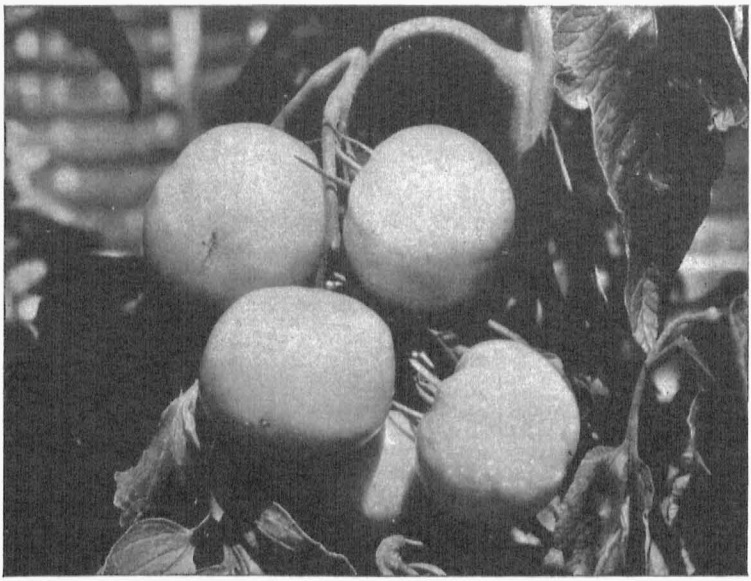
JUNE 1943 BULLETIN 470

UNIVERSITY OF MISSOURI COLLEGE OF AGRICULTURE
AGRICULTURAL EXPERIMENT STATION

M. F. MILLER, *Director*

Tomato Production in Missouri

T. J. Talbert and Aubrey D. Hibbard



A Cluster of Marglobe Tomatoes

COLUMBIA, MISSOURI

Tomato Production in Missouri

T. J. TALBERT AND AUBREY D. HIBBARD

Tomatoes now rank among our foremost vegetable crops. This is true for acreage, food value, and health giving qualities. The crop may be grown successfully on a large variety of soils and under varied climatic conditions. It yields well and does not lose its sprightly flavor, freshness, and vitamin C content when processed and canned.

The demand for the fruit has increased steadily. Its high rank and value in the diet has been firmly established by extensive and recent nutritional studies. Also, tomatoes excell most food products from the garden and field in their wide range of uses. When served raw, cooked, made into salads, soups, tomato juice, catsup, sauce, pickles, conserves, etc., the tomato has few if any equals.

Tomatoes are grown on a commercial scale in many districts of the State. The fruit is supplied to both local and distant markets. The canning areas of Southwest, Northcentral, and Northwest Missouri are particularly noteworthy for the recent marked developments in cultural practices, harvesting methods, and processing procedures.

Moreover, the tomato is generally given first importance and consideration in the home garden. The crop is also grown widely under glass, especially in the trucking centers near our larger cities. Missouri tomatoes, therefore, may be available on some markets throughout the State nearly every day of the year.

TOMATO VARIETIES FOR MISSOURI

There has been a great improvement in tomato varieties during the last few years. Plant breeders have been directing their efforts toward securing better market types of deep globular shape with thick walls and solid meaty centers. Canning varieties have been developed which are smooth and of improved color. The drought years stimulated a search for varieties which were resistant to injury from dry weather, hot winds and intense sunshine. Workers in the northern states have been interested in producing early kinds adapted to a short growing season. Selection and breeding to secure resistance to fusarium wilt was one of the first problems to be attacked in tomato improvement. Highly resistant varieties have now become standard. Material in the hands of plant breeders gives promise that wilt immune sorts will appear in the immediate future.

The grower will find among the long list of tomato varieties offered by seedsmen some that are suitable only for growing in the home garden, others for local markets, some for long distance shipping and still others for the cannery. High quality and productivity

are the most desirable characteristics for a home garden variety. Tomatoes for shipping should have in addition good handling and keeping qualities. Canners like varieties that have a bright red color, a smooth surface and a small core.

Tomato varieties are more sensitive to differences of soil fertility and climate than is generally believed. For mid-western conditions desirable characteristics are resistance to fusarium wilt, sufficient foliage to protect the fruit from the sun, ability to develop good red color in hot weather, early bloom to escape blossom drop in mid-summer, freedom from cracking and rapid ripening of the fruit. There is no one variety however that is best adapted to meet all of the various soil, climatic and market conditions found in this State. The experiment station has recently produced a number of new tomatoes which are almost completely wilt resistant and which are now under field trial. Some of these should be available for general distribution within the next two years.

The following list does not contain all the good varieties, but it does include some which are of proven merit, well adapted for special and general purpose use and readily available through seed dealers. There are several newer varieties which have not been thoroughly tested. The older varieties not listed are either obsolete or too limited in use to include in a general list. The number given after each variety indicates the days from transplanting to first picking.

Grothen's Red Globe (60 days).—This is one of the best early varieties for Missouri. It is a selection from Break O'Day that ripens and colors better during hot weather. Maturity is a few days later than the Earliana strains but it is much better in type and quality.

The vines are large with an open habit of growth and resistant to fusarium wilt. The foliage is medium heavy but not sufficient to protect the fruit during hot weather. The fruit is bright red and globular in shape. When well grown it attains good size, is very smooth and quite firm for an early tomato.

It ripens more uniformly than most early kinds during hot weather being free from yellow at the stem end. This variety is recommended for market garden use where earliness is of first importance. It is not a desirable canning variety.

Stokesdale (64 days).—This medium early, wilt resistant variety is said to be replacing the varieties of the Bonny Best group. It seems to have wide adaptability since it is being used as a shipper from the South and as a canner in the northern states. The spreading vine is of medium size with about average foliage. It is somewhat resistant to dry weather but does not produce enough foliage for protection on light soils. The fruit sets well and the variety is highly productive. It is similar to Marglobe in shape but slightly smaller. The internal color is good with ripening progressing from

the inside outward. The fruit is very solid and ships well. The chief defects are the small size of the fruit and insufficient foliage on poor soils. This is a very promising early midseason variety for general use.

Early Baltimore (67 days).—A wilt resistant selection from Indiana Baltimore was the parent of this variety, but it is distinctly different from the Indiana strain. The vines are smaller and finer. The habit is spreading. It is well suited for growing on soils high in nitrogen and is also very dependable under unfavorable weather conditions. The foliage does not offer sufficient protection on light soils. The fruit is firm and free from cracks but somewhat smaller than the Indiana Baltimore. The canning quality is good, and is very productive. It does not seem to be adapted to the light soils of the Ozark region. It is apparently a canning and home garden variety well suited for growing on the heavier and more fertile soils in the northern part of the State.

Pritchard (72 days).—This wilt resistant second early variety is very productive under all conditions and one of the best all around varieties for the home garden. The vines are rather small upright and self-topping, therefore, it can be set closer than most varieties. The soil should be made very fertile before attempting to grow this variety. The fruit is smooth, very resistant to cracking and globular in shape. The flesh is solid, the walls thick, and the flavor mild. The color is a medium scarlet which is not as desirable for canning as some of the other varieties. On poor soils the size becomes very small toward the end of the season. Its chief merits are productiveness and high quality.

Marglobe (78 days).—This is the most popular and widely grown variety today. It was one of the first of the new varieties which combined high quality with the wilt resistant character. It is also resistant to the nail head rust disease. It is a late mid-season variety grown extensively for shipping and canning. It has long been a favorite in the home garden. The vine is vigorous and upright with a medium coverage of coarse leaves that are resistant to drought and disease. The fruits have a deep globular shape, which has become the standard for a market variety. They are uniform, smooth, and solid with meaty centers. The color is deep scarlet. There is a tendency for deep radial cracks to form around the stem end. Also during warm weather the fruit colors slowly and ripens unevenly on the shoulders. During hot weather the blossoms drop heavily. Despite these defects it is one of the best all around varieties.

Indiana Greater Baltimore (78 days).—Improvement in this variety has been towards meeting the requirements of a canning tomato. It has become the leading variety grown for this purpose throughout the central states.

Unfortunately it cannot be grown where the soil has become infested with the fusarium wilt disease. The vine is vigorous, semi-erect and well covered with a heavy foliage that affords excellent protection from sun-scald. It is also resistant to heat and drought. On fertile soils, it is probably not as productive as members of the Marglobe group. The fruit is smooth, large and firm with small cells. The size is maintained throughout the picking season. The bright, deep red color extends throughout the flesh. The color forms rapidly and evenly over the entire fruit. The flattened shape is not the most desirable for slicing. Also the fruit lacks the solidity for a first class shipping tomato. On soils very high in nitrogen the foliage growth and blossom drop may become excessive. Because of its canning quality and drought reistance it is well adapted to the Ozark region.

Rutgers (80 days).—A wilt resistant late maturing tomato bred for an intense internal color so desired by the juice and tomato products industries. It has also become popular in the South as a green wrapped shipping tomato because of its solidity and keeping quality. The vines are only medium in size but disease resistant and vigorous. The stock upright vines are well covered with heavy foliage. In the Ozark region production has not been as high as with some of the other varieties but the quality has been excellent. This large tomato is bright scarlet in color with the ripening progressing from the inside outward. The fruit is of a flattened globular shape, very firm and of excellent quality. It is said to grow somewhat rough under certain conditions. The chief defect in the variety has been the light fruit set during periods of hot-dry weather.

Norton (85 days).—A wilt resistant selection of the Stone variety. The large spreading vine carries an abundance of foliage that is resistant to heat and disease. The large leaves give excellent protection and mature fruit of good size and quality throughout the season. The tomatoes are large, oval, solid and smooth. The rich red color appears evenly over the fruit. This is a good variety where a late maturing type is desired for the cannery or home garden. It is resistant to adverse weather conditions and does well on light colored soils. It does not yield as well as the early maturing varieties. On very fertile soils the vine growth becomes excessive.

LOCATION AND SOILS

The tomato has a wide range of adaptation to various soil types. With proper care and attention, the fruit will thrive upon any soil suited to the production of farm crops. New land is often preferred because of the increased yields and because there are fewer weeds to fight and less cultivation required. In general, a well drained, moisture holding, fertile loam is desired.

In Missouri, successful crops have been grown on many different soil types, from heavy bottom lands to the light gravelly soils of the Ozark uplands. Light soils in this state are subject to drought and are hard to keep supplied with organic material. Heavier soils are later and are preferred for the main and canning crops.

Tomatoes will often make a fair crop under adverse conditions and on rather poor land. For this reason a mistaken impression has sometimes been obtained that tomatoes do not require a fertile soil. On the contrary, there are few crops as sensitive or responsive to conditions of soil fertility. Instead of planting on medium or poor soils the best land brought to a high state of fertility and preparation should be used for best returns.

Improving Soil Fertility.—By plowing under barnyard manure and such leguminous crops as cowpeas, soybeans, vetch, red clover, alfalfa, sweet clover and lespedeza, humus and nitrogen are added to the soil.

Non-leguminous crops like wheat, rye, oats and others may also be plower under, but a nitrogen fertilizer or a complete fertilizer high in nitrogen should be applied broadcast at the rate of about 100 pounds per acre before plowing. Unless this is done, the following tomato crop may be starved for nitrogen.

Every acre or portion of an acre selected for tomato growing should be fitted as economically as possible for maximum yields. This is true because the cost of plants, fertilizer, spraying materials, cultural equipment, and labor expended will not be materially higher on productive soils than they will be on poor soils.

Consequenty, before planting tomatoes, the producer may well consider such problems as the location as regards to good air drainage, importance of satisfactory soil drainage, and adequate supply of organic matter. The proper solution of such problems will generally make tomato growing profitable.

Short Cropping Systems.—(1) Early oats sown for hay may be followed by a cover crop of cowpeas to be plowed under in the fall. Tomatoes may be set the next spring. (2) Early potatoes may be followed by a crop of cowpeas to be plowed under in the fall. As in the first example, tomatoes may be set the next spring. (3) Hairy vetch may be sown on a well prepared and thoroughly compacted seedbed about August 15th, in which case the crop should make a good fall and early winter growth and cover the soil thoroughly during the fall and winter. The vetch may be plowed under during the latter part of April or the first half of May. The tomatoes may then be planted as soon after the frost-free date as seems advisable. (4) Cowpeas or soybeans may be planted in rows and cultivated and the crop plowed under in the fall. Tomatoes may be set early in the spring.

It is important that each grower plan a system of crop rotation to fit his own particular conditions. He should remember, however, that if diseases are present in the soil, tomatoes should not be grown oftener than once in six or seven years unless disease-resistant varieties are used. If crops such as potatoes, peppers or egg plant are included in the rotation, the effect is very much the same as an extra crop of tomatoes. This is true because the vegetables mentioned are closely related to tomatoes, and some of the diseases affecting one may affect all.

Manure.—While the tomato requires a fertile soil, it is very sensitive to an unbalanced nutrient condition. For this reason it is usually best to apply barnyard manure to the crop preceding tomatoes in the rotation. Especially is this true of heavy soils where an application of manure immediately preceding tomatoes may cause excessive vine growth. If manure is to be applied, the application should be made and turned under in the fall. The manure may also be made much more profitable by adding and applying about 250 to 300 pounds of superphosphate per acre.

Commercial Fertilizers.—The tomato plant is a heavy feeder and demands a constant supply of plant food from the soil. From the time the seed germinates until the last fruit has been gathered, the plant should be supplied with a balanced supply of plant nutrients. A shortage of plant food at any time may be reflected in a decreased yield.

The best fertilizer for the plant bed is well rotted manure. This can be applied at the rate of 1 ton per 1,000 square feet of bed space.

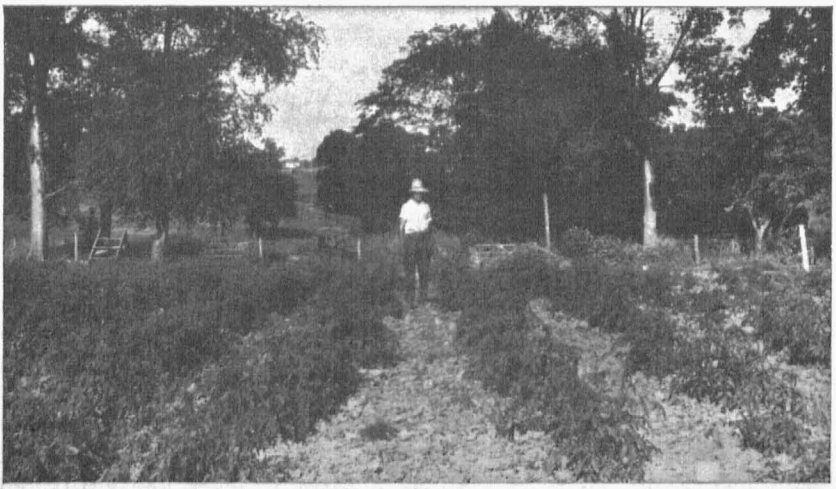


Fig. 2.—Phosphate fertilizer is highly effective in tomato production. The plot on the left received manure plus 200 pounds of superphosphate. That on the right received manure only.

Increased growth can be secured by reinforcing each ton of rotted manure with about 35 lbs. of a complete fertilizer mixture such as 4-16-4 or 50 lbs. of 20% superphosphate. Plants grown in a fertile seed bed can be set in the field with less shock than those which have become stunted.

Fertilizer mixtures analyzing 4% nitrogen, 12-20% phosphorus and 4% potash will usually give profitable returns when used at rates up to 500 lbs. to the acre. If the soil has been well manured, an application of phosphorus alone such as superphosphate may give good results. If the soil has been well supplied with nitrogen through the use of legumes and manures, a commercial fertilizer which does not contain nitrogen may be used.

Method of Application.—The fertilizer, to be effective, must be applied so that it is available to the plant but far enough away to avoid injury. High concentration of fertilizer salts are toxic to plant roots and stems and should not be placed in direct contact with the plant. The fertilizer is often applied in the furrow or row and mixed thoroughly with the soil before planting. A more economical method of applying the fertilizer consists of placing it in a narrow band 2 to 3 inches wide about four inches away from the plant and from 3 to 4 inches deep. Most transplanting machines are made to apply the fertilizers in this way. Where the setting is done by hand, a furrow can be made with a hoe or cultivator next to the plant and the fertilizer distributed by hand and later covered with soil. The fertilizer may also be applied before plowing by broadcasting over the surface.

Use of Starter Solution.—The use of fertilizer salts dissolved in water at transplanting time may be beneficial by giving the plant a quicker start. This is particularly true when the plant has been stunted, overgrown or crowded in the plant bed. The starter solution is prepared by mixing about 2 lbs. of di-ammonium phosphate or ammo-phos and 1 lb. potassium nitrate in 50 gallons of water. If these materials are not obtainable, an ordinary complete fertilizer mixed at the same rate can be used. One-half pint of the solution is poured around the roots at transplanting time.

SEEDS AND PLANTS

The best of planning and management resulting in soil developed to a high state of fertility will be of little value if the grower uses poor seed or plants. Perhaps no one things is more essential to a successful crop than securing good seeds and plants from the best seed stock obtainable. A tomato variety in the hands of a careless seed grower may, after several years, become almost unrecognizable. Happily, there are many reliable and careful seed growers whose products are as represented. Local county agents, teachers of voca-

tional agriculture, good truck growers and the Agricultural Experiment Station will know the better sources of seed and plants.

Planting Dates.—Early setting is important since setting the plants in the garden or field on the frost free date or as soon after as weather and soil conditions permit will increase yields materially. Early set plants generally develop a good crop of early fruit before the extreme heat and drought of summer. Plantings made after June first are usually less profitable, because they reach their fruiting stage at a period which may be very unfavorable for growth due to the excessive heat and dryness. Fertilizers are also less effective in increasing yields because of the lack of moisture.

Planting time for tomatoes will vary with the location within the State. According to the U. S. Weather Bureau, the average dates at Columbia of the latest and earliest killing frosts are April 16 and October 13, giving a growing season of approximately 175 days. (The tomato requires from 150-170 days to mature a crop from seed). Extreme southern and northern parts of the State will vary from these dates approximately ten days.

A desirable tomato plant for setting in the field should have a well developed root system, a thick sturdy stem and plenty of dark green leaves. Approximately 6 to 8 weeks' time is required to produce a plant of this type from seed. As tomato plants are very susceptible to frost injury, it is well to postpone setting in the field until after the frost-free date. In Central Missouri this would be about May 10. For those who desire extra early tomatoes, plant protectors may be used and the date of setting out plants can be moved up two or three weeks. However, plant protectors will not afford protection for more than two or three degrees below freezing.

To obtain plants for setting during the early part of May, seed may be sown in hot beds about March 1-15. Seed sown in cold frames will not ordinarily grow plants as quickly as in hot beds, so transplanting will be delayed or smaller plants must be set out. Generally, in Central Missouri, seed should not be sown in cold frames until the last two weeks in March. For extreme South Missouri, seed may be sown about 10 days earlier while for the more northern portions of the State seeding should be about 10 days later.

Moreover, locally grown plants sold by reliable producers are much more likely to give good results than the so-called "shipped in" southern plants. The planting of the latter by commercial growers, particularly of Southwest Missouri, has brought much grief and disappointment. This is true because the southern plants are often infected by serious diseases.

Growing Plants.—Tomato plants are grown in several ways. The home gardener may purchase plants from an experienced plant grower, or he can easily grow a sufficient quantity of plants by

sowing seed in a box and keeping the box in a warm room in the house. After the seed has germinated, it is essential that the small plants receive sunlight and they should be placed in or near a window.

The market gardener and truck farmer usually desire early tomatoes in order to derive the benefit of early high prices. Unless the plants can be purchased very cheaply, special plant-growing structures are necessary. Greenhouses, of course, are much to be desired. Convenience in culture and better control of temperature and watering are advantages of this type of structure. The disadvantage is the cost of erection and maintenance. Hot beds and cold frames are utilized by most growers. Hot beds are necessary for very early plants, especially in the northern parts of the State. Cold frames are widely and successfully used, however, even though the plants are somewhat later.

Tomatoes for canning are produced as cheaply as posible. Temporary cold frames and open plant beds are utilized. The cheapest and simplest method is to sow the seed in open beds after the season is far enough advanced that the plants can grow without protection. This method will produce small hardy plants, easy to transplant, if the plants are thinned sufficiently to avoid crowding in the bed. A better method, however, of growing canning tomatoes is to produce the plants in coldframes. Plants may be secured 2 to 3 weeks earlier by this method, resulting in a longer picking season and greatly increased yields.

Coldframe Method.—Experimental results for six years have shown that good plants for the main crop can be grown in the ordinary coldframe without the use of artificial heat. Seed sown in Central Missouri on April 1, usually produces stocky plants by May 10. The coldframe can be started safely two weeks earlier in south Missouri. New soil on which tomatoes have not been grown should be used in the coldframe each year.

Only the most fertile loam available should be used for growing plants. Reinforcing such soil with a generous application of rotten manure and one-half pound of a complete fertilizer such as 4-16-4 per sash will aid in the production of vigorous healthy plants.

Seed Treatment and Planting.—The tomato seed should be treated before planting to prevent damping off or rotting of the young seedlings. Good protection can be secured by mixing one-fourth ounce of red copper oxide dust with each pound of seed. There are several commercial preparations on the market which are satisfactory for treating tomato seed.

Seeding in Plant Bed.—The seeds are usually sown in rows spaced about 4 inches apart. When the plants are 1½ to 2 inches tall, they are thinned to stand about ¾ inch apart in the rows. With this spacing, over 800 plants can be produced under each sash.

It is a common practice, when growing plants in the greenhouse or hotbed, to sow thickly in a flat and transplant when the first true leaf appears. The transplants are given more space per plant since they will be larger by transplanting time than those grown in the coldframe.

In watering, care should be taken to prevent damping off and the growing of spindling plants. Water should be applied only when needed and then thoroughly to soak the soil to a depth of several inches. Watering during the early morning of bright days in order that the soil surface may become dry by night fall will also be helpful. The bed should be watered thoroughly after sowing the seed but sparingly until the plants are thinned.

Protecting Bedded Plants from Disease and Insects.—The growing plants can be protected from leaf diseases by spraying three times at 10-day intervals with a 4-4-50 bordeaux mixture. If leaf eating insects appear, an arsenical (lead arsenate) may be added to the spray mixture at the rate of 1 lb. to 50 gallons.

Conditioning.—If the plants are grown in cold frames or hot beds, more and more ventilation should be provided until the sash or covering is entirely removed both day and night for several days before transplanting. Water should be applied only when necessary to stop severe wilting of the plants. The management of plants grown in greenhouses is much the same, although it is difficult to attain the same low temperatures available to the plants in smaller structures.

Selecting Plants.—Transplanting provides an opportunity for selection of the best plants and for discarding small, spindling or malformed ones. Only the best should be used. A well-grown plant is an important part of a profitable crop.

Stocky, vigorous plants, get a quick start in the field following planting and may prove very productive, while weak, spindly, succulent plants are likely to be slow in coming into production and give poor returns.

PREPARING THE GROUND

Before setting out the plants, every effort should be made to put the ground in good condition. When the land has been fall plowed, a firm and compact seed bed is readily obtained. The soil should be thoroughly worked so that all clods are broken up and all weeds destroyed. The time spent in working the soil before transplanting will mean a saving in cultivating later, and, in addition, will give the plant a much better opportunity to grow well.

Transplanting.—The plants should be taken up with as much dirt as possible adhering to the roots. Where they have been transplanted and spaced in the hot bed or cold frame, they may be cut out and lifted if the soil is properly watered with comparatively small disturbance to the roots. Blocking off the plants by cutting

squares about each a few days before setting in the field is recommended. Plants that are grown in pots or paper bands may also be transplanted with little root disturbance. Handled in this way, they should continue to grow without appreciable checking. When the plants are pulled, all the fine root hairs and portions of the larger roots may be left in the ground. The plant then must grow new root hairs before moisture can be taken in. If temperatures are high and there is a drying wind at the time of setting, they may wilt beyond recovery. Small pulled plants may be set with a transplanting machine. Larger ones with potted or blocked soil should be set by hand in a furrow or in a hand-made hole.

The depth to set the plant will vary with its size. However, all sizes should be planted well down in the soil. A tall slender plant, if not placed deep in the ground, may be snapped off by the first gust of wind. A depth of about 3 inches should prove satisfactory for most plants.

The soil should be carefully firmed about all transplants and no air spaces left near the roots. Where only a small number of plants are to be set out and the soil is dry, it is advisable to water each as it is set. Setting out with water is not so feasible with large numbers of plants unless some irrigation system is available. The most favorable time for transplanting to the field is late evening or on a cloudy day, preferably just before a rain. The plants should be well watered before being removed from the plant bed.

Spacing.—Spacing in the field will vary considerably. Soil fertility, variety, method of pruning, and staking must be considered. Untrained plants may be spaced 3 x 4 feet to 4 x 6 feet as the soil fertility increases. If they are staked and pruned to one or two stems, they may be spaced 2 to 3 feet apart in rows 3 to 4 feet apart. The following table shows the number of plants required per acre for various planting distances:

Planting distances	Plants required per acre
2 x 3	7260
3 x 3	4840
2 x 4	5445
3 x 4	3630
4 x 4	2722
3 x 5	2904
4 x 5	2178
4 x 6	1815

An ounce of seed germinating 95% should produce approximately 2000 plants.

Cultivation.—Cultivation should be frequent as the plants are growing, and the first one should be given soon after the plants are

set in order to loosen the soil that has been packed during transplanting. Early cultivations may be fairly deep, but, as the plant increases in size and the roots fill more of the soil spaces, the depth should be decreased. After the plant has fairly well covered the ground, cultivation should stop.

Timeliness in cultivation is essential. Weeds should not be allowed to get a start. Where the ground is well supplied with organic matter or humus, cultivations may be made much sooner after rains.

HARVESTING

The tomato fruit is highly perishable and tender. Care must be taken at picking time to obtain fruit at the proper stage of maturity. For most fresh markets the fruit is picked when showing from 65-80% color. When tomatoes are shipped to distant markets, the fruit is picked either at the "green wrap" stage or at the "turning pink" stage. A few growers in Buchanan, McDonald, and Newton counties ship fresh tomatoes to other states.

Tomatoes for canning should be picked at the full ripe stage as only ripe tomatoes will make a high quality canned product. In most states where tomato canning is a well organized industry, very definite grades are established and growers are paid according to grade. Color cards illustrating the degree of ripeness necessary for each grade are used by the inspectors. Generally, a tomato must show about 90% of the surface to be colored and to be free from injury and disease before being graded as a No. 1 canning tomato. Careful handling of the picked fruit is essential. A bruised tomato deteriorates rapidly and may injure the sales value of an otherwise attractive basket of fruit.

SAVING SEED

Some growers may desire to save their own seed for future crops. This practice, however, is not recommended except to careful individuals. To save seed, several outstanding vines should be selected during the season. These should be marked by stakes and the fruit allowed to mature fully before picking. The fruit of the selected vines should, of course, show the characteristics that the grower desires, such as earliness, large prospective yield, quality and vigor of plant. A small portion of the seed from each vine should be kept and planted separately the next year. Yields records or observations should show which selection should be retained for future seed production. Constant observation and selection will be necessary to maintain the desirable properties of the strain.

The seed is obtained from the ripe tomato by cutting the fruit in half, squeezing out the pulp and seeds into a container, and adding

some water. After fermenting several days the pulp separates from the seed and rises to the top along with light immature seed, and is poured off when the seed is washed. It is then dried and stored in a dry clean place.

DISEASES

Many sections in Missouri have suffered heavy losses due to tomato diseases. There are several of these which concern the home gardener and commercial grower. A description of the more common diseases and suggestions for control follow:

Fusarium Wilt.—This disease is reported in many sections of the State. It is caused by a fungus organism known as *Fusarium lycopersici.* The organism is found in the soil where infected plants have been grown and may live there several years before the soil is safe for another tomato crop. Entrance in the plant is made through the roots. The disease attacks the tomato plant at all stages of growth. Seedlings grown on infected soil may wilt and die before being transplanted. When disease free plants are set in infected soil, the symptoms may not appear until later in the season. Most commonly the plant will show symptoms at the time the first few clusters of fruit are developing.

Fig. 3.—Tomatoes grown on wilt-infested soil. The two rows on the left were Bonny Best and two on the right were Marglobe. The Marglobe yield was three times greater than that of the Bonny Best.

The start of the disease is indicated first by an unward rolling of the leaves followed by wilting and yellowing. The symptoms are first noted on the lower leaves, later advancing upward. After entering the plant through the roots, the fungus progresses upward

through the stem by way of the water conducting tubes. The breaking down and obstructing of the conducting tubes by the fungus result in shutting off the water supply, with consequent wilting. If the stem of a diseased plant is split, brown discolored streaks will be noted in the tissue. A cross section of the stem will show the discoloration in the form of a dark ring.

A rotation of crops which brings tomatoes to the same land only once in 6 or 7 years is effective whenever practical. When tomatoes must be grown oftener on the same ground, disease resistant varieties should be used. Several worthwhile varieties have been developed which have a relatively high degree of resistance. However, none of these are completely immune and an exceedingly hot dry unfavorable growing season will result in a greater percentage of plants of the resistant varieties dying of wilt. A grower who has not been troubled with tomato wilt should take every precaution to prevent its introduction to his soil. This disease is commonly introduced by buying diseased plants that were grown on infected soil.

Septoria Leaf-spot.—This leaf spot, sometimes spoken of as "blight", often gives much trouble in rainy seasons. The disease affects the lower leaves first, causing small gray spots with black borders to appear, followed by drying and dropping of the leaf. The disease frequently advances upward until the plant is practically defoliated. The loss of leaves may cause scalding of the fruit. Also, the reduced leaf area will lower the food manufacturing power of the plant so that the tomatoes will not mature properly. The organism responsible for Septoria leaf-spot is *Septoria lycopersici.* The disease may be checked by using clean soil in the plant bed, by spraying the small plants with a 2-3-50 bordeaux and the large ones in the field with a 3-4-50 mixture at intervals of 10 days or 2 weeks. Cleaning up and burning old vines and leaves after each crop, deep fall plowing, and crop rotation, will aid in reducing losses.

Mosaic.—This is a virus disease which is characterized by crinkled mottled areas of light and dark green on the leaves. The fruit of badly infected plants is malformed, yields are cut in most cases, and if infection takes place before the flowers develop the fruit may be a total loss. Infected plants should be removed and destroyed, as the disease is easily spread by insects, pruning tools, or by handling infected plants. In the greenhouse each plant should be carefully inspected before any pruning is done.

Blossom-end Rot.—It affects the green fruit, causing sunken, discolored spots on the blossom end. A proper soil moisture supply generally reduces injury to the fruit. An abundance of organic matter in the soil helps to hold moisure, and seems to lessen the damage. Spraying is of no value.

INSECTS

Tomato Worm.—This insect is a large greenish colored worm often called the tobacco worm. It may be controlled by spraying with 1½ pounds of arsenate of lead in 50 gallons of water or bordeaux mixture. If the sprays are applied as soon as injury is observed, they will be more effective. If the arsenate of lead is combined with bordeaux fungous diseases may also be controlled. Seven parts of air slaked lime and one part of lead arsenate dusted on the plants should also prove effective. If the worms are ½ to full size, five parts lime should be used to one part lead arsenate. Hand picking and destroying the worms is feasible in small plots.

Fruit Worm.—This worm is very destructive in some seasons. The worms bore into the green and ripening fruit and are especially damaging to half-grown green fruit. All affected tomatoes should be picked and destroyed as this helps to eliminate later broods. Just after the first fruits are the size of marbles a spray or dust of lead arsenate will help greatly in control of the pest. The application should be repeated in a week or ten days.

Blister Beetle.—Severe damage may be done by these beetles, which often appears in large numbers. The beetles feed on the plant foliage and may strip the plants of leaves in a very short time. They can be driven from a field by starting at one side, beating the soil with a branch or paddle near the beetles and shaking the vines, working gradually to the other side of the plot. Straw or dead grass is placed here and when the insects have entered it, they are destroyed by setting fire to the litter. Heavy applications of cryolite as a spray or dust may also help control the beetles.

Cut Worm.—Cut worm damage may be severe in cool weather. The small plants are cut off at the ground level. Although warmer weather usually brings a halt in the activities of the warm, conditions may be such that the cut worms will continue to do considerable damage. The best remedy is the use of poisoned bran broadcast very thinly along the tomato rows late in the evening just before dark. To prepare the poisoned bran, mix dry 6 pounds of bran and 4 ounces of white arsenic or paris green. Then mix one pint of molasses and the juice and cut up rind of two lemons with a gallon of water and add to the bran and poison. Mix thoroughly adding enough more water to make a moist mash after which it is ready to use. Paper collars an inch tall wrapped around the base of the plants as they are transplanted will prevent damage and is a practical procedure where only a comparatively few plants are involved.

Flea Beetles.—From two to four sprays at intervals of about 7 days may be needed, making the first application as soon as injury is noted. Use 6-6-100 bordeaux plus two pounds of calcium arsenate. Spraying is generally superior to dusting but where spraying equip-

ment is not available a 15-5-80 copper sulphate, calcium arsenate, hydrated lime dust may prove valuable if applied early in the morning when the plants are wet with dew.

SANITATION MEASURES

Dipping plants down to the roots in a poisoned bordeaux solution at the time of transplanting will help ward off early flea beetle injury. Tomato fields and patches should be kept free from horsenettle, ground cherry, and nightshade as these plants are hosts for mosaic diseases that may spread to the tomato plants. The destruction of all growing weeds in and near tomato patches is essential in insect control. At the close of the season many insects and diseases may be destroyed and kept under control by plowing under deeply or burning all crop remnants.

THIS BULLETIN AT A GLANCE

1. Varieties should be selected which are especially suited to the purpose for which they are grown. They should also be adapted to the soil and climate and have satisfactory yield records for the localities in which they are grown. Page 3.

2. The best seed and plants obtainable will in the long run prove to be the cheapest. Page 9.

3. In growing cannery tomatoes, the coldframe method of producing plants generally gives the best results. The needs of the market gardener and home grower can usually be met satisfactorily by the use of the hotbed if greenhouse facilities are unavailable. Page 11.

4. Avoid "shipped in" plants on account of losses that may be entailed through the introduction of serious diseases. Page 11.

5. Setting the plants on or soon after the U. S. Weather Bureau frost free date increases earliness, total yield, hastens good growth before the occurrence of summer drought, and lengthens the picking season. Page 11.

6. To improve tomato soils, the use of short cropping systems and manure is suggested. Page 8.

7. Of the commercial fertilizers, phosphorus generally gives the best results. For the cannery crop, light applications of 200 to 300 pounds per acre is suggested, while the market and home gardeners may use profitably additional amounts. Page 9.

8. Prevent tomato wilt by growing in disease-free soil or by using wilt resistant varieties. Page 15.

9. Control insects through good culture and the application of timely dusts or sprays. Page 17.

10. It pays to cooperate with the local cannery and marketing agents in picking, handling, and packing operations in order to deliver a high quality product. Page 14.