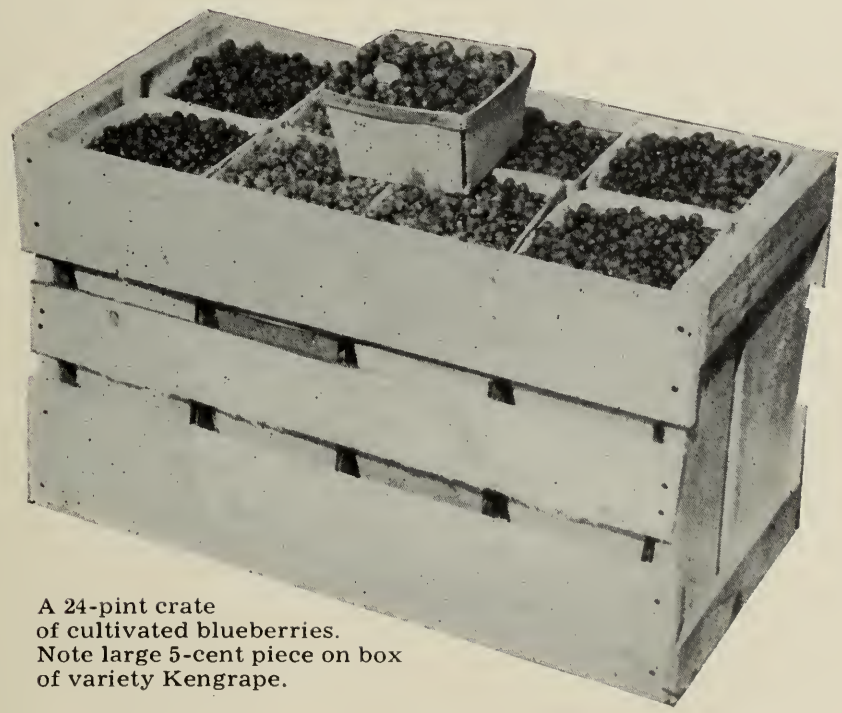
PUBLICATION 754 FARMERS' BULLETIN 120

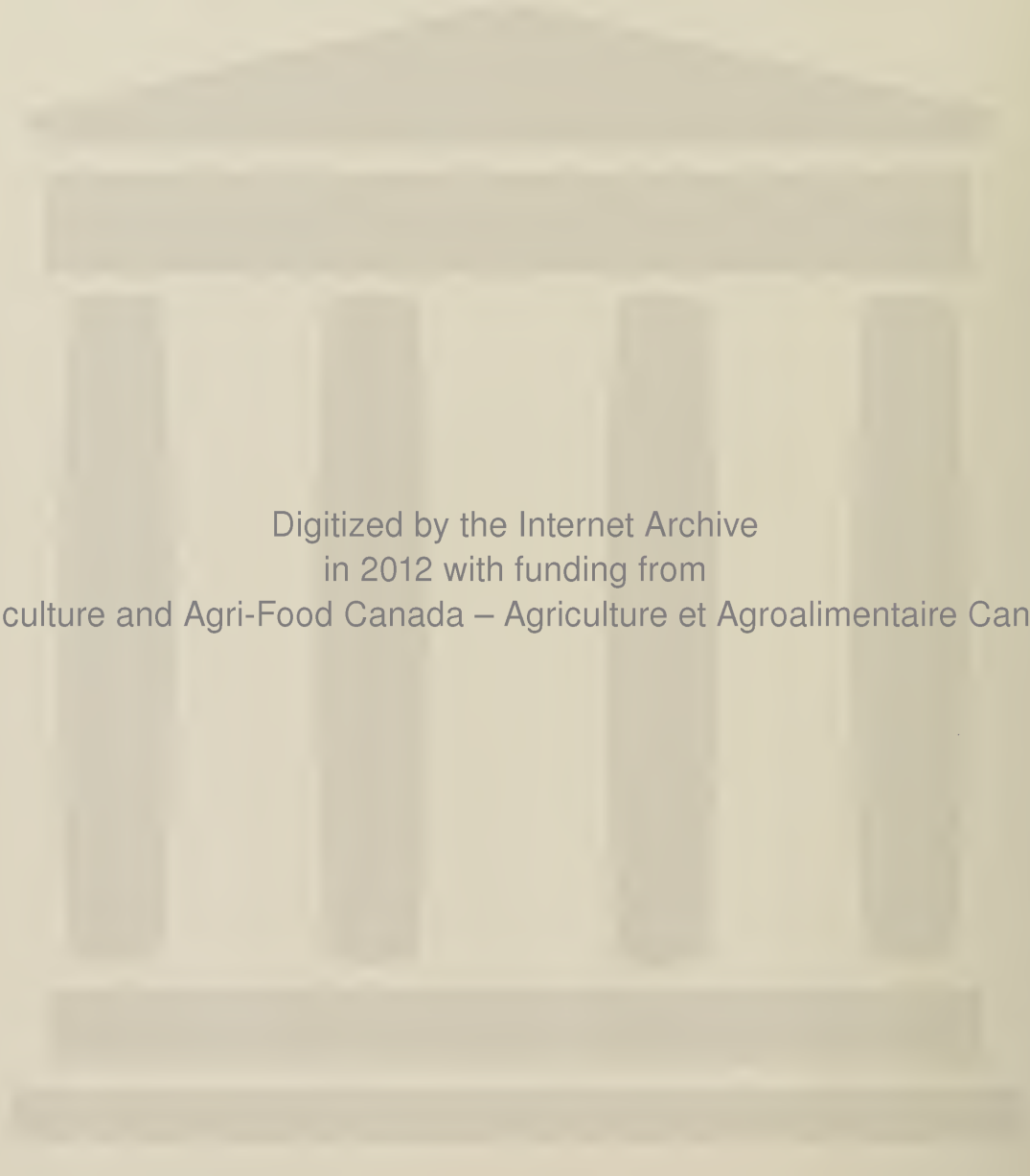
THE BLUEBERRY

Division of Horticulture
Experimental Farms Service



A 24-pint crate
of cultivated blueberries.
Note large 5-cent piece on box
of variety Kengrape.

DEPARTMENT OF AGRICULTURE
OTTAWA, CANADA



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ISSUED AUGUST, 1950
REPRINT

THE BLUEBERRY

BLUEBERRY CULTURE AND PROPAGATION

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BLUEBERRY INSECTS AND THEIR CONTROL

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DISEASES OF THE BLUEBERRY

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Published by authority of the Rt. Hon. JAMES G. GARDINER,
Minister of Agriculture; Ottawa, Canada

5M—14195—850

BLUEBERRY CULTURE AND PROPAGATION

BY

E. L. Eaton[1]

The blueberry, one of the most relished of the native fruits, has been an important item of diet in Eastern Canada, and to a lesser extent in the West, ever since the first white settlers reached this part of the continent. Its appearance, flavour and wide range of habitat all contribute to a well-merited popularity. Because the fruit is gathered so widely no complete record of local yields and sales is possible and commercial shipments certainly represent a mere fraction of the total crop harvested. All of these Canadian shipments are fruit of the wild or semi-wild, low-bush type. Commercial production of the cultivated high-bush varieties is yet in its infancy in Canada, although a few individuals, inspired by the success of the crop in the United States, have started small plantations. One fairly large development is in production in British Columbia.

Review by Provinces

Nova Scotia

McLaine (13) stated in 1931 that "approximately 43,000 acres are devoted to blueberries in the western counties, 33,000 of which belong to blueberry associations and the remainder are privately owned. With the rotation of burning, two-thirds of the acreage is in bearing each year. Cumberland county is also a large shipper; in the eastern section of the province there are large acreages but the industry has not been developed."

In 1940 only one blueberry association existed and the acreage controlled was small. A considerable area has been developed in Guysboro county since Mr. McLaine made his survey.

While the shipments vary considerably from year to year, over 46,000 crates of fresh fruit were shipped, chiefly to Boston and New York, in the season of 1930. This number has been much reduced since restrictions have been imposed on shipments containing maggot.

The canning trade is using an increasing quantity of fruit. In 1940 over 35 tons were shipped from one small district in Cumberland county to a canning plant in the province. Carload shipments of frozen berries were also made to the United States.

Prince Edward Island

Wild blueberries have not been commercialized as highly in Prince Edward Island as elsewhere but both soil and climate are suitable and the industry is expanding rapidly. McLaine (13) estimated that around 200,000 pounds were marketed in 1930. More than three times this quantity of frozen fruit was shipped in 1940 to central Canada and the United States (11).

New Brunswick

Immense areas of the province have been burned over at various times and grow little else but blueberries and other heath plants. In Charlotte county systematic care of the blueberry fields with burning every third year

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65852—1½

is a common practice and is being introduced elsewhere. Dusting with an arsenical for the control of the blueberry maggot is also common. Similar care in other parts of the province would vastly increase the output. Many berries are shipped frozen and many are sent fresh to canneries in Maine. Exports through the port of St. Stephen in 1947 amounted to 1,103,197 pounds. Estimates of total annual production have varied from a low of 2,000,000 pounds in 1944 to approximately 4,000,000 in several recent years, and over 5,000,000 in 1943 (11).

Quebec

The largest area of blueberry land in Quebec is in the Lake Saint John district with smaller areas in Charlevoix county and elsewhere. The estimated yield is about equal to that of New Brunswick. Several canneries and chilling plants are in operation and Montreal is a large receiving centre for shipments from points outside the province.

Ontario

Most of the wild blueberry land is in the newer areas of the province where the fruit is gathered and sold locally. Canning operations are limited and the estimated crop is considerably below that of Quebec.

Prairie Provinces

Limited areas in each of these provinces grow native blueberries but they have not been recognized as of great commercial importance.

British Columbia

According to J. J. Woods of the Dominion Experimental Station, Saanichton, B.C., the main commercial trials with blueberries in British Columbia have been made on pure peat soils on Lulu Island. The total available area of this type of soil is in excess of 40,000 acres. This raw peat and land is covered with a variety of vegetation, a large portion of which consists of young pine trees and native species of cranberries and low-bush blueberries. The average water-table is high, from one to three feet below the surface. Where blueberries are grown some drainage by open ditches is necessary. Gates in ditches should be arranged for so that control of run-off water may be obtained. Under such conditions soil to within an inch or so of the surface is always moist. During the winter and early part of the growing season the water-table should not be higher than 14 inches from the surface and during the picking season a two-foot water-table is satisfactory. The pH value of the soil and water is in both cases less than 4. On a low-lying mineral soil at Sidney, Vancouver Island, there is a quarter-acre block of seedlings which was planted in 1935. There is sufficient evidence from this small block to prove that such soils, while not giving the growth that is obtained on Lulu Island peat, offer commercial possibilities.

In preparation for planting, land must first be cleared of trees and stumps and much of the surface growth may be burned off when care to prevent deep fires in this operation is exercised. The area may then be ploughed and disked for a full season before planting in order to kill the native growth. Killing the native growth may be accomplished by skinning off the top 4 inches of the soil, the approximate depth of root penetration. This is done by cutting the surface into narrow strips 2 feet wide and 4 inches deep and then grubbing this layer off with a potato hook. For initial planting this procedure may be modified by cutting out 2-foot strips every 6 feet and plants may then be set. Later the areas between the rows should be cleared off.

There are a large number of new small blueberry farms. A substantial increase in the acreage is due to the activity of a commercial peat company in planting blueberries on some of the bogs from which peat has been removed. The larger plantings are all on the mainland and mostly in the Fraser Valley. On Vancouver Island limited areas have been set both on peat and on mineral soils of high organic content but the latter soils have been unsuitable.

The original bushes planted on Lulu Island were all seedlings but the disadvantage of this kind of stock is now apparent. There is considerable variation in the size and vigour of the plants. The majority of plants produce marketable fruit but in any considerable population there are some plants which, through lack of vigour or small size berry, are of no commercial value. The established growers are turning to named varieties but there is relatively little information as to the most suitable kinds. Johnston Bros. have raised a very large number of seedlings and have attained considerable success in a few outstanding new varieties. Two- or three-year old stock is used and when the older plants are set in the fall they will produce a small crop the following year but will not be fully grown for nine years. Weeds should be kept in control by cultivation, the amount of weed infestation depending to a considerable degree on the care with which the new land was originally prepared. Grasses may prove troublesome and should be controlled before becoming firmly established.

Only very limited trials have been made with fertilizer but definite responses have been obtained from complete mixtures relatively high in phosphate and potash. As with other crop plants, the amount of fertilizer to be used must be based on the vigour of the plants which is estimated by the growth of new wood and average yields. Yields on established areas in B.C. are between two and three tons per acre.

The picking season continues for approximately ten weeks, starting in some years as early as June 15. It is desirable in any given plantation to have varieties of different maturity to extend the season as much as possible, especially when the fresh-fruit market is being supplied. Where canning and quick-freezing are practised an extended season is not so necessary. To harvest the crop, approximately twenty pickers per acre are needed. For the fresh-fruit market the berries are put up in strawberry hallocks and crates. They are either graded or ungraded as to size the graded for table use and the ungraded for pies. Blueberries have to sell at a price which puts them in the luxury class for dessert fruit. A blueberry will remain in good condition on the plant for several days and also will hold up for 4 or 5 days after picking before commencing to shrivel. Only sound berries should be crated and varieties on which the skin breaks easily when being picked should be discarded. The berry is best picked with a rolling rather than a pulling motion.

In small plantings robins can prove a very serious pest once the fruit commences to ripen but in larger areas their depredations, while severe, are not so noticeable.

Messrs. Suckling and Johnston have had good success in propagating both from seeds and hardwood cuttings, following, in general, the directions given in this publication. Hardwood cuttings are taken during the winter, stored in peat and planted in frames during March and April. The rooting medium is a mixture of sand and peat and beds are made 3 feet wide with sides 10 inches high by any convenient length. The frames are kept covered with onion sacking to provide shade and to keep the atmosphere humid. Watering is frequent but care must be exercised to guard against fungus growth at the soil surface. The water used is peat bog water of high acidity. Rooting of cuttings is from 75 to 90 per cent successful. Some varieties propagate much more easily than others.

Botanical Relationship

Gray's Manual places the blueberry in the *Ericacae* or Heath family and among the *Vaccinoideae* or Whortleberry subfamily. This subfamily contains the genera *Chiogenes* or snowberry; *Gaylussacia* or huckleberry; and *Vaccinium,* which includes the cranberries, the deerberry of New England, Ontario and southwards, and the various blueberries.

The earlier classifications of blueberry species were based on plants collected from native sources and overlooked the fact, quickly discovered by horticulturists, that a wide range of types was frequently found in the open-pollinated progeny of an individual plant. The seedling populations derived from controlled crosses opened a completely fresh source of material for the systematic botanist. Camp (3) offers a new and more logical listing based on a careful analysis of a large number of these plants. In this classification which harmonizes the study of the taxonomist with the efforts of the modern plant breeder, chromosome numbers have served as an additional guide. Diploids (2n=24), tetraploids and hexaploids have been recognized and their relationship traced. The intermediate type, baffling to earlier botanists, and resulting from the natural crossing of forms occurring in the same region are now assigned their proper places. Simple, common names are suggested for the chief species and the entire treatise, although not complete in every detail, is a distinct advance in the knowledge of this important group of fruit plants.

The species of importance in Canada are arranged by Camp as follows:

Vaccinium myrtilloides Michx.
V. Canadense Kolm
V. pennsylvanicum var. *myrtilloides* Fernald
Cyanococcus canadensis Rydb.
Diploid (2n=24)

This is the most widely distributed species in Canada, being found from the Atlantic to the Pacific and as far north as Labrador and the Northwest Territories. Persisting in shade or semi-shaded locations, it is the common form in land newly cleared of forest growth and is readily recognized by its pubescent or hairy leaves and twigs. The colonies are dense and of moderate size only. The fruit, later-ripening than the one next described, is a bright, metallic blue colour, lacking somewhat in flavour and is known by many blueberry pickers as "Sour Top". Camp (3) offers the common name, Canadian Blueberry.

Vaccinium angustifolium Ait.
V. pennsylvanicum var. *angustifolium* A. Gray
V. pennsylvanicum var. *alpinium* Wood.
V. pennsylvanicum var. *laevofolia* House
Diploid (2n=24)

This species is common in the burned-over areas of Eastern Canada and northeastern United States. The leaves are shiny above and below and the twigs also lack pubescence. The colonies are dense and often large. The fruit is bright blue and of excellent flavour. This species gradually replaces the previous one in areas that are pruned by rotational burning. Low Sugar Blueberry is suggested as a common name.

Vaccinium lamarckii Camp
V. pennsylvanicum Lam.
Tetraploid (2n=48)

This is found in the same climatic range and is believed to have originated from a doubling of the chromosomes of *V. angustifolium.* The colonies are less

extensive, the plants taller, the fruit somewhat larger, bright blue and of excellent flavour. It is referred to as Lamarcks Sugar Blueberry.

Vaccinium brittonii Porter ex Bickn.
V. nigrum Britton
Tetraploid (2n=48)

The leaves and twigs of this species are dull or glaucous, the plants usually large and in compact colonies, the fruit dull or shiny black, large, and of good flavour. This type is common in most commercial fields in the Maritimes and New England.

It is equally as good as the previous three varieties for canning but is unpopular on the fresh fruit market because of its "shopworn" appearance. No diploid source of this species has been reported.

Vaccinium vacillans Torrey
V. vacillans var. *crinitum* Fernald
V. vacillans var. *columbianum* Ashe
V. vacillans var. *columbianum f. mollifolium* Ashe
V. vacillans torreyanum Camp
Cyanococcus vacillans Rydb.
Diploid (2n=24)

This species, in dense colonies, covers the same range as *V. angustifolium* with which it crosses freely and which, in many places, it appears to be replacing. The fruit is dull to black in colour and of fair flavour.

Vaccinium corymbosum L.
V. albeflorium Hooker
V. corymbosum var. *glabrum* A. Gray
V. corymbosum var. *amoenum* A. (not *V. amoenum,* Ait.)
V. corymbosum var. *pallidum* A. (not *V. pallidum,* Ait.)
V. corymbosum var. *fuscatum* A. (not *V. fuscatum,* Ait.)
V. vicinum Bicknell
Cyanococcus corymbosum Rydb.
Tetraploid (2n=48)

This is the high-bush type of New England, Michigan, southwestern Ontario and southwestern Nova Scotia and includes the cultivated high-bush varieties grown commercially throughout this region. The plants grow singly and any apparent tendency to spread in a colony is usually due to the layering of a branch. The leaf is usually large and ornamental, the fruit very large and of excellent flavour. The cultivated varieties display a wide range of fruit, leaf and plant characters.

Camp (3) says, "An understanding of the complexity of *corymbosum* cannot be obtained solely by a study of its materials. They are too variable and one must look to other species. For those who cannot study the basic materials in the field, perhaps the next best way to gain an understanding of it is to read the descriptions of *VV. arkansanum, simulatum, australe, marianum* (Southern species), *lamarckii* and *brittonii.* Then mix them together, much as if one were producing all possible hybrid complications in a long-term breeding program, and in succeeding generations, covering at least 10,000 years, to back cross, and re-cross further in all possible combinations, and then select all those plants over 1 m. in height whose leaves are over 2 cm. wide and 4 cm. long. The result would be *V. corymbosum* which is not an imaginary population, but a very real one, and quite as complex as the results of our hypothetical experiment would have been."

FIGURE 1—A Pint of Cultivated High-bush Blueberries

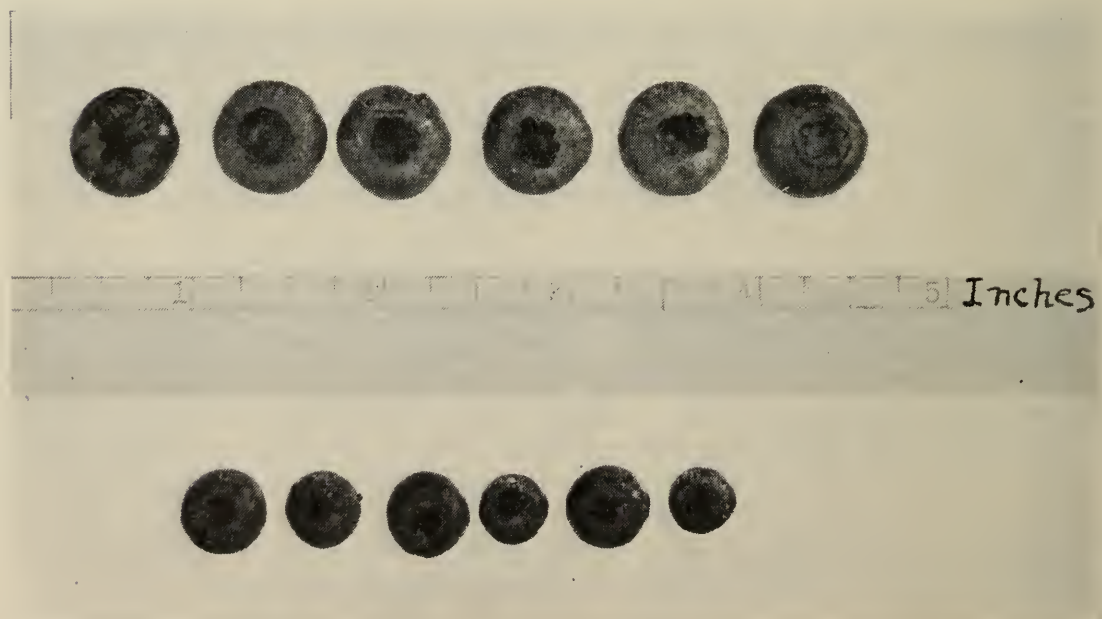

FIGURE 2—A Contrast—(Above) Cultivated High-bush Blueberries. (Below) Selected Wild Low-bush Blueberries

With such a variable source to draw upon, the rapid progress in developing improved varieties is understandable.

V. australe Small
Tetraploid (2n=48)

This is known as the Southeastern High-bush Blueberry and is found as far north as New Jersey. The same author (3) says, "This species more than any other has contributed to the excellent qualities of the modern high-bush commercial blueberries; in fact until very recently the better varieties were mostly selections of *V. australe* taken from the wild. Introduced to cultivation at various times since about 1850, but in commercial plantations only since about 1910."

The plants are said to sucker freely and form a small dense colony if undisturbed. They reach a height of six to twelve feet and produce large, blue fruit of good quality.

Vaccinium caesariense Mackenzie
Diploid (2n=24)

This is believed to be the diploid source of *V. australe* previously mentioned. It is somewhat smaller in stature, and the fruit, also smaller, is of good flavour. It is mentioned as the New Jersey Blueberry (3).

The Low-bush Blueberry

This is the chief blueberry of commerce. A wide range of varietal types exists in every natural blueberry field. These individual types are frequently found in colonies, evidently having originated from a single chance seedling and later spread by underground stems. This tendency is particularly noticeable in old fields where blueberries have been permitted to grow naturally. The individual types differ in earliness, flavour, size, colour, firmness and shape of fruit; size, vigour and productiveness of plant and density of colour, shape and resistance to disease on the part of the foliage.

Since all of the areas in commercial production are the result of natural seeding, and as the conditions suitable for blueberries also favour many other wild shrubs, the weed problem is a costly one.

The uneven ripening of the fruit is a cause of severe loss. Green berries are not acceptable to the canners, freezers, or fresh-fruit dealers and as there are no mechanical means of separating them from the ripe fruit, it is customary to delay picking until the later colonies are ripe. A large number of the early ones have then fallen. Estimated losses from this source often exceed 20 per cent. From the mass of native material at hand it seems possible to select distinct types, which if established by themselves in clean ground would provide a succession of varieties over a much longer season. Such a plan would not only greatly reduce the loss already mentioned but might well avoid most of the present serious weed competition. No practical means of propagating and planting has yet been devised but the problem is being studied by the Experimental Farms Service.

Soil Requirements

Low-bush blueberries are found on nearly every soil type but they thrive best on well-drained areas free from competing plants. Most blueberry soils are highly acid, but Chandler (5) states that applications of ground limestone totalling as high as 18 tons per acre over a 5-year period did no injury.

FIGURE 3—Low-bush Blueberry, Old Growth.
(Note lack of fruit buds except at tips of twigs.)

FIGURE 5—High-bush Blueberry, Growth of Current Year.
(Note fine strong fruit buds at top.)

FIGURE 4—Low-bush Blueberry, Growth of Current Year.
(Note strong fruit buds on upper three-fourths of stem, smaller leaf buds on lower portion.)

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Low-bush blueberries are frequently found growing wild in an acid layer of decaying plant debris overlying limestone rocks or limestone soils. If these areas are ploughed and the alkaline material brought to the surface, it becomes very difficult to establish blueberries again.

Cultural Practices

As the blossoms and fruit of the blueberry are borne on the growth of the previous season a large proportion of strong, new shoots is needed and these can only be forced by severe pruning. Fire has been accepted as the simplest method of removing old growth and it is customary to divide the area into three parts, burning one-third each year. A large crop is usually produced the year following the burning, a fair crop the second year and burning is repeated the third year. Firing more than one in three years is believed to destroy too much humus and a longer interval reduces the yields. This method, although the best yet devised to maintain yield, is not entirely satisfactory as the long-time trend of yields in all regions is downward. How much of this is due to soil fertility and how much to the gradual change from one species or type to another is still a matter of conjecture.

In regions where systematic management is followed the growers often join together for burning. In any case it is desirable to have plenty of help before the work is started; a few small stirrup pumps are a great aid in directing the fire.

The work of burning is done in early spring before the green grass appears, while snow still lingering in the woods may serve as a fire protection. Where there is not enough old material to carry the fire, old hay or straw is sometimes scattered lightly over the ground the previous fall. The snows of winter crush the mulch around the old stems, thus aiding in a thorough clean-up.

Burning the entire area without leaving any "islands" is important as the old plants form a refuge for maggots and other insects and also lessen the yield response from the pruning operation.

Among the common plants that are troublesome among blueberries are common brake or bracken (*Pteris species* L.), sheep laurel or lambkill (*Kalmia anqustifolia* L.), bayberry (*Murica calinensis* Mill), sweet gale (*Myrica gale* L.), wild spiraea, hardhack or meadow sweet (*Spiraea latifolia* Borkh) and wild rose or brier (*Rosa blanda* Ait).

Workers in New England (6) state that the sweet fern can be controlled by regular mowing in late June and early July. Late fall cutting is said to increase its spread. In Yarmouth, Nova Scotia, annual mowing in July, August or September has been equally effective.

The common brake or bracken is sensitive to calcium arsenate dust and where this is used regularly as an insecticide this weed is rarely a serious problem.

The other plants mentioned resemble the blueberry so much in their requirements that no easy control has been devised. In the absence of better information, mowing in midsummer is suggested to discourage further spread.

Fertilization

Fertilizer applications have not become a regular part of low-bush blueberry management. A three-year test in Yarmouth county using nitrogen, phosphorus, and potash fertilizers alone and in combination failed to give any consistent response aside from increasing the grass in the plots receiving nitrogen.

Workers in New England (6) have reported yield increases from fertilizers when the competing plants were entirely removed.

Blueberry foliage is highly sensitive to fertilizer and applications can be made safely only before the buds burst.

Picking

In pioneer districts picking is usually done by hand, entire families frequently moving to a convenient camp and spending the late summer season there. Transportation from these areas is not always the best. Therefore, the fruit from these districts often arrives at the rail or truck line in an over-ripe, wasty condition and is sold to processors for a proportionately low price. Hand picking is also followed for some of the fancy fresh-fruit trade, standard quart boxes being used and care taken to select only the large, sound, attractive berries. Blueberries for the canning plants are usually gathered with rakes or scoops. These are made from sheet metal, not unlike a heavy dust pan, with the bottom carrying a row of closely spaced, stiff wire teeth.

Where picking operations are on a larger scale the fields are divided by white twine into lanes six or eight feet wide. Each picker is assigned one lane and the berries are raked or, perhaps more accurately, combed from the bushes and gathered in wide-mouthed, galvanized pails. A small fanner operated by a light gasoline engine is set at a convenient place and leaves and other rubbish are blown out as the fruit is gathered. The cleaned fruit is packed in shallow boxes and moved immediately to the processing plants.

The High-bush Blueberry

The high-bush blueberry grows wild in many parts of New England, Michigan, southern Ontario, and is common in the three southwestern counties of Digby, Yarmouth and Shelburne in Nova Scotia. Here the winter temperatures approach those of New England; in fact, the mean temperatures for December, January and February are slightly higher at Yarmouth than at Amherst, Massachusetts.

The plants usually grow from a single, large, woody crown and under favourable growth conditions reach a height of 6 feet or more. They spread from suckers less freely than the low-bush type.

Marie-Victorian (12) suggests that the low-bush blueberry is found in more northerly regions, not because it is more hardy but because it is lower than the winter snow line and is thus protected from the frost injury. On the other hand, the high-bush type is less common because it lacks this natural protection.

Individual plants with a crown several inches thick, relatively free from suckering habit but recumbent in form are found wild on fertile soil in the colder areas where only low-bush berries are usually recognized. It is probable these would be much taller if they were in a more favourable location.

Although the cultivated high-bush blueberry has not been grown widely in Canada as yet, there is evidence that it is adapted to regions beyond those where the wild form is found. As breeding and selection work continues the development of still more hardy sorts may be expected. At Kentville, well beyond their natural habitat, a large number of varieties have been growing successfully since 1926. The plants at Kentville vary in height from four feet for Harding and Greenfields to seven feet for Katharine, Rubel and Grover. Yields of five and six quarts per plant were produced by 10-year-old plants in 1947 and double this from older bushes. The plants have a mass of shallow, fibrous roots which are easily injured by deep cultivation or drying near the surface.

Soil Requirements

Under natural conditions the wild plants are usually found in swampy places on hummocks or ridges above the general water level. In most of the earlier cultivated areas an attempt was made to imitate these natural conditions as far as possible. Soil with an abundance of subsoil moisture but well drained and having a generous supply of organic matter has usually been recommended.

It is important that the water level should be about 15 inches below the surface during the growing season; higher levels during the dormant season do not appear to be harmful.

Reasonably level, fertile, well drained soil which has received an application of three or four inches of mill sawdust has proved suitable. The sawdust apears to insulate the soil, reducing evaporation and thus holding the moisture in reserve until used by the plant. Regular and generous supplies of moisture are essential during July and August if the fruit is to reach marketable size and the twigs develop for the next year's crop. Land that is wet in spring and dry in summer is unsuitable, and the lifting which occurs in early spring on a waterlogged soil is likely to result in broken roots and damaged plants. The sawdust mulch has been particularly useful in preventing this "lifting". Acid soils are preferred, a pH of around 5·0 to 5·5 being suitable.

Varieties

Since the original breeding and selection work by Dr. F. V. Colville of the United States Department of Agriculture assisted by Miss Elizabeth C. White of New Lisbon, New Jersey, many improved varieties have been bred in several States of the Union and in Canada. The first varieties were selected from the wild and were named for the men on whose farms they were found: Harding—Ralph Harding; Sam—Samuel Lemon; Adams—James Adams; Grover—Russel Grover and Rubel—Ruben Leak. Several of the common varieties may now be identified with fair accuracy by their foliage (2).

Rubel, considered the best of the original selections in New England, was crossed with Grover to produce Jersey. The same good qualities have been drawn on in the building of many other new varieties.

The following varieties have fruited at Kentville: Adams, Atlantic, Burlington, Charlotte, Concord, Dixi, Evelyn, Fraser, Greenfields, Grover, Harding, Jersey, Johnston, Lulu, Pemberton, Pioneer, Rancocas, Richmond, Rubel, Sam, Scammel, Stanley and Weymouth, as well as the varieties Kenafter, Kengrape and Kenlate, named at Kentville and a large number of unnamed seedlings.

Jersey, Burlington, Stanley, Rancocas and Pioneer have done consistently well and are recommended for general planting. Greenfields and Sam are inferior. Adams, Harding and Grover are rated as fair. Katharine is of high quality but tears in picking. Several others are promising and merit further test.

Of the three named at Kentville, Kengrape has the largest berry of any so far tested. It is a bright blue in colour but lacks flavour. The bush is low with wide-spreading branches and remains below the snow line when most others are exposed. It is moderately vigorous and productive and has been used as a parent in numerous crosses. The Kenafter and Kenlate on the basis of first performance were judged to be late. They are still on probation. A brief description of the more familiar varieties follows:

Rancocas.—Rancocas is one of the earliest and easiest varieties to propagate by rooted cuttings. The plant is erect and vigorous but too narrow at the base for an ideal bush. The fruit clusters are so close and large that the berries may be small unless carefully pruned. The berry is large and bright blue for the most part but the waxy covering is easily rubbed off to disclose the dark under-colour. The flavour is good when mature but too acid if picked early. The variety is said to be partially resistant to stunt.

Pioneer.—This variety follows Rancocas by a few days. The bush is broad with the branches well distributed and easy to prune. The fruit is large, of bright blue colour and in close tight bunches that are difficult to pick quickly. The flavour is excellent.

Rubel.—This is the best of the original wild selections and it has transmitted many of its excellent qualities to its progeny. The bush is erect,

FIGURE 6—The Original Kengrape Plant. Experimental Station, Kentville, 1941.

FIGURE 7—Pioneer. Experimental Station, Kentville, 1941.

vigorous, and highly productive. The fruit clusters are long and lax so that any berry may be quickly removed without disturbing the others. The fruit, by present standards, is of medium size only but is an excellent shipper and canner.

Jersey.—Jersey is a cross between Rubel and Grover and combines the best qualities of both parents. The bush is erect, vigorous, productive and easily pruned. The berry is large, easily picked, an excellent shipper and retains its flavour and bright blue appearance longer than most. It is one of the best.

Burlington.—This is one of the newer varieties to come into fruiting at Kentville and although the bushes are not yet mature, evidence to date places this as a close rival to Jersey for first place. It appears to be a week later than Jersey. The bush is particularly vigorous and productive. The fruit is large, attractive and of good flavour and ripens more uniformly than most.

FIGURE 8—Rancocas (close-up of one branch). Note large fruit clusters. Experimental Station, Kentville, 1940.

Stanley.—This is one of the most ornamental of all the cultivated blueberries, the broad waxy leaves giving it a distinct claim to beauty. The bush is erect and vigorous but too open for maximum yields. The fruit is large, bright blue, and has a spicy, aromatic flavour not equalled by any other wild or cultivated variety tested.

Adams.—Adams is one of the original wild selections, a large, spreading, vigorous bush. The yellow colour of the bark on the new growth is distinctive. This is a most tedious variety to prune because of the many fine branches that must be removed each year. The fruit is large and of fine flavour but a bit soft for shipping; it loses its waxy colour in handling and ripens over too long a season—usually five weeks or more at Kentville.

Harding.—Harding is a small-growing but productive bush. The slate-coloured, medium-sized fruit is mild in flavour and excellent to consume direct from the bushes but too dark in colour and loses flavour rapidly.

Grover.—This is one of the largest bushes at Kentville, and one of the latest-ripening. It has an excellent flavour but is a light cropper, loses its bright colour easily and, like the Adams, ripens over too long a period.

Fraser, Charlotte, Johnston and Richmond.—These were all originated by E. W. Johnston of Eburne, B.C., who also named the varieties Evelyn and Lulu. These varieties are all of high quality but have not been thoroughly tested at Kentville.

Preparation of Land

The land for blueberries should be cleared and thoroughly cultivated for at least a year before the plants are set. Drainage, if necessary, should be taken care of and any low spots should be filled in at this time. A depth of at least 15 inches from the soil to the water level is needed in the growing season to provide space for root development.

If dry upland soil is being prepared, a cleaning crop or summerfallow is suggested to destroy weeds and work down the sod. Sawdust to a depth of two or three inches can then be added. Evidence is lacking yet as to whether the sawdust should be left on top or worked thoroughly into the soil. Earlier tests used sawdust as a surface mulch, gradually mixing it with the soil in subsequent years by ordinary cultivation. On a new section of the plantation at Kentville the sawdust applications have been worked thoroughly into the soil before the plants were set and this has given excellent results.

Once applied the sawdust remains for many years. Experience at Kentville suggests that a couple of inches every five or six years may be desirable. Little if any change in the acidity of the soil has resulted from the use of sawdust.

Planting

In Eastern Canada spring planting is usually followed although fall setting is preferred on the Pacific Coast. The soil is thoroughly cultivated, the rows laid out and holes dug with a shovel or spade. Blueberry roots are easily injured by drying so that planting is done speedily and with as little disturbance of the roots as possible. As in all transplanting the earth is firmly packed around the roots to exclude air.

Two-year-old plants are preferable to younger ones and four- or five-year plants are to unwieldy for general shipment. If old plants are moved, a generous share of the top is removed and at all ages as much soil as possible is left on the roots. If tractor or team cultivation is to be practised, the rows are spaced 10 feet apart and the plants 5 feet in the row. In small backyard plots where all the work is done by hand, a square block with the plants 6 feet by 6 feet or 5 feet by 5 feet will give room for many years. The 6-foot rows, used at first at Kentville, are now much too close for convenient picking.

While pollination studies with blueberries are incomplete, many varieties are believed to be partially self-unfruitful. The bloom period of all varieties at Kentville overlaps enough to provide sufficient pollen for the purpose and annual full crops have been gathered for many years.

Cultivation

The high-bush blueberry demands and repays thorough care. Clean cultivation is needed for the first year or two and at no time should the soil be worked deeply as the roots are close to the surface and easily injured. If cultivation is continued after late July the plants may fail to harden off properly and may suffer from winter killing.

A common practice in commercial areas in early spring is to ridge each space in the centre with a shallow grape plough, turning the soil away from the rows. The remaining strips near the plants are hoed out by hand and the weeds left in

the centre of the spaces. Thorough cultivation by a tractor or team completes the destruction of the weeds. At the last cultivation the soil is thrown towards the plants with an out-throw or one-way disk. Annual weeds or annual crops of oats or buckwheat are allowed to occupy the ground for the remainder of the season thus using the extra moisture and plant food, helping to mature the plants for winter, adding humus for next year and preventing washing or eroding of the soil.

Fertilizing

As the blueberry fruit is produced on the wood of the previous year vigorous annual growth is needed to maintain production. The plants respond readily to chemical fertilizer and regular, generous applications are recommended. Nitrogen gives the most conspicuous response in growth and fruitfulness but a complete fertilizer provides a better balance of plant development.

In the early years at Kentville a special 4-8-7 fertilizer was used and later a 5-10-5 mixture. These were sometimes supplemented by an extra application of a nitrogen fertilizer. When wartime restrictions reduced the brands offered, the standard 9-5-7 used commonly in apple orchards was substituted. This has given strong growth of twigs and foliage and large yields of fruit.

Pruning

Pruning is an operation which cannot be slighted if a full crop of large fruit is to be secured. As with the low-bush type, the fruit buds for the following year are all produced on the new shoots. To force this new growth, removal of old branches is necessary. Pruning serves a further purpose in reducing the number of fruit buds when more are present than the bush can mature.

The work is done during the dormant season. During the first two years the weakest branches only are removed as too heavy pruning retards growth. Any fruit buds or blossoms which appear in this period are also taken off so that all the plant food may be used for growth.

In later years the following procedure is advised (1):

"The pruning treatment of the different varieties varies according to the character of their growth. Those producing many shoots from the base require more thinning out of this growth than those with a few shoots. Varieties branching freely need more top-thinning than those with few branches. Varieties whose shoots have fruit buds in the terminal two-thirds or three-fourths require more cutting back than varieties whose shoots have fruit buds in the terminal one-third or fourth only.

"The following outline of pruning practice is given as a general guide, not as a set of rules:

"First, remove or cut back a few of the older stems. These stems after they are 3 or 4 years old, tend to produce short weak shoots and small berries.

"Second, remove all branches which are so near the ground that their fruit gets dirty.

"Third, remove the shorter, weaker shoots to prevent crowding.

"Fourth, cut back shoots with too many fruit buds. Usually 3 or 4 buds on a shoot are enough because each bud produces a cluster of 8 to 12 berries. If more buds are left so many berries will develop that they will be small.

"Finally, cut freely to encourage new growth. If pruning the first time, seek expert advice."

Picking

The month of August is blueberry picking time at Kentville, although a few early varieties may be gathered in July and a few extremely late ones have remained on the bushes until October.

If annual weeds or cover crop are in the way of the pickers, mowing may be done once or twice between pickings.

Since the blue colour appears some time before real maturity and immature fruit rarely drops, it is highly desirable to delay the first picking until a fair quantity of the berries acquire full size and flavour. Weekly pickings are made the remainder of the season. Rancocas, Pioneer, Jersey, Burlington and Stanley are usually gathered in three pickings, while Harding, Adams and Grover blossom and ripen over a long period.

Berries picked on rainy or dewy days do not keep well and picking is better postponed unless a market exists which will consume the fruit at once. The blueberry keeps well on the bushes and picking is rarely so urgent that fine weather cannot be chosen.

The usual market container is the pint wood-veneer box, covered with cellophane, and packed in crates or flats. Rubber bands or strips of narrow gummed tape hold the cellophane sheet in place. Mature fruit carefully picked and packed in this way remains fresh and attractive at the usual summer temperatures for upwards of a week. In cold storage or household refrigerator the life of the fruit is extended several weeks.

Propagation of High-bush Blueberries

New plants are procured from rooted cuttings, by layering, and from seed. The first two methods provide plants that are identical with the parent, while seedlings are grown chiefly by the plant breeder as a source of new varieties. The standard commercial method is by rooting hardwood cuttings in peat or peat and sand in a humid atmosphere. The nursery practice of budding or grafting common in the growing of tree fruits is not suitable for general use in blueberry propagation. It has considerable value as a step in the rapid multiplication of new kinds since the transfer of buds to vigorous new shoots in large bushes forces rapid growth of the new variety the twigs of which may then be rooted as cuttings.

Hardwood Cuttings

These are selected during the dormant season from the vigorous growth of the previous year and cut in pieces 4 or 5 inches long. The fruit buds, which are near the terminal end, are discarded and the basal portion bearing the smaller, slender leaf buds is used. In preparing the cuttings a clean cut is made just below the lower bud as there is a larger area at this point from which roots may spring. The cuttings are tied in bundles as quickly as possible so that the fresh surface will not dry out. They are then packed in peat or damp sawdust until planting time.

Softwood Cuttings

These are selected from the vigorous growth of the current year, usually in early July. They are prepared in the same way as the hardwood cuttings except that two of the upper leaves are left and the cuttings are put directly into the propagating frames.

The Propagating Frame

The work of rooting blueberry cuttings calls for the closest care and attention. The first stage in rooting is the formation of a large callus on the basal cut and from this the roots originate. Drying and excessive heat are fatal and the common bread mould is an ever present foe if the proper balance of heat, air and moisture is not maintained.

FIGURE 9—Softwood Cuttings in Propagating Frame.
(Opened for photo only.)

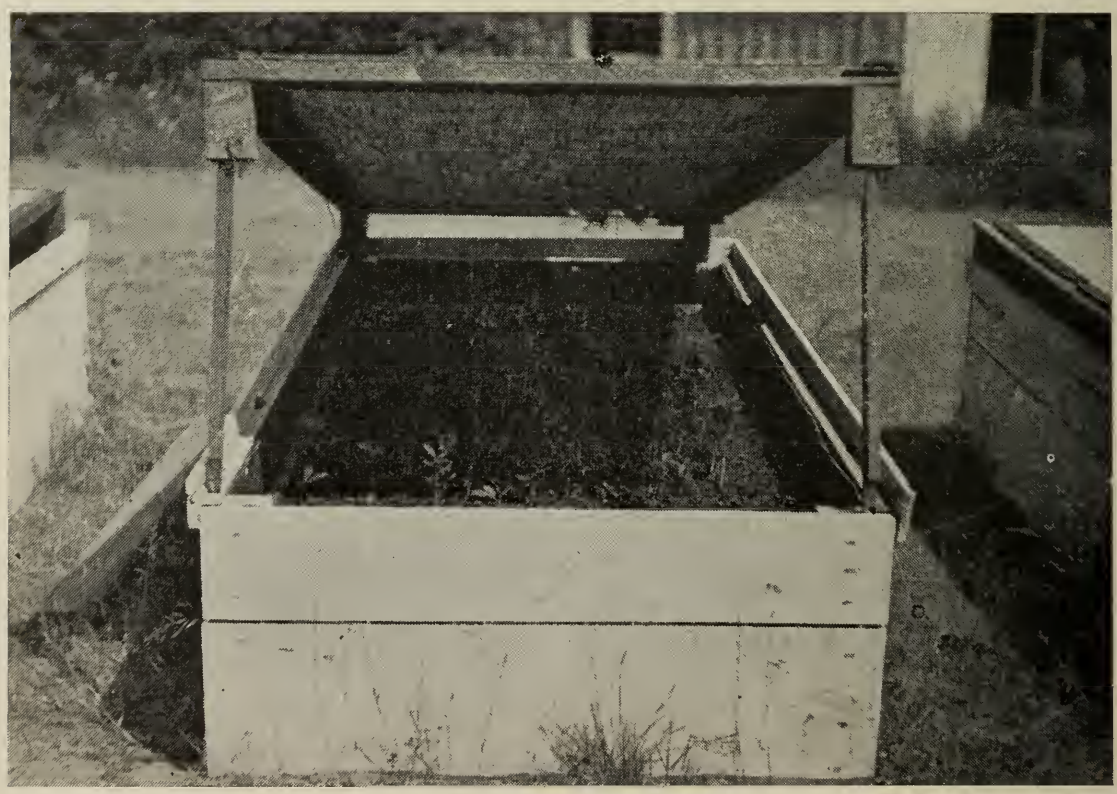

FIGURE 10—Hardwood Cuttings in Propagating Frame. Glass removed after rooting has taken place.

Satisfaction has been obtained with a cold frame lined with tar paper to exclude outside air and provided with a bottom tray which is clear of the ground. A tight sash cover and burlap shade are essential. The cold frame may be made any convenient size to suit standard cold frame sash or idle storm windows. The tray which fits snugly inside the frame is 4 inches deep and the bottom is covered with a galvanized wire screen of quarter-inch mesh. It is important that the burlap screen, set 4 inches above the grass, be free from holes as any such opening will cause sunburning of the unshaded area beneath.

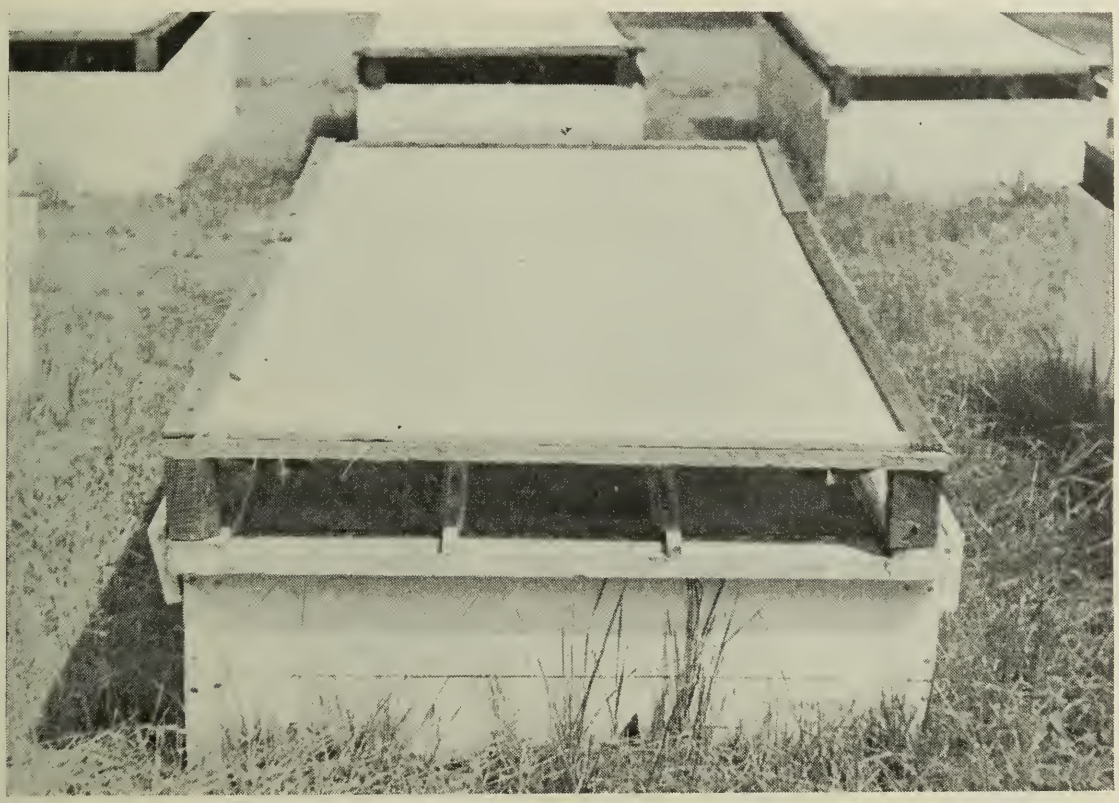

FIGURE 11—Propagating Frame (closed).

The tray is loosely filled with peat and cuttings are set in rows 4 inches apart with 2-inch spacing in the rows. One or two buds are left above the peat and the base of the cutting is an inch or so above the wire screen.

European peat was originally preferred for this and many other horticultural uses. During the war Canadian peat that had been dried, granulated and baled was found to be reasonably satisfactory at Kentville. This is broken up, watered, stirred and watered again and finally allowed to stand for a day or two to become thoroughly moistened before placing in the frames.

Cuttings usually require six to eight weeks to strike root; they seldom need watering more than once or twice in that time. Each frame is examined daily and any cuttings with drooping or discoloured leaves are removed at once. After the buds burst the sash may be opened slightly at alternate ends for ventilation particularly during dull weather. Moisture on the inside of the glass is an indication of the need for more air.

After the cuttings are rooted, the glass is removed and the frames are left covered with the burlap for several weeks. The cuttings are gradually hardened off by lifting the burlap screens on dull days and for longer periods. In the winter an inch or so of sand is scattered over the peat and the entire frame covered with spruce brush.

If the frames are being used a second time in the same summer for softwood cuttings the tray may be removed to a sheltered cold frame. Where enough frames are available few commercial growers now use softwood cuttings because if they are left on the bushes the same twigs will make hardwood cuttings for the following season.

FIGURE 12—Batteries Nos. 1 and 2—High-bush Blueberry Propagation Project, conducted by W. T. Suckling and Miss Agnes McDonald at Lulu Island, B.C. Each battery consists of 22 frames, 3 feet wide and 8 feet long—(approximately 500 cuttings under each frame)—making a length of about 170 feet each battery. The shade covering is onion bag sacking, single thickness. Note sub-irrigation ditch, with catwalk on both sides of ditch. Black spot in centre of ditch near the far end is water table gauge. These two batteries run east and west. There are approximately 22,000 cuttings set out in these two batteries.

Courtesy, W. T. Suckling, Lulu Island, B.C.

Softwood cuttings require special winter care since they are too tender to survive out of doors. A cool, frost-proof root cellar to which the entire frames are moved in the fall before severe frost has been a satisfactory storage at

Kentville. By spring the cuttings have shed their leaves, passed into dormancy, and are ready for transplanting to special nursery beds. It is sometimes convenient to have the nursery beds near the propagation frames. The used peat from the frames is mixed with the soil of the beds to aid in regulating and holding the needed moisture.

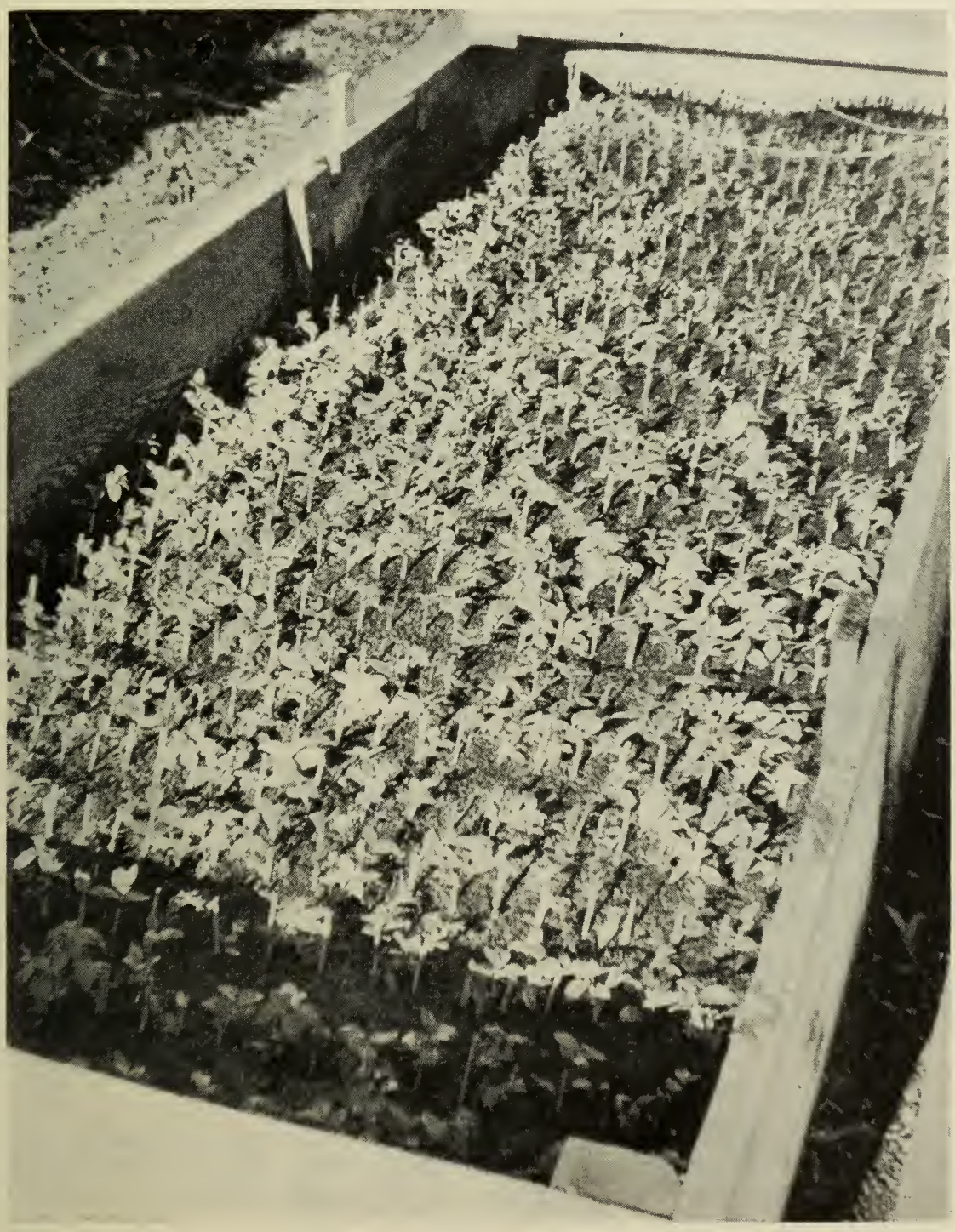

FIGURE 13—A good showing of Jersey striking—about 500 cuttings (one frame) exposed for this picture. Picture was taken three months after cuttings were set out.

Courtesy, W. T. Suckling, Lulu Island, B.C.

The rooted cuttings require a year in nursery beds before transfer to their permanent place. Fertile, clean land, either damp soil or land which has received a layer of sawdust mulch, is needed for this.

Growth Stimulants

Experience at Kentville indicates that growth stimulants, otherwise called plant hormones, encourage the rootings of softwood cuttings particularly of those varieties which are slow to initiate roots unaided. No benefit has been observed from their use on hardwood cuttings.

Naphthaleneacetic acid, indoleacetic acid, indolebutyric acid and sodium salt of the latter, when mixed with powdered charcoal were found to be useful. These same materials, as well as a trade product, Hormodin A, at from 10 to 20 parts per million in a water solution were also helpful.

The dusts were applied by dipping the twigs and shaking off the excess. Where solutions were used, the base of the cutting was immersed for 24 hours just before planting.

Seedlings

Blueberry seed grows freely if taken directly from the fruit but, after drying, the seed coat becomes extremely hard and germination is slow and irregular.

As in many other fruits the seed reaches maturity before the pulp so that either fully or partially ripe berries may be used. To obtain seed the pulp is thoroughly mashed and the seed washed out with water, or the berries may be crushed or rolled with sharp, dry sand until the seed and pulp are separated.

In growing plants from seed, flats are half-filled with fertile garden soil and a layer of mixed sand peat added. The seed or sand and seed is then scattered thinly and covered lightly with fine sand. The flats are thoroughly soaked, covered to keep them damp, placed in a warm location and watered daily. At Kentville a section of greenhouse in which the temperature may be kept between 70° and 90° F. is usually available in early fall. At this temperature from six to eight weeks is usually required for germination. Then the flats are uncovered and watered daily.

The seedlings grow slowly at first but by spring are usually large enough to transplant, after hardening, into outside nursery beds. These nursery beds are of fine, fertile soil mixed with about one-third granulated peat and are within reach of a garden hose for thorough daily watering.

Spruce boughs are used as a protection the first winter outside. After two years in the nursery bed the plants are large enough to be moved to their permanent setting.

When crosses are made during the winter in the greenhouse the fruit is usually stored in a refrigerator until fall. The seed of this fruit is treated in the same way as that gathered directly from the field.

Propagation of Low-bush Blueberries

So far little work has been done on the commercial propagation of low-bush blueberries. Seedlings can be grown in the same way as described for the high-bush type; the young plants respond in the same way to care and fertility. The habit of spreading by underground stems, however, introduces a different problem, as even shallow hoeing soon hinders this natural growth. For this reason weeding must either be done by hand or abandoned at an early stage.

Initial attempts to propagate from cuttings indicate that the usual sprouts are too slender to take root freely. However, further experience may suggest a means either of increasing the diameter of the sprouts or utilizing the normal sizes.

Propagation of underground stems has so far given the best stands of plants. The stems are divided and planted at once in the early spring. Immediate planting prevents the drying of these cuttings.

There is a wide difference in the spreading ability of various low-bush blueberry colonies, and it is hoped that some of them may prove to be easily rooted and multiplied.

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BLUEBERRY INSECTS AND THEIR CONTROL IN THE MARITIME PROVINCES

By C. W. Maxwell[1] and A. D. Pickett[2]

Blueberry Maggot

The most important insect pest of blueberries is the blueberry maggot, *Rhagoletis pomonella* (Walsh). The development of the larva, a small white maggot, within the berry causes premature ripening and breakdown of the fruit. The presence of this maggot in fresh, canned or frozen fruit, although not injurious to the health of persons eating it, is obviously objectionable. It also affects the export of blueberries to the United States where regulations of the Pure Food and Drug Act prohibit the sale of infested fruit which has entered inter-state commerce or has been imported.

The adult fly is somewhat smaller than a common house fly. It emerges from the soil in July, the emergence date in any one locality varying slightly from year to year according to weather conditions. The egg is laid beneath the skin of the fruit; a few days later the maggot hatches and remains actively feeding in the fruit for about two weeks, after which it leaves the berry and drops to the ground, burrowing into the soil where it remains for the winter. Most of the flies emerge the following year but a fairly large number remain in the soil for two winters and a few possibly even longer.

Control

Both cultural and chemical control methods may be used against this pest. Where blueberries are grown as a commercial crop the fields are usually burned over about every third year in the early spring, usually in March or early April. Where this practice is thoroughly carried out it serves the double purpose of stimulating new growth in the blueberry plants and also preventing fruiting for one year. As a result the blueberry maggot flies emerging that season cannot find fruit in which to deposit eggs and thus the maggot population will be reduced. This method of control would be quite effective if it were not for the fact that some of the insects may remain dormant in the soil for two or more winters. As large areas as possible should be treated and no unburned patches should be left. Sometimes it is necessary to spread hay or straw, one ton per acre, over the area in order to get a satisfactory burn.

Keeping the blueberry areas free of bushes and other tall-growing plants is helpful in maggot control by removing protection that is beneficial to the flies.

To keep down the maggot population, cultural practices usually must be augmented by the use of insecticides. Applications may be made by the use of power or hand dusters, depending on the size of the areas to be treated. In many blueberry producing sections calcium arsenate, 6 pounds per acre per application, applied first as the earliest berries turn blue and again two weeks later, gives good results. In some places this treatment is unsatisfactory owing to the injury caused by the insecticide on the blueberry foliage. In such areas it is necessary to use hydrated lime in combination with calcium arsenate or to use some other insecticide. Any one of the following mixtures will give good results:

1. Calcium arsenate 1 part, hydrated lime 3 parts, 20 to 24 lb. per acre per application.

[1] Dominion Entomological Laboratory, Fredericton, N.B.
[2] Dominion Entomological Laboratory, Annapolis Royal, N.S.

2. Dehydrated copper sulphate 20 lb., calcium arsenate 40 lb., hydrated lime 40 lb., applied at the rate of 15 lb. per acre per application.

3. Dehydrated copper sulphate 10 lb., calcium arsenate 40 lb., hydrated lime 50 lb., applied at the rate of 6 lb. per acre per application.

Where infestations are not severe and where applications have to be made by hand machine 10 pounds of lead arsenate per acre in only a single application at the time the first fruits turn blue has given fairly satisfactory results, but this would probably not be effective in the case of a heavy infestation. Dusts should be applied when the air is calm and preferably while there is some dew. Early morning is usually the most satisfactory time.

On cultivated blueberries a rotenone or derris dust may be used for the control of this pest. The dust is applied 8 to 10 days after the emergence of the first flies and followed by one or two additional applications, as may be required, at 7- to 10-day intervals. From 15 to 20 pounds per acre of a 5 per cent rotenone dust is used for each application.

Black Army Cutworm

The black army cutworm, *Aotebia fennica* (Tauscher), has caused serious losses to blueberry growers. It is a periodical pest occurring in outbreaks at intervals of several years. When an outbreak occurs it may strip the foliage of blueberry and several other associated plants. The black caterpillars are normally night-feeding, climbing cutworms but, during heavy outbreaks when food becomes scarce and the caterpillars are well grown, they may develop the marching habit and feed night and day. When the presence of these insects is suspected every precaution should be taken to detect them as early as possible in the spring. Producing areas, particularly those burned the previous year, should be carefully inspected in late April or early May. The caterpillars at this time are $\frac{1}{4}$ to $\frac{1}{2}$ inch in length and feed principally on the terminal buds, eating out the interior after entering through a small hole which they make in the side. Usually the outer bud scales are left intact and the entrance hole is therefore very inconspicuous. After a caterpillar has destroyed all or most of the buds on one stem it moves to another and continues its destruction. As the growth of the buds proceeds the contrast between injured and normal buds increases and infested areas become more easily detected. The caterpillars continue feeding until about the time the plants are in full bloom when they do extensive damage to the blossoms. When their growth is completed they desert the blueberry plants and enter the soil where they eventually develop into moths which emerge to lay eggs probably during August. The insects are believed to spend the winter in the soil or surface debris as small caterpillars but it is possible that some may winter in the egg stage.

A satisfactory way of examining blueberries for this insect is to sweep the plants at night with a stoutly made insect net. This may be constructed by using a hoop about 16 inches in diameter attached to a 5-foot handle, and with the open end of a cotton bag about 30 inches deep fastened securely to the hoop. The insects are collected by sweeping the net back and forth across the tops of the plants as the observer advances slowly across the area under inspection. A count of the cutworms should be made following 50 sweeps and if the number exceeds 25, control measures should be applied as soon as possible. If the number collected averages less than 12, control measures are usually not warranted.

Control

Until recently, poisoned bran bait, such as that used for garden cutworms, armyworms or grasshoppers, has been recommended for this pest but trials with this material in New Brunswick did not prove satisfactory. A 3 per cent DDT dust used at the rate of 30 pounds per acre has been found quite effective and it is believed that smaller amounts would be satisfactory if evenly distributed.

Blueberry Flea Beetle

The blueberry flea beetle, *Altica sylvia* Mall., is a common pest of blueberries which usually causes damage in localized areas. Occasionally, however, it becomes fairly general and in 1947 was prevalent in many areas in southern New Brunswick where it caused extensive injury.

The immature stage of this beetle is a black slug-like grub about $\frac{3}{8}$ of an inch in length when full-grown. The insects overwinter as eggs. These hatch in the spring after development of the blueberry plants has begun and the young grubs feed on the expanding foliage.

The adult beetle, which appears in early July, is roundish, shiny coppery-bronze in colour and less than $\frac{1}{4}$ inch in length. Like all flea beetles it jumps suddenly when disturbed. Both grubs and adults feed on the blueberry foliage, eating out angular holes. The grubs feed readily on the blueberry blossoms and may do extensive damage in this way. They may be readily collected in an insect net such as that described for collecting the black army cutworm.

Control

When the grubs are first discovered, the area should be dusted with 3 per cent DDT at the rate of approximately 30 pounds per acre. The first blueberry maggot application of 6 pounds of arsenate of lime has proved entirely satisfactory for control of the adults of the blueberry flea beetle but this application is too late for control of the grubs.

Currant Fruit Weevil

In Nova Scotia the grub of this small snout beetle, *Pseudanthonomus validus* Dietz, may develop in the fruit of the blueberry in numbers. The female deposits her eggs in the calyx lobes of the berries while they are small and green. The tiny grub which emerges from the egg late in June or early July is white in colour with a light brownish head. It feeds on the pulp of the berry for approximately a month until full-grown. It then changes to a white pupa inside the berry and remains in this stage for about 9 or 10 days. Usually when the first berries are ripe both the grubs and the pupae may be found, but within a week or 10 days practically all the grubs will have changed to pupae, and a week or so later most of the infested berries will have dropped.

In early August the adult weevils begin to appear. These are very small reddish-brown beetles, somewhat less than $\frac{1}{8}$ of an inch long, and have the long snout characteristic of weevils. The beetles feed on the berries but unless very numerous, damage is negligible.

Control

No work has been done on the control of this insect on the blueberry but observations made over a two-year period suggest that it is of no importance on newly burned areas except when this operation has not been well done. For export shipments or for processing, the berries should be examined in the same way as for the blueberry maggot* and if weevils are found in apreciable numbers picking should be deferred until the test indicates that the infested fruit has dropped.

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* Method of testing blueberries for maggots: Take a sample of the raw berries composed of about enough to fill two number two cans. Place these in a suitable container with a small amount of water to prevent burning and give a quick thorough cooking for about two to three minutes, stirring more or less in the meantime. From the sauce thus prepared take a test portion consisting of a number two can full. The two cans of raw berries taken should be slightly more than is necessary to produce that amount of sauce.

The sample of sauce should then be washed in a 6-mesh to the inch sieve in a pan of water. The maggots by this operation will pass through into the pan while the refuse and the berries which do not break through should be discarded. The test pan of water should then be decanted in such a way as to carry over the most of the water and leave the maggots in the bottom of the pan. More water is then added, the mixture stirred up, allowed to settle and decanted a second time. Pour the residue on the bottom of the pan into a flat black bottom baking pan or tray and count the number of maggots.

No boiling is necessary for canned blueberries.

Chain-Spotted Geometer

The chain-spotted geometer, *Cingilia catenaria* Drury, is an occasional pest of blueberries in various parts of Eastern Canada where it may completely destroy the foliage and fruit under outbreak conditions. In addition to blueberry, it attacks many other plants commonly found growing on blueberry lands. Sweet fern appears to be its preferred food plant but rhodora, huckleberry, cranberry, wild spiraea and many others may be attacked. Under severe outbreak conditions it may defoliate many species of deciduous trees and conifers after the foliage of the low-growing plants is destroyed.

The caterpillars are yellowish with prominent black spots along the sides and when fully grown reach a length of 1½ to nearly 2 inches. Like all geometers or measuring worms, they move with a typical looping motion. The caterpillar stage occurs from early June until late in August. The moths, which are day fliers, may be found during September and October. They lay their eggs mostly on the leaves of sweet fern and other plants. These drop later and so the eggs winter over in the dead leaves on the ground. The moths may be distinguished by their smoky white, almost transparent wings, the outer edges of which are marked by faint black lines and several distinct black spots.

Control

Treatments should be applied as soon as the insects are discovered. Dusting with a mixture of (*a*) 70 parts gypsum or talc to 30 parts cryolite at about 30 to 40 pounds per acre or (*b*) lead arsenate at 10 to 15 pounds per acre should be effective. It is suggested that a 3 per cent DDT dust at 30 pounds per acre may prove effective but this has not been tested to date.

Other Blueberry Insects

Various other species of native insects have been recorded as causing damage to the blueberry in the New England States but as yet these have not been reported as injurious in the Maritime Provinces. One of these is the blueberry leaf beetle, *Galerucella vaccinii* Fall. The adult overwinters among the debris near the stems, feeding in the spring on the under surface of the leaves, usually one larva to a leaf, and leaving only a network of small veins. The recommended control consists of periodic burning and arsenical sprays and dusts.

Investigations being carried on in Charlotte County, New Brunswick, at the present time are showing that other species of insects are causing some damage to the blueberry, the most important of these being the blueberry tipworm, *Contarinia vaccinii* Felt, and a thrips, tentatively identified as *Frankliniella vaccinii* Morgan. The former insect is found mostly on *Vaccinium myrtilloides* Michx., on all stages of growth including sprouts of one- and two-year-old plants. The larvae tightly roll the terminal leaves of the plants and feed within. Observations during 1947 indicated that 12 per cent of the new shoots were affected. Controls for this pest have not yet been discovered. The thrips seems to be confined to *Vaccinium angustifolium* Ait. Injury is caused by the thrips rolling varying numbers of leaves around the stem of the plant, damage sometimes extending its complete length. On one barren the number of plants affected amounted to 35 per cent. Control measures are not known.

DISEASES OF BLUEBERRY

by

J. F. Hockey[1]

Blueberry plants are subject to parasitic diseases as are most, if not all, agricultural crops. Some diseases attack the foliage, causing leaf spots or mildew; others attack the fruit causing it to shrivel or rot; and others attack the stems causing canker or witches' broom. Any of these diseases may affect the crop but, in the Maritime Provinces, there has seldom been a serious outbreak of disease in blueberries. The following brief notes may help in the identification and control of those found in wild or cultivated plants.

Red Leaf Spot

Occasional plants may be found with brilliant red leaves during June or July. The leaves produce a white mass of mould-like growth on the lower surface before gradually drying up and falling in mid-summer. This conspicuous disease is caused by a fungus, *Exobasidium vaccinii* Wor. It is readily distinguished from the reddening of foliage caused by mildew or drought. Periodical burning has given satisfactory control of this disease in some districts.

Mildew

Blueberries are susceptible to mildew caused by the fungus *Microsphaera alni, var. vaccinii* (S.) Sal. which in seasons of moist weather may cause a partial defoliation early in the summer. There is no conspicuous leaf spot associated with mildew but frequently the leaves turn reddish prior to falling. Affected leaves are susceptible to copper and arsenical dust injury.

Witches' Broom

The presence of balsam fir in the vicinity of blueberry plants has a decided influence on the prevalence of the stem rust fungus, *Puccinastrum Goeppertiana* Kuhn. on blueberries. When this fungus attacks the blueberry plant, it causes a characteristic swelling of the stems and profuse development of shoots which result in the production of a "witches' broom". The witches' broom is fairly conspicuous on account of its upright, compressed appearance. Affected plants seldom produce more than two-thirds of a normal crop. Burning has no effect on the control of the rust but the elimination of balsam fir from the barrens and borders of plantings will reduce the disease.

Fruit Rot

In moist seasons twig blights and fruit rots may occur on blueberries due to the activity of a Sclerotinia or a Botrytis fungus. Either of these fungi will cause a fruit rot and both are favoured by similar weather conditions. A greyish mould develops on affected fruit which gradually shrivels as the season advances. Other occasional fungus fruit rots may be found but they are seldom of any appreciable importance.

Twig Blight

A fungus which causes a fruit rot of cranberries also produces a twig blight of the cultivated blueberry. This fungus (*Diaporthe vaccinii*) is found in the imperfect, or *Phomopsis*, stage on cranberry fruits and on the over-wintering leaves. On the blueberry the same fungus causes a wilt and die-back of the young growing tips. Occasionally it attacks older wood producing a local canker. Affected parts should be pruned and destroyed.

[1] Laboratory of Plant Pathology, Kentville, N.S.

FIGURE 14—Witches' broom on wild blueberry. Caused by fungus *Calytospora goeppertiana.*

Stunt

The name "stunt" is applied to a virus disease of blueberry which causes the affected plant to develop dwarfed growths and generally to assume a stunted appearance. The fruit is small and adheres to the fruiting branches long after maturity. The foliage of affected plants is somewhat smaller and turns reddish in late summer. Young leaves on new growth are usually paler than normal foliage. The disease is probably spread by insects. The best control of stunt is to pull and destroy affected plants as soon as they are identified.

Canker

Occasionally some lesions that develop into cankers are found on the older wood of blueberries. These cankers may ultimately girdle and kill the branch. A fungus, *Godronia cassandrae*, is known to cause such cankers. The

imperfect stage of this fungus (a *Fusicoccum*) has been isolated from cankers on blueberry plants and from cranberry fruits. No control has been suggested for the disease in blueberries other than to prune out and destroy the cankers.

Other causes of canker may be found as greater attention is given to the culture of blueberries. Specimens of affected plants should be sent to the nearest Laboratory of Plant Pathology for identification. The location of these laboratories is listed in a paragraph at the end of this section.

Moisture Deficiency

Blueberry plants are quite susceptible to dry soil conditions. Their reaction to drought is first noted by a foliage reddening. The berries are usually smaller on such plants and an early defoliation follows. Plants suffering from drought are subject to dust injury, particularly from arsenicals. Where heavy coatings of arsenical dust have been made on plants, injuries may appear in the form of spots with or without concentric rings or as marginal burning. Such plants defoliate soon after the injury is apparent.

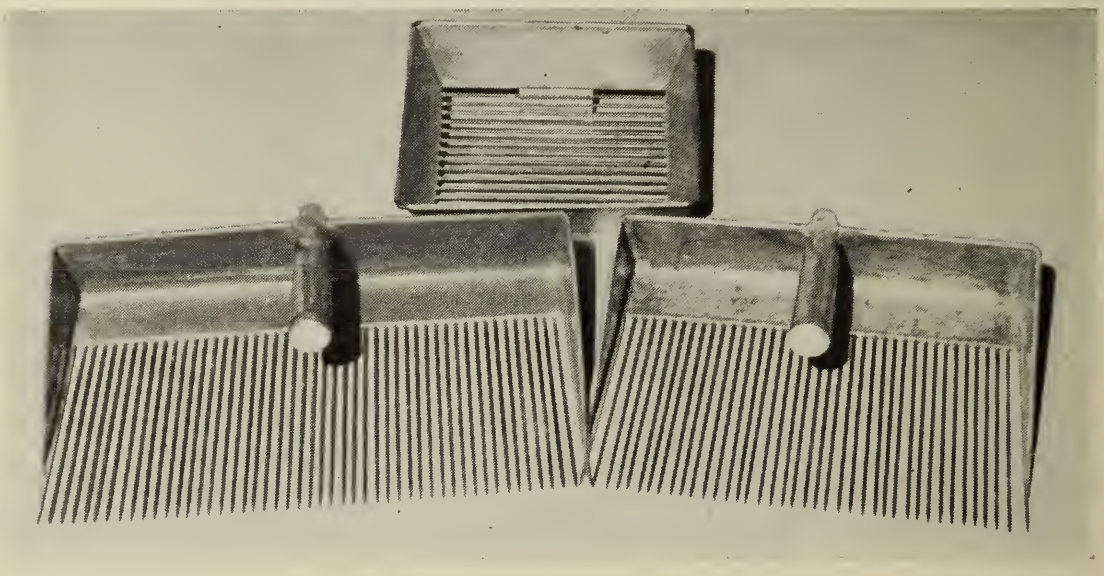

FIGURE 15—Blueberry Rakes and Hand Screen for Grading Small Lots of Fresh Fruit. The Wider Rakes Are Preferred For Large Scale Harvesting.

Fungicide Dusts

Little experimental work has been done with fungicides on blueberries in Nova Scotia. In the State of Maine it has been found that dusting at blossom fall and again 10 to 14 days later has protected the foliage from diseases and increased the yield of blueberries particularly in the year after burning. The dusts were applied at rates to give 10 to 13 pounds of monohydrated copper sulphate per acre. These rates were obtained by using approximately 35 pounds per acre of a 38 per cent copper lime dust or 50 pounds per acre of a 20 per cent copper lime dust. Arsenicals for insect control may be added to such dust mixtures in the proportions necessary to give the desired application rate per acre.

Before attempting the use of fungicides on blueberry plants, it is advisable to consult the nearest Dominion Laboratory of Plant Pathology for its recommendation. These laboratories are located at Kentville, N.S.; Charlottetown, P.E.I.; Fredericton, N.B.; Ste. Anne de la Pocatiere, Quebec; St. Catharines and Harrow, Ontario; Winnipeg, Manitoba; Saskatoon, Saskatchewan; Edmonton, Alberta; and Summerland, Vancouver and Saanichton, B.C. Communications may also be addressed to the Dominion Botanist, Science Service Building, Ottawa, Ontario.

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