



GROWING TOMATOES IN PLASTIC GREENHOUSES

UNIVERSITY OF ARKANSAS
APR 4 1960
AGRICULTURAL LIBRARY

TEXAS AGRICULTURAL EXTENSION SERVICE
J. E. Hutchison, Director, College Station, Texas

Cover Photo

The cover photograph shows tomato plants in a plastic greenhouse owned by A. William Schild, Waller, Texas

Growing greenhouse tomatoes is a very exacting operation. A plastic greenhouse can be easily constructed, but it is another thing to profitably grow tomatoes in a plastic house. The investment in terms of a greenhouse, materials and labor to grow hothouse tomatoes is expensive. The financial return that a grower can expect is related directly to management of the greenhouse and the timely attention to production practices. Growers who are not trained in greenhouse management should get into greenhouse production of tomatoes gradually. A plastic greenhouse, 25 feet wide by 40 feet long, as described in MP-341, "Plastic Greenhouse for Growing Vegetables in Texas," would be a good size for a grower to start with for the first 2 or 3 years. Inadequate training and experience of growers are the principal causes of failure in growing greenhouse tomatoes.



Fig. 1. A good set of fruit on the first two clusters. This set of fruit was obtained by tapping the flower clusters daily.

Growing Tomatoes in Plastic Greenhouses

A. L. HARRISON, H. C. MOHR, D. R. PATERSON AND CLYDE SINGLETARY*

HOTHOUSE TOMATO PRODUCTION differs from open field growing since temperature and soil moisture can be controlled within greenhouses. This advantage allows growers to extend the tomato season into the winter and early spring months.

Growing tomatoes in greenhouses under Texas conditions was not practical until the evaporative cooling system for controlling excessively high temperatures in greenhouses was recently developed by the Floriculture Department, Texas A. & M. College System.

It costs more to grow a pound of tomatoes in a greenhouse during the winter but the net profit per pound generally is greater due to a high wholesale price. The demand for hothouse tomatoes is greater than for field-grown fruit on markets where they have established a reputation, because of greatly superior quality.

This publication presents suggestions for growing hothouse tomatoes in plastic greenhouses under Texas conditions, based on research results. Timely attention to production details is the key to success.

VARIETIES

Tomato varieties which are adapted for open field growing may or may not be suited for greenhouse production. Greenhouse varieties and hybrids, frequently called "forcing types", are specially developed so that plants can easily be trained to a single stem and at the same time produce many, large clusters of fruit.

Trials show that varieties for the plastic film greenhouse should be resistant to the leaf mold disease. The *Waltham Mold-Proof* forcing varieties which are immune to all races of this fungus have given fair yields in limited

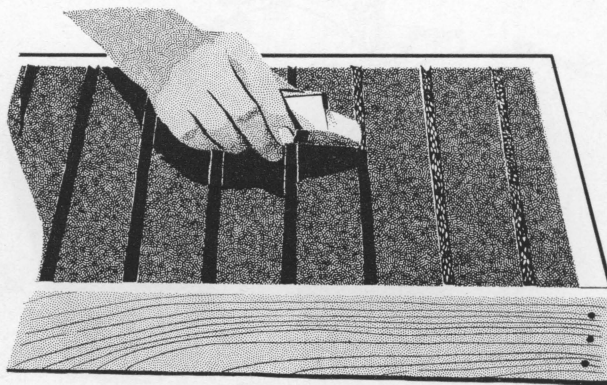


Fig. 2. A typical method of planting seed in a flat.

tests. The fruits are smaller than desired in Texas but most of them are of marketable grade as hothouse tomatoes. Research is now underway to develop a variety or hybrid which is resistant to important diseases and adapted to greenhouse conditions in Texas.

In some cases very good results have been obtained with hybrids such as the Michigan-Ohio Hybrid and Tuck-Cross Hybrid. These are not resistant to leaf mold, so growers may suffer heavy losses if the disease occurs but size of fruit and quality are very good.

GROWING TRANSPLANTS

Healthy, stocky transplants are important in obtaining good quality and yield of fruit. The seed are sown in flats, filled with a soil mixture of one-third soil (clay or clay loam), one-third peat moss and one-third perlite. Rows about 2 inches apart and $\frac{1}{4}$ inch deep are made in the soil mixture and about 10 seed per inch are placed in the rows and covered $\frac{1}{4}$ inch deep.

The seed flat is watered with a Copper A fungicide solution to prevent damping-off of the young seedlings. Directions for mixing and applying the Copper A solution appear on the package label. In late summer, the seed flat should be shaded to keep the temperature below 85 degrees F. The soil mixture must remain moist, but not wet.

*Respectively, plant pathologist in charge, Plant Disease Laboratory, Yoakum, Texas; associate professor, Department of Horticulture; associate professor, Department of Horticulture; and extension horticulturist—vegetables, The Texas A. & M. College System.



Fig. 3. A stocky, healthy transplant grown in a clay pot.

The plants are ready for transplanting to individual containers when about 1½ inches high, in about 10 days. The same soil mixture used for growing the seedlings is suitable for the first transplanting. Containers such as Vita-bands, peat and clay pots and wooden or paper bands such as cut-up milk cartons are suitable for growing the transplants. Peat pots have given the best results in most cases. The containers should be a minimum of 3" x 3" x 3" in size.

Firm the soil mixture up to ¼ inch of the top of the container to allow for easy watering. Make a small hole in the center of the container with the finger or small peg. Place the roots in the holes leaving about ½ to 1 inch of the tomato leaves and bud above soil level. Handle the plants by the large leaves only—never by the stem. Firm the soil around the roots of each plant and soak the soil with the Copper A solution. Shade the plants from full sunlight for the first week and gradually harden them to direct sunlight.

PREPARING GREENHOUSE SOIL

One of the major differences between field and greenhouse tomato production lies in the preparation of soil. Greenhouse operators have found it profitable to "build" soil to desired specifications.

The soil must be maintained in the best possible physical condition to allow sufficient root growth and development for each plant. Frequent irrigations and walking between the rows may cause the ordinary soil types to become compacted. Materials which may be added to the soil to aid in keeping it loose and friable are well-rotted manure, compost, peat moss and perlite. The amounts of each needed to "build" an ideal soil will depend on the condition of the soil in the beginning.

It may be necessary to add agricultural lime to soils of low pH; approximately 6.0 is the best pH for tomatoes. Lime is also a good material for improving the physical condition of soil.

A soil analysis should be obtained after the addition of organic materials, but before the addition of lime¹. This analysis will indicate the requirements for lime, and, also will give the quantities of nitrogen, phosphorus and potassium available to the plant in the soil. A recommendation will be made as to quantities of fertilizer needed for best greenhouse tomato production if requested.

All of the above materials applied to the greenhouse soil should be *thoroughly mixed* into the top 6 to 8 inches of soil. A rotary tiller will do a good job.

Drainage is very important, and the greenhouse should be located so that excess water will flow away from it freely.

Soil sterilization to control weeds, nematodes and certain diseases is practiced by most greenhouse tomato growers. Steam is used primarily by large operators, but methyl bromide gas is used more commonly in small greenhouses. Your county agent can provide directions for using methyl bromide.

TRANSPLANTING TO GREENHOUSE SOIL

The long established spacing for greenhouse tomato plants is 18 inches apart in rows 3 feet apart. In some instances, closer spacing has been used successfully, but tends to result in smaller fruit size. It also increases the danger of heavy losses from leaf mold since it is more difficult to get adequate circulation of air around the foliage. Furrows for irrigation may be placed close to the plants.

The ground should be marked off before planting so that the plants will be set in

¹Your county agricultural agent can assist you in getting this done.

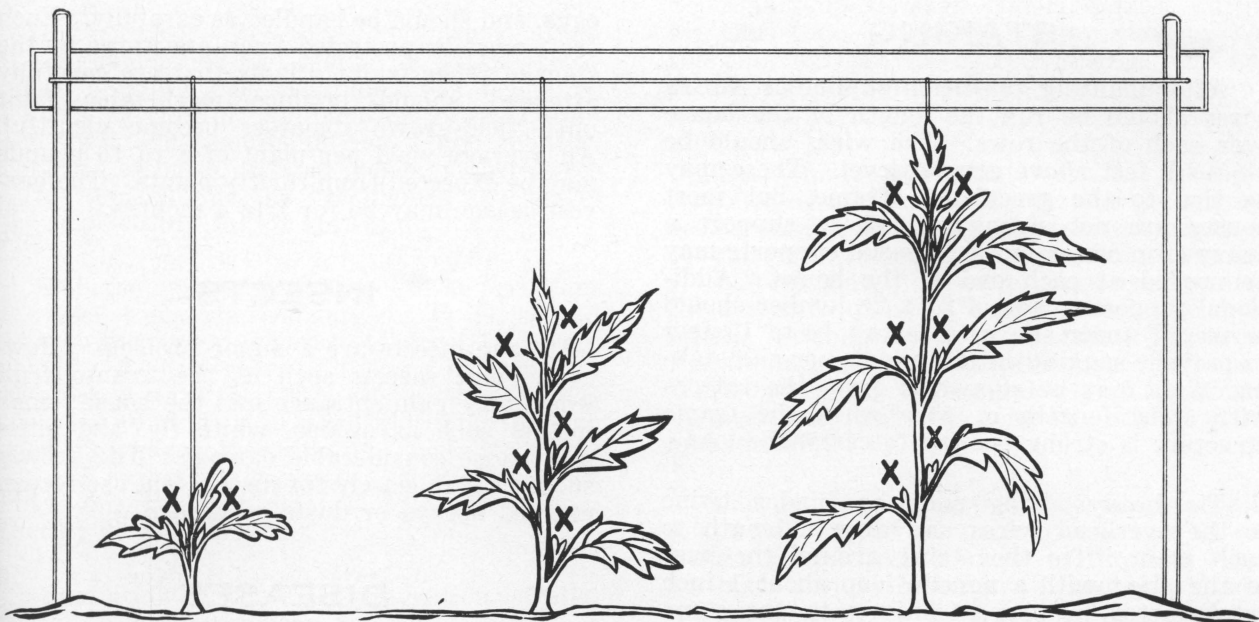


Fig. 4. Three stages of development of tomato plants showing the method of tying and training to a single stem. The side shoots marked with an X are removed as they start to develop leaving only the terminal bud.

straight rows and directly under the overhead staking wires.

Strong healthy transplants (see Figure 3) should be set so that no more than 6 inches of the plants are above ground. Water the plants immediately after transplanting.

WATERING AND FERTILIZING

The soil should remain moist but not wet. Tests show that over-watering during harvest may cause soft, puffy tomatoes. Furrow irrigation is preferred over the sprinkler type. Before using a new source of irrigation water, have it tested for suitability for this purpose.

When fruit begins to ripen sidedress each plant with 1 tablespoon of ammonium nitrate. Repeat at two week intervals thereafter. A plant with a heavy set of fruit has a high nitrogen requirement.

TEMPERATURE

A night temperature of 60 to 65 degrees F. with a day temperature of 70 to 80 degrees F. is considered ideal for greenhouse tomatoes. Wide fluctuations in temperature will seriously reduce yields. Refer to MP-341, "Plastic Greenhouses for Growing Vegetables in Texas," for information on heating and cooling systems.

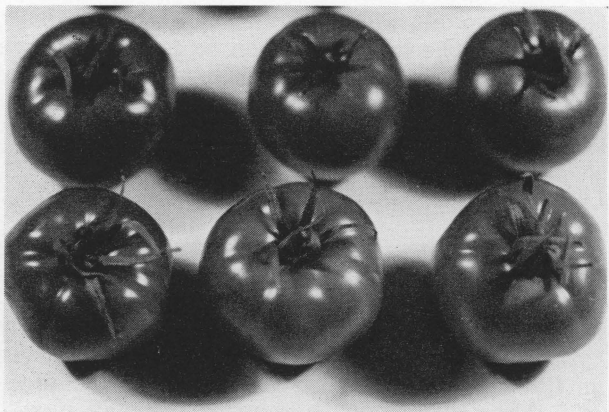


Fig. 5. Greenhouse tomatoes are harvested with the stems left on.

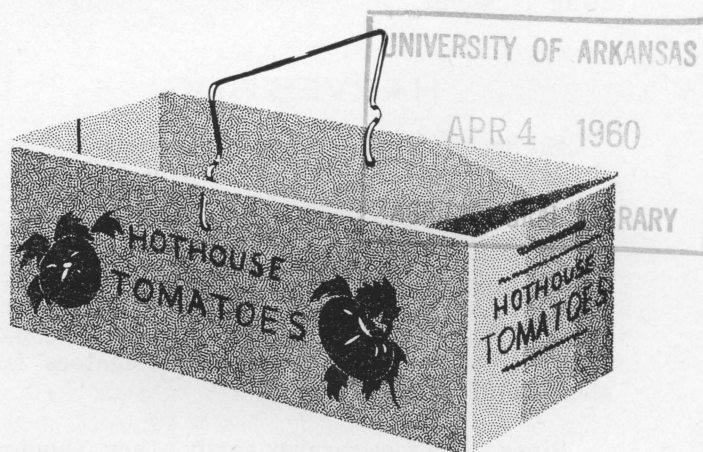


Fig. 6. A typical carton for marketing hothouse tomatoes. This type comes in the 8 and 10-pound sizes.

STAKING

After planting, television guyline or No. 11 wires should be run the length of the house over each of the rows. The wires should be 6½ to 7 feet above ground level. These may be tied to the greenhouse frame, but most houses are not strong enough to support a heavy crop of tomatoes. Special supports may be needed at each end of the house. Additional supports made of 2" x 2" lumber should be placed under the wires every 10 to 15 feet to prevent sagging in the middle; or the staking wires may be supported from the rafters with short lengths of wire when the frame structure is strong enough to carry the load.

Tie heavy string such as binder twine to the overhead wires and drop a length to each plant. Tie the string around the base of the plant with a nonslip loop about 1 inch in diameter to prevent injury to the stem. Twine the string around the plant as it grows and as the string begins to tighten, loosen it at the overhead wire.

Remove all side shoots which develop at the axil of the leaves as soon as they are large enough to grasp with the finger and thumb. Train the plants to a single stem. See figure 4.

POLLINATING

The staking and pruning operations, as well as the movement of plants caused by the exhaust fan, provide some pollination. However, to assure the maximum set of fruit, daily tapping of each flower cluster at midmorning as the flowers open is recommended. A piece of rubber tubing on the end of a pencil is satisfactory for tapping flower clusters. Electric hand-operated vibrators may be used in pollinating blossoms.

HARVESTING

Hothouse tomatoes are picked with the stems attached. The green stems identify hothouse tomatoes from field-grown fruit. Harvest the fruit at the vine ripe stage. Hothouse tomatoes should be picked often and marketed immediately. Growers should check the market carefully to determine how to grade and package the fruit. A common type of container used to market hothouse tomatoes is shown in figure 6.

Since tomatoes bruise easily, they should be harvested, graded and packaged carefully. Hothouse tomatoes are more valuable than

eggs, and should be handled as carefully. Each fruit must be protected from punctures by the stem of other fruit. Plants that are carefully attended should produce marketable fruit until field-grown tomatoes become plentiful. An average yield per plant of 8 to 10 pounds may be expected from thrifty plants. The harvest season may be for 3 to 4 months.

INSECTS

Large insects are a minor problem. However, some insects such as the tomato fruit worm may gain entrance into the house; small insects such as aphids, white fly, and mites may cause considerable damage. The grower should watch closely for insects and use recommended sprays or dusts as needed.

DISEASES

Leaf mold is the most destructive disease in greenhouse tomatoes. Resistant varieties should be grown as soon as suitable ones are available. The humidity in the greenhouse should be kept low by frequently circulating the air.

Leaf mold is not normally a problem if relative humidity can be kept below 90 per-



Fig. 7. Harvesting greenhouse tomatoes. Stems are left on. Note thermometer and thermostat control.

cent (at the surface of the leaves). In general, fungicide sprays have not proved effective in controlling leaf mold. A skilled greenhouse operator can keep humidity below 90 percent by careful manipulation of ventilators and the heating source during winter months, but this becomes difficult when temperatures inside and outside the greenhouse are nearly the same—as in fall or spring.

Tobacco mosaic is a virus disease prevalent in most tomato greenhouses. It is spread mainly by workers who use tobacco. Growers should not allow users of tobacco in a tomato greenhouse until they have washed their hands thoroughly. This is particularly important for workers who are transplanting, training, pruning and harvesting tomatoes. Mosaic does not kill plants but may delay and reduce production by 25 to 75 percent.

Sanitation is the best prevention of diseases. Every precaution should be taken not to carry diseases into the house.

PRODUCTION SEASON

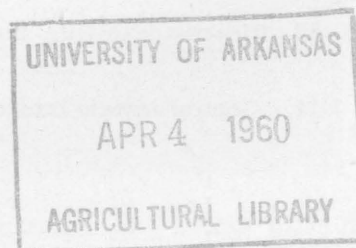
Greenhouse tomato experiments conducted for the past 3 years at College Station and Yoakum have shown that the greenhouse tomato grower should plant his tomato seed about

September 10 to have vine-ripe fruit during the Christmas to Easter holiday seasons. At this time of year, the market price is high and there is little competition from field-grown tomatoes.

The tomato transplant with six to eight true leaves can be moved into the greenhouse bed around October 15 and should begin to set the first cluster of fruit around November 1. Approximately 45 to 50 days are required for a tomato to ripen from the time the fruit is set. A tomato which is set around November 1 will mature a few days before Christmas. When harvesting begins the last of December, the peak harvest yields generally begin around mid-January.

The practice of tapping the flowers daily to provide a good set of fruit on each flower cluster should begin as soon as the first flowers open around November 1 and should continue for about 40 days prior to the expected end of harvest. Assuming that the last harvest date is expected around the middle of April, the grower would discontinue pollination about March 1.

Since the price for hothouse tomatoes is much higher than the price of field-grown fruit, the highest quality standards should be maintained. Handle each tomato carefully—it is worth 10 to 15 cents!



11 Steps to Growing

GREENHOUSE TOMATOES



1. Use adapted varieties.
2. Grow stocky, healthy transplants.
3. Select a rich, well-drained greenhouse soil and improve it, if possible.
4. Sterilize the soil with chemicals or steam.
5. Obtain a soil analysis and apply recommended amounts of fertilizer.
6. Properly space plants. Don't crowd them!
7. Properly regulate the greenhouse temperature, ventilation and soil moisture.
8. Prune plants to a single stem.
9. Tap flower clusters daily to facilitate pollination.
10. Harvest fruit with stem attached. Grade and pack in attractive containers.
11. Control insects and diseases.

