

# AGRICULTURAL EXPERIMENT STATION

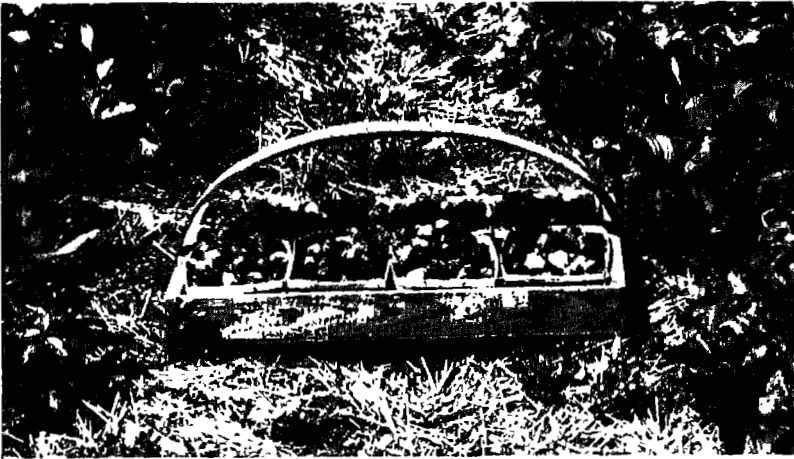
KANSAS STATE COLLEGE OF AGRICULTURE  
AND APPLIED SCIENCE

MANHATTAN, KANSAS

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DEPARTMENT OF HORTICULTURE

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A CARRIER FULL OF DUNLAP STRAWBERRIES

## STRAWBERRY GROWING IN KANSAS

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The strawberry is one of the very important fruits of North America. Its high quality of fruit, large acreage and yields, wide adaptation, ease of culture, and great number of varieties all contribute to its popularity. Both the home gardener and the commercial grower successfully produce the strawberry in all agricultural sections of the continent except in the far south.

As would be expected, this fruit thrives in every part of Kansas where moisture and soil fertility are adequate for the support of agriculture. Home patches are found everywhere and commercial production on a limited scale is nearly equally extensive. In 1929 the area in strawberries in Kansas was reported as 1,792 acres and

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1. Contribution No. 100 from the Department of Horticulture.

the yield in 1928 was 126,572 crates. These figures show an increase of 821 acres and 81,500 crates in the past decade. The average yield, nearly 70 crates to the acre, is a small yield for this fruit. Doniphan, Wyandotte, and Jackson are the leading counties in strawberry growing. Only sixteen counties of the state report no strawberries. The quantity of this fruit produced in Kansas does not nearly supply local demands even during the season of home-grown berries, and a great extension in the acreage and a large increase in the yield per acre would not cause an overproduction of this fruit for home consumption. There is nearly always a demand for high-quality strawberries at a price which insures a profit to the grower.

#### VARIETIES OF STRAWBERRIES FOR KANSAS

Scores of varieties of strawberries have been carefully tested by the Agricultural Experiment Station at Manhattan and by growers in all parts of the state. These experiments have led to a practically unanimous selection of a small number of varieties as best adapted to the climate and soils of the state. Prominent in this list are Excelsior, Dunlap, Aroma, and the everbearing varieties, Progressive and Superb. When a supply of water is available late in the strawberry season the Gandy has many characteristics to recommend its addition to the list as a late berry, but early summer drouths greatly reduce the yield from this variety.

The amateur grower may wish to experiment with new varieties as they appear, and will get a great deal of enjoyment out of such tests. He should remember, however, that the price asked for plants of new varieties is often excessive and, though a few of these may be planted, the producing patch should be of the tried and recommended varieties.

**Excelsior.**—The qualities which give value to this variety are its very early season, its firmness of berry which insures good shipping quality, and its abundant production of runners. These good characters are in part offset by the small size and high acidity of the berries and the susceptibility of the plants to the leaf-spot disease. The berries are oblate to round, of good red color, and rated as good in dessert quality when allowed to ripen on the plant. Excelsior ranks high among the early varieties.

**Dunlap.**—The Dunlap is one of the hardiest and most drouth-resistant varieties. These qualities, with its other good points of size, color, quality, productiveness, and disease resistance, place this variety well in the lead of all strawberries for the northern Mississippi valley. Fortunately, it is a free producer of runners and so is popular with the nurserymen. The fact that the flesh of the fruit is not very firm somewhat reduces its value for shipping and canning. It is a mid-season berry in Kansas. (See illustration, page 1.)

**Aroma.**—The Aroma originated in Kansas in 1889. It is the principal variety grown in the southern part of the Mississippi valley. The season closely follows that of the Dunlap. Firmness of

flesh and high dessert quality characterize the fruit of the Aroma. Other valuable qualities are bright crimson color, large size, healthy foliage, high yields, and good runner production. It does especially well on rather heavy soils.

**Gandy.**—The middle Atlantic states produce the Gandy in large quantities. Its berries are large, firm, dark crimson in color, and of good quality. The plants are usually healthy and produce runners freely. This is one of the good canning varieties and, if grown in fertile clay soil, is productive. It can be recommended as a late variety for Kansas.

**Progressive.**—Among the everbearing strawberries the Progressive is most widely grown. It produces a light crop the same year it is planted, if conditions are favorable, and continues to yield until frost. The berries are small, firm, dark crimson in color, and very good in quality. The plant is resistant to leaf spot and will produce runners freely on rich soil. It is recommended for home gardens and might prove profitable as a commercial variety under intensive culture.

**Superb.**—The berry of Superb is larger than that of Progressive and is also somewhat softer, and lighter in color. It varies in quality from poor to good. It is superior to Progressive only in that it yields larger crops on soils which are low in nitrogen but well supplied with moisture.

**Mastodon.**—This variety, introduced in 1921, has become popular with growers of everbearing or autumn-bearing strawberries. It yields more plants than Progressive. Its fruits, medium to large in size, color unevenly to a medium red, are frequently hollow and are of good quality. The plant is susceptible to leaf spot and seems especially attractive to the leaf folder. The place of the Mastodon, like other everbearing varieties, would seem to be in the home garden.

#### NUMBER OF VARIETIES TO PLANT

The home garden might well contain four or more good varieties, but the commercial grower usually finds one or two of them best adapted to his particular needs, and concentrates on these. In many parts of Kansas the Dunlap constitutes 50 to 100 per cent of the commercial patch. It is probable, though, that 25, 50, and 25 per cent each of three varieties arranged in order of ripening would be more profitable, especially for a local market. Excelsior, Dunlap, and Aroma would make a good combination. The hazard of the loss of a crop is lessened and greater economy in picking secured by this arrangement. This latter phase will be discussed in connection with harvesting the strawberry.

**SITE FOR A STRAWBERRY PATCH**

**Air and Water Drainage.**—The soil in which strawberries are planted must be free from standing water at all times of the year. Even a few days of submergence will prove fatal to the plants. A well-drained soil but one with good water-holding capacity is needed for this crop. The strawberry is unusually subject to injury by late spring frosts because of its early blooming habit and its clinging close to the surface of the ground where the coldest air collects during the night. Planting on a slope, thus securing good air drainage, will reduce this injury. However, soil conditions are usually more



FIG. 1.—Newly set strawberries used as an intercrop in a young apple orchard

favorable on nearly level areas. Nearly level land is often chosen because the strawberry blossoms, open in flushes over several weeks and any particular frost destroys only those blossoms which are then open. A sloping site is shown in figure 1, where the plants are set as an intercrop in a young apple orchard.

**Moisture Requirement.**—The roots of the strawberry plants spread out close to the surface and do not penetrate very deeply. Hence the soil in which strawberries are grown should be well supplied with water. It should be able to absorb large quantities of water and retentive enough that brief drouths will not cause the surface to become dry. A soil which is rich in organic material best holds the moisture. Drouth during harvest time or while new runner plants are setting rapidly is one of the worst things which can happen to the strawberry. Auxiliary irrigation often proves a profitable

investment during years when such drouths occur. Either surface or overhead systems may be used, but water in sufficient volume to soak the soil thoroughly should be available.

**Soil Requirements.**— Strawberries are found growing on all types of Kansas soils from light sand to heavy clay. In general, however, the lighter soils such as the sandy loams give the best yields. Sandy soils favor early ripening and are to be given preference on this account if their fertility and moisture content are adequate. The different varieties vary somewhat in their soil adaptations, but this is not a marked character. All varieties do well on fertile, moist, sandy loam soils.

It is in general much better practice to make the soil which is to be planted to strawberries fertile and productive before setting the plants than to attempt to increase the store of plant food greatly after the patch is set. The addition of liberal amounts of barnyard manure to each of the two or three preceding crops and a proper crop rotation should take care of this matter.

Good tilth is as important as high fertility in growing strawberries. A soil which is hard to work, which bakes badly, or which absorbs water slowly is undesirable. The crop which precedes the strawberries will have an effect on this matter of soil texture. In all cases strawberries should follow a cultivated crop, never a cereal or grass because the cereal leaves the soil low in nitrogen, especially for fall planting, and grass land is usually infested by the white grub.

#### OBTAINING STRAWBERRY PLANTS

Like all fruit plants, strawberry varieties must be perpetuated by bud propagation. Fortunately, this plant naturally sets runners which, after they have taken root, may be severed from the mother plant and used for setting a new patch. Great care must always be taken, when more than one variety is grown, to make sure that the sets come from plants of the desired variety.

**Propagating Plants.**— For propagating purposes, maiden plants, that is those which have not borne fruit, of known variety and of good vigor should be planted on soil of high fertility about two feet apart in the rows and 40 inches between rows. These special plants should have the best of care and be permitted to set as many runner plants as they will, but not allowed to bear any fruit. At transplanting time all the plants should be dug from the bed and those which have strong root systems, except the original mother plants, should be used to set the new patch. Available evidence does not sustain the popular idea that the late-set runner plants, those at the tip of the runner, are less valuable than the earlier-rooted ones. If a plant has a good root system it should be used whatever its location on the runner may have been.

Under favorable conditions, varieties such as the Dunlap will give an average production of 15 well-rooted sets to each mother plant. If, then, 1,500 plants were needed to set the new patch, the

propagation bed should contain 100 mother plants and occupy somewhat less than 700 square feet of land.

**Buying Plants.**—Frequently, the grower will find it better to buy his plants than to grow them. In that case he should select a reliable grower, order well ahead of planting time, and pay enough to obtain the best plants of the varieties desired. A good strawberry plant for setting will be of the preceding summer's growth, will have an abundance of light-colored roots, but few leaves, a slender neck or crown, and be free from disease or injurious insects. Dark brown roots, many old leaf stems causing a thick neck, and an abundance of leaves indicate an old plant; one that is of no value whatever to set in a new patch. An old plant probably will not live if set. If it does live, it will make but a small production of runners, and is more likely to introduce pests than is a young plant.

**Number of Plants Needed.**—The number of plants needed to set the patch is easily calculated after the size of the proposed patch and the planting distances are determined. A one-acre patch contains 43,560 square feet. If the plants are to be set 20 inches apart with 48 inches between rows, each plant would occupy 6.6 square feet of land. Dividing 43,560 by 6.6, gives 6,600, the number of plants needed. A home patch 30 by 50 feet, or preferably 15 by 100 feet, would require 230 plants if set as above indicated.

#### STRAWBERRY ROTATIONS

Prevailing practices regarding the resetting of the same land to a second crop of strawberries and the number of years a patch is allowed to persist vary rather widely. It is never advisable to attempt to grow strawberries continuously on the same land. One of the best rotations is secured when strawberries occupy the land three years, yielding two crops, and are followed by other crops for an equal length of time before strawberries are reset. Longer intervals between the strawberry plantings probably would be better if well adapted land is abundant; but especially good care, including heavy manuring, may shorten the needed interval between crops to one year.

Some rotations found in practice are as follows: (1) Alfalfa four years, garden vegetables and manure one year, and strawberries for three years; (2) clover two years, early potatoes one year, followed by a cover crop and manure in the fall and spring-planted strawberries; (3) garden crops with liberal applications of manure two years, and strawberries; (4) clover two years, grain and potatoes each one year, and strawberries. Occasionally, a grower will plow out the strawberry plants after the second or third harvest and attempt to get the soil into shape to replant the next spring, but this practice seldom proves successful.

Strawberries should never be planted on land which is foul with grass or weeds.

### STRAWBERRY CULTURE

**Preparation of the Soil.**—The first requisite in securing a good patch of strawberries is thorough preparation of the soil. The soil should be plowed to a depth of six to ten inches and the furrow slice should be thoroughly pulverized. The plowing may be done either in the fall or in the spring. Thorough disking and harrowing and perhaps floating the surface is necessary to secure a well compacted soil, after which the land should be marked in rows and sometimes cross-marked for the plants.

**Planting Distances.**—The fertility and moisture supply of the soil, the method of training, whether hand or horse cultivation is used, and in a measure the variety selected, will influence planting distances. Rows are sometimes spaced as close as 24 inches and as far apart as 54 inches, but these extremes are rarely recommended. For Kansas soils of average fertility and moisture supply and in case horse-drawn implements are to be used, from 36 to 42 inches between rows are common planting distances under the hill system, and from 40 to 48 inches if the plants are to be grown in a matted row.

For hill culture the plants are commonly spaced 18 inches apart in the row. If the runners are allowed to grow and form a matted row the distance between plants is variable, usually from 12 inches to as much as 30 inches. Varieties which produce many runners may be planted at the greater distances, say 24 inches apart.

**Care of the Plants.**—The nurseryman ships plants just sufficiently well packed to reach their destination in good condition. The grower must, therefore, get them as soon as possible after their arrival. He should at once unpack the plants and water the roots thoroughly. If the soil is ready, planting should be done at once, but if the weather is such as to prevent immediate setting the plants should be either stored in a cool place and kept moist or heeled in in some shaded spot. Strawberries are easy to transplant if reasonable care is given them, but exposure of the roots to wind and heat will quickly weaken the plants or kill them outright. Careful handling is very profitable.

**Setting the Plants.**—Strawberry plants are set by hand. Three men or two men and a boy constitute an economical team for this work. One man, or the boy, drops the plants for the other two to set. In drying weather not more than one or two plants should be dropped ahead of the setting team and the supply of plants must be so carried as to protect them from the wind and sun.

Various implements may be used for making the holes for the plants, but a flat dibble and a mason's trowel are among the best. The tool is thrust into the soil and then pressed forward. The roots of the plant are spread out in fan shape, having been previously trimmed to about three inches in length, and are inserted into the hole behind the tool, which is then withdrawn. The soil must be

packed firmly around the roots and the depth of planting should be such that the crown of the plant is exactly level with the surface of the packed soil. Either the planter's foot or the setting implement may be used to firm the soil. If the plant can be pulled up by a quick upward pull on one leaf, it has not been set firmly enough. The leaf stem should break.

**Training Systems.**— Nearly all Kansas strawberries are grown by the matted-row system. Under this method the newly set plants are allowed to produce and set runners at will throughout the first summer's growth. The following year's crop is borne from these runner set plants and the yield will be more closely related to the care given them and their vigor than to the kind of season, barring



FIG. 2.—A splendid Kansas strawberry field at picking time.

frost injury, which comes during the fruiting period. One plant to each 36 square inches constitutes a good stand in the matted row, the row itself being 12 to 14 inches wide. The matted-row system is well illustrated in figure 2, though the plants there stand somewhat too thick.

If the hill system of training is adopted the newly set plants are allowed to produce neither runners nor blossoms the first season. This concentrates the growth of the plants in a series of offsets or crowns around the original plant. From these the first crop is produced. Some growers claim that the hill system gives better yields in dry sections than does the matted row, but it is not generally popular. It might well be tested in the home garden patch.

Various "hedge-row" systems are used in some parts of the country but are in general disfavor because of their high labor requirement. To follow them requires the actual placing of each runner



plant in its position in the row and the removal of all surplus runners.

**Cultivation of the Soil.**—Beginning at once after the plants are set the strawberry field should have frequent cultivations throughout the growing season. These may at first be close to the row and as much as four inches deep, but should allow more space for the row and become more shallow as the season advances. Some hand work may be necessary to keep the weeds and grass out of the rows, but the principal part of this is better accomplished by careful cultivation and rotation of crops during the year or two preceding the setting of the patch.

The cultivation during subsequent years is usually delayed until after harvest, especially when the straw mulch is left between the rows. In unmulched patches the cultivation should begin early. Thorough cultivation is always needed following renovation and until a good supply of runner plants have set. Cultivation close to the plants must always be shallow.

**The Winter Mulch.**—Good growers place a mulch of hay or straw on the strawberry bed during December. The principal purpose of the mulch is to prevent heaving of the soil and the consequent breaking of the roots of the plants. The layer of straw should be four to six inches thick when applied and must be raked off the plants as soon as leaf growth starts in the spring. Usually, part of the mulch should be taken off the field at this time but the greater part is left between the rows until after harvest, when it is nearly all removed. Some of the straw can be cultivated into the soil if the soil moisture is abundant.

In addition to preventing heaving, the mulch is of value in conserving moisture, controlling weeds, keeping the berries clean, reducing the frost hazard, and making picking conditions more pleasant. About five tons of wheat straw per acre are needed. It should be free from weed seeds. Baled straw can usually be purchased for mulching the small home patch, but should be thoroughly torn to pieces when applied.

**Renewal or Renovation of the Patch.**—Following harvest the strawberry patch must be renewed or renovated. This cultural process may involve four steps, which should be taken as follows: First, the mulch is removed, only such quantities as may readily be incorporated in the soil being left between the rows. Second, if a pest such as leaf spot or leaf folder is present the leaves are mowed, allowed to dry, and then burned when a brisk breeze is blowing. Third, the rows are cut down with some implement to a width of about 4 inches. Fourth, the patch receives cultivation at seven- to ten-day periods for two or three months.

The cutting back of the row can be done with a stirring plow and a rolling cutter attachment. Some successful growers merely straighten up one edge of the matted row, say the left, and plow away from the right side till only the desired width is left. This

brings the left half of the new row on soil not previously occupied by the strawberry plants. The strip of row left should be about 4 inches wide and, if the cutting back is done with a plow, the soil should be cultivated back into the furrows as soon as practicable. Some of the plowed-out plants may start to grow, too, if surface cultivation is not commenced at once.

The plants in the strip of row which was left should quickly begin to produce runners. These are allowed to establish themselves until the matted row is again 12 to 14 inches wide. Shallow cultivation of the space between rows is continued until fall.

**Irrigation of Strawberries.**— In the eastern part of Kansas the yield of strawberries can be increased greatly by irrigation in some seasons, while in western Kansas irrigation is needed nearly every year. The water may be applied in furrows between the rows or by an overhead sprinkler system. The former is much cheaper to install but the latter, possibly, is more economical to operate.

There are two times during which drouths are particularly harmful to the strawberry. The first of these is while the crop is maturing. Depending on the type of soil, the patch needs three to six inches of water during this period. The second period of special water demand comes just after the patch is renovated. The water is then used to produce new runner plants for the second crop and to enable these new plants to store an abundance of food in their crowns for the beginning of growth the following spring. Sufficient water should be given to keep the plants growing vigorously through the latter part of July and August. This is also the period during which the everbearing varieties must have a liberal supply of water if the fall crop is to be abundant.

#### INSECT PESTS OF THE STRAWBERRY<sup>2</sup>

Strawberry patches are unusually free from serious insect pests in Kansas, but a few species sometimes become destructive.

The root louse is a dark green aphid which attacks the crown and roots of the strawberries and causes the plants to turn yellow and die. Short rotations and clean plants for setting are the principal control measures.

The white grub of the June beetle is sometimes destructive in strawberry patches, the injury being caused by the grub's feeding on the rootlets of the plant. The attacks may be largely avoided by planting strawberries only on land which has been in a cultivated crop the year before and to which infested barnyard manure has not been applied.

The strawberry leaf folder injures the foliage of the plants during midsummer. Thorough spraying with arsenate of lead for the second and third broods will control this pest. Mowing and burning the leaves immediately after harvest is also recommended as a control measure.

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2. For a fuller discussion of these insects the reader is referred to "Insects Injurious to Fruits," by G. A. Dean and L. M. Peairs. Agricultural Education, Vol. VI, No. 2, December, 1913. 151 pp. Figs. 130. Division of College Extension, K. S. C.

DISEASES OF THE STRAWBERRY

Leaf spot is the most serious disease of the strawberry and is found in all parts of Kansas. This disease appears in the form of small, irregularly distributed spots on the leaves. The spots are at first reddish-brown or purple; later the center becomes grayish-white with a red or purple border. Plants on heavy or wet soils are most subject to attacks of leaf spot and varieties vary in their degree of susceptibility to it.

Bordeaux mixture, 4-4-50 strength, applied twice before harvest and once after renovation is of value in the control of leaf spot. Mowing and burning the leaves after harvest also lessens later in-

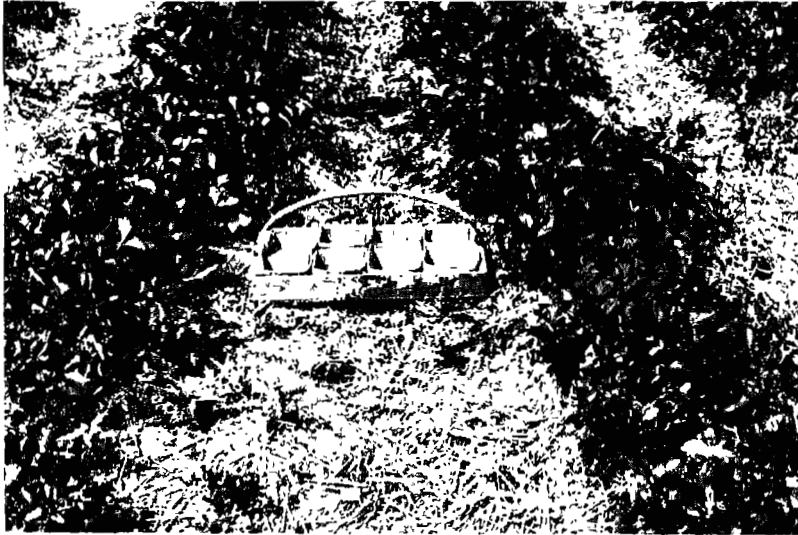


FIG. 3.—An eight-cup picking carrier ready to be filled.

fections. Care should be taken to set no infected plants when the new patch is started.

Powdery mildew, black mold, and gray mold are of some economic importance as strawberry diseases in this region. If they appear, directions for their control can be obtained from the Agricultural Experiment Station.

HARVESTING STRAWBERRIES

**Picking Equipment.**—If the strawberry is grown in commercial quantities, preparation for harvest must be considered before the fruit begins to ripen. A supply of crates and boxes or cups should be obtained as soon as a fairly accurate estimate of the crop can be made. Records of previous crops or of those grown by neighbors serve as a guide in making this estimate. The crates and cups should be of good grade and workmanship, clean and new.

Prices of crates vary from year to year and always seem high, but these supplies are necessary if the fruit is to go on the general market, and it pays to use good ones. Both crates and cups are frequently made up after being hauled to the patch as shook.

At least one picking carrier should be provided for each picker. These should carry six to twelve cups and should be provided with handles. An eight-cup picking carrier is illustrated in figure 3.

**The Packing Shed.**—The berries must be protected from the sun and wind while being packed and while the crate covers are being nailed on. This protection may be afforded by a simple shelter of

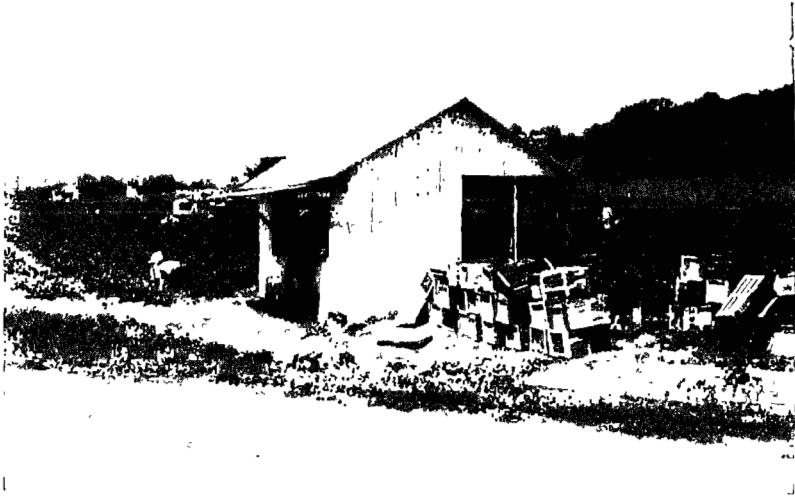


FIG. 4—A convenient packing shed. This shed is by a paved highway and hundreds of crates of berries are sold direct through it to the consumer.

rough boards, or a more elaborate shed may be built. It should be located near the center of one side of the patch, and is well worth the small amount which it costs. A good type of packing shed and standard shipping crates are shown in figure 4.

**Secure Labor Early.**—As soon as an accurate estimate of the crop can be made, steps should be taken to secure a supply of pickers. Children over 12 years of age can harvest strawberries satisfactorily if under competent supervision. Some large growers secure the children's school teacher as a forewoman and have found the results excellent. City women and children are sometimes available if good, sanitary camping quarters are provided for them. In general, strawberry picking is piece work.

**Training Pickers.**—The number of pickers needed will vary from four to eight for each acre. They should be numerous enough to get over the patch at least once in 48 hours, but yet enable the

pickers to put in as nearly full time as possible. A good distribution of pickers is shown in figure 5. The whole place should be a "School of Pickers" during the first few days of harvest. Full instructions must be given regarding the stage of ripeness or color to look for, clean picking, picking by the stem instead of by grasping the berry, sorting while picking, and many other details of the operation. Pickers who do not do good work by the third day should be replaced.

If a given acreage is planted to three varieties which ripen in succession, a smaller and better-trained picking crew can be em-



FIG. 5.—A picking crew at work in a Kansas strawberry patch. This crew can pick about five acres of berries.

ployed for a longer harvest season. Each grower can follow this method, or that of concentrating on one variety and thus having a short and hurried harvest, as appears best to him, being guided largely by the demands of his market.

**Packing the Berries.**—In many sections even the strawberries shipped to the general market are not packed. They are merely graded as to ripeness by the top berries of the cup and the crates at once nailed up. Other growers will go to the other extreme and pack each individual berry according to a definite system. This pays only when large-size, high-grade berries are produced and can be sold on a market which will pay considerably more than the going price. More commonly, only the top layer of berries in each cup is arranged or packed. This consists in so facing each box with representative fruits that no stems show, thus giving the package a neat appearance.

### SHIPPING AND MARKETING THE STRAWBERRY

Strawberries are usually shipped by express. They should have been picked at the stage of ripeness adapted to the shipping distance which the fruit must travel. The fruit may be full color but not soft for a 12-hour shipment, three-fourths red for a 24-hour shipment, and white in color for longer shipments. For home use they should be ripe but not soft, when picked. Similar shipping rules would apply when the fruit is transported by truck.

**Marketing Methods.**—Strawberries are sold on either the local or the general market. Association selling has proved profitable in many commercial districts, especially where the fruit is shipped in car lots; in fact some type of cooperation is necessary if a large quantity of strawberries produced in one locality is to be sold profitably on the general market during a season of average production.

Individual commercial growers, especially those isolated from other growers, often sell at profitable prices on local markets. Under these conditions, arrangements may be made with local retail stores to handle the fruit or, through advertising, considerable quantities may be sold at the farm gate. The writer knows one grower who disposed of a large crop from more than an acre of berries by the sole means of a sign at the gate. His house, however, was situated on a paved highway. Frequently, the selling of the crop will require as much study and ingenuity if well managed as will the growing and harvesting. It is also true with this fruit as with others that well-grown and well-packed fruit is already half sold.

### SOME PRECAUTIONS FOR THE NEW STRAWBERRY GROWER

Locate the strawberry patch on fertile soil which contains an abundance of organic material.

Clean the land of weeds, especially grasses, before setting the plants.

Do not undertake a large acreage until experience has been gained with smaller patches. Profits do not always increase at the same rate as the acreage.

Select only thoroughly tested varieties for commercial planting.

Reject for planting all plants which are old, diseased, or weak.

Do not allow spring set plants to bear fruit the first season.

Destroy a patch which is declining in production, usually immediately after the second crop is harvested.

Practice a rotation which includes a legume for two years and in which the strawberries are preceded by a cultivated crop.

Remember that good renovation methods will greatly increase the next crop.

Provide for a supply of containers and pickers before the berries begin to ripen.

Study the methods of the successful growers in your neighborhood.

Keep records of costs and sales.