

Blackberry and Raspberry Culture in Missouri

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Blackberry and Raspberry Culture in Missouri

D. D. HEMPHILL

CONSIDER THE POSSIBILITIES OF THESE FRUITS

Include Brambles in All Home Fruit Plantings.—Few families will be able to enjoy these delicious fruits unless they grow their own. Bramble fruits, especially raspberries are scarce and expensive. Frozen fruits are excellent and usually available all seasons of the year, but they are not a satisfactory substitute for fresh fruit. The cane fruits mature their crops at a time when there is very little fresh fruit available. By a wise choice of red, black, and purple varieties, fresh raspberries may be picked for approximately six weeks during June and July. Everbearing raspberries, if given special attention, will produce a fall crop.

These fruits are excellent for canning, preserving and freezing, and every family with sufficient acreage to have a fruit planting should not be without them. The inferior quality of some market berries, especially blackberries, has prejudiced people against them as a dessert fruit, but home grown fruit of a good variety picked when fully mature are among our most delicious treats.

Little capital is required to establish and maintain the planting. A small sprayer is necessary to carry out a spray program for insect and disease control but most families have or should have a sprayer as part of their gardening equipment.

The plants come into bearing early; if they get off to a good start, a fair crop will be produced the year after planting. New plants for extending the planting can be easily propagated from one's own patch.

Blossoms are seldom killed by late spring frosts due to late blooming—thus a regular crop is possible, however, it must be pointed out that brambles require excellent care. The site must be desirable and insects, diseases and weeds must be controlled if you are to be successful in growing these fruits.

Local Demand Is Good.—Persons who are able to grow more fruit than their family can use will find a ready local market for fruit of good quality. There are few communities in Missouri which produce enough for local demand. This demand will increase if quality fruit is available. Inferior quality of most wild blackberries and "shipped-in" Boysenberries and raspberries picked before they fully mature, has depressed the demand for these fruits.

Erect Blackberries Well Adapted to all of Missouri.—Wild blackberries are found growing in all sections of Missouri; domesticated types,

therefore, are well adapted. Where wild types are not readily available, this crop should be considered for both home and commercial plantings. Domesticated varieties of blackberries will usually sell even though there be an abundant supply of wild types, because of their firmness and improved quality.

Raspberries Are Exacting in Their Requirements.—They are best adapted to areas where the summers are cool and the air is moist. The long hot summers with their hot drying winds are not favorable to raspberries. Fluctuating winter temperature results in considerable winter killing of the canes, especially in red raspberries. After the rest period of the buds is broken by low temperatures, the buds become active when the temperature rises above 43°F. Unseasonable warm periods during the winter months starts growth in the buds and causes the buds and canes to be susceptible to low temperatures.

Commercial plantings are not recommended except in those areas in northern Missouri where climatic conditions are more favorable and only on soils well adapted to this crop.

Consider These Factors Before Making a Commercial Planting.—The prospective grower should first of all consider his markets. The local market has marked advantages for a grower and at present this market is not fully supplied with bramble fruits. If local markets are not available the distance to your market is an important factor.

For local market and roadside sales it is usually advisable to include all three kinds of raspberries along with blackberries. It is not advisable to make a large planting of Boysenberries, except perhaps in southern Missouri. Extra care must be given this berry due to its tenderness to cold and yields tend to be low due to winter injury.

Before making a planting, information should be obtained as to kinds for which there is a preference in the region. In some localities red raspberries are preferred while in other areas blacks may be in demand. Purple raspberries are not widely known but they are considered excellent for jams and jellies and freezing as well as for fresh dessert fruit by those who have tried them.

The site should be considered carefully. The site can well determine whether the planting will be profitable or unprofitable.

Availability of labor for picking is an important factor at present when there is a scarcity of farm labor.

Unless it is known that large quantities of fruit can be sold at a reasonable profit, that the grower is experienced in the culture of brambles and that conditions are favorable for their development, it is advisable to start with a small planting to be enlarged as returns and market demands justify.

The various factors of market supplies, demands, prices along with

the suitability of available sites should be carefully weighed before making a commercial planting.

CHOOSE THE BEST VARIETIES

Consider dessert and freezing qualities, productivity, season of ripening, resistance to diseases and insects, shipping and handling qualities, ability to withstand unseasonable weather fluctuations and soil adaptation, when choosing varieties and types for planting.

Kinds and varieties should be selected that will mature in succession over a long season. With a supply of good fruit available over such a season, a grower is able to keep a high-class trade and to make a better utilization of his pickers.

A number of new varieties have been introduced in comparatively recent years, some of which have proved their worth; some others are promising but information on them is limited. Extensive planting of varieties that have not been tested in this section is inadvisable. A grower interested in new varieties might well test several in a small plot to determine their value under his own conditions before planting any large acreage.

Red Raspberries

Most varieties of red raspberries are quite subject to winter injury due to early winter freezes and the fluctuating winter temperatures, even though they will withstand lower temperatures than other types after they have become hardened.

Latham: the standard variety for commercial production in Missouri. Fruit: berries large, medium red, firm but often crumbly, fair in quality. Season: midseason. Plants: vigorous, productive, mosaic susceptible.

Indian Summer: may have a place in the home fruit planting as a so-called everbearing variety. Fruit: dark red, large, soft, crumbly, good quality. Season: early. Bears a second crop in the fall on the tips of new canes but ripens too late some years. Plants: vigorous, susceptible to anthracnose, resistant to mosaic.

Newburgh: a variety which may have a place in commercial production. Compare a few plants of this variety with Latham. Fruit: dark red, firm, good quality, tends to crumble. Season: early to midseason. Plants: vigorous, tend to branch, somewhat resistant to mosaic. Susceptible to anthracnose.

Sunrise: shows some promise as an early red variety for commercial use. Fruit: medium-sized, bright red, fairly firm, good quality. Season: early. Plants: hardy, suckers freely, resistant to anthracnose.

September: a so-called everbearing variety for the home fruit planting. Produces its fall crop two weeks or more ahead of Indian Summer.

Purple Raspberries

These are hybrids between black and red varieties and are usually more vigorous in growth and more productive than either parent. They resemble the reds in flavor more than the blacks. Purples are highly desirable for canning and preserving and the best of the raspberries for flavoring ice cream.

Customer acceptance is not good at first because their color is not as attractive as that of reds or blacks. The plants are more resistant to temperature fluctuations in late fall and early winter than reds. Sodus and Potomac are the standard varieties at present in Missouri.

Sodus: Fruit: very large, firm, good quality. Season: late and long. Plants: vigorous, productive, hardy, upright spreading.

Potomac: Fruit: large, firm, tart, quality good. Season: late and long. Plants: very vigorous, productive, very hardy, somewhat resistant to anthracnose and leaf spot.

Marion: This is a promising new variety for trial as a commercial and a home berry.

Black Raspberries

Black raspberries are not as hardy as reds from the standpoint of withstanding extremely low temperatures, however, in Missouri they usually exhibit less winter injury than reds because they are not as subject to damage resulting from fluctuating temperatures.

Cumberland: Fruit: large, firm, very good quality. Season: mid-season. Plants very susceptible to anthracnose and virus diseases, vigorous and productive when not diseased.

Bristol: one of the most vigorous and productive. Recommended for part of the planting. Fruit: very large, firm good quality. Season: mid-season. Plants: vigorous and hardy, but susceptible to anthracnose.

Logan: has shown sufficient promise to warrant its planting as an early variety. Fruit: large, firm, good quality. Season: early, matures most of its crop ahead of Cumberland. Plants: vigorous, hardy. Appears resistant to certain virus diseases.

Black Pearl (Pearl): sometimes grown as a companion variety with Cumberland. Preferred by some Missouri growers to any other black variety. Fruit: large, firm. Season: early and usually short. Plants: hardy.

Dundee: more productive than Cumberland in limited trials. Promising for home and local markets.

Erect Blackberries

At present a serious disorder is prevalent in most varieties of erect blackberries. The plants bloom prolifically but fruit does not develop. Until the causal agent is known and can be controlled or until a source

of plants of each variety free of this disorder is found, Early Harvest is the only variety recommended for planting. As yet this condition does not appear to be spreading through wild plants and plants of the Early Harvest variety.

Eldorado and Alfred are good varieties when free of the above disorder.

Semi-erect Blackberries

Brainerd: a promising new variety for South Missouri. Fruit: medium sized, fair quality. Season: late. Plants: very vigorous, need trellis support, very spiny, anthracnose resistant, only semi-hardy.

Trailing Blackberries

Boysenberry: a variety for extreme southern Missouri. Fruit: very large, dark red, soft when mature, tart, excellent for dessert, pies, canning, and freezing. Season: early and short. Plants: vigorous, prostrate and should be fruited on trellis, not highly productive in Missouri. Very susceptible to anthracnose and cane borer. When grown outside of Southeast Missouri it should have winter protection of straw or soil.

Lucretia: The leading and recommended variety of the so-called dew-berries.

Youngberry and Loganberry: Varieties of western trailing blackberries which are more tender than the Boysenberry and consequently are not too desirable for Missouri.

SELECT A FAVORABLE SITE

No factor is more important in determining success or failure than is the selection of the proper site. Commercial plantings of brambles, raspberries especially, should be placed only on the most favorable sites. For home plantings place it on the most desirable soil near the home.

Topography and Exposure.—Choose a gently-rolling northern slope. The site should be sufficiently rolling to permit proper air and water drainage but not so steep that the soil will erode. Plants in low areas are more apt to be injured by cold, and diseases such as anthracnose are worse in such areas. Northern slopes provide a good site for brambles. Such an area is less subject to damaging winds. Winter winds increase injury by their drying effect and summer winds break new shoots of black and purple raspberries as well as increase water loss from the soil and plants. The humus content and overall fertility of the soil of northern slopes is usually better than that of southern slopes.

Select a Desirable Soil.—The selection of the proper soil is essential to the successful production of brambles. The essentials of a desirable soil are: moderately fertile, retentive of moisture, good underdrainage, easily worked, high organic matter content. Good water-holding capacity is important because of shortage of water just before and during the

ripening period reduces yield markedly. Even though the soil must be retentive of moisture it must be well drained. Proper underdrainage is dependent upon a subsoil open enough for the excess water to drain away. The character of the subsoil should be determined by use of soil augers or holes dug at several points over the prospective site. Subsoils of a brown or reddish color are more open and drain better than those of a yellow or gray color.

Gravelly and sandy soils do not have sufficient water-holding capacity, while heavy clays do not absorb water readily and much of the water they contain is not available to the plants.

Deep soils which will permit the roots to invade the soil to a depth of several feet provides a greater area from which to obtain moisture and nutrients. Texture is more important than fertility, because barnyard and green manure can be used to improve humus content and commercial fertilizer can be used to improve plant food content.

The ideal soil for brambles is a deep, well-drained, silty loam well supplied with humus and essential mineral elements.

Isolate Planting from Diseases—To protect the new planting from certain diseases, brambles should not set on soil that has grown grapes or tree fruits for several years. Brambles are very susceptible to crown gall, a bacterial disease that attacks a number of fruit plants. Land which has been in field crops for several years is likely to be relatively free of crown gall organisms.

USE HEALTHY PLANTING STOCK

The Inexperienced Grower Should Purchase His Planting Stock.—

One of the most important requirements for success with brambles is use of vigorous disease-free planting stock. Do not obtain plants from an old planting unless you can recognize the insects and diseases common to brambles. If you have had little experience in bramble culture, it will be to your advantage to obtain certified planting stock from a reliable nursery. Such plants are more likely to be vigorous, true to variety, and disease free.

The Experienced Grower May Propagate His Own Planting Stock.—

Commercial growers and home gardeners who have had wide experience may desire to propagate plants from an established planting for their own use in increasing their acreage or for sale. If plants are to be sold they should be inspected and certified by the State Department of Agriculture. To obtain this service write to the State Entomologist, Jefferson City, Missouri.

Loose sandy or silt loams are ideal soils for plant propagation.

Learn the Essentials of Propagation.—Bramble plants are produced

vegetatively and methods of propagation are relatively simple, because the plants, unlike tree fruits, are grown on their own roots.

Black and Purple Raspberries

The standard varieties of black and purple types propagate themselves naturally by plants produced at the tips of the new canes. However, better plants are obtained by placing the tips in the soil and firming it about them, and moreover, a sufficient number of purple tip plants usually do not form unless "tipping" is fostered. The canes are ready for "tipping" when the ends become swollen and assume a "snaky" bending

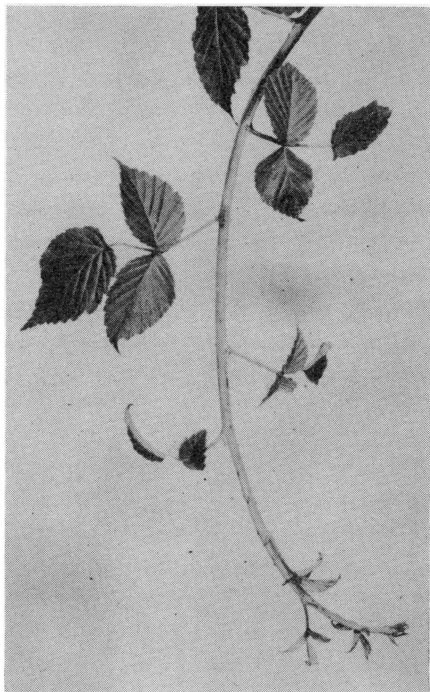


Fig. 1.—Purple Raspberry cane ready for tipping.

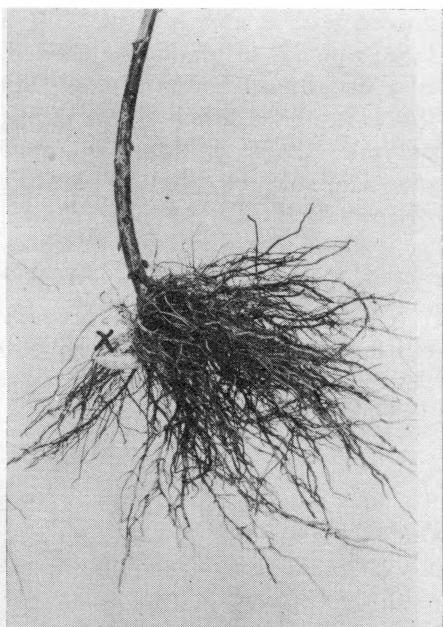


Fig. 2.—Tip plant of black raspberry showing young shoot starting at x from the crown of the new plant. Tip plants should be set before the shoots become any longer.

with the leaves small and wrinkled. This condition usually develops in late August or early September. The tips are easily damaged by hot soil or by being brushed about by wind. If injured, new plants may fail to develop or a profuse growth of short laterals may be produced, each of which may root but the plants are weak and undesirable.

Tips inserted into the soil in a vertical position usually produce the best plants. A spade or trowel can be used to open the soil to enable one to insert the tips in this position. As previously stated, it is necessary to firm the soil around the tip to prevent drying. For a more rapid method

of covering the tips, a furrow may be plowed, the tips laid in place and the furrow filled by any convenient method.

Red Raspberries

Red raspberries are propagated by means of sucker plants which arise from underground stems. For small plantings canes along the sides of the fruiting row can be dug in spring before growth starts or later the young suckers can be moved with a clump of soil. If a large number of plants are needed, it is usually advisable to plow out the entire row either in the spring or fall. Only the most vigorous plants should be used in planting or for sale.

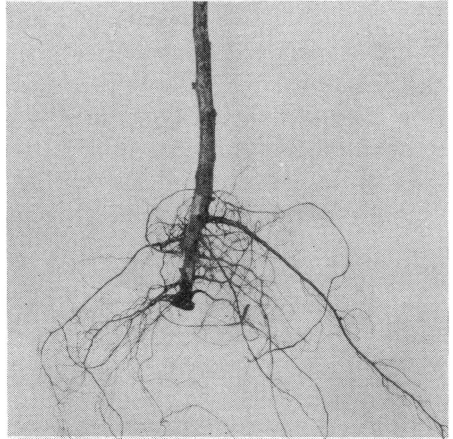


Fig. 3.—A red raspberry sucker plant.

Erect Blackberries

Blackberries may be propagated by either sucker plants or root cuttings. Usually plants with better root systems for transplanting are obtained from root cuttings, however, sucker plants are quite satisfactory.

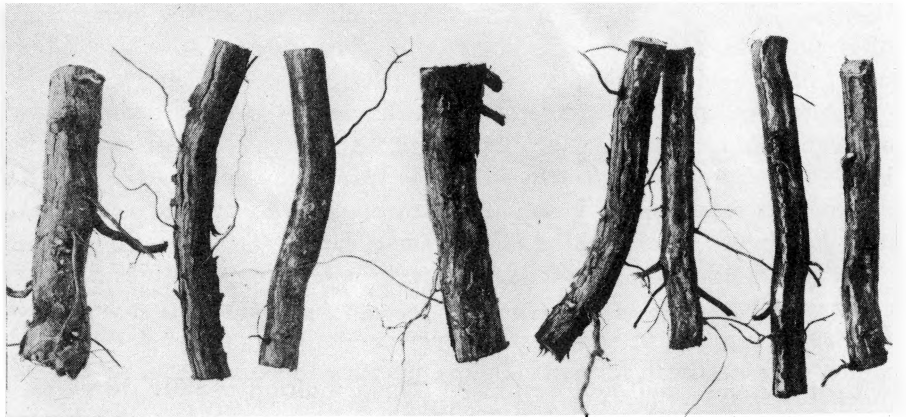


Fig. 4—Blackberry root cuttings. Roots one-fourth to one-half inch in diameter are cut into three to four inch lengths.

If root cuttings are to be used, dig up the roots between the rows in the fall or spring before growth starts. Use roots which are about one-half inch in diameter and cut into three to four-inch lengths. If made in the fall, bury them in well-drained soil or in moist material in a cool place. Plant horizontally in trenches about three inches deep. After one season's

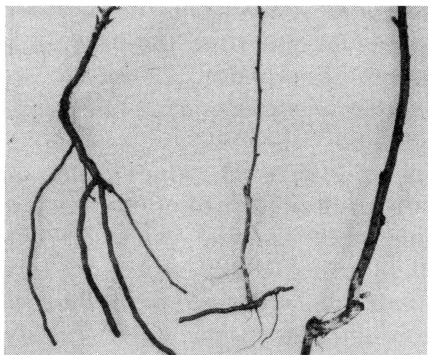


Fig. 5.—At left, a well-developed blackberry plant produced from a root cutting. It is the type of plant recommended for starting a new planting. At center, a sucker plant dug with a section of the parent root. At right, a sucker plant that has produced a few roots. A poor type for planting.

growth they are ready to dig and set in the field.

Sucker plants which grew the year before along the sides of the main row may be dug in the spring before growth starts and used in a new planting. Vigorous new sucker plants which are well rooted can be moved in the spring along with a clump of soil. These are very useful as replants.

Trailing Blackberries

These varieties propagate readily by means of tip layerage as employed for black and purple raspberries.

PREPARE THE SOIL IN ADVANCE

Use Intensively Cultivated Crops to Eradicate Weeds.—Preparation of the soil for brambles should begin two or three years in advance. Grow some intensively cultivated or hoed crop on the land for one or more years to eradicate weeds and to improve the tilth where sods have been turned under. It is not advisable to plant raspberries immediately after potatoes, tomatoes, egg plant or muskmelons because a soil-born wilt fungus which attacks these crops also attacks raspberries.

Add Humus.—Unless the soil is well supplied with organic matter, a green manure crop, preferably a legume, which has been well fertilized to promote heavy growth should be turned the year before planting or ten to twenty tons of barnyard manure relatively free of weed seeds may be plowed under in the fall or early spring.

Prepare the Soil Carefully.—Plowing should be deep and in most cases fall plowing is preferable if the danger of erosion is not too great. Subsoiling may be of considerable help in this preliminary treatment if a plow sole has been formed. Before planting, disk and harrow the soil until it is well pulverized and firmly packed.

PROVIDE ADEQUATE PLANT FOOD

Determine Fertility Level.—The fertility level of the site should be determined before establishing the planting. Although the site may be desirable from the standpoint of topography, exposure, soil texture, etc., certain essential mineral elements such as phosphorus may not be available in sufficient amounts. The availability can be determined by chemical soil tests.

Supply Sufficient Mineral Elements for Duration of Planting.—If any mineral elements are not present in adequate quantities they should be incorporated into the soil before planting. Phosphorus, potassium and calcium should be mixed into the soil at a considerable depth to encourage deep rooting.

Brambles are not heavy feeders as far as mineral elements are concerned but our best plant growth and yields are obtained on soils of high fertility and, without doubt, an abundance of all essential elements should be available. If we use as a criterion the fertility level of our better soils, there should be a minimum of 150 pounds available phosphoric acid and 250 pounds potassium per acre. Brambles are not particularly sensitive to soil pH within the range 5.0 to 6.5, however, the application of lime will benefit the brambles either directly or indirectly. The amount of lime added should not be great enough to make the soil alkaline.

It will not be necessary to apply any fertilizer except nitrogen for the duration of the planting after a high level of fertility has been established before planting. A starter application of 200 to 300 pounds of mixed fertilizer will be advisable to foster the growth of winter cover crops, however.

Apply Nitrogen Annually.—An annual application of a nitrogen fertilizer or well rotted barnyard manure will usually improve cane vigor and growth and consequently yields of the established planting. Use 200 to 250 pounds of ammonium sulphate or 125 to 150 pounds of ammonium nitrate. Apply early in the spring before any growth begins.

A light coating of well-rotted manure applied within the row during the winter is a very satisfactory source of nitrogen and also adds valuable organic matter.

If a mulch of straw or woody material is used, the amount of nitrogen applied must be increased by 50 to 100 per cent for the first three years or longer to replace the nitrogen tied up by the soil bacteria as they decompose the mulch.

CONSERVE WATER AND SOIL

The grower of brambles will be well paid for that time spent in carrying out conservation practices. Soils high in organic matter and essential nutrient elements are necessary for profitable production, and any practice that aids in moisture conservation is likely to show a profit.

Run the Rows on the Contour.—On level land or where a permanent mulch covers all the surface, plants may be set in straight rows, but on sloping ground where cultivation is to be practiced run the rows on the contour. Even on gently sloping land there will be a continual sheet erosion with perhaps imperceptible loss of soil, but in a few years a considerable amount of the best soil will have been lost. Contour planting

prevents loss of humus-bearing soil—so important to the vigor of the planting—and increases water intake which may prove especially valuable during dry summers.

The rows are run practically on the level or given a slight grade which permits excess water to flow slowly from the field. Contour planting may be used alone or in connection with terrace systems.

Graded Contours Cannot Be Laid Out With the Unaided Eye.—The County Agent should be consulted if you do not have access to and are not experienced in the use of a farm level instrument.

It is neither practical nor necessary to have every row on the exact grade. Pronounced depressions should not be planted but sodded down to serve as spillways, to catch any soil that may flow down the middles and to avoid irregular rows. Cultivation equipment can be dragged across such areas. Such strips can serve as turnways and convenient alleyways in picking and spraying. The plants should be set at the ground level and not on ridges. With cultivation soil will be worked gradually from the middle to the plant rows forming essentially a small terrace at each row.

Provision must be made for roadways in large plantings to facilitate spraying, removing picked fruit and mulching.

CONSIDER THESE FACTORS IN PLANTING

Consider the Possible Systems of Planting and Training.—Red raspberries in Missouri are grown according to the hill system or in a hedge row. Where red raspberries are grown in the hill system they are set and maintained at a distance of 5 x 5 or 6 x 6 feet. A single stake is set beside each original plant during the first season. The canes should be tied twice to each stake. Five or more strong canes are left in each hill. Under the hill system of culture cultivation can be in both directions if excessive erosion will not result.

The hedge row system is perhaps best suited for most growers. The plants are set three to four feet apart within the row and seven to eight between rows. Red raspberries produce canes from the leader buds on the original plant and send up shoots (suckers) from their roots. The width of the row must be restricted by cultivation and pruning to a width of not more than 18 inches. When plants are trained to the hedge row, more hand labor is required for weed control because cultivation can be in only one direction, but greater yields are possible than when the plants are set in the hill system. No trellis is necessary although a two-wire vertical or horizontal trellis may be used.

The linear system of culture is used for black and purple raspberries. Their training is much simpler than that of red raspberries because they do not send up suckers from their roots. Plants are set three to four

feet apart in the row and seven to eight feet between rows. By proper pruning the plant can be made to support its load of fruit without trellising, although a two-wire trellis with a wire on each side of the row about three feet high is sometimes used to help support the canes.

Erect blackberries are grown in a hedge row. They send up sucker plants from their roots similar to red raspberries. Trellising is usually not necessary because the canes are erect. It is important to keep the hedge row narrow, not more than 18 inches. Plants are usually set three feet apart in rows eight feet apart.

Trailing blackberries are usually trained to stakes or a trellis. Lucretia, the leading variety of the eastern trailing blackberry (dewberry), is usually planted 5 x 5 feet and a stake placed by each original plant. The canes are allowed to grow on the ground and are tied to the stakes early in the spring just before growth begins. Boysenberries are usually planted 2½ to three feet apart in the row with rows seven to eight feet apart. A two-wire vertical trellis with the top five feet above the ground is a satisfactory type of trellis. The canes are allowed to trail on the ground until early spring. The canes must be protected during the winter. Apply three to four inches of straw over the canes after killing frosts but before temperatures drop below 20°F. The last week in November is usually a desirable time although it may be sooner or later in different years.

Set Plants at Most Desirable Time.—The best time to set tip plants of black and purple raspberries is early in the spring while the plants are still dormant. Greater loss of plants result if the “tips” are transplanted in the fall or in the spring after growth has started.

Red raspberries and blackberries may be set either in the fall or spring but in general spring planting is more desirable. Fall set plants need to be protected during the winter by mulching with straw or by plowing soil to them from each side of the row.

Protect the Plants from Drying.—Every precaution should be taken to prevent the drying out of the plants. Drying of the plants between time of digging and planting is a common cause of failure of plants to grow.

Immediately upon arrival of plants from the nursery they should be soaked in water for a few minutes and “heeled-in” if they cannot be planted within a day or two.

Drying during planting can be held to a minimum by carrying the plants to the field in wet burlap. Plants should be set as they are dropped. Roots can be protected somewhat by dipping the roots in a puddle of clay and water.

Set Plants with Care.—The important points in setting are to avoid bunching or crowding the roots, to firmly pack moist, well-pulverized

soil about the roots and crown and to place the growing points at the proper depth—neither too deep nor too shallow. Failure to observe these points may result in the loss of large numbers of transplants and poor growth of those which live.

Setting is usually done in a trench made by plowing, or in holes with a spade. The best way to get a well set plant is to do the preliminary work with the hands. The remainder of the soil can then be shoveled in and firmed about the plants with the feet.

With black and purple raspberries and the trailing blackberries the crowns are covered to a depth of two to two and one-half inches in silt loams, but may be planted three to four inches in sandy soils. Red raspberries and blackberries are planted three to four inches with the deeper planting being used in sandy soils.

The new shoots may not be able to push their way to the surface of the ground, if the plants are set too deep. On the other hand, the plants are subject to drying out, to droughts, and to injury from winter heaving, and the new shoots are more likely to be broken by winds, if planting was too shallow.

As a sanitary measure to help control anthracnose, the "handle" or short section of old cane of tip plants left at digging to facilitate handling and planting, should be removed at ground level after planting.

The canes of red raspberries and blackberries should be shortened to 18 inches or less depending upon cane vigor. The plants are weakened if the canes are cut back excessively.

STUDY THE POSSIBLE METHODS OF SOIL MANAGEMENT

Control of Weeds Is Essential.—Control of weeds must be achieved in any method of soil management for it to be successful. Weeds rob the plants of moisture at the critical period of fruit sizing and ripening, make conditions more suitable for disease development and deprive the plant of nitrogen and other nutrient elements.

Benefits of Cultivation.—The primary object of cultivation is the control of weeds. Cultivation, however, serves others purposes, such as aerating the soil and increasing bacterial action, but most important is the destruction of weeds which drain the soil of moisture as well as nutrient elements.

Cultivation should begin early and be as frequent and as thorough as is necessary to keep down weeds and the soil loose enough to absorb water from rains. Cultivation should be shallow, as deep working of the soil damages the roots and causes excessive suckering of blackberries and red raspberries. Cultivation during harvest is not advisable. Cultivation should cease in August in time to plant a cover crop.

Mulches Increase Yields.—Aside from the control of weeds that can be obtained by the proper use of mulches, there are other important benefits which outweigh their value in weed control. They keep the surface soil cooler in summer, the soil beneath becomes loose, absorbing heavy and frequent rains better than bare soil, and the moisture from light rains is held instead of being evaporated into the air as it does in uncovered soils. On gentle slopes where the rows have been planted on the contour it further reduces soil erosion, and on steep slopes a permanent mulch covering the entire planting may be the only practical method of soil management. As mulch decays, valuable humus is added to the soil.

Mulch may be applied only on the rows while the middles are still cultivated or the entire planting may be covered. Apply the mulch to a depth of three to five inches to achieve effective weed control.

Grain straw, spoiled hay, sweet clover, strawy manure, sawdust, leaves, ground corn cobs, etc., may be used if free of viable weed seed.

Mulches have certain disadvantages that must be considered: (1) They are costly. (2) A fire hazard may be created. (3) Water-logging of the soil is aggravated and they should not be used unless soil drainage is good. (4) A nitrogen deficiency may result due to the bacteria tying-up the nitrates during the decomposition of the mulch.

In spite of these disadvantages mulching appears to have an important place in bramble culture. It is an excellent way to handle home plantings. The native habitat of brambles is at the fringes of wooded areas where they receive partial shade and are well mulched with leaves.

Cover Crops are Valuable.—Cover crops grown between the rows in late summer are valuable in helping to maintain humus, in supplying nitrogen if a legume is used, checking erosion, and in hardening the canes for winter by competing with the brambles for moisture and nutrients in late summer and fall.

Seeding is usually most successful in August or September. For rapid development of the cover crop a starter application of 200 to 300 pounds per acre of a complete fertilizer is recommended.

Crops such as oats, millet, and soybeans which are killed by freezes are more manageable than overwintering crop such as vetch, rye or sweet clover.

Cover crops can be used in combination with mulches where only the row is mulched.

The use of cover crops between rows of trailing blackberries is not practical because of the difficulty of seeding. This also may be the case with vigorous black and purple raspberries.

Be Cautious in the Use of Chemical Weed Killers.—Chemical weed control is still "on trial" in brambles. Chemicals are not recommended

for use in the planting at present, although some chemicals are promising. Blackberries and raspberries are somewhat resistant to 2,4-D. This chemical used at the rate of one-fourth to one-half pound acid per acre will control a number of broad-leaved weeds. The salt formulations are less toxic than esters. Never use 2,4-D during the period the plants are blooming and setting fruit. New canes are easily injured, especially when the tips are sprayed.

TCA (sodium trichloroacetate) and IPC (iso-propyl N-phenyl carbamate) have been used but results have been erratic.

Irrigate To Defeat Drought.—Bramble yields are very frequently reduced by insufficient soil moisture. Even though water conservation practices such as contour planting, maintaining high organic matter, controlling weeds, and mulching are carried out there are many years when irrigation would be very profitable.

A surface system may be used when the rows are laid out on carefully graded contours. The topography of the land must be such that the water can be distributed by gravity. On very sandy or gravelly soils it is almost impossible to irrigate by this method. A large amount of labor is needed to apply the water under this system.

The overhead sprinkling system is gaining in popularity since the advent of portable light-weight pipe. Water is delivered to the field under pressure and distributed by rotary sprinklers. The cost of the portable system is relatively small compared to the cost of a permanent system. The sprinkler system requires no special preparation of the land before use and is efficient on uneven land and various soil types.

For small plantings a porous canvas hose can be used. It is relatively inexpensive to install and operate. A supply of water under pressure is required. The hose is placed alongside the row and the water oozes out through the canvas.

USE PROPER METHODS OF PRUNING AND TRAINING

Understand the Growth Habits.—Brambles grown in Missouri have perennial roots and biennial tops. The roots live for several years while the tops are produced one season and die the next summer after fruiting. Pruning and training practices are based upon the growth habits.

In the spring new shoots arise from the buds at the bases of the older canes and reach full size that growing season. In the case of red raspberries and erect blackberries shoots arise also from roots or underground stems.

The pruning and training of black and purple raspberries and trailing blackberries is not as difficult as that of red raspberries and blackberries, for they grow in clumps making it comparatively easy to keep them confined to the plants originally set. Erect blackberries and red

raspberries send up sucker plants at random from the original plants and very wide rows will result unless width is reduced by cultivation and pruning.

Pruning Black and Purple Raspberries.—The first year after the plants are set, the new shoots, if making a vigorous and rapid growth, should have two or three inches of the tip removed as soon as they have

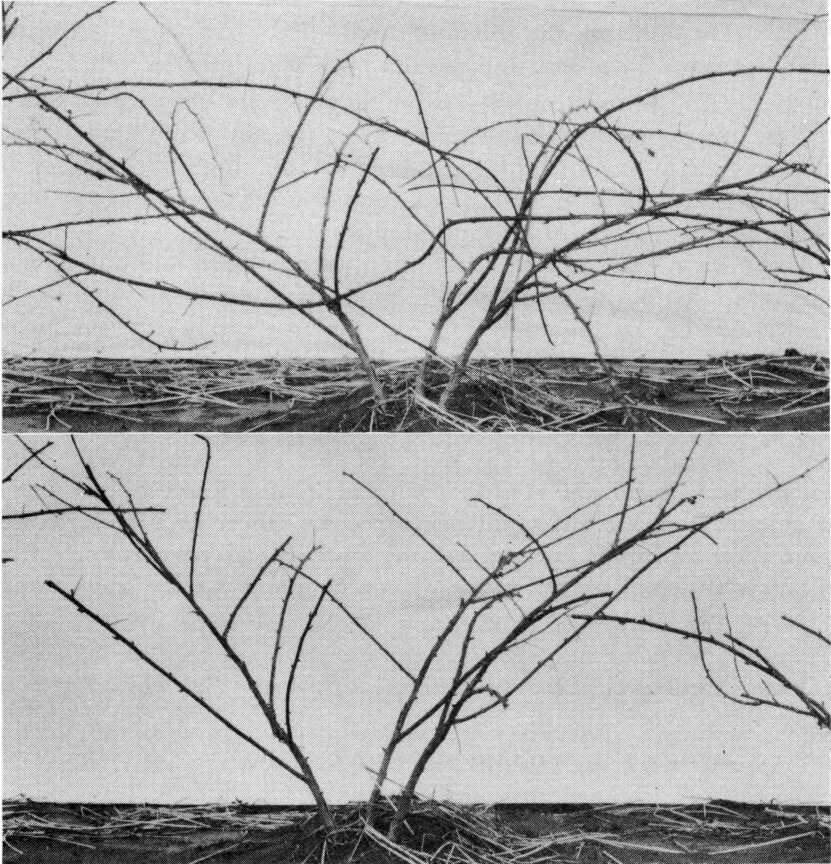


Fig. 6.—Potomac purple raspberries before (above) and after (below) pruning.

reached a height of 18 to 24 inches in the case of blacks and 24 to 30 inches in the case of purples. "Topping" restricts length growth and induces the production of well developed laterals, giving a low stocky branched plant instead of a long slender trailing cane. If the plants do not make a good start the first season, no topping is done.

Just before growth starts in the spring of the second year, dead or diseased wood is removed and the lateral canes (branch canes) are shortened to four to six inches for blacks and six to eight inches in the

case of purples. It is undesirable to overload the plant with fruit this first fruiting season, because poor growth of new canes may result. This dormant pruning should be delayed until severe winter weather is over because there is less risk of drying out and dying back from cut ends. Winter injured wood can be detected at this time and removed.

As soon as the fruit has been harvested the bearing canes should be removed. The old canes crowd the new canes and serve as a source of infection for anthracnose and other diseases.

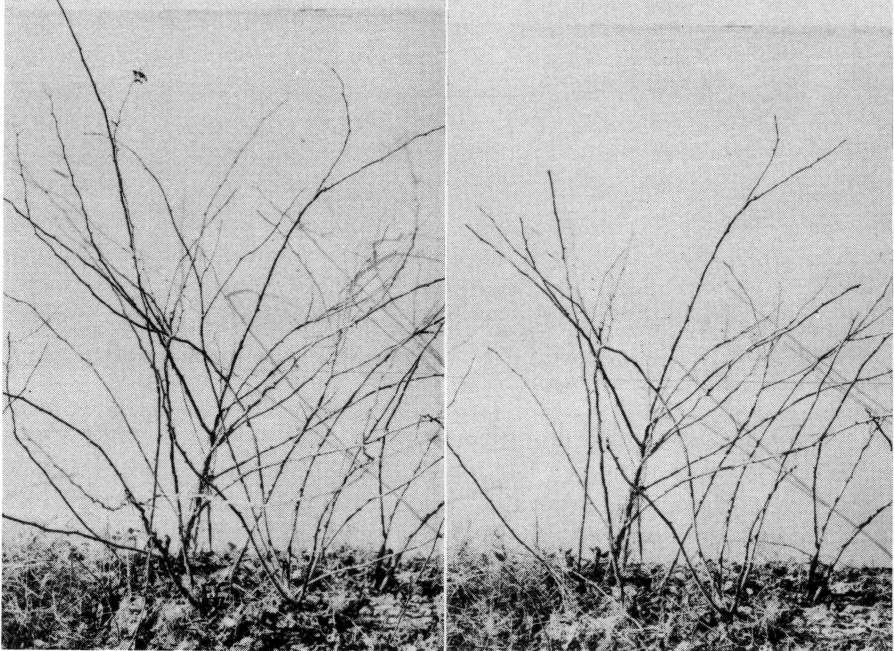


Fig. 7.—Newburgh, a variety of red raspberry which branches considerably. At left, before dormant spring pruning; at right, after pruning.

Each succeeding year during the life of the planting the treatment is essentially the same: (1) the new shoots are topped at 18 or 24 inches depending on type. (2) In the spring just before growth starts, the weak and damaged wood is removed and the laterals shortened to eight to 12 inches (blacks) and 10 to 16 inches (purples) with some thinning of canes and laterals if the bushes are excessively thick. (3) The bearing canes are removed after fruiting.

Shortening and thinning the laterals is a fruit thinning operation. In proper amount, it prevents overbearing and increases size of the berries. A balance is maintained between current fruit production and the growth of canes for the succeeding crop. Increase in size of berries can be obtained with little or no loss in total volume or weight.

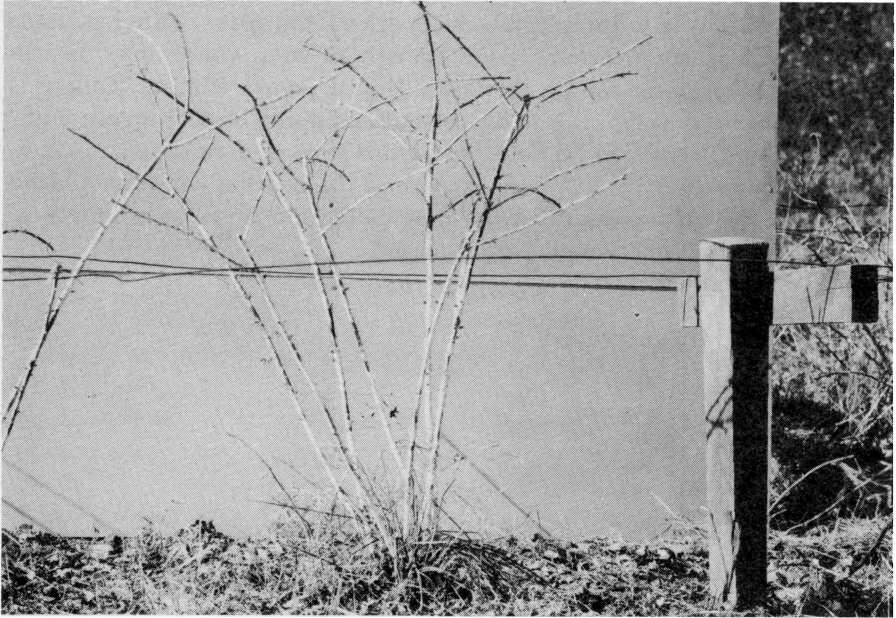


Fig. 8.—A two-wire horizontal type of trellis which is sometimes used for support of black, purple and red raspberries.

With this system of pruning plants are usually able to support themselves, however, a two-wire horizontal trellis with a wire on each side of the row will help keep the fruit clean and protect young shoots from breaking due to strong winds. Posts are set in the row about three feet in height with a cross bar at top to support the wires. Cross wires or laths are necessary at intervals to keep the two wires from spreading too far apart between the post.

Pruning Red Raspberries.—The narrow hedge row and the hill system are the most common systems of training.

When using the hedge row method the suckers are allowed to grow at random between and to either side of the original plants. The hedge row should be kept narrowed to 12 to 18 inches.

Topping is not practiced with red raspberries. Laterals tend to be weak, do not harden properly and consequently severe injury results. Topping also induces extra suckers which are usually undeveloped and subject to winter injury.

As the shoots should not be topped and heavy heading back of canes in the spring is undesirable, the canes sometimes become too tall and slender to carry a load of fruit without bending or breaking, and some kind of support should be provided. A common form consists of posts in the plant row with one wire to which the canes are tied or two horizontal wires supported by cross bars with the canes between.

In the hill system all shoots but five to 10 around each stake are kept removed.

Before growth begins in the spring remove all short and weak canes. In the hedge row system canes should be thinned to four to six inches apart and the row narrowed to 12 to 18 inches if this has not been done during the growing season. The canes are headed back only a small amount; if winter injured, back to healthy wood. Heavy pruning, one-fourth to one-third of the top, reduces the crop, as there is little increase in size of berries from reducing the number as occurs with blacks and purples. Also, the earliest berries are produced at the tip.

The bearing canes are removed as soon as the crop is harvested.

Pruning Erect Blackberries.—Erect blackberries are grown in the hedge row system since they send up suckers as do red raspberries. Early Harvest shoots are topped at about 24 inches while other strong growing varieties are topped at 24 to 30 inches depending on vigor. The hedge row should not be permitted to exceed two feet in width.

In the early spring before growth starts, weak and slender canes are removed and the others thinned to stand eight to 12 inches apart. The laterals are shortened to eight to 12 inches with short internode varieties such as Early Harvest and 12 to 18 inches with varieties which have their buds farther apart.

Canes are removed after fruiting as with other brambles.

Pruning Trailing Blackberries.—Dewberries such as Lucretia are usually trained to stakes. The shoots are allowed to grow on the ground

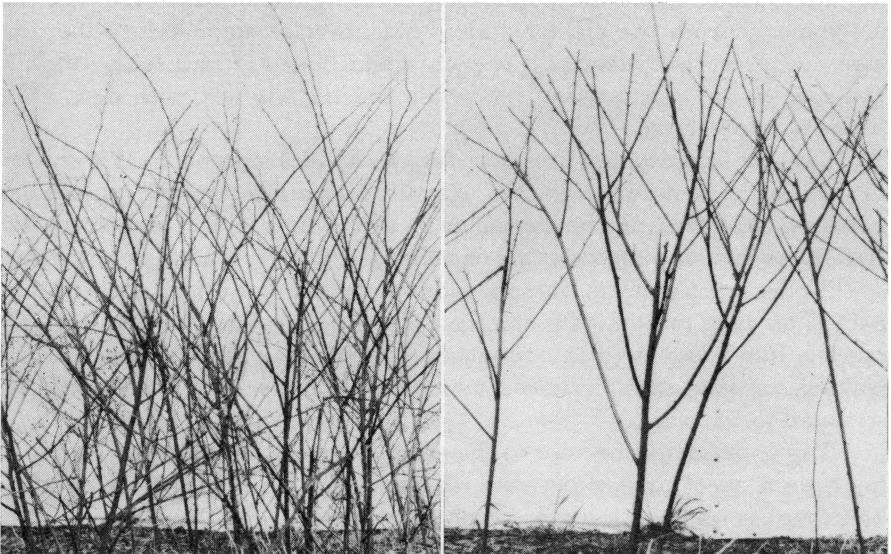


Fig. 9.—Early Harvest Blackberries before (left) and after (right) dormant pruning.

and remain there until just before growth starts in the spring when the canes are pulled up around the stakes and tied in two or more places. The ends of the canes are cut a little above the five foot height.

The canes of the Boysen and Young varieties are allowed to grow on the ground along the row until early spring when they are uncovered and placed on a trellis. A two-wire vertical trellis with the top wire about five feet in height is commonly used. Any weak or winter injured canes are removed and the remainder may be shortened to eight feet, looped over the top wire and tied to the lower wire. The canes may be left at their full length and individual canes or bundles of three or more are woven on the trellis using various designs. It is desirable to have the canes separated as much as possible to admit maximum light and facilitate picking but long free ends of canes should be avoided. Fruiting canes should be removed immediately after harvest.

PICK AND HANDLE WITH UTMOST CARE

Care in picking and handling is of utmost importance. The berries are soft and easily bruised or crushed, and fruit in this condition is unattractive and will soon spoil.

Pick raspberries for the market when the fruit is firm but well colored and is mature enough to separate readily from the receptacle or "core". If picked too early the berries are lacking in flavor and some varieties crumble badly in pulling them loose. For home use the fruit may be left on the plant slightly longer.

Pick blackberries after they have softened somewhat and will separate easily from the cluster. Most blackberries color before they are ripe and there is a tendency to pick while they are still sour. Pick in the cool of the morning but not while the fruit is wet with dew. Wet berries mold very readily.

Use the thumb and first two fingers in picking and hold very few berries in the hand at one time. Handle the berries carefully; place—do not drop—the fruit in the container in which it is to be marketed. The fruit is too soft to permit sorting or moving from one container to another.

Pickers use carriers holding four to eight boxes which may be supported on legs to eliminate stooping. Picking is done directly into the carrier, into a box held in one hand with the other hand being used for picking, or into small carriers which hold one or two boxes and are strapped to the waist.

The fruit should be kept in the shade as much as possible. Exposure for even a short time will cause raspberries to heat and dry out, while blackberries will become red and bitter.

The planting should be picked every other day. Six to eight pickers are usually required per acre.

PREPARE AN ATTRACTIVE PACK

Bramble fruits are highly perishable. They must be handled with extreme care and must be marketed quickly. An attractive pack is necessary to the successful marketing of this short-lived product.

Berries for the market are packed in pint or quart boxes. The American style box is a substantial attractive container and is popular in this section. For local marketing flat crates which hold 12 to 18 pints are sometimes used. Red raspberries, dewberries, and Boysenberries are usually packed in pint boxes.

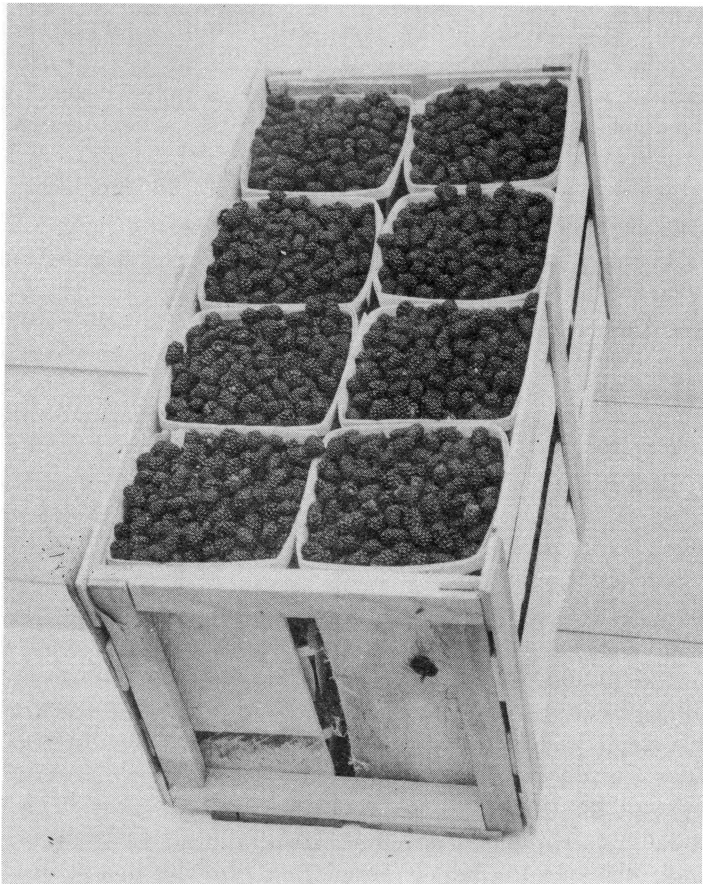


Fig. 10.—The 24-quart American type crate is commonly used for blackberries. Raspberries and trailing blackberries are usually marketed in pint containers.

It is necessary that the boxes be well filled and that all the berries are in excellent condition. The boxes must be filled a little higher than it appears necessary since the fruit tends to settle resulting in a slack pack otherwise.

Some kind of a packing shed near the planting is necessary. It serves as a control point to which the fruit can be brought for protection against sun and rain and for inspection and packing into crates. Such a structure can be simple and temporary, with only a roof and supporting framework.

CONTROL DISEASES AND INSECTS

Sanitation Is the First Step.—The application of sanitary measures is an important step in controlling most diseases and insects of brambles. Eradicate all wild plants and old run-down diseased plantings in the vicinity before establishing a new one. All prunings should be removed from the field and burned.

A careful watch should be kept for such serious diseases as crown gall, virus diseases and orange rust. At their first appearance in the field affected plants should be removed, including all the roots, and burned.

Sanitary measures are the most practical and in some cases the only method of controlling certain insects and diseases.

Rose Scale.—The rose scale is a small reddish insect which completely covers itself with a waxy coating.

Small white flecks along the basal portions of the cane indicate the presence of this insect. Sometimes the entire lower parts of the canes are encrusted with the whitish scale coverings.

Control.—Rose scale is easily controlled by spraying with liquid lime sulfur, one gallon to eight gallons of water. A delayed dormant application of liquid lime sulfur for anthracnose will also control this insect. Removal of infested canes during the early spring dormant pruning is advisable.

Red-Necked Cane Borer.—Swellings an inch or two in length on basal portion of bramble canes are caused by this insect. The insects either kill the canes or weaken them until they are practically worthless for fruit production. Attacks are most serious on trailing blackberries with some damage on red raspberries.

Control.—The best and simplest method is to cut out and burn all canes showing such swellings by the first of April. Wild plants in the vicinity should be destroyed.

Red Spiders.—Red spiders, along with several other species of mites, occasionally damage the foliage and young growing tips of brambles. It is only during long, dry periods that they become abundant enough to cause any appreciable damage. They are very small and mostly infest the undersides of the leaves. Considerable damage can be done before their presence is noticed. The foliage exhibits a dull faded appearance or the leaves may have light colored pin-point speckles if the insects feed on the upper sides of the leaves. With heavy infestations the leaves

may brown at the edges and drop and there is usually some webbing about the young tips of the shoots.

Control.—The use of one gallon of summer or white oil in 100 gallons of water has been the standard method. The spraying was carried out only when the insects became numerous. A number of new organic mitacides are available at present. One of the most promising is p-tert-butylphenoxy isopropyl 2—chloroethyl sulfite. The 15 per cent wettable powder is sold under the trade names of Aramite, Orthomite and Niagramite.

Use $\frac{3}{4}$ pound of the 15 per cent wettable powder per 100 gallons of spray or one level tablespoon per gallon.

Do not spray for red spiders as a regular practice, only when the presence of mites make it necessary.

Insects of Minor Importance.—Tree crickets, raspberry cane maggots, sawflies, leaf-rollers and fruit worms may cause some damage, but it is very seldom.

Tree crickets, raspberry fruit worms, leaf-rollers, and sawflies can be controlled by lead arsenate sprays or sprays or dusts of DDT, Toxaphene, Lindane, or TDE.

The adult cane maggot is a small grayish fly which emerges from the cane and lays its eggs in the new buds or in the tips of new shoots. The larvae girdle the stem and work down into the cane. Control consists of removing injured canes while dormant pruning and cutting off girdled canes several inches below cut during summer.

Anthracnose.—Black raspberries are the most severely attacked of brambles although all are subject to attack. All of the above-ground parts of the plants may suffer infection. The trailing types of blackberries are quite susceptible while purple and red raspberries and erect blackberries are more resistant.

The disease first appears in the spring on the shoots as small purplish slightly raised spots. As the shoots grow, the spots enlarge and become somewhat oval in shape and edged with slightly raised reddish purple borders. Later the centers of the spots turn grayish in color, become sunken and often crack length-wise of the stem. When the spots are numerous the margins may join to form large diseased areas. Under such severe conditions the shoots may be killed or the canes may be weakened making them more subject to winter injury. Movement of water is interrupted and during dry weather the following spring and summer the berries dry up before they mature. Injury to black and purple raspberries is due mostly to shoot or cane infections.

Most of the losses with blackberries and red raspberries are due to fruit stem infections. Spots similar to those produced on canes may be produced on the shoots which grow out from the canes in the spring and

bear fruit. The berries will not mature properly if the spots are abundant.

The seriousness of fruit stem infections on red raspberries seems to depend largely upon the development of the "gray bark" stage of anthracnose. During the late summer and early fall the fungus produces an extensive grayish white superficial growth on the cane. This growth is most extensive on the areas exposed to wind and sun. The gray appearance of the shoot is due to the presence of large numbers of colonies of fungus which have fused. Sometimes individual colonies can be seen as elongated areas in which numerous small black dots are arranged in concentric rings. The gray bark stage probably does little damage in

itself but with rains in the spring the disease is scattered to all new growing parts of the plants.

On the leaves the disease develops as small angular spots with purplish borders, the spots resembling those of *Septoria* Leaf Spot, another disease which usually is more abundant on the foliage of brambles than is anthracnose. This phase of anthracnose is rarely of any consequence. When the fruit is diseased the entire berry or such parts as are infected may remain small and dry or they may develop without much flavor and turn a dull dark brown color.

Control.—A combination of sanitary measures, spraying and selection of resistant varieties should be used in the control of this disease. The "handles" or sections of old stem on the tip plants of black and purple raspberries and trailing

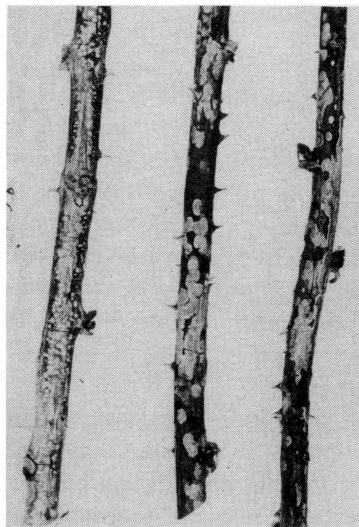


Fig. 11.—Anthracnose lesions on black raspberry canes.

blackberries should be removed at planting time. The removal of the fruiting canes as soon as the berries are harvested will aid somewhat.

Spraying is usually necessary in addition to other measures. A spray applied just as the buds are opening in the spring is most effective. Unless this spray is made, control is not likely to be satisfactory. Sprays at 10 day intervals until bloom are advisable. See spray program page 29 for materials.

Resistant varieties whenever available should be used.

Crown Gall.—Crown gall is a bacterial disease which is found on a large number of species of plants, and consequently the organism causing

the disease may be present in the soil if any fruit plants, especially, have been grown on the site.

Black and red raspberries are very susceptible and purples to a lesser extent. Both erect and trailing blackberries are subject to attack but seldom show any ill effects. The general effect on raspberries is a weakening of the plants.

Galls or wart-like swellings may appear on the roots, at the crowns, or along the canes.

Control.—Preventative measures are the only methods of control. Purchase only certified plants from reliable nurseries. Make a careful inspection of each plant before it is put into the soil and discard it if it shows any signs of gall on any part.

Deep cultivation is not recommended in established plantings. Roots are cut and entry of the organism is made easier.

Orange Rust.—This disease is readily recognized by the yellowish to orange colored spots which appear in the spring on the undersides of the leaves and the clusters of small weak shoots growing from the crowns of infected plants.

Orange rust is primarily a disease of blackberries. Black raspberries are somewhat susceptible, but the disease is seldom of any consequence.

Once a plant is infected it never recovers. The leaves are usually so heavily infected that they are of little value to the plant and diseased plants do not bear a crop.

Control.—Once a plant becomes infected with the orange rust fungus there is no way of eradicating it or controlling it with chemical sprays. Sanitation is the only control. Dig out and burn affected plants with their entire root system early in the spring before the orange colored spores begin to scatter. After the disease becomes general over a planting it is necessary to plow up the field and plant on a different site.

A method of eradicating individual infected plants which is quicker than digging and more efficient because it is difficult to remove the extensive root systems is to treat the stubs of infected canes with Ammate or 2,4,5-T. The chemicals are translocated into the roots and killing of all parts results.

Cane Blight.—The cane or individual laterals suddenly wilt and die about the time the fruit begins to mature. If the cane below the wilted branch is observed, a diseased area will be found. Infected parts of the bark are lighter colored and are likely to have smutty patches due to masses of the fungus spores extruded on the surface.

The fungus enters the bark through some wound either insect or mechanical.

Control.—Cane blight has not been readily controlled by fungicidal sprays. Control consists for most part of preventive measures. Secure

plants free from the disease. Cut out and burn old canes as soon as possible after fruiting. Avoid wounding canes unnecessarily.

Leaf Spot.—This fungus disease is one of the most common of bramble disease although it seldom causes serious losses. Trailing blackberries and red raspberries are more susceptible than other types.

In the case of blackberries, small purple dots appear on the leaves of plants in June. The center of the spots usually turn grayish in color. Small black fungus fruiting bodies can be seen on the gray central portion. Diseased leaves turn yellow and drop prematurely.

On raspberries, small, dark brown spots appear. Later they attain a size of about $\frac{1}{8}$ inch in diameter, have a circular to irregular shape and develop a gray color. The disease may be on the canes in the form of dark circular spots about $\frac{1}{8}$ inch in diameter.

Control.—A spray program designed for anthracnose control will also control leaf spot on raspberries. On erect and some trailing blackberries where anthracnose sprays may not be necessary, a weak spray of bordeaux (3-3-100) applied when the fruit is about half grown and a strong spray (8-8-100) after harvest will usually give satisfactory control.

Virus Diseases.—Leaf curl, Mosaics, and Streak are virus diseases which may be encountered in brambles.

Leaf curl is characterized by a marked downward curling of the leaves. The color of the curled leaves is a deep green and stunting of growth accompanies the curling of the leaves. Stunting of canes becomes very severe after a number of years and the fruit is small and poor in quality.

Mosaic is widespread and especially serious on black raspberries. Three or more forms of Mosaic may be present on blacks. Leaves may exhibit the characteristic mottling, may be small, yellowish in color with their margins turned upward, or the tips of young shoots may be killed or stopped in a growth. Green blisters may appear on the leaves of red raspberry suckers late in the spring.

Mosaic is accompanied by stunting and the canes are more subject to winter injury.

Streak is a virus disease which derives its name from the characteristic discolorations produced on young stems. Dots and irregular streaks of blue appear on the young shoots in June and July. The tip leaves of young canes show a peculiar curling. The tips of the leaflets are curved

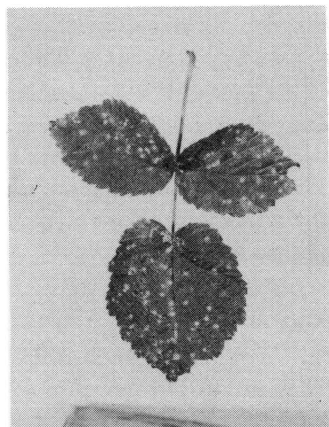


Fig. 12.—Septoria Leaf Spot on raspberries.

downward and inward so that they have a peculiar hooked appearance.

Black raspberries are the only very susceptible bramble, although purples have been known to exhibit infection.

Control.—The casual agents of virus diseases are too small to be seen by an ordinary microscope and classification depends upon the symptoms exhibited by plants. Different plants react differently to the same virus and the same virus may produce different symptoms on the same plant under different climatic conditions, consequently diagnosis is very difficult. Nevertheless, it is not so important for the grower to be able to distinguish between different virus diseases, but is important for him to distinguish between virus diseases and diseases or disorders caused by other agents or conditions.

The first step in controlling virus diseases is to start with virus-free plants. Secure certified plants from reliable nurseries if you cannot recognize virus infected plants.

The new planting should be separated a considerable distance from old fields. Raspberry aphids (plant lice) of at least two genera transmit the infection from diseased to healthy plants as they feed.

Regular inspections should be made and any plant which shows a stunted growth, curled, mottled or yellowish leaves or short laterals should be removed and burned. Before the plant is removed some method of destroying any aphids which are feeding on it must be used. The plant may be sprayed with a strong concentration of Lindane, Nicotine Sulfate, Toxaphene, Parathion or the leaves may be burned or scorched with a torch of any type.

Since aphids spread these diseases it would seem that they could be controlled by destroying these insects. Experience has shown that the spread of virus diseases could not be handled satisfactorily because it was never possible to control all the insects.

Varieties differ in their susceptibility and it is wise to choose those varieties which have shown the most resistance in trials in your region.

Black raspberries are very susceptible and should not be grown along with reds.

Spray Program for Brambles

Spraying should be a regular practice in the case of raspberries and trailing blackberries.

1. When the buds break in the spring (as the green leaf tips appear), use Liquid lime sulfur (preferred) one pint (2 cups) in one gallon of spray, $6\frac{1}{4}$ gallons in fifty gallons; or Dry lime sulfur— $1\frac{1}{4}$ cups in one gallon—twenty pounds in fifty gallons.

2. When the first new shoots at the bases of the plants are two to four inches in height, use Ferbam (preferred) 2 tablespoons in one gallon—one pound in 50 gallons: First wet the Ferbam (Fermate) with a small

amount of water and stir until reduced to a smooth paste before adding the full amount of water;

or Dry lime sulfur—5 tablespoons in one gallon, 4 pounds in 50 gallons;

or Liquid lime sulfur $\frac{1}{3}$ cup in 1 gallon—1 gallon in 50 gallons.

3. Continue spraying about every ten days until blooming begins, using the same materials as in the second sprays.



Fig. 13.—Insect and disease control is essential for healthy foliage and heavy bearing.

PROTECT THE PLANTING FROM RODENTS

A serious problem in bramble growing is the damage done by rodents. Mice seldom cause serious damage, but rabbits frequently cause serious losses by girdling the canes during the winter months.

A number of chemical repellents are available, but as yet none have proven as satisfactory as desired.

For small plantings as well as large commercial plantings the most satisfactory methods of protection from rabbits is fencing with 2-inch mesh wire netting 30 inches high.

INCREASE YIELDS AND EXTEND LIFE OF PLANTING

Under Missouri conditions black raspberries may be expected to yield 1200 to 1800 quarts per acre. Purple will usually yield more than the blacks. The average yield of reds will probably be less than 1000 quarts per acre but under good conditions the yield may be considerably above 2000 quarts per acre.

The Early Harvest variety has produced more than other varieties of erect and trailing blackberries and it can be expected to yield 2000 or more quarts per acre.

The duration of a planting of raspberries in Missouri will range from four or five years to eight to 10 years. Blacks are usually the shortest-lived because of virus diseases.

Blackberries will produce for 12 to 15 years or longer if given proper care.

Factors which determine the annual yield of a planting are also the factors which determine the profitable duration of the planting.

Much can be done to keep yields high and to postpone the time of decline in production by preventing the loss of soil by erosion, by maintaining a liberal supply of humus in the soil, by liberal annual applications of nitrogen supplying materials, by conserving moisture, and by controlling insects and diseases by sanitary and other preventive measures and spraying.

Careful attention must be given to the problems that have been outlined and discussed herein as well as others that may arise.

The yields and the duration of your planting will be a measure of how well you meet these problems.

UNIVERSITY OF MISSOURI COLLEGE OF AGRICULTURE AND THE UNITED STATES

DEPARTMENT OF AGRICULTURE COOPERATING

J. W. BURCH, Director, Agricultural Extension Service

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