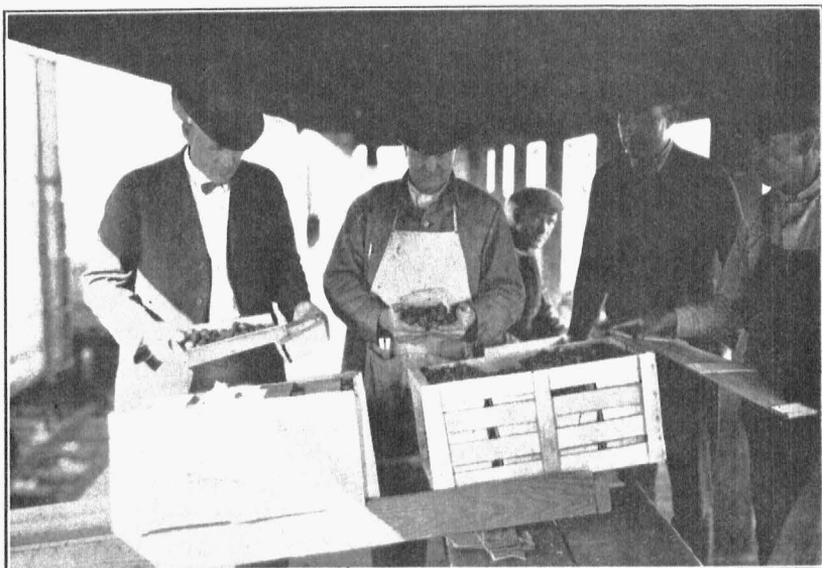


# Strawberry Growing In Missouri

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Missouri Strawberries Meet Federal and State Inspection.

The strawberry succeeds under a great variety of soil and climatic conditions. It is an early profitable cash crop, filling a great need in the producer's business. Being a short-season crop, it fits well into most crop rotation systems. It is not exhaustive of soil fertility. The plants are very productive, unusually hardy, and rarely require spraying to control diseases and insects.

The crop may be planted at a small initial cost, and will bring quick returns and high yields. It blossoms through a rather long season, thus enabling the grower to obtain a crop when practically all other crops are destroyed by late spring freezes and frosts. As it is the first fresh fruit to appear on the early spring markets, it

is always in demand. Its spritely flavor and attractive appearance make it not only the most sought but the most beautiful small fruit, if not the perfect fruit.

According to the Bureau of Agricultural Economics, United States Department of Agriculture, the average acreage of strawberries for Missouri from 1929 to 1932 inclusive was 16,265. The average price per crate for the same years was \$3.04. Under the economic conditions which have prevailed during this period, the strawberry has made a good showing, especially when compared with the acreage and returns of other crops produced by the farmer.

### NEW OR OLD LAND

Formerly, new land was used almost exclusively for commercial strawberry production, on account of expense and difficulty generally experienced in keeping down weeds, grasses, and clovers on old land. Since new land is now becoming scarce in many sections and, in some instances, practically impossible to obtain near shipping centers it is more important than ever before that growers carefully consider cropping systems in preparing old land for strawberry production.

Before planting strawberries on old land, a crop requiring good clean cultivation for one or more years should usually be grown. This is for the purpose of destroying the seeds of weeds, grasses and clovers and to prevent their reseeding. Most growers agree that if the weed and grass problem can be solved old ground may be made satisfactory for the growing of strawberries. Too much emphasis, therefore, cannot be placed upon clean, thorough, and timely cultivations in the growing of crops preceding strawberries.

It is possible with better methods of soil handling, and clean cultivation before planting, for the grower to succeed as well on old land as new. The old land may also offer such advantages as being closer to the shipping point, more accessible, and less difficult for cultural and harvesting operations.

### LOCATION AND SOILS

The strawberry has a wide range of adaptation to various conditions of soil and climate. It is a well known fact that with proper care and attention this fruit will thrive upon any soil suited to the production of farm crops. In many instances growers maintain that on poor soils they secure comparatively larger yields from strawberries than they do from grain crops. In general, most varieties do better on light, sandy, gravelly or stony soils than on clay, heavy or wet soils. New land is often preferred because of the increased yields and because there are fewer weeds to fight and less

cultivation required. For best results, a well drained, fairly light, moisture-holding, medium fertile soil is generally desired.

Soil and location will influence to some extent the time of harvest and the earliness of spring growth. For instance, a light, sandy or stony soil with a southern exposure will produce earlier fruit than a heavy, moist soil with a northern exposure. Also high ground with good air drainage is most satisfactory for strawberry production, while poor air drainage and low lands increase the liability of the plants to frost injury.

### IMPROVING THE SOIL FERTILITY

While it is believed that for most old land barnyard manure will be very helpful in preparing the land for more profitable strawberry production, there are many heavily cropped soils which will be very satisfactory for strawberry growing without the use of manure. That is, while the use of manure is strongly suggested, it is not absolutely necessary for success with strawberries. This will be particularly true where such leguminous crops as cowpeas, soybeans, hairy or winter vetch and clover, are liberally used, and plowed under occasionally in the crop rotation system. Where cowpeas, soybeans, or vetch are used, a much bigger crop yield will usually be obtained by applying superphosphate at the rate of 200 to 250 pounds to the acre, and by inoculating the seed in every instance.

By plowing under barnyard manure and such leguminous crops as cowpeas, soybeans, vetch, clover, or alfalfa, humus and nitrogen are added to the soil. Non-leguminous crops like wheat and rye may also be plowed under for the purpose of building up the water-holding capacity and humus content of the soil. In most cases, it is perhaps more important to loosen and aerate the soil and increase its water-holding capacity than it is to add fertility in the form of nitrogen. Strawberries require large quantities of soil moisture in maturing a crop, but only a moderate amount of nitrogen.

On account of the danger of injury from the white grub, clover, timothy, bluegrass and other sod lands should be planted to truck or grain crops for a year or two before setting strawberries.

### CROPPING SYSTEMS FOR STRAWBERRIES

The chief purposes of the suggested rotations are to grow one or more leguminous crops in the rotation to build up the nitrogen and humus content of the soil and to precede the planting of strawberries with cultivated crops to destroy weeds, clover, diseases, and insects. If the grower is not very careful in his cropping systems, he may often leave weed or clover seed near the surface

where it will sprout and grow and thus interfere seriously with strawberry culture.

Short cropping systems may consist of: (1) Early oats sown for hay followed by a cover crop of cowpeas to be plowed under in the fall. Strawberries may be set the next spring. (2) Early potatoes may be followed by a cover crop of cowpeas or vetch to be plowed under in the fall or early spring. Strawberries may be set in the spring.

A FIVE-YEAR CROPPING SYSTEM CONSISTING OF CORN, OATS AND COWPEAS, AND STRAWBERRIES

Year	Field 1	Field 2	Field 3	Field 4	Field 5
1929	Corn	Oats and Cowpeas	Young Strawberries	Fruiting Strawberries	Fruiting Strawberries
1930	Oats and Cowpeas	Young Strawberries	Fruiting Strawberries	Fruiting Strawberries	Corn
1931	Young Strawberries	Fruiting Strawberries	Fruiting Strawberries	Corn	Oats and Cowpeas
1932	Fruiting Strawberries	Fruiting Strawberries	Corn	Oats and Cowpeas	Young Strawberries
1933	Fruiting Strawberries	Corn	Oats and Cowpeas	Young Strawberries	Fruiting Strawberries

The foregoing five-year cropping system for the improvement and preparation of old land for strawberry production illustrates a practical method of rotating and cropping five different fields to corn for one year, oats and cowpeas for one year, and strawberries for three years. Other crops such as tomatoes, sweet potatoes, or late cabbage may be substituted for corn, while early potatoes, early cabbage or Bermuda onions may be substituted for oats and followed by cowpeas immediately after harvest. Manure may be plowed under in the fall preceding the planting of corn or a substitute for corn, and it is assumed that the cowpeas will be plowed under in the fall or early winter.

In order for such a system to work out properly, five different fields are required, or there should be as many fields as there are years in the crop rotation system. As a result, every year one field is in corn, one in oats and cowpeas, one in young strawberries and two in fruiting strawberries. Where more acreage is desired for strawberries, this may be secured by extending or increasing the acreage of each field.

It should be noted in this suggestive rotation plan that the strawberry fields are fruited for only two years. While it is true that strawberry fields may be profitable for fruiting a third year and in

some instances even a fourth year, generally diseases and insects are much more difficult to control after the second year. Over a series of years, therefore, it is believed that a cropping system similar to that outlined, fruiting the strawberry fields only two years, will usually be most profitable and satisfactory.

Potatoes, beans, tomatoes, cabbage, sweet potatoes, and other truck crops usually leave the soil in excellent condition for strawberries. This is because such crops are generally well cultivated and are kept free from weeds for a considerable portion of the season and are usually well manured and fertilized. When strawberry soils are handled as suggested, it will rarely be necessary or profitable, to apply fertilizers after planting.

### SELECTION OF VARIETIES

There are many varieties which are cosmopolitan and may be grown successfully over a wide area. Other varieties are restricted to certain sections or localities. Of the 1800 or more varieties of strawberries, relatively few are adapted to any one combination of soil, climate, methods of growing or marketing conditions.

In the strawberry growing districts of South Missouri the leading commercial varieties in the order of their ripening are as follows: Aroma and Gandy; while in North Missouri the main varieties are: Premier, Dunlap, Aroma and Gandy. The Aroma, although not doing as well generally north of the Missouri River as in the southern and southwestern parts of the State, is usually the most satisfactory for commercial planting where long distance shipments are contemplated. This will be particularly true for the region south of the Missouri River. The Aroma should be satisfactory here and the best variety to grow on a commercial scale for handling, shipping, and distant markets. This is due not only to its excellent shipping and handling qualities, but also to its attractive appearance, productiveness and disease resistance. Blakemore and Gandy are favorites for the home fruit garden. The Progressive and Mastodon are leading everbearing sorts. Other newer varieties which are being tried out in the State are Luckystrik, Bitter Root and Champion.

When the strawberry is desired for home use from spring until fall, the grower may plant an extra early variety, a mid-season sort and an everbearing variety. The very early varieties will supply a moderate crop, and the everbearing varieties fresh fruit for table use during late summer and early fall. For best results, as a rule the grower should limit his planting to a few varieties.

Some varieties, are called pistillate or imperfect varieties because of the plant's failure to produce the pollen necessary for fer-

tilization, and they produce little or no fruit when planted alone. This difficulty may be overcome by planting every third or fourth row to a staminate or perfect variety such as Dunlap. For best results generally only staminate or perfect varieties should be planted. With perfect varieties, the grower eliminates one risk, and he may also count on just as large yields from such varieties. Pistillate or imperfect sorts have not therefore been listed or described.

A partial list of standard varieties is given below, with the season of ripening. Some of these varieties should do well in all parts of the State. The letter (S) indicates a staminate or perfect variety. The leading commercial varieties are printed in CAPITALS.

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<i>Early</i> Premier (S)	<i>Mid-season</i> DUNLAP (S)	<i>Late</i> GANDY (S)
<i>Medium Early</i> Blakemore (S)	<i>Medium Late</i> AROMA (S)	<i>Everbearing</i> Progressive (S) Mastodon (S)

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### DESCRIPTION OF VARIETIES

**Premier** is one of the best early varieties for home and local market use. It is generally superior in size and productiveness and is usually well adapted to all parts of the State. It is not a prolific plant maker and for this reason should be planted closer in the row than such varieties as Aroma and Dunlap.

**Blakemore** is a medium early variety, originated by the United States Department of Agriculture. It is a cross between Premier and Missionary. Fruit is dark red, of a round to conical shape and somewhat smaller than Aroma, especially in dry seasons. It is productive. The fruit is firm, stands handling and ships satisfactorily.

**Dunlap** is the most widely grown variety in Central and North Missouri. It is a good plant producer and the fruit is high in quality and also very attractive. Dunlap is one of the best pollenizers for pistillate sorts, as it blooms heavily from early until late with its greatest production occurring in mid-season. It thrives better under neglect than most other sorts. It is not firm enough for distant shipments, but is a good variety for canning.

**Aroma** is not only the leading commercial variety of the Ozark region, including Southwest Missouri, but also of the State. It is valued highly because of its uniformly large size and its productiveness. The Aroma is disease-resistant, a good shipper and very attractive. It ripens from mid-season to late.

**Gandy** is the standard late variety. It has certain soil requirements and for the greatest return does best on a rich soil with a clay subsoil and an abundant supply of moisture. It is also an excellent

shipper. Although a staminate variety, it produces very little viable pollen and for best results should be planted with some strongly staminate variety such as Dunlap or Aroma.

**“Everbearing” Strawberries (Progressive and Mastodon).** Of the everbearing varieties, the most popular in the State are Progressive and Mastodon. These varieties are more widely grown than any other sorts of their class. Investigations at the Missouri Agricultural Experiment Station made under irrigation conditions and under the normal rainfall conditions have shown that the everbearing varieties are not as profitable as the spring bearing sorts. Everbearing varieties may be successfully grown, however, in the garden for home and local use. Where moisture is adequate and markets are favorable, they might be grown with profit on a commercial scale.

Certainly not all of the good or profitable varieties of strawberries, including the standard and everbearing sorts, have been listed and described. For some localities and districts it is possible that other varieties would do as well or better than those which have been discussed. On the other hand, some of those varieties which have proven themselves over a series of years and made successful production records have been named and suggested to producers. Before planting new sorts extensively, however, it is generally advisable to try them out for a few years.

## PREPARATION OF SOIL

For planting during the spring, it is generally best to plow the ground in the fall or winter where conditions will permit. By so doing, the grower is usually able to prepare the field for planting earlier in the spring. A firmer and more compact soil results from fall or winter plowing. This is an advantage to the strawberry plant because such soil preparation usually makes available a larger and more constant water supply to the roots.

If the ground is plowed in the fall or winter, it is generally best to postpone harrowing or disking until the spring preparation. With some soils several diskings or harrowings may be necessary to put the soil in the proper condition for planting. It is important that the surface soil be stirred sufficiently to make the ground loose and friable. Rolling or otherwise packing the soil is desirable on newly prepared land as it aids in judging the correct depth to set the plants and in making the soil more retentive of moisture. Fall plowing may result in some leaching of nitrogen from the soil, but since the strawberry is not a particularly heavy nitrogen feeder the advantages of fall plowing more than offset the loss of nitrogen.

### TIME OF PLANTING

Early spring planting is generally preferable to late spring, summer or fall planting. Spring-set plants, except everbearing varieties, do not bear fruit until the following year. Plants set in the early fall and grown under favorable conditions should bear a small crop the following spring. For spring setting, the planting should be done as soon as the soil and weather conditions will permit; while the latter part of August or early September is usually best for fall planting. Early spring planting should be emphasized in every instance because it will generally prove to be more profitable.

### SELECTING PLANTS

The best growers agree that it is highly important to plant large, sturdy, vigorous, one-year-old plants. Generally not enough thought and attention are given to the matter of securing the best plants. The large plants usually stand transplanting better, start forming runners or new plants more quickly and are more resistant to diseases and insects than small and less thrifty ones. Runners that root after September cannot be expected to produce much fruit the next year.

The best results are generally secured by purchasing the plants from some reliable nurseryman who makes a specialty of growing good plants. Many growers are in the habit of procuring plants for setting from the old strawberry beds or fields, and if good judgment and care are used satisfactory plants may be obtained in this way. But with the general infestation of old fields with the strawberry crown borer the greatest caution should be observed in getting plants from fields that are not positively known to be free of the pest. Growers are taking a great risk to purchase plants which have not been inspected and approved by the officials of the State Plant Board.

### CARE OF PLANTS ON ARRIVAL

Every year a large number of strawberry plants either fail to grow or make a very unsatisfactory growth on account of careless handling or delay in setting. The plants may have been grown well in the nursery and represent the best stock. The digging, storing, packing and shipping methods may have been the best. If the plants are poorly handled upon arrival and are not transplanted properly they may be a disappointment, in which case the nurseryman is often blamed when really the fault is with the purchaser and planter. To obtain the best results with strawberry plants the following practices should be observed:

(1) As soon as the plants are received, examine the roots to see if they are moist. If they are not, moisten them at once and keep them so in a cool place away from the sun until transplanted. The roots should never be allowed to dry out or be exposed to the drying action of the wind and sun for even a few minutes. When planting, the roots of the plants may be kept in a bucket or tub partly filled with water or they may be covered with damp packing material or wrapped in damp gunny sacks.

(2) In case the strawberry plants cannot be planted immediately upon arrival they should be heeled-in as soon as possible. This is accomplished by digging a shallow trench and covering the roots with moist earth and wetting them down. It is important that the ties of the bundles be cut and the plants spread out in the trench so as to allow the moist soil to come in close contact with the roots. When the plants are spread out in the trench, the varieties may be distinguished by marking and driving stakes between the different lots.

### PLANTING SYSTEMS

The commercial growers generally prefer the matted row system of training. It is the simplest and easiest to establish and maintain. The runners are allowed to set at random in a row 18 to 20 inches wide. Some growers train the runners and space the plants while hoeing, but this is not required. The plow breaks off the runners and drags them lengthwise, which will prevent the middles between the rows from filling with young plants. If the runners are weighted lightly with soil, they may be induced to root more quickly.

### PRUNING BEFORE TRANSPLANTING

Strawberry plants will generally give better results if they are pruned before planting. This will be especially true if the tops are large at time of setting. Part of the leaves are removed to reduce transpiration before the roots become established in the soil. The amount of pruning will depend upon the season of the year, the size of the plants, and the condition of the weather and soil at planting time. Early in the spring when the leaves are small and few in number, little pruning is required. When the plants are older and the time of planting later, all but one or two of the smallest leaves in the center should be removed by cutting the stems near the crown of the plant. There is always more danger of cutting off too few leaves than of cutting too many. The roots are usually cut back from one-fourth to one-fifth of their length, leaving them about 4 or 5 inches long. The removal of a portion of the root system will

permit better spreading of the roots and facilitate transplanting. When transplanting is late and the tops large, pruned plants will usually make a better growth than unpruned ones planted under similar conditions.

### HOW TO SET STRAWBERRIES

It is important that strawberry plants be transplanted to the proper depth. An opening in the prepared soil should be made just deep and wide enough to accommodate the roots when spread slightly and to allow the crown of the plant to be level with the ground when the soil has been thoroughly firmed about the roots. The opening in the soil may be made with a dibble or other implement suitable for the purpose, or with the fingers. If the crown of the plant is covered with soil, the plant will usually die or make a slow growth. If the crown extends too far above the surface of the ground, the plant may dry out and die or become unprofitable.

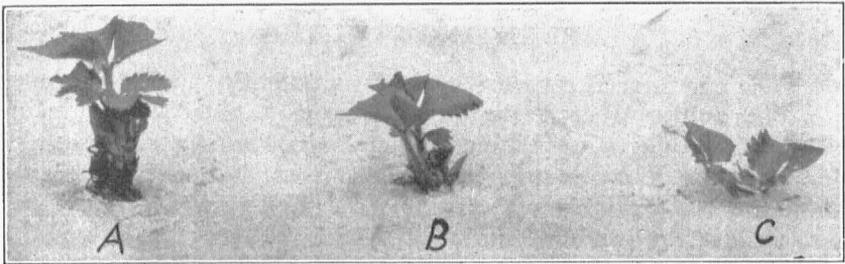


Fig. 2.—Planting depths for strawberries. A shows a strawberry plant too shallow; B indicates the proper planting depth; and C shows a plant set too deep.

When the soil has been well prepared, the land may be laid off in rows by means of a plow equipped with a rather long, narrow, shovel. The furrows may be crossed with a marker to indicate the planting distance in the row. The ground is sometimes checked with furrows running in transverse directions and the plants are placed at the point where the furrows cross. Other methods also are employed in checking and marking off the land for planting. The most important points to remember in transplanting strawberries are to thoroughly firm and compact the soil around the roots of the plants and when the work is finished to have the crown or growing point of the plant just level with the top soil.

For large acreage, machine planters are used, while for small plantings hand planting is employed. The same planting machine is used for cabbage planting. Two men set the plants and 30,000 plants, or from three to five acres a day, may be set (See Fig 2).

## SPACING AND DISTANCE BETWEEN ROWS

The best distance between the plants in the row, and the best distance between rows will usually depend upon a number of factors, the most important of which are the plant-making habit of the variety, method of training, location, nature of the soil and type of cultivation to be used.

The average spacing and planting distances of commercial growers in Southwest Missouri for the matted row system, are from 3 to  $3\frac{1}{2}$  feet in the row and 4 feet between the rows. This will allow the first two or three cultivations to be made in both directions, thus facilitating cultural practices. For the Aroma variety, the type of soil generally used, and the horse cultivation employed, these distances appear to be, after years of experience, the most satisfactory. It is possible, however, that a planting distance of  $2\frac{1}{2}$  feet in the row and  $3\frac{1}{2}$  feet between the rows would give as good or better results under many conditions.

For the home garden, and where hand cultivation is employed, perhaps better planting distances would be about 2 to  $2\frac{1}{2}$  feet apart, in rows 3 feet apart. It is also true that other planting distances (usually less than those mentioned for commercial plantings) for local markets and other varieties would give more satisfactory returns.

The number of plants required for an acre may be obtained by multiplying the number of feet between the plants in the row by the number of feet between the rows. This will give the number of square feet occupied by one plant. Then divide the number of square feet in an acre, which is 43,560, by this sum. The quotient will be the number of plants needed for one acre. In order to have enough plants to replace those which die or do not thrive after being transplanted for a period of about three weeks, some growers order about one-tenth more plants than are required to set the field. With the plants set  $3\frac{1}{2}$  by 4 feet 3111 would be required for one acre. About one-tenth more for loss and replacements gives 3400 the number usually needed for one acre, planted  $3\frac{1}{2}$  x 4 feet.

## CULTURE AFTER HARVEST

**Removal of Leaves and Mulch.**—The strawberry field should usually be mowed and raked immediately after the harvesting period. These operations will rid the patch of injured leaves, and assist in the control of fungous diseases and insect pests. A mowing machine with the cutter bar tilted slightly in front may be used effectively for this purpose. After mowing, the leaves and mulch may be raked into windrows and removed from the field.

Instead of mowing and raking, the practice of burning the field is sometimes used. There is danger, however, of the fire doing injury to the crowns of the plants if the mulch material is rather heavy, the ground dry, and the fire does not move over the field rapidly. The practice of burning is not recommended and should generally be discouraged.

**Reducing Width of Rows.**—The next operation, after removing leaves and mulch, is to narrow-down the old matted row. This may be accomplished in a number of ways. One of the most common is to plow a furrow down either side of the row, throwing the soil away from the row. The same results may also be secured by running twice between the rows with a two-horse cultivator. In this way the old strawberry row is reduced to the desired width, which is usually from 8 to 12 inches.

Another method consists of plowing on both sides of the row, throwing the soil toward the center. This covers the weak plants near the ends of the runners and leaves the strongest ones near the parent plants. Where this method is used it is important to harrow the land until most of the soil has been removed. If the crowns of the plants are covered to any appreciable depth they will not push through and the plants will die.

**Leveling and Cultivating.**—After the width of the strawberry row has been reduced the soil is leveled and cultivated with the harrow. The harrow is operated in the rows and across the rows, thus pulverizing and spreading the soil around the plants. Some of the crowns of the plants may be slightly bruised and injured as a result of the cultivation across the rows; but this injury is seldom if ever severe enough to overbalance the beneficial effects of the cultivation and of the fresh, loose soil placed around the crowns of the plants. Since the crown of the strawberry plant grows further out of the ground each year it is very important that fresh soil be brought up and worked around the base of the old crowns at the time of renewal. The hoe may be used after plowing, to level and pulverizing the soil, to accomplish additional thinning if needed, and to remove old crowns and weeds.

## CULTIVATION

**“Tillage is Manure.”**—Perhaps there is no more important factor in strawberry production than thorough and frequent stirring of the soil to make available plant food and to assist in the conservation of moisture. Thorough cultivation is essential. The old saying, “Tillage is manure,” holds true for strawberries. This applies to both the new and old fields. For best results as many as 12 or 15 plowings and 4 or 5 hocings for new fields, may be required,

although few strawberry fields receive this much care. In other words, the plants should be cultivated at intervals of ten days or two weeks from the time they are set until vegetation is killed by the frost in the fall. The number of plowings and hoeings will depend a great deal upon the amount of rainfall. It is very important that the ground be stirred as soon after each rain as it will do to work. If the interval between rains is four or five weeks, more than one shallow cultivation should generally be given between rains.

**Removal of Blossoms During Cultivation.**—Fruit production is a great drain on the plant. For this reason, all blossom stems should be pinched off during the first year following transplanting in order to produce many strong, vigorous plants. The removal of the blossoms by pinching may be accomplished at the periods of plowing and hoeing.

### INTERCROPPING WITH STRAWBERRIES

The young orchard can be profitably intercropped with strawberries until it comes into bearing. If the strawberries are properly managed and cared for they will bring in a good return from the land until the trees bear paying crops of fruit. The strawberries should not be planted too close to the trees, however, because the crop may remain in the soil two or three years. It is important that they be planted well outside the limit of the root growth. Since the roots of the trees extend beyond the horizontal spreading of the branches in the tree top, the strawberries should be planted at least three or four feet beyond the spread of the limbs. With young trees, this would allow the first row of strawberries to be planted on either side of the tree row at a distance of 6 to 8 feet from the tree trunks. Where this plan is adopted, the strawberries will do the trees no harm and the cultivation and fertilization given should greatly benefit the trees, providing the following caution is observed:

**Caution.**—The cultural requirements of strawberries and apples and other fruit trees are different. The bearing fields are not cultivated in the spring when trees should usually be, but they are cultivated in the late summer and fall when trees are not cultivated because late cultivation in orchards may induce the trees into growth and cause their wood to be unprepared for winter conditions. Fruit trees should not therefore be cultivated as a rule later than the first half of August and in central and northern parts of the State it would be safer to discontinue the cultivation in July.

## FERTILIZATION

Where the soil fertility has been kept up by the rotation of crops, the growing and plowing under of leguminous or non-leguminous crops and barnyard manure, it is usually unnecessary to use commercial fertilizers. Fertilizers and manure are generally of more value to strawberries if they are used properly in growing crops preceding strawberries. Their use in many cases might actually be a detriment rather than a benefit to the crop. This would be particularly true if too much vegetative growth occurs. The fruit is made much softer, and poorer in color by heavy fertilization. It is also less desirable for shipping purposes. Where the soil will grow good crops of potatoes, corn or wheat, usually a profitable crop of strawberries can be produced without fertilization.

Experimental work at the Agricultural Experiment Station at Columbia and in the Ozark Region near Sarcoxie indicates that acid phosphate at the rate of about 250 pounds per acre, is more often needed as a fertilizer than potash or nitrogen. If a phosphate fertilizer is used, it may be applied as a side-dressing about two or three inches from the plants and placed just beneath the soil. This is usually done about ten days or two weeks after the plants are set. The fertilizer may be spread in the rows at planting time with a grain drill or at the renewal period it may be spread broadcast and thoroughly mixed and worked into the soil by the use of plows or hoes.

In general, fertilizers are applied to strawberries with little knowledge of the results that may follow. Moreover, a study of the results of fertilization throughout the country show that the effects are very variable and that the strawberry does not respond the same under all conditions to fertilizer treatments.

There is some very good evidence pointing to the fact that highest yields are often obtained when fertilizers are applied as late as the first half of September of the first year and as late as the middle of August of the fruiting year. This is significant in that these dates are near the time of fruit bud differentiation or when some of the buds of the strawberry are changed over from leaf or shoot buds to fruit buds.

Fertilization suggestions for strawberries may be summarized about as follows:

- (1) Previous to planting strawberries, build up a supply of decayed organic matter in the soil by plowing under barn manure, a green manure crop or a legume.

- (2) At the time of preparing the soil for strawberries, cultivate into the top three or four inches superphosphate, 250 to 300 pounds and muriate of potash 50 to 100 pounds per acre, or a com-

plete fertilizer, 2-8-2 or 4-12-4 or similar combination, at the rate of 250 to 300 pounds per acre. This may prove profitable.

(3) After planting, a nitrogen fertilizer like sulphate of ammonia or a corresponding amount of another nitrogen fertilizer on poor soils, when used at the rate of 250 pounds per acre, may show increased returns. The application may be made about three or four weeks after planting or during the latter half of August or early September. Where only one application is made, the August or September period is likely to be of greater advantage.

(4) When renewing fields and beds, a fertilizer high in nitrogen with some superphosphate and potash may be tried. Quantities of from 250 to 300 pounds per acre are not too much on the less productive soil types.

**Caution.**—Where acid phosphate is used at planting time or around the plants when the fields are renewed, it is important in order to prevent injury by burning that the fertilizer be well mixed with soil before being worked closely around the crowns or roots of the plants. Nitrate of soda or ammonium sulphate may also seriously burn the leaves and stems of the strawberry if applied directly to them. This will be particularly true when the foliage is wet.

## MULCHING

Under most conditions mulching is a profitable practice in Missouri. Nevertheless, many of the Ozark strawberry producers procure profitable yields from their fields without mulching. This is particularly true where the surface of the soil is covered with stones, chert or flint rock, and there is only a small amount of soil near the surface. The stones appear to have an effect upon the soil similar to that of a straw mulch.

The mulch should generally be spread in the fall or early winter after the first hard freeze, which is generally in December. A mulch from 2 to 3 inches in depth will conserve moisture, keep the soil cool and damp during the season when fruit is being produced, tend to prevent heaving of the soil during the winter, and keep the ripe fruit clean at harvest time. The best material for this purpose is wheat straw—provided it is free from wheat and weed seeds, since these may interfere seriously with cultural operations. Rye straw, hay, leaves, and other materials are frequently used, but these are generally not as satisfactory. The mulch should be raked lightly from the center of the rows toward the middle between the rows early in the spring just before growth starts. If the mulch is left on the rows too late, the time of ripening may be delayed for a week or more. In locations subject to frost, the mulch may be used to



Fig. 3.—A strawberry field mulched for winter with wheat straw. (At the Missouri Agricultural Experiment Station.)

delay the blossoming period but if left on too long the new growth will be tender and when uncovered will be more likely to injury by cold weather.

## HARVESTING

**Harvest Time and Pickers.**—The harvesting period for the Ozark Region generally commences during the latter part of May and lasts three or four weeks. In Central and North Missouri the harvest is from a week to ten days later and the period is slightly shorter than that of the Ozark Region. In some communities, local help is relied upon for picking, but in a great many districts it is necessary to import pickers. When the pickers are brought in, camping grounds, water, tents, houses and other facilities are often furnished. The best growers have learned that it pays to employ the best and most reliable help and to procure the same pickers year after year if possible. To do this, it is necessary to exercise the best judgment in the care and handling of the pickers.

The pickers are generally supplied with a six- or eight-quart basket carrier. The carrier facilitates the prompt removal of the berries to the packing shed after picking, which is very important.

**How to Pick.**—The berries should be picked with an attached stem about one-fourth inch long. This may be done by pinching the stem between the thumb and finger. Crushing or bruising the berries should be prohibited and this can usually be prevented by



Fig. 4.—An excellent strawberry field just before harvest.

instructing the pickers against the practice of holding several berries in the hand. The pickers when assigned to definite rows should be held responsible for them.

**Keeping Harvesting Records.**—Many methods of keeping the harvesting record are employed, and perhaps no one is best under all conditions. Tickets for punching as the quart baskets are received at the packing shed, are popular with some growers; while coupons and metal checks are used successfully in other instances. It may be necessary for each producer to work out the system of checking the harvesting record best adapted to his conditions.

**Grading and Packing.**—Careful grading and packing will generally pay big dividends. As the berries come from the field they should be sorted over in the packing shed. With some pickers very little sorting will be required as much may be done in the field by placing the marketable berries in certain boxes and the culls and soft berries in others reserved for this purpose. Pan grading is generally recommended for the Aroma because the berries if picked at the right time and properly, are firm and will not be damaged in the operation. For softer varieties which are likely to be injured, pan grading may not be advisable although for local markets and home use it will frequently pay.

One grader in the packing shed may be able to handle the ber-

ries of three or more pickers. It is very important that all small, malformed, bruised and over-ripe berries be removed. Since boxes properly filled with berries of uniform size and color give a better appearance and usually sell at a higher price, it is very important that the graders and pickers cooperate and strive to choose berries of uniform color and size. Full boxes also generally arrive on the market in better condition and make a much more favorable impression on the buyers. In the long run, it is "penny wise and pound foolish" to attempt to evade the picking, grading, and packing rules. It is important that the fruit be carefully and honestly graded according to the rules of the association and removed to the refrigerator car or cold storage without delay.

**Rules for Picking.**—The following rules for picking and handling strawberries are in force in one of the western fruit exchanges, and should be of vital interest to Missouri growers:

1. Berries must not be picked while there is moisture on plants.
2. Berries should be pink all over, or three-fourths red.
3. Berries should be picked riper in cool weather than in warm.
4. A picker must not be allowed to hold more than one or two berries in his hand at the same time.
5. Filled carriers must not be allowed to stand in the sun.
6. Berries must be picked with a stem a quarter of an inch long and not longer or shorter.
7. Sort out all green, over-ripe, misshapen, and small berries.
8. No culls in boxes. Put in nothing but fair sized berries.
9. Use clean crates and keep them from being soiled.
10. Haul in spring wagon and cover to keep out the dust.

**When to Pick.**—In order that the berries may be pre-cooled properly and reach the market in good condition the picking should be done when the fruit is cool and dry and in just the right condition of maturity. When the weather is warm it may be necessary to pick over the field every day. Early in the season and during cool weather picking every other day may be all that is required. The morning hours are usually best for picking, because the berries are cool, firm and subjected to less injury by the hot sun. The fruit ships with less likelihood of damage if picked when cool and firm, and the pickers can do more and better work during the cooler part of the day. The only objection to picking during the morning hours is that the berries may be wet with dew. Since the berries go down faster when picked wet, they should be picked dry if possible.

**Shipping.**—To make sales profitable, standard varieties must be grown, adequate shipping facilities must be maintained and an efficient marketing organization is essential. The acreage near the shipping point should be sufficient to load at least one car daily. This will require from 75 to 100 acres which should be located within a radius of not more than three or four miles from the shipping

point. Most commercial districts load 420 crates into a standard refrigerator car, each crate containing 24 full quarts. These are usually placed in the car four crates high, seven crates wide and fifteen crates long, and properly braced. Crates generally weigh about 40 pounds each.

**Shipping Point Inspection.**—The inspection of fruit at shipping point is one of the most valuable services to the fruit grower! Under the supervision of both the Federal and State authorities grades, standards and packs are more rigidly maintained. The certificate of inspection received by the producer enables him to deal in a more business-like way with buyers. The buyers also know that they cannot reject or refuse Federal and State inspected fruit without proper procedure and check up. The inspection certificate is *prima facie* evidence that fruit of a certain grade left the shipping points in condition suitable for its arrival at destination in marketable condition. It adds force, life and confidence to contracts regarding grade, marketable condition and carriers' responsibility. The certificate is without question invaluable in the proper adjustment of claims and controversies between shipper, buyer and carrier.

## INSECTS AND DISEASES

In many parts of the state strawberries may be grown successfully without a great deal of trouble from an attack of insect pests and fungous diseases. This will be particularly true where the strawberry field is rotated with garden, truck, and field crops, where strong, healthy, vigorous plants are used for the setting of the fields and where fields are not fruited more than two years in succession. Too much emphasis cannot be placed upon the importance of securing plants from fields free from infestation by the strawberry crown borer.

The strawberry leaf spot, a fungous disease which seriously affects some varieties, and the strawberry leaf roller and crown-borer insects, may affect the plants badly enough to justify spraying with bordeaux to destroy the fungus and with arsenate of lead to kill the insects. Where spraying is necessary, the first application should be made shortly after growth is started in the spring, using 3-4-50 bordeaux and  $1\frac{1}{4}$  pounds of arsenate of lead. The second application should be made when the berries are about one-third grown. Two sprays will usually be sufficient. Where diseases and insects are especially serious, however, a third application after the crop is harvested may be helpful.

# Essentials of Strawberry Production

(Page numbers point the way to detailed explanations in this circular.)

1. In selecting the site, convenience of location for harvesting and marketing should be considered as well as the fertility of the soil. Old land can be renewed by good cropping systems and manure; but an inconvenient location is a permanent handicap. Page 2.
2. Prepare the soil by good deep plowing in fall or winter, and thorough harrowing or disking in the spring before planting. Pages 3 and 7.
3. Plant the best variety or varieties, after a careful consideration of all factors involved. Page 5.
4. Use the best one-year-old plants obtainable as they will prove to be the cheapest in the long run. Page 8.
5. In setting the plants use care in preventing the plants from drying out and see that the crowns are set level with the top of the ground. Pages 9-12.
6. Renew the old strawberry field by mowing the tops and plowing through the old rows, harrowing and leveling, to thin the stand and give new plants a chance to grow. Then cultivate frequently until fall. Page 11.
7. Timely, frequent, and thorough cultivating will produce thrifty, productive plants. Page 12.
8. Keep up the fertility of the soil by the rotation of crops and by applying fertilizers, remembering that barnyard manure free from weed seed, is generally the best. Page 14.
9. Protect the plants and fruit by mulching with clean wheat straw. Page 15.
10. Control injurious diseases and insects by rotation of crops and the use of sprays when required. Page 19.