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# Missouri Strawberries



Aroma strawberries, grown in Missouri, ready for inspection and shipment.

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# Missouri Strawberries

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ABSTRACT.—The strawberry is the most valuable small fruit grown in Missouri. It will succeed under a great variety of soil and climatic conditions. Crop rotation systems using legumes and non-legumes, with and without manure, are valuable in preparing old land for strawberry production. All factors considered, the Aroma variety is the best commercial strawberry for the State. This is especially true for the region south of the Missouri River and where long distance shipments are contemplated. The renewal of strawberry fields will generally be profitable if properly performed. The average production per acre for the past thirteen years at Monett is 70 crates, while the average sale price per 24-quart crate for this period is \$3.38. The response of strawberries to fertilizers is usually unsatisfactory. Acid phosphate has shown the most beneficial results in yield. Nitrogenous fertilizers are generally harmful rather than helpful to yields with the Aroma variety. Pedigreed strawberry plants are rarely better than the original variety. Offsprings from high yielding plants were no more productive than those from low yielding parentage. Everbearing strawberries under irrigation and normal rainfall, have not been found to be as profitable as the standard spring bearing varieties.

The strawberry is now the most valuable of all the small fruits grown in Missouri. Its prominence is of recent origin, however, as only about thirty years ago an endless number of varieties were grown in the Ozark region and commercial production was not considered seriously. Only one variety, the Aroma, is now grown in this section and strawberry production assumes major importance in many counties.

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. Since the plant is a shallow feeder, the roots rarely penetrating the soil to a depth greater than 8 to 10 inches or extending beyond the spread of the leaves, 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 Missouri Federal and State Crop Reporting Service, the 1925 commercial crop from 13,000 acres amounted to \$3,696,000 and the average sale price per 24-quart crate was \$4.56, while the total car lot shipments for the season up to June first was 1571 cars, averaging 420 crates each.

The estimated acreage for 1926 is 16,120, or a gain of 3,120 acres over the acreage of 1925, representing an increase of 24 per cent.

Through the courtesy of Mr. E. A. O'Dwyer, Secretary of the Monett Fruit Growers' Association, Monett, Missouri, the general average price received from the sale of strawberries from 1913 to 1925 inclusive, is given in the following table:

MONETT FRUIT GROWERS ASSOCIATION PRICES 1913 TO 1925 INCLUSIVE  
(Average Price Received for 24-Quart Crate)

1913.....	\$1.84	1920.....	\$7.00
1914.....	2.31	1921.....	3.50
1915.....	2.07	1922.....	2.55
1916.....	1.50	1923.....	3.33
1917.....	2.88	1924.....	3.35
1918.....	3.10	1925.....	4.75
1919.....	5.80	13-year average.....	\$3.38

This association also reports regarding harvesting expenses per 24-quart crate and gives the general average production per acre as follows:

Picking expenses at 3c per quart.....	\$ .72
Twenty-four quart crates at 30c each.....	.30
Hauling, grading, and loading, per crate.....	.23
	-----
Harvesting cost per crate.....	\$1.25

Deducting the harvesting expenses, \$1.25 per crate, from the general average sale price, \$3.38 per crate, leaves the grower a return of \$2.13 on each crate. The average production per acre for the 13-year period has been 70 crates, which gives the average producer a return over this period of \$149.10 per acre.

Barry County, which ranks first in commercial strawberry production, reports car lot shipments averaging 420 crates each as follows for the year 1925:

Monett .....	180 Cars	Exeter .....	34 Cars
Purdy .....	57 Cars	Cassville .....	24 Cars
Butterfield .....	51 Cars	Total .....	393 Cars
Wheaton .....	47 Cars	Valued at .....	\$784,035.00

#### 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 for the constantly increasing strawberry acreage, it is more important than ever before that growers care-

fully 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 reseeded. 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.



Fig. 2.—Strawberries as they arrive from the fields and packing sheds at the railroad station for inspection and loading.

### 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, low lands with poor air drainage are not as satisfactory as higher ground with good air drainage for strawberry production, because 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, and clover, are liberally used, and plowed under occasionally in the crop rotation system. Where cowpeas or soybeans are used, a much bigger crop yield will usually be obtained by applying acid phosphate 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, 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

One or more of the suggestive cropping systems or combinations of them, described under Manuring Systems, or Systems Without Manure, should, without great inconvenience, fit into most farm operations and assist very materially in the preparation of old land for profitable strawberry production. The methods, crops, plans or parts of them suggested may be applied to old land now growing strawberries but which must be rotated or changed before resetting, or the same practices may be used on land which has never grown a strawberry crop.

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.

**Manuring Systems.**—**SYSTEM I:** *First Year (Fall).* Plow under from 10 to 12 tons of barnyard manure. Sow oats early in the spring and cut the crop for hay. Plow and seed the land to cowpeas as soon after the oat crop is

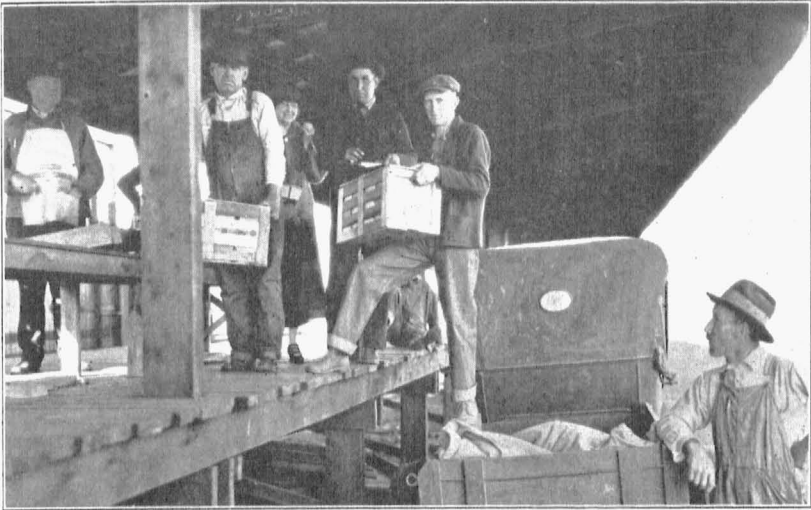


Fig. 3.—Growers unloading strawberries at the car for inspection.

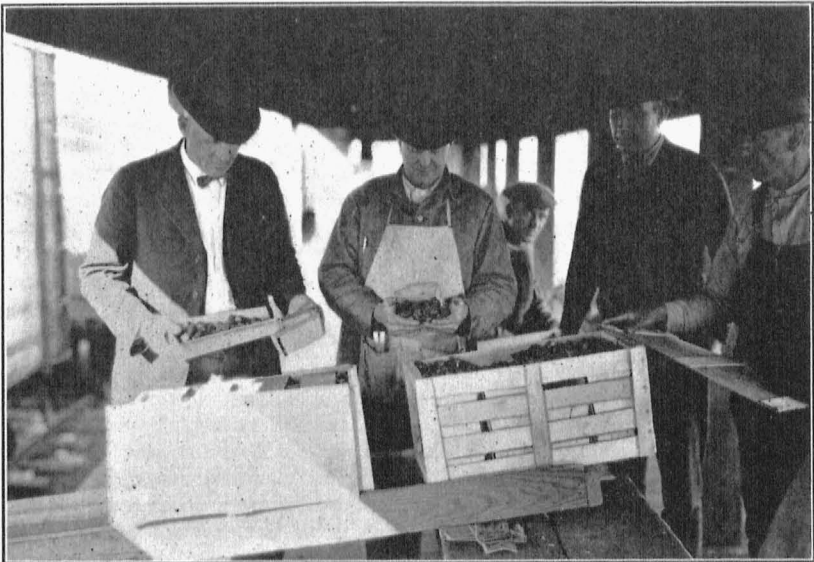


Fig. 4.—Inspecting strawberries at the car door, Federal and State Inspection Service, Monett, Missouri

harvested as possible. Plow under the cowpeas in the fall or winter. *Second Year.* Grow soybeans in rows, cultivate and cut the crop for hay; or plant field beans and harvest the crop. Plow the stubble under in the fall. *Third Year.* Set strawberries in the early spring. Amounts of manure suggested are on an acre basis.

SYSTEM II: *First Year (Fall).* Apply from 10 to 12 tons of barnyard manure and plow in the fall or winter. Plant to tomatoes the next year. Plow in the fall or winter after the tomato harvest. *Second Year.* Grow corn. Plow in the fall or winter. *Third Year.* Set strawberries in the early spring.

SYSTEM III: *First Year (Fall).* Apply from 10 to 12 tons of barnyard manure and plow in the fall or winter. Grow Bermuda onions or early potatoes the next year. Follow the harvest with a green manure crop of cowpeas. Plow in the fall. *Second Year.* Grow tomatoes or corn. Plow in the fall or winter. *Third Year.* Set strawberries in the early spring.

SYSTEM IV: *First Year (Fall).* Apply 10 to 12 tons of barnyard manure and plow in the fall or winter. Plant sweet potatoes, tomatoes, or corn in the spring and plow in the fall or winter. *Second Year.* Plant early potatoes or cabbage and follow with cowpeas as soon after the crop is harvested as possible. Plow the cowpea crop under in the fall. *Third Year.* Plant tomatoes and plow in the fall or winter. *Fourth Year.* Set strawberries in the early spring.

SYSTEM V: *First Year (Fall).* Apply from 10 to 12 tons of barnyard manure and plow in the fall or winter. Grow sweet corn or early potatoes the next year. Follow the harvest with a green manure crop of cowpeas. Plow in the fall. *Second Year.* Grow tomatoes or corn. Plow in the fall or winter. *Third Year.* Set strawberries in the early spring.

**Systems Without Manure.**—SYSTEM I: *First Year.* Grow corn, tomatoes, or sweet potatoes, and plow the land the following fall or winter. *Second Year.* Sow early oats for hay and follow the harvest with cowpeas. Plow the cowpeas under in the fall. *Third Year.* Set strawberries in the early spring.

SYSTEM II: *First Year.* Sow oats in the early spring, seeding clover with the crop. *Second Year.* Cut both crops of clover. Plow the clover stubble in the fall or winter. *Third Year.* Grow corn or tomatoes and plow in the fall or winter. *Fourth Year.* Repeat the same crop or grow another requiring good cultivation and plow in the fall or winter. *Fifth Year.* Set strawberries in the early spring.

SYSTEM III: *First Year.* Sow oats in the early spring for hay, and follow with cowpeas. Plow the cowpea crop under in the fall. *Second Year.* Grow early potatoes followed by cowpeas. Plow under the cowpeas in the fall. *Third Year.* Set strawberries in the early spring.

SYSTEM IV: *First Year.* Grow corn with or without soybeans in the hill. Plow in the fall or winter. *Second Year.* Sow oats with clover in the early spring. *Third Year.* Cut both crops of clover for hay and plow under the clover stubble in the fall. *Fourth Year.* Grow tomatoes, sweet potatoes or corn and plow in the fall. *Fifth Year.* Repeat the same crop or grow another requiring good cultivation and plow in the fall or winter. *Sixth Year.* Set strawberries in the early spring.

SYSTEM V: *First Year.* Grow corn, tomatoes, or sweet potatoes, and plow the land the following fall or winter. *Second Year.* Sow oats early for hay,



to be followed by a green manure crop of cowpeas. *Third Year.* Repeat the crops of oats and cowpeas, plowing in the fall. *Fourth Year.* Set strawberries in the early spring.

**Shorter Cropping Systems.**—The systems of cropping suggested above for the improvement of old land for strawberry production range in duration from three to six years. While the longer periods will generally produce better results, yet shorter cropping systems may be helpful.

For example: (1) Early oats sown for hay may be 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 to be plowed under in the fall. Strawberries may be set the next spring. (3) Cowpeas or soybeans may be planted in rows and cultivated and the crop plowed under in the fall. Strawberries may be set early the next 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
1926	Corn	Oats and Cowpeas	Young Strawberries	Fruiting Strawberries	Fruiting Strawberries
1927	Oats and Cowpeas	Young Strawberries	Fruiting Strawberries	Fruiting Strawberries	Corn
1928	Young Strawberries	Fruiting Strawberries	Fruiting Strawberries	Corn	Oats and Cowpeas
1929	Fruiting Strawberries	Fruiting Strawberries	Corn	Oats and Cowpeas	Young Strawberries
1930	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.



Fig. 5.—End view of 24-quart strawberry crates packed in a strawberry refrigerator car, showing the neat and attractive label, "Red Bird, Ozark Fruits, Ozark Fruit Growers' Association."

### 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; Klondike, Aroma and Gandy; while in North Missouri the main varieties are: 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. Clyde and Gandy are favorites for the home fruit garden. The Progressive and the Superb are the leading everbearing sorts.

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 fertilization, 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.

<b>Early</b>	<b>Mid-season</b>	<b>Late</b>
Premier (S)	DUNLAP (S)	GANDY (S)
<b>Medium Early</b>	<b>Medium Late</b>	<b>Everbearing</b>
Clyde (S)	Klondike (S)	Progressive (S)
	AROMA (S)	Superb (S)

#### 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.

**Clyde** is an excellent berry for home use and near markets. It is too soft for handling and shipping to distant markets. A strong soil is required for the full development of the fruit and profitable yields.

**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.

**Klondike** is grown almost exclusively in the Gulf States for northern markets. It is one of the best shipping sorts, of good size and attractive in appearance, but poor in quality. Aroma, however, excels it in flavor and is equal or better for South Missouri in every other respect.

**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.



Fig. 6.—View from the refrigerator car door showing strawberry crates properly loaded, braced and the car ready to move to market.

**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 Superb).**—Of the everbearing varieties, the most popular in the State are Progressive and Superb. These varieties are more widely grown than any other sorts of their class. Investigations at this 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 rainfall or irrigation, and markets are favorable, they might be grown with profit on a commercial scale.

### 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 can be worked; while the latter part of August or early September is usually best for fall planting. Early spring planting should be emphasized in every instance.

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 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.

### SELECTING THE PLANTS

The best growers agree that it is highly important to plant large, sturdy, vigorous, one-year-old plants. See figures 7 and 8. 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.

### PEDIGREE STRAWBERRY PLANTS

Investigations have shown that "pedigreed" or improved strawberry plants are rarely, if ever, better than the original variety from which they were derived. Strawberries at this Station propagated by runners (buds) for ten generations gave no evidence that the high or low yielding habit of the parent plant was transmitted. In other words, the offspring from high yielding plants were no more productive than those from low yielding parentage. The variations exhibited in the offspring were also found to be just as great as those in the original stock.

### 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. See figures 7, 8, and 10.

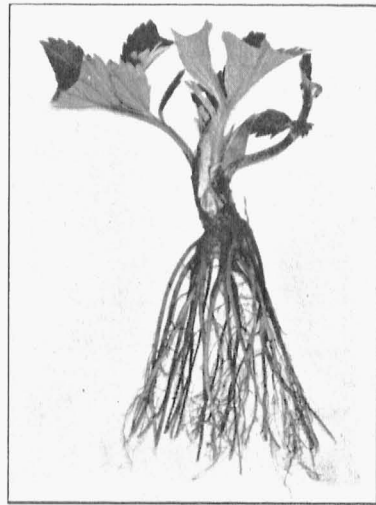
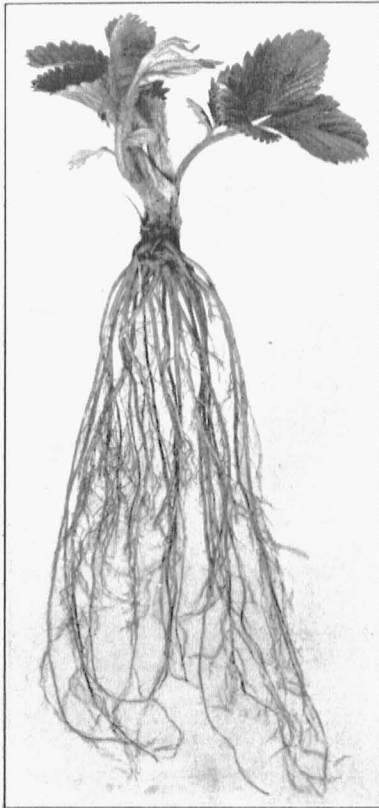


Fig. 7 (at left).—A one-year-old vigorous strawberry plants before pruning.

Fig. 8 (at right).—The same plant after pruning. Note that very little pruning of the top is required when the plants are secured early.

### 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 it may become unprofitable. See figures 11 and 12.

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 transplant-

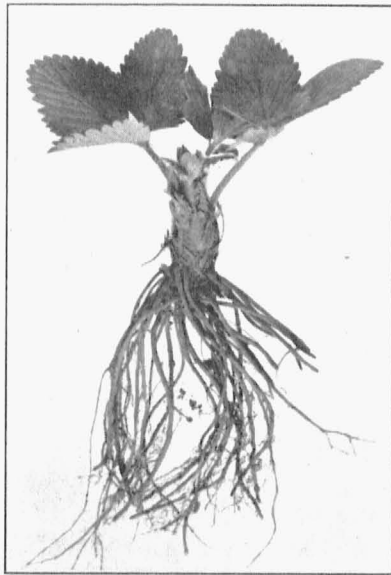


Fig. 9.—A two-year-old strawberry plant. These are not generally as satisfactory for planting as one-year-old plants.

ing 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.

The plants should be protected from the sun and wind during the planting operations. They should not be dropped too far in advance of the planters. A pail, basket or bag may serve as a carrier and for protection to the plants.

For large acreages, 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.



## 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 3½ 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.

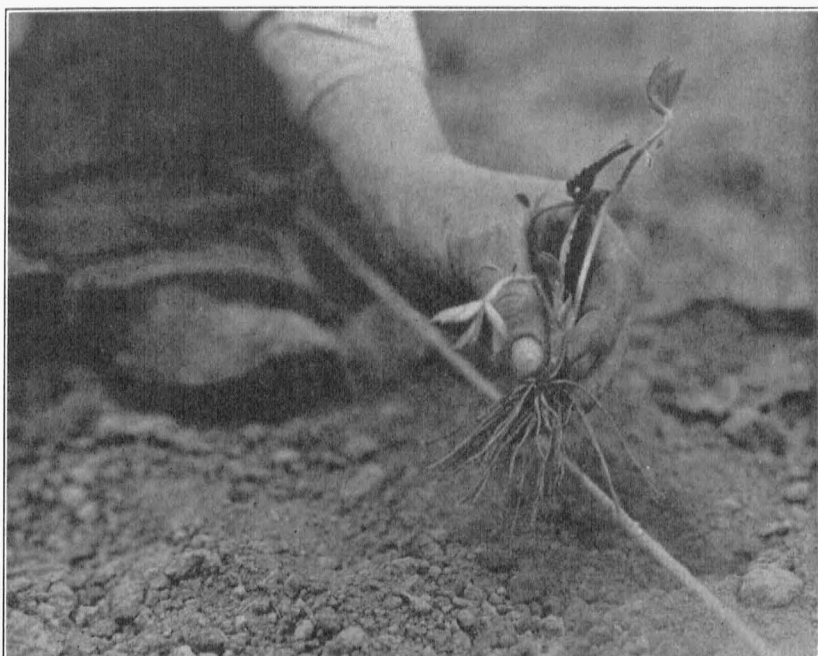


Fig. 10.—Setting strawberry plants in rows marked off by stretching a cord from one side of the field to the other.

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 2½ feet in the row and 3½ 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 2½ 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.



Fig. 11.—Setting strawberries with a machine planter, Ozark Region, Southwest Missouri.

### RENEWING THE STRAWBERRY FIELD

**Operations Involved.**—The renewal of a strawberry field after harvest involves the following operations: first, the renewing of the tops of the plants by mowing or burning; and second, the reduction of the number of plants by plowing and hoeing. Following the renewal of the strawberry field, frequent shallow cultivations should be given during the remainder of the growing season.

**When to Renew.**—Strawberry fields and beds are generally renewed after the first crop. In some cases it may be profitable to renew after the second and third crops. In so doing, the fields or beds are fruited two or three years. It is not usually profitable, however, to renew the crop more than once, but strawberries may again follow in a rotation after vegetable and farm crops. Only well cared for fields are worth renewing. Where the old patch has become weedy and grassy it may cost more to renew it than to plant a new field, which will usually be more profitable.

**Purpose.**—The purpose of renewal is to thin out the older and less productive plants in the rows and to give those that remain an opportunity to make vigorous, healthy, new plants. The amount of thinning will depend upon the fertility of the soil, season, stand, vigor and thriftiness of the plants, and the ability of the variety to produce new plants. In old fields

where the stand is poor and the conditions unfavorable for plant making, few if any plants should be removed. Where the conditions are good for the growth and multiplication of the plants, they may be thinned with a hoe or plow, leaving a row of plants closer together than originally set, because they will not make as many runners and plants, as a rule, as they did the first year.

**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 of narrowing-down the width of the old matted strawberry rows has been successfully used on the grounds of the Missouri Agricultural Experiment Station. It 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

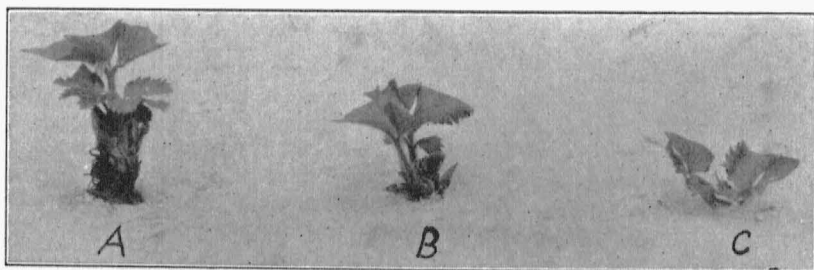


Fig. 12.—Planting depths for strawberries. A. shows a strawberry plant transplanted too shallow; B. indicates the proper planting depth; and C. shows a plant set too deep.

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 pulverize the soil, to accomplish additional thinning if needed, and to remove old crowns and weeds.

**Fertilizing and Cultivating.**—Better results may be secured if renewed fields are fertilized. An application of 200 to 250 pounds of acid phosphate per acre may be applied to the rows and harrowed into the soil. After renewal, frequent and thorough cultivation particularly soon after rains should be given until growth ceases in the fall.

### 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 hoeings 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.



Fig. 13.—An excellent strawberry field just before harvest, Columbia, Missouri.

### 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. 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 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 spread broadcast along the rows about ten days or two weeks after the plants are set, and worked in with hoe and cultivator; or it may be spread in the rows at planting time or at the renewal period and thoroughly mixed and worked into the soil by the use of plows or hoes.

Acid phosphate applied the current year has not in general affected the plants noticeably or given appreciable increases in yield. For the next year following a spring application the effect has usually been the development of more vigorous plants and an increased yield. Nitrate of soda and dried blood have given, in general, negative results the current year and the year following and in some cases have even caused a decrease in yield. Because of the darker green foliage usually produced and a greater vegetative growth resulting from the use of nitrogenous fertilizers, growers are often mistaken as to the actual benefits obtained.

The work of Chandler, formerly of the Missouri College of Agriculture, in the Sarcoux district of Southwest Missouri, showed that the value of phosphorous was not conclusive although it gave as a rule satisfactory and increased yields. The work did show, however, much more conclusively that nitrogenous commercial fertilizers are generally harmful rather than beneficial with the Aroma variety. This was true because nitrogen tended to stimulate runner growth instead of bloom. The results might have been different had some other variety been used.

These investigations also show that the response of strawberries to fertilizers is usually very unsatisfactory. The rainfall or moisture, drainage, physical condition of the soil, toxic effect of soil elements and other factors may play an important role in the marked variations and behavior of individual plants of the same variety.

**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. Some growers prefer to use dried blood as the source of nitrogen, and tankage or bone meal as their source of phosphates because of their inert nature, and no danger of injury to the plants when spread broadcast over the fields or beds.

### 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



Fig. 14.—A strawberry field mulched for winter with wheat straw, University of Missouri Agricultural Experiment Station.

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 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 AND MARKETING.

**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. Note figure 16. 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 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.



Fig. 15.—Strawberry picking on a commercial scale.



One grader in the packing shed may be able to handle the berries 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 marketing a success, 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.

In the Ozark Region, the growers through organization generally submit to federal and state inspection and the cars are sold at auction each night

as loaded. This method of selling facilitates shipment by rail and the benefits to be derived from quick service and car lots are secured.

**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.



Fig. 16.—Strawberry pickers grouped at the packing shed for instruction before starting their work.

### 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 and where strong, healthy, vigorous plants are used for the setting of the field. Too much emphasis cannot be placed upon the importance of securing plants from fields free from infestation by the strawberry crown borer and which have been inspected and approved by the officials of the State Plant Board.

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 pound of arsenate of lead. The second application should be made when the berries are about one-third or one-half 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.



Fig. 17.—Strawberries as a catch crop in a young orchard near Pierce City, Missouri

# Essentials of Strawberry Production

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

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 5.
2. Prepare the soil by good deep plowing in fall or winter, and thorough harrowing or disking in the spring before planting. Pages 6 and 13.
3. Plant the best variety or varieties, after a careful consideration of all factors involved. Page 11.
4. Use the best one-year-old plants obtainable as they will prove to be the cheapest in the long run. Page 14.
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. Page 16.
6. Timely, frequent, and thorough cultivating will produce thrifty, productive plants. Page 20.
7. Protect the plants and fruit by mulching with clean wheat straw. Page 22.
8. 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 18.
9. 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 21.
10. Control injurious diseases and insects by rotation of crops and the use of sprays when required. Page 26.
11. Join your local strawberry association and comply carefully with all the rules and regulations regarding picking, grading, packing, and marketing. Page 24.