



Growing Cucumbers in Greenhouses

Types

There are two major types of cucumbers that may be grown in greenhouses for home and commercial production. The most popular are the long, seedless varieties often referred to as European, Japanese or English cucumbers. These cucumbers have smooth, thin skins with longitudinal ridges. The length of the cucumbers varies from 12 to 24 inches at harvest. The eating quality is good but the tender skin causes them to quickly dehydrate. Therefore they are often found shrink-wrapped in plastic film when sold in stores.

The second major type is the American slicing cucumber. Most of these cucumbers will have seeds. The thick, dark-green skin often has evenly distributed bumps and spines and protects the cucumber during transportation. The cucumbers are harvested when they are 7 to 8 inches in length. Pickling cucumbers are smaller but similar to the slicing cucumbers. The smaller size makes them suitable for canning.

Pollination

Seeded varieties require pollination to produce cucumbers. Plants such as cucumbers, gourds, squash and melons in the cucurbit (*Cucurbitaceae*) family are monoecious. Each plant has separate male and female flowers (see below). All flowers have yellow petals and are similar in size. The male flowers have stamens with anthers that produce the pollen. The female flowers have a pistil and develop what looks like an immature cucumber.

Pollination is the process of transferring pollen from male flowers to the female flowers. Outdoors under good weather conditions, insects take care of the pollination. Because natural pollinators may not be present in greenhouses, the transfer of pollen from male to female flowers may need assistance. Removing the petals of the male flowers will expose the anthers with the pollen. Touching the male flowers to the

center of the female flowers works well for pollination. The transfer of pollen can also be done with a small, soft-bristled brush. Inadequate pollination results in no or poor fruit development with misshapen or less than fully expanded cucumbers.

Seedless varieties are most commonly grown in greenhouses. Plants that develop fruits without seed formation are called parthenocarpic. Since no seeds are formed, pollination is not necessary or desired. The seedless varieties that are now available only produce female flowers. If male flowers develop on these plants, they either have no pollen or the pollen is not viable.

Seeding

The seeds are sown in a porous medium at a depth of $\frac{1}{2}$ to 1 inch. If growing only a few plants, sow seeds directly into individual containers or directly into the ground of a hoop house to reduce transplanting shock. For large-scale production, sow seeds in flats with large cells for good root development.

The optimum germination temperature for seedless varieties is 80° to 82°F while seeded varieties germinate well at 70° to 75°F. The soil temperature should not drop below 60°F during germination. Cover the seeded flats with glass or plastic to reduce heat loss and to prevent drying. Remove the cover as soon as the seeds have germinated and emerged. Soil temperatures should be between 70° and 75°F during the day and at least 65°F at night. Keep seedlings moist and provide a minimum of 14 hours of light each day.

Transplant to individual 4-inch containers when the cotyledons (seed leaves) have expanded on the seedlings. A potting mixture with good water-holding capacity as well as adequate drainage is desirable. Peat, coconut fiber and vermiculite are popular amendments to improve water-holding capacity. Perlite and horticulture-grade sand are commonly used to improve drainage. Three days after transplanting or when true leaves have emerged, begin watering with a fertilizer solution.

The Greenhouse Environment

Two to three weeks after seeding, the transplants will be ready for planting in their final location. In hoop houses or high tunnels, the cucumbers can be grown directly in the ground in the available field soil amended with compost. In greenhouses, cucumbers are often grown in containers



Male flower



Female flower

or hydroponic systems. One or two plants can be grown in containers with 5 to 8 gallons of growing media. A peatlite mixture with good porosity and drainage works well.

Spacing the plants to allow for adequate air circulation and light is essential for good growth and production. An arrangement with 12 to 18 inches between plants in rows that are 4 to 5 feet apart is suitable for a vertical trellising system. Cucumbers are highly responsive to the amount of light in the growing environment. With less light than naturally available during an Alaska summer, plants may need to be spaced farther apart for satisfactory growth.

Greenhouse cucumbers grow rapidly with optimum temperatures. A range of 75° to 80°F during the day is desirable. For earliest cucumber production, night temperatures should not drop below 60°F. Cucumber harvest can be expected to start 50 to 70 days after seeding.

Fertilizing

A continuous supply of nitrogen and other essential nutrients in the irrigation water will support the growth and development of cucumbers. Start with about 1 quart of fertilizer solution per plant per day when the plants are small. As the plants grow and increase in size, larger amounts of water and fertilizer will be needed. A mature plant that is producing cucumbers will require 1 to 2 gallons of nutrient solution per day.

Premixed fertilizers specifically developed for cucumbers are available for purchase. These fertilizers will provide all the essential elements, including micronutrients, and are convenient to use. They come with recommended rates and instructions for how to mix the fertilizer with water. The concentration rate of the nutrient solution should start out low and increase as the plants grow.

Most commercial growers mix their own fertilizers. This approach gives them the opportunity to tailor the fertilizer to specific crop requirements and the quality of the water used for irrigation. Depending on the source, the pH and levels of calcium, sodium and micronutrients in the water will vary. The fertilizer formulation needs to be based on and adjusted to the results of a water analysis. If the water is alkaline (high pH), phosphoric acid may be used to decrease pH and to provide phosphorous. Two examples of fertilizer formulations are provided below.

Trellising and Pruning

Trellising is used to improve space utilization and the production of quality cucumbers. The umbrella system is commonly used for seedless greenhouse-type varieties. A vertical wire is suspended 6 to 8 feet above the ground. For each plant, a string is attached to the base of the stem and then fastened to the overhead wire. Tomato clips can be used to secure the plant or the string can be wrapped around the

stem as the plant grows. When the main stem reaches the overhead wire, two side shoots (laterals) are trained over the wire to hang down on each side of the main stem. The process can be repeated with additional side branches (see diagram and instructions below).

Seeded cucumber varieties perform best with the tree trellis system (see diagram and instructions on next page). In this system, several horizontal wires are suspended about 2 feet apart with the top wire 6 to 8 feet above the ground. As the main stem grows, it is attached to the horizontal wires. When the main stem reaches the top wire, it is cut to remove the growing tip. Side shoots (laterals) are allowed to develop at each leaf (node) on the main stem. These side shoots are pruned by cutting the stem after two leaves have developed.

For optimal yield, vegetative and reproductive growth needs to be balanced. Pruning of side branches, leaves, flowers and fruits is therefore needed throughout the season. Older leaves should be removed to improve air circulation and al-

Basic Feeding Formula

Formulas	Concentration (ppm)	oz/100 gal
A. potassium	200K	4.3
magnesium sulphate	25 Mg	1.6
diammonium	36P	0.9
phosphate (21-53-0)	33N	
calcium nitrate (15.5-0-0)	135N	11.6
	148Ca	
or		
B. potassium chloride (0-0-62)	80K	1.72
potassium nitrate (13-0-44)	30N	3.0
	84K	
magnesium sulfate	25Mg	1.6
phosphate (0-53-34)	55K	
calcium nitrate (15.5-0-0)	140N	12.0

Minor elements for both formulas		Concentration (ppm)	gms/100 gal
iron chelate (10% Fe)	Fe	1.0	3.78 g
manganese sulphate (28% Mn)	Mn	0.3	0.4 g
boron (20.5% B)	B	0.7	1.3g
zinc sulphate (36% Zn)	Zn	0.1	105.0 mg
copper sulphate (25% Cu)	Cu	.03	45.0 mg
molybdenum (54% Mo)	Mo	.05	35.0 mg

Basic fertilizer formulas: Formula A may require the addition of sulfuric or phosphoric acid to lower pH of the fertilizer solution. A milky precipitate after tank mixing indicates the need for pH adjustment.

low light to reach developing cucumbers. Flower production depends on the number of leaves and branches. Removing developing cucumber fruits stimulates vegetative growth. Lateral shoots, flowers and fruit developing in the lower five to seven leaf axils (nodes) on the main stem must be removed (see diagrams below and on next page) to ensure the development of a strong plant.

When too many cucumbers are developing at the same time, some will shrivel or fall off due to lack of sufficient nutrients. Seedless greenhouse-type cucumbers can only support one fruit per leaf axil (node). If more than one fruit develop, the additional cucumbers need to be removed. Varieties producing smaller and seeded cucumbers can handle more than one fruit per node and additional cucumbers can be left intact.

Pest and Disease Control

Integrated pest management (IPM) is a long-term approach to managing pest problems while minimizing the impact on human health, the environment and non-target organisms. This approach focuses on an understanding of the biology and interactions of pests, natural enemies and other organisms in the environment. The first step in an IPM program is to properly identify the organism causing the problem. A range of pest management control techniques is then evaluated to decide on the best control strategies. IPM strategies may include physical, cultural, mechanical, biological and chemical control methods. For more information about IPM, please visit www.uaf.edu/ces/ipm/.

Gray mold (*Botrytis*) and powdery mildew are commonly encountered diseases in greenhouse production. Inadequate

ventilation, particularly during periods of high humidity, increases gray mold damage. High humidity and excessive use of nitrogen fertilizers promote powdery mildew. Removing lower leaves to increase the airflow around the plant, controlling greenhouse humidity and avoiding overapplication of nitrogen can help reduce the damage caused by these diseases. Powdery mildew-resistant seedless greenhouse varieties are now available.

Whiteflies are considered the most difficult pest in greenhouse cucumbers. Fortunately, whiteflies are not commonly encountered in Alaska. Other pests include fungus gnats, thrips and spider mites. Aphids can also become a serious problem. The most effective method for dealing with these pests is to develop and follow IPM practices. Examples of management strategies include sticky traps for monitoring, removing unwanted vegetation around the greenhouse and positive pest identification to evaluate and select the most appropriate control methods.

Insect pests may transmit viruses from other host plants. Several viruses can infect cucumbers, such as cucumber mosaic, watermelon mosaic and squash mosaic viruses. Symptoms of virus infections include stunted plant growth, leaf spots and decreased cucumber production. There are no methods for controlling viruses in an infected plant. Managing pests that are known to transmit viruses, such as aphids, is therefore essential.

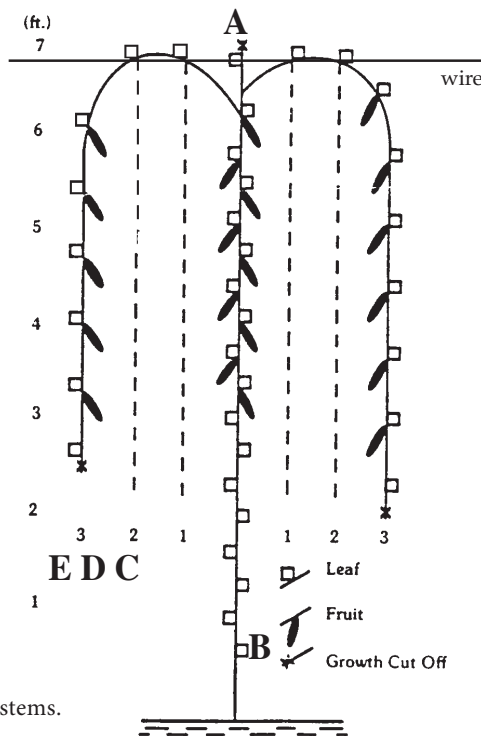
Harvest

A high-quality cucumber should be firm and bright green in

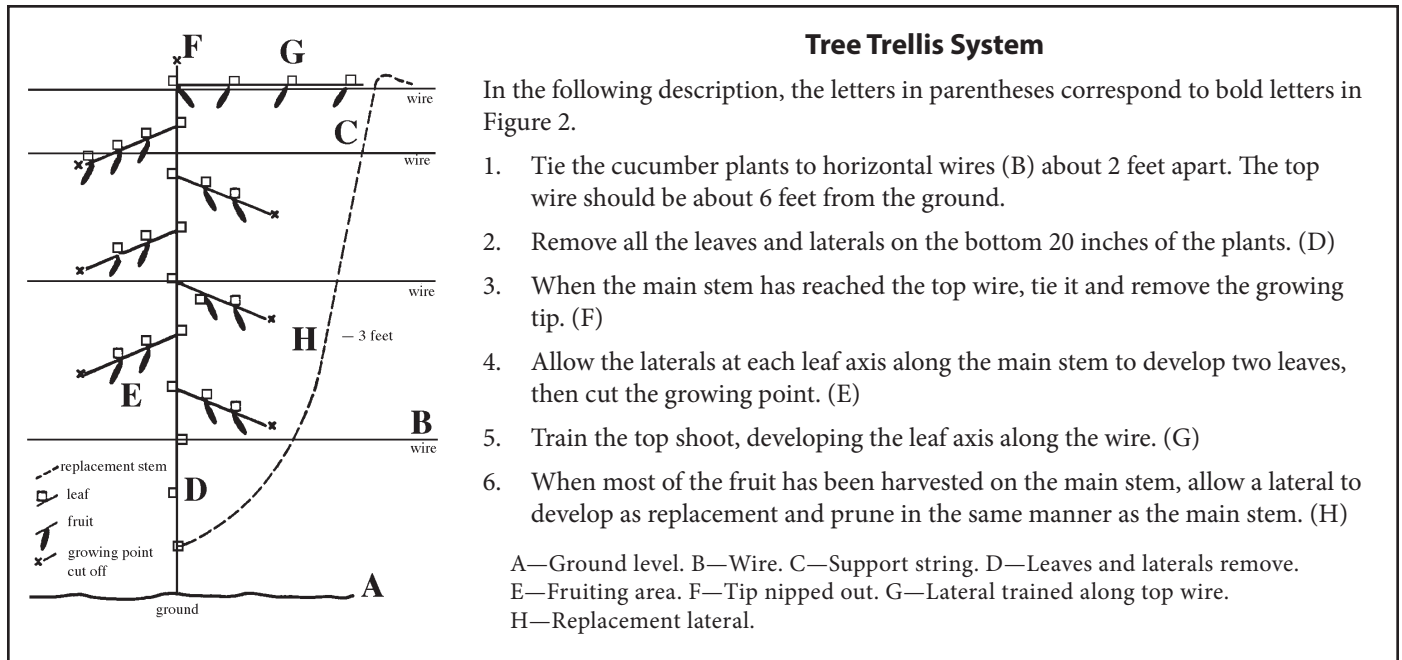
Umbrella System

This system is straightforward, not too demanding in labor and easily understood.

1. Tie the cucumber plant to a vertical wire (A) 7 feet tall. Pinch out the growing point at the top.
2. Provide support for all fruit that develops on the lower part of the main stem.
3. Remove all laterals in the leaf axis on the main stem. (B)
4. The top two laterals should be trained over the wire to hang down on either side of the main stem. Allow these to grow to two-thirds of the way down the main stem. (E)
5. When the fruits on the first laterals have been harvested (C), those laterals should be removed back to a strong shoot, allowing the second laterals to take over (D). Repeat this process for lateral (E).
6. This renewal system will maintain productivity of plants.



A—Top wire. B—Support. C,D,E—Lateral fruiting stems.



color. The size and length at harvest will vary with the type of cucumber grown. When harvesting, cut the fruit from the plant with a sharp, clean knife to reduce damage and avoid creating potential entry points for diseases. Mature fruits left on the plant will impact the development of younger cucumbers negatively and reduce overall production. Regularly

scheduled harvests to remove fully developed cucumbers will maintain plant productivity through the season.

Seedless cucumbers have thin, tender skins. Significant amounts of moisture can be lost through the skin after harvest, resulting in soft cucumbers. To avoid losses, store cucumbers at 45° to 50°F and 80 to 90 percent relative humidity.

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Meriam Karlsson, Professor of Horticulture, Institute of Agriculture, Natural Resources and Extension. Originally prepared by Wayne Vandre, former Extension Horticulturist.

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