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EC1257 Revised 1933 Grape Growing in Nebraska

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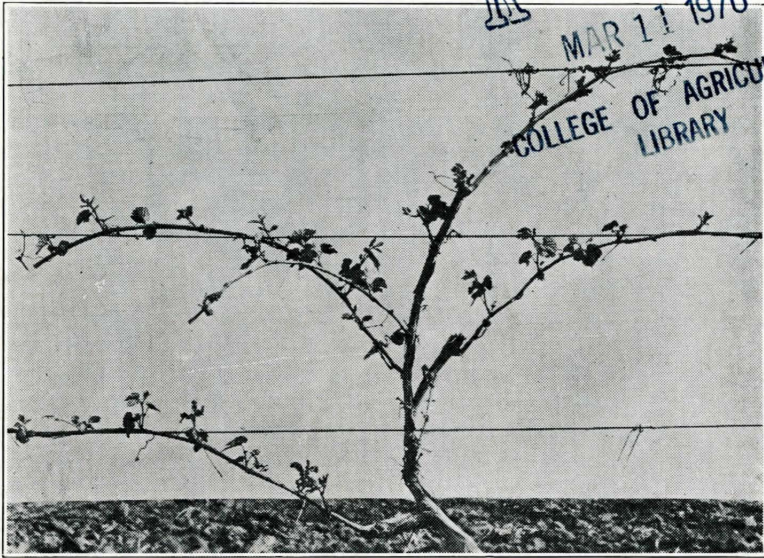
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Grape Growing in Nebraska



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GRAPE GROWING IN NEBRASKA

C. C. WIGGANS AND E. H. HOPPERT

Grapes have long been a favorite fruit for the owner of a farm fruit garden and possibly even to a greater degree for the city dweller who has only a limited space for fruit plants. As a commercial crop this fruit has also been profitable in sections adapted by soil, climate, and markets for its culture. Grape growing for home use has been practiced in Nebraska from the time of the earliest settlers who found wild grapes thriving along the streams and in timbered areas. Some commercial plantings have also been developed in the extreme eastern part of the state, largely around such centers as Florence, Peru, Brownville, and Lincoln. The acreage has been very materially increased in recent years. The area over which grapes can be produced for home use has also increased with the better knowledge of culture and varieties, coming with longer experience.

Nebraska, according to the latest census, produced in 1919 nearly 2,500,000 pounds or approximately 150 carloads of grapes, while the crops in more recent years have been even larger. Apples and cherries are the only fruits grown in this state with a higher crop value. Statistics show, however, that only a relatively small amount of the total grape production is packed for shipment, indicating the presence of a very large number of small plantings. Even in the case of some of the larger vineyards, local markets absorb the crop.

The eastern or river counties of this state are well adapted by soil and climate for profitable grape growing and undoubtedly a greatly increased production could be used in nearby markets. Length of growing season and the summer rainfall are very similar to conditions in the western New York and southern Michigan grape growing centers while the summer humidity is lower and therefore less favorable for diseases. Nebraska grapes and likewise those in western Iowa, ripen at a time when there is comparatively little competition from other heavy producing regions and consequently market conditions are very good.

The advantages of this fruit for home use are numerous. Besides its value for the table it has numerous uses for jelly, juice, jam, etc. Although grapes are generally classed as a



Fig. 1. A productive Concord vineyard in the Missouri River Section.

perishable product yet they may be held in storage for several weeks. The proper choice of varieties will also considerably lengthen the fresh fruit season. The production of grapes, even for home use, in the central and western parts of the state is attended with considerable difficulty, because of winter injury, hail, and lack of moisture. Winter protection for the less hardy but more desirable varieties is an absolute essential there.

SOILS

The grape does best on a loose, warm loam but many successful vineyards are planted on sandy or gravelly soils. Clay soils are generally too hard and difficult to work and should be avoided if possible. The presence of some clay in the subsoil in sandy regions is an advantage, however, because of its effect on the water holding capacity. The loess soil along the Missouri River bluffs is ideal for this fruit.

The subsoil is nearly as important as the surface soil. Grape roots penetrate rather deeply even in tight clays. Deep rooting should be encouraged because of the greater resistance in such plants to the effects of drought and low winter temperatures. On the other hand a water table too near the surface is positively harmful.

The fertility of the average well-cared-for Nebraska soil is sufficient for grape production. The rich heavily manured garden soil is apt to cause great stimulation of wood and leaf growth. Such vines are likely to be somewhat

unfruitful although proper spacing and pruning helps overcome this difficulty. Conversely, poor soils are too low in fertility and in that case only weak growth of fruit and vine is made. Such soils need manuring if they are to produce satisfactory grape crops.

SITES

Rough hilly lands are frequently used for grape culture but ground not too steep is much more conveniently worked. Generally speaking, there should be lower ground adjacent to any vineyard since in spite of its late leafing and flowering habit the grape is subject to occasional injury from spring frosts. An elevation offers some protection in such cases although in some sections where the rainfall is short, the frost protection of the slope is abandoned for the better water supply in the bottoms. Some successful vineyards are being grown under such conditions at various points in the Platte Valley.

Although south or southeastern slopes induce earlier spring growth with subsequent danger of frost injury, yet they are to be preferred to north or northwestern ones because of the greater amount of winter killing which occurs on the latter. Southern exposures cause the fruit to ripen somewhat earlier and are therefore especially valuable in those sections where the season is too short for the proper maturing of the crop.

VARIETIES

A great many varieties of American grapes have been developed and one or more can be found to fill practically any need or to grow in nearly every location. The choice of the Nebraska grower depends upon his location and also upon the use which is to be made of the fruit. Nearly all varieties are hardy in the extreme southeastern counties but in the western two-thirds of the state the number which will thrive is much more restricted. The commercial grower will limit himself to a few black varieties while the grower producing grapes for his own use or for a local market will include a larger number of varieties, some of which may be red or white in color.

Below are listed some of the more important Nebraska varieties with a brief description of their characteristics and uses:

Concord (black) is by far the outstanding variety grown for both home use and commercial purposes. It is an all purpose variety, vigorous, productive, and adapted to a

wide range of soils. It is of good quality and is the standard market variety. The clusters are rather loose and are medium in size. It is a mid-season to late variety and for this reason does not develop to full maturity in the short season of the western part of the state.

Moore Early (black) is very similar to the Concord but ripens about two weeks earlier. It is not so productive nor as hardy as the Concord and cannot be grown successfully over as wide a range. It is a desirable variety for both home and commercial use because it helps to lengthen the grape season.

Worden (black) is a high quality, large-clustered, productive variety ripening just ahead of the Concord. The large berries have a tendency to split badly in a wet season because of their thin skins. It is a very useful variety throughout the state and especially in the western end because it frequently will ripen where the Concord does not.

Diamond (white) and **Niagara** (white) both produce large handsome clusters of high quality fruit. These are the standard white varieties for the home planting but are of little value commercially.

Brighton (red) is a large clustered, high quality, productive variety ripening about with Concord. It is an excellent table grape but has little market value.

Delaware (red) is one of the highest quality grapes grown. However, it lacks hardiness and vigor and produces very small berries and clusters. It is valuable only for home planting.

Beta (black) is one of the hardiest varieties grown in the state. It is a very poor table grape but makes good juice and jelly. It may be grown throughout the state without winter protection. The phylloxera (root lice) attack it badly in the eastern half of the state and hence other resistant, higher quality varieties should replace it.

Elvira (white) is a very close clustered sort which is fairly hardy. It will thrive without winter protection over a large part of the state. The quality is not very good.

PROPAGATION

Grape plants can usually be secured so cheaply from the nurseryman that home propagation is hardly worth while. However, if only a few plants or plants from a favorite vine are wanted, they can be very easily secured.

Cuttings are used more extensively than any other means in grape propagation. Nearly all varieties can be grown in this way. The cuttings should be made in the fall after the leaves have dropped and before any possible winter injury has taken place. Spring made cuttings do not root so well. Hardwood cuttings are made from well matured, vigorous, medium sized one-year-old wood or canes. Weak, winter injured stems, as well as the extremely vigorous long-jointed water sprouts and suckers should be avoided. Each cutting consists of two or more joints, the basal end of the cutting being just below a joint. A three-eye or three-bud cutting is usually 10 to 12 inches long. Shorter cuttings may be used but they will require more care. In certain varieties, somewhat difficult to propagate, a small section of older wood at the base of the cutting facilitates rooting.

After being tied into bundles, the cuttings are buried in an outside pit or packed away in a cool storage cellar, in slightly dampened sand or in sawdust from freshly cut logs. They must neither dry out nor be wet enough to rot. No bud growth occurs if the temperature is kept low (below 45° F.) but callus formation does take place. This is desirable since it is quite advantageous for rooting in the spring.

As soon as the soil has warmed up somewhat in the spring, the cuttings should be set in the nursery row. They are planted 6 inches apart in rows 3½ feet apart. To facilitate rooting they are set on a slant so that the base is not surrounded by cold soil. Only one bud remains above the soil line and even this is sometimes covered with a shallow ridge of soil to prevent drying. Care must be taken to pack the soil firmly about the cutting. Good cultural and seasonal conditions will produce a plant of transplantable size in one year but two years may be required.

Layering is suitable for use with any variety of grapes. It is useful in filling vacancies in a vineyard or where only a few plants are needed. Strong one-year canes are selected, bent to the ground and covered with soil at one or more points. Frequently the cane is girdled or notched at these points and if necessary is weighted or staked down. The soil covering must be deep enough to prevent drying out. Many variations of this method are in use but the net result in each case is a plant of sufficient vigor to be separated from the parent vine after one or two seasons' growth. Layering is usually done in early spring.

Grafting is used extensively in Europe and California to secure plants resistant to insect injury or better adapted

to adverse soil conditions. About the only use such a method will have in Nebraska is in the top-working of an undesirable variety to one of higher quality. The stem of the old plant is sawed off at or below the soil line, and a notch or cleft made in the stump. Dormant scions (one-year canes) 3 to 5 inches long are so shaped as to fit these notches and one inserted on either side so that the bark lines of stock and scion are brought in contact. Wax is not necessary but the union should be covered with soil. The work is done just after growth begins. If both scions live, one is later removed. All sucker growth from the stock must be broken off.

PLANTING

Plants and Their Care. The nurseryman generally offers for sale three grades of grape vines, 1 yr. No. 1, 2 yr. No. 1, and 2 yr. No. 2. Only well grown vigorous vines (No. 1) should be purchased. Commercial growers frequently prefer one year plants because they are somewhat cheaper, more easily set and more likely to grow. The older, somewhat larger plants may sometimes be more desirable if an immediate showing is wanted. Regardless of their age or grade, the buyer should insist upon thrifty plants with a vigorous root system.

Plants should be set at once upon receipt from the nursery, but if immediate planting is impossible they may be held several days by heeling-in. The bundles are opened, the roots spread out in a trench and moist soil firmly packed about them. Plants received in a dry condition should be soaked in water for a few hours and heeled in, or the entire plant may be covered with soil.

Time of Planting. Grapes in this state are more likely to thrive if planted in early spring. Winter-killing and heaving often occur with fall set plants. There is also the risk of a dry fall. If fall planting is to be practiced, the plants should be pruned and then covered over entirely with soil,—the soil to be removed when spring comes.

Distance to Plant. The distance recommended for the usual varieties is 8x9 feet,—the wider distance being between the rows. Many of the older plantings are 8x8 or even less but this is too close for convenience in cultivation; the moisture supply in dry seasons may also be insufficient. With the more vigorous growing varieties this distance should be increased rather than decreased. On very steep ground it may be necessary to increase the distance between rows quite materially in order to permit necessary

cultivation. However, where only a single row of grapes is being grown, as in a garden or arbor, the distance between plants may be decreased, if necessary space for the development of cane and leaf growth is provided by the use of a higher trellis.

The rows preferably should run north and south in order to secure a uniform distribution of sunshine. On hilly ground they should run across the slope regardless of direction. The shape of the field may also be a determining factor in direction of rows.

Method of Planting. Fall plowed land can be worked easier and sooner than that plowed in the spring. With proper soil preparation, grapes can be planted with very little labor. One man digs a hole large and deep enough for the extensive root system while another prunes back long, straggling or injured roots and all of the canes except one. The soil is thoroughly tramped about the plant. The remaining cane is then cut back to two buds.

Where large acreages are to be planted, rows may be laid off in one or both directions with a plow or lister. Too many rows should not be laid off ahead of the planting gang, however, since under these conditions the soil may dry out considerably. The roots of the plants being set may be kept moist by the use of wet burlap.

CULTURE

The grape responds more freely to good culture and care than almost any other fruit plant. Annual fruitfulness depends upon the annual production of good vigorous canes. Under no circumstances should the vineyard become sodded. Cultivation from spring until late July or mulching should always be the rule. Extremely late cultivation, however, is undesirable because it may stimulate late growth which is subject to winter killing. The growth of foxtail, weeds, etc., late in the season may be helpful in hastening the hardening of the new wood.

During the first one or two years it is often possible to grow a cash crop between the grape rows. This, however, should be a hoed crop and should in no way hinder the growth of the grape plants. Tomatoes, potatoes, and even sweet corn are good crops. Vine crops sometimes tend to smother out the grapes while all fruit crops with the possible exception of strawberries must be eliminated. If strawberries are used they should be set at the same time as the grapes and then plowed up after their first crop.

A reversible disc is commonly used in the cultivation of the spaces between the rows. The amount of handwork necessary to keep down weed growth in the row may be greatly reduced thru the use of a one horse grape hoe, the share of which is guided by manipulating a rudderlike disk. Continuous clean cultivation gradually lowers the fertility of any soil and hence some arrangement to return humus must be made thru a proper cropping system or by manuring.

A straw mulch may also be used. This must be deep enough to keep down weed and grass growth, and is especially valuable in small farm vineyards where cultivation is apt to be neglected. A mulch in a commercial vineyard, however, is undesirable since it would interfere seriously with the removal of prunings. It may also harbor injurious insects.

PRUNING

Purpose Pruning begins at the time the plant is set and must be repeated annually. During the early years, this operation results in the establishment of a good root system and the development of a desirable framework. Later on pruning helps to regulate the fruitfulness of the vine.

If pruning is neglected for even a single season in either young or old plants, undesirable results follow. On an unpruned young plant too many buds attempt to grow and consequently only weak canes are produced. Lack of pruning on a bearing vine generally results in overproduction of fruit and a weak cane growth. Annual pruning is imperative, to maintain the proper balance between wood growth and fruit production.

Time Pruning should always be done during the dormant season, that is, after the leaves drop and before growth begins the following spring. If winter protection is to be given, the pruning should be done in the fall to facilitate the covering operation. Where protection is not necessary the pruning is usually delayed until February or March. Bleeding follows late pruning but even this is preferable to leaving the plants unpruned.

The value of summer pruning for any purpose other than training to a given number of canes is very small. However, in cases where exceedingly heavy vine growth has been produced, shearing off some of the excess growth on the sides of the row results in earlier and better ripening of the fruit. This is easiest done with a hand sickle or corn knife.

Fruiting Habit A knowledge of the fruiting habit of the grape is essential to a proper understanding of grape

pruning. Several training systems are in use but the logic back of all of them is the same. The grape always fruits from the buds of last year's canes—each bud producing one or more clusters on its new shoot. Thus, vigorous new growth must be produced each season so as to form strong buds for the next year's crop. If, for any reason, the main shoot from a bud is injured, a secondary bud generally will develop from the compound eye. The fruit produced by these secondary shoots will probably not exceed 25% of a full crop.

Pruning Young Plants Comparatively little fruit will be produced on the grape before the third season. The entire energy of the plant up to this time should be used in vine growth. To restrain the fruiting tendencies, heavy pruning is practiced. Pruning the grape after its first season in the vineyard is similar to the method followed at planting time—namely removing all growth except one cane and then shortening this to two or three buds. Such treatment insures a few strong canes for the next year's crop instead of a great many weak unfruitful ones.*

During the second season only two shoots should be allowed to develop. These shoots should be tied to stakes or the lower wire of the trellis.

Training Systems The training system used determines the ultimate shape of the plant,—that is, the length, number, and disposition of trunks, canes and spurs. Before the plant is pruned at the beginning of the third season, the training system to be used should be determined. Various systems such as fan, Kniffen, Chautauqua, etc., are used in the different grape growing regions and each has its particular advantages. For Nebraska, however, the Kniffen is generally the most satisfactory.

The Kniffen system of training consists essentially of a single trunk reaching to the top wire of the trellis with four to six fruiting canes extending along the trellis. A few short renewal spurs to keep the next year's fruiting wood close to the trunk are also desirable. Each year the fruiting canes are renewed from the spurs or from strong basal buds on the canes of the previous season. The trunk is replaced as often as needed, (about every five years) by training up a sprout or sucker from the crown. This sprout is cut off at the height of the top wire and allowed to develop side shoots. The following year the old trunk can

* In the case of exceptionally vigorous plants the cutting back need not be so severe and if there are several strong shoots, one of them may be left long enough to tie to the trellis wires.

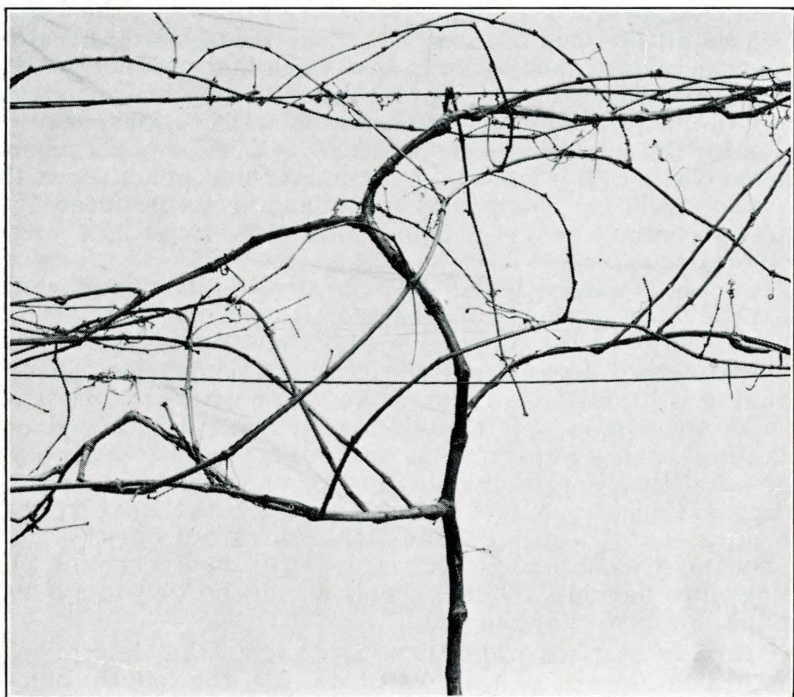


Fig. 2. A vigorous unpruned plant 4 years old. Heavy annual pruning insures thrifty fruiting canes for next years crop.

be removed entirely. The trunk renewal will need to be more frequent where the plants require winter protection since the younger, smaller trunks can be more readily bent to the ground.

Pruning the Older Plants At the beginning of the third season a strong straight cane is selected and left long enough to reach the upper wire. Three or four strong laterals, if they are present on this cane, are shortened back to 3 to 5 buds each and all others removed entirely. All other canes are removed except with extra vigorous plants, in which case one or more short canes may be left. (These are removed the following year.) The number of buds left for fruiting should be proportionate to the vigor of the individual plant.

There is usually a small production of fruit the third year from strong vines but weak growing plants or varieties require a longer time to reach production. The fourth year

should find the average plant in full bearing, although the size of the crop will depend upon the variety and also upon the care which the plant has received. As the plant gets older and stronger, a larger number of buds may be left. From 40 to 60 buds are sufficient for the ordinary vine. This means 4 to 6 canes each 8 or 10 buds long and 2 or 3 renewal spurs. Seldom should a cane be more than 12 buds long. The most fruitful canes are approximately $\frac{1}{4}$ inch in diameter with medium length internodes, 4 to 7 inches. They usually arise from canes or spurs of the preceding year and should originate as near the main trunk as possible. Excessively strong, long-jointed canes such as water sprouts or suckers do not fruit heavily—neither do weak canes. However, if these are cut back to spurs, they will produce good fruiting wood for the next year.

The mistake of leaving too much fruiting wood is a common one. While this increases the number of clusters, it will likely decrease their size and also the size of the

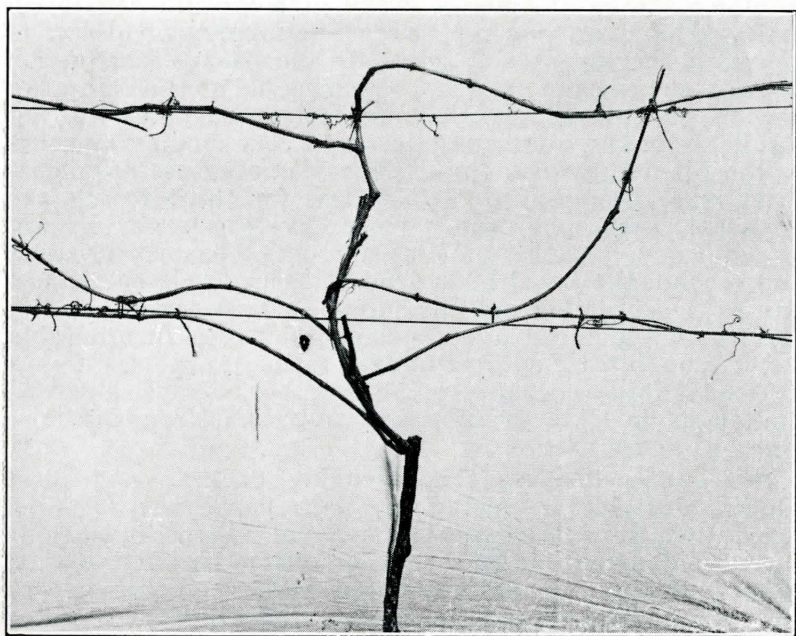


Fig. 3. Vine shown in Fig. 7 after pruning. Six canes originating close to the trunk have been left and these shortened to 8 or 10 buds. Note also the renewal spurs which insure production of fruiting wood near the old trunk.

individual berries. It likewise weakens the cane growth for the following crop. A yield of 10 to 12 pounds is as much as should be expected from the average vine. This amount should be produced by 50 to 60 buds—assuming that the buds will average one three-ounce cluster each. At the same time the plant can be producing a sufficient number of vigorous canes for the following crop. Unless this condition is maintained, the yield from year to year will fluctuate considerably.

Cane vs. Spur Pruning Frequently a grape grower is found who insists on pruning his plants according to a so-called "spur" system. This differs from the plan recommended above in that the fruit buds are distributed in a large number of spurs, 2 or 3 buds each, rather than in a smaller number of longer canes. The total number of buds may not be greatly different in which case there may be little difference in the results obtained. Too often, however, spur pruning degenerates into simply a shearing process, in which the basal buds of every cane are allowed to remain. This overloads the vine. The amount of old wood is greatly increased each year with a consequent reduction in the vigor of cane growth. Experiments at the Nebraska Station indicate that with young, vigorous vines the net results from these two practices are very similar but that as the plants grow older the cane pruned vines are somewhat more productive. Two causes for these results are apparent; first, spur pruned vines have the larger amount of old wood and this amount annually becomes greater; and second, the basal buds are not as vigorous or productive as those farther out on the cane. It is possible that a combination of the two methods can be followed profitably but it is doubtful if spur pruning alone is desirable. If spur pruning is followed, however, the number of buds should be limited as in cane pruning and only the stronger, more vigorous spurs used.

Renovation Pruning The bringing back to a fruitful condition of vines neglected for one or more years is called renovation. Renovation must be gradual, at least in extreme cases, and often cannot be accomplished in one season. From four to six good fruiting canes should be selected as close to the root system as possible and all other parts of the plant cut off. If these canes can be found on not to exceed three trunks, so much the better. Such pruning will stimulate new growth close to the root system and then the following year more of the old wood can be removed and the number of trunks still further reduced. This process

is continued until eventually the plant assumes the desired shape—in fact an entirely new top may be developed. The increased production will give ample returns upon the labor involved in such cases.

Pruning Arbor Grapes Where grapes are grown for covering as on a pergola or arbor, a somewhat different plan of pruning must necessarily be followed. Shade as well as fruit is desired. Consequently in order to get an early covering of leaves it is necessary to leave a larger number of buds than when fruit is the major consideration. Usually there should be a single trunk reaching up the side and half way across the top of the arbor. Numerous relatively short canes are then left distributed along the trunk. If the vines are planted rather close, the pruning plan suggested will give fairly satisfactory fruiting as well as a quick covering effect.

THE TRELLIS

Since the grape is not self supporting some kind of a trellis must be provided. Probably the most satisfactory sort for the commercial vineyard is one with three No. 10 galvanized wires, the lower one being 2 feet from the ground, the upper about 4½ feet high and the other midway between. Many growers use a two-wire trellis but an extra wire permits better distribution of canes and fruit. The trellis should not be as high in locations exposed to the summer winds as in sheltered areas. One post for each three vines is sufficient. Either wood or steel posts may be used. If light steel posts are used, occasional stay posts are necessary. End posts should be well braced. Wires should be tightened occasionally and hence tight stapling is to be avoided.

The trellis should be in place at the beginning of the second season but only the lower wire is needed until the third season.

TYING

In the pruning process nearly all connections between the wires and canes are cut or broken and hence there is nothing to hold the plant in position. Therefore, more or less tying is necessary. This work should be done before growth begins or a great many shoots with their fruit clusters will be broken off. The need for such tying is only temporary, however, since the new tendrils soon establish a connection with the wires. Short lengths of cord or other material are used. The raffia ordinarily used by florists is inexpensive and if properly used is very satisfactory. Whatever the

material used, it should not be too permanent or it will cause considerable inconvenience at pruning time the following spring. Girdling will result if the tie is drawn too tightly.

An attempt should be made to properly distribute the canes on the trellis. Bunching the canes in tying, or twisting them about the wires, will give trouble later.

WINTER PROTECTION

In the eastern third of the state, the common hardy varieties like Concord, Worden, Diamond, and Brighton will survive the average winter without protection. Tender sorts like Delaware and Caco will require some protection even in southeastern Nebraska if they are exposed to the northwest winds. Any method that will keep these winds from getting a free sweep at the vines will serve. The vinifera type of grapes like Black Hamburg and Tokay have been grown successfully at Brownville by laying down the vines and covering the tops with three or four inches of dirt.

In the central and western parts of the state severe injury is likely to occur nearly every year unless some sort of protection is given. Protecting the canes against drying out is more important than protecting them from low temperatures. If irrigation water is available, the soil should be thoroly soaked before the ground freezes. The vines should be pruned, bent over and pegged down if necessary, and covered with a few inches of soil. Plants so treated should come thru the winter with sound, plump buds and canes. Budding out of the covered canes may be delayed in early spring by applying a covering of straw. The straw reflects the sun and keeps the soil from warming up so rapidly. When the buds begin to swell, it is necessary to take off the mulch, and the canes should be straightened up and tied to the trellis.

The varieties, Beta, Lucille, and Elvira, can withstand western Nebraska conditions without winter covering provided they are located where they are protected against the winter winds. These varieties are not good table varieties but will serve for jams, jellies, and juice.

In the central part of the state, Concord and Worden may be grown successfully where protected by a good windbreak. If a windbreak is not available then one may be provided by piling corn fodder against the north or the west side of the trellis.

Winter injury is generally worse where vines are left unpruned. An unpruned vine produces a great number of weak shoots and very few vigorous ones. These thin, weak shoots are much more easily killed by the dry cold winds than are the thicker, more vigorous canes.

HARVESTING AND PACKING

Grapes color before they are thoroughly ripened and hence color cannot be used as a guide for the proper time to harvest. Immature grapes, even though well colored, are sour and of poor quality generally. Furthermore, the flavor of such grapes does not improve after harvest since sugar formation ceases when the cluster is severed from the vine. If fully flavored grapes are desired they must remain on the plant until mature, thus differing materially from some of our other fruits. Maturity is indicated by slight shriveling of the cluster stem, by brown color of the seeds, and by the greater ease with which seeds and pulp may be separated. Flavor is also a good guide.

The use to which fruit is put, determines to some extent the time of picking. Although high class jelly can be made from fully ripened grapes, yet many prefer to use only partially ripened fruit for this purpose because of the greater ease and certainty with which jelly can be produced. For table use and for juice purposes only fully matured fruit is desirable.

Grapes are harvested by cutting the cluster from the vine with shears or a knife. Rough handling crushes many of the berries and hence pickers should be cautioned against squeezing the fruit or dropping the clusters into the container. Shallow baskets or trays are most desirable for picking containers. The fruit should never be allowed to remain in direct sunshine after it is picked.

The 4 quart Climax basket is the standard package used for packed grapes, although for roadside stands or other bulk sales, larger containers are in demand. The small grower seldom either grades or packs his fruit, being content to sell it "vine run". In graded fruit, however, the smaller or straggly clusters, clusters with diseased or deformed berries, and clusters with green or only partially ripened fruit, are put into the cull grade. Such fruit is then sold for jelly purposes, usually at a reduced price. The large, well formed, well ripened clusters are used for the basket grapes. If the grapes are allowed to wilt somewhat before packing they can be packed easier and there is less trouble

from shrinking and shelling of the berries. Grapes may be held in cold storage for several weeks if they are properly packed and stored.

INSECTS AND DISEASES

Fortunately for the Nebraska grape grower, the damage caused by diseases and insects is not serious enough at present to warrant the application of sprays according to a regular schedule. However, serious outbreaks of certain pests have occurred in the past and under certain climatic conditions disease damage has been of some consequence. Such conditions are likely to occur again and it is well, therefore, for the grower to be on the lookout and ready to spray on short notice. Frequent inspection of the vineyard from the time the buds begin to swell until mid-summer will indicate whether or not a spray application is necessary.

Below are brief descriptions of the insects and diseases of the grape which have been found most frequently in this state, also methods for their control. More detailed descriptions of these and other grape pests are found in Farmers' Bulletin 1220 which may be secured free of charge from the Nebraska Agricultural Extension Service, Lincoln, or from the County Extension Agents.

The Grape Flea-beetle has caused considerable damage in Nebraska vineyards during recent years by destroying the swelling or newly opened buds. It is a small, shiny, bluish-green beetle which usually drops to the ground if the plant on which it is feeding is disturbed. Control: Lead arsenate 2 pounds per 50 gallons of water (2 tablespoonsful per gallon) applied just as the buds begin to swell with a second application 10 days later.

The Grape Leafhopper is a small whitish sucking insect which causes the yellowing or mottling of leaves so conspicuous late in the season. Badly affected leaves may drop, thus lowering the vitality of the plant. The adults are winged while the young are wingless. Control: Nicotine sulphate $\frac{1}{2}$ pint to 50 gallons of water (1 teaspoonful per gallon) applied to the under surface of the leaves early in July before the insects develop into the winged form. Soap at the rate of 1 pound per 50 gallons should also be used unless the Nicotine sulphate is added to Bordeaux or lead arsenate sprays.

The Grape Root Worm does its greatest damage through the destruction of the small roots and rootlets by the larvae. About the middle of June the larvae develop into adults which feed on the leaves. The presence of these beetles is indicated

by the chain-like feeding punctures seen on the foliage. Control: Arsenate of lead, $1\frac{1}{2}$ pounds to 50 gallons of water to which is added 1 gallon of cheap molasses, should be applied as soon as the feeding punctures are noticed. The root worm and leafhopper sprays may be combined.

All other Leaf Eating Insects such as rose-chafer, 8 spotted forester, grape curculio, etc., may be controlled by applying arsenate of lead $1\frac{1}{2}$ lbs. to 50 gallons, as soon as injury is noticed.

The Grape Berry-moth is the insect responsible for the destruction of the clusters through webbing together the blossoms or young fruits. The larvae then feed upon the young fruits, passing from one berry to another. Control: Lead arsenate, $1\frac{1}{2}$ pounds per 50 gallons of water, should be applied 3 - 4 days after the blossoms have fallen and again 3 - 4 weeks later.

The Grape Cane-borer is a brownish beetle $\frac{1}{3}$ inch in length, which burrows into the cane at or near a bud thus causing the wilting of all new shoots beyond that point. They are much more numerous in neglected vineyards or near wooded areas. Control: Affected canes should be removed and these together with all prunings should be burned as soon as possible. Cultivation of the vineyard will help the affected vines to recover from this injury. Spraying is of no value in controlling this pest.

The Grape Phylloxera is a small root louse feeding for the main part below ground. During the summer, winged adults develop which deposit their eggs in the leaf tissue. Wart-like formations or galls later develop on the lower leaf surface. Most of the varieties commonly grown are resistant to the attacks of this insect. The Beta, however, in southeastern Nebraska is quite susceptible. Control: There are no practical control measures for this insect except thru the use of resistant varieties.

Black Rot is the fungous trouble causing the rotting of the berries. The disease appears first as small spots on the leaves but later the stems, tendrils, and fruits are also affected. Affected berries soften, turn brown and then shrivel. It is destructive here only in wet seasons. Control: Bordeaux Mixture (4 pounds stone lime, 4 pounds copper sulfate and 50 gallons of water) should be applied when the second or third leaf appears on the new shoot. Other applications are made at intervals of 10 days to 2 weeks, the number necessary depending upon seasonal conditions and the severity of the infection.

Downy Mildew is a disease seldom of importance in this state. It is rarely found except in low places and in very wet seasons. It attacks all tender succulent parts of the plant appearing on the under side of the leaves as grayish-white downy spots. Proper trellising to facilitate air circulation will practically eliminate this disease, as well as the preceding one. Control: The spray schedule outlined for black rot will also control this trouble.

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(6-25-10M)
(5-33-10M)