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Commercial Strawberry Culture In Missouri

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Strawberry picking on a commercial scale.

The strawberry succeeds under a great diversity of soil and climatic conditions. It is an early, profitable, cash crop, thereby filling a need in the producer's business. Being a short-season crop it fits well into most rotation systems. The plants produce a full crop of fruit the year following planting and may continue to fruit profitably for one or more years through the proper culture of fields or beds. The grower may go into or out of business quickly; and this may prove to be an advantage in one case while it is a disadvantage in another.

In general, the fruit is highly perishable and must be harvested, processed, or consumed within comparatively narrow time limits. It is not exhaustive of soil fertility. The plants are productive, unusually hardy, and rarely require spraying to control diseases and insects. They may be set at a small initial cost, and bring quick returns with high yields. Blossoming lasts through a rather long season, thus producing a set of fruit 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 sprightly flavor and attractive appearance make it not only the most sought for but the most beautiful small fruit, if not the most perfect.

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 an 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, rye, and barley 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 SUGGESTED

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
First	Corn	Oats and Cowpeas	Young Strawberries	Fruiting Strawberries	Fruiting Strawberries
Second	Oats and Cowpeas	Young Strawberries	Fruiting Strawberries	Fruiting Strawberries	Corn
Third	Young Strawberries	Fruiting Strawberries	Fruiting Strawberries	Corn	Oats and Cowpeas
Fourth	Fruiting Strawberries	Fruiting Strawberries	Corn	Oats and Cowpeas	Young Strawberries
Fifth	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 suggested rotation plan that the strawberry fields are fruited for only two years. While strawberry fields may be profitable for fruiting a third year and in some instances even a fourth year, it is generally much more difficult to control diseases and insects 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 straw-

berries. 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.

Plant New Field Every Year

Observations, experience of growers, and some evidence from experimental work, strongly suggest the advisability of planting a strawberry field each year. This would necessitate some changes in the crop rotation systems suggested above.

A four-year cropping system might be adopted instead of a five-year plan. In such instances, the fruiting of strawberries one year instead of two on the same field would be permitted.

All will admit that the planting of strawberries every year should tend to reduce materially the damage from insects and diseases and the resulting reduction in crop yields. Such a system, if conscientiously adopted by growers, should also tend to stabilize production, improve the quality of the berries, and increase the returns to producers.

On the other hand, it may be said that planting every year will run up costs of production. If the expense of renewing the field after harvest is considered, production costs will be raised little or none. Moreover, the larger yields and higher quality of berries from fields fruiting once only should offset considerably any greater expense resulting from the planting of berries every year.

Where for any reason it seems advisable to fruit a field more than one year, this should not interfere with the plan to put out a crop each year. A new strawberry field every year has merit and this suggestion is worthy of careful consideration by producers.

While the strawberry will grow and produce profitably nearly everywhere, there is a marked difference in its growth and production in different sections. Perhaps no other fruit crop is influenced so greatly by soil and climatic conditions. A distance of 50 to 100 miles may be very influential. It is important that varieties of firm flesh and good handling quality be selected for shipment. Frequently only one variety is grown in a district for commercial purposes as other sorts may rank low in production, are poor in quality, and do not ship well.

Time of ripening varies greatly. For some localities late varieties are most profitable because the harvest comes when there are fewer berries on the markets. For others, early kinds may be selected as the crop meets less competition. It may pay to plant early, mid-season, and late varieties, in order to prolong the harvest, sales, and shipments. If this is done, a careful study of the available variety list should be made in order to choose kinds best adapted to the particular section and market demands.

Varieties for Commercial Production

When producing strawberries for market, a grower should set only those varieties which have been proven to be of value in his locality. Varieties which have been tested in actual production, known to be productive, and have a market demand already established, will generally be found most profitable for producers. A new and untried kind may be both productive and high in quality but fail to sell satisfactorily because it is unknown on the markets and unfamiliar to the consumers.

Most strawberry varieties are adapted to a narrow range of soil and climatic conditions. The four most widely planted varieties in Missouri are not produced with equal success in all sections of the state. The Blakemore seems to be best adapted to the extreme Southern part. In general, the best commercial berry for the Ozark region is the Aroma. For the Northern and Central part there is no variety which is equal in all respects to the Premier. The Dunlap is still the leading commercial berry in the extreme Northern part. While each of these varieties can be grown successfully in every section of the state, a grower should probably set the major portion of his acreage to the leading variety for the locality. All of the varieties described have perfect flowers and do not need to be set with other sorts to secure fruit.

Premier.—This is probably the most widely adapted variety among those being planted commercially in this state. It is a sure cropper and adapted to most soils. The plants are vigorous and healthy. Runners are produced freely even under adverse conditions of drought and poor soil. The fruit is medium red, attractive, good flavor, long conic in shape, very uniform, and a fair shipper. The season is early. It is the best early variety and can be generally recommended for all sections of Missouri.

Aroma.—This is the leading commercial variety because of its large size, attractive appearance, and shipping quality. The plants are fairly vigorous, but its plant making ability is only medium. The foliage is resistant to disease. The berries are large, wedge conic in shape. The color is a very brilliant light red with bright yellow seeds. This attractive color is retained during shipping and holding so that the fruit maintains its attractive appearance for many days. The calyx is bright green. The flesh is firm and resistant to bruising. The quality is only fair, the flesh open, spongy, and poorly colored at the center. It grows best on the heavy clay soils of the Ozark region. Commercial production is limited to Southwestern Missouri, Northwestern Arkansas, Kentucky, and Tennessee. The season is midseason to late.

Blakemore.—This is the most widely planted of all varieties throughout the country. It has attained this popularity because of its productivity and drought resistance. The growth is vigorous and

plants are produced abundantly. Under favorable conditions it frequently sets so many plants that attention must be given to spacing to avoid crowding in the row. It is resistant to most of the leaf diseases. The berries are medium size and uniform in shape. The bright red color extends to the center. This attractive color is retained as long as the berries are in good condition. The calyx is of medium size and light green. The fruit is round conic in shape and frequently necked. Since the flesh is very firm and the skin quite tough, the shipping quality is excellent. The flavor is too tart for the best dessert quality, but is desirable when the fruit is to be used for preserving or freezing. Its chief weaknesses are the tendency to run down in size as the season advances and to set such thick stands of plants that the size and yields are frequently lowered. This variety also shows a tendency to sport to yellow leaved plants which are unproductive. The strains being propagated, however, by reliable nurserymen are highly resistant to this trouble. The fruit ripens early in the season.

Dunlap.—This has long been one of the leading varieties in the Northern states. It is well adapted for home use and local markets but is not firm enough for distant shipment. For commercial production it is being replaced by Premier. The plants are vigorous and resistant to injury from drought and cold. It is of greatest value in Northern and Western parts of the state although it succeeds well in all sections. The fruit is high in quality and very attractive. The berry is medium size, conic in shape, not very firm and dark crimson with a deep red flesh. It is a favorite for the home garden since it thrives better under neglect than most varieties.

VARIETIES FOR TRIAL

Culver.—One of the best of the newer introductions. It is more resistant to drought, summer heat, and disease than most varieties. The berries are large, regular, deep crimson in color. This color extends through the berry. The flavor is sprightly and the quality very good. The fruit is firmer than Premier but not equal to the Aroma for shipping.

Catskill.—A very productive and vigorous variety in Central Missouri, but does not seem to be adapted to the Ozark region. The berry is large and rough. The color is bright crimson. The flavor is mild sub-acid. The quality is good. It is recommended as a medium late berry for home use because of its productiveness and large size. It is too soft for commercial shipment.

Fairmore.—A cross of the Fairfax and Blakemore. The plants are strong growers and produce runners abundantly like the Blakemore but the plants and leaves are larger. It is apparently disease resistant. The berry is uniform in shape and holds its size well throughout the season. The color is a very glossy crimson but does not

become dull on holding. It should possess excellent shipping quality since the flesh is very firm. The flavor is sub-acid. The dessert quality is excellent.

Pathfinder.—This is a highly productive variety which is very resistant to the red steel disease. The plant is healthy and vigorous. The berries are uniform in shape and almost round. The color is an attractive light red. The berries are quite soft and the quality is poor. It is adapted to a heavy fertile soil where other varieties do not succeed.

Cato.—A very drought resistant and productive variety adapted for home and local market use. The fruit is of high quality. The color is bright red to the core. The berries are regular, very glossy, and attractive. The plants are very vigorous and will produce a good row under adverse conditions. It is too soft for shipping.

Dresden.—This variety has been fruited for only one season under Missouri conditions. The plants are apparently vigorous, healthy, and increase rapidly. The berries are large and regular, conic to wedge conic in shape. The color is a glossy medium red. The skin is tough. The flesh is firm, and medium red in color. The flavor is sub-acid. The first season this variety fruited, it was very productive and the size of the berries was maintained through the harvest period. The season is early.

TIME OF PLANTING

Early Spring.—As a general rule, strawberry plants should be set as early in the spring as the weather permits and the ground can be worked. In fact, it is almost impossible to set them too early under Missouri conditions. Hard freezes after the plants are set will do no harm. The plants should be ordered early so that they arrive during the first part of March. The plants can be held temporarily for a few days in a cool cellar, or much longer if heeled-in outside. Plantings later than the first of April frequently fail to make a good row.

Late Fall.—Several growers in Southwestern Missouri have found late fall setting to be profitable. Their experience has been confirmed by experimental work done on the Horticulture Experiment Field near Monett.

Fall set plants will frequently produce a better row since the plants get off to an earlier start in the spring. For Southwest Missouri conditions, about the middle of November appears to be the best date for fall planting. To prevent winter injury, a mulch must be applied. Only enough straw to shade the plant is needed. Cultivation is started in early spring as soon as the soil can be worked. The grower generally experiences better weather in the fall for the work of preparing the ground and transplanting.

SELECTING PLANTS

The best growers agree that it is highly important to plant medium 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 State Entomologist.

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 and judicious spacing and thinning usually brings increased yields of higher quality berries. 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 runner plants are pressed into the soil and covered lightly, 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 or no 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 may permit better spreading of the roots and prevent doubling over and twisting.

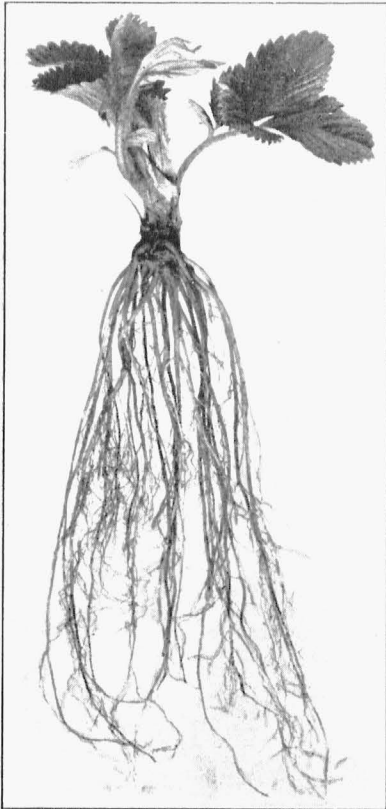


Fig. 2.—A vigorous one-year-old strawberry plant which requires little or no pruning of top or roots.

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 spade, dibble, or other implements 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.

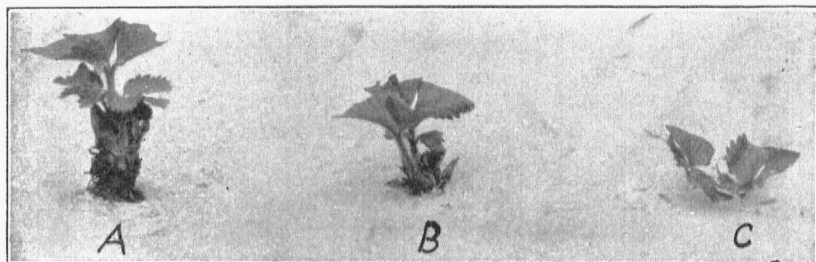


Fig. 3.—Planting depth for strawberries. *A* shows a strawberry plant transplanted too shallow. *B* indicates the proper depth for planting. *C* shows a plant set too deep.

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 may be used for cabbage and sweet potato planting. Two men can set 30,000 plants, or from three to five acres a day.

Spacing and Distance Between Rows

The best distance between the plants in the row and 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 the keeping down of weeds and grass. 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 and especially with less vigorous varieties.



Fig. 4.—A properly spaced field of strawberries fruiting for the first time.

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 be-

ing 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.

Spacing and Training New Runner Plants

The early runner plants should be saved and developed as rapidly as possible. It is also very important that they be carefully spaced and encouraged to root rapidly in order that they may grow the maximum number of leaves and healthy, vigorous crowns for the next year's crop. Rooting can usually be facilitated by pressing gently the young plants into the mellow soil and pulling a thin layer over the runners.

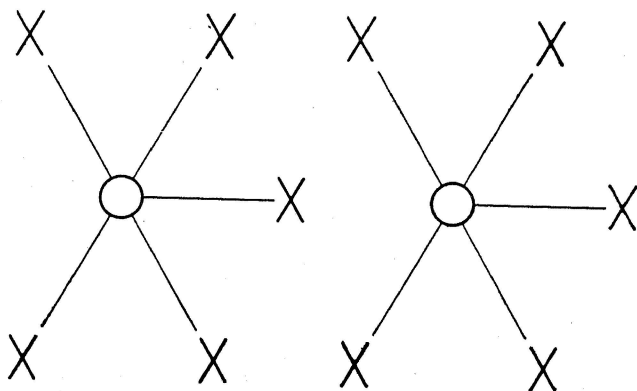


Fig. 5.—Spacing plan for strawberries to show the method. O indicates the plant set or the mother plant, while X represents the new runner plants. Actual field plant spacing work need not be so exact for good results. Proper plant spacing distances range from 6 to 9 inches apart.

From four to six plants per square foot are usually sufficient for good yields but, where early, strong runner plants can be developed, three or four plants per square foot may even give better returns. In general, it is unprofitable to go to great trouble about spacing the plants at any particular distance. In hoeing and plowing, however, the grower should space the early runner plants about 6 to 9 inches apart to be assured of the most profitable yields of high quality berries. The width of the spaced row may vary from about 12 to 24 inches. An average of about 18 inches in width usually proves satisfactory. All surplus runners which encroach upon the middle space should be kept cut away with the hoe or plow.

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. Moreover, if the blossoms remained and the plants were allowed to set fruit, the yield would be very small and unprofitable. 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, provided 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 the 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.



Fig. 6.—The strawberry plants on the left were grown on a deep fertile soil too rich in nitrogen for good fruit formation and development. The plant on the right was grown about 30 feet away on soil of less fertility which resulted in much greater production per plant of firm, marketable berries.

Experimental work at the Agricultural Experiment Station at Columbia and in the Ozark Region near Sarcoxie indicates that

superphosphate 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 in a narrow band about two or three inches from the plants and placed at about the same depth as the lower one-half of the roots in 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 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 complete 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. A 4-12-4 fertilizer is suggested.

Caution.—Where superphosphate 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.

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 10 to 16 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 pulver-

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

MULCHING

Recent investigations have shown very conclusively that strawberry plants may be seriously injured by both late fall and winter cold and that mulching should generally be done earlier than it has been in the past. No variety is immune from this so-called winter injury, although the damage may vary materially with the different sorts.

The injury may cut the yield of the plants the following spring anywhere from about 10 per cent to as much as 100 per cent. Production is frequently reduced from one-third to one-half and the cause is often attributed to an attack of diseases and to the effects of drought, one or both.

Crowns and Roots Injured Early.—The plant crowns and roots may be injured early. Consequently, if temperatures drop to near zero or below during the latter part of November or in early December, great reductions in the strawberry yield may occur in the following year. This will be especially true if warm weather lasts until very late in the fall and is followed by a sudden drop in temperature. In such cases the damage is likely to be much greater than in years when cold weather comes on gradually. It is also true that the plants under normal weather conditions gradually become hardened or more resistant to cold later in the winter.

Damaged Plants.—Crowns and roots that have been injured are much more susceptible to drought damage than uninjured ones, and they are less likely to recover in the spring. Spaced plants, ranging from six to nine inches apart or plants that have made a so-called thin row will generally show considerably more injury than plants in a thick, matted row.

Temperatures of Mulched and Unmulched Plants.—It is obvious that exposed crowns and roots are in danger of much greater damage than those that are not exposed. This is confirmed by experimental findings which indicate that there may be as much as 32 degrees Fahrenheit difference between the air near crowns covered with a mulch as compared with crowns unmulched, two or three plants away. A mat of strawberry leaves may make as much as 15 degrees Fahrenheit difference in temperature when compared with the temperature of plants in the open a foot or two away.

Time to Mulch.—To avoid injury by cold it will generally be found advisable to mulch the strawberry plants during the early part of December or the last week in November. In most cases it will be well to have the mulch on before the first hard freeze and not after. If the plants are growing rapidly as a result of good growing conditions, mulching should be postponed as long as possible. This

is true because early mulching is likely to injure growthy plants. Furthermore, it is natural for the strawberry plant to continue to grow in late fall and early winter. By thus postponing mulching, plants are made most fruitful and hardiness is developed. Growers that keep in touch with the U. S. Weather Bureau stations should experience little difficulty in determining the occurrence of freezing weather in all sections of the State.



Fig. 7.—A strawberry field mulched for winter with wheat straw. University of Missouri Agricultural Experiment Station.

Study Weather Bureau Forecasts.—In most instances it will be advisable to place in the strawberry fields or on the borders early in November a part or all of the mulching material needed. It will then be necessary to watch the forecasts of the U. S. Weather Bureau, particularly during November and early December just preceding the application of the mulch. When temperatures of 15° F. to 20° F. or lower are predicted by the Weather Bureau, it is highly important that at least a part of the mulch be spread over the strawberry rows. An observance of such precautions and procedure may frequently prevent material reductions in the crop the following year. In other words, such timely and painstaking work may mean the difference between success or failure of the enterprise.

Mulching Material.—The most common mulching material consists of wheat straw, oat and rye straw, sage grass, leaves and strawy manure. Leaves are not as satisfactory as the other materials, because they lie closely together and pack down in such a way that they may smother out the plants if heavy applications are made.

Wheat straw and marsh grass are generally considered the best materials. Coarse strawy manure, rye straw, pine needles and various kinds of hay or roughage may be used to advantage. The materials should be as free as possible from seeds. Otherwise, yields may be materially reduced in dry springs and renewal after harvest is made more difficult.

A mulch of from 2 to 4 tons per acre is usually sufficient and it should cover the plants from 2 to 3 inches in depth. The mulch is to prevent cold injury to crowns and roots, conserve moisture, keep the soil cool and damp during the season when the fruit is ripening, prevent heaving out the plants in winter, and keep the fruit clean at harvest time.

HARVESTING

Harvest Time and Pickers.—The harvesting period for the Ozark Region generally commences about the middle 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.



Fig. 8.—Aroma strawberries, grown in Missouri, ready for inspection and shipment.

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 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

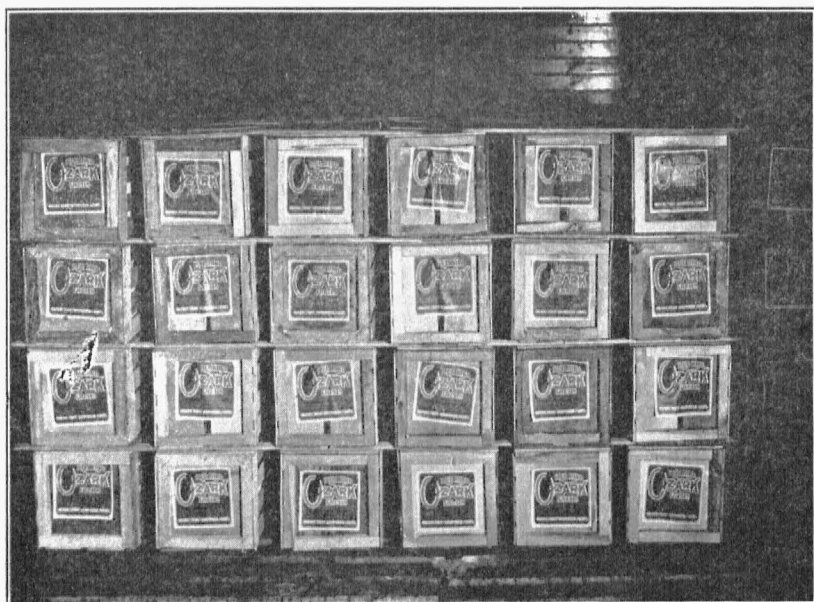


Fig. 9.—End view of 24-quart strawberry crates packed in a strawberry refrigerator car, showing the neat and attractive label, "Red Bird, Ozark Fruits, Ozark Fruit Growers' Association."

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 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 without injury 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,

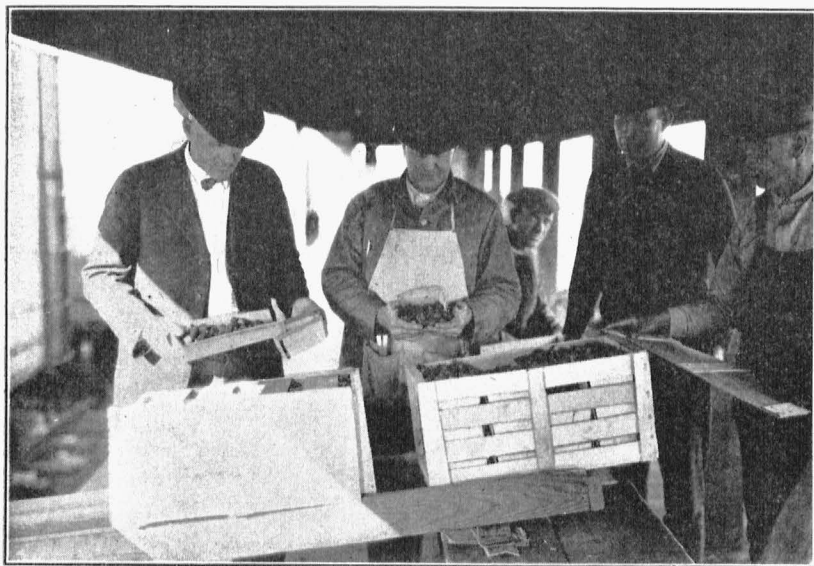


Fig. 10.—Inspecting strawberries at the car door. Federal and State Inspection Service, Monett, Missouri.

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 1¼ 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.