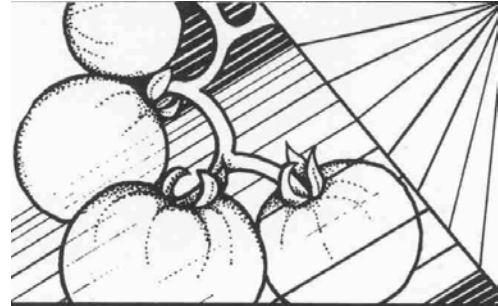


# Greenhouse Vegetable Production- General Information and Bibliography



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*This publication is intended for general inquiries about commercial greenhouse vegetable production in California. An extensive list of references is provided for more detailed treatment of the subject. It was not prepared for hobby greenhouse owners but may be useful for those seeking general information or additional references.*

Producing greenhouse-grown vegetables can be profitable, but it is a difficult and complex enterprise. Cultural methods must be based on sound technical knowledge and planned to produce high yields of consistently top-quality produce; marketing must be carefully researched and planned before harvest; and, above all, each phase of the operation must be well managed.

## **Location**

An ideal location for a greenhouse is where the light intensity is high, winter air temperatures are mild, and atmospheric humidity is moderate. Such locations are difficult to find, but they provide the best environment for crop growth and minimize fuel and power costs.

High-desert areas provide excellent light intensity, but winters are cold and summers

are hot. Low-desert areas are mild in winter, but summers are hot with frequent periods of high humidity. Coastal areas have mild winter temperatures, but the humidity is often high and light intensity is reduced by overcast skies or fog. Some Central Valley locations are also subject to long periods of winter fogs and overcast. Metropolitan areas should be avoided because of air pollution.

Construct greenhouses on level, well-drained soil. Sandy loam soils 4 to 5 feet deep are best if you plan to grow the crop in field soil. Build greenhouses away from trees or buildings that might block or interfere with sunlight.

Water quality and volume of supply are important considerations when you choose a location. Seek a reliable source of information or take a sample of the available water and have it analyzed by a reputable agricultural laboratory. Avoid waters with excessive salts (over 700 ppm) or with excessive boron (over 0.5 ppm). The supply source should be able to provide a minimum of one gallon of water per plant per day.

When you choose a location, consider the proximity to markets or a means of transporting the product to a distant market. Refrigerated trucking is not available in all locations.

Another important consideration is the type and availability of fuel for greenhouse

heating. Natural gas is not available in many remote locations. Propane and fuel oil are the alternatives.

## Construction

Many designs for greenhouses in which crops can be grown successfully are available. Shape varies from Quonset to gable roof to straight wall with arched roof; but shape is of less importance than quality of construction and durability.

To provide the optimum environment for a crop, maximum light and temperature control and ventilation equipment must be included in the greenhouse design. In California, heating and cooling may be required in many locations throughout the year to maintain minimum night and maximum daytime temperatures.

Where installations are to exceed an acre, a series of gutter-connected greenhouses is preferable to a group of smaller, separated units. Besides the initial savings in labor and materials (because there are fewer exterior walls), less energy is required to heat and cool connected installations, and labor and management are more efficient.

Clear polyethylene plastic sheeting (usually 4 mils thick) is a practical covering for wood-frame greenhouses: it is inexpensive and transmits light well. Weather and sunlight cause deterioration in common grades of polyethylene, which must be replaced every year; but ultra-violet-inhibiting films are now available which remain serviceable for two to three years in some locations.

Corrugated fiberglass is a very durable covering material and until recently was the most widely-used greenhouse covering in California. But since soft films became more

durable, many greenhouses are again being covered with plastic or a combination of fiberglass walls and soft-film roofs. Varying qualities of fiberglass are available; the best grades will retain their clarity and remain durable for many years. Metal-frame greenhouses covered with fiberglass or glass are recommended for permanent installations.

A recent innovation in California greenhouses is the airsupported roof. Two layers of polyethylene sheeting are attached at the edge of the rain gutter on each side of the greenhouse and supported by arched supports from wall to wall and a ridge pole. External air is supplied to inflate the roof from a small, squirrel-cage fan. The inflated roof reduces construction costs by eliminating roof trusses and also serves as insulation to reduce heat losses at night. This type of roof is considered to be adequately wind stable, although damage has occurred to some installations under severe conditions.

## Environmental Control

Humidity control is important for preventing tungous diseases. The humidity should be maintained below 85 percent by using a combination of heat, fans and ventilation.

Temperature control is important for best plant growth and fruit development. Suggested temperatures for some crops are:

**Cucumbers:** Day, 75 to 80° F; night, 65° F. Lower temperatures delay plant growth and fruit development.

**Tomatoes:** Day, 75 to 80° F; night, not below 60° F. High daytime temperatures (85 to 90° F and above) can cause fruit set failure and prevent red color development in maturing fruit.

**Lettuce:** Day, 65 to 70° F; night, 50 to 55° F. Higher temperatures induce seed stalks in some varieties.

Artificial lighting is not recommended because research has shown that the costs of lighting fixtures and energy required exceed the value derived from the faster growth rate.

## What to Grow

Cucumbers are rapidly becoming the most important greenhouse vegetable crop in California. They grow more rapidly than tomatoes, produce earlier and yield more fruit per plant. European varieties are recommended because they are seedless, have better flavor than field-grown slicing cucumbers and require no bees for pollination. Good management can lead to a yield of 20 pounds of fruit per plant during a three-month harvest period. Many varieties are available, but those most commonly grown in California are Sandra, Toska 70 and Farbio.

**Tomatoes** are adapted to greenhouse culture in California for harvest periods between November and May. Fruit quality is generally poor when maturity occurs from mid-May through September because of high temperatures and increased sunlight. Yields depend on length of harvest period. In general, you can expect 8 to 10 pounds of fruit per plant during a 2- to 3-month fall harvest period; 15 to 18 pounds of fruit per plant from spring crops harvested over a 4- to 5-month period. High average yields require a combination of experience, knowledge and good management. The varieties most commonly grown are Tropic and Jumbo.

**Lettuce** is an important eastern greenhouse crop. In California, however, since

field-grown lettuce is produced year-round, the greenhouse product may be more difficult to market. Butterhead and loose-leaf varieties need less time to mature than other varieties and are the best choices.

Other crops, such as beans, peppers and eggplant, must be tested on a very limited scale. Little is known about the cultural requirements, varieties and market for these crops when grown in California greenhouses.

Greenhouse growers in the western United States should consider the large quantities of field-grown vegetables produced in Florida and Mexico during winter. Premium prices on a well-supplied market can be realized only if greenhouse produce is of superior quality.

## Culture

Both cucumbers and tomatoes are pruned to single stems and trained vertically to support strings which hang from horizontal overhead wires or small steel cables. Cucumbers are planted in either single or double rows allowing about 6 square feet per plant. Tomatoes are generally planted in double rows allowing about 4 square feet per plant. Irrigation is almost universally by drip or trickle system so that aiseways between plant rows can be kept dry for cultural and harvest operations. Plants are grown in both natural soil and soil less media, both of which are successful if managed properly. But costs vary widely.

Gravel, sand, artificial soil mixes and wood shavings are being used successfully for greenhouse vegetable production. While soulless systems cost more because of the additional equipment and materials involved, they are practical if native soils have poor structure or drainage or contain

soil-borne diseases. However, soil-less culture offers no special advantage in yield or quality over a good, pathogen-free natural soil.

Fertilization programs vary with crop, soil and type of cultural system used, but fertilization is essential to supply the plant's nutritional needs. A plant-tissue and soil analysis program helps prevent both excesses and deficiencies. Beware of indiscriminate insurance-type fertilization programs. Consult your local farm advisor for assistance in planning your fertilizer program. (See References for further reading on cultural practices.)

## Disease and Insect Problems

Without proper control, plant diseases and insect pests can severely damage or ruin your crop. It is important to maintain constant vigilance so that proper control programs can be initiated before damage occurs. Fungicides and insecticides are often required, but it is essential to use them with caution and only on the recommendation of an expert.

## Some Final Thoughts

Large-scale greenhouse vegetable production is costly and exacting; only those with sufficient knowledge should try it. You can acquire experience at minimal expense by beginning on a small scale, by consulting your farm advisor and successful growers, and by studying all available publications on the subject.

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