Peach culture

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PEACH CULTURE
PLUM CULTURE
GRAPE CULTURE
STRAWBERRIES
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BLACKBERRIES AND DEWBERRIES
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PREFACE

The International Library of Technology is the outgrowth of a large and increasing demand that has arisen for the Reference Libraries of the International Correspondence Schools on the part of those who are not students of the Schools. As the volumes composing this Library are all printed from the same plates used in printing the Reference Libraries above mentioned, a few words are necessary regarding the scope and purpose of the instruction imparted to the students of—and the class of students taught by—these Schools, in order to afford a clear understanding of their salient and unique features.

The only requirement for admission to any of the courses offered by the International Correspondence Schools, is that the applicant shall be able to read the English language and to write it sufficiently well to make his written answers to the questions asked him intelligible. Each course is complete in itself, and no textbooks are required other than those prepared by the Schools for the particular course selected. The students themselves are from every class, trade, and profession and from every country; they are, almost without exception, busily engaged in some vocation, and can spare but little time for study, and that usually outside of their regular working hours. The information desired is such as can be immediately applied in practice, so that the student may be enabled to exchange his present vocation for a more congenial one, or to rise to a higher level in the one he now pursues. Furthermore, he wishes to obtain a good working knowledge of the subjects treated in the shortest time and in the most direct manner possible.

In meeting these requirements, we have produced a set of books that in many respects, and particularly in the general plan followed, are absolutely unique. In the majority of subjects treated the knowledge of mathematics required is limited to the simplest principles of arithmetic and mensuration, and in no case is any greater knowledge of mathematics needed than the simplest elementary principles of algebra, geometry, and trigonometry, with a thorough, practical acquaintance with the use of the logarithmic table. To effect this result, derivations of rules and formulas are omitted, but thorough and complete instructions are given regarding how, when, and under what circumstances any particular rule, formula, or process should be applied; and whenever possible one or more examples, such as would be likely to arise in actual practice—together with their solutions—are given to illustrate and explain its application.

In preparing these textbooks, it has been our constant endeavor to view the matter from the student's standpoint, and to try and anticipate everything that would cause him trouble. The utmost pains have been taken to avoid and correct any and all ambiguous expressions—both those due to faulty rhetoric and those due to insufficiency of statement or explanation. As the best way to make a statement, explanation, or description clear is to give a picture or a diagram in connection with it, illustrations have been used almost without limit. The illustrations have in all cases been adapted to the requirements of the text, and projections and sections or outline, partially shaded, or full-shaded perspectives have been used, according to which will best produce the desired results. Half-tones have been used rather sparingly, except in those cases where the general effect is desired rather than the actual details.

It is obvious that books prepared along the lines mentioned must not only be clear and concise beyond anything heretofore attempted, but they must also possess unequaled value for reference purposes. They not only give the maximum of information in a minimum space, but this information is so ingeniously arranged and correlated, and the indexes are so full and complete, that it can at once be made available to the reader. The numerous examples and explanatory remarks, together with the absence of long demonstrations and abstruse mathematical calculations, are of great assistance in helping one to select the proper formula, method, or process and in teaching him how and when it should be used.

This volume, which is the second in this library on fruit growing, deals with peaches, plums, grapes, and the small fruits, including strawberries, red, black, and purple-cane raspberries, blackberries, dewberries, currants, and gooseberries. These fruits are accorded the same completeness of treatment that marked the discussion of the fruits in the first volume. For each fruit, the topics covered include a thorough description of varieties, systems of planting, the methods of management, harvesting, storage, and marketing, and the insect pests, diseases, and miscellaneous injuries, with a full description of each and a discussion of the best methods of control or prevention. In the consideration of the peach, the renovation of old orchards is treated at some length. The many systems of pruning and training grapes are fully and explicitly described and illustrated. Emphasis is placed on the commercial possibilities of small fruit growing, and every effort has been made to present in a simple and concise form the somewhat complicated methods of producing these fruits. The volume is profusely illustrated and many of the fruits are shown in colors.

The method of numbering the pages, cuts, articles, etc. is such that each subject or part, when the subject is divided into two or more parts, is complete in itself; hence, in order to make the index intelligible, it was necessary to give each subject or part a number. This number is placed at the top of each page, on the headline, opposite the page number; and to distinguish it from the page number it is preceded by the printer's section mark (§). Consequenty, a reference such as § 16, page 26, will be readily found by looking along the inside edges of the headlines until § 16 is found, and then through § 16 until page 26 is found.

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PEACH CULTURE

(PART 1)

INTRODUCTION

1. The peach was introduced into America sometime previous to 1633, and apparently thrived immediately. The Indians assisted greatly in its distribution, and by 1733 it was being grown rather extensively in Georgia; by 1758 it was well known in Louisiana. Peach growing became of commercial importance about 1830, at which time extensive plantings were made in Southern New Jersey, in Delaware, and on the eastern shore of Maryland. About 1848, the commercial production of peaches was started in Michigan along the shore of Lake Michigan. The industry soon extended from Massachusetts to Georgia and westward to the Mississippi River. In recent years, the introduction of hardy varieties and the practice of efficient methods of orchard management have greatly increased the possibilities in peach growing, and today the fruit is grown commercially in many sections from the Great Lakes to the Gulf of Mexico and from New Jersey to California.

Notwithstanding the fact that peach growing as an industry is now widespread, certain districts have, because of favorable conditions of climate, soil, markets, labor, and other such factors, become centers for the commercial production of the fruit. There are, in general, only four great peach-growing districts in North America, although there are many regions in which small areas are favorable to the industry. The four districts are: the Atlantic-coast region, the Great Lakes region, the Gulf States region, and the Pacific-coast region. Within each of these districts there are small areas that are not favorable to peach production. These areas are usually low, stony, rough, or otherwise unfit for cultivation, or the transportation facilities are such that peaches, if grown, could not be profitably transported to market. Also, within each district there are areas that are favorable to the production of peaches but in which the industry has not been developed.

The Atlantic-coast peach-growing district includes the southern part of Massachusetts, all of Connecticut with the exception of a small area along the seashore, certain counties in Eastern Pennsylvania and Southern New York, all of New Jersey with the exception of a narrow area along the ocean front, the greater part of Delaware and Maryland, the eastern part of West Virginia, practically the whole of the Piedmont region in Virginia, the Carolinas and Georgia, and a few scattered regions in the northern part of Florida. The coastal plains of the Atlantic coast are not suited for peach growing.

The Gulf States peach-growing district includes the greater part of Alabama, a large area in Mississippi, the northern and western parts of Louisiana, the northeastern part of Texas, and areas in Tennessee, Missouri, Kansas, and Arkansas. A few peaches are grown in Kentucky and in New Mexico, but the industry in these states is conducted on a small scale. In Mississippi and Louisiana peach growing is largely confined to home orchards, and is of little commercial importance. The peach industry in the Gulf States district is developing most rapidly in Alabama, Texas, Arkansas, and Missouri, where numerous orchards are being planted.

The Great Lakes peach-growing district is a narrow belt along the shores of the Great Lakes in the states of New York, Pennsylvania, Ohio, and Michigan, and in the province of Ontario, Canada. The tempering effect of the water of the lakes is responsible for the climatic condition that makes possible the production of peaches in this district.

The Pacific-coast peach-growing district includes principally areas in California, Washington, and Oregon, and limited areas in Idaho, Colorado, Utah, and Nevada. Because of the mountainous conditions in this district the fruit is produced chiefly in small but specially favored areas.

FIG. 1

FIG. 2

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VARIETIES OF PEACHES

2. The varieties of peaches may be classified, in a general way, as *early*, *mid-season*, and *late*, depending on the time the fruit ripens. They may be classified, also, as *clingstone* and *freestone*. In **clingstone** varieties the flesh, when the fruit is mature, adheres more or less closely to the pit. In **freestone** varieties the flesh separates readily from the pit.

A great many varieties of peaches have been propagated in America but only a few have become of commercial importance. The following discussion will be confined to varieties that are grown commercially.

3. Early Varieties.—The following varieties may be classed as early; they are described in about the order of their ripening.

The **Greensboro,** which is the best market variety of its season, is a good variety to plant where an early peach is in demand. The trees are hardy and productive. The fruit ripens very early; it is white fleshed, of medium to large size, oblong oval, often somewhat flattened, of fair flavor, and rather soft for long-distance shipping. The Greensboro is a clingstone variety.

The **Waddell** variety, illustrated in Fig. 1, is from 8 to 10 days later than the Greensboro, but the fruit is of more desirable flavor and stands shipment better than that of the latter. The trees are hardy and productive. The fruit is white fleshed, of medium size, and oblong conic in shape. It is necessary, in order to obtain good size in the fruit, to thin a crop severely. The Waddell is a semiclingstone variety. It is not extensively planted.

The **Carman** variety, illustrated in Fig. 2, ripens a few days after the Waddell. It is regarded as being the first important early shipping variety, but the fruit is not of high enough flavor for canning. The trees are hardy and bear well. The fruit is white fleshed, large, roundish oval in shape, and of fair flavor for shipping purposes. The Carman is a semiclingstone peach.

The **St. John** is the earliest yellow-fleshed market peach and is very acceptable for family use. A peach of this variety is shown in Fig. 3. The trees are fairly hardy and bear well in some localities. The fruit is of medium size, round, and of high flavor, but is rather soft for long-distance shipment. The St. John is a freestone peach.

The **Mountain Rose** variety, illustrated in Fig. 4, is medium early, the fruit ripening from about 7 to 9 days after that of the Carman. The trees are fairly hardy and in favorable seasons bear satisfactorily. The fruit is white fleshed, of medium size, nearly round, of high flavor, and has fair shipping qualities. The variety is an old one and is rather extensively grown. The Mountain Rose is a freestone variety.

The **Hiley,** or *Early Belle,* variety has displaced the Mountain Rose peach in some localities, as the trees are hardier and the fruit is of better shipping quality; both varieties ripen at about the same time. The fruit of the Hiley is white fleshed, large, oblong conic, and of high quality and flavor. The Hiley is a freestone variety.

4. **Mid-Season Varieties.**—The following varieties ripen in mid-season; they are described in about the order of their ripening.

The **Champion** variety ripens from about 5 to 8 days after the Mountain Rose and the Hiley. It is an especially desirable variety for home orchards, The trees are hardy and bear well. The fruit is white fleshed, large, round, and of the highest flavor; it is rather soft for shipping a long distance, but otherwise is valuable for market purposes. The Champion is a freestone variety.

The **Belle,** or *Belle of Georgia,* variety, illustrated in Fig. 5, ripens a few days after the Champion. It is valuable for both commercial and home orchards. The trees are productive and hardy. The Belle is a freestone variety and the fruit is white fleshed, large, oblong conic, of high flavor, very firm, and of excellent shipping qualities.

The **Reeves** variety, illustrated in Fig. 6, ripens at about the same time as the Belle. It is in much demand for home

FIG. 3

FIG. 4

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FIG. 5

FIG. 6 § 10 24909

Fig. 7

Fig. 8

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orchards. The trees are fairly hardy but as generally grown are not very productive. The fruit is yellow fleshed, very large, round, of high flavor, and has good shipping qualities. The Reeves is a freestone variety.

The **Early Crawford** variety is losing favor for commercial orchards, except in a few localities where yellow-fleshed peaches are extensively grown. The trees are rather tender in bud but are productive in favorable seasons. The fruit is yellow fleshed, of medium size, roundish oval in shape, and of high quality; it is rather too tender for shipping. The Early Crawford is a freestone peach.

The **Elberta,** illustrated in Fig. 7, is the most popular market peach grown. It is a few days later than the Belle. The trees are hardy and very productive. The fruit is yellow fleshed, very large, oblong oval, of medium to good quality according to the locality, firm, and excellent for shipping. The Elberta is a freestone peach.

The **Ede** variety ripens at about the same time as the Elberta, but is hardly equal to the latter as an all-round market peach. The trees are productive and hardy. The freestone fruit is yellow fleshed, large, roundish oval, higher in flavor than that of the Elberta, and has good shipping qualities. If its season were somewhat earlier or later the variety would be in much greater demand.

The **Frances** peach ripens a few days after the Elberta. It is a promising new variety that can be used to prolong the Elberta season. The trees are hardy and productive. The fruit is yellow fleshed, large, roundish oval, and of high flavor and good shipping quality. The Frances is a freestone variety.

5. Late Varieties.—The following varieties, which may be classed as late, are described in approximately the order in which the fruit ripens.

The **Fox,** or *Fox Seedling*, variety, which ripens from about 10 to 14 days after the Elberta, is the best commercial variety of its season. The trees are hardy and bear well. The fruit is white fleshed, large, oval conic, and of good flavor and shipping qualities. The Fox is a freestone variety.

The **Late Crawford** variety is of about the same season as the Fox. The trees are rather tender in bud and are, therefore, variable in productivity. The fruit is yellow fleshed, large, roundish oval, of good but rather acid flavor, and ships fairly well. The Late Crawford is a freestone peach.

The **Smock** peach, which is an old variety, ripens at about the same time as the Late Crawford. On account of the mediocre quality of the fruit, there is comparatively little demand for the variety. The trees are hardy and bear well. The fruit is yellow fleshed, rather dry, medium to large in size, oblong oval, of fair flavor, and has good shipping qualities. The Smock is a freestone peach.

The **Edgemont Beauty** variety ripens at about the same time as the Smock, the Late Crawford, and the Fox. This is a promising new variety with less acidity of fruit than the Late Crawford. The trees are slightly more hardy and productive than those of the Late Crawford, although they are of the same type. The fruit is yellow fleshed, large, roundish oval, and has good shipping qualities. This is a freestone variety.

The **Iron Mountain** peach ripens from 5 to 6 days later than the Edgemont Beauty. The trees are vigorous, hardy, and productive. The fruit, which sells well locally, is white fleshed, greenish white in appearance, large, oblong oval, of high quality, and firm. The Iron Mountain is a freestone variety.

The **Krummel October** peach, which ripens 2 to 4 days after the Iron Mountain, is a promising new variety. The trees are medium hardy and are productive if grown in rich soil where the season is long. The fruit is yellow fleshed, round, large, and of high quality; it stands shipment well. This is a freestone variety.

The **Salway** variety, which ripens from 4 to 7 days later then the Krummel October, requires a long season and good soil. The variety is illustrated in Fig. 8. If grown under proper conditions, the trees are medium hardy and productive. The fruit is yellow fleshed, medium to large in size, roundish oval, and of good flavor if the season is long enough to allow proper ripening; the shipping qualities of the fruit are good. This is a freestone variety.

The **Bilyeu** variety ripens about 2 weeks later than the Salway or about 1 month after the season of the Late Crawford. It is grown commercially in only a few regions. The trees are hardy and productive if grown where the season is long and the soil is rich. The fruit is white fleshed, medium to large in size, roundish oval, of fair quality, and very firm. The Bilyeu is a freestone variety.

6. **California Varieties.**—The following varieties are grown extensively in California:

The **Briggs**, or *Briggs Red May*, is a standard early variety. The fruit is of medium to large size, round, and has a white skin with a rich red cheek. This is a semiclingstone variety. The worst fault of the Briggs peach is that it is susceptible to mildew.

The **Alexander** is a widely grown early variety in California. The fruit is of a greenish-white color, nearly covered with red, of medium to large size, firm, juicy, and sweet; it stands shipment well. The Alexander is a semiclingstone peach.

The **Foster** variety is widely grown in California, where it ripens at about the same time as the Early Crawford. The trees are hardy and productive. The fruit is yellow fleshed, uniformly large, rich, juicy, and of good flavor. The Foster is a freestone peach.

The **Oldmixon** variety ripens at about the same time as the Foster. The fruit is white fleshed, large, roundish, or slightly oval in shape, juicy, and of excellent flavor.

The **Muir** variety ripens about the same time as the Oldmixon or a little before. The trees are strong growers and bear well. The fruit is yellow fleshed, large to very large, and of excellent flavor. The peaches are valuable for both shipping and canning, and, because of the sweetness and density of the flesh, are particularly well adapted for drying. The Muir is a freestone peach.

The **Newhall** variety ripens at about the same time as the Muir. The fruit is yellow fleshed, very large, and of rich flavor that is somewhat vinous. The trees are hardy, healthy, and vigorous. This variety is not much affected by peach-leaf curl. The Newhall is a freestone peach.

The **Yellow Tuscany** is a late variety that is grown extensively in Southern California. The fruit ripens about 2 weeks later than that of the Muir. The peaches are yellow fleshed, large, and especially desirable for canning. The trees are strong growers and very productive. The Yellow Tuscany is a clingstone variety.

The **Staley** is a late variety that ripens about 3 weeks after the Salway. The fruit is white fleshed, very large, juicy, tender, and of delicious flavor. This is a freestone variety.

PEACH PESTS AND INJURIES

DISEASES

7. The peach is attacked by a number of diseases, some of which are extremely puzzling. The diseases of the peach that are rather well understood are: *brown rot*, *leaf curl*, *peach scab*, *shot-hole fungus*, *mildew*, *crown gall*, *blight*, and *root rot*. The diseases that are not understood and consequently cannot be successfully combated are: *peach yellows*, *little peach*, and *peach rosette*. The last three diseases are so serious that they are dreaded by all peach growers. Peach yellows has been more or less prevalent in this country since before 1790 and yet its real nature is still undetermined. Little peach and peach rosette have not been prevalent as long as peach yellows, but, like the latter, their true nature is still in doubt. All three diseases are apparently similar in character, yet they have some distinct differences. They are equally destructive, and a tree is worthless after it is once attacked by any one of the three diseases.

8. Brown Rot.—The fungous disease known as brown rot attacks the fruit of the peach, the plum, and the cherry, causing decay. It is most severe in moist, humid regions, where it often causes a complete loss of the fruit crop. In the case of the peach, the stage usually noticed by the casual observer is that illustrated in Fig. 9; peaches affected with the disease will, if they remain on the tree long enough, assume this appearance at ripening time. Often, however, the fruit decays when it is small and green. When serious rotting of the fruit occurs, the twigs and leaves also are frequently killed. A number of the peaches that decay on the trees at ripening time dry and cling to the branches during the dormant season. The appearance of these dried peaches, usually spoken of as mummified peaches, is illustrated in Fig. 10. A close examination of mummified fruits will disclose the fact that they are covered with a brown, powdery substance. This powder consists of brown-rot spores. The spores pass the winter on mummified fruit and also in the crevices of the bark, and are distributed in the spring to the leaves, blossoms, and young fruit. From this statement it may readily be deduced that all mummified peaches should be destroyed.

Fig. 9

Fig. 10

If hot, moist weather conditions prevail at blossoming time, brown rot may destroy some of the blossoms. The blossoms killed by the disease may be readily distinguished, as they cling to the tree after becoming dry and are covered with spores. Also, when blossoms are killed by brown rot, there is an exudation of gum at the base of each, and sometimes a cankered spot on the twig.

One way in which brown-rot spores are spread is by the plum curculio. This insect attacks the leaves and fruit of peach trees, and in crawling about over infected parts it comes in contact with brown-rot spores, which adhere to it, and when feeding on young peaches it innoculates them with these spores. From the point attacked by the curculio, the rot spreads until it involves the entire fruit. It is obvious from these statements that the control of the curculio is closely associated with the control of brown rot. This point will be discussed later.

Brown rot is likely to be serious if hot, moist weather prevails at the ripening time of the fruit. In fact, so rapidly does the disease develop that a few days of such weather may result in the total loss of a crop of peaches. When dry, bright weather prevails, the disease seldom becomes serious except on very susceptible varieties such as the Alexander, the Early Rivers, and the Triumph; as a rule, these varieties should not be planted.

9. Until recently brown rot was difficult to control, because of the lack of an effective fungicide that could be used with safety on peach foliage. However, the discovery of the possibilities of self-boiled lime-sulphur as a summer spray has been of great value to peach growers, and this is the best remedy for brown rot known at the present time. The following control measures are recommended for combating the disease:

1. Avoid orchard sites where the air drainage is poor.
2. Do not plant varieties known to be especially susceptible to the disease.
3. Prune and train the trees so that plenty of sunlight can reach all fruiting branches and twigs.
4. Remove and destroy all mummified fruit.

5. Spray as follows: (1) Just as the calyxes are being shed from the newly set fruit, apply self-boiled lime-sulphur and lead arsenate. The mixture should be made by adding 3 pounds of lead-arsenate paste to each 50 gallons of water used in making the self-boiled lime-sulphur mixture. (2) About 3 weeks after the first spraying make a second application of self-boiled lime-sulphur, omitting the lead arsenate. (3) About 3 weeks after the second spraying make a third application of self-boiled lime-sulphur, omitting the lead arsenate. (4) In the case of

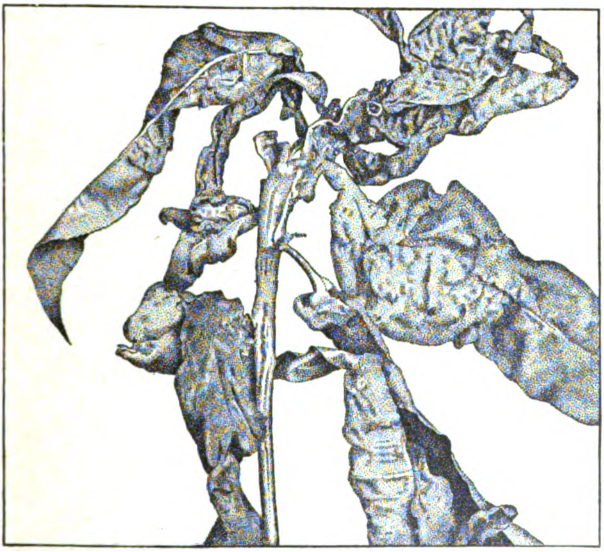


FIG. 11

late varieties, it may be advisable to make a fourth application about 3 weeks after the third spraying, but no spray should be applied within 3 weeks of the ripening time of the fruit, as it might give the peaches a whitewashed appearance when they are ready for market.

10. Leaf Curl.—The disease known as leaf curl attacks the leaves of the peach tree in the spring as they unfold from the buds. Leaves affected with leaf curl become curled and distorted, as illustrated in Fig. 11, turn a yellowish green, become much thickened, and finally wither, turn brown, and fall to the ground. In severe cases the trees are nearly defoliated, which condition affects the setting fruit, causing much of it to drop. Leaf curl is especially likely to cause damage in regions where cool, moist weather prevails in early spring during the time that the leaves are developing; but if warm, dry weather prevails after the disease appears, its development is greatly checked. The spores of the disease remain on the trees over winter and are ready to develop in early spring.

11. After the leaves become curled it is useless to spray to control the disease, as the fungus is already established in the leaf tissues. However, if spraying is done in time, leaf curl may be readily controlled. Any good fungicide is effective. Bordeaux mixture was used as a remedy until it was demonstrated that lime-sulphur could be used with as good results; the latter is now almost universally employed. The disease can be controlled by the regular spraying with lime-sulphur spray in early spring for the control of the San José scale, the details of which are given later. The soluble oils, which are frequently recommended for controlling the scale, are not as effective against leaf curl as lime-sulphur.

12. Peach Scab.—The disease known as peach scab causes considerable damage in some peach-growing regions. The disease appears in the form of minute grayish-black spots on the upper side and the ends of the fruit. In New Jersey the spots can first be detected on fruit of early varieties such as the Greensboro, the Carman, and the Mountain Rose from the first to the middle of June; it is seen somewhat later on late varieties such as the Elberta and the Fox. The spots rapidly increase in size and are frequently so numerous as to form a black, sooty blemish on the fruit; when peaches are severely affected in this way they frequently crack open and decay rapidly. Fig. 12 illustrates the appearance of scab on the fruit and of the cracks formed.

A microscopical examination of a peach-scab spot shows the skin of the fruit to be cracked beneath the spot. These cracks allow brown-rot spores to enter and cause decay; this explains why fruit affected with scab decays so quickly as a result of attacks of brown rot.

Peach scab is most serious in level, sandy areas where the air is warm and moist. It seldom occurs as a serious trouble in districts where the land is rolling and there is a continuous circulation of air. Provided no spraying is done to control it, the disease may cause more or less damage from Central New Jersey to Georgia in the Atlantic-coast peach-growing district,

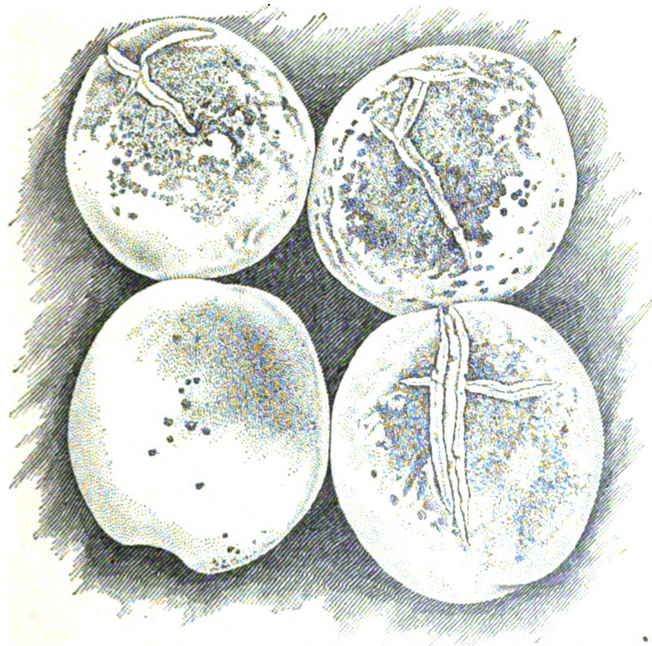


FIG. 12

and in the south central part of the Gulf States district. Peach scab seldom occurs in the Great Lakes district or the Pacific-coast district; when it does occur in these districts it is usually confined to late seedling peaches that are of little importance commercially. In sections where it is likely to occur annually, it is most severe in sheltered locations where the trees are planted closely, and especially where the tops of the trees are dense and the foliage is vigorous.

Before the possibilities of self-boiled lime-sulphur as a spray were discovered, peach scab caused severe losses to growers in some districts. The disease is now being very effectually controlled, however, by thorough spraying with this material. The method recommended for spraying to control brown rot applies also to peach scab.

13. **Shot-Hole Fungus.**—The shot-hole fungous disease of the peach attacks the leaves, but when the trees are kept vigorous by proper fertilization and thorough cultivation of the soil, it seldom causes much injury. However, in certain seasons when much warm, moist weather prevails in spring, followed by hot, dry weather, the disease may cause a loss of foliage even in well-managed orchards, but it is seldom serious.

The disease first appears in the form of small reddish-brown spots on the leaves. These spots are dead parts of the leaf tissues that fall away from the unaffected parts of the leaf, leaving a shot-hole effect. The spots develop in large numbers along the midrib of the leaf, which soon turns yellow and falls to the ground.

If self-boiled lime-sulphur is applied to control brown rot and peach scab, no additional spraying is necessary for the control of the shot-hole fungous disease.

14. **Mildew.**—Damage is sometimes caused to peach foliage by mildew, but the annual injury is largely confined to a few regions and localities. The disease is likely to occur when there is a wide range in temperature during the day, and sudden changes from hot to cool weather. It is usually confined to the foliage at the tips of the branches. Mildew may be effectually controlled by the application of self-boiled lime-sulphur whenever weather conditions are such that the disease is likely to occur.

15. **Crown Gall.**—Peaches, like apples and other tree fruits, are affected with crown gall, which may occur either in the nursery or on mature trees. Instances are on record where a serious attack of this disease has occurred when peaches have been planted on the site of an old red-raspberry plantation.

The only way to control crown gall is to plant trees only on ground known to be free from the disease, and, when planting an orchard, to discard all nursery trees that show evidence of being affected.

16. Blight.—Peach trees are subject to a blight that is perhaps more prevalent in the West than in the East. In the winter dead spots appear on the young shoots of affected trees, especially at the buds. As a result, the buds and much of the previous season's growth soon die, causing a loss of fruiting wood. Spraying as described in the following paragraphs will control peach blight:

1. Spray with Bordeaux mixture in November.
2. In the spring just before the buds open, spray with Bordeaux mixture or with lime-sulphur of the strength usually recommended for dormant spraying.

17. Root Rot.—The root rot, or toadstool, disease described in a previous Section as affecting the apple is also injurious to the peach. The remedy is the same in the case of all kinds of fruit trees.

18. Peach Yellows.—The disease known as peach yellows appeared in the vicinity of Philadelphia previous to 1790, and quickly spread through the peach district of New Jersey, Delaware, and Maryland. From there it gradually spread north to Connecticut and Canada, and northwest to Michigan, and now occurs as far south as North Carolina, but has never been found in Georgia, California, or in any foreign country.

During certain periods the ravages of the disease have been so serious as nearly to wipe out the peach industry in some of the older districts. It is now believed that these so-called outbreaks are due in no small measure to the failure to eradicate all diseased trees as soon as they are detected. It has been observed that trees grown on wet soils are especially susceptible to yellows, and this fact should be kept in mind when the location for an orchard is being considered.

As has been previously stated, the exact nature of peach yellows is still unknown. The most certain and prominent symptoms of the disease are the premature ripening of the fruit and the development of characteristic sickly, wiry shoots on the trunk and main branches. The fruit of diseased trees ripens from a few days to 3 weeks before the normal time, and instead of a uniform blending of colors, the fruit is blotched and spotted with red, and the flavor is usually insipid and sometimes bitter. The flesh of the fruit also may be spotted with red and is usually a deep red about the pit. Fig. 13 illustrates the characteristic spotted and blotched appearance of affected fruit. Although the characteristic shoots commonly develop as suckers on the trunk and main limbs, they may also occur at the tips of the branches. The leaves on these shoots are very narrow and commonly yellowish-green in color. Fig. 14

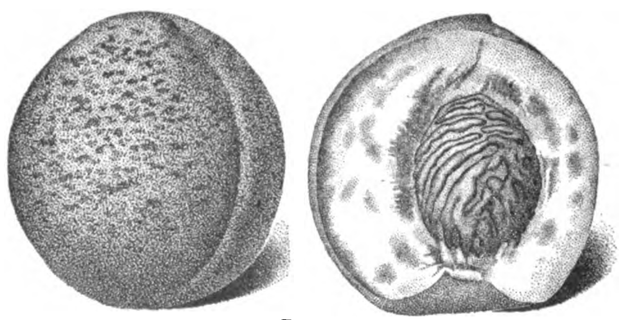


Fig. 13

illustrates a tree nearly dead from yellows and shows the characteristic sickly, wiry shoots.

Trees affected with yellows commonly indicate it by the yellowish green color of the foliage, but this in itself may be misleading, as the foliage of the trees may become yellowish-green from other causes. Early stages of yellows are now readily recognized by those familiar with the disease, and affected trees may be detected before any of the advanced characteristics appear. Early stages of the disease can frequently be detected by a peculiar drooping of the leaves in the center of the tree. Such leaves are commonly a yellowish-green in color, and shorter, stiffer, and more hardened than normal leaves. An early stage of little peach may appear much the same, however, and often it is impossible to distinguish between the two diseases. But this is not important from the standpoint of a peach grower, because the trees should be removed if affected with either disease.

Any check to the growth of a tree in early stages of yellows is likely to bring out the advanced symptoms of the disease within a short time. Neglect of fertilization and cultivation,

FIG. 14

dry weather, injuries by borers, and excessive fruit bearing may reduce the vigor of a tree and cause an early stage of yellows to develop suddenly into an advanced stage. Before early stages of the disease were recognized, this led to much misunderstanding as to the cause of yellows. Peach growers frequently noted a large number of diseased trees in seasons of very heavy crops and attributed the cause of yellows to excessive fruit bearing. In most cases of this sort the disease was already present, but a heavy crop served to bring out the advanced symptoms more prominently.

Another peculiar feature of yellows is that one branch of a tree may show the effects of the disease by producing premature fruit and the other branches may appear to be perfectly healthy. Yet buds taken from the apparently healthy branches will invariably produce yellows when propagated on healthy nursery stock. The removal of a diseased branch from a tree does not apparently delay the progress of the disease, for it seldom fails to appear the following season in the branches that previously appeared to be healthy.

Trees once affected with yellows are worthless and may be the means of affecting adjoining healthy trees.

19. A number of eradication tests have been made to determine whether yellows can be successfully controlled by annual inspection of orchards and prompt destruction of all diseased trees in a locality. The results have been very encouraging, for in certain orchards the average annual loss of from 8 to 15 per cent. has been reduced to about 1 per cent. or less. Where little or no attention is given to diseased trees, an increasing proportion becomes affected each year. For the best results, peach growers in any one locality need to organize and see that all diseased trees are promptly destroyed. Prompt eradication in any one orchard is of value, but if such an orchard is surrounded by orchards where diseased trees are allowed to remain, the best results cannot be secured. Japanese plums also are attacked by yellows, and any affected trees should be destroyed, not only to check the progress of the disease in plum orchards, but in peach orchards as well.

Where trees are removed because of yellows, other trees may be replanted without much danger of incurring the disease. In old orchards, however, it would be of doubtful economy to reset trees, as they are not likely to come into bearing before most of the other trees become unprofitable because of age and decline in vigor. It has recently been proved that yellows is sometimes distributed in nursery stock, and for this reason nurserymen should use much care in the selecting of buds for propagation.

20. Little Peach.—The disease known as little peach, as has already been said, appears to be of the same general nature as peach yellows. It was first observed in Michigan about 1895, and was thought for a time to have originated there, but an infestation has recently been discovered in New York State that appears to have been in existence even longer than the infestation in Michigan. The disease is now almost as widely distributed as yellows, and is just as destructive; in some cases it has appeared to spread even faster than yellows. It differs from yellows in that the fruit of affected trees, instead of ripening prematurely, remains small and does not ripen until from about 7 to 10 days later than normal fruit of the same variety. The sickly, wiry shoots characteristic of yellows seldom develop on trees affected with little peach. In many cases early stages of yellows and little peach cannot be distinguished from each other, as has already been stated, but after the trees come into bearing the distinction can readily be made by the appearance of the fruit.

Trees affected with little peach should be destroyed as promptly as those affected with yellows. Eradication tests are being made in some districts the same as for yellows, and with the same encouraging results.

21. Peach Rosette.—The disease known as peach rosette occurs, so far as known, only in Georgia and in a certain peach-growing district in Kansas. It has occurred in Georgia since about 1880. Rosette appears to be of about the same general nature as peach yellows and little peach, but it differs from these diseases in that the fruit of affected trees shrivels and drops. A characteristic of the disease is the development of numerous shoots that branch very finely, forming tufts, or rosettes, of leaves, from which the disease derives its name. Rosette appears to cause the death of trees affected with it in a much shorter time than yellows or little peach. All affected trees should be destroyed as soon as they are detected.

INSECTS

22. The insects that are most injurious to the peach are: the *peach borer*, the *San José scale*, the *plum curculio*, the *bark beetle*, the *black peach aphis*, the *terrapin scale*, *climbing cutworms*, *green plant lice*, and the *peach-twig borer*, or *peach worm*. The San José scale was, until recently, regarded as the most serious insect enemy of the peach, but as remedies are now known that, if used intelligently, make its control a certain and not very difficult matter, it is not dreaded by fruit growers. The peach borer, however, is an insect that can be combated only with difficulty, for when it once becomes established underneath the bark of a tree, it cannot be destroyed by either stomach or contact poisons. The other insects mentioned can be readily controlled if proper precautionary measures are used.

23. Peach Borer.—The peach borer has been an enemy of the peach ever since the fruit was introduced into America, but despite the great length of time the pest has been known, methods for its control have been improved but little. A mature peach borer is wasp-like in appearance. The females lay eggs on the trunks of trees near the surface of the ground from June to September; these eggs hatch in a short time and the larvas, or borers, at once enter the bark of the tree. The damage to the trees is done by the borers cutting through the bark. If left to work unmolested, they soon girdle the tree at or just below the surface of the ground, and thus cause its death. Some borers feed for a time in shallow burrows just beneath the outer bark; others burrow in directly to the inner bark. Fig. 15 illustrates a tree affected with borers *a*. It was necessary, in order to obtain the photograph from which this illustration was made, to remove the soil from the base of the tree and to cut away some of the bark. Fig. 16 shows a peach borer much enlarged. By November the earliest-hatched borers may be $\frac{3}{4}$ inch in length; others will be found that will be less than $\frac{1}{4}$ inch. In orchards where preventive measures for the control of this insect are practiced very few of the large-sized borers are found.

24. The only method known to insure control of the peach borer is to examine the trees and destroy the borers by the use

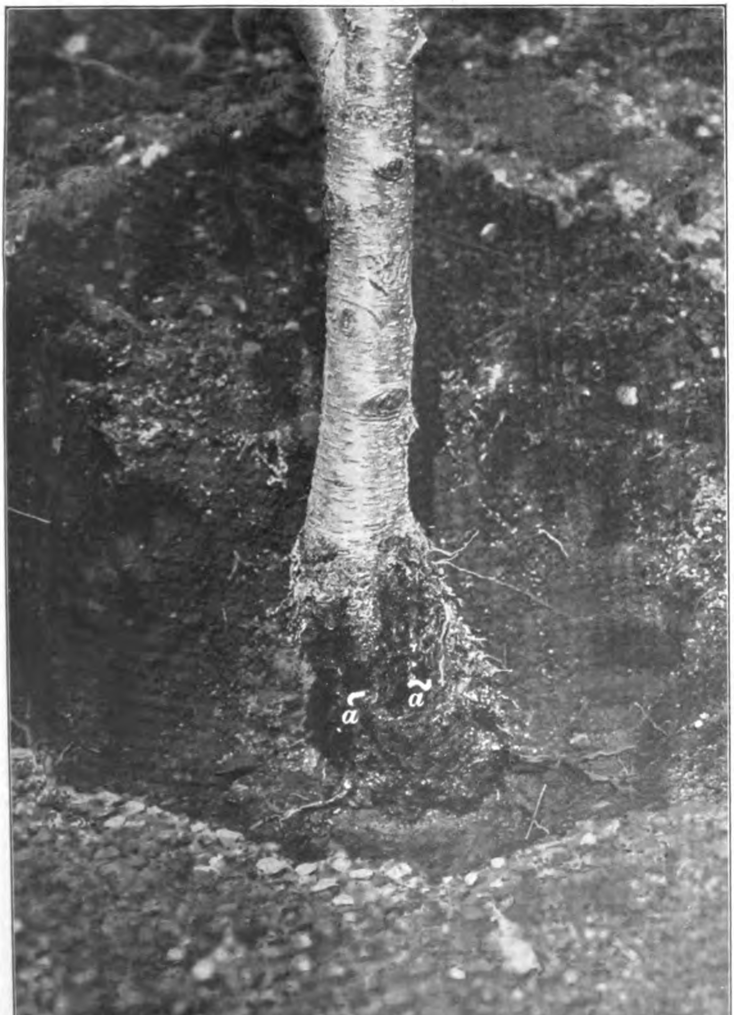


FIG. 15

of a knife or wire. In most districts this can best be done early in May, because at that time all of the borers should be of sufficient size to be easily detected. The presence of borers in a tree is usually indicated by an exudation of gum and the presence of sawdust at the base of the tree. To remove the pests, the soil is dug away from the base of the tree to a depth of from 6 to 8 inches and all burrows that are found may be cut open with a knife and the insects destroyed, or a stiff wire may be inserted in the burrow and pushed through the cavity until it strikes the borer and destroys it. If the borers are cut out with a knife, the cut should always be made up and down the trunk of the tree, never across, and there should be as little cutting of bark as possible.

Fig. 16

It is sometimes recommended that an examination for borers be made in the fall. Some of the insects can be detected at this time and removed, but others will be so small that they will escape detection. The spring examination should not be neglected, however, even if one is made in the fall. Where trees have been neglected for a year or more, it is imperative that a fall examination be made, as many large borers are likely to be found.

The soil that is removed from the base of the trees in hunting for borers should be replaced soon after the work has been accomplished; if this is not done the bark of the exposed roots is liable to be injured by freezing and the trees may suffer as a result of heavy rains and high winds in the spring. Bark injury is especially likely to occur in the case of trees planted on moist, retentive soil.

A good practice to follow in combating borers is to mound the soil about the trunks of the trees during the latter part of June; this will cause the borers to enter the trunks of the trees somewhat higher than they would otherwise, and thus they can be more easily discovered and destroyed. A repellant that is thought by many growers to be of some value in preventing egg laying and the entrance of borers in trees is composed of 40 pounds of lime to 50 gallons of water and to this is added from 3 to 4 gallons of concentrated lime-sulphur spray mixture. This solution is applied to the trunks of the trees from 6 to 8 inches above and below the surface level of the soil immediately after the borers have been removed in May, and another application is made about July 1. The solution can be applied by means of a spray pump; a coarse nozzle should be used on the hose. Soap, tar, tallow, paint, and asphaltum are also sometimes applied to the trunks of peach trees, but none of these have been found entirely successful in repelling borers.

25. **San José Scale.**—Like the apple, the peach is attacked by the San José scale, and unless proper precautionary measures are taken, an orchard in which this pest is found will soon be destroyed. The same remedies are used for both fruits—spray during the dormant period with either concentrated lime-sulphur solution or one of the miscible oils. The lime-sulphur spray is diluted until it has a specific gravity of 1.03, which is the same strength used for apples. The miscible oils, if proprietary mixtures, are used as directed by the manufacturers. Lime-sulphur spray, on account of its being effective also for peach-leaf curl, is more often used than miscible oils in combating the scale on peach trees.

26. **Plum Curculio.**—The plum curculio, which has already been described in a previous Section, is a pest of peach trees that frequently causes much damage to a peach crop. In fact, the insect causes much more injury to peaches than most growers are aware. The curculio lays its eggs about the time the peaches have reached a size of from $\frac{1}{4}$ to $\frac{1}{2}$ inch in diameter. The female makes crescent-shaped slits in the young peaches and deposits an egg in each slit. These eggs hatch into minute grub-like larvas that bore their way to the seed capsules and feed on them. Fruit thus affected soon falls to the ground and is of no value.

The larvas that fall to the ground in peaches are about $\frac{1}{2}$ inch in length and nearly full grown. They soon leave the fruit and enter the ground, where they pupate. During the time the beetles are laying their eggs they feed on some of the newly set peaches; a part of these will fall to the ground before maturity, and those that do not fall will show blemishes. It is while crawling about the trees in depositing eggs or feeding on the fruit that the curculio often inoculates peaches with brown-rot spores, as has already been mentioned.

When a heavy set of fruit occurs on peach trees, the damage done by the curculio is often slight, because the thinning of the fruit that results is likely to be a benefit. But when the set of fruit is just sufficient for a good crop, much injury by the curculio is a serious matter. Injury frequently occurs in the case of young trees that are producing their first crop of fruit and should be guarded against.

A practical method for checking the attacks of the curculio on peaches is to spray the trees thoroughly with arsenate of lead at the rate of 2 pounds of the paste form or 1 pound of the powdered form to 50 gallons of water just as the petals fall from the blooms. This treatment will not destroy all of the insects but it will check their ravages. Formerly, a common method for controlling the curculio was to place a canvas under an infested tree and jar the insects off onto this, but this is now seldom practiced.

It is advisable, in order to reduce to a minimum the number of available hibernating places, to keep all hedgerows or other underbrush near the orchard trimmed and free from rubbish.

27. Bark Beetle.—The fruit bark beetle occasionally causes some damage to peach trees. The presence of the beetles in live peach trees is indicated by small masses of gum oozing from holes in the bark of the trunk or the main branches of a tree. The bark beetle seldom attacks healthy, vigorous trees; hence, the presence of the insect in a tree indicates a weakness that may be due to some such trouble as root injury, yellows, little peach, or peach rosette. If a tree is thoroughly infested, it should be taken out and burned, as it is likely to be of little value and will be a source of infestation to other trees. As a further precaution, peach orchards should be kept free from dead branches and weak trees.

28. Black Peach Aphis.—The black peach aphis, or plant louse, is sometimes a pest in peach orchards. The aphides occur, as a rule, on the roots of infested trees, but they are not infrequently found on young growing shoots. Fig. 17 illustrates the root of a peach tree affected with aphides.

The type of soil on which peach trees are growing seems to have something to do with the occurrence of the aphides; orchards on stiff, heavy soils are seldom troubled with this

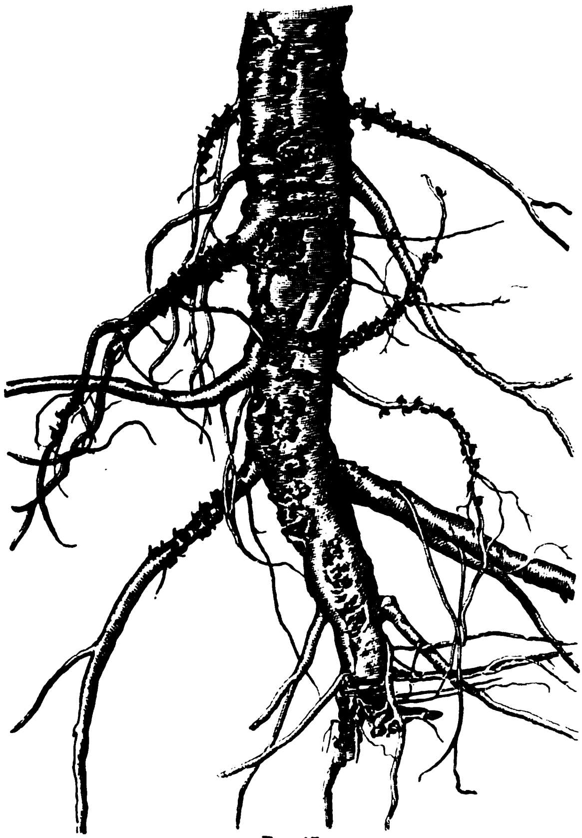


Fig. 17

pest, whereas those on warm, loose, sandy soils are likely to be infested.

The effect of the presence of the insects is most noticeable in the spring and early summer. Affected trees fail to make as much growth as healthy trees and the leaves are small and commonly of a lighter green than under normal conditions.

If an orchard is kept well fertilized and thoroughly cultivated, there should be very little damage caused by the root aphis.

When orchard trees are being injured by this insect, the soil should be removed from about the trunk so as to form a shallow basin at least 1 foot in diameter. About 1 pound of ground tobacco should then be worked into the soil and the trees should be stimulated to make a rapid growth by means of fertilizers and thorough cultivation.

Nursery trees grown on sandy soils in the very warm regions are sometimes infested with the root aphis. If they are set without being treated to destroy the insects, the trees are likely to make a poor growth the first season. The treatment for nursery stock is to prune the roots and then dip them in a solution of whale-oil soap made up at the rate of 1 pound of soap to 4 gallons of water.

29. Terrapin Scale.—A soft-bodied scale known, on account of its resemblance to a terrapin, as the terrapin scale, is sometimes an enemy of peach trees. The soft-bodied scales differ from the San José and other similar scales in that the scale, or covering, is a part of the body, whereas in the case of scales of the San José type, the scale is not a part of the body, but is simply a covering that can be easily removed from above the insect.

The terrapin scale is hemispherical in form, with a wrinkled margin. The females hibernate during the winter in an immature state; they may be observed attached to the twigs of peach, plum, maple, or apple trees. The are mottled brown in color, with radiating streaks of black toward the sides and an orange-red spot on the top. Fig. 18 shows the terrapin scale on the leaves and twigs of the peach; the scales shown on the section of wood at the bottom of the illustration are about natural size. The females reach maturity from the middle to the last of May, at which time they lay eggs. The eggs hatch in about a month and the young appear as flattened, oval, greenish larvas that soon crawl to the leaves and settle along the ribs and veins. The larvas reach sexual maturity in about 6 weeks; at this age the males impregnate the females, which then pass to the under side of young twigs, where they settle and remain until the next spring.

During the time the insects are on the leaves and twigs, they suck the juices of the tree and weaken its vitality, but

FIG. 18

the principal damage is due to the secretion by the insects of large quantities of honey dew, a sweetish, sticky substance that is an excellent host for the sooty fungus, which discolors the fruit and foliage. When the trees are badly infested they become blackened and the ground beneath them appears as if soot had been spread over it. The peaches themselves are much blackened, and thus are practically unsalable.

The terrapin scale is combated during the dormant season of the tree. As the scales commonly cluster at the tips of the past season's growth, a heading back of the branches will remove many of them. The twigs removed will dry out on the ground and the insects on them will die before they have an opportunity to deposit eggs. In addition to pruning, the trees should be thoroughly sprayed just before the buds start in the spring with a good grade of miscible oil, diluted about 1 to 15 or 1 to 20. The oil will destroy the scales not removed by the pruning. Experiments seem to show that lime-sulphur spray is not effective for the control of this scale.

30. Climbing Cutworms.—The so-called climbing cutworms that have been described in a previous Section as affecting the apple are sometimes injurious to the peach. The damage is done to recently planted trees or to trees that are beginning to make their second season's growth. As previously explained, cutworms are less likely to be found in cultivated orchards than in those where grass, weeds, or some such succulent growth is allowed to remain on the ground during midsummer. The principal remedy, therefore, is clean cultivation. Trapping and the use of poisoned baits is also sometimes employed.

31. Green Plant Lice.—The common green aphis described in a previous Section is sometimes found on peach trees, but seldom in sufficient numbers to become of economic importance. The remedy, in case trees become seriously infested, is to spray with tobacco decoction. If commercial preparations are used, the strength for the aphis will be given on the package. The home-made preparation is used at about the strength indicated in a previous Section.

32. Peach-Twig Borer, or Peach Worm.—The peach-twig borer, also known as the peach worm, is found in all parts of the United States. In California, where it formerly caused much damage annually, it was one time considered to be the most serious insect affecting the peach. In the western peach-producing regions it affects both twigs and fruit, but east of the Mississippi River the damage done by the insect is confined primarily to the twigs. This insect is not so serious a pest as it was formerly, as the modern practice of spraying peach trees during the dormant season seems to keep it in control.

The insects pass the winter as minute larvas in small cavities or galleries just under the bark at the crotches of small twigs. These cavities are lined with silk and can further be detected by chips at the opening. As soon as the trees begin to grow in early spring the insects leave the cavities and pass from one young shoot to another, eating cavities in them. They soon reach full growth, form brown pupæ, and within a week or so from the time of pupating, become small, dark-gray moths. The moths lay eggs at the base of growing shoots; larvas soon hatch and eat into these tender shoots, causing them to wilt and eventually die. In the western peach-growing regions the larvas sometimes enter the fruit and cause damage by reason of the cavities they form.

The remedy for twig borers is a spraying of lime-sulphur early in the spring before the buds open. The spray penetrates the cavities and destroys the insects. If peach trees are sprayed with lime-sulphur for the curculio in the spring, any insects that have escaped the effects of the dormant spray are likely to be destroyed by this subsequent application.

MISCELLANEOUS INJURIES

33. Gummosis.—The term gummosis is applied to the exudation of gum from the trunk or branches of trees. This condition is most common on stone and citrus fruits, and is brought about by insect or other injury, disease, lack of vigor, an extremely wet spring, and unfavorable environment, such as a wet soil. On peach trees where injury has been caused by borers or bark beetles, or where brown-rot cankers occur on the twigs, gum is generally exuded. Trees winter injured at the roots, or those injured by caustic fertilizers applied too close to the trunk, also show accumulations of gum. Whenever a tree begins to show much gumming and no mechanical injuries are apparent, an examination should be made to ascertain the cause of the trouble, and the tree cared for accordingly.

34. Little Peach of the Western States.—In the Western States a condition known as little peach occurs which is very different from the little peach disease of the Eastern States. This trouble in the West is accredited to the effect of imperfect pollination. Some, or in a few cases, all of the

FIG. 19

fruit remains small and undeveloped, and other fruit attains full size. Fig. 19 shows branches with both normal and undeveloped peaches. The trouble is more prevalent after seasons of heavy rainfall at blossoming time than during normal seasons.

35. Sour Sap.—Peaches and some other fruits sometimes suffer from a seasonal trouble known as sour sap. Affected trees may die suddenly just as they are starting into growth in the spring, or occasionally only one limb or one portion of the tree may die after the leaves have started or after the fruit is partly grown. The trouble seems to result from the effect of warm weather in winter or early spring followed by a change

FIG. 20

to colder weather. The sap may be started into circulation by warm weather and then be checked by cold weather following. This causes a stagnation of the sap and finally fermentation.

The remedy is to prune back to healthy wood so that the tree may make a growth of new wood.

36. California Yellows, or Little Leaf.—In California, a seasonal trouble known as California yellows, or little leaf, occurs in certain sections. The trouble is characterized by the development of spindling, yellow, sickly shoots on new growth. These shoots have small, narrow, yellow leaves. The leaves along the side of the shoots fall during the summer, leaving a tuft of leaves at the end. Fig. 20 shows two shoots, one with the small leaves at the sides, and one with only the tuft of leaves at the end of the shoot. Fruit fails to develop on affected trees. Trees from 3 to 7 years old are more often affected than those younger or older.

The trouble generally occurs following an unusually dry season, and is especially prevalent where trees are growing in a light soil or in one underlaid with a coarse, sandy subsoil. In irrigated districts the trouble can usually be controlled by practicing regular irrigation late in the season, especially when the regular rains of autumn and winter are late in commencing.

37. Winter Injury.—Winter injury to the peach is of three general kinds: injury to the fruit buds, injury to the twigs, and injury to the roots. The vigor and condition of trees is an important factor in winter killing, strong, healthy trees being less liable to injury than those that are weak and sickly.

If unusually warm weather prevails in December or January, the fruit buds often start into growth and are then killed by temperatures which they could resist if such growth had not taken place. However, if a temperature of from 10° to 15° F. below zero is reached and this continues for several hours, injury to fruit buds is likely to occur, even in a well-managed orchard where the buds have remained entirely dormant.

Some varieties are more susceptible to winter injury than others. For example, the buds of Early Crawford, Late Crawford, Reeves, and Mountain Rose are more likely to be killed by severe winter temperature than are Greensboro, Carman, and Belle. In fact, buds of the latter varieties are often uninjured when buds of the former varieties are killed.

Except in unusual seasons, winter injury of well-matured twigs seldom takes place at temperatures higher than from 25° F. to 30° F. below zero. Trees that make a late, succulent growth are more susceptible to twig injury than those that cease growth early in the growing season and become well matured before winter. The extent of wood growth can be controlled largely by methods of cultivation and cover cropping, as will be explained in another Section. Trees growing on deep, well-drained soils and kept vigorous by means of good orchard management will generally withstand low temperature in winter without serious twig injury.

38. The weather conditions of the previous summer have an effect on the extent of twig injury that may occur. Trees may be so severely checked in growth by drouth in midsummer that many twigs will die back in winter, even in a comparatively mild season. Also, lack of moisture during the fall may cause injury to tree twigs during the winter. Moisture is given off from the twigs during the winter and the supply must be maintained through the agency of the roots. If the soil becomes exceedingly dry in late fall and deep freezing, which prevents water from getting down to the roots, soon follows, there is likely, on account of the lack of moisture, to be injury to the twigs during the winter. Deep freezing and subsequent injury may be lessened somewhat by the use of cover crops.

39. Injury to the roots is likely to occur in the case of young peach trees, especially if they are growing on heavy soil where they are exposed to strong winds during the fall, and where winter temperatures are distinctly variable. The swaying of the trees during the late fall often causes a hole to be formed about the base; if water gathers in this hole, and, during winter, freezes and thaws several times, the bark of the main root is likely to be injured. The trees may fail to show the effect of the injury until the summer following, when a rolling of the leaves will indicate that something is wrong. An examination of the inner bark of the main root will show it to be more or less spongy and sometimes blackened or partly decayed. The remedy for this trouble is to prune the trees severely during the next dormant period; when thus treated they will generally recover, provided the injury has not been too severe. If the trees are allowed to remain without pruning, they become weak and are likely to be attacked by the bark beetle, and, as a result, will soon die.

40. Spring Frosts.—In general, the peach grower has more to fear from spring frosts than from severe winter weather. Warm weather in late winter may start the buds so early that they are likely to open from 2 weeks to a month earlier than normally. The buds are then in much danger of being destroyed by spring frosts. Even in a normal season when the buds open at the usual time, there is some danger from frost. When the fruit buds of the peach are advanced far enough to show the pink color, they can resist a temperature as low as 15° F.; when they are just ready to open, 25° F. is the danger point; when they are actually in bloom, 26° to 28° F. is as low a temperature as they are likely to withstand without injury. After the peaches begin to form, a light frost will destroy them.

Altitude has an important influence on danger of frost injury to peach buds. In low areas, as, for example, the coastal-plain region along the Atlantic coast, the peach blooms earlier than in higher altitudes in the same latitude. For this reason peaches on low areas are more likely to be injured by spring frosts than are those growing on high areas. Certain small areas in peach districts are found that are very susceptible to frost injury and, of course, should be avoided when selecting a site for a peach orchard. In general, it may be said that on account of danger from this source, it is usually preferable to plant peaches on fairly high lands.

The variety is often a factor in the amount of frost injury done to peach buds. In some seasons there is a difference of from one to several days in the time of blooming of different varieties of peaches. As a rule, Early Crawford, Mountain Rose, Elberta, and Fox are early bloomers; Greensboro, Carman, and Belle are classed as late bloomers. The Belle is especially late, often being as many as 5 days later than the early blooming varieties mentioned. If cool weather occurs just as the trees are beginning to bloom, the difference is somewhat greater than just mentioned; if the weather happens to be very warm there will be less difference. In fact, all of the varieties may, by excessively warm temperatures, be forced into bloom within a few hours of each other.

Although there are some exceptions, the early varieties of peaches are a little later in blooming than the mid-season and late varieties. However, most of the early varieties have what is known as the large type of bloom, and blooms of this type do not generally expose the stamens and pistils as early as those of the small and medium types. The selection of late-blooming varieties for sections that are likely to have late spring frosts is recommended and may be of marked value in preventing injury.

Orchard heaters are used in many sections for the protection of the blossoms from spring frosts. The types of heaters and manner of using them is the same as described for apples. In orchards that are subject to loss from spring frosts the use of heaters is strongly recommended.

PEACH CULTURE

(PART 2)

PEACH-ORCHARD ESTABLISHMENT

SIZE AND LOCATION FOR A PEACH ORCHARD

1. Size for an Orchard.—When the establishment of a peach orchard is being planned, the number of trees to plant should be carefully considered. If the fruit can be disposed of locally, the orchard may be of any size that suits the convenience of the owner, but if it will be necessary to ship the fruit by rail or boat, even for a short distance, an orchard of 1,000 trees is as small as should be planted, as small shipments from a few trees are likely to bring unsatisfactory returns; in other words, the shipments should be large enough to attract the attention of dealers who buy in large quantities. If the distance to market is much greater than 300 miles, the orchard should be comparatively large, say of about 10,000 trees. Growers generally find that it is advantageous to ship their fruit in carload lots, and in order to be able to do this, it is necessary that an orchard of good size be planted.

2. In deciding on the size of orchard to plant, a grower should consider the cost of equipment and the cost of maintenance. The amount of money required for these items will vary considerably even in the same locality. For example, many growers conduct some other line of agriculture along with peach growing and thus are enabled to employ teams, tools, and other equipment for both lines of farming, thereby cutting down the expense for each. Especially is this condition true for orchards of only about 1,000 trees; in fact, it is seldom that a grower gives his entire time and attention to an orchard of this size.

3. The distance to market or to a shipping station and the condition of the roads have an important bearing on the team expense at harvest time. For example, from a certain orchard in New Jersey the roads are such that only 60 crates of peaches can be hauled at a load to the shipping station, whereas from another orchard in the same state 115 crates can be hauled.

4. Notwithstanding the preceding statements, a general estimate of the cost of equipment and maintenance can be given; but this, however, will require modification to suit individual cases. For an orchard of 1,000 trees one team will be needed. This will cost from about $300 to $600. A common barrel-spray-pump outfit that can be purchased for $25 or less may be gotten along with, but a small pump mounted on a 100-gallon tank will be more satisfactory; this should not cost more than $35. A disk harrow, a spring-tooth harrow, two one-horse plows or one two-horse plow, hoes, pruning tools, and other small articles will cost from $60 to $75. A packing house suitable for accommodating the fruit from 1,000 trees can be built for from about $150 to $200. Often, however, there is some building on the farm that can be used as a packing house. The cost of the fruit packages will depend on the kind used and the size of the crop, and will be, for trees in full bearing, from 30 cents to 75 cents a tree, or from $30 to $75 for 1,000 trees.

The maintenance cost for a 1,000-tree orchard is influenced largely by the care given to the orchard and whether or not the owner works in the orchard or simply directs his laborers. The cost of fertilizing, pruning, spraying, and harvesting will be from 30 cents to 50 cents a tree, or from $30 to $50 for 1,000 trees.

In addition to the expenses enumerated, many miscellaneous costs are likely to be added. For example, it may be necessary to hire an extra team for getting the fruit to market or to the shipping station. These miscellaneous items will vary from practically nothing to, say, $50 for the season.

5. From the preceding figures the estimated cost for equipping and maintaining a 1,000-tree peach orchard is as follows:

Cost of Equipment	Minimum	Maximum
Team	$300	$600
Spray outfit	25	35
Harrows, plows, etc.	60	75
Packing house		200
Total	$385	$910

Cost of Maintenance	Minimum	Maximum
Fertilizing, pruning, spraying, and harvesting	$ 30	$ 50
Cost of packages	30	75
Miscellaneous items		50
Total	$ 60	$175

6. For an orchard of 10,000 trees at least two teams will be required during the growing season and extra teams are likely to be needed at picking time; in the latter case the teams can usually be hired by the day. The cost of the two teams will range from $600 to $1,200. A power spraying outfit will be necessary for this size of orchard. One can be purchased for from about $300 to $350. Harrows, plows, and pruning equipment for a 10,000-tree orchard will cost from about $125 to $200. A packing house suitable for the proper handling of the fruit from 10,000 trees will cost from about $600 to $800. The cost for fruit packages will vary from $300 to $750, depending on the kind used and the size of the crop. The cost of fertilizing, pruning, spraying, and harvesting may be estimated at practically the same rate per tree as in the case of a 1,000-tree orchard; this will make the cost from $300 to $500. The miscellaneous items will vary from, say, $100 to $500.

7. From the figures just given the total cost for equipping and maintaining a 10,000-tree orchard will be approximately as follows:

Cost of Equipment	Minimum	Maximum
Teams	$ 600	$1,200
Spray outfit	300	350
Harrows, plows, etc.	125	200
Packing house	600	800
Total	$1,625	$2,550

Cost of Maintenance	Minimum	Maximum
Fertilizing, pruning, spraying, and harvesting	$ 300	$ 500
Cost of packages	300	750
Miscellaneous items	100	500
Total	$ 700	$1,750

8. Selecting of the General Location for an Orchard. The importance of selecting a favorable location for commercial peach production can hardly be overemphasized, for on the right choice of a location depends, in a large measure, the success of an orchard. In general, it is advisable to locate a commercial orchard in one of the recognized peach-growing districts, or at least where a large number of peaches are being grown. In such regions there is likely to be an opportunity to secure extra labor during harvesting time, whereas in regions where but a relatively few peaches are grown, labor is difficult to secure.

Climatic conditions, too, should be considered in the selecting of a location for a commercial peach orchard. Areas that are subject to severe winter weather that is likely to cause tree injury should be avoided. The same is true also of regions that are subject to warm weather in late winter; this causes the fruit buds to open so early that they are likely to be killed by frost. Low areas that are subject to late spring frosts are especially undesirable for peach production.

Another important point that should be considered in the selecting of a location for a peach orchard is the nearness to a good shipping station. Peaches are such a perishable product that they must be marketed quickly after being picked, and a grower whose orchard is located a considerable distance from a shipping station is likely to find himself handicapped for hauling facilities. If a large number of peaches are shipped daily, the matter of hauling to the station is an extremely important one; this is especially true if the road is hilly, muddy, or very sandy.

The nearness of the shipping station to the market where the fruit is to be sold is another factor that should be considered in the selecting of a location for commercial peach growing. If fruit is hauled only a short distance it is likely to arrive at the market in better condition than if it is hauled a long distance. Then, too, when the distance is short a grower is better able to keep in touch with a shipment until the fruit is sold than where the distance is long. The most important advantage of a short haul, however, is that the freight rates are lower than for a long haul. For example, the freight rate to New York from the Georgia peach district is from 50 to 55 cents a carrier and that from points in New Jersey that are within 100 miles of New York is only from 10 to 14 cents a carrier.

9. It is advantageous to have a peach orchard located near a station where a large quantity of peaches is shipped daily, for in this case the freight service is generally prompt, regular, and efficient, and consequently the fruit will reach the market at a time of day when it will sell for the best price. For most markets, peaches should reach the market at, or perhaps a little before, midnight. In New York City, for example, the peach market opens soon after midnight, and the best sales are made before 5 o'clock in the morning. By 7 or 8 o'clock in the morning, the business for the day is practically over, and if a car of peaches should arrive after that time it must be sold at a sacrifice or be held over until the next morning, in which case it will be in competition with fresh fruit that arrives during the night. The difference between early- and late-arriving fruit is often as much as 25 cents a carrier or a box. From points where perishable freight is being shipped regularly, the schedules are usually arranged for prompt delivery early in the night, and such stations are favorable ones from which to ship peaches. Also, stations that have two or more railroads by which shipments can be made to market are likely to be good shipping points.

10. In selecting a location for a commercial peach orchard, a grower should not overlook the advantages offered by a local market. It is possible to find locations where there is a good local market and at the same time good shipping facilities to a distant market. Such locations may be regarded as ideal, so far as the sale of the fruit is concerned, for any fruit that becomes too ripe for distance shipment may be disposed of locally. In addition, the local market will afford a means for disposing of second-grade fruit, which can always be sold to better advantage on a local market than on a distant market where it must compete with first-class fruit. Large towns and small cities often offer exceptionally good opportunities for a local peach trade.

11. Selecting of the Site for an Orchard.—The selecting of the site for an orchard involves a consideration of the soil and the exposure, or lay, of the land. The peach can be made to grow well on a variety of soils, provided they are well drained, and in some sections, properly irrigated. Perhaps the ideal soil for a peach orchard is a deep, well-drained, sandy loam. The peach does well also on rather light sandy soils if there is a retentive soil strata a foot or so below the surface. Stony loams also, if they are well drained, are acceptable for peach growing. Heavy, poorly drained soils should be avoided.

12. The importance of the exposure of peach orchard sites has in the past been somewhat overemphasized. In a level or slightly rolling country the exposure is of little importance, except that low-lying areas, or pockets, should be avoided on account of the likelihood of the fruit in such places being destroyed by spring frosts. In a decidedly hilly country it is advisable to avoid sites that are exposed to severe prevailing winds, and also sheltered spots with a southern exposure, where fruit buds would be likely to make too early a development.

A good rule to follow in a hilly region is to choose a site that is somewhat above the general level of the surrounding land, where air drainage is good and there is sufficient area to allow of the orchard being laid out as desired. Exceedingly high areas and steep hillsides are not desirable for peach growing, as the cost of cultivation and harvesting in such places is likely to be excessive. Also, low land in hilly regions should be avoided, on account of the danger of frost injury to the buds in spring.

SELECTION OF VARIETIES

13. The choice of varieties for planting is of prime importance to peach orchardists. Naturally, the varieties grown should be adapted to the locality. It would be well, therefore, for a prospective grower to learn from other growers what varieties are giving the best satisfaction in the particular region under consideration. For a commercial orchard the varieties should be those demanded by the market where the fruit is sold; if the fruit is to be shipped a long distance, varieties that stand shipment well should be planted. For a home orchard or an orchard from which fruit will be sold locally, it is not, of course, necessary to pay much attention to the shipping qualities of a variety, but the varieties planted must be adapted to the district and all be of the kinds desired on the local market.

PROCURING OF TREES

14. Unless a grower is making plantings every year, it will generally prove to be more economical to purchase young trees of a reliable nurseryman than to propagate them at home; if plantings are made each year, however, home propagation of the trees will often be advantageous. An advantage claimed for home-grown trees is that the propagator may be sure that they are of the variety or varieties desired, whereas, if the trees are procured from a nursery it is possible that a mistake may be made or that the nurseryman may intentionally attempt to dispose of surplus stock under the guise of a fictitious name.

Another advantage of home-grown trees is that the young stock is on the ground ready for planting as soon as it has reached the proper age.

PROPAGATING OF PEACH TREES

15. The peach is propagated by budding. Seedlings are grown from pits, the young trees being budded when of the proper size with buds taken from trees of the desired variety.

16. Methods of Growing Seedlings.—It is recommended that the pits from which the seedlings are grown be obtained from natural seedling trees. However, the supply of natural-seedling pits is rather limited and often not equal to the demand. Tennessee and North Carolina are the largest producers of these pits. It is thought that, as a rule, seedlings grown from the pits of cultivated varieties are not so hardy for budding as those grown from natural-seedling pits. In view of the fact that the supply of natural seedling pits is so limited, however, it may be necessary in the future to give attention to the production of pits from cultivated varieties for the growing of seedlings. It has been suggested by some growers that the pits of some of the hardiest varieties would be satisfactory for the purpose, and this is probably true. Often pits from the refuse of canneries are sold as natural-seedling pits, and as they may be from varieties that are not hardy, they should be guarded against.

Nurserymen usually secure pits just at the close of the peach-ripening season. These are either stratified and planted the following spring, or they are planted directly in the nursery rows in early summer or late fall.

When pits are to be stratified, an area is selected in a well-drained cultivated spot, the soil is removed to a depth of from 4 to 6 inches, and a layer of pits not exceeding an inch or two in depth is placed in the bottom of the area. About an inch of soil is placed over the layer of pits, then a second layer of pits is added, and over this is placed a layer of soil. The last layer of pits may be above the general soil level, but the area of stratified pits should be level, as otherwise the soil may become dry. If conditions are favorable the pits keep moist and the action of the frost during the winter breaks the outer shells at the suture. In the spring the pits are dug up and the kernels are separated from the shells. Any pits that have not been opened by the frost are cracked with a hammer.

After the kernels have been removed from the shells they are ready for planting in the nursery. A peach nursery should be located on rich, well-drained loam, and be distant from any orchard containing trees affected with yellows, little peach, or other such diseases. As soon as the soil is dry enough in the spring, the area should be plowed and harrowed and furrows made to receive the kernels. Nursery rows are generally made from 3 to 4 feet apart; the pits are dropped from 2 to 3 inches apart in the row, and are covered with from 2 to 3 inches of soil. This distance apart in the rows allows for a thinning of the trees, as the young seedlings should not stand closer than 6 inches when they are 1 year old. Trees too close together in nursery rows are likely to be light and spindling and hence undesirable.

In case the pits are to be planted directly in the nursery row—without being stratified—the planting is done in late summer or early fall in the same manner as explained for kernels from stratified pits, except that closer planting in the row is generally practiced; the reason for this is that the frost may fail to open all of the pits and as a result many may fail to grow.

The young seedlings, whether from stratified pits or from those planted directly in the rows, should receive thorough and frequent cultivation from the time they appear above ground until about the first of August, when cultivation should be discontinued. At this time the young seedlings are ready for budding; they should be from ¼ to ½ inch in diameter 3 inches above the ground.

17. Budding of Peach Seedlings.—Peach seedlings are usually budded in August, the work being delayed until this time in order that the buds shall not make much growth before the next spring, as any new growth would likely be killed during the winter by freezing. The budding should not be delayed, however, until the trees have stopped growth for the season, as the bark at this time will not slip well and a bud, if inserted, would likely fail to unite with the stalk on which it was placed.

Nurserymen generally cut buds from nursery trees that were budded the previous season. This practice, commonly known as budding from nursery row to nursery row, has come into rather general vogue since the introduction of the San José scale, nurserymen preferring to take buds from nursery trees rather than from orchard trees, as they are more likely to be free from scale. Besides, the procuring of buds from nursery trees is convenient and does away with the necessity of maintaining an orchard for propagating purposes. Most authorities agree, however, that it is best to secure buds from bearing trees, and many of the larger peach nurseries are establishing orchards from which to secure buds for propagation.

The method used in budding trees has already been described in a previous Section. The spring following the budding the tops of the seedling trees are cut off just above the inserted bud. Other buds on the seedling stock will start into growth and must be rubbed off and only the desired bud allowed to grow. Thorough and frequent cultivation should be given to the trees during the summer. In the fall or the following spring they are ready to be sold as 1-year-old trees, nurserymen computing the age of a tree from the time it was budded.

In the Southern States June budding is sometimes practiced by nurserymen when there is a shortage of any variety and when they wish to secure trees in the shortest possible time. When this is done the budded trees are offered for sale in the fall or the following spring and are known as *June buds*. For average conditions, 1-year-old trees are to be preferred to June buds, and for this reason the practice of June budding is gradually being discontinued except in cases of special demand for trees.

PROCURING OF TREES FROM A NURSERY

18. Ordering of Trees.—If a grower desires to procure trees from a nursery rather than to propagate them himself, he should secure the name of some reliable nurseryman and write to him several months in advance of the time the trees are wanted, in order to ascertain whether an order for trees of the variety and grade desired can be filled. This method of procedure is of advantage to the grower, as the nurseryman will be compelled to state whether or not he is in position to furnish the kind of trees wanted. If a large number of trees are to be purchased, it is a good plan to request sample trees and prices on the grade of tree submitted. Often, too, it is an advantage for a grower to visit the nursery and personally select the trees desired.

It makes but little difference whether trees have been propagated in a local nursery or at a considerable distance north or south of the place where they are to be planted, provided they are healthy and have been well grown and have not been allowed to start into growth before being shipped. If yellows or little peach or other serious diseases are known to occur in the vicinity of a nursery it is well to order elsewhere.

19. Grades of Trees.—Nurserymen sort peach trees into several grades, some grading them only as to height, others grading them according to height and caliper, the caliper being the diameter of the trunk 3 inches above the point where the bud was inserted. The following is one method for the grading of trees according to both height and caliper: First-class trees from 6 to 7 feet in height and from $\frac{5}{8}$ to $\frac{3}{4}$ inch in caliper are graded as *extra XX;* first-class trees from 5 to 6 feet in height and from $\frac{5}{8}$ to $\frac{3}{4}$ inch in caliper are graded as *No. 1;* first-class trees from 4 to 5 feet in height and from $\frac{1}{2}$ to $\frac{5}{8}$ inch in caliper are graded as *No. 2;* first-class trees from 3 to 4 feet in height and from $\frac{7}{16}$ to $\frac{1}{2}$ inch in caliper are graded as *No. 3;* and whips from 2 to 3 feet in height and from $\frac{3}{8}$ to $\frac{7}{16}$ inch in caliper are graded as *No. 4.* It should be understood, however, that no system of grading trees is in universal use.

In Fig. 1 are illustrated five grades of peach trees, graded according to both height and caliper. The trees shown in (*a*) are from 5 to 6 feet high; those shown in (*b*) and (*c*) are from 4 to 5 feet high, but those in (*b*) are of larger caliper than the ones in (*c*); those in (*d*) are from 3 to 4 feet high; and those in (*e*) are from 2 to 3 feet high.

Medium-sized 1-year-old trees are the most economical to plant, as they cost less than large trees, are easier to handle,

FIG. 1

and will have made as much growth by the end of the second summer. An ideal tree for planting is one that is well grown, free from injurious insects and diseases, and that calipers from about $\frac{5}{8}$ to $\frac{3}{4}$ inch. There is no advantage in excessive height; if trees are from 3 to 4 feet in height they are fully as satisfactory as taller ones. However, tall trees of, say, from 4 to 6 feet in height will make a good growth if they are properly handled; the objection to them is that generally they are expensive. Very small trees may make a good growth if they are planted on good soil, but often such trees are the weaker ones from among a lot of large and medium-sized trees, and for this reason may lack vigor.

PLANTING OF TREES

20. Arrangement of Varieties in An Orchard.—The peach is both a self-pollinated and a cross-pollinated fruit; and as the fruit seems to set equally well in either case, no attention need be paid to this point in the arranging of varieties in an orchard. But for convenience and economy in harvesting the peaches, it is a good plan to plant each variety by itself. In most cases it is well to have the variety that ripens earliest nearest the packing house and the variety that ripens latest the farthest away, the others being arranged in the order of their ripening. In this case the trees near the packing house will be bare of fruit and the branches will be out of the way when fruit is transported from late-bearing trees. This plan, however, sometimes needs slight modification. If the soil of any part of the orchard retains moisture better in late summer than other parts, it is well to plant late-maturing varieties on it, as they require larger quantities of water late in the season than do early-maturing varieties.

21. Time of Year for Planting.—Fall planting is sometimes recommended for peach trees, and where the ground is well drained and the trees well matured, the practice may be successful. The roots of peach trees are, however, sensitive to the action of freezing and thawing, and for this reason in regions where there is danger of heaving of the soil by frost it is better to plant the trees in early spring.

22. Preparing of the Land.—Land that is to be set to peaches should be as thoroughly tilled as for corn or potatoes. Plowing should be done as early in the spring as conditions will permit, and should be followed immediately by a thorough harrowing of the soil. Such preparation will get the ground into good condition for an early growth of the trees and will lessen the labor of setting the trees. Poor or newly cleared land should be cultivated in hoed crops for at least 1 year previous to being set to peaches.

23. Distance Apart for Planting.—On strong, non-irrigated soils where the peach grows to a large size the trees are generally set 20 feet apart each way. If the orchard is to be irrigated, from 22 to 24 feet is not excessive. On light soils the trees may be set as close as 18 feet each way, especially if a system of close pruning is to be practiced. Peaches are sometimes planted as close as 15 feet each way, but this requires close pruning and in a few years the trees are likely to become crowded.

Sufficient distance should always be left between the outside rows of trees and any surrounding fences, hedgerows, or woodlands to allow for thorough cultivation of these rows and for the passage of sprayers and other orchard implements. Roadways are seldom left through peach orchards, as there is sufficient space between rows to allow teams to be driven through.

24. Treatment of Trees Before Planting.—As soon as trees are received from a nursery, they should be unpacked and examined to see whether the order has been correctly filled. If the trees are somewhat dried out it is often an advantage to place them in water for a few hours; this treatment will generally insure a better growth, when they are planted, than if no such precautions were taken.

Young trees require pruning before being planted, and the best time to do this is soon after they arrive from the nursery. The tops should be cut back so that they do not exceed a height of 2 feet above the point where the trees were budded. Some growers prefer to cut them back to within 6 inches of the bud, but it is a question whether anything is gained by such a severe cutting back. If the side branches are large they are pruned to stubs; if they are slender the tree is cut to a cane. All injured roots should be cut smooth and all side roots cut so that not over 6 inches of root remains. Fig. 2 illustrates proper and improper pruning of nursery trees; the height is indicated on the scale. In (*a*) is shown an unpruned tree as received from the nursery and in (*b*) a tree properly pruned. It will be noticed that the top was removed at a distance of about $1\frac{1}{2}$ feet above the point *a* where the tree was budded, that the side branches

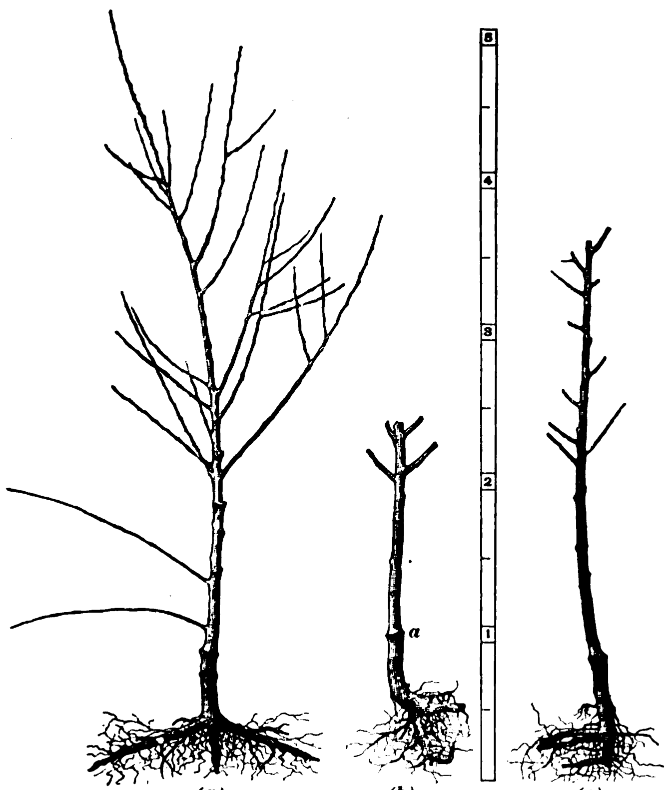


FIG. 2

were pruned to stubs, and that the roots were pruned to within 6 inches of the trunk. In (*c*) is shown a tree that was improperly pruned. It was headed too high, the distance of the top from the point of budding being about 3 feet.

Nursery trees that are grown in a section where leaf curl occurs annually may be infested with this disease when they leave the nursery; and after they have been pruned for planting it is well to dip the tops in Bordeaux mixture or in cold concentrated lime-sulphur mixture, diluted to about the strength used for the dormant spraying. The roots of nursery trees are sometimes infested with the black peach aphis, and in such cases they should be dipped in a solution of whale-oil soap made up at the rate of 1 pound of soap to 3 gallons of water.

After the trees have been pruned and dipped they should be heeled-in near the site of the orchard, so that they will be convenient at planting time.

25. Setting of Trees.—Peach trees should be set in rows as described for apples. If the setting is done on a bright day, the roots should be kept moist by a piece of damp burlap or other heavy cloth, and the trees should not be distributed much faster than they can be set. It is advisable to set the trees a little deeper than they stood in the nursery. Good, moist surface soil should be packed firmly about the roots. In humid regions trees set early in the spring on well-prepared soil should not require watering, but in dry regions watering may be necessary. As soon as the trees are set, the land between the rows should be well harrowed to fill in any open furrows that may have been made and to form a dust mulch for the purpose of holding moisture in the soil.

PEACH-ORCHARD MANAGEMENT

MANAGEMENT DURING THE FIRST YEAR

26. Fertilizing of a Young Peach Orchard.—It is often a good plan to fertilize a newly-set peach orchard. The kind and quantity of fertilizer to use will depend, of course, on the fertility of the land and the treatment the area has received previous to the planting of the trees. For soils of average fertility, such as those that are fertile enough to produce good crops of corn, potatoes, or vegetables, it is a good plan to sow the following kinds and quantities per acre of fertilizer: From 150 to 200 pounds of sulphate or muriate of potash; from 100 to 150 pounds of pure ground bone; and 200 pounds of acid phosphate of a good grade. For soils that are below medium in fertility, 200 pounds per acre of each of the preceding fertilizers should be sown, and in addition, 200 pounds of nitrate of soda. If it is difficult to secure unmixed fertilizers, a good complete fertilizer of a 4–8–10 formula may be used; this should be sown at the rate of from 500 to 800 pounds per acre, the exact quantity to use depending on the condition of the land. Soils that have been in truck crops and have been liberally fertilized will require little or no fertilizer the first year after being planted to peaches.

The fertilizer should be applied when the land is being prepared or just after the planting of the trees. It should be sown broadcast and harrowed into the ground immediately.

If the soil has not been limed for a time previous to planting the trees, it is a good plan to make an application of lime. For sandy soils about 2,000 pounds per acre of ground limestone should be applied; for strong, loamy soils from 2,000 to 3,000 pounds of burnt lime or from 4,000 to 6,000 pounds of ground limestone per acre will prove satisfactory. The liming of the soil will improve its physical condition and tend to promote a better growth of the trees than would otherwise be made.

27. Intercropping in a Young Peach Orchard.—A newly planted peach orchard should be thoroughly cultivated in order to conserve moisture and to destroy weeds. It is often a good plan to grow hoed crops, such as peas, beans, tomatoes, or potatoes, between the rows the first season; this may also be practiced the second season. Corn is frequently grown between the rows and there is no objection to the practice, provided the corn rows are at least 4 feet from the rows of trees and that clean cultivation is maintained throughout the growing season. It is not advisable to grow grain crops, such as rye or wheat, in a newly planted peach orchard, as they take so much water from the soil that the young peach trees are likely to suffer from lack of moisture.

MANAGEMENT AFTER THE FIRST YEAR

PRUNING OF PEACH TREES

28. Pruning of 1-Year-Old Trees.—In order to obtain the best results from peach trees, they should be properly pruned from the beginning. The first pruning after planting should be done during the dormant period after the first season's growth. If the trees when set were cut back to a height of not more than 2 feet above where they were budded, they will, by the end of the first growing season, have developed several vigorous side branches. In Fig. 3 (*a*) is shown a 1-year-old tree—that is, a tree that has been planted for a year—before being pruned. In (*b*) is shown the same tree after pruning. The pruning of such a tree should be done as follows: Retain the best two, three, or four main branches that will tend to make the tree strong and well balanced and prune off all the others close to the trunk. Retain such secondary branches as will tend to make the tree well rounded. If two secondary branches occupy much the same space, retain one and cut away the other. If the tree is compact and of good form, cut back the leading branches very lightly, to from about 12 to 18 inches in length, preferably just above a side branch.

In the case of the tree shown in Fig. 3 the only pruning that was necessary was the removing of a few branches and a light cutting back of some of the others. Often, however, a tree will tend to develop a central leader at the expense of the side branches. Such a tree is illustrated in Fig. 4; in (*a*) is shown the tree before pruning, and in (*b*), the same tree after pruning.

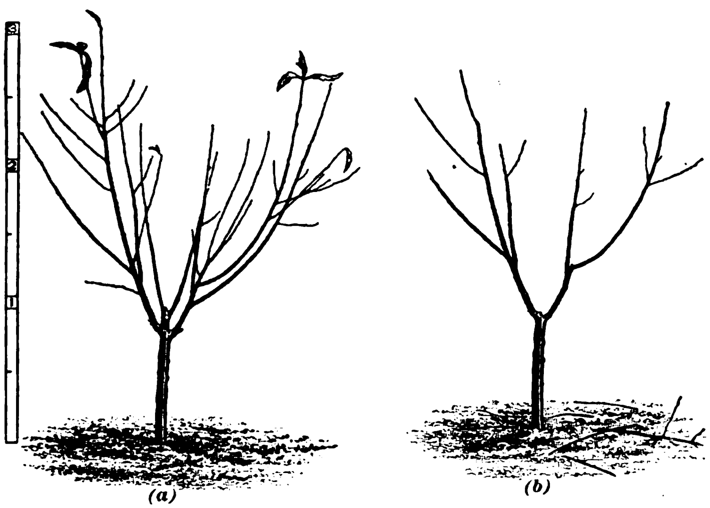
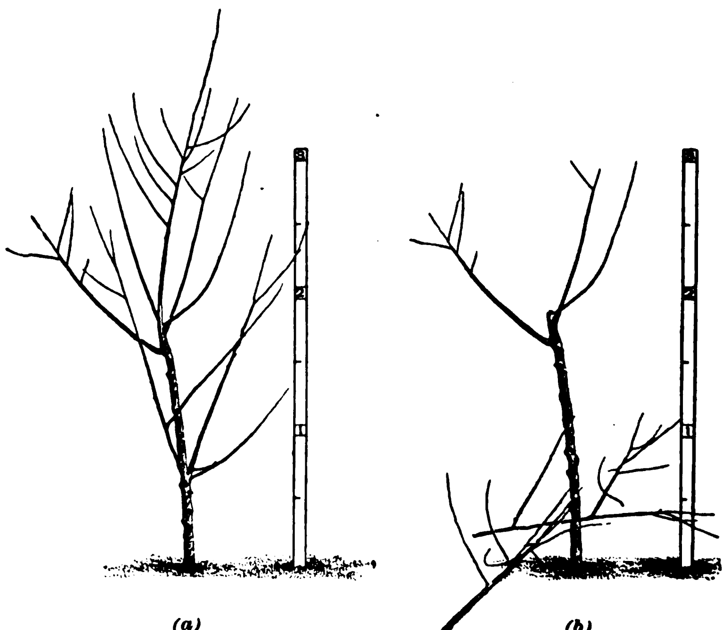


FIG. 3

The pruning consisted of removing the central leader and superfluous branches, thus allowing the side branches to develop to form the head.

29. Pruning of 2-Year-Old Trees.—During the dormant season after the end of the second summer's growth, peach trees should be pruned again. The pruning at this age consists of thinning out secondary branches that, when the trees become larger, would exclude the light, and of cutting back the previous season's growth on the principal branches from one-third to one-half its length. If some of the branches have made an excessive or an irregular growth it may be necessary to cut them back more severely than this in order to maintain a well-balanced top. If two branches occupy much the same space or cross each other, the weaker or more irregular one should be removed.

30. Pruning of Trees After Second Year.—After the second year, when the form of the tree has become established, the pruning should consist of cutting back the annual growth of the leading branches from about one-third to one-half and



(a) *(b)*

FIG. 4

keeping the top well thinned. In the cutting back of any leading branch, it is best to make the cut above or beyond a side branch; if no such branch exists, the cut should be made just above or beyond a bud on the outside of the branch being pruned. Any branches that become broken by snow or ice in winter, or by a load of fruit in summer, should be cut off smoothly where they join other branches; they are then in condition to heal quickly and put out a new growth.

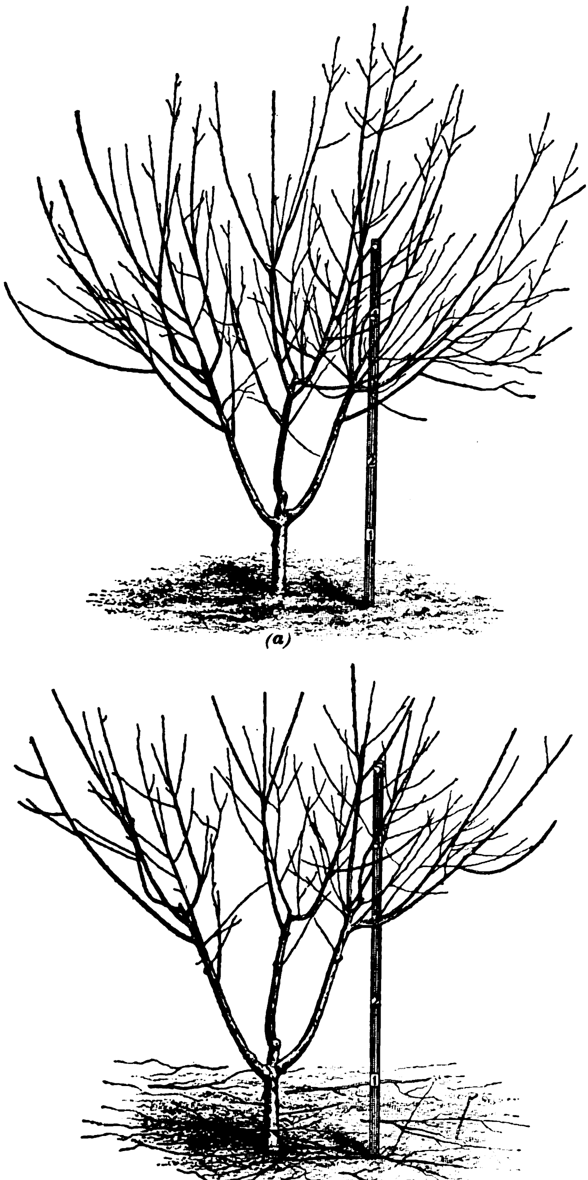


FIG. 5

Fig. 5 illustrates the method of pruning a peach tree after the second year. In (*a*) the tree is shown before it was pruned, and in (*b*) after it was pruned. It will be seen that only a moderate cutting back of the annual growth was necessary. In

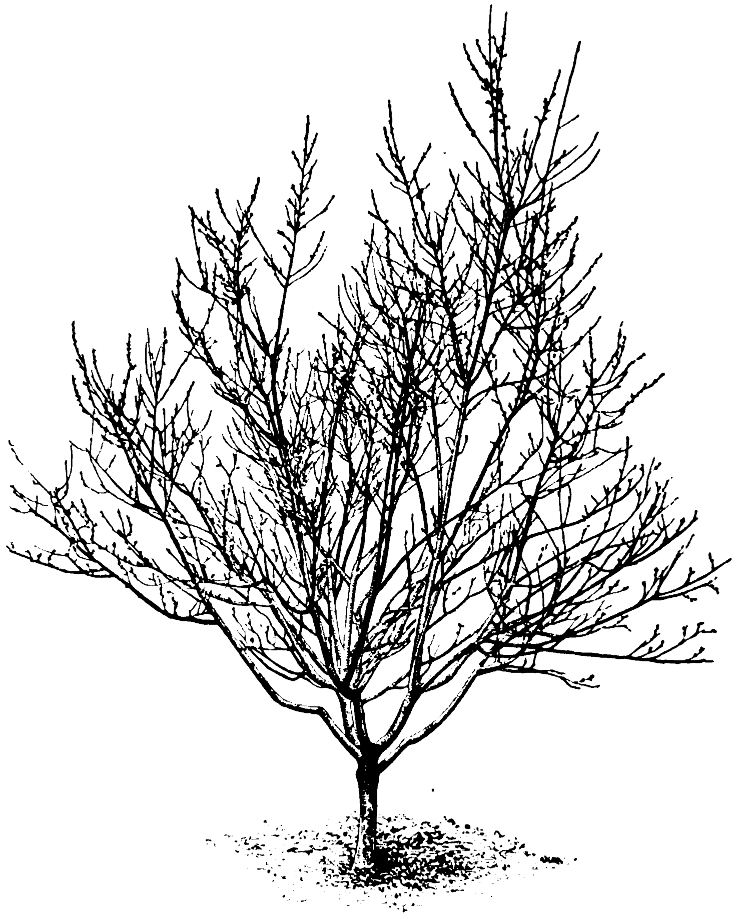


FIG. 6

Fig. 6 is illustrated a tree that has developed an upright habit of growth due to the lack of pruning after the second year. Proper pruning would have remedied this difficulty.

The peach produces its fruit principally on the wood or twig growth of the previous season, although some fruit is produced on spurs and short twigs that develop on portions of branches that are 2 and in some cases even 3 years old. It is evident, therefore, that the annual cutting back of bearing peach trees reduces the bearing surface and may considerably reduce the crop, but the commercial varieties of peaches set such an abundance of fruit buds that some annual cutting back is necessary to retain the vigor of the tree. Unpruned trees frequently produce a somewhat larger crop the first season than trees that have been regularly pruned, but after the first or second crop the pruned trees generally produce the larger crop, as they are likely to be more vigorous and to have a greater annual growth, or actual fruit-bearing surface. Peach trees that are regularly pruned are much longer lived than unpruned trees, and the buds are less likely to be injured in winter. In addition, larger fruit is likely to be produced on pruned trees, as they are more vigorous and thus more food and water are available for each fruit.

31. Pruning of Winter-Injured Trees.—When winter injury to buds or branches occurs, the trees should receive special pruning before growth begins in the spring. If only the fruit buds have been injured, merely the previous season's growth should be cut off, but in cases of severe injury such as when the twigs and branches are affected, it is well to cut back even into 2- or 3-year-old wood. When young trees are winter injured the main branches may be cut back to within a short distance of the trunk; main branches that exceed 2 or 3 inches in diameter, however, do not sprout readily when cut back, and in the case of these the cut should be made farther from the trunk.

32. Pruning in Summer.—Summer pruning of peach trees is of great value in the thinning of dense tops and the training of irregular branches. During the second or third season after planting, young peach trees tend to develop a very dense top. This tendency can best be corrected by proper summer pruning. The peach frequently makes a very rapid,

(a) (b)

FIG 7

vigorous growth the second summer after planting, especially on warm, sandy soils. Some of the trees will be certain to

Fig. 8

make an irregular growth; part of these will develop branches largely on one side; others will make a rapid, upright growth with a poor development of the side branches. Proper summer

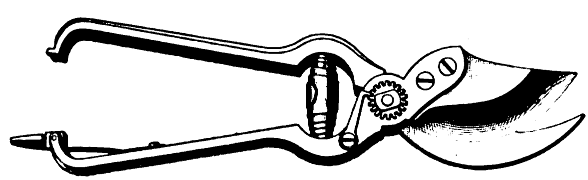


Fig. 9

pruning will tend to correct these irregularities and make the trees more uniform. Pruning for the thinning of dense tops may be done any time during the growing season; pruning for the correction of irregular growth should be done during June or July.

In Fig. 7 is illustrated a peach tree during the second summer's growth that was much improved by summer pruning. In (*a*) the tree is shown before being pruned and in (*b*), after being pruned. The shoots about the base were removed and the tip of the leading branch cut off to encourage a better development of the side branches.

In Fig. 8 is illustrated a young peach tree that shows excessive development on one side. The cutting back of the two main branches *a* and *b* will cause a development of the side branches and thus give the top a better form.

If a tree makes a compact, strong, well-balanced growth during the second and the third season, there is no necessity for summer pruning.

33. Tools for Peach Tree Pruning. The most important tool used in the pruning of peach trees is pruning shears. Shears for peach pruning should be about 8 inches long and preferably of the type shown in Fig. 9. Formerly the pruning knife was much used for pruning peach trees but of late years it has been displaced by shears. The pruning of young trees can be done more readily with a pair of shears than with a knife, and in using a knife the operator is likely to cut branches that are not intended to be removed. If the trees are pruned annually, shears will be the only pruning tool necessary for the first 3 years. After this it is a good plan to make use of a hand pruning hook for cutting back the leading branches. A desirable form of hook pruner is shown in Fig. 10. For peach

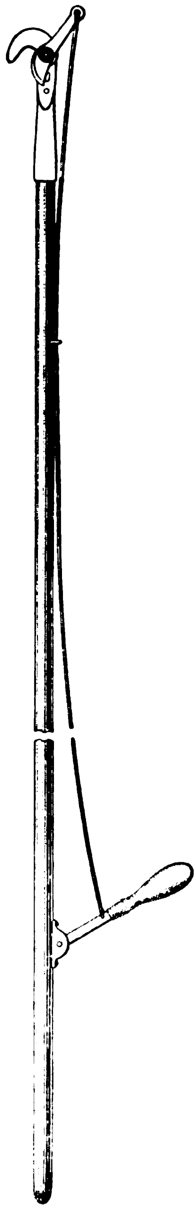


FIG. 10

trees it is desirable to procure a pruner with an 8-foot or a 10-foot handle. In the case of 4- and 5-year-old trees that have been headed low a 6-foot pruner would be more convenient than one of 8 or 10 feet in length but it would be too short for older trees.

When peach trees come into bearing, a pruning saw will be necessary for the removing of superfluous or injured branches. One of the best forms of saws to use for this purpose is the single-edged saw. Double-edged pruning saws are not generally popular, as the upper edge is likely to scratch or cut the bark of parts of the tree that should not be injured.

SPRAYING OF PEACH TREES

34. The spraying of the trees is a detail of peach-orchard management that is of extreme importance. The sprays to use and the time for applying them depend, of course, on the kind of pests to be combated and, to some extent, on the variety of peach to be sprayed. Following is given an outline for the spraying of peach trees in regions where San José scale, peach leaf curl, peach scab, curculio, and brown rot occur. If scab and brown rot are not prevalent in a region, the fourth and the fifth spraying may be omitted. If pests other than those mentioned are found, additional spraying with the material used to combat them will, of course, be necessary.

1. Before the buds open spray with lime-sulphur mixture of a specific gravity of 1.03. This spraying is for the control of San José scale and peach leaf curl.
2. Just after the petals fall from the blossoms spray with arsenate of lead, using from 2 to 3 pounds of the paste to 50 gallons of water. This spraying is for the control of the curculio.
3. When the calyxes are being shed from the fruit spray with self-boiled lime-sulphur and arsenate of lead, using 6 pounds of lime, 6 pounds of sulphur, 50 gallons of water, and 2 pounds of arsenate-of-lead paste. This spraying is for the control of the curculio, scab, and brown rot.
4. Three weeks after the third spraying spray with lime-sulphur, using 6 pounds of lime, 6 pounds of sulphur, and

50 gallons of water. This spraying is for the control of scab and brown rot.

5. Three weeks after the fourth spraying spray, in the case of mid-season and late varieties such as the Elberta, the Fox, the Salway, and the Bilyeu, with self-boiled lime-sulphur made as given in paragraph 4. This spraying is for the control of scab and brown rot.

Peach trees are sprayed with the same kind of implements and devices that are used for apple trees. Peach trees, however, are smaller than standard apple trees and consequently are easier and less expensive to spray. For a small orchard a good barrel-pump outfit will be satisfactory. If the orchard is as large as from 10 to 15 acres, it is advisable to make use of a strong double-action pump mounted on 100- or 150-gallon tank. In large orchards a good gasoline power sprayer is almost a necessity.

FERTILIZING OF BEARING PEACH ORCHARDS

35. Although the peach can be grown successfully on land that is somewhat less fertile than that necessary for the successful production of apples, it is advisable, in most peach-growing sections, to apply to the soil some form of plant-food.

Stable manure is a satisfactory source of plant-food for bearing peach orchards, but in general it is expensive, considering the quantity of plant-food it contains, and the bulk is so great in proportion to the plant-food value that if the manure is brought from any great distance the transportation charges will be excessive. Stable manure can seldom be purchased and applied to land for less than $3 a ton, especially if it is procured from city sources, and as from 8 to 10 tons are required for each acre to secure noticeable results, the expense is likely to be rather excessive. However, stable manure from the farm of the grower or that secured locally at a reasonable price can be used to advantage in peach orchards. If a portion of an orchard is in need of organic matter, stable manure is an especially good material to apply.

Notwithstanding the fact that stable manure is a good fertilizer for peach orchards, most growers are obliged to depend on commercial fertilizer. Either home-mixed or factory-mixed goods may be used, but as soil is often markedly deficient in one or two of the fertilizer ingredients, the use of home-mixed goods is likely to prove the better, for then the grower can mix the fertilizer to meet the needs of his particular soil.

A complete fertilizer is likely to give the best results for peaches. Orchard tests have shown that for this fruit nitrate of soda is the best source of nitrogen, and that acid phosphate is a good material for the supplying of phosphoric acid when immediate results are desired. Ground bone also is commonly used instead of or in addition to other phosphates. It contains phosphoric acid, which becomes available slowly, and generally from 2 to 3 per cent. of nitrogen. If the soil is inclined to be acid, basic slag is a desirable phosphate for peach orchards, as it contains lime as well as phosphoric acid. Either sulphate or muriate of potash may be used as a source of potash.

For average soils that are capable of producing fairly good crops of corn or potatoes, the following kinds and quantities per acre of fertilizer should give good results: From 150 to 200 pounds of nitrate of soda, 200 pounds of sulphate or muriate of potash, 200 pounds of ground bone, and 200 pounds of acid phosphate or basic slag.

If the soil is well supplied with nitrogen and leguminous cover crops are grown in the orchard, the quantity of nitrate of soda may be reduced to 100 pounds per acre or, in some cases, omitted entirely. In case ground bone is high in price or hard to obtain, 400 pounds per acre of acid phosphate or basic slag may be used instead.

All fertilizers should, as a rule, be applied broadcast in early spring and should be plowed or harrowed in by the time growth begins. If, however, the trees show a need of available nitrogen in summer by a lack of growth or by an unthrifty condition of the foliage while carrying a crop of fruit, some nitrate of soda should be applied. The results will show the following season in the formation of more fruit buds and greater vigor in the trees. In seasons of full crops of fruit and in dry seasons more nitrogen is required to keep the trees vigorous than under other conditions.

CULTIVATING OF PEACH ORCHARDS

36. The majority of successful peach growers practice what is known as the clean-culture method of cultivation. Even in the case of very rich soils that are supplied with abundant moisture, this method seems to give better results than any other. The details of the clean-culture method vary slightly with the location and other conditions, but in general it consists of thorough cultivation of the soil from early spring until about midsummer, when a cover crop is sown to be turned under the following spring. The ground should be plowed early in the spring, as soon as weather conditions will allow it, and be cultivated at least once every 10 days until the cover crop is sown. Unless the ground is particularly stony, a disk or cutaway harrow may be used for the first few cultivations after the plowing; on stony ground, a spring-tooth harrow may be used for the early cultivations. Later in the season either a spring-tooth or a spike-tooth harrow may be used for working the soil; if the ground is hard or stony a spring-tooth harrow should be used, but if the ground is mellow and loose a spike-tooth harrow will give the best results.

Peach orchards that are situated on steep slopes will, if cultivated throughout, wash badly and for this reason should be handled somewhat differently than just outlined. In such cases the orchard should be planted in a manner to allow of cultivation across the slope, and a narrow strip of grass should be left along the rows at right angles to the slope. This will prevent much washing. The cultivated area should, of course, be protected by a cover crop during the fall and winter.

The growing of intercrops in a peach orchard is frequently practiced for the first and second seasons after the orchard is planted. Under ordinary conditions, however, a young peach orchard should not be cropped the third season after being planted, for by this time the trees will be large enough to require all of the plant-food and moisture available in the soil.

GROWING OF COVER CROPS IN PEACH ORCHARDS

37. In regularly cultivated peach orchards it is necessary to sow cover crops to prevent washing of the soil and leaching of much of the available fertility. Also, as the cover-crop plants take considerable water from the soil, they hasten the ripening of wood in the fall, which is an advantage, as it causes the twigs to mature and thus lessens the danger of winter injury. Cover crops prevent deep freezing of the soil in winter, and when they decay they add humus to the soil. This latter effect is of much importance, as many soils, especially those that have been cropped for a long time, are in need of additional organic matter.

For New Jersey conditions, cover crops should be planted about August 1. For other conditions the time for planting will vary largely with the climatic conditions. The time will vary also with the varieties of peaches grown. In the case of late varieties that require moisture late in the season for developing the crop, the time for planting the cover crop should be somewhat later than for early or mid-season varieties. The character of the season, too, has an influence on the time for planting the cover crop. If the season is wet and the soil well saturated with water, the cover crop may be planted a few days earlier than in a normal season; if the season is dry, the planting should be delayed for a few days, perhaps a week.

If a cover crop is such that the plants start growth the following season, it should be plowed under in the spring before it has made much growth, otherwise the growing plants will take from the soil a quantity of plant-food and moisture that is needed for the peach trees.

Unless the soil of a peach orchard is exceedingly fertile, leguminous plants should be used for cover crops, as plants of this order add available nitrogen to the soil. Among the legumes used for peach orchards are: Hairy vetch, Crimson clover, cowpeas, and soybeans. Hairy vetch is hardy and is the best legume for northern districts. For the best results, the seed should be sown at the rate of from 35 to 40 pounds per acre; it should not be sown later than August 1. Crimson clover is a good cover crop for regions south of Central New Jersey and Pennsylvania. If sown farther north, it is commonly winter killed. About 15 pounds of seed should be sown per acre. Red clover is often used for a cover crop in sections that are too cold for cowpeas or Crimson clover, as it will withstand a lower winter temperature than these crops. From 8 to 12 pounds of seed are sown per acre, the larger quantity being used when conditions are not the most favorable for germination. Cowpeas make a good cover crop in southern peach districts, but in northern districts they are killed by the first frost. About 1½ to 2 bushels of seed is required per acre. Soybeans, in sections north of New Jersey, will make a somewhat better growth than cowpeas and are not so susceptible to frost killing. About 1 bushel or more of seed is sown per acre.

In the case of peach orchards where the soil is excessively fertile, a non-leguminous cover crop is better than a leguminous crop, because the former adds no nitrogen to the soil. For orchards grown under such a condition, rye, wheat, oats, barley, rape, and buckwheat are frequently sown. For all of these crops except rape from 1½ to 2 bushels per acre of seed is required; for rape from 4 to 6 pounds per acre of seed should be sown. Some of the crops mentioned make an early growth the spring following the planting; these crops should be plowed under early. When non-leguminous plants are used as orchard cover crops, care should be taken to prevent the trees from being injured by mice and rabbits, as the crop, owing to the height of the plants, will afford a good harboring place for these animals.

Often a non-leguminous crop can be combined with a leguminous crop for sowing in peach orchards. Rye at the rate of 1 bushel per acre combined with 25 pounds per acre of Hairy vetch seed is a good mixture for a cover crop. Also, rye at the rate given combined with from 10 to 12 pounds per acre of Crimson clover seed is a mixture that is desirable where the clover is hardy.

THINNING OF PEACHES

38. Proper thinning of peaches is an important orchard operation. If peach trees are allowed to produce excessively a large proportion of the fruit will be small and inferior and there is danger of the trees being injured by the breaking down of branches; in addition, there is a possibility that the trees may become somewhat irregular in bearing. Unfortunately, much less attention is paid to the thinning of peaches than should be the case.

With favorable weather at blooming time, the peach often sets fruit as close as 1 inch apart on all the vigorous 1-year-old twig growth, and unless a large proportion of this fruit drops because of imperfect pollination, insect injury, or other causes, the peaches will be entirely too numerous. In the case of most varieties the fruit should be thinned so that the peaches are not closer than 4 inches on the same side of the branch; commercial varieties that are inclined to bear rather small fruit should be thinned to 6 inches. If the set of fruit is light, two peaches may be allowed to remain near each other if they are on opposite sides of the branch. The Mountain Rose, the Crosby, and the St. John varieties are inclined to produce undersized fruit and consequently require more thinning than varieties like the Elberta, the Reeves, and the Belle, which often produce peaches that are too large to pack well. A peach from 9 to 10 inches in circumference is sufficiently large for all commercial purposes; those that measure, say, 11 inches in circumference are often difficult to market and are seldom profitable to grow unless they can be sold to a special trade.

Although the distance apart of the peaches is the important feature of thinning, imperfect or injured fruit should always be removed. In the case of well-pruned trees, thinning can be done rapidly; the simple bending of a fruit to one side with the fingers will generally cause it to break from the branch.

The thinning of peaches should be done just as the natural thinning, or the dropping, begins; this is from about 50 to 60 days after the time of blooming.

RENOVATION OF NEGLECTED PEACH ORCHARDS

39. Whether or not it will pay to renovate a neglected peach orchard depends altogether on conditions. Many peach orchards never become profitable; some are planted on sod land and then left to care for themselves with the result that they are failures from the beginning; others are cultivated for a few years and then neglected; and still others are cultivated to some extent, but are either starved by a lack of plant-food or are allowed to become the prey of San José scale, borers, and serious fungous diseases. If a grower comes into possession of a neglected orchard he must consider whether the failure was due to some fundamental cause that cannot be set aside or whether it was due to neglect; if he finds that the failure was due to neglect he must consider whether or not it will pay to attempt to renovate the orchard. Most peach-orchard failures are the result of a lack of care.

In considering whether or not it will pay to renovate a neglected orchard, the matter should be viewed from several standpoints, such as the variety or varieties of trees, the age and condition of the trees, and the size, location, and accessibility of the orchard.

The variety or varieties of trees in the orchard is perhaps the most important point to consider. If the orchard consists largely of trees of unsalable varieties it will not pay to attempt to renovate it, even if the trees are in fairly good condition.

The age of the trees is another important point for consideration. The exact age may be difficult to ascertain, but trees from 1 to 4 years old can easily be distinguished from those that are from 10 to 12 years old. However, exact information as to the time the trees were planted is usually procurable in some manner. Peach trees that are from 10 to 12 years of age and in a neglected condition are of little value under average conditions, and it is only in exceptional cases that it will pay to renovate them.

In the case of orchards that are from 1 to 3 years old, if the trees have been entirely neglected from the beginning they are likely to be of little value. Some of the trees are almost sure to be dead, and the others will be so severely checked or injured by scale, borers, and bark beetles that they will be likely to succumb at an early age to attacks of yellows and little peach, if such diseases occur in the locality. In fact, trees that have been planted only 1 or 2 years and have been neglected during that time, will have no advantage over newly planted trees, as the latter will soon overtake them in development.

A young orchard of good varieties that has been well planted and only partly neglected is generally well worth proper care and attention. To distinguish between such an orchard and a badly neglected orchard is not difficult. A prospective purchaser should be cautious about spending much money or labor on a peach orchard that has been badly neglected; it is nearly always best to start a new orchard.

The size, location, and accessibility of an orchard are, obviously, important points to consider in determining whether or not it will pay to renovate the trees. The influence of these factors is so apparent that they need not be discussed.

The value of a neglected peach orchard that is from 4 to 8 years old is not easy to determine. If such an orchard is located in districts where little peach and peach yellows are prevalent it is unsafe to purchase it during the dormant season, unless the purchaser has the assurance of an expert that the orchard was free from these diseases the previous season. In general, neglected orchards from 4 to 8 years of age in such districts contain trees in early or advanced stages of these diseases, and thus their value is not very great. Inexperienced persons have been known to purchase such orchards and at high prices, only to find them almost worthless.

Peach orchards from 4 to 8 years of age that are practically free from yellows and little peach and that are not in a badly neglected condition can, however, often be profitably renovated. The directions for the work are as follows: Prune the trees thoroughly, cutting out all the dead branches, and if the trees are in a weak condition or have made but little growth, cut back all the live branches severely. Spray the trees before the buds open with lime-sulphur spray to destroy scale and to prevent attacks of peach-leaf curl. Plow the orchard as early in the spring as soil conditions will permit, and keep it well cultivated until midsummer; in midsummer sow a cover crop. Apply fertilizers annually as directed for the fertilization of bearing orchards.

Under average conditions, a neglected peach orchard is less likely to pay for renovation than a neglected apple orchard, and for this reason great caution should be exercised in purchasing a peach orchard for renovation.

HARVESTING AND MARKETING OF PEACHES

HARVESTING

PICKING

40. Stage of Maturity for Picking of Peaches.—The peach is one of the most perishable of fruits, consequently the picking and handling of a crop for market requires close attention. An important detail of the work is to pick the fruit at just the right stage of ripeness. White-fleshed peaches are green in color when immature, but as the ripening stage approaches the green turns to greenish-white with perhaps a yellowish tint. Yellow-fleshed peaches are a yellowish-green when immature, but when the ripening begins they gradually change to an orange yellow. An immature peach is hard and not easily bruised by pressure; a ripe peach is soft and will remain flattened when pressed; one just beginning to ripen is somewhat elastic, or springy, when pressed in the palm of the hand.

For a local market, peaches may be allowed to remain on the trees until they are almost fully ripe. A peach picked green may improve somewhat in color as it ripens in the basket, but it will not compare in flavor with fruit that has ripened on the tree. Peaches that are to be shipped short distances by rail should be picked at a stage when about 1 or 2 days more would have been sufficient to bring them to the softening stage. The fruit of such varieties as Elberta, Belle, and Hiley, can, because of their firm flesh, be allowed to become more fully ripe before picking than fruit of tender-fleshed varieties like Greensboro, Early Crawford, and Mountain Rose. If the fruit is to be shipped to a distant market, great care should be exercised in picking it at the right time. In New York and other cities carloads of peaches are sometimes condemned and destroyed by Board of Health inspectors because the fruit is too green and therefore unfit for food. In such cases not only the fruit itself is a loss to the grower but he is compelled to pay the freight, which will amount to considerable if the shipment was made from a distant point. If overripe fruit is mixed with firm fruit the results also will be disastrous for the grower if the shipment is made by rail. Every package of peaches, therefore, should contain nothing but fully developed yet firm fruit.

41. Picking Appliances.—If peach trees have been pruned and trained low, most of the fruit can be picked by the pickers standing on the ground, but if the trees have been allowed to grow tall, a step ladder will be necessary for the picking. A three-legged step ladder, forms of which have been illustrated and described in a previous Section, is better, especially on rough land, than the common four-legged step ladder, as it is more stable on the ground.

Peaches should always be picked in a strong basket with wide, smooth, wooden staves, as such a basket is less likely to bruise the fruit while it is being carried from the tree to the packing house than a cheap, flimsy basket. Often the regular market package of the locality is used as a picking basket. In the Ontario peach-growing district, the large Climax basket is commonly used; in the Michigan district, the bushel basket is popular; and in the New Jersey-Delaware-Maryland district the Delaware basket is the one most commonly used. Many progressive growers now use the round half-bushel basket with a swing handle; this basket has already been illustrated and described in a previous Section.

42. Method of Picking.—Each peach should be carefully picked from the tree by hand and should not be pinched with the fingers. If each fruit is tipped sidewise and twisted slightly as it is removed from the branch, it can be released much easier and with less danger of its being bruised than if the picker attempts to pull it directly from the branch. Each peach as it is picked should be placed quickly but carefully into the picking receptacle; under no circumstances should the fruit be thrown into the basket. Picking is often carried to extremes by inexperienced persons; either much time is wasted by a too cautious handling of the fruit or it is handled too roughly by being dropped or thrown into the receptacle.

43. Management of Pickers.—For harvesting a peach crop, pickers are usually employed by the day. As a rule a foreman is placed in charge of the work and it is his business to see that the pickers do a certain amount of work and do not injure the fruit on the trees. Individual pickers are sometimes assigned to certain rows so that the foreman can determine the amount and the character of the work done by each. Contracts are sometimes made for the picking of peaches at a given price per basket, but in most cases this plan has been found to be detrimental to the trees and the fruit.

A good system for the managing of pickers is the ticket system. Each picker, as he begins work for the day, is provided with a bunch of tickets, each ticket bearing the same number. A picker places a ticket in each basket of fruit that he picks. At the packing house these tickets are collected and payment made accordingly.

GRADING AND PACKING

44. Importance of Proper Grading and Packing. Experience proves that it pays to grade and pack peaches carefully. Bruised or partly decayed peaches should never be packed in the same basket with sound fruit and small or unsightly peaches should be separated from those of desirable size and appearance. If peaches are to be sold on a local market they need not be packed firmly but they should be arranged in an attractive manner. The top layer of each package should be placed with the most attractive side uppermost, and if the fruit is likely to stand in the market place it is a good plan to cover the packages with red or pink cheesecloth, as this will add to the appearance and besides will keep out flies and wasps. If peaches are to be sold on a distant market even greater care should be exercised in the grading and packing than if they are to be sold locally, for they must withstand transportation and be in competition with other shipments.

45. Peach Packages.—A number of different kinds of packages are used for peaches. In Virginia, the Carolinas, Georgia, and other Southern States peaches are shipped almost

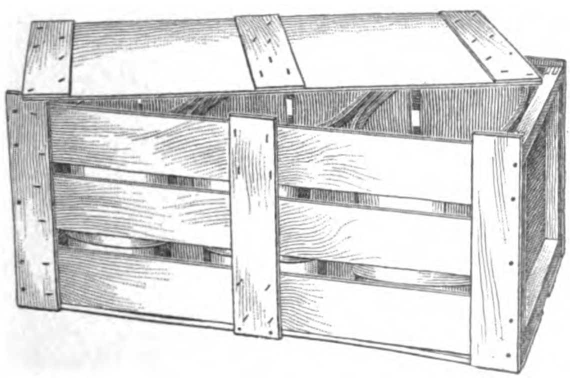


Fig. 11

exclusively in what is known as the Georgia carrier, which is illustrated in Fig. 11. A Georgia carrier is 24 in. × $11\frac{1}{2}$ in. × $10\frac{1}{2}$ in., outside measurements. In each carrier there are six small baskets, known as till baskets, which are arranged in two layers and separated by a thin wooden slat. A carrier will hold about 40 pounds of fruit. When the baskets are empty the carrier weighs about 10 pounds. The material for the carriers is generally purchased sawed to the right dimensions and is put together at the orchard.

The Georgia carrier is a good long-distance shipping package, and also is a popular package on the market, as a prospective purchaser can see all of the fruit in the baskets without much disturbing of the pack. Another advantage is that the cover cannot easily be removed without the aid of a hatchet or some such tool; consequently the fruit, when in transit, is not subject to the ravages of petty thieves.

Peaches from the Pacific coast are shipped in shallow boxes like the one illustrated in Fig. 12. These boxes are 18½ inches long, 11½ inches wide, and 2½, 3, 3½, 4, 4½, 5, or 5½ inches deep, inside measurements. The depth of box used is determined by the size of the peaches. The ends are made of either ⅝-inch or ¾-inch material; the sides, top, and bottom are of ¼-inch material. The boxes are usually made at the orchard. Some of the advantages of this form of package are that the peaches are not likely to be bruised in shipping, the boxes are convenient size for handling, they pack well in cars, and they are not easily broken. A box will hold from about 20 to 25 pounds of fruit.

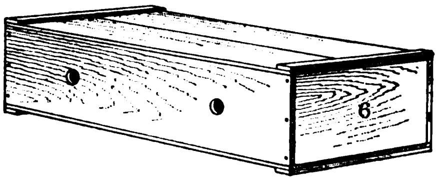


FIG. 12

Formerly, most of the fruit from the eastern peach-growing sections was marketed in the so-called Delaware basket, one of which is illustrated in Fig. 13, but in recent years the Georgia carrier has come into extensive use for long-distance shipment. A full-sized Delaware basket will hold 16 quarts of peaches, and when full weighs about 25 pounds. In New York State, modified forms of the Delaware basket are used to some extent. They are similar in construction and of nearly the same shape as the genuine Delaware basket, but are somewhat smaller in size. One size holds 10 quarts of peaches and another holds 14 quarts. The 10-quart baskets are usually shipped in pairs and are known as twins. The Delaware basket is a poor carrier for long-distance

FIG. 13

shipments, as it is easily tipped over, the sides are so thin that they are easily broken and the covers can be easily removed by thieves.

The bulk of the crop from the Ohio and Michigan peach-growing sections is marketed in bushel baskets like that illustrated in Fig. 14. This form of package is not popular in most markets, as there is such a large quantity of fruit in one basket that much of it may become bruised in transit.

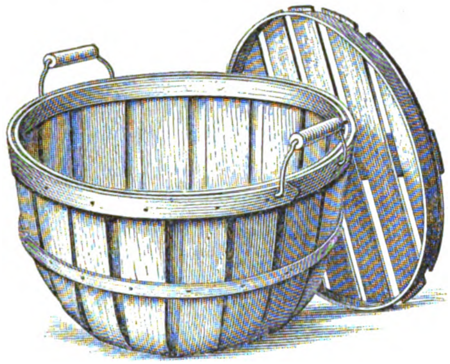


FIG. 14

The Climax basket, one of which is shown in Fig. 15, is used almost exclusively in Ontario and to some extent in Michigan. For local use these baskets do fairly well, but for long-distance shipments they are not very satisfactory, as they can easily be

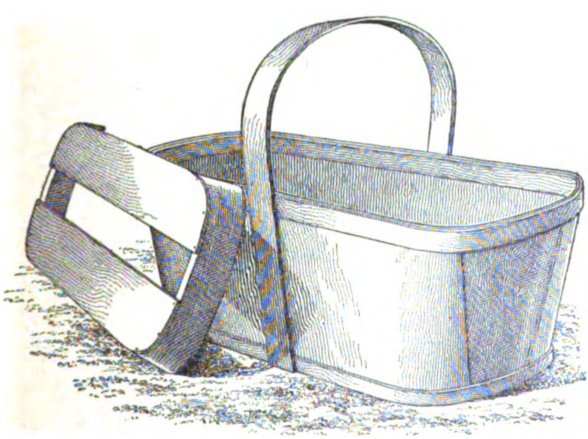


FIG. 15

opened by thieves and the fruit is more likely to be bruised than if packed in Georgia carriers or in boxes.

46. Peach Packs.—When Delaware baskets are used for the commercial packing of peaches, attempts are seldom made to place the fruit in the baskets in a regular arrangement. It is well, however, to sort the peaches according to size, and to face the top layer of each package with the most attractive side of the peaches uppermost.

If the bushel basket is used as the commercial package, no regular arrangement of the fruit in the body of the package is made, but the top is faced as in the case of Delaware baskets. Fig. 16 shows a faced bushel basket of peaches.

When Climax baskets are used as commercial peach packages, a system of packing is adopted that accords with the size of the fruit. If the peaches are small three are placed side by side across the basket, as shown in Fig. 17 (*a*), enough layers being used to fill the basket. If the fruit is too large to be arranged in three tiers, two tiers are placed along one side to make the first layer, as shown in (*b*); the second double row is placed along the opposite side of the basket, as shown in (*c*); the layers are thus alternated until the basket is full. At the top of the illustration is shown a basket filled with peaches that are arranged in three tiers.

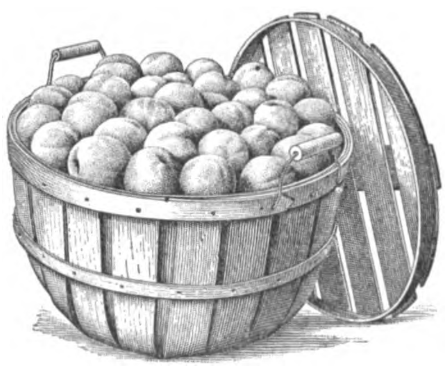
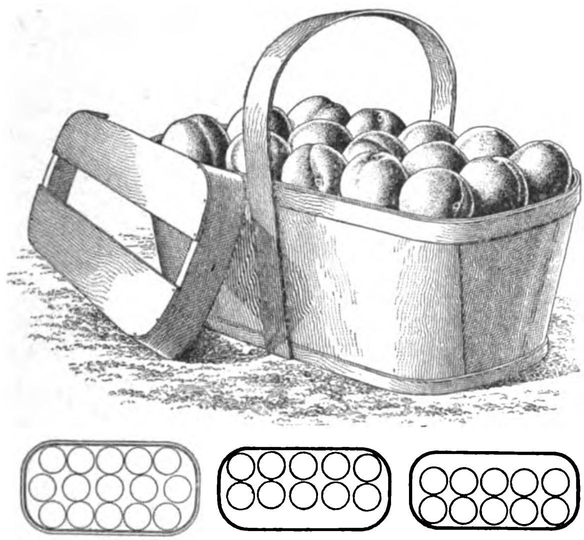


FIG. 16

47. The form of pack used in the Georgia carrier varies according to the size and shape of the fruit. In the case of small peaches a 2-2 pack is best. To make this pack, a peach is placed in one of the lower corners of the till and another midway across the end; this constitutes the first cross-row. Succeeding cross-rows are alternated until the layer is complete. The second layer is placed in the same manner as the first, except that the peaches are placed over the spaces between those of the bottom layer. The third layer is packed like the first. For most peaches three layers will be sufficient to fill the basket. Fruit of medium to large size requires a 3-tier, 2-1 pack. This is illustrated in Fig. 18. Each layer in this pack is made alike, the second being placed directly over the first and the third directly over the second.

Fruit, to be suitable for rapid packing in carriers, should be uniform in size; consequently, it is necessary that it be carefully



(a) (b) (c)

FIG. 17

graded. The packing must, of course, be done by hand. Packing tables that are well padded to avoid bruising of the fruit are needed; and the fruit should be spread out on these tables so that each peach can be quickly seen. This enables packers to work rapidly. A form of pack should be used that will bring the top layer of fruit in each till about $\frac{3}{4}$ inch above the top, otherwise the crate will be slack and the peaches will shake out of place and become bruised in transit. When the cover is nailed on the crate it should have a bulge of about $\frac{1}{2}$ inch; this can be secured by having the center till slightly higher than the end tills.

When the peaches are uniform and of good size, a rapid packer can pack from 175 to 250 crates a day. An ordinary

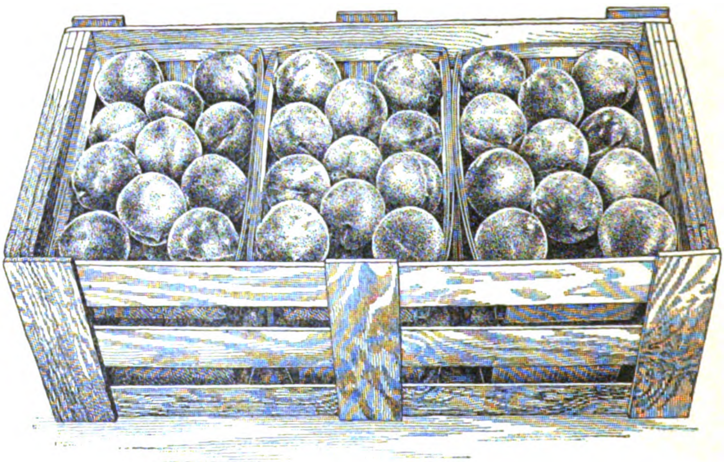
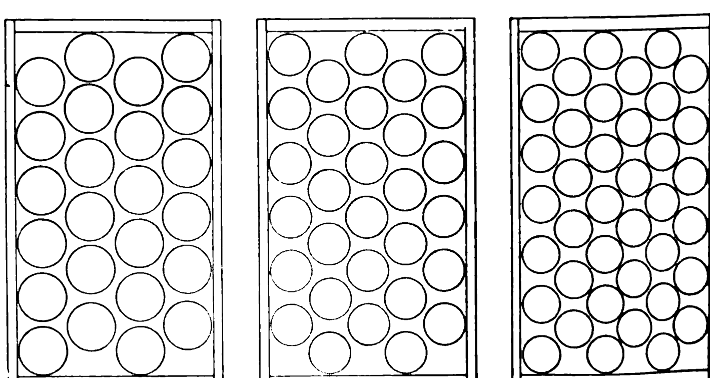


FIG. 18

workman should be able to pack from 125 to 150 crates a day. In both cases, however, in order to pack the number of crates just given, a packer must be kept supplied with peaches and

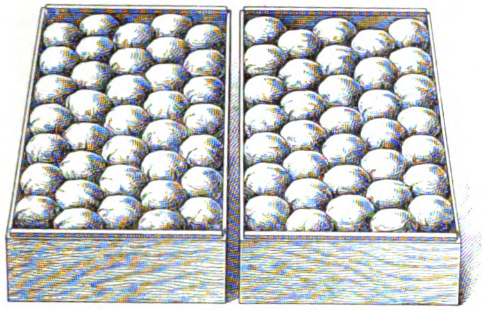


(a) (b) (c)

FIG. 19

crates and have a convenient packing table. Peaches of varieties such as the Elberta can be packed much more rapidly than those of varieties like the Greensboro and Champion, as they are more uniform in size and maturity.

48. The packing of peaches in the flat Pacific-coast boxes is much the same as the packing of apples in bushel boxes. The peaches are carefully graded to size, wrapped in paper, and arranged in layers. Generally they are arranged in two layers, but in the case of very small peaches three layers are sometimes



(a)

(b)

FIG. 20

necessary to fill a box; as a rule, however, it does not pay to pack extremely small peaches in boxes. As explained previously, the boxes are of various depths; the height of box to use will, of course, depend on the size of the peaches to be packed. A convenient packing table is necessary, and the sheets of paper, which are usually 7 in. × 7 in. or 8 in. × 8 in. in size, should be placed where they are convenient to the packer.

As a rule, the diagonal style of pack is employed, the peaches being arranged in the so-called 2-2, 2-3, or 3-3 packs, which are illustrated, respectively, in Fig. 19 (*a*), (*b*), and (*c*), which show the arrangement of the peaches in the first layer. In each form of pack the second layer is arranged so that the peaches do not come directly over those in the first layer. Fig. 20 illustrates the appearance of boxes of peaches after being packed; in (*a*) is shown a 2-3 pack and in (*b*) a 2-2 pack.

49. The number of peaches in the rows that run lengthwise of a box, or the tiers as they are commonly called, will vary, of course, with the size of the fruit and the method of packing. The number of peaches in a box will vary with the style of pack and the number of peaches in the rows. In Table I is given data concerning the commonly used box packs.

TABLE I

DATA CONCERNING BOX PACKS

Packs	Number of Peaches in Tiers	Number of Peaches in Box
3-3	9-8	102
3-3	8-8	96
3-3	8-7	90
3-3	7-7	84
3-3	7-6	78
3-3	6-6	72
2-3	7-7	70
2-3	7-6	65
2-3	6-6	60
2-3	6-5	55
2-3	5-5	50
2-2	5-5	40
2-2	5-6	44
2-2	6-6	48
2-2	6-7	52
2-2	7-7	56


EXTRA SELECTED STOCK,
FROM THE
J. H. HALE
Orchards at
South Glastonbury, Conn.
No. 1 SELECTED STOCK,
FROM THE
J. H. HALE
Orchards at
South Glastonbury, Conn.
Superior Quality · Fully Guaranteed
HALE'S FRUITS
ALWAYS BEST IN MARKET
Scientifically Grown · Ripened on the Tree
BEST PLANTS AND TREES CATALOGUE FREE
LARGEST PEACH GROWERS IN THE WORLD
325,000 Trees
HALE GEORGIA ORCHARD CO.
FORT VALLEY, GA.
J.H.HALE, SOUTH GLASTONBURY CONN.
PACKED BY
No.
SAME ALL THROUGH "U.C.TOP-U.C.ALL"

FIG. 21


New Jersey Peaches

FIG. 22

The peaches should be pressed into the box firmly so that each layer is snug and the sides are slightly bulged. The cover should press firmly on the top layer so that each peach in the box will be held in position.

50. Labeling of Peach Packages.—A comparatively recent practice among growers of peaches is to place an attractive label on each package of fruit. This practice is to be highly commended, as a label not only adds to the attractiveness of a package but is a means of advertising the product of individual growers. However, it pays to label only uniform, high-grade, well-sorted, and carefully packed fruit; there is little to be gained by labeling inferior fruit. Some peach growers have their labels registered in the United States Patent Office. This gives them exclusive use of the label. In Fig. 21 are shown forms of labels. The two small labels at the top are used as supplementary labels to specify the grade of fruit in a particular package. These labels are red and white, and are very attractive. Another form of label is shown in Fig. 22.

MARKETING

51. Methods of Selling.—The selling of peaches differs somewhat from the selling of apples and pears. Peaches are so perishable that they must be sold soon after reaching the market. In view of this fact, there is alway the possibility of overstocking the market at receiving centers. Individual growers and associations can do much toward obviating this difficulty. They can, by means of telegraphic reports, learn of the supply at the different central markets and avoid sending a surplus to any one market.

The selling of peaches on a local market is much simpler than selling on a large central market. In selling on a local market, a grower generally sells direct to the consumer or to grocers. He should watch his market, however, and avoid, if possible, the placing of fruit on sale when the supply is large.

Fruit dealers at the large markets often have buyers located at central shipping points, and growers can often dispose of their shipments advantageously to these buyers. There is always a likelihood, however, that the several buyers that are at a shipping point will agree to offer a certain uniform price for each load of peaches offered to them. By such an agreement they can keep the price low. But if competition among the buyers can be brought about, the prices offered are likely to be satisfactory.

Growers shipping to a market center must, as a rule, depend on commission merchants. It is always well to ascertain the standing of a commission man before consigning fruit to him. In order to learn which dealers give the best prices, it is a good plan to divide a shipment occasionally, sending a part of it to one dealer and a part to another, and then check the returns. Some commission men who handle peaches make a specialty of selling first-class fruit; others specialize in medium or low-grade fruit. In view of this condition, growers will find it to their advantage to ship their first-class fruit to merchants who deal in this class, and their medium or poor quality fruit to dealers who specialize in these classes.

A grower's reputation for honest and uniform packing is an important asset in the selling of peaches. When a commission dealer receives a consignment of fruit from such a grower he is not obliged to open every package to determine its quality, and he can safely recommend and sell such fruit to exacting customers, often at prices somewhat above the market.

In order to avoid losses, a grower should keep daily accounts of the number of crates, boxes, or baskets of fruit shipped, the grade and number sent to the different dealers, and the returns received from each consignment.

52. Precooling of Peaches.—Peaches, when picked, are often at a temperature of from 80° to 90° F. If they are packed in a warm car at this temperature they will remain warm throughout the time they are in transit, the ripening process will continue, and as a result, especially if shipped for a long distance, they will reach the market in a soft or wilted condition. Formerly, many long-distance shipments were made in box cars and returns were very often unsatisfactory. The next step in advance was the shipping of fruit in refrigerator cars. However, if peaches are packed in a refrigerator car at the picking temperature, there is a likelihood of some of the packages spoiling, as from 1 to 2 days are required for a car of fruit to cool thoroughly, even if the car is properly iced. The loss of peaches in refrigerator cars sometimes is as high as 35 per cent. It should be stated, however, that little loss will occur if the packages are not stacked too high in the car and the car is properly iced in transit.

Experience proves that much loss of peaches in transit can be avoided if the fruit is cooled to about 40° F. before it is shipped. This process is known as the precooling of peaches. One method employed by transportation companies is to provide large cooling rooms at central shipping stations where the loaded cars can be placed until the fruit is cool. Disadvantages of this method are that the fruit must be assembled at only a few points along a transportation line, and that considerable time is necessary for the precooling. Another method of precooling is to force cold air through cars loaded with peaches until the fruit is sufficiently cooled for shipment. This method seems to be as promising as any thus far devised.

53. Cold Storage of Peaches.—If peaches are picked just before the softening stage is reached and are placed in storage immediately at a temperature of about 32° to 34° F. they may be held in an edible condition for several weeks. Unless the peaches are being held for exhibition purposes, a temperature lower than this should not be employed, as otherwise the fruit will lose its texture and flavor. Peaches in storage should be placed in rooms by themselves, as they readily absorb odors from such materials as vegetables and meats. In addition, they are likely to absorb odors of pine wood and in a short time may become inedible.

Although it is possible to keep peaches in storage, it is only occasionally that it is of commercial advantage to do so, because fresh fruit is sent to the market continually during the peach season, and besides, there is the likelihood of the fruit losing its flavor or absorbing undesirable odors.

PLUM CULTURE

SPECIES AND IMPORTANT VARIETIES OF PLUMS

IMPORTANCE OF PLUM GROWING

1. At the close of the 19th century the plum ranked third in commercial value among orchard fruits grown in America; it was outranked only by the apple and the peach. A remarkable gain was made during the decade ending with 1899, both in the number of trees planted and in the yield of fruit, the actual gains in the United States being 334.9 per cent. in the number of trees and 304.1 per cent. in the yield of fruit. These great increases were due to the extensive planting of prunes on the Pacific coast and to the planting of native and Japanese plums throughout the country. The extension of the industry was less during the years 1900 to 1910, due to low prices for the dried fruit on the Pacific coast and in the East to the lack of organization for distribution and to disappointment in regard to the quality of the fruit of the Japanese plum trees that came into bearing.

Plum growing is largely confined to ten states, namely, California, Oregon, Washington, Idaho, New York, Michigan, Ohio, Iowa, Texas, and Arkansas. These states produced 82 per cent. of the plum crop of the United States in 1899; four of these states, California, Oregon, Washington, and Idaho grow prunes largely; Iowa, Texas, and Arkansas, produce the native and Japanese varieties; New York, Michigan, and Ohio grow most of the domestica plums that are sold fresh. A large part of the plums produced in the western part of the United States are grown for the purpose of drying, although at the present time large shipments of fresh plums are made from the Western to the Eastern States, and, due to the improved refrigerator service, the precooling of fruit, and the excellent methods of picking and packing in vogue in the West, these shipments are more liable to increase than to diminish, unless the eastern growers develop a better quality of fruit than they have yet supplied. The eastern growers are at present not well organized; in fact, they are practically unorganized, and their shipping facilities 50 miles from market are no better than those from the West 3,000 miles away, since it costs practically the same to ship in small quantities 50 miles by express that it does to ship 3,000 miles by the carload. Because of cooperation among the growers of the West, they are able to secure reasonable freight rates and frequently their fruit arrives at its eastern destination in much better condition under refrigeration than small shipments sent 50 miles by express.

Owing to western competition, plum growing in the Eastern States has not been actively pushed in the past; in fact, it has been neglected, and in many cases orchards have been pulled out; however, the time is now ripe for increased attention to the plum crop and for a study of varieties having high quality and good shipping characters.

CLASSIFICATION OF PLUMS

2. The plums grown in the United States may be classified into four groups: (1) The *European group*, which consists of plums introduced into America from Europe; (2) the *native group*; (3) the *Japanese group*, which consists of plums introduced into America from Japan; and (4) the *hybrid group*.

3. European Group.—Of the European group of plums only two species, the *Prunus domestica* and the *Prunus insititia*, are of sufficient importance to the grower to be worthy of consideration.

FIG. 1

4. The **Prunus domestica** is a species that is probably indigenous to the Caucasus Mountains and the vicinity of the Caspian Sea, and some of the varieties produce fruit of the highest quality. The species was introduced into Europe by the Huns, Turks, Mongols, and Tartars, with whom the dried fruit, or prune, was a staple. The trees of the domestica species are comparatively weak in constitution, need an equable climate, and cannot endure extremes of heat and cold, wet and dry, and also suffer extensively from parasitic insects and diseases.

The area of America in which the varieties of the domestica are successfully grown is limited, consisting of small areas in Nova Scotia, Quebec, and Central New England, and a comparatively large area in Western New York. In Southern New York few domestica plums are grown. They are grown in small areas in Southern Ontario and Michigan; from this westward, domestica are not found until the irrigated valleys of the Rocky Mountains and the Great Basin are reached. They are most extensively grown in the parts of California along the Pacific coast.

The habit of growth of the domestica species is illustrated in Fig. 1, which shows a tree of the German Prune variety.

5. The **Prunus insititia** is a species of plum found growing wild in nearly all temperate parts of Europe and in Western Asia. The original habitat is supposed to have been Southern Europe and the adjoining parts of Asia. By some botanists the insititia is considered to be a variety of the domestica, but by the majority of botanists it is considered to be a distinct species.

The trees of the insititia are readily distinguished from those of the domestica, being smaller and having more ovate leaves. The fruit is smaller, more nearly round, more uniform in shape, and with a less distinct suture than the fruit of the domestica. The color of the fruit is usually either purple or yellow with no intermediate colors. The fruit is much less variable than that of the domestica. All varieties of this species are hardy, thrifty, and productive, and grow with much less care than is required by the domestica. The insititia grow readily from suckers and also come true to seed.

6. Native Group.—The native plums of North America were early brought under cultivation and developed, and today they constitute one of the most important of the four groups of plums. The cultivation of the native American plums has developed many distinctly diverse types, and for this reason the native plums have been classified into a large number of species. Only four of these species, however, are of sufficient importance to warrant discussion here. These are *Prunus Americana*, *Prunus hortulana*, *Prunus nigra*, and *Prunus munsoniana*.

7. The **Prunus Americana** is the predominant native plum, and is found from Maine to Florida and from Mexico to Canada. Plums of the Americana species grow wild in nearly all parts of the country, and are hardy in the Mississippi Valley, where the European plums will not survive, but thus far under cultivation there has been comparatively little improvement in the plums of the species. The trees are sometimes found growing in swamps that may be submerged for part of the year; they prefer moist land, although they are sometimes found on comparatively dry upland, and they seem to prefer soils containing considerable lime. The plant is, generally speaking, a bush with a thick, thorny top; it attains a height of 15 or 18 feet, and occasionally a height of 30 feet. The fruit of the cultivated varieties is yellowish or reddish in color, is clingstone, and varies in size from that of the Damson variety to that of the Green Gage variety. The flavor is usually pleasant and is best when the fruit is fully ripe. The skin of plums of the species is somewhat astringent, but if this is removed the flavor of the fruit is hardly surpassed by that of a plum of any other species.

8. The **Prunus hortulana** is a species of native plum of which there are a number of valuable varieties that are adapted to a wide range of climate. These plums are well adapted to the Southern States and to the Mississippi Valley.

The hortulana plums are suitable for preserves, for spicing, and for jelly, but are too acid and the flesh clings too tenaciously to the stone to make them desirable for dessert or for ordinary culinary purposes. The flesh is firm, the skin tough, and they ship and keep well. They are the latest of the native plums to ripen, consequently they extend the plum season materially. Certain varieties make good stock on which to graft varieties of the same and other native species.

9. The **Prunus nigra** is the native plum of Canada and is often called the *Canada plum*. The plums of this species grow further north than those of any other American species, being found as far north as Newfoundland and the Strait of Mackinac. They are common in New York and New England and have been reported as growing in the Appalachian Mountains as far south as Northern Georgia. The varieties of Prunus nigra are important because they endure more cold than the varieties of the Americana, and as the trees of the species have tough wood they are more able to withstand the weight of snow and the stress of winds in northern regions than are the trees of other species. As the plums ripen early they may be grown with more certainty than other plums in regions where the season is short. The fruit is more oblong in shape, darker in color, has less bloom and a thinner skin than that of the Americana.

10. The **Prunus munsoniana** is the most important species of native plum in the southern part of the United States, and some varieties are hardy as far north as Geneva, New York. The fruit of this species is of particular value for dessert and culinary use; it is attractive in appearance, is bright colored, and has a thin skin. This species of plum forms dense thickets in its native habitat. When budded and grown in orchards, the tree attains a height of 25 feet or more.

11. Japanese Group.—The plums of the Japanese group, which were introduced into America less than 50 years ago, belong to the species known as **Prunus triflora.** China is supposed to be the native home of the plums of this species, although they have been grown in Japan for many years. They show a very wide range of adaptability; they are vigorous and productive, come into bearing early, and are comparatively free from diseases. The fruit is generally large, handsome, and moderately good in flavor, but inferior to that

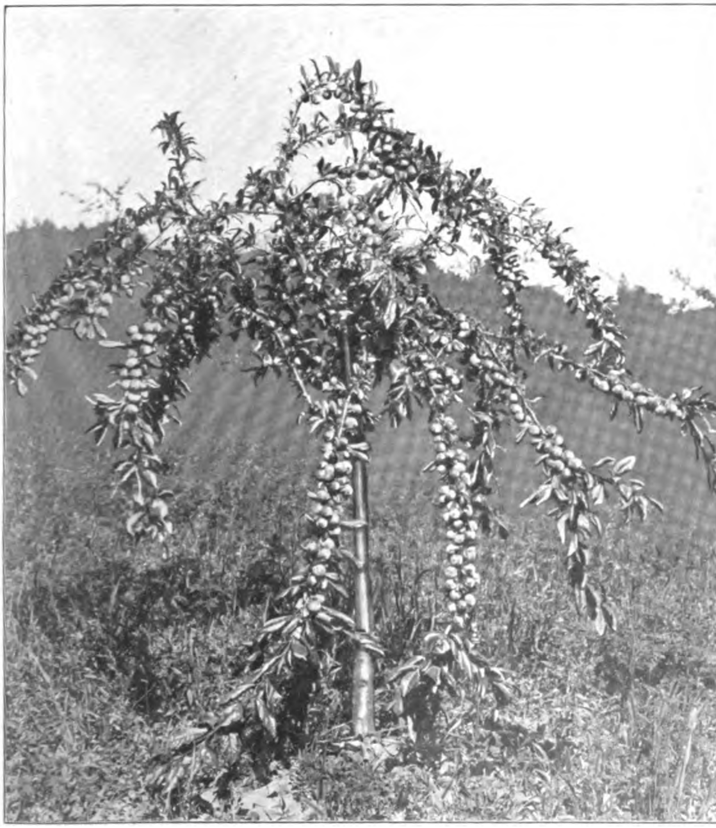


FIG. 2

of the domestica species. The triflora plums are grown both in the Southern States and in the Northern States; they are closely related to the native American plums, but are larger and better in flavor. They have shown a marked tendency to vary when grown under different conditions.

The habit of growth of trees of the triflora species is illustrated in Fig. 2, which shows a tree of the Burbank variety. The fruit on this tree should have been thinned.

12. **Hybrid Group.**—The hybrid group of plums consists of a large number of varieties that have been produced by crossing plums of one species with those of another. The number of new species is being constantly increased through crossing, and many of the hybrids thus produced have proved to be of excellent quality.

IMPORTANT VARIETIES OF PLUMS

13. Some of the important varieties of plums grown in America are named and briefly described in the following list:

14. The **Abundance,** or *Botan,* plum is a variety of the triflora species that has been much overplanted in America. There are several distinct strains of the variety grown, but the fruit of all strains is subject to brown rot and drops so readily that it must be picked before it is ripe. The color is pinkish red to dark red.

15. One of the best varieties of plums grown in America for the production of prunes is the **Agen,** which belongs to the domestica species. There are many strains of this variety, all of which are excellent for home orchard or for commercial purposes. The trees of the variety bear regularly and heavily. The fruit hangs well on the tree, is rich in sugar and solids, and is very good for preserving. The defect of the fruit is lack of size.

16. The name **Apple** is applied to a hybrid variety of plums. The trees of this variety are robust growers. The fruit is large and has firm, compact, red flesh. It has excellent keeping qualities, but is of a peculiar flavor, which makes it inferior for dessert or culinary use.

17. The **Archduke** is a well-known variety of the domestica species. The trees of this variety are medium growers.

The fruit is a rich, dark-purple color. It keeps and ships well and is suitable for both home and market use. Fruit of this variety is illustrated in Fig. 3.

18. The **Arctic** is a variety of the domestica species. The trees of this variety are small but hardy and productive. The fruit is blue in color and medium in size. It ripens about mid-season.

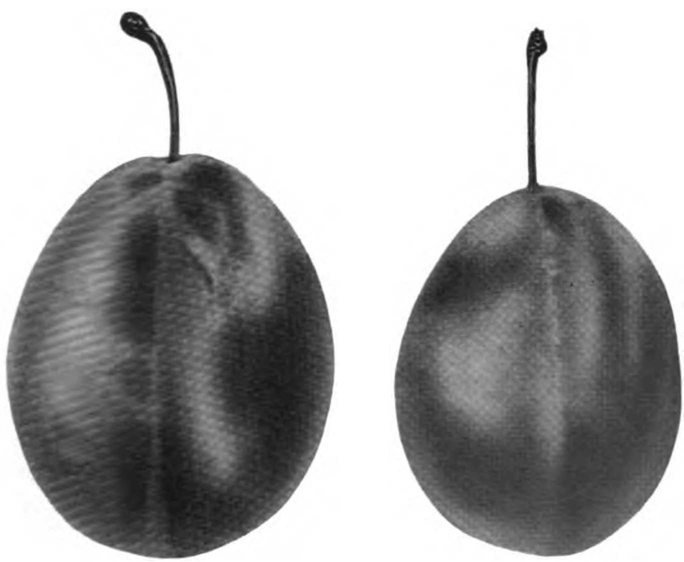


FIG. 3

19. One of the best of the plums is the **Bavay**, which is a variety of the domestica species. This variety has been developed from the Green Gage variety, which will be described later. The trees of this variety are of medium size and are vigorous growers. The fruit ripens late and keeps well. It is excellent for dessert and is also good for canning. It is good in flavor, although in this respect it is not quite equal to the Green Gage.

20. The **Bradshaw** is a variety of the domestica species. The trees of this variety are hardy, productive, and regular bearers. The fruit ripens in the peach season, which is a fault of the variety, because at this time there is not the demand for plums that there is at other seasons. However, the fruit is moderate in flavor and ships well.

21. The **Burbank** plum is a variety of the triflora species. The trees of the variety are vigorous in growth but the wood is somewhat brittle. The fruit is red in color and handsome. It keeps and ships better than Abundance and ripens 1 week later.

22. A hybrid variety of the native plums is known as the **Compass.** This variety has been extensively advertised to be

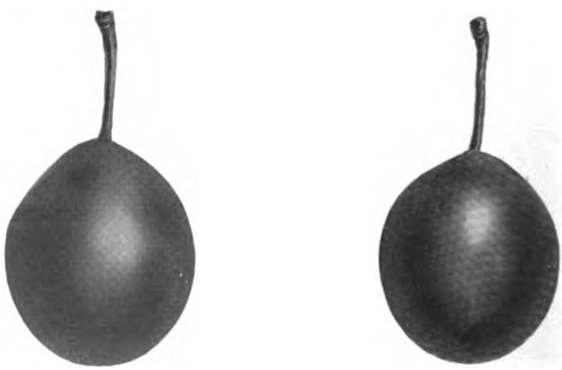


FIG. 4

of commercial value for the Northwest. However, the fruit is small and of poor quality, and the variety is of no value unless it can be grown in regions where better varieties will not live.

23. The **Crittenden** is a variety of the insititia species and an offspring of the Damson variety. The variety is sometimes called the *Cluster Damson* and sometimes the *Farleigh*. It ranks high among the plums produced in England but is not a great favorite in America. Trees of this variety are of medium size and productive. The fruit, which is illustrated in Fig. 4, is of medium size and slightly necked. It is purplish black in color and is covered with a thick bloom. The flesh is greenish yellow, firm, medium juicy, and tender.

24. The **Damson** is one of the oldest and best varieties of the insititia species. The name of this variety is a corruption of the name Damascus, near which city the variety is said to have originated. The Damson variety shows great adaptability to various soils and climates. In hardiness, vigor of tree, and productiveness it is scarcely surpassed by any variety. The fruit is medium in size, oval, and usually black. There are a number of varieties of insititia that are offspring of the Damson variety but have been propagated under different names. These varieties are often grouped together and are spoken

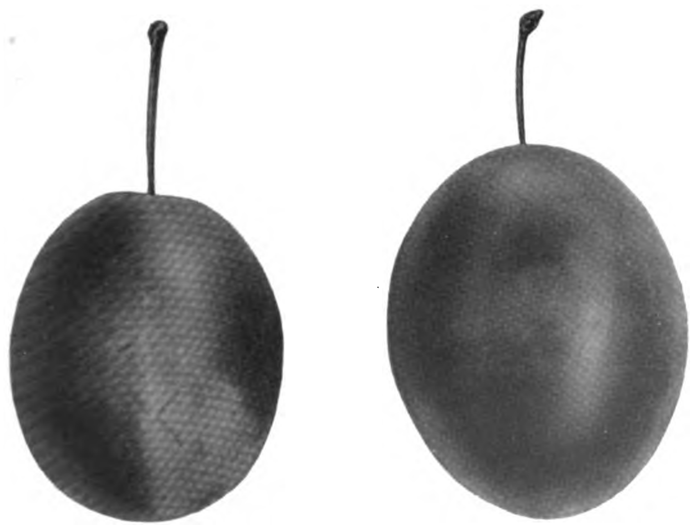


FIG. 5

of as the Damson group. Many of these varieties excel the original Damson in quality of fruit.

25. The **Diamond** is one of the varieties of the domestica species. Trees of this variety are vigorous, hardy, and productive. The fruit, which is illustrated in Fig. 5, varies in color from a reddish purple to a purplish black. It is large, well formed, and ships well, but the flesh is coarse and the flavor poor, and for these reasons it is rather disappointing for market fruit.

26. The **French** is a variety of the insititia species and is an offspring of the Damson variety. It is often called the

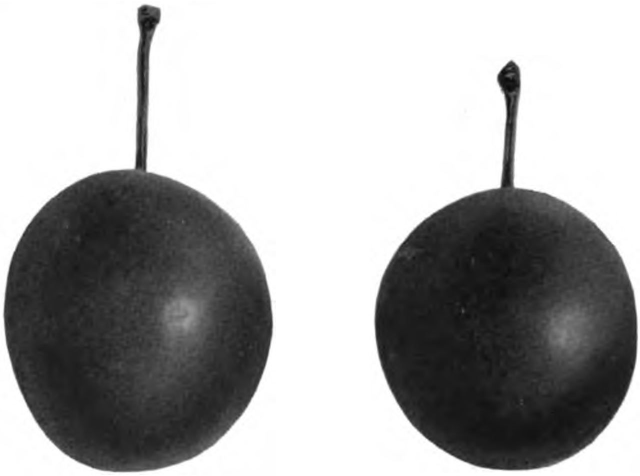


Fig. 6

French Damson. The trees of this variety are large, hardy, and bear abundantly and annually. The fruit, which is illustrated in Fig. 6, is larger than that of any other variety that has developed from the Damson. In color the fruit is dull black

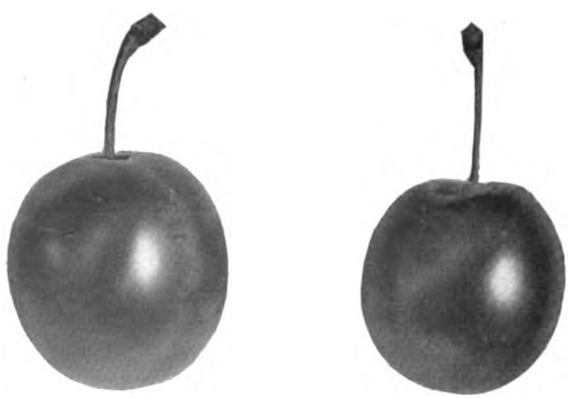


Fig. 7

and is covered with a thick bloom. The flesh is greenish in color and is sweet and juicy.

27. Frogmore is a variety of the insititia species and one of the best of the offspring of the Damson variety. The trees are small and have thorny branches. They are round topped, hardy, and very productive. The fruit, which is illustrated in Fig. 7, is clingstone; it is medium in size, and purplish black in color, overspread with a thick bloom. The flesh is of a golden color. It is tender, sweet, and juicy.

28. The **German,** or *German Prune*, a variety of the domestica species, is one of the oldest plums under cultiva-

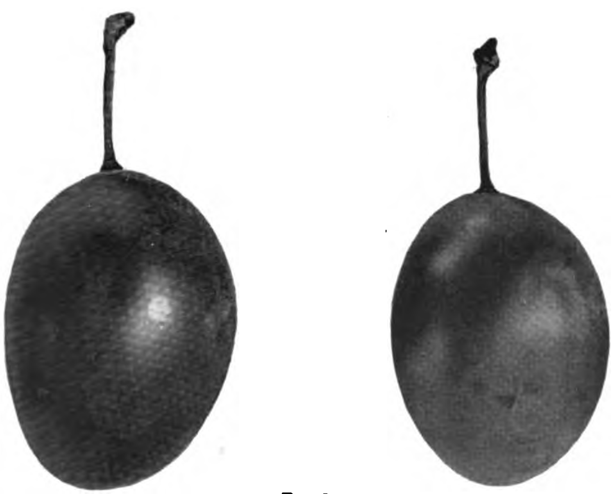


FIG. 8

tion. There are several strains of the variety. The trees are medium to large in size. The fruit, which is illustrated in Fig. 8, is purplish black in color and has a yellowish-green flesh; it ripens late in the season.

29. The **Golden Drop** is a variety of the domestica species. It is one of the best of the yellow plums, but is fit only for the home garden.

30. The **Grand Duke** is a variety of the domestica species. Trees of this variety are rather late in coming into bearing, but the fruit, which is illustrated in Fig. 9, is large and hangs to the tree well. In color, it is dark reddish purple or purplish black and overspread with a thick bloom. The plum has a fairly good flavor and is especially good for canning. It ships well.

31. The **Green Gage,** which is also known as the *Reine Claude*, has been for many years the standard variety of the domestica species and deserves a place in every orchard where

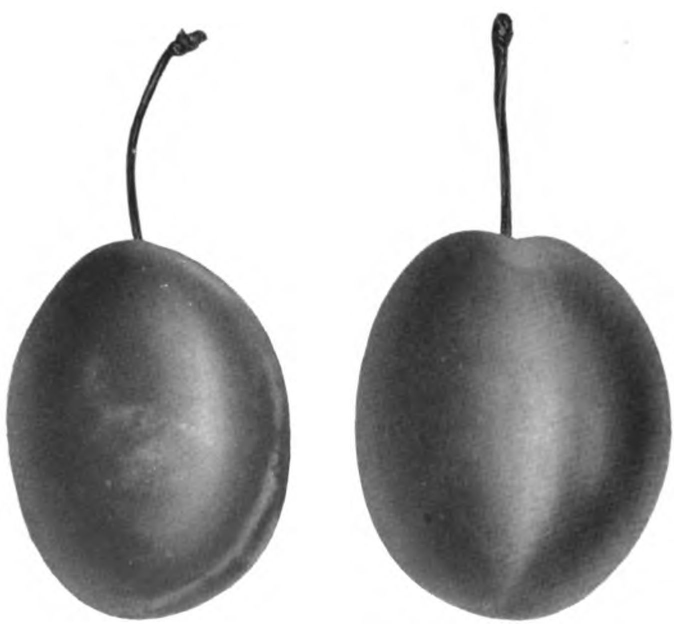


Fig. 9

the domestica can be grown. A large number of varieties of excellent quality have been developed in America from the Reine Claude. The trees of the variety are of medium size and productive, but grow very poorly in the nursery and are likely to sun scald. The fruit is of good size, yellowish green in color, and unexcelled in quality.

32. The **Guell** is a variety of the domestica species. The trees come into bearing early and bear abundantly, and the fruit ships well. Because of these facts the variety is a standard, although the fruit is of poor quality. The fruit, which is illustrated in Fig. 10, is medium in size and in color is a dark-purplish black overspread with a thick bloom.

33. The **Hawkeye,** which is a variety of the Americana species, seems to be well adapted to cold climates. The trees are of medium size and hardy, and they bear annually and

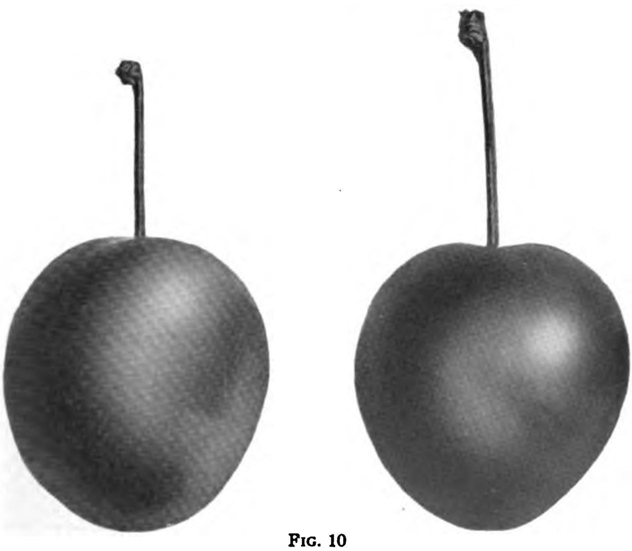


FIG. 10

abundantly. The fruit is above average in size and dark red in color. The plum is sweet, has a sour skin, and is of good quality but seems to be easily infected with brown rot.

34. The **Italian Prune,** which is one of the most widely-grown varieties of the domestica species, is the leading plum grown in the Pacific Northwest. The trees of this variety are large, hardy, productive, and regular bearers, but are capricious as to soil and climate, and seem to be susceptible to disease. The fruit, which is illustrated in Fig. 11, is large, purple in color, attractive, and of fine flavor. It ships well.

35. The **Lombard,** which is one of the most easily grown varieties of the domestica species, is now grown rather extensively in some states for canning purposes. The trees are hardy, productive, and regular bearers, and young trees are much used as stocks on which to graft weaker varieties. The fruit is of good size and appearance. Its color is purple overspread with a thick bloom. Its quality is fairly good for canning but very poor for other purposes.

36. The **Middleburg** is one of the best varieties of the domestica species for planting in the region of New York. The

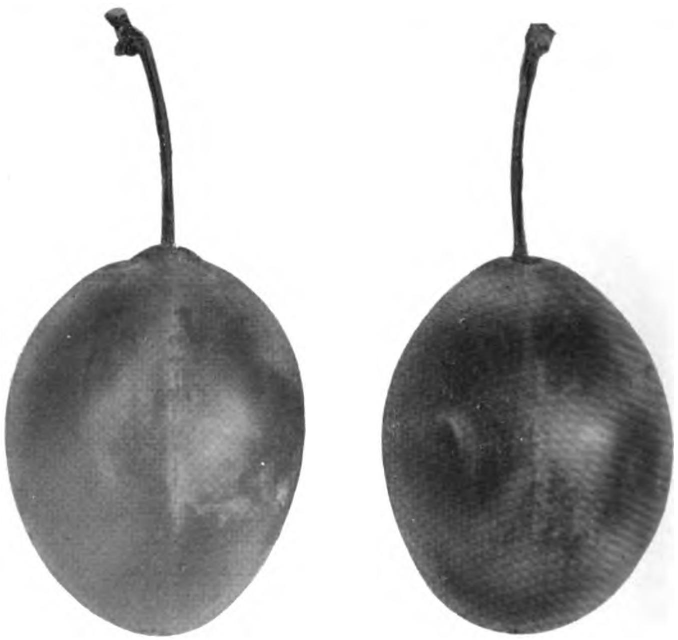


FIG. 11

trees of this variety are of medium size, hardy, and usually productive. The variety is excellent for home-orchard collections and may be grown commercially with profit. The fruit is somewhat surpassed in appearance by other purple plums, but few are better in quality. As illustrated in Fig. 12, the fruit is of good size. It varies in color from a light to a deep purplish red overspread with a thick bloom. These plums ripen late, hang to the tree well, and keep and ship well.

37. The first of the native group of plums to receive a name was the **Miner,** which is a variety of the hortulana species. This variety is extensively grown in the Middle West, and from it many valuable varieties have been developed. It is unproductive unless cross-fertilized. The trees are robust and usually productive. The fruit is of medium size, dark red, of good quality, and is especially suited for culinary use. It is somewhat late in ripening and is comparatively curculio proof.

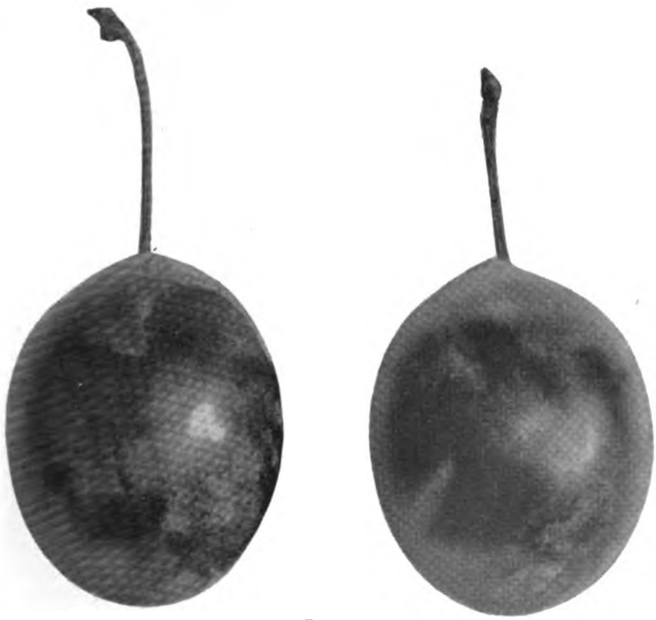


FIG. 12

38. The **Monarch** is one of the most popular of the recently introduced varieties of the domestica species. The trees are of medium size and vigor. The fruit is of good size and form, and, being of a rich, purple color, presents a handsome appearance. The quality, however, is not of the best, but it ranks well with that of other purple plums. The fruit ripens late.

39. The **Moreman** is the hardiest variety of the hortulana species. The trees are vigorous growers. The fruit is bright red and of pleasant flavor, but is small and for this reason not so satisfactory as that of several other varieties of this species.

40. The best late variety of the triflora species is the **October,** which is, however, not especially desirable. The trees are late in coming into bearing and cannot be depended

FIG. 13

on to bear satisfactory crops regularly. The fruit is large, dark red, juicy, and of good flavor.

41. The **Pond** is a variety of the domestica species. The trees of this variety are of medium size and vigorous in growth. The fruit, which is illustrated in Fig. 13, is larger than that of any other variety of the domestica. It is purple in color and presents a very pleasing appearance, but is only fair in quality.

FIG. 15 § 12 24909

42. A plum especially adapted to northern latitudes is the **Pottawattamie,** which is a variety of the munsoniana species. The trees of this species are dwarf, vigorous, and productive, and will grow as far north as the 44th parallel. The fruit is medium in size and of a currant-red color. It is pleasant in flavor and of fair to good quality.

43. The **Quackenboss** is a variety of the domestica species. The trees of this variety are large, vigorous, and

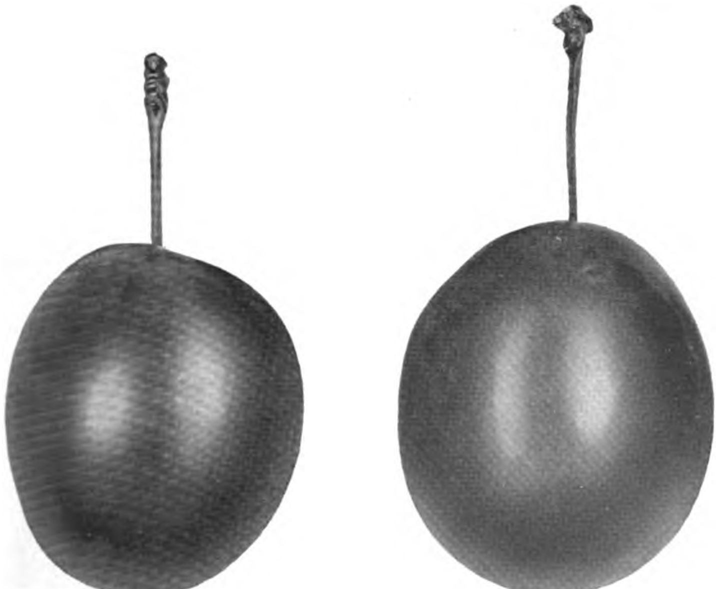


FIG. 14

hardy, but do not have the reputation of being fruitful. The fruit, which is illustrated in Fig. 14, is of large size, has a dark purple color, and is covered with a heavy bloom. It is sweet and of pleasant flavor, and is an excellent market plum.

44. The **Satsuma** is a variety of the triflora species. The trees of this variety are medium to large in size. They are fairly hardy and are moderately productive. The fruit, which is illustrated in Fig. 15, is of medium size and has a dark, dull-red color; the flesh is a dark purplish red. The fruit is the best of the red-fleshed plums for either dessert or culinary purposes. It keeps and ships well, but when grown in the Southern States is subject to brown rot.

45. The **Shropshire,** which is a variety of the insititia species, is probably the best known of the varieties that have developed from the Damson variety. The trees surpass those of all other varieties of insititia in vigor, hardiness, and freedom from disease, and these qualities make the variety a general favorite. The fruit, which is illustrated in Fig. 16, is one of the best plums for culinary purposes and may also be eaten out of hand with relish when fully ripe or after a light

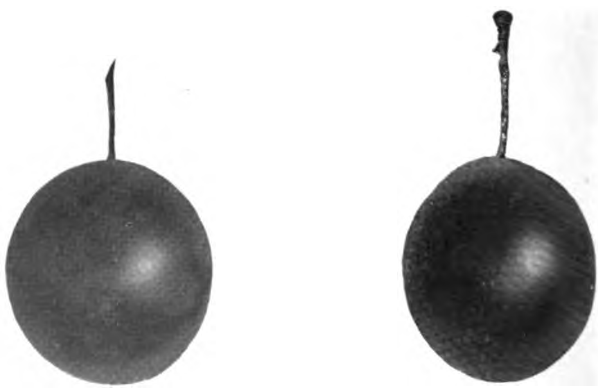


FIG. 16

frost. The fruit is of very good size and quality, but in both of these respects it is surpassed by that of the French variety. The color is purplish black overspread with thick bloom.

46. The **Washington** is a variety of the domestica species and one of the best of the varieties that have been developed from the Green Gage. The trees of this variety are large, vigorous, hardy, and very productive. The fruit, which is illustrated in Fig. 17, is large for a variety developed from the Green Gage; in color, it is greenish yellow or light yellow; in flavor, it is fine. These plums are unsurpassed for dessert purposes and they keep and ship well.

FIG. 17 § 12 24909

47. The **Wayland,** a variety of the hortulana species, is especially valuable for growers in the South and the Middle West, as the trees are able to withstand hot, dry weather better than those of any other species. The trees are large, hardy, and productive. The fruit, which is illustrated in Fig. 18, is small and of a dark, currant-red color. It is sour but of fair to good quality and is excellent for jellies and preserves. The fruit ripens very late.

48. The **Wild Goose** plum is a variety of the munsoniana species. It is probable that more trees of this variety are cul-

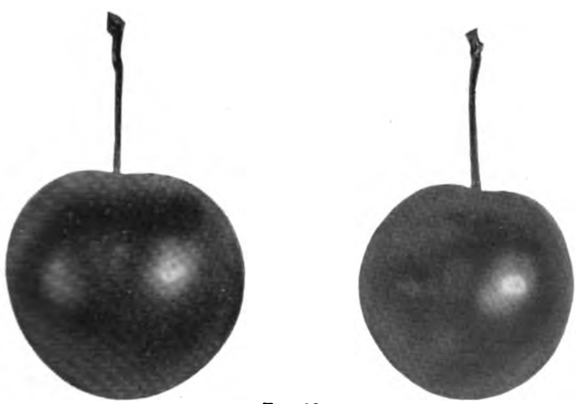


Fig. 18

tivated than of any other native plum. The trees are very large and vigorous, but should always be planted near some other native variety for cross-pollination. The fruit, which ripens very early, is of medium size, bright red in color, and of good flavor. The skin of the plums of this variety is tough, which makes them especially good for shipment and for long keeping.

49. One of the standard native plums is the **Wolf,** which is a variety of the Americana species; it is well adapted for growing in the northern part of the Mississippi Valley. The trees of this variety are large, vigorous, hardy, and productive.

The fruit is small to medium in size and dull crimson in color. It is freestone and fair to good in quality.

50. The **Yellow Egg** plum is a variety of the domestica species. The tree is large, hardy, and productive. The fruit is the largest and handsomest of the yellow plums, but is fit only for culinary use.

PLUM-ORCHARD ESTABLISHMENT AND MANAGEMENT

NURSERY TREES

51. Methods of Propagation.—In some parts of America plums are propagated by means of sprouts from the base of old trees. This can be done only in the case of trees growing on their own roots, otherwise the sprouts will not be of the same variety as the tree from which they are taken. It is said by some growers that this method of propagation produces trees that sent up many sprouts from the roots. This method is inexpensive, but it is not used extensively. Plums are generally propagated either by grafting or by budding. The stock may be grown from seed by the orchardist or 1-year-old stock may be purchased from importers. The method of grafting generally used is to root graft on 1-year-old stock. Top grafting of old plum trees is practiced very little. It is, however, used in some cases to renew the tops of trees that have been broken. When plums are propagated by budding, 1-year-old trees are secured for stock. The roots and tops are trimmed and the trees set out in the spring. Thorough cultivation is maintained throughout the season, and the stock is budded as soon as the buds mature on the parent trees, which is some time in August. The bud remains dormant until the following spring, when growth starts and the top of the stock should be cut off just above the bud. The tree may be dug the following fall and sold as a 1-year-old tree, the age of the bud being considered, or the tree may be allowed to grow for another year and sold as a 2-year-old tree.

52. Stocks for Propagation.—Plums are successfully grown on a number of different stocks. The kind of stock used by nurserymen depends on the variety of plums to be grown, the type of soil, and the location in which the tree is to be grown. There is, however, comparatively little experimental data on the subject. A fruit grower generally accepts the stock his nurseryman claims to be best for his conditions. In New England and the North Atlantic States, Myrobalan stock is generally used, although some of the Japanese plums are worked on the peach, especially for sandy land, and some of the native species are worked on Americana stock. For the Gulf States and north to Southern Pennsylvania the peach is preferred, especially for light soils, with the Myrobalan as second choice. For the interior region west of the Atlantic States, north of the Gulf States, and east of the Mississippi River, the Myrobalan is used as stock for the European plums and for most others, although some nurserymen prefer the St. Julien as a stock for the domestica and some varieties of the insititia, but object to the high cost of importing this variety. In this region the peach is generally recommended for the triflora species and Americana stock for the native species. In the states in the northern part of the Mississippi Valley all plums must be worked on native stocks, and in this region nothing but native varieties are grown. On the plains, the Myrobalan is used almost exclusively for European varieties and most largely for the triflora varieties, with the peach second, and Americana stock is used for the native varieties. In Oklahoma, Texas, and New Mexico the Americana is used. On the Pacific coast the Myrobalan and the peach are used in about equal numbers, the first for heavy soils and the latter for light soils. The almond is sometimes used in California, and some plum growers in that state propagate their own trees from suckers.

In New York, the Myrobalan stock is used almost exclusively, because when grown on this stock, the trees at 2 years of age are larger and finer than those grown on other stocks. Other advantages are that the stock is cheap, is easy to bud, makes a good union with nearly all varieties, and can be imported in large numbers from France. The defects of the Myrobalan as a stock are that there is considerable variation on account of the stock being grown from seed, that in the South it suckers badly, and that in the colder states, on the great plains, and even in the coldest parts of New York, the roots are winter killed.

Formerly St. Julien stock was used to some extent, and some growers still claim that it is a much better stock than any other for the domestica and certain insititia varieties, including the Damson. This claim is based on the belief that the trees are longer lived, more thrifty, more hardy, and sucker less. Its disadvantages are that it is expensive, hard to obtain, difficult to bud, and the stock is subject to fungous troubles in the nursery row. It does not make a good tree at 2 years old, and in order to keep the stock true to type it must be propagated by layering. Where the soil and climate are favorable to its growth, the peach is largely used as stock for plums, because it makes a quick growth, the trees come into bearing early, and the roots do not produce sprouts. For the domestica and for the Damson varieties of the insititia, the peach is not good stock, as the roots are less hardy than the tops and some varieties make a poor union. Peach stock makes a good union with the triflora varieties, but peach borers are sometimes troublesome when peach stock is used.

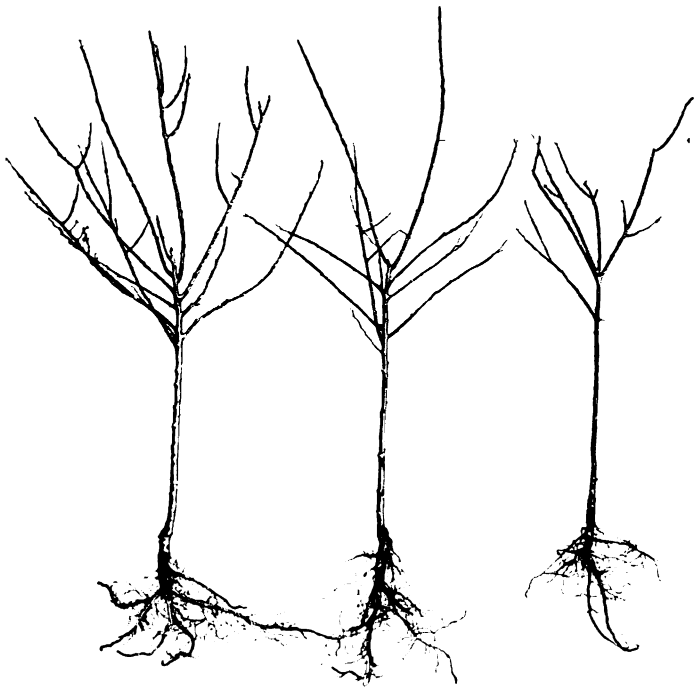
The Marianna plum has been used largely in the Southern States as a stock. It is believed to be a hybrid between Myrobalan and the native Chickasaw plum and is propagated from cuttings, but is not hardy in the North. In the colder parts of the great plains and as far east as Wisconsin, the Americana seedlings are the best stocks to use for growing the native plums, which are the only ones adapted to these sections. The disadvantages of this stock are that the seed is expensive and the trees sucker rather badly. The western sand cherry is used as a stock for dwarfing varieties of plums. This stock is extremely hardy and produces trees that bear early and abundantly and are able to endure a colder and drier climate than trees grown on most other stocks. The sand cherry is sometimes budded on Americana seedlings and grown for its fruit.

53. Selecting of Nursery Trees.—The general tendency of purchasers when buying trees is to demand a large tree, and the nurseryman has catered to this demand by charging more for large than for small trees; in fact, the trees are sold by height and caliper, and a tree 1 inch in caliper and 6 feet tall is considered to be worth more than a tree $\frac{3}{4}$ inch in caliper and 6 feet tall. A sliding scale of prices is fixed so that a tree of $\frac{5}{8}$ inch caliper and 5 feet tall is sold for still less. The caliper is taken 2 inches above the bud and the height is taken from the bud to the top of the limbs.

Experience has shown that a large tree is not the best to plant. A strong 1-year-old tree 3 to 4 feet in height is a better tree to plant than the best 2-year-old tree, as more of the root system is taken up with the tree, which is easier to dig, easier to plant, and less costly to ship, and at the end of 4 years will probably show better growth than a 2-year-old tree planted beside it. Another advantage of planting small trees is that it is much easier to form the head on a 1-year-old tree than on a 2-year-old. The disadvantage to the nurseryman in selling the 1-year-old trees is that there are frequently trees in the block that may be sold as light grades at 2 years old that would be too small to sell at 1 year old, and if only the best trees are sold, a higher price for each tree must be secured.

54. Description of a Good Nursery Tree.—A good nursery tree should be on roots adapted to the locality in which it is to be planted, and should be well grown for the variety. Varieties, however, differ considerably in growth. For example, a Lombard will have a straighter trunk and be larger than a Green Gage of the same age. A tree for planting should be free from diseases and insect pests, should have a good root system, and should have normally matured its buds before being dug. Many nurserymen practice stripping the leaves from young trees early in the fall to compel the tree to ripen its wood to be ready for early shipment. Trees that have been stripped are not so vigorous as those that are allowed to mature normally, and they make a poor growth the first year after planting. Fig. 19 (*a*) shows a No. 1 grade, 2-year-old, German

Prune tree. This tree measured 4 feet 11 inches above the bud and 7 inches below and calipered $\frac{11}{16}$ inch; (b) shows a No. 2 grade, 2-year-old, German Prune tree that measured 5 feet 1 inch



(a) (b) (c)

FIG. 19

above the bud and 8 inches below and calipered $\frac{5}{8}$ inch; (c) shows a No. 3 grade, 2-year-old, German Prune tree that measured 4 feet above the bud and 7 inches below and calipered $\frac{1}{2}$ inch.

ESTABLISHMENT OF THE ORCHARD

55. Influence of Climate on Plum Culture.—Climate is one of the most important factors in plum culture, for it largely determines what varieties can be grown in a locality or whether plums can be grown at all. Extremes of heat and cold are unfavorable to plum growing, and cold, wet, or windy weather at blooming time materially reduces the yield. At the Geneva, New York, Experiment Station, records show that the condition of the weather at the time of bloom is one of the most important factors in determining the plum crop, and that during a period of 25 years, whenever the weather has been warm and dry during blossoming time, there has been a good crop of fruit, and that in years in which there were late frosts, wet weather, low temperature, strong winds, or wide daily ranges in temperature at the time of blooming there was little or no plum crop, even though the trees bore an abundance of bloom.

56. Character of Soil.—The plum will thrive on many varieties of soil; the principal requisite is that the soil shall have good drainage. The domestica varieties and some varieties of the insititia do best in the eastern section of the United States on rich clay loams, and the triflora varieties do best in the same locality on lighter soils well adapted to peaches, the ideal being sandy or gravelly loam. On the Pacific coast, plums are grown on soils of various character, from light to heavy, in many cases the fruit being grown under irrigation, by which means the producer is able to control the moisture content of the soil.

57. Character of Site.—The site selected for a plum orchard should be one that has good air drainage as well as good soil drainage. Except in irrigated regions, undulating land is better than level land for plum growing, because of the better drainage. A situation on a northern slope no doubt lessens the liability of injury from late frosts to some extent, but some plum growers prefer a southeast slope, especially in a region where late frosts are not a serious factor.

58. Preparation of the Soil for Planting.—If the site selected for planting a plum orchard is not thoroughly drained, the first thing that should be done in preparing the soil is to drain the land. In many sections of the country where the land is not subject to washing during the winter, the plowing may be done in the fall, and if clover or some other leguminous crop has been grown and is turned under at this time, good results will follow. The soil should be thoroughly prepared as has been indicated for apples, and in case the land has been in sod for several years it may be advisable to grow a cultivated crop for 1 year previous to the planting of plums, in order that the soil may become mellow and that troublesome insects may be destroyed.

59. Planting.—If trees for planting arrive from the nursery dry, they should be thrown into water for 24 hours before planting. If the trees can be planted the same day they are taken up in the nursery, they are more liable to grow than when stored for some time. The holes should not be dug far ahead of the planting if the spring is dry, and in setting the tree it is imperative in all cases that the soil be compacted tightly so as to leave no large air spaces round the roots. Great care must be taken to prevent the roots from drying out before planting, as plums are much more susceptible to injury in this way than are some other fruit trees. The tree should be planted about 2 inches deeper than it stood in the nursery, and the surface soil should be left loose in order to form a mulch, or a mulch of straw or manure should be applied about the tree.

Owing to the poor growth of trees that have been stripped to insure early fall shipment, fall planting of plums has been discredited, and most plantings are now made in the spring; however, fall planting of trees that have normally matured their foliage is probably advisable under some conditions.

The land is prepared and marked out for plum planting as already indicated for other trees. When trees are to be planted in the spring they should be set out as early as possible, and they should not be pruned more than is absolutely necessary. In the case of most of the domestica and some of the insititia varieties four or five main branches and a leader are left. The roots need not be pruned back except to remove any that are injured, nor should the ends of the limbs that are left be cut, as the terminal bud will start into growth much sooner than any other; and the earlier the growth starts, the greater will be the development of the tree during the first season.

60. Spacing of Trees.—In the past there has been a tendency to plant plum trees too close together. At the present time the tendency is toward wider planting—from 12 to 20 feet apart. Trees of any free-growing variety should be set at the latter distance.

61. Arrangement of Varieties in the Orchard.—If several varieties of plums are grown and soil and other conditions are favorable so that they can be arranged in the orchard at pleasure, it is always advisable to plant those that are to be harvested first in the part of the orchard farthest from the prevailing wind, and those that are to be harvested last at the side of the orchard that gets the wind first. The object of this is to prevent, so far as possible, the distribution of spores of brown rot. These spores naturally attack the earliest maturing fruit first, and if this is put to windward it will be a constant source of infection to the whole of the orchard.

Many plums are sterile to their own pollen, and for this reason it is necessary to plant close together two varieties that bloom at the same time. With the domestica varieties and the Damson varieties of the insititia there is not the same necessity for this care that there is in the case of the triflora or the native varieties. A good method to insure pollination is to plant three rows of one variety, then three rows of another, and so on alternately.

ORCHARD OPERATIONS

62. Tillage.—The best plum orchards are cultivated. This usually consists of shallow plowing in the spring, followed by constant cultivation until the end of July or August, when a cover crop is sown. The cover crop may consist of clover, cowpeas, soybeans, oats, or barley, or a mixture of these, with Cow Horn turnips and rape, depending on the location. The most desirable cover crop is some legume, because nitrogen as well as humus is added to the soil when it is turned under. In some localities it may be necessary to maintain cultivation well into August, since the plum is a great water consumer and cultivation to save moisture is frequently a very important factor in its growth. However, this must not be carried on so long that it will make the securing of a stand of the cover crop difficult, especially in the more northern states. Orchards in which cover crops are grown require less fertilizer than others and are usually more productive. The cover crop serves many purposes; it not only tends to check soil washing, but it adds humus and, in the case of legumes, nitrogen; it tends to better physical structure of the soil; hastens maturity of the wood in the fall and forms a protective covering in winter, and where there are snows it tends to hold the snow, which also aids in preventing root killing.

If any interplanted crops are grown in the plum orchard during the first 2 or 3 years, they should be crops that permit of cultivation, and should be far enough removed from the trees so that a cover crop can be grown in the strip near the trees; however, most commercial orchardists feel that it is better to devote all of the land to the trees.

The implements of tillage are those usually used in other orchards. A spring-toothed harrow is a very useful tool for surface cultivation during the summer.

63. Pruning.—The extent of pruning required by plum trees varies with the species. The domestica varieties naturally make good heads with little pruning, and need only to have an occasional branch removed to keep the top from becoming too dense. Many of the native plums produce trees that are crooked, straggling, and unsightly, or that have dense, thorny heads that make the gathering of the fruit very difficult. These errors in growth must be corrected as much as possible by pruning. However, many growers are of the opinion that native plum trees should not be pruned as severely as apple trees. On the other hand, it has been found necessary to prune some of the triflora varieties of plums very severely. In fact, some growers have recommended that a renewal system somewhat like the system used in growing grapes be used for these plums, because of the fact that they tend to make a long, trailing growth each year. It is very important to remember, however, that those who begin to prune heavily must continue it. Once begun, it must be consistently followed, and some growers believe that those who pruned little may use other means to check the growth and secure the same results. Early bearing is in itself one means of checking the long growth, and the judicious growth of cover crops and the stopping of tillage in August, when the fruit buds are forming, will aid, although even with these methods on certain rich soils it may be necessary to use the shears to a considerable extent to head in the growth of the triflora varieties each year.

Owing to the expense of picking, the fruit must be maintained where it can be reached easily. The aim is, therefore, to keep the trees low; in some orchards they are absolutely shorn off at a certain height and not allowed to make a growth of more than two or three buds above this each year.

Two methods of pruning plum trees are commonly followed. One is to allow a leader with four or five branches coming from it, the leader being checked after it reaches a certain height. This method is often used for the domestica and the insititia varieties. The second method, which is often used for the triflora varieties, is to remove the leader and allow four or five branches to grow, forming the tree into a vase shape, or somewhat like an inverted umbrella. The branches should be from 4 to 6 inches apart on the trunk to prevent splitting. The trees are usually headed about 2 feet from the ground. The subsequent pruning consists of the removal of the limbs that cross. Until the trees begin to bear, as little pruning as possible should be done; this tends to early bearing.

64. Fertilizing.—Practically no data is in existence from which conclusions may be drawn concerning the benefits derived from fertilizing plum orchards. It is a well-known fact, however, that plums do well on fertile soil, and no doubt in order to secure the best results the soil of the plum orchard should be maintained in fairly fertile condition. However, plum trees are comparatively deep rooted, and because of this fact have a large feeding zone. A plum crop does not draw heavily on the fertility of a soil, and it is claimed by some growers that in case the soil of plum orchards is in a fairly fertile condition, the addition of fertilizer will not pay. This is a matter that each grower can determine for himself by experiment under his own local conditions.

65. Spraying.—It is important to remember that plum foliage is much more susceptible to injury by Bordeaux mixture than is apple foliage. Bordeaux mixture should be applied at less than half the strength of the solution used for apples. About the right proportions are 1 to 2 pounds of copper sulphate and 2 to 3 pounds of lime to 50 gallons of water. Self-boiled lime-sulphur and certain proprietary spray compounds containing sulphur may be used on plum foliage with little or no injury. The best insecticide spray for plums is arsenate of lead used at the rate of 2 pounds to 50 gallons of water.

66. Thinning of Plums.—In order to produce first-class fruit, it is usually necessary to thin the fruit on plum trees. Plum trees will often set from two to ten times as much fruit as they should mature. This is especially true of some of the Japanese and native plums. In some localities this thinning of plums has become an established custom. In other localities, however, it is very much neglected. Thinning should be done immediately after the early-summer drop, often spoken of as the June drop, occurs. No plum that can come in contact with another should be left, and some growers claim that the fruit should be thinned to be from 6 to 9 inches apart on the branches. The best method of thinning is by hand picking, and judgment must be used as to what fruit should be left on the tree. This method of thinning is somewhat expensive, but growers who practice it find that the quality of fruit secured more than pays for the expense. Some growers attempt to secure the results of thinning by pruning off part of the branches and others thin by drawing a fine-toothed garden rake over the branches. Such methods are no doubt better than no thinning, but are less desirable than hand thinning.

67. Plum-Orchard Renovation.—The plum tree is usually not nearly so long lived as the apple or pear, and for this reason does not offer as great possibilities of return from the renovation of old trees as are offered by the trees last mentioned. For this reason comparatively little has been done toward renovating neglected plum orchards. When a plum orchard is neglected for a number of years it declines so rapidly that it is generally conceded by orchardists to be better policy to plant new trees rather than to attempt to renovate an old orchard.

HANDLING OF THE PLUM CROP

68. Harvesting.—Plums, unless for immediate home use, should be picked a few days before they are thoroughly ripe, and the greater the distance they are to be shipped the greener they must be picked. Aside from the better shipping qualities of plums that are picked before fully ripe, there are other advantages in picking the crop at this time. Plums, if allowed to become fully ripe on the tree, are much more liable to be injured by brown rot than when picked green, and the skin of many of the native plums is likely to crack if they are allowed to ripen on the tree. Many of the varieties of the triflora species may be picked from 6 to 10 days before the plums are fully ripe, and they will develop both color and flavor after picking. The domestica varieties are allowed to ripen on the trees until they are well colored, but they must be picked while still firm. There is no satisfactory mechanical device for picking plums, and the work must be done by hand. The stems should be left on the plums, because their removal breaks the skin and causes early decay of the fruit. The stems also help to hold the fruit in place in the package and prevent bruising. In harvesting the crop care should be taken to guard against bruising the fruit or destroying the bloom.

69. Grading.—In the Eastern States comparatively little grading of plums is done. In many cases the packages in which the fruit is sold are taken to the orchard and the fruit is picked directly into them. There is no reason, however, why the Eastern growers should not grade their plums before shipment and thus secure a better price. In some of the Western States plums are well graded before being shipped.

70. Packing.—Much of the success of the plum industry depends on the proper packing and marketing of the fruit. The size of the package to be used for plums depends on the custom in the market to be supplied, but unquestionably the plum grower will derive the greatest profit by marketing large, first-class plums in small packages that the retailer can sell over the counter. It is also found profitable to wrap fancy fruit in tissue paper; in the case of ordinary fruit this would probably not pay.

Wrapped fruit in small packages is shipped from the Far West and even from South Africa to New York and arrives in good condition. Fruit shipped in small packages is damaged less by shipment than when shipped in large packages. As has been said, the package to be used depends on the custom in the market for which it is intended. Climax baskets made of wood veneer and holding 4, 6, or 8 pounds are often used for plums. The six-basket Georgia peach carrier is sometimes used for fancy fruit; a carrier holding the same quantity and containing nine shallower baskets is also very good for shipping fancy plums. Peck baskets and half-bushel baskets are used in some places for shipping plums. These large packages should be used only for ordinary fruit; fancy fruit will bring a much better price in small packages.

71. Storing.—Thus far plums have not been grown with the idea of storing the fruit, although there is no doubt but that in the future varieties will be developed with this in view. Some of the newer varieties, as for example the Apple, are capable of being held for several weeks after picking. Late plums and some of the prunes, with ordinary care, may be held 3 or 4 weeks in common storage without any extraordinary precautions. This is also true of some of the Damson varieties and a number of the other European varieties, although it is not usually customary to hold the fruit more than a week in common storage and from 3 to 4 weeks in cold storage. By careful methods of handling in picking and packing and the best facilities for cold storage, Green Gage plums have been kept in good condition for a period of 10 weeks at a temperature of 32° F.

72. Marketing.—The usual method of marketing plums is too expensive because the fruit must pass through too many hands after leaving the farm before reaching the consumer. In addition to this in the Eastern States the business is handicapped by the small quantities of fruit usually grown in a given locality. The fruit is shipped in small quantities at the highest freight rate, frequently by express, and is often roughly handled. There is a lack of capital on the part of both the grower and the man who buys to ship. The fruit is perishable and no one is prepared to take much chance on it, so that the price must be low to tempt buyers. Another disadvantage of the industry is the restricted outlet for a surplus. In the West, the prunes are dried or cured so that they can be shipped at any time. In the East, no such development has taken place, neither is there any great demand for preserved fruits or jellies from plums or marmalades or confections which might be made from a surplus. These are the conditions at present, and undoubtedly they will have to change considerably before the plum industry becomes well established.

Some data secured in Michigan shows that for that locality the cost of production of a bushel of plums, including marketing, was about 50 cents.

PLUM PESTS AND INJURIES

INSECTS

73. The **plum curculio** is one of the most troublesome insects that attack the plum. This insect also attacks the peach and has been described in a previous Section. The female curculio begins to deposit eggs as soon as the young plums are formed; she pierces the skin of the plum and deposits an egg in the puncture, about which she cuts a crescent-shaped gash. The presence of the larva in the plum is indicated by the crescent-shaped gash and by small drops of whitish gum exuding from the puncture. The infested plums usually drop by the time they are half grown, although some remain on the trees until picking time.

The adult insects may be destroyed by spraying with arsenate of lead, 2 pounds to 50 gallons of water, as soon as the leaf buds begin to open. A second spraying should be given just before the fruit buds burst, and another as soon as the plant is out of bloom, and if necessary two more sprayings may be given at intervals of 7 or 10 days. A preventive measure that has been used successfully by some orchardists is to jar the trees. The adult insects, when disturbed, have the habit of feigning death, and will drop to the ground. If a sheet is spread under the plum tree and the tree suddenly jarred many insects may be collected from the sheet. Dealers in orchard supplies have for sale curculio catchers that are more convenient than a sheet. The catcher is made by covering a large frame like that of an inverted umbrella with oil cloth and is mounted on wheels. At the center is a circular hole for the trunk of the tree, and at one point is an opening that allows the device to be set around the bottom of the tree. A can or other receptacle containing kerosene is placed under the opening at the center of the catcher, and when the tree is jarred the insects fall on the catcher and roll down into the kerosene. This method of destroying curculio should be used in the early morning, as toward midday the insects do not drop so readily when the tree is jarred.

Fig. 20

74. The **plum gouger** is an insect that resembles the curculio in appearance and that has much the same habits. The insect, shown in Fig. 20, is common through the Mississippi Valley, and may be distinguished from the plum curculio from the fact that the wing covers do not have the humps that are found on the wing covers of the curculio. The insect is about $\frac{3}{8}$ inch long, the snout being about one-third of the entire length. The color is gray, finely spotted with black and brown, the thorax and head being marked with ocher yellow. The female gouger drills a hole in the fruit, deposits its eggs in a manner similar to the curculio, but unlike the latter it does not cut a crescent-shaped gash about the puncture where the egg is deposited. On emerging from the egg, the larva makes its way into the pit of the plum, where it feeds until full grown, when it cuts a hole through the hard shell of the pit. The larva enters into the pupal stage on the inside of the plum pit, and the adult escapes from the pit through the hole made before the pupal stage and makes its way out through the flesh of the plum. The plum gouger, like the curculio, also injures the fruit by drilling holes into it to obtain food. Plums injured by the gouger become worthless but do not drop so readily as do those that have been injured by the curculio.

The treatment for this insect is the same as for the curculio, although on jarring the tree the beetle does not drop so readily and takes wing more quickly than the curculio.

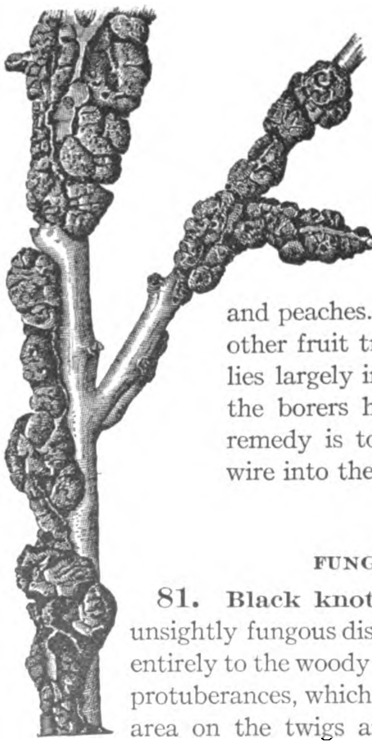
75. The **San José scale,** which sometimes attacks the plum, should be treated by spraying with a lime-sulphur solution of a specific gravity of 1.03, or with miscible oil, at the time when the trees are dormant.

76. The **russet plum louse** is an aphis that causes considerable injury to plum foliage, especially in the South and Southwest. It is readily distinguished from other aphides by its color, which is rusty brown with white at the base of the antennæ and on the legs and tail. The insects collect on the under side of leaves and on the young twigs, from which they suck the sap, causing the leaves to curl and die. When present in large numbers they sometimes attack the blossoms and prevent the setting of fruit. The winged females of this species migrate early in the summer to certain common grasses such as foxtail, red top, crab grass, etc., where they continue to breed until fall, when the winged forms return to the plum tree and deposit eggs for the next season's brood. The remedy for this aphis, as for others that infest the plum, is to spray with a contact insecticide early in the season before the leaves begin to curl.

77. The **mealy plum louse** is a light-green aphis having much the same life history and for which the remedies are the same as for the russet plum louse.

78. A number of leaf-eating caterpillars, among them the case bearer, the tent caterpillar, and the canker worm, which have been described in another Section, and also some leaf-eating beetles are injurious to the plum. All of these may be controlled by the use of a poison spray consisting of 2 pounds of arsenate of lead to 50 gallons of water.

79. The **pear-tree slug,** described in another Section, sometimes does considerable damage to plums by eating the foliage. This insect may also be controlled by the arsenate of lead spray.



80. The **peach-tree borer** and the **apple-tree borer** sometimes infest the plum and do considerable damage, especially to young trees. Borers are not, however, so serious a menace to plums as they are to apples and peaches. The remedy, as in the case of other fruit trees liable to attack by borers, lies largely in preventive measures. When the borers have entered the tree the only remedy is to cut them out or to run fine wire into their burrows and pierce them.

FUNGOUS DISEASES

81. Black knot is a very common and most unsightly fungous disease of the plum. It is confined entirely to the woody parts, and consists of wart-like protuberances, which sometimes cover a considerable area on the twigs and smaller limbs, as shown in Fig. 21. These knots usually appear in the spring, although they occasionally make their appearance in the fall. The first sign of the disease is a slight swelling of the branch, which increases until the bark is broken and the fungus becomes visible. By the time the fungus is full grown it is black in

FIG. 21

color and remains so. Black knot spreads during the late spring or early summer, and if all infested branches are pruned away and destroyed before this time the disease in most cases may be easily controlled. In some cases spraying with Bordeaux mixture may be advisable. In case Bordeaux is used, one application should be made during the late winter and one when the buds begin to swell, which may be followed by from one to three other sprayings, as may seem necessary.

82. Brown rot, which also attacks peaches and cherries, is one of the most serious diseases of the plum. The disease is most commonly seen on the ripening fruit. The skin of the fruit first decays and at last becomes covered with the gray spores of the fungus. The fruit continues to hang on the tree and in time becomes mummified. This mummy fruit is often a source of infection the following spring, and should be gathered and destroyed during the winter. Although most readily observed on the fruit, this disease also attacks the stem and foliage of plums. Spraying with Bordeaux mixture has proved of some value in the control of this disease, but many growers believe that spraying with self-boiled lime-sulphur is a more satisfactory remedy, as it is not so liable to injure the fruit.

83. Plum pocket is the name given to a fungous disease that produces a spongy mass in the fleshy tissue of the plum and retards and sometimes even prevents the development of the pit. This disease also attacks the leaves and young shoots. The stems become swollen and twisted, and the leaves become curled and distorted and have much the same appearance as leaves affected with peach-leaf curl. Fig. 22 shows plums affected with the disease and Fig. 23 shows its effects on a stem.

Plum pocket is distributed over a considerable portion of the United States and attacks all varieties of plums. Little has been accomplished toward the control of the disease. All diseased parts should be removed as soon as observed, and it is possible that spraying with Bordeaux mixture when the buds begin to swell and again just before the blossoms open will aid in checking the spread.

84. Scab of plums is caused by a fungus that attacks the fruit and causes gray or brownish spots, which seem to be incrusted with dry flakes of skin. Spraying with Bordeaux mixture or with lime-sulphur of a specific gravity of 1.007 will no doubt control this disease.

85. The **shot-hole fungus** attacks the foliage of the plums at about the time that the young leaves appear in the spring. Small spots on the leaf are affected. These spots at first have a yellow color but turn to a brown, when the tissue in the

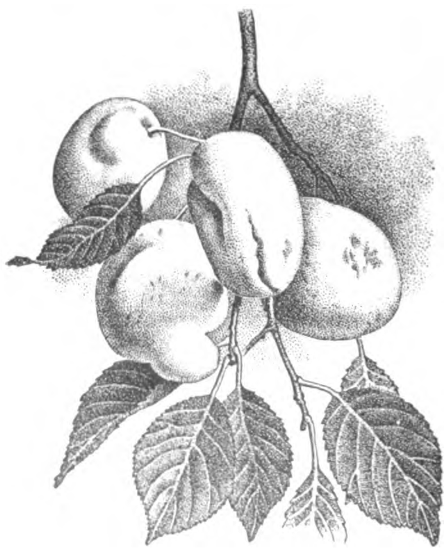


FIG. 22

FIG. 23

affected spot finally withers and falls out, giving the leaf the appearance of being filled with shot holes. Bordeaux mixture has been the chief remedy for this fungus. Two applications are made, the first about 10 days after the blossoms fall and the second about 3 weeks after the first. Recently lime-sulphur of a specific gravity of 1.007 has been used successfully to control this fungus. It should be applied at intervals of 2 or 3 weeks until the fruit begins to color, or self-boiled lime-sulphur may be used after the fruit forms.

86. The **leaf rust** that attacks the foliage of other stone-fruit trees also injures the foliage of the plum tree. It is probable that this fungus can be controlled by a spray of Bordeaux mixture.

87. **Powdery mildew** attacks the leaves and stems of plum as well as of other fruit trees. It may be controlled by a weak lime-sulphur spray.

88. **Gummosis,** which is an extensive flow of gum, frequently follows injuries of any kind to the trunk or branch of a plum tree. The remedy is to prevent or remove the cause of injury.

89. **Crown gall,** which has been discussed in a previous Section, is not so troublesome to plum as to some other fruit trees. Trees affected with this fungus should be discarded at planting time.

GRAPE CULTURE

(PART 1)

INTRODUCTION

1. The grape may be termed a truly American fruit. Of the forty wild species of grapes in the world, about two-thirds are found in North America, some variety being found in almost every section in which fruit can be grown. All of the cultivated grapes in America, except those grown on the Pacific coast, have been developed from native wild grapes within a little more than a century.

At the present time there are about 250,000 acres of grapes of native and hybrid varieties in the United States. The product of this acreage is used chiefly for dessert purposes, but from it is made annually about 19,000,000 gallons of wine, 1,000,000 gallons of champagne, and 2,000,000 gallons of grape juice. The making of the latter product is becoming so extensive that within a few years it is likely the production will exceed that of wines and champagnes combined. Unfortunately, raisins cannot be made from the fruit of native varieties.

Outside of the Pacific coast region, the growing of grapes commercially in the United States is, at the present time, almost wholly confined to ten states. These are, in the order of their production, New York, Ohio, Pennsylvania, Michigan, Illinois, Indiana, Kansas, Missouri, Georgia, and New Jersey. But the industry is still further localized. For example, in New York commercial grape growing is carried on in only four regions, namely, in Chautauqua county, about the five central lakes, along the shore of Lake Ontario, and in the valley of the Hudson River; in Pennsylvania and Ohio, the industry is largely confined to the shore of Lake Erie; in Michigan, it is confined to the regions about the towns of Paw Paw and Lawton; in Missouri, it centers about the town of Hermann. The industry is similarly localized in the other grape-growing states. There are, however, few localities in any part of the United States where tree and small fruits can be grown in which some variety of grape will not thrive.

In the past, grape growing has shifted from place to place more than any other fruit growing. This was due to the fact that growers were not able to control black rot and the mildews. Now that greater knowledge of these troubles and how to control them has been acquired, the industry has become permanent in localities adapted to it.

2. The prospects for the grape industry in North America are very encouraging from several standpoints. First, the remarkable spread and development of grape growing in California in less than a half century is one of the marvels of modern agriculture; so, too, perhaps no other plant in the history of the world has attained, in so short a time from the wild state, such importance as the native grape. In both the West and the East, the industry is certain to continue to grow. Second, grape breeders are constantly improving the fruit in all desirable qualities, its capacity for improvement, as indicated by the past, being little short of wonderful. Third, as wild grapes are found practically everywhere in the United States, there is every reason to believe that eventually domesticated vines will be grown in all parts of the country and of so many diversified varieties that every purpose to which grapes are put shall be met. Fourth, the steady increase in the production of wine, champagne, and, more particularly, grape juice, augers well for the industry. Fifth, knowledge of the control of insect pests and fungous diseases has removed the chief uncertainties of grape growing. Sixth, as transportation, storage, and marketing facilities are improved, the industry will become more stable. Seventh, the country is not yet well supplied with grapes, and as the population increases the demand will increase.

3. The several different species of grapes, each with its many varieties, thrive under widely different soil and climatic conditions; are grown for more or less distinct purposes; are differently pruned, trained, cultivated, and marketed; and are subject to different insect and fungous troubles. The first task, then, for a grape grower is to become informed regarding the different species and varieties.

The common species of grapes are the *Vinifera*, the *Labrusca*, the *Rotundifolia*, the *Aestivalis*, and the *Riparia*. Besides these species, there are a number of hybrids of importance. A description of each of the species mentioned will be given first, after which the varieties of each species will be described.

4. Vinifera Grapes.—The Vinifera species (*Vitis vinifera*) is the only species of grape grown in the Old World. It is the grape referred to in the myths, fables, sacred writings, and poetry of the Old-World countries. The Vinifera grape is as old as civilized man and has followed him from place to place throughout the world. It is one of the principal cultivated plants of temperate climates.

The Vinifera varieties of grapes can be grown in America only west of the Rocky Mountains, particularly in California, where the great wine, raisin, and dessert-grape industries are founded on the successful culture of this one species. Native grapes can be grown in California but they cannot compete with the Viniferas for any purpose. Numerous attempts have been made to grow Vinifera grapes east of the Pacific coast. From the time of the earliest settlements until the end of the first half century after the establishment of the Union, attempts to grow Vinifera vines were continuous. Chief among the experiments conducted on a large scale by expert vine growers were those at Jamestown in 1607 on the lands of John Smith; by a company founded by Peter Legaux at Philadelphia in 1793; by the Kentucky Vineyard Society on the Ohio River in 1769; by the Harmonists, a religious sect, near Pittsburg in 1805; and by French officers and soldiers of Bonaparte's army in the

Vine and Olive Colony on the Tombigbee River, Alabama, in 1817. The thorough trials made by these large companies, as well as by hundreds of individual growers, have demonstrated conclusively that Vinifera grapes cannot be grown commercially east of the Pacific slope.

The chief cause of the failure to grow Viniferas in the eastern part of the United States was not ascertained until nearly the end of the 19th century, when a tiny plant louse, known as phylloxera, was discovered. This louse feeds on the leaves and roots of Vinifera grapes but does little harm to American, or native, grapes. In addition to the phylloxera, three other troubles, black rot, downy mildew, and powdery mildew, are more destructive to Vinifera grapes than to native grapes. Also, the climate east of the Rocky Mountains is too variable in temperature and humidity for the commercial growing of Vinifera grapes. All of these factors militate to such a degree against the growing of Viniferas that it is practically impossible to grow any of the varieties in Eastern America, except in greenhouses or under very exceptional garden conditions. Despite this fact, however, there are still persons who are attempting to cultivate vines of the species in the hope that some variety will be found that will grow successfully in this region.

Within the area in which it grows on the Pacific coast, the Vinifera grape has wonderful adaptability. It grows at all altitudes and on nearly all soils; it may be planted on either dry or irrigated lands; it is variously treated and thrives under all treatments, even neglect, although it never fails to respond to care. The number of Vinifera varieties runs into several hundred, some being grown for wine, others for raisins, and still others for use as table grapes. About 385,000 acres of Vinifera grapes are grown on the Pacific coast annually; approximately 50 per cent. of the product is used for the making of wine, 20 per cent. as table grapes, and 30 per cent. for the making of raisins and for other purposes.

5. **Labrusca Grapes.**—The Labrusca (*Vitis labrusca*) is one of the most important of the native species of grapes. Modern Labrusca grapes are descendants of the wild Labrusca,

or fox, grape of the Atlantic coast. The species first attracted attention shortly after the close of the Revolutionary War, when Thomas Jefferson recommended the culture of the Alexander, a Labrusca variety. The Labrusca now furnishes more cultivated varieties than all of the other native species combined, no less than 500 varieties having been introduced since the Alexander was domesticated. Chief among these are the well-known Catawba, Concord, Niagara, and Worden.

6. Rotundifolia Grapes.—The Rotundifolia species (*Vitis rotundifolia*), commonly known as the Muscadine grape, is another important species of grape. Varieties of this species are found growing wild along the Atlantic coast from the Potomac River to the Gulf of Mexico. Rotundifolia grapes have been used for wine and dessert since the time of the English settlement at Jamestown; and vines are to be found on arbors, fences, and in gardens on nearly every farm in the South, the bountifulness of the half-wild vines obviating the necessity of domesticating them. The Scuppernong, James, Flowers, and Mish are well-known varieties of the species.

7. Aestivalis Grapes.—The Aestivalis species (*Vitis aestivalis*) is the summer, or bunch, grape of southern forests. It has greater horticultural possibilities, perhaps, than the Rotundifolia species. Varieties of this grape are preeminent in the making of wine, the fruit producing the best red wines of the claret type made from native grapes. The oldest and one of the best Aestivalis varieties is the Norton, which came into cultivation near Richmond, Virginia, about 1800. A score or more varieties of the Aestivalis grape are now cultivated in the South. The berries of the true Aestivalis grape are too small and too tart to make good dessert, but an offshoot of this species, known as the *Bourquiniana grape*, furnishes several good varieties for dessert purposes. Chief of these varieties is the Delaware, the introduction of which, some years ago, gave a great impetus to American grape growing, the variety being the highest in quality of all the native grapes of America. Herbemont and Lenoir, other varieties of the Bourquiniana grape, hold a high place in the South.

8. Riparia Grapes.—One other species of the wild grapes of America is commonly cultivated in the United States. This is the Riparia species (*Vitis riparia*), or Riverbank grape, found in damp woods from the St. Lawrence River to the Gulf of Mexico. More than a century ago this grape came under cultivation through a variety called the Worthington. It has become prominent on account of its resistance to the phylloxera, the vine being extensively used in Europe and America as a stock on which to graft Vinifera varieties. The Riparia is also a good wine grape. The Clinton, Canada, and Bacchus are well-known varieties of the species.

9. Hybrid Grapes.—Besides the species of grapes discussed in the preceding pages, there are a number of hybrids of these species that are of importance. In fact, many of the best grapes now grown are hybrids. At first the attempts at hybridization were confined to crossing the Vinifera, or Old-World, grape with native American grapes. So successful were these attempts that at the present time nearly half of the 1,500 varieties of grapes known in America are hybrids of this cross.

A statement of the differences between Vinifera and American grapes will give an idea why hybrids of the two are desirable. Vinifera grapes have a higher percentage of sugar and solids than native grapes and therefore keep much longer, stand shipment far better, and make better wines than the latter; in addition, raisins can be made from Vinifera grapes but not from native grapes. Viniferas are usually of better flavor, being richer and lacking the strongly aromatic odor and taste, called foxiness, of many of the native grapes. The bunches and berries of the Vinifera grapes are larger and are borne in far greater quantities than those of native grapes. The pulp, seeds, and skins are not so objectionable as in the American varieties, and the berries do not shell from the stems so quickly after being harvested. The vines of Vinifera grapes are more compact, require less pruning and training, are adapted to more kinds of soil, and are more easily propagated than those of native grapes. American grapes have two important points of superiority over the foreign grapes which make their culture desirable: they are not seriously attacked by the phylloxera and are more resistant to diseases than the Viniferas. Also, to many persons their flavor is more pleasant than that of the Vinifera grapes; and from them is made nearly all of the grape juice now produced, which is an important source of income to eastern grape growers.

The success achieved in hybridizing the grapes of the Old and the New World quickly led to similar attempts among the native species. Most of the hybrids of American grapes are characterized by great vigor and productiveness, and though few are of importance for table purposes, a number of them are extensively used in the making of wine.

VARIETIES OF GRAPES

VINIFERA VARIETIES

10. Although grown only on the Pacific coast, **Vinifera** grapes are first in commercial importance in America. The grapes of this species have been used since the dawn of civilization for the making of wine and raisins, and are now and must long continue to be the wine and raisin-making grapes of the world. Many of the varieties of grapes now cultivated in the Middle and Eastern States are hybrids of the Vinifera and some native species. The following varieties are commonly cultivated in the West.

11. In California, the **Black Ferrara** is considered excellent both for local-market sale and for shipping a long distance. The bunches and berries are large and the berries cling well to the stems. As the name implies, the berries are black. The flavor of the fruit is somewhat inferior, the skin is thick, and the flesh is of rather poor texture.

12. The **Black Hamburg** is a popular local-market grape in California, but it is not well adapted for long-distance shipping. The bunches are large and very broad at the shoulders;

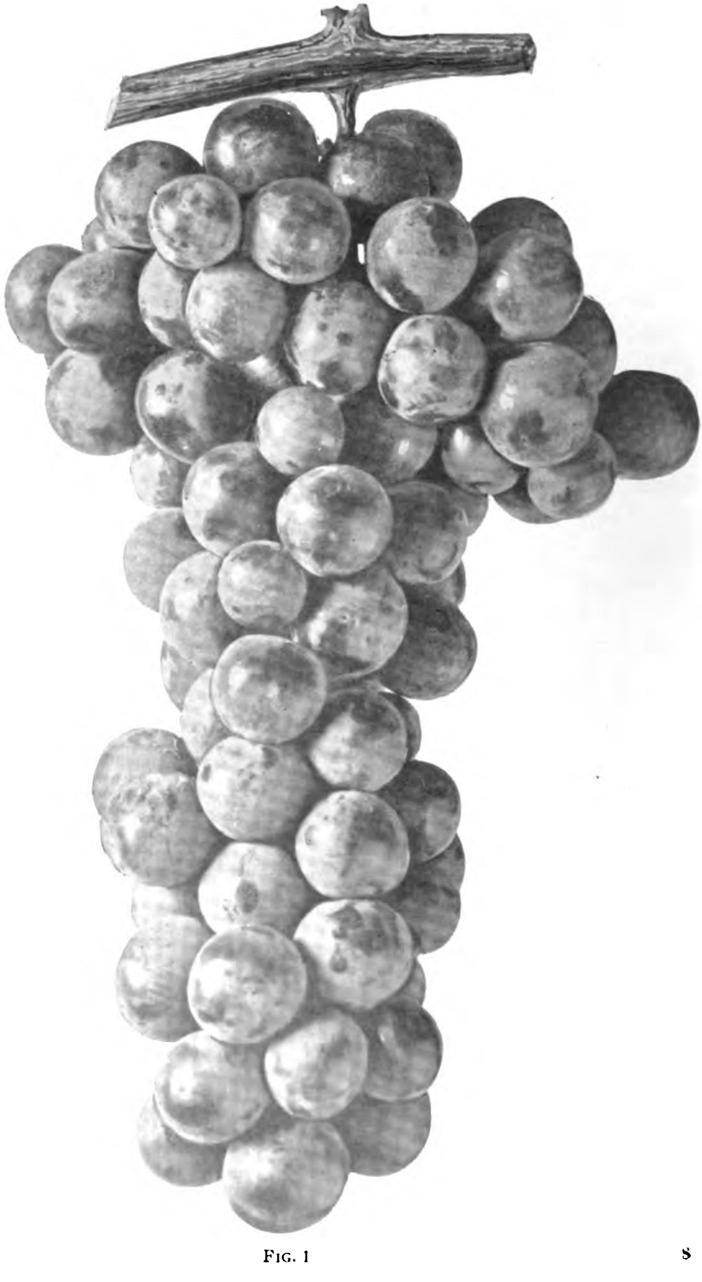


Fig. 1

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FIG. 2

FIG. 3

11 Fig. 4

the berries are very large and of a roundish shape, inclining to oval; the skin is thick and of a dark purple to black color; the flesh is sweet, juicy, rich, and of high quality.

13. The **Black Morocco** is rather remarkable as a strong-growing, productive variety, the fruit being well adapted for sale on local markets and for shipping. The bunches are very large, short, and shouldered, their great size and rigidity making it difficult to pack the fruit. The berries are very large, round, and often compressed; the skin is thick and of a dull purple color. The fruit is deficient in flavor, but its fine appearance makes it excellent for commercial purposes.

A typical bunch of Black Morocco grapes is shown in Fig. 1.

14. The **Purple Cornichon** variety is often spoken of as *Black Cornichon*. The vines are very vigorous and bear large, loose bunches of grapes on long peduncles; the berries, which are borne on long pedicels, are large, long, and more or less curved; the skins are dark in color, spotted, and thick. The quality of the fruit is not the best; but because of its excellent shipping qualities, lateness, and the curious shape of the grapes, the variety is desirable.

In Fig. 2 is shown a bunch of Purple Cornichon grapes.

15. The **White Cornichon** grape resembles the Purple Cornichon in shape and flavor, but it has a thinner and more tender skin than the latter, which makes it better for the table but poorer for shipping. The fruit is, as the name implies, of a whitish color.

A bunch of White Cornichon grapes is shown in Fig. 3.

16. The **Emperor** is an excellent shipping variety that is desirable for the interior parts of California but undesirable for the coast region, where the fruit sets irregularly and often fails to ripen. The vines are strong, vigorous, and productive. The bunches are very large, long, conical, and loose; the berries, which are usually of a dull purple color, are large, oval, firm, and of very good quality.

Fig. 4 shows a bunch of Emperor grapes.

13

Fig. 5

17. The **Gros Colman** is a variety that is remarkable for the large size, fine appearance, and good keeping qualities of its fruit. The vines are strong growers and very productive. The bunches are large, short, and well filled, but not compact. The berries are very large, round, dark blue in color, and have thick but tender skins; the tenderness of the skin and the fact that the berries crack somewhat when ripe make the Gros Colman an undesirable variety for long-distance shipping, although it is one of the best local-market grapes grown.

In Fig. 5 is shown a bunch of grapes of the Gros Colman variety.

18. The **Malaga,** or **White Malaga,** variety is grown in Southern California as a table grape and for the production of raisins. The vines are strong growers. The bunches, which are borne on long, flexible stems, are very large, loose, shouldered, and long; the berries are very large, oval, yellowish green, and covered with white bloom; the skins are thick; and the flesh, which is firm, is of good quality.

A bunch of Malaga grapes is shown in Fig. 6.

19. The **Mission,** a delicious table grape, is grown more or less in California, but it is not shipped out of the state in very large quantities. The vines are very vigorous and productive. The bunches are of medium size, slightly shouldered, and loose; the berries are of medium size, round, dark purplish-black in color, and are covered with a heavy bloom; the skins are thin; and the flesh is juicy, very sweet, and delicious.

20. The **Muscat,** the full name of which is *White Muscat of Alexandria,* is the leading table and raisin grape of the Pacific coast. The vines, although short and straggling, are vigorous and productive, often bearing two and sometimes three crops annually. The bunches are long, loose, and shouldered; the berries are oblong, light yellow in color, nearly transparent, and covered with bloom; the skins are thick; and the flesh is firm, very sweet, and rich, with a musky flavor.

In Fig. 7 is illustrated a bunch of Muscat grapes.

FIG 6

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FIG. 7

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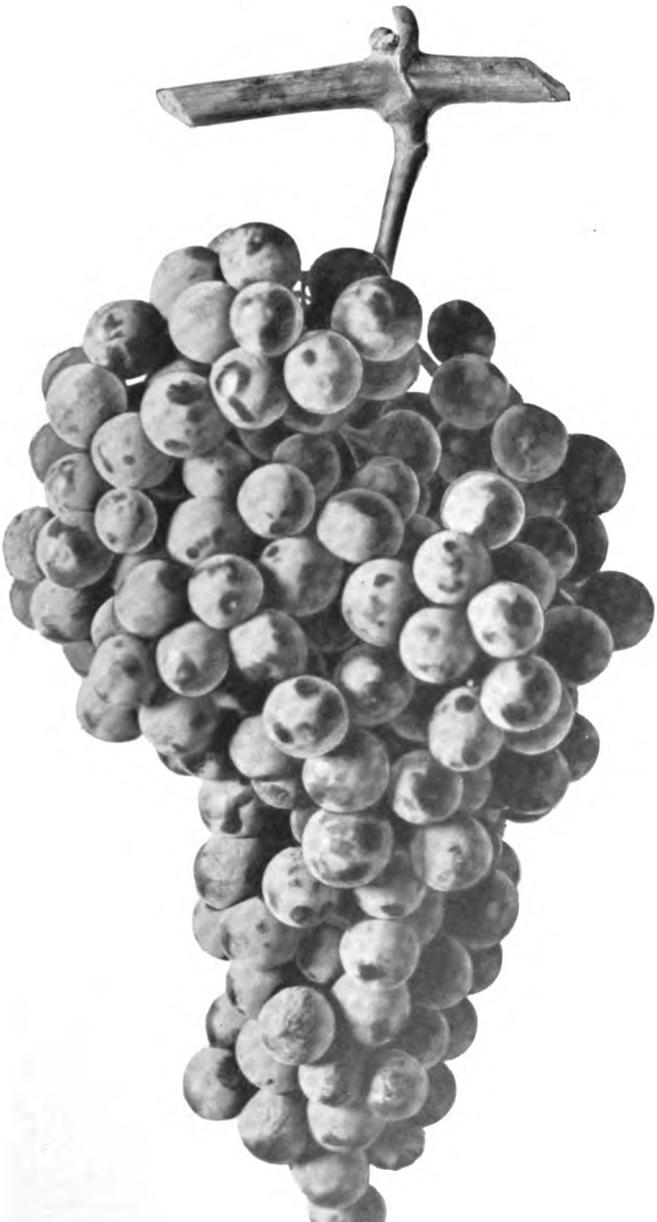

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FIG. 8

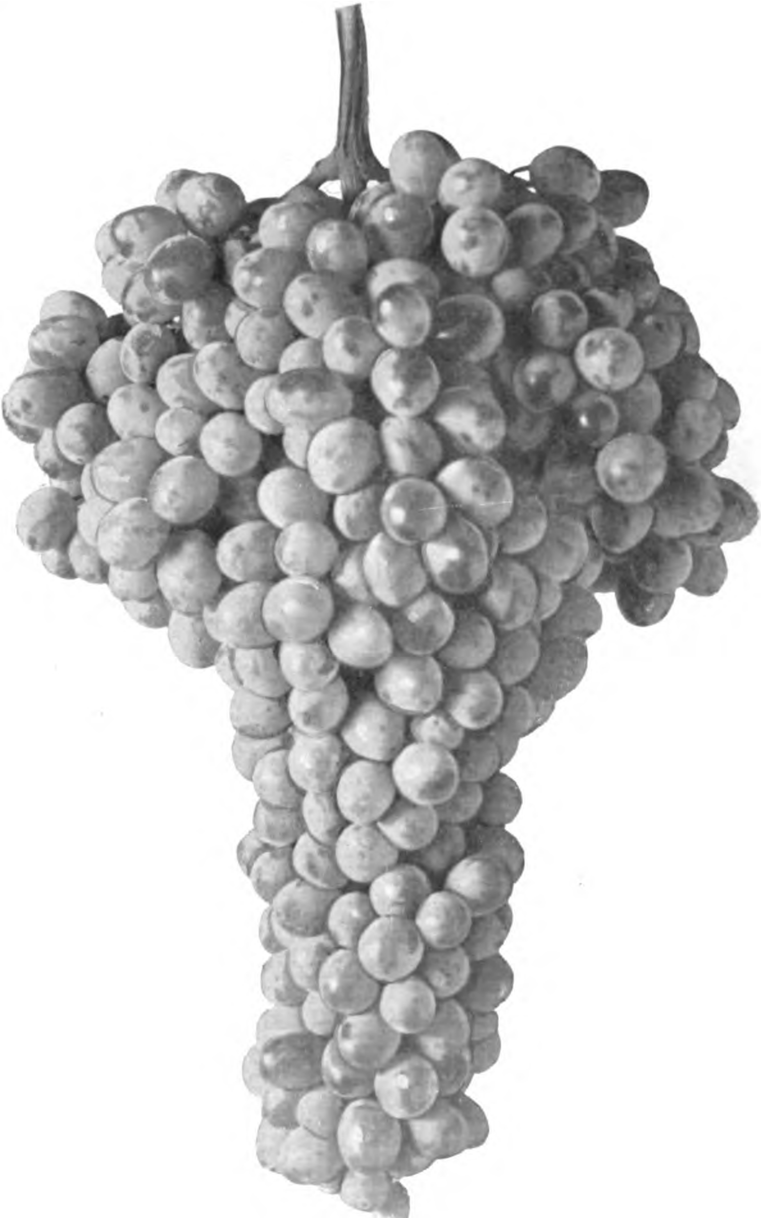

FIG. 9

16

17

FIG. 10

21. The **Palomino** grape is perhaps as well known by the name *Golden Chasselas* as by its proper name. The vines are of medium vigor. The bunches are very large, conical, loose, and shouldered; the berries are round, of medium to large size, sometimes compressed, and pale green or yellowish in color; the skins are thin and tender; and the flesh is rather soft, juicy, and sweet. The Palomino is considered a very good variety for local markets and is shipped to some extent.

22. The **Rose of Peru** is a very productive variety that is well adapted for local-market sale, but the fruit does not stand shipment well. The vines are very vigorous and productive. The bunches are large, shouldered, and loose; the berries are large, round, and black; the skins are rather thin and tender; and the flesh is firm, crackling, sweet, rich, and of the best quality.

A bunch of grapes of the Rose of Peru variety is shown in Fig. 8.

23. The **Sultana** grape was formerly much cultivated in California but in recent years it has been largely superseded by Thompson's Seedless variety. The vines are vigorous and upright growers. The bunches are large, heavily shouldered, and loose; the berries are small, round, firm, of a golden yellow color, and nearly or entirely seedless; and the flesh is of a piquant flavor.

A bunch of Sultana grapes is shown in Fig. 9.

24. **Thompson's Seedless** variety, which is, as the name implies, seedless, is now the most popular seedless grape grown on the Pacific coast, being found in vineyards in all parts of the Vinifera-grape districts. The vines are very vigorous, having an especially large trunk and long canes; the bunches are large, cylindrical, and well filled; the berries are below medium or small in size, and oval; the skins are rather thick and of a fine golden-yellow color; the flesh is firm, crisp, juicy, and of very good quality.

A bunch of Thompson's Seedless grapes is shown in Fig. 10.

FIG. 11

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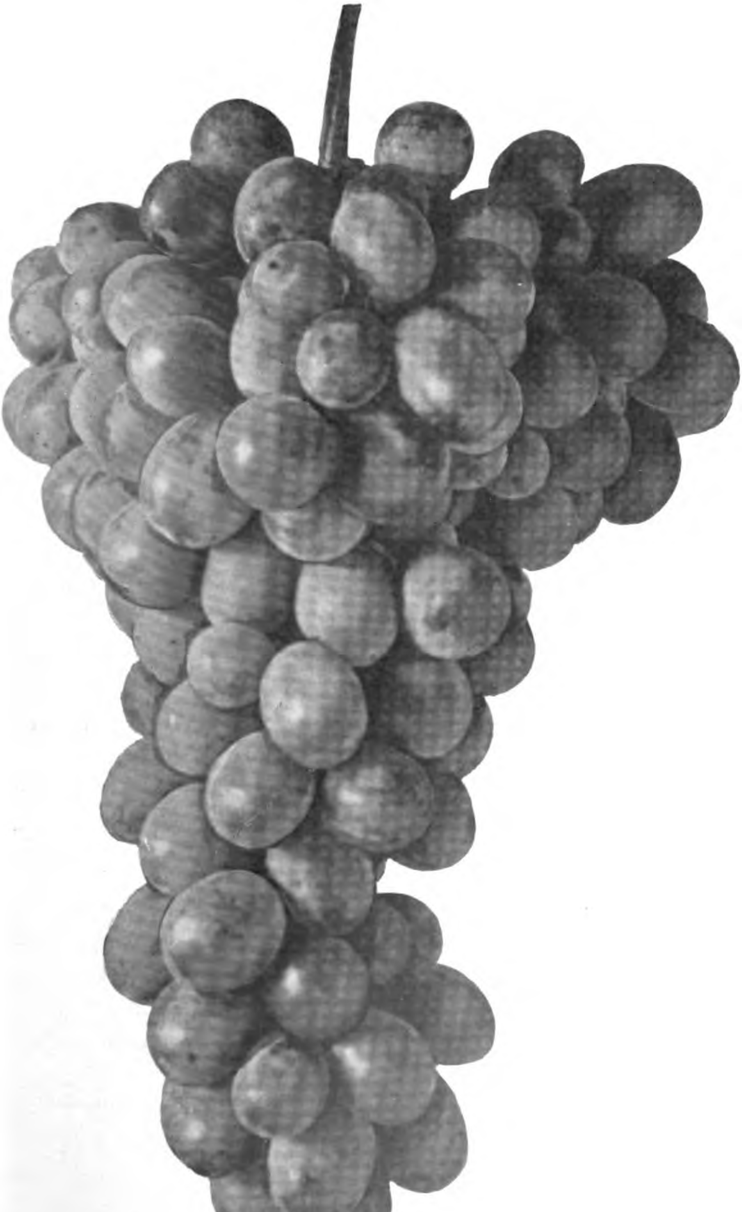

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Fig. 12

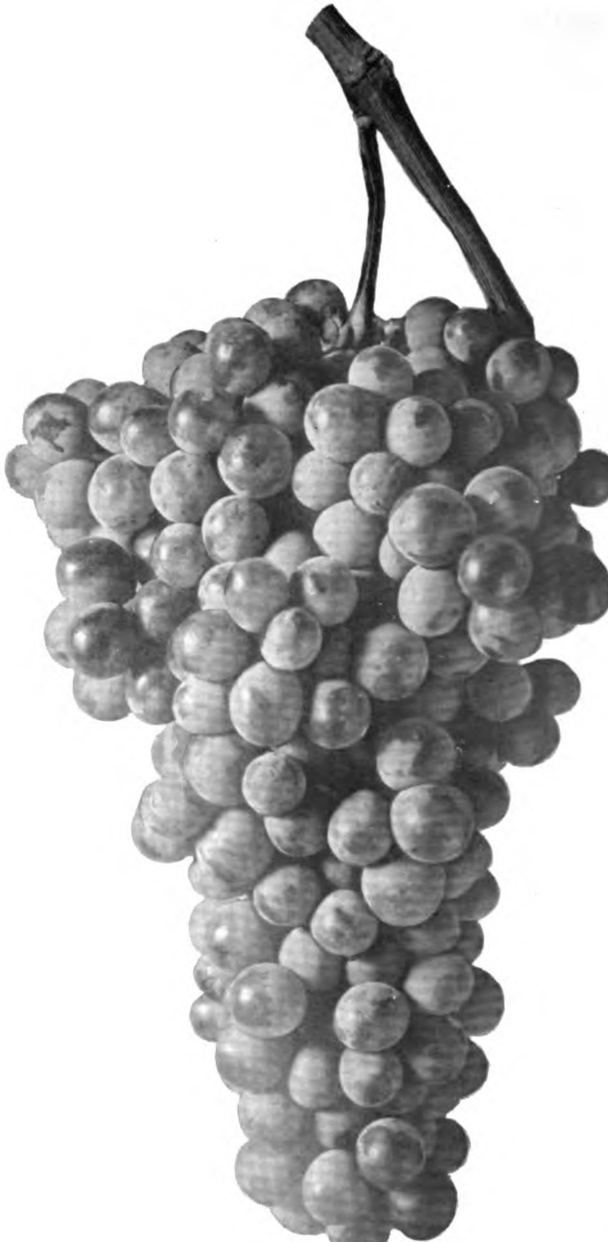


FIG. 13

25. The **Tokay,** or **Flame Tokay,** is the leading shipping grape of the Pacific coast. The vines are very vigorous, all parts being large. The bunches are very large, sometimes weighing from 8 to 10 pounds, compact, and shouldered; the berries are very large, oblong, red or reddish, and covered with heavy bloom; the skins are thick; and the flesh is firm, crackling, and of rather poor quality.

In Fig. 11 is shown a bunch of Tokay grapes.

26. The **Verdal** grape is grown extensively on the Pacific coast for local-market sale and somewhat for shipping as a very late table grape. The vines are hardy and of medium vigor; the bunches are large to very large, irregular, long conical, often with small shoulders, and compact; the berries are of a greenish yellow color and large to very large in size; the skins are thick but tender; the flesh is crisp and juicy but rather insipid in flavor.

27. The **Dattier de Beyrouth** grape, a recent introduction into California, gives promise of being extensively cultivated. The grape is one of the most popular varieties of Asia Minor. The bunches are large but only slightly shouldered and never compact; the berries are large, oval in form, very fleshy, of a beautiful golden-amber color, and are covered with a whitish bloom; the flesh is juicy and sweet, with little or no acidity. The keeping qualities of the fruit are unsurpassed. The season of this variety is August.

Fig. 12 shows a bunch of Dattier de Beyrouth grapes.

28. The **Dronkane** is a late shipping grape that is excellent for table use. The bunches are large and compact; the berries are oval shaped, of a metallic-red color, very firm, and highly flavored. The fruit is of better quality than that of the Emperor. The variety is not grown extensively in California.

In Fig. 13 is shown a bunch of grapes of the Dronkane variety.

29. The **Gros Guillaume** is a black table grape of excellent quality. The bunches are of medium size; the berries are large, often being as large as Damson plums, of the very best

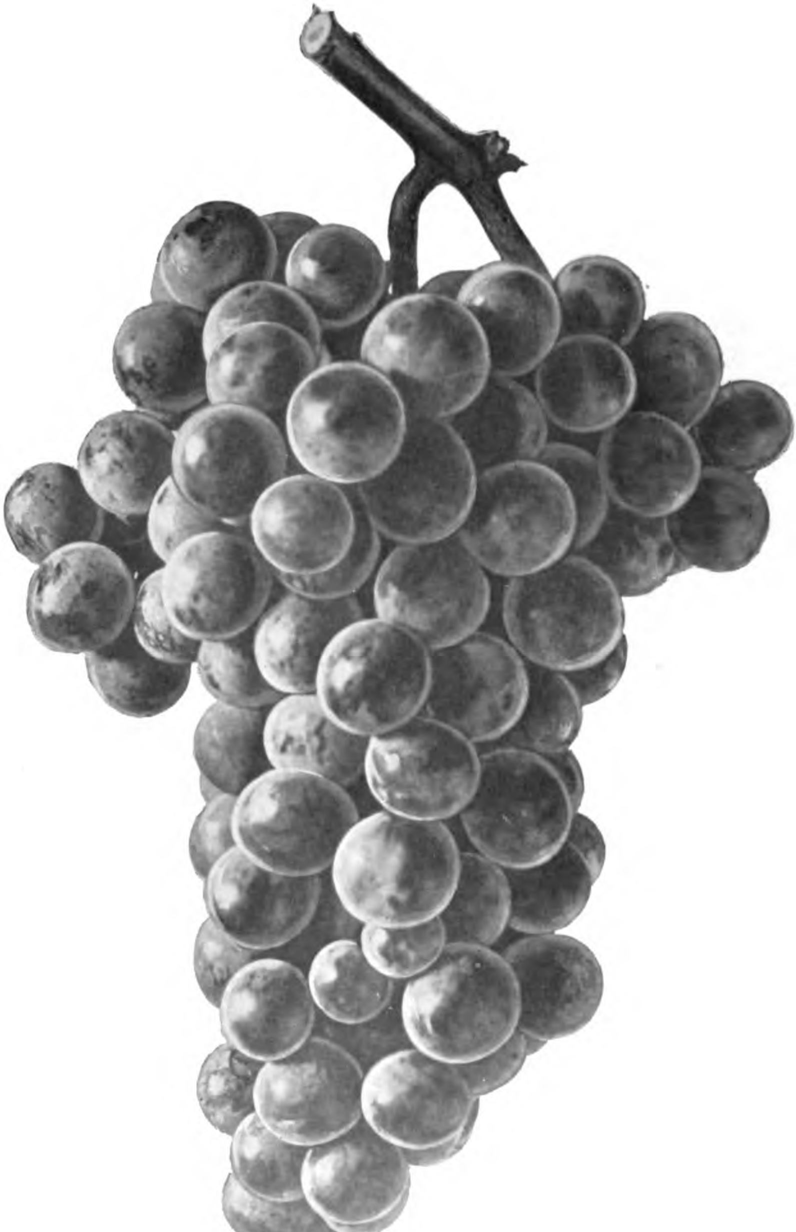


FIG. 14

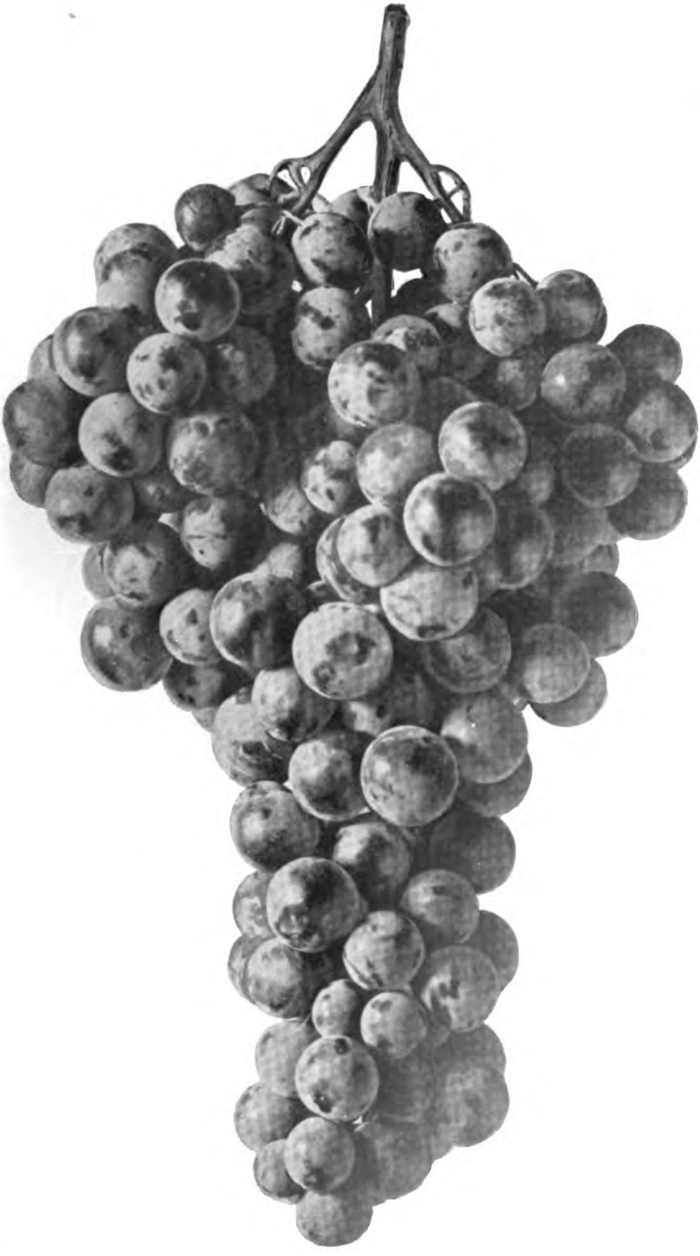


Fig. 15

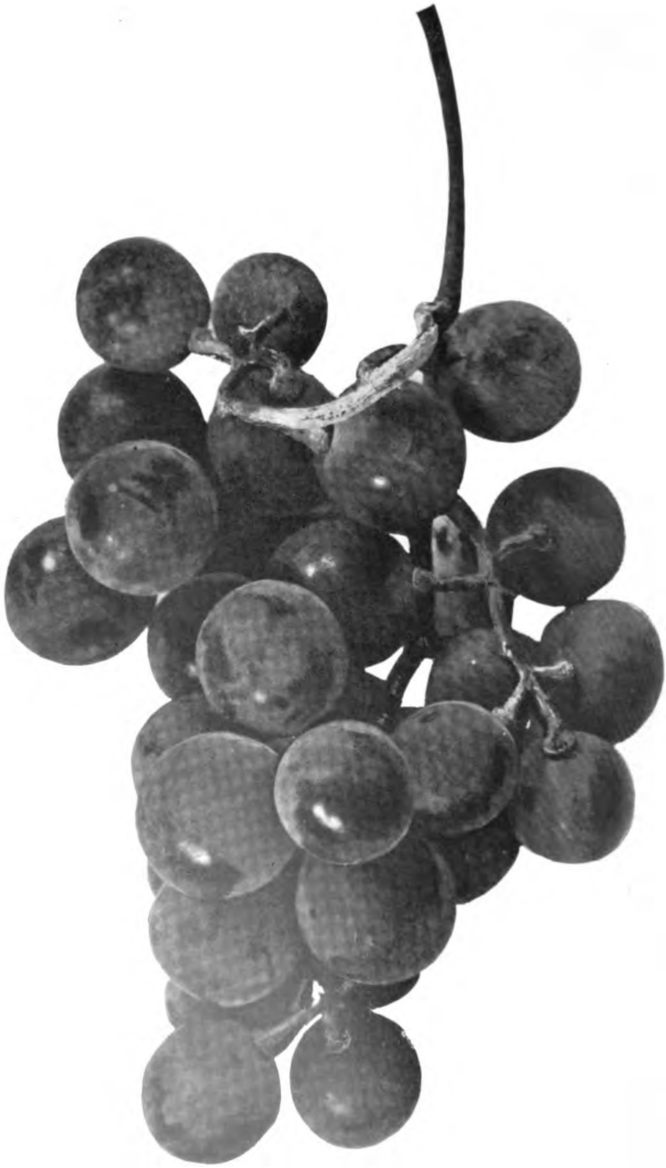


Fig. 16

flavor, and black; the fruit, which has the appearance of having been molded in wax, ripens early in September but keeps well until the middle of October. The variety is recommended for trellising.

A bunch of Gros Guillaume grapes is shown in Fig. 14.

30. The **Maraville de Malaga** is an excellent market variety of table grape. The bunches are long and loose; the berries are large, conical, oval, of a reddish color, and when the fruit is fully matured, they have a bluish tint; the flesh is crisp and juicy. The fruit of this variety ripens in September and will keep in good condition until the middle of October.

Fig. 15 shows a bunch of Maraville de Malaga grapes.

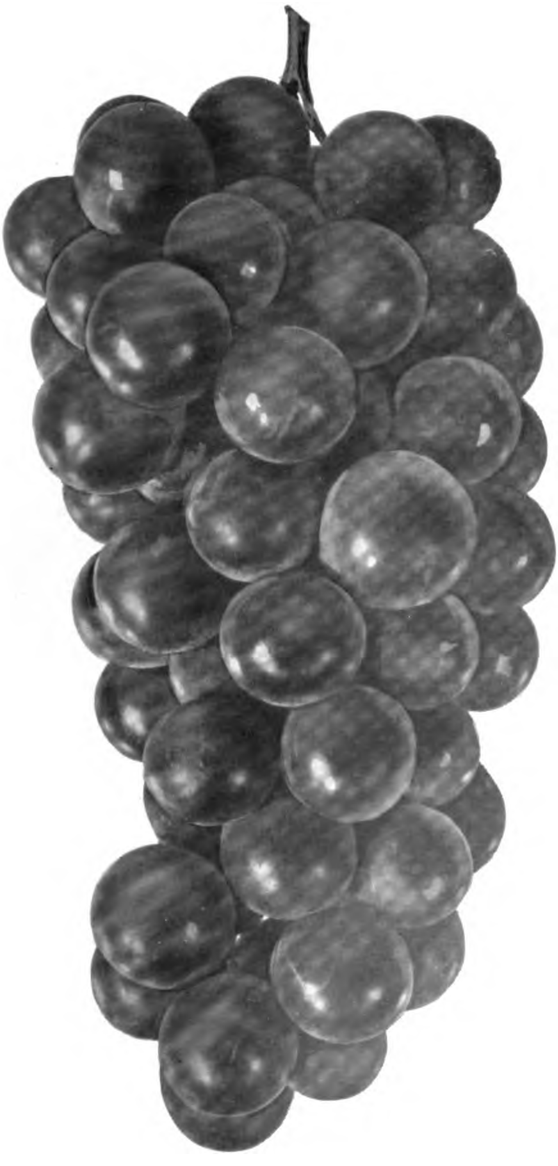
LABRUSCA VARIETIES

31. The **Labrusca** is by far the most important species of grapes cultivated east of the Rocky Mountains. To this group belong more than three-fourths of the grapes grown in the region in which the species thrives. The characteristics that make Labrusca grapes preeminent are: their adaptability to a wide range of conditions, their vigor and hardiness, their resistance to disease, their productivity, the ease with which they can be propagated and cultivated, and the great diversity of the varieties. Labrusca grapes may be crossed readily with those of other species; in fact, the Labrusca has been crossed with the Vinifera grape and with all of the cultivated species of the United States. The following are the most important Labrusca varieties and hybrids.

32. The **Agawam** is the best known of the hybrid grapes of the Labrusca and the Vinifera species. The qualities that commend the Agawam are: the vigor of the vines; the attractive appearance, fine flavor, and excellent keeping qualities of the fruit; and the capacity of the variety for self-fertilization. The bunches are large; the berries, which are large and oval, are of a beautiful purplish-red color, and have a rich, sweet, aromatic flavor.

A bunch of Agawam grapes is shown in Fig. 16.

FIG. 17



27 FIG 18

33. The **Brighton** is one of the leading varieties for amateur grape growing and is also important as a commercial variety, ranking among the ten or twelve leading commercial grapes of the Middle and Eastern States. The vines are vigorous and productive but the variety is self-sterile to a more marked degree than any other native grape. The Brighton is well adapted to a variety of soils and is noted for its resistance to fungi. The fruit, which is of a light- to dark-red color, is very attractive in appearance, but it deteriorates in quality very quickly after being picked.

In Fig. 17 is shown a bunch of Brighton grapes.

34. **Campbell's Early** variety is deficient in not being adapted to many soils and in being rather unproductive, but it is an excellent grape for marketing. The fruit ripens early, usually about 2 weeks before the Concord. It is of large size, has an attractive appearance, a rich, sweet flavor, and is of high quality when mature. The berries, which are of a dark-purple color, have small seeds that separate readily from the flesh.

Fig. 18 shows the fruit of Campbell's Early variety.

35. The **Catawba** is one of the leading varieties of grapes grown east of the Rocky Mountains. One of its chief points of excellence is its adaptability to a great variety of soils. The vines are vigorous, hardy, and productive. The bunches are large and very attractive; the berries, which are of a dull purplish-red color, are rich, sweet, and delicious in flavor when fully ripe; the skins are thick, but not disagreeable; and the flesh is juicy, fine grained, sweet, and rich. The fruit has splendid keeping qualities. The chief defects of the Catawba are that it is susceptible to attacks of fungi, and the fruit matures so late that the variety is not well adapted for cultivation in northern regions.

In Fig. 19 is shown a bunch of Catawba grapes.

36. The **Concord** ranks first among the grapes of the Middle and the Eastern States. Probably 50 per cent. of the grapes grown east of the Pacific slope are Concords, and at least 75 per cent. of those put on the markets are of this variety. The qualities of the Concord that make it preeminent are:

FIG. 19 § 13 24909

FIG. 20

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FIG. 19 § 13 24909

Fig. 20

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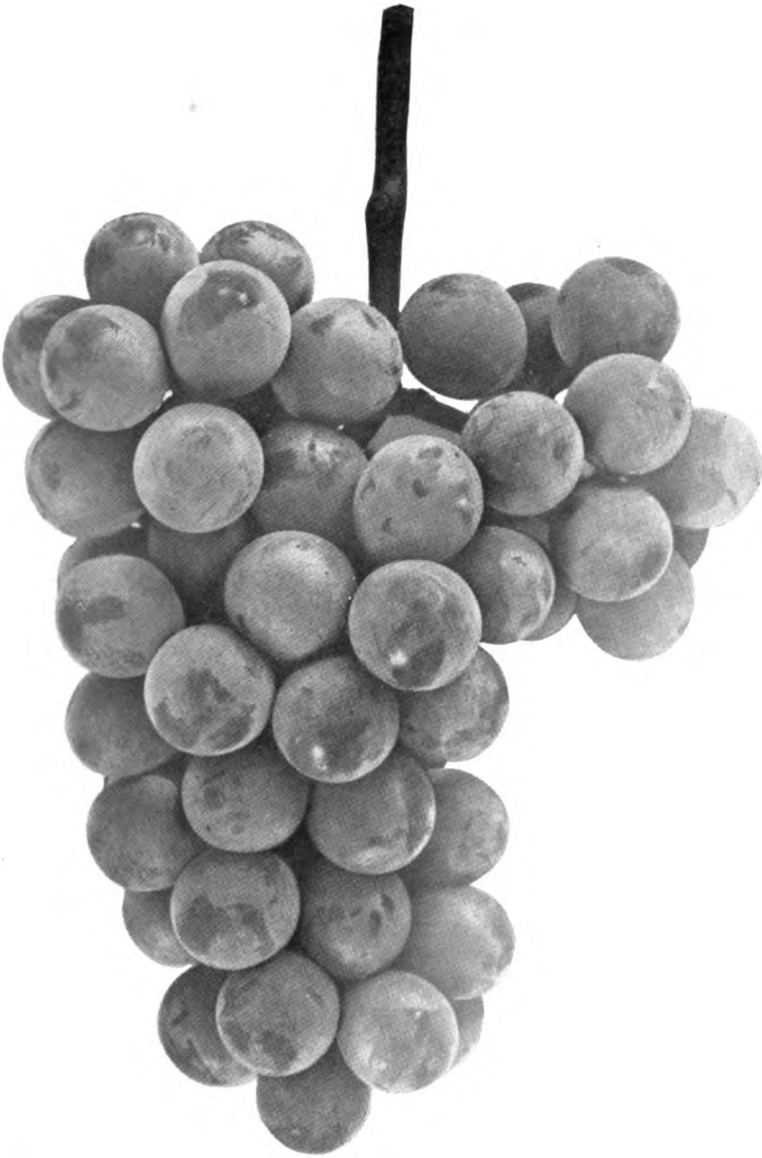


29 FIG. 21

its adaptability to many soils and climates; its great productivity; its hardiness; its ability to withstand diseases and insects; the certainty of the fruit maturing in northern regions; and the attractiveness of the bunches and berries, the latter being of a beautiful blue-black color. The Concord is particularly well adapted to northern regions, because it leafs out and blossoms late in the season and consequently does not suffer from spring frosts. Its faults are: mediocre quality and objectionable seeds and skins; the seeds are large and abundant, and the skins are tough and astringent. The Concord is grown in the South, but it is essentially a northern grape, as it suffers from fungi and insects in warm climates. It is not only one of the best shipping grapes of its class but it is the only grape from which grape juice is made in any quantity, several thousand tons being used each year in the eastern part of the United States for this purpose.

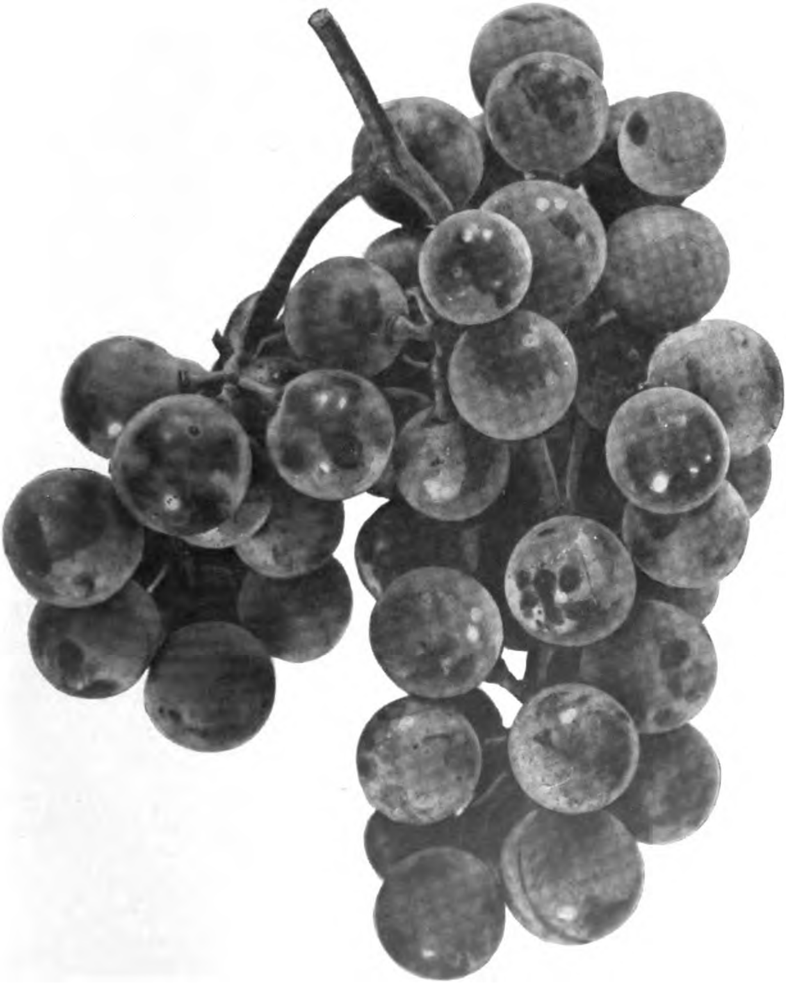
A bunch of Concord grapes is shown in Fig. 20.

37. The **Diamond** is one of the leading green grapes of the Labrusca group, being surpassed in quality and beauty by few other grapes. In fact, it rivals Niagara for first place among the green grapes. It is early, hardy, productive, and vigorous, and the fruit is of splendid quality. The grapes ship and keep fairly well and make a good white wine. The chief fault of the Diamond is its susceptibility to attacks of fungi.

A bunch of Diamond grapes is shown in Fig. 21.

38. The **Eaton** is an offspring of the Concord, which it resembles but surpasses in size of bunch and berry but does not equal in flavor. Its season is a few days earlier than that of the Concord. The vines are healthy, vigorous, hardy, and productive. As the fruit is very soft and juicy and ripens early, the variety is better suited for local-market sale than for shipping.

39. The **Empire State** grape must be classed as being one of the best of the green grapes. The vines are vigorous, productive, and free from fungi and insects. The bunches and berries are large and of good quality, but not quite as attractive in appearance as those of some other green grapes.



31 FIG. 22

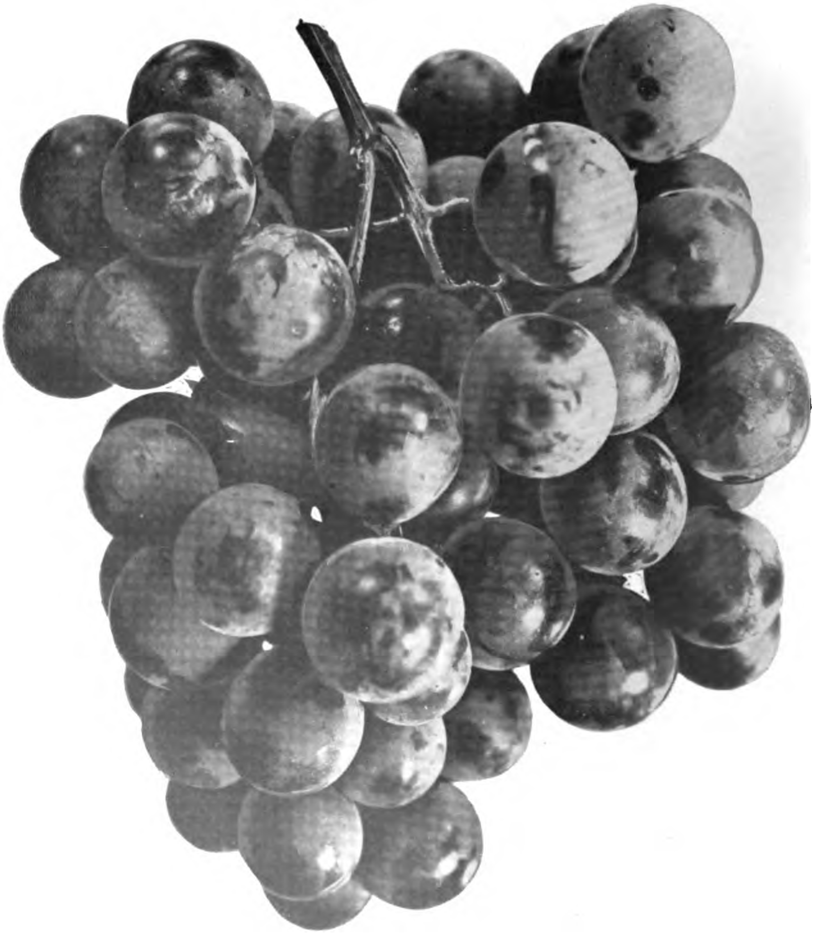
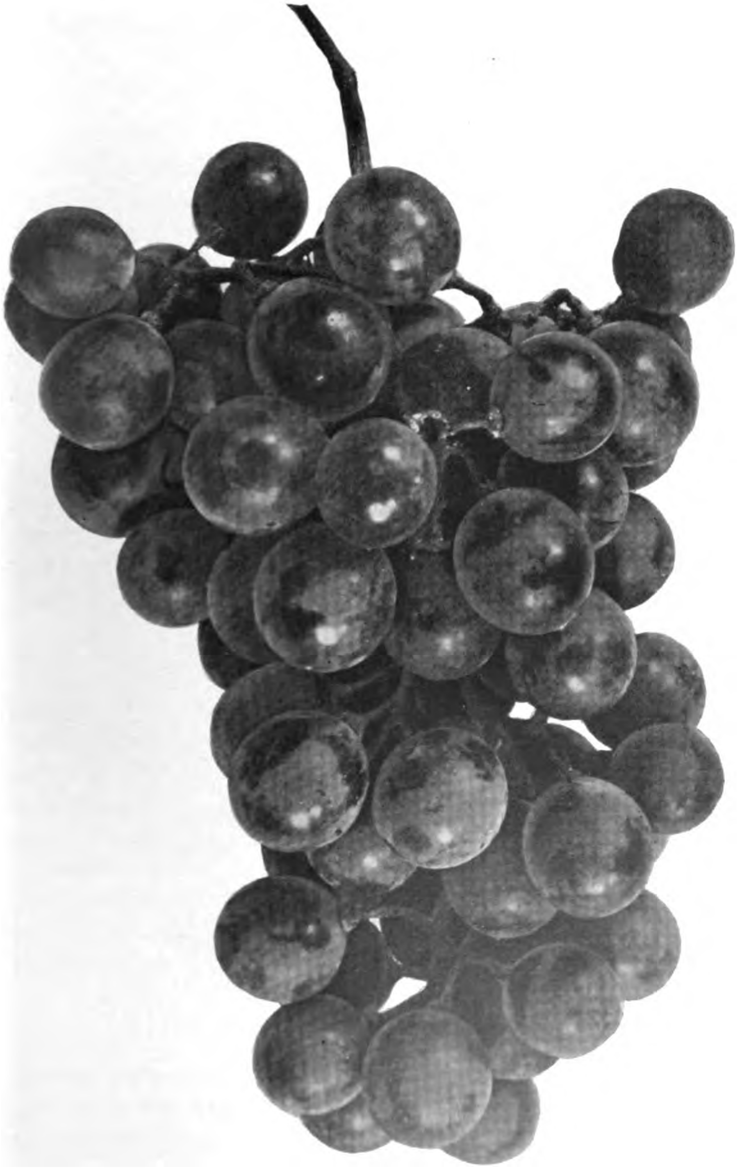


Fig. 23



33 Fig. 24

249—12

The fruit is excellent for wine making and may be shipped to distant markets, as it keeps and ships well. The chief fault of the Empire State grape, as compared with other green grapes, is that it is not very attractive in appearance.

40. The **Gaertner,** which is a cross between a Vinifera variety and a Labrusca variety, is not, when at its best, surpassed in appearance of the fruit by any other such hybrid. The clusters and berries are large and handsomely colored, being a light to dark glossy red. The vines are vigorous, productive, and as hardy as those of any similar hybrid. The fruit ripens unevenly and stands shipment rather poorly because of its fine, tender skin. The Gaertner keeps well, however, and is a splendid grape for local-market sale.

Fig. 22 shows the fruit of the Gaertner variety.

41. The **Herbert** has all of the merits and the faults of the Gaertner, differing from it chiefly in being a black grape, in being possibly a little more productive, and in standing shipment a little better. It has the fault of being self-sterile and consequently must be set near other varieties.

In Fig. 23 is shown a bunch of Herbert grapes.

42. The **Iona** grape is unsurpassed in quality by any of the native grapes, having a delicate and sprightly flavor, which makes it one of the best grapes for dessert and for wines. The bunches and berries are of medium size, the fruit being of a beautiful light-red color. The Iona is best adapted for local-market sale, as it does not ship well and, moreover, must be cared for much better than commercial grape growers are willing to care for grapes. To do well it must be planted in a deep, rather dry, sandy or gravelly soil and in a region that is fairly free from fungi.

Fig. 24 shows a bunch of Iona grapes.

43. The **Jefferson** grape is a cross between the Concord and the Iona. It resembles, although it does not equal, the Concord in vigor, productivity, and healthiness of the vines; in color and quality of fruit it resembles the Iona. Two faults debar it from general culture: it is a little too late, being

 FIG. 25

2 weeks later than the Concord, and is not quite as hardy as is desired. The bunches are large, well formed, and compact; the berries are uniform in size and color, being of a beautiful attractive red; the flesh is firm, tender, and juicy; the flavor is sweet, rich, and vinous. The Jefferson is one of the best grapes for local-market sale.

Fig. 25 shows the fruit of the Jefferson variety.

44. The **Salem** is one of the best of the Labrusca and Vinifera hybrids. The vines are hardy, vigorous, healthy, and productive of handsome fruit of high quality that is suitable for both table use and wine making. The bunches and berries are of large size, the berries being of a beautiful red color. This variety will doubtless be more widely grown in the future than it is at present.

45. The **Vergennes** is the standard late-keeping grape in northern regions, often being found in markets as late as January. The vines are productive and vigorous, seldom failing to bear a crop. The bunches and berries are attractive, the latter being of a dark-red color; the quality is not high, yet it is good, the flavor being agreeable and neither skins nor seeds are objectionable. This variety is somewhat unpopular, because the straggling habit of the vines makes vineyard operations difficult.

46. The **Winchell** is a standard early green grape. The vines are vigorous, hardy, healthy, and productive; and the fruit keeps and ships well, remaining of very good quality throughout the season. Unfortunately, the bunches and berries are small, and this, together with the fact that green grapes are not as popular as black ones, has kept the Winchell from being extensively planted.

47. The **Worden** is a seedling of the Concord and has most of the good qualities of its parent, being equally as hardy, healthy, vigorous, and productive. It differs from the Concord, chiefly in having larger bunches and berries, in being better in quality, and in being a week earlier. The quality that keeps it from being as popular as the Concord is that it is not

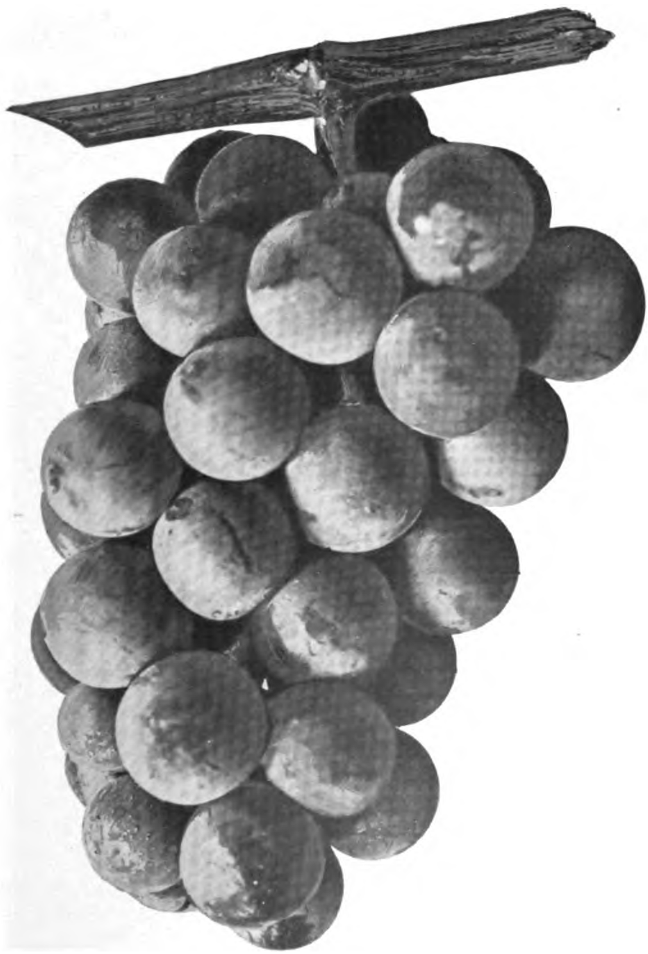


FIG. 26

as adaptable to different soils, and the berries crack badly. The flesh of the Worden is a little softer than that of the Concord and the grapes do not keep quite as well, so that the variety is not as good for shipping. The Worden is one of the best varieties for local-market sale in northern grape regions.

Fig. 26 shows a bunch of Worden grapes.

48. The **Niagara** was at one time the leading variety of green grapes, but plantings of it have so signally failed that it is now ranked below several other varieties. In vigor and productiveness, it nearly equals the Concord, but in hardiness it is far inferior to this variety and to a number of other green grapes. The fruit, although highly esteemed by many, has too much foxiness to be of high quality. The grapes shell badly, do not keep well, and have no value for wine making. The Niagara ripens at about the same time as the Concord. The bunches are medium to large in size, usually shouldered, and compact; the berries are large, oval, and of a light green or pale yellow color; the skin is thin, tender, and astringent; and the seeds, which separate easily from the flesh, are rather numerous and of large size. The defects of the Niagara are such that the variety should be planted as a commercial grape in but few regions.

The fruit of the Niagara grape is shown in Fig. 27.

ROTUNDIFOLIA VARIETIES

49. The **Rotundifolia** is the leading grape of the cotton belt, being grown farther north, however, than cotton. The vines are resistant to insects, fungi, and heat, but do not stand drouth well. The grapes of this species grow best on sandy or alluvial soils, but they are often successful on loams and clays. Under favorable conditions the vines attain great size, live long, and are enormously productive. Rotundifolia grapes part from the cluster when ripe, a drop of juice usually exuding from the berry at the point of juncture with the stem, so that the fruit, if handled in quantity, is badly smeared. For this reason these grapes are not attractive in the markets

FIG. 27

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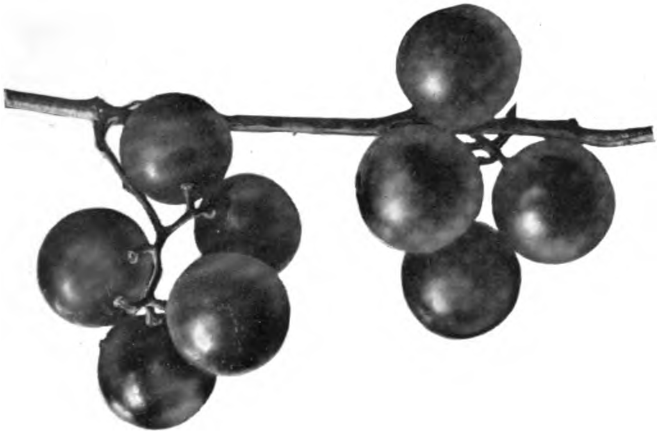

FIG. 28

FIG. 29

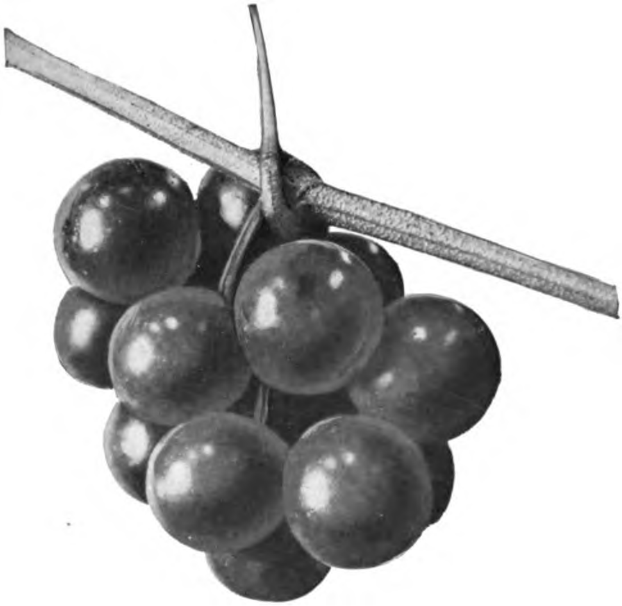

FIG. 30

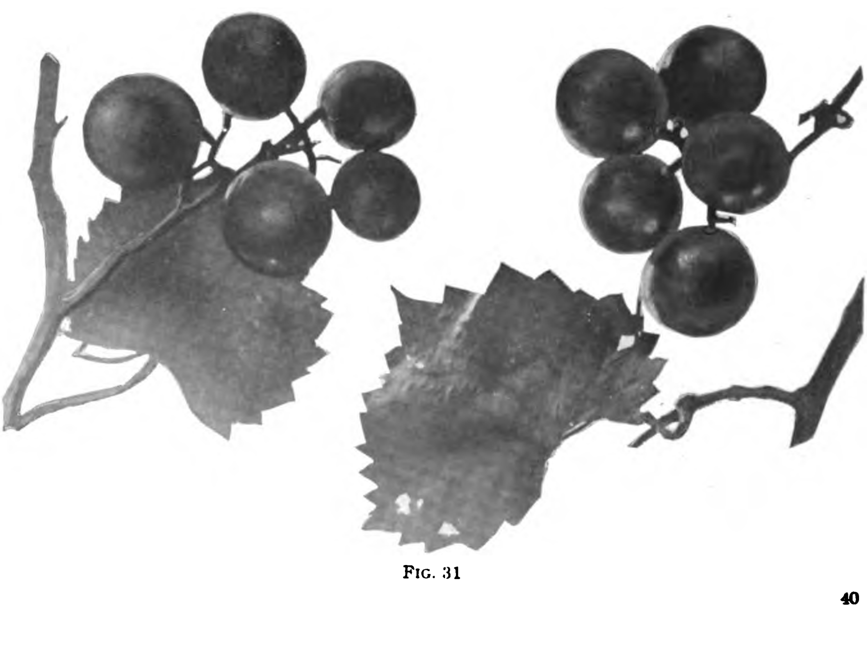

FIG. 31

and are seldom shipped out of the region in which they are grown, although the demand for them is strong.

50. The **James** is probably the best general-purpose Rotundifolia grape for the South. It ripens about the end of August and remains on the vines 2 or 3 weeks longer. The vines are vigorous, productive, and healthy; the bunches bear from four to twelve blue-black grapes of large size; the skins are thin; the flesh is sweet and juicy and the quality is very good.

Fig. 28 shows the fruit of the James.

51. The **Thomas** grape ripens a little later than the James, but does not ripen quite as uniformly. The vines are as hardy and vigorous as those of the James, and even more productive; the bunches usually bear from four to ten reddish-purple grapes; the berries are sweet and of good quality; and the skins are thin.

The Thomas grape is illustrated in Fig. 29.

52. The **Mish** grape ripens at about the same season as the James, but in most qualities it is not as good; the fruit is of a different color and slightly better quality than that of the James. The vines are very vigorous and productive, the bunches bearing from six to fifteen medium-sized reddish-black grapes; the skins are thin; and the flesh is juicy, tender, and very sweet.

Fig. 30 shows the fruit of the Mish.

53. The **Flowers** grape is one of the very late Rotundifolias, ripening the last of September and remaining on the vine until the last of October. The vines are vigorous, healthy, and exceedingly productive, the bunches bearing from ten to twenty large, oblong, purplish-black berries; the skins are thick and tough; the flesh is tough, acid, and pulpy; and the quality is good only when the fruit is very ripe.

54. The **Memory** is considered the best table grape of the Rotundifolia species. The vines are vigorous and productive; the bunches bear from four to twelve large, round, brownish-black berries; the skins are thick and tough; the flesh is juicy, sweet, and tender; and the quality is the best.

The fruit of the Memory grape is shown in Fig. 31.

55. The **Scuppernong,** which is the oldest of the cultivated varieties of the Rotundifolia grape, is extensively grown. The vines are very vigorous, healthy, and productive; the

Fig. 32

bunches bear from six to ten large brownish or amber-colored berries; the skins are thin; the flesh is sweet, juicy, and vinous, having a peculiar flavor that is characteristic of the variety; and the quality is very good. The berries of the Scuppernong do not hang on nearly as well after ripening as those of the black varieties.

Fig. 32 shows the Scuppernong grape.

AESTIVALIS VARIETIES

56. Of the true **Aestivalis** grape, which is a southern species, but two varieties—the Cynthiana and the Norton—are commonly cultivated. The others mentioned belong to the Bourquiniana division. The Cynthiana and the Norton are grown only in the South. They are hardy to heat, resistant to insects, fungi, and drouth, and otherwise adapted to a wide range of conditions. In the Bourquiniana division of the group is found one of the most important varieties of grapes cultivated in America, namely, the Delaware. Aestivalis grapes have been comparatively little used in breeding, and most of the varieties are pure bred. In the true species, the grapes are used almost entirely for wine making, but in the Bourquiniana division the varieties are highly suitable for either dessert or for wine making.

57. The **Cynthiana** is so distinctly a Southern variety that it cannot be grown very far north of the Potomac and Ohio rivers. The vines are vigorous, healthy, usually productive, and hardy in the South. The fruit ripens very late and keeps well; the bunches are medium to small in size and compact; the berries are very small, round, and black, with much bloom; the skins are thin, tough, adherent, and astringent; and the flesh is tough, juicy, spicy, and acid. The fruit is too poor in quality for dessert purposes but is splendid for the making of red wine.

58. The **Norton** is the leading grape for wine making east of the Rocky Mountains, but has small value for any other purposes. The variety has great soil adaptability but does best in rich alluvial soils. The vines are robust, very productive, as free, or more so, from diseases than those of any other native grape, and very resistant to insects. The bunches are of medium size; the berries are small and almost black in color; the flesh is firm, rich, spicy, and pure flavored but acid; and the skins are thick. The fruit keeps well. The variety is difficult to propagate from cuttings and its vines do not bear grafting readily.

Fig. 33

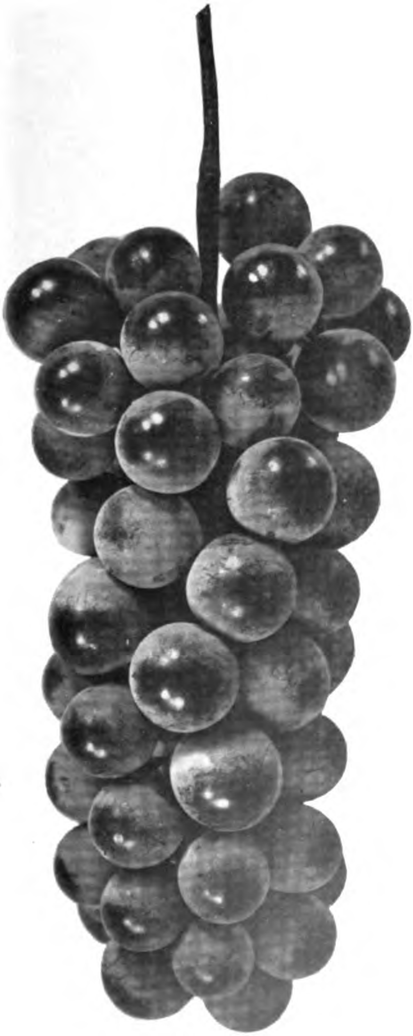

FIG. 34

59. The **Berckmans** grape is a cross between the Delaware variety of the Bourquiniana division and the Clinton variety of the Riparia species. The vines are very vigorous, healthy, hardy, and productive. The bunches and berries are very similar to those of the Delaware, the color being exactly the same but the size being a trifle larger; the quality of the fruit is not quite as good as in the case of the Delaware, the berries lacking somewhat in sweetness and richness. The vines are not as productive as those of the Clinton. This variety is likely to prove satisfactory where either of its parents are successfully grown.

Fig. 33 shows the fruit of the Berckmans variety.

60. Next to the Concord, the **Delaware** is probably the most popular grape in the Middle and Eastern States for local-market sale, for shipping, and for the wine press. It usually sells at a premium, often bringing twice as much as the Concord. The vines are productive, hardy, and adapted to a variety of soils and conditions. The fruit matures sufficiently early to make a crop certain, and keeps and ships well. The berries are of a handsome red color. The faults of this grape are: small size of vines, bunches, and berries, and slowness of growth; also, it suffers very seriously from depredations of robins. The variety is fairly immune to fungous diseases.

A bunch of Delaware grapes is shown in Fig. 34.

61. In the South, the **Herbemont** holds the place that the Concord holds in the North. The variety cannot be grown north of the Ohio river and fails in Missouri and Arkansas because of its tenderness. It is also a little fastidious as to soil and care. The vines, where the variety succeeds, are very vigorous, healthy, and productive; the bunches are large and very attractive; the berries are glossy black in color; the flesh is tender, juicy, rich, sweet, and highly flavored; and neither the skins nor the seeds are objectionable. This variety is esteemed as a table grape and for wine making, and its beautiful foliage makes it an attractive ornamental.

62. The **Lenoir** grape differs from the Herbemont only in a few minor points. In fact, the two are so similar that they are often confused. Both thrive under the same conditions and are planted for the same purposes.

63. The **Moyer** is almost identical with its parent, the Delaware. It differs from the latter in being from one to two weeks earlier, somewhat hardier, and better adapted to colder regions. It is not quite as productive as the Delaware, and the fruit does not set as well nor is it quite as high in quality as that of the latter.

64. The **Walter** is another seedling of the Delaware, which it resembles in many respects. When well grown the fruit is more attractive than that of the Delaware, but is not quite as good in quality. The variety is usually adapted to conditions under which the Delaware thrives, but it is much more subject to fungi than its parent. It is suitable for local-market sale under conditions where especial attention is given to spraying.

RIPARIA VARIETIES

65. As the **Riparia** grape is the most widely distributed of any of the American wild grapes, is one of the healthiest and hardiest, and is of very good quality as a wild fruit, it has been considered of great promise in the evolution of American grapes. It has not, however, fulfilled expectations, chiefly because the grapes do not seem to be variable and consequently are more or less incapable of being improved. The bunches and berries are small, the flavor is sharply acid, and the seeds are very prominent. The vines are perhaps more resistant to the phylloxera than those of any other species. The varieties of the Riparia species have been much used as stock upon which to graft Vinifera varieties. Most of the following varieties bear more or less traces of other species. The grapes make excellent wine.

66. The **Bacchus** is a wine grape that was first grown from seed of the Clinton, which it much resembles in vine characters but surpasses in quality of fruit and in productivity. Little

FIG. 35

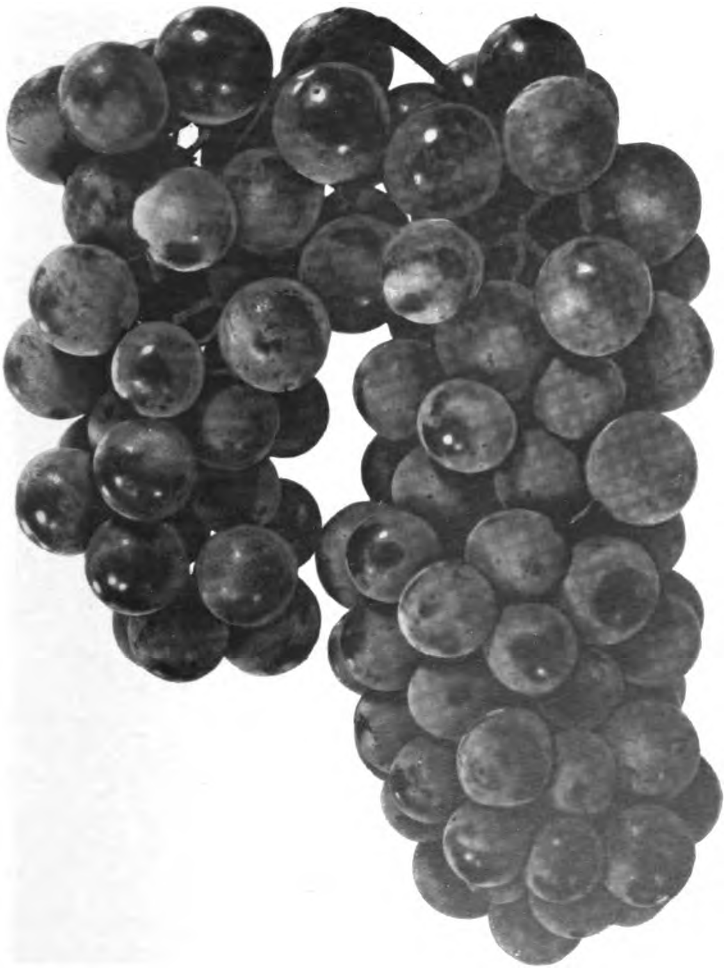

Fig. 36

Fig. 37

by little the Bacchus is superseding its parent. The vines are vigorous, hardy, and productive, free from mildew, and adapted to a great variety of soils. The bunches and berries are small, the latter being of a dark-red color. The fruit is rather too sour for table use, yet if left on the vines until after frosts occur, it becomes fairly good.

A bunch of Bacchus grapes is shown in Fig. 35.

67. The **Canada** grape is another seedling of the Clinton. The vines are medium to very vigorous, hardy, not always healthy, and usually productive. The fruit ripens in mid-season and keeps fairly well. The bunches are intermediate in size, rather slender, and compact; the berries, which are not uniform, are medium to small in size, round, purplish black, and glossy; the skins are thin and rather tough; the flesh is very juicy, tender, spicy, of pleasant flavor, sweet, and rich. The Canada is a very good table grape and is excellent for wine making.

A bunch of the Canada grapes is shown in Fig. 36.

68. The **Clinton** grape is now comparatively little known, its place having been taken by several of its offspring. It is still grown on a small scale, however, because of the great vigor, hardiness, and productivity of its vines. The bunches are small but compact; the berries are small, round, and black; the flesh is firm and sour and does not separate readily from the seeds; and the skins are tough and a little astringent. This variety, like the Delaware, suffers greatly from depredations of robins and other birds. It is not well adapted to limy soils, but grows on almost any other soil suitable for grapes.

The fruit of the Clinton is shown in Fig. 37.

69. The **Elvira** is probably the most popular of the green Riparia grapes for wine making. The qualities which commend it are: its great productivity; its earliness, the fruit ripening at the same time as that of the Concord; its exceedingly good health, the vines being almost free from disease; its great vigor, which is shown by the stocky growth and ample foliage; and its hardiness as far north as Canada. Its good qualities are offset somewhat, however, by the fact that the berries have a very thin skin that cracks easily, thus debarring the fruit from shipment; and by the low quality and poor appearance of the

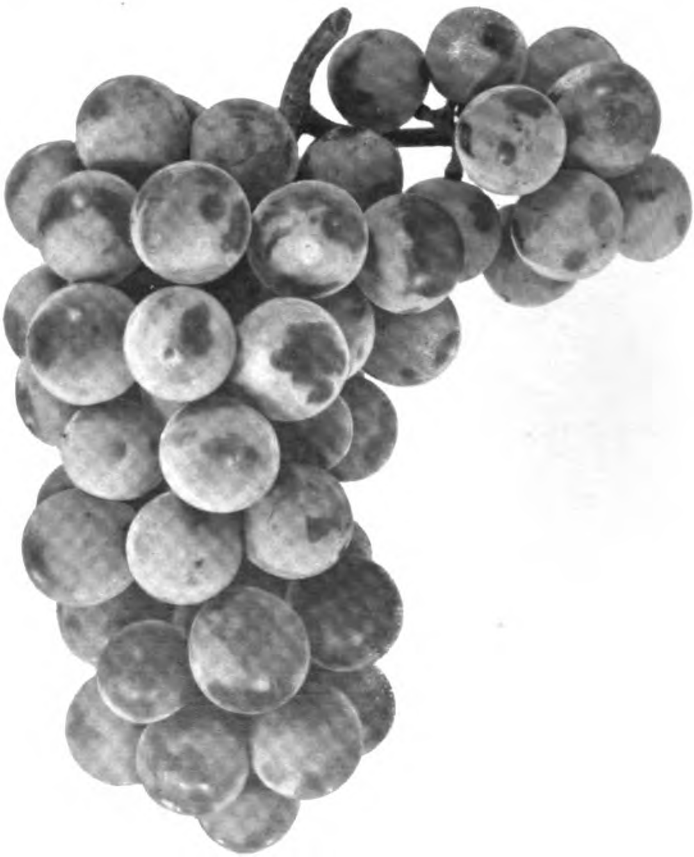

FIG. 38

fruit, which make it fit only for the wine press. The Elvira is highly valued for wine making, the wine being well adapted for blending with more highly flavored wines.

Fig. 38 shows a bunch of Elvira grapes.

70. The **Janesville** grape withstands a greater degree of cold than any other grape and consequently is a good variety for northern localities. It is one of the first grapes to become colored, although it is not ripe until some time after becoming fully colored. The vines are healthy, vigorous, and productive; the fruit, however, is undesirable where better varieties can be grown. The bunches and berries are small, the latter being

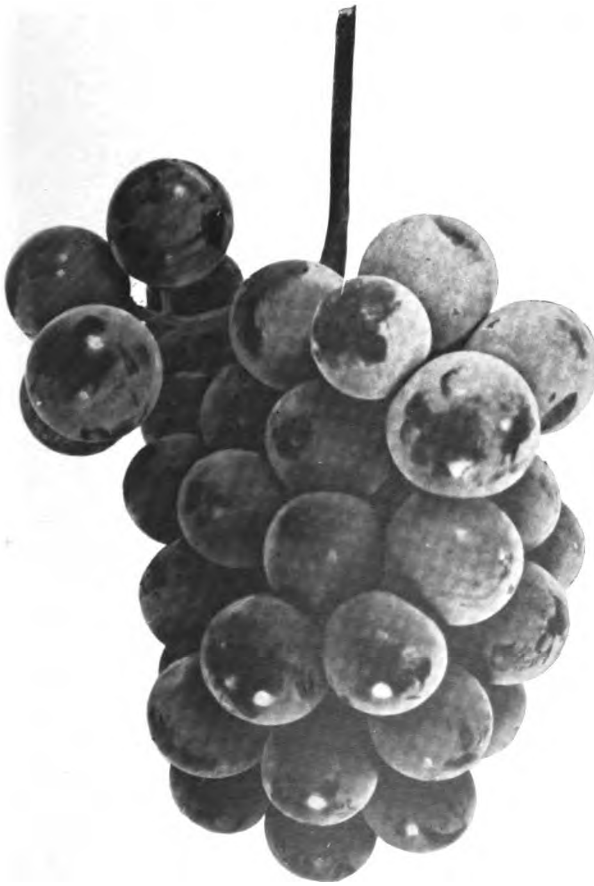

Fig. 39

pulpy, tough, and seedy, and having a thick skin and a disagreeable acid taste; the glossy black berries are not unattractive in appearance. The variety is little subject to diseases or insects and is adapted to most soils.

Fig. 39 shows the fruit of the Janesville grape.

Fig. 40

71. The **Noah** grape is rather extensively grown in Missouri, where it is much used for wine making. It is a green grape, being one of the few good ones of this color in the Riparia species. The variety is remarkable for the health and productivity of the vines. The bunches and berries are large for the species. The fruit ripens at about the same time as that of the Concord, but does not keep and stand shipment as well as Concord grapes. The seeds do not separate readily from the flesh and are numerous; the flesh is tough, although juicy, and rather acid. The Noah is extensively used for making white wines.

In Fig. 40 is shown the fruit of the Noah variety.

GRAPE TROUBLES

DISEASES

72. Like all other cultivated fruits, the grape suffers from various diseases. Fortunately, however, but few of these are prevalent in any one locality, and occasionally some highly favored region is found in which grapes seem to be immune from diseases and many other troubles as well. Such a locality is, of course, valuable for grape growing as long as the immunity lasts, but experience has proved that sooner or later, a decade or two perhaps, pests will come into a locality that was at first free from them.

The five most troublesome diseases of grapes, named about in the order of their destructiveness, are: *black rot*, *downy mildew*, *powdery mildew*, *anthracnose*, and *chlorosis*. Some varieties of grapes are more susceptible to a particular disease than other varieties, consequently a grower should become informed in regard to the prevalence of diseases in a locality before choosing varieties for planting.

73. Black Rot.—The disease known as black rot is probably the most serious of all the fungous troubles of grapes in the United States, both in destructiveness and in distribution

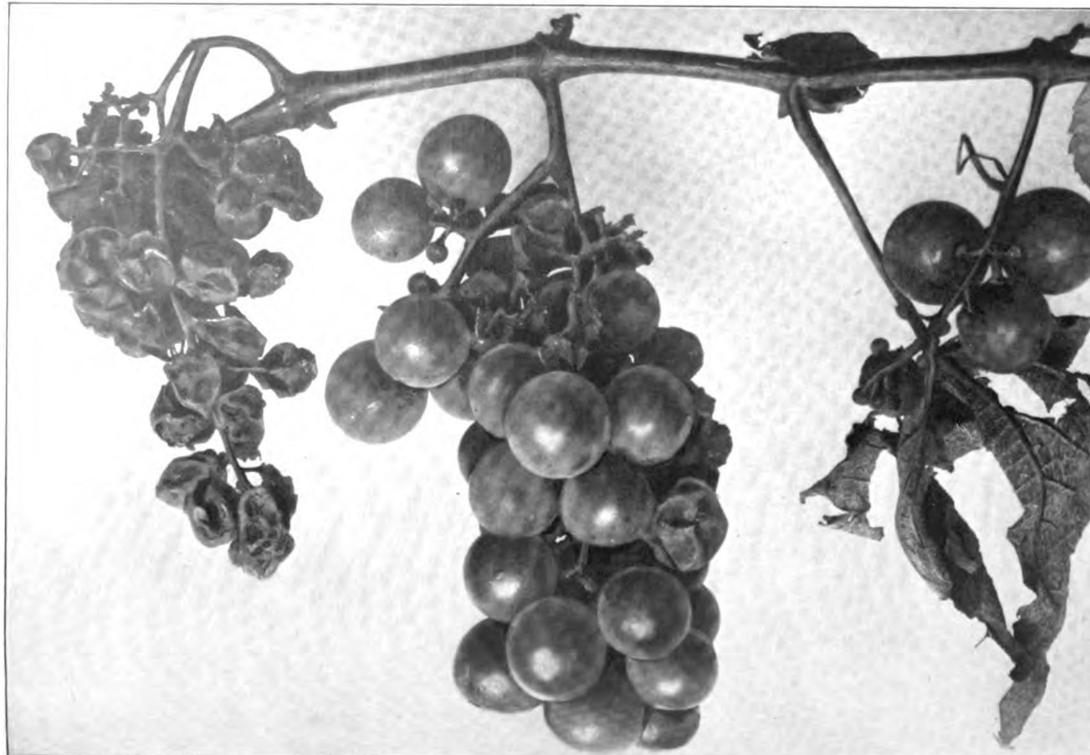

Fig. 41

throughout the country. This disease occurs in all of the grape-growing regions of America, except those of the Pacific slope, and wherever found is a serious trouble in the case of varieties susceptible to it. In many regions grape growing would be impossible because of this disease alone were it not that it can be controlled by spraying. Some varieties are nearly immune from the disease, as for example, the Scuppernong, varieties bearing light-colored fruit generally being freer from it than those bearing dark fruit. Also, there is a great difference in the virulency of the disease in different localities. Comparatively dry regions where the air drainage is good are nearly free from black rot.

Description.—Black rot usually appears first on the leaves, where it forms circular, reddish-brown spots on which black pimples, or spore cases, develop. Within these spore cases, at maturity, are the summer spores. The spores are distributed by the elements to the growing parts of the plant and form new centers of infection. Diseased berries have analogous circular spots that bear spore cases, and as the disease progresses the grapes wither, turn black, and become hard and shriveled, sometimes clinging to the vine until the following spring. Fig. 41 shows the effect of black rot on grapes. Growing shoots are attacked as well as the leaves and fruit. During winter and spring the resting spores are formed, usually on the shriveled berries.

Treatment.—The treatment for black rot consists of destroying, as far as possible, all diseased fruit, old leaves, prunings, and rubbish, and spraying the vines thoroughly with Bordeaux mixture. The spray should be put on at the following periods:

1. Just as the pink tips of the first leaves appear.
2. From 10 days to 2 weeks after the first spraying.
3. Just after the blossoming.
4. From 10 days to 2 weeks after the third spraying.
5. From 10 days to 2 weeks after the fourth spraying.

In regions where the disease is not virulent and in seasons unfavorable to its spread, the fourth and fifth treatments may be omitted.

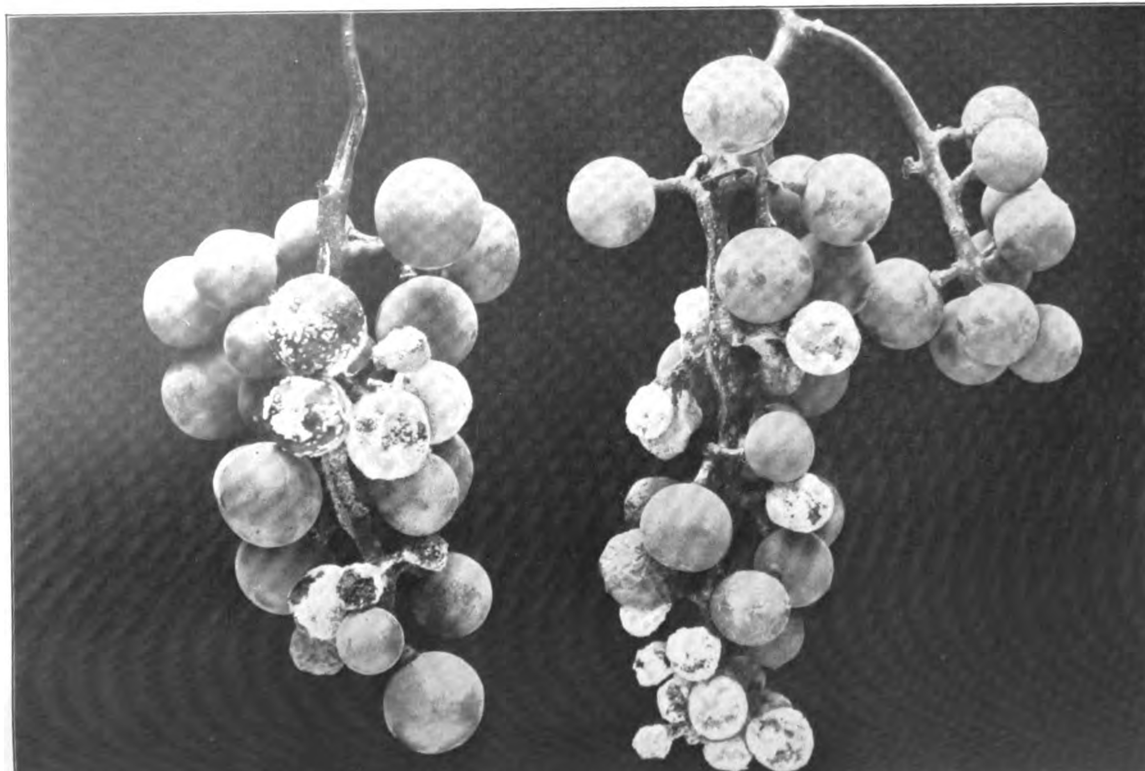

FIG. 42

74. Downy Mildew.—When first known, downy mildew, which is an American fungus, was confined to the Mississippi Valley and the Middle Atlantic States. This mildew is now to be found, like black rot, in all of the grape-growing regions of America, except those of the Pacific slope, but it is not nearly as troublesome in some regions as in others. It is found on practically all grapes, wild or cultivated, and there are few varieties that are very resistant under all conditions. Fortunately, this trouble is relatively easy to control by spraying.

Description.—Downy mildew attacks all of the tender growing parts of the grape. It does much damage to the leaves, on the upper surface of which it produces greenish-yellow spots of irregular outline, and on the under surface a loose, downy, white growth. This white growth consists of short filaments that bear spores, the summer spores, which are carried by the elements to other growing parts of the plant, thus spreading the disease. Affected berries, if young, first show a brown spot, later becoming covered with a gray down, which distinguishes the fungus. The appearance of young grapes affected with the disease is illustrated in Fig. 42. On mature berries the fungus causes a brownish-purple spot that spreads until it covers the whole berry, which sometimes becomes soft and falls, and in other cases becomes hard and remains on the vine. At this stage the disease is commonly known as *brown rot.* The winter, or resting, spores are produced in the tissue of fruit and leaves and have a thick protective covering. The winter spores are dark, almost black, in color. Downy mildew spreads and does most damage in hot, wet weather.

Treatment.—Spraying with Bordeaux mixture as recommended for black rot will keep the downy mildew fungus in check.

75. Powdery Mildew.—Powdery mildew is one of the most universally distributed of all fungi, being found not only in all parts of America on grapes but wherever grapes are grown. In California, it is the most destructive of all the diseases of the vine. Fortunately, it is not a serious trouble elsewhere except in certain seasons and under certain conditions.

It is far more troublesome, too, on some species, such as the Vinifera for example, and on some varieties than on others.

Description.—Powdery mildew is caused by a fungus that lives on the surface of the leaves. It subsists by means of

FIG. 43

sucker-like organs that penetrate the walls of the surface layer of cells. The vegetative portion of the parasite consists of fine white filaments that spread over the surface of the leaves, shoots, and fruit. In summer these filaments send up short, irregular stalks on which large numbers of barrel-shaped spores are produced in chain-like arrangement. These are the summer spores of the fungus. They are borne in greater number on the upper surfaces of the leaves than on the under surfaces, and give the leaves a gray, powdery appearance, as shown in Fig. 43. Affected leaves finally become light brown and often fall. Diseased fruits are gray in color, are scurfy, become speckled with brown, fail to develop, and often burst on one side, thereby exposing the seeds. The winter, or resting, spores are borne in sacks during the latter part of the season. The spore sacks, in turn, are borne in small, black, spherical spore cases, each of which is furnished with a number of slender appendages having curled tips. Powdery mildew, unlike most other fungous troubles of the grape, is usually most prevalent in comparatively hot, dry weather.

Treatment.—Powdery mildew is combated by dusting the vines with flowers of sulphur or by spraying them with Bordeaux mixture, as for black rot. If it is unnecessary to spray for black rot, the sulphur treatment is the better.

76. Anthracnose.—The anthracnose disease of the grape is a comparatively new disease in America, not having been observed until about 1885. It is now prevalent in most parts of the country where grapes are grown, but has not yet been noted with certainty on the Pacific slope. The disease may cause great injury when it becomes epidemic, particularly in view of the fact that it cannot be readily treated.

Description.—Anthracnose attacks all of the tender portions of a growing vine. When the leaves are affected, dark spots are at first formed on their surfaces. As the disease advances these spots enlarge and irregular cracks are often formed through the dead tissue. Frequently, many of these small cracks run together, forming a long irregular slit through the leaf. Similar marks are formed on the tender shoots, although they are not so noticeable. When the fruit is attacked the disease is sometimes called *bird's-eye rot*, circular spots being formed on the surface of the berry. The spots may be of different colors and usually have a dark border; as the spots enlarge and eat in, seeds are often exposed. In rotting, the tissue becomes hard and wrinkled. Sometimes the disease girdles the stem of a fruit cluster, cutting off the supply of sap from the grapes and causing them to shrivel and die. The effect of anthracnose on vines and berries is shown in Fig. 44. Anthrac-

FIG. 44

nose does not spread as rapidly as some other vineyard diseases, neither does it yield as readily to treatment.

Treatment.—When a vineyard is badly infected with anthracnose, prompt attention and careful treatment are necessary to control the disease. It cannot be satisfactorily controlled by Bordeaux mixture alone. It is suggested that in addition to the Bordeaux treatment recommended for black rot, a warm saturated solution of iron sulphate be applied in spring when the buds are swelling but before they begin to open. Before the solution is applied 1 per cent. or more of sulphuric acid may be added to it. This solution must be handled with care, as it is very caustic. It may be applied with swabs or, if the acid is not used, by spraying. It is essential that the work be done thoroughly, all the surface of the canes being covered.

77. Chlorosis.—The disease chlorosis, or *yellow leaf*, causes the foliage to turn yellow and later to become brown. It is common in all parts of the country where grapes are grown. Chlorosis is more likely to appear in wet seasons, and some varieties, such as the Diamond, are more susceptible than others.

Description.—In some instances, portions of the leaves become yellow but may eventually regain their normal color, so that at the close of the season the vine appears to be in a healthy condition. In other instances, the yellow color extends over the entire leaf; brown, dead patches appear; and the leaf curls and eventually drops from the vine. If the vine loses its leaves two or three seasons in succession it is likely to die. One striking peculiarity of the disease is the fact that a badly diseased vine may appear by the side of a perfectly healthy vine of the same variety.

The cause of chlorosis, as given by foreign investigators, is the presence of a large quantity of calcium carbonate in the soil, which prevents the roots from taking up sufficient iron for satisfactory growth.

Treatment.—Experiments seem to show that chlorosis may be successfully treated by applying a small quantity of iron sulphate around affected plants. But as there are a number of good American varieties that are not subject to chlorosis, perhaps the best method to pursue is to plant only such varieties as are known to be free from this trouble.

INSECT PESTS

78. In grape growing a large number of pestiferous insects are encountered, but fortunately many of these are of little or no economic importance, being merely casual visitants. Of all the insects that affect the grape, only six are extremely serious pests, but some one or several of these six must be reckoned with in every part of the country. The important six are: the *phylloxera*, the *grape-vine fidia*, the *steely flea beetle*, the *grape leaf hopper*, the *grape-berry moth*, and the *rose chafer*.

79. The Phylloxera.—The grape phylloxera, a minute insect related to the scale insects and the plant lice, is the most important enemy of the grape. It is a native of the United States east of the Rocky Mountains, where it is found living on wild vines. The phylloxera is present in greater or less numbers on the grapes of all cultivated species. It is particularly destructive to Vinifera grapes, so much so, in fact, that the culture of these grapes on their own roots is impossible except in regions free from the pest. If it had not been discovered that Vinifera grapes can be grown on the roots of American species, the vineyards of California and the Old World would surely have succumbed to this pest, for no satisfactory means of destroying it has been found. The difficulty of control lies in the fact that the insects infest the fibrous roots at a depth of 2 or 3 feet in the soil.

During the first year or two after a vine is attacked by phylloxera there is little apparent damage. In fact, the effect of the phylloxera is equivalent to root pruning, and in some cases results in an unusually large crop of grapes. The year after this crop, however, the vine, having endured the double strain of heavy bearing and root injury, is unable to recuperate and usually dies. In rich, moist soil the death of the vine is not so sudden, and two or even more crops may mature after symptoms of the disease are evident.

The amount of nutriment taken from the vine by such minute insects, even when present in the immense numbers in which they sometimes occur, is not sufficient to account for the disastrous effect of phylloxera on the plant. The death of the vine is largely due to the decay that sets in wherever the phylloxera inserts its sucking tube, for a swelling is produced which soon causes decay. When this swelling occurs at the end of a young rootlet, growth in length is stopped; when it occurs on larger roots, a decay spot is finally formed, which soon extends around the root, and all below the point of attack dies.

Description.—The phylloxera has four forms: the leaf-gall form, the root form, the winged form, and the sexual form. The egg of a sexual insect is laid in the fall on old wood; the following spring a louse hatches from it and at once goes to the upper surface of a leaf and inserts its beak. The irritation thus produced causes a gall to form on the lower side of the leaf. In 15 days the louse becomes a full-grown wingless female and proceeds to fill the gall with eggs, after which it dies. In about a week females hatch from the eggs and migrate to form new colonies. Several generations of females occur in a summer. At the approach of winter the lice go into the ground, where they remain dormant until spring; in the spring they attack the roots, forming galls analogous to those on the leaves and producing offspring that pass through a series of generations similar to those of the insects above ground. In the fall of the second year some of the root forms give rise to winged females, which fly to neighboring vines. These lay eggs on the wood of the grape. The eggs are of two sizes; from those of the smaller size, males are hatched, and from those of the larger size, females. In the sexual stage no food is taken and the insects quickly pair. The female produces an egg that fills its entire body and after 3 or 4 days lays it, this being the winter egg, the beginning of the cycle.

Control Measures.—There are no remedies for phylloxera that are worthy the name. The only efficient preventive is to graft vines of susceptible varieties on to the roots of resistant varieties. The varieties of the Rotundifolia and the Riparia species are more resistant than any other, Riparia varieties being more generally used as stocks, due to the fact that Rotundifolia grapes are hard to propagate and do not make good graft unions with vines of other species.

80. The Grape-Vine Fidia.—The grape-vine fidia, or, as it is commonly called, the grape-root worm, is an American insect that is found in all of the grape-growing regions east of the Rocky Mountains. It is not a serious pest as yet, however, except in New York, Pennsylvania, and Ohio. In these three states it is perhaps the most troublesome pest that vineyardists have to contend with, having been the cause of thousands of dollars of loss during the past 20 years. It is rapidly spreading in the infested Lake Erie region, and there is reason to fear that in time it may ravage the vineyards of all the Eastern States, as it occurs everywhere on wild grapes.

Description.—The grape-vine fidia is a robust beetle, $\frac{1}{4}$ inch in length; it is brown in color but whitened by a thick covering of yellowish-white hairs. The beetle lays its eggs well above ground in the cracks and crevices of the bark of the grape vines. The eggs are produced in large numbers, often as many as several hundred to the vine. When the larvas hatch they quickly worm their way into the ground and begin to feed on the fibrous roots of the vine, passing from these to the larger roots. Possibly the chief damage is done on the larger roots, which are often entirely stripped of bark for a length of several feet. The larvas attain their full size, $\frac{1}{2}$ inch in length, by the middle of August, and then hibernate until the following June. The winter is spent in earthen cells. After about 2 weeks as pupæ in June, the full-grown beetles emerge from the ground and begin to feed on the upper surface of the leaves, eating out the cellular tissue, thus skeletonizing the foliage. The adults disappear the succeeding August.

Fig. 45 (*a*) shows a larva of this insect; (*b*), roots injured by larvas; and (*c*), a leaf injured by larvas.

Control Measures.—The most efficient means known for checking the fidia is an application of an arsenical spray applied during the time the beetles are feeding on the foliage. Arsenate of lead is the best of the arsenicals for this purpose and is usually combined with Bordeaux mixture. Also, the use of 1 gallon of molasses and 6 pounds of arsenate of lead to 100 gallons of water is very effective.

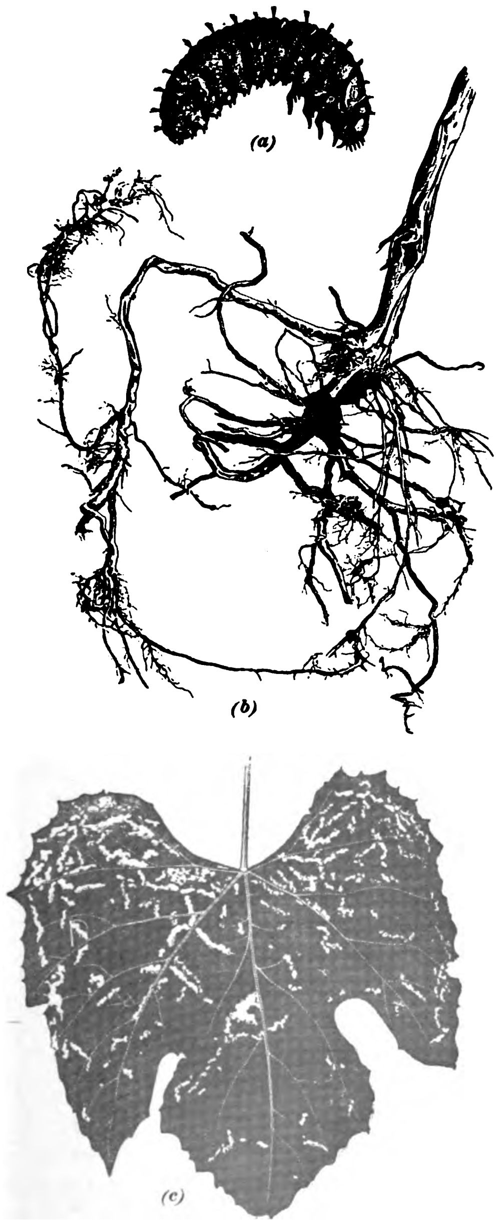

Fig. 45

81. The Steely Flea Beetle.—The steely flea beetle, or grape-vine flea beetle, as it is commonly called, is an American insect that is common to the eastern part of the country, occasionally being found as far west as Colorado and New Mexico. The pest, in the great region inhabited by it, is rather localized, being found in considerable numbers near orchards, undergrowth, woods, or other places suitable for hibernation. The attacks of the beetles are desultory, the insects being scarcely noticeable for a number of years and then suddenly breaking out in great numbers to ravage vineyards for a season or two, after which they disappear. Usually, their attacks are concentrated on a few acres of a vineyard but occasionally a large acreage is infested.

Description.—The adult insects are shiny steel-blue beetles about $\frac{1}{5}$ inch in length. They live during the winter under the bark of old vines or in rubbish in the field. They emerge from their winter quarters during the first warm days of spring and feed on the opening buds and young leaves. Egg laying is begun late in April or early in May. The eggs are placed singly near the buds or on the leaves, and hatch in about 10 days. The young larvas are dark brown in color but soon become prominently marked with black dots and patches. They become full grown in from 3 to 4 weeks, at the end of which time they are from about $\frac{1}{4}$ inch in length. The larvas feed on the foliage, devouring only the soft parts at first, but finally eating irregular holes through the leaves. When ready to pupate they go a short distance into the ground. The adults emerge during the latter part of June or early in July. They probably feed during all of the summer, finally seeking shelter for the winter as previously described.

Fig. 46 (*a*) shows a steely flea beetle enlarged; (*b*), the eggs near buds; and (*c*), larvas feeding on a leaf.

Control Measures.—To control the steely flea beetle, the vines should be sprayed with arsenate of lead, 4 pounds to 50 gallons of water, or with some other arsenical poison, just before the buds begin to swell. Much care should be taken to make this application thorough. Later, when the worms appear on the leaves, arsenate of lead may be applied at the usual

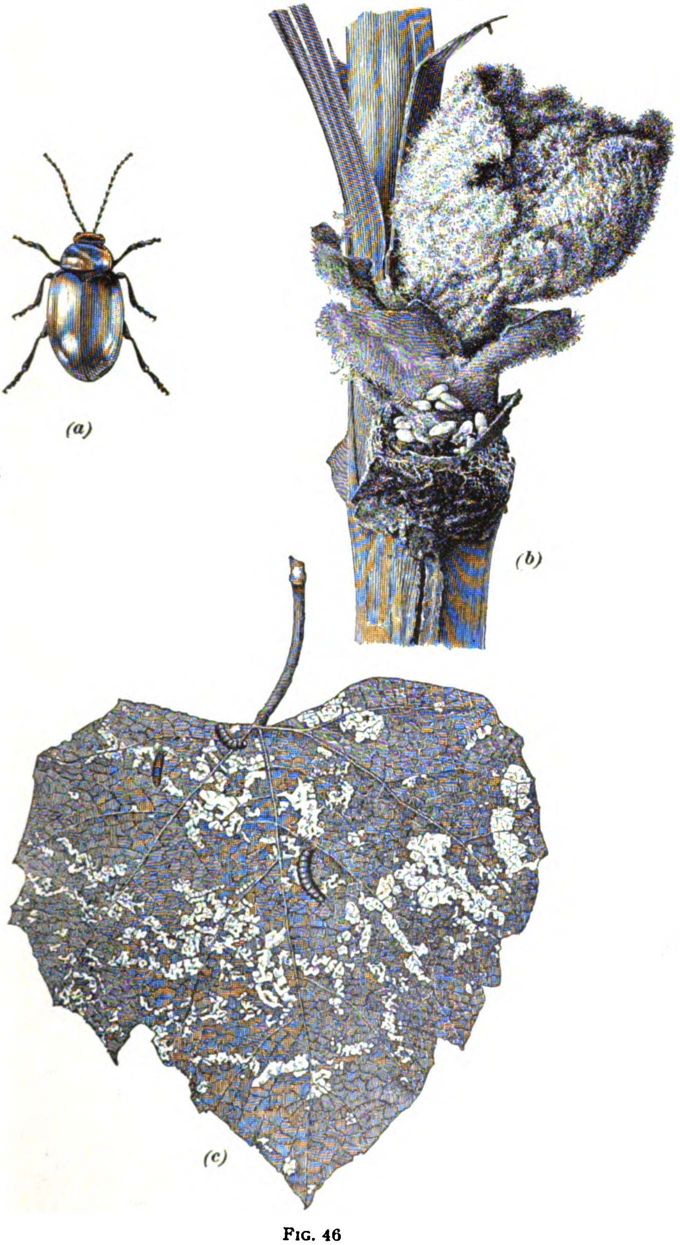

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FIG. 46

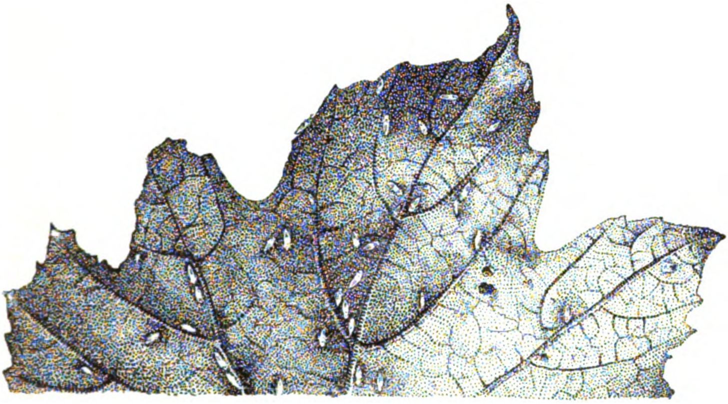
strength, 8 pounds to 150 gallons of water, or combined with Bordeaux mixture. Both the upper and the under surfaces of the leaves should be covered. Applications of arsenicals for the grape-vine fidia will help greatly to keep the steely flea beetle in check.

82. The Grape Leaf Hopper.—The grape leaf hopper, often erroneously known as *thrips*, is an American insect that, so far as is known, is found in injurious numbers wherever grapes grow in this country. The insect is usually of small importance, but during some seasons in some localities it is one of the worst pests, literally destroying the grape foliage of whole regions. Only within the last few years have efficient control measures been discovered.

Description.—There are several species of leaf hoppers that attack the grape in different parts of the country. In the commonest species the adult insects are about $\frac{1}{8}$ inch in length. They vary greatly in color, but the prevailing color is usually a light yellowish green. The back and wings are ornamented with bright red, yellow, and brown. The insects are found on the vines from spring until fall. They feed together, sucking the sap from the leaves, principally from the under surface, causing them to turn brown in patches. The eggs are deposited singly in the tissue of the under surface of the leaves. The young resemble the adults in form, but are not provided with wings and are green or yellowish green in color. There are several broods during the season. Some of the adults of the last brood hibernate in any convenient rubbish about the vineyard.

In Fig. 47 (*a*) are shown leaf hoppers feeding on a grape leaf, the leaf and insects being about natural size; in (*b*), the insects are shown greatly enlarged.

Control Measures.—The hoppers are very easily killed by the use of a nicotine preparation guaranteed to contain 2.7 per cent. of nicotine, diluted with from 65 to 100 parts of water. Lime-sulphur solution as dilute as 1 gallon to 100 gallons of water has proved to be very effective against the leaf hopper, but it generally causes some injury to the foliage and the fruit.



(a)

(b)

FIG. 47

83. The Grape-Berry Moth.—The grape-berry moth does considerable damage in some regions, being particularly injurious to the grape crop of the Lake Erie grape-growing region in Ohio, Pennsylvania, and New York.

Description.—The young caterpillars of the grape-berry moth feed within the grapes, finally causing them to turn dark

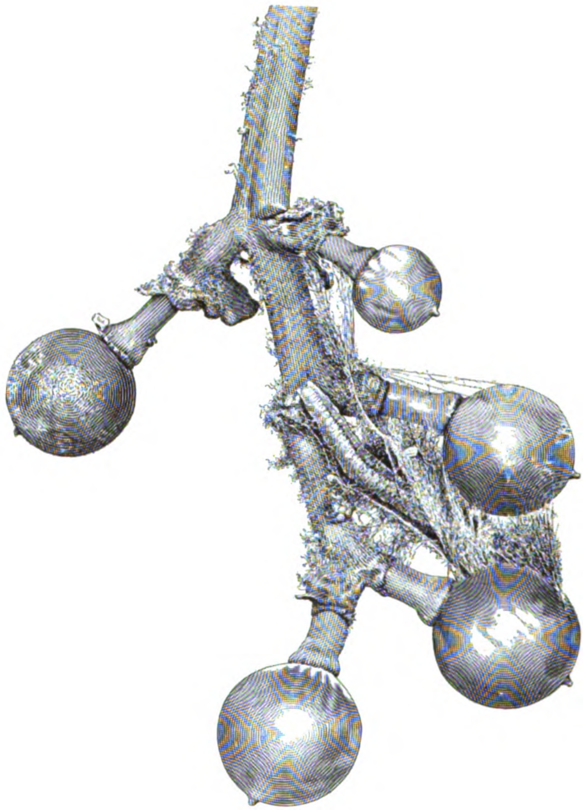


Fig. 48

colored and to wither. This injury is sometimes mistaken for black rot. After devouring the soft parts of one grape, a caterpillar goes to another, fastening the two together by a silken thread. This may be continued until several in a bunch have been destroyed. The young caterpillars are light green in

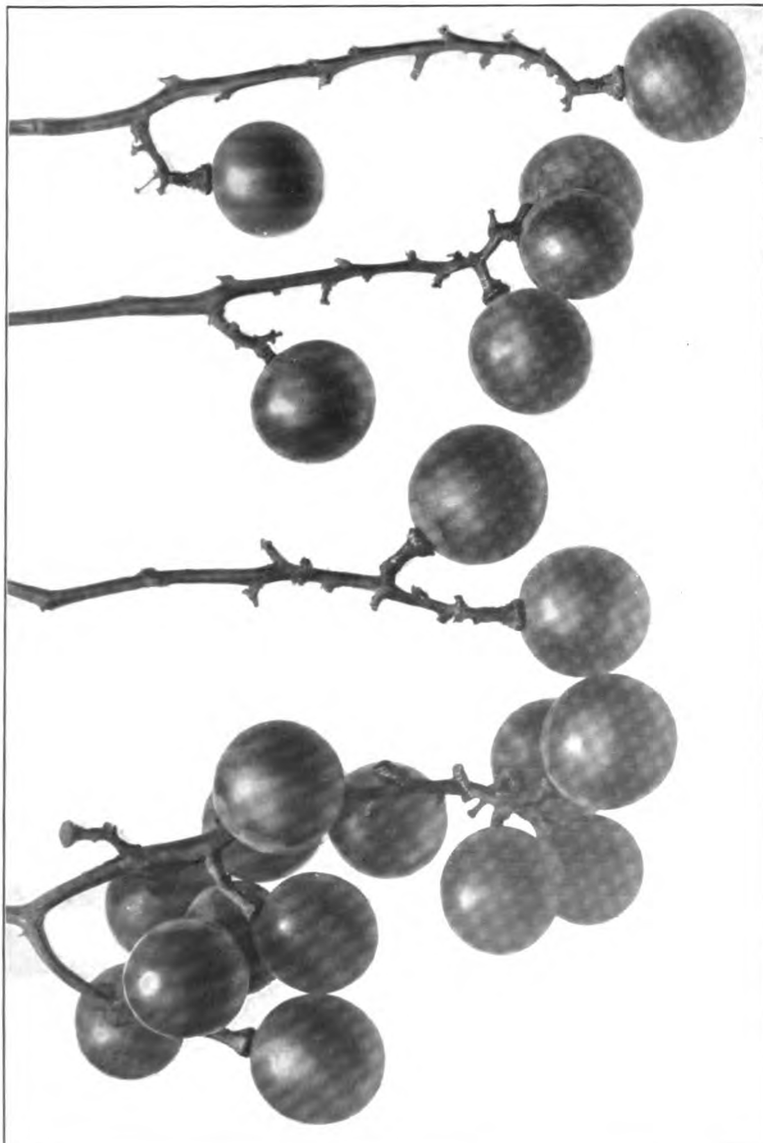


FIG. 49

color, with brown heads. When full grown they measure about $\frac{1}{4}$ inch in length and are of a dark olive-green color, slightly tinged with red. The cocoon is formed on a leaf and is composed partly of two small pieces cut out of the leaf. The adults of the spring brood emerge in from 12 to 14 days. The fore wings have a bluish tinge and are marked with brown and the posterior wings are dull brown. The moths are small, measuring nearly $\frac{1}{2}$ inch from tip to tip when the wings are spread. The eggs are probably laid late in June or early in July. There are two broods annually.

Fig. 48 shows a larva and the work of the grape-berry moth.

Control Measures.—As the caterpillars spend most of their lives within the grape berries, spraying does not entirely control the pest, but the arsenicals applied for the grape-vine fidia will help much in keeping it in check. Picking and destroying infested fruit and leaves containing cocoons also help a great deal.

84. The Rose Chafer.—The rose chafer beetle, found in most of the states east of the Rockies, is a serious pest when it is numerous.

Description.—The body of an adult chafer is about $\frac{1}{2}$ inch in length and is yellow and brown in color. The head and the thorax are really black but are covered with a number of yellow hairs that give these parts a light appearance. The wing covers, which are brown in color, are also covered with yellow hairs. The legs of the insect are of a dark reddish-brown color and the long feet are black. The antennæ of the rose chafer differ very much from those of the grape-root worm and grape flea beetle, bearing knoblike structures at the tips. The adult beetles feed on the blossoms and are thus able to destroy an entire crop; they also do much damage to the foliage.

In Fig. 49 is shown the work of the rose chafer in reducing a crop of grapes. Fig. 50 shows the nature of the injury done to a leaf by rose chafers.

The adults emerge from the ground about the time the grapes are beginning to blossom. Mating takes place during much of the time the adults are feeding. The females burrow into the soil, usually sandy soil, and deposit their eggs, which hatch by the first week in August. The larvas feed on the roots of grass until November, when they burrow to a depth of about a foot and form larval chambers, after which they resume feeding. During the latter part of May the larvas form cells

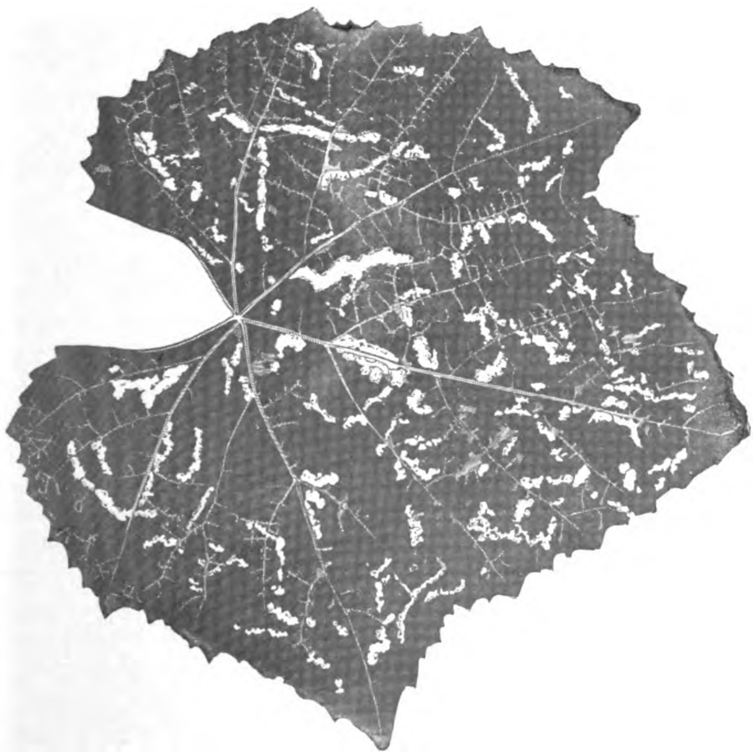


FIG. 50

in which they change to pupæ. The pupal stage lasts from 3 to 4 weeks.

Control Measures.—Experiments have been made with various insecticides to kill the rose chafer. A mixture consisting of 10 pounds of arsenate of lead, 25 pounds of glucose, and 100 gallons of water has been found to be the most effective for killing the insects. The spray should be applied as soon as the insects appear. Experiments show, too, that the numbers of the rose chafer can be materially reduced by cultivating the soil when the insects are in the pupal stage.

MISCELLANEOUS TROUBLES

85. Winter Killing.—Profitable culture of grapes is possible in regions where, under natural conditions, the vines are more or less injured by low temperatures. Indeed, some of the most profitable vineyards in the Northern States are in regions where the extra care to prevent winter killing is more than paid for by the high price received for the fruit.

Where winter injury is imminent, certain precautions are necessary. Cultivation must be stopped comparatively early, and other means, such as withholding nitrogenous fertilizers and sowing cover crops, must be taken to hasten the maturity of the vines. If the danger is but slight, these precautions for hastening maturity may be sufficient. However, if the danger is great, the grape vines must be *laid down*, that is, placed on the ground to be protected by snow or other covering. In order to avoid having trunks too stiff for bending, when laying down of the vines is necessary, the vines should be trained by some system in which renewals from near the ground may be frequently made; the various systems of training grape vines are explained in a subsequent Section.

In the laying down of a vine, the plant must, of course, be loosened from the wires or other supports and otherwise handled so that it is usually advisable to prune it before laying it down. After pruning has been done, a spadeful of earth should be removed from the side of the vine, the vine should be bent over, and earth should then be placed on the canes in such a manner as to keep the vine in place on the ground. In very cold climates or in the case of tender varieties it may be necessary to cover the whole plant with earth. Some growers use coarse manure, straw, marsh hay, or cornstalks for the covering, but for a commercial vineyard, earth is the only practicable material to use. Fence rails or other timbers are sometimes used to hold the vines on the ground, the covering material being placed above these. The laying down can be done at any time after the foliage drops in the fall and must be done before the earth and vines freeze.

It is very important that the vines be taken up at the right time in the spring. If they are put on the wires too early and cold weather follows, injury is much more likely to result than if the vines had not been covered. On the other hand, if the covering is left on too late, the young foliage will be tender to both sunshine and light frosts. The cost of laying down vines varies a good deal, $6 an acre being perhaps a fair average. The chief drawback to the operation is the fact that occasionally a trunk is broken.

86. Frosts.—In the North late frosts sometimes seriously injure vineyards. The first shoots may be killed and the vines are thus forced to put out a second growth on which the crop, if any, must be borne. Grapes that are borne on secondary growths are of small quantity and poor quality. The grower must usually give up hopes of a crop when the young shoots are seriously frosted, but for the sake of the vines the frozen parts should be removed. If these are allowed to remain, the vines are weakened through loss of moisture. The proper procedure is to pull off the frozen shoots, a task that can be done for about $1 or less per acre. Grapes in leaf will stand a temperature of 30° F. without injury.

Fall frosts very often do considerable damage to grapes, although if the fruit is ripe or nearly so a slight frost is of little consequence. Late-ripening grapes should not be planted in localities where early fall frosts are of frequent occurrence. In the case of either spring or fall frosts, much may be done toward averting injury by starting smudges or fires in the vineyards; this is an old and successful practice in Europe. Smudges may be made from straw, leaves, prunings, or rubbish of any kind that will burn in a slow, smoldering manner, but the best practice is to burn crude petroleum, oil, or some tar-like substance in orchard heaters. The theory of the smudge is that the heat of the earth, which would otherwise pass quickly into space, is checked by the smoke. A dense, uniform smudge must be kept going until danger of frost is past, if smudging is to be efficient. By far the best smudges can be maintained on level land where air-currents are not strong.

It is not possible, of course, to build a large or a very hot fire in a vineyard because of the closeness of the plants. For this reason, to heat the air successfully small heaters burning some kind of oil or tar must be used. In the case of smudges, the heat of the fire no doubt makes the protection much greater. Most of the orchard heaters now on the market combine the two functions of smudging and heating. On rolling land it is sometimes feasible to build a large fire at the bottom of a slope, thus creating an air-current that will help somewhat in keeping off frost.

It is very important in the fighting of frosts in vineyards that the grower keep in close touch with the local representative of the United States Weather Bureau. The predictions of this Bureau can generally be relied on as a guide to whether or not precautions against frost are necessary at any particular time. Also, a grower may acquire sufficient skill in the use of a wet-and-dry-bulb thermometer to determine fairly accurately from the amount of moisture in the air whether or not there is danger of frost.

87. Sunscald.—In hot regions and in hot summers in cold regions, the fruit and sometimes the foliage of grapes suffers from sunscald. There is no preventive except to train the vines so as to give shade to the fruit. The fruit suffers less from sunscald where the vines are trained by the drooping systems than where they are trained by the upright and horizontal systems; these systems of training will be explained in a subsequent Section. Trunks and canes of grapes suffer but little from sunscald, either in summer or winter.

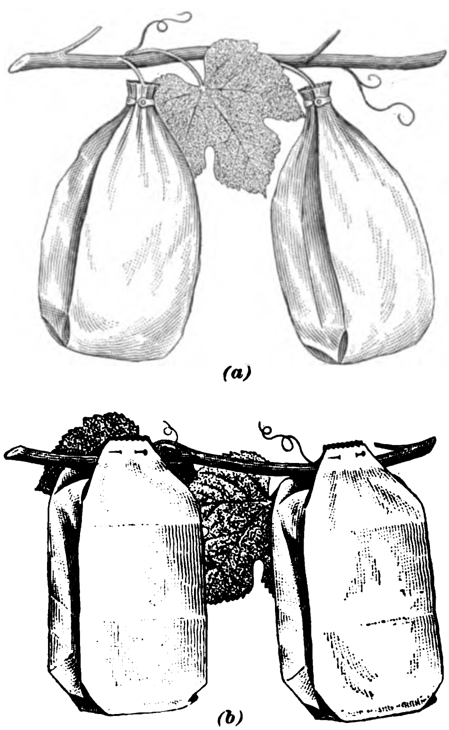
88. Rain, Cold Weather, and Wind.—Rain and the cold and wind that usually accompany it at blossoming time cause the loss of more grapes than any other climatic agency. The damage is done in several ways. The most serious injury is the washing of pollen from the anthers. The secretion on the stigmas also is often washed away or becomes so diluted that the pollen does not germinate. It is probable, too, that the chill of rainy weather decreases the vitality of pollen and prevents the growth of pollen tubes; also, an excess of moisture often causes pollen grains to swell and burst. Rainy weather prevents bees and insects from carrying pollen and in the fall causes the berries to crack.

Where the average daily range in temperature is widest the danger to blossoms is greatest. The most jeopardizing weather to a grape crop, from the standpoint of temperature, is warm, sunny days followed by still, cloudless, cold nights; in such weather the heat of the day forces out the blossoms prematurely and they are injured by frost at night. Cold weather and rains at any time of the year are unpreventable, however, and their injury cannot be lessened.

The good and bad effects of wind on grapes may be summarized as follows: Long-continued, warm, dry winds injure blossoms by evaporating the secretion from the stigmas, thereby preventing the retention and germination of pollen; a cold, dry, north wind at blooming time chills vegetation and stops the normal functions of flowers and leaves; on cold, clear nights, winds keep off frost by renewing the heat or by bringing fogs or clouds from bodies of water.

There is much difference of opinion as to whether or not windbreaks are of value for vineyards. From the experience of vineyardists in many regions, it may be said that the value of a windbreak depends largely on the topography of the land. A windbreak situated so as to cause the air to be still is detrimental as far as cold and frosts are concerned. If it is planted so as to deflect or cause air-currents, it may be of value in keeping off frosts. More often than not, however, a windbreak seriously checks atmospheric drainage, and the damage by frost is thereby increased. Also, when a windbreak is to the north, the buds on the vines so sheltered are forced in the spring and are therefore liable to injury by late spring frosts. Windbreaks also often shelter injurious insects and birds. In very sandy soils in the arid regions of the West, however, windbrakes are necessary to prevent injury from drifting sand.

89. Birds.—In many localities, grapes suffer more from the depredations of robins than from any other trouble. A few other species of birds eat grapes but none do as much damage as robins. Grapes that have small berries and tender pulp and shell readily from the stems suffer most. Among standard varieties, the Delaware is most frequently destroyed by these depredators. There is but one way of preventing the damage by robins and that is to bag the clusters.



(a)

(b)

FIG. 51

Bagging of grapes not only keeps away robins but also insects and fungi. Because of the warmth that the bags give, the bunches ripen a little earlier and the grapes are of slightly higher quality than those not bagged. In seasons of early fall frosts, the fruits are protected also from frosts by the bags. Some growers, especially where a fancy product is desired, consider bagging an absolute necessity to profitable grape growing.

The work of bagging grapes is done as soon as the grapes are well set—when the berries are about the size of small peas; the sooner bagging is done the less damage there will be from fungi. For the bagging of grapes a patent bag made especially for the purpose may be used, or the common 1½- or 2-pound manila bag used by grocers will be satisfactory. In Fig. 51 (*a*) is shown a bag known as the Ideal Clasp bag and the method of using it. This bag has a metal clasp attached to the top for securing the bag in place over a bunch. In (*b*) is shown the method of fastening in place the common manila grocer's bag. Before this bag is placed over a bunch of grapes, the corners of both the top and the bottom are cut off; this cutting off of the corners enables the operator to close the top neatly over the cluster and allows any water that gets in the bag to drain out. The corners of several bags may be cut off at one time by using a broad, sharp chisel. When a bag is being put on, the top is pinned above the lateral from which the bunch hangs, the largest pins to be had of dry-goods merchants being used. The bags should be allowed to remain over the bunches until picking time; they seemingly grow stronger with exposure to the sun and wind.

The heaviest item of expense in bagging grapes is the labor required. Many growers employ women and girls for this work, as they soon become very skilful. It is possible to bag grapes for about $2 per thousand bags; this estimate includes the cost for both bags and labor. Where extra fine grapes are wanted, such an expenditure is justifiable.

90. Rattling, or Shelling, of Grapes.—In the case of some varieties of grapes the berries, under certain conditions, drop badly from the stem. This trouble is known as rattling or shelling. So far, neither the cause nor the remedy for rattling is known. The berries begin to fall first from the apex of the cluster and from bunches farthest from the trunk of the vine. The fruit that drops prematurely is found to have an insipid taste. The conditions under which grapes rattle are various. As a rule, however, the trouble is found in vineyards where the vines are not in good health. The outer margins of the leaves on vines from which grapes rattle are commonly found to be dried up. The cause of rattling is thought by some investigators to be a lack of some element of plant-food, potash being most frequently named, but applications of the several fertilizers have not, as yet, uniformly prevented the trouble. There is a possibility that rattling may be due to a disease of the vine, but no specific disease has been discovered. It is thought by many that the trouble is due to faulty nutrition, but what the conditions are that cause the physiological defect no one has yet discovered. With this uncertainty as to the cause for rattling, no remedy can be suggested, except to keep the vines in vigor and health.

GRAPE CULTURE
(PART 2)

VINEYARD ESTABLISHMENT

CHOOSING OF A LOCATION

NATURAL FACTORS FOR CONSIDERATION

1. In America, grapes are grown in home gardens under an extremely wide range of natural conditions; but as a commercial industry, grape culture is largely confined to certain more or less extensive regions where the conditions are particularly favorable. As commercial grape culture is not possible in all localities, it is advisable for a grower, before planting a vineyard, to know what conditions are necessary for the success of the business. He should know what influence certain natural factors have in adapting a locality for grape culture.

The chief natural factors that should be considered in the choosing of a location for a vineyard are: the latitude and altitude, the water supply, the soil, air-currents, and insects and fungi.

2. Influence of Latitude and Altitude.—The varieties of any species of grapes are usually best adapted to the latitude in which the species grows wild, and they will not do as well in a different latitude. Varieties that are native to the North do not succeed in the South, and vice versa. In view of this fact, a grape grower should know the species to which a particular variety belongs and the range in latitude of the wild grapes of the species. Most cultivated varieties have a more or less wider latitudinal range, however, than wild varieties of the same species, growing successfully a little farther north and south than the species is found naturally.

Three very important points are, to a considerable extent, determined by the latitude and altitude of a locality, namely, the range in temperature, the amount and intensity of the sunlight, and the length of the growing season.

Grape growing is affected more by temperature than by any other single factor. Temperature largely determines which varieties can be grown successfully in any region, and, in many seasons, whether there shall be a crop even in favorable localities. Its influence may be seen at different seasons of the year in winter-killing, damage by spring or fall frosts, shriveling and drying up of the leaves, and sun scald of the fruit. In general, regions in which there is a comparatively low temperature during the growing season of May, June, and July, and much sunshine during the maturing season of August, September, and October, produce the best grapes. The temperature of a region may, of course, be influenced by the proximity of bodies of water as well as by latitude and altitude.

The amount and intensity of the sunlight is a prime factor to consider when choosing a location for the growing of grapes, because on sunlight depends to a high degree the percentage of sugars and solids in grapes. The percentage of these constituents is of importance when the grapes are to be used for the making of wine, grape juice, or raisins, and affects to a considerable degree the keeping and shipping qualities of dessert grapes. In general, the more sunshine and the greater its intensity in a grape-growing region, the better is the region for grapes.

The length of the growing season has much to do with the adaptability of a locality for the growing of a particular variety. For instance, many Southern varieties are perfectly hardy in vine in the North, but the seasons in the Northern latitude are not long enough for the fruit to ripen. On the other hand, some Northern grapes mature so early in the South that they pass through maturity to decay so quickly as to be worthless. If a grower desires to cultivate certain varieties he should, therefore, choose a location where the length of the growing season will be suitable.

Notwithstanding the preceding statements, it is important to keep in mind that the normal influence of latitude and altitude is often set aside in grape growing by local modifications. For example, it often happens that valleys in a region not apparently adapted to grape culture are so protected from cold winds, so open to sunshine, or so free from fogs or frosts that they afford ideal conditions for a vineyard. Some of the most profitable vineyards are found in exceptional places in regions where grapes are not generally grown.

3. **Influence of Water Supply.**—Grapes are very sensitive to moisture conditions. If a vineyard is to be established in a humid climate, not only must the total annual rainfall be considered, but also its distribution throughout the season. The smallest quantity of water required for good vine growth produces the best crops, freest from disease. An excess of rainfall at blooming time hinders the proper setting of fruit; an excess during the growing and the maturing season favors the growth of fungi, checks and weakens root development, and induces too great a growth of vine. A comparatively dry soil is favorable to a large root growth, which enables a grape plant to stand drouth well and to resist fungous diseases but renders it more susceptible to the phylloxera. Species and varieties differ greatly in their capacity to withstand an excess of moisture. Vinifera varieties, in particular, cannot be grown profitably in localities where there are frequent summer showers, owing to their susceptibility to fungous diseases.

4. **Influence of Soil.**—As in the case of all other crops, the soil largely determines the value of a location for grape growing. The grape does best on sandy, gravelly, and shaly soils. In addition to this general soil adaptation, each variety of grapes does better in some soils than others. In order to be successful, therefore, a grower must ascertain what soils are

best for different varieties. The chemist and soil physicist can help but little; in most cases an actual test in the field is the only way of determining whether a variety will or will not thrive in a particular soil. American varieties are much more limited in their adaptation to various soils than the European, or Vinifera, varieties.

The grape is affected more by the physical structure of a soil than by its fertility. In the case of two soils of the same fertility, one a sandy soil and the other a clay soil, there will be a similar growth of vine but the sandy soil will produce more and better grapes than the clay soil. Grapes do better on light, friable soils than on stiff, compact soils. The lightness and friability of a soil can, of course, be increased by subsoiling and proper surface drainage or by the use of cover crops and stable manure.

It is unnecessary to select soil of great natural fertility for grape growing. Soils that are too rich produce an overdevelopment of the vines at the expense of hardiness and fruitfulness. The grapes of some species grow naturally on very poor, light soils. Any deficiency of natural fertility in soil selected for grape growing can be largely supplied by cover crops, stable manure, and fertilizers.

The fact that grapes do particularly well on sands, loams, shales, and gravels is due largely to the heat found in such soils. The farther north, or the longer the season required for ripening, the greater is the necessity for a warm soil. Soils can be made warmer by drainage, by the addition of humus-forming material, and by cultivation.

The grape is no more exacting as to soil requirements than other fruits. However, the necessity for selecting a suitable soil, together with favorable climatic conditions, for commercial grape culture needs no stronger argument than the fact that the viticulture of America is centered in comparatively small districts, and commercial success with the grape appears to be impossible in other regions, even though they produce good crops of other fruits. The necessity of having a large quantity and a high quality of fruit in commercial grape growing, in order for the business to be profitable, makes it very necessary to consider carefully the soil requirements of the different varieties.

5. Influence of Air-Currents.—The prevalence or lack of air-currents in a region is of some little importance in fitting or unfitting it for grape growing. Air-currents do considerable good in suppressing fungi. It has long been noticed that in regions where there are strong air-currents, black rot and the mildews are not nearly as harmful as elsewhere. Winds may be beneficial, too, when they bring warm air, when they are moisture laden, and when they keep frosty air in motion; it is possible, also, that they have some effect in suppressing insects such as the leaf hopper. On the contrary, they may be detrimental when too dry, strong, or cold.

6. Influence of Insects and Fungi.—Often the prevalence or the absence of insects and fungi determines the value of a region for grape growing. In several instances, the vineyards of entire regions have been destroyed by insects or fungi, or both. On the other hand, the magnitude of grape growing in certain regions is almost wholly due to the fact that neither insects nor fungi are seriously troublesome. The increase in the practice of spraying and the dissemination of information relative to vineyard pests are lessening the importance of the parasite factor in determining the value of a region for grape growing, but it is still of great importance.

COMMERCIAL FACTORS FOR CONSIDERATION

7. Influence of Marketing Facilities.—In order for a commercial vineyard to be successful, markets must be accessible to a high degree. Grapes are easily injured by long hauls and are very perishable even where handled without injury. There must, therefore, be good wagon roads over which to haul the fruit to a local market or to a shipping station; and if the fruit is shipped, the transportation service must be rapid. Transportation by water is often better than by rail, as there is usually less jarring of the fruit on boats than on cars. If there are two or more competing transportation agents, the shipper will, as a rule, get better service and cheaper rates than if there is no competition.

Grape growing, more than the growing of any other fruit, is a specialized and concentrated industry. This is as it should be, especially if the product is grown for a distant market, as it is important that enough grapes be raised in a locality to make the shipping and selling of the fruit of sufficient magnitude to command special attention from buyers and carriers. There are great advantages in shipping fruit in carload lots and selling it cooperatively. A grower should consider, therefore, before establishing a vineyard, whether he will grow grapes for the general market—usually a distant one—or for the local market, and in either case, whether the marketing facilities are adequate for his particular needs.

If grapes are grown for the general market, the vineyarding, to be profitable, must usually be conducted on a somewhat extensive scale. There should be a large acreage with but few varieties. In general-market vineyards the different varieties are cultivated similarly and the various kinds of fruit are handled, packed, and marketed in the same way; as a rule, the prices received are comparatively low. In the growing of grapes for the general market the vineyard is the unit. If grapes are grown for a local market the vineyard may consist of but a few acres; but there should be several or many varieties that ripen in succession. In local-market vineyards special treatment is given to each kind of grape. The different varieties are trained, pruned, and fertilized differently, and each kind of fruit is packed in a particular way; the fruit usually sells for a higher price than that of a general-market vineyard. The variety is the unit in the growing of grapes for a local market.

The opportunities in the growing of grapes for the general market are well recognized in America and the industry has become extensive. On the other hand, grape growing for local markets is not well developed, although there are splendid opportunities in many parts of the country for such a business. In regions where intensive grape growing for local markets has been developed to a high degree, it has proved very profitable.

8. Influence of Distributing Agencies.—Several agencies of distribution by means of which grapes go from the producer to the consumer must be considered in choosing a location for a vineyard. Some of these are: Local buyers, who ship from the grower to a center of distribution; carriers, such as railroads, steamboats, and trolley lines; commission merchants, who distribute the grapes to retailers; and retailers, who deliver the grapes to the consumer. The fewer of these distributing agencies the grower must make use of and the better the ones available, the better is the location for grape growing.

9. Influence of Extent of Production.—A grower, when choosing a location for a vineyard, is naturally confronted with the question of whether there is danger of overproduction in a particular locality. No matter how large a quantity of fruit is produced in a given region, the growers who pay attention to the cost of production will make the most profit and suffer least from the competition. Should there be overproduction, those laboring under the most expensive difficulties, whose cost of production is highest, must stop growing; those whose production is lowest can continue with an assurance of profit.

If all of the factors at the command of a grower insure the lowest cost of production, there need be no hesitancy about entering the business. A prospective grower should first ascertain whether there is likely to be a permanent demand for his product, then consider whether or not there are natural advantages for grape growing in the locality, and finally make sure that the transportation facilities are adequate. The cost of labor, too, should be the same as or less than that of his competitors.

10. Influence of Labor Supply.—No one should engage extensively in grape growing in a locality where there is no certainty of an abundance of labor at picking time. It sometimes happens that, although no labor is available in a locality, pickers can be brought from a near-by city. In many grape-growing sections, women are employed as pickers, as they quickly become skilful in the work, which is not particularly fatiguing. In addition to pickers there must be some laborers in the locality that are skilled in horticultural pursuits, as common farm laborers do vineyard work poorly and can seldom be hired in sufficient numbers.

11. Influence of Amount of Capital.—Less capital is required to engage in grape growing than in the culture of tree fruits, as grapes come into bearing sooner; but, on the other hand, much more capital is required than for the growing of farm or truck crops. The cost of land for commercial grape growing will vary from $50 an acre in some parts of the East to $500 an acre on the Pacific coast. The operating expenses, however, are not nearly so variable. An average taken from several grape-growing regions in the United States is about as follows per acre: Pruning, $6; thorough cultivation, $12; spraying, $10; seed for cover crops, $4. If fertilizers are used instead of cover crops, the expenses must be increased about $10 per acre. Perhaps 10 per cent. on the investment is a conservative estimate of the net income for vineyards the country over.

SELECTION OF VARIETIES

12. When a location for a vineyard has been chosen, the next step is to make a selection of varieties for planting. If grapes are to be grown for the general market this will not be difficult, as only a few varieties are under general cultivation in any particular grape-growing center. On the other hand, if grapes are to be grown for a local market it is often exceedingly difficult to choose varieties.

Not less than three hundred varieties of grapes are offered to the grape growers of America by nurserymen. Most of these varieties are best characterized by their faults and none are perfect. Although all of them have more or less defects some have greater ones than others and are, therefore, less desirable. Because of this condition, the selection of suitable varieties is very important. In fact, it may be laid down as a rule that failure in commercial grape growing is certain if a mistake is made in the choice of varieties. Fortunately, in established grape-growing regions the experience of the past can be relied on to a reasonable degree as a guide in the selecting of varieties.

Certain factors must be kept in mind by a grower when choosing varieties for a commercial vineyard. The most important of these is that a variety must be adapted to the markets and to the uses for which it is intended. Another important factor is that a variety should be free, or reasonably so, from parasitic troubles. Also, in order to facilitate the employing of help and the shipping of fruit, varieties should be chosen that ripen in proper succession.

Much is being said at the present time about sex in fruits and especially about the impotency of varieties, on account of which their fruits do not set well. Grapes fail to set fruit, for the most part, because of cold weather, rains, and heavy winds at blooming time, but some varieties are self-sterile to the extent that they will not produce crops unless interplanted with self-fertile varieties that bloom at the same time. It is important that the fruit of all of the varieties planted have value, as it is not worth while to encumber land with a variety fit only for a pollinator. Contrary to a very general opinion, the fruits themselves are not changed by cross-pollination. The status of varieties as to sterility has already been given in the preceding Section.

PROCURING OF VINES FOR PLANTING

13. When a grower has chosen a location for his vineyard and has selected the varieties for planting, the next step is to procure vines. This may be done in two ways: The vines may either be propagated by the grower himself or be procured from a commercial nursery. Experienced growers often produce their own vines, as it is not particularly difficult to propagate grapes. Until some experience has been acquired, however, it is not advisable to undertake home propagation on a very extensive scale.

14. Propagating of Grapes.—The grape is propagated from seeds, layers, and cuttings. It is grown from seeds for the purpose of obtaining stock resistant to the phylloxera on which to graft Vinifera varieties, and for the purpose of producing new varieties. The seeds are taken from the pulp at harvest time and stored in damp earth in a cool place until spring. In spring they are sown in garden soil in rows convenient for cultivation, being planted about an inch deep and a few inches apart in the row. Usually, the seeds sprout well and the subsequent care consists chiefly of cultivation.

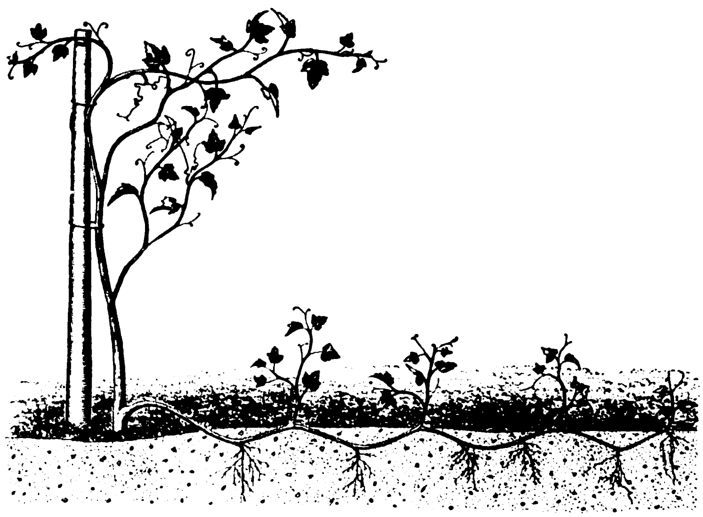


Fig. 1

Layering is somewhat extensively practiced in the propagating of Aestivalis and Rotundifolia varieties, which do not root readily from cuttings. Even in the case of other varieties, layering is often the simplest method of propagation, particularly if only a few vines are needed. This method is especially desirable for the filling in of vacancies in rows.

Layering is done by bending down and covering with earth in the spring a cane of the previous year's growth. Some growers simply lay the cane on the ground and cover it so as to leave a small part exposed at intervals, as shown in Fig. 1.

Sprouts will form on the exposed parts and roots on the covered parts. As soon as the young sprouts are thoroughly rooted they may be separated from each other and from the parent plant. Perhaps the commonest method of layering is to lay the cane in a shallow trench, which is then partly filled with fine earth, the earth being packed firmly about the vine; later, as the young shoots grow, the trench is gradually filled. From 4 to 8 inches of the end of the cane is left above ground. The following fall the plants that have arisen from the buds will be ready for transplanting. If layering is practiced for the purpose of filling vacancies in rows, the cane should be put in a trench several inches deep so that it will not be torn out in plowing. The young sprouts need not be detached from the parent until the second year and should bear the third year.

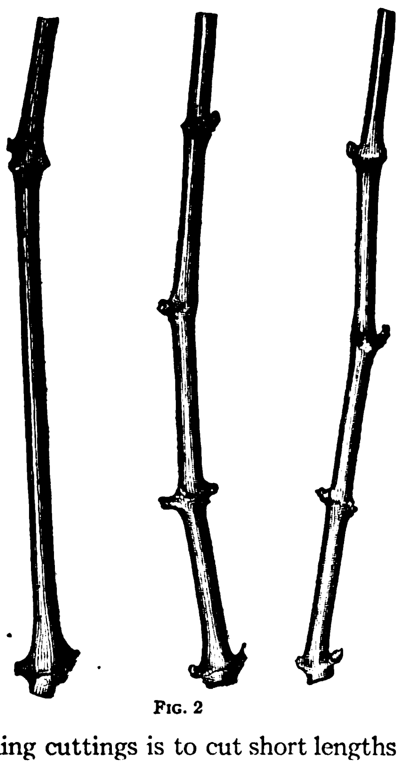


Fig. 2

15. The prevailing method of propagating grapes employed by nurserymen and many experienced growers is by means of cuttings. Perhaps the commonest method of obtaining cuttings is to cut short lengths from the hard wood of ripened canes in autumn or winter when the vines are pruned. Only canes that are well ripened and rather short jointed are used. These are cut so that there will be two or more buds on each cutting, the lower cut being close to a bud. Fig. 2 shows the appearance of cuttings. After a sufficient number of cuttings have been made, they are tied in bundles of fifty or one hundred and stored in sand, moss, or sawdust until spring, when they are planted outdoors at the approach of warm weather. The general practice is to place the cuttings from 4 to 8 inches apart in rows that are far enough apart to allow of horse cultivation. The cuttings should be set deep enough that the upper bud will be flush with the surface of the ground. When propagation by this method is extensive, a furrow may be plowed, the cuttings being placed upright against the land side and the earth being firmly pressed around them. Many propagators insist that the cuttings be set at an angle, claiming advantages from the fact that the soil can be packed more firmly and that the heat of the sun's rays can penetrate more readily to the lower ends of the cuttings than when the cuttings are set upright. The cuttings may produce plants large enough for planting in the vineyard the following fall; but it is usually preferred to let the plants grow 2 years before planting them permanently. In such cases it is customary, in many nurseries, to transplant the young plants at the end of the first season. On the Pacific slope, cuttings are often planted directly in the vineyard if the soil is favorable to rooting. If this is done, the cuttings are made from 15 to 18 inches long.

FIG. 3

Green-wood cuttings are sometimes used in summer in the case of new or rare varieties, but they are not in general favor. Single-eye cuttings, such as the one shown in Fig. 3, are sometimes used for propagating grapes; as a rule, they are started under glass. If they are started in February, they will be large enough for transplanting to a well-prepared seed-bed very early in the spring.

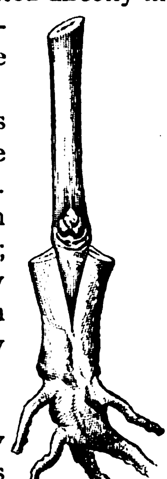


FIG. 4

16. Grape vines may be readily grafted by several methods. The cleft graft, which is commonly used in the case of old plants, is by far the most important method, as it is the one resorted to when the varieties in a vineyard are to be changed. In cleft grafting, the earth should be removed from the old vine to the first lateral roots and the top sawed off cleanly from 3 to 4 inches below the surface of the ground. The vine should then be split across its center and one or two scions inserted, as in the grafting of fruit trees. The appearance of the graft at this stage is illustrated in Fig. 4. The cleft should be bound with string or raffia and covered with earth; no wax is necessary. Cleft grafting is usually done in early spring when the vines are leafing out.

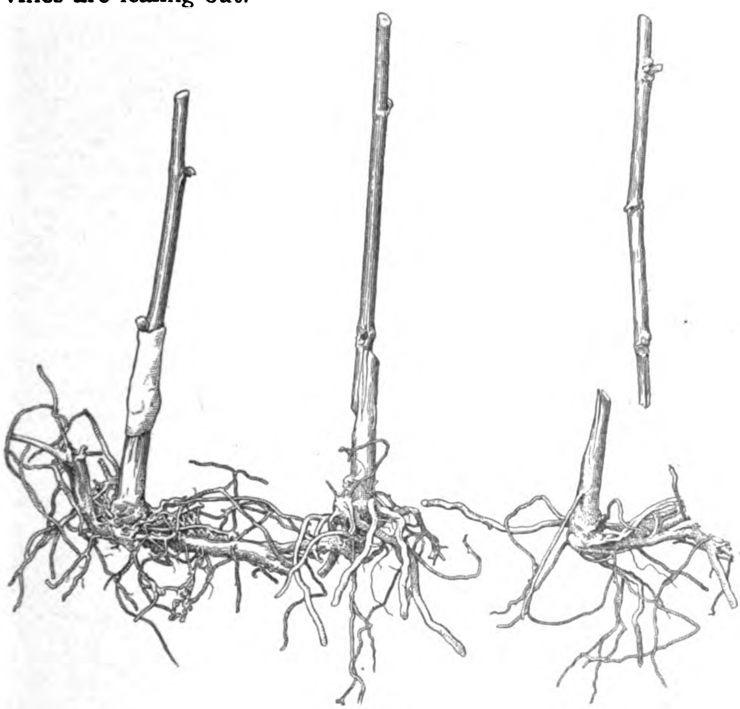


FIG. 5

Young grape plants may be whip-grafted indoors, asd escribed for fruit trees. The successive steps in making the graft are illustrated in Fig. 5. This is the most approved method of grafting Vinifera varieties on phylloxera-resistant stocks, the grafts being rooted in a nursery before being planted.

No matter what method of grafting is used, care must be taken from year to year to cut off all roots from the scions.

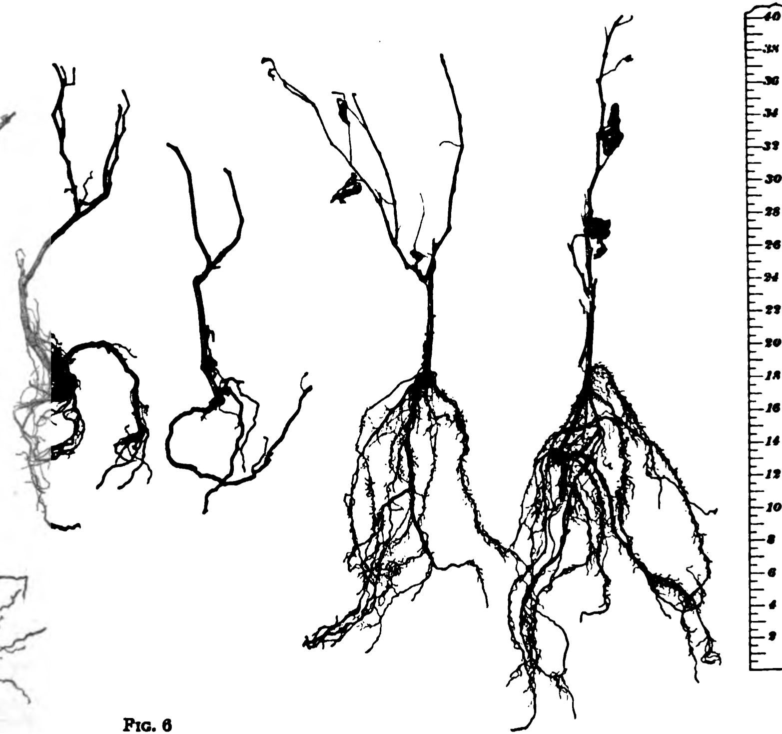


FIG. 6

Grafting of the grape in this country is largely confined to California where the Vinifera varieties are grafted on phylloxera-resistant native vines, but the operation could be used to advantage in working over old vineyards in all parts of America.

17. Procuring of Vines From a Nursery.—As a rule, fruit plants grown near home are somewhat better for planting than those brought from a distance. This is less true in the case of the grape, however, than in the case of any other fruit, as grape vines are very tenacious of life, are not so easily injured as fruit trees, and can be cheaply propagated and well grown only in certain localities.

In buying vines, it is advisable to make certain that they are true to name and free from insect and fungous pests, and that the roots and the tops, even to the remotest parts, are alive. In most cases first-grade 1-year-old vines are much to be preferred to larger 2-year-old ones. The 2-year-old vines are often the inferior 1-year-old vines of the previous season that have been transplanted and allowed to get another year's growth; they are stunted and considerably less vigorous than first-grade vines. In Fig. 6 are shown three different grades of vines. The two vines at the left are overgrown, overaged specimens; the two in the middle are stunted and lacking in vigor; the two at the right are desirable first-grade vines.

PLANTING OF A VINEYARD

PREPARING OF THE LAND

18. Draining of the Land.—Usually, the first operation in planting a vineyard is to drain the land. No cultivated grape thrives in poorly drained land despite the fact that several wild species do. It is nearly always found that in a time of drought moisture is far better conserved in a well-drained vineyard than in one that is undrained. Unquestionably, too, the soil in a drained vineyard is better aerated and is warmer than that of an undrained vineyard; the warmth of the soil is an especially important factor in the case of the grape, as has already been stated. The opinion prevails that sloping land is always well drained, but often this is not the case. So, too, the erroneous opinion prevails that sandy, gravelly, and shaly soils are always well drained. Such soils often need as thorough drainage as loamy and clayey soils.

19. Preparing of the Soil.—A vineyard that is properly located, well planted, and intelligently cared for will stand for a generation or longer. The necessity for thorough soil preparation before setting the vines is apparent, because after a vineyard is planted such operations as grading and subsoiling cannot be carried on. No subsequent treatment can make up for careful preparation of the soil at the outset.

The soil for a vineyard may need some grading to make the surface level. As a rule, it is a good practice to turn under a heavy coating of stable manure or a crop of some green manure such as clover, cowpeas, or soybeans, the kind of crop depending on which does best in the particular locality. This manuring is especially desirable if vines are to follow vines, that is, if the land has previously been planted to grapes. Some soils are much benefited by subsoiling; others are not. A grower must determine whether subsoiling is advisable by studying his soil and ascertaining the experience of his neighbors. In the case of sands, gravels, and shales, subsoiling is seldom necessary, but clays and loams are often benefited by the operation. If subsoiling is practiced, the subsoil should be loosened only, not mixed with the surface soil, as mixing of the two soils often permanently injures the land. If not subsoiled, the ground should be plowed rather deeply. Finally, it should be put in the best possible condition by harrowing and rolling. For the harrowing, a disk or a cutaway harrow followed by a smoothing harrow will give good results.

PLANTING OF THE VINES

20. Vines are always planted in rectangles, usually with less distance between plants in the rows than between rows. The distance between vines and rows depends largely on the variety and somewhat on the soil. Vines of strong-growing varieties, such as those of the Rotundifolia species, are usually planted in rows about 15 feet apart, the vines being about 30 feet apart in the rows. Vines of Labrusca, Riparia, and Aestivalis varieties are, as a rule, planted in rows from 8 to 12 feet apart, the distance between vines being a little less than that between rows. In a large number of commercial vineyards where native varieties are grown, the rows are 9 feet apart and the vines are 8 feet apart in the rows. Vinifera vines are planted in rows from 5 to 12 feet apart, the vines being from 3 to 10 feet apart in the rows; the distance apart the vines are planted depends largely on the variety and local conditions. Grapes can, of course, be planted closer together in poor soils than in fertile soils, as in the case of the former there will be less growth. It is doubtful whether rows ought ever to be less than from 8 to 10 feet apart, however, as there should always be sufficient room between for cultivating with two-horse implements, for spraying, and for hauling out brush and fruit.

In some grape-growing regions vineyardists set twice the number of vines required in a row, with the expectation of cutting out alternate vines when two or three crops have been harvested. Although this practice is far preferable to interplanting with bush fruits, experience has not proved it to be very advantageous. The tendency is to let the filler vines remain too long, with the result that the growth of the permanent vines is checked and they are more or less stunted for several years. Double planting may be profitably practiced only where the culture is intensive and where the grower will cut out the fillers when two, or at most three, crops have been harvested.

There is much difference of opinion as to the direction in which rows should run. In many cases, this should be determined entirely by the lay of the land; in others, by convenience. In general, it may be said that the ideal direction for grape rows is north and south. When rows are planted thus the morning sun dries the dew on the east side and the western wind dries the dew on the west side. Such drying of the dew is of much help in the control of fungous diseases.

21. In large vineyards, for convenience in carrying on operations, it is necessary to have avenues through the plantation. The vineyard should, as a rule, be cut into blocks of 3, 4, or 5 acres, the most convenient shape being a block twice as long as it is broad. On hilly land the blocks must often be made in accordance with the lay of the land so as to give the avenue best suited for hauling. An avenue is usually made by leaving out a row of vines. Ample distances between rows makes fewer avenues necessary.

The number of vines required to set an acre is calculated by multiplying the distance between rows by the distance between vines and dividing the product into 43,560, the number of square feet in an acre. For example, find the number of vines required for 1 acre when the distance between rows is to be 9 feet and the distance between vines in the row is to be 8 feet. Thus, $8 \times 9 = 72$; $43,560 \div 72 = 605$ vines.

22. Various methods are used for locating the holes for the young vines. Some planters use a marker similar to the kind used for marking corn or potato rows; others use a measuring wire or a chain; and still others use a plow. Marking the ground with a plow is perhaps the simplest method and is accomplished as follows: First, the rows are measured off at the distance apart decided on; then a furrow is plowed along the line of each row, the plowing being done in both directions in order to make the furrow deep; finally, small stakes are set in the furrow at the proper distance for the vines, and care is taken to line up the stakes accurately both in the direction of the rows and crosswise. Holes are then dug in the furrows, with the stakes as centers, by means of a hoe or a spade. The depth of setting depends somewhat on the variety and the soil, but a fairly safe rule to follow is to set each vine a little deeper than it stood in the nursery row; this applies to all vines except grafted resistant vines, which should be planted with the union at or just above the surface of the ground. The holes should be dug deep enough to permit of a spadeful of surface soil being thrown in before the plants are set and large enough to accommodate the roots without crowding.

23. Grape vines must be handled with considerable care in packing, transporting, and taking them to the field, because the roots are very small, tender, and easily injured. Success with a vineyard often depends on getting a good start; and this can be done only when the vines are in condition to begin growing at once after being planted. In handling vines in the field before planting, it is a good plan to keep the roots in water.

24. No exact time for planting can be specified, but the general statement can be made that vines should be planted only in the spring and that planting should begin as soon as the ground can be worked to advantage. It is a mistake to set vines when the soil is cold, wet, and heavy. Local experience and the judgment of the planter must dictate how late the planting can be done; usually it is not advisable to set vines after the leaf buds begin to burst.

25. Vines are prepared for planting by cutting away all dead or injured roots and shortening the healthy roots so that they can be conveniently placed in the hole in which they are to be set. Grape roots can be pruned rather severely if the stubs that remain are healthy; as a rule, the stubs should be from 6 to 10 inches in length. The top should always be cut back to a single cane and this to two or three buds. In planting, the roots are spread in the hole so that they are in a somewhat natural position, and a little surface soil is tamped firmly about them. The hole is then filled, the soil firmed, and the surface left loose as a mulch to check evaporation.

VINEYARD MANAGEMENT

GENERAL CULTURAL OPERATIONS

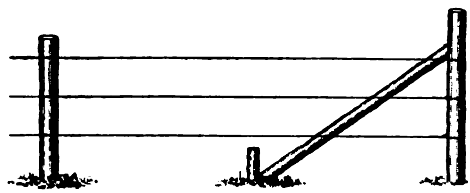
26. The aim of a grower for the first two or three seasons after a vineyard is planted should be to develop a good root system in the vines. To do this, the growth of the first summer should be cut back late the following winter or early the next spring to two buds and the vines left in apparently the same condition as they were when set. If the vines are to be grown on trellises, one wire of the trellis should be put up at the end of the first year, not for the purpose of beginning definite training of the vine, but to keep the canes out of the way of the cultivator. If the vines are to be grown on stakes, the stakes should be set at this time. Some fruit is likely to set the second season, but it should be removed before it has attained much size. Two years after setting, the vines should be ready for permanent training on the trellises or on the stakes.

East of the Rocky Mountains, grapes are grown commercially on trellises. On the Pacific coast, all but a few varieties are grown on stakes. In both regions, amateurs frequently grow them on arbors, fences, and sides of buildings, practices that need not be discussed here.

27. Trellising of Vines.—In the trellising of vines, a fairly heavy post is set at each end of a row and smaller posts or stakes are set at regular intervals in the row. In the case of native grapes, a post to every three vines is sufficient. For Vinifera grapes that require a trellis, a stake is usually driven at each vine; sometimes, however, the stakes are put between the vines, and if the vines are less than 9 feet apart in the row some growers use only one stake to every two or three vines. For all native varieties except the Rotundifolias, the posts should be from 6 to 8 feet long; posts from 8 to 10 feet long should be used for

Rotundifolia grapes, as they are strong growers. In the case of Vinifera grapes that require trellising, it is customary to use a 3-foot stake for a one-wire trellis and a 4-foot stake for a two-wire trellis, 18 inches of the stake in each case being driven into the ground. In the North, chestnut or locust posts are used; in the South, heart-pine posts; and in the West, redwood, or Sequoia, stakes.

The end posts should be driven or otherwise set to a depth of from 22 to 24 inches, and should be well braced. In Fig. 7 (*a*) and (*b*) are shown two common methods of bracing end posts. The posts or stakes in the rows can, after being sharpened to a tapering point, be driven into holes made in the ground with a crowbar. A convenient method of driving long posts is for the operator to stand in a wagon. Care should be taken to place all of the posts or stakes in such a manner that they will be in line on the side toward the prevailing wind, on which side the wires should be fastened.


(*a*)

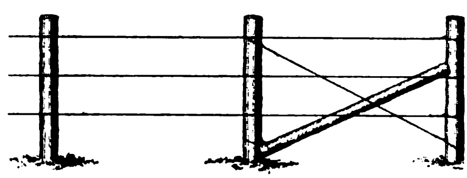

(*b*)

FIG. 7

After the posts or stakes are set, wires are stretched along each row, the number and height of the wires depending on the vigor of the vines and the system of training used; these points will be discussed later. No. 9 or No. 10 wire is generally used by Eastern growers, and No. 10, No. 11, or No. 12 wire, by Western growers. The wires can be fastened to the end posts by winding each wire once around the post and then around itself. They are secured to the posts or stakes in the rows by means of wire staples, so as to permit loosening or tightening of the wires.

A great diversity of material is used for tying vines to the trellises. Perhaps the commonest material in use is ordinary wrapping twine. Some growers, however, prefer raffia; others use strips of cloth; others use rye straw; and still others use wire. In the order of popularity, doubtless twine ranks first, wire second, and raffia third.

28. Staking of Vines.—Vinifera grapes, with the exception of a few varieties, are staked. The staking is done, as has already been stated, the first winter after the vines are set, or at least before the buds start in the following spring. The size of the stake to use depends on the variety and the method of pruning to be adopted. For short pruning, the stakes should be of such length that when driven into the ground they will remain firm when the wind strikes the broad surface of the mature vine, and enough should be above ground to extend from 2 to 3 inches above the height at which the vines are to be headed. The stakes for short-pruned vines are usually from $1\frac{1}{4}$ to $1\frac{1}{2}$ inches square, the size depending on the length. If long pruning is practiced and the vines are staked, the stakes should be about 5 feet long and about 2 inches square; a stake should be driven 2 feet into the ground. Some growers dip the lower end of the stakes in hot asphalt or tar before setting them in the ground; these materials serve as preservatives. The stakes should be driven into the ground about 1 or 2 inches from the vine and on the side opposite to the prevailing wind; if this is done the force of the wind is exerted against the stake instead of against the tying material. Redwood, or Sequoia, stakes are almost universally used for staking grapes. Various materials such as small rope and wire are used for tying the vines to the stakes.

29. Intercropping in a Vineyard.—Intercropping, although practiced more or less, is seldom profitable in commercial vineyards. It may pay in some localities to grow such truck crops as potatoes, beans, tomatoes, or cabbage between the rows or even in the rows the first year and possibly the second. But the growing of gooseberries, currants, raspberries, or strawberries is, all things considered, a very poor practice unless the vineyard is small or the land is very valuable, or other conditions are such that the most intensive culture is necessary and possible. The following troubles arise in intercropping in a vineyard: The vines are often robbed of food and moisture, thereby being stunted; and the operations necessary for cultivating and handling the intercrops are often such that there is danger of injury to the vines.

30. Irrigating of a Vineyard.—As a rule, grapes withstand drouth very well and irrigation is practiced and is desirable only in semiarid regions. The problems relating to irrigation, where it must be practiced, are perhaps the most difficult that a grower has to solve, and must, for the most part, be solved according to the particular locality, soil, and season. Thus, the frequency and the time of irrigating, the manner of applying the water, and the quantity to apply varies greatly with the factors enumerated. However, the following general rule can be given: Grapes should be irrigated in such a way that the wood and leaf growth will be strong and thrifty and of good color, but the growth must not be excessive or rank; and the fruit must be abundant and of good size, but not monstrous or watery. In order to irrigate properly, a person must know all of the conditions of vineyarding in a locality and have good judgment and skill in vineyard operations. The tendency in irrigating grapes is usually to irrigate too frequently and to use too much rather than too little water.

31. Tilling of a Vineyard.—Whatever doubt may exist as to the desirability of tilling for some tree fruits, none can exist with regard to the desirability of tilling for grapes. Sod or any of the sod mulches will bring about ruin in a vineyard. Frequent and thorough tillage is absolutely necessary in the growing of good grapes. Moreover, it must be practiced continually year after year. Failure to cultivate a vineyard for a single season will often result in the vines being stunted for several years.

Tillage should be commenced in the spring by plowing a single furrow on each side of a row, the soil being thrown toward the row. After these single furrows have been plowed, the remainder of the ground between the rows should be plowed. When a cover crop is plowed under, as should be done whenever possible, the plow should be followed by a disk harrow or some similar tool. The ground should be cultivated every week or 10 days during the summer months, the frequency depending largely on the kind of soil and its physical condition.

In general, the tools needed for cultivation will be one of the several spring-tooth harrows, some type of smoothing harrow or weeder, a one-horse grape hoe, and a heavy hand hoe. In Fig. 8 is shown a desirable form of grape hoe. This hoe may easily be guided in and around the posts and vines, by means of the disk castor wheel to which the handle is attached. A horse is hitched to one side of the pole, which arrangement allows plenty of room for the plow to work under the vines. By changing the position of the blade, the soil can

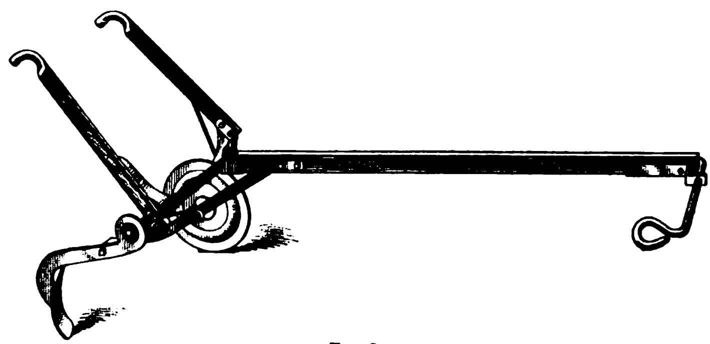


FIG. 8

be thrown toward or away from the vines. A cultivator attachment can be had with these hoes at a small additional cost.

Soon after the grapes blossom the grape hoe is used to level down the furrow turned up to the grapes in the spring plowing. The cultivator should then be used several times. After the last cultivation the seed for the cover crop should be sown and harrowed in.

The object of this frequent tillage is not, as might be thought, to kill weeds, but to conserve moisture, to set free plant-food, and to aerate the soil. Cultivation is probably the most necessary factor to the maintenance of perfect conditions in a vineyard, and there is no danger of giving too much tillage, as may be done in the case of some tree fruits.

32. Sowing of Cover Crops in a Vineyard.—Cover crops are largely an undeveloped resource for the betterment of vineyards, being far more generally used for the tree fruits than for grapes. However, cover crops have as great a value for vines as for trees, and there are no vineyards that will not respond profitably to the annual use of a cover crop. The only objection to using cover crops for grapes is that pickers, mostly women, object, because of getting wet, to picking in a vineyard having a cover crop and discriminate against such vineyards. This seemingly insignificant factor often gives grape growers much trouble at harvest time.

Three classes of cover crops are grown in vineyards: First, *legumes*, such as Mammoth, Red, and Crimson clover, cowpeas, soybeans, and the vetches; second, *cruciferous plants*, such as rape and cow-horn turnips; third, *cereals*, such as oats, wheat, barley, and rye. The plants of all three classes cover the land well and consequently give winter protection to tender varieties, hold snow in northern regions, keep heavy soils from becoming sticky and cemented, and prevent washing on hillsides. In addition, they add humus to the soil and improve its physical properties. But, besides these general benefits, each class has a special benefit. The legumes add nitrogen to the soil in considerable quantities. Rape and turnips are supposed to use rather more phosphoric acid than other plants and when plowed under turn over this plant-food to the grapes. In the case of the cereals, the mass of roots puts the soil in good physical condition when the crop is turned under.

The preceding statements in regard to the benefits of cover crops will suffice to indicate what crop should be planted in any particular vineyard. In most cases it will be found that combinations of these crops are best, as there are few grape plantations that may not be improved in all of the particulars for which cover crops are planted. In the great grape-growing belt in Chautauqua County, New York, a very common mixture per acre for a cover crop is 1 bushel of oats or barley, 12 pounds of any one of the clovers, 15 pounds of winter vetch, and 1 pound of cow-horn turnips. This combination makes a crop almost certain even in the most adverse season. No matter what crop is grown, however, it should be plowed under in the spring as soon as the ground can be worked, otherwise the grapes will be robbed of plant-food and particularly of moisture.

33. Fertilizing of a Vineyard.—The fertilizer requirements of grapes are still largely a matter of conjecture, and until more is known about the subject, a grape grower should be certain of the benefits to his particular soil before he spends much money for commercial fertilizers. A general truth that should be kept in mind is that grapes do not require nearly as much fertilizer, when grown in average soil, as farm and truck crops. This statement is based on experimental evidence from several sources and on the following theoretical considerations:

1. From 80 to 90 per cent. of the grape crop is water; and the food used in the foliage is returned to the soil. The percentage of solid matter is much less than in farm and truck crops.
2. Grape vines have a preparatory season of several years before they begin bearing. Farm and truck crops come and go in a season.
3. The growing season for grapes is long, lasting from early spring to late fall. The growing season for farm and truck crops is comparatively short.
4. In the case of grapes, the roots go down and spread out well. In the case of farm and truck crops, the root systems are comparatively restricted.
5. Grapes transpire relatively larger quantities of water than farm and truck crops and therefore relatively more diluted solutions of plant-food suffice to furnish food.
6. It is possible to give grapes more thorough cultivation than farm and truck crops, thereby better conserving moisture and making food more available.

It should not be inferred from the preceding statements that grapes never need commerical fertilizers. When grown in very light sandy or gravelly soils that are deficient in potash or phosphoric acid and subject to droughts, or in soils of such shallowness or of such mechanical texture as to limit the root range, or in soils so wet or so dry or so devoid of humus as to prevent proper biological activities in the soil, grapes may need commercial fertilizers. For the most part, however, soils that have the unfavorable qualities named are unfitted for grape culture. At any rate, there are still thousands of acres of available fruit land in every part of the grape regions of the United States that do not have these objectionable qualities and consequently do not need to be fertilized. There are probably many vineyards that may be benefited by an application of one of the chief elements of fertility, that is, nitrogen, phosphoric acid, or potash, and some may require two of the elements; but few will require a complete fertilizer.

The question arises, then, as to how a grape grower may know whether his vines need fertilizers. It may be assumed at once that if the vines are vigorous, bearing well, and producing a fair quantity of new wood each season, they need no additional plant-food. If the vines are not in the healthful condition described, the logical thing to do is to look to the drainage, tillage, and health of the plants first, and try fertilization afterwards.

Fertilizers ought not to be used to rejuvenate vines unless the owner has obtained positive evidence that his soil is lacking in some of the elements of plant-food. To obtain such evidence, a grower should carry on a fertilizer experiment. In making such a test, a portion of the vineyard that is as uniform as possible both in soil and varieties should be selected. If possible at least twenty-five vines should be used for each plat. On different plats the following fertilizers should be used: (1) Sufficient acid phosphate to give about 50 pounds of phosphoric acid to the acre, which will be about 500 pounds of phosphate; (2) the same quantity of phosphate as in (1), and sufficient muriate of potash to give 100 pounds of potash to the acre, or about 200 pounds of muriate of potash; (3) the same quantity of phosphate and muriate of potash as in (2), and sufficient nitrate of soda and dried blood to give 50 pounds of nitrogen per acre, or about 500 pounds of medium-grade dried blood and 150 pounds of nitrate of soda, or the nitrogen may be supplied by adding good stable manure at the rate of 6 tons to the acre; (4) 6 tons of stable manure; (5) a plat should be left unfertilized for a check.

This experiment is much less laborious and complex than it seems, for the fertilizer combinations are built up one from another and the mixing can be done and the quantities weighed out in winter when vineyard work is not pressing.

The fertilizers and manure should be applied in the spring as soon as the ground can be worked and be spread uniformly. The manure should be applied before plowing and the fertilizers immediately afterwards and be harrowed in well. The experiment, to be conclusive, should run for several years, and the crops from each plat should be carefully weighed or measured.

There is little doubt as to the value of stable manure in vineyards if cover crops are not plowed under. If, however, a good crop of clover, with now and then some other of the crops mentioned, can be turned under annually, it is extremely doubtful whether it will pay to purchase much stable manure for a vineyard. If a grape grower feels that he does not care to experiment and wants to run the risk of waste in using commercial fertilizers, the material and quantities suggested for the experiment are suitable for the average soil.

PRUNING AND TRAINING OF GRAPES

GENERAL CONSIDERATIONS

34. Pruning and training of the vines are perhaps the most complex operations having to do with grape culture. So many systems are in vogue for these operations that an inexperienced person may easily become confused. However, if one typical system in each general class is thoroughly mastered the others in the class should not be difficult.

35. Purposes of Pruning and Training.—Grapes are pruned and trained for a number of purposes. They are pruned to maintain the vigor of the vines, to obtain good size and quality in the fruit, to prevent overbearing, and to keep the vines within proper bounds so that they will occupy a minimum area of ground and not be in the way of vineyard operations. Grapes are trained particularly for the purpose of keeping the vines in manageable shape.

36. Time for Pruning.—The time for pruning grapes extends from the dropping of the leaves in the fall to just before the swelling of the buds in the spring. Some vineyardists prune in the spring after a vigorous flow of sap has begun, and claim that no serious injury results, but the so-called bleeding of the vines that follows late pruning is no doubt devitalizing to the plants. There is considerable sap flow in a vine even before weather conditions appear favorable for it, so that it is best not to delay pruning until vegetation starts in the spring.

In sections where it is necessary, in order to prevent freezing, to cover the vines in position or to lay them on the ground for covering, pruning is done before the vines are covered. In this case it is advisable to leave more wood than is actually needed for the next year's crop, as there is danger of some of the buds being broken off or the canes being injured by the covering and uncovering.

It is seldom advisable to prune vines when they are frozen, as frozen canes are brittle and easily broken during handling. Except for this, there is no reason why pruning should not be done at any time during the dormant season.

37. Definition of Terms.—Unfortunately, the nomenclature pertaining to vine pruning and training is not uniform throughout the country. This applies particularly to the terms used to designate different parts of a vine, and makes it somewhat difficult to describe the operations of pruning and training so that they will be readily understood in all sections. In the following explanation of pruning and training systems, the nomenclature advocated and used by Prof. U. P. Hedrick, of the New York Agricultural Experiment Station, and Prof. L. H. Bailey, of Cornell University, noted viticultural authorities, will be used. No doubt this nomenclature is as much in accord with common usage, or more so, than any other.

In order that the nomenclature just referred to may be understood, the principal terms will be defined. These terms are: *trunk*, *arm*, *spur*, *cane*, and *shoot*. By **trunk** is meant the body of a vine when 2 years old or more. In Fig. 9 the trunk is shown at *a*. An **arm** is a branch from the trunk that is 2 years old or more. Arms are shown in the illustration at *b*. A **spur** is a very short division of an arm or of the trunk, annually lengthening unless cut back, from which cane renewals

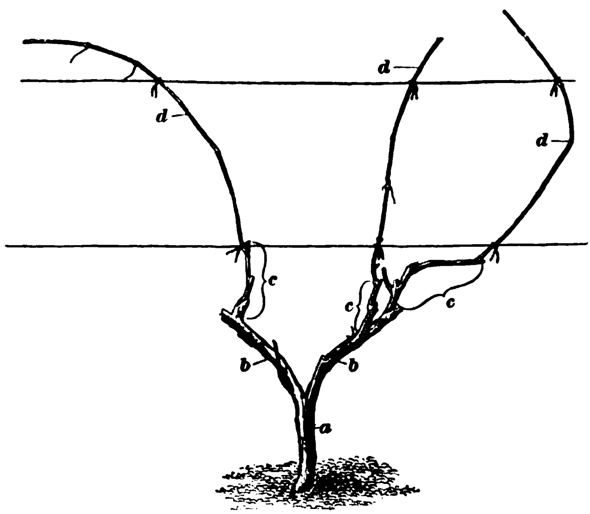


Fig. 9

are made. In the illustration, spurs are shown at *c*. A **cane** is a 1-year-old branch of an arm or the trunk. Canes are shown in the illustration at *d*. A **shoot** is a growing, leafy branch of the current season's growth.

38. Relation of Wood Growth to Fruit Bearing. No matter what method of pruning and training is adopted, a grower must keep in mind the relationship of wood growth to fruit bearing. Grapes are borne on the base of shoots of the current year's growth that spring from canes of the preceding year's growth. As an example of how knowledge of this fact should be applied in pruning, the following specific case is given: The average yield for a Concord grape vine is about 15 pounds of fruit. In order for a vine to produce this yield, from forty to sixty clusters of grapes are required. As each shoot bears from two to three clusters, usually two, from twenty to thirty buds must be left on the canes of the previous year's growth to furnish the required number of clusters. These buds might be left on a single cane, but usually two, three, or more canes that are variously distributed on one or two main arms, depending on the system of pruning and training adopted, are selected to be retained. Good pruning, then, consists of removing all wood except canes or spurs sufficient to furnish the shoots necessary for the desired number of clusters.

PRUNING AND TRAINING SYSTEMS

39. Pruning is more important than the training of vines to any particular system; but there necessarily exists a relationship between pruning and training. When the conditions of a vine permit, it may be pruned for training to a definite system, but, in many instances, the vigor of a vine, as shown by the wood produced, will not permit the pruning necessary to train it to a desired system. Hence, pruning and training are largely matters to be governed by individual judgment. A vineyardist should decide how much pruning each vine in his vineyard should receive and then choose a system of training by which the wood can be handled to the best advantage. If the vines are in a vigorous condition, the system of training to be adopted is, of course, somewhat optional with the grower; although there is no doubt that certain varieties do best when trained in a particular way. For example, it is generally agreed that strong-growing varieties such as the Concord and the Niagara do best when trained with the shoots drooping; and that weaker, slower-growing varieties such as the Delaware do best when trained with the shoots upright, other conditions being the same in each case.

40. Drooping Systems.—In the so-called drooping systems of pruning and training the shoots are allowed to droop and hang free, not being tied. These systems have the advantage of being economical, as no summer tying is necessary, and the clusters hang in such a way that there is little liability of sun scald. The first drooping system was originated by William Kniffen, whose name is perpetuated in all modifications of the system.

The following drooping systems are in common use: the *single-stem, four-cane Kniffen system;* the *two-stem, four-cane Kniffen system;* the **Y**-*stem Kniffen system;* the *umbrella Kniffen*

Fig. 10

system; and the *one-wire,* or *low, Kniffen system.* Other modifications of the drooping system have been devised, but for one reason or another they are no longer in use in commercial vineyards.

41. In the **single-stem, four-cane Kniffen system** of pruning and training, which is illustrated in Fig. 10, a two-wire trellis is used, the lower wire being from 3 to 3½ feet above the ground and the top wire about 2½ feet above the lower wire. If the vines are strong, training by this system can be begun the third year after setting, but if they are weak, it should be deferred until the fourth year after setting. A single trunk, or stem, is carried to the top wire and is tied to this and also to the bottom wire; the trunk is kept in this position permanently. Two canes at the level of or just below each wire are selected for leaving, and these are tied to the right and the left along each wire. The two upper canes are left longer and with more buds than the two lower. In the case of strong-growing varieties like the Worden, each of the upper canes may bear ten buds and each of the lower ones five, making thirty

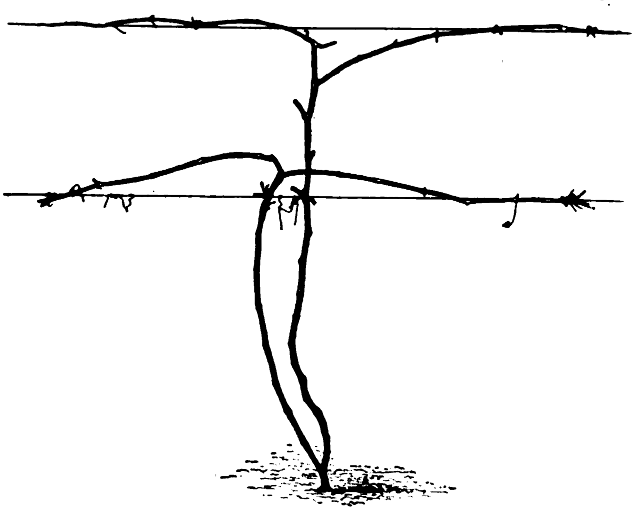


Fig. 11

buds to the vine. Some growers prefer to have twelve buds on each of the upper canes and only four on each of the lower. These canes produce the fruiting shoots of the current year; these shoots will mature and form the canes from which the four strongest will be selected for the succeeding year's growth. At the winter pruning the four old canes of the previous year should be cut away and with them all new growth except four canes. It is not necessary that the canes left should be those nearest to the trunks, for it may be that these are the weakest; but, other things being equal, these canes are preferable because their selection keeps the spurs short. Each spring the four canes left after pruning should be tied to the right and the left of the trunk along each wire. The spurs will lengthen rapidly, consequently it will be necessary to remove them entirely every 5 or 6 years. This can be done if well-placed shoots that arise from time to time from the trunk are selected to be retained.

42. The **two-stem, four-cane Kniffen system,** which is illustrated in Fig. 11, is very similar to the system just described, the difference being that two permanent stems, or trunks, are used instead of one. One stem is carried to the top wire and two canes are taken off, one to the right and one to the left, the canes being tied; the trunk is tied to both wires and kept in this position permanently. The other stem is carried to the lower wire and tied, two canes being taken off and tied as

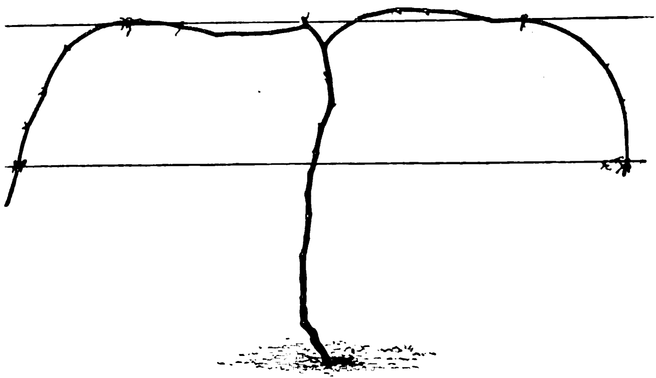


FIG. 12

in the case of the first stem. Some vineyardists prefer to tie the two stems together in order to make them stiffer. In the two-stem method of training, the canes taken off from each stem may be the same length and have the same number of buds, each stem being considered a distinct vine. Subsequent pruning is the same as in the single-stem system.

43. The **Y-stem Kniffen system** differs from the two-stem system in that instead of two stems being brought up from near the ground, one stem is taken from the other at a height a little below the lower wire, and carried to the top wire where it is tied. This makes a Y-shaped joint in the vine, whence the name of the method. The number of canes laid down and the subsequent treatment are the same as in the other systems so far described.

44. In the **umbrella Kniffen system,** which is illustrated in Fig. 12, but two canes are used. The stem is carried to the top wire, where it is tied. Two canes with from eight to twenty buds each are taken from the spurs on the trunk at the height of the top wire, and are tied to the right and the left along this wire and then bent down to the lower wire and secured. The canes are renewed yearly from spurs.

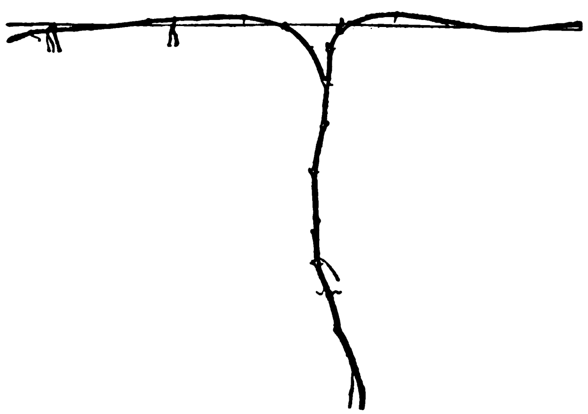


FIG. 13

45. The **one-wire Kniffen system,** sometimes called the *low Kniffen system,* which is illustrated in Fig. 13, is a modification of the umbrella Kniffen system. The trellis has but one wire, which is placed 3 or 4 feet above the ground. The single stem extends up to the wire, at which point two canes with from 10 to 12 buds each are taken off and laid down to the right and the left of the stem. The cane renewal each year, as in the other systems so far discussed, is from spurs. The quality of the fruit produced and the cheapness of the trellis commend this system of training.

46. Upright Systems.—In the upright systems of pruning and training, two or more canes or arms are carried

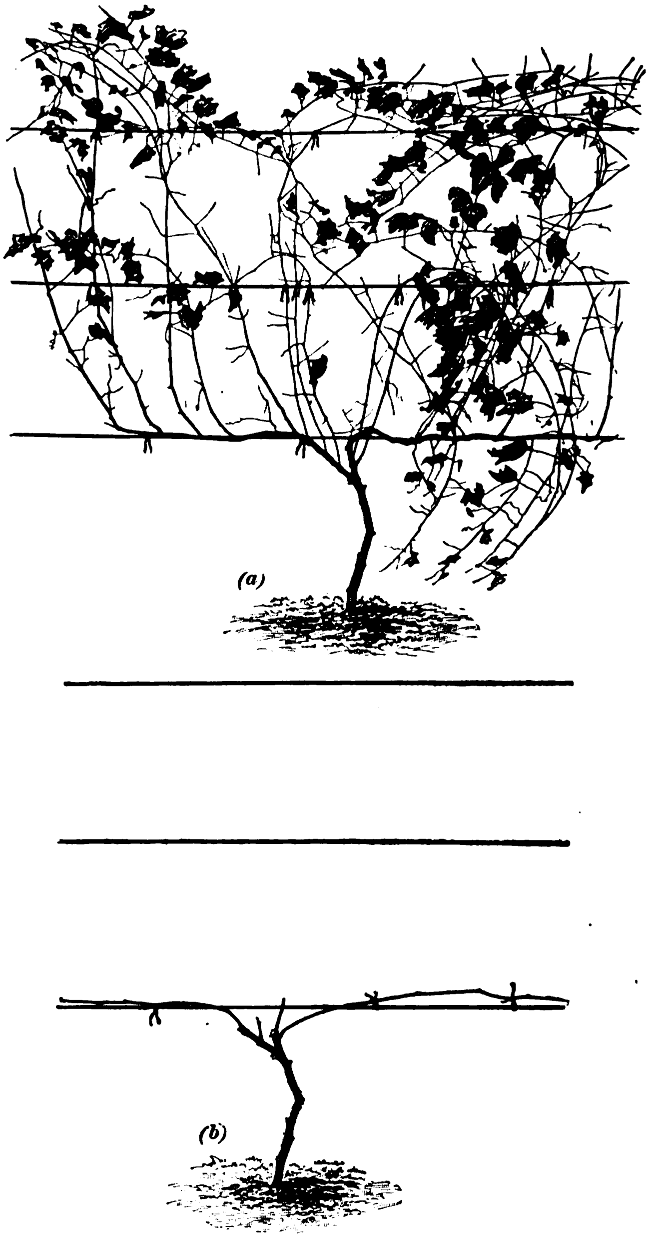
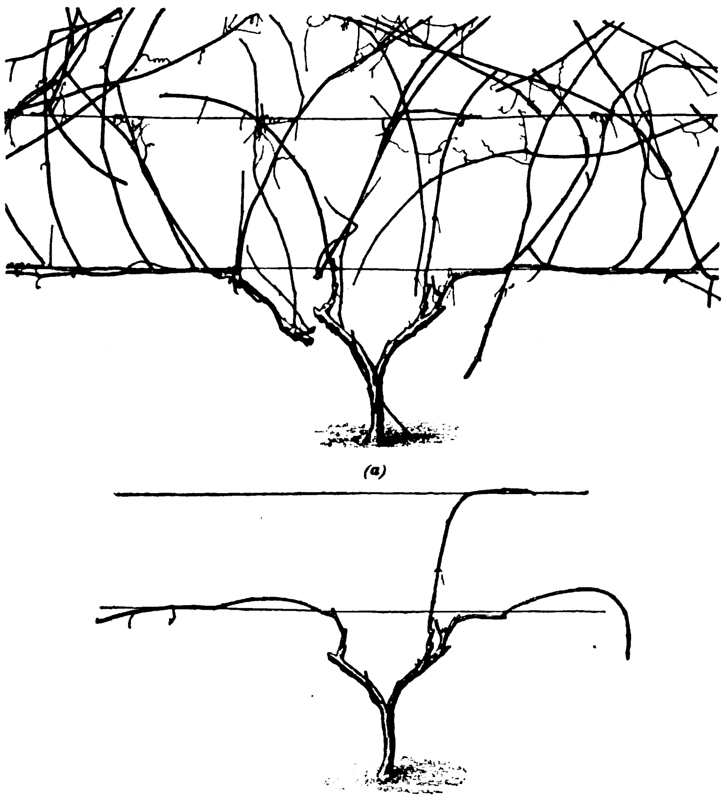


FIG. 14

horizontally along the wires or obliquely across them and the shoots, as they develop, are tied to wires above. The following upright systems are in common use: the ***high-renewal system***, the *Keuka system*, the ***horizontal-arm spur-renewal system***, the *Chautauqua spur-renewal system*, and the *fan system*.

47. The **high-renewal system,** which has much to commend it, is illustrated in Fig. 14. An unpruned vine is shown in (*a*), and the same vine is shown pruned in (*b*). The trellis is usually made with three wires, the lower wire being placed from 18 to 30 inches above the ground, the second wire 18 inches above the first, and the third wire 20 inches above the second. The main trunk, or stem, of the vine is carried up to or just below the first wire; and two canes, each bearing from six to ten buds, are taken off, preferably a little below the level of the wire. One cane is tied to the right and the other to the left. The bearing shoots that grow from the buds on these canes are tied to the second wire when they have reached a sufficient length, and to the third wire as soon as growth will permit. When they reach above the upper wire, they may be cut off or pinched back. The next year the vine should again be cut back to two canes, cutting being as close to the head as possible. Near the base of each cane, but on older wood at the head of the stem, short spurs carrying two or three buds are maintained, from which shoots develop and which in turn are used to furnish the fruiting shoots of the following year. Thus, the spurs are the means of renewing the fruiting wood. From these statements it will be seen that the quantity of old wood retained is reduced to a minimum, but that the work of tying is much greater than in any of the drooping systems.

48. The **Keuka system,** which is practiced in the Keuka Lake district of New York, is a modification of the high-renewal system. The method of pruning and training vines by this system is illustrated in Fig. 15; in (*a*) is shown a pruned but unstripped vine, and in (*b*) the same vine is shown stripped. The first year after being set the vines are allowed to grow at random on the ground. At the beginning of the second year they are pruned back to two buds. If the vines are strong growers they are tied this season to the lower wire of the trellis, which is from 18 to 20 inches above the ground. At the beginning of the third year the vines are cut back to a stem, or trunk, from 10 to 20 inches high and are then tied to the lower wire. The fourth year the vines consist of a short trunk and two or

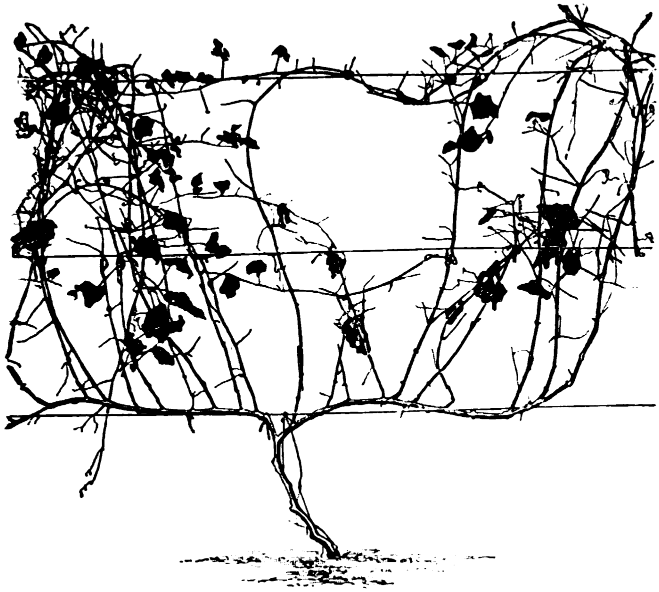


(a)

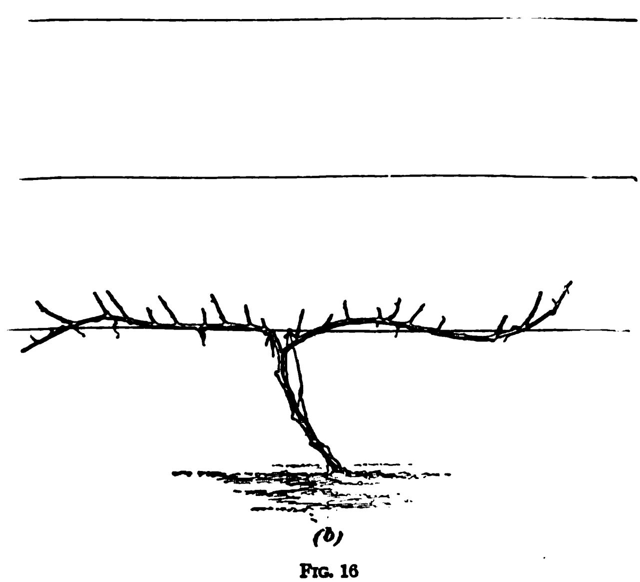
(b)

FIG. 15

three canes, each of from five to eight buds; these canes are laid along the lower wire and tied. The shoots from these are carried perpendicularly to the second wire, which is about 20 inches above the first wire, as fast as the growth will permit; they are then carried to the third wire, which is about 20 inches above the second. The following year all the wood



(a)



(b)

FIG. 16

is cut away except two or three canes that have grown from the buds nearest the head of the trunk. These canes carry from five to eight buds. If two canes are left they are tied to the right and the left along the lower wire; if three are left, the third is carried to the second wire and then tied, as shown in the illustration. As there is a tendency for long spurs to result from the repeated renewals secured in this manner, buds from the head of the stem are allowed to develop and fruiting wood is secured from them. Thus, the fruiting wood arises from near the head of the trunk, and as this is usually short, almost the entire vine is renewed annually. When the trunk approaches the end of its usefulness, a shoot is allowed to grow from the ground and this eventually becomes the trunk, the old one being cut away. The advantages of this method of training are the low head, the reduction of the old wood to a minimum, and the ease of getting a complete renewal.

49. The **horizontal-arm spur-renewal system** is illustrated in Fig. 16. In (*a*) is shown a vine trained by this system before it was pruned, and in (*b*) is shown the same vine after it was pruned. The trellis used in this system of pruning is practically the same as that used in the high-renewal system. The trunk is taken up to a point at or just below the lower vine. Two canes are taken from the head of the trunk and laid along the lower wire, one to the right and the other to the left. The number of buds to leave on each cane will depend on the vigor of the vine and the distance between adjoining vines. These canes are to become permanent arms and do service for several years. The shoots that develop from buds on these canes the current year are cut back in the fall or winter to two buds. Two shoots are allowed to grow from each of the spurs thus formed and are tied to the upper wires. In the fall the cane developed from the upper bud of each spur is cut entirely away and the other cane is cut to two buds as before. The spurs lengthen rapidly and become crooked, consequently it is advisable to cut them away entirely every few years and grow others from shoots that arise from the arms. The spurs may be distributed from 5 to 21 inches apart on the arms.

50. The **Chautauqua spur-renewal system,** which is used by the grape growers of the Chautauqua district of New York, is a modification of the horizontal-arm spur-renewal system. Permanent arms are maintained to support the canes, which are tied yearly to a two- or a three-wire trellis; the canes may be tied obliquely or perpendicularly. If a two-wire trellis is used, the wires are usually placed 34 inches apart; if a three-wire trellis is used, they are placed about 20 inches apart. The canes for tying up each year develop directly from the old wood of the arms, or from spurs on the arms, or from the base buds of the previous season's canes. The old arms should be renewed at frequent intervals, as in time they become crooked and gnarled, and the extremities reach to a considerable distance from the head of the vine. The Concord grape is well adapted for training by this system.

51. The **fan system** of training, although still used in a few localities, is not nearly so popular as it was some years ago. In this system, the renewals are made yearly from spurs near the ground, very little old wood being retained. The shoots are tied to the wires in the direction that they naturally assume; they may be tied vertically, horizontally, or obliquely across the wires. In regions where grapes are grown for home use and the climate necessitates winter protection, the fan system may be used to advantage. One serious objection to the system, however, is the tendency of the spurs to become long and crooked.

52. Horizontal Training System.—Horizontal training is little used at the present time, as the cost of the trellis and the labor required for tying the vines render it prohibitive. An ordinary two-wire trellis is used, but a strong stake reaching to the top wire is driven at the side of each vine and four perpendicular slats, which do not touch the ground, are fastened to the trellis, two on each side of the vine and from 12 to 15 inches apart. Woven-wire fencing of narrow width is sometimes used in place of slats. The vine is annually renewed back to the trunk, which is from 1 to 2 feet high, and a single cane and spur are left at each pruning, the cane being tied to the stake at the top. About six bearing shoots on each side of this cane are left to grow; these shoots are tied horizontally to the slats. One advantage of this system is that the vines of varieties that are likely to overbear, or vines that are weakened and need careful nursing, may be easily controlled.

53. Pruning Systems for Vinifera Grapes.—Vinifera grapes are commonly tied to stakes, although there are some varieties that do better when trellised. Tieing to stakes, in the case of varieties that will allow of it, has two great advantages over trellising: First, staking is less expensive than trellising; and, second, staking allows cultivating to be done in both directions. Two general systems of pruning Vinifera grapes are in vogue on the Pacific slope. These are known as the *short-pruning system* and the *long-pruning system*. In the short-pruning system the vines are tied to stakes; in the long-pruning system they are sometimes tied to stakes and sometimes to trellises, depending largely on the variety. It should be understood, however, that a great many modifications of these general systems are found in different localities.

54. The **short-pruning system,** which is known also as the *spur system* and the *stool system*, is in general use on the Pacific slope for stocky varieties. It is the simplest and cheapest method of pruning and tieing vines. The vines are usually staked, as has already been explained, at the end of the first season's growth. The pruning at this time consists of removing all but the strongest cane and cutting this back to 12 inches in length, all lateral branches being cut away. In Fig. 17 (*a*) is shown the appearance of a 1-year-old vine after being pruned and tied.

The following season shoots are permitted to grow from only the two uppermost buds. The two resulting canes are cut back in winter to spurs of two buds each. The appearance of a vine at this stage is shown in Fig. 17 (*b*). The following year the two spurs are allowed to produce growth and the resulting canes are again cut back to spurs and all of them allowed to remain if the vine is strong. The appearance of a vine at this stage is shown in Fig. 17 (*c*). Thus a vine, under ordinary conditions, consists, at the beginning of the fourth year after planting, of a trunk from which spring four or five arms, on each of which a cane has been cut back to a spur of from one to four buds. When the vine is pruned the following winter, all or nearly all of the canes that have grown from the spurs are entirely removed. The spurs of the last season are cut off just outside the inner canes, which are cut back to spurs. The pruning each winter after this is to promote a regular system of spur renewal. As the vines become older and stronger and can stand more cropping, more spurs are left to increase the fruiting capacity of the plant.

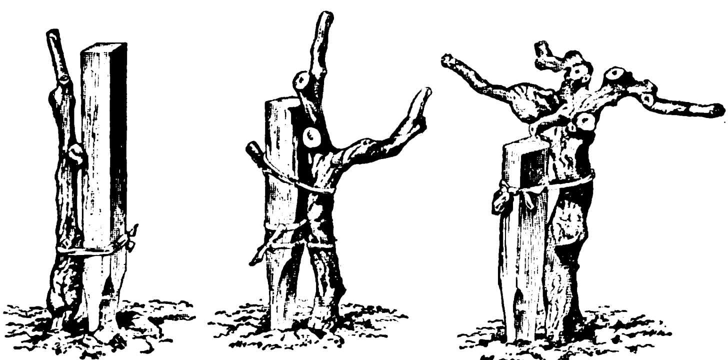

(*a*) (*b*) (*c*)

Fig. 17

In the course of time the arms of the respective spurs are renewed, and entirely new arms and spurs are grown. In the case of some varieties in which the lower buds are not sufficiently productive, the length of the spurs should be increased and each spur allowed to have four or even five buds.

Sometimes two or more trunks are allowed to come from the same root; this is very undesirable, as it increases the cost of pruning and has no compensating advantage. When from 5 to 8 years old, a vine does not need the support of a stake, consequently this may be removed.

55. The **long-pruning system** is used for strong-growing varieties such as Thompson's Seedless and the Sultana.

Thompson's Seedless variety does best when trellised as shown in Fig. 18. This is a modification of what is known as the Guyot system of pruning, and is not only theoretically correct, but is easy to explain to pruners. The horizontal position of the canes has a tendency to promote the starting of numerous shoots and the consequent production of a large number of fruit clusters. At the same time the buds on the wood spurs are forced to start, and not being shaded they tend to grow vigorously. It is best to tie the shoots from the wood spurs in a vertical position to the stake, and they should not

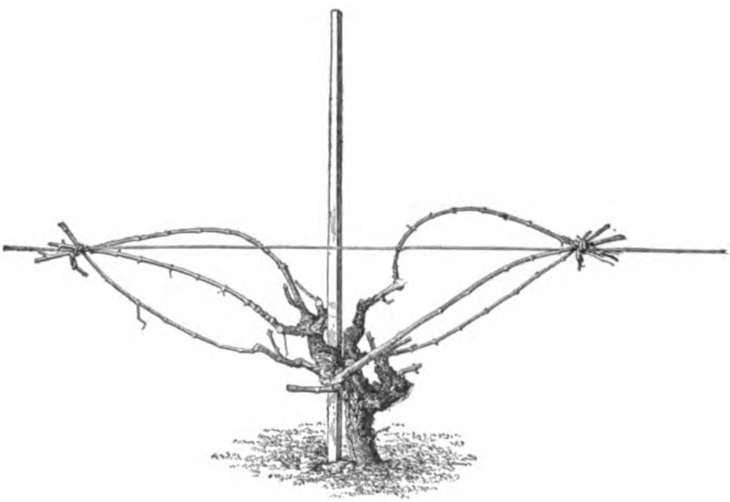


Fig. 18

be topped. These shoots are retained for fruit canes at the winter pruning, and new wood spurs are then left for the next year. This trellising system is now being used extensively in the best vineyards of California where Thompson's Seedless variety is grown.

A great many methods are in vogue for tieing long-pruned vines to stakes. Perhaps the commonest method is to retain from two to six fruit canes each year and an equal number of renewal spurs of two buds each, the canes being tied to a stake, as shown in Fig. 19. The fruit is borne on shoots that arise from these canes. A vine should not be drawn up close to the stake in the middle, but should be allowed to bulge out, as this will cause the buds to push out better and render them more fruitful. The stakes are retained permanently. Owing to the fact that various modifications of this method are practiced in different localities and in the case of different varieties, it is advisable for a grower to consult the nearest experiment station regarding the exact procedure to follow in pruning and training his vines.

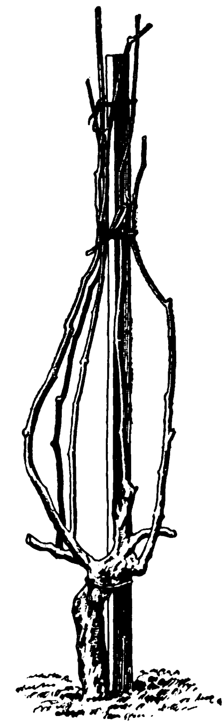


Fig. 19

In the long-pruning system, it is important to see that the canes left are not water sprouts, that is, do not arise from wood more than 2 years old.

56. Training to Arbors and Bowers. Little skill is needed to train the grape as a covering for arbors and bowers. When it is desired to train vines for this purpose, the permanent trunks should be trained to the top of the arbor or bower, and from year to year, at intervals of about 2 feet, canes should be led out from the trunk; this is possible only by leaving spurs for renewals. The vines should stand from 6 to 10 feet apart, and the canes should be cut to half the distance between the vines, the canes of two adjoining vines meeting in the middle of the dividing space. The shoots springing from the canes will cover the arbor or bower.

The object of this sort of training is to secure shade, and it is not to be expected that fine grapes can be grown; but, if the vines are severely cut back from year to year, grapes of fair quality and in considerable quantity may be produced.

MISCELLANEOUS INFORMATION ABOUT PRUNING AND TRAINING

57. Summer Pruning.—Summer pruning of grapes is practiced much less now than formerly, the tendency being to discontinue the practice entirely. Grapes are pruned in summer in two ways, namely, by removing superfluous shoots and by cutting back, or heading in, the canes.

Often shoots grow from weak buds on the fruiting canes to the detriment of stronger shoots. These weaklings should be rubbed off. Again, shoots often spring from arms, from spurs, or even from the trunk, and are, in the main, not wanted. These too, should be removed. Secondary shoots often appear on the fruiting shoots, especially in the axils of the latter, and must be removed. The sooner all of these superfluous shoots are removed the better; indeed, many should be rubbed off in the bud before they begin to grow. Here, for the most part, summer pruning should end.

Cutting back of the main canes, although sometimes necessary to keep them within proper bounds, is, in general, a poor practice. Two troubles arise from this kind of summer pruning: First, it often causes a growth of laterals which cover the vine with foliage that does not ripen, and is, therefore, a detriment; second, in the case of some varieties, under some systems of training, it prevents the development of a sufficient quantity of foliage properly to nourish the vines. In either case, the vines are much weakened. If summer pruning of this kind seems absolutely necessary, it should be done lightly and as late in the season as possible, so that lateral growths will not be so likely to start. In the majority of cases if it seems necessary, because of climatic or soil conditions, to head in vines annually in order to keep them within proper bounds, the necessity can be obviated in three ways: First, by having a greater distance between vines; second, by the adoption of a drooping system of training; and third, by training the vines very high. It may be necessary to head in the cane tips of the vines of strong-growing varieties that, under a drooping system, reach the ground; this heading is best done with a sickle.

58. Pruning and Training of Neglected Vines. Occasionally, an old vineyard is found in which the vines have never been pruned or have been pruned improperly. The vines in such a vineyard can seldom be made over. If they are healthy and vigorous, new vines should be grown from canes taken from the roots. The old trunks should be allowed to remain until the new ones are strong enough to be tied to the wires. In order to induce vigorous growth in the new trunks, the old trunks should then be rigorously cut back.

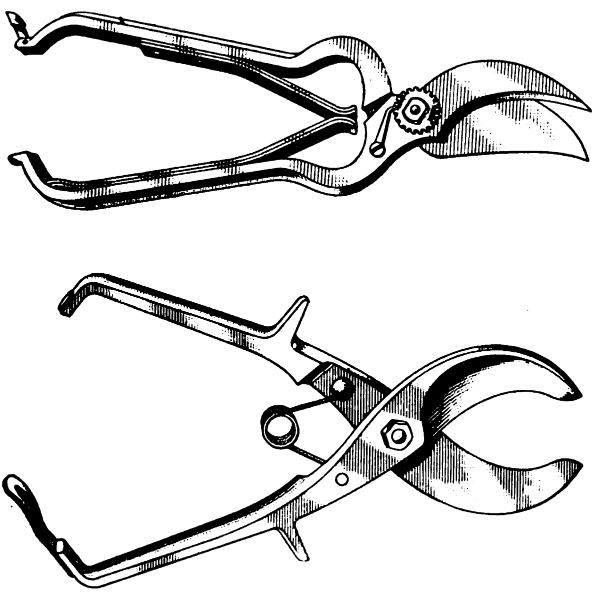


Fig. 20

If the new canes are vigorous and mature well, they can be tied to the wires at the end of the first season. More often, however, they will be so weak in growth that they should be cut back in the winter to about three buds, from one of which the permanent trunk can be grown the second season. The new trunks may then be treated as if they were young vines. The old stumps should, if possible, be cut off below the ground and covered with earth to prevent the excessive formation of suckers; all suckers, as they arise, should be removed.

The remodeling of old vines is worth while only when the vines are strong and healthy. In many cases it is far better to graft neglected vines rather than to attempt to train them. The method of grafting has already been described.

59. Method of Pruning and Stripping.—Grapes are pruned with small, light, specially made shears, two forms of which are shown in Fig. 20. Usually the canes are allowed to remain tied to the wires or stakes until the pruning is done, although in the Kniffen systems the strings may be cut. The actual pruning is done by a skilled man who does nothing but make the cuts, this work being called *blocking out*. After a vineyard has been blocked out, the wires must be *stripped*. Stripping is done by boys or unskilled low-priced laborers any time after the pruning has been done until spring. The prunings are hauled from the vineyard by a horse or horses attached to any one of a score or more devices. One of the best devices for this purpose is a pole a little smaller than the pole used to bind a load of hay. A horse is hitched to the pole by means of a rope drawn through a hole about 4 feet from the large end. The small end of the pole is held in the hand as the butt is pulled along the ground. After the first vines between two rows are caught, the rest of the brush clings to the wood until a load is secured. Stripping and hauling must be done before the buds swell in the spring, otherwise many young buds will be broken off of the pruned vines.

60. Tying of Vines.—The tying of canes and shoots to trellises is a task requiring quickness, skill, and some judgment. Canes are tied in the spring before the buds begin to swell; shoots are tied, or "put up," as vineyardists say, during the summer. In both operations the work is light and can be done by boys, girls, women, or other low-priced laborers. The materials used for tying, as has already been explained, are wrapping twine, wire, raffia, rye straw, etc. At the present time wire is almost always used for the tying of canes and twine or raffia for the growing shoots. The wire should be annealed, preferably of about 18 gauge, and cut into lengths of about 4 inches. In tying, the workman stands on the opposite side of the wire from the cane. The tie is usually made by making a double loop about the trellis wire and the cane, the object being to bind the cane securely so that there will be no chafing. Any method of tying that accomplishes this purpose and is convenient will be satisfactory. Where soft annealed wire is used for tying, the work may be done in cold weather, as mittens can be worn. In the tying of shoots, the tie is made very loose in order to allow the shoot to grow in diameter.

61. Ringing of Vines.—Ringing of grape vines is a common practice in some regions. It consists in removing from the bearing canes a ring of bark about an inch wide, or of sufficient width that the bark will not heal over the wound. The girdling is done when the grapes are about the size of a pea. Usually, ringing causes the vines to produce larger bunches and berries and the fruit to ripen earlier. The securing of good results depends on several factors, among which are the variety, the season, the abundance of healthy foliage, the culture, and the quantity of fruit the vine is allowed to mature. The fruit of some varieties suffers a loss of quality when the vines are ringed; that of others is not at all affected. Cutting back the new growth on ringed arms appears to give better quality to the fruit.

Ringing is more or less devitalizing in its effect on the vine, depending, in part at least, on the factors mentioned in the previous paragraph. It has been found in practice, however, that some varieties, when judiciously managed, may be ringed for a number of years in succession with little injury to the vine; the Concord, the Catawba, the Niagara, and the Worden are often ringed. Vines grown on one of the renewal systems are better adapted to ringing than those grown on the Kniffen systems, as in the case of the former more wood can be left to support the vine than is possible in the case of the latter.

SPRAYING OF GRAPES

62. It is impossible to give a spray calendar for grapes that will apply in all sections of the country, as, fortunately, but a few of the many insect enemies and diseases of this fruit are commonly found in any particular locality. A grower must be guided in his spraying operations entirely by the insects and diseases that are prevalent in his community. Just what these are may be learned by experience, by inquiring of other growers, or by communicating with authorities.

The different diseases and insects of the grape and the treatments and control measures for each have already been discussed in the preceding Section. It is not the purpose here to repeat the information given there; the present discussion will be confined to the chronological order for applying various sprays. The following, although perhaps subject to modification in different localities, will serve as a guide for spraying.

1. For the control of the grape-vine flea beetle, spray thoroughly just before the buds begin to swell with arsenate-of-lead solution (4 pounds of arsenate of lead to 50 gallons of water). Later in the season, when the worms appear on the leaves, arsenate of lead should be added to one of the Bordeaux sprayings (8 pounds of arsenate of lead to 150 gallons of Bordeaux mixture).

2. If anthracnose has to be combated, apply to the surface of the canes when the buds are swelling, but before they begin to open, a warm, saturated solution of iron sulphate, to which may be added, if necessary to make it stronger, 1 per cent. of sulphuric acid. This solution is very caustic and should be handled with care. If the saturated solution of iron sulphate is used alone the solution may be sprayed on, but if the sulphuric acid has been added, it is safer to apply it to the canes with a swab.

3. For the control of black rot, and incidentally for the control of downy mildew and powdery mildew, spray with Bordeaux mixture (4 pounds of copper sulphate, 4 pounds of lime water, and 50 gallons of water) just as the pink tips of the first leaves appear.

4. From 10 to 14 days after the spraying described in paragraph 3, spray again with the same Bordeaux for the same troubles.

5. Repeat the spraying just after blossoming.

6. Repeat the spraying in from 10 to 14 days later.

7. Repeat the spraying in from 10 to 14 days later.

8. For the control of the grape-vine fidia, or grape root worm, while the beetles are feeding on the foliage about the middle of June, spray with a molasses-arsenical mixture (1 gallon of molasses, 6 pounds of arsenate of lead, and 100 gallons of water).

9. For the control of the grape leaf hopper, when the hoppers appear spray with a nicotine preparation guaranteed to contain at least 2.7 per cent. nicotine diluted with from 65 to 100 parts of water.

10. For the control of the rose chafer, when the insects are present, spray with glucose-arsenate mixture (10 pounds of arsenate of lead, 25 pounds of glucose, and 100 gallons of water).

11. If the sprayings for black rot are not necessary, other means of control must be applied for powdery mildew. In such cases in dry climates, dusting the vines with flowers of sulphur is effective.

12. If the vines are suffering from chlorosis, or yellow leaf, this trouble is thought by some persons to be overcome by applying a small quantity of iron sulphate to the soil about the vine. But as a number of the American varieties are known to be free from this trouble, planting of such varieties is probably the wiser course.

HARVESTING, PACKING, AND MARKETING OF GRAPES

HARVESTING

63. Time for Picking of Grapes.—Grapes must not be picked until they are fully ripe, as they do not mature any after being separated from the vine. Large quantities of grapes are sent to the market much too green, the shipper being under the erroneous impression that because they are fully colored they are ripe. Although the color is somewhat of a guide as to whether grapes are ripe, the only conclusive evidence of ripeness is the texture of the pulp and the taste of the fruit. It is impossible to give specific instructions with reference to these

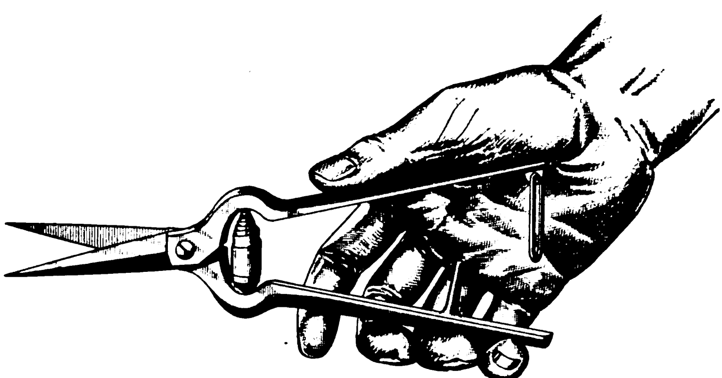


FIG. 21

points, but a grower soon learns by experience what the color, texture of the pulp, and taste should be.

64. Appliances for Picking of Grapes.—The appliances for picking grapes are few and simple. As soon as full maturity has been reached, the grapes should be cut from the vines by means of grape scissors, a desirable form of which is shown in Fig. 21. Such scissors are inexpensive and may be had from almost any dealer in orchard and vineyard tools. The bunches should be handled as little as possible, in order to avoid injuring the bloom of the fruit. Sometimes, immediately after being picked, grapes are placed in the receptacles in which they are to go to market. This gives almost no opportunity for grading and is, therefore, often a poor practice. More generally, and far better, the fruit is put in trays, which may be of several sizes and shapes, usually holding from 25 to 35 pounds, and is conveyed in these to the packing house. A desirable form of tray for this purpose, with dimensions, is shown in Fig. 22. The picked fruit must be handled very carefully and should be conveyed from the field to the packing shed in a wagon provided with flexible springs. In commercial vineyards one-horse platform wagons, the front wheels of which will pass under the platform, are used for this purpose.

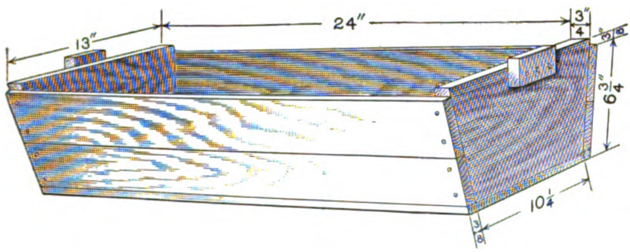


Fig. 22

65. Managing of Pickers.—Picking is done in grape regions by transient help, mostly foreign men, women, and children, from neighboring towns and cities. As a rule, the best results are obtained if pickers are hired to work by the piece rather than by the day. When paid by the piece, pickers usually do more and better work. In a large vineyard there must be one or several competent persons in charge of the pickers to see that the work is done properly, and to keep them from wasting time. A good foreman can often double the average picking capacity of a gang of pickers. Some growers pay their pickers each day; others pay less frequently. In either case, a part of the pay should be reserved until the close of the season, otherwise the pickers may leave when unpleasant weather comes or when the grapes for any reason become scarce or hard to pick.

There are many ways of keeping accounts with pickers. Probably the most common is to give a ticket when the receptacle of grapes is delivered. A form of ticket often used for this purpose is shown in Fig. 23, the ticket at the right being the original and the one at the left a duplicate. When such tickets are used the grower keeps either the original or the duplicate and gives the picker the other half. One objection to the ticket system is that the pickers often lose them, exchange them with other pickers, or are irregular in redeeming them. Some growers use tags, each one of which bears the picker's name and is attached to the person. The tags have marginal numbers or other divisions that are canceled by a punch as

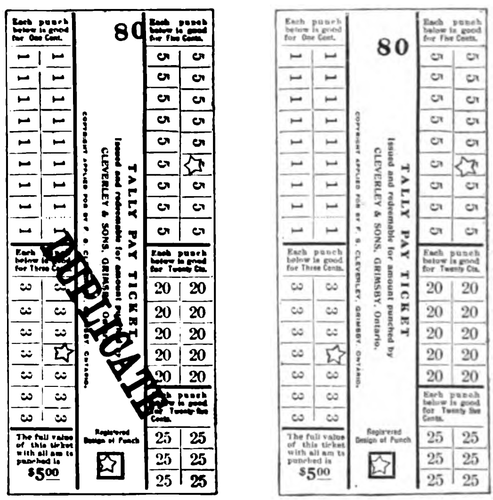


FIG. 23

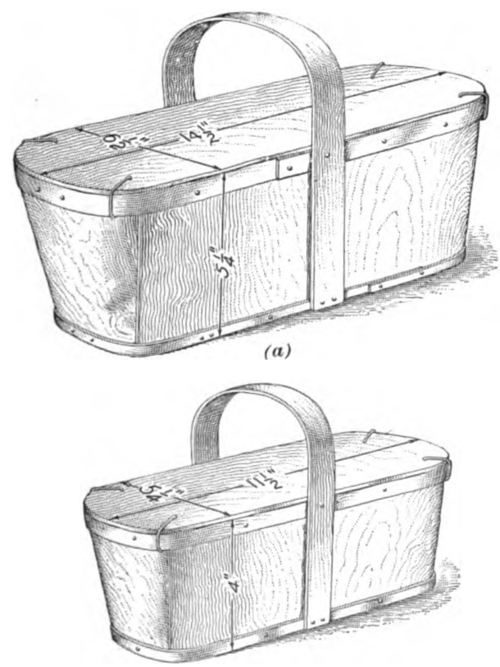
the pickers deliver the grapes. Some growers prefer to keep a book account with each picker; often, in this case, payment is made by the pound, each receptacle being put on the scales as it is brought in from the field and credit being given for the number of pounds. This method has many advantages over the others mentioned.

66. Grading of Grapes.—In commercial vineyarding, only good fruit, in many seasons only the best, is worth grading; it is more profitable to sell poor fruit by the ton than to grade it. The higher the price, the more special the market, the better the fruit, and the more carefully the crop is picked, the more profitable it is to grade and pack it well.

As compared with other fruits, grapes are easily graded. There are usually but two grades, firsts and culls. Firsts are grapes that are free from insect and fungous injuries and of a uniform degree of ripeness; berries must not be missing from the stems, and the bunches must be approximately uniform in size. Grapes not conforming to these specifications are culls.

PACKING

67. Packages for Grapes.—In the East and South, table grapes are always invariably packed for market in 4-pound or



(b)

FIG. 24

8-pound baskets like those illustrated in Fig. 24; in (*a*) is shown an 8-pound basket and in (*b*) a 4-pound basket. The sizes given are for gross weight. Unfortunately, no way has been found for securing uniformity in the size of these baskets, consequently much variation is found in different grape-growing regions. Occasionally, grapes are packed in 2-pound and 12-pound baskets of the style illustrated. Also, they are sometimes packed in trays made so as to fit in cases.

On the Pacific coast, large quantities of table grapes are packed in kegs, the bunches being protected by ground cork or other material. Trays of various sizes are also extensively used. Fig. 25 shows an attractive tray of Western grapes. Whatever package is used, it should be clean, of a natural color, of sound wood, and well made.

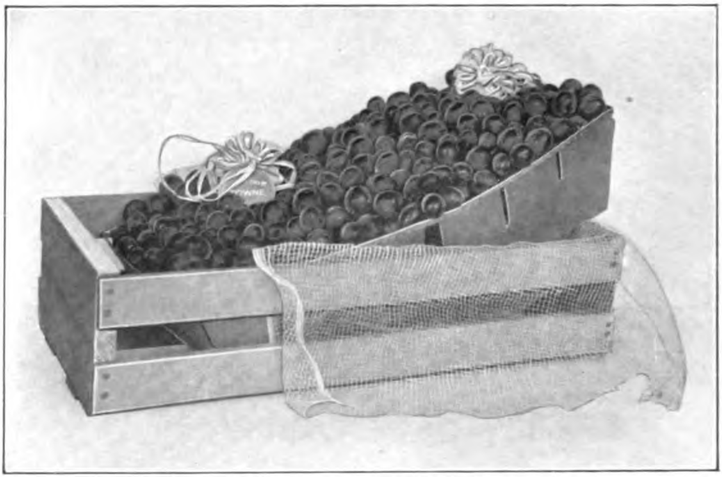


FIG. 25

Grapes for wine, grape juice, and raisins are usually sold by the ton to establishments manufacturing these products. In this case the grapes are usually delivered in trays holding $\frac{1}{2}$ bushel or thereabouts. At the present time there is considerable demand for grapes for home wine making and where sales are made for this purpose the grapes are usually packed in either $\frac{1}{2}$-bushel trays or 12-pound baskets.

68. Packing Houses for Grapes.—Two general types of packing houses are commonly found in commercial vineyards. One type is a combined packing and storage house and the other is strictly a packing house, being merely a sort of half-way station between the vineyard and the shipping station. In a house of the first type grapes may be stored for some time after being picked; in one of the second type, no provision is made for storage.

A desirable packing house of the combined packing and storage type is illustrated in Fig. 26. This house is provided with a cellar for the storage of the grapes; the first floor is used for packing and storage, and the second floor, or attic, is used for the storage of baskets, crates, and the like. The building is

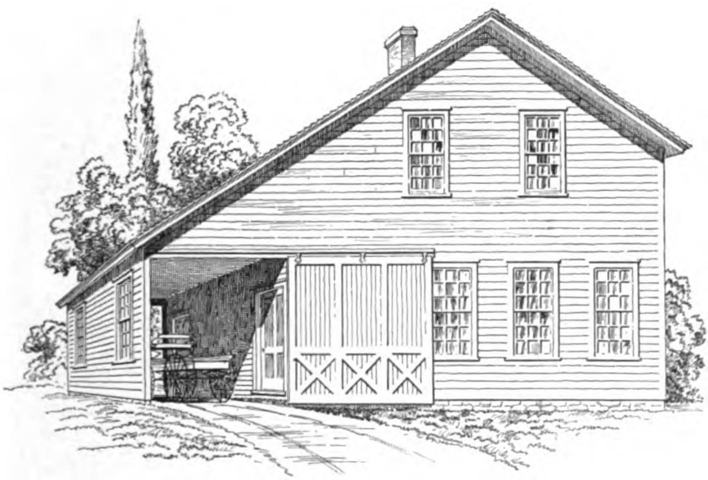


FIG. 26

25 feet by 60 feet. The foundation walls are 24 inches thick, and windows are provided in them for ventilating the cellar; ventilation is also secured by means of a chimney that extends from nearly the middle of the cellar up through the roof. If attention is paid to the ventilation, the temperature of the cellar can be kept as low as 50° F. or lower during September and October. The cellar floor is of dirt. The first floor is divided into two rooms, the front one, which is 25 feet square, being used for packing, and the back one, which is 25 feet by 35 feet, being used as a shipping room. The floor between the cellar and the first floor rooms is double and made of $1\frac{1}{4}$-inch

matched pine with an air space between the two layers. Such a building can be constructed for about $1,200.

If cold-storage facilities are convenient and the rates are reasonable, there is little need of going to the expense of making the packing house a storage house. Under such conditions, a house of the second type mentioned will be satisfactory. Such houses are so simple to construct and of so many differ-

Fig. 27

ent designs that it is neither necessary nor possible to describe them in detail. Any sort of a substantial building that will protect the packers and afford convenience in packing will serve the purpose.

In every packing house there should be a dry, airy room in which the baskets may be stored when packed, otherwise the fruit may become moldy. This room should be darkened, as light causes the baskets to become of an undesirable color.

A packing house must have a packing table of some kind. A very convenient form of packing table is illustrated in Fig. 27. This table extends the length of the room, passages being left at the ends. The trays of grapes from the field are set before the packers, who pack the fruit into a basket at their left. When a basket is filled it is placed on a shelf at the back and above the inclined table. Empty trays are slid through an

FIG. 28

opening at the back onto a shelf. An attendant with a truck keeps the packers supplied with trays of grapes, removes the filled baskets, and keeps up the supply of empty baskets.

69. Method of Packing.—In order for grapes to pack well they should be allowed to stand for from 12 to 24 hours after being picked; this will give them time to wilt. Unless grapes are wilted when packed they will shrink and the package will not be full when it reaches the market. In addition, grapes do not handle well in packing unless wilted. In packing in baskets, each bunch of grapes is placed separately in the basket, and the bunches are arranged in concentric tiers. The top layer should be placed with special care. The bunches should all be clean and fresh, free from spraying material, unbroken, and with the bloom on the berries disturbed as little as possible. When the basket is completely filled, the lid should be put on, care being taken not to crush the grapes. Much the same method is used when the grapes are packed in trays, except that a lid is not used. When grapes are packed in kegs, enough of the ground cork or other packing material is used to separate the bunches.

70. Labeling of Grape Packages.—A commercial grape grower will often find it of great advantage to use a label on his packages of fruit. A label adds to the attractiveness of a package and should be a guarantee of the contents, both as to the name of the variety and the quality of the fruit. A label is a sign by which a grower's fruit may be distinguished, and consequently is a valuable advertising medium. It is not worth while to label poor grapes. Many growers have their labels registered in the United States Patent Office in order to prevent unscrupulous persons from using them. In Fig. 28 is illustrated the labels used by two commercial vineyardists; the upper label is registered.

MARKETING

71. Many of the table grapes grown on the Pacific coast are sold through cooperative associations. This is true, too, of much of the product grown in Western New York, the largest grape-growing region of the East. There are a few cooperative selling agencies in other regions, but, for the most part, outside of the districts named and even in parts of these most of the grape crop passes through the hands of local buyers or commission men in the cities.

There are a number of advantages in selling through cooperative organizations. Through such organizations the grapes are handled as nearly as is possible in accordance with one standard in picking, grading, and packing; the output is distributed throughout the country in such a way as to prevent disastrous competition; favorable transportation rates are secured; and in most cases the supplies needed in producing the crop and in marketing it are purchased more economically. Grape growers, in common with all other agricultural producers, meet at every turn combinations of capital, and cooperation becomes almost a necessity for self-preservation. The business of producing and selling must be carried on in a large way if the grower is to obtain an adequate share of what the consumer pays for grapes.

It is not possible to discuss cooperation at length, but a few fundamental principles may be given that should govern associations of growers. The ideal cooperative association is one in which there are, as nearly as possible, no profits or dividends. All members have an equal voice in the management of the association and share alike its successes and failures. In such an association every member should be a producer and absolutely all of his products should be sold through the association. Such profits as of necessity arise should be distributed to the members in proportion to the amount of business that each has done. The association should carry on its work at as near cost as possible, and declare profits only after expenses, depreciation, interest on capital, and capital for future operations are deducted. Such a plan should give each member as nearly as possible exactly what his fruit has brought in the markets.

The commercial grape-growers in the United States who are succeeding best belong to organizations that are founded on the principles just outlined. As the industry increases, the necessity for forming some such organization wherever grapes are grown for market becomes greater.

GRAPE BY-PRODUCTS

72. Grape growing is seldom profitable on a large scale or in any grape-growing regions unless in times of abundant crops the grapes may be used for other purposes than for dessert. On the Pacific coast and in some parts of the East, the industry is almost or wholly founded on the manufacture of grape by-products. These are wines, raisins, and grape juice.

73. Wines.—Wine is the fermented juice of the grapes. The process of making wine differs with conditions such as the climate, the variety of grapes, the conditions of growth, and the kind of wine to be made. However, the fundamental principles are much the same under all conditions and may be described as follows:

Grapes for wine must not be picked until they have reached full maturity, thus insuring a high sugar content and perfect color. The composition of the must, or sweet juice, as to sugar and acid content is determined by various instruments. If the must lacks sugar, this ingredient is added; if it is too acid, water is added; or the composition may be otherwise changed, although the best wine is made from grape juice that has been changed as little as possible. The grapes are crushed at once after being harvested. The modern method is to use mechanical crushers that break the skins but do not crush the seeds.

For some wines, the stems of the grapes are removed; for others, they are not. If white wine is to be made the juice is separated from the skins and pulp at once; if red wine is to be made, fermentation is allowed to take place in the crushed grapes.

Fermentation is carried on in large tanks. Some wine makers prefer open tanks; others prefer closed tanks. The duration of fermentation may be from 2 or 3 to 20 days, depending on the percentage of sugar, the temperature, and the activity of the ferments. The limits of temperature below which and above which fermentation does not take place are 55° and 95° F.; from 70° to 85° F. is the most desirable temperature.

When the sugar in the must has been converted into alcohol, the new wine is drawn from the tanks into casks to age. Before being bottled the wine is racked two or three times into new casks to clear it and stop secondary fermentation.

Special treatments give distinct wines. Red wines are made from dark-colored grapes, the juice being fermented on the crushed fruits; white wines are made from light-colored grapes or from juice not allowed to ferment on the crushed fruits. Dry wines are those in which the sugar is practically all converted into alcohol; sweet wines are those which retain more or less sugar. Still wines are those in which the carbonic-acid gas formed by fermentation has wholly escaped; sparkling wines contain a greater or less amount of carbonic-acid gas. Champagne is a sparkling wine.

74. Grape Juice.—Grape juice is made from clean, sound, but not overripe grapes. In commercial practice, the juice is pressed out by machinery, but in home manufacture of the product the grapes may be pressed by hand. If a light-colored juice is desired, the liquid is extracted without heating the grapes; if a red juice is desired, the grapes must be dark in color and the pulp must be heated before being pressed. If heating is necessary, it is done in a double boiler so that the juice does not come in direct contact with the fire. The proper temperature ranges from 180° to 200° F.; it must not exceed 200° F. if the flavor of uncooked grapes is desired. After being heated, the juice is allowed to settle for 24 hours in a glass, earthenware, or enameled vessel, after which it is carefully drained from the sediment and strained through some sterilized filter. In home practice, several thicknesses of flannel, previously boiled, will do for a filter. The liquid is then poured into clean bottles, room being left for expansion in the second heating. The bottled juice is now heated a second time, after which it is immediately corked and sealed.

The principles involved in making grape juice are the same as those observed in canning fruit, and the operation may be varied in the former as it is in the latter if only certain fundamental processes are followed.

75. Raisins.—A raisin is a dried and cured grape. Raisin making is a simple process. The grapes are arranged on shallow trays and placed in the sun to dry; when two-thirds dry, the grapes are turned by placing an empty tray on a full one and turning both over, after which the top tray is removed. When the raisins are nearly dry the trays are piled on top of one another and the drying is finished out of contact with the direct rays of the sun. When the grapes are properly dried they are put in bins to sweat preparatory to packing and shipping. The finishing touch in the drying, however, is sometimes given in curing houses, to avoid injury from rain or dust.

Seeding, grading, packing, and selling of raisins are now separate industries from growing and curing. At present all raisins are made from varieties of the Vinifera grape, no American variety having been found suitable for raisin making. Grapes adapted for making raisins must have a large percentage of sugar and solids, a thin skin, and high flavor. American grapes lack in sugar content and have a skin so thick and tough that the fruit does not cure properly for raisin making.

The raisin industry in the United States is carried on only in California, the great bulk of the crop coming from the San Joaquin Valley and the southern counties. Formerly, the raisins used in this country were wholly imported; now this product of the grape is exported and in increasing quantities. The annual production of raisins is in the neighborhood of 100,000,000 pounds.

STRAWBERRIES
(PART 1)

INTRODUCTION

1. The **strawberry** is the most important commercially of all the small fruits, which also include the bush fruits, the more important of which are the raspberries, blackberries, dewberries, currants, and gooseberries.

In the United States in 1909 a total of 425,565,863 quarts of small fruits were produced as against 463,218,612 quarts in 1899. The value of these small fruits in 1909 was $29,974,481, and in 1899 it was $25,030,877. Of this total production of small fruits in 1909, considerably more than half consisted of strawberries, of which there was a total of 254,702,035 quarts, valued at $17,913,926.

From these figures it will be seen that the strawberry crop is relatively one and one-half times larger than all of the bush fruits taken together. The crop is nearly four times as large as the raspberry crop, including both red and black raspberries, slightly more than four times as large as the blackberry crop, fifteen times as large as the currant crop, and nearly thirty times as large as the gooseberry crop.

The strawberry is the most popular of the small fruits for several very good reasons: (1) In quality, it is generally excellent; (2) it is one of the first of the fresh fruits to come into the market; (3) it is comparatively easy to grow; (4) it is a hardy plant, and some varieties will grow and thrive anywhere in the United States where any fruit will grow; (5) strawberry growing can be conducted profitably on a large as well as on a small scale, and the needs of a family can be supplied from a small area. Notwithstanding its present popularity, the strawberry has not been a popular fruit for any great length of time; it has been prominent in the market for only about 75 years.

2. Time of Ripening of Small Fruits.—The time of ripening of small fruits is important and is considered here for the reason that many planters desire to have a succession of such fruits for supplying a local market. The dates of ripening given are for the latitude of New York, and although the order of ripening will be the same in most localities where small fruits can be grown, the times of ripening will naturally vary considerably. The following dates of ripening are considered to be close approximations, but slight variations may be found in different localities even in the latitude of New York:

Fruit	Date of Ripening
Strawberry	June 20 to July 4
Black raspberry	July 4 to 15
Red raspberry	July 8 to 20
Dewberry	July 10 to 15
Currant	July 10 to 20
Purple-cane raspberry	July 15 to 25
Gooseberry	July 15 to 25
Blackberry	July 20 to August 10

3. Cost of Production of Strawberries.—The business of strawberry growing in the matted row on a fairly large scale, say from 10 to 15 acres, is usually considered to require a working capital of $300 per acre, outside of the cost of the land. This sum is considered necessary to cover the proper preparation of the land, the cost of the plants, fertilizers, setting, cultivation, equipment, harvesting, and incidentals. About 20 per cent. of this working capital is usually expended to prepare the land by good tillage and for fertilization; about 10 per cent. is counted on for the purchase and setting of the plants; and about 50 per cent. is allowed for labor. These items collectively would take about 80 per cent. of the working capital, or about $240 per acre. The balance of $60 per acre is usually considered sufficient to pay the expense of harvesting until a return is secured from the sale of part of the fruit. Under different management these estimates may be expected to vary widely.

The cost of production of 1 acre of strawberries as estimated by three prominent strawberry growers, the yields per acre, and the returns are shown in Table I. The rent of the land for the first grower is higher than that of the other two because of the higher value of the land. As shown in the table, the largest average crop was produced at the highest cost, but the larger crop was produced the most economically, as the increased value of the crop was much more than the difference in the cost of production. The 8,000-quart crop was produced at an average of 3.71 cents a quart; the 5,000-quart crop, at an average of 4.44 cents a quart; and the 4,000-quart crop, at an average cost of 5.87 cents a quart. In an oversupplied market where the fruit would have to be sold for 5 cents a quart, only growers No. 1 and No. 3 would be able to obtain any profit, and of course at higher prices their profit would be correspondingly higher.

In some of the trucking sections where market gardeners grow strawberries in fairly large quantities for market, the cost of production of a good-sized crop is estimated to be about 5 cents a quart, of which amount 1½ cents is paid for picking. This estimate is more than that of growers No. 1 and No. 2 on the basis of a 5,000-quart crop, which is considered more than an average yield; the cost of production of a crop this large would be about $250.

4. Considering the previous estimate to be approximately correct, the net profit that may be expected from a 5,000-quart crop of strawberries can be readily figured up from the prices current in any particular market. Taking the country over, strawberries of a high quality may be expected to bring the producer from 8 to 15 cents per quart basket, the differences in price being due to varying local conditions, supply and demand, and the skill with which the marketing is conducted. At 8 to 15 cents a quart a 5,000-quart crop of strawberries will return from $400 to $750 per acre, but to secure these prices the berries must be of the finest quality. Strawberries of medium quality often go begging for buyers in the market at 5 cents per quart.

The equipment for strawberry growing is simple. Trowels, or flat steel dibbles, as shown in Fig. 1, are used for setting the

TABLE I

COST OF PRODUCTION OF STRAWBERRIES PER ACRE

Items of Cost	Grower No. 1	Grower No. 2	Grower No. 3
Rent of land	$ 30.00	$ 10.00	$ 15.00
Preparation of land	5.00	5.00	2.50
Fertilizers	50.00	25.00	30.00
Plants	30.00	35.00	36.00
Setting	5.00	10.00	7.50
Tillage	30.00	25.00	9.50
Mulch and mulching	15.00	25.00	16.50
Harvesting and marketing, including cost of packages	132.00	100.00	105.00
Total cost of production	$297.00	$235.00	$222.00
YIELDS PER ACRE AND RETURNS			
Average crop secured	8,000 quarts	4,000 quarts	5,000 quarts
Average cost of production per quart	3.71 cents	5.87 cents	4.44 cents
Net profit at 5 cents per quart	$103.00	*$35.00	$ 28.00
Net profit at 8 cents per quart	$343.00	$85.00	$178.00

*Deficit

plants. Round dibbles may be used, but they are not so convenient. The hoe used for strawberries differs from the ordinary hoe in that it is narrower and is cut to points on the sides, but it is no more expensive. The ordinary garden spike-tooth cultivators are used.

Strawberries require about as much horse cultivation as would be needed on a crop of potatoes or corn, and sometimes considerable hand cultivation is also needed. For the proper care throughout the growing season of 1 acre of strawberries according to the matted-row system, the constant attention of one man for hoeing is needed.

5. Size for a Plantation.—The size of a strawberry plantation depends to a great extent on the other interests of a grower and the kind of market he intends to supply. The market gardener who caters to a small local market and who grows a large variety of products, each on a small scale, may find that the crop from 1 acre of strawberries will be as much, or even more, than he can handle or dispose of. On the other hand, a grower who is in the business on a large scale, or who ships to a distant market and sells through an association or to a commission house, will usually find that he cannot afford to work less than 10-acre blocks. How many such 10-acre blocks a grower is capable of managing is a question that each individual must decide for himself.

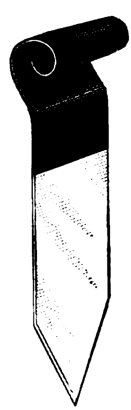


FIG. 1

The actual area operated by different growers of strawberries and other small fruits, as determined by the Cornell Department of Pomology in a survey of Western New York is given in Table II. It will be noted that the average acreage of 125 strawberry growers was 2.38 acres. This seems like a rather small acreage per grower, but is an accurate statement of the conditions actually existing in that part of the country, and may be considered as an indication of conditions existing in other sections.

6. Exposure for a Plantation.—The exposure for a strawberry plantation depends to some extent on the varieties to be grown. In the localities where there is danger of very late spring frosts, the wisest plan is to set the early varieties of strawberries on elevated land where frosts are least likely to damage them, and the exposure should preferably be to the north or west. A southern exposure is likely to cause a too rapid development in the early spring, which will force out the blossoms prematurely and render them liable to injury from frosts.

If, however, earliness is the all-important factor to good profit, the grower often secures more profit by taking a chance and planting his early varieties on a southern slope. The injury

TABLE II

AVERAGE ACREAGE PER GROWER AND VALUE OF SMALL FRUITS IN WESTERN NEW YORK

Fruit	Number of Growers	Average Acres per Grower	Value of Crop After Deduction of Freight and Commission
Strawberries	125	2.38	$58,958.42
Red raspberries	115	1.58	21,631.52
Black raspberries	97	2.67	21,223.91
Purple-cane raspberries	50	4.50	13,094.43
Blackberries	40	1.55	6,773.63
Red currants	19	1.70	4,718.39
Gooseberries	6	.36	117.62
Dewberries	4	1.19	1,084.88
Black currants	2	.81	163.72

from a single frost would seldom be sufficient to spoil an entire crop, as the frost is likely to injure only the blossoms open at the time it comes.

A location for strawberries where snow lies all winter will go far toward insuring a good crop of fruit, as the snow will prevent the ground from alternately freezing and thawing, and thus keep the plant roots from being broken and the plants from being heaved partly out of the ground.

7. **Soils for Strawberries.**—The best growers take great care in selecting soils for strawberries. Although strawberries do well in any soils, when maximum returns are looked for

the varieties that will do best in certain particular soils must be found. This is a local problem and must be worked out largely by each grower for himself.

In many sections of the country early varieties of strawberries are planted on shaly or gravelly soils; mid-season varieties are planted on sandy loam soils, and late varieties, such as the Marshall and the Brandywine, are planted on clay loam soils. Many failures have been made by mistakes in planting varieties on soils not suited to them.

As a general rule, the ideal soil for strawberries is a medium to sandy loam that is well filled with humus and well drained. Most soils that are in good shape to raise garden crops will raise good crops of strawberries. That a strawberry bed be well drained is absolutely essential to the success of a crop, but the other extreme should also be avoided and the soil should not be too well drained. The soil should be of such a nature that the upper foot will not hold too much moisture. If, however, the subsoil is very open and not retentive of moisture, the crop is likely to suffer severely from drouth at a time when moisture is most needed to swell the strawberry, that is, just about the time when the fruit is beginning to color. Therefore, a subsoil that is comparatively compact is an advantage.

If both early and late varieties of strawberries are to be grown, preferably two pieces of land should be selected and set with the varieties best suited to each.

8. In the selection of a location for strawberries, the crop or crops just removed from the land should receive due consideration. Freshly plowed grass-sod land should not be planted to strawberries, because such land will contain many insects, such as white grubs, cutworms, and wireworms, injurious to that fruit. These insects will do a great deal of damage to the roots and crowns of strawberry plants. In the trucking sections, fields from which a crop of corn or melons infested with aphids has just been removed should be avoided, because the ants that associate with corn and melon aphids, carrying them from plant to plant, will also associate with the strawberry aphids and spread these insects quickly over the field.

White potatoes, and, in the trucking sections, tomatoes and sweet potatoes, prepare the land well for strawberries, because they require thorough cultivation and the insects attacking these crops are not serious pests of strawberries. When the crop preceding strawberries is white potatoes or tomatoes, a cover crop of some sort should be sown either immediately after the crop is removed or during the latter part of its growth, so that a certain quantity of green manure may be plowed under the following spring before the strawberries are set.

SELECTION OF VARIETIES

GENERAL DISCUSSION

9. The selection of varieties of strawberries for planting in any particular locality is a serious problem, and careful consideration should be given to the experiences of local growers and the state experiment stations. No list of recommended varieties should be considered as absolute authority for any locality until local climatic conditions and local markets have been carefully inspected. Many varieties may do well in a particular section, but one, two, or three varieties will probably do exceptionally well under the same conditions, and the most profit can be secured only by planting these. The object of here discussing and recommending varieties for trial is not to speak the last word on the selection of varieties for any particular locality, but to suggest ideas that may be of value in such a selection. Among the lists of varieties mentioned later some will be found adapted to almost every locality.

The two fundamental points to be considered in the selection of varieties of strawberries are: (1) To secure varieties that will produce strawberries of the type most in demand in the market, and (2) to secure varieties that will be hardy and abundantly productive under the climatic conditions existing in the locality.

The **ideal strawberry** for market is one that will measure from 1 to $1\frac{1}{2}$ inches across at the hull end and be about one-fourth longer than the extreme breadth; the berry should taper gradually to a blunt point; preferably the berry should be of a bright, uniform red color, with bright-yellow seeds that are small to medium in size; the hull should be large and green, and should part fairly easily from the fruit. The flesh of an ideal market strawberry should be bright red, solid, meaty, and without a hard core. A good market berry should ripen evenly, that is, the plants should mature their fruits as near together as possible. The chief objection to two of the greatest market varieties is the fact that they do not ripen their fruits evenly, but have green tips, sometimes called green noses, at picking time. The Klondike strawberry is one of the most popular market strawberries because it possesses a combination of the preceding good qualities, is of fair flavor, and ships well.

VARIETIES OF STRAWBERRIES

10. The following varieties of strawberries have been recommended for planting over a large area, and many of the varieties are suitable for localities in widely separated parts of the coun-

FIG. 2

try. The varieties are designated as perfect and imperfect. These terms refer to the sex of the flowers. A perfect flower is one that has properly developed both sets of reproductive organs, that is, both stamens, or male organs, and a pistil, or female organ; a perfect flower is self-fertile. Such a flower is shown in Fig. 2 (*a*); the stamens are shown at *a*, and the pistil at *b*. An imperfect flower is one that has only the pistil well developed; the stamens may be either entirely absent or in an undeveloped, and hence more or less useless, state; an imperfect flower is not self-fertile, or at least not satisfactorily so, and to produce symmetrical fruit must receive pollen from an outside source. An imperfect strawberry flower with the stamens entirely absent is shown in Fig. 2 (*c*). An imperfect strawberry flower with the stamens *a* only partly developed is shown in Fig. 2 (*b*). Varieties that have any imperfections in their blossoms should not be planted by themselves, as they will produce either a very light crop or no crop at all. As described elsewhere, such varieties should be planted interspersed with plants of perfect varieties in the proportion of one row of perfect strawberries to two to four rows of imperfect strawberries; usually they are planted in the proportion of one to three.

FIG. 3

11. The **Michel,** or *Michel's Early,* strawberry, shown in Fig. 3, is a perfect variety. The fruit is pointed and conical in shape, and medium or smaller in size; the seeds are not prominent; the fruit has a dull, pale-red appearance; the flesh is pale red, juicy, and normally acid, but subacid when dead ripe, and also rather soft at this time; the fruit is of medium quality. The plant is a moderately vigorous grower, and the foliage is moderately good and hardy, but rusts slightly to considerably. The fruit ripens extra early in the season.

FIG. 4

12. The **Virginia** strawberry, shown in Fig. 4, is an imperfect variety. The fruit is large to medium in size, those ripening late being small; it is roundish conic to wedge shaped, bluntly pointed, and often with a depression at the apex; in color, the fruit is a light and dark glossy scarlet; the seeds are deeply depressed; the flesh is a medium red, of average firmness, mild, and not high in flavor or quality. The runner plants set are few in number, of medium vigor, healthy, and productive; the leaves are inclined to be large, and are rather dark green in in color. The plants bloom early in mid-season. The fruit ripens slightly before mid-season, and is not so liable to injury in picking as some of the other varieties. Virginia is only a fairly desirable variety from the commercial standpoint.

13. The **Bederwood** strawberry, shown in Fig. 5, is a perfect variety. The fruit is round to conical in shape and of

FIG. 5

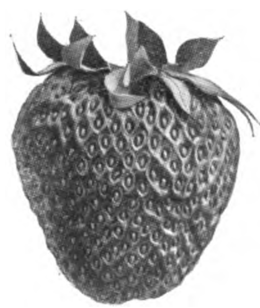


FIG. 6

medium size; the color is pale red; the seeds are not prominent, the flesh is pale red, juicy, acid, moderately firm, and of good quality. The plant is a vigorous grower, with numerous runners; the foliage is moderately good but rusts considerably. The fruit ripens early to extra early.

14. The **Clyde** strawberry, shown in Fig. 6, is a perfect variety. The fruit is round and large to very large in size, and pale red in color; the flesh is pale red, juicy, subacid, pleasant, firm, and of fair quality. The plant is a vigorous grower, with numerous runners; the foliage is poor to fairly good, being susceptible to disease. The fruit ripens early to medium.

15. The **Lovett** strawberry, shown in Fig. 7, is a perfect variety. The fruit is pointed to wedge conical in shape, above medium in size, and of a bright, glossy red in color; the flesh is bright red, juicy, acid, moderately firm, and above medium in quality. The plant is a vigorous grower but produces few runners; the foliage is poor to fair and is susceptible to disease. The fruit ripens early to medium. The Lovett is an attractive berry.

16. The **Warfield** strawberry, shown in Fig. 8, is an imperfect variety. The fruit is pointed, conical in shape, of medium size or a little larger, with a deep, glossy red color,

FIG. 7

FIG. 8

and rather prominent seeds; the flesh is deep red, juicy, acid, and moderately firm, and of medium quality. The plant is a vigorous grower, with a large number of runners; the foliage is fairly good, but rusts considerably. The fruit ripens early to medium. This variety bears handsome berries and is very productive.

17. The **Glen Mary** strawberry, shown in Fig. 9, is a perfect variety. The fruit is irregular in shape but generally round to wedge conical, large to very large in size, and deep red in color at the stem end, shading paler toward the tip; the seeds are not prominent; the flesh is bright red, juicy, watery, subacid, firm, and of medium quality. The plant is a fairly

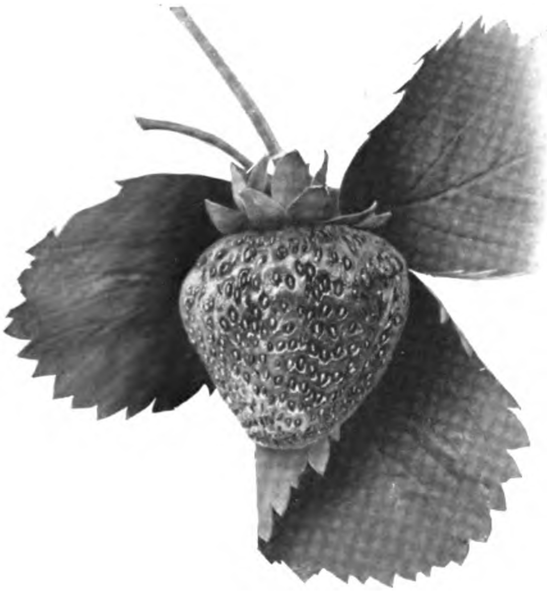


FIG. 9

FIG. 10

vigorous grower, with numerous runners; the foliage is fair to good, but rusts a good deal. The fruit ripens about in midseason.

18. The **Dunlap,** or *Senator Dunlap*, strawberry, shown in Fig. 10, is a perfect variety. The fruit is handsome, pointed, and wedge shaped; it is medium to large in size, and of a deep, glossy red color; the seeds are not prominent; the flesh is rich red, juicy, tender, subacid, fairly firm, and above medium in quality. The plant is a vigorous grower and produces large numbers of runners; the foliage is fairly good, but is susceptible to disease. The fruit ripens early in the season. The Dunlap is a variety that bears handsome berries and is productive.

FIG. 11

FIG. 12

19. The **Sample** strawberry, shown in Fig. 11, is an imperfect variety. The fruit is handsome, pointed, and regular in shape, and above medium to large in size; the color on first sight appears to be bright red, but in reality it is a very glossy deep red; the seeds are fairly prominent; the flesh is bright red, juicy, almost watery, subacid, moderately firm, and of medium quality. The plant is a vigorous grower and productive, with a large number of runners; the foliage is fairly good to good, but is susceptible to disease. The season of ripening is medium to late. The fruit of this variety is handsome and is borne in abundance.

20. The **President,** or *President Wilder*, strawberry, is an imperfect variety. The fruit is slightly conic, of the largest size.

and the seeds are slightly depressed; the color is an attractive, bright scarlet; the flesh is a medium light red, firm, moderately juicy, mild in flavor, and of fair to good quality. The plant is a vigorous grower, sending out many runners, and is productive; the leaves are large, dark green, and somewhat susceptible to injury from disease. The plants bloom and the fruit ripens in mid-season, and the fruit picks easily.

21. The **Brandywine** strawberry, shown in Fig. 12, is a perfect variety. The fruit is roundish to sugar-loafed in shape, medium to large in size, dull, deep red in color, and of unattractive appearance; the seeds are not prominent; the flesh is bright red, juicy, subacid, firm, and of good quality. The plant is a vigorous grower, with a medium number of runners; the foliage is fairly good to good, and rusts slightly to seriously. The fruit ripens late in the season. The Brandywine is considered to be a good late variety for commercial purposes.

Fig. 13

22. The **Gandy** strawberry, shown in Fig. 13, is a perfect variety. The fruit is roundish, medium to large in size, pale, dull red in color, and seeds not prominent; the flesh is bright red, juicy, subacid, firm, of pleasant flavor, and above medium to good in quality. The plant is moderately vigorous, with a moderate number of runners; the foliage is good but rusts slightly. The fruit ripens late in the season.

23. The **Marshall** strawberry, shown in Fig. 14, is a perfect variety. The fruit is pointed conical, large to very large in size, of a deep-red color, and has seeds that are not prominent; the flesh is pale red, moderately juicy, mildly subacid, firm, and of good quality. The plant is a vigorous grower, with a large number of runners; the foliage is good but rusts considerably. The fruit ripens medium to late in the season. This variety is probably better for planting in the home garden than for planting for market.

24. The **Bubach**, or *Bubach's No. 5*, strawberry, shown in Fig. 15, is an imperfect variety. The fruit is irregular and wedge shaped, of very large size, bright red in color, and has seeds that are not prominent; the flesh is bright red, juicy, subacid, moderately firm, and of good quality. The plant is

FIG. 14

a vigorous grower, with a moderate number of runners; the foliage is moderately good but rusts considerably. The fruit ripens medium to late in the season. This is one of the most satisfactory varieties in regard to size and appearance of fruit, productiveness, and good foliage.

25. The **Stevens**, or *Stevens' Late Champion* strawberry, shown in Fig. 16, is classed as a perfect or semiperfect variety. The fruit is somewhat irregular in shape, but averages wedge shaped; it is of large size and retains its size well throughout the season; the color is an attractive light scarlet and the berries are well colored; the seeds are depressed; the flesh is a light scarlet, firm, agreeably acid, and of good quality. The plant is a vigorous, healthy grower, but sets few plants and is unproductive; because it sets but few plants, this variety should be set closer than most varieties; the foliage is healthy, and is made up of large, dark-green leaves. The plants bloom and the fruit ripens in mid-season.

26. The **Klondike** strawberry, shown in Fig. 17, is a perfect variety. The fruit is blunt, roundish conic to wedge shaped; in size, the fruit is large to medium; the color is a dull,

Fig. 15

Fig. 16

Fig. 17

unattractive scarlet; the seeds are variable in position; the flesh is dark red in color, firm, acid, of unpleasant flavor, and of fair quality. The plant is a vigorous, healthy grower, setting a moderate number of runners; the foliage is medium to large in size, and dark green, and the leaf stems are long. The fruit ripens slightly before mid-season.

27. The **Belt,** or *William Belt,* strawberry, shown in Fig. 18, is a perfect variety. The fruit is irregular in shape and varies from wedge shape to conical; it is of large size, of a bright-red color, and the seeds are fairly prominent; the flesh is bright red, firm, juicy, subacid, and of very good quality.

The plant is a vigorous grower, sending out a large number of runners; the foliage is fairly good, but rusts considerably at

Fig. 18

times. The fruit ripens late in the season. This is one of the highest quality berries grown, but it is unfortunately irregularly productive.

VARIETIES SUITABLE TO A LOCATION

28. According to information compiled by the American Pomological Society, varieties of strawberries, and also of all other fruits, vary widely in their adaptability to different sections of the country. Some varieties have been found to succeed well in many different sections of the country, though with varying degrees of success in different sections, and other varieties have been found to do well in certain few sections only. To simplify matters, the Society has divided the United States and the lower part of Canada into eighteen pomological divisions, or districts. These districts have nothing to do with state or provincial boundaries but consist of territory adapted, because of its natural conditions, to the growing of fruits, due

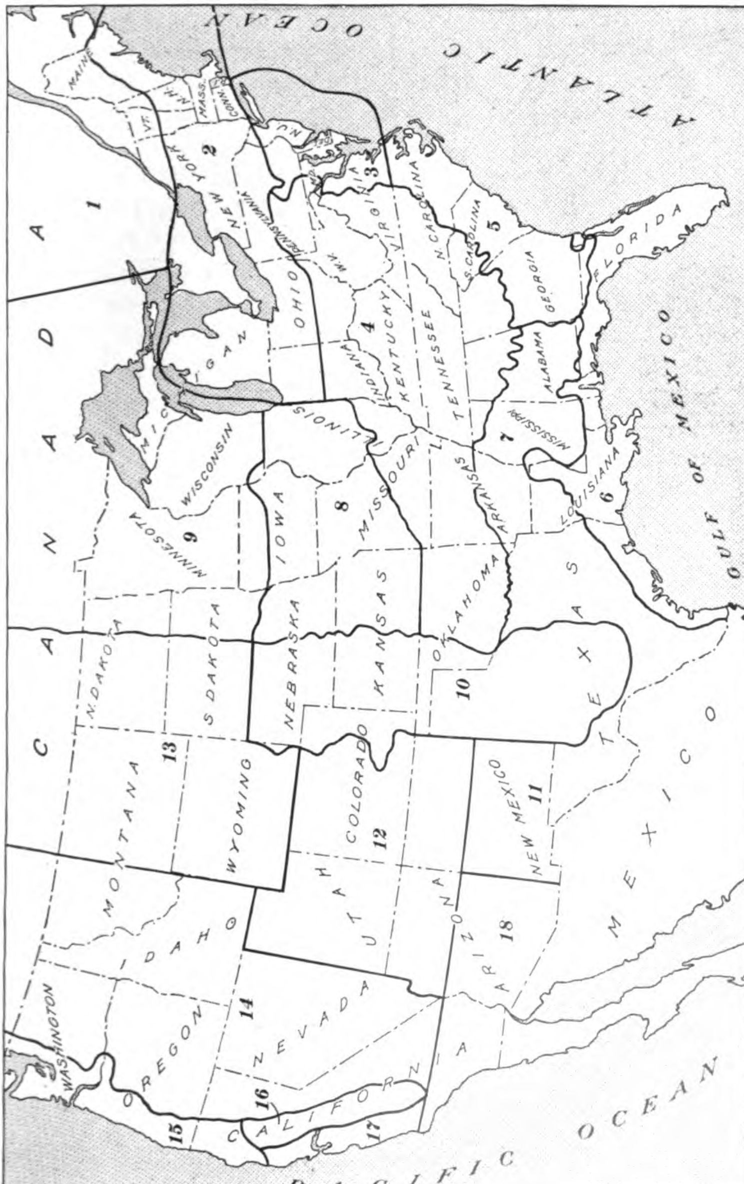

CANADA
ATLANTIC OCEAN
PACIFIC OCEAN
GULF OF MEXICO
MEXICO
TEXAS
MAINE
VT.
N.H.
MASS.
CONN.
NEW YORK
N.J.
PENNSYLVANIA
OHIO
W.V.
VIRGINIA
N. CAROLINA
S. CAROLINA
GEORGIA
FLORIDA
ALABAMA
MISSISSIPPI
LOUISIANA
TENNESSEE
KENTUCKY
INDIANA
ILLINOIS
MICHIGAN
WISCONSIN
MINNESOTA
IOWA
MISSOURI
ARKANSAS
OKLAHOMA
KANSAS
NEBRASKA
S. DAKOTA
N. DAKOTA
MONTANA
WYOMING
COLORADO
NEW MEXICO
ARIZONA
UTAH
NEVADA
IDAHO
OREGON
WASHINGTON
CALIFORNIA
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FIG. 19

consideration being given to the influence of latitude, elevation, prevailing winds, and the nearness to oceans or lakes. These eighteen districts are outlined and numbered on the map in Fig. 19.

The following list of varieties, arranged by districts, gives, under each district, the varieties of strawberries that are known to succeed in that district. The varieties given in Italics are known to be highly successful in the divisions in which they occur. The first time the name of a variety is given its less common name is put after it in parenthesis. Where a division heading is omitted, such as Division 11 in the list, no varieties of strawberries are known to do well in that division. Some of the varieties of strawberries included in the list will not be found described in detail in the descriptions of varieties. Such varieties are considered not to be entirely desirable from a commercial standpoint, even though they may grow and produce well.

The information given in the list should not be regarded as infallible, although it has been compiled with the greatest possible accuracy from the statements of the leading strawberry growers within each district. When the planting of any particular plot of ground is considered the experiences of local growers and the recommendations of the local agricultural experiment station should receive careful consideration.

Division 1: Bederwood, Belt (William Belt), ***Bubach*** (Bubach's No. 5), Carrie, Clyde, ***Crescent*** (Crescent Seedling), Downing (Charles Downing), Gandy, Glen Mary, Greenville, *Haverland*, Jessie, Michel (Michel's Early), Saunders, ***Sharpless***, Warfield, Wilson (Wilson's Albany), Woolverton.

Division 2: Aroma, Bederwood, Belt, Brandywine, ***Bubach***, Buster, Carrie, Clyde, Crawford, Crescent, Cumberland (Cumberland Triumph), Downing, ***Dunlap*** (Senator Dunlap), Enhance, Eureka, Excelsior, ***Gandy***, Glen Mary, ***Haverland***, Jessie, Lovett, Marshall, Michel, Parker Earle, Ridgway, Ruby, Sample, Sandoval, Saunders, Sharpless, Splendid, Van Deman, *Warfield*, Williams, Wilson, Woolverton.

Division 3: Bederwood, Belt, Bismarck, Brandywine, ***Bubach***, Buster, Clyde, Crescent, Enhance, Enormous, ***Gandy***, Glen

Mary, Greenville, *Haverland*, Lovett, Marshall, Michel, Saunders, Seaford, Sharpless, Tennessee (Tennessee Prolific), Thompson (Lady Thompson), Warfield, Wilson, Woolverton.

Division 4: Bederwood, *Brandywine*, Bubach, Cloud, Crescent, Cumberland, Downing, Enhance, Eureka, Excelsior, Gandy, Glen Mary, Greenville, Hoffman, Klondike, Michel, *Neunan* (Neunan's Prolific), Sandoval, Saunders, Sharpless, Splendid, *Thompson*, Wilson, Woolverton.

Division 5: Clyde, Excelsior, Gandy, Haverland, Hoffman, Thompson, Wilson.

Division 6: Bederwood, *Brandywine*, Bubach, Cloud, Crescent, Cumberland, Downing, Enhance, Eureka, Excelsior, Gandy, Glen Mary, Greenville, Hoffman, Klondike, Michel, *Neunan*, Sandoval, Saunders, Sharpless, Splendid, *Thompson*, Wilson, Woolverton.

Division 7: Cloud, Crescent, Excelsior, *Gandy*, Hoffman, Klondike, Michel, Monarch (Monarch of the West), Neunan, Parker Earle, Texas, *Thompson*.

Division 8: Aroma, *Bederwood*, Belt, *Bubach*, *Crescent*, Cumberland, Downing, *Dunlap*, *Gandy*, Greenville, *Haverland*, Jessie, Michel, Parker Earle, Sample, Sharpless, *Warfield*, Wilson, Woolverton.

Division 9: Aroma, *Bederwood*, Brandywine, Bubach, *Clyde*, *Crescent*, Downing, *Dunlap*, Enhance, Gandy, Glen Mary, Greenville, *Haverland*, Jessie, Lovett, *Parker Earle*, Saunders, Sharpless, *Splendid*, *Warfield*, Wilson, Woolverton.

Division 10: Aroma, Bederwood, Brandywine, Captain Jack, Crescent, *Downing*, Dunlap, Gandy, Glen Mary, Haverland, Hood River, Jessie, Luther (August Luther), Vick (James Vick), Warfield, Wilson.

Division 12: *Bederwood*, Brandywine, Captain Jack, *Crescent*, Cumberland, Downing, *Gandy*, Glen Mary, *Haverland*, Jessie, Parker Earle, Saunders, Sharpless, Warfield, Wilson, Woolverton.

Division 13: Bubach, *Crescent*, Downing, *Dunlap*, Enhance, *Gandy*, Haverland, Jessie, Lovett, Manchester, Michel, Parker Earle, Sharpless, *Warfield*, Wilson.

Division 14: Brandywine, Bubach, Dollar, Downing, Dunlap, Gandy, *Hood River*, Jessie, Jacunda (Knox's 700), *Magoon*, Michel, Oregon (Ironclad), *Parker Earle*, Sharpless, Warfield, *Wilson*.

Division 15: Belt, *Dollar*, Dunlap, Excelsior, Hood River, *Jessie*, Jacunda, *Magoon*, Michel, *Sharpless*, *Wilson*.

Division 16: Brandywine, Bubach, Crawford, *Dollar*, Jessie, *Parker Earle*, Sharpless.

Division 17: Brandywine, Dollar, Excelsior, Jessie, Longworth (Longworth's Prolific), Magoon, *Sharpless*.

Division 18: *Brandywine*, Sharpless.

29. Varieties Most in Demand in Markets.—After a canvass of many of the prominent commission merchants in the markets of New York, Philadelphia, Boston, Pittsburg, Baltimore, Chicago, Cleveland, and Cincinnati, Prof. Charles S. Wilson found that the varieties of strawberries given in the following list were the best known and most in demand, and the number after each variety indicates the number of commission merchants who considered that variety the most desirable market berry:

Gandy, 25; Klondike, 21; Lady Thompson, 11; Excelsior, 8; Michel's Early, 7; Warfield, 6; Aroma, 5; Hoffman, 4; Senator Dunlap, 3; Marshall, 2; Hefflin, 2; Prize, 2; Climax, 1; Clyde, 1; Jessie, 1; Crescent, 1; Johnson, 1; Tubbs, 1; Chesapeake, 1; Brandywine, 1.

30. Varieties Largely Planted Commercially.—In Western New York and Oswego, where large quantities of strawberries are grown, Professor Wilson found that fifteen varieties were grown more than others. These varieties and the number of growers raising them are as follows:

Williams, 38; William Belt, 27; Glen Mary, 21; Bederwood, 21; Senator Dunlap, 13; Sample, 13; Parson's Beauty, 9; Bubach, 6; Uncle Jim, 5; Wineberry, 5; Jessie, 4; Corsican, 3; Haverland, 3; Climax, 3; Prolific, 3.

31. Everbearing Varieties.—Varieties of strawberries called everbearing strawberries, which in some localities will continue to bloom and ripen fruit during the summer and autumn long after the ordinary varieties of strawberries have finished bearing fruit, have been introduced as very desirable strawberries. Some botanists consider this everbearing habit to be due to the transformation of the runners of these varieties into flower-bearing stems, and this contention seems to be borne out by the fact that these everbearing varieties produce but few runners.

The wild wood strawberry and some of its varieties, notably the Alpine, has, in differing degrees, the characteristic of bearing more or less fruit during the summer and fall. All these strawberries, however, bear small fruit and for this reason are of little commercial value. For the purpose of fixing this everbearing habit on more desirable types of strawberries, other varieties have been produced by crossing large-fruited sorts with some of these wild strawberries. Some of the more prominent of these so-called everbearing varieties are the St. Joseph and the Oregon Everbearing. Neither of these varieties, however, will commonly bear enough fruit late in the season to make them of any importance commercially.

The success obtained with the everbearing varieties of strawberries is largely dependent on weather conditions. If, after the regular fruiting season is over, a spell of very dry weather is experienced this will discourage the production of runners and cause fruit stalks to be thrown up by the plant. Then, if the dry spell during which such stalks are formed is followed by a long stretch of warm, damp weather, the fruit will develop and ripen.

32. Pedigree Strawberry Plants.—Some firms offer for sale what they term pedigree strawberry plants. Such a name would logically indicate that the plants were produced from seed produced by breeding from desirable known parents for a number of generations, new blood being added in each generation. But, as strawberries do not come true to seed, this would obviously be an impracticable method of producing plants for commercial planting. The so-called pedigree strawberry plants, have, as a matter of fact, been produced by selecting year after year the best runner plants produced from desirable original plants, and growing all of the plants under the most favorable conditions obtainable. Many of these so-called pedigree plants have not lived up to the claims made by their propagators, but the principle on which they are selected is sound, and if painstakingly carried out is certain to produce good results. A strain produced in this way, however, can be maintained only by careful selection each year; many of the good qualities gained in early selection may be lost by a careless selection in any year, especially if plants lacking in vitality are chosen for the production of better plants.

SELECTION OF NURSERY STOCK

PROPAGATION

PROPAGATION FROM RUNNERS

33. The common method of propagating strawberry plants, and in fact the only feasible commercial method, is from runners, or stolons. These runners are long, slender, prostrate stems that are sent out from the crown of a strawberry plant in the spring and take root where they touch the soil and develop new plants. This is illustrated in Fig. 20. At *a* is shown the original plant; at *b*, *b* are shown runners, or stolons; and at *c*, *c* are shown the runner plants formed where these runners have taken root. Some strawberry plants will send out as many as fifteen or twenty runners, this characteristic varying mainly according to the variety. The propagation of strawberry plants by means of runners is the natural method of increasing the individuals of a variety. With the exception of the slight variations that normally occur in the vegetative, or sexual, propagation of all plants, the strawberry plants grown from the runner plants of an established variety will produce fruit like that produced by the plants from which they came.

In selecting strawberry plants for setting, the most desirable will be those that were formed from the first runners sent out from the original plant. Such plants are usually the strongest and most vigorous, because they take root first and have a longer growing season. Hence, though all of the runner plants from a strawberry plant will produce fruit of a type closely resembling the original, a selection should be made on the basis of strength and vitality in order to secure the best possible yields.

Varieties of strawberries vary widely in their ability to reproduce themselves through the development of new plants from runners. With some varieties new plants are produced in

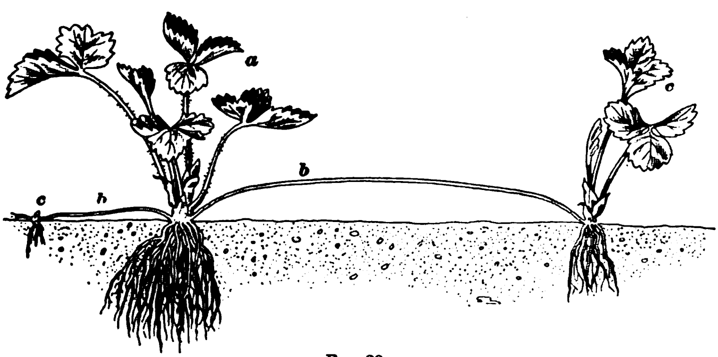
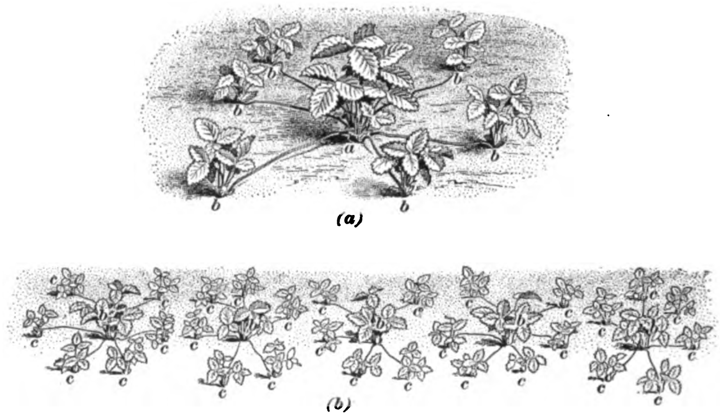


FIG. 20

such large numbers that the plants in the rows will be seriously overcrowded unless the original plants are set far enough apart or the superfluous plants are cut out. On the other hand, some varieties set so few new plants, some only 2 or 3 per cent. of the number set by the most vigorous varieties, that the original plants should be spaced comparatively close together.

34. The method of propagating strawberry plants from runners is the basis of all commercial strawberry growing, and to secure satisfactory results in the culture of this fruit, a clear idea of the various steps in the life history of a strawberry plant is necessary. This, perhaps, can be most clearly shown by means of a diagram, starting with one original plant and tracing the progeny of this through their various stages. In commercial work, and even for the home propagation of strawberries, the number of original plants would, of course, be large.

To begin with, as shown in Fig. 21 (*a*), one original plant *a* of the desired variety, of satisfactory type and vigor, and, preferably, one that has never borne fruit, is secured and planted early in the spring. This plant will soon send out a number of runners, the majority of which will take root and develop new plants *b*, about 4 to 8 inches from the original plant *a*. All these plants, including the original, are allowed to develop



(*a*)

(*b*)

Fig. 21

throughout the first summer, but are not allowed to bear fruit, the blossoms being pinched off before the fruit has time to form; the proper stage for pinching off a blossom is shown at *a*, in Fig. 22. Plants of some varieties will send out too many runners, some as many as fifteen or twenty, and some of these must be pruned off or more plants will be set than the original plant will be capable of developing properly.

In some localities the plants *b* are dug in the fall and transplanted in rows or hills in the field where the crop is to be produced, but in the great majority of cases the plants are allowed to remain in the ground during the winter and are dug in the spring for spring planting. This practice is commonly followed by growers who have their own propagating beds. The plants *b* transplanted in a row are shown in Fig. 21 (*b*). During the first season they are set in this row these plants will also send out runners and in their turn form new plants *c*. As in the case of the plants in (*a*), the plants in (*b*) are not allowed to bear fruit the first season but are forced to expend all their energy in vegetative development. The plants *c* are kept within the limits of the row largely by cultivation.

During the spring following the transplanting of the plants *b*, all the plants in the row in (*b*), including the plants *b*, which are now 2 years old, and the plants *c*, which are now 1 year old, will blossom. These strawberry blossoms are allowed to remain and the fruit will be borne early in the summer on the plants of both ages.

After the fruit is harvested from the plants in (*b*), one of two methods of procedure may be followed. Either, as is often the case, the strawberry plants are plowed under and the ground devoted to some other crop, or, as described elsewhere, the bed is continued and another crop of fruit is secured the following summer.

FIG. 22

From the foregoing explanation it will be seen that fruit is not ordinarily secured from an original strawberry plant until the third year. Fruit can, of course, be secured the first year, but this will be at the expense of the crop of the following year or of the ability of the plant to produce strong runner plants.

35. Growers who buy their strawberry plants for setting do not practice that part of the process of strawberry growing shown in (*a*), but pay the nurseryman for doing it for them. Such growers practice only that part of the process shown in (*b*), the plants they buy and set out in the field where the crop is to be produced being represented by the plants *b*. In this way they secure a crop the second year. After once getting a propagating bed, such as that shown in (*a*), in operation, growers who produce their own plants for setting will also enjoy the same advantage, because each year they will have a fresh lot of plants that correspond to the plants *b* to set in the fruiting bed. In addition to this they will also have the advantage of knowing that they control the varieties they are propagating. A propagating bed is perpetuated by taking some of the plants *b* and setting them in a separate plot of ground to continue the process shown in (*a*), while the larger number of the plants *b* are set out in the fruiting beds.

In some systems of strawberry culture, especially when the plants are set in hills, the plants that correspond to the plants *b* in (*b*) are not allowed to set any runner plants similar to the plants *c*, but all of the vegetative growth the first season is confined to the plants *b*. As a consequence, such plants will ordinarily make a large growth, and the fruit borne the second summer will be large and of fine quality. Such a method of strawberry growing, however, is not considered to be productive of the best results commercially, as the income received will not usually warrant the excessive expense for labor.

When set in their permanent places in a bed, strawberry plants are commonly expected to bear the next year after planting, and will usually continue to bear for 5 or 6 years. The first and second crops, however, are generally the best, and commercially but one crop is usually harvested.

PROPAGATION FROM SEED

36. New varieties of strawberries may be obtained by propagation from seeds. On account of the short time from the planting of the seed until the plants bear fruit—about a year at the shortest—a great many experiments in this line have been made. The results obtained are, of course, variable, because no two seeds from a cultivated variety of strawberries are likely to produce plants that will bear fruit exactly alike. For the best results, several hundred, or even several thousand, plants should be propagated at a time, because the likelihood of securing many plants that are better than the original is small. The securing of one plant out of a thousand that will bear better fruit than the plant from which the seed came is considered fortunate.

The fruit obtained from any seedling strawberry plant the first season is not necessarily an indication that the plant will continue to produce such fruit or will transmit to its runner plants the power to produce similar fruit. Many plants that show a great deal of promise the first season fail utterly in later seasons. For this reason runner plants should be propagated from the promising seedlings and fruited for 2, or, better, 3 years to determine with some degree of certainty the persistency with which the parent transmits its good qualities to its runner plants.

37. Strawberries may be propagated from seeds according to two plans:

1. Immediately after ripening, the seeds may be planted in soil that is kept continually moist. Such seeds, if properly handled, will germinate in 4 or 5 weeks, and if the conditions of growth are favorable during the first summer, the plants from these seeds will bear fruit the second summer. The growth of such plants is usually aided by planting them in cold frames where they will be protected from cold weather late in the autumn. This will give them a longer period of growth the first season, than they would have if they were planted in the open. No runners should be allowed to form the first year, as the vitality of the plants will probably be sapped.

2. The seeds may be held over for planting until the following spring after ripening; strawberry seeds may, if necessary, be kept 3 years without having their power of germination injured. This plan has the disadvantage that it takes 1 year longer to secure results. To keep strawberry seed for this purpose properly, it should be stored in dry sand or in envelopes where it can be kept dry. In the following spring the seed should be sown in shallow drills, not more than $\frac{1}{4}$ inch deep, in well-prepared soil. As soon as the plants are large enough they should be transplanted. If only a small number of plants

are to be handled, they may be transplanted in a nursery, being set about 6 inches apart each way. Preferably, no runner plants should be allowed to set this season, or the vitality of the plants may be reduced. The following spring, the plants should be set out in their permanent places in a field, in hills about 3 feet apart each way, where they are allowed to fruit. If a large number of plants is to be handled, transplanting them directly to their permanent places in the field where they are to fruit may be found to be the most economical of labor.

SELECTION OF NURSERY PLANTS

38. None but the best strawberry nursery plants should ever be planted in a strawberry plantation. The cost of good plants is but little more than the cost of inferior ones, and the results obtained from the former are often many times those obtained from the latter. The majority of growers must depend to a great extent on the nurseryman for plants for setting, and care should be taken to deal only with the most reliable firms. Good strawberry nursery plants cost money to grow, and if a nurseryman is to produce good plants and continue in business he must obtain a fair price for them. For this reason, apparent bargains in nursery stock rarely prove to be so in the end. Plants grown by a nurseryman in the immediate vicinity or by the grower himself are preferable to those grown at a distance, because such plants may be dug and planted while still fresh. Also, complaints can be more readily adjusted with a near-by nurseryman.

Although the production of strawberry nursery plants for sale has of late years developed into a very extensive business, and the buying of high-quality nursery plants is now possible, the person who grows strawberries extensively can usually better afford to grow his own plants. Because of the asexual method of propagation, there is no difficulty in keeping varieties true to type, and satisfactory plants can be produced provided none but vigorous, healthy plants of the desired type are propagated from. The home growing of plants also avoids the risk of securing varieties untrue to name.

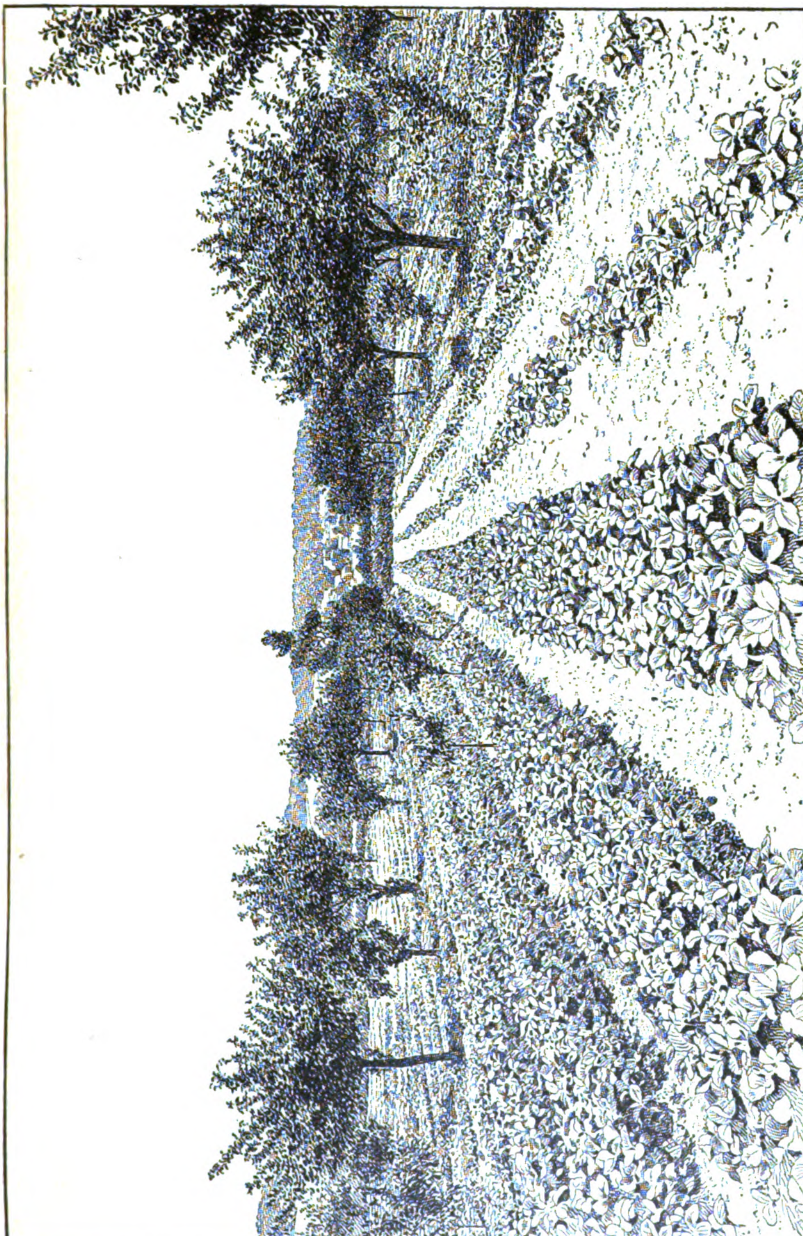


Fig. 23

39. The best strawberry plants to set in a new plantation are the strongest of those from runners of the previous year from plants that have not fruited. Young plants formed according to this plan receive a large proportion of the vitality of the parent plant. Plants that are made by plants that have already fruited are very often deficient in vitality. The grower who produces his own strawberry plants should have his own propagating bed separate from his fruiting beds.

A thrifty propagating bed is shown in Fig. 23. The rows at the right have had the runner plants removed; none of the runner plants have been removed from the rows on the left. In this propagating bed the old plants are never allowed to fruit, the blossoms being taken off, as shown at *a* in Fig. 22, before the fruit has a chance to form; thus, all of the vitality of the plant is forced into the runners. The plants that are propagated from plants that are not allowed to fruit should be vigorous and healthy. Those propagated from plants that have fruited are usually lacking in vitality and are likely to be infested with disease and insects.

40. Strawberry plants for setting should appear to be vigorous. A vigorous, strong-growing plant will have deep-green, clean, fresh foliage free from spots and will also have a root system made up of an abundance of fibrous, light-colored roots. Plants with a root system of this kind are usually produced in soil that is mellow, rich, and well drained. Strawberry plants having leaves with a yellowish tinge or small, dark-colored roots are not fit to set. When selecting strawberry plants for setting, however, the varietal differences between plants which are prominently shown in the foliage should be carefully borne in mind, and nursery plants should not be indiscriminately condemned. Certain varieties of strawberries have green leaves of a darker shade than others when grown on the same soil and under the same treatment.

Generally speaking, to be of the productive type a strawberry plant should have a small crown, an abundant root system, and a moderate growth of leaves. Desirable types of nursery plants are shown in Fig. 24. These plants appear just as they were when taken from the bundle of plants received from the nurseryman. They are well developed, but the crowns are not too large, and they have an abundance of fibrous roots. They are also free from disease or decay of any kind and are bright and clean looking.

Undesirable types of nursery plants are shown in Figs. 25 and 26. Those in Fig. 25 are undersized and their root development is not of the best. Such plants are by no means the worst that can be chosen, but they are not desirable when better

FIG. 24

plants can be secured. Fig. 26 illustrates several undesirable types of nursery plants. Those in (*a*) are extremely undesirable, being dwarfish, either because of a late start during the growing season or because the plants from which they were set were lacking in vitality. The chances are that such plants would make but a very feeble effort at setting new plants and that the plants set would bear but little fruit. The plants shown in (*b*) are too large, having long, straggly, dark roots, dark crowns, and a general look of debility. The lack of vitality is so evident that their chances of proving satisfactory, even under the best conditions, are very small.

FIG. 25

41. A word of caution should be given in regard to the selection of very vigorous strawberry plants for setting.

FIG. 26

Although productiveness and resistance to disease are closely associated with vigor, unfortunately the most vigorous plants are not always the most productive, and often plants that appear to be vigorous when bought will not make as vigorous a growth as expected. In other words, the inherent qualities of a plant are very difficult to judge from a superficial examination. Other factors, such as the conditions under which the plant was grown, should be taken into consideration. The quantity of plant-food in the soil, and particularly the quantity of nitrogenous fertility present, have a marked influence on the growth of a plant and its apparent vigor. Under less favorable conditions, many plants will appear much less promising than they do in an ideal soil.

FIG. 27

The most common error made in purchasing strawberry nursery plants is that of buying plants of varieties not suitable for cross-pollination. Imperfect varieties should not be planted alone, and when an imperfect and a perfect variety are to be planted together care should be taken to get varieties that will blossom at the same time, for otherwise the fertilization of the imperfect blossoms will not be secured. Errors of this kind are entirely unnecessary and may be avoided by carefully studying the characteristics of the different varieties.

42. Plants for Fall Setting.—The best plants for setting in the fall are pot-grown plants, such as the one shown in

Fig. 27. Such plants are obtained by sinking small pots filled with fine, composted soil in the ground near newly-set strawberry plants and as the runners develop from the original plant, training the runners to root in the pots. The plants formed in this way are identical with those formed in the ordinary way, except that they have better soil to grow in and they are not injured so much in transplanting. When they are taken up in the pots the roots are undisturbed, as they are kept in the ball of earth in which they have been growing. Such plants suffer but little check in transplanting, usually continuing their growth without any apparent setback; on the average they will make stronger plants and will bear more fruit than strawberry plants produced in the ordinary way. Some growers prefer them for commercial plantings, although they are usually considered too expensive for that purpose.

STRAWBERRIES
(PART 2)

STRAWBERRY PLANTING

GENERAL DISCUSSION

1. Systems of Planting Strawberries.—Strawberries are planted either in rows or in hills. The system of planting in rows is varied in detail according to the preference of the grower. The **matted-row system** and the **hedge-row system** of planting are the two main systems of row planting. Hedge-row planting may be dismissed with a few words, as it is not used commercially to any great extent. Two systems of hedge-row planting are used, the *single hedge-row system* and the *double hedge-row system*. The **single hedge-row system** consists in setting the original plants in rows from 2½ to 3½ feet apart and the plants about 2 feet apart in the rows, and allowing each plant to set but two runner plants, one on either side in the direction of the row. The pruning in this system requires considerable labor. The **double hedge-row system** differs from the single hedge-row system in that the rows are set a trifle farther apart, from 3 to 4 feet, and each original plant is allowed to set four runner plants instead of two.

2. The matted-row system of planting strawberries is usually considered the most practical system on a large scale, as it gives the best results with the least labor. Sometimes the matted-row system is divided into the *narrow matted-row system* and the *wide matted-row system*, but these are not definite

FIG. 1

FIG. 2

3

terms, because much depends on the varieties planted, on the soil, and on other conditions. In other words, the width of the matted row must be varied according to the conditions existing on each particular field and the variety chosen for planting.

3. In Fig. 1 are shown strawberries planted in matted rows. This system of planting is followed by the great majority of growers in the East. In many commercial strawberry-growing sections the rows are planted 4 feet apart and the plants are spaced 18 inches apart in the rows; planting at these distances will allow plenty of room for the runner plants to set and still leave space enough between the rows for cultivation and for picking. Some growers prefer to set the original plants in rows 3 and 3½ feet apart, but, at such distances, unless the rows are kept very narrow the spaces between the rows will not be wide enough for working in. The width of the row can be readily regulated by the cultivating instruments, and thus expensive hand pruning avoided. From the results actually obtained in commercial plantings, apparently nothing is gained by planting strawberries closer than 18 inches by 4 feet, as the yields are no greater.

4. In Fig. 2 are shown strawberries planted on the **hill system.** This system is employed to some extent in the West and more particularly in the Northwest. Strawberry plants set according to this system usually produce larger berries and often larger yields per acre, but the cost of production is higher and more labor is necessary. In localities where labor is scarce this, of course, is an undesirable feature.

When only a small area is planted, and especially when strawberries are planted in the home garden, the hill system of planting produces good results. This system requires careful cultivation and attention to keep the runners cut off, and when a fruit grower has other interests besides strawberry growing this work is often difficult to perform properly. Commercial growers who begin planting on the hill system frequently discontinue it after a time in favor of the matted-row system.

The hill system consists in growing each plant equidistant from every other plant and in pruning off the runners from each plant so that all the strength of the plant will be thrown into the development of that plant and resu t in the production of extra large berries. The plants are set at varying distances from each other; 1, $1\frac{1}{2}$, and 2 feet each way are common distances; the first gives about 43,560 plants per acre, the second about 19,360, and the third about 10,890. Frequent pruning off of the runners is necessary to prevent new plants from being formed. This pruning results in the formation of numerous crowns on each plant, and a vigorous growth that

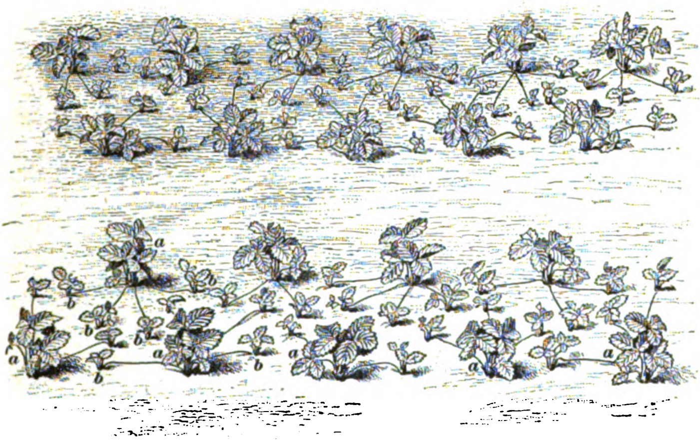


Fig. 3

develops plants to four or five times the size of the average plant, and capable of bearing a crop of fruit in proportion to the size. The most essential point to observe when growing plants in the hill system is to prune off the runners while they are very small, as this will conserve the energies of the plants to the greatest extent.

One disadvantage in setting strawberry plants as closely as 1 foot apart each way, or even 2 feet apart each way, is that by the time the plants are full grown the ground will be almost completely covered. For this reason the hill system is rarely strictly adhered to, but one row of plants is usually omitted across the field every third or fifth row in order to provide paths for the pickers.

In some instances growers prefer to set their strawberry plants staggered in the rows, as shown in Fig. 3. The original plants are marked *a* and the runner plants that are just beginning to develop are marked *b*. Each alternate plant is allowed to set runners in one direction only, and in a very short time the row is filled in the same way as in the ordinary matted-row system. The advantage claimed for this system is that each additional plant sets fewer young plants (only those on one side) and thus produces stronger and more vigorous and productive offspring.

5. Preparation of Land for Strawberries.—The preparation of the soil for a strawberry plantation should be well and carefully done, and, preferably, the land should be fairly free from weeds before the work is started.

Fall manuring and plowing is desirable, and a second plowing in the spring followed by deep thorough harrowing with a good smoothing harrow should be given as early as convenient. If the plants are not ready to be set when the final smoothing has been completed, the land may be left without further treatment until just before the plants are ready for setting, when the ground should again be surface harrowed, in order to have the surface soil moist and in good condition for setting.

Immediately before the plants are to be set, rows should be marked out across the field from 2 to 4 feet apart, according to the system of setting previously decided on. A convenient implement for marking out the rows is a corn planter. This marks out two rows at a time and the furrower leaves the ground in good condition to receive the roots.

6. Planting to Secure Proper Pollination.—Different varieties of strawberries are peculiar in that they have different kinds of flowers, as described in the previous Section. These differences in the blossoms of strawberries makes it essential to arrange varieties in a field in such a way that there will be abundant pollen for proper fertilization. Unfortunately some of the best varieties of strawberries have imperfect flowers and are thus not self-fertile. To make them productive, these blossoms must be pollinated by pollen from perfect flowers and hence the pollen-bearing varieties need so to be interspersed with the non-pollen bearing imperfect flowering plants that the chances will be all in favor of an abundant supply of pollen at the right time.

The common method of planting perfect and imperfect varieties of strawberries together is to plant from two to four rows, usually three rows, of a pistillate, or imperfect, variety to one row of a perfect variety. It is essential, however, in this kind of a planting, that the varieties flower at the same season. There are many varieties of strawberries, and they vary in their blossoming as well as in their bearing season, within somewhat wide limits. The first of the early kinds, in fact, have often finished fruiting before the late kinds have ripened much fruit. It is essential, therefore, that perfect and imperfect varieties that are to be planted together blossom at the same time.

The argument is sometimes made that matters could be simplified by planting none but perfect varieties. But many tests have shown that some of the pistillate, or imperfect, varieties when properly mated are the biggest producers and that the fruit is of the highest quality. Even in fields where none but perfect varieties are planted at least three to four varieties should be planted in order to secure cross-pollination, for in this way a larger crop will be secured than when only one variety is planted.

7. **Time for Planting.**—As a general rule, spring planting of strawberries is the most satisfactory, though autumn planting, particularly in some sections of the country, has also been successful. Spring planting is generally considered the best because at this time the soil is in good condition to receive the plants, as it is cool and moist and the plants will grow rapidly and send out many runners during the summer.

When planted in the spring, strawberry plants should be set in the ground as soon as the land can be prepared for them.

They are perfectly hardy and will stand considerable frost without injury. Because they do not get such a good start as early-set plants, strawberry plants set late in spring are likely to suffer severely during any hot, dry weather in the early part of the summer. The desirability of planting strawberries early is emphasized by Horace Roberts, of New Jersey, who grows between 60 and 70 acres each year. He plants them as early in the spring as possible. In 1911 he planted whenever the ground was thawed out. If it thawed at 8 o'clock in the morning he would start to plant and plant for the rest of the day. In this way he figures that he avoids serious trouble from drought and is able to get his berries into the market early.

In the latitude of New York, April or May is considered the best time for planting. If started later, the drought that so usually occurs in the summer makes it difficult to secure a good stand. In New England, spring planting is also best. South of New York, in the Atlantic States, August and September are usually considered the best months for planting strawberries. In Georgia, fall-set plants are considered to give the most profitable returns.

When strawberry plants are set in the autumn, they will ordinarily bear only a late crop of fruit the following season, unless the weather happens to be favorable and the soil is moist when the plants are set out; under such favorable conditions the crop may come a trifle earlier than it otherwise would. If the planting is to be done late in the summer or in the autumn, plants should be secured as soon as they can be obtained with a sufficiently large root system. Pot-grown plants are preferable for autumn planting. These plants are rather expensive for commercial plantings but are economical for the home garden.

Spring-set plants are expected to fruit early the following summer, usually from 13 to 15 months after setting.

8. **Procuring and Handling of Plants.**—When strawberry plants must be secured from a distance, they should be ordered to arrive early in the spring, at least a short time before

they will be needed for planting. This is much safer than to run the risk of getting them too late.

Preferably, strawberry plants should be set in their permanent places shortly after their arrival, but if this is not possible the plants should be taken out of the bundles; if left tied up they are likely to heat up or to dry out, and in either case their vitality will be injured and they will be less desirable for planting.

As soon as the plants have been unpacked they should be heeled-in in a well-drained but moist soil. A shallow furrow should be opened up, deep enough to accommodate the roots of the plants, but the crown of each plant should be left just

Fig. 4

above the ground. The plants may be placed in the furrows as follows: A bundle, after being trimmed, is laid in the furrow with the roots reaching to the bottom and straightened out. The fastening of the bundle is then cut and the plants carefully spread to both sides. They should be placed close together, but one should not be placed on top of the other. Fig. 4 illustrates the method. After the first row of plants is heeled-in another furrow should be opened up from 6 to 8 inches from the first. The soil from this furrow should be thrown over on the roots of the plants in the first furrow and firmly packed over the roots, either by stamping with the foot or with a heavy wooden tamper. If the soil is not packed closely about the roots when the plants are heeled-in, the plants are likely to dry out and die. The second furrow is now ready to receive plants, and the process of heeling-in can be similarly continued in any number of furrows. In Fig. 5 is shown a row of plants heeled-in and another furrow opened up ready to receive another row of plants. Plants heeled-in in this way will grow new roots and will improve in condition so that they will be better than when first received, but if not taken care of in this way they are likely to deteriorate very seriously.

9. **Preparation of Plants for Setting.**—In order to secure the best results with strawberries, some preparation

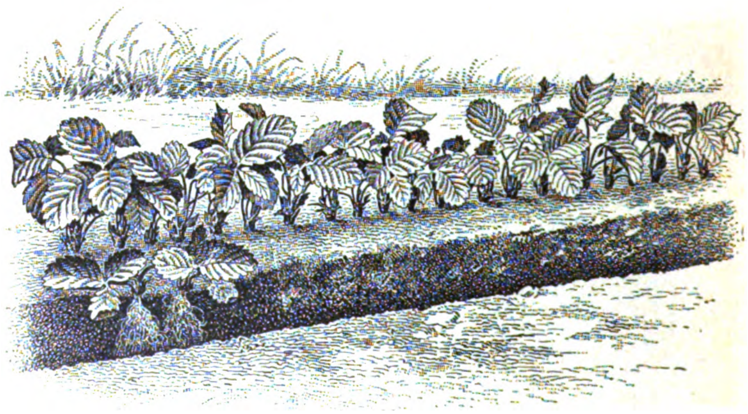


FIG. 5

of the plants is necessary before they are set. Some strawberry-plant growers trim the plants before shipping them, but it is usually necessary for the grower to trim his own plants, and it is, of course, always necessary when home-grown plants are used. When strawberry plants are bought they usually come in little bundles of twenty-five to thirty. As soon as these bundles are received the roots should be pruned by taking the bundle in one hand and clipping off about one-third of the root system with the scissors. Also, all large leaves except one or two of the healthiest should be removed. The removal of these leaves prevents a too rapid transpiration of moisture from the plant before the plant is able to establish itself, and this may even prevent the plants from drying if a period of dry weather follows planting. In Fig. 6 strawberry plants before and after pruning are shown. The one in (*a*) is unpruned and that in (*b*) is pruned. In this case all but one of the large leaves has been removed, although in the case of large vigorous plants it is sometimes advisable to leave two leaves. The small, partly developed leaves at the top of the crown are, of course, lef

(*a*) (*b*)

FIG. 6

untouched, as they will form the future leaves on the plant. Any fruit buds on the plants should also be removed.

10. Depth of Planting.—The depth of planting strawberries is extremely important. The crown should be set so as to stand just at the surface of the ground, after the ground has been pressed against it. If the crown is left too high out of the ground it will dry out, and if it is planted too low it will be likely to rot. In Fig. 7 three strawberry plants are shown planted in different ways; the one in (*a*) is planted too high, the one in (*b*) is planted at the proper depth, and the one in (*c*) is planted too deep.

11. Setting of Plants.—After the rows are marked out, the setting of the strawberry plants may be done with a dibble or a spade. A dibble particularly adapted for strawberry setting has been previously illustrated and is shown in operation in Fig. 8. Round dibbles may also be used, but they are not

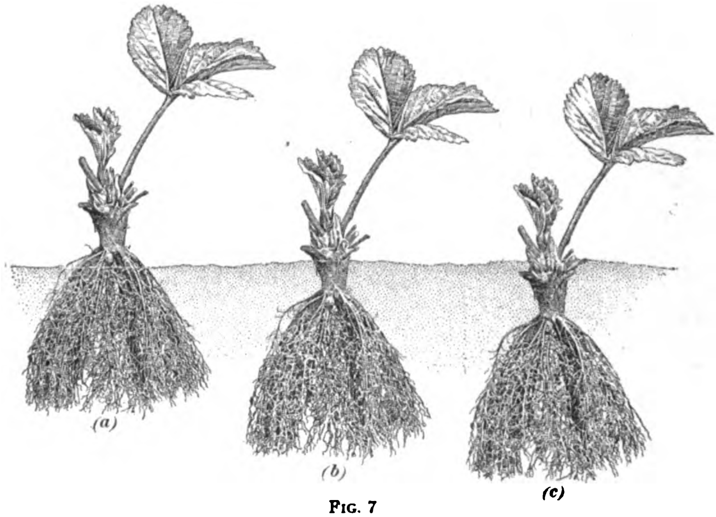


FIG. 7

so satisfactory, as they have a tendency to compact the roots, while the flat dibble allows the roots a good spread. Planting machines similar to those used in planting tomatoes, cabbage, and tobacco plants, are used by some growers and are satisfactory when the work is carefully done and the season is favorable.

When the setting is done with a dibble, one man is able to do all the work of setting. When a spade is used, it is more convenient and more economical of time to have two men working together, one making the holes and firming the ground around the plants and the other carrying and setting the plants in the holes made by the other.

In setting strawberry plants with a dibble, the dibble should be taken in one hand, thrust into the soil about 6 inches deep and pressed to one side, preferably away from the body. A dibble that has just made a hole in the ground in this way is shown in Fig. 8 (*a*); the cavity in the ground is V-shaped, is about 4 inches wide at the top, and tapers to a point at the bottom. The plant to be set should be taken up in the other hand, placed in the hole, and given a quick whirl so that the roots will be spread out as much as possible. The dibble should be removed from the hole, placed in the soil from 3 to 4 inches

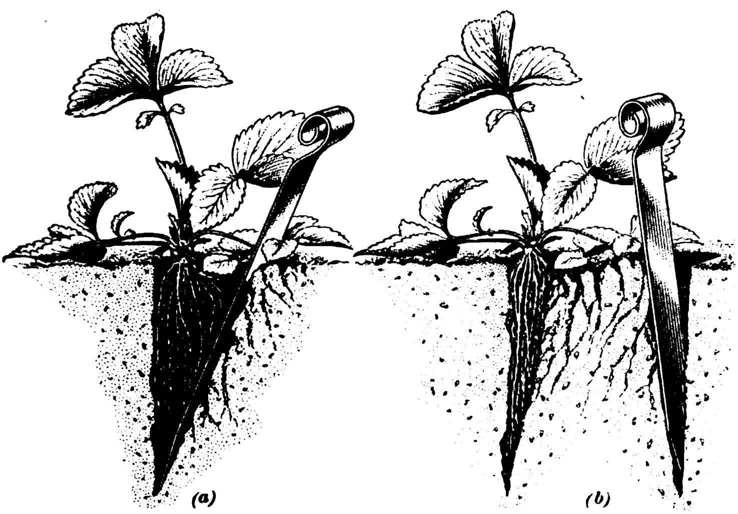


FIG. 8

from the first hole, as shown in (*b*), and the earth pressed firmly about the roots of the plant; commonly the dibble is inserted in the ground the second time on the side of the plant farthest from the operator and the pressure applied by pulling on the top of the dibble. The soil should be pressed with the hands or feet closely around the crown of the plant, and the setting will then be complete. When setting with a spade, the work can be done even more rapidly, as one man opens and closes the holes and the other places and adjusts the plants.

As described elsewhere, great care should be taken when setting to get the plants at the proper depth. The difficulty of securing accuracy in depth of planting with a machine is one of the strongest arguments against the use of such an apparatus.

The rate of setting strawberry plants is a matter that varies widely according to the management, which, of course, includes the matter of selecting laborers, the method of planting, and the care used in setting. The setting of from 1,500 to 2,000 plants per day will be a good day's work for one man, and five men with three boys to help them should set 1 acre of strawberry plants in 1 day when provided with good plants and the soil has been properly prepared. This amount of work would appear small to some strawberry growers, but more could hardly be expected except under particularly good management.

When strawberry plants are planted immediately after being received they are usually kept under cover in a shed and taken to the field in boxes on a wagon. They should be protected in transit and while waiting to be set by a covering of wet burlap bags. These boxes of plants are unloaded from the wagon at convenient places in the field.

STRAWBERRY-PLANTATION MANAGEMENT

CULTIVATION

12. The value of a strawberry crop depends largely on the strength of the runners, and as moisture is absolutely essential for the development of strong runners, careful cultivation, especially during the first season, is of prime importance. Cultivation should begin as soon as the plants are set. The first few cultivations should be deep and the spaces between the plants should be hoed by hand. The first few cultivations should be given at intervals of a few days.

If properly managed, cultivation need not interfere with the setting of the runners. As soon as the runners begin to form, any that tend to run into the space between the rows should be moved within the matted row and placed so that the new plants will be from 4 to 6 inches apart. Any excess runners should be cut off. In average cases in the latitude of New York, all of the runners that should be allowed to set plants should be placed by July 15, and any runners formed thereafter should be trimmed out. The time for trimming out strawberry runners will vary in different latitudes.

A strawberry bed is likely to suffer severely from drought during the summer months unless a good soil mulch is provided at all times. The cultivation during the first and second years is somewhat different. During the first year intensive tillage is practiced to keep the plants growing properly and to keep down the weeds. Practically all growers agree in this practice. During the second year, cultivation is varied to a very large extent, depending on whether or not the patch is to be kept over for a second crop. On a commercial scale few growers work for a second crop from the same plants. Those who do, cultivate early in the season before picking time. This cultivation is productive of good results if done early enough, but if done too late it will make the berries sandy, or dirty. If the weeds are present in the rows they are either pulled or hoed out. Hoeing is a good practice but is usually found to be expensive. In cases where a second crop of strawberries is not desired from a plantation, very little if any cultivation is done the second year.

Most careful strawberry growers cultivate one way only. This practice keeps the width of the row within bounds and induces the runners to set mostly within the row. Such cultivation also reduces the possibility of tearing up the plants after they once get started.

13. The details of the cultivation of strawberries may be described as follows: The day after the plants are set, it is a good plan to go over the field close to the rows with a four-tooth cultivator and use a steel rake between the plants. The root system of the strawberry plant is very thick and fibrous but does not extend over much ground, and the soil must be mellow and well aerated to get the best growth. A few weeks after the plants have become established the cultivator teeth that work close to the row need to be shortened and left only long enough to loosen and make a mulch of the top 1 inch of soil. It is a good plan every third or fourth cultivation to run a shovel cultivator through the center of the rows to loosen the soil to a depth of 3 or 4 inches, so that the soil the horses have packed down in working the spike-tooth cultivator will be broken up. The teeth of the shovel cultivator should not work nearer than 12 inches to the row.

Some growers prefer to remove the mulch the second season and cultivate the ground up to harvest time. This is hardly necessary if the mulch is reasonably heavy and properly worked into the rows. If the cultivation the previous season has been properly done and the land is well drained the roots will have gone well down and the plants will suffer little from drought unless conditions should be very abnormal.

The best tools for use in the tillage of strawberries are the common spike-tooth cultivator and the hoe.

14. Care of Plants During First Few Weeks After Planting.—For the first few weeks after planting, in addition to practicing clean culture, the blossoms should be kept off of the newly-set plants. Late in June and during July the plants will begin to send out runners in abundance. The treatment at this time is varied, according to the system of culture adopted. The parent, or seed, plants are trimmed to a greater or less extent by the removal of a part of their runners and the rows are shaped as desired. This part of strawberry culture requires considerable work. The subsequent cultivation is described later.

15. Handling of Patch After Picking Season.—Provided the strawberry bed is to be fruited only a single season, the patch may be plowed immediately after the picking season is over and a fall crop sown. If, however, the bed is to be carried over for another harvest the following year, it should be gone over with a shovel cultivator and about one-half of the plants removed. At this time it is also desirable to clean off the mulch and thoroughly till the spaces between the rows.

Some growers, after a thorough tillage of the space between the rows, encourage the setting of plants in this space for the next season's crop. This is practically setting a new plantation. Then with a single plow the old rows are turned under and cultivated down. This process is not easy, but it is sometimes practiced and is undoubtedly more satisfactory than leaving the old rows without any treatment. In this, however, there is the disadvantage that the plants for the second crop are set by plants that have already fruited.

A good plan is to go over the field with sharp hoes and cut out strips of plants at right angles to the rows. This, in reality, is a thinning process, and although it appears to be harsh treatment, the plants benefit through having more room for development and a good place in which to set new plants.

16. Cultivation of Bed the Second Spring.—The second spring but little cultivation is necessary in a strawberry bed before fruiting time if the previous year's work has been properly done. Strawberry plants make such a vigorous growth that weeds do not get much of a foothold, and if the mulch is well distributed between the rows this will take the place of cultivation.

WATER SUPPLY FOR STRAWBERRIES

17. Strawberries appear to be the small fruit most susceptible to changes in environment, especially to changes in moisture conditions. Severe drought during the ripening season will decrease both the yield and the size of the fruit. Varieties, however, differ somewhat in the degree in which they suffer from drought. This susceptibility of the strawberry plant to moisture conditions is probably due to the comparatively small and shallow root system of the plant. For this reason, the problem of supplying strawberry plants with sufficient water for their needs is of the greatest importance and probably the most serious. So far as known there is no reliable data showing the quantity of water used by a strawberry plant during its growth, or more especially during the ripening season. The quantity used, however, must be large, because there is rapid transpiration of moisture from the leaf system, which, in proportion to the roots, is extensive, and any lack of water is sharply indicated in a decreased yield. The fruit itself is made up largely of water. On an average, 100 pounds of ripe fruit consist of 87 to 94 pounds of water. This water in the fruit in itself would not, of course, be a big item, as a crop of 5,000 quarts of strawberries per acre would not contain much more than 500 gallons of water. The importance of the water supply, however, lies in the fact that it must be obtained at certain times, and for this reason the artificial application of water by some form of irrigation usually produces pronounced beneficial effects on strawberries.

IRRIGATION OF STRAWBERRIES

18. The yield and quality of strawberries can be improved to a marked degree by irrigation. This may be by the furrow or ditch method or by overhead irrigation. One of the principal difficulties in many parts of the country in producing a satisfactory yield is the lack of sufficient moisture for the crop during the ripening period. The yield and the quality can be increased one-third by intelligent and careful irrigation in a normal season. During a dry season the benefit far exceeds these estimates.

The two principal methods of irrigation have been suggested. The overhead system, notably the Skinner system, is the most practicable in the Eastern States. Where the water is taken from streams and the land is approximately level, flowage is frequently adopted because of the lesser initial expense. The water cannot, however, be as satisfactorily applied in this way as by overhead watering, and the commercial grower will almost invariably find the installation of such a system a profitable investment.

MULCHING OF STRAWBERRIES

19. The mulching of strawberries is important. In the late fall or early winter, when the ground is frozen to a depth of 2 or 3 inches, the strawberry field should be mulched for winter protection. The object of such a covering is not to prevent the frost from entering the ground but to prevent alternate freezing and thawing and the subsequent breaking off of the strawberry root systems and the lifting of the plants, commonly called heaving. The mulch may consist of a variety of materials. The important point is to get a mulch that will protect the ground properly and still not smother the plants. This mulch should be from 3 to 4 inches thick over the rows when first applied, but should not be thick enough to mat down and thus exclude the air.

Straw is undoubtedly the best mulch for strawberries, because it may be easily handled and applied, contains no weed seeds, does not mat down, can be worked between the rows the following season, and is of value in supplying humus to the soil. Clean meadow hay is also a suitable mulch, for, although it may contain weed seeds, such seeds are usually of plants that do not thrive on uplands, and in other respects the hay closely resembles the straw. Corn stover will protect the strawberries from alternate freezing and thawing, but it has little fertilizing value and its removal may prove to be a great nuisance the following spring. Strawy manure is a fairly suitable mulch. It is not generally advisable for use, however, because it is likely to mat down and exclude the air. From other standpoints it is a very desirable mulch, however, and in some cases it may be advisable to use a mulch of strawy manure and straw or clean meadow hay combined.

A strawberry field being covered with a mulch of straw is shown in Fig. 9. The straw is first dumped in heaps over the field as shown in the background and then spread over the ground evenly, as shown in the foreground.

20. On an average, an increase in the yield of about 10 to 12 per cent. may be expected from properly mulching a

20

FIG. 9

strawberry bed during the winter. This statement is borne out by experiments at the Maryland Agricultural Experiment Station from 1908 to 1911, inclusive, a summary of which is given in Table I. Plot No. 1 was not mulched but was cultivated in the spring. Plot No. 2 was mulched early in the winter and cultivated in the spring. Plot No. 3 was mulched early in the winter but not cultivated in the spring. Plot No. 4 was a check plot and was neither mulched in the winter nor cultivated in the spring.

The 4-year average secured in these experiments shows that, under the conditions existing in that part of Maryland, mulch-

TABLE I

EFFECT OF MULCHING AND SPRING CULTIVATION ON STRAWBERRY YIELDS

Plot	Mulched	Cultivated in Spring	1908 Quarts per Acre	1909 Quarts per Acre	1910 Quarts per Acre	1911 Quarts per Acre	Total Yield of 4 Years Quarts	Average Yield of 4 Years Quarts
1	No	Yes	3,700	4,028	4,849	1,872	14,449	3,612
2	Yes	Yes	4,200	4,598	5,053	2,556	16,407	4,101
3	Yes	No	6.400	4,332	4,495	1,764	16,991	4,275
4	No	No	4,300	4,598	5,053	1,352	15,203	3,800

ing without any cultivation the next spring after planting produced the best results. Except during the season of 1911, when the month of May was very dry, cultivation the second spring actually resulted in a loss; the average yearly loss by spring cultivation during the 4 years was 188 quarts per acre. The plants on the spring-cultivated plots usually grew more luxuriantly and did not ripen fruit quite as early as those on the uncultivated plots. One factor not brought out in the table is the fact that the strawberries from the mulched plots were always brighter, cleaner, and often larger than those from the unmulched plots.

21. Disposal of Mulch in Spring.—In the spring, after the weather is settled, the mulching material should be raked from the rows into the space between them. If the mulch is left on too late the strawberry plants will make a soft, blanched growth underneath the mulch, and this growth is likely to be scorched later by the sun or injured in removing the mulch. The plants should not be uncovered until the possibility of freezing and thawing is past.

When the mulch is raked from the plants it is placed between the rows and worked down flat and even. A good covering of material will do much to take the place of the soil mulch, which can be maintained only by frequent cultivation. Such a mulch between the rows will conserve the moisture in the soil and keep down the weed growth. In addition, when pruning time comes, such a mulch will serve to keep the fruit clusters along the edges of the rows off the soil, and thus keep the berries clean.

ROTATION FOR STRAWBERRIES

22. The customary recommendation in regard to the rotation of strawberries is that strawberries should not follow strawberries on the same ground, but that some well cultivated vegetable crop or a clover crop should intervene. Most practical strawberry growers, however, pay little attention to rotation and frequently grow strawberries almost continuously on the same field, planting new crops as often as they deem fit. Such growers, however, are usually located on soils that are particularly adapted for strawberry growing. It is not advisable for a beginner to follow such a system, but rather to rotate strawberries with potatoes, cabbage, or similar crops.

As a general rule, strawberries have been found to do best after a well-fertilized and well-tilled crop. Preferably strawberries should not follow grass in a rotation on account of the liability of injury from the white grub. On the other hand, a clover sod plowed under is of great value as a bed for strawberries.

Companion crops may, in some instances, be grown in the strawberry bed with profit the first season, but the companion crop grown should cover only a small area and should come to an early maturity. Some growers set onion sets and lettuce between the strawberry plants and plant a row of snap beans between the strawberry rows. Some growers plant peas between strawberry rows and get a crop the first spring, after which they allow the strawberry plants to have all the space.

Horace Roberts, of New Jersey, advocates planting tomato plants in the strawberry rows. About June 1, he plants a tomato plant between every other hill of strawberries, and claims that it protects the strawberry plants during the hot weather of August. The sprayings given the tomatoes also benefit the strawberries, and he claims that this practice keeps the strawberry plants from getting too thick, since they enter the winter in good shape, and does not injure them in any way.

It is questionable, however, whether the practice of intercropping in a strawberry bed is profitable in the long run.

FERTILIZATION OF STRAWBERRIES

23. Strawberries respond readily to heavy fertilization, but care should be taken not to supply them with too much free nitrogen, particularly just before fruiting. Abundant nitrogen produces an excessive growth of foliage at the expense of the fruit, and if nitrate of soda or a similar fertilizer is applied shortly before fruiting the quality of the berries will invariably be injured and their shipping quality damaged.

The first fertilization of the strawberry bed should occur the fall previous to setting the plants or in the spring. This should consist of the application of from 10 to 15 cords of well rotted stable or barnyard manure. As average stable manure weighs about 2 tons per cord of 128 cubic feet, and barnyard manure weighs about 3 tons per cord, this would mean an application of from 20 to 30 tons according to the kind of manure used. With land well prepared, the newly-set plants should start into vigorous growth. After growth is well started a top dressing of 1,000 pounds to the acre of a fertilizer analyzing 2 per cent. of available nitrogen, 8 per cent. of available phosphoric acid, and 8 per cent. of available potash will rarely fail to produce a satisfactory growth. The early application the second spring of 500 pounds to the acre of a fertilizer analyzing 5 per cent. of nitrogen and 8 per cent. each of phosphoric acid and potash by broadcasting it over the rows will start a vigorous, healthy growth early in the season. It is particularly important that the application the second spring be made early, soon after the plants start into growth.

To mix the 2–8–8 fertilizer at home, the following materials will be required (the quantities given are approximate): 120 pounds of nitrate of soda; 235 pounds of tankage—2 per cent. nitrogen, 8 per cent. phosphoric acid; 460 pounds of acid phosphate—14 per cent.; 185 pounds of sulphate of potash.

To mix the 5–8–8 fertilizer, the following materials will be required: 150 pounds of nitrate of soda; 275 pounds of acid phosphate; 75 pounds of sulphate of potash.

A fertilizer spreader, operated either by horse or hand, is satisfactory for applying fertilizers, but many growers apply by hand. Careful supervision is required to insure even spreading.

Strawberries do best on land that has not been limed. For this reason acid phosphate is a particularly valuable fertilizer for this crop.

24. As might naturally be expected, growers vary considerably in their methods of applying fertilizers to strawberries. Manure, however, is generally applied in the fall as a mulch and the best results are obtained from the application of both manure and commercial fertilizer. A suitable commercial fertilizer for this purpose is one analyzing 4 per cent. of nitrogen, 8 per cent. of phosphoric acid, and 10 per cent. of potash. In some instances a potassic fertilizer alone is used.

Most commercial strawberry growers use commercial fertilizer and vary in the use or omission of manure. The fertilizer is usually applied in the spring of the second year before the buds start. Nothing is gained from the use of both manure and fertilizer during the fruiting year. The best method of fertilization is to apply manures the first year and commercial fertilizer the second year.

Horace Roberts, of New Jersey, advises against the chemical commercial fertilizers for strawberries, claiming that they interfere with the growth of the plant. He advocates the selection of fairly good land for the strawberry bed. Immediately after the plants are set he applies 1,000 pounds of ground bone to the acre, and a little later in the season he applies 500 pounds of tankage.

THINNING OF STRAWBERRY RUNNERS

25. Some varieties of strawberries send out too many runners, especially when planted closely. This results in the production of a large number of weak plants when it is desirable to produce a smaller number of correspondingly stronger plants. The trimming off of the runners is a very laborious and expensive method of getting rid of surplus runners, and hence some other method is more advisable.

The picking off of all the blossoms the first year as soon as they appear has a tendency to make the plants set an extensive number of runners for the reason that all the energy of the plant is sent into the vegetative growth and none into the reproductive growth. This difficulty may be at least partly avoided by allowing berries to develop the first season to a size of from $\frac{1}{4}$ to $\frac{3}{8}$ inch and then clip them off. On many varieties that are prone to set a large number of runners, this will have a tendency to give fewer and stronger runners.

26. The strawberry plant is allowed to send out runners in number according to the system of culture adopted. A single plant of some varieties will send out as many as twelve to twenty plants if allowed to grow unmolested. The wide matted-row system provides for the greatest number of plants, and the limit to the width of the row is set by the cultivator, which rips out the plants growing beyond bounds. It is frequently the practice when this system is adopted to limit the pruning to that done by the cultivator. The same is often true with the narrow matted-row system. The cultivator is run closer to the row and the surplus plants pulled off in cultivation or they are removed when the strawberry bed is hoed. The circular cutters are of value in limiting the width of the rows if they are kept sharp enough to do the work for which they are intended, namely, to sever the runners connecting the young plants with the mother plant. If this is not done the uprooted runner plants continue to draw on the resources of the old plant.

For the single hedge row and double hedge row much hand pruning is necessary. A small paring knife or a jackknife is the best cutter, and the runners are cut off close to the mother plants, either two or four being left, according to the system adopted.

In the hill system all runners are kept off. This necessitates a large expenditure of labor, and it is the amount of work required to remove the runners that is the greatest argument against this system.

For the matted-row systems, the time for pruning is when a sufficient number of runner plants have set in the row. For the hill system, the sooner the runners are removed the less the mother plants are sapped of their strength.

INSECT PESTS AND INJURIES

INSECT PESTS

27. The principal insect enemy of the strawberry is the **white grub,** which is the larva of a beetle. This white grub is shown in Fig. 10. Usually but one white grub will be found in a plant. When once in a strawberry bed, the white grub can be controlled only by digging it out from below the crown of the infested plant, and by cultivating the land about the plants early in the fall. Strawberries should not be set on sod land likely to be infested with white grubs. If cultivated for a year in corn or other farm crops (not potatoes) on which the grub does not feed, a field will be rid of most of them.

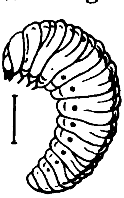


FIG. 10

28. The **strawberry leaf roller** often does considerable damage to strawberry beds, causing the leaves to roll, or fold together, and become dry and brown, due to the feeding of the small green caterpillars on the inside of the folds. Leaves affected with leaf rollers are shown in Fig. 11. The strawberry leaf roller is rarely troublesome for more than a year or two in succession. The damage done by this insect is usually confined to a small area. If spraying is delayed until after the leaves begin to roll, or fold over, the control of this pest will be difficult, because the caterpillars cannot be reached, but in strawberry beds where spraying is systematically conducted, as described later, this insect will not be bothersome.

FIG. 11

DISEASES

29. Strawberries are attacked by fewer diseases than almost any other fruit. The only disease that has as yet done serious injury to strawberries is the **strawberry leaf spot,** which is also known as the *strawberry leaf blight* and as the *strawberry rust*. This disease is more prevalent during some seasons than others, and more serious on some varieties than on others. It may be said that generally the more vigorous the growth of a variety the less damage it will suffer from leaf spot.

The strawberry leaf spot is nearly always present to some extent on both wild and cultivated varieties of strawberries, though on some it does but little damage. The development of this disease, like that of most other fungous diseases, is favored by moisture and heat; a heavy dew when the spores of this disease are present will greatly assist infection. Weather favorable to infection followed by several hot, dry days may cause very serious injury. In some localities entire plantings have been destroyed in a few days by strawberry leaf spot.

Fig. 12

Strawberry leaves infected with leaf spot are shown in Fig. 12. These spots are small, usually from $\frac{1}{8}$ to $\frac{1}{4}$ inch in diameter, and are bordered with red or purple, the older spots having white or ashen centers. When the spots are numerous they may run into one another and form large irregular blotches. The disease may also be found on the fruit stems, where it proves very injurious, as it diminishes the food supply received by the fruit and thus greatly reduces the crop.

30. Spraying of Strawberries.—Few commercial growers spray strawberries at all, and on account of the few troubles to which this plant is subject, such a practice is safer than it is with almost any other fruit. On the other hand, however, the increased yield of fruit that can be secured by the systematic application of sprays makes spraying profitable. The following method of spraying for the control of the strawberry leaf spot and the strawberry leaf roller has been recommended (the other strawberry troubles are controlled as described elsewhere):

1. Soon after the growth of the newly set plants begins, spray with 4–5–50 Bordeaux mixture (4 pounds of copper sulphate, 5 pounds of stone lime, water-slaked, and 50 gallons of water).

2. Repeat this spraying in about 2 weeks, and two or three times more during the first season, as may be needed.

3. The second spring, before the plants blossom, spray with the Bordeaux mixture of the formula given in paragraph 1. Whenever the strawberry leaf roller is present add from 2 to

3 pounds of arsenate of lead to each 50 gallons of the Bordeaux mixture.

4. About 2 weeks later give another spraying with the Bordeaux mixture mentioned in paragraph 1.

Another spray that will be equally as effective as the Bordeaux mixture is a dilute lime-sulphur solution (specific gravity .006, that is, 33° Baumé concentrated lime-sulphur solution, diluted 1 to 40 with water). When the concentrated lime-sulphur solution is purchased, that is, does not have to be boiled at home, the lime-sulphur is often found to be more convenient to use than the Bordeaux mixture.

FROST INJURIES AND FROST PROTECTION

31. Frost injury to strawberries occurs principally when the plants are in bloom, and a frost during the blossoming period will always do damage. Strawberry blossoms that have been injured by frost may be detected by the centers, or hearts, of the blossoms turning black the next day after the frost. Strawberry buds rarely suffer from frosts, and then only when there is an exceptionally hard frost. Neither will the fruit set be injured by an ordinarily hard frost.

Late spring frosts are particularly damaging to the blossoms of the early-blooming varieties of strawberries, and in some parts of the country it is not profitable to grow such varieties for this reason. Of the early blossoming varieties the Geneva, New York, Experiment Station recommends Mascot, Parcel Early, and Superior for a test in the colder sections.

The injurious effects of frosts on strawberry plantations may to some extent be prevented by smudging with smudge pots similar to those used for tree fruits. This method of preventing damage from frosts is, however, not of practical importance. Practical growers avoid frosts by a careful selection when setting the strawberry beds. When a good mulch is on the strawberry bed and the grower is forewarned of frost in time, it is possible to protect the strawberry plants by shaking a light mulch over them. The practical application of such a method, however, very seldom works out satisfactorily.

WINTER KILLING

32. Strawberries are almost never winter killed if properly mulched. Winter killing is caused by a breaking of the roots by the heaving caused by freezing and thawing. A good mulch of straw, hay, seaweed, pine needles, or any material that will not mat down so as to smother the plants, but will prevent alternate freezing and thawing, is entirely suitable. The mulch should be put on as soon as the ground is well frozen in the fall and it should not be packed too tightly over the plants. The mulch should be allowed to remain on the plants until after danger of frost has passed in the spring, and after the plants are uncovered the mulch should be placed between the rows and under the sides of the plants to keep the fruit clean. Soon after the fruit is picked the mulch should be removed and the plantation plowed.

The advice is often given to grow a crop of something between the rows in order to furnish a mulch. This practice, however, is not to be recommended, because the crop grown will take considerable moisture from the strawberry plants in the summer and if a grain or grass crop it will be difficult to subdue it in the spring without considerable injury to the strawberry plants.

CAUSES OF POORLY SHAPED STRAWBERRIES

33. Poorly shaped strawberries, or nubbins, are caused by unfavorable weather and a lack of proper pollination. The common cause is unfavorable weather, as both the flower and the growing fruit of the strawberry is susceptible to injury from the cold winds and low temperatures that are frequent in some sections. Heavy rains during the blossoming period are also likely to interfere with the proper pollination. Poorly shaped fruit that is due to improper pollination may, to a great extent, be overcome by planting together the proper varieties; that is, imperfect varieties should not be planted by themselves, but if the planting of the imperfect varieties is desirable they should be planted in the proportion of two to four rows of imperfect varieties to one row of a perfect variety.

HARVESTING AND MARKETING

PICKING

34. The picking of strawberries is a very important operation. The fruit is of a highly perishable nature and, if the greatest profit is to be secured, the berries must be carefully picked. Also, this work of picking should be so carried on that all of the fruit will be harvested. For this purpose reliable pickers must be hired, and they should be paid a price for picking that will insure careful, thorough work; when pickers feel

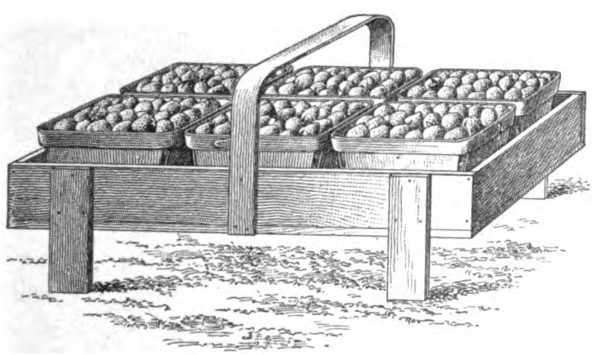


FIG. 13

that they have to hurry at top speed in order to earn a day's wages good work cannot be expected. In many sections, strawberry pickers are paid $1\frac{1}{2}$ cents a quart for careful picking.

To insure more careful handling of the fruit as well as for the sake of convenience, the pickers should be supplied with a picking stand that will hold from four to six 1-quart baskets. A picking stand holding six 1-quart baskets is shown in Fig. 13. The short legs on the stand hold the tray off the ground and keep the baskets free from dirt and dampness. As the tray holds a number of baskets the picker can readily grade the fruit by simply dropping those of a size in a basket. Grading in this way, provided it is conscientiously done, makes a great saving in labor and justifies the payment of good prices for picking.

35. Where a large number of pickers are employed and the work is paid for by the quart, some system of keeping account of the number of quarts picked by each person is a necessity. In some cases, the count is kept in a book by one man, but this often leads to dissatisfaction. In other cases, small tickets, slips, or cards, with numbers representing either quarts or money printed on them, are given to each picker as the fruit is delivered at the packing house, and these are cashed in at the end of the day, week, or season, as the case may be. The disadvantage of this system is that the tickets are often lost and complaints difficult of adjustment are made. The use of a tag similar to a shipping tag, with numbers representing quarts printed on one side, is usually more satisfactory than either of the other methods. This tag is fastened to the clothing of the picker and hence is seldom lost, and the punch marks on it form a perfectly definite record of the amount due the picker. Such a tag is shown in Fig. 14. Whenever a picker delivers a picking stand of six 1-quart baskets to the packing shed one of the 6's is punched out of the card. The 1's at the end of the card are for odd quart baskets that may be turned in. In case the picking stands hold but four 1-quart baskets, 4's should be printed on the card instead of 6's. A punch suitable for punching such tags is shown in Fig. 15.

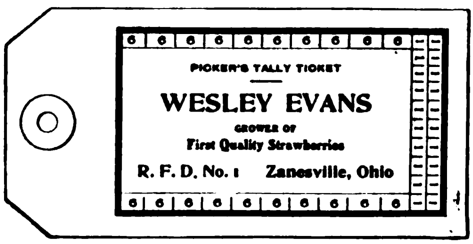


FIG. 14

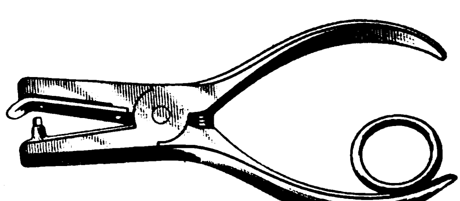


FIG. 15

36. Strawberries should be dry and firm when picked; they should never be picked when wet, because they will

Fig. 16

deteriorate very rapidly in quality in that condition. For this reason the sun should be allowed to dry the dew off the berries in the morning before the fruit is picked, and they should never be picked too soon after a rain. When possible, the heavy picking should be done in the afternoon.

FIG. 17

The fruit should be graded into firsts and seconds as it is picked. As mentioned before, rapid picking operates against having fruit well graded. With strawberries particularly, grading is better done in the field than in the packing shed, as grading at this time saves rehandling the fruit and more or less bruising in consequence. In the case of fancy berries, the baskets may be faced in a packing shed, but it should not be necessary to do any grading there. To maintain a high standard of picking, each quart basket should be inspected before it is crated for shipment.

For shipment to near-by markets, the fruit should be picked when ripe. For a distant market it should be picked in the

FIG. 18

proper underripe state to insure its reaching the market in fine condition; the determination of the right time to pick requires

Fig. 19

experience. To have all the fruit picked at the proper time it may be necessary to go over a patch more than once. Fig. 16 shows a spray from a plant with the fruit in different stages of ripening and explains why it is necessary to pick the field over more than once.

Strawberries should be picked with short stems, as shown in Fig. 17, the stems being severed by the finger nails. Berries with short stems keep better than those without stems.

A plant loaded with fruit is shown in Fig. 18, and a gang of strawberry pickers is shown in Fig. 19. The picking stands shown in Fig. 19 are not of the best type, as they have no legs to hold the trays off the ground. The plant shown in Fig. 18 has an abundance of fruit on it, but the fruit varies in size, and if only fancy fruit is desired more than one picking is advisable.

PACKING

37. There are no standard packs for strawberries. The bulk of the strawberries sent to market are so small that any

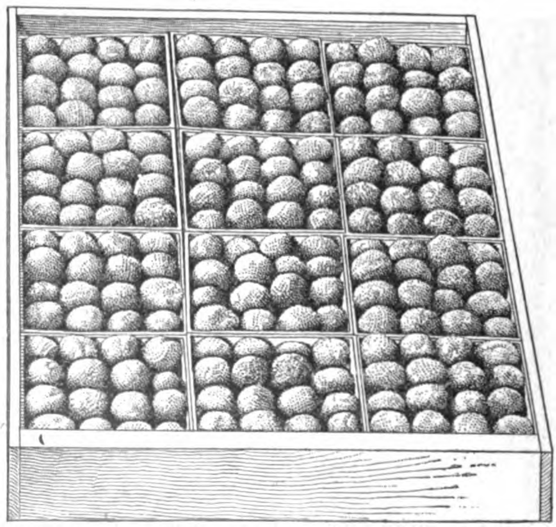


Fig. 20

definite pack is out of the question. Large, fancy berries, however, show off to better advantage when uniformly packed,

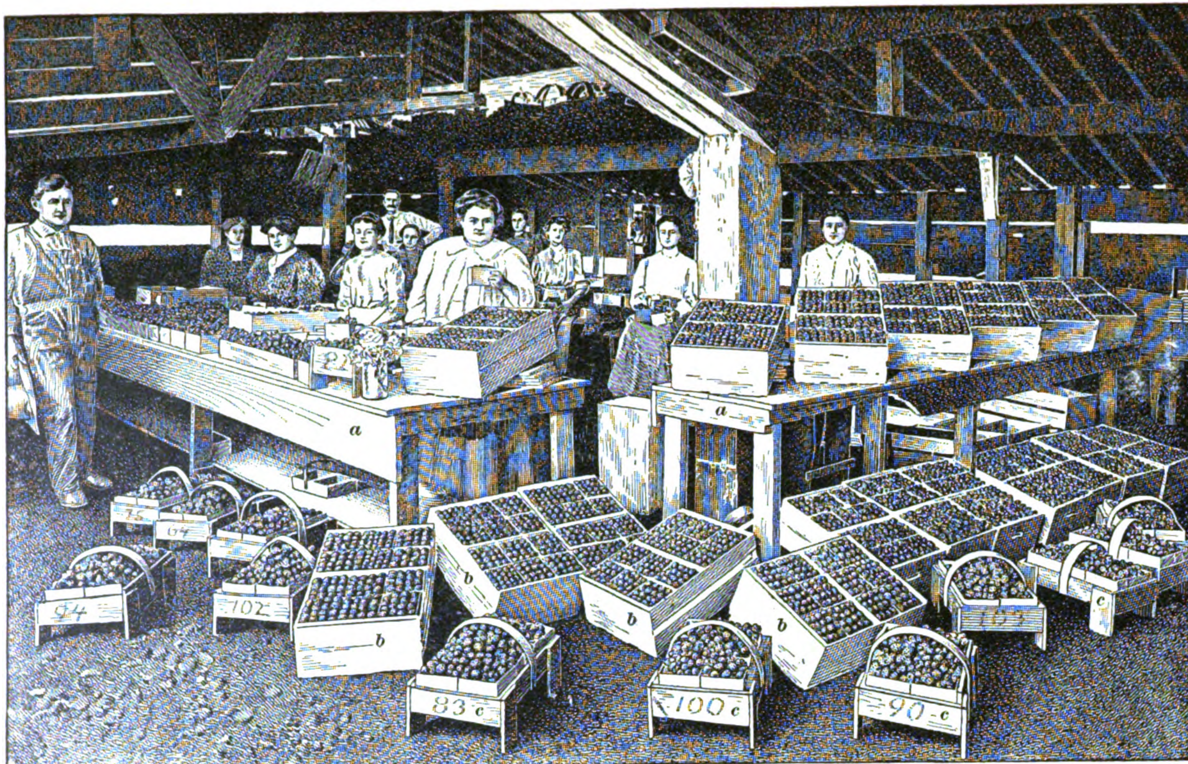
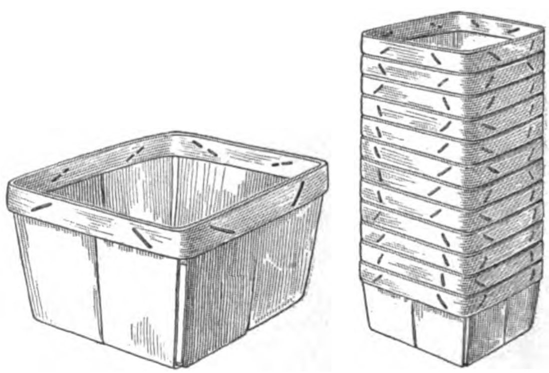


Fig. 21

and such packing pays when the fruit is to be offered to a discriminating trade. Large, fancy berries should be packed with the upper layer in rows in the quart boxes with the hulls all one way and the sides of the berries showing; this is called *facing*. The berries should not be laid flat but should be tilted a trifle so that the points will be slightly higher than the stem end. In this position the berries will show off to the best advantage. Berries packed in the manner described are shown in Fig. 20.

When large quantities of strawberries are to be packed, a packing house or shed is necessary, because the berries should not be kept in the sun any length of time after being picked,



(a) (b)

Fig. 22

and in a packing shed the packing can be continued in inclement weather after the picking is stopped. Such a shelter also makes packing more of a pleasant task for the packers and, incidentally, enables them to work faster and better. A packing shed may be constructed in a great variety of ways. A substantial packing shed is shown in Fig. 21. The roof is strongly made to keep off the sun as well as the rain, and openings are left in the sides to allow good ventilation. Packing tables are shown at *a*. The fully packed crates are shown at *b*, and the picker stands, or carriers, with six 1-quart baskets in each, are shown at *c*.

38. Strawberry Baskets and Boxes.—In Fig. 22 (*a*) is shown the common 1-quart strawberry basket. Such baskets were formerly put together with tacks, but some are now made with wire staples and these are stronger and less liable to come apart. In (*b*) is shown a number of these baskets nested. When thus nested they may be packed 160 in a 32-quart crate and 96 in a 24-quart crate; they are usually packed this way when crates are ordered at the same time as the baskets. Usually, when baskets and crates are ordered together, the crates to be shipped in the flat so as to save freight, the manufacturer will nail together enough crates to hold the baskets. When the baskets are ordered by themselves they are usually shipped in temporary crates holding 1,000 or less, according to the number ordered.

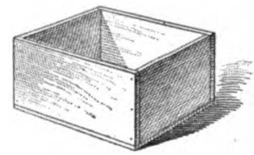


Fig. 23

When bought in large quantities, strawberry baskets will normally cost from $2.75 to $3 per thousand. In the winter they may be bought for as low as $2.35 per thousand, and in July they bring as high as $3.25 per thousand.

An old-style strawberry box is shown in Fig. 23. Such a box is usually bought in the flat and tacked together by the grower. About 1 pound of tacks will do for putting together 1,000 boxes. A magnetic hammer is useful for this work. Some firms furnish a form which facilitates the work of putting the boxes together. The building of 1,000 to 1,200 boxes is considered a good day's work. The box shown in Fig. 23 is used in the crate shown in Fig. 28; it will not fit in all crates. It is not now used so extensively as baskets in the marketing of strawberries.

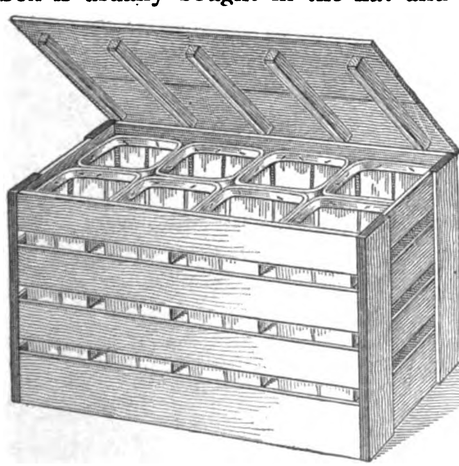


Fig. 24

39. Strawberry Crates.—Strawberry crates are made in several styles. A strong, durable type of crate in common

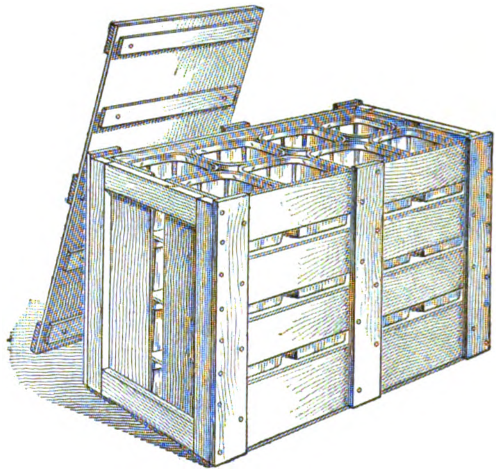


FIG. 25

use is that shown in Fig. 24. This crate will hold thirty-two 1-quart baskets, but it is also made in a size to hold twenty-four 1-quart baskets. This crate is built of strong wood, is iron bound, and is hinged with wire hinges. Such a crate is commonly not given with the fruit, but is given only to customers on the agreement that it will be returned after the fruit has been sold. In large quantities, such crates will cost more than 50 cents each.

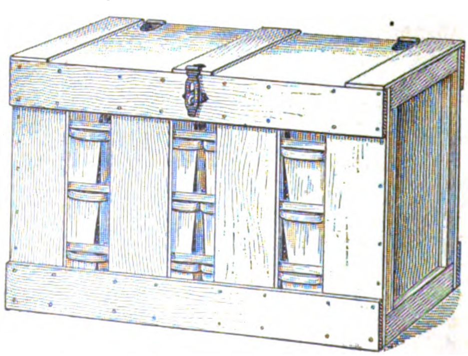


FIG. 26

A cheaper crate, commonly called a gift crate, because it is not returned to the grower, is shown in Fig. 25. This crate is similar to the one shown in Fig. 24, but is built of lighter material and lacks the iron reinforcement and the hinges, and in large quantities sell for 30 cents each.

A type of strawberry crate less substantially made than those illustrated in Figs. 24 and 25, but supplied with a hinged lid, is shown in Fig. 26.

A low type of strawberry crate, used to some extent in the West, is shown in Fig. 27. This is built to hold twenty-four 1-quart baskets.

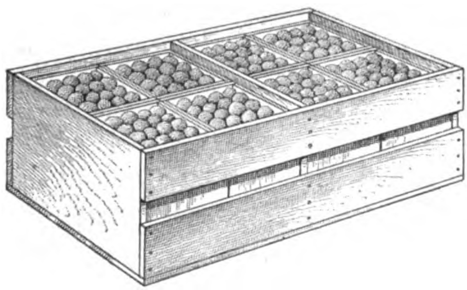


FIG. 27

An old style of crate used with the box illustrated in Fig. 23, is shown in Fig. 28. This crate is usually made to hold twenty-four or thirty-six 1-quart boxes, and may be most cheaply purchased in the flat with the covers ready made.

The strawberry crates shown in Figs. 24, 25, 26, 27, and 28, are all used for shipping the fruit short distances or for selling in a local market.

A refrigerator shipping crate for strawberries is shown in Fig. 29. This crate is strongly and solidly built to stand long-distance shipments. At *a* is shown a deep pan that fits in the upper part of the crate and is used for holding ice. The lid of the crate is shown at *b*.

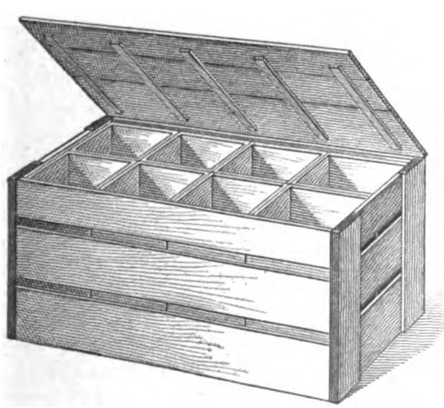


FIG. 28

40. Labels for Strawberry Crates. Every strawberry grower who aims to sell and establish a market for high-grade berries should sell all such fancy fruit under a distinctive label. Fruit of an inferior grade should not be sold under the same label; it would be best not to sell it under a label of any kind. The producer never gets the most advantage out of a sale of fine fruit unless the buyer knows who the producer is. The securing of a high price for fruit that is worth it is not all that is to be considered. The most profit can be secured only from the advertising that a label will secure, as this will usually

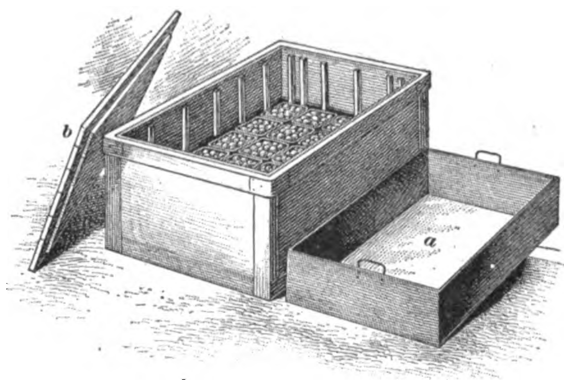


FIG. 29

result in other orders. The label serves as a means of identification, and its value is being recognized more and more every day. The selling of inferior fruit under a label is, however, very inadvisable, as this will tend to keep buyers away from it.

STORAGE

41. The cold storage of strawberries is ordinarily not very satisfactory. At the best it is not possible to store strawberries for any length of time, as they very quickly go to pieces when removed from cold storage. The usual practice is to bring them instantly from the cold temperature of the storage plant into the warmer temperature outside, which causes them to sweat quickly, and this spoils their appearance and makes conditions favorable for rapid decay. Under ideal conditions of cold storage it might be possible to store strawberries satisfactorily, but with this fruit the practice is very risky. A temperature of about 40° F. is as cold as it is desirable to have in a storage place for strawberries.

Some varieties will keep or stand up much better than others. A notable example of this is the Klondike, a variety that is popular with the truckers in the South, because when it reaches Northern markets it is bright and attractive in appearance.

MARKETING

42. Classes of Strawberry Buyers.—Considered from the viewpoint of the strawberry grower, the buying public may be classed in three groups: (1) Those persons who want nothing but the best strawberries procurable—commonly called the fancy trade; (2) those persons who desire good strawberries at a fair price and who will go without rather than use poor fruit; and (3) those persons who buy only when the fruit is cheap and who pay little attention to quality.

The demand of those of the first group is very rarely supplied. Strawberry and other fruit growers have had difficulty in getting into direct communication with this class of purchasers and as a rule have not put forth sufficient effort to produce, pack, and advertise the best grade of fruit properly.

Those of the second group form a large consuming class and they absorb large quantities of fruit when good strawberries are obtainable at a fair price, which is from 10 to 15 cents per quart at retail.

Those of the third group usually buy strawberries and other fruits only when the market is flooded and when the quality of the fruit is below that desired by those of the second group. When the market gluts with poor berries these are usually disposed of at a very low price to peddlers and hucksters, who retail them from house to house and supply the largest part of the third group with their fruit.

43. Time Strawberry Crops Enter the Market.—The Florida strawberry crop reaches the New York and New England markets late in February and early in March. Crops from similarly located states inland are harvested at approximately the same time. Strawberries are not obtained in large quantities in the Northern markets at this time, but continue in light supply until May, when the Carolinas and Maryland begin to ship their crops. These are closely followed by the strawberry crops from Delaware and New Jersey.

The strawberry crops of the Middle Western and Far Western states are marketed locally, with the exception of those sections shipping to the St. Louis and Chicago markets, and the crops of the states of Washington and Oregon. Texas and Louisiana get early strawberries into the large markets of the Central States at approximately the same dates as the states in the same latitude on the Atlantic coast, that is, late in February and early in March.

The strawberry crop of Washington and Oregon, where strawberries grow to great perfection, are marketed along the Pacific coast late in April and during May.

44. Factors Affecting Strawberry Prices.—The question of whether the early, mid-season, or late crop of strawberries will prove the most profitable in any particular locality, depends entirely on the market catered to and on the season. Often the grower of fancy strawberries gets the best prices after the season is well advanced.

Earliness is of more importance to the Florida and Carolina than to the New Jersey and New England strawberry growers. In the case of the first-named growers, the market is in the large cities and the trade catered to there is the trade always hunting for the unseasonable product and willing to pay an extra price to secure it. In the case of the New Jersey and New England growers, their crops come into the market when strawberries have ceased to be a novelty, and hence quality is of the utmost importance. Early in the season very inferior berries will often sell for much higher prices than berries of the highest quality later in the season.

A continuous supply of strawberries, which may be obtained by planting a proper assortment of varieties, is desirable where the grower caters to a retail trade, but when the grower sells his berries in a wholesale market it is not so necessary. The main advantage that the man selling in the wholesale market can obtain from a succession of strawberries is that if part of his crop happens to strike a glut in the market and brings low prices he will still have another crop which will probably bring better prices.

When shipments must be made to distant markets there is less likelihood of receiving prices equally as high as those that may be obtained in the home market, unless large quantities of strawberries can be shipped at one time and the matter of marketing is skilfully conducted. The rapidity with which strawberries deteriorate in quality after picking makes it essential to move them promptly and handle them carefully, and also makes it often necessary to reduce the price of the fruit to the consumer in order to increase the consumption and prevent loss. The markets of the larger cities of the United States rarely pass through a season without a glut in strawberries, and when this occurs prices fall to a point where the producer can secure no profit. Gluts may be of long or of short duration, depending principally on the skill with which the growers distribute their berries. Organized selling agencies have done much to lessen this trouble.

Seasonal conditions are often important in causing gluts in the strawberry market. In 1912, for instance, the strawberries from both the Carolinas and Maryland arrived in the Northern markets by the carloads at the same time; in normal seasons the strawberries from the Carolinas are out of the market before the Maryland berries are shipped in any quantities.

The best strawberry markets are not always in the largest cities. Frequently, berry markets for a limited quantity of berries may be found in the smaller centers of population, principally because such markets are often neglected and do not receive their shipments from a wide territory. Very fancy fruit, however, will usually bring more money in the markets of the larger cities than elsewhere.

45. During 1912 strawberries expressed to Northern markets from the Southern States, sold for from 5 to 7 cents per quart at wholesale for a number of weeks, and at this price, considering the long shipment, the grower could have secured but small returns. The same condition of affairs has existed more or less every 2 or 3 years, since strawberries have been extensively grown in the South and for shipment North early in the season.

Local markets frequently experience times of oversupply, principally because the bulk of the strawberries received in them is of poor quality, and to be disposed of they must be sold at any price they will bring.

Growers of fancy strawberries pay little attention to the general market prices, because they are usually able to secure the prices they ask. The average strawberry grower receives from 5 to 9 or 10 cents per quart for his berries.

RASPBERRIES

RED RASPBERRIES

GENERAL DISCUSSION

1. Red raspberries are highly prized by consumers of small fruit, chiefly on account of their flavor.. They are not, however, so popular with fruit growers for several important reasons: (1) The red raspberry plants, as a rule, are not productive in all localities; (2) certain diseases that attack the raspberry are difficult to control and work serious and permanent injury; (3) red raspberry bushes are not heavy yielders and the expense of harvesting is considerable; (4) red raspberries ship poorly, the structure and delicacy of the berry making it difficult to handle and ship them without considerable deterioration.

In spite of the disadvantages connected with the raising of red raspberries, there are several good points in their favor that make their culture profitable to many growers: (1) The red raspberry usually commands a very satisfactory price in the market; (2) the demand for red raspberries is active and the crop may be disposed of quickly; (3) good yields of red raspberries may be obtained by careful attention to the location of the plantation, the culture, and the fertilization; and (4) the ready salability of the red raspberry makes it a desirable addition to the fruit product of a grower near a good market, because it will give him cash early in the season and will help him to secure customers for his later crops of fruit.

The life of the average raspberry patch, of either the red or the black varieties, is from 8 to 15 years unless some disease such as cane blight or orange rust makes serious inroads.

2. The raspberry crop, including both red and black raspberries, is about one-third as large as the strawberry crop, and red raspberries are a little more than half of the total raspberry crop. According to the 1910 census there was produced in the United States, during 1909, 60,918,196 quarts of raspberries and loganberries (the value of the latter being unimportant), valued at $5,132,277. The states that produce the bulk of the raspberry crop are New York, Michigan, Ohio, Pennsylvania, and Indiana.

There is no immediate prospect of overproduction of red raspberries. The market demand for the fruit is very good, and the supply of berries of good quality has always been far short of the demand. Red raspberries are the most popular of the bush fruits, and, as they begin to ripen from 3 to 4 weeks after strawberries, they come into market at a very favorable time.

Red raspberries are eaten raw, are canned, are preserved in jams, and are made into a vinegar that is diluted with water and used as a drink; it is similar to grape juice.

3. Red raspberries are hardy plants, and practically all varieties are hardy in the United States. The red raspberry is the most popular bush fruit in Canada, due to a considerable extent to the fact that so many varieties succeed well in that country. The red raspberry is hardy over a greater territory in Canada than the black raspberry, and is grown much farther north. In Canada, the native red raspberries grow in abundance as far north as the Yukon and have been picked on mountains at an altitude of 7,000 feet.

The injury that often occurs to red raspberries in winter is frequently due to other causes than cold, such, for instance, as a weakened condition of the plant due to disease, drought, or too much moisture.

4. Under favorable conditions, a half crop of fruit may be expected from a red raspberry plantation the second year, and a total of eight or ten profitable crops may be secured during the life of a plantation. From the third to the fifth years, a plantation should produce a somewhat larger crop each year, but under normal conditions no material increase can be expected after the fifth year. A yield of about 1,500 quarts per acre may be considered a full crop, and at an average price of 10 cents per quart this will give an income of about $150 per acre.

5. Red raspberries are not as productive as black raspberries, but with good culture red raspberries should yield about 75 bushels to the acre. A low average price would be $5 a bushel of 64 pints, and at this yield and price the returns would be very satisfactory, especially since there is a possibility of securing a much greater return by getting the fruit on the market early.

6. Fred W. Card estimates the cost of producing a crop of red raspberries from an acre that is in bearing to be about $50. In addition to this there will be a cost of from 2 to 4 cents per quart for picking and marketing. Red raspberries are commonly sold by the pint, and they should net the grower about 5 cents per pint after deducting the cost of picking and marketing. At 75 bushels per acre, this would mean a gross income of about $240, from which the cost of production will have to be deducted. Many growers secure a net of only $60 per acre, but it can be readily seen that, under proper management, about three times this amount may be secured.

SIZE, SOIL, AND EXPOSURE FOR A RED RASPBERRY PLANTATION

7. Units for a Plantation.—The average plantation of red raspberries for 115 growers, as shown in the Section on strawberries, is 1.58 acres. This means that the average grower of red raspberries is in the business principally for supplying a local market, and he usually raises a number of other bush or orchard fruits.

A plantation of a size suitable for a grower who expects to sell in a wholesale market would be 10 acres.

8. Soils for Red Raspberries.—Red raspberries do well on a great many different varieties of soil, but they thrive best in a deep, moist, humus-filled soil that is well drained. Good drainage is essential, but the soil must be able to withstand drought, because a soil too dry is as bad as one too wet.

Generally, the soils on which a fruit is planted commercially indicate the types of soils on which the fruit does best, although the statistics given in Table I show that this is not always the case. The information given in Table I is a summary of the data collected during a survey of Western New York in 1910 by the Cornell Department of Pomology, and shows the number of acres of red raspberries planted on the different kinds of

TABLE I

YIELD OF RED RASPBERRIES ON DIFFERENT KINDS OF SOIL

Kind of Soil	Acres	Farms	Average Yield Per Acre Quarts	Average Income Per Acre
Gravelly loam	63.5	40	1,414	$141.43
Sandy loam	30.6	21	1,306	147.29
Clay loam.........	7.4	7	2,097	237.40

soil on the different farms examined, the average yield per acre, and the average income per acre. The farms included in this survey had red raspberries planted on three types of soil—gravelly loam, sandy loam, and clay loam, and although the general impression has been that red raspberries do best on gravelly and sandy soils, it was found that the clay loam soils in this section produced crops that were about 54 per cent. larger than those produced on the lighter soils, and that furthermore the crops on heavier soils brought an income about 64 per cent. greater than the crops from the lighter soils. This is a convincing argument in favor of planting red raspberries on the heavier soils, a fact that has heretofore not been appreciated. The total acreage of red raspberries included in this survey was not as large as might be desired, being only about

111 acres, but as it was divided among 68 farms the data should be considered sufficient to indicate the kind of soil best suited to red raspberries in Western New York. Doubtless the same soil would also be found most suitable in other sections of the country.

Soil that is not naturally drought resistant may be improved in this respect, if the subsoil is hard, by underdraining or by subsoiling; or if it lacks humus, by adding this in the form of manure or green cover crops. The process of adding humus to a soil should, however, be gradual. The sudden addition of too much undecayed vegetable matter may reduce the quantity of capillary moisture in a soil for a time and thus reduce the quantity of moisture available for the growing plants. Brambles such as the red raspberry thrive well in a virgin soil because of the large quantity of humus in such a soil.

Land that is to be used for red raspberries should be free from such pernicious and hardy weeds as sorrel and crab grass, because the tillage of red raspberry bushes on account of the thorns, is attended with more difficulty than the tillage of most crops. In fact, weeds will always be a most serious trouble in any plantation of perennial plants where there is no opportunity to plow up the surface of the ground.

9. Exposure.—The red raspberry does best on a northern or a western exposure, and hence such exposures are preferable for commercial plantations. The best and sweetest fruit grows in the cool, shady places, such as can be secured on northern and western exposures, and this is true even of different parts of the bush—the largest and sweetest berries are found in the center of the bush, which is the most shaded part. For planting in the home garden, where a choice of exposure is not often possible, a cool spot such as may be found in the shadow of a wall or of a tree is preferable.

FIG. 1

7

FIG. 2

VARIETIES OF RED RASPBERRIES

10. The varieties of red raspberries that are widely planted are as follows:

The **Cuthbert** red raspberry, shown in Fig. 1, has a strong-growing bush, but it is only moderately hardy; where this variety is hardy it is productive and is usually the main crop variety. The fruit is large, of a dull-red color, moderately juicy, of good quality, and a good shipper. The fruit ripens in mid-season.

The **Herbert** red raspberry, shown in Fig. 2, has a strong-growing bush that is hardy and very productive. This variety

FIG. 3

is likely to replace the Cuthbert in localities where the latter variety is not sufficiently hardy. The fruit is bright red, sweet, juicy, and of good quality. The fruit ripens in mid-season. This variety has all the good points required in a berry for a local market.

The **Loudon** red raspberry, shown in Fig. 3, has a bush that is only a medium grower but that is hardy. This variety is not

9

FIG. 4

sufficiently productive in all localities to be generally profitable for market. The fruit is large, bright red, and of good flavor. The fruit ripens in mid-season.

The **Marlboro** red raspberry, shown in Fig. 4, has a fairly strong-growing bush that is hardy and productive in most localities. The fruit is of medium size or a little larger, and is bright red, firm, and of medium quality. This is the best early variety.

The **Miller** red raspberry has a bush that is a moderate grower and tender, and that is not productive in northern localities. The fruit is of medium size, bright to dark red, juicy, and of fairly good quality. This variety is not as good as many other varieties.

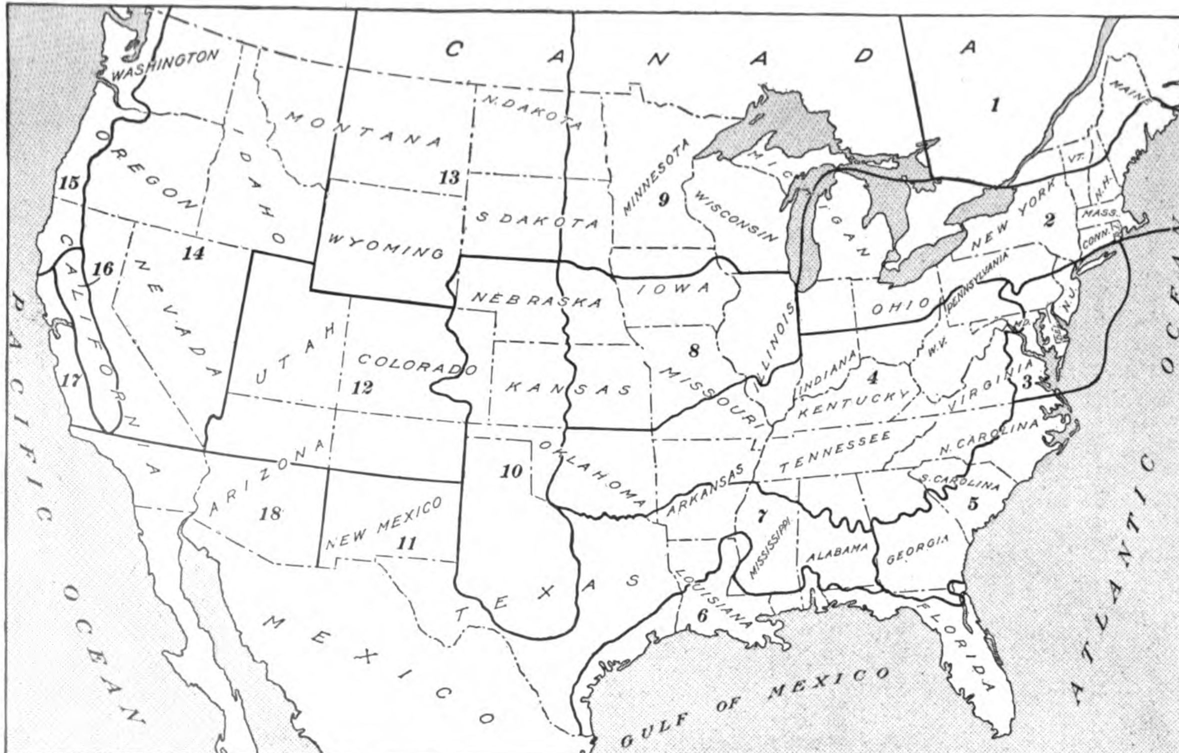
The **King**, or *Early King*, red raspberry has a fairly strong-growing bush that is moderately hardy and productive in localities where it is not winter killed. The fruit is of fair size, bright red, and of medium quality. The fruit ripens early. This variety is not as promising as many others.

The **Brandywine**, or *Wilmington*, red raspberry has a strong-growing bush, but, owing to its susceptibility to being winter killed it is not productive in northern localities. The fruit is of medium quality, and ripens in mid-season.

The **Turner** red raspberry has a very strong-growing and very hardy bush. The fruit is rather small in size, of a deep red color, and of good flavor. The fruit ripens early in the season. This variety is very much like a wild raspberry and is useful in home gardens in localities where the winters are unusually severe, but the fruit is too small to grow for market.

SELECTION OF VARIETIES SUITABLE TO A LOCATION

11. According to information compiled by the American Pomological Society, varieties of red raspberries, like varieties of other fruits, vary widely in their adaptability to different sections of the country. Some varieties have been found to succeed well in many different parts of the country, although with varying degrees of success in different sections, and other


CANADA
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UTAH
ARIZONA
COLORADO
NEW MEXICO
N. DAKOTA
S DAKOTA
NEBRASKA
KANSAS
OKLAHOMA
TEXAS
MINNESOTA
IOWA
MISSOURI
ARKANSAS
LOUISIANA
WISCONSIN
ILLINOIS
MISSISSIPPI
MICHIGAN
INDIANA
KENTUCKY
TENNESSEE
ALABAMA
OHIO
W.V.
VIRGINIA
N. CAROLINA
S. CAROLINA
GEORGIA
FLORIDA
PENNSYLVANIA
NEW YORK
N.J.
MD.
MAINE
VT.
N.H.
MASS.
CONN.
MEXICO
PACIFIC OCEAN
ATLANTIC OCEAN
GULF OF MEXICO

Fig. 5

varieties have been found to do well in a few sections only. To simplify matters, the Society has divided the United States and the lower part of Canada into eighteen pomological divisions, or districts. These districts have nothing to do with the state or provincial boundaries but consist of territory adapted, because of its natural conditions, to the growing of fruits. In making up these districts due consideration was given to the influence of latitude, elevation, prevailing winds, and the nearness to oceans and lakes. These eighteen districts are plainly outlined and numbered on the map that is shown in Fig. 5.

The following list of varieties, arranged by districts, gives under each division the varieties of red raspberries that are known to succeed in that division, or district. The varieties given in Italic are known to be highly successful in the divisions in which they occur. The first time the name of a variety is given its less common name is put after it in parenthesis. Where a division heading is omitted (Divisions 6, 11, and 13), no varieties of red raspberries are known to do well in that division. Some of the varieties included in the list will not be found described in detail in the descriptions of varieties. Such varieties are considered to be not entirely desirable from a commercial standpoint. The information given in this list should not, however, be regarded as infallible, although it has been compiled with the greatest possible accuracy from the statements of the leading red raspberry growers within each division. When the planting of any particular plot of ground is considered, the experiences of local growers and the recommendations of the local agricultural experiment stations should receive careful consideration.

Division 1: Blair, *Cuthbert*, *Golden* (Golden Queen), Hansell, Loudon, Marlboro, Miller, Turner.

Division 2: Brandywine (Wilmington), Golden, Hansell, Loudon, Marlboro, Miller, Turner.

Division 3: Brandywine, *Cuthbert*, Marlboro, Miller, Turner.

Division 4: *Cuthbert*, Golden, Loudon, Miller, Turner.

Division 5: *Cuthbert*, Golden, Loudon.

Division 7: Cuthbert.

Division 9: Brandywine, *Cuthbert*, *King* (Early King), *Loudon*, Marlboro, Miller, *Turner*.

Division 10: *Cuthbert*, Marlboro.

Division 12: Brandywine, *Cuthbert*, Golden, Loudon, *Marlboro*, Turner.

Division 14: *Cuthbert*, Loudon, Marlboro.

Division 15: *Cuthbert*, *Miller*.

Division 16: *Cuthbert*, *Hansell*.

Division 17: Cuthbert.

Division 18: *Cuthbert*, Loudon.

12. Comparatively few varieties of red raspberries are grown in large quantities. The Cuthbert is the variety most generally grown. According to Prof. Charles S. Wilson, who conducted an investigation among the commission men of the principal cities of the United States, the following varieties are the most largely sold in the principal markets: Cuthbert, Loudon, Marlboro, Miller, King, Brandywine, and Turner.

PROPAGATION OF RED RASPBERRIES

13. Red raspberries are propagated from suckers and from root cuttings. These two methods of propagation are really very nearly the same, because, in a certain sense, the suckers are also root cuttings. Suckers are sprouts which may be developed from the roots near the surface of the ground, both naturally and as result of injury to the roots. They are often induced to grow in abundance when red raspberry roots are injured in cultivation. Such injury may be done when a patch is cultivated too deeply. In some patches root injury by cultivation is very common, because the roots have been allowed to grow too near the surface, as a result of too shallow cultivation when the plants were young. The method of propagation by suckers is the most common one, and when they are to be used for propagation they are dug up with a spade with from 3 to 5 inches of roots adhering, or with as much more as can be conveniently detached, and immediately set in the place where they are to stand permanently. The method of propagating red raspberries by suckers is the most common, because most varieties sucker freely, and no other method of propagation is needed. A few varieties, however, send up suckers sparingly, and these are propagated by what may be strictly termed root cuttings.

When red raspberries are to be propagated by root cuttings, pieces of roots from 4 to 5 inches long and about as thick as a lead pencil are cut from a vigorous plant, usually in the fall,

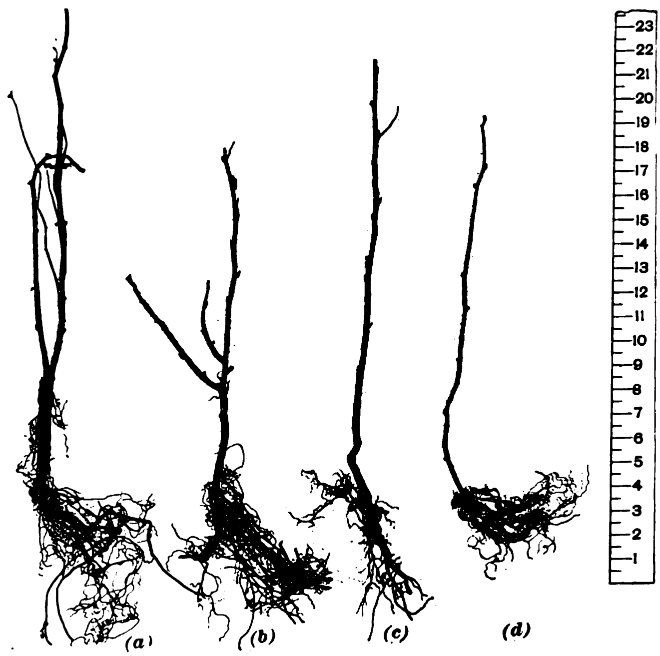

Fig. 6

and are bedded in sand over the winter. By spring, the cut ends will have calloused over and the root cuttings may be placed in a shallow furrow and covered over with 2 or 3 inches of dirt until they each develop one or two good canes. After this they will be ready for setting in their permanent places in a plantation.

Red raspberry plants from young bushes are preferable, as they are likely to have greater vigor than plants taken from older bushes, and will be less likely to carry disease.

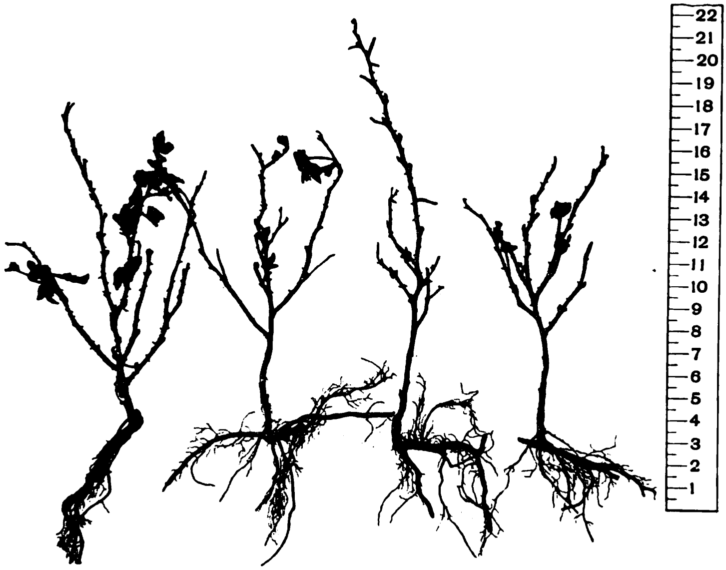
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FIG. 7

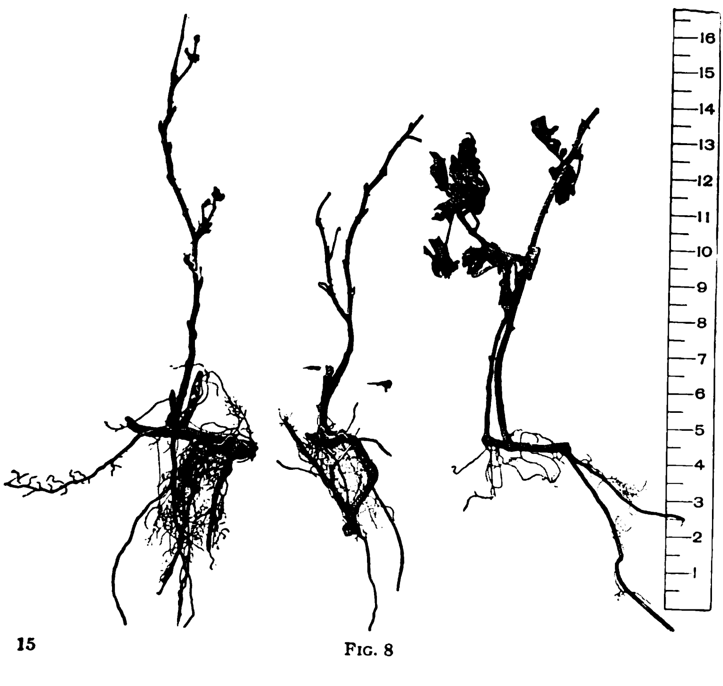
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FIG. 8

The character, or individuality, of the parent bush is usually disregarded when selecting the bushes from which to produce young plants for new plantations. Such a practice does not produce the best results, because the vigor and fruit-bearing qualities of the parent bush may be the factor that determines the profitableness of the offspring. It is a great waste of time and money to plant young plants from inferior parent bushes and give them all the care needed to bring them to fruit-bearing age, only to find after all this expense that they will not bear sufficient fruit to pay expenses.

14. Red raspberry nursery plants of different grades are shown in Figs. 6, 7, and 8. All those in Fig. 6 are considered to be of the first grade, and were sold as such; those shown in (*a*) and (*b*), however, have a much better fibrous root system, are more vigorous, and in every way are more desirable than those shown in (*c*) and (*d*); this illustrates the fact that a personal selection of nursery plants is more desirable than buying on the grading of the nurseryman, even if a premium must be paid for the privilege of purchasing in this way. The red raspberry nursery plants in Fig. 7 are second-grade plants, and those in Fig. 8 are culls.

The scale in Figs. 6, 7, and 8 is graduated in inches in order more clearly to indicate the actual size of the nursery plants. The same scale is used in Figs. 23 and 29.

PLANTING OF RED RASPBERRIES

15. Red raspberries may be planted either in the fall or in the spring; spring planting is the more common. The distances at which red raspberries are planted vary considerably. Some growers prefer to plant them in rows 6 or 7 feet apart and to space the bushes from 4 to 6 feet apart in the rows. Other growers plant the bushes as close as 4 feet each way, cultivate them both ways of the field, and restrict the plants to a limited space. J. H. Hale claims to have secured the best yields by setting the plants in hills from 7 to 8 feet apart. The average commercial grower of red raspberries usually finds that setting the bushes in rows 6 feet apart and spacing the plants 3 feet apart in the rows to be satisfactory and that the crop will be larger than when planted at any of the other distances given. If the bushes begin to crowd too much when planted in this way, they may be thinned out somewhat in the rows, even to the extent of removing every other bush if necessary.

In preparing the ground for planting red raspberry bushes in rows of 6 feet apart and spaced 3 feet in the rows, straight furrows should be opened up in one direction across the field at distances of 6 feet apart and about 3 inches deep.

16. The small raspberry plants should be kept heeled-in near at hand, and when preparations for planting are complete a small bundle of the plants should be taken out of the ground at a time and the roots kept moist with a wet burlap sack. Often some pruning of the plant is necessary before it is set, and in such cases the pruning is done immediately before the plant is put in the ground. Any long, straggly roots should be trimmed back, and any broken roots that have ragged ends should be trimmed to a smooth surface, so that the cut will heal well. The cane should be cut back to a strong bud 12 to 15 inches from the crown. Most of the new growth should come from new buds at the crown of the root, and it is usual to cut out the old cane entirely the following spring after planting.

Two men should work together in planting red raspberries; one man should have a spade to open up the holes for the plants and the other should carry the plants, see to it that their roots are kept moist, prune them, and set them in the holes. When the rows are marked out by a shallow furrow, the setters can work rapidly. The one with the spade should sink that implement in the ground about 4 inches below the bottom of the furrow and press it to one side to make an opening for the plant; the other should set the plant in the hole in the center of the furrow, and both men should simultaneously push the soil against the cane from opposite sides and firm it. Then a little loose soil should be kicked over the firmed soil to form a mulch. Sometimes it is difficult to get a perfect alinement of the plants in the row, and the use of a line to set the plants against may facilitate matters. The getting of red raspberry plants into perfect alinement is not, however, very important for after the first year the canes spread out in a row 1 or more feet in width, and minor irregularities are not as noticeable as they would be with many other plants.

TILLAGE FOR RED RASPBERRIES

17. In an average humid climate, the tillage of a red raspberry plantation should begin as soon as possible in the spring and continue until midsummer, when a cover crop should be sown between the rows. Preferably such a cover crop should be one that will kill out during the winter, for then there will be no necessity for subduing it in the spring to the detriment of the raspberry bushes. Cover crops such as rye are not suitable, because they will live through the winter; cowpeas and similar crops will be more suitable. In dry climates it may be advisable to continue to cultivate throughout the entire season.

Plowing between the rows in a red raspberry plantation in the spring is not a good practice, as it injures the roots and induces the growth of too many suckers; this excessive wood growth will lessen the power of the bushes to produce an abundant crop of fruit. Spring plowing, moreover, is not necessary if the ground was properly tilled throughout the previous season.

Cross-cultivation, that is cultivation in two directions on a field, whenever possible, is particularly beneficial to a red raspberry plantation. This should be done as early as possible in the spring, and again after the fruit has been picked and the old canes cut out. Without such cross-cultivation it will be difficult to prevent a red raspberry plantation from quickly forming thick hedgerows. The cultivator used in a red raspberry plantation should be equipped with some form of cutting blades that will cut off suckers; such a device will save considerable work in pruning.

18. Unless a red raspberry plantation is well taken care of it will be better if it is not intercropped. If, however, the plantation is to be handled in a painstaking manner, intercropping may be practiced to advantage during the first season. Preferably, such a crop should be one that will allow of horse cultivation, so that the surface soil may be stirred 2 or 3 inches deep and the root growth of the raspberries kept well below the surface. A second crop of some small vegetable may also sometimes be satisfactorily grown between the rows in the late summer and fall.

PRUNING OF RED RASPBERRIES

19. In order to prune red raspberries properly it is important to understand that the canes of this plant are biennial—that is, live for two seasons only—but that the roots are perennial—that is, live through many years. The canes, or shoots, grow up from the roots one season, bear fruit the next season, and die at the end of the second season. Hence, on each raspberry bush, after it is 1 year old, will normally be found some canes that are bearing fruit, and others that are developing for the production of fruit the next year. The objects of pruning are to thin and train the young canes so that they will bear a large crop of good-sized berries, and to cut out the old canes after they have fruited in order to supply sufficient space for the growth of new canes.

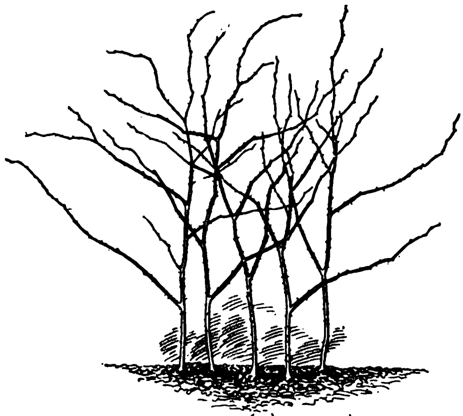
The first year after planting red raspberries, and during subsequent years, a certain amount of pruning of the young canes is essential and should be done systematically. The tendency of the plant is to grow more canes than are desirable for the production of fruit of good quality, and to produce the best results the extension of the plants must be restricted. The first year from four to five canes should be allowed to develop in each hill. The time and the method of pruning the young red raspberry canes varies with different growers and in different parts of the country. Some growers allow the young canes to grow at will during the first summer and cut them back the following winter or early in the spring; other growers advocate the pinching off of the terminal buds of the young canes in the summer, so as to force the growth of lateral, or side, branches before winter. In most cases, the best practice has been found to allow the young red raspberry canes to grow at will during their first summer and then early in the following spring, after there is no more danger that they will be winter killed, to cut back all the canes that are expected to fruit that season.

The second spring, the 1-year-old canes that were allowed to grow at will the first summer are cut back to a height of 3 or 4 feet, or in the case of low-growing varieties to a height of 2 feet. The fruiting canes that are cut back in this way in the spring will throw out a large number of strong side branches as soon as growth starts. These laterals will produce all the fruit that one cane should bear. This pruning should be delayed until there is no more danger that they will be winter killed.

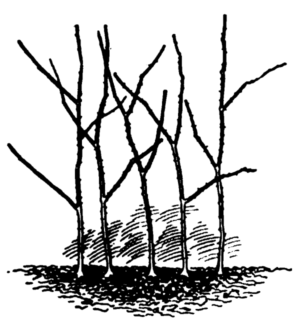
The commonly approved method of pruning a red raspberry bush is illustrated in Fig. 9. In (*a*) is shown a bush at the beginning of the second spring in which the canes have been allowed to grow at will; in (*b*) is shown the same bush properly cut back to a height of 3 or 4 feet; and in (*c*) is shown the same bush a little later in the spring after it has sent out the side branches that are to bear the fruit.

The younger canes that come up the second season should be thinned out to from five to seven in a hill. As soon as the fruit has been harvested from the canes developed the previous summer, these canes should be cut out, but in doing this care should be taken not to remove too many of the younger canes, along with the old ones, for this will have the same effect as an excessive thinning of the fruit and will lessen the possibility for a large crop the following season. The best practice is to remove the older canes as soon as they have finished fruiting, because: (1) the old canes can be cut easier at this time than in the winter, when they become toughened; (2) all subsequent growth during the summer will go into the canes that will bear fruit the following year; (3) it will allow of cross-cultivation and a good general cleaning up of the plantation, provided the bushes are planted far enough apart in the rows; and (4) the early removal of old canes, if they are at once taken out of the plantation and burned, may also help to check the spread of insect and fungous troubles.

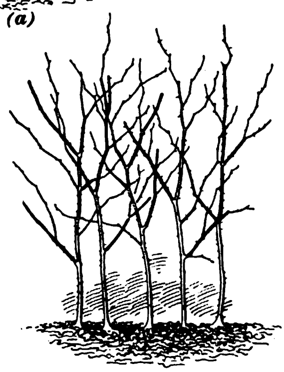
20. In cases when it is deemed advisable to prune young red raspberry canes during the summer, the tender tips are



(a)



(b)



(c)

FIG. 9

pinched off, when they reach a height of about 18 inches, by the thumb and finger. If the pinching off is done at this height it will allow the side branches produced by the lower buds to make a good growth early in the season and become as well ripened as possible before they are frozen in the winter. The most experienced growers, however, are now beginning to doubt the advisability of this summer pruning of the young red raspberry canes, because: (1) it seems to have a tendency to increase the number of suckers thrown up by the roots, and this excessive growth of wood lessens the ability of the bush to produce fruit; (2) the pinching out of the terminal buds of the young canes does not lead to the growth of strong, vigorous side branches from the lower buds but to the production of weak branches that are more or less liable to be winter killed; (3) preferably, the side branches that are forced into the production of wood early the first summer should remain dormant until the following spring, when they may be developed into good fruiting branches by the method of pruning previously described.

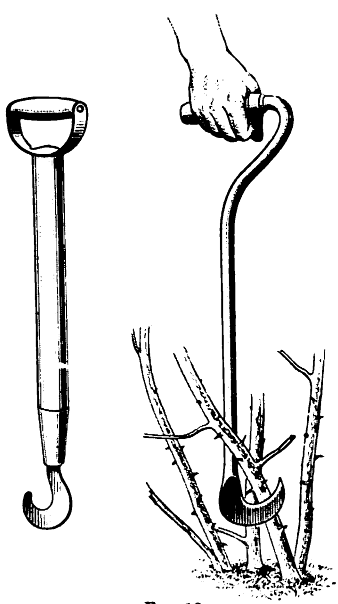


Fig. 10

In some exceptional cases, however, it may be more advisable to prune red raspberries in the summer than to prune them early in the spring before growth starts. For example, very rapdily growing varieties of red raspberries or red raspberries planted on very strong soil may need pruning in the summer; otherwise, most of the energies of the plant may go to wood production and the yield of fruit may not be abundant. Red raspberries, however, should not be pruned as much in the summer as black raspberries.

21. As a red-raspberry plantation grows older, unless it is carefully pruned, the spaces between the plants gradually become filled and the rows become nearly a solid hedge. To facilitate picking and cultivation and to keep up the vigor of the plants, too many canes should not be allowed to grow. The number that should be allowed to grow can be determined only by experience, as local conditions will greatly influence the growth of the bushes. The rows should be kept as narrow as possible, without pruning the plants too much, so that cultivation will be possible over most of the surface of the ground and so that hand hoeing in the rows will not be too difficult.

22. Implements for Pruning.—The canes of red raspberries, and of all brambles, are so well supplied with spines, or thorns, that, at the best, pruning them is unpleasant work, and the pruner should wear leather gloves and use tools that will facilitate the work as much as possible. Pruning hooks, two types of which are shown in Fig. 10, are the most useful tools for the pruning of brambles. They consist of a handle about 3 or 4 feet long with a hooked-knife blade at the end. They are strongly constructed and by means of them the bases of the canes can be readily reached and the canes sheared off with little difficulty. Hand pruning shears are also necessary for the pruning off of winter-killed wood and the trimming back of the canes in the spring.

FERTILIZATION OF RED RASPBERRIES

23. The economical fertilization of red raspberries is a problem that must be worked out on each plantation, because a wasteful application of fertilizers is just as likely to be made as an insufficient application. On some soils, such as those that have been well cultivated and fertilized for a number of years in the raising of other crops, the addition of nitrogen and other plant-foods does not produce a pronounced effect on red raspberries. Hence, the application of liberal quantities of fertilizer on such soils would be a waste of money.

Stable manure is a good fertilizer for raspberries in general, but when applied to red raspberries that are growing on moist, rich soil, it may force too much growth. Cover crops are valuable on red raspberry plantations because of the humus they add to the soil, and leguminous cover crops may furnish all the nitrogen needed for the growth of the bushes. Crimson clover, where it succeeds, is a good leguminous cover crop for raspberries, but it is somewhat difficult to uproot in the spring.

Floats, ground bone, and basic slag are good materials for supplying phosphoric acid to raspberries, and wood ashes and muriate of potash are suitable for supplying potash.

A newly set raspberry plantation should be fertilized to induce a vigorous wood growth early in the season. When land is being prepared for the setting out of a raspberry plantation, it should be heavily manured the fall previous, or should be heavily dressed with well-rotted manure in the spring. After the plants have started to grow, an application of from 500 to 800 pounds of a high-grade 5-8-8 commercial fertilizer should be made. Preferably most of the nitrogen in this fertilizer should be in a readily soluble form, such as nitrate of soda. This fertilizer should be applied broadcast and cultivated in. It should induce a strong, healthy growth of cane early enough in the season so that the wood will have plenty of time to ripen before winter.

24. Although red raspberries do not respond to fertilizers as much as many other fruits, an investigation by the Cornell Department of Pomology in Western New York in 1910 brought out the fact that the use of fertilizers, as well as manure, was profitable. In this investigation it was found that the most common practice of growers was to apply fertilizers in the form of stable manure or commercial mixtures before the plants were set out. After the plants had come into bearing some growers applied stable manure, others applied commercial fertilizers, and many applied no fertilizer at all. Table II gives a summary of the information gathered in this survey, and shows the number of farms, the total number of acres, the average yield per acre, and the average income per acre for the farms examined on which red raspberries were grown under four conditions: (1) On ground on which neither manure nor commercial fertilizer was applied; (2) on ground on which both manure and commercial fertilizer were used; (3) on ground on which only commercial fertilizer was applied; and (4) on ground on which only manure was used as a fertilizer. As this survey included an examination of eighty-three farms on which 98 acres of red raspberries were planted, the data may be considered as very useful.

On about 47 per cent. of the farms neither manure nor commercial fertilizer was applied and still the average income was $116.69 per acre, which indicates the possibilities of red raspberry culture even under adverse circumstances.

On about 15 per cent. of the farms both manure and commercial fertilizers were used, and on these farms an average income of $176.69 per acre was secured, or an increase in income of

TABLE II

INFLUENCE OF FERTILIZATION ON RED RASPBERRIES

Fertilizer Used	No. of Farms	No. of Acres	Average Yield Per Acre Quarts	Average Income Per Acre
No manure or commercial fertilizer	39	31	1,162.35	$116.69
Manure and commercial fertilizer	13	14	1,526.70	176.69
Commercial fertilizer only	10	30	1,439.00	142.85
Manure only	21	23	1,472.00	170.50

more than 51 per cent. over that from farms on which no fertilizer was used; no figures are available as to the cost of the manure and fertilizer applied per acre, but a reasonable estimate would not place the cost of these materials at more than half of the extra income secured.

On about 12 per cent. of the farms commercial fertilizer only was applied, and on these farms an average income of $142.85 per acre was secured, or an increase in income of about 22 per cent. as compared with the 51 per cent. increase secured by the application of both manure and commercial fertilizer; these two sets of figures, however, indicate very clearly that commercial fertilizer is beneficial on red raspberries, a fact that many have formerly been inclined to dispute.

On about 26 per cent. of the farms manure only was applied, and on these farms an average income of $170.50 per acre was secured, or an increase in income of about 47 per cent. as compared with the farms on which no manure nor commercial fertilizer was applied. This increase is only slightly less, about 4 per cent. less than that secured by the application of both manure and commercial fertilizer, showing that, when applied in connection with manure, commercial fertilizer is not particularly effective, and is not economical, because the small increase in income would not pay for the fertilizer.

RASPBERRY PESTS AND INJURIES

INSECT PESTS

25. Saw Fly.—The saw fly is one of the two insect pests that do the most damage to raspberries. It attacks the bushes about the time raspberries are in blossom and riddles the leaves with small holes. The work of the Saw Fly is shown in Fig. 11. The adult saw fly is about the size of the house fly and has a dull, reddish spot about the middle of the upper side of the abdomen. The adult fly punctures the leaf and lays its eggs in the tissues, the place of deposit appearing as a small brown spot. The eggs hatch in about a week. The larvas, which are small green false caterpillars about ½ inch long, do the most damage to the leaves. After about a month, or a little less, the larvas become full grown, fall to the ground, and spin small cocoons about themselves beneath the surface of the soil. There is only one brood during the year.

The saw fly may be controlled by spraying as described later. The application of white hellebore will kill the insects; a weak solution of Paris green or arsenate of lead is also effective. After the fruit is formed, however, it is not safe to use the last named poisons, and only hellebore should be used.

26. Cane Borer.—The cane borer is the other of the two insects that do the most damage to red raspberries. The adult is a long, slender, black beetle with a yellow thorax, small head, and long feelers. When the adult female lays her eggs she will girdle the tip of a cane in two places, from ½ inch to 1 inch apart, as shown at *a a* in Fig. 12. In the space between the two girdles she makes a small hole in the cane and lays a single, long, yellow egg in the cavity. The girdling causes the tip to die. It begins to droop shortly after the girdling and has the appearance of the canes shown in Fig. 13. The egg will hatch in a few days, and the larva, or young borer, that comes

Fig. 11

from it first lives on the pith of the dead tip and then bores down the center of the stem, eating the pith until it gets to the crown, taking two seasons in the process. About the latter part of August the larva becomes full grown but does not emerge from the cane until the second spring after the laying of the egg, when it changes into a pupa. The adult beetles may be found on the canes in June. Canes affected with borers seldom bear fruit because of their lessened vitality.

The only method of control is to cut out affected canes as soon as they begin to droop and wilt. An affected cane should be cut off at a point well below the girdle, so that there will be

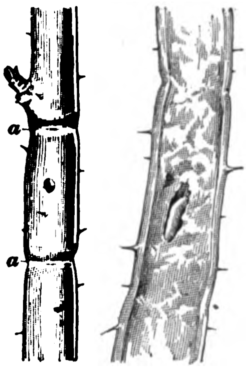


Fig. 12

Fig. 13

no danger of leaving the grub in the cane. The prunings from diseased canes should be taken from the plantation and burned.

FUNGOUS DISEASES

27. Five diseases are commonly found to be troublesome on raspberries, namely, *raspberry anthracnose; raspberry wilt,* or *cane blight; crown gall,* or *root knot; red rust,* or *orange rust;* and *leaf spot.*

28. Raspberry Anthracnose.—Raspberry anthracnose is one of the most troublesome of the diseases of raspberries. It will first be noted when the young canes are from 12 to 15 inches high and will be found in the form of brownish or purplish spots and blotches on the young canes and on the leaf stalks. As the young canes grow the blotches increase in size. By the end of the season these blotches may grow so much as entirely to encircle and girdle a cane. This disease is not very serious on the red raspberry. It is very severe on the black raspberry and is also found on the blackberry. Canes affected with raspberry anthracnose are shown in Fig. 14.

Spraying, as later described, will reduce the damage from anthracnose, but it is not entirely satisfactory and often will prove to be unprofitable. Preventive measures are the most desirable, and only plants that are free from anthracnose should ever be set. If all the old canes, as soon as they have borne fruit, and the new ones that are badly affected are cut out and burned, the disease may often be kept in check. If, however, the disease appears to be persistent, the plantation should be abandoned before it has become badly diseased. All the canes should be cut off and burned and the roots plowed under as deeply as possible.

FIG. 14

29. Raspberry Wilt, or Cane Blight.—Raspberry wilt, or cane blight, is caused by a fungus that attacks the canes at various points and kills both the bark and the wood. The part of the cane above the point of attack will suddenly wilt as shown in Fig. 15. This illustration clearly shows the difference in the appearance of the leaves on healthy and affected shoots. The disease is one of the most destructive on red and black raspberries, but is not found on blackberries.

No definite methods of control for this disease are known, except that of eradication and the planting of uninfected plants. Plants for a new plantation should be taken only from patches where the disease is not prevalent. The cutting out of the old canes as soon as the fruit is harvested will help to keep this trouble in check.

30. Crown Gall, or Root Knot.—Crown gall, or root knot, is caused by a fungus that induces the growth of large irregular knots about the crown and on the roots. In Fig. 16

is shown a red raspberry bush badly infected with crown gall. This disease is found on both red and black raspberries, but

Fig. 15

is especially destructive on red raspberries; it is also found on blackberries.

Precautionary measures are the only ones that are effective against crown gall. Brambles should never be planted on land that has been previously infected with the disease, and no plants showing crown galls or root knots should ever be set. Crown

FIG. 16

gall is readily communicated, and for this reason no apparently healthy plant from a diseased plantation should ever be planted in another.

31. Red Rust, or Orange Rust.—Red rust, or orange rust, or, as sometimes called *yellows*, is a fungous disease that is so serious in some sections of the country as to make the growing of raspberries and blackberries impractical, and in other sections it is not found at all. A raspberry leaf affected with this disease is shown in Fig. 17. This is particularly destructive on the black raspberry and blackberry; whole plantations of black raspberries have been destroyed by red rust.

The only effective method of control for red rust is to pull up and burn all infected plants as soon as the disease is detected.

32. Leaf Spot.—Leaf spot is caused by a fungus, the spores of which are spread by wind and rain. This disease first appears as small brownish spots on the leaves. Later these spots become lighter at the center and small black lumps

Fig. 17

will be found in them. A leaf infected with leaf spot is shown in Fig. 18. This disease is found on both raspberries and blackberries.

Leaf spot may be controlled by spraying with Bordeaux mixture as described later.

33. Control of Fungous Injuries.—Spraying is not often practiced on raspberries, because the diseases and insects that trouble them are largely controlled by cutting out diseased and old canes. In fact, the spraying of these plants

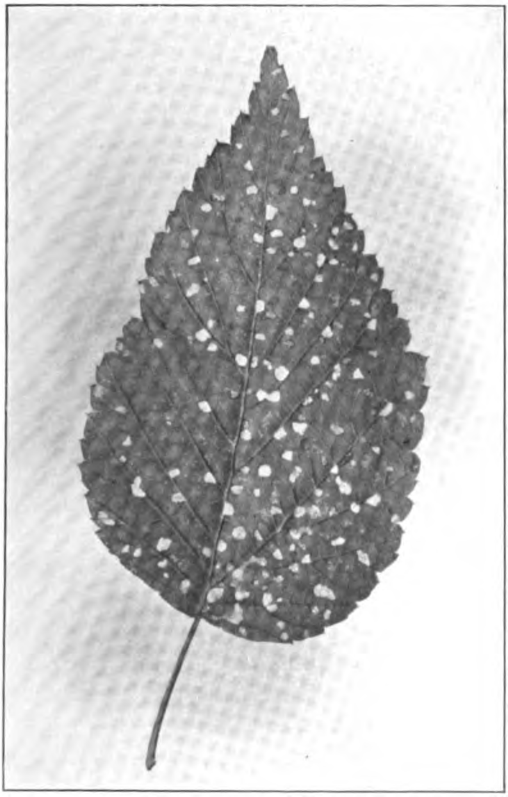


FIG. 18

is largely a matter of economy. A certain amount of damage may be prevented by spraying, but it will usually be the case that the cost of applying the spray will be more than the benefit secured. For this reason, few commercial growers spray but prefer to run the chances of a small loss to avoid the expense and trouble of spraying.

WINTER INJURIES

34. To prevent the winter killing of red raspberry bushes in localities where the winters are severe, some form of protection must be provided. The most satisfactory method of protection is to loosen the soil on one side of the roots, bend the top of the bush over until it touches the ground, and cover it with soil. The canes are usually bent over in the direction of the row so that the tips of one plant will be over the crown of the next. The point of the compass toward which the tops are bent makes little difference, but if there is a preference they should be turned toward the south. The canes should be lifted early in the spring, and the soil firmed about the roots on the loosened side to help support the canes. In a locality where snow is abundant, this method of treatment is particularly effective in preventing winter killing.

HARVESTING AND MARKETING OF RED RASPBERRIES

35. The fruiting season of the red raspberry in the latitude of New York is from the early to the middle part of July, following the picking of late strawberries, and often a part or all of the strawberry pickers can be used in the raspberry patch to advantage. The red raspberry should not be picked until it parts readily from the plant and it should be picked shortly after this stage is reached, because it soon gets so ripe that an unusual jarring of the canes or a heavy rain, such as are of frequent occurrence at that season of the year, will knock many of the berries from the canes. The fruit should not be picked wet, because this injures its shipping qualities.

Red raspberries require much care in picking and subsequent handling. Girls and women are often the best pickers in the raspberry patch, not so much because their fingers are nimble and quick, but because they will naturally handle the berries lightly and so prevent bruising. A picker with the customary equipment is shown in Fig. 19. The raspberry is hollow and will not stand much pressure without practically spoiling it for the fancy trade. This is one of the reasons that the fruit is nearly always sold in shallow pint veneer baskets made so that they will pack into the regular strawberry crates. Pickers are usually paid $1\frac{1}{2}$ cents a pint for picking raspberries, the cost being about $\frac{1}{2}$ cent more than for the picking of strawberries.

The picking of the fruit should be so carefully done that it will not need to be graded or handled again to prepare it for market. This is more important in the case of raspberries

FIG. 19

than in the case of almost any other fruit, because of its delicate nature. For the same reason a fruit grower who can sell his red raspberries in a local market has a considerably greater advantage over those who must ship by rail. The red raspberries that are taken to market on a spring wagon will arrive there in better condition, bring more money, and give greater satisfaction than the berries that must be shipped by rail.

The market price of red raspberries varies from 20 to 25 cents a pint early in the season to 7 or 8 cents a pint when the market is well supplied.

36. Drying of Red Raspberries.—Red raspberries are sometimes dried in the same way that black raspberries are dried, but such a practice is not profitable. Red raspberries lose too much weight on being dried because 1 quart of fresh red raspberries will make only about 14 ounces of dried fruit. This means a production of but from 7 to 8 pounds of dried fruit per bushel. In addition to the excessive loss of weight, the red raspberry when dried, is of an unattractive dull-red color and is not popular in the market.

BLACK RASPBERRIES

GENERAL DISCUSSION

37. Black raspberries are native to the northern sections of the United States and thrive under conditions like those suited to the red raspberries. The black raspberry has been considerably improved under cultivation, the size and quality of the berries being increased and the bushes yielding larger crops. The **black cap,** as the black raspberry is often called, is more important commercially than the red raspberry, although it commonly sells at a lower price.

The black raspberry is gaining in popularity in many sections for several reasons: It is a heavier yielder than the red raspberry, can be sold at a good profit for a considerably smaller price per quart, and some varieties have a very pleasant flavor. These points make it desirable for selling as a dessert fruit, but the one point that recommends it particularly to growers in some sections is the fact that it can be dried and any surplus fruit thus kept from being wasted. The demand for dried black raspberries is steadily increasing, and in some sections the fruit is grown for that purpose alone.

There are some objections to the black raspberry, the principal one being that the fruit is more seedy and smaller than that of the red raspberry. In some sections this has made it less in demand than the red raspberry.

The black raspberry is hardy and can be grown fairly far north. It does not, however, have as wide a range as the native red raspberries of Canada. It can be planted almost anywhere in the United States without danger of serious injury from low temperatures in winter. Like the red raspberry, about half a crop of fruit can reasonably be expected from a black raspberry plantation the second year. After this about four good crops on the average can be secured. At the end of this time the problem of keeping down weeds and of securing a growth of cane that will be vigorous enough to produce large berries becomes a serious one, and it is often more profitable to plant a new plantation after the first one is 6 or 7 years old than it is to struggle along with an old one.

38. The soil requirements for the black raspberry are similar to those for the red raspberry. The black raspberry, however, does not seem to be so particular as to soil as the red raspberry, but it seems equally at home on any well-drained sandy loam or clay soil; heavy, compact, cold soils are not suitable. The general impression is that if the black raspberry shows any preference at all it is for soils that are rather light and warm, but Professor Wilson's investigations on the red raspberry in Western New York, as set forth in Table I, would seem to indicate that the black raspberry, like the red raspberry, might be found to be more productive on the heavier soils.

VARIETIES OF BLACK RASPBERRIES

39. In the selection of varieties of black raspberries suitable to a location, the fact should be borne in mind that this fruit is not as hardy as the red raspberry, and for this reason none of the black raspberries will do well as far north as the red raspberries. Hence, the term hardy, as used in the descriptions of the varieties of black raspberries must be considered as a relative one. The following list of black raspberries includes the varieties most commonly planted:

The **Cumberland** black raspberry, shown in Fig. 20, has a strong-growing bush and is one of the hardiest and most productive varieties. The fruit is large, black, sweet, and of good flavor. It ripens a little earlier than mid-season. This variety is highly considered on account of its hardiness.

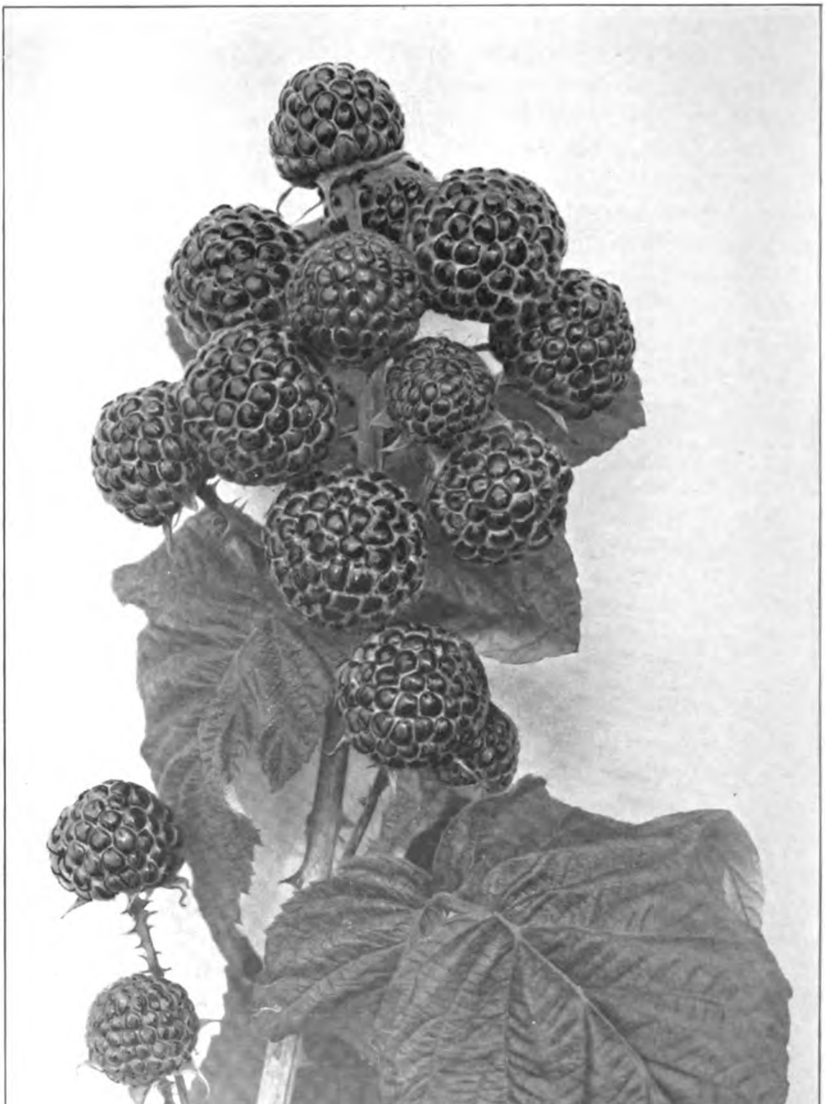


Fig. 20

The **Gregg** black raspberry, shown in Fig. 21, has a very strong-growing bush; it is not hardy in all localities but is productive when not winter killed. The fruit is large to very large, is black with a gray bloom, is moderately juicy, sweet, and of good quality. The fruit ripens late in the season. This variety is one of the most widely planted of the black raspberries.

The **Kansas** black raspberry has a moderately growing bush; it is not hardy very far north, but is promising where hardy. The fruit is above the average in size, is glossy black, and of good quality. The fruit ripens in mid-season.

The **Black Diamond** black raspberry has a vigorous-growing bush that is resistant to disease and very productive. The fruit is large, black, and a good shipper. It ripens in mid-season, and a few days later than the Kansas variety.

The **Ohio** black raspberry has a strong-growing bush; it is productive but is not as hardy as the Cumberland. The fruit is of medium size, but is very seedy, and for this reason is particularly desirable for drying, because it will yield a high percentage of dried fruit to the bushel. The fruit ripens in mid-season. This variety is not planted as much now as formerly.

The **Palmer** black raspberry has a strong-growing bush that is not always hardy but is usually moderately productive. The fruit is of medium size, black, juicy, sweet, and of good quality, and ripens early. This variety is probably the best of the early varieties in localities where it is not winter killed.

SELECTION OF VARIETIES SUITABLE TO A LOCATION

40. According to information compiled by the American Pomological Society, varieties of black raspberries, like varieties of other fruits, vary widely in their adaptability to different sections of the country. Some varieties of black raspberries have been found to succeed well in many different parts of the country, though with varying degrees of success in different sections, and other varieties have been found to do well in a certain few sections only. In the following list, the varieties are classified in the same divisions as red raspberries, the numbers

Fig. 21

of the divisions corresponding with those given on the map in Fig. 5. The varieties given in each division are known to do well in that district. The varieties given in Italic are known to be highly successful in the divisions in which they occur. The first time the name of a variety is given its less common name is put after it in parenthesis. Where a division heading is omitted (Divisions 6, 11, 13, 16, and 17), no varieties of black raspberries are known to do well in that division. Some of the varieties included in the list will not be found described in detail in the description of varieties. Such varieties are considered not to be entirely desirable from a commercial standpoint. The other remarks given under red raspberries apply with equal force to black raspberries.

Division 1: Doolittle (Doolittle's Black Cap), Earhart, *Gregg*, Hilborn, Lotta, McCormick (Mammoth Cluster), Ohio, Older, Palmer, Souhegan, Tyler.

Division 2: Conrath, Cumberland, Eureka (Mohler), *Gregg*, Hilborn, *Kansas*, Lotta, Mills, Nemaha, Ohio, Older, Palmer, Souhegan, Tyler.

Division 3: Cumberland, Gregg, Kansas, Palmer, Souhegan, Tyler.

Division 4: Cumberland, Eureka, *Gregg*, *Kansas*, McCormick, Nemaha, Ohio, Palmer.

Division 5: Conrath, Cumberland, Gregg.

Division 7: Doolittle.

Division 8: Doolittle, *Kansas*.

Division 9: Conrath, Cumberland, *Eureka*, *Gregg*, *Kansas*, Lotta, *Nemaha*, *Ohio*, *Older*, *Palmer*, Souhegan.

Division 10: Cumberland, Eureka, *Gregg*, *Kansas*, Tyler.

Division 12: *Gregg*, *Kansas*, McCormick, Nemaha, Ohio, Palmer, Souhegan, Tyler.

Division 14: *Gregg*, *Kansas*, Ohio.

Division 15: Cumberland, Gregg.

Division 18: Gregg.

After a canvass of forty-two commission men in the principal markets of the country, Professor Wilson found the most popular black raspberries to be: Gregg, Cumberland, Kansas, Tyler, Palmer, Ohio, and Black Diamond.

PROPAGATION OF BLACK RASPBERRIES

41. The black raspberry is propagated by tip layering. This is done by covering with soil the tips of the canes that droop close to the ground, as shown in Fig. 22. Those held firmly in place in the soil will readily take root. Soon after a tip has begun to send out roots, a crown composed of buds will form at the surface of the ground and a new cane will grow up from this. When the tip is well rooted, it is severed from the parent cane and the new plant is ready to be moved. Tip layers with part of the old cane attached are shown in Fig. 23; the piece of old cane serves as a handle for carrying the plant. The

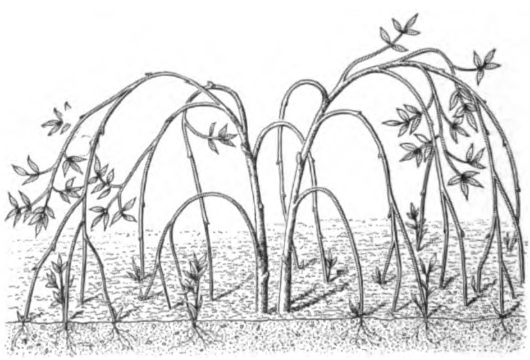


FIG. 22

crown bud is shown at the top of the thick mat of roots. From this crown bud the new cane of the new plant will be developed.

In the latitude of New York the time for tip layering black raspberry plants will be about the middle of August or a little later. Under favorable conditions, these tip layers will be ready for severing from the parent plant about October 1, but if so desired can be allowed to remain attached to the parent plant until the following spring.

Black raspberry canes are allowed to make sufficient growth during the summer to bend over and nearly touch the soil. The tips are then covered with about 2 or 3 inches of soil; care should be taken not to bury the tips too deep and also to secure them firmly in place. In a state of nature the black raspberry tip takes root readily if it no more than touches the soil, but in commercial propagation tips are secured so that they will not be blown about by the winds. Some growers recommend pinning the tip down by means of a wooden stake or a small rock. This practice might do on a small scale, but it is not feasible on a large commercial plantation.

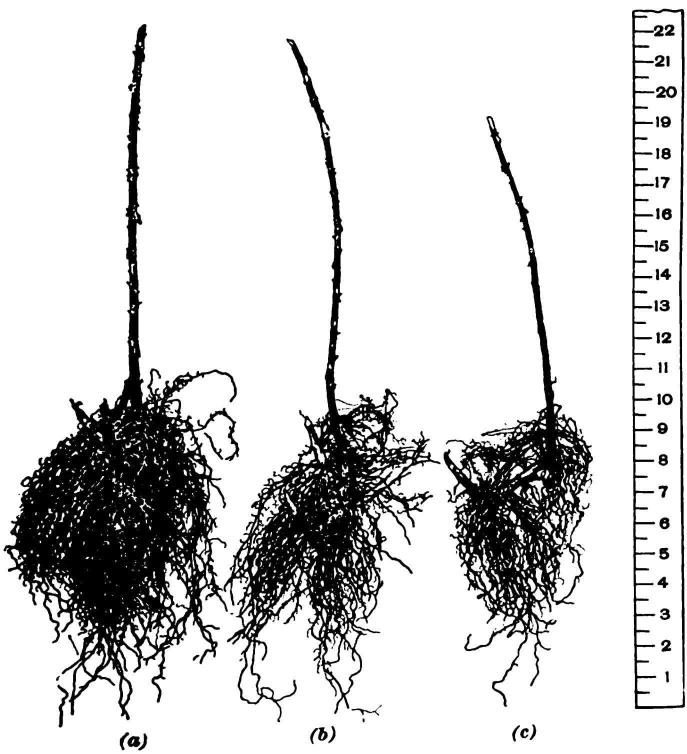


FIG. 23

Types of black raspberry nursery plants are shown in Fig. 23. In (*a*) is shown a type of plant desirable on account of the abundant root system. The plants shown in (*b*) and (*c*) are good plants but do not have as abundant root systems and hence are not as desirable as the one shown in (*a*). The scale in Fig. 23 is the same as that used in Figs. 6, 7, and 8.

PLANTING OF BLACK RASPBERRIES

42. On account of their spreading habit of growth, black raspberries should be planted in rows somewhat farther apart than red raspberries. Black raspberries should be planted in rows 7 feet apart, although the plants may be spaced $2\frac{1}{2}$ feet apart in the rows. Preferably, they should be planted in the spring.

The method of planting black raspberries should also have careful attention. The crown bud of a black raspberry tip layer should not be covered with too much soil or it will very likely be smothered. A depth of soil of less than 2 inches over the crown bud is all that is necessary. The proper depth

FIG. 24

of planting is shown in Fig. 24. The part of the old cane attached to the tip layer serves as a handle to use in planting and may be clipped off after the tip layer is set in place.

43. Supports for Black Raspberries.—Supports for black raspberry bushes are sometimes advisable, in order to keep the bushes within bounds and facilitate cultivation; red raspberries may also be supported if necessary. Such supports may be made by setting strong posts from 16 to 20 feet apart in the rows and extending about 5 feet above the ground.

One or two wires should be strung on both sides of these posts, and if two wires are used on each side they should be about 1 foot apart. The canes are then trained to grow between these wires. Training the canes in this way makes cultivation and picking more convenient than they would otherwise be. This training is not essential, however.

TILLAGE, PRUNING, AND FERTILIZATION OF BLACK RASPBERRIES

44. Tillage.—Frequent and deep tillage is needed to keep the black raspberry in a thriving condition, as it is likely to suffer from drought, especially in soils that are inclined to be dry.

45. Pruning.—The habit of growth of the black raspberry is similar to that of the red raspberry, inasmuch as its wood is also biennial and its new canes grow up from the roots. The growth of the black raspberry differs from the red raspberry, however, in that the new canes do not come from suckers, or stolons, but from the crown, or base, of the bush, since the black raspberry is essentially a hill, or stool, plant. For this reason new plants are not secured by digging up young sprouts, or new canes, with roots attached, as is the case with the red raspberry, but by allowing the tips of the new branches to come in contact with the ground, where they will take root.

Systematic pruning is as important for the black as for the red raspberry. To secure the best results, the black raspberry should be pruned both in the summer and in the winter, or early in the spring, as follows:

1. The pruning of the black raspberry in the summer is necessary to make the canes stocky and upright (naturally they are slender and drooping), and to stimulate the formation of a large number of well-formed side branches on each new cane during its first season of growth. When properly done, this will put the bush in the best condition for bearing a good crop of fruit the following summer.

As soon as the young canes reach a height of about 18 inches

PLANTING OF BLACK RASPBER...

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FIG. 25

...tened a trifle more, so that after all the side branches ...en pruned, each cane with its side branches will appear ...y cone shaped, as shown in Fig. 25 (*c*).

...laterals ... branches, that have taken root at their ...should ...ust above the point where they are ...ed ... new plants secured in this way may their tender tips should be pinched off at *a* in Fig. 25 (*a*) with the thumb and finger. When this is done early in the summer, the side branches produced from the buds lower down on the cane will make a growth of several feet before fall and will appear as shown in (*b*). Black raspberry canes should never be allowed to grow too high before their tips are pinched off, because the side branches will then be produced from the weaker buds lower down on the cane and will not be so desirable. Hence, to make sure that all of the new canes will be pinched back at the right height, the rows must be gone over several times a season.

As soon as the side branches grow long enough to touch the ground they should be trained along the rows where they will not be injured by cultivation and where they may take root for the production of new plants.

Some growers advocate clipping off the tips of the side branches after these laterals have grown to a length of from 12 to 15 inches, in order to force them in their turn to send out side branches, and thus greatly increase the fruit-bearing surface of the bush for the following year. Although it may seem good in theory, little or no advantage is gained by this practice. The excessive pruning adds additional expense to the cost of production and stimulates the production of a multitude of small, poorly developed laterals, many of which will likely be killed by low temperatures during the winter.

2. The winter or early spring pruning of the black raspberry is done to get the plantation in shape for the convenient picking of the crop and to hinder the spread of harmful diseases and insects. All canes that bore fruit the previous season and all diseased canes should be cut off close to the ground, taken out of the plantation, and burned; in some black raspberry plantations, as soon as the crop has been picked the canes that bore the fruit are pruned out, in order that all later growth may go into the younger canes; this practice has its advantages. At all events, when the bushes are pruned in the spring, nothing should be left in the rows but strong, well-developed 1-year-old canes and from three to five such canes to a hill are sufficient.

The 1-year-old canes that are to be left in the rows will also require some pruning. If they were properly pruned the previous summer, these canes will be well branched and will resemble small trees. The lower laterals on these canes should be cut off to a length of 12 to 18 inches, according to the apparent vigor of the individual cane, and each side branch above should

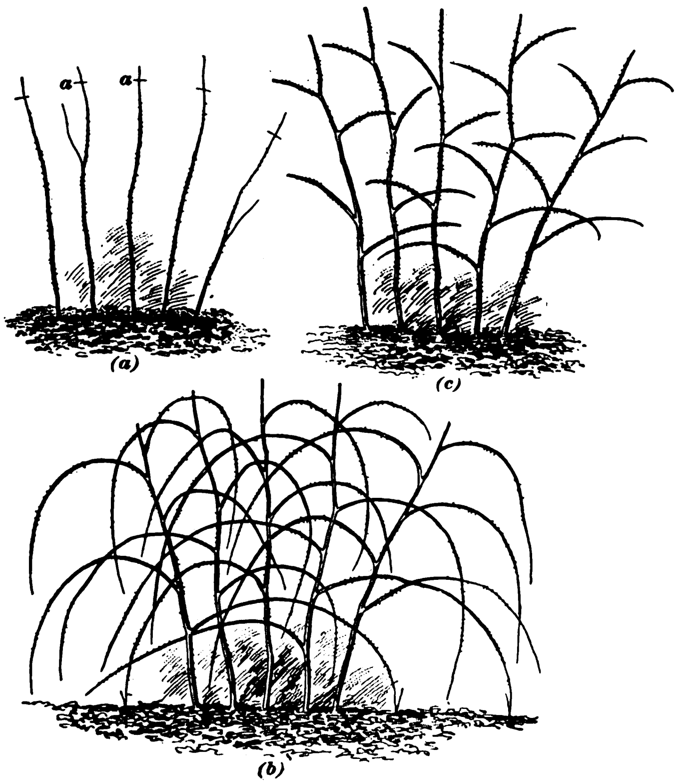


Fig. 25

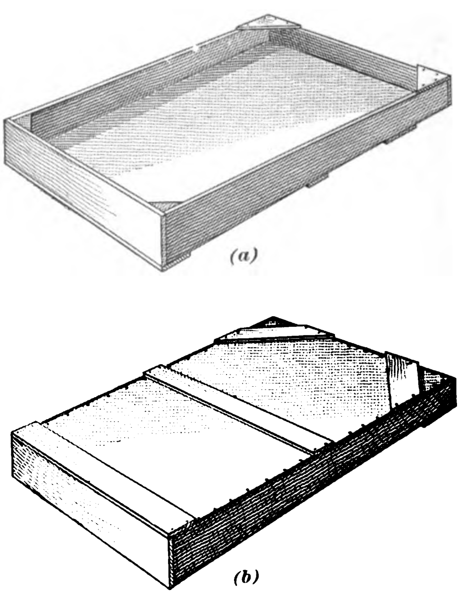
be shortened a trifle more, so that after all the side branches have been pruned, each cane with its side branches will appear roughly cone shaped, as shown in Fig. 25 (*c*).

The laterals, or side branches, that have taken root at their tips should be cut off just above the point where they are attached to the soil. The new plants secured in this way may be allowed to remain where they are to take the place of an old bush that may need to be cut out or they may be dug up and transplanted.

46. Fertilization.—As soon as black raspberry plants are put in the ground they should be liberally dressed with manure. The first season it is important to induce an early, strong, and rapid wood growth, and to get this plenty of plant-food and moisture is needed. The directions given for the fertilization of red raspberries will also apply to black raspberries.

HARVESTING AND MARKETING OF BLACK RASPBERRIES

47. Black raspberries may be picked, and are packed, and marketed in the same way as red raspberries. The market demand for black raspberries is less than that for red raspberries, and the price will not average so high. The use of the black raspberry should be more general and in time probably will be. It is particularly desirable for canning and drying and such industries are springing up in certain localities that are well adapted to small-fruit culture.



(a)

(b)

Fig. 26

Black raspberries are sometimes picked by hand but this is not often the case, because the work can be done much more rapidly with berry harvesters. With one of these implements a single picker can harvest from 8 to 10 bushels per day. A common type of berry harvester is shown in Fig. 26. A front view of the harvester is shown in (*a*) and a rear view in (*b*); it consists merely of a light wooden frame lined with cloth or canvas of some kind, making a sort of large tray. The berry harvester is shown in use in Fig. 27. The operator holds it close to the bush and by striking the canes with a stout stick jars the fruit

Fig. 27

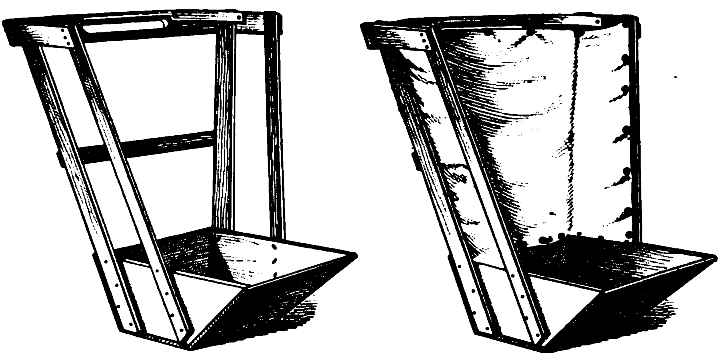
off into the harvester. An improved type of harvester and one that will hold more berries is shown in Fig. 28. In (*a*) is shown a view of the frame of the harvester; in (*b*) is shown a view of the harvester covered with cloth and ready to be used.

Fresh black raspberries are marketed in 1-quart baskets packed in a strawberry crate. Dried black raspberries are marketed in boxes holding 50 pounds and in barrels holding 125 pounds. None but packages that are put up to prevent the entrance of insects should be used for packing this fruit.

48. Yields and Profits.—An average yield of black raspberries is about 2,500 quarts, or 80 bushels, per acre. A high yield would be 9,600 quarts, or 300 bushels, of fresh fruit.

The yield of dried fruit varies somewhat according to the time of the season when the fruit is picked. Four quarts of early fruit is estimated to yield about 1 pound of dried fruit; 2 quarts of later fruit is estimated to yield 1 pound of dried fruit. On an average, it is safe to estimate that 1 bushel of fresh fruit will yield 10 pounds of dried fruit.

Ohio is the best variety of black raspberry for drying; Gregg is the next best.



(a) (b)

FIG. 28

The profits that may be expected from dried black raspberries may be estimated by taking as a basis a yield of 750 pounds of dried fruit per acre and a selling price of from 15 to 20 cents per pound. This will produce a gross revenue of from about \$112 to \$150, and from this must be deducted the cost of harvesting and marketing, which has been estimated by Card to be about as follows:

Harvesting, 2,500 quarts, $\frac{1}{2}$ cent per quart	\$12.50
Evaporating, $2\frac{1}{2}$ cents per pound	18.75
Cleaning, 1 cent per pound	7.50
Marketing, 1 cent per pound	7.50
	\$46.25

This will leave a gross profit of from about $65 to $104 per acre, and the net profit will be found by deducting from this the rent of the land, the interest on the money invested in tools and machinery, the labor cost, etc.

The net profits from fresh black raspberries sold at the average price of 6 cents per quart will be about the same as that given for dried black raspberries.

49. Evaporation of Black Raspberries.—The average grower who produces black raspberries for evaporation expects to secure about 10 pounds of dried fruit to the bushel. This quantity will vary considerably, however, according to the season and the variety. In a wet season as much as 4 quarts of fresh fruit may be required to make 1 pound of dried fruit and at the end of a dry season only 2 quarts of fresh fruit may be required to make 1 pound of dried fruit. As previously mentioned, the Ohio variety, due largely to its large proportion of seeds, is considered to be one of the heaviest yielders of dried fruit per bushel; it is, however, one of the poorest berries in quality. Other varieties that are grown largely for evaporation are Gregg and Shaffer, and both are better berries than the Ohio.

Dry weather does not so seriously diminish the crop of the man who is growing black raspberries for evaporation as it does of the man who is growing the fruit for the dessert trade. Of course, if the drought exists throughout the entire season, the yields of all will be materially lessened, but although the producer who sells his fruit as fresh fruit will find his yield materially lessened by a short dry spell just prior to ripening time, the grower who grows for drying will not suffer this disadvantage. Dry weather at this time will reduce the number of quarts he gets per acre much more than it will the number of pounds of dried fruit he will obtain. For this reason the grower who is growing black raspberries for evaporation purposes, if he cultivates thoroughly throughout the season, will find that he is particularly independent of the rainfall, except in exceptionally bad seasons.

PURPLE-CANE RASPBERRIES

50. Purple-cane raspberries are intermediate between the black and the red raspberries. The purple-cane raspberry is a new berry commercially, and few growers are producing

FIG. 29

it as yet, but those who do produce it usually have much larger patches than those growing other kinds.

The purple-cane raspberry has certain advantages. It is hardy, easy to grow, has a strong cane growth, yields well, and is fairly resistant to diseases. These advantages, however, are somewhat counterbalanced by the fact that the berries do not bring a good price on the market as fresh fruit. They are good in quality but their dull, purplish color is not attractive.

The purple-cane raspberries are sold mostly to canning factories, and make an excellent substitute for red raspberries, from which they can scarcely be told after canning.

51. The purple-cane raspberry very closely resembles the black raspberry in its manner of growth. The bush, however, grows larger and more vigorously, and for this reason the plants are usually set farther apart than recommended for the black raspberry. It has been found that planting purple-cane raspberries in rows 7 feet apart and the plants spaced 3 feet apart in the rows gives the best results. The next most satisfactory distance for planting is to have the rows 6 feet apart and the plants spaced 3 feet apart in the rows.

52. Purple-cane raspberries are propagated from tips in the same way that black raspberries are propagated. Specimens of the purple-cane raspberry nursery plants are shown in Fig. 29. The plants shown in (*a*) and (*b*) are preferable to the one shown in (*c*) because of their better root development. The scale in Fig. 29 is the same as that used in Figs. 6, 7, 8, and 23.

53. The two varieties that are usually planted are the Shaffer and the Columbian.

The **Shaffer** purple-cane raspberry has a very strong-growing bush, that is fairly hardy and very productive when the canes are not winter killed. The fruit is large, dark-purplish red, juicy, and of fair quality, but softer than that of the Columbian. The fruit ripens in mid-season and later. Although this variety is not attractive for market, it is excellent for canning.

The **Columbian** purple-cane raspberry has a strong-growing bush that is also very productive when the canes are not injured during the winter. The fruit is large, dark-purplish red, firm, juicy, and of good quality. The fruit ripens late.

54. The following list of varieties of purple-cane raspberries are classified in divisions by the American Pomological

Society in the same way that the varieties of red and black raspberries previously described were classified. The numbers of the divisions correspond with those given on the map in Fig. 5. The varieties of purple-cane raspberries given in each division are known to do well in that district; the varieties given in Italic are known to be highly successful in the divisions in which they occur. Where a division is omitted, no varieties of purple-cane raspberries are known to do well in that division. The other remarks given under red raspberries apply with equal force to purple-cane raspberries.

Division 1: *Columbian, Shaffer.*
Division 2: *Columbian, Shaffer.*
Division 3: Shaffer.
Division 4: Columbian, Shaffer.
Division 5: Columbian.
Division 7: Columbian.
Division 8: Columbian, *Shaffer.*
Division 9: *Columbian, Shaffer.*
Division 10: Columbian.
Division 12: Columbian, Shaffer.
Division 15: Shaffer.

55. Purple-cane raspberries sell for much less than the fruit of either the black or the red varieties. On an average the growers receive about 6 or 7 cents per quart.

The cost of black raspberry plants for planting is about $6 per thousand.

BLACKBERRIES AND DEW-BERRIES

BLACKBERRIES

GENERAL DISCUSSION

1. The **blackberry** is a commercial fruit only in America, where it ranks in importance with the raspberry, and it is probably more extensively cultivated than the raspberry, because it will stand more neglect and yet yield fair-sized crops. The blackberry is a native of the Eastern States, and all varieties have been developed from the native wild plants.

The blackberry is a somewhat neglected fruit, not being grown on as extensive a scale commercially as its value would seem to warrant. Under proper culture, larger yields may be secured from the blackberry than from any of the other bush fruits. The blackberry sells well in the market, especially when properly ripened, but unfortunately it is often picked too soon.

The three main difficulties that confront the blackberry grower are: (1) The low prices the fruit brings when the peach crop is heavy, (2) the susceptibility of the bushes to being winter killed, and (3) the susceptibility of the bushes to drought, which often results in a greatly decreased yield.

The states in which the blackberry is most extensively grown are Illinois, Michigan, Indiana, Mississippi, Ohio, California, New Jersey, and New York. According to the census of 1910, 55,343,570 quarts of blackberries and dewberries, valued at $3,909,831, were produced in the United States in 1909.

The blackberry thrives particularly well in the Northwest and in adjacent parts of British Columbia, but even in this section some localities are better adapted to blackberry culture than others. C. I. Lewis claims that the blackberry seems to thrive much better west of the Cascades than it does east of these mountains, due in some degree no doubt to the more abundant rainfall in the former locality.

In some parts of the country the blackberry has bigger commercial possibilities than is commonly supposed. In the Northwest, it is reported that there are canneries that could each handle the fruit from more than 500 acres of blackberries but that are unable to secure even a small part of this quantity. No doubt similar conditions exist in many other parts of the country.

2. A partial crop may be expected from a blackberry plantation the next season after planting, but the plantation will not be in full bearing until the third season after planting. If diseases are kept down, a blackberry plantation will continue to bear for a long time, but it will bear best when from 3 to 5 years old, and profitable crops are not expected after from five to seven crops have been harvested. The best practice is to renew commercial plantations every 8 to 10 years.

3. When conditions are favorable, the blackberry is the best yielder among the brambles and many big yields are on record; but as the blackberry is sensitive to winter injury and, just before the filling out of the fruit, to dry weather, the crop is very uncertain in some localities and the yields secured are much less than those from the other bush fruits. Professor L. H. Bailey estimates an average yield of blackberries at from 50 to 100 bushels, or from 1,600 to 3,200 pounds, per acre, but good growers in favorable localities seem to have little difficulty in securing yields of over 3,000 quarts, or about 100 bushels per acre. A high yield for blackberries would be about 10,000 quarts per acre.

The cost of production of a crop of blackberries after a plantation has once been brought to bearing age may be estimated as follows:

Fertilizers	$ 20.00
Cultivation and hoeing	10.00
Pruning	5.00
Cutting out old canes	5.00
Incidentals	10.00
Picking, 3,000 quarts, 1¼ cents per quart	37.50
Packages, 1 cent per quart	30.00
Packing and selling, 1 cent per quart	30.00
Total	$147.50

With an average selling price of 9 cents per quart, a gross income of $270 per acre may be expected from an average crop. The average blackberry grower will figure that with a cost of 3¼ cents or a little more per quart for picking, packing, and marketing he should secure a net income of about 5 cents per quart. Deducting $50 from this for the cost of production up to the marketing stage will leave a profit of about $100 per acre on a 3,000-quart crop. Under careful management such a profit may be secured with fair certainty. One grower is reported as having secured a gross income of $500 from the fruit of ½ acre.

4. A northern slope will give the exposure most desirable for blackberries, as in such a location they will be less liable to be winter killed or injured by late spring frosts. In the cold parts of the country blackberries do well in locations where they are protected by a good coat of snow during the winter, but do not do so well where they are not well protected during cold weather.

In localities where a plantation is exposed to strong winds, and especially if such winds blow steadily, windbreaks are desirable.

5. The blackberry thrives in moist soils that are well filled with humus, but it does best on medium to heavy loams that are well drained. In fact, the blackberry does well on a great variety of soils that are well drained. The blackberry is naturally a strong, vigorous grower and for this reason should not be planted on a soil that is too strong, that is, that contains too much humus and nitrogen, because on such a soil the bushes will tend to make a rank growth and the yield of fruit will not be as large as it would be under more favorable conditions. Small crops of fruit, however, are likely to be secured when blackberries are planted on a light sandy soil, because such a soil is likely to be very deficient in moisture during dry weather and there will not be enough moisture to mature all the fruit that is set.

As a matter of fact, both types of soil have their advantages and disadvantages. Winter killing is less frequent on heavy soils, but sandy soils are often preferred because the bushes will heave less in them than in heavier soils.

VARIETIES OF BLACKBERRIES

6. The varieties of blackberries generally considered most satisfactory for planting, either in commercial plantations or the home garden, are: Agawam, Eldorado, Mercereau, Rathbun, and Snyder. There are, of course, many other varieties of blackberries and some that will do well in certain localities, but those mentioned are good, all-around varieties and will generally do well under most conditions.

The **Agawam** blackberry, shown in Fig. 1, has a vigorous-growing bush and is one of the most hardy and productive varieties. The fruit is medium to large in size, glossy black, firm, juicy, sweet, and of good quality. The fruit ripens in mid-season or a little earlier.

The **Eldorado** blackberry has a strong-growing bush and is one of the hardiest, but is only moderately productive. The fruit is medium to large, black, sweet, juicy, and of good quality. The fruit ripens about the same time as that of the Agawam.

The **Mercereau** blackberry has a good-growing bush but is not as hardy as the Agawam. The fruit is above medium in size, glossy black, sweet, juicy, and of good flavor. The fruit

5

FIG. 1

Fig. 2

ripens fairly early. The Mercereau is a promising variety in sections where it is not winter killed.

The **Rathbun** blackberry, shown in Fig. 2, has a moderately strong-growing bush, but is not hardy enough for some parts of the northern United States and for Canada. The fruit is large, black, and of good quality.

The **Snyder** blackberry, shown in Fig. 3, has a vigorous-growing and productive bush, and is one of the hardiest. The fruit is of medium size, black, but sometimes marked with a reddish tinge, juicy, sweet, and of good quality. The fruit ripens in mid-season or a little earlier.

The **Blowers** blackberry, shown in Fig. 4, has a good-growing bush. The fruit is attractive and of good quality and ripens early in the season. This is a new and promising variety.

7. Selection of Varieties Suitable to a Location. According to information compiled by the American Pomological Society, varieties of blackberries, like varieties of other fruits, vary widely in their adaptability to different sections of the

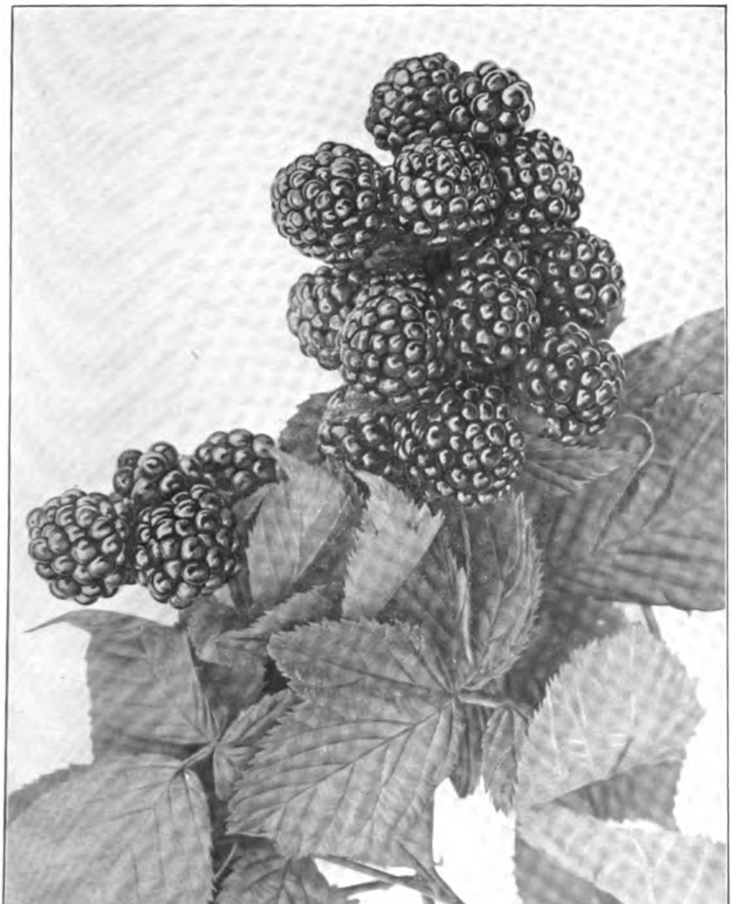
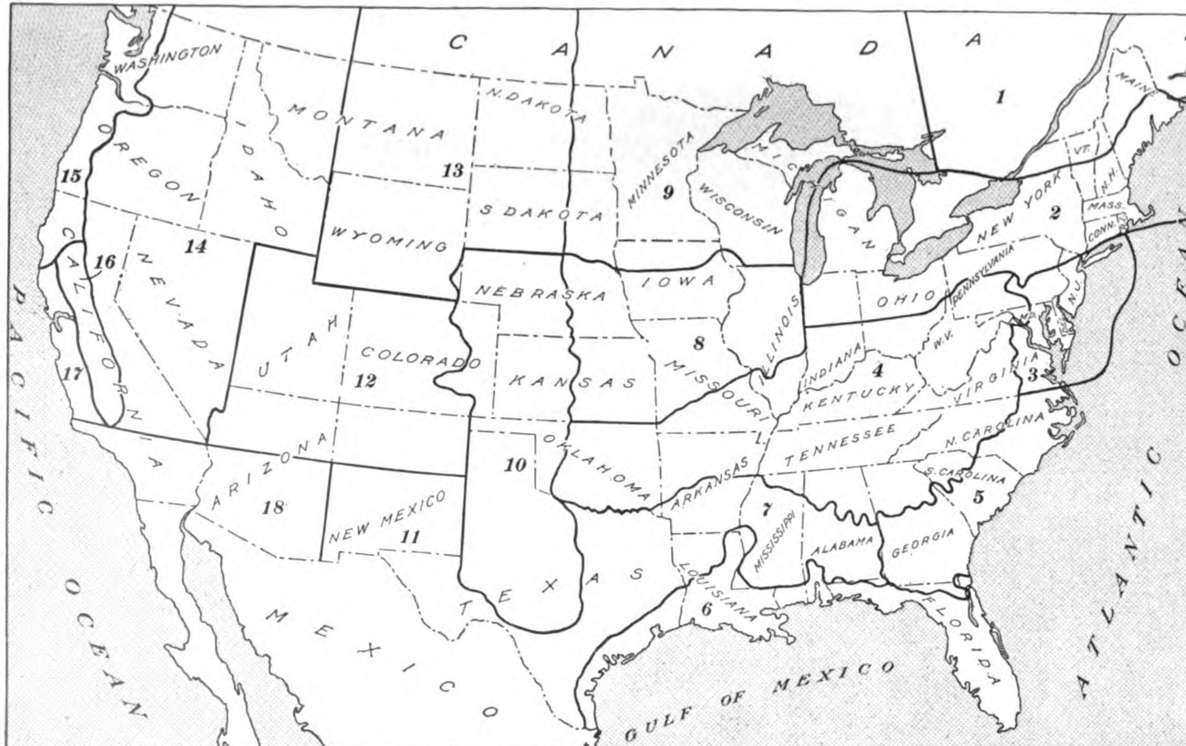


FIG. 3

country. Some varieties have been found to succeed well in many different parts of the country, but with varying degrees of success in different sections, and other varieties have been found to do well in a few sections only. To simplify matters, the Society has divided the United States and the lower part of Canada into eighteen pomological divisions, or districts. These districts have nothing to do with the state or provincial

FIG. 4

boundaries but consist of territory adapted, because of its natural conditions, to the growing of fruits. In making up these districts due consideration was given to the influence of latitude, elevation, prevailing winds, and the nearness to oceans and lakes. These eighteen districts are outlined and numbered on the map in Fig. 5.


CANADA
ATLANTIC OCEAN
PACIFIC OCEAN
GULF OF MEXICO
MEXICO
WASHINGTON
OREGON
CALIFORNIA
IDAHO
NEVADA
MONTANA
WYOMING
UTAH
COLORADO
ARIZONA
NEW MEXICO
N. DAKOTA
S DAKOTA
NEBRASKA
KANSAS
OKLAHOMA
TEXAS
MINNESOTA
IOWA
MISSOURI
ARKANSAS
LOUISIANA
WISCONSIN
ILLINOIS
MICHIGAN
INDIANA
OHIO
KENTUCKY
TENNESSEE
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
S. CAROLINA
N. CAROLINA
VIRGINIA
W.V.
PENNSYLVANIA
NEW YORK
N.J.
MD.
MAINE
VT.
N.H.
MASS.
CONN.
1
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3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18

Fig. 5

The following list of varieties, arranged by districts, give under each division the varieties of blackberries that are known to succeed in that division. The varieties given in Italic are known to be highly successful in the divisions in which they occur. The first time the name of a variety is given its less common name is put after it in parenthesis. Where a division heading is omitted (Divisions 6, 11, and 13) no varieties of blackberries are known to do well in that division.

Some of the varieties of blackberries included in the list will not be found described in detail in the descriptions of varieties. Such varieties are considered to be not entirely desirable from a commercial standpoint, although they may be satisfactory for the home garden.

The information given in this list, however, should not be regarded as infallible, although it has been compiled with the greatest possible accuracy from the statements of the leading blackberry growers within each division. When the planting of any particular plot of ground is considered the experiences of local growers and the recommendations of the local agricultural experiment station should receive careful consideration.

Division 1: Agawam, *Snyder*, Taylor (Taylor's Prolific).

Division 2: *Agawam*, Allen, Blowers, Briton (Ancient Briton), Brunton, Early Harvest, *Eldorado*, Erie, King (Early King), Kittatinny, Lawton, Minnewaska, *Rathbun*, *Snyder*, Stone (Stone's Hardy), Taylor, Wachusett, Wilson.

Division 3: Briton, *Early Harvest*, Eldorado, Erie, Kittatinny, Lawton, Minnewaska, Snyder, Taylor, Wilson.

Division 4: *Early Harvest*, Kittatinny, Lawton, Minnewaska, *Snyder*, Stone, Taylor, Wilson.

Division 5: *Dallas*, *Early Harvest*, Erie, Kittatinny, Snyder, Stone.

Division 7: Dallas, *Early Harvest*, *Erie*, Kittatinny.

Division 8: Blowers, *Briton*, *Early Harvest*, *Eldorado*, *Erie*, King, Lawton, Mercereau, *Snyder*, *Taylor*, Wachusett.

Division 9: *Briton*, Eldorado, *Snyder*.

Division 10: Briton, *Early Harvest*, Eldorado, Erie, Kittatinny, Lawton, Mercereau, Minnewaska, Snyder, Wilson.

Division 12: Acme, *Briton*, Early Harvest, Erie, Kittatinny, Lawton, *Minnewaska*, Stone, Wilson.

Division 14: Early Harvest, Eldorado, *Erie*, Kittatinny, Lawton, *Logan* (the Loganberry, a blackberry-raspberry hybrid), Snyder, Wilson.

Division 15: Himalaya, *Kittatinny*, Lawton, *Logan*, Mammoth, Snyder, Stone.

Division 16: *Crandall* (Crandall's Early), Gardenia, Lawton, *Logan*, Mammoth, *Phenomenal*.

Division 17: *Crandall*, Early Harvest, Evergreen, Kittatinny, *Logan*, *Mammoth*.

Division 18: *Crandall*, Kittatinny, Lawton, *Logan*, *Mammoth*.

8. Commercial Varieties of Blackberries.—The selection of varieties of blackberries is necessarily a local problem, but the aim should be, as far as possible, to select varieties that are in demand in the markets. After a canvass of forty-two commission merchants in the principal markets of the country Professor Charles S. Wilson, of the Cornell Department of Pomology, found that the following varieties were considered the most important in the markets: Wilson, Lucretia (a dewberry), Lawton, and Snyder. A survey of Monroe County, New York, showed that the varieties most extensively planted were Lawton, Erie, and Kittatinny. The names of varieties, however, are sometimes confusing, since they are known in the markets by names different from those commonly given to them by growers.

SELECTION OF NURSERY STOCK

9. Propagation of Blackberries.—The blackberry is propagated by means of suckers and root cuttings. The suckers grow up naturally from the roots and are most used in commercial propagation. Suckers may also be induced to grow in great abundance by injuring the roots, such as is often done during cultivation. Blackberry suckers often become bothersome because they grow with considerable vigor and are not as easy to cut out as raspberry suckers.

Blackberry root cuttings consist of short pieces of roots about 2 or 3 inches long and about the thickness of a lead pencil, or about $\frac{3}{8}$ inch. These are often made in the fall and carried over the winter in moist sand; such cuttings may be started into growth under glass early in the spring, and later transplanted in nursery rows about 3 inches deep, or they may be planted out in nursery rows without the preliminary forcing. Root cuttings may also be made in the spring and

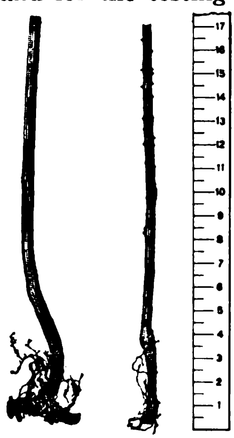
(a) (b) (c)

FIG. 6

planted directly in the nursery row. Nursery plants produced in any of these ways will be ready for setting in a permanent plantation after one season's growth. They are dug for transplanting both in the fall, about October 1, and in the spring.

With a blackberry plantation of a suitable kind once fairly started there should be little difficulty in propagating enough plants to extend it as desired. If enough suckers do not grow naturally, it is only necessary to thrust a spade down into the ground deep enough to wound some roots and 1 or 2 feet away from the row to induce the growth of an abundance of suckers. These suckers may, if desired, be taken up in the fall, packed in moist sand or sawdust, and stored in a cool cellar; or, better, they may be left in the ground until spring, when they should be transplanted directly to the place of setting.

New varieties of blackberries are constantly being brought out. They are produced mostly by selection and crossing, and a certain number of them prove to be desirable. Some growers set aside a small section of ground for the testing of new varieties, and by planting a small number of bushes of each new variety as it is brought out they are able to judge for themselves of its merits under their own particular conditions of soil and climate. For the person who is in the commercial production of blackberries, etc. this is the best policy to follow.



(a) (b)

Fig. 7

10. Selection of Nursery Plants. Strong 1-year-old suckers are the best blackberry nursery plants for setting in a commercial plantation. Such plants may be obtained for about $12 per 1,000. Specimens of first-grade blackberry nursery plants are shown in Fig. 6. In (*a*) is shown a strong desirable type of 1-year-old sucker. The plants shown in (*b*) and (*c*) are good but are less desirable than that shown in (*a*). The quantity of fibrous roots on a blackberry nursery plant is an important indication of its ability to make a thrifty growth.

In Fig. 7 are shown two undesirable blackberry nursery plants. These have very few roots and could not be counted on to produce vigorous plants. These plants are noticeably deficient in cross-roots, the one in (*a*) having only a short cross-root and the one in (*b*) having none at all. Many well-grown nursery plants are greatly injured by the breaking off of the cross-roots through carelessness in digging.

The scale in Figs. 6 and 7 is graduated in inches and is used to give a good idea of the size of the nursery plants. The same scale is used in Figs. 11 and 12.

PLANTING OF BLACKBERRIES

11. The best time to plant blackberries is in the spring, because blackberry bushes planted in the fall are often injured by low temperature during the winter. If blackberry bushes are planted in the fall, each bush should be covered with a mulch of earth or of strawy manure. This mulch should be removed in the spring before growth starts.

Blackberry bushes are usually planted about the same distances apart as black raspberries, that is, in rows 7 feet apart and the bushes spaced 2½ feet apart in the rows; at these distances about 2,489 plants will be set per acre. Many successful growers, however, claim that blackberries should have more space and that the rows should not be less than 8 feet apart with the plants spaced 3 feet apart in the rows. At these distances there will be about 1,815 plants per acre. The recommendation is sometimes made that the bushes be spaced 4 feet apart in the rows, allowing 1,361 plants per acre, in order to permit of cultivation in two directions across the field for 1 or 2 years after planting. Where this is possible the weeds may be kept down well, but cross-cultivation of blackberries set 4 feet apart is unpleasant work. Some blackberry growers claim that they obtain the best results from planting their bushes in check-rows from 7 to 8 feet apart each way, but most commercial growers would consider such planting a waste of space, as this would allow but from 680 to 888 bushes per acre.

When blackberry bushes are planted in their permanent places in the plantation they should be set 1 or 2 inches deeper in the ground than they stood in the nursery row.

Just before the bushes are set some pruning is necessary. All broken roots should be cut off smooth and the top cane should be cut back to one or two buds. This cane is not expected to make much growth, but the bud at the crown should develop a good cane. Care should be taken to see that this bud looks to be strong and capable of throwing up a vigorous cane. In the nursery, plants with weak-looking buds should be discarded.

A convenient method of planting blackberries is to open up deep furrows with a plow from 7 to 8 feet apart across the field one way, according to the distance the rows are to be spaced. Light cross-marks may then be made every 2½, 3, or 4 feet, as the case may be, with some light marking device. In soil that has been well plowed and harrowed and where only a small number of plants are to be set, the planting may be done quickly by marking the ground slightly in two directions with a marker and opening up the holes if the plants are to be set with a spade.

When planting blackberries, as well as all other brambles, care should be taken to see that the roots of the young plants are not exposed to the wind and sun long enough for them to dry out. If the young plants are being dug from an old plantation they should be immediately taken to their new rows and planted without delay. Wet burlap should be kept wrapped around the roots until the bushes are finally in the ground. If the nursery plants are secured from a nurseryman and the roots are dry when they arrive, it is a good plan to soak the roots in a thin mud. When the roots are properly moistened, and arrangements are not completed for setting them, they should be heeled-in deep enough so that from 2 to 4 inches of the cane is buried in the ground; the tops are best turned toward the south and the soil should be firmly packed around the roots when the trench is filled in; the soil should also be firmly packed about the roots when the plants are set in the rows. So handled, the plants may be kept for a considerable time without injury. Such precautions may seem trivial to an inexperienced person, but the cost is very little and the work will count much toward the securing of a full stand in the rows.

BLACKBERRY-PLANTATION CULTURE

12. **Cultivation and Mulching of Blackberries.**—As plenty of water is essential to the successful development of a crop of blackberries, cultivation should be conducted with a view to saving all the water possible for the use of the bushes. For this reason it must be thorough and frequent, but should be shallow, because deep cultivation will injure the roots and stimulate the development of an excessive number of suckers at the expense of the fruit. The cultivation of the newly-set blackberry plantation should, however, be deep for the first year in order to force the bushes to send their roots deep into the soil.

The value of thorough cultivation for blackberries, especially while the bushes are young, in order to give them a good start, can hardly be overemphasized. Intensive cultivation has been known to increase a crop of blackberries nearly 40 per cent. Clean, systematic cultivation should be practiced throughout the life of the patch, because any relaxation in this matter is liable to injure the bushes at a critical time. Cover crops are not desirable in a blackberry plantation, principally because the operation of plowing or deep disking in the spring, necessary to turn the cover crop under, injures the blackberry roots and stimulates an excessive growth of suckers.

Because blackberries do not ripen until later in the season than most fruits, cultivation will have to be continued late, usually until the fruit is nearly ready for picking. Cultivation should also be given after the fruit is harvested and the old canes cut out, but should not be continued so late in the fall that the young growth will be kept soft and susceptible to being winter killed.

The greatest difficulty in the culture of the blackberry is to conserve sufficient moisture at the fruit-ripening period, which comes during the latter part of July or in the early part of August, at a season when drought is most common and the loss of moisture from the soil is most rapid. Unless the bushes can have plenty of moisture at this time they will not be able properly to mature their fruit.

At this season the mulch method of culture proves particularly valuable, as it will conserve the moisture in the soil without the necessity for frequent horse cultivation; the driving of horse-drawn cultivators through the rows at this time is likely to knock off considerable fruit. If the mulch that was put on early in the season is found to be insufficient, an addition at this time would be well worth while. In fact, in small blackberry patches it may be advisable to substitute a mulch for cultivation; this may also be an economical practice on some large commercial plantation where mulching material may be secured at a low price. Meadow hay or some kind of cheap straw is a suitable material for a mulch. To be effective, a mulch must be from 3 to 5 inches deep. Such a covering of the soil will check weed growth and keep the soil damp. If this method of mulching is once adopted on a blackberry plantation it must be kept up, because the root systems of the bushes, under such conditions, will develop very largely near the surface of the ground, and cultivation after 1 or 2 years of mulching would greatly injure the bushes.

Some commercial growers have found that good results are produced by mulching blackberries with green clover in the rows and cultivating between the rows.

The extermination of a blackberry plantation after it has outlived its period of profitable bearing is usually difficult, on account of the vigorous and persistent growth of the canes. A good practice is to mow down and burn all canes immediately after the last crop is picked, and then plow and turn the roots under as deeply as possible. A thorough harrowing should then be given, and in most cases it is preferable to use for this purpose a cultivator with knife-like sweeps that will cut off any protruding suckers. The plantation should be replowed 2 months later. If all the work of extermination has been thoroughly done, this second plowing may be sufficient completely to subdue the blackberry bushes, but in some cases further plowing and harrowing must be done.

13. Pruning of Blackberries.—The pruning of the blackberry should receive special attention. The work is not difficult and in many respects is similar to the pruning of raspberries; nevertheless, it must be properly done, because the success of a crop depends to a great extent on the character of the pruning.

The blackberry resembles the red raspberry in its habit of growth. The canes are biennial and the roots are perennial.

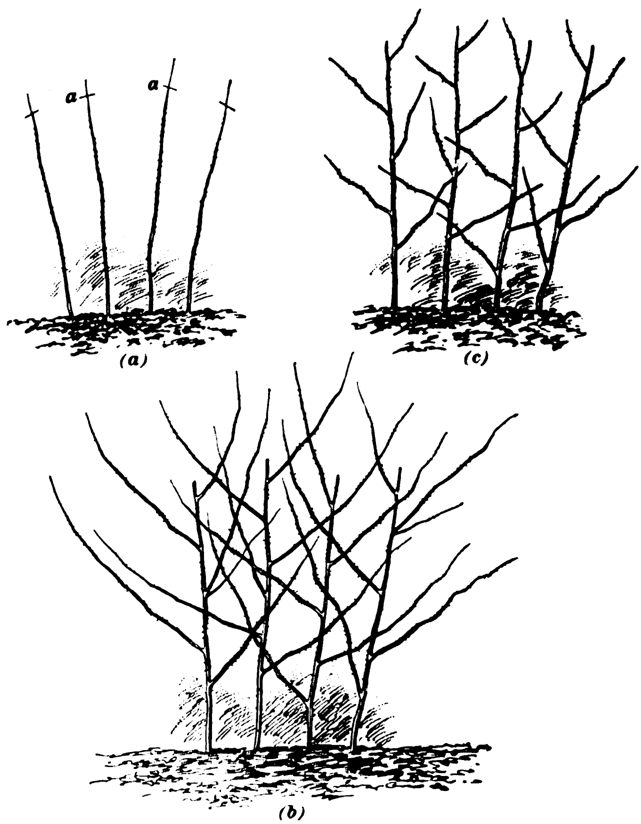


FIG. 8

The new wood springs up from the roots as suckers and bears fruit the second season, dying at the end of that season. The pruning of the blackberry, however, is more like that of the black raspberry, the summer-pruning being practically the same.

The first year, the young canes are allowed to grow until they are from 18 to 24 inches high, when their tips are pinched off at a point *a*, Fig. 8 (*a*), and all except three or four of the most vigorous canes are cut out of each hill. The height at which the young canes are pinched off varies according to the vigor of the variety, the young canes of the more vigorous varieties being allowed to grow to a height of about 2 feet. This pinching off of the tips of the young canes at a height of 18 to 24 inches is done to induce early branching, which will produce a stocky bush with well-developed side branches capable of producing and supporting a heavy crop of fruit. The growth induced by this practice is shown in (*b*), which shows a plant at the end of the summer's growth. The pinching off of the young canes at the height mentioned, 2 feet or less, is particularly important, because the most vigorous buds will always be found near the tips of the canes. If the young canes are allowed to grow too high, say to a height of 4 or 5 feet, and are then cut back to a height of 2 feet, the buds below this point will be weak, the side branches will not form so readily, their growth will be poor, the bush will be low, and the yield of fruit will be light. Usually, a patch will have to be gone over several times early in the season in order to get the young canes pinched off at the proper height.

Late in the winter or early the next spring after planting, the 1-year-old canes should be pruned much the same as 1-year-old black raspberry canes are pruned. The side branches, or laterals, on these canes, which should be well developed, are usually cut back to a length of from 12 to 18 inches; but this pruning requires experience, because varieties vary in their habit of bearing fruit buds, some bearing most of their fruit buds close to the main stem and some bearing them farther out. Hence, it is not safe to cut the side branches of all varieties back the same. If in doubt, wait until blossoming time before trimming. The upper laterals should be cut a little shorter than the lower ones so that when the pruning has been finished each cane with its trimmed laterals will be somewhat cone-shaped in outline. The appearance of a bush after this pruning is shown in (*c*). When doing this pruning it should be borne in mind that this is the method of thinning the fruit, and that although the cutting out of a large quantity of wood is a necessity, too much should not be removed or the yield of fruit will be greatly reduced.

During the second summer of growth, from five to six of the most vigorous of the young canes in each hill should be allowed to develop and should be pinched back at the proper height. As soon as they have borne their crop of fruit the three or four original canes (now considered old canes) should be removed, taken out of the plantation at once and burned. This will to a great extent prevent the spread of insect and fungous troubles, and will leave room for the symmetrical development of the new canes. The pruning out of the old canes as soon as they have fruited is somewhat more important in the case of the blackberry than in the case of the raspberry, because of the more vigorous growth of the plant and the consequent greater demand on the soil for water and plant food.

The third spring the laterals on the 1-year-old canes are pruned as previously described. The plantation should be gone over and any 2-year-old canes that were overlooked in the pruning of the previous summer should be cut out. No canes should be left in the rows except five or six of the most vigorous 1-year-old canes that are expected to bear fruit during the coming season. The pruning in subsequent years is a repetition of that just described.

In localities where moisture is likely to be deficient, it is frequently advisable to modify the method of pruning just suggested. In this case the young canes are often not trimmed back during the summer, but are allowed to develop into long straight canes, which are cut back in the spring to a height of from 2½ to 3 feet. In dry localities, this method of pruning will generally provide enough fruiting wood for all the fruit the bush will be capable of maturing.

A few blackberry growers in some parts of the country train their blackberry bushes on wires as suggested in the case of raspberries. In such cases the young shoots, or suckers, are allowed to grow at will, are not pruned back in the spring, and the long canes are tied to the wires for support. Blackberries are not as convenient to pick when trained in this manner as when grown on a stocky bush.

Fig. 9

The closely-pruned, stocky blackberry bush has another advantage over the long, straggly kind in that it may be covered more easily with straw and protected against late spring frosts when occasion requires.

A vigorous full-grown blackberry bush is shown in Fig. 9. This bush is a good type to model after. It is a trifle thick

FIG. 10

with canes but the fruit is placed where it can be readily picked. The bush shown in Fig. 10 is thinner and illustrates more clearly the lateral branches on which the fruit is borne.

14. Fertilization of Blackberries.—Blackberries should be fertilized with due regard for the soil in which they are growing, and too much nitrogen should not be applied to bushes that are planted in soil that is naturally rich in this element. As a general rule, however, blackberries should be fertilized about the same as other small fruits. Manure and fertilizers rich in nitrogen should be applied the first year to stimulate a vigorous wood growth. In later years, when the plantation is in fruiting, the proportion of nitrogen in the fertilizer should be decreased and the proportion of the phosphoric acid and potash increased. An excess of nitrogen when the plants are fruiting will favor a rank growth of wood at the expense of the fruit. On most soils, the application of liberal quantities of potash is advisable, though the quantities that will give the best net results on any particular soil can be determined only by experiment.

An increase of about one-third in the crop of fruit has been secured by a judicious use of fertilizer.

INSECT PESTS AND INJURIES

15. Insects and Diseases.—The principal insects that attack blackberries and dewberries are the saw fly and the cane borer; the principal diseases are anthracnose; crown gall, or root knot; red rust, or orange rust; and leaf spot. All of these pests have been described and the methods of control given in the Section on *Raspberries*.

In some sections of the country, at rare intervals, the canes in a blackberry plantation will suddenly be found to be covered with dark-brown soft scales. These may be so abundant as almost to cover the entire canes. These insects suck the sap from the plants and greatly weaken them. In case of such an attack, all of the unnecessary wood should be pruned out and in the spring before growth begins a thorough spraying given with lime-sulphur solution (at specific gravity 1.03—that is, concentrated lime-sulphur solution of 33° Baumé diluted 1 to 8 with water) or with a kerosene emulsion. In most cases, however, it will be found necessary to abandon a blackberry plantation so attacked and to set out another on fresh, good, rich soil.

16. Winter Injury.—Blackberries cannot be successfully raised in many parts of the country without protecting them in the winter. The amount of moisture present, as well as the lowness of the temperature, has an important bearing on the necessity for this protection; if the air and soil are dry, unprotected blackberry bushes will suffer severely during cold weather. Though winter protection is absolutely essential to success in some parts of the country, there are, in fact, very few sections where some such protection will not be of advantage; in some localities where it has never been considered necessary, winter protection has been known greatly to increase the yields of fruit the following year.

The best method of protecting a blackberry bush for the winter is in the fall to loosen the earth on both sides of the plant, carefully bend it over in the direction of the row until the tips of the canes touch the ground and then cover them with soil. Bend the next plant over so that the tips of the canes will come over the roots of the first plant, cover with earth, and continue this process throughout each row. In comparatively mild climates this covering of the tips of the canes is sufficient, but in localities where the winters are severe the whole plant should be covered. The cost of this operation should not exceed $10 per acre.

Some growers run over a blackberry row with a low-axle wagon to bend down the plants and then throw earth or some other covering over them. This, however, is a rather rigorous treatment.

HARVESTING AND MARKETING OF BLACKBERRIES

17. Blackberries ripen during the latter part of July and in the early part of August in the latitude of New York. They are not ripe when they first turn black and should be allowed to remain on the bush for some time after this, in order to give them time to ripen; preferably they should be allowed to remain until they will drop off when the bush is shaken. If the fruit is to be shipped to a near-by market, the berries should be allowed to mature on the bush, for a blackberry is at its best only when allowed to ripen on the plant. For long-distance shipments, the berries should be picked when well colored but while still firm.

A well-grown blackberry fruit should measure $\frac{3}{4}$ to 1 inch in length, and the diameter should be about half the length. The fruit is borne at a convenient height, is solid, and the yield is usually large, so that blackberries are easier to pick than raspberries. This, however, should not be taken to mean that the blackberry should not be carefully handled. Though the fruit is solid and will not crush as readily between the fingers as a raspberry, the outer skin of the blackberry, when the fruit is fully ripe, is very tender, more so in some varieties than in others, and if this skin is broken the appearance of the fruit will be greatly injured, and the fruit will not stand up well in shipment or in the market.

Blackberries should not be exposed to the sun after they are picked, because they will spoil quickly.

The first season no fruit should be expected from a blackberry plantation, but the second year there should be half a crop, and the third year a full crop. The blackberry is naturally prolific and under equally good culture it will generally outyield the raspberries; usually it is the most profitable bramble to grow, provided the climate and other general conditions are favorable.

Blackberries are packed in strawberry baskets and handled in the strawberry crate.

The price in the markets varies from 7 to 18 cents a quart, depending on the quality, season, and supply.

DEWBERRIES

GENERAL DISCUSSION

18. The **dewberry** is distinguished from the blackberry by its trailing habit of growth, by the manner in which it reproduces, and by its fewer flower clusters. The dewberry is of value, because it ripens earlier than the blackberry and is sweeter.

The dewberry crop is profitable in years when the fruit matures. Due to its susceptibility to being winter killed it is an uncertain crop in some localities, especially in the north and in exposed locations, and for this reason it is not more extensively planted. The dewberry has been cultivated extensively only during the last 25 years.

An average yield of dewberries is from 300 to 400 Colorado crates, or from 3,600 to 5,000 quarts per acre. The average price received by the Colorado growers is about $2.25 per crate, or from 18 to 19 cents per quart.

Dewberries do not do well in the scorching sun and therefore should be planted on a slope with a northern or northwestern exposure or in a shady place.

Dewberries do well on any soil, but do best on a light sandy soil.

VARIETIES OF DEWBERRIES AND NURSERY STOCK

19. The varieties of dewberries most generally grown are the Lucretia and the Mayes. In the market dewberries are usually classed as blackberries. The Lucretia, the more popular of the two, is commonly called a blackberry and ranks as one of the blackberries most in demand in the markets. Dewberries ripen earlier than blackberries and for this reason are looked on as early blackberries. The dewberries are not as hardy as the blackberries.

The **Lucretia** dewberry has a good-growing bush but is not hardy in northern localities. The fruit is large, glossy black, sweet, juicy, and of good quality. The fruit ripens early.

The **Mayes** dewberry, or *Austin dewberry*, or *Austin-Mayes* dewberry, has a strong-growing bush but lacks hardiness. The fruit is very large, glossy black, juicy, and of good quality. The fruit ripens very early in the season.

20. Selection of Varieties Suitable to Location. According to information compiled by the American Pomological Society, varieties of dewberries, like varieties of other fruits, vary widely in their adaptability to different sections of the country. Some varieties of dewberries have been found to succeed well in many different parts of the country, though with varying degrees of success in different sections, and other varieties have been found to do well in a certain few sections only. The following list of varieties are classified in the same divisions as blackberries, the numbers of the divisions corresponding with those given on the map of Fig. 5. The varieties given in each division are known to do well in that district. The varieties given in Italic are known to be highly successful in the divisions in which they occur. The first time the name of a variety is given its less common name is put after it in parenthesis. Where a division heading is omitted from the list (Divisions 1, 6, 9, 11, 13, 15, and 17), no varieties of dewberries are known to do well in that division. The other remarks given under blackberries apply with equal force to dewberries.

Division 2: Lucretia.
Division 3: *Lucretia*, Mayes (Austin, Austin-Mayes).
Division 4: *Lucretia*, *Mayes*.
Division 5: Lucretia, Mayes.
Division 7: *Lucretia*, *Mayes*.
Division 8: *Lucretia*, Mayes.
Division 10: *Lucretia*.
Division 12: *Lucretia*.
Division 14: Lucretia.
Division 16: Lucretia.
Division 18: Lucretia.

21. Propagation.—Dewberries are propagated from tips in the same way that black raspberries are propagated. These tips root very readily when they come in contact with the soil.

In the spring before dewberries are pruned, the tips that have taken root from the young growth that has fallen to the ground the previous summer will be developed enough for transplanting, and any that are needed to replace old hills or to set a new plantation should be secured at this time.

22. Selection of Nursery Stock.—In Fig. 11 are shown

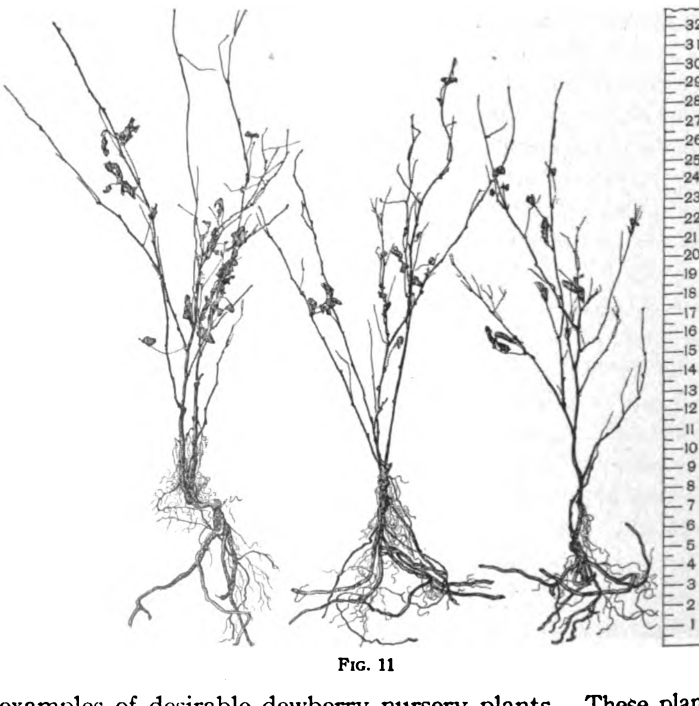


FIG. 11

examples of desirable dewberry nursery plants. These plants are large and well developed and are sturdy for dewberry bushes. In Fig. 12 are shown examples of undesirable, undersized dewberry bushes. The scale in Figs. 11 and 12 is the same as that used in Figs. 6 and 7.

PLANTING, CULTIVATION, PRUNING, AND HARVESTING

23. Planting.—Spring planting usually produces the best results with dewberries. Different varieties should be planted

FIG. 12

together to secure proper fertilization. The method of planting is the same as for blackberries. Dewberries are planted at a variety of distances. When they are to be trained to a stake a common distance for planting is 4 feet by 4 feet and the canes are tied to the stakes about 3 feet above the ground. At this distance about 2,722 plants may be set per acre. Some growers prefer to plant dewberries in rows 5 feet apart and to space the plants 2½ feet apart in the rows, which gives about 3,484 plants per acre. Whether this close planting will produce a greater net profit is a local problem depending largely on soil conditions. When dewberries are planted in this way the stakes are often put in the rows in the spring about 5 feet apart, beginning half way between the first two hills and continuing in like manner down each row. This arrangement will permit the plants in two hills to be tied to one stake and is economical in the matter of stakes.

When dewberries are to be trained on a wire trellis they are commonly planted in rows 6 feet apart and the plants spaced 3 feet apart in the rows. At these distances about 2,420 plants will be set per acre.

Only the bearing canes are tied up on stakes or on a trellis, new growth being allowed to lie on the ground until spring.

In some instances dewberries have been found not to fruit well, owing to poor pollination, and for this reason the recommendation is often made to plant more than one variety in a block, in order to insure consistant crops of good fruit. Some varieties in particular are self-sterile when planted alone.

24. Cultivation.—The cultivation of dewberries is practically the same as for the other bush fruits. It should begin early in the spring, be discontinued before the time when the passing back and forth between the rows will damage the fruit, and, in order to stimulate the young canes into a vigorous growth, should be resumed again and continued for some time after the fruit has been harvested and the old canes pruned out. Clean cultivation should be practiced until the new canes become too thick. Then the new canes are allowed to cover the ground as a mulch during the fall and winter until they are ready to be pruned and tied up in the spring.

25. Pruning.—Dewberries are pruned similarly to blackberries, except that on account of their trailing habit of growth and limberness, the fruiting canes must be supported on stakes or on a trellis. Dewberries are somewhat difficult to prune because the new growth makes a dense mat on the ground, and the lifting and tying of the canes to the stakes or trellis is unpleasant work. The fruiting canes are the ones that are tied up, and this is done in order to prevent the fruit from becoming soiled and to keep the canes from interfering with cultivation.

No summer pruning is necessary, but the old canes should be cut out as soon as they have fruited. The young canes are allowed to grow at will, forming a mat over the ground; some growers, however, turn the new canes so that they lie

Fig. 13

in the rows and thus they are able to continue cultivation longer without damaging the bushes. The young canes are allowed to remain on the ground during the winter. In the spring they are pruned back to a height of from 3 to 5 feet and are tied up with binder twine, or some similar twine, on stakes as shown in Fig. 13 or on a trellis made of wires strung on stakes as shown in Fig. 14. Tying up on stakes is usually considered the more satisfactory method. This feature of dewberry culture is one that adds very much to the expense of production.

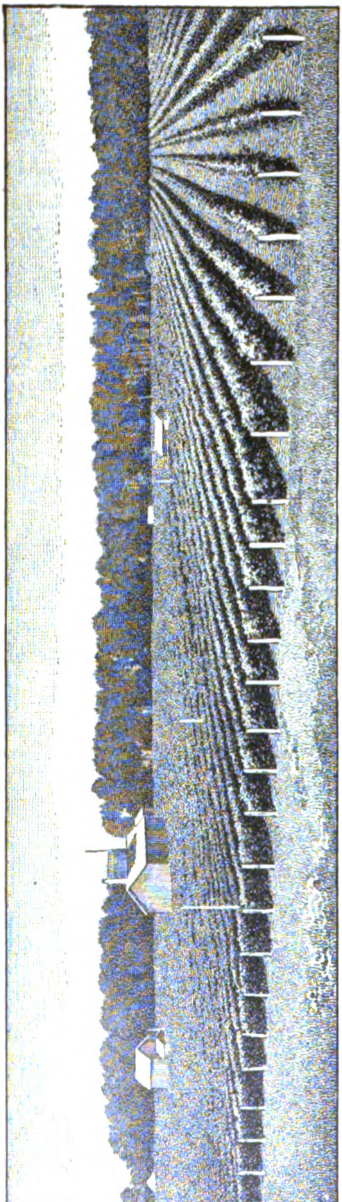


FIG. 14

One good method of constructing a trellis is to secure good strong 7-foot posts. Cedar posts are very satisfactory when they are available. These posts should be set about 2 feet deep in the ground, stand 5 feet above ground, and be spaced not more than 32 feet apart in the rows. The end posts in each row should be securely anchored, as there is considerable strain on them when the vines are loaded with fruit. The posts should be strung with three galvanized-iron wires, of about No. 12 gauge. The top wire should be placed over the tops of the posts, the lower wire should be fastened about 20 inches from the ground, and the third wire should be strung about half way between the other two. All wires should be made taut and stapled with stout staples.

As soon as the dewberry canes have borne their crop of fruit, they are cut out and preferably burned. This gives the young canes all possible room for growth.

26. Harvesting.—The picking of dewberries is a serious problem on account of the thorns and the trailing habit of growth. To protect the hands, pickers are obliged to use gloves. An entire glove is used on one hand to lift the canes, and the glove on the other hand has the tips of the fingers removed, in order to facilitate picking. Pickers in a dewberry patch are shown in Fig. 15. A convenient cart for transporting berries to the packing shed is shown in the foreground. This cart could be used for any small fruit.

Fig. 15

Dewberries are picked into small baskets, either quarts or pints, and marketed in crates. The Colorado growers pack dewberries in veneer pint boxes and pack twenty-four of these boxes in a crate of two tiers.

Dewberries should be crated as picked. The pickers usually receive 30 cents per crate if paid daily and 35 cents per crate if payment is deferred until the end of the picking season.

BLACKBERRY-RASPBERRY HYBRIDS

GENERAL DISCUSSION

27. Blackberry-raspberry hybrids are plants that have been produced from seeds from either blackberry or raspberry bushes, the flowers of which have been fertilized with pollen from the flowers of the other kind. Such plants can be reproduced true to type only by propagation by means of suckers, cuttings, or tip layers, as the case may demand. The reason for discussing such hybrids is because by breeding and selecting such plants, new commercial varieties of fruit may be produced that will be superior to the varieties of blackberries and raspberries already grown. This is important, because the varieties of blackberries and raspberries at present under cultivation have their disadvantages to both the consumer and the producer. Few varieties of blackberries or raspberries fully meet the requirements of the consumer of dessert fruit or of the canning factory; and the grower of blackberries and raspberries finds even greater objections to many varieties for several reasons: (1) They show great variations in their adaptability to different types of soil, (2) they are more or less susceptible to injury by frost, and (3) they are susceptible to the ravages of disease.

That the conditions just stated exist, seems to be but natural when the sources from which the fruits were derived and the conditions under which the varieties were produced are carefully considered. Practically all of the present varieties of raspberries have originated from the varieties of European garden raspberries imported into this country from time to time, from the American black raspberries, from the American wild red raspberries, and from the natural hybrids of these three types. The blackberries and dewberries are represented by five or six species, or varieties, of native fruits and also by several hybrids of these varieties that are of a very variable character.

Little attention has been given to the production of varieties of raspberries and blackberries by systematic breeding, and the varieties of these fruits now grown in this country have for the most part been secured by propagating from some unusual and seemingly desirable variation that may have occurred in various nursery patches, in commercial plantations, and through the selection and propagation of stray hybrids accidentally discovered. The desire to produce new varieties that might bring the nurseryman higher prices than the old varieties has led to the propagation of a large number of such plants, with the result that there are now a multitude of varieties that vary slightly in the form of their fruit, but that vary more in hardiness, vigor of growth, and productiveness. Hence, at the present time, too many varieties are offered for sale, but among these are very few varieties that are desirable from all points of view.

Some of the defects of plants that will be noticed in every blackberry and raspberry plantation are: (1) A certain percentage of plants that produce no fruit or very little fruit, (2) plants that produce fruit of poor flavor, (3) plants that produce soft fruit, (4) plants from which the nearly ripe fruit drops off very easily on being shaken, (5) plants that will be badly infested with insects or diseases or both, (6) a greater or less number of plants that will lack vitality, and (7) some plants that do both well and poorly in moist spots and some that do both well and poorly in dry spots.

Some of the blackberry-raspberry hybrids show promise of overcoming many of the above shortcomings of blackberries and raspberries, and in this field of endeavor the plant breeder apparently has a great opportunity to produce a fruit worth while.

Some of the problems the breeder of blackberry-raspberry hybrids aims to solve, and in which the native species of the genus *Rubus*, which includes the native blackberries and raspberries, may be used, are summarized by Lawrence as follows: (1) To secure an early-bearing, early-maturing, heavy-yielding bush blackberry free from the attacks of insect pests and not susceptible to crown gall and anthracnose; (2) to secure a cross of the blackberry, or a hybrid blackberry, with the wild blackberry or dewberry to secure a better-flavored, small-seeded fruit that will have a large proportion of flesh and will still be excellent for shipping; (3) to secure a hybrid of the blackberry and the salmon berry that will stand a greater quantity of water than the blackberry, and hence which will be adapted to planting on a large area of soils at the present time not suitable for fruit growing because they are not well drained during the early part of the growing season; and (4) to secure crosses of the Mercereau with some other bramble that will bear a fruit with a fleshy core. Many more such problems might be suggested.

METHOD OF PRODUCING BLACKBERRY-RASPBERRY HYBRIDS

28. To be of value, blackberry-raspberry hybrids should be produced by systematic breeding and this may be accomplished according to the following method:

1. A number of plants, the larger the number the better, of commercial varieties of blackberries, dewberries, and raspberries, and also of some of their hybrids already in existence, should be secured and planted in a plot in separate rows. Care should be taken to see that all of the plants are vigorous and that they come from plants that have a record of producing exceptionally desirable fruit of its kind.

2. During the first summer particular attention should be paid to the manner in which the plants grow. Any that make a weaker growth than is thought desirable should be dug up and discarded. In doing this, however, due allowance should be made for the variations in growth that occur in different kinds of fruit and in different varieties of the same fruit.

3. The effect of the winter on the remaining plants should also be carefully noted. The breeder will be fortunate indeed if he happens to be favored with a very rigorous winter the first year. In case any plants are totally destroyed by the winter this will save the trouble of digging them out. All plants

that show any considerable effect from winter killing should also be discarded. In this way only the most vigorous plants and those best adapted to resisting winter killing will be left.

4. When the plants come into bloom in the spring (sometimes it may be better to wait until the second spring after planting in order to make the selection for vigor and resistance to winter killing and disease) the stamens, anthers, or pollen sacks should be removed from certain of the best flowers on each plant that it is desired to breed from. This will prevent these blossoms from becoming self-fertilized. These blossoms, sometimes called emasculated blossoms, should then be pollinated by hand. That is, pollen should be shaken from a flower of some other plant on to a watch crystal or some similar container, carried to the emasculated flower, and dusted on the pistil of this flower by means of a small camel's-hair brush. Each flower fertilized in this way should then be enclosed in a paper bag and the bag tied securely about the cane below the flower. This will prevent the pistil of the flower from becoming fertilized with pollen from any other flowers and thus interfering with the cross intended. The bag should be kept over the flower until the fruit has set, and should then be removed in order to allow the fruit to develop to perfection. The fruits fertilized in this way should be marked so that their identity will not be lost. One convenient way is to tie a tag, on which full information in regard to the cross has been written, to the cane below the fruit in question. The more such crosses that are made the greater will be the chance of securing a few desirable seedlings.

5. As soon as the fruit is ripe, the marked fruits should be harvested, each lot crossed in the same way by themselves. The seed should be separated from the pulp, dried, and kept separate in a dry place so that it will not deteriorate.

6. The next spring this seed should be planted. Usually the best practice is to plant it in small flats in a greenhouse and get the young plants well started before time for setting in the field. As soon as the plants are strong enough and the weather permits they should be set out in a good soil in the open and carefully tended.

7. The next year after setting, these plants, or at least the desirable ones, will bear fruit. At this time a careful selection of the plants should be made, due attention being given to the form, color, flavor, and apparent shipping qualities of the fruit, and the vigor, and resistance to disease and winter killing of the bushes. Probably only a few bushes will show a combination of all of the good qualities. Only such bushes should be retained for propagation. The propagation should be by means of suckers, tip layers, or cuttings as the case may require, because only plants propagated in this way can be expected to come true to type. The progeny from all of these different plants should be kept separate, for probably only a comparatively few even of these will prove to be satisfactory. The securing of new varieties in this way requires time, but any desirable variety secured in this way may be assumed to be worth while.

THE LOGANBERRY

29. The **loganberry** is probably the best known of the blackberry-raspberry hybrids and is a valuable fruit in parts of the West and the Northwest. The loganberry was produced accidentially many years ago from a seed of the Aughinbaugh blackberry, the very variable wild blackberry of California, that had been accidentally fertilized from a near-by red raspberry bush, supposedly of the old Red Antwerp variety.

Although the loganberry is a heavy yielder, some single vines or bushes, bearing as much as 10 to 15 quarts of fruit, it is not sufficiently hardy in all parts of the country to be of importance commercially. It will, however, prove satisfactory in the home garden in many places where it would not prove profitable commercially. In many parts of the West and Northwest the loganberry succeeds and is an important commercial crop. In the East, this fruit has not been as much of a success as it was expected to be. In almost all localities it is too tender, and to be brought through the winter in satisfactory condition must be well protected. Probably the best protection is to lay the vines on the ground and completely cover them with soil late in the autumn. Such a practice, however, is expensive in a commercial plantation.

The loganberry bush, often called a vine on account of its trailing habit of growth, is strong-growing, dark green in color, and of the trailing dewberry type of growth. The loganberry fruit, shown in Fig. 16, has many characteristics of both of its parents. When ripe, the fruit is of a rich, dark-red color, and on some bushes will average from $\frac{3}{4}$ inch to $1\frac{1}{4}$ inches in length,

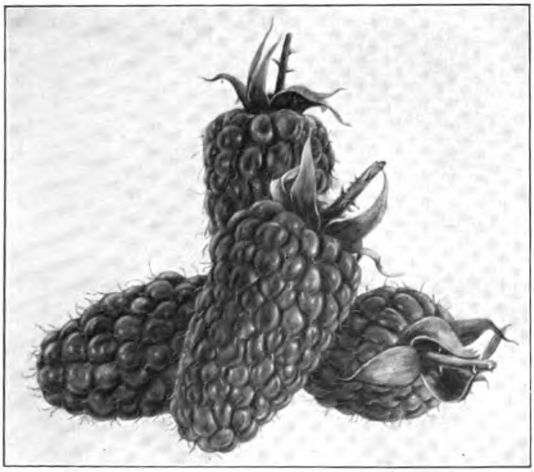


FIG. 16

but the quality is only fair. The fruit is not adapted to long-distance shipment. The best results are secured when the fruit is grown within a short distance of the market, and is not picked until it is nearly ripe, or when it is grown near to and sold to a canning factory.

30. The loganberry can be propagated according to two methods, the most common method being from tip layers. These are secured by *tipping* the vines, that is, by letting the tips of the vines fall to the ground and covering them with earth late in the summer or early in the fall. The plants from such tips should be ready for transplanting about March of the following spring. The loganberry can also be propagated from cuttings taken from the hard wood of the plant and containing at least one bud. Plants raised from seed are little likely to produce fruit true to type.

As in the case of the dewberry, the loganberry should be trained on a trellis, on stakes, or on a wall. This is necessary in order to keep the fruit off the ground and to prevent it from becoming soiled. The cultivation and pruning is the same as for the dewberry.

Loganberries, in localities where the conditions are favorable, should yield one-third of a crop, or a little more, the next year after planting and a full crop in succeeding years. A crop of 4 tons to the acre is considered possible under good management, although crops of 6½ tons have been secured. At some canneries a price of $80 per ton is paid, making on a 4-ton crop, gross receipts of $320. Of this amount about half should be net to the grower after paying the expenses of production and harvesting.

In some sections loganberries are coming to have a variety of uses. They are put on the market fresh, canned, and evaporated; it takes about 5½ pounds of fresh fruit to make 1 pound of dried fruit. There is also some demand for the loganberry for making juice for flavoring and for soft drinks, and also for making wine.

CURRANTS AND GOOSEBERRIES

CURRANTS

GENERAL DISCUSSION

1. Currants are of three commercial classes, namely, red, black, and white, the color of the skin of the fruit being the basis for this classification. In the United States the **red currant** is the most important class, and since the more rigid enforcement of the pure-food laws, the demand for this crop has increased. In Europe, both the red and the **black currants** are extensively cultivated for market. The **white currant** is of little importance commercially, its appearance not being attractive. The only demand for white currants is for a limited quantity for the dessert trade.

In the United States, currants are grown in the Northern, in the Central, and in some of the Western States. They fail in the Southern States, except on elevations, and do not do well on the Western plains. The states that produce the bulk of the currant crop are New York, Michigan, Iowa, Ohio, Wisconsin, Indiana, Pennsylvania, and California. They are also grown in the fruit-growing sections of Canada.

The currant as grown commercially is a low, bushy plant. It is perfectly hardy to cold and thrives only in cool climates. The three classes require practically the same cultural methods.

2. Uses of Currants.—To a limited extent currants are used on the table, but the main use is for the juice, which is largely used in the making of jellies, as a flavor, and as a drink.

In the United States the currant is grown almost solely for the production of jellies. The pure-food law has been the means of greatly increasing the quantity of currants used in making jelly. Formerly large quantities of so-called currant jelly were made of apple juice artificially colored and flavored, but now, to conform with the law, any jelly sold as currant jelly must be made from currants.

Since the advent of the pure-food law, currant juice is also coming into use as a flavor for other fruits in preserves. Frequently, currant juice is put up with raspberries; it may also be added to the Russian mulberry and to the June berry to improve the flavor of products made from these fruits.

Currant juice is sometimes mixed with sugar and water to make a drink similar to lemonade.

The fruit of the black currant is credited with much medicinal value in Europe, being used for alleviating soreness of the throat. It is also used for jam and jelly, and the leaves are sometimes used for making tea.

3. Growth of Demand for Currants.—The demand for currants is rapidly increasing, the greatest demand being for red currants, especially since the more rigid enforcement of the pure-food laws. As an example of the result of the increased demand for currants, the following case may be quoted. Fifteen years ago, a man near Rochester, New York, who had planted 2 or 3 acres, was asked what he was going to do with his enormous crop of currants when the bushes came into bearing. There was practically no sale for them at the time, but now, although he has several times the area he then had, he is but a small factor in the vicinity of Rochester in the production of red currants.

Ten years ago the demand for red currants was largely confined to New England. Today carloads are shipped daily from Western New York as far west as Chicago, and the industry is in a healthy condition. At the present time the demand is greater than the prospective supply; on the other hand the difficulties attending the production of the fruit are rapidly increasing, and these, of course, tend either to curtail or to eliminate the crops of the less experienced growers. The fruit is popular but the market has never been systematically developed.

Although at the present time there is only a limited demand for black currants in the United States, the demand for them appears to be slowly increasing.

4. **Possibility of Overproduction of Currants.**—From the present outlook, the possibility of an overproduction of currants need not be seriously considered. There are two reasons for this. The demand for currants is stable and increasing, and the difficulties attending their production are rapidly increasing. Few currants are used for the table. The bulk of the crop is used for making jelly, and the demand for first-class jelly made from pure fruit juice seems to increase more rapidly than the population. The increase in the number of plant diseases and insect pests attacking the currant, notably the San José scale and the currant borer, has been very rapid, and the damage done by these agencies seems to increase annually.

5. **Influence of Quality of Currants on Demand.** Thus far the tendency of the retail market has been in favor of currants with large berries and long bunches, but the canners and jelly makers have as yet paid little attention to these details. It is the belief of experts that a small tart currant, such as the Victoria, is really better for jelly making than a milder flavored and larger currant, such as Perfection, but on the open market the larger fruit, in most cases, would probably outsell the smaller. Wherever the larger fruit is equally as productive as the smaller, it is the most profitable to grow, because, in addition to being more in demand, the large-berried fruit is also more easily harvested.

6. **Yields of Currants.**—Yields of red currants vary greatly, an average being perhaps from 1,500 to 2,000 pounds per acre. Good yields wi l run from 3,000 to 4,000 pounds

per acre, and exceptional yields will run as high as 14,000 pounds per acre. In order to make the crop a paying one, yields of 4,000 pounds should be secured. Currant bushes will bear well for 7 to 15 years, depending on the care given to them.

The black currant is less productive than the red currant, and in order to make its culture equally profitable the grower would need to secure from 1½ to 2 cents per pound more for them.

SIZE AND LOCATION OF A CURRANT PLANTATION

SIZE, EQUIPMENT, LABOR, AND CAPITAL

7. **Size for a Currant Plantation.**—If the shipping facilities, labor supply, and natural conditions are favorable to the production of currants, the size of plantation will be limited only by the ability of the owner to manage it. If the fruit is to be shipped to distant markets, sufficient fruit should be raised so that carload lots may be shipped. This would necessitate planting 10-acre blocks of fruit so that fruit in sufficient quantities could be secured at one time. For a small local market a patch of 1 acre may be ample.

8. **Equipment and Labor.**—The tool equipment for a currant plantation is simple. Unless special planting machinery as described later is desired, only the ordinary farm cultivators will be necessary to keep the crop in good condition and almost any spraying machine, provided it is not too large, may be adapted for use on currants.

The labor required for currants, other than that used in spraying and harvesting, is not much greater than that required for the production of a good corn crop. Under proper management, the necessary pruning is usually done in winter, when labor is abundant.

9. **Capital Required for a Currant Plantation.** Properly handled, a currant plantation may be expected to pay

its running expenses by the fourth or fifth year after planting. The amount of capital required will vary somewhat with the locality. On soil suitable for trucking, a vegetable crop could be grown between the rows the first year, and this should meet all expenses of tillage, etc., for that year. On the other hand, in localities where the soil is heavy, the whole of the land may have to be given to the currant crop and all of the expenses paid out of capital. If no interest is charged and no charge made for supervision, the cost of financing a currant plantation for 4 years is about $220 per acre. In one case in Western New York with interest at 6 per cent. and allowing $10 per acre per year for supervision, the cost of planting and carrying a currant plantation through its first 4 years amounts to about $350 per acre. Many plantations are run for less than this sum per acre, but probably such plantations will be of less value after they come into bearing.

An itemized statement of the amount of money expended per acre in developing a currant plantation (exclusive of cost of land) in Western New York during the first 5 years, and also the income during that time, follows:

FIRST YEAR

Expenses:		
Plants (set 4 ft. × 4 ft. = 2,723, at 4 c.)	$108.92	
Plowing and fitting	7.00	
Manure and applying 10 loads	20.00	
Marking and planting	8.50	
Cultivation, twenty to thirty times	20.00	
Taxes	.50	
Rent	5.00	
Interest on capital $200 at 6 per cent. for 6 months	6.00	
Supervision	10.00	
Cover-crop seed	1.50	
Use of tools	2.00	
General expenses	3.00	
Total	$192.42	
Receipts: No crop.		
Net expense		$192.42

Expenses: SECOND YEAR

Replacing plants	$ 2.00
Cultivation	20.00
Hoeing	1.50
Spraying three times	6.00
Cover-crop seed	1.50
Supervision	10.00
Use of tools	2.00
General expenses	3.00
Taxes	.50
Rent	5.00
Interest on $200 for 1 year	12.00
Interest on $60 for 6 months	1.80
Total	$ 65.30

Receipts: No crop.

Net expense $65.30

Expenses: THIRD YEAR

Cultivation	$ 20.00
Hoeing	1.50
Spraying	8.00
Cover-crop seed	1.50
Fertilizer	10.00
Supervision	10.00
Use of tools	3.00
General expenses	3.00
Taxes	.50
Rent	5.00
Interest on $260 for 1 year	15.60
Picking 200 pounds	2.00
Marketing, etc.	1.00
Total	$ 81.10

Receipts:

200 pounds of currants at 5 c. 10.00

Net expense $71.10

FOURTH YEAR

Expenses:		
Cultivation	$ 20.00	
Hoeing	1.50	
Spraying	8.00	
Cover-crop seed	1.50	
Fertilizer	10.00	
Supervision	10.00	
Use of tools	3.00	
General expenses	3.00	
Taxes	.50	
Rent	5.00	
Picking	15.00	
Marketing	7.00	
Interest on $330 for 1 year	19.80	
Total	$104.30	
Receipts: 1,500 pounds of currants at 5 c.	75.00	
Net expense		29.30
Net expense for 4 years		$358.12

FIFTH YEAR

Expenses:		
Cultivation	$ 20.00	
Hoeing	1.50	
Spraying	8.00	
Cover-crop seed	1.50	
Fertilizer	10.00	
Supervision	10.00	
Use of tools	3.00	
General expenses	3.00	
Taxes	.50	
Rent	5.00	
Picking	36.00	
Marketing, etc.	14.00	
Interest on $350 for 1 year	21.00	
Total	$133.50	
Receipts: 3,600 pounds of currants at 5 c.	180.00	
Profit		46.50
Net expense for 5 years		$311.62

SELECTION OF LOCATION

10. The most important factors to be considered in the production of currants are facilities for disposing of the crop quickly and a plentiful supply of labor to pick it. Although the importance of favorable natural conditions should not be overlooked, it is evident that unless the crop can be picked and shipped quickly, it cannot be produced at a profit, no matter how favorable the natural conditions may be.

In selecting the location for a currant plantation for the production of fruit for shipment to distant markets, the nearness of a shipping point on a railroad, the character of service that can be depended on on that railroad, the time it will take the railroad to deliver the fruit to market, and the character of the roads between the plantation and the shipping station are points that should be carefully considered.

A plentiful supply of cheap labor, such as women and children, must be in the immediate neighborhood and must be easily secured, or the fruit grower must have the ability to arrange to have laborers on hand when they are needed. Laborers will be needed for but 7 to 10 days to harvest currants. Hence, it is usually most satisfactory to have currants one of a series of crops demanding such help, thus warranting the importation of help if it is not on hand. Currant picking follows immediately after strawberry picking, and is generally coincident with sour-cherry picking.

Sometimes currant plantations are situated near a canning factory that will take the entire production at a specified price. Such an arrangement is often satisfactory. Otherwise, the grower should have good shipping facilities to at least one good market, though it is preferable to have more than one market to ship to.

The currant crop is harvested in the hottest part of the year—in July in New York—and the fruit must either be used quickly, as in a canning factory, or else cooled it if is to be shipped to a distant market.

Red currants can be grown under partial shade, and for this reason they are sometimes planted under young apple trees.

Such a course may be permissible in a small orchard, where land is very high in price and the labor is done largely by hand, but it is not good practice for a large plantation. Each crop does best when planted by itself.

11. Site for Currants.—Almost any exposure is suitable for currants, provided the plantation is located on a site where the circulation of air will be good. Currants should not be placed on land that is too low, because in frost pockets an entire crop may be lost in some years, due to freezing at blossoming time.

In Pennsylvania, an altitude of 1,000 feet is better for currants than a lower altitude. Currants will stand cold, and even fairly cool, climates, but not a hot one. In a hot climate the leaves of the currant bushes will fall early, thus reducing the strength of the plant and its ability to produce good crops in succeeding years.

12. Character of Soil for Currants.—Currants are grown on all kinds of soils, but each variety seems to have a set of soil and climatic conditions under which it will thrive best. Although almost any variety will grow and produce some sort of a crop and perhaps pay expenses anywhere in the Northeastern and Central States or in Eastern and Central Canada, yet the men who have achieved marked success in growing currants have been those who have found the one variety or strain particularly adapted to their conditions, as discussed under varieties, and have grown that one.

Generally speaking, the richer the soil is for currants, the better. It should be friable and easy of tillage to make expenses for this operation as small as possible. It should be well supplied with moisture, but not wet. If not properly drained it should be underdrained. Currants will not thrive if their roots are continually in an excessive amount of moisture.

SELECTION OF VARIETIES

COMMERCIAL VARIETIES

13. Red Currants.—Of the fifty or more varieties of red currants, the following are the more important commercially:

The **Cherry** currant has a strong-growing bush that is productive in most places. The fruit is large to very large and is borne in long, well-filled bunches; it is deep red in color, acid, and medium in quality. The tips of the branches of this variety sometimes go blind. The Cherry currant originated in Italy. The fruit matures in mid-season.

The **Fay**, or *Fay's Prolific*, currant shown in Fig. 1, has a bush that is a medium, spreading grower, the branches lopping and the fruit usually getting soiled; it is slow in starting to bear in some localities, but nevertheless is extensively grown. The fruit is large to very large and is borne in well-filled bunches; the berries are red and of a milder acid flavor than Cherry. The Fay currant originated in New York. The fruit matures in mid-season.

The **London Market** currant, as its name indicates, originated in England. The bush is erect in growth and is less injured by diseases and borers than many others. The fruit resembles that of the Fay, but is more acid. It matures its fruit in mid-season.

The **Prince Albert** currant, which originated in England, has an upright-growing bush with strong canes and is moderately productive. The fruit is medium in size and is borne in short bunches; it is pale scarlet in color and medium in quality. It matures its fruit very late.

The **Red Cross** currant had its origin in New York. Its bush is a strong grower and productive. The fruit is large and is borne in short, compact bunches; it is red in color and of excellent flavor. It matures its fruit in mid-season.

The **Filler** currant is productive and the fruit is red and of good quality, but it is not of as much importance commercially as some of the other varieties.

FIG. 1

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The **Pomona** currant has a bush that is rather spreading in its habit of growth and is productive. The fruit is bright red, of good quality, and contains but few seeds.

The **Red Dutch** currant is not recommended for planting. Both the bush and the fruit are small.

The **Versaillaise,** or *La Versaillaise*, currant is a seedling of Cherry and something like it. It originated in France. The bush is a good grower and productive. The fruit is matured in mid-season.

The **Victoria,** or *May's Victoria*, currant which originated in England, has a good growing bush that is little troubled by leaf diseases or borers; the foliage is very good, but is susceptible to injury by hot weather; the bush is very productive. The fruit is small, red, acid, and of good flavor; it is matured in the latter part of mid-season.

The **Wilder** currant had its origin in Indiana. The bush is a strong, upright grower and productive. The fruit is large and hangs well; it is red and of a good, mild flavor. The fruit is matured in mid-season.

The **Perfection** currant, shown in Fig. 2, is a good variety for table use when well grown. The bush is productive and the foliage good. The fruit is large, mild in flavor, and is borne in long bunches. The variety originated in New York, is comparatively new, and its place is not yet well determined.

The **Diploma** currant is a new variety with a strong-growing bush. The fruit is large and of good quality.

14. Black Currants.—A type of black currant is shown in Fig. 3. The following are the most commonly planted varieties of black currants:

The **Naples,** or *Black Naples*, currant has a strong-growing bush. The fruit is large and is borne in small bunches. The fruit matures in mid-season.

The **Lee,** or *Lee's Prolific*, currant is an improvement on Black Naples and is similar to it. The fruit matures in mid-season.

The **Champion,** or *Black Champion*, currant has a good-growing bush. The fruit is large, of mild flavor, and matures in mid-season.

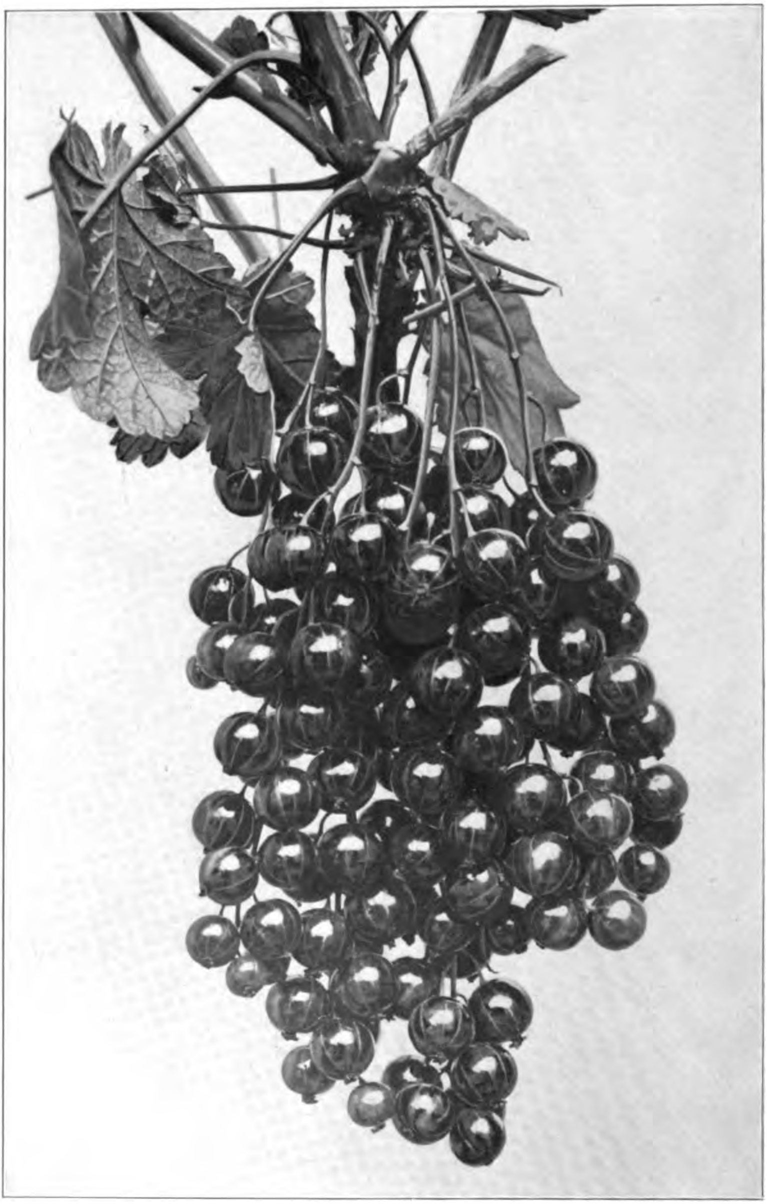

Fig. 2

13 Fig. 3

15. White Currants.—The following are the most commonly planted varieties of white currants:

The **White Imperial** is the best of the white currants. The bush is productive, and the fruit is a pale yellow, sweet, rich, and excellent for table use.

The **White Grape** currant has a productive bush, and pale yellow fruit that is mild and of good quality.

SELECTION OF VARIETIES SUITABLE FOR A LOCATION

16. The selection of varieties of currants for planting should be governed to a great extent by the success of various varieties in the immediate neighborhood of the purposed plantation. The experiences of growers in different localities on types of soil similar to that under consideration should also be considered. As examples of what has been done in the raising of currants the following instances may be noted:

In Niagara County, New York, one grower succeeds with Pomona and has secured as high as 7 tons per acre.

In Seneca County, New York, Prince Albert, a late variety, ripening in August and September, has proved profitable.

Fay is a standard variety, and, when well fertilized, a very good one in many localities. The bush tends to lop, however, and the fruit gets dirty.

Hepworth, of Marlboro, New York, grows Filler and has 70,000 plants. Filler is much more upright in growth than Fay and the berries are as large.

Perfection is doing well on heavy loam soils at Rochester, New York, and near by on a lighter loam soil Victoria outyields it.

Victoria, Versaillaise, Red Cross, and Wilder have done well in New Jersey.

Cherry is a good standard variety for a great many locations, but the bushes tend to produce smaller berries as they grow older.

Jefferson County Seedling and Versaillaise have done well on shaly land in the Hudson River Valley, New York.

According to information compiled by the American Pomological Society, varieties of currants, like varieties of other fruits, vary widely in their adaptability to different sections of the country. Some varieties have been found to succeed well in many different parts of the country, though with varying degrees of success in different sections, and other varieties have been found to do well in a certain few sections only. To simplify matters, the Society has divided the United States and the lower part of Canada into eighteen pomological divisions, or districts. These districts have nothing to do with the State or provincial boundaries but consist of territory adapted, because of its natural conditions, to the growing of fruits. In laying out these districts due consideration was given to the influence of latitude, elevation, prevailing winds, and the nearness to oceans and lakes. These eighteen districts are outlined and numbered on the map in Fig. 4.

The following lists of varieties arranged by districts, give under each division the varieties of currants that are known to succeed in that district. The varieties given in italics are known to be highly successful in the divisions in which they occur. The first time the name of a variety is given its less common name is put after it in parentheses. Where a division heading is omitted, such as Divisions 6, 7, 11, 17, and 18 in the following list, no varieties of currants are known to do well in that division. No detailed descriptions will be found of some of the varieties included in the following list. Such varieties are not considered to be entirely desirable commercially.

The information given in this list, however, should not be regarded as infallible, though it has been compiled with the greatest possible accuracy from the statements of the leading currant growers within each division. When the planting of any particular plot of ground is considered the experiences of local growers and the recommendations of the local agricultural experiment station should have careful consideration.

Division 1: Albert (Prince Albert), Champion (Black Champion), *Cherry*, *Fay* (Fay's Prolific), Lee (Lee's Prolific), Naples (Black Naples), Red Cross, Red Dutch (Large Red Dutch), Red Grape, Saunders (Saunders' Seedling Black), Versaillaise

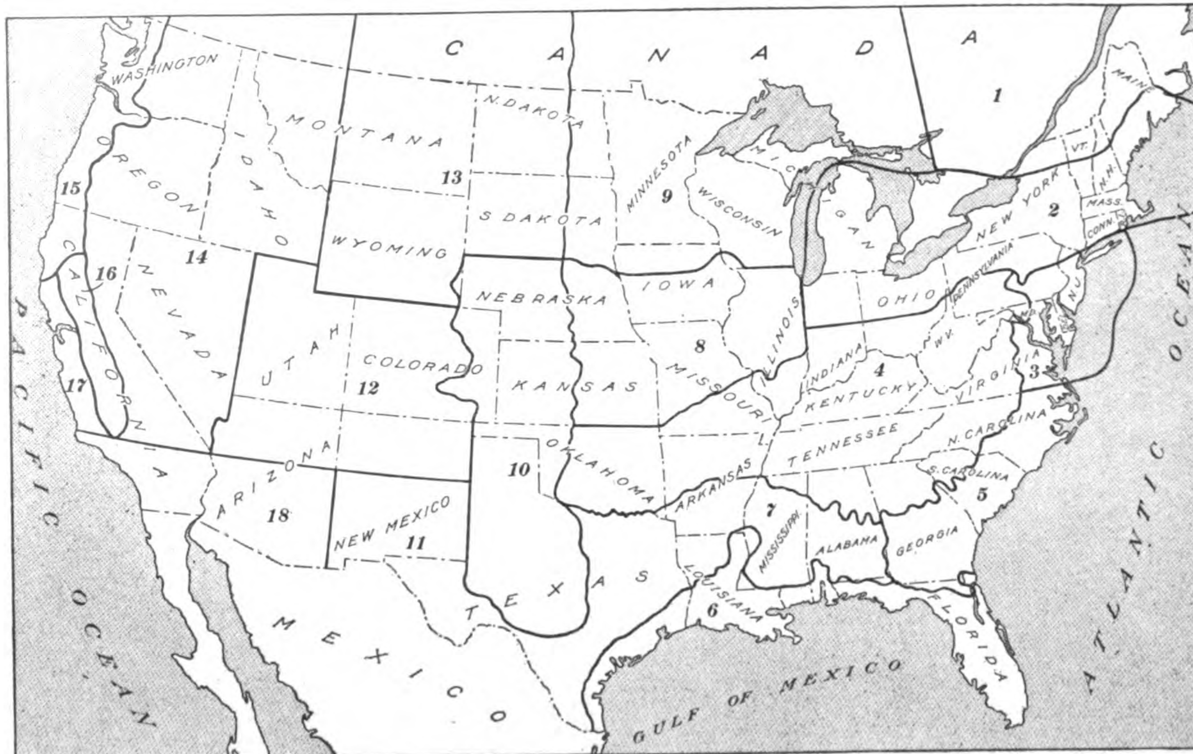
CANADA
PACIFIC OCEAN
ATLANTIC OCEAN
GULF OF MEXICO
MEXICO
WASHINGTON
OREGON
CALIFORNIA
IDAHO
NEVADA
MONTANA
WYOMING
UTAH
COLORADO
ARIZONA
NEW MEXICO
N. DAKOTA
S DAKOTA
NEBRASKA
KANSAS
OKLAHOMA
TEXAS
MINNESOTA
IOWA
MISSOURI
ARKANSAS
LOUISIANA
WISCONSIN
ILLINOIS
MICHIGAN
INDIANA
OHIO
KENTUCKY
TENNESSEE
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
S. CAROLINA
N. CAROLINA
VIRGINIA
W.V.
PENNSYLVANIA
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FIG. 4

(La Versaillaise), Victoria (May's Victoria), Wales (Prince of Wales), White Dutch (White Antwerp), *White Grape* (Imperial White), *Wilder* (Wilder Red).

Division 2: Albert, Champion, *Cherry*, English (Common Black), *Fay*, Holland, Lee, London (London Market), Naples, North Star, Pomona, *Red Cross*, Red Dutch, Saunders, Versaillaise, Victoria, White Dutch, White Gondouin (Gondouin White), White Grape, *Wilder*.

Division 3: *Cherry*, *Fay*, Lee, Moore, Ruby, Red Dutch, Versaillaise, Victoria, White Dutch, White Gondouin, White Grape, *Wilder*.

Division 4: Champion, *Cherry*, Lee, *Fay*, *Red Dutch*, Victoria, Wales, White Dutch, *White Grape*, Wilder.

Division 5: Crandall (Crandall's Black).

Division 8: Champion, *Cherry*, *Fay*, Holland, Lee, *Perfection*, Red Dutch, Versaillaise, *Victoria*, White Dutch, *White Grape*, Wilder.

Division 9: Albert, Champion, Cherry, English, Fay, *Holland*, Lee, *London*, Naples, *North Star*, Perfection, *Pomona*, Red Cross, *Red Dutch*, Red Grape, Versaillaise, *Victoria*, Wales, White Dutch, *White Grape*.

Division 10: Cherry, Defiance, *Fay*, North Star, Red Cross, *Red Dutch*, Red Grape, Victoria, White Grape.

Division 12: Albert, *Cherry*, *Fay*, Holland, London, *Red Dutch*, *Versaillaise*, Victoria, *White Dutch*, White Grape.

Division 13: Champion, *Cherry*, *Fay*, Holland, Lee, London, Naples, *Red Dutch*, Red Grape, Saunders, Versaillaise, Victoria, Wales, White Dutch, White Grape.

Division 14: Champion, *Cherry*, *Fay*, North Star, Red Cross, Red Dutch, Red Grape, *White Grape*.

Division 15: Cherry, *Fay*, Victoria, *White Dutch*, *White Grape*.

Division 16: Fay, Red Dutch.

17. Variations in Yields of Currants.—The average yield of different varieties of currant plants varies materially as is shown by a 3-years' record of a test at the Geneva, New York, Agricultural Experiment Station. In this experiment six varieties yielded as follows:

Variety	Average Yield Per Plant Pounds
Cherry	5.15
Fay	4.70
Gloire des Sablons	2.07
London Red	7.14
Prince Albert	8.86
Victoria	6.25

Under other conditions, however, entirely different results might have been secured, and hence the importance of finding out the yields of varieties in any particular neighborhood. With 2,723 currant bushes to the acre planted 4 ft.×4 ft., the difference in yield per acre with Gloire des Sablons at 2.07 pounds per bush and Prince Albert at 8.86 pounds per bush might be the difference between 5,637 pounds and 24,126 pounds, or as much as 18,489 pounds. At 5 cents per pound this would mean a difference in cash of $924.45 per acre. This no doubt is an extreme case, but it will serve to illustrate the importance of selecting the varieties best adapted to a location. It can readily be seen that different varieties may mean a difference in income of several hundred dollars per acre without any increase in cost of production outside of harvesting.

PROPAGATION AND SELECTION OF NURSERY STOCK

PROPAGATION OF CURRANTS

18. The currant is propagated commercially by means of cuttings and layers. A **cutting** is a young shoot cut off for rooting and development into an independent plant. A **layer** is a shoot or twig partly covered by earth to take root without being detached from a plant. The only difference between a cutting and a layer is that the cutting is entirely detached from the parent plant, while the layer remains at least partly connected with it. The method of propagation by cuttings has not proved uniformly successful in all instances, although large quantities of cuttings are made and sold every year for this purpose.

19. Propagation by Cuttings.—Currant cuttings should be taken from good, vigorous shoots of new wood, that is, from shoots of the current year's growth. Cuttings from young bushes that have not borne fruit appear to give better results than those from old bearing bushes, so far as rooting power and growth in the nursery are concerned.

Currant cuttings are usually made in the fall before freezing weather, though they may be made at any time from late in August to spring. In the dry climate of the Middle West the cuttings are usually taken in September. Currant cuttings are also sometimes taken after winter has set in, that is, during the time from December to February, although the latter time is preferable for taking cuttings during the dormant period. It is preferable to make cuttings after the foliage has dropped from the plant, and if taken late in the summer or early in the fall the leaves should be stripped off a week before the cuttings are made.

In the East, the cuttings are made from 6 to 10 inches long, though from 7 to 8 inches is the more common length. On account of the dryness of the climate in the Middle West, cuttings of 9 inches or longer are usually taken.

It is important to take considerable care in making currant cuttings, for the reason that they should be planted with the upper end, as it grew on the bush, up out of the ground. There is so little difference in diameter between the two ends of a currant cutting that some quicker means of identifying the two ends than examining the buds and leaf scars must be resorted to. This may be done by always cutting the lower end square off and cutting the upper end off at an angle. The portion of a currant cutting that was the lower end on the original bush will always produce the roots and the upper buds on the cutting will always produce the stems and leaves, no matter how the cutting is planted. Hence, in order to have straight plants, which the trade demands and which are generally more satisfactory, the plants must be put in the ground right end up, and they must also be planted straight.

After currant cuttings are made it is preferable to hold them dormant until their ends are well calloused. This may be done by tying them in bundles, usually from twenty-five to one hundred in a bundle, and storing them in sand or sawdust that is kept moist continually; moist moss is sometimes used, but because of its tendency to heat it is not desirable. Sawdust should be well wetted and allowed to drain before it is used. The callus is the white, waxy tissue thrown out by the cutting to sear, or cover up, the cut surface. The roots arise from the internal tissue, the cambium layer, beneath the callus. If freshly-cut wood is placed directly in the ground it starts root growth much less readily than when calloused over before setting.

In the dry parts of the Middle West, currant cuttings are not usually calloused by being stored in moist sand or sawdust, but after being cut in early September they are buried, butts up, (in order to prevent them from becoming water soaked) under 3 inches of soil until November, when they are planted in the nursery rows, right end up, and covered about 2 inches deep. In the spring this covering is raked off. This procedure is necessary on account of the dry climatic conditions.

Currant cuttings are usually grown 2 years in the nursery rows before being transplanted or sold. They are then known as 2-year-old plants.

20. Propagation by Layering.—A much more certain way of securing good currant plants than from cuttings is by **mound layering** stock plants. To do this certain bushes may be planted 5 to 6 feet apart each way, and allowed to become well established and begin to bear to make sure of the correctness of the variety. After the variety has been satisfactorily determined, the bushes can be cut back, early in the spring if necessary, to stimulate new growth, and the earth mounded up around them early in the fall, the mound extending high enough to cover the new wood. This encourages the sending out of roots from the new wood and the establishment of a number of independent young plants. The shoots that have sent out roots are removed from the stock plants early the following spring and transplanted in the nursery row. This operation is, of course, a severe pruning of the stock plant, and hence the stock plant is stimulated to send out another growth of young shoots during the summer that may, in turn, be mound layered in the fall. Under such treatment a vigorous stock plant is good for probably 5 or 6 years after the process of mound layering has been started.

21. Propagation of New Varieties.—New varieties of currants are grown from seed, which may be taken as soon as the fruit is ripe. These seeds are washed from the pulp, mixed with sand, and kept in a cool, shady place until spring, when they may be sown ½ inch deep in flats, or shallow boxes, filled with rich loam. These flats should be sunk in the ground or put in the greenhouse and kept damp. The seeds soon germinate, and the plants are potted when they are 2 or 3 inches tall, and are later transplanted in the nursery. No dependence can, of course, be placed on securing good currant bushes from plants grown from seed, and for that reason many plants are of no value commercially. In fact, a grower may have to work for many years before he secures a bush that may be considered a desirable new variety.

22. Planting Currants in the Nursery Row.—For the best results, the land for a currant nursery must be rich, easily worked, not too stony, and should be reasonably free from weeds—the freer from weeds the better. In the fall the land should be well and deeply plowed and well manured, and in the spring it should be well harrowed and the soil reduced to a finely pulverized condition.

The rows for the currant plants should then be marked out from 3 to 3½ feet apart and a trench about 6 inches deep opened on each row. If a large quantity of stock is to be planted the trench may be most economically opened with a **trencher,** shown in Fig. 5 (*a*); the detail of the plow is shown in (*b*). The purchase of such an implement is warranted only when a large number of plants are set annually, as in a commercial nursery. If only a small number of currants are to be planted the trench may be opened with a spade.

The trench being ready, a man drops the cuttings or layers at distances along it so that they are convenient for the planters. If the bundles are made up of cuttings, the planters, men or boys, take a bundle in one hand and stick the cuttings singly into the trench with the other, putting them in straight and from 2 to 3 inches apart and of such depth that but two buds, or eyes, project above ground. When the trench is opened

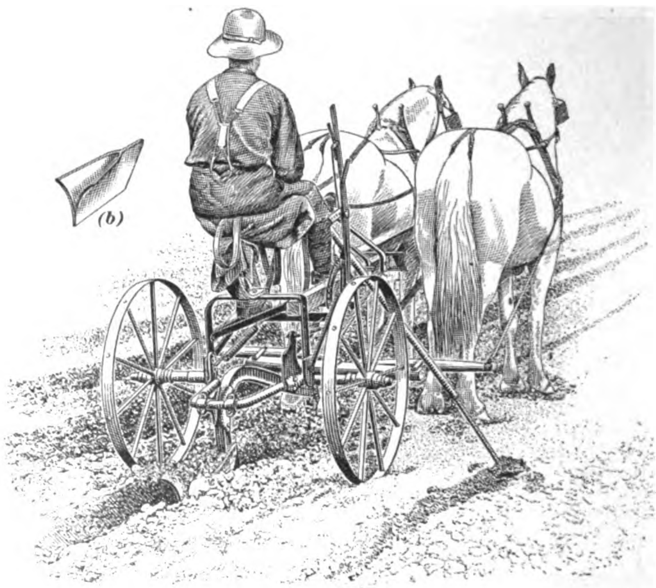
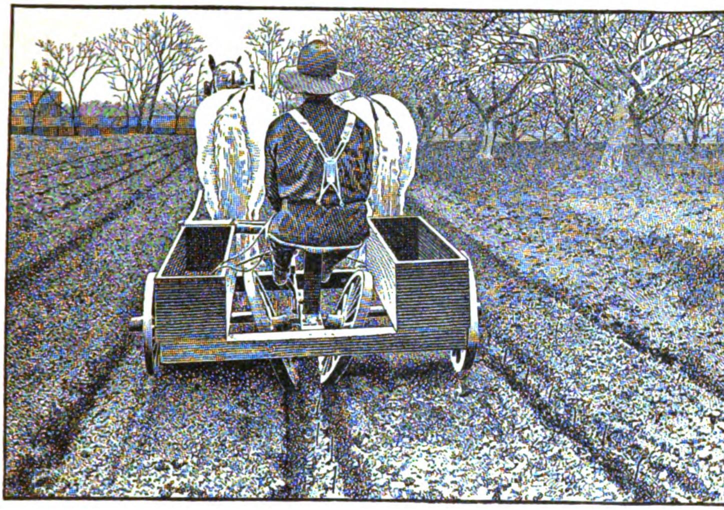


FIG. 5

with a spade it is commonly the case that the man using the spade also sticks the cuttings into the ground, three to the width of the spade. As soon as the cuttings are in the ground the earth should be firmly pressed about them; nothing else in the planting process is so important as this packing. When the planting is done on a large scale the earth is usually pressed about the cuttings by a **firmer,** shown in Fig. 6, which is drawn by horses, but on a small scale the earth is usually



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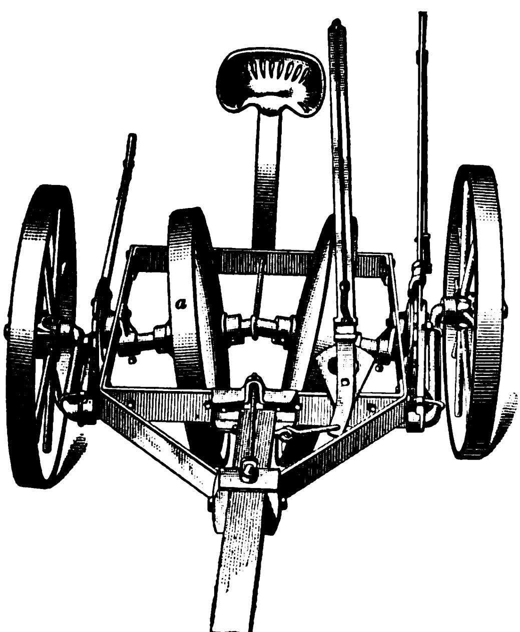

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FIG. 6

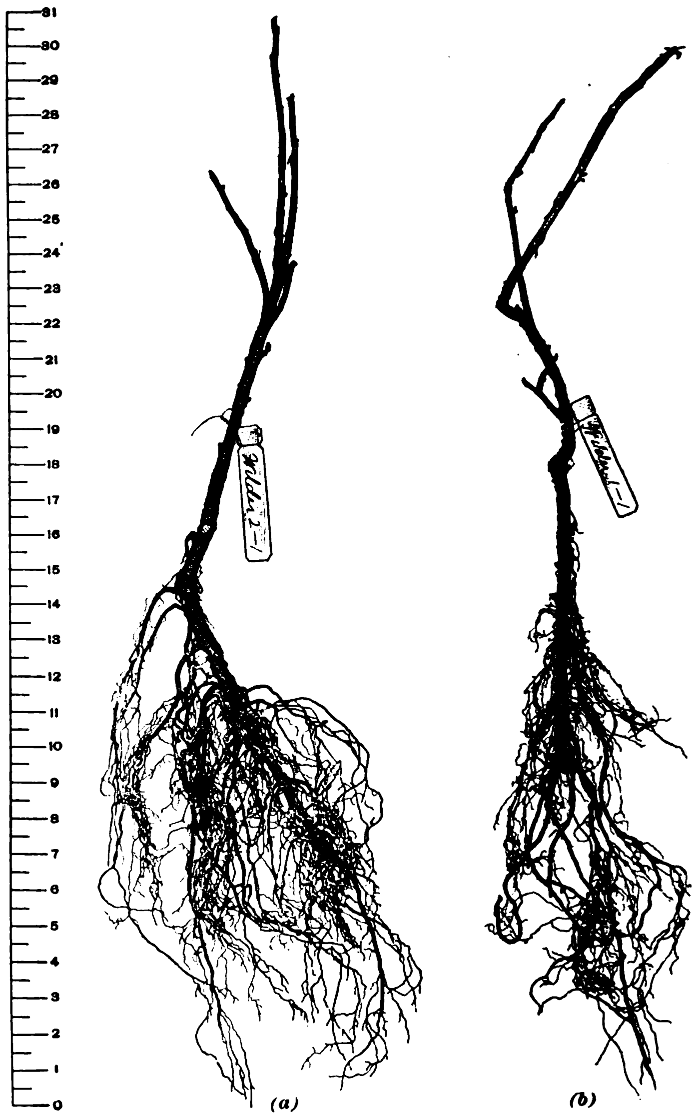
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FIG. 7

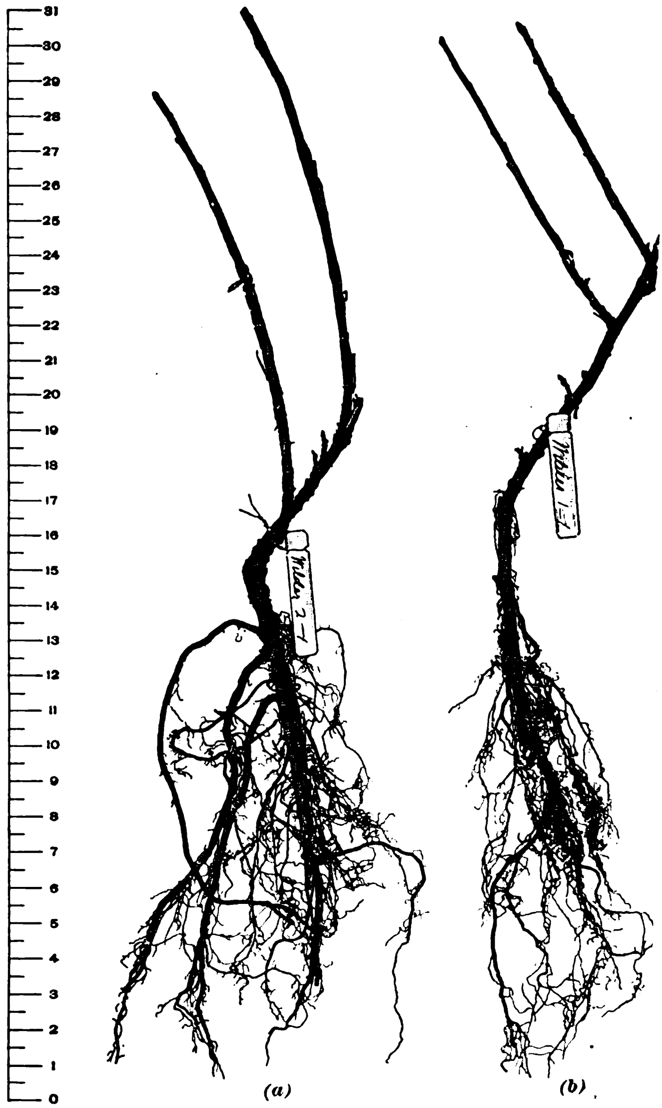
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FIG. 8

tramped firm with the heel. In Fig. 6 (*a*) is shown a home-made firmer, in which the necessary weight is secured by loading the boxes on the sides with stones; in (*b*) is shown a manufactured firmer in which the packer wheels *a* weigh 500 pounds each and are adjustable on the axle for any width of row.

After the ground around the cuttings has been firmed the space between the rows should be cultivated immediately.

No manure or fertilizers should be applied after the currant cuttings or layers are in the ground. All such materials should be applied before the planting, and should be applied to the previous crop if possible. Currant cuttings and layers are very easily injured by coming in contact with such fertilizer ingredients as acid phosphate, muriate of potash, nitrate of soda, etc.

Next to avoiding the application of fertilizers after the cuttings are set, the most important thing is cultivation. This should be done by running the cultivator carefully up one side of the row and down the other, taking a row at a time, and giving each row the same treatment. This should be done at least once a week.

Currant worms may have to be fought in a currant nursery, as described later.

SELECTION OF NURSERY STOCK

23. Qualities of a Good Currant Nursery Plant. Currant plants are sold as 2-year-old No. 1 and No. 2, and 1-year-old No. 1 and No. 2 plants. The size of the bush will depend somewhat on the variety; a good 2-year-old No. 1 will be stocky, vigorous, 15 or more inches in height above the roots, and will have a strong, vigorous root system. A good nursery plant should be free from cane borers and other injurious insects. The No. 2 grade differs from the No. 1 grade only in that it is smaller in size.

In Fig. 7 are shown desirable currant nursery plants; in (*a*) is shown a good 2-year-old plant, and in (*b*) a good 1-year-old plant. Note the much better root system of the 2-year-old plant. An abundant root system is the most important feature to secure in a currant nursery plant. In Fig. 8 (*a*) and (*b*) are shown 2-year-old and 1-year-old currant nursery plants, respectively; these are good plants but slightly less desirable than those shown in Fig. 7, on account of their less abundant root systems. Both 2-year-old plants are of the No. 1 grade and both will sell for the same price, but the one shown in Fig. 7 (*a*), on account of the more abundant root system, will be more likely to produce the better results; this may appear to be an unimportant point, but the most successful fruit growers owe their success to attention to such details. The same will also hold true of the 1-year-old plants. The scale shown in Figs. 7 and 8 is graduated in inches and serves to give an idea of the actual size of the plants.

24. Purchasing of Currant Plants.—In the purchasing of currant plants, as with any other fruit stocks, it is wise to deal with reliable firms, preferably with those in the immediate vicinity. Visit the nursery and see the stock. If not conversant with the different varieties of currants, the prospective buyer should take some person with him who knows and the visit should be made while the plants are in leaf. Almost all varieties have some characteristic, some earmark, which indicates their identity, but to become acquainted with such details entails a certain amount of experience.

In the fall or in the spring, according to which planting season is selected, the planter should go to the nursery and get the plants dug as they are needed. They are much better for being freshly dug, and this is one advantage of buying the plants near home.

PLANTING OF CURRANTS

25. For currants, the soil should be rich. If it has been growing alfalfa or clover and these crops have been well manured it will be in good condition for currants. Generally speaking, a soil cannot be too rich in organic matter for currants.

For currants the land should be plowed in the fall, and if the weather conditions at this time are favorable, there is no objection to finishing the preparation of the soil then and planting out the currants at that time, although the spring is more generally preferred. If left until the spring, the planting must be done early, for the currant is one of the earliest plants to start into leaf.

It is possible to plant currants even after the buds have started and the leaves have begun to show, provided care is taken to keep the roots damp while they are out of the ground and not to permit them to be long exposed to the air. But should a frost come at night, after a warm day, as is often the case, currant plants planted in this condition are liable to injury that will seriously retard them for the season. It is much better, all things considered, to keep the plants dormant, if possible, until they are planted.

26. Distances for Planting Currants.—For planting currants, all kinds of distances between 4 ft.×4 ft. and 6 ft. ×6 ft. are used, more space being commonly given to the black currant then to the red and white. In selecting the distance for planting on any particular farm, the characteristic growth of the variety chosen for planting under the given set of conditions will have to be known and considered by the planter. The habits of growth of a variety under one set of conditions may be no guide to another planter, and this is reason for proceeding with caution. It should always be borne in mind that sunlight is an absolute necessity in the fruit business, and that for the best results room enough must be allowed between the plants so that the sun will reach all parts of the bush at some time during the day.

A common distance given for currants on sandy land or on land that will not tend to produce a vigorous wood growth in the bushes is 4 ft.×4 ft. On heavy land in New York are some currant bushes that have been planted 4 years which are 5 feet in diameter, so that, although they were planted 5 ft. ×6½ ft., it is now impossible to cultivate between them in one direction after the fruit has set, because of the damage that will be done.

In general, 4 ft.×4 ft. is a good distance to plant currants on almost any soil, because this distance will give the plants plenty of room during the first 4 years of growth. If, after this time.

they begin to crowd, the alternate diagonal rows may be removed, throwing the bushes into a new alinement and spaced 5 ft. 8 in.×5 ft. 8 in. On land that is known to produce an abundant wood growth in currants, it may be better to plant the currants originally $4\frac{1}{2}$ ft.×$4\frac{1}{2}$ ft., and then when the alternate diagonal rows are removed the bushes will finally stand 6 ft. 4 in.×6 ft. 4 in.

Some currant growers space their rows from 4 to 6 feet apart and plant the bushes from 2 to 3 feet apart in the rows, but this method of planting is not good, because it permits of cultivation in one direction only, and usually causes the plants to become crowded.

27. Preparation of Soil for Planting.—Soil should be well prepared for currants, because it is important that they get a good start in their permanent positions. The soil should be well plowed and then cultivated with harrows until it is in a finely pulverized condition and suitable for a seed-bed for almost any kind of plant. If the bushes are to be planted in the spring, the soil should be plowed in the fall, and the preparation finished in the spring. This practice will enable the planter to get his currant bushes in early—a very essential point in currant planting.

28. Method of Planting.—As soon as a good seed-bed has been secured, the rows for the currants should be marked out in both directions at the desired distance, as is often done for corn when planting the seed by hand. A good plowman may now throw out furrows in both directions across the field, following the marks previously made. In doing so, it is important that the plowman either plow out the furrows all one way, returning across the field with his plow out of the ground, or else plow half the field one way and half the other, practically making the whole field into one large plow land. This is an important detail to observe, for it will be found that in plowing backwards and forwards on adjacent rows there will be a discrepancy in the diagonal alinement of the intersecting points, which will be less pronounced if half the field is plowed one way and half the other. Theoretically, there should be no difference whether the furrows are all turned one way or are turned alternately in opposite directions, if the plowman follows the marks on the ground, but practically it does not work out that way.

This matter may seem to be an unimportant detail, but it is important for the reason that it is necessary to have the currant bushes line up in every direction so that horse-drawn tools can be used for cultivation in any direction, and that after they are once adjusted to the distance between the plants, the cultivation can be carried on rapidly without injuring any of the individual bushes in the field.

After the rows are furrowed out the currant plants are dropped by one man at the intersections of the furrows. He is followed by planting crews of two men each, one crew on each row if the planting is extensive enough to warrant such a working force. In small plantings two men should be able to handle the work. In the planting crew one man should shovel out the hole at the intersection of the rows a little deeper if necessary and fill in the dirt around the bush, and the other man should hold and sight the bush into line and then tramp the earth into place as soon as it has been filled in.

No pruning is given to currant bushes at this time other than to remove an injured root or branch. As soon as the field is planted a one-horse cultivator should be run through the patch in both directions; this stirs the soil close to the plant, pushes a little soil toward each plant, and makes a dust mulch over the whole field.

CURRANT PLANTATION CULTURE

TILLAGE, MULCHING, AND COVER CROPS

29. On a small currant plantation a common five-toothed one-horse cultivator will be one of the most generally used tools, and for the first year after planting, either this or a two-horse riding cultivator which straddles a row of bushes, will be all the implements needed.

It is not the best practice to plow a currant plantation. Preferably the land should be kept level. If the land is weedy, for example, full of quack grass, it is better to concentrate on the problem the first year while the bushes are small and clean up the ground as completely as possible. To do this it will be necessary to cultivate every few days, throwing the soil toward the plants to cover up small weeds at the start, and then taking it away later by adjusting the cultivators to do so, and thus saving hand labor. If this is done properly there will be no necessity for hand hoeing the first year.

The second and succeeding years, if a cover crop is grown, the land between the bushes may be disked as early in the spring as it is possible for a horse to go on it, running a narrow disk harrow in both directions. After this has chopped up the cover crop and weeds, it is a good practice to use a narrow-toothed orchard cultivator and cultivate the land in both directions. Later, wider teeth should be put on the harrow, and finally the shovel points, or sweeps, which run under the surface of the ground and cut off anything that may be alive, should be used.

After the bushes are well grown and it is necessary to work close to them, attach a long sweep 12 to 14 inches to each of the side teeth of a large sized one-horse cultivator; these sweeps will run under the overhanging part of the bushes and cultivate the ground, and after they have been run through in four directions there are but few weeds left to be removed by hand. When a currant plantation is cultivated in this way one hand hoeing per season will be enough to keep it free from all weeds. The important thing to remember in this cultivation is to begin early enough in the season, before the buds start into growth if possible, so that all the cultivation close to the plants will be over before there is a possibility of knocking off the fruit and leaf buds. The tillage need not be deep—about 2 inches is deep enough.

As already indicated, cultivation of the most thorough kind should be given in the currant plantation from early spring until July when the fruit is picked. Just before or about picking time, it is advisable to sow a cover crop. Some good growers do not plant a cover crop, but keep the land cleanly cultivated during the whole season. Such treatment, however, is not considered the best practice.

In sections where snow storms are severe and the bushes tend to bend down under the weight of the snow, it is customary to tie them up in the fall, using binder twine or some such material. The twine is merely run around the bush as a whole and serves to keep its branches from spreading out and down. This tying up must be done before the wood is frozen; otherwise it is apt to crack and break.

30. On a small scale, mulching with straw, coarse hay, etc. is a success with currants, and there is no reason why it would not give satisfaction in extensive plantations where suitable and sufficient mulching material is available. If mulching is regularly employed, a somewhat closer planting than that previously recommended will be suitable.

31. The clovers are particularly desirable cover crops for currants. Wherever the land and climatic conditions are suitable, Crimson clover may be sown at the rate of 12 to 15 pounds per acre, or the same quantity of a mixture of equal parts, by measure, of Red clover and Crimson clover, sometime late in June or in July after picking. An excellent cover crop in some sections is either of the above with 1 pound of Cowhorn turnip seed per acre added, or, in other years, instead of the turnips, 3 pounds of Dwarf Essex rape. If the land is foul with quack grass, no other crop is so effective in helping to check it as rape; in such cases a heavy seeding of from 4 to 5 pounds per acre should be made; the rape grows quickly and covers the land effectually.

Where Crimson clover will not thrive, one grower finds ragweed and pigweed, especially the latter, excellent cover crops, and both have the advantage that they seed themselves and thus reduce the expense to a minimum. A good crop of almost any of the so-called weeds is an excellent cover crop.

In the South, a crop of cowpeas or soybeans may be grown between currant bushes, seeding at the rate of from 3 to 5 pecks, or 45 to 75 pounds, per acre, and for a late cover crop for sowing in September, oats or barley at the rate of 3 bushels per acre are acceptable, since they make a thick mat and are usually winter killed.

PRUNING OF CURRANTS

32. Currants are pruned to stimulate the growth of sufficient new fruit-bearing wood, to get rid of the wood that is no longer suitable for fruit bearing, and to keep the bush open to admit light to color the fruit.

Practically no pruning is given to currants until the plants have been established for 4 or 5 years, at which time the process

FIG. 9

of securing on each bush a succession of canes of different ages is begun. Each cane, or branch, is believed to reach its best development in from 3 to 5 years, and after this it should be removed. The aim should be to keep each bush with about five or six canes. The new shoots arise from the roots, and if one of these is allowed to develop annually and the other new shoots are removed, together with one old one, the bush will be renewed all the time. Currant bushes so handled have been vigorous and productive for 30 years after planting, so that a currant plantation need not be so short lived as many have been; 8 to 12 years is the average life of a currant plantation when neglected. A full-grown currant bush is shown in Fig. 9.

Fig. 10

In England, a certain amount of summer pruning is practiced on currant bushes with very good results. The new growth is shortened back to two or three buds in July or August, thus encouraging the production of fruit buds lower down on the cane. In this way one cane is left on a bush much longer than 5 years. So far as known, this method of pruning has not been practiced in commercial plantations in America.

Tree currants, as shown in Fig. 10, are sometimes grown, either by training the bush to a central stem as a trunk, or by grafting the currant on the Missouri, or Flowering, currant, a native of the western part of the Mississippi Valley. Such plants, however, are oddities and are of no commercial value, for if the borers work in the trunk the bush is totally destroyed; in the bush form there are usually from four to eight separate canes to work with, and it is unlikely, when even ordinary care is given to a plantation, that all of the canes will suffer from borers at once. The tree currant, shown in Fig. 10, was photographed in its second year of bearing.

FERTILIZATION OF CURRANTS

33. Since currants naturally grow in land rich in organic matter, the native varieties being found in such locations, it is generally advisable to apply barnyard manure to currants on any type of soil. If the manure is not rotted, probably the best plan is to apply it in the fall, so that it will not interfere with spring cultivation. Where good cover crops are grown, it may be possible to get along without the use of manure, provided proper quantities of concentrated chemical fertilizers are used.

In regard to the matter of chemical fertilizers, which must be frequently used, either to augment manure or as a substitute, it is practically impossible to give the grower more than a suggestion. Each grower must determine for himself the materials that will give the best results on any particular patch, and this can be ascertained only by experiment. The necessity for such experiments is shown by the fact that frequently only one or two of the three principal fertilizer ingredients—nitrogen, phosphoric acid, and potash—will be needed on a soil, and that the others, if applied, are applied at a loss. For instance, on the soil at the Massachusetts Agricultural Experiment Station, it was found that marked benefit was secured on currants from the application of potassic fertilizers only. To determine the efficiency of fertilizers, test strips should be made through the currant plantation; that is, certain sections of the ground should be reserved for experiments and fertilized in different ways. On some strips only one each of the fertilizer ingredients should be applied, and on others different combinations should be tried. The determination by experiment in this way of the relative values of different forms of phosphates such as basic slag, acid phosphate, and ground bone is even advisable. In addition to nitrate of soda, some of the more slowly available forms of nitrogen are worthy of trial on currants. One of the best of these is cottonseed meal, and if fish guanos, and wool and hair wastes can be economically secured, they may also be used for this purpose.

34. During the time that experiments such as the preceding are being tried, or even as a general, though perhaps not an economical, practice, an application of from 400 to 500 pounds of bone meal and 100 pounds of dried blood, or an equivalent of some grade of tankage, to the part of the plantation not being experimented on, would be safe. In place of these materials, it might be wise to try as a substitute 600 or 800 pounds of basic slag, 100 pounds of nitrate of soda, and 100 pounds of muriate of potash per acre, the basic slag and the muriate of potash being applied in the fall after the foliage has fallen from the bushes, and the nitrate of soda being applied close to the rows with a fertilizer barrow, similar to that shown in Fig. 11, after the growth has started in the spring; care, however, must be taken not to allow the nitrate of soda to come in contact with the plants, because it is liable to burn them. Where a good clover crop is grown annually as a cover crop, the application of the nitrate of soda may possibly be omitted without affecting the growth of the plants.

For currants, the late Professor Vorhees, of the New Jersey Experiment Station, suggested an application of from 500 to 1,000 pounds per acre of a mixture composed of 100 pounds each of ground bone, acid phosphate, and muriate of potash, or of 150 pounds of ground bone and 100 pounds of muriate of potash.

Samuel Fraser, of Livingston County, New York, a prominent currant grower, applies to his currant patch each year in the fall or winter 1,000 pounds of basic slag and 200 pounds of muriate of potash, and care is taken not to allow the latter to touch the plants. In the spring after the fruit has set he applies 150 to 200 pounds of nitrate of soda. Every 3 or 4 years he applies 1 to 2 tons of lime per acre.

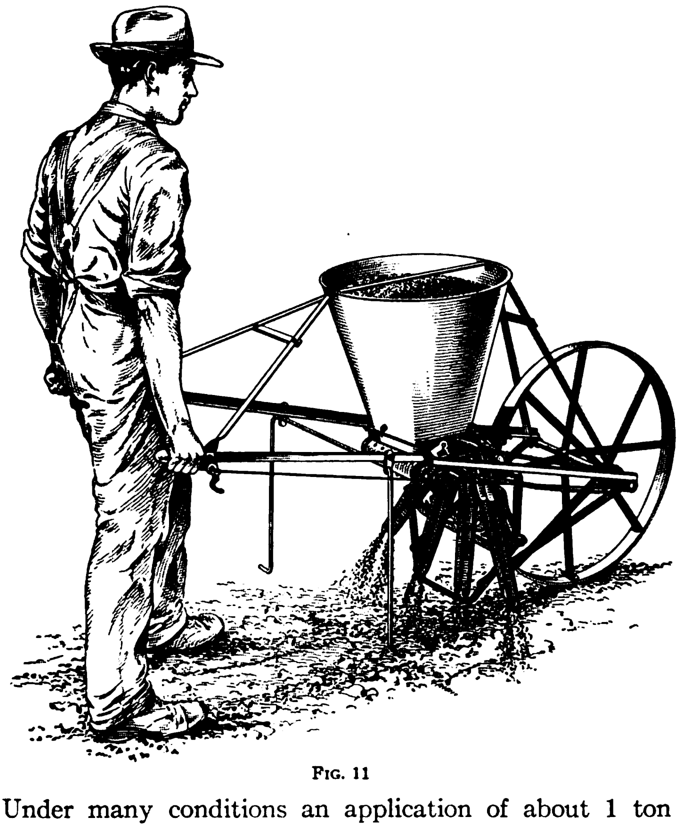

FIG. 11

Under many conditions an application of about 1 ton of air-slaked lime, or its equivalent, to each acre may be advisable.

The importance of getting most of the work of applying fertilizers and lime done when travel among the currant bushes is easy, should constantly be borne in mind. The bulk of these materials should be applied during the fall and winter.

CURRANT TROUBLES

INSECTS

35. San José Scale.—One of the most serious troubles of the currant in the past has been the San José scale, the life history and description of which has been given in the discussion of tree fruits. On the currant, it can be controlled by thorough sprayings early in the spring with lime-sulphur or with some oil preparation, but unless particular care is taken to make a thorough application some scales will be missed and these will multiply rapidly. In the Eastern States during the last 15 years many currant plantations have been wiped out by the San José scale.

36. Currant Borer.—The parent of the currant borer, the currant moth, is bluish-black in color and has three yellow bars extending across the abdomen. It lays eggs on the cane in the spring. These eggs soon hatch out small borers, which eat their way into the pith, where they feed for the season. These small borers pupate in the fall and give rise to the mature moth the next spring. The injury done to the cane by the currant borer is generally sufficient to cause its death, and in any event materially to weaken the plant. So far as known, the only way to overcome it seems to be to watch for weak canes, and when these are found, cut them off close to the ground, take them off the plantation and burn them. In Fig. 12 are shown currant canes that have been injured by the currant borer. In (*a*) are shown the horizontal tracks of young larvas; the bark has been cut away to show the burrows and the first development of a gall. In (*b*) is shown the cross-section of a currant cane through a gall; at *a* is shown the point of entrance of the larva, and at *b* the lateral track of the larva.

37. Currant Worm, or Currant Saw Fly.—An enemy of the currant known as the currant worm, or currant saw fly, shown in Fig. 13, was imported into America from Europe. The adult is a four-winged fly something like a common house fly.

These flies will lay small white eggs on the under side of leaves, frequently in a row on the veins of the foliage. There may be two or four broods a year. It is, therefore, important that the first brood be controlled. Some poisonous insecticide should be used for this purpose. Since it is now necessary in most places to spray the foliage to preserve it from fungous diseases, it is wise to combine the insecticide with the fungicidal spray used at this time. If the spraying is done as soon as the plants have finished blooming and before the currants are large no danger of getting poison on the fruit is incurred, but it is not

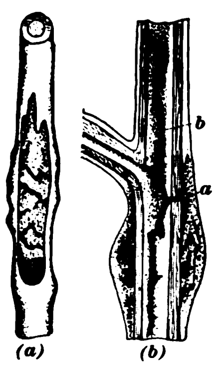

FIG. 12

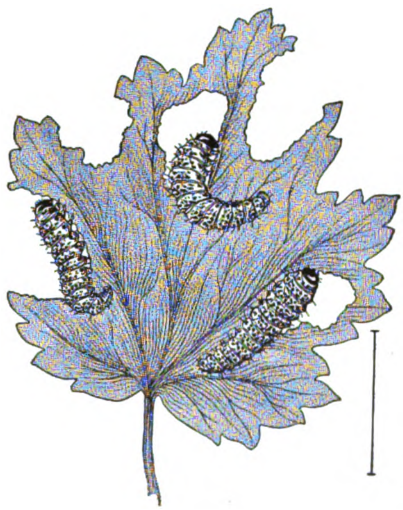

FIG. 13

wise to apply an arsenical poison when the currants are near maturity. Should a spraying have to be made when the fruit is near maturity, it is more advisable to apply hellebore, either dry or mixed with water, strength ½ ounce (1 teaspoonful) to 1 gallon, rather than any poisonous material.

If arsenate of lead is used as the insecticide, it should be used at the rate of 2 pounds to 50 gallons of the spray liquid. It is much better than Paris green, because it sticks to the foliage longer.

It is important in spraying for the control of the currant worm that all of the foliage be coated. No halfway measures will be sufficient to control this pest. Whenever a good spraying with arsenate of lead is given in the first instance there will be no need to spray the currants again for the currant worm when the fruit is near maturity.

38. Green Leaf Hopper, or Currant Leaf Hopper. A sucking insect, called the green leaf hopper, or currant leaf hopper, sometimes causes trouble on currant bushes by sucking the juice from the under side of the foliage. These insects must be controlled by contact sprays. Perhaps the best means for controlling them is one of the standard nicotine preparations mixed with the ordinary Bordeaux mixture, lime-sulphur, or other spraying material.

FIG. 14

39. Yellow Leaf Currant Bug, or Four-Lined Leaf Bug.—The insect known as the yellow leaf currant bug, or four-lined leaf bug, is sometimes troublesome. It is about $\frac{1}{3}$ inch long and has four black stripes extending its entire length, hence the name. These bugs appear in May, but are then very small, and depart in July. There is but one brood.

The individuals of this brood lay eggs on the tips of the shoots. The young insects emerge from these eggs the following May and suck the juices from the leaves, causing brown, angular areas of dead tissue, such as shown in Fig. 14. One means of controlling this pest is to remove and burn the tips of the branches with the eggs on them. To kill the insects themselves it is necessary to use a contact spray, and since they are the least active early in the morning, this is the best time to apply it. Nicotine is probably the most effective insecticide.

40. Grape Flea Beetle.—Currant foliage is sometimes injured after the fruit is harvested by the attacks of the grape flea beetle, which eats holes in the leaves. This pest may be controlled by spraying with some arsenical poison.

41. Currant Plant Louse.—The small currant plant louse appears on the under surface of the currant leaves toward midsummer, causing the leaf to assume a blistered and puckered appearance. Unless these insects are controlled early in the season they soon curl the leaves so that they are difficult to reach with a spray. Many of the lice are destroyed by the two-spotted lady bug and certain other parasitic insects also attack them. Usually, currant growers do not spray for the currant plant louse, but should it be deemed necessary one of the nicotine sprays would probably be best. Like other insects of this class, it must be controlled by contact sprays.

42. Currant Miner.—The small larva called the currant miner is the early stage of a tiny moth. This larva works under the bark and makes small holes in the currant canes; the holes, although not of themselves serious, afford entrance to fungi, which become serious menaces to the life of the plant. No means of control of the currant miner is yet known.

DISEASES

43. Leaf Spots.—The two principal diseases that attack the foliage of currants are the leaf spots. Leaves affected with these two diseases are shown in Figs. 15 and 16. These

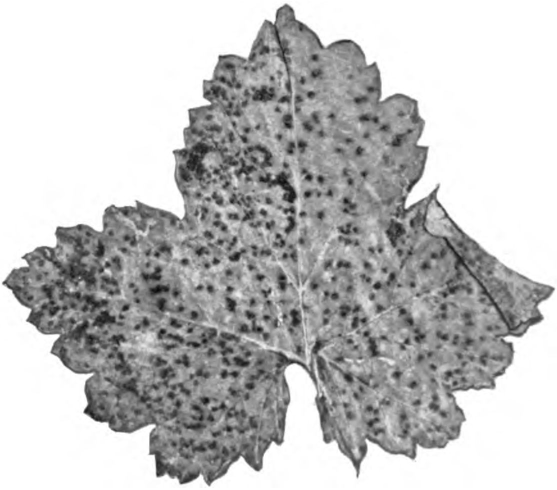

Fig. 15

Fig. 16

diseases cause the formation of spots on the leaves and the ultimate loss of the foliage by the early part of the summer. This seriously weakens them for the succeeding year.

The two leaf spot diseases can be controlled by thorough applications of Bordeaux mixture or of lime-sulphur. Spraying with a 5–5–50 Bordeaux mixture (5 pounds copper sulphate, 5 pounds of stone lime, water slaked, 50 gallons water) to which has been added 4 pounds of arsenate of lead has been found to be the most effective. Lime-sulphur solution for the combating of the currant leaf spots should be of specific gravity 1.009 (that is, concentrated lime-sulphur solution of 33° Baumé, or specific gravity 1.295, diluted 1 to 30 with water). The presence of arsenate of lead in combination with lime-sulphur also increases the fungicidal value of the lime-sulphur.

Several of the proprietary fungicidal spray solutions have also been found to be effective on the currant leaf spots.

SPRAYING OF CURRANTS

44. When spraying currants it is necessary to have a sprayer that is conveniently arranged and one capable of giving satisfactory results. It is the experience of successful currant growers that an automatic sprayer with standards of nozzles on the sides will not apply the spray satisfactorily to all parts of a large bush. It has been found absolutely necessary to have trailers, and for the men operating the trailers to spray each bush from all sides in order to coat it properly. The spray pump should be powerful enough to maintain a constant pressure of at least 80 to 100 pounds per square inch even when two nozzles are placed on each hose, as is necessary when large bushes are to be sprayed.

One grower made a very efficient spray that is narrow and has a long tank with a capacity of 150 gallons. On top of the tank is a large pump that can be operated either by hand or by a small gasoline engine if desired. The rig is equipped with sufficient hose to spray three rows on each side of the machine, or six rows in all, at one time. A compressed-air spraying outfit is a very convenient one, since the trucks can be made quite narrow, but a good man-power outfit, such as the one just described, is sufficient for a plantation up to 10 acres.

To control the insect enemies and the diseases of currants, the following sprayings should be given:

1. Before the buds open with a 1 to 9 lime-sulphur solution to control the San José scale (specific gravity 1.03—that is, 33° Baumé lime-sulphur diluted 1 to 9 with water).

2. As soon as the plants have gone out of bloom, with 5–5–50 Bordeaux mixture (5 pounds of copper sulphate, 5 pounds of lime, water slaked, 50 gallons of water), and a 2–50 arsenate of lead (2 pounds of arsenate of lead to 50 gallons of Bordeaux mixture) combined to control the leaf spots and currant worm; when arsenate of lead is used in this spraying there is often no necessity for applying it again. Sometimes a 6–6–50 Bordeaux mixture is used.

3. As soon as the fruit is harvested, with the same spray as that given in paragraph 2, or without the arsenate of lead if the currant worm has been controlled by the previous spraying.

In some cases an application of 5–5–50 Bordeaux mixture between the second and third regular sprayings is advisable to control the leaf spots, but this application should not be made so late that the spray will stain the fruit.

INJURIES DUE TO LOW TEMPERATURES

45. Thus far no means have been tried in the East for the protection of currant plantations from frost, nor has it been considered necessary to do so, since it is cheaper and more satisfactory to locate a plantation properly and thus avoid the possibility of such troubles. As in the location of other fruit plantations, care should be taken to avoid frost pockets; the bushes should always be located on a slope or on an elevated part of land where they will have a good circulation of air about and between them.

Currant bushes are very susceptible to injury from frost, and if they are located in a frost pocket, or are in a spot exposed to frosts, and the buds start early in the spring and are injured by a frost, the entire crop may be lost. In some cases the leaf buds as well as the fruit buds may be injured by a frost. In other cases, due to unfavorable weather conditions, the bunches of fruit will not be well filled and the tip berries will fall off. This may be due to frost injury but it is possible that it may be due to a lack of pollination.

HARVESTING, STORING, AND MARKETING

HARVESTING

46. Currants are harvested from the latter part of June to the middle or the latter part of July, as soon as the bunches begin to show a uniform color of red, white, or black, as the case may be. Only one picking is made, the bushes being picked clean at this time. From 7 to 10 days are generally available for the harvesting, because currants will hang on the bushes and remain fairly firm for several days after they are well colored. For this reason, the crop does not have to be handled with the same haste that the strawberry and raspberry crops must be handled.

The pickers are usually engaged by piece work. If they are paid from $\frac{3}{4}$ to 1 cent per pound, some pickers will earn $2.50 per day. Sometimes the pickers are paid by the quart basket, and receive 2 cents per basket. Women and children are usually employed for the work, and frequently one watcher is needed for every ten or twenty pickers.

To secure the best results, certain precautions should be taken. The fruit should not be picked when wet, as moisture in the crates will hasten its decay. To be attractive when it reaches the market, it must be kept clean. To avoid bruising the fruit by too much handling, it is best to have the picking done so that the fruit will have to be sorted but little. Further, to prevent the crushing and bruising of the fruit, care should be exercised as to the method of picking. The fruit is borne in clusters, and to avoid crushing it the stem of each cluster should be grasped with the thumb and forefinger and the bunch detached from the bush without touching the berries at all. There is a tendency on the part of currant pickers to strip the berries off the bunch as they pick them. This injures the keeping quality of the fruit, and its salability, because it mutilates large numbers of the berries and liberates large quantities of juice, which smears the perfect berries and hastens their

Fall Brook Farm
½

Fall Brook Farm
1

Fall Brook Farm
3

Fall Brook Farm
5

Fall Brook Farm
10

FALL BROOK FARM
GENESEO, NEW YORK
ONE DOLLAR

Fig. 17

decay; as the temperature is usually very high during currant-picking time, the decay is rapid. In addition, fruit in such a bruised condition cannot be washed without considerable loss of juice, and therefore is not readily salable, even at the canneries.

The fruit may be conveniently picked into quart baskets, which are put into carriers, thirty-two carriers to the crate, for shipment to the city markets, or into 6- or 8-pound grape baskets when they are to be sent to the canning factory.

In some currant plantations, as soon as the fruit is picked, it is taken to a central station, where the fruit is paid for by the pound or by the basket. In some localities the owners have a system of pasteboard checks for the pickers, which are redeemed in cash at the end of the season. Samples of such checks are shown actual size in Fig. 17. To facilitate handling and to help avoid mistakes the ½-cent check is red, the 1-cent check green, the 3-cent check yellow, the 5-cent check blue, and the 10-cent and the $1 checks are white but of different sizes.

When the currant crop is sold to the canning factory no grading is necessary, and practically no packing. The canning factories make little or no difference in price for the size of the berries. All the packing that is necessary is to put a lid on the grape basket in which the currants have been picked, and tie this down with a string; if the haul is a short one it is not even necessary to tie the lid on. When the fruit is to be shipped for table use, none but the largest berries should be shipped; they should be packed in quart baskets and shipped in carriers similar to those used for strawberries.

STORING

47. It is not usual to store currants, but if they are carefully picked and placed immediately in a cool cellar they may be held for several days, or if placed in cold storage at a temperature of from 32° to 34° F. they may be held from 4 to 6 weeks. They keep better if protected by a paper covering, so that when currants are to be stored the crates should be lined with paper. The red varieties of currants keep better than the white or the black.

It is sometimes advisable to hold part of the currant crop for a late market, but in doing so the grower enters the region of speculation and must take the speculator's chances.

MARKETING

48. For shipment to distant markets, currants should be picked when they are hard and firm. For the home dessert they may be left until they are thoroughly ripe and soft.

A currant crop should be handled quickly in order to secure the best results. When a large quantity is grown, arrangements should be made in advance of the harvesting for the disposal of the entire crop, as it is rather risky to wait until the crop is being harvested to sell it. The most convenient way of marketing the crop is to sell it to a near-by canning factory, as there is not the same necessity for care in regard to the time of picking in such cases; for instance, if the fruit is picked wet it may spoil before reaching a distant market, but it would be all right if used the same day in a canning factory. If arrangements are not made with a canning factory, it is wise to have a contract with some firm at some particular point to handle all or at least a certain part of the crop.

Currants may, of course, be shipped on consignment, as other fruits are, but sometimes this is not satisfactory. In some localities wholesalers from different points will send men to purchase currants, just as strawberries are purchased, and will then themselves ship the fruit in well-iced refrigerator cars. In this way shipments are made from New York as far west as Chicago.

Unless a grower can sell his currants in a near-by market it is essential to plan to ship them in carload lots. Smaller quantities are sent by express, but at the present rates of transportation, this consumes a large part of the profit.

The markets are seldom overstocked with currants, and frequently when a market is being neglected, advanced prices are secured by the wise salesman.

GOOSEBERRIES

GENERAL DISCUSSION

49. Gooseberries closely resemble currants in many respects. They are not so extensively cultivated as currants, but their propagation and general popularity are on the increase. The area devoted to the gooseberry crop in North America is about one-half of that devoted to currants, so that the industry is relatively one of the smallest of the various fruit-growing interests.

Gooseberries are native to North America, are very hardy, and are found growing wild as far north as Northern Canada. The growing of the cultivated varieties of gooseberries is confined to the Northern States and Canada, practically none being grown in the Southern and the South Central States. The states in which the bulk of the gooseberry crop is produced are Indiana, Iowa, Missouri, Illinois, Ohio, and Michigan.

The culture of gooseberries has been carried on more extensively in England than in this country, so much so in fact that it is the popular impression that the gooseberry is an English fruit. The English gooseberries have been developed to a greater size and better quality than any of the American kinds, largely because Americans have not developed a taste for this fruit and consequently have given little attention to it. The English gooseberry is commonly eaten raw when ripe, but the American kinds are usually cooked while green.

The gooseberry grows naturally in bush form to a height of 25 to 30 inches and will have a spread about equal to the height. The canes have sharp spurs. The berries are borne on the lower side of the canes, both singly and in pairs, and under good cultivation the bushes are exceedingly prolific.

The two great classes of gooseberries grown for market in North America are the native, or American types, and the

European types. The American cultivated types of gooseberries have been developed largely from two strains, or species, one of which is prickly-fruited, and the other of which may be regarded as smooth-fruited, or nearly so. These types of gooseberries are found native over a large part of North America and but few have been brought into cultivation. What will happen when the attention of a number of expert plant breeders is directed to gooseberry culture can only be imagined. There is a wonderful opportunity for development. The remarkable development of gooseberries in England in the past century is an indication of the scope and possibilities of the plant. There is no doubt but that the gooseberry is capable of development, and that this development will be made when the hand and mind of the capable plant breeder are applied to it, and the call for the fruit commercially has become sufficiently large.

50. Possibilities of Overproduction.—At the present time there is little possibility of an overproduction of gooseberries, although there have been times in the past when the small quantity of this fruit put on the market has been dumped on account of the lack of ability to sell it. Today, however, because of the increased demand for gooseberries at the canning factories and the fruit-flavor makers, and the small acreage planted to this fruit, there is little danger that the supply will exceed the demand.

51. Influence of Quality on Demand.—The market calls for large gooseberries, and even the canning factories prefer them. On this account the European types, which bear the largest gooseberries, are preferred. European gooseberries have been grown which will measure $1\frac{1}{2}$ inches in length and 1 inch in diameter, and some have even exceeded these dimensions, while the fruit of the Downing, an American variety and a large one, would not average more than $\frac{3}{4}$ inch in length.

The gooseberries of the English varieties will generally sell for from 2 to 3 cents more a quart than the Downing. On account of their large size, the European varieties can be sold as green gooseberries earlier in the season than the American.

Most Americans are not acquainted with the ripe gooseberry as a dessert fruit. It might be possible to develop a special trade for these in a local market, but at the present time the greatest demand is for the green gooseberry for cooking. It is used in the making of sauce, jellies, jams, pies, etc.

52. Location and Soil for Gooseberries.—Gooseberries are especially adapted for cultivation in regions where the season is not long enough to ripen grapes successfully.

They succeed well on a variety of soils, provided the soil is rich enough to grow a first-class crop of corn, is well drained, and is capable of easily being kept cultivated. No profit can be obtained from planting gooseberries on a poor soil, because they will not yield enough to make it pay. A heavy clay soil is too hard to work, and a light sandy soil is not sufficiently retentive of moisture.

Gooseberries prefer a moist, medium to heavy loam. They will do well on a lighter soil, but their bearing period will be shorter and the plants will be more subject to disease. For gooseberries, a soil should also be free from acid and well supplied with humus.

53. Character of Site for Gooseberries.—The site for a gooseberry plantation should be selected with even more care than that for a currant plantation, as it is even more essential than in the case of currants that the site have good air drainage and that the plants have a free circulation of air among them at all times; this is especially important when European varieties are to be planted.

If gooseberries are planted on low land where fogs collect they are sure to suffer from mildew. They cannot, for the same reason, be successfully grown in small enclosures, such as gardens with a fence around them, nor can they be protected to too great an extent by woods. They may have a northern exposure, but air drainage is a prime requisite.

SELECTION OF VARIETIES

COMMERCIAL VARIETIES

54. The two main classes of commercial varieties of gooseberries are the European and the American. There are many

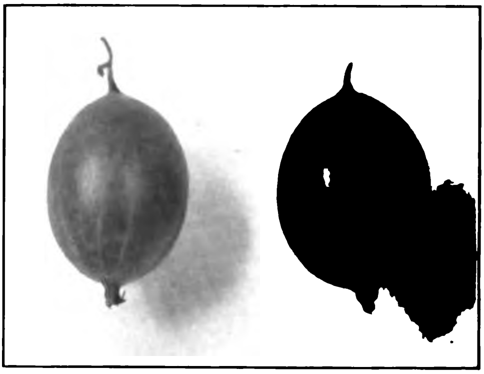

FIG. 18

European varieties, but very few are of any value under American climatic conditions, as they are readily subject to mildew.

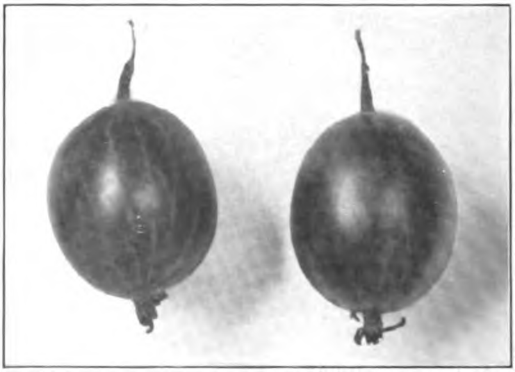

FIG. 19

55. Character of the Bushes.—The most important characteristic of the bushes of the European gooseberries is their stockiness; they have upright, straight, thick branches in contrast to the curved or drooping, slender twigs of the

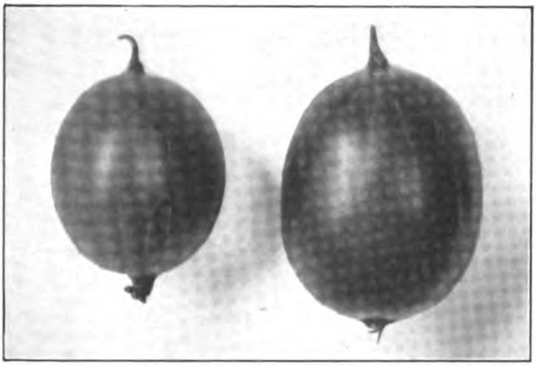

FIG. 20

American varieties. The new shoots of the European varieties show a light-gray color in the fall, making the bush appear as if it had been artificially whitened; the American varieties show a pale straw or a reddish-brown color. The old wood on the bushes of the European varieties is dark gray or pale brown; the old wood on the bushes of the American varieties has more of a reddish tinge. The spines of the European varieties are

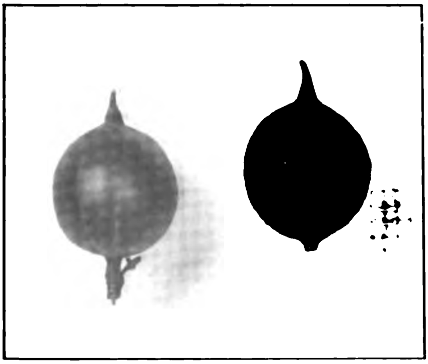

FIG. 21

strong, thick, and of a whitish to straw color, one to three in number at the base of the leaf stalk, and the same number along the stems; the American varieties bear smaller, more slender spines of the characteristic reddish-brown color, and fewer long spines just below the base of the leaf stalks; frequently, on the American varieties, a thick growth of fine bristles, or spines, will also be found near the ground. The leaves of the European varieties are thick, leathery, and shiny on the upper surface; the leaves of the American varieties are thin and lacking in gloss.

56. Character of the Fruit.—The fruit of the European gooseberries is large and either smooth or bristled, and dark red, green, or yellow, or almost white, with combinations and shades of these colors. The fruit of the American gooseberries is smaller, rarely exceeding $\frac{3}{4}$ inch in diameter, and is either green or red in color, although the native wild prickly gooseberry is of a dull brownish-purple color when ripe and has dark-green pulp. In Figs. 18, 19, 20, and 21 are shown specimens of European and American gooseberries illustrating the differences in size. In Figs. 18, 19, and 20 are shown specimens of Wellington Glory, Industry, and Galopin, respectively—all European gooseberries. In Fig. 21 are shown specimens of Pearl, an American variety. These berries are actual size.

57. Quality of the Fruit.—In quality, the best American are superior to the best foreign gooseberries in that they have a more delicate flavor and a thin skin, but are not as highly regarded for jam making or in the markets. For selling green, the European gooseberries are preferred, because they reach a salable size earlier than the native fruit; for selling ripe, they are also preferred, because they are so much larger than the American gooseberries and hence attract the most attention.

58. Productiveness.—The American are much more productive than the European gooseberries. At the Geneva, New York, Agricultural Experiment Station, taking the best varieties of each class and the average yields for 4 years, it was found that the American varieties yielded an average of 7.1 pounds per bush, and that the European varieties yielded an average of 4.56 pounds per bush. The details of this experiment are shown in Table I. The European varieties have also proved to be less hardy than the American varieties under American climatic conditions.

A yield of from 200 to 400 bushels of gooseberries to the acre is considered a good crop, although with average yields of 5 to 8 quarts per bush, as shown in Table I, and with the bushes planted 4 ft.×6 ft., the yield would run from 300 to 500 bushels per acre.

TABLE I

AVERAGE YIELD PER BUSH OF EUROPEAN AND AMERICAN VARIETIES OF GOOSEBERRIES

Classes and Varieties	Average Yield per Bush for 1896 Pounds	Average Annual Yield per Bush for 4 Years Pounds
European class:		
Chautauqua	.47	1.99
Crown Bob	a few fruits	2.28
Dagwell's No. 1	.19	2.20
Golden Prolific	a few fruits	2.13
Industry	2.37	8.27
Puyallup	2.94	5.03
Triumph	3.55	6.24
Wellington Glory	1.25	8.35
Whitesmith	2.42	4.54
American class:		
Crystal	7.75	13.13
Downing	7.30	9.95
Houghton	5.33	6.85
Mountain	2.50	2.67
Pale Red	5.68	10.58
Pearl	3.58	4.37
Smith (Improved)	.69	2.13

59. American Gooseberries.—The most important varieties of gooseberries from the commercial point of view are as follows:

FIG. 22

Fig. 23

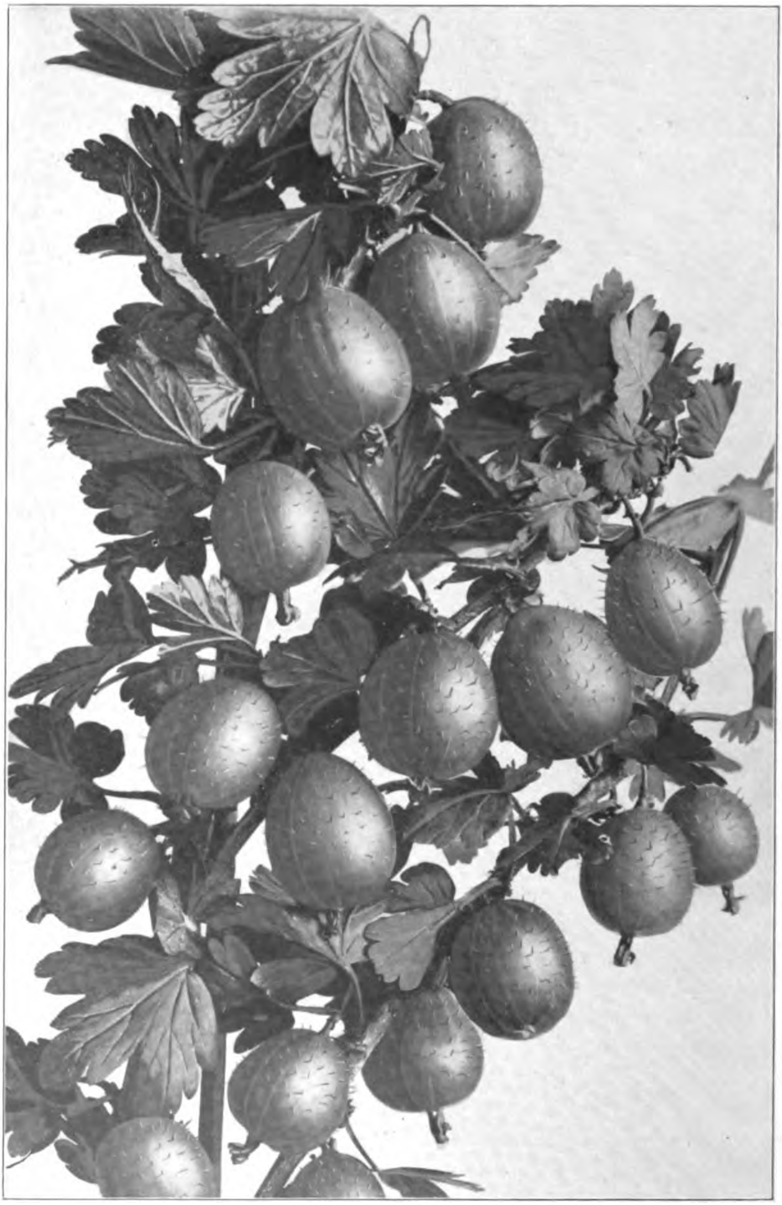

FIG. 24

The **Downing** gooseberry, shown in Fig. 22, is one of the best of the American class and is the variety most widely grown. The bush is a strong grower, is seldom troubled with mildew, and is very productive. The fruit is large for a variety of its class; has a thin, smooth, pale-green skin; the pulp is soft, sweet, juicy, and of good quality. The fruit ripens in mid-season.

The **Houghton** gooseberry is the parent of the Downing. The bush is vigorous and hardy, but is a somewhat drooping grower, and is productive. Although the fruit is small and dark red in color, with a whitish bloom, the flavor is very good.

The **Pearl** gooseberry, shown in Figs. 21 and 23, is a cross between the Downing and Ashton's Seedling or Broom Girl, and closely resembles the Downing. The bush is a strong, fairly erect grower, is seldom attacked by mildew, and is productive. The fruit is medium in size, or about as large as the fruit of Downing, the skin is pale green, and the pulp is juicy and of good flavor. The fruit ripens in mid-season.

The **Red Jacket,** or *Josselyn*, gooseberry is a cross between the Houghton and the Warrington Red. The bush is a strong grower, does not mildew, and is productive. The fruit is of good size; the skin is reddish green to red and is tender; the pulp is rich, fragrant, and of good quality. This variety is highly esteemed by some growers. The fruit matures in mid-season.

The **Purple Red** gooseberry has a strong-growing bush and is productive.

60. European, or English, Gooseberries.—Among the European, or English, gooseberries, of which about a thousand are catalogued, the following appear to have been of some value in certain sections of the Northern States and Canada:

The **Industry** gooseberry, shown in Fig. 24, is one of the best of the European gooseberries for American conditions. The bush is a heavy cropper where it succeeds, but it often suffers from mildew. The fruit is medium to large in size, the skin is smooth or nearly so and dark red, and the pulp is very good in flavor. The fruit of this variety is excellent for marketing in an unripe condition.

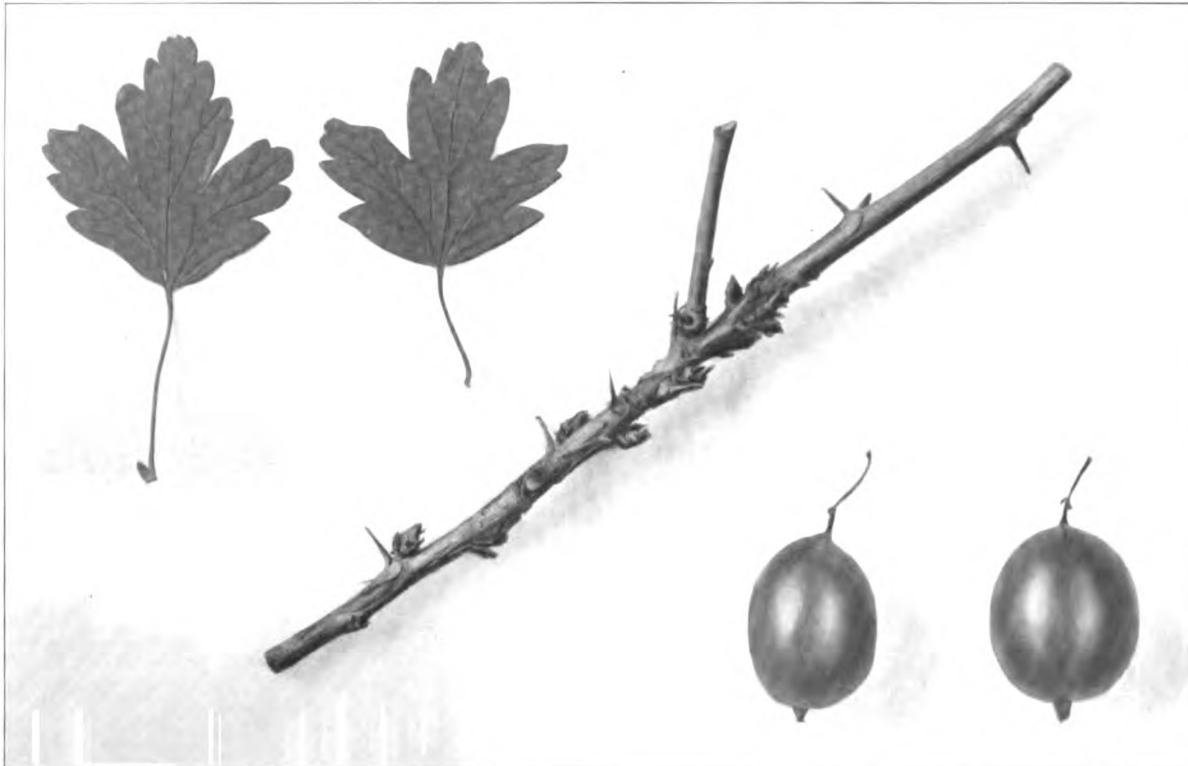

FIG. 25

Fig. 26

The **Crown Bob** gooseberry is a good variety for the early market. The fruit resembles the fruit of the Industry in color but is smaller.

The **Wellington Glory** gooseberry, shown in Fig. 25, has proved productive in some parts of the country. The fruit is an attractive pale yellow.

The **Warrington Red** gooseberry has a strong-growing bush that is somewhat subject to mildew. The fruit is a pale red and hairy, and the pulp is sweet and of good quality.

The **Whitesmith** gooseberry is frequently recommended as a desirable variety, especially for the home garden. The fruit is medium to large in size, the skin is smooth and pale yellowish green, and the pulp is of good quality.

61. American-European Hybrid Gooseberries.—Two of the American-European hybrid gooseberries, which resemble the European gooseberries in type, are of value:

The **Columbus** gooseberry has a strong-growing bush that is comparatively free from mildew. The fruit is white or greenish yellow, and of good quality.

The **Chautauqua** gooseberry, shown in Figs. 26 and 28, has a vigorous, healthy growing bush. The fruit is large, smooth, and pale green.

SELECTION OF VARIETIES SUITABLE TO A LOCATION

62. According to information compiled by the American Pomological Society, varieties of gooseberries, like varieties of other fruits, vary widely in their adaptability to different sections of the country. Some varieties of gooseberries have been found to succeed well in many different parts of the country, though with varying degrees of success in different sections, and other varieties have been found to do well in a certain few sections only. The following lists of varieties are classified in the same divisions as currants, the numbers of the divisions corresponding with those given on the map of Fig. 4. The varieties given in each division are known to do well in that district. The varieties given in italics are known to be highly successful in the divisions in which they occur. The first time the name of a variety is given its less common name is put after it in parentheses. Where a division heading is omitted, such as Divisions 5, 6, 7, 11, 17, and 18 in the following list, no varieties of gooseberries are known to do well in that division. The other remarks given under currants apply with equal force to gooseberries.

Division 1: *Downing* (Downing's Seedling), *Houghton* (Houghton's Seedling), Industry (Wyndham's Industry), Josselyn (Red Jacket), *Pearl*, Smith (Smith's Improved), Whitesmith (Sir Sidney Smith).

Division 2: Champion (Mills' Champion), Chautauqua, Columbus (Triumph), Crown Bob, *Downing*, Houghton, Industry, *Josselyn*, Pale Red (American Red), Pearl, Smith, Wellington (Wellington's Glory), Whitesmith.

Division 3: Champion, Chautauqua, Columbus, Crown Bob, Downing, Houghton, Josselyn, Smith.

Division 4: *Downing*, *Houghton*, Industry, Josselyn, Pale Red, Smith.

Division 8: Champion, Crown Bob, *Downing*, *Houghton*, *Josselyn*, Pale Red, Pearl, Smith.

Division 9: Carrie, Champion, Chautauqua, Columbus, Crown Bob, *Downing*, *Houghton*, Industry, Josselyn, *Pearl*, Wellington.

Division 10: Champion, Chautauqua, Columbus, *Downing*, Industry, Houghton, Pearl, Poorman, Smith.

Division 12: Berkeley (Dwinelle), Champion, Chautauqua, *Downing*, *Houghton*, Industry, *Josselyn*, Oregon (Oregon Champion), *Smith*, Whitesmith.

Division 13: Downing, *Houghton*, *Industry*, Pearl, Smith.

Division 14: *Champion*, Downing, *Houghton*.

Division 15: *Champion*, Downing, Industry.

Division 16: Berkeley, Champion, Houghton.

The prospective gooseberry grower will have to make trials for himself to determine which are the best varieties for his conditions.

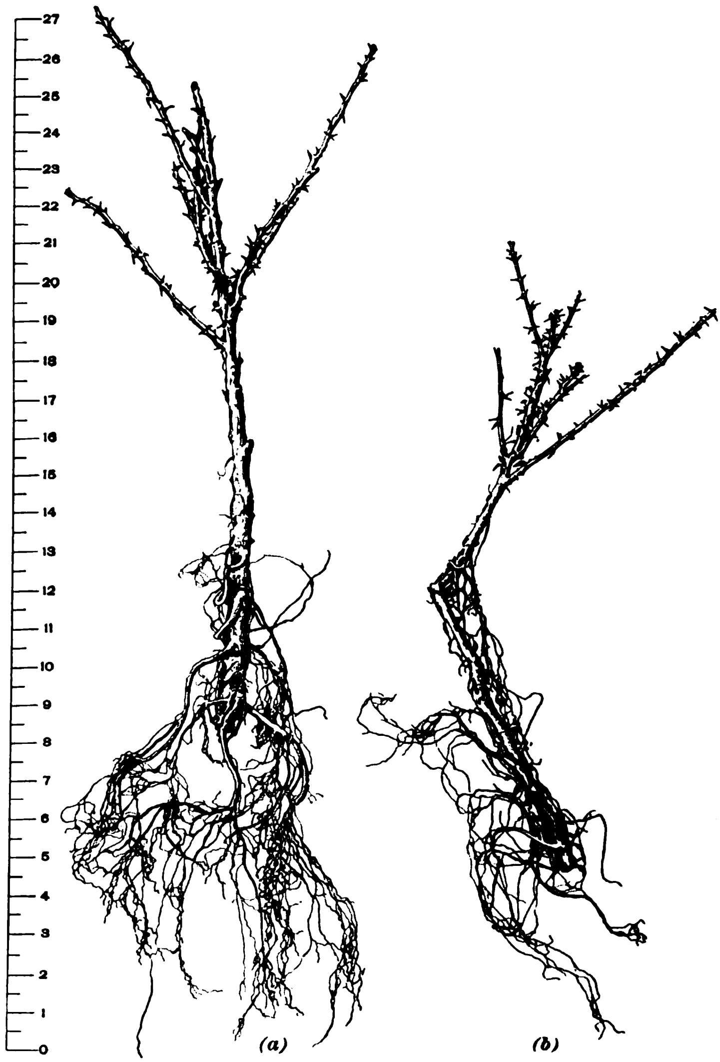

FIG. 27

SELECTION OF NURSERY STOCK

63. The cultivated varieties of gooseberries do not reproduce themselves true to type from seed. In fact, gooseberry seeds are planted only when new varieties are sought, as described for currants. There is always the possibility that the bulk of the seedlings raised from the gooseberry will be much inferior to the parent. The seedlings will begin to fruit when they are from 3 to 4 years old.

Gooseberries are usually propagated commercially by layering, mound layering, as outlined for currants, being the most common method of propagation. In England, gooseberries are sometimes propagated by cuttings, but this is not so successful in America. In a small way, gooseberries may be propagated by taking rooted canes from old plants and transplanting them.

A desirable 2-year-old gooseberry nursery plant is shown in Fig. 27 (*a*); a 1-year-old plant is shown in Fig. 27 (*b*). Note the more abundant root growth on the 2-year-old plant. This abundant root growth is the most important feature of a gooseberry nursery plant, as such a root development insures a good, strong-growing plant. The scale used in Fig. 27 is the same as that used in Figs. 7 and 8, and serves to indicate the actual size of the plants.

PLANTING, PRUNING, AND FERTILIZATION

64. Planting of Gooseberries.—In commercial gooseberry plantations, 2-year-old plants are usually planted. The method of planting is similar to that outlined for currants, the distance apart being much the same, 5 ft. × 5 ft. and 6 ft. × 6 ft. being common, and 4 ft. × 6 ft. being used. After gooseberries are planted, shallow tillage should be maintained until about the middle of August, when the land may be sown to a cover crop.

The plan frequently suggested of planting gooseberries under apple or other fruit trees to secure shade is not to be recommended. When planted in this way they will not do as well as when they have all of the land for their own use, and the spraying of the larger trees will frequently discolor the gooseberries. Gooseberries are sometimes planted in a vineyard, the vines being planted 10 feet apart, with the gooseberries half way between.

65. Pruning of Gooseberries.—Gooseberries need practically no pruning at the time of planting other than to take off injured roots or twigs, nor is any usually given for the first 2 or 3 years, except now and then to head in a branch that is growing too rapidly.

Gooseberries are pruned into two forms, the bush form and the tree form. When pruned in the bush form, as shown in Fig. 28, four, five, or six canes are allowed to develop in each bush in the same way as described for currants; this is the best commercial form. In some gardens and in Europe the tree form, as shown in Fig. 29, with a single main stem 8 to 12 inches high is made and the bush is prevented from producing suckers that would grow up to be additional canes. The tree form is not as good as the bush form, because, should the single trunk receive any serious injury, the entire bush will be destroyed and a new one must be planted in its place. Even when uninjured the tree form is not as long lived as the bush form. In the tree form, the plants begin to fail after 6 or 8 years of bearing; in the bush form, they may remain vigorous for 25 years or more, although they are frequently discarded after 10 or 12 years. Gooseberry bushes may be expected to reach maturity after 4 or 5 years, and it may be wise to plant a new gooseberry plantation on a different piece of ground every 6 or 8 years to take the place of the older plantation rather than to continue to carry an old plantation after it is 10 or 12 years old.

There is a mistaken idea that the center of the gooseberry bush should be pruned so as to keep it open. This is not necessary. In fact, it may be detrimental, as it exposes the fruit to too much sun. As a general rule, the new wood should be pruned back probably one-half of its growth each year after the bush is three or four seasons old, in order to encourage the development of the lower buds; otherwise the terminal buds will grow too rapidly and much blind wood, that is wood with no

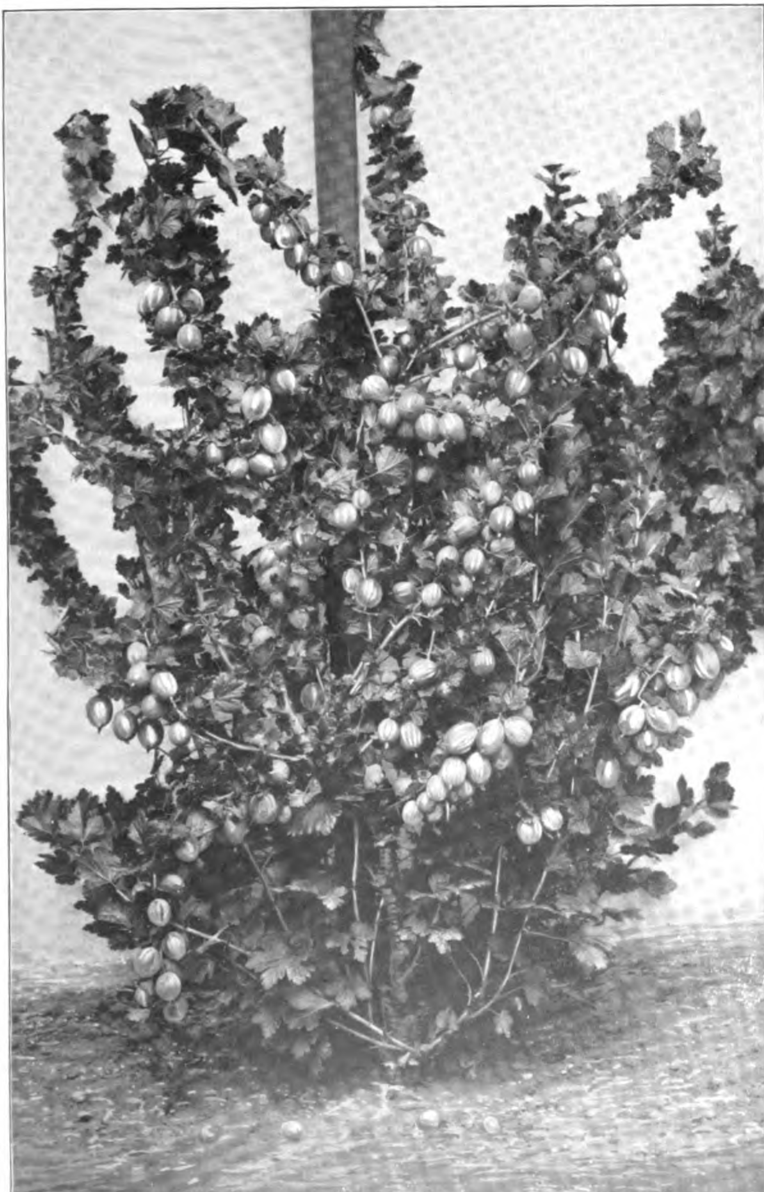

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Fig. 28

buds, will be left; such pruning will also tend to keep the bush stocky and will prevent the formation of long, drooping branches, which bend over and place the fruit in contact with the soil. One of the old canes, 4 to 6 years old, should be taken out from

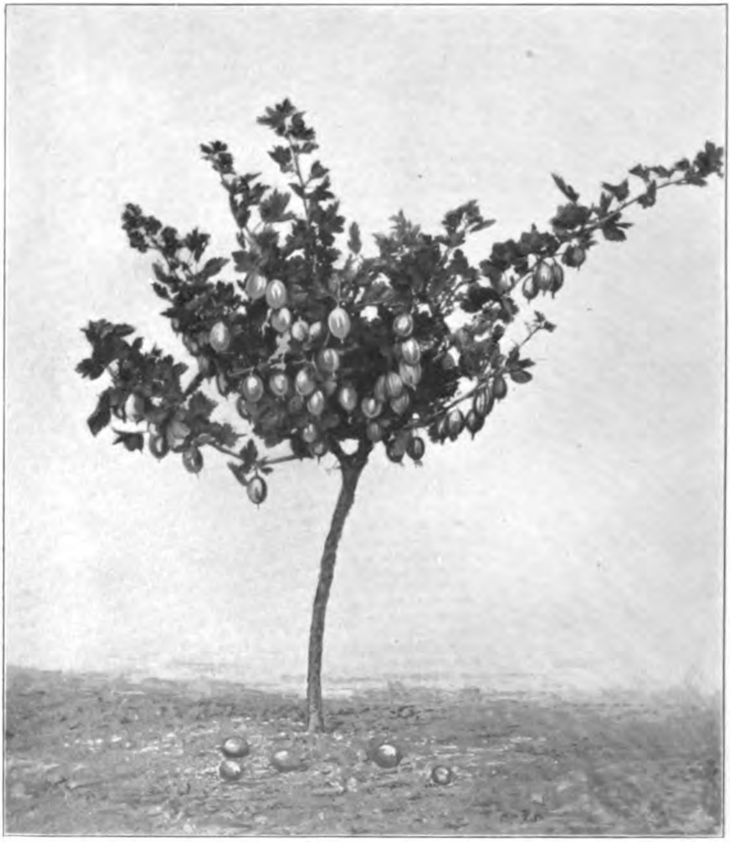

Fig. 29

time to time and a new one allowed to develop, but care should be taken to prune out most of the suckers so that too many new canes will not develop. A good proportion of the wood on each bush should be from 3 to 5 years old, as the best fruit is borne on wood of this age.

66. Fertilizers for Gooseberries.—To give good results, gooseberry bushes must be well fed and the soil about them must be made rich in organic matter. Cow manure, about a pitchforkful to a bush, is one of the best fertilizer materials to apply to gooseberries; this should be applied in the fall and worked into the ground the following spring. This may be supplemented with liberal applications of ground bone or basic slag, with some potassic fertilizer such as muriate of potash, and with dried blood or tankage. If enough manure can be secured, the application of this alone will produce the best results.

GOOSEBERRY TROUBLES

67. Insects and Diseases Attacking Gooseberries. Gooseberries are subject to the same insects and diseases that attack currants, with the addition of one more disease, the well-known **gooseberry mildew.** In Fig. 30 is shown a section of a gooseberry plant attacked by mildew, the cane, leaves, and fruit all being affected. This disease is a serious one with the European gooseberries. It attacks both the foliage and the fruit, causing them first to assume a white, frost-like appearance, and later to turn brown. In some seasons, for unaccountable reasons, there is freedom from this disease, and in other seasons, in spite of all that can be done, the mildew will destroy the crop.

To avoid and prevent, as much as possible, the ravages of the mildew, the gooseberry plantation should be properly located and well cultivated, and the bushes should be well pruned and systematically sprayed. The plantation should be located so that it will have proper air drainage, or a good circulation of air about the bushes, and proper soil drainage. For this reason, low, flat lands or places where there is a poor circulation of air should be avoided. The ground around the bushes should be constantly cultivated, and care should be taken to keep the ground free from weeds, especially under the bushes, until after picking time, in order to permit the circulation of air around the plants. All low, drooping branches should be pruned back for the same reason.

68. Spraying of Gooseberries.—The first two sprayings for the gooseberry should be the same as those for the currant.

Fig. 30

Then, as soon as the fruit is set, the plants should be thoroughly sprayed with a 1 to 35 lime-sulphur solution (specific gravity 1.008, that is, concentrated lime-sulphur solution of 33° Baumé diluted 1 to 35 with water) or with a solution of 1 ounce of potassium sulphide in 2 gallons of water; both the upper and the under surfaces of the foliage should be well covered. These sprayings should be repeated at intervals of 10 days until the fruit is harvested. Even in spite of all that can be done, however, the mildew will sometimes destroy the crop. After the fruit is harvested the bushes should be sprayed with 4-5-50 Bordeaux mixture (4 pounds of copper sulphate, 5 pounds of stone lime, water slaked, 50 gallons of water). If any insects are present, 2 pounds of arsenate of lead may be added to this spray.

HARVESTING AND MARKETING

69. Gooseberries are harvested both green and ripe. The advantages in favor of picking and marketing this fruit green are: (1) The hard, green fruit is not as easily injured in picking and packing as the pulpy, ripe fruit, and it will stand transportation better. (2) The fruit that is allowed to ripen on the bushes is exposed longer to attacks of sun scald and mildew, and should long-continued rain follow a period of drought, the ripening fruit is liable to crack and spoil. (3) The ripening of the fruit and seed is an exhaustive process which may result in a reduced crop the following year and from which the bush is partly relieved when the fruit is marketed green. (4) The proceeds received from the sale of the green fruit usually compare favorably with the proceeds received from the ripe fruit, although the large, ripe fruit of the English varieties sometimes brings the highest prices of the season; as a general rule, however, the early prices for green gooseberries are usually as good, or even better, than the prices of ripe fruit. There is no reason why an individual could not work up a high-class trade for ripe gooseberries in a local market, if he can figure that the drawbacks just mentioned can be more than counterbalanced by the extra price he can get.

The picking of gooseberries is not pleasant work because of the spines on the branches, but with some practice and a little skill, the work may be done without much trouble. When the fruit is harvested green, the common method of picking is to lift a branch with the left hand, and rapidly strip off the green fruit along with the foliage with the right. The right hand should be protected with a thick mitten or a soft leather glove. After the fruit is picked in this way it should be run through a fanning mill to get rid of the leaves and twigs, and then packed into baskets for market. When picked green in this way the fruit can be shipped almost any distance and arrive at its destination in first-class condition.

If gooseberries are allowed to ripen before they are picked they must be handled much more carefully than just described. They should not be bruised nor their skins broken.

Pickers are usually paid from $1\frac{1}{4}$ to $1\frac{1}{2}$ cents per quart and will pick on an average from 60 to 100 quarts per day.

No system of grading or packing has been evolved for gooseberries. The fruit is shipped, according to the requirements of the different markets, like currants, either in grape baskets or in quart baskets.

No attempts are usually made to hold the gooseberry crop either in common or in cold storage, and owing to the limited quantity grown no definite market methods have been evolved.

The prices for gooseberries in the New York market vary from $1.75 to $2 per bushel, and sometimes go much higher. In markets where gooseberries are sold by the pound, they will bring from 4 to 10 cents per pound, depending on the variety and on market conditions.

The largest market for the fruit is at the canning factories.

INDEX

NOTE.—All items in this index refer first to the section (see the Preface) and then to the page of the section. Thus, "Carman peach, §10, p3," means that Carman peach will be found on page 3 of section 10.

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