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Michigan State University Agricultural Experiment Station
Special Bulletin
N.L. Partridge, Horticulture
Issued November 1937
14 pages

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Sent to Michigan

Special Bulletin 141 (Revised)

November, 1937

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Profitable Pruning of the Concord Grape

By N. L. PARTRIDGE

From 1921 to 1925, the Michigan Agricultural Experiment Station carried on extensive pruning and cultural experiments with the Concord grape. Three vineyards, one representing vigorous, one moderate, and one rather weak vine growth were used. Two of the vineyards were located in Van Buren County and one in Kent County. Seasonal conditions during the four-year period presented about the usual amount of variation that is to be expected.

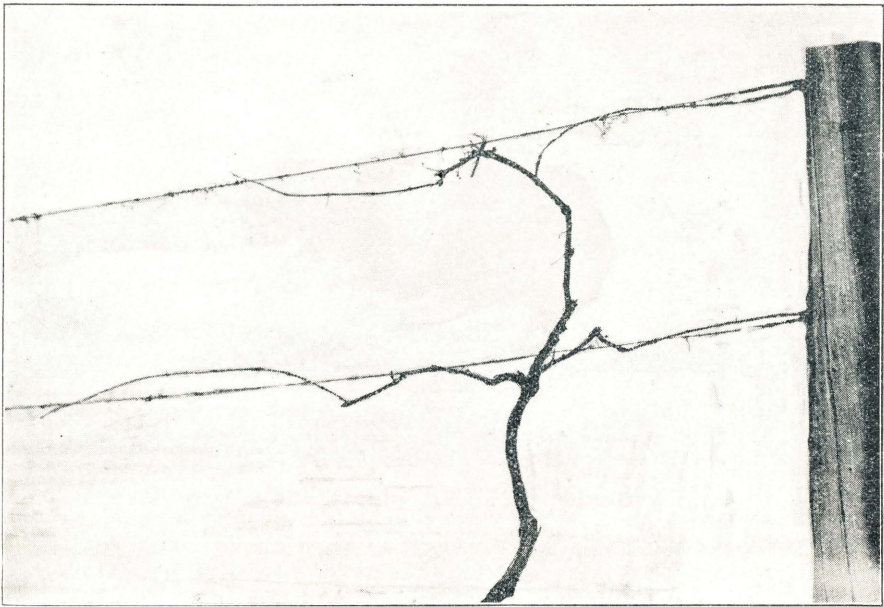


Fig. 1. A vine pruned according to the four-cane Kniffen system of training.

A large number of data were accumulated on the bearing habits and growth characteristics of this variety. Careful study of these data seemed to warrant fairly definite statements regarding the responses that may be expected from various pruning treatments and fairly definite conclusions regarding pruning methods suitable for vines of different degrees of vigor. Observations made during the seasons that have followed have served to confirm the accuracy of the conclusions drawn from those experiments, especially regarding the necessity for balancing the production of the vine to its capacity to produce.

Growth and Yield Are Inter-related

If growing conditions are reasonably favorable, the crop produced by a vine during any one year depends on the vigor of its growth during the preceding season. Increasing the vigor of most vines as found in Michigan vineyards would also increase their capacity to produce fruit, although some very strong vines may not be benefited by greater growth. In general, the greater the amount of cane growth that a vine produces, the larger the yield of fruit the next harvest.

The larger the crop produced by a vine, the smaller the amount of shoot growth produced during that season. Seasonal conditions and attacks by insects or diseases sometimes obscure this effect. A vine that is permitted to overbear makes a comparatively weak growth during that season, with the result that the amount or weight of the canes to be removed by pruning the following winter is usually less

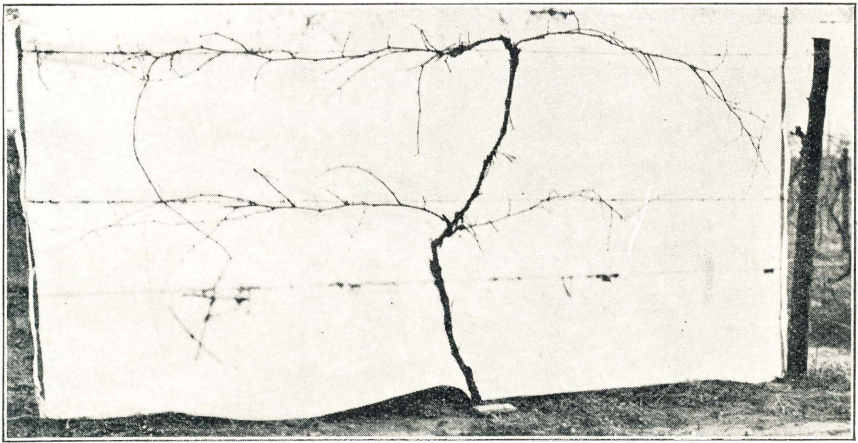


Fig. 2. A vine weakened by overbearing due to underpruning.
Compare with Fig. 3.

than the amount obtained the winter preceding the crop. The vine is weakened by overbearing. A vine that is not permitted to bear a full crop usually produces a greater weight of cane growth than it did the preceding year. The vine is strengthened by overpruning. However, overpruning is not the best method to use in strengthening weak vines because it is too expensive and the following crop is too much reduced. Soil treatments are a better means for obtaining the same result.

Under a given set of environmental conditions, maturity of fruit and cane depends on the ratio of effective leaf surface to pounds of fruit on the vine. A vine that is overbearing will not mature fruit and canes so early or so well as it would if it were carrying a smaller crop. The use of certain fertilizers increases leaf area so these vines are able to mature their fruit better than are similar unfertilized vines. Neglected vines which are poorly cultivated or poorly sprayed do not have so large an effective leaf area as the well-cared for vine and will not be able to mature as large a crop as the vine receiving better treatment.

The severity of pruning should be varied to meet the conditions which are to be expected during the following season. If cultivation is to start late and be scanty and if spraying is to be neglected, the vines should not be permitted to bear so large a crop as though good cultivation, fertilization, and spraying were contemplated. In other words, any practice which will reduce the number or size of the leaves produced by the vine, or which will make them less effective through unchecked attacks of insects or diseases, should be balanced by more severe pruning which will reduce the size of the crop to an extent sufficient to permit it to mature properly.

Good Pruning Trains the Vine and Thins the Crop

Grape pruning must train the vine and thin the crop. Proper training is obtained by leaving those canes on the vine that will give it the desired arrangement on the trellis when tied. The crop is thinned by leaving a sufficient number of fruitful buds on the vine to produce the fruit it is able to bear, and by removing the surplus to prevent over-bearing.

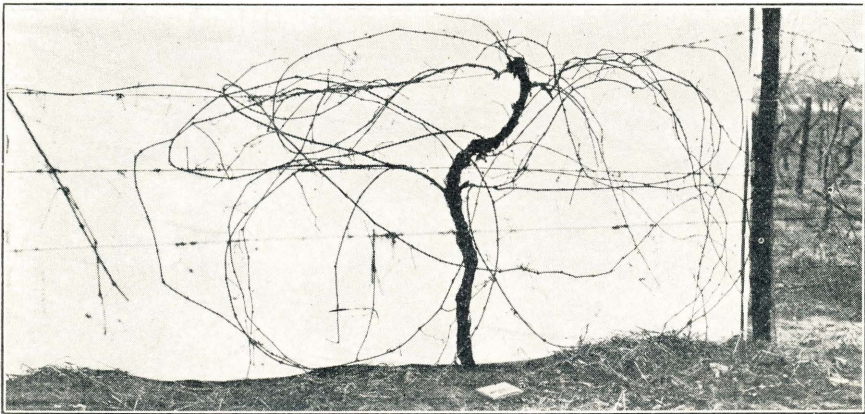


Fig. 3. A vine in good condition as a result of balanced pruning.
Compare with Fig. 2.

Training the Vine

The four-cane Kniffen system (Fig. 1) is the best plan of training for most Michigan vineyards. Growers have demonstrated that this is the most economical method which will provide the necessary amount of properly placed fruiting wood. Some modifications are necessary in the case of vigorous vines, where one or more canes must be added to provide sufficient bearing surface. This is done by selecting canes growing from the trunk at about the height of the lower wire, or from the lower arms, and tying them to the upper wire so that they are spread apart like the ribs of a fan. In very vigorous vineyards a third wire may be used on the trellis, and six canes used for fruiting which will give a better distribution of wood than can be obtained on two wires. Such vineyards are rare in Michigan.

Thinning the Crop

Proper thinning is accomplished by balancing fruit production with the fruiting capacity of the vine. Overbearing should be avoided not only because the quality of the crop is lowered but also because the crop for the following year is reduced. Underproduction is unprofitable because of the immediate reduction in the amount of fruit produced. The appearance of the vine following a crop indicates whether a correct balance between cane growth and fruit production has or has not been secured. If the cane growth is short and weak, too many buds were left on the vine the preceding season. If the growth is long and vigorous, the pruning has been correct. (Compare Figs. 2 and 3.) If the canes are too large to be of a good fruiting type, overpruning has been practiced, and too small a crop produced.

The severity of the thinning is measured by the productiveness as well as the number of the buds left on the vine. The fruit buds on



Fig. 4. Fruiting on a quarter-inch cane. Compare with Fig. 5.

a vine are not all of the same fruiting capacity. Some are much more productive than others on growths of a less fruitful type. If a selection is made of the buds left, it is often possible to find 30 very productive buds that will yield as much or more fruit than 60 less productive buds found on the same vine. Equal thinning and equal crop yield may be obtained by selecting a large number of relatively unfruitful buds or a smaller number of very fruitful ones.

The use of a smaller number of the more productive buds is more profitable to the grower than the use of a larger number of less productive buds. The smaller the number of buds that may be left on a vine which will still produce the necessary amount of fruit, the cheaper will be the pruning, tying, spraying, and picking. More vines are pruned per day when a relatively small number of buds are left on them because fewer canes need be saved. Where the canes are few and short, the number of ties is reduced. Spraying is easier and more thorough where the vine has fewer shoots. The fruit is picked faster

because the bunches are fewer and larger. The fruit of the vine is limited to a smaller number of shoots, with the result that they are more vigorous and usually produce canes of a better fruiting type. Renewal canes are obtained more easily.

Select Fruitful Canes of Large Diameter

The more fruitful buds are easily recognized by the diameter of the cane and the distance between its buds. Buds growing on canes about a quarter of an inch in diameter, or perhaps a little larger, are more productive than those on canes of a smaller or larger diameter. (Compare Figs. 4 and 5.) Buds on quarter-inch canes that have the joint between the fifth and sixth buds from 5 to 8 inches in length are more productive than those on canes where this joint is shorter or longer. The canes for fruiting should be selected because of their diameter and the length of the joint rather than for either character



Fig. 5. Fruiting on a weak cane. Compare with Fig. 4.

alone. The least productive canes are those which are small in diameter and which have short joints. It is seldom possible to find a sufficient number of well-placed canes of the most fruitful type on any vine. A choice must often be made between a cane a little too large and one a little too small. The buds on a cane a sixteenth or an eighth of an inch larger than the ideal size are more productive than those on a cane which is correspondingly smaller. The cane whose fifth and six buds are more than 8 inches apart is better than the cane on which these buds are less than 5 inches apart. The diameter is usually a better indication of productivity than the distance between the buds. The best canes are those characterized by both suitable cane diameter and joint length. Canes which taper very rapidly (Fig. 6) are not of a productive type and should be discarded when possible.

More importance should be attached to the selection of canes of relatively productive types than to the location of the cane on the vine. A cane of a certain type will prove a little more productive if

it grows from the trunk or from a short arm than if the same cane grows from a long arm. The difference, however, is slight. The difference in yield between canes of different fruiting types is large. If the grower wishes to have a good harvest for the next fall, the good fruiting canes should be used in preference to poor fruiting wood, no matter where it is found on the vine.

If a considerable length of two-year old wood is left, it is essential to remove the buds at the base of the canes which are discarded. Otherwise a considerable number of practically worthless non-bearing shoots will be produced (Fig. 7) which will reduce the vigor of the other shoots produced on the cane and arm, making it more difficult to obtain good renewal the following year. It may be necessary to leave a spur as near the base of the arm as possible for renewal, in such cases. (Fig. 8.)

The buds near the base and tip of the cane are less productive than those found between. The decline in productivity toward the tip is more rapid in the case of the smaller canes than the quarter-inch or

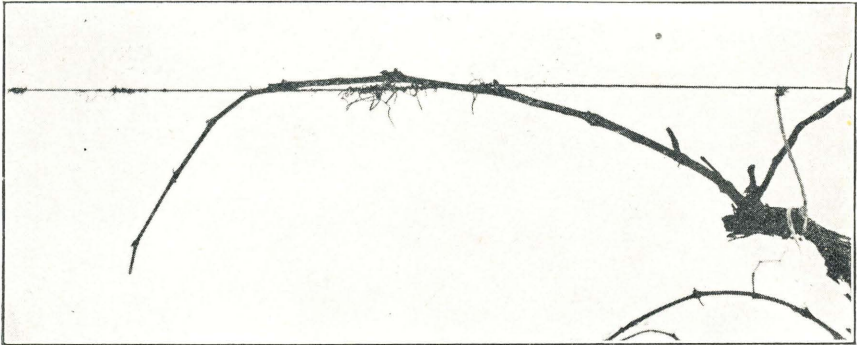


Fig. 6. A rapidly tapering cane. Such canes are less productive than those which taper slowly.

larger-sized ones. Consequently, if any small canes must be saved for fruiting, they should be pruned shorter—to a smaller number of buds—than the more vigorous canes. Figure 9 shows a vine on which the number of buds has been balanced to correspond with the strength of the canes. Another reason for balancing the number of buds left on any cane to its diameter is the fact that the smaller sized cane will permit the growth of only a few good shoots, but the stronger canes will carry more shoots without reducing their strength materially. Not more than six or seven buds should be left on a very small cane. A quarter-inch cane may be permitted to carry nine or ten buds without reducing the strength of the shoot growth materially.

Laterals (Fig. 10) may be used for fruit production on vigorous vines. Large sized canes are usually long-jointed, so it is difficult to find room on the trellis for a vigorous 10- or 12-bud cane. Space may be economized by saving a few lateral spurs of two or three buds each on these larger canes. The first few buds on vigorous laterals which grow from canes more than a quarter of an inch in diameter

are more productive than those on the parent cane. Where the parent cane is less than a quarter of an inch in diameter, the buds on the laterals, which are rather weak in most cases, are less productive than those on the main cane. Laterals growing from small canes and those of very weak growth should never be saved for fruiting.

Several Factors Determine Number of Buds Saved

It is not always possible to designate the exact number of buds to which any grape vine should be pruned. There are variations in the capacity of a vine to bear fruit which are not expressed in its apparent vigor. This is due to the influence of the preceding crop on the growth made. A fairly satisfactory scale of the number of buds to be saved on vines of varying vigor has been made; but this scale might be modified profitably in some instances. For example, if the cultivation and spraying is neglected and no fertilizers are used, the number of buds should be somewhat reduced. If the soil is excep-

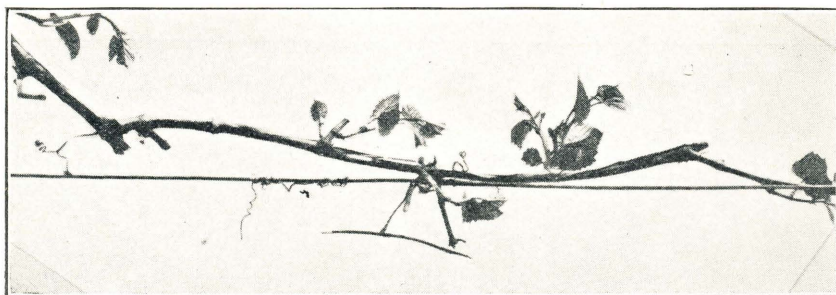


Fig. 7. Carelessness leaves many short spurs on two-year wood when it is necessary to save a cane for fruiting that is far from the trunk. These shoots will not be very productive but will help to reduce the vigor of all shoot growth on the arm. This will increase the difficulty of finding good renewal next winter.

tionally fertile and fertilizers are used, the number should be increased. As a rule it is safer to prune a weak vine too severely rather than too lightly, but the reverse is true in the case of the very vigorous vine. The vines should be pruned as individuals to correspond with their fruiting capacity.

In balancing the number of buds to the vigor of the vine, it is necessary to have a measure of the growth of the vine. The weights given are those of the one- and two-year old wood removed from the vine at pruning time. If any older wood is cut off the vine, it should not be weighed. This weight gives a fairly good index of the vigor of the vine. The number of buds refers to the total number left on the canes, since the less productive basal buds are included in the count. It is assumed, however, that these are buds on the most productive type of cane. Nevertheless, it is not advisable to increase this number to any considerable extent, even though the buds are on small-sized, less productive canes, because this would enlarge the number of growing points and thus reduce the strength of the individual shoots which will be next year's fruiting canes. The pruning scale follows:

Pounds of prunings	No. of buds left on the vine
Less than $\frac{1}{4}$ lb.	16
$\frac{1}{4}$	20
$\frac{1}{2}$	24
$\frac{3}{4}$	28
1	30
$1\frac{1}{4}$	32
$1\frac{1}{2}$	34
$1\frac{3}{4}$	36
2	38
$2\frac{1}{4}$	40
$2\frac{1}{2}$	42
$2\frac{3}{4}$	44
3	48

Leave two more buds for each additional quarter of a pound of prunings in excess of three pounds.

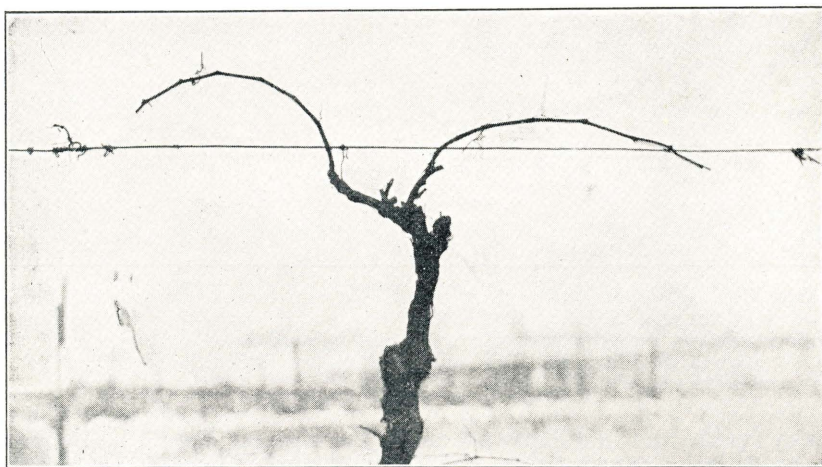


Fig. 8. Two-bud spur left to provide a cane close to the trunk for fruiting wood for next year.

This scale has given satisfactory results in the Michigan State College experimental blocks every year after 1921. Since few vines vigorous enough to yield much more than three pounds of prunings were found on these plots, only a limited amount of experience with very vigorous vines has been obtained and the scale may have to be modified in dealing with the most vigorous vines which sometimes yield as much as 10 or 11 pounds of prunings and which should have 100 buds or more according to the scale.

Some growers believe that this careful balancing of potential production to vigor is impractical. No doubt it would be impractical to weigh all the prunings from vines on 40 or 50 acres. However, experience has shown that a pruner is soon able to make an accurate estimate of the weight of the prunings removed from a vine after

half a day's training with the actual weighing of the brush. The pruning thereafter will be done a little slower than when no estimate is made of the weight and little attention is given to obtaining the proper balance between vigor and number of buds retained. The extra time spent is well repaid at the harvest in quality as well as in yield.

It is difficult to balance pruning to fruiting capacity without actually counting the buds left on some of the vines. When weak vines are pruned, they are left with short canes—the strong vines with longer ones. However, the number of buds per foot of cane is much larger on the weak than the strong vine. A count will often reveal the fact that more buds have been left on the weak vine than the strong one, though the reverse had been intended. An occasional check count is well worth while.

When the type of pruning is changed materially, care should be taken to see that the thinning is of the proper severity. When the canes saved are of a more fruitful type than has been used previously, it is usually necessary to reduce the number of buds left on the vine



Fig. 9. A vine on which the number of buds retained on the different canes has been balanced to correspond with the strength of the canes.

if overbearing is to be avoided. An instance has been observed where a change of this sort was made. The vines were moderately vigorous and had been pruned to four 10-bud canes of a weak growth type and several spurs were left regularly on each vine. The system adopted for half the vineyard was four 9-bud canes of the best type available, and no spurs were left. The crop was nearly twice as large on the latter vines as on the former, with the result that the vines suffered severely from overbearing. It is also true that if the number of buds left per vine is reduced, this reduction must be accompanied by an increase in the fruiting capacity of the buds left if a reduction in yield is to be avoided.

If it is necessary to modify the pruning practice materially it is probably better to make the change gradually during two or three years

rather than very abruptly. This will tend to avoid very marked under or over production in the vineyard.

Within reasonable limits, if a grapevine be pruned to the same number of buds for several years, it will produce about the same weight of fruit per year after the first crop. The first year, the crop is nearly proportional to the number of buds left on the vine—considering the fruitfulness of the buds left. Thus a moderately vigorous vine consistently underpruned for some years previously, and then pruned to 60 buds will be nearly twice as productive as a similar vine pruned to 30 buds, the first year. The second year, however, the vine pruned to 60 buds will not produce any more and usually not quite so much fruit as the vine pruned to 30 buds for two years. The average weight of the bunches produced on the thirty-bud vine is a trifle greater the first year, and considerably greater the second year. Consequently, the quality of the fruit is improved by the more severe pruning. The very strong vine is an exception to this treatment. If it be severely pruned

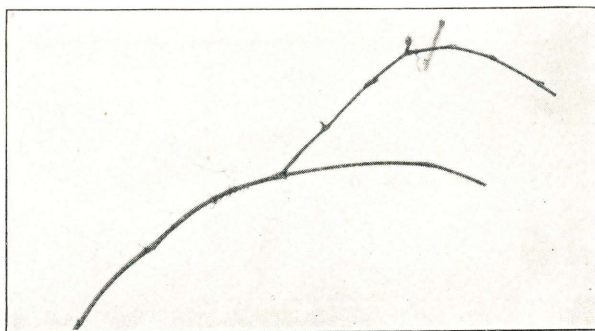


Fig. 10. A cane with a lateral which may be retained for fruiting. It should be cut back to the point indicated by a short line.

the crop is often less per bud and so is very much less per vine, than where the vine is pruned correctly. The cane growth also becomes so heavy that it is difficult to find good fruiting wood for the following season, so the injury extends over a term of years.

Biennial Bearing Caused by Faulty Pruning

Biennial bearing may be induced by faulty pruning. If the crop is reduced by a spring frost or freeze, the cane growth is more vigorous, and the vine appears to be much strengthened. The buds on such a vine are more productive than those on similar canes grown on vines producing a good crop. As a result the pruning practiced after a crop failure is usually less severe than should be given and too much fruit is produced. This excessive crop reduces the vigor of the vines and canes. The vine appears very weak and is pruned severely. The buds on a vine which has overproduced are less productive than buds on similar cane types on vines with a moderate crop. This vine will then produce a crop smaller than it is able to mature and its growth will

be more vigorous. Thus biennial bearing is established. Usually all the vines in a district will produce their large crops the same year because they were all affected by the same weather conditions at the commencement of the first cycle. This has an influence upon the price of the fruit, it being higher in the years of low production and lower in the years of high production. Such a habit may be corrected by pruning the vine somewhat more severely the winter before the heavy crop is expected. The extent of the overpruning necessary will depend on the fluctuation between the large and small crops. Where



Fig. 11. Vine renewal two years old. The trunk of the old vine is crooked and prevents close cultivation. The young vine was brought to the lower wire the first year and now has two lower arms with a trunk extending to the upper wire.

the difference is very large, it may be necessary to reduce the number of buds as much as a third to prevent over-production. Usually the correction need not be so severe.

Renew Old Trunks as Occasion May Demand

The trunk of the mature vine should be renewed occasionally. Many old trunks are crooked enough to interfere with the cultivation of the vineyard. Most of them are partially dead and infected with fungi of various sorts. When the dead arm disease is abundant, the prompt renewal of the trunk is essential since, otherwise, many of the vines will die and cause numerous vacancies in the vineyard, thus reducing acre yields. Even when the vines are not diseased conspicuously they usually seem more vigorous after a new trunk has been brought up.

A vigorous sucker growing upright from the roots should be selected for the renewal trunk. It should be cut off beyond the first bud above the lower wire and tied at this bud to the wire at such a point that the cane will be straight, even though it may be slanted away from the old vine somewhat. It should never be brought to the top wire the first year since the lower buds will then remain dormant and the trunk will not produce arms for the lower wire. The second season, the cane growing most nearly upright is brought to the top wire and the lower arms established (Fig. 11). The string by which the top bud is tied to the wire usually will girdle the cane at the top bud, and usually the cane growing from it must be discarded. As the young vine increases in size and vigor, it may be permitted to carry a larger part of the crop of the vine. One convenient method of training the second season is to remove both arms from the old vine on the side on which the renewal vine is being grown. The whole of the old vine may be removed as soon as the young vine is provided with its four arms. This pruning may be somewhat severe, but the reduction in yield is only temporary, and the danger of infecting the young trunk with diseases from the old one is reduced.

Pruning Other Varieties of Grapes

The vines of other varieties of grapes are usually pruned similarly to Concord in Michigan vineyards. Pruning experiments and observations of the fruiting habits of the Campbell Early grape have shown marked differences from the Concord both in regard to the external characteristics of the most fruitful canes and the number of buds needed to balance equal amounts of growth in the two varieties. Doubtless, similar differences occur with other varieties, but they have not been determined. In general, the growth of the vine will serve as a guide for the severity of pruning those varieties. Whenever the vine growth becomes weak or the fruit does not mature at the proper season, the probability is that the vine is not being pruned severely enough. Fertilizers may serve to increase the vigor of growth or the vines may be pruned more severely to bring them into balance. On the other hand, when growth is very vigorous and the production is low, it may prove necessary to leave more buds on the vines. The differences between the productiveness of different types of canes on these varieties may not be determined so easily. Nevertheless, if the grower will retain a few canes of different sizes, marking them at pruning time, he will have no difficulty in discovering whether there are any large differences in productivity associated with size of cane as are found in both the Concord and the Campbell Early.

Directions for Pruning a Vine

The annual pruning for a Concord vine of medium vigor—that is, a vine yielding from two to two and a half pounds of prunings, should be about as follows: First, select four fruiting canes as nearly a quarter of an inch in diameter as possible, with the joint between the fifth and sixth buds between five and eight inches in length. These canes are to be trained in either direction along the two wires and should originate from the trunk or as near the base of the arms or branches

as this type of wood may be found. Second, if the fruiting cane does not originate within 6 or 8 inches of the trunk and if there is another cane growing closer to the trunk than the one retained for fruiting, this cane may be cut back to a one- or two-bud spur to provide a renewal for next year's fruiting. Third, cut back the canes left for fruiting so that the total number of buds on the vine is about 40, balancing the distribution of the buds so that the larger numbers are left on the larger canes. Fourth, remove all other wood. Pruning other vines should be similar except that the buds left should balance the fruiting capacities of the particular vine pruned, as explained in the pruning scale.

Most grape pruners do not devote sufficient time to the vines they trim. The grower will be repaid at the harvest for the time that he spends in choosing the best wood for fruiting and accurately balancing the production of vine and cane to its capacity.