

Greenhouse Tomato Production Practices

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Tomatoes have been grown in greenhouses for nearly 100 years. For this reason, there are many techniques for growing tomatoes in a greenhouse and there is more written about greenhouse tomatoes than any other greenhouse crop. Additionally, hydroponics was developed for greenhouse tomato production, so there can be many complicated steps to the production of tomato fruit in a greenhouse. There is no single BEST way to grow greenhouse tomatoes; many ways are successful. An individual grower must experience tomato production, in order to determine the best and economic techniques in his or her greenhouse. This publication is a general summary of greenhouse tomato practices. It is highly recommended that the reader obtain the publications listed below to get a more thorough view of greenhouse tomato production, hydroponics and the production of other vegetables in the greenhouse.



Light and Temperature Control --

Tomatoes are a warm season vegetable crop. They grow best under conditions of high light and warm temperatures (summer conditions). Low light in a fall or winter greenhouse, when it is less than 15% of summer light levels, greatly reduces fruit yield when heating costs

are highest (Table 1). For this reason, it is difficult to recommend that a



greenhouse operator should grow and harvest fruit from December 15 to February 15. Even with the problem of low light and high energy costs, winter greenhouse tomatoes are common in southern Canada and Europe. These greenhouses may use expensive supplementary HID lighting (street lamps) and are able to sell their tomatoes at very high prices because their market is willing to pay a high price for high quality winter tomatoes. Greenhouse tomatoes are not very common in the U.S. or Kentucky, because consumers seem unwilling to pay a high price for winter tomatoes. If you have a market willing to pay for greenhouse tomatoes, then tomatoes may be a successful crop in your winter greenhouse.



Table 1. Relative percentages of heat costs and percent of light, compared to summer months, for fall, winter and spring months in Kentucky.

	Percent of sunlight compared to mid-summer	Percent of annual heating costs
September	90	0
October	41	3
November	32	15
December	14	26
January	14	28
February	27	18
March	50	8
April	65	2
July	100	0

Many greenhouses have been built in Kentucky to grow tobacco transplants. Based on many years of experience from many growers and farmers, tomato production is most successful in the spring. Excellent light, moderate heating costs and good prices annually demonstrate this is the best time for greenhouse tomato production. Yet, tobacco growers have tobacco transplants in their greenhouse in the spring.

Low winter light and high heating costs create a problem for winter greenhouse tomato production. Trials were completed at the University of Kentucky and on Kentucky farms in 1995 and 1996 to evaluate late summer and fall production for greenhouse tomatoes. Total fruit yields were 8 to 10 lbs. per plant in the UK trials, but farmers were only able to sell 4 to 5 lbs. per plant. Most of these farmers did not continue to grow tomatoes because they simply did not earn enough for their effort. Review HortFacts 10-

02, Kentucky Greenhouse Tomato Trials, to see the results of these growing media and tomato variety trials for fall production.

Tomato plants grow best when the night temperature is maintained at 60-62° F. Temperatures below 60° will prevent normal pollination and fruit development. This is especially true for standard greenhouse varieties, so the grower must be sure that thermostats control heaters properly. In warm or hot outdoor conditions, tomato greenhouses must be ventilated to keep temperatures below 90° F. High temperatures not only effect the leaves and fruit, but increased soil temperatures also reduce root growth.

Greenhouse tomatoes grown in Kentucky tobacco greenhouses.



Plant Support -- Plants must be tied or clipped with tomato clips to a string or twine suspended from a strong overhead cable. This starts as soon as they are about 10 inches high and continues

throughout production. A separate support system must be built inside the greenhouse from pipe, etc. to support the crop. You must remember that each plant may



Figure 1 Tomato clips are used to tie the tomato stem to a string suspended from the support structure.

weigh 10 to 15 pounds when it is loaded with fruit so the support

system must be quite strong. Kentucky farmers have used different ways to support tomatoes in tobacco greenhouses (see previous photos). Typical greenhouse structures are usually NOT strong enough to support a tomato crop, consult the greenhouse manufacturer for details; greenhouses designed to support a tomato crop are available from some manufacturers. Actively growing tomatoes will have to be clipped to the support string or twined around the string every 6-10 days.

Water, Fertilizer and Growing Media --

Tomato production requires that plant nutrition be monitored carefully and regularly. Tomatoes require a well drained growing medium, regular watering and regular applications of fertilizer. The application of water is typically done with a trickle irrigation system composed of distribution lines with drip tubes or spray stakes. Drip tubes or spray stakes are placed at the base of each plant. Tomato plants use a great deal of water, especially in warm weather, so the use of a time clock to control

the irrigation system is highly recommended and relatively inexpensive.

Many types of fertilizer have been used for tomatoes.

Generally, the fertilizer is moderate in nitrogen and high in phosphorus, potassium, calcium and

magnesium. A grower must be sure that calcium and magnesium are included in the fertilizer program. Normal plant and fruit growth requires these nutrients to be present in the correct amounts. A number of companies - Cropking Inc., Hydro-Gardens, Inc., Totalgro Plant Foods are listed below - have excellent fertilizer mixes for tomatoes. The fertilizer typically comes in two parts, calcium nitrate and a complete fertilizer (without calcium). This is because calcium



Figure 2 A pump type fertilizer injector used to add concentrated fertilizer to the irrigation water.



Figure 3 A tomato greenhouse with plants grown in the soil.

nitrate is not compatible with other fertilizers in the concentrated form. With two fertilizers, the irrigation system has two injectors, each to inject a specific amount of each type of fertilizer at each watering.

Many growing media can be used successfully for greenhouse tomatoes:

- Good field soil in the greenhouse floor,
- Packaged commercial growing media composed primarily of composted bark, peat or coir,
- Perlite alone,
- Peat-lite mixes,
- Rock wool slabs,
- Straw bales, uniform river gravel,
- A thin layer of irrigation water in a plastic tube (NFT - nutrient film technique),
- Controlled Water Table sub-irrigation system.

Rock wool slabs are the most economical for large installations and are used commonly in the U.S., Europe and Canada. Perlite bags are used by smaller growers in the U.S and fit their operations best. Commercial growing media can also be used because they are quite flexible. The media can be placed into pots or simply left in the bag and the bag is laid on the floor of the greenhouse. Each plant requires ½ to 1 cubic foot of growing medium. Photos above have both perlite and growing media bags for tomato production.

Tomato Variety Selection -- Tomato variety selection is difficult. Many cultivars have been selected for greenhouse production in Europe, Canada and the U.S. The best varieties in the best greenhouses produce 35 pounds or more of fruit per plant in 10-12 months. Most of that production occurs in spring and summer. Beefsteak (large) tomatoes are the primary type of greenhouse tomato. ‘Trust’ is a classic variety that continues to be a favorite for flavor, even though disease problems are significant. Cluster tomatoes are commonly shipped into U.S. markets, so growers should consider these as well. Growers can get recommendations from the seed suppliers listed at the end of this publication.



Figure 4. Typical indeterminate beefsteak tomato variety (top), indeterminate field tomato variety (middle), plum-type garden tomato variety (bottom).

Good garden varieties will perform well when grown as a spring or fall crop in greenhouses in Kentucky. Growers should also consider cherry or salad sized tomatoes depending on local market interest. Optimum fruit production will occur from greenhouse

tomato cultivars but new growers can learn details of production on good garden cultivars.

Flower Pollination -- Tomato flowers must be pollinated in order to get fruit set and fruit development. Traditionally, flower clusters are shaken manually with a tomato flower pollinator as soon as the yellow petals open.

Pollination must be done every day, seven days a week, usually between 9 a.m. and 1 p.m.

Bumblebees are available from insect

companies for pollination as well. Simply purchase a box or hive of bees and place them in the greenhouse when tomato flowers open. The bees do a very good job, just be careful to protect the bees from pesticide applications.



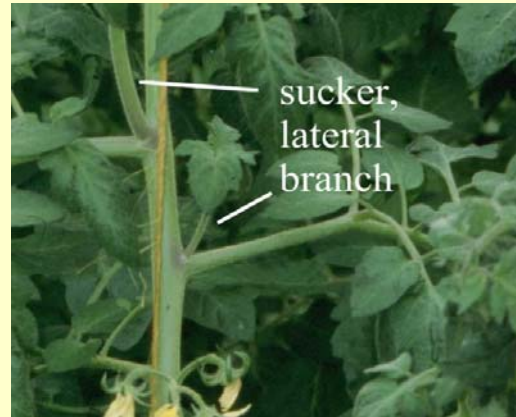
Figure 5. An old-fashioned battery operated tomato pollinating device that shakes the flowers.

Figure 6. Domesticated European bumblebees are available from commercial suppliers for tomato pollination.



Pruning, Suckering -- Tomato plants in a greenhouse are pruned to a single stem. All

lateral branches or suckers must be removed when they are one to three inches long. This allows for maximum air circulation and simplifies pest control problems. Suckering must be done regularly; plants should be checked at least once per week.



Pest Control -- Insects and diseases can be a big problem because so few pesticides are labeled for greenhouse vegetables. Remember, the pesticide label must identify tomatoes and greenhouse applications for it to be legal in the greenhouse (ENTFACT-306, [Controls for Greenhouse Vegetable Insect Pests](#)). The cleared pesticides have low toxicity, so they **MUST** be applied thoroughly and regularly. Start a regular disease and insect control program after the plants have been set for a week and continue this at 7 to 10 day intervals for the life of the crop. Use sticky yellow cards to monitor the pest population in the greenhouse. Do not wait until your plants are infested to start spraying. Whiteflies are typically controlled by

predatory insects so all tomato growers should learn about biological control insects and consider using them from the beginning of the crop.

Marketing and Economics -- The market for greenhouse tomatoes continues to expand in the U.S. Imports from Canada and Europe are the basis of the market. More greenhouses are being built in the U.S. to compete with the imported fruit. In general the market is quite good for greenhouse tomatoes. A spring crop is the easiest to produce and sell for Kentucky growers. Fall and winter



Figure 7. Yellow sticky cards are hung within the crop and monitored for problem insects.

tomatoes are quite difficult for small growers because yields are so low and fuel costs are so high. Many farmers who have tried fall tomatoes have stopped, not enough yield for the costs.

Tomatoes can be sold directly from the greenhouse at retail prices or sold to wholesale distributors, supermarkets or restaurants at wholesale prices. Be sure to contact tomato buyers early in the season so they will know you will have fruit and so you may learn how they want the tomatoes packaged for their use. We hope that greenhouse tomatoes will always receive at least \$1.00 per pound but prices often average near \$1.50 per pound.

Success in greenhouse tomatoes depends completely on fruit yield. A spring/summer

crop may yield 25 or more pounds per plant and requires significant labor. You should keep good records through the crop, so you can honestly evaluate your costs and returns. One thousand plants in a greenhouse (4000 square feet) can produce approximately 25,000 pounds of fruit from late March to early July and return approximately \$25,000. to \$35,000. in gross sales to the greenhouse operator.

Additional Sources of Information on Greenhouse Tomatoes

- Florida Greenhouse Vegetable Production Handbook, Vol. 1, 2, 3. 1991. Publications, IFAS Bldg. 664, Gainesville FL 32611-0011. (about \$20.00);
- Greenhouse Tomatoes, Lettuce, and Cucumbers 1979. S.H. Wittwer and S. Honma. Michigan State University Press, East Lansing MI 48824. (about \$35.00);
- Hydroponic Food Production. 1995. Howard M. Resh. 5th Edition. Woodbridge Press, Santa Barbara, CA 93160. (about \$45.00)
- <http://res2.agr.ca/harrow> -- Greenhouse Processing Crops Research Centre, Harrow Ontario CANADA
- <http://www2.msstate.edu/~ricks/> ; <http://www.msucare.com/pubs/pub1828.htm> -- Greenhouse vegetable publications at Mississippi State University
- <http://www.ces.ncsu.edu/depts/hort/hil/> -- Greenhouse tomato resources from North Carolina State University
- <http://nj-nscort.rutgers.edu/visitor/tps/index.html> -- Information on single truss greenhouse tomato production from Rutgers University in New Jersey.
- <http://www.ag.arizona.edu/hydroponictomatoes> -- Interactive web site from the University of Arizona provides practical, accurate information on growing hydroponic tomatoes for students, hobbyists, and beginning growers.
- <http://archimedes.galilei.com/raiar/histhydr.html> -- History of Hydroponics - A well-written article by Gary V. Deutschmann covering the history and future of hydroponic gardening.
- <http://hsa.hydroponics.org/> -- Hydroponics Society of America
- <http://www.growingedge.com/> -- Growing Edge magazine, good source of information on hydroponics
- search the World Wide Web for information on hydroponics, greenhouse tomatoes, etc.

Suppliers for Greenhouse Vegetable Production

- Agro Dynamics, 12 Elkins Road, East Brunswick NJ 08816; 908-257-4000
- Bruinsma Seeds, P.O. Box 1463, High River, Alberta, CANADA; 403-652-4768
- Cropking Inc., Box 310, Medina OH 44258; 216-725-5656; <http://www.cropking.com>
- De Ruiters Seeds, Inc., P.O. Box 20228, Columbus OH 43220; 614-459-1498
- Hydro-Gardens, Inc., Box 9707, Colorado Springs CO 80932; 800-634-6362; <http://www.hydro-gardens.com>
- Totalgro Plant Foods, P.O. Box 805, Winnsboro LA 71295; 800-433-3055.

Trade names used in this publication are used for identification purposes only. No specific recommendation is implied to the exclusion of other similar products.

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