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IN CALIFORNIA

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Frontispiece.—Fruiting branch of Cory Thornless blackberry.

# BUSH FRUIT CULTURE IN CALIFORNIA

A. H. HENDRICKSON<sup>1</sup>

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Bush fruits, especially the brambles, or fruits of the raspberry and blackberry type (see frontispiece), are grown in nearly all parts of California. The plantings vary from the few bushes cultivated for home use to plantations in which several hundred acres may be devoted to the production of enough berries to supply both local and distant markets with fresh fruit and allow a considerable portion of the surplus to be canned. Nearly all of the bush fruits are adapted to California soil and climatic conditions. Although some of the sorts are not grown extensively in the hot, dry sections of the state, even these may be grown in home gardens by judicious handling. With a succession of varieties, berries for the table may be produced throughout a long season.

Bush berries are, for the most part, best adapted for growing in regions comparatively close to the consuming centers. They are generally consumed in the fresh conditions and must, therefore, be fully mature and present an attractive appearance when displayed for sale. In some districts a considerable portion of the crop is preserved, or made into jams and jellies. Small quantities are sometimes dehydrated and sold as dried fruit. Probably the chief outlet for the commercially canned berries is the bakery trade, in which they are made into pies or tarts. This trade also uses a considerable quantity of frozen berries. In the latter case, the berries are frozen and kept in the original container at a temperature of about 20 degrees Fahrenheit until used. Berries handled in this way are said to retain more nearly the fresh flavor and aroma than those preserved in any other manner.

Bush berries are usually grown in small plantations. The customary size of planting is the acreage that can be conveniently cared for by one family throughout all operations except picking, when extra help is necessary. When supplying a local market a combination of varieties ripening over a considerable period of time is often desirable. If the berries are being produced for eastern shipment, usually only two or three varieties are grown.

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The perishable nature of this crop does not permit any delay in picking. Ability to secure sufficient labor to go over the entire plantation every two or three days is a factor of great importance. In some districts, the help used in picking berries comes from the nearby towns and neighboring farms. In other cases, use is made of itinerant labor travelling from place to place by automobile. Very often, if working conditions are good and the picking rates high enough to enable the pickers to make fair wages, the same people return year after year. Picking berries offers employment to the whole family, although the younger children must be watched rather carefully to see that they do not crush the fruit. Picking is usually done on a piece-work basis, often with a bonus for remaining the entire season.

The costs of bringing a plantation into bearing and of handling the crop are so variable that it is impossible to give any accurate figures. Yields, likewise, vary widely with the district, the variety grown, and the systems of pruning and irrigation.

The costs of grading range from \$10 to \$30 or more per acre, according to the topography of the land. The number of plants to the acre varies, according to the planting distance used, from 800 to 2,500. Planting costs from \$15 to \$25 per acre, according to the topography of the land. The cost of the plants themselves, which may vary from \$50 to \$200, is often the largest single item of expense. After one acreage has been planted, however, plants for succeeding plantations may be secured at small cost by propagating from the existing plants.

Hoeing, cultivating, pruning, irrigating, and other cultural operations vary widely in cost, but in general they are considerably more expensive than would be the case for a similar area planted to orchard fruits. If trellises are necessary, the cost of stakes and wire must be added. Yields may vary from 1 to 10 tons per acre, according to the variety, and the way in which the planting is handled.

Bush berries are often used as an intercrop in young orchards until the trees begin to bear. Many orchards in California have been started in this way. The berry plantation itself is often intercropped, the first year after setting, with lettuce or some similar vegetable. In many cases the berry plants are removed as soon as the orchard begins to bear, in spite of the fact that the berries could profitably be kept for several years longer. Thus centers of production often change from district to district as the newly planted orchards reach maturity. The principal reasons for these changes are probably labor problems

and, to a lesser extent, the prevalence of diseases and insect pests. It is a singular fact that when the interplanted orchard comes into bearing, many people develop a distaste for the somewhat irksome labor necessary with small fruits, even though the latter are often more profitable than the orchard fruits.

Although the acreage planted with bush berries to supply local markets has probably increased slowly, and the acreage of certain varieties adapted to eastern shipment has increased rather markedly, the production of these fruits for commercial canning has shown a decisive decrease. Table 1, compiled by the Cannery League of California, shows the number of cases of berries preserved during the past seven years.

TABLE 1  
CASES OF BUSH BERRIES CANNED IN CALIFORNIA.

Year	Blackberries	Loganberries	Raspberries	Gooseberries
1920	161,359	14,267	.....	.....
1921	85,542	6,198	1,200	.....
1922	135,289	17,675	3,182	.....
1923	118,530	34,553	.....	.....
1924	48,103	22,594	12	2,074
1925	31,131	4,081	.....	1,051
1926	24,366	937	.....	.....

### CHOICE OF A LOCATION

The choice of a location for a berry plantation is important for several reasons. In general, sites subject to late spring frosts should be avoided. Bottom lands or swales, into which cold air drains from the higher surrounding elevations, are often dangerous. A southern aspect is often thought to be desirable because of earlier ripening of fruit. Early berries usually command the best prices. Rolling or hilly land, while it may be free from frost, is generally somewhat more difficult to cultivate and irrigate than land which is nearly level.

As a rule, bush berries produce over a longer season in the cool coastal sections than they do in the warm interior valleys. Along the coast, some varieties produce two crops during a season, or tend to bear throughout the summer, but in the warm sections the picking season is much shorter. Bush berries are seriously injured by hot drying winds, especially if they are not irrigated frequently. Currants and gooseberries are often scalded by temperatures of 90° Fahrenheit or above.

An unfailing supply of water for irrigation is extremely important except in the few sections where berries are grown without irrigation. While some bush berries are comparatively deep rooted and seem to stand drought fairly well, others require rather frequent irrigation. The soil, during the growing season, must be kept sufficiently moist to keep the leaves turgid and the plants in a healthy vigorous condition. Lack of available moisture during the growing season results in weak, spindling canes and reduced fruit production the following year. If the plants are allowed to suffer for moisture shortly before or during the ripening season, the berries are inclined to be small and to crumble easily. Trouble with red spider is often serious in berry fields which are allowed to show the usual symptoms accompanying the lack of available moisture. Most bush berries are vigorous growers, spread rapidly, and fill up the spaces between plants with new canes. Moisture to supply this large leaf surface must be supplied from a comparatively small area; hence, it is essential to irrigate at frequent intervals.

#### SOILS FOR BERRIES

The brambles—blackberries, raspberries, dewberries, and loganberries—are adapted to a wide range of soils. Success with this class of fruits seems to depend more on the skill of the individual grower and on such other factors as site, suitable labor supply, and accessibility to market, than on the choice of any particular soil. However, most of the successful plantings are found on soils ranging from sandy loam to clay loam types. In general, the lighter types of soils are easier to handle, but the fruit is often small if not given proper cultivation and irrigation, while, on the other hand, the heavier types of soils, though harder to cultivate, produce larger crops.

Currants and gooseberries may be grown on fairly heavy soils and often flourish on soil which is wet for a considerable portion of the year. Soils which bake or become cloddy are rather difficult to manage because of the amount of cultivation and hoeing which is necessary.

Blackberries grown on soils having a high calcium content, or underlaid with what is often locally known as marl, are frequently subject to a trouble known as 'chlorosis', which is indicated by the light yellow color of the leaves and by the reduced crop. Such soils should be avoided. The application of iron sulfate in furrows close to the plants aids in overcoming this chlorotic condition, but such treatment may not be economically feasible.

### METHODS OF PROPAGATION

One important and favorable factor in growing small fruits is the ease and readiness with which a new planting may be started. New plants may be obtained from older plantations with but little trouble, or they may be purchased from a nursery at comparatively low prices. This factor is of special significance to the man of limited means just starting to grow fruit. Many of the brambles propagate naturally and abundantly of their own accord. Currants and gooseberries root readily from cuttings. The result is that new plantings may be set out, using older plantings already in existence as a source of supply, with no cost except for the labor of collecting and setting out. Plants secured in this way should be individually inspected before planting, to ascertain that they are not taken from diseased stock or stock infected with insects.

*Upright Blackberries and Red Raspberries.*—Blackberries and red raspberries may be propagated either by root cuttings or by suckers. The suckers, which appear wherever a root has been cut or injured, may be dug up and used as new plants, care being taken to secure a large portion of the roots. This method of obtaining new plants is very commonly adopted in this state and had proved thoroughly satisfactory. It is used with upright-growing varieties of blackberries and with red raspberries. The common procedure of nurseries in securing plants by root cuttings, is to dig up a number of old plants and cut the roots into short pieces, three inches or less in length. These roots are set out in rows in carefully prepared nursery soil. If not allowed to dry out and if given careful cultivation, they produce plants large enough to set out in one year from the time of making the cuttings.

*Trailing Blackberries, Dewberries, Loganberries, and Black Raspberries.*—Nearly all of the trailing varieties of blackberries, dewberries, and loganberries, as well as the black raspberries, are usually propagated by tip layering. The method of obtaining plants in this way is to cover the end of the canes with a shovelful of earth during the latter part of the summer. The covered portion of the shoot sends down roots from the nodes and forms a plant that can be set out the following spring. Unless carefully handled, loganberry tips are easily injured. For this reason some growers prefer to use tips of this variety which have been grown in the nursery row before being set out in the permanent plantation.

*Currants and Gooseberries.*—New currant and gooseberry plants are usually obtained from cuttings or by mound layering. Gooseberries which do not grow readily from cuttings are easily propagated by mound layerage. Cuttings are made about seven to ten inches long from matured or ripened one-year-old wood. They may be cut at any time during the dormant season, and set out immediately in rows or stored in moist sand in a cellar or other cool place until spring. The cuttings are planted in nursery rows with one or two buds above the surface, care being exercised to see that the soil is firmly pressed around the buried portion. The resulting plants are grown in the nursery for one or two years. It is the practice in some sections of California to set these cuttings out in permanent form, instead of growing plants in the nursery row for a year.

#### METHODS OF PLANTING

Bush fruits are planted so that they may be easily cultivated in one or two directions. They are planted in hills or rows to conform to the growth of the plant and the nature of the site upon which they are set. The planting distance is governed by the ultimate size of the plants and convenience in cultivating and picking. Whenever practicable, these fruits should be set out early in the season, preferably not later than February. A larger number of plants survive when set out early than when set out in March or later. Gooseberries and currants start to grow very early in the season and should be planted as soon as the plants are mature or can be secured from the nursery.

The preparation of the soil for the new berry plantations should be as thorough as possible. On account of the shallowness of the feeding roots of small fruits, the effort expended in preparing the soil before planting will be repaid by the vigor and thrift of the young plants. The soil should be plowed deeply in time to allow the weeds and cover crops to decompose before the plants are set out, and should be made as fine and friable as possible by frequent harrowings. A mellow soil, free from lumps, enables the young plants to become established quickly and to survive the first year in greater numbers than is the case when the soil is carelessly prepared. During the first year, no special care is necessary for bush berries, as a rule, except to keep the young plants growing thriftily.

*Blackberries, Loganberries, and Dewberries.*—Blackberries should be set out not later than February or March in order to receive the benefit of the late rains. The plants ordinarily require but little care



in setting out. The long, slender roots are cut off, and the plants are placed at the same depth at which they have been grown in the nursery. A hole is opened by a spade, the roots are spread out in a fan shape, and the earth is crowded firmly around them so that all portions of the root-system come into immediate contact with the soil. The old stem is usually left to serve as a marker or guide in cultivating before the appearance of the new shoots from the crown. Instead of opening each hole with a spade or shovel, a furrow may be plowed along the row and the plants placed along the landside, and handled in much the same way as that just described.

Blackberries of an upright-growing habit, such as the Lawton, are usually planted in rows 6 to 8 feet apart, with the plants 4 to 6 feet apart in the rows. If planted in hills, they are usually set 6 to 8 feet apart each way. The trailing varieties, like the Mammoth and Cory, are planted in rows about 8 feet apart and are placed 8 to 16 feet apart in rows. Himalayas make a rank growth and should be planted somewhat further apart in the row than the Mammoth.

Loganberries, Youngberries, and dewberries are trailing in habit and are spaced about the same as the Mammoth.

*Raspberries.*—No definite standard planting distance can be set for raspberries. The distances vary according to the variety and the district. If set out in hills, the plants are from 3 to 6 feet apart each way. If they are set out in rows, the rows are ordinarily 6 to 8 feet apart, and the rows themselves may be a solid mass of plants or may have the separate plants from 1½ to 6 feet apart. Ordinarily the black raspberry requires more room than do the red varieties because it is more spreading in nature.

*Currants and Gooseberries.*—When planted in rows, currants and gooseberries are placed 2½ to 5 feet apart in the rows, with the rows 5 to 6 feet apart. In hills, the plants are set on the square system, 5 or 6 feet apart each way.

### CULTIVATION

Shallow cultivation is the practice with all small fruits. The feeding roots are comparatively near the surface and are destroyed by deep cultivation. With the brambles, a great many roots are broken by deep cultivation; this practice produces a large number of suckers in the middle of the row which must be cut out with a hoe. In other cases, an entire plant is often pulled out by catching the cultivator under one of the main roots. The land should be plowed in the spring,

as shallow as possible; but a clean furrow must be turned over to cover completely the trash or cover crop that may be on the ground. The plowing should be followed by shallow cultivation, preferably with a light, fine-toothed implement, as often as necessary to prevent weed growth.

Bush fruits may be plowed deeper toward the middle of the row and shallower close to the plants. If the furrows are thrown away from the row, it is much easier to hoe out any weeds that may be growing in the row itself, while if the furrow is thrown toward the row, these weeds are covered up, only to appear later in the season. Unevenness due to leaving the back-furrow or dead furrow in the middle of the row is easily remedied by a few cultivations. Another plan, adopted by many growers, is to harrow or disk the plantation instead of plowing. This plan works satisfactorily if followed before the cover crop has reached such a size that it can be covered only by plowing.

#### IRRIGATION

An unfailing source of water is a requisite for growing bush berries for these fruits, except in a few districts are grown under irrigation. The practice, which is fairly well standardized, consists in applying water every two or three weeks until the berries begin to ripen; then the irrigations are given more frequently, sometimes every four to seven days. After picking, the plantation is irrigated every few weeks until late in the season, when the plants are allowed to mature and become dormant. Because frequent irrigation is necessary, the land must be carefully leveled and graded before planting, in order that the water may be applied evenly and economically.

The water is applied in furrows on both sides of the row (fig. 1). This practice leaves a high middle portion between rows which remains dry and serves as a place for the pickers to stand. If a comparatively large head of water is used, the furrows are large, from 200 to 300 feet long, and are laid out on a grade nearly level. The furrows are filled level full with water. When a smaller head of water is used, the grade is sufficient to permit the water to reach the lower end, and the water is allowed to run for a longer time. Very often when the row becomes wide and filled with canes because of the unchecked growth of suckers, the central portion is not wetted by the ordinary irrigation. There is a tendency on the part of many growers to hurry the water from one end of the furrow to the other and then to con-

sider the work done. During the hot weather, bush berries use a tremendous amount of water, most of which is taken from the upper 2 or 3 feet of soil. Exhaustion of moisture in this area is quickly shown by wilting of the leaves and shrivelling of the fruit. Lack of moisture during the growing period materially shortens the picking season and reduces the crop.



Fig. 1.—Bush berries are irrigated in furrows close to the row.  
(From Exp. Sta. Cir. 164.)

#### PRUNING AND TRELLISING

Blackberries and raspberries produce fruit usually but once on a cane of one season's growth. The canes necessary for the bearing of the crops are produced during one season, flower and bear fruit during the next, and must then be removed. As soon as the canes have borne a crop of fruit, their usefulness ends, and they usually die before winter. A few varieties, such as the Himalaya and the Evergreen, have perennial canes, but the pruning of these varieties is not essentially different from that given the varieties having the canes which live for only two years. Since the perennial canes are often

infested with rose scale, it is desirable that they be replaced by the younger growth. On the other hand, certain varieties of raspberries, like the Ranere, bear fruit during the *first* season at the ends of the new canes. These ends which have fruited should be cut off at the regular pruning time.

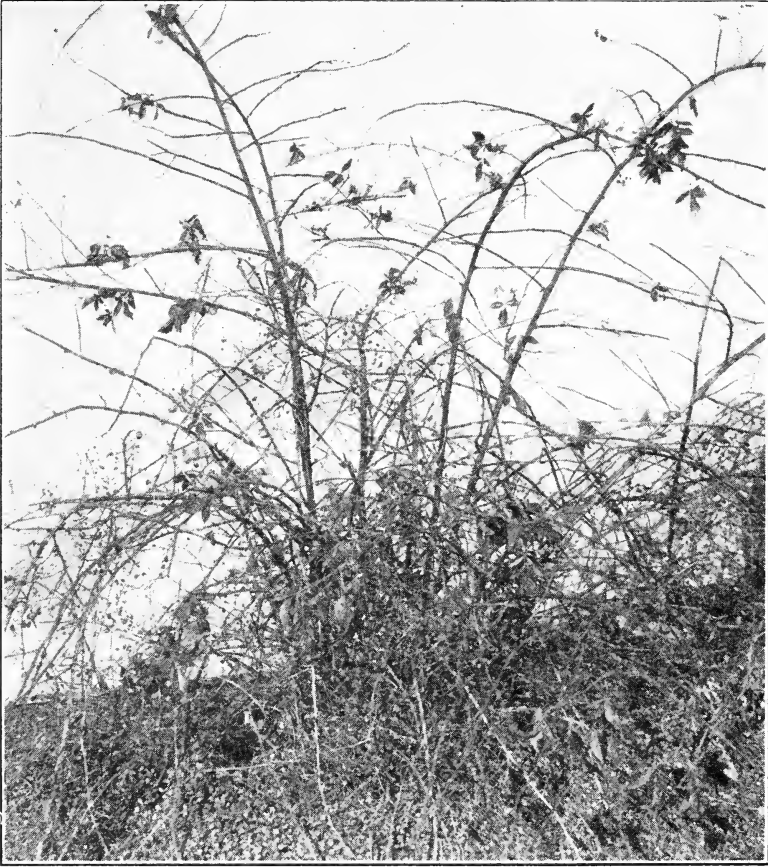


Fig. 2.—Crandall blackberry before pruning.

The aim of the grower in pruning should be to accomplish two things: first, to cut off the tips of the new canes, if they have already borne fruit, and to remove the old canes which are of no more value to the plant; and second, to provide a supply of new shoots for bearing fruit the following season. New canes should not be left too thick. Wider spacing produces tall canes and thereby facilitates picking.

*Blackberries, Loganberries, and Dewberries.*—Blackberries are pruned in such a way that they may be tied to wire trellises or to

stakes, or trained to grow upright without support of any kind. The varieties that trail, or produce long runners that naturally lie on the ground, are trained to wire stretched on posts, and the stronger, upright-growing varieties are tied to stakes or pruned short so that they are able to support their own weight (figs. 2 and 3). The length of the canes left to produce the following season's crop varies considerably with the variety and with the practice found best in different sections. Strong-growing varieties like the Lawton and Crandall are

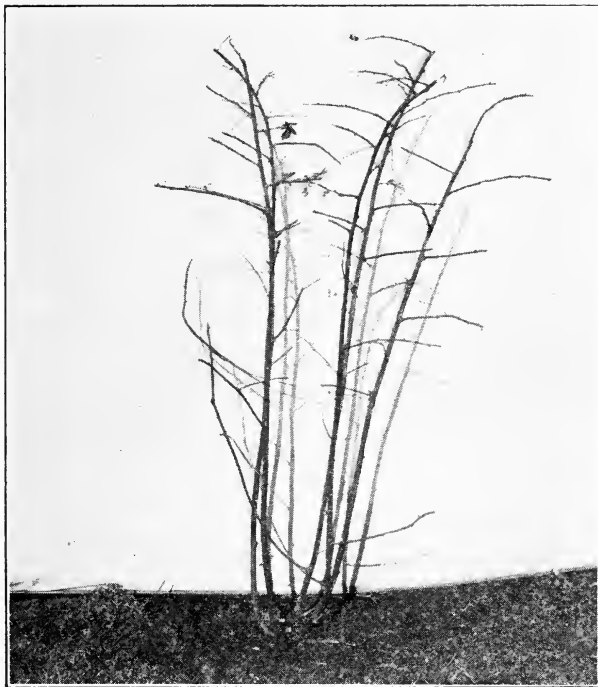


Fig. 3.—Same plant as in figure 2, after pruning.

usually pruned back to 3 or 4 feet. Trailing varieties like the Mammoth, Logan, and Cory are cut back, leaving 8 to 16 feet, according to the distance between the plants. It is a good practice to tip back or cut off the ends of the growing shoots during the summer, as soon as they have reached the desired length.

New canes to replace the old ones removed after fruiting come up as suckers around the crown of the plant. More of these suckers are produced than should be allowed to grow. For most varieties, from 4 to 7 healthy new canes should be left to each hill and all small or inferior ones cut off close to the ground. This thinning of canes can

be done during the early growing season. All canes cut off should be removed from the plantation and burned as soon as practicable.

After the first growing season, trailing varieties are trained to one or two wire trellises. When one wire is used, it is stretched along stakes in the row at a height of  $2\frac{1}{2}$  or 3 feet above the ground, and the canes are wound about it or tied to it. (fig. 4). Another method which has proved successful is to use a two-wire trellis and weave the canes around both wires in a loose spiral. The canes should be spread on the wires (fig. 5), and not twisted together like strands in a wire cable. The new canes that grow during the summer are allowed to lie



Fig. 4.—Loganberries tied to a single wire trellis. The young shoots are allowed to grow under the row during the first season. (From Exp. Sta. Cir. 164.)

on the ground under the row during the growing season. During the winter pruning, the old canes are cut and pulled off the wire, and the new canes are brought up and tied in their place. In another two-wire system, the lower wire is 2 to 3 feet from the ground and the upper one  $1\frac{1}{2}$  to  $2\frac{1}{2}$  feet above the lower. The young canes are trained to the upper wire, and the bearing canes to the lower. This method provides shade for the fruiting canes and aids in producing berries of large size.

Loganberries (including the Phenomenal variety), Youngberries, and dewberries are pruned and trained in the same manner as trailing blackberries. The general practice in many sections has been to train

these varieties on a single wire, extending the canes along the wire either in one or in both directions from the crown of the plant.

Number 14 gauge wire is used for raspberries and dewberries, and number 12 gauge for the heavy-growing sorts like Himalaya.



Fig. 5.—Trailing varieties are often woven around the trellis wires in loose spirals. (From Exp. Sta. Cir. 164.)

Another method of training adopted for some of the trailing blackberries is to use a two-wire trellis, the wires being fastened to the ends of short cross arms nailed to the posts. The canes are supported by slats resting on the wires, and but little tying is necessary (figs. 6 and 7). This method is sometimes used with the Himalaya, but unless

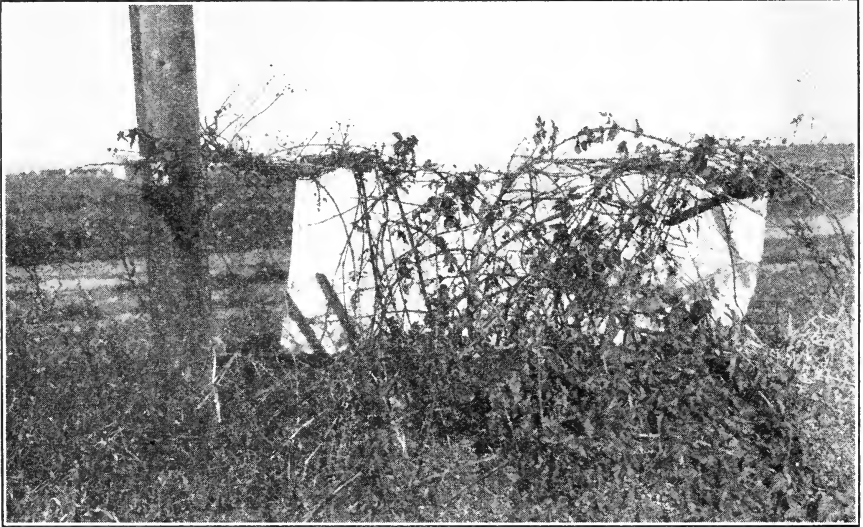


Fig. 6.—Cory Thornless blackberry before pruning.

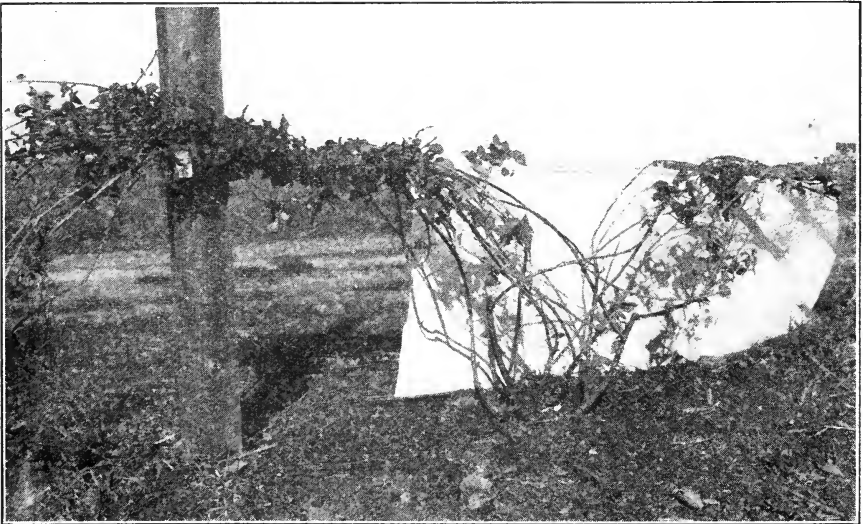


Fig. 7.—Cory Thornless blackberry after being pruned and placed on the slats in a two-wire trellis.



this variety is thinned out severely each year, there is such an impenetrable accumulation of canes that only a portion of the berries can be picked. Moreover, thorough spraying of these hedge rows is difficult.

*Raspberries.*—Both the red and the black varieties of raspberries are for the most part trained to stand alone. In some cases, when varieties are drooping in nature, or when a rank, heavy growth is produced, posts are set along the row, and short cross-arms, 18 or 20 inches in length, are nailed at a convenient distance from the ground, usually  $2\frac{1}{2}$  to  $3\frac{1}{2}$  feet. Wires are stretched from post to post at the



Fig. 8.—Raspberries partially supported by two wires stretched between short cross arms on the stakes. (From Exp. Sta. Cir. 164.)

end of these cross-arms. The plants are pruned so that they grow up between these wires (fig. 8) and are supported by them, and, as a rule, no additional tying is considered necessary. Some varieties of blackberries may also be trained to this system. By means of short cross-pieces fastened to the wires, a number of different methods of training may be devised to suit local conditions.

Raspberries produce their fruit in the same manner as do blackberries: hence, the old canes must be removed after fruiting. This work is usually done immediately after the early summer crop. During the dormant season the plants are thinned, leaving 3 to 7 canes in each

hill. The canes are cut off about 3 to 4 feet above the ground, according to the nature of the growth and the training system followed. Weak-growing varieties without supports must be cut back more heavily than the sturdier kinds. Large numbers of suckers spring up from the roots of red raspberries, and, unless it is desired to have a more or less solid row, these suckers must be grubbed out with a hoe, and the plants maintained in single units. New canes of the Ranere raspberry should not be cut back too heavily during the winter pruning, for the early fruits are produced near the ends of these canes.

*Currants and Gooseberries.*—Currants and gooseberries must be treated in an entirely different manner from that described for the brambles. Their growing habit and method of bearing fruit must be carefully studied in order to prune them correctly. The bushes are more compact in form and are treated more like tree fruit than are the brambles. New wood is produced both by the branching of existing limbs and by suckers that come up from the root. These suckers, however, come up near the crown of the plant and not promiscuously from the roots as in the case of some of the raspberries. The larger portion of the fruit is borne on short spurs on the two and three-year-old wood, a smaller amount being produced on the four and five-year-old wood. The pruning consists in removing the three and four-year-old wood, which is easily distinguished by the dark color, and in thinning out the new shoots when they are too thick. Ordinarily from 3 to 5 old stems are removed each year and an equal number of new shoots are left at pruning time.

#### DURATION OF PLANTATION

Small fruits come into bearing early, reach their maximum production in from 3 to 5 years, and then begin to decline. Very few of the bush fruits remain profitable after 8 or 10 years, although some varieties like the Lawton produce satisfactory crops for 20 or 25 years. In some districts, loganberries die out in 5 or 6 years; in others, they are productive for a longer period. The presence of one or more diseases in a field often makes it advisable to plow up and burn all the old plants and start over again rather than attempt to eradicate the trouble in the existing plantation.

Certain varieties of raspberries, like the Ranere, often produce a few berries the same year they are planted, and usually bear a profitable crop the second season. Blackberries usually produce a few berries the second season after planting, reach their maximum pro-

duction in from 3 to 5 years, and are ready for removal in from 7 to 10 years, according to the character of the soil and the care given the plants. Loganberries often produce fairly heavy crops the second season after planting and remain profitable for a number of years. Currants and gooseberries ordinarily do not produce crops until the third year, are at their best from the third to the sixth year, and are removed about the ninth or tenth year.

### USE OF FERTILIZERS

Although fertilizers of various kinds are often used with bush berries, there is little or no authentic evidence in California concerning the benefits of this practice. These berries are nearly always grown under methods of soil management similar to those used in growing vegetables, the fertility of the soil being maintained by the use of animal manures. It seems desirable to have the soil fairly well supplied with organic matter before setting the plants. During the succeeding years, it is generally the practice to fertilize with applications of from 10 to 20 tons of barnyard manure to the acre, when this material is obtainable. Some growers make a practice of adding manure at irrigation time, so that it can be shovelled into the irrigation streams and distributed by the water. Chicken manure is often composted with strawy material before using.

Evidence from experiment stations in other states seems to indicate that nitrogenous mineral fertilizers are beneficial when applied to raspberries which are making weak growth and producing poorly. With blackberries the use of nitrogenous mineral fertilizers seemed to give negative or inconclusive results.

Legumes are often recommended for cover crops to supply nitrogen and vegetable matter to the soil. These crops should not be allowed to grow too late in the spring because of the difficulty in getting them plowed under when allowed to grow too rank.

### COMMON DISEASES AND INSECTS

There are several serious insect pests and fungous diseases injurious to berry plants. The heavy annual pruning to which berries are subjected, in which the old wood and such new shoots as may show signs of disease or insect injury are removed, serves to hold some of these troubles in check. The comparatively frequent removal of the plantation also serves to prevent the permanent infestation of

a given piece of ground. In many cases it is cheaper to pull out the old plants and reset with healthy ones in a new location than to combat these insects or fungous diseases by spraying or by other preventive measures. On the other hand, certain troubles can be controlled only by spraying.

*Crown Gall (Bacterium tumefaciens).*—One of the most serious diseases of the brambles with which the grower must contend, is crown-gall or root-knot. This is a bacterial disease forming a warty growth on the roots and ultimately causing the death of the plants. This disease can be held in check only by setting out clean stock when making new plantations and by removing and burning old plants which are infected in the older plantings.

*Oak Root Fungus (Armillaria mellea)*<sup>2</sup>.—In some districts brambles become infected with oak fungus. There is no remedy for this disease. As soon as the plantation is decimated so that it is no longer profitable, it should be plowed out.

*Leaf Spot (Mycosphaerella rubi).*—Brambles are sometimes infected with leaf spot, which appears on the leaves as light-colored dead spots with reddish borders. Orange rust (*Gymnoconia interstitialis*) which is shown by masses of bright orange spores on the lower surface of the leaves is prevalent in some years. The remedy for both is to cut out all infected canes at pruning time and to give the plants a thorough spraying with Bordeaux mixture (5-5-50) or lime-sulfur solution (1-10) during the dormant season.

*Blue Stem, Verticilliosis, or Wilt (Verticillium albo-atrum).*—Raspberries, particularly the Ranere, are susceptible to blue stem. This disease is characterized by a stunting and killing of new canes, by loss of lower leaves, and finally by an intense blue discoloration of the canes. The blade of the diseased leaf falls first, leaving the petiole, which does not drop until several weeks later. In the last stages, only a small tuft of leaves remains at the tip of the infected canes. The disease enters the plant through the roots. No specific control measures are known. Diseased plants should be removed and burned. New raspberry plantings should not follow tomatoes or potatoes when this disease is known to have been present.

*Mildew (Sphaerotheca mors-uvae).*—Currants and gooseberries are often infected with mildew which forms a whitish, powdery growth on the new leaves and shoots, reducing the vigor of the plants and ultimately decreasing the crop. If the disease is serious, the infected

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<sup>2</sup> For a further discussion of this disease see: Hendrickson, A. H., Oak fungus in orchard trees. California Agr. Exp. Sta. Cir. 289:1-13. 1925.

shoots should be cut off and burned during the pruning season. A dormant spray of lime-sulfur (1 to 10), followed by dusting with sulfur when the disease first appears, usually gives satisfactory results.

*Raspberry Horntail* (*Hartigia cressoni*).—Raspberries, and sometimes loganberries and Himalaya blackberries, are often attacked by the raspberry horntail, the larvae of which girdle the tips of tender new shoots, and cause them to wilt. The wilted canes should be cut out a few inches below the evidence of wilt. All canes showing any signs of the presence of borers should be removed at pruning time.

*Rose Scale* (*Aulacaspis rosae*).—Rose scale is occasionally found on the canes of blackberries and raspberries. Ordinarily the winter pruning serves to hold this insect in check, but in case of severe infestation the plantation should be sprayed in the winter with a distillate emulsion or lime-sulfur solution.

*Red Spider* (*Tetranychus telarius*).—One of the most serious pests on the brambles is a minute, pale yellow mite with from two to six dark spots on its back, commonly known as red spider. It is known by a number of names, such as the two-spotted mite, yellow mite, and summer mite. It appears in early summer and does great damage to raspberries by causing the leaves to fall and the fruit to shrivel and dry. This pest spins webs on the under side of the leaves, where the eggs and adults may be seen in all stages of development. It feeds upon the tissues, of the plant, sucking the juice. As it spends the winter in the ground, there is no way of control by spraying until it begins to appear with the approach of warm weather. Different forms of sulfur have been used to control this pest on tree fruits, but when tried on raspberries severe burning of the foliage usually results. Sulfur is not a safe remedy for red spider, either on bush berries or on strawberries. The most promising spray for this pest is a one per cent summer oil emulsion.

*Blackberry Mite* (*Eriophyes gracilis*).—The Himalaya, Cory Thornless, Mammoth, and Crandall blackberries, and rarely the loganberry, are affected by a trouble known as "red berry." The fruit grows to approximately full size, but does not mature, all or part of the drupelets remaining red and hard. This trouble is caused by a very minute mite. It is readily controlled by a spray consisting of 4 to 8 gallons of lime-sulfur solution to 100 gallons of water, applied when the leaf buds are beginning to open in early spring. An additional spray, during the summer, of 5 pounds of wettable sulfur to 100 gallons of water is also effective.

*Snowy Tree Cricket (Oecanthus niveus)*.—The snowy tree cricket has been doing considerable damage to raspberries in the Santa Clara Valley for the last few years. The injury is chiefly due to feeding on the parts of the flower which results in deformed, worthless berries, or none at all. Leslie M. Smith<sup>3</sup> of the Division of Entomology and Parasitology, who has been studying this insect during the past year, has found that a dust containing 70 per cent sodium fluosilicate applied at the rate of 50 pounds to the acre gives complete control in five to ten days. The dust is poisonous to man and no berries should be picked for two weeks after dusting. The best time for application is between the early summer and late summer crops.

*Currant Borer (Aegeria tipuliformis)*.—Currants and gooseberries are injured by the currant borer. This insect works in the heartwood of the branches or stem of the plant. These parts are either killed or injured to such an extent that they break down under the weight of the fruit. The only remedy is to watch carefully for its work and remove all infested parts when pruning.

In some districts currants are also attacked by the flat-headed apple borer (*Chrysobothris mali*).

#### HARVESTING

Berries are among the most perishable fruits grown on a commercial scale, and cannot be handled in the same way as even the tender kinds of tree fruits. The length of time between the attainment of maturity, when they are of highest quality for table use, and the beginning of deterioration is very short. The perishable nature of this class of fruit necessitates extremely careful handling, prompt shipping, and immediate consumption. No class of fruit has better flavor or quality when at the proper stage of ripeness, or decays more quickly when not properly handled. If the tender skin of a few berries is injured so that the juice runs out, this fruit is quickly infected with various molds or rots, and the contents of the entire container may be unfit for use within 24 hours.

*Brambles*.—The brambles should be picked often during the height of the season. During the early part of the picking season, the patch should be picked every three or four days; but when the berries begin to ripen faster, the entire patch should be picked each day. Blackberries should not be picked until the little depression in the center of each drupelet is entirely filled.

<sup>3</sup> California Agr. Expt. Sta. Annual Report, July 1, 1927 to June 30, 1928. [In press.]

Berries should be picked directly into the box or cup in which they are sold, and should not be handled by regrading or sorting. The marketable grades should be picked directly into the market packages, and the soft fruit either picked into a separate receptacle or dropped on the ground. Berries crushed in picking should not be mixed with the sound fruit. The picked fruit should not be left standing in the sun, but should be placed in the shade under a tree or shed (fig. 9). No berries should be picked when wet from rain or

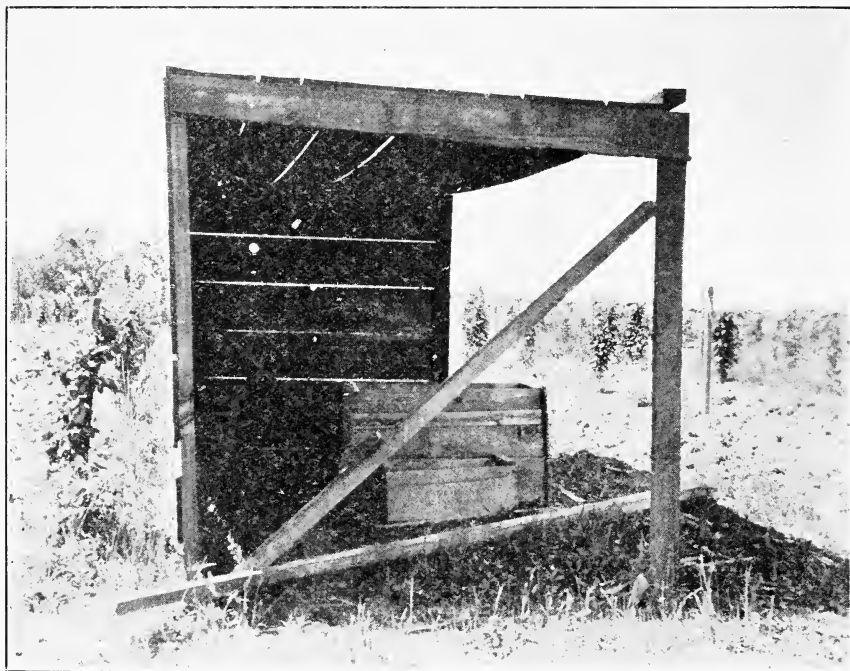


Fig. 9.—An inexpensive shed to protect the picked berries from the sun.  
(From Exp. Sta. Cir. 164.)

fog. All fruit should be taken to market or shipping station as soon after picking as possible.

The use to be made of the berries determines the exact stage of ripeness at which they should be picked. Generally speaking, raspberries may be used for local or nearby markets when they separate from the 'core' without crumpling or falling apart. For long distance shipments, only the firmer berries should be used, while the softer grades are utilized for canning. Blackberries, loganberries, and other brambles in which the berry does not separate from the core or receptacle must be picked for long-distance shipments, when hard and firm, though well colored.

Basket carriers holding six or eight baskets and provided with a bale are generally used in picking berries (fig. 10). To avoid stooping, pickers sometimes use carriers fitted with short legs. Many workers, when picking the thorny varieties, wear gloves from which the fingers have been removed on the picking hand.

In some districts the package used for marketing this class of fruits locally is the twenty-drawer chest, each drawer of which holds six small cups. In other districts crates hold 12, 20, or 30 (fig. 10)

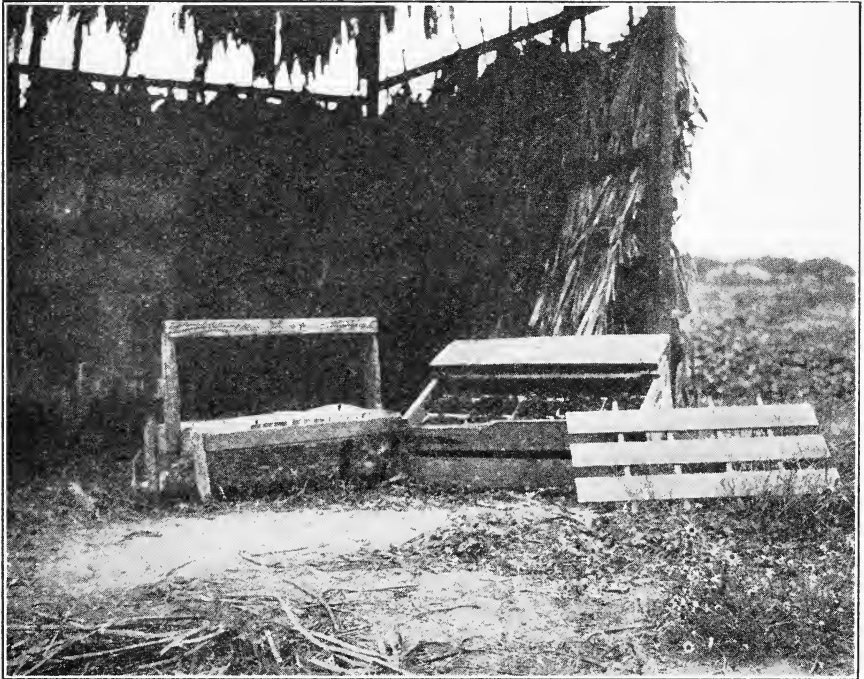


Fig. 10.—Field carrier used for picking berries, and crate containing 30 baskets, used in southern California.

small cups or containers. The sizes of berry baskets which may be used, are defined in the California Fruit, Nut, and Vegetable Standardization Act of 1927 as either the dry pint, with a capacity of approximately 33.6 cubic inches, or the dry one-half pint, with a capacity of approximately 16.8 cubic inches.

While blackberries and raspberries are essentially adapted to local or nearby markets, considerable success has been attained in shipping these fruits to eastern consuming centers. The fruit for long-distance shipment must be picked in exactly the right condition, handled carefully, and precooled. Such shipments are usually handled



by refrigerator express on fast passenger trains. Some varieties ship better than others. The best shippers are those which the grower knows as 'dry berries,' varieties which do not bruise easily or allow the juice to escape. One variety that seems to fill the requirements of a good shipping berry is the Ranere, which is grown extensively in the region adjacent to San Francisco Bay.

Hauling to market is now largely done by automobile truck. The various associations and companies handling fruit usually arrange to have the fruit collected at the farm. The grower simply places his

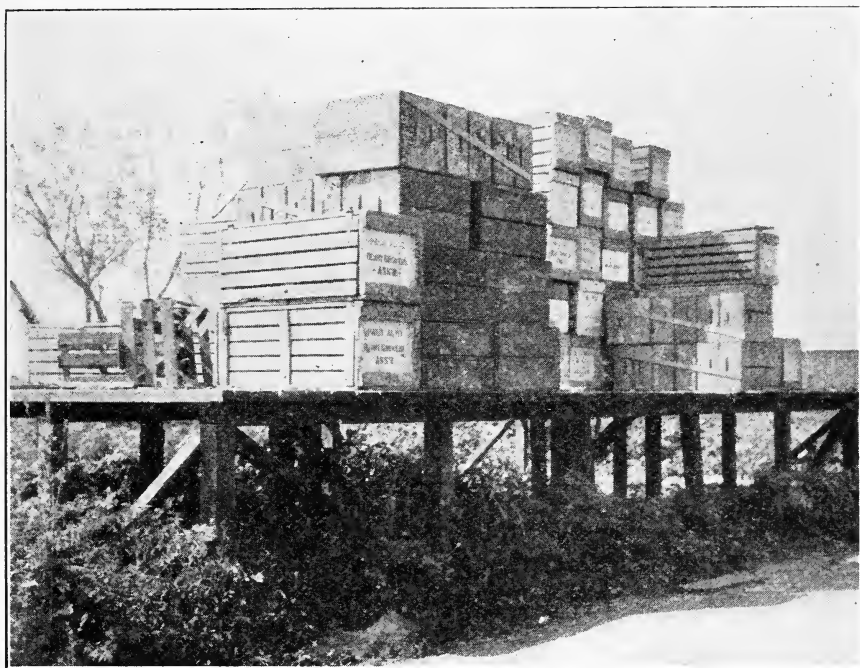


Fig. 11.—Platform for loading berry chests on automobile trucks.

chests or crates of berries on a loading platform (fig. 11) located at a convenient place, and the shipment is picked up by a truck which follows a route from farm to farm.

Most blackberries and raspberries are consumed in the fresh state or used for making jams and jellies in the home. Outlets through commercial canneries or long-distance shipments are usually practicable only when the production in a given district is large enough to be handled in carlots. Considerable quantities of blackberries are sometimes frozen and held in cold storage and then used in the bakery trade. Dehydration of blackberries and loganberries is also practicable and has been carried on to some extent. This method of

handling the crop is particularly advantageous during years of heavy production, or during the peak of the seasons when the supply exceeds consumption.

*Currants and Gooseberries.*—Currants are usually harvested in two pickings. There is no danger of the fruit becoming soft under ordinary conditions, but injury from scalding often results during a period of hot weather. The danger of loss from this cause is reduced by making two pickings. The fruit is in right condition for picking when all the berries on the cluster are red. The cluster should be picked whole, and the berries not separated from the stem, for when the berries are picked from the cluster, the entire package is moistened with the juice which escapes, and decay quickly follows.

Gooseberries are sometimes picked by holding a portion of the bush in a gloved hand and picking with the bare hand. On a large scale they are picked by stripping the leaves and fruit into a shallow box and then removing the leaves by running the entire picking through a fanning mill, which blows out the leaves and pieces of branches. As the fruit is picked while still hard and green, no injury results from this method of handling.

Currants are often sold in plum or grape baskets containing approximately five pounds of fruit. Gooseberries are usually handled loose in small lug boxes and sold by weight.

#### FUTURE OUTLOOK OF THE INDUSTRY

The growing of berries in California usually goes hand-in-hand with the planting of new orchards and vineyards, because it is often considered one of the best means of securing returns from the land before the trees come into bearing. Not all young orchards, however, are intercropped with berries. Berries come into fruiting early, usually producing a fair crop the second year. Increases in acreage closely follow high prices. On the other hand, the bushes may readily be removed to make room for other crops when prices are low. These factors often bring about marked fluctuations from year to year in the acreage devoted to berry growing. The difficulty in securing cheap labor, and the disinclination of many to perform the somewhat irksome task of caring for a berry plantation, exert an influence against any long-continued period of over-production. With the city population in California increasing, it would seem that a berry plantation of moderate size promises fair returns to the grower who is favorably situated and who is willing and able to do most of the necessary work himself.

**BLACKBERRY VARIETIES<sup>4</sup>**

*Burbank Thornless*.—Said to be a shy bearer in many districts.

*Cory Thornless*.—Extremely vigorous, hardy, strong grower, productive. Canes semi-trailing, and occasionally have thorns. Fruit large, sweet when ripe; inclined to be soft and difficult to handle, not suitable for long distance shipments. Becoming popular for local markets. Mid-season. Easy to handle and popular in the home garden because of absence of thorns. Plants from root suckers or root cuttings revert to the thorny form.

*Crandall*.—Vigorous; hardy; very productive; ripens fruit over a long season in the coast region, while in the interior valleys it is inclined to have a short season. Fruit large, firm, and sweet. Season early. Fair shipper. Popular in southern part of state.

*Early Harvest*.—Strong, upright grower; hardy; good producer. Fruit medium to small, sweet, and of good quality. Season early, and fruit ripens over long period. Susceptible to leaf rust, said to be self-fertile.

*Evergreen (Oregon Evergreen)*.—Bush vigorous, strong growing; drooping, perennial. Fruit large, firm, and sweet, and of good quality. Season late to very late. Worthy of trial.

*Himalaya*.—Bush extremely vigorous; very spiny; trailing or semi-trailing; perennial and heavy producer. Fruit roundish in form, of medium size, and juicy. Season from June to late fall. Very popular. Subject to redberry disease.

*Kittatinny*.—Strong grower; hardy; productive. Fruit large, glossy black, sweet, and of good quality. Mid-season to late.

*Lawton*.—Bush sturdy, erect; strong grower; heavy producer. Fruit large, black, sweet, and of excellent quality. Mid-season. A standard variety in California.

*Macatawa*.—Probably identical with Crandall.

*Mammoth*.—Extremely vigorous; fairly hardy; a rapid grower, and a heavy producer. Flower considered partly self-sterile. Canes semi-trailing or trailing. Fruit very large, long in shape; black, sweet, and soft when fully ripe. Very popular in California, ripening early to mid-season, usually between the loganberry and the Lawton. Often sold as a 'black loganberry.'

<sup>4</sup> The discussion of varieties of small fruits is confined to brief descriptions of the principal varieties now being grown and those considered worthy of trial.

### HYBRID VARIETIES

*Loganberry*.—Canes vigorous, hardy, and exceptionally productive; trailing in habit, covered with a large number of rather small spines. Fruit long, large; dark-red in color; sub-acid in flavor and good in quality. Excellent for shipping or canning. Season early. Grown in nearly all berry sections of California. Comparatively short-lived in some sections.

*Phenomenal*.—Held by some growers to be indistinguishable from the original loganberry. Vines strong, vigorous, and productive. Fruit large, long; red in color; sub-acid in flavor; larger than loganberry but softer in texture. Generally given same culture as the logan; ripens about a week later.

*Youngberry*.—A cross between the Phenomenal and the Mayes dewberry. A vigorous grower; trailing in nature; and bears heavily. Fruit large; dark red in color; juicy, and sweet when fully ripe. Ripens about the same time as the logan. Worthy of trial in California.

### DEWBERRY VARIETIES

*Gardena*.—Vigorous grower; heavy producer. Fruit large; glossy black; firm, sweet, and delicious. Season early. Popular in southern part of state.

*Lucretia*.—Hardy and productive; berries large, sweet; black in color, and soft; said to ripen shortly after the Gardena. A general purpose variety. Self-fertile.

### RED RASPBERRY VARIETIES

*Cuthbert*.—Hardy; vigorous grower, with heavy foliage which protects fruit from sunburn. A heavy and regular bearer. Fruit deep red in color; large, conical; firm; separates readily from core; a good shipper.

*La France*.—Recently introduced. Canes strong, vigorous, produce fruiting laterals freely. Berries very large; light red; of excellent flavor and quality. Mid-season to late, sometimes producing until Thanksgiving. A prime dessert fruit.

*Ranere*.—Also commonly called St. Regis or Ranaree. Plant vigorous; hardy; sends up suckers freely. Berries small to medium;

bright red; firm; season early and very long. Is what is termed a 'dry' berry and is an excellent shipper. The leading variety in the central coast region of California.

*Superlative*.—New variety. Fruit medium to large; of excellent flavor; ripens over a long season.

*Surprise*.—Canes rather slender; plant hardy. Bears through a long season. Berries medium in size and of good quality; not a good shipper. Desirable for planting in central and southern parts of state.

#### BLACK RASPBERRY VARIETIES

*Gregg*.—Plants strong, hardy, and productive. Berries medium in size; firm, and sweet. Mid-season. The standard variety of black-caps for home or commercial planting.

*Kansas*.—Strong; vigorous grower; hardy and productive. Fruit early in season; medium size; black; firm; of good quality.

#### CURRENT VARIETIES

*Cherry*.—Bush fairly vigorous; hardy; medium in size; a good bearer. Fruit large; bright red and borne in rather stout, well-filled bunches. The leading variety in the central part of the state. Somewhat subject to attacks of mildew and cane borers.

*Perfection*.—A new variety, grown very successfully in eastern and north Pacific districts. Bush vigorous; healthy; strong-growing; very productive. Berries large; sub-acid; bright red, borne on long well-filled bunches.

#### GOOSEBERRY VARIETIES

*Champion*.—Bush a strong grower and a prolific bearer. Berries medium in size, smooth, roundish-oval; sweet when fully matured. Resistant to mildew. Principal commercial variety in California.

*Downing*.—Bushes vigorous, sturdy, and productive. Berries medium to large; oval in shape; smooth; yellow sprinkled with red dots when ripe. Flavor sweet and pleasant when fully ripe. A good market variety.

*Houghton*.—One of the oldest varieties. Bush strong-growing, long-lived, and productive. Berries small, roundish; dull red when fully ripe; skin smooth and thin. Season in advance of the Downing. Chief disadvantage of this variety is the small size of the berry. Resistant to mildew.



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