



# Ontario Department of Agriculture

## FRUIT BRANCH

### The Grape in Ontario

F. M. CLEMENT

#### INTRODUCTION.

The following pages are written with the hope that they may serve as a help and guide to those who have not had an extended experience with vineyards and to others who may desire to study the subject a little more fully. Only a small part of the experimental work under way at the Vineland Experiment Station is here reported because it is largely new. It is hoped that some time in the not too distant future, the different phases of grape growing may be dealt with in detail in special bulletins.



Vineyard in early spring before growth has started. Notice the peach bloom in the distance.

If the experienced grape grower obtains from these pages helpful suggestions here and there, and the new men get hints that help them to develop more fully their vineyards, the hopes of the writers will have been fulfilled.

No attempt is made to present new material, but rather to present a practical outline of grape growing in Ontario. The information has been gathered from talks and discussions with growers in Ontario and parts of New York State and from practical experience. The field work has been done largely by Mr. L. R. Jones, who has charge of the grape investigations at the Station.

## HISTORY AND STATUS OF THE GRAPE.

The grape is one of the oldest and most popular of our fruits. Its culture dates back to prehistoric times. Seeds have been found in the remains of the Swiss Lake dwellings of the Bronze period and entombed with the mummies of Egypt. In later days, it was cultivated by the Greeks and Romans, and the instructions for cultivation by Virgil are as authentic as ours to-day. Notice his instructions:—

“ With iron teeth and rakes and prongs to move  
The crusted earth, and loosen it above,  
Then exercise they sturdy steers to plow  
Between the vines,” etc.

and also:

“ And let thy hand supply the pruning knife,  
And crop luxuriant stragglers, nor be loth  
To strip the branches of their leafy growth,” etc.

One species, *Vitis vinifera*, is grown in Europe. From this has been made wines for centuries, and from it to-day are made the raisins of commerce. Eastern American viticulturists have not been able to grow this species successfully, though recent experiments seem to indicate that with the best care and the application of the most modern cultural methods, there are some hopes of success. This species is also the grape of commerce of California. The grapes of Eastern America and Ontario have been developed largely from native species (*Vitis labrusca*), with here and there a sprinkling of European blood. The “Rogers” varieties, so familiar to all, are the result of crosses between a large fruited variety known locally as Carter or Mammoth Globe (*Labrusca*) fertilized by pollen secured from Black Hamburg and White Chasselas (*Vinifera*). The greater number of the remaining varieties, including Concord and Worden, are pure American varieties. Large quantities of grapes are imported from California into Canada, but these grapes being of the European type and consequently of a distinct quality and flavor, do not come in direct competition with our native grapes. The Easterner prefers the Eastern grape which he can obtain in quantity, but at the same time uses the California product for special dessert purposes. The imported product is firm, sweet, little subject to rot and of good quality, and may be found on the fruit stands of our cities at all times during the grape season. The price of the imported product is necessarily high, being from ten to twenty cents per pound retail, while the home product sells from twenty to thirty-five cents an eight pound basket retail.

Following is the quantity and value of the grapes imported into Canada during past years:—

Year.	Quantity.	Value.
1895 .....	977,754 lbs.	\$ 56,118
1900 .....	936,344 “	55,327
1910 .....	3,50,989 “	221,887
1914 .....	7,712,447 “	490,128
1915 .....	6,200,160 “	317,183

From the following list it will also be noticed that the heaviest import months are our heaviest shipping months:—

Month.	1913-14	Value.	1914-15	Value.
April .....	1,564 lbs.	\$ 728	5,378 lbs.	\$ 1,268
May .....	195 "	186	287 "	230
June .....	130 "	203	496 "	163
July .....	192 "	80	16,580 "	1,620
August .....	328,051 "	19,327	493,742 "	24,614
September .....	1,419,993 "	67,871	1,308,378 "	51,433
October .....	2,189,579 "	118,916	1,583,569 "	52,486
November .....	3,010,946 "	216,962	2,058,283 "	129,528
December .....	695,683 "	57,614	596,164 "	42,091
January .....	40,406 "	4,112	109,816 "	10,348
February .....	20,931 "	2,804	14,513 "	1,839
March .....	4,777 "	1,325	12,954 "	1,563

We are not particularly concerned with the details of the development of the grape industry in America, but it might possibly be of interest to note the development in Ontario. As late as 1880, the Province was credited with not more than 400 acres of commercial grapes. By 1890, this area had increased to 2,400 acres, and by 1901, to 5,750 acres. The census of 1911 does not give directly the number of acres in Ontario, but the Ontario Bureau of Industries credits Ontario with 11,586 acres, and the 1914 Bureau of Industries credits Ontario with 10,850 acres. The figures of the last few years show a steady small decrease in area possibly due to the taking out of grapes in isolated sections.

The following is a list of counties showing the acreage in each:—

Lincoln .....	5,071 acres.		Halton .....	184 acres.
Wentworth .....	2,790 "		Peel .....	168 "
Welland .....	926 "		Kent .....	134 "
Essex .....	275 "			

The other counties have still smaller acreages. These figures would seem to indicate that the commercial grape areas of Ontario are largely on the lake shore between Niagara and Toronto, and on the north shore of Lake Erie in the two most south-westerly counties.

Grapes are used largely for the manufacture of fermented wine, for the manufacture of grape juice, and for dessert and jelly purposes. Where the European varieties are grown they are used quite largely for the production of currants and raisins. All our common varieties are used more or less largely for the first named purposes. We have no variety that will dry to make raisins or currants.

As stated previously, great importations for purposes largely to supply the fruit stand trade, amount for the year ending March, 1915, to 6,200,160 lbs., valued at \$317,183.00.

Great Britain .....	635,276 lbs., valued at	\$48,086.00
United States .....	5,533,640 lbs., valued at	266,886.00
Spain .....	31,244 lbs., valued at	2,211.00

This is an average value of more than five cents per pound for 6,200,160 pounds, or more than 3,100 tons, which is equal to the production of more than a thousand



acres in Ontario in a good season. There is a possibility that this shortage may be made up some day, but not likely in the very immediate future.

In the same connection also it is interesting to note something of the raisin industry. Raisins are dried grapes prepared and packed in a special way. Last year Canada imported for consumption as follows:—

Source.	Quantity.	Value.
From Great Britain .....	226,601 lbs.	\$ 11,648
“ United States .....	16,100,284 “	1,060,375
“ Spain .....	4,099,927 “	252,636
“ Turkey .....	1,584,289 “	80,368
“ Other countries .....	606,836 “	36,733
	22,617,937 lbs.	1,441,760

As shown previously, the counties of the Niagara Peninsula—Lincoln, Welland and Wentworth—are the leading grape centres. The first record of planting that has been brought to the attention of the writers is that of the small area set out on the farm now owned by Mr. Porter Adams, at Queenston, in the Township of Niagara, in the year 1857. The next year, Mr. W. D. Kitchen and Mr. J. R. Pettit planted some vines on their farms at Grimsby. In 1862, Mr. Wm. Read, of Port Dalhousie, planted three acres of Concord, Hartford Prolific and Delaware, and in the same year Mr. Peter Wright, of Stamford, planted three acres of Isabella. In 1863, Mr. Lusee, Mr. J. M. Stewart, Henry Lottridge, and Christopher Biggar, all planted small vineyards. In 1868, Mr. F. G. Stewart, of Stamford, planted two and a half acres of Concord and Delaware, and Mr. Prest, of the same place, planted an acre of Delaware, Concord and Hartford Prolific. In 1869, Mr. Walter Kerr, of Drummondville, planted two acres of Concord and Delaware. In 1873, Mr. D. J. Lowry, of St. Davids, set out 200 Concord, 50 Isabella, 50 Diana and 15 Delaware vines. These were set in rows sixteen feet apart and the plants twelve feet apart, and were trained to chestnut stakes seven feet high. No special stimulus seems to have been given the industry until about 1882, when the much advertised “Niagara” variety was introduced. Vines of this variety were sold at \$1.25 each, and all cuttings had to be returned to the company. In spite of the high cost, a great deal of money was made from this variety during the years following its introduction.

Crops, as a rule, were uniformly good, and the disease and insects of to-day were scarcely, if at all, noticeable.

As shown previously, from this time on the growth was rapid, but though more than thirty-five years have passed and many vineyards may be considered old, and many of our best growers may be considered of long standing, the industry is still in its infancy.

#### SITES AND SOILS.

From the examination of the table of acreages by counties it has been seen that the grape centres are largely in those sections that are, more or less, protected from the greater extremes of heat and cold. This indicates that the best varieties are somewhat tender. They will, however, thrive fairly well without winter pro-

tection in the greater part of Western Ontario, and especially near the large bodies of water. Some thrive also on the north shore of Lake Ontario, but the plantings are almost entirely gardens.

Confining ourselves to the commercial centres, we find that grapes are grown on a great variety of soils under varied conditions. Two points, however, must always be kept in mind: first, the danger of loss from late spring frosts; second, the danger of loss from non-maturity in the fall. A third point might be mentioned also, that of protection from insects and diseases.

The danger from frosts is largely one of situation or site. The low-lying, flat land suffers first. Cold air settles in the hollows and basins hold cold air on cool nights much the same as basins accumulate and hold water. Elevated lands, on the other hand, are always more or less affected by air currents. Wind blows over them and cool air flows down their sides.

Large bodies of water also have a modifying effect on the atmosphere, holding in check the extreme cold of winter, delaying blossoming in the spring—and it might be added also, delaying ripening in the fall. Deep hollows and ravines also tend to draw off the cool air, and it is seldom, if ever, that vines on the hill tops are injured. The danger of loss from non-maturity in the fall is largely the result of a short growing season, cool nights and days, or most likely too cold soil. It might also be a question of too rich soil or soil that is unbalanced in its fertilizing ingredients.

A short growing season is one that cannot be overcome except by planting earlier and quicker-maturing varieties. Cool nights and days often occur at a time when warm days are most needed, and cannot be overcome by direct means. The sowing of a quick-growing cover crop, such as five pecks of oats to the acre, may assist a little, but ceasing cultivation and allowing the weeds to grow and the canes to ripen, is often all that can be done. This was all that could be done in the season of 1915. Warm weather very late in the season hastened maturity a great deal.

As stated before, cold soil is most often the main cause of slow maturity. Coldness is largely due to the water content of the soil. Grapes thrive best on the warmer soils, are sweeter and mature much quicker. A moist, cool sand, the ideal for strawberries and raspberries, invariably fails to ripen the grape. On the other hand, the harder, heavier clays ripen the grapes early as a rule. An exception will be mentioned later. Underdrainage will make the cool sands warmer, but the undertaking is considered inadvisable as these soils are more valuable when planted to small fruits.

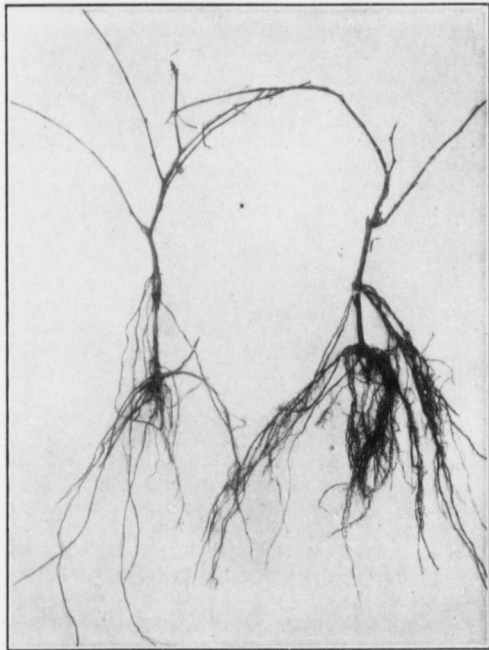
Two types of soil give large crops of high quality grapes. These are the silty soils in the various townships found below the escarpment in the Niagara Peninsula, and the soils of the first ledge of the escarpment mapped in the soil survey work as Dunkirk clay loam. The former is of a grey or black color and from six to nine inches deep underlaid with a heavy subsoil of bluish or drab colored clay. Where the proportion of organic matter is greatest, the soil is darkest and most open and friable. This type of soil is derived from glacial lake deposits and occupies low-lying areas. The latter soil is dark brown to greyish brown clay and clay loam, about eight inches in depth, somewhat hard and cracks on drying. Owing to its nature, it is usually easy of drainage, but the subsoil is hard and impervious to water. The grit and gravel well mixed with the greater part of this soil tend to keep it more loose and open than it otherwise would be. The exception to these

two types of grape soils is found in the warm, drier sands such as are found in the Fonthill district and scattered in various other parts of the grape-growing areas.

A part of the grape soils of New York State are of this nature. Warmer, drier, natural conditions, tend to early ripening and good quality. The quantity is possibly somewhat lower, but the warmth is an insurance against non-maturity.

#### NURSERY STOCK.

In ordinary nursery practice grape vines are propagated from cuttings. The cuttings may be prepared any time after the vines are dormant, but, other things

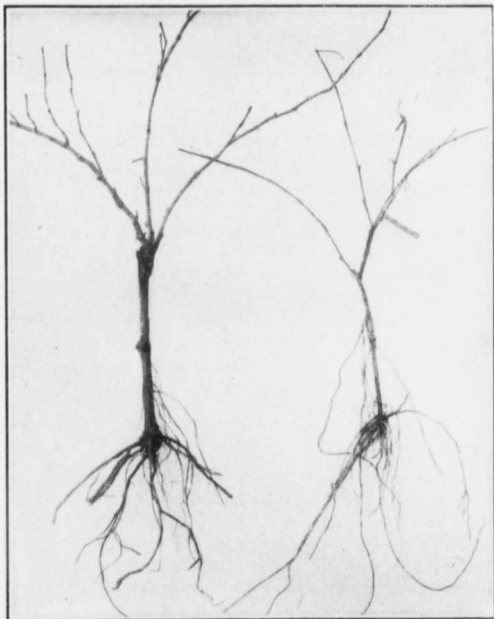


Concord vines one and two years of age as they are received from the nursery.

equal, and provided they are afterwards well cared for the sooner they are taken after the vines become dormant the better. The majority of grape growers do not grow their own vines but buy them from nurserymen. A few of the large nurserymen grow their own vines to propagate from; others gather their cuttings from nearby commercial and varietal vineyards.

The wood for cuttings is gathered from the vineyards shortly after pruning. Cuttings are made from well-matured wood of the same season's growth; and preferably from medium-sized, short-jointed wood. Cuttings are usually made

three buds, or about ten to twelve inches long. A slanting cut is made just below the lowest eye, and another about an inch above the third or fourth bud. The cuttings are then tied in bundles of convenient size, the buds all turned the same way; and then heeled in or buried in trenches, butt ends up, and covered with three to six inches of soil. Inverting the bundles causes the butts to callus while the top remains dormant. Hence, the cuttings are ready to send out rootlets as soon as planted. If the tops were not inverted in this way, the shoots would start before the roots could support them.



Muscat and Concord one-year-old vines as received from the nursery.

In the spring, as soon as the soil is dry, warm enough and thoroughly worked, these cuttings are set two to three inches apart in furrows three to four feet apart. The furrows are usually made on a slight slant, and are deep, so that, when the cuttings are placed in them only the upper bud projects above the surface. The cuttings are hoed and cultivated frequently during the summer, and by fall the young vines will usually have made a strong growth.

When the young vines have properly matured their wood, about November first, they are plowed out. The vines are then gathered in bundles of convenient size for a man to handle and are taken to storage cellars. Here bundles of vines of different varieties are packed in separate bins. The vines are usually piled in

two tiers with the tops out and the roots in. By this method the roots are prevented from drying out, and air is allowed to circulate around the tops, thus holding mildew in check. Of course, the new storage cellars are equipped with a proper system of ventilation by means of which the moisture content and temperature of the air can be controlled.

While in the cellars the vines are graded as No. 1's, No. 2's, and culls. Any two-year-old vines on hand are also divided into these three grades. Cuttings which have made a strong, well-balanced growth of root and top are classed as No. 1 year-old vines. A No. 2 year-old vine has made a somewhat weaker growth or the top may be a little over-developed compared to the root system. Culls are those vines which do not fall in either grade, and are usually discarded.

Those vines which are not sold in the spring are replanted and sold the following year as two-year-olds. In a few cases vines of the standard varieties, and some of the weaker-growing kinds are allowed to grow in the nursery for two years before being sold.

From this description the grower will readily see that for commercial plantings first-class one-year-old vines are to be preferred to first-class two-year-olds. Most large growers realize this, but to the small, inexperienced planters the larger, two-year-old vines look more promising.

Very frequently the grower does not place enough importance on the selection of first-class stock. To many the lower price of the poorer grade appeals strongly. Nevertheless, in purchasing vines it must always be borne in mind that the young vines are the foundation stock upon which the vineyard is to be built; and, if poor vines are planted, the vineyard will be handicapped right from the start.

Immediately on receiving the vines from a nursery the bundles should be opened, the vines spread out, and heeled in in some sheltered spot. The earth should be well mounded up to the vines and care taken not to mix the varieties.

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## PLANTING.

Land to be planted to grapes should be thoroughly prepared and in a good state of tilth. It is poor practice to set vines in sod land which has been plowed under the previous fall, because, when the furrows are plowed in the spring for planting the sod will be turned up. If grapes must be set on such land, it should be summer fallowed in August preceding planting, and plowed again at the time of planting. To thoroughly prepare and clean the land for grapes it is best to grow some hoed or grain crop the year before planting.

As soon as the land is dry enough to work in the spring, it should be cultivated with a disc and worked both ways with a spring tooth cultivator.

Vines may be planted from as soon as the soil is in good tilth in the spring until about the first of June. The earlier the vines are set the better, because this enables them to become well established in the soil before the heat of the summer comes on.

The young vines must be pruned before planting. If the vine has several canes, all but one should be removed and this one should be shortened to two buds. This pruning makes the vine less liable to dry out before rooting, and forces the growth from the lower buds which produce more vigorous shoots.

The roots should also be thinned and cut back to about nine inches. Long roots are of no advantage to the young vine, because they are not the feeding roots, and are of no use until they develop feeding roots.

Previous to planting, the vineyard must be staked to show the location of the rows. Needless to say, care must be experienced in making these rows straight. The ease of all subsequent vineyard practices depends more or less upon this. Then to facilitate striking a straight furrow in which to set the vines, stakes may be set at frequent intervals along these rows. As deep a furrow as possible is made the first time and then by returning in the same furrow it can be made about ten to twelve inches deep, which is sufficient for the vines. Where the soil is shallow, it may be necessary to dig all holes instead of using the plow except for marking.

As soon as the furrow is made, planting should be begun, and should follow up the plow all the time. A rod cut to a length equal to the distance apart of the vines in the row is used to show the position of the vines. One man usually does the planting, but in case of large plantings two men are often used, and a boy supplies them with vines, which have already been pruned.

In planting, the roots of the vine should be spread out carefully, and the ground firmly tramped over them and beyond them to a distance of eighteen inches. The vines must be set so that the two buds left on the cane are just above the ground. If the vines are set deep enough, the roots of the young vines spread out, and the soil well firmed over them the grower can count on most of his vines taking.

The distances of the planting vary very much throughout the grape district. They range from 12 x 10 and 10 x 10 to as close as 8 x 8 and 8 x 7. These differences are due to variations in the soil, and variations in the vigor of the varieties of grapes. Vines planted on the lighter, sandy soils, require more feeding space than the same varieties planted on clay or clay loam. Such varieties as the Niagara and Lindley are far more vigorous, requiring longer pruning than either Moore Early or Delaware; and hence, must be farther apart in the rows than these latter varieties.

The distance between the row has been practically fixed to nine or ten feet, the smallest space in which a waggon can pass conveniently down the rows to gather the fruit.

For the Standard varieties, as Concord, Niagara, Vergennes, Worden and any of the Roger's varieties, a space of nine and a half to ten feet between the rows and nine feet in the rows is recommended. For the less vigorous, smaller growing varieties, as Moore Early and Delaware, a space of nine and a half to ten feet between the rows and seven or eight feet in the row is sufficient on average grape soil.

The practice of setting the vines 10 x 4 ft. or 10 x 5 ft., with the idea of removing every other vine after the fourth or fifth year is not to be recommended. Although this system of planting would, if vines could be purchased at two and a half cents each, considerably lessen the cost of establishing a vineyard, it is not practical because the grower will not remove the extra vines at the proper time, with the result that the whole lot are injured by being cramped into too small a space.

A practical plan to increase the yield per acre is to plant the rows closer, eight feet apart. By this means enough ground will be gained over the regular ten-foot planting to set an extra row of vines every fourth row. The difficulty of gathering the fruit with a standard waggon can be overcome by using a special grape truck which measures four feet ten inches over all in width. Because of the cross reaches

used on these trucks they can be turned easily in a space fifteen feet wide. These trucks cost \$70 f.o.b. the manufacturers.

ALLEYS.—In vineyards which are to cover an area of five or more acres, alleys running crosswise the rows should be provided at certain intervals. These facilitate cultivation and make shorter hauls possible during the picking season. These alleys should be wide enough to permit turning with a two-horse wagon.

## CULTURAL METHODS.

### CULTIVATION.

Frequent and thorough cultivation throughout the growing season is absolutely necessary for the best growth of the vines and the production of the crop in normal seasons. The first operation in the spring as soon as the soil is dry enough to work is to plow away from the vines. A single horse plow is used to turn the first two furrows away from the vines, and the remainder of the ground is turned over with a gang plow which does the work quicker and more evenly than a single plow. A furrow three inches deep is sufficient to turn over the surface soil, and still not deep enough to disturb the surface roots of the vine. It is very important that roots of well-established vines should not be torn up or carelessly exposed by deep plowing. They usually extend to some distance from the vines, and their loss might weaken the vine permanently. In some cases where the soil is friable and there is not any cover crop to plow under the disc may be used instead of the plow to loosen the soil in the spring. The grape hoe and hand hoe should now be used to work the soil away from the vines. Subsequent cultivation at least every two weeks during the summer should be given the soil with the disc or spring-tooth harrow. Especial care should be taken to cultivate in seasons of drought and before the soil has become caked and crusted after heavy rains.

All cultivation should be stopped by the first of August to give the vines a chance to ripen their wood and fruit before freezing. Fall plowing up to the vines may be done at this time, or later after the crop is off. The disadvantages of early plowing are: that some fruit may be torn from the vines by the plow or horses; and, that the soil is left in too rough a condition for the pickers to walk and work quickly along the rows, and for the wagon gathering the fruit to be driven over easily.

### INTERCROPPING.

The growing of such crops as early potatoes, cabbage, and tomatoes between the rows of a newly set vineyard will in no wise retard the growth of the vines, provided these crops are not planted closer than three feet to the vines and that the soil is well cultivated. Such crops as corn which shade the vines and check the circulation of air should never be planted in a vineyard. After the first year no crop, other than the cover crop, should be planted in the rows because from then on the vines are able to utilize all the available plant food themselves.

### MULCHING.

The mulching of young vines late in the fall with strawy manure is a practice to be recommended. The manure not only serves as a protection, but, when plowed under in the spring improves the physical condition of the soil.

## FERTILIZING.

The problem of the use of commercial fertilizers in vineyards is one which involves so many other factors that it is impossible to give general advice which will suit the individual cases of the growers. As a general rule the vineyards of this district do not need commercial fertilizers. What they do need in cases where the crops are decreasing and the wood growth is weak, is better drainage, and more thorough and frequent cultivation to make available the elements of plant food already in the soil.

On the heavier types of clay and clay loam soils frequent applications of strawy barnyard manure are necessary to improve the physical condition and add humus to the soil. An application of ten tons to the acre every three to four years is usually sufficient. This manure should be spread well over the row and not heaped around the trunk of the vine, because the feeding rootlets of the vine come from the larger roots and are not produced directly from the trunk of the vine. When applying barnyard manure, it must be borne in mind that a large percentage of the plant food it supplies is nitrogen, and, that frequent and liberal applications will produce an excessive wood growth and diminish the crop of fruit. No experimental data is available illustrating the value of applications of commercial fertilizer.

## COVER-CROPPING.

Cover crops are not generally used in the vineyards of the grape sections. A large percentage of the plantings have been made on mountain wash, and black clay loam soils which are rich in humus. Nevertheless, there are many cases where the use of a cover crop in the vineyard would solve the very problem which is perhaps puzzling the grower.

The functions of cover crops are to check growth, thus giving the vine time to ripen its wood before freezing; to utilize the nitrates available in the soil after the vine has ceased growth, and in this manner prevent the leaching of these valuable elements of plant food from hillsides which are exposed to washing during the winter and spring months; to add humus to the soil, and also nitrogen when a leguminous plant is used; and lastly, to hold the snow thus preventing deep freezing in the vineyards.

Some of the best cover crops to use are: Rye and Vetch, Rye, Oats, Buckwheat or Oats and Clover. These should be sown about August 1st and at the rate of:

Buckwheat—1 bushel 48 lbs. per acre.

Oats—1 to 1¼ bushels, 34 to 42½ lbs. per acre.

Rye—1 bushel 56 lbs. per acre.

Oats and Clover—Oats, 1 bushel; Clover, 15 lbs. per acre.

Rye and Vetch—Rye, 1 bushel; Vetch, 12½ lbs. per acre.

When sowing a space of eighteen to twenty inches should be left on each side of the row of vines to give a clear space for the pickers to walk in. These crops should be plowed under in the spring at the regular time of working the land.

## TRELLISING.

Trellises are used to support the vines and furnish a means of uniformly distributing the growth, foliage, and crop of the vine.

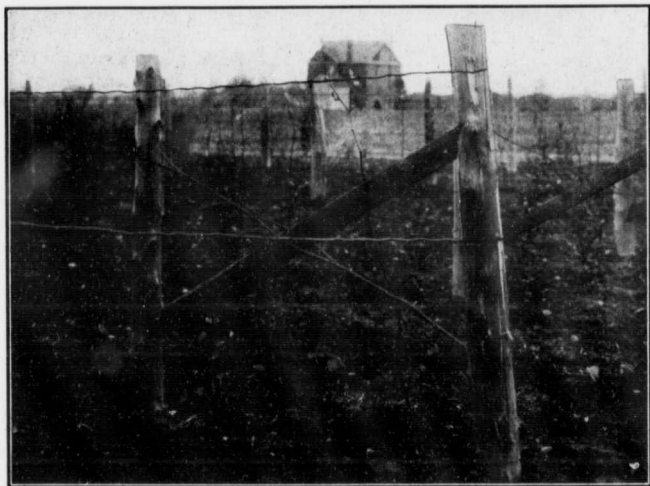
To enable the trunks of young vines to make a strong straight growth they must be tied to the trellis the second year after planting. This means that the



posting and wiring of the vineyard must be done while the vines are making their first season's growth.

Well cured cedar posts are the best to use, and the most economical in the end. The end posts should be at least five inches in diameter and eight and a half feet long, the intermediate posts three inches in diameter and six and a half to seven feet long. A trellis made of good cedar posts, the butts of which have been tarred before setting, will last about twenty years. The posts should be set from twenty-four to thirty feet apart, depending on the distance apart the vines are planted in the rows; and from two and a half to three feet deep.

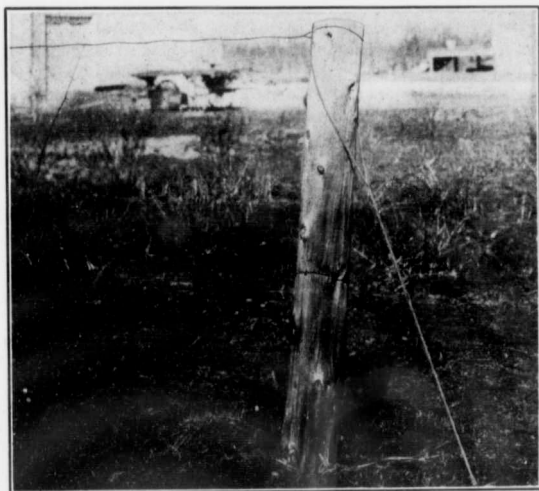
There are many methods of setting and supporting the end posts. In any case the end post must be set four to four and a half feet deep to enable it to withstand



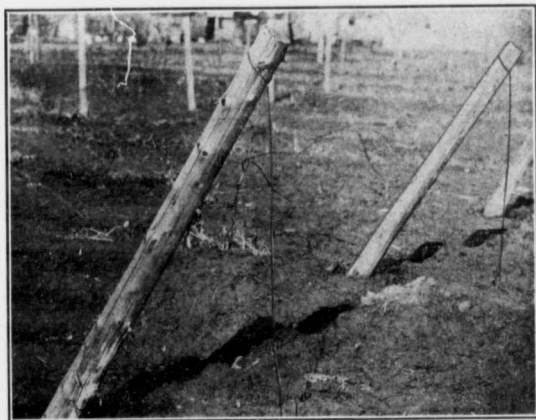
The method of bracing the end posts in the vineyard at the Vineland Experiment Station.

heaving, and to support the weight of the vines and fruit. Perhaps the oldest method is that of bracing the end post with a rail or scantling from another post set about eight feet away in the row. The brace should reach from a point about a foot above the ground on the second post to within eighteen inches of the top of the end posts. To complete the bracing a guy must be passed from about six inches of the top of the second post to a short distance from the ground on the end post. This method is one of the strongest and most satisfactory. The high cost of scantling for braces and also the cost of an extra post are the factors which are against its more general use.

Another method which is being much used because of its low cost is that of guying the end post. The post is set in a hole at a slight angle, some large, heavy stones may be placed in the bottom and the rest of the hole filled and packed with soil. The post is then guyed with a strong galvanized wire, one end of which is



Post anchored to rocks buried several feet in the ground. This is by many considered the best method of bracing.



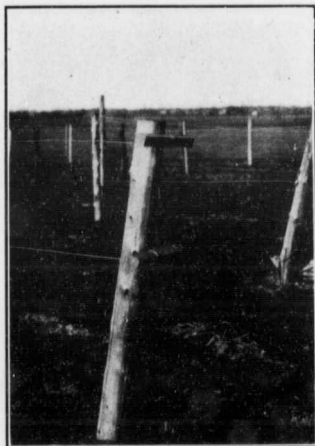
Another method of bracing. Notice the slope to the anchored post.

fastened to the post one foot from the top and the other end to a stone, or short post buried three and a half feet to four feet in the soil and from four to five feet from the post which is as near to the post as it is possible to get without decreasing its purchase. Besides the small original cost of setting these guys they furnish strong support to the posts while they last. The wires, however, are a nuisance in cultivating. The implements will not only often hitch into them, sometimes breaking them off; but the wires are bound to rust and break, and it is hard and expensive to replace them. Another point is that the head rows of the vineyard are much more difficult to keep clean when this method of supporting the end posts is used, than when they are braced or set in cement.

Still another method which is being used to some extent is that of setting the end posts in cement. The holes are made as deep as for the other methods, but the



A common patent used for taking up the slack in the wire.



A very common method of taking up the slack in the wire.

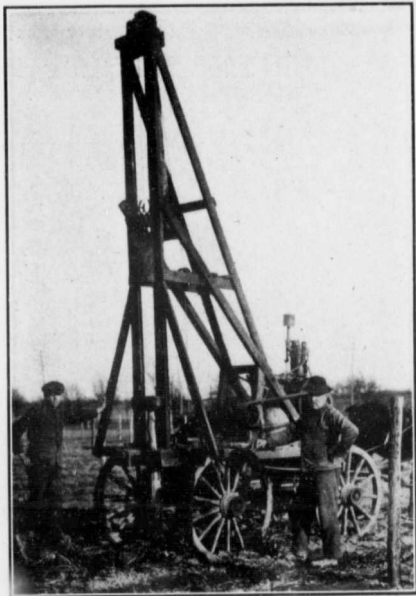
bottoms are cut out to twice the usual diameter. This is done to give the cement and post more of a purchase on the surrounding soil. Notches are cut with an axe on each side of the butt end of the post to enable the cement to hold the post firmly when it sets. When the cement is mixed with sand and rubble in the proportion of five sand and rubble to one of cement, it is found that one bag will do about four holes. About two feet of this concrete in the bottom of the hole will hold the post. To prevent the post rotting the hole may be filled slightly above the surface of the soil. With the end posts set in concrete the trellises present a very neat appearance; they are strong, and it is easy to keep the dead rows of the vineyard clean. In certain clay loam, and clay soils, these posts will heave so badly in the spring that it is only a few years before they are out of the ground entirely.

The cost of well-cured, clear cedar posts will vary from fifteen to twenty-five cents, depending on the number and size bought.

## WIRE.

No. 9 galvanized wire is the proper size to use. A lighter wire gives way too soon.

Two wires are usually sufficient to train the vine on. The first one is put thirty inches above the ground and the second thirty inches above the first. In some special cases three and even four wires are used. If the trellis is made with the three wires they should be spaced twenty inches apart up the post. This would bring the third wire to a height of five feet above the ground. In the case of four wires on a six-foot trellis, the first two may be put fifteen inches apart on the post.



A "driver" at work on the farm of a prominent grower near St. Catharines.

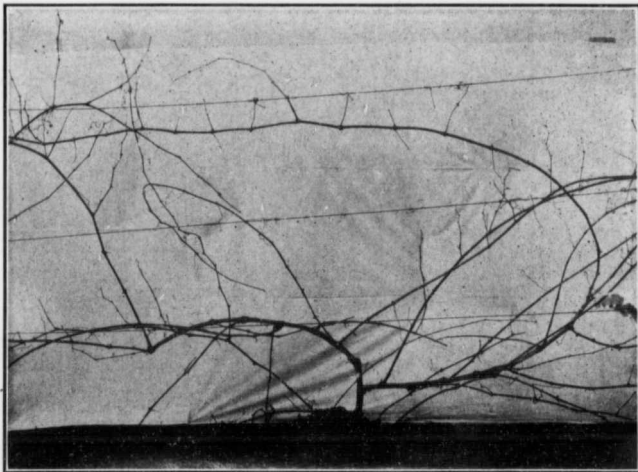
The space between the wires may be increased in proportion to the length of the posts.

Wiring a vineyard may be done very quickly. Quarter inch holes are bored in the end posts, the same direction as the wire is to be strung, and at the distances the wires are to be above the ground. When the wire is stretched along the row both ends of it are passed through these holes in each end post and made fast to the wire tightener. Many simple devices are in use for tightening the wire. One of the most common is a block of hard wood one and a half by one and a half inches square and eight or nine inches long with a quarter inch hole bored through the middle of it. The wire is passed through the hole in the stick and made fast; then

it is tightened by turning the block with a monkey wrench. The tautness of the wire, together with its shape, keeps the block in place.

In another method a small iron reel is fastened to the end post directly opposite the hole bored for the wire. When the wire is strung it is passed through the hole, made fast to the axle of the reel, and tightened by turning the reel with a special detachable handle. A small "dog" attached to the outside of the reel prevents it from unwinding.

When stapling the wires to the posts space should be left to allow the free passage of the wire when it is slackened in the fall and tightened in the spring. Unless the wire is regularly slackened in the fall, it and the posts will be subjected to an undue strain when the already taut wire contracts with the cold weather. This strain will in time either loosen the posts or break the wire.



A vine that looked difficult to prune.

#### NUMBER OF FEET TO THE POUND OF DIFFERENT SIZED WIRE\*

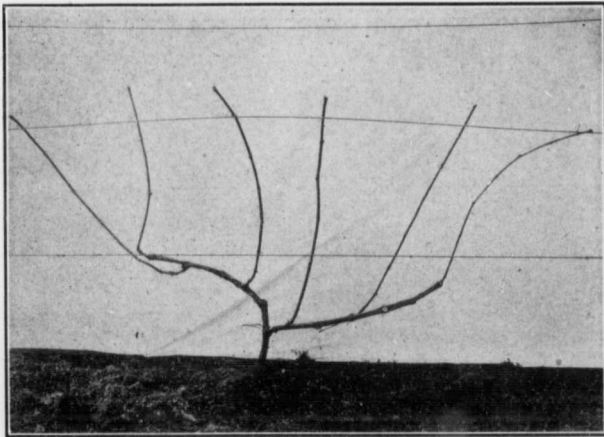
No. 9.—Feet to the Pound....	17.95		No. 11.—Feet to the Pound....	27.34
No. 10.— “ “ “ ....	23.33		No. 12.— “ “ “ ....	34.29

#### PRUNING AND TRAINING.

The objects of pruning are to restrict the growth of the vine sufficiently to enable it to produce the maximum quantity and quality of fruit year after year without injury to the vigor of the vine; to economize in space and to facilitate cultivation, spraying and harvesting.

With young vines the main or only object in pruning is to develop a framework of the proper form. Young vines, which are pruned with this in view, are not

only stronger and have straight trunks, but they bear earlier, and the subsequent crops are larger than those from vines which have not been cared for. The proper treatment of the young vine at the close of its first season's growth is to cut it back to two buds. In the spring, when shoots are produced, all excepting the two strongest should be rubbed off when they are about nine inches long, or before they begin to get woody. As these shoots grow they should be trained to the wires in such a way as to make a strong, straight growth. All suckers and secondary shoots which are produced below the first wire should be rubbed off. If this is done carefully, the grower will rarely be troubled with suckers, and shoots coming out here on these vines when they are mature. After the third season's growth the vine is pruned to suit the system of training which is to be followed; and from then on it is treated as a mature vine.

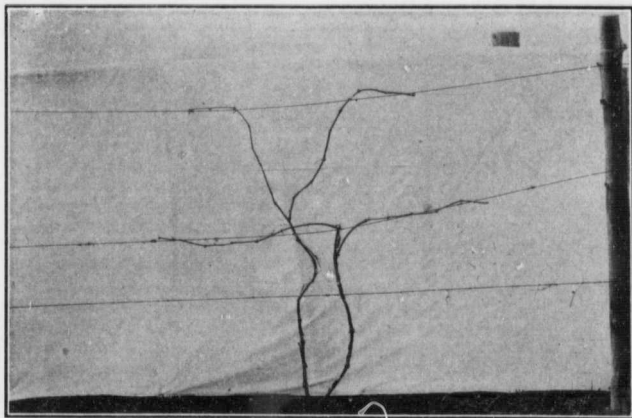


The same vine pruned and tied.

Pruning may be done any time after the leaves have fallen from the vines until the vines begin to "bleed" in the spring. The usual practice throughout the Province is to do most of the pruning during the months of January, February and March. Any time during these months will be quite satisfactory except on very cold days, when the vines are very brittle from heavy freezing and on such other days as it is impossible for a man to work conveniently and to good advantage out-of-doors. The usual plan in the Niagara District is to prune the grapes first during the winter months, leaving the peaches till the warmer days of early spring.

Different systems of pruning are followed by different individuals, but, except for the general advantage of uniformity of work and appearance, no distinct advantage seems to be gained. The proper number of buds on the canes well selected and distributed seems to give as great a quantity of good fruit as where a definite system based on certain rules is laid down. The best pruners seem to be able to size up a vine, select certain canes and prune accordingly.

In the very next vine other canes spaced very differently may be chosen. In the absence of definite experimental evidence, it is perhaps not well to make a definite statement on pruning, but the discussion might be carried still further. No fixed number of buds or certain length of cane can be said to give most fruit. These vary with the variety. A Delaware cane may be very short, twenty-four to thirty inches, and still have eight to ten healthy buds, while a Concord may be twice the length and have no more buds. The general rule of twenty-eight to forty buds per mature vine may be laid down, but it depends on the variety and the distance apart the vines are planted. Some growers in Michigan and in New York leave many more buds, or from forty to sixty per vine. The medium sized yet thrifty canes, about the thickness of a lead pencil, are considered best, though it has not been established that the larger canes, sometimes called "bull" canes, are not of equal value. General opinion, however, is that they are not as good. Experience also seems to



A young vine being pruned on the Improved Kniffin System. This is approaching the ideal, but there is much room for improvement.

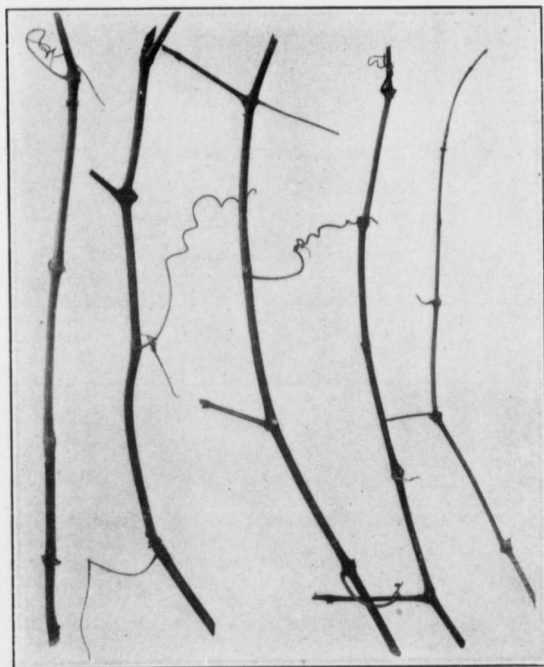
point to the fact that the best fruiting buds are not at the base of the cane, but rather are included in the fourth to seventh buds.

One other point to remember is that the fruit is always borne on shoots that have sprung from canes produced the previous year. This is why it is highly essential to prune a grape heavily. No fruit spurs are produced.

More than a dozen so-called systems of pruning are in practice and mentioned in various books and bulletins, but the most commonly used in Ontario are the Kniffin, Improved Kniffin, Fan System and Arm System, or a combination of the Arm and Horizontal System. Which is the best for general use the writers are not prepared to state, as each system has its particular merits. It is claimed for the Kniffin that the largest bunches and highest quality are produced; for the Improved Kniffin, that is, when the main stem is divided below the first wire, the food supply is more evenly divided between the upper and lower arms; for the Fan system is claimed an even distribution of bearing wood, a greater weight of

fruit, though the bunches may be smaller; and for the Arm system, an equal quantity of fruit, high up from the ground where it is least affected by disease. Ease and rapidity of pruning are also claimed for this system.

It is sometimes necessary to renew an old vine because the trunk has become crooked and bent, and has deteriorated from disease. This can, very often, if not always, be effected by bringing a new lateral from near the ground if the root is healthy. Part of the crop may be lost for a year or two, but the attempt is worth while.



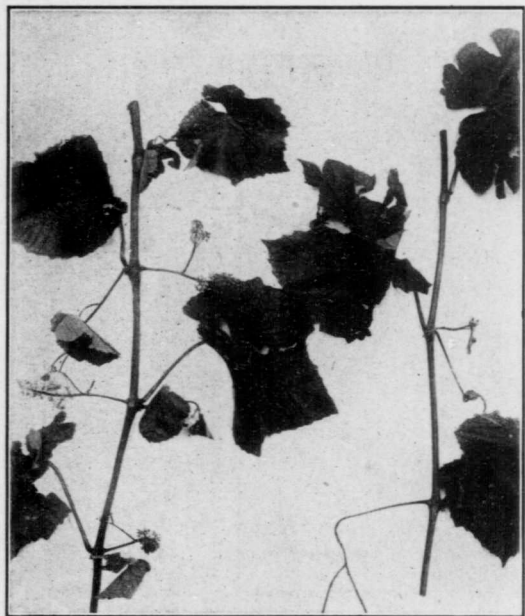
Cuttings from new wood showing the buds from which springs the growth on which fruit is produced.

Usually the only pruning tool that is necessary is a pair of hand clippers, but if any old wood is to be cut out an ordinary pruning saw may be necessary.

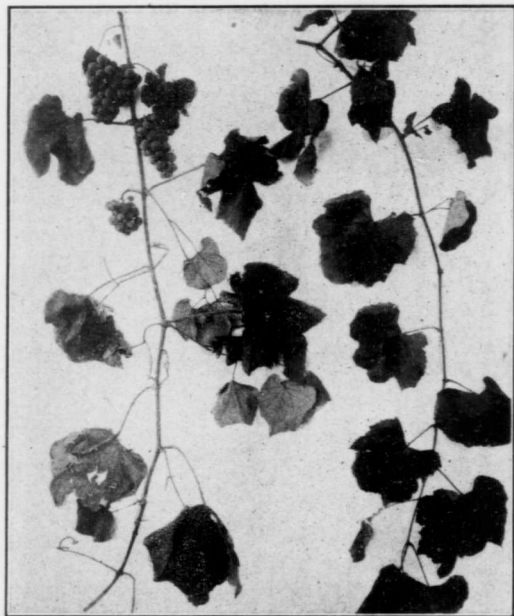
#### TYING.

Tying is a vineyard operation which naturally follows pruning, and which should be completed before growth starts in the spring. Tying should not be done when the canes are frozen, because then they are brittle and break very easily. But this operation cannot be delayed until after growth starts because then many of the shoots and buds may be rubbed off in handling the canes.





Concord in blossom.

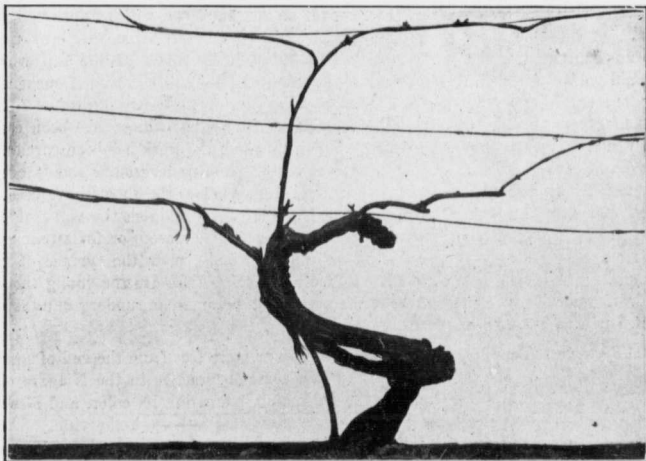


Concord in fruit. All of the fruit produced on the cane is not shown.

Grape twine is used by most of the growers for tying, and is by far the best material. Fine wire is also used to some extent, but this is not as satisfactory in many respects. Wire cannot be used to secure the trunk and main arms of the vine to the trellis, because of the danger of girdling and killing the vines. But when carefully used wire gives very satisfactory results in tying the fruiting canes. It holds the cane securely, and can be tied a little more rapidly than grape twine.

In vineyards which are subject to heavy winds grape rope is used to secure the trunk and arms of the vine to the wires.

When tying a fruiting cane of a vine trained on either of the Kniffin systems to the trellis, it should be given one or two twists about the wire, depending on its length, and then tied securely at the end and again near the point where it leaves the arm. This wrapping of the cane about the wire secures the vine more



Notice the new cane being brought up from the root. This is to be used to renew the vine.

firmly to the trellis than merely stretching the cane along the wire. With the other systems of training, the Fan and Horizontal Arm, the canes are tied in upright positions to the trellis, and hence cannot be wrapped around the wires.

When tying with grape twine or grape rope the cord is given two turns around the wire, a knot made, and then the cane tied securely to the wire. By this method of tying, any slipping of the cord along the wire is prevented, and besides room for the expansion of the cane is allowed.

Wire used for tying is held in position parallel to the wire, then, while the cane is pressed tightly between the two wires, the ends of the fine grape wire are twisted securely around the wire of the trellis. When the fruiting canes are parallel to the wires, the fine tying wire is simply passed once around the wire of the trellis and the cane, and the ends twisted together and bent backwards.

It is false economy to hurry over the tying up of the vines, or to use material for tying which is not sufficiently strong or durable. This always results in much troublesome re-tying and often injured arms.

## SUMMER PRUNING.

**DISBUDDING.** Disbudding is practised on young vines which have not yet formed a stem in order to concentrate the growth into one or two shoots. The following year the stronger of these shoots will be selected to form the stem of the vine. In case of mature vines, disbudding consists in rubbing off all the buds on the lower part of the vine and on the trunk which are not needed for renewal purposes. This is done in order to concentrate the growth in the shoots above and prevent the production of shoots down below the first wire where they would eventually have to be cut off. These buds or young shoots should not be removed until they are from three to four inches long. Since there are many dormant and adventitious buds on the trunks of the vines, any attempt to remove the buds too early would force them out and necessitate going over the vineyard too often.

**SUCKERING.** Suckering is the removal of all the shoots which appear on the trunk of the vine at or below the surface of the soil. These suckers bear little or no fruit, and hence grow vigorously, appropriating much of the sap which should go to the vine. A great deal of time and expense will be saved if suckering is done carefully during the first four or five years of the vine's growth. After the fifth year very few suckers will be produced from vines which have been carefully suckered when they were young. Vines on which the work has been carelessly done will always produce an abundant growth of these underground shoots every year. Suckering should be done early in the summer before the shoots have become hard and woody; not only because of the fact that they diminish the vigor of the vine; but also, because if the shoots are left for the whole season, or for any length of time, they promote the production of dormant buds below the surface of the ground. These old suckers are more difficult to remove than are the young shoots, and, if imperfectly removed the remaining part becomes an underground spur which will be a source of perennial trouble.

**TOPPING.** Topping, or the removal of two or more feet from the end of growing shoots, during the month of August is a common practice in the Niagara district. It is done to admit light to the fruit, thus increasing its color, and also to control mildew by permitting a better circulation of air through the vine. Since topping is done towards the latter part of the summer a great number of leaves are removed, which is very weakening to the vine. In the case of very vigorous vines this may not be serious, but, if severe topping is practised annually it is bound to weaken even the strongest vines. In general this practice has the tendency of increasing the size of the fruit at the expense of the quality.

In certain seasons when excessive growth is produced because of a prolonged rainy season, it may become necessary to resort to topping to admit sufficient light to color the fruit, or to check the spread of mildew; but never in a normal season. At least seven or eight leaves should be left above the fruit when topping in August. The grower should, however, be able to maintain the equilibrium of his vine by increasing or diminishing the amount of fruiting wood left when pruning without having to resort to this weakening practice of topping.

## VARIETIES.

*Concord* is the most popular and widely grown grape in the Province. It is in demand for wine, grape juice and dessert. It adapts itself readily to varying conditions of soil and climate. Though one of the lowest in sugar and somewhat

high in acid, the flavor is such that the fruit is relished. It is one of the heaviest yielding varieties; blue in color with a heavy bloom; quite large bunch and medium-sized berry with good shipping qualities. For grape juice, the sugar and acid content is such that it gives the beverage a most pleasing and sprightly flavor with invigorating qualities. The Concord is the standard in grapes to which other varieties are compared. It is largely self-fertile, but to insure strong pollination it is better planted near some other varieties.

*Worden* is a seedling of Concord, but not nearly so popular as its parent. Being from seven to ten days earlier than the Concord, it is largely planted in the earlier sections for shipment to the Western markets early in the season. The berry and bunch are both larger than the Concord. The color is blue with a heavy bloom. Ordinarily, it is not as heavy a bearer as the Concord, but some claim it is worth more money because of its earliness. It is not adapted to so wide a range of soil and the berries have the bad habit of splitting in unfavorable weather conditions, such as continued rainfall. The quality is equal to or better than the Concord. It is largely self-fertile, but is better cross-fertilized.

*Champion* is losing, if it has not already completely lost, its popularity. Its only good quality is its earliness. Because it colors, and consequently looks very attractive before it ripens, it has been put on the market very early. Really being green, it has lost its popularity because of its extremely poor quality. When fully ripe, it is almost black in color, is very soft and shells badly. The variety has only its earliness to commend it.

*Niagara* is the most popular white grape, but like the *Champion*, has suffered from being cut before it is ripe. It has also suffered because of being advertised too highly when first introduced. This variety, however, still holds a good place, and if it was permitted to fully ripen before being marketed, it would undoubtedly regain some of its lost popularity as a dessert grape. It is a heavy cropper but not entirely disease resistant.

*Campbell Early* is the most popular of our early grapes. It has suffered somewhat from being marketed when it has obtained color without being fully mature. When fully ripened, it is of excellent quality. It is blue in color with medium heavy bloom. It bears as heavily as the Concord, ripens about ten days to two weeks earlier and is larger in both bunch and berry. It is firm and ships well. It is largely self-fertile, but to insure a crop should be planted with other varieties.

*Moore Early* was at one time a very popular variety, but has given way somewhat to the more heavily producing *Campbell*. The berry is large, but the bunch is sometimes loose. The berry also sometimes cracks and shells badly. It is adapted to loose, open, well-drained soils and, being a few days earlier than *Campbell*, is, under ideal conditions, a good variety. The large blue berry with good bloom is very attractive. It stands shipment fairly well. Plant it with other varieties to insure cross-pollination.

*Delaware* is a grape of highest quality. The bunch and berry are small but attractive. The fruit is red, the vines are small and not very spreading, and for this reason must be planted close together. They are somewhat subject to attacks of mildew. The quantity of fruit produced per vine is not as high as the large blue varieties, but by planting closely, heavy yields per acre may be obtained. The price per basket usually runs from three to five cents higher for *Delawares* than for ordinary blue and white varieties.

*Lindley (Rogers 9)* is the most widely planted of the Rogers' varieties in Ontario. It is an example of quality; is red in color and brings from three to seven cents per basket more than the ordinary blues. The vine is fairly hardy, a strong grower, and is not as susceptible to mildew as most *labrusca-vinifera* hybrids. Ordinarily, it is a poor producer, because of its marked self-sterility, but when planted with or near other varieties is a good cropper. It is well worthy of more extensive planting.

*Agawam (Rogers 15)* is as popular as the Lindley, and by some considered a great deal more favorably. It is widely distributed and seems adapted to clay and clay loam soils. The fact that it is somewhat more self-fertile than most of the Rogers' makes it, under ordinary conditions, a better bearer, but not always. It is of high but not the highest quality. The vine is subject to mildew. The fruit is red in color and brings a high price because of its color and quality.

*Salem (Rogers 22)* is a good grape in most respects as either Lindley or Agawam, and is possibly of better quality than either. It is red in color ships well and is as good a bearer as any of the Rogers when near other varieties. Alone, it is self-sterile. It is also very subject to mildew. At the Vineland Experiment Station the few vines have borne exceptionally well and the variety is recommended for further planting.

*Wilder (Rogers 4)* is black in color with a heavy bloom and very attractive. The bunch and berry are both large, the vine is thrifty and strong growing, and though subject to mildew is not exceptionally so. It is self-sterile and consequently must be planted with other varieties. Its self-sterility is its greatest fault. This is one of the varieties that might be tested further.

*Brighton* is grown more or less generally wherever grapes are grown in Ontario. It is attractive, red in color, large bunch and of good quality. It ripens earlier than the Concord and though somewhat subject to mildew, is a little more resistant than the average of the Rogers varieties. Being self-sterile, it must of necessity be planted near pollen-bearing varieties. It is recommended for planting on a small scale in commercial vineyards. For the amateur, there is no more attractive variety.

*Vergennes* is one of the best Ontario grapes. The fruit is red and attractive when well ripened. It is an excellent shipper, and though not of the highest quality, compares very favorably with the best commercial varieties. Ordinarily, it bears very heavy crops, but sometimes does not ripen well. Because of late ripening and somewhat straggling habit of vine growth, it is not favored by some growers. However, the fact that the fruit ships and keeps well (it will keep till January) makes it quite popular. It is largely self-fertile.

Other varieties that are quite commonly grown and are more or less popular are Winchell, Pocklington, Massasoit, Diamond, Catawba, Barry, etc. For descriptions of these varieties and others more or less commonly grown, see "Fruits of Ontario," published by the Ontario Department of Agriculture. This publication also gives an estimate of the commercial importance of these varieties.

The following varieties are recommended for general planting, both garden and commercial:

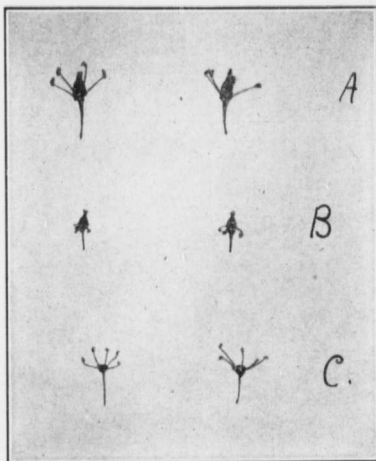
*Black or Blue:* Concord, Campbell, Worden, Moore, Wilder.

*Red:* Lindley, Agawam, Delaware, Vergennes, Salem, Brighton.

*White:* Diamond, Niagara, Winchell.

## POLLINATION.

We are constantly faced with the problems of self-sterility. Some of the best varieties, those of the highest quality, as mentioned under "Varieties," in past seasons, have often failed to set heavy crops of fruit and many seasons have failed to set any fruit in quantity. Some other varieties "set" very regularly and bear good crops annually. The main reason for this apparent difference in the ability of varieties to bear crops is largely one of pollination. To understand the question at all fully, it is necessary to study the grape flower. These are of two types, perfect or hermaphrodite, and pistillate. In wild species there are vines that are staminate only. These latter produce pollen in abundance but cannot possibly set fruit. Varieties that have perfect flowers can set fruit from self-pollination,



- A Perfect flowers.  
 B Pistillate flowers—stamens are degenerate in this case.  
 C Staminate flowers. The pistil is absent in this case.

but those that have only pistillate flowers, flowers that have female parts only, and consequently produce no pollen or only degenerate pollen, cannot possibly fertilize themselves, and must be cross-pollinated if fruit is to be produced. These varieties that are self-fertile are likely to "set" more fully if other pollen is near to cross-fertilize them. The case is not entirely hopeless though when other varieties are absent.

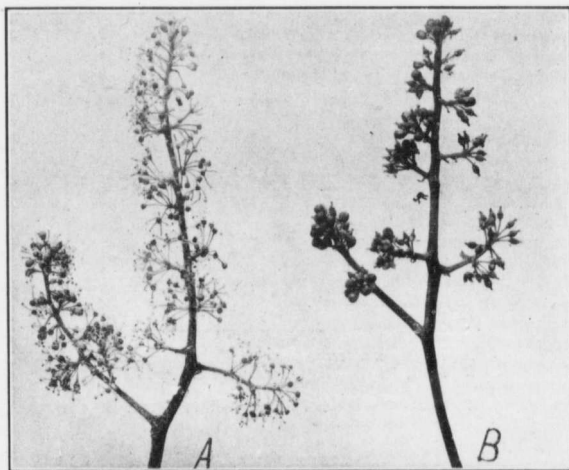
Some other factors also enter into pollination:

(a) Varieties to cross-pollinate must mature their blossoms at the same season or the stigmas must be receptive at the time the pollen is ripe and blowing. Records show that in the Station vineyard the blossoming season lasts about six days; that is, while the Champion blossoms were ready to pollinate on June 29th last year the Wilder and Vergennes were not ready until July 4th and 5th.

(b) The weather must be suitable. Damp, dark, cool weather, not only does not permit of the proper maturing and scattering of the pollen, but keeps bees and other insects from working. A grape crop may be greatly reduced by storms during the blossoming season. Bright weather is particularly important to the Rogers' varieties, and all others that must be cross-pollinated in order that fruit may be produced.

Pollination tests in the spring of 1915 gave the following results:

Variety	Degree of Self Fertility	Variety	Degree of Self Fertility
Brighton .....	7.1 %	Niagara .....	62 %
Campbell .....	60 %	Pocklington .....	77 %
Concord .....	66 %	Salem .....	00 %
Delaware .....	82 %	Vergennes .....	58 %
Lindley .....	00 %	Wilder .....	00 %
Massasoit .....	00 %	Winchell .....	90 %
Moore Early .....	57 %	Worden .....	75 %
Moyer .....	00 %		



A, male; B, female. Clusters taken from *V. riparia*.

These figures, however, represent only one year's results and cannot be accepted as final. They are, though, fairly indicative of the degree of self-fertility. From data collected by Prof. S. A. Beach, formerly of the New York Experiment Station, at Geneva, our common varieties may be divided into the following classes:

Self-fertile: Campbell, Delaware, Moore, Niagara, Winchell.

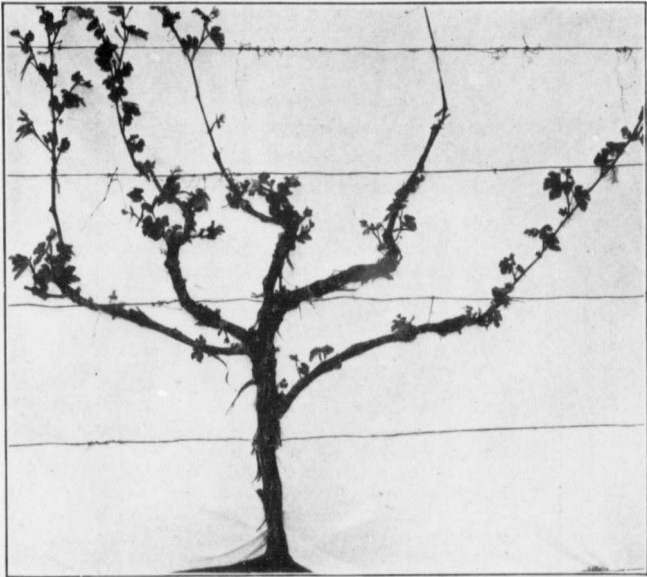
Largely self-fertile: Agawam, Concord, Vergennes, Worden.

Self-sterile or nearly so: Brighton, Herbert, Massasoit, Salem, Wilder, Lindley.

The figures of percentages of fruit set on self-fertile and partly self-fertile varieties for this Station, are probably lower on an average than might be expected

because of unfavorable weather conditions at the time of pollination. They are, nevertheless, fairly accurate, and can be relied on when making a selection of varieties.

One other point worthy of emphasis is the fact that though many varieties are self-fertile and will set good crops of fruit without the introduction of foreign pollen, it is an admitted fact that cross pollination, as a rule, is stronger than self-pollination, and for this reason, two varieties or more are better planted together than single varieties in isolated blocks.



The third leaf is showing. This is the time for the first spray.

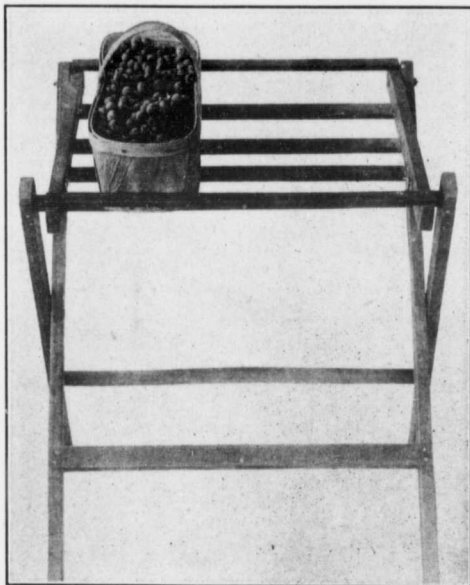
### SPRAYING.

Grape growers have not usually considered regular sprayings absolutely necessary. Experience has taught that fruit trees left unsprayed may be weakened to the attacks of insects or the fruit be made unsalable from the attacks of insects and disease, but the lessons have not yet been sufficiently emphasized when applied to the grape. Some growers spray once; some twice; some three times and more; but the great majority do not spray at all. The widespread attacks of mildew and rot favored by damp weather conditions last year (1915), strongly emphasized this point. The loss in some vineyards was as much as fifty per cent.; in others, even more, and the general quality of the grapes, with some exceptions, was not up to the usual standard. Grapes yield a steady income and it cannot be so strongly emphasized that the sooner spraying methods become general, the sooner the general quality of the fruit will be advanced. The following sprayings are recommended:



- 1st. Use Bordeaux mixture, 4:4:40 when the third leaf begins to show.
- 2nd. Use Bordeaux mixture just before the blossoms open.
- 3rd. Use Bordeaux mixture just after the fruit is set.

Other sprayings must be judged largely by weather conditions or any sign of outbreak of disease. Rainy weather or damp conditions are conducive to the growth of all fungi. Dry conditions or bright weather are adverse to the growth of fungi. The spray material, if possible, should be applied before, not after, a shower. If



Folding table used when packing in the vineyard.

sufficient time elapses for the spray to dry there is no danger of it being washed off by the shower.

- (1) Note carefully the times mentioned for spraying.
- (2) Note carefully the mixture recommended.
- (3) The work must be done thoroughly.

Specially constructed traction or power spraying machines are speedy and fairly satisfactory, but any hand or power pump suitable for spraying fruit trees can be used. For special sprays and treatments see paragraphs under "Insects and Diseases."

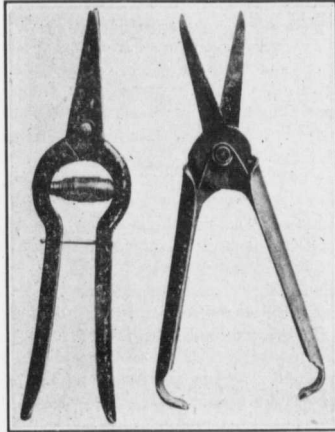
The quantity of spray required to cover a mature vine just breaking into leaf is from one-quarter to one-half gallon. For the second spray, when the leaves are much farther advanced, three-quarters to one gallon per vine is necessary to cover thoroughly. This latter amount will be also required for subsequent sprayings. The time required to do the work depends entirely on the kind of pump and number

of nozzles used. The quantity of spray applied and the thoroughness and completeness of the work are the determining factors in disease and insect control.

#### HARVESTING.

The cutting is done largely by women and girls who cut by the basket. Usually the baskets are filled, drawn to the packing house and the tops levelled and covered. A few growers are repacking in packing house, discarding such bunches as would depreciate the value of the pack. A method that has been adopted with success in some of the large vineyards of New York State is to pack in the vineyard directly from a small folding table especially made for the purpose.

This style of packing table, which is commonly used throughout the Chautauqua district, was invented by an old grape grower of Portland, N.Y. The table



Cutting shears that might be used instead of a knife.

is carried along the row and the grapes are cut and packed directly into baskets. Of course, baskets have previously been distributed through the vineyard, so that it is only necessary for the packer to carry the table along the row. The use of this table makes packing in the vineyard possible, and hence does away with the necessity of handling the grapes twice. Since these tables are easily folded up, they can be stored in quite a small space at the close of the season.

The workers usually use knives with small sharp blades for cutting, but cutting shears are more satisfactory. When once the cutter has become accustomed to them they are quicker than the knife. Also less damage is done the bunch because it is not necessary to grasp it so tightly.

#### MARKETS

The demand for grapes is from a number of sources: for fermented wine, for grape juice, for jelly and for dessert. In past years, the fermented wine industry has taken a fair share of the grapes produced. According to the 1911 census, in

that year Canada produced approximately 860,000 gallons. In late years, production has fallen off somewhat.

Grape juice manufacture is not new in Canada, but it is new on a large scale. Concord is used almost entirely, and these must be well ripened and of uniform quality. A good price, usually higher than current market price, is paid, but the quality must be first-class or the fruit is rejected.

Grapes for jelly purposes are sold quite early in the season and before the fruit has reached full maturity. A large quantity of the fruit sold for dessert purposes early in the season can be used only for jelly purposes, because it is not sufficiently ripened to be eaten out of the hand.

The package used is almost entirely the six-quart Climax basket which holds approximately seven and a half pounds net of fruit.

### THE PLACE OF THE GRAPE ON THE FARM.

The grape is grown most largely in districts of the Province where land is high-priced. The cherry and peach have received most attention because, generally speaking, these two fruits promise greater returns, and under favorable cultural and market conditions give high returns per acre. The grape, except by a few, has been given a lesser place but in spite of this has gradually shoved its way to the front.

A complete failure of the grape crop is almost unknown. Phenomenal yields, coupled with high prices are equally few but average yields, average prices and steady incomes are common. That is the place the grape holds.

Of all our vine and tree fruits it is subject to the least extremes of variation and yields the least varying income.

The lands on which it thrives best are those clay and clay loams that for the peach and cherry are not considered ideal. Planted on these with due consideration to drainage and atmospheric conditions, it matures its fruit at a season when the rush of the earlier fruits is over. When once established and given fairly intelligent care, it is only slightly subject to disease and the loss among the vines is reduced to a minimum. It fills almost to an ideal a place on the farm with various types of soils. The peach has its preference, the cherry its preference, and the other tree fruits their preferences. The grape has its preference also, but if the soil is dry it can be expected to yield profitably on a soil that for other fruits might be considered unfavorable.

### THE EXPERIMENTAL VINEYARD.

The Experimental vineyard at the Vineland Experiment Station, contains spaces for 1,036 vines planted nine by eleven feet apart. This area, with the exception of forty-one spaces, has been filled during the past eight years. There are now under test one hundred and thirty-eight varieties, including twenty-four vinifera varieties on their own roots. One hundred and fifty vines are being used to compare the five different methods of training most commonly practiced in this district: Kniffin, on second and third wire; Kniffin on first and second wire; Improved Kniffin, Arm and Fan systems. Also five hundred and four vines representing eighteen commercial varieties are being used for the study of the correlation between the number of buds left when pruning and the vigor, productiveness and longevity of the vine. The vines are, in part, also used for self-fertility and self-sterility tests and for all breeding and improvement work undertaken at the Experiment Station.

The following is the list of varieties under test:

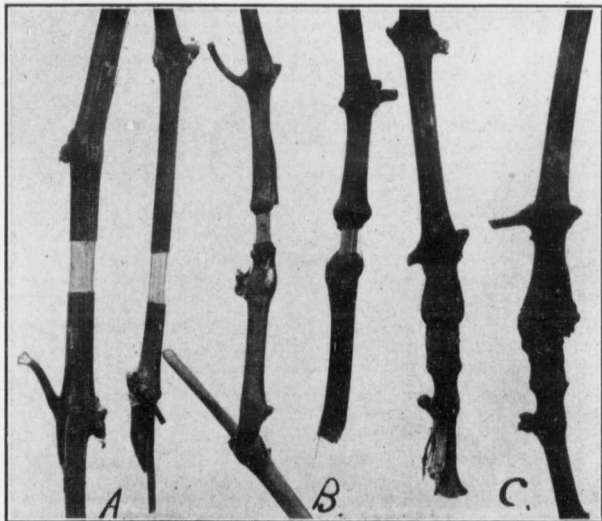
Augustina.	Early Victor.	Muscata.
Adobe Giant.	Empire State.	Morocco.
Australis.	Early Ohio.	Martha.
Agawam (R. 15).	Eaton.	R. W. Munson.
Aminia.	Ellen Scott.	Muench.
Amber Queen.	Ester.	Moyer.
America.	Etta.	Muscata Blanc.
Armalaga.	Eumelan.	Manito.
August Giant.	Early Daisy.	Mericaedel.
Black Morocco.	Elvira.	M. Riesling.
Brighton.	Eclipse.	McPike.
Barry.	Fehér Zagos.	Moore Early.
Banner.	Flame Tokay.	Massasoit (R. 3).
Bell.	Fern Munson.	Merrimac.
Ben Hur.	Golden Chasselas.	Mary.
Berckmans.	Golden Queen.	Niagara.
Bailey.	Green's Early.	Nitodal.
Bacchus.	Green Mountain.	Phillippi.
Concord.	Geneva.	Patricia.
Cottage.	Gaertner.	Prentiss.
Campbell Early.	Golden Drop.	Perkins.
Chasselas de Fontainebleau.	Herbemont.	President.
Cornichon.	Herbert.	Pierce.
Catawba.	Hartford.	Pense Malaga.
Chasselas Vibert.	Francis B. Hayes.	Pocklington.
Cynthiana.	Hicks.	Rose of Peru.
Chasselas avec Royal.	Headlight.	Requa.
Champion.	Hernito.	Rockwood.
Carman.	Hermann Jaeger.	Rommel.
Clinton.	Italian—Walker's.	Rogers' 24.
Cloeta.	Iona.	Rogers' 36.
Charlton.	Ives.	Rogers' 26.
Colerain.	Isabella.	Read's Hybrid.
Captivator.	Janesville.	Sabal Kanski.
Carman.	Jessica.	Sauvignon Juane.
Caco.	King.	Salem (R. 22).
Creveling.	King Phillip.	Thompson Seedless.
Dattier de Beyrouth.	Lindley.	Telegraph.
Dog Ridge.	Lady Finger.	Ulster Prolific.
Diana.	Lucile.	Vergennes.
Duchess.	Lutie.	Worden.
Dracut Amber.	Lady Washington.	White Cornichon.
Delaware.	Last Rose.	Wyoming.
Diamond.	Lukfata.	Woodruff Red.
Emperor.	Malaga.	Wilkins.
	Mission.	Wilder.

#### RINGING GRAPES.

Ringling is a practice followed by some growers to hasten the ripening of the fruit. It consists of removing a ring of bark one-half to three-quarters of an inch wide, sometimes narrower, from the cane below the bunches of grapes that it is expected will be affected by the operation. The sap is still able to flow upward through the undisturbed wood but is unable to return to the roots and main parts of the plant because of the disturbed union in the bark. Theoretically, the food supplies of plants taken in by the roots are carried to the leaves to be elaborated or made available to the plant. The removal of the bark prevents the return of the elaborated or digested food and consequently the bunches of grapes have an opportunity to make use of it. Experiments show that grapes treated in this way ripen from two days to two weeks earlier than normally. The bunches, generally speaking, are larger and more compact. In this way, exhibition grapes are secured, and in a few cases small growers are practicing it to induce earliness in order to receive

the higher prices. The quality and flavor of the fruit is, however, much deteriorated, so much so, that the practice cannot be recommended even on a small scale. The cane, beyond the ringing, dies as is common with all girdled limbs or branches. The roots of the ringed plants must suffer also as the food elaborated in the particular leaves on the ringed canes is not permitted to return to build up the plant. All canes ringed on a vine in one season would likely cause the vine to die in a year or two, but it cannot be said that one or two ringed canes each year produces a marked loss of vigor in the plant.

The ringing may be done any time following the setting of the fruit or when the berries are about the size of grains of wheat, small peas or smaller. If done too early, the canes are apt to be broken by the wind.



A. Ringing completed.  
 B. A "ring" that has partly grown over by fall.  
 C. A "ring" that has completely grown over by fall.

In view of the fact that ringing so deteriorates the quality of the fruit, it is doubtful if the practice should be permitted at all. Even for exhibitions the advisability of the practice is doubtful.

The appearance of the grape and bunch is enhanced at the expense of the eating qualities.

#### GRAPES IN THE NORTH.

Grapes are of extreme interest to those who attempt to grow them either commercially or in the home garden. They bear early, respond readily to training and care, and in a few years will spread over a tree, the side of a building or an old fence if allowed to ramble. But most varieties are tender and in order to grow them successfully in the colder sections, they must receive special treatment. The main injury comes from winter freezing of the vines and buds or spring freezing

of the young shoots after the buds have burst, due to late spring frosts. Under such conditions, it is necessary to cover the vines in winter. To facilitate this, it is necessary to keep the main trunk low or close to the ground. This may be done by cutting back to two or three buds or two short spurs bearing two buds each every time the vines are pruned for the first, second and third years. The vine will not be injured by severe cutting. When once the base or trunk is formed, the pruning is a simple matter. The Fan system or the Arm system of pruning must be followed as described and illustrated previously.

As soon as the grapes are harvested in the fall and the leaves have fallen, the pruning can be done. Cut away everything except the few canes that are to produce the fruit wood the following year. These canes should contain about forty buds in all. As soon as there is danger of the ground freezing lay the canes down flat and cover with earth. This is why it is necessary to keep the trunk short, not more than eight or ten inches high, and to use the Fan or Arm systems of pruning. It would be impracticable to attempt to cover a vine pruned after the Kniffin system.

Canes more than one year old do not bend readily without breaking. Leave the vines covered in the spring until the danger of severe frosts is over but before the buds have begun to swell. If left too long there is great danger of damaging the swelling buds. When the earth has been removed, tie up the vine as indicated previously.

For the colder districts where the vine must be covered but where ripening is certain, Prof. Macoun\* recommends the following varieties:—

*Black:* Early Daisy, Manito, Moore Early, Merrimac.

*Red:* Moyer, Delaware, Brighton, Lindley.

*White:* Winchell, (Green Mountain), Moore Diamond.

For coldest district where ripening is not certain, Prof. Macoun recommends the following:

*Black:* Beta, Early Daisy, Manito, Moore Early, Jewel, Brant, Canada.

*Red:* Moyer.

*White:* Winchell (Green Mountain).

## HOME MANUFACTURE OF GRAPE WINE.

### IMPORTANCE OF RIPENESS, VARIETIES USED.

Every housewife has an opportunity to make a small amount of pure grape wine. Because of the large amount of sugar found in ripe grapes their juice is one of the best natural materials from which to make this beverage. Ontario grapes, however, are not as rich in sugar as grapes grown in Britain, Spain and California. Hence it is especially important in producing grapes for wine either to choose hardy varieties that will keep their foliage and reach full maturity or to spray weaker varieties that they may remain healthy for an equal length of time. The Concord is the leading wine grape. The Niagara may be used to produce light colored wines. Rogers' varieties are too tender and too unproductive for commercial wine making. For home use they are of high quality.

### MAIN PRINCIPLES IN WINE MAKING.

It is well known that grape juice or must ferments. When placed in a warm room bubbles rise to the surface. This fermentation is the work of yeasts. Yeasts are simply small plants, so small that they cannot be seen with the naked eye.

\*Central Experimental Farm (Circular No. 11).

The chief article used by yeasts in their growth is sugar. This they change into alcohol, giving off bubbles of gas, called carbon dioxide. Fermentation may be done properly by *only one kind of yeast*. There are many other kinds of these small plants present on the surface of grape skins but most of these others produce bad flavors in wine. Mouldy grapes and grapes which have split or have been crushed by rough handling and allowed to stand around are rich in microscopic "plants" which will injure the wine.

The proper yeast is most abundant in juice produced from sound, ripe, and quickly and carefully handled grapes.

#### METHOD OF HOME MANUFACTURE.

For very small amounts, 1-5 gallons, the sound, ripe grapes should be stemmed and then pressed into a pulp in a granite dish pan. Run off as much juice as possible and squeeze the remaining pulp through cheesecloth. Strain the whole through flannel. This part of the process may be done in a larger way if a cider press and pulper can be obtained.

Having obtained the clear must add granulated sugar three pounds for every gallon. Ontario grapes at their ripest do not contain quite enough sugar to insure a good wine.

Procure clean kegs or barrels of the proper size. A keg which has had good wine in it is best. Never use any vessel which has had sour material in it. Scald the keg and fill three-quarters full with the sweetened must. Do not plug tightly. Place in a room with a temperature of 65F. to 70F. A vigorous fermentation should start immediately and be completed in a week or ten days. This part of the fermentation completed rack the wine off the lees. This may readily be done by having a faucet in place one or two inches from the bottom of the keg and by running off the clear liquid at the proper time. The keg containing the clear wine should be kept at a moderate, even temperature. A slow fermentation will continue for five to six months. Rolling and shaking the cask from time to time assists fermentation by mixing air with the wine. If after six months fermentation is complete and yet the wine not as clear as is desired it would be advisable before racking a second time to mix in white of egg, one egg to fifteen gallons. Beat up the egg before mixing with the wine.

From now on the oftener the wine is racked off the lees or sediment, the clearer and finer will the wine become.

#### HOME MANUFACTURE OF GRAPE JUICE.

No beverage is more pleasing or healthful than unfermented grape juice. It has an attractive appearance and pleasing aroma. It is not only a beverage but a food also. It contains less sugar, has more carbohydrates largely in the form of sugar, but less protein and fat than milk. It is a drink that can be used in any place at any time. It is stimulating and refreshing. The flavor may vary according to the variety of grape from which the beverage is manufactured. Those unfermented juices that are considered best have a lively, fruity flavor and aroma, and are high in natural acid and not too rich in sugar. The American varieties are particularly favored in these respects, especially the Concord, which is used to the greatest extent commercially. Only clean, sound, well ripened, but not over-ripe grapes, should be used. These may be crushed either by hand or in an ordinary cider mill. Either a light-colored or dark-colored juice may be made.

If a light juice is desired, allow the juice to drain off, or if it does not drain off readily lend the necessary assistance by squeezing. A convenient strainer may

be made from any clean cotton or soft sackcloth. Heat the strained juice in a double boiler to between 180° F. and 195° F. If possible, use a thermometer and under no conditions allow the temperature to go up to more than 200° F. A double boiler is advised to prevent direct contact with the fire. Remove from the fire, pour into glass or crockery vessels and allow to stand for twenty-four hours. Arrange a filter of heavy woolen or quite thick cloth and again filter. Pour the juice into clean bottles and prepare to sterilize before sealing. Any person familiar with home canning processes can now finish the task.

A good sterilizer is a wash boiler arranged with a board or slats in the bottom. Partly fill this with water about half way up the necks of the bottles. Slowly bring almost to a boil and then remove and cork at once. Use clean new corks that have been soaked in warm water for a few minutes. When red juice is required, heat the juice, pulp and all before extracting. Allow the pulp to drain but use little or no pressure. Put away the juice to settle and cool. Extra precautions may be taken to prevent fermentation by sealing the corks with wax. Like fruit when exposed to the air, moulds and germs get in and cause fermentation. If kept sealed, the product will keep indefinitely.



A label that is a guarantee of quality. Notice the words, "Not less than 5½ lbs. net."

#### A COMPARISON OF THE CHAUTAUQUA AND NIAGARA DISTRICTS FROM A VITICULTURAL STANDPOINT.

The Chautauqua and Niagara districts, when compared from a viticultural point of view present a very similar impression to that which is made by a comparison of the wheat industry of the Western Provinces to that of Ontario. In the West the production of wheat is the central, the main occupation of most farmers, while in Ontario we seldom find a farmer who devotes most of his land, time, and energy to wheat growing. Wheat here is no longer the special crop it is in the West, but takes its place as one of the general farm crops. Grape growing in the Niagara district, like wheat raising throughout Ontario, is not the central or main occupation of the fruit-growers as it is in the Chautauqua Belt; but, the grape as it is produced to-day is simply one of the important products of the fruit farms of the Niagara district.

Variations in topography and soil throughout the Niagara district are to some extent responsible for the fact that grapes are here produced in relatively small blocks when compared to the large acreages of the Chautauqua belt. This belt is



a narrow strip of land some two to three miles wide bordering the south-eastern shore of Lake Erie, and reaching from about fifteen miles south of Buffalo through to Erie, Pa. The southern boundary of this strip of land is a high escarpment which runs parallel to the lake. This escarpment ranges from 500 to 700 feet above the plain and from 500 to 1,000 feet above the lake. The plain is gently rolling and descends rapidly from the bluff of the lake to the escarpment with a grade of from 100 to 200 feet to the mile, forming in most places well-marked foot-hills to the escarpment which forms its southern boundary.

Like the Chautauqua belt, the Niagara district comprises a narrow strip of land which is bordered on the north by Lake Ontario and on the south by a high escarpment. The plain is gently rolling, but does not ascend as rapidly from the bluff of the lake to the escarpment as does the Chautauqua plain. With the exception of a single range of hills just at the base of the escarpment the plain is unbroken by hills or gravel ridges.

The soils of the Niagara district vary much more than do the soils in the Chautauqua belt, and this proves to be one of the chief factors which have made grape growing on these Ontario farms simply one of the occupations. Very little of the land in the Chautauqua belt is unsuitable for grape culture. There are no large sections there as in the Niagara district which are specially suited for the production of some other fruits of great market value as: peaches, raspberries, and strawberries; and where it would not be practical to set out vines.

The climates of these districts are very much the same, but the air circulation in the Chautauqua belt is more marked than in the Niagara district. This is undoubtedly due to the fact that the Niagara plain does not rise from the bluff of the lake to the escarpment on as steep a grade as does the Chautauqua plain.

Vineyards of the two districts present strikingly different appearances, not only in size, but also in their plan, and the method of posting. Because of the expansion of the grape industry in recent years, these growers have utilized nearly all the available farm land for grape production. Instead of having the rows of vines ten by ten feet or even twelve by twelve feet apart in the vineyard, as they often are in the Niagara district, the vines are usually set out eight by eight and a half feet part. This distance of eight and a half feet between the rows has proved to be the most convenient distance for plowing with the three gang plow commonly used, and is plenty wide enough for other vineyard operations.

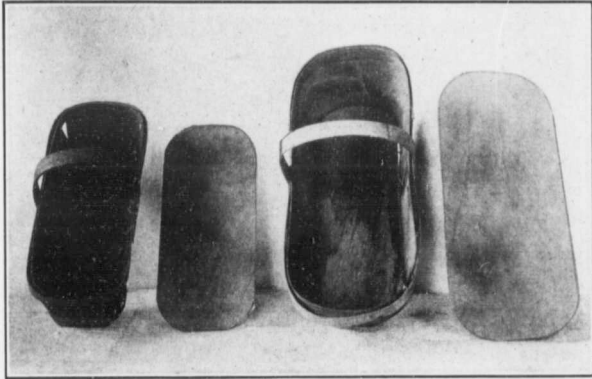
One of the points which a Niagara district grape grower is very particular about when setting a vineyard is the posting. For various reasons the Chautauqua grape grower appears to be quite slack about this point. As a general rule the posts are set shallow, and the end posts poorly braced from a short stake driven in the ground about six feet away in the row. Perhaps this apparent carelessness is due to the shallowness of the soil; or, it may be due to the fact that such large numbers of posts have to be set and looked after each year that the men grow careless about them. Again, the posts used in this district are of chestnut or locust and do not give as long service as do the cedar posts generally used in the Niagara district.

Along with these large vineyards we find that the vineyard operations are carried out on a much larger scale than they are in the Niagara district. Pruning is usually begun as soon as the leaves have fallen in the fall and continued until growth starts in the spring. Many growers often prune after the vines have commenced to bleed. There are a few gangs of experienced pruners who work in the district, but many of the growers prune their own vines. Although there are various systems of pruning followed in both districts the Niagara growers favor

some form of the drooping type, as the Kniffin system, while the Chautauqua growers favor the upright types, such as the high renewal system. This difference is due to the fact that the soils of the Chautauqua belt are more shallow, and possibly less fertile than those of the Niagara district, thus necessitating that the vines be trained in that position in which they will make the most growth. On the other hand, the Niagara growers tend to check the growth of their vines by using some form of the drooping type. In both districts it is the general practice to keep the vineyards thoroughly cultivated during the growing season; and for this purpose the disc and spring toothed cultivators are the most popular implements.

Because of the gravelly or shaley character of a large part of the soils in the Chautauqua belt it has become necessary to make use of cover crops, commercial fertilizers, and manures to maintain the fertility. But still the use of the cover crops and commercial fertilizers cannot be said to have become general practice.

Since the Chautauqua district is remarkably free from pests, spraying has not been generally practiced; and, only the best growers spray regularly. Spraying outfits especially made for use in vineyards are used by the large growers.



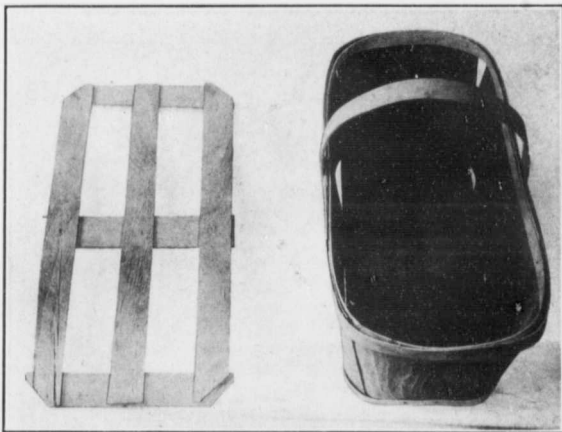
The two grape baskets in common use.

It is in the harvesting operations that the greatest differences are to be noticed between American and Canadian methods. Because of the narrow space between the rows, which will not permit the passage of an ordinary waggon, a specially constructed grape truck is used. This truck, which has the same general appearance as a small-sized lorry is about five feet eight inches wide over all, and so constructed with double reaches that it can be turned around in quite a small area, approximately sixteen feet in diameter. When this truck is turned the hind wheels do not travel in a smaller circle than do the fore wheels, as in the case of an ordinary waggon, but follow in the tracks made by the fore wheels.

The grapes from the time they are cut until they are packed and ready for shipment are treated in many different ways. Some growers pack their grapes in the vineyard, so that the person cutting must also be able to pack efficiently. This practice is followed when harvesting small blocks of early grapes, or when taking the first ripe fruit from the larger plantations for the early market. When the fruit is sold to the grape juice factories or wineries these companies usually

furnish flats in which to pack the grapes in the vineyards. Many of the larger growers who have an extensive basket trade also follow this practice of using flats to carry the fruit from the vineyard to their packing houses. These flats vary in size, but the average is thirty inches long, eighteen inches wide and six inches deep. The bunches are placed in these flats by those cutting, and the full flats left on the shady side of the row until they are collected.

Most of the larger growers have specially constructed packing houses where experienced packers, mostly women, grade and pack the grapes in baskets. A typical packing-house or shed is arranged with a sloping table on three sides at a height convenient for the packers who sit on benches while working. One or two men are required to remove the empty flats and supply full ones. There are three sizes of baskets in general use: the "pup" basket, the six-pound basket, and a still larger one holding approximately twenty pounds. The first two are fitted with solid covers while the largest basket has a slatted cover.



This basket is still used to some extent, but not in Ontario. It holds about 20 lbs net.

Until recently most of the grapes shipped from this belt were handled by the Chautauqua and Erie Company, which is a growers' union. Within the last three years two or three other companies have been formed.

An increasing percentage of the grape crop of this district is being used by the grape juice factories and wineries. By requiring that all grapes sold to them be thoroughly ripened, and well colored, these companies have had a great influence on the time of harvesting throughout the belt.

In the Chautauqua district as in the Niagara Peninsula the Concord is pre-eminently the leading market variety. About ninety per cent. of the grapes grown are Concord. The remaining ten per cent. is divided among the following varieties: Niagara, Worden, Moore Early, Catawba, and Delaware.

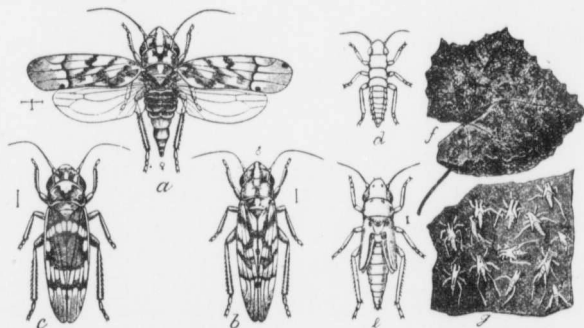
A very large share of all the available land which is suitable for the production of grapes in the Chautauqua belt has already been planted, so that any further development of the industry here must take place at the extremities of the region.

But, since the escarpment becomes quite low at these points the climatic and atmospheric conditions are not as suitable for grape culture, and make grape growing in these localities not a very paying proposition. In the Niagara district on the other hand, although there have been extensive plantings of vines; there still remains for future planting fully as large an acreage of just as good, and as well suited land.

## INSECTS ATTACKING GRAPES.

PROF. L. CAESAR, ONTARIO AGRICULTURAL COLLEGE, GUELPH.

The chief insects that attack the grape in Ontario are the Grape leaf-hopper, the Grape-vine Flea-beetle, and the Rose Chafer or Rose Bug as it is often called. No one of these is ever destructive any season in all the vineyards of the province, but all occur more or less locally and often with a considerable interval between severe outbreaks.



Grape leaf-hopper (*Typhlocyba comes*): (a) Adult female; (b) adult male; (c) another form of the species, showing variation in markings; (d) newly-hatched nymph; (e) last stage nymph; (f) appearance of injured leaf; (g) cast pupa skins. (a.e) Much enlarged; (g) less enlarged; (f) reduced. (From Marlatt.)

### THE GRAPE LEAF-HOPPER.

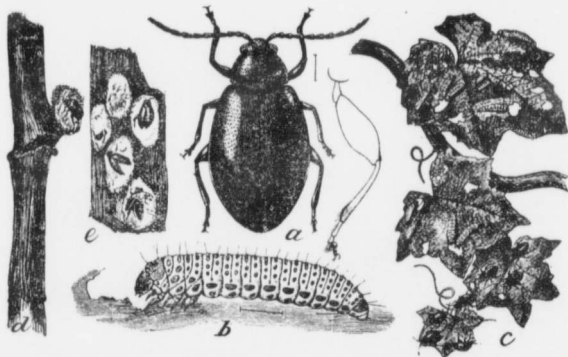
(*Typhlocyba comes*.)

The Grape Leaf-hopper is the most common insect attacking grapes in Ontario. It is usually worst in the neighborhood of woods and waste places where long grass, weeds, and rubbish afford good winter quarters for the adults. It is not however, limited to such places, as vineyards with comparatively clean surroundings are sometimes badly infested.

The adult insect is very small, not more than one-eighth of an inch in length, slender and tapering to one end. The color is pale yellow or whitish with darker markings which are usually reddish. These markings are most conspicuous in spring and fall. Individuals, however, differ so much in the color of the markings that they might easily be mistaken for different species. The adults are very shy and if at all disturbed will leap or fly to another vine. The young leaf-hoppers or nymphs are at first nearly white but as they grow older take on a yellowish tinge. They resemble the adults in shape but have no wings and seldom leap, but

instead, if disturbed, run actively away with a sidewise movement. *It is in this nymphal stage when the body is not protected by wings and when they cannot fly that this pest can be best controlled.*

The life-history is briefly as follows: The winter and late autumn are passed in the adult stage under the protection of long, dead grass, weeds or other shelter in fence corners, along old ravines, in waste places and the margins of woods. In the warm days of spring when vegetation begins they emerge and feed on almost any kind of green plant, being specially fond of raspberry and strawberry plants. As soon as the foliage of the grape has got well started, they migrate to vineyards and feed on this. Eggs are laid in the tissues of the leaf during June and the nymphs from these begin hatching towards the end of June and in July. The oldest of these nymphs in an ordinary season becomes full grown by about the middle of July. There is a partial second brood. The winter is passed only in the adult stage, adults seeking winter quarters as soon as severe cold weather comes in autumn.



Grape-vine flea-beetle (*Haltica chalybea*): (a) Adult or beetle, with more enlarged leg at right; (b) larva, (c) larvae and beetles on foliage; (d) injury to buds; (e) beetles killed by fungus. a, b, Much enlarged; c, d, e, about natural size. (From Marlatt.)

The injury is caused both by the adults and the nymphs. They feed on the under-side of the leaf and with their sharp needle-like mouth parts pierce through the lower epidermis and suck the sap out of the interior. Wherever the insects are numerous, the leaves at first become mottled on the upper surface above where the sucking was done; later they turn brown and sometimes drop off. The result is that the fruit is smaller than it otherwise would be. The quality is poorer also.

#### Means of Control.

1. *Clean Culture.*—In the majority of cases no other steps will be found necessary than to take care to see that old fences are removed and no long grass, weeds, bushes or other hiding places allowed to grow up and form winter quarters for the pest. Sometimes the same object can be secured by burning over in early spring grassy or weedy places near the vineyard to destroy the hibernating adults.

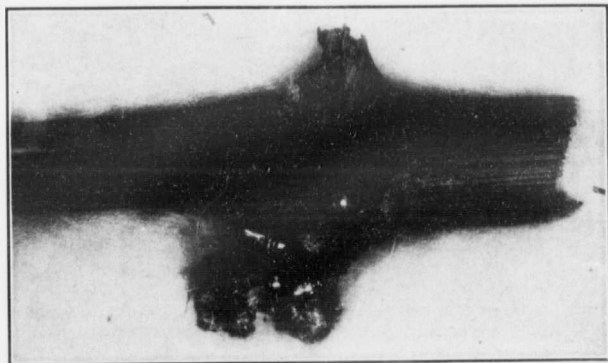
2. *Spraying.*—An examination of the under side of the foliage should be made at the end of June and, if many adults and nymphs are found, the under

surface of the leaves should be thoroughly sprayed with Black-Leaf-40 (40 per cent. nicotine sulphate), 1 part to 1,500 or 1,600 parts of water or of Bordeaux mixture. In most years the best time for this application will be from about the 10th to the 20th of July because at these dates the majority of the nymphs have hatched from the eggs and yet are not old enough to have transformed into adults. The spray does not kill the adults because the wings protect them. Special care must be taken when spraying to use an angle nozzle and fairly high pressure, AND TO COVER THE UNDER SIDE OF EVERY LEAF, IF POSSIBLE. One good spraying is sufficient.

#### THE GRAPE-VINE FLEA-BEETLE.

(*Haltica chalybea*.)

This is a pretty little beetle nearly one-fifth of an inch in length and varying in color from a greenish-blue to a purplish-blue. Though most of our vineyards are exempt, or practically exempt, from its attack, yet it does a considerable amount of damage almost every year in at least a few localities. The vineyards most likely



Grape-vine flea-beetle (*Haltica chalybea*).

to be attacked are those situated near woods, thickets or waste lands. This is because these places afford ideal hiding places for the beetles in winter. Vineyards may be attacked in spring by the over-wintering adults, or in late June and July by the larvæ, or in late July, August and September by the new brood of beetles from these larvæ. Of these three attacks the one by the adults in spring is far the most destructive and in fact the only one in which any appreciable damage is done. On warm sunny days in May the beetles come out from their winter quarters and attack the swelling buds, eating holes into them and destroying them. The destruction of a bud means the loss of all the fruit that might have been borne on the vine from that bud that season. A single beetle may destroy several buds and thus, if the insects are numerous, great loss may be caused in a few days.

The female beetles soon begin to lay eggs under the bud scales, in crevices in the canes and under the bark. The eggs hatch towards the end of June and during July. The grubs from these are brown, with black heads and legs, and many conspicuous black spots on the back of the body. When full grown they are about one-third of an inch long. They feed on the upper surface of the leaf for about three weeks, eating away the green tissues and causing the injured area to

turn brown. There are, however, so many leaves on the vines by this time that the larvæ or grubs are never numerous enough to do much damage. Once they are full grown they drop to the ground, work their way into the soil a couple of inches, and pupate. In about two weeks new adult beetles begin to emerge from these pupæ. These new beetles, like the grubs, feed on the foliage but do very little damage. When cold weather approaches they cease feeding, seek good hiding-places, especially in woods, thickets and waste places, and here hibernate until next spring.

#### *Means of Control.*

1. *Clean Culture.* From the above account of the insect's habits it is evident that it will help much to ward off danger if the owners of vineyards try to get as clean surroundings as possible. Old fences around vineyards should be removed, useless thickets cut down, brush heaps burned and a general cleaning up made so far as this is practicable.

2. *The Use of Frames Saturated with Kerosene.* Considerable benefit has been obtained by using frames made of narrow strips of lumber, the frames being about 6 ft. long by 3 ft. wide and covered over with muslin, which must be kept saturated with kerosene. Boys carry these frames along, hold them low beside the vines and gently tap these to cause the beetles to fall into them. This should be done in spring on sunny days as soon as the beetles begin to attack the buds. Care must be taken not to hit too hard or the beetles from the vines ahead will also drop and escape. The kerosene on the muslin kills the beetles that fall on it.

3. *Spraying for Adults in Spring.* To prevent the destruction of the buds in spring by spraying, it is necessary to watch carefully for the first sign that there are sufficient beetles present to justify an application. Then use four or five lbs. of arsenate of lead to 40 gals. of water, and see that every bud is thoroughly covered. It is claimed that the addition of half a gallon of cheap molasses to the above helps to attract the beetles and insures their being more quickly poisoned. If rain comes soon after spraying it will have to be repeated.

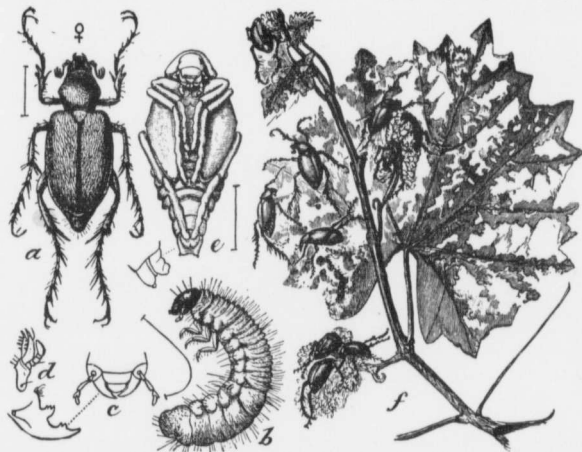
4. *Spraying for Larvæ.* By the time the larvæ have appeared it is of course too late to prevent the buds having been destroyed, but by killing the larvæ one will help greatly to make the number of adults so small that injury the next year will be prevented. For the larvæ use about 3 lbs. of arsenate of lead in 40 gallons of water, or better still of Bordeaux mixture, as this will help to control fungous diseases. Apply carefully to the foliage about the end of June or as soon as larvæ are present. One application should be sufficient.

#### THE ROSE-CHAFER.

##### *(Macrodactylus subspinosus.)*

The Rose-Chafer is a somewhat slender beetle, nearly half an inch long. It is so densely covered with very fine, short, greenish-yellow hairs on the thorax, and yellowish brown hairs on the wing covers that the whole upper surface has a fawn appearance. The legs are long and slender. The beetle is slow and awkward in its movements and can easily be captured when feeding. Fortunately this pest breeds only in light sandy or gravelly soil, especially in localities where there is much waste land of this character. In such places it is often very abundant and destructive. On several occasions whole vineyards have been noted with almost every grape cluster completely destroyed and many of the leaves badly riddled.

The beetles come suddenly from their breeding grounds when the Concord grapes are just coming into blossom. They alight often in large numbers upon the blossoms, feed on these and the forming berries, and to some extent on the leaves, for about two weeks, then migrate to other plants that are in bloom, such as the sumac, raspberry, blackberry and rose. Often they attack the foliage and young fruit of apples, pears, plums and cherries, and do considerable harm. In about a month from the time they first appear their work is over and the most of the adults have died, though a few linger on for a week or two weeks longer. In the meantime the females have laid their eggs in the light sandy or gravelly soil, especially in the waste places near the vineyard. The larvæ on hatching feed on the roots of weeds and grasses, and become about full grown by November. Full-grown larvæ are about four-fifths of an inch long and resemble white grubs but are smaller and more slender. They then burrow down to a depth of about a foot and remain there over winter. The following spring they come up nearer



Rose-chaffer (*Macrodactylus subspinosus*): (a) adult or beetle; (b) larva; (c) (d) mouth parts of same; (e) pupa; (f) injury to leaves and blossoms of grape, with beetles at work. a, b, e, Much enlarged; c, d, more enlarged; f, somewhat reduced. (From Marlatt.)

the surface and about May 24th begin changing into pupæ in little earthen cases from three to six inches below the surface. Adults emerge from these pupæ in from three to four weeks, or, as stated above, about the time Concord grapes are in bloom.

#### Means of Control.

1. *Cultivation.* Ploughing the breeding places about 6 or 7 inches deep soon after May 24th and discing or harrowing them several times before June 21st will destroy great numbers of the pupæ, and is of great importance.

2. *Spraying.* Several entomologists in the United States have tested a sweetened poison compound of five lbs. arsenate of lead to forty gallons of water containing 1 gallon of cheap molasses, and found that this quickly kills the beetles. It should be carefully applied just as the beetles attack the grapes. Mr. George Brown, of Fonthill, tells me he has used this remedy for several years and finds it



good. I examined some cherry trees near Beamsville that had been sprayed with it for this insect and found dead beetles on the soil below each tree, apparently proving that the mixture worked well. In case of rain it will be necessary to repeat the spraying.

#### MINOR GRAPE INSECTS.

There are about a dozen more insects that attack grapes in this province, but only the following three seem worthy of mention:

1. THE GRAPE-BERRY MOTH (*Polychrosis viteana*.) There are two broods of this insect. The first-brood larvæ injure the blossoms and young fruit by webbing them together and feeding upon them. The second-brood larvæ attack much later in the season and do not web the grapes together, but each larvæ attacks a separate berry, bores into it and feeds upon the pulp and seeds. The larvæ are small, 3-8 inch long and somewhat dark in color. The insect can readily be identified by its habits. It never seems to occur in Ontario in sufficient numbers to justify taking any steps to combat it.

2. THE GRAPE ROOT-WORM (*Fidia viticida*.) This is a small grayish-brown beetle about one-quarter inch long. The beetles themselves do some injury by feeding on the foliage in July and eating out chain-like holes, but the larvæ or grubs do far the most harm, because they live in the soil all the latter part of the summer and all fall and feed upon the roots, thus weakening the vines greatly and in many cases killing them. Although this is a very destructive and common pest in much of the Eastern United States it has, so far as I know, only been found a couple of times in Ontario near the Michigan border and has not done any damage worth mentioning.

3. THE GRAPE PLUME MOTH (*Oxyptilus persicelidactylus*.) The larvæ of this little plume moth webs together the leaves at the tips of the young shoots, and feeds on them. It is sometimes abundant in a small part of a vineyard but never does sufficient damage to require treatment. It pupates right in the clustered leaves.

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#### GRAPE DISEASES.

J. E. HOWITT, PROFESSOR OF BOTANY, O.A.C., GUELPH.

Nearly all the common diseases of the grape are found in Ontario vineyards, but fortunately it is very seldom that any disease causes serious loss over any large area of the grape growing districts. However, in the past there have been severe epidemics of Black Rot and frequent local outbreaks of Downy and Powdery Mildew. It is, therefore, important that grape growers should become familiar with the appearance of the common diseases and the best methods of combatting them in order that they may recognize them if they appear in their vineyards and apply the measures necessary for their control. Timely and intelligent application of methods of control will almost entirely prevent loss from grape diseases.

#### BLACK ROT OF THE GRAPE.

(*Guignardia bidwellii* (Ell.) Viala & Ravaz.)

This is generally considered to be the most destructive disease of grapes. In the past it has caused severe losses to the grape growers in some sections of the Niagara District. During recent years it has given very little trouble but has been present to a limited extent every year in some of the vineyards in the neigh-

borhood of St. Catharines and one or two other localities in the Niagara District, and may at any time become epidemic again if climatic conditions become favorable to its development.

*Symptoms.*—Black Rot affects the leaves, berries, tendrils and canes. It does most damage to the berries on which pale or light spots first appear and gradually enlarge until the whole berry is involved, turns brown and finally shrivels up and becomes hard and black with the surface covered with minute black pimples, the fruiting bodies of the black rot fungus. Such berries are called “mummies” and are frequently seen hanging on the vines. Entire bunches or only a few berries in a bunch may be thus affected. On the leaves the disease produces comparatively small, circular, brown spots with distinct dark margins. On the surface of these spots minute black specks, the fruiting bodies of the fungus, may be seen. Similar but more elongated spots are seen on the shoots.

*Life-History.*—Numerous spores are produced in the minute fruiting bodies at the surface of the diseased berries, leaves and shoots. These are discharged in enormous numbers whenever the vines are wet by rain, and thus the disease spread during the summer months. It is interesting to note that the disease cannot spread during dry weather as it requires considerable moisture to cause the discharge of the spores from the fruiting bodies. The disease is carried over the winter by the spores in the affected fruits, shoots and tendrils. The mummied fruits hanging on the vines or lying on the ground beneath are the chief source of fresh infection in the spring.

*Treatment.*—Gather and burn the mummied fruits that may be on the vines. Rake up and burn the trimmings from the vines. Plow as early in the spring as is practicable, taking care to turn under the rotten bunches and leaves as completely as possible. Spray thoroughly with Bordeaux mixture (4-4-40 formula). The time and frequency of spraying will depend upon the weather. Contrary to the usual practice, spraying before rather than after rain is recommended. The general directions for spraying with Bordeaux mixture to prevent Black Rot are as follows: Spray first when the second or third leaf is showing; give a second application just after the fruit is set, and repeat again whenever wet weather threatens during the development and ripening of the fruit. Spraying, in order to be effective, must be very thoroughly done; all the fruit and vines must be covered with the Bordeaux. This can only be accomplished by spraying with a good pressure (not less than 100 lbs.) and having a man follow behind the sprayer with a line of hose in order to cover all the bunches and tips of the shoots that may be missed by the spraying machine if stationary nozzles are used.

#### DOWNY MILDEW OF THE GRAPE.

(*Plasmopara viticola* (B. & C.) Beil & De Tomi.)

This is one of the commonest diseases of grapes in Ontario. It is present to some extent nearly every year and sometimes does serious damage. It seldom becomes troublesome over any great area of vineyards but is frequently found doing considerable damage to vineyards here and there throughout the grape-growing districts of Ontario.

*Symptoms.*—The Downy Mildew attacks the leaves, berries, young shoots and tendrils. It is usually most noticeable on the leaves, on the upper surface of which it appears first as irregular greenish-yellow blotches which later become brown in color. When the disease is severe the blotches increase in size and run into each other so that the whole leaf becomes brown and withered. On the under

surface of these blotches a white downy fungous growth may readily be seen. It is a common thing to see a vine or two in a row of grapes with the leaves completely destroyed by this disease. On diseased shoots whitish patches are seen and, when the disease is bad, the shoots frequently become brown and withered. The berries are often attacked when quite small, become covered with white mildew, and cease to grow. On larger berries a half or more grown the disease causes brown spots which increase in size until the whole fruit becomes brown and rotten. This stage of the disease is spoken of as brown rot.

*Life-History.* On the under surface of the diseased leaves, and on the surface of affected shoots and berries numerous spores are produced. These are scattered by rain and wind and thus the disease spreads during the summer months. Continued damp weather appears to be necessary for the rapid increase of this disease. In the fall in the tissues of infected leaves and shoots another form of spore is produced. These are thick-walled resting spores which serve to carry the fungus over the winter. They are liberated into the soil by the decay of the leaves and shoots and give rise to the disease again the following summer if the climatic conditions are favorable to its development.

*Treatment.*—Same as that described for Black Rot.

#### POWDERY MILDEW OF GRAPE.

(*Uncinula necator* (Schw.) Burr.)

This disease is common in Ontario vineyards and sometimes causes considerable damage, especially to red-skinned varieties of grapes. Varieties derived from the European grape (*Vitis vinifera*) are said to be most susceptible to this mildew.

*Symptoms.*—The Powdery Mildew affects the leaves, young shoots, blossoms and fruits. It is first observed on both surfaces of the leaves as circular, whitish spots which have a finely powdered appearance. If the disease is very severe these spots may enlarge until the whole leaf is involved. Such badly attacked leaves are frequently somewhat stunted and distorted. Mildewed blossoms fail to set fruit. Berries that are attacked may cease to grow and drop, or develop irregularly and fail to ripen.

*Treatment.*—Spray with Bordeaux mixture as recommended for Black Rot and at the first sign of this mildew thoroughly dust the vines with flowers of sulphur and repeat the application as often as may be necessary to keep the disease in check until danger to the fruit is past. Many grape growers claim to control this mildew by the use of flowers of sulphur alone.

#### ANTHRACNOSE, BIRD'S-EYE ROT.

(*Gloeosporium ampelophagum*, Sacc.)

This disease has not proved a serious trouble to grape growers in Ontario. However, it has been observed in various localities in the Niagara District and those who grow grapes to any extent should be on the watch for it as it has been known to cause considerable loss when weather conditions were favorable for its development.

*Symptoms.*—This is a very striking and easily recognized disease. It attacks the fruits, shoots and leaves, but is usually most noticeable upon the fruit. On affected berries greyish-brown spots appear with well defined purplish-brown margins. Frequently between the dark outer margin and the lighter inner area

there is a red circle which gives to the spot the appearance suggestive of a bird's eye. The spots may be numerous and completely cover the berry or there may be but one or two spots on one side; in such cases the unaffected portion of the berry remains green. The spots on diseased shoots are similar to those on the berries but are less highly colored, more elongated and more sunken in the centre. On the leaves spots with pale centres and brown-red borders are produced.

*Life-History.*—Spores are produced on the surface of the central portions of the diseased spots. These may be scattered by rain or currents of air and thus the disease may be spread during the growing season. It is thought that the disease is carried over the winter by spores adhering to diseased fruits, leaves or shoots.

*Remedy.*—Spraying with Bordeaux mixture as recommended for Black Rot of Grapes, and the prompt pruning out of diseased canes and bunches of fruit will prevent the disease from doing serious damage.

#### CHLOROSIS OR YELLOW LEAF.

This disease is frequently seen in Ontario vineyards. It is said to be worse on soils rich in lime. The foliage of affected vines first becomes pale, sickly yellow and later brown. In some cases the leaves may turn yellow in the early part of the season but regain their normal healthy green appearance before fall. In other instances the leaves may all yellow, then gradually turn brown and wither. If the foliage is destroyed in this manner for two or three years in succession, the vine is very likely to die. It is a common thing to notice one vine among a number of healthy ones showing symptoms of chlorosis. European investigators state that chlorosis is due to the lack of available iron in the soil. The yellowing of the leaves characteristic of true chlorosis may, however, be caused by other conditions, such as winter injury and "wet feet" (excessive water in the soil).

*Remedy.*—The results of the experiments conducted by European investigators indicate that true chlorosis may be overcome by applying a liberal dressing of sulphate of iron around the affected vines. Top dressing with nitrate of soda in addition to the sulphate of iron is reported as being beneficial.

#### CROWN GALL.

(*Pseudomonas tumefaciens*, Erw. Smith and Townsend).

This bacterial disease has been observed from time to time on grapes in Ontario, but there are no records of it ever having caused any appreciable damage. It produces swellings or enlargements somewhat similar to those characteristic of the disease when it attacks apples, peaches and raspberries. They are, however, not confined to the crown but are found upon the main arms and larger branches.

*Treatment.*—Cut out the affected portions of the vine and burn them.

#### SIDE ARM OR NECROSIS.

(*Fusicoccum viticolum*, Reddick.)

This disease has been reported from Ontario but does not appear to be widespread or to have done sufficient injury to attract the attention of grape growers. It has been reported as a serious disease in New York by Prof. Reddick of Cornell University.

*Symptoms.*\*—"The most prominent indication of the presence of the disease, at most times in the year, is the dead arm which gives the trouble its name; but another striking symptom, visibly only in June and early July is the peculiar yellow coloration of the foliage and the dwarfing, crimping and curling of the leaves that mark affected portions of the vine. The yellowing should attract the attention of every grower during cultivation, and the diseased arm or vine should be removed at once or marked for such treatment at pruning time. There are several other less prominent signs of the disease which enable the expert to distinguish it from other troubles, but which would not be so quickly noticed by the ordinary vinedayist. These are peculiar, longitudinal, ribbed excrescences on the trunk or arm, dry rot in the heart of the trunk and usually extending to the margin, small reddish brown or black spots on the green shoots, petioles, peduncles and leaf veins, and spotting and rotting of the berries very similar to those produced by black rot."

*Remedy.*—"The diseased vines should be marked in early summer, when they are easily recognizable from the yellow leaves, and all affected wood removed and burned. By carrying a piece of old cotton or linen cloth when cultivating the vineyard, it is but the work of seconds to attach to the diseased vine a strip of cloth to direct attention to it when trimming. Often the removal of a single arm eradicates the disease, but in other cases the whole trunk will be found affected. If the characteristic discoloration or dry rot of the wood of the main trunk is apparent, the whole vine should be sawed off at a point below the last indications of rot. In many cases it will be best to cut off the vine close to the ground so that renewals will come from below the surface. If all sources of infection are removed, such renewals are sure to be healthy and to develop rapidly into strong vines. In some years it might be safe to leave infected wood to bear fruit while the renewal canes are growing, but when conditions are favorable for infection such a procedure would be very unwise. In any case each renewal should be inspected carefully some time during late summer to see that it has not been infected; for if it has been attacked by the fungus, even slightly, it should be rejected. To insure one healthy renewal it is well to leave two or three suckers at the base of the stump from which to select when tying up. At the regular trimming time precaution should be made not to leave for bearing wood any canes that show lesions of the disease. Detection of these is easy with a little care, as they are usually conspicuous at this time, being reddish in color and slightly elevated."

#### CONCLUSION.

Practically all the serious diseases of the grape in Ontario can be prevented from causing loss by spraying with Bordeaux mixture as recommended for Black Rot, with the addition of flowers of sulphur later in the season if Powdery Mildew appears. Except in localities which experience has shown to be practically immune to disease, spraying should be done every year as an insurance against outbreaks.