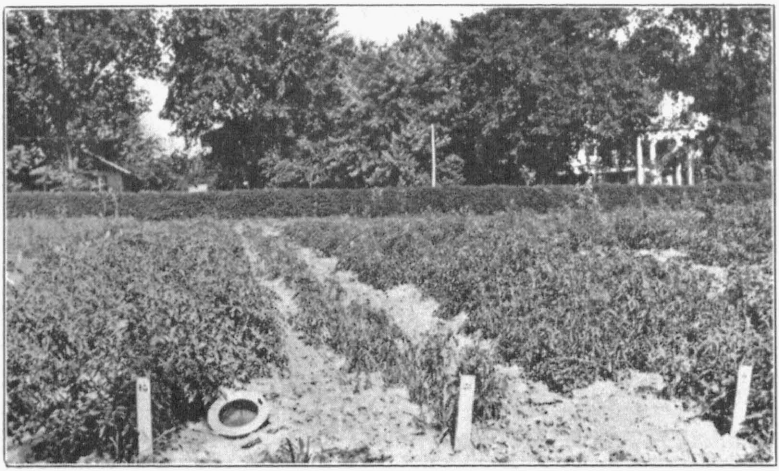
UNIVERSITY OF MISSOURI COLLEGE OF AGRICULTURE
AGRICULTURAL EXPERIMENT STATION
BULLETIN 212

TOMATO CULTURE IN MISSOURI



Tomatoes grown on soil infected with the wilt disease. Wilt resistant varieties are shown in Row 2 (left) and Row 4 (right); ordinary variety in Row 3 (center). Experiment grounds of the College of Agriculture, Columbia, Mo., July, 1923.

COLUMBIA, MISSOURI
MAY, 1924

UNIVERSITY OF MISSOURI

COLLEGE OF AGRICULTURE

Agricultural Experiment Station

TOMATO CULTURE IN MISSOURI

J. T. QUINN

Abstract.—A sandy loam soil of high fertility is one of the best types for the production of tomatoes in Missouri. The hotbed method of starting plants is recommended for the home and market gardener. The coldframe or open bed method is best adapted to the cannery crop. Phosphorus seems to be the most important fertilizer element for tomato production on Missouri soils. The application of 400 to 500 pounds of fertilizer for the early crop, and 200 to 300 pounds for the cannery crop, is recommended. Data presented indicate that staking and pruning to one stem is unprofitable. Mulching with straw is recommended for the home gardener. Data show that profitable yields may be obtained on land infected with Fusarium wilt by the use of wilt-resistant varieties. The principal diseases and insects with their control are described.

The tomato is one of the most important truck crops in Missouri; dependable in the home garden, and profitable in the market garden. The tomato industry in Missouri has gradually grown from 7,000 acres in 1915 until approximately 18,000 acres are now grown annually. The canning sections of Southwest Missouri are chiefly responsible for the increase in acreage, while a large acreage of the market crop is grown near the principal cities. Although Missouri's yield per acre is comparatively low, yet it increased from 2.2 tons in 1918 to 3.5 tons per acre in 1922.

SOILS

A sandy loam soil of high fertility is one of the best types for the production of tomatoes. This does not mean that tomatoes cannot be grown on other soil types, as a great portion of Missouri's commercial tomato crop is grown on the gravelly loams of Southwest Missouri.

Loose sandy soils generally produce larger yields than the heavier clay soils, while any well drained soil with the aid of commercial fertilizer should give profitable yields.

Tomatoes may be successfully grown year after year on the same land, provided the soil does not become seriously infected with organisms causing tomato diseases, and provided the fertility of the soil is maintained by the use manures and commercial fertilizers. However, when the soil becomes infected with such an organism as *Fusarium lycopersici* (tomato wilt) it will be necessary to practice at least a seven-year rotation, except where varieties resistant to this disease are used.

SEED

The grower should purchase seed from a reliable seedsman who is known for his production of high grade seed; or he should save seed from his own crop. The saving of home seed is a simple procedure. With the desirable type of

NOTE.—This work prior to 1923 was carried on by J. T. Rosa, Jr., formerly of this Station. A portion of the data was published in 1922 as Missouri Agricultural Experiment Station Bulletin 194.

plant in mind, stakes should be placed near such plants as seem to conform to the ideal type. This should be done about the time the plants are ripening their first fruit. If the plants staked continue to bear fruit of the type desired and seem to be resistant to diseases as the season advances, they should be the source of your seed. Only fruit of the type desired should be saved from the staked plants. By following this method of selection year after year it is possible to build up a very desirable strain.

VARIETIES

The variety that seems the best adapted to the grower's conditions is the one which should be grown. For the home garden the selection of an early and a late variety will not only supply early tomatoes, but the later variety will furnish tomatoes for fall canning. For the market gardener where earliness is the main factor, such early varieties as Bonny Best, Livingston's Globe and June Pink are satisfactory. In the canning sections of South and Southwest Missouri, a medium late, sturdy growing variety with large smooth fruit is desirable. Such varieties as the Stone, Greater Baltimore and Red Rock are recommended.

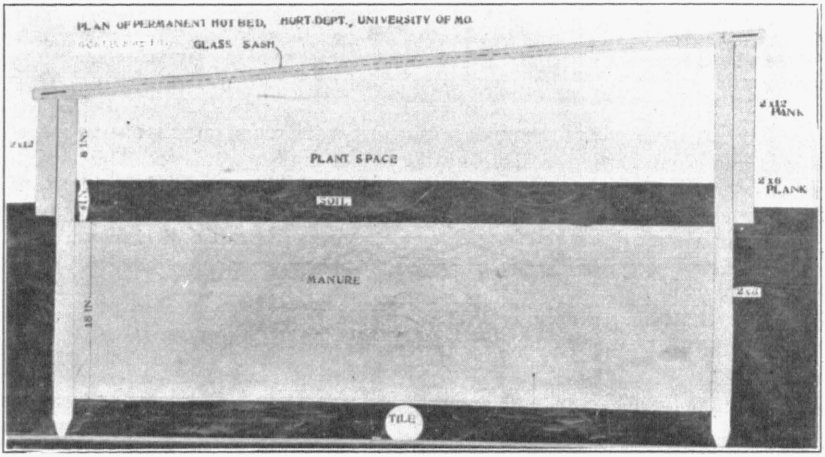


Fig. 2.—Cross section showing the construction of permanent hotbed.

PLANT GROWING

The production of well grown healthy plants is essential to the production of a profitable tomato crop. Where the plants are to be grown for the production of early fruit, as in the case of the home garden and market garden, the hotbed method is used. The coldframe and open bed method are used almost exclusively by cannery growers, as the need for early fruit is not so important as in the case of the market gardener, and the cost of production is much less.

The Hotbed Method.—For Central Missouri the hotbed should be prepared the latter part of February or first of March. It is very important that the hotbed be properly constructed, together with the correct amount of manure and soil as indicated in figure 2.

The preparation of the manure to be used in the hotbed should begin about ten days before the time the hotbed is to be used. Fresh horse manure containing straw or leaves about equal to one-third its total bulk has been found to be the most satisfactory heating material for the hotbed. The manure should be piled in a compact heap. As soon as fermentation begins, it should be forked over and repiled. When the entire heap seems to be heated thoroughly it is ready to be placed in the pit of the hotbed. The manure should be thoroughly tramped, especially is this true with the corners and edges. Soil should be placed on top of the manure. When plants are to be grown in flats, and the flats placed in the hotbed, 2 inches of soil is sufficient, but when plants are to be transplanted directly into the bed at least 4 inches of soil should be used. As soon as the soil is in place, the sash are placed on the frame and the heating allowed to continue until it has dropped to about 90° F. at which time seed may be sown. If seed is to be sown in flats, they should be well watered and placed in the hotbed. The most common method is to sow the seed directly in the hotbed in rows about 4 inches apart. When the plants are about 3 inches

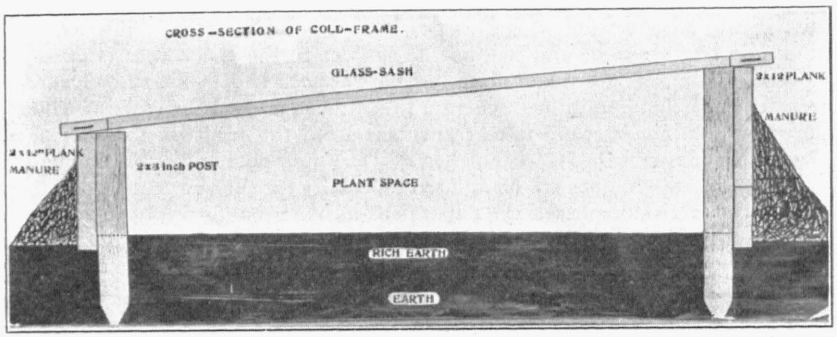


Fig. 3.—Cross section showing construction of coldframe.

high they may be pricked off and transplanted to stand 3 inches apart in a hotbed or coldframe. Enough seedlings for one acre can be grown in a hotbed area of 6 by 4 feet. When the plants are transplanted 3 by 3 inches apart it will require a hotbed or coldframe space of 6 by 30 feet for one acre.

The Coldframe Method.—This method is much the same as the hotbed method except that the seed is sown later, usually the latter part of March. Very often the ordinary sash is replaced with paraffin or oil treated cloth, this having been found to be just as efficient and much cheaper.

Care of Hotbeds and Coldframes.—The ventilating of the hotbed is very important. To keep the temperature constant requires a considerable amount of attention. The amount of ventilation will depend on outside weather conditions. For the early spring the amount of ventilation may be very little while as the season advances, the sash may be removed from the frame on warm sunny days. For the last week or ten days before the plants are to be set in the field, it is well to leave the sash off the frame both day and night if the weather is favorable. This will harden the plants and the number lost from exposure after being set in the field will be very small. Tomatoes grow best at a temperature around 75° during the day with a minimum of 60° at night.

Watering.—The soil should be thoroughly wet just after sowing the seed or transplanting the plants. The amount of subsequent watering required will depend on weather conditions. A good watering every ten days to two weeks is usually sufficient during the cool days of March while later in the spring, it may be necessary to apply water every two or three days. Do not apply water unless the soil shows signs of drying out. When watering do not sprinkle, but water thoroughly.

The Open Bed Method.—This is the method most used in many of the cannery sections of the state. Seed is sown in the open without protection. Plants should be thinned so as to allow space for the plants to develop. The aim of the grower is to produce healthy, stocky, well grown plants for setting in the field at as low a cost as possible. Plants grown in this way are usually much later than the hotbed or coldframe plants, but are early enough for the cannery crop.

TRANSPLANTING

The transplanting of seedling plants at least once before setting in the field should be practiced whenever possible. Plants handled in this way will be strong and vigorous and will not be subject to the check that is often incurred when plants are taken directly from the seed bed. Under home garden or market garden conditions, where a greenhouse is used for starting plants, the most common method is to transplant from the seed flat to other flats, placing the plants from 1½ to 3 inches apart. Paper pots or dirt bands ranging in size from 2 to 4 inches are being used especially for the very early tomatoes. Due to the fact that most of the paper used in paper bands or pots decompose quite rapidly, it is unnecessary to remove the pot or band when setting the plant in the field.

Setting in the Field.—Tomato plants should not be set in the field until all danger of frost is past. This is usually about the first week in May for Central Missouri. Very little is gained and more often a loss is incurred by setting out plants before the frost-free date. Setting the plants in the field is done mostly by hand, except in some of the canning sections, where the horse-drawn transplanter is used to some extent. When only a few plants are to be set out, a hoe or spade will serve the purpose. When larger amounts are to be planted, a furrow, its depth depending on the size of the plants, should be opened. The plants are placed in the furrow at the desired distance and the soil packed firmly about the plant. The depth of setting will depend upon the size of the plant. Short, vigorous plants need to be set about 4 inches deep while larger plants may have to be set 8 to 10 inches deep. In any case shallow planting should be avoided. The plant bed should be thoroughly soaked with water before removing the plants so that as much soil as possible will adhere to the roots.

The setting of the plants in the field should be done when conditions are most favorable. Setting on cloudy days or late afternoon will help the plants to become established.

Planting Distance.—The planting distance will vary with the fertility of the soil, variety grown and method of culture. Large growing varieties such as the Greater Baltimore will require more space than smaller growing varieties. For the home garden, plants may be placed as close as 3 feet by 3 feet. Under field conditions on a soil of high fertility the minimum distance should be 3 by 5 feet.

CULTURAL METHODS

Cultivation should begin soon after the plants are set in the field. This will loosen the soil that has become packed during the transplanting operations. The cultivator can also be used in pulling the soil up around the plant. The first cultivation should stir the soil to a good depth, each succeeding cultivation becoming shallower. Prevailing weather conditions will have much to do with the number of the cultivations required. However, thorough cultivations of the tomato field during the early part of the season will have much to do with the success of the crop.

Mulching.—It has been found profitable for the home or market gardener to mulch tomatoes with straw, clean grass or other materials. On a large area the expense would be too great to justify mulching. Mulching is especially profitable during dry seasons as it conserves moisture and seems to lessen the amount of blossom-end rot which is so common during dry seasons. The mulch also keeps the vines and fruit from coming in contact with the soil, thereby reducing the amount of disease and spoiled fruit.

Staking and Pruning.—In many home gardens and with a few market gardeners the staking and pruning of tomatoes is a common procedure. Many advantages and disadvantages are claimed for this method. Where the garden area is limited more tomato plants may be set in a given space; also the amount of spoiled fruit due to the contact with the soil may be lessened. Again, plants staked and pruned are more exposed to the sun's rays and thus the amount of sun scald on both stem and fruit is increased. The results of four years' experiments as shown in Table 1 indicate that the largest yield of fruit was produced by plants neither staked nor pruned.

TABLE 1.—EFFECT OF DIFFERENT METHODS OF TRAINING ON YIELD AND EARLINESS OF TOMATOES.*

Treatment	Year	Yield in pounds per acre				Percentage early fruit
		Early	Midseason	Late	Total	
Plants set 2' x 3'; staked and pruned to single stem	1918	8,630	11,080	5,720	25,420	24.0
	1919	2,940	6,120	9,320	18,380	16.0
	1920	3,380	11,233	6,617	23,230	14,5
	1921	9,620	5,510	1,743	16,873	57.0
	Avg.	6,140	8,485	5,850	20,976	30.8
Plants set 2' x 3'; staked but pruned	1918	-----	-----	-----	-----	--------
	1919	-----	-----	-----	-----	-----
	1920	2,640	27,470	13,730	43,840	6.0
	1921	7,040	9,130	2,160	18,330	38.4
	Avg.	4,840	18,300	7,945	31,085	22.2
Plants set 3' x 3'; staked but not pruned	1918	5,720	26,360	6,780	38,689	14.6
	1919	8,080	16,000	20,000	40,080	19.8
	1920	3,240	18,600	9,300	31,140	10.3
	1921	6,380	9,320	2,740	18,440	34.6
	Avg.	5,855	17,570	9,705	32,085	19.8
Plants set 3' x 3'; not staked nor pruned	1918	10,620	43,200	4,030	53,200	20.0
	1919	3,100	21,300	12,000	36,400	8.5
	1920	2,800	24,730	12,370	42,900	13.5
	1921	9,000	12,820	3,600	25,420	35.3
	Avg.	7,130	25,513	8,000	39,840	19.3

*Missouri Agricultural Experiment Station Bulletin 194, 1922.

The data also show that the percentage of early fruit was greater from the plants staked and pruned to a single stem, while the total amount of early fruit was greater from those plants grown in the natural way. The total amount of late fruit was also materially affected by staking and pruning.

COMMERCIAL FERTILIZERS

Although tomatoes are not very exacting as to their soil requirements, it has been shown by experiments that few other plants respond more quickly or profitably to the correct use of commercial fertilizer. Many different fertilizers are being used in different sections of the state, but in general a complete fertilizer of the approximate formula of 3-12-4 or a 2-12-2 has given the best results. Table 2 gives the results from the use of different formulas of fertilizers.

TABLE 2.—SUMMARY OF EXPERIMENTAL FERTILIZER RESULTS FOR 1923
(In pounds per acre)

Fertilizer used	Am't per acre	Total yield	Gain over check	% Gain over check
None	0	15,628		
Manure	8 tons	21,611	5,983	38.3
4-10-2*	300 lbs.	29,810	14,182	90.7
2-10-2	300 lbs.	27,312	11,684	74.1
0-10-2	300 lbs.	26,577	10,949	70.0
2-10-6	300 lbs.	28,125	12,497	79.9
2-10-4	300 lbs.	29,127	13,495	80.6
3-12-4	300 lbs.	30,724	15,096	96.6
2-10-0	300 lbs.	27,051	11,423	73.1
2-16-2	300 lbs.	33,585	17,957	144.9
2-12-2	300 lbs.	29,177	13,549	86.7
Commercial				
3-8-6	300 lbs.	23,973	8,345	54.6
Acid phosphate 16%	300 lbs.	26,354	10,726	68.6
3-12-2	300 lbs.	25,590	9,962	63.7
0-8-6	300 lbs.	21,445	5,817	37.2

*Commercial fertilizer containing 4% nitrogen, 10% phosphoric acid, and 2% potash.

This test was conducted on a Putnam silt loam of medium fertility. The fertilizer was applied in the row and mixed well with the soil before setting the plants. These tests were on a Putnam silt loam of medium fertility. The per cent of early fruit was greater from the complete fertilizer. Manure seemed to retard the production of early fruit, but the total yield from 8 tons of manure was approximately equal to that from 200 pounds of a complete fertilizer.

Amounts Applied.—The amounts of fertilizer to apply will depend to some extent on the type of soil. Table 4 gives a summary of four years' test at Columbia. In 1920 the test was on Knox silt loam of rather high fertility, the fertilizer used was 4-12-0 formula. The tests for 1921, 1922, and 1923 were on a Putnam silt loam of a medium to low fertility. A 2-12-2 formula was used during 1921 and 1922 while a 3-12-4 was used in 1923. In 1922 and 1923 maximum yields were received from 500 lb. applications, while in 1921 and 1922 the yield increased with heavier applications. Although increases were received from the heavier applications during 1921 and 1922, most of the increase in production comes at a time when tomatoes are cheap and it is doubtful whether the increase in yield would justify the heavier applications of fertilizer.

TABLE 3.—RESULT OF TOMATO FERTILIZER DEMONSTRATIONS BY THE COLLEGE OF AGRICULTURE, IN BARRY COUNTY, MISSOURI, 1923.*

Cooperators	Fertilizer	Rate (lbs. per acre)	Soils	Yield (lbs. per A.)	Check lbs. per A.	Lbs. increase	% of increase
Tim Martin Washburn	2-16-2	250	Gravelly Silt Loam hill land	7,840	4,687	3,153	67.3
J. E. Watson Washburn	3-12-4	250	Gravelly Silt Loam hill land	13,136	6,292	6,844	108.7
F. M. Cornman, Jenkins	2-12-2	200	New gravelly hillland	6,000	5,500	500	9.0
Averages for recommended fertilizer against unfertilized				8,992	5,493	3,499	63.7
Walter Weathers Washburn	2-12-6 2-12-2	250 250	Sandy upland (low in potash)	7,950	6,630	1,320	20.0
W. S. Senter Washburn	2-12-2 2-16-2 2-8-2	250 250 250	Gravelly Silt Loam	5,000 4,000	3,000	2,000 1,300	66.6 43.3
Averages for recommended fertilizer against other fertilizer				5,750	4,815	1,540	32.0

*This work was conducted by Mr. E. M. Page, Extension Specialist in Horticulture (truck crops), University of Missouri College of Agriculture.

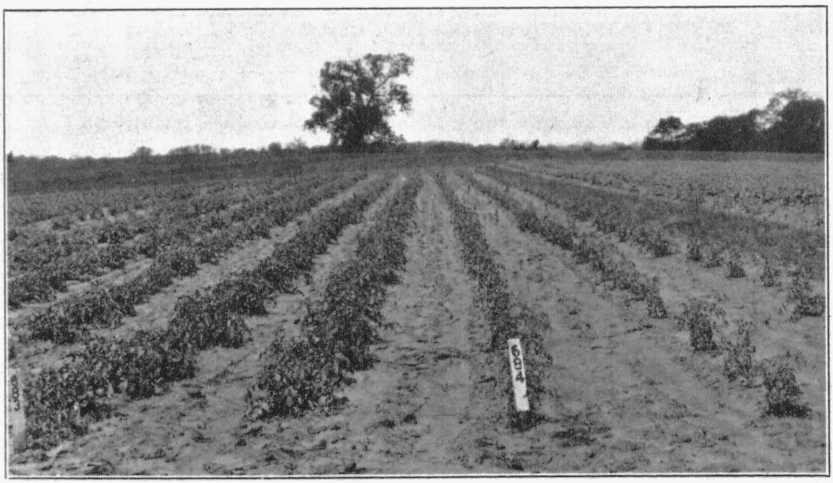


Fig. 4.—Effect of fertilizer on early vine growth. Plot 683 (left) was fertilized with 300 pounds of a 3-12-4 fertilizer. Plot 684 (right) received no fertilizer.

Methods of Applying.—The two common methods of applying fertilizer are broadcasting before or after setting the plants in field, and drilling in the row. Table 5 gives the summary of five years' tests at Columbia on methods of applying fertilizer.

In broadcasting, the fertilizer was harrowed into the soil. The fertilizer in the row was applied by hand, a single-shovel cultivator being run through the row so that the fertilizer would be thoroughly mixed with the soil. The data above would indicate that the best method of applying the fertilizer is

TABLE 4.—EFFECT OF VARIOUS AMOUNTS OF FERTILIZER ON YIELDS OF TOMATOES.*

Amount of fertilizer per acre	Yield lbs. per A.	Gain lbs. per A	Per cent gain
1920			
None	21,050	-----	----
125 lbs	24,700	3,650	17.3
250 lbs.	25,710	4,660	22.1
500 lbs.	27,400	6,350	30.1
1,000 lbs.	27,350	6,200	29.4
1921			
None	9,640	-----	----
125 lbs.	12,280	2,640	27.4
250 lbs.	13,550	3,910	40.6
500 lbs.	15,080	5,440	56.4
1,000 lbs.	17,260	7,620	78.1
1922			
None	10,618	-----	----
125 lbs.	13,930	3,312	31.2
250 lbs.	14,570	3,952	37.2
500 lbs.	17,830	7,212	67.9
1,000 lbs.	20,190	8,572	80.7
1923			
None	15,423	-----	----
125 lbs.	18,906	3,483	22.5
250 lbs.	21,240	5,817	37.7
500 lbs.	24,180	8,757	56.9
1,000 lbs.	23,460	8,037	52.1

*Data for 1920 and 1921 are from Missouri Experiment Station Bulletin 194, 1922.

by applying in the row before the plants are set. Where fertilizer was applied in the row in 1921* there was an increase in early fruit of 118 per cent against 35 per cent for the broadcast and 45 per cent for the top dressing. On soils of high fertility and especially where they have been receiving heavy applications of manure, acid phosphate alone should be used. On soils of medium fertility a 2-12-2 or 2-16-2 is preferred, while on soils of low fertility a 3-12-4 may be used. There are certain soils in some of the tomato growing sections which are sandy in nature and on these, a fertilizer a little higher in potash, such as 2-12-6 should be used. For the early market crop of tomatoes the above fertilizers depending on the soil should be applied at the rate of 400 to 500 pounds per acre. For the main or cannery crop 200 to 300 pounds will will be sufficient.

*Missouri Experiment Station Bulletin 194, 1922.

TABLE 5.—YIELDS WITH DIFFERENT METHODS OF APPLYING FERTILIZERS*

Year	Fertilizer used	Amount per acre	How applied	Lbs. per Acre		% Gain
				Total yield	Gain over check	
1919	2–12–2	250 lbs.	On row, 5 days before setting	14,860	3,820	34.6
1919	2–12–2	250 lbs.	Top dressing, 10 days after setting	12,200	1,260	11.4
1920	4–12–0	250 lbs.	In row same day plants were set	25,700	4,500	21.2
1920	4–12–0	250 lbs.	Top dressing 10 days after setting	23,600	2,860	13.7
1921	2–12–2	400 lbs.	In row same day plants were set	15,550	5,910	61.0
1921	2–12–2	400 lbs.	Broadcast before setting plants	15,050	5,410	56.0
1921	2–12–2	400 lbs.	Top dressing 10 days after setting	13,000	3,360	35.0
1922	2–12–2	400 lbs.	In row same day plants were set	18,720	10,430	125.8
1922	2–12–2	400 lbs.	Broadcast before setting plants	16,140	6,510	67.7
1922	2–12–2	400 lbs.	Top dressing 10 days after setting	13,500	5,840	76.2
1923	3–12–4	300 lbs.	In row same day plants were set	26,540	8,240	45.0
1923	3–12–4	300 lbs.	Broadcast before setting plants	21,260	5,380	33.9

*The data for 1919, 1920 and 1921 are from Missouri Experiment Station Bulletin 194.

HARVESTING

Fruits for the local market or for home use should be well ripened and firm when harvested. When the tomatoes are being sold to the canning factory, the fruit should be allowed to ripen on the vines. Over-ripeness should be avoided, as it can be overcome by careful and frequent pickings. When fruit is to be shipped to distant markets, it is advisable to harvest just as the fruit is beginning to turn red. Carelessness in harvesting the fruit will decrease the total yield through injury to the vines.

TOMATO DISEASES

Tomato Wilt.—This is one of the most destructive tomato diseases in Missouri. It has been reported not only from the commercial canning sections of the Ozarks, but from many home and market gardens throughout the state. In many communities the soil has become so thoroughly infected with the wilt organism that it is almost impossible to produce a crop of tomatoes from common "stock" seed. The disease attacks tomato plants in all stages of development. Very often seedlings which are planted in "sick soil" in the seed bed do not show signs of the disease until after they have been transferred to the field.

Symptoms.—Tomato wilt is caused by a fungus known as *Fusarium lycopersici* (Sacc.). It is a soil organism living over in the soil from year to year and attacking the plant by entering through the root system.

Where plants have become infected in the seed bed, the disease often kills the young plants before they are moved to the field. However, where healthy plants are planted in an infected field, the disease usually does not appear until midsummer, or about the time the first fruits are ripening.

The start of the disease is indicated by the upward rolling of the leaves followed by a gradually yellowing and wilting until the entire plant has the ap-

pearance of the plant in figure 5. Cross-sections of the stem of the diseased plant in the advanced stages will show a discoloration in the form of a ring. This is especially noticeable in the main stem of the plant.

Control Measures.—Since tomato wilt is caused by a fungus which lives in the soil from year to year, the application of sprays on the plant will be of no use. Control measures must consist of some form of soil treatment, rotation of the crop or the use of resistant varieties. Soil treatment may be practiced under greenhouse or plant bed conditions, but as yet no practical means has been devised for the treatment of soil under field conditions. The rotation of the crop, that is, not growing tomatoes on the same field more than once in six or seven years is perhaps the most practical method and should be practiced where land is available. However, this is not always possible, especially with the small gardener; so he must either rely on resistant varieties or discontinue growing tomatoes.

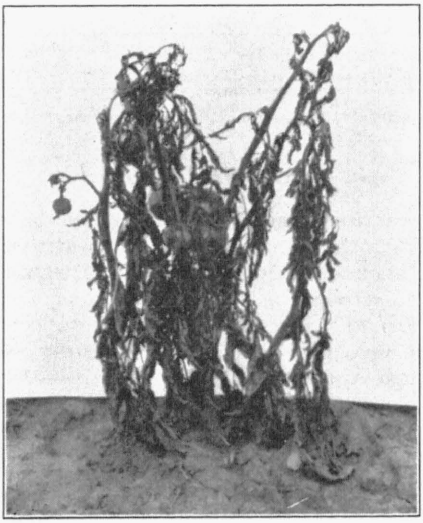


Fig. 5.—A tomato plant affected with Fusarium wilt.

Resistant Varieties.—The development of varieties and strains which are resistant to the Fusarium wilt have been carried on for some time by the United States Department of Agriculture and also by many of the agricultural experiment stations. The selection of disease-resistant plants is based upon the theory that many individual plants are more immune to attacks of a disease than are others of the same variety. It also seems to be a characteristic of such plants to transmit this immunity not only in the same degree, but often each successive generation tends to show slightly greater immunity than the original selection.

It is also known that many of our most resistant varieties, while being resistant to the wilt, are commercially of little or no importance. Preliminary work on the selection for disease resistance was started at this Station in 1919

with some of the more common varieties such as Bonny Best, Stone and Globe, which were grown on a piece of soil heavily infected by the fusarium fungus. This was continued in 1920 with the addition of a number of varieties from the United States Department of Agriculture. A few of the more promising resistant varieties are shown in Table 6.

Although the varieties in the table seem to be quite resistant, they are lacking in many respects when compared with the best of our market varieties.

TABLE 6.—SUMMARY OF THREE YEARS' DATA ON WILT RESISTANT VARIETIES OF TOMATOES

(In pounds per acre)

Variety	Year	Wilt July 15	Wilt Aug. 15	Yield of early fruit	Yield of late fruit	Total yield	Gain for resistant varieties
Columbia	1921	slight	slight	2460	8200	10,660	4,500
	1922	slight	medium	3153	2759	5,912	5912
	1923	very slight	severe	4474	8342	13,116	9873
Marvel	1921	slight	severe	3220	9150	12,370	6,210
	1922	slight	medium	13421	3799	17,220	16,566
	1923	very slight	severe	4428	17158	21,586	18,342
Norton	1921	slight	moderate	2810	9600	12,410	6,250
	1922	slight	medium	4462	7308	11,770	11,116
	1923	slight	severe	3405	17600	21,005	17,762
Norduke	1921	very slight	slight	950	7520	8,470	2,310
	1922	slight	slight	5308	7081	12,389	11,735
	1923	slight	slight	4104	14723	18,827	15,584
Bonny Best (seedman's stock)	1921	severe	all dead	4720	1440	6,160	------
	1922	severe	all dead	654	------	654	------
	1923	severe	all dead	3243	------	3,243	------

Leaf Spot.—This disease (*Septoria lycopersici*) is a very common fungous disease of the foliage, and is present to some extent in most tomato fields. The spores of the fungus causing this disease are spread by wind, rain, insects and animals, which makes it all the more difficult to control, due to its methods of dissemination. The disease attacks the lower leaves first and may be distinguished by its dark-colored, water-soaked spots. These small spots grow in size, causing the affected leaves to turn yellow, and finally die. Like many other fungous diseases, this one is especially destructive in damp weather.

This disease is known to live over the winter on old tomato leaves and vines and is one of the main sources of infection to the young plants in the spring. The burning of the old vines and deep fall plowing seems to help in reducing spring infection. From observations at this Station and from experiments from other stations it is known that leaf spot may be controlled by the use of bordeaux mixture. The first application of bordeaux mixture should be in the form of a 2-2-50 formula applied to plants in the plant bed. If the plants are well sprayed in the plant bed it may not be necessary to apply other sprays.

Blossom-end Rot.—This disease causes a rotting at the blossom end of both the green and ripened fruit. The disease is favored by dry weather; there-

fore, any cultural methods that will tend to keep the plants growing vigorously and conserve moisture will aid in the control of this disease.

Bordeaux Mixture.—Standard bordeaux mixture, commonly known as 4-4-50 bordeaux, is composed of 4 pounds of copper sulphate (blue vitriol) and 4 pounds of stone lime to 50 gallons of water. To prepare a 4-4-50 bordeaux mixture, dissolve 4 pounds of copper sulphate in a few gallons of water and add additional water to make up to 25 gallons. In another vessel slake 4 pounds of stone lime, being careful to use just enough water to keep the lime from becoming dry. After the lime is all slaked, add water to make 25 gallons and pour the two solutions simultaneously into the sprayer. This mixture should be strained through a fine sieve to remove any sediment that might clog up the spray nozzles.

TOMATO INSECTS

Tomato Worm.—This is the large greenish worm commonly called the tobacco worm. They may be controlled by the use of 1½ pounds of powdered arsenate of lead to 50 gallons of water or bordeaux. The arsenate of lead may be combined with the bordeaux, when this spray is being used for any of the fungous diseases.

Fruit Worm.—During some seasons this insect is very destructive. The worms bore into the green and ripening fruit, and are especially destructive on the half-grown green fruit. When picked, all affected tomatoes should be destroyed, as this will help eliminate later broods. The use of a few rows of sweet corn, planted near the tomato field has proven successful as a trap crop. The wormy corn should be gathered and destroyed.

Blister Beetles.—These insects are often called the old fashioned potato beetles. They move about in large numbers and can do great damage to a tomato field in a single day. Driving from the field with the aid of brush or other means, has proven to be the most effective method of control.

Cut Worm.—These worms are responsible for the loss of many of the newly set plants. The best remedy is the use of a poisoned bait. To prepare this bait mix 6 pounds of bran and 4 ounces of white arsenic or paris green. Then mix one pint of molasses and the juice and rind of one lemon in about one gallon of water. Sprinkle this over the bran mixture and mix thoroughly. This bait should then be sown broadcast along the rows. It is best to apply this bait late in the evening just before dark in order that it may be in a moistened condition when the worms come out to feed.

SUMMARY AND RECOMMENDATIONS

Poor seed is expensive at any price. Good seed can be obtained by home selection and saving.

For best results seedlings should be transplanted at least once before setting in the field.

The yield of the crop will depend largely on the vigor of the plant.

The hotbed is the most satisfactory method of starting plants for the home and market gardener. The coldframe method is probably the most satisfactory for the cannery grower.

Phosphorus seems to be the most important fertilizer element for tomato production on soils in Missouri. It can be applied as acid phosphate, bone meal or in a complete fertilizer.

Following are general recommendations for the use of fertilizers:

Barnyard manure at the rate of 8 tons per acre gives about the same yield of tomatoes as 250 pounds of a high grade commercial fertilizer.

For the early market tomatoes 400 to 500 pounds per acre of commercial fertilizer should be used.

For the cannery crop 200 to 300 pounds per acre should be used. The kind of fertilizer to use will vary with the soil as follows: On soils of high fertility or when barnyard manure or cover crops have been turned under, acid phosphate alone will probably give the best results.

On soils of medium fertility, a mixed fertilizer such as 2-12-2 or a 2-16-2 will be found profitable.

On poor or badly worn soils, a 3-12-4 fertilizer seems to be the best, while on soils low in potash a 2-12-6 is recommended.

Mulching with straw is recommended for the home gardener.

Staking plants and pruning to a single stem is unprofitable; while staking without pruning does not affect the yield to any extent and saves space for the home gardener.

Tomato wilt can be prevented by growing on disease-free soil, or by the use of resistant varieties.

Spraying the plants in the plant bed will aid in the control of leaf spot or "blight".

TOMATO CULTURE IN MISSOURI

Missouri's acreage of tomatoes increased from 7,000 acres in 1915 to 18,000 in 1923. The yield per acre also shows an upward trend—from 2.2 tons in 1918 to 3.5 tons in 1922.

A sandy loam soil of high fertility is best for tomatoes, although any well drained soil aided by fertilizer will give profitable yields. A very large part of Missouri's commercial tomato crop is grown on the gravelly loams of Southwest Missouri.

Poor seed is expensive at any price. Seed should be saved at home or purchased from none but reliable seedsmen. Seedlings should be transplanted at least once before setting in the field. Yield depends largely on the vigor of the plant.

Phosphorus seems to be the most important fertilizer element for tomato production on Missouri soils. It can be applied as acid phosphate, bone meal, or in a high grade mixed fertilizer. Barnyard manure at the rate of 8 tons per acre will prove about as effective as 250 pounds of high grade commercial fertilizer.

Specific recommendations for fertilizer applications follow: For early market tomatoes, 400 to 500 pounds per acre; for the cannery crop, 200 to 300 pounds per acre. On soils of high fertility, with barnyard manure, acid phosphate gives best results. On soils of medium fertility 2-12-2 or 2-16-2 fertilizers are recommended. On badly worn soils the best formula is 3-12-4 or 2-12-6.

Mulching the tomato patch with straw is profitable for the home gardener, but is too expensive to be practiced on a large scale.

Staking plants and pruning to a single stem is not profitable; but staking without pruning saves considerable space for the home gardener and does not change the yield noticeably.

Tomato wilt can be prevented by growing on disease-free soil, or by the use of resistant varieties. When ground becomes infected, at least a seven-year rotation must be used if tomatoes are to succeed.

Spraying the plants in the plant bed will aid in the control of leaf spot. In some localities this disease is called blight.

The chief tomato insects are tomato worm, fruit worm, blister beetle, and cut worm. These pests are best controlled by sprays, trap crops, driving, and poisoned bran bait.