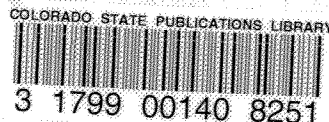


COLORADO STATE UNIVERSITY EXTENSION SERVICE

## Greenhouse tomatoes for commercial growers

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### Quick Facts

Tomato greenhouses may be oriented north-south or east-west. They should be located on good soil, be free from shading and have some protection from the prevailing wind.

Covering material may be glass, fiberglass or plastic film.

The cropping system used will depend upon economics as influenced by weather, operational costs and tomato prices.

Tomato seedlings should undergo a cold treatment prior to being set permanently in the greenhouse.

A plant population of 10,000 per acre (4,047 square meters) is optimum.

Pollination is effected by vibrating the flowering clusters daily between 10 a.m. and 4 p.m.

### Location and Site

Greenhouses in Colorado may be oriented either east-west or north-south. For glass-covered greenhouses, an east-west row orientation favors light exposure in winter, while a north-south orientation is most desirable during spring and summer. Orientation is not a factor when the house is covered with fiberglass or plastics.

Protection from cold winds will reduce greatly fuel requirements for heating. Shading from trees and buildings should be avoided. If ground beds are to be used, the soil type should be a well-drained sand or silt loam; however, heavier soil also can become productive when properly amended.

### Growing Structure

There is a wide range of structures used for growing tomatoes. The type of structure will depend on the scope of operation, available finances, degree of permanence desired, site location and local building codes. Superstructures of wood, pipe and aluminum all can be covered with glass, fiberglass reinforced plastic (FRP) panels, or plastic film.

Glass presently is the most permanent but is vulnerable to hail and vandalism. FRP coverings are easier to install and have been proved to be superior to glass in promoting plant growth and development. A plastic film covering is most economical on a short-term basis. Double sheets of film with an air pressure of 0.2 inch (5 centimeter) of water between the layers will withstand high winds and save 20- to 30-percent heat loss when compared to other covers.

### Varieties

There are about 1,000 acres (4,047 square kilometers) of greenhouse tomatoes grown in this country, with fewer than 10 of these in Colorado. This limits the amount of seed that can be sold, the number of greenhouse tomato breeding programs, and the number of seed producers who sell

greenhouse tomato seed. As a result, several outdoor tomato varieties are being used in greenhouse production.

#### Red Greenhouse Varieties:

Mich-Ohio Hybrids 3 and 7, Spartan Red 8  
Michiana 138, Moto Red  
Ohio-Indiana Hybrid O  
Tuckcross Hybrids M, O, V, W, I and 520  
Vinequeen, Veegan, Vantage, Vendor  
Waltham Hybrid, Waltham MRI, Wolverine 119

#### Pink Greenhouse Varieties:

WR-7, WR-25, WR-29  
Hoosier Hybrid  
Spartan Pink 10

#### Adapted Outdoor Varieties:

Floradel, Floralou  
Indiana River, Manapal, Tropic

### Cropping

In the "two crops per year system," the spring crop is sown in December and permanently transplanted to the greenhouse in February. Harvest begins in April and continues until July. The fall crop is seeded July 1 and transplanted to the greenhouse in mid-August. Plants are topped in October when harvest begins and harvest is concluded by March 1.

In the "early spring single crop system," seeding is made in late September and transplanted to permanent location in November. Harvest extends from May to August.

The "fall crop" comes into harvest in November and extends through the winter months. The "full year crop" comes into harvest in February and continues until late fall. Neither of these systems have proven very economical.

The late spring crop can be initially "intercropped with lettuce," allowing spaces for permanent tomato rows. The two crops are grown together for two to five weeks during which time the temperature is held below 60°F (15.6°C). After the lettuce crop is harvested, the temperature is raised; but any fruit that sets at these low temperatures often is of poor quality.

### Sowing Seed

Tobacco mosaic virus, which may be present on the seed coat, may be eliminated by soaking the tomato seed for 15 minutes in a tri-sodium phosphate solution composed of ¼ pound (113.4 grams) of tri-sodium phosphate per gallon (3.8 liters) of water. After drying, the seed may be sown in flats of vermiculite in furrows one inch (2.5 cm) deep. The flats may be wrapped with clear polyethylene and held at 70°F (21.1°C), out of the sunlight until the seedlings emerge, after which the polyethylene should be removed and seedlings should receive full sunlight.

All equipment coming in contact with these seedlings should be disinfected with tri-sodium phosphate or steam.

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Transplant seedlings into small containers when the cotyledons are fully expanded and the first true leaves are visible. During growth, plants never should be allowed to crowd.

## Plant Growing

**Temperature**—During seed germination, a constant day and night temperature of 70°F (21.1°C) is desirable. After the cotyledons are fully expanded, the seedlings should be subjected to a cold treatment consisting of a 54°F (12.2°C) night temperature and a 57°F (13.9°C) day temperature for two weeks. After the cold treatment, the plants should be permanently set in the greenhouse and held at 60°F (15.6°C) night temperature and a 70°F (21.1°C) day temperature. During flowering and fruiting, the night temperature should be held at 62°F (16.7°C) and a day temperature at 70°F (21.1°C) if possible.

**Light intensity**, rather than duration, influences early flowering. Artificial lighting is useful only in supplementing natural light (up to a level of 3,000 foot-candles) but not to extend the daylight period.

**Carbon dioxide enrichment** up to 1,500 ppm is suggested, especially in the early stages of development.

**Nutrient level** should be maintained at a high level, especially in early stages of development. This may be done by using diammonium phosphate (21-53-0) at the rate of ½ ounce per gallon (14.2 g per 3.8 l) in the irrigation water. This solution should be used once a week when the plants are small, increasing to twice a week after they reach a height of six inches (15.2 cm).

If a soilless growing media is used, a complete fertilizer must be substituted. The fertilizer solution should not be permitted to dry on the foliage. Excessive soft growth during cloudy weather should be controlled by withholding water, not nutrients. The width of a well-grown transplant should be equal to or exceed its height.

**Ground bed preparation** should begin by incorporating organic matter and fertilizer as required. This operation is followed by sterilization, preferably with steam. Before planting, a jar half-full of soil should be planted with lettuce seed and sealed. If the seed germinates and produces healthy seedlings, tomatoes may be permanently set in the bed.

**Soilless growing media**—consisting of perlite, vermiculite, peat, and other inorganic or organic materials, either alone or in combination—may be substituted for soil. Baled straw has even been used successfully as a medium for producing tomato plants. These materials generally are disease free when first obtained, but if reused they must undergo the same sterilization process as recommended for soil.

## Greenhouse Management

A plant population of 10,000 per acre (4,047 sq m) is considered optimum and can be achieved by spacing 15 inches (38.1 cm) apart in 42-inch (106.7 cm) rows (4.3 square feet [4 sq m] per plant).

**Watering** is done sparingly at first to encourage deep rooting. At the time of transplanting, the plants are watered with a standard nutrient solution and spot watered as needed for several weeks. Once established, they will go for several

weeks without any irrigation, depending upon conditions. During this period, a watering system (usually a drip irrigation) should be installed so that the major part of the soil surface remains dry during irrigations.

**Pruning and training** are accomplished by removing all side shoots weekly and training to a single stem. Twine is tied in a loop to the base of the plant and extended to an overhead wire where it is tied and cut, leaving four feet (1.2 m) of excess. The plant is wrapped around this twine as it grows. When it reaches the overhead wire, the twine is lowered and retied, using some of the excess twine and the wrapping process continues. Lower leaves are removed as soon as they become yellow, and the beds are kept trash free.

**Pollination** is accomplished by shaking each flowering cluster daily between 10 a.m. and 4 p.m. An electric cluster vibrator generally is used for this job. A night temperature of 62°F (16.7°C) and a day temperature of 70°F (21.1°C) is conducive to maximum pollen production and fruit set.

**Ventilation and air circulation** must be provided in order to maintain temperature and humidity. Turbulating fans and air distribution systems help to maintain even temperatures, dry foliage and bring CO<sub>2</sub> in contact with leaf surfaces where it is used.

**Insects and disease** generally do not become major problems when good management practices are followed. One exception, however, is the white fly. The conditions under which greenhouse tomatoes are grown are particularly favorable for the white fly, with the result that most tomato greenhouses eventually become infested with this pest. Eradication is seldom achieved but control is possible by using one or more of the following treatments in a regular control program:

Vapona 10-percent aerosol—0.32 ounces (9.1 g) for each 1,000 cubic feet (283 cu m) of space. Do not use tomatoes within one day of application.

Malathion 10-percent aerosol—one pound (454 g) for each 50,000 cubic feet (14,150 cu m) of space. Do not use tomatoes within one day of application.

Thiodan 50-percent wettable powder—one pound to 100 gallons (454 grams to 378.5 liters) of water. Do not use tomatoes within one day of application.

Thiodan 2 emulsifiable concentrate—one quart to 100 gallons (.95 liters to 378.5 liters) water. Do not use tomatoes within one day of application.

Malathion 57-percent Liquid EC—one quart to 100 gallons (.95 liters to 378.5 liters) water. Do not use tomatoes within one day of application.

Persons applying sprays should use an approved respirator or mask. Those applying aerosols also should wear approved equipment and not remain in the greenhouse any longer than necessary.

## References

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- Wittwer, S. H. and S. Houma. *Greenhouse Tomatoes Guidelines for Successful Production*. Michigan State University Press, E. Lansing, Mich., 1969.