

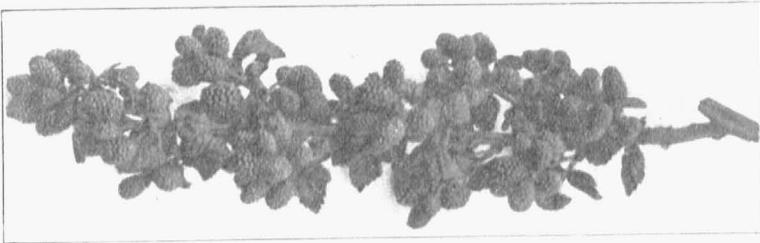
UNIVERSITY OF MISSOURI

COLLEGE OF AGRICULTURE

AGRICULTURAL EXPERIMENT STATION

BULLETIN 231

# Blackberry, Raspberry and Dewberry Culture



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# Blackberry, Raspberry and Dewberry Culture

H. G. SWARTWOUT

**Abstract.**—Recommendations are given for the culture of raspberries, blackberries and dewberries based on recent work at the Missouri Agricultural Experiment Station. Short pruning is recommended for those varieties of blackberries and raspberries which produce their fruit buds close together and close to the bases of the laterals; long pruning for those which produce their fruit buds far apart and far out from the bases of the laterals. The yield of red raspberries has been found to be too low for general commercial planting. Cardinal, a purple raspberry, is recommended as a substitute. Experiments with bordeaux and lime sulphur have shown that raspberry anthracnose can be successfully controlled. Soils, sites, propagation, preparation of the soil, treatment of nursery stock, planting, cultivation, fertilization, pruning, harvesting, packing and the control of insects and diseases are discussed.

Blackberries, raspberries, and dewberries can be successfully grown in practically every section of Missouri and should be more extensively planted both for sale and for home use. The area devoted to the commercial culture of these fruits is very small, yet the demand especially for raspberries greatly exceeds the supply. The abundance of wild blackberries is probably largely responsible for the lack of interest in the culture of blackberries and dewberries, but with the rapid disappearance of wild blackberries as more and more land is cleared and put under cultivation and with the introduction of improved varieties, these fruits should prove commercially profitable.

There are practically no commercial plantings near a large number of the smaller Missouri cities and towns, each one of which would consume locally all the fruit produced from several acres. They are many opportunities for locating large commercial plantings near cities or along railroads that have direct connection with large consuming centers.

There are, of course, a number of special problems encountered in the production of bush-fruits. The berries are a soft, perishable product which must be handled carefully and quickly. The fruit ripens rapidly and in a comparatively short time, necessitating large picking crews; and it moulds or sours quickly, making immediate disposal imperative. The bushes are short-lived, shallow-rooted and subject to injury from summer drought.

On the other hand, there are two big advantages in growing bush fruits: Returns can be expected within two or three years, and large

returns are possible from an acreage so small that one man can easily handle the entire plantation, except at picking time. -These two advantages make it possible to conduct the business upon high priced land advantageously located for quick and easy disposal of the fruit. It is not necessary, however, that the plantation be close to the market, since with careful handling and under proper refrigeration blackberries and raspberries can be successfully shipped to markets from 24 to 36 hours distant which makes possible the use commercially of cheap land some distance from the larger consuming centers.

### TYPES OF THE BRAMBLES

Three general classes or types of raspberries, the black, red and purple are grown commercially in this country. The black and red raspberries represent distinct species, while the purple is a hybrid of the two. Of these the black raspberry, known also as the blackcap, is the most important for commercial planting in Missouri, adapting itself to a wider range of conditions. It also produces berries that are firmer, more

easily picked, handled and marketed and adapted to more varied uses than the red or purple raspberries. A raspberry bearing yellow berries is sometimes grown for special markets and as a curiosity, but is not suitable to general commercial culture.

The commonly cultivated varieties of blackberries are for the most part chance seedlings of our native wild blackberries. As a result of the natural crossing and recrossing of the different species, the varieties show such a mixture of characters that they cannot be easily classified



Fig. 2.—Fruit cluster of Robinson blackberry.

according to the species from which they came. Our dewberry varieties have likewise originated from native species. Blackberries and dewberries hybridize easily and a number of blackberry-dewberry hybrids are now under cultivation.

### CHARACTERISTICS

Under favorable conditions for development the black raspberry produces strong, vigorous, arched, blackish-purple canes with stiff thorns. The Cardinal and related varieties of purple raspberries make the same general type of growth as the black raspberries, but the canes are lighter in color and more vigorous. Both produce their new shoots from underground buds on the old canes, near the bases of the original plants.

The red raspberry canes are light brown to reddish brown in color and generally rather slender and upright in habit of growth. The Cuthbert, as grown on the Station grounds, often branches, producing long laterals, which do not have the stiff arched appearance of the black and purple raspberries, but are rather loose and straggly. The red raspberry produces new canes, both from buds near the bases of the old plants and from adventitious buds on the roots. This sucker-producing habit is undesirable, sometimes making it difficult to keep the plants within bounds.

The blackberry has the same sucker-producing habit as the red raspberry, and anyone who has tried to exterminate a blackberry patch knows with what tenacity it will hold on and continue to send up shoots from every root or piece of root left in the ground.

The blackberry canes have a decidedly upright habit of growth, while the dewberry trails on the ground. The hybrids between the blackberry and dewberry might be classed as semi-upright or semi-trailing. Some of these hybrids are rather upright with fairly long laterals; while others, like the McDonald, are only slightly upright with long trailing laterals, reaching in some cases the length of dewberry runners.

The brambles bear their fruit in terminal clusters on lateral shoots arising the same year the fruit is produced. These shoots arise from buds on the main canes and laterals which grew the year before. No further growth is made after the fruit is produced, and the canes die soon after the crop is matured. The ordinary varieties are perennial plants with biennial canes, a new crop of canes being produced each season to replace those which have fruited and died.

### PROPAGATION

The black and many of the purple raspberries naturally propagate themselves by means of plants produced at the tips of the canes; that is,

by natural tip layering. In order to secure new plants of such varieties it is only necessary to make sure the tips are covered with soil in early fall. This can be most conveniently and easily done by cultivating the bed thoroughly in August. A large percentage of the tips will be covered either during cultivation or through the action of subsequent rains. The rooted tips are generally left attached to the parent plants until the following spring, when the canes are cut several inches above the ground and the rooted tips lifted, packed and stored, or set directly in the field.

The red raspberry and such varieties of the blackberry as sucker freely are propagated by means of the suckers or shoots which grow from the roots. Shoots which are one year old are best, although young succulent sprouts can be used if a portion of the mother root is removed with the shoots.

Varieties of purple raspberries which do not produce new plants at the tips of canes and varieties of red raspberries and blackberries which do not sucker freely are usually propagated by means of root cuttings. For this purpose roots about the size of a lead pencil are best. They are cut into lengths of three or four inches, packed in damp, not wet, sand or sawdust and stored until spring where they will not freeze. They are then dropped 5 or 6 inches apart in shallow furrows and covered with about three inches of loose, sandy soil. No buds are on the roots when cut, but adventitious buds develop later, and by spring one or more of these buds can be seen. Generally, after one year the plants will have made enough growth that they can be dug and set in the field.

The dewberry may be propagated by several methods. Tip-rooted plants, however, have the best developed root systems and are therefore preferable to plants propagated by other methods.

### SOILS AND SITES

**Soils.**—The brambles do well on a wide range of soil types. In general, however, the land should be moderately fertile and well supplied with humus. If the soil is not already well supplied with humus, it can be added by plowing under cover crops, or by the addition of barnyard manure. Although the brambles must be well supplied with water, the soil in which they grow must be well drained.

The black raspberry will do well on a greater variety of soils than any of the other raspberries, but it does best in a rich clay loam top-soil with a more clayey subsoil which is retentive of moisture. It will, however, do well on a rather sandy soil well supplied with manure and water. In fact, a better yield will be secured on such a soil well handled than on the ideal soil poorly managed.

The red raspberry thrives on a lighter and more sandy soil than the black, but does well on any soil from a sandy to a clayey loam, provided

other conditions are suitable for its growth. The purple raspberry does best on a silty loam soil.

The blackberry requires a rather clayey loam soil of moderate fertility. A sandy or gravelly soil, unless underlaid with a porous clay subsoil which is retentive of moisture is not suited to the growing of the blackberry. Such a soil becomes too dry just at the time when the blackberry is maturing its crop and in need of a great amount of water.

The dewberry is found growing wild on rather sandy well-drained soils and it is on the more sandy types of soils such as the sandy loams that it will probably do its best under cultivation.

**Sites.**—The most important consideration in the selection of a site is drainage, both atmospheric and soil. Since the brambles usually bloom late enough to escape spring frosts, atmospheric drainage is not so important from the standpoint of spring frosts as from the standpoint of winter injury. If the plantation is located on a hillside high enough that the cold air can drain away to lower lands, the amount of winter injury to the canes will be found to be less than where the plants are located in "pockets" or on low lands. A location which has good atmospheric drainage generally has good soil drainage though this is not necessarily true. All wet spots should be avoided, as the canes are more liable to winter injury in such places.

If a northern exposure is available, it should be used, as such a slope is cooler and more moist than other slopes. This is, however, the least important factor in the selection of a site and should be the last insisted upon when it is impossible to find the ideal location.

### PREPARATION OF THE SOIL

Preparatory to planting it is advisable to grow on the land some intensively cultivated or hoed crop to rid the land of weeds; or if the land is lacking in humus, better still to plant it to some cover crop to be turned under. Plowing may be done either in fall or early spring but preferably in the fall. The land should be deeply plowed, especially the heavier soils, and well pulverized. Plowing to a depth of 6 to 8 inches, using a steep moldboard to pulverize the furrow slice, followed by a thorough disking and harrowing will put the land in good condition. If a cover crop is not turned under it is advisable to work in a liberal supply of manure, as the bed will probably stand five to ten years and humus producing materials can be more easily added to the soil at this time than after planting.

### NURSERY STOCK

Very often in putting out a new plantation a grower will select plants from his old one, or from his neighbor's. This may be done with-

out danger, if the old plants are healthy, vigorous and practically free of disease; but generally it is better to buy nursery stock from reliable nurserymen who make it a practice to grow their plants from young and healthy stock.

Plants affected with crown gall should be discarded. Such plants are usually weakened and do not make as vigorous growth and are less productive than disease-free plants. Crown gall can be recognized by the knots or warty swellings which appear on the roots or about the crowns of the plants.

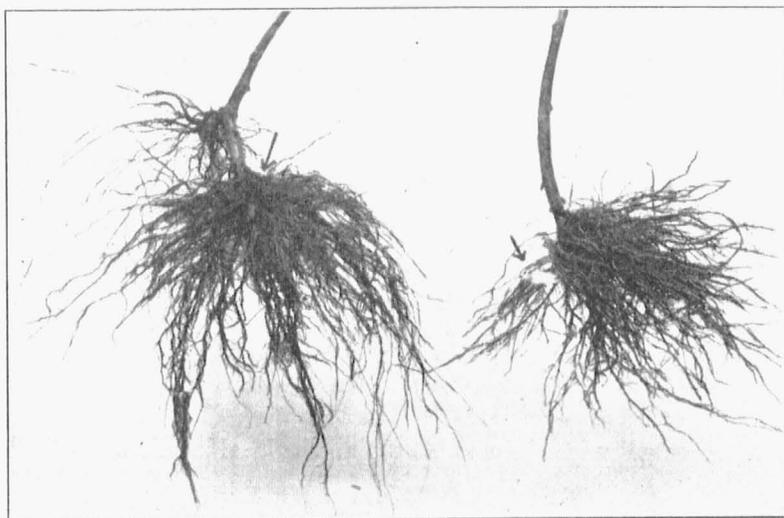


Fig. 3.—Well rooted black raspberry plants showing young shoots arising from the crowns of the new plants.

If the plants are not to be set as soon as received they should be unpacked and heeled-in to prevent drying out or rotting. For heeling-in a trench is dug with the back side sloped at an angle of about 45 degrees and deep enough to permit the plants being covered as deeply as they stood in the nursery. The bundles should be opened and the plants spread one layer deep in the trench and covered with loose, moist soil worked well down among and packed about the roots. If the plants are dry they should be allowed to stand in water for several hours before heeling-in.

#### SETTING THE PLANTS

Before setting, if the day is warm and sunny, the roots should be dipped in a puddle of clay and water to protect them from the drying effects of the sun and wind and, in the case of tip-rooted plants, the old

canes should be cut back to 4 or 6 inches to lessen the number of flowering shoots which would weaken the small and poorly established plants. No harm will result if the canes are cut shorter since their main purpose is to mark the rows after setting. In fact, if the canes are affected with anthracnose it would be better to remove them entirely in order to remove the source of infection of this disease. The shoots of blackberry and red raspberry plants should be cut back to 6 or 8 inches. For protection against dry weather it is advisable to set the plants a little deeper than they stood in the nursery. Care should be used, however, with the black and purple raspberries, not to set the crowns of the plants deeper than 3 inches unless the soil is quite sandy. The shoots of these plants are very tender and if set too deep in a heavy soil will not be able to push their way to the surface. Ordinarily, red raspberry and blackberry plants are set 3 to 4 inches below the surface of the ground. On land that drains well, an excellent method of planting is to set the plants in the bottom of a 6 or 8-inch trench, the plants at first being covered with only about 2 inches of soil. As the new shoots grow the trench is gradually filled as the plants are cultivated. By planting in this manner deeply rooted plants are secured, with canes arising from crowns so deep that they are not easily broken down by winds.

The best time for setting plants is in the early spring, but they can be planted in the fall, if mulched with a layer of straw for protection during the winter. It is very important that they be set early in the spring before growth has started. If setting is delayed too long there is danger of breaking off the shoots or their tender tips. Furthermore the roots which have started growing will be injured in moving and drought may set in before the plants have become established.

The actual setting may be done, either by digging holes into which the plants are set; or by pushing a spade into the ground, then pushing it forward and dropping the plants into place, removing the spade and tamping the soil firmly about the plants, much as sweet potato slips are set.

### PLANTING DISTANCES

As grown in Missouri, raspberries and blackberries are generally set in rows 6 to 8 feet apart with the plants 3 to 4 feet apart in the rows. Distances of less than 6 feet between rows will usually result in crowding, while distances greater than 8 feet generally involves a waste of land. Red raspberries and blackberries which are grown in hedge rows may be planted closer than 3 feet apart in the rows if plants are obtainable at a reasonable price, since the closer the plants are set the sooner will a solid row be formed. Black and purple raspberries, however, which grow

in clumps are best planted about 4 feet apart in order to allow the individual plants sufficient room for proper development. When grown in rows dewberries are generally set 3 feet apart in rows 6 or 7 feet apart. When grown in hills, they are usually set 5 feet apart each way.

### CULTIVATION AND MULCHING

The purple and black raspberries do not spread, but grow in clumps from the plants originally set. Consequently, it is no trouble to keep the plants within bounds and the rows as originally set. The red raspberry and blackberry, however, may send up shoots anywhere from the roots and with them it is sometimes quite a problem to keep the middles clean and the rows straight and of proper width. This can, however, be accomplished in large measure by shallow plowing in the spring, throwing the soil away from the rows. Plowing to the depth of 3 or 4 inches is sufficient. In no case should it be deeper than 4 inches.

Cultivation with a spring-tooth cultivator or five-shovel cultivator should begin at once after the plowing, keeping up a constant and thorough stirring of the soil until picking time. If plowing is not practiced, the soil should first be worked with a double-shovel cultivator after which the spring-tooth or five-shovel cultivator is used. This should be done early enough to keep ahead of weeds and suckers.

It is desirable, to maintain a dust mulch, but cultivation should be shallow, especially next to the plants, as some of the roots are so near the surface that they will be injured by too deep cultivation. This is especially true of the black and purple raspberries. During the ripening season cultivation is sometimes discontinued. A better practice however, is to cultivate a strip between the rows after each picking.

Thorough cultivation and conservation of moisture in the case of the blackberry can hardly be over-emphasized, as the blackberry is supporting and maturing a heavy crop of fruit whether the weather is normally the hottest and driest.

To keep the weeds out of the rows at least two hoeings will be necessary, one in the spring and one in midsummer. If the ground is very weedy, one or two additional hoeings are advisable.

Cultivation should stop about the middle of August, since cultivation in the fall leads to the development of new growth and prevents the maturing of the canes. Some growth of grass and weeds will of course result, but this growth will aid in drying out the soil and in maturing the canes.

For the home garden the berry patch can be mulched to good advantage. Straw, hay, leaves or similar material applied to the depth of 4 to 6 inches will prove satisfactory. Such a mulch keeps down weeds,

checks evaporation and takes the place of cultivation. On account of the cost, its use however, cannot be recommended at present for large commercial plantings.

### FERTILIZATION

The question of fertilization is a very much disputed one, due doubtless, in large part to the wide variation of the soils on which brambles are grown. Unfortunately, there are not at present enough reliable experimental data to warrant any definite fertilizer recommendations. Each grower must determine the needs of his particular soil by the application of fertilizers to small plots, noting the effect upon cane growth, yield and quality of fruit.

Of the fertilizers used, stable or barnyard manure is the most popular adding nitrogen and humus to the soil, both of which favor the development of strong, vigorous canes. It should be applied during late fall or early spring. However, the use of commercial fertilizer containing large amounts of quickly available nitrogen or the excessive use of barnyard manure apparently is dangerous, as it causes excessive vegetative growth at the expense of fruit production. The usual application of barnyard manure is from 5 to 10 tons per acre.

### PRUNING AND TRAINING

Every spring raspberries, blackberries and dewberries send up new shoots from the crowns or from adventitious buds formed on the roots. These replace the fruiting canes which die soon after the crop is matured. The method of pruning and training these shoots varies with the kind of fruit and variety.

**Black and Purple Raspberries.**—The black raspberries and most of the commercially grown varieties of the purple raspberries send up new shoots from buds near the bases of the previous year's canes or from latent buds on older portions of the crowns. To prevent these shoots from developing into long, slender, weak canes which will bend or break to the ground with a heavy crop, the tips are pinched out of the new shoots as soon as they have reached a definite height. With black raspberries the shoots are pinched when 18 to 20 inches long. With purple raspberries, which usually grow more vigorously, the shoots are not pinched until they have reached a height of 24 to 26 inches. Pinching stops length growth, causes a thickening and strengthening of the shoots and induces the production of laterals near the tops. On these laterals the buds that are to produce next year's fruiting shoots develop. It is important that the pinching be done as soon as the shoots reach the proper height. If pinching is delayed and the shoots are cut back later,

the buds left will be comparatively inactive and laterals will be slow in starting, weak, poorly developed and improperly matured at the end of the season.

Many more fruit buds will be produced on the laterals than the plants are capable of properly developing. To prevent overbearing, these laterals must be shortened. This is done preferably in early spring just after the buds have started into growth. At this time dead and weakened buds can be easily detected and only strong, vigorous ones left.

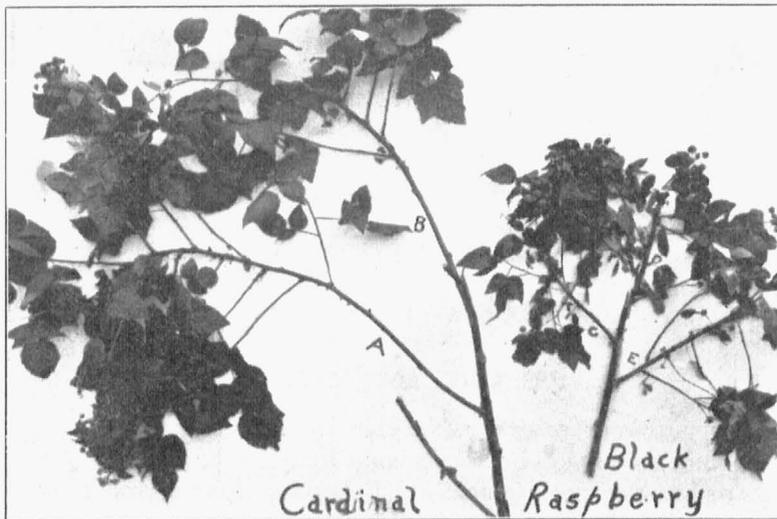


Fig. 4.—Comparison of the fruiting habit of the Cardinal (at left), a purple raspberry, with that of the black raspberries (at right). The Cardinal produces its fruiting shoots well out on the laterals. In pruning, therefore, the laterals should be left fairly long. The black raspberries produce their fruiting shoots close to the bases of the laterals, and in pruning the laterals should be cut comparatively short.

The length to which the laterals should be shortened depends on the fruiting habit of the variety. Cardinal as grown on the Station grounds at Columbia produces fewer buds near the bases of the laterals than the black raspberries. Averages of a number of counts show 6.1 buds on the basal 8 inches of Cardinal laterals as compared with 9.2 buds on black raspberries. Moreover, many of the buds near the bases of vigorous Cardinal laterals are poorly developed and either fail to grow or produce little or no fruit. Thus, the basal portion of vigorous Cardinal laterals is relatively unproductive and, to insure a heavy crop, the laterals must be left fairly long. On small laterals, however, especially secondary laterals, the buds are close together and well developed, the number found on the basal portion of such laterals being practically

identical with the number found on black raspberry laterals. No great difference was found in the fruiting habit of the different black raspberry varieties studied. Though no hard and fast rules can be laid down as to how long the laterals should be left, in general black raspberries should be shortened to 12 to 18 inches, while those of purple raspberries like Cardinal should be left 18 to 24 inches long.

Shortly after the fruit is produced the old canes die. To give the new shoots more room and sunlight and to check the spread of disease and insect pests, they should be removed as soon as the crop has been

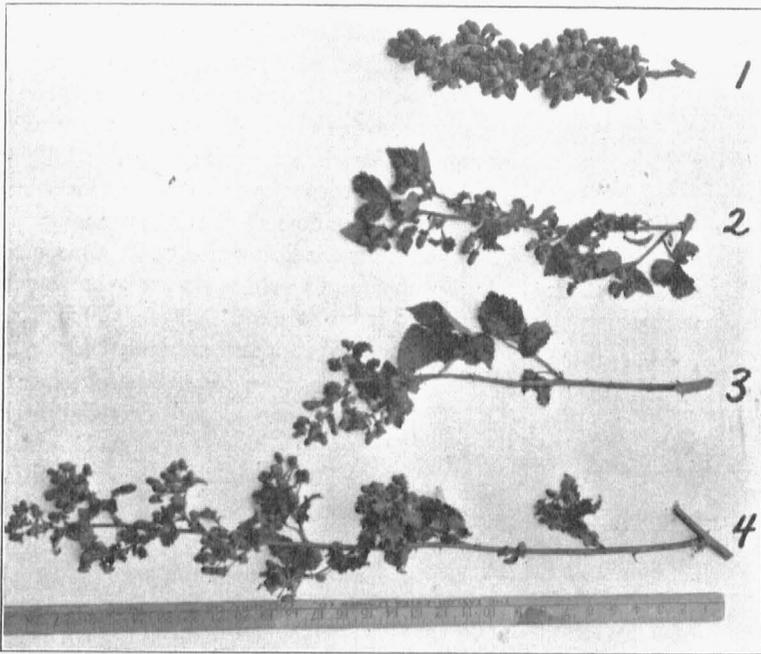


Fig. 5.—Comparison of the fruiting habits of different varieties of blackberries. Varieties which produce their fruit buds close together and close to the bases of the laterals like Early Harvest and Robinson (1 and 2) should be pruned short; those which produce their fruit buds some distance from the bases of the laterals and far apart as Snyder and El Dorado (3 and 4) should be pruned long. Close pruning of such varieties will greatly reduce the crop by removing most of the fruit buds as shown at 3.

harvested. The new shoots should also be thinned at this time to leave only 4 or 5 strong, vigorous, healthy shoots to each plant.

Ordinarily no method of trellising is used in growing raspberries in Missouri, but it has been found advisable on the trial grounds at Columbia to support the canes of the black and purple raspberries with a horizontal trellis. If this is not done and the plantation is exposed to strong winds, many of the new shoots are likely to be broken down.

This will have a decided effect on next year's crop, as it is then too late for these shoots to be replaced by others.

The trellis is constructed by placing posts 24 to 30 inches in height at intervals of 20 to 30 feet in the rows. Cross arms of 2 x 4's about 18 inches long are then nailed to the flat tops of the posts. No. 10 or No. 12 smooth galvanized wire is stretched along both sides of the row and fastened to the ends of the cross arms.

Such a trellis is easily constructed, permanent and of neat appearance. It prevents the new growth from being whipped about by the wind or bent over and broken, and it supports the fruiting canes, holding them out of the mud and dirt and out of the way of cultivation.

**Red Raspberries.**—Red raspberries send up new shoots from the crowns of the old plants and from adventitious buds formed on the roots. Unlike the black and purple raspberries these shoots are not pinched. Pinching the shoots of red raspberries leads to greater winter killing of the canes and as they naturally suffer from winter killing in this section, pinching will generally result in a serious loss of fruiting wood.

In the spring after growth commences living and dead canes can be readily distinguished. Dead, injured and weak canes are then removed and the remaining ones thinned to leave strong, vigorous canes 8 to 10 inches apart. The canes are not pruned unless very long and slender,

when they should be cut back to one-fourth to one-third their length to prevent their bending or breaking to the ground with their crop. As soon as the crop has been harvested the old canes should be removed to make way for the new shoots.

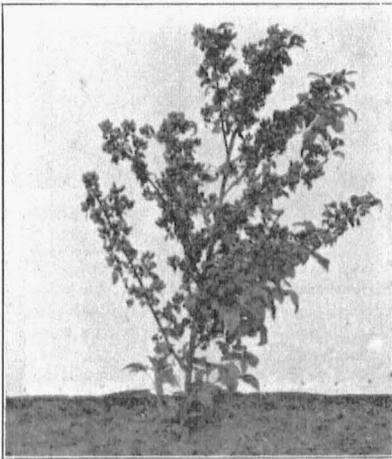


Fig. 6.—A blackberry cane which was pinched at the proper height. Note the short, stocky growth of the cane with well distributed laterals, enabling the cane to support a heavy crop of fruit.

**Blackberries.**—Blackberries like red raspberries, send up new shoots both from buds at the crowns of old plants and from adventitious buds formed on the roots. These new shoots are pinched when they have reached a height of 20 to 30 inches, depending on the variety. The more vigorous growing the variety and the stockier the shoots, the greater the height at which the shoots are

pinched. As with the black and purple raspberries, the pinching should be done as soon as the shoots have reached the proper height.

Early in the spring the smaller and weaker canes should be removed and the remainder thinned to stand on the average 8 to 10 inches apart. The smaller and weaker laterals also should be removed and the stronger ones shortened. The length to which they should be shortened depends on the fruiting habit of the variety. On the basal 8 inches of Early Harvest laterals an average of 8.6 buds has been found and almost as large a number on laterals of the Robinson. On the other hand, on Snyder, Eldorado, Taylor and Rathburn there were 4.5, 4.4, 3.9 and 5.4 buds respectively, or only about one-half the number of buds found in the same region on Early Harvest and Robinson. The number of buds increased slightly farther out on the laterals but approximately the same ratio was maintained between the two



Fig. 7.—A blackberry cane which was pinched too high. Such a cane becomes top-heavy and is likely to bend or break to the ground under a heavy load.

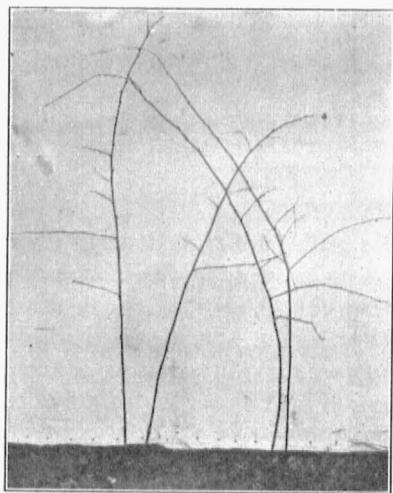


Fig. 8.—Blackberry canes which were not pinched. Note the long, slender growth of the canes and the small and poorly developed laterals.

groups of varieties. With varieties of the second group it is therefore necessary to leave longer laterals or a greater number. Since these varieties produce comparatively few laterals it is usually necessary to leave them longer. When possible, however, it is advisable to cut the laterals comparatively short and leave a greater number, since very long laterals with a heavy crop near the tip are likely to split off from the main canes. In general, Early Harvest and Robinson laterals are shortened to 10 to 15 inches, while those of Snyder, Eldorado, Taylor and similar varieties are left 18 to 24 inches long. As in raspberries the old canes should be removed after the crop has been harvested.

**Dewberries.**—The common method of handling dewberries in Missouri is to allow the canes to trail on the ground. This is cheaper than tying or training to stakes or wires, but picking is more difficult and recent investigations at this Station indicate that the yield is less than for plants trained to stakes. When so trained the new shoots are allowed to grow on the ground and to lie there over winter. In the spring before growth starts they are gathered together in a bundle, wound around the stakes, which are usually 5 or 6 feet long, and tied at two or three places. The ends of the canes are cut off at or a little above the tops of the posts. After the crop has been harvested the bearing canes are removed. When the canes are allowed to trail on the ground the only pruning done is the removal of the old canes after fruiting.

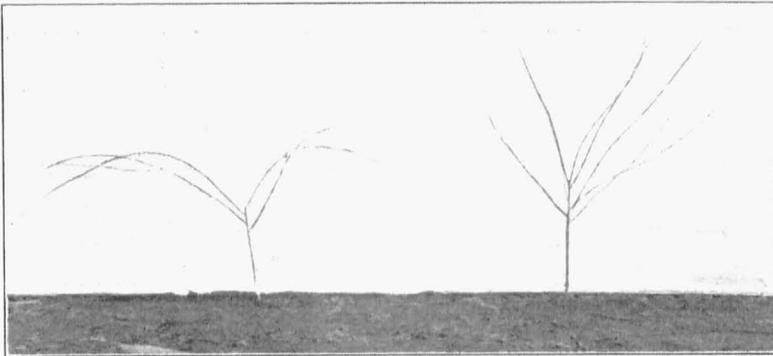


Fig. 9.—Well developed black raspberry cane (left) and blackberry cane (right) produced by proper pinching. The pinching stopped length growth, caused a thickening and strengthening of the main canes and the production of several strong healthy laterals.

### LIFE OF PLANTATION

The length of time a plantation will remain profitable depends upon soil conditions, diseases and care. If the moisture supply is inadequate or if the plants are allowed to overbear, few, if any, new canes are developed and the plants are weakened or killed. This is particularly true of the black raspberry. Under present conditions and cultural methods the commercial life of a plantation in Missouri is from five to ten years.

### HARVESTING

Raspberries are ready to pick as soon as they will separate readily from the receptacle. At that time they are not so easily bruised in picking and handling, will hold up better under shipment and are not so subject to the attacks of fungi as when allowed to become fully ripe.

Blackberries do not reach their highest state of perfection until fully ripe and to be at their best must be eaten soon after picking. As the

fruit colors before it is ripe, it should be allowed to become soft before picking for home use. For shipment the blackberry should be picked as soon as it separates fairly easily from the cluster.

In picking, three fingers should be used and but few berries should be held in the hand at one time. The fruits should be placed, not dropped into the containers. They should be picked directly into the pint or quart boxes in which they are to be marketed. Additional handling of these soft fruits will result in broken skins which detract from their appearance and hasten deterioration.

For picking, trays or carriers holding from four to six boxes should be used. The use of carriers holding more than six quarts is not to be recommended, as the berries first picked are exposed to the sun so long that the fruit becomes overheated and damaged. Blackberries when exposed to the sun for long periods, turn red and develop a bitter taste.

All grading, except where the packer separates the boxes of fruit according to the picker or the appearance on top, is done by the picker. The picker should reserve one or two boxes in the carrier for the decayed over-ripe, green, misshapen and injured berries. The carriers when full should be placed in the shade under the plants, to be gathered up later by a person whose duty it is to bring in the full trays, or they may be brought directly to the packing sheds by the pickers.

The best time for picking is in the morning as soon as the dew is off and while it is still cool. At this time the berries are cool, and the pickers do much better work than in the heat of the day. Not only are warm berries harder to cool, but the thin membranous covering is weaker and more easily broken in picking and handling.

### PAYING THE PICKERS

Two general methods are used in paying pickers; one by the hour, the other by piece work. Both have their advantage and disadvantages. The great disadvantages in piece work include the tendency of the pickers to fill their boxes as fast as they can with little regard to grading and careful handling and their fondness for picking where the berries are the thickest and leaving the scattering fruit. Most pickers must be watched constantly and checked to secure clean picking and careful handling. In order to hold pickers at the end of the season when the berries become scattering it is often necessary to give them more per quart or give a bonus to those who stay throughout the season. On the other hand, paying by the hour is expensive, as few if any of the pickers will work at a maximum speed.

There are three general methods of keeping a record of the number of berries gathered by each picker. The first and least satisfactory is the daybook system where the foreman merely enters the picker's name,

the date and the number of quarts picked. The two better methods are the check system, and the punch-card system. In the check system each picker is given a check for each quart or tray brought in. These checks are kept by the picker and turned in on pay day. They are best made of some metal such as aluminum and stamped with the design of the fruit being harvested; they are generally in denominations of 1 pint or 1 quart, and 1 tray (4 to 6 boxes). In the punch-card system each picker is given a card much like a shipping tag in outline. On this card is written the picker's name and the rate per quart he is to be paid, and around the margin are printed numbers which are punched according to the number of quarts brought in by the picker. In using this system the punch must be changed frequently to prevent the picker securing and using a punch of like design. This system is used with various modifications as to arrangement, the length of time the cards will last and the number of cards used.

With any system frequent pay days are necessary to prevent discontent and to guard against mistakes.

### PACKAGES

The 24-quart crate as used for strawberries is perhaps the best crate in which to market dewberries and black raspberries. A 32 or 48-quart crate might be used when marketing locally, but for shipping such crates are too large. The added weight of fruit above tends to crush the berries in the boxes near the bottom. Furthermore the 24-quart crate best meets the demands of the customers buying in crate lots.

The American style one-quart box is one of the best and most popular of the quart boxes. They are made up at the factory and shipped nested, and there is no expense or inconvenience of making up at home. They fit into the American 24-quart crate in three tiers of eight boxes each, with a divider between each two tiers.

The purple and red raspberries are best marketed in shallow pint boxes. They are rarely marketed in quart boxes, except where the markets are conservative and demand the quart box. The weight of the extra berries in the quart box will crush those near the bottom; and generally, because of the high price of the red raspberry, the consumer prefers to buy in pints.

To comply with the Net Weight Amendment to the Food and Drugs Act, the shipper, when shipping to another state, must stamp plainly on the outside of the package the contents and number of open packages contained, in terms of the largest unit contained. For example, the 24-quart crate would be marked: "Contents 24 dry quarts," or "This crate contains 24 dry quarts." Further, the standardization of the berry

box makes it illegal to ship from state to state berry boxes which do not contain in cubical contents one pint, one-half pint, one quart or multiples of one quart, all dry measure.

### PACKING SHED

Some sort of packing shed is essential in the small fruit industry. It protects the fruit from the hot sun and rain, creates a central packing point and provides a storage place for packing material and equipment. It may be a very cheaply constructed affair, consisting only of a framework and roof that will keep out the sun and rain, or it may be more substantially constructed with a storage room or loft, thoroughly protected from the weather. Such a place provides a permanent storage place for packing material.

### YIELDS

As may be seen by referring to Tables 1 and 2, yields vary considerably from year to year, with different soil and environmental conditions, and with different varieties. Under ordinary conditions and with good care the black raspberry should yield from 1,200 to 1,800 quarts per acre, the purple raspberry about the same, and the red raspberry, under Missouri conditions, 400 to 800 quarts. Sometimes very large yields will be secured, as with the Kansas, which produced in 1919 over 4,000 quarts per acre at Columbia. Blackberry varieties that will not average 1,200 quarts per acre when given good care are not adapted to commercial planting. Averages of 1,800 to 2,000 quarts per acre may be regarded as good yields.

The tables of blackberry and raspberry yields show that there are varieties which run consistently low in yield. Such varieties may be suitable for planting in the home garden because of some other quality they possess in a superior degree, but they should never be planted for commercial purposes. The red raspberry, even with the additional price paid for it, is not as profitable as the blackcap. However, the fruit of the purple-caned varieties is usually sold as a red raspberry and, as a matter of fact, it is an acceptable substitute. There are varieties of this group that are profitable under Missouri conditions.

### VARIETIES

**Black Raspberries.**—From an examination of Table 1 it will be noted that there is considerable difference between the varieties of black raspberries grown on the horticultural grounds at Columbia and those grown on the University Fruit Farm near Turner Station. The soil at Columbia, being richer and better supplied with humus than that at Turner Station, gave much larger yields. Of the varieties grown at

Turner Station, Gregg and Cumberland gave the highest yields, while at Columbia the Kansas and Cumberland were the highest yielding varieties. All three, Kansas Cumberland and Gregg, are strong, vigorous growers and hardy enough under Missouri conditions. The Kansas is a few days earlier than the Cumberland, while the Gregg is the last of the three to ripen. The Kansas has a tendency to run small in size, especially near the end of the season.

TABLE 1.—YIELD OF RASPBERRIES

Variety	Yield per Acre in Quarts			
	1919	1920	1921	Average
<b>Blackcaps</b>				
<i>Turner</i>				
Kansas.....	904	459	360	574
Black Pearl.....	1,217	414	450	694
Cumberland.....	1,647	380	520	849
Plum Farmer.....	1,127	431	438	665
Gregg.....	1,769	487	502	919
Improved Gregg.....	1,017	256	490	588
<i>Columbia</i>				
Kansas.....	4,148	1,827	----	2,987
Conrath.....	2,924	1,962	----	2,443
Cumberland.....	3,194	1,815	----	2,505
<b>Purple</b>				
<i>Turner</i>				
Cardinal.....	1,565	857	1,300	1,241
<i>Columbia</i>				
Cardinal.....	2,219	1,396	----	1,807
<b>Red</b>				
<i>Turner</i>				
Louden.....	386	573	412	457
Cuthbert.....	322	476	344	381
King.....	480	539	386	488
<i>Columbia</i>				
Eaton.....	699	None	----	349
Cuthbert.....	901	None	----	450
King.....	985	309	----	647

Explanation of Tables 1 and 2.—The blackberries, and those raspberries marked Turner were grown on the trial grounds at Turner, Missouri in loess soil. Those marked Columbia were grown on the trial grounds at Columbia in a heavy silt loam, rich and reasonably well drained.

The blackberries and raspberries at Turner were set 4 feet apart in rows 8 feet apart. At Columbia the raspberries were set 3 feet apart in rows 7 feet apart.

In 1920 many of the canes of the black and purple raspberries were killed by anthracnose and in 1921 many of the fruit buds of the blackcaps were killed by the late spring freezes which resulted in unusually low yields for these two years.

**Purple Raspberries.**—The Cardinal is the only purple raspberry that has been tested by this Station and the yield was large enough to make it profitable.

**Red Raspberries.**—None of the red raspberries tested proved to be of commercial value. The Cuthbert, although it yields a little less than some of the other varieties is the best red for the home garden because of its superiority in quality and flavor.

The everbearing raspberry, of late introduction, has been widely advertised and many questions have been asked as to its value. None of the varieties of everbearing raspberries have been grown on the Station grounds and it is doubtful if this type will prove profitable under Missouri conditions, except, possibly, in a few special districts where the consumer will buy regardless of price, or in the home garden where cost is no consideration.

TABLE 2.—YIELD OF BLACKBERRIES

Variety	Yield per acre in quarts					
	1919	1920	1921	1922	1923	Average
McDonald.....	1,658	432	1,424	2,576	1,440	1,506
Early Harvest.....	1,738	1,871	2,708	1,464	2,872	2,131
Robinson.....	2,792	1,433	2,232	1,248	2,256	1,992
Blowers.....	1,492	1,168	1,792	1,520	1,728	1,540
Ward.....	1,588	1,085	1,624	1,928	1,960	1,637
Snyder.....	2,126	1,552	1,600	1,096	1,168	1,508
Ambrosia.....	485	256	1,056	168	1,264	646
Lagrange.....	988	406	1,648	784	1,800	1,125
Eldorado.....	1,715	750	1,280	1,156	1,092	1,199
Ancient Briton.....	886	1,028	768	1,024	694	880

**Blackberries.**—The blackberries may be divided roughly into the early and late maturing sorts. The early varieties include Robinson, Early Harvest and McDonald, the last named a hybrid between the blackberry and dewberry. The late varieties include Blowers, Ward, Snyder, Ambrosia, Lagrange, Eldorado and Ancient Briton. In general the early varieties are to be preferred, because they ripen before the wild plants and thus avoid competition with them and because they escape in part the hot, dry weather that so often prevails during the ripening season of the later varieties.

Of the varieties tested, the Early Harvest gave the highest yield for the five years. The Robinson produces larger and better quality fruit than the Early Harvest and the yield was nearly as high. The Robinson

however, is very susceptible to orange rust; yet, properly handled, the plants will produce profitable crops for 5 or 6 years. The McDonald, although producing large dewberry-like berries, is subject to winter killing and as a consequence is not dependable. Furthermore, because of its semi-trailing habit of growth and formidable thorns, picking is slow and unpleasant. Ward was the highest yielding of the late varieties. Blowers, Snyder and Eldorado produced moderate yields, while Ambrosia, Lagrange and Ancient Briton produced yields too low to be recommended for commercial planting.

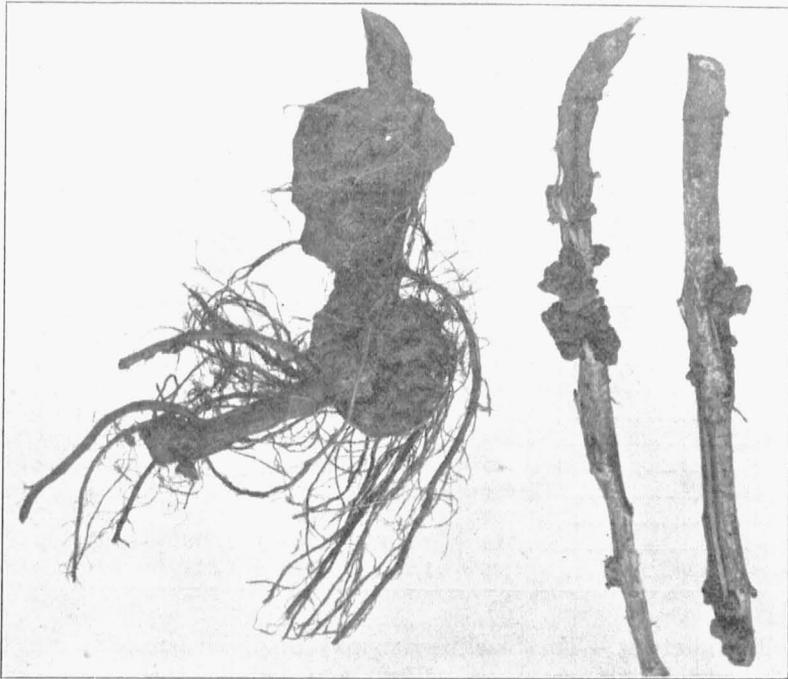


Fig. 10.—Crown gall on roots and canes of the black raspberry.

## INSECTS AND DISEASES

**Insects.**—Of the insects attacking the brambles none is of sufficient importance at present to necessitate the use of special remedial measures.

**Diseases.**—*Crown gall.*—Crown gall is of very common occurrence among the brambles, sometimes causing serious losses, especially among raspberries. Affected plants are characterized by a gall or wart-like swelling which appears on the roots, at the crown, or on the lower por-

tions of the canes. The disease greatly weakens the plants and may eventually cause their death.

*Control.*—The only practical method of controlling crown gall is to plant disease free stock. Nursery stock should be carefully examined and all plants which show symptoms of the disease discarded. When diseased plants are found in the plantation, they should be dug up and burned.

*Anthracnose.*—Anthracnose is a very common and serious disease of black and purple raspberries. Red raspberries, blackberries and dewberries, though subject to attack, are seldom severely injured. The disease affects all the above ground parts of the plants, canes, leaves and fruit, but is most noticeable and most destructive on the canes. It appears first on the new shoots when 8 to 10 inches high as small, dark colored spots. As these increase in size, they assume a roundish and

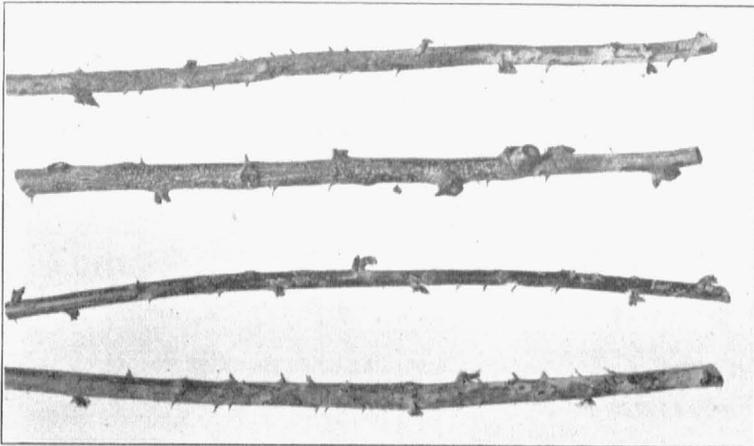


Fig. 11.—Raspberry Anthracnose. Note the small round spots on the canes.

finally a more or less elliptical form with gray centers bordered with a blackish purple, narrow and slightly raised border. As the spots increase in size they often split lengthwise of the stem. When abundant, the spots may coalesce to form large patches of diseased bark. In bad infestations the canes will be greatly weakened and unable to properly mature a crop of fruit the next spring.

*Control.*—Investigations carried on at the Missouri Agricultural Experiment Station the past two years indicate that anthracnose can be held in check by thorough and timely spraying. Either lime-sulphur

solution or bordeaux mixture may be used. The following spraying schedule is recommended.

FIRST SPRAY	Just before growth starts	Lime-sulphur 7 gal. to 43 gal. of water
SECOND SPRAY	When new shoots are 8-10 inches high	Lime-sulphur $1\frac{1}{4}$ gal. to 50, or bordeaux mixture 3-4-50.
THIRD SPRAY	Just before blossoms open	Same as in second spray
FOURTH SPRAY	Immediately after harvest.	Same as in second spray.

The cutting out of the old canes as soon as they have fruited and the badly infected new growth also aids in holding the disease in check by removing the source of infection and opening up the interior of the rows to better ventilation and more sunlight.

*Orange Rust.*—Orange Rust is a disease of both blackberries and raspberries, but it more often found on blackberries. It is easily recognized by the bright orange-red color which appears in the spring on the under sides of the leaves of affected plants.

*Treatment.*—Diseased plants as soon as detected should be dug up and burned. If there are only a few diseased plants and the work is thorough, the disease can often be eradicated by this means. When a large number of plants are affected it is impractical to dig out all the diseased plants, but diseased canes should be cut as soon as detected and burned to check the spread of the disease to other plants. Affected wild plants near the plantation are usually the primary source of infection and should be destroyed.