Oregon Agricultural College
Experiment Station
Division of Horticulture

Grape Culture, With Special Reference to Commercial Production Under Irrigation in Eastern Oregon

BY

R. W. ALLEN

CORVALLIS, OREGON
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Grape Culture, With Special Reference to Commercial Production Under Irrigation in Eastern Oregon

BY

R. W. Allen, Superintendent of the Umatilla Branch Experiment Station
Hermiston, Oregon, *
GRAPE CULTURE, WITH SPECIAL REFERENCE TO COMMERCIAL PRODUCTION UNDER IRRIGATION IN EASTERN OREGON

Introduction

The light soil and warm summers of the river valleys of Eastern Oregon are very congenial for grape plants. A sweet, highly flavored and early fruit of excellent quality is being produced in a number of localities along the Columbia River and its tributaries. Relatively heavy yields and freedom from disease render the cost of producing American varieties comparatively low. The Viniferas, or so-called European varieties, are grown with varying degrees of success. Owing to the season being somewhat short, late varieties do not reach full maturity every year.

The commercial manufacture of grape juice within the district has created a desire on the part of many people to enter extensively into grape growing.

That grape production in this district is scarcely past the experimental stage is evident by the random selection of varieties for home and commercial vineyards, varied practices in culture and training, and a decided lack of system and cooperation in handling and marketing the fruit. By systematic marketing of fancy table varieties and the manufacture of grape juice, there is promise of substantial increase and fair profit in grape production.

It is the purpose of this bulletin to give, as accurately as possible, the present status of the grape industry in the Columbia River basin; to assist in regulating the systems adopted for planting, cultivating, training, harvesting and marketing best suited to the proper development of the industry; to describe the vigor of growth, quality, and comparative value of desirable varieties; to caution people to investigate this industry before investing too heavily; and to encourage more general use of grapes in general farming districts. The preparation of the bulletin has followed a careful investigation and study of local conditions and other factors bearing upon the successful development of a commercial industry.

Present Status of the Grape Industry

Within the United States there are two very important grape-producing districts, the greater of which is in California and the other about the Great Lakes. A number of lesser districts have developed in various parts of the Union.

California produces the old-world or Vinifera types, of which she has approximately 144,097,670 vines. Their fruit is sold mostly as raisins and wine. There are 56,413,734 vines in the four principal grape-producing states bordering on the Great Lakes. The fruit, which is of the American
varieties, has been sold for use as desert until recently. During the past few years there has sprung up, in that region, a large industry in the manufacture of grape juice.

The products of these two regions are extensively marketed in the Pacific Northwest. The consumption of grapes in Oregon is not only much less than of other common fruits, but is also much lower than it should be. Of the quantity imported, much the greater part comes from California. Abundant yields, cheap production and low cost of transportation are accountable for the large shipments of grapes from California into Oregon, Washington and British Columbia.

There is a total of 703,309 grape plants in Oregon and Washington, which supply a very small part of the demand within these two states. Numerous varieties of Vinifera and American grapes have been tried out in many parts of Oregon. From the many small and widely distributed vineyards, the possibilities of successful grape production have been well demonstrated. It is readily observed that the American varieties are much better adapted to the irrigated lands of Eastern Oregon than are the Viniferas. The necessity of covering Viniferas in winter, and the frequent failure of some varieties to reach full maturity, render crops uncertain, thereby increasing the cost of production. A few varieties reach full maturity and are of excellent quality.

The climatic conditions of this district are very congenial for the growth and proper maturity of many varieties of grapes. They are a combination of dry atmosphere and mild weather resulting from interior location and low altitude. Comparatively long growing seasons and mild open winters usually prevail.

The mean temperature during the six months from April 1 to October 1 for the past three years is 64.8 degrees F. By consulting Table I it can be seen that the growing season is fairly cool, but day temperatures are warm enough to influence rapid growth.

**Table I. Monthly Temperature (Deg. F.), 1912 to 1914, Inclusive**

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<td>1912, mean</td>
<td>41</td>
<td>52</td>
<td>61</td>
<td>69</td>
<td>72</td>
<td>69</td>
<td>59</td>
<td>48</td>
<td>1912, minimum</td>
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<tr>
<td>1912, maximum</td>
<td>71</td>
<td>78</td>
<td>91</td>
<td>104</td>
<td>102</td>
<td>102</td>
<td>57</td>
<td>78</td>
<td>1912, maximum</td>
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<tr>
<td>1913, mean</td>
<td>45</td>
<td>53</td>
<td>60</td>
<td>68</td>
<td>74</td>
<td>83</td>
<td>60</td>
<td>50</td>
<td>1913, minimum</td>
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<tr>
<td>1913, maximum</td>
<td>94</td>
<td>86</td>
<td>87</td>
<td>92</td>
<td>105</td>
<td>103</td>
<td>91</td>
<td>81</td>
<td>1913, maximum</td>
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<tr>
<td>1914, mean</td>
<td>49</td>
<td>54</td>
<td>61</td>
<td>66</td>
<td>74</td>
<td>73</td>
<td>61</td>
<td>53</td>
<td>1914, minimum</td>
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<tr>
<td>1914, maximum</td>
<td>70</td>
<td>75</td>
<td>91</td>
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<td>15</td>
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<td>1913, minimum</td>
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<td>42</td>
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<td>1913, minimum</td>
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<td>1914, minimum</td>
<td>20</td>
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<td>44</td>
<td>42</td>
<td>37</td>
<td>31</td>
<td>1914, minimum</td>
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Early-maturing varieties ripen in August. Late varieties of American grapes and early Viniferas are matured with a fair degree of uniformity. By having sufficient time for full normal maturity the fruit of most varieties is highly flavored and very sweet.
Since the grape is a very late bloomer, it seldom suffers from frost injury. Frosts exert less injury upon grapes, in fact, than on most other fruits, on account of the late appearance of the blossoms. The average date for late spring frost, which is April 23, is previous to the appearance of blossoms during normal seasons.

Possibilities of Commercial Production

Grapes require well-drained soil and relatively warm climate. The success of certain varieties and species varies greatly with change in their environment. This is shown by the pronounced difference in adaptability and productiveness of different varieties grown under varying conditions of soil and climate. Certain varieties thrive in all parts of Oregon where mild weather prevails and where sufficient moisture is available.

The warm climate and long growing season of southern Europe and Asia, where the Viniferas were originated, are not sufficiently duplicated here to meet the full requirements of but a limited number of Vinifera varieties. Several varieties, however, are grown with a fair degree of success. Covering in winter, careful thinning, and summer pruning to prevent excessive shading of the fruit, are necessary practices for best results. The Sultanina (Thompson seedless), Malaga, Black Price, Black Hamburg, and Muscat of Alexandria reach full maturity, but the Flame Tokay, a very desirable variety, cannot be ripened and colored with certainty.

On account of the fact that the natural habitat of American varieties, of Labrusca and other hardy stocks, is in the northeastern part of the United States, where low winter and relatively high summer temperatures prevail, they find this a very congenial home. As the soils and climate are favorable, the growth of varieties having hardy parentage is vigorous, and their fruit is fully matured. The fruit ripens fully 10 days earlier than the same varieties in the cooler valleys near the coast. The fruit is sweet and highly flavored. Where irrigation is applicable there is a possibility of developing commercial vineyards on properly selected soils unless in very high altitudes where the season is too short. Early-maturing varieties can be grown in high altitudes, where the seasons are comparatively short and cool, but commercial production is not feasible under such conditions.

Establishing the Vineyard

Choice of Soils

The selection of soil to plant to grapes is much more important than that of location, and frequently of greater importance than getting a perfect site. Many varieties of grapes prefer light soils to clay or adobe. They also do better on sandy loam soils than on coarse soils. Of the soils that are being put under irrigation in this district the finer types are much more desirable than the coarse types on which to grow grapes. Equal results cannot be rightly expected from planting on coarse and fine soils. Success should not be anticipated from the coarser soils without their first being modified.
by liberal fertilization. By the selection of hardy varieties, better results can be had from coarse soils than would otherwise result.

Grapes require deep, warm, well-drained soil and do not thrive in wet, seepy places or on soils made shallow by the presence of a high water table.

When but a small number of vines are grown for home use, they should be placed on a productive soil in the garden or shrubbery plat. By placing them on well-fertilized soil, fewer vines are required to supply the home, and fruit of the best quality is produced.

Choice of Site

Damaging frosts are less prevalent on high land and near large bodies of water than elsewhere. Preferable locations on irrigated lands in this vicinity are toward the upper part of the projects, near steep, sloping land, where there is a rapid descent for considerable distance, or near a body of water.

Cold air collects in low places and renders frost injury more frequent in such locations than on higher adjacent land. The infrequency of destructive frosts near large streams is due to the tempering effect of the water.

Steep land is not desirable for a vineyard owing to the inconvenience of getting around on it, and to the difficulty of irrigating it properly. South or southwest slopes are not highly desirable on account of damage to the vines resulting from occasional severe winds. Land with this exposure becomes very warm during hot weather and plants are frequently injured by sunscald. There appears to be little choice of direction in which land slopes, excepting to avoid exposure to the sun and wind. These factors can be largely overcome by the use of windbreaks and shade crops.

Plants for the home vineyard should be located near the residence. They can be placed in rows parallel to flumes or fences where but very little space is required for them.

Figure 1. Grape vines trained on a trellis near a flume, a practice that makes waste places useful.
Selection and Description of Varieties

For the proper selection of varieties attention should first be given to the market upon which the fruit is to be sold. The manufacture of grape juice requires but a small number of varieties, only two being necessary, and an equal number of possible value. To lengthen the season and to supply special limited demands for color and flavor of table grapes, a number of varieties become necessary. All varieties required for juice, jellies, marmalades, etc., are valuable for desert. Only varieties of best quality should be chosen for either purpose, and the number of varieties should be kept at a minimum.

With the present meager knowledge of the yield and quality of fruit produced by different varieties under the environment of this district, recommendations made at the present time might be found erroneous at a later date. The fruit and value of certain varieties grown here have been found to differ widely in character from the same varieties grown at other places.

The Concord and Worden are preferred for the manufacture of black juice. For red juice, the Catawba is preferred.

Early Moore, Winchell, and Delaware are promising for early desert varieties. The Early Campbell, Worden, and Diamond are superior mid-season varieties. For late season and storage varieties the Concord, Catawba and Niagara are preferable.

But a small number of Vinifera can be recommended for general planting, as late varieties do not reach full maturity. The most successful are Sultanina (Thompson seedless), Malaga, Muscat of Alexandria, Flame Tokay, Black Hamburg and Black Prince.

Varieties for home use should be selected from this list. It includes a sufficient number from which a succession of hardy and productive varieties can be taken to supply fresh fruit from August to December, or even until January with proper storage.

Description of American Varieties

Catawba. Vine vigorous, hardy, and fairly productive, flowers fertile. Fruit late, one of best keepers, clusters of medium size and rather loose; berries of medium size, dull red, persistent, skin tough, quality very good. Valuable for red juice and for storage.

Concord. Vine vigorous and hardy on medium soils but weak on new land, productive, flowers fertile. Fruit matures September 1 to 15, good keeper, clusters medium in size and compactness, berries medium, black with heavy blue bloom, sweet and of excellent quality. Standard of market varieties and is used extensively for the manufacture of grape juice.

Delaware. Vine a weak grower, fairly hardy, fairly productive, flowers fertile. Fruit ripens before Concord, keeps well, clusters small and compact, berries small, light red, sweet and of best quality. Good for early market and for home use.

Diamond. Vines vigorous, hardy and productive, flowers fertile. Fruit
ripens mid-season, keeps fairly well, clusters medium to large, compact, berries medium or above, greenish yellow, persistent, sweet, very good. Fair market variety and very desirable for the home vineyard.

**Early Campbell.** Vine vigorous, hardy and productive, flowers fertile. Fruit matures August 20 to September 1 and markets with the Worden or before, keeps and ships well. Clusters of medium size and usually loose, berries large, black, persistent with fairly tough skin, sweet, and generally considered to have better flavor than Concord. A good market variety. Can be gathered through a long season and keeps well.

**Early Moore.** Vine weak on coarse soils, yields light, flowers fertile. Fruit ripens about August 15 to 20, not a long keeper, clusters small, berries large, purple with thick bloom, not persistent, fair quality. Desirable for early market.

**Lindley.** Vine vigorous, apparently hardy, yield medium, flowers sterile. Fruit ripens with Worden, keeps well, berries large, dark red, fairly persistent, skin tough, quality very good. Desirable for home and market use.

**Niagara.** Vine of medium vigor, fairly hardy, yield medium to heavy, flowers fertile. Fruit ripens with Concord or later, clusters medium, berries large, green, persistent, tender skin, quality fair to good. Valuable for home vineyards and for marketing with the Concord and Catawba.

**Winchell (Green Mountain).** Vine fairly vigorous and hardy, productive, flowers fertile. Fruit very early, keeps quite well, clusters medium and compact, berries medium light green, persistent, skin tender, sweet and of excellent quality. Favorable for limited sale on early markets.

**Worden.** Vine vigorous, hardy, productive, flowers fertile. Fruit ripens 6 to 10 days before Concord, August 25 to September 1, fair keeper, clusters large, compact, berries large, purple to black with heavy bloom, fairly persistent, skin rather tender and cracks by rough treatment or from rains. Popular on account of heavy yields and excellent quality, but is not marketed to as good advantage as Concord. Promising for making grape juice and excellent for the home vineyard.

**Description of Viniferas**

**Sultana (Thompson Seedless).** Makes a vigorous growth, matures its fruit early and appears to be less affected by crown gall and low temperatures than the Muscat and Tokay. The fruit, which is small, sweet, and light green in color, is borne in large, loose bunches. It is one of the most desirable varieties.

**Malaga.** A long-keeping variety of good quality. The fruit is large, light green in color and sweet. The plants appear to be less affected by crown gall and low temperatures than the Muscat and Tokay.

**Muscat of Alexandria.** This is one of the widest known and most popular varieties. The fruit, which is borne in large, loose bunches, is large, firm and possesses a very attractive flavor. The plants are vigorous unless weakened by the attack of crown gall or by winter freezing.

**Flame Tokay.** The fruit of this variety is large, firm, sweet and of a
bright red color when mature. It requires a long season and does not become fully ripe every year. The plants are susceptible to serious injury from crown gall and to freezing in winter.

Such varieties as the Black Prince, Black Hamburg, and Cornichon are favored by some growers, but have not been extensively planted.

**PLANTS FOR THE VINEYARD**

**Selection and Care of Stock.** Well-rooted plants one year of age give best results. Older vines do not respond as readily as young ones when transplanted and usually make a much smaller growth. Cheap stock is more expensive in the end than first-class material, as it frequently produces many weak plants. Reputable nurseries, only, should be patronized, as there is greater certainty of getting quality of stock and varieties as ordered. When received from the nursery, the bunches of plants should be broken and the plants carefully heeled in where the ground is damp and cool. If the bunches are not broken, heating or drying frequently results, with injury to the roots and buds.

**Number and Cost of Plants for an Acre of Land.** The number of plants required to plant an acre of land depends upon the space given to each.

Table II shows the number of plants for each distance at which grapes are usually set:

<table>
<thead>
<tr>
<th>Distance in feet</th>
<th>No. of Plants per Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>8x8</td>
<td>680</td>
</tr>
<tr>
<td>8x9</td>
<td>605</td>
</tr>
<tr>
<td>9x9</td>
<td>538</td>
</tr>
<tr>
<td>9x10</td>
<td>484</td>
</tr>
<tr>
<td>10x8</td>
<td>545</td>
</tr>
<tr>
<td>10x10</td>
<td>435</td>
</tr>
</tbody>
</table>

The cost of plants depends upon the difficulty with which different varieties are propagated, and the grade of stock purchased. Concords of best quality can be bought at $16 a thousand; Wordens at $25, from nurseries in the Eastern grape belt, and at $6 to $15 a hundred from Western nurseries. Viniferas, which can be procured locally and from California nurseries, cost $16 to $20 a thousand. The cost of transportation should be added to the above estimates.

**Propagation.** Grapes can be readily and successfully propagated by cuttings. Wood taken for this purpose should be chosen from plants that have fruited, and are known to be true to name. Well-ripened canes of medium size should be used. Immature wood at the extremity of the canes and the first few short internods at the base should be discarded. Four properly-trimmed cuttings are shown in Figure 2 a.

Cuttings should be made early in winter. They should be placed in layers in a box of damp sand and put away in a cellar, or other well-protected place, until spring. Care should be taken to keep the sand about them from...
becoming dry, or too wet, as either extreme will result in injury to the wood. While stored in this manner the ends callous (heal) over and are in better condition for planting than cuttings taken from wood that has been subjected to severe weather and cut immediately before planting.

Cuttings should have at least three buds and should be from 8 to 12 inches long. A distance of 4 to 6 inches should be given them in the row, and they should be covered to the upper bud. Rich soil, preferably garden land, should be chosen and the cuttings planted in a convenient place, where frequent attention can be given them. The plants will be ready for transplanting at the close of the first year, if they are well grown.

**PLANTING THE VINEYARD**

**Preparation of Land for Planting Grapes.** Land that is to be planted to grapes should be thoroughly graded and prepared for irrigation. If left uneven and in a state of incomplete preparation, much difficulty will be met with in growing the vines.

Distributing ditches and flumes should be put in their permanent location. They should be well constructed and of sufficient capacity to carry the maximum of water that can be used at one time in irrigating the vineyard.

Grapes succeed better on land that has been cropped for a time than upon raw land. It is advisable to grow vetch, sweet clover, soy beans, or some similar crop, and plow it into the land before planting vines. They succeed fairly well on raw land, but do much better on carefully prepared land.

**Laying Out the Vineyard.** On irrigated land there is usually little opportunity for choice in the direction or orientation of the rows, as it is necessary to place them to conform with the irrigation furrows. They should be placed at a wide angle to the direction of the prevailing wind. By so doing, less injury results from tearing down and breaking the vines. When possible, it is to the advantage of the grower to run the rows north and south, as equal exposure is given each side of the rows and the fruit is well shaded during the heat of the day.

Liberal space should be left for headlands to permit of cultivating with a two-horse team without injury to the trellis and flumes in turning.

Avenues are not necessary on coarse, irregular soils, where parallel flumes are placed as close as 200 feet. On finer soils, where flumes are not close together, avenues become necessary for convenience in distributing picking receptacles and in removing the fruit. With liberal headlands and rows 9 or 10 feet apart a team and wagon can be driven between the rows.

In large vineyards, where considerable help is necessary for harvesting the crops, avenues are not necessary, as one man loading from each side of the wagon can gather the boxes from three rows without difficulty. Access to the field and rows is gained by headlands parallel to irrigation flumes.

**Distance Between Plants.** In no case should the rows be placed too close together, to admit of cultivation being done with a two-horse team.
The use of but one horse requires extra labor and is much more expensive than doing the work with two horses. The influence of character of soil upon the vigor of vines is, that a much stronger growth occurs on fine than on coarse types. Maturity of fruit can be hastened by lack of moisture and soil fertility. Some people advocate close planting to bring this about. Early maturity frequently occurs on coarse soils, which indicates that the range of soil conditions existing in this country will cause grapes to ripen through an unusually long period. The distance between plants and rows should be influenced by the character of the soil and vigor of the varieties to be planted. Such slow-growing varieties as the Delaware do not require as much space in the row as rapid-growing varieties, such as the Worden.

Best results will follow the establishment of a uniform distance of 8 to 10 feet between the rows and by placing vines in the rows according to their size. Delaware plants should be placed 8 feet apart, Early Moore 8 feet, Winchell, Early Campbell, Worden, Concord, Catawba and Niagara, 10 feet apart on silt and sandy loam soils and from 1 to 2 feet closer on coarse soils. Viniferas usually make a more vigorous growth and require from 10 to 12 feet in the row. Plants of the Sultanina being quite vigorous, should be placed at least 12 feet apart.

Staking the Land. Stakes should first be placed at the ends of the rows. By means of a cord used to establish the lines and a measuring stick to mark the proper spaces, holes can be dug, and the plants set and aligned by means of the cord. For extensive planting it is best to have a small wire with indicators securely tied, wrapped or soldered onto it at the proper intervals for marking the location of plants. By stretching this on the row in such a manner as properly to establish the first and last hills on the base lines, and setting stakes to mark the place of each plant in the row, a great saving of time and accurate alignment will result. The entire field should be staked off before planting is undertaken, as a decided waste of time results from attempting to carry both operations on together. Cross alignment is difficult to accomplish by laying out and planting one row at a time.

Distribution of the Varieties. To intermingle varieties is fully as important with grapes as with other fruits. Most of the varieties suited to this region are fertile and bear quite well when isolated. It is important, however, to have two or more varieties close together, as it has frequently been noted that more perfect fertilization and greater uniformity of fruit result.

The mixing of varieties in a vineyard, which is advisable for no reason except to facilitate cross pollination, should be done systematically. Single hills or individual rows should be avoided. Lack of system in this work often renders harvesting and care tedious and expensive. From 2 to 6 rows of a variety should be placed together so that their care will not cause extra trouble if attention is required at different times by different varieties.

Platting the Field. A plat or chart of the field should be made at the time of planting, since it is valuable for the purpose of keeping an exact record of the location of each variety. Such charts are frequently referred
Figure 2. (a). Cuttings from the canes of American grapes.
(b). A very good grape plant one year from the cutting.
(c). The plant shown at b after being pruned preparatory to planting in the field.

to and are found very convenient in checking up missing plants. It also serves as a record of the number of hills of each variety there is in the vineyard, a matter that is so frequently forgotten before the grapes begin fruiting. The little effort required to make a chart of the vineyard on a sheet of durable material will be repaid many times over by the valuable assistance it affords.

Digging Holes and Setting Plants. The holes should be made large enough to permit of spreading the roots out uniformly. The plants should be placed with the base of the new growth near the surface of the ground. Either top dirt or a small amount of partly decayed stable manure should be put in about the roots and packed down firmly. If it is possible to obtain sufficient material, all plants should be well fertilized when set out. Irrigation should be applied immediately to settle the soil closely about the roots. Temporary protection should be given by placing a light mulch of straw or coarse manure about the plants. Shading, which is also necessary for a
time, can be supplied by placing a shingle to the southwest of each plant in such a manner as to protect them from sunburning when warm days occur.

Too much is usually expected of young plants put out in new land. It must be borne in mind that such soil has never been cultivated or irrigated and is in poor condition to grow crops. Upon being removed from the nursery row, the plants, having lost a large portion of their roots, experience considerable difficulty in reestablishing themselves. All planting should be done early in the season and with special care.

The roots of plants should be trimmed off to 6 or 8 inches in length to facilitate planting, and if too thick should be thinned out somewhat (Figure 2 b-c). The top should be cut back to two or three good buds on a single cane at the time of planting or soon afterward. Trimming the top is usually the last operation in planting, since all danger of destroying buds is past at that time (Figure 2 c).

Figure 3. (a). Vineyard of American grapes on a trellis.
   (b). A part of the vineyard shown by a without a support; the rows shown at a are in the background.
Figure 4. At a is shown a much better method of bracing end post that is indicated by b. Stakes, d, or boulders, c, may be used to hold the braces in place. Ratchets or spools for regulating the tension of the wire should be placed on one end post of each row.

THE TRELLIS

A support for the vines is necessary properly to distribute the fruit and foliage for normal growth. For this purpose a trellis of two or three wires is necessary. By fastening the vines to a rigid support in a systematic manner, the fruit is kept off the ground and is easily gathered. Even distribution of fruit and foliage, brought about by proper training upon a trellis, keeps the fruit clean and influences it to grow and mature uniformly.

The height and strength of the trellis should be designed to meet the greatest need of the varieties for which it is built. From 1 to 3 wires are necessary for either the American or Vinifera grapes.

Number 12 wire is large enough, when properly supported, to carry vines of average vigor, and is quite generally used. Larger wire is difficult to handle and to keep tight. Table III shows the number of feet to the pound of different sized wire. It will be of value in estimating the amount of wire needed for making a trellis.

Table III. Number of Feet to the Pound of Different Sized Wire

<table>
<thead>
<tr>
<th>No.</th>
<th>Feet to the pound</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>17.95</td>
</tr>
<tr>
<td>10</td>
<td>22.33</td>
</tr>
<tr>
<td>11</td>
<td>27.34</td>
</tr>
<tr>
<td>12</td>
<td>34.29</td>
</tr>
<tr>
<td>13</td>
<td>44.09</td>
</tr>
<tr>
<td>14</td>
<td>58.91</td>
</tr>
</tbody>
</table>

Posts at the end of the rows should be strong and well braced. Wooden braces inside are preferable to wires extending into the headland, as the latter interfere with traffic and frequently become loosened or broken. Medium-sized posts from 2 to 4 hills apart, or strong posts at greater distances with staves between the hills, are necessary properly to support the vines. A trellis for American grape vines of medium size should be 3 to 5 feet tall, and for Viniferas it should be 4 to 6 feet tall.

Cost of Materials for the Trellis. An acre of land, 209 feet square, would have 22 rows 9 feet apart; 22 rows 200 feet long would require 8,800 feet of wire for a trellis of two wires. This amount of 12-gauge wire equals 250 pounds, which at five cents, the price in bulk at Hermiston, would cost $12.50. Forty-four end posts, at 12 cents, cost $5.28. One hundred ninety-
eight smaller posts for the rows, at 10 cents, would amount to $19.80. Forty-four braces, 2x4-16, amounting to 528 board feet, at $16 a thousand, would amount to $8.45. The total of $46 for one acre of trellis alone would be greater than for each acre in a larger vineyard on account of the greater number of end posts and braces required. The cost of center posts can be diminished by using fewer posts and putting in staves of similar character and in the same manner to that in which they are employed in railroad right-of-way fences.

Fastening Wires to End Posts. Arrangement should be made for tightening or loosening the wires at one end of the rows. This can be done by means of metal ratchets, by small wooden spools, or by drawing the wire tight with a pulley and wrapping the free end about the post.

Fastening Vines to the Trellis. All vines should be fastened to the windward side of the trellis so they will be held against the support rather than being torn from it by severe winds.

Shoots of the Viniferas need to be fastened to the trellis as soon as they attain sufficient length, which is usually in June. The canes of American varieties are tied after pruning in winter and require no attention in summer, as the shoots are allowed to droop or hang down.

Cotton cord or small soft wire are used for tying. The wire is cut into short pieces and bent around the wood and support in such a manner as to hold them firmly together.

TRAINING AND PRUNING

Training is an important and much discussed phase of the work of producing grapes. Systems best adapted to the climatic conditions and vine growth of this district have not been satisfactorily worked out. A most important practice in training is to dispose of the growth in such a manner as to reduce the labor of pruning to a minimum. Pruning is necessary each year to restrict the growth into a small number of shoots for the purpose of increasing vigor of growth and the quality of fruit. But little is known of the effect of, and proper season for, summer pruning. Since grapes are mostly grown as a minor product on the farms of this district, but little attention appears to have been paid to training.

By experiments conducted with vines on the Experiment Station and from observations on various farms, two systems of training have been worked out for Viniferas. They are designed to keep the permanent part of the plants close to the ground so they can be easily and effectively covered, and to render the operation of pruning as simple as possible.

A few small vineyards of American grapes are trained to some of the described methods, but no definite training has been adopted and put into general practice at any point in the district. Many varieties branch so profusely that systematic training and pruning are rendered quite different from that in other localities. When plants become well established and make a strong growth, less branching occurs and pruning becomes less difficult.
The Objects of Training and Pruning

Pruning, which is necessary to influence training, has for its principal object the removal of wood for the purpose of restricting growth to a small number of shoots. By so doing the vigor of growth is greatly increased. As a result of this process the energy of the vine, upon being directed into a small number of shoots, causes rapid growth and the development of a few large bunches of fruit, whereas if this were not done numerous short canes and a large number of small bunches of fruit would result.

Proper training of grapes reduces the labor of pruning to a minimum and renders spraying and cultivation possible and effective without the interference of vines.

Parts of the Grape Plant

It is important that a definite understanding be had of the different parts of a vine and that the names of each be learned before training and pruning are undertaken. If the reader is not familiar with them a written explanation of a system of training is of little value, as confusion and misunderstanding would result. All the parts are illustrated in Figure 5.

In order to show definitely the nature of each part, a small plant has been chosen. Each portion should be so well known that it can be recognized regardless of its position on the vine. Among the characters upon which recognition depends are the nature of the bark, diameter of the wood, and relative position of the parts.

From this description all the parts of any plant in the vineyard should be readily recognized. By studying Figure 5 it will be seen that the body or stem (a) is the largest woody portion. From the stem arms (b) extend. The arms (b) are termed branches near the trunk and arms at the extremity

Figure 5. A mature grape plant one-half of which is pruned to the Umbrella or two-caned Kniffin system. Plants trained to the four-caned Kniffin system would have two branches at each of the wires of the trellis. The parts of a grape plant, all of which are shown here, are: a, body or stem; b, branches or arms; c, cane; d, a branched cane; e, water sprout; f, a sucker; g, spurs.
Training and Pruning American Varieties

American varieties of grapes are trained to a number of forms, all of which appear to have certain merits. The habit of growth of varieties and climatic conditions under which they are grown influence, to a measurable extent, the system of pruning that should be used.

Since neither of the established methods of training have been found of superior value in this climate, all that can be said of training is by suggestion in accordance with prevailing conditions as compared with those existing in well-established grape districts.

Among the most successful methods of training that are extensively practiced in the Eastern grape regions are the four-caned Kniffin, the two-caned Kniffin, and the Muson systems. A brief description of each system has been taken from Farmers' Bulletin No. 471.

Training Young Plants. No pruning is necessary between the time of planting and the close of the first growing season. At this time, however, all new growth should be removed but two or three buds at the base of the strongest cane (Figure 6).

During the second season the growth should be confined to one shoot. This should be kept securely tied to a strong stake to prevent its being broken by the wind, or by tools used in working the land (Figure 7). Stakes for this purpose should be tall enough to hold the plant until it is ready to be fastened to the trellis. They should be at least 1.5 inches in diameter and need to be driven well into the ground so as to form a rigid support.

If the plants are still weak at the end of the second year they should be cut back again to two or three buds. If the plants are strong the best shoot or cane should be selected and cut off at a place which will depend upon the method of training to be employed. If for the four-cane Kniffin system, it should be at the bottom wire (Figure 8 a), and for the two-cane Kniffin
or Munson systems at the top wire (Figure 8 b), in which case the spurs (a) would not be developed. This operation should be followed by training a cane out each way on the wire during the third year to serve as a foundation for fruiting wood the fourth season (Figure 5 b). For the four-cane Kniffin system a cane of the second year's growth should be taken from the lower to the upper wire, and cut back, as was previously done at the lower wire. This will influence the establishment of branches at the top wire in the same manner as for the two-cane Kniffin or Munson systems (Figure 5b-c). Great stress should be placed on the early training of grape vines, for they are more readily and more effectively handled at this time than at any other.

The Four-Caned Kniffin System. "On the trunks of the vine at the lower wire of a two-wire trellis, about 30 inches from the ground, 2 canes and 2 spurs are left of last year's growth, and 2 more canes and spurs are left at the top wire, about 56 inches * from the ground. These canes, which are tied to the wire on each side of the vine, produce fruiting shoots which are allowed to hang down or droop, as seen at Figure 5. The same vine as it appears after pruning at the end of the fourth year, when trained according to the four-caned Kniffin system, is shown in Figure 5. This system is named after William Kniffin, who first employed it. It has been extensively used along the Hudson River and elsewhere, and is said to be especially adapted to strong-growing varieties. Vines trained by this system are easily and quickly pruned and require only a limited amount of labor in the growing season."

Figure 7. Two-year old grape plants supported by stakes. At this age they are ready to be put onto the trellis.

*The height in this locality should be influenced by the vigor of growth of different varieties. Weak-growing varieties should be kept close to the ground to prevent too great exposure to the wind and sun.
The Umbrella or Two-Caned Kniffin System. "A system generally used in the training of American vines, known as the Umbrella or two-cane Kniffin system, differs from the foregoing in that no canes or spurs are left at the lower wire, the trunk of the vines extending directly to the top wire, where the growth is annually cut back to two canes and two spurs, one on each side, which are fastened to the top wire (Figure 5 h). It is best to tie the trunk to both the upper and lower wires to prevent violent whipping of the hanging shoots. Some growers dispense with the lower wire. Figure 5 shows a vine, trained according to this system, before and after pruning at the end of the fourth year.

"This system is really an improvement on the four-caned Kniffin system. The absence of the two lower canes insures a good upright trunk and the renewal of the fruit-bearing wood to one head makes the vine more easily pruned, leaves less old wood and results in cleaner and better ventilated vines."

The Munson System. "The Munson system derives its name from its originator, Prof. T. V. Munson, of Denison, Texas. As first practiced by him, use was made of two rows of light posts or stakes, the posts being opposite each other, their tops being about 18 to 20 inches apart. Wires were stretched along the tops of the posts in each row, with a third wire somewhat lower and midway between them upon cross wires.

"Munson now uses single posts. Across the top of each post a cross-bar of wood is fastened. The outer wires of the trellis are fastened to the outer ends of the crossbar, and the inner wire is fastened to the post the desired distance lower down. The writer secures essentially the same results in practice by using durable posts sufficiently heavy to allow pieces of 2x4 inch joist, 2 feet long, to be firmly spiked to them either at the side or top, when sawed off at the right height for the purpose. The outer wires are stretched on the cross joist, and the lower wire is either stapled against or run through the posts at the desired distance below, as shown in Figure 9. Four to 4½ feet above the ground is good height for the lower wires for most varieties.*

"By this system a single main trunk for each vine is grown and tied to the lower wire. In pruning this trunk, two canes and two spurs are annually left. The canes running to the right and the left are securely tied to the lower wire. The outer wires are for the sole purpose of supporting the growing shoots, which naturally develop from the canes and gradually droop towards the ground. Figure 9 shows the vines pruned and unpruned, trained after the modified Munson system. The writer considers this the

* A lower trellis would be advisable in most localities in this district.
best all-round system of training for use in localities where rains and storms occur during growing season. It protects the fruit and places it in the most advantageous surroundings for the best results. It makes practicable and facilitates spraying for fungous diseases and insect pests, and after the original outlay for the trellis has been incurred, lessens the cost of all operations and makes them easy and pleasant."

**Training and Pruning Viniferas**

Vinifera plants require being kept near the ground to facilitate covering for protection in winter. They can be trained to low stumps (the short system) or horizontal arms, that can either be left on the ground during summer or tied up to the lower wire of the trellis. Shoots springing from spurs on older wood of the plants constitute the fruiting part and should be tied up to a trellis.

A form of trellis with two wires is in common use. When the horizontal arms are tied up to the lower wire, three wires become necessary.

Pruning should be done as soon as the leaves fall, so the plants may be covered before cold weather occurs.

**The Short or Stump System.** Training young plants for the stump system is very simple. It consists in pruning back to short spurs near the crown of the plants until a stump, or much-branched, stem is established (Figure 10). These stems, or bodies, should be kept close to the ground to facilitate covering. Pruning is accomplished by cutting back a few strong shoots to spurs having two or three buds, and in removing all the remaining growth. The stump is kept from gaining in height by careful selection and close pruning of spurs.

The fruiting wood should be tied up to the trellis, and all remaining growth removed. Other shoots or sprouts that come on during the growing season need to be removed to prevent excessive shading of the fruit near the center of the bushes.

![Figure 10](image-url)

Figure 9. The Munson system of training in which the new canes, a, are tied up, each year to the lower wire of the trellis, b. The new growth is allowed to hang over the two outer wires c. The annual pruning consists of removing the two-year old wood, d, with the canes, e, that bore fruit the previous year by cutting at the point indicated by f.
Horizontal Arm System. Young plants are trained to the horizontal arm system by confining the growth to a small number of shoots (one or two) until two strong canes are produced. One cane is made secure in a horizontal position each way in the row from the plant, and the ends recoved at a point near the center of the space between the plants (Figure 11). Growth springing from these permanent arms constitutes the fruiting part of the plant and is tied onto the trellis each year in a vertical position (Figure 11).

The pruning of vines trained to this system is accomplished by cutting the canes back each winter to spurs on the permanent arms. The number of spurs left on each plant should be influenced by its vigor. As many canes as the plant can support should be tied up to the trellis as soon as they are large enough, and at the same time all remaining growth should be removed. This should be done as soon as the new growth gets long enough to reach the top wire of the trellis.

When to Prune

The heavy annual pruning necessary to regulate the fruiting of vines should be done during the dormant season. Plants that require winter protection need to be pruned as soon as they become dormant. Hardy vines can be pruned at any time during the dormant season when the wood is not

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Figure 10. Vinifera grape plant trained to the Short system. The pruning would be completed by removing the remainder of the canes as indicated by the letter a. The canes remaining tied to the wires illustrate the manner in which the shoots are tied and pruned back in early summer.

Figure 11. The horizontal arms, a, are permanent parts of the plant which are kept close to the ground so they can be covered easily. Pruning is accomplished by removing the canes at b, leaving spurs, c. The new growth is tied up in early summer, in the manner shown by the canes now on the trellis.
frozen. It is advisable, however, to prune before February in this region, as late pruning frequently results in bleeding and serious weakening of the plants.

Summer pruning to diminish shade and hasten maturity of the fruit appears to be necessary with Viniferas on account of their vigorous growth. The usual practice is to remove all suckers and the ends of bearing canes beyond the last bunches of fruit. With summer pruning care should be taken not to expose the fruit, as sunscald might result. No definite system is adopted for this work, nor is its effect upon growth and production at all well understood.

TILLAGE AND CARE OF THE VINES

Cultivation and Irrigation

The methods of cultivation and irrigation generally applied to other fruit crops are, for the most part, suitable for grapes. Under prevailing soil conditions the matter of fertility and proper irrigation should have first attention. Cultivation may or may not be of advantage on coarse soils. These soils upon drying after irrigation become very loose and form a loose surface mulch. With improvement by the addition of organic matter, they become firm and eventually require cultivation to prevent their becoming settled and hard. When this condition prevails, frequent cultivation will of course be necessary.

Finer soils, that usually become firm by the action of rain, or from applying irrigation water, should be stirred in order to prevent their becoming hard, and to diminish the loss of moisture resulting from rapid evaporation from compact surfaces. By plowing green manure crops under in early spring and practicing clean culture during the summer, economy of water results, and the fertility of the soil is increased.

A very close study should be made of the water requirements of grapes, as their limited growth under irrigation has not as yet given us definite knowledge of their requirements of moisture. Over-production of wood and light fruiting sometimes result from excessive irrigation. Such a condition indicates the extravagant use of water or the presence of a high water table. Close study should be made to determine what treatment the plants need to influence vigor of growth, yield and quality of fruit, and time of maturity of the fruit. It is also important that the natural characteristics of varieties be learned. If this is not done, the slow growth of some dwarf varieties will be mistaken for lack of vigor. This would result in over-stimulation in an endeavor to make the plants appear like their more rapid-growing neighbors. Proper maturity of fruit and medium growth of the plants is necessary, and should be fostered by careful treatment. Early maturing fruit will be an important line of grape production in this locality.

On account of the many parallel rows in vineyards, irrigation water is most successfully applied by means of furrows. The soils of the district are economically irrigated by this method on account of the combined in-
influences of physical character and a somewhat irregular topography. Water should be uniformly distributed over the land regardless of the location of the rows, as roots of a mature vineyard extend in a fairly close network to all the available land about the plants (Figure 12).

The frequency of irrigation will depend a great deal upon the age of plants and condition of the soil, especially with reference to its physical condition and content of organic matter. Frequent light applications of water are necessary properly to supply the plants by maintaining a uniform and adequate quantity of moisture in the soil.

Irrigation should begin at about the time growth starts in the spring. The time will vary, however, with the extent and frequency of spring rains. Care should be taken to prevent the ground from becoming dry in early spring. The proper time to apply the last irrigation depends upon the age of the plants and the degree of maturity of fruit and wood.

Winter irrigation might be essential during dry and cold periods, but does not appear to have been necessary during recent years.

Frequent applications of water should be made to young vineyards, as the most critical period in their development is during the first year. Two irrigating furrows should be used for each row. The distance from plants to the irrigating furrows should be governed by the character of the soil. In coarse soils the water should be applied within 10 inches of the plants and at a distance of 1 to 1.5 feet in sandy loam or silt soils.

If a liberal amount of water is supplied to the plants they have an opportunity to become established and make considerable growth the first year. Unless frequent irrigation is applied heavy losses will result.

When young plants are set in older vineyards, frequent losses result
from lack of care. Rows of mature vineyard, having young plants placed in them, require frequent attention for success in developing the new plants.

**Fertilizers and Shade Crops.**

The fertilizers required by grapes on light soils are very similar to those required by other crops. This condition results from a uniform lack of nitrogen and organic matter in the soil of arid regions. Analyses show potash, phosphoric acid, and fertilizers of minor importance to be present in sufficient quantity to last for a considerable period. The application of potash might be necessary in time, as grapes feed quite heavily upon it. As for other crops, fertilizers can best be applied in the form of stable manure or green manure. Where insufficient manure is available, fall-sown crops of vetch should be used.

Excessive growth of grape vines is not of frequent occurrence here. It can usually be traced to excessive fertility, especially of nitrogen, or to over irrigation. The cause should not be difficult to determine.

**Green Manure Crops for the Vineyard.** The most feasible means of increasing soil fertility on the large number of farms where insufficient manure is produced, is to grow crops for use as green manure.

The nature of crop needed depends upon the element of fertility required. For the addition of organic matter to the land, vigorous and early-maturing plants should be chosen. Rye is a very good crop for this purpose. When nitrogen and organic matter are required, legumes, of which hairy vetch is very desirable, should be used. Cowhorn turnips that are usually grown to accumulate potash, and render it available by decay, have not been tried out here. They are hardy and should succeed by proper care.

**Nitrogen-gathering Crops.** To improve soils that are already set to grapes and for the maintenance of fertility in vineyard soils, green manure crops are invaluable. Hairy vetch, *Vicia villosa*, is very desirable for this purpose. It should be sown in August or September and can be worked or plowed into the land the following April or May. Annual crops can be grown and plowed in for a few years to good advantage. Care will need to be taken in applying nitrogen to fine soils, and the cropping system varied according to their requirements. One green manure crop carrying nitrogen might be found sufficient for three years on one soil, while on other soils a crop each year would be required. When organic matter is necessary to improve the physical condition of the soil and nitrogen is not required, some such crop as rye should be grown instead of vetch.

**Crops that Accumulate Potash.** Crops of such plants as cowhorn turnips or mustard are necessary to accumulate potash, as they feed heavily upon this element, and when they decay, render it available for other crops. They should be planted at about the same time in the fall as vetch.

**Shade Crops.** During the past few years frequent serious cases of sunscald of grapes have been seen, especially on *Vitis vinifera*. A striking example

*For detailed report on the use of green manure crops, see Oregon Experiment Station Bulletin No. 120.*
of this was in a peach orchard where grapes are planted as fillers. A portion of the orchard was seeded to alfalfa and only a light stand secured. Where this crop is growing, considerable shade is afforded the ground surface. Grape plants are vigorous and productive and but little affected by sunscald. Where the ground is not shaded, scalding of the fruit occurs. The plants have small, light colored foliage and grow very slowly. From this it would appear that the shading serves to prevent sunscald, and that the presence of alfalfa, either from shading the soil or from its influence as a fertilizer, is causing more vigorous growth of vines than occurs in other parts of the orchard. It appears that vigorous plants, by furnishing more shade, suffer less from sunscald than those that grow slowly, but considerable fruit is injured on vigorous plants where the land is bare.

Since shading of the roots of grape plants is common in their natural habitat, it is probable that they would profit by having the vineyard soil shaded and kept comparatively cool during periods of warm weather. Observations have been made that indicate a considerable benefit to result from summer shading of vineyard soils, but its full value has not been determined. It appears, however, that the practice is worthy of trial in commercial vineyards.

Such crops as Canadian field peas, or soy beans, are well adapted to this purpose. Fall sown vetch, if allowed to remain on the ground, forms an effective shade and will mature seed sufficient to reseed the land.

Diseases and Insect Pests.

So far as is known, American varieties of grapes are but little affected by disease in this locality; neither are they appreciably damaged by insects. It is not to be considered, however, that this condition will prevail for any great length of time, as some of the many grape pests can be expected to make their appearance from time to time as the industry is developed. Insect pests and fungous diseases are of general occurrence in old vineyard districts of the East and their control has become an expensive and perplexing factor in grape production. A number of troubles that require constant attention are present in the vineyards of the Southwest.

Crown Gall. Vinifera grapes are quite generally attacked by crown gall, which greatly diminishes their vigor. Some varieties are worse affected by it than are others. The Sultanina and Malaga grapes appear to be more resistant than other varieties in general use, while the Tokay and Muscat of Alexandria are very susceptible. The Tokay might possess a natural susceptibility to the disease, but as it is subjected to frequent and serious injury by freezing this doubtless renders its power of resistance to the disease quite low.

No successful method is known for combatting crown gall. As a means of prevention, however, badly affected plants should be destroyed to prevent the disease from spreading to neighboring trees or vines. The general and frequent appearance of crown gall on Vinifera grapes renders them undesirable companions for peaches, prunes or other fruits susceptible to the disease.
Mildew. The freedom of so-called susceptible varieties from serious attacks of mildew is due, in a large measure, to the dry condition of the atmosphere. Diseases of this nature are serious only in heavily shaded or damp places. Careful pruning does a great deal to prevent its occurrence. Where the disease persists in occurring, sulphur should be applied to destroy it. Finely ground sulphur is very effective in preventing the spread of mildew. It should be applied, when the blossoms begin to open, by being shaken through a loose woven cloth bag of the nature of an ordinary grain sack. All shaded foliage, and the ground about the plant, should be given a light coating of sulphur. It stays on better if applied when the foliage is damp with dew or soon after a light shower.

Winter Protection of Vines

The tender Viniferas, not being capable of withstanding low temperatures, require covering as a safeguard against injury or loss during winter. Not all varieties are affected by the same temperatures, but as all suffer in occasional seasons, covering becomes necessary.

Some of the so-called American varieties, which are crosses between American and Vinifera parents, although more hardy than the latter, suffer from freezing in cold districts and might be injured here in times of extremely low temperature.

A series of experiments have been carried out to determine the most effective method and best material to use for covering grape vines. The vines should be pruned and laid down, or pruned back close to the ground before covering. Vineyard soil is preferable to straw or litter to cover plants with, and can be applied with a plow or shovel.

When the plants are properly prepared, they can be readily covered by running a 12- or 14-inch plow along each side of the row and throwing the soil onto the vines. It will be necessary to complete the operation with a shovel, as thorough covering cannot be done with a plow. Plants pruned to the short system frequently stand 10 to 16 inches above the ground and necessitate the handling of considerable soil to cover them completely.

If exposed to the wind, the covering is liable to be blown off and should be protected by a light covering of straw or litter.

There are two objections to the use of straw for covering grape vines. Materials of this character furnish agreeable quarters for rodents, which frequently injure the vines by gnawing at the body or roots. It frequently begins to decay in early spring and heats before the proper time for it to be removed. Covering materials upon heating cause the buds and wood to be killed or badly weakened.

Grape vines should be uncovered when danger of frost is past. Plants covered with soil are frequently left in place and the new growth allowed to come through it. The liability of late frosts renders uncovering hazardous before growth begins, and to leave the plants covered causes the new growth to be small and weak underground. Neither method is entirely successful,
but for greatest safety to the vine it is preferable to allow the new growth to come up through a small amount of soil. Part of the covering should be removed when severe weather is past, and when the new growth is well advanced, the remainder of it should be taken off. Arms of plants trained to the horizontal system can be raised out of the covering by the time warm weather occurs, while plants that are laid down must be uncovered and tied up to the support as soon as danger of frost is past so the new growth will not be disturbed by a change of position.

HARVESTING AND MARKETING

Harvesting

The climatic conditions in this district being fairly warm and dry during the fall, are very desirable for handling fruit, and especially for grapes. The degree of maturity of fruit is an important factor in marketing. That which is gathered early, to be rushed onto the market, is often inferior in quality, and destroys what would otherwise be a good demand for properly matured fruit. When gathered before they are ripe, grapes are usually quite sour, and do not hold up as well as when allowed to become thoroughly mature. Fruit that is to be shipped, should be spread in some protected place for a short time to allow the stems to dry. When this is done the bunches hold together much better and consequently reach the markets in a more desirable condition than if the stems were not allowed to dry.

Packing should be done with considerable care. Eight or twelve pound baskets are used for small quantities and 24-pound crates for large quantities. The latter are most generally used for Viniferas. There is doubtless considerable to be accomplished in perfecting methods of handling the fruit and in devising better packages.

The preparation of fruit for marketing to grape juice factories requires no particular skill or equipment. It is the general practice for the manufacturer to send to the growers such boxes as they need for shipping the fruit. The boxes are taken to the field, where they are filled level full by carefully laying the bunches in as they are taken from more convenient picking receptacles or by gathering into the boxes. These boxes are, in turn, laid on a car and shipped without being covered. The principal care in harvesting for this trade is that the fruit be fully matured and free from broken or decaying berries.

The cost of harvesting and handling in bulk is much less than when packing is necessary. They can be gathered and loaded in bulk for about $4.50 to $6.00 a ton. By the packing system, however, about $4.50 is required to gather and pack four tons of grapes (a crop from one acre) and $4.00 additional to get them aboard the car.

Storage

With proper storage of late varieties, the grape season in this region can be made to cover a period of about five months.
Fruit that is to be put in storage should be thoroughly matured, free from defective berries and should be exposed to the open air for a sufficient time to dry the stems. It might be kept in ordinary cool storage rooms, such as basements and cellars, where the air is cool and not extremely wet or dry, but better results follow its being kept in properly constructed storage houses.

The bunches should be selected and carefully laid in thin layers in shallow boxes. Between the layers should be placed sheets of newspaper or other material that will absorb moisture from the fruit, should it begin to decay. It is necessary to use shallow boxes to prevent the lower layers of fruit from being injured by weight from the fruit above.

Storage is of value both for late marketing and for home use. When properly handled in storage, grapes can be kept from six weeks to three months.

Marketing

The consumption of grapes in the Pacific Northwest is very light at the present time. Use is being made each year of about 300 cars of Vitis vinifera from California. On account of this fruit being readily available, a larger demand has developed for it than for American grapes, a few cars of which are imported annually from the East. But little of this fruit reaches the many small towns and large numbers of residents in rural districts.

Vitis vinifera grapes produced in Oregon usually sell well in competition with the California product. Locally grown American grapes are sold in limited quantities and compete splendidly with Eastern grapes of the same varieties. Until recently, no use has been made of grapes for other than the table trade. In 1913 Mr. M. H. Church of Kennewick, Washington, utilized 150 tons of Wordens and Concords in the manufacture of grape juice. His enterprise appears to have successfully established the manufacture of grape juice in the Columbia River Basin.

There are a number of channels through which the consumption of grapes can be increased in this country. The market for table grapes, grape juice, jams, jellies, etc., should be successfully enlarged in the greater part of the Pacific Northwest where grapes are at present seldom used by the average person.

Upon the possibility of placing an early fruit of high quality on the market from this district, rests an excellent opportunity of developing a substantial table trade. Such markets can be continually supplied with fruit of best quality through a long season by the selection and careful manipulation of varieties that mature in succession through the entire season. More highly specialized trade can be created and maintained by offering choice varieties with pleasing characteristics of color and flavor. Although of less immediate importance than the handling of early varieties, there is an opportunity of developing a large demand for choice varieties held in storage.
In developing markets particular attention must be paid to supplying the small towns and rural districts where fruit is not generally produced. Juice manufacture and other processes of preserving grapes offer the greatest prospect for immediate increase in consumption. The rapid development and great magnitude the industry has attained in several Eastern states shows its importance and possibilities. Grapes grown under the soil and climatic influences of this district produce an excellent quality of juice. An extensive development in production is feasible under existing cultural conditions but must be controlled by the possibilities of marketing the product. Grapes must be grown cheaply for the manufacture of juice, as present prices do not warrant heavy cost of production. With our freedom from diseases and pests, favorable climate and soils, there is promise of this industry being developed, but its success depends largely upon the success of processing enterprises springing up within the district.

The manufacture of wine and vinegar, except as practiced for the utilization of inferior fruit, is of doubtful economic importance on account of the high cost of production, comparatively light yields, and limited market demand for the product.

By proper selection of varieties, there is little doubt but that the production of grapes can be pushed into many districts where it is now considered impossible. To increase production at a more rapid rate than markets can be developed would be disastrous to the interests of growers and to the industry in general. Markets are not available, and until they are developed, increase of production should be steady and moderate.

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