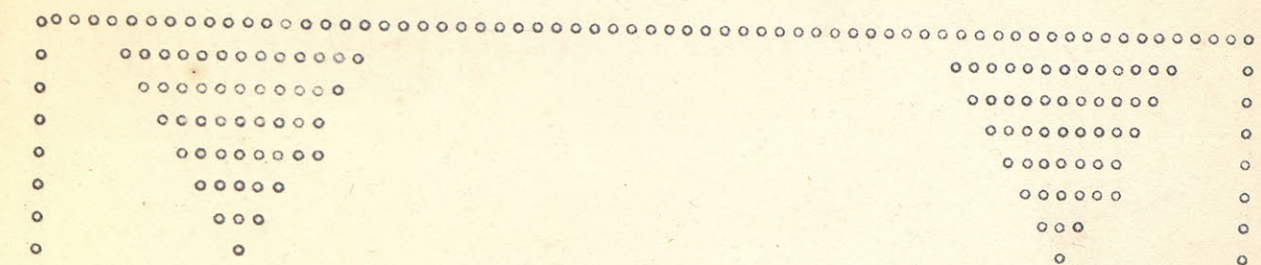


1927
L. 6



T H E S I S

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"SOME PROBLEMS OF THE KANSAS GRAPE GROWER"

by

A. A. Werner

upon graduation from the

KANSAS STATE AGRICULTURAL COLLEGE

1907.



SOME PROBLEMS OF THE KANSAS GRAPE GROWER.

**

Importance of Viticulture.

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The grape promises to become one of the most important fruits of Kansas. It is without question, our most certain fruit crop. An entire failure is scarcely known. The high quality of some of the best varieties is not equaled by any fruit we are able to grow. Its hygienic and food value is shown to be great. The demand for it in the fresh and preserved condition is constant and an over supply does not surfeit the consumer. The great variety of ways in which this fruit may be preserved makes it available the entire year. The vine is adapted to our changeable climate better than any other fruit. It endures great extremes of heat and drought and is less likely to be injured by insect pests and fungus diseases than most other fruits.

Climatic Requirements.

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The grape demands a rather dry atmosphere and a location free from heavy dews and frequent fogs. Excess of moisture in the air and on the vine favors the development of fungus diseases, such as the mildews and rot, and also lowers the quality of the fruit. To insure rapid drying of the vines as early in the day as possible, the vinyard should be planted on an east, southeast, or northeast slope.

Such a slope also protects the vine to some degree from the hot afternoon sun.

One of the most important points in the selection of a vineyard site is the altitude above the surrounding land. An elevation of from eight to fifty or more feet greatly lessens the amount of dew fall and danger from late spring frosts as well as secures the perfect drainage demanded by the vine. Low damp, undrained lands are worthless for grape growing as the crop is invariably lost by rot and late frosts not to mention the inferior flavor and shipping quality which low lands produce. This is well illustrated by two vineyards in East-Central Kansas. They are about one-hundred yards apart; one located in a level valley and the other from eight to twelve feet above on a hill side. The latter has always produced fair crops of first class fruit while the former has never born a satisfactory crop.

The ideal location is upland or bluffs and gentle slopes near a river or lake. This tends to keep the air sufficiently moist to refresh the leaves during the night. Shelter belts on the north and south and west sides of the vineyard are often of great value in preventing the excessive drying of the vines when frozen in the winter and consequent winter-killing; also in lessening the injury from the dry hot winds of summer.

Soil Requirements.

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The grape adapts itself to a great variety of soils; but different varieties require somewhat different soils for their best development. This is explained by the fact that all our grapes are derived directly or indirectly from the several native species of grapes found growing wild in the United States.

A good grape soil is a well-drained, deep clay, or sand loam, moderately rich with plenty of lime. An over rich soil causes an over production of wood and leaves at the expense of fruit. It also encourages growth to continue until late in the fall resulting in the winter-killing of this immature growth. Soils formed from lime-stone or granite are excellent. Very sandy soils often produce grapes of poor shipping quality. A considerable proportion of clay is preferable to loose sand or gravel. A spot protected from north winds and having a south exposure and a sandy soil will often produce ripe fruit five to seven days earlier than one not so favorably located.

Preparation of Soil.

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This should be begun in the fall preceding the spring in which the vines are planted. The fall treatment should consist in plowing to conserve the moisture in the soil as well as what falls during the winter. It is not well to grow a late maturing and moisture consuming crop the year previous to planting the vineyard. As early as possible in the

spring when the ground is not too wet or dry it should be rather deeply plowed and subsoiled. The subsoil plow should follow immediately after the stirring plow and run about sixteen or eighteen inches below the bottom of the furrow. If the subsoil is of a very coarse, sand, or gravel, subsoiling is not needed. The plowing is immediately followed with a subsurface packer and harrowed or simply harrowed several times. It is again harrowed; or, cultivated after each rain until planting time.

Planting

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This should be done early in the spring. It should never be delayed until growth starts. Use strong one or two year old vines purchased from some reliable nursery. Probably the most satisfactory plan is to purchase from some of the standary New York nurseries or from T. V. Munson of Dennison, Texas. Ellwanger & Barry, of Rochester, N. Y. or G. S. Josselyn, of Fredonia, N. Y. are reliable firms, and handle a great variety of grapes. Stock from these firms may be depended upon as being true to name.

If the ground is nearly level, the rows should run north and south or northeast and southwest so as to offer the least surface to the two o'clock afternoon sun. On slopes the rows should follow such a direction that all vines in the row shall be on the same level. This will prevent the rapid washing away of the soil. Steep hillsides

should be terraced before planting. For Kansas conditions the rows should be no less than nine or ten feet apart. In the dryer western part of the state the distance should be increased to ten or twelve feet. The distance apart in the row will vary with the variety. Weak growers may be planted seven or eight feet apart, but strong ones need ten to twelve feet. Before planting the vine is cut back to two or three strong buds and the longest roots shortened. For rapid planting, a double furrow may be thrown out with a lister or plow and the vines set in this. Very firm tamping of the soil about the roots is necessary to insure the growth of the plant. To prevent rapid drying out of the compacted soil, it should be covered with about three inches of loose soil.

Self-fertile and Self-sterile Varieties.

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Since some varieties are unable to set fruit unless planted near a vine having staminate or perfect flowers, these should be alternated in the row. The self-fertile should preferably be on the south side of the self-sterile vine to secure the advantage of wind pollination. Very thorough investigations of the self fertility of the grape have been made by the New York Agricultural Experiment Station at Geneva, New York. The results are to be had in bulletin 157 issued by that Station.

Training to Trellis.

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During the first season the vine is allowed to grow at will on the ground. During the winter following, the trellis should be built. The form of trellis will depend upon the system of training desired. A great many systems are in use and are fully described in Bailey's Pruning book, the Bushberg Catalog, and ^{Grape} Manual, and in bulletin 110 of the Kansas Experiment Station. Grape bulletins issued by the various State Experiment Stations all describe these systems more or less completely. Some form of trellis is an absolute necessity to the health and productiveness of the vines. If the growing vines and fruit are near the moist ground, rot and mildew soon ruin the crop. Owing to the scarcity of cheap labor in this state the so-called upright systems of training are out of the question owing to the necessity of tying each of the young shoots to wires above the supporting cane. The drooping systems such as the Kniffin and Umbrella, have a great advantage over the upright systems in that the shoots need little or no tying. But the Kniffin exposes the shoots too much to our high winds while the fruit is too much exposed to the attack of birds. The umbrella system requires no tying of the shoots and usually conceals the fruit very well from birds. It is admirable adapted to vines planted on steep hillsides. Owing to the fact that this form of trellis requires a post

for each vine and the frame at the top of the post upon which the vine is trained is exceedingly likely to be broken off in cultivation, this system is little likely to be used on a large scale. Two systems of training will be described; The Fan and the Munson. These are believed to be the best for our conditions. They both allow the vine to be laid on the ground and covered to protect it from winter-killing.

The fan system renews the vine each year from a point near the ground, thus removing all old wood each year. Fruiting canes are selected which start near the ground and are four to eight feet long. These are tied as high as possible on the trellis wires. The longer the canes and the higher they are tied, the further the bearing shoots are from the ground and the less ~~ty~~ing they will require during the growing season. The trellis for the fan system is merely a three-wire fence. Posts are set between every other vine and the wires stapled to them. The top wire is about four and a half feet, the middle, three feet, and the lower eighteen inches from the ground. This kind of training, however, has some serious objections. Much of the fruit is necessarily near the ground and thereby more subject to attack by rot and mildew and late spring frosts. Many of the lower shoots will need to be tied up to keep them from the ground. It is also difficult to train the growth so as

to make a mass dense enough to conceal the fruit from birds.

The munson system renews the growth each year from a main trunk at a distance of five or six feet from the ground. The trellis consists of two posts set in the same hole with their tops diverging. A wire is stretched along the tops of these posts and a third wire is hung lower between them. The trunk of the vine or its head is secured to this middle lower wire and the shoots top over the side wires. The growth makes a trough-like mass of herbage.

The bearing canes are renewed each year from the top of the trunk and carried along and tied to the middle wire. The shoots which grow vertically at first soon drop over the side wires and fasten themselves. No tying is necessary. "Among the advantages secured by this system are: Simplicity and convenience of trellis, allowing free passage in any direction through the vineyard; circulation of air without danger of breaking the tender shoots; ease of spraying, pruning, cultivation, and harvesting; ease of laying down in winter; its construction is cheap and durable." The main trunk should be trained at an angle of 45 to 60° to make it less resistant to laying down.

The munson system is highly recommended by several experiment stations, especially in the southern half of the United States, where on account of its perfect adaptation to very hot summer climates, in which the rainfall is often

very heavy for short periods, it is the most desirable system. Regent W. E. Blackburn of Anthony, who has used this form of training for a number of years on a considerable number of varieties, highly recommends the same.

The fan system, requires the growth to be cut back to two or three buds at the end of the first season. The next summer the new shoots are tied to the wires but all flower clusters must be removed, or the vigor of the vine will be much impaired. The third year, the vine may bear a light crop, if it makes a strong growth the second summer.

For the munson system all growth is cut back to two or three buds at the end of the first season's growth. The second summer a single shoot is allowed to grow and is trained by a stake or string to the middle or lower wire. Here it is fastened and trained along the wire horizontally. In the fall the growth is cut back to a point several buds above the point where the vine reaches the lower wire. Not more than three to five bearing shoots are allowed to grow the following spring. If the growth of the vine has not been strong, it is advisable to cut all growth back to two or three buds from the ground, thus delaying the fruiting another year. At the end of the third fall two bearing canes of six to ten buds each may be left, extending in each direction along the lower wire. All shoots starting from the trunk below the lower wire should be removed as soon as they appear.

The main trunk of the vine should be renewed every six to eight years in order to keep the vine in vigorous growth. About four years previous to the renewal, a shoot starting near the ground is allowed to grow during the season. In the fall it is cut back to two or three buds. Next year one shoot is allowed to grow and is trained to the trellis. When large enough to support a crop, the old trunk is cut off near to or below the ground.

Pruning.

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To avoid confusion, a leafy branch of a grape vine is called a shoot. A ripened shoot is called a cane. A branch two or more years old is called an arm. The principle of pruning lies in the fact that the fruit is born on shoots arising from the ripened cane of the previous season's growth. Whatever the training, only well-ripened, firm, smooth canes of medium thickness should be left at the fall pruning for the production of bearing shoots the next season. If the canes have many strong laterals, as often happens, with strong growing varieties, then the best fruit buds will be found on these laterals. Therefore, instead of removing these laterals from the canes intended for next years' fruit, they are shortened to one to three buds each. This method is very important as some extra strong growing, heavy fruiting varieties have been condemned as light bearers simply because the laterals were removed, consequently leaving but few good buds to produce the next crop.

Extra vigorous varieties require longer bearing canes than weak growers. The most fruitful buds on strong growers are some distance from the trunk, while on weak growers they are rather near the trunk. Weak growers should have the canes intended for the following crop cut back to about two to four feet in length, while strong growers may be left from five to eight feet in length.

On the best canes every bud should produce an average of two clusters of fruit. To avoid over-bearing, the total number of buds left should be carefully considered. If the variety is a strong grower and naturally produces small clusters, the number of buds required may be relatively large. A variety forming large clusters such as Catawba, which is only a moderate grower, will require but few buds for a full crop. In a locality where the vines are subject to winter-killing or are liable to be injured by late spring frosts, the number of buds left should be about twice as large as is really needed for a crop. After danger of frost is over the surplus shoots may easily be pulled off. An estimate of the number of buds actually needed for a crop by representative varieties would be :

20 to 50 buds per vine for Concord,
20 to 25 " " " " Delaware,
12 to 20 " " " " Catawba.

Ten per cent or more should be allowed for barren shoots and worthless buds.

Summer Pruning.

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This consists in pinching off the tips of all the bearing shoots and in removing all barren and surplus shoots as soon as they appear. These surplus shoots are a serious drain upon the fruitfulness of the vine. Summer pruning is very important in this state. It is by this means that a sufficiently dense growth of shoots can be secured to protect the fruit from the hot sun and from birds. Opinions differ as to the best time to summer prune. The weight of opinion seems to favor the removal of the tips of the young shoots one or two joints beyond the last bunch. In order to check the vigorous shoots and aid the more tardy buds in their development, and to injure the vine as little as possible, this removing of tips should be done as soon as possible, before the vine is in full bloom. This encourages the early forming of laterals which aid in forming a dense canopy of foliage. In summer pruning it is necessary to leave from two to four shoots which start from or near the trunk. These should not be pruned but should have their flower buds pinched off as soon as they appear, since these shoots are desired for next year's fruit and must make a strong growth. This point is strongly emphasized by Mr. T. V. Munson, the best known authority on grape culture, in the South. In regard

to the benefits of summer pruning when practiced on vines trained to the Munson trellis, the testimony of Regent, W. E. Blackburn, of Anthony is valuable. Mr. Blackburn has had a wide experience in grape growing in Southern Kansas, where in spite of heat and drought he has succeeded in growing many of the best varieties successfully. He says; "I always summer prune the American sorts; being on the Munson canopy trellis, I summer prune when the strongest shoots reach the ground on either side, (the horizontal wires being five feet six inches from the ground) : At this time three fourths of the shoots are about half way to the ground. By taking a sharp corn-knife and cutting off two feet below the wire on each side it practically tips the shortest lengths, forces out side growth which protects the fruit from sun-scald and birds and allows a free circulation of air under the vines. By having the foliage as a flat table where it receives the sun all day, and an abundance of pure air circulating about the fruit and through the vines, fruit of the highest quality is produced. I do not think this high quality, especially in the wine grape, can be produced by the vertical system of training and pruning".

Uneven Ripening.

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This has been one of the serious draw-backs to grape growing in this state. The popular Concord and Worden together with some other choice varieties have suffered

the most from this trouble. The causes seem tolerably certain to be heat, drought, and over-bearing and also insufficient cultivation. This trouble seems to be more or less inherent in those varieties derived from the eastern Fox-grape, (*Vitis labrusca*). This wild species is a native of the Eastern States and has its native habitat in rather low, moist lands. Some of our most popular grapes, such as Concord and Worden, are derived from this species and are consequently not well adapted to our dry, hot climate.

Observations in a rather large Concord vineyard the past season seems to indicate that a thrifty Concord vine cannot safely bear more than thirty to forty clusters, while a Worden should be limited to twenty-five or thirty. Many vigorous vines ripen twenty to forty clusters perfectly. This is equivalent to from eight to eighteen pounds. Some vigorous vines bearing twenty to thirty-five pounds ripen their fruit so unevenly as to unmarketable except as jelly fruit. All weak vines had unevenly ripened fruit. This vineyard had excellent care in cultivation and spraying and the season's rainfall was greater than normal. All varieties show a tendency to ripen unevenly when allowed to over bear. The Oklahoma Experiment Station recommends the Munson trellis as a remedy for uneven ripening. By giving the fruit a uniform exposure to heat, light, and air, this system of training may lessen this evil to a

considerable extent.

Cultivation.

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The grape responds readily to thorough cultivation. From the time the vineyard is planted it should be plowed at least once each season to a depth of four to five inches as soon as possible in the spring and immediately harrowed, to prevent drying out. A one-horse plow with a short padded single-tree is about the only implement available for the spring stirring. The large two-horse plow leaves the ground too much ridged and furrowed.

The summer hoeing can be greatly lessened by means of a cultivator made with two gangs of shovels. These gangs are set on the frame so as to leave about eighteen to twenty-four inches of blank space between them. A cultivator this widened allows cultivation close to the row. A good mechanic can remodel a one-horse cultivator into such an implement.

Cultivation should follow as soon after each rain as the condition of the soil will permit and again at intervals of ten days or less. Late cultivation should not be practiced as it tends to encourage growth too late in the fall and consequent winter-killing of the immature growth. If the vineyard consists of hardy varieties which are not to be covered after pruning, the space between the rows should be sown to some cover crop such as rye, which is one of the best for

the purpose, about the last of August. This uses the surplus moisture and plant food and encourages early maturing of the wood and thereby lessening the danger of winter-killing. Cover crops also prevent leaching and washing away of the soil and add humus which improves its texture and water-holding capacity.

Injury by Birds.

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Birds are a source of serious ^{loss} in Kansas vineyards. The worst pests seem to be a certain species of Oriole which migrate ^s through the state during August. Among the native species Sparrows and Swallows are the principal offenders, but fortunately these are serious pests only in and near villages and cities. In such places perhaps the only remedy is bagging the clusters. For this purpose two-pound manilla paper bags of medium heavy weight are used. These should be put on just after blossoming. When put on this early the fruit is protected from both birds and fungus diseases. Before putting on the bags they are cut at the lower corners with a chisel to allow the escape of rain water which is almost certain to enter the bags. They are then fastened to the shoot supporting the cluster by means of one or two pins. A leather pad on the finger used in driving the pin is essential. The cost of bagging is from one-half cent to one cent per pound, depending upon the variety and price of labor. With choice varieties

and a market willing to pay a fair price for ^{an} extra quality of fruit, bagging may be profitable.

Poisoning birds cannot be recommended as it destroys valuable species which aid in keeping insect pests in check. In ordinary practice the most convenient method of protecting the fruit is to so train the new shoots that the fruit will be concealed. To this end Mr. Blackburn strongly recommends the Munson trellis. He says; "I believe that in the country it would almost prevent bird damage, except from Swallows. In town the English Sparrow can roost on the bunches and work, but the larger birds are not apt to do that unless very hungry. With the Munson trellis the bunches hang clear and perches for an attack on a bunch are not convenient!" Where the Munson trellis is used, two or even three bearing canes may be left extending in each direction on the middle wire at the fall pruning. This will provide plenty of shoots which, when summer pruned, will provide laterals sufficient to form a dense canopy.

Late Spring Frosts.

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The young shoots and flower buds of the grape are easily killed by frost. As late frost is one of the large problems of the Kansas grape grower, the prevention of frost and the treatment of frosted vines is highly important. Planting on high ground or on slopes near large bodies of water are the usual ways of avoiding this trouble. Some-

times a high trellis serves as a partial protection, especially on sloping ground. Smudges, or filling the air over the vineyard with dense clouds of smoke when a frost is expected is a popular remedy in France where thousands of acres are thus protected. The smudge is made from a mixture of wet and dry straw, grape prunings, or cold-tar burned in shallow iron pans set about thirty feet apart on the windward side of the vineyard. The smudge must be kept over the vineyard until sometime after sunrise. The planting of varieties late in starting is often recommended, but cannot be considered a valuable remedy for this trouble here. Other preventative measures are, irrigating the vineyard or sprinkling the vines or cultivating the ground if moist the evening before frost is expected. The object of this being to raise the dew point by increasing the humidity of the air surrounding the vineyard.

In case a frost wholly or partially kills the new shoots, they must be removed at once, especially if only the flower buds are killed. These shoots are easily and quickly removed. The result will be that the dormant buds on the vine will at once start and set another crop.

Fungus Diseases.

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Anthracnose or Bird's Eye Rot, attacks both leaves and fruit. On the leaves it appears first as dark spots which enlarge. Irregular checks are formed through the dead tissue. On the fruit a circular spot which may be of

different colors and usually having a dark border, appears. The spots enlarge, destroy the tissue, until the seed is often exposed. The berries do not rot, but become hard and wrinkled. The disease often girdles the stem of the fruit cluster, thus destroying it. Anthracnose does not spread rapidly, yet it is one of the most difficult diseases to control. The treatments consists in removing all diseased branches and burning them. After this the vineyard is sprayed as for Black rot. If the disease is established in the vineyard perhaps the only remedy of value is washing the canes in the spring ^{before the buds start.} with the following mixture:

- Sulphate of Iron 110 lbs.
- Sulphuric acid 1 qt.
- Hot water 26 gls.

This mixture is applied when fresh with a swab of rags tied to a stick.

Black rot affects the green shoots and fruit as well as the leaves. On the leaves bright, reddish-brown spots appear. On these spots small black pimples develop. Similar spots develop on the fruit, causing it to become hard, shriveled and black. The diseased fruit adheres a long time to the stem. The treatment consists in removing the diseased fruit from the vineyard and in spraying with Bordeaux mixture as follows:

1. When tips of leaves appear
2. Ten to fourteen days later
3. Just after blossoming

4. Ten to fourteen days after the third treatment
5. Ten to fourteen days later.

Downy Mildew, or Brown Rot attacks nearly every portion of the current season's growth. On the leaves dry brick-red spots appear on the upper surface, while on the under surface are the inter-laced threads of the fungus. These spots spread and may destroy the leaves. The fruit turns dark-brown and becomes soft and shriveled. No variety is entirely exempt, but some are much more susceptible to the disease than others. Remedies are the same as for Black Rot.

Powderly Mildew forms dull-white powdery patches on the upper surface of the leaves and on young shoots. The berries may be attack^{ed} at the same time. This disease is most troublesome in dry weather. Remedies are the same as for Black Rot.

Ripe Rot attacks the leaves, stems and fruit. It is most noticeable on the fruit when the latter is nearly ripe and may continue its destruction after the fruit is picked. On the fruit it appears as reddish-brown spots which finally ^pspread over the entire berry. Small dark, elevated postules then appear which bear the spores. The disease much resembles Black Rot, but differs from it in that the fruit does not shrivel and is easily detached from the cluster.

Insect Enemies.

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The Cane Borer is a small cylindrical beetle which bores into the stems near the base of new shoots. It breeds in dying wood and hence all such wood should be removed and burned.

The grape vine Flea Beetle is a shining, steel-blue beetle, one-fifth inch in length. The adult winters under bark of old vines and under rubbish. It emerges early in the spring and feeds upon the opening buds and young leaves. Eggs are laid on buds or young leaves and hatch in about ten days. The larva are one-fourth inch long, dark-brown, marked with black spots and patches. The remedy consists in spraying well with Paris-green, 1 lb., water fifty gallons, just before the buds begin to swell; when worms appear, spray again with Paris-green, 1 lb., water 150 gals., and the regular Bordeaux mixture. Cover both sides of leaves with spray.

The Grape Fruit Worm is a caterpillar one-fourth inch long which lives within the fruit on which it feeds. After devouring the soft part it passes to another fruit fastening the two together with silken threads. The remedy is to destroy the injured fruit and the cocoons which are to be found on the leaves.

Leaf Hoppers ^often wrongly called Thrips, are about one-eighth inch long, usually of a light yellowish-green color. They are to be found on the vines the entire growing season.

They feed by sucking the sap mainly from the lower side of the leaves. The remedy consists in keeping the vineyard free from rubbish. A prepared shield made by stretching cloth over a frame is often used. This is kept moist with kerosene and carried horizontally between the rows while the vines are agitated. The insect jumps upon this shield and is killed by the oil.

The Grape Curculio, (*Craponius inequalis*) has not yet been a serious pest in Kansas. It is, however, very destructive in some of the Eastern and Southern States, notably West Virginia. This beetle lays its eggs under the skin of the immature berry very much as a plum Curculio does. The young larva soon hatches and feeds upon the pulp and seeds. About eighteen days from the time the egg is laid, the larva leaves the fruit and pupates on or in the ground, usually under clods or rubbish. In two or three weeks the adult emerges and for the remainder of the season, feeds upon the upper surface of the leaves. The adult lives about thirteen months. This insect is readily controlled by spraying, because of the habit of the adults in feeding upon the leaves during the greater part of the growing season. Spraying with a mixture of Paris green, 1 lb., lime sixteen pounds, water 200 gallons, about June 12th and again repeating every ten days until four sprayings are given, has proven an almost perfect remedy at the West Virginia Experiment Station.

Marketing.

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Picking should be done on cool days or during the cool portions of the day. The leaves and fruit should be free from moisture when the picking is done. The clusters should be removed from the vines with a grape shear or a knife. In order that the fruit may be kept several days on the market, it should be placed in thin layers or trays or tables in a cool, dry room. If left in such a place several hours, or until the stems slightly wilt, its keeping quality is greatly improved. Before packing, all imperfect berries are removed with a small shear having short narrow blades.

Only fully ripe fruit should be marketed. The injury done to the market by growers who persist in picking the fruit before it is fully ripe is beyond calculation. The grape does not ripen as do some other fruits after being picked.

For both local and distant market the four and eight pound baskets are convenient and attractive. The extra care required in packing a basket so that the fruit is handsomely displayed with no stems showing on the top, is sure to pay in the end. Poor bunches should not be mixed with perfect bunches. Since a reputation for producing first class fruit, pays it is necessary that ^a grower place on the market only fruit of good quality as well as appearance, and should see that his name appears on every

package. It is also well to have the name of the variety on each package as the demands of the market may then become more definitely known. It frequently happens that a basket containing several choice varieties of different colors will sell readily on a market over-stocked with one variety. This is invariably true during the season that the Concord is ripe. The wide-awake grower will see that his fruit is well advertised before the crop is ripe. It often happens that a fine variety is past its season by the time the trade appreciates its value.

Uses for Surplus Crop.

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Every season produces some grapes which are unsaleable because the clusters are too small or irregular or unevenly ripened. The unevenly ripened bunches, especially Concords find a ready sale in limited quantities for jelly making. The ripened bunches may be used in making a most excellent quality of syrup. One of the most profitable uses of fully ripe, perfect grapes of high quality is in the manufacture of unfermented grape juice. On the market it commands a high price. Its manufacture on a large scale is at present confined mainly to New York, but may no doubt be profitable here when first-class grapes can be regularly produced. On a small scale it can be put up by anyone able to can fruit, as the principle is the same. The process when done on a small scale is something as follows: Clean,

sound, well ripened grapes are crushed and pressed by hand or in a clean cider press. The juice is slowly heated in a double boiler until it reaches 180 to 200 degrees F., but never above 200°. A thermometer should be used; but if not, the heating is continued until the liquid steams but it must not be allowed to boil or the flavor will be much injured. It is then poured into glass or enameled jars and allowed to settle for twenty-four hours. The juice is then carefully poured off the sediment and strained through a clean flannel and put into bottles or fruit jars, filling to within one-inch of the top to allow for the expansion of the liquid in the second heating. These jars are then set in a wash boiler partly filled with water. It is necessary to place thin strips of wood in the bottom of the boiler on which the jars may rest while the water is brought slowly to a simmering heat. The covers and corks should be thoroughly boiled in a closed vessel just previous to using them. The bottles and jars with their contents being thus heated are sealed while very hot. To fully protect the contents from moulds it will be necessary to cover the tops with red sealing wax as soon as possible. To produce a red juice from black grapes, the crushed grapes should be heated to 180° before pressing. The final heating of the juice should be slightly lower than the first heating in order to prevent the forming of sediment. Bulletin No. 24 of the Bureau of

Plant Industry, Dept. of Agriculture, Washington, D. C., contains full information concerning the manufacture of grape juice on a commercial scale as well as a description of its manufacture on a small scale.

Varieties.
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The following list contains some of the best known grapes which are profitable in this state:

Variety	Color	Bloom	Ripe	Perfect or imperfect flowers.
Headlight	red	early	7-25	perfect
Moore's Early	black	medium	8-1	"
Moyer	red	"	8-1	imperfect*
Aminia	black	med	8-5	"
Green Mt.	yel-green	med	8-10	perfect
Diamond	"	med	8-10	"
Niagara	"	med	8-10	"
Potter	black	early	8-10	"
Brighton	red	med	8-14	imperfect†.
Delaware	"	med	8-15	perfect
Beacon	black	med	8-20	"
Concord	"	med	8-20	"
Bell	yel-green	early	8-20	"
Brilliant	red	early	8-25	"
Cynthiana	black	late	9-3	"
Woodruff	red	med	9-4	?
Requa	red	med	9-5	imperfect
Berckmans	red	early	8-4	perfect
Catawba	red	med	9-10	perfect
Ozark	black	late	9-10	imperfect
Lenoir	black	late	9-10	perfect
Gothé	red	med	9-10	perfect
Xlna	----	----	9-15	imperfect
Opal	yellow-green	late	9-15	perfect

* See note under head of "Planting."

Varieties sufficiently hardy to withstand the freezing and drying of our severest winters are: Bell, Concord, Elvira, Moore's Early, Potter, and Worden. All the rest should be covered during the winter. Even these hardiest varieties show some injury from the coldest winters.

The following varieties show sufficient resistance to drought to be recommended for central and southern Kansas: Headlight, America, Beacon, Delaware, Green Mountain, Dracut Amber, Niagara, Norton's Virginia, Klnta, and Fern Munson. This list has been tested by Mr. W. E. Blackburn in his experimental vineyard at Anthony and is recommended by him as adapted to the South-Central portion of the state. He has discarded the Concord on account of its uneven ripening and its excessive acidity in the center of its flesh. From the records of the State Experimental vineyard at Manhattan, and from the opinion of prominent grape growers in other parts of the state, it is believed that the following varieties may be added to Mr. Blackburn's list; for Central and Southern Kansas: Potter, Brighton, Agawam, Herbert, Aminia, Brilliant, Bell, Cynthiana, Berckmans, Elvira, Catawba, Ozark, Lenoir, and Opal.

For the drier western parts of the state the following are believed to be worthy of trial: Headlight, Moyer, Green Mountain, Agawam, Berkemans, Cynthiana, Brighton, Faith, Lenoir, Ozark, and America.

Mr. Munson, of Denniston, Texas, has originated a number

of valuable varieties suited to hot, dry climates. These have not been fully tested in this state. Someone who has an inclination toward experimenting in Horticulture could do his state valuable service by giving these a thorough trial.

Some of the varieties having the appearance, quality, firmness and productiveness required in a market grape are: Headlight, Moore's Early, Aminia, Niagara, Potter, Cottage, Hicks, Brighton, Delaware, Concord, Agawam, Herbert, brilliant, Woodruff, Requa, Berckmans, Catawba, Ozark, Gothe, Klata, and Opal.

The most profitable at present are; Moore's Early, Brighton, Delaware, Concord, Potter, Agawam, Woodruff, and Catawba, provided the locality is favorable.

Those having the finest quality are: Moyer, Aminia, Green Mountain, Niagara, Brighton, Delaware, Agawam, Worden, Brilliant, Requa, Catawba, and Gothe. Of those already named, the most likely to rot before ripe are: Elvira, Diamond, and Lenoir.

The Elvira and Lenoir are excellent jelly grapes but are too low in quality for table use.

The varieties recommended herein are by no means all the best available. They have been, however, thoroughly tested in at least some portion of the state. All growers should be cautioned against the pretentious claims made by some nursery-men for newly discovered varieties.

Winter Protection. ***

This consists in covering the vines after the fall pruning, just before freezing weather, with from five to eight inches of earth. Before covering, it is of advantage to plow the vineyard rather shallow, throwing the earth toward the vines. The vines may then be rapidly covered, with a shovel. One man holds the vine close to the ground while one or two others shovel dirt over it. The vines must be uncovered before the buds swell in the spring. This treatment affords perfect protection from winter-killing.

Fertilizers. ***

Fertilizers are occasionally needed to keep the vines healthy and productive. Unleached manure should be sparingly applied as the excess of nitrogen in such manure over-stimulates wood growth at the expense of fruit and causes winter-killing by inducing growth too late in the fall. Lack of nitrogen is shown by yellowish foliage and scanty growth. When nitrogen is lacking, a thin application of unleached manure is valuable. Otherwise, it is better to use leached manure, wood ashes, or some of the potash and phosphorous fertilizers.

Acknowledgments.

The following works have been freely consulted while writing this paper:

State Experiment Station Bulletins;

Geneva, N. Y., 157, 169, 170, 223, 234.

Ithaca, N. Y., 76.

Morgantown, West Va., 100.

Lexington, Ky., 92.

Manhattan, Kans., 110.

Stillwater, Okla., 59.

Experiment, Ga., 53.

College Station, Texas, 56.

Auburn, Ala., 110.

Columbia, Mo. 46.

Washington D. C., Farmers' Bulletins, 70, 118, 156, 284.

Other works:

Topeka, Kansas, Kansas State Horticultural Society;

"The Grape", by W. S. Barnes.

Kansas City, Mo., Missouri State Horticultural Society;

"47th Report", by L. A. Goodman.

L. H. Bailey, "Pruning Book", and "Principles of Fruit Growing".