to three years

HEATING

The heating requirement of a greenhouse depends on the desired temperature for the plants grown, the location and construction of the greenhouse and the total outside exposed area of the structure. The heating system must be adequate to maintain the desired day or night temperature.

Heating systems can be fueled by electricity, gas, oil or wood. The heat can be distributed by forced hot air, radiant heat, hot water or steam. For safety purposes and to prevent harmful gases from contacting plants, all gas, oil and woodburning systems must be properly vented to the outside. Use fresh-air vents to supply oxygen for burners for complete combustion. Safety controls, such as safety pilots and a gas shutoff switch, should be used as required. Portable kerosene heaters used in homes are risky because some plants are sensitive to gases formed when the fuel is burned. Unvented heaters (no chimney) using propane gas or kerosene are not recommended.

AIR CIRCULATION

Installing circulating fans in your greenhouse is a good investment. During the winter when the greenhouse is heated, you need to maintain air circulation so that the temperatures remain uniform throughout the greenhouse. Without air-mixing fans, the warm air rises to the top and cool air settles around the plants on the floor.

Small fans with a cubic-foot-per-minute (ft^3/min) air-moving capacity equal to one quarter of the air volume of the greenhouse are sufficient. For small greenhouses (less than 60 feet long), place the fans in diagonally opposite corners but out from the ends and sides. The goal is to develop a circular (oval) pattern of air movement. Operate the fans continuously during the winter. Turn these fans off during the summer when the greenhouse will need to be ventilated.

VENTILATION

Ventilation is the exchange of inside air for outside air to control temperature, remove moisture or replenish carbon dioxide (CO_2).

Natural ventilation uses roof vents on the ridge line with side inlet vents (louvers). Warm air rises on convective currents to escape through the top, drawing cool air in through the sides.

Mechanical ventilation uses an exhaust fan to move air out one end of the greenhouse while outside air enters the other end through motorized inlet louvers. Exhaust fans should be sized to exchange the total volume of air in the greenhouse each minute.

Ventilation requirements vary with the weather and season. One must decide how much the greenhouse will be used. In summer, one to one and a half air volume changes per minute are needed. Small greenhouses need the larger amount. In winter, 20 to 30 percent of one air volume exchange per minute is sufficient for mixing in cool air without chilling the plants.

COOLING

Air movement by ventilation alone may not be adequate in the middle of the summer; the air temperature may need to be lowered with evaporative cooling. Also, the light intensity may be too great for the plants. During the summer, evaporative cooling, shade cloth or paint may be necessary. Shade materials include roll-up screens of wood or aluminum, vinyl netting and paint.

Small package evaporative coolers have a fan and evaporative pad in one box to evaporate water, which cools air and increases humidity. Heat is removed from the air to change water from liquid to a vapor. Moist, cooler air enters the greenhouse while heated air passes out through roof vents or exhaust louvers. The evaporative cooler works best when the humidity of the outside air is low. The system can be used without water evaporation to provide the ventilation of the greenhouse. Size the evaporative cooler capacity at one to one and a half times the volume of the greenhouse.

CONTROLLERS/AUTOMATION

Automatic control is essential to maintain a reasonable environment in the greenhouse. On a winter day with varying amounts of sunlight and clouds, the temperature can fluctuate greatly; close supervision would be required if a manual ventilation system were in use.

Thermostats can be used to control individual units or a central controller with one temperature sensor can be used. In either case, the sensor or sensors should be shaded from the sun, located about plant height away from the sidewalk, and have constant airflow over them.

WATER SYSTEMS

A water supply is essential. Hand watering is acceptable for most greenhouse crops if someone is available when the task needs to be done; however, many hobbyists work away from home during the day. A variety of automatic watering systems are available to help to do the task over short periods of time. Time clocks or mechanical evaporation sensors can be used to control automatic watering systems.

CARBON DIOXIDE AND LIGHT

Carbon dioxide and light are essential for plant growth. As the sun rises in the morning to provide light, the plants begin to produce food energy (photosynthesis). The level of CO_2 drops in the greenhouse as it is used by the plants. Ventilation replenishes the CO_2 in the greenhouse.

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Prepared by Nancy Doubrava, HGIC Information Specialist, and Bob Polomski, Extension Consumer Horticulturist, Clemson University.

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