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THE RASPBERRY AND ITS CULTIVATION IN CANADA

BY
M. B. DAVIS

WITH
A SECTION ON INSECTS AFFECTING
THE RASPBERRY

By W. P. G. GARLICK, Entomological Branch

AND
A SECTION ON RASPBERRY DISEASES

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With Water Colour Drawings by Faith Fyles

DIVISION OF HORTICULTURE
DOMINION EXPERIMENTAL FARMS

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DOMINION OF CANADA
DEPARTMENT OF AGRICULTURE

BULLETIN No. 114--NEW SERIES

THE RASPBERRY AND ITS CULTIVATION IN CANADA

BY

M. B. DAVIS

The raspberry is easily the most important bush fruit grown in Canada. Among the small fruits it ranks second to the strawberry. In a bulletin issued in February, 1927, from the Bureau of Statistics, Department of Trade and Commerce, the total production for the Dominion (excepting Quebec), for 1926, was given as 2,132,000 quarts, with a value of \$469,040. The Quebec Department of Agriculture reports a commercial crop of 135,544 quarts, bringing the total to 2,267,549 quarts. Undoubtedly the actual production is somewhat higher, as the fruit is grown in city lots and back gardens, an estimate of which is almost impossible. These figures would represent, therefore, a conservative estimate of the commercial production of raspberries in Canada.

While the bulletin does not give the acreage of bearing raspberries, at the rate of 1,500 quarts per acre this crop would require about 1,500 acres of land at least, which would not include any estimate for young plantations. Probably a total acreage (taking into consideration new plantations) of close to 2,500 acres would not be far astray.

British Columbia is easily the leading province, with Ontario second. Nova Scotia is not credited with any commercial production and neither are the provinces of Manitoba, Alberta or Saskatchewan. In spite of this, however, the raspberry is cultivated in every province of the Dominion to a profitable extent and is found growing wild in one form or another from coast to coast and as far north as the delta of the Mackenzie River. With such a wide distribution it is small wonder this has become such an important and highly prized fruit. Its commercial production is bound to increase and there would seem to be no good reason why those provinces which are not now recorded as producing commercial quantities should not be able profitably to increase their plantings in the very near future.

Species of Raspberries

While it is not within the scope of this bulletin to deal with the botany of the raspberry, a few words relative to the more important species under cultivation should prove of value to the reader. The most important of all the raspberries is that group designated by the term "red raspberries" and botanically classified as *Rubus idaeus*, which embraces both the European and the American form of the red raspberry. In the earlier works each of these was given specific rank, but the moderns place all the true red raspberries in one species and treat the European form as a variety under the classification of *Rubus idaeus vulgatus*, and the American form, which was formerly *Rubus strigosus*, now becomes *Rubus idaeus strigosus*. This *strigosus* is looked upon as the progenitor of the most of our cultivated varieties, either through hybridizing with the European *vulgatus* or through crossing within itself. In addition to this important American variety there is another which offers interest to plant breeders and this is *Rubus idaeus canadensis*, which is found wild in Manitoba and possibly over wider areas in Northwestern Canada. The second important group is the black raspberry, known as "blackcaps" or "thimbleberry." This group

is botanically classified as *Rubus occidentalis* and includes all the important varieties of thimbleberries known to commerce. A third group, of considerable importance in commercial plantations, is the purple raspberry, botanically known as *Rubus neglectus*. This group is of hybrid origin, resulting from crosses between the reds and the blacks. In popularity they probably rank second to the reds.



Raspberry plantation, Central Experimental Farm, Ottawa, 1919.

As some reader may wonder where the whites or yellows are placed it may be wise to point out that they fall under two species, viz., *idaeus* and *occidentalis*. The Golden Queen variety, for instance, is considered a sport from Cuthbert, hence is really a true red minus the colour in the fruit. On the other hand we have at this Station (and there are also others in existence) a variety of the blackcap raspberry, the fruit of which is yellow. A botanical classification on the basis of the lack of colour in the fruit is, therefore, impossible.

Location and Soils

As a raspberry plantation occupies the land for a considerable period it must be looked upon as something more than a mere temporary investment. It possesses some value as a semi-permanent industry and hence considerable attention should be paid to its location.

While raspberries are being grown profitably at great distances from an ultimate market, nevertheless the closer one gets to a good sized consuming centre, or a dehydrating and canning plant, the greater the opportunity for the successful and profitable marketing of a perishable crop like raspberries. A satisfactory market close at hand may often compensate for somewhat lower yields due to a lack of optimum growing conditions, so that a prospective grower who has not already selected his site might do well to bear marketing possibilities in mind as a primary consideration. Naturally the next point would be the selection of an actual site for the plantation, taking into consideration contours of land and adaptability of the soil.

While all raspberries are lovers of humus and moisture and will do their best on loamy soils, they can, nevertheless, be made to produce on lighter soils and fairly heavy clays, providing the drainage is good. Surface drainage is particularly important, for a few weeks of submergence in early spring or late fall may cause complete ruin to the plantation. Underdrainage is also an important consideration and only well drained sites should be chosen. As in strawberries, a gentle slope or hillside is to be preferred to a low-lying flat with surrounding higher land. Black raspberries will succeed better on the lighter soils than the reds, but are not at all successful on a cold or wet soil.

Preparation of the Land

Careful preparation of the soil before planting will be amply repaid in increased returns from the plants. Land badly infested with any but annual weeds should be carefully cleaned before planting, as it is an exceedingly difficult and expensive operation to clean between the canes after they are once established. Couch grass, or quack grass, is a difficult weed to control in a raspberry plantation and is better cleaned out by approved methods before the land is used for raspberry purposes.



Red raspberry plantation after pruning in autumn, Central Experimental Farm, Ottawa, 1919.

As the incorporation of humus is a difficult operation after planting, unless plenty of manure is available, it is well to apply a liberal quantity of barnyard before planting, or, failing this, to plant the area to clover or alfalfa and turn under a good crop of this green manure. As will be mentioned later, this use of green manure crops in raspberry culture will become a more important factor in the future than it has been in the past. Following the turning under of either manure or a green crop a thorough disking of the soil should be given.

Planting

Planting may take place in very early spring before the canes have budded out, or it may be practised with equal success in the fall, during the month of September or even as late as the middle of October.

The distance at which the rows and plants are to be placed depends largely upon the type of training to be followed. In the east two systems are in general use, the hill system and the hedge-row system. In the hill system the plants are set at least 4 by 4 feet apart, which permits, with care, the use of a single horse cultivator either way. Where land is cheaper and labour higher the distance may be increased to 7 by 7 feet, permitting the use of a double cultivator and eliminating most of the hand hoeing. If the hedge-row system is adopted the rows may be placed six feet apart, or wider, and the plants set three feet apart in the row. When this system is used, if the plants are checked in the rows so that they all come opposite, a single horse cultivator may be used the first season and thus cut down maintenance costs by a considerable amount. In the hedge-row system the suckers of the red raspberries are permitted to fill the row until a complete hedge row of canes, about two to two and one-half feet wide is obtained. As the purple and black raspberries are non-suckering they are usually grown in the hill system or by the linear system, to be mentioned later.

In the west some growers prefer the linear system, which is in reality a modified hedge-row. It consists of rows of canes six to eight feet apart, with plants set two to three feet apart and from which no suckers are permitted to grow. Cultivation is practised only one way.

PLANTING OPERATIONS

If the plantation is of any size the best method to adopt is to run a deep furrow and set the plants in this. As a rule there is greater danger of shallow planting than of too deep planting. The tip of the crown should be set at least four inches lower than the level of the ground, in such a manner that the row of plants are in a depression rather than on a hill, then as cultivation continues this hollow can be filled up and the field levelled off. Crowns must be kept well below the surface of the ground if the plantation is to succeed over any length of time. In small plantations a hole for the reception of the plant may be dug with a spade or pointed shovel. In setting the plants the earth should be tramped firmly about the roots to ensure proper contact between soil and small roots.

Cultivation

While clean cultivation of plantations has been the practice in the past, other systems are coming to the fore with considerable success, and we now have clean cultivation, mulch and a combination of clean cultivation, and cover crops.

Under the continuous clean cultivation system there is no opportunity for the replenishing or maintenance of humus except by the abundant use of manure or the frequent renewal of the plantation on a rotation basis. This system is one of the best methods for weed control and if adopted should consist of thorough and frequent cultivation from early spring until the end of the fruiting season.

If a cover crop is to be used, millet will probably be as good as any and should be sowed just before the last picking takes place. This may be ploughed under in spring or in fall. If there is any danger whatever of water lying over the ground during late fall or early spring, ploughing towards the plants, leaving a furrow in the centre of the rows is good practice. In the spring this may be levelled down by the use of a cultivator.

The mulch system consists in supplying some sort of mulch in the form of old hay or straw and has been found an efficient means of moisture control. In addition, as the straw rots, considerable humus is added to the soil. A modification of this system could consist of mulching every other row one year and cultivating the balance, reversing the procedure the following season. There is no doubt but that better moisture control is obtained where an adequate mulch is used and with the modified system referred to above the straw is soon rotted down and the texture of the soil greatly improved. While this method is more expensive than clean cultivation it proves valuable during dry seasons and is commended where mulching material is at all available.

Training and Pruning

The training and pruning of the suckering, or red raspberries, is somewhat different from that of the tip-layering varieties, so will be dealt with separately.

RED OR SUCKERING VARIETIES

Although there are a great many recommendations extant as to various methods of training and pruning, there is very little experimental evidence in support of any particular type of pruning, so it is difficult to make any very specific recommendations outside of a few general practices. As the raspberry fruits on canes that are one year old the first principle is that the fruiting canes should be removed after the end of the fruiting season. This may be done either in the fall or in early spring. As these old canes are frequently carriers of disease and insect pests, it is well to be assured that this is done and to see that they are destroyed by burning.

As red raspberries are suckering varieties large numbers of canes will be produced by the parent plant and its progeny, so that after the third year, or perhaps even after the second season, considerable thinning out will be necessary. If the plantation is to be grown on the hill system six or eight canes may be left to each plant, and each hill should be staked with a stout stake tall enough for the variety, which will range from $4\frac{1}{2}$ feet for Newman to over 6 feet for Viking and Herbert. All suckers are kept removed from between the rows and between the hills in the row and only six or eight new canes permitted to form each season. Tying the canes at a couple of places with strong cord or raffia will hold them in place.

If grown on the hedge-row system the suckers and canes are permitted to fill in the row until a solid row about $2\frac{1}{2}$ feet wide is obtained. Thinning out after the third season is frequently necessary if good stout canes are to be obtained. One stout and vigorous cane is worth more than several weak and slender ones. If each cane is permitted to have about four square inches of space this will be found ample.

Where difficulty is found in keeping the fruit off the ground the hedge-row may be trellised. This is best accomplished by driving or setting stout posts at intervals of ten feet in the centre of the row. To these posts two cross arms are attached, one at about 18 inches from the ground and the other at about 4 or $4\frac{1}{2}$ feet. In the case of a low growing variety one cross arm at 2 feet will prove sufficient. Along these cross arms ordinary galvanized wire of No. 15 gauge is strung. Some growers also put cross strands of wire every five feet. These wires will hold the canes up when laden with fruit and prevent loss from splashing and the breaking of canes.

In the linear system, which, as previously stated, is simply a thin row of canes, a single wire is frequently used to which the canes are tied by raffia. Sometimes the canes are bent over this single wire and then caught between the canes of the next hill. Two wires may also be used here as in the hedge-row

system, only the cross arm need not be so wide, as the linear row is only about 9 or 10 inches in width as compared to 2 or 2½ feet for the hedge-row.

The value of actual pruning or cutting back of raspberry canes is a debatable point. There are three systems in vogue: (1) Not to prune or top the canes at all, (2) to prune back in early spring, and (3) to pinch back in the summer.

Where canes have to be bent over for winter protection it is better not to prune or cut back at all, unless this is deferred until spring. In severe localities, where winter injury frequently results to the tops, the canes may be pinched during the summer to a height of eighteen or twenty inches, just as soon as they reach that point. This produces a stocky plant with plenty of laterals, which are generally covered with snow and come through the winter satisfactorily. The laterals thus produced are also cut back to about fifteen inches in late fall or early spring.

As far as the actual comparisons made at this Station are concerned the canes which have been permitted to grow unchecked have given the best yields. If the canes are not protected during winter there is generally a little killing back of the tips, which amounts to a spring pruning, so that further cutting back is not necessary. Where a variety is especially tall a topping given in late fall or spring may be desirable, but otherwise our recommendations are generally to permit unrestricted growth of top, as experiments conducted at this Farm have so far failed to reveal any advantage in cutting back red raspberries. Both the summer pinching and spring pruning were compared with no pruning at all. The following table gives the yields of the different treatments for 1928, which can be taken as typical of the results obtained from year to year:

| | Calculated yield per acre |
|-------------------------------|------------------------------|
| Summer pruned or pinched..... | 3,772 boxes |
| Spring pruned | 3,120 " |
| Not pruned at all..... | 5,274 " |

The variety used was Herbert.

PURPLE AND BLACK RASPBERRIES

As these types do not sucker they are grown either in hills or on the linear system. Removal of the old canes and the spacing of the new ones is the same as for the red.

The actual pruning, however, differs somewhat. The purples are generally cut off at about twenty-four to thirty inches, while the blacks are cut at about eighteen inches to two feet, during the summer, just at about the time they reach that height. This may be done with the fingers. These cut or pinched back canes will produce laterals which, by late summer, will reach a height of several feet. These laterals are generally shortened in spring to about eight to ten buds. As the fruit is borne on the current year's wood, which in turn is produced from these laterals, it is important to obtain by this pruning a moderate number of well developed lateral buds rather than a larger number of poorly developed buds which would result if no pruning was given.

Fertilizers

The question of the maintenance of fertility in a raspberry plantation is very simple if plenty of barnyard manure is available. As already pointed out, a liberal application should be given when the plantation is set out. At the end of the second season another good application should be made in late fall or early spring. Failing the manure, either the cover crop system or mulch system referred to should be adopted, if for no other purpose than to maintain the humus of the soil.

Where manure is not applied until spring a cover crop is also advisable to prevent too late growth. If the mulch system is followed the manure should be applied in the late fall after growth has ceased. Where manure is not available commercial fertilizers may be employed, especially in conjunction with either the mulch or the cover crop system. A complete fertilizer, consisting of 125 pounds ammonium sulphate, or 175 pounds nitrate of soda, 300 pounds acid phosphate and 75 pounds muriate of potash per acre should be applied each spring.

As the advent of mosaic disease is making it advisable to renew plantations more frequently the grower who is unable to get large quantities of manure will find that this shorter rotation lends itself more to the cover crop and mulch system, for each new plantation may be preceded for a season by a crop of clover or alsike which, when turned under, will leave the soil in excellent condition for the new plantation. This method of renewal, say every six years, with proper green manuring, cover crop or mulch, and adequate quantities of commercial fertilizers will render it possible for raspberry growing to take its place beside orcharding in being more or less independent of the failing and increasingly expensive supply of manure.

Propagation

Red raspberries are propagated from suckers which spring up around or near the old plants. These are dug either in the fall or in the early spring so are thus one-year-old plants. Suckers older than this do not transplant quite so easily and there is very little object in using them. At the time of lifting the suckers each plant should be cut back to within about six inches of the ground. The black and purple varieties do not sucker, but may be propagated by tip-layering. Shortly after the fruiting season the tips of the canes throw out a long growth which is terminated by a tuft rather than a bud. At this juncture the canes should be staked to the ground or a little earth placed on the tips, which will enable them to take root. These rooted tips may be severed from the main plant by the following spring and they may be transplanted to permanent positions. In some parts of the country, where the season is shorter, it is necessary to leave the young tips until the fall before separating them from the parent cane. About five or six inches of cane is all that is necessary to leave attached to the young root. Where it is desired to increase a variety, rapidly, cut back the parent plant in early spring to within a foot of the ground. This will cause the production of a large number of laterals which by late summer can be layered.

Harvesting

As the raspberry is a soft fruit it should naturally be picked before too ripe. The majority of the reds may be gathered when they are just turning red; at this stage they are quite firm and will stand a reasonable amount of handling. Do not allow the pickers to hold too many berries in the hand at once and get them to place the berries in the box rather than drop them. See that over-ripe berries are either discarded or placed in a separate receptacle. This should eliminate any further handling so that the fruit as picked is ready for marketing.

As soon after picking as possible get the fruit in a cold place and ship at once. At present raspberries are handled in pint boxes rather than in the full quart. This makes it possible to ship longer distances and even for short hauls puts the product on the market in better condition, due to the lessened pressure on the lower layers of the smaller bulk in the pint box.

Protection in Winter

In some parts of Canada some varieties of raspberries do not succeed very well unless the canes are protected in winter. This is readily done by bending down the canes just before winter sets in and holding them down by a little soil on the tips. To bend and cover them without breaking, a little soil is taken out on one side of the hill, the canes are then collected in a bunch, pressed down in the line of the row by means of a fork in the hands of one man while suffi-



Raspberries being prepared for winter. In the foreground are the branches bent over and held by clods of earth and in the background they are covered with straw held down by poles. Rosthern Experimental Station.



Showing method of covering raspberries for winter protection. Lethbridge Experimental Station.

cient earth is applied by another man to hold them down. The cost of the labour involved in covering an acre is not very great. When protected in this way canes will come through the winter in good condition, when if unprotected they are badly injured. On the prairies best results are obtained when the canes are entirely covered with soil. Much of this covering can be done by horse labour, for which purpose the rows are placed at least eight feet apart.

Yield of Raspberries

The crop of raspberries, like most other fruits, depends largely on climatic conditions, and even though the best variety is planted, if the season is unfavourable or the plantation has not been cared for properly, the yield will be much lessened. As a rule it will be found that the more the crop can be increased by special care the greater the profits will be, the extra labour and expense made being much more than repaid by the increased crop and additional revenue. A crop of raspberries, according to Bailey, ranges from 50 to 100 bushels per acre. Card found that the average yield of red raspberries, estimated from the information received from fifty-six growers, is about 69 bushels per acre. Clement, in Bulletin 210 of the Ontario Department of Agriculture, reports an average yield per acre of 2,225 quart boxes from 32 plantations covering 68½ acres. At the Central Experimental Farm the average yield of the Herbert raspberry for two years, on one row 90 feet in length, was at the rate of more than 205 bushels per acre, or about 6,586 pounds. From two rows, each 18 feet in length, or one row 36 feet long, the average yield for three years was over 229 bushels per acre, or 7,357 pounds. The average yield of the Brighton from two rows each 18 feet long was over 175 bushels per acre, or 5,602 pounds. The highest individual yield was obtained from the Herbert in 1904, which produced 50 pounds 12 ounces of fruit from two rows each 18 feet in length, or one row 36 feet long, which is at the rate of 10,234 pounds per acre, or 319 bushels 26 pounds, estimating a bushel at 32 pounds.

While these large yields are from small plots, they show the possibility of increasing the average yield throughout the country very much.

The following table gives the comparative yields of some of the leading varieties of red raspberries for the last three years at Ottawa, and will give some idea of the possibilities of these varieties under good conditions.

**Three-Year Average of Yields Obtained During 1926-27-28 at the
Central Experimental Farm, Ottawa**

| Variety | Yield, 1926 | | Yield, 1927 | | Yield, 1928 | | Average yield |
|--------------------|----------------|-----|----------------|-----|----------------|-----|------------------|
| | lb. | oz. | lb. | oz. | lb. | oz. | |
| Hiram..... | 17 | 10 | 35 | 13 | 35 | 14 | 29 12 |
| Viking..... | | | | | 26 | 7 | 26 7 |
| Latham..... | 6 | 7 | 18 | 9 | 36 | 5 | 20 7 |
| Newman No. 23..... | 5 | 0 | 22 | 12 | 31 | 5 | 19 11 |
| Lloyd George..... | 2 | 4 | 11 | 2 | 30 | 8 | 14 10 |
| Brighton..... | 7 | 9 | 18 | 11 | 15 | 14 | 14 0 |
| Ohta..... | 5 | 3 | 11 | 13 | 23 | 3 | 13 6 |
| Herbert..... | 1 | 10 | 15 | 9 | 22 | 11 | 13 4 |
| Newman No. 20..... | 4 | 6 | 12 | 11 | 20 | 14 | 12 10 |
| Count..... | 2 | 14 | 19 | 8 | 11 | 9 | 11 5 |

All yields were from a thirty-six foot row of twelve bushes.

An examination of the above results reveals that the recommended varieties are among the best yielders, Viking, Latham and Newman being well to the fore. (The yield for Viking, of course, is for one year only.)

The 1928 yields, being the first yields obtained after the plantation was fully established, probably indicate the relative potentialities of the different varieties about as satisfactorily as might be expected, and here again the recommended sorts are well to the fore, Herbert, an old standby, being well up in the list for this year.

The year 1926 witnessed at Ottawa a considerable amount of winter injury to raspberry plantations and served as a good measure of the hardiness of different sorts under our conditions.

The notes referred to below were taken from a plantation where no method of protection was practised. The canes were simply left standing to take their chances so were exposed to any severe conditions which arose. The results were rather interesting as will be seen by examining the table:

Relative Amount of Winter Injury on a Few Leading Varieties of Red Raspberries in 1926 at the Central Experimental Farm

Less than 10 per cent injury:

Latham
Newman No. 20
Viking—very small plants, newly set, so covered entirely by snow.
Newman No. 23
Hiram
Ohta
Sunbeam

Less than 20 per cent injury, but more than 10 per cent:

Brighton

Between 30 and 40 per cent injury:

Count
Lloyd George
Herbert

It should be noted that the varieties, Latham and Newman, are among the hardiest, the data on Viking for this year being of doubtful value, but this variety during 1927 and 1928 came through unharmed, while Herbert, another of the recommended sorts, was severely injured. Where laid down and permitted to be covered by snow Herbert came through in good condition.

Present recommendations should be, therefore, that where any of the varieties not mentioned in the first group are being grown in a climate as severe as Ottawa they should be laid down for the snow to cover.

Varieties

The selection of a suitable variety is one important consideration for any grower. The following descriptions include the outstanding varieties used in Canada and the valuable feature of each variety is specially noted:—

BLACK RASPBERRIES

Conrath (chance seedling near a plantation of Gregg).—Orig. C. H. Woodruff, Ann Arbor, Mich., 1886, Introd. 1894 by Conrath Bros. Fruit large, black; moderately firm; quality good. Season early to late. A strong grower. Has done well in some parts of the province of Ontario.

Cumberland (supposed seedling of Gregg).—Orig. David Miller, Harrisburg, Pa. Brought into notice about 1896. Fruit large, black; firm; juicy, sweet, good flavour; quality good to very good. Season medium early to late. Plant a strong grower, fairly hardy and productive.

Farmer (Plum Farmer).—Orig. Ohio. Introd. L. J. Farmer, Pulaski, N.Y., 1895. Fruit large, black, but with a bloom and not glossy as some varieties; firm, juicy, sub-acid to milder when fully ripe; quality good. Season early. Plant a very vigorous grower, hardy and productive. A very promising new sort.

Gregg (chance seedling found wild).—Orig. Messrs. R. and J. Gregg, Aurora, Indiana, 1866. Came into prominence about 1876. Fruit large to very large, roundish, slightly flattened, black with a conspicuous grey bloom; firm; moderately juicy, sweet, good flavour; quality good, though not so good in quality as some others. Season late. Plant very vigorous and productive but a rather tender sort. Has been one of the standard late sorts for many years in the districts where black caps do well.

Hilborn (chance seedling).—Orig. W. W. Hilborn, Arkona, Ont. Introduced by him 1886. Fruit medium to large, black, glossy with a little bloom; firm; juicy, sweet, good flavour; quality very good. Season medium. Plant vigorous, hardy and productive. One of the hardiest and best for Canadian conditions.

Older (chance seedling).—Orig. Mr. Older, Independence, Iowa, about 1872. Introduced. L. K. Ballard, Warren, Ill., in 1882. Fruit large, black, glossy and without bloom; firm; juicy, sweet; quality good. Season medium early. A strong grower, hardy and productive. The Older and Hilborn have proved hardiest at Ottawa.

Smith Giant (seedling of either Gregg or Shaffer).—Orig. A. M. Smith, St. Catharines, Ont., 1888. Introduced. A. M. Smith, St. Catharines, Ont. Fruit large to very large, roundish, black with a grey bloom; firm; moderately juicy, sweet; quality good. Season late. A very strong grower and productive where hardy, but too tender at Ottawa. Much like Gregg but a little hardier.

PURPLE RASPBERRIES

Columbian (a seedling of Cuthbert, probably pollenized by Gregg).—Orig. J. T. Thompson, Oneida, N.Y., 1888. Introduced about 1894. Fruit large, roundish conical, dark purplish red; firm; moderately juicy, briskly subacid and of good flavour and quality. Season late. This is a strong growing, non-suckering, very productive variety. It is not so acid as the Shaffer, which it resembles very much in outward appearance. While the purple raspberries are not very popular for eating raw, they are excellent for preserving or for mixing with the red to give more acidity.

Royal Purple.—Originated in Indiana. Berries are large and firm; a very late variety. At Ottawa it has proved quite as hardy as Columbian and a very productive sort; almost smooth caned. Should be given a good trial where purple sorts are wanted.

RED RASPBERRIES

Brighton.—Orig. Wm. Saunders, London, Ont. Introduced 1907 by Horticultural Division, Central Experimental Farm, Ottawa. Fruit above medium in size, roundish or slightly conical, bright red; moderately firm; moderately juicy, mildly subacid; medium to above medium in quality. Season early. A hardy, early, vigorous and productive variety.

Count (a seedling of Biggar seedling).—Orig. Wm. Saunders, London, Ont. Introduced 1907 by Horticultural Division, Central Experimental Farm, Ottawa. Fruit large, roundish, bright red; moderately firm; juicy, briskly subacid, with a pleasant but not high flavour; quality above medium. Season early. A hardy, early, vigorous and productive variety for eastern and central Canada.

Cuthbert.—Originated by Thos. Cuthbert, Riverdale, N.Y. This old standby is gradually being replaced by hardier and more disease-resistant sorts. It is a large-fruited variety; fruit conical, deep red and firm, making it a good shipper. Productive but only moderately hardy and of recent years subject to bad attacks of virus diseases. For many years the most popular variety in the warmer parts of Canada.

Herbert.—Originated by R. B. Whyte, Ottawa, Ont. Another very popular variety, especially in the colder parts of eastern Canada where it has superseded Cuthbert. A tall, vigorous grower, fairly hardy, producing large, roundish fruit of good flavour, but rather too soft for long-distance shipments.

Hiram.—This is an old variety which has never become very popular on account of having been considered not hardy enough. In recent years, however, it has given a good account of itself and we think may be worth extended trial. It is very vigorous, very productive and has large fruit of good quality, about as firm as Herbert. Altogether it is worthy of serious trial.

King.—Introd. by the Cleveland Nursery Co., Red Vista, Va., 1892. While a rather small-fruit variety, it has proved valuable on account of earliness and hardiness. One of the varieties recommended for the prairie provinces. Especially suitable for heavy soils. Quality inferior.

Latham.—Originated by the Minnesota Experiment Station, St. Paul, Minn. One of the new hardy varieties of outstanding merit. Plant is vigorous and a good yielder. Fruit large, of good quality and only a fair shipper. Has proved somewhat harder than Herbert, but otherwise not as good as that variety.

Lloyd George.—This is a new variety of English origin. It is a very vigorous grower with distinctive canes covered with reddish bristles. The fruit is large and very long-conic in shape. It has only proved moderately productive with us and we do not consider it compares with either Newman or Viking as a shipper, the fruit being very soft. It is also a fall-bearing variety, producing a small crop in late fall.



Raspberry plantation, Experimental Station, Lacombe, Alberta.



Faith + Tyler.

HERBERT

Loudon.—Orig. Frank W. Loudon, Janesville, Wis. Introd. 1894, C. A. Green, Rochester, N.Y. Fruit medium to large, conical, bright red; firm, moderately juicy, subacid, sprightly, and of good flavour; quality good. Season medium. A medium to weak grower but a very hardy sort. Not productive enough.

Newman No. 23.—Originated by C. P. Newman, Ville LaSalle, Que. This variety is of outstanding merit. It is medium height, almost spineless, productive and bears very large, firm fruit of excellent shipping quality. For table use not as good as Herbert, but as a commercial sort superior. Has proved hardy at Ottawa.

Newman No. 20.—This variety was originated by C. P. Newman, Ville LaSalle, Que. It is a large-fruited sort with a very firm, roundish berry. Canes almost smooth, of a grayish-brown colour. In season it is a little later than Newman No. 23. Not quite as productive as that variety.

Ohta.—Originated by N. E. Hansen, South Dakota. One of the hardest varieties. Fruit is rather small and moderately firm. Where Newman and Viking can be grown it is not to be recommended, but is desirable for use in very severe areas. It is also much earlier than most varieties.

Ranere (St. Regis).—Originated in New Jersey. Fruit medium in size, roundish, bright crimson; firm, moderately juicy, mildly subacid, little distinct flavour; quality medium. Season very early to very late. Plant hardy, vigorous and productive. This is commonly known as St. Regis Everbearing, but it was grown for some time under the name of Ranere before being introduced by the firm of J. T. Lovett under the name of St. Regis. Most of the crop of this variety is borne in the early part of the summer, but a small proportion develops and a still smaller proportion ripens on the new canes. A wet autumn is usually favourable for late fruiting. In dry weather the fruit does not develop well. The amount of the late crop depends very much on the character of the season. Where one has plenty of room and desires raspberries in autumn this variety will usually supply them, but it is not good enough in quality to depend on for the main crop.

Sunbeam.—Another production of Hansen's which succeeds on the prairies without protection. Recommended along with Ohta for very severe areas.

Viking.—A new introduction from the Experimental Station at Vineland, Ont. This variety is one of the most vigorous and upright growers we have ever met. The cane is almost smooth, very stout and over six feet in height. It has stood three years without any protection and came through alive to the tip. It is very productive, producing a moderately firm berry of conical shape and of good quality. Its one bad feature is loss of size of fruit too early in the season.

The above descriptions include only those we consider have some promise. New and untried sorts are not mentioned and old discarded ones have been omitted.

The following recommendations from the different Experimental Farms offer the best selections for the districts concerned. The four most outstanding varieties are all of Canadian origin, viz., Brighton, Herbert, Newman and Viking.

Varieties of Raspberries Recommended by the Experimental Farms and Stations

PRINCE EDWARD ISLAND

Charlottetown.—(Black) Older and Gregg, (Purple) Columbian, (Red) Herbert and Viking, (Yellow) Golden Queen.

NOVA SCOTIA

Kentville.—(Black) Older, Cumberland, (Purple) Columbian, (Red) Herbert, Newman No. 23, Newman No. 20 and Viking.

Nappan.—(Red) Newman No. 23, Herbert, Cuthbert. Brighton for early.

NEW BRUNSWICK

Fredericton.—(Red) Herbert and Newman No. 23.



Bush fruit plantation, Experimental Station, Lacombe, Alberta, showing method of protecting gardens with Caragana and spruce hedges on the prairies.

QUEBEC

Cap Rouge.—(Red) Brighton, Herbert and Newman No. 23.

Lennoxville.—(Red) Herbert, Newman No. 23.

Ste. Anne de la Pocatiere.—(Red) Newman No. 23, Brighton and Latham, (Yellow) Golden Queen.

La Ferme.—(Red) Herbert, Count and Sunbeam.

ONTARIO

Ottawa.—(Purple) Columbian and Royal Purple, (Red) Newman No. 23, Viking, Herbert and Count and Brighton for early, (Yellow) Golden Queen.

Kapuskasing.—(Red) Herbert and Newman No. 23.

MANITOBA

Brandon.—(Red) Sunbeam and Herbert.

Morden.—(Red) Newman No. 23, Herbert, Latham, Ohta and Sunbeam.

SASKATCHEWAN

Indian Head.—(Red) Herbert, Latham, Ohta and Sunbeam.

Rosthern.—(Red) Herbert, Newman No. 23 or Latham when protection is given; Ohta or Sunbeam where no covering is offered.

Scott.—(Red) Herbert, Count, Brighton, Ohta and Sunbeam.

ALBERTA

Lethbridge.—(Red) Herbert, Cuthbert and Loudon.

Lacombe.—(Red) Herbert, King and Cuthbert. Sarah for late.

Beaverlodge.—(Red) Herbert and Sunbeam.

Fort Vermilion.—(Red) Cuthbert, Herbert, St. Regis and Newman No. 23.

BRITISH COLUMBIA

Agassiz.—(Red) Cuthbert.

Summerland.—(Red) Cuthbert and Herbert. For trial—Viking.

Saanichton.—(Red) Cuthbert.

Invermere.—(Red) Herbert, King, Count, St. Regis and Brighton.

Canning and Dehydration Results of a Few Varieties

Several varieties of raspberries have been tested over a period of two or three years for home canning purposes. While all varieties were desirable for canning, a few were more outstanding than others:—

Newman No. 23 and Newman No. 20 made attractive looking products, retaining their shape perfectly and having a bright red colour, but flavour was slightly acid and seedy.

Latham proved superior for flavour but was more easily broken up and was slightly pale in colour.

Viking had a bright red colour and retained its shape equally as well as Newman No. 23 and Newman No. 20. It was somewhat smaller in size and had a mild flavour.

Herbert had a good colour and fairly pleasing flavour, but was more easily broken up than Newman and Viking.

Hiram had good colour and fairly pronounced flavour, which was slightly acid, and retained their shape well although soft in texture.

Count was a dark red colour with quite a pronounced flavour; small in size and slightly broken.

Brighton resembled Count in colour but retained their shape better; quite flat in flavour.

Three varieties were tested for dehydration, namely, Newman No. 23, Viking and Herbert. Newman No. 23 and Viking made an excellent appearing product, whole, firm and good colour. Herbert was much smaller when dried but darker in colour and better flavour when refreshed.

INSECTS AFFECTING THE RASPBERRY

By W. P. G. GARLICK, ENTOMOLOGICAL BRANCH

General Control Recommendations

In attempting to control insects which attack raspberries the following general considerations should be borne in mind:—

(1) Wild raspberries and blackberries should not be allowed to grow in the immediate vicinity of raspberry plantations, as such plants serve as breeding places for injurious insects.

(2) Old fruiting canes should be cut out, as close to the ground as possible, and burned any time after the crop is harvested and before growth commences in the following spring.

(3) When pruning, all sickly and injured canes should be removed and burned.

The Strawberry Leaf Beetle, *Paria canella* Fab

Occasionally, in early spring, the strawberry leaf beetle—a dark brown or black, shiny, oval-shaped beetle about one-eighth of an inch long—appears in large numbers in raspberry plantations and feeds voraciously on the buds just as they are bursting. In a short while nearly every bud on the attacked canes may be eaten out. Usually only a part of the plantation is attacked and the damage may pass unnoticed until the uninjured canes are coming into leaf when the injured leafless ones show up in marked contrast.

LIFE HISTORY.—The insect passes the winter in the adult stage, under old leaves, mulch or other suitable shelter. As soon as growth commences in the spring the beetles fly to their food plants (raspberry, blackberry, strawberry, etc.) and feed on the buds and leaves. Some egg-laying is done in raspberry plantations, but most of the eggs are deposited in strawberry fields in the soil close to the crowns of the plants and on the undersides of dead leaves lying around the plants. The tiny grubs which hatch from the eggs burrow into the soil and feed on the rootlets. When full grown they are about one-sixth of an inch long and resemble miniature white grubs. They pupate in the soil and the new adult beetles emerge from about the end of July to September. These beetles feed for a short while before seeking winter quarters.

CONTROL.—As soon as the beetles are found in numbers feeding on the buds, spray with arsenate of lead two pounds, or calcium arsenate one and one-half pounds in forty gallons of a 2-6-40 Bordeaux mixture. If the presence of the beetle is not noticed until the leaves are nearly expanded it will only be necessary to spray the canes in the affected area. Hand picking of the beetles may be resorted to where only a few canes are concerned and where there is no means of spraying at hand. It will be necessary in this case to go over the canes several times as the beetles have the habit of dropping to the ground when the canes are jarred.

The Raspberry Byturus, *Byturus unicolor* Say

This is a small, dull-brownish beetle about one-sixth of an inch long, which feeds on the tender young growth and blossom buds about the time the latter are opening. The caterpillar-like larvae may be found later in the hulls of the fruit.

When the fruit is picked the hulls left on the plant are normally white or cream coloured but where *Byturus* larvae are present the hulls will be partly or wholly dark in colour with often one or more holes tunnelled by the larvae. The chief damage, however, is done by the adults when eating out holes in the flower buds.

LIFE HISTORY.—The beetles, which probably pass the winter in the soil, appear about the time growth is well started and after feeding for a time they lay their eggs usually on or near the flower buds and blossoms. The larvae hatching therefrom bore into the buds where they live chiefly on the hull (receptacle) of the berry. When full grown the larvae are about one-fifth of an inch long and dull white with a dark band across each segment. They drop to the ground where they pupate in little earthen cells, the adult probably remaining in the cell until the following spring.

CONTROL.—As soon as the beetles are found in sufficient numbers spray with arsenate of lead, one and one-half pounds in forty gallons of a 2-6-40 Bordeaux mixture. Do not spray if many blossoms are out and the bees are visiting them. Where there are only a few canes, hand-picking of the beetles will probably suffice.

The Raspberry Sawfly, *Monophadnoides rubi* Harris

The greenish, spiny larvae of this sawfly, when present in large numbers, will eat the leaves until only the framework is left and the leaves resemble pieces of lacework. At first numerous holes will be noticed in the leaves particularly in the middle and lower ones. The larvae are difficult to see at first glance since their colour is exactly like that of the leaves they feed on. They may occur on either surface of the leaves and are often found resting along the veins where they are even harder to see.



Leaves skeletonized by the raspberry sawfly.

LIFE HISTORY.—The insect winters in the larval stage in the soil around the canes. In the spring the larvae pupate and later the adults emerge from the soil. The adult sawfly is about one-quarter of an inch long and black except the legs, a small spot at the base of the wings, and a broad band across the abdomen which are lighter in colour. The flies emerge from the soil at the end of May and in June. Eggs are deposited in the leaf tissue and give rise to small blisters on the underside of the leaf against the sides of the more prominent veins. On hatching the larvae feed on the leaves until full grown when they are about three-quarters of an inch long. They then enter the soil and spin a cocoon about an inch below the surface where they remain till the following spring.

CONTROL.—Spray with arsenate of lead one and one-half pounds and hydrated lime five pounds in forty gallons of water. Do not spray when the blossoms are out and bees visiting them.

The Red Spider, *Tetranychus telarius* L

This species is identical with the red spider or mite which is such a serious pest in greenhouses. It attacks many kinds of plants. The mite is only about one-fiftieth of an inch long, and though sometimes red (notably in the fall or on dead or dying foliage) it is more often coloured a similar green to the foliage on which it is feeding. Under favourable weather conditions (hot and dry) it becomes exceedingly abundant and by sucking the juices from the undersides of the leaves will cause them first to show numerous fine yellowish dots on the upper surface and later a browning and deadening of the whole leaf. If the undersides of leaves showing the characteristic injury are examined many mites may be seen as tiny moving dots. Injury to raspberry usually shows up about three weeks or less before picking time.

LIFE HISTORY.—The adult mites hibernate during the winter probably near the base of weeds and cultivated plants. As soon as growth starts in the spring they crawl up to the leaves and commence egg-laying. The mites which hatch from these eggs mature rapidly in warm, dry weather, and in turn lay eggs which produce more mites. There may be ten generations in a year.

CONTROL.—Since raspberry foliage is exceedingly susceptible to spray injury, especially during hot, dry weather when the mites are likely to be troublesome, none of the sprays ordinarily used to control the pest on other plants can be used with safety. It is advisable to keep the plantation and surroundings free from all weeds as these may provide shelter for the red spiders.

The Raspberry Cane Borer, *Oberea bimaculata* Oliv.

In early summer the tips of young canes are sometimes found wilted over. If the cane be examined just below the withered part two rows of punctures will be found about half an inch apart, completely girdling the cane. These punctures are made by the adult beetle of the cane borer at the time of egg laying.

LIFE HISTORY.—The adults, which are dark-coloured slender beetles about one-half of an inch long, emerge from the canes in June and lay their eggs singly in the cane between the girdles. The larvae on hatching, bore in the pith of the cane where they feed all season, passing the winter not far below the point of girdling. The next season the larvae continue feeding and pass the second winter in the cane at or below the ground level. The full grown larvae is about three-quarters of an inch long. Pupation takes place in the cane the following spring.



Faith Tyler.

VIKING



Cane girdled by the raspberry cane borer.

CONTROL.—Cut the injured tips well below the lower girdle as soon as noticed and burn them. This insect is seldom troublesome where the old fruiting wood is regularly removed.

The Raspberry Cane Maggot, *Phorbia rubivora* Coq.

The injury caused by this insect is similar to that of the raspberry cane borer except that no external girdling of the cane will be found.

LIFE HISTORY.—The insect winters in the pupal stage within the cane. In the spring the adult (a two-winged insect like a house fly) emerges and deposits eggs singly amongst the unopened leaves at the growing tips of the canes. The maggot, on hatching, bores down the cane for several inches and then girdles it just beneath the bark, causing the tip to wilt over. The maggot continues feeding until full grown when it pupates in the cane and remains there until the following spring.

CONTROL.—Cut out and burn the wilted tips as soon as seen. In pruning out the old wood each year, canes injured by this insect may be removed as well.

The Striped Tree Cricket, *Oecanthus nigricornis* Walker

This is one of the most common of the raspberry pests and its injuries may be seen in almost any plantation. Rough scars, from one to several inches long, may be found running lengthwise on the cane. If these are examined closely they will be found to consist of rows of small holes, and on splitting open the

canes at such places, the eggs of the tree cricket may be readily seen. Each little hole is the puncture made by the female in depositing an egg. The rows of punctures weaken the cane and the part above the injury may die. Where the scars are numerous the canes are rendered brittle and may be split or broken off by wind and other agencies.

LIFE HISTORY.—The insect winters in the egg stage in the canes. The eggs hatch after the canes are out in leaf and the young tree crickets feed on aphids and other insects. When full grown they are pale green in colour and about three-quarters of an inch long. The females lay their eggs in the canes during the fall.



Stripped tree cricket egg scars on raspberry canes.

CONTROL.—When removing the old fruiting canes, or when pruning before the leaves are out in the spring, include the canes showing egg punctures and burn them. Do not allow weeds to grow up amongst the canes and keep the plantation and surroundings clean.

The Red-Necked Cane Borer, *Agrilus ruficollis* Fab.

Sometimes canes are found with swellings from one to three inches long, the bark on these swellings usually being split lengthwise. Such canes may die or produce no fruit and in any case are weakened. The swelling or gall is caused by the feeding of the larva of the red-necked cane borer.

LIFE HISTORY.—The insect hibernates as a larva in the canes. Pupation takes place within the burrow in spring and the adult beetles emerge in June. The beetle is slender, elongate and about one-third of an inch in length. It is

black, except the thorax or "neck," which is copper coloured. The female inserts the egg in the bark and the larva on hatching burrows in the sapwood causing the swelling. The larva does not reach maturity until the following spring.

CONTROL.—Cut out and burn all canes showing the swellings. This may be done when the old fruiting wood is removed.

The Raspberry Root Borer, *Bembecia marginata* Harr.

As the larvae of this insect bore in the roots and the lower parts of the canes the visible injury may consist of only a weakening and general unthriftiness of affected canes.

LIFE HISTORY.—Two years may be required to complete the life cycle of this insect. The adults, clear-wing moths which resemble wasps, appear in the late summer and lay their eggs on the underside of the leaves near the margins. The larvae on hatching crawl down to the base of the cane and establish themselves under the bark just below ground level. The following season is spent burrowing in the roots and the bases of the canes. Winter is passed in the burrows at or near the ground level. Feeding continues during the following season until July, when the larva pupates in the burrow and the adults later emerge, usually through a hole in the side of the cane near the base.

CONTROL.—Where only a few plants are affected they may be dug up and burned. If, however, the injury is general the plantation should be ploughed up. If this is done in October there will be little danger of the infestation passing to nearby plantations.

The Rose Scale, *Aulacaspis rosae* Bouche

This is seldom a serious pest of the raspberry and does not commonly occur where raspberries are grown in the shade and in damp situations. The whitish scales of this species may be seen usually near the base of the canes (see illustration).



Rose scale on raspberry.

CONTROL.—A spray of lime sulphur 1 to 7 on the dormant wood, in the spring, before growth commences will control this insect.

RASPBERRY DISEASES

By G. H. BERKELEY, Phd., DOMINION LABORATORY, ST. CATHARINES, ONTARIO

The most serious diseases of raspberries are undoubtedly mosaic and leaf curl. Formerly these two diseases were confused under the term "yellows." Mosaic and leaf curl are general in Canada wherever raspberries are grown to any extent.

Mosaic on Red Raspberries

Mosaic symptoms are largely confined to the leaves, although a general dwarfing of affected plants—canes, laterals, etc.—is present as well. Leaves of mosaic plants do not dry up, wilt or fall, but instead become mottled and puckered. Leaves on mosaic plants show large irregular green blisters with the tissue surrounding the green blister of a yellowish to yellowish-green colour. The result is a true mosaic pattern hence the name "mosaic." Mosaic symptoms as outlined above are especially noticeable on new growth, especially suckers. In the early summer this is where the first signs of mosaic are apparent, and in looking for mosaic in a plantation look always on the present season's growth.

In addition to the "mottling" on the leaves, mosaic plants become stunted although there may be very little dwarfing noticeable the first year of infection, but thereafter dwarfing becomes gradually more pronounced each year. The fruit from dwarfed mosaic bushes is greatly reduced in quantity and the berries are mostly soft, crumbly, and insipid.

Mosaic on Black Raspberries

Mosaic is general and more serious on black raspberries than on red raspberries. Recent research work has shown that in so far as symptoms are concerned there are at least three different types of mosaic on black raspberries.

One type is called "mild" mosaic because of the fact that the mottling is of a uniformly fine speckling character, and because the dwarfing of affected plants and reduction in crop production is gradual and slow in comparison with the other types of mosaic.

The second type is the so-called "yellow" mosaic. In this case the tip leaves take on a fine yellowish green mottling, become small in size and curl upward at the margin. Later the entire plant shows marked symptoms of mosaic, and affected plants are short lived, being usually killed the third winter after infection.

The third type of mosaic found on black raspberries is the "red raspberry" mosaic. This type is the result of the "mosaic" on red raspberries being transferred to black raspberries, resulting in a stunting or killing back of terminal tips, accompanied by a discoloration of the wood.

Leaf Curl

As with mosaic, so with leaf curl, the symptoms of the disease are confined to the leaves. The leaves in this case are not mottled, however, but are abnormally dark green in colour and are wrinkled and curled. The curling on newly infected plants may be very slight but later the entire margin of the leaf becomes rolled downward and inward. The fruiting laterals are short and usually stand upright. The suckers from a diseased bush of a previous year

are dwarfed and terminate in a yellowish stunted tip. The fruit is dry and seedy and is not worth picking. Once a bush has become diseased, it is not only useless from the standpoint of production, but in addition it is a source of constant spread of infection to nearby healthy bushes.

Leaf curl is found on red and black raspberries.

Control for Mosaic and Leaf Curl

The most permanent and satisfactory control measures for mosaic and leaf curl begin with the setting out of healthy, certified raspberry stock. Such stock has now been available in Ontario for the past five years as a result of the raspberry inspection and certification service carried on by the Dominion Laboratory at St. Catharines. Experiments with this stock have shown it to be in all respects satisfactory. Therefore in setting out a new plantation use only healthy certified stock. Never use doubtful stock from a neighbour's plantings just because it costs you nothing. It is false economy. This has been demonstrated time and time again.

Our experience with these diseases demonstrates that although certified stock is the first essential in control, the roguing* of diseased bushes during the first two seasons at least should by no means be neglected. Roguing has proved to be a valuable aid in mosaic control and we therefore strongly recommend its use in all plantings up to three years of age that contain a small amount of mosaic. This is particularly true for plantations, set out with certified stock, where only a trace of mosaic will creep in the first year.

Therefore during the first season the young plantation should be carefully and systematically inspected several times by the grower and all diseased plants should be dug out, roots and all, and removed immediately from the plantation before the foliage has had time to wilt. If the bushes are allowed to wilt before removing, the aphids will have had a chance to pass on the wilted leaves to nearby healthy leaves and thus in place of effecting control, spread has actually taken place. In the removing of the bushes great care should be taken to see that the diseased bushes are not dragged along the ground, or allowed to brush healthy plants, since the aphids which are feeding on the diseased plants, may be then knocked off and left to infect healthy bushes.

During following seasons it is absolutely essential to continue careful inspections and roguing. Constant vigilance will be necessary to keep the patch free from disease. However, five years' experience has demonstrated that it can be done satisfactorily and with very little labour, provided the planting is started with certified stock.

In roguing, unless the bushes have just recently been set out, and are therefore some considerable distance apart in the row, it is advisable to rogue the healthy bush on either side of the mosaic in order that this apparently healthy bush may not act as a bridge to pass on the infectious principle to the next adjacent bush. Experience has repeatedly demonstrated the advisability of so doing. Rogued bushes should be carried carefully outside the plantation and burned.

Gaps, the result of roguing, may be reset with healthy stock at any time, provided all roots of the previous diseased bush have been removed. If such roots have not been removed, suckers will spring up therefrom which may infect the healthy reset.

New plantings of healthy stock should be isolated at least 300 feet from nearby wild or cultivated raspberries.

For further information about mosaic and leaf curl, write to Publications Branch, Ottawa, or Dominion Laboratory of Plant Pathology, St. Catharines, for pamphlet No. 72, N.S.

*By roguing is meant the digging out of all diseased bushes, roots and everything.

Crown Gall

Crown Gall is a bacterial disease caused by *Bacterium tumefaciens* E.F. Sm., and Towns and is too often a limiting factor in the growing of raspberries. This disease is readily diagnosed by the swellings or tumor-like galls that occur on the crown and underground parts of the plant, as well as by the aerial galls that are often found on the canes.

CONTROL.—1. Never set out nursery stock of any kind that shows the presence of crown gall.

2. When soil has become infested with the crown gall bacteria, crops attacked by crown gall should not be planted therein for at least three years. In other words, practise crop rotation using such crops as corn, oats, wheat, etc., which are not susceptible to crown gall.

3. Avoid injuries to root and crown since it is mainly through wounds that the crown gall bacteria gain an entrance to the plant.

Verticillium Wilt

Wilt, caused by *Verticillium ovatum*, Berk., and Jack, is now of considerable importance on black and red raspberries in Ontario. The black raspberry is especially susceptible.

ON RED RASPBERRIES.—The disease first becomes apparent in the field by a yellowing and wilting of the lower leaves. These leaves then droop and fall. This wilting and casting of the leaves progresses from the ground upwards. As a result the cane finally becomes devoid of leaves, with the possible exception of a tuft of small brownish leaves at the extreme tip. This tuft of terminal leaves sometimes adheres for a considerable period.

Generally accompanying this wilting and casting of the leaves is a blue discoloration of the cane, hence its former name: "Blue stem." This discoloration may be present as stripes starting from about the ground line and closely following the upward progress of defoliation, or the discoloration may cover the entire circumference of the cane. The important, striking and constant symptom is therefore a yellowing, wilting and casting of the leaves.

ON BLACK RASPBERRIES.—On black raspberries the disease is much the same as described for red varieties with the exception that the blue discoloration is more pronounced, and generally girdles the cane. Sometimes the first indication is a premature drying of the fruit. Black varieties are much more susceptible to this disease, and a plantation of such varieties more readily succumbs than the red variety due no doubt in part to the fact that the black varieties do not sucker. That is, once a black variety takes this disease, since it is a root as well as shoot disease, the plant as a whole becomes infected and is eventually killed. In suckering varieties, however, new shoots may be sent up some little distance away from the parent plant, which therefore may escape infection, at any rate for a time. That such is actually the case has been observed quite commonly in the field.

CONTROL.—Since this is a comparatively new disease, very little is known as yet concerning definite control measures. However, from our present knowledge of the fungus causing this disease, we would strongly advise as follows:—

(1) Set out healthy, certified stock that has come from plantations free of this and other diseases.

(2) Do not set such plantings into soil that has just previously been planted to potatoes, tomatoes, or egg-plants, particularly if these crops showed any signs whatever of "wilting," because these crops are subject to the same wilt disease as raspberries and therefore if raspberries follow one of these crops,

wilt may almost certainly be expected in the new setting. It has been the experience of many growers that under such conditions wilt very often became prevalent in the raspberry plantation. Of course, if the previous crop of potatoes, tomatoes or egg-plants was healthy, then it would be safe to follow with raspberries.

(3) Since the fungus is able to live over in the soil, practice a four- or five-year crop rotation taking into consideration that potatoes, tomatoes and egg-plants are subject to this same disease.

(4) It is not advisable to plant potatoes, tomatoes or egg-plants between rows of raspberries as "wilt" may be thus introduced.

Anthracnose

This disease is quite common on raspberries particularly black raspberries. It is caused by the fungus *Plectodiscella veneta* (Speg) Burk. The symptoms of the disease are generally most severe on the cane just above the ground. At first purplish spots are apparent, followed later by large irregular ashy gray areas with raised purplish margins. The petioles and leaflets are sometimes severely attacked as well. "Shot hole" of the leaf is sometimes caused by anthracnose.

CONTROL.—New plantings should be set out with disease-free stock.

Stubs of old canes attached to tip plants may be a source of new infection to the tip plants. Therefore it is recommended that the part of the old cane remaining above ground after planting should be removed and burned.

All fruiting canes should be cut out and burned after harvest. New canes badly infected at this time should also be cut and burned.

Practise clean cultivation.

In badly infected plantations spraying with Bordeaux mixture is to be recommended. Bordeaux and lime sulphur are both apt to be injurious to raspberry foliage but if the applications are put on early in the season the injury will most likely be negligible.

First application.—Bordeaux 4:6:40 with 2 pounds resin fish oil soap to every 40 gallons applied as a delayed dormant, or when the leaves are just appearing.

Second application.—Applied about two weeks later directing the spray on the young canes only.

Spur Blight

Spur blight, caused by *Mycosphaerella Rubina* (Pk Jacz) is very common wherever raspberries are grown. In some seasons spur blight causes considerable loss through defoliation and injury to the buds which produce next year's laterals.

Large chocolate-brown discoloured areas are produced on the canes at the nodes, where the leaves are attached. Later these areas spread until sometimes considerable of the cane tissue becomes involved and defoliation of the lower leaves takes place.

CONTROL.—Spraying with Bordeaux 3:6:40, to which two or three pounds of resin fish oil soap has been added to every 40 gallons, has been shown to be very effective. This spray is applied only to the young canes. The first application should be applied when they are from 6 to 12 inches high. It will generally be necessary to give a second application in two weeks time. In some seasons a third application may be required.

Old fruiting canes should be removed as soon as possible after the fruit is picked.

Cane Blight

Cane blight is another fungus disease that causes considerable damage in some localities.

The whole cane or single branches suddenly wilt and die. Brown areas are produced on the canes usually around pruning wounds or other injuries. Later such affected canes become lighter in colour and are covered with smutty black patches due to the masses of the fungous spores produced on the surface of the cane. The wood is very brittle and easily broken. Warm wet seasons are favourable for the growth of this fungus. New canes are not usually killed the first season, hence it is generally the year following infection that wilting of the cane occurs.

CONTROL.—Spraying has not proven effective. Cut out canes affected with the disease. Practise clean cultivation. Cut out and burn all fruiting canes as soon after fruiting as possible.

Orange Rust

Orange rust caused by *Gymnoconia interstitialis* (Schl) Lag. occurs commonly on both blackberry and raspberry. The black raspberry is much more severely affected by this disease than is the red raspberry. Orange rust occurs early in the spring, often being noticed before the leaves are entirely unfolded. The first symptoms occur on the upper surface of the leaves as black dots, followed later by yellowing of the surrounding tissue and still later by masses of orange coloured spores on the under surface of affected leaves.

Blackberries and raspberries never recover once they are attacked because the fungus lives from year to year within the canes and roots.

Start new plantings with rust free stock. If the new shoots from tip plants show rusted leaves the season they are set out, such plants were infected before they were set out. Such infected plants never recover and they should be dug and burned as soon as rust appears. In old plantations the only satisfactory means of control is to dig and burn all rusted plants.

Nearby wild blackberries and raspberries should be destroyed as they may become infected and spread the disease.

Leaf Spot

This disease is caused by the fungus *Septoria rubi* Westd and is found on black and red raspberries as well as the blackberry. This is not considered a serious disease and seldom warrants preventive measures. However in severe cases the spray schedule as outlined for anthracnose should give fair control.

General Control Measures for Raspberries

(1) Use nothing but clean, healthy, certified stock. This is the first essential in successful growing of raspberries. Government certified stock is now available. Demand such stock from your nurseryman. For further information concerning certified stock, inquire of the Dominion Laboratory of Plant Pathology, St. Catharines, Ontario.

(2) Practise clean cultivation.

(3) Practise rotation of crops. After destroying an old raspberry plantation do not replant it to berries for at least three or four years. Grow some such crops as corn, grasses, cereals, legumes, etc.

(4) Destroy wild raspberries or blackberries in the vicinity of the cultivated varieties.

(5) Remove fruiting canes as soon after harvest as possible. At the same time dig and destroy all badly diseased plants.

(6) Systematically remove from the plantation and burn all rogued plants, or prunings.



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