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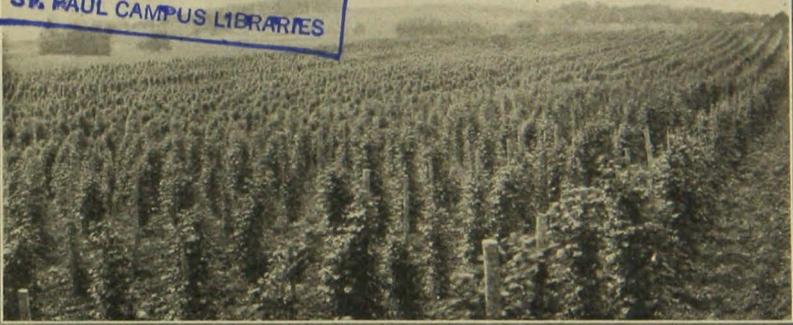
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MODERN BUSH FRUIT GROWING

By Franc P. Daniels
Division of Horticulture
Agricultural Experiment Station

RASPBERRIES BLACKBERRIES
CURRANTS GOOSEBERRIES

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Staked Hill System for Red Raspberries

UNIVERSITY OF MINNESOTA
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BUSH fruit growing in Minnesota is a pleasant and paying enterprise when correctly handled and is of increasing importance.

During the ten years from 1910 to 1920 there was a considerable increase in both acreage and yield of all the important bush fruits, and with present improved methods of cultivation and of pest control, the increase will undoubtedly continue for some time.

There have been many advances in small-fruit cultural methods during recent years, standing out pre-eminently being the principle of restriction of plants and fruiting wood in order to insure the highest quantity and quality of fruit. This restriction is accomplished by regular annual pruning of the currant and gooseberry; and by the adoption of the 3- to 6-cane staked hill, or narrow hedge-row system of culture for the raspberry and other brambles. Modern culture also emphasizes thoro cultivation, the maintenance of a high humus content in the soil, the use of cover crops, and the control of insects and diseases by means of field sanitation as well as by spraying.

THE RASPBERRY

Characteristics of the Raspberry

Raspberry roots are perennial, but the canes are biennial, and new shoots that come up from the crown or root one season live over to fruit the second season, at the end of which they die, and should be removed and destroyed. The fruit is borne on lateral branches which grow out from the one-year-old upright canes the second year. The fruit of the everbearing raspberry is borne near the tips of the one-year-old canes in the late summer and fall.

Raspberries are divided into two classes, according to manner of growth and methods of propagating. One, the red raspberry, produces an upright growing cane and propagates by suckers—canes which grow up from any part of the root system, and are used in establishing new plantings.

In the other group, comprising the black and the purple raspberries, the canes all come up from a central crown and propagation is by tip layering. The canes curve and the tips come down to the ground. Under favorable conditions, they will take root in late summer and form new plants which are set out the following spring.

Selection of Varieties

In selecting a variety of raspberry, hardiness is a factor of great importance. Some varieties require winter covering in all but the most favored parts of Minnesota. Others are entirely hardy in some or all parts of the state. Many growers prefer to grow the tender

varieties and undergo the labor and expense of covering and uncovering with dirt every year, because of the extra yield or quality that they think they may obtain from these tender varieties.

Other factors of importance in a variety are high quality of fruit, heavy yielding ability, resistance to disease, and vigor. A berry that holds well to the plant and does not "shell" readily is preferable to one that will fall off when the plant is shaken, as in a windstorm.

Varieties in Order of Ripening

Red

King: Tender in most parts of the state; has been one of the most popular and widely grown varieties for either home or market use.

Cuthbert: Quite tender; requires protection in practically the entire state; berries of very high quality.

Sunbeam: Hardest of the red raspberries recommended for Minnesota. Should be used only in the western and northern parts of the state, in sections where extreme hardiness is of more importance than yield and quality. Does well on some sandy soils.

Latham (Minn. No. 4): The most desirable of the thoroly tested red raspberries now available for the Northwest; heavy yielding and hardy without protection in most parts of the state; excellent for home or market. Berries large.

Yellow

Golden Queen: A yellow variety very similar to Cuthbert in all ways; suitable only for home use.

Black

Cumberland: Heavy yielder; good quality; perhaps the most popular of the blacks among commercial growers. Season late.

Plum Farmer: A little older and better known black raspberry than the Cumberland and popular with growers who wish an early berry.

Gregg: An old reliable late black raspberry.

Purple

Columbia.

Location

A northern exposure giving protection from the hot dry winds of summer is more important than for strawberries because the fruiting season comes at a time when there is less rainfall. Good water drainage is essential and if not present naturally should be supplied by means of tile drains. Air drainage is equally important, and the site should be high enough to allow cold air to drain off readily to lower areas, thereby giving some protection from late spring and early fall

frosts. If anything, the water drainage should be more thoro, for the plants are deeper rooting than strawberry plants. The soil may be heavier than for the strawberry. In fact, many of the red raspberries seem to do better on a friable clay loam than on a lighter soil. The soil should be deep, fertile, moist, and high in organic matter, and should not pack or puddle.

The soil for raspberries may be greatly improved and built up by the use of barnyard and green manures. Too much nitrogen may cause damage by inducing late growth, and consequent winter injury.

Preparation for Planting

Unless the soil is very high in organic matter, a green manure crop or a last cutting of clover should be turned under. Old sod that has been cultivated for one year makes an excellent soil. Plowing should be done early in the fall and should be very deep. The ground should be disked before plowing, especially if much organic matter is being turned under. In early spring it should be disked thoroly and put into seedbed condition as soon as possible, for early planting is essential in the raspberry. If the plants are to be set in the fall, work the ground up at once after plowing.

Planting Systems for the Red Raspberry

Hill system.—For the raspberry there are the same extremes in training systems that there are for the strawberry, the hill and the hedge systems, with the same numerous intermediate modifications. In the hill system plants are set in checks for cross-cultivation, and the number of canes in each hill is limited. There are two common types of hill system, the supported and the unsupported. In the supported system there is usually a stake in the center of the hill to which the canes are tied. A stake of tamarack is preferred if obtainable because of its strength and durability. The canes are limited to from 4 to 7 in a hill and are allowed to cover only a very small area of ground. This allows cultivation of practically all the ground with a horse cultivator and eliminates all hand hoeing except a small amount directly in the hill. Some growers leave a wide aisle every fourth or fifth row to allow a team to go through for hauling manure, as it is impossible to drive over the row when the stakes are in place. In the unsupported hill system from eight to twelve canes are left per hill and these necessarily must occupy a much larger area of ground. These canes must also be pruned more severely in the spring than those in the staked hill system, because they will not have the artificial support. In some systems of training a string or cord is tied around the canes just before the laterals begin to grow in the spring. This helps

to make the canes self-supporting and prevents them from being borne down with the weight of the crop later on.

The advantages of the hill system are:

1. Cultivation may be carried on both ways, eliminating much hand work.
2. More thoro tillage is possible.
3. Fruit averages larger.
4. Fruit is more easily picked.
5. Cost of pruning and caning is lower.
6. Control of insects and diseases is easier, especially of the By-turus, or raspberry fruit worm, and Raspberry Mosaic.

The objections to the hill system are that it is not suited to hill-sides or to long narrow fields, and in the staked hill system there is the extra expense of stakes and tying.

In some sections a wire-supported hill system is finding favor. In this system only 3 or 4 canes are allowed in the hill, and the hills are $2\frac{1}{2}$ to 3 feet apart in rows 6 feet apart. A single wire runs down the row about 4 feet above the ground, to which the canes in each hill are tied after first bending them so that their upper portions parallel the wire. No cross-cultivation is possible in this system.

Hedge or solid row system.—In this system the sucker plants are allowed to come up between the plants that are set out and so form a solid row or hedge. It is a very satisfactory system if the canes are properly thinned, but is open to the severe criticism that most growers will not, or do not, properly thin. The canes should be thinned to at least 7 inches apart. In this system the canes may or may not be supported. The support has the advantage of keeping the outside canes from being borne down into the dirt by the weight of the fruit and by rain and wind storms.

The common support in this part of the country is made by running a series of posts down the center of the row. Each post is equipped with a cross arm along the outer ends of which is attached a wire which supports the canes.

The advantages of the hedge row system, other than its adaptability to certain sites and to fields of certain shapes, is that the patch may be neglected with less serious results than in the hill system.

The disadvantages are that there is a tendency to leave the canes in a too crowded condition. There is less thoro tillage of the ground, resulting in increased insect and disease trouble and often in smaller berries. More hand weeding and hoeing is required to keep the patch clean. If the canes are thinned as they should be, much hand labor is required. At pruning and caning times the cost is greater than in

the hill system because of the greater number of canes to be handled. Picking is slower and more difficult.

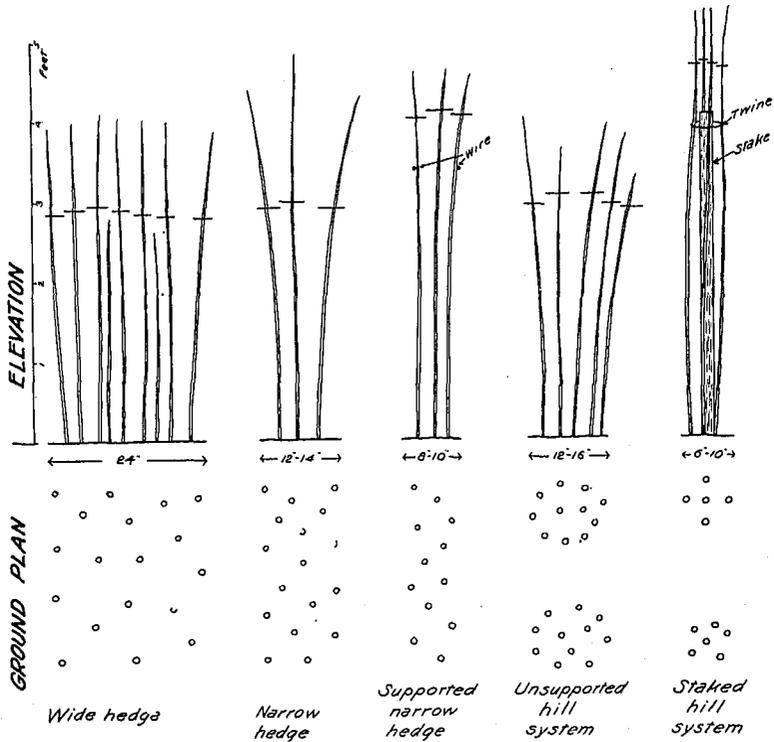


Fig. 1. Raspberry Training Systems. Lines indicate spring or dormant pruning.

Planting Distances

Planting distances for red raspberries in the hill system are from 4x5 feet to 4x7 feet with 4x6 feet probably the most common. In the hedge row the plants are set from 2 to 3 feet apart in the row and the rows from 6 to 8 feet apart, with 2½ feet in the row and 7 feet between the rows as the usual plan. Whenever the contour of the land allows, it is best to have the wide aisle run north and south, as this allows the sun to shine on one side of the row in the morning and on the other side in the afternoon.

Black Raspberry Planting Plans

Owing to its sprawling manner of growth, the black raspberry is seldom planted in hills. The plants do not sucker, but send up their canes from the central original crown. The canes grow upright for a time and then curve to the ground, at times reaching a considerable distance from the center of the plant, making cross cultivation very

difficult, if not impossible. For this reason the continuous row planting plan is used and the plants are set from 3 to 4 feet apart in rows 7 to 8 feet apart. Perhaps the most common planting distance is $3\frac{1}{2}$ feet between the plants with the rows 7 feet apart. Some growers use a wire support for the canes, but this is not the general custom.

Planting

Raspberries are generally planted in the spring and that is always the best time for the black varieties. Red raspberries may be planted in the fall if the season is favorable and the work is done carefully. Unless the ground is thoroly moist, fall planting should not be done, but if it is practiced, the stub of the cane should be cut to one or two inches above the ground, covered with soil, and then the plants lightly mulched with strawy manure. The advantage of this fall setting, where it is feasible, is that the plants are all set and ready to grow early in the spring, as soon as the ground warms up. The suckers which come up from the root start early in the spring and are likely to be broken off unless the plants are set while thoroly dormant.

When the plants are received from the nursery, they should be heeled in immediately, unless they are to be planted within a few hours. The bunches should be cut and the roots puddled in muddy water before heeling in. If the canes are long, they should be cut back severely.

The ground should be stirred just before planting, then planked or rolled and marked and cross-marked if the patch is large. The most common plan is to set the plants with a spade, altho on a large field it may be advantageous to furrow out one way with the plow, using the spade to finish the hole at the point where the plant is to be set. Cross-marking allows cross-cultivation the first year even in the hedge row system, unless the patch is to be intercropped. This cross-cultivation saves much labor the first year. When the ground is ready for planting, the plants are taken out of the ground where they have been heeled in, just as they are needed, a few at a time. The roots should again be puddled in muddy water before being carried to the field and should be kept shaded at all times during the planting operation to keep the roots from drying out. Set the roots so that they have contact with moist soil. Spread them well, cover with soil, and then thoroly firm the ground against them. Loose soil should be left on top. Red raspberry plants are set two or three inches deeper than they grew and lack raspberry plants only one or two inches deeper. After planting, the top should be cut to a stub of four or five inches if it is longer than that. This stub of the cane is to serve only as a marker for the first year. The plant should not be allowed to

produce fruit, as all energy must be devoted to plant growth in preparation for the following year's crop. Removal of the surplus wood also helps to check disease.

Culture the First Year

Cultivation should start immediately after the plants are set and should be kept up at frequent intervals throughout the summer. Cultivation should be thoro and not more than 3 inches deep except in early spring. The common five- to seven-shovel cultivator with a square-point shovel to cut suckers of the red raspberry is the most commonly used tool. Cultivation should be stopped by the first of September, or earlier, every year. Later cultivation may induce late wood growth and subsequent winter injury to the immature canes. If a cover crop such as rape or cowhorn turnip is to be planted between the rows, it should be sown just before the last cultivation and cultivated into the ground. This should be planted between the middle of August and the first of September. Some hand hoeing close to the plants will be necessary the first year but no pruning will be needed other than at planting time. Only two or three canes should be allowed to develop the first year.

Companion crops may be used between the raspberry rows the first year. They should be crops that start late, require thoro cultivation, are fairly small in size, and do not require cultivation after the first of September. Beans, late cabbage, beets, carrots, and crops of similar type are commonly used. The use of a companion crop undoubtedly checks the development of the raspberries to a certain extent, but the financial return obtained by growing them is often considered worth while by commercial growers.

Winter Protection

In some parts of the country certain varieties need winter covering for, if not given protection, some canes will be killed entirely or in part and others may be simply weakened. This results later in the falling off of fruiting laterals. In many localities where the need of covering is not so great, growers consider it a good insurance and feel that altho it may not be necessary every year, the benefit from protection in the years when it is necessary more than compensates for the cost of covering in the other years. The common plan is to bend the canes down and cover them so that there are two or three inches of soil over the highest part of the cane. This should be done as late as possible before the ground freezes, when the canes are thoroly mature and the wood well hardened for winter. In covering the plants two men work together, one bending down the tips of the canes and holding

them in place while the other throws enough dirt on the tips to hold the canes down. The pressure of the foot against the base of the cane, when it is being bent down, helps to prevent breaking at this time. When the entire patch has been bent down, a plow is run along each side of the row, throwing a back furrow over the plants. Some growers use iron pins or staples to hold the canes down until the dirt has been piled over them. In certain localities where berries are grown extensively and where no support is used for the canes, a machine is used to bend down and cover the plants. This requires four horses and three men and bends down the canes and throws a furrow of dirt over each side at one passage. This machine can not be operated where any system of support is used. More canes are broken when covered by a machine, so a few extra canes are usually left.

Uncovering in Spring

The canes should be uncovered while still dormant and before the buds begin to swell, or many buds will be broken off. The ordinary practice is to uncover them as soon as the frost is out of the ground and the ridges are well dried. Many growers first go over the ridges with some device which will scrape off part of the soil and leave a part of the canes arching up through the ridge. This makes the work much easier, as the canes can be seen. A common fork is used to lift the canes and is inserted about two-thirds of the distance from the base to the tip and then lifted. This springs the canes out of the ground and they must then be straightened by bearing the fork against them near the base. The dirt in the row must then be taken out and the ground leveled. In cross-cultivated fields, this can be done largely with a cultivator and finished in the hill with a hoe or fork. In the hedge-row system all the dirt must be moved from the row by hand tools.

Pruning

Early in the spring all one-year-old canes should be cut back somewhat to give greater mechanical strength so that the canes can bear the load, to get the fruit within reach of the pickers, and to produce better berries, for the fruit near the tips, where the canes are weak, is usually small. Good, strong, red raspberry canes are cut back to from 2 to 4 feet for an unsupported row and from 3 to 5 feet if supports are used. Black raspberries are headed at 3 to 4 feet. Weaker canes are headed in to a point where they will have strength to hold up a load. Any very small, weak, or injured canes should be cut out entirely. All laterals that grew out from the cane the season previous should be headed in to 10 or 15 inches.

At the end of the fruiting season, the canes which have fruited should be removed and burned, in order more easily to control diseases. Surplus new canes may be removed at this time also.

The heading in or pinching back of new canes during the growing season, which is practiced in some localities, is seldom desirable in Minnesota and should never be practiced if the plants are to be covered, as the resulting laterals are broken off when the canes are laid down.

Pruning Tools

The spring heading in is done with a pruning knife, pruning shears, or light sickle. The last will do a good job and do the work quicker than almost any other tool. For removing old or large canes at the base, a pruning hook or lopping shears should be used.

Culture After the First Year

As soon as the canes are uncovered, cultivation should start. The first cultivation should be quite deep. If the canes were not covered, a light plow may be used. This is especially desirable if there is a heavy cover crop on the ground or if there has been a heavy application of barnyard manure. The cultivation otherwise is the same as the first year. Some growers stop cultivation during the picking season. This is a mistake, for there is no time in the whole year during which the plants need food and moisture more than at the fruiting season. If the plants are properly handled they will not fall down into the aisle and if the cultivator follows closely after the pickers few of the berries will fall off. After picking, thoro cultivation in the hill and row should be given to maintain vigorous growth and to aid in controlling the *Byturus*. If the patch has made a vigorous growth, the cover crop may be sown about the middle of August and cultivated in. If the canes are slightly weak and have not made the growth desired, cultivation should be continued until the first of September, a cover crop being sown immediately before the last cultivation.

Harvesting the Crop

Care should be observed in handling raspberries. They crush easily and for that reason pint boxes are used, altho quart boxes are used for the black variety. The field carriers for the boxes should have long legs so that the picker will not have to bend down to place berries in the boxes. The only grading the berries receive is given them at the time of picking. Government investigations have shown that berries picked with three fingers are less bruised than those picked with two fingers and will therefore hold up better after harvesting.

Duration of the Patch

With healthy stock, clean land, good care, and a good humus content in the soil, a raspberry patch should remain in good bearing condition from six to ten years.

Raspberry Insects

Byturus or raspberry fruit worm.—This little worm, which is found in the cup of the raspberry or tunneling in the receptacle of the berry after the berry has been picked, is the larva of a small brown beetle which feeds on the foliage of the raspberry in the spring. The female lays the egg in the flower bud and the larva hatching there feeds upon the developing fruit. Much trouble with crumbly raspberries is caused by this insect. It may usually be held in check by thoro cultivation of the patch, kept up as late in the summer as is advisable with the need of the maturing of the wood in the fall kept in mind. Cultivation during picking, especially in the latter part of the picking season and immediately after, is very important, for it is at this time that the larva, having dropped to the ground, burrows into the soil and pupates. Thoro cultivation will destroy the pupa. The restricted hill system or the well restricted hedge row allows much better soil stirring than do the wider rows or larger hills. Where the insect is a really serious pest the staked hill system is perhaps the best cultural plan to follow.

Snowy tree cricket.—The snowy tree cricket causes severe injury to raspberry canes by making a series of egg punctures which weaken the cane. These egg punctures run in a row lengthwise of the cane and are made during the late summer and fall. The following spring the eggs hatch. The harm done is in the weakening of the cane so that it is not strong enough to hold up under a load of fruit or in heavy winds and the probable check in food and moisture transportation. To control the insect, prune out and burn the infected wood during the dormant period.

Red-necked cane-borer.—Raspberry and blackberry canes are often found to have irregular swellings or galls, one to three inches in length. The cane is swollen or enlarged somewhat and often the bark is split. The adult beetle lays an egg on the young growth, from which hatches the small whitish larva. It feeds on the sapwood just under the bark, working spirally up or down the cane, girdling it. The galls form where the cane is injured. The best control method is to cut out infected canes several inches below the lowest gall during the dormant period and burn them immediately.

Raspberry Diseases

Anthracnose.—Anthracnose is one of the very serious diseases of raspberries in Minnesota. Anthracnose causes grayish sunken areas with purplish borders on the canes. These gray spots sometimes appear on the leaf stem and on the leaves themselves. All affected canes should be cut out and burned immediately after the fruit is picked. Seriously infected patches should be destroyed and where the disease is severe a short rotation should be followed, no raspberries being grown on the ground which has been occupied by affected canes until several years have elapsed.

Spraying combined with good cultural practices will practically eliminate loss from anthracnose. Either bordeaux mixture (4-4-50) or lime-sulphur may be used. The first application should be made as the first leaves begin to unfold, using bordeaux mixture (4-4-50) or lime-sulfur (1-10). The second application should be applied about one week before the blooming period, using bordeaux mixture (4-4-50) or lime-sulfur (1-40).

Cane blight.—Cane blight causes the canes and branches to wilt, usually starting at the tip and working downward. In some sections the disease is quite serious. As fast as it appears, the affected canes should be pruned out and burned. Spraying, as for anthracnose, is of doubtful value, but may aid slightly in control. Canes showing any signs of disease should never be set out and a rotation should be followed as for the control of anthracnose.

Gray bark disease.—Gray bark disease or "spur blight," as it is sometimes called, produces bluish or brownish patches on the canes. As the disease progresses these patches affect large areas of the bark, which become grayish in color and peel away. The graying of the bark distinguishes this disease from cane blight. The disease weakens the canes, makes them more susceptible to winter injury, and greatly reduces the yield of fruit. As in the other cane diseases, all wood should be cut out and pruned immediately after the picking season. Spraying with bordeaux 3-2-50, with resin-fish oil soap at the rate of 2 pounds to 50 gallons of spray, is effective in giving a fair measure of control. The first application is made when the canes are 6 to 8 inches high. This is followed by three other applications at intervals of from two to three weeks, with one application immediately after picking.

Crown gall.—Unlike the other diseases just discussed, crown gall is caused by bacteria. The disease spreads readily from infected plants to healthy plants in other parts of the patch, largely through cultivation. Altho some injury from cultivation is unavoidable, care will help to lessen the spread of the disease. The bacteria remain in

the soil for several years after the plants have been removed. For this reason a rotation is important. If the disease is particularly severe, the patch can be fruited for only a few seasons. New patches should not be set near old infected patches, particularly if there is danger of the germs being carried from the old to the new patch in the natural soil water movement. The characteristic development of the disease is the formation of hard, knotty, irregular, tumor-like growths on the roots and lower part of the canes. In some cases where the canes are laid down, the galls also appear on the upper part of the canes. Infected plants should never be used in setting out a new patch nor should apparently healthy plants be used if they have been dug from a patch in which the disease is prevalent.

Leaf curl.—Leaf curl checks the growth of the plants, first affecting the leaves so that they curl downward with a heavily wrinkled appearance. The leaves are usually abnormally dark green in color. As the disease becomes more severe, the entire plant may be dwarfed and the laterals are less vigorous than normal. Apparently the disease is spread by insects, and the best method of control is to destroy affected plants as soon as they are noticed. The control for leaf curl is the same as for raspberry mosaic, given below.

Mosaic

Mosaic is unquestionably the most serious disease of raspberries in Minnesota. It is an old disease but has only recently been recognized as a specific disease for the control of which effective methods can be used. Undoubtedly it is responsible more than any other one factor for the so-called "running out" of raspberries that is so well known to all raspberry growers of the country.

The cause of the disease is not known, at least no definite organism has been isolated, but that it can be transferred by plant lice from a diseased plant to a healthy plant has been definitely proved. The disease is in the sap and apparently affects all parts of the plant. In the early stages it is rather difficult to identify, but as the disease advances it becomes easier to recognize.

The first effect usually noticed is that the foliage of parts of the plant have a somewhat lighter color than the normal, healthy, dark-green plant. This is apparent first in the new foliage, and in newly infected plants there may be no outward signs in the older growth. After the first stages of the infection, however, the new growth on the entire plant shows signs of the disease and in subsequent seasons the entire plant takes on the lighter color that was first noticeable in the young growth. A careful examination of the new leaves which are infected shows a characteristic mottling, due to areas or spots of

light green on the dark-green leaf. One characteristic of the disease that aids in identifying it is that when a leaf on a shoot becomes affected and has the characteristic mottled appearance, all new foliage produced on that shoot will develop the same mottling. Later these light-green areas become yellowish and the leaf surface becomes somewhat irregular. This mottled appearance may be most clearly seen if the leaves are held up to the light on a cloudy day. The mottling is most apparent on the plant while new foliage is being rapidly produced in early summer.

As the disease advances the foliage not only turns lighter in color, but the leaves of affected plants become smaller than normal and the entire foliage loses its glossy appearance and becomes dull. The effect on the growth, vigor, and production of the plant is very serious. As the disease advances it is accompanied by a progressive reduction in vigor and the plant usually becomes dwarfed and the fruiting laterals shorter than in the healthy plant. The berries are crumbly and the yields are greatly reduced. The general lack in vigor is accompanied by a lack of hardiness and often serious winter injury follows. In advanced stages the entire fruiting cane turns yellow and dries up before the end of the fruiting season, resulting in small hard berries of poor or unmarketable quality.

The disease may be carried in young plants dug for establishing a new field or it may be carried from diseased plants to healthy ones by aphids. By far the most important method of control is to use only mosaic-free plants in establishing a new field. In establishing a plantation free from mosaic, healthy plants should be used and they should be in a situation well isolated from any diseased plantings and it is well also to rogue out any plants which may develop symptoms of the disease later. The Minnesota State Nursery Inspection Service is carefully inspecting the nurserymen's stocks of raspberries in Minnesota and is granting special double inspection certificates covering plants dug from those fields twice inspected and from which all visibly infected plants have been removed. The most profitable and productive plantings of the future will be those established with stock of this type, stock that is free from the disease. Undoubtedly the hill system will be a most effective cultural aid in controlling mosaic, for if the plants are kept in hills, the disease may be more easily detected than in the hedge row system of training, and an entire infected hill may be eliminated. Constant vigilance will be necessary to keep the patch free from the disease and any plants which develop it should be promptly dug up and destroyed. They should be dug out and carried carefully outside the field, where they should be burned promptly. If they are carried out carelessly, brushing on other plants,

the aphids feeding on the diseased plants may be knocked off and left to infect healthy canes.

Raspberry mosaic attacks practically all varieties, altho certain varieties seem to be more affected than others. Its greatest damage in Minnesota has been on red raspberries, altho it has been found on black raspberries and other brambles.

It is impossible to get satisfactory production or continuous profits from a mosaic infested field. The disease is so very serious and far reaching in its results that it behooves every raspberry grower to take whatever steps are necessary to eliminate it and to establish new plantings of only healthy plants.

Eastern blue stem or bramble streak.—Eastern bluestem is a disease which works somewhat the same as mosaic. The organisms causing the disease have not yet been isolated and control measures are similar to those for mosaic. It is an extremely serious disease in the east and has been found in parts of Minnesota. Apparently it works only on black raspberries.

THE BLACKBERRY

There are two main types of blackberries—the common upright growing form, of various types, and the trailing type, called the Dew-berry. The canes of the latter, which is not commonly grown in Minnesota, are not self-supporting, but trail along on the ground, and the plant propagates by tiprooting as does the black raspberry.

The common blackberry is similar to the suckering type of raspberry in its manner of growth and in the general culture and pruning required. It is more susceptible to injury from hot weather, largely because its fruiting season comes in the hottest, driest time of the year, August. For this reason a cooler site and slightly heavier soil, with high organic content, is more desirable for the blackberry than for the raspberry. Many growers select a slightly lower site than for the other fruits because of the greater need for moisture, but good air drainage should not be sacrificed. The blackberry is propagated by suckers or root cuttings as is the red raspberry.

The plants should be set in the spring. The common planting plan is the hedge row, with the plants 2 to 3 feet apart, in rows 7 to 8 feet apart. The same kind of wire support used by some for the red raspberry may be used for the blackberry. The canes should be thinned as in the hedge row of the red raspberry. Wherever the canes do not need to be covered, the growing tip may be pinched off when the new cane is from 2 to 2½ feet high.

In most parts of Minnesota covering is necessary. Ordinarily spring pruning should be delayed until the plants are in bloom or too much fruiting wood may be removed.

Blackberries should be allowed to ripen well on the vine before picking. They turn black before they are thoroly ripe. After picking, they should not be exposed to the sun longer than is necessary as they are likely to sunscald. In very hot weather some varieties sunscald badly even before picking.

The three most widely used varieties in Minnesota are Eldorado, Ancient Briton, and Snyder.

In all matters of general culture, use of cover crops, winter protection, removal of old canes, and planting of a patch, the blackberry and the red raspberry are treated alike.

THE CURRANT

The currant is not so important a fruit for home use or market as either the raspberry or blackberry, but in a limited way it is very desirable for both home and commercial use. Its chief use is for making jelly. From six to twelve plants should supply the ordinary family's needs.

Characteristics of the plant.—The root and top of the currant are perennial, as in our common trees and shrubs, and the branches will continue to bear for many years. The plant is entirely hardy in the north. It starts growth and blooms very early in the year and for that reason is often injured by late spring frosts. In spite of the fact that the wood will continue to bear when quite old, the best fruit and the most fruit is borne on young thrifty wood and therefore all the older canes should be removed. The most suitable location for the currant is cool and moist, with a cool, retentive soil. It will even endure partial shade and still produce satisfactorily. While the currant will thrive in neglect, few plants will respond more promptly and more satisfactorily to good care

Varieties

The varieties of currants recommended for Minnesota are:

Red: Pomona, Red Cross, Perfection, Long Bunch Holland, and Wilder.

Black: Black Naples.

White: White Grape.

Location.—The most suitable site for the currant is on a north-eastern exposure where there will be protection from the hot dry south and southwest winds. In the home garden they may often be placed to advantage on the north side of buildings or fences. A windbreak

to the south and southwest of a commercial planting is advantageous. Deep snowdrifts in the winter are not desirable, so if a site can be selected that will be free from deep drifts, so much the better. A heavy loam to a clay soil type is the best for currants, as it is cool and moist. However, the soil should be friable and easily worked, should be deep, and preferably have a high organic content. The more fertile the soil, the more abundantly will the plants yield.

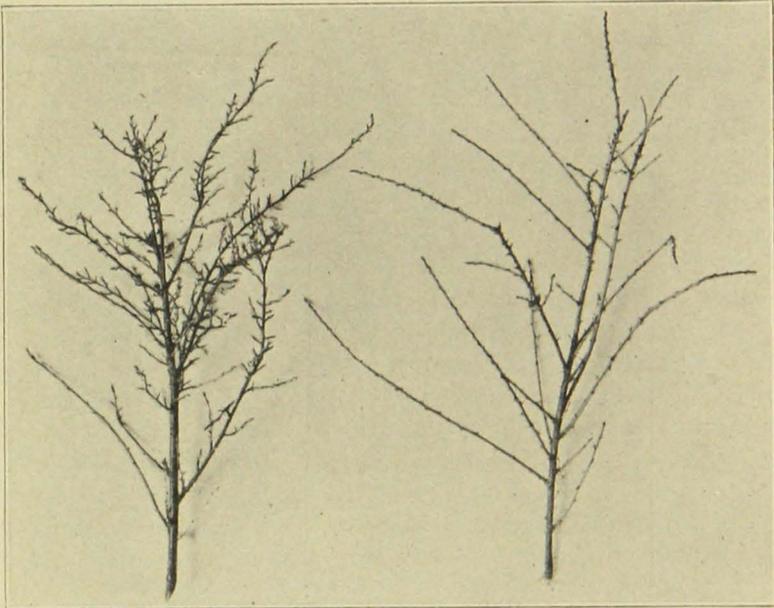


Fig. 2. The strong growth of gooseberry wood on the right will yield heavily of large berries while the weak growth on the left with five-year-old wood will produce only small berries and a light crop.

Fertilizers

The root system of the currant is very compact and the plants are not rangy feeders. Therefore fertilizers should be placed close to and under the plants so that the food will quickly reach the root system. Currant and gooseberry plants will stand more nitrogen without injury than will other bush fruits. Rotted barnyard manure is the best material to use.

Propagation

Currants are usually propagated by means of long hardwood cuttings. They may be layered readily, but because cuttings are so much simpler to make and because they give such a satisfactory stand of plants, they are more commonly used. For commercial planting a one-year-old plant is probably the best to use at present because of its lower price. In a home garden the cost of the plant is not so

important, and the two-year-old plant may be more suitable, as it will produce berries sooner.

Planting

Spring is the most common time for planting currants. The land should be fall plowed and worked down as early as possible in the spring, for currants start growth exceedingly early and, as they should be planted in a dormant condition, the work must be done promptly with the coming of spring. Fall planting is practiced by many and in a moist fall is satisfactory. After planting in the fall the ground about the plants should be well mulched. The currant is well adapted to fall planting as it becomes dormant early in the fall and the planting can be done early, insuring that the plants will be well established in the ground by the time winter sets in. The plants should be set deeper than they grew in the nursery row and at least deep enough so that all branching from the crown takes place just at or below the ground. Currants should be given plenty of room. For cross-cultivated patches they should be planted from 4 to 5 feet apart in the row, and the rows 6 feet apart. For the continuous row, where the plants are not to be cross-cultivated, they may be set one foot closer in the row. Black currants should be given more space, the plants being a foot farther apart in the row than the red and the rows from 7 to 8 feet apart. The ground should be marked both ways before setting. A large enough hole should be dug to allow a full spread of the roots and to get the plants down to the proper depth. For small plantings a spade is used, and for larger plantings a plow may be used, with a spade to finish the hole.

Pruning at Setting

Before setting, the roots should be pruned a little, cutting off long and scraggy roots and any which may have been injured. The canes should be headed in one-third to one-half and if there are many canes all but four or five should be removed at the base.

Culture the First Year

Cultivation should be begun at once after planting and should be kept up at frequent intervals throughout the growing season. It should be clean and thoro and should be supplemented with a hoe around the plants. The cultivator shovels should not go very deep close to the plants as the roots are rather shallow at this point. Ordinarily cultivation is stopped by the middle of August and a cover crop should be sown just before the last cultivation. A companion crop may be grown between the currants the first year.

Winter Protection

The currant needs no winter protection from cold, but sometimes the canes are broken down with the settling of heavy snows. For this reason if there is likelihood that deep drifts of snow may be formed over the plants, it is well to gather up the canes into a more or less compact upright bunch and tie them in this position for the winter. Where this is practiced, it is a good plan not to cut the strings until after the first cultivation the following spring. This allows thoro cultivation of the ground close to the plant.

Subsequent Culture

The culture the following year is similar to that of the first year. The spring plowing which is given to some bush fruits is usually omitted with the currant because of the shallow root system, or if it is given, it is confined to the center of the aisle. No companion crop is used after the first year. Mulching, which is sometimes done, is not generally satisfactory and should usually be omitted. It tends to increase insects and diseases and to bring the roots closer to the surface, where a subsequent later cultivation or hoeing may injure them.

Harvesting

In harvesting currants the entire cluster of berries is picked by the stem. They should be picked when ripe, but before they have softened and usually when the berries at the tip of the cluster are not entirely colored. The berries should not be torn off from their stems or they will soon spoil. They are commonly picked directly into the quart box in which they are to be sold, and are marketed in 16- or 24-quart crates.

Pruning

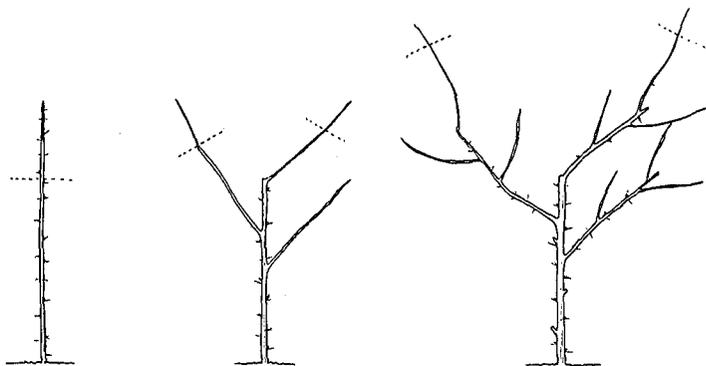
Currants will usually produce some fruit with no pruning, but for heavy yields of large berries they should be pruned regularly. They may be pruned at any time in the dormant period, late winter and early spring being the most common. As they start growth very early, it is best to prune them in the fall if there is danger of neglecting and delaying the work in the spring. The pruning of the currant is very simple if its fruiting habit is understood, and it is so very important if good fruit is desired that it should not be neglected. The best fruit is found on one-, two-, and three-year-old wood. It is borne on (a) one-year-old wood which comes up from the crown of the plant (basal shoots), and one-year-old wood which grows from older wood. The lower part of the one-year-old wood bears heavier than the upper part and at the union of one- and two-year-old wood the

fruit is especially heavy; (b) on one-year-old spurs on two-year-old wood, and (c) on two-year-old spurs on three-year-old wood.

While wood much older than this will fruit, the fruit is not so good as that obtained from younger and more vigorous wood. Usually too much wood is left in the plant, with the result that the fruit is hard to pick, light and air can not get into the center of the bush, the plant lacks vigor, and the berries are small and inferior. A plant in proper condition for fruiting should be a vigorous grower. The length of growth made by the terminal shoots indicates the plant's vigor. The four following rules are good guides in pruning the currant:

1. Remove at the ground all canes which have fruited three crops.
2. Remove at the ground all but three or four of the best one-year basal shoots. Those which grow most nearly horizontally are the least desirable and should be removed first.
3. Prune back all strong growing one-year-old wood one-fourth to one-third.
4. Thin out the center if it has become too crowded.

The pruning tools commonly used are hand pruning shears or a knife for the light wood and lopping shears or a small saw for the large canes at the base. The pruning hook used for the raspberries is seldom of value in working on the currant.



One year branch

Two year branch

Three year branch

PRUNING OF CURRANT AND GOOSEBERRY

Dotted lines indicate heading in of one-year wood

Currant Insects

Imported currant worm.—The currant worm is the larva of a sawfly and works on both gooseberries and currants. The color is greenish with markings of numerous black dots. The worms feed very rapidly and often eat the leaves off the bushes before they are noticed. There are two generations, one early in summer and the

other about six weeks later, about the time the fruit is ready for harvesting. They may easily be controlled by spraying the foliage with arsenate of lead, paris green, or hellebore, put on as a liquid spray or as a dust as soon as the worms begin to feed. Ordinarily hellebore is used only in control of the second generation at the time the fruit is ripening, if an application is needed then.

Currant borer.—The currant borer is the larva of a moth which burrows into the canes of the currant and gooseberry, weakening them and eventually killing them. Wherever canes have been killed or wherever they show an unnaturally poor and unthrifty growth, it would be well to examine the canes to see if a borer is present in them. All injured stems should be pruned out and burned before June 1. If this is not done before June 1 it will do no good, as the insect leaves the cane at about that time.

Currant aphid.—The currant aphid works on the under side of the leaves, sucking out the juice. This causes the leaves to curl under with a much wrinkled appearance and with bright red blotches on the upper surface. In order to kill these insects by spraying they must be actually struck by the spraying material, so it is necessary that the work be done before the leaves are sufficiently curled to protect them from the spray. The best control is a dormant lime-sulphur (1-9) application just before the buds burst, followed by a tobacco spray just before the leaves attain their full growth.

Currant Diseases

Leaf spot.—Leaf spot on currants is quite frequent in Minnesota, but is seldom serious. Some varieties show more marked injury than others. The leaves which are affected fall prematurely and in this way check the development of the plant. In some seasons the attack comes early and is severe, the leaves falling before the crop of fruit has been harvested. Such injury is serious, affecting the crop of the next season as well. Spraying with bordeaux mixture early in the spring and as often as necessary to protect the leaves, will give good results. Destroying by burning or plowing under any diseased leaves in the fall or very early spring will also aid in the control of the disease.

THE GOOSEBERRY

In general characteristics, manner of growth, and soil and cultural requirements, the gooseberry is very similar to the currant. The growth is not quite so vigorous from the base, there being fewer basal shoots produced, but there are more and stronger lateral shoots produced from one-, two-, and three-year-old wood. This strong wood

coming from older canes tends to keep up the vigor of the plant and to maintain larger production and larger berries than the currant, even when neglected. One outstanding difference between the gooseberry and the currant is the presence of thorns on the gooseberry bush. This makes picking the fruit very objectionable and necessitates more or less care and protection of arms and hands with gloves or other covering. When the plants are neglected for some time it is extremely difficult to harvest the crop from the inner part without severe scratching. In well tended and well pruned plants the thorns are not so troublesome.

Varieties Recommended for Minnesota

Carrie, Como (Minn. No. 43), Downing, Pearl, and Champion are the best varieties for planting in Minnesota.

Carrie is the most popular at present, owing to its relative freedom from thorns. The thorns of Carrie do not persist on old wood, being found only on the one-year-old shoots. The berries of some varieties remain green when ripe. Those of other varieties turn red. Those that do not take on the reddish tinge are preferred by some growers for market because they may be left longer on the plants and still present a bright green appearance, which is demanded in most markets.

Culture

In matters of site, soil, fertilization, planting, and culture the gooseberry is practically the same as the currant. In propagation, cuttings may be used as for the currant, but in most varieties grown in Minnesota there is not so much assurance of satisfactory growth as in the currant. For this reason layering is usually resorted to. The pruning is similar to that of the currant, except that there is more occasion to thin out the wood in the center of the plant and somewhat around the edges in order to make the head more open, and the wood may be left longer, it being a common practice with many growers to leave the wood for four crops. This may be done with less falling off in size and yield than in the currant, but in the long run the plan of removing wood after three crops is undoubtedly the best.

Picking

The gooseberry will stand more abuse in picking and handling for market than any other berry. This is due to the fact that it is usually marketed while still hard and green. The quickest way to harvest the crop is to strip off the berries on either a cloth or a canvas spread on the ground under the bush, or into a small basket held under the branches. If the picker's arms are covered and he wears good gloves the work can be done very rapidly, especially when the plant is in

good condition from proper culture and well thinned out in the head by proper pruning. The berries are picked by simply stripping them off, using the fingers as a comb, dropping them into the basket or on the cloth as fast as they are separated from the stem. Harvesting them in this way always takes off a certain number of leaves and sometimes fruit spurs and small branches. These must be sorted out before the berries are packed in the quart boxes for market. If a fanning mill is available, the berries may be run through that. If there is no fanning mill to use, the berries may be poured from a basket on to a large cloth spread on the ground, doing the work where there is a strong wind to fan out the trash, or by supplying artificial wind with large fans.

The berries are generally marketed in 16- or 24-quart crates. One of the outstanding good points of the gooseberry from a market grower's viewpoint is that there is seldom any great rush about harvesting, for the berries can be picked at any time in from one to two weeks in average years. They may be harvested as the market seems best and as the labor supply makes it convenient. Coming as they do between strawberry and raspberry picking seasons, they serve as a very convenient balance wheel for the labor, as when the pickers are through with the late strawberries and not busy with the early raspberries they may be put into the gooseberry patch. In some years, when raspberries ripen before strawberries are through, there is considerable difficulty in getting the gooseberries picked. After picking, the berries can be kept in a cool place longer than can any of the other berries, it being a not uncommon practice with some growers to pick on Saturday for Monday's market. However, whenever it is possible, it is the best plan with gooseberries, as with all fruits, to have as short a time as possible between harvesting and marketing.

Gooseberry Insects

Currant worm.—This pest, described under currant insects, works also on the gooseberry and is controlled as described under the currant.

Gooseberry fruit worm.—The gooseberry fruit worm is a small green caterpillar which eats into and destroys the gooseberry fruit. When full grown the caterpillars drop to the ground and pupate there. In well cultivated, clean patches these insects are seldom serious and may be best controlled by thoro cultivation around and under the bush and by cleaning up and burning trash and litter.

Gooseberry Diseases

Powdery mildew affects the leaves, stems, and berries of the gooseberry, covering them with a flourlike dust which later becomes brownish. It is very serious in some sections and with some varieties, but in Minnesota can usually be avoided by the selection of resistant varieties. Where control measures are necessary, potassium sulphide, one ounce to two gallons of water, should be sprayed on the plants, the first application being given as soon as the leaf buds break. Repeat at intervals of about ten days or two weeks.

Leaf spot.—Leaf spot is the same on gooseberries as on currants and the same control methods should be used.