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THE CRANBERRY

CRANBERRY CULTURE

By E. L. EATON

CRANBERRY DISEASES

By K. A. HARRISON

CRANBERRY INSECTS

By C. W. MAXWELL and A. D. PICKETT



Published by the Authority of
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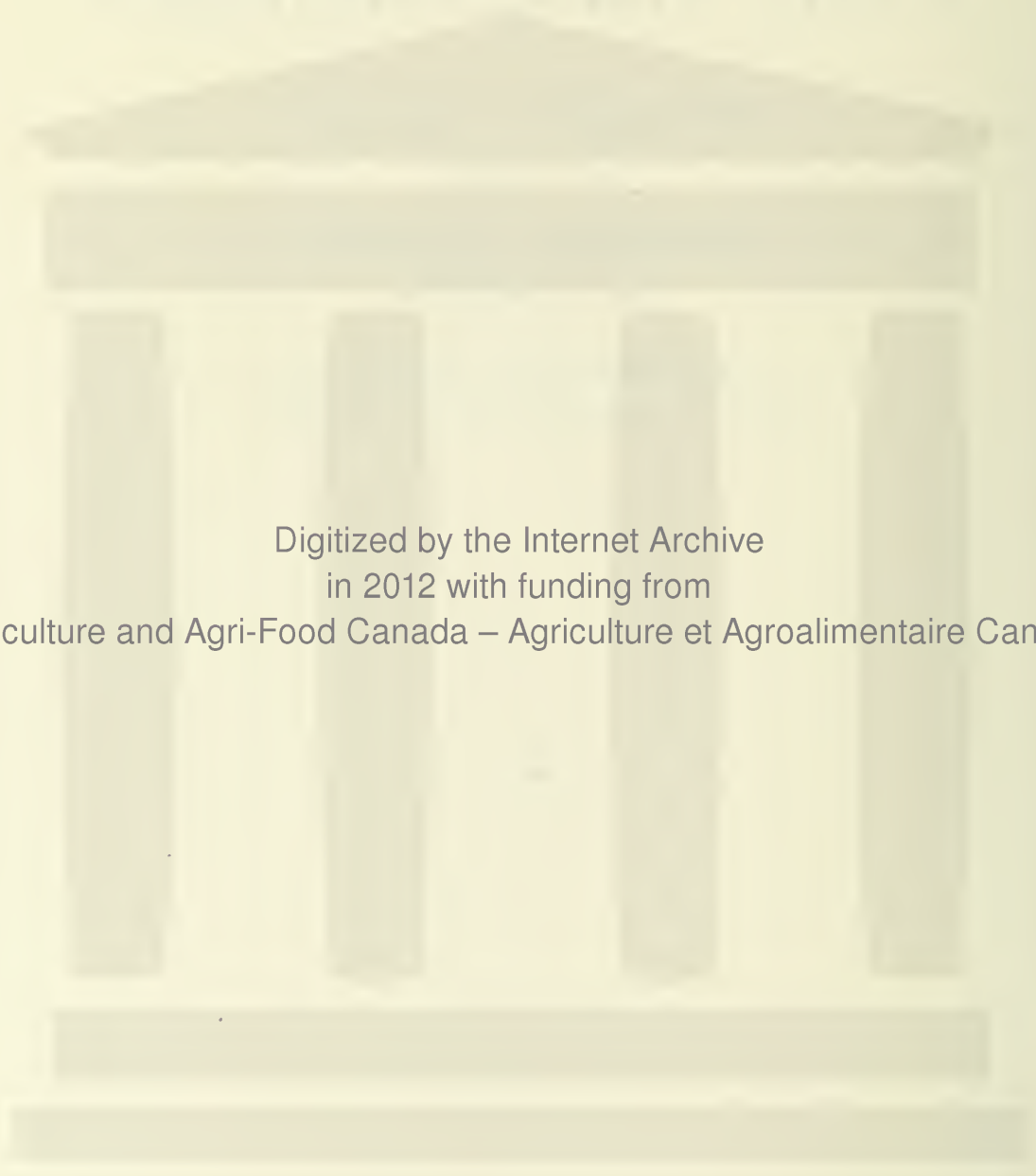
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Fig. 1—A well kept bog showing arrangement of ditches. Note how free the ditches are of weeds

CRANBERRY CULTURE

By

E. L. Eaton¹

MARKET POSSIBILITIES OF THE CRANBERRY

THE culture of cranberries, although still a minor industry in Canada, can be developed with profit much more widely than at present. A comparatively few bogs have been built in Nova Scotia, New Brunswick, Prince Edward Island, Quebec and British Columbia, but there are many more acres of unused land suitable for the production of this valuable crop, in the provinces named and doubtless elsewhere.

Most of the cranberries sold in Canada are imported from the United States. In 1946 this amounted to 1,972,010 pounds, valued at \$530,539. As most of these originate on Cape Cod, the freight haul is little, if any, more for a Canadian producer who desires to sell in the western markets.

For a large share of the consuming public this beautiful, tasty and vitamin-rich fruit is known only as a relish with fowl or meat on rare festive occasions. For the favoured few who have access to a full winter's supply, no more popular fruit exists for pies, tarts, jelly, juice or preserves, alone or blended with less distinctive fruits, such as apples, pears or peaches.

It would appear, therefore, that Canada offers an excellent opportunity for a great expansion in the cranberry industry, particularly as the recent population increases in both this country and the United States are largely urban and therefore potential buyers, not producers, of foods. This is further emphasized by the fact that this is one of the few products for which the demand has consistently outstripped the supply.

In the period just prior to World War II small shipments of American cranberries were made to Europe where they are said to have met a ready sale. When normal trade relations are resumed, this overseas market offers another prospective outlet, so the long-term outlook for the industry is distinctly bright.

THE CRANBERRY ITSELF

To most people the word "cranberry" suggests two types, the "high-bush" and the "low-bush" species. The so-called "high-bush" cranberry is botanically known as *Viburnum trilobum* Marsh, of which the well-known snowball, so often used as an ornamental shrub, is a cultivated species. Fruit of the *Viburnum* is often used as a substitute for the common cranberry, but the latter commands a more ready market and is the subject of this bulletin.

The ordinary cranberry, sometimes referred to as the "low-bush" cranberry, has usually been classed in the genus *Vaccinium*², of which three common species are native to this country.

Vaccinium macrocarpon Ait., is the large cranberry of commerce, sometimes referred to as bog cranberry.

¹ Horticulturist, (Native Fruits).

² "Gray's Manual of Botany"

Vaccinium Oxycoccus Linn. is the small, often mottled one, sometimes called spiceberry or buckberry; the leaves, runners and fruit are all much smaller than those of the first-named.

The other common member of the group, *Vaccinium Vitis-Idaea* var *minus* Lodd, known variously as partridge berry, fox berry, mountain cranberry, rock cranberry or lingon berry, is abundant in the more exposed coastal regions, and is also found on moss-covered rocks and in old pastures. This species makes fewer runners, the fruit is highly coloured but is softer and earlier than the large cranberry, and, in favourable places, grows with a profusion that appears to carpet the ground in crimson. J. M. Macoun writes,

“Along the Gaspé Coast and the north shore of the Gulf of St. Lawrence, the fishermen’s families gather this fruit in large quantities for their own use and for sale, calling it the “low-bush” cranberry; and throughout the whole of northern Canada, hunters and trappers, as well as native Indians, have frequently to depend upon it for food when game and fish are scarce. Deemed of no value in the warmer parts of Canada, and pronounced by Gray to be acid and bitter and scarcely edible, it seems when in its home in the cold rocky woods of the north, or along the shores of Hudson Bay or the Arctic Ocean, to derive a size and flavour from the very conditions that dwarf or kill its less hardy competitors.”

The foxberry is often shipped to market in kegs filled with water. There is no record of its having been cultivated successfully and some attempts at transplanting to the usual bogs have failed.

Another classification* places this group in a separate genus and accepts the name *Oxycoccus macrocarpus* (Ait.) Pers. for the large cranberry and *Oxycoccus quadripetalus* Gilib. Fl. Lithuan. for the small, speckled cranberry.

As in most wild plants, there are many variations, and intermediate types appear. It is believed that a study of their genetic background may help to clarify a somewhat confused situation.

* Porsild in The Canadian Field Naturalist, Nov. 1938.

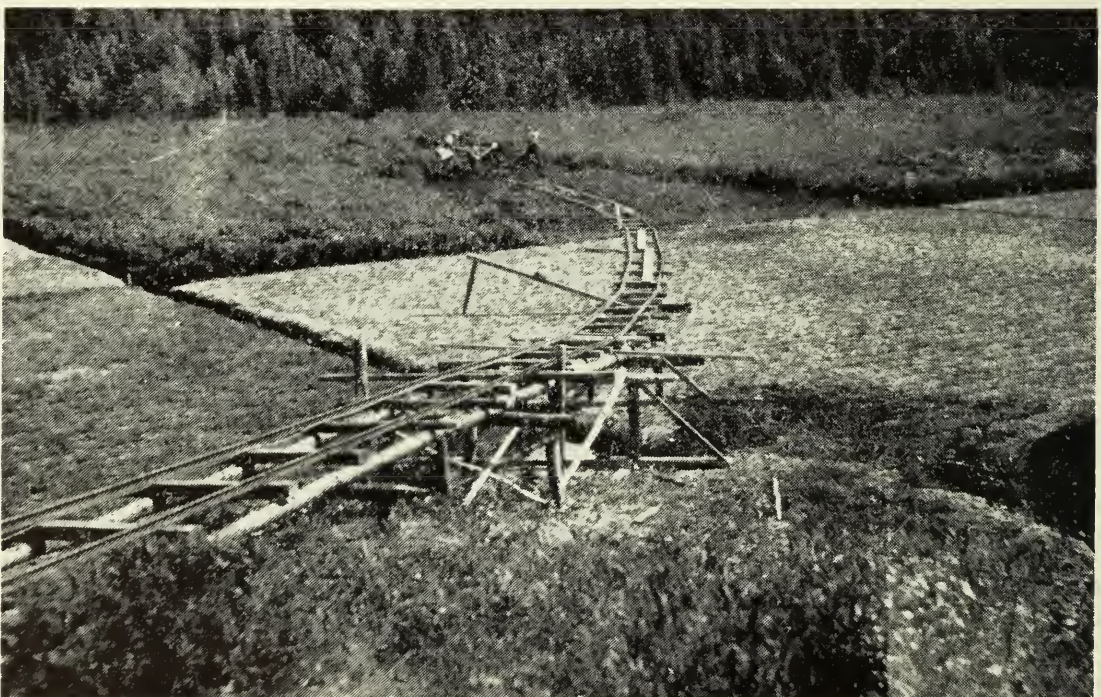


Fig. 2—Turving new section of bog. Note portable track along which car is hauled by cable to carry material ashore. (Courtesy of J. E. Adams.)

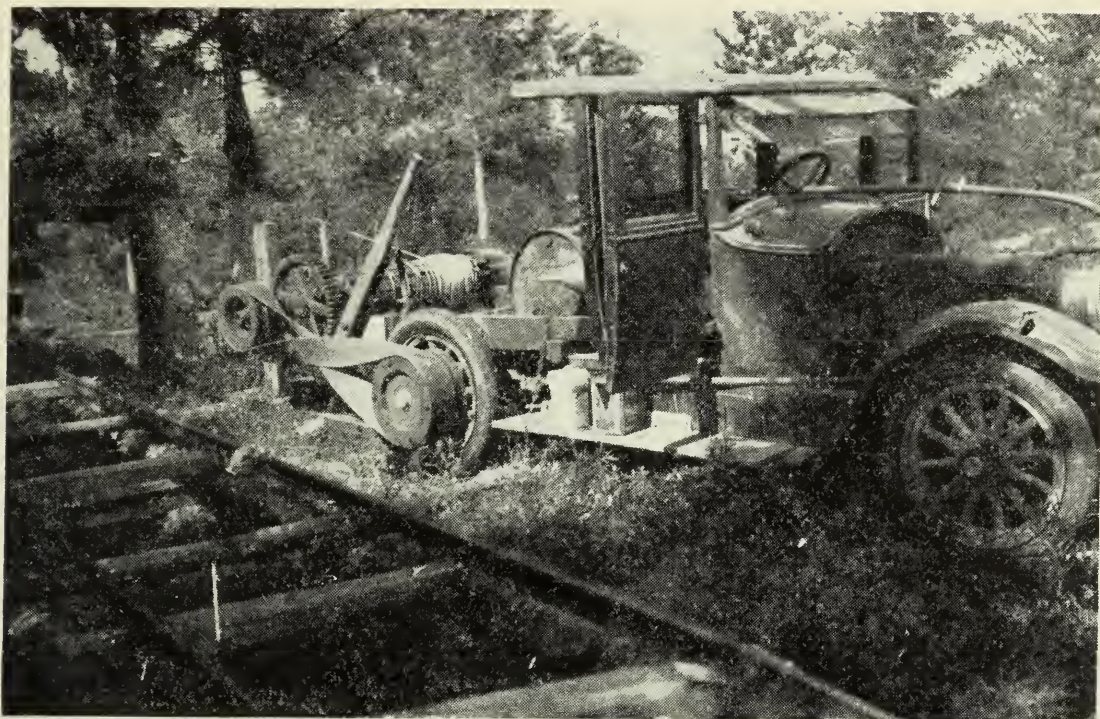


Fig. 3—Winch made from old truck, placed on high ground, cable on drum hauls car up portable track to remove top material from bog. (Courtesy of J. E. Adams).

Cranberries are widely distributed in the North Temperate and Sub-Arctic zones of America, Europe and Asia, the relative prevalence of the different species depending on the soil, temperature and winter protection.

SELECTION OF THE CRANBERRY SITE

The location of the prospective cranberry bog is the first important consideration. Cranberry sites may be roughly divided into two classes, low and high bogs. The former, year in and year out, is the more productive.

THE LOW BOG

The low bog, as its name implies, is situated on low ground where it can be flooded, and, if well chosen, is the ideal place for cranberry culture.

There are four essentials to consider for a profitable cranberry bog; soil, location and quality of sand, drainage, and water supply.

Soil.—Cultivated cranberries do best under conditions closely approaching those under which they grow in the wild state. They prefer low, moist or swampy soil of a muck or peat formation. A few inches of peat or muck will suffice, and many good bogs are underlain with blue clay or sand. Other bogs thrive on sand or clay with little or no muck, but these may require more fertilizer to supply the plant food otherwise provided by the decaying organic matter. Meadow land under good cultivation is rarely used for cranberries as it is likely to be weedy; other land, unsuitable for general farm purposes, is satisfactory for cranberries.

Sphagnum moss bogs are undesirable. There are many of these in Canada, often of a considerable depth, which should not be mistaken for peat.

The cranberry plant prefers an acid soil, and the numerous alkaline peat and muck bogs are unsuitable for cranberries. A pH of 4.0 to 5.5 is favoured.

Sand.—Sand is of primary importance in cranberry production. No matter how good the soil or the location, profitable crops can seldom be grown without repeated applications of sand. An ample supply within reasonable distance is therefore a requisite. Although coarse sand or gravel is preferred, fine sand is also suitable if it is clean, gritty and free from clay or loam. The cranberry is a water-tolerant plant, but a few inches of well-aerated top-soil is needed for best growth. A further useful purpose served by the sand is in checking moss and preventing mild frosts. Heat from the sun is absorbed by the coarse sand and is later given off. As sanding will be repeated at frequent intervals, the nearer the pit is located the cheaper this laborious operation will be.

Drainage.—Another important point to be considered is drainage. The bog should lie so that excess water can be carried off rapidly in the early spring, giving the plants time to blossom and mature fruit. The water from surrounding high land is likely to flow into the bog, so the outlet should be large enough to carry this away without delay and damage. The ditches through the bog need to be close enough and deep enough to lower the water-table a foot or more from the surface. This will usually mean ditches from two to three feet deep. It should be remembered that if the top soil of the bog is to be removed, the ditches will be that much shallower as a result, and the natural decay and settling of any newly drained land also lowers the bog surface. The permanent culverts and spillways



Fig. 4—Border ditch with levelled and sanded bog ready for planting at left.



**Fig. 5—Main ditch with dam gate and partly constructed dyke in background—
Lemieux, Quebec.**



Fig. 6—Levelling bog with roller scraper.

should all be set considerably deeper than appears necessary at the time, in order to provide for future deepening of the ditches, as it is cheaper to dig a little deeper at first than to rebuild the whole structure later.

Water Supply.—A bog with an unlimited water supply offers the best insurance against frost, drought and many insects. If the reservoir is higher than the bog, a system of sluices will permit flooding at any time. If the reservoir is

lower than the bog, as is the case in many sites, low-lift pumps are available at moderate cost, which can raise the water rapidly from six to twelve feet or even higher. Flowing by gravity is cheaper, but if this cannot be arranged, the bog should be planned as near the reservoir level as possible so that pumping costs will be minimized. The capacity of pumping outfits is discussed in another paragraph.

Sprinkler systems are now being installed on many bogs which cannot be flooded. These are used where the water supply is too small for flooding. Somewhat more costly to install, they have the advantage of checking the frost the moment the water is turned on, and picking can be resumed more quickly after danger has passed. Some growers believe berries are firmer and hold longer in storage if they are not immersed in water at any time.

THE HIGH OR DRY LAND BOG

Being native along the Atlantic seaboard, the cranberry is frequently found on dry soils near enough to the sea or inland bodies of water so that low summer temperatures retard evaporation and permit the maturing of moderate yields of fruit. Many of these natural areas are never flooded at any time of the year but are nevertheless, a valued source of income. Since the vines have appeared naturally, complete neglect is too often their fate, and briers, laurel, hardhack, alders and other shrubs and trees sooner or later take possession. The few natural bogs of this sort that receive proper care are highly productive. Development costs are low, as turfing can be cheaply done by a bulldozer or highway grader and sand can be hauled by truck at most seasons of the year. In many places the machine can start at the centre and push the turf to each of the four sides, thus making a dyke to hold a partial winter flood. Re-sanding and weeding are just as important on this as on the low bog. Vine growth is usually slower and yields are lower.

The cranberry fruitworm is usually a serious pest under these conditions, but it can be kept in check by using some of the newer insecticides.

PREPARATION OF BOG LAND

Having selected the best available site, the first step is to ditch or drain the bog. If there is any uncertainty about the levels or the outlet these should be checked by means of a drainage level. If this instrument is not available a reasonably accurate job may be done with an ordinary carpenter's level clamped to a ten-foot, straight-edged board. A marginal ditch, dug around the outside of the whole area and opening into the outlet, cares for the accumulated water and any that may come from the higher land. This also serves as a barrier for weeds and insects that may later seek to invade the bog. The material from this ditch is thrown to the outside and may form a part of the final border dyke. Any needed cross-ditches are then opened, serving as lateral feeders into the main outlet. The distance between these will depend on the amount of water to be removed, and they will later serve a second purpose in distributing the flood water quickly and evenly.

Drainage is followed by clearing off the trees, stumps and other trash, all of which may be piled and burned. The top sod is then removed, the most costly part of bog construction. Most of the older bogs have been turfed by hand and the turf carried ashore in wheelbarrows run on plank strips. If the land will carry a horse, the turf is sometimes cut with a large revolving disk set in a heavy frame or with a sharp stiff colter fastened to a plough beam. These long strips are then cut into smaller pieces and loaded. On some of the newer bogs turfing has been done by setting an engine and a winch on the edge of the bog, with a large hook or claw fastened to the end of a wire cable. This claw rips out large shrubs and

pieces of turf which are pulled, either directly or on trolleys, to the edge of the bog. The steel cable, passing through a block anchored to the opposite bank, draws the hook back by reversing the winch. In other cases tractors with broad wheels or caterpillar tread may be used.

Chemical weed killers are now being used more widely to kill the vegetation and avoid much of the heavy labour costs for turfing. Where it is difficult to lower the outlet for proper drainage, this method helps by leaving the land somewhat higher than if the whole top layer were removed. Ammonium sulphamate, dissolved in water at the rate of 75 pounds to 100 gallons of water, and sprayed or sprinkled at 200 to 400 gallons per acre will destroy most growing plants. The soil is ready for planting the following year.

DYKING

Dykes are built around the borders, outside the marginal ditch and, if the bog is large, cross-dykes are added to permit flooding in sections. It is highly convenient for later work around the bog if these dykes are wide enough to serve as roads. Before the dyke is started, a trench or key is cut in the bottom, lengthwise of the ditch, down to the sand, clay or hardpan, to prevent the escape of water, and filled with earth, sand or clay. The turf removed from the surface of the bog may be used to face the dykes. If the dyke is built wider on the base than on top, with both edges sloping, the soil is less likely to wash down into the ditch. At this time the flumes or spillways, which allow water to enter and leave the bog, are also built. Concrete flumes, although more costly than wood, are more permanent and in the end more economical, unless the subsoil is too soft to support this heavy structure. If wood is used, it should be treated with creosote or other wood preservative.

If the bog slopes so steeply that the cost of grading is unreasonable, it may be cheaper to divide it into sections that can be flooded at different levels. Each of



Fig. 7—Showing a marking machine in use. (Courtesy A. D. Makepeace and Co., Warcham, Mass.)



Fig. 8—Planting gang in operation, Lemieux, spring of 1940.

these sections is made as nearly flat as possible. Not only are more time and water needed to flood the uneven bog, but low spots may be buried too deeply while other places are exposed. Such islands are likely to suffer from frost. They also offer a place of refuge to insects which might be destroyed by the immersion.

SANDING

The ditching, levelling and removal of debris having been completed, the next operation is to cover the entire area with three or four inches of sand. Many systems have been devised for doing this, depending on the season, location of the sand, and the equipment at hand.

The simplest method, if the sand pit is near, is to run a row of planks on the bog and carry the sand in a wheelbarrow. In other instances, a series of sturdy wooden mats ten or twelve feet long and six or eight feet wide, are used, and the sand carried by wagons. Sometimes light portable wooden rails and cars are employed. Hauling by dump truck and spreading directly on the ice of the flooded bogs in the winter is the cheapest method, particularly if the pit is a distance away. If the bog will not support a truck it may be necessary to dump the sand on the side of the bog and take it from there with wheelbarrows. When the sand reaches the bog it is spread at once by shovels or rakes.

If the sand pit contains stones, these should all be removed, by screening if necessary, or if more convenient, picked up and carried from the bog. Otherwise they are unpleasant for the pickers and may be gathered with the berries.

PLANTING

The vines for planting are taken from a vigorous, healthy bog and are mown with a hand scythe, preferably before new growth starts. If it is not possible to set these cuttings at once, they may be opened out in a thin layer, sprinkled and covered with a canvas. If more convenient, they may be kept in a cool cellar or spread out in a ditch or stream. If left too long in bales or sacks without air and light the leaves will fall and the vines may even die.

Planting is preferably done in May or June as this gives the vines time to root firmly before fall, although vines will root at any time. The land is scratched each way with a rake-like marker, shown in Fig. 7, the vines being set at each intersection. Seven to twelve inches apart is a common distance. The closer plantings cover the ground more quickly and better resist pulling with scoops when picking time arrives.

Two or three pieces of vine are set in a bunch. This is done by placing them on the ground and pushing them in with a dibble or planting tool. Professional



Fig. 9—Setting cranberry cutting with dibble.

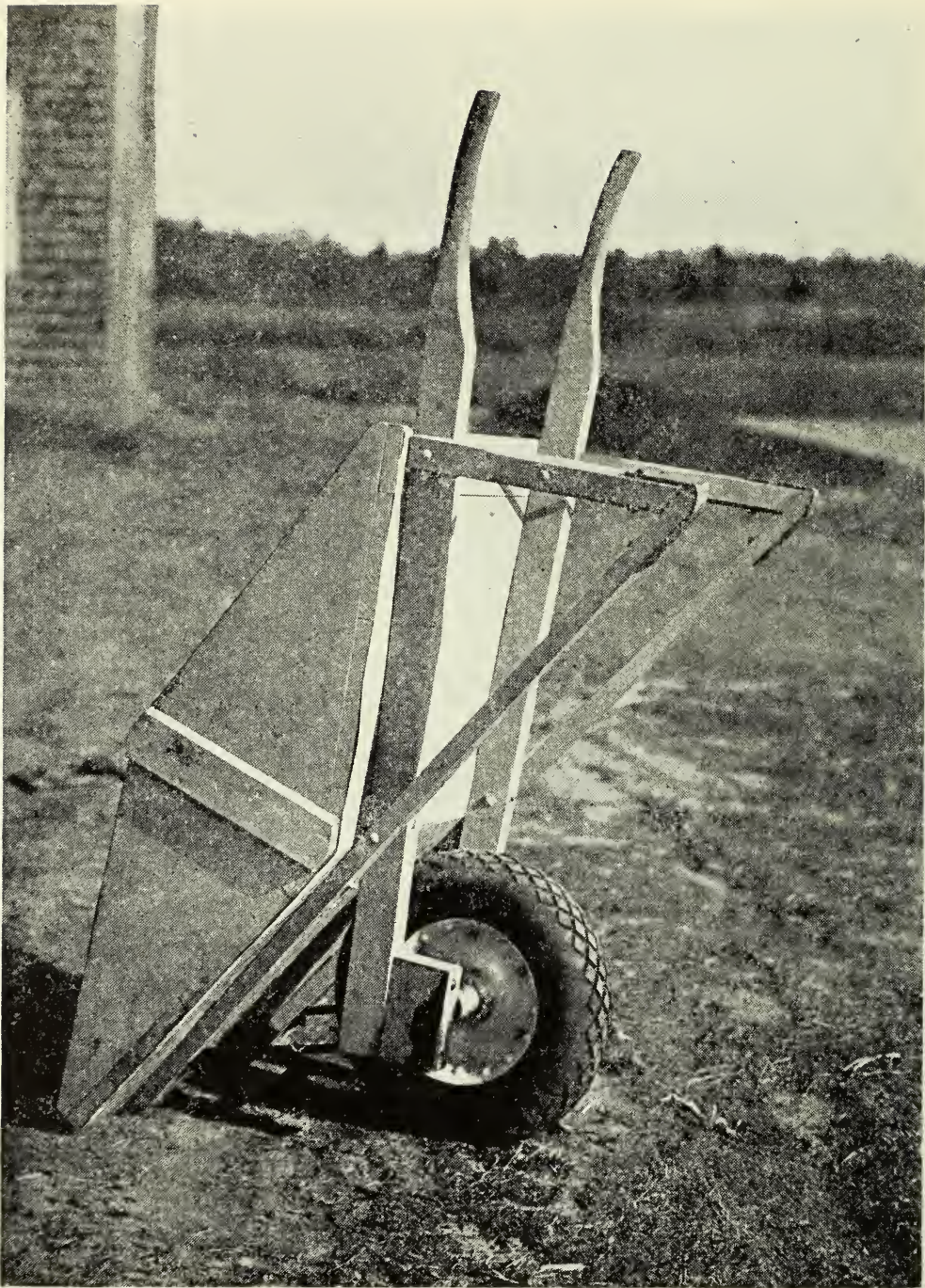


Fig. 10—Cape Cod wheelbarrow.

planters in New England carry the vines in a basket, use a short dibble and work on their knees. Another method more popular with some is for the planters to work in pairs, one carrying the vines and walking backwards and the other following with the planting tool. This tool is a narrow, blunt, wooden spade faced with thin sheet metal, and having the edge concave in order to grip the vines. The cuttings are placed on the ground by the first operator, the person with the tool pushes them into the sand and then closes the soil firmly with his heel.

CARE OF THE NEW BOG

Immediately after planting, if water is available, the ditches are filled and the water held close to the surface a couple of days to freshen the plants. The water is then lowered to the bottom of the ditches and no further flooding is necessary unless the season is particularly dry. All weeds should be removed, as it is quite

as important to keep cranberries free from competing plants as it is with any other crop.

WEED CONTROL

Thorough drainage is the most important step in weed control. Poor drainage stimulates the growth of moss, sedges, rushes, loosestrife and other water-loving plants. Bogs are rarely if ever ditched too deeply, but on the other hand shallow ditches are far too prevalent.

If the water-table is near the surface the roots are shallow and during a dry period the plants may actually suffer from drought. Deep ditches encourage a deeper root system, which in turn supports a larger top growth. Vigorous vines not only produce larger yields of fruit but also make it much more difficult for weeds to become established.

Although no complete substitute for hand weeding has been found, selective weed killers are claiming a larger place in modern bog management. A few of the more important materials are discussed below.

Water-white Kerosene—Stove oil or any coloured petroleum product is likely to damage cranberry vines. The clear transparent oil may be used in early spring with little injury. It is recommended for grasses, sedges, and loosestrife at 400 to 600 gallons per acre. Individual clumps of rushes may be treated by punching a hole in the crown and filling with a cup or two of oil.

Ferric Sulphate—This is useful on horsetail, rushes and some grasses. It is sown at the rate of 15 to 20 pounds per square rod, on young plants.

Sodium Arsenite—Sold under the trade name of Weedicide, this is highly poisonous to animals and destroys most living plants. It is only used for the banks of ditches and dykes. Apply as a spray, 15 pounds per hundred gallons of water.

Ammonium Sulphamate—Known to the trade as Ammate, this material is non-poisonous but destructive to most plants, including the cranberry. It is used for ditch banks and dykes, and is coming into popularity as a substitute for turfing new bogs. It may be used as a spray or sown by hand at 200 to 300 pounds per acre.

2, 4-D—All the forms of this new weed-killer are fatal to cranberries. The only exception is if the weeds are so thick that the cranberry vines are sheltered. Generally speaking, none of the narrow-leaved plants, such as grasses, sedges or rushes, are affected.

FLOODING

If the ground is frozen so that the plants cannot secure water, cranberry vines are often injured or killed by drying winds. In regions of heavy snowfall the snow covering seems to be reasonably satisfactory, but open bogs are frequently swept free of snow and for this reason water is a safer and more dependable protection.

As soon as the sand becomes stiff enough to resist denting with the heel, the water is turned on just deeply enough to cover the vines. A shallow flood allows the plants to receive more light and there is less danger that cracks in the ice will tear the vines. When thaws occur, the outlet must be kept free so the water will not rise and lift the ice and with it the embedded vines.

It is customary to hold the winter flood in the Maritimes until around May 24 unless ample water is available for re-flooding. While early draining encourages the fruit-worm and false army-worm, late draining is favourable to the cutworm; thus bogs with a full water supply are sometimes drained early in April in alternate years.

Re-flooding may be necessary whenever there is danger of frost, but should be avoided at blossom time. If the bog is well graded it may be possible to raise the water just up to the bottom of the vines and the heat given off by the water will check several degrees of frost. The new growth, fruit buds and bloom are all easily injured by frost. Green fruit is also tender but as maturity approaches the danger from frost is lessened.

The Experimental Station at East Wareham, Mass., has found that ripe berries of the Early Black and Howes varieties show no softening after exposure to 23°F., but that 22° causes slight harm. There is an opinion among shippers that any appreciable frost shortens the storage life of cranberries. Flooding at this time interferes with picking and also softens the berries to that temperature forecasts should be studied carefully and the use of water kept at a minimum.

Immediately after picking, flooding for a week or ten days freshens the roots that have been loosened and also lifts much of the rubbish and fallen fruit.

In the extremely dry weather of midsummer an occasional shallow flood for a night may increase the crop materially.

The use of sprinklers has been referred to in the paragraph on drainage.

RE-SANDING

Frequent applications of sand, from a quarter-inch to an inch, are a protection against mild frosts and many insects, and also aid in checking moss and weeds. Bogs with a limited water supply should be sanded every year or second year. If the vine growth is weak, sanding will stimulate new roots and uprights. Bogs with plenty of water and a fair growth of vines may be sanded every three or four years. The only bogs on which fresh sand is not needed are those with heavy vines and full supplies of water for insect and frost protection at all times.

Sanding on the ice during the winter, as mentioned in an earlier paragraph, needs the least labour, but is not recommended after the bog comes into production. Covering the ice with sand excludes light, partially starving the plants, and the crop usually suffers severely the next season. Laying planks for a track, and spreading direct from a wheelbarrow, using a square-mouth shovel, is the best. The least injury is done to the plants if the sand is spread in the fall after picking is finished.

FERTILIZING

On most peat or muck bogs no attention need be paid to fertilizer. Sufficient plant food is usually present to produce a healthy cover of vines and regular crops of fruit. On hard-bottom bogs or those badly neglected, the use of nitrate of soda may stimulate growth. Stable manure is not satisfactory as it carries weed seeds; sulphate of ammonia is injurious; potash is said to be of little benefit.

The East Wareham Station suggests 150 pounds of nitrate of soda and 300 pounds of superphosphate per acre, at the beginning of bloom. However, little is known of the nutrition of the cranberry, and grass, sedges and other weeds are often stimulated more than the cranberry vines. For this reason it may be wise to try the effect on a small plot before making a large outlay.

PRUNING

Following the picking season, torn vines should be removed. In cases where the vines become extremely thick it may be desirable to prune lightly. A pruning rake, having curved blades in place of teeth, is used, but this operation is recommended only if the vines become so thick and matted that the yields of fruit are reduced.

PICKING AND CARING FOR THE CROP

The first picking date will depend on the varieties grown. When early and late varieties are both present the picking season is extended. In Cape Cod the work is usually begun the first of September and finished the middle of October. In Nova Scotia, where Early Blacks have only recently been introduced, the fruit



Fig. 11—Cranberry pickers at work showing use of long-handled and short-handled scoops.



Fig. 12—Cranberry Bog of J. E. Adams, Southampton, N.S., showing pickers at work, dam and spillway in the background and re-sanding from adjacent pit in the foreground. (Courtesy of J. E. Adams)

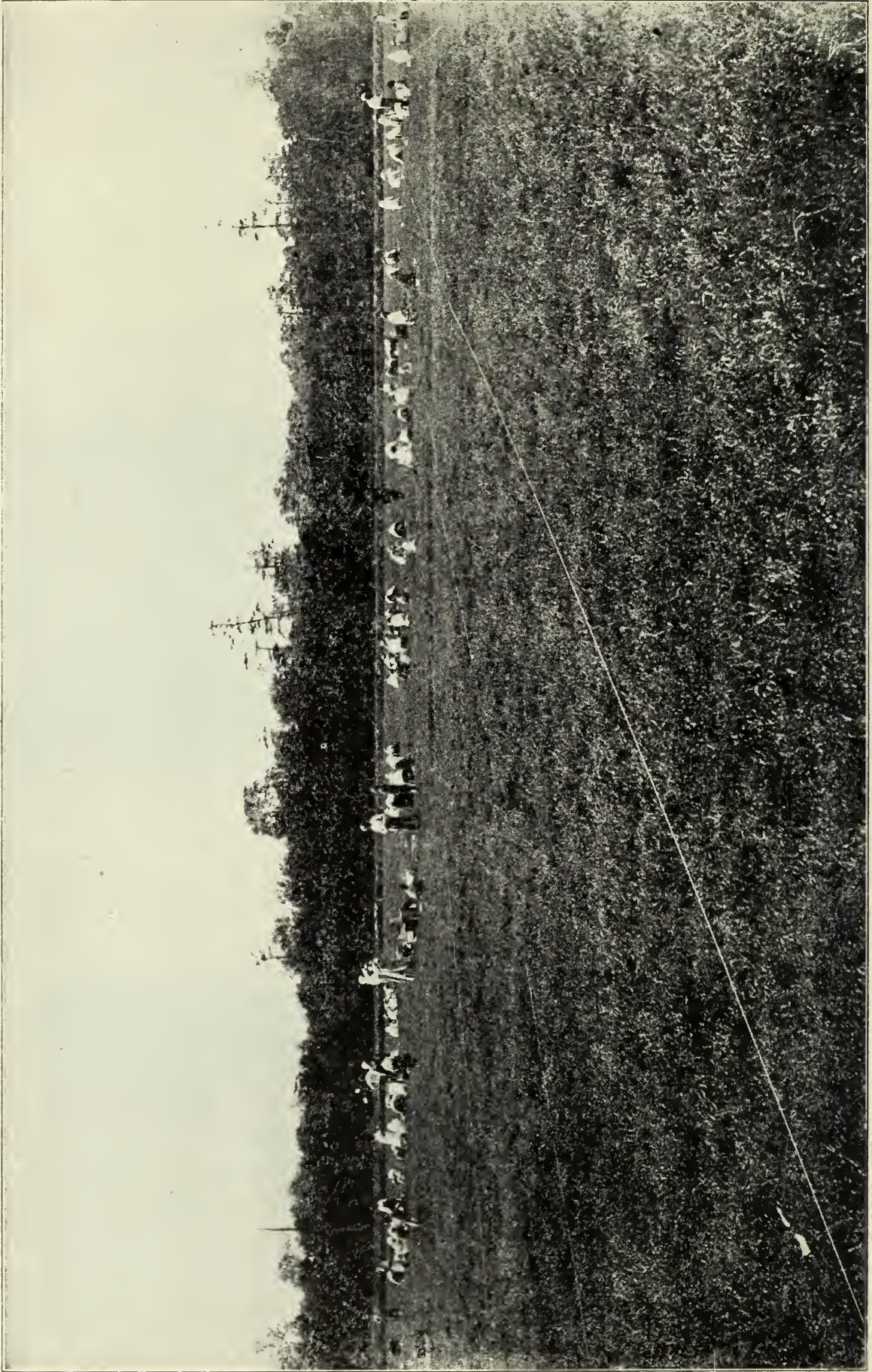


Fig. 13—Cranberry pickers at work. Note strings put down to guide pickers.

(Photo by M. B. Davis)

is seldom ripe enough to gather before September 10, and the work is pushed rapidly to finish before severe frosts. The berries should be allowed to ripen on the vines as fully as possible, since well coloured fruit not only brings a higher price but is less easily bruised, keeps longer, gives higher yields and makes better sauce.

Until the vines are firmly established and covering the ground, hand picking is necessary. Special snap pickers have been made for this work, but these require a strong grip and a fair degree of skill. When the bog reaches maturity, scoops of varying width are used for picking. These are illustrated in Fig. 11.



Fig. 14—Hand sorting cranberries at the packing house of the New England Cranberry Sales Co., at West Wareham, Massachusetts.

Pickers are kept in line by stretching strings to form lanes, thus avoiding crowding and skipping. This is shown in Fig. 13.

Picking should be done only when the plants are dry. If flooding is necessary because of a frosty night, picking may be impossible the next day. Berries are picked in slatted boxes and carried or wheeled to the edge of the bog, from which they are hauled to the storage sheds or screenhouse. The berries are stored in these boxes until they can be graded and packed.

The screenhouse is a frost-proof building with a cool storage and a well-lighted, warm room for sorting. The berries are first run through a separator, provided with a fan for removing the chaff and having several bounding boards which take out the rotten and light berries. From the separator the fruit passes over an endless belt, where green berries are removed by hand. The separator is preferably

set up in a cool room from which the berries can be carried on an endless belt to the sorting room and return to empty themselves into shipping boxes.

The 25-pound or quarter-barrel box is the standard container. To meet the modern demand for pre-packaged food, some shippers enclose in each box twenty-



Fig. 15—Late Howe in August of the second season, Lemieux, Que.

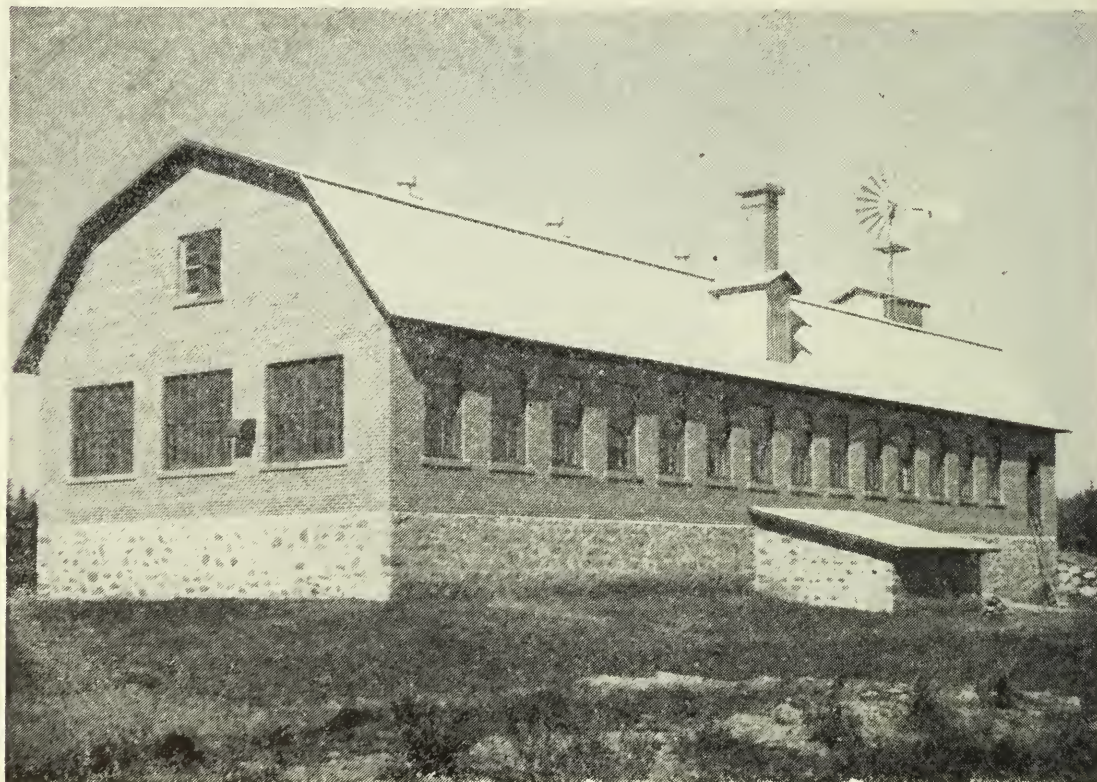


Fig. 16—Grading and storage building at Lemieux, Quebec. Property of Edgar Larocque.

five attractively printed cellophane bags; the retailer packs these from the contents of the box during slack periods and at once has a fresh, attractive counter or window display for quick sale in the rush hours.

The proper grading and packing of the cranberry crop is of the utmost importance to Canadian growers. Only fruit of attractive size and colour should go to the fresh-fruit trade. Recent expansion of the canning industry and increasing popularity of the canned product provides an outlet at prices often equal in net returns to those received for fresh fruit.

Odd-sized boxes, barrels and bags are completely out of date; a food product as valuable as the cranberry deserves a good container.

VARIETIES

Very few named varieties of cranberries are grown in Canada. Several growers in Nova Scotia have selected varieties of their own, and a few importations of Cape Cod sorts were made many years ago. A few new bogs in Nova Scotia, New Brunswick and Quebec are testing the better American varieties, Early Black and

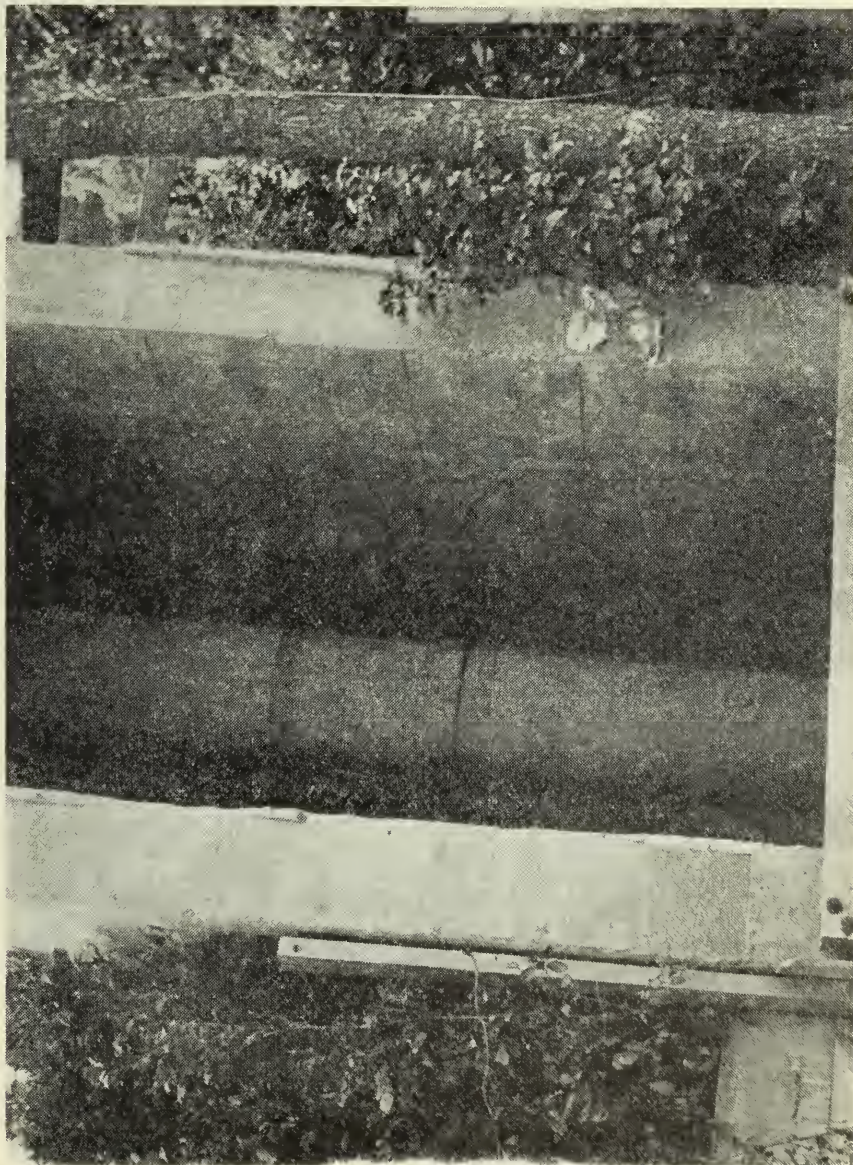


Fig. 17—Enclosed impeller pump driven by motor. It is housed in a building shown in Fig. 18. It lifts water from a brook and pumps through the flume shown in Fig. 18 to the reservoir shown in Fig. 19.

Howes. These two varieties are among a large number selected from the wild by early Cape Cod growers. Cyrus Cahoon developed the Early Black, and James Payson Howes, the variety which perpetuates his name.

Early Black ripens about ten days before Howes and is also earlier than most of the native types found in the Maritimes. The berry is smaller than some but the plant develops a large number of fine uprights, which in turn carry a very heavy yield. With the development of the canning industry and cold storages, late keeping is less important, and as fall frosts are an ever-present danger, early ripening becomes even more desirable. The superior colour and flavour which comes with maturity is bringing a premium for the relatively small supply of Early Blacks on the local markets of the Maritimes. In New Brunswick and Quebec in 1947 Howes was distinctly late and only the limited acreage made the harvest possible before severe freezing.

The Experimental Farms Service has collected a large number of the more promising native plants in order to determine their earliness, yield, keeping, culinary and market quality in comparison with the varieties at present under cultivation. These will require several years of testing before their value can be measured accurately.

In planting a bog, only one variety should be used on a section. If more than one variety is to be set, each should be under separate flood control. This is im-



Fig. 18—Pump house and flume.



Fig. 19—Reservoir into which water is pumped.

portant, as the varieties have different blooming and ripening dates and vary in their susceptibility to diseases and insect pests.

PUMPING OUTFITS

When selecting equipment for flooding, an engine and pump should be secured of larger capacity than that which is estimated to do the job when working

APPROXIMATE TIME TO FLOOD ONE ACRE—IN HOURS AND MINUTES

Depth in inches per acre	Gallons on each acre	Time required and flow per minute					
		100 gals. per m.	500 gals. per m.	1,000 gals. per m.	5,000 gals. per m.	10,000 gals. per m.	20,000 gals. per m.
1 in.....	27,154	4 h.	54 m.	27 m.	5½ m.	2 m. 40 s.	1 m. 20 s.
2 “	54,309	9 h.	1¾ h.	55 m.	11 m.	5 m. 30 s.	2 m. 45 s.
3 “	81,463	13½ h.	2¾ h.	1¼ h.	16 m.	8 m.	4 m.
4 “	108,617	18 h.	3½ h.	1¾ h.	22 m.	11 m.	5½ m.
5 “	135,771	22½ h.	4½ h.	2¼ h.	28 m.	14 m.	7 m.
6 “	162,926	27 h.	5½ h.	2¾ h.	33 m.	16½ m.	8¼ m.
7 “	190,080	31½ h.	6½ h.	3¼ h.	38 m.	19 m.	9½ m.
8 “	217,234	36 h.	7½ h.	3¾ h.	44 m.	22 m.	11 m.
9 “	244,389	40½ h.	8 h.	4¼ h.	49 m.	25 m.	12½ m.
10 “	271,542	45 h.	9 h.	4¾ h.	54 m.	27 m.	13½ m.
11 “	298,697	49½ h.	10 h.	5¼ h.	60 m.	30 m.	15 m.
12 “	325,851	54 h.	11 h.	5¾ h.	1 h. 6 m.	33 m.	16½ m.
18 “	488,777	81½ h.	16 h.	8 h.	1h. 38m.	49 m.	24½ m.
24 “	651,703	108½ h.	22 h.	11 h.	2h. 10m.	1h. 5m.	32½ m.

perfectly. A reserve of power and speed is always useful in an emergency, and is less costly than the loss that sometimes follows too light an installation. The pump should be large enough to flood the bog in six or seven hours. It is well also to deal with a firm having experience in supplying pumping units for cranberry bogs.

If the lift is under six feet, the ordinary propeller pump is probably the cheapest and most efficient, but if the lift is greater, a rotary or impeller pump is suggested.

The following table is useful in estimating the amount of water needed for flooding and also the capacity of the pump required.

The table shows that 6 inches of water can be applied on one acre in $5\frac{1}{2}$ hours by a pump throwing 500 gallons per minute. With a six-acre bog to flood it is readily seen that it will take a pump of six times the capacity, or 3,000 gallons per minute, to do the job. Other calculations can be made similarly.

Figure 17 shows an installation designed to lift water from a brook, through a flume, Fig. 18, to a reservoir sixteen feet or more above and a half-mile away. From this reservoir or compound, Figure 19, another pump lifts the water a similar distance to flood a thirty-acre bog. In this way flooding is done quickly and cheaply.

COST OF CONSTRUCTING A BOG

Complete cost figures are not available for older established bogs. However, careful time sheets have been kept for two small bog developments in which the Experimental Farms Service shared, and these give a useful lead in this connection.

The first of these was at Port Mouton, N.S., and covered the preparation of a one-acre addition to a bog where the main reservoir, ditch and dams were already built. This was a black muck soil, heavily covered with laurel, leather-leaf and swamp grass. The following are the hours of man-labour required for the one acre:

Ditching.....	54 hours
Turfing.....	977 "
Hauling and spreading sand.....	584 "
Cutting and planting vines.....	117 "
Total.....	1,732 hours

The second of these was at Cumberland Point, N.B., where the bog was on a stiff clay bottom, covered with heavy swamp grass. The turf was not removed but was cut and turned completely under. The figures are for three-fourths of an acre:

Clearing land.....	3 hours
Draining.....	40 "
Ditching.....	229 "
Levelling.....	59 "
Turfing.....	286 "
Sanding—Man.....	419 "
Sanding—Team.....	65 "
Total man hours.....	1,036 hours
Total team hours.....	65 "



Figure 20, 21, 22—Upper: Clones of wild and cultivated cranberries studied by the Horticultural Division at Aylesford, N.S.; Center: Overhead sprinkler on bog of H. Oyler, Auburn, N.S.; Lower: Profile of good cranberry bog. The 4" label shows the layer of sand above the black muck.

A large, privately owned bog, completed just before World War II, is stated by the owner to have cost around \$1,000 per acre, including the large reservoir, dykes and ditches.

Yields of forty to fifty barrels per acre are often obtained and thirty barrels per acre is a fair average. Occasional yields as high as a hundred barrels per acre are on record.

When in full production, many bogs have returned in gross sales for a single year an amount equal to their entire initial cost. This has only been achieved by close attention to every detail and it is not suggested that cranberry growing is an easy path to wealth for the careless or incompetent.

An indication of the permanence of the investment under careful management is shown in the famous three-acre "East Bog" of the late J. S. Bishop, Auburn, N.S. Built and operated by him for over sixty years, this bog, while lacking a border ditch and without summer flooding, is still in good production, and, said he, "It has put three children through university." There are other bogs in the same locality equally as well located but lacking close personal care that have gone back to a wilderness of shrubs and scrub forest.

CRANBERRY DISEASES

by

K. A. Harrison¹

The cranberry is comparatively free from destructive diseases and it has been suggested that this is due to the fact that it is a native plant growing in its natural surroundings. The chief troubles are a virus disease known as false blossom, several fungous diseases of the vines, and certain storage rots of the harvested fruit. Other losses can occur through frosts and flooding. Two diseases to be discussed here have not been found in Canada, but they are present in the important cranberry-growing districts of the United States and undoubtedly will be found in Canada as the area planted to this crop increases and more attention is paid to it.

FALSE BLOSSOM (Caused by a virus)

The most serious disease of cranberries in North America is false blossom, which is a virus disease and derives its name from the abnormal flowers. So destructive is the disease that bogs in which control measures are not carried out become unprofitable and have to be planted again. In the early stages of the disease, the flowers stand erect instead of drooping normally, and the petals have a tendency to be brighter coloured than healthy ones. In advanced cases, the flowers do not develop properly and have stunted petals or none. The plants themselves take on the appearance of a witches' broom, as a result of the lateral branches and small leaves growing close to the stem. Diseased plants do not produce a marketable crop. The disease is most easily recognized when the plants are in blossom or during the latter part of August when the witches' brooms are most prominent.

False blossom is carried from bog to bog and from district to district in affected vines used for new plantings. In a bog and between neighbouring bogs, it is spread only by the blunt-nosed leaf hopper.

The control of this disease requires careful attention on the part of the grower. When planting a new bog the grower must take great care to get vines from a disease-free bog. The need for healthy vines for planting cannot be stressed too strongly, for the disease spreads most rapidly in a newly planted bog and most slowly in an old, well-established bog. If the disease is established at a number of points in a bog, it becomes necessary to control the blunt-nosed leaf hopper, for, as just stated, this insect is the carrier responsible for the spread of the disease from plant to plant. Methods of control of this insect will be found in the section of this bulletin dealing with insect pests.

All varieties of cranberries are not equally susceptible to this disease. For example, Howes is quite susceptible and Early Black, moderately resistant.

FUNGUS DISEASES OF THE VINES

A number of fungous diseases cause damage in the cranberry bogs, but none has proved destructive over large areas. Such diseases are usually limited to one bog, or to a more or less definite area in a bog, and in such a manner that it is obvious that the surroundings must have determined the severity of the attack.

¹ Dominion Laboratory of Plant Pathology, Kentville, N.S.

TIP BLIGHT AND HARD ROT (Caused by *Sclerotinia Oxycocci* Wor.)

Although tip blight kills the young points just before blossom time and is therefore considered a vine disease, it is more important as a fruit rot. It starts as a typical blight, killing the tips of the vines. The tips turn brown and become mis-shapen as a result of the growth of the fungus at certain points within the bark. These points of fungus growth develop a greyish powdery mass of spores, which serve to infect the berries at blossoming time. The berries do not show outward signs of the disease until they start to ripen in the fall, although if an unripe infected berry is cut open, a cottony fungus growth will be found around the seeds. Infected berries do not colour naturally, but become yellowish in colour and remain quite firm and hard. They are white and cottony inside. During the fall, they shrivel, become mummified, and drop to the ground, where they overwinter. In the spring, they produce the fruiting bodies of the fungus from which infection of the young tips occur during wet weather.

This disease is most important in Wisconsin and on the Pacific coast, but has been found in New Brunswick. No control measures have yet been recommended.

ROSE BLOOM AND RED LEAF SPOT (Caused by *Exobasidium Oxycocci* Rostr. and *E. Vaccinii* Fekl. Wor.)

Rose bloom and red leaf spot are conspicuous diseases that immediately attract attention because of the bright colours induced in the diseased parts of affected plants. Neither of these diseases have yet been of commercial importance in Canada.

In plants affected with rose bloom, dormant buds along the stem are stimulated so that they develop as shoots early in the spring. The foliage on these shoots is bunched, twisted, rose-coloured, and its resemblance to a flower accounts for the descriptive name applied to the disease.

In plants affected with red leaf spot, the bright red colour of the spot is conspicuous on the upper surface of the leaves. The colour is duller on the lower surface and the spots are covered with a bloom of spores. Sometimes red spots caused by this fungus are found on the fruit.

The organisms causing these two diseases are very closely related and are widely distributed throughout the world. They have been of most economic importance on the Pacific coast.

Rose bloom has been controlled by flooding the bog for from 36 to 40 hours just before the spores are discharged.

RED GALL (Caused by *Synchytrium Vaccinii* Thomas)

Red gall is recognized by the small shot-like red galls on the young buds, leaves, and shoots. It is very erratic in its behaviour and is not usually of great economic importance, although infected shoots do not bear fruit. Its irregularity in attacking the plants is due to the fact that the fungus depends on water for its distribution.

This disease occurs along the Atlantic seaboard and has been found in Nova Scotia, where it was severe in one bog. Control may be secured by controlling flooding in the spring.

FAIRY RINGS

Caused by *Psilocybe agrariella* Atk. var. *Vaccinii* Charles)

Fairy rings in cranberry bogs are similar in origin to fairy rings in lawns and pastures and, like them, are caused by a species of mushroom. In a bog, the vines are killed, apparently by the fungus smothering the roots as it grows in a widening circle from some point. As the circle extends, the centre becomes filled in with new vines so that the trouble is most apparent under poor growing conditions or in dry seasons. This disease is troublesome in Massachusetts and New Jersey, but has not been recognized in Canada. It can be controlled by ditching around the infected ring.

BLACK SPOT

(Caused by *Mycosphaerella nigro-maculans* Shear)

Black spot is a disease that has been reported from all the American cranberry districts but is of economic importance only in the Pacific coastal region. It becomes troublesome in seasons of excessive moisture. The leaves are infected first, and the infection spreads until it reaches the stem, where it forms a black canker that frequently kills the plant. This disease has been effectively controlled by spraying with bordeaux mixture.

LEAF DISEASES

(Caused by *Naevia Oxycocci* Dearness)

A leaf disease, caused by *Naevia Oxycocci* has been reported as occurring on certain dry bogs in New Brunswick. The vines weaken and die. This fungus is reported as causing a witches' broom in the United States. Control measures have not been worked out.

(Caused by *Gibbera compacta* (Pk.) Shear)

Another leaf disease that occurs wherever cranberries grow is caused by *Gibbera compacta*. It forms black spots on the underside of the leaves. It is considered as only slightly harmful. Special control measures have not been attempted.

STORAGE ROTS

Storage rots are responsible for an annual estimated loss of 25 per cent of the cranberry crop of the United States. They have been intensively studied in that country by investigators who have discovered that fungi are responsible for most of the damage. In a certain percentage of the affected berries no organism can be found and in such cases the rot has been named sterile breakdown. It has been found possible to check this trouble by proper ventilation and sufficiently low temperatures.

The different rots of cranberries are so similar in appearance that the causal organisms cannot be identified without making isolations from them in the laboratory. The fungi responsible for the rots are widely distributed wherever cranberries grow and this importance locally is determined largely by the mean temperature during the growing season. Thus under the higher summer temperatures in New Jersey the fruit may rot in the bogs before harvesting while in Nova Scotia rotting berries are rarely found until after the fruit is in storage.

The most important storage rot in Nova Scotia is end rot, caused by *Godronia Cassandrae* Pk. (*Fusicoccum putrefaciens*, Shear). Sterile breakdown is the next most important cause of loss in storage. Together, these two rots accounted for

72 per cent of the rotted fruit in Nova Scotia in 1945. The remaining 28 per cent was attributable to a number of organisms common to one or other of the cranberry-growing areas of North America. These were *Sporonema Oxycocci* Shear, *Pestalozzia Guepini* var. *Vaccinii* Shear, both causing storage rots; *Ceuthospora lunata* Shear, causing bitter rot, and *Diaporthe Vaccinii* Shear, causing fruit rot.

Special mention should be made of two rots that are serious in the United States. Early rot, caused by *Guignardia Vaccinii* Shear, and blotch rot, caused by *Acanthorhynchus Vaccinii* Shear, are both present in Nova Scotia and were repeatedly isolated from the skin of apparently sound cranberries.

However, under the higher temperature in New Jersey these two organisms cause serious losses through field and storage rots.

It has been found in Nova Scotia and elsewhere that various rot fungi are present late in the storage season in the calyx of many sound berries. It is known that infection takes place in the bog and it is suspected that the rot organisms are able to lie dormant awaiting conditions favourable to the initiation of the rot. The presence of the fungi in the calyx is suggested as the explanation for the progressive rotting of berries after harvesting and indicates the necessity for the maintenance of proper storage conditions.

The control of storage rots depends on a number of factors. Details relative to methods of control vary according to the locality concerned and the conditions of the fruit. The firmness of the berries in some years ensures good keeping qualities without much trouble while in other years the berries are so tender that very careful handling and good storage conditions are required to get the fruit on the market in an attractive condition. The following are general recommendations: The fruit must be carefully handled during harvesting, cleaning and packing to prevent bruising. The berries must be dry when stored, and if they have to be harvested wet, should be dried quickly. The fruit should be stored at cool temperatures with good ventilation.

Spraying will reduce storage rots and is necessary in New Jersey where the rots appear in the bogs before harvesting.

Spraying as a general practice is not necessary in the more northern of the cranberry districts. If it is necessary for some particular disease, the following formula is recommended:

10 pounds of copper sulphate (bluestone),
10 pounds of hydrated lime,
100 gallons of water,
1¼ pounds of commercial fish oil soap.

Dissolve the soap in water and add to the bordeaux. Fresh stone lime (10 pounds) may be used to replace the hydrated lime. Spraying should start at blossoming time, and should be discontinued not later than the middle of August.

Another spray that has rapidly come into favour is Fermate at the rate of 2½ pounds to 100 gallons of water. This spray has given good control of field rots.

Any grower wishing to secure further information for his own district or wishing to have disease specimens identified should communicate with the Dominion Botanist, Central Experimental Farm, Ottawa, or the Dominion Laboratory of Plant Pathology in the province in which the grower resides. These laboratories are situated at Saanichton, Vancouver, and Summerland, B.C.; Edmonton, Alta.; Saskatoon, Sask.; Winnipeg, Man.; St. Catharines and Harrow, Ont.; Ste. Anne de la Pocatière, Que.; Fredericton, N.B.; Kentville, N.S.; and Charlottetown, P.E.I.

INSECTS AFFECTING THE CRANBERRY

by

C. W. Maxwell¹ and A. D. Pickett²

CRANBERRY FRUITWORM

The cranberry fruitworm, *Mineola vaccinii* (Riley), is the most serious insect pest with which growers of the low bush or bog cranberry in the Maritime Provinces have to contend and the ravages of this pest cause losses each year amounting to thousands of dollars. The insect is native to this country and is often found infesting cultivated and natural or wild bogs. This insect has also been found at times damaging the low bush blueberry.

The cranberry fruitworm spends the winter as a full grown larva in a cocoon either on the surface of the soil or slightly below. The cocoon may be formed of small grains of sand or particles of peat or trash, held together by strands of silk. In the spring the larva goes into the pupal stage to emerge as a moth when the cranberry is in the late bloom stage. The female moth usually lays her eggs within the calyx cup under the lobes but they may be laid on any part of the berry. The newly hatched larva enters the berry near the stem end and closes the entrance with a fine silken web. After feeding for some time on the pulp the larva leaves the berry to enter a second one in the same manner. When, as usually happens, the larva enters a third, fourth or fifth berry, it does so through the side. Early in the fall it becomes fully grown and constructs the cocoon in which it hibernates.

Control—Infestations of this insect may be reduced to a minimum by the use of insecticidal dusts and sprays or by flooding the bog, if such facilities are available. Cranberries growing wild on lowlands bordering rivers which are normally flooded each spring by freshet water do not usually support heavy infestation of this insect but on higher ground, further back from the river, the infestation usually increases. A large measure of control occurs on cultivated bogs provided the water is held on the bog until near the end of May. If the infestation persists and flood water is available, the bog should be flooded again immediately after harvest and the water held for seventeen days.

Where flooding is not possible the bog may be treated with insecticides, in either dust or spray form, the preference depending on the site and nature of the bog, the water supply, and the machinery available. Two applications of the insecticide are necessary, the first being made when two-thirds of the blooms have dropped and the second application ten days later.

Heavy spraying machinery cannot be used on cranberry bogs without causing serious damage to vines. However, such spraying machinery can be set up on the edge of the bog and applications made by the use of a long hose. Hand-pumped or small power sprayers may be used to advantage. The spray rod should consist of a boom of at least three nozzles capable of delivering a fine spray and should be offset at an angle of approximately 135 degrees with the handle of the rod. The hose should be held off the vines by an assistant during spraying operations. The amount of spray used per acre should not be less than 400 gallons, delivered at a minimum pressure of 250 pounds per square inch.

¹ Dominion Entomological Laboratory, Fredericton, N.B.

² Dominion Entomological Laboratory, Annapolis Royal, N.S.

Nicotine sulphate at the rate of $1\frac{1}{3}$ quarts in 100 gallons of water has proved effective against this insect and when combined with bordeaux mixture (10-10-100) the control has been even more satisfactory. The nicotine sulphate should be added to the completed bordeaux mixture. DDT in the emulsion form is more effective than nicotine sulphate but serious injury to vines has resulted from it when used at a strength greater than $\frac{1}{2}$ pound of actual DDT per 100 gallons. The wettable powder form of DDT should be effective when used at the rate of 2 pounds of actual DDT to 100 gallons of water or bordeaux mixture and should not injure the vines.

Control of this pest by applications of insecticidal dusts is less troublesome than spraying. The applications are much less time consuming and the outlay for dusting machinery need not be as great as for spraying equipment. In large commercial cranberry growing areas, small dusters powered by gasoline engines are used. Being light and equipped with two rubber-tired wheels of the bicycle or motorcycle type they may be pulled across the bog by two operators or may be self-propelled. A hand-turned duster, of the old model Niagara type, mounted on a platform and geared to one of the two bicycle wheels on which it is mounted has proved effective in the control of this insect. This traction-driven duster has three dust nozzles and carries a trailing canvas or apron which is indispensable in dusting this crop. The hand-turned duster, when used as such, is not entirely satisfactory. In order to get reasonably satisfactory results, weather conditions must be ideal and with only two dust nozzles a thorough and even coverage may be applied only when extreme care is taken. On areas missed or where the dust has not thoroughly penetrated, injured berries are likely to be found. It is preferable to make all dust applications during the later afternoon rather than in the early morning when vines are wet with dew.

A mixture of 70 parts finely ground dusting gypsum, talc or pyrophyllite combined with 30 parts of synthetic cryolite has given good control of this pest. Freshly mixed dusts have been found most satisfactory. Material left over from a previous season is difficult to apply, particularly if the carrier used is gypsum, and especially if applied with a hand-turned duster. Not less than 50 pounds per acre should be used. A 3 per cent DDT dust has been found to be a satisfactory dust treatment, applications of which should be made at approximately 40 pounds per acre.

FIREWORMS

There are a number of species of fireworms which occasionally cause damage to cranberry bogs of which the black-headed fireworm, *Rhopobota naevana* (Hbn.), is the most serious in the Maritime Provinces. In Nova Scotia this insect frequently causes very serious damage to cultivated bogs and in New Brunswick it has occasionally injured quite large areas of lowland bogs. The young caterpillars feed on the terminal leaves, tying them more or less together, in the early stages, and skeletonizing them, with the result that heavily infested areas become brown suggesting scorching by fire. There are two generations a year, the caterpillars of the first generation, which usually cause the most serious injury, appearing in May from eggs laid by the overwintering moths. The adults of the second generation appear in late June and early July and caterpillars of this generation tie together the tender uprights and feed upon the leaves and berries. Other species of fire-worms attacking the cranberry are the yellow-headed fireworms, *Acleris minuta* (Rob.), which prefers highland bogs and is seldom seen on lowland bogs and the striped fireworm, *Aroga triangularis* (Chamb.), which may become a serious pest of highland bogs only.

Control—Holding the winter flood well into May or, with bogs drawn about May 10, flooding again from 48 hours about May 28, if the worms are about one-half inch long, results in an excellent control of the black-headed fireworm. Where

flood water is not available fireworms may be controlled by spraying with arsenate of lead at the rate of 6 pounds per 100 gallons of water. Pyrethrum dust (0.9% pyrethrins) or 5 per cent DDT dust applied at the rate of 50 pounds per acre have proved effective. The addition of $1\frac{3}{4}$ pints of nicotine sulphate to the aforementioned mixture adds to its effectiveness.

CHAIN-SPOTTED GEOMETER

The measuring worm, *Cingilia catenaria* (Drury), reaches outbreak numbers in some years and has at such times caused very serious damage to cranberry bogs in the Maritime Provinces. During such outbreaks the larvae behave similarly to armyworms, devouring the foliage from practically all species of plants in their paths of travel. They have been observed stripping the foliage from blueberry, wild spiraea, birch, huckleberry, sweet fern, and other plants as well as cranberry. The overwintering eggs hatch in the spring, the larvae becoming fully grown in mid-July and then enter the pupal stage. The moths emerge in late August and early September to lay their overwintering eggs.

Control—Treatments should be applied as soon as the insects are discovered. Because of their yellow and black spotted colours the “worms” are not readily detected and growers should be on the lookout for any injuries that might be caused by them. Control may be obtained by spraying with arsenate of lead at the rate of 5 pounds per 100 gallons or dusting with a mixture composed of 70 parts gypsum or talc and 30 parts of synthetic cryolite.

Preliminary trials suggest that pyrethrum dusts are quite effective. It also appears likely that the insects may be controlled by the use of a 3 per cent DDT dust.

BLUNT-NOSED CRANBERRY LEAFHOPPER

Although species of leafhoppers frequently cause extensive damage to various crops by puncturing plant tissue and sucking out the plant juices, cranberry growers are mostly concerned about the blunt-nosed cranberry leafhopper, *Ophiola vaccinii* (Van D.), as this insect is responsible, through its feeding activities, for the spread of the virus disease known as ‘false blossom’. This disease has been found in all parts of Nova Scotia except Cape Breton Island but has not as yet been reported in New Brunswick. Where it does not exist and where the leafhoppers are not prevalent enough to cause general damage there is little necessity of controlling this insect. The overwintering eggs of the leafhopper hatch early in the spring and the nymphs reach the adult stage early in the summer. These leafhoppers may be controlled by applying pyrethrum dust (0.9% pyrethrins) at the rate of 50 pounds per acre when the vines are one-tenth in bloom. A spray of pyrethrum soap, 6 pounds per 100 gallons of water, at the rate of 400 gallons per acre is also effective. This soap should not be used when the vines are in full bloom or when the berries are small as it may injure the berries.

SPITTLE BUGS

The cranberry spittle bug, *Clastoptera vittata* Ball, is another bog pest which in some years becomes numerous and causes considerable injury. The presence of this pest is easily detected by the froth or spittle on the vines. Within each ball of spittle is a single insect which obtains food by piercing the vine and extracting the plant juices. When numerous, these bugs may reduce the vigour of the vines and the size of the crop.

There is only one generation of this insect in a season. The winter is passed in the egg stage, the egg being inserted into the bark of the vine. The eggs hatch in early June, and the spittle is found soon after. The adults which emerge in July are easily flushed up from the vines when startled by a person passing over the bog.

Control—A spray of $1\frac{1}{3}$ quarts of nicotine sulphate in 100 gallons of water thoroughly applied at the rate of 400 gallons to the acre will give excellent control of this pest. Dusting with pyrethrum when the spittle becomes abundant, usually in late June, is also effective.

OTHER INSECTS

There are a number of other species of insects which may cause damage to cranberry bogs among which are the blossomworms, tipworms, cutworms, root grubs, cranberry girdler, etc. Satisfactory methods of combating these pests have been found which often include the use of insecticides and of quick-flooding facilities. Insect life in the cranberry bog should be carefully watched by the growers in commercially producing areas and estimations of insect populations arrived at by making regular use of the sweeping net. The net is similar in principle to the butterfly net and the operator sweeps it across the tops of vines in front of him as he walks across the bog. The insects are dislodged from the vines and fall into the net. In this way the particular pests and their prevalence may be determined, the stage or period of their development noted, and the treatment for control accurately timed.

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