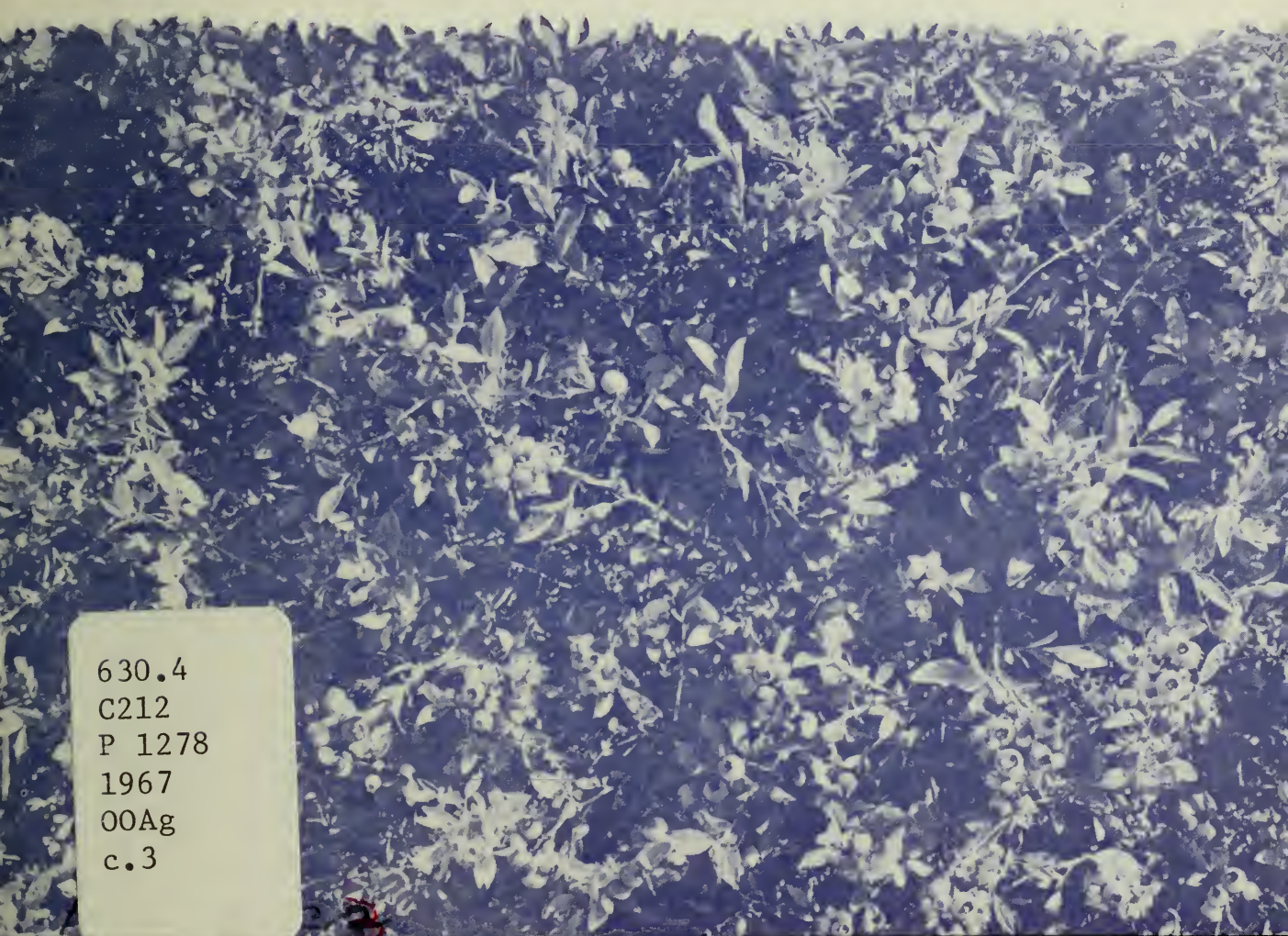
LOWBUSH BLUEBERRY

PRODUCTION IN CANADA



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For maximum production and greatest economic return:

- Select fields where wild blueberry plants are already growing.
- Develop areas where there are few large boulders and weeds.
- To encourage best growth burn late in the fall or early in the spring.
- To control most weeds use 2,4-D; 2,4,5-T· or amitrole at the recommended rates.
- Apply nitrogenous fertilizers only if blueberry growth is very poor and grass is absent.
- Supplement native bees with honeybees if you have low fruit set.
- Be able to recognize insect and fungus pests and know what pesticides to apply at the proper time.
- Delay harvesting until berries are fully ripe.

LOWBUSH BLUEBERRY PRODUCTION IN CANADA

I.V. Hall, L.E. Aalders, L.P. Jackson, G.W. Wood,

and C.L. Lockhart

CONTENTS

NOTE ON PESTICIDES

Information on chemical pest control in this publication is valid for 1967. As new pesticides are continually appearing on the market and some in current use are being discontinued, growers should also get the latest information from their provincial government or agricultural representative.

LOWBUSH BLUEBERRY PRODUCTION AND MANAGEMENT

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The production of lowbush blueberries in Canada is confined almost entirely to Eastern Canada. Since blueberries are part of the native vegetation, they are well adapted to this temperate climate. Blueberry growing is restricted to acid soils of moderate to low fertility. Probably the largest acreage of blueberry land has been developed from abandoned or run-out farmland. This is particularly true in Nova Scotia and New Brunswick. Most fields in the Province of Quebec formerly supported stands of jack pine.

Some lowbush blueberries are sold as fresh fruit, but the largest volume is processed. This fruit is very popular as a pie filler or as a supplement to muffin and pancake mixes.

The market outlet for lowbush blueberries at the present time is very good. The price of frozen lowbush blueberries compares favorably with that of highbush blueberries and of other competing fruits, such as sour cherries. The production of lowbush blueberries in the five eastern provinces has varied between 15 and 20 million pounds annually during the period 1960 to 1965 (Table 1). This volume is normally less than that for the State of Maine, which is the only other large producing area in the world.

Table 1. Commercial Production of Lowbush Blueberries
(thousands of pounds)

	1960	1961	1962	1963	1964	1965
Nova Scotia	5,400	5,700	7,400	7,000	5,100	7,000
Newfoundland	2,814	2,934	1,250	1,401	1,036	2,500
Prince Edward Island	130	451	238	150	200	240
New Brunswick	3,500	4,500	4,000	4,000	3,000	2,500
Quebec	6,098	2,715	3,429	8,551	8,762	3,081
Maine	21,336	25,550	30,282	22,795	21,863	10,607

Source: Value of fruit production – 1965. December 16, 1966, Dominion Bureau of Statistics, Catalogue No. 22-003. Supply and use of blueberries in Maine. March, 1966, revised by D. A. Abdalla. Formerly: Maine Agric. Expt. Sta. Mimeographed Report No. 27 (1924 to 1950).

CLASSIFICATION OF BLUEBERRY PLANTS

Five kinds of blueberries grow wild in Canada. Four are lowbush types and the other is a highbush type. The fruits of all, with the possible exception of ground hurts, are harvested and sold commercially.

Velvet-leaf Blueberry *(Vaccinium myrtilloides)*

This species can be distinguished by its hairy leaves and stems and nontoothed margins of the leaves. It is the blueberry most often found in woodlands and is the most abundant species in blueberry fields recently developed from woods. It tends to be eliminated by repeated burning. The velvet-leaf blueberry ranges from Nova Scotia to Vancouver Island.

Ground Hurts *(Vaccinium boreale)*

The stems of this species are much branched and the plant grows along the ground. It is most abundant on the exposed headlands of Newfoundland, and is rarely found elsewhere in Canada.

Common Lowbush Blueberry *(Vaccinium angustifolium)*

This kind has shiny, smooth leaves with toothed margins, the points of which bear minute glands. It is the most abundant type of blueberry in stands developed on abandoned hayfields and in other fields that have been burned for many years. It ranges from Newfoundland to Manitoba.

Black Lowbush Blueberry *(Vaccinium angustifolium* forma *nigrum)*

This type can be distinguished by its blue-green leaves and black, shiny berries. In range and habitat it is similar to the common lowbush blueberry except that it tends to increase more rapidly with repeated burning.

Highbush Blueberry *(Vaccinium corymbosum)*

The foliage and stems of this species are extremely variable in size, but typical plants are three to eight feet high. It crosses freely with the common lowbush blueberry and in certain areas a complex of intermediate and parental types is found. Its range is from Nova Scotia to Ontario and it grows mostly in or around the edges of bogs or swampy areas.

The velvet-leaf and ground hurts are both diploid species (24 chromosomes), whereas the other two lowbush types and the highbush species are tetraploid (48 chromosomes). This is important in pollination. Plants of species with the same chromosome number will effectively pollinate each other, whereas crosses between species with different chromosome numbers rarely, if ever, set fruit.

Figure 1. Left, flower buds (at top) and vegetative buds of the common lowbush blueberry. Right, an extra flower bud, which sometimes develops on a vigorous shoot.

In most of Eastern Canada plants of the two common species, velvetleaf and common lowbush, are found intermingled in lowbush blueberry fields. Plants within a given species differ greatly in vigor and productiveness; color, shape, and size of leaves; resistance to foliage disorders; and earliness, flavor, size, color, firmness, and shape of fruit.

DEVELOPMENT OF THE PLANT

Most of the new shoots of mature plants develop from dormant buds on underground stems called rhizomes. The tips of growing shoots die in the early part or middle of the summer and the buds develop into either vegetative or flowering types. Whether a particular bud will be vegetative or flowering is determined the year the shoot arises. By late September most, though not all, flower buds can be distinguished from vegetative buds (Figure 1) as they are usually about three times as large. The ratio of flower to vegetative buds is greater on new sprouts than on older twigs. The flower buds formed on new sprouts are also hardier and contain more flowers per bud.

Lowbush blueberry plants spread by their rhizomes. The rhizomes give rise to additional roots and new crowns, which may develop to a size and

Figure 2. Blossoms of the lowbush blueberry, about 1/4 inch long.

shape similar to the parent crown. If separated from the parent plant, a piece of rhizome with well-developed roots is capable of continued independent growth. In moderately heavy sod, rhizomes grow an average of two to three inches a year. In areas with few competing plants, however, blueberry rhizomes have been found to grow as much as 15 inches in one season.

Typical lowbush blueberry flowers are shown in Figure 2. These need to be pollinated by insects, of which bumblebees, solitary bees, and introduced honeybees are the usual ones. Bumblebees and solitary bees work in colder weather than honeybees. In places where wild bees are scarce the introduction of colonies of honeybees usually insures a higher fruit set. In many areas a honeybee population of one hive per acre is considered necessary for adequate pollination. Honeybees are particularly useful when the pollinating season is cut short by rapid development of the flowers under warm weather conditions.

SOIL REQUIREMENTS

Lowbush blueberries occur throughout Eastern Canada, especially on light, well-drained soils. The pH of these soils is generally in the range of 4.0 to 5.5.

Although blueberry plants respond to applications of fertilizer, especially ammonium nitrogen, competing plants also respond vigorously. Under our present cultural methods, fertilizers are helpful only on soils of extremely low fertility, so it is well to make a test application. Apply a fertilizer to a small plot and evaluate its effects before applying it to the entire field. Under moderate fertility, fertilizers stimulate competing plants more than the blueberries. This makes picking more difficult and often reduces the fruit yield. Under extremely infertile conditions applications of fertilizer may stimulate grass growth with no reduction in crop yield. This is especially true in Newfoundland, where the additional grass is needed to carry a fire when burn-pruning.

DEVELOPING BLUEBERRY FIELDS

Abandoned farmland has the greatest potential for blueberry production since the land has been previously leveled and cleared of rocks. It is then easier to burn, dust, and harvest. Through cultivation, the woody

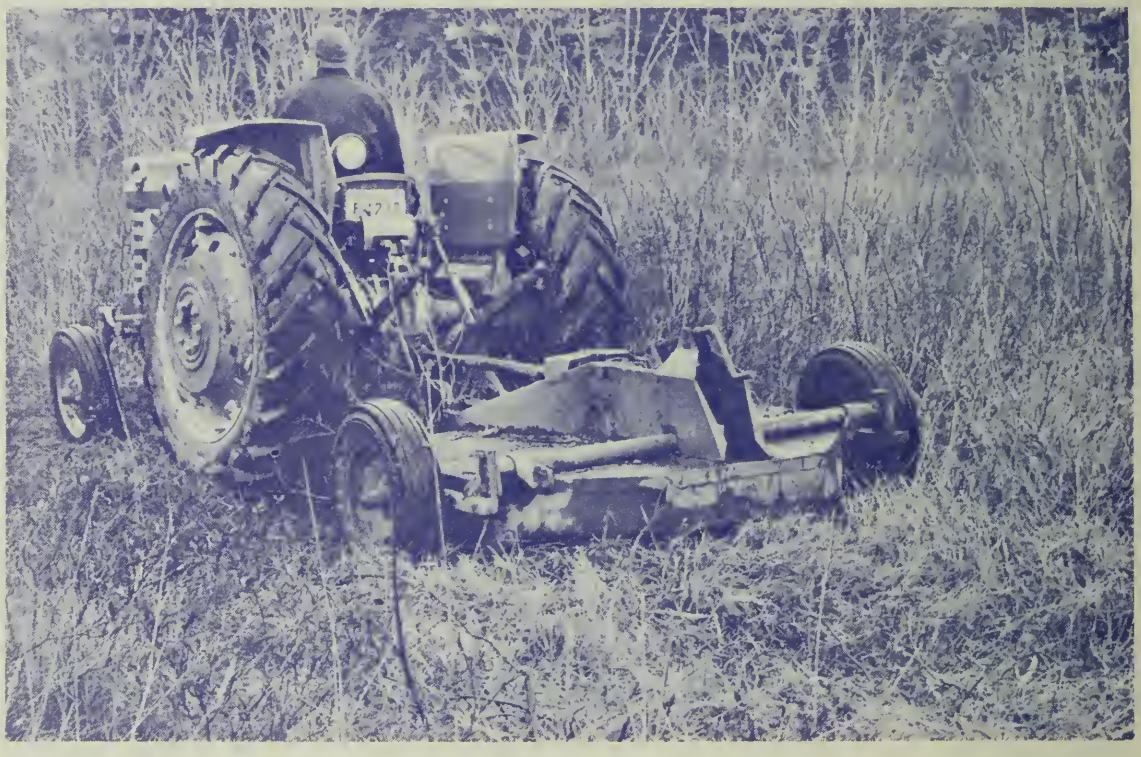

Figure 3. A rotary mower cutting brush in preparation for burning the field.

shrubs have been largely removed and the weed problem consists more of keeping out weeds than of controlling existing plants. However, many productive fields, especially in New Brunswick, have been developed from former woodlands. In either case, the procedure in developing the blueberry field is essentially the same.

First cut and remove any trees on the area. Haul the brush to a barren area, such as a rock pile, for burning. Do not burn brush in the field as the intense heat from such a fire will destroy underlying blueberry plants. Burn brush only when the fire hazard is low. Mow hardwood saplings with a rotary mower (Figure 3) before burning.

BURNING

Burning is essentially a pruning process. Old, highly branched bushes have few flower buds and they must be replaced by single shoots that are more productive. Burn the entire area (Figure 4) without leaving any "islands" because old plants provide refuge for insects and fungi.

Figure 4. Field after burning in the fall.

Burn in late fall or early spring. This burning induces the growth of new sprouts, many of which will have flower buds. No fruit will develop during the growing season following the burn. The fruit will develop the second season, and if the plants are not burned after this harvest, a smaller crop will develop during the third season after burning.

Divide your blueberry land into two sections and burn one half each year. Build a fire guard by plowing three or four furrows around the edge of the area intended for burning. If it is not possible to plow or bulldoze a strip, burn a swath with an oil or gas burner when the bushes are wet. Have some other workers on hand to take care of any emergency.

Three types of fuel are commonly used: straw, oil, and propane gas.

Straw

The average cost of straw burning is $20.00 to $30.00 an acre. This fuel is recommended for growers with a cheap supply of marsh hay or straw.

Scatter straw or marsh hay at three quarters to one ton per acre (Figure 5). Spread straw late in the fall after harvest (Figure 6) and burn

Figure 5. Spreading straw.

as early in the spring as possible. Late spring burning adversely affects the shoot growth and the fire hazard is greater then than in early spring.

Oil

Oil burning (Figure 7) costs $15.00 to $20.00 an acre and is the most satisfactory way to prune large acreages of blueberries, except where fields are extremely rough.

Set the burner so that it takes 40 to 50 gallons of stove or furnace oil to burn an acre. Have the fire just hot enough to kill the twigs.

Propane Gas

Propane gas burning (Figure 8) costs $12.00 to $15.00 an acre, and since it is slower than oil burning it is recommended for growers with small fields or acreage.

Adjust the burner so that it takes 200 to 250 pounds of propane to burn an acre.

Figure 6. A properly strawed field.

Figure 7. An oil burner.

Figure 8. A propane-gas burner.

Figure 9. Part of a blueberry field, showing cord used to make lanes for picking.

Figure 10. Gathering blueberries with a rake.

Figure 11. Harvesting blueberries: *A*, berries brought from the field in pails; *B*, weighing berries; *C*, cleaning by winnowing; *D*, berries ready for shipping in half-bushel boxes.

PICKING

Harvest the field when 90 percent of the berries are blue and you will get the most attractive pack of fruit. Green berries and foreign material are not acceptable to the trade. Their removal is time consuming and

increases the cost of production. Try to delay harvesting as long as possible, but do not delay too long in a season of cold weather as berries touched with frost are of little market value.

Divide each field with cord into lanes 6 to 8 feet wide (Figure 9). Assign a picker to each lane and instruct him or her to pick only within an allotted strip. Where possible, have the pickers with their backs to the sun. In such a position they are better able to see the fruit.

Lowbush blueberries are usually harvested with a rake (Figure 10). Pickers run the rake through the bushes in a forward and upward motion, catching the berries with the rake teeth. The berries collect in the bottom of the rake. After every two or three strokes, twigs and grass are removed by passing the bottom of the rake over the side of a hand, and the berries are poured over the back of the rake into a pail or other container. A full pail is carried to the end of the field, where the berries are weighed, cleaned, and emptied into shallow boxes for trucking to a central plant (Figure 11).

WEEDS AND THEIR CONTROL

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The lowbush blueberry is one of many plants forming a natural succession in the change from cleared land to forest. As blueberries begin to establish themselves, other weeds such as lambkill, hardhack, hay-scented fern, pearly everlasting (Figure 12), wild rose, birch, poplar, and chokeberry also appear. They all compete with the blueberry for space, light, moisture, and soil nutrients.

Since so many weeds thrive on the care given the blueberry field, they are hard to control. The various methods of weed control can be grouped into three general classes: mechanical methods, such as mowing or pulling; burning; and treatment with herbicides.

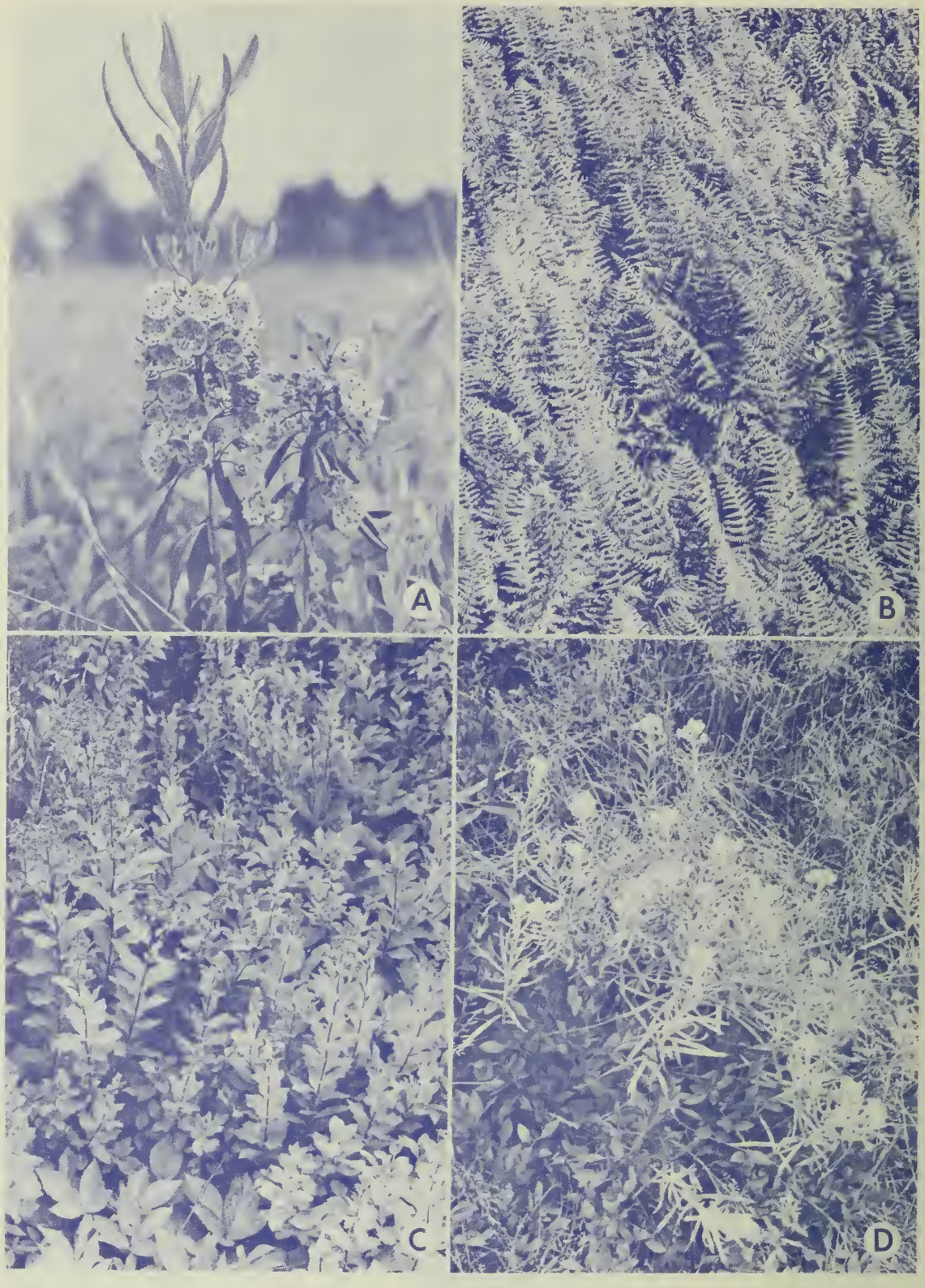

Figure 12. Some of the worst weeds found in blueberry fields: *A*, lambkill; *B*, hay-scented fern; *C*, hardhack; *D*, pearly everlasting.

Tests have shown that the annual cutting of weeds in midsummer can be expected to control bracken fern, hardhack, wild rose, hardwood saplings, and similar types of growth.

The value of burning for pruning and weed control has been mentioned in the previous section.

Chemical treatment is the most effective and acceptable method for the control of weeds in large fields. Three well-known herbicides are now recommended for use on certain weeds in blueberry fields. They are: 2,4-D; 2,4,5-T; and amitrole (amino triazole). When applied to the growing leaves these chemicals are taken into the plant and move in the plant sap to all parts, including the roots. When conditions are right, not only the tops but all living parts of any susceptible weed can be killed. Herbicides are usually obtained in the form of concentrated liquids and must be diluted with water or oil according to directions given on the container.

The best method of applying herbicides depends upon the size of the operation. The simplest one is the glove method (Figure 13). The leaves and stems of the weeds can be wiped with a woolen mitten soaked in weed

Figure 13. Applying herbicide with a glove.

killer. Carry the herbicide in a pail and wear a rubber glove beneath the mitten to prevent your skin from absorbing the chemical. This method is somewhat risky, time consuming, and suitable only for those wishing to treat a small area or for spot treatment of the few plants not killed by a more intensive but less costly method of control. Growers with moderate-sized holdings will find it more economical to use a knapsack sprayer supplied with pressure from a hand pump. The least expensive method of applying herbicide to fields is with a power sprayer, and growers with 20 acres or more find this method economical even though the initial cost is high. Two machines, the roller (Figure 14) and the revolving brush applicator, have been developed in the State of Maine for use on very large acreages and they have great possibility for use in Canada as well.

Herbicides should be applied to most weed species when the growth is active and leaves are green. Lambkill, one of the most difficult weeds to control, should be sprayed thoroughly with 2,4-D following berry harvest, when blueberry leaves have dropped but the lambkill leaves are still green. Be sure to burn early the next spring to prevent movement of the herbicide into the blueberry rhizomes.

The foliar spray of 2,4-D at 32 ounces acid equivalent in 100 gallons of water is recommended for lambkill, willow, alder, sweet fern, wire birch, and bayberry.

Apply the herbicide 2,4,5-T at the rate of 64 ounces of acid in 100 gallons of water for foliar treatment of rhodora, wild rose, poplar, hardhack, witherod, wild pear, chokeberry, and bush honeysuckle.

For stump or bark treatment use 2,4,5-T at the rate of 32 ounces of acid in 10 gallons of fuel oil. Apply it with a brush or a knapsack sprayer.

Bunchberry, pearly everlasting, and hay-scented fern are hard to control in established blueberry fields and they should be eradicated before production starts. The chemical amitrole is useful as a spot treatment. To treat an acre apply 5 pounds of the active ingredient in 50 gallons of water. After using amitrole do not harvest any berries nearby, because the crop must not contain any residue of this chemical. Consult your agricultural representative for further information.

For all classes of weeds, and for all strengths of weed killers used, a single treatment ordinarily will not give complete control. Generally, some clumps will require re-treatment to eliminate misses and survivors. Control of most weeds is a continuing problem.

Figure 14. Homemade machine for applying weed killer: top, a sprayer; bottom, the blanket-encased drum, which rolls over the vegetation.

When spraying, apply sufficient material to wet the leaves but not so much that it drips off. A fan type of nozzle usually provides the best spray coverage. Spraying pressures of 50 pounds per square inch are adequate.

Foliar sprays are most effective when applied in summer, when leaves are green.

Mixtures of 2,4-D and 2,4,5-T; in kerosene or fuel oil are recommended for stump treatments. Stumps can be treated a considerable time after cutting but best results are obtained when cut surfaces are treated as soon as possible.

INSECTS AND THEIR CONTROL

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Blueberry Maggot

The blueberry maggot (Figure 15) is the most important insect pest of lowbush blueberry in the Maritime Provinces. Although common to most blueberry areas in Maine and the Maritimes, it is not a problem in Quebec and apparently does not occur in Newfoundland. This insect commands attention not because of crop losses directly related to feeding damage, but because the presence of maggots makes any fresh, canned, or frozen fruit unacceptable for marketing.

The adult is a fly, slightly smaller than a house fly, with black bands across the wings and white lines on the abdomen. Adults emerge from early July to late August. Egg laying begins about 10 days after

Figure 15. Blueberry maggot: *A*, egg; *B*, full-grown maggots, side and top views; *C*, puparium.

emergence and some of the last flies to emerge are still laying when the crop is being harvested in late August or September. The flies prefer sheltered places such as rock walls, cradle hollows, and very weedy parts of the field. As a result, the infested fruit is often unevenly distributed in a field.

The egg is laid beneath the skin of the fruit. A few days later the maggot hatches, and feeds in the fruit for about two weeks. The maggot then drops to the ground, burrows into the soil and pupates. Most of the flies emerge the next year, but a few puparia remain in the soil for two or more years.

The blueberry maggot has no important natural enemies. Burning the fields every second or third year helps reduce the number of maggots, but in most areas insecticides are necessary. For maggot control, apply 50 percent calcium arsenate dust at the rate of 6 to 8 pounds per acre. Make two applications, the first when the blueberries are beginning to turn blue (about mid-July) and the second about two weeks later. If it rains within two days after either application, repeat the treatment.

Black Army Cutworm

There are several species of climbing cutworms that feed on blueberry foliage, but only the black army cutworm has caused extensive crop losses. In most years this species, like all the other cutworms, appears in low numbers, but periodically widespread outbreaks occur and the entire crop may be lost on hundreds of acres.

Cutworms spend the winter in the soil or surface debris as small caterpillars, and begin feeding in late April as the blueberry flower buds start to swell. At this time they feed mostly on the terminal buds, eating out the interior after entering through a small hole that they make in the side of the bud (Figure 16). As the growth of the buds proceeds, the contrast between injured and normal buds increases and infested areas become more easily detected. Foliage of blueberry and other plants growing in the same field may be completely stripped, and severely infested areas look as if they had been swept by fire. Feeding is usually done at night and the caterpillars rest in the surface debris during the day. During heavy outbreaks, however, food supplies may be rapidly depleted and the cutworms develop the marching habit and feed during the day and night.

Small caterpillars are velvety black, but when they are full grown (about 1½ inches long) they are brownish black on top and grayish beneath. Their sides are black with a white stripe. Feeding is continued

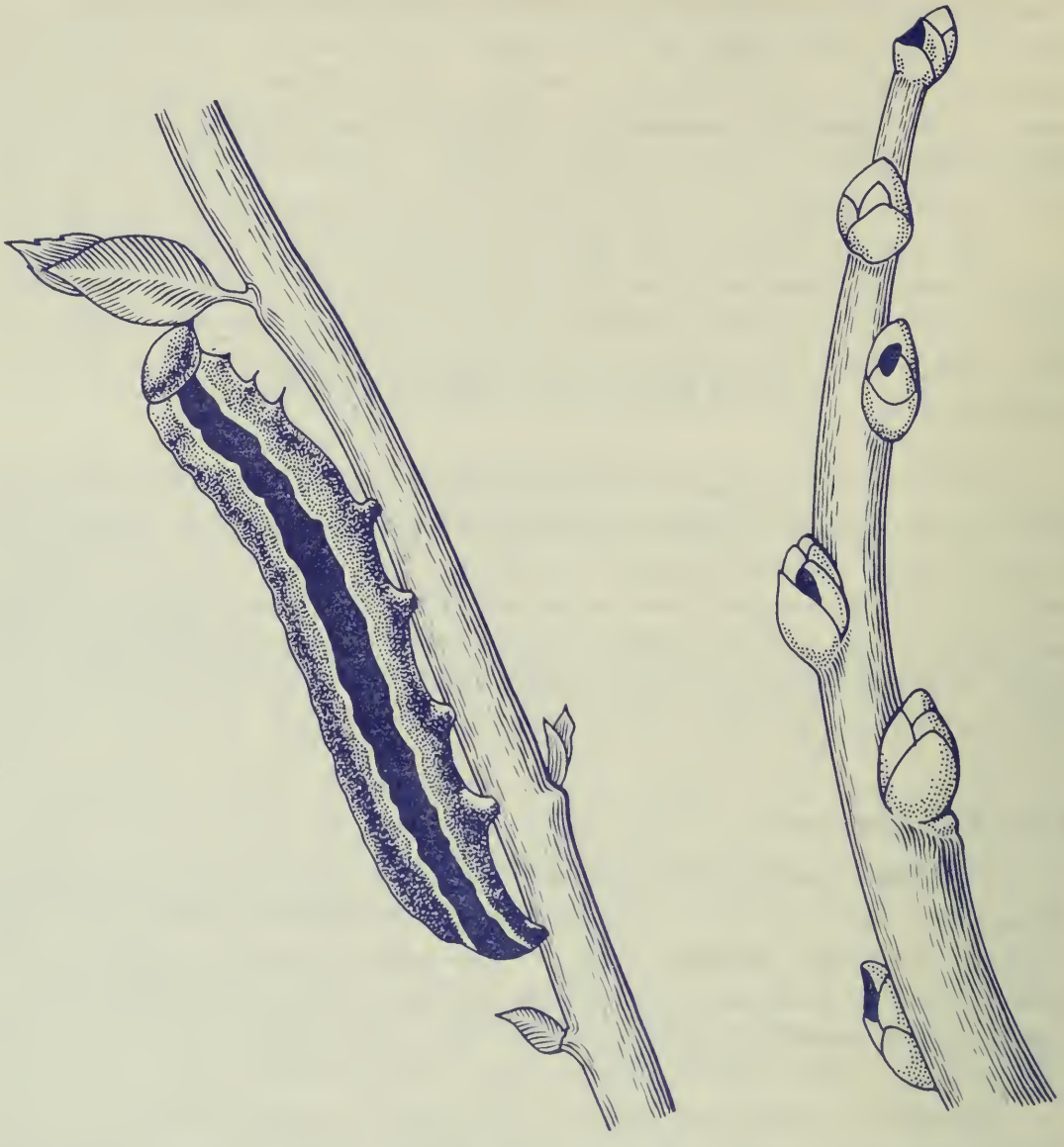

Figure 16. Left, the black army cutworm. Right, buds of the blueberry, showing hole through which the cutworm enters.

until early June and the cutworms pupate soon afterwards in the litter layer. The adult moths begin to emerge during the latter part of July and soon mate and lay their eggs. The new generation of cutworms hatches in October but the caterpillars do very little feeding until the following spring.

If the black army cutworm is a problem, apply 5 percent DDT dust at the rate of 20 pounds per acre. Apply the dust as soon as the cutworms become active in the spring. If it is hard to detect damage to the plants

by observation alone, you can soon tell if there are cutworms by sweeping the area at night with a stoutly made insect net. First-crop fields should be given foremost attention because they will harbor larger insect populations than fields that have been cropped once or more often.

Chain-spotted Geometer

The chain-spotted geometer is an occasional pest of blueberries, which in an outbreak may completely destroy the foliage and fruit. It also attacks many other plants such as sweet fern, rhodora, and hardhack, which are commonly found on blueberry lands.

The caterpillars are yellowish with prominent black spots along the sides, and when fully grown they are 1½ to 2 inches long. 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 on the foliage of blueberry and other plants, and spend the winter in the egg stage on fallen leaves. The moths may be distinguished by their smoky white, almost transparent wings, the outer edges of which are marked with faint lines and several distinct black spots.

Good control may be obtained by applying 5 percent DDT dust at 20 pounds per acre as soon as the caterpillars are discovered.

Blueberry Flea Beetle

The blueberry flea beetle usually causes damage in localized areas, although occasionally the damage is widespread.

The immature stage of this beetle is a black grub about 3/8 inch long when full grown. Soon after the blueberry plants begin to develop in the spring, the grubs hatch from overwintered eggs and begin feeding on the foliage. The grubs feed until late June, enter the pupal or resting stage for about two weeks, and then emerge as adults and continue feeding. The adult beetle is roundish, shiny coppery bronze, and less than ¼ inch long. Like all flea beetles, it jumps suddenly when disturbed. Eggs are laid in late July and August and do not hatch until the following spring.

Good control may be obtained by applying 5 percent DDT dust at the rate of 20 pounds per acre as soon as the grubs appear in the spring. The adults are also kept under control by the application of calcium arsenate dust for maggot control in mid-July.

Blueberry Casebearer

The blueberry casebearer has recently become an important pest of lowbush blueberry. Although serious damage is still limited to Cumberland County, Nova Scotia, this species is present in most blueberry areas and more evidence of damage can be expected in the future.

The insect overwinters as an adult beetle and emerges during late April or May. Eggs are laid about the middle of June and the larvae hatch in about ten days. The eggs are laid in a dark-brown or blackish bell-shaped case of excreta and are attached to a leaf or stem by a short stalk. The larva hatches within the case and breaks it off from the stalk. The larva feeds and moves about with its abdomen curved upward and enclosed within the case (Figure 17). The case is gradually enlarged by the addition of more excreta and at the time of pupation it is about ¼ inch long and resembles the burned head of a wooden match. The larvae feed mainly on the leaves but also to some extent on the fruits and stems. Pupation takes place within the case, which is sealed over and attached to the main stem of the blueberry plant or one of its branches.

The adults emerge in late August or early September and they feed on the bark of the blueberry shoots until November. On many shoots only one

Figure 17. Larvae of the blueberry casebearer.

or two areas of bark on the bottom two inches is chewed off, but other twigs may have a dozen or more such areas. Extensive girdling will kill the shoot back to ground level. Fortunately, new growth will arise from underground rhizomes after the stand is burned, but repeated feeding could cause permanent damage.

To control this insect, apply 5 percent carbaryl at the rate of 20 pounds per acre at the beginning of the larval feeding period (late June). Carbaryl is poisonous to bees, so honeybee colonies must be removed from the field before dusting is carried out. The adults are harder to kill than the larvae because they feed at the base of the stems rather than on the foliage, but some control is possible by dusting with carbaryl during the fall.

Blueberry Thrips

Thrips-infested leaves do not unfold normally and they turn reddish. In sprout fields the leaves are generally wrapped around the stem of the plant, while in crop fields one or more leaf rolls are formed (Figure 18). In most fields infestations are spotty, but in others the thrips become major pests and may reduce yields by more than 50 percent.

Figure 18. Blueberry shoots showing: left, severe leaf roll, and center, terminal leaf roll, caused by thrips; right, a normal shoot.

Two species of thrips have been identified and a third species appears to be involved in the complex. The life histories of these species and the type of injury they cause are similar. The adults overwinter in the soil and emerge during late April or May. Only the females survive the winter and they lay eggs in the developing leaf tissue in late May or June. All stages in the life cycle of the thrips are passed within the curled leaves. The next generation of adults appear in July and August and the insects soon leave the plant. The adult is yellowish gray and only about 1/16 inch long.

Control blueberry thrips during the sprout year because it is then that the greatest damage is done. Infested sprouts bear little, if any, fruit during the following crop year. Treat infested sprout areas with 2½ percent dieldrin dust at 20 pounds per acre when the sprouts are breaking through the soil. In heavily infested fields a similar application may be advisable on crop fields at the time when the blossom buds are separating in the clusters.

Other Blueberry Insects

The following species of insects may cause damage to blueberries but in general they are only of minor importance.

The blueberry tipworm causes a rolling of the terminal leaves of infested plants. The injury caused by the tipworm is similar to that of blueberry thrips, but the leaf rolls are usually not as tightly folded as those injured by thrips and the reddening of the foliage is less pronounced. The tipworm is most often found on velvet-leaf blueberry, whereas thrips prefer the common lowbush blueberry. If one or more small maggots are found on injured foliage there is little doubt that the injury has been caused by the tipworm. Occasionally, however, both the tipworm and the thrips may inhabit the same leaf roll.

In some years sawfly larvae are fairly abundant in blueberry fields but their feeding does not seriously affect the crop. Of 19 species of sawflies that were collected in one field by sweeping, only three species fed on blueberry; the others were species that feed on other plants growing in blueberry fields. The larvae of those species that feed on blueberry are normally green but sometimes pink specimens may be found. Full-grown larvae are about ¼ inch long. The peak of the feeding period is late May and early June.

A leaf roller often infests sprout fields. Damage occurs from late August to October when the small brown caterpillars fasten two or more

leaves together with a silken web and skeletonize them from within the enclosure. Feeding is confined to leaves that would normally be shed within a short time, so their effect on the plant is not serious.

Stem galls are found on a few plants in most fields. Populations of the insect causing these are very low, however, and this insect is not considered important.

DISEASES AND THEIR CONTROL

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The lowbush blueberry is not susceptible to many widespread or destructive diseases, possibly because it is a native plant growing in its natural habitat. Control measures for any specific disease are generally applied only in areas where disease outbreaks occur or in fields that have a history of a particularly troublesome disease. Blueberry growers should become familiar with the common diseases.

Monilinia Blight

Monilinia blight is an important disease of the blueberry caused by a fungus that attacks the twigs, blossoms, leaves, and fruit. Diseased leaves (Figure 19) have water-soaked or dark-brown areas along the midvein. A grayish-green mold develops on the affected areas and the twigs wilt. This mold produces spores that attack the blossoms. Affected blossoms turn brown and cling to the twigs. The fungus also attacks the young fruit, turning it into a mass of fungus tissue called a mummy berry. Mummy berries drop to the ground and overwinter there. In the spring apothecia grow out of the mummy berries. These cup-shaped bodies (Figure 19, inset) produce spores, which infect blueberry twigs.

This disease is more serious in wet weather and in coastal areas where fog is prevalent. If rainfall is below average there may not be enough moisture for blight to develop, so the plants escape with little infection.

Monilinia blight on the lowbush blueberry can be satisfactorily controlled by dusting with 7 percent ferbam or 3.9 percent zineb at 15 pounds per acre. The first application should be made at either leaf or flower bud

Figure 19. Leaves infected by monilinia blight. Inset, apothecium on a mummy berry.

break and repeated at 7- to 10-day intervals until the end of the bloom period. Three applications usually give satisfactory control. If continuous wet weather occurs, however, four or five applications may be required.

Apply ferbam or zineb dusts when blueberries are wet with dew or rain. Applications of ferbam or zineb are not to be made after the blueberries begin to form.

The practice of burning lowbush blueberries every other year aids in controlling the blight by destroying mummy berries, dead twigs, and plant debris.

Botrytis Blight

Botrytis blight is caused by a fungus that also attacks the twigs, leaves, blossoms, and fruit. It can be as destructive as monilinia blight. The symptoms of the two diseases are similar. Leaves infected by *Botrytis* are light brown and they become covered with a gray mold (Figure 20). Spores produced by the mold attack the blossoms and cause them to turn brown (Figure 21). The fungus attacks the young fruit and causes a soft rot. It overwinters on plant debris and continues producing its typical gray mold stage throughout the growing season. Weather conditions favorable for outbreaks of *Botrytis* are the same as those for monilinia blight.

To control botrytis blight, dust with ferbam or zineb.

Figure 20. Leaves infected by botrytis blight.

Figure 21. Blossoms infected by botrytis blight.

Figure 22. Leaves infected by red leaf disease.

Red Leaf

Red leaf, a systemic disease of lowbush blueberries, is also caused by a fungus. It appears in patches in blueberry fields throughout Canada from Newfoundland to British Columbia. Red leaf is most conspicuous during June and early July, when the plants exhibit pronounced red to pink foliage (Figure 22). During late June and early July a white, feltlike spore-producing layer of the fungus forms on the under surface of the reddened leaves. By midsummer the affected leaves drop and the crop on these plants is usually very small. Occasionally, red leaf is found in late summer or early fall, especially on sprouts. Red leaf disease spreads by air-borne spores and also by mycelium through rhizomes of affected plants.

Eradication of diseased plants is the only way to control red leaf. Spot-spray diseased areas with a mixture of 2,4-D and 2,4,5-T in water, at the standard rate for weed control.

Burning does not control red leaf once the fungus has invaded the rhizome. Fungicides prevent the spread of red leaf by spores but they are ineffective against the spread of the fungus through rhizomes.

Figure 23. Plant infected by witches'-broom.

Witches'-broom

Witches'-broom is caused by a rust fungus. It is of minor importance except in the northeastern counties of Nova Scotia, where up to 10 percent of the plants in some fields have been found infected. Elsewhere, most fields show less than 2 percent infection.

The fungus stimulates the production of multiple shoots and a broom-like mass of swollen shoots is formed (Figure 23). In the spring, spores produced on these shoots are carried by wind to the balsam fir, where they infect the needles of the current year's growth. Another type of spore produced in small pustules on fir needles infects the blueberry and causes shoots to swell. The fungus growth is perennial in the blueberry and the symptoms persist until the plant dies.

Remove balsam fir trees from the vicinity of blueberry fields to reduce the incidence of witches'-broom. Burning the blueberries does not give control because infections become established in the crowns of the plants.

Figure 24. Twigs infected by dieback.

Dieback

Dieback is caused by one or more weak parasitic fungi that attack blueberry shoot tips after they have fruited or have been exposed to winter injury. The disease is seldom serious except in fields held over for a second crop. The tops of affected shoots become light to dark brown as the dieback or canker progresses down the stem (Figure 24). The affected shoots are very prominent in the second-crop year. On vigorous shoots the dieback stops above fruiting twigs of the current year, but on less vigorous shoots the disease progresses farther down the main shoot and kills new fruiting twigs.

When dieback becomes troublesome in a lowbush blueberry field, burn the field in alternate years.

Powdery Mildew

In hot and dry seasons powdery mildew can cause reddening of the leaves and defoliation in August or early September. Reddish areas appear on the leaves where the fungus has invaded, usually on the upper surface of the leaves but sometimes on the under surface. The fungus is usually not visible without the aid of a hand lens. The leaves turn red before

falling and they can be readily distinguished from those infected with red leaf disease by the lack of a white mat on their lower surfaces.

Powdery mildew is seldom serious enough to warrant control measures.

Leaf Rust

Leaf rust is a disease caused by a rust fungus, which passes part of its life cycle on hemlock and part on lowbush blueberry. Leaf rust causes little damage. Affected blueberry leaves show light-green areas on the upper surfaces in September. On the under surface of these light-green areas, rust-colored pustules of spores develop in September or later. Partial or complete defoliation occurs after harvest time, when rust is abundant. Hemlock is the alternate host of the rust.

Septoria Leaf Spot

Septoria leaf spot, caused by a fungus, is of minor importance on the blueberry. Irregular brown spots with white centers appear on affected leaves in August (Figure 25). Small, black, raised dots, the spore-producing structures of the fungus, are scattered over the surface of the spots, and

Figure 25. Leaves infected by septoria leaf spot.

Figure 26. Blotch on blueberry leaves.

Figure 27. Flecking of blueberry leaves.

Figure 28. Ring spot on blueberry leaves.

Figure 29. Pinpoint spots on leaves.

when the disease is severe, defoliation occurs, mainly in scattered patches throughout the blueberry field.

Septoria leaf spot is seldom serious enough to warrant control measures.

Gloeosporium Leaf Spot

Gloeosporium leaf spot is also caused by a fungus, which produces a circular, brown to black spot with white growth of the fungus appearing in its lower surface. The disease is rarely found on the lowbush blueberry.

Other Leaf Spots

Leaf spotting of unknown cause occurs on lowbush blueberries during midsummer and is more severe in crop years. The spotting occasionally appears in the sprout year during prolonged dry weather or where blueberries are grown on light sandy or gravelly soils. Unshaded leaves show more injury than those in the shade. Four different types are found on affected blueberry leaves, and two or more types sometimes occur on the same leaf.

Figure 30. Leaves injured by arsenical dust.

Blotch appears as circular brown spots, which are scattered over the upper surfaces of the leaves (Figure 26). Symptoms are more pronounced on leaves on the top or exposed branches than on those on the lower or shaded branches.

Flecking appears as irregular grayish-brown flecks, which sometimes form a faint ring with a green area in the center of the spot (Figure 27).

Ring spot appears as a circular green area with a brown circular to slightly irregular border (Figure 28). The spots are 1/8 to 1/4 inch in diameter.

Pinpoint spots are reddish to dark-brown areas about 1/16 inch in diameter (Figure 29). There is no known control for leaf spotting.

Arsenical Injury

Arsenical injury (Figure 30) appears either as brownish leaf spots with dark centers and red margins, or as a marginal burning of the foliage. Since bracken ferns are particularly sensitive to arsenic, suspected cases of arsenical injury can often be verified by examining this weed for leaf burn.

SCIENTIFIC NAMES

INSECT PESTS

Blueberry maggot	*Rhagoletis mendax* Cn.
Black army cutworm	*Actebia fennica* (Tausch.)
Chain-spotted geometer	*Cingilia catenaria* (Drury)
Blueberry flea beetle	*Altica sylvia* Mall.
Blueberry casebearer	*Chlamisus cribripennis* (Leconte)
Blueberry thrips	*Frankliniella vaccinii* Morgan
	Taeniothrips vaccinophilus Hood
Blueberry tipworm	*Contarinia vaccinii* Felt
Sawflies	*Neopareophora litura* (Klug)
	Pristiphora idiota (Nort.)
	Pristiphora sp.
Leafroller	*Aroga trialbamaculella* (Chamb.)
Stem galler	*Hemadas nubilipennis* (Ashm.)

DISEASES

Monilinia blight	*Monilinia vaccinii-corymbosi* (Reade) Honey
Botrytis blight	*Botrytis cinerea* Pers.
Red leaf	*Exobasidium vaccinii* Wor.
Witches'-broom	*Pucciniastrum goeppertianum* (Kühn.) Kleb.
Dieback	*Diaporthe vaccinii* Shear
Powdery mildew	*Microsphaera penicillata* (Wallr. ex Fr.) Lev. var. *vaccinii* (Schw.) W.B. Cke.
Leaf rust	*Pucciniastrum vaccinii* (Wint.) Jørstad
Leaf spot	*Septoria* sp.

WEEDS

Hay-scented fern	*Dennstaedtia punctilobula* (Michx.) Moore
Bracken fern	*Pteridium aquilinum* var. *latiusculum* (Desv.) Underw.

Willow	*Salix* sp.
Trembling aspen or poplar	*Populus tremuloides* Michx.
Bayberry	*Myrica pensylvanica* Loisel.
Sweet fern	*Comptonia peregrina* (L.) Coult.
Wire birch	*Betula populifolia* Marsh.
Alder	*Alnus rugosa* (Du Roi) Spreng.
Hardhack	*Spiraea latifolia* (Ait.) Borkh.
	Spiraea tomentosa L.
Black chokeberry	*Pyrus melanocarpa* (Michx.) Willd.
Wild pear	*Amelanchier laevis* Wieg.
Wild rose	*Rosa carolina* L.
Bunchberry	*Cornus canadensis* L.
Rhodora	*Rhododendron canadense* (L.) Torr.
Lambkill	*Kalmia angustifolia* L.
Bush honeysuckle	*Diervilla lonicera* Mill.
Witherod	*Viburnum cassinoides* L.
Pearly everlasting	*Anaphalis margaritacea* (L.) C.B. Clarke

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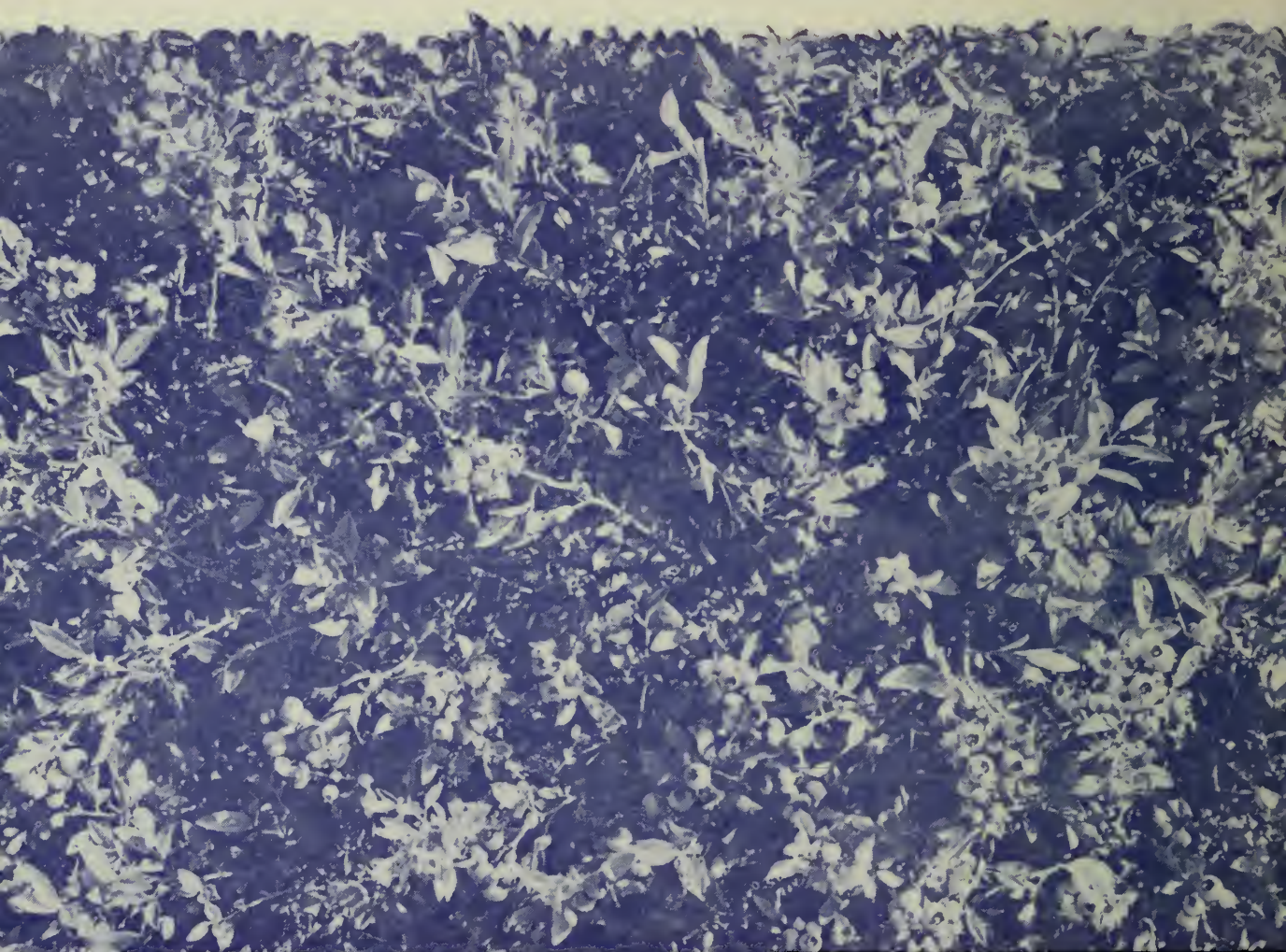

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