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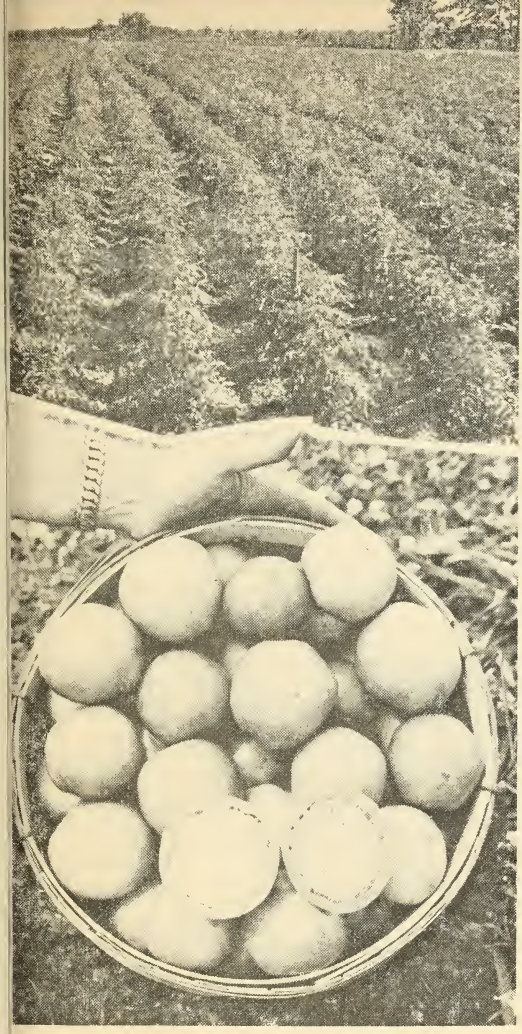

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Tomato Production For Fresh Market

MISSISSIPPI STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
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STATE COLLEGE MISSISSIPPI

TOMATO PRODUCTION FOR THE FRESH MARKET

By JOHN A CAMPBELL, STEVE L. WINDHAM and W. O. THOMAS[1]

The tomato is a very important crop in Mississippi for fresh market as well as home garden use.

Its universal consumption, nutritional value, and popular use in salads keep this crop in good demand in all sections of the United States.

In recent years the demand for higher quality in tomatoes has increased and to this end research efforts have been concentrated on breeding improved varieties, better cultural and fertilizer practices along with disease and insect control programs. Considerable study has also been given to the effects of handling and storage on the quality of tomatoes offered consumer through the various markets.

Production of high quality tomatoes requires considerable skill in the use of recommended practices. When these practices are properly applied, growing tomatoes for fresh market can be a very profitable enterprise. The per-acre cost of producing tomatoes is higher than most vegetable crops, ranging from $175 to $200 per acre. Therefore, every recommended practice which eliminates guess work and hazards as far as possible must be used.

Because of readily available markets, both local and distant, tomato production is adaptable as a part or full-time, small or large scale, enterprise at most any location within the State. Small plots of one to three acres, where members of a family perform all labor, fit well into a vine ripe market. In such cases the tomatoes are harvested every two days when color is showing on the fruit. Many growers in the Copiah County area have made from $1,000 to $2,000 gross per acre harvesting and selling tomatoes at vine ripe maturity. Larger acreages requiring extra labor may be better adapted to harvesting at the mature-green stage of maturity and marketing on the green-wrap market. In any case a grower should establish his market connections before going into such an enterprise.

Recommendations in this bulletin are based on the results of many years of research in all phases of production at the Truck Crops Branch Experiment Station.

Varieties

Many new varieties of tomatoes, developed and released in recent years, have improved quality and yielding capacity along with resistance to certain diseases. Some are better adapted to certain areas than others. Therefore, selection of the variety to be grown is an important decision which could mean the difference between success and failure.

The color of the ripe fruit may be important in deciding on a variety. Varieties which develop full red ripe color are most commonly grown and usually are the best yielders according to trials conducted over many years at the Truck Crops Branch Experiment Station. However, the market in certain locations, or certain individuals may prefer the pinkish red ripe fruit color that is characteristic of the Gulf State variety. The following recommendations are given for each type:

Red varieties: Marion and Kokomo have been the highest yielding red-fruited varieties in trials at the Truck Crops Branch Experiment Station for many years. These two varieties are widely grown in Mississippi and grower reports

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substantiate results obtained at the Station. Both are resistant to Fusarium wilt and produce smooth globe shape fruit that are readily accepted on the market or for home use. Marion fruit are larger, with an average U.S. No. 1 weight of .39 pounds when compared to .36 for Kokomo Where larger fruit are preferred, Marion would be better adapted

Pink varieties: The best pink varieties have consistently produced 75 to 100 bushels per acre lower yields than the best red varieties in trials at the Truck Crops Station. When pink varieties are preferred, however, the following varieties are recommended:

Bradley and Pink Shipper both have produced greater yields than Gulf State Market. They are also resistant to Fusarium wilt whereas Gulf State Market is highly succeptible to this disease. The fruit of Bradley are somewhat larger, having an average U.S. No. 1 weight of .39 pounds as compared to .35 for Pink Shipper. Both varieties have an indeterminant type of plant growth and produce globe shaped tomatoes In general, pink tomatoes have a thinner skin than red varieties and tend to crack to a greater extent with fluctuations in moisture and temperature while fruit are maturing.

Seedbed and Coldframe Treatment

A common practice of many growers producing tomato plants is to rotate the seedbed site each season or move in "new soil" from the woods or fence row. Other than this, few growers make an effort to control soil borne pest in the seedbed. Soil in old hotbeds and coldframes may be used for more than one year if sterilized after each season or after the removal of each crop of plants. Certain practices must be carefully followed for best results. They are as follows:

1. The soil should be finely pulverized and should contain moisture enough for seed germination. All operations for making a plant bed except seeding should be completed before applying the treatment.

2. For even distribution and penetration the seedbed should be thoroughly watered immediately after application of the soil sterilant.

3. Any equipment suitable for drenching may be used, for example, a greenhouse sprinkler can. When applying dust or granular materials these should be evenly distributed over the soil surface and worked into the top 2 inches of soil.

4. After sterilant application and just prior to planting, break crust and plant seed. Cover lightly and water if necessary.

Experiments at this Station indicate that Mylone, Bedrench, or Vapam as shown in Table 1 will reduce harmful soil borne microorganisms in old hotbed soil.

Table 1.—Results of tomato sseedbed treatment test.

Treatments	Mean stand 2 yr. av.	Rate of cemical per 100 sq. ft.
Check (no sterilant)	100	——
Temporary soil sterilants		
Mylone W-50	156*	1.5 lb.
Mylone-85 granular	169*	1.5. lb.
Bedrench	224*	1.5 pt.
Vapam	212*	1.5 pt.

*Significantly greater than the check at 5% pt.

Application: Vapam or Bedrench—apply 1.5 pints of either per 100 square feet of seedbed area. Dilute with enough water (2 to 4 gallons) to evenly cover the soil surface. Thoroughly water the seedbed immediately after application.

Mylone W-50—apply 1.5 pounds per 100 square feet of seedbed area. Mix with enough water (2 to 4 gallons) to evenly cover the soil surface.

Mylone-85, granular or powder—evenly distribute and work into the top 2 to 4 inches of soil 1.5 pounds per 100 square feet of seedbed area. Thoroughly water the seedbed immediately after application of Mylone.

Wait 15 to 20 days before planting seed when Bedrench, Vapam, or Mylone is used.

Temporary soil fumigants are more volatile in soil temperatures above 50-F. More effective results may be obtained from their use if applied during the fall rather than early winter. Materials such as Dow-Fume and Chloropicrin may be used. Follow directions on the container.

Plant Production

Good healthy and vigorous plants to set in the field are essential to success. Therefore, careful attention must be given to the planting and growing or securing desirable plants.

Under Mississippi conditions seed must be planted around January 20 to February 1 in hotbed, greenhouse, or heated coldframe in order to have tomatoes ready for market by the first week in June. The recommended method is to plant seed in seed flats and place in hotbed, or plant seed directly to hotbed. The soil should be treated with temporary sterilizing chemicals well ahead of planting (see section on seedbed and coldframe treatment). A good planting soil can be prepared by mixing two parts good loamy field soil with one part sand and one part well rotted chicken litter or barnyard manure.

It is recommended that seed be sown in rows or drills 2½ to 3 inches apart and covered about ¼ inch deep. This will make possible the removal of plants in bunches and reduce the loss of roots when the plants are pulled for transplanting to flats or coldframe (See Figures 1 and 2). One ounce of tomato seed is usually required for the area covered by one hotbad sash 3 feet wide and 6 feet long, or each 18 square feet of bed space. This should produce enough plants for one acre in the field.

For best germination the soil temperature should be 70° to 75° F. This can be easily maintained by use of thermostatically controlled soil heating cable.

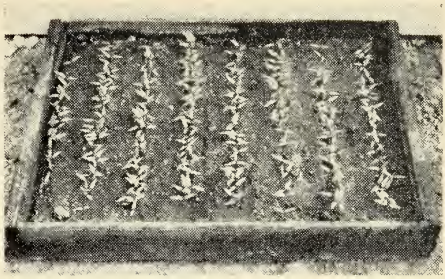

Figure 1.—Tomato seedlings grown in flat ready for transplanting to other flats or coldframe.

Other sources of heat can be used but the cable is the most satisfactory. Experiments at this Station have shown that plants started in the hotbed with electric soil heating cable were superior, and required less electricity than plants started in coldframes with soil heating cable or electric light bulbs as a source of heat. This was due primarily to the lower heat. loss in the hotbed compared with the other structures.

These studies showed that the consumption of electricity for heating a hotbed 6 feet wide and 36 feet long or 12 sash (Figure 3) was approximately 300 KWH which on the average home load and rate would cost $4.80 for the size hotbed just mentioned, or about 40c per sash covered area. Lead covered cables were used in these studies. Plastic covered cable is now available at lower cost.

When seed germinate and plants emerge care should be taken to ventilate when outside temperature will permit. Sunlight through glass or clear plastic covering generates considerable heat so that the sash should be raised or pushed up and down alternately when outside temperature reaches 45°F. or above with no air movement (See Figure 4). If plants begin growing nitrogen rapidly, the electricity can be cut off when temperature is above freezing, thereby reducing the rate of growth. Add water between the drills as needed to prevent excessive wilting without getting plants wet. This is usually

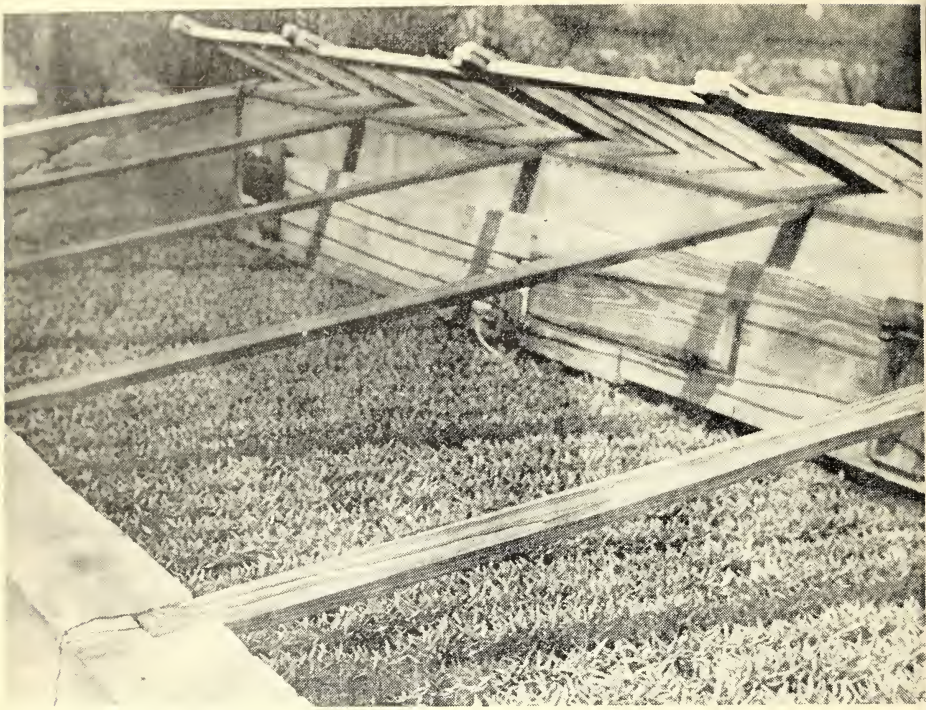

Figure 2.—Tomato plants grown in electrically heated hotbed ready to transplant to flats or coldframe.

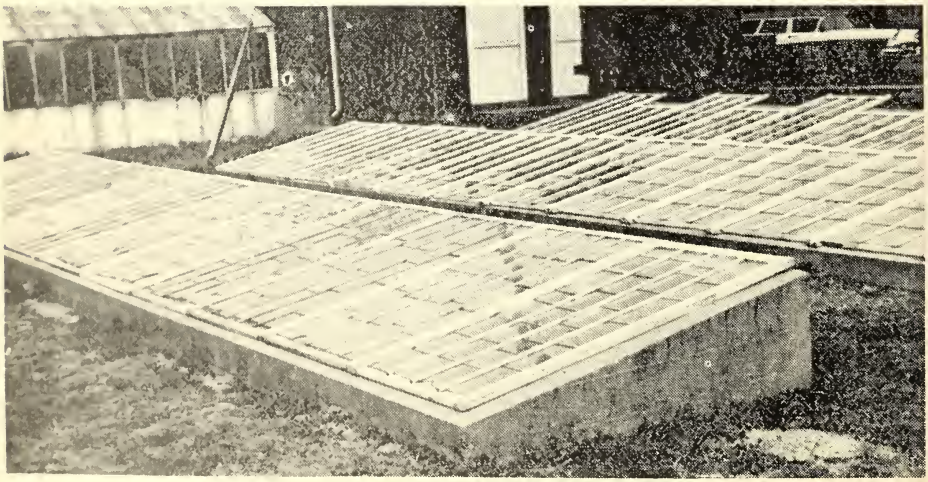

Figure 3.—Hotbeds 36 feet long and 6 feet wide requiring 12 sash. Amounts of electricity used to heat hotbed from time seed were planted until plants were transplanted to coldframe was 300 KWH at a cost of $4.80 or 40 cents per sash.

best done with a water hose at low vol ume.

When temperatures drop to below 20° F. additional protection may be needed. This can be supplied by covering the hotbed with a coldframe cloth or tarpaulin and banking straw to a depth of 8 to 10 inches over the top and sides of the hotbed. When temperature is above 20°F. the cloth or tarpaulin will be adequate without straw, provided the electric cable or other source of heat is on. The cloth cover should be removed when temperature gets to 30°F. or above in order to provide adequate light to the plants. In order to exercise proper control over the hotbed frequent checks must be made during each day.

Transplanting to coldframe: The coldframes should be prepared 2 to 3 weeks before setting. The standard coldframe that will hold enough transplanted plants for one acre is 10½ feet wide and 64 feet long. The general appearance and construction is shown in Figure 5. If plants are to be transplanted directly to the coldframe, each coldframe should be fertilized with a broadcast application of 50 pounds of 5-10-5, or equivalent, worked into the soil. The bed should be worked up well with hoe or potato digger and raked off, removing all trash, grass and clods. The bed should be sloped from center to sides with the center about 2 inches higher than sides.

Plants should be large enough to transplant around February 15 to 20 when first true leaves appear and plants have reached a height of 2½ to 4 inches. Soil should be loosened around the plant drills so that plants can be pulled in bunches. This will reduce loss of roots. Remove plants from hotbed only in quantities that can be set within a reasonable time, before they start wilting. Place plants standing in a shallow pan or container and add one-half inch of water. Do not let foliage get wet and keep in shade protected from wind.

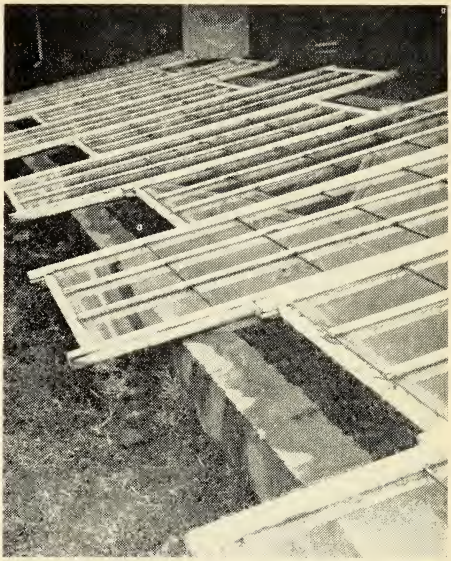

Figure 4.—Ventilating hotbeds when outside temperature is 45° or higher.

Holes are made with a multihole puncher, made with pegs 4 inches long spaced 3 inches apart, between 2 pieces dressed lumber 1 in. x 3 in. x 6 ft. (Figure 6). Start making holes at center of bed with rows 3 to 4 inches apart at one end and work toward the other end standing on plank. Holes in the center section are then made and set. Remove plank and make holes and set to complete the full block width of frame. Soil should be packed well around roots.

When one block section is completed cover with one end of coldframe cloth and continue to pull cloth cover up behind setters so that when transplanting is complete the whole frame will be covered and the earlier set plants will have been protected from wilting by wind and sun. Secure the cloth to all sides of frame and add straw to at least two-thirds up each side and across ends. During freezing weather it will be necessary to cover entire frame with straw to a depth of 6 to 8 inches. Either broom sedge straw or pine straw can be used.

After plants have been set for 3 to 5

days, depending on how rapidly they recover from transplanting, remove straw and cloth and spray or dust to control insects. The coldframe should then be covered and ventilated by propping up the cloth at each end. When plants begin to grow and temperature is above 50° to 55°F. remove sheet during warmest part of day. Check the coldframe frequently and if plants begin wilting replace sheet and air the ends of bed.

Use straw cover on sheet only when there is a chance of the temperature going below 30°F. Straw should be removed and bed aired whenever the temperature will permit after each rain. It is well to check weather reports frequently and act accordingly. If there is no chance of frost and plants are making good growth the sheet may be left off at night. This is essential during last week prior to setting in field in order to toughen the plants.

Use of flats for growing plants: Transplanting to flats is done much the same way as described for the coldframe. Soil

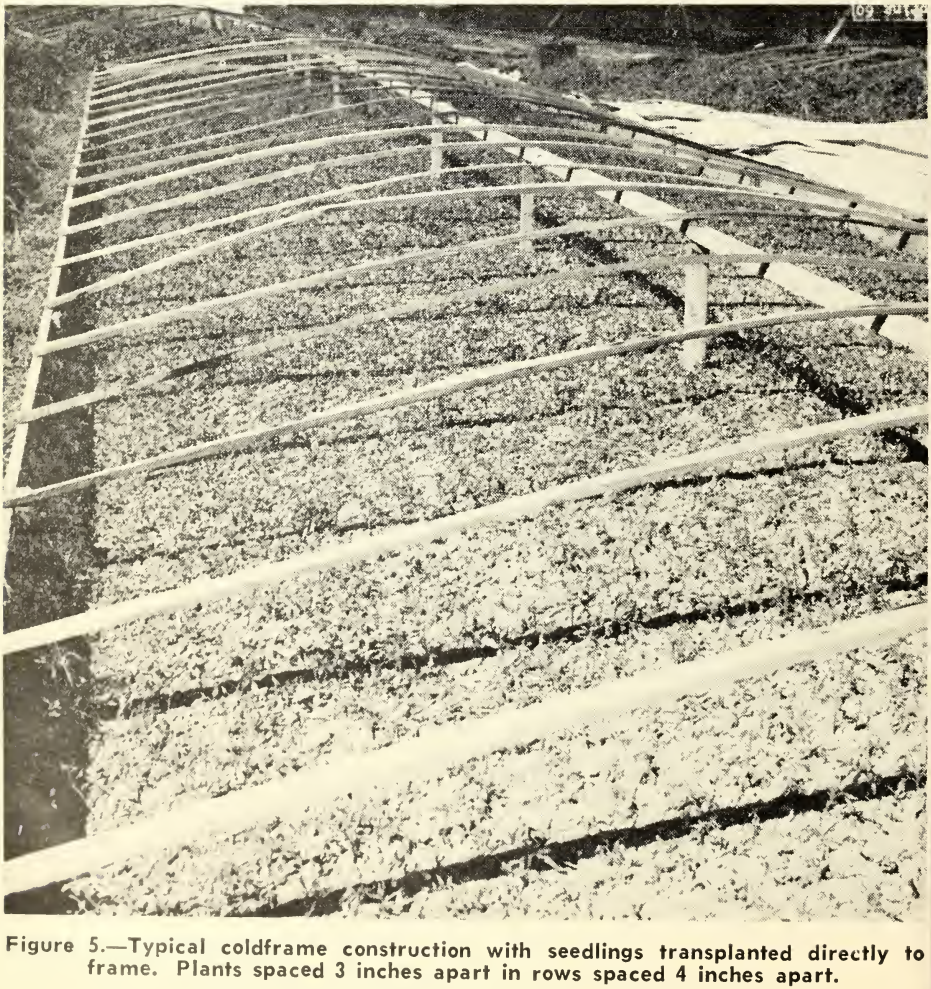

Figure 5.—Typical coldframe construction with seedlings transplanted directly to frame. Plants spaced 3 inches apart in rows spaced 4 inches apart.

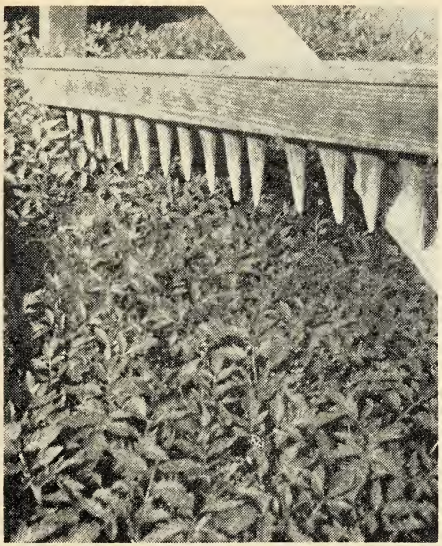

Figure 6.—A multi-hole puncher used in transplanting plants directly to coldframe.

in the flats to be transplanted is composed of the same mixture as for planting soil and should be moist. The flats can be stacked under a shed or a barn protected from wind and weather where the transplanting operation can be performed. Flats containing the seedling plants should be well watered and placed near the transplanting operation. Plants should be pulled and transpanted without placing them in a pan of water.

Holes are made with a multipuncher built to fit the flat with pegs spaced 2½ to 3 inches apart as shown in Figure 7. A flat 20 inches long, 15 inches wide and 3 inches deep will hold 40 to 45 plants. Each flat should be well watered immediately after transplanting to prevent wilting. When a sufficient number have been transplanted they can be placed in the coldframe side by side as shown in Figure 8 and covered with the cloth as described above. Operation of the coldframe would be the same as where the plants are set directly in the frame.

No fertilizer is required in the coldframe soil where flats are to be placed. However, the soil should be worked up and raked off so the flats will rest level. The flats should be watered as needed while they remain in the coldframe where they tend to dry out to a greater extent.

Use of flats offers several advantages over transplanting directly to the coldframe. They are as follows:

1. Transplanting can be done with greater ease.
2. Transplanting can be better accomplished under unfavorable weather conditions.
3. The plants can be taken to the field in the flats in better condition for setting to the field.

Flats are usually sold in pre-cut or pre-sawed pieces of heart redwood or cypress lumber to be put together after they are received. They have a useful life of from 10 to 15 years depending on how well they are taken care of. Prices (1962) for the knocked down flats range around 65 cents per flat delivered in quantities of 100.

Coldframe cloth covers: A coldframe

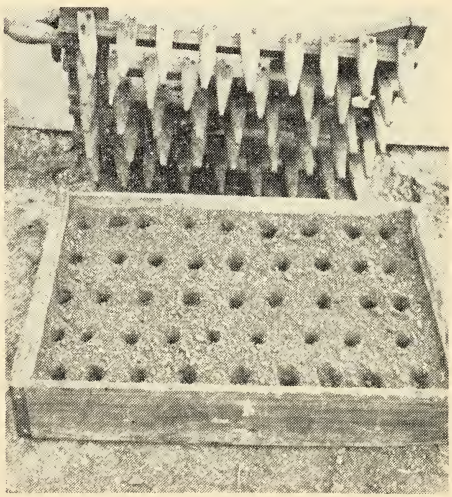

Figure 7.—Flat prepared for transplanting with multi-hole puncher made to fit. Each flat holds 45 plants spaced 3 in. x 3 in. apart.

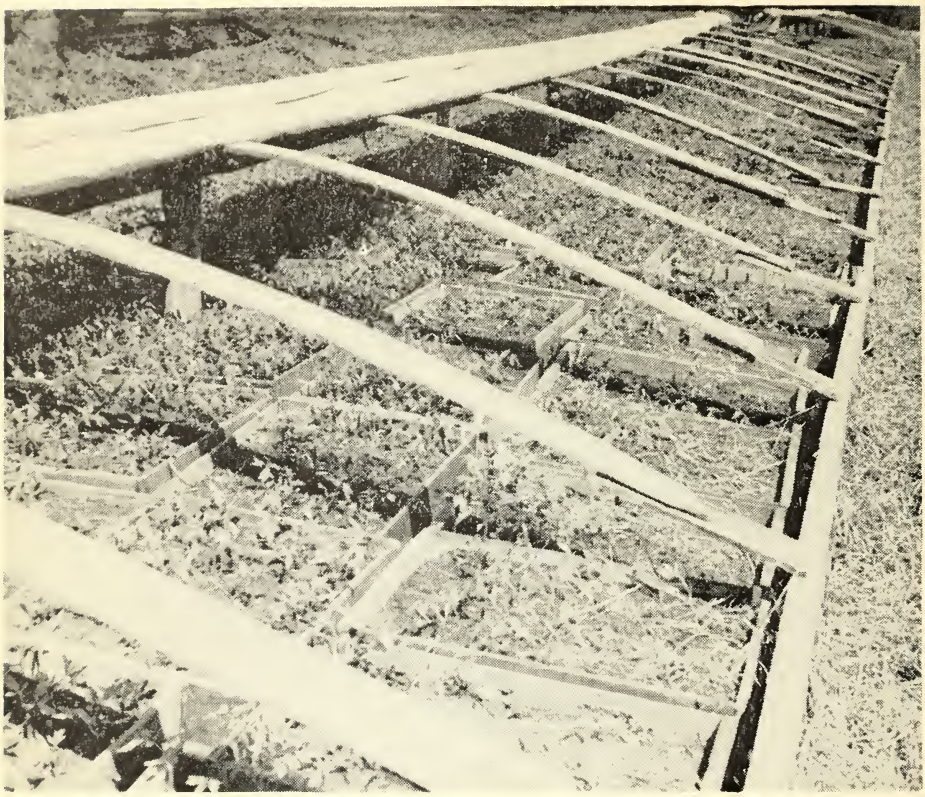

Figure 8. Coldframe showing transplanted flats set in frame.

cloth is made by sewing together 4 lengths, each 66 feet long and 36 inches wide of LL grade unbleached domestic cotton sheeting. Roller poles made of 1 in. x 2 in. x 12 ft. are spliced and tacked to the 2 lengthwise edges. This makes it easy to roll the cloth up over the coldframe benders. The cloth is put over the benders so that the loose edges along the seams are up, or exposed to outside, in order to reduce leakage. The price of the 36 in. width cloth should range between 25 to 30 cents per yard in bolt quantities.

Soil Selection

Soils selected for tomatoes must have good surface and internal drainage, yet retain ample moisture to prevent rapid soil moisture fluctuations. A well-drained silt loam soil with a deep top soil should be used if available. Heavier soils (silt and clay loams) or lighter soils (sandy loams) can be used but require better management practices for maximum yields. Moderate to severely eroded soils and soil types with mottled light yellow and or white subsoils should be avoided. As a precautionary measure soils should not be selected for tomato production on which tomatoes, peppers Irish potatoes, beans, cantaloupes, etc were grown just prior to this crop.

Soil Preparation

Little can be done to correct poor soil preparation once the plants are established. Prior to transplanting the soil should be broken as deeply as possible with conventional equipment. However, the depth of plowing should be limited

to prevent the turning up of raw subsoil. At the time of transplanting the settled seedbed should be approximately 6 inches high after harrowing. The use of a disc harrow or similar equipment may be necessary to obtain a loose, friable bed if seedbeds become compacted between the time of breaking and transplanting.

Fertilizer Requirement

a. Pre-transplanting: Soil samples should be taken and an analyses obtained for soils for which the acidity and fertility levels are unknown. Lime applications should be made on soils with pH levels of 6.0 and below as indicated by soil tests.

Research indicates applying lime on strongly acid soils will increase marketable yields by reducing losses from blossom-end rot and manganese toxicity.

Results of tests over the past 20 years indicate that under most conditions 60 to 80 pounds of N, 120 to 160 pounds of P_2O_5, and 60 to 80 pounds of K_2O should be applied as pre-transplanting treatment. In mixed materials, a 1:2:1 ratio should be used. The pre-transplanting fertilizer should be applied at least 2 weeks prior to transplanting. The material is applied in a single band in the center or slightly to one side of the row. The depth should be such that the roots of the plants at transplanting are 1 to 2 inches above the fertilizer band.

b. Sidedressing: At the time flowers on the first cluster are in full bloom additional nitrogen and or a complete fertilizer should be added as a sidedressing. This is added 8 to 10 inches to the side on the drill and 2 to 3 inches deep.

Table 2 indicates that larger yields are harvested when a complete, water soluble 1:1:1 ratio fertilizer is used as sidedressing. These data also indicate that sodium nitrate is superior as a source of nitrogen, when nitrogen alone is applied.

Establishing Plants in Field

The plants should be transplanted to the field between March 20 and April 1. In experiments at this Station, plants grown in flats and transplanted with a block of soil around the roots grew off faster and produced a greater early and total yield of U.S. No. 1 fruit when compared with plants handled by other methods, (Table 3). This method offers a decided advantage over the others. The increased early and total yield during one season would more than pay the cost of the flats which can be used over and over for a period of 10 to 15 years. Cost of 3-inch peat pots (Figure 9) would be

Table 2.—Influence of sidedressing materials on tomato yields (2 Yr. Av. 1959-1960).

Material	Lbs. per acre	Yield (60 lb. Boxes per acre) No. 1	Total marketable
Ammonium nitrate	100	288	323
Sodium nitrate	200	309	352
13-13-13*	250	359	395

*Water soluble

Table 3.—Comparison of different methods of production and handling tomato plants as they effect yield of vine ripe tomatoes.

Treatment Method of growing and handling plants	Yield — No. 60 lb. Boxes per Acre U. S. No. 1	U. S No. 2	Total No. 1 and 2
Slip rooted plants, roots muddy	137	52	189
Coldframe sod plants	167	118	285
Flat grown sod plants	207	105	312
Transplanted to peat pot plants	166	89	255
Seed planted to peat pots same day seeding transplanted in other methods. Thinned to one plant at seedling stage	167	80	247

Figure 9.—Tomato plants grown in 3-inch peat moss pots.

about equal to that of the flats to produce the same number of plants. The pots would be good for only one season.

Where this method is used, the flats of plants should be well watered before removing to the field. The rows should be harrowed with a section or chain harrow. A small narrow shovel plow run in the center of the top of the row will open a furrow deep enough to receive the plants with a sod of soil around the roots. The setting operation will require teams of two workers, one to carry the flat and the other with a trowel to remove the plants with sod (Figure 10) and set the furrow. Plants should be set to a depth up to the first true leaf. Soil should be packed firmly around each plant.

The second most profitable method is when the plants are grown directly in coldframe and removed with a specially made trowel so that a 3-inch block of soil, intact around roots as shown in Figure 11, can be transferred to the field. Wetting the soil before removing plants will aid in keeping the soil intact. Transfer of plants to the field is made by placing the plants with sod on a slide which has a flat surface. The slide should be narrow enough to be pulled between two rows either by a tractor or mule. The bed preparation and transplanting operation would be the same as described for the use of flat grown plants.

It must be pointed out that where either of the two methods described above are used the soil on which the plants are grown should have a clay or silt content sufficient for the sod to hold its form when removed.

The two methods described above are well adapted to the grower who plants a small acreage. Neither system is adapted to the conventional mechanical transplanter.

For the grower who is mechanized for large acreage production, the slip rooted plants as shown in Figure 12 may prove more economical. With this method the soil in the coldframe is loosened with a fork and the plants pulled bare rooted. The roots are muddied in a mud slurry and transplanted either by hand or mechanical transplanter.

Spacing

Spacing depends primarily on the

Figure 10.—Tomato plants grown in flat being removed with sod for transplanting.

Figure 11.—Plant grown directly in cold-frame soil removed with sod for transplanting.

method of training. When tomatoes are pruned, staked and tied, and trained to a double stem, plants should be spaced 2 feet apart on rows 4 feet apart. For untrained plants the plants are spaced 18 inches on rows spaced 7 feet apart. If soil suitable for tomato production is not a limiting factor, distance between rows may be increased for trained plants to facilitate late cultivation and spraying.

Table 4 shows that a larger number of U.S. No. 1 and total marketable fruit can be produced per acre when plants are staked and tied. This is due in part to less area (2 ft. x 4 ft.) required for trained plants as compared to untrained plants (spaced 1.5 ft. x 7 ft.) On the untrained plants a larger number of fruit are lost due to soil rot and discoloration, and more mature fruit are missed during harvesting of untrained plants. The time required to harvest fruit from untrained plants is greater. These factors are more important when fruit are being harvested in the vine ripe stage than for fruit harvested in the mature green stage.

Training

Plants are normally pruned and tied 3 times, approximately one week apart. The first pruning should take place when the flowers begin to open on the first cluster. All side shoots, sometimes called suckers, are removed below the first two clusters, except the one occurring in the leaf axis immediately below the first cluster as shown in Figure 13. This side shoot is left for the second stem. After the third pruning all additional growth is left. The plants should not be topped.

Stakes may be of wood or metal. They should be approximately ½ to 1 inch in diameter and 40 inches in length. The string used must have a soft finish such as jute twine. Small diameter, hard finish material is not satisfactory as it will girdle the stems of plants. Care must be taken in both staking and tying to prevent fruit from resting against the stake, which will cause scarring of the fruit. The stake originally should be placed on the opposite side of the first cluster. When plants are tied, the plant should be turned to place each subsequent cluster away from the stake.

Table 4.—Influence of staking and tying on marketable yields of tomatoes (2-Yr. Av. 1959-60).

	Yield (60 lb. Boxes per Acre)	
	No. 1	Total Marketable
Untrained	172	192
Trained	326	368

Cultivation

Cultivate only to control grass and weeds, and to aid in the uptake of water by the soil. The first cultivation is made after plants have recovered from transplanting and are showing signs of growth. This is done with side harrow or a group of small shovel plows. The cultivation should be very shallow close to the plants pushing soil toward the plants and somewhat deeper further away from the plants so as to leave the shoulders and middles of the rows in a uniform pulverized condition. This type of cultivation may be repeated as needed after a rain or as grass and weeds begin to re-appear. Cultivation at this stage can be done

Figure 12.—Good stocky slip root plants 8 inches tall.

either by a mule or tractor.

Just before the plants are to be staked and when the first cluster flowers are in full bloom the plants can be cultivated and given the first sidedressing in the same operation as shown in Figure 14. After the plants have been staked cultivation must be done with mule drawn plows or especially built high clearance tractor. Shovels and sweeps or combination of the two at shallow depths are used after the plants have been staked.

Some hoeing may be required to eliminate grass and weeds in the drill or center of row around and between plants.

Irrigation

A uniform soil moisture supply is required for maximum yields of marketable grades of tomatoes. The natural rainfall must be supplemented almost every year at one time or another by irrigation in order to meet this requirement. During the month of April and the early part of May the plants should receive 1½ to 2 inches of rainfall or the equivalent in irrigation every 10 days to 2 weeks depending on temperature and amount of sunshine. During the remainder of the growing season the plants should receive this amount of water every 5 to 7 days.

If a drought or a water deficiency is allowed to occur during fruit development a physiological disease known as "blossom-end rot" will occur causing a loss in marketable fruit. The critical period when plants are most susceptible to damage from drought is during the time that tomato fruits are growing and developing. Experiments conducted at the Truck Crops Branch Experiment Station have shown that during the fruit growing period one irrigation of 1½ inches of water during a 2 weeks period without rain, increased the yield of marketable tomatoes by 55 boxes (60 pounds each) per

Figure 13.—The second stem is initiated in the leaf axis just below first cluster.

acre.

Either sprinkler or furrow flood irrigation may be used.

Harvesting and Handling

The type market for which the tomatoes are being grown will determine the maturity and how often the fruit are to be picked. There are two types of markets; "vine ripe" and "green-wrap."

Harvesting for the vine ripe market: High quality in tomatoes, as measured by soluble solids content and other factors which contribute to flavor and taste, etc., is associated with vine ripe maturity. By the term "vine ripe" we mean that a tomato is left on the vine until color characteristics of a ripening fruit is visible. Tomatoes harvested and sold at this stage of maturity usually bring a premium price. This is due in part to the fact that grocery shoppers recognize visible characteristics of vine ripe tomatoes and discriminate in their favor.

When harvested at this stage, it is necessary to pick the fruit as color is turning or when 10 to 25 percent of the fruit surface is showing color. At this stage of maturity the fruit are firmer and will withstand handling better than when the fruit are ripened to a greater degree. In order to "catch" the bulk of the fruit at this stage it is necessary to pick every second day.

Cloth or metal buckets of 3 to 5 gallon capacity should be used in the harvest. Each fruit should be carefully placed in the container as picked. Tomato fruits are easily bruised and should be handled

Figure 14.—Cultivating and sidedressing tomatoes just before staking.

as though they were eggs because within a few hours each bruised area will show up as a dark blotch on the fruit. Growers should not harvest in hampers or other container with rough surfaces, wire or nail ends protruding or any sharp rough edges that will damage the tomatoes.

After harvest the tomatoes should be carefully graded according to United States standards for grades, and packed. The most popular containers for vine ripe tomatoes is the one-half bushel basket lined with paper and the 20-pound wood lug or 20-pound fiber board carton. The fruit should be packed so as to give a neat appearance, usually with the stem end facing downward and to give the net weight indicated on the container. The buyer or shipper will in most instances specify the container to be used.

Harvesting for the green-wrap market: Tomatoes for this market are harvested at the "mature-green" stage. The term "mature-green" means that the tomato fruit is matured to the extent that the seed are fully developed and a jelly like substance has developed in the seed cavity. The fruit at this stage will show a brown ring at the stem scar and the light green color at the blossom end will take on a yellow-green cast. At this point the fruit are fully grown and are just before showing a pink or red tinge of color characteristic of a ripening fruit. Usually the position of the fruit on the plant will help determine maturity as the first fruits set on the plant should reach maurity ahead of those set later. A good way to test these indicators and develop experience is to slice thru the fruit with a sharp knife. If the seed and jelly-like substance is fully developed no seed will be cut as they will slip or slide around the knife cutting edge at the mature-green stage. When seed are cut by this slicing, it indicates that the seed and jelly-like substance is not fully developed and that the fruit is not mature enough for this type harvest and market.

Tomatoes for the green-wrap market at the mature-green stage are harvested 3 to 4 days apart using the same care and picking containers as for vine-ripe fruit. In most instances tomatoes are emptied from picking containers into field boxes or paper lined bushel baskets in which they are transported to the market or packing shed where they are to be sold. At the packing shed the tomatoes are graded according to United States standards for grades, and sorted as to size usually by machine. The fruit are then packed in 40 to 60 pound wire-bound crates or fiber board boxes of the same capacity. Green-wrap tomatoes packed in this manner are normally sold to re-pack firms where they are placed in ripening rooms and re-packed in various types of containers for the retail trade.

Disease and Insect Control for Tomatoes

Tomatoes are plagued by blights, rots and insect damage. For the past ten years most of the growers in Mississippi have produced their own plants. As late blight does not over-winter in this area, this practice is an effective way to prevent this disease. At present the State Plant Board prohibits the shipment of tomato plants out of areas where this disease over-winters.

The primary disease in Mississippi is early blight. Under conditions of severe infection this foliage and fruit disease may drastically reduce the yield. Buckeye and soil rots occur occasionally under extreme weather conditions but are usually of minor importance on staked and pruned tomatoes.

Many of these troubles may be controlled by using recommended fungicides and insecticides. Timely applications of fungicides and insecticides are important practices in tomato producton. The disease and insect control program should be applied as a preventive measure rather than a "cure-all", and control efforts should begin before trouble de-

velops. The insect control measures are given in Table 6.

Steps in Disease Control

Diseases can be controlled and yields increased by using recommended fungicides. Spray is more effective than dust in controlling leaf, stem, and fruit diseases. Table 5 presents a 3-year average yield of tomatoes produced under the recommended spray schedule. Dyrene and Dithane M-22 treatments produced the highest yield of marketable tomatoes for a 3-year average.

The following steps in a tomato disease control program are essential:

1. If home grown plants are used, apply first spray application in the coldframe about two weeks before transplanting.

2. Begin field spray program about 2

Table 5.—Effects of fungicides on yield of marketable tomatoes.

Spray Treatment	Pounds fungicide in 100 gals. of water	3-Year Av. Yield. no. 60 lb. boxes per acre	Early blight[1] disease on foliage Mean
Check	--	229	4.0
Tribasic Copper Sulphate	4	259	2.0
Dithane Z-78 or Parzate	2	249	2.0
Dithane M-22 or Manzate	2	292	1.5
Dyree	2	329	1.0

[1]1—very slight, 2—moderate, 3—severe, 4—very severe.

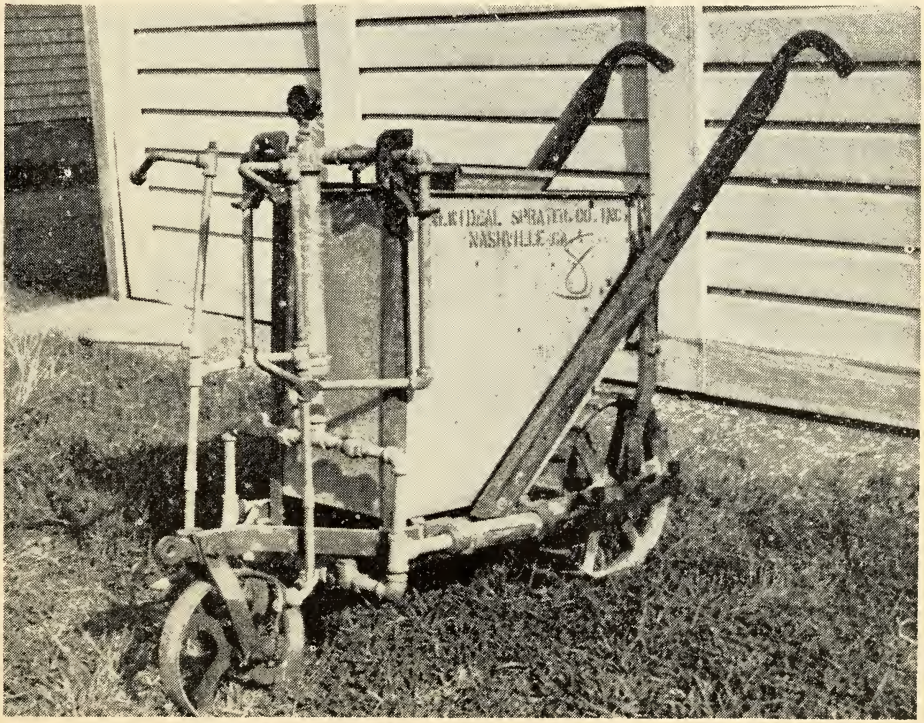

Figure 15.—A mule drawn sprayer. Pressure provided by pumps operated by rear wheels. This sprayer does an adequate job of applying fungicidal and insecticidal sprays.

Table 6.—Schedule for Tomato Insect Control.

		Dust	Spray	
			Rates below are per acre.	
Insects	Schedule	Apply approximately 15 to 20 lbs. per acre for good coverage	In large plants use approximately 100 gals. water per acre	Comments
Cutworms — in coldframe or field	Treat soil surface in coldframe and tops of rows in field just prior to transplanting.	Toxaphene, Endrin, or Dieldrin	Toxaphene, Endrin or Dieldrin, for small amounts one teaspoon per gallon.	Follow rates and directions on container for soil application.
Grass worm in coldframe	First application about three days after transplanting. Treat as needed.	4% or 5% Malathion 10% Sevin	Malathion or Sevin, for small amounts one teaspoon per gallon.	Do not dust or spray excessively. Too much will burn young plants. Use only enough for uniform coverage.
Aphids (plant lice) in coldframe or field	Begin control when aphids appear and continue until plants are clean.	4% or 5% Malathion	1 to 1½ lbs. Malathion	Watch for infestation. Repeat application as necessary.
Fruit insects: pin worm, tomato fruit worm, horn worm	Begin treatment at first fruit set. Add insecticide to each fungicide application.		1 lb. Methoxochlor or 1 lb. DDD, or 2½ lbs. Sevin	Repeat application at 5 to 7 day intervals. follow restrictions on label.
Green stink bug	This insect may begin feeding during early season and continue damaging fruits until harvest.	10% Sevin, 20% Sabadilla	2½ lbs. Sevin	Damage may be noted by small sunken or freckle like spots on green fruit. On mature fruit the area just under the skin is gray and corky in appearance.
Colorado potato beetle	Apply insecticide at first sign of damage or insect. Usually two applications will give control.	Endrin, 10% Sevin	¼ to ½ lb. Endrin or Dieldrin	Do not apply after fruit begins to set.

CAUTION: Read and follow directions and restrictions given on label. Handle concentrates with great care.

weeks after plants have been transplanted in the field.

3. Apply treatments every 7 to 10 days until harvest begins.

4. For good coverage use power equipment.

5. If rain occurs repeat application as soon as possible. Use any of the following materials:

a. Tribasic copper sulphate; 4 lbs. to 100 gal. water.

b. Dithane M-22 or Manzate; 2 lbs. to 100 gal. water Use a sticker spreader.

c. Dyrene; 2 lbs. to 100 gal. water.

For good coverage when using wettable powders in spray, a wetting agent of some type should be used Several commercial preparations are on the market. All are sold as "sticker spreaders". Directions on the container should be followed for each one.

Mix recommended fungicide and insecticide together and apply in one application.

The one-row mule drawn sprayer in Figure 15 is very economical and efficient in operation. This equipment can be adjusted to spray staked tomatoes and other vegetable crops. Pressure is created by rear wheel traction which operates 2 pistons connected to the spray line. Most of the sprayer parts are plumbing accessories and can be obtained or replaced at most hardware stores.