



Greenhouse Cucumber Production - Florida Greenhouse Vegetable Production Handbook, Vol 3¹

R. C. Hochmuth²

Greenhouse cucumber production is very popular in many areas of the world (Fig. 1). The cucumber is a warm season crop with required growing conditions of 80 to 85°F and plenty of sunlight. The primary type of cucumber grown in Florida greenhouses is the European seedless type. The fruits are mild in flavor, seedless, and have a thin edible skin that requires no peeling. Harvested fruit generally range from 12 to 14 inches in length and weigh about 1 pound each. However, smaller fruits of mini cucumbers have become more popular and commercial production has increased. European greenhouse cultivars are parthenocarpic (produce fruit without pollination). Gynoecious cultivars, i.e., those producing only female flowers or predominately gynoecious cultivars should be grown. If pollination does occur, the fruit will form seeds, the shape of the fruit will be distorted and a bitter tasting fruit will develop. It is therefore essential to prevent bees and other pollinators from entering the greenhouse and carrying pollen from outdoor gardens or field cucumber plantings. Cucumber plants are indeterminate in growth, continually producing fruit on new growth, similar to greenhouse tomatoes.

Greenhouse cucumbers are more sensitive to low temperatures than tomatoes. Minimum temperatures should be no lower than 65F for sustained production. Prolonged temperatures above 95F should also be avoided as fruit production and quality are reduced at extremely high temperatures.

Establishment

Several different types of production systems and substrates can be used to grow greenhouse cucumbers. Possible production systems include: trough, NFT, bag culture, and rockwool. For further information, readers are referred to the earlier discussion in this manual on production systems.

Greenhouse cucumbers are ordinarily established in the greenhouse as transplants using rockwool or foam blocks. Seed costs are very high; a typical cost is 25 to 30 cents per seed. Germination is generally close to 100%, so one seed per transplant container is sufficient. Producers may choose to over-plant the number of containers by 10% to 15% to make up for those few seeds that do not germinate and those plants

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1. This document is HS790 and a part of SP48, a chapter of the Florida Greenhouse Vegetable Production Handbook- Volume 3, one of a series of the Horticultural Sciences Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Date first printed: December, 1990. Date revised: December 2001. Please visit the EDIS Web site at <http://edis.ifas.ufl.edu>.
 2. R. C. Hochmuth, extension agent IV, North Florida Research and Education Center - Suwannee Valley, Institute of Food and Agricultural Sciences, University of Florida. The Florida Greenhouse Vegetable Production Handbook is edited by George Hochmuth, professor of Horticultural Sciences and Center Director, North Florida Research and Education Center - Quincy and Robert C. Hochmuth, extension agent IV, North Florida Research and Education Center - Suwannee Valley, Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL 32611.

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Figure 1. Slender European greenhouse cucumbers.

lost during or shortly after transplanting. Some growers have successfully direct seeded cucumber into perlite bags and at the same time seeded a few transplants to use as replacement plants. Transplant production should be confined to a small transplant production area of the greenhouse or a separate greenhouse entirely to make efficient use of space and energy and to assist in sanitation practices for disease control.

Cucumber seed germinates rapidly (2 to 3 days) at an optimum germinating temperature of 84F in the germination room. Once the seed has germinated, the temperature should be lowered to 77F. During the seeding and transplant production stage, the plants must never become stressed for water or nutrients. A plant with three or four true leaves is ready to be transplanted. The transplants should maintain an upright growth habit (no curves in the stem) to aid in successful transplanting.

Selecting Cultivars

There are many cultivars available for greenhouse cucumber production. The cultivars available are generally produced by European seed companies, however, a few of the companies have sales and technical support representatives in North America. Cultivars change frequently and, as a result, growers should consult current recommendations through local Extension agents and industry representatives. Several factors should be considered when selecting a cultivar, including disease resistance, plant vigor, early and total yields, fruit size and color, and general fruit quality. Disease resistance is an especially important factor when selecting a cultivar. Diseases can be severe in Florida greenhouses, and fungicide options are limited in the greenhouse. Diseases that can be problems in greenhouse cucumbers in Florida include: gummy stem blight, gray mold, downy mildew, powdery mildew, cucumber mosaic, watermelon mosaic, and Pythium root rot in NFT. Growers must determine the levels of resistance or tolerance in the cultivars considered for production. Selection of a resistant cultivar may be the only practical method of control for some diseases.

Two evaluations of twelve cultivars were conducted in the fall of 1995 and the spring of 1996 at Live Oak. Several cultivars performed well in that trial including 'Kalunga', 'Bellissima', 'Millagon', 'Discover', 'Marianna', 'Fitness', 'Aramon', and 'Fidelio'. In the trial that were most susceptible to mildew were '90-0048', 'E1828', 'Futura', and 'B-1157'. 'Fidelio', a long-time popular cultivar produced well in the trial, and had especially smooth fruit, however, it had the shortest fruit length of the twelve cultivars. The longest fruits were consistently produced by '90-0048'. The darkest fruit color was found 'Kalunga', 'Bellissima', and 'E1828'. The lightest green fruit color was found in Futura. The cultivar 'Tyria' has been especially susceptible to gummy stem blight lesions inside the fruit in Florida growers trials and is not recommended in Florida. 'Bologna' has also been very popular among Florida producers since the late 1990s.

In addition to the standard long European cucumbers, special markets may also be developed

for shorter miniature or "beit-alpha" types. Some miniature cucumber cultivars are especially susceptible to powdery mildew and the tolerance level of each cultivar should be checked.

Spacing and Training

Greenhouse cucumber plants have very large leaves, grow vigorously, and require large amounts of sunlight (Fig. 2). Under good sunlight conditions, each plant should be provided 5 to 7 square feet of greenhouse space. More space is often required in the northern United States, where light conditions are poor. Exact spacing between rows and between plants within a row will depend upon the type of training and production system to be used.



Figure 2. Young cucumber crop.

Several training systems exist for greenhouse cucumber. The basic principle in developing a training system is to uniformly maximize the leaf interception of sunlight throughout the house. The selection of a system will largely depend on the greenhouse facility, the production system, and grower preference.

A vertical cordon system trains plants vertically to an overhead wire. Once the plants reach the wire they are topped and then pruned using an umbrella system (to be described later). Single, evenly spaced rows can be used, however, double-row production is very popular. Typical spacings for this double-row system would be approximately 5 to 6 feet between the centers of each pair of rows. The distance between the two rows within a pair is approximately 2 feet. The spacing of plants in the row for such a double-row system would be 18 to 24 inches. Single,

evenly spaced rows in a vertical cordon system would be approximately 4 to 5 feet between rows and 12 to 18 inches between plants within the row.

A second popular training system is the V-cordon. Single rows are evenly spaced approximately 5 feet apart and plants are distanced approximately 12 inches apart within each row, and the 2 wires are spaced approximately 30 inches apart from each other. The support strings are then tied alternately to each wire. In this manner the plants are trained up the string and will grow at an incline away from the row center. The plants form a V-arrangement down the row.

Pruning

The most common pruning system for either vertical cordon or V-cordon trained plants is known as the umbrella system. In this system, all lateral branches are pruned out as they appear until the main stem reaches the overhead wire. The growing point of the main stem is removed when one or two leaves have developed above the wire. Two lateral branches near the top of the plant are allowed to grow and are trained over the overhead wire resulting in these two branches growing downward. The growing point of each lateral is removed when nearly to the ground. Fruits are developed at the node of each leaf. The fruits on the base 30 inches of the main stem should be pruned off as soon as they appear. This allows the plant to vigorously produce early vegetative growth which is essential for maximum fruit production. Fruits above the basal 30 inches of the main stem are then allowed to develop. The productivity of the laterals is generally less than the main stem.

A comparison of two pruning systems was made in 1995 and 1996 at Live Oak. A drape system allowed the main stem to drape over the trellis cable and grow down to the floor. In the drape system, the apical meristem was not removed. The pinch system required the apical meristem to be removed once reaching the trellis cable. One side branch was then allowed to grow over the trellis cable and back down to the floor. In both systems, all other side branches were removed. In the two trials, the drape

system produced higher yield and quality in most instances. The pinch system resulted in a delay in new growth before the side branch began producing fruit.

Fruit Development

A fruit may be developed at each node and more than one fruit may begin to develop at some nodes (Fig. 3). It is usually best to thin these multiple-fruit clusters to a single fruit, however, vigorous plants can sometimes mature more than one cucumber at a node. Miniature and beit-alpha types will support several fruit per node. Any distorted fruit should be removed immediately. The greatest growth of the fruit occurs between day 6 and 14 after the bloom opens (anthesis). Maximum fruit length occurs at day 14 followed by diameter increase. The shape of the fruit is somewhat tapered being largest at the stem end prior to day 10 after bloom, however, the fruit becomes uniformly cylindrical by day 14. During the spring season, commercially acceptable fruit size is usually reached by the 11th day after the bloom opens.



Figure 3. Parthenocarpic greenhouse cucumber flower and young fruit.

Nutrient Programs

Greenhouse seedless cucumbers have a high nutrient requirement and grow very rapidly when supplied with sufficient nutrients. As a result, growers must plan for an optimum nutrient program making adjustments in the program as the crop demands change. The greatest demand for nutrients is during the peak fruit production period. Nitrogen and potassium are required in the greatest amounts, however, a complete nutrition program including

essential minor elements is required. Fertilizer recipes are presented in the chapter on fertilization in this volume. Designing a fertility program varies depending on the production system desired and extreme caution must be used when interpreting or comparing research or articles from one production system to another.

Florida greenhouse producers are using soilless production systems. In these systems, a complete nutrient solution is used to supply the needed nutrients to the crop. Soilless culture increases the grower's ability to control the growth of the plant, but it also requires management to achieve success. Many of the guidelines for soilless culture of tomato, presented earlier in this handbook, also apply to cucumber.

One concern of the soilless system grower is the supply of micronutrients or trace elements (those needed only in trace amounts). Soilless growers not only must supply their crop with the six macronutrients (nitrogen, phosphorus, potassium, calcium, magnesium, and sulfur), but also the 7 micronutrients (iron, manganese, copper, zinc, molybdenum, boron, and chlorine). It is especially important in a soilless system to test the source of water prior to developing a nutrient program. The raw water will have some amounts of many of the essential plant nutrients. These may need to be considered when developing a fertility program. The pH of the water is also critical and may need to be adjusted. Frequently groundwater in Florida has a high pH of 7.0 or above. The target pH of the nutrient solution supplied to the plants should be between 5.5 and 6.0.

Generally, either nitric, sulfuric, or phosphoric acid is recommended for pH control. If it is necessary to raise the pH, potassium hydroxide is usually used. If the source water is alkaline due to high bicarbonate concentrations, the pH should be adjusted before the fertilizer salts are added to prevent precipitation.

Plant tissue testing can be a useful tool in addition to a good soil testing or nutrient solution program to monitor the fertility. Cucumber leaf-nutrient ranges are presented in the chapter on fertilizer management elsewhere in this volume. The reported ranges should be used as a guide to assist in

avoiding major problems, both toxicities and deficiencies.

Several research articles report a sudden temporary wilt of greenhouse cucumber plants when using NFT. Cucumber roots have a greater oxygen requirement when compared with roots of tomatoes. Cucumbers develop a large root system in the growing tubes and as a result may become stressed for oxygen. Because of this concern, measures may need to be taken to provide improved oxygen supplies to the root zone. Continuous aeration of the nutrient solution and increasing the slope of the tubes to 2 feet or more in height for every 30 feet in length are reported to help. High solution temperatures also reduce the amount of dissolved oxygen in the solution. Growers must avoid high temperatures in the solution.

Managing Pests

Several diseases, insects, and nematodes can potentially be pests of greenhouse cucumbers. Cultivar selection, greenhouse sanitation, and well-timed applications of properly selected pesticides are all important in managing these pests in the greenhouse. The pest control portion of this handbook has details for managing pests of greenhouse cucumbers.

Harvesting

Fruits are harvested when uniform length, shape, and diameter is reached and before any yellowing appears on the blossom end (Fig. 4). Typical fruit length is 12 to 14 inches and current USDA Grade standards require a minimum of 11 inches in length. Updated copies of the U.S. Grade standards for greenhouse cucumbers are available through: Agricultural Marketing Service, USDA, Room 2056 South Blvd., Washington, D.C. 20250.

Frequent harvests are required because the fruits quickly become overmature. Fruits are harvested as soon as they are marketable to avoid retarding the development of any younger fruit on the plant. Continued, timely harvest keeps the plants in a productive mode since cucumber plants have a limit



Figure 4. Greenhouse cucumbers ready for harvest.

to the number of fruits they can support any instance. Harvest is usually required three or four times per week.

Total expected yield will depend directly on length of harvest period. Yields range from 1 to 3 pounds of fruit per plant per week during the peak harvest period. A normal harvest period of 12 weeks in a well managed crop can yield a total of 20 to 25 pounds of fruit per plant.

Packing and Storage

European greenhouse cucumbers have a very thin skin resulting in high susceptibility to water loss and softening of harvested fruit. Immediately after harvest, containers should be covered to avoid exposure to direct sunlight. Each fruit is individually wrapped in a shrink-wrap film before packaging. Shrink-wrapping will minimize moisture loss and extend shelf life by several days. Since each cucumber has to be shrink wrapped, this crop is very

labor-intensive and time consuming. Growers often mention they were not aware of the considerable time needed to properly shrink-wrap greenhouse cucumbers. Growers should invest in a commercial shrink-wrapping machine designed for cucumbers so that the shrink wrapping is done in a professional manner. There are several types and sizes of shrink wrapping machines available to meet the needs of all sizes of growers.

European greenhouse cucumbers are considered highly susceptible to chilling injury caused by exposure to low, but nonfreezing temperatures. Chilling injury can occur at temperatures below 50F for most vegetables. Chilling injury on cucumber fruit results in a pitting of the fruit surface and a tendency for more rapid loss of green color. Fungal decay often follows chilling injury. Optimum fruit holding conditions are approximately 55F and 95% relative humidity.

Cucumbers are also sensitive to ethylene gas. When cucumber fruits are exposed to ethylene, they lose chlorophyll and rapidly become yellow. Exposure to levels of 1 ppm ethylene for 1 day at 59F will result in a noticeable yellowing of the fruit. Chilling injury to cucumber fruit, even for a short duration, will increase the production of ethylene by the fruit. It is very important that cucumbers not be held or shipped in the same compartment with moderate to high ethylene producing fruits or vegetables such as tomatoes, cantaloupes, apples, and peaches. Consult IFAS Vegetable Crop Fact Sheet VC-34 Ethylene in Post harvest Horticulture for further information on ethylene.

Suggested Reading

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More Information

For more information on greenhouse crop production, please visit our website at <http://nfrec-sv.ifas.ufl.edu>.

For the other chapters in the Greenhouse Vegetable Production Handbook, see the documents listed below:

Florida Greenhouse Vegetable Production Handbook, Vol 1

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Marketing Considerations, HS772

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General Aspects of Plant Growth, HS784

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Production of Greenhouse Tomatoes, HS788

Generalized Sequence of Operations for Tomato Culture, HS789

Greenhouse Cucumber Production, HS790

Alternative Greenhouse Crops, HS791