Growing Grapes in Washington
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Growing Grapes in Washington
John C. Snyder, Extension Horticulturist

Grape culture began in the New World soon after the colonists established homes here. Species native to the continent, along with those brought from the Old World, were planted by the early settlers. New varieties, sought and produced by the early grape growers, were transplanted to the newly developed areas of the United States as soon as the populace became established in these areas. As a result, grapes now may be found in each of the forty-eight states.

CLIMATIC REQUIREMENTS

Grapes show a wide variation in climatic adaptations. They grow in almost every condition of heat and cold, and wetness and dryness. They seldom suffer from hot weather if there is sufficient moisture and foliage.

Of the many varieties, each has a length of season all its own. That required by American species is approximately 160 days. Cool nights may offset warm days and delay maturity. Rains, fogs, and humid atmosphere, as found in western Washington, tend to delay maturity there; the delay is so pronounced that the Concord variety does not usually ripen its fruit in that area. Cold and rainy weather during blossoming sometimes prevents fruit set. Humid weather during maturity often causes spoilage. In humid areas, air currents are considered desirable because of their drying effect. To permit air drainage as a protection against frost, areas adjacent to lower land are desirable in sections subject to frost.

The seasonal sum of heat required for ripening American species appears to be between 1,600 and 2,400 units, as given by the United States Weather Bureau. No variety should be planted where there is insufficient heat. The amount of heat in any region can be determined by consulting the United States Weather Bureau. By comparing the heat units in a new location with those in an area where a proposed variety grows well, it is possible to determine whether or not there is sufficient heat in the new location for the proposed variety.

Most European grapes (Vitus vinifera) are at the mercy of the weather where the temperature drops below 0° F. For such areas,
hardy varieties are usually preferable. To overcome unfavorable climatic conditions, protective measures are sometimes employed. Covering the vines with soil in the fall and limiting the water supply in late summer to harden off the plants are among the most common measures.

In the European grape belts of California, sites with a winter temperature of 35° to 50° F. and a summer temperature of 70° to 85° F. are sought. It is reported that the sum of the daily temperatures above 50° F. should be between 3,000 and 5,000. The sum of daily temperatures in some irrigated areas of Franklin, Benton, and Yakima counties of Washington lies within the lower part of this range, although winter temperatures sometimes drop considerably below 35° F.

PROPAGATION

American grapes, as represented by *Vitis labrusca*, are usually propagated by cuttings. Mature wood of the preceding growing season approximately one-fourth inch in diameter, with buds four or five inches apart, is used (Fig. 1). The cuttings are usually collected in the fall or midwinter, although they may be collected shortly before planting in the spring. The latter practice usually produces the poorer stand.

![Fig. 1.—Grape cuttings collected in the fall when canes are dormant.](image)

In securing cuttings, make them eight to ten inches long, leaving three buds on each. To encourage callusing and root formation, make the basal cut immediately below the lowest bud and the
upper one an inch or two beyond the top bud. As soon as the cuttings are made, tie them in bundles of twenty-five to fifty with butt ends all one way. Place them in a trench or pit located in a well-drained area. Cover them immediately with three inches of light soil or sand which completely fills the trench. As soon as freezing weather sets in, add six inches of straw or manure. In the spring, when freezing weather is past, remove the straw or manure to permit the top soil to warm up. The cut surface at the base of the cuttings will then callus. As soon as the soil in the nursery or garden can be worked, the cuttings may be planted. Plant them three or four inches apart in rows three or four feet apart, leaving only the top bud above ground.

Propagation by layerage is sometimes used in filling occasional vacancies in the vineyard. When using this method, select a cane of good vigor on a plant next to the vacancy. Dig a trench four or five inches deep and a foot or eighteen inches long in the place where the plant is missing. Place the propagating cane in the trench and refill the trench, leaving three or four buds exposed beyond the covered point. The cane, laid in early spring, will take root at this point. The new plant may be severed from the mother plant the next spring.

Phylloxera (*Phylloxera vitifolia*) may be devastating to European varieties (*Vitis vinifera*) when grown on their own roots. Present regulatory measures appear to be effective in keeping this pest out of the areas of the state of Washington where European grapes are grown. To guard further against this pest, these varieties may be grafted on resistant stocks. Although no one resistant stock is suitable for all *vinifera* varieties because of lack of congeniality of stock and scion and because of varying climatic and soil conditions under which *vinifera* varieties are grown, resistant stocks for specific varieties and regions may be selected. Desired varieties are usually grafted on resistant stock. This stock must necessarily be demonstrated to be adapted to the soil and climatic conditions under which it is to be grown.

**Top-Working**

Occasionally, because undesirable varieties are planted for one reason or another, it is advisable to change varieties after the vineyard has been established. The vineyard can be converted to the desired varieties and brought into bearing earlier by top-working than by pulling and resetting. Top-working may be done most successfully in the spring, either before the heavy sap flow starts or just after it has passed the peak.

Grafting grapes differs from grafting apples, in that the graft is located two or three inches below the surface of the ground and no
wax is used. Scions, made of one-year-old wood, are two to four buds long. Some propagators claim greater success with the shoulder graft than with the usual cleft graft, by which the stock is split. As soon as the scions have been made and inserted carefully, they are covered with soil; only the top bud is left exposed. In fine soil, soft paper or similiar material is sometimes placed between the scions to exclude the soil from the cleft. As the grafts start to grow, they should be protected from the wind, and the sprouts arising from the stock should be removed.

Root stocks have a definite influence upon the grafts. Production of some *vinifera* varieties is being increased by grafting on selected stocks. Recent experimentation indicates that the yields from some *labrusca* varieties also may be improved by grafting on certain stocks.

**NURSERY STOCK**

First-grade, one-year-old plants are usually more satisfactory than two-year-old plants. Two-year-old plants are often culls from the preceding year. The size of plants is not necessarily an indication of their quality, although heavily rooted plants of medium size are usually equal to large ones and superior to small ones. A healthy appearance of both root and top, as well as a strong root system, is essential if the plants are to make a satisfactory start in the vineyard.

**PLANTING THE VINEYARD**

The best time to build up the soil for the vineyard is before setting. In soil known to be deficient in organic matter or otherwise run down, soil improvement is particularly important. Old orchard land and new land from which top soil has been removed from high spots in leveling for irrigation, require special soil-building attention. Two or three years frequently can be used to advantage in getting the soil into condition before setting any plants. Poorly prepared, unfertile soil will keep even the best of plants from starting well.

**Time of Planting**

Spring setting usually is more satisfactory than fall setting. It is well to set as early in the spring as possible in order that growth may be well started before hot weather. Early setting, by extending the growing season, results in more growth during the first season. At this time, the vineyard needs careful attention. Every possible effort should be made to get the plants to start well.
The slope of the land is a factor to be considered in determining the direction of the rows. Because of its advantages in controlling soil erosion and in cultural operations, planting across rather than up and down the slope is preferable on rolling land. Another factor is the wind. In regions of strong prevailing winds, planting in the direction of the wind minimizes damage from it. On level land where winds are not serious, an east-and-west direction provides fullest exposure to the sun when the distance between vines is greater than the distance between rows. When the distance between rows is greater, a north-and-south direction offers some advantage.

**Planting Distances**

Planting distances for varieties such as Concord vary from eight to ten feet between plants and eight to ten feet between rows. Many vineyards are set eight feet by eight feet. In some of these vineyards where the soil has been built up to, and maintained at, the desired state of fertility, the vines are crowded because there is insufficient room on the trellis to distribute the fruiting canes properly, although fruiting canes generally should not be left longer than three feet. In such vineyards and with such vigorous varieties as Niagara and Agawam, nine by nine is more desirable than eight by eight.

Another system is to space the plants eight feet apart in the rows and the rows ten feet apart, thus allowing ample space for harvesting machinery. Nine feet between rows should be the minimum distance if trucks are to be used in hauling the fruit out. Some vineyards have been planted so that every other space between rows is nine feet wide and the intervening space is eight feet in order that the wide spaces can be used as alleys. This is not entirely satisfactory, for it necessitates adjusting machinery or some double cultivation. Cross alleys wide enough to accommodate tractors and hauling machinery every twenty rods or so make for greater efficiency.

**Table 1. Approximate Number of Plants Required per Acre for Various Planting Distances**

<table>
<thead>
<tr>
<th>Planting Distances</th>
<th>No. of Plants</th>
<th>Planting Distances</th>
<th>No. of Plants</th>
<th>Planting Distances</th>
<th>No. of Plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 x 8</td>
<td>910</td>
<td>6 x 9</td>
<td>805</td>
<td>6 x 10</td>
<td>725</td>
</tr>
<tr>
<td>7 x 8</td>
<td>780</td>
<td>7 x 9</td>
<td>690</td>
<td>7 x 10</td>
<td>625</td>
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<tr>
<td>9 x 8</td>
<td>605</td>
<td>9 x 9</td>
<td>540</td>
<td>9 x 10</td>
<td>485</td>
</tr>
<tr>
<td>10 x 8</td>
<td>545</td>
<td>10 x 9</td>
<td>485</td>
<td>10 x 10</td>
<td>435</td>
</tr>
</tbody>
</table>
If the space allowed for a single vine is greater than usual, the vine apparently develops a larger top and root system, so that all of the available soil is occupied with feeding roots. As a result, the yield per plant is increased. On the basis of this observation, particularly in home plantings, it is better to allow more space than is needed rather than to crowd the plants.

SOILS

Generally speaking, grapes grow best on well aerated, free-working soils. Some varieties appear to have special soil requirements, but the more common ones, such as Concord, are not so exacting. Heavy clay soils are inclined to produce excessive wood growth and to delay maturity of both fruit and wood. The delay in maturity may be serious during seasons of early fall frosts. Extremely light sandy soils, on the other hand, present problems of maintaining soil fertility and soil mixture. Soils of sandy texture, however, are sometimes utilized successfully in western Washington because they hasten maturity and permit harvesting before fall rains start. Maturity in home vineyards of western Washington may be hastened by planting in protected places, such as near the south sides of buildings and on distinct south slopes.

Good drainage is essential, but steep rolling land often introduces serious problems of soil management and soil erosion control. Contrary to general belief, grapes seldom thrive on stony soils unless these contain considerable organic matter. If the stones are mixed with a deep soil otherwise suited to grapes, the principal disadvantage is the inconvenience of working stony land.

A slightly acid soil is preferable, but neutral or alkaline soils are satisfactory. Strongly alkaline soils, such as are found in some of the irrigated sections, are to be avoided, however.

Grape roots apparently utilize soil to a depth of at least four to six feet. Although vineyards planted on shallower soils may produce well when young, the cost of maintaining production in such vineyards during later years becomes higher than in vineyards on deep soil. Deep soil, therefore, is cheaper in the long run. Calcareous hardpan deposits and layers of coarse gravel at shallow depths are to be avoided, because they limit root penetration.

FERTILIZATION

Strong vine growth and healthy dark green foliage are essential for heavy production. The period at which the vines make most of the growth is as important as the amount of growth they make. Excessive growth during late summer and fall, for example, prevents the
proper ripening of both fruit and wood. Excessive or sparse growth during blossoming may have an inhibiting influence on fruit set. Weak foliage usually is associated with small, loose clusters. An over-vegetative condition of the vines may also cause loose clusters, although few, if any, vineyards in Washington are in this condition.

Fertilization is usually necessary to keep the vines in good production. Nitrogen appears to be the main fertilizer element that is of direct benefit to vineyards in Washington. In the lower Yakima valley and in the Grapeview area, phosphorus, applied to increase cover crop growth, may be beneficial on some vineyard soils.

Barnyard manure, when available, is an excellent source of nitrogen. It also supplies organic matter, which is an important factor in maintaining the proper physical condition of the soil. It should be applied by late winter at the rate of about five tons per acre. On soil known to be deficient in phosphorus, fifty to a hundred pounds of available phosphoric acid per acre may be broadcast with the manure.

Where barnyard manure is not available, nitrogen may be supplied in the form of leguminous green-manure crops. On poor soil, it may be advisable to apply fifty to a hundred pounds of available nitrogen and a similar amount of phosphoric acid to stimulate the growth of the green-manure crop. These elements in turn will be available to the vines when the green manure decomposes.

Rye, although not a legume, is a good green-manure crop (Fig. 15). It should be sown at the rate of sixty to ninety pounds per acre. Thirty to sixty pounds of winter vetch or Austrian winter peas may be sown with it to increase the amount of nitrogen in the green manure. When either vetch or peas are added, the amount of rye may be reduced slightly. In western Washington, vetch and Austrian winter peas sown alone have been satisfactory. Sixty pounds per acre seems to be about the right amount to sow. Crimson clover sown at the rate of ten pounds per acre in early September has given good results in western Washington (Fig. 15). Best results are obtained from the green-manure crops when sowing is completed immediately before fall rains, which usually start in late August or early September. When planted two or three weeks ahead of harvest, they usually make a reasonable fall growth and withstand the abuse of harvesting machinery without serious injury. The growth they make in the fall and during the winter protects the soil from blowing, which is of considerable importance on light soils. They are usually disked in or plowed under when they start to head or before they deplete the soil moisture needed by the grape crop. Plowing or disking should not be deeper than three or four inches.
CULTIVATION

A large percentage of the feeder roots usually grow near the surface. Although they may be forced down by consistent deep cultivation, they may be expected to function more efficiently if allowed to remain in their natural location. For this reason, shallow cultivation is preferable.

Early spring cultivation tends to stimulate early vine growth. To avoid early growth and possible subsequent frost damage, it is well to delay spring cultivation until two to three weeks before bloom. Because food materials are needed within the plant at the time of fruit set, the first spring cultivation should not be delayed later than ten days before bloom. Cultivation should be thorough and as frequent as necessary to keep the vineyard clean. The grape hoe is a tool that aids greatly in minimizing hand labor (Fig. 2).

Fig. 2.—Grape hoe used to reduce hand labor in keeping the row clean.

CARE OF YOUNG PLANTINGS

The newly set plants should be given extra care. It may be necessary to water them two or three times in the early part of the season while the roots are becoming established. During the latter part of the season, irrigating should be regulated to cause a cessation of growth and to divert food materials elaborated in the leaves into an extension of the roots. The plants may thus be induced to mature, instead of growing vigorously until frost. If the top is succulent at the time of freezing weather in the fall, the roots are likely to be forced to start growth in a weakened condition the following spring because of injury, although the injury may not be apparent at once.
IRRIGATION

The irrigation of vineyards does not differ greatly from that of other deciduous fruits. After growth starts in the spring, allow the vines to exhaust most of the available moisture in the root feeding zone, and then wet the soil thoroughly. Continue this practice until the fruit is nearly ripe. Avoid irrigating during bloom and in the latter part of the ripening period. This program must necessarily be modified according to local soil type and climatic conditions.

THE TRELLIS

The most common type of trellis consists of two wires stretched tightly on firmly set posts. It is good economy to build a substantial trellis capable of carrying heavy loads and serving for a long period without requiring renewal.

The end posts are larger and longer than the line posts, so that they may be set firmly enough to endure the necessary wire stretching. Two methods of bracing the end posts are common. One is to set the first line post about eight feet from the end post with a wooden brace extending from near the top of the line post to near the top of the end post. A twisted wire extending from the top of the line post to the base of the end post holds the brace in place. The other method is to set a "dead man," consisting of a rock, buried three feet beyond the end post. Heavy wire is fastened to the top of the end post and the rock; the wire is tightened after the rock has been set firmly.

The posts are set sixteen to twenty-four feet apart. No more than three plants should be set between each two posts. More increases the difficulty of keeping the wires tight. Some growers prefer only two.

Heavy No. 9 galvanized wire or its equivalent is preferable. Anchor the wire firmly to the end post by winding it once around the post and looping the end around the stretched wire. In regions of prevailing winds, place the wires on the windward side. Place the lower wire twenty-six inches from the ground and the upper one this same distance above the lower. Drive the staples in just far enough to hold the wire close to the post but at the same time to allow the wire to slide freely when being tightened.

The trellis should be in place by the beginning of the second growing season. If the trellis cannot be erected by this time, stakes may be used, although it is difficult to train the young vines on a stake.
PRUNING
Principles of Pruning

Pruning concentrates growth in the parts left. The concentration of growth is intended to increase the market value of the fruit by increasing its size and quality (Fig. 3). Along with the possibility of improving size and quality, the total tonnage may actually be increased. There is also the danger of reducing total growth and fruit production. If the pruning is excessive, the decreased production may more than offset the value of the improvement in size and quality. The job of the pruner, therefore, is to produce the desired improvement without reducing production any more than necessary. He must understand that pruning is closely associated with growth and production and that pruning reduces leaf area and may in turn reduce the fruit-producing capacity of the vine. When these basic principles are understood, it becomes clear that there must be a reason for removing each cane that is eliminated.

Vines weakened by overproduction usually may be partially restored by pruning. To resort entirely to pruning for this purpose, however, may reduce the bearing capacity of the vine excessively. Good cultural practices, including fertilization, should be considered, also. It is usually impossible to restore the vigor of weak vines in one season. A better practice is to keep them in good vigor.

The more shoots there are on a vine, the less each shoot grows and (within limits) the greater its tendency to fruit. The more vigorous the shoots, above a certain point, the less tendency there is to fruit. In other words, weak vines tend to overload, and overvegetative vines do not load heavily enough. Between an undervegetative and an overvegetative condition, there is a state of vigor at which the vine yields an optimum amount of fruit.
The Amount of Pruning

The fruiting capacity of a vine is limited. That is, with the available nutrients, it can produce only so much fruit and at the same time produce the necessary fruiting canes for next year's crop. The pruner must decide, taking into consideration the past history of the vine, how heavily to prune. With most American varieties it may be assumed that, when a mature vine produces a full crop of fruit and numerous fruiting canes approximately one-fourth inch in diameter, measured between the fifth and sixth buds, the vine is in the desired state of vigor.

To get an indication of how heavily to prune a vine whose past performance you may not know, count the number of fruit buds that were left the previous year. If there were fifty, for example, and the vine bore a crop of fruit and also produced the necessary fruiting canes with no overvegetative canes, leave fifty fruit buds again this year. If the vine failed to produce sufficient fruiting canes, prune it more heavily; but if it produced numerous overvegetative, big canes and a crop of fruit, leave more than fifty buds to utilize the full fruiting capacity of the vine (Fig. 4).

![Fig. 4.—Upper fruiting cane showing fruit load of a vine pruned according to the single-stem, four-cane Kniffin system.](image)

Time of Pruning

Late winter or early spring is considered the safest time to prune in areas where there is danger of winter injury. The fact
that winter injury does not occur often may justify starting earlier where large acreages are to be pruned. If early pruning is to be considered, it should be kept in mind that vines pruned early are more subject to winter injury than are those pruned later. Pruning when the wood is frozen is to be avoided, because of the discomfort to the pruner and the brittleness of the vines. Bleeding, resulting from late pruning, apparently is of no serious injury to the vines.

Pruning before leaf fall causes an appreciable loss of food materials stored in the prunings, but the loss of these materials apparently is negligible if the pruning is done after leaf fall.

**Summer Pruning**

Leaves are the manufacturing organs responsible for the vigor and fruiting capacity of the vine. Their loss through summer pruning, or any other means, inevitably affects fruit production. In the very early part of the growing season, the weakening effect is slight and the stimulating effect upon the parts retained is almost as pronounced as in the dormant season. Summer pruning, therefore, may be employed advantageously on young plants in the early part of the growing season to direct the growth into the parts which are to become the framework.

**Parts of the Vine**

**Trunk:** Main stalk.

**Arms:** Main branches extending directly from the trunk.

**Secondary Arms:** Branches arising from the arms.

**Canes:** Dormant wood, one year old or less, arising from two-year-old wood; bark adhering tightly.

**Fruiting Canes:** Canes selected to bear fruit; fruit-bearing shoots arise from buds on fruiting canes.

**Laterals:** Side branches of a shoot or cane.

**Spurs:** Canes cut back to one to several buds.

**Shoots:** Leaf-bearing growths, called shoots during the growing season and canes after shedding leaves.

**Methods of Pruning American Grapes**

Pruning is made easier by following a definite method. In the state of Washington, two methods of pruning American grapes are common. These are the long-cane and the spur methods. Although both are used, the long-cane is more common.
THE LONG-CANE METHOD OF PRUNING

Systems of Training

Training is directing the growth of young plants and placing the vines on the trellis after they have been pruned. There are numerous systems of training, of which the single-stem, four-cane Kniffin is the most common in the state of Washington. A modification of the Chautauqua arm system is used to a limited extent in western Washington.

The Single-Stem, Four-Cane Kniffin System

Training the newly set plant consists of removing all except the strongest cane and cutting it back to two buds.

Pruning the First Year after Planting

One to several shoots arise during the first growing season from each of the two buds left on the newly set plant. Select one of these and keep all the rest off during the first two or three weeks. Allow the plants to grow with no further summer pruning. Removing surplus shoots at this time concentrates growth in the shoot that is ultimately to form the trunk. This summer pruning should not extend past the first two or three weeks of the growing season, because of the danger of its growth-retarding influence.

Training the strongest shoot during this first growing season favors the development of a strong cane, which is brought to the top wire at the time of the first pruning if it is long enough (Fig. 5). Remove all except the strongest cane and cut it off beyond the bud immediately above the top wire. After pruning, stretch it tightly and tie it firmly to the top wire so that a straight trunk will develop. Destroy the top bud, beyond the tie, to insure the development of suitable canes from the two buds immediately below.

If there are laterals, select two immediately below each wire and remove all others. Leave these laterals two to eight buds long, depending on the vigor of the plant; and, if they are long, tie them tightly just inside the last bud. No consideration need be given to renewal spurs at this time. Tie the trunk loosely to the bottom wire and tightly to the top wire.

Should the strongest cane fail to reach the top wire at the end of the first growing season, it may be pruned in one of two ways. Until recently, it has been the accepted practice to cut it back to two buds and train the plant during the subsequent second season as just described. Recent investigational work, however, indicates that there is some advantage in training these undersized canes to-
SINGLE-STEM, FOUR-CANE KNIFFIN SYSTEM OF PRUNING

One-year-old Vine

Fig. 5.—Left, before pruning; right, after pruning.

Two-year-old Vine

Fig. 6.—Left, before pruning; right, after pruning.

Three-year-old Vine

Fig. 7.—Left, before pruning; right, after pruning.
ward the wire with a string rather than cutting them back to two buds. Trained in this manner, they produce several shoots during the second growing season. A strong one originating near the tip is then trained to the wires as soon as it is long enough. A larger plant and more fruit the subsequent third season results when this practice is followed. When the strong shoot reaches the top wire, head it just beyond this point to encourage the development of laterals. Remove the shoots toward the base of the trunk during the early part of the growing season.

**Pruning the Second Year after Planting**

The trunk, brought to the top wire following the first dormant pruning, produces numerous laterals during the second growing season (Fig. 6A). Select four of these for fruiting canes. Those
arising below the wires are preferable to those arising above the wires. Spurs, one or two buds long, may be left below the points on the trunk where the fruiting canes originate. These may furnish fruiting canes for next year to replace the original four, or they may furnish supplementary fruiting canes, should the capacity of the vine require selecting more than four at this time. Allow six to eight buds on each fruiting cane.

Pruning the Third Year after Planting

The four fruiting canes of the previous season are replaced by canes originating from them. On each of the four old canes, select one fruiting cane originating near the trunk. Instead of using the one nearest the trunk, use the second one, if suitable, and cut the first one back to two buds for a renewal spur (Fig. 7). Leave each fruiting cane eight to ten buds long, depending on the vigor of the vine. Cut off last year's fruiting cane immediately beyond the origin of the new fruiting cane. The rest of the old cane becomes the arm from which fruiting canes and renewal spurs arise from year to year. During this pruning, extra renewal spurs may be left midway between the wires and below the bottom wire.

The primary objective during the first two years is to grow a strong plant, giving no consideration to fruit production for these years. Beginning with the third year, the plant is capable of bearing some fruit, although not a full crop. There is danger at this time of allowing the vine to overbear. It is better to prune too heavily than too lightly at this stage because the plant is still developing.

Pruning Mature Vines

The vine should be in a state of high production by the fourth year. It is usually fairly vigorous during the third, fourth, and fifth years. Because of its vigor when it is young, it can be made to produce fairly good crops with little effort on the part of the grower. As a result, vines are often allowed by underpruning to overbear at this time. To avoid injury from overproduction, special attention should be given to maintaining the desired vigor.

As the vines get older, there is a tendency for the fruiting canes to originate at some distance from the trunk. A special effort must be made, therefore, to select those originating near the trunk. By leaving numerous spurs near the trunk, enough well-located fruiting canes can usually be provided (Figs. 8 and 9).

Attention must also be given to the selection of first-class fruiting canes. Avoid overvegetative and weak canes. Select those with buds four to five inches apart. Avoid canes arising directly
from old wood. These usually are nonproductive. Observe the vines constantly to avoid overpruning and underpruning. To prune them just right requires judgment and experience.

**Chautauqua Arm System**

Occasionally there is a tendency for the growth on the top wire to choke out that on the lower wire when the single-stem, four-cane Kniffin system is used. Although this tendency usually is not serious, it is quite pronounced in western Washington. To overcome it, a modification of the Chautauqua system of training, a description of which follows, is used by some growers.

**Pruning the First Year after Planting**

The vines may be allowed to grow unhindered during the first season, or all except one of the first early shoots may be removed to direct the growth into one to be used later as the trunk. In either case, the first dormant pruning consists of removing all except one of the strongest canes and cutting it off beyond the bud just above the lower wire. The trunk is then tied firmly to the wire. Shoots arise below the tie.

**Pruning the Second Year**

Numerous canes are produced on the short trunk during the second growing season. Select two of these originating near the top of the trunk. Cut them back to eight to ten buds each and tie them to the lower wire, extending one in each direction (Fig. 10).

Should the trunk possess laterals at the time of the first dormant pruning, select two immediately below the lower wire for arms, and head the trunk just above them. Cut the arms to six to eight buds and tie them to the wire. Ties, except those at the tips, should be loose to avoid girdling the arms.

Numerous canes develop from these arms during the second growing season. Select one on each arm originating a short distance from the trunk and cut the arm off immediately beyond this point. The other canes originating between the selected fruiting cane and the trunk should be cut back to renewal spurs two or three buds long. Stretch the selected cane obliquely to the top wire and tie it firmly, cutting it back to ten to twelve buds.

**Pruning the Third Year**

Select two fruiting canes from each arm, cutting them back to eight to ten buds or just beyond the top wire. Stretch them obliquely to the top wire and tie them firmly (Fig. 11). A middle wire is sometimes used to relieve the strain of the upper tie, thus minimizing re-
Fig. 10.—Two-year-old vine after pruning, showing early stage of pruning and training according to modified Chautauqua system.

Fig. 11.—Three-year-old vine after pruning, showing early stages of pruning and training according to modified Chautauqua system.
tying. These canes should originate from wood of the previous season. Retain two or three two-bud renewal spurs on each arm to produce fruiting canes for the following season.

Pruning the Fourth Year

Pruning the fourth year is similar to that of the third year (Fig. 12). As the vine becomes older, it sometimes becomes necessary to renew the arms. The old arms are replaced by canes arising from renewal spurs near the trunk. New arms are developed from these in much the same fashion that they are developed on young vines.

![Mature vine after pruning, showing advanced stage of pruning and training according to modified Chautauqua system.](image)

This method of training requires more tying than does any other method. With it there is a slight tendency for most of the growth to appear at the ends of the fruiting canes. As a result, it is sometimes difficult to select suitable fruiting canes. Delaware is a variety that seems to lend itself to upright training as used in this method.

The ideal vine pruned by this method consists of a trunk sixteen to eighteen inches high extending almost to the bottom wire with an arm about two feet long extending in each direction and two fruiting canes arising about a foot apart from each of the two arms. The upper wire is thirty to thirty-four inches above the lower one, which is twenty to twenty-four inches from the ground.
THE SPUR METHOD OF PRUNING

As practiced in the state of Washington, spur pruning appears to be a combination of the single-stem, four-cane Kniffin system of training and the spur method of pruning.

Pruning the First Two Years

During the first two years of the spur method, pruning is practically the same as for that of the single-stem, four-cane Kniffin system (Figs. 5 and 6). It differs only in that renewal spurs are not left during the second dormant pruning.

Pruning the Third Year

The four fruiting canes selected during the second dormant pruning are allowed to become permanent arms. Shoots develop on these canes during the third growing season. Cut the canes formed by these shoots back to fruiting spurs two or three buds long (Fig. 13). On weak vines, it is necessary to thin the fruiting spurs. Thin them by cutting part of them back to one bud for renewal spurs. Should any arms be too short to nearly reach those of adjacent plants, extend them by selecting suitable canes near the ends. Tie these to the wire in the same manner that the arms were tied the previous season.

Pruning the Fourth Year

There are several canes on each spur of the previous season. Select one cane on each old spur and cut it back to a two- or three-bud fruiting spur for the following season. Occasionally, it may be advisable to leave more than one new spur on the old spur, but care must be taken to avoid leaving too many. The new spur should be as near the base of the old spur as possible. Thin out weak canes.

As the vines get older, there is a tendency for the spurs to become weak, congested, and distant from the arm and trunk. It therefore becomes necessary to remove completely some of the canes in order to space the spurs on the arms. Special attention must also be given to keeping them close to the arm. Occasionally, it is advisable to renew the entire arm and to develop a new set of spurs.

LONG-CANE VERSUS SPUR PRUNING

Each method of pruning has its advantages. The long cane method is more common than any other in the areas in which American grapes are grown. It would seem, as experimental work indicates, that this method generally is more satisfactory than the spur method, although it does require more labor in tying. This dis-
Fig. 13.—Three-year-old vine pruned according to the spur method.

Fig. 14.—Mature vine pruned according to spur method.
advantage is partially offset by the fact that fruit may usually be harvested more easily from cane-pruned than from spur-pruned vines. Although it is advisable to follow a definite method of pruning, the pruning itself has more to do with production than has the method. For example, some growers use one method and obtain high production and others use another and get just as good production.

**Pruning Neglected Vines**

Neglected vines usually lack vigor. As a result, good fruiting canes are scarce. Not only are they scarce, but they usually occur near the tips of long vines far from the main trunk. Although the task of pruning the vine, complicated by the tangled mass of vines and the scarcity of suitable fruiting canes, may appear to be extremely difficult, it is simple when understood.

The first step is to observe the vine carefully. If the new growth is less than approximately eighteen inches in length, as is often true with vines that have been neglected for several years, the simplest way is to cut the trunk back to the ground and develop a new top. No fruit may be expected the following season when this practice is followed.

Vines with more vigor may be pruned less severely. Although an attempt is made to select canes originating as near the trunk as possible when pruning commercial vineyards, it is sometimes necessary to go to a considerable distance from the trunk to get suitable fruiting canes when pruning neglected vines. As many good fruiting canes as the vine seems capable of supporting are selected and cut back to about ten buds each. Vines trained on arbors may support as many as fifteen such canes, whereas ten may be too many for smaller and less rambling vines. Because the fruit is borne on shoots of canes arising from two-year-old wood, a supply of fruiting canes should be produced each year. To produce these canes, it is advisable to prune the vines each year.

**Pruning European Grapes**

A completely satisfactory method of pruning European grapes in Washington has not been determined. In California, the principal European-grape growing section of the United States, the length of the bearing unit is usually determined by the location of the fruit buds on the cane and by the size of the clusters. Long-cane rather than spur pruning is practiced on varieties such as Thompson Seedless, for example, whose basal buds are sterile.
Varieties, such as Carignane, on the other hand, whose basal buds are fruitful, may be spur pruned.

Cane pruning encourages the development of large clusters on such varieties as the Rieslings, which otherwise produce small clusters. The tendency of such varieties as Muscat of Alexandria to produce straggly clusters may be partially corrected by cane pruning. When cane pruning is practiced on these varieties, cluster thinning is usually necessary to keep them from overbearing.

**SYSTEMS OF PRUNING EUROPEAN GRAPES**

**Head Pruning**

The trunk is from one to three feet high. On mature vines, it is so stiff that a trellis is not needed. At the crown of the trunk are
numerous arms, covering an area of one to several square feet. Arising from each of the arms are several spurs varying in length from one to three buds. The number of spurs depends on the vigor of the vine.

Because the fruiting spurs originate from a relatively small area compared with that of other systems of pruning, the fruit is massed together in a rather compact space. This system obviously does not lend itself to winter protection. The severity of pruning which it entails inevitably limits growth and production. It does offer the advantage, however, of rapid pruning and no trellising after the vines are mature.

Cane Pruning

Cane pruning differs from spur pruning in that the fruiting units are canes ten to fifteen buds long instead of spurs. The canes arise from two-bud renewal spurs on arms. The canes may arise from a head trunk, described under head pruning, or they may arise from arms as described under the single stem, four-cane Kniffen system of training. These methods obviously are not suitable for tender varieties because of the difficulty in providing winter protection.

Spur Pruning

The newly set plant is cut back to two buds. During the first growing season, the vine is allowed to grow with little or no pruning except for removing the suckers arising from beneath the surface of the ground. When grafted plants are used, removing shallow roots at this time is recommended to prevent root development on the scion. This practice also aids in keeping the root system from developing too near the surface.

Pruning the First Year

The first dormant pruning usually consists of cutting the strongest cane back to about six inches and removing all others. A two-wire trellis as described on page 11 should be in place at the beginning of the second growing season. (Should there be several strong canes, one may be trained in each direction, and all others removed. On tender varieties, these two, which ultimately form the arms, should originate near the ground; thus the trunk is only a few inches in length. Keeping the trunk short aids in covering. For hardy varieties, the trunk may be extended to the lower wire. These arm-forming canes are headed back to eight to twelve buds, depending upon the vigor of the vine. This heading, done during the first dormant pruning, applies only to vigorous vines and not to those cut back to two buds during the first dormant pruning.)
Pruning the Second Year

One to several buds arise from the trunk during the second growing season. As soon as the strongest shoots of the two top buds are two or three inches long, remove all others, including the suckers from beneath the surface of the ground. Train these remaining shoots in opposite directions, allowing them to trail along on the ground until long enough to reach the bottom wire when brought up in a slanting position. When they are long enough, train them to the lower wire, making the tie loose and several inches back of the tip to avoid injuring the growing shoot. Do not remove any laterals. These shoots may make a growth of ten feet or more during the second growing season. On tender varieties, following leaf fall, cut them back to about eight feet and the laterals back to a foot to facilitate covering. Tender varieties not requiring long pruning may be shortened even more.

When the vine is uncovered in the spring, cut the arm back midway between adjacent plants, and shorten the spurs to two buds except on varieties requiring long pruning. On these, leave two to six canes ten to fifteen buds long. Should the vine be unusually vigorous, the spurs may be left longer, or a third arm may be developed. Vary the number of canes and spurs as well as their length, according to the vigor of the plant. To keep the fruit off the ground, remove the spurs at the base of the arm.

Pruning the Third Year

During the third growing season, each spur produces two or three lateral shoots. These shoots bear the fruit and are tied to the top wire when they are long enough. They furnish fruit spurs for the following year. One, usually the basal one, is cut back to a spur two or three buds long, and the other one or two are removed completely. The removal cut is made just beyond the base of the new spur. Pruning long cane varieties differs from this method in that renewal spurs are selected each year and that the fruiting canes are not shortened to spurs.

Pruning the Fourth and Later Years

As the vine ages, it becomes necessary to renew the arm to keep it from becoming too stiff for covering. To make the renewal, select a cane originating near the base of the arm, and handle it in the same manner that the original arm was handled the first year. With hardy varieties not requiring covering, it becomes necessary to renew the secondary arms or old spurs. They are renewed by cutting properly located water sprouts back to renewal spurs.
VARIETIES OF EUROPEAN GRAPES

European (Vitis vinifera) grapes generally are not so hardy as the American (Vitis labrusca) varieties. Although the vinifera species, as a whole, is tender, several varieties appear to possess a considerable degree of hardiness. Just how hardy these varieties are in the state of Washington remains to be determined. They, and even the tender varieties, have withstood the mild winters of the past five years with no serious injury.

Zinfandel, Carignane, Alicante Bouschet, Muscat of Alexandria, Malvoisie, Mataro, Johannesberg Riesling, Franken Riesling, Chasselas Rose, Black Prince, Black Hamburg, and Pearl of Csaba are the principal varieties grown commercially in Washington. In addition to these, a few varieties are grown principally in home vineyards and for fresh fruit. Among these are Thompson Seedless, Flame Tokay, and Ribier. Of all these varieties, Franken Riesling, Johannesberg Riesling, Pearl of Csaba, and Chasselas Rose have shown signs of being hardy.

Because European varieties have not been grown commercially as a regular practice over a long period of time in Washington, the descriptions are based upon observations made in other areas as well. These descriptions will be modified as more information is obtained from experimental work in progress in this state.

Zinfandel:

Clusters: Medium-sized, winged, cylindrical, compact.
Berries: Medium-sized, spherical, reddish to black.
Vine: Moderately vigorous, very productive.
Season: Early to midseason.
Remarks: Is suited to cooler districts in California; requires berry thinning; is slow growing; requires covering; is a wine grape.

Alicante Bouschet:

Clusters: Medium-sized, well-filled to compact, shouldered, conical.
Berries: Medium-sized, spherical, brilliant black, covered with bloom.
Season: Late to midseason.
Remarks: Is best suited to fertile soils; has red juice; requires covering; is a wine grape.

Malvoisie (Cinsaut):

Clusters: Medium-sized, loose to well-filled, winged, cylindrical.
Berries: Medium to large, ellipsoidal, reddish black to black.
Season: Early to midseason.
Vines: Vigorous and productive.
Remarks: Loses water rapidly after picking; requires covering; is a wine grape but has some characteristics of a table grape.
Mataro:
Clusters: Medium to large, usually two shouldered, conical, compact.
Berries: Medium-sized, spherical, black, covered with heavy bloom, firm, pulpy.
Season: Late to midseason.
Vines: Moderately vigorous, erect, moderately productive.
Remarks: Buds start late in spring; requires covering; is a wine grape.

Ribier (Alphonse Lavallee):
Clusters: Medium-sized, short, often heavily shouldered, conical, loose to compact.
Berries: Very large, ellipsoidal, jet black; normally seeded; firm; firmly attached.
Season: Midseason.
Vines: Moderately vigorous and productive.
Remarks: Is cordon-pruned; in California is a table grape; requires covering.

Malaga:
Clusters: Large to very large, conical, well-filled.
Berries: Uniform, large, ellipsoidal, whitish green to whitish yellow; normally seeded; firm; firmly attached; a good keeper.
Season: Midseason.
Vine: Vigorous and very productive.
Remarks: Is a table grape; requires covering.

Flame Tokay:
Clusters: Large, shouldered, short, conical, compact.
Berries: Large to very large, ovoid truncate, brilliant red to dark red, normally seeded, very firm, firmly attached.
Season: Midseason to late.
Vine: Moderately vigorous, productive.
Remarks: Sunburns easily; is a table grape; requires covering.

Thompson Seedless (Sultanina):
Clusters: Large, heavily shouldered, long, cylindrical, well-filled.
Berries: Uniform, medium-sized, greenish-white to light golden; always seedless; firm, tender, very sweet when fully ripe; poorly attached.
Season: Early to midseason.
Vines: Very vigorous, very productive.
Remarks: Requires cane pruning; girdling increases size of berries; is a raisin grape; is used also for table grape and for wine; requires covering. Sultanana Rose is a pink variation.

Muscat of Alexandria:
Clusters: Medium-sized, shouldered, conical, loose, and often straggly.
Berries: Large, ovoid, dull green, covered with bloom; normally seeded; pulpy; pronounced Muscat flavored; moderately tough-skinned.
Season: Late to midseason.
Vines: Moderately vigorous, very productive.
Remarks: Long pruning with flower-cluster thinning aids in preventing straggly clusters; is subject to sunburn; is a raisin grape; is used also for wine and table grapes; requires covering.
**Johannesberg Riesling**:

Cluster: Small, cylindrical, well-filled.
Berries: Medium-sized, spherical, greenish-yellow; skin spotted with russet spots; juicy, somewhat aromatic.
Season: Early midseason.
Vine: Vigorous, moderately productive with long pruning.
Remarks: Responds to long pruning; does not require covering.

**VARIETIES OF AMERICAN GRAPES**

Concord is the principal variety of American grape grown commercially in Washington. Campbell Early ranks second in importance and is followed by Delaware, Niagara, and Agawam.

These and numerous other varieties are grown in home vineyards. Among the others are Fredonia, Moore Early, Worden, Brighton, Vergennes, and Diamond.

New varieties appear each year. Some of these, although still experimental, are promising. The early and late varieties are particularly promising in lengthening the fresh fruit season in home vineyards. Seneca, Ontario, Golden Muscat, Early Concord, Keuka, and Sheridan are some of the most promising but still experimental new varieties.

**Agawam**:

Clusters: Variable, medium to large, broad, tapering to somewhat cylindrical, sometimes single shouldered, loose.
Berries: Round; dull, purplish red; covered with lilac bloom; short and pale green brush; thick, tough skin; foxy; two- to five-seeded; very good dessert quality.
Season: Midseason to late.
Vine: Vigorous, only fairly productive.
Remarks: Is often used for blending wines; is very aromatic; keeps well after being picked; sometimes suffers winter injury.

**Brighton**:

Clusters: Large to medium, long, tapering, often shouldered, loose to compact.
Berries: Medium to large, oval round, light and dark red, somewhat glossy, covered with dark lilac bloom; aromatic; pale green, thick, short brush, with brown tinge; thick and tender skin; one- to five-seeded; excellent dessert quality.
Season: Early to midseason.
Vine: Vigorous, productive.
Remarks: Is self-sterile; should be planted with suitable pollinizer. Deteriorates in quality quickly after being picked.

**Catawba**:

Clusters: Large to medium, rather long, single to double shouldered, loose to compact; stem swollen at point of attachment to berry.
Berries: Medium-sized, round, dull purplish red, covered with light lilac bloom; short, pale green brush; slightly foxy; frequently aborted seeds; very good dessert quality.
Season: Late.
Vine: Vigorous, productive.
Remarks: Is adapted to a wide variety of soil conditions.

Campbell Early:
Clusters: Very large to medium, long and broad, tapering to cylindrical, often single shouldered, compact to slightly loose.
Berries: Dark purplish black, medium-sized, round, covered with heavy bloom; long, light wine-colored brush; thin, tough skin; not foxy; high quality; one to four seeds.
Season: Early.
Vine: Vigorous to medium. Very productive.
Remarks: Attains its full color before it is ripe; is not adapted to a wide variety of soil conditions; is not so hardy as Concord.

Island Belle:
Considered a close synonym, if not a true synonym, of Campbell Early.

Concord:
Clusters: Uniform, large to medium, wide, broadly tapering, single or double shouldered, medium to rather compact.
Berries: Medium to large, round, black, covered with abundant blue bloom; firm, pale green brush; moderately tough skin; slightly foxy; good quality; one to four seeds.
Season: Midseason.
Vine: Of average vigor, very productive.
Remarks: Is adapted to wide variety of soils; is subject to chlorosis in calcareous soils; is most common variety of American grape.

Concord Seedless (Experimental):
Clusters: Small, similar to Concord.
Berries: Small, usually seedless, similar to Concord in flavor and color.
Remarks: Has possibilities as pie stock, probably a sport of Concord.

Delaware:
Clusters: Small, usually shouldered, compact.
Berries: Small, round, light red, covered with thin lilac bloom; intermediate; light brown brush; thin skin; aromatic; excellent quality; one to four seeds.
Season: Early.
Vine: Only fairly vigorous, fairly productive.
Remarks: Is subject to leaf hopper; responds to fan-pruning.

Diamond:
Clusters: Variable in size, medium to short, somewhat blunt, cylindrical to slightly tapering, often single shouldered, compact, stem of berry wide at point of attachment.
Berries: Medium to large, round; slender, pale green brush with tinge of yellow, less yellow than Niagara; white, covered with thin gray bloom; slightly aromatic; one to four seeds. Very good dessert quality.
Season: Early to midseason.
Remarks: High quality; has some *vinifera* blood.

**Fredonia (Experimental):**
Clusters: Medium-sized, cylindrical, compact.
Berries: Large, oblate; green brush; thick, tough skin; black; good quality.
Season: Early.
Vine: Vigorous, hardy, productive, rambling, often tangled.
Remarks: Berries are inclined to drop during some seasons.

**Golden Muscat (Experimental):**
Clusters: Very large, tapering, single shouldered, compact.
Berries: Large, oval, juicy, tender, sweet, aromatic, golden, high quality.
Season: Late.
Vine: Vigorous.
Remarks: Requires season ten days longer than that of Concord; possesses muscat aroma of European Muscat; is promising for home use.

**Keuka (Experimental):**
Clusters: Medium-sized, compact.
Berries: Medium-sized, roundish oval, covered with heavy lilac bloom; sweet *vinifera* flavored and very good in quality; green brush.
Season: Midseason.
Vine: Vigorous, very productive.
Remarks: Is mostly European; hardy, resembles Delaware; flesh scarcely separates from skin; skin and flesh may be eaten.

**Lucile:**
Clusters: Medium to large, cylindrical to tapering, usually single shouldered, very compact.
Berries: Long to medium, oval round; dark red, covered with dull lilac bloom; light brown brush; foxy; one to four seeds, average of three.
Season: Early.
Vine: Moderately vigorous; productive.
Remarks: Clusters are sometimes so compact that the berries crack.

**Moore Early:**
Clusters: Intermediate in size, irregularly cylindrical to tapering, inclined to looseness.
Berries: Large, round, purplish-black to black, covered with abundant blue bloom; short red brush; slight foxiness; fair dessert quality.
Season: Early.
Vine: Moderately vigorous, fairly productive.
Remarks: Is about two to three weeks earlier than Concord.

**Niagara:**
Clusters: Large to medium, tapering to cylindrical, often single shouldered, moderately compact.
Berries: Medium to large, roundish oval, light green changing to pale yellowish green upon ripening; covered with thin gray bloom; pale green
brush of medium length; thin skin adhering slightly to pulp; very good quality.
Season: Midseason.
Vine: Vigorous, very productive.
Remarks: Not quite so hardy as Concord. A labrusca grape with Concord as one parent.

Ontario (Experimental):
Clusters: Medium-sized, usually single shouldered.
Berries: Round, medium-sized, green skins, and very good quality.
Season: Early.
Vine: Vigorous, productive.
Remarks: Is a cross between Winchell and Diamond.

Portland (Experimental):
Clusters: Large.
Berries: Large, round, green, good quality.
Season: Early.
Vine: Very vigorous, hardy, productive.

Seneca (Experimental):
Clusters: Medium-sized, tapering, compact.
Berries: Medium to small, oval; yellow; firm; aromatic; very good quality.
Vine: Vigorous, very productive, hardy.
Remarks: Has firm texture like that of true vinifera; skin can be eaten with the berry; is good for dessert.

Sheridan (Experimental):
Clusters: Large, compact.
Berries: Large, round, black, good quality.
Season: Late, one week later than Concord.
Vine: Moderately vigorous, fairly productive.
Remarks: Is considered as a good variety for extending Concord season.

Vergennes:
Clusters: Medium-sized, cylindrical to tapering, inclined to be loose.
Berries: Large to medium, oval round, red, covered with lilac bloom; slender, pale green brush; thick, tough skin; fair to good quality.
Season: Midseason.
Vine: Sprawling, productive.
Remarks: Is a regular cropper; is inclined to overbear; is a fairly good keeper.

Worden:
Clusters: Large, medium to long, tapering to cylindrical, usually single shouldered.
Berries: Large, round, dark purplish-black to black, covered with blue bloom; long, light green brush; thin skin; excellent dessert quality.
Season: Ten days to two weeks earlier than Concord.
Vine: Fairly productive.
Remarks: Is a high quality black grape; is a Concord seedling; is not adapted to all types of soil. Fruit cracks badly.

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