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GROWING TOMATOES FOR THE CANNING FACTORY

J. T. ROSA, JR.

The business of growing tomatoes for canning purposes has reached considerable proportions in Missouri, about ten thousand acres being devoted to the crop. This area is located largely in the Ozark hills, in the southern and southwestern parts of the state. The soils and climatic conditions of these sections are especially favorable to the production of high quality tomatoes. Other sections of Missouri are also well adapted to growing cannery tomatoes. This work may be made a very profitable side line to general farming, since it offers a cash income and there is a demand for the product. Most canneries contract with the growers before the crop is planted to take the entire yield at a stated price.

Missouri ranks low in point of yield of tomatoes per acre. The average yield in 1918 was 2.2 tons, as compared with an average of 5.4 tons per acre for the entire United States. Other states situated less favorably are getting more satisfactory yields. For example, New Jersey and Michigan average more than three times as many tomatoes per acre, altho their growing season is shorter. Obviously there is need for the tomato growers of Missouri to adopt improved methods of culture conducive to larger yields, otherwise the crop may be unprofitable to the growers, and the canning factories may not be able to get enough fruit to operate at full capacity. That tomatoes can be made to produce abundantly in Missouri has been demonstrated by many growers, and yields secured at the Missouri Experiment Station last year averaged as much as 27 tons to the acre. Some of the practical means of increasing yields of tomatoes in Missouri are:

- (1) The use of varieties better suited to canning purposes.
- (2) The use of seed of better quality.
- (3) Growing better plants for setting in the field.
- (4) Getting a good start by setting the plants in the field as early in the season as possible.
- (5) The judicious use of fertilizers.
- (6) The use of stable manure or clover sod land for the tomato crop.
- (7) The control of such troubles as wilt, leaf spot, blossom-end rot and the tomato fruit worm.
- (8) More careful cultivation after the plants have been set in the field.

DESIRABLE VARIETIES

A large number of varieties of tomatoes are being grown for canning purposes in Missouri and some of them are of poor quality or otherwise unsuited to canning purposes. The ideal canning variety of tomato should have the following qualities:

- (1) Medium to large, smooth, regular fruit, and a good deep red color of flesh.
- (2) A large, vigorous-growing plant capable of producing heavy yields of fruit.
- (3) Early maturity coupled with continued production until the plants are killed by frost.
- (4) Disease resistance.

It may be said that no such ideal variety exists, but there is no reason why any grower may not obtain and produce a strain approximating this ideal.

Among the varieties found most satisfactory for canning purposes are the Greater Baltimore, Red Rock, John Baer and Landreth. Varieties which are more strictly adapted for home and market garden use are the Bonny Best, Earliana and June Pink. The latter group comprises varieties that are very early and produce well on rich soils.

Some varieties are more subject than others to irregular ripening, cracking and splitting, and to the blossom-end rot. Such varieties should be avoided, since clean sound fruit is always more acceptable to the canners and more profitable to the growers.

SOURCE OF SEED

Care should be exercised in obtaining seed. When a large quantity of seed is to be used, there is a tendency to buy at the lowest price regardless of quality. Loss is often caused by mixed seed, varieties unsuited for canning purposes, and seed from fruit or plants of low quality or poor type. Much of this low-priced seed is a by-product from the canneries and catsup makers' establishments. As a rule, the grower will profit in buying from a reliable seedsman or grower who has a reputation for high quality tomatoes, even though such seed costs a little more. (Fig. 1.)

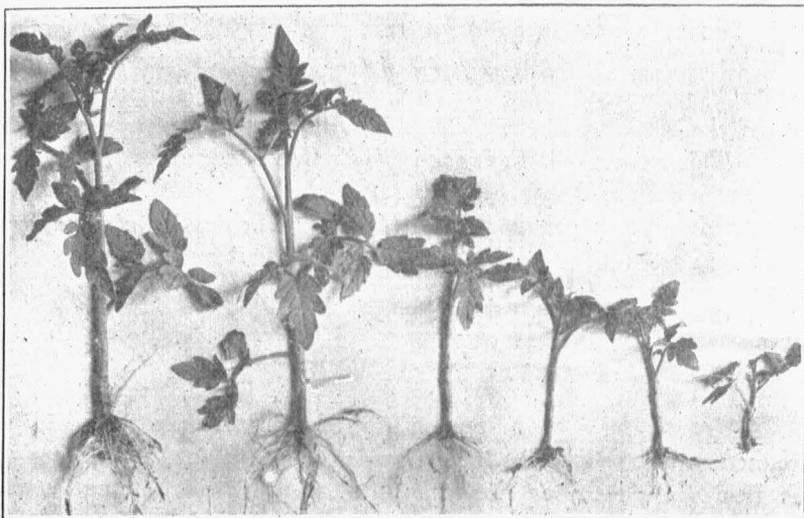


Fig. 1.—Variation in tomato plants from the same packet of seed. Use high quality seed to produce uniformly vigorous plants.

It will probably be best for tomato growers to save seed for their own use, provided they are willing to go to the pains of selecting it from the best plants in their fields. Some factors which should be considered in saving seed from the tomato crop are:

- (1) Seed from early maturing fruit produce an earlier crop than seed saved from fruit maturing in the latter part of the season.
- (2) The shape, size, flesh and color of each fruit should be considered.

- (3) It must be remembered that such characteristics as disease resistance, hardiness to drouth, and vigor of plant may be transmitted by the parent thru the seed.

If seed is to be saved by the grower the following procedure is suggested: Inspect the field early in the season when the first fruits are beginning to mature. Mark with stakes some of the most promising plants, marking more than are necessary to furnish seed for the next season's crop. A few weeks later inspect the field again and leave the stakes beside only those plants which are healthy and give promise of continued heavy bearing. Perfect fruit are to be taken from these selected plants. Place the selected fruit in a barrel, reducing it to a pulp by pounding. The addition of a quantity of water will bring about fermentation in a few days, whereby the pulp will be loosened from the seed. The seed will sink to the bottom of the barrel while the fruit skins, pulp and inferior seeds will float. This process is facilitated by frequent stirring. After the seed and pulp are fairly well separated, the water and pulp should be poured off and the seed washed once or twice to remove any remains of pulp. The seed must then be spread out to dry thoroly before storing. After drying, store the seed in sacks or cans in a dry place.

GROWING PLANTS

After obtaining good seed of high quality the next step is the production of the plants. A desirable tomato plant for setting in the field will be ten or twelve inches tall, with thick, tough stem, plenty of dark green leaves, and with the crown bud developed (Fig. 2). It will have a large fibrous root system which will enable it to stand transplanting well. It is well to get plants into the field before the crown buds bloom, otherwise the blossoms usually drop without setting fruit, causing a loss of the extra early fruit.

Various methods of producing tomato plants are in use among growers. As a rule the easiest and cheapest method will be followed by the growers producing tomatoes for the canning factories, due to the fact that large numbers of plants are needed, that extreme earliness is not essential, and that fruit must be produced cheaply. However, the method which seems the cheapest may prove costly in the

long run, due to the small yield and lateness of the crop produced by such plants.



Fig. 2.—A well-grown tomato plant in a four-inch dirt band.

THE OPEN BED METHOD

The cheapest and simplest method of producing tomato plants is to sow the seed in open beds after the season is far enough advanced so that plants can grow without any protection. This produces small hardy plants, easy to transplant, if the plants are thinned out sufficiently so that they are not crowded in the bed. The objection to this method is the low yield, due to the fact that most of the plants do not come into bearing until late in the season.

THE COLDFRAME METHOD

An improvement on this method is to sow the seed in coldframes (Fig. 3) which are prepared the latter part of March in a warm sunny location. The beds should contain rich sandy soil. The seed are sown rather thin in rows four inches apart. After the plants come up, thin them to stand one or two inches apart. The

beds may be covered with cloth treated with hot linseed oil to render it water-proof and more or less transparent, or ordinary glass hot-bed sash may be used.

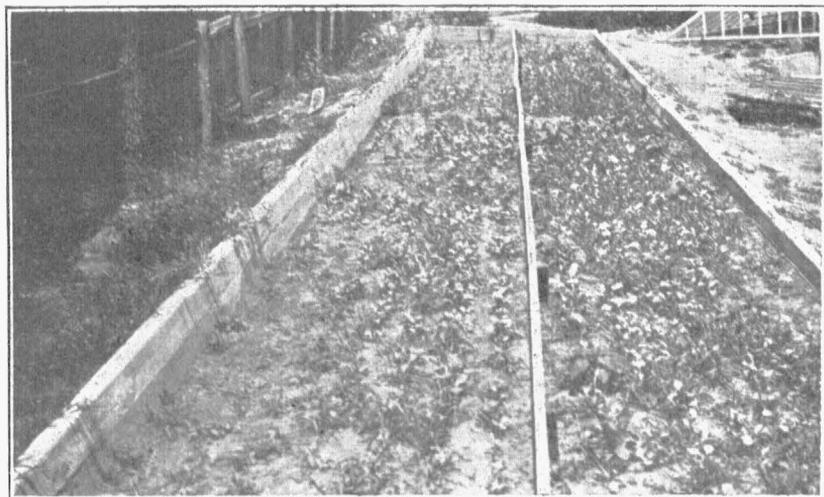


Fig. 3.—Coldframe made of concrete, adapted to the growing of tomato plants

THE HOTBED METHOD

A method of producing still earlier tomato plants of good quality, at low cost, is to sow the seed rather thickly in rows 4 inches apart in a mild hotbed containing a layer of ten or twelve inches of freshly fermented stable manure. The hotbed should be prepared the latter part of February in central Missouri. After the seed have germinated well, the plants are thinned to give room for the development of a root system and stocky stem. When the plants are about three inches high, they may be transplanted to stand 3 or 4 inches apart in a cold frame covered with cloth or sash. If the plants are becoming too tall and spindly in the cold frame, this can be checked by increasing the ventilation, or removing the covers from the frame entirely during the day time, to check the growth and to make the plants more stocky and hardy. Early in May the plants are ready to be set in the field.

Probably this method is to be most highly recommended for the main cannery crop, as it is comparatively inexpensive and furnishes a means of producing strong vigorous plants for early setting. Enough plants for five acres can be started in a hotbed 8 by 18 feet in size, and a coldframe 6 by 27 feet in size with the plants set 3 by 3 inches apart will hold enough for one acre. Overcrowding in

the bed will result in tall spindly plants with weak stems and small roots. A large proportion of such plants die upon transplanting, and those which survive require an unusually long period to start growth, therefore maturing only a late crop.

PLANTS FOR EXTRA EARLY CROP

A fourth method of growing tomato plants especially well adapted for market gardeners and home gardeners, is to sow the



Fig. 4.—Stocky tomato plants grown in a flat 4 by 4 inches apart

seed thickly in flats, either in a greenhouse or strong hotbed, early in February for central Missouri. As soon as the first rough leaves appear, the plants are transplanted to other flats (Fig. 4), or to pots or dirt bands, which are then placed in a mild hotbed. This transplanting favors the development of a compact fibrous root system which is not disturbed in transplanting to the field, so that vigorous growth may begin at once.

This method is somewhat more expensive but results in stronger and larger plants than any other method. The factor that makes it particularly good, is the early start it gives the plants, the importance of which can hardly be over-emphasized. The use of dirt bands (Fig. 2) 4 by 4 by 4½ inches in size has been found especially advantageous.

CARE OF PLANTS IN THE BEDS

Suitable soil should be used in the plantbeds, and this should be renewed each season. It has been found that a mixture of equal

parts of sand, well rotted manure, and garden loam is a very satisfactory soil in which to grow tomato plants. The object is to have a soil that will stimulate moderately rapid growth, and the development of a large root system.

While tomato plants are growing in the beds they should receive careful attention. The soil should be kept moderately moist by thoro waterings. Light watering too frequently is likely to cause the plants to "damp-off". Likewise, care should be exercised in regulating the temperature. A thermometer should be placed in the bed so that it does not rest on the ground and so that the sun does not shine directly upon it. Day temperatures in the bed should range from 70° to 80° during the early part of the season. Night temperatures should not go below 45°. The temperature of the hotbed can be regulated nicely by the amount of ventilation given. Some ventilation is necessary to permit the escape of moisture from the bed, and to change the air. On cold or cloudy days a little ventilation can be given by raising one end of the sash. In case the sun is shining brightly ventilation must be given freely.

On cold nights, the beds should be covered closely. A convenient way to provide additional cover is to keep a quantity of loose straw near-by. This can be forked over the bed quickly in case the extra protection is needed.

HARDENING OFF

As the season advances, lower temperatures may be allowed by removing the covers from the bed in the day time. For several days before the plants are transplanted the cover should be removed entirely and moisture withheld to such an extent that the plants are just on the verge of wilting. Under these conditions, plants slow up their growth, become tough and woody and are thereby better able to withstand sun, wind, cold, and dry soils. They will recover from the shock of transplanting very much better than tender succulent plants that have not been properly hardened. Well-hardened plants will start off promptly with a vigorous growth when set in the field.

TOMATO SOILS

The tomato is not very particular as regards soil. Good crops can be grown on nearly every soil, altho the production of large

crops at small cost limits the planting to certain especially desirable soil types. Gravelly loams and the "Post Oak" soils of southwest Missouri are particularly desirable for tomatoes. On them the tomato matures a good crop of fairly early fruit of high quality. In the southeastern part of the state a considerable area of canning tomatoes is being grown on sandy loam soils. This type of soil is better suited to the production of early tomatoes for market, rather than a midseason crop for canning, as yields are liable to be unsatisfactory in periods of drouth. The loess soils also produce splendid tomatoes, especially in the rough hills along the Missouri river. The black prairie and heavy clay soils generally are to be avoided, altho on these soils tomatoes often do well if started sufficiently early in the season and are given good cultivation.

PREPARATION OF TOMATO LAND

ROTATIONS

One of the best crops to precede tomatoes in rotation is sod, either red clover or blue grass. Grain stubble land is also used frequently by cannery tomato growers. Turning under the sod in the fall provides the soil with a large amount of organic material which is highly beneficial to the tomato plants. Other crops do especially well when planted after tomatoes, as the tomato plant leaves the soil in exceptionally good condition.

FITTING SOIL

Thoro preparation of land is very desirable. It should be broken quite deeply, since the tomato is a deep rooting plant. The surface should be fitted by disking several times. The use of moderate quantities of stable manure on tomato land will generally be found advantageous. Many growers are afraid to use stable manure as it is said to delay the maturity of the crop. However, on the light loam and gravelly soils, fifteen to twenty tons per acre of stable manure can probably be used to advantage. It is well to apply this manure as long before planting the tomato crop as possible. The use of fresh strawy manure to mulch the crop during the early summer is also beneficial. In this way, the tomato crop receives the benefit of the mulch and the plant food slowly leaches into the soil. The organic matter will be incorporated in the soil when the land is plowed at the end of the season. When manure or any other mulching material is used, it should be applied shortly after the plants

have been set in the field and before the vines have spread over the ground.

THE USE OF COMMERCIAL FERTILIZERS

Tomatoes respond to the use of commercial fertilizers when these materials are applied judiciously. It is well to remember that nitrogenous fertilizers, including stable manure, stimulate vine growth. Many of the cannery growers are now using commercial fertilizers in a limited way. No experiments have as yet been made at this Experiment Station to determine just which particular fertilizer combination is best adapted to the tomato crop. On light or poor soils, the use of such nitrogenous fertilizers as nitrate of soda, or dried blood is advisable to give the plants a good vigorous start. The most effective method of applying fertilizers is in the open row at planting-out time, or a portion of the fertilizer may be applied thus, using the remainder as a side-dressing to the rows later in the season. Another way of applying fertilizer is to apply it broadcast, working it into the soil by disking before marking off the rows. High grade mixed fertilizers can often be used to advantage in this way.

Often the tomato crop appears somewhat stunted a few weeks after having been set in the field, due to unfavorable weather conditions and to lack of available plant food in the soil. This condition is often remedied by a top dressing or side dressing of nitrate of soda.

TRANSPLANTING

Tomato plants should not be set in the field until after danger of frost is over, altho they will withstand a slight frost if they have been properly hardened off. As a rule, transplanting to the field should be deferred until after the 10th of May in the latitude of central Missouri. Where a large area is to be planted the horse-drawn machine planters will prove of great advantage. Several of the cannery growers in Missouri are already using these machines. Where a number of growers are situated near each other, it would be a good investment for them to own a transplanting machine on a cooperative basis. The machine can be used to set other plants, such as sweet potatoes, early cabbage and strawberries. In setting plants by hand, the row should be opened in advance, the depth of the furrow depending upon the size of the plants to be transplanted. In case the plants are tall, the rows should be made at least 8 inches deep so that a large proportion of the stem of the plant can be

planted below ground. The shallow setting of large plants is very undesirable, in that the big tender stem is liable to fall over and become broken. However, when this stem is placed deep in the ground roots will be formed along the underground portion, resulting in a more extensive root system. It is especially desirable to firm the soil well around the roots of the plants as they are set, leaving the soil on the surface loose to prevent too rapid drying out of the soil. In setting plants on a small scale, it is desirable to pour a little water into the hole with the plant as it is set. Some of the machine transplanters are constructed to supply water to each plant automatically.

The most favorable time for transplanting to the field is late evening or on a cloudy day, preferably when the soil is quite moist. To prevent excessive wilting the plants should be well watered before removal from the plant bed, and care should be taken to avoid mutilation of the roots. A small ball of earth should be retained around the roots of each plant when it is taken up for transplanting. In transit between bed and field plants should be covered to prevent excessive wilting.

Shortly after the plants have been set, it is well to go over the field with a hoe or light cultivator and draw the earth toward the stems. If the plants are rather tall and leggy, hilling up will give additional support to the plant and will prevent excessive loss of moisture. Plants which die or are killed by cutworms should be replaced as promptly as possible. There should be an abundant reserve of plants for resetting in such case.

If cutworms are troublesome at plant setting time, they can be killed by distributing poisoned bait over the field, either the day before or the same day that the plants are set. The formula for this bait will be given later under the control of grasshoppers. A means of preventing plants from being injured by cutworms in the garden is to place a slip of heavy paper around each plant in the form of a collar extending one inch below the surface and one or two inches above the surface of the ground. If these collars are left in place for a week or two after transplanting the danger will be passed. On large plantations, however, it is more practicable to eliminate the cutworms by use of poisoned bait, which should be applied late in the afternoon.

PLANTING DISTANCE

The distance between the plants depends upon the fertility of the soil and the varieties grown. The richer the soils, the greater the

amount of space allowed for each plant. Rank-growing varieties such as Greater Baltimore, require much more space than varieties of slight growth, as the Earliana and Bonny Best. On soils of average fertility the planting distances should be approximately $4\frac{1}{2}$ by 4 feet. For garden plots the plants can be placed closer. Vigorous-growing varieties can be planted 4 by 5 feet. It has been found that relatively close setting produces a heavier yield the early part of the season. However, close setting requires a greater number of plants and increases the labor cost.

IMPORTANCE OF EARLY SETTING

The earlier tomato plants are set in the field the more satisfactory crops are likely to be. This is especially true in this part of the country, where the midsummer season is usually hot and dry. Plants set in the field about the middle of May will make an early and vigorous start, and set a good crop of early fruit before the extreme heat and drouth of the summer. Plants set out June 1, or later are usually less successful due to the fact that they reach the fruiting stage just at a period rendered extremely unfavorable for fruit formation by excessive heat and lack of moisture. Also it is well to remember that when commercial fertilizers are used, they are utilized by the plants when the soil is full of moisture. In case of rather late transplantings, moisture is lacking and a large portion of the fertilizer may remain in the soil without becoming available to the plant.

CULTIVATION

Tomatoes require careful cultivation from the time the plants are set in the field until the vines begin to cover the ground. The first row-cultivation should be rather deep, forming a slight ridge of earth around the plants, for which purpose the ordinary corn cultivator is excellent. As the plants get larger, this tool should be discarded for a one-row cultivator. Later cultivations should be shallow so as not to injure the plant roots. Even after horse cultivation is discontinued the tomato field should be gone over with the hoes to kill late weeds. It simplifies the tillage question very much if the plants are set in check-rows so that cultivation can be carried on in both directions with horse drawn tools.

CONTROL OF PESTS

Leaf spot and blight are among the diseases most destructive to the tomato in Missouri. They can be held in check to a great ex-

tent by thoro spraying with bordeaux mixture. On farms where trouble has been experienced in previous years, it would be well to take the precaution of cleaning up the plant beds, which are often a serious source of infection. It is well to remove all the dirt and manure from the hotbed each season and to sterilize the wood-work and interior with a solution of formaldehyde (1 pint to 15 gallons of water). The plant beds should be made up of fresh composted soil obtained from a source which could not possibly have become contaminated with tomato disease.

Another measure is to spray the plants thoroly with Bordeaux mixture just before they are transplanted to the field. It is much more convenient and economical to spray the plants while they are in the beds than to defer the spraying until they have been set in the field. If the plants are well sprayed at this time, the blight does not usually become very serious until after midsummer. As soon as signs of leaf spot or blight become evident on the plants in the field, spraying with bordeaux mixture should be begun. For this the 4-4-50 formula is suggested. Usually about three applications ten days apart will check it satisfactorily. A further precaution is to burn the dead vines at the end of the season, wherever there has been trouble with any disease. In this way there will be much less chance of the disease being carried over in the soil until the following year.

Wilt.—The wilt disease of the tomato is very common in the tomato-growing sections of Missouri. The fungus lives in the soil year after year, and once the soil has become infected it is inadvisable to grow tomatoes on that soil for several years, unless a wilt resistant variety is used. The fungus obstructs the water-carrying parts of the plant, so that the upper part of the plant cannot obtain water. This causes the plant to wilt slowly, until finally killed. The plant may not be completely killed until late in the season, but its yield will be unsatisfactory. The disease spreads thru the soil, and is liable to be distributed from field to field by manure, work tools or by drainage water.

Blossom-end rot commonly destroys a large proportion of the tomato fruit during periods of hot dry weather. This disease seems to be caused almost entirely by lack of moisture and is therefore hard to control or prevent.

Careful and rather frequent cultivations until the latest possible date will lessen the amount of this disease as cultivation helps to retain the moisture in the soil. For the home gardener, or where the

area grown is small, the disease can be largely prevented by irrigation, or by mulching the plants with straw or other organic material. The mulching material will shade the soil, keep the soil temperature low, and help retain the moisture. It supplies some plant food to the soil, keeps the surface of the soil from becoming hard and baked, the fruit is kept off the ground and is clean and healthy. Another way in which this trouble may be reduced is by selecting those varieties which are less affected by blossom-end rot. As yet there is no wholly immune variety.

Grasshoppers.—Occasionally grasshoppers may damage the tomato crop. They do not feed on the foliage of the plant but may attack the fruit when nearly ripe, making it unfit for use. They may be controlled by spreading poisoned bran mash over the tomato field, and especially around the edges where grasshoppers are working in from other fields. Poisoned bran mash is made as follows: Take 1 pound of paris green or white arsenic and 20 pounds of wheat bran. After these materials are thoroly mixed, another mixture consisting of two or three gallons of water, two quarts of cheap molasses and the pulp of two or three oranges or lemons is added to the poisoned bran. This mixture is then worked up as a rather dry mash, adding enough water to bring it to a flaky consistency. It should be sprinkled over the infested area very early in the morning, or late in the evening, as it loses its attractiveness for insects after drying.

Fruit worms cause more or less damage to the tomato crop each season, altho they are much more severe some seasons than others. This pest usually becomes most serious during September. Winter plowing of all fields in which worms were troublesome on corn or tomatoes, will help to control it and to protect the crop next year. When spraying plants with bordeaux mixture for leaf spot, it is advisable to add one pound of arsenate of lead powder to 50 gallons of bordeaux mixture, in case the tomato worms are giving trouble.

STAKING AND PRUNING TOMATOES

Where tomatoes are grown for home use or for early markets it may be desirable to support the individual plants on stakes. The method of tying plants to stakes and pruning to a single stem will give a comparatively early crop of fancy fruit. However, the total yield from such plants will be less than that of plants which are neither pruned nor staked. Staking plants, without pruning, may

reduce the total yield slightly, but it improves the quality of the fruit and its appearance, lessens the likelihood of disease, and facilitates cultivation and inter-cropping in the home garden. Furthermore, it is desirable to stake tomatoes in the home garden since plants can be placed much closer together than when they are allowed to run on the ground in the normal way.

HARVESTING THE CROP

The tomato crop requires frequent picking during a long season. Under ordinary conditions the tomato field should be gone over once each week in order to gather the matured fruits. If the field is not picked over often enough there is considerable waste due to the fruit becoming overripe. When intended for immediate use or for sale to a canning factory, the fruit should be ripened on the vines. This is necessary to bring out the full quality of the fruit. Underripe fruits have to be culled out and kept on hand for several days until they have ripened, require a longer period of cooking, and they result in a lighter colored product than fruit ripened on the vine. In case the fruit are to be shipped some distance it is desirable to gather them slightly underripe.

For use in harvesting the tomato crop, a number of light strong containers should be at hand. Lug boxes or round baskets holding about one bushel are convenient for this purpose. The boxes are preferable, in that they can be stacked conveniently on wagons for hauling to the canning factory or shipping point.

Preventing a market glut.—It is important for tomato growers to avoid or prevent as far as possible periods of oversupply or glut on the market. This condition is due to a large number of growers having crops approaching the height of their yield at approximately the same time. As a consequence the growers are taxed to harvest the crop, and the canneries are unable to handle all the tomatoes delivered. Any means which will provide a more even distribution of the crop is desirable, both from the standpoint of the grower, produce dealer and the canning factory operator. As a rule a field which is planted early will ripen more uniformly thruout the season than one which is planted late. Furthermore, on well fertilized soils there is a better distribution of the crop, and less likelihood of a large part of the fruit ripening at one time. It sometimes may be advisable to divide the tomato crop by planting two or three varieties which vary somewhat in season of maturity and period of

heaviest yield, or to regulate the supply by varying the planting date, having a portion of the crop planted early, and another portion of the crop two or three weeks later.

The higher the yield obtained (within certain limits) the lower the cost of production per ton. When only two or three tons per acre are obtained the cost of production per ton must be high, even when the cheapest methods are used. It will pay the grower to spend more for good seed, large early plants, fertilizers and manure, prepare his soil better, and use greater care in handling the crop. Especially important is that of getting the crop started early.

No tomato grower should be content with a yield of less than five tons per acre, even on poor gravelly land. On good land the yield should be ten or twelve tons per acre. It is easily possible to obtain yields larger than this with methods of handling and cultivation not necessarily very much more expensive than the careless methods of production too commonly employed by cannery growers.