

# Grape Growing in Ohio



Fig. 1.—A grape vine from a fertilizer plot in northern Ohio. The heavy crop, large sized berries and well filled bunches are a result of good cultural practices.

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# Grape Growing in Ohio



GRAPE growing in Ohio really began with the work of Nicholas Longworth of Cincinnati, who is known as the "father of American grape culture."<sup>1</sup> In 1825, he received the Catawba variety from John Adlum of the District of Columbia, who introduced it as the first dependable American grape about 1823. Longworth disseminated the new grape, became a promoter for the region in which he lived, and made Cincinnati the center of what was then the foremost grape growing district in the country. Before 1825 the horticulturists of that day had been trying to grow the European sorts, but in spite of many trials had failed. It was only when attention was turned to the native grapes that it was possible to grow this fruit in the New World.

It was not long before the vineyards that had seemed to do so well in the Cincinnati district, became affected with a terrible "sickness." The vines withered and the fruit failed to ripen properly. The "sickness" was undoubtedly a combination of black rot and mildew. A large number of the vineyards were pulled out and the production of the district rapidly decreased.

Even a short history of grape growing in Ohio is not complete without mention of George W. Campbell (1817-1898) of Delaware, Ohio. Mr. Campbell is known because he produced and introduced the Campbell's Early, a variety that is today an outstanding early grape. For many years before his death Mr. Campbell had been the leading speaker and writer in the north on the culture of the grape and grape breeding, and it was this work that had such a marked influence on the improvement of grape growing in Ohio and in other states as well.

In 1865-6, the planting of grapes in Northern Ohio progressed at such a rate as to be described as the time of the "grape fever."<sup>2</sup> The success of a few vineyards along the shore and on the islands of Lake Erie attracted so much attention that a number of vineyards were planted and the extent of the planting was only limited by the supply of the vines. The acreage of grapes in 1874, after ten years of planting, was estimated at 10,983 acres.

At the present time Ohio ranks fourth in grape production, being preceded by California, New York, and Michigan, in the order named. In 1930 there were 8,738,560 grape vines of bearing age, and 814,362 vines not of bearing age, or an equivalent of 14,063 acres planted to grapes. The commercial grape region is located in a definite area in the counties that border on Lake Erie, with a few commercial vineyards scattered in other parts of the state, principally near the large cities. Grapes are grown for home use in all parts of the state. They are trained over arbors and are useful not only for their fruit but also for their shade and their pleasing addition to the landscape planting around the dooryard.

<sup>1</sup> Hedrick, U. P.—Grapes of New York. Dept. of Agr. of New York, p. 23.

<sup>2</sup> Proceedings of the Ohio State Horticultural Society for 1875-6, pp. 74-5.

## VARIETIES OF GRAPES

Most of the grapes in Ohio are and should be of the Concord variety. A few other sorts are grown for home use, to supply a special market or to lengthen out the season. Different colored grapes are sometimes grown. Mixed in the same packages, the different colors often increase the attractiveness and sales value of small baskets. Blue grapes may be mixed with either red or white ones for these combinations. A brief description of varieties is given as follows:

*Concord (blue)* is of good quality, ripens evenly, handles and ships well. It will grow on a wide variety of soils and is the best variety for commercial use. The Concord should be selected as the major sort and the other varieties added as conditions seem to warrant.

*Moore Early (blue)* is of high quality, but inclined to crack and shell. It ripens about ten days before the Concord and is sometimes used to lengthen out the season where an early grape is wanted. The commercial value of the variety is limited because it does not yield well. The berries are very large and juicy.

*Campbell's Early (blue)* is a high quality early grape that has not been appreciated as much as its quality deserves. When well grown, the bunches are very well formed and beautiful. The variety demands good soil and a vigorous vine for the production of high quality fruit. The vines should be carefully pruned so that overbearing is prevented and large well filled bunches are insured.

*Worden (blue)* is similar to Concord, with better quality, but the fruit is inclined to crack and to shell so that it will not stand shipment. The variety ripens just before the Concord; it is profitable where it can be sold locally and should be included in the planting for home use.

*Niagara (white)* is of good quality and is specially noted for its large compact bunches. Niagara will yield well and can be grown on almost any type of soil. As white grapes are in limited demand on most markets, the variety should be planted only in amounts and locations to suit local requirements.

*Delaware (red)* is one of the best quality grapes that can be grown in Ohio. It is very high in sugar content, and is in demand for eating out of the hand as a table grape. The vines, bunches, and berries are small and consequently the yields are low. Topworked on a vigorous stock such as Riparian Gloire the vigor and yield is greatly increased. The vines require severe pruning in order to maintain satisfactory growth. Delaware sells readily at the roadside stands or wherever its quality is known and appreciated.

*Catawba (red)* is second in importance to Concord in Ohio, being found in many of the old vineyards around Sandusky and on the islands in Lake Erie. It ripens late and for this reason is adapted to sites that have a long growing season. The vines are small, yielding less than the Concord. The fruit is used principally for juice purposes.

## New Varieties

Several new varieties have recently been introduced and some of them very promising. Certainly, the perfect grape for eastern conditions has yet been found. Why would it not be possible to develop a good early variety which could supply the market in the summer, or a late variety which would ripen in cool weather and could be kept in common storage to be marketed throughout the winter? Many of these possibilities make us hope that the search for new sorts will continue and that better kinds will be developed or discovered. The following varieties are so promising that they are listed for planting. A brief description of each is given.

*Sheridan (blue)* originated by the New York Experiment Station, is of high quality, with a large berry, and makes a very large compact bunch. It ripens late, keeps well, and is suggested for trial by anyone interested in a late grape of the Concord type. The originators of the Sheridan state that it is more productive than the Concord and is sweeter and richer in flavor.

*Portland (white)* originated by the New York Experiment Station, is an early white grape that is similar to the Niagara in appearance. It has a moderately tender flesh and pleasing flavor, being rated as very good in quality. The vines are hardy, vigorous, and productive.

*Fredonia (blue)* originated by the New York Experiment Station, is an early grape, ripening about two weeks before Worden. The clusters are of medium size, the fruit of good quality, and the vine vigorous and hardy.

## SOILS AND SITES

Grapes thrive on all types of soil that are naturally well drained. They do well on a gravel loam, heavy clay, or any of the intermediate kinds of soil that are in good physical condition and are rich in humus. Grapes should never be planted on soils where there is a high water table, an impervious subsoil, or imperfect drainage.

In Ohio, the yield is usually higher on the gravelly loams than on the clay soils because the gravel usually has better drainage. Whatever the soil type, the addition and maintenance of organic matter by the use of cover crops or manures tends to aid in the moisture holding capacity, and to better the physical condition of the soil, so that otherwise poor producing vineyards may be made into thrifty, high yielding ones. The old saying that the "soil is the basis of our agricultural wealth" is just as true for the grape vineyard as for any other type of farming.

Plant the vineyard on an elevation where the cold air naturally drains away. Avoid frosty sites. Do not plant on a steep hillside where the soil is apt to wash under cultivation, but select a gentle slope and avoid low spots.

A northern exposure usually causes late blooming and late ripening of the fruit, while a southern exposure favors the opposite conditions. In sections where spring frosts are a factor, a northern or eastern slope is preferred. Near Lake Erie, where that large body of water tempers the climate, the direction of the slope is not important. In all other sections of the state it is.

## PROPAGATION OF GRAPES

### *Cuttings*

Propagation of the grape by cuttings is the common method used in the nursery. It is a very simple process and may be easily done by the grape grower or home gardener. The cuttings are made from mature canes of medium sized wood of the past season's growth by dividing the canes into lengths of 8 to 10 inches, a distance that will usually include three buds. The lower cut should be just below the bottom bud; the top cut well above the upper one (see Fig. 2). The location of the cuts is based on the fact that the roots, as a rule, arise most readily in the region of a node, and the cuts described above tend to encourage root development.

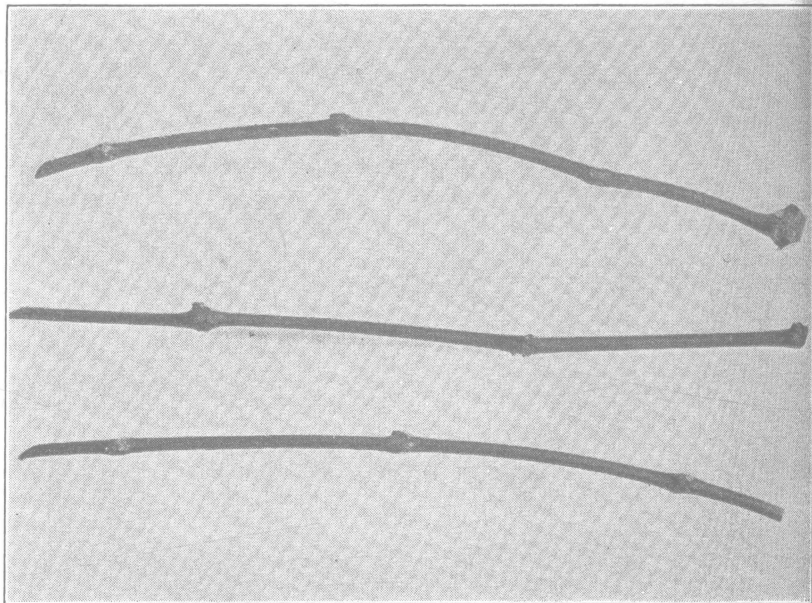


Fig. 2.—Grape cuttings: *Upper cane*, mallet cutting frequently used. *Center cane*, properly cut. *Lower cane*, cut too far from lower bud.

Give the cuttings one of the following treatments:

1. Make the cuttings in the fall or early winter and store them in sand in a cool cellar, keeping them just moist enough to prevent drying out, and in the early spring set them in the nursery row.

2. Make the cuttings in the winter and tie them into bundles, placing all the butts at one end. Bury them bottom end up in a warm well drained spot, covered with 3 or 4 inches of soil. The butt ends, being in warmer soil, should callous and begin to start roots, while the other ends remain dormant. In the spring, set the cuttings in the nursery. They develop more readily because of callousing.

3. Put the cuttings in the nursery row in the fall and cover with a mulch to prevent freezing or thawing.

The cuttings are set 3 to 6 inches apart in the nursery row. With a three-bud cutting two buds are put below the ground and one above, slanting the canes if necessary. The resulting plants will be ready to set in the field the following season. Generally, the percentage of cuttings that grow is not high; about 40 to 50 per cent is common.

### *Layering*

Grapes are very easily propagated by layering. For this purpose, select a suitable 1-year-old cane in the early spring or late winter and lay it down on the ground (see Fig. 3). Cover one or more buds with dirt and leave a few buds beyond the covering. Roots normally develop from the covered buds and leaves from the exposed ones. If the new plant was produced in a vacancy it is left where it has rooted and cut off from its parent after it is well estab-

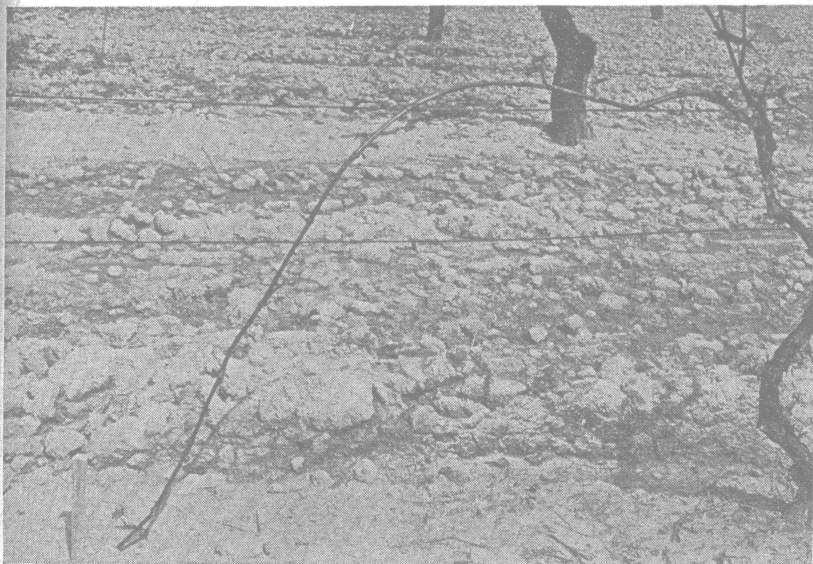


Fig. 3.—Layering a cane from a mature vine. This method is the easiest and surest way to propagate grapes. It is commonly used to replace missing vines.

lished. This may take two or three years. If it is to be moved, it is dug up and reset at the proper place in the vineyard after a year's growth.

Layering is the best method to replace missing vines in the vineyard, and is a sure, cheap, and easy way to secure a limited number of new plants. It is the best method for the grape grower, but not for the nurseryman.

### *Grafting*

Varieties of American grapes are improved by being grafted on vigorous stocks. The vines make larger growth, and produce more fruit of better quality than if they are on their own roots. Delaware and Catawba are specially benefited. Delaware has done best on the Riparia Gloire, while Catawba is unquestionably better on the Clinton. Both of these varieties are notoriously small producers and should be grafted for the best results. Concord does better on the Gloire than on any other stocks tested.

The quality of the fruit is markedly superior on the grafted vines, the bunches are larger and the berries more compact. In fact, the whole general appearance is improved by the grafting process. Certainly, results are enough to justify the planting of grafted vines in the home vineyard, and the only objection in the commercial vineyard is the cost of the vines. Perhaps in the demand for grafted vines is sufficient the nurserymen will be able to supply them at a price that will not be objectionable. The advantages are enough on the higher quality weak growing vines that they should now be grafted before setting in the commercial vineyard.

*Vineyard Grafting.*—For topworking vines in the vineyard, the cleft graft so commonly used in the orchard is most satisfactory. The best time for this work is in the early spring just before there is any upward movement of the sap, although it can be done after the vigorous sap flow has passed. Cut the stock cleanly across with a small saw 2 or 3 inches below the soil level. Saw a slot in the stub and open it with a narrow wedge for the insertion of the scions.

Select dormant 1-year-old canes for scions and store them in a cool moist place so that they do not dry out. When the grafting is to be done cut the canes into scions about two to four buds long. Cut the lower end of the scion into a wedge, making one side thicker than the other with a bud on the thick side at the top of the wedge. Insert the scion in the cleft, the thick side out, slanting it a little so that the cambium layers of the stock and scion cross and come into contact along the cut surfaces in as large an area as possible. The cambium is the layer under the bark that is next to the hard wood. If the stock is large, put in two scions; otherwise only one. Remove the wedge without disturbing the scions. Do not wax. Throw the soil back in place and the job is done. If the soil is very heavy and wet, it may be necessary to remove the mound to allow the graft to dry out before the soil is replaced.

*Root and Cutting Grafts.*—Either 1-year-old rooted plants or cuttings may be grafted with the common whip or tongue method. Cuttings, successfully grafted, do better, after transplanting, than do 1-year-old plants. Cut the stock and the scion with a long slanting cut. Then split each one so that there is a tongue to be inserted into the opening of both the stock and the scion. Wrap the graft with No. 16 cotton string that has been impregnated with grafting wax; only a few turns of the string are necessary.

Callous the grafts by placing them upright in a deep box filled with sawdust saturated with water and covering them with about 2 inches of the damp sawdust. Place the entire box in a pan of water so that the sawdust will take up the water and continue to be saturated. The callousing process should take place in about three weeks, if the grafts are placed in a room where the temperature is about 80 degrees; it will take longer if the temperature is lower.

Plant the grafts in the nursery row in the same way that ordinary cuttings would be handled, with the exception that they must not be allowed to dry out. Keep them covered with wet bagging during the planting operation. Two or three times during the season remove the dirt to the depth of the union and cut away all roots that may have started from the scion. If this



done the stock dies and the scion grows from its own roots, thwarting the purpose of the grafting.

The number of these grafts that grow will generally average about 50 per cent. Some years the success will be greater and some years less. For further information on grafting write to the Horticultural Extension Department, Ohio State University, Columbus, Ohio, or apply to your County Agricultural Agent for literature.

### PLANTING

In setting out a new vineyard, purchase vines from a reliable nursery rather than propagate them at home. Buy only 1-year-old plants with a well developed root system. Older plants have no advantage and may be the culls left over from the year before.

Early spring is the best time to plant grape vines. As soon as the plants arrive from the nursery, remove them from the bundles. If the ground is not ready, "heel" them in by covering the roots with dirt; later they may be planted in their permanent location. Where the soil is prepared at the time the plants arrive, they may be set directly from the package. The vines may be set 8, 9, or 10 feet apart in the row. On soils rich in humus a heavy vine growth may be expected, and the 10-foot distance should be used. At this distance, tractors, power sprayers, and cultivating equipment may be used to best advantage. On poorer soils, 9 or even 8 feet may be sufficient where large equipment is not a factor.

Prepare a good seedbed and mark out the rows. Plow out a furrow where the vines are to be set, taking care that the rows are straight and parallel. A vineyard lasts for many years and there is every reason for it to be set out with straight rows, so that future work will be made as easy as possible.

Prune the roots of the new plants by taking off all broken, bruised, or dead portions. Spread out the roots and with the aid of a spade set the plant just a little deeper than it was in the nursery. Level up the dirt, firming the soil around each vine with the feet.

The plants required for an acre at given planting distances are listed in the accompanying table:

Planting distances	No. of plants
by 10 feet	434
by 9 feet	484
by 8 feet	544

### SOIL MANAGEMENT

#### *Cultivation*

Thorough cultivation is necessary for successful production of grapes. The vines, which come out into leaf in the spring and develop a large amount of foliage in a short period, need favorable growing conditions to produce a good crop. All this calls for frequent tillage, a supply of humus, and a good physical condition of the soil.

*Cultivation before Bloom.*—Before blossoming time in the spring, make ground with a one-horse plow, throwing the soil towards the vines, plowing not deeper than 3 to 4 inches. Then work the middles, using a plow on a clay soil and either a plow or disk on the lighter types. The cover crop and all material on the surface should be turned under and completely covered.



Fig. 4.—Using the horse hoe to eliminate weeds under the grape wires. The dirt thrown towards the vines earlier in the season can now be pulled down. Careful use of the horse hoe eliminates much hand hoeing in the vineyards.

Where berry moth has been serious, do not work the soil again until after bloom. (See note on berry moth control, pages 23, 24 and 26.)

*Cultivation after Bloom.*—Cultivate frequently after bloom with a spike or spring tooth harrow, levelling the ground as the season advances. Where the soil is ridged, it can be pulled down with the grape or horse hoe so that



Fig. 5.—Using a spike tooth harrow in the vineyard. Note that surface slopes towards the center of the row to provide for surface drainage.

a little hand work next to the vines is needed (see Fig. 4). When the soil is level, the weeds under the wires may be controlled by throwing the soil towards the vines, smothering out the small weeds. At the last cultivation on clay soils, just before seeding the cover crop throw the soil towards the vines to prevent heaving during the winter. Do not leave an excessively high ridge, but just enough for surface drainage (see Fig. 5). On gravel or sandy soils, no ridge is necessary.

### *Cover Crops*

Because the grape vineyard lasts for many years and crop rotation cannot be practiced, the regular and annual use of soil improving cover crops is needed to keep up the humus content, to check growth of vines in the late season, and in ripening the wood, and to prevent soil washing. Cover crops are absolutely necessary for best results.

*Soybeans.*—Of all crops that can be grown in the vineyard for soil improvement, soybeans are the best. Where the soil is treated so as to grow them well they return a lot of humus for the bulk turned under. Sow Manchu soybeans, 2 bushels per acre, or other varieties if desired, about the first of July in northern Ohio and a little earlier in southern Ohio, after inoculating the seed. Where berry moth is a problem, plow or disk the soybeans under and seed to rye or oats in August at the rate of  $1\frac{1}{2}$  bushels per acre. Do not disturb the ground till the next spring. Where this insect is not a problem, disk down the soybeans and plant the rye or oats in September.

*Rye.*—Rye, which is the most commonly grown cover crop, should not be used on heavy clay soils because in a wet spring the growth cannot be checked under promptly, and the competition seriously damages the grape crops. Where soy beans are not used sow rye in early August  $1\frac{1}{2}$  bushels per acre. Turn it under the next spring before it is knee high.

*Oats and Buckwheat.*—For heavy soils, oats can be sown in July or early August at the rate of 2 bushels per acre. Buckwheat, 1 bushel per acre, seeded at the same time, can be used satisfactorily. These crops do not live over winter and can be used on all soils.

### *Fertilizers*

Perhaps the best and easiest way to keep up the fertility of the vineyard is to make annual applications of manure at the rate of 5 to 8 tons per acre supplemented with 250 pounds of 0-14-6 mixed fertilizer. The manure should be applied in the early spring and the commercial fertilizer just before seeding of the cover crop. Reports of tests made in Ohio show that the use of manure increased the yield 20 to 30 per cent.

Since manure is usually not available to the vineyardist, he must turn to commercial fertilizers and soil improving cover crops. By so doing, the yield of the vineyard will be maintained or increased in a satisfactory and economical manner.

Tests made with nitrate of soda applied at the rate of 250 pounds per acre have given profitable increases in yield of from 20 to 35 per cent. On gravel soils this response came quickly, while on the clay soils, the fertilizer applications were made for three years before a definite increase was noted.

Similar results were found in the tests made in New York and in Michigan, where nitrogen was found to be the limiting element, and where nitrogen plus phosphorus was best for the grapevine and cover crop growth.

The recommendations, then, are to apply to each acre 250 pounds nitrate of soda, 200 pounds sulfate of ammonia, or an equivalent amounts of some other quickly available nitrogen fertilizer, broadcast in the spring just as growth is starting. Continued use of sulfate of ammonia increases soil acidity, but a ton of agricultural limestone will correct the acidity developed by a ton of sulfate of ammonia. At the last cultivation, just previous to sowing the cover crop, apply 150 pounds per acre of a fertilizer such as 0-14-6.

This program will furnish the nitrogen, which seems to be the limiting element for the production of grapes, and will also furnish the other materials for the proper growth of the cover crop. The lime requirement of the soil

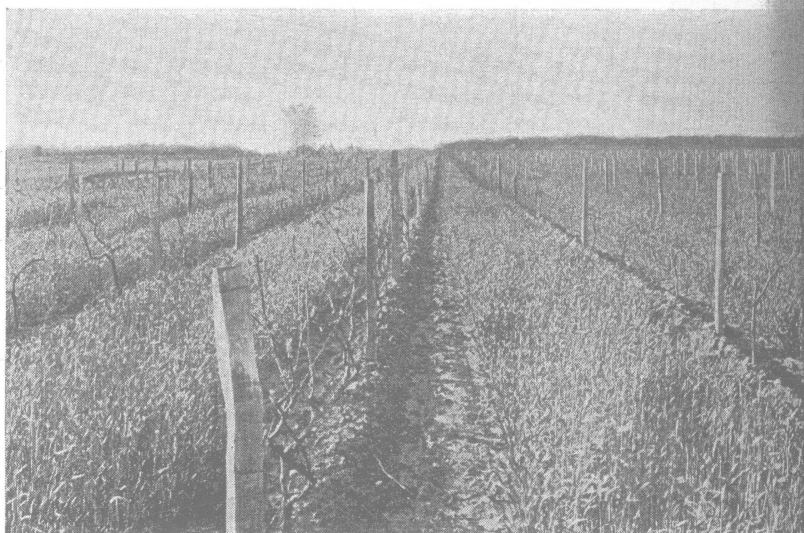


Fig. 6.—A vineyard scene in northern Ohio. The initial step in turning under the rye cover crop has just been completed. The dirt has been thrown toward the vines, covering up the rye and any over-wintering berry moth cocoons.

does not often have to be taken into account, inasmuch as grapes will grow on either an acid or sweet soil. On extremely acid soils, it may be necessary to apply lime before a good growth of cover crop can be secured. See your county agricultural agent, or send soil samples to the Soils Department, Ohio State University, for recommendation as to liming. Under most conditions, no lime is needed where the soil is able to grow soybeans satisfactorily. The cover crops mentioned will grow on acid soil and are used because they fit into conditions under which grapes are grown.

#### THE TRELLIS

Where good growth of vines has occurred, the trellis should be in place ready to support the vines at the beginning of the second season, otherwise not later than the beginning of the third season.



Fig. 7.—Bracing the end posts with stay posts as above, is a better method than using wire attached to a “dead man” (see Fig. 8).



Fig. 8.—Method of bracing end posts by wire attached to a “dead man” (log buried in ground).

Set a post between every two vines, or every 20 feet where the vines are 10 feet apart. Use posts that are from  $7\frac{1}{2}$  to  $8\frac{1}{2}$  feet long, and sharpen them at the end so that they may be driven into the ground each spring if necessary. Select posts of naturally durable wood, or posts that have been treated to make them more durable.

Strong posts, firmly anchored and braced, should be placed at the end of each row. A good method is to use a brace that is set in a notch of the end post and slopes to the ground, where it is held in place against a short post set in the row. Another method is to carry a wire from the top of the end post to a “dead man” (a log buried 24 to

30 inches in the ground). The objection to this method is that a wire always extends beyond the row to catch into tools and wagons as they pass. The advantage is that the end post is firmly anchored. Use No. 10 wire, well galvanized, running about 2,000 feet per hundred pounds. If heavier wire is desired, use No. 9 wire; or if lighter, No. 11 wire.

Put up two wires, the bottom one 30 to 36 inches from the ground and the top one 24 to 30 inches higher. The wire trellis must be high enough on vigorous vineyards to allow for space to carry a good crop. Most of the Ohio vineyards have the wires too low. The heights of 3 feet for the lower wire and 5½ feet for the top wire are suggested as being desirable.

Attach the wire at the proper height by the use of long staples driven into the posts so that the wire slips. On the end posts, fasten the wires tightly. In this way, the weight of the crop will allow the wire to adjust itself without pulling unduly on any one post.

## PRUNING

There are a few general principles connected with the growth of the grapevine that the grower should remember when he prunes the vine. (1) The fruit is produced on shoots which spring from the 1-year-old wood, and therefore the pruning of the vine is primarily a renewal proposition. A certain amount of wood of the previous year's growth must be saved for fruiting purposes. It is never desirable to have more old wood than is necessary to shape the vine. (2) The vigor of growth of the coming season is to a certain extent influenced by the amount of pruning. If too much new wood is left, so many bunches are produced that they are small and scraggly. Weak growth results from such pruning and the yield drops. On the other hand, if too little wood is left after pruning, the growth becomes excessive at the expense of fruitfulness. A wise pruner recognizes these principles and regulates the amount of fruiting wood according to the new growth when he starts to prune the vine.

### *Time of Pruning*

Grape vines may be pruned in Ohio any time during the dormant season except when the weather is very cold, at which time the canes are brittle and break easily when handled.

In New York, tests have shown that for best results the pruning should be done in late winter or early spring. In Ohio, there seems to be little difference between early or late pruning as long as the vines are dormant.

The general advice is to prune grapes before the sap starts to run, or before the vines "bleed." Bleeding probably causes no damage to the vine, but is disagreeable to the person doing the work; therefore, the advice is sound. Finish the pruning before the vines bleed but, if the work cannot be done before that time, then prune up to the time when the new growth starts. *Never allow the vines to go without any pruning.*

## Summer Pruning

No pruning is needed during the growing season. If the heavy growth is in the way of cultivation, tie up the shoots or tuck them in out of the way. The development and ripening of the fruit of the grape is dependent on the food materials synthesized in the leaves. Consequently, if many leaves are removed by summer pruning, the grapes tend to remain sour and fail to develop and color properly. Grapes, unlike tree fruits, do not need direct sunlight for the development of color. They color perfectly in the dense shade

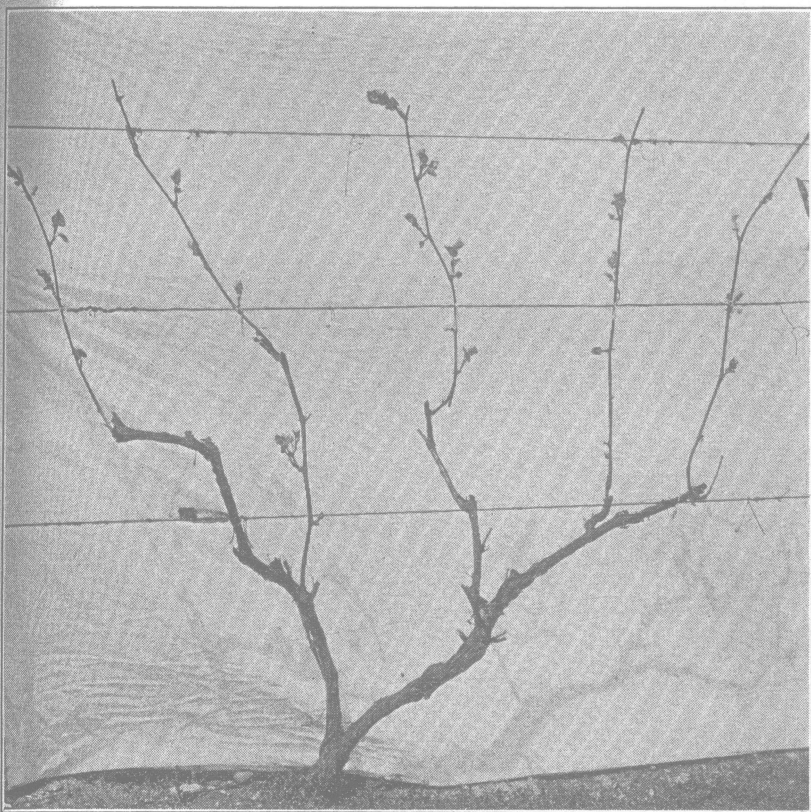


Fig. 9.—The modified Fan system of training as practiced in Ohio. Note that the upper buds are starting first and give promise of making the most vigorous growth.

of the leaves, provided those leaves are healthy and can store sufficient carbohydrate materials in the growing fruits. Hence, summer pruning of grapes differs from dormant pruning because it reduces quality, while the dormant pruning tends to increase that factor.

Pruning in the summer often greatly affects the pruning in the next dormant season. Desirable canes, properly located, will sometimes be the ones that were cut back in the summer pruning. Less desirable canes must then be used, and the future production of the vineyard is thus affected.

## Training the Vines

Grapevines, because of their habit of growth, are very easily trained. The system that is most common in Ohio is the Modified Fan system.

*The Modified Fan System.*—This consists of shaping the vine by training and pruning so that the trunk of the vine together with the canes resemble a fan. The trunk may be compared to the handle and the canes to the ribs of the fan. The modifications of this system are usually confined to varying the length of the trunk and the number of canes that are left. The Modified Fan as used in Ohio consists of a trunk that extends from the ground to the

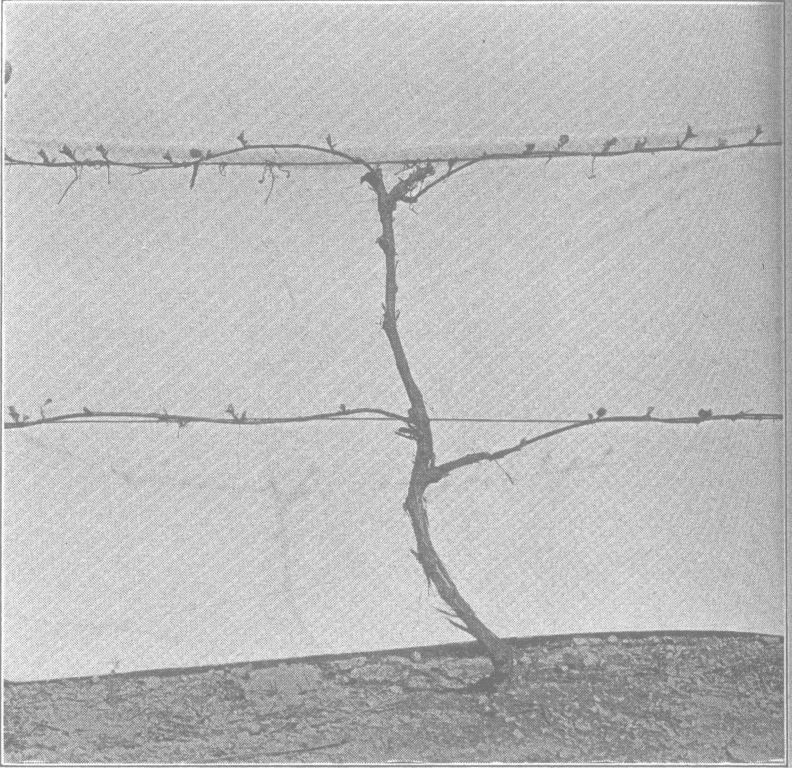


Fig. 10.—A vine pruned and trained to the Kniffen system. Branch of the vines is just starting out. Spurs have been left close in to the trunk for renewal pruning next season.

first wire, usually a distance of 30 inches; and four canes that arise from about the place where the trunk reaches the first wire, trained in a spreading diagonal manner to the top wire, where they are tied in place (see Fig. 9).

The Modified Fan system is best suited to vineyards and to varieties that do not make vigorous growth. It seems to be the best system for such kinds as the Catawba and the Delaware, but is not the best for the Concord or other vigorous growing grapes. With the Modified Fan system the canes are trained in an upright manner and the new shoots that develop during



the growing season start in the same direction but droop from their own weight as soon as they fruit. Then they must be tied in the summer as the season develops.

*The Kniffen System.*—This consists of training the vine so that the trunk is left to extend from the ground to the top wire. From a point about where the trunk crosses the bottom wire two canes are selected and trained horizontally along the bottom wire. Just below the top wire two other canes are selected to be trained horizontally along the top wire. Thus the system consists of a straight trunk and four canes that are all trained in a horizontal manner (see Fig. 10).

The shoots that develop from the canes all droop down and do not need to be tied during the summer. They do need sufficient space below the bottom

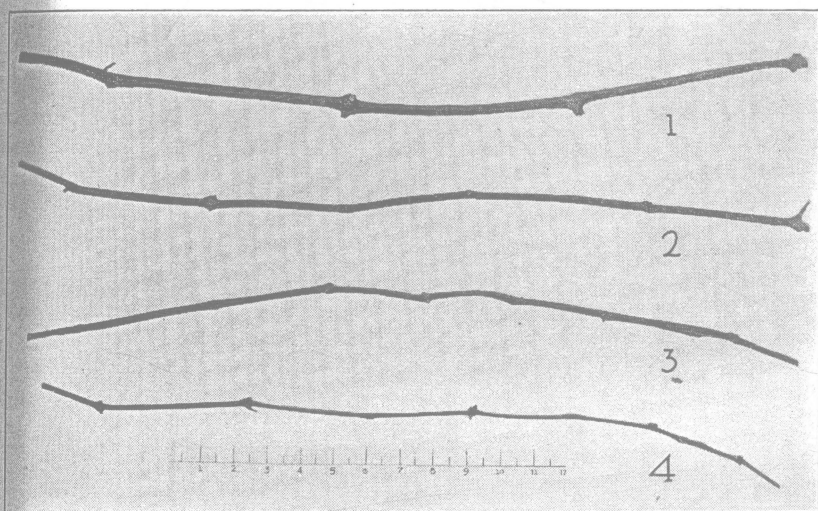


Fig. 11.—Fruiting canes. No. 1 is too large; buds are far apart and are usually small. Nos. 2 and 3 are canes of the intermediate size and type. No. 3 is especially good. Notice the short distance between buds, while bud itself is large and plump. No. 4 is too small.

wire and between the bottom and top wires. The system, therefore, requires higher posts and wires than the Fan system. On vigorous vineyards trained to the Kniffen system, the bottom wire should be located 30 to 36 inches from the ground, and the top one an equal distance above that. This would make a trellis with the top wire  $5\frac{1}{2}$  to 6 feet from the ground.

The chief advantages of the system are that no summer tying is needed, there is good aeration through the vines, spraying may be done more effectively, and harvesting more easily, than with other methods of training. With the good aeration and more effective spraying, diseases and insects may be more easily controlled. Where the system has been tried in comparison with others it has been found to be superior for the Concord, and for the other varieties of similar vigor. It is not desirable for varieties that are not

vigorous in their growth. The disadvantage of the system is that high posts and wires are needed in the construction of the trellis.

### *Pruning the Young Vines*

*First Year.*—After the vines are set, prune off all but the strongest cane and cut it back to two buds. Then, the new vine will get a good start and be able to make a satisfactory growth the first season.

*Second Year.*—After one year's growth, the pruning will vary with the amount of growth made. All canes but one are removed. If this cane is vigorous, it may be left long enough to reach the first wire for Fan or Kniffen system training, or the second wire for the Kniffen system training. If growth is weak, remove all but two buds on one cane, as was done the first season.

*Third Year.*—This year the vine can stand about twenty to twenty-five buds. If the trunk was brought up the year before, two canes can be carried up from the lower wire to the top one to start the Fan system. For the Kniffen system take four shorter canes off the trunk. Select two at the lower wire and two at the top wire. Tie these out horizontally in opposite directions along the wire.

### *Pruning Mature Vines*

*Selection of the Fruit Canes.*—The first step in pruning a grapevine is to select the fruiting canes. On the Concord those the size of a lead pencil are best. They are about average in growth, being neither excessively small nor excessively large.

Canes on Concord,  $\frac{1}{4}$  inch in diameter, measured between the fifth and sixth bud, have been found to be the highest yielders. A number of measurements of canes from  $\frac{1}{8}$  to  $\frac{3}{8}$  inch in diameter were taken and the yield from each cane was secured. On all types of soil, the canes  $\frac{1}{4}$  inch, or slightly larger in diameter, gave largest yields.

Excessively large canes are usually poor fruit producers. They are sometimes called "Bull canes" and are spoken of as being barren. Their buds are

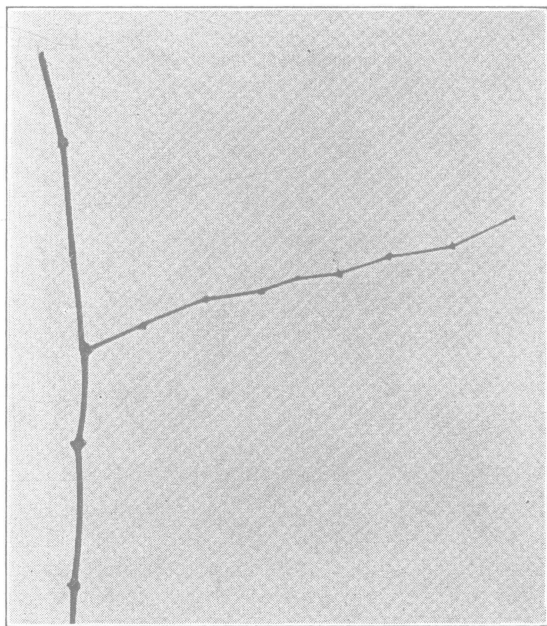


Fig. 12.—An over vigorous cane with a lateral that is of medium size. The lateral is a good fruiting cane and may be used in the dormant pruning.

small and a long distance apart. Such canes usually produce laterals which are desirable for fruiting purposes. If, because of their location, it becomes necessary to use large canes, cut them off just above the lateral inasmuch as the buds of the lateral are more desirable for fruit production than the large cane.

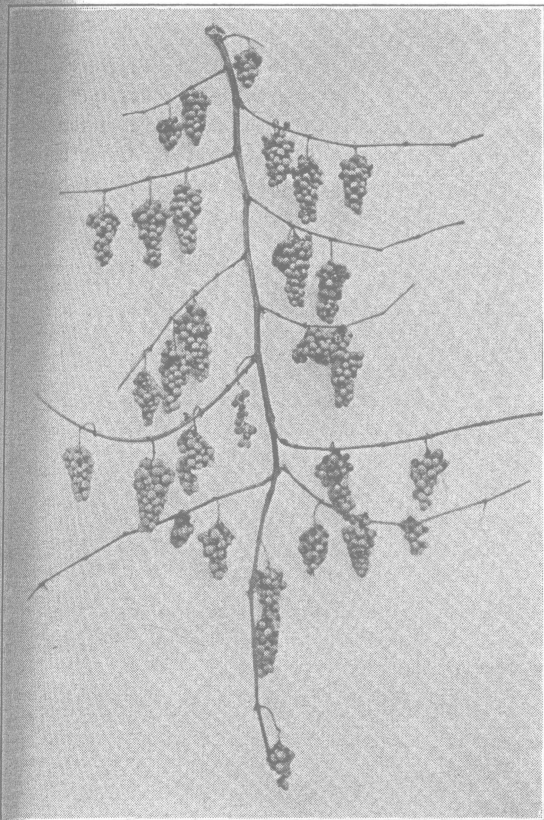


Fig. 13.—A fruiting Catawba cane showing the location of the best clusters and where the most fruit is produced. The basal and terminal buds are very poor producers. The third to eighth buds usually have the most fruit.

In essence, pruning is thinning. Experience in Ohio has shown that the most desirable number of buds on the whole vine will range from twenty-five to forty. These buds should be distributed over about four or five canes, each carrying from eight to ten buds. Perhaps the most universal practice is to leave four canes of eight buds each, totaling thirty-two buds for the vine. In every vineyard there are weak and strong vines. The weak vines should not carry as much as thirty buds, while the strong ones may possibly carry more.

The length of these canes has quite a lot to do with the fruit production because all the

buds on a cane do not produce a like amount. Usually the first two or three buds are very poor producers. The fifth, sixth and seventh are usually conceded to be the most fruitful. Under some conditions this is true; under other conditions, the longer the canes the more fruitful they will be. For practical purposes an eight- to ten-bud cane is about the best of all.

Often it is hard to find canes much longer than that unless weak buds are left on the ends. On extremely strong vines, it may be best to increase the amount of wood by increasing the length of the canes rather than increasing the number. Under the systems of training commonly in use, excessively long canes are hardly practical.

*The Method of Pruning.*—After selecting the right kind of fruiting canes, the next step is to determine which ones have the best location on the vine. As described under training, pick out four canes for the Modified Fan system at about the height of the lower wire. These are the fruiting canes. Cut them back to eight or ten buds.

For the Kniffen system, pick out four canes—one on the right and one on the left just below the upper wire, and one on the right and one on the left just below the lower wire. Cut all four canes back to eight or ten buds. Find three or four other canes that are well located and cut them back to one or two buds for renewal spurs, from which canes can develop to be used the next pruning season. Remove all surplus wood, leaving only the spurs.

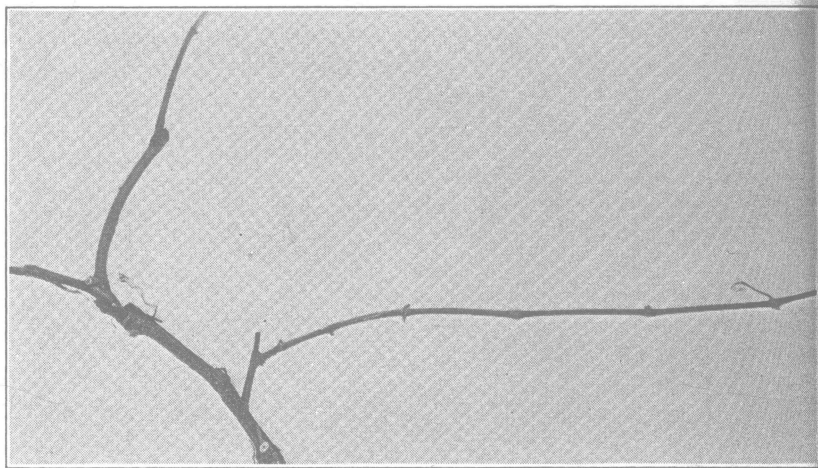


Fig. 14.—The fruiting wood shown on the left grew from a last year's cane, and that on the right, from a spur.

and the fruiting wood. The pruning job is now finished. The vine is ready to be tied.

### *Tying the Vines*

After the pruning is done, the brush hauled away and the wires tightened, then everything is ready for the canes to be tied in place for the new crop.

Where the Fan system is to be used, spread out the canes so that the new shoots will have plenty of room to develop. Tie the canes in an upright manner, tying tightly to the upper wire with twine or a very light wire and loosely in other places where support is needed.

Where the Kniffen system is used, there is little choice as to where the canes are to be spread. They are trained horizontally on each wire and tied tightly at the end of each cane. Oftentimes, twisting the cane once around

the wire will hold the vine and nothing more is needed. Frequently a loose tie is necessary where the trunk crosses one or both wires.

With a young vine, tie the cane up tight and hold it straight. It later becomes the trunk of the mature vine. If straight, it is not unduly in the way of cultivation, but if crooked it becomes a source of trouble, hooking single-ness, wheel hubs, and all tools used in cultivation, throughout the life of the vineyard.

## HARVESTING

### *Time of Picking*

Grapes to be packed and sold as fresh fruit should be picked when the berries have their full color and are sweet but are not over-ripe. Concord grapes become blue before they are fully ripe, and it is only when the bunch is held up to the sunlight that the red or immature shade is noted. Accordingly, there is a temptation to pick grapes when they are immature, but there is no practice more apt to reduce demand for this delightful fruit. The partially ripened grape does not have enough sugar in it and is very poor in quality as compared to fruit ripened on the vine.

If grapes are to be used or sold for juice purposes, allow them to become fully ripe. The sugar content of such grapes is more important than their appearance. When picked late, berries often shell from the bunch, but they contain more sugar and make much better grape juice than if they are picked early.

### *Method of Picking*

Build a small light stand to support the basket or baskets into which the grapes are to be picked. Make the stand of a height convenient to the picker, so that the picker will have no temptation to toss the bunches into the package, but can handle them carefully.

Cut the bunches from the vines with small dull pointed shears, leaving only a short stem on the bunch. Remove any bad berries and lay (don't throw) the bunches carefully into the basket.

Most growers pick and pack the grapes all in one operation, directly in the vineyard. By so doing, they save handling and bruising but are apt to have a slack pack by this method. Picked in a field container and packed in a packing house, the stems of the grapes have a chance to dry out slightly and a full pack is more easily made.

In packing, start at one end of the basket and fill the package to the top at that end, placing the bunches so that the stems are not visible on the face of the package. Then continue putting in grapes from the bottom to the top of the basket until the other end is reached. With the hand, gently press the grapes towards the starting end and fill in any space thus created. The completed package should be full and well faced, and should not settle enough to make a slack pack.

# Grape Insects and Diseases, and Their Control

By T. H. PARKS, *Entomologist*,  
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Agricultural Extension Service, the Ohio State University

The grape is attacked in Ohio by a number of insects and diseases which are capable of causing heavy loss. However, on the average farmstead, grapes of fair quality are sometimes grown without any spraying treatment being given them. This is especially true where judicious yearly pruning is practiced and where vines are kept in a vigorous growing condition.

Insect and disease problems vary in different vineyards. Therefore, the control measures employed must depend on the conditions present. As a result, it is impossible to construct a spray schedule for grapes that will have general application.

In considering the spraying of the vineyard, it seems desirable to consider the quality of the crop previously produced and the type of insect or disease injury, if any, which was present. The injury may be due to a single insect or disease which results in a definite type of damage to the fruit or vine. If one or more of these troubles persist in appearing each year, the spray or sprays designed to correct that trouble should be used (see Tables, pages 23-24). Thorough applications made at the proper time will usually result in producing grapes of good quality.

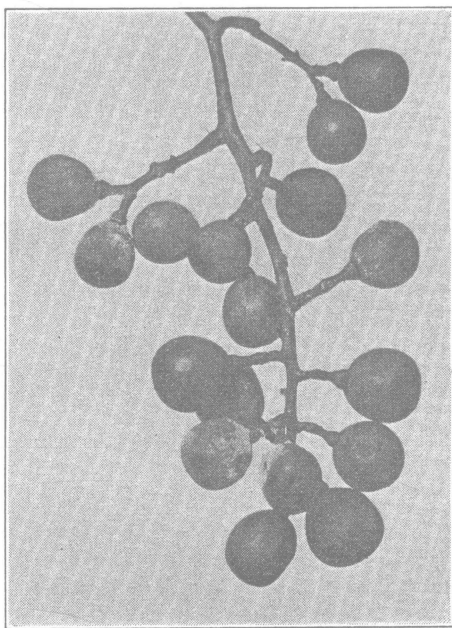


Fig. 15.—Downy mildew on grapes.

At the western end of the Lake Erie grape belt, black rot, berry-moth (wormy berries), and leafhoppers constitute the usual pests. In northwestern Ohio, leafhoppers and root worms largely determine the spraying program used. In southern counties, black rot and berry moth furnish probably the outstanding requirements of spraying needs.

The accompanying insect and disease calendar aims to cover the principal insect and disease enemies of the grape. Not all of these pests will appear in one vineyard during one or a series of years. A few of them appear each year in the commercial grape area in northern Ohio, where the extensive grape culture promotes their continuation as a pest.

The vineyard owner is advised to study this calendar of insects and diseases. From their description he then will probably be able to pick out the spray or sprays needed to control his existing trouble.

In order to reduce production costs, it is essential that the grower apply only such sprays as are *actually necessary* to protect his fruit, and to so adjust his cultural and pruning practices as to aid in insect and disease control.

### GRAPE SPRAY PROGRAM

NAME AND TIME OF SPRAY	MATERIALS TO USE	TO CONTROL	FURTHER SUGGESTIONS
PRE-BLOSSOM Before blossom buds open when the new shoots are 12 to 18 inches long.	4-6-50 bordeaux mixture. (See page 25.)	Mildew Black rot	Necessary only in case these diseases are present. Cover all leaves and bud clusters.  If rose chafers are eating the buds, add 2 lbs. of arsenate of lead and 1 gal. of molasses to 50 gals. of spray.
PETAL FALL (Immediately after blossoming.) Three to 5 days after the fall of the bloom.	2-3-50 bordeaux mixture <i>and</i> Arsenate of lead... 1½ lbs. <i>and either</i> Resin fish-oil soap <sup>1</sup> . 1 lb. <i>or</i> Fish-oil <sup>1</sup> ..... ½ pint Water to make ... 50 gals.	Berry-moth Mildew Black rot	Very important where berry-moth is serious. Dissolve the soap in hot water and add to bordeaux, with agitator going.  If rose chafers are present, increase the poison and add molasses as given in pre-blossom spray.
REPEAT SPRAY Seven to 10 days after petal-fall spray.	Same as for petal-fall spray.	Berry-moth Root-beetle Black-rot	Very necessary where berry-moth is serious. Be sure to cover fruit clusters.  If young leafhoppers are numerous on the underside of the leaves, add 1/3 pint of nicotine sulfate and, with high pressure, force the spray against underside of leaves.
SPECIAL LEAFHOPPER SPRAY (In July before the first leafhoppers develop wings.)	Same as petal-fall spray, except that 1/3 pint of nicotine sulfate is substituted for arsenate of lead. <sup>2</sup>	Leafhopper	This special spray is sometimes necessary in order to control leafhoppers and prevent "rusty" foliage. Direct against insects as advised in previous spray.

<sup>1</sup> One of these materials is necessary as a spreader in this and the later sprays. Laundry soap can be substituted but is more difficult to dissolve.

<sup>2</sup> Arsenate of lead should not be applied later than the "Repeat Spray" because of the residue remaining on the harvested fruit.

**CALENDAR OF GRAPE PESTS AND DISEASES**  
With Remedy and Spray Recommendations Suitable for Small Plantings

INSECT OR DISEASE	DESCRIPTION	REMEDY OR PREVENTION	WHEN TO APPLY
GRAPE BERRY MOTH	Small worms which develop in fruit, causing it to color prematurely. Infested berry later cracks open or shrivels and drops from bunch	Spray fruit with arsenate of lead 4 level tablespoons in 1 gal. of water with soap spreader. This is 1 pint to 8 gals. Combine with 2-3-50 bordeaux if disease is present. Repeat above 10 days later when berries are size of B-B shot	1st. Just after bloom falls (No. 2 under Black rot) 2nd. Ten days later,
GRAPEVINE FLRA BEETLE	Small, steel-blue jumping beetles that eat the opening buds in spring and destroy the new cane and fruit The dark brown larvae feed on upper surface of the leaves in June	Beetles are difficult to control Hold a large pan containing a film of kerosene under canes and gently tap them; beetles will drop or Spray as for rose chafer if beetles are seen on buds Spray foliage with arsenate of lead (pwd.) 4 level tablespoons to 1 gal. water (1 pint to 8 gals.) to kill larvae	When beetles are noticed In May In June when grubs are feeding
GRAPE ROOT WORM	Small, grayish-brown beetles which eat chainlike marks in the leaves in June and July Larvae feed on roots of grape	Spray foliage with arsenate of lead (pwd.) 5 level tablespoons to 1 gal. water (1 pint to 6 gals.)  Cultivate soil thoroughly to kill pupae	In June when beetles are first noticed Repeat in 10 days Late in May and early June
ROSE CHAFER (rose bug)	Long-legged, yellowish brown beetles about 1/2 inch long. Eat blossom buds, newly set fruit and foliage	Hand picking is practical on a few vines Spray with arsenate of lead (pwd.) 5 level tablespoons to 1 gal. water, sweetened with sirup (1 pint arsenate of lead to 6 gals. water) or Spray beetles with pyrethrum spray	When beetles are first noticed
CLIMBING CUTWORMS	Brown cutworms that hide on ground near canes by day and feed on the buds by night	Apply poisoned bran mash and place bands of cotton batting around post and cane	As soon as damage is noticed
LEAF HOPPER	Very small elongate insects marked with yellow and red, which jump from the leaf when disturbed Suck the sap from underside of leaf. Cause speckled appearance of leaf	Spray insects with nicotine sulfate, 1 1/2 teaspoon to 1 gal. soapy water or bordeaux mixture (see page 25) Spray undersides of leaves or Dust with nicotine dust containing not less than 3 per cent nicotine Keep down tall grass about grapevines	When noticed and before hoppers have developed wings  Repeat in 10 days if necessary
<i>Black rot</i>	Fruit rots, blackens, shrivels, and is covered with black dots Leaves with brown spots having gray centers and many black dots	Spray with bordeaux mixture 2-3-50 (see page 25) or Dust with 20-80 copper-lime Include insecticides in 2d and 3d applications	1st. When shoots are 10-15 in. long (may be omitted if mildew is not serious) 2d. Just after blossoms fall 3d. Ten days later when berries are the size of B-B shot
<i>Downy mildew</i>	Leaves with indefinite yellowish areas above; white, downy patches beneath. Young shoots covered with white, downy growth	Same as for <i>Black rot</i>	



## BORDEAUX MIXTURE

Bordeaux mixture is an excellent fungicide and carrier for insecticide used in grape sprays. It is safe to use on the common varieties of grapes and prevents burning from arsenate of lead. Where bordeaux is not used as a carrier for the arsenical, it is advisable to add hydrated lime to the water at the rate of 3 pounds to 50 gallons of water. The lime should be freshly hydrated and preferably a special fine high calcium spray lime.

Bordeaux mixture is spoken of as 2-3-50, 3-4-50 and 4-6-50. This means (for the first mentioned) 2 pounds of blue vitriol and 3 pounds of good hydrated lime used in each 50 gallons of water, etc. The weaker strength is used in the after-bloom sprays, as the stronger mixtures sometimes cause foliage injury. There are two general methods now in use for preparing bordeaux mixture. The standard method is Method I, as follows:

*Method I.*—Prepare a stock solution of copper sulfate by dissolving the required amount of copper sulfate in the ratio of 1 pound to 1 gallon of water. To do this always suspend the copper sulfate crystals in a sack submerged just beneath the surface of the water. The warmer the water, the more rapidly the crystals will dissolve, but they will dissolve in moderately cold water in a few hours.

The stock hydrated lime is prepared by making a lime paste of known strength which can be washed into the tank through a screen, or a stock solution may be prepared in a barrel by mixing 2 pounds of lime with each gallon of water. If a good grade of freshly hydrated lime is available it may be sifted directly into the tank.

To fill a 100-gallon tank with a 2-3-50 bordeaux mixture, fill the tank two thirds full of water, and start the engine to keep the agitator running. Mix the 6 pounds of hydrated lime into a cream and pour through a strainer into the tank; *when thoroughly mixed* add the 4 gallons of copper sulfate stock solution. Complete the filling of the tank to 100 gallons. If arsenate of lead is to be used it should be added, and lastly (if necessary) the spreader, which has previously been dissolved.

*Method II.*—The second method is the preparation of *instant bordeaux mixture*. Recently, copper sulfate has been manufactured in what is known as snow form, which dissolves quickly. No stock solution, therefore, is necessary. The mixture is made as follows: Fill the tank half full with water and, with the agitator running, wash in the hydrated lime through the screen. Next fill the tank two-thirds to three-fourths full, place the copper sulfate snow on the screen and wash through, and then completely fill the tank.

This method is the simplest for making bordeaux, but has not been thoroughly satisfactory. If the copper sulfate snow, or powder, does not dissolve properly, a lumpy bordeaux is made, and nozzle trouble follows.

## SPREADERS

When spraying grapes for control of berry moth it is necessary to include a spreader and sticker to enable the spray to adhere to the waxy coating of the grape and to the bodies of the leafhoppers. Many materials have been tried,

but resin fish-oil soap and fish oil have been found most suitable. One pound of resin fish-oil soap dissolved in hot water or  $\frac{1}{2}$  pint of fish oil is added to each 50 gallons of spray material. It should be added last, with the agitator going. These materials do not injure fruit or foliage. Mineral oils should not be used as spreaders, as they give the grapes a dull finish and add to the spray residue problem.

### SPRAY RESIDUE

To prevent the harvested grapes from carrying too much arsenic residue, spraying for the second brood of berry moth worms is prohibited. This means that no application of arsenate of lead can be applied to the fruit clusters after the first week of July. Great care must be taken to get a good covering of spray against the first brood of berry moth worms. This spray is applied just after the fall of the bloom. It should not be repeated 10 days later unless the double application is absolutely necessary to control the worms. Two sprays against the first brood of berry moth worms sometimes result in too much residue on the harvested fruit.

The spray made for root beetle is not so likely to cause residue, as this spray is directed against the upper sides of the foliage and not driven into the fruit clusters.

Until a satisfactory method is found to remove arsenic residue from grapes, late spraying with arsenicals must be abandoned. Soil culture, to bury the overwintering berry moth cocoons, coupled with spraying against the first brood of worms, must be depended upon, at present, for control.

### CULTURAL METHODS OF VALUE.

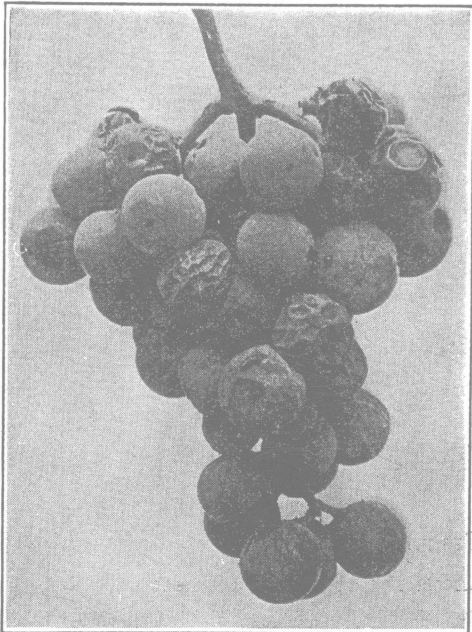


Fig. 16.—Grapes injured by grape berry moth larvae.

The grape berry moth overwinters on the ground in cocoons made by the folding and rolling of damp or decayed grape leaves. These cocoons are found under the vines. From these cocoons the adult insect (a moth) emerges about the time the grapes are in bloom.

Experiments carried out by G. A. Runner at Sandusky, Ohio, showed that where these cocoons were buried under a comparatively shallow soil covering, practically no emergence of moths resulted. This inability of moths to emerge from buried cocoons indicates that this method can be put to practical use in com-

mercial vineyards. Tests made in 1931 point to this as a valuable supplementary method to reduce the number of first brood moths. The method is suggested for vineyards previously showing a heavy infestation.

To carry out this idea, the ground should be kept cultivated during the summer but cultivation discontinued after August. No further cultivation is made until spring, the berry moth cocoons being left unprotected on the soil surface under the vines. Cultivation is made in the spring so that it completely covers all of the earth and old leaves under the wires. Do not again disturb until after the blooming period, which is after the time of moth emergence. The soil can then be cultivated away from vines and later seeded to a cover crop.

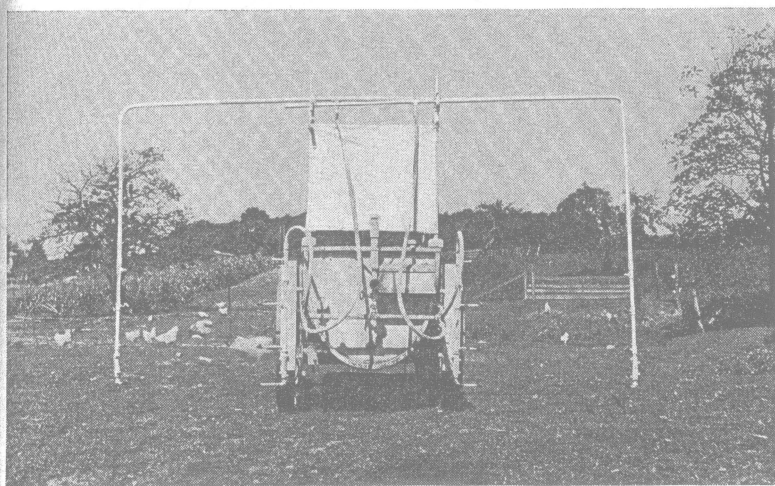


Fig. 17.—A vineyard sprayer with a boom that sprays both sides of two rows. Note the upper nozzle A that sprays the upper leaves, the nozzles on both sides are set to spray the under sides of the leaves, and the spray boom is flexible so that if an obstruction is struck the boom gives or swings without being broken.

### SPRAY EQUIPMENT AND PROCEDURE

During the time a vineyard is coming into production and even during the early years of bearing, there is frequently no spraying required. As the vines become older, diseases and insects are likely to establish themselves and make regular spraying necessary. Rows must be spaced at least 10 feet apart for the use of a power sprayer. Judicious pruning and tying of vines must be followed to secure the best results.

Where spraying is necessary, adequate equipment should be provided. For commercial plantings this consists of a gasoline power sprayer of suitable capacity and capable of delivering the spray under pressure of 250 pounds or higher. From 125 to 150 gallons of spray per acre are required for proper coverage, though this varies in different plantings.

Either the fixed boom or the trailer method may be followed. If a fixed boom is used it should be so constructed and fitted as to cover both sides of the

same row simultaneously. These booms are fitted to the sides of the sprayer and are usually equipped with 7 nozzles. Three nozzles direct the spray against each side of the row and one from above. The fixed boom reduces the labor required and is both rapid and efficient.

Some growers prefer to operate the nozzles by trailing the sprayer and spraying one side of a row at a time. This method enables the operator to change the course of the spray at will and give special attention to the fruit clusters. It requires more hand labor and is a slower method, but is effective in the hands of a careful operator.

Regardless of the method followed, only thorough work will successfully control grape insects and diseases.

#### SUGGESTIONS FOR HOME PLANTINGS

The equipment serviceable for home plantings, where only a few grapes are to be sprayed, is a good hand sprayer of barrel or bucket type that will deliver the spray under sufficient pressure. Prepared bordeaux mixture may be used if desired, as the amount required will not make the expense prohibitive.

Dilutions of spray materials used for both commercial and home plantings are as follows:

MATERIAL	50 GALLONS OF SPRAY	5 GALLONS OF SPRAY
Bordeaux mixture:		
Copper sulfate .....	2 lbs.	3 oz
Lime .. .. .	3 lbs.	1 pint
Arsenate of lead.....	1½ lbs.	1 pint
Nicotine sulfate.....	1/3 pint	5 teaspoons
Spreader:		
Fish-oil soap .....	1 lb.	2 oz.
or		
Laundry soap .....		¼ bar
or		
Fish-oil .....	½ pint	7 teaspoons

Where grape diseases only are to be combated, a prepared fungicide dust may be applied to the foliage with a hand duster. The proper dust to choose is 20-80 copper-lime dust which can either be purchased ready mixed or mixed at home. It should be dusted on while the foliage is wet with dew. Dust applications against grape insects have not proved satisfactory, because of their poor adhesive qualities.